



STEEL TUBE AND PIPE HANDBOOK



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Note:

Page numbers of actual product sort and groups – see production program on the page 4–5.

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Dear customers, dear ladies and gentlemen,

we prepare this technical tube guide with the view of continual development of our firm mutual business relations. Tube guide includes technical data of steel tubes and tube semi-products, made in company Železiarne Podbrezová. Technical data are included in national and world-wide standards or regulations, or bilateral technical delivery conditions and terms.

Application of tube products have to be in compliance with particular law and rules, concerning safety, health protection and environment. For this reason is short standardisation survey listed in handbook.

Attention:

In the countries of European Union there were European standards (EN) adapted into the system of national standards. Previous standards are not valid by now. Previous standards **should not be used in commercial communication** for this reason, but valid EN standards.

Data from previous standards, shown in surveys, **during temporary period** support the comparison of individual tube parameters, older technical documentation study, possible tube alternative to previous standards finding e.t.c.

GOST, USA (ASTM, ASME, ANSI, API) and JIS standards are still valid.

Committee for standardization and standard

International, worldwide recognized actual standards are issued by two standardization institutions resident in Geneva:

ISO (International Standards Organization) – issuing universal standards

IEC (International Electrotechnical Commission) – issuing electrotechnic standards

ISO standards are accepted worldwide and therefore they usually do not go through the national standard systems. For steel tube they are applied rarely. ISO numbers are in brackets.

European standardization

European standardization is analogous to global system, but it consists of three committees. Two first resident in Brussels, the third one in Sophia Antipolis (France):

CEN (Comité Européen de Normalisation) – issues universal standards. Standards regarding iron and steel are issued by European Commission for Standardization of Iron and Steel (ECISS) and appropriate Technical Committees.

CENELEC (Comité Européen de Normalisation Électrotechnique) – issues electrotechnic standards

ETSI (European Telecommunications Standards Institute) – issues telecommunication standards

National committee for standardization

They issue national standards. Connecting to European Union enlarging are European standards (EN) implemented into the national standard systems (technical standard harmonization). Unlike ISO standards are EN implemented without modification and hereby all discordant national standards have to be cancelled. Connected with this the philosophy of standard use has essentially changed: in the past was performance of standard regulations obligatory. At present appear two terms: relevance and obligation of standard. The standard is valid but, except some clauses, its observance is not compulsory. Standard gives recommend technical terms, which need not be applied. On the other hand two factors arise:

- if the standard is specific in the contract between seller and buyer, it will become a part of contract and all its demands have to be executed
- in the case some damage occurs in consequence of failure of harmonized standard claims, he who failed terms, defined by government act, bear liability. That's because by law if national standard system assumes harmonized EN, it will become also harmonized. After publishing in Official publication of national standards standard may be used for advisement of technical terms execution.

Another standards

Here belong mainly company standards. These can not be contrary to national standards.

Further class are the standards of craft companies, e.g. in USA (AISI, ASTM, ASME, API, SAE).

Valid bilateral technical terms or specifications can be shut-down between commercial partners.

Technical standards

are a part of legislation valid in appropriate industrial field. Specific connection of particular regulations is shown in the chapters of individual tube range.

Steel tubes – classification and terminology

Mentioned terms of steel tubes are in standard EN 10079 or others (ISO 6929).

Tube classification goes out several aspects: mode of production, cross section shape, tube ends treatment, sphere of tube usage.

According to EN 10079 tubes rank among so-called long products. It is a product having permanent circular or another hollow section along, with both ends free and with relatively long length.

By mode of production are tubes divided to two big groups – seamless and welded. Each of this groups can be sectionalized by method of tube production – hot or cold production.

A part of tube products are also so-called **hollow sections**. Here belong seamless or welded tubes of circular, square or rectangular section, used as part of building steel constructions or machine units.

Hollow bars are seamless tubes of circular section designed for production of machine parts by machining. Different from the two first tube groups hollow bars have qualitative and dimensional parameters, which fit to requirements of workability, heat treatment or surface quality.

Tubes in this guide book are ordered **by application** considering mode of production, similar to ordering in new steel tube EN.

Technical standards of steel tubes

Technical characteristics of steel tubes are detailed in the appropriate technical standards.

Pipe parameters could be divided into three main groups:

- dimensions and their tolerances (depending upon the tube manufacturing method)
- steel grade and steel conditions
- technical delivery conditions

Individual national bureaus of standards use different procedures for data standardization of steel pipes. In real life three options are used:

- each main group of parameters is contained in a single standard. The standards are interconnected using references to the related ones. Dimensional standard contains dimensional tables and their tolerances; steel standard contains its chemical composition and mechanical properties for various methods of pipe manufacturing and steel tempers. The third standard of the technical delivery conditions (TDC) sets out all remaining requirements for pipes – testing, acceptance, certificates, packaging, marking, etc. At the same time it contains references to other standards where these activities are described (e.g. STN, ČSN).
- the second option is when steel and its characteristics are included into the TDC standard, and this one contains dimensional tolerances. Two standards are used to describe a pipe – dimensional standard that contains dimensional table and the TDC standard (e.g. DIN).
- the third option – pipe parameters are in a single standard, which also contains the dimensional table, or extraction from the general table of dimensions constituting which is the content of the general dimensional standard (e.g. NFA, EN).

In real life there are cases, where both the seller and the buyer make bilateral TDC contracts, or they deliver pipes in accordance with the buyer's specifications, which can also include the references to national standards. Normally, this is the case, where the demands for pipes are higher than those set-up in the national standards.

Production programm – products classification by application

Continuously cast steel blooms

Page 13

Seamless steel tubes for building and mechanical and general use

Page 14

Steel tubes for building (hollow structural sections)

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Tubes for mechanical and general engineering

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Tubes for machining

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Tubes for machine parts and general use *

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Precision tubes and HPL tubes (seamless and welded)

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Seamless steel tubes for pressure equipments

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Tubes with specified room temperature properties

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Tubes with specified elevated temperature properties

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Alloy fine grain steel tubes for pressure equipments

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Tubes with specified low temperature properties

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Tubes for heat exchangers * *

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Tubes with internal riffling

Page 53

Pipes suitable for welding and threading

Page 54

Line pipe

Page 56

Casing and tubing (upon agreement)

Page 58

* Upon agreement also tubes (sections) with non-rounded cross section

** Special offer upon agreement:
Seamless or welded tubes for heat exchangers:
carbon-, low alloy-, ferritic- and austenitic alloy steels
the possibility of deliveries of long tubes
U - bending and finning capabilities

Precision cold drawn seamless steel tubes

Page 60

Standard precision tubes

Page 60

Cylinder tubes (for mechanical treatment – HPZ)

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Cylinder tubes (HP – „ready to use“)

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Tubes for hydraulic and pneumatic lines – HPL

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Tubes for automotive industry

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Injections tubes (for Diesel engines)

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Bearings tubes

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Precision welded steel tubes

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Cold sized precision welded tubes

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Cold drawn precision welded tubes

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Cold sized precision welded square and rectangular tubes

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Precision welded tubes for automotive industry

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Precision welded tubes for hydraulic and pneumatic lines

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Precision welded tubes for heat exchanger

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Tube semiproducts

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Buttwelding steel pipe fittings

Page 94

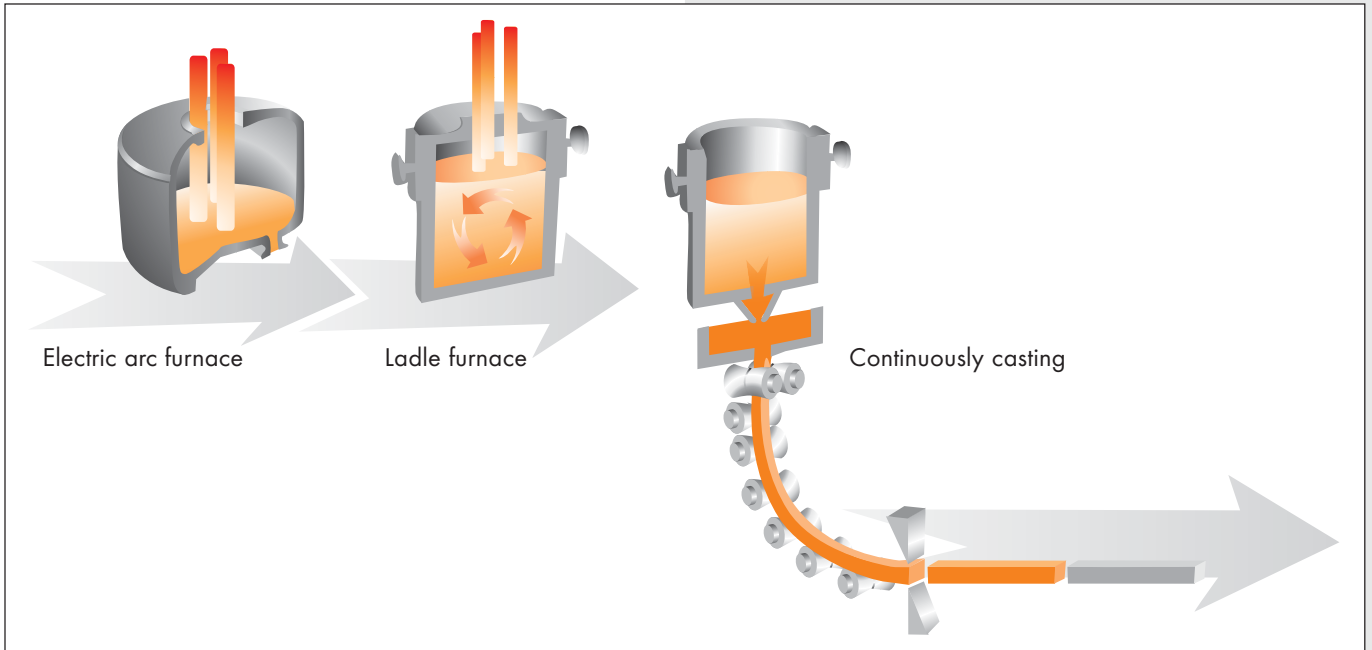
Submerged arc longitudinal welded steel tubes and pipes

Page 102

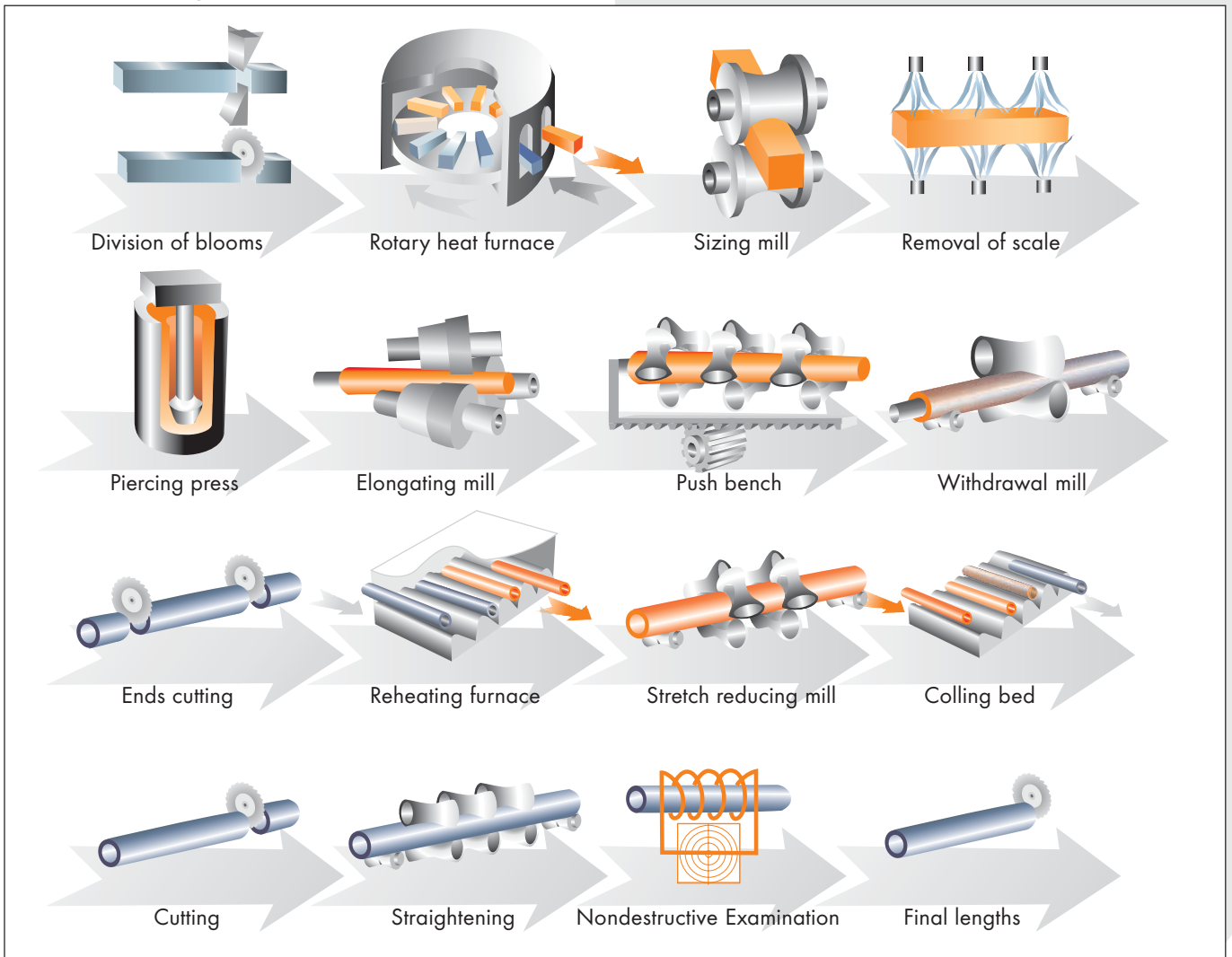
Summary of technical delivery conditions for groups of tubes according to purpose of application see page 124.

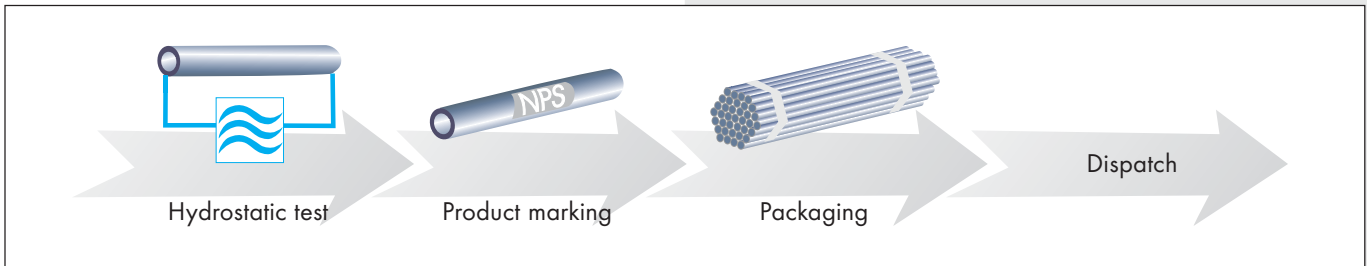
Production flow chart in Železiarne Podbrezová

Steel production

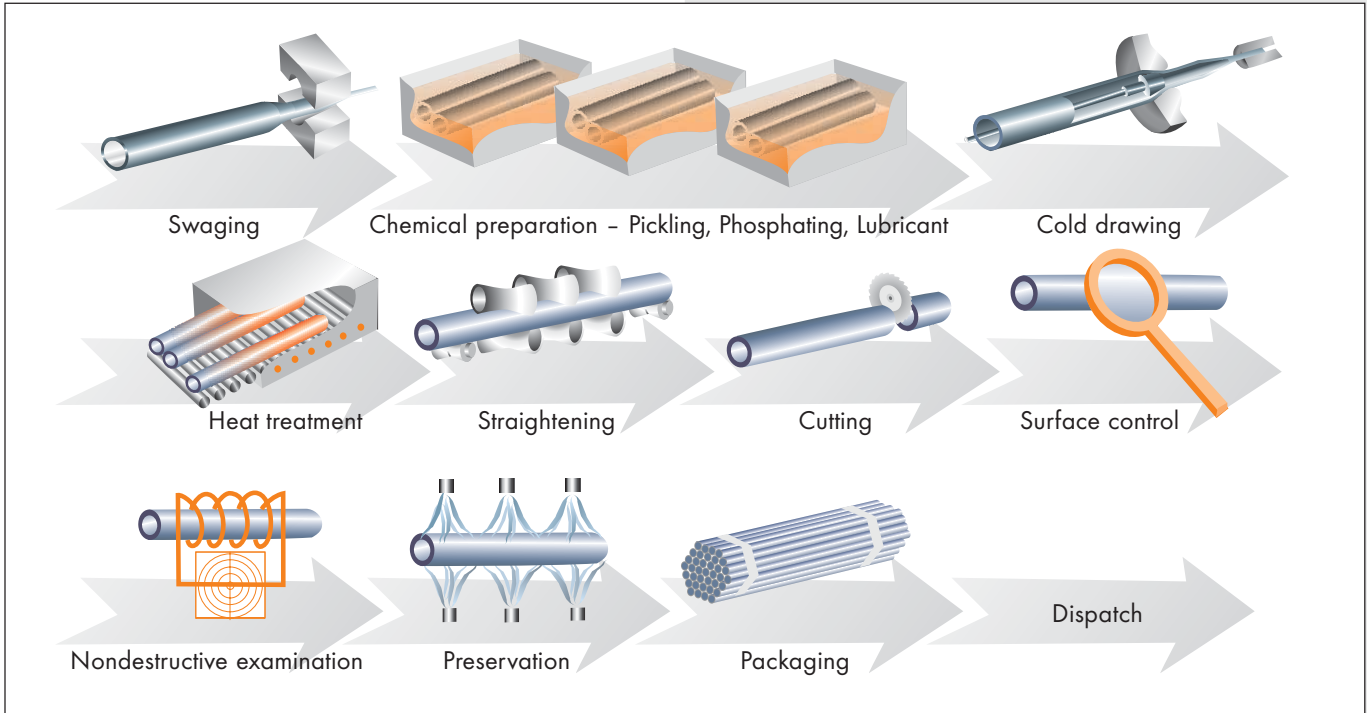


Hot finished tubes production

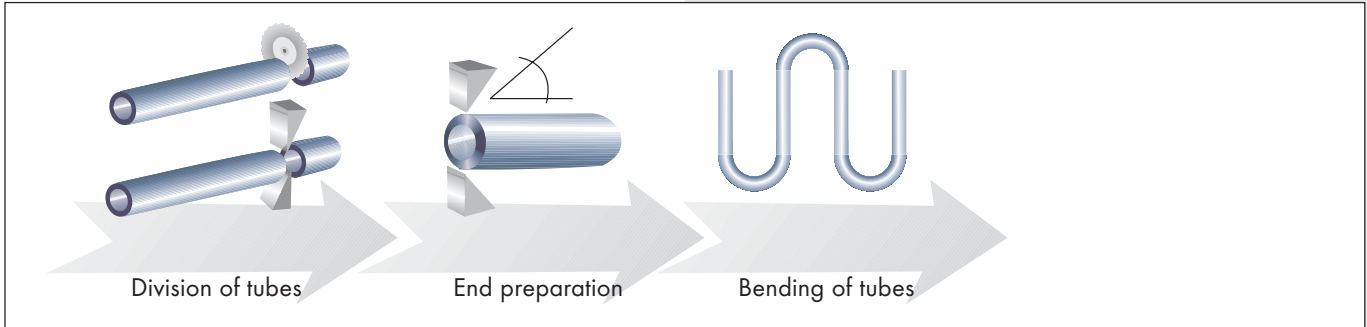




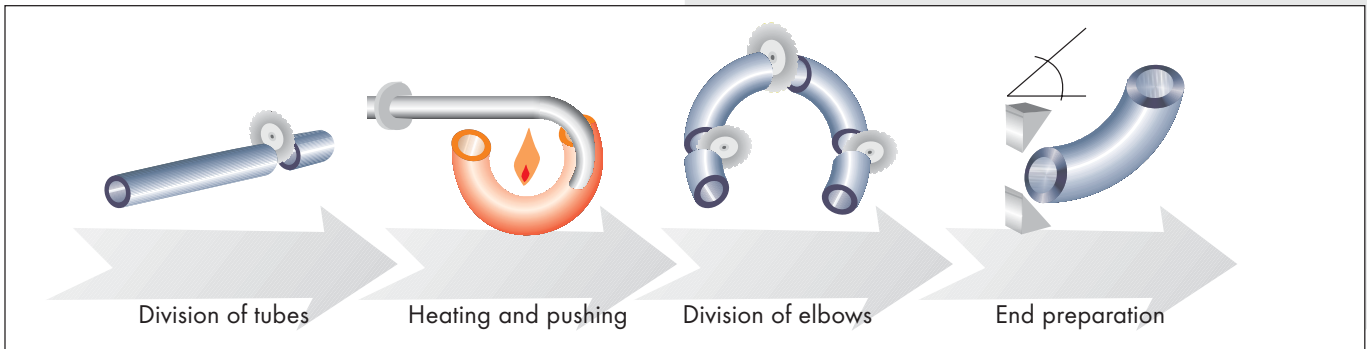
Precision cold drawn tubes production



Semiproducs fabrication



Buttwelding fittings production



Review of basic characteristics of steel tubes

The basic characteristics classification is detailed in the previous section. In this chapter there is a general description of these characteristics with the aim to serve as basis for description of individual particular types and groups of steel tubes. They are:

- tube sizes
- steel for tubes
 - steel classifications and definitions
 - steel marking system for tubes according to EN
- technical delivery conditions (TDC) of tubes (excludes testing)
- tube testing
 - test types
 - types of document control
 - individual tests

Tube dimensions

The tube dimensions belong among the basic characteristics of tubes. For industry needs and general use, tubes are manufactured in diameters ranging from tenths of millimeters to those having diameter of a few meters.

It is mandatory that the tube sizes be set out in such a way that they define the tube completely from this point of view. In the tubes with circular cross section, there are, except for the length, three main dimensions: outside diameter, inside diameter and wall thickness. In circular tubes two values out of those mentioned are given. According to tube types we can also assign to dimensions the appropriate dimensional tolerances.

Dimensions of individual tubes are not created by chance, but they are arranged into the dimensional sequels under the specific system. The tube sizes are in mm; in the USA and some other countries they use inches ("Zoll" in German). In this case tubes are also classified into two groups - "Tubes" are those used in mechanical applications and in energy facilities, while inches are used for the actual outside diameter. "Pipes" are those used in pipelines for different matters. Pipe size is denoted as the nominal pipe size, and up to 12 inches the denotation is given as an approximate value (clearance) of the inside pipe diameter (more details can be found in the particular pipe types).

After converting the pipe dimensions to millimetres used in the SI system there is a first and preferred sequel of outside diameters of steel pipes created (the first series in EN 10220, DIN 2448, etc.). However, this doesn't mean that the pipes within Series 2 and 3 are not used at all. The sizes in Series 2 and 3 (for use in Europe, and supplemented by rounded off dimensions in mm) constitute the standards for Tubes, used in energy facilities design, and in tubes intended for mechanical usage.

Sequel of pipe wall thicknesses has its origin in the inch Unit system, where in order to express a size uses fractions. The series "Schedule" forms pipe wall thickness (40, 60, 80, 120, etc.), and in some dimensions is interconnected with the mass class (STD, XS, XXS). These values, converted to millimeters, form a part of pipe wall thickness series. (Note: size - value Schedule, e.g. 40, is not constant, but dependant upon the outside diameter of a pipe). In the Tube category the wall thickness values are derived either from "scales" BWG, SWG, or other ones. After conversion to millimetres, these values become a part of sequel in steel tube wall thicknesses.

For precision tubes used in Europe and in countries using SI units are established the dimensional series with rounded off measures of outside diameters and wall thicknesses.

The following formula is used for calculation of reference weight (mass):

$$M = (D - T) \times T \times 0,0246615 \text{ (kg/m)}, \text{ or } \times 10,69 \text{ [in(lb/ft)]}.$$

Formula is applicable for carbon steel. For other steel the value is multiplied by the following coefficient:

Steel	Specific weight	Coefficient
Carbon	7,85 kg.dm ⁻³	1
Austenitic stainless	7,97 kg.dm ⁻³	1,015
Ferritic and martensitic	7,73 kg.dm ⁻³	0,985

Steels for tubes

Steel definition and division according to **EN 10020** - steel is defined like:

- material with iron mass rate upper then rate of any other elements
- content of carbon (C) is less than 2%, what is current limit between steel and cast iron (except some Cr-steel with allowed content of carbon more than 2%)
- steel contains also more elements, shown in following table:

Limit value of elements for non alloyed and alloyed steel - column Nr.1

Weldable fine grain structural alloyed steel. Limit value of chemical composition of qualitative and high-grade steel - column Nr. 2

Element	Mass rate in %	
	1	2
Al aluminium	0,30	
B boron	0,0008	
Bi bismuth	0,10	
Co cobalt	0,30	
Cr chrome	0,30	0,50
Cu copper	0,40	0,50
La lantanides (each)	0,10	
Mn manganese	1,65	1,80
Mo molybdenum	0,08	0,10
Nb niobium	0,06	0,08
Ni nickel	0,30	0,50
Pb lead	0,40	
Se selenium	0,10	
Si silicium	0,60	
Te tellurium	0,10	
Ti titanium	0,05	0,12
V vanadium	0,10	0,12
W wolfram	0,30	
Zr zircon	0,05	0,12
Other elements (except: carbon, phosphorus, sulphur, nitrogen), (each)		0,10

Index of defining of alloying elements content characteristic number

Element	Index
Cr, Co, Mn, Ni, Si, W	4
Al, Be, Cu, Mo, Nb, Pb, Ta, Ti, V, Zr	10
Ce, N, P, S	100
B	1000

Note - Alloy steel:

1. Steel is also given in EN.
2. Cast analysis is valid.
3. Minimum element content - see table.
4. In the case when maximum element content is given, 70% of that value (except Mn) is used for qualification.

Classification of steels according to EN 10020

Steel quality groups according to chemical composition	Classification of steel within the main quality groups	
NON-ALLOY STEELS	NON-ALLOY QUALITY STEELS	NON-ALLOY SPECIAL STEELS
Element contents beyond the tabulated values	For general requirements: - impact energy - grain size - formability	+
STAINLESS STEELS		BASIC CHARACTERISTICS
Max. contents C 1,2% Min. contents Cr 10,5% Ni contents less than 2,5% or Ni contents over 2,5%		Corrosion resisting steels Creep resisting steels Heat resisting steels
OTHER ALLOY STEELS	ALLOY QUALITY STEELS	ALLOY SPECIAL STEELS
Non stainless steel, contents of, at least, a single element within the tabulated values.	fine-grain steels steels for rails and reinforcing steels for demanding use alloy steels by Cu steels for electronics	+
		structural steels for pressure vessels for anti-friction bearings tool steels high-speed steels special physical characteristics

• Classification of steels see also ISO 4948-1 and ISO 4948-2

Designation system for steels according to EN

EN 10027 – 1 (ISO/TS 4949)	Steel names
	Abbreviated designation system
	Principal symbols
EN ECISS IC10	Additional symbols
EN 10027 – 2	Numerical system

According to **EN 10027 – 1** the steel names divide into the two main groups:

- Group 1 – steel designated according to the usage and mechanical properties
- Group 2 – steel designated according to the chemical composition. These further divide into the four subgroups.

Group 1

- S – structural steel (for general usage)
- P – steel for pressure equipments
- L – steel for pipelines
- E – steel for machine parts (the subsequent number stands for the minimum yield value in ν N/mm²)
- B – concrete reinforcing steel
- Y – prestressed concrete reinforcing steel
- R – steel for rails
- H – high strength steel for cold rolled flat products
- D – sheet products from mild steel for cold forming – cold rolled
- T – thin sheets and strips for packing
- M – sheets and strips for electronic industry

The first four steel kinds are used for tubes.

Group 2 – includes 4 subgroups

- **non-alloy carbon steel** (with controlled C content) – designation: Letter C and the number corresponding to the centuplicate of the average range specified for carbon content (**C22**)
- **Non-alloy carbon steel** containing Mn > 1% **and alloyed steel** with the contents of individual alloying elements less than 5% – designation:

- a) number corresponding to the carbon contents centuplicate
- b) chemical symbols of alloying elements arranged according to the descending content of elements
- c) numbers set out following the alloying elements content. Mean element content, multiplied by index from table and approximated to higher number (**25CrMo4**).

- **alloy steel** with alloying addition content (a minimum of a single element over 5%) – designation:

- a) characteristic letter **X** (**X11CrMo9-1**)
- b) number – centuplicate of the mean carbon content
- c) chemical symbols of alloying elements
- d) numbers set out following the alloying elements content. Mean element content approximated to higher number.

- **high-speed steel** – designation

- a) characteristic letters HS (**HS 6-5-2**)
- b) numbers set out following the alloying elements content

Regulation **EN ECISS IC10** sets out additional symbols for **steel** (Group 1 and 2). These symbols form the suffixes to the steel mark end (e.g. S 275 J0). The supplementary symbols for **steel products** are detailed in Table 1, 2 and 3, and plus (+) must separate them from the preceding symbols – e.g. S 275 J0+A.

Symbols for steel tubes

- G – other characteristics (according to the need 1 to 2 digits)
- H – hollow profile or steel for higher temperatures according to steel type (S, P)
- L – steel for low temperatures
- R – steel for room temperatures (ambient temperature)
- M – thermo mechanically rolled
- N – normalized annealing or normalized rolled
- Q – quenched
- T – steel for tubes

EN 10027 – 2 includes the numerical system. The first digit is 1 – steel, followed by two digit of the steel and the steel sequence number (**1.0402, 1.7218, 1.7386, 1.3339**).

Technical delivery conditions (TDC) of tubes (excludes inspection)

All tubes requirements are concentrated in the TDC Standards. Specific data are included in standards for several groups of tubes General TDC for steel production are EN 10021 (ISO 404). Symbols and definitions of terms for use in product standards are in EN 10266. Important part is the tube testing.

Tube inspection

Tube testing proves that properties of tubes meet the requirements of an order and appropriate standards.

The process divide up into three parts:

- setting out the test type (EN 10021, EN 10204, ISO 10474)
- setting out the type of a document inspection (EN 10204)
- selection of individual tests (particularly TDC)

The individual parts are connected without possibility of any combination. Proper tests of particular tubes are specified in TDC.

• Non-specific and specific inspection

Non-specific inspection

- contains only mandatory tests according to the particular standard
- test specimens do not have to be from their own delivery
- testing station does not have to be independent from the tubes treatment plant

Specific inspection

- except for mandatory tests it contains other free selected tests
- tube specimens are from the delivery, and their number is set by standard
- testing station must be independent from the pipe treatment plant

• Tests

- mandatory - as per individual TDC standards
- optional - agreed upon while placing an order for the tubes chosen from standard

• Quality – TR 1, TR 2 depends on:

- chemical composition (Al contents)
- mechanical properties value (bending impact test)
- type of tubes testing (specific and non-specific testing)

• Test category – TC1 and TC2 depends on:

- establishing of a standard
 - chemical composition (carbon or alloyed steel)
 - possibility of choice in placing an order for pipes (in C steel)
- The categories differ from each other mainly by the requirement for non-destructive testing of pipes, or selection of alternative tests.

• Types of inspection documents

The summary of certificate types meets the requirements of EN 10204 in accordance with the type of inspection:

Non-specific inspection

- 2.1 Certificate of compliance with the order (manufacturer)
- 2.2 Test Report (manufacturer)

Specific testing

- 2.3 Specific Test Report (manufacturer) – manufacturer's test certificate, test results based on specific testing. This is only issued if the manufacturer has no independent testing station. If the testing station is independent, in lieu of this certificate a Certificate 3.1.B has to be issued.

3.1.A Inspection Certificate 3.1.A (office inspector)

3.1.B Inspection Certificate 3.1.B (works inspector)

3.1.C Inspection Certificate 3.1.C (purchase inspector)

3.2 Inspection Report 3.2 (works and purchase inspector)

EN 10204: 2004 Issue customizes following test certificates:

2.1 Declaration of compliance with the order

2.2 Test report

2.3 Not considered

3.1 Inspection certificate 3.1 (former 3.1.B)

3.2 Inspection certificate 3.2 (former 3.1.A, 3.1.C, 3.2)

In EN is the table – Relation between class qualification according to Regulation 97/23 EU, supplement I., section 4.3 and type of certificate.

The tests are divide into groups:

• **value of steel chemical composition** - cast
- product

• **dimensional inspection**

• **mechanical properties*** - tensile test
- (hardness)

- impact test

• **technological tests***

- flattening

- drift expanding

- flanging

- bending

- ring tensile test

• **leak tightness test**

- hydrostatic test

- non-destructive testing

• **non-destructive testing**

(eddy currents, leakage fluxes, ultrasonic)

- longitudinal defects

- transverse defects

- laminar defects

• **other tests** (metallography, corrosion resistance, etc.)

* see page 110

Table below lists the overview of the leak tightness test and non-destructive testing:

Method	STN, CSN	DIN (SEP)	EN	ASTM	Dimensions	ISO
Tightness test						
Hydrostatic pressure	42 0415.8		Normy TDP		D < 140 mm	
NDT	01 5047 01 5049 01 5054	SEP 1925	10 246 - 1		vid' NDT	9302
Non-destructive tests (NDT)						
Eddy currents	01 5054	(PRP 02-74)	10 246 - 3	E 309	D > 4 mm, T > 0,5 mm	9304
Leakage fluxes	01 5047	SEP 1913	10 246 - 5	E 570	D > 32 mm, T > 2 mm**	9402
Ultrasonic – L longitudinal imperf.	01 5028 - 2	SEP 1915	10 246 - 7	E 213	D > 13 mm, T > 1(2) mm**	9303
Ultrasonic – Q transverse imperf.	01 5028 - 3	SEP 1918	10 246 - 6			9305
Ultrasonic – D laminar imperf.	01 5028 - 4	SEP 1919	10 246 - 14			

Tube lengths - see List of standards given for each of tube groups

1)** Values for Podbrezová 2) SEP 1917 - Eddy currents testing for electric-resistance welded tubing

Leak tightness test and NDT of tubes for pressure purposes according to EN

EN 10216 – 1	EN 10216 – 2, 3, 4
Quality TR1 or TR2	Test category TC1 or TC2
C-steel, sort of quality is included in steel name	C-steel – option TC1 or TC2 Alloy steel – TC2 only
1. Leak tightness test Mandatory test for all tubes. Option from methods: 1.1 Hydrostatic test Hydrostatic test shall be carried out at a test pressure of 70 bar or a test pressure P calculated using the following equation, whichever is lower: $P = 20x (SxT)/D$, where S = stress in MPa, corresponding to 70% of minimum yield strength. 1.2 NDT (electromagnetic test) according to EN 10246 – 1 (E) Option from methods: 1.2.1 encircling coil – diameter of drilled hole in reference standard may be specific as percentage of wall thickness or diameter of tube 1.2.2 rotary probe coil – reference standard with depth of the notch of 12,5% of nominal wall thickness T (min. 0,5 mm, max 1,5 mm). Width of notch is smaller as depth, length min. 50 mm.	
2. Non-destructive testing – longitudinal imperfections	
2.1 Quality TR2 - optional test - option from methods: 2.1.1 EN 10246-3 (electromagnetic) 2.1.2 EN 10246-5 (flux leak tightness) 2.1.3 EN 10246-7 (ultrasonic) Level 3, sub-category C	2.2 Test category TC2 – mandatory test - option from methods: 2.2.1 EN 10246-7 (ultrasonic) Level U2, sub-category C 2.2.2 EN 10246-5 (flux leak tightness) Level F2 2.3 transverse imperfections (EN 10246-6, U2C) and 2.4 laminar imperfections (EN 10246-14, U2) 2.5 measurement of WT (EN 10246-13) – only as optional test upon agreement.

Note

EN 10216-1 – only C-steel is included in standard

The pressure tubes of category TC2 are usually tested with combination of two NDT: - electromagnetic (eddy current) test (leak tightness)
- ultrasonic test (NDT)

Testing methods

E – Eddy Current (EN 10246-1 and 3). (Test 1.2 and 2.1.1 in the table above.) For tubes with $D \geq 4$ mm.

Encircling coil – level of admittance E1H, E2H, E3H, E4H (diameter of drilled hole in reference standard may be specific as a function of diameter D – see table in standard)

Rotary probe coil – level of admittance E2, E3, E4, E5

F – Flux Leakage (EN 10246-5). (Testing 2.1.2 and 2.2.2 in the table above.) For tubes with $D \geq 10$ mm.

Level of admittance F2, F3, F4, F5, F6

U – Ultrasonic – longitudinal imperfections EN 10246-7

– transverse imperfections EN 10246-6

– laminar imperfections EN 10246-14 (WT over 5 mm)

– measurement of WT (EN 10246-13) (WT over 4,5–5 mm)

(Tests 2.1.3, 2.2.1, 2.3, 2.4 and 2.5 in the table above). For tubes with $D \geq 10$ mm and rate $D/T > 5$. For smaller rate agreement.

Level of admittance of EN 10246-7 – U1, U2, U3, U4, U5, U6

Semilevel A, B, C, D

Test level and depth of gauge notch in % of wall thickness:

1	3
2	5
3	10
4	12,5
5	15
6	20

Subcategory – minimum depth of notch (mm)

A	0,1
B	0,2
C	0,3
D	0,5

Subcategories A, B, C, D are applied for cold formed and machined tubes. Subcategories C and D are applied for hot rolled tubes. Other values of levels of admittance as in EN – upon agreement.

Transverse, laminar testing and measurement of WT imperfections – upon agreement only.

Testing according to ASTM A - see page 39

Quality management system, certification, legislation

The manual is, primarily, focused on providing an overview of technical parameters of steel tubes produced by Železiarne Podbrezová. The tubes themselves as well as products and facilities whose parts consist of the tubes must also meet requirements of respective state or professional regulations, rules and decrees aimed at safety of operation, health and environment protection. Also the quality management system must be in accordance with respective regulations and is subject to certification issued by authorised company.

Quality management

can consist of several stages:

- certification of the quality management system in accordance with international ISO standards 9001: 2000
- certification of the quality management system in accordance with specific technical regulations
- certification of products. This part consist of three areas:
 1. Production certification – certification that products produced in accordance with standards meet the requirements of the regulations (e.g. EU regulations)
 2. Products intended for construction purposes – compliance demonstration
 3. Certification of products – acknowledgement of companies authorised to accept tubes that the products meet requirements of the respective standards

SEM or EMS

Environmental Management System is certified according to standard EN ISO 14 001.

OHSAS 18001

OHSAS is an international Occupational Health and Safety Management System specification.

Legislation

Steel tubes are, depending on the purpose of their use, divided into particular groups which are subject to superior regulations of various type and strength.

In EU countries are valid for several groups of products Directive and Standards.

Directive are the part of national legislation. Designation of directives:

- year of edition / number / EU

Virtue acquired past its edition in Official Journal EU (collection of Laws).

In OJ is directive marked:

- OJ L number / date

Standards are valid for several groups of tubes and pipes.

With respect to the aforementioned there are three distinctive types of tubes:

- tubes intended for building and construction purposes
- tubes intended for pressure use
- tubes for machinery building

Tubes intended for building and construction purposes

They are classified as final products. Procedure applied to compliance demonstration:

- CPD Directive No. 1989/106 EU (Construction Products Directive), implemented to laws and related regulations (in Slovakia, Act No. 90/1998 Coll., in the Czech Rep. Act No. 22/1997 Coll.) and subsequent regulations and decrees.
- Technical standard (voluntary, harmonised, e.g. EN standard). Standards specify technical requirements applied to products.
- Declaration of conformity – certificate that assessed products are fully in conformity with safety requirements.

Conformity marking – Ü-Zeichen will be replaced with CE-Zeichen. For the Slovak Republic, the designation C_{SK} is applied at the present. CE is valid for EN 10210, EN 10219, EN 10224, EN 10255.

Tubes intended for pressure equipments

They are classified as materials used for construction of pressure equipment.

- PED Directive No. 1997/23 EU (Pressure Equipment Directive) and its Annex 1 clause 4.3. (see page 25 too)
- The directive is transposed to EN standards, which apply for example to construction of boilers and also specify the standards for particular materials (previously so called Regelwerke). Example: EN – EN 12 952
- EN standards for steel tubes for pressure use – EN 10216 – 2 (standard for boiler tubes) – manufacturer's certificate that the standards correspond to the requirement of respective regulations.

Tubes for mechanical purpose and machinery building

For machinery building – see Machinery Directive 98/37/EC. For deliveries of tubes for automotive industry it is necessary, so supplier is certified according to ISO/TS 16949 and (or) standard of VDA series 6. ISO/TS 16949 are supplementary requirements for use of standard ISO 9001: 2000 in automotive industry. VDA 6.1 is standard for audit of Quality – Management System.

First standard was published from IATF – International Automotive Task Force and JAMA – Japan Automobile Manufacturers Association. VDA is Verband der Automobilindustrie in Germany.

Continuously cast steel blooms

Steel blooms are the starting material for the production of seamless hot finished tubes and pipes. They are also used for the production of other metallurgical semi products by hot forming (rolling, forging, pressing).

Dimensions and tolerances

Blooms of square cross-section

Square side [mm]	Tolerances [mm]	Sidelong max* [mm]	Cross-section area [mm ²]	Weight [kg/m]	Edge of the bloom [mm]
150	±3	±6	22 420	175,5	R = 5 mm ±1 mm
160	±3	±6	25 600	199,7	R = 10 mm ±1 mm
180	±3	±7	32 100	252,7	R = 10 mm ±1 mm
200	±4	±7	39 680	312,0	R = 10 mm ±1 mm
225	±5	±9	50 170	394,8	45°/15 mm
280	±8	±11	76 662	598,0	R = 45 mm ±1,5 mm

* Difference of diagonals of square

Blooms of circular cross-section

Diameter [mm]	Tolerances [mm]	Ovality [mm]	Cross-section area [mm ²]	Weight [kg/m]
150	±2	3	17 662	137,7
180	±3	5	25 434	198,4
210	±4	5	34 618	270,0
260	±5	6	53 066	414,0
280	±5	7	61 575	480,0

Lengths

The blooms are delivered in lengths of 4000 - 9000 mm with length tolerance of +50 mm.

Straightness tolerance - 1% of length

Obliqueness of front side - 5°

Steel quality

The steel is produced by electric process and is fully killed. The chemical composition of the steel is determined by standards and steel grades for individual groups of tubes. It is also possible to deliver blooms from other steel grades to meet specific customer requirements.

Element content in % of weight																	
	C	Mn	Si	Cr	Mo	Ni	V	S	P	Cu	Sn	Al	Ti	B	Nb	O	N
min	0,05	0,3	0,1	0,05	0,05	max	0	max	max	max	max	0,005					
max	1,2	2,5	1,3	2,5	1,1	3,4	0,8	0,035	0,035	0,40	0,040	0,050	0,050	0,001	0,050	0,00035	0,010

Gases volume: O max. 0,00035% (3,5ppm), H max. 0,0050% (50ppm), N max 0,010% (100 ppm) - according agreement max. 0,008%.

Conversion: a (%) x 10 000 = b (ppm). (But the using of ppm is in system SI non-permissible).

Heat treatment, delivery condition and surface quality

After casting the blooms are not heat treated, nor is the surface treated. Blooms are delivered according to technical delivery requirements.

Testing

Blooms are tested according to appropriate standards.

Marking

Blooms are stamped on their face. Markings include: heat number, steel grade code, stream number. In special cases blooms are marked with colour.

Laying of blooms

Square cross-section - in layers

Circular cross-section - in special wooden pads or bound with steel strip.

Certification

Test report certificate in accordance with the specification: DIN 50049, EN 10204 - 2.2 or others.

Steel tubes for building – Hollow structural sections (HSS)

Standards	Dimensional standards	Dimensional range	Dimensions				
			Tolerance D	Tolerance T	Lengths	Straightness	Tube ends
EN	10210-2	Table 1/Page 26 Hot finished circular hollow sections (HFCHS)	<ul style="list-style-type: none"> • $\pm 1\%$ • min $\pm 0,5$ mm • max ± 10 mm • ovality 2 % • weight $\pm 6\%$, max 8 % 	<ul style="list-style-type: none"> • -10 % • -12,5 % for seamless profiles • + tolerance is limited by allowed weight 	Informative values: <ul style="list-style-type: none"> • $D < 60,3$ mm 5-6 m • $D \geq 60,3$ mm / $T < 7,1$ mm 5-6 m or 10-14 m • $D \geq 60,3$ mm / $T \geq 7,1$ mm 5-6 m Kinds: <ul style="list-style-type: none"> • random • fixed ± 500 mm • exact $L < 6$ m 0 +10 mm $L > 6$ m 0 +15 mm 	Allowed 0,002.L of whole length locally 3 mm/m	<ul style="list-style-type: none"> • square cut ends • free from excessive burrs
DIN	2448		<ul style="list-style-type: none"> • $\pm 1\%$ • min $\pm 0,5$ mm • weight -8 % +12 % 	<ul style="list-style-type: none"> • $D < 130$ mm • $T \leq 2T_n$ -10 % +15 % • $2T_n < T < 4T_n$ -10 % +12,5 % • $T > 4T_n$ $\pm 9\%$ T_n - basic wall thickness according to DIN 2448 $D = 130-320$ mm <ul style="list-style-type: none"> • $T \leq 0,05D$ -12,5% +17,5% • $T > 0,05-0,11D$ $\pm 12,5\%$ • $T > 0,11D$ $\pm 10\%$ 	<ul style="list-style-type: none"> • exact $L > 12$ m - tolerances upon agreement 		
NFA	49-501			<ul style="list-style-type: none"> • $D < 101,6$ mm -12,5 % +15 % • $D = 101,6-406,4$ mm -12,5 % +17,5 % 			
STN ČSN	42 5715 42 5716				See page 24-25		
GOST	8732				See page 36-37		

Notes:

- C - carbon equivalent formula: $CEV(IIW) = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15$.
- steel are weldable, specific conditions see individual standards.
- rate cold workability is set by mechanical steel properties and is definite with regulations.
- tubes according to ASTM A500 (steel Grade A, B, C, D), ASTM A501 and JIS G3444 (steel STR290, STK400, STK540) upon agreement.
- possibility of hot dip zinc coating of tubes is necessary to discuss at inquiry (see page 15).

List of dimensional standards and technical delivery conditions standards

EN 10 025	Hot rolled products of structural steels. Part 1-6.
EN 10 210-1,2	Hot finished structural hollow sections of non-alloy and fine grain structural steel. Part 1: TDC. Part 2: Tolerances, dimensions and sectional properties. See also ISO 630-2 (TDC) and ISO 657-14 (DS).
EN 10266	Steel tubes, fittings and structural hollow sections - Symbols and definitions of terms for use in product standards.
DIN 1629	Seamless circular tubes of non-alloy steel with special quality requirements.TDC.
DIN 2448	Plain end seamless steel tubes. Dimensions.
DIN 17100	Steel for general structural purposes. Quality standard.
DIN 17121	Seamless structural steel circular tubes for structural engineering purposes.
DIN 17124	Seamless circular tubes of fine grain steel for engineering purposes.
NFA 49-501	Steel tubes. Seamless or welded hot finished structural hollow sections. Dimensions. TDC.
STN 42 0250	ČSN 42 0250 Hot formed seamless tubes from steel class 10 to 16. TDC.
STN 42 5715	ČSN 42 5715 Hot formed seamless steel tubes. Dimensions.
STN 42 5716	ČSN 42 5716 Hot formed seamless steel tubes with smaller tolerances. Dimensions.
GOST 8731	Seamless hot-formed steel pipes. TDC.
GOST 8732	Seamless hot-formed steel pipes. Dimensions.
JIS G3444	Carbon steel tubes for general structural purposes.

TDC standards	Steel grade			Testing and certificates		Other TDC		
	Name	Condition	Surface	Testing	Certificate	Marking	Surface protection	Packing
10210-1 (10025) (10113)	S235 JRH S275 JOH S355 JOH S275 J2H S355 J2H	Hot finished • as rolled Cold finished • normalized	adequate to production mode	option: (steels JRH, JOH) • non-specific • specific	10204 • 2.2 • series 3	Bundle-label or Tubes-possibilities: • stenciling • stamping • attached label Data: • EN 10210-Steel • manufacturer • specific inspection: - number - mark of the inspection representative	• without • oiled	bundle 300- 3500 kg
	S275 NH S275 NLH S355 NH S355 NLH S460 NH S460 NLH	Hot finished • normalising rolled • normalized Cold finished • normalized		Specific (steels J2H, NH, NLH) tests (obligatory) only: • cast analysis • tensile test • impact test • tube surface (visual examination) • dimensions • NDT of weld	10204 • 3.1 • 3.2 see also pg.10			
17 121 (17 100)	RS1 37-2 St 44-2	Hot finished • as rolled Cold finished • normalized		option:	50049 • 2.2 • 3.1 B,C	CE marking (in inspection document)		
	St 37-3 St 44-3 St 52-3			• tensile test • tube surface • dimensions • impact test (T > 5 mm)	50049 • 3.1 B,C			
17 124	StE 255 TS1E 255 ES1E 255 StE 285 TS1E 285 ES1E 285 StE 355 TS1E 355 ES1E 355 StE 420 TS1E 420 ES1E 420 StE 460 TS1E 460 ES1E 460	Hot finished • normalising rolled • normalized Cold finished • normalized		• cast analysis • tensile test • impact test (T > 5 mm) • tube surface • dimensions	50049 • 3.1 A,B,C	Label on bundle Punching upon agreement Data: • producer logo • steel grade • mark SS • mark of test laboratory		
49-501	TU E235 TU E275 TU E355 TU E450 Grade 2,3,4	Hot finished • as rolled Cold finished • normalized						
42 0250	11 353 11 453 11 503 11 523	Hot finished			See page 25			
8731	1050: 10, 20 19281: 09G2S				See page 37			

Steel designation according to EN

S – structural steel

235 – minimum yield strength in N/mm²

Signs at the end of steel designation – additional symbols for steel names

- non-alloy steel
 - J – impact test, min. average absorbed energy KV – 27J
 - R – room temperature
 - 0 – temperature 0 °C
 - 2 – temperature -20 °C
 - H – hollow section
- fine grain steel (ferritic grain size equal to or finer than 6)
 - basic series
 - N – normalized structure
 - H – hollow section
 - low temperature series
 - N – normalized structure
 - L – low temperature series
 - H – hollow section

Fine grain structural steel designation according to DIN 17124

StE – basic series (-20 °C)

TS1E – deep-drawing series with minimum absorbed energy at temperature of -50 °C

ES1E – deep-drawing series with minimum absorbed energy at temperature of -60 °C

255 – minimum yield strength in N/mm²

Steels for structural tubes – see page 19

Possibility of hot dip zinc coating

All structural steels are possible to hot dip zinc, but quality, appearance and thickness of coating influences the chemical composition of steel (the content of Si + P).

For general structural steels is recommended to keep the content of Si + P in range 0,13 % – 0,28 %.

CEV (IIW) - Carbon Equivalent Value (CEV) according to the International Institute of Welding (IIW).

Tubes for mechanical engineering and general use

Standards	Dimensional standards	Dimensional range	Dimensions				
			Tolerance D	Tolerance T	Lengths	Straightness	Tube ends
EN	10294-1 (upon agreement) **	<ul style="list-style-type: none"> deliveries in agreement tubes from mill are not machining operated in preference as precision tubes 	D ≤ 75 mm ±0,5 mm D = 75 - 180 mm ±0,75 % D > 180 mm ± 1%	D ≤ 180 mm, T ≤ 15 mm ±12,5 % min ±0,4 mm	<ul style="list-style-type: none"> random exact upon agreement 	<ul style="list-style-type: none"> 0,001.L locally (1 mm/m) upon agreement 	<ul style="list-style-type: none"> square cut ends free from excessive burrs
	10297-1 (10220)	<ul style="list-style-type: none"> dimension OD x ID (up to OD = 100mm) 	D ≤ 219,1 mm ±1 % min ±0,5 mm	D ≤ 219,1 mm ±12,5 % min ±0,4 mm	<ul style="list-style-type: none"> random exact L < 6 m 0 +10 mm L = 6 - 12 m 0 +15 mm L > 12 m upon agreement	D > 33,7 mm 0,0015.L	
	10305-1 (upon agreement)	Table 16/Page 64 Table 17/Page 65	See page 60-64 (Cold formed precise)	See page 60-64 (Cold formed precise)			
DIN	2448	Table 1/Page 26	See page 22				
	2448 (2391)						
BS	6323/3		±1% min ±0,5 mm	≤ 3% D ±15 % > 3% D - 12,5 % +15 %	<ul style="list-style-type: none"> random exact L < 6 m 0 +10 mm L > 6 m 0 +15 mm		<ul style="list-style-type: none"> square cut ends free from excessive burrs

List of dimensional standards and technical delivery conditions standards

EN 10 083	Steels for quenching and tempering. Part 1: General TDC. Part 2: TDC for non-alloy steels. Part 3: TDC for alloy steels.
EN 10 084	Case hardening steel. TDC.
EN 10 216 - 1	Seamless steel tubes for pressure purposes. TDC. Part 1: Non-alloy steel tubes with specific room temperature properties.
EN 10 294 - 1	Hollow bars for machining. Part 1: Non-alloy and alloy steel.
EN 10 297 - 1	Seamless circular steel tubes for mechanical and general engineering purposes. Part 1: Non-alloy and alloy steel tubes.
DIN 1629	Seamless circular tubes of non-alloy steel with special quality requirements. TDC.
DIN 1630	Seamless circular tubes of non-alloy steel with very high quality requirements. TDC.
DIN 2448	Seamless tubes. Dimensions.
DIN 17200	Steels for quenching and tempering. TDC.
DIN 17204	Seamless circular tubes of steel for quenching and tempering. TDC.
DIN 17210	Case hardening steels. TDC.
BS 6323	Specification for seamless and welded steel tubes for automobile, mechanical and general engineering purposes. Part 1: General requirements. Part 3: Specific requirements for hot finished seamless steel tubes.
ISO 2937	Plain end seamless steel tubes for mechanical application.
ISO 2938	Hollow steel bars for machining.

▶▶▶ Tubes for mechanical engineering and general use

Standards	Dimensional standards	Dimensional range	Dimensions				
			Tolerance D	Tolerance T	Lengths	Straightness	Tube ends
NF A	49-311 49-312	Table 1/Page 26	±1 % min ±0,5 mm Weight -8 % +10 %	T < 20 mm ±15 % min ±0,5 mm	• random • exact		• square cut ends • free from excessive burrs
UNI	4991 (ISO 4200) 7729		Hot finished: D ≤ 51 mm ±0,5 mm D = 51-419 mm ±1% Weight ±10% Cold finished: D ≤ 25 mm ±0,25 mm D = 25-51 mm ±0,35 mm D = 51-168,3 mm ±0,75 mm Weight -8 % +10 % ±1 % min ±0,5 mm Weight ±10 %	- 15 % + non-specific (limited by weight) T ≤ 7mm ±12% min ±0,10mm T > 7mm -10 +12 % T/D ≤ 3 % ±15 % T/D > 3 % ±12,5 % (do D = 168,3 mm)	• random • exact L < 6 m 0 +10 mm L > 6 m 0 +15 mm	1,5 mm/m	• square cut ends • free from excessive burrs
STN ČSN	42 5715 42 5716					See page 24	
GOST	8732					See page 36	
PN-H	74219					See page 24	
ASTM ASME	A53* SA-53* A519	Table 2/Page 28 Table 5/Page 31 Table 18/Page 66 Table 19/Page 67	NPS ≤ 1½ ±1/64 inch (±0,4 mm) NPS ≥ 2 ±1 % Weight ±10 % Hot finished (table 6): D ≤ 76,17 mm ±0,51 mm D = 76,2-114,2 mm ±0,64 mm D = 114,3-152,3 mm ±0,79 mm Cold finished: Table 8 and 9 of standard	-12,5 % (Table X 2.4) Table 7 of standard Table 9 of standard	• fixed 6 m ±500 mm • exact 6 m -0 +15 mm	visually straight	• square cut ends • plain, not threadet • NPS ≤ 1½ (DN 40/48,3 mm) option of the manufacturer • NPS ≥ 2 (DN 50/60,3 mm) WT=Std, XS, les than 0,5 inch/12,7 mm beveled (s. 98) WT > 0,5 inch and XXS - plain and square cut
JIS	G3445	Table 10/Page 52				See page 24	

* Ends preparing is valid for ASTM A53, for A519 as NF A.

List of dimensional standards and technical delivery conditions standards

- STN 42 0250 ČSN 42 0250 Hot formed seamless tubes from steel class 10 to 16. TDC.
 STN 42 5715 ČSN 42 5715 Hot formed seamless steel tubes. Dimensions.
 STN 42 5716 ČSN 42 5716 Hot formed seamless steel tubes with smaller tolerances. Dimensions.
 ASTM A53 Pipe, steel, black and hot-dipped, zinc-coated, welded and seamless.
 ASTM A519 Seamless carbon and alloy steel mechanical tubing.
 ASTM A530 General requirements for specialized carbon and alloy steel pipe.
 UNI ISO 4200 Plain end steel tubes, welded and seamless. General dimensions and masses per unit length.
 UNI 663 Unalloyed seamless steel tubes. Plain end tubes for general purposes.
 UNI 4991 Standard plain end seamles and welded tubes. Dimensions.
 UNI 7729 Unalloyed seamless steel tubes - plain end tubes for mechanical application.
 NFA 49-311 Seamless steel tubes for mechanical application. Dimensions. TDC.
 NFA 49-312 Seamless steel tubes with improved mechinability for mechanical machined parts.
 GOST 8731 Seamless hot-formed steel pipes. TDC.
 GOST 8732 Seamless hot-formed steel pipes. Dimensions.
 JIS G 3445 Carbon steel tubes for machine structural purposes.
 PN-H 74219 Hot rolled seamless steel tubes.
 PN-H 84018 Low-alloy steel with higher properties.
 PN-H 84019 Carbon steel for heat treatment.
 PN-H 84023/7 Steel for higher purposes. Steel for tubes.

TDC standards	Steel grade			Testing and certificates		Other TDC			
	Name	Condition	Surface	Testing	Certificate	Marking	Surface protection	Packing	
49-311	TU 37-b TU 52-b TU 56-b TU XC35	Hot finished • as rolled		• tensile test • cast analysis • other tests upon agreement	Upon agreement	Longitudinally on tube Label on bundle	• without • upon agreement	bundle 300- 3500 kg	
49-312	S 470M S 450MG2	Hot finished • as rolled • normalized							
663	Fe 35-1 Fe 45-1 Fe 52-1 Fe 55-1 Fe 35-2 Fe 45-2 Fe 52-2 Fe 55-2	Hot finished • as rolled Cold finished • normalized		• hydrotest • other tests upon agreement					
7729	Fe 360 Fe 510 Fe 540			• visual • tensile test • dimensions		• producer's logo • steel grade • standard			
42 0250				Data - see page 25					
8731	→			Data - see page 37					
74219	→			Data - see page 25					
	→			steel 84018: 18G2, 18G2A; 84019: 10, 20, 35, 45, 55; 84023/7: R35, R45, R55, R65 (chemical composition see also page 71)					
A53/A530 SA53/SA 530	Grade A Grade B	Hot finished • as rolled Dimensions 1/8- 3/8 (DN 6-10) cold finished and thereafter heat treated	• adequate to produc- tion mode • upon agreement insulation	• product analysis • tensile test • impact test (NPS ≤ 2 inch) • flattening • leakage - optional: - NDT (NDE) E213, E309, E570 - hydrostatic pressure, values in table X 2.2		Tube or bundle: Data: • producer • seamless • steel grade • standard size • length • cast number method of testing NPS < 1 1/2 - label	at non insulated tubes upon agree- ment	according to A700	
A519	Steel grade according to table	Hot finished (HF) Cold finished (CW) • A (annealed) • N (normalized) • SR (stress relieved) • QT (quench. and temp.)		• product analysis • tensile test (upon agreement) • hardness (upon agreement) • drift expanding (upon agreement) • NDT (upon agreement)					
G3445	Steel grade according to table	Seamless tubes: S Hot finished: H Cold finished: C • condition according to agreement		• product analysis • tensile test • impact test • flattening • hydrotest or NDT upon agreement		Tube or bundle: • steel • method (SH, SC) • dimension • producer			

Steels for structural tubes (see on page 14-15, steels according ČSN and GOST see pages 20 and 21)

Standards	Steel grade	Chemical composition [%]										Mechanical properties					
		C	Si	Mn	P _{max}	S _{max}	Cr	Ni	Mo	Cu	Other	Re min MPa	min ksi	Rm min MPa	max ksi	A5 min %	
DIN																	
17 121	RS1 37-2	max.0,17	-	-	0,050	0,050	-	-	-	-	N 0,009	235	-	340	470	-	26
	Si 44-2	max.0,21	-	-	0,050	0,050	-	-	-	-	N 0,009	275	-	410	540	-	22
	Si 44-3	max.0,20	-	-	0,040	0,040	-	-	-	-	Al min.0,020	275	-	410	540	-	22
	Si 52-3	max.0,22	-	-	0,040	0,040	-	-	-	-	Al min.0,020	355	-	490	630	-	22
17 124	SiE 255	max.0,18	max.0,40	0,50-1,30	0,035	0,030	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020	255	-	360	480	-	25
	TSiE 255	max.0,16	max.0,40	0,50-1,30	0,030	0,025	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020	255	-	360	480	-	25
	ESiE 255	max.0,16	max.0,40	0,50-1,30	0,025	0,015	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020	255	-	360	480	-	25
	SiE 285	max.0,18	max.0,40	0,60-1,40	0,035	0,030	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020	285	-	390	510	-	24
	TSiE 285	max.0,16	max.0,40	0,60-1,40	0,030	0,025	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020	285	-	390	510	-	24
	ESiE 285	max.0,16	max.0,40	0,60-1,40	0,025	0,015	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020	285	-	390	510	-	24
	SiE 355	max.0,20	0,10-0,50	0,90-1,65	0,035	0,030	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020	355	-	490	630	-	22
	TSiE 355	max.0,18	0,10-0,50	0,90-1,65	0,030	0,025	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020	355	-	490	630	-	22
	ESiE 355	max.0,18	0,10-0,50	0,90-1,65	0,025	0,015	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020	355	-	490	630	-	22
NFA																	
49-501	TU E235	max. 0,20	-	-	0,040	0,040	-	-	-	-	-	235	-	340	480	-	25
	TU E275	max. 0,22	-	-	0,040	0,040	-	-	-	-	-	275	-	410	550	-	22
EN																	
10210-1	S 235 JRH	max.0,17	-	max.1,40	0,045	0,045	-	-	-	-	N 0,009	235	-	340	470	-	26
	S 275 JOH	max.0,20	-	max.1,50	0,040	0,040	-	-	-	-	N 0,009	275	-	410	560	-	22
	S 275 J2H	max.0,20	-	max.1,50	0,035	0,035	-	-	-	-	-	275	-	410	560	-	22
	S 355 JOH	max.0,22	max.0,55	max.1,60	0,040	0,040	-	-	-	-	N 0,009	355	--	490	630	-	22
	S 355 J2H	max.0,22	max.0,55	max.1,60	0,035	0,035	-	-	-	-	-	355	--	490	630	-	22
	S 275 NH	max.0,20	max.0,40	0,50-1,40	0,035	0,030	max.0,30	max.0,30	max.0,10	max. 0,35	V max.0,05	275	-	370	510	-	24
	S 275 N1H	max.0,20	max.0,40	0,50-1,40	0,030	0,025	max.0,30	max.0,30	max.0,10	max. 0,35	Nb max.0,05	275	-	370	510	-	24
	S 355 NH	max.0,20	max.0,50	0,90-1,65	0,035	0,030	max.0,30	max.0,50	max.0,10	max. 0,35	V max.0,12	355	-	470	630	-	22
	S 355 N1H	max.0,18	max.0,50	0,90-1,65	0,030	0,025	max.0,30	max.0,50	max.0,10	max. 0,35	Ti max.0,03	355	-	470	630	-	22
	S 460 NH	max.0,20	max.0,60	1,00-1,70	0,035	0,030	max.0,30	max.0,80	max.0,10	max.0,70	V max.0,20	460	-	550	720	-	17
	S 460 N1H	max.0,20	max.0,60	1,00-1,70	0,030	0,025	max.0,30	max.0,80	max.0,10	max.0,70	Al min.0,020	460	-	550	720	-	17

Standards	Steel grade	Chemical composition [%]										Mechanical properties					
		C	Si	Mn	P _{max}	S _{max}	Cr	Ni	Mo	Cu	Other	Re min MPa	Re min ksi	Rm min MPa	Rm min ksi	A5 min %	
EN																	
10083-2	C22E	0,17-0,24	max.0,40	0,40-0,70	0,035	0,035	max. 0,40	max. 0,40	max. 0,10				240	430		24	
	C22R	0,17-0,24	max.0,40	0,40-0,70	0,035	0,040	max. 0,40	max. 0,40	max. 0,10				240	430		24	
	C25E	0,22-0,29	max.0,40	0,40-0,70	0,035	0,035	max. 0,40	max. 0,40	max. 0,10				260	470		22	
	C25R	0,22-0,29	max.0,40	0,40-0,70	0,035	0,040	max. 0,40	max. 0,40	max. 0,10				260	470		22	
	C30E	0,27-0,34	max.0,40	0,50-0,80	0,035	0,035	max. 0,40	max. 0,40	max. 0,10				280	510		20	
	C30R	0,27-0,34	max.0,40	0,50-0,80	0,035	0,040	max. 0,40	max. 0,40	max. 0,10				280	510		20	
	C35E	0,32-0,39	max.0,40	0,50-0,80	0,035	0,035	max. 0,40	max. 0,40	max. 0,10				300	550		18	
	C35R	0,32-0,39	max.0,40	0,50-0,80	0,035	0,040	max. 0,40	max. 0,40	max. 0,10				300	550		18	
	C40E	0,37-0,44	max.0,40	0,50-0,80	0,035	0,035	max. 0,40	max. 0,40	max. 0,10				320	580		16	
	C40R	0,37-0,44	max.0,40	0,50-0,80	0,035	0,040	max. 0,40	max. 0,40	max. 0,10				320	580		16	
	C45E	0,42-0,50	max.0,40	0,50-0,80	0,035	0,035	max. 0,40	max. 0,40	max. 0,10				340	620		14	
	C45R	0,42-0,50	max.0,40	0,50-0,80	0,035	0,040	max. 0,40	max. 0,40	max. 0,10				340	620		14	
	C50E	0,47-0,55	max.0,40	0,60-0,90	0,035	0,035	max. 0,40	max. 0,40	max. 0,10				355	650		12	
	C50R	0,47-0,55	max.0,40	0,60-0,90	0,035	0,040	max. 0,40	max. 0,40	max. 0,10				355	650		12	
	C55E	0,52-0,60	max.0,40	0,60-0,90	0,035	0,035	max. 0,40	max. 0,40	max. 0,10				370	680		11	
	C55R	0,52-0,60	max.0,40	0,60-0,90	0,035	0,040	max. 0,40	max. 0,40	max. 0,10				370	680		11	
	28Mn6	0,25-0,32	max.0,40	1,30-1,65	0,030	0,035	max. 0,40	max. 0,40	max. 0,10								
	C22	0,17-0,24	max.0,40	0,40-0,70	0,045	0,045	max. 0,40	max. 0,40	max. 0,10				240	430		24	
	C25	0,22-0,29	max.0,40	0,40-0,70	0,045	0,045	max. 0,40	max. 0,40	max. 0,10				260	470		22	
	C30	0,27-0,34	max.0,40	0,50-0,80	0,045	0,045	max. 0,40	max. 0,40	max. 0,10				280	510		20	
	C35	0,32-0,39	max.0,40	0,50-0,80	0,045	0,045	max. 0,40	max. 0,40	max. 0,10				300	550		18	
	C40	0,37-0,44	max.0,40	0,50-0,80	0,045	0,045	max. 0,40	max. 0,40	max. 0,10				320	580		16	
	C45	0,42-0,50	max.0,40	0,50-0,80	0,045	0,045	max. 0,40	max. 0,40	max. 0,10				340	620		14	
	C50	0,47-0,55	max.0,40	0,60-0,90	0,045	0,045	max. 0,40	max. 0,40	max. 0,10				355	650		12	
	C55	0,52-0,60	max.0,40	0,60-0,90	0,045	0,045	max. 0,40	max. 0,40	max. 0,10				370	680		11	
	10084	C10E	0,07-0,13	max.0,40	0,30-0,60	0,035	0,035										
		C10R	0,07-0,13	max.0,40	0,30-0,60	0,035	0,040										
		C15E	0,12-0,18	max.0,40	0,30-0,60	0,035	0,035										
		C15R	0,12-0,18	max.0,40	0,30-0,60	0,035	0,040										
		C16E	0,12-0,18	max.0,40	0,60-0,90	0,035	0,035										
		C16R	0,12-0,18	max.0,40	0,60-0,90	0,035	0,040										
	10294-1	16MnCr5	0,14-0,19	max.0,40	1,00-1,30	0,035	0,035	0,80-1,10									
		E355+AR	max. 0,22	max. 0,50	max. 1,50	0,045	0,050	max. 0,30	max. 0,40	max. 0,08	max. 0,30	V max.0,10	355	490		18	
E355+N		max. 0,22	max. 0,50	max. 1,50	0,045	0,050	max. 0,30	max. 0,40	max. 0,08	max. 0,30	V max.0,10	355	490		20		
20MnV6+AR		0,16-0,22	0,10-0,50	1,30-1,70	0,045	0,050	max. 0,30	max. 0,40	max. 0,08	max. 0,30	V 0,08-0,15	470	650		17		
20MnV6+N		0,16-0,22	0,10-0,50	1,30-1,70	0,045	0,050	max. 0,30	max. 0,40	max. 0,08	max. 0,30	V 0,08-0,15	420	600		19		
10297-1	E235	max. 0,17	max. 0,35	max. 1,20	0,030	0,035						235	360		25		
	E275	max. 0,21	max. 0,35	max. 1,40	0,030	0,035						275	410		22		
	E315	max. 0,21	max. 0,30	max. 1,50	0,030	0,035						315	450		21		
	E355	max. 0,22	max. 0,55	max. 1,60	0,030	0,035						355	490		20		
	E275K2	max.0,20	max.0,40	0,50-1,40	0,030	0,030	max.0,30	0,30	max.0,10	max.0,35	V max.0,05 Ti max.0,03 Al min.0,02	275	410		22		
	E355K2	max.0,20	max.0,50	0,90-1,65	0,030	0,030	max.0,30	0,50	max.0,10	max.0,35	V max.0,12 Ti max.0,05 Al min.0,02	355	490		20		
	C60E	0,57-0,65	max. 0,40	0,60-0,90	0,035	0,035						390	710		10		
	38Mn6	0,34-0,42	0,15-0,30	1,40-1,65	0,035	0,035						400	670		14		
	25CrMo4	0,22-0,29	max. 0,40	0,60-0,90	0,035	0,035	0,90-1,20		0,15-0,30								
	34CrMo4	0,30-0,37	max. 0,40	0,60-0,90	0,035	0,035	0,90-1,20		0,15-0,30								
42CrMo4	0,38-0,45	max. 0,40	0,60-0,90	0,035	0,035	0,90-1,20		0,15-0,30									
20NiCrMo2-2	0,17-0,23	max. 0,40	0,65-0,95	0,035	0,035	0,35-0,70	0,40-0,70	0,15-0,25									
GOST																	
1050	10	0,07-0,14	0,17-0,37	0,35-0,65			max.0,15					205	330		31		
	20	0,17-0,24	0,17-0,37	0,35-0,65			max.0,25					245	410		25		
	35	0,32-0,40	0,17-0,37	0,50-0,80			max.0,25					315	530		20		
	45	0,42-0,50	0,17-0,37	0,50-0,80			max.0,25					355	600		16		
19281	09G2S	max.0,12	0,50-0,80	1,30-1,70			max.0,30	max.0,30		max.0,30		345	490		21		
JIS																	
G 3445	STKM 11A	max.0,12	max.0,35	max.0,60	0,040	0,040							290		35		
	STKM 12A	max.0,20	max.0,35	max.0,60	0,040	0,040						175	340		35		
	STKM 12B	max.0,20	max.0,35	max.0,60	0,040	0,040						275	390		25		
	STKM 12C	max.0,20	max.0,35	max.0,60	0,040	0,040						355	470		20		
	STKM 13A	max.0,25	max.0,35	0,30-0,90	0,040	0,040						215	370		30		
	STKM 13B	max.0,25	max.0,35	0,30-0,90	0,040	0,040						305	440		20		
	STKM 13C	max.0,25	max.0,35	0,30-0,90	0,040	0,040						380	510		15		
	STKM 14A	max.0,30	max.0,35	0,30-1,00	0,040	0,040						245	410		25		
	STKM 14B	max.0,30	max.0,35	0,30-1,00	0,040	0,040						355	500		15		
	STKM 14C	max.0,30	max.0,35	0,30-1,00	0,040	0,040						410	550		15		
	STKM 15A	0,25-0,35	max.0,35	0,30-1,00	0,040	0,040						275	470		22		
	STKM 15C	0,25-0,35	max.0,35	0,30-1,00	0,040	0,040						430	580		12		
	STKM 16A	0,35-0,45	max.0,40	0,40-1,00	0,040	0,040						325	510		20		
	STKM 16C	0,35-0,45	max.0,40	0,40-1,00	0,040	0,040						460	620		12		
	STKM 17A	0,45-0,55	max.0,40	0,40-1,00	0,040	0,040						345	550		20		
	STKM 17C	0,45-0,55	max.0,40	0,40-1,00	0,040	0,040						480	650		10		
	STKM 18A	max.0,18	max.0,55	max.1,50	0,040	0,040						275	440		25		
	STKM 18B	max.0,18	max.0,55	max.1,50	0,040	0,040						315	490		23		
	STKM 18C	max.0,18	max.0,55	max.1,50	0,040	0,040						380	510		15		
	STKM 19A	max.0,25	max.0,55	max.1,50	0,040	0,040						315	490		23		
STKM 19C	max.0,25	max.0,55	max.1,50	0,040	0,040						410	550		15			
STKM 20A	max.0,25	max.0,55	max.1,60	0,040	0,040					V max.0,15	390	540		23			
PNH																	
84019	10	0,07-0,14	0,15-0,40	0,35-0,65	0,040	0,040	max.0,30	max.0,30	max.0,10	max.0,30							
	20	0,17-0,24	0,15-0,40	0,35-0,65	0,040	0,040											
	35	0,32-0,39	0,10-0,40	0,50-0,80	0,040	0,040											
	45	0,42-0,50	0,10-0,40	0,50-0,80	0,040	0,040											

Steel 20MnV6+AR = E470, 20MnV6+N = E420J2, 20MnV6+QT = E590K2 (see also pages 114 and 115).
Alloy steel in EN 10083-3 see pages 120-121. Steel for tubes according PNH see page 71.

