AYDIN BORU

GENERAL PRODUCT CATALOG

Oil Line Pipes
Gas Line Pipes
Boiler Pipes
Heat Exchanger Pipes
Mechanical Steel Drawing Pipes
Steel Construction Pipes
Large Diameter Straight Welded Pipes

aydinboru.com

OUR VISION

Thanks to its solutions and services in the Seamless Steel Pipe industry, and its distinctive expertise, to be the leader in Turkey and have a say in the international market.

OUR MISSION

To provide the optimal solution and to subsidize with our experienced and competent team for meeting the needs of our customers in the Steel Drawn Pipe industry.

To be a company that is open to career opportunities and which people prefer and work with pleasure. To be a trusted and followed solution partner with our accurate and open communication approach.

OUR VALUES

Reliability: Acting according to the understanding of honest work, to fulfill expectations on time, develop trust-based relationships, and live up to end of the bargain.

Customer Centricity: By offering businesslike, realistic, and applicable solutions and displaying constructive attitudes beyond just fulfilling the obligations arising from the business partnership, to ensure continuity in the satisfaction of our customers.

Openness (Transparency): To behave plainly in our communications and applications.

Solution Oriented: To provide effective and rapid services with our belief in professional understanding and teamwork and to approach the proposed and taken decisions with lucidity.

Flexibility: Since our management puts emphasis on unbiased approach, our employees develop solution-oriented suggestions without sacrificing professional and corporate values.

ACRONYMS

ANSI: American National Standards Institute
BS: British Standards
CSN: Czech State Norm
DIN: Deutsches Institute für Normung
EN: European Norm
GOST: Gosudarstvennyj Standart
ISO: International Standardization Organization
JIS: Japanese Insdutrial Standards
AFNOR: Association Française de Normalisation
TSE: Turkish Standards Institute

API: American Petroleum Institute
ASME: American Society of Mechanical Engineers
ASTM: Amercan Society of Testing and Materials
CE: Conformite Europeenne
MSS: Manufacturers Standardization Society
NACE: National Association of Corrosion Engineers
SAE: Society of Automotive Engineers

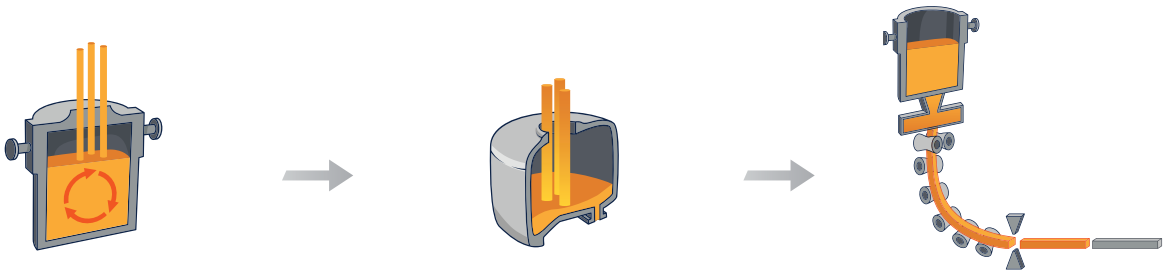
NPS: Nominal Pipe Size
OD: Outside Diameter
WT: Wall Thickness

NDE: Non Destructive Examination

EFW: Non Destructive Examination
EIW: Electric Induction Welding
ERW: Electric Resisstance Welding
PWHT: Post Weld Heat Treatment Services

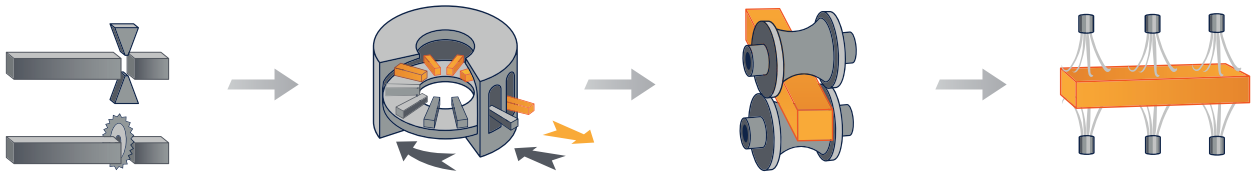
PRODUCTION FLOW CHART

Steel Production

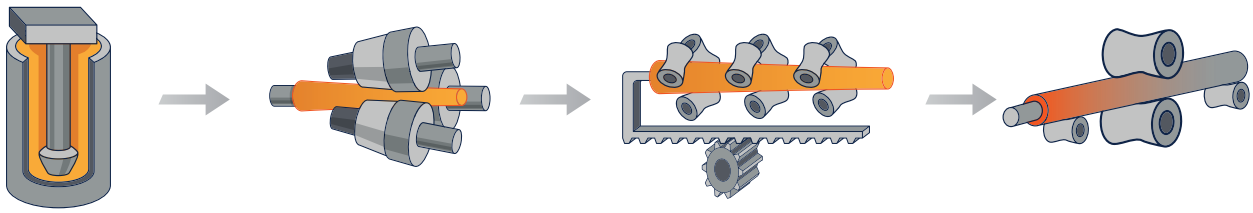


Electric Arc Furnace → Ladle Furnace → Continuously Casting

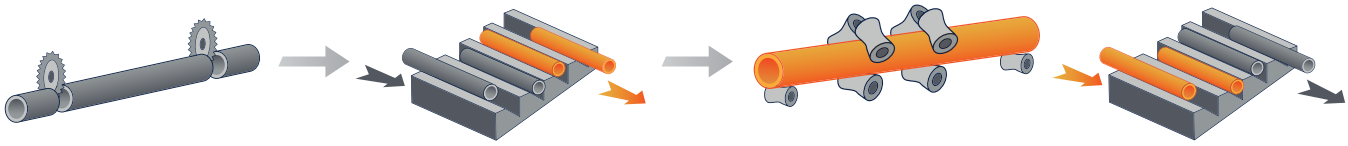
Hot Finished Tubes Production



Division of Blooms → Rotary Heat Furnace → Sizing Mill → Removal of Scale

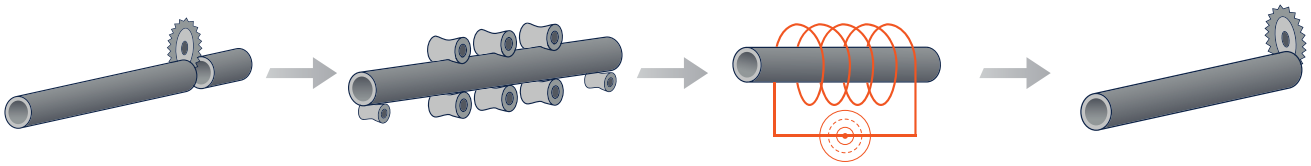


Piercing Press → Elongating Mill → Push Bench → Withdrawal Mill

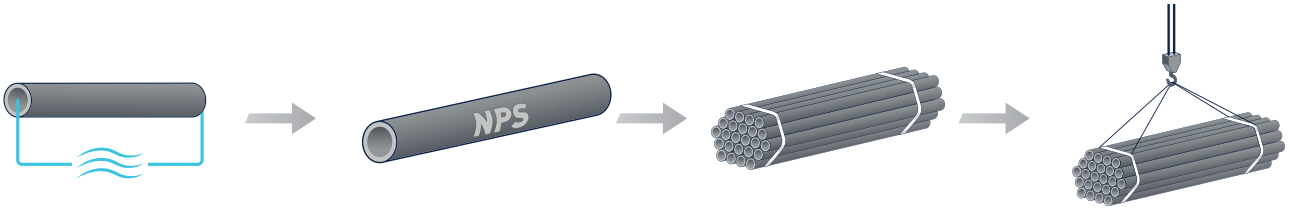


Ends Cutting → Reheating Furnace → Stretch Reducing Mill → Cooling Bed

PRODUCTION FLOW CHART

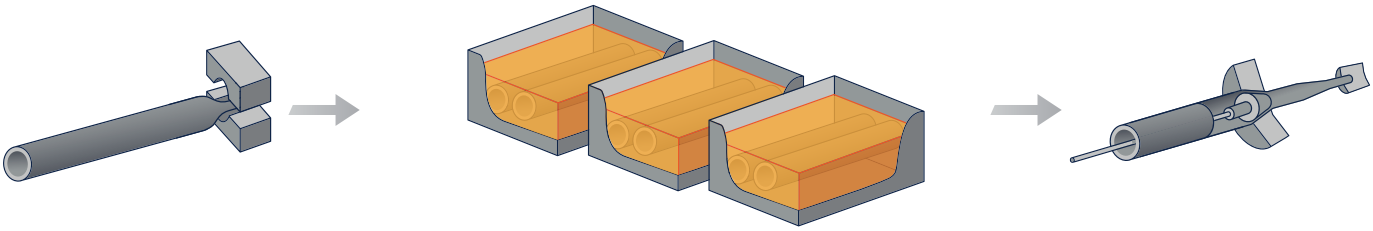


Cutting | Straightening | Nondestructive Examination | Final Lenghts

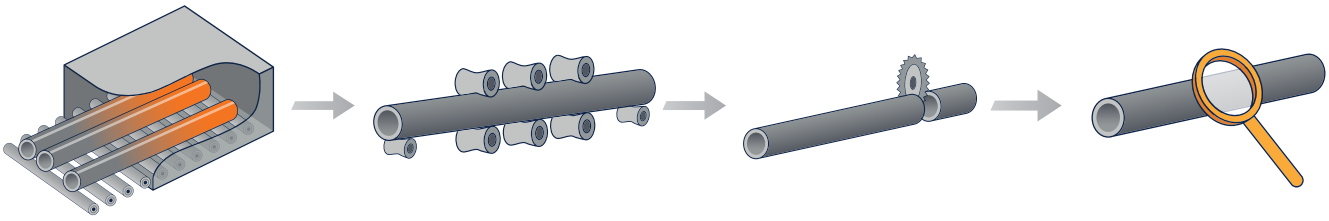


Hydrostatic Test | Product Marking | Packaging | Delivery

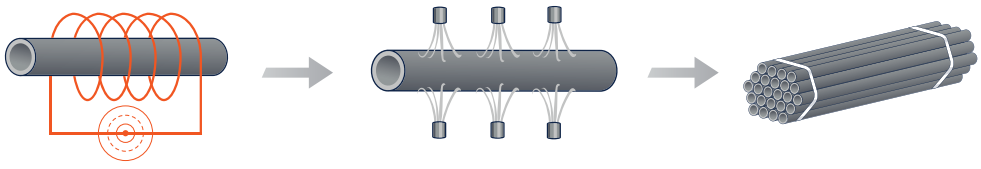
Presicion Cold Drawn Tubes Production



Swaging | Chemical Preparation - Pickling, Phosphating, Lubricant | Cold Drawing



Heat Treatment | Straightening | Cutting | Surface Control



Nondestructive Examination | Preservation | Packaging

OIL, GAS AND LINE PIPES - ASTM A106 AND ASTM A53 PIPES

Fields of Usage

Used for steam, water, gas and air lines, as well as general purpose.

Chemical Composition

Standard	Grade	C	Mn	Si	P	S	Cu	Ni	Cr	Mo	V	Al	N	Nb,Ti, B,As,W
ASTM A53	Gr. A	≤ 0.25	≤ 0.95	-	≤ 0.050	≤ 0.045	≤ 0.40	≤ 0.40	≤ 0.40	≤ 0.15	≤ 0.080			
ASTM A53	Gr. B	≤ 0.30	≤ 1.20	-	≤ 0.050	≤ 0.045	≤ 0.40	≤ 0.40	≤ 0.40	≤ 0.15	≤ 0.080			
ASTM A106	Gr. A	≤ 0.25	0.27 - 0.93	≤ 0.10	≤ 0.035	≤ 0.035	≤ 0.40	≤ 0.40	≤ 0.40	≤ 0.15	≤ 0.080			
ASTM A106	Gr. B	≤ 0.30	0.29 - 1.06	≤ 0.10	≤ 0.035	≤ 0.035	≤ 0.40	≤ 0.40	≤ 0.40	≤ 0.15	≤ 0.080			
ASTM A106	Gr. C	≤ 0.35	0.29 - 1.06	≤ 0.10	≤ 0.035	≤ 0.035	≤ 0.40	≤ 0.40	≤ 0.40	≤ 0.15	≤ 0.080			

Mechanical Properties

Standard	Grade	Heat Treatment	Heat Treatment			Tensile Strength (Mpa)	Elongation A5 Min. (%)	Impact Energy (J)	Temperature of Application
			t 0 - 16 mm	t 16 - 40 mm	t 40 - 65 mm				
ASTM A53	Gr. A	U, N	205	205	205	≥ 330			20
ASTM A53	Gr. B	U, N	240	240	240	≥ 415			20
ASTM A106	Gr. A	N	205	205	205	≥ 330	35		475
ASTM A106	Gr. B	N	240	240	240	≥ 415	30		475
ASTM A106	Gr. C	N	275	275	275	≥ 485	30		20

Tolerances

ASTM A106

Outside Diameter (mm)	Permissible Variations of Outside Diameter	
	Upper (mm)	Lower (mm)
48.3 - 114.3 (including)	+ 0.8	- 0.8
114.3 - 219.1 (including)	+ 1.6	- 0.8
219.1 - 457 (including)	+ 2.4	- 0.8
Permissible Variations of Wall Thickness	- 12.5%	
Permissible Variations of Weight	+ 10% / -3.5%	

ASTM A53

Dış Çap	İzin Verilen Dış Çap Toleransı
Permissible Tolerance Weight for Outside Diameter of 63 mm and Above	± 1%
Permissible Variations of Wall Thickness	- 12.5%
Permissible Variations of Weight	Weight in The Dimensional Standard ASME B36.10M Can Not Differ By More Than ±10