Seamless steel tubes for pressure equipments for room temperatures

Standards	Dimensional standards	Dimensional range	Dimensions				
			Tolerance D	Tolerance T	Lengths	Straightness	Tube ends
EN	10216-1 10305-1 (upon agreement)	Table 1/Page 26 Table 16/Page 64	D ≤ 219,1 mm ±1 % min ±0,5 mm See page 60 - 64 (Cold formed precise)	D ≤ 219,1 mm ±12,5 % min ±0,4 mm See page 60 - 64 (Cold formed precise)	Kinds: • random • fixed ±500 mm • exact Informative values: • D < 60,3 mm 5 - 6 m • D ≥ 60,3 mm / T < 7,1 mm 5-6 m or 10-14 m • D ≥ 60,3 mm / T ≥ 7,1 mm 5-6 m • longer upon agreement Precise length tolerances: • L < 6 m 0 +10 mm • L = 6-12 m 0 +15 mm • L > 12 m 0 +upon agreement	Allowed 0,0015.L for tube calculation to 1 m max. 3 mm	• square cut ends • free from excessive burrs • option: with beveled ends (see page 98)
DIN	2448 2391-1 (upon agreement)	Table 1/Page 26 Table 16/Page 64	D ≤ 100 mm ±1 % min ±0,5 mm D = 100-200 mm ±1 % See page 60 - 64 (Cold finished precise)	D < 130 mm • T ≤ 2T _n -10 % +15 % • 2T _n < T < 4T _n -10 % +12,5 % • T > 4T _n ±9 % T _n - basic wall thickness according to DIN 2448 D = 130 - 320 mm • T ≤ 0,05D -12,5 % +17,5 % • T > 0,05 - 0,11D ±12,5 % • T > 0,11D ±10 % See page 60 - 64 (Cold finished precise)		Visually straight	• square cut ends • free from excessive burrs • option: with beveled ends (T ≥ 3,2 mm)
BS	3600	Table 1/Page 26	±1 % min ±0,5 mm Cold finished tubes with less tolerances	≤ 3%D ±15 % > 3%D -12,5 % +15 %	• random • exact with tolerances: L ≤ 6 m 0 +6 mm L > 6 m 1,5 mm/m, max 12 mm	Visually straight	• square cut ends • free from excessive burrs

List of dimensional standards and technical delivery conditions standards

EN 10216-1	Seamless steel tubes for pressure purposes. TDC. Part 1: Non-alloy steel tubes with specified room temperature properties.
DIN 1629	Seamless circular tubes of non-alloy steel with special quality requirements. TDC.
DIN 1630	Seamless circular tubes of non-alloy steel with very high quality requirements. TDC.
DIN 2448	Plain end seamless steel tubes. Dimensions.
BS 3600	Dimension and masses per unit length of welded and seamless steel pipes and tubes for pressure purposes.
BS 3601	Carbon steel pipes and tubes with specified room temperature properties for pressure purposes. TDC.
ISO 9329-1	Seamless steel tubes for pressure purposes. TDC. Part 1: Non-alloy steel tubes with specified room temperature properties.

Steel designation according to EN:

- P - steel for pressure equipments
- 235 - minimum yield strength in N/mm²
- T - steel for tubes
- R - room temperature
- 1, 2 - group of quality
- TR 1 - Fluid Transportation - General Purposes (see page 54)
- TR 2 - Piping and Pressure Purposes (PED, AD 2000 Merkblatt W4)

Note:

Very often used steel St52 (according to DIN) is now produced as fine grain. For this reason the steel was moved to the part 3 of EN 10216, containing fine grain steel (New name is P355N).

TDC standards	Steel grade			Testing and certificates		Other TDC		
	Name	Condition	Surface	Testing	Certificate	Marking	Surface protection	Packing
10216-1	P195TR1 P235TR1 P265TR1 P195TR2 P235TR2 P265TR2	Hot finished: Quality TR1 • as rolled • normalising formed • normalized Quality TR2 • normalising formed • normalized Cold finished: Quality TR1 and TR2 • normalized	Visually without defects, adequate to production mode. Surface treatment possibility.	Quality TR1: • non-specific • specific Quality TR2: • specific Mandatory testing: • cast analysis • tensile test • leak tightness (page 11) • dimensions • visual • impact test (TR2) at room temperature	10204 • 2.2 • 3.1 • 3.1 • 3.2 (see also page 10)	D < 51 mm - label D > 51 mm - data on tube end Data: • manufacturer • EN standard • steel • specific inspection - cast number - mark of insp. represent. - identification number	• without protection • upon agreement	bundle 300- 3500 kg
1629	St 37.0 St 44.0 St 52.0	Hot finished: • as rolled • condition N after normalizing only upon agreement Cold finished: • normalized - condition NBK		• tensile test • ring • leak tightness (page 11) • dimensions • visual • chemical composition (scope of inspection certificate of series 3)	50049 • 2.2 • 3.1.A • 3.1.B • 3.1.C	Data: • manufacturer • steel • letter S • mark of insp. represent. • mark at 2470T1 - marking usually die stamping or label on the bundle - marking NDT at DIN 1630		
1630	St 37.4 St 44.4 St 52.4			• tensile test • ring • leak tightness (page 11) • dimensions • visual • chemical composition (scope of inspection certificate of series 3) Upon agreement: • NDT • impact test (T > 10 mm)	50049 • 3.1.A • 3.1.B • 3.1.C			
3601	360 430	Hot finished: • as rolled • normalized Cold finished: • normalized		• tensile test • flattening • impact test • visual • leak tightness (page 11) • hydrotest or NDT	• test certificate • test results			

Leakage test

according to standards ASTM A (ASME SA)

Within limits it is necessary to use in preference the methods of NDE (NDT), especially for cold finished tubes. If hydrostatic test is agreed, a minimum hydrostatic test pressure is determined by the following equation:

ASTM A450 and ASTM A 1016 (Tube)

Inch - Pound units: $P = 32000 t / D$

SI units: $P = 220.6 t / D$

The minimum hydrostatic test pressure need not exceed these values:

D (in., mm)

Under 1 (25,4)

1 - under 1 1/2 (25,4 - under 38,1)

1 1/2 - under 2 (38,1 - under 50,8)

2 - under 3 (50,8 - under 76,2)

3 - under 5 (76,2 - under 127)

5 and over (127 and over)

Pressure P (psi, MPa)

1 000 (7)

1 500 (10)

2 000 (14)

2 500 (17)

3 500 (24)

4 500 (31)

The values are valid for ASTM A 450, for ASTM A 1016 is valid value 1000 psi - 7 MPa

Higher pressure according to agreement. The tube wall stress shall be determined by the following equation:

$$S = PD / 2t \text{ (psi, MPa).}$$

ASTM A 530 and A999 (Pipe)

Each length of pipe shall be tested to a hydrostatic pressure which will produce in the pipe wall a stress not less that 60% of the minimum specified yield strength for C-steel pipe:

$$P = 2 St / D$$

$$S = PD / 2t$$

The minimum hydrostatic test pressure need not exceed

2500 psi (17,0 MPa) for pipe 3,5 in or

2800 psi (19,0 MPa) for pipe over 3,5 in (88,9 mm)

Seamless steel tubes for pressure equipments for room temperatures

Standards	Dimensional standards	Dimensional range	Dimensions				Straightness	Tube ends
			Tolerance D	Tolerance T	Lengths			
NFA	49-112	Table 1/Page 26	$\pm 1\%$ min $\pm 0,5$ mm	$D \leq 101,6$ mm, $T \leq 10$ mm $\pm 12,5\%$ min $\pm 0,5$ mm $D \leq 101,6$ mm, $T > 10$ mm $\pm 10\%$ $D > 101,6$ mm see Tab. 4 of st.	<ul style="list-style-type: none"> random exact with tolerances: $L \leq 8$ m 0 +10 mm $L > 8$ m 0 +15 mm 	3 mm/m, total 0,2 % of length	<ul style="list-style-type: none"> square cut ends free from excessive burrs option: with beveled ends ($D \geq 42,4$ mm) 	
	49-210		$D \leq 38$ mm $\pm 0,25$ mm $D > 38$ mm $\pm 0,75\%$	$\pm 10\%$ min. $\pm 0,20$ mm Weight -8 % +10 %				
UNI	7287		$D \leq 50$ mm $\pm 0,5$ mm $D > 50$ mm $\pm 1\%$	-15 % Weight $\pm 10\%$	<ul style="list-style-type: none"> random exact with tolerances: $L \leq 6$ m 0 +10 mm $L > 6$ m 0 +15 mm 		<ul style="list-style-type: none"> square cut ends free from excessive burrs 	
STN ČSN	42 5715 42 5716 (42 6710) (42 6711)	(Table 6/Page 32)	42 5715 $D \leq 219$ mm $\pm 1,25\%$ min $\pm 0,5$ mm 42 5716 $D \leq 219$ mm $\pm 1\%$ min $\pm 0,5$ mm 42 6710 $\pm 1\%$ min $\pm 0,4$ mm 42 6711 see precision tubes	-15 % +12,5 % $\pm 12,5\%$ $T \leq 3$ mm -10 % +15 % $T > 3$ mm -10 % +12 %	<ul style="list-style-type: none"> random exact 0 +15 mm multiple +5 mm on cut, max +50 mm 	<ul style="list-style-type: none"> straightened 3 mm/m precise straightened 1,5 mm/m 	<ul style="list-style-type: none"> square cut ends free from excessive burrs option: with beveled ends 	
GOST	8732	See page 36						
PN-H	74219	Table 1/Page 26 Table 10/Page 52	$D \leq 50$ mm $\pm 0,50$ mm Over 50 mm Class of precision D1 = $\pm 1,25\%$ Class of precision D2 = $\pm 1,00\%$	Class of precision D1 = $\pm 15\%$ Class of precision D2 $D \leq 130$ mm $\pm 10\%$ $D = 130-320$ mm $\pm 12,5\%$ $D > 320$ mm $\pm 15\%$	<ul style="list-style-type: none"> random 4-12,5 m exact up to 7 m: $L \leq 6$ m 0 +10 mm $L > 6$ m 0 +15 mm multiple +5 mm on cut fixed ± 500 mm 	<ul style="list-style-type: none"> T up to 20 mm 1,5 mm/m T > 20 mm 2,0 mm/m 	<ul style="list-style-type: none"> square cut ends beveled ends for $D > 101,6$ mm and T up to 16 mm 	
ASTM ASME	A53 SA-53	See page 18						
JIS	G3454		Hot finished: $D \leq 40$ mm $\pm 0,5$ mm $D = 50-125$ mm $\pm 1\%$ $D > 150$ mm $\pm 1,6$ mm Cold finished: $D \leq 25$ mm $\pm 0,3$ mm $D > 32$ mm $\pm 0,8\%$	$T \leq 4$ mm -0,5 mm +0,6 mm $T > 4$ mm -12,5 % +15 % $T \leq 3$ mm $\pm 0,3$ mm $T > 3$ mm $\pm 10\%$		Visually straight	<ul style="list-style-type: none"> square cut ends free from excessive burrs option: with beveled ends 	
	G3455		Hot finished: $D \leq 50$ mm $\pm 0,5$ mm $D = 50-160$ mm $\pm 1\%$ Cold finished: $D \leq 40$ mm $\pm 0,3$ mm $D > 40$ mm $\pm 0,8\%$	$T \leq 4$ mm $\pm 0,5$ mm $T > 4$ mm $\pm 12,5\%$ $T \leq 2$ mm $\pm 0,2$ mm $T > 2$ mm $\pm 10\%$				

List of dimensional standards and technical delivery conditions standards

NFA 49-112	Steel tubes. Plain end seamless hot rolled tubes with specified room temperature properties and with special delivery conditions. TDC.
NFA 49-210	Steel tubes – Seamless cold drawn tubes for fluids piping. Dimensions. TDC.
UNI 7287	Seamless plain end tubes made from basis non-alloy steel.
STN 42 0250	ČSN 42 0250 Hot formed seamless tubes from steel class 10 to 16. TDC.
STN 42 5715	ČSN 42 5715 Hot formed seamless steel tubes. Dimensions.
STN 42 5716	ČSN 42 5716 Hot formed seamless steel tubes with smaller tolerances. Dimensions.
GOST 8731	Seamless hot-formed steel pipes. TDC.
GOST 8732	Seamless hot-formed steel pipes. Dimensions.
PN-H 84018	Low-alloy steel with higher properties.
PN-H 74219	Hot rolled seamless steel tubes for structural and distribution purposes.
PN-H 84023/07	Steel for higher purposes. Steel for tubes.
ASTM A53	Pipe, steel, black and hot-dipped, zinc-coated, welded and seamless.
ASTM A530	General requirements for specialized carbon and alloy steel pipe.
JIS G 3454	Carbon steel pipes for pressure service.
JIS G 3455	Carbon steel pipes for high pressure service.

TDC standards	Steel grade			Testing and certificates		Other TDC		
	Name	Condition	Surface	Testing	Certificate	Marking	Surface protection	Packing
49-112	TU E220A TU E235A	Hot finished • as rolled Cold finished • normalized	Visually without defects, adequate to production mode. Surface treatment possibility.	<ul style="list-style-type: none"> product analysis tensile test flattening drift expanding leak tightness (page 11) dimensions visual upon agreement NDT 	49-000 49-001 Type A Type B Type D (CCPU)	D < 26,9 mm label D > 26,9 mm each tube or label • producer • standard • steel grade D > 48,3 mm each tube	<ul style="list-style-type: none"> without protection upon agreement 	bundle 300- 3500 kg
49-210	TU 37B TU 42B	Cold finished • normalized						
7287	Fe 320	Hot finished • as rolled Cold finished • normalized						
42 0250 (42 0260)	11 353* 11 453 11 503 11 523 11 550 11 650 12 040 12 050 12 060	Hot finished • as rolled condition .1 behind steel designation Cold finished • normalized	.0+ scaled .1+ pickled .5+ asphalt .6+ zinc coated Cold finished .4+ metallic clean .9+ special agreement (first number behind DS)	<ul style="list-style-type: none"> tensile test Upon agreement: hardness flattening drift expanding leak tightness (page 11) NDT 	42 0250 .0+ acknowledgement .1+ test certificate .2+ customer .9+ agreement	<ul style="list-style-type: none"> label colour stripes 		
8731 (1050)	10 20	See page 37						
74219 (84023) (84018)	R35, R45 18G2A	Hot finished • as rolled • other condition according to agreement Cold finished • normalized	Visually without defects, adequate to production mode. Surface treatment possibility.	Pipeline - Groups of tests A1 - 3 Structural - Groups of tests B1 - 3 <ul style="list-style-type: none"> dimensions - all groups surface - all groups composition - all except A1 leak tightness - A1 - 3 mechanical - all except A1, B1 technological - A3, B3 	<ul style="list-style-type: none"> compliance with PN-H certificate 	D ≤ 31,8 mm, T ≤ 3,2 mm label on bundle D and T over - each tube Data: • producer • steel • cast number (at alloy steels)	<ul style="list-style-type: none"> black tubes (CZ) according to agreement 	
ASTM A53/A530	Grade A Grade B	See page 19						
G3454	STPG 370 STPG 410	Hot finished • as rolled Cold finished • normalized		<ul style="list-style-type: none"> product analysis tensile test flattening impact test hydrotest or NDT dimensions 	G0303	<ul style="list-style-type: none"> steel process (-SH, -SC) dimensions manufacturer - at JIS G 3454 symbol Z3 or Z4 Z3 - ultrasonic Z4 - eddy current - at JIS G 3455 Z2, Z3, Z4, Z5 Z2 - yield elev. temperat. Z5 - impact test 		
G3455	STS 370 STS 410 STS 480							

* Mainly the first four steels are used for pressure purposes and as steels for building. All steels are used for machine and common purposes (see pages 18 and 19).

Pressure equipment and legislation

Brief overview of European Directives for pressure equipment in respect to used materials (see also pages 3 and 12):

- Directive 97/23/EC of the European Parliament and of the Council (PED 97/23 EC) valid for selected pressure equipment. Pressure equipment in terms of this directive withstands the maximum allowable pressure (PS) that is greater than 0.5 bar, whereby here we are talking about pressure above the normal atmospheric pressure i.e. overpressure.
- Pursuant to Directive PED 97/23 EC, pressure equipments are divided into three types for which the harmonized EN standards are valid. They are as follows:
 1. Steam and hot-water tube boiler - EN 12952 and EN 12953
 2. Pressure vessels (unfired) - EN 13445
 3. Metallic industrial piping - EN 13480
- Parts of two of these harmonized standards are prescribed by materials that are used for construction of equipment that is pressure stressed. (In the case that other materials are used for construction than the two quoted standards, in order to use these materials it is necessary to evaluate the utilization of these materials it and to use special procedure). The steel tubes must be delivered in accordance with EN 10216-2, EN 10216-3, EN 10216-4, EN 10217-2, EN 10217-3, EN 10217-4, EN 10217-5 and EN 10217-6 (applies to carbon and low-alloy steel).

Comment: For pressure equipment the German Directives were used in the past and even internationally. They were: TRD, TRB, TRR and AD-Merkblatt. For the transition period the AD 2000 - Merkblatt directives were prepared, where the steel is done according to the EN standards.

Outside diameter [mm]	Wall thickness [mm]															
	0,5	0,6	0,8	1	1,2	1,4	1,6	1,8	2	2,3	2,6	2,9	3,2	3,6	4	4,5
	Tube weight [kg/m]															
10,2	0,120	0,142	0,185	0,227	0,266	0,304	0,339	0,373	0,404	0,448	0,487					
12,0	0,142	0,169	0,221	0,271	0,320	0,366	0,410	0,453	0,493	0,550	0,603	0,651	0,694			
12,7	0,150	0,179	0,235	0,289	0,340	0,390	0,438	0,484	0,528	0,590	0,648	0,701	0,750			
13,5	0,160	0,191	0,251	0,308	0,364	0,418	0,470	0,519	0,567	0,635	0,699	0,758	0,813	0,879		
14,0	0,166	0,198	0,260	0,321	0,379	0,435	0,489	0,542	0,592	0,664	0,731	0,794	0,852	0,923		
16,0	0,191	0,228	0,300	0,370	0,438	0,504	0,568	0,630	0,691	0,777	0,859	0,937	1,01	1,10	1,18	
17,2	0,206	0,246	0,324	0,400	0,474	0,546	0,616	0,684	0,750	0,845	0,936	1,02	1,10	1,21	1,30	1,41
18,0	0,216	0,257	0,339	0,419	0,497	0,573	0,647	0,719	0,789	0,891	0,987	1,08	1,17	1,28	1,38	1,50
19,0	0,228	0,272	0,359	0,444	0,527	0,608	0,687	0,764	0,838	0,947	1,05	1,15	1,25	1,37	1,48	1,61
20,0	0,240	0,287	0,379	0,469	0,556	0,642	0,726	0,808	0,888	1,00	1,12	1,22	1,33	1,46	1,58	1,72
21,3	0,256	0,306	0,404	0,501	0,595	0,687	0,777	0,866	0,952	1,08	1,20	1,32	1,43	1,57	1,71	1,86
22,0	0,265	0,317	0,418	0,518	0,616	0,711	0,805	0,897	0,986	1,12	1,24	1,37	1,48	1,63	1,78	1,94
25,0		0,361	0,477	0,592	0,704	0,815	0,923	1,03	1,13	1,29	1,44	1,58	1,72	1,90	2,07	2,28
25,4			0,485	0,602	0,716	0,829	0,939	1,05	1,15	1,31	1,46	1,61	1,75	1,94	2,11	2,32
26,9			0,515	0,639	0,761	0,880	0,998	1,11	1,23	1,40	1,56	1,72	1,87	2,07	2,26	2,49
30,0			0,576	0,715	0,852	0,987	1,12	1,25	1,38	1,57	1,76	1,94	2,11	2,34	2,56	2,83
31,8				0,760	0,906	1,05	1,19	1,33	1,47	1,67	1,87	2,07	2,26	2,50	2,74	3,03
32,0				0,765	0,911	1,06	1,20	1,34	1,48	1,68	1,89	2,08	2,27	2,52	2,76	3,05
33,7				0,806	0,962	1,12	1,27	1,42	1,56	1,78	1,99	2,20	2,41	2,67	2,93	3,24
35,0				0,838	1,00	1,16	1,32	1,47	1,63	1,85	2,08	2,30	2,51	2,79	3,06	3,38
38,0				0,912	1,09	1,26	1,44	1,61	1,78	2,02	2,27	2,51	2,75	3,05	3,35	3,72
40,0				0,962	1,15	1,33	1,52	1,70	1,87	2,14	2,40	2,65	2,90	3,23	3,55	3,94
42,4							1,61	1,80	1,99	2,27	2,55	2,82	3,09	3,44	3,79	4,21
44,5							1,69	1,90	2,10	2,39	2,69	2,98	3,26	3,63	4,00	4,44
48,3							1,84	2,06	2,28	2,61	2,93	3,25	3,56	3,97	4,37	4,86
51,0							1,95	2,18	2,42	2,76	3,10	3,44	3,77	4,21	4,64	5,16
54,0							2,07	2,32	2,56	2,93	3,30	3,65	4,01	4,47	4,93	5,49
57,0							2,19	2,45	2,71	3,10	3,49	3,87	4,25	4,74	5,23	5,83
60,3							2,32	2,60	2,88	3,29	3,70	4,11	4,51	5,03	5,55	6,19
63,5							2,44	2,74	3,03	3,47	3,90	4,33	4,76	5,32	5,87	6,55
70,0							2,70	3,03	3,35	3,84	4,32	4,80	5,27	5,90	6,51	7,27
73,0							2,82	3,16	3,50	4,01	4,51	5,01	5,51	6,16	6,81	7,60
76,1							2,94	3,30	3,65	4,19	4,71	5,24	5,75	6,44	7,11	7,95
82,5									3,97	4,55	5,12	5,69	6,26	7,00	7,74	8,66
88,9									4,29	4,91	5,53	6,15	6,76	7,57	8,38	9,37
101,6									4,91	5,63	6,35	7,06	7,77	8,70	9,63	10,8
108,0									5,23	6,00	6,76	7,52	8,27	9,27	10,3	11,5
114,3											7,16	7,97	8,77	9,83	10,9	12,2
127,0															12,1	13,6
133,0															12,7	14,3
139,7																

Note:

Dimensions 28, 32, 35, 40, 76, 89, 102, 114, 121 and 140 with wall thickness 2,5; 2,8; 3; 3,5; 5,4; 5,5; 6; 6,5; 7; 7,5; 8,5; 9; 9,5 and 12 mm according to standards STN, ČSN and GOST are delivered upon agreement.

Dimensions according to standards JIS (Tubes and Pipes) are delivered upon agreement (see table 10 and 11 page 52).

Tolerances [mm]		
Outside diameter	Tolerance of outside diameter	Tolerance of wall thickness
$D \leq 219,1$	$\pm 1\%$ or $\pm 0,5 \text{ mm}^*$	$\pm 12,5\%$ or $\pm 0,4 \text{ mm}^*$

* bigger value is applied

see also values presented in national standards

ISO 4200 - Plain and steel tubes, welded and seamless - general tables of dimensions and masses per unit length

ISO 5252 - Tolerance systems

Dimensions and weight of seamless tubes according to standard ANSI / ASME B36.10M (API 5L)

Table 2

NPS	Outside diameter		Wall thickness		Schedule No	Weight class	DN	Weight	
	[inch]	[mm]	[inch]	[mm]				[lbs/ft]	[kg/m]
1/8*	0.405	10,3	0.068	1,73	40	STD	6	0.24	0,37
1/8*	0.405	10,3	0.095	2,41	80	XS	6	0.31	0,47
1/4*	0.540	13,7	0.088	2,24	40	STD	8	0.43	0,63
1/4*	0.540	13,7	0.119	3,02	80	XS	8	0.54	0,80
3/8*	0.675	17,1	0.091	2,31	40	STD	10	0.57	0,84
3/8*	0.675	17,1	0.126	3,20	80	XS	10	0.74	1,10
1/2	0.840	21,3	0.109	2,77	40	STD	15	0.85	1,27
1/2	0.840	21,3	0.147	3,73	80	XS	15	1.09	1,62
1/2*	0.840	21,3	0.188	4,78	160	...	15	1.31	1,95
3/4	1.050	26,7	0.113	2,87	40	STD	20	1.13	1,69
3/4	1.050	26,7	0.154	3,91	80	XS	20	1.48	2,20
3/4*	1.050	26,7	0.219	5,56	160	...	20	1.95	2,90
1	1.315	33,4	0.133	3,38	40	STD	25	1.68	2,50
1	1.315	33,4	0.179	4,55	80	XS	25	2.17	3,24
1*	1.315	33,4	0.250	6,35	160	...	25	2.85	4,24
1 1/4	1.660	42,2	0.140	3,56	40	STD	32	2.27	3,39
1 1/4	1.660	42,2	0.191	4,85	80	XS	32	3.00	4,47
1 1/4*	1.660	42,2	0.250	6,35	160	...	32	3.77	5,61
1 1/2	1.900	48,3	0.145	3,68	40	STD	40	2.72	4,05
1 1/2	1.900	48,3	0.200	5,08	80	XS	40	3.63	5,41
1 1/2*	1.900	48,3	0.281	7,14	160	...	40	4.86	7,25
2*	2.375	60,3	0.083	2,11	...	...	50	2.03	3,03
2	2.375	60,3	0.109	2,77	...	...	50	2.64	3,93
2	2.375	60,3	0.125	3,18	...	...	50	3.01	4,48
2	2.375	60,3	0.141	3,58	...	...	50	3.37	5,01
2	2.375	60,3	0.154	3,91	40	STD	50	3.66	5,44
2	2.375	60,3	0.172	4,37	...	...	50	4.05	6,03
2	2.375	60,3	0.188	4,78	...	...	50	4.40	6,54
2	2.375	60,3	0.218	5,54	80	XS	50	5.03	7,48
2	2.375	60,3	0.250	6,35	...	...	50	5.68	8,45
2**	2.375	60,3	0.281	7,14	...	...	50	6.29	9,36
2**	2.375	60,3	0.344	8,74	160	...	50	7.47	11,11
2 1/2*	2.875	73,0	0.083	2,11	...	...	65	2.48	3,69
2 1/2	2.875	73,0	0.109	2,77	...	...	65	3.22	4,80
2 1/2	2.875	73,0	0.125	3,18	...	...	65	3.67	5,48
2 1/2	2.875	73,0	0.141	3,58	...	...	65	4.12	6,13
2 1/2	2.875	73,0	0.156	3,96	...	...	65	4.53	6,74
2 1/2	2.875	73,0	0.172	4,37	...	...	65	4.97	7,40
2 1/2	2.875	73,0	0.188	4,78	...	...	65	5.40	8,04
2 1/2	2.875	73,0	0.203	5,16	40	STD	65	5.80	8,63
2 1/2	2.875	73,0	0.216	5,49	...	...	65	6.14	9,14
2 1/2	2.875	73,0	0.250	6,35	...	...	65	7.02	10,44
2 1/2	2.875	73,0	0.276	7,01	80	XS	65	7.67	11,41
2 1/2*	2.875	73,0	0.375	9,53	160	...	65	10.02	14,92

* Delivered as cold drawn.

** Delivered upon agreement.

*** Upon agreement also further dimensions according to standard ASME B 36,10M, not included in API 5L:

outside diameter	10,3	wall thickness	1,24 / 1,45
	13,7		1,65 / 1,85
	17,1		1,65 / 1,85
	21,3		1,65 / 2,11 / 2,41
	26,7		1,65 / 2,11 / 2,41
	33,4		1,65 / 2,77 / 2,90
	42,2		1,65 / 2,77 / 2,97
	48,3		1,65 / 2,77 / 3,18
	60,3		1,65
	73		2,11 / 3,05
	88,9		3,05
	101,6		2,11 / 3,05
	114,3		2,11 / 3,05

NPS	Outside diameter		Wall thickness		Schedule No	Weight class	DN	Weight	
	[inch]	[mm]	[inch]	[mm]				[lbs/ft]	[kg/m]
3*	3.500	88,9	0.083	2,11	...	...	80	3.03	4,52
3*	3.500	88,9	0.109	2,77	...	...	80	3.95	5,88
3	3.500	88,9	0.125	3,18	...	...	80	4.51	6,72
3	3.500	88,9	0.141	3,58	...	...	80	5.06	7,53
3	3.500	88,9	0.156	3,96	...	...	80	5.58	8,30
3	3.500	88,9	0.172	4,37	...	...	80	6.12	9,11
3	3.500	88,9	0.188	4,78	...	...	80	6.66	9,92
3	3.500	88,9	0.216	5,49	40	STD	80	7.58	11,29
3	3.500	88,9	0.250	6,35	...	...	80	8.69	12,93
3	3.500	88,9	0.281	7,14	...	...	80	9.67	14,40
3	3.500	88,9	0.300	7,62	80	XS	80	10.26	15,27
3**	3.500	88,9	0.438	11,13	160	...	80	14.34	21,35
3 1/2*	4.000	101,6	0.109	2,77	...	...	90	4.53	6,75
3 1/2*	4.000	101,6	0.125	3,18	...	...	90	5.18	7,72
3 1/2	4.000	101,6	0.141	3,58	...	...	90	5.82	8,65
3 1/2	4.000	101,6	0.156	3,96	...	...	90	6.41	9,54
3 1/2	4.000	101,6	0.172	4,37	...	...	90	7.04	10,48
3 1/2	4.000	101,6	0.188	4,78	...	...	90	7.66	11,41
3 1/2	4.000	101,6	0.226	5,74	40	STD	90	9.12	13,57
3 1/2	4.000	101,6	0.250	6,35	...	...	90	10.02	14,92
3 1/2	4.000	101,6	0.281	7,14	...	...	90	11.17	16,63
3 1/2	4.000	101,6	0.318	8,08	80	XS	90	12.52	18,64
4*	4.500	114,3	0.109	2,77	...	...	100	5.12	7,62
4*	4.500	114,3	0.125	3,18	...	...	100	5.85	8,71
4	4.500	114,3	0.141	3,58	...	...	100	6.57	9,78
4	4.500	114,3	0.156	3,96	...	...	100	7.24	10,78
4	4.500	114,3	0.172	4,37	...	...	100	7.96	11,85
4	4.500	114,3	0.188	4,78	...	...	100	8.67	12,91
4	4.500	114,3	0.203	5,16	...	...	100	9.32	13,89
4	4.500	114,3	0.219	5,56	...	...	100	10.02	14,91
4	4.500	114,3	0.237	6,02	40	STD	100	10.80	16,08
4	4.500	114,3	0.250	6,35	...	...	100	11.36	16,91
4	4.500	114,3	0.281	7,14	...	...	100	12.67	18,87
4	4.500	114,3	0.312	7,92	...	...	100	13.97	20,78
4	4.500	114,3	0.337	8,56	80	XS	100	15.00	22,32
4**	4.500	114,3	0.438	11,13	120	...	100	19.02	28,32
4**	4.500	114,3	0.531	13,49	160	...	100	22.53	33,54

* Delivered as cold drawn.

** Delivered upon agreement.

Tolerances according to standards ASTM A530/A530M, ASTM A999/A999M (ASME SA)

Weight	Outside diameter	Wall thickness
All standards: NPS 12 and under -3,5 % +10 % over NPS 12 -5 % +10 % ASTM A999: With minimum wall thickness max +16 % (upon agreement)	$1/8 - 1 1/2"$ (10,3-48,3 mm), incl. $-1/32$ (0.031) $+1/64$ (0.015) -0,8 +0,4 mm	All standards: -12,5 % + limited by weight ¹⁾ ASTM A999: Minimum wall thickness (upon agreement only) there shall be no variation under the specified WT
	over $1 1/2 - 4"$ (48,3-114,3 mm), incl. $-1/32$ (0.031) $+1/32$ (0.031) -0,8 +0,8 mm	
	over 4-8 (114,3-219,1 mm), incl. $-1/32$ (0.031) $+1/16$ (0.062) -0,8 +1,6 mm	

- 1) According ASTM A 530 is plus tolerance of WT (latest edition):
 NPS $1/8 - 2 1/2"$, all t/D ratios +20%
 NPS 3 - 18", up to t/D 5 % +22,5 %
 NPS 3 - 18", t/D over 5 % +15 %

2) Ovality for thin-wall pipes (WT ≤ 3% OD) under 1,5% of specified OD

Mechanical tubes and tubes delivered according to standard ASTM A450/A450M

Tube dimensions: Outside diameter – absolute value

Wall thickness – in B.W.G., S.W.G. or another units

Conversion table of inch and decimal values (1 inch = 25,4 mm)

x/64	Adjusted value	Decimal value	MM [mm]
1/64		.016	0,406
2/64	1/32	.031	0,787
3/64		.047	1,19
4/64	1/16	.063	1,60
5/64		.078	1,98
6/64	3/32	.094	2,38
7/64		.109	2,77
8/64	1/8	.125	3,18
9/64		.141	3,58
10/64	5/32	.156	3,96
11/64		.172	4,37
12/64	3/16	.188	4,77
13/64		.203	5,16
14/64	7/32	.219	5,56
15/64		.234	5,94
16/64	1/4	.250	6,35
17/64		.266	6,76
18/64	9/32	.281	7,14
19/64		.297	7,54
20/64	5/16	.313	7,95
21/64		.328	8,33
22/64	11/32	.344	8,73
23/64		.359	9,12
24/64	3/8	.375	9,52
25/64		.391	9,92
26/64	13/32	.406	10,32
27/64		.422	10,72
28/64	7/16	.438	11,11
29/64		.453	11,51
30/64	15/32	.469	11,91
31/64		.484	12,30
32/64	1/2	.500	12,70

Table 3

x/64	Adjusted value	Decimal value	MM [mm]
33/64		.516	13,10
34/64	17/32	.531	13,49
35/64		.547	13,89
36/64	9/16	.563	14,29
37/64		.578	14,68
38/64	19/32	.594	15,08
39/64		.609	15,48
40/64	5/8	.625	15,88
41/64		.641	16,28
42/64	21/32	.656	16,66
43/64		.672	17,07
44/64	11/16	.688	17,47
45/64		.703	17,86
46/64	23/32	.719	18,26
47/64		.734	18,65
48/64	3/4	.750	19,05
49/64		.766	19,45
50/64	25/32	.781	19,84
51/64		.797	20,24
52/64	13/16	.813	20,65
53/64		.828	21,03
54/64	27/32	.844	21,43
55/64		.859	21,82
56/64	7/8	.875	22,22
57/64		.891	22,62
58/64	29/32	.906	23,02
59/64		.922	23,42
60/64	15/16	.938	23,82
61/64		.953	24,21
62/64	31/32	.969	24,61
63/64		.984	25,00
64/64	1/1	1.000	25,40

Standard wire gauge for wall thickness

Nr gauge	B.W.G.		S.W.G.		Nearest 1/64 inch (BWG)
	inch	mm	inch	mm	
36	0.004	0,102	0.0076	0,193	-
35	0.005	0,127	0.0084	0,213	-
34	0.007	0,178	0.0092	0,234	-
33	0.008	0,203	0.0100	0,254	-
32	0.009	0,229	0.0108	0,274	-
31	0.010	0,254	0.0116	0,295	-
30	0.012	0,305	0.0124	0,315	-
29	0.013	0,330	0.0136	0,345	-
28	0.014	0,356	0.0148	0,376	-
27	0.016	0,406	0.0164	0,417	1/64
26	0.018	0,457	0.018	0,457	1/64
25	0.020	0,508	0.020	0,508	1/64
24	0.022	0,559	0.022	0,559	1/64
23	0.025	0,635	0.024	0,610	1/32
22	0.028	0,711	0.028	0,711	1/32
21	0.032	0,813	0.032	0,813	1/32
20	0.035	0,889	0.036	0,914	1/32
19	0.042	1,067	0.040	1,016	3/64
18	0.049	1,245	0.048	1,219	3/64
17	0.058	1,473	0.056	1,422	1/16
16	0.065	1,651	0.064	1,626	1/16
15	0.072	1,829	0.072	1,829	5/64

Table 4

Nr gauge	B.W.G.		S.W.G.		Nearest 1/64 inch (BWG)
	inch	mm	inch	mm	
14	0.083	2,108	0.080	2,032	5/64
13	0.095	2,413	0.092	2,337	3/32
12	0.109	2,769	0.104	2,642	7/64
11	0.120	3,048	0.116	2,946	1/8
10	0.134	3,404	0.128	3,251	9/64
9	0.148	3,759	0.144	3,658	9/64
8	0.165	4,191	0.160	4,064	11/64
7	0.180	4,572	0.176	4,470	3/16
6	0.203	5,156	0.192	4,877	13/64
5	0.220	5,588	0.212	5,385	7/32
4	0.238	6,045	0.232	5,893	15/64
3	0.259	6,579	0.252	6,401	17/64
2	0.284	7,214	0.276	7,010	9/32
1	0.300	7,620	0.300	7,620	19/64
0	0.340	8,636	0.324	8,230	11/32
2/0	0.380	9,652	0.348	8,839	3/8
3/0	0.425	10,80	0.372	9,449	27/64
4/0	0.454	11,53	0.400	10,16	29/64
5/0	-	-	0.432	10,97	-
6/0	-	-	0.464	11,78	-
7/0	-	-	0.500	12,70	-

Dimensions and weight of seamless tubes according to standard ASTM A450/A450M

Table 5

Wall thickness			Outside diameter															
in BWG			inch	1	1 1/4	1 1/2	1 3/4	2	2 1/8	2 1/4	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	
Gauge	inch	mm	mm	25,40	31,75	38,10	44,45	50,80	54,00	57,00	63,50	76,20	88,90	101,60	114,30	127,00	139,70	
12	0,109	2,77	kg/m	1,55	1,98	2,41	2,85	3,28	3,50	3,70	4,15	5,02						
			lbs/ft	1,04	1,33	1,62	1,91	2,20	2,35	2,49	2,79	3,37						
11	0,120	3,05	kg/m	1,68	2,16	2,64	3,11	3,59	3,83	4,06	4,55	5,50						
			lbs/ft	1,13	1,45	1,77	2,09	2,41	2,58	2,73	3,06	3,70						
10	0,134	3,40	kg/m	1,84	2,38	2,91	3,44	3,97	4,24	4,49	5,04	6,10	7,17	8,23	9,30			
			lbs/ft	1,24	1,60	1,96	2,31	2,67	2,85	3,02	3,39	4,10	4,82	5,53	6,25			
9	0,148	3,76	kg/m	2,01	2,60	3,18	3,77	4,36	4,66	4,94	5,54	6,72	7,89	9,07	10,25	11,43		
			lbs/ft	1,35	1,74	2,14	2,54	2,93	3,13	3,31	3,72	4,51	5,31	6,10	6,89	7,68		
8	0,165	4,19	kg/m		2,85	3,50	4,16	4,82	5,15	5,46	6,13	7,44	8,75	10,07	11,38	12,69		
			lbs/ft		1,91	2,35	2,80	3,24	3,46	3,67	4,12	5,00	5,88	6,76	7,65	8,53		
7	0,180	4,57	kg/m			3,78	4,49	5,21	5,57	5,91	6,64	8,07	9,50	10,94	12,37	13,80		
			lbs/ft			2,53	3,02	3,50	3,74	3,97	4,46	5,42	6,38	7,35	8,31	9,27		
6	0,203	5,16	kg/m					5,81	6,22	6,60	7,42	9,04	10,66	12,27	13,89	15,50		
			lbs/ft					3,90	4,18	4,43	4,99	6,07	7,16	8,25	9,33	10,42		
5	0,220	5,59	kg/m					6,23	6,67	7,09	7,98	9,73	11,48	13,24	14,99	16,74		
			lbs/ft					4,19	4,48	4,76	5,36	6,54	7,72	8,89	10,07	11,25		
4	0,238	6,05	kg/m					6,68	7,15	7,60	8,57	10,47	12,36	14,26	16,15	18,05		
			lbs/ft					4,49	4,80	5,10	5,76	7,03	8,31	9,58	10,85	12,13		
3	0,259	6,58	kg/m								9,24	11,30	13,36	15,42	17,48	19,54		
			lbs/ft								6,21	7,59	8,98	10,36	11,75	13,13		
2	0,284	7,21	kg/m								10,01	12,27	14,53	16,78	19,04	21,30	23,56	
			lbs/ft								6,73	8,24	9,76	11,28	12,80	14,31	15,83	
1	0,300	7,62	kg/m										15,27	17,66	20,05	22,43	24,82	
			lbs/ft											10,26	11,87	13,47	15,07	16,68

Wall thickness			Outside diameter															
in SWG			inch	1	1 1/4	1 1/2	1 3/4	2	2 1/8	2 1/4	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	
Gauge	inch	mm	mm	25,40	31,75	38,10	44,45	50,80	54,00	57,00	63,50	76,20	88,90	101,60	114,30	127,00	139,70	
12	0,104	2,64	kg/m	1,48	1,90	2,31	2,72	3,14	3,34	3,54	3,96	4,79						
			lbs/ft	1,00	1,27	1,55	1,83	2,11	2,24	2,38	2,66	3,22						
11	0,116	2,95	kg/m	1,63	2,10	2,56	3,02	3,48	3,71	3,93	4,41	5,33						
			lbs/ft	1,10	1,41	1,72	2,03	2,34	2,50	2,64	2,96	3,58						
10	0,128	3,25	kg/m	1,78	2,28	2,79	3,30	3,81	4,07	4,31	4,83	5,85						
			lbs/ft	1,19	1,53	1,88	2,22	2,56	2,73	2,90	3,24	3,93						
9	0,144	3,66	kg/m	1,96	2,54	3,11	3,68	4,25	4,54	4,81	5,40	6,55	7,69	8,84	9,99	11,13		
			lbs/ft	1,32	1,70	2,09	2,47	2,86	3,05	3,23	3,63	4,40	5,17	5,94	6,71	7,48		
8	0,160	4,06	kg/m		2,77	3,41	4,04	4,68	5,00	5,30	5,95	7,22	8,49	9,77	11,04	12,31		
			lbs/ft		1,86	2,29	2,72	3,14	3,36	3,56	4,00	4,85	5,71	6,56	7,42	8,27		
7	0,176	4,47	kg/m			3,71	4,41	5,11	5,46	5,79	6,51	7,91	9,31	10,71	12,11	13,51		
			lbs/ft			2,49	2,96	3,43	3,67	3,89	4,37	5,31	6,25	7,19	8,14	9,08		
6	0,192	4,88	kg/m					5,53	5,91	6,27	7,05	8,58	10,11	11,64	13,17	14,70		
			lbs/ft					3,71	3,97	4,21	4,74	5,77	6,79	7,82	8,85	9,88		
5	0,212	5,39	kg/m					6,04	6,46	6,86	7,72	9,41	11,10	12,79	14,48	16,17		
			lbs/ft					4,06	4,34	4,61	5,19	6,32	7,46	8,59	9,73	10,86		
4	0,232	5,89	kg/m					6,52	6,99	7,42	8,37	10,21	12,06	13,90	15,75	17,59		
			lbs/ft					4,38	4,70	5,00	5,62	6,86	8,10	9,34	10,58	11,82		
3	0,252	6,40	kg/m								8,93	11,01	13,02	15,02	17,03	19,03		
			lbs/ft								6,00	7,40	8,75	10,09	11,44	12,78		
2	0,276	7,01	kg/m								9,77	11,96	14,16	16,35	18,55	20,74	22,94	
			lbs/ft								6,56	8,04	9,51	10,99	12,46	13,94	15,41	
1	0,300	7,62	kg/m										15,27	17,66	20,05	22,43	24,82	
			lbs/ft											10,26	11,87	13,47	15,07	16,68

BWG - Birmingham Wire Gauge

SWG - Standard Wire Gauge

Tube tolerances - see page 33 (minimum wall thickness).

With those tolerances tube deliveries upon agreement.

Hot rolled tubes are usually delivered with average wall thickness.

Weight is calculated with given wall thickness.

Smaller diameter tubes (from 1/4 inch = 6,35 mm) upon agreement (see pages 51 and 66 - 67).

Method of manufacture and delivery conditions - hot formed or cold drawn - depend on tube dimension or upon agreement.

Dimensions and weight of seamless cold drawn tubes according to standards EN, DIN, BS, UNI, NF, GOST, STN, ČSN

Table 6

Outside diameter [mm]	Wall thickness [mm]														
	0,5	1,0	1,5	2,0	2,5	3,0	3,5	4,0	4,5	5,0	6,0	7,0	8,0	9,0	10,0
	Tube weight [kg/m]														
4	0,043	0,074													
5	0,055	0,099													
6	0,068	0,123	0,166	0,197											
8	0,093	0,173	0,240	0,296	0,339	0,370									
10	0,117	0,222	0,314	0,395	0,462	0,518									
12	0,142	0,271	0,388	0,493	0,586	0,666	0,734	0,789							
14	0,166	0,321	0,462	0,592	0,709	0,814	0,906	0,986	1,054						
15	0,179	0,345	0,499	0,641	0,771	0,888	0,993	1,085	1,165						
16	0,191	0,370	0,536	0,691	0,832	0,962	1,079	1,184	1,276						
18	0,216	0,419	0,610	0,789	0,956	1,110	1,252	1,381	1,498						
20	0,240	0,469	0,684	0,888	1,079	1,258	1,424	1,578	1,720	1,850	2,071				
22		0,518	0,758	0,986	1,202	1,406	1,597	1,777	1,942	2,096	2,367				
24		0,567	0,832	1,085	1,326	1,554	1,769	1,973	2,164	2,343	2,663				
25		0,592	0,869	1,134	1,387	1,628	1,856	2,072	2,275	2,446	2,811				
28		0,666	0,980	1,282	1,572	1,850	2,115	2,368	2,608	2,836	3,255				
30		0,715	1,054	1,381	1,695	1,988	2,287	2,565	2,830	3,083	3,551				
32		0,764	1,128	1,480	1,819	2,146	2,460	2,762	3,052	3,329	3,847	4,316			
35		0,838	1,239	1,628	2,004	2,367	2,719	3,058	3,385	3,699	4,291	4,834			
36		0,863	1,276	1,677	2,065	2,441	2,805	3,157	3,496	3,822	4,439				
38		0,912	1,350	1,766	2,189	2,589	2,978	3,354	3,718	4,069	4,735	5,352	5,919		
40		0,962	1,424	1,874	2,312	2,737	3,150	3,551	3,940	4,316	5,031	5,697	6,313		
42			1,498	1,973	2,435	2,885	3,323	3,749	4,162	4,562	5,327	6,042	6,708		
46			1,646	2,170	2,682	3,181	3,668	4,143	4,605	5,055	5,919	6,733	7,497		
48			1,720	2,269	2,805	3,329	3,841	4,340	4,827	5,302	6,215	7,078	7,892	8,656	9,371
50			1,794	2,368	2,929	3,477	4,014	4,538	5,049	5,549	6,511	7,423	8,286	9,100	9,865
52			1,868	2,466	3,052	3,625	4,188	4,735	5,271	5,795	6,807	7,768	8,681	9,544	10,36
55			1,979	2,614	3,237	3,847	4,445	5,031	5,604	6,165	7,250	8,286	9,273	10,21	11,10
58			2,090	2,762	3,422	4,069	4,704	5,327	5,937	6,535	7,694	8,804	9,865	10,88	11,84
60			2,164	2,861	3,545	4,217	4,877	5,524	6,159	6,782	7,990	9,149	10,26	11,32	12,33
62			2,238	2,959	3,668	4,365	5,049	5,721	6,381	7,028	8,286	9,495	10,65	11,76	12,82
65			2,349	3,107	3,853	4,587	5,308	6,017	6,714	7,398	8,730	10,01	11,25	12,43	13,56
70			2,534	3,354	4,162	4,957	5,740	6,511	7,269	8,015	9,470	10,88	12,23	13,54	14,80
75				3,601	4,470	5,327	6,172	7,004	7,824	8,632	10,21	11,74	13,22	14,65	16,03
80				3,874	4,778	5,697	6,603	7,497	8,379	9,248	10,95	12,60	14,21	15,76	17,26
85				4,094	5,086	6,067	7,035	7,990	8,934	9,865	11,69	13,47	15,19	16,87	18,50
90				4,340	5,395	6,437	7,466	8,484	9,489	10,48	12,43	14,33	16,18	17,98	19,73
100				4,834	6,011	7,176	8,329	9,470	10,60	11,71	13,91	16,06	18,15	20,20	22,20
110					6,628	7,916	9,193	10,46	11,71	12,95	15,39	17,78	20,12	22,42	24,66
120						8,656	10,06	11,44	12,82	14,18	16,87	19,51	22,10	24,64	27,13

Exact tolerance value depending on:

- ordering mean of precision tubes (Dxd, DxT, dxT)
- tube delivery condition (cold finished/hard or heat treated)
- custom tolerance qualification

Actual values are given in appropriate standards (usually $D \leq \pm 0,5 \%$, $T = \pm 10 \%$).

Permissible tolerances of weight according to ASTM A450 and ASTM A1016

Seamless hot finished	Seamless cold finished		Welded
	OD ≤ 1 1/2" (38,1 mm)	over OD > 1 1/2" (38,1 mm)	
0 +16 %	0 +12 %	0 +13 %	0 +10 %

Permissible tolerances of outside diameter according to ASTM A450/A450M, ASTM A1016/A1016M (ASME SA)

Outside diameter			
Hot finished	4" (101,6 mm) and under	-1/32 (0,8 mm)	+1/64 (0,4 mm)
Cold finished	over 4" - 7 1/2" (101,6 - 190,5 mm) incl.	-3/64 (1,2 mm)	+1/64 (0,4 mm)
	under 1" (25,4 mm)	-0.004 (0,1 mm)	+0.004 (0,1 mm)
	1" - 1 1/2" (25,4 - 38,1 mm) incl.	-0.006 (0,15 mm)	+0.006 (0,15 mm)
	over 1 1/2" - 2" (38,1 - 50,8 mm) excl.	-0.008 (0,2 mm)	+0.008 (0,2 mm)
	2" - 2 1/2" (50,8 - 63,5 mm) excl.	-0.010 (0,25 mm)	+0.010 (0,25 mm)
	2 1/2" - 3" (63,5 - 76,2 mm) excl.	-0.012 (0,3 mm)	+0.012 (0,3 mm)
Cold finished	3" - 4" (76,2 - 101,6 mm) incl.	-0.015 (0,38 mm)	+0.015 (0,38 mm)
	over 4" - 7 1/2" (101,6 - 190,5 mm)	-0.015 (0,38 mm)	+0.025 (0,64 mm)

Ovality for thin-wall tubes [WT≤0,020in (0,5mm) / WT≤2% of OD, up to OD=2in (50,8mm) / WT≤3% of OD for OD over 2in]:
 Tubes with OD≤1in (25,4mm) = 0,020in (0,5mm), tubes with OD>1in = up to 2% of OD (difference of maximum values)

Permissible tolerances of wall thickness according to ASTM A450/A450M, ASTM A1016/A1016M (ASME SA)

Wall thickness				
Hot finished	under 0,095" (2,4 mm)	0,095" - 0,15" (2,4 - 3,8 mm)	0,15" - 0,18" (3,8 - 4,6 mm)	over 0,18" (4,6 mm)
	0 +40 %	0 +35 %	0 +33 %	0 +28 %
Cold finished	by outside diameter			
	1 1/2" (38,1 mm) and under	0 +20%	over 1 1/2" (38,1 mm)	0 +22%
Welded	0 +18 %			

For tubes with OD≥2in a WT≥0,220in (5,6mm) are permitted divergences from average WT: ±10% for seamless tubes, ±5% for welded tubes.

Steels for room temperature pressure purpose tubes

Standards	Steel grade	Chemical composition [%]										Mechanical properties						
		C	Si	Mn	P _{max}	S _{max}	Cr	Ni	Mo	Cu	Other	Re min MPa	Re min ksi	Rm min MPa	Rm max MPa	A5 min %		
STN, ČSN																		
	11 353	max.0,18			0,050	0,050								235		340	440	25
	11 453	max.0,24			0,050	0,050								265		441	539	21
	11 503	max.0,18	max.0,55	max.1,60	0,035	0,035	max.0,30	max.0,30			max.0,30	Al min.0,015 Nb 0,015-0,08	355		490	630	22	
	11 523	max.0,22	max.0,55	max.1,60	0,035	0,035						Al min.0,015	353		510	628	23	
ASTM																		
A 53	GradeA	0,25		0,95	0,050	0,045								205	30	330		48
	GradeB	0,30		1,20	0,050	0,045								240	35	415		60
DIN																		
1629	St 37.0	max.0,17			0,040	0,040								235		350	480	25
	St 44.0	max.0,21			0,040	0,040								275		420	550	21
	St 52.0	max.0,22			0,040	0,035								355		500	650	21
1630	St 37.4	max.0,17	max.0,35	min.0,35	0,040	0,040							Al min.0,020	235		350	480	25
	St 44.4	max.0,20	max.0,35	min.0,40	0,040	0,040							Al min.0,020	275		420	550	21
	St 52.4	max.0,22	max.0,55	max.1,60	0,040	0,035							Al min.0,020	355		500	650	21
BS																		
3601	360	max.0,17	max.0,35	0,40-0,80	0,040	0,040						Al max.0,06	235		360	500	25	
	430	max.0,21	max.0,35	0,40-1,20	0,040	0,040						Al max.0,06	275		430	570	22	
NFA																		
49-112	TU E 220A	max.0,20	max.0,40	max.0,85	0,045	0,045								220		360	500	23
	TU E 235A	max.0,24	max.0,40	max.1,05	0,045	0,045								235		410	550	21
EN																		
10216-1	P 195 TR1	max.0,13	max.0,35	max.0,70	0,025	0,020	max.0,30	max.0,30	max.0,08	max.0,30		V max.0,02 Ti max.0,04	195		320	440	27	
	P 195 TR2	max.0,13	max.0,35	max.0,70	0,025	0,020	max.0,30	max.0,30	max.0,08	max.0,30		V max.0,02 Ti max.0,04 Al max.0,02	195		320	440	27	
	P 235 TR1	max.0,16	max.0,35	max.1,20	0,025	0,020	max.0,30	max.0,30	max.0,08	max.0,30		V max.0,02 Ti max.0,04	235		360	500	25	
	P 235 TR2	max.0,16	max.0,35	max.1,20	0,025	0,020	max.0,30	max.0,30	max.0,08	max.0,30		V max.0,02 Ti max.0,04 Al max.0,02	235		360	500	25	
	P 265 TR1	max.0,20	max.0,40	max.1,40	0,025	0,020	max.0,30	max.0,30	max.0,08	max.0,30		V max.0,02 Ti max.0,04	265		410	570	21	
	P 265 TR2	max.0,20	max.0,40	max.1,40	0,025	0,020	max.0,30	max.0,30	max.0,08	max.0,30		V max.0,02 Ti max.0,04 Al max.0,02	265		410	570	21	
GOST																		
1050	10	0,07-0,14	0,17-0,37	0,35-0,65			max.0,15							205		330		31
	20	0,17-0,24	0,17-0,37	0,35-0,65			max.0,25							245		410		25
	35	0,32-0,40	0,17-0,37	0,50-0,80			max.0,25							315		530		20
	45	0,42-0,50	0,17-0,37	0,50-0,80			max.0,25							355		600		16
JIS																		
G3454	STPG 370	max.0,25	max.0,35	0,30-0,90	0,040	0,040								215		370		30
	STPG 410	max.0,30	max.0,35	0,30-1,00	0,040	0,040								245		410		25
G3455	STS 370	max.0,25	0,10-0,35	0,30-1,10	0,035	0,035								215		370		30
	STS 410	max.0,30	0,10-0,35	0,30-1,40	0,035	0,035								245		410		25
	STS 480	max.0,33	0,10-0,35	0,30-1,50	0,035	0,035								275		480		25
PN-H																		
84023/07	R35	0,07-0,16	0,12-0,35	0,40-0,75	0,040	0,040	max.0,30	max.0,30	max.0,10	max.0,30				215		360		24
	R45	0,16-0,22	0,12-0,35	0,60-1,2	0,040	0,040	max.0,30	max.0,30	max.0,10	max.0,30				255		430		22
	R55	0,32-0,40	0,20-0,35	0,60-0,85	0,045	0,045	max.0,30	max.0,30	max.0,10	max.0,30				295		540		17

Seamless steel tubes for pressure equipments for elevated temperature

Standards	Dimensional standards	Dimensional range	Dimensions				Straightness	Tube ends
			Tolerance D	Tolerance T	Lengths			
EN	10216-2	Table 1/Page 26	Outside diameter D $\pm 1\%$ min $\pm 0,5$ mm	$\pm 12,5\%$ (D $\leq 219,1$ mm) min $\pm 0,4$ mm	Kinds: • random • exact	allowed 0,0015.L on tube calculated to 1 m max. 3 mm	• square cut ends • free from excessive burrs • option: with beveled ends (see page 98)	
	10305-1 (upon agreement)	Table 16/Page 64	Outside diameter D $\pm 1\%$ min $\pm 0,5$ mm	$T_{min} + 28\%$ (D $\leq 219,1$ mm) min $+0,8$ mm				Informative values: • D < 60,3 mm 5-6 m • D $\geq 60,3$ mm / T < 7,1 mm 5-6 m or 10-14 m • D $\geq 60,3$ mm / T $\geq 7,1$ mm 5-6 m • longer (22-24 m) upon agreement
Inside diameter d or d_{min} • see article 8.7.4.1 of standard • delivery upon agreement only			Wall thickness T	Exact length tolerances: • L < 6 m 0 +10 mm • L = 6-12 m 0 +15 mm • L > 12 m + upon agreement				
Inside diameter d or d_{min} • see article 8.7.4.1 of standard • delivery upon agreement only			Wall thickness T_{min}					
Cold finished: $\pm 0,5\%$ min $\pm 0,3$ mm			$\pm 10\%$ min $\pm 0,2$ mm					
DIN	2448	Table 1/Page 26	D < 100 mm $\pm 0,75\%$ min $\pm 0,5$ mm D = 100-320 mm $\pm 0,90\%$	D < 130 mm • T $\leq 2T_n - 10\% + 15\%$ • $2T_n < T < 4T_n - 10\% + 12,5\%$ • T > 4T_n $\pm 9\%$ T _n - basic wall thickness according to DIN 2448	Kinds: • random • fixed ± 500 mm • exact Informative values: • D < 60,3 mm 5-6 m • D $\geq 60,3$ mm / T < 7,1 mm 5-6 m or 10-14 m • D $\geq 60,3$ mm / T $\geq 7,1$ mm 5-6 m • longer upon agreement	Visually straight	• square cut ends • free from excessive burrs	
2391-1 (upon agreement)	Table 16/Page 64	Cold finished: D < 120 mm $\pm 0,6\%$ min $\pm 0,25$ mm D > 120 mm $\pm 0,75\%$	according to DIN 2391-1					
		Cold formed - precision See page 60 and 64		Exact length tolerances: like EN				
BS	3059-1	Table 1/Page 26	Hotfinished (HFS): $\pm 1\%$ min $\pm 0,5$ mm	$\pm 12,5\%$	• random • exact with tolerances: L ≤ 6 m 0 +3 mm L > 6 m 1,5 mm/m, max 12,5 mm	Visually straight	• square cut ends • free from excessive burrs	
	3059-2		Cold finished (CFS): $\pm 0,5\%$ min $\pm 0,10$ mm	$\pm 7,5\%$				
		3602-1 3604-1	Class S1: $\pm 0,5\%$ min $\pm 0,10$ mm Class S2: $\pm 0,75\%$ min $\pm 0,30$ mm (Cold finished)	$\pm 7,5\%$ $\pm 10\%$				
	Cold finished (CFS): $\pm 0,75\%$ min $\pm 0,50$ mm		$\pm 7,5\%$					
Hotfinished (HFS): $\pm 1\%$ min $\pm 0,5$ mm	T/D = 3% $\pm 15\%$ T/D = 3-10% $\pm 12,5\%$ T/D > 10% $\pm 12,5\%$ (D < 168,3 mm)							

List of dimensional standards and technical delivery conditions standards

EN 10216-2	Seamless steel tubes for pressure purposes. TDC. Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties.	BS 3059-2	Specification for carbon, alloy and austenitic steel tubes with specified elevated temperature properties.
DIN 2391-1	Seamless precision steel tubes. Part 1: Dimensions.	BS 3600	Dimensions and masses per unit length of seamless and welded steel pipes and tubes for pressure purposes.
DIN 2448	Plain end seamless steel tubes. Dimensions.	BS 3602-1	Steel pipes and tubes for pressure purposes: carbon and carbon manganese steel with specified elevated temperature properties. Part 1: Specification for seamless and electric resistance welded including induction welded tubes.
DIN 17175	Seamless steel tubes for elevated temperatures.		
BS 3059-1	Steel boiler and superheater tubes. Specification for low tensile carbon steel tubes without specified elevated temperature properties.		