T: *Wall Thickness* U: *Without Hear Treatment* N: *Normalizing*

OIL, GAS AND LINE PIPES - API 5L

Chemical Composition

Standard	Grade	C	Mn	Si	P	S	Cu	Ni	Cr	Mo	V	Al	N	Nb,Ti,B,As,W
API Spec. 5L	A (L210) PSL 1	≤ 0.22	≤ 0.90		≤ 0.030	≤ 0.030	≤ 0.50	≤ 0.50	≤ 0.50	≤ 0.15				
API Spec. 5L	B (L245) PSL1	≤ 0.28	≤ 1.20		≤ 0.030	≤ 0.030	≤ 0.50	≤ 0.50	≤ 0.50	≤ 0.15				Nb+V ≥ 0.06 Nb+V+Ti ≤ 0.15
API Spec. 5L	BR (L245R) PSL 2	≤ 0.24	≤ 1.20	≤ 0.40	≤ 0.025	≤ 0.015	≤ 0.50	≤ 0.30	≤ 0.30	≤ 0.15				Ti ≤ 0.04 Nb+V ≥ 0.06
API Spec. 5L	X42 (L290) PSL 1	≤ 0.28	≤ 1.30		≤ 0.030	≤ 0.030	≤ 0.50	≤ 0.50	≤ 0.50	≤ 0.15				Nb+V+Ti ≤ 0.15
API Spec. 5L	X42N (L290N) PSL 2	≤ 0.24	≤ 1.20	≤ 0.40	≤ 0.025	≤ 0.015	≤ 0.50	≤ 0.30	≤ 0.30	≤ 0.15	≤ 0.060			Nb ≥ 0.05 Ti ≤ 0.04
API Spec. 5L	X46(L320) PSL 1	≤ 0.28	≤ 1.40		≤ 0.030	≤ 0.030	≤ 0.50	≤ 0.50	≤ 0.50	≤ 0.15				Nb+V+Ti ≤ 0.15
API Spec. 5L	X46N (L320N) PSL 2	≤ 0.24	≤ 1.40	≤ 0.40	≤ 0.025	≤ 0.015	≤ 0.50	≤ 0.30	≤ 0.30	≤ 0.15	≤ 0.070			Nb ≤ 0.05 Ti ≤ 0.04 Nb+V+Ti ≤ 0.15
API Spec. 5L	X52 (L360) PSL 1	≤ 0.28	≤ 1.40		≤ 0.030	≤ 0.030	≤ 0.50	≤ 0.50	≤ 0.50	≤ 0.15				Nb+V+Ti ≤ 0.15
API Spec. 5L	X52N (L360N) PSL 2	≤ 0.24	≤ 1.40	≤ 0.40	≤ 0.025	≤ 0.015	≤ 0.50	≤ 0.50	≤ 0.50	≤ 0.15	≤ 0.010			Nb ≤ 0.05 Ti ≤ 0.04 Nb+V+Ti ≤ 0.15
API Spec. 5L	X56 (L390) PSL 1	≤ 0.28	≤ 1.40		≤ 0.030	≤ 0.030	≤ 0.50	≤ 0.50	≤ 0.50	≤ 0.15				Nb+V+Ti ≤ 0.15
API Spec. 5L	X56N (L390N) PSL 2	≤ 0.24	≤ 1.40	≤ 0.45	≤ 0.025	≤ 0.015	≤ 0.50	≤ 0.30	≤ 0.30	≤ 0.15	≤ 0.010			Nb ≤ 0.05 Ti ≤ 0.04 Nb+V+Ti ≤ 0.15
API Spec. 5L	X60 (L415) PSL 1	≤ 0.28	≤ 1.40		≤ 0.030	≤ 0.030	≤ 0.50	≤ 0.50	≤ 0.50	≤ 0.15				Nb+V+Ti ≤. 0.15
API Spec. 5L	X60N (L415N) PSL 2	≤ 0.24	≤ 1.40	≤ 0.45	≤ 0.025	≤ 0.015	≤ 0.50	≤ 0.50	≤ 0.50	≤ 0.50	≤ 0.010			Nb ≤ 0.05 Ti ≤ 0.04 Nb+V+Ti ≤ 0.15
API Spec. 5L	X65 (L450) PSL 1	≤ 0.28	≤ 1.40		≤ 0.030	≤ 0.030	≤ 0.50	≤ 0.50	≤ 0.50	≤ 0.15				Nb+V+Ti ≤ 0.15
API Spec. 5L	X65Q (L450Q) PSL 2	≤ 0.18	≤ 1.70	≤ 0.45	≤ 0.025	≤ 0.015	≤ 0.50	≤ 0.50	≤ 0.50	≤ 0.50	≤ 0.010			Nb ≤ 0.05 Ti ≤ 0.04 Nb+V+Ti ≤ 0.15

Mechanical Properties

Standard	Grade	Heat Treatment	Yield Strength (Mpa)			Tensile Strength (Mpa)	Elongation A5 Min. (%)	Impact Energy (J)	Temperature of Application
			t 0 - 16 mm	t 16 - 40 mm	t 40 - 65 mm				
API Spec. 5L	A (L210) PSL 1	U, N	210	210	210	≥ 335			
API Spec. 5L	B (L245) PSL1	U, N	245	245	245	≥ 415			
API Spec. 5L	BR (L245R) PSL 2	U, N	245 - 450	245 - 450		415 - 760		T = 27 (0°C); L = 41 (0°C)	
API Spec. 5L	X42 (L290) PSL 1	U, N	290	290	290	≥ 415			
API Spec. 5L	X42N (L290N) PSL 2	U, N	290 - 495	290 - 496		415 - 760		T = 27 (0°C); L = 41 (0°C)	
API Spec. 5L	X46(L320) PSL 1	U, N	320	320	320	≥ 435			
API Spec. 5L	X46N (L320N) PSL 2	U, N	320 - 525	320 - 525		435 - 760		T = 27 (0°C); L = 41 (0°C)	
API Spec. 5L	X52 (L360) PSL 1	U, N	360	360	360	≥ 460			
API Spec. 5L	X52N (L360N) PSL 2	U, N	360 - 530	360 - 531		460 - 760		T = 27 (0°C); L = 41 (0°C)	
API Spec. 5L	X56 (L390) PSL 1	U, N	390	390	390	≥ 490			
API Spec. 5L	X56N (L390N) PSL 2	U, N	390 - 545	390 - 545		490 - 760		T = 27 (0°C); L = 41 (0°C)	
API Spec. 5L	X60 (L415) PSL 1	U, N	415	415	415	≥ 520			
API Spec. 5L	X60N (L415N) PSL 2	U, N	415 - 565	415 - 565		520 - 760		T = 27 (0°C); L = 41 (0°C)	
API Spec. 5L	X65 (L450) PSL 1	U, N	450	450	450	≥ 535			
API Spec. 5L	X65Q (L450Q) PSL 2	U, N	450 - 600	450 - 600		535 - 760		T = 27 (0°C); L = 41 (0°C)	

T: *Wall Thickness* **U:** *Without Hear Treatment* **N:** *Normalizing*

OIL, GAS AND LINE PIPES - API 5L

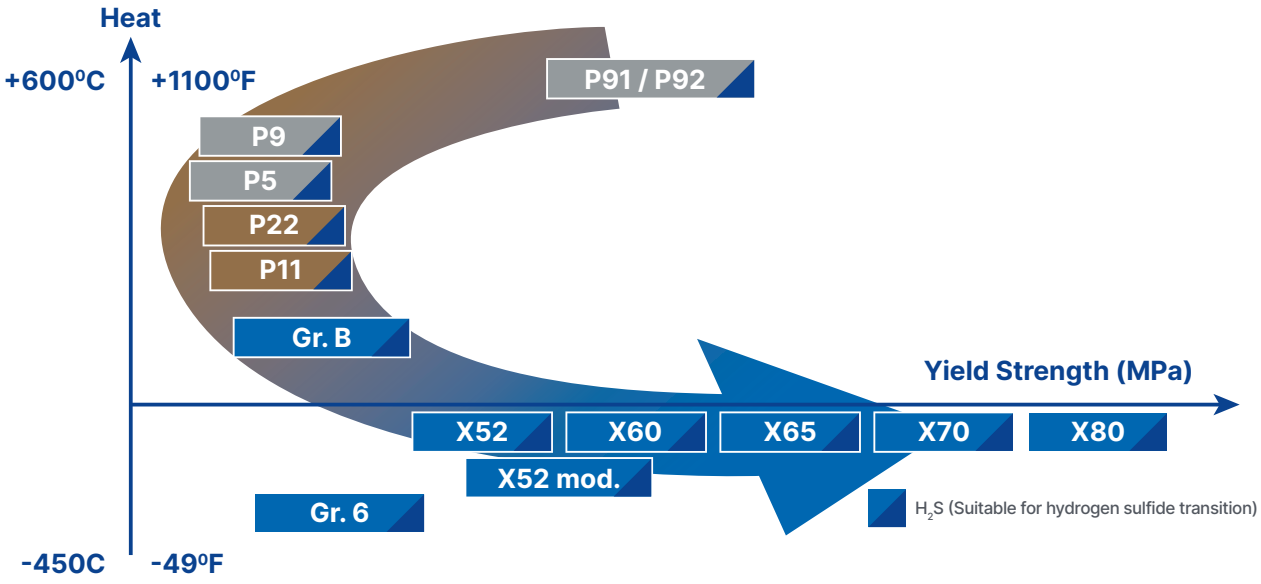
Fields of Usage

Used for, water, steam, oil, fuel oil, petroleum, natural gas and chemical liquid transportation.

API 5L Comparison Table

API 5L / ISO	ISO 3183	DNV OS F101	ASTM 106	ASTM 333
Gr B.	L245N	SMLS 245	Gr. B	Gr. 6
			Gr. C	
X 42	L290N	SMLS 290		
X 46				
X 52	L360N / 360Q	SMLS 360		
X 56				
X 60	L415Q	SMLS 415		
X 65	L450Q	SMLS 450		
X 70	L485Q	SMLS 485		
X 80	L555Q	SMLS 555		
X 90	L625Q			
X 100	L690Q			

Service Temperature and Tensile Strength of Steels According to Their Grade



OIL, GAS AND LINE PIPES - ASTM A333 PIPES

Fields of Ussage

Used in construction, oil refinery, natural gas and chemical plants.

Chemical Composition

Standard	Grade	C	Mn	Si	P	S	Cu	Ni	Cr	Mo	V	Al	N	Nb,Ti, B,As,W
ASTM A333	Gr. 1	≤ 0.30	0.40 - 1.06	≥ 0.1	≤ 0.025	≤ 0.025								
ASTM A333	Gr. 3	≤ 0.19	0.31 - 0.64	0.18 - 0.37	≤ 0.025	≤ 0.025		3.18 - 3.82						
ASTM A333	Gr. 4	≤ 0.12	0.50 - 1.05	0.18 - 0.37	≤ 0.025	≤ 0.025	0.40 - 0.75	0.47 - 0.75	0.44 - 1.01			0.040 - 0.30		
ASTM A333	Gr. 6	≤ 0.30	0.29 - 1.06	≥ 0.1	≤ 0.025	≤ 0.025								
ASTM A333	Gr. 7	≤ 0.19	≤ 0.90	0.13 - 0.32	≤ 0.025	≤ 0.025		2.03 - 2.57						
ASTM A333	Gr. 8	≤ 0.13	≤ 0.90	0.13 - 0.32	≤ 0.025	≤ 0.025		8.40 - 9.60						
ASTM A333	Gr. 9	≤ 0.20	0.40 - 1.06		≤ 0.025	≤ 0.025	0.75 - 1.25	1.60 - 2.24						
ASTM A333	Gr. 10	≤ 0.20	1.15 - 1.50	0.13 - 0.32	≤ 0.03	≤ 0.015	≤ 0.015	≤ 0.25	≤ 0.15	≤ 0.50	≤ 0.12	≤ 0.060		
ASTM A333	Gr. 11	≤ 0.10	≤ 0.6	≤ 0.35	≤ 0.025	≤ 0.025		35.0 - 37.0	≤ 0.50	≤ 0.50				

Mechanical Properties

Standard	Grade	Heat Treatment	Yield Strength (Mpa)			Tensile Strength (Mpa)	Elongation A5 Min. (%)	Impact Energy (J)	Temperature of Application
			t 0 - 16 mm	t 16 - 40 mm	t 40 - 65 mm				
ASTM A333	Gr. 1	U, N	205	205	205	≥ 380	35	L = 18 (-45°C)	- 50
ASTM A333	Gr. 3			≥ 240		≥ 450	≥ 30		
ASTM A333	Gr. 4			≥ 240		≥ 415	≥ 30		
ASTM A333	Gr. 6	U, N	240	240	240	≥ 415	30	L = 18 (-45°C)	- 50
ASTM A333	Gr. 7			≥ 240		≥ 450	≥ 30		
ASTM A333	Gr. 8			≥ 515		≥ 690	≥ 28		
ASTM A333	Gr. 9			≥ 315		≥ 435	≥ 28		
ASTM A333	Gr. 10			≥ 450		≥ 550	≥ 22		
ASTM A333	Gr. 11			≥ 240		≥ 450	≥ 18		

T: *Wall Thickness* U: *Without Hear Treatment* N: *Normalizing*

MECHANICAL PROPERTIES OF CARBON STEELS

EN 10216-2 EN 10216-3 EN 10216-4 (2007 / 2022)	ASTM A 106 - 06a	ASTM A 333-05	API 5L / ISO 3183 (PSL2) (2008)
P 235 GH (10216-2) YS 235 / TS 350 - 500	Gr. A YS 205 / TS 330	Gr.1 (KV -45°C) YS 205 / TS 380	
P 265 GH (10216-2) YS 265 / TS 410 - 570	Gr. B YS 240 / TS 415	Gr.6 (KV -45°C) YS 240 / TS 415	L245R veya BR YS 245 - 450 / TS 415 - 750
P 265 NL (10216-4) YS 265 / TS 410 - 570		Gr.4 (KV -100°C) YS 240 / TS 415	
		Gr.7 (KV -75°C) YS 240 / TS 450	
		Gr.3 (KV - 100°C) YS 240 / TS 450	
P 275 (10216-3) YS 275 / 390 - 530	Gr. C YS 275 / TS 485		
			L290R veya X42BR YS 245 - 450 / TS 415 - 760
		Gr.9 (KV -75°C) YS 315 / TS 435	L320R veya X46BR YS 320 - 525 / TS 435 - 760
P 355 (10216-3) YS 355 / TS 490 - 650			L360N veya X52N YS 360 - 530 / TS 450 - 760
			L390N veya X56N YS 390 - 545 / TS 450 - 760
			L415Q veya X60Q YS 415 - 565 / TS 520 - 760
P 460 (10216-3) YS 460 / TS 560 - 730		Gr.10 (KV -60°C) YS 450 / TS 550	L415Q veya X65Q YS 450 - 600 / TS 535 - 760
			L4850 veya X70Q YS 485 - 635 / TS 570 - 760
		Gr.8 (KV -60°C) YS 515 / TS 690	
			L555Q veya X800 YS 555 - 705 / TS 625 - 825
P 620 (10216-3) YS 620 / TS 740 - 930			
P 690 (10216-3) YS 690 / TS 770 - 960			

YS: *Yield Strength* **TS:** *Tensile Strength* **R:** *Rolled* **N:** *Normalized* **QT:** *Hardened and Tempered*

Size Range of Seamless Line Pipe According to API 5L/ASTM A106 Gr B or A333 Gr 6

Outside Diameter			Wall thickiness in mm, weight in kg/m									Non-schedule		
			Schedule											
NPS	DN	MM	20	30	40	60	80	100	120	140	160	STD	XS	XXS
3/8	10	17.1			**2.31** 0.84		**3.20** 1.10					**2.31** 0.84	**3.20** 1.10	
1/2	15	21.3			**2.77** 1.27		**3.73** 1.62				**4.78** 1.95	**2.77** 1.27	**3.73** 1.62	**7.47** 2.55
3/4	20	26.7			**2.87** 1.69		**3.91** 2.20				**5.56** 2.90	**2.87** 1.69	**3.91** 2.20	**7.82** 3.64
1	25	33.4			**3.38** 2.50		**4.55** 3.24				**6.35** 4.24	**3.38** 2.50	**4.55** 3.24	**9.09** 5.45
1 1/4	32	42.2			**3.56** 3.39		**4.85** 4.47				**6.35** 5.61	**3.56** 3.39	**4.85** 4.47	**9.70** 7.77
1 1/2	40	48.3			**3.68** 4.05		**5.08** 5.41				**7.14** 7.25	**3.68** 4.05	**5.08** 5.41	**10.15** 9.55
2	50	60.3			**3.91** 5.44		**5.54** 7.48				**8.74** 11.11	**3.91** 5.44	**5.54** 7.48	**11.07** 13.44
2 1/2	65	73			**5.16** 8.63		**7.01** 11.41				**9.53** 14.92	**5.16** 8.63	**7.01** 11.41	**14.02** 20.39
3	80	88.9			**5.49** 11.29		**7.62** 15.27				**11.13** 21.35	**5.49** 11.29	**7.62** 15.27	**15.24** 27.68
3 1/2	90	101.6			**5.74** 13.57		**8.08** 18.64					**5.74** 13.57	**8.08** 18.64	
4	100	114.3			**6.02** 16.08		**8.56** 22.32		**11.13** 28.32		**13.49** 33.54	**6.02** 16.08	**8.56** 22.32	**17.12** 41.03
5	125	141.3			**6.55** 21.77		**9.53** 30.97		**12.70** 40.28		**15.88** 49.12	**6.55** 21.77	**9.53** 30.97	**19.05** 57.43
6	150	168.3			**7.11** 28.26		**10.97** 42.56		**14.27** 54.21		**18.26** 67.57	**7.11** 28.26	**10.97** 42.56	**21.95** 79.22
8	200	219.1	**6.35** 33.32	**7.04** 36.82	**8.18** 42.55	**10.31** 53.09	**12.70** 64.64	**15.09** 75.92	**18.26** 90.44	**20.62** 100.93	**23.01** 111.27	**8.18** 42.55	**12.70** 64.64	**22.23** 107.93
10	250	273	**6.35** 41.76	**7.80** 51.01	**9.27** 60.29	**12.70** 81.53	**15.09** 95.98	**18.26** 114.71	**21.44** 133.01	**25.40** 155.10	**28.58** 127.27	**9.27** 60.29	**12.70** 81.53	**25.40** 155.10
12	300	323.8	**6.35** 49.71	**8.38** 65.19	**10.31** 79.71	**14.27** 108.93	**17.48** 132.05	**21.44** 159.87	**25.40** 186.92	**28.58** 208.08	**33.32** 238.69	**9.53** 73.86	**12.70** 97.44	**25.40** 186.92
14	350	355.6	**7.92** 67.91	**9.53** 81.33	**11.13** 94.55	**15.09** 126.72	**19.05** 158.11	**23.83** 194.98	**27.79** 224.66	**31.75** 253.58	**35.71** 281.72	**9.53** 81.33	**12.70** 107.40	
16	400	406.4	**7.92** 77.83	**9.53** 93.27	**12.70** 123.31	**16.66** 160.13	**21.44** 203.54	**26.19** 245.57	**30.96** 286.66	**36.53** 333.21	**40.49** 365.38	**9.53** 93.27	**12.70** 123.31	
18	450	457	**7.92** 81.71	**11.13** 122.38	**14.27** 155.81	**19.05** 205.75	**23.83** 254.57	**29.36** 309.64	**34.93** 363.58	**39.67** 408.28	**45.24** 459.39	**9.53** 105.17	**12.70** 139.16	
20	500	508	**9.53** 117.15	**12.70** 155.13	**15.09** 183.43	**20.62** 247.84	**26.19** 311.19	**32.54** 381.55	**38.10** 441.52	**44.45** 508.15	**50.01** 564.85	**9.53** 117.15	**12.70** 155.13	
22	550	559	**9.53** 129.14	**12.70** 171.10		**22.23** 294.27	**28.58** 373.85	**34.93** 451.45	**41.28** 527.05	**47.63** 600.67	**53.98** 672.30	**9.53** 129.14	**12.70** 171.10	
24	600	610	**9.53** 141.12	**14.27** 209.65	**17.48** 255.43	**24.61** 355.28	**30.96** 442.11	**38.89** 547.74	**46.02** 640.07	**52.37** 720.19	**59.54** 808.27	**9.53** 141.12	**12.70** 187.07	
26	650	660	**12.70** 202.74									**9.53** 152.88	**12.70** 202.74	
28	700	711	**12.70** 218.71	**15.88** 272.23								**9.53** 164.86	**12.70** 218.71	

Dimensions and weight conform to ASME B36.10m-2000.

NPS: *(Nominal Pipe Size): Is a dimensinless designator that has been substituted in the customary units section for the previous term inch nominal size.*

DN: *(Nominal Diameter): Is a dimensionless designator used in the SI (metric) system describe pipe size.*

STD: *Standard*

XS: *Extra strong*

XXS: *Double extra strong*

BOILER TUBES

Fields of Usage

Used in boilers, furnaces, lines and tanks at high temperatures and high pressure.

Chemical Composition

Standard	Grade	C	Mn	Si	P	S	Cu	Ni	Cr	Mo	V	Al	N	Nb, Ti, B, As, W
EN 10216-2	P195GH	≤ 0.13	≤ 0.70	≤ 0.35	≤ 0.025	≤ 0.020	≤ 0.30	≤ 0.30	≤ 0.30	≤ 0.08	≤ 0.02	≤ 0.020		Cr+Cu+Mo+Ni ≤ 0.7
EN 10216-2	P235GH	≤ 0.16	≤ 1.20	≤ 0.35	≤ 0.025	≤ 0.020	≤ 0.30	≤ 0.30	≤ 0.30	≤ 0.08	≤ 0.02	≤ 0.020		Cr+Cu+Mo+Ni ≤ 0.7
EN 10216-2	P265GH	≤ 0.20	≤ 1.40	≤ 0.40	≤ 0.025	≤ 0.020	≤ 0.30	≤ 0.30	≤ 0.30	≤ 0.08	≤ 0.02	≤ 0.020		Cr+Cu+Mo+Ni ≤ 0,7
EN 10216-2	16Mo3	0.12 - 0.20	0.40-0.90	≤ 0.35	≤ 0.025	≤ 0.020	≤ 0.30	≤ 0.30	≤ 0.30	0.25 - 0.35		0.040		
EN 10216-2	13CrMo4-5	0.10 - 0.17	0.40-0.70	≤ 0.35	≤ 0.025	≤ 0.020	≤ 0.30	≤ 0.30	≤ 0.30	≤ 0.65		0.040		
EN 10216-2	10CrMo9-10	0.08 - 0.14	0.30-0.70	≤ 0.50	≤ 0.025	≤ 0.020	≤ 0.30	≤ 0.30	≤ 0.30	0.90 - 1.10		≤ 0.020		
EN 10216-2	11CrMo9-10	0.08 - 0.15	0.40-0.80	≤ 0.50	≤ 0.025	≤ 0.020	≤ 0.30	≤ 0.30	≤ 0.30	0.90 - 1.10		≤ 0.020		
EN 10216-2	X10CrMoVNb9-1	0.08 - 0.12	0.30-0.60	0.20-0.50	0.025	≤ 0.010	≤ 0.30	≤ 0.40	≤ 0.40	0.85 - 1.05	0.18 - 0.25	0.40	0.03 - 0.07	Nb 0.06-0.10
EN 10216-2	14MoV6-3	0.10 - 0.15	0.40-0.70	0.15-0.35	≤ 0.025	≤ 0.020	≤ 0.30	≤ 0.30	≤ 0.30	0.50 - 0.70	0.22 - 0.28			
EN 10216-2	20MnNb6	≤ 0.22	1.00-1.50	0.15-0.35	0.025	≤ 0.020	≤ 0.30					0.60		Nb 0.015-0.10
EN 10216-2	10CrMo5-5	≤ 0.15	0.30-0.60	0.50-1.0	0.025	≤ 0.020	≤ 0.30	≤ 0.30	≤ 0.30	0.45 - 0.65		0.40		
EN 10216-2	15NiCuMoNb5-6-4	≤ 0.17	0.80-1.20	0.25-0.50	0.025	≤ 0.020	0.50-0.80	1.0-1.30	1.0-1.30	0.55 - 0.50		0.50		Nb 0.015-0.045
EN 10216-2	25CrMo4	0.22 - 0.29	0.60-0.90	0.40	0.025	≤ 0.020	≤ 0.30	≤ 0.30	≤ 0.30	0.15 - 0.30		0.40		
EN 10216-2	X10CrWMOVNb9-2	0.07 - 0.13	0.30-0.60	0.50	0.020	≤ 0.010		≤ 0.30	≤ 0.30	0.30 - 0.60	0.15 - 0.25	0.40	0.030 - 0.070	Nb 0.04-0.09

Mechanical Properties

Standard	Grade	Heat Treatment	Yield Strength (Mpa)			Tensile Strength (Mpa)	Elongation A5 Min. (%)	Impact Energy (J)
			t 0 - 16 mm	t 16 - 40 mm	t 40 - 65 mm			
EN 10216-2	P195GH	U, N	195			320 - 440	27	T-27 (0°C); L=40 (0°C)
EN 10216-2	P235GH	U, N	235	225	215	360 - 500	25	T=27 (0°C); L=40 (0°C)
EN 10216-2	P265GH	U, N	265	255	245	410 - 570	23	T-27 (0°C); L=40 (0°C)
EN 10216-2	16Mo3	N	280	270	260	450 - 600	22	T=27 (20°C); L=40 (20°C)
EN 10216-2	13CrMo4-5	Z	290	290	280	440 - 590	22	T=27 (20°C); L=40 (20°C)
EN 10216-2	10CrMo9-10	Z	280	280	270	480 - 630	22	T=27 (20°C); L=40 (20°C)
EN 10216-2	11CrMo9-10	Z	355	355	355	540 - 680	20	T=27 (20°C); L=40 (20°C)
EN 10216-2	X10CrMoVNb9-1	Z	450	450	450	630 - 830	19	T-27 (20°C); L=40 (20°C)
EN 10216-2	14MoV6-3	Z	320	320	310	460 - 610	20	T=27 (20°C); L=40 (20°C)
EN 10216-2	20MnNb6	Z	355	345	335	500 - 650	22	T=27 (0°C); L=40 (0°C)
EN 10216-2	10CrMo5-5	Z	275	275	265	410 - 560	22	T=27 (20°C); L=40 (20°C)
EN 10216-2	15NiCuMoNb5-6-4	Z	440	440	440	610 - 780	19	T=27 (20°C); L=40 (20°C)
EN 10216-2	25CrMo4	Z	345	345	345	540 - 690	18	T=27 (20°C); L=40 (20°C)
EN 10216-2	X10CrWMOVNb9-2	Z	440	440	440	620 - 850	19	T=27 (20°C); L=40 (20°C)

T: *Wall Thickness* **U:** *Without Hear Treatment* **N:** *Normalizing*

SERVICE TEMPERATURE COMPARISON TABLE

Highest Service Temperature	EN 10216-2 Europe	ASTM USA	DIN 17175 Germany	BS 3059 - 3601 3602 - 3603 3604 - 3606 UK	AFNOR NF A 49 - 213 NF A 49 - 215 France	JIS G 3456 G 3458 G 3461 G 3462 Japan
-100°C -40°C		A 334 Gr. 3 A 334 Gr. 145		503 LT 430 LT	TU 10 N 14 TU 42 BT	
475 °C		A 179 A 106 Gr. A A 192	ST 35.8	320 360	TU 37 C	STPT 38 STB 35
	P265GH	A 106 Gr. B A 210 Gr. A1	ST 45.8	430	TU 42 C	STPT 42 STB 42
		A 106 Gr. C A 210 Gr. C	17Mn4	440	TU 48 C	STPT 49
			19Mn5	500 Nb	TU 52 C	STB 52
500 °C	16M03		15Mo3	243	TU 15 D 3	
	16Mo3	A 209 T1 A 335 P1	16Mo5 (VD TÜV)	245		STBA 12 STPA 12 STBA 13
550 °C		A 213 T2 A 335 P12			TU 15 CD 2.05	STBA 20 STPA 20
560 °C	13CrMo4-5	A 213 T2 A 335 P12	13CrMo44	620 - 460	TU 13 CD 4.04	STBA 22 STPA 22
560 °C		A 213 T11 A 335 P11		621	TU 10 CD 5.05	STBA 22 STPA 23
600 °C	X11CrMo5 10CrMo9-10	A 213 T5 A 335 P5 A 213 T22 A 335 P22	12CrMo195 10CrMo910	625 622 - 490	TU Z 10 CD 05.05 TU Z 12 CD 05.05 TU 10 C 9.10	STBA 25 STPA 25 STBA 24 STPA 24
			14MoV63			
625 °C	11CrMo9-10	A 213 T9 A 335 P9	X12CrMo91 (VD TÜV)	629 - 470 629 - 490	TU Z 10 CD 09	STBA 26 STPA 26
650 °C	X10CrMoVNb9-1	A 213 T91 A 335 P91	X10CrMoVNb9-1		TU Z 10 CDVNb 09.01 TU Z 10 CDNbV 09.02	