TDC standards	Steel grade			Testing and certificates		Other TDC		
	Name	Condition	Surface	Testing	Certificate	Marking	Surface protection	Packing
10216-2	P195GH P235GH P265GH 16Mo3 14MoV63 10CrMo55 13CrMo45 10CrMo9-10 11CrMo9-10 25CrMo4 Other steels according to agreement	+ N + N + N + N + NT + NT + NT + NT + QT +QT Conditions for: Hot finished Cold finished + N - normalized + NT - normalized + tempered + QT - quenching and tempered + I - isothermal annealed Normalising formed includes normalizing	Adequate to production mode of tubes and heat treatment. Visually without defects, to remove defects surface can be worked according to appropriate standard articles. Specific working upon agreement.	Specific testing Non-alloy special steel TC1 or TC2 Alloy special steel - TC2 Mandatory testing: • product analysis • tensile test • flattening or ring expanding • drift expanding • leak tightness (Page 11) • dimensions • visual • NDT (at TC2) (Page 11) • material identification (at alloy steel) • impact test according to steel grade and dimensions Optional testing upon agreement	EN 10204 Inspection certificate • 3.1 • 3.2 See also page 10	Indelibly marking D < 51 mm on label D > 51 mm at end Data • producer • standard • steel grade • TC (C - in steel) • cast (code) • inspector's mark • identification number Optionally: • additional marking upon agreement	• without • upon agreement	
17175	St 35.8 St 45.8 17Mn4 19Mn5 15Mo3 13CrMo4 4 10CrMo9 10 14MoV6 3	Hot finished • as rolled • normalized Cold finished • normalized Hot finished • tempered • normalized and tempered Cold finished • normalized and tempered Hot finished Cold finished • normalized and tempered (both methods)		Quality class I. or III. Quality class III. Testing like EN	DIN 50049 Kinds of protocol like EN	Usually die stamping or agreement At both ends Data: • steel • grade of quality (C-steel) • manufacturer • inspector • color strap At one end for OD ≥ 159 mm • cast number • tube number (III. grade)		
3059-1	320	Hot finished • as rolled (HF) • normalized (N) Cold formed • normalized		• visual • tensile test • flattening • drift expanding • leak tightness (hydrotest or NDT)	Standard requirements execution	Indelibly marking Usually die stamping At one end or Label on the bundle Data: • manufacturer • standard • steel • identification number • cast (at 3604-1)	• without • upon agreement	
3059-2	360 440 243 620 622-490	Cold finished • normalized N N (N + T) N + T or Ann (tempered)		• testing category 1 with NDT • testing category 2 with hydrotest Other tests like BS 3059-1				
3602-1	360 430	Hot finished • as rolled (HF) • normalized (N) Cold formed • normalized		• visual • tensile test • flattening • testing category 1 with NDT - ultrasonic • testing category 2 with NDT - eddy current				
3604-1	620-440 621 660 622	N+T* N+T N+T N+T						

* Condition N+T is valid for method HFS and CFS

BS 3604-1

Steel pipes and tubes for pressure purposes: ferritic alloy steel with specific elevated temperature properties. Part 1: Specification for seamless and electric resistance welded tubes.

BS 3606

Steel tubes for heat exchangers.

ISO 9329-2

See EN 10216-2

Testing comparison	
DIN 17175	EN 10216-2
Quality class	Testing category
I	TC 1
III	TC 2

Boiler steel designation according to EN:

- base non-alloy steel
- P – steel for pressure equipments
- 235 – minimum yield strength in N/mm²
- G – general characteristic, devise to second symbol
- H – high temperature
- alloy steel
- steel designated according to chemical composition

Seamless steel tubes for pressure equipments for elevated temperature

Standards	Dimensional standards	Dimensional range	Dimensions				
			Tolerance D	Tolerance T	Lengths	Straightness	Tube ends
NFA	49-211	Table 1/Page 26	D ≤ 48,3 mm -0,8 +0,4 mm D = 60,3-114,3 mm ±0,8 mm D = 139,7-219,1 mm -0,8 +1,6 mm Tube weight -3,5 +10 %	T ≤ 3,2 mm -0,15T +0,5 mm T = 3,2-20 mm -0,125T +0,15T	Exact lengths tolerances: • L ≤ 8 m 0 +10 mm • L > 8 m 0 +15 mm	max. 3 mm/m total 0,15% of tube length	• square cut ends tol. 0,5 %D (min. 0,5 mm, max. 1,6 mm) • beveled D > 60,3
	49-213		Hot finished: D ≤ 63,5 mm ±0,50 mm D = 63,5-114,3 mm ±0,75 % D > 114,3 mm ±1 % Cold finished: D ≤ 33,7 mm ±0,25 mm D > 33,7 mm ±0,5 % min ±0,25 mm	±12,5 % min ±0,4 mm ±10 %	Exact lengths tolerances: • D ≤ 88,9 mm a L ≤ 7,5 m 0 +5 mm • D > 88,9 mm 0 +10 mm • L > 7,5 m +1 mm/1 m	max. 3 mm/m total by length 6 m = 8 mm	• square cut ends • free from excessive burrs
UNI	(ISO 1129) Pipe line 4991 Boiler 5463		Hot finished: D ≤ 51 mm ±0,5 mm D = 51-419 mm ±1 % Cold finished: D ≤ 139,7 mm ±0,75 % min ±0,3 mm Tube weight -8 +10%	D ≤ 139,7 mm ±12,5 % ±10 %	Exact lengths tolerances: • L ≤ 6 m 0 +10 mm • L > 6 m 0 +15 mm		• square cut ends • free from excessive burrs
STN ČSN	42 5715 42 5716 (42 6710) (42 6711)	(Table 6/Page 32)	42 5715 D ≤ 219 mm ±1,25 % min ±0,5 mm	D < 219 mm, T < 20 mm -15 % +12,5 %	Exact lengths tolerances: 0 +15 mm Multiple: +5 mm for cut, max. +50 mm	Straightened - 3 mm/m Exact straight- ened- 1,5 mm/m	• square cut ends • free from excessive burrs • option: with beveled ends
			42 5716 D ≤ 219 mm ±1 % min ±0,5 mm	D < 219 mm, T < 20 mm ±12,5 %			
			42 6710 ±1 % min ±0,4 mm	T ≤ 3 mm -10 % +15 % T > 3 mm -10 % +12 %			
			42 6711 see precision tubes				
GOST	8732 TU 14-3-190 TU 14-3-460	Table 1/Page 26	D ≤ 50 mm ±0,50 mm D = 50-219 mm usually ±1 % increased ±0,8 %	D ≤ 219 mm, T ≤ 15 mm usually -15% +12,5% increased ±12,5%	Exact lengths tolerances: • L ≤ 6 m 0 +10 mm • L > 6 m 0 +15 mm	1,5 mm/m	• square cut ends • option: beveled for WT 5-20 mm
PN-H	74252		D ≤ 50 mm ±0,50 mm D = 50-219 mm usually ±1 % increased ±0,8 %	D ≤ 219 mm, T ≤ 15 mm usually -15% +12,5% increased ±12,5%	Exact lengths tolerances: • L ≤ 6 m 0 +10 mm • L > 6 m 0 +15 mm	1,5 mm/m	• square cut ends • option: beveled for WT 5-20 mm
ANSI ASME	B36.10	Table 2/Page 28	See table 2, page 28,29 Except 1. row tolerance ±0,4 (not -0,8 mm)		Depending on tube dimension length upon agreement. See EN	Visually straight	• square cut ends • plain ends • NPS ≤ 1/2 (DN 40/48,3 mm) agreement • NPS ≥ 2 (DN 50/60,3 mm) WT ≤ XS - beveled WT > XS - plain and square cut

Note: At NFA 49-213 - also steel TU 15CD2-05.

List of dimensional standards and technical delivery conditions standards

NFA 49-211	Steel tubes. Seamless plain-end unalloyed steel tubes for fluid piping at elevated temperatures.. Dimensions. TDC.
NFA 49-213	Steel tubes. Seamless unalloyed and Mo and Cr-Mo alloyed steel tubes for use at high temperatures. Dimensions (with standard tolerances). TDC.
ISO 1129	Steel tubes for boilers, superheaters and heat exchangers. Dimensions, tolerances and weight per unit lengths.
UNI 4991	Seamless and welded steel tubes with plain ends. Dimensions.
UNI 5462	Seamless steel tubes - tubes for elevated temperatures and pressures.
UNI 5463	.....
STN 42 0251	ČSN 42 0251 Seamless steel tubes with guaranteed properties of elevated temperatures.
STN 42 5715	ČSN 42 5715 Hot formed seamless steel tubes.
STN 42 5716	ČSN 42 5716 Hot formed seamless steel tubes with smaller tolerances.

TDC standards	Steel grade			Testing and certificates		Other TDC		
	Name	Condition	Surface	Testing	Certificate	Marking	Surface protection	Packing
49-211	TUE 220 TUE 250 TUE 275	Hot finished • as rolled • normalized Cold finished • normalized	Adequate to production mode of tubes and heat treatment. Visually without defects, to remove defects surface can be worked according to appropriate standard articles. Specific working upon agreement.	Testing as in EN • leak tightness by hydrotest - pressure according to formula	NFA 49-001 3.1.B	Indelibly marking 26,9 mm and under-label 26,9 - 48,3 mm - tube or label Over 48,3 mm at tube	• without • upon agreement	• D < 60,3 mm - bundles • tubes of larger diameter can be free laid
49-213	TU 37C TU 42C TU 48C TU 52C TU 15D3 TU 13CD4-04 TU 10CD5-05 TU 10CD9-10	Hot finished • as rolled • normalized Cold finished • normalized N N+T N+T N+T		• hot finished tubes of grade: L1, L2, L3 • cold finished tubes of grade: F1, F2, F3 • NDT ultrasonic of grade: L2, L3, F2, F3	NFA 49-001 company certificate C.C.P.V (3.1.B) or inspection test 3.2.C	Data • manufacturer • steel, condition • standard • dimensions • pressure at test • identification number • inspector		
5462	C14 C18 16Mo5 14CrMo3 12CrMo9-10	Hot finished • as rolled • normalized Cold finished • normalized N N+T N+T		• dimensions • hydrostatic test • drift expanding • flattening • tensile test • NDT upon agreement		Marking according to agreement		
42 0251	11 368 11 418 12 021 12 022 12 025 15 020 15 121 15 128 15 313	Hot finished • as rolled • normalized Cold finished • normalized condition .1 behind steel mark Hot finished • normalized and tempered Cold finished • normalized and tempered condition .5 behind steel mark	.0+ scaled .1+ pickled Cold finished .2+ free of scale .4+ metallic clean .9+ special agreement (first number behind DS)	• surface • dimensions • leak tightness • tensile test • flattening • drift expanding • impact test • ring-expanding • material identification • NDT (Tube class 3) (Tube class 1 and 3)*	• 6+ test certificate • 7+ customer inspection • 9+ special arrangement + = tube class	Colour according to ČSN 42 0010 Tested NDT - colour strip D < 70 mm label on bundle Marking of tubes according to TDC	• without • upon agreement	• bundles 300-3500 kg, bounded with steel stripes • other upon agreement
8731 4543 20072 TU 14-3-190 TU 14-3-460	10 20 10G2 15ChM 12Ch1MF	Hot finished • as rolled, • normalized Hot finished • normalized and tempered Cold finished • normalized and tempered		• product analysis • hardness • visual • tensile test • impact test • grain size • inclusions • leak tightness • NDT	According to GOST 10692	According to GOST 10692 D over 159 (114) mm and WT over 3,5 mm at tube Smaller tubes label Data: • dimensions • steel • manufacturer • alloy steel - cast and tube number	According to GOST 10692	According to GOST 10692
74252 (84024)	K10 K18 16M, 10H2M 15HM 13HMF	Hot finished • as rolled, • normalized Hot finished, Cold finished • normalized and tempered						
ASTM A106 (A530) ASME SA-106 (SA-530)	Grade A Grade B Grade C	Hot finished • as rolled Cold finished • normalized		• product analysis • hardness • tensile test • impact test (up to NPS 2") • flattening • impact test • hydrostatic or NDT - E 213, E 309, E 570 • dimensions • weight • drift expanding • flanging • (upon agreement equivalent C)	A530	A530 + A700 + article 24 of standard Under 2 in (60,3 mm) data on a label. Data: • manufacturer • standard • steel grade	A530 + A700 + article 24 of standard	A530 + A700 + article 24 of standard

*Option of class of tubes according to working conditions (temperature, pressure) in compliance with standards ČSN 13 0020, ČSN 42 0090 and ČSN 69 0010

- STN 42 6710 ČSN 42 6710 Cold drawn seamless tubes with standard tolerances.
- STN 42 6711 ČSN 42 6711 Precision seamless steel tubes.
- GOST 4543 Alloy structural steel.
- GOST 20072 Heat resistant steel.
- GOST 8731 Hot formed seamless steel tubes. TDC.
- GOST 8732 Hot formed seamless steel tubes. Dimensions.
- GOST 8733 Seamless cold or hot formed steel tubes.
- GOST 8734 Cold formed seamless steel tubes.
- TU 14-3-190 Seamless steel tubes for boilers and pipelines.
- TU 14-3-460 Seamless steel tubes for steam boilers and pipelines.
- ANSI/ASME B 36.10M Welded and seamless wrought steel pipe. Dimensions.

Seamless steel tubes for pressure equipments for elevated temperature

Standards	Dimensional standards	Dimensional range	Dimensions				Straightness	Tube ends
			Tolerance D	Tolerance T	Lengths			
ASTM ASME	A192 SA-192	Table 5/Page 31	See page 33	See page 33	Depending on tube dimension length upon agreement. Informative - like EN. Tolerance: A 450 α A 1016 Seamless, hot finished: All dimensions 0+3/16 in. (0+5mm) Seamless, cold finished: D under 2 in. (50,8 mm) 0 + 1/8 in. (0+3mm) D 2 in.(50,8 mm) and over 0 + 3/16 in. (0+5mm) Welded: As seamless, cold finished Toler. for L under 24 ft. (7,3 m) L over 24 ft: 0 + 1/8 in. (+3 mm) for each 10 ft (3 m) or 0 + 1/2 in. (0+13 mm) smaller value is valid A 530 α A 999 Seamless and welded (electric resistant) For L under 24ft. (7,3 m) incl. 0 + 1/4 in. (0+6 mm) For larger lengths under agreement (Valid for A 999) Tolerances of random lengths upon agreement.	Visually straight	<ul style="list-style-type: none"> square cut ends free from excessive burrs beveled ends according agreement only 	
	A209 SA-209							
	A210 SA-210							
	A213 SA-213							
	A335 SA-335	Table 2/Page 28 or Table 5/Page 31	Ordering of Pipe or Tube See tolerances table on page 29	See tolerances table on page 29 Nominal T - 12,5 % Minimum T to + only				
	A556 SA-556	Table 5/Page 31 interval 5/8 - 1 1/4 in (15,9 - 31,8 mm)	See table page 33	See table page 33				
JIS	G3456	Table 11/Page 52	D ≤ 50 mm ±0,50 mm D = 50-160 mm ±1 %	T ≤ 4 mm ±0,5 mm T > 4 mm ±12,5 %			<ul style="list-style-type: none"> square cut ends free from excessive burrs beveled ends according agreement only 	
	G3458							
	G3461	Table 10/Page 52	Hot finished Cold finished (Tolerances see standards)		D ≤ 50 mm, L ≤ 7 m 0+7 mm D ≤ 50 mm, L > 7 m +3 mm/m, max 15 mm D > 50 mm, L ≤ 7 m 0+10 mm D > 50 mm, L > 7 m +3 mm/m, max 15 mm			
	G3462							

List of dimensional standards and technical delivery conditions standards

ASTM A106	Seamless carbon steel pipe for high-temperature service.
ASTM A192	Seamless carbon steel boiler tubes for high-pressure service.
ASTM A209	Seamless carbon-molybdenum alloy-steel boiler and superheater tubes.
ASTM A210	Seamless medium-carbon steel boiler and superheater tubes.
ASTM A213	Seamless ferritic and austenitic alloy-steel boiler, superheater and heat-exchanger tubes.
ASTM 335	Seamless ferritic alloy-steel pipe for high-temperature service.
ASTM A450	General requirements for carbon, ferritic alloy and austenitic alloy steel tubes.
ASTM A530	General requirements for specialized carbon and alloy steel pipe.
ASTM A556	Seamless cold drawn carbon steel feedwater heater tubes.
ASTM A692	Seamless medium-strength carbon-molybdenum alloy steel boiler and superheater tubes.
ASTM A999	General requirements for alloy and stainless steel pipe.
ASTM A1016	General requirements for ferritic alloy steel, austenitic alloy steel and stainless steel tubes.

TDC standards	Steel grade			Testing and certificates		Other TDC		
	Name	Condition	Surface	Testing	Certificate	Marking	Surface protection	Packing
A192 (A450) SA-192 (SA-450)	A192	Hot finished • as rolled Cold finished • normalized	Adequate to production mode of tubes and heat treatment. Visually without defects, to remove defects surface can be worked according to appropriate standard articles.	<ul style="list-style-type: none"> product analysis hardness flattening drift expanding hydrostatic or NDT 	A450	A450, A700, A1016 Under OD 1 1/4 in (31,8 mm) data on the label Data: • manufacturer • standard • steel grade	A450 + A700	A450 + A700
A209 (A1016) SA-209 (SA-1016)	Grade T1 Grade T1a Grade T1b	Hot finished • normalized Cold finished • normalized • normalized + tempered			Specific working upon agreement.		A1016	A450 + A700	A450 + A700
A210 (A450) SA-210 (SA-450)	Grade A-1 Grade C	Hot finished • as rolled Cold finished • normalized		<ul style="list-style-type: none"> product analysis hardness flattening tensile test drift expanding hydrostatic or NDT 	A450		A450 + A700	A450 + A700
A213 (A1016) SA-213 (SA-1016)	T2 T11 T12 T21 T22 T24	Hot finished • normalized + tempered Cold finished • normalized + tempered		<ul style="list-style-type: none"> product analysis tensile test hardness flattening drift expanding hydrostatic or NDT - E 213, E 309 	A1016			
A335 (A999) SA-335 (SA-999)	P1 P2 P11 P12 P21 P22 P24	Hot finished • normalized + tempered Cold finished • normalized + tempered		<ul style="list-style-type: none"> product analysis tensile test hardness dimensions hydrostatic and NDT - E 213, E 309, EN 570 impact test 	A999	Under OD 2 in (60,3 mm) data on the label Data: • manufacturer • standard • steel grade		
A556 (A450) SA-556 (SA-450)	Grade A2 Grade B2 Grade C2	Cold finished • normalized		<ul style="list-style-type: none"> product analysis tensile test hardness dimensions flattening drift expanding NDT 	A450	Under OD 1 1/4 in (31,8 mm) data on the label Data: • manufacturer • standard • steel grade		
G3456	STPT 370 STPT 410 STPT 480	Hot finished • as rolled Cold finished • normalized		<ul style="list-style-type: none"> product analysis tensile test flattening impact test hydrostatic or NDT according to JIS G0582 or JIS G0583 		Small diameters - label Data: • steel grade • method of manufact. (-SH), (-SC) • ND x NWT / OD x WT • manufacturer • supplem. requirements Z		
G3458	STPA 12 STPA 20 STPA 22 STPA 23 STPA 24	Hot finished • normalized + tempered Cold finished • normalized + tempered						
G3461	STB 340 STB 410 STB 510	Hot finished • as rolled (340,410) • normalized (510)		<ul style="list-style-type: none"> product analysis tensile test flattening drift expanding hydrostatic or NDT according to JIS G0582 or JIS G0583 	JIS G0303	Small diameters - label Data: • class (steel) • method of manufact. (-SH), (-SC) • dimensions • manufacturer • supplem. requirements Z		
G3462	STBA 12 STBA 13 STBA 20 STBA 22 STBA 23 STBA 24	Cold finished • normalized Hot finished • normalized + tempered Cold finished • normalized + tempered						

Tube and pipe from steels T5 (A213) and P5 (A335) according agreement.

- JIS G 3456 Carbon steel pipes for high temperature service.
- JIS G 3458 Alloyed steel pipes.
- JIS G 3461 Carbon steel boiler and heat exchanger tubes.
- JIS G 3462 Alloy steel boiler and heat exchanger tubes.
- PN-H 74 252 Seamless boiler steel tubes

Note:

Alloy steel tube and pipe according to standard ASTM (ASME) - it is recommended to test the tube with combination of two NDT methods - usually according to ASTM E309 and ASTM E213.

* The boiler tubes belong into pressure tube group. Except the standards for own tube the requirements of superior regulations for pressure vessels are valid. The manufacturer have to own the respective certificates.

Reference standards:

ASTM E213 (ultrasonic) - the depth of the notches shall not exceed 12 1/2 % of WT. (According to agreement 10% or 5%)

ASTM E309 (eddy current) - max. diameter of drilled hole:
for tube: 0,031 in (0,8 mm)
for pipe: see Table in Standards A999

ASTM E570 (flux leakage) - values as in Standard ASTM 213

Steel grade of boiler tubes

Standards	Steel grade	Chemical composition [%]										Mechanical properties				
		C	Si	Mn	P _{max}	S _{max}	Cr	Ni	Mo	Cu	Ostatné	Re min | min MPa | ksi	Rm min | max | min MPa | MPa | ksi	A5 min %		
STN, ČSN																
	11 368	max.0,15	max.0,35	min.0,40	0,040	0,040	max.0,30	max.0,30		max.0,30		245	350	440	26	
	11 418	max.0,20	max.0,35	max.0,50	0,040	0,040	max.0,30	max.0,30		max.0,30		255	400	490	24	
	12 021	0,07-0,15	0,17-0,35	0,35-0,60	0,040	0,040	max.0,25	max.0,25		max.0,25		235	340	470	25	
	12 022	0,15-0,22	0,17-0,37	0,50-0,80	0,040	0,040	max.0,25	max.0,25		max.0,25		255	410	570	21	
	12 025	0,14-0,20	0,17-0,37	0,60-1,00	0,040	0,040	max.0,25	max.0,25		max.0,25	V 0,05-0,09	320	440	600	23	
	15 020	0,12-0,20	0,15-0,37	0,50-0,80	0,040	0,040			0,25-0,35	Al min.0,015	270	450	600	22		
	15 121	0,10-0,18	0,15-0,35	0,40-0,70	0,040	0,040	0,70-1,30		0,40-0,60		295	440	590	22		
	15 128	0,10-0,18	0,15-0,40	0,45-0,70	0,040	0,040	0,50-0,75		0,40-0,60	V 0,22-0,35	365	490	690	18		
	15 313	0,08-0,15	0,15-0,40	0,40-0,80	0,035	0,035	2,00-2,50		0,90-1,10		265	480	630	20		
BS																
3059/1	320	max.0,16	0,10-0,35	0,30-0,70	0,040	0,040						195	320	480	25	
3059/2	360	max.0,17	0,10-0,35	0,40-0,80	0,035	0,035						235	360	500	24	
	440	0,12-0,18	0,10-0,35	0,90-1,20	0,035	0,035						245	440	580	21	
	243	0,12-0,20	0,10-0,35	0,40-0,80	0,035	0,035			0,25-0,35	Al max.0,012	275	480	630	22		
	620-460	0,10-0,15	0,10-0,35	0,40-0,70	0,035	0,035	0,70-1,10		0,45-0,65	Al max.0,020	180	460	610	22		
ASTM																
A 106	GradeA	0,25	min.0,10	0,27-0,93	0,035	0,035						205	30	330	48	35
A 556	GradeB	0,30	min.0,10	0,29-1,06	0,035	0,035						240	35	415	60	30
(Grade A2)	GradeC	0,35	min.0,10	0,29-1,06	0,035	0,035						275	40	485	70	30
A 192		0,06-0,18	max. 0,25	0,27-0,63	0,035	0,035					137HB/77HRB	180	26	325	47	35
A 209	Grade T1	0,10-0,20	0,10-0,50	0,30-0,80	0,025	0,025			0,44-0,65			205	30	380	55	30
	Grade T1a	0,15-0,25	0,10-0,50	0,30-0,80	0,025	0,025			0,44-0,65			195	28	365	53	30
	Grade T1b	max.0,14	0,10-0,50	0,30-0,80	0,025	0,025			0,44-0,65			220	32	415	60	30
A 210	Grade A-1	max.0,27	min. 0,10	max. 0,93	0,035	0,035						255	37	415	60	30
	Grade C	max.0,35	min. 0,10	0,29-1,06	0,035	0,035						275	40	485	70	30
A 213	Grade T11	0,05-0,15	0,50-1,00	0,30-0,60	0,025	0,025	1,00-1,50	max. 0,40	0,44-0,65			205	30	415	60	30
A 335	Grade T12	0,05-0,15	max. 0,50	0,30-0,61	0,025	0,025	0,80-1,25		0,44-0,65			220	32	415	60	30
(Grade P)	Grade T22	0,05-0,15	max.0,50	0,30-0,60	0,025	0,025	1,90-2,60		0,87-1,13			205	30	415	60	30
	Grade T24	0,05-0,10	0,15-0,45	0,30-0,70	0,020	0,010	2,20-2,60		0,90-1,10	V, Ti, B	415	60	585	85	20	
	Grade T2	0,10 - 0,20	0,10 - 0,30	0,30-0,61	0,025	0,025	0,50-0,81		0,44-0,65			205	30	380	55	30
	Grade T21	0,05 - 0,15	max. 0,50	0,30-0,60	0,025	0,025	2,65-3,35		0,80-1,06			205	30	415	60	30
	Grade T5	max.0,15	max. 0,50	0,30-0,60	0,025	0,025	4,00-6,00		0,45-0,65			205	30	415	60	30
	Grade T91	0,08-0,12	0,20-0,50	0,30-0,60	0,020	0,010	8,00-9,50		0,85-1,05	V, Nb	415	60	585	85	20	
DIN																
17175	St 35.8	max.0,17	0,10-0,35	0,40-0,80	0,040	0,040						235	360	480	25	
	St 45.8	max.0,21	0,10-0,35	0,40-1,20	0,040	0,040						255	410	530	21	
	17Mn4	0,14-0,20	0,20-0,40	0,90-1,20	0,040	0,040	max.0,30					270	460	580	23	
	19Mn5	0,17-0,22	0,30-0,60	1,00-1,30	0,040	0,040	max.0,30					310	510	610	19	
	15Mo3	0,12-0,20	0,10-0,35	0,40-0,80	0,035	0,035			0,25-0,35			270	450	600	22	
	13CrMo44	0,10-0,18	0,10-0,35	0,40-0,70	0,035	0,035	0,70-1,10		0,45-0,65			290	440	590	22	
	10CrMo9 10	0,08-0,15	max. 0,50	0,40-0,70	0,035	0,035	2,00-2,50		0,90-1,20			280	450	600	20	
	14MoV 6.3	0,10-0,18	0,10-0,35	0,40-0,70	0,035	0,035	0,30-0,60		0,50-0,70	V 0,22-0,32	320	460	610	20		
UNI																
5462	C14	max.0,17	0,10-0,35	max.0,40	0,035	0,035						240	350	450	28	
	C18	max.0,21	0,10-0,35	max.0,50	0,035	0,035						260	450	550	23	
	16Mo5	0,12-0,20	0,15-0,35	0,50-0,80	0,035	0,035			0,45-0,65			290	450	550	22	

Informative comparison of steel grade for boiler tubes

Standard	450 - 475 - 500 (by test category)				500 - 530		550 - 560		Maximal
EN 10216-2	P235GH	P265GH	(P295GH)	(P310GH)	16Mo3				13CrMo4-5
(W.Nr.)	1.0345	1.0425			1.5415				1.7335
DIN 17175	St 35.8	St 45.8	17Mn4	19Mn5	15Mo3				13CrMo4 4
(W.Nr.)	1.0305	1.0405	1.0481	1.0482	1.5415				1.7335
DIN 17176									13CrMo4 4
(W.Nr.)							16Mo5		1.7335
BS 3059-1	320								
BS 3059-2	360	440			243				620 - 460
BS 3602-1	360	430							
BS 3604					500Nb				620 - 440
NFA 49-211	TUE220B	TUE250B	TUE275B						
NFA 49-213	TU37C	TU42C	TU48C	TU52C	TU15D3			TU15CD2-05	TU13CD4-04
UNI 5462	C14	C18					16Mo5		14CrMo3
STN 42 0251	12 021	12 022			15 020				15 121
GOST 1050	10	20							
GOST 4543									15ChM
GOST 20072									
PN-H 84024	K10	K18					16M		15HM
ASTM A106	Grade A	Grade B	Grade C						
ASTM A192	A192								
ASTM A209								T1 T1a T1b	
ASTM A210		Grade A-1	Grade C						
ASTM A213								T2	T12
ASTM A335								P1	P2
									P12
ASTM A556	Grade A2	Grade B2	Grade C2						
ASTM A692							A692		
JIS G 3456	STPT370	STPT410	STPT480						
JIS G 3458						STPA12		STPA20	STPA22
JIS G 3461	STB340	STB410	STB510						
JIS G 3462						STBA12	STBA13	STBA20	STBA22

Standards	Steel grade	Chemical composition [%]										Mechanical properties					
		C	Si	Mn	P _{max}	S _{max}	Cr	Ni	Mo	Cu	Other	Re min MPa	Re min ksi	Rm min MPa	Rm max MPa	A5 min %	
NFA																	
49-211	TU E220	max.0,17	max.0,35	max.0,85	0,030	0,030							220	370	490	26	
	TU E250	max.0,23	max.0,40	max.1,05	0,030	0,030							250	410	530	23	
	TU E275	max.0,25	max.0,45	max.1,40	0,030	0,030							275	470	590	20	
49-213	TU 37C	max.0,18	0,05-0,35	0,30-0,80	0,040	0,040						max.0,25	Sn max.0,03	220	360	460	
	TU 42C	max.0,22	0,07-0,40	0,40-1,05	0,040	0,040						max.0,25	Sn max.0,03	235	410	510	
	TU 48C	max.0,24	0,09-0,40	0,60-1,30	0,040	0,040						max.0,25	Sn max.0,03	275	470	570	
	TU 52C	max.0,22	0,13-0,55	0,95-1,60	0,040	0,040						max.0,25	Sn max.0,03	350	510	630	
	TU 15D3	0,10-0,22	0,10-0,40	0,40-0,90	0,040	0,040	max.0,40	max.0,30	0,21-0,39			max.0,25	Sn max.0,03	265	430	550	22
	TU 13CD4-04	0,08-0,20	0,05-0,40	0,30-0,80	0,035	0,035	0,65-1,15	max.0,30	0,41-0,69			max.0,25	Sn max.0,03	290	440	590	22
	TU 15CD2-05	0,08-0,20	0,05-0,40	0,40-1,00	0,035	0,035	0,30-0,75	max.0,30	0,41-0,64			max.0,25	Sn max.0,03	275	440	570	22
EN																	
10216-2	P 195 GH	max.0,13	max.0,35	max.0,70	0,025	0,020	max.0,30	max.0,30	max.0,08	max.0,30		V max.0,02 Ti max.0,04 Al min.0,020	195	320	440	27	
	P 235 GH	max.0,16	max.0,35	max.1,20	0,025	0,020	max.0,30	max.0,30	max.0,08	max.0,30		V max.0,02 Ti max.0,04 Al min.0,020	235	360	500	25	
	P 265 GH	max.0,20	max.0,40	max.1,40	0,025	0,020	max.0,30	max.0,30	max.0,08	max.0,30		V max.0,02 Ti max.0,04 Al min.0,020	265	410	570	21	
	14MoV 6-3	0,10-0,18	0,10-0,35	0,40-0,70	0,025	0,020	0,30-0,60		0,50-0,70			V 0,22-0,32	320	460	610	20	
	16Mo3	0,12-0,20	0,15-0,35	0,40-0,90	0,025	0,020			0,25-0,35			Al max.0,040	280	450	600	22	
13CrMo4-5	0,10-0,17	0,15-0,35	0,40-0,70	0,025	0,020	0,70-1,15		0,40-0,60			Al max.0,040	290	440	590	22		
GOST																	
1050	10	0,07-0,14	0,17-0,37	0,35-0,65			max.0,15						205	330		31	
	20	0,17-0,24	0,17-0,37	0,35-0,65			max.0,25						245	410		25	
	35	0,32-0,40	0,17-0,37	0,50-0,80			max.0,25						315	530		20	
	45	0,42-0,50	0,17-0,37	0,50-0,80			max.0,25						355	600		16	
4543	10G2	0,07-0,15	0,17-0,37	1,20-1,60									245	420		22	
	15ChM	0,11-0,18	0,17-0,37	0,40-0,70			0,80-1,10		0,40-0,65				275	440		21	
20072	12Ch1MF	0,10-0,15	0,17-0,37	0,40-0,70	0,030	0,025	0,90-1,20	max.0,30	0,25-0,35		V 0,15-0,30	235	410		21		
JIS																	
G3456	STPT 370	max.0,25	0,10-0,35	0,30-0,90	0,035	0,035							215	370		30	
	STPT 410	max.0,30	0,10-0,35	0,30-1,00	0,035	0,035							245	410		25	
	STPT 480	max.0,33	0,10-0,35	0,30-1,00	0,035	0,035							275	480		25	
G3458	STPA 12	0,10-0,20	0,10-0,50	0,30-0,80	0,035	0,035			0,45-0,65				205	380		30	
	STPA 22	max.0,15	max.0,50	0,30-0,60	0,035	0,035	0,80-1,25		0,45-0,65				205	410		30	
G3461	STB 340	max.0,18	max.0,35	0,30-0,60	0,035	0,035							175	340		35	
	STB 410	max.0,32	max.0,35	0,30-0,80	0,035	0,035							255	410		25	
	STB 510	max.0,25	max.0,35	1,00-1,50	0,035	0,035							295	510		25	
G3462	STBA 12	0,10-0,20	0,10-0,50	0,30-0,80	0,035	0,035			0,45-0,65				205	380		30	
	STBA 22	max.0,15	max.0,50	0,30-0,60	0,035	0,035	0,80-1,25		0,45-0,65				205	410		30	
PN-H																	
84024	K10	max.0,17	0,10-0,35	min.0,40	0,045	0,045	max.0,20	max.0,35			max.0,25		235	340	440	25	
	K18	0,16-0,22	0,10-0,35	min.0,60	0,045	0,045	max.0,20	max.0,35			max.0,25		255	440	540	21	
	16M	0,12-0,20	0,15-0,35	0,50-0,80	0,040	0,040	max.0,30	max.0,35	0,25-0,35		max.0,25	Al max.0,020	285	440	540	22	
	15HM	0,11-0,18	0,15-0,35	0,40-0,70	0,040	0,040	0,70-1,10	max.0,35	0,40-0,55		max.0,25	Al max.0,020	295	440	570	22	

temperature [°C]							
575 - 580	600	625	650	675			
14MoV6-3 1.7715	10CrMo5-5 1.7338	10CrMo9-10 1.7380	X11CrMo5+1 1.7362	X11CrMo9-1+1 1.7386	X20CrMoV11-1 1.4922	X10CrMoVNb9-1 1.4903	
14MoV6 3 1.7715		10CrMo9 10 1.7380			X20CrMoV12-1 1.4922	X10CrMoVNb9-1 1.4903	
			12CrMo19-5 1.7362	X12CrMo9-1 1.7386			
		622 - 490		629 - 470	762		
660	621	622	625	629 - 470	762		
	TU10CD5-05	TU10CD9-10 12CrMo9-10	TUZ12CD05-05	TUZ10CD9		TUZ10CDVNb09-01	
15 128		15 313					
(12Ch1MF) (12HMF)							
	T11	T22	T5 T5B T5C	T9		T91	T92
	P11	P22	P5 P5B P5C	P9		P91	P92
	STPA23	STPA24	STPA25	STPA26		STPA28	
	STBA23	STBA24	STBA25	STBA26		STBA28	

Alloy fine grain steel tubes for pressure equipments

Standards	Dimensional standards	Dimensional range	Dimensions				
			Tolerance D	Tolerance T	Lengths	Straightness	Tube ends
EN	10216-3	Table 1/Page 26	Hot finished: D ≤ 219,1 mm ±1 % min ±0,5 mm	D ≤ 219,1 mm ±12,5 % min ±0,4 mm	Kinds: • random • exact Informative values: • D < 60,3 mm 5-6 m • D ≥ 60,3 mm / T < 7,1 mm 5-6 m or 10-14 m • D ≥ 60,3 mm / T ≥ 7,1 mm 5-6 m • longer upon agreement Exact length tolerances: • L < 6 m 0+10 mm • L = 6-12 m 0+15 mm • L > 12 m + upon agreement - 0	Permissible 0,0015.L for tube conversion to 1 m max. 3 mm	• square cut ends • free from excessive burrs • option: with beveled ends (see page 98)
	10305-1 (upon agreement)	Table 16/Page 64	Cold finished: ±0,5 % min ±0,3 mm Delivery by d _{min} a T _{min} upon agreement (page 34)	±10 % min ±0,2 mm			
DIN	2448	Table 1/Page 26	D ≤ 100 mm ±1 % min ±0,5 mm D = 100-200 mm ±1 %	D < 130 mm • T ≤ 2T _n -10 % +15 % • 2T _n < T < 4T _n -10 % +12,5 % • T > 4T _n ±9 % D > 130 mm See page 22 T _n - basic wall thickness according to DIN 2448	Kinds: • random • fixed ±500 mm • exact Informative values: • D < 60,3 mm 5-6 m • D ≥ 60,3 mm / T < 7,1 mm 5-6 m or 10-14 m • D ≥ 60,3 mm / T ≥ 7,1 mm 5-6 m • longer upon agreement Exact length tolerances: • L ≤ 6 m 0+10 mm • L ≥ 3 m +1,5 mm/m max 15 mm	• visually straight • upon agreement	• square cut ends • free from excessive burrs • option: with beveled ends (T ≥ 3,2 mm)
	2391-1 (upon agreement)	Table 16/Page 64	Cold finished-precision See page 60 a 64				

List of dimensional standards and technical delivery conditions standards

DIN 2391-1	Seamless precision steel tubes. Part 1: Dimensions.
DIN 2448	Plain end seamless steel tubes. Dimensions.
DIN 17179	Seamless circular tubes of fine grain steel for special requirements. TDC.
EN 10 216-3	Seamless steel tubes for pressure purposes. TDC. Part 3: Non-alloy and alloy fine grain steel tubes.

Steel types

Comparison of steel according to DIN and EN standards: Fine grain steel are delivered in 4 series (steel grades):

Series	DIN 17179		EN 10216 - 3	
	Identification	Grade	Identification	Grade
Basic	StE	255, 285, 355, 420, 460	P-N	355, 460
High temperature	WStE	255, 285, 355, 420, 460	P-NH	355, 460
Low temperature	TStE	255, 285, 355, 420, 460	P-NL1	275, 355, 460
Low temperature special	EStE	255, 285, 355, 420, 460	P-NL2	275, 355, 460

Note: Steel grade condition Q are not given in comparison.

Designation of steel according to EN:

- P – steel for pressure equipments
- 355 – minimum yield strength in N/mm²
- N – normalized or normalising formed
- NH – high temperature steel
- NL1 – low temperature steel
- NL2 – special low temperature steel

Note: Fine grain steel – ferritic grain size 6 or finer according to ASTM E112.

Tests on page 43:

TC1 or TC2 upon specification in order. Steels P620 and P690 with TC2 only.

TDC standards	Steel grade			Testing and certificates		Other TDC		
	Name	Condition	Surface	Testing	Certificate	Marking	Surface protection	Packing
10216-3	P355N P460N P355NH P460NH P275NL1 P355NL1 P460NL1 P275NL2 P355NL2 P460NL2	Hot finished • at P355N and P355NH normalising formed is enough • other steels normalized designation +N Cold finished • normalized designation +N	• visually free from surface defects • adequate to production mode	Category 1 and 2 (TC1 and TC2) see page 42: • cast analysis • tensile test • flattening • drift expanding or • ring expanding • impact test • leak tightness (page 11) • dimensions • visual • NDT • material identification • optional tests upon agreement	10204: • 3.1 • 3.2 See also page 10	Indelibly marking D < 51 mm on label D > 51 mm at end Data • producer • standard • steel grade • TC (C - in steel) • cast (code) • inspector's mark • identification number Optionally: • additional marking upon agreement	• without protection • upon agreement	
17179	See table on the page 42	Hot finished • normalising formed • normalized Cold finished • normalized		• cast analysis • tensile test • impact test • drift expanding • NDT-upon agreement • leak tightness • visual • dimensions • other upon agreement	50049 3.1.A 3.1.B 3.1.C	Usually die stamping Small diameter - label Data: • manufacturer • steel • symbol S • inspector's mark • cast • number of tube (D over 159mm) • symbol for NDT		

Steel grade of fine grain steel

Standards	Steel grade	Chemical composition [%]										Mechanical properties				
		C	Si	Mn	P _{max}	S _{max}	Cr	Ni	Mo	Cu	Other	Re min MPa	min ksi	Rm min MPa	min ksi	A5 min %
DIN																
17179	StE 255	max.0,18	max.0,40	0,50 - 1,30	0,035	0,030	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020	255		360	480	25
	WSiE 255	max.0,18	max.0,40	0,50 - 1,30	0,035	0,030	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020	255		360	480	25
	TSiE 255	max.0,16	max.0,40	0,50 - 1,30	0,030	0,025	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020	255		360	480	25
	ESiE 255	max.0,16	max.0,40	0,50 - 1,30	0,025	0,015	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020	255		360	480	25
	StE 285	max.0,18	max.0,40	0,60 - 1,40	0,035	0,030	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020	285		390	510	24
	WSiE 285	max.0,18	max.0,40	0,60 - 1,40	0,035	0,030	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020	285		390	510	24
	TSiE 285	max.0,16	max.0,40	0,60 - 1,40	0,030	0,025	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020	285		390	510	24
	ESiE 285	max.0,16	max.0,40	0,60 - 1,40	0,025	0,015	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020	285		390	510	24
	StE 355	max.0,20	0,10 - 0,50	0,90 - 1,65	0,035	0,030	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020	355		490	630	22
	WSiE 355	max.0,20	0,10 - 0,50	0,90 - 1,65	0,035	0,030	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020	355		490	630	22
TSiE 355	max.0,18	0,10 - 0,50	0,90 - 1,65	0,030	0,025	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020	355		490	630	22	
ESiE 355	max.0,18	0,10 - 0,50	0,90 - 1,65	0,025	0,015	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020	355		490	630	22	
EN																
10216-3	P275NL1	max.0,16	max.0,40	0,50 - 1,50	0,025	0,020	max.0,30	max.0,50	max.0,08	max.0,30	V max.0,05 Ti max.0,04 Al min.0,020	275		390	530	24
	P275NL2	max.0,16	max.0,40	0,50 - 1,50	0,025	0,015	max.0,30	max.0,50	max.0,08	max.0,30	Ti max.0,04 V max.0,05 Al min.0,020	275		390	530	24
	P355N	max.0,20	max.0,50	0,90 - 1,70	0,025	0,020	max.0,30	max.0,50	max.0,08	max.0,30	V max.0,10 Ti max.0,04 Al min.0,020	355		490	650	22
	P355NH	max.0,20	max.0,50	0,90 - 1,70	0,025	0,020	max.0,30	max.0,50	max.0,08	max.0,30	V max.0,10 Ti max.0,04 Al min.0,020	355		490	650	22
	P355NL1	max.0,18	max.0,50	0,90 - 1,70	0,025	0,020	max.0,30	max.0,50	max.0,08	max.0,30	V max.0,10 Ti max.0,04 Al min.0,020	355		490	650	22
	P355NL2	max.0,18	max.0,50	0,90 - 1,70	0,025	0,015	max.0,30	max.0,50	max.0,08	max.0,30	V max.0,10 Ti max.0,04 Al min.0,020	355		490	650	22
	P460N	max.0,20	max.0,60	1,00 - 1,70	0,025	0,020	max.0,30	max.0,80	max.0,10	max.0,70	V max.0,20 Ti max.0,04 Al min.0,020	460		560	730	19
	P460NH	max.0,20	max.0,60	1,00 - 1,70	0,025	0,020	max.0,30	max.0,80	max.0,10	max.0,70	V max.0,20 Ti max.0,04 Al min.0,020	460		560	730	19
	P460NL1	max.0,20	max.0,60	1,00 - 1,70	0,025	0,020	max.0,30	max.0,80	max.0,10	max.0,70	V max.0,20 Ti max.0,04 Al min.0,020	460		560	730	19
	P460NL2	max.0,20	max.0,60	1,00 - 1,70	0,025	0,015	max.0,30	max.0,80	max.0,10	max.0,70	V max.0,20 Ti max.0,04 Al min.0,020	460		560	730	19

Seamless steel tubes for pressure equipments for low temperature

Standards	Dimensional standards	Dimensional range	Dimensions					
			Tolerance D	Tolerance T	Lengths	Straightness	Tube ends	
EN	10216-4 10305-1 (upon agreement)	Table 1/Page 26 Table 16/Page 64	Hot finished: $D \leq 219,1 \text{ mm} \pm 1 \%$ min $\pm 0,5 \text{ mm}$ Cold finished: $\pm 0,5 \%$ min $\pm 0,3 \text{ mm}$	$D \leq 219,1 \text{ mm} \pm 12,5 \%$ min $\pm 0,4 \text{ mm}$ $\pm 10 \%$ min $\pm 0,2 \text{ mm}$	$D \leq 219,1 \text{ mm} \pm 12,5 \%$ min $\pm 0,4 \text{ mm}$ $\pm 10 \%$ min $\pm 0,2 \text{ mm}$	Kinds: • random • exact Informative values: • $D < 60,3 \text{ mm}$ 5-6 m • $D \geq 60,3 \text{ mm} / T < 7,1 \text{ mm}$ 5-6 m or 10-14 m • $D \geq 60,3 \text{ mm} / T \geq 7,1 \text{ mm}$ 5-6 m • longer upon agreement Exact length tolerances: • $L < 6 \text{ m}$ 0+10 mm • $L = 6-12 \text{ m}$ 0+15 mm • $L > 12 \text{ m}$ + upon agreement - 0	Permissible 0,0015.L for tube conversion to 1 m max. 3 mm	• square cut ends • free from excessive burrs • option: with beveled ends (see page 98)
DIN	2448 2391-1 upon agreement	Table 1/Page 26 Table 16/Page 64	$D \leq 100 \text{ mm} \pm 1 \%$ min $\pm 0,5 \text{ mm}$ $D = 100-200 \text{ mm} \pm 1 \%$	$D < 130 \text{ mm}$ • $T \leq 2T_n - 10 \% + 15 \%$ • $2T_n < T < 4T_n - 10 \% + 12,5 \%$ • $T > 4T_n \pm 9 \%$ T_n - basic wall thickness according to DIN 2448	$D < 130 \text{ mm}$ • $T \leq 2T_n - 10 \% + 15 \%$ • $2T_n < T < 4T_n - 10 \% + 12,5 \%$ • $T > 4T_n \pm 9 \%$ T_n - basic wall thickness according to DIN 2448	Kinds: • random • fixed $\pm 500 \text{ mm}$ • exact Informative values: • $D < 60,3 \text{ mm}$ 5-6 m • $D \geq 60,3 \text{ mm} / T < 7,1 \text{ mm}$ 5-6 m or 10-14 m • $D \geq 60,3 \text{ mm} / T \geq 7,1 \text{ mm}$ 5-6 m • longer upon agreement Precise length tolerances: like EN	• visually straight • upon agreement	
BS	3600	Table 1/Page 26	Hot finished: $\pm 1 \%$ min $\pm 0,5 \text{ mm}$ Cold finished: $\pm 0,75 \%$ min $\pm 0,5 \text{ mm}$	$\leq 3 \% D \pm 15 \%$ $3-10 \% D \pm 12,5 \%$	$\leq 3 \% D \pm 15 \%$ $3-10 \% D \pm 12,5 \%$	• random • exact with tolerances: $L \leq 6 \text{ m}$ 0+6 mm $L > 6 \text{ m}$ 1,5 mm/m, max 12 mm		
NFA	49-215		$D \leq 20 \text{ mm} \pm 0,10 \text{ mm}$ $D = 20-38 \text{ mm} \pm 0,15 \text{ mm}$ $D = 38-50 \text{ mm} \pm 0,25 \text{ mm}$ $D > 50 \text{ mm} \pm 0,30 \text{ mm}$	$\pm 9 \% \text{ min}$ $\pm 0,20 \text{ mm}$ upon agreement 0+18%	$\pm 9 \% \text{ min}$ $\pm 0,20 \text{ mm}$ upon agreement 0+18%	Exact with tolerances: $L \leq 6 \text{ m}$ 0+3 mm $L = 6-9 \text{ m}$ 0+4,5 mm $L = 9-12 \text{ m}$ 0+6 mm $L = 12-15 \text{ m}$ 0+7,5 mm $L = 15-18 \text{ m}$ 0+9 mm	• locally 3 mm/m • total: $L < 4 \text{ m}$ 2 mm/m $L = 4-6 \text{ m}$ 8 mm/m $L > 6 \text{ m}$ 8 mm +1 mm/m	• square cut ends • free from excessive burrs

List of dimensional standards and technical delivery conditions standards

- EN 10 216 - 4 Seamless steel tubes for pressure purposes. TDC. Part 4: Non-alloy and alloy steel tubes with specified low temperature properties.
- DIN 2391-1 Seamless precision steel tubes. Part 1: Dimensions.
- DIN 2448 Plain end seamless steel tubes. Dimensions.
- DIN 17173 Seamless circular steel tubes for low temperatures. TDC.
- DIN 28180 Seamless steel tubes for tubular heat exchangers. Dimensions, tolerances, materials.
- BS 3600 Dimension and masses per unit length of welded and seamless steel pipes and tubes for pressure purposes.
- BS 3603 Carbon and alloy steel pipes and tubes with specified low temperature properties for pressure purposes.
- NFA 49-215 Seamless tubes for ferritic non alloy and alloy steel heat exchangers. Dimensions. TDC.

TDC standards	Steel grade			Testing and certificates		Other TDC		
	Name	Condition	Surface	Testing	Certificate	Marking	Surface protection	Packing
10216-4	P215NL P265NL 12Ni14	+ N + N +NT Conditions valid for both methods: Hot finished Cold finished	• visually free from surface defects • adequate to production mode	Category TC1 and TC2 • cast analysis • tensile test • flattening • drift expanding or • ring expanding • impact test (by dimension) • leak tightness (page 11) • dimensions • visual • NDT-to TC2 (page 11) • material identification • optional tests upon agreement See note	10204: • 3.1 • 3.2 See also page 10	Indelibly marking D < 51 mm on label D > 51 mm at end Data • producer • standard • steel grade • TC (C - in steel) • cast (code) • inspector's mark • identification number Optionally: • additional marking upon agreement	• without protection • upon agreement	
17173	TTS135N 10Ni14	N V(N) N - normalized V - quenched and tempered Conditions valid for both methods: Hot finished Cold finished		Tests like EN	50049 3.1.A 3.1.B 3.1.C			
3603	430LT 503LT (HFS, CFS)	Hot finished • normalising formed HF • normalized N Cold finished • normalized N Hot finished Cold finished • normalized N • normalized and temp. N+T		• cast analysis • visual • tensile test • flattening • impact test • Cat.1 - ultrasonic • Cat.2 - leak tightness • hydraulic test • eddy current	• test certification • test results			
49-215	TU42BT TU10N9 TU10N14	Cold finished • normalized N Cold finished • normalized N • normalized and temp. N+T		• product analysis • tensile test • flattening • drift expanding • visual • dimensions • NDT • leak tightness	49-001 Typ A Typ B Typ C			

Designation of steel for low temperature according to EN:

- P - steel for pressure equipments
- 215 - minimum yield strength in N/mm²
- N - normalized or normalising formed
- L - low temperature steel
- Alloy steel - see page 9

Test category:

- Non alloy steels - TC1 or TC2 upon agreement in order
- Alloy steels - TC2 only

Seamless steel tubes for pressure equipments for low temperature

Standards	Dimensional standards	Dimensional range	Dimensions				
			Tolerance D	Tolerance T	Lengths	Straightness	Tube ends
UNI	4991	Table 1/Page 26	Hot finished: D ≤ 51 mm ±0,5 mm D > 51 mm ±1 % Cold finished: D ≤ 25 mm ±0,25 mm D = 25-51 mm ±0,35 mm D > 51 mm ±0,75 % Weight -8 % +10 %	D ≤ 323,9 mm ±12,5 % (-17,5 %) Cold finished: Di ≤ 7 mm ±12 % (-14 %) min ±0,10 mm Di > 7 mm ±10 % (-12 %)	• random • exact with tolerances: L ≤ 6 m 0 +10 mm L > 6 m 0 +15 mm	Straightened - 3 mm/m Flat straightened -1,5mm/m	• square cut ends • free from excessive burrs • option: with beveled ends (see page 98)
STN ČSN	42 5715 42 5716 42 6710 42 6711	Table 6/Page 32	42 5715 D ≤ 219 mm ±1,25 % min ±0,5 mm 42 5716 D ≤ 219 mm ±1 % min ±0,5 mm 42 6710 ±1 % min ±0,4 mm 42 6711 see precision tubes	D ≤ 219 mm, T ≤ 20 mm -15 % +12,5 % ±12,5 % T ≤ 3 mm -10 % +15 % T > 3 mm -10 % +12 %	Exact length tolerances: 0 +15 mm Multiple: +5 mm on cut, max. +50 mm		
ANSI ASME	B 36.10	Table 2/Page 28	See page 29		See page 38	Reasonably straight	• square cut ends • free from excessive burrs
ASTM ASME	A334 SA-334	Table 5/Page 31	See page 33			See page 38	
ANSI	B 36.10	Table 2/Page 28	See page 29			See page 36	

List of dimensional standards and technical delivery conditions standards

UNI 4991	Seamless and welded steel tubes with plain ends. Dimensions.
UNI 5949	Special unalloyed and alloyed steel seamless tubes with low temperature impact test.
STN 42 0165	ČSN 42 0165 Sheets and pipes of ferritic – perlitic steel with guaranteed impact properties at low temperatures. TDC.
STN 42 5715	ČSN 42 5715 Hot formed seamless steel tubes. Dimensions.
STN 425716	ČSN 42 5716 Hot formed seamless steel tubes with smaller tolerances. Dimensions.
STN 42 6710	ČSN 42 6710 Cold drawn seamless tubes with normal tolerances from steel class 11 – 16. Dimensions.
STN 42 6711	ČSN 42 6711 Precision seamless steel tubes. Dimensions.
ANSI/ASME B 36.10	Welded and seamless wrought steel pipe. Dimensions.
ASTM A333	Seamless and welded steel pipe for low-temperature service. TDC.
ASTM A334	Seamless and welded carbon and alloy-steel tubes for low-temperature service. TDC.
ASTM A450	General requirements for carbon, ferritic alloy and austenitic alloy steel tubes. TDC.
ASTM A524	Seamless carbon steel pipe for atmospheric and lower temperatures. TDC.
ASTM A530	General requirements for specialized carbon and alloy steel pipe. TDC.
ASTM A999	General requirements for alloy and stainless steel pipe.
ASTM A1016	General requirements for ferritic alloy steel, austenitic alloy steel and stainless steel tubes.
ISO 9329-3	Seamless steel tubes for pressure purposes. TDC. Part 3: Non-alloy and alloy steel tubes with specified low temperature properties.

TDC standards	Steel grade			Testing and certificates		Other TDC		
	Name	Condition	Surface	Testing	Certificate	Marking	Surface protection	Packing
5949	C15 C20	Hot finished • normalized Cold finished • normalized	• visually free from surface defects • adequate to production mode				• without • upon agreement	• bundles 300 - 3500 kg, bundled with steel strips • other upon agreement
42 0165	11 369 11 419 11 448 11 449 11 503	Hot finished • normalized Cold finished • normalized		• visual • dimensions • tensile test • impact test • flattening • drift expanding • leak tightness • NDT • product analysis	• 6+ certificate • 7+ customer inspection • 9+ special arrangement + = group (kind) of test	• colored according to 42 0010 • tested NDT D < 70 mm - label on bundle		
A333 (A999) SA-333 SA-999	Grade 1 Grade 3 Grade 6 Grade 7	Hot finished • normalized Cold finished • normalized		• product analysis • tensile test • (grain size) • impact test	A999	see page 39 for A999		
A334 (A1016) SA334 A524 (A530) SA524	Grade 1 Grade 3 Grade 6 Grade 7 Grade I and II	Hot finished • normalized Cold finished • normalized		• flattening, • flaring • leak tightness - hydrostatic pressure or NDT according to E 213 or E309 • visual • hardness (A334)	A1016 A530	see page 39 for A 1016 see page 39 for A 1016		

Steel grades for pressure tubes for low temperature

Standards	Steel grade	Chemical composition [%]										Mechanical properties					
		C	Si	Mn	P _{max}	S _{max}	Cr	Ni	Mo	Cu	Other	Re min MPa	min ksi	Rm min MPa	max ksi	A5 min %	
STN, ČSN																	
	11 369	max.0,14	max.0,35	max.0,80	0,040	0,040	max.0,30	max.0,30		max.0,30	Al min.0,020	226		353	441		
	11 419	max.0,20	max.0,35	max.0,80	0,040	0,040	max.0,30	max.0,30		max.0,30	Al min.0,020	255		400	490		
	11 448	max.0,20	max.0,40	max.1,30	0,035	0,035	max.0,30	max.0,20		max.0,30		275		430	580	22	
	11 449	max.0,15	max.0,40	max.1,50	0,035	0,035	max.0,30	max.0,20		max.0,30	Al min.0,020	295		430	530	22	
	11 503	max.0,18	max.0,55	max.1,60	0,035	0,035	max.0,30	max.0,30		max.0,30	Al min.0,015	355		490	630	22	
ASTM																	
A 333	Grade 1	max.0,30		0,40 - 1,06	0,025	0,025						205	30	380		55	35
	Grade 3	max.0,19	0,18 - 0,37	0,31 - 0,64	0,025	0,025		3,18 - 3,82				240	35	450		65	30
	Grade 6	max.0,30	min. 0,10	0,29 - 1,06	0,025	0,025						240	35	415		60	30
A 334	Grade 1	max.0,30		0,40 - 1,06	0,025	0,025						205	30	380		55	35
	Grade 3	max.0,19	0,18 - 0,37	0,31 - 0,64	0,025	0,025		3,18 - 3,82				240	35	450		65	30
	Grade 6	max.0,30	min. 0,10	0,29 - 1,06	0,025	0,025						240	35	415		60	30
	Grade 7	max.0,19	0,13 - 0,32	max.0,90	0,025	0,025		2,03 - 2,57				240	35	450		65	30
A 524		max.0,21	0,10 - 0,40	0,90 - 1,35	0,035	0,035						240	35	414	586	60	30
DIN																	
17173	Tt St 35N	max.0,17	max.0,35	min.0,40	0,030	0,025					Al min.0,020	225		340	460		25
	10Ni14	max.0,15	max.0,35	0,30 - 0,80	0,025	0,020		3,25 - 3,75			V max.0,05	335		470	640		20
BS																	
3603	430 LT	max.0,20	max.0,35	0,60 - 1,20	0,035	0,035					Al min.0,020	275		430	570		22
	503LT	max.0,15	0,15 - 0,35	0,30 - 0,80	0,025	0,020		3,25 - 3,75			Al min.0,020	245		440	590		16
NFA																	
49-215	TU 42BT	max.0,22	max.0,40	max.1,15	0,040	0,040						235		410	510		23
	TU 10N9	max.0,17	max.0,35	max.1,00	0,035	0,035		2,00 - 2,60				245		450			20
	TU 10N14	max.0,17	max.0,40	max.0,75	0,035	0,035		3,20 - 3,80				245		450			20
EN																	
10216-4	P 215 NL	max.0,15	max.0,35	0,40 - 1,20	0,030	0,020	max.0,30	max.0,30	max.0,08	max.0,30	V max.0,02 Ti max.0,03 Al min.0,020	215		360	480		25
	P 265 NL	max.0,20	max.0,40	0,60 - 1,40	0,030	0,020	max.0,30	max.0,30	max.0,08	max.0,30	V max.0,02 Ti max.0,03 Al min.0,020	265		410	570		24
	12Ni14	max.0,15	0,15 - 0,35	0,30 - 0,80	0,025	0,010		3,25 - 3,75		max.0,30	V max.0,05	345		440	620		20
UNI																	
5949	C15	max.0,15	0,15 - 0,35	max.1,00	0,035	0,035						220		350	500		28
	C20	max.0,20	0,15 - 0,35	max.1,00	0,035	0,035						250		450	600		24

Tubes for heat exchangers (seamless and welded)

Standards	Dimensional standards	Dimensional range	Dimensions				Straightness	Tube ends
			Tolerance D	Tolerance T	Lengths			
SEAMLESS TUBES								
EN	10216-2	Table 1/Page 26	See boiler tubes page 34, production method as cold drawn (Tubes for low temperature see EN 10216-4, Page 44)					
DIN	28180 (2391-1)	Table 9/Page 51	Tolerance class 1: D = 16-30 mm ±0,08 mm D > 38 mm ±0,15 mm Tolerance class 3: D = 16-38 mm ±0,50 mm	T ≤ 2 mm ±0,2 mm T > 2 mm ±10 % T ≤ 2 mm ±0,2 mm T > 2 mm -10 % +15 %	Exact lengths: L ≤ 5 m 0+5 mm L 5-10 m 0+10 mm L > 10 m upon agreement (seamless max. 18,3 m)	• visually straight • upon agreement	• square cut ends • free from excessive burrs	
BS	3606	Table 6/Page 32	D ≤ 25 mm ±0,10 mm D = 25-38 mm ±0,15 mm D 38-50 mm ±0,20 mm	• ±10 % • upon agreement: D ≤ 38 mm 0+20 % D > 38 mm 0+22 %	Exact lengths: L ≤ 6 m 0+3 mm L > 6 m +1,5 mm/m, max+12,5 mm	visually straight		
NF A	49-215	Table 6/Page 32	See page 44					
UNI	ISO 1129	Table 6/Page 32	See page 36					
STN	42 6710	Table 6/Page 32	See page 36					
ČSN	42 6711		See page 36					
GOST	8734 (8732)	Table 6/Page 32	Cold finished: D = 5-10 mm ±0,15 mm D = 10-30 mm ±0,30 mm D = 30-50 mm ±0,40 mm D > 50 mm ±0,8 %	T ≤ 1 mm ±0,12 mm T = 1-5 mm ±10 %	• random • exact 0+10 mm	D = 5-8 mm 3 mm/m D = 8-10 mm 2 mm/m D > 10 m 1,5 mm/m	• square cut ends • free from excessive burrs • beveled for WT over 5 mm	
	1060		D ≤ 29 mm ±0,2 mm D = 29-51 mm ±0,30 mm D > 51 mm -0,8% +0,6%	• Trieda 1 -10 % +8 % • Trieda 2 ±8 %		1,5 mm/m		
ASTM ASME	A179 SA-179	Table 7/Page 51	According to ASTM A450 See page 33	See page 33	• upon agreement • max 18,3 m		• square cut ends • free from excessive burrs	
JIS	G3461	Table 10/Page 52	See page 38	See page 38			• square cut ends • free from excessive burrs	
	G3462							
WELDED COLD SIZED TUBES								
DIN	28181 (2394-1)	Table 9/Page 51	Tolerance class 1: D = 16-30 mm ±0,08 mm D > 38 mm ±0,15 mm Tolerance class 2: D ≤ 16 mm ±0,12 mm D = 20-30 mm ±0,15 mm D > 38 mm ±0,20 mm Tolerance class 3: D = 16-38 mm ±0,50 mm	T ≤ 2 mm ±0,20 mm T > 2 mm ±10 %	Exact lengths: L ≤ 5 m 0+5 mm L 5-10 m 0+10 mm L > 10 m upon agreement (welded max. 15 m)	• visually straight • upon agreement	• square cut ends • free from excessive burrs	
ASTM	A214 A178 A334	Table 7/Page 51	See page 33	0 + 18 %			• square cut ends • free from excessive burrs	
NF A	49-243	Table 1/Page 26	Quality F ±0,5 % min ±0,2 mm	Quality F ±9 % min ±0,25 mm	Exact lengths: D ≤ 88,9 mm: L ≤ 6,5 m 0+5 mm	3 mm/m max 8 mm	• square cut ends • free from excessive burrs	
	49-245	Table 7-9/Page 51	D ≤ 20 mm ±0,10 mm D = 20-38 mm ±0,15 mm D = 38-50 mm ±0,25 mm D > 50 mm ±0,30 mm	±9 % min ±0,20 mm 0+18% upon agreement	Exact lengths: L ≤ 6 m 0+3 mm L = 6-9 0+4,5 mm L = 9-12 0+6 mm			

Notes: 1. Delivery of tubes according to other standards for seamless and welded tubes (EN 10217-2, ISO 9330-1,2,3) upon agreement. 2. See also standards for heat appliances (pages 34-39, 44-47). 3. Tubes according to 49-243 in quality F2 and F3 (page 37). 4. For low temperatures tubes according to STN, ČSN 42 0165 (page 46)

TDC standards	Steel grade			Testing and certificates		Other TDC		
	Name	Condition	Surface	Testing	Certificate	Marking	Surface protection	Packing
10216-2	P235GH 16Mo3	See boiler tubes page 35						
1629 17175 17173	St37.0 St35.8 15Mo3 TTSi35N	Cold finished • normalized (NBK)			See page 23 See page 35 See page 45			
3606	320 440 243 620 622	N N N, N+T N, N+T Cold finished • condition upon steel or agreement		<ul style="list-style-type: none"> product analysis dimensions visual tensile test flattening drift expanding hydrostatic test NDT - ultrasonic - eddy current 	<ul style="list-style-type: none"> test certificate test result 			
49-215	TU37C TU42C TU48C TU15D3 TU13CD4-04	N N N N N+T	See pages 37 and 45					
5462	16Mo5	See page 37						
42 0251	12 021 12 022 12 025 15 020 15 121 15 128 15 313	Cold finished • normalized number .1 behind steel Cold finished • normalized and temper. number .5 behind steel	See page 37					
550	1050: 10 20 4543: 10G2	Cold finished • normalized		<ul style="list-style-type: none"> product analysis dimensions tensile test impact test flattening drift expanding hardness 	10692			
1060	1050: 10							
A179 (A450) SA-179	A179	Cold finished • normalized		<ul style="list-style-type: none"> product analysis hardness flattening drift expanding flanging NDT according to E309 (HF upon agreement) 		<ul style="list-style-type: none"> each tube marked according to A 450 and name and order of the purchaser 		Upon agreement
G3461 G3462	STB340 STB410 STB510 STBA12	Cold finished • normalized	See page 39					
1626 17174 17177	St37.0 TTSi35N St37.8 St42.8	As DIN 1629 page 23 As DIN 17173 page 45 As DIN 17175 page 35						
A214 A178 A334 (A1016)	A214 Grade A, B, C Grade 1 Grade 6	Cold finished • normalized (Calibrated)	See A179 See page 47					
49-243 49-245	TS37C TS42C TS48C TS52C TS15D3 TS34C TS37C TS42C TS48C	N N N N N+T N N N N	See pages 37 and 45					

List of dimensional standards and technical delivery conditions standards

EN 10216-2	Seamless steel tubes for pressure purposes. TDC. Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties.
DIN 1629	Seamless circular tubes of non-alloy steel with special quality requirements. TDC.
DIN 2391-1	Seamless precision steel tubes. Part 1: Dimensions.
DIN 17175	Seamless steel tubes for elevated temperatures. TDC.
DIN 28180	Seamless steel tubes for tubular heat exchangers. Dimensions, tolerances, materials.
BS 3606	Steel tubes for heat exchangers.
NFA 49-215	Seamless tubes for ferritic non alloy and alloy steel heat exchangers.
NFA 49-243	Longitudinally pressure welded tubes $D \leq 168,3$ mm of non-alloy and ferritic alloy steel used at elevated temperatures. Dimensions. TDC.
NFA 49-245	Longitudinally pressure welded tubes of non-alloy and ferritic alloy steel for heat exchangers of diameter 15,9 - 76,1 mm inclusive. Dimensions. TDC.
STN 42 0251	ČSN 42 0251 Seamless steel tubes with guaranteed properties at elevated temperatures. TDC.
STN 42 6710	ČSN 42 6710 Cold drawn seamless tubes with normal tolerances from steel class 11 - 16. Dimensions.
STN 42 6711	ČSN 42 6711 Precision seamless steel tubes. Dimensions.
GOST 550	Seamless steel tubes for petroleum processing and petrochemical industry.
GOST 8734	Seamless steel tubes cold deformed.
ANSI/ASME B 36.10M	Welded and seamless wrought steel pipe. Dimensions.
ASTM A178	Electric resistance welded carbon steel and carbon manganese steel boiler and superheater tubes.
ASTM A179	Seamless cold drawn low-carbon steel heat exchanger and condenser tubes. TDC.
ASTM A199	Seamless cold drawn intermediate alloy steel heat exchanger and condenser tubes. TDC.
ASTM A214	Electric resistance welded carbon steel heat exchanger and condenser tubes.
ASTM A334	Seamless and welded carbon and alloy-steel tubes for low-temperature service. TDC.
ASTM A450	General requirements for carbon, ferritic alloy and austenitic alloy steel tubes. TDC.
JIS G 3461	Carbon steel boiler and heat exchanger tubes.
JIS G 3462	Alloy steel boiler and heat exchanger tubes.