DIN NORM

Chemical Composition

Standard	Grade	C	Mn	Si	P	S	Cu	Ni	Cr	Mo	V	Al	N	Nb, Ti, B, As, W
DIN 17175	St 35.8	≤ 0.17	0.40 - 0.80	0.10 -0.35	≤ 0.040	≤ 0.040								
DIN 17175	St 45.8	≤ 0.21	0.40 - 1.20	0.10 -0.35	≤ 0.040	≤ 0.040								
DIN 17175	17Mn4	0.14 - 0.20	0.90 - 1.20	0.20 - 0.40	≤ 0.040	≤ 0.040			≤ 0.030					
DIN 17175	19Mn5	0.17 - 0.22	1.00 - 1.30	0.30 - 0.60	≤ 0.040	≤ 0.040			≤ 0.030					
DIN 17175	15M03	0.12 - 0.20	0.40 - 0.80	0.10 - 0.35	≤ 0.035	≤ 0.035				0.25 - 0.35				
DIN 17175	13CrMo44	0.10 - 0.18	0.40 - 0.70	0.10 - 0.35	≤ 0.035	≤ 0.035			0.70 - 1.10	0.45 - 0.65				
DIN 17175	10CrMo910	0.08 - 0.15	0.40 - 0.70	≤ 0.50	≤ 0.035	≤ 0.035			2.00 - 2.50	0.90 - 1.20				
DIN 17175	14M0V63	0.10 - 0.18	0.40 - 0.70	0.10 - 0.35	≤ 0.035	≤ 0.035			0.30 - 0.60	0.50 - 0.70	0.22 - 0.32			
DIN 17175	X20CrMoV121	0.17 - 0.23	0.40 - 0.70	≤ 0.50	≤ 0.030	≤ 0.030		0.30 - 0.80	10.00 - 12.50	0.80 - 1.20	0.25 - 0.35			

Mechanical Properties

Standard	Grade	Heat Treatment	Yield Strength (Mpa)			Tensile Strength (Mpa)	Elangation A5 Min. (%)	HB Max.	Temperature of Application
			t 0 - 16 mm	t 16 - 40 mm	t 40 - 65 mm				
DIN 17175	St 35.8	U, N	235	225	215	360 - 480	25		475
DIN 17175	St 45.8	U, N	255	245	235	410 - 530	21		475
DIN 17175	17Mn4			275		460 - 580			
DIN 17175	19Mn5			315		510 - 610			
DIN 17175	15M03	U, N	≤ 10: 285 10 - 16: 270	270	260	450 - 600	22		500
DIN 17175	13CrMo44	Z	≤ 10: 305 10 - 16: 290	290	280	440 - 590	22		560
DIN 17175	10CrMo910	Z	280	280	270	450 - 600	20		600
DIN 17175	14M0V63	Z	320	320	310	460 - 610	20		600
DIN 17175	K20CrMoV121		490	490		690 - 850			

Z: *Quenched and tempered* **U:** *Without Heat Treatment* **N:** *Normalized*

BOILER TUBES - ASTM A335 PIPES

Fields of Usage

Used in different industries for high temperatures, high pressure services.

Chemical Composition

Standard	Grade	C	Mn	Si	P	S	Cu	Ni	Cr	Mo	V	Al	N	Nb,Ti, B,As,W
ASTM A335	P1	0.10 - 0.20	0.30 - 0.80	0.10 - 0.50	≤ 0.025	≤ 0.025				0.44 - 0.65				
ASTM A335	P2	0.10 - 0.20	0.30 - 0.61	0.10 - 0.30	≤ 0.025	≤ 0.025			0.50-0.81	0.44 - 0.65				
ASTM A335	P5	≤ 0.15	0.30 - 0.60	≤ 0.50	≤ 0.025	≤ 0.025			4.00-6.00	0.44 - 0.65				
ASTM A335	P11	0.05 - 0.15	0.30 - 0.60	0.50 - 1.00	≤ 0.025	≤ 0.025			1.00-1.50	0.44 - 0.65				
ASTM A335	P12	0.05 - 0.15	0.30 - 0.61	≤ 0.50	≤ 0.025	≤ 0.025			0.80-1.25	0.44 - 0.65				
ASTM A335	P22	0.05 - 0.15	0.30 - 0.60	≤ 0.50	≤ 0.025	≤ 0.025			1.90-2.60	0.87 - 1.13				
ASTM A335	P91	0.08 - 0.12	0.30 - 0.60	0.20 - 0.50	≤ 0.020	≤ 0.010		≤ 0.40	8.00-9.50	0.85 - 1.05	0.18 - 0.25	≤0.02	0.030-0.070	Ti ≤ 0.010
ASTM A335	P92	0.07 - 0.13	0.30 - 0.60	≤ 0.50	≤ 0.020	≤ 0.010		≤ 0.40	8.50-9.50	0.30 - 0.60	0.15 - 0.25	≤0.040	0.030-0.070	B 0.001-0.006 W 1.5-2.00
ASTM A335	P122	0.07 - 0.14	≤ 0.70	≤ 0.50	≤ 0.020	≤ 0.010	0.30 - 1.70	≤ 0.50	10.00-12.50	0.25 - 0.60	0.15 - 0.30	≤0.040	0.040-0.100	B 0.0005-0.005 W 1.50 - 2.50 Cb 0.04 - 0.10

Mechanical Properties

Standard	Grade	Heat Treatment	Yield Strength (Mpa)			Tensile Strength (Mpa)	Elongation A5 Min. (%)	Impact Energy (J)	HB Max.	Temperature of Application
			t 0 - 16 mm	t 16 - 40 mm	t 40 - 65 mm					
ASTM A335	P1	N	205	205	205	≥ 380	30			530
ASTM A335	P2	Z	205	205	205	≥ 380	30			560
ASTM A335	P5	Z	205	205	205	≥ 415	30			600
ASTM A335	P11	Z	205	205	205	≥ 415	30			560
ASTM A335	P12	Z	220	220	220	≥ 415	30			560
ASTM A335	P22	Z	205	205	205	≥ 415	30			560
ASTM A335	P91	Z	415	415	415	≥ 585	20		250	650
ASTM A335	P92	Z	440	440	440	≥ 620	20		250	650
ASTM A335	P122	Z	400	400	400	≥ 620	20			650

T: *Wall Thickness* U: *Without Hear Treatment* N: *Normalizing*

DIN 2448 SEAMLESS STEEL DRAWN PIPE DIMENSIONS AND WEIGHTS

da mm	S mm	1.6 0.063	1.8 0.071	2 0.079	2.3 0.091	2.6 0.102	2.9 0.114	3.2 0.126	3.6 0.142	4 0.157	4.5 0.177	5 0.197	5.6 0.22	6.3 0.248	7.1 0.28	8 0.315	8.8 0.346	10 0.394	11 0.433	12.5 0.492
10.2	1.8	0.339	0.373	0.404	0.448	0.487														
13.5	1.8		0.519	0.567	0.635	0.699	0.758	0.813	0.879											
16	1.8		0.630	0.691	0.777	0.859	0.937	1.01	1.10	1.18										
17.2	1.8		0.684	0.750	0.845	0.936	1.02	1.10	1.21	1.30	1.41									
19	2			0.838	0.947	1.05	1.15	1.25	1.37	1.48	1.61	1.73								
20	2			0.888	1.00	1.12	1.22	1.33	1.46	1.58	1.72	1.85								
21.3	2			0.952	1.08	1.20	1.32	1.43	1.57	1.71	1.86	2.01								
25	2			1.13	1.29	1.44	1.58	1.72	1.90	2.07	2.28	2.47	2.68	2.91						
25.4	2			1.15	1.31	1.46	1.61	1.75	1.94	2.11	2.31	2.52	2.73	2.97						
26.9	2			1.23	1.40	1.56	1.72	1.87	2.07	2.26	2.49	2.70	2.94	3.20	3.47					
30	2.3				1.57	1.76	1.94	2.11	2.34	2.56	2.83	3.08	3.37	3.68	4.01					
31.8	2.3				1.67	1.87	2.07	2.26	2.50	2.74	3.03	3.30	3.62	3.96	4.32	4.70				
33.7	2.3				1.78	1.99	2.20	2.41	2.67	2.93	3.24	3.54	3.88	4.26	4.66	5.07				
38	2.6					2.27	2.51	2.75	3.05	3.35	3.72	4.07	4.47	4.93	5.41	5.92	6.34			
42.4	2.6					2.55	2.82	3.09	3.44	3.79	4.21	4.61	5.08	5.61	6.18	6.79	7.29	7.99		
44.5	2.3					2.69	2.98	3.26	3.63	4.00	4.44	4.87	5.37	5.94	6.55	7.20	7.75	8.51	9.09	
48.3	2.6					2.93	3.25	3.56	3.97	4.37	4.86	5.34	5.90	6.53	7.21	7.95	8.57	9.45	10.1	11.0
51	2.6					3.10	3.44	3.77	4.21	4.64	5.16	5.67	6.27	6.94	7.69	8.48	9.16	10.1	10.9	11.9
54	2.6					3.30	3.65	4.01	4.47	4.93	5.49	6.04	6.68	7.41	8.21	9.08	9.81	10.9	11.7	12.8
57	2.9						3.87	4.25	4.74	5.23	5.83	6.41	7.10	7.88	8.74	9.67	10.5	11.6	12.5	13.7
60.3	2.9						4.11	4.51	5.03	5.55	6.19	6.82	7.55	8.39	9.32	10.3	11.2	12.4	13.4	14.7
63.5	2.9						4.33	4.76	5.32	5.87	6.55	7.21	8.00	8.89	9.88	10.9	11.9	13.2	14.2	15.7
70	2.9						4.80	5.27	5.90	6.51	7.27	8.01	8.89	9.90	11.0	12.2	13.3	14.8	16.0	17.7
73	2.9						5.01	5.51	6.16	6.81	7.60	8.38	9.31	10.4	11.5	12.8	13.9	15.5	16.8	18.7
76.1	2.9						5.24	5.75	6.44	7.11	7.95	8.77	9.74	10.8	12.1	13.4	14.6	16.3	17.2	19.6
82.5	2.9							6.26	7.00	7.74	8.66	9.56	10.6	11.8	13.2	14.7	16.0	17.9	19.4	21.6
88.9	3.2							6.76	7.57	8.38	9.37	10.3	11.5	12.8	14.3	16.0	17.4	19.5	21.1	23.6
101.6	3.6								8.70	9.63	10.8	11.9	13.3	14.8	16.50	18.5	20.1	22.6	24.6	27.5
108	3.6								9.27	10.3	11.5	12.7	14.1	15.8	17.20	19.7	21.5	24.2	26.3	29.4
114.3	3.6								9.83	10.9	12.2	13.5	15.0	16.8	18.10	21.0	22.9	25.7	28.0	31.4
127	4									12.1	13.6	15.00	16.8	18.8	21.00	23.50	25.7	28.9	31.5	35.3
133	4									12.7	14.3	15.8	17.6	19.7	22.0	24.7	27.0	30.3	33.1	37.1
139.7	4									13.4	15.0	16.6	18.5	20.7	23.2	26.0	28.4	32.0	34.9	39.2
152.4	4.5										16.4	18.2	20.3	22.7	25.4	28.5	31.2	35.1	38.4	43.1
159	4.5										17.1	19.0	21.2	23.7	26.6	29.8	32.6	36.7	40.1	45.2
168.3	4.5										18.2	20.1	22.5	25.2	28.2	31.6	34.6	39.0	42.7	48.0
177.8	5											21.3	23.8	26.6	29.9	33.5	36.7	41.4	45.2	51.0
193.7	5.6												26.0	29.1	32.7	36.6	40.1	45.3	49.6	55.9
219.1	6.3													33.1	37.1	41.6	45.6	51.6	56.5	63.7
244.5	6.3													37.0	41.6	46.7	51.2	57.8	63.3	71.5
273	6.3													41.4	46.6	52.3	57.3	64.9	71.1	80.3
323.9	7.1														55.5	62.3	684	77.4	84.9	96.0
355.6	8															68.6	75.3	85.2	93.5	106
406.4	8.8																86.3	97.8	107	121
457	10																	110	121	137
508	11																		135	153
559	12.5																			168
610	12.5																			184
660	14.2																			

Toleranslar DIN 17175 / EN 10216'ya göre belirlenmiştir.

+15% -10%

+12.5% -10%

+9% -9%

+17.5% -12.5%

+12.5% -12.5%

+10% -10%

+22.5% -12.5%

+15% -12.5%

+12.5% -10%

14.2 0.559	16 0.63	17.5 0.689	20 0.787	22.5 0.874	25 0.984	28 1.102	30 1.181	32 1.26	36 1.417	40 1.575	45 1.172	50 1.969	55 2.165	60 2.362	65 2.5597	70 2.745	75 2.953	80 3.15	85 3.346	90 3.543	100 3.937
12.9																					
13.9																					
15.0	16.2																				
16.1	17.5	18.5																			
17.3	18.7	19.9																			
19.5	21.3	22.7	24.7																		
20.6	22.5	24.0	26.1																		
21.7	23.7	25.3	27.7																		
23.9	26.2	28.1	30.8	33.0																	
26.2	28.8	30.8	34.0	36.5	39.4																
30.6	33.8	36.3	40.2	43.5	47.2	50.8	53.0	54.9													
32.8	36.3	39.1	43.4	47.0	51.2	55.2	57.7	60.0	63.9												
35.1	38.8	41.8	46.5	50.4	55.5	59.6	62.7	64.9	69.5												
39.5	43.8	47.3	52.8	57.4	62.9	68.4	71.8	75.0	80.8	85.8											
41.6	46.2	49.8	55.7	60.7	66.6	72.5	76.2	79.7	86.1	91.7											
433.9	48.8	52.7	59.0	64.3	70.7	77.1	81.2	85.0	92.1	98.4	105										
48.4	53.8	58.2	65.3	71.3	78.5	85.9	90.6	95.0	103	111	119	126									
50.7	56.4	61.1	68.6	74.9	82.6	90.5	95.4	100	109	117	127	134									
54.0	60.1	65.1	73.1	80.0	88.3	96.9	102	108	117	127	137	146	154								
57.3	63.8	69.2	77.8	85.2	94.2	103	109	115	126	136	147	158	167								
62.9	70.1	76.0	85.7	93.9	104	114	121	128	140	152	165	177	188								
71.8	80.1	87.0	98.2	108	120	132	148	148	163	177	193	209	223	235	247	257					
80.6	90.2	98.0	111	122	135	149	159	168	185	202	221	240	257	273	288	301	314	325			
90.6	101	110	125	137	153	169	180	190	210	230	253	275	296	315	333	350	366	381	394		
108	121	132	150	165	184	204	217	230	256	280	310	338	365	390	415	438	460	481	501	519	552
120	134	146	166	183	204	226	241	255	284	311	345	377	408	437	466	493	519	544	567	590	630
137	154	168	191	210	235	261	278	295	329	361	401	439	477	513	547	581	613	644	674	702	756
155	174	170	216	238	266	296	316	335	374	411	457	502	545	587	628	668	707	744	780	815	880
173	194	212	241	266	298	331	354	376	419	462	514	565	614	663	710	756	801	844	887	928	1006
191	214	234	266	294	329	367	391	416	464	512	570	628	684	738	792	844	895	945	994	1041	1132
209	234	256	291	322	361	402	429	456	510	562	627	691	753	814	874	932	990	1046	1101	1154	1258
226	254	277	316	349	392	436	466	496	554	612	683	752	821	888	954	1019	1082	1144	1205	1265	1381

MEDIUM CARBON STEEL TUBES FOR HEATEXCHANGER AND BOILER

Fields of Usage

Used in boilers, heat exchangers and condensers.

Chemical Composition

Standard	Grade	C	Mn	Si	P	S	Cu	Ni	Cr	Mo	V	Al	N	Nb,Ti, B,As,W
ASTM A210	A1	≤ 0.27	≤ 0.93	≥ 0.10	≤ 0.035	≤ 0.035								
ASME A210	C	≤ 0.35	0.29 - 1.06	≥ 0.10	≤ 0.035	≤ 0.035								
ASTM A556	A2	≤ 0.18	0.27 - 0.63		≤ 0.035	≤ 0.035								
ASTM A556	B2	≤ 0.27	0.29 - 0.93	≥ 0.10	≤ 0.035	≤ 0.035								
ASTM A556	C2	≤ 0.30	0.29 - 1.06	≥ 0.10	≤ 0.035	≤ 0.035								

Mechanical Properties

Standard	Grade	Heat Treatment	Yield Strength (Mpa)			Tensile Strength (Mpa)	Elongation A5 Min. (%)	Impact Energy (J)	Temperature of Application
			t 0 - 16 mm	t 16 - 40 mm	t 40 - 65 mm				
ASTM A210	A1			≥ 255		≥ 415	30		
ASME A210	C			≥ 275		≥ 485	30		
ASTM A556	A2			≥ 180		≥ 320	35		
ASTM A556	B2			≥ 260		≥ 410	30		
ASTM A556	C2			≥ 280		≥ 480	30		

International Standard Comparison Table

ASTM	BS	DIN	NFA	JIS
ASTM A210	3602 Pt1	17175	A 49215 / 9	G 3461
ASME A210	St 430 Cat2	St 45.8 / 1	T 442 b / F	St B 410
ASTM A556	3606	17175		
ASTM A556	St 440 Cat2	17 Mn 4		

LOW CARBON STEEL TUBES FOR HEATEXCHANGER AND BOILER

Fields of Usage

Used in boilers, heat exchangers and condensers.

Chemical Composition

Standard	Grade	C	Mn	Si	P	S	Cu	Ni	Cr	Mo	V	Al	N	Nb,Ti, B,As,W
ASTM A179	Seamless	0.06 - 0.18	0.27 - 0.63		≤ 0.035	≤ 0.035								
ASTM A214	ERW	≤ 0.18	0.27 - 0.63		≤ 0.035	≤ 0.035								
ASTM A192	Seamless	0.06 - 0.18	0.27 - 0.63	≤ 0.25	≤ 0.035	≤ 0.035								
ASTM A226	ERW	0.06 - 0.18	0.27 - 0.63	≤ 0.25	≤ 0.035	≤ 0.035								

Mechanical Properties

Standard	Grade	Heat Treatment	Yield Strength (Mpa)			Tensile Strength (Mpa)	Elongation A5 Min. (%)	Impact Energy (J)	Temperature of Application
			t 0 - 16 mm	t 16 - 40 mm	t 40 - 65 mm				
ASTM A179	Seamless			≥ 180		≥ 325	35		
ASTM A214	ERW			≥ 180		≥ 325	35		
ASTM A192	Seamless			≥ 180		≥ 325	35		
ASTM A226	ERW			≥ 180		≥ 325	35		

International Standard Comparison Table

ASTM	BS	DIN	NFA	JIS
ASTM A179	17175 ST 35.8 / 1	3602 Pt1 3059 Pt2 St 360	A 49215 TU 37C	G 3461 STB 340
ASTM A214	17175 ST 35.8 / 1	CAT2 3602 Pt1 3059 Pt2 ST 360 CAT2	A 49215 TU 37C	JIS G 3461 STB 340
ASTM A192	17177 ST 37.8 / 1	BS 3059 Pt2 3602 Pt1 ERW 360 CAT2	A 49242 A 49245 TS 37C	G 3461 STB 340
ASTM A226	17177 ST 37.8 / 1	BS 3059 Pt2 BS 3602 Pt1 ERW 360 CAT2	A 49242 A 49245 TS 37C	G 3461 STB 340

ALLOY STEEL TUBES FOR HEATEXCHANGER AND BOILERS

Fields of Usage

Used in boilers, heat exchangers and condensers.

Chemical Composition

Standard	Grade	C	Mn	Si	P	S	Cu	Ni	Cr	Mo	V	Al	N	Nb,Ti, B,As,W
ASTM A209	T1	0.10 - 0.20	0.30 - 0.80	0.10 - 0.50	0.025	0.025				0.44 - 0.65				
ASTM A209	T1a	0.15 - 0.25	0.30 - 0.80	0.10 - 0.50	0.025	0.025				0.44 - 0.65				
ASTM A209	T1b	≤ 0.14	0.30 - 0.80	0.10 - 0.50	0.025	0.025				0.44 - 0.65				

Mechanical Properties

Standard	Grade	Heat Treatment	Yield Strength (Mpa)			Tensile Strength (Mpa)	Elongation A5 Min. (%)	Impact Energy (J)	Temperature of Application
			t 0 - 16 mm	t 16 - 40 mm	t 40 - 65 mm				
ASTM A209	T1			≥ 205		≥ 380	30		
ASTM A209	T1a			≥ 220		≥ 415	30		
ASTM A209	T1b			≥ 195		≥ 365	30		

ASTM A213

Chemical Composition

Element Grade	UNS Designation	C	Mn	P	S	Si	Ni	Cr	Mo	V	B	Nb	N	Al	W	Other
T2	K11547	0.10-0.20	0.30-0.61	0.025	0.025[B]	0.10-0.30	-	0.50-0.81	0.44-0.65	-	-	-	-	-	-	-
T5	K41545	0.15	0.30-0.60	0.025	0.025	0.50	-	4.00-6.00	0.45-0.65	-	-	-	-	-	-	-
T5b	K51545	0.15	0.30-0.60	0.025	0.025	0.10-2.00	-	4.00-6.00	0.45-0.65	-	-	-	-	-	-	-
T5c	K41245	0.12	0.30-0.60	0.025	0.025	0.50	-	4.00-6.00	0.45-0.65	-	-	-	-	-	-	Ti 4xC-0.70
T9	K90941	0.15	0.30-0.60	0.025	0.025	0.25-1.00	-	8.00-10.00	0.90-1.10	-	-	-	-	-	-	-
T11	K11597	0.05-0.15	0.30-0.60	0.025	0.025	0.50-1.00	-	1.00-1.50	0.44-0.65	-	-	-	-	-	-	-
T12	K11562	0.05-0.15	0.30-0.61	0.025	0.025[B]	0.50	-	0.80-1.25	0.44-0.65	-	-	-	-	-	-	-
T17	K12047	0.15-0.25	0.30-0.61	0.025	0.025	0.15-0.35	-	0.80-1.25	-	0.15	-	-	-	-	-	-
T21	K31545	0.05-0.15	0.30-0.60	0.025	0.025	0.50-1.00	-	2.65-3.35	0.80-1.06	-	-	-	-	-	-	-
T22	K21590	0.05-0.15	0.30-0.60	0.025	0.025	0.50	-	1.90-2.60	0.87-1.13	-	-	-	-	-	-	-
T23	K40712	0.04-0.10	0.10-0.60	0.030	0.010	0.50	-	1.90-2.60	0.05-0.30	0.20-0.30	0.0005 -0.006	0.02 -0.08	0.03	0.030	1.45-1.75	-
T24	K30736	0.05-0.10	0.30-0.70	0.020	0.010	0.15-0.45	-	2.20-2.60	0.90-1.10	0.20-0.30	0.0015 -0.007	-	0.012	0.02	-	Ti 0.06-0.10
T36	K21001	0.10-0.17	0.80-1.20	0.030	0.025	0.25-0.50	1.00-1.30	0.30	0.25-0.50	0.02	-	0.015 -0.045	0.02	0.050	-	Cu 0.50-0.80
T91	K90901	0.07-0.14	0.30-0.60	0.020	0.010	0.20-0.50	0.40	8.00-9.50	0.85-1.05	0.18-0.25	-	0.06 -0.1	0.030 -0.070	0.02	-	Ti 0.01 Zr 0.01
T92	K92460	0.07-0.13	0.30-0.60	0.020	0.010	0.50	0.40	8.00-9.50	0.30-0.60	0.15-0.25	0.001 -0.006	0.04 -0.09	0.030 -0.070	0.02	1.50-2.00	Ti 0.01 Zr 0.01
T122	K91271	0.07-0.14	0.70	0.020	0.010	0.50	0.50	10.00-11.50	0.25-0.60	0.15-0.30	0.0005 -0.005	0.04 -0.10	0.040 -0.100	0.02	1.50-2.50	Cu 0.30-1.70 Ti 0.01 Zr 0.01
T911	K91061	0.09-0.13	0.30-0.60	0.020	0.010	0.10-0.50	0.40	8.50-9.50	0.90-1.10	0.18-0.25	0.0003 -0.006	0.06 -0.10	0.040 -0.090	0.02	0.90-1.10	Ti 0.01 Zr 0.01

Mechanical Properties

Grade	UNS Designation	Tensile Strength (MPa)	Yield Strength Min. (MPa)	Elongation in 2 in or 50mm min %[A,B]	Hardness, Max	
					Brinell / Vickers	Rockwell
Low Alloy Steels						
T5b	K51545	415	205	30	179 HBW/190 HV	89 HRB
T9	K90941	415	205	30	179 HBW/190 HV	89 HRB
T12	K11562	415	220	30	163 HBW/170 HV	85 HRB
T23	K40712	510	400	20	220 HBW/230 HV	97 HRB
T24	K30736	585	415	20	250 HBW/265 HV	25 HRC
T36 Class 1	K21001	620	440	15	250 HBW/265 HV	25 HRC
T36 Class 2	K21001	660	460	15	250 HBW/265 HV	25 HRC
T91	K90901	585	415	20	250 HBW/265 HV	25 HRC
T92	K92460	620	440	20	250 HBW/265 HV	25 HRC
T122	K91271	620	400	20	250 HBW/265 HV	25 HRC
T911	K91061	620	440	20	250 HBW/265 HV	25 HRC
All other low alloy grades		415	205	30	163 HBW/170 HV	85 HRB
Austenitic Stainless Steels						
TP201	S20100	655	260	35	219 HBW/230 HV	95 HRB
TP202	S20200	620	310	35	219 HBW/230 HV	95 HRB
XM - 19	S20910	690	380	35	250 HBW/265 HV	25 HRC
-	S21500	540	230	35	192 HBW/200 HV	90 HRB
- TP304	S25700 S30400	540 515	240 205	50 35	217 HBW 192 HBW/200 HV	95 HRB 90 HRB
TP304L	S30403	485	170	35	192 HBW/200 HV	90 HRB
TP304H	S30409	515	205	35	192 HBW/200 HV	90 HRB
-	S30432	590	235	35	219 HBW/230 HV	95 HRB
-	S30434	500	205	35	192 HBW/200 HV	90 HRB
TP304N	S30451	550	240	35	192 HBW/200 HV	90 HRB
TP304LN	S30453	515	205	35	192 HBW/200 HV	90 HRB
-	S30615	620	275	35	192 HBW/200 HV	90 HRB
- TP309S	S30815 S30908	600 515	310 205	40 35	217 HBW 192 HBW/200 HV	95 HRB 90 HRB
TP309H	S30909	515	205	35	192 HBW/200 HV	90 HRB
TP309Cb	S30940	515	205	35	192 HBW/200 HV	90 HRB
TP309HCb	S30941	515	205	35	192 HBW/200 HV	90 HRB
-	S31002	500	205	35	192 HBW/200 HV	90 HRB
TP310S	S31008	515	205	35	192 HBW/200 HV	90 HRB
TP310H	S31009	515	205	35	192 HBW/200 HV	90 HRB