Steel grade for heat-exchanger tubes

Standards	Steel grade	Chemical composition [%]										Mechanical properties				
		C	Si	Mn	P _{max}	S _{max}	Cr	Ni	Mo	Cu	Other	Re min MPa	Re min ksi	Rm min MPa	Rm min ksi	A5 min %
STN, ČSN																
	11 368	max.0,15	max.0,35	min.0,40	0,040	0,040	max.0,30	max.0,30		max.0,30		245	350	440	26	
	11 418	max.0,20	max.0,35	max.0,50	0,040	0,040	max.0,30	max.0,30		max.0,30		255	400	490	24	
	12 021	0,07-0,15	0,17-0,35	0,35-0,60	0,040	0,040	max.0,25	max.0,25		max.0,25		235	340	470	25	
	12 022	0,15-0,22	0,17-0,37	0,50-0,80	0,040	0,040	max.0,25	max.0,25		max.0,25		255	410	570	21	
	12 025	0,14-0,20	0,17-0,37	0,60-1,00	0,040	0,040	max.0,25	max.0,25		max.0,25	V 0,05-0,09	320	440	600	23	
	15 020	0,12-0,20	0,15-0,37	0,50-0,80	0,040	0,040			0,25-0,35		Al min.0,015	270	450	600	22	
	15 121	0,10-0,18	0,15-0,35	0,40-0,70	0,040	0,040	0,70-1,30		0,40-0,60			295	440	590	22	
	15 128	0,10-0,18	0,15-0,40	0,45-0,70	0,040	0,040	0,50-0,75		0,40-0,60		V 0,22-0,35	365	490	690	18	
ASTM																
A 161	Grade C	0,10-0,20	max. 0,25	0,30-0,80	0,035	0,035						179	26	324	47	35
	Grade T-1	0,10-0,20	0,10-0,50	0,30-0,80	0,025	0,025			0,44-0,65			207	30	379	55	30
A 179		0,06-0,18		0,27-0,63	0,035	0,035					max.72 HRB	180	26	325	47	35
A 199	Grade T4	0,05-0,15	0,50-1,00	0,30-0,60	0,025	0,025	2,15-2,85	max. 0,40	0,44-0,65		V 0,18-0,25 max.0,04	170	25	415	60	30
	Grade T11	0,05-0,15	0,50-1,00	0,30-0,60	0,025	0,025	1,00-1,50		0,44-0,65			170	25	415	60	30
A 335	Grade P12	0,05-0,15	max.0,50	0,30-0,61	0,025	0,025	0,80-1,25		0,44-0,65			220	32	415	60	30
DN																
1629	St 37.0	max.0,17			0,040	0,040						235	350	480	25	
17175	St 35.8	max.0,17	0,10-0,35	0,40-0,80	0,040	0,040						235	360	480	25	
	15Mo3	0,12-0,20	0,10-0,35	0,40-0,80	0,035	0,035			0,25-0,35			270	450	600	22	
BS																
3606	320	max.0,16	-	0,30-0,70	0,050	0,050						195	-	-	21	
	440	0,12-0,18	0,10-0,35	0,90-1,20	0,040	0,035						265	440	440	21	
	243	0,12-0,20	0,10-0,35	0,40-0,80	0,040	0,040			0,25-0,35		Al max.0,12	250	450	450	22	
	620	0,10-0,15	0,10-0,35	0,40-0,70	0,040	0,040	0,70-1,10		0,45-0,65		Al max.0,20	180	460	460	22	
UNI																
5462	16Mo5	0,12-0,20	0,15-0,35	0,50-0,80	0,035	0,035			0,45-0,65			290	450	550	22	
NFA																
49-215	TU 37c	max.0,18	0,05-0,27	0,30-0,80	0,045	0,045				max.0,25	Sn 0,03	220	360	450		
	TU 42c	max.0,22	0,07-0,40	0,40-1,05	0,045	0,045				max.0,25	Sn 0,03	235	410	510		
	TU 48c	max.0,24	0,09-0,40	0,60-1,30	0,045	0,045				max.0,25	Sn 0,03	275	470	570		
	TU 15D3	0,10-0,22	0,10-0,40	0,40-0,90	0,040	0,040	max.0,40	max.0,30	0,21-0,39	max.0,25	Sn 0,03	265	430	530	22	
	TU 13CD4.04	0,08-0,20	0,05-0,40	0,30-0,80	0,035	0,035	0,65-1,15	max.0,30	0,61-0,69	max.0,25	Sn 0,03	290	440	590	22	
EN																
10216-2	P 235 GH	max.0,16	max.0,35	max.1,20	0,025	0,020	max.0,30	max.0,30	max.0,08	max.0,30	V max.0,02 Ti max.0,04 Al min.0,020	235	360	500	25	
	16Mo3	0,12-0,20	0,15-0,35	0,40-0,80	0,030	0,025			0,25-0,35		Al max.0,040	280	450	600	22	
GOST																
1050	10	0,07-0,14	0,17-0,37	0,35-0,65			max.0,15					205	330		31	
	20	0,17-0,24	0,17-0,37	0,35-0,65			max.0,25					245	410		25	
4543	10G2	0,07-0,15	0,17-0,37	1,20-1,60								245	420		22	
JIS																
G3461	STB 340	max.0,18	max.0,35	0,30-0,60	0,035	0,035						175	340		35	
	STB 410	max.0,32	max.0,35	0,30-0,80	0,035	0,035						255	410		25	
	STB 510	max.0,25	max.0,35	1,00-1,50	0,035	0,035						295	510		25	
G3462	STBA 12	0,10-0,20	0,10-0,50	0,30-0,80	0,035	0,035			0,45-0,65			205	380		30	
	STBA 22	max.0,15	max.0,50	0,30-0,60	0,035	0,035	0,80-1,25		0,45-0,65			205	410		30	

Cold drawn heat exchanger tubes with minimum wall thickness (sizes in inch)

Table 7

Outside diameter		Minimum wall thickness													
		BWG (inch)	20 (.035)	18 (.049)	16 (.065)	14 (.083)	13 (.095)	12 (.109)	11 (.120)	10 (.134)	9 (.148)	8 (.165)	7 (.180)	6 (.203)	5 (.220)
[mm]	[inch]	[mm]	0,89	1,24	1,65	2,11	2,41	2,77	3,05	3,40	3,76	4,19	4,57	5,16	5,59
12,70	1/2	lb/ft	0,190	0,256	0,327	0,399	0,441	0,487	0,519	0,555	0,586				
	.500	kg/m	0,283	0,351	0,487	0,594	0,657	0,725	0,773	0,826	0,873				
15,88	5/8	lb/ft	0,242	0,328	0,423	0,521	0,581	0,647	0,696	0,752	0,804				
	.625	kg/m	0,360	0,488	0,630	0,776	0,865	0,964	1,036	1,120	1,198				
19,05	3/4	lb/ft	0,290	0,400	0,518	0,643	0,720	0,807	0,872	0,948	1,021				
	.750	kg/m	0,431	0,595	0,771	0,957	1,072	1,202	1,299	1,412	1,521				
22,23	7/8	lb/ft		0,472	0,614	0,767	0,864	0,973	1,056	1,158					
	.875	kg/m		0,702	0,913	1,141	1,285	1,448	1,571	1,722					
25,40	1	lb/ft		0,543	0,709	0,887	0,998	1,128	1,225	1,342	1,456	1,587	1,696		
	1.000	kg/m		0,808	1,056	1,321	1,487	1,680	1,824	1,998	2,169	2,363	2,526		
31,75	1 1/4	lb/ft		0,686	0,900	1,131	1,277	1,448	1,577	1,734	1,891	2,071	2,225	2,451	2,607
	1.250	kg/m		1,022	1,340	1,684	1,902	2,157	2,349	2,583	2,816	3,085	3,313	3,650	3,882
38,10	1 1/2	lb/ft		0,830	1,090	1,375	1,556	1,769	1,930	2,128	2,326	2,556	2,753	3,047	3,253
	1.500	kg/m		1,236	1,624	2,048	2,317	2,634	2,875	3,169	3,464	3,807	4,100	4,538	4,845
50,80	2	lb/ft			1,472	1,863	2,114	2,409	2,636	2,914	3,196	3,525	3,810	4,241	4,547
	2.000	kg/m			2,192	2,775	3,148	3,588	3,925	4,340	4,759	5,250	5,674	6,316	6,771
63,50	2 1/2	lb/ft			1,854	2,351	2,671	3,050	3,341	3,701	4,066	4,494	4,867	5,435	5,839
	2.500	kg/m			2,761	3,502	3,978	4,542	4,976	5,512	6,055	6,693	7,249	8,094	8,696
76,20	3	lb/ft				2,840	3,228	3,691	4,047	4,487	4,935	5,464	5,924	6,628	7,132
	3.000	kg/m				4,229	4,808	5,497	6,027	6,683	7,350	8,137	8,823	9,871	10,622

Cold drawn heat exchanger tubes with medium wall thickness (sizes in inch)

Table 8

Outside diameter		Medium wall thickness													
		BWG (inch)	20 (.035)	18 (.049)	16 (.065)	14 (.083)	13 (.095)	12 (.109)	11 (.120)	10 (.134)	9 (.148)	8 (.165)	7 (.180)	6 (.203)	5 (.220)
[mm]	[inch]	[mm]	0,89	1,24	1,65	2,11	2,41	2,77	3,05	3,40	3,76	4,19	4,57	5,16	5,59
12,70	1/2	lb/ft	0,173	0,236	0,302	0,369	0,410	0,445	0,487	0,523	0,557				
	.500	kg/m	0,259	0,351	0,450	0,551	0,612	0,678	0,726	0,780	0,829				
15,88	5/8	lb/ft	0,220	0,301	0,388	0,480	0,537	0,600	0,647	0,703	0,754				
	.625	kg/m	0,328	0,447	0,579	0,716	0,801	0,897	0,965	1,046	1,124				
19,05	3/4	lb/ft	0,267	0,366	0,475	0,591	0,664	0,745	0,807	0,881	0,952				
	.750	kg/m	0,398	0,547	0,708	0,881	0,989	1,110	1,203	1,312	1,418				
22,23	7/8	lb/ft		0,432	0,562	0,702	0,791	0,891	0,967	1,060					
	.875	kg/m		0,643	0,836	1,045	1,177	1,326	1,439	1,577					
25,40	1	lb/ft		0,497	0,649	0,812	0,918	1,037	1,128	1,239	1,346	1,471	1,575		
	1.000	kg/m		0,740	0,966	1,212	1,366	1,550	1,681	1,845	2,006	2,192	2,347		
31,75	1 1/4	lb/ft		0,628	0,822	1,034	1,172	1,328	1,448	1,597	1,741	1,912	2,056	2,272	2,417
	1.250	kg/m		0,933	1,225	1,542	1,744	1,980	2,159	2,377	2,595	2,848	3,063	3,383	3,606
38,10	1 1/2	lb/ft		0,759	0,996	1,256	1,426	1,619	1,769	1,955	2,137	2,353	2,537	2,814	3,009
	1.500	kg/m		1,127	1,483	1,870	2,121	2,413	2,636	2,909	3,184	3,504	3,779	4,191	4,481
50,80	2	lb/ft			1,343	1,699	1,933	2,201	2,409	2,670	2,929	3,246	3,499	3,896	4,185
	2.000	kg/m			2,000	2,533	2,876	3,281	3,591	3,974	4,362	4,816	5,210	5,807	6,232
63,50	2 1/2	lb/ft			1,690	2,143	2,440	2,783	3,050	3,385	3,717	4,126	4,460	4,980	5,360
	2.500	kg/m			2,517	3,194	3,631	4,148	4,547	5,039	5,539	6,128	6,641	7,424	7,983
76,20	3	lb/ft				2,586	2,947	3,365	3,691	4,102	4,508	5,006	5,421	6,064	6,536
	3.000	kg/m				3,855	4,385	5,016	5,502	6,104	6,717	7,440	8,072	9,040	9,734

Note: Other OD and WT (according SWG) - see table 4, 5, 6 page 30-31 and tables 18 and 19 on pages 66 and 67.

Cold drawn heat exchanger tubes (sizes in mm)

Table 9

Outside diameter [mm]	Wall thickness [mm]							
	1,2	1,6	2	2,6	3,2	4	4,5	5
	Tube weight [kg/m]							
16	0,438	0,568	0,691					
20		0,726	0,888	1,12				
25		0,923	1,13	1,44	1,72			
30		1,12	1,38	1,76	2,11	2,56		
38			1,78	2,27	2,75	3,35		
51 (50)			2,42	3,1	3,77	4,64	5,16	5,67

Dimensions and weight of tubes according to standards JIS (Tubes)

Table 10

Outside diameter [mm]	Wall thickness [mm]																
	1,2	1,6	2,0	2,3	2,6	2,9	3,2	3,5	4,0	4,5	5,0	5,5	6,0	6,5	7,0	8,0	9,5
	Tube weight [kg/m]																
15,9	0,435	0,564	0,686	0,771	0,853	0,930											
19,0		0,687	0,838	0,947	1,05	1,15											
21,7			0,972	1,10	1,22	1,34	1,46										
25,4			1,15	1,31	1,46	1,61	1,75	1,89									
27,2			1,24	1,41	1,58	1,74	1,89	2,05	2,29								
31,8				1,67	1,87	2,07	2,26	2,44	2,74	3,03							
34,0					2,01	2,22	2,43	2,63	2,96	3,27	3,58						
38,1					2,28	2,52	2,75	2,99	3,36	3,73	4,08	4,42					
42,7					2,57	2,85	3,12	3,38	3,82	4,24	4,65	5,05	5,43				
45,0					2,72	3,01	3,30	3,58	4,04	4,49	4,93	5,36	5,77	6,17			
48,6					2,95	3,27	3,58	3,89	4,40	4,89	5,38	5,85	6,30	6,75	7,18		
50,8					3,09	3,43	3,76	4,08	4,62	5,14	5,65	6,14	6,63	7,10	7,56	8,44	
54,0					3,30	3,65	4,01	4,36	4,93	5,49	6,04	6,58	7,10	7,61	8,11	9,07	
57,1						3,88	4,25	4,63	5,24	5,84	6,42	7,00	7,56	8,11	8,65	9,69	
60,3						4,10	4,51	4,90	5,55	6,19	6,82	7,43	8,03	8,62	9,20	10,3	
63,5						4,33	4,76	5,18	5,87	6,55	7,21	7,87	8,51	9,14	9,75	10,9	12,7
65,0						4,44	4,88	5,31	6,02	6,71	7,40	8,07	8,73	9,38	10,00	11,2	13,0
70,0						4,80	5,27	5,74	6,51	7,27	8,01	8,75	9,47	10,20	10,90	12,2	14,2
76,2							5,76	6,27	7,12	7,96	8,78	9,59	10,40	11,20	11,90	13,5	15,6
82,6							6,27	6,83	7,75	8,67	9,57	10,50	11,30	12,20	13,10	14,7	17,1
88,9							6,76	7,37	8,37	9,37	10,30	11,30	12,30	13,20	14,10	16,0	18,6
101,6								8,47	9,63	10,80	11,90	13,00	14,10	15,20	16,30	18,5	21,6
114,3									10,90	12,20	13,50	14,80	16,00	17,30	18,50	21,0	24,6

Dimensions and weight of pipes according to standards JIS (Pipes)

Table 11

Nominal diameter [mm]		Outside diameter [mm]	Nominal wall thickness					
A	B		Schedule 40		Schedule 80		Schedule 160	
			Thickness [mm]	Weight [kg/m]	Thickness [mm]	Weight [kg/m]	Thickness [mm]	Weight [kg/m]
6	1/8	10,5	1,70	0,369	2,40	0,479		
8	1/4	13,8	2,20	0,629	3,00	0,799		
10	3/8	17,3	2,30	0,851	3,20	1,11		
15	1/2	21,7	2,80	1,31	3,70	1,64		
20	3/4	27,2	2,90	1,74	3,90	2,24		
25	1	34,0	3,40	2,57	4,50	3,27		
32	1 1/4	42,7	3,60	3,47	4,90	4,57	6,40	5,73
40	1 1/2	48,6	3,70	4,10	5,10	5,47	7,10	7,27
50	2	60,5	3,90	5,44	5,50	7,46	8,70	11,10
65	2 1/2	76,3	5,20	9,12	7,00	12,00	9,50	15,60
80	3	89,1	5,50	11,30	7,60	15,30	11,10	21,40
90	3 1/2	101,6	5,70	13,50	8,10	18,70		
100	4	114,3	6,00	16,00	8,60	22,40	13,50	33,60

Note: The tube and pipe are hot formed or cold formed (according technical possibilities or agreement).

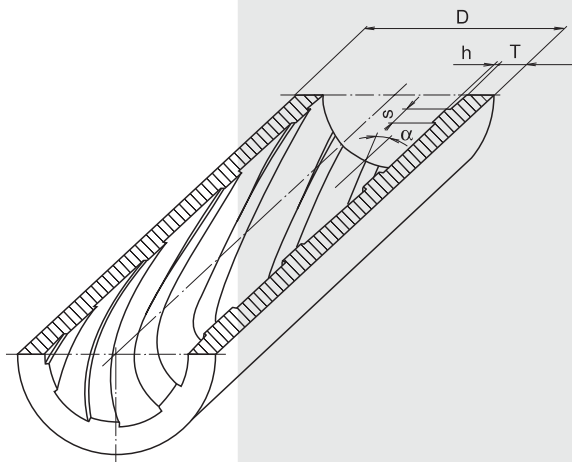
Tubes with internal riffling

This type of precision tube is used as boiler or exchanger tubes. Contrary to the tubes with smooth inside surface, the advantages of tubes with internal riffling include:

- optimum turbulence stage inside heat - transferring medium
- permanent contact of medium with inside surface tube, whereby the heat - transfer coefficient is increased by 40 - 60 %
- braking action of internal rifflings against rigid particle sedimentation in transported medium
- a very effective corrosion resistance and a large increase in the service life of the piping.

Tubes with internal rifflings are furnished according to the given parameters. In the table there is a dimensional range. Required parameters are a matter of agreement between the manufacturer and the purchaser.

Symbol	Parameter	Range	
		[mm]	[inch]
D	Outside diameter	18-72	.750-3.000
T	Wall thickness	1-6,5	.047-.250
	Number of riflings	6-8	
h	Height of rifling	0,3-1,0	.016-.047
s	Width of rifling (cross section)	3-8	.125-.313
β	Angle of rifling flank	30°	
r	Radius of rifling	0,1-0,15	.004-.006
α	Lead angle of rifling	25°-35°	
	Lead length of rifling (360°)	depending on outside diameter	
	Center-to-center spacing of riflings in the longitudinal direction	upon agreement	
	Top width of rifling (longitudinal section)	upon agreement	
	Top width of span between riflings (longitudinal section)	upon agreement	
	Inside circumference of tube	upon agreement	
	Cross diameter of tube	upon agreement	
	Weight of tube	kg/m	lb/ft
	Length of tube	upon agreement	



Dimensions of tubes with internal riffling

Table 12

Outside diameter [mm]	Wall thickness [mm]													
	0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6	6,5	
	Maximum rib height [mm]													
18														
20														
25			0,5 mm											
30														
35														
40					0,7 mm									
45														
50														
55										1 mm				
60														
65														
70														
72														

Pipes suitable for welding and threading

Standards	Dimensional standards	Dimensional range	Dimensions					
			Tolerance D	Tolerance T	Lengths	Straightness	Tube ends	
EN	10224	Table 1/Page 26	±1 % min ±0,5 mm is valid for welded pipe too at D = 219,1 mm (method EW and BW)	±12,5 % (D ≤ 219,1 mm) min ±0,4 mm is valid for welded pipe too (method EW and BW)	<ul style="list-style-type: none"> random fixed exact: L = 2-6 m 0 +10 mm L = 6-12 m 0 +15 mm L > 12 m 0 + upon agreement 	Allowed deviation max 0,2% L	<ul style="list-style-type: none"> square cut ends free from excessive burrs beveled for T ≥ 3,2 mm, unless otherwise ordered square cut ends free from excessive burrs plain ends (no threaded) 	
	10255	Table 13/Page 54	See table 13 (valid for series H and M) For Type L, L1, L2 see standard	Seamless ±12,5 % Welded • series H, M Type L ±10 % • Type L1, L2 -8 %				
DIN	2440 2441			-12,5 % + delimited by weight Weight ±10 %		Visually straight		
	2442							
	2460							
BS	1387			-8 % (light series) -10 % (medium and heavy series)				
NFA	49-115 (49-145)			-12,5 % Weight ±10%				
UNI	8863 6363		±1 %, min ±0,5 mm	-12,5 % + undetermined Weight ±10 %				
STN ČSN	42 5710 42 5711		See table 13	-12,5 % + undetermined Weight ±10 %	<ul style="list-style-type: none"> random exact: +5 mm to section max + 100 mm 	3 mm/m, max 20 mm		
GOST	3262		Usual accuracy: D ≤ 40 mm -0,5/+0,4 mm D > 40 mm -1,0/+0,8 mm	-15 %	<ul style="list-style-type: none"> random exact: + 5 mm to section + 10 mm to length 	D ≤ 20 mm 2 mm/m D > 20 mm 1,5 mm/m		
PN-H	74220		See table 13		<ul style="list-style-type: none"> random fixed exact: L = 2-6 m 0 +10 mm L = 6-12 m 0 +15 mm 			
	74200							
ASTM ASME	A53 SA-53 A795	Table 2/Page 28			See page 18			

List of dimensional standards and technical delivery conditions standards

EN 10224	Steel pipes, joints and fittings for the conveyance of aqueous liquids including potable water.	BS 1387	Screwed and socketed steel tubes.	ČSN 425710	Steel tubes suitable for threading. Medium.
EN 10255	Non-alloy steel tubes suitable for welding or threading.	ČSN 425711	Steel tubes suitable for threading. Heavy.	GOST 3262	Water and gas supply steel pipes.
DIN 2440	Steel tubes; medium-weight suitable for screwing.	ASTM A53	Pipe, steel, black and hot-dipped, zinc-coated, welded and seamless. TDC.	ASTM A795	Black and hot-dipped zinc-coated (galvanized) welded and seamless steel pipe for fire protection use.
DIN 2441	Steel tubes; heavy-weight suitable for screwing.	PN-H 74200	Steel tubes for gas list threading.	JIS G 3452	Carbon steel pipes for ordinary piping.
DIN 2442	Threaded tubes made to quality specifications.	ISO 65	Tubes for screwing	ISO 559	Tubes for water and sewage
DIN 2460	Steel tubes for waterworks services.				
NFA 49-115	Hot finished seamless tubes suitable for threading. Dimensions. TDC.				
UNI 6363	Seamless and welded steel tubes for waterworks services.				
UNI 8863	Seamless non-alloy steel tubes suitable for threading in accordance with UNI ISO 7/1.				

Dimensions of pipe suitable for threading

Table 13

Size	Nominal outside diameter (mm)	Light series II					Light series I					Medium series - M				Heavy series - H			
		Outside diameter (mm)		Wall thickness (mm)	Weight (kg/m)	Outside diameter (mm)		Wall thickness (mm)	Weight (kg/m)	Outside diameter (mm)		Wall thickness (mm)	Weight (kg/m)	Outside diameter (mm)		Wall thickness (mm)	Weight (kg/m)		
Nominal	DN	max.	min.			max.	min.			max.	min.			max.	min.				
1/8	6	10,2								10,6	9,8	2,00	0,404	10,6	9,8	2,60	0,487		
1/4	8	13,5								14,0	13,2	2,30	0,641	14,0	13,2	2,90	0,765		
3/8	10	17,2								17,5	16,7	2,30	0,839	17,5	16,7	2,90	1,02		
1/2	15	21,3				21,7	21,0	2,35	1,10	21,8	21,0	2,65	1,22	21,8	21,0	3,25	1,45		
3/4	20	26,9	26,9	26,4	2,35	1,41	27,1	26,4	2,35	1,41	27,3	26,5	2,65	1,58	27,3	26,5	3,25	1,90	
1	25	33,7	33,8	33,2	2,65	2,01	34,0	33,2	2,90	2,21	34,2	33,3	3,25	2,44	34,2	33,3	4,05	2,97	
1 1/4	32	42,4	42,6	41,9	2,65	2,58	42,7	41,9	2,90	2,84	42,9	42,0	3,25	3,14	42,9	42,0	4,05	3,84	
1 1/2	40	48,3	48,4	47,8	2,90	3,25	48,6	47,8	2,90	3,26	48,8	47,9	3,25	3,61	48,8	47,9	4,05	4,43	
2	50	60,3	60,2	59,6	2,90	4,11	60,7	59,6	3,25	4,56	60,8	59,7	3,65	5,1	60,8	59,7	4,50	6,17	
2 1/2	65	76,1	76,0	75,2	3,25	5,80	76,3	75,2	3,25	5,81	76,6	75,3	3,65	6,51	76,6	75,3	4,50	7,90	
3	80	88,9	88,7	87,9	3,25	6,81	89,4	87,9	3,65	7,65	89,5	88,0	4,05	8,47	89,5	88,0	4,85	10,10	
4	100	114,3	113,9	113,0	3,65	9,89	114,9	113,0	4,05	11,00	115,0	113,1	4,50	12,10	115,0	113,1	5,40	14,40	

Note: Dimensions 1/8, 1/4, 3/8 are delivered as cold drawn also in medium (M) and heavy (H) series.

(Fluid-, Water Transportation and House Instalation)

TDC standards	Steel grade			Testing and certificates		Other TDC		
	Name	Condition	Surface	Testing	Certificate	Marking	Surface protection	Packing
10224	L235 L275 L355	Hot finished • as rolled	• visually errorless • adequate to production mode	• cast analysis • tensile test • flattening • leak tightness-hydrost.press.-NDT • visual • dimensions • leak tightness-hydrost.press.-NDT • visual • tensile test • bend test • flattening (D > 60,3 mm)	10204 • non-specific 2.2 • specific 3.1 • agreement	• producer • standard • steel • testing- number • symbol S Alt. - label to the bundle	Upon agreement	
10255	S 195T	Hot finished • as rolled Cold finished • normalized (for small diameters)							• leak tightness-hydrost.press.-NDT • visual • tensile test • bend test • flattening (D > 60,3 mm)	10204 non-specific 2.1	Label to the bundle Data: • producer • series H, M or type L, L1, L2
2440 2441	DIN 17100 St33-2	Hot finished • as rolled Cold finished • normalized (for small diameters)		• leak tightness-hydrost.press.-NDT • visual • tensile test • flattening (D > 60,3 mm)	50049 2.1 (2.2)	• symbol S Alt. - colour strip • heavy series - red • medium series - blue • type L - green • type L1 - white • type L2 - brown		
1629	St37.0							
1629	St37.0 St52.0							
	See page 23							
1387	1387	Hot finished • as rolled Cold finished • normalized (for small diameters)		• leak tightness - hydrost.press. - NDT • visual • tensile test • flattening (D > 60,3 mm)	Test result certificate			
49-115 (49-145)	TU34-1				Mill certificate	Producer's mark		
8863 6363	Fe330 Fe360 Fe410, Fe510					• producer • steel grade • standard		
42 0250	11 353	Hot finished • as rolled Cold finished • normalized (for small diameters)		See page 25				
3262	1050: 10	• normalized (for small diameters)		• leak tightness - hydrost. pressure - NDT • visual • tensile test • flattening (D > 60,3 mm)	10692			
74220 (84023/7)	R35 R45							
74 200	12X, 12AL							
A53	Grade A Grade B							
A795								
See page 19								

Notes:

Documents for products delivered according to EN 10 224 and EN 10 255 are marked with a mandatory conformity mark (symbol) CE. Dimensions with wall thickness of types L, L1, L2 upon agreement (cold drawn and normalized - in EN 10255). In EN standards is wall thickness round down to one decimal number, value 4,85 to 5,0. Pipes according PN-H 74200 and JIS G 3452 from steel SGP according agreement.

Steel grade of pipe for threading

Standards	Steel grade	Chemical composition [%]										Mechanical properties				
		C	Si	Mn	P _{max}	S _{max}	Cr	Ni	Mo	Cu	Other	Re min MPa	min ksi	Rm min MPa	max ksi	A5 min %
STN, ČSN																
	11 353	max.0,18			0,050	0,050						235		340	440	25
ASTM																
A 53*	GradeA	0,25		0,95	0,050	0,045	0,40	0,40	0,15	0,40	V 0,08	205	30	330		48
	GradeB	0,30		1,20	0,050	0,045	0,40	0,40	0,15	0,40	V 0,08	240	35	415		60
A 795	Grade A	max.0,25		max.0,95	0,035	0,035										
	Grade B	max.0,30		max.1,20	0,035	0,035										
DIN																
2440	St 33-2															
1629	St 37.0	ma.0,17			0,040	0,040						235		350	480	25
BS																
1387		max.0,20		max.1,20	0,045	0,045						195		320	460	20
UNI																
8863	Fe 330	max.0,17		max.0,65	0,040	0,040						210		330	520	22
NFA																
49-115	TU 34-1				0,060	0,050						185		320		18
EN																
10224	L 235	max.0,17	max.0,35	max.0,80	0,040	0,040						235		360	500	25
	L 275	max.0,21	max.0,35	max.1,20	0,040	0,040						275		430	570	21
	L 355	max.0,22	max.0,35	max.1,60	0,040	0,040						355		500	650	21
10255	S 195T	max.0,20		max.1,40	0,035	0,030						195		320	520	20
GOST																
380	St0	max.0,23														
1050	10	0,07 - 0,14	0,17 - 0,37	0,35 - 0,65			max.0,15					205		330		31
PN-H																
84023/7	R35	0,07 - 0,16	0,12 - 0,35	0,40 - 0,75	0,040	0,040										
	R45	0,16 - 0,22	0,12 - 0,35	0,60 - 1,2	0,040	0,040										

* The total composition for elements Cr, Ni, Mo, Cu, V shall not exceed 1,00%.

Line pipe

Standards	Dimensional standards	Dimensional range	Dimensions					Straightness	Tube ends
			Tolerance D	Tolerance T	Lengths				
EN	10208-1	Table 1/Page 26 (Type S)	Tubes: ±0,75 % min ±0,5 mm Ovality 2% (D > 60 mm)	T < 4 mm -0,5 +0,6 mm T = 4-25 mm -12,5 % +15 %	Class r1 (6-11 m): min 4 m, average 8 m Class r2 (9-14 m): min 6 m, average 11 m (in dependance on diameter of pipe and upon agreement)	• deviation max 0,2% L • locally 4 mm/m	• square cut ends • free from excessive burrs • beveled for T ≥ 3,2 mm, unless otherwise ordered • deviation max. 1 mm (D ≤ 220 mm)		
	10208-2		Tube ends: upon agreement ±0,50 % min ±0,5 mm, max ±1,6 mm Ovality 1,5 % (D > 60 mm) (Part 2) Weight -3,5 % +10 %						
DIN	2448	2448	See page 22						
	2448		D ≤ 200 mm ±1 % min ±0,5 mm Weight -8% +10%	D ≤ 130 mm ±10 % D > 130 mm ±12,5 %	• random average 6 m (3-8 m) average 8 m (4-11 m) average 11 m (5,5-14 m) • fixed (±500 mm) • exact	Flexion max 2 mm/m	• square cut ends • free from excessive burrs • beveled according agreement		
UNI	7088		See table in standard Weight ±10 %	-12,5 % + non-specific					
API ISO ASME	5L 3183 B36.10M	Table 14/Page 57	D < 60,3 mm (2,375 in) -0,80 +0,40 mm (-0,031 +0,016 in) D ≥ 60,3 ≤ 168,3 mm (2,375-6,625 in) ±0,0075 D Tube ends -0,40 +1,60 mm Ovality - tube / tube end 0,020D / 0,015 D	Seamless pipes: T ≤ 4mm (0,157 in) -0,5 +0,6 mm (-0,020 +0,024 in) T ≥ 4mm (0,157 in) ≤ 25mm (0,984 in) -0,125T +0,150T Pipe weight -3,5% +10%	In dependance on diameter • (SRL) - nom. 20 ft (6 m) min - middle - max ft: 9,0 - 17,5 - 22,5 m: 2,74 - 5,33 - 6,86 • (DRL) - nom. 40 ft (12 m) ft: 14,0 - 35,0 - 45,0 m: 4,27 - 10,67 - 13,72	Visually straight, max flexion 0,2% L	• square cut ends • free from excessive burrs • deviation for D ≥ 2 3/8" max. 1/16" (1,6 mm) • beveled for T ≥ 3,2 mm, unless otherwise ordered		

List of dimensional standards and technical delivery conditions standards (Product specification PSL1 according to API)

API 5L	Specification for line pipe.	ISO 3183-1	Steel tubes for line pipe, Class A, Part 1.
DIN 2448	Plain end seamless steel tubes. Dimensions.	ISO 3183-2	Steel tubes for line pipe, Class B, Part 2.
DIN 2460	Steel tubes for waterworks services.	UNI 7088	Unalloyed steel seamless tubes - Plain gas tubes for high pressure.
DIN 2470-1	Steel gas pipelines - pressure up to 16 bar.	EN 10 208-1	Steel pipes for pipelines for combustible fluids. TDC. Part 1: Pipes of requirement class A.
DIN 2470-2	Steel gas pipelines - pressure exceeding 16 bar.	EN 10 208-2	Steel pipes for pipelines for combustible fluids. TDC. Part 2: Pipes of requirement class B.
DIN 17172	Steel pipes for pipelines for the transport of combustible fluids and gases.		

Steel grade for line pipe

Steel designation according to EN: see page 58

Standards	Steel grade	Chemical composition [%]										Mechanical properties					
		C	Si	Mn	Pmax	Smax	Cr	Ni	Mo	Cu	Other	Re min MPa	Re min ksi	Rm min MPa	Rm max MPa	A5 min %	
API 5L	Grade A	max.0,22		max.0,90	0,030	0,030						207	30	331		48	
	Grade B	max.0,27		max.1,15	0,030	0,030						241	35	413		60	
	Grade X42	max.0,29		max.1,25	0,030	0,030						289	42	413		60	
	Gr. X46, X52	max.0,31		max.1,35	0,030	0,030						317	46	434		63	
DIN	1629	Si 37,0			0,040	0,040						235		350	480	25	
	17172	StE 210.7	max.0,17	max.0,45	min. 0,35	0,040	0,035					210		320	440	26	
		StE 240.7	max.0,17	max.0,45	min. 0,40	0,040	0,035					240		370	490	24	
		StE 290.7	max.0,22	max.0,45	0,50-1,10	0,040	0,035					290		420	540	23	
		StE 320.7	max.0,22	max.0,45	0,70-1,30	0,040	0,035					320		460	580	21	
		StE 360.7	max.0,22	max.0,55	0,90-1,50	0,040	0,035					360		510	630	20	
UNI	7088	Fe 35-1	max.0,18	-	-	0,045	0,045					240		350	450	25	
		Fe 45-1	max.0,22	-	-	0,045	0,045					260		450	550	21	
	7287	Fe 320	-	-	-	0,060	0,060							320	530	15	
EN	10208-1	L 210 GA	max.0,21	max.0,40	max.0,90	0,030	0,030					Al 0,015-0,060	210		335	475	25
		L 235 GA	max.0,16	max.0,40	max.1,20	0,030	0,030					Al 0,015-0,060	235		370	510	23
		L 245 GA	max.0,20	max.0,40	max.1,15	0,030	0,030					Al 0,015-0,060	245		415	555	22
		L 290 GA	max.0,20	max.0,40	max.1,40	0,030	0,030					Al 0,015-0,060	290		415	555	21
		L 360 GA	max.0,22	max.0,55	max.1,45	0,030	0,030					Al 0,015-0,060	360		460	620	20
		L 245 NB	max.0,16	max.0,40	max.1,10	0,025	0,020						245-440		415		22
	10208-2	L 290 NB	max.0,17	max.0,40	max.1,20	0,025	0,020					V/Ti max.0,05/0,04	290-440		415		21
		L 360 NB	max.0,20	max.0,45	max.1,60	0,025	0,020					V/Ti max.0,10/0,04	360-510		460		20
		L 415 NB	max.0,21	max.0,45	max.1,60	0,025	0,020					V/Ti max.0,15/0,04	415-565		520		18

TDC standards	Steel grade			Testing and certificates		Other TDC		
	Name	Condition	Surface	Testing	Certificate	Marking	Surface protection	Packing
10208-1	L210GA L235GA L245GA L290GA L360GA	Hot finished • as rolled • normalising formed Cold finished • normalized	• visually free from surface defects • adequate to production mode	Part 1: Option: 10204 Part 2: Specific: • cast analysis • tensile test • technological tests • hydrostatic test* • visual • dimensions • NDT* (p. 59) EN 10246-7 U3/C (U2/C) [EN 10246-5 F3 (F2)] • impact test • tube weight	2.2/serie 3 • 3.1 • 3.2 See also page 10	D ≤ 48,3 mm (1.900) label with information D > 48,3 mm (1.900) – information at tube: • paint stencil • die stamping Data: • manufacturer • specification • compatible standards • dimension • steel (grade and class) • PSL (API) • process (S or E or F) • treatment (API) • test pressure (API) • certificate (EN) • inspector's mark (EN) Supplementary requirements (API): • color identification API licensees: • API monogram • date • length	Upon agreement: • temporary • permanent	
10208-2	L245NB L290NB L360NB L415NB	Hot finished • normalising formed (N) • normalized (N) Cold finished • normalized						
2470-1/1629	St37.0	see DIN 1629 - page 23			50049: 3.1.B 3.1.C			
2470-2/17172	StE210.7 StE240.7 StE290.7 StE320.7 StE360.7 StE415.7	Hot finished • as rolled Cold finished • normalized		• cast analysis • tensile test • impact test • hydrostatic pressure • visual • dimensions • NDT upon agreement	50049: 3.1.B 3.1.A 3.1.C			
7088	Fe35-1 Fe45-1			• cast analysis • tensile test • impact test • hydrostatic pressure • visual • dimensions • NDT upon agreement				
5L	Grade A Grade B Grade X42 Grade X46 Grade X52 Grade X60 see page 113	Hot finished see page 113 Cold finished • normalized		• cast analysis • tensile test • impact test • flattening • hydrotest, • NDT (p. 59) • dimensions • visual • compliance NACE MR0175	API 5L			

Dimensions of pipe line according to API 5L Table 14

NSD SD	Outside diameter		Schedule	Wall thickness		Weight	
	[inch]	[mm]		[inch]	[mm]	[lbs/ft]	[kg/m]
0.405 (1/8)	0.405	10,3	STD	0.068	1,7	0.24	0,36
			XS	0.095	2,4	0.31	0,43
0.540 (1/4)	0.540	13,7	STD	0.088	2,2	0.43	0,62
			XS	0.119	3,0	0.54	0,79
0.675 (3/8)	0.675	17,1	STD	0.091	2,3	0.57	0,84
			XS	0.126	3,2	0.74	1,10
0.840 (1/2)	0.840	21,3	STD	0.109	2,8	0.85	1,28
			XS	0.147	3,7	1.09	1,61
1.050 (3/4)	1.050	26,7	STD	0.113	2,9	1.13	1,70
			XS	0.154	3,9	1.48	2,19
1.315 (1)	1.315	33,4	STD	0.133	3,4	1.68	2,52
			XS	0.179	4,6	2.17	3,21
1.660 (1 1/4)	1.660	42,2	STD	0.140	3,6	2.27	3,43
			XS	0.191	4,9	3.00	4,51
1.900 (1 1/2)	1.900	48,3	STD	0.145	3,7	2.72	4,07
			XS	0.200	5,1	3.63	5,43
2 3/8 (2)	2.375	60,3	STD	0.154	3,9	3.66	5,42
			...	0.172	4,4	4.05	6,07
			...	0.188	4,8	4.40	6,57
			XS	0.218	5,5	5.03	7,43
			...	0.250	6,4	5.68	8,51
			...	0.281	7,1	6.29	9,31
2 7/8 (2 1/2)	2.875	73,0	...	0.156	4,0	4.53	6,81
			...	0.172	4,4	4.97	7,44
			...	0.188	4,8	5.40	8,07
			STD	0.203	5,2	5.80	8,69
			...	0.216	5,5	6.14	9,16
			...	0.250	6,4	7.02	10,51
3 1/2 (3)	3.500	88,9	XS	0.276	7,0	7.67	11,39
			...	0.125	3,2	4.51	6,76
			...	0.141	3,6	5.06	7,57
			...	0.156	4,0	5.58	8,37

NSD – Nominal Size Designation

NSD SD	Outside diameter		Schedule	Wall thickness		Weight	
	[inch]	[mm]		[inch]	[mm]	[lbs/ft]	[kg/m]
3 1/2 (3)	3.500	88,9	...	0.172	4,4	6.12	9,17
			...	0.188	4,8	6.66	9,95
			STD	0.216	5,5	7.58	11,31
			...	0.250	6,4	8.69	13,02
			...	0.281	7,1	9.67	14,32
			XS	0.300	7,6	10.26	15,24
4 (3 1/2)	4.000	101,6	...	0.156	4,0	6.41	9,63
			...	0.172	4,4	7.04	10,55
			...	0.188	4,8	7.66	11,46
			STD	0.226	5,7	9.12	13,48
			...	0.250	6,4	10.02	15,02
			...	0.281	7,1	11.17	16,55
4 1/2 (4)	4.500	114,3	XS	0.318	8,1	12.52	18,68
			...	0.156	4,0	7.24	10,88
			...	0.172	4,4	7.96	11,92
			...	0.188	4,8	8.67	12,96
			...	0.203	5,2	9.32	13,99
			...	0.219	5,6	10.02	15,01
4 3/4	4.750	119,1	STD	0.237	6,0	10.80	16,02
			...	0.250	6,4	11.36	17,03
			...	0.281	7,1	12.67	18,77
			...	0.312	7,9	13.97	20,73
			XS	0.337	8,6	15.00	22,42
			...	0.438	11,1	19.02	28,25
5	5.000	127,0	...	0.531	13,5	22.53	33,56
		

Notes: Dimensions 1/8, 1/4, 3/8 are delivered as cold drawn.
Table is valid for tubes for threading and plain end tubes. Values in brackets were valid until 1995. From 2000 in the range 10,3–48,3 mm designation of tube scale Size and outside diameter D is equal. From diameter 60,3 mm are valid values of the designation of Size and D without brackets below the line. Pipe with WT of STD and XS are also designed for threading.
See also table 2 page 28 and note 3 at page 113.

Casing and tubing (upon agreement)

The tubes are used in oil and gas industry.

List of standards for casing and tubing

Standard	Dimensional standard	Dimensions	TDC	Steel grade
API	API 5CT	Table 15/Page 59	API 5CT	H40, J55, K55, N80

Dimensional standard and technical delivery condition standard

API 5CT Specification for casing and tubing

Dimensions and tolerances

Dimensions are given in Table 15. Tubes are delivered mainly as hot rolled.

Tube lengths (Tubing)

Group 1: 6,10–7,32 m (20–24 ft)
 Group 2: 8,53–9,75 m (28–32 ft)
 Group 3: 11,58–12,80 m (38–42 ft)

Tube lengths Casing

Group 1: 4,88–7,62 m (16–25 ft)
 Group 2: 7,62–10,36 m (25–34 ft)
 Group 3: 10,36–14,64 m (34–48 ft)

Straightness

Tubes are visually straight.

Tube ends

Plain tube ends without threading and flanges.

Steel grade

Steel grades are given in survey table.

Informative steel comparison according to DIN, EN and API 5L

DIN 1629	EN 10208-1	API 5L
(St 33)	L 210GA	A
St 37.0	L 235GA	
(St 37.0)	L 245GA	B
St 44.0	L 290GA	X42
St 52.0	L360GA	X52
17172	10208-2	
StE 210.7		A
StE 240.7	L 245NB	B
StE 290.7	L 290NB	X42
StE 320.7		X46
StE 360.7	L 360NB	X52
StE 385.7		X56
StE 415.7	L 415NB	X60
StE 445.7	L 450NB	X65
StE 480.7	L 485NB	X70
	L 555NB	X80

Final supply conditions and surface condition

Hot finished tubes are not heat treated. Surface of tubes corresponded to the method of tube manufacturing.

Pipe and bundle marking

- stamp marking
- stencil marking (Ink Jet)
- colour bands

Bundles are marked with one or more metal tags with required information.

Surface protection

The pipes are supplied either uncoated or with manufacturer's standard mill coating. Upon request the tube ends could be plugged with plastic caps.

Packaging

Pipes are packed in round bundles with weight 1000–3500 kg. Each bundle is bounded with 4 steel strips.

Testing

Tubes are tested according to requirements of standard API 5CT, eventually additional agreed tests.

Certified test report

API 5CT
 DIN 50049 – 3.1.B
 EN 10204 – 3.1

Steel designation according to EN:

- EN 10208-1 (Steel pipes for pipelines for combustible fluids.
 Part 1: Pipes of requirement class A)
 L – steel for pipeline
 210 – minimum yield strength in N/mm²
 GA – pipes of requirement class A
- EN 10208-2 (Steel pipes for pipelines for combustible fluids.
 Part 1: Pipes of requirement class B)
 L 415NB, L 415QB, L 415MB
 N – normalised or normalising formed
 Q – quenched
 M – thermomechanically formed
 B – pipes of requirement class B

Dimensions of oil tubes

Table 15

Size	Outside diameter		Weight	Wall thickness		Weight	
	[inch]	[mm]		[inch]	[mm]	[lbs/ft]	[kg/m]
PLAIN END TUBES							
1,050	1,050	26,7	1,14	0,113	2,87	1,13	1,68
		(26,67)	1,48	0,154	3,91	1,48	2,19
1,315	1,315	33,4	1,70	0,133	3,38	1,68	2,50
		(33,40)	2,19	0,179	4,55	2,17	3,24
1,660	1,660	42,2	2,09	0,125	3,18	2,05	3,06
		(42,16)	2,30	0,140	3,56	2,27	3,39
			3,03	0,191	4,85	3,00	4,46
1,900	1,900	48,3	2,40	0,125	3,18	2,37	3,54
		(48,26)	2,75	0,145	3,68	2,72	4,05
			3,65	0,200	5,08	3,63	5,41
2 ^{3/8}	2,375	60,3	4,00	0,167	4,24	3,94	5,86
		(60,32)	4,60	0,190	4,83	4,44	6,61
			5,80	0,254	6,45	5,76	8,57
2 ^{7/8}	2,875	73,0	6,40	0,217	5,51	6,17	9,17
		(73,02)	7,80	0,276	7,01	7,67	11,41
			8,60	0,308	7,82	8,45	12,57
3 ^{1/2}	3,500	88,9	7,70	0,216	5,49	7,58	11,29
		(88,90)	9,20	0,254	6,45	8,81	13,12
			10,20	0,289	7,34	9,92	14,76
4	4,000	101,6	9,50	0,226	5,74	9,12	13,57
		(101,60)	10,70	0,262	6,65	10,47	15,57
			13,20	0,330	8,38	12,95	19,27
4 ^{1/2}	4,500	114,3	12,60	0,271	6,88	12,25	18,23
		(114,30)	15,20	0,337	8,56	15,00	22,32
			17,00	0,380	9,65	16,77	24,90
CASING (WITHOUT THREADING)							
4 ^{1/2}	4,500	114,3	9,50	0,205	5,21	9,41	14,02
		(114,30)	10,50	0,224	5,69	10,24	15,24
			11,60	0,250	6,35	11,36	16,91
			13,50	0,290	7,37	13,05	19,44
			15,10	0,337	8,56	15,00	22,32

Notes:

Tubes of OD 2.063 in (52,4 mm), 5 inch (127 mm) and 5 1/2 inch (139,7 mm) upon agreement.
 Dimensions in brackets are from edition API 5CT - 2005.

Tolerance of dimensions:

Tolerance D < 4^{1/2} inch = ±0,79 mm (±0,031 inch)
 D ≥ 4^{1/2} inch = -0,5 % +1,0 % D
 T = -12,5 % (+ limited by weight)
 weight (1 tube) = -3,5 % +6,5 %

Steel grade of Casing and tubing (Group 1 and Type 1 according API 5CT)

Standards	Steel grade	Chemical composition [%]										Mechanical properties					
		C	Si	Mn	P _{max}	S _{max}	Cr	Ni	Mo	Cu	Other	Re		Rm		A5 min %	
												min MPa	min ksi	min MPa	max MPa		
API 5CT																	
	Grade H40	-	-	-	0,030	0,030						276	40	414		60	
	Grade J55	-	-	-	0,030	0,030						379	55	517		75	
	Grade K55	-	-	-	0,030	0,030						379	55	655		95	
	Grade N80				0,030	0,030						552	80	689		100	

Tubing is delivered according of requirements PSL 1. Level PSL 2 and PSL 3 (Annex H of API 5CT) according agreement.

Note to page 57:

*HT - mandatory test for all pipes, in EN 10208-1 is possibility to replace of HT with NDT
 NDT - mandatory at EN 10208-2 and API 5L - PSL 2. At PSL 1 according agreement only.

Precision cold drawn seamless standard steel tubes

Standards	Dimensional standards	Dimensional range	Dimensions				
			Tolerance D	Tolerance T	Lengths	Straightness	Tube ends
EN	10305-1	Table 16/Page 64 Table 17/Page 65 Table 20/Page 68 (Other dimensions upon agreement)	See dimensional tables (Inside diameter tolerance is also shown in table) • other tolerances upon agreement • possibility to shift tolerance • by heat treated tubes increasing of tolerance range • ovality included in D tolerances • eccentricity included in T tolerances	$\pm 10\%$ min $\pm 0,1$ mm (Applied for ordering by: • OD x T • ID x T)	<ul style="list-style-type: none"> random 3-7 (9) m fixed with tolerance ± 500 mm exact with tolerance 0 + upon agreement max length 18 m - upon agreement 	D > 15 mm • total deviation: ReH < 500 MPa 0,0015 L ReH > 500 MPa 0,002 L • local deviation max 3mm/m D ≤ 15 mm upon agreement	<ul style="list-style-type: none"> square cut ends free from excessive burrs plain ends possibility - tol. of O.D. outside values in table (cutting method) specified end finishing
DIN	2391-1		See notes at page 62		Value for exact lengths: L ≤ 0,5 m 0 + 2 mm L = 0,5-2 m 0 + 3 mm L = 2-5 m 0 + 5 mm L = 5-7 (8) m 0 + 10 mm L ≥ 7 (8) m agreement (0 + 15 mm) Value in brackets valid for NF A	<ul style="list-style-type: none"> D > 15 mm 0,25% L locally 3mm/m 	
BS	6323/4						
NF A	49-310 49-312		Quality range: A - usual tolerances B - reduced tolerances C - cylinder tubes D - special requirements	D ≤ 5 mm $\pm 20\%$ D = 5-8 mm $\pm 15\%$ D > 8 mm $\pm 10\%$ min $\pm 0,12$ mm			
UNI	7945		See dimensional tables (Inside diameter tolerance is also shown in table) • other tolerances upon agreement • possibility to shift tolerance • by heat treated tubes increasing of tolerance range • ovality included in D tolerances • eccentricity included in T tolerances	$\pm 10\%$ min $\pm 0,1$ mm (Applied for ordering by: • OD x T • ID x T)			

List of dimensional standards and technical delivery conditions standards

EN 10305-1	Steel tubes for precision applications. Part 1: Seamless cold drawn tubes.
DIN 2391	Seamless precision steel tubes. Part 1: Dimensions. Part 2: TDC.
BS 6323	Seamless and welded steel tubes for automobile, mechanical and general engineering purposes. Part 1: General requirements. Part 4: Specific requirements for cold finished seamless steel tubes.
NFA 49-310	Seamless precision tubes for mechanical application.
UNI 7945	Plain end seamless precision steel tubes.
ISO 3304	Plain end seamless precision steel tubes - TDC.

TDC standards	Steel grade			Testing and certificates		Other TDC		
	Name	Condition	Surface	Testing	Certificate	Marking	Surface protection	Packing
10305-1 (Other TDC upon agreement)	E215 E235 E355 (Other steel upon agreement)	Cold finished Symbol for steel condition: + C + LC + SR + A + N (See page 63)	Outside and inside surface smooth Roughness $\leq 4 \mu\text{m}$ Tubes in condition +C and +LC with layers of lubricant and lubricant carrier	Non-specific Specific: • product analysis • tensile test • dimensions • visual • optional - upon agreement (including NDT)	10204: 2.2 3.1 See also page 10	Label with data on bundle Upon agreement letter spraying on tube: • producer • dimension • standard • steel grade • cast • test style • identification number by specific testing	Temporary upon agreement	Bundle with section: • round • hexagonal Max weight 2000 kg
2391-2 (Other TDC upon agreement)	St35 St45 St52 (Other steel upon agreement)	Cold finished Symbol for steel condition: BK BKW BKS GBK NBK		Grade A of quality Grade C of quality • dimensions • visual • tensile test • flattening* • drift expanding* • optional - upon agreement	50049/2.2 3.1.B			
6323/ 1,4	CFS 3 CFS 4 CFS 5 CFS 6 CFS 7 CFS 8	Cold finished Symbol for steel condition: BK BKW GBK NBK		• product analysis • tensile test • flattening • leak tightness - upon agreement	Test results			
49-310 49-312	TU37b TU52b TU20MV6 S 470M S 450MG2	Symbol for steel condition: BK BKW BK + S GBK NBK		• tensile test • flattening* • drift expanding* • dimensions • visual • other tests - upon agreement	49-001 non-specific • 2.2 specific • 3.1.B • 3.1.C			
7945	Fe280 Fe320 Fe360 Fe410 Fe490	Cold finished Symbol for steel condition: BK BKW GBK NBK		Non-specific Specific: • product analysis • tensile test • dimensions • visual • optional - upon agreement (including NDT)	10204/2.2 3.1			

Note: * technological test for heat-treated tubes only

Designation of steels for precision tubes according to EN:

- machining steel tubes:
 - steel E355 + AR, E 355 + N
 - E – steel for machine part
 - 355 – minimum yield strength
 - + AR – heat treatment not applied, + N – normalized or normalising formed
 - steel 20MnV6
 - steel designated by chemical composition – guaranteed mean C content 0,20%
 - guaranteed content of Mn and V
 - + AR – heat treatment not applied, + N – normalized or normalising formed
- steels for machine parts
 - steels for working without next heat treatment
 - non-alloy steel E 235, E275, E315, E355
 - condition +AR or +N
 - steels with specified impact properties (fine grain) E275K2, E355K2
 - K2 – minimum average absorbed energy 40J (K) at a test temperature of -20°C
 - steels for heat and chemical-heat treatment of parts after working
 - steel C22E
 - C – steel with C content 0,22%, E – assignment on controlled mean of S and P
 - steel 38Mn6
 - guaranteed mean C content and guaranteed Mn content

Precision cold drawn seamless standard steel tubes

Standards	Dimensional standards	Dimensional range	Dimensions				Straightness	Tube ends
			Tolerance D	Tolerance T	Lengths			
STN ČSN	(42 6710) 42 6711 42 6712	Delivery upon agreement Table 16/Page 64 Table 17/Page 65 Table 20/Page 68 (Other dimensions upon agreement)	D ≤ 30 mm ±0,20 mm D = 30-50 mm ±0,30 mm D = 50-200 mm ±0,8 %	D ≤ 10 mm ±0,20 mm D > 10 mm, T ≤ 1 mm ±0,12 mm D > 10 mm, T = 1-3 mm -10% +12% D > 10 mm, T > 3 mm ±10 %	see page 36	• random 3-7 (9) m • fixed with tolerance ±500 mm • exact with tolerance 0 + upon agreement • max length 18 m - upon agreement L ≤ 3 m 0 +5 mm L > 3 m 0 +10 mm	D ≤ 15 mm Straightened 3 mm/m .+1 Precise straightened 1,5 mm/m .+2 (second number behind RN)	• square cut ends • free from excessive burrs • plain ends
GOST	8734 9567 12132		D = 5-10 mm ±0,15 mm D = 10-30 mm ±0,30 mm D = 30-50 mm ±0,4 mm D > 50 mm ±0,8 %	T ≤ 1 mm ±0,12 mm T = 1-5 mm ±10 % T > 5 mm ±8 %		Flexion max 1,5 mm/m		
			See dimensional tables (Inside diameter tolerance is also shown in table) • other tolerances upon agreement • possibility to shift tolerance • by heat treated tubes increasing of tolerance range • ovality included in D tolerances • eccentricity included in T tolerances	D = 5-108 mm T = 0,2-0,8 mm ±0,05 mm T = 0,8-5 mm ±7,5 % T > 5 mm ±6 %				
			Quality range: • usual • increased • high see article 1.10 of standard					
PN-H	74240 (74220)		See dimensional tables (Inside diameter tolerance is also shown in table) • other tolerances upon agreement • possibility to shift tolerance • by heat treated tubes increasing of tolerance range • ovality included in D tolerances • eccentricity included in T tolerances	±10 % min ±0,1 mm (Applied for ordering by: • OD x T • ID x T)	• fixed with tolerance ±500 mm • exact with tolerance 0 + upon agreement • max length 18 m - upon agreement	• total deviation: ReH < 500 MPa 0,0015 L ReH > 500 MPa 0,002 L • local deviation max 3 mm/m		
ASTM	A519				See page 18			
JIS	G3445				See page 18			

Notes:

- Tolerances of outside or inside diameter are not given like % of diameter as with rolled tubes, but they are usually a part of dimensional tables. Values in Table 16 are taken from EN 10305-1. Exact tolerance values of tubes according to other standards are given in appropriate standards.
- Tubes shall be ordered: D x ID, D x T, ID x T (ID = inside diameter). The tolerances are valid for these two ordered values.
- Tubes for mechanical and pressure purposes (page 16-49) upon agreement can be delivered as precision according to dimensional standards for precision tubes.
- Precision tubes can be delivered also upon bilaterally agreed TDC and technical specifications.
- Ovality and eccentricity see p. 27.

List of dimensional standards and technical delivery conditions standards

STN 42 0260	ČSN 42 0260	Cold drawn precision seamless steel tubes from steel class 10 to 16.
STN 42 6710	ČSN 42 6710	Cold drawn seamless tubes with normal tolerances. Dimensions.
STN 42 6711	ČSN 42 6711	Precision seamless steel tubes. Dimensions.
STN 42 6712	ČSN 42 6712	Precision seamless steel tubes with increased accuracy. Dimensions.
GOST 8733		Seamless steel tubes cold and hot deformed. TDC.
GOST 8734		Seamless steel tubes cold deformed. Dimensions.
GOST 12132		Electrowelded and seamless steel tubes for automotive and bicycle industries.
GOST 21729		Cold deformed and hot deformed structural carbon and alloyed steel tubes.
PN-H 74220		Seamless steel cold drawn or rolled tubes for general purposes.
PN-H 74240		Seamless cold drawn precision steel tubes. (Titles of standards for steels see page 90)
ASTM A519		Seamless carbon and alloy steel mechanical tubing.
JIS G 3445		Carbon steel tubes for machine structural purposes.

TDC standards	Steel grade			Testing and certificates		Other TDC		
	Name	Condition	Surface	Testing	Certificate	Marking	Surface protection	Packing
42 0260	11 353 11 453 11 503 11 523 11 550 11 650 12 040 12 050 12 060	Cold finished Symbol for steel condition: .0 No heat treatment .1 Normalized Other conditions upon agreement	• 0+ - scaled • 1+ - pickled • 2+ - free of scale • 3+ - bright • 4+ - metallic clean • 9+ - special agreement (first number behind DS)	• dimensions • tensile test .1, .2, .4 • hardness .3 • flattening .4 • drift expanding .4 • leak tightness .2, .4 • NDT - upon agreement	.1+ - certificate .2+ - inspection .9+ - agreement	Label with data on bundle Upon agreement Data: • manufacturer • order • dimension • steel • condition • quantity • colour strap on tube	Temporary upon agreement	Bundle with section: • round • hexagonal Max weight 2000 kg
8733 21729	1050: 10 20 35 45 4543: 10G2 15ChM 19281: 09G2S	Cold finished Symbol for steel condition: No heat treatment Normalized Other conditions upon agreement		• product analysis • dimensions • visual • hardness • leak tightness			GOST 10692	
74240 (74220)	84018: 18G2A 18G2 84019: 10 20 35 45 55 84023/7: R35 R45 R55 R65	Cold finished Symbol for steel condition: BK BKW GBK NBK						
A519 G3445				See page 19 See page 19				

Condition and heat treatment terminology – STN 42 0002, STN 42 0004, EN 10052, DIN 2391-2 and EN 10305-1, ISO 4885

Delivery conditions and heat treatment according to DIN and EN

Precision tubes are delivered in following conditions (first symbol lists previous designation, the new one according to EN is in brackets):

BK (+C) Cold finished/hard (cold finished as drawn).
No heat treatment after last cold forming process.

BKW (+LC) Cold finished/soft (lightly cold worked).
After last heat treatment there is a light finishing pass (cold drawing).

BKS (+SR) Cold finished/stress relieve annealed.
After the final cold forming process the tubes are stress relieve annealed.

GBK (+A) Annealed. After the final cold forming process the tubes are annealed in a controlled atmosphere.

NBK (+N) Normalized. After the final cold forming process the tubes are annealed above the upper transformation point in a controlled atmosphere.

Material condition designation depending on heat treatment according to ČSN and STN (first supplementary number behind steel grade):

- 0 - without heat treatment
- 1 - normalized
- 2 - annealed (kind stated)
- 3 - soft annealed
- 4 - quenched and tempered
- 5 - normalised and tempered
- 6 - heat treatment with the object of achieving a minimum tensile within a specified range
- 7 - heat treatment with the object of achieving an average tensile within a specified range
- 8 - heat treatment with the object of achieving a maximum tensile within a specified range
- 9 - specific (upon agreement)

Steel condition designation according to ASTM A519:

- CW - Cold Worked
- A - Annealed
- N - Normalized
- SR - Stress Relieved or Finished Annealed
- QT - Quenched and Tempered

Outside diameter [mm]	Tolerance	Wall thickness [mm]																				
		0,5	0,8	1	1,2	1,5	1,8	2	2,2	2,5	2,8	3	3,5	4	4,5	5	5,5	6	7	8	9	10
Inside diameter and tolerances																						
4		3±0,15	2,4±0,15	2±0,15	1,6±0,15																	
5		4±0,15	3,4±0,15	3±0,15	2,6±0,15																	
6		5±0,15	4,4±0,15	4±0,15	3,6±0,15	3±0,15	2,4±0,15	2±0,15														
7		6±0,15	5,4±0,15	5±0,15	4,6±0,15	4±0,15	3,4±0,15	3±0,15														
8		7±0,15	6,4±0,15	6±0,15	5,6±0,15	5±0,15	4,4±0,15	4±0,15	3,6±0,15	3±0,25												
9		8±0,15	7,4±0,15	7±0,15	6,6±0,15	6±0,15	5,4±0,15	5±0,15	4,6±0,15	4±0,25	3,4±0,25											
10	±0,08	9±0,15	8,4±0,15	8±0,15	7,6±0,15	7±0,15	6,4±0,15	6±0,15	5,6±0,15	5±0,15	4,4±0,25	4±0,25										
12		11±0,15	10,4±0,15	10±0,15	9,6±0,15	9±0,15	8,4±0,15	8±0,15	7,6±0,15	7±0,15	6,4±0,15	6±0,25	5±0,25	4±0,25								
14		13±0,08	12,4±0,08	12±0,08	11,6±0,15	11±0,15	10,4±0,15	10±0,15	9,6±0,15	9±0,15	8,4±0,15	8±0,15	7±0,15	6±0,25	5±0,25							
15		14±0,08	13,4±0,08	13±0,08	12,6±0,08	12±0,15	11,4±0,15	11±0,15	1,60±0,15	10±0,15	9,4±0,15	9±0,15	8±0,15	7±0,15	6±0,25							
16		15±0,08	14,4±0,08	14±0,08	13,6±0,08	13±0,08	12,4±0,15	12±0,15	11,6±0,15	11±0,15	10,4±0,15	10±0,15	9±0,15	8±0,15	7±0,15							
18		17±0,08	16,4±0,08	16±0,08	15,6±0,08	15±0,08	14,4±0,08	14±0,08	13,6±0,15	13±0,15	12,4±0,15	12±0,15	11±0,15	10±0,15	9±0,15							
20		19±0,08	18,4±0,08	18±0,08	17,6±0,08	17±0,08	16,4±0,08	16±0,08	15,6±0,15	15±0,15	14,4±0,15	14±0,15	13±0,15	12±0,15	11±0,15	10±0,15	9±0,15	8±0,25				
22		21±0,08	20,4±0,08	20±0,08	19,6±0,08	19±0,08	18,4±0,08	18±0,08	17,6±0,08	17±0,15	16,4±0,15	16±0,15	15±0,15	14±0,15	13±0,075	12±0,15	11±0,15	10±0,15				
25		23,4±0,08	23±0,08	22,6±0,08	22±0,08	21,4±0,08	21±0,08	20,6±0,08	20±0,08	19,4±0,15	19±0,15	18±0,15	17±0,15	16±0,15	15±0,15	14±0,15	13±0,15					
26		24,4±0,08	24±0,08	23,6±0,08	23±0,08	22,4±0,08	22±0,08	21,6±0,08	21±0,08	20,4±0,15	20±0,15	19±0,15	18±0,15	17±0,15	16±0,15	15±0,15	14±0,15					
28		26,4±0,08	26±0,08	25,6±0,08	25±0,08	24,4±0,08	24±0,08	23,6±0,08	23±0,08	22,4±0,08	22±0,15	21±0,15	20±0,15	19±0,15	18±0,15	17±0,15	16±0,15					
30		28,4±0,08	28±0,08	27,6±0,08	27±0,08	26,4±0,08	26±0,08	25,6±0,08	25±0,08	24,4±0,08	24±0,15	23±0,15	22±0,15	21±0,15	20±0,15	19±0,15	18±0,15					
32		30,4±0,15	30±0,15	29,6±0,15	29±0,15	28,4±0,15	28±0,15	27,6±0,15	27±0,15	26,4±0,15	26±0,15	25±0,15	24±0,15	23±0,15	22±0,15	21±0,15	20±0,15	18±0,15				
35	±0,15	33,4±0,15	33±0,15	32,6±0,15	32±0,15	31,4±0,15	31±0,15	30,6±0,15	30±0,15	29,4±0,15	29±0,15	28±0,15	27±0,15	26±0,15	25±0,15	24±0,15	23±0,15	21±0,15	19±0,15			
38		36,4±0,15	36±0,15	35,6±0,15	35±0,15	34,4±0,15	34±0,15	33,6±0,15	33±0,15	32,4±0,15	32±0,15	31±0,15	30±0,15	29±0,15	28±0,15	27±0,15	26±0,15	24±0,15	22±0,15			
40		38,4±0,15	38±0,15	37,6±0,15	37±0,15	36,4±0,15	36±0,15	35,6±0,15	35±0,15	34,4±0,15	34±0,15	33±0,15	32±0,15	31±0,15	30±0,15	29±0,15	28±0,15	26±0,15	24±0,15			
42				39,6±0,20	39±0,20	38,4±0,20	38±0,20	37,6±0,20	37±0,20	36,4±0,20	36±0,20	35±0,20	34±0,20	33±0,20	32±0,20	31±0,20	30±0,20	28±0,20	26±0,20			
45	±0,20			42,6±0,20	42±0,20	41,4±0,20	41±0,20	40,6±0,20	40±0,20	39,4±0,20	39±0,20	38±0,20	37±0,20	36±0,20	35±0,20	34±0,20	33±0,20	31±0,20	29±0,20			
48				45,6±0,20	45±0,20	44,4±0,20	44±0,20	43,6±0,20	43±0,20	42,4±0,20	42±0,20	41±0,20	40±0,20	39±0,20	38±0,20	37±0,20	36±0,20	34±0,20	32±0,20	30±0,20	28±0,20	
50				47,6±0,20	47±0,20	46,4±0,20	46±0,20	45,6±0,20	45±0,20	44,4±0,20	44±0,20	43±0,20	42±0,20	41±0,20	40±0,20	39±0,20	38±0,20	36±0,20	34±0,20	32±0,20	30±0,20	
55	±0,25			52,6±0,25	52±0,25	51,4±0,25	51±0,25	50,6±0,25	50±0,25	49,4±0,25	49±0,25	48±0,25	47±0,25	46±0,25	45±0,25	44±0,25	43±0,25	41±0,25	39±0,25	37±0,25	35±0,25	
60				57,6±0,25	57±0,25	56,4±0,25	56±0,25	55,6±0,25	55±0,25	54,4±0,25	54±0,25	53±0,25	52±0,25	51±0,25	50±0,25	49±0,25	48±0,25	46±0,25	44±0,25	42±0,25	40±0,25	
65	±0,30			62,6±0,30	62±0,30	61,4±0,30	61±0,30	60,6±0,30	60±0,30	59,4±0,30	59±0,30	58±0,30	57±0,30	56±0,30	55±0,30	54±0,30	53±0,30	51±0,30	49±0,30	47±0,30	45±0,30	
70				67,6±0,30	67±0,30	66,4±0,30	66±0,30	65,6±0,30	65±0,30	64,4±0,30	64±0,30	63±0,30	62±0,30	61±0,30	60±0,30	59±0,30	58±0,30	56±0,30	54±0,30	52±0,30	50±0,30	
75	±0,35							71±0,35	70,6±0,35	70±0,35	69,4±0,35	69±0,35	68±0,35	67±0,35	66±0,35	65±0,35	64±0,35	63±0,35	61±0,35	59±0,35	57±0,35	55±0,35
80								76±0,35	75,6±0,35	75±0,35	74,4±0,35	74±0,35	73±0,35	72±0,35	71±0,35	70±0,35	69±0,35	68±0,35	66±0,35	64±0,35	62±0,35	60±0,35
85	±0,40							81±0,40	80,6±0,40	80±0,40	79,4±0,40	79±0,40	78±0,40	77±0,40	76±0,40	75±0,40	74±0,40	73±0,40	71±0,40	69±0,40	67±0,40	65±0,40
90								86±0,40	85,6±0,40	85±0,40	84,4±0,40	84±0,40	83±0,40	82±0,40	81±0,40	80±0,40	79±0,40	78±0,40	76±0,40	74±0,40	72±0,40	70±0,40
95	±0,45							91±0,45	90,6±0,45	90±0,45	89,4±0,45	89±0,45	88±0,45	87±0,45	86±0,45	85±0,45	84±0,45	83±0,45	81±0,45	79±0,45	77±0,45	75±0,45
100								96±0,46	95,6±0,45	95±0,45	94,4±0,45	94±0,45	93±0,45	92±0,45	91±0,45	90±0,45	89±0,45	88±0,45	86±0,45	84±0,45	82±0,45	80±0,45
110	±0,50								105,6±0,50	105±0,50	104,4±0,50	104±0,50	103±0,50	102±0,50	101±0,50	100±0,50	99±0,50	98±0,50	96±0,50	94±0,50	92±0,50	90±0,50
120												114±0,50	113±0,50	112±0,50	111±0,50	110±0,50	109±0,50	108±0,50	106±0,50	104±0,50	102±0,50	100±0,50

Other dimensions (up to diameter 162) and tolerances upon agreement.