	ISWG M/W mm	ISWG M/W mm	BWG M/W mm	BWG M/W mm	ISWG M/W mm	ISWG M/W mm	BWG M/W mm	BWG M/W mm	ISWG M/W mm	ISWG M/W mm	BWG M/W mm	BWG M/W mm	ISWG M/W mm	ISWG M/W mm	BWG M/W mm	BWG M/W mm	ISWG M/W mm	ISWG M/W mm	BWG M/W mm	BWG M/W mm	ISWG M/W mm	ISWG M/W mm	BWG M/W mm	BWG M/W mm	ISWG M/W mm	ISWG M/W mm	BWG M/W mm	BWG M/W mm	ISWG M/W mm	ISWG M/W mm	BWG M/W mm	BWG M/W mm	ISWG M/W mm	ISWG M/W mm	BWG M/W mm
	25 0,508	25 0,508	25 0,507	25 0,507	23 0,610	23 0,610	23 0,634	23 0,634	22 0,711	22 0,711	22 0,761	22 0,761	21 0,813	21 0,813	21 0,812	21 0,812	20 0,914	20 0,914	20 0,889	20 0,889	19 1,016	19 1,016	19 1,086	19 1,086	18 1,219	18 1,213	18 1,244	16 1,626	16 1,626	16 1,651	16 1,651	15 1,829	15 1,829	15 1,828
3/16" 4,76 mm	0.058	0.053	0.058	0.050	0.068	0.062	0.075	0.065	0.077	0.071	0.081	0.075	0.086	0.079	0.086	0.079	0.094	0.087	0.092	0.085	0.101	0.094	0.106	0.089											
1/4" 6,35 mm	0.080	0.073	0.080	0.073	0.095	0.086	0.098	0.089	0.108	0.099	0.113	0.104	0.121	0.111	0.121	0.111	0.133	0.123	0.131	0.12	0.145	0.134	0.153	0.141	0.167	0.154	0.169	0.157	0.202	0.189	0.204	0.191	0.216	0.204
3/8" 9,53 mm	0.125	0.113	0.125	0.113	0.148	0.134	0.153	0.139	0.170	0.155	0.179	0.165	0.183	0.175	0.192	0.15	0.213	0.194	0.208	0.189	0.234	0.0213	0.247	0.226	0.273	0.250	0.278	0.254	0.344	0.317	0.348	0.321	0.375	0.347
1/2" 12,35 mm	0.169	0.153	0.169	0.152	0.201	0.182	0.208	0.189	0.232	0.210	0.245	0.224	0.262	0.238	0.262	0.238	0.292	0.266	0.285	0.259	0.322	0.293	0.342	0.311	0.379	0.345	0.385	0.351	0.485	0.444	0.491	0.450	0.534	0.490
5/8" 15,88 mm																	0.372	0.337	0.362	0.329	0.410	0.372	0.436	0.396	0.485	0.441	0.494	0.449	0.626	0.572	0.635	0.579	0.693	0.634
3/4" 19,05 mm																	0.541	0.409	0.440	0.398	0.499	0.542	0.530	0.481	0.590	0.536	0.601	0.545	0.766	0.698	0.779	0.709	0.852	0.777
7/8" 22,2 mm																									0.696	0.631	0.709	0.543	0.909	0.826	0.919	0.835	1.010	0.919
1" 25,4 mm																									0.802	0.726	0.817	0.714	1.048	0.953	1.068	0.970	1.17	1.063
11/16" 26,99 mm																													1.121	1.107	1.137	1.032	1.251	1.135
11/8" 28,58 mm																													1.193	1.081	1.210	1.097	1.331	1.207
11/4" 31,75 mm																													1.333	1.208	1.350	1.225	1.487	1.349
11/2" 38,1 mm																													1.615	1.462	1.637	1.483	1.805	1.635
13/4" 44,45 mm																																		
2" 50,8 mm																																		
21/4" 57,15 mm																																		
21/2" 63,5 mm																																		
23/4" 69,85 mm																																		
3" 76,2 mm																																		
31/4" 82,55 mm																																		
31/2" 88,9 mm																																		
33/4" 95,25 mm																																		
33/4" 95,25 mm																																		

BWG M/W mm	ISWG M/W mm	ISWG M/W mm	BWG M/W mm	BWG M/W mm	ISWG M/W mm	ISWG M/W mm	BWG M/W mm	BWG M/W mm	ISWG M/W mm	ISWG M/W mm	BWG M/W mm	BWG M/W mm	ISWG M/W mm	ISWG M/W mm	BWG M/W mm	BWG M/W mm	ISWG M/W mm	ISWG M/W mm	BWG M/W mm	BWG M/W mm	ISWG M/W mm	ISWG M/W mm	BWG M/W mm	BWG M/W mm	ISWG M/W mm	ISWG M/W mm	ISWG M/W mm	ISWG M/W mm	ISWG M/W mm	ISWG M/W mm	AD OD ED
15 1,828	14 2,032	14 2,032	14 2,108	14 2,108	13 2,337	13 2,337	13 2,413	13 2,413	12 2,642	12 2,642	12 2,768	12 2,768	11 2,947	11 2,947	11 3,048	11 3,048	10 3,251	10 3,251	10 3,403	10 3,403	9 3,658	9 3,658	9 3,760	8 4,064	8 4,064	8 4,191	8 4,191	7 4,471	7 4,471	7 4,572	7 4,572	
																															3/16" 4,76 mm
0.204																															1/4" 6,35 mm
0.347																															3/8" 9,53 mm
0.490	0.581	0.536	0.599	0.551	0.647	0.597	0.662	0.612	0.706	0.655	0.729	0.678																			1/2" 12,35 mm
0.633	0.758	0.694	0.781	0.716	0.850	0.78	0.872	0.801	0.936	0.862	0.895	0.895																			5/8" 15,88 mm
0.777	0.936	0.853	0.964	0.881	1.053	0.962	1.082	0.990	1.165	1.069	1.210	1.111																			3/4" 19,05 mm
0.918	1.112	1.012	1.147	1.045	1.255	1.146	1.290	1.179	1.394	1.276	1.450	1.328	1.523	1.401	1.523	1.441	1.657	1.521		1.5579											7/8" 22,2 mm
1.063	1.29	1.171	1.331	1.211	1.459	1.329	1.502	1.368	1.624	1.483	1.691	1.545	1.780	1.635	1.835	1.680	1.940	1.176	2.014	1.846	2.137	1.961		2.007		2.137		2.192			1" 25,4 mm
1.134	1.377	1.251	1.424	1.294	1.561	1.421	1.607	1.463	1.742	1.586	1.814	1.654	1.195	1.747	1.972	1.800	2.083	1.903	2.165	1.980	2.298	2.105									11/16" 26,99mm
1.206	1.466	1.330	1.514	1.376	1.521	1.170	1.557	1.854	1.690	1.933	1.763	2.041	1.862	2.101	1.919	2.223	2.310	2.112	2.455	2.248											11/8" 28,58mm
1.349	1.644	1.489	1.697	1.541	1.865	1.695	1.921	1.764	2.082	1.897	2.171	1.979	2.290	2.093	2.356	2.157	2.505	2.285	2.607	2.379	2.772	3.107	2.836	2.596	3.030	2.775	3.108	2.848			11/4" 31,75 mm
1.636	1.998	1.807	2.064	1.871	2.268	2.061	2.341	2.124	2.541	2.310	2.656	2.412	2.801	2.555	2.894	2.635	3.071	2.794	3.199	2.912	3.408	3.680	3.489	3.134	3.736	3.411	3.836	3.505	4.055	3.708	4.133	3.780	11/2" 38,1 mm
		2.351	2.126	2.430	2.201	2.676	2.427	2.759	2.502	3.003	2.724	3.137	2.845	3.311	3.015	3.423	3.112	3.636	3.303	3.791	3.445	4.044	4.253	4.142	3.772	4.443	7.047	4.564	4.161	4.833	4.408	4.928	4.496	13/4" 44,45 mm
		2.704	2.444	2.796	2.531	3.084	2.793	3.180	2.879	3.461	3.138	3.619	3.279	3.822	3.478	3.953	3.589	4.201	3.812	4.38	3.978	4.680	3.939	4.795	4.361	5.149	4.684	5.292	4.817	5.610	5.108	5.717	5.212	2" 50,8 mm
		3.054	2.762	3.163	2.861	3.490	3.159	3.596	3.256	3.920	3.551	4.098	3.712	4.332	3.939	4.482	4.066	4.765	4.321	4.975	4.510	4.332	3.398	5.450	4.949	5,856	5.320	6.022	5.473	6.387	5.808	6.517	5.928	21/4" 57,15 mm
		3.407	3.080	3.529	3.192	3.896	3.525	4.020	3.635	4.379	3.965	4.582	4.146	4.843	4.401	5.011	4.544	5.332	4.830	5.567	5.044	5.951	5.398	6.101	5.538	6.562	5.957	6.751	6.130	7.164	6.508	7.312	6.644	21/2" 63,5 mm
		3.761	3.399	3.896	3.552	4.302	3.891	4.436	4.013	4.838	4.379	5.060	4.580	5.353	4.862	5.541	5.021	5.897	5.339	6.159	5.576	4.687	5.971	6.757	6.126	7.268	6.593	7.479	6.786	7.941	7.208	8.106	7.36	23/4" 69,85 mm
		4.121	3.716	4.262	3.852	4.708	4.257	4.859	4.391	5.298	4.792	5.545	5.013	5.864	5.323	6.07	5.499	6.462	5.848	6.751	6.109	7.223	6.644	7.411	6.715	7.975	7.229	8.208	7.442	8.718	7.908	8.901	8.076	3" 76,2 mm
						5.115	4.623	5.278	4.768	5.757	5.206	6.023	5.446	6.394	5.785	6.599	5.976	7.027	6.356	7.343	6.642	7.858	7.116	8.064	7.304	8.681	7.866	8.933	8.098	9.496	8.608	9.696	8.792	31/4" 82,55 mm
						5.521	4.989	5.698	5.145	6.216	5.620	6.504	5.879	6.885	6.246	7.129	6.453	7.593	6.866	7.935	7.715	8.494	7.699	8.173	7.893	9.387	8.502	9.661	8.755	10.273	9.308	10.491	9.508	31/2" 88,9 mm
										6.675	6.034	6.985	6.313	7.395	6.708	7.657	6.93	8.158	7.375	8.526	7.708	9.130	8.262	9.370	8.841	10.094	9.138	10.393	9.411	11.050	10.009	11.285	10.223	33/4" 95,25 mm
																										10.8	9.775	11.122	10.066	11.828	10.709	12.080	10.939	33/4" 95,25 mm

MECHANICAL PROPERTIES OF ALLOY STEEL

Operating Temperature	EN 10216-2+A2 2007	ASTM A213-08	ASTM A335-06	Heat Treatment ACC. to ASTM	ACC. to ASTM A213
350°C (662°F)	16M03 YS 280/TS 450-600 N 890°C-950°C	-	P1 YS 205/TS 380	T> 650°C or T: 650°C-705°C	-
570°C (1058°F)	-	T2 YS 205/TS 415 163 HB (85HRB)	P2 YS 205/TS 380	T> 650°C-730°C(A213) T: 650°C-705°C(A335) veya > 675°C (A335)	C 0.10 0.20 Cr 0.50-0.81 Mo 0.44 -0.65
570°C (1058°F)	10CrMo5-5 YS 275/TS 410-560 N 900-960 °C T 650-750 °C	T11 YS 205/TS 415 163 HB (85HRB)	P11 YS 205/TS 415	T> 650°C	C 0.10 0.20 Cr 0.50-0.81 Mo 0.44 -0.65
570°C (1058°F)	13CrMo4-5 YS 290/TS 440-560N 900-960 °C T 660-730 °C	T12 YS 220/TS 415 163 HB (85HRB)	P12 YS 220/TS 415	T> 650°C - 730°C(A213) T: 650°C-705°C (A335) veya >650°C (A335)	C 0.05-0.15 Cr 0.80 -1.25 Mo 0.44 -0.65
570°C (1058°F)	10CrMo9-10 YS 280/TS 480-630 N 900-960 °C T 680-750 °C	T22 YS 205/TS 415 163 HB (85HRB)	P22 YS 205/TS 415	T> 675°C	C 0.05-0.15 Cr 0.90 -2.60 Mo 0.87-1.13
570°C (1058°F)	-	T5 YS 205/TS 415 163 HB (85HRB)	P5 YS 205/TS 415	T> 675°C	C 0.15 Cr 4.0-6.0 Mo 0.45-0.65
570°C (1058°F)	7CrWVMoNb9-6 YS 400/TS 510-740 N 1040-1080°C T 7300-780 °C	T23 YS 400/TS 510 220 HB (97HRB)	P23 YS 400/TS 510	N: 1040°C-1080°C T:730°C -800°C	C 0.04 -0.10 Cr 1.90-2.60 Mo 0.05-0.30 V 0.20 0.30 W 1.45-1.75
570°C (1058°F)	7CrWVMoNb10-10 YS 450/TS 565-840 N 980-1020 °C T 730-770 °C	T24 YS 415/TS 585 250 HB (25HRB)	-	N: 980°C -1080°C T:730°C-800°C	C 0.05-0.10 Cr 2.20-2.60 Mo 0.90-1.10 V 0.20 0.30 Ti 0.60 -0.10
570°C (1058°F)	X11CrMo9-1+1 YS 210/TS 460-640 I 1950-980 °C	T9 YS 205/TS 415 179 HB (89HRB)	P9 YS 205/TS 415	T> 675°C	C 0.15 Cr 8.0-10.0 Mo 0.90-1.10
610°C (1130°F)	X10CrMoVNb9-1 YS 450/TS 630-830 N 1040-1090 °C T 730-780 °C	T91 YS 415/TS 585 250 HB (25HRB)	P91 YS 415/TS 585 250HB (25HRC)	N: 1040°C 1080°C T:730°C-800°C	C 0.07 -0.14 Cr 8.0-9.5 Mo 0.85-1.05 V 0.18-0.25 Nb 0.06 0.10
610°C (1130°F)	X10CrWMOVNb9-2 YS 440/TS 620-850 N 1040 1090 °C T 730-780 °C	T92 YS 440/TS 620 250 HB (25HRC)	P92 YS 440/TS 620 250HB (25HRC)	N: 1040°C-1080°C T:730°C-800°C	C 0.07 -0.13 Cr 8.5-9.5 Mo 0.30-0.60 V 0.15 0.25 W 1.5-2.00

YS: *Yield Strength*
TS: *Tensile Strength*
R: *Rolled*
N: *Normalized*
QT: *Hardened and Tempered*