Tolerances D are valid for conditions BK and BKW according to DIN standards and for conditions +C a +LC according to EN standards. At heat treated tubes (conditions NBK, GBK, BKS according to DIN standards and conditions +N, +A, +SR according to EN standards) can be tolerances enlarged, as is shown in the table on page 65.

This is valid also in other standards.

Dimensions of precision seamless cold drawn steel tubes with reduced tolerances

Table 17

Outside diameter [mm]	Tolerance	Wall thickness [mm]															
		0,5	1	1,5	2	2,5	3	3,5	4	4,5	5	5,5	6	7	8	9	10
Inside diameter and tolerances																	
5		4±0,12	3±0,12														
6		5±0,12	4±0,10	3±0,12	2±0,12												
7		6±0,12	5±0,10	4±0,12	3±0,12												
8		7±0,10	6±0,10	5±0,10	4±0,12	3±0,15	2±0,15										
9		8±0,10	7±0,10	6±0,10	5±0,12	4±0,15	3±0,15										
10	±0,05	9±0,08	8±0,07	7±0,08	6±0,12	5±0,15	4±0,15	3±0,15									
12		11±0,08	10±0,07	9±0,08	8±0,10	7±0,15	6±0,15	5±0,15	4±0,20								
14		13±0,08	12±0,07	11±0,07	10±0,10	9±0,12	8±0,15	7±0,15	6±0,20	5±0,20	4±0,20						
15		14±0,08	13±0,07	12±0,07	11±0,10	10±0,12	9±0,15	8±0,15	7±0,15	6±0,20	5±0,20						
16		15±0,08	14±0,07	13±0,07	12±0,10	11±0,12	10±0,15	9±0,15	8±0,15	7±0,15	6±0,20						
18		17±0,08	16±0,06	15±0,05	14±0,05	13±0,05	12±0,05	11±0,05	10±0,05	9±0,15	8±0,15						
20		19±0,08	18±0,06	17±0,05	16±0,05	15±0,05	14±0,05	13±0,05	12±0,05	11±0,15	10±0,15	9±0,15	8±0,15				
22		21±0,08	20±0,06	19±0,05	18±0,05	17±0,05	16±0,05	15±0,05	14±0,05	13±0,10	12±0,15	11±0,15	10±0,15				
25	±0,05	24±0,08	23±0,08	22±0,08	21±0,08	20±0,08	19±0,08	18±0,08	17±0,06	16±0,06	15±0,06	14±0,06	13±0,06				
26		25±0,08	24±0,08	23±0,08	22±0,08	21±0,08	20±0,08	19±0,08	18±0,06	17±0,06	16±0,06	15±0,06	14±0,06				
28	±0,07		26±0,08	25±0,08	24±0,08	23±0,08	22±0,08	21±0,08	20±0,08	19±0,08	18±0,06	17±0,06	16±0,06				
30			28±0,08	27±0,08	26±0,08	25±0,08	24±0,08	23±0,08	22±0,08	21±0,08	20±0,08	19±0,06	18±0,06	16±0,06			
32	±0,10		30±0,12	29±0,12	28±0,12	27±0,10	26±0,10	25±0,10	24±0,10	23±0,08	22±0,08	21±0,08	20±0,08	18±0,08	16±0,08		
35			33±0,12	32±0,12	31±0,12	30±0,10	29±0,10	28±0,10	27±0,10	26±0,08	25±0,08	24±0,08	23±0,08	21±0,08	19±0,08		
38	±0,12		36±0,014	35±0,14	34±0,14	33±0,10	32±0,010	31±0,10	30±0,10	29±0,10	28±0,08	27±0,08	26±0,08	24±0,08	22±0,08		
40			38±0,14	37±0,14	36±0,14	35±0,10	34±0,10	33±0,10	32±0,10	31±0,10	30±0,08	29±0,08	28±0,08	26±0,08	24±0,08	22±0,10	20±0,10
42			40±0,18	39±0,18	38±0,18	37±0,18	36±0,15	35±0,15	34±0,15	33±0,15	32±0,10	31±0,10	30±0,10	28±0,10	26±0,10	24±0,10	22±0,10
45	±0,15		43±0,18	42±0,18	41±0,18	40±0,18	39±0,15	38±0,15	37±0,15	36±0,15	35±0,10	34±0,10	33±0,10	31±0,10	29±0,10	27±0,10	25±0,10
48			46±0,18	45±0,18	44±0,18	43±0,18	42±0,15	41±0,15	40±0,15	39±0,15	38±0,10	37±0,10	36±0,10	34±0,10	32±0,10	30±0,10	28±0,10
50			48±0,18	47±0,18	46±0,18	45±0,18	44±0,15	43±0,15	42±0,15	41±0,15	40±0,12	39±0,10	38±0,10	36±0,10	34±0,10	32±0,10	30±0,10
55	±0,18			52±0,18	51±0,18	50±0,18	49±0,15	48±0,15	47±0,15	46±0,15	45±0,12	44±0,10	43±0,10	41±0,10	39±0,10	37±0,15	35±0,15
60				57±0,18	56±0,18	55±0,18	54±0,15	53±0,15	52±0,15	51±0,15	50±0,12	49±0,10	48±0,10	46±0,10	44±0,10	42±0,15	40±0,15
65	±0,20			62±0,20	61±0,20	60±0,20	59±0,20	58±0,20	57±0,20	56±0,15	55±0,15	54±0,15	53±0,15	51±0,15	49±0,15	47±0,15	45±0,15
70				67±0,25	66±0,25	65±0,25	64±0,20	63±0,20	62±0,20	61±0,15	60±0,15	59±0,15	58±0,15	56±0,15	54±0,15	52±0,15	50±0,15
75	±0,25			72±0,30	71±0,30	70±0,30	69±0,25	68±0,25	67±0,25	66±0,20	65±0,20	64±0,20	63±0,20	61±0,20	59±0,20	57±0,20	55±0,20
80				77±0,30	76±0,30	75±0,30	74±0,25	73±0,25	72±0,25	71±0,20	70±0,20	69±0,20	68±0,20	66±0,20	64±0,20	62±0,20	60±0,20
85	±0,30			82±0,32	81±0,32	80±0,32	79±0,30	78±0,30	77±0,30	76±0,25	75±0,20	74±0,20	73±0,20	71±0,20	69±0,20	67±0,20	65±0,20
90				87±0,32	86±0,32	85±0,32	84±0,30	83±0,30	82±0,30	81±0,25	80±0,25	79±0,25	78±0,20	76±0,20	74±0,20	72±0,20	70±0,20
95	±0,35				91±0,35	90±0,35	89±0,35	88±0,30	87±0,30	86±0,30	85±0,25	84±0,25	83±0,22	81±0,22	79±0,20	77±0,20	75±0,20
100					96±0,35	95±0,35	94±0,35	93±0,30	92±0,30	91±0,30	90±0,25	89±0,25	88±0,22	86±0,22	84±0,20	82±0,20	80±0,20
110	±0,40				106±0,40	105±0,40	104±0,40	103±0,35	102±0,35	101±0,35	100±0,30	99±0,30	98±0,25	96±0,25	94±0,25	92±0,25	90±0,25
120					116±0,40	115±0,40	114±0,40	113±0,35	112±0,35	111±0,35	110±0,30	109±0,30	108±0,25	106±0,25	104±0,25	102±0,25	100±0,25

Tolerance of wall thickness ±7,5 %.

Possible values of outside diameter for heat treated tubes

DIN, EN	NFA, UNI	STN, ČSN	Coefficient value
Ratio T/D	Ratio T/D	Ratio D/T	
> 0,05	> 1/20	≤ 20	1
0,05 - 0,025	1/20 - 1/40	20 - 40	1,5
< 0,025	1/40 - 1/60	40 - 60	2
	< 1/60	≥ 60	2,5

Dimensions and weight of cold drawn steel tubes according to standards ASTM A450 and A1016 - weight in lb/ft **Table 18**

Outside diameter		Tube weight in lb/ft with wall thickness (gauge/inches/mm)																	
		25g	20g	18g	16g	14g	13g	12g	11g	10g	9g	5/32	3/16	7/32	1/4	9/32	5/16	3/8	
		.020	.035	.049	.065	.083	.095	.109	.120	.134	.148	.156	.188	.219	.250	.281	.313	.375	
mm	inch	0,51	0,89	1,24	1,65	2,11	2,41	2,77	3,05	3,40	3,76	3,96	4,78	5,56	6,35	7,14	7,95	9,53	
6,35	1/4" (.250)	.049	.080	.105	.128														
9,53	3/8" (.375)	.075	.127	.170	.215	.258	.284												
12,70	1/2" (.500)	.102	.173	.236	.302	.369	.410	.445	.487										
15,88	5/8" (.625)			.301	.388	.480	.537	.600	.647										
19,05	3/4" (.750)			.366	.475	.591	.664	.746	.807										
22,23	7/8" (.875)			.432	.562	.702	.791	.891	.967	1.060									
25,40	1" (1.000)			.497	.649	.812	.918	1.037	1.128	1.239	1.346	1.406							
28,58	1 1/8" (1.125)			.563	.735	.923	1.045	1.183	1.288	1.418	1.544	1.614							
31,75	1 1/4" (1.250)			.628	.822	1.034	1.172	1.328	1.448	1.597	1.741	1.832	2.132						
34,93	1 3/8" (1.375)			.693	.909	1.145	1.299	1.437	1.608	1.776	1.939	2.031	2.383	2.704	3.004				
38,10	1 1/2" (1.500)			.759	.996	1.256	1.426	1.619	1.769	1.955	2.137	2.239	2.634	2.996	3.338	3.658			
41,28	1 5/8" (1.625)				1.083	1.369	1.552	1.764	1.929	2.133	2.334	2.447	2.885	3.289	3.671	4.033			
44,45	1 3/4" (1.750)				1.170	1.478	1.679	1.910	2.089	2.313	2.532	2.656	3.136	3.581	4.005	4.409	4.804		
47,63	1 7/8" (1.875)				1.257	1.589	1.806	2.055	2.249	2.491	2.729	2.864	3.387	3.873	4.339	4.784	5.222		
50,80	2" (2.000)				1.343	1.699	1.933	2.201	2.409	2.670	2.927	3.072	3.638	4.166	4.673	5.159	5.639	6.508	
53,98	2 1/8" (2.125)				1.430	1.809	2.060	2.346	2.569	2.849	3.125	3.281	3.889	4.458	5.006	5.534	6.057	7.009	
57,15	2 1/4" (2.250)				1.517	1.921	2.186	2.492	2.730	3.027	3.322	3.489	4.140	4.750	5.340	5.909	6.475	7.509	
60,33	2 3/8" (2.375)				1.604	2.031	2.313	2.638	2.890	3.207	3.520	3.697	4.391	5.043	5.674	6.284	6.893	8.010	
63,50	2 1/2" (2.500)				1.690	2.143	2.440	2.783	3.050	3.385	3.717	3.905	4.642	5.335	6.008	6.659	7.311	8.511	
66,68	2 5/8" (2.625)				1.777	2.253	2.567	2.928	3.210	3.565	3.915	4.114	4.893	5.627	6.341	7.035	7.729	9.011	
69,85	2 3/4" (2.750)				1.864	2.364	2.699	3.074	3.371	3.743	4.112	4.322	5.144	5.920	6.675	7.409	8.147	9.512	
73,03	2 7/8" (2.875)				1.951	2.474	2.820	3.220	3.671	3.922	4.310	4.530	5.395	6.212	7.009	7.785	8.564	10.01	
76,20	3" (3.000)				2.037	2.586	2.947	3.365	3.691	4.102	4.508	4.739	5.646	6.505	7.342	8.160	8.982	10.51	
79,38	3 1/8" (3.125)				2.124	2.696	3.074	3.510	3.851	4.208	4.705	4.947	5.897	6.797	7.676	8.535	9.400	11.01	
82,55	3 1/4" (3.250)				2.211	2.807	3.200	3.656	4.011	4.458	4.903	5.155	6.148	7.089	8.010	8.910	9.818	11.51	
88,90	3 1/2" (3.500)					3.029	3.455	3.947	4.332	4.817	5.298	5.571	6.650	7.674	8.678	9.660	10.65	12.52	
92,08	3 5/8" (3.625)						3.139	3.582	4.092	4.492	4.996	5.495	5.780	6.901	7.966	9.011	10.04	11.07	13.02
95,25	3 3/4" (3.750)						3.251	3.708	4.238	4.652	5.174	5.693	5.988	7.152	8.258	9.345	10.41	11.49	13.52
101,60	4" (4.000)						3.472	3.962	4.529	4.972	5.532	6.088	6.404	7.344	8.843	10.01	11.16	12.33	14.52
104,78	4 1/8" (4.125)												6.613	7.905	9.135	10.69	11.53	12.74	15.02
107,95	4 1/4" (4.250)														9.428	10.86	11.91	13.16	15.52
114,30	4 1/2" (4.500)														10.01	11.35	12.66	14.00	16.52
120,65	4 3/4" (4.750)														10.60	12.01	13.41	14.83	17.52

Permissible tolerances of outside diameter according to ASTM A450/A450M and ASTM A1016/A1016M

Outside diameter			
Hot formed	under 4" (101,6 mm)	-1/32 (0,8 mm)	+1/64 (0,4 mm)
	4" - 7 1/2" (101,6 - 190,5 mm)	-3/64 (1,2 mm)	+1/64 (0,4 mm)
Cold drawn	under 1" (25,4 mm)	-0.004 (0,1 mm)	+0.004 (0,1 mm)
	1" - 1 1/2" (25,4 - 38,1 mm)	-0.006 (0,15 mm)	+0.006 (0,15 mm)
	over 1 1/2" - 2" (38,1 - 50,8 mm)	-0.008 (0,2 mm)	+0.008 (0,2 mm)
	2" - 2 1/2" (50,8 - 63,5 mm)	-0.010 (0,25 mm)	+0.010 (0,25 mm)
	2 1/2" - 3" (63,5 - 76,2 mm)	-0.012 (0,3 mm)	+0.012 (0,3 mm)
	3" - 4" (76,2 - 101,6 mm)	-0.015 (0,38 mm)	+0.015 (0,38 mm)
	4" - 7 1/2" (101,6 - 190,5 mm)	-0.015 (0,38 mm)	+0.025 (0,64 mm)

Dimensions and weight of cold drawn steel tubes according to standards ASTM A450 and A1016 - weight in kg/m Table 19

Outside diameter		Tube weight in kg/m with wall thickness (gauge/inches/mm)																	
		25g	20g	18g	16g	14g	13g	12g	11g	10g	9g	5/32	3/16	7/32	1/4	9/32	5/16	3/8	
		.020	.035	.049	.065	.083	.095	.109	.120	.134	.148	.156	.188	.219	.250	.281	.313	.375	
mm	inch	0,51	0,89	1,24	1,65	2,11	2,41	2,77	3,05	3,40	3,76	3,96	4,78	5,56	6,35	7,14	7,95	9,53	
6,35	1/4" (.250)	0,073	0,119	0,156	0,190														
9,53	3/8" (.375)	0,112	0,189	0,253	0,320	0,384	0,423												
12,70	1/2" (.500)	0,152	0,257	0,351	0,449	0,549	0,610	0,662	0,725										
15,88	5/8" (.625)			0,448	0,577	0,714	0,799	0,893	0,963										
19,05	3/4" (.750)			0,545	0,707	0,880	0,988	1,110	1,201										
22,23	7/8" (.875)			0,643	0,836	1,045	1,177	1,326	1,439	1,577									
25,40	1" (1.000)			0,740	0,966	1,208	1,366	1,543	1,679	1,844	2,003	2,092							
28,58	1 1/8" (1.125)			0,838	1,094	1,374	1,555	1,760	1,917	2,110	2,298	2,402							
31,75	1 1/4" (1.250)			0,935	1,223	1,539	1,744	1,976	2,155	2,377	2,591	2,726	3,173						
34,93	1 3/8" (1.375)			1,031	1,353	1,704	1,933	2,138	2,393	2,643	2,886	3,022	3,546	4,024	4,470				
38,10	1 1/2" (1.500)			1,130	1,482	1,869	2,122	2,409	2,633	2,909	3,180	3,332	3,920	4,459	4,967	5,444			
41,28	1 5/8" (1.625)				1,612	2,037	2,310	2,625	2,871	3,174	3,473	3,642	4,293	4,895	5,463	6,002			
44,45	1 3/4" (1.750)				1,741	2,200	2,499	2,842	3,109	3,442	3,768	3,953	4,667	5,329	5,960	6,561	7,149		
47,63	1 7/8" (1.875)				1,871	2,365	2,688	3,058	3,347	3,707	4,061	4,262	5,040	5,764	6,457	7,119	7,771		
50,80	2" (2.000)				1,999	2,528	2,877	3,275	3,585	3,973	4,356	4,572	5,414	6,200	6,954	7,677	8,392	9,685	
53,98	2 1/8" (2.125)				2,128	2,692	3,066	3,491	3,823	4,240	4,651	4,883	5,787	6,634	7,450	8,235	9,014	10,431	
57,15	2 1/4" (2.250)				2,258	2,859	3,253	3,708	4,063	4,505	4,944	5,192	6,161	7,069	7,947	8,794	9,636	11,175	
60,33	2 3/8" (2.375)				2,387	3,022	3,442	3,926	4,301	4,773	5,238	5,502	6,535	7,505	8,444	9,352	10,258	11,920	
63,50	2 1/2" (2.500)				2,515	3,189	3,631	4,142	4,539	5,037	5,531	5,811	6,908	7,939	8,941	9,910	10,880	12,666	
66,68	2 5/8" (2.625)				2,644	3,353	3,820	4,357	4,777	5,305	5,826	6,122	7,282	8,374	9,436	10,469	11,502	13,410	
69,85	2 3/4" (2.750)				2,774	3,518	4,017	4,575	5,017	5,570	6,119	6,432	7,655	8,810	9,933	11,026	12,124	14,155	
73,03	2 7/8" (2.875)				2,903	3,682	4,197	4,792	5,463	5,837	6,414	6,741	8,029	9,244	10,431	11,585	12,745	14,896	
76,20	3" (3.000)				3,031	3,848	4,386	5,008	5,493	6,104	6,709	7,052	8,402	9,680	10,926	12,143	13,367	15,641	
79,38	3 1/8" (3.125)				3,161	4,012	4,575	5,223	5,731	6,262	7,002	7,362	8,776	10,115	11,423	12,701	13,989	16,385	
82,55	3 1/4" (3.250)				3,290	4,177	4,762	5,441	5,969	6,634	7,296	7,671	9,149	10,550	11,920	13,260	14,611	17,129	
88,90	3 1/2" (3.500)					4,508	5,142	5,874	6,447	7,168	7,884	8,291	9,896	11,420	12,914	14,376	15,849	18,632	
92,08	3 5/8" (3.625)					4,671	5,331	6,090	6,685	7,435	8,177	8,602	10,270	11,855	13,410	14,941	16,474	19,376	
95,25	3 3/4" (3.750)					4,838	5,518	6,307	6,923	7,700	8,472	8,911	10,643	12,289	13,907	15,492	17,099	20,120	
101,60	4" (4.000)					5,167	5,896	6,740	7,399	8,233	9,060	9,530	10,929	13,160	14,896	16,608	18,349	21,608	
104,78	4 1/8" (4.125)												9,841	11,764	13,594	15,908	17,158	18,959	22,352
107,95	4 1/4" (4.250)													14,030	16,161	17,724	19,584	23,096	
114,30	4 1/2" (4.500)													14,896	16,891	18,840	20,834	24,584	
120,65	4 3/4" (4.750)													15,774	17,873	19,956	22,069	26,073	

Notes:

- Weights are valid for average (nominal) wall thickness.
- Other dimensions upon agreement. Wall thickness according BWG and SWG (see table 4 on page 30) within range 25 - 2/0 (BWG) and 25 - 3/0 (SWG).

Permissible tolerances of wall thickness according to ASTM A450/A450M

Wall thickness				
Hot formed	≤ 0,095" (2,4 mm) 0 +40%	0,095" - 0,15" (2,4 - 3,8 mm) 0 +35%	0,15" - 0,18" (3,8 - 4,6 mm) 0 +33%	≥ 0,18" (4,6 mm) 0 +28%
Cold formed	With outside diameter			
Welded	≤ 1 1/2" (38,1 mm)	0 +20%	≥ 1 1/2" (38,1 mm)	0 +22%

Dimensions and weight of precision seamless cold drawn steel tubes according to standards STN, ČSN, BS, GOST (dimensions are valid also for other standards)

Table 20

Outside diameter [mm]	Wall thickness [mm]														
	0,5	1,0	1,5	2,0	2,5	3,0	3,5	4,0	4,5	5,0	6,0	7,0	8,0	9,0	10,0
	Tube weight [kg/m]														
4	0,043	0,074													
5	0,055	0,099													
6	0,068	0,123	0,166	0,197											
8	0,093	0,173	0,240	0,296	0,339	0,370									
10	0,117	0,222	0,314	0,395	0,462	0,518									
12	0,142	0,271	0,388	0,493	0,586	0,666	0,734	0,789							
14	0,166	0,321	0,462	0,592	0,709	0,814	0,906	0,986	1,054						
15	0,179	0,345	0,499	0,641	0,771	0,888	0,993	1,085	1,165						
16	0,191	0,370	0,536	0,691	0,832	0,962	1,079	1,184	1,276						
18	0,216	0,419	0,610	0,789	0,956	1,110	1,252	1,381	1,498						
20	0,240	0,469	0,684	0,888	1,079	1,258	1,424	1,578	1,720	1,850	2,071				
22		0,518	0,758	0,986	1,202	1,406	1,597	1,777	1,942	2,096	2,367				
24		0,567	0,832	1,085	1,326	1,554	1,769	1,973	2,164	2,343	2,663				
25		0,592	0,869	1,134	1,387	1,628	1,856	2,072	2,275	2,446	2,811				
28		0,666	0,980	1,282	1,572	1,850	2,115	2,368	2,608	2,836	3,255				
30		0,715	1,054	1,381	1,695	1,988	2,287	2,565	2,830	3,083	3,551				
32		0,764	1,128	1,480	1,819	2,146	2,460	2,762	3,052	3,329	3,847	4,316			
35		0,838	1,239	1,628	2,004	2,367	2,719	3,058	3,385	3,699	4,291	4,834			
36		0,863	1,276	1,677	2,065	2,441	2,805	3,157	3,496	3,822	4,439				
38		0,912	1,350	1,766	2,189	2,589	2,978	3,354	3,718	4,069	4,735	5,352	5,919		
40		0,962	1,424	1,874	2,312	2,737	3,150	3,551	3,940	4,316	5,031	5,697	6,313		
42			1,498	1,973	2,435	2,885	3,323	3,749	4,162	4,562	5,327	6,042	6,708		
46			1,646	2,170	2,682	3,181	3,668	4,143	4,605	5,055	5,919	6,733	7,497		
48			1,720	2,269	2,805	3,329	3,841	4,340	4,827	5,302	6,215	7,078	7,892	8,656	9,371
50			1,794	2,368	2,929	3,477	4,014	4,538	5,049	5,549	6,511	7,423	8,286	9,100	9,865
52			1,868	2,466	3,052	3,625	4,188	4,735	5,271	5,795	6,807	7,768	8,681	9,544	10,36
55			1,979	2,614	3,237	3,847	4,445	5,031	5,604	6,165	7,250	8,286	9,273	10,21	11,10
58			2,090	2,762	3,422	4,069	4,704	5,327	5,937	6,535	7,694	8,804	9,865	10,88	11,84
60			2,164	2,861	3,545	4,217	4,877	5,524	6,159	6,782	7,990	9,149	10,26	11,32	12,33
62			2,238	2,959	3,668	4,365	5,049	5,721	6,381	7,028	8,286	9,495	10,65	11,76	12,82
65			2,349	3,107	3,853	4,587	5,308	6,017	6,714	7,398	8,730	10,01	11,25	12,43	13,56
70			2,534	3,354	4,162	4,957	5,740	6,511	7,269	8,015	9,470	10,88	12,23	13,54	14,80
75				3,601	4,470	5,327	6,172	7,004	7,824	8,632	10,21	11,74	13,22	14,65	16,03
80				3,874	4,778	5,697	6,603	7,497	8,379	9,248	10,95	12,60	14,21	15,76	17,26
85				4,094	5,086	6,067	7,035	7,990	8,934	9,865	11,69	13,47	15,19	16,87	18,50
90				4,340	5,395	6,437	7,466	8,484	9,489	10,48	12,43	14,33	16,18	17,98	19,73
100				4,834	6,011	7,176	8,329	9,470	10,60	11,71	13,91	16,06	18,15	20,20	22,20
110					6,628	7,916	9,193	10,46	11,71	12,95	15,39	17,78	20,12	22,42	24,66
120						8,656	10,06	11,44	12,82	14,18	16,87	19,51	22,10	24,64	27,13

Exact value of tolerances depends on:

- the method of ordering of precision tubes (Dxd, DxT, dxT),
- tube delivery condition (drawn hard or heat treated),
- optional tolerance requirements.

Specific figures are given in appropriate standards (generally $D < \pm 0,5 \%$, $T = \pm 10 \%$).

Dimensions according to JIS see Table 10 p. 52.

Standard wire gauge for wall thickness

Nr gaude	B.W.G.		S.W.G.		Nearest 1/64 inch (BWG)
	inch	mm	inch	mm	
36	0.004	0,102	0.0076	0,193	-
35	0.005	0,127	0.0084	0,213	-
34	0.007	0,178	0.0092	0,234	-
33	0.008	0,203	0.0100	0,254	-
32	0.009	0,229	0.0108	0,274	-
31	0.010	0,254	0.0116	0,295	-
30	0.012	0,305	0.0124	0,315	-
29	0.013	0,330	0.0136	0,345	-
28	0.014	0,356	0.0148	0,376	-
27	0.016	0,406	0.0164	0,417	1/64
26	0.018	0,457	0.018	0,457	1/64
25	0.020	0,508	0.020	0,508	1/64
24	0.022	0,559	0.022	0,559	1/64
23	0.025	0,635	0.024	0,610	1/32
22	0.028	0,711	0.028	0,711	1/32
21	0.032	0,813	0.032	0,813	1/32
20	0.035	0,889	0.036	0,914	1/32
19	0.042	1,067	0.040	1,016	3/64
18	0.049	1,245	0.048	1,219	3/64
17	0.058	1,473	0.056	1,422	1/16
16	0.065	1,651	0.064	1,626	1/16
15	0.072	1,829	0.072	1,829	5/64

Nr gaude	B.W.G.		S.W.G.		Nearest 1/64 inch (BWG)
	inch	mm	inch	mm	
14	0.083	2,108	0.080	2,032	5/64
13	0.095	2,413	0.092	2,337	3/32
12	0.109	2,769	0.104	2,642	7/64
11	0.120	3,048	0.116	2,946	1/8
10	0.134	3,404	0.128	3,251	9/64
9	0.148	3,759	0.144	3,658	9/64
8	0.165	4,191	0.160	4,064	11/64
7	0.180	4,572	0.176	4,470	3/16
6	0.203	5,156	0.192	4,877	13/64
5	0.220	5,588	0.212	5,385	7/32
4	0.238	6,045	0.232	5,893	15/64
3	0.259	6,579	0.252	6,401	17/64
2	0.284	7,214	0.276	7,010	9/32
1	0.300	7,620	0.300	7,620	19/64
0	0.340	8,636	0.324	8,230	11/32
2/0	0.380	9,652	0.348	8,839	3/8
3/0	0.425	10,80	0.372	9,449	27/64
4/0	0.454	11,53	0.400	10,16	29/64
5/0	-	-	0.432	10,97	-
6/0	-	-	0.464	11,78	-
7/0	-	-	0.500	12,70	-

Conversion table

US units	SI	SI	US units
1 inch	25,4 mm	1 mm	0.03937 inch
12 inches = 1 foot	304,8 mm	1 m	3.2808 feet
1 sq inch	645 mm ²	1 mm ²	0.00155 sq inch
1 sq foot	0,093 m ²	1 m ²	10.753 sq feet
1 cubic foot	0,02831685 m ³	1 m ³	35.31 cubic feet
1 lb	0,453592 kg	1 kg	2.20462 lbs
1 short ton (US)	0,907185 metric t	1 metric t	1,10231 short ton
1 long ton (UK)	1,01605 metric t	1 metric t	0,9842 long ton
1 ksi	6,894757 Mpa	1 Mpa	0,145038 ksi

Units: inch
foot
lb - libra

Temperature: °C = 5/9 (°F - 32)
°F = 9/5 °C + 32

Conversion of weight to length - C-steel:

Dimensions in mm: 0,0246615 (D - T).T (kg/m)

Dimensions in inch: 10,68142 (D - T).T (lbs/ft)

Weight conversion: kg/m = 1,48816 lb/ft

lb/ft = 0,67197 kg/m

Pressure conversion:

1 Pa = 1 N/m²

1 MPa = 1 N/mm²

1 MPa = 10,1972 Atm

1 MPa = 10⁶ Pa = 10 bar

1 Atm = 0,09806 MPa

1 Atm = 0,98066 bar

1 bar = 1,01972 Atm (tech)

1 bar = 100 000 Pa (100 kPa)

1 bar = 14,504 psi

1 psi = 0,006894757 MPa (6 895 kPa)

1 psi = 0,06894 bar

1 ksi = 1 000 psi = 6,895 (6,9) MPa

Steels for precision cold drawn seamless standard tubes

Standards	Steel grade	Chemical composition [%]										Mechanical properties				
		C	Si	Mn	P _{max}	S _{max}	Cr	Ni	Mo	Cu	Other	Re min MPa	Re min ksi	Rm min MPa	Rm max MPa	A5 min ksi	A5 min %
STN, ČSN																
	11 353	max.0,18			0,050	0,050							235	340	440	25
	11 453	max.0,24			0,050	0,050							265	441	539	21
	11 503	max.0,18	max.0,40	max.1,40	0,035	0,035	max.0,30	max.0,30			max.0,30	Nb 0,015-0,008 Al min.0,015	355	490	630	22
	11 523	max.0,20	max.0,55	max.1,60	0,050	0,045							353	510	628	23
	11 550	max.0,40			0,050	0,050							314	539	637	17
	11 650	max.0,55			0,050	0,050							363	637	735	12
	12 040	0,32-0,40	0,15-0,40	0,50-0,80	0,040	0,040	max.0,25	max.0,30			max.0,30		295	530	530	18
	12 050	0,42-0,50	0,17-0,37	0,50-0,80	0,040	0,040	max.0,25	max.0,30			max.0,30		325	590	590	17
	12 060	0,52-0,60	0,15-0,40	0,50-0,80	0,040	0,040	max.0,25	max.0,30			max.0,30		375	640	640	13
ASTM																
A 53	GradeA	0,25		0,95	0,050	0,045							205	30	330	48
	GradeB	0,30		1,20	0,050	0,045							240	35	415	60
A 519	MT 1010	0,05-0,15		0,30-0,60	0,040	0,050										
	MT 1015	0,10-0,20		0,30-0,60	0,040	0,050										
	MT X 1015	0,10-0,20		0,60-0,90	0,040	0,050										
	MT 1020	0,15-0,25		0,30-0,60	0,040	0,050										
	MT X 1020	0,15-0,25		0,70-1,00	0,040	0,050										
	1008	max.0,10		0,30-0,50	0,040	0,050										
	1010	0,08-0,13		0,30-0,60	0,040	0,050										
	1012	0,10-0,15		0,30-0,60	0,040	0,050										
	1015	0,13-0,18		0,30-0,60	0,040	0,050										
	1016	0,13-0,18		0,60-0,90	0,040	0,050										
	1017	0,15-0,20		0,30-0,60	0,040	0,050										
	1018	0,15-0,20		0,60-0,90	0,040	0,050										
	1019	0,15-0,20		0,70-1,00	0,040	0,050										
	1020	0,18-0,23		0,30-0,60	0,040	0,050							221	32	345	50
	1021	0,18-0,23		0,60-0,90	0,040	0,050										
	1022	0,18-0,23		0,70-1,00	0,040	0,050										
	1025	0,22-0,28		0,30-0,60	0,040	0,050							241	35	379	55
	1026	0,22-0,28		0,60-0,90	0,040	0,050										
	1030	0,28-0,34		0,60-0,90	0,040	0,050										
	1035	0,32-0,38		0,60-0,90	0,040	0,050							276	40	448	65
	1040	0,38-0,44		0,60-0,90	0,040	0,050										
	1045	0,43-0,50		0,60-0,90	0,040	0,050							310	45	517	75
	1050	0,48-0,55		0,60-0,90	0,040	0,050							345	50	552	80
	1518	0,15-0,21		1,10-1,40	0,040	0,050										
	1524	0,19-0,25		1,35-1,65	0,040	0,050										
	1541	0,36-0,44		1,35-1,65	0,040	0,050										
DIN																
1629	St 37.0	max.0,17			0,040	0,040							235	350	480	25
	St 44.0	max.0,21			0,040	0,040							275	420	550	21
	St 52.0	max.0,22	max.0,55	max.1,60	0,040	0,035					Al min.0,020		355	500	650	21
1630	St 37.4	max.0,17	max.0,35	min.0,35	0,040	0,040					Al min.0,020		235	350	480	25
	St 44.4	max.0,20	max.0,35	min.0,40	0,040	0,040					Al min.0,020		275	420	550	21
	St 52.4	max.0,22	max.0,55	max.1,60	0,040	0,035					Al min.0,020		355	500	650	21
2391-2	St 35	max.0,17	max.0,35	min.0,40	0,025	0,025							235	340	470	25
	St 45	max.0,21	max.0,35	min.0,40	0,025	0,025							255	440	570	21
	St 52	max.0,22	max.0,35	max.1,60	0,025	0,025							355	490	630	22
17204	C22	0,17-0,24	max.0,40	0,30-0,60	0,045	0,045							260	420	550	21
	Ck22	0,17-0,24	max.0,40	0,30-0,60	0,035	0,035							260	420	550	21
	Cm22	0,17-0,24	max.0,40	0,30-0,60	0,035	0,035							260	420	550	21
	C35	0,32-0,39	max.0,40	0,50-0,80	0,045	0,045							300	520	670	17
	Ck35	0,32-0,39	max.0,40	0,50-0,80	0,035	0,035							300	520	670	17
	Cm35	0,32-0,39	max.0,40	0,50-0,80	0,035	0,035							300	520	670	17
	C45	0,42-0,50	max.0,40	0,50-0,80	0,045	0,045							350	610	760	16
	Ck45	0,42-0,50	max.0,40	0,50-0,80	0,035	0,035							350	610	760	16
	Cm45	0,42-0,50	max.0,40	0,50-0,80	0,035	0,035							350	610	760	16
	34CrMo4	0,30-0,37	max.0,40	0,60-0,90	0,035	0,035	0,90-1,20		0,15-0,30							
17210	C15	0,12-0,18	max.0,40	0,30-0,60	0,045	0,045										
	Ck15	0,12-0,18	max.0,40	0,30-0,60	0,035	0,035										
	Cm15	0,12-0,18	max.0,40	0,30-0,60	0,035	0,035										
	16MnCr5	0,14-0,19	max.0,40	1,00-1,30	0,035	0,035	0,80-1,10									
BS																
6323	CFS 3	max.0,20	max.0,35	0,60-1,00	0,050	0,050							215	360		24
	CFS 4	max.0,25	max.0,35	max.1,20	0,050	0,050							235	410		22
	CFS 5	max.0,23	max.0,50	max.1,50	0,050	0,050							340	490		20
	CFS 6	0,30-0,40	max.0,35	0,50-0,90	0,050	0,050							280	460		21
	CFS 7	0,20-0,30	max.0,35	1,20-1,50	0,050	0,050							-	-		-
	CFS 8	0,40-0,55	max.0,35	0,50-0,90	0,050	0,050							340	540		18
UNI																
663	Fe 35-1	max.0,18	-	-	0,045	0,045							240	350	450	25
	Fe 45-1	max.0,22	-	-	0,045	0,045							260	450	550	21
	Fe 55-1	max.0,36	-	-	0,045	0,045							340	550	650	17
	Fe 35-2	max.0,17	0,10-0,35	min.0,40	0,035	0,035							240	350	450	28
	Fe 45-2	max.0,22	0,10-0,35	min.0,50	0,035	0,035							260	450	550	23
	Fe 55-2	max.0,36	0,10-0,35	min.0,50	0,035	0,035							340	550	650	18
7945	Fe 280	max.0,13		max.0,60	0,050	0,050							155	280		25
	Fe 320	max.0,16		max.0,70	0,050	0,050							195	320		25
	Fe 360	max.0,17	max.0,35	max.0,80	0,050	0,050							215	360		24
	Fe 410	max.0,21	max.0,35	max.1,20	0,050	0,050							235	410		22
	Fe 490	max.0,23	max.0,35	max.1,50	0,050	0,050							285	490		21
NFA																
49-310	TU 37-b	max.0,18	max.0,35	max.0,80	0,040	0,040							240	360	500	25
	TU 52-b	max.0,20	max.0,50	max.1,50	0,040	0,040							350	510	650	22
49-312	S470M	0,15-0,22	max.0,50	1,00-1,70	0,030	0,040					max.0,30	V 0,08-0,15	470	620	620	18
	S450MG2	0,15-0,22	max.0,50	1,00-1,70	0,030	0,040					max.0,30	V 0,08-0,15	450	550	720	22

Standards	Steel grade	Chemical composition [%]										Mechanical properties						
		C	Si	Mn	P _{max}	S _{max}	Cr	Ni	Mo	Cu	Other	R _e min MPa	R _e min ksi	R _m min MPa	R _m min ksi	A5 min %		
EN	10216-1	P 195 TR1	max.0,13	max.0,35	max.0,70	0,030	0,025	max.0,30	max.0,30	max.0,08	max.0,30	V max.0,02 Ti max.0,03	195		320	440	27	
		P 195 TR2	max.0,13	max.0,35	max.0,70	0,030	0,025	max.0,30	max.0,30	max.0,08	max.0,30	V max.0,02 Ti max.0,03 Al min.0,02	195		320	440	27	
		P 235 TR1	max.0,16	max.0,35	max.1,20	0,030	0,025	max.0,30	max.0,30	max.0,08	max.0,30	V max.0,02 Ti max.0,03	235		360	500	23	
		P 235 TR2	max.0,16	max.0,35	max.1,20	0,030	0,025	max.0,30	max.0,30	max.0,08	max.0,30	V max.0,02 Ti max.0,03 Al min.0,02	235		360	500	23	
		P 265 TR1	max.0,20	max.0,40	max.1,40	0,030	0,025	max.0,30	max.0,30	max.0,08	max.0,30	V max.0,02 Ti max.0,03	265		410	570	22	
		P 265 TR2	max.0,20	max.0,40	max.1,40	0,030	0,025	max.0,30	max.0,30	max.0,08	max.0,30	V max.0,02 Ti max.0,03 Al min.0,02	265		410	570	22	
	10216-3	P 355 N	max.0,20	max.0,50	0,90-1,70	0,030	0,025	max.0,30	max.0,50	max.0,08	max.0,30	V max.0,10 Ti max.0,03 Al min.0,02	355		490	650	22	
10294-1 10297-1		E235	max.0,18	max.0,35	max.1,20	0,045	0,045						235		360		25	
		E275	max.0,21	max.0,35	max.1,40	0,045	0,045						275		410		22	
		E315	max.0,21	max.0,30	max.1,50	0,045	0,045						315		450		21	
		E355	max.0,22	max.0,55	max.1,60	0,045	0,045						355		490		20	
		E275K2	max.0,20	max.0,40	max.1,40	0,035	0,030	max.0,30	0,30	max.0,10	max.0,35	V max.0,05	275		410			
		E355K2	max.0,20	max.0,50	max.1,65	0,035	0,030	max.0,30	0,50	max.0,10	max.0,35	V max.0,12	355		490		20	
		C22	0,17-0,24	max.0,40	0,40-0,70	0,045	0,045						260		420		21	
		C35	0,32-0,39	max.0,40	0,50-0,80	0,045	0,045						300		520		17	
		C45	0,42-0,50	max.0,40	0,50-0,80	0,045	0,045						350		610		16	
		C60	0,57-0,65	max.0,40	0,60-0,90	0,045	0,045						390		720		13	
		38Mn6	0,34-0,42	max.0,35	1,40-1,65	0,035	0,035						400		670		14	
		20MnV6	0,16-0,22	0,10-0,50	1,30-1,70	0,035	0,040					V max.0,15	420		600		19	
	10305-1		E 215	max.0,10	max. 0,05	max.0,70	0,025	0,025					Al min.0,025	215		290	430	30
			E 235	max. 0,17	max. 0,35	max. 1,20	0,025	0,025						235		340	480	25
		E 355	max. 0,22	max. 0,55	max. 1,60	0,025	0,025						355		490	630	22	
		E 255	max.0,21	max.0,35	0,40-1,10	0,025	0,025						255		440	570	21	
		26Mn5	0,20-0,30	max. 0,40	1,20-1,50	0,035	0,035											
		C 35E	0,32-0,39	max. 0,40	0,50-0,80	0,035	0,035	max. 0,40		max. 0,10				280		460		21
		C 45E	0,42-0,55	max. 0,40	0,50-0,80	0,035	0,035	max. 0,40		max. 0,10				340		540		18
		20V1 (E 410)	0,16-0,22	0,10-0,50	1,30-1,70	0,030	0,035					V 0,08-0,15	410		550	700	22	
		26Mo2	0,22-0,29	max. 0,40	max. 1,50	0,035	0,035		max. 0,40	0,15-0,25								
		25CrMo4	0,22-0,29	max. 0,40	0,60-0,90	0,035	0,035	0,90-1,20		0,15-0,30								
	42CrMo4	0,38-0,45	max. 0,40	0,60-0,90	0,035	0,035	0,90-1,20		0,15-0,30									
GOST		10	0,07-0,14	0,17-0,37	0,35-0,65			max.0,15					205		330		31	
		20	0,17-0,24	0,17-0,37	0,35-0,65			max.0,25					245		410		25	
		35	0,32-0,40	0,17-0,37	0,50-0,80			max.0,25					315		530		20	
		45	0,42-0,50	0,17-0,37	0,50-0,80			max.0,25					355		600		16	
	19281	09G2S	max.0,12	0,50-0,80	1,30-1,70			max.0,30	max.0,30		max.0,30		345		490		21	
JIS	G 3445	STKM 11A	max.0,12	max.0,35	max.0,60	0,040	0,040								290		35	
		STKM 12A	max.0,20	max.0,35	max.0,60	0,040	0,040						175		340		35	
		STKM 12B	max.0,20	max.0,35	max.0,60	0,040	0,040						275		390		25	
		STKM 12C	max.0,20	max.0,35	max.0,60	0,040	0,040						355		470		20	
		STKM 13A	max.0,25	max.0,35	0,30-0,90	0,040	0,040						215		370		30	
		STKM 13B	max.0,25	max.0,35	0,30-0,90	0,040	0,040						305		440		20	
		STKM 13C	max.0,25	max.0,35	0,30-0,90	0,040	0,040						380		510		15	
		STKM 14A	max.0,30	max.0,35	0,30-1,00	0,040	0,040						245		410		25	
		STKM 14B	max.0,30	max.0,35	0,30-1,00	0,040	0,040						355		500		15	
		STKM 14C	max.0,30	max.0,35	0,30-1,00	0,040	0,040						410		550		15	
		STKM 15A	0,25-0,35	max.0,35	0,30-1,00	0,040	0,040						275		470		22	
		STKM 15C	0,25-0,35	max.0,35	0,30-1,00	0,040	0,040						430		580		12	
		STKM 16A	0,35-0,45	max.0,40	0,40-1,00	0,040	0,040						325		510		20	
		STKM 16C	0,35-0,45	max.0,40	0,40-1,00	0,040	0,040						460		620		12	
		STKM 17A	0,45-0,55	max.0,40	0,40-1,00	0,040	0,040						345		550		20	
		STKM 17C	0,45-0,55	max.0,40	0,40-1,00	0,040	0,040						480		650		10	
		STKM 18A	max.0,18	max.0,55	max.1,50	0,040	0,040						275		440		25	
		STKM 18B	max.0,18	max.0,55	max.1,50	0,040	0,040						315		490		23	
		STKM 18C	max.0,18	max.0,55	max.1,50	0,040	0,040						380		510		15	
		STKM 19A	max.0,25	max.0,55	max.1,50	0,040	0,040						315		490		23	
STKM 19C	max.0,25	max.0,55	max.1,50	0,040	0,040						410		550		15			
STKM 20A	max.0,25	max.0,55	max.1,60	0,040	0,040					V max.0,15	390		540		23			
G3454	STPG 370	max.0,25	max.0,35	0,30-0,90	0,040	0,040						215		370		30		
	STPG 410	max.0,30	max.0,35	0,30-1,00	0,040	0,040						245		410		25		
G3455	STS 370	max.0,25	0,10-0,35	0,30-1,10	0,035	0,035						215		370		30		
	STS 410	max.0,30	0,10-0,35	0,30-1,40	0,035	0,035						245		410		25		
	STS 480	max.0,33	0,10-0,35	0,30-1,50	0,035	0,035						275		480		25		
G3456	STPT 370	max. 0,25	0,10-0,35	0,30-0,90	0,035	0,035						215		370		30		
	STPT 410	max. 0,30	0,10-0,35	0,30-1,00	0,035	0,035						245		410		25		
	STPT 480	max. 0,33	0,10-0,35	0,30-1,00	0,035	0,035						275		480		25		
PNH	84018	18G2A	max.0,20	0,20-0,55	1,0-1,6	0,040	0,040	max.0,30	max.0,30				365		510		22	
		18G2	max.0,22	0,20-0,55	1,0-1,6	0,050	0,040											
	84019	10	0,07-0,14	0,15-0,40	0,35-0,65	0,040	0,040	max.0,30	max.0,30	max.0,10	max.0,30		195		345		25	
		20	0,17-0,24	0,15-0,40	0,35-0,65	0,040	0,040	max.0,30	max.0,30	max.0,10	max.0,30		225		440		21	
		35	0,32-0,39	0,10-0,40	0,50-0,80	0,040	0,040	max.0,30	max.0,30	max.0,10	max.0,30		255		540		17	
		45	0,42-0,50	0,10-0,40	0,50-0,80	0,040	0,040	max.0,30	max.0,30	max.0,10	max.0,30		295		640		14	
		55	0,52-0,60	0,10-0,40	0,60-0,90	0,040	0,040	max.0,30	max.0,30	max.0,10	max.0,30	max.0,050	380		680		11	
	84023/07	R35	0,07-0,16	0,12-0,35	0,40-0,70	0,040	0,040	max.0,30	max.0,30	max.0,10	max.0,30		215		360		24	
		R45	0,16-0,22	0,12-0,35	0,60-1,20	0,040	0,040	max.0,30	max.0,30	max.0,10	max.0,30		255		430		22	
		R55	0,32-0,40	0,20-0,35	0,60-0,85	0,045	0,045	max.0,30	max.0,30	max.0,10	max.0,30		295		540		17	
		R65	0,45-0,52	0,20-0,35	0,60-0,85	0,045	0,045						380		640		16	

Cylinder tubes

Precision tubes for mechanical treatment – HPZ

Dimensions

Dimensions of HPZ tubes are given in Table 21.

Tolerances

- outside diameter according to standards DIN 2391-1, EN 10305-1, ČSN/STN 42 6712
- inside diameter – Table 21
- wall thickness $\pm 7,5\%$
- eccentricity is included in the tolerances of wall thickness

Lengths

- random lengths 3 – 6 m
- fixed lengths max. 6 m

Straightness

1 mm/m (1 : 1 000) – measured on outside surface.

Tube ends

Plain, upon request ends could be plugged with plastic caps.

Steel grade

- 11 523 according to STN, ČSN
- St 52 (1.0580) according to DIN 2391, St 52-3 (1.0570) according to DIN 17100
- E 355 (1.0580) according to EN 10305-1
- 20 Mn V 6 according to EN 10294-1 (see page 21, 114, 115)
- another steel upon agreement

Delivery condition

BKS (+SR) – cold finished / stress relieve annealed.
Other conditions upon agreement.

Outside diameter

Smooth after cold drawing (DIN 2391).

Testing

- cast analysis
- tensile test
- visual test
- dimensional test
- NDT (eddy current test)
- other tests upon agreement

Marking

Colour stencilling along whole tube length:

- producer's logo
- size (O.D. – I.D.)
- steel
- heat No.
- standard number (or according to customer's specification)

Surface protection

Tubes are oiled.

Packaging

Tubes are packed in round or hexagonal bundles with weight max. 2000 kg, fastened with steel strips.

Certified test report

According to DIN 50049 (EN 10204) - 3.1.B. , (3.1)

Dimensions and weight of HPZ tubes for mechanical treatment

Table 21

Inside diameter [mm]	Tolerance of insidediameter [mm]	D x t [mm]	Weight [kg/m]	
40	-0,20 -0,40	50 x 5	5,55	
		52 x 6	6,80	
		55 x 7,5	8,78	
		60 x 10	12,33	
45		55 x 5	6,16	
		57 x 6	7,55	
		60 x 7,5	9,71	
		65 x 10	13,56	
50		60 x 5	6,78	
		62 x 6	8,28	
		65 x 7,5	10,64	
		70 x 10	14,80	
55		-0,20 -0,50	65 x 5	7,40
			67 x 6	9,03
			70 x 7,5	11,56
			75 x 10	16,03
60	70 x 5		8,01	
	72 x 6		9,77	
	75 x 7,5		12,48	
	80 x 10		17,26	
63	73 x 5		8,38	
	75 x 6		10,21	
	78 x 7,5		13,04	
	83 x 10		18,00	
65	75 x 5	8,64		
	77 x 6	10,51		
	80 x 7,5	13,41		
	85 x 10	18,50		
70	80 x 5	9,25		
	82 x 6	11,25		
	85 x 7,5	14,33		
	90 x 10	19,73		

Inside diameter [mm]	Tolerance of insidediameter [mm]	D x t [mm]	Weight [kg/m]	
75	-0,20 -0,55	85 x 5	9,86	
		87 x 6	11,99	
		90 x 7,5	15,26	
		95 x 10	20,96	
		80	90 x 5	10,48
92 x 6			12,72	
95 x 7,5			16,18	
100 x 10			22,20	
85			95 x 5	11,10
		97 x 6	13,46	
		100 x 7,5	17,11	
		105 x 10	23,43	
		90	-0,25 -0,70	100 x 5	11,71
102 x 6				14,20
105 x 7,5				18,03
110 x 10	24,66			
100	110 x 5			12,95
	112 x 6	15,68		
	115 x 7,5	19,88		
	120 x 10	27,13		
	105	-0,25 -0,75		115 x 5	13,56
117 x 6				16,42
120 x 7,5			20,81	
125 x 10			28,36	
110			120 x 5	14,18
	122 x 6		17,16	
	125 x 7,5		21,73	
	130 x 10		29,59	
	115		125 x 5	14,80
127 x 6			17,90	
130 x 7,5			22,66	

Upon agreement also tubes with inside diameter 30 mm with WT 5 / 6 / 7,5 / 10 mm. Tolerances ID according to agreement. The tube weight according to the formula (see page 8).

Chemical composition and mechanical properties of steel for HPZ tubes

Delivery condition BKS (+SR)

Steel	C max %	Mn max %	Si max %	P max %	S max %	Al min %	ReH (N/mm ²)	Rm (N/mm ²)	A %
St 52	0,22	1,60	0,55	0,025	0,025	0,020	min. 420	min. 580	min. 10
E 355	0,22	1,60	0,55	0,025	0,025	0,020	min. 450	min. 580	min. 10

Chemical composition and mechanical properties of steel 11 523 and St 52-3 are approximately identic to steel grades in table. Steel 20 Mn V 6 includes V (0,08 - 0,15%), or a part of V is possible to replace with Nb providing that Vmin is 0,05% and contents V + Nb is under 0,15%.

Cylinder tubes

Precision hydraulic tubes – HP – „ready to use“

Dimensions

Dimensions and HP tube weight are given in Table 22.

Tolerances

- outside diameter according to standards DIN 2391-1, EN 10305-1, ČSN/STN 42 6712
- inside diameter – ISO H8, H9 – Table 22
- wall thickness $\pm 7,5\%$ or $\pm 10\%$
- eccentricity is included in the tolerances of wall thickness

Lengths

- random lengths 2 – 6 m
- fixed lengths max. 6 m

Straightness

1 mm / m (1 : 1000) – measured on outside surface.

Tube ends

Plain, upon request ends could be plugged with plastic caps.

Steel grade

- 11 523 according to STN, ČSN
- St 52 (1.0580) according to DIN 2391, St 52-3 (1.0570) according to DIN 17100
- E 355 (1.0580) according to EN 10305-1
- 20 Mn V 6 according to EN 10294-1 (see page 21, 114, 115)
- another steel upon agreement

Delivery condition

BKS (+SR) - cold finished / stress relieve annealed. Other upon agreement (NBK, +N, BK, +C).

Outside surface

Smooth after cold drawing (DIN 2391).

Inside surface

Roughness $R_a \leq 0,4 \mu\text{m}$, $R_z \leq 1,5 \mu\text{m}$.

Testing

- cast analysis
- tensile test
- visual test
- dimensional test
- NDT (eddy current test) according to SEP 1925, EN 10246-1 or another agreed method
- other tests upon agreement

Marking

Colour stencilling along whole tube length:

- producer's logo
- size (inside diameter x wall thickness)
- steel
- heat No.
- standard number (or according to customer's specification)
- bundle with label with supplementary informations

Surface protection

Tubes are oiled.

Packaging

Tubes are packed in round or hexagonal bundles with weight max. 2 000 kg, fastened with steel strips.

Certified test report

According to DIN 50049 (EN 10204) - 3.1.B. (3.1)

Dimensions, tolerances and weight of HP tubes

Table 22

Inside diameter [mm]	Tolerance of inside diameter [mm]		D x t [mm]	Weight [kg/m]	Maximum length [mm]
	H8	H9			
40	+0,039	+0,062	48 x 4	4,34	3 000
			50 x 5	5,55	
			52 x 6	6,81	
			55 x 7,5	8,79	
50	+0,039	+0,062	60 x 5	6,78	4 000
			62 x 6	8,29	
			65 x 7,5	10,64	
60	+0,039	+0,062	70 x 5	8,01	5 000
			72 x 6	9,77	
			75 x 7,5	12,48	
63	+0,039	+0,062	73 x 5	8,38	5 000
			75 x 6	10,21	
			78 x 7,5	13,04	
70	+0,046	+0,074	80 x 5	9,24	6 000
			82 x 6	11,25	
			85 x 7,5	14,33	
			90 x 10	19,73	
80	+0,046	+0,074	90 x 5	10,48	6 000
			92 x 6	12,73	
			95 x 7,5	16,18	
			100 x 10	22,20	
90	+0,054	+0,087	100 x 5	11,71	6 000
			102 x 6	14,21	
			105 x 7,5	18,03	
			110 x 10	24,66	
100	+0,054	+0,087	115 x 7,5	19,88	6 000
			120 x 10	27,13	
110	+0,054	+0,087	125 x 7,5	21,73	6 000
			130 x 10	29,59	

The diameters 80 x 10 mm (17,26 kg/m) and 126 x 8 mm (23,28kg/m) upon agreement

Chemical composition and mechanical properties of steel for HP tubes
Delivery condition BKS (+SR)

Steel	C max %	Mn max %	Si max %	P max %	S max %	Al min %	ReH (N/mm ²)	R _m (N/mm ²)	A %
St 52	0,22	1,60	0,55	0,025	0,025	0,020	min. 420	min. 580	min. 10
E 355	0,22	1,60	0,55	0,025	0,025	0,020	min. 450	min. 580	min. 10

Chemical composition and mechanical properties of steel 11 523 and St 52-3 are approximately identical to steel grades in table. Steel 20 Mn V 6 includes V (0,08 - 0,15%), or a part of V is possible to replace with Nb providing that V_{min} is 0,05% and contents V + Nb is under 0,15%.

Tubes for hydraulic and pneumatic lines – HPL

Tubes are used in hydraulic and pneumatic power systems.

A list of standards according to which HPL tubes are delivered:

Standards	Dimensional standards	Dimensions	Technical delivery conditions	Steel grade
STN	42 6711	Table 23/Page 78	42 0260	11 353, 11 523
ČSN	42 6712			
ASTM	A 822	Tab. 18,19/Pg. 66,67	A 822/A 450	A 822
DIN	2391-1 2445-2	Table 23/Page 78	2391-2C 2445-2 1630	St 35 St 37.4, St 44.4, St 52.4
BS	7416		7416	CFS 360, CFS 430
UNI	7945		7945	Fe 280, Fe 320, Fe 360, Fe 410, Fe 490
NFA	49-330		49-330	TU 37B, TU 42BT, TU 52B
EN	10305-4		10305-4	E 215, E 235, E 355
JIS	JOHS-102	Table 11/Page 52	JOHS-102	OST 1-JIS G3454 – STPG370 OST 2-JIS G3455 – STS370
PN-H	74245	Tab. 23/Strana 78	74245	10, 20, 18G2A

List of dimensional standards and technical delivery conditions standards

STN 42 0260	ČSN 42 0260 Cold drawn precision seamless steel tubes from steel class 10 to 16. TDC.
STN 42 6711	ČSN 42 6711 Precision seamless steel tubes. Dimensions.
STN 42 6712	ČSN 42 6712 Precision seamless steel tubes with increased accuracy. Dimensions.
ASTM A450	General requirements for carbon, ferritic alloy and austenitic alloy steel tubes.
ASTM A822	Seamless cold drawn carbon steel tubing for hydraulic system service.
DIN 1630	Seamless circular tubes of non-alloy steel with very high quality requirements. TDC.
DIN 2391	Seamless precision steel tubes.
DIN 2413/1	Steel tubes, calculation of wall thickness of steel tubes subjected to internal pressure.
DIN 2445	Seamless steel tubes for dynamic loads. Part 1: Hot finished tubes in fluid systems, PN 100 to PN 500. Part 2: Steel tubes for precision application in fluid systems, PN 100 to PN 500. Supplement: Design rules.
BS 7416	Precision finished seamless cold drawn low carbon steel tubes for use in hydraulic fluid power systems.
UNI 7945	Plain end seamless precision steel tubes.
NFA 49-330	Seamless cold drawn tubes for hydraulic and pneumatic power systems.
EN 10305-4	Steel tubes for precision applications. Part 4: Seamless cold drawn tubes for hydraulic and pneumatic power systems.
EN 10305-6	Steel tubes for precision applications. Part 6: Welded cold drawn tubes for hydraulic and pneumatic power systems.
JOHS-102	Carbon steel precision tubes for hydraulic line service.
PN-H 74245	Cold drawn or rolled seamless steel tubes of specified application.

Dimensions

Dimensions are given in Table 23.

Tolerances

According to standards, special tolerances could be agreed on request.

Lengths

- exact lengths 6 000 mm (tolerances - standard lengths 0+50 mm, exact lengths 0+10 mm)
- on request other fixed lengths in the range 3 000 – 9 000 mm

Straightness

3 mm/m, totally max 0,0015% of tube length.

Tube ends

Plain ends, plugged with plastic caps.

Steel grade

Steel is shown in the table of chemical composition and mechanical properties (see page 79).

Delivery condition

Normalized:

.1 - STN, ČSN

NBK - DIN

+N - EN

N - ASTM

Roughness (OD and ID), ID over 15 mm, $R_a \leq 4 \mu\text{m}$.

Micropurity (data upon agreement)

According to NFA 04-106 or ASTM E45 (ranking JK) max. A4 - B2 - C2 - D2. Also according to ISO 4967 or EN 10 247 upon agreement.

A - sulphide, B - Alumina, C - Silicate, D - Oxides, DS - Oxides)

Grain size (data upon agreement)

According to EN ISO 643 - 5 and finer.

Testing

Non specific inspection or specific inspection. In both cases leak tightness test will be carried out in accordance with EN 10246-1 (electromagnetic test). Other tests according to standards.

Marking

Each tube shall be marked with Ink-Jet system along whole tube length according to standard or customer's specification. The bundle of tubes shall be marked with a label attached to the bundle.

Surface protection

- oiled
- phosphated and oiled
- outside surface of tube as chromating – upon agreement only

Packaging

Tubes are packed in round or hexagonal bundles of maximum 2000 kg each, fastened with steel strips. On request – paper below the stripes and plastic bags at the bundle ends.

Certified test report

According to DIN 50049 - EN 10204

non specific inspection - 2.2

specific inspection - 3.1.B.

upon agreement - 3.1.C.

See also page 10.

Pressure chart for hydraulic tubes – see page 80–83. (Calculation according to DIN 2413)

Dimensions, flow cross section and weight of HPL tubes

Table 23

Outside diameter [mm]	Wall thickness [mm]	Inside diameter [mm]	Tolerance of inside diameter	Flow cross section [cm ²]	Weight [kg/m]
6	1	4	± 0,12	0,13	0,123
6	1,5	3	± 0,15	0,071	0,166
6	2	2	± 0,15	0,031	0,197
8	1	6	± 0,10	0,28	0,173
8	1,5	5	± 0,10	0,20	0,240
8	2	4	± 0,15	0,13	0,296
10	1	8	± 0,08	0,50	0,222
10	1,5	7	± 0,12	0,38	0,314
10	2	6	± 0,15	0,28	0,395
10	2,5	5	± 0,15	0,20	0,462
12	1	10	± 0,08	0,79	0,271
12	1,5	9	± 0,10	0,64	0,389
12	2	8	± 0,12	0,50	0,493
12	2,5	7	± 0,15	0,38	0,586
12	3	6	± 0,15	0,28	0,666
14	1	12	± 0,08	1,13	0,321
14	1,5	11	± 0,08	0,95	0,462
14	2	10	± 0,12	0,79	0,592
14	3	8	± 0,15	0,50	0,814
15	1	13	± 0,08	1,33	0,345
15	1,5	12	± 0,08	1,13	0,499
15	2	11	± 0,10	0,95	0,641
15	3	9	± 0,15	0,64	0,888
16	1,5	13	± 0,08	1,33	0,536
16	2	12	± 0,15	1,13	0,691
16	2,5	11	± 0,12	0,95	0,832
16	3	10	± 0,15	0,79	0,962
18	1,5	15	± 0,08	1,77	0,610
18	2	14	± 0,08	1,54	0,789
18	2,5	13	± 0,15	1,33	0,956
18	3	12	± 0,15	1,13	1,11
20	1,5	17	± 0,08	2,27	0,684
20	2	16	± 0,08	2,01	0,888
20	2,5	15	± 0,15	1,77	1,08
20	3	14	± 0,15	1,54	1,26
20	4	12	± 0,15	1,13	1,58
22	1,5	19	± 0,08	2,84	0,758
22	2	18	± 0,08	2,55	0,986
22	3	16	± 0,15	2,01	1,41
25	2	21	± 0,08	3,46	1,13
25	2,5	20	± 0,08	3,14	1,39
25	3	19	± 0,15	2,84	1,63
25	4	17	± 0,15	2,27	2,07
25	5	15	± 0,15	1,77	2,47

Outside diameter [mm]	Wall thickness [mm]	Inside diameter [mm]	Tolerance of inside diameter	Flow cross section [cm ²]	Weight [kg/m]
28	1,5	25	± 0,08	4,91	0,980
28	2	24	± 0,08	4,52	1,28
28	3	22	± 0,15	3,80	1,85
28	4	20	± 0,15	3,14	2,37
28	5	18	± 0,15	2,55	2,84
30	2	26	± 0,08	5,31	1,38
30	2,5	25	± 0,08	4,91	1,70
30	3	24	± 0,15	4,52	2,00
30	4	22	± 0,15	3,80	2,57
30	5	20	± 0,15	3,14	3,08
30	6	18	± 0,15	2,55	3,55
35	2	31	± 0,15	7,55	1,63
35	3	29	± 0,15	6,61	2,37
35	4	27	± 0,15	5,73	3,06
35	5	25	± 0,15	4,91	3,70
35	6	23	± 0,15	4,16	4,29
38	2,5	33	± 0,15	8,55	2,19
38	3	32	± 0,15	8,04	2,59
38	4	30	± 0,15	7,07	3,35
38	5	28	± 0,15	6,16	4,07
38	6	26	± 0,15	5,31	4,74
42	2	38	± 0,20	11,34	1,97
42	3	36	± 0,20	10,18	2,89
42	4	34	± 0,20	9,08	3,75
50	4	42	± 0,20	13,85	4,54
50	5	40	± 0,20	12,57	5,55
50	6	38	± 0,20	11,34	6,51
50	8	34	± 0,20	9,08	8,29
55	4	47	± 0,25	17,34	5,03
55	6	43	± 0,25	14,51	7,25
55	8	39	± 0,25	11,95	9,27
55	10	35	± 0,25	9,62	11,10
60	5	50	± 0,25	19,63	6,78
60	8	44	± 0,25	15,20	10,26
60	10	40	± 0,25	12,57	12,33
60	12,5	35	± 0,25	9,62	14,64
70	5	60	± 0,30	28,26	8,02
70	8	54	± 0,30	22,89	12,23
70	10	50	± 0,30	19,63	14,80
70	12,5	45	± 0,30	15,90	17,72
80	6	68	± 0,35	36,30	10,95
80	8	64	± 0,35	32,15	14,21
80	10	60	± 0,35	28,26	17,26
80	12,5	55	± 0,35	23,75	20,81

Tolerances of outside diameter:

- D: 6-30 mm ±0,08 mm
- D: 35-38 mm ±0,15 mm
- D: 42-50 mm ±0,20 mm
- D: 55-60 mm ±0,25 mm
- D: 70 mm ±0,30 mm
- D: 80 mm ±0,35 mm

Other dimensions upon agreement.

Chemical composition and mechanical properties of steel for HPL tubes

Standards	Steel grade	Chemical composition [%]										Mechanical properties					
		C	Si	Mn	P _{max}	S _{max}	Cr	Ni	Mo	Cu	Other	Re min MPa	min ksi	Rm min MPa	max MPa	min ksi	A5 min %
STN, ČSN																	
	11 353	max.0,18			0,050	0,050							235		340	440	25
	11 523	max.0,20	max.0,55	max.1,60	0,050	0,045					Al min.0,015	353		510	628	23	
ASTM																	
A 822		max.0,18		0,27-0,63	0,048	0,058						170	25	310		45	35
DIN																	
1630	St 37.4	max.0,17	max.0,35	min.0,35	0,040	0,040						235		350	480	25	
	St 44.4	max.0,20	max.0,35	min.0,40	0,040	0,040						275		420	550	21	
	St 52.4	max.0,22	max.0,55	max.1,60	0,040	0,035						355		500	650	21	
BS																	
3602/1	CFS 360	max.0,17	max.0,35	0,30-0,80	0,035	0,035					Al max.0,06	235		360	500	25	
	CFS 430	max.0,21	max.0,35	0,40-1,20	0,035	0,035					Al max.0,06	275		430	570	22	
3603	430 LT	max.0,20	max.0,35	0,60-1,20	0,035	0,035					Al min.0,020	275		430	570	22	
UNI																	
7945	Fe 280	max.0,13		max.0,60	0,050	0,050						155		280		25	
	Fe 320	max.0,16		max.0,70	0,050	0,050						195		320		25	
	Fe 360	max.0,17	max.0,35	max.0,80	0,050	0,050						215		360		24	
	Fe 410	max.0,21	max.0,35	max.1,20	0,050	0,050						235		410		22	
	Fe 490	max.0,23	max.0,35	max.1,50	0,050	0,050						285		490		21	
NFA																	
49-330	TU 37B	max.0,20	max.0,40	max.0,85	0,045	0,045						220		360	480	23	
	TU 52B	max.0,22	max.0,55	max.1,60	0,045	0,045						350		510	630	19	
EN																	
10305-4	E215	max.0,10	max.0,05	max.0,70	0,025	0,015					Al min.0,025	215		290		30	
	E235	max.0,17	max.0,35	max.1,20	0,025	0,015						235		350		25	
	E355	max.0,22	max.0,55	max.1,60	0,025	0,015						355		500		22	
JIS																	
JOHS-102	OST 1	max.0,20	max.0,55	0,25-0,60	0,040	0,040						180		450			
	OST 2	0,08-0,18	0,10-0,35	0,30-0,60	0,035	0,035				max.0,20		200		450			

Steels according to Standard PN - H see page 71



Pressure table for hydraulic tubes (MPa)

Steel 37.4 (E235) without specific testing according to 3.1.B (3.1)

Table A

Outside diameter [mm]	Wall thickness														
	0,5	1,0	1,5	2,0	2,5	3,0	3,5	4,0	4,5	5,0	6,0	7,0	8,0	9,0	10,0
5	25,0	49,9													
6	20,8	41,6													
7	17,8	35,7													
8	15,6	31,2	46,8												
9	13,9	27,7	41,6												
10	12,5	25,0	37,4	49,9											
12	10,4	20,8	31,2	41,6											
14	8,9	17,8	26,7	35,7	44,6										
15	8,3	16,6	25,0	33,3	41,6	49,9									
16	7,8	15,6	23,4	31,2	39,0	46,8									
18	6,9	13,9	20,8	27,7	34,7	41,6	48,5								
20	6,2	12,5	18,7	25,0	31,2	37,4	43,7	49,9							
22		11,3	17,0	22,7	28,4	34,0	39,7	45,4	51,0						
24		10,4	15,6	20,8	26,0	31,2	36,4	41,6	46,8						
25		10,0	15,0	20,0	25,0	29,9	34,9	39,9	44,9	49,9					
28		8,9	13,4	17,8	22,3	26,7	31,2	35,7	40,1	44,6					
30		8,3	12,5	16,6	20,8	25,0	29,1	33,3	37,4	41,6	49,9				
32		7,8	11,7	15,6	19,5	23,4	27,3	31,2	35,1	39,0	46,8				
35		7,1	10,7	14,3	17,8	21,4	25,0	28,5	32,1	35,7	42,8				
36		6,9	10,4	13,9	17,3	20,8	24,3	27,7	31,2	34,7	41,6				
38		6,6	9,9	13,1	16,4	19,7	23,0	26,3	29,6	32,8	39,4	46,0			
40		6,2	9,4	12,5	15,6	18,7	21,8	25,0	28,1	31,2	37,4	43,7	49,9		
42			8,9	11,9	14,9	17,8	20,8	23,8	26,7	29,7	35,7	41,6	47,5		
45			8,3	11,1	13,9	16,6	19,4	22,2	25,0	27,7	33,3	38,8	44,4		
48			7,8	10,4	13,0	15,6	18,2	20,8	23,4	26,0	31,2	36,4	41,6	46,8	
50			7,5	10,0	12,5	15,0	17,5	20,0	22,5	25,0	29,9	34,9	39,9	44,9	49,9
52			7,2	9,6	12,0	14,4	16,8	19,2	21,6	24,0	28,8	33,6	38,4	43,2	48,0
55			6,8	9,1	11,3	13,6	15,9	18,2	20,4	22,7	27,2	31,8	36,3	40,8	45,4
58			6,5	8,6	10,8	12,9	15,1	17,2	19,4	21,5	25,8	30,1	34,4	38,7	43,0
60			6,2	8,3	10,4	12,5	14,6	16,6	18,7	20,8	25,0	29,1	33,3	37,4	41,6
62			6,0	8,1	10,1	12,1	14,1	16,1	18,1	20,1	24,2	28,2	32,2	36,2	40,3
65			5,8	7,7	9,6	11,5	13,4	15,4	17,3	19,2	23,0	26,9	30,7	34,6	38,4
70			5,3	7,1	8,9	10,7	12,5	14,3	16,0	17,8	21,4	25,0	28,5	32,1	35,7
75			5,0	6,7	8,3	10,0	11,6	13,3	15,0	16,6	20,0	23,3	26,6	29,9	33,3
80			4,7	6,2	7,8	9,4	10,9	12,5	14,0	15,6	18,7	21,8	25,0	28,1	31,2
85				5,9	7,3	8,8	10,3	11,7	13,2	14,7	17,6	20,6	23,5	26,4	29,4
90				5,5	6,9	8,3	9,7	11,1	12,5	13,9	16,6	19,4	22,2	25,0	27,7
100				5,0	6,2	7,5	8,7	10,0	11,2	12,5	15,0	17,5	20,0	22,5	25,0
110				4,5	5,7	6,8	7,9	9,1	10,2	11,3	13,6	15,9	18,2	20,4	22,7
120					5,2	6,2	7,3	8,3	9,4	10,4	12,5	14,6	16,6	18,7	20,8

Theoretical allowed operating pressure without test certificate [MPa] is calculated according to DIN 2413-93 by 20°C (1 MPa = 10 bar)

Pressure table for hydraulic tubes (MPa)

Steel 37.4 (E235) with specific testing 3.1.B (3.1)

Table B

Outside diameter [mm]	Wall thickness														
	0,5	1,0	1,5	2,0	2,5	3,0	3,5	4,0	4,5	5,0	6,0	7,0	8,0	9,0	10,0
5	28,3	56,7													
6	23,6	47,2													
7	20,2	40,5													
8	17,7	35,4	53,1												
9	15,7	31,5	47,2												
10	14,2	28,3	42,5	56,7											
12	11,8	23,6	35,4	47,2											
14	10,1	20,2	30,4	40,5	50,6										
15	9,4	18,9	28,3	37,8	47,2	56,7									
16	8,9	17,7	26,6	35,4	44,3	53,1									
18	7,9	15,7	23,6	31,5	39,4	47,2	55,1								
20	7,1	14,2	21,3	28,3	35,4	42,5	49,6	56,7							
22		12,9	19,3	25,8	32,2	38,6	45,1	51,5	58,0						
24		11,8	17,7	23,6	29,5	35,4	41,3	47,2	53,1						
25		11,3	17,0	22,7	28,3	34,0	39,7	45,3	51,0	56,7					
28		10,1	15,2	20,2	25,3	30,4	35,4	40,5	45,5	50,6					
30		9,4	14,2	18,9	23,6	28,3	33,1	37,8	42,5	47,2	56,7				
32		8,9	13,3	17,7	22,1	26,6	31,0	35,4	39,9	44,3	53,1				
35		8,1	12,1	16,2	20,2	24,3	28,3	32,4	36,4	40,5	48,6				
36		7,9	11,8	15,7	19,7	23,6	27,6	31,5	35,4	39,4	47,2				
38		7,5	11,2	14,9	18,6	22,4	26,1	29,8	33,6	37,3	44,7	52,2			
40		7,1	10,6	14,2	17,7	21,3	24,8	28,3	31,9	35,4	42,5	49,6	56,7		
42			10,1	13,5	16,9	20,2	23,6	27,0	30,4	33,7	40,5	47,2	54,0		
45			9,4	12,6	15,7	18,9	22,0	25,2	28,3	31,5	37,8	44,1	50,4		
48			8,9	11,8	14,8	17,7	20,7	23,6	26,6	29,5	35,4	41,3	47,2	53,1	
50			8,5	11,3	14,2	17,0	19,8	22,7	25,5	28,3	34,0	39,7	45,3	51,0	56,7
52			8,2	10,9	13,6	16,4	19,1	21,8	24,5	27,3	32,7	38,2	43,6	49,1	54,5
55			7,7	10,3	12,9	15,5	18,0	20,6	23,2	25,8	30,9	36,1	41,2	46,4	51,5
58			7,3	9,8	12,2	14,7	17,1	19,5	22,0	24,4	29,3	34,2	39,1	44,0	48,9
60			7,1	9,4	11,8	14,2	16,5	18,9	21,3	23,6	28,3	33,1	37,8	42,5	47,2
62			6,9	9,1	11,4	13,7	16,0	18,3	20,6	22,9	27,4	32,0	36,6	41,1	45,7
65			6,5	8,7	10,9	13,1	15,3	17,4	19,6	21,8	26,2	30,5	34,9	39,2	43,6
70			6,1	8,1	10,1	12,1	14,2	16,2	18,2	20,2	24,3	28,3	32,4	36,4	40,5
75			5,7	7,6	9,4	11,3	13,2	15,1	17,0	18,9	22,7	26,5	30,2	34,0	37,8
80			5,3	7,1	8,9	10,6	12,4	14,2	15,9	17,7	21,3	24,8	28,3	31,9	35,4
85				6,7	8,3	10,0	11,7	13,3	15,0	16,7	20,0	23,3	26,7	30,0	33,3
90				6,3	7,9	9,4	11,0	12,6	14,2	15,7	18,9	22,0	25,2	28,3	31,5
100				5,7	7,1	8,5	9,9	11,3	12,8	14,2	17,0	19,8	22,7	25,5	28,3
110				5,2	6,4	7,7	9,0	10,3	11,6	12,9	15,5	18,0	20,6	23,2	25,8
120					5,9	7,1	8,3	9,4	10,6	11,8	14,2	16,5	18,9	21,3	23,6

Theoretical allowed operating pressure without test certificate [MPa] is calculated according to DIN 2413-93 by 20°C (1 MPa = 10 bar)

Pressure table for hydraulic tubes (MPa)

Steel St 52.4 (E355) without specific testing according to 3.1.B (3.1)

Table C

Outside diameter [mm]	Wall thickness														
	0,5	1,0	1,5	2,0	2,5	3,0	3,5	4,0	4,5	5,0	6,0	7,0	8,0	9,0	10,0
5	36,4	72,8													
6	30,4	60,7													
7	26,0	52,0													
8	22,8	45,5	68,3												
9	20,2	40,5	60,7												
10	18,2	36,4	54,6	72,8											
12	15,2	30,4	45,5	60,7											
14	13,0	26,0	39,0	52,0	65,0										
15	12,1	24,3	36,4	48,6	60,7	72,8									
16	11,4	22,8	34,1	45,5	56,9	68,3									
18	10,1	20,2	30,4	40,5	50,6	60,7	70,8								
20	9,1	18,2	27,3	36,4	45,5	54,6	63,7	72,8							
22		16,6	24,8	33,1	41,4	49,7	57,9	66,2	74,5						
24		15,2	22,8	30,4	37,9	45,5	53,1	60,7	68,3						
25		14,6	21,9	29,1	36,4	43,7	51,0	58,3	65,6	72,8					
28		13,0	19,5	26,0	32,5	39,0	45,5	52,0	58,5	65,0					
30		12,1	18,2	24,3	30,4	36,4	42,5	48,6	54,6	60,7	72,8				
32		11,4	17,1	22,8	28,5	34,1	39,8	45,5	51,2	56,9	68,3				
35		10,4	15,6	20,8	26,0	31,2	36,4	41,6	46,8	52,0	62,4				
36		10,1	15,2	20,2	25,3	30,4	35,4	40,5	45,5	50,6	60,7				
38		9,6	14,4	19,2	24,0	28,8	33,5	38,3	43,1	47,9	57,5	67,1			
40		9,1	13,7	18,2	22,8	27,3	31,9	36,4	41,0	45,5	54,6	63,7	72,8		
42			13,0	17,3	21,7	26,0	30,4	34,7	39,0	43,4	52,0	60,7	69,4		
45			12,1	16,2	20,2	24,3	28,3	32,4	36,4	40,5	48,6	56,7	64,8		
48			11,4	15,2	19,0	22,8	26,6	30,4	34,1	37,9	45,5	53,1	60,7	68,3	
50			10,9	14,6	18,2	21,9	25,5	29,1	32,8	36,4	43,7	51,0	58,3	65,6	72,8
52			10,5	14,0	17,5	21,0	24,5	28,0	31,5	35,0	42,0	49,0	56,0	63,0	70,0
55			9,9	13,2	16,6	19,9	23,2	26,5	29,8	33,1	39,7	46,4	53,0	59,6	66,2
58			9,4	12,6	15,7	18,8	22,0	25,1	28,3	31,4	37,7	44,0	50,2	56,5	62,8
60			9,1	12,1	15,2	18,2	21,2	24,3	27,3	30,4	36,4	42,5	48,6	54,6	60,7
62			8,8	11,7	14,7	17,6	20,6	23,5	26,4	29,4	35,2	41,1	47,0	52,9	58,7
65			8,4	11,2	14,0	16,8	19,6	22,4	25,2	28,0	33,6	39,2	44,8	50,4	56,0
70			7,8	10,4	13,0	15,6	18,2	20,8	23,4	26,0	31,2	36,4	41,6	46,8	52,0
75			7,3	9,7	12,1	14,6	17,0	19,4	21,9	24,3	29,1	34,0	38,9	43,7	48,6
80			6,8	9,1	11,4	13,7	15,9	18,2	20,5	22,8	27,3	31,9	36,4	41,0	45,5
85				8,6	10,7	12,9	15,0	17,1	19,3	21,4	25,7	30,0	34,3	38,6	42,9
90				8,1	10,1	12,1	14,2	16,2	18,2	20,2	24,3	28,3	32,4	36,4	40,5
100				7,3	9,1	10,9	12,7	14,6	16,4	18,2	21,9	25,5	29,1	32,8	36,4
110				6,6	8,3	9,9	11,6	13,2	14,9	16,6	19,9	23,2	26,5	29,8	33,1
120					7,6	9,1	10,6	12,1	13,7	15,2	18,2	21,2	24,3	27,3	30,4

Theoretical allowed operating pressure without test certificate [MPa] is calculated according to DIN 2413-93 by 20°C (1 MPa = 10 bar)

Pressure table for hydraulic tubes (MPa)

Steel St 52.4 (E355) with specific testing 3.1.B (3.1)

Table D

Outside diameter [mm]	Wall thickness														
	0,5	1,0	1,5	2,0	2,5	3,0	3,5	4,0	4,5	5,0	6,0	7,0	8,0	9,0	10,0
5	40,3	80,5													
6	33,5	67,1													
7	28,8	57,5													
8	25,2	50,3	75,5												
9	22,4	44,7	67,1												
10	20,1	40,3	60,4	80,5											
12	16,8	33,5	50,3	67,1											
14	14,4	28,8	43,1	57,5	71,9										
15	13,4	26,8	40,3	53,7	67,1	80,5									
16	12,6	25,2	37,7	50,3	62,9	75,5									
18	11,2	22,4	33,5	44,7	55,9	67,1	78,3								
20	10,1	20,1	30,2	40,3	50,3	60,4	70,4	80,5							
22		18,3	27,4	36,6	45,7	54,9	64,0	73,2	82,3						
24		16,8	25,2	33,5	41,9	50,3	58,7	67,1	75,5						
25		16,1	24,2	32,2	40,3	48,3	56,4	64,4	72,5	80,5					
28		14,4	21,6	28,8	35,9	43,1	50,3	57,5	64,7	71,9					
30		13,4	20,1	26,8	33,5	40,3	47,0	53,7	60,4	67,1	80,5				
32		12,6	18,9	25,2	31,5	37,7	44,0	50,3	56,6	62,9	75,5				
35		11,5	17,3	23,0	28,8	34,5	40,3	46,0	51,8	57,5	69,0				
36		11,2	16,8	22,4	28,0	33,5	39,1	44,7	50,3	55,9	67,1				
38		10,6	15,9	21,2	26,5	31,8	37,1	42,4	47,7	53,0	63,6	74,2			
40		10,1	15,1	20,1	25,2	30,2	35,2	40,3	45,3	50,3	60,4	70,4	80,5		
42			14,4	19,2	24,0	28,8	33,5	38,3	43,1	47,9	57,5	67,1	76,7		
45			13,4	17,9	22,4	26,8	31,3	35,8	40,3	44,7	53,7	62,6	71,6		
48			12,6	16,8	21,0	25,2	29,4	33,5	37,7	41,9	50,3	58,7	67,1	75,5	
50			12,1	16,1	20,1	24,2	28,2	32,2	36,2	40,3	48,3	56,4	64,4	72,5	80,5
52			11,6	15,5	19,4	23,2	27,1	31,0	34,8	38,7	46,5	54,2	61,9	69,7	77,4
55			11,0	14,6	18,3	22,0	25,6	29,3	32,9	36,6	43,9	51,2	58,6	65,9	73,2
58			10,4	13,9	17,4	20,8	24,3	27,8	31,2	34,7	41,6	48,6	55,5	62,5	69,4
60			10,1	13,4	16,8	20,1	23,5	26,8	30,2	33,5	40,3	47,0	53,7	60,4	67,1
62			9,7	13,0	16,2	19,5	22,7	26,0	29,2	32,5	39,0	45,5	51,9	58,4	64,9
65			9,3	12,4	15,5	18,6	21,7	24,8	27,9	31,0	37,2	43,4	49,5	55,7	61,9
70			8,6	11,5	14,4	17,3	20,1	23,0	25,9	28,8	34,5	40,3	46,0	51,8	57,5
75			8,1	10,7	13,4	16,1	18,8	21,5	24,2	26,8	32,2	37,6	42,9	48,3	53,7
80			7,5	10,1	12,6	15,1	17,6	20,1	22,6	25,2	30,2	35,2	40,3	45,3	50,3
85				9,5	11,8	14,2	16,6	18,9	21,3	23,7	28,4	33,2	37,9	42,6	47,4
90				8,9	11,2	13,4	15,7	17,9	20,1	22,4	26,8	31,3	35,8	40,3	44,7
100				8,1	10,1	12,1	14,1	16,1	18,1	20,1	24,2	28,2	32,2	36,2	40,3
110				7,3	9,1	11,0	12,8	14,6	16,5	18,3	22,0	25,6	29,3	32,9	36,6
120					8,4	10,1	11,7	13,4	15,1	16,8	20,1	23,5	26,8	30,2	33,5

Theoretical allowed operating pressure without test certificate [MPa] is calculated according to DIN 2413-93 by 20°C (1 MPa = 10 bar)

Tubes for automotive industry

Production programm – see Tables 16–20 p. 64–68 and Tables 24 and 25 p. 90 and 91.

Production process

Precision steel tubes: seamless or welded as cold sized or welded as cold drawn.

Standards	Steel grade
ASTM A519	Table 1 and 2 of standard
DIN 2391	St 35, St 45, St 52
BS 6323 Part 4	CFS 3, CFS 4, CFS 5, CFS 8, CFS 10, CFS 11
NF A49-310	TU 37-b, TU 52-b, TU 20MV6

Other standards and steel grades upon agreement (EN 10305-1, EN 10305-2, EN 10305-3 and analogous standards). Deliveries according to TDC of customer upon agreement.

List of dimensional standards and technical delivery conditions standards

ASTM A519	Seamless carbon and alloy steel mechanical tubing.
DIN 2391	Seamless precision steel tubes.
BS 6323-4	Specification for seamless and welded steel tubes for automobile, mechanical and general engineering purposes. Part 4: Specific requirements for cold finished seamless steel tubes.
NF A49-310	Steel tubes – Seamless precision tubes for mechanical application.

Lengths

- random 3–9 m
- exact cut lengths
- cutting of tubes (tubes can be also worked by other technologies – see page 92)

Steel grade

Steel is shown in the table of chemical composition and mechanical properties.

Delivery conditions (see pages 63 and 88)

- BK (+C) – cold finished/hard (without heat treatment)
- BKW (+LC) – cold finished/soft
- BKS (+SR) – cold drawn and stress relieve annealed
- NBK (+N) – normalized

Testing

Tubes are tested according to the production standards. Eddy current test upon request according to PRP 02-74.

Marking

According to the production standards or, on request, colour stencilling along whole tube length according to customer specification.

Surface protection

Without protection or oiled.

Packaging

In round bundles of maximum weight 2 tons each, fastened with steel strips.

Certified test report

According to DIN 50049 (EN 10204)2.2, 3.1.B., 3.1.C. (See also page 10).

Injection tubes

Tubes for injection system of Diesel engines are produced upon agreement. (ČSN 42 6718, DIN 73000, ISO 8353-1, steel grades 12015, St 30Al, St 30Si).

Bearings tubes

Dimensions of precision bearings tubes:

Outside diameter [mm]	Wall thickness [mm]
22-25	3-4,1
25,01-29	3-5
29,01-32	3-6,7
32,01-40	3-7,8
40,01-70	3-8

Tolerances

outside diameter	D < 50 mm:	0 + 0,15 mm
	D ≥ 50 mm:	0 + 0,25 mm
wall thickness		±7,5 % (upon agreement ±5 %)

Lengths

3 000 ±500 mm

Straightness

1 mm/1000 mm, max 2,5 mm/3000 mm

Steel grade

DIN 17 230 - 100Cr6 (or 14 109 according STN, ČSN).

C	Mn	Si	P	S	Cr	Ni	Cu	Sn
0,90	0,30	0,15	max	max	1,30	max	max	max
1,10	0,50	0,30	0,017	0,015	1,65	0,10	0,15	0,010

Delivery condition (heat treatment)

GKZ + K + G - annealed for globular carbide + cold finished + soft annealed.

Hardness

After soft annealing is 174 - 220 HB. Dispersion of hardness along the tube length max 15 HB. Hardness by quenching test is min 61 HRC.

Surface condition

The tubes are delivered with surface after soft annealing. Max depth of defects is 0,25 mm inclusive decarbonizing.

Microstructure

Tested according to SEP 1520:

- size of carbide 2.1 - 2.3
- lamellar pearlite 3.0
- carbide net 5.2
- carbide line spacing

max 6.3 - continuous
max 7.3 - released

Micropurity

Tested according to DIN 50602. Total value (oxide + sulphide) K3 ≤ 10.

Demagnetizing

Residual magnetism max 10 Oe.

Tube ends

Plain square cut ends, one end bevelled 0,5-4 mm x 45°.

Testing

Testing according to DIN 17 230. NDT upon agreement according to EN 10246-3 E2H and EN 10246-7 U2/B and test of material identification of alloy steel.

Marking

Bundles are marked with label.

Surface protection

Oiled.

Packaging

Tubes are packed in bundles of weight of 1 000-3 000 kg.

Certified test report

According to DIN 50049 - EN 10204 - 3.1.B. (3.1).

Notes:

1. Possible to deliver also in condition Hot finished.
2. Deliveries according standard EN ISO 683-17 too:
 - Dimensions and tolerances upon agreement.
 - Surface condition and designation:
 - Hot formed - without or HW
 - Cold drawn - CD
 - Heat treatment and delivery condition:
 - Without heat treatment - without or +U
 - Heat treatment for spheroidization and cold drawn +AC+C
 - Heat treatment for spheroidization +AC

Cold sized precision welded tubes

Standards	Dimensional standards	Dimensional range	Dimensions				
			Tolerance D	Tolerance T	Lengths	Straightness	Tube ends
EN	10305-3	Table 24/Page 90	See table 24 • Values for tubes without heat treatment in conditions +CR1, +CR2 • For heat treated tubes possibility to increase tolerances • Ovality in D tolerances • Other tolerances upon agreement	$T \leq 1,5 \text{ mm} \pm 0,15 \text{ mm}$ $T > 1,5 \text{ mm} \pm 0,1T$ max $\pm 0,35 \text{ mm}$	<ul style="list-style-type: none"> standard 6 m/6,4 m, tol. 0 +100 mm exact - tolerances: 0,5-2 m 0 +3 mm 2-5 m 0 +5 mm 5-8 m 0 +10 mm > 8 m - upon agreement max L = 15 m - upon agreement 	$D > 15 \text{ m} \quad 3 \text{ mm/m}$	<ul style="list-style-type: none"> square cut ends free from excessive burrs plain ends
DIN	2394-1			$\pm 10\%$ max $\pm 0,35 \text{ mm}$	<ul style="list-style-type: none"> random fixed tol $\pm 500 \text{ mm}$ exact - tolerances: 0,5-2 m 0 +3 mm 2-5 m 0 +5 mm 5-8 m 0 +10 mm > 8 m - upon agreement 	Visually straight	
BS	6323-5		see Table 2 of standard	$T \leq 3 \text{ mm} \pm 10\%$ $T > 3 \text{ mm} \pm 8\%$ (weld except)	<ul style="list-style-type: none"> random fixed exact - tolerances: 0,5-2 m 0 +3 mm 2-5 m 0 +5 mm 5-8 m 0 +10 mm > 8 m - upon agreement 	$D > 16 \text{ mm} \quad 2 \text{ mm/m}$ Total max 0,2%L	
XPA (NF A)	49-646 (replaces NF A: 49 - 542 49 - 643 49 - 645)		Without heat treatment: $\pm 0,5\%$ min $\pm 0,15 \text{ mm}$ Normalized tubes: • $T/D > 1/20 \pm 0,5\%/\pm 0,15^*$ • $T/D > 1/40 \pm 0,6\%/\pm 0,20^*$ • $T/D > 1/48 \pm 0,8\%/\pm 0,25^*$ • $T/D < 1/48$ - upon agreement * minimum value in mm	$T \leq 1,5 \text{ mm} \pm 7,5\%$ min $\pm 0,10 \text{ mm}$ $T > 1,5 \text{ mm}$ min $\pm 0,13 \text{ mm}$	<ul style="list-style-type: none"> standard 6 m 0 +100 mm specific 0 +50 mm exact $L < 4 \text{ m} \quad 0 +3 \text{ mm}$ 	$D > 16 \text{ mm} \quad 2 \text{ mm/m}$ Total max 0,2%L	
UNI	7947						
STN ČSN	42 6713		See table 24	$T \leq 2 \text{ mm} \pm 6\%$ $T > 2 \text{ mm} \pm 8\%$ (Note - upon agreement, standard from 1976)	<ul style="list-style-type: none"> random fixed $\pm 500 \text{ mm}$ exact 0 +50 mm multiplies of precise 5 mm, cut +50 mm 	3 mm/m Total allowed flexion = conjunction of tolerance and length	
GOST	10704						
PN-H	74241						
ASTM	A513	Table 5/Page 31 • table of seamless tubes is valid • interval in range of tab. 24/Page 90 • delivers upon agreement	Tolerances are depend on method of production and OD (definition of type see page 89): Type 1 (AWHR) - Tab. 4 of St. Type 3, 4, 5, 6 - Tab. 5 of St. Type 2 (AWCR) - Tab. 8 of St.	Tab. 6 of Standard Tab. 7 of Standard Tab. 9 of Standard	Standard over 5 ft (1,5m) Tolerances of lengths Table 10 and 11 of Standard	D under 8 in (203mm) 0,030in/3ft (0,76mm/1m)	
JIS	G 3445	Table 10/Page 52					See page 24

Notes:

* Technological tests at heat treated tubes only

** Condition .1 tied with surface .2 (number behind DS)

Summary of precision welded mechanical tubes is shown in this part. Welded tubes for heat appliances (exchangers etc.) see page 48.

Upon agreement also tubes according to EN 10296-1. Mode of production EW. Steel grades E155, E195, E235, E275, E355, E460. Condition +U, +CR, +A, +N.

Tolerance D $\pm 1\%$, min. $\pm 0,5 \text{ mm}$, tolerance T $\pm 10\%$ (weld except).

TDC standards	Steel grade			Testing and certificates		Other TDC		
	Name	Condition	Surface	Testing	Certificate	Marking	Surface protection	Packing
10305-3	E155 E195 E235 E275 E355 E190 E220 E260 E320 E370 E420	Welded cold sized Possible conditions: +CR1 +A +N Welded cold sized Delivery condition: + CR2	Strip condition: • S1 - raw black • S2 - pickled • S3 - cold rolled • S4 - coated Outside weld seam removing. Roughness Ra ≤ 4 μm	Non-specific Specific: • product analysis • tensile test • dimensions • visual • optional - upon agreement	10204: 2.2 • 3.1.B • 3.1.A • 3.1.C See also page 10	Label on bundle Upon agreement Data: • manufacturer • dimension • standard • steel • cast number • condition • identification number	• without • upon agreement	Bundle with steel strips
2394-2	RSt 34-2 RSt 37-2 St 44-2 St 52-3	Welded cold sized Possible conditions: BKM GBK NBK	Roughness Ra ≤ 6,3 μm (beyond weld area)	Grade A Grade C: • visual • tensile test • flattening* • drift expanding* Optional upon agreement	50049/2.2 3.1.B			
6323/ 1,5	ERW1 ERW2 ERW3 ERW4 ERW5	Welded cold sized Possible conditions: KM GKM NKM		• product analysis • tensile test • flattening • drift expanding • leak tightness	Test results			
49-646	ED 03 ES 200 ES 250 ES 300 ES 380 ED 420 ES 185 ES 235 ES 275 ES 355	Welded cold sized No heat treated Welded cold sized Normalized	Strip condition: • A1 - raw black • A2 - pickled Ra ≤ 3 μm • A3 - cold rolled • A4 - suitable for chromating Ra ≤ 0,4 μm • A5 - coated	Non-specific Specific: • product analysis • tensile test • dimensions	10204/2.1 3.1.B (upon agreement)			
7947	Fe 280 Fe 320 Fe 360 Fe 410 Fe 460							
42 0142	11 320 11 343 11 373 11 523	Welded cold sized Not heat treated = .0 steel grade behind Normalized = .1 steel grade behind**	.0 - raw black .1 - matte .2 - free of scale .3 - cold finished as drawn	• dimensions • visual • straightness • tensile test .+1 • other upon agreement	.1+ test certificate .2+ inspection .9+ upon agreement			
10707	1050: 10 20							
74241	84023: 08XA 12X 84020: Si35X 84018: 18G2A	Welded cold sized Possible conditions: BKM BKS GBK NBK						
A513	MT1010 MT1015 MT1020 MTX1015 MTX1020 1008 1010 1012 1015 1020	Welded cold sized • no final thermal treatment • annealed • normalized (Tube types and their numbers -see Surface)	Type 1 A.W.H.R Welded from hot rolled steel (upon agreement) Type 2 A.W.C.R Welded from cold rolled steel	• product analysis • tensile test • dimensions • hardness • NDT upon agreement		Tube or bundle Data: • manufacturer • dimension • type • order • standard		
G3445		See page 21						

Deliveries also according standards: EN 10 219-1, EN 10 217-1, 2, 3, 4, EN 10 224, EN 10 208-1, 2, DIN 2458, DIN 1626, DIN 1628, ČSN 42 5723, ČSN 42 0152. Upon agreement also tubes of steel grades according standards: EN 10 130, EN 10 139, EN 10 149 and EN 10 268.

Strips for production of tubes which are delivered in condition +CR 2 (steel type of E190) are thermomechanically rolled and therefore the tubes are not annealed. The tubes in condition +CR 1 are not annealed too, but the tubes (steel) are suitable for final annealing (of product).

Cold sized welded square and rectangular tubes according to the standard EN 10 305-5, DIN 2395-1,2, ČSN 42 6935, ČSN 42 6936, ČSN 42 0121 upon agreement only.

Cold drawn precision welded tubes

Standards	Dimensional standards	Dimensional range	Dimensions				
			Tolerance D	Tolerance T	Lengths	Straightness	Tube ends
EN	10305-2	Table 25/Page 91	See table 25 • Data for no heat treated tubes in condition +CR1, +CR2 • possibility to shift tolerance for heat treated tubes • ovality included in D tolerances • other tolerances upon agreement	At ordering D x T: ±7,5% min ±0,05 mm max ±0,35 mm	• random 4-7 m • fixed 4-7 m ±500 mm • exact - tolerance: 4-5 m 0 +5 mm 5-7 m 0 +10 mm > 7 m - upon agreement	D > 15 mm, Reh ≤ 500 MPa 0,0015.L D > 15 mm, Reh > 500 MPa 0,002.L locally max 3 mm/m	• square cut ends • free from excessive burrs • plain ends
DIN	2393-1		See table 25	±7,5% max ±0,35 mm	• random • fixed • exact - tolerance: 4-5 m 0 +5 mm 5-7 m 0 +10 mm > 7 m - upon agreement	D > 15 mm 0,25%L Reh > 500 MPa 0,3%L locally max 3 mm/m	
BS	6323-6		Ratio D/T max 33:1: • ≤ 30 mm ±0,10 mm • 30-50 mm ±0,15 mm • 50-70 mm ±0,20 mm • 70-90 mm ±0,25 mm Ratio D/T > 33:1 - upon agreement	±7,5% min ±0,1 mm			
UNI	7946						
STN ČSN	42 6714		See table 25	T ≤ 1 mm ±0,1 mm T > 1 mm ±7,5 %	• random • fixed • exact - tolerance: 2-5 m 0 +7 mm > 5 m 0 +15 mm		
ASTM	A513	See page 86	See page 86		Standard over 5 ft (1,5m) Tolerances of lengths Table 10 and 11 of Standard	D under 8 in (203mm) 0,030in/3ft (0,76mm/1m)	
	A512 (upon agreement)	Table 18/Page 66 • table of seamless tubes is valid • interval in range of tab. 25/Page 91 • delivers upon agreement	Drawing without mandrel: D ≤ 12,7 mm 0 +0,10 mm D = 12,7-38,1 mm 0 +0,13 mm D = 38,1-76,2 mm 0 +0,25 mm Mandrel drawn: See table 4 of Standard	Drawing without mandrel: ±15 % ±10 % ±10 %	According to the possibilities of producer and agreement	0,8 mm/m - upon agreement It does not pay for annealed and small-diameter tubes.	
Valid for conditions: MD, SD, MDSR, SDR							

Notes:

* Technological tests at heat treated tubes only

Upon agreement also tubes according to PN-H 74243, steel grade according to PN-H 84023 and NFA 49-341, steels TS 30-a, TS 34-a, TS 37-a, TS 42-a, TS 47-a.

Summary of delivery conditions and heat treatment of precision tubes according to DIN and EN (see also page 63):

Tube kind	Standards	Cold finished hard	Cold finished soft	Cold finished stress relieved	Annealed	Normalized
Seamless drawn	2391-2	BK	BKW	BKS	GBK	NBK
	10305-1	+C	+LC	+SR	+A	+N
Welded drawn	2393-2	BK	BKW	BKS	GBK	NBK
	10305-2	+C	+LC	+SR	+A	+N
Welded calibrated	2394-2	BKM			GBK	NBK
	10305-3	+CR1, +CR2			+A	+N
Welded rectangular	2395-2	BKM, M				NBK
	10305-5	+CR1, +CR2			+A	+N

BKM – cold calibrated; M – cold calibrated, hot strip; CR1 – not heat treated, suitable for final (product) annealing; CR2 – not heat treated, without final annealing (see page 86).

HPL tubes standards are in EN standards – Part 4 for seamless tubes, Part 6 for welded tubes. These are delivered in condition +N.

TDC standards	Steel grade			Testing and certificates		Other TDC		
	Name	Condition	Surface	Testing	Certificate	Marking	Surface protection	Packing
10305-2	E155 E195 E235 E275 E355	Welded cold drawn Possible steel condition: +C +LC +SR +A +N	Typical of the production process and tube delivery condition. Roughness Ra ≤ 4 μm (except seam section)	Non-specific Specific: • product analysis • tensile test • dimensions • visual Optional upon agreement	10204: 2.2 • 3.1.B • 3.1.A • 3.1.C See also page 10	Label on bundle Upon agreement	• without protection • upon agreement	Bundle with steel strips
2393-2	RSi34-2 RSi37-2 Si44-2 Si52-3	Welded cold drawn Possible steel condition: BK BKW BKS GBK NBK	Ra ≤ 6,3 μm	Grade A Grade C: • dimensions • visual • tensile test • flattening* • drift expanding* Optional upon agreement	50049/2.2 3.1.B			
BS6323/1,6	CEW1 CEW2 CEW3 CEW4 CEW5	Welded cold drawn Possible steel condition: BK BKW GBK NBK		• product analysis • tensile test • flattening • drift expanding • leak tightness - upon agreement	Test results			
7946	Fe280 Fe320 Fe360 Fe410 Fe460							
42 0142	See page 87							
A513	Steel grade - see page 87	Type 2 - A.W.C.R Type 4 - S.D.C.R Type 5 - M.D Type 6 - S.S.I.D	Typical of the production process	• product analysis • tensile test • dimensions • hardness • NDT upon agreement		Tube or bundle Data: • manufacturer • dimension • type • order • standard		
A512		Possible steel condition: MD-mandrel drawn, no final thermal treatment SD-sink drawn, no final thermal treatment MDSR SDSR MDSA SDSA Norm-MD-SR Norm-SD-SR						

Mechanical Tubing according to ASTM A – sizing methods and thermal treatments

ASTM A512 (buttweld and cold drawn Carbon steel)

Condition

MD - mandrel drawn, no final thermal treatment

SD - sink drawn, no final thermal treatment

MDSR - mandrel drawn and stress relieved

SDSR - sink drawn and stress relieved

MDSA - mandrel drawn and soft annealed or normalized

SDSA - sink drawn and soft annealed or normalized

NORM-MD-SR - normalized, mandrel drawn and stress relieved

NORM-SD-SR - normalized, sink drawn and stress relieved

Thermal conditions : no final thermal treatment, stress relieved, annealed, normalized

ASTM A519 (seamless, Carbon and Alloy steel)

Sizing methods

HF - hot finished

CW - cold worked

RT - rough turned

G - ground

Thermal treatments

A - annealed

N - normalized

QT - quenched and tempered

SR - stress relieved or finish anneal

ASTM A513 (resistance welded, Carbon and Alloy steel)

Condition (sizing methods)

Type Code letters Description

1	A.W.H.R.	as welded from hot rolled steel
2	A.W.C.R.	as welded from cold rolled steel
3	S.D.H.R.	sink drawn hot rolled steel
4	S.D.C.R.	sink drawn cold rolled steel
5	M.D.	mandrel drawn
6	S.S.I.D.	special smooth inside diameter

List of dimensional standards and technical delivery conditions standards of cold sized tubes

STN 42 0142	ČSN 42 0142	Welded steel tubes precision or threaded. TDC.
STN 42 0152	ČSN 42 0152	Longitudinally welded smooth tubes made of steel groups 11 and 12. External diameter up to 152 mm. TDC
STN 42 5723	ČSN 42 5723	Longitudinally welded smooth tubes made of steel groups 11 and 12. External diameter up to 152 mm. Dimensions
STN 42 6713	ČSN 42 6713	Precision welded steel tubes. Dimensions.
ASTM A513		Standard specification for electric-resistance-welded carbon and alloy steel mechanical tubing.
DIN 2394		As-welded and sized precision steel tubes. Part 1: Dimensions. Part 2: TDC.
BS 6323		Specification for seamless and welded steel tubes for automobile, mechanical and general engineering purposes. Part 5: Specific requirements for electric resistance welded and induction welded steel tubes.
XP A49-646		Precision tubes of round, square and rectangular section longitudinally induction welded. Dimensions. TDC.
UNI 7947		Precision plain end welded steel tubes.
EN 10296-1		Welded steel tubes for mechanical and engineering purposes. Part 1: Non alloy and alloy steel tubes.
EN 10305-3		Steel tubes for precision applications. Part 3: Welded cold sized tubes.
GOST 10 704		Steel tubes electrically welded. Dimensions.
GOST 10 707		Cold deformed steel tubes electrically welded. TDC.
PN-H-74 241		Welded cold calibrated steel tubes.
PN-H-84 018		High strength low alloy steel.
PN-H-84019		Unalloyed wrought steel for case hardening and for quenching and tempering.
PN-H-84 020		Structural unalloyed steel for general purposes.
PN-H-84 023/7		Steel for determined purposes. Pipe steel. Grades.
PN-H-84024		Steels for elevated temperature service. Grades.
JIS G3445		Carbon steel tubes for machine structural purposes.
ISO 3306		Plain end as-welded and sized precision steel tubes. TDC.

Dimensions and weight of precision welded cold sized tubes according to European standards

Table 24

Outside diameter D [mm]	Tolerance	Wall thickness [mm]											
		1,0	1,2	1,5	1,8	2,0	2,2	2,5	3,0	3,5	4,0	4,5	5,0
DN		Tube weight [kg/m]											
(19)	± 0,15	0,444	0,527	0,647	0,764	0,838	0,911	1,02	1,18				
20		0,469	0,556	0,684	0,808	0,888	0,966	1,08	1,26				
22		0,518	0,616	0,758	0,897	0,986	1,07	1,20	1,41				
25		0,592	0,704	0,869	1,03	1,13	1,24	1,39	1,63				
30	± 0,20	0,715	0,852	1,05	1,25	1,38	1,51	1,70	2,00	2,29			
32		0,765	0,911	1,13	1,34	1,48	1,62	1,82	2,15	2,46			
35		0,838	1,00	1,24	1,47	1,63	1,78	2,00	2,37	2,72			
38		0,912	1,09	1,35	1,61	1,78	1,94	2,19	2,59	2,98	3,35		
40	± 0,25	0,962	1,15	1,42	1,70	1,87	2,05	2,31	2,74	3,15	3,55		
45		1,09	1,30	1,61	1,92	2,12	2,32	2,62	3,11	3,58	4,04		
50		1,21	1,44	1,79	2,14	2,37	2,59	2,93	3,48	4,01	4,54	5,05	
55		1,59	1,98	2,36	2,61	2,86	3,24	3,85	4,45	5,03	5,60		
60	± 0,30		1,74	2,16	2,58	2,86	3,14	3,55	4,22	4,88	5,52	6,16	6,78
70	± 0,35		2,04	2,53	3,03	3,35	3,68	4,16	4,96	5,74	6,51	7,27	8,01
80	± 0,40		2,33	2,90	3,47	3,85	4,22	4,78	5,70	6,60	7,50	8,38	9,25
90				3,27	3,92	4,34	4,76	5,39	6,44	7,47	8,48	9,49	10,48

Dimensions upon agreement: Outside diameter - 24; 25,4; 26; 27; 28; 31,75; 38,1; 42; 42,4; 48; 48,3; 50,8; 51; 82
Wall thickness - 2,3; 2,6; 3,2; 3,25; 3,8

Tolerances of outside diameter of heat treated tubes (see also page 88)

Ratio T/D	Tolerances from Table 24 are multiplied by:
> 0,05	1
0,05 > T/D ≥ 0,025	1,5
< 0,025	2

List of dimensional standards and technical delivery conditions standards of cold drawn tubes

STN 42 0142	ČSN 42 0142	Welded steel tubes precision or threaded. TDC.
STN 42 6714	ČSN 42 6714	Precision welded steel tubes with increased accuracy. Dimensions.
ASTM A512		Cold drawn butt-weld carbon steel mechanical tubing.
ASTM A513		Standard specification for electric-resistance-welded carbon and alloy steel mechanical tubing.
DIN 2393		Precision welded steel tubes of specific accuracy. Part 1: Dimensions. Part 2: TDC.
BS 6323		Specification for seamless and welded steel tubes for automobile, mechanical and general engineering purposes. Part 6: Specific requirements for cold finished electric resistance welded and induction welded steel tubes.
NFA 49-341		Precision welded tubes for mechanical application. Dimensions. TDC.
UNI 7946		Precision welded tubes.
EN 10305-2		Steel tubes for precision applications Part 2: Welded cold drawn tubes.
ISO 3305		Plain end welded precision steel tubes. TDC.

Dimensions of precision welded cold drawn tubes according to European standards

Table 25

Outside diameter [mm]	Tolerance	Wall thickness [mm]														
		0,5	0,8	1	1,2	1,5	1,8	2	2,2	2,5	2,8	3	3,5	4	4,5	
Inside diameter and tolerances [mm]																
4	± 0,08	3±0,15	2,4±0,15	2±0,15												
5		4±0,15	3,4±0,15	3±0,15												
6		5±0,15	4,4±0,15	4±0,15												
7		6±0,15	5,4±0,15	5±0,15	4,6±0,15	4±0,15										
8		7±0,15	6,4±0,15	6±0,15	5,6±0,15	5±0,15										
9		8±0,15	7,4±0,15	7±0,15	6,6±0,15	6±0,15										
10		9±0,15	8,4±0,15	8±0,15	7,6±0,15	7±0,15	6,4±0,15	6±0,15								
12		11±0,15	10,4±0,15	10±0,15	9,6±0,15	9±0,15	8,4±0,15	8±0,15								
14		13±0,08	12,4±0,08	12±0,08	11,6±0,15	11±0,15	10,4±0,15	10±0,15	9,6±0,15	9±0,15						
15		14±0,08	13,4±0,08	13±0,08	12,6±0,08	12±0,15	11,4±0,15	11±0,15	10,6±0,15	10±0,15						
16		15±0,08	14,4±0,08	14±0,08	13,6±0,08	13±0,08	12,4±0,15	12±0,15	11,6±0,15	11±0,15						
18		17±0,08	16,4±0,08	16±0,08	15,6±0,08	15±0,08	14,4±0,08	14±0,08	13,6±0,15	13±0,15	12,4±0,15	12±0,15	11±0,15			
20		19±0,08	18,4±0,08	18±0,08	17,6±0,08	17±0,08	16,4±0,08	16±0,08	15,6±0,15	15±0,15	14,4±0,15	14±0,15	13±0,15	12±0,15		
22		21±0,08	20,4±0,08	20±0,08	19,6±0,08	19±0,08	18,4±0,08	18±0,08	17,6±0,08	17±0,15	16,4±0,15	16±0,15	15±0,15	14±0,15		
25		23,4±0,08	23±0,08	22,6±0,08	22±0,08	21,4±0,08	21±0,08	20,6±0,08	20±0,08	19,4±0,15	19±0,15	18±0,15	17±0,15	16±0,15		
26		24,4±0,08	24±0,08	23,6±0,08	23±0,08	22,4±0,08	22±0,08	21,6±0,08	21±0,08	20,4±0,15	20±0,15	19±0,15	18±0,15	17±0,15		
28		26,4±0,08	26±0,08	25,6±0,08	25±0,08	24,4±0,08	24±0,08	23,6±0,08	23±0,08	22,4±0,08	22±0,15	21±0,15	20±0,15	19±0,15		
30		28,4±0,08	28±0,08	27,6±0,08	27±0,08	26,4±0,08	26±0,08	25,6±0,08	25±0,08	24,4±0,08	24±0,15	23±0,15	22±0,15	21±0,15		
32		30,4±0,15	30±0,15	29,6±0,15	29±0,15	28,4±0,15	28±0,15	27,6±0,15	27±0,15	26,4±0,15	26±0,15	25±0,15	24±0,15	23±0,15		
35	± 0,15	33,4±0,15	33±0,15	32,6±0,15	32±0,15	31,4±0,15	31±0,15	30,6±0,15	30±0,15	29,4±0,15	29±0,15	28±0,15	27±0,15	26±0,15		
38		36,4±0,15	36±0,15	35,6±0,15	35±0,15	34,4±0,15	34±0,15	33,6±0,15	33±0,15	32,4±0,15	32±0,15	31±0,15	30±0,15	29±0,15		
40		38,4±0,15	38±0,15	37,6±0,15	37±0,15	36,4±0,15	36±0,15	35,6±0,15	35±0,15	34,4±0,15	34±0,15	33±0,15	32±0,15	31±0,15		
42						39±0,20	38,4±0,20	38±0,20	37,6±0,20	37±0,20	36,4±0,20	36±0,20	35±0,20	34±0,20	33±0,20	
45	± 0,20					42±0,20	41,4±0,20	41±0,20	40,6±0,20	40±0,20	39,4±0,20	39±0,20	38±0,20	37±0,20	36±0,20	
48						45±0,20	44,4±0,20	44±0,20	43,6±0,20	43±0,20	42,4±0,20	42±0,20	41±0,20	40±0,20	39±0,20	
50						47±0,20	46,4±0,20	46±0,20	45,6±0,20	45±0,20	44,4±0,20	44±0,20	43±0,20	42±0,20	41±0,20	
55	± 0,25					52±0,25	51,4±0,25	51±0,25	50,6±0,25	50±0,25	49,4±0,25	49±0,25	48±0,25	47±0,25	46±0,25	
60						57±0,25	56,4±0,25	56±0,25	55,6±0,25	55±0,25	54,4±0,25	54±0,25	53±0,25	52±0,25	51±0,25	
65	± 0,30					62±0,30	61,4±0,30	61±0,30	60,6±0,30	60±0,30	59,4±0,30	59±0,30	58±0,30	57±0,30	56±0,30	
70						67±0,30	66,4±0,30	66±0,30	65,6±0,30	65±0,30	64,4±0,30	64±0,30	63±0,30	62±0,30	61±0,30	
75	± 0,35							71±0,35	70,6±0,35	70±0,35	69,4±0,35	69±0,35	68±0,35	67±0,35	66±0,35	
80									76±0,35	75,6±0,35	75±0,35	74,4±0,35	74±0,35	73±0,35	72±0,35	71±0,35

Cold sized welded square and rectangular tubes - see page 87

Precision welded tubes for automotive industry - see pages 86 - 91

Precision welded tubes for hydraulic and pneumatic lines

- deliveries upon agreement according to EN 10305-6

Tube semiproducts

Specially designed tube semi-finished products, tailored to customer's needs are available upon request. Cold drawn precise tubes are machined, but when requested, hot finished tubes are furnished as various forms of semi finished products.

Products

- Tube cut in short exact lengths by:
 - sawing
 - shearing
 - rotary cut-off head with slides
- Tube with bevelled ends
- Tube bending

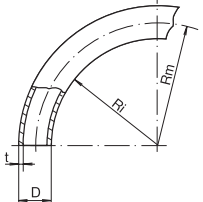
Tube bending

	Bend angle Rm												
	20	25	32	40	50	60	80	100	125	160	200	250	
D = 10 t ≥ 1													
D = 12 t ≥ 1													
D = 14 t ≥ 1													
D = 15 t ≥ 1													
D = 16 t ≥ 1													
D = 18 t ≥ 1													
D = 20 t ≥ 1													
D = 22 t ≥ 1													
D = 24 t ≥ 1													
D = 25 t ≥ 1													
D = 28 t ≥ 1													
D = 30 t ≥ 1,5													
D = 32 t ≥ 1,5													
D = 35 t ≥ 1,5													
D = 38 t ≥ 1,5													
D = 40 t ≥ 1,5													
D = 42 t ≥ 1,5													

$t = D/20$
 $R_i = 2D$

$t = D/30$
 $R_i = 3D$

$t = D/50$
 $R_i = 4,5D$



It is possible to bend the tubes in three planes without destroying the tube at the bend point (see table) by CNC tube bender.

Bend parameters:

- max. size of bent tube - 42 x 2,5 mm
- bend radius - 12-260 mm
- max. bend angle - 187 °
- tolerance on bend angle - ±0,1 °
- tube length under the final bend - max 3 000 mm
- tolerance of length - ±0,1 mm

Packaging

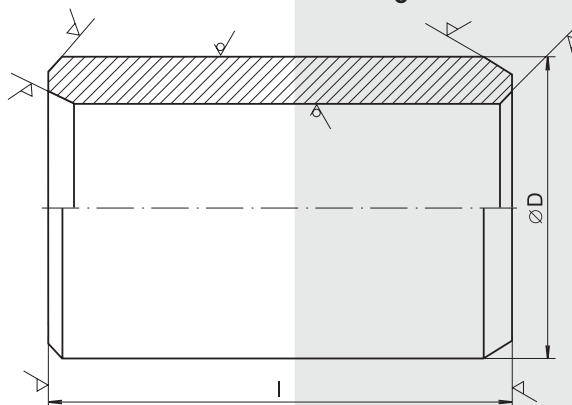
Semi-finished products are delivered according to customer specifications in mettalic box pallets, collapsible pallets, cardboard cartons placed on wooden europallets or bundled.

Certified test report

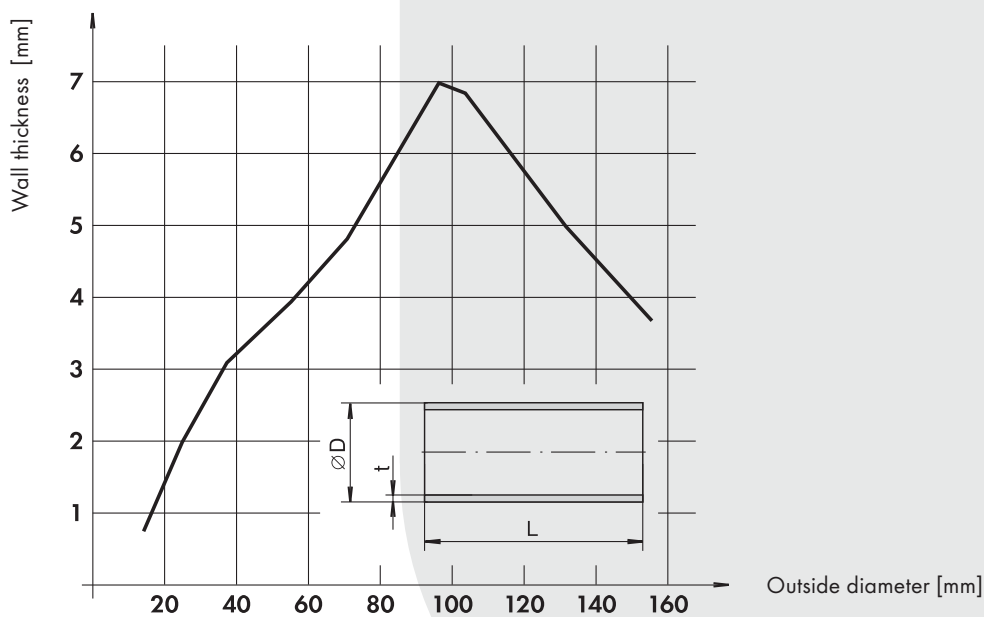
According to DIN 50049 - EN 10204 - 2.2 or 3.1.B.

Parameter	Sawing 1	Method		Rotary cutt-off
		Sawing 2	Shearing	
		Range		
Outside diameter	12-102 mm	10-81 mm	15-152 mm	20-90 mm
Wall thickness	1-3 mm	0,5-7 (12) mm	max. 7 % D	0,7-12 mm
Lenghts	20 (130)-3250 mm	15-600 mm	25-780 mm	150-2000 mm
Tolerances	±0,25 mm	±0,025 mm	±0,25 mm	±0,11 - ±0,19 mm
Stabilization of production process		$CpK > 1,67$		$CpK > 1,67$
Tube ends	Brushing L = 100-4500 mm	Tube ends bevelling		
		D = 10-81 mm L = 15-340 mm 5°-85° (min. d = 12 mm)	D = 15-70 mm L = 30-690 mm	D = 20-90 mm L = 150-2000 mm 5°-85° (min. d = 18 mm)
Surface protection	Washing and passivating at L = 100-3000 mm	Without protection or oiled		

Tube ends bevelling



Shearing of tubes



Butt-welding steel pipe fittings

List of standards of butt-welding elbows

Standards	Dimensional standards	Dimensions	Standards for elbows		Standards for pipe	
			TDC	Steel Grade	TDC	Steel Grade
Elbows for steel construction, machine parts and common use – standard steel						
STN, ČSN	42 5760	Table 27 Page 96	ŽP-05-04	11 353	42 0250	11 353
DIN	2605 - 1, 2		2609 (A)	St 37.0	1629	St 37.0
			2609 (B)	St 44.0		St 44.0
			2609 (C)	St 52.0		St 52.0
EN	10 253 - 1		10 253 - 1	S 235 S 265	10 210 - 1	S 235 JRH S 275 JOH
Elbows for pressure purposes – room temperature						
STN, ČSN	42 5760	Table 27 Page 96	ŽP-05-04	11 353	42 0250	11 353
DIN	2605 - 1, 2		2609 (A)	St 37.0	1629	St 37.0
			2609 (B)	St 44.0		St 44.0
			2609 (C)	St 52.0		St 52.0
NF A	49 - 186 49 - 281		49 - 186 49 - 281	AE 220 A AE 220, 250, 275	49 112	TU E 220A TU E 235A
EN	10 253 - 2		10 253 - 2	P 235 TR2 P 265 TR2 P 235 TR2 P 265 TR2	10 216 - 1	P 235 TR1 P 265 TR1 P 235 TR2 P 265 TR2
Elbows for pressure purposes – elevated temperature						
STN, ČSN	42 5760	Table 27 Page 96	ŽP-05-05	12 021 12 022 15 020	42 0251	12 021 12 022 15 020
ASTM ASME	ANSI B 16.9	Table 28 Page 97	A 234 / A 960	WPB WPC	A 106	Grade B Grade C
DIN	2605 - 1, 2		2609 (F, G) 2609 (H)	St 35.8 I, III 15Mo3	17 175	St 35.8 I, III 15Mo3
BS	1965 - 1	Table 27	1965 - 1	Grade 410	3602 - 1	HFS 360
EN	10 253 - 2	Page 96	10 253 - 2	P 235 GH P 265 GH 16Mo3	10 216 - 2	P 235 GH P 265 GH 16Mo3
Elbows for pressure purposes from fine grain steel						
DIN	2605 - 1, 2	Table 27 Page 96	2609 (R) 2609 (S) 2609 (T)	WSiE 355 TSiE 355 TSiE 285	17 179	WSiE 355 TSiE 355 TSiE 285
EN	10 253 - 2		10 253 - 2	P 355 N P 355 NH P 355 NL1	10 216 - 3	P 355 N P 355 NH P 355 NL1
Elbows for pressure purposes – low temperature						
PN ŽP	42 5760	Table 27 Page 96	ŽP-05-04	11 369 11 419 11 503	42 0165	11 369 11 419 11 503
ASME	ASME B 16.9	Tab. 28 Pg. 97	A 420 / A 960	WPL 6	A 333	Grade 6
EN	10 253 - 2	Table 27 Page 96	10 253 - 2	P 215 NL P 265 NL	10 216 - 4	P 215 NL P 265 NL
Elbows for water and gas pipe line						
PN ŽP	42 5760	Table 27	ŽP-05-04	11 353	42 0250	11 353
DIN	2605 - 1	Page 96	2609 (A)	St 37.0	2440, 2441	St 33-2, St 37.0
Elbows for pipe line						
DIN	2605 - 1, 2	Table 27 Page 96	2609 (D) 2609 (E)	SiE 290.7 SiE 360.7	17 172	SiE 290.7 SiE 360.7
EN	10 523 - 2		10 253 - 2	L 415NB	10 208 - 2	L 415NB

Notes: Deliveries of welding neck flanges upon agreement.
Standards: DIN 2631, DIN 2632, DIN 2633, DIN 2635
ANSI B16,5
STN 13 1229, STN 13 1231, STN 13 1233
EN 1092-1
Dimensions: DN 15-150, ANSI 1/2"-6"
Steel grades: 11 375, 11 416, RSt 37-2, C22.8, A105/C4

List of dimensional standards and technical delivery conditions standards for fittings

ŽP-05-04	Buttwelding elbows. TDC.
ŽP-05-05	Buttwelding elbows with specified elevated temperature properties
STN 42 0165	ČSN 42 0165 Sheets and pipes of ferritic-perlitic steel with guaranteed impact properties at low temperatures. TDC.
STN 42 0250	ČSN 42 0250 Hot formed seamless tubes from steel grade 10 to 16.
STN 42 0251	ČSN 42 0251 Seamless steel tubes with specified elevated temperature properties.
ŽP 42 5760	Buttwelding elbows. Dimensions.
STN 13 220	ČSN 13 220 Steel buttwelding fittings. Building dimensions.
ASME B16.9	Factory-made wrought steel buttwelding fittings.
ASTM A106	Seamless carbon steel pipe for high temperature service.
ASTM A234	Piping fittings of wrought carbon steel and alloy steel for moderate and high temperature service.
ASTM A333	Seamless and welded steel pipe for low temperature service (Pipe).
ASTM A420	Piping fittings of wrought carbon steel and alloy steel for low temperature service.
ASTM A860/MSS-SP-75 (MSS sor dimession NPS over 14)	Wrought high strength low alloy steel butt welding fittings. (Steel grade WPHY 42, 46, 52, 60, 65, 70). Deliveries upon agreement.
ASTM A960	Common requirements for wrought steel piping fittings.
ASTM A999	General requirements for alloy and stainless steel pipe.
ASTM A1016	General requirements for ferritic alloy steel, austenitic alloy steel and stainless steel tubes.
DIN 1629	Seamless circular tubes of non-alloy steel with special quality requirements.
DIN 2440	Steel tubes, medium weight suitable for screwing.
DIN 2441	Steel tubes, heavy weight suitable for screwing.
DIN 2519	Steel flanges. TDC.
DIN 2605-1	Elbows. Reduced correlation of utilization.
DIN 2605-2	Elbows. Full correlation of utilization.
DIN 2609	Buttwelding fittings.
DIN 2631, 2632, 2633, 2634, 2635	Steel flanges. Nominal pressure 6, 10, 16, 25, 40.
DIN 17 172	Steel pipes for long-distance pipelines for combustible liquids and gases.
DIN 17 175	Seamless tubes of heat resistant steel.
DIN 17 179	Seamless circular fine grain steel tubes to special requirements.
BS 1965-1	Buttwelding pipe fittings for pressure purposes. Carbon steel.
BS 3602-1	Steel pipes and tubes for pressure purposes: carbon and carbon manganese steel with specified elevated temperature properties.
NF A49-112	Plain ends seamless steel hot rolled tubes with specified room temperature properties and with special delivery conditions.
NF A49-186	Tubular accesories – bends – reduction for welding, made from seamless tubes for general use. Dimensions. TDC.
NFA 49-281	Steel tubes, tubular accesories, bends, tee, reduction for welding, made from seamless tube with quality specifications. Dimensions. TDC.
EN 1092-1	Flanges and their joints – circular flanges for pipes, valves, fittings and accessories. Part 1: Steel flanges, PN designated.
EN 10208-2	Steel pipes for pipelines for combustible fluids. TDC. Part 2: Pipes of requirement calss B.
EN 10210-1	Hot finished structural hollow sections of non-alloy and fine grain structural steel.
EN 10216-1, 2, 3, 4	Seamless steel tubes for pressure purposes. TDC. Part 1: Non-alloy steel tubes with specified room temperature properties. Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties. Part 3: Non-alloy and alloy fine grain steel tubes Part 4: Non-alloy and alloy steel tubes with specified low temperature properties.
EN 10253-1	Buttwelding pipe fittings. Part 1: Wrought carbon steel for general use and without specific inspection requirements.
EN 10253-2	Buttwelding pipe fittings. Part 2: Wrought carbon and ferritic alloy steel with specific inspection requirements.
EN 10297-1	Seamless steel tubes for mechanical and general engineering purposes. TDC. Part 1: Non-alloy and alloy steel tubes.
EN 764-5	Pressure equipment. Compliance and inspection document of metal materials.
ISO 3419	Non-alloy and alloy steel buttwelding fittings.
RToD M0803	Dutch rules for pressure vessels. Seamless fittings.

Dimensions of elbows

Elbow dimensions of type K (90°) and DK (180°) sort 3D, made according to European standards

Table 27

Size		Outside diameter [mm]	Wall thickness [mm]	r [mm]	Height b [mm]	2b [mm]	Elbow weight	
NPS	DN						90° [kg]	180° [kg]
1/2	15	21,3	2,00	28	38	76	0,04	0,08
3/4	20	26,9	2,30	29	43	86	0,06	0,13
		31,8	2,60	35	51	102	0,10	0,20
1	25	33,7	2,60	38	56	112	0,12	0,24
1	25	33,7	3,20	38	56	112	0,14	0,28
		38,0	2,60	45	64	128	0,16	0,32
1 1/4	32	42,4	2,60	48	69	138	0,19	0,38
1 1/4	32	42,4	3,60	48	69	138	0,26	0,52
1 1/4	32	42,4	4,00	48	69	138	0,28	0,56
		44,5	2,60	51	73	146	0,22	0,44
1 1/2	40	48,3	2,60	57	82	164	0,26	0,52
1 1/2	40	48,3	4,00	57	82	164	0,39	0,78
		51,0	2,60	63,5	88	176	0,31	0,62
		57,0	2,90	72	100	200	0,44	0,88
2	50	60,3	2,90	76	106	212	0,49	0,98
2	50	60,3	4,50	76	106	212	0,74	1,48
		63,5	2,90	82,5	114	228	0,56	1,12
		70,0	2,90	92	127	254	0,69	1,38
2 1/2	65	76,1	2,90	95	133	266	0,78	1,56
2 1/2	65	76,1	5,00	95	133	266	1,46	2,90
		82,5	3,20	107,5	149	298	1,06	2,12
3	80	88,9	3,20	114	159	318	1,22	2,44
3	80	88,9	5,60	114	159	318	2,06	4,18
3 1/2		101,6	3,60	133,5	184	368	1,82	3,64
		108,0	3,60	142,5	196	392	2,07	4,14
4	100	114,3	3,60	152	210	420	2,37	4,74
4	100	114,3	6,30	152	210	420	4,00	8,00
		127,0	4,00	175	238	476	3,34	6,68
		133,0	4,00	181	247	494	3,62	7,24
5	125	139,7	4,00	190	260	520	4,01	8,02
		152,4	4,50	215	291	582	5,54	11,08
		159,0	4,50	216	294	588	5,82	11,64
6	150	168,3	4,50	229	313	626	6,54	13,08
7	175	193,7	5,60	270	367	734	10,60	21,20
8	200	219,1	6,30	305	414	828	15,80	31,60
10	250	273,0	6,30	381	518	1036	24,80	49,60
10	250	273,0	7,10	381	518	1036	27,90	55,80
12	300	323,9	7,10	457	619	1238	39,80	79,60
14	350	355,6	8,00	533	711	1422	57,50	115,00
16	400	406,4	8,80	610	813	1626	82,60	165,20
18	450	457,0	10,00	686	914	1828	119,00	237,00
20	500	508,0	11,00	762	1016	2032	162,00	323,00
24	600	610,0	12,50	914	1219	2438	266,00	531,00

Upon agreement also dimensions:
 26,9 x 3,20
 33,7 x 3,60
 48,3 x 3,60
 76,1 x 4,00
 88,9 x 4,50

Other dimensions up to diameter of 610 mm upon agreement.

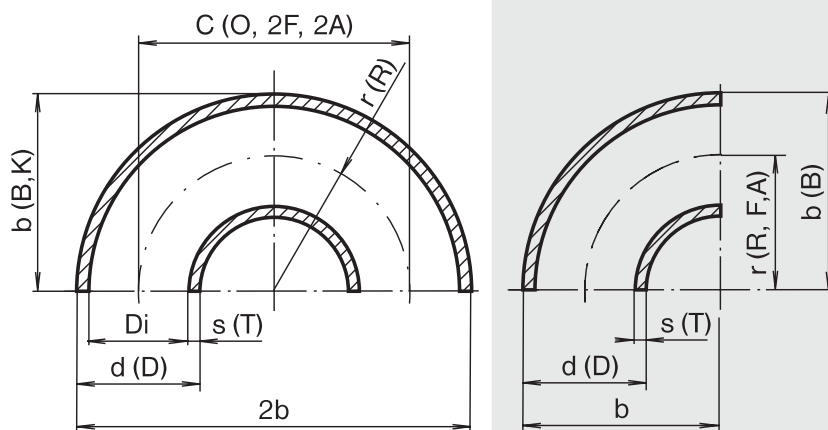
Upon agreement it is also possible to deliver elbows up to 914 mm, made from welded segments (outside diameters 711, 813 and 914 mm, i.e. 28", 32" and 36") and elbows of type 45°/30°, 60°.