MECHANICAL PROPERTIES OF CARBON STEEL

API Specification I / ISO 3183 (PSL2) (2008)	ASTM A106-06a	ASTM A335-05	EN 10216-2 / 10216-3 10216-4 (2007-2002)	CSA Z 245.1-07
	Gr. A YS 205 / TS 330	Gr.1 (KV-45°C) YS 205/TS 380	P 235 GH (10216-2) YS 235/TS 350-500	
L245 or BR YS 245-450/TS 415-760	Gr. B YS 240 / TS 415	Gr.6 (KV -45°C) YS 240/TS 415	P 265 GH (10216-2) YS 265/TS 410-570	Gr.241 YS 241-495/TS 414-760
		Gr.4 (KV-100°C) YS 240/TS 415	P 265 NI (10216-4) YS 265/TS 410-570	
		Gr.7 (KV-75°C) YS 240/TS 415		
		Gr.3 (KV-100°C) YS 240/TS 450		
	Gr. C YS 275 / TS 485		P 275 (10216-3) YS 275/TS 390-530	
L290R or X42R YS 290-495 /TS 415-760				Gr.290 YS 290-495/TS 414-760
L320R or X46R YS 320-525 /TS 435-760		Gr.9 (KV-75°C) YS 315/TS 435		
L360N veya X52R YS 360-530/TS 460-760			P 355 (10216-3) YS 355/TS 490-650	Gr.359 YS 359-530/TS 455-760
L390N veya X56N YS 390-545/TS 490-760				Gr.386 YS 386-540/TS 490-760
L4150 or X600 YS 415-565 /TS 520-760				Gr.414 YS 414-565/TS 517-760
L4500 or X650 YS 450-600/TS 535-760		Gr.10 (KV-60°C) YS 450/TS 550	P 460 (10216-3)* YS 460/TS 560-730	Gr.448 YS 448-600/TS 531-760
L4850 or X70Q YS 485-635 /TS 570-760				Gr.483 YS 483-620/TS 565-760
		Gr.8 (KV-195°C) YS 515/TS 690		
L555Q or X800 YS 555-705 /TS 625-825				Gr.550 YS 550-690/TS 620-830
			P 620 (10216-3) YS 620/TS 740-930	Gr.620 YS 620-760 /TS 690 - 900
			P 690 (10216-3) YS 690/TS 770-960	Gr.690 YS 690-825/TS 760-970
				Gr.825 YS 825-1050/TS 915-1145

YS: *Yield Strength*
TS: *Tensile Strength*
R: *Rolled*
N: *Normalized*
QT: *Hardened and Tempered*

SEAMLESS STEEL PIPES FOR MECHANICAL APPLICATION

Fields of Usage

It is used in machinery manufacturing, pipelines, tank construction and the production of their parts, automotive industry, hydraulic systems, wagon manufacturing industry and agricultural tools industry.

Chemical Composition

Standard	Grade	C	Mn	Si	P	S	Cu	Ni	Cr	Mo	V	Al	N	Nb, Ti, B, As ve W
DIN 1629	St 37.0	≤ 0.17			≤ 0.040	≤ 0.040							0.009 - 0.014	
DIN 1629	St 44.0	≤ 0.21			≤ 0.040	≤ 0.040							0.009 - 0.014	
DIN 1629	St 52.0	≤ 0.22	≤ 1.60	≤ 0.55	≤ 0.040	≤ 0.035						≤ 0.020	0.009 - 0.014	
EN 10216-1	P195TR1	≤ 0.13	≤ 0.70	≤ 0.35	≤ 0.025	≤ 0.020	≤ 0.30	≤ 0.30	≤ 0.30	≤ 0.08	≤ 0.020			
EN 10216-1	P195TR2	≤ 0.13	≤ 0.70	≤ 0.35	≤ 0.025	≤ 0.020	≤ 0.30	≤ 0.30	≤ 0.30	≤ 0.08	≤ 0.020	≤ 0.020		
EN 10216-1	P235TR1	≤ 0.16	≤ 1.20	≤ 0.35	≤ 0.025	≤ 0.020	≤ 0.30	≤ 0.30	≤ 0.30	≤ 0.08	≤ 0.020			≤ Nb = 0.010.Ti - 0.04 Cr + Cu + Mo + Ni ≤ 0.7
EN 10216-1	P235TR2	≤ 0.16	≤ 1.20	≤ 0.35	≤ 0.025	≤ 0.020	≤ 0.30	≤ 0.30	≤ 0.30	≤ 0.08	≤ 0.020	≤ 0.020		≤ Nb = 0.010.Ti - 0.04 Cr + Cu + Mo + Ni ≤ 0.7
EN 10216-1	P265TR1	≤ 0.20	≤ 1.40	≤ 0.40	≤ 0.025	≤ 0.020	≤ 0.30	≤ 0.30	≤ 0.30	≤ 0.08	≤ 0.020			≤ Nb = 0.010.Ti - 0.04 Cr + Cu + Mo + Ni ≤ 0.7
EN 10216-1	P265TR2	≤ 0.20	≤ 1.40	≤ 0.40	≤ 0.025	≤ 0.020	≤ 0.30	≤ 0.30	≤ 0.30	≤ 0.08	≤ 0.020	≤ 0.020		≤ Nb = 0.010.Ti - 0.04 Cr + Cu + Mo + Ni ≤ 0.7
EN 10216-3	P355N	≤ 0.20	0.90-1.70	≤ 0.50	≤ 0.025	≤ 0.020	≤ 0.30	≤ 0.50	≤ 0.30	≤ 0.08	≤ 0.10	≤ 0.020	≤ 0.020	Nb + Ti + V ≤ 0.12

Mechanical Properties

Standard	Grade	Heat Treatment	Yield Strength (Mpa)			Tensile Strength (Mpa)	Elongation A5 Min. (%)	Impact Energy (J)	Temperature of Application
			t 0 - 16 mm	t 16 - 40 mm	t 40 - 65 mm				
DIN 1629	St 37.0	U, N	235	225	215	350 - 480	25		300
DIN 1629	St 44.0	U, N	275	265	225	420 - 550	21		300
DIN 1629	St 52.0	U, N	355	345	335	500 - 650	21		300
EN 10216-1	P195TR1	U, N	195	185	175				
EN 10216-1	P195TR2	U, N	195	185	175	320 - 440	27		
EN 10216-1	P235TR1	U, N	235	225	215	360 - 500	25		
EN 10216-1	P235TR2	U, N	235	225	215	360 - 500	25	KV = 27 (0°C)	
EN 10216-1	P265TR1	U, N	265	255	245	410 - 570	21		
EN 10216-1	P265TR2	U, N	265	255	245	410 - 570	21	KV = 27 (0°C)	
EN 10216-3	P355N	U	355	345t	335	490 - 650	22	KV = 27 (-20°C)	

STEEL SEAMLESS CONSTRUCTION PIPES - DIN 17121, EN 10210

Fields of Usage

Used in bridge and crane construction, in structures requiring high strength such as roofs, underground and foundations.

Chemical Composition

Standard	Grade	C	Mn	Si	P	S	Cu	Ni	Cr	Mo	V	Al	N	Nb,Ti,B,As,W
DIN 1630	St 37.4	≤ 0.17	≥ 0.35	≤ 0.35	≤ 0.040	≤ 0.040						≥ 0.020		
DIN 1630	St 44.4	≤ 0.20	≥ 0.40	≤ 0.35	≤ 0.040	≤ 0.040						≥ 0.020		
DIN 1630	St 52.4	≤ 0.22	≥ 1.60	≤ 0.55	≤ 0.040	≤ 0.350						≥ 0.020		
DIN 17121	St 37.2	≤ 0.17			≤ 0.050	≤ 0.050							0.009	
DIN 17121	St 37.3	≤ 0.17			≤ 0.040	≤ 0.040						≥ 0.020		
DIN 17121	St 44.2	≤ 0.21			≤ 0.050	≤ 0.050							0.009	
DIN 17121	St 44.3	≤ 0.20			≤ 0.040	≤ 0.040						≥ 0.020		
DIN 17121	St 52.3	≤ 0.22	≤ 1.60	≤ 0.55	≤ 0.040	≤ 0.040						≥ 0.020		
EN 10210-1	S235JRH	≤ 0.17	≤ 1.40		≤ 0.040	≤ 0.040							≤ 0.009	
EN 10210-1	S275J0H	≤ 0.20	≤ 1.50		≤ 0.035	≤ 0.035							≤ 0.009	
EN 10210-1	S275J2H	≤ 0.20	≤ 1.50		≤ 0.030	≤ 0.030						≥ 0.020		
EN 10210-1	S355J0H	≤ 0.22	≤ 1.60	≤ 0.55	≤ 0.035	≤ 0.035							≤ 0.009	
EN 10210-1	S355J2H	≤ 0.22	≤ 1.60	≤ 0.55	≤ 0.030	≤ 0.030						≥ 0.020		
EN 10210-1	S355K2H	≤ 0.22	≤ 1.60	≤ 0.55	≤ 0.030	≤ 0.030	0.30	0.30	0.30					

Mechanical Properties

Standard	Grade	Heat Treatment	Yield Strength (Mpa)			Tensile Strength (Mpa)	Elongation A5 Min. (%)	Impact Energy (J)	Temperature of Application
			t 0 - 16 mm	t 16 - 40 mm	t 40 - 65 mm				
DIN 1630	St 37.4	U, N	235	225	215	350 - 480	25	T = 27 (0°C)	300
DIN 1630	St 44.4	U, N	275	265	225	420 - 550	21	T = 27 (0°C)	300
DIN 1630	St 52.4	U, N	335	345	335	500 - 650	21	T = 27 (0°C)	300
DIN 17121	St 37.2	U, N	235	225	215	340-470	26	KV = 27	300
DIN 17121	St 37.3	U, N	235	225	215	340-470	26	KV = 27 (-20°C)	300
DIN 17121	St 44.2	U, N	275	265	255	410-540	22	KV = 27	300
DIN 17121	St 44.3	U, N	275	265	255	410-540	22	KV = 27 (-20°C)	300
DIN 17121	St 52.3	U, N	355	345	335	490-630	22	KV = 27 (-20°C)	300
EN 10210-1	S235JRH	U, N	235	225	215	360-510	26	L = 27	20
EN 10210-1	S275J0H	U, N	275	265	255	410-560	23	L = 27 (0°C)	20
EN 10210-1	S275J2H	U, N	275	265	255	410-560	23	L = 27 (-20°C)	300
EN 10210-1	S355J0H	U, N	355	345	335	470-630	22	L = 27 (0°C)	20
EN 10210-1	S355J2H	U, N	355	345	335	470-630	22	L= 27 (-20°C)	300
EN 10210-1	S355K2H	U, N	355	345	335	470-630	22	L= 27 (-20°C)	300

T: *Wall Thickness* **U:** *Without Hear Treatment* **N:** *Normalizing*

CASING, API 5CT/ ISO 11960

Fields of Usage

Used in oil, natural gas, hot water and steam drillings

Labels		Outside Diameter	Weight kg/m	Wall mm	Steel Grades	Pipe Ends
Inch	Lb/ft					
4-1/2"	09.50	114.3	14.14	5.21	H40, J55, K55	P,S
4-1/2"	10.50	114.3	15.63	5.69	J55, K55	P,S,B
4-1/2"	11.60	114.3	17.26	6.35	J55,K55, L80, N80, C90, T95, P110	P,S,L,B
4-1/2"	13.50	114.3	20.09	7.37	L80, N80, C90, T95, P110	P,L,B
5"	11.50	127	17.11	5.59	J55, K55	P, S
5"	13.00	127	19.35	6.43	J55, K55	P, S, L, B
5"	15.00	127	22.32	7.52	J55, K55, L80, N80, C90,T95, P110	P, S, L, B
5"	18.00	127	26.79	9.19	L80, N80, C90, T95, P110	P, L, B
5-1/2"	14.00	139.7	20.83	6.2	H40, J55, K55	P,S
5-1/2"	15.50	139.7	23.07	6.98	J55, K55	P, S, L, B
5-1/2"	17.00	139.7	25.3	7.72	J55, K55, L80, N80, C90,T95, P110	P, S, L, B
5-1/2"	29.50	139.7	29.76	9.17	L80, N80, C90,T95, P110	P, S, L, B
6-5/8"	20.00	168.28	29.76	7.32	H40, J55, K55	P, S, L, B
6-5/8"	24.00	168.28	35.72	8.94	J55, K55, L80, N80, C90,T95, P110	P, S, L, B
7"	23.00	177.8	34.23	8.05	J55, K55, L80, N80, C90,T95	P, S, L, B
7"	26.00	177.8	38.69	9.19	J55, K55, L80, N80, C90,T95, P110	P, S, L, B
7"	29.00	177.8	43.16	10.36	L80, N80, C90,T95, P110	P, L, B
7"	32.00	177.8	47.62	11.51	L80, N80, C90,T95, P110	P, L, B
7-5/8"	26.40	193.68	39.29	8.33	J55, K55, L80, N80, C90,T95	P, S, L, B
7-5/8"	29.70	193.68	44.2	9.52	L80, N80, C90,T95, P110	P, L, B
7-5/8"	33.70	193.68	50.15	10.92	L80, N80, C90,T95, P110	P, L, B
8-5/8"	28.00	219.08	41.67	7.72	H40	P, S
8-5/8"	32.00	219.08	47.67	8.94	H40, J55, K55	P, S
8-5/8"	36.00	219.08	53.57	10.16	J55, K55, L80, N80, C90,T95	P, S, L, B
8-5/8"	40.00	219.08	59.53	11.43	L80, N80, C90,T95, P110	P, S, L, B
9-5/8"	36.00	244.48	53.57	8.94	H40, J55, K55	P, S, L, B
9-5/8"	40.00	244.48	59.53	10.03	J55, K55, L80, N80, C90,T95	P, S, L, B
9-5/8"	43.50	244.48	64.73	11.05	L80, N80, C90,T95, P110	P, L, B
9-5/8"	47.00	244.48	69.94	11.99	L80, N80, C90,T95, P110	P, L, B
10-3/4"	40.50	273.05	60.27	8.89	H40, J55, K55	P, S, B
10-3/4"	45.50	273.05	67.71	10.16	J55, K55	P, S, B
10-3/4"	51.00	273.05	75.9	11.43	J55, K55, L80, N80, C90,T95, P110	P, S, B
11-3/4"	42.00	298.45	69.94	9.53	J55, K55	P, S, B
11-3/4"	47.00	298.45	80.36	11.05	J55, K55	P, S, B
13-3/8"	54.50	339.72	81.1	9.65	J55, K55	P, S, B
13-3/8"	61.00	339.72	90.78	10.92	J55, K55	P, S, B
13-3/8"	68.00	339.72	101.19	12.19	J55, K55, L80, N80, C90,T95, P110	P, S, B
13-3/8"	72.00	339.72	107.15	13.06	L80, N80, C90,T95, P110	P, S, B
16"	75.00	406.4	111.61	11.13	J55, K55	P, S
16"	84.00	406.4	125.01	12.57	J55, K55	P, S, B
18-5/8"	87.50	473.08	130.21	11.05	H40, J55, K55	P, S, B
20"	94.00	508	139.89	11.13	H40, J55, K55	P, S, L, B
20"	106.50	508	158.49	12.7	J55, K55	P, S, L, B

Abbreviations

P: Plain End *L: Long threaded*
S: Short threaded *B: Buttress threaded*

Casing thread types:

P: Plain end
SC: Short round Casing thread
LC: Long round Casing thread
BC:Buttress Casing thread

Tolerances:

Outside Diameter permissible deviation: +%1 / -%0,5
Wall Thickness permissible deviation: -%12,5 (+tolerance by weight)
Weight Deviation: +%6,5 / -%3,5

Length Ranges:

Range-1: 16- 25 feet (4,88 - 7,62m)
Range-2: 25- 34 feet (7,62 - 10,36)
Range-3: 34- 48 feet (10,36 - 14,63)

TUBING, API 5CT ISO 11960

Fields of Usage

Used in oil, natural gas, hot water and steam drillings

Tubing Pipe Dimensions and Weights

Labels			Outside Diameter	Weight		Wall	Steel Grades	Pipe Ends
Inch	NU	EU		NU	EU			
	Lb/ft	Lb/ft	mm	kg/m	kg/m	mm		
1.900"	2.40	-	48.26	-	-	3.18	H40, J55	P
1.900"	2.75	2.90	48.26	4.09	4.32	3.68	H40, J55, L80, N80, C90, T95	P, N,U
1.900"	3.65	3.73	48.26	5.43	5.55	5.08	H40, J55, L80, N80, C90, T95, P110	P,U
1.900"	4.42	-	48.26	6.58	-	6.35	L80, C90, T95	P
2-3/8"	4.00	-	60.32	5.95	-	4.24	H40, J55, L80, N80, C90, T95	P,N
2-3/8"	4.60	4.70	60.32	6.85	6.99	4.83	H40, J55, L80, N80, C90, T95,P110	P,N,U
2-3/8"	5.80	5.80	60.32	8.63	8.85	6.45	L80, N80, C90, T95, P110	P,N,U
2-7/8"	6.40	6.50	73.02	9.52	9.67	5.51	H40,J55,L80, N80, C90, T95, P110	P,N,U
2-7/8"	7.80	7.90	73.02	11.61	11.76	7.01	L80, N80, C90, T95, P110	P,N,U
2-7/8"	8.60	8.70	73.02	12.80	12.95	7.82	L80, N80, C90, T95, P110	P,N,U
2-7/8"	9.35	9.45	73.02	13.91	14.06	8.64	L80, N80, C90, T95	P,U
3-1/2"	7.70	-	88.90	11.46	-	5.49	H40,J55,L80, N80, C90, T95	P,N
3-1/2"	9.20	9.30	88.90	13.69	13.84	6.45	H40,J55,L80, N80, C90, T95, P110	P,N,U
3-1/2"	10.20	-	88.90	15.18	-	7.34	H40,J55,L80, N80, C90, T95	P,N
3-1/2"	12.70	12.95	88.90	18.90	19.27	9.52	H40,J55,L80, N80, C90, T95, P110	P,N,U
4"	9.50	-	101.60	14.14	-	5.74	H40,J55,L80, N80, C90, T95	P,N
4"	10.70	11.00	101.60	-	16.37	6.65	H40,J55,L80, N80, C90, T95	P,U
4"	13.20	-	101.60	19.64	-	8.38	L80,C90,T95	P
4-1/2"	12.60	12.75	114.30	18.75	18.97	6.88	H40,J55,L80, N80, C90, T95	P,N,U
4-1/2"	15.20	-	114.30	22.62	-	8.56	L80,C90,T95	P
4-1/2"	17.00	-	114.30	25.30	-	9.65	L80,C90,T95	P
4-1/2"	18.90	-	114.30	28.13	-	10.92	L80,C90,T95	P

Abbreviations

P: Plain End
N: Non-upset T&C
U: External-upset T&C
NU: Non-upset Tubing Threaded and coupled
EU: External-Upset Tubing Threaded and Coupled

Tolerances:

Outside Diameter permissible deviation: ±0,031 inch/ ±0,79 mm
Wall Thickness permissible deviation: -%12,5 (+tolerance by weight)
Weight Deviation: +%6,5 / -%3,5

Length Ranges:

Range-1: 20- 24 feet (6,10 - 7,32m)
Range-2: 28- 32 feet (8,53- 9,75)

COMPARİSON TABLE (GOST 8731 - 8732 VE DIN 17121, 1629, 1630)

Chemical Composition

Steel Grade		Chemical Composition (%)							
GOST	DIN	C	Mn	Si	P	S	Cr	N	Al
10		0.07 - 0.14	0.35 - 0.65	0.17 - 0.37	≤ 0.035	≤ 0.040	≤ 0.15	≤ 0.008	
	St 37.0	≤ 0.17	-	-	≤ 0.040	≤ 0.040	-	≤ 0.009	-
	St 37.2	≤ 0.17	-	-	≤ 0.050	≤ 0.050	-	≤ 0.009	-
	St 37.3	≤ 0.17	-	-	≤ 0.040	≤ 0.040	-	-	≥ 0.020
	St 37.4	≤ 0.17	≥ 0.35	≤ 0.35	≤ 0.040	≤ 0.040	-	-	≥ 0.020
20		0.07 - 0.24	0.35 - 0.65	0.17- 0.37	≤ 0.035	≤ 0.040	≤ 0.25	≤ 0.008	
	St 44.0	≤ 0.21	-	-	≤ 0.040	≤ 0.040	-	≤ 0.009	-
	St 44.2	≤ 0.21	-	-	≤ 0.050	≤ 0.050	-	≤ 0.009	-
	St 44.3	≤ 0.20	-	-	≤ 0.040	≤ 0.040	-	-	≥ 0.020
	St 44.4	≤ 0.20	≥ 0.40	≤ 0.35	≤ 0.040	≤ 0.040	-	-	≥ 0.020
35		0.32 - 0.40	0.50 - 0.80	0.17 - 0.37	≤ 0.035	≤ 0.040	0.25	≤ 0.008	
40		0.42 - 0.50	0.50 - 0.80	0.17 - 0.37	≤ 0.035	≤ 0.04	≤ 0.25	≤ 0.008	-
	St 52.0	≤ 0.22	≤ 1.6	≤ 0.55	≤ 0.040	≤ 0.035	-	-	≥ 0.020
	St 52.3	≤ 0.22	≤ 1.6	≤ 0.55	≤ 0.040	≤ 0.040	-	-	≥ 0.020
	St 52.4	≤ 0.22	≤ 1.6	≤ 0.55	≤ 0.040	≤ 0.035	-	-	≥ 0.020

Mechanical Properties

Steel Grade		Tensile Strength (MPa)	Yield Strength (MPa)			Elongation	
GOST	DIN		t ≤ 16 mm	16 ≤ t ≤ 40	t > 40	Longitudinal	Transverse
10		≥ 353	≥ 206	≤ 0.035	≤ 0.040	24	
	St 37.0	350 - 480	≥ 235	≤ 0.040	≤ 0.040	25	23
	St 37.2	340 - 470	≥ 235	≤ 0.050	≤ 0.050	26	24
	St 37.3	340 - 470	≥ 235	≤ 0.040	≤ 0.040	26	24
	St 37.4	350 - 480	≥ 235	≤ 0.040	≤ 0.040	25	23
20		≥ 412	≥ 245	≤ 0.035	≤ 0.040	21	
	St 44.0	420 - 550	≥ 275	≤ 0.040	≤ 0.040	21	19
	St 44.2	410 - 540	≥ 275	≤ 0.050	≤ 0.050	22	20
	St 44.3	410 - 540	≥ 275	≤ 0.040	≤ 0.040	22	20
	St 44.4	420 - 550	≥ 275	≤ 0.040	≤ 0.040	21	19
35		≥ 510	≥ 294	≥ 294	≥ 294	17	
40		≥ 588	≥ 323	≥ 323	≥ 323	14	
	St 52.0	500 - 650	≥ 355	≥ 345	≥ 335	21	19
	St 52.3	490 - 630	≥ 355	≥ 345	≥ 335	22	20
	St 52.4	500 - 650	≥ 355	≥ 345	≥ 335	21	19

CHEMICAL COMPOSITION REQUIREMENTS OF CASINGS AND TUBINGS

Group	Grade	Type	C		Mn		Mo		Cr		Ni max.	Cu max.	P max.	S max.	Si max.
			min.	max.	min.	max.	min.	max.	min.	max.					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	H40	-	-	-	-	-	-	-	-	-	-	-	0.030	0.030	-
	J55	-	-	-	-	-	-	-	-	-	-	-	0.030	0.030	-
	K55	-	-	-	-	-	-	-	-	-	-	-	0.030	0.030	-
	N80	1	-	-	-	-	-	-	-	-	-	-	0.030	0.030	-
	N80	Q	-	-	-	-	-	-	-	-	-	-	0.030	0.030	-
	R95	-	-	0,45 C	-	1.90	-	-	-	-	-	-	0.030	0.030	0.45
2	M65	-	-	-	-	-	-	-	-	-	-	-	0.030	0.030	-
	L80	1	-	0,43	-	1.90	-	-	-	-	0.25	0.35	0.030	0.030	0.54
	L80	9Cr	-	0.15	0.30	0.60	0.90	1.10	8.00	10.00	0.50	0.25	0.020	0.020	1.00
	L80	13Cr	0.15	0.22	0.25	1.00	-	-	12.00	14.00	0.50	0.25	0.020	0.020	1.00
	C90	1	-	0.35	-	1.20	0,25b	0.85		1.50	0.99	-	0.020	0.020	-
	T95	1	-	0.35	-	1.20	0,25d	0.85	0.40	1.50	0.99	-	0.020	0.020	-
	C110	-	-	0.35	-	1.20	0.25	1.00	0.40	1.50	0.99	-	0.020	0.020	-
3	P110	e	-	-	-	-	-	-	-	-	-	-	0,03e	0,03e	-
4	Q125	1	-	0.35		1.35		0.85		1.50	0.99	-	0.020	0.020	-

A: The carbon content for L80 may be increased up to 0,50 % maximum if the product is oil-quenched.
B: The molybdenum content for Grade C90 Type 1 has no minimum tolerance if the wall thickness is less than 17,78 mm.
C: The carbon content for R95 may be increased up to 0,55 % maximum if the product is oil-quenched.
D: The molybdenum content for T95 Type 1 may be decreased to 0,15 % minimum if the wall thickness is less than 17,78 mm.
E: For EW Grade P110, the phosphorus content shall be 0,020 % maximum and the sulfur content 0,010 % maximum.

Mechanical Properties of API 5CT Casing and Tubing

Grade	Yield Strength, psi/MPa		Tensile Strength, psi/MPa	Elongation %
	min.	max.		
H40	40000/276	80000/552	60000/414	28
J55	55000/ 379	80000/ 552	75000/ 517	23
K55	55000/ 379	80000/ 552	95000/ 655	19
N80	80000/ 552	110000/ 758	100000/ 689	18
L80-1	80000/ 552	95000/ 655	95000/ 655	19
C90	90000/ 621	105000/ 724	100000/ 689	18
T95	95000/ 655	110000/ 758	105000/ 724	17
P110	110000/758	140000/ 965	125000/ 862	15
Q125	125000/862	150000/1034	135000/931	14

Drill-Pipe-Body Outside-Diameter Tolerances

Label	Tolerances
Pipe Body	
≤4	±0,79 mm
>4	+1% Ddp
	-0,5%
Drill-pipe-body behind the meu	
≥2-3/8 to ≤ 3-1/2	+2,38% / -0,79 mm
>3-1/2 to ≤ 5	+2,78 / -0,75% Ddp
> 5 to ≤ 6-5/8	+3,18 / -0,75% Ddp

Drill-Pipe Length (meters)

Length, L, inclusive	Range 1 6,10 - 7,01	Range 2 8,84- 9,75	Range 3 12,19- 13,72
Limitation for 95% of order quantity			
Maximum variation	0.61	-	-
Minimum Length	6.40	-	-
Limitation for 90% of order quantity			
Maximum variation	-	0.91	0.91
Minimum Length	-	9.14	12.19

Chemical Composition Requirements of Drill Pipes

Length, L, inclusive	Phosphorus Maximum %	Sulfur Maximum %
Pipe body: Grade E	0.030	0.020
Pipe body: Grade X, G and S	0.020	0.015
Tool Joint	0.020	0.015

Mechanical Properties of API 5DP Drill Pipes

	Yield strength, MPa		Tensile strength, Mpa	Elongation, %
Drill-pipe- body	Min.	Max.	Min.	Max.
Grade E	517	724	689	19
Grade X	655	862	724	18
Grade G	724	931	793	16
Grade S	931	1138	1000	13
Tool Joint	827	1138	965	13

API 5DP Drill Pipes, Main Dimensions and Mass

Designations					Pipe body OD	Wall thickness	Weld neck	Takım Kafaları				Bevel Dia.	Mass kg/m
								OD	ID	OD Length	OD Length		
Label-1	Label-2	Grade	Upset Type	RSC Type	Ddp mm	T mm	Dte mm	D mm	Dp mm	Lpb mm	Lb mm	Df mm	Wdp kg/m
						-12.50%	Max.	±0,8	-0.5	±6,4	±6,4	±0,4	Calculated
4"	14.00	X	IU	NC40	101.6	8.38	106.4	133.4	68.3	177.8	254	127.4	22.76
4"	14.00	G	IU	NC40	101.6	8.38	106.4	139.7	61.9	177.8	254	127.4	23.61
4-1/2"	13.75	E	IU