Dimensions of long radius elbows and returns according to standard ASME/ANSI B16.9

Table 28

NPS	Outside diameter		Wall thickness		Identification	Schedule No.	Inside diameter		90° elbow A (r)		180° elbow			
	[inch]	[mm]	[inch]	[mm]			[inch]	[mm]	[inch]	[mm]	O	K		
1	1.315	33,4	0.133	3,38	STD	40	1.049	26,64	1.50	38	3.00	76	2.19	56
1 1/4	1.660	42,2	0.140	3,56	STD	40	1.380	35,08	1.88	48	3.75	95	2.75	70
1 1/2	1.900	48,3	0.145	3,68	STD	40	1.610	40,94	2.25	57	4.50	114	3.25	83
2	2.375	60,3	0.109	2,77	-	-	2.157	54,76	3.00	76	6.00	152	4.19	106
2	2.375	60,3	0.154	3,91	STD	40	2.067	52,48	3.00	76	6.00	152	4.19	106
2 1/2	2.875	73,0	0.203	5,16	STD	40	2.469	62,68	3.75	95	7.50	191	5.19	132
3	3.500	88,9	0.125	3,18	-	-	3.250	82,54	4.50	114	9.00	229	6.25	159
3	3.500	88,9	0.216	5,49	STD	40	3.068	77,92	4.50	114	9.00	229	6.25	159
3 1/2	4.000	101,6	0.141	3,58	-	-	3.718	94,44	5.25	133	10.50	267	7.25	184
3 1/2	4.000	101,6	0.226	5,74	STD	40	3.548	90,12	5.25	133	10.50	267	7.25	184
4	4.500	114,3	0.141	3,58	-	-	4.218	107,14	6.00	152	12.00	305	8.25	210
4	4.500	114,3	0.237	6,02	STD	40	4.026	102,26	6.00	152	12.00	305	8.25	210
6	6.625	168,3	0.172	4,37	-	-	6.281	159,56	9.00	229	18.00	457	12.31	313

Upon agreement it is possible to deliver elbows up to 914 mm (36"), made from welded segments.



Standard		Symbols						
PN ŽP 42 5760	DN	d	s	r	b	2b	b	
DIN 2605	DN	d _o	s	r	b	2b	b	
NF A 49 186	DN	D	T	(R)	F	C	B	
EN 10 253	DN	D	T	(R)	F	C	B	
BS 1965	NPS (OD)	(WT)		A	O	K		
ASME B 16.9	NPS	D			A	O	K	

Dimensional tolerances

Exact values are listed in corresponding standards. Approximate data are shown in the Table of tolerances (page 101).

Steel

Elbows are made from steel shown in survey table. At standard DIN 2609 there is shown also steel qualification according to this standard. As a supplement of the survey there is listed also standard and steel grade of tube which is a part of pipeline together with elbow.

Elbow verify according to requirements of standard NACE MR 0103, NACE MR 0175. C-equivalent calculating formula see page 14.

Heat treatment, delivery condition and surface quality

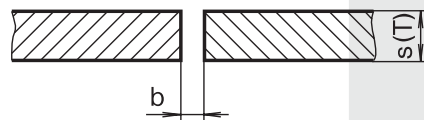
The elbows are made by hot forming process and they are delivered without heat treatment. Normalising includes normalising forming. Surface quality is corresponding to manufacturing process.

End preparation

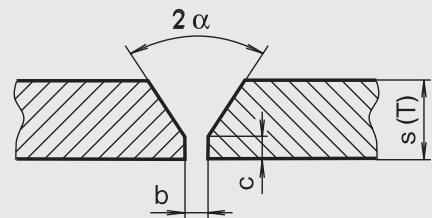
Elbows are delivered with plain ends. Preparation of ends for welding (beveling) according to standards:

- STN, ČSN 13 1075
- ASME (ANSI) B16.9
- DIN 2559
- EN 10 253 and other EN standards
- NFA 29-032 and standards for pipes
- ISO 6761

Preparation of ends:



DIN	T < 3 mm (Form 1)
EN	T < 3 mm
ANSI (ASME)	T < 3 (5) mm
ČSN, STN	T < 2,6 (3-4) mm (according method of welding)



DIN	T = 3-16 mm (Form 22)
	2α = 40°-60°, c = to 2 mm
EN	T = 3-20 mm ¹⁾
	α = 30° 0° +5°
	c = 1,6 ±0,8 mm
ANSI (ASME)	T < 22 mm ²⁾
	α = 37,5° ±2,5°
	c = 1,6 ±0,8 mm
	(c = 1/16 ±1/32 inch)
ČSN, STN	T = 3-20 mm
	2α = 70° ±2°
	c = 1,5 +0,5 mm
	(T = 2,9-11 mm)

Testing

Pipes as a raw material and finished elbows are tested according to corresponding standards.

Marking

The elbows are delivered with marking:

- without marking
- colour marking - steel grade according to corresponding standard
- stamping of data according to standard, customer's requirements or equipment possibilities (size of elbow).

Surface protection

The elbows are delivered without surface protection. Temporary protection with oil upon agreement.

Packaging

Fittings are packed in cartons, placed on wooden pallets, or in matalic box pallets.

Certificates

Certification in accordance with the following standards:

STN, ČSN 42 0165, 42 0250, 42 0251

ASTM A234/A234, A420/A420M

DIN 50049 - 2.2, 3.1.A, 3.1.B, 3.1.C

EN 10 204 - for EN 10253-1 - 2.2 (non-specific testing)

- for EN 10253-2 - 3.1.B (specific testing) eventually 3.1.A, 3.1.C, 3.2 (see also page 10)

Chemical composition and mechanical properties of steel for elbows production (informative values)

Standards	Steel grade	Chemical composition [%]										Mechanical properties					
		C	Si	Mn	P _{max}	S _{max}	Cr	Ni	Mo	Cu	Other	Re min MPa	min ksi	min MPa	Rm max MPa	min ksi	A5 min %
STN, ČSN																	
	11 353	max.0,18			0,050	0,050							235		340	440	25
	11 369	max.0,14	max.0,35	max.0,80	0,040	0,040	max.0,30	max.0,30		max.0,30	Al min.0,020	226		353	441		
	11 419	max.0,20	max.0,35	max.0,80	0,040	0,040	max.0,30	max.0,30		max.0,30	Al min.0,020	255		400	490		
	11 503	max.0,18	max.0,40	max.1,40	0,035	0,035	max.0,30	max.0,30		max.0,30	Nb min.0,015	355		490	630	22	
	12 021	0,07 - 0,15	0,17 - 0,35	0,35 - 0,60	0,040	0,040	max.0,25	max.0,25				235		340	470	25	
	12 022	0,15 - 0,22	0,17 - 0,37	0,50 - 0,60	0,040	0,040	max.0,25	max.0,25				255		410	570	21	
	15 020	0,12 - 0,20	0,15 - 0,37	0,50 - 0,80	0,040	0,040			0,25 - 0,35		Al min.0,015	270		450	600	22	
ASTM																	
A 234	WPB	max.0,30	min.0,10	0,29 - 1,06	0,035	0,035	max.0,40	max.0,40	max.0,15	max.0,40	V min.0,08	240	35	415	585	60	30
	WPC	max.0,35	min.0,10	0,29 - 1,06	0,035	0,035	max.0,40	max.0,40	max.0,15	max.0,40	V min.0,08	275	40	485	655	70	30
A 420	WPL 6	max.0,30	0,15 - 0,30	0,60 - 1,35	0,035	0,030	max.0,30	max.0,40	max.0,12	max.0,40	V min.0,05	240	35	415	585	60	30
DIN																	
2609	St 37.0	max.0,17			0,040	0,040						235		350	480	25	
	St 44.0	max.0,21			0,040	0,040						275		420	550	21	
	St 52.0	max.0,22	max.0,55	max.1,60	0,040	0,035					Al min.0,020	355		500	650	21	
	St 35.8	max.0,17	0,10 - 0,35	0,40 - 0,80	0,040	0,040						235		360	480	25	
	15Mo3	0,12 - 0,20	0,10 - 0,35	0,40 - 0,80	0,035	0,035			0,25 - 0,35			270		450	600	22	
	TSIE 285	max.0,16	max.0,40	0,60 - 1,40	0,030	0,025	max.0,30	min.0,30	max.0,08		Al min.0,020	285		390	510	24	
	TSIE 355	max.0,18	0,10 - 0,50	0,60 - 1,65	0,030	0,025	max.0,30	min.0,30	max.0,08	max.0,20	Al min.0,020	355		490	630	22	
	WSIE 355	max.0,20	0,10 - 0,50	0,90 - 1,65	0,030	0,030	max.0,30	min.0,30	max.0,08	max.0,20	Al min.0,020	355		490	630	22	
	SIE 290.7	max.0,22	max.0,45	0,50 - 1,10	0,040	0,035						290		420	540	23	
	SIE 360.7	max.0,22	max.0,55	0,90 - 1,50	0,040	0,035						360		510	630	20	
BS																	
1965-1	360	max.0,17	0,10 - 0,35	0,30 - 0,80	0,035	0,035					Al max.0,06	235		360	500	25	
NFA																	
49-186	AE 220A	max.0,20	max.0,40	max.0,85	0,045	0,045						220		360	500	23	
EN																	
10253-1	S 235	max.0,16	max.0,35	max.1,20	0,030	0,025						235		360	500	26	
10253-2	P235TR2	max.0,16	max.0,35	max.0,70	0,030	0,025	max.0,30	min.0,30	max.0,08	max.0,30	Al min.0,020	235		360	500	25	
	P265TR2	max.0,20	max.0,40	max.1,40	0,030	0,025	max.0,30	min.0,30	max.0,08	max.0,30	Al min.0,020	265		410	570	21	
	P355N	max.0,20	max.0,50	0,90 - 1,70	0,030	0,025	max.0,30	min.0,50	max.0,08	max.0,30	Nb min.0,05	355		490	650	22	
	P235	max.0,16	max.0,35	max.1,20	0,030	0,025	max.0,30	min.0,30	max.0,08	max.0,30	Al min.0,020	235		360	500	25	
	P265	max.0,20	max.0,40	max.1,40	0,030	0,025	max.0,30	min.0,30	max.0,08	max.0,30	Al min.0,020	265		410	570	21	
	16Mo3	0,12 - 0,20	max.0,35	0,40 - 0,90	0,030	0,025	max.0,30	min.0,30	0,25 - 0,35	max.0,30		280		450	600	22	
	P355NH	max.0,20	max.0,50	0,90 - 1,70	0,030	0,025	max.0,30	min.0,50	max.0,08	max.0,30	Nb min.0,05	355		490	650	22	
	P215	max.0,15	max.0,35	0,40 - 1,20	0,030	0,025	max.0,30	min.0,30	max.0,08	max.0,30	Nb min.0,10	215		360	480	23	
	P355NL1	max.0,18	max.0,50	0,90 - 1,70	0,025	0,020	max.0,30	min.0,50	max.0,08	max.0,30	Nb min.0,05	355		490	650	22	
	L415NB	max.0,21	max.0,45	max.1,60	0,025	0,020	max.0,30	min.0,30	max.0,10	max.0,25	Nb min.0,05	415		520		18	
10025	S355J2G3	max.0,20	max.0,55	max.1,60	0,035	0,035						355		490	630		

Notes to page 98:

- In standard EN 10253 (fittings) there is possibility to complete preparation of ends for welding also by beveling of outside edge on 30° and inside edge on 18° to axle of fitting (upon agreement only).
- Values are valid for products, where beveling is according standard ANSI B 16-25.
 - The values for beveling of ends according standard API 5L and for pipes according to ASTM A (ASME SA) are identical with standard EN. In case of preparation of inside edge angle can not exceed 7° to longitudinally axle (T ≤ 10,5 mm) and 9,5° to WT 10,5 - 14 mm. (upon agreement only).
 - Pipe according to API 5 CT are delivered with square cut plain ends.

Sulfide Stress Cracking (SSC) Resistant Metallic Materials - Requirements

NACE STANDARD MR 0103 - Materials Resistant To Sulfide Stress Cracking in Corrosive Petroleum Refining Environments.

NACE STANDARD MR 0175 - Sulfide Stress Cracking Resistant Metallic Materials for Oilfield Equipment.

ISO 15156-2 - Petroleum and natural gas industries - Materials for use in H₂S - containing environments in oil and gas production.

Part 2 - Cracking resistant carbon and low alloy steels and the use of cast irons.

Note: acronym "NACE" Has more meanings than one. "NACE" code means "Classification of Economic activities" which in Slovakia was known until now as "OKEC". In our case "NACE International" is the leading international organization focusing on corrosion of materials. Current name is derived from the acronym of this organization "National Association of Corrosion Engineers", which was founded in USA to address corrosion protection of tubings and pipes. Specifications of this American organization NACE International THE CORROSION SOCIETY labeled as NACE Standard MR (Standard Material Requirements) are establishing materials suitable to use in environment where there is Hydrogen Sulphide present.

Tube reducers

List of standards for tube reducers

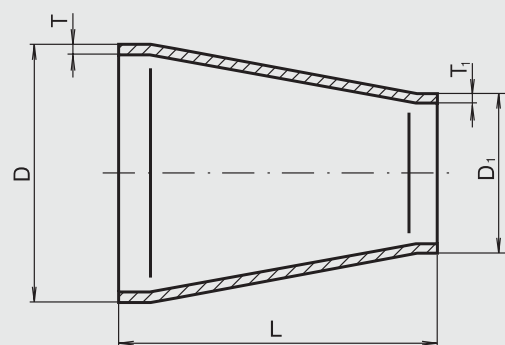
Standards	Dimensional standards	Dimensions	TDC	Steel grade
STN, ČSN	13 2200	Tab. 29	13 2370	11 353
	13 2380 (13 2385)			12 021
DIN	2616 - 2		2609 (A) 2609 (F, G)	St 37.0
				St 35.8
ISO	3419		3419	
EN	10 253 - 1		10 253 - 1	S 235, S 265

Upon agreement it is possible to deliver reducers made also from other steel (see survey table of butt welding elbows).

List of dimensional standards and technical delivery conditions standards

STN, ČSN 13 2200	Steel pipe fittings for butt welding. Construction dimensions.
STN, ČSN 13 2370	Reducers. TDC.
STN, ČSN 13 2380	Reducers Js 20 - Js 350, Jt 40 - Jt 100.
STN, ČSN 13 2385	Reducers DN 20 - DN 500, PN 40 - PN 100.
DIN 2609	Butt welding fittings. TDC.
DIN 2616-2	Reducers. Full correlation of utilization.
EN 10 253-1	Butt-welding pipe fittings. Part 1: Wrought carbon steel for general use and without specific inspection requirements.
ISO 3419	Butt welding fittings wrought carbon and alloy steel.

GOST 17378 Reducers. Dimensions.
GOST 17380 Reducers. TDC.



Tube reducers dimensions - Type 1

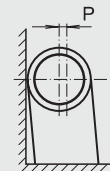
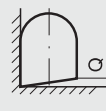
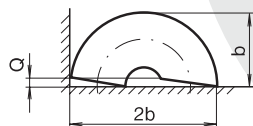
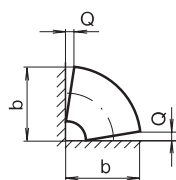
Table 29

NPS	Side D			NPS ₁	Side D ₁			Length L [mm]	Teoret. weight [kg]		
	DN	D [mm]	T [mm]		DN ₁	D ₁ [mm]	T ₁ [mm]				
3/4	20	26,9	2,3	1/2	15	21,3	2,0	38	0,06		
1	25	33,7	2,6	3/4	20	26,9	2,3	50	0,10		
				1/2	15	21,3	2,0	50	0,10		
1 1/4	32	42,4	2,6	1	25	33,7	2,6	50	0,13		
				3/4	20	26,9	2,3	50	0,13		
				1/2	15	21,3	2,0	50	0,13		
1 1/2	40	48,3	2,6	1 1/4	32	42,4	2,6	64	0,19		
				1	25	33,7	2,6	64	0,19		
				3/4	20	26,9	2,3	64	0,19		
				1	25	33,7	2,6	76	0,29		
2	50	57,0	2,9	1	25	33,7	2,6	76	0,31		
		60,3	2,9	1 1/2	40	48,3	2,6	76	0,31		
				1 1/4	32	42,4	2,6	76	0,31		
				1	25	33,7	2,6	76	0,31		
2 1/2	65	76,1	2,9	2	50	60,3	2,9	90	0,48		
						57,0	2,9	90	0,48		
						1 1/2	40	48,3	2,6	90	0,48
						3/4	20	26,9	2,3	90	0,48
						1 1/4	32	42,4	2,6	90	0,48
3	80	88,9	3,2	2 1/2	65	76,1	2,9	90	0,61		
				2	50	60,3	2,9	90	0,61		
						57,0	2,9	90	0,61		
						1 1/2	40	48,3	2,6	90	0,61
						3	80	88,9	3,2	100	0,93
						2 1/2	65	76,1	2,9	100	0,93
4	100	114,3	3,6	2	50	60,3	2,9	100	0,93		
						57,0	2,9	100	0,93		
						3	80	88,9	3,2	100	1,00
						2 1/2	65	76,1	2,9	100	1,00
						2	50	60,3	2,9	100	1,00

Reducers up to D 406,4 mm (16") or large diameter welded reducers can be delivered upon agreement.

Dimension and form tolerances of fittings

Parameter	Standards				
	PN ŽP 42 5760	DIN 2605, DIN 2609	EN 10 253-2	ASME (ANSI) B 16.9	
				in	mm
Outside diameter	±1,25 % min. ±0,5 mm	±1 % allowed ±0,5 mm	±1 % min. ±0,5 mm	1/2 - 2 1/2	21,3 - 73,0 ±1
				3 - 3 1/2	88,9 - 101,6 ±1
				4	114,3 -1 +2
				5 - 8	141,3 - 219,1 -1 +3
				10 - 18	273 - 457 -3 +4
				20 - 24	508 - 610 -5 +6
				26 - 30	660 - 762 -5 +7
				26 - 30	660 - 762 -5 +7
Inside diameter	min. 80 % of theoretical inside diameter (= D - 2T)			1/2 - 2 1/2	21,3 - 73,0 ±0,8
				3 - 3 1/2	88,9 - 101,6 ±1,6
				4	114,3 ±1,6
				5 - 8	141,3 - 219,1 ±1,6
				10 - 18	273 - 457 ±3,2
				20 - 30	508 - 762 ±4,8
				20 - 30	508 - 762 ±4,8
				20 - 30	508 - 762 ±4,8
Ovality	D > 200 2% (4%)		1,5%		
Wall thickness	-15 % +12,5 % (±17,5 %)	-12,50 % +15 %	D ≤ 610 mm T ≤ 4 mm -12,5 % +20 % T > 4 mm -12,5 % +15%	Wall thickness > 87,5 % of nominal wall thickness (-12,5%)	
b (K)	31,8 - 76,1 ±2,5 mm	DN 15 - 65 ±2,5 mm	±7 mm	1/2 - 24 ±0,25	21,3 - 600 ±7
	82,5 - 114,3 ±3,0 mm	DN 80 - 100 ±3,0 mm			
	133,0 - 219,1 ±3,5 mm	DN 125 - 200 ±3,5 mm			
	D > 220 ±4,0 mm	DN > 250 ±4,0 mm			
2 b	31,8 - 76,1 ±8 mm	DN 15 - 65 ±8 mm	±14 mm	1/2 - 8 ±0,25	21,3 - 200 ±7
	82,5 - 114,3 ±9 mm	DN 80 - 100 ±9 mm			
	133,0 - 219,1 ±10 mm	DN 125 - 200 ±10 mm			
	D > 220 ±14 mm	DN > 250 - 450 ±14 mm			
Q/P	±4°	±1 % of outside diameter or min ±1 mm	±1 % of outside diameter or min ±1 mm For EN 10224 Q max 1,6 mm	1/2 - 4	21,3 - 114,3 1/2
				0,03/0,06	141,3 - 219,1
				5 - 8	2/4
				0,06/0,12	273 - 323,8
				10 - 12	3/5
				0,09/0,19	335,6 - 406,4
				14 - 16	3/7
				0,09/0,25	457 - 610
18 - 24	4/10				
0,12/0,38	660 - 762				
26 - 30	5/10				
0,19/0,38	5/10				



Submerged arc longitudinally welded steel tubes and pipes

Standards	Dimensional standards	Dimensions	TDC	Steel grade
Structural tubes – standards steel grade				
STN, ČSN	ŽP 42 5717	Table 30/Page 104	ŽP 42 0154 ŽP-06-14/98	11 373, 11 375, 11 425, 11 523 C – steel
DIN	2458	Table 31/Page 104	1615 17120	St 33 (St 37.2) USt 37-2, RSt 37-2, St 37-3 St 44-2, St 44-3, St 52-3
EN	10219 - 2	Table 33/Page 105	10219 - 1	S 235 JRH, S 275 JOH S 275 J2H, S 355 JOH, S 355 J2H
Structural tubes – fine-grain steel				
STN, ČSN	ŽP 42 5717	Table 30/Page 104	ŽP 42 0154, ŽP-06-14/98	11 369, 11 503
DIN	2458	Table 31/Page 104	17123	StE, TStE, ESStE 255, 285, 355, 420, 460
EN	10219 - 2	Table 33/Page 105	10219 - 1	S 275 NH, S 275 NLH S 355 NH, S 355 NLH S 460 NH, S 460 NLH S 275 MH, S 275 MLH S 355 MH, S 355 MLH S 460 MH, S 460 MLH
Tubes for mechanical and common use				
STN, ČSN	ŽP 42 5717	Table 30/Page 104	ŽP 42 0154	11 523
DIN	2458	Table 31/Page 104	1626	St 37.0, St 44.0, St 52.0
BS	3600	Table 31/Page 104	6323 - 7	SAW4, SAW 5
EN	10296 - 1	Table 33/Page 105	10296 - 1	E155, E185, E235, E275, E355
Tubes for pressure piping – room temperature				
STN, ČSN	ŽP 42 5717	Table 30/Page 104	ŽP 42 0154, ŽP-06-14/98	11 375, 11 523
ASTM, ASME	ANSI B36.10 (API 5L)	Table 32/Page 105	A 671 / A530	Pipe Grade CA 55 Type of Steel A 285 - Grade C Class 10, 11, 12, 13
DIN	2458	Table 31/Page 104	1626 1628	St 37.0, St 44.0, St 52.0 St 37.4, St 44.4, St 52.4
BS	3600	Table 31/Page 104	3601	Grade 430
EN	10217 - 1	Table 33/Page 105	10217 - 1	P195, P235, P265 (TR1, TR2)
Tubes for pressure piping – elevated temperature				
STN, ČSN	ŽP 42 5717	Table 30/Page 104	ŽP 42 0154	11 416, 11 523 15 020, 15 121, 15 128
ASTM, ASME	ANSI B36.10 (API 5L)	Table 32/Page 105	A 672 / A 530	Pipe Grade A 45, A 50, A 55 Type of Steel A 285 - Grade A, B, C Class 10, 11, 12, 13
DIN	2458	Table 31/Page 104	17155	H I, H II
BS	3600	Table 31/Page 104	3602 - 2	Grade 430, 490
EN	10217 - 5	Table 33/Page 105	10217 - 5	P 235 GH, P 265 GH, 16Mo3
Tubes for pressure piping – fine-grain steel				
DIN	2458	Table 31/Page 104	17178	StE, WStE, TStE, ESStE 255, 285, 355, 460
EN	10217 - 3	Table 33/Page 105	10217 - 3	P 275 NL1, P 275 NL2, P 355 N, P 355 NH, P 355 NL1, P 355 NL2 P 460 N, P 460 NH, P 460 NL1, P 460 NL2
Tubes for pressure piping – low temperature				
STN, ČSN	ŽP 42 5717	Table 30/Page 104	ŽP 42 0154	11 369, 11 503
DIN	2458	Table 31/Page 104	17174 17178	TT St 35 N TStE 255, 285, 355, 460
EN	10217 - 6	Table 33/Page 105	10217 - 6	P 215 NL, P 265 NL
Pipe for conveyance of aqueous liquids				
DIN	2460	Table 31/Page 104	1626	St 37.0, St 52.0
EN	10224	Table 33/Page 105	10224	L 235, L 275, L 355
Pipe for gas and combustible liquids				
API	API 5L	Table 32/Page 105	API 5L	Grade A, B, X42, X 46, X 52
DIN	2458	Table 31/Page 104	2470 - 1 2470 - 2 17172 17178	1626 - St 37.0 according to DIN 17 172 StE 210.7, StE 240.7, StE 290.7, StE 320.7, StE 360.7 StE, WStE, TStE, ESStE 255, 285, 355, 460
EN	10208 - 1 10208 - 2	Table 33/Page 105	10208 - 1 10208 - 2	L210GA, L235GA, L245GA, L290GA, L360GA L245NB, L290NB, L360NB, L245MB, L360MB
GOST	20295	Table 30/Page 104	20295	1050: 10, 20

- Notes:
1. Tube according to another standards upon agreement.
 2. Pipe for potable water upon agreement.
 3. Steel according to GOST 20295 with hardness class K34, K38, K42, K50, K52, K55, K60.
 4. Steel according to GOST 20295 are delivered as type 3.
 5. Deliveries according to EN 10219 with CE marking.

List of dimensional standards and technical delivery conditions standards

ŽP 42 0154	Longitudinally welded steel pipes. TDC.
ŽP 42 5717	Longitudinally welded steel pipes. Dimensions.
ŽP-06-14/98	Steel pipes determined for protective pipes.
ANSI B36.10	Welded and seamless wrought steel pipe. Dimension and weight (Pipe).
API 5L	Specification for line pipe.
ASTM A530	General requirements for specialized carbon and alloy steel pipe.
ASTM A671	Electric-fusion-welded steel pipe for atmospheric and lower temperatures.
ASTM A672	Electric-fusion-welded steel pipe for high-pressure service at moderate temperatures.
DIN 1615	Welded circular tubes of non-alloy steel without special quality requirements.
DIN 1626	Welded circular tubes of non-alloy steel with special quality requirements.
DIN 1628	Welded circular tubes of non-alloy steel with very high quality requirements.
DIN 2458	Plain end welded steel tubes, dimensions and conventional masses per unit length.
DIN 2460	Steel tubes for waterworks services.
DIN 2470-1	Steel gas pipelines for permissible service pressures up to 16 bar.
DIN 2470-2	Steel gas pipelines for permissible service pressures exceeding 16 bar.
DIN 17120	Welded structural steel circular tubes for structural engineering purposes.
DIN 17123	Welded structural fine grain steel circular tubes.
DIN 17155	Sheet metal and strip from steel with specified elevated temperature properties.
DIN 17172	Steel pipes for pipelines for the transport of combustable fluids and gases.
DIN 17174	Welded circular steel tubes for low temperatures.
DIN 17178	Welded circular fine grain steel tubes for specified properties.
BS 3600	Dimensions and masses per unit length of welded and seamless steel pipes and tubes for pressure purposes.
BS 3601	Carbon steel pipes and tubes with specified room temperature properties for pressure purposes.
BS 3602-2	Specification for steel pipes and tubes for pressure purposes: carbon and carbon manganese steel with specified elevated temperature properties.
BS 6323	Part 2: Submerged arc welded tubes. Seamless and welded steel tubes for automobile, mechanical and general engineering purposes. Part 1: General requirements. Part 7: Specific requirements for submerged arc welded steel tube.
EN 10208-1, 2	Steel pipes for pipelines for combustible fluids. Part 1: Pipes of requirement class A. Part 2: Pipes of requirement class B.
EN 10217-1, 3, 6	Welded steel tubes for pressure purposes. TDC. Part 1: Non alloy steel tubes with specified room temperature properties. Part 3: Non alloy and alloy fine grain steel tubes. Part 5: Submerged arc welded non-alloy and alloy steel tubes with specified elevated temperature properties. Part 6: Submerged arc welded non-alloy steel tubes with specified low temperature properties.
EN 10219-1, 2	Cold formed welded structural hollow sections of non-alloy and fine grain steel. Part 1: TDC. Part 2: Tolerances, dimensions and sectional properties.
EN 10220	Seamless and welded steel tubes. Dimension and masses per unit length.
EN 10224	Steel pipes, joints and fittings for the conveyance of aqueous liquids including potable water.
EN 10296-1	Welded steel tubes for mechanical and general engineering purposes. TDC. Part 1: Non alloy and alloy steel tubes.
GOST 20295	Steel welded pipes for main gas and oil pipelines.
ISO 4019	Structural steels. Cold-formed, welded, structural hollow sections. Dimensions and sectional properties.
ISO 10799	Structural steels. Cold-formed, welded, structural hollow sections. TDR.
ISO 9330-1	Welded steel tubes for pressure purposes. TDC. Part 1: Non alloy steel tubes with specified room temperature properties.
ISO 9330-4	Part 4: Submerged arc welded non-alloy and alloy steel tubes with specified elevated temperature properties.
ISO 9330-5	Part 5: Submerged arc welded non-alloy steel tubes with specified low temperature properties.

Dimensions

Pipe are delivered with OD, WT and weight according to tables 30, 31, 32 and 33.

Tube dimensions and weight according to standards ŽP and GOST 20295

Table 30

Outside diameter [mm]	Wall thickness [mm]									
	5	6	8	10	12	14	16	18	20	22
	Theoretical tube weight [kg/m]									
324	39,3	47,1	62,3							
355,6	43,2	51,7	68,6							
377	45,9	54,9	72,8							
406	49,4	59,2	78,5	97,7						
426	51,9	62,1	82,5	102,6	122,5					
530	64,7	77,5	103,0	128,2	153,3	178,2	202,8			
630	77,1	92,3	122,7	152,9	182,9	212,7	242,3			
720			140,5	175,1	209,5	243,8	277,8	311,6		
820			160,2	199,8	239,1	278,3	317,2	356,0		
920			179,9	224,4	268,7	312,8	356,7	400,4	443,9	
1 020			199,7	249,1	298,3	347,3	396,2	444,8	493,2	
1 220			239,1	298,4	357,5	416,4	475,1	533,6	591,9	
1 420				347,7	416,7	485,4	554,0	622,4	690,5	758,5
1 620				397,1	475,9	554,5	632,9	711,1	789,2	867,0
1 820				446,4	535,1	623,5	711,8	799,9	887,8	975,5
2 020				495,7	594,2	692,6	790,7	888,7	986,5	1 084,0
2 220				545,0	653,4	761,6	869,7	977,5	1 085,1	1 192,5

Tube dimensions and weight according to standard DIN 2458

Table 31

Outside diameter [mm]	Wall thickness [mm]													
	5	5,6	6,3	7,1	8	8,8	10	11	12,5	14,2	16	17,5	20	22,2
	Theoretical tube weight [kg/m]													
323,9	39,3	44,0	49,3	55,5	62,3									
355,6	43,2	48,3	54,3	61,0	68,6									
406,4	49,5	55,4	62,2	69,9	78,6	86,3	97,8							
457	55,7	62,3	70,0	78,8	88,6	97,3	110,2							
508	62,0	69,4	77,9	87,7	98,6	108,3	122,8	134,8	152,7					
559	68,3	76,4	85,9	96,6	108,7	119,4	135,4	148,7	168,5	190,8	214,3			
610	74,6	83,5	93,8	105,6	118,8	130,5	148,0	162,5	184,2	208,6	234,4			
660	80,8	90,4	101,6	114,3	128,6	141,3	160,3	176,1	199,6	226,2	254,1			
711				123,3	138,7	152,4	172,9	189,9	215,3	244,0	274,2	299,3		
762					148,8	163,5	185,5	203,7	231,0	261,9	294,4	321,3		
813					158,8	174,5	198,0	217,6	246,8	279,7	314,5	343,3		
864					168,9	185,6	210,6	231,4	262,5	297,6	334,6	365,3		
914					178,7	196,4	222,9	245,0	277,9	315,1	354,3	386,9	440,9	
1 016					198,9	218,6	248,1	272,6	309,3	350,8	394,6	430,9	491,3	
1 220					239,1	262,9	298,4	328,0	372,2	422,3	475,1	519,0	591,9	
1 420							347,7	382,2	433,9	492,3	554,0	605,3	690,5	765,3
1 620							397,1	436,5	495,5	562,3	632,9	691,6	789,2	874,8
1 820							446,4	490,7	557,2	632,4	711,8	777,9	887,8	984,3
2 020							495,7	545,0	618,8	702,4	790,7	864,2	986,5	1 093,8
2 220							545,0	599,2	680,5	772,5	869,7	950,5	1 085,1	1 203,3

- Notes:
1. Other tube dimensions upon agreement.
 2. Maximum outside diameter D = 3 400 mm, maximum wall thickness t = 30 mm.
 3. This is actual for tables 30, 31, 32 a 33.

Theoretical inside diameter = outside diameter - (2 x wall thickness).

Weight calculation and reduction to length unit (C-steel):

dimension in mm: $0,0246615 (D - t) \cdot t$ [kg/m] 1 kg/m = 1,48816 lb/ft

dimension in inch: $10,68142 (D - t) \cdot t$ [lbs/ft] 1 lb/ft = 0,67197 kg/m

Tube dimensions and weight according to standards API 5L (delivery upon agreement)

Table 32

DN	Outside diameter		Wall thickness [mm/inch]																	
			5,6	6,4	7,1	7,9	8,7	9,5	10,3	11,1	11,9	12,7	14,3	15,9	17,5	19,1	20,6	22,2	23,8	25,4
	[mm]	[inch]	0,219	0,250	0,281	0,312	0,344	0,375	0,406	0,438	0,469	0,500	0,562	0,625	0,688	0,750	0,812	0,875	0,938	1
Theoretical tube weight [kg/m]																				
400	406,4	16	55,4	63,1	69,9	77,6	85,3	93,0	100,6	108,2	115,8									
450	457	18	62,3	71,1	78,8	87,5	96,2	104,8	113,5	122,1	130,6									
500	508	20	69,4	79,2	87,7	97,4	107,1	116,8	126,4	136,0	145,6	155,1	174,1							
550	559	22	76,4	87,2	96,6	107,4	118,1	128,7	139,4	150,0	160,6	171,1	192,1							
600	610	24		95,3	105,6	117,3	129,0	140,7	152,3	163,9	175,5	187,1	210,1	233,0						
650	660	26		103,2	114,3	127,0	139,7	152,4	165,0	177,6	190,2	202,7	227,7	252,6						
700	711	28		111,2	123,3	137,0	150,7	164,4	178,0	191,6	205,2	218,7	245,7	272,6	299,3					
750	762	30		119,3	132,2	146,9	161,6	176,3	190,9	205,6	220,1	234,7	263,7	292,6	321,3					
800	813	32			141,1	156,9	172,6	188,2	203,9	219,5	235,1	250,7	281,7	312,6	343,3	374,0	402,6			
850	864	34			150,0	166,8	183,5	200,2	216,9	233,5	250,1	266,6	299,7	332,6	365,3	398,0	428,5			
900	914	36				176,5	194,2	211,9	229,6	247,2	264,7	282,3	317,3	352,2	386,9	421,5	453,9	488,2	522,5	556,6
	965	38				186,5	205,2	223,9	242,5	261,1	279,7	298,3	335,3	372,2	408,9	445,6	479,8	516,2	552,4	588,6
1 000	1 016	40				196,4	216,1	235,8	255,5	275,1	294,7	314,2	353,3	392,2	430,9	469,6	505,7	544,1	582,4	620,5
	1 067	42					227,1	247,8	268,4	289,0	309,6	330,2	371,2	412,2	452,9	493,6	531,6	572,0	612,3	652,5
1 100	1 118	44					238,0	259,7	281,4	303,0	324,6	346,2	389,2	432,2	474,9	517,6	557,5	599,9	642,2	684,4
	1 168	46					248,7	271,4	294,1	316,7	339,3	361,8	406,9	451,8	496,5	541,2	582,9	627,3	671,6	715,7
1 200	1 219	48					259,7	283,4	307,0	330,7	354,2	377,8	424,8	471,8	518,5	565,2	608,8	655,2	701,5	747,7
1 300	1 321	52						307,3	332,9	358,6	384,2	409,8	460,8	511,8	562,6	613,2	660,6	711,1	761,4	811,6
1 400	1 422	56						330,9	358,6	386,2	413,8	441,4	496,4	551,4	606,1	660,8	711,9	766,4	820,7	874,8
1 500	1 524	60						354,8	384,5	414,1	443,8	473,3	532,4	591,4	650,2	708,9	763,8	822,2	880,5	938,7
1 600	1 626	64						378,7	410,4	442,1	473,7	505,3	568,4	631,3	694,2	756,9	815,6	878,1	940,4	1 002,6
1 700	1 727	68									503,3	536,9	604,0	671,0	737,8	804,5	866,9	933,4	999,7	1 065,9
1 800	1 829	72										568,9	640,0	710,9	781,8	852,5	918,7	989,2	1 059,6	1 129,8
	1 930	76										600,5	675,6	750,6	825,4	900,1	970,0	1 044,5	1 118,8	1 193,0

Tube dimensions and weight according to standard EN 10220

Table 33

Outside diameter [mm]			Wall thickness [mm]														
Series			5	5,4	5,6	6,3	7,1	8	8,8	10	11	12,5	14,2	16	17,5	20	22,2
1	2	3	Theoretical tube weight [kg/m]														
323,9			39,3	42,4	44,0	49,3	55,5	62,3									
355,6			43,2	46,6	48,3	54,3	61,0	68,6									
406,4			49,5	53,4	55,4	62,2	69,9	78,6	86,3	97,8							
457			55,7	60,1	62,3	70,0	78,8	88,6	97,3	110							
508			62,0	66,9	69,4	77,9	87,7	98,6	108	123	135	153					
		559	68,3	73,7	76,4	85,9	96,6	109	119	135	149	168	191	214			
610			74,6	80,5	83,5	93,8	106	119	130	148	162	184	209	234			
		660	80,8	87,2	90,4	102	114	129	141	160	176	200	226	254			
711							123	139	152	173	190	215	244	274	299		
	762							149	163	185	204	231	262	294	321		
813								159	175	198	218	247	280	314	343		
		864						169	186	211	231	262	298	335	365		
914								179	196	223	245	278	315	354	387	441	
1 016								199	219	248	273	309	351	395	431	491	
1 067								209	230	261	286	325	369	415	453	516	
1 118								219	241	273	300	341	387	435	475	542	
	1 168							229	252	286	314	356	404	455	497	566	
1 219								239	263	298	328	372	422	475	519	591	
	1 321									323	355	403	458	515	563	642	
1 422										348	383	435	493	555	606	692	766
1 626		1 524								373	410	466	529	595	650	742	822
1 829		1 727								399	438	497	564	635	694	792	878
										423	466	529	600	675	738	842	933
1 829		1 930								449	493	560	636	715	782	892	989
										474	521	591	671	755	825	942	1 044
2 032										499	548	623	707	795	869	992	1 100
		2 134								524	576	654	742	836	913	1 043	1 156
2 235										549	604	685	778	876	957	1 093	1 211

Tolerances of dimension and form (informative values)

Outside diameter

Outside diameter (mm)	Maximal variation of diameter (mm)
324-1 020 (1 000)	$\pm(0,5 \%D + 1)$
1 220-2 220	$\pm 6 (5)$

Smaller values upon agreement

Ovality of tube ends

Ratio D/t	Ovality
$D/t < 50$	max 1,4 %
$50 \leq D/t \leq 100$	1,4-2 %
$D/t > 100$	ovality is not guaranteed

Wall thickness

Wall thickness	Maximal variation
$t \leq 5$ mm	-0,25/+0,30 mm
$5 \text{ mm} < t \leq 10$ mm	-0,35/+0,45 mm
$t > 10$ mm	-0,50 mm/upper limit terminated by allowed variation of theoretical weight

Straightness

Tubes are visually straight. Tolerance of straightness is 2 mm on 1 m (0,002 x l). Whole tolerance presents conjunction of permissible value and tube length, but result must not exceed:

- 10 mm with length up to 6 m
- 15 mm with length 6 - 9 m
- 20 mm with length 9 - 12 mm

Pipe weight

Permissible tolerances: -8%/+12% (+10%) of theoretical weight.

Square cut

Outside diameter (mm)	Variation of square cut (mm)
324-630	2
720-1020	3
1 220-1 620	4
1 820-2 220	5

Scarf-weld

Wall thickness (mm)	Variation (mm)
$t \leq 8$	$\leq 2,5$
$8 < t \leq 14$	$\leq 3,0$
$14 < t \leq 40$	$\leq 4,0$

Lengths and tolerances of length

The pipes with outside diameter 324 - 1220 mm - max. length 12 m

The pipes with outside diameter over 1220 mm - length upon agreement

Kinds of lengths: a) production

b) fixed - ± 500 mm

c) exact - tolerances upon agreement

(To achieve required lengths, tubes are cross welded. Max. length of one part is 3 m).

Steel quality

As shown in List of standards table and table of chemical composition and mechanical properties. The pipes are made without heat treatment. The pipes are produced from sheets, those condition is in accordance with corresponding standards.

Steel marking according to EN see page 9.

Standards	Steel grade	Chemical composition [%]										Mechanical properties					
		C	Si	Mn	P _{max}	S _{max}	Cr	Ni	Mo	Cu	Other	Re min MPa	Re min ksi	Rm min MPa	Rm max MPa	A5 min ksi	A5 min %
STN, ČSN																	
	11 369	max.0,14	max.0,35	max.0,80	0,040	0,040	max.0,30	max.0,30			max.0,30	Al min.0,020	226		353	441	
	11 373	max.0,20			0,050	0,050							235		360	470	24
	11 375	max.0,17			0,045	0,045							225		360	470	24
	11 416	max.0,20	max.0,35	max.0,50	0,040	0,040							245		400	490	22
	11 425	max.0,22			0,050	0,000							255		412	510	22
	11 503	max.0,18	max.0,40	max.1,40	0,035	0,050	max.0,30	max.0,30			max.0,30	Al min.0,010	355		490	630	22
	11 523	max.0,20	max.0,55	max.1,60	0,050	0,045						Al min.0,015	353		510	628	23
	15 020	0,12-0,20	0,15-0,37	0,50-0,80	0,040	0,040			0,25-0,35			Al min.0,015	270		450	600	22
	15 121	0,10-0,18	0,15-0,35	0,40-0,70	0,040	0,040	0,70-1,30		0,40-0,60				295		440	590	22
	15 128	0,10-0,18	0,15-0,40	0,45-0,70	0,040	0,040	0,50-0,75		0,40-0,60			V 0,22-0,35	365		490	690	18
API 5L																	
	Grade A	max.0,22		max.0,90	0,030	0,030							207	30	331		48
	Grade B	max.0,27		max.1,15	0,030	0,030							241	35	413		60
	Grade X42	max.0,29		max.1,25	0,030	0,030							289	42	413		60
	Grade X46	max.0,31		max.1,35	0,030	0,030							317	46	434		63
	Grade X52	max.0,31		max.1,35	0,030	0,030							358	52	455		66
ASTM																	
A 285	Grade A	max.0,17		max.0,90	0,035	0,045											
	Grade B	max.0,22		max.0,90	0,035	0,045											
	Grade C	max.0,28		max.0,90	0,035	0,045											
BS																	
3601	Grade 430	max.0,25	max.0,50	max.1,20	0,040	0,040							275		430	570	22
3602-2	Grade 430	max.0,25	0,10-0,35	0,61-1,40	0,030	0,030							250		430	550	23
	Grade 490	max.0,22	0,10-0,40	0,91-1,60	0,030	0,030							325		490	610	21
6323-7	SAW 4	max.0,25	max.0,35	max.1,20	0,050	0,050							235		410		22
	SAW 5	max.0,23	max.0,50	max.1,50	0,050	0,050							340		490		20
GOST																	
20 295	10	0,07-0,14	0,17-0,37	0,35-0,65			max.0,15						205		330		24
	20	0,17-0,24	0,17-0,37	0,35-0,65			max.0,25						245		410		21
	35	0,32-0,40	0,17-0,37	0,50-0,80			max.0,25						315		530		20
	45	0,42-0,50	0,17-0,37	0,50-0,80			max.0,25						355		600		16
DIN																	
1615	St 33												175		290	540	17
1626	St 37.0	max.0,17			0,040	0,040							235		350	480	25
	St 44.0	max.0,21			0,040	0,040							275		420	550	21
	St 52.0	max.0,22			0,040	0,035							355		500	650	21



Standards	Steel grade	Chemical composition [%]										Mechanical properties				
		C	Si	Mn	P _{max}	S _{max}	Cr	Ni	Mo	Cu	Other	Re min MPa	min ksi	Rm min MPa	max ksi	A5 min %
DIN																
1628	St 37.4	max.0,17	max.0,35	min.0,35	0,040	0,040							235	350	480	25
	St 44.4	max.0,20	max.0,35	min.0,40	0,040	0,040							275	420	550	21
	St 52.4	max.0,22	max.0,55	max.1,60	0,040	0,035							355	500	650	21
17120	USI 37.2	max.0,17			0,050	0,050							235	340	470	26
	RSI 37.2	max.0,17			0,050	0,050							235	340	470	26
	St 37-3	max.0,17			0,040	0,040							235	340	470	26
	St 44-2	max.0,21			0,050	0,050							275	410	540	22
	St 44-3	max.0,20			0,040	0,040							275	410	540	22
	St 52.3	max.0,22			0,040	0,040							355	490	630	22
17 123 17 178	StE 255	max.0,18	max.0,40	0,50-1,30	0,035	0,030	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020		255	360	480	25
	TSIE 255	max.0,16	max.0,40	0,50-1,30	0,030	0,025	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020		255	360	480	25
	ESIE 255	max.0,16	max.0,40	0,50-1,30	0,025	0,015	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020		255	360	480	25
	StE 285	max.0,18	max.0,40	0,60-1,40	0,035	0,030	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020		285	390	510	24
	TSIE 285	max.0,16	max.0,40	0,60-1,40	0,030	0,025	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020		285	390	510	24
	ESIE 285	max.0,16	max.0,40	0,60-1,40	0,025	0,015	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020		285	390	510	24
	StE 355	max.0,20	0,10-0,50	0,90-1,65	0,035	0,030	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020		355	490	630	22
	TSIE 355	max.0,18	0,10-0,50	0,90-1,65	0,030	0,025	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020		355	490	630	22
	ESIE 355	max.0,18	0,10-0,50	0,90-1,65	0,025	0,015	max.0,30	max.0,30	max.0,08	max.0,20	Al min.0,020		355	490	630	22
	StE 420	max.0,20	0,10-0,60	1,00-1,70	0,035	0,030	max.0,30	max.1,00	max.0,10	max.0,20	Al min.0,020		420	530	680	21
	TSIE 420	max.0,20	0,10-0,60	1,00-1,70	0,030	0,025	max.0,30	max.1,00	max.0,10	max.0,20	Al min.0,020		420	530	680	21
	ESIE 420	max.0,20	0,10-0,60	1,00-1,70	0,025	0,020	max.0,30	max.1,00	max.0,10	max.0,20	Al min.0,020		420	530	680	21
	StE 460	max.0,20	0,10-0,60	1,00-1,70	0,035	0,030	max.0,30	max.1,00	max.0,10	max.0,20	Al min.0,020		460	560	730	19
	TSIE 460	max.0,20	0,10-0,60	1,00-1,70	0,030	0,025	max.0,30	max.1,00	max.0,10	max.0,20	Al min.0,020		460	560	730	19
	ESIE 460	max.0,20	0,10-0,60	1,00-1,70	0,025	0,030	max.0,30	max.1,00	max.0,10	max.0,20	Al min.0,020		460	560	730	19
17155	H I.	max.0,16	max.0,35	0,40-1,20	0,035	0,035							235	360	480	24
	H II.	max.0,20	max.0,35	0,50-1,30	0,035	0,035							265	410	530	22
17172	StE 210.7	max.0,17	max.0,45	min. 0,35	0,040	0,035							210	320	440	26
	StE 240.7	max.0,17	max.0,45	min. 0,40	0,040	0,035							240	370	490	24
	StE 290.7	max.0,22	max.0,45	0,50-1,10	0,040	0,035							290	420	540	23
	StE 320.7	max.0,22	max.0,45	0,70-1,30	0,040	0,035							320	460	580	21
	StE 360.7	max.0,22	max.0,55	0,90-1,50	0,040	0,035							360	510	630	20
17174	TT St 35N	max.0,17	max.0,35	min.0,40	0,030	0,025					Al min.0,020		225	340	460	25
EN																
10025	S 355 J2G3	max.0,20	max.0,55	max.1,60	0,035	0,035							355	490	630	
10208-1	L 210 GA	max.0,21	max.0,40	max.0,90	0,030	0,030							210	335	475	25
	L 235 GA	max.0,16	max.0,40	max.1,20	0,030	0,030							235	370	510	23
	L 245 GA	max.0,20	max.0,40	max.1,15	0,030	0,030							245	415	555	22
	L 290 GA	max.0,20	max.0,40	max.1,40	0,030	0,030							290	415	555	21
	L 360 GA	max.0,22	max.0,55	max.1,45	0,030	0,030							360	460	620	20
10208-2	L 245 NB	max.0,16	max.0,40	max.1,10	0,025	0,020							245-440	415		22
	L 290 NB	max.0,17	max.0,40	max.1,20	0,025	0,020					V max.0,05 Ti max.0,04		292-440	415		21
	L 360 NB	max.0,20	max.0,45	max.1,60	0,025	0,020					V max.0,10 Ti max.0,04		360-510	460		20
10217-1	P 195 TR1	max.0,13	max.0,35	max.0,70	0,030	0,025	max.0,30	max.0,30	max.0,08	max.0,30			195	320	440	27
	P 235 TR1	max.0,16	max.0,35	max.1,20	0,030	0,025	max.0,30	max.0,30	max.0,08	max.0,30	Al min.0,020		235	360	500	25
	P 265 TR1	max.0,20	max.0,40	max.1,40	0,030	0,025	max.0,30	max.0,30	max.0,08	max.0,30	pre TR2		265	410	570	22
10217-3	P 275 NL1	max.0,16	max.0,40	0,50-1,50	0,030	0,020	max.0,30	max.0,50	max.0,08	max.0,30	Al min.0,020		275	390	530	24
	P 275 NL2	max.0,16	max.0,40	0,50-1,50	0,025	0,015	max.0,30	max.0,50	max.0,08	max.0,30	Al min.0,020		275	390	530	24
	P 355 NH	max.0,20	max.0,50	0,90-1,70	0,030	0,025	max.0,30	max.0,50	max.0,08	max.0,30	Al min.0,020		355	490	650	22
	P 355 NH	max.0,20	max.0,50	0,90-1,70	0,030	0,025	max.0,30	max.0,50	max.0,08	max.0,30	Al min.0,020		355	490	650	22
	P 355 NL1	max.0,18	max.0,50	0,90-1,70	0,030	0,020	max.0,30	max.0,50	max.0,08	max.0,30	Al min.0,020		355	490	650	22
	P 355 NL2	max.0,18	max.0,50	0,90-1,70	0,025	0,015	max.0,30	max.0,50	max.0,08	max.0,30	Al min.0,020		355	490	650	22
	P 460 N	max.0,20	max.0,60	1,00-1,70	0,030	0,025	max.0,30	max.0,80	max.0,10	max.0,70	Al min.0,020		460	560	730	19
	P 460 NH	max.0,20	max.0,60	1,00-1,70	0,030	0,025	max.0,30	max.0,80	max.0,10	max.0,70	Al min.0,020		460	560	730	19
	P 460 NL1	max.0,20	max.0,60	1,00-1,70	0,030	0,020	max.0,30	max.0,80	max.0,10	max.0,70	Al min.0,020		460	560	730	19
	P 460 NL2	max.0,20	max.0,60	1,00-1,70	0,025	0,015	max.0,30	max.0,80	max.0,10	max.0,70	Al min.0,020		460	560	730	19
10217-5	P 235 GH	max.0,16	max.0,35	max.1,20	0,030	0,025	max.0,30	max.0,30	max.0,08	max.0,30	Al min.0,020		235	360	500	25
	P 265 GH	max.0,20	max.0,35	max.1,40	0,030	0,025	max.0,30	max.0,30	max.0,08	max.0,30	Al min.0,020		265	410	570	23
	16Mo3	0,12-0,20	max.0,35	0,40-0,90	0,030	0,025	max.0,30	max.0,30	0,25-0,35	max.0,30	Al max.0,040		280	450	600	22
10217-6	P 215 NL	max.0,15	max.0,35	0,40-1,20	0,030	0,020	max.0,30	max.0,30	max.0,08	max.0,30	Al min.0,020		215	360	480	25
	P 265 NL	max.0,20	max.0,40	0,60-1,40	0,030	0,020	max.0,30	max.0,30	max.0,08	max.0,30	Al min.0,020		265	410	570	24
10219-1	S 235 JRH	max.0,17		max.1,40	0,045	0,045							235	340	470	26
	S 275 JOH	max.0,20		max.1,50	0,040	0,040							275	410	560	22
	S 275 J2H	max.0,20		max.1,50	0,035	0,035							275	410	560	22
	S 355 JOH	max.0,22	max.0,55	max.1,60	0,040	0,040							355	490	630	20
	S 355 J2H	max.0,22	max.0,55	max.1,60	0,035	0,035							355	490	630	20
	S 275 NH	max.0,20	max.0,40	0,50-1,40	0,035	0,030	max.0,30	max.0,30	max.0,10	max.0,35	Al min.0,020		275	370	540	24
	S 275 NLH	max.0,20	max.0,40	0,50-1,40	0,030	0,025	max.0,30	max.0,30	max.0,10	max.0,35	Al min.0,020		275	370	540	24
	S 355 NH	max.0,20	max.0,50	0,90-1,65	0,035	0,030	max.0,30	max.0,50	max.0,10	max.0,35	Al min.0,020		355	470	630	22
	S 355 NLH	max.0,18	max.0,50	0,90-1,65	0,030	0,025	max.0,30	max.0,50	max.0,10	max.0,35	Al min.0,020		355	470	630	22
	S 460 NH	max.0,20	max.0,60	1,00-1,70	0,035	0,030	max.0,30	max.0,80	max.0,10	max.0,35	Al min.0,020		460	550	720	17
	S 460 NLH	max.0,20	max.0,60	1,00-1,70	0,030	0,025	max.0,30	max.0,80	max.0,10	max.0,35	Al min.0,020		460	550	720	17
	S 275 MH	max.0,13	max.0,50	max.1,50	0,035	0,030	max.0,30	max.0,30	max.0,20		Al min.0,020		275	360	510	24
	S 275 MLH	max.0,13	max.0,50	max.1,50	0,030	0,025	max.0,30	max.0,30	max.0,20		Al min.0,020		275	360	510	24
	S 355 MH	max.0,14	max.0,50	max.1,50	0,035											

The weld

The pipes are by double submerged-arc-welding process produced (longitudinal seam). Value of seam is $v = 0,75 - 1$.

Pipe ends

Pipe shall be furnished with ends according to standards:

DIN 2559 - 22

API 5L

EN 10 208-1, 2

ČSN, STN 13 1075 (T < 10 mm without beveling or according agreement)

Anti-corrosion coatings

The pipes are delivered:

- without anti-corrosion coatings
- with anti-corrosion coatings:
 - standard bituminous coating
 - bitumen + fiberglass (20 kV)
 - bitumen + double fiberglass (25 kV)
 - bitumen + impregnated paper + fiberglass (25 kV)
 - bitumen + PVC + fiberglass (35 kV)
 - according to standard DIN 30672
 - painting
 - polyethylen coating (in cooperation)

Inspection

Testing is performed in accordance with corresponding standards. Following tests are performed: visual control of weld and surface condition, control of dimensions, mechanical testing of steel plate material and weld joint (tension test, Charpy V - notch test, bend test), hydrostatic test, nondestructive examination of weld joint, testing of isolation. Other tests by agreement.

Marking

There are following information stamped on the pipe:

- producer
- dimension: outside diameter x wall thickness
- steel grade
- heat number
- production pipe number
- sign of technical control
- sign of welder

Certification

Test report certificate in accordance with the specification: DIN 50049, EN 10204, ASTM A 530, API 5L.

Other products of the mill

Besides longitudinally welded large diameter pipes, the mill provides following services and products:

- parts of stable pressure vessels
- welded elbows, reducers and other fittings
- pipeline with flanges
- irrigation pipes (zinc coated, with demountable joints)
- isolation of another pipes and fittings

Packaging of tubes and pipes

On request or according to standard tubes and pipes are delivered with ends closed with plastic plugs or caps.

Hot finished tubes and pipes

The tubes are shipped in round bundles with diameter max. 800 mm, max. mass is 3 500 kg.

On request hexagonal bundles.

Standard methods:

The bundle binded by wire

The bundle binded by steel strap

Steel strap underlayed by paper tape (tapaten)

Non – standard methods:

The ends of bundle are wrapped in PE-foil or tapaten and foil

Precision cold drawn tubes

The tubes are shipped in round bundles with diameter max. 800 mm, max. mass is 2 000 – 2 500 kg.

On request hexagonal bundles.

Standard methods:

The bundle binded by steel strap

Steel strap underlayed by tapaten

Non-standard methods:

The bundle is wrapped in PE-foil

The ends of bundle are wrapped in PE-foil or other material

Wooden mats round the bundle as a mechanical protection

Wooden box- tubes are in box lose or in bundle

Combinations of various types of packaging

Pipe fittings

Metal boxes

Cardboard boxes on wooden palette

Tube semiproducts

Standard methods:

Metal boxes (840 x 1 240 x 860 mm)

Hexagonal bundles

Hydraulic tubes are shipped in round bundles with mass max. 2 000 kg and length of 6 m binded by steel strap

Packaging according to customer requirements :

Cardboard boxes on wooden palette

Wooden boxes (mass max. 1 000 kg)

Large-volume bage BIG-BAGS

Palettes of wooden prisms



Mechanical and technological testing of tubes and pipes

The tubes and pipes shall be subjected to the tests specified in individual standards.

Mechanical testing

Tensile test at room temperature (*Zugversuch bei Raumtemperatur*)

Determined values:

The upper yield strength **ReH** or the 0,2% proof strength **Rp0,2** (MPa)

The tensile strength **Rm** (MPa)

Elongation **Amin.**(%)

EN 10002/1, DIN 50 145, ČSN 42 0310, ASTM A370 (ASME SA 370)

Tensile test at elevated temperature (*Zugversuch bei erhöhter Temperatur*)

Determined values:

The proof strength at the agreed temperature **Rp0,2** (MPa)

EN 10002-5, DIN 50 145, ČSN 42 0312

Hardness test (*Härteprüfung*) (according to agreement and possibilities)

Brinell: EN 10003, EN ISO 6506, DIN 50 351, ČSN 42 0371, ASTM E 10

Rockwell: EN 10004, EN ISO 6508, DIN 50 103, ASTM E 18

Vickers: EN ISO 6507, DIN 50 133, ASTM E 92, ASTM E 384

Conversion table *hardness to Rm* : DIN 50 150

Impact test at 20 °C (*Kerbschlagbiegeversuch bei 20 °C*)

Impact test at low temperatures (*Kerb. bei niedrigen Temperaturen*)

Determined values:

Minimum average absorbed energy **KV** (impact energy) (J)

EN 10045-1, DIN 50 115, ČSN 42 0381

Creep testing (*Langzeitwarmfestigkeit*)

The creep rupture properties shall not be subject to verification

Determined values:

The creep proof strength (*Zeitdehngrenze*) – **Rp** or (**Rt**) (MPa) at (t/A/T) –

e.g. XYZ (MPa) at 1% elongation, t= 100 000 h, T= 500 °C

The creep rupture strength (*Zeitstandfestigkeit*) – **RmT** (MPa) at (t/T) –

e.g. XYZ (MPa) rupture at t= 100 000 h, T= 500 °C (value for practice).

EN 10291, ČSN 42 0351, ASTM E 319

Fatigue testing – test is not included in standards for tubes and pipes

Technological testing (Manipulating tests)

When tested in accordance with related standards the test piece shall withstand being tested without cracking.

The following tests are made to prove ductility of tubular products :

Bend test (Biegeversuch) – (in full size tubular sections).

Test is used for pipe in sizes 2 in. or 65 mm and under. In this test a sufficient length of full size pipe is bent cold through (90°) around a cylindrical mandrel having a diameter e.g. 12 times the nominal diameter of the pipe.

EN 10232 is replaced by EN ISO 8491, ASTM A 370 (A 2,A 2.5), ČSN 420415.3

Flattening test (Ringfaltversuch)

The test piece shall be flattened at room temperature between parallel flat platens until the distance between the platens H (in mm) measured under load reaches the value given by the equation in standard.

Tested are tubes - O.D. shall by 600 mm and under and with W.T. shall by 15% of O.D. and under.

EN 10233 is replaced by EN ISO 8492, DIN 50 136,ASTM A 370 and standards for tubes and pipes, ČSN 42 0415.4.

Flaring test (Drift expanding test)/ (Aufweitversuch)

The test piece shall be expanded by a tapered mandrel, having an included angle of 30°, 45° or 60° at the option of the manufacturer until the percentage increase in outside diameter shown in tables in standards is reached.

O.D. shall be 150 mm and under and W.T. shall be max. 10 mm.

EN 10234 is replaced by EN ISO 8493, DIN 50 135, ASTM A 370, ČSN 42 0415.5

Flanging (Flange) test (Bordelversuch)

The test piece shall have a flange turned over at right angles to the body of the tube to the width required by the applicable material specifications.

O.D. max 150 mm, W.T. max. 10 mm.

EN 10235 is replaced by EN ISO 8494, DIN 50 139, ASTM A 370, ČSN 42 0415.6

Ring-expanding test (Ringaufdornversuch)

The test piece shall be expanded with a conical tool until it breaks. The surface outside the fracture zone shall be free from cracks or breaks.

O.D. 18-150 mm (114,3 mm), W:t. 2-16 mm (12,5 mm)

EN 10236 is replaced by EN ISO 8495, DIN 50 137, ČSN 42 0415.7

Ring tensile test (Ringzugversuch)

The test piece shall be subjected to strain in the circumferential direction until fracture occurs. After fracture the test pieces shall not show any visible cracks without the use of magnifying aids (excluding the fracture point).

O.D. above 150 mm, I.D. above 100 mm and W.T. 40 mm and under.

EN 10237 is replaced by EN ISO 8496, DIN 50 138

Others additional technological tests

Crush test (upsetting test) (Anstauchen test)

The test piece is placed on end and crushed endwise by hammer or press to the distance prescribed by the applicable material specifications.

Reverse flattening test (Reversionringfaltversuch)

For testing of welds of electric welded tubing

(Transverse guided) Bend test of welds (Biegeprüfungen von Schweissnahten)

This bend test is used to determine the ductility of fusion welds.

ISO 377

Steel and steel products - Location and preparation of samples and test pieces for mechanical testing

Comparison of steels for tube and pipe (Not all the steels are delivered by ŽP a. s.)

Steels for hollow structural sections, Type S according to EN

Steel	EN		Steel	DIN		BS		NFA		UNI Steel	ČSN,STN Steel	GOST		PN-H		ASTM		JIS	
	W.Nr.	Standard		W.Nr.	Standard	Steel	Standard	Steel	Standard			Steel	Standard	Steel	Standard	Steel	Standard	Steel	Standard
S185	1.0035	10025-2	S13-2	1.0035	17100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S195T	1.0026	10255	-	-	-	BS1387	1387	TU34-1	49-115	Fe330	-	-	-	-	-	Gr.A	A53	STK 290	G 3444
S235	-	10253-1	S1370	1.0254	2609	-	-	-	-	-	11353	-	-	-	-	-	-	-	-
S235JRH	1.0039	10210-1	RS137-2	1.0038	17119	-	-	-	-	-	11373	-	-	-	-	-	-	-	-
S235JRH	1.0039	10219-1	RS137-2	1.0038	17120	-	-	-	-	-	11373	-	-	-	A795	A795	-	-	-
S235JR	1.0038	10025-2	RS137-2	1.0038	17121	HFS 3	63233	TUE235/Q2	49501	Fe35-1	11353	10	1050	R35	84023/7	Gr.A	A53	-	-
-	-	-	S1373	1.0116	17119	-	-	-	-	-	11373	-	-	-	-	-	-	-	-
S235JRG2	-	-	S1373	1.0116	17120	-	-	-	-	-	11375	-	-	-	-	-	-	-	-
-	-	-	S1373	1.0116	17121	-	-	-	-	-	11353	-	-	-	-	-	-	-	-
S265	-	10253-1	S1440	1.0256	2609	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S275JOH	1.0149	10210-1	S1442	1.0044	17119	-	-	-	-	-	11443	-	-	-	-	-	-	-	-
S275JOH	1.0149	10219-1	S1442	1.0044	17120	-	-	-	-	-	11425	-	-	-	-	-	-	-	-
S275JO	1.0143	10025-2	S1442	1.0044	17121	-	-	-	-	-	11453	-	-	-	-	-	-	STK 400	G 3444
S275J2H	1.0138	10210-1	S1443	1.0144	17119	-	-	-	-	-	11448	-	-	-	-	-	-	-	-
S275J2H	1.0138	10219-1	S1443	1.0144	17120	SAW 4	63237	TUE275/Q4	49501	-	11448	-	-	-	-	-	-	-	-
S275J2	1.0145	10025-2	S1443	1.0144	17121	HFS 4	63233	TUE275/Q3	49501	Fe45-1	11453	20	1050	R45	84023/7	Gr.B	A53	-	-
-	-	-	SE255	1.0461	17123	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	SE255	1.0461	17124	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	SE255	1.0461	17125	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	TSIE255	1.0463	17123	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	TSIE255	1.0463	17124	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	TSIE255	1.0463	17125	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	ESIE255	1.1103	17123	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	ESIE255	1.1103	17124	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	ESIE255	1.1103	17125	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S275NH	1.0493	10210-1	SE285	1.0486	17123	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S275NH	1.0493	10219-1	SE285	1.0486	17124	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S275N	1.0490	10025-3	SE285	1.0486	17125	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S275NLH	1.0497	10210-1	TSIE285	1.0488	17123	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S275NLH	1.0497	10219-1	TSIE285	1.0488	17124	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S275NL	1.0491	10025-3	TSIE285	1.0488	17125	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	ESIE285	1.1104	17123	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	ESIE285	1.1104	17124	-	-	-	-	-	-	09G2S	19281	09G2	84018	-	-	STK 490	G 3444
-	-	-	ESIE285	1.1104	17125	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S275MH	1.8843	10219-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S275MLH	1.8844	10219-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S355JOH	1.0547	10210-1	S1523	1.0570	17119	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S355JOH	1.0547	10219-1	S1523	1.0570	17120	SAW 5	63237	-	-	-	-	-	-	-	-	-	-	-	-
S355JO	1.0553	10025-2	S1523	1.0570	17121	HFS 5	63233	TUE355/Q3	49501	Fe 52-1	11523	18G2	19281	18G2A	84018	-	-	STK 500	G 3444
S355J2H	1.0576	10210-1	S1523	1.0570	17119	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S355J2H	1.0576	10219-1	S1523	1.0570	17120	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S355J2G3	-	-	S1523	1.0570	17121	-	-	-	-	-	11523	-	-	-	-	-	-	-	-
S355NH	1.0539	10210-1	SE355	1.0562	17123	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S355NH	1.0539	10219-1	SE355	1.0562	17124	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S355N	1.0545	10025-3	SE355	1.0562	17125	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S355NLH	1.0549	10210-1	TSIE355	1.0566	17123	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S355NLH	1.0549	10219-1	TSIE355	1.0566	17124	-	-	-	-	-	11503	-	-	-	-	-	-	-	-
S355NL	1.0546	10025-3	TSIE355	1.0566	17125	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	ESIE355	1.1106	17123	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	ESIE355	1.1106	17124	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	ESIE355	1.1106	17125	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S355MH	1.8845	10219-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S355MLH	1.8846	10219-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	SE420	1.8902	17123	-	-	-	-	-	-	-	-	-	-	-	-	STK 540	G 3444
-	-	-	SE420	1.8902	17124	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	SE420	1.8902	17125	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	TSIE420	1.8912	17123	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	TSIE420	1.8912	17124	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	TSIE420	1.8912	17125	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	ESIE420	1.8913	17123	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	ESIE420	1.8913	17124	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	ESIE420	1.8913	17125	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S420MH	1.8847	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S420MLH	1.8848	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S460NH	1.8953	10210-1	SE460	1.8905	17123	-	-	TUE450/Q4	49501	-	-	-	-	-	-	-	-	-	-
S460NH	1.8953	10219-1	SE460	1.8905	17124	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S460N	1.8901	10025-3	SE460	1.8905	17125	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S460NLH	1.8956	10210-1	TSIE460	1.8915	17123	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S460NLH	1.8956	10219-1	TSIE460	1.8915	17124	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S460NL	1.8903	10025-3	TSIE460	1.8915	17125	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	ESIE460	1.8918	17123	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	ESIE460	1.8918	17124	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	ESIE460	1.8918	17125	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S460MH	1.8849	10219-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S460MLH	1.8850	10219-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Steels for Line Pipe, Type L according to EN

EN			DIN			BS		NFA		UNI		ČSN,STN		GOST		PN-H		API		ISO	
Steel	W.Nr.	Standard	Steel	W.Nr.	Standard	Steel	St.	Steel	Standard	Steel	Stan.	Steel	St.	Steel	Standard	Steel	Stan.	Steel	Standard	Steel	Standard
L235	1.0252	10224	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
L275	1.0260	10224	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
L355	1.0419	10224	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	A25	API5L	L175	3183-1
L210GA	1.0319	10208-1	StE210.7	1.0307	17172	-	-	TSE220	49-400	-	-	-	-	K34	20295	-	-	A	API5L	L210	3183-1
L235GA	1.0458	10208-1	St37.0	1.0254	1629	-	-	-	-	Fe35-1	7088	-	-	-	-	-	-	-	-	-	-
L245GA	1.0459	10208-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	B	API5L	L245	3183-1
L290GA	1.0483	10208-1	St44.0	1.0256	1629	-	-	-	-	Fe45-1	7088	-	-	-	-	-	-	X42	API5L	L290	3183-1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X46	API5L	L320	3183-1
L360GA	1.0499	10208-1	St52.0	1.0421	1629	-	-	-	-	-	-	-	-	-	-	-	-	X52	API5L	L360	3183-1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X56	API5L	L390	3183-1
L245NB	1.0457	10208-2	StE240.7	1.0457	17172	-	-	TSE250	49-400	-	-	-	-	K38	20295	-	-	BN	API5L	L245N	3183-2
L290NB	1.0484	10208-2	StE290.7	1.0484	17172	-	-	-	-	-	-	-	-	K42	20295	-	-	X42N	API5L	L290N	3183-2
-	-	-	StE290.7	1.0484	2609	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	StE320.7	1.0409	17172	-	-	TSE320	49-400	-	-	-	-	K50	20295	-	-	X46N	API5L	L320N	-
L360NB	1.0582	10208-2	StE360.7	1.0582	17172	-	-	TSE360	49-400	-	-	-	-	K52	20295	-	-	X52N	API5L	L360N	3183-2
-	-	-	StE360.7	1.0582	2609	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	StE385.7	1.8970	17172	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	K55	20295	-	-	X56N	API5L	L390N	-
L415NB	1.8972	10208-2	StE415.7	1.8972	17172	-	-	TSE415	49-400	-	-	-	-	K60	20295	-	-	X60N	API5L	L415N	3183-2
L415NB	1.8972	10253-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	StE445.7TM	1.8975	17172	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
L450.B	-	10208-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X65	API5L	L450x	3183-2
-	-	-	StE480.7TM	1.8977	17172	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
L485.B	-	10208-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X70	API5L	L485x	3183-2
L555.B	-	10208-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X80	API5L	L555x	3183-2
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	H40	API5CT	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	J55	API5CT	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	K55	API5CT	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	N80	API5CT	-	-

Notes:

1. The steels according to the **EN 10208-2** standard are possible to deliver in the following delivery conditions:

- NB Seamless pipes - normalizing rolled or normalized
Welded pipes - normalizing rolled strips or sheets and normalizing of weld seam or pipe
Steel of type LxyzNB with minimum tensile strength 245, 290, 360, 415 MPa
- QB Seamless pipes - quenched and tempered
Steel of type LxyzQB with minimum tensile strength 360, 415, 450, 485, 555 MPa
- MB Welded pipes - normalizing rolled or normalized or thermomechanical rolled strips or sheets
Steel of type LxyzMB with minimum tensile strength 245, 290, 360, 415, 450, 485, 555 MPa

Delivery conditions **QB and MB** upon agreement only.

2. The steels in the **API 5L** standard (forty-fourth edition, October 1, 2007) are also designated according to the **ISO 3183-1,2** standard. Relationship between PSL, steels (according to ISO and API 5L) and delivery conditions is the following:

- | | | |
|-------|--|--|
| PSL 1 | L175 or A25
L210 or A | As-rolled, normalizing rolled or normalized |
| | L245 or B
L290 or X42
L320 or X46
L360 or X52
L390 or X56
L415 or X60
L450 or X65
L485 or X70 | As-rolled, normalizing rolled, normalized or normalized and tempered |

PSL 2 L245R or BR
L290R or X42R

As-rolled

L245N or BN
L290N or X42N
L320N or X46N
L360N or X52N
L390N or X56N
L415N or X60N

Normalizing rolled, normalized, normalized and tempered

Quenched and tempered

L245Q, L290Q, L320Q, L360Q, L390Q, L415Q, L450Q, L485Q, L555Q

(BQ, X42Q, X46Q, X52Q, X56Q, X60Q, X65Q, X70Q, X80Q)

Thermomechanical rolled

L245M, L290M, L320M, L360M, L390M, L415M, L450M, L485M, L555M, L625M, L690M, L830M

(BM, X42M, X46M, X52M, X56M, X60M, X65M, X70M, X80M, X90M, X100M, X120M)

Possible combinations of acceptable processes of manufacture (type of pipe seamless or welded), PSL and steelgrade are given in Table 2 of the API 5L standard, 44. Edition.

Deliveries from Podbrezova - PSL 1 and steels inclusive X56. Other steels are given for information only or deliveries upon agreement only.

3. The calculated table weight (**kg/m, tables 2 and 14**) of a line pipe may differ depending on the wall thickness figure (mm) used in the calculation. The figure may be rounded off to one decimal place (dimensions according to The API 5L Standard, editions up to 2004), or it may be rounded off to two decimal places (dimensions according to The ASME B 36.10M Standard are valid currently for line pipes according to API5L standard as well).

4. In GOST standards the data indicate the class of strength of the steel.

5. The table of L - type steels according to the EN standard also contains the steels according to the API 5CT standard.

C-steels for mechanical engineering, Type E according to EN

EN			DIN			BS		NFA		UNI		ČSN,STN		GOST		PN-H		ASTM		JIS		
Ocel	W.Nr.	Standard	Ocel	W.Nr.	Standard	Ocel	Standard	Ocel	Standard	Ocel	Stand.	Ocel	Standard	Ocel	Stand.	Ocel	Standard	Ocel	Stand.	Ocel	Standard	
E155	1.0033	102961	-	-	-	-	-	-	-	Fe280	7945	-	-	-	-	-	-	-	-	-	-	
E155	1.0033	103052	-	-	-	-	-	-	-	Fe280	7946	-	-	-	-	-	-	-	-	-	-	
E155	1.0033	103053	-	-	-	-	-	-	-	Fe280	7947	-	-	-	-	-	-	-	-	-	-	
E155	1.0033	103055	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E155	1.0033	103056	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E190	1.0031	102961	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E190	1.0031	103053	-	-	-	-	-	-	-	-	-	11320	420142	-	-	-	-	-	-	-	-	
E190	1.0031	103055	S93	1.0035	2395-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E195	1.0034	102961	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E195	1.0034	103052	RS9342	1.0034	2393-2	CEW2	6323-6	ES185	49-646	Fe320	7946	11343	420142	-	-	12X	84023	-	-	-	-	
E195	1.0034	103053	RS9342	1.0034	2394-2	ERW2	6323-5	ES185	49-646	Fe320	7947	11343	420142	-	-	12X	84023	-	-	-	-	
E195	1.0034	103055	-	-	-	-	-	-	-	Fe320	7287	-	-	-	-	-	-	-	-	-	-	
E195	1.0034	103056	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E215	1.0212	103051	Si30Al	1.0212	2391-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E215	1.0212	103054	Si30Al	1.0212	2391-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E220	1.0215	102961	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E220	1.0215	103053	-	-	-	-	-	ES200	49-646	-	-	-	-	-	-	-	-	-	-	-	-	
E220	1.0215	103055	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E235	1.0308	102961	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E235	1.0308	102971	-	-	-	HFS3	6323-3	TU37-b	49311	Fe360	7729	-	-	-	-	-	-	-	-	-	-	
E235	1.0308	103051	S935	1.0308	2391-2	CFS3	6323-4	TU37-b	49310	Fe360	7945	11353	420250	10	1050	10	84019	Gr.A	A53	-	-	
E235	1.0308	103052	RS9372	1.0038	2393-2	CEW3	6323-6	ES235	49-646	Fe360	7946	-	-	-	-	R35	84023	-	-	-	-	
E235	1.0308	103053	RS9372	1.0038	2394-2	ERW3	6323-5	-	-	Fe360	7947	11373	420142	10	10707	Si3x	84020	-	-	-	-	
E235	1.0308	103054	-	-	-	-	-	TU37-b	49330	-	-	-	-	-	-	-	-	-	A822	A822	-	-
E235	1.0308	103055	RS9372	1.0038	2395-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E235	1.0308	103056	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	Fe35-1	663	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	Fe35-2	663	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	Fe360	6363	-	-	-	-	-	-	-	-	-	-	
E255	-	103051	-	-	-	CFS4	6323-4	TU42-b	49310	-	-	-	-	-	-	-	-	-	-	-	-	
E255	-	103051	-	-	-	CFS4	6323-4	TU42BT	49330	-	-	-	-	-	-	-	-	-	-	-	-	
E255	-	103051	-	-	-	HFS4	6323-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E260	1.0220	102961	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E260	1.0220	103053	-	-	-	-	-	ES250	49-646	-	-	-	-	-	-	-	-	-	-	-	-	
E260	1.0220	103055	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E275	1.0225	102961	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E275	1.0225	102971	-	-	-	-	-	-	-	Fe430	7729	-	-	-	-	-	-	-	-	-	-	
-	-	-	S445	1.0408	2391-2	CFS4	6323-4	TU42-b	49310	Fe410	7945	11453	420260	20	1050	20	84019	Gr.B	A53	STKM18A	G 3445	
E275	1.0225	103052	S442	1.0044	2393-2	CEW4	6323-6	ES275	49-646	Fe410	7946	-	-	-	-	-	-	-	-	-	-	
E275	1.0225	103053	S442	1.0044	2394-2	ERW4	6323-5	ES275	49-646	Fe410	7947	-	-	20	10707	R45	84023	-	-	-	-	
E275	1.0225	103055	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E275	1.0225	103056	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	Fe45-1	663	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	Fe45-2	663	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	Fe410	6363	-	-	-	-	-	-	-	-	-	-	
E275K2	1.0456	102961	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E275K2	1.0456	102971	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E295	1.0050	100252	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E315	1.0236	102971	-	-	-	-	-	ES300	49-646	Fe460	7946	-	-	-	-	-	-	-	-	-	-	
E315	1.0236	102971	-	-	-	-	-	ES300	49-646	Fe460	7947	-	-	-	-	-	-	-	-	-	-	
E320	1.0237	102961	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E320	1.0237	103053	-	-	-	-	-	ES320	49-646	-	-	-	-	-	-	-	-	-	-	-	-	
E320	1.0237	103055	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E335	1.0060	100252	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E355	1.0580	102941	-	-	-	-	-	-	-	Fe52-1	663	-	-	-	-	-	-	-	-	-	-	
E355	1.0580	102961	-	-	-	-	-	-	-	Fe52-2	663	-	-	-	-	-	-	-	-	-	-	
E355	1.0580	102971	-	-	-	HFS5	6323-3	TU52-b	49311	Fe510	7729	11523	420250	-	-	-	-	-	-	-	-	
E355	1.0580	103051	S62	1.0580	2391-2	CFS5	6323-4	TU52-b	49310	Fe490	7945	11523	420260	-	-	-	-	1524	A519	-	-	
E355	1.0580	103052	Si52.3	1.0570	2393-2	CEW5	6323-6	ES355	49-646	Fe510	7946	-	-	18G2A	19281	18G2A	84018	-	-	-	-	
E355	1.0580	103053	Si52.3	1.0570	2394-2	ERW5	6323-5	ES355	49-646	Fe510	7947	-	-	-	-	-	-	1518	A519	-	-	
E355	1.0580	103054	Si52.0	1.0421	1629	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E355	1.0580	103055	Si52.3	1.0570	2395-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E355	1.0580	103056	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	Fe510	6363	-	-	-	-	-	-	-	-	-	-	
E355K2	1.0920	102961	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E355K2	1.0920	102971	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E360	1.0070	100252	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E370	1.0261	102961	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E370	1.0261	103053	-	-	-	-	-	ES380	49-646	-	-	-	-	-	-	-	-	-	-	-	-	
E370	1.0261	103055	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E410	-	103051	-	-	-	-	-	TU20MV6	49310	-	-	-	-	-	-	-	-	-	-	-	-	

From point of view of chemical composition are identical following steels:

E155 = E190, E195 = E220, E235 = E260, E275 = E320, E355 = E370 in standard EN 10305-3.

The strips for production of welded tubes are differed with method of production and with mechanical properties (see p. 87).



EN			DIN			BS		NFA		UNI		ČSN,STN		GOST		PN-H		ASTM		JIS	
Ocel	W.Nr.	Standard	Ocel	W.Nr.	Standard	Ocel	Standard	Ocel	Standard	Ocel	Stand.	Ocel	Standard	Ocel	Stand.	Ocel	Standard	Ocel	Stand.	Ocel	Standard
E420	1.0575	103053	-	-	-	-	-	ES420	49-646	-	-	-	-	-	-	-	-	-	-	-	-
E420	1.0575	103055	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E420J2	1.0599	10297-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E460K2	1.8891	10296-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E460K2	1.8891	10297-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E470	1.0536	10297-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	TU56-b	49311	Fe55-1	663	11550	42 0250	-	-	R55	84 023/7	1541	A519	-	-
-	-	-	-	-	-	-	-	TU56-b	49311	Fe55-2	663	11550	42 0250	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	TU56-b	49311	Fe540	7729	11550	42 0250	-	-	-	-	-	-	-	-
-	-	-	-	-	-	HFS8	63233	-	-	-	-	11650	42 0250	-	-	-	-	-	-	-	-
E590K2*	1.0644	10297-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E730K2*	1.8893	10297-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E275M*	1.8895	10296-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E355M*	1.8896	10296-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E460M*	1.8898	10296-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

* for information only

C-steels for quenching and tempering and case hardening steels, Type C according to EN

EN			DIN			BS		NFA		UNI	ČSN,STN	GOST		PN-H		ASTM		JIS	
Steel	W.Nr.	Standard	Steel	W.Nr.	Standard	Steel	Standard	Steel	Standard	Steel	Steel	Steel	Standard	Steel	Stan.	Steel	Standard	Steel	Standard
-	-	-	S30Si	1.0211	2391-2	-	-	-	-	-	-	-	-	-	-	1008	A519	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1008	A513	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1008	A512	-	-
-	-	-	C10	1.0301	17210	045M10	970	XC10	35551	C10	-	10	1050	-	-	1010	A519	STKM11A	G3445
-	-	-	C10	1.0301	17210	-	-	-	-	-	-	-	-	-	-	1010	A513	STKM11A	G3445
-	-	-	C10	1.0301	17210	-	-	-	-	-	-	-	-	-	-	1010	A512	STKM11A	G3445
C10E	1.1121	10084	Ck10	1.1121	17210	040A10	970	XC10	35551	C10	12010	10	1050	10	84019	1010	A519	STKM11A	G3445
C10E	1.1121	10084	Ck10	1.1121	17210	-	-	-	-	-	-	-	-	-	-	1010	A513	STKM11A	G3445
C10E	1.1121	10084	Ck10	1.1121	17210	-	-	-	-	-	-	-	-	-	-	1010	A512	STKM11A	G3445
C10E	1.1121	10297-1	Ck10	1.1121	17210	-	-	-	-	-	-	-	-	-	-	1010	A519	STKM11A	G3445
C10E	1.1121	10297-1	Ck10	1.1121	17210	-	-	-	-	-	-	-	-	-	-	1010	A513	STKM11A	G3445
C10E	1.1121	10297-1	Ck10	1.1121	17210	-	-	-	-	-	-	-	-	-	-	1010	A512	STKM11A	G3445
C10R	1.1207	10084	-	-	-	-	-	-	-	-	-	-	-	-	-	1010	A519	STKM11A	G3445
C10R	1.1207	10084	-	-	-	-	-	-	-	-	-	-	-	-	-	1010	A513	STKM11A	G3445
C10R	1.1207	10084	-	-	-	-	-	-	-	-	-	-	-	-	-	1010	A512	STKM11A	G3445
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	MT1010	A519	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	MT1010	A513	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	MT1010	A512	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1012	A519	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1012	A513	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1012	A512	-	-
-	-	-	C15	1.0401	17210	080M15	970	XC15	35551	C15	-	-	-	-	-	1015	A519	-	-
-	-	-	C15	1.0401	17210	-	-	-	-	-	-	-	-	-	-	1015	A513	-	-
-	-	-	C15	1.0401	17210	-	-	-	-	-	-	-	-	-	-	1015	A512	-	-
C15E	1.1141	10084	Ck15	1.1141	17210	080M15	970	XC15	35551	C15	12023	15	1050	-	-	1015	A519	S15CK	G4051
C15E	1.1141	10084	Ck15	1.1141	17210	-	-	-	-	-	-	-	-	-	-	1015	A513	-	-
C15E	1.1141	10084	Ck15	1.1141	17210	-	-	-	-	-	-	-	-	-	-	1015	A512	-	-
C15E	1.1141	10297-1	Ck15	1.1141	17210	-	-	-	-	-	-	-	-	-	-	1015	A519	-	-
C15E	1.1141	10297-1	Ck15	1.1141	17210	-	-	-	-	-	-	-	-	-	-	1015	A513	-	-
C15E	1.1141	10297-1	Ck15	1.1141	17210	-	-	-	-	-	-	-	-	-	-	1015	A512	-	-
C15R	1.1140	10084	Gm15	1.1140	17210	-	-	-	-	-	-	-	-	-	-	1015	A519	-	-
C15R	1.1140	10084	Gm15	1.1140	17210	-	-	-	-	-	-	-	-	-	-	1015	A513	-	-
C15R	1.1140	10084	Gm15	1.1140	17210	-	-	-	-	-	-	-	-	-	-	1015	A512	-	-
C15R	1.1140	10297-1	Gm15	1.1140	17210	-	-	-	-	-	-	-	-	-	-	1015	A519	-	-
C15R	1.1140	10297-1	Gm15	1.1140	17210	-	-	-	-	-	-	-	-	-	-	1015	A513	-	-
C15R	1.1140	10297-1	Gm15	1.1140	17210	-	-	-	-	-	-	-	-	-	-	1015	A512	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	MT1015	A519	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	MT1015	A513	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	MT1015	A512	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	MIX1015	A519	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	MIX1015	A513	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	MIX1015	A512	-	-
C16E	1.1148	10084	-	-	-	-	-	-	-	-	-	-	-	-	-	1016	A519	-	-
C16E	1.1148	10084	-	-	-	-	-	-	-	-	-	-	-	-	-	1016	A513	-	-
C16E	1.1148	10084	-	-	-	-	-	-	-	-	-	-	-	-	-	1016	A512	-	-
C16R	1.1208	10084	-	-	-	-	-	-	-	-	-	-	-	-	-	1016	A519	-	-
C16R	1.1208	10084	-	-	-	-	-	-	-	-	-	-	-	-	-	1016	A513	-	-
C16R	1.1208	10084	-	-	-	-	-	-	-	-	-	-	-	-	-	1016	A512	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1017	A519	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1017	A513	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1018	A519	STKM12A	G3445
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1018	A513	STKM12A	G3445
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1018	A512	STKM12A	G3445
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1019	A519	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1019	A513	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1019	A512	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1020	A519	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1020	A513	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1020	A512	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1021	A519	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1021	A513	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1021	A512	-	-
-	-	-	C22	1.0402	17200	040A20	970	1C22	35552	C20	12024	20	1050	-	-	1022	A519	S22C	G4051
-	-	-	C22	1.0402	17204	-	-	-	-	-	-	-	-	-	-	1022	A513	-	-
C22E	1.1151	10297-1	Ck22	1.1151	17200	070M20	970	XC18	35552	C20	12024	20	1050	20	84019	-	1022	A519	S20C
G4051	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C22E	1.1151	10297-1	Ck22	1.1151	17204	-	-	-	-	-	-	-	-	-	-	1022	A519	-	-
C22E	1.1151	100832	Ck22	1.1151	17200	-	-	-	-	-	-	-	-	-	-	1022	A513	-	-
C22E	1.1151	10297-1	Ck22	1.1151	17204	-	-	-	-	-	-	-	-	-	-	1022	A519	-	-
C22E	1.1151	100832	Ck22	1.1151	17200	-	-	-	-	-	-	-	-	-	-	1022	A513	-	-
C22E	1.1151	100832	Ck22	1.1151	17204	-	-	-	-	-	-	-	-	-	-	1022	A513	-	-
C22R	1.1149	100832	Gm22	1.1149	17200	-	-	-	-	-	-	-	-	-	-	1022	A519	-	-
C22R	1.1149	100832	Gm22	1.1149	17204	-	-	-	-	-	-	-	-	-	-	1022	A513	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	MT1020	A519	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	MT1020	A513	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	MT1020	A512	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	MIX1020	A519	STKM13A	G3445
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	MIX1020	A513	STKM13A	G3445
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	MIX1020	A512	STKM13A	G3445



EN			DIN			BS		NFA		UNI	ČSN, STN		GOST		PN-H		ASTM		JIS	
Steel	W. Nr.	Standard	Steel	W. Nr.	Standard	Steel	Standard	Steel	Standard	Steel	Steel	Steel	Standard	Steel	Stan.	Steel	Standard	Steel	Standard	
			C25	1.0406	17200	070M26	970	1C25	35552	C25	12030	-	-	-	-	1025	A519	-	-	
			C25	1.0406	17200	-	-	-	-	-	-	-	-	-	-	1025	A513	-	-	
C25	1.0406	100832	C25	1.0406	17200	-	-	-	-	-	-	-	-	-	-	1025	A512	-	-	
C25E	1.1158	100832	Cl25	1.1158	17200	070M26	970	XC25	35552	C25	12030	25	1050	-	-	1025	A519	S25C	G4051	
C25E	1.1158	100832	Cl25	1.1158	17200	-	-	-	-	-	-	-	-	-	-	1025	A513	-	-	
C25E	1.1158	100832	Cl25	1.1158	17200	-	-	-	-	-	-	-	-	-	-	1025	A512	-	-	
C25R	1.1163	100832	Gm25	1.1163	17200	-	-	-	-	-	-	-	-	-	-	1025	A519	-	-	
C25R	1.1163	100832	Gm25	1.1163	17200	-	-	-	-	-	-	-	-	-	-	1025	A513	-	-	
C25R	1.1163	100832	Gm25	1.1163	17200	-	-	-	-	-	-	-	-	-	-	1025	A512	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1026	A519	STKM14A	G3445	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1026	A513	STKM14A	G3445	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1026	A512	STKM14A	G3445	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1027	A513	-	-	
			C30	1.0528	17200	-	-	-	-	-	12031	-	-	-	-	1030	A519	-	-	
			C30	1.0528	17200	-	-	-	-	-	-	-	-	-	-	1030	A513	-	-	
C30	1.0528	100832	C30	1.0528	17200	-	-	-	-	-	-	-	-	-	-	1030	A512	-	-	
C30E	1.1178	100832	Cl30	1.1178	17200	080M30	970	XC32	35552	C30	12031	-	-	-	-	1030	A519	S30CM	G4051	
C30E	1.1178	100832	Cl30	1.1178	17200	-	-	-	-	-	-	-	-	-	-	1030	A513	-	-	
C30E	1.1178	100832	Cl30	1.1178	17200	-	-	-	-	-	-	-	-	-	-	1030	A512	-	-	
C30R	1.1179	100832	Gm30	1.1179	17200	-	-	-	-	-	-	-	-	-	-	1030	A519	-	-	
C30R	1.1179	100832	Gm30	1.1179	17200	-	-	-	-	-	-	-	-	-	-	1030	A513	-	-	
C30R	1.1179	100832	Gm30	1.1179	17200	-	-	-	-	-	-	-	-	-	-	1030	A512	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1033	A513	-	-	
C35	1.0501	100832	C35	1.0501	17200	080M36	970	1C35	35552	C35	12040	35	1050	-	-	1035	A519	STKM15A	G3445	
C35	1.0501	100832	C35	1.0501	17204	-	-	-	-	-	-	-	-	-	-	1035	A519	STKM15A	G3445	
C35	1.0501	100832	C35	1.0501	17200	-	-	-	-	-	-	-	-	-	-	1035	A513	STKM15A	G3445	
C35	1.0501	100832	C35	1.0501	17204	-	-	-	-	-	-	-	-	-	-	1035	A513	STKM15A	G3445	
C35	1.0501	100832	C35	1.0501	17200	-	-	-	-	-	-	-	-	-	-	1035	A512	STKM15A	G3445	
C35	1.0501	100832	C35	1.0501	17204	-	-	-	-	-	-	-	-	-	-	1035	A512	STKM15A	G3445	
C35E	1.1181	102971	Cl35	1.1181	17204	CF56	63234	XC38H1	35552	C35	12040	35	1050	35	84019	1035	A519	STKM15A	G3445	
C35E	1.1181	102971	Cl35	1.1181	17204	CF56	63234	-	-	-	12040	35	1050	35	84019	1035	A513	STKM15A	G3445	
C35E	1.1181	102971	Cl35	1.1181	17204	CF56	63234	-	-	-	12040	35	1050	35	84019	1035	A512	STKM15A	G3445	
C35E	1.1181	100832	Cl35	1.1181	17200	CF56	63234	-	-	-	12040	35	1050	35	84019	1035	A519	STKM15A	G3445	
C35E	1.1181	100832	Cl35	1.1181	17200	CF56	63234	-	-	-	12040	35	1050	35	84019	1035	A513	STKM15A	G3445	
C35E	1.1181	100832	Cl35	1.1181	17200	CF56	63234	-	-	-	12040	35	1050	35	84019	1035	A512	STKM15A	G3445	
C35R	1.1180	100832	Gm35	1.1180	17200	-	-	-	-	-	-	-	-	R55	84023	1035	A519	STKM16A	G3445	
C35R	1.1180	100832	Gm35	1.1180	17204	-	-	-	-	-	-	-	-	R55	84023	1035	A519	STKM16A	G3445	
C35R	1.1180	100832	Gm35	1.1180	17200	-	-	-	-	-	-	-	-	R55	84023	1035	A513	STKM16A	G3445	
C35R	1.1180	100832	Gm35	1.1180	17204	-	-	-	-	-	-	-	-	R55	84023	1035	A513	STKM16A	G3445	
C35R	1.1180	100832	Gm35	1.1180	17200	-	-	-	-	-	-	-	-	R55	84023	1035	A512	STKM16A	G3445	
C35R	1.1180	100832	Gm35	1.1180	17204	-	-	-	-	-	-	-	-	R55	84023	1035	A512	STKM16A	G3445	
C40	1.0511	100832	C40	1.0511	17200	080M40	970	1C40	35552	C40	12041	-	-	-	-	1040	A519	-	-	
C40	1.0511	100832	C40	1.0511	17200	-	-	-	-	-	-	-	-	-	-	1040	A513	-	-	
C40E	1.1186	100832	Cl40	1.1186	17200	080M40	970	XC42H1	35552	C40	12041	40	1050	-	-	1040	A519	S40C	G4051	
C40E	1.1186	100832	Cl40	1.1186	17200	-	-	-	-	-	-	-	-	-	-	1040	A513	-	-	
C40R	1.1189	100832	Gm40	1.1189	17200	-	-	-	-	-	-	-	-	-	-	1040	A519	-	-	
C40R	1.1189	100832	Gm40	1.1189	17200	-	-	-	-	-	-	-	-	-	-	1040	A513	-	-	
C45	1.0503	100832	C45	1.0503	17200	080M46	970	1C45	35552	C45	12050	45	1050	-	-	1045	A519	S45C	G4051	
C45	1.0503	100832	C45	1.0503	17204	-	-	-	-	-	-	-	-	-	-	1045	A519	-	-	
C45E	1.1191	102971	Cl45	1.1191	17200	CF58	63234	XC48H1	35552	C45	12050	45	1050	45	84019	1045	A519	S45C	G4051	
C45E	1.1191	102971	Cl45	1.1191	17204	CF58	63234	-	-	-	12050	45	1050	45	84019	1045	A519	-	-	
C45E	1.1191	100832	Cl45	1.1191	17200	CF58	63234	-	-	-	12050	45	1050	45	84019	1045	A519	-	-	
C45E	1.1191	100832	Cl45	1.1191	17204	CF58	63234	-	-	-	12050	45	1050	45	84019	1045	A519	-	-	
C45R	1.1201	100832	Gm45	1.1201	17200	-	-	-	-	-	-	-	-	R65	84023	1045	A519	STKM17A	G3445	
C45R	1.1201	100832	Gm45	1.1201	17204	-	-	-	-	-	-	-	-	R65	84023	1045	A519	STKM17A	G3445	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1545	A519	-	-	
			C50	1.0540	17200	-	-	1C50	35552	C50	12051	-	-	-	-	1050	A519	-	-	
			C50	1.0540	17200	-	-	-	-	-	-	-	-	-	-	1050	A513	-	-	
C50E	1.1206	100832	Cl50	1.1206	17200	080M50	970	XC50H1	35552	C50	12050	50	1050	-	-	1050	A519	-	-	
C50E	1.1206	100832	Cl50	1.1206	17200	-	-	-	-	-	-	-	-	-	-	1050	A513	-	-	
C50R	1.1241	100832	Gm50	1.1241	17200	-	-	-	-	-	-	-	-	-	-	1050	A519	-	-	
C50R	1.1241	100832	Gm50	1.1241	17200	-	-	-	-	-	-	-	-	-	-	1050	A513	-	-	
C55	1.0535	100832	C55	1.0535	17200	070M55	970	1C55	35552	C55	12060	55	1050	-	-	1055	A519	S55C	G4051	
C55	1.0535	100832	C55	1.0535	17204	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
C55E	1.1203	100832	Cl55	1.1203	17200	070M55	970	XC55H1	35552	C55	12060	55	1050	55	84019	1055	A519	S55C	G4051	
C55E	1.1203	100832	Cl55	1.1203	17204	-	-	-	-	-	12060	-	-	55	84019	-	-	-	-	
C55R	1.1209	100832	Gm55	1.1209	17200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
C55R	1.1209	100832	Gm55	1.1209	17204	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
C60	1.0601	100832	C60	1.0601	17200	-	-	1C60	35552	C60	12061	60	1050	-	-	1060	A513	S58C	G4051	
C60	1.0601	100832	C60	1.0601	17204	-	-	-	-	-	-	-	-	-	-	1060	A513	-	-	
C60E	1.1221	102971	Cl60	1.1221	17204	070M62	970	XC60H1	35552	C60	12061	60	1050	-	-	1060	A513	S58C	G4051	
C60E	1.1221	100832	Cl60	1.1221	17200	-	-	-	-	-	-	-	-	-	-	1060	A513	-	-	
C60R	1.1223	100832	Gm60	1.1223	17200	-	-	-	-	-	-	-	-	-	-	1060	A513	-	-	
C60R	1.1223	100832	Gm60	1.1223	17204	-	-	-	-	-	-	-	-	-	-	1060	A513	-	-	

C-steels for tubes for pressure purposes, Type P according to EN

Steel	EN		DIN			BS		NFA		UNI	ČSN,STN	GOST		PN-H		ASTM		JIS	
	W.Nr.	Standard	Steel	W.Nr.	Standard	Steel	Standard	Steel	Standard			Steel	Steel	Stand.	Steel	Standard	Steel	Standard	Steel	Standard
P195TR1	1.0107	102161	-	-	-	-	-	-	-	Fe320	-	-	-	-	-	-	-	-	-
P195TR1	1.0107	102171	-	-	-	-	-	-	-	Fe320	-	-	-	-	-	-	-	-	-
P195TR2	1.0108	102161	-	-	-	-	-	-	-	-	-	-	-	-	-	A822	A822	-	-
P195TR2	1.0108	102171	-	-	-	-	-	-	-	-	-	-	-	-	-	A822	A822	-	-
P195GH	1.0348	102162	-	-	-	320	3059-1	-	-	-	-	-	-	-	-	-	-	-	-
P195GH	1.0348	102172	-	-	-	320	3606	TS34C	49-245	-	-	-	-	-	-	-	-	-	-
P215NL	1.0451	102164	TTSi35N	1.0356	17173	430LT	3603	-	-	C15	11369	-	-	-	-	Gr.1	A333	STPL380	G3460
P215NL	1.0451	102174	TTSi35N	1.0356	17174	-	-	-	-	-	-	-	-	-	-	Gr.1	A334	STBL380	G3464
P215NL	1.0451	102176	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P215NL	1.0451	102532	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P235	-	102532	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P235TR1	1.0254	102161	S370	1.0254	1629	-	-	-	-	Fe320	11353	-	-	-	-	-	-	-	-
P235TR1	1.0254	102161	S370	1.0254	2609	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P235TR1	1.0254	102171	S370	1.0254	1626	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P235TR2	1.0255	102161	S374	1.0255	1630	360	3601	-	-	-	-	-	-	R35	84023	-	-	STPG370	G3454
P235TR2	1.0255	102171	S374	1.0255	1628	-	-	-	-	-	-	-	-	-	-	-	-	STS370	G3455
P235TR2	1.0255	102161	-	-	-	CFS360	7416	TUE220A	49-112	-	-	-	-	-	-	-	-	-	-
P235TR2	1.0255	102161	-	-	-	-	-	AE220A	49-186	-	-	-	-	-	-	-	-	-	-
P235TR2	1.0255	102161	-	-	-	-	-	AE220	49-281	-	-	-	-	-	-	-	-	-	-
P235TR2	1.0255	102532	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P235GH	1.0345	102162	S35.8	1.0305	17175	360	3059-2	TU37c	49-213	C14	12021	10	1050	K10	74252	Gr.A	A106	STPT370	G3456
P235GH	1.0345	102162	S35.8	1.0305	17175	360	3602-1	TU37c	49-215	C14	12021	10	1050	K10	74252	A179	A179	STPT370	G3456
P235GH	1.0345	102162	S35.8	1.0305	17175	360	3602-1	TU37c	49-215	C14	12021	10	1050	K10	74252	A192	A192	STPT370	G3456
P235GH	1.0345	102162	S35.8	1.0305	17175	360	3602-1	TU37c	49-215	C14	12021	10	1050	K10	74252	Gr.A-2	A556	STPT370	G3456
P235GH	1.0345	102162	S35.8	1.0305	2609	-	-	TUE220	49-211	-	-	-	-	-	-	Gr.A	A178	STB340	G3461
P235GH	1.0345	102162	S35.8	1.0305	2609	-	-	TUE220	49-211	-	-	-	-	-	-	A214	A214	STB340	G3461
P235GH	1.0345	102172	S378	1.0315	17177	-	-	TS37C	49-243	-	-	-	-	-	-	-	-	-	-
P235GH	1.0345	102175	S378	1.0315	17177	-	-	TS37C	49-245	-	-	-	-	-	-	-	-	-	-
-	-	-	SE255	1.0461	17179	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	SE255	1.0461	17178	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	WSE255	1.0462	17179	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	WSE255	1.0462	17178	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	TSE255	1.0463	17179	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	TSE255	1.0463	17178	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	ESE255	1.1103	17179	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	ESE255	1.1103	17178	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P255QL	1.0452	102164	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P265	-	102532	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P265TR1	1.0258	102161	S44.0	1.0256	1629	-	-	-	-	-	11453	-	-	-	-	-	-	-	-
P265TR1	1.0258	102161	S44.0	1.0256	2609	-	-	-	-	-	11453	-	-	-	-	-	-	-	-
P265TR1	1.0258	102171	S44.0	1.0256	1626	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	430	3601	-	-	-	-	-	-	-	-	-	-	-	-
P265TR2	1.0259	102161	S44.4	1.0257	1630	CFS430	7416	TUE235A	49-112	-	-	-	-	R45	84023	-	-	STPG410	G3454
P265TR2	1.0259	102171	S44.4	1.0257	1628	-	-	-	-	-	-	-	-	R45	84023	-	-	STS410	G3455
P265TR2	1.0259	102532	S44.4	1.0257	2609	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P265GH	1.0425	102162	S45.8	1.0405	17175	430	3602-1	TU42c	49-213	C18	12022	20	1050	K18	74252	Gr.B	A106	STPT410	G3456
P265GH	1.0425	102162	S45.8	1.0405	17175	430	3059-2	TU42c	49-215	C18	12022	20	1050	K18	74252	Gr.A-1	A210	STPT410	G3456
P265GH	1.0425	102162	S45.8	1.0405	17175	430	3602-1	TUE250	49-211	-	-	-	-	-	-	Gr.B-2	A556	-	-
P265GH	1.0425	102162	S45.8	1.0405	17175	430	3602-1	TUE250	49-281	-	-	-	-	-	-	WPB	A234	-	-
P265GH	1.0425	102172	S42.8	1.0498	17177	440	3606	TS42c	49-243	-	-	-	-	-	-	Gr.B	A178	STB410	G3461
P265GH	1.0425	102175	S42.8	1.0498	17177	440	3606	TS42c	49-245	-	-	-	-	-	-	Gr.B	A178	STB410	G3461
P265NL	1.0453	102164	TTSi35V	1.0356	17173	430LT	3603	TU42BT	49-215	C20	11419	-	-	-	-	Gr.6	A333	-	-
P265NL	1.0453	102174	TTSi35V	1.0356	17174	430LT	3603	TU42BT	49-215	C20	11448	-	-	-	-	Gr.6	A334	-	-
P265NL	1.0453	102176	TTSi35V	1.0356	17173	430LT	3603	TU42BT	49-215	C20	11419	-	-	-	-	WPL6	A420	-	-
P265NL	1.0453	102532	-	-	-	-	-	TU48c	49-213	-	-	-	-	-	-	-	-	STS480	G3455
-	-	-	-	-	-	-	-	TU48c	49-215	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	TS48c	49-243	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	TS48c	49-245	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	AE275	49-281	-	-	-	-	-	-	-	-	-	-
-	-	-	SE285	1.0486	17179	-	-	TUE290B2	49-411	-	-	-	-	-	-	-	-	-	-
-	-	-	SE285	1.0486	17178	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	WSE285	1.0487	17179	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	WSE285	1.0487	17178	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P275NL1	1.0488	102163	TSE285	1.0488	17179	-	-	TUE290B3	49-411	-	-	-	-	-	-	-	-	-	-
P275NL1	1.0488	102163	TSE285	1.0488	2609	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P275NL1	1.0488	102173	TSE285	1.0488	17178	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P275NL2	1.1104	102163	ESE285	1.1104	17179	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P275NL2	1.1104	102173	ESE285	1.1104	17178	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	SE52.0	1.0421	1629	-	-	-	-	-	11523	-	-	-	-	-	-	-	-
-	-	-	SE52.0	1.0421	2609	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	SE52.0	1.0421	1626	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	SE52.4	1.0581	1630	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	SE52.4	1.0581	1628	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P355N	1.0562	102163	SE355	1.0562	17179	-	-	TUE360B2	49-411	-	-	-	-	-	-	-	-	-	-
P355N	1.0562	102532	SE355	1.0562	17179	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P355N	1.0562	102173	SE355	1.0562	17178	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P355NH	1.0565	102163	WSE355	1.0565	17179	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P355NH	1.0565	102532	WSE355	1.0565	2609	-	-	-	-	-	-	-	-	-	-	-	-	-	-



EN			DIN			BS		NFA		UNI	ČSN,STN	GOST		PN-H		ASTM		JIS	
Steel	W.Nr.	Standard	Steel	W.Nr.	Standard	Steel	Standard	Steel	Standard	Steel	Steel	Steel	Stand.	Steel	Standard	Steel	Standard	Steel	Standard
P355NH	1.0565	10217-3	WSiE355	1.0565	17178	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P355NL1	1.0566	10216-3	TSiE355	1.0566	17179	-	-	TUE360B3	49-411	-	11503	-	-	-	-	-	-	-	-
P355NL1	1.0566	10217-3	TSiE355	1.0566	17178	-	-	-	-	-	11503	-	-	-	-	-	-	-	-
P355NL1	1.0566	10253-2	TSiE355	1.0566	2609	-	-	-	-	-	11503	-	-	-	-	-	-	-	-
P355NL2	1.1106	10216-3	ESiE355	1.1106	17179	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P355NL2	1.1106	10217-3	ESiE355	1.1106	17178	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			SiE420	1.8902	17179	-	-	TUE420B2	49-411	-	-	-	-	-	-	-	-	-	-
			SiE420	1.8902	17178	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			WSiE420	1.8932	17179	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			WSiE420	1.8932	17178	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			TSiE420	1.8912	17179	-	-	TUE420B3	49-411	-	-	-	-	-	-	-	-	-	-
			TSiE420	1.8912	17178	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			ESiE420	1.8913	17179	-	-	-	-	-	-	-	-	-	-	-	-	-	-
			ESiE420	1.8913	17178	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P460N	1.8905	10216-3	SiE460	1.8905	17179	-	-	TUE485B2	49-411	-	-	-	-	-	-	-	-	-	-
P460N	1.8905	10217-3	SiE460	1.8905	17178	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P460NH	1.8935	10216-3	WSiE460	1.8935	17179	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P460NH	1.8935	10217-3	WSiE460	1.8935	17178	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P460NL1	1.8915	10216-3	TSiE460	1.8915	17179	-	-	TUE485B3	49-411	-	-	-	-	-	-	-	-	-	-
P460NL1	1.8915	10217-3	TSiE460	1.8915	17178	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P460NL2	1.8918	10216-3	ESiE460	1.8918	17179	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P460NL2	1.8918	10217-3	ESiE460	1.8918	17178	-	-	-	-	-	-	-	-	-	-	-	-	-	-
*P620Q	1.8876	10216-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
*P620QH	1.8877	10216-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
*P620QL	1.8890	10216-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
*P690Q	1.8879	10216-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
*P690QH	1.8880	10216-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
*P690QL1	1.8881	10216-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
*P690QL2	1.8888	10216-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

* for information only

Alloy steels for tubes for mechanical purposes and heat treatment, Type 26Mn5 according to EN

EN		DIN			BS		NFA		UNI	EN, STN	GOST		PN-H		ASTM		JIS		
Steel	W. Nr.	Stand.	Steel	W. Nr.	Stand.	Steel	Stand.	Steel	Standard	Steel	Steel	Steel	Stand.	Steel	Standard	Steel	Stand.	Steel	Standard
Mn steel																			
			21Mn4	1.0469	17115					20Mn4		20G	4543	20G	84019				
26Mn5	1.1161	10305-1				CFS7	6323-4					25G2	4543						
28Mn6	1.1170	10083-2	28Mn6	1.1170	17200	150M28	970	28Mn6	35-552	C28Mn	13141	30G2	4543	30G2	84030/04	1330	A519	SCMn1	G 4051
			16Mn9								13320					1527			
			36Mn4	1.0561	17204							35G	4543						
			36Mn5	1.1167	17204	150M36	9703	35M5	35-552			35G2	4543	-	-	1335	A519	SMn438	G4052
			[36Mn7]								14240	35G2	4543						
38Mn6	1.1127	10297-1	36Mn6									40G2	4543						
			46Mn5	1.1128															
			46Mn7	1.0912							13250	45G2	4543						
Mn-B steel																			
20MnB5	1.5530	10083-3						20MB5	35-552										
30MnB5	1.5531	10083-3																	
38MnB5	1.5532	10083-3						38MB5	35-552										
Mn-Cr steel																			
16MnCr5	1.7131	10084	16MnCr5	1.7131	17210	590M17	970	16MC5	35-551	16MnCr5	14220	18ChG	4543			5115	A519	SCr415	G 4051
16MnCr5	1.7131	10297-1									14220								
20MnCr5	1.7147	10084	20MnCr5	1.7147	17210			20MC5	35-551	20MnCr5	14221	18ChG	4543	-	-	(5120)	A519		
Mn-Cr-B steel																			
16MnCrB5	1.7160	10084									14224	20ChGR	4543						
27MnCrB5-2	1.7182	10083-3																	
33MnCrB5-2	1.7185	10083-3																	
39MnCrB6-2	1.7189	10083-3																	
Mn-Cr-Si steel																			
[30MnCrSi4]	1.71XY										14331	30ChGSA	4543						
[12MnCrSiMoTi]	1.51XY										POD200								
Mn-Cr-V steel																			
27MnCrV4	1.8162										15231								
Mn-Si steel																			
			10MnSi6 3	1.5125								09G2S	19281	-	-	-	-	-	-
[18MnSi6-3]												18G2S	5781						
[25MnSi6-3]												25G2S	5781						
			37MnSi5	1.5122				38MS5			13240	35GS	5781						
[20MnSi7]	1.51XY										Pre Trip								
Mn-V steel																			
20MnV6	1.5217	10294-1	20MnV6	1.5217		Gr.55	4360	20MV6	49-310	20MnV5	13220			18G2AV	84018	K01907		STKM20A	G 3445
[E410]	1.0509	10305-1	[StE460]	1.8905	17124			S470M	49-312					-	-	K12202		STKM20A	G 3445
Mo steel																			
26Mo2	1.5417	10305-1				CFS 9	6323-4												
20MoCr3	1.7320	10084																	
20MoCr4	1.7321	10084	20MoCr4	1.7321	17210														
Cr-Ni steel																			
16NiCr4	1.5714	10084								16CrNi4						3115	SAE		
15NiCr13	1.5752	10084	14NiCr14	1.5752		655M13	970	12NC15			16420							SNC815	G 4052
			31NiCr14	1.5755				(30NC12)			16440	30ChN3A	4543			3435	SAE		
10NiCr5-4	1.5805	10084	[10NiCr6]																
35NiCr6	1.5815	10083-3																	
17CrNi6-6	1.5918	10084	15CrNi6	1.5919	17210	[815M17]	970	16NC6	35-551	16CrNi4	16321	[12ChN2]							
Cr-Ni-Mo steel																			
36CrNiMo4	1.6511	10083-3	36CrNiMo4	1.6511	17200	817M37	970-1			38NiCrMo4		40ChGNM	4543			9840	SAE		
36CrNiMo4	1.6511	10297-1																	
34CrNiMo6	1.6582	10083-3	34CrNiMo6	1.6582	17200	817M40	970			35NiCrMo6	16343	36Ch2N2MA	4543						
30CrNiMo8	1.6580	10083-3	30CrNiMo8	1.6580	17200	823M30	970	30CND8	35-556	30NiCrMo8	16430								
30CrNiMo8	1.6580	10297-1																	
18CrNiMo7-6	1.6587	10084	17CrNiMo6	1.6587	17210			18NCD6	35-551		16326							SNCM431	G 4103
Ni-Cr-Mo steel																			
			16NiCrMo2							16NiCrMo2						8617	A519		
20NiCrMo2-2	1.6523	10084	21NiCrMo2	1.6523	17210	805M20	970	20NCD2	35-551	20NiCrMo2	16125	20ChGNM	4543			8620	A519	SNCM220	G 4103
20NiCrMo2-2	1.6523	10297-1																	
41NiCrMo7-3-2	1.6563	10297-1	40NiCrMo73							40NiCrMo7									
17NiCrMo6-4	1.6566	10084	17NiCrMo5							17NiCrMo5									
14NiCrMo13-4	1.6657	10084	14NiCrMo134	1.6657		832M13	970	16NCD13								9310	A519		
36NiCrMo16	1.6773	10083-3	35NiCrMo16			835M30	970	38NCD16	35-571	34NiCrMo16									
39NiCrMo3	1.6510	10083-3																	
26NiCrMo8-5	1.6931		26NiCrMo85	1.6931							16431								
18NiCrMo14-6			17NiCrMo14	1.3533	17230														
Cr steel																			
38Cr2	1.7003	10083-3	38Cr2	1.7003	17200			38C2	35-552	38Cr2									
46Cr2	1.7006	10083-3	46Cr2	1.7006	17200			42C2	35-552	45Cr2						5045	A519		
17Cr3	1.7016	10084	17Cr3	1.7016	17210	523M15	970-1	18C3			14120	15Ch	4543			(5015)	A519	SCr415	G 4104
			20Cr4	1.7027	17210														
28Cr4	1.7030	10084	28Cr4	1.7030	17200	530A30	970					30Ch	4543			5130	A519		

Steel 25CrMo4 is steel for machinery parts (see p. 21 and 111).

In EN 10216-2 is as boiler steel with reduced contents of P and S and guaranteed contents of Al.



EN			DIN			BS		NFA		UNI	ČSN/STN	GOST		PN-H		ASTM		JIS	
Steel	W. Nr.	Stand.	Steel	W. Nr.	Stand.	Steel	Stand.	Steel	Standard	Steel	Steel	Steel	Stand.	Steel	Standard	Steel	Stand.	Steel	Standard
34Cr4	1.7033	10083-3	34Cr4	1.7033	17200	530A32	970-1	32C4	35-552	34Cr4	14141	35Ch	4543	-	-	5132	A519	SCr430	G 4052
37Cr4	1.7034	10083-3	37Cr4	1.7034	17200	530M36	970-1	38C4	35-553	38Cr4	14140	38Ch	4543			5135	A519	SCr435	G 4052
41Cr4	1.7035	10083-3	41Cr4	1.7035	17200	530A40	970-1	42C4	35-552	41Cr4	14 148	40Ch	4543	40H	84030	(5140)	A519	SCr440	G 4051
41Cr4	1.7035	10297-1	41Cr4	1.7035	17204					-	(14 151)	40Ch	4543	40H	84030	(5140)	A519	SCr440	G 4051
100Cr6	1.3505	683-17	100Cr6	1.3505	17230	535A99	970-1	100C6	35-565	100Cr6	14 109	Ch15	801	LH 15	84041	52100		SUJ 2	G 4805
Cr-Mo steel																			
18CrMo4	1.7243	10084						18CD4	35-551	18CrMo4	15 124	20ChM	4543					SCM418	G 4052
25CrMo4	1.7218	10083-3	25CrMo4	1.7218	17200	708A25	970-1	25CD4	35-552	25CrMo4	15 130	30ChM	4543			4130	A519	SCM420	G 4105
25CrMo4	1.7218	10297-1	25CrMo4	1.7218	17204	CFS 10	6323-4	(27CD4)			15 130	30ChM	4543			4130	A519	SCM420	G 4105
30CrMo4	1.7216	10297-1								30CrMo4		30ChM	4543						
34CrMo4	1.7220	10083-3	34CrMo4	1.7220	17200	708A37	970-1	34CD4	35-552	34CrMo4	15 141	35ChM	4543			4135	A519	SCM435	G 4052
34CrMo4	1.7220	10297-1	34CrMo4	1.7220	17204														
42CrMo4	1.7225	10083-3	42CrMo4	1.7225	17200	708A40	970-1	42CD4	35-552	42CrMo4	15 142	38ChM	4543			4140	A519	SCM440	G 4052
42CrMo4	1.7225	10297-1	42CrMo4	1.7225	17204	CFS 11	6323-4									4142	A519	(SCM4)	G 4052
50CrMo4	1.7228	10083-3	50CrMo4	1.7228	17200			50CD4	35-552	50CrMo4						4150	A519	SCM445	G 4052
100CrMo7-3	1.3536	683-17	100CrMo7	1.3537	17230			100CD7	35-565	100CrMo7									
Cr-Mn-Mo steel																			
12CrMnMoV8-6	1.79XY										(POD 90)								
16CrMnMoV8-7	1.79XY		(BTR 110)								POD2000								
15CrMnMo9	1.79XY							15CMD9											
Cr-V steel																			
			42CrV6	1.7561							15 241								
			(30CrV9)	1.76XY							15 230								
51CrV4	1.8159	10083-3	50CrV4	1.8159	17200	735A50	970-1	50CV4	35-552	50CrV4	15 260	50ChGFA	14959			6150H	A519	SUP 10	G 4801
Cr-Mo-V steel																			
			15CrMoV5-9	1.8521	17211														
			15CrMoV5-10	1.7745															
			15CrMoV6	1.7734				15CDV6		15CrMoV6									
21CrMoV5-7	1.7709	10269	21CrMoV5-7	1.7709	17240			20CDV6	35-559	24CrMoV55	15 320	25Ch1M1F	20072						
30CrMoV9	1.7707	10250-3	30CrMoV9	1.7707	17200						15 330	30Ch3MF	4543						
31CrMoV9	1.8519	10085								31CrMoV9	15 330	30Ch3MF	4543						
										31CrMoV10									
32CrMoV12-9		10085	32CrMoV1210	1.7765				32CDV12											
40CrMoV13-9	1.8523	10085	39CrMoV139	1.8523	17211	897M39	970-1	40CDV13	35-590										
Cr-Al-Mo steel																			
			34CrAl6	1.8504							14 340	(38Ch2Ju)	4543						
32CrAlMo7-10	1.8505	10085																	
34CrAlMo5-10	1.8507	10085	34CrAlMo5	1.8507	17211			30CAD6.12		34CrAlMo7						K23510	A355		
41CrAlMo7-10	1.8509	10085	41CrAlMo7	1.8509	17211	905M39	970	40CAD6.12	35-552	41CrAlMo7	15 340	38Ch2MJuA	4543			K24065	A355	SACM645	G 4202
31CrMo12	1.8515	10085	31CrMo12	1.8515	17211	722M24	970	30CD12		32CrMo12									
34CrAlNi7-10	1.8550	10085	34CrAlNi7	1.8550	17211						(16 347)								
Cr-Si steel																			
			(38 CrSi6-5)	(171XY)							14 341	38ChS							

Alloy steels for pressure purposes, Type 16Mo3 according to EN

EN		DIN			BS		NFA		UNI		GOST		PN-H		ASTM		JIS		
Steel	W.Nr.	Stand.	Steel	W.Nr.	Stand.	Steel	Stand.	Steel	Stand.	Steel	Steel	Steel	Stand.	Steel	Stand.	Steel	Stand.	Steel	Standard
Mn steel																			
(P295 GH)	1.0481	-	17Mn4	1.0481	17175	40	30592	TUE275	49211	-	11481	14G2	4543	-	-	Gr.C	A106	STPT480	G3456
-	-	-	17Mn4	1.0481	17175	-	-	TUE275	49211	-	13030	-	-	-	-	Gr.C	A178	-	-
-	-	-	17Mn4	1.0481	17175	-	-	TUE275	49211	-	-	-	-	-	-	Gr.C	A210	-	-
-	-	-	17Mn4	1.0481	17175	-	-	TUE275	49211	-	-	-	-	-	-	WPC	A234	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Gr.C2	A556	-	-
(P310 GH)	1.0482	-	19Mn5	1.0482	17175	-	-	TU52c	49213	-	-	-	-	-	-	Gr.D	A178	STB510	G3461
(P355 GH)	1.0473	-	19Mn6	1.0473	17155	-	-	TSS2C	49243	-	-	-	-	-	-	-	-	-	-
Mn + Nb, V steel																			
20MnNb6	1.0471	10216-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17MnV4	-	-	17MnV4	-	-	-	-	-	-	-	12025	-	-	-	-	-	-	-	-
Mo steel																			
16Mo3	1.5415	10216-2	15Mo3	1.5415	17175	243	30592	TU15D3	49213	16Mo3	15020	-	-	16M	74252	-	-	-	-
16Mo3	1.5415	10217-2	15Mo3	1.5415	17177	243	3606	TU15D3	49215	-	15020	-	-	16M	74252	-	-	-	-
16Mo3	1.5415	10217-5	15Mo3	1.5415	17177	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16Mo3	1.5415	10253-2	15Mo3	1.5415	2609	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	TS15D3	49243	-	-	-	-	-	-	-	-	-	-
-	-	-	16Mo5	1.5423	-	-	-	-	-	16Mo5	-	-	-	-	-	T1, T1a, T1b	A209	STBA12	G3462
-	-	-	-	-	-	-	-	-	-	16Mo5	-	-	-	-	-	P1	A335	STPA12	G3458
20Mo5	1.5419	10213-2	-	-	-	245	3606	-	-	-	-	-	-	-	-	A692	A692	STBA13	G3462
8Mo B 5-4	1.5450	10216-2	-	-	-	261	3606	-	-	-	-	-	-	-	-	-	-	-	-
Cr - Mo steel																			
25CrMo4	1.7218	10216-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26CrMo4-2	1.7219	10216-4	26CrMo4	1.7219	17173	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(15CrMo2-5)	-	-	-	-	-	-	-	TU15CD2-05	49213	-	-	-	-	-	-	T2	A213	STBA20	G3462
-	-	-	-	-	-	-	-	TU15CD2-05	49213	-	-	-	-	-	-	P2	A335	STPA20	G3458
13CrMo4-5	1.7335	10216-2	13CrMo4-4	1.7335	17175	620	30592	TU13CD4-04	49213	14CrMo3	15 121	15CHM	4543	15HM	74252	T12	A213	STBA22	G3462
13CrMo4-5	1.7335	10253-2	13CrMo4-4	1.7335	2609	620-440	3604-1	TU13CD4-04	49215	-	-	-	-	-	-	P12	A335	STPA22	G3458
-	-	-	-	-	-	620	3606	-	-	-	-	-	-	-	-	-	-	-	-
10CrMo5-5	1.7338	10216-2	-	-	-	621	3604-1	TU10CD05-05	49213	-	-	-	-	-	-	T11	A213	STBA23	G3462
10CrMo5-5	1.7338	10253-2	-	-	-	621	3604-2	-	-	-	-	-	-	-	-	P11	A335	STPA23	G3458
-	-	-	-	-	-	621	3606	-	-	-	-	-	-	-	-	-	-	-	-
10CrMo9-10	1.7380	10216-2	10CrMo9-10	1.7380	17175	622-490	30592	TU10CD09-10	49213	12CrMo9-10	15313	10Ch2M	5520	-	-	T22	A213	STBA24	G3462
10CrMo9-10	1.7380	10253-2	10CrMo9-10	1.7380	2609	622	3604-1	-	-	-	-	-	-	-	-	P22	A335	STPA24	G3458
11CrMo9-10	1.7383	10216-2	-	-	-	622	3606	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	12CrMo12-10	1.7381	17176	-	-	-	-	-	-	-	-	-	-	T21	A213	-	-
-	-	-	12CrMo12-10	1.7381	-	-	-	-	-	-	-	-	-	-	-	P21	A335	-	-
X11CrMo5	1.7362	10216-2	12CrMo19-5	1.7362	17176	625	3604-1	TU12CD5-05	49213	-	17102	15Ch5M	550	-	-	T5, T5b, T5c	A213	STBA25	G3462
X11CrMo5	1.7362	10253-2	12CrMo19-5	1.7362	17176	625	3606	TU12CD5-05	49215	-	17102	15Ch5M	20072	-	-	P5, P5b, P5c	A335	STPA25	G3458
(X12CrMo7)	(1.7368)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(T7)	A213	-	-
(X12CrMo7)	(1.7368)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(P7)	A335	-	-
X11CrMo9-1	1.7386	10216-2	X12CrMo9-1	1.7386	17176	629	30592	TU12CD9	49213	-	17116	-	-	-	-	T9	A213	STBA26	G3462
X11CrMo9-1	1.7386	10253-2	-	-	-	629	3604-1	-	-	-	-	-	-	-	-	P9	A335	STPA26	G3458
Cr-Mo-V steel, alloyed also with B, Cu, Nb, Ni, Ti, W																			
7CrMoVTiB10-10	1.7378	-	17CrMoV 10	1.7766	590	-	-	-	-	-	15323	-	-	-	-	-	-	-	-
7CrMoVTiB10-10	1.7378	-	-	-	-	-	-	-	-	-	-	-	-	-	-	T24	A213	-	-
-	-	-	8CrMoNiNb9-10	1.6770	640	-	-	-	-	-	15418	-	-	-	-	P24	A335	-	-
(12CrV2-2)	(1.75XY)	-	-	-	-	-	-	-	-	-	15110	-	-	-	-	-	-	-	-
14MoV6-3	1.7715	10216-2	14MoV6-3	1.7715	17175	660	3604-1	14DCV6	49213	-	15128	-	-	-	-	-	-	-	-
(16CrMoV3-5-5)	(1.77XY)	-	-	-	-	-	-	-	-	-	15229	-	-	-	-	-	-	-	-
(12CrMoV4-3-2)	(1.77XY)	-	-	-	-	-	-	-	-	-	-	12Ch1MF	20072	-	-	-	-	-	-
20CrMoV13-5-5	1.7779	10216-2	20CrMoV13-5	1.7779	17176	-	-	-	-	-	15423	-	-	-	-	-	-	-	-
X10CrMoVNb9-1	1.4903	10216-2	-	-	-	629-590	30592	TU10CDVNb09-01	49213	-	17119	-	-	-	-	T91	A213	STBA28	G3462
X10CrMoVNb9-1	1.4903	10253-2	-	-	-	-	-	TU10CDVNb09-01	49213	-	17119	-	-	-	-	P91	A335	STPA28	G3458
X20CrMoV11-1	1.4922	10216-2	X20CrMoV12-1	1.4922	17175	762	30592	-	-	-	17134	-	-	-	-	-	-	-	-
X20CrMoV11-1	1.4922	10216-2	X20CrMoV12-1	1.4922	17175	762	3604-1	-	-	-	17134	-	-	-	-	-	-	-	-
7CrWVMoNb9-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	T23	A213	HCM 2S	-
X11CrMoWVNb9-1-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	T/P911	A213	-	-
X10CrWVMoNb9-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	T/P92	A213	STBA 29	-
11CrWCMoNb9-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	T/P122	A213	HCM 12A	-
Ni steel																			
(10Ni9)	(1.56XY)	-	-	-	-	-	-	TU10N9	49215	18Ni9	-	-	-	-	-	Gr.7	A333	-	-
-	-	-	-	-	-	-	-	TU10N9	49215	18Ni9	-	-	-	-	-	Gr.7	A334	-	-
12Ni14	1.5637	10216-4	10Ni14	1.5637	17173	503IT	3603	TU10N14	49215	18Ni14	16222	-	-	-	-	Gr.3	A333	STPL450	G3460
12Ni14	1.5637	10253-2	10Ni14	1.5637	17173	503IT	3603	TU10N14	49215	18Ni14	16222	-	-	-	-	Gr.3	A334	STBL450	G3464
X12Ni5	1.5680	10216-4	12Ni19	1.5680	17173	-	-	-	-	-	16527	-	-	-	-	-	-	-	-
X10Ni9	1.5682	10216-4	X8Ni9	1.5662	17173	509IT	3603	TU26N9	49215	X12Ni09	17501	-	-	-	-	Gr.8	A333	-	-
X10Ni9	1.5682	1.5662	17173	509IT	3603	TU26N9	49215	X12Ni09	17501	-	-	-	-	-	-	Gr.8	A334	-	-
Ni-Mn steel																			
11MnNi5-3	1.6212	10216-4	11MnNi5-3	1.6212	17173	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13MnNi6-3	1.6217	10216-4	13MnNi6-3	1.6217	17173	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15NiCuMoNb5-6-4	1.6368	10216-2	(WB36)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	T/P36

Conversion table of Vickers hardness, Brinell hardness, Rockwell hardness and Tensile strength

Tensile strength N/mm ²	Hardness			
	Vickers HV 10	Brinell HB	Rockwell HRB	Rockwell HRC
255	80	76,0		
270	85	80,7	41,0	
285	90	85,5	48,0	
305	95	90,2	52,0	
320	100	95,0	56,2	
335	105	99,8		
350	110	105	62,3	
370	115	109		
385	120	114	66,7	
400	125	119		
415	130	124	71,2	
430	135	128		
450	140	133	75,0	
465	145	138		
480	150	143	78,7	
495	155	147		
510	160	152	81,7	
530	165	156		
545	170	162	85,0	
560	175	166		
575	180	171	87,1	
595	185	176		
610	190	181	89,5	
625	195	185		
640	200	190	91,5	
660	205	195	92,5	
675	210	199	93,5	
690	215	204	94,0	
705	220	209	95,0	
720	225	214	96,0	
740	230	219	96,7	
755	235	223		
770	240	228	98,1	20,3
785	245	233		21,3
800	250	238	99,5	22,2
820	255	242		23,1
835	260	247	(101)	24,0
850	265	252		24,8
865	270	257	(102)	25,6
880	275	261		26,4
900	280	266	(104)	27,1
915	285	271		27,8
930	290	276	(105)	28,5
950	295	280		29,2
965	300	285		29,8
995	310	295		31,0
1030	320	304		32,2
1060	330	314		33,3

Tensile strength N/mm ²	Hardness			
	Vickers HV 10	Brinell HB	Rockwell HRB	Rockwell HRC
1095	340	323		34,4
1125	350	333		35,5
1155	360	342		36,6
1190	370	352		37,7
1220	380	361		38,8
1255	390	371		39,8
1290	400	380		40,8
1320	410	390		41,8
1350	420	399		42,7
1385	430	409		43,6
1420	440	418		44,5
1455	450	428		45,3
1485	460	437		46,1
1520	470	447		46,9
1555	480	(456)		47,7
1595	490	(466)		48,4
1630	500	(475)		49,1
1665	510	(485)		49,8
1700	520	(494)		50,5
1740	530	(504)		51,1
1775	540	(513)		51,7
1810	550	(523)		52,3
1845	560	(532)		53,0
1880	570	(542)		53,6
1920	580	(551)		54,1
1955	590	(561)		54,7
1995	600	(570)		55,2
2030	610	(580)		55,7
2070	620	(589)		56,3
2105	630	(599)		56,8
2145	640	(608)		57,3
2180	650	(618)		57,8
	660			58,3
	670			58,8
	680			59,2
	690			59,7
	700			60,1
	720			61,0
	740			61,8
	760			62,5
	780			63,3
	800			64,0
	820			64,7
	840			65,3
	860			65,9
	880			66,4
	900			67,0
	920			67,5
	940			68,0

Values from standards DIN 50150, EN ISO 18265, ISO/TR 10108, ASTM E 140

Summary of TDC for tube groups according to application

Tube group	EN	DIN	BS	NF A	UNI	ČSN,STN	GOST	PN-H	ASTM A ASME SA	JIS	ISO	
Hollow structural sections	10210-1 (10025)	17121, 17124 (17100)		49-501		42 0250	8731 (1050, 19281)		A 500 A 501	G 3444	630-2	
For machine parts and general use	10294-1 10297-1 10083-1-3 10084	1629, 1630 17200 17204 17210	6323/1,2	49-311 49-312	663 7729	42 0250	8731	74219 (84018) (84019) (84023/7)	A 53 A 519	G 3445	2937 2938	
P r e s s u r e	For room temperatures	10216-1	1629, 1630	3601	49-112 49-210	7287	42 0250	8731, (1050)	74219 (84023/7)	A 53	G 3454 G 3455	9329-1
	For elevated temperatures (boiler)	10216-2	17175	3059/1,2 3602-1 3604-1	49-211 49-213	5462	42 0251	8731 TU14-3-190 TU14-3-460 4543,20072	74252 (84024)	A 106, A 192 A 209, A 210 A 213, A 335 A 556	G 3456 G 3458 G 3461 G 3462	9329-2
	Alloy fine grain steels	10216-3	17179									
	For low temperatures	10216-4	17173	3603	49-215	5949	42 0165			A333, A 334		9329-3
	For heat exchangers	10216-2 10216-4	17173 (17174) 17175 (17177) (28180, 28181)	3606	49-215 49-243 49-245	5462 5949	42 0165 42 0251	550 1060		A 179, A 178 A 214 A 333, A 334	G 3461 G 3462	6758 6759
For welding and threading	10224 10255	2440, 2441 (2442), 2460	1387	49-115	8863 6363	42 0250	3262	74220 74200	A 53 A 795	G 3452	65 559	
Line pipe	10208-1 10208-2	2470-1/1629 2470-2/17172			7088				API 5L ISO 3183-1,2		3183	
Casing and Tubing									API 5 CT ISO 11 960		11960	
Precision seamless cold drawn standard tubes	10305-1	2391-2	6323/1,4	49-310 49-312	7945	42 0260	8733 12132, 21729	74240 (74220)	A 519	G 3445	3304	
Cylinder tubes HPZ and HP	Precision tubes from steel St 52, E 355 Type HPZ for mechanical treatment, Type HP - "ready to use"											
For hydraulic lines	10305-4	2391-2c/2445-2	7416	49-330	7945	42 0260		74245	A 822	JOHS-102		
Injection tubes	Deliveries upon agreement only (ČSN 42 6718, DIN 73000, ISO 8535-1)											
Bearing tubes	ISO 683-17	17230										
Cold sized welded tubes	10305-3 (10305-5)	2394-2 (2395-2)	6323/1,5	49-646	7947	42 0142 (42 6713)	10707	74241	A 513	G 3445	3306	
Cold drawn precision welded tubes	10305-2 10305-6	2393-2	6323/1,6		7946	42 0142 42 6714			A 513 A 512		3305	
Buttwelding fittings	10253-1,2	2609	1965-1	49-186		ŽP05-05			A 234, A 420		3419	
Submerged arc welded steel tubes and pipes	TDC Standards – see survey table on page 102											

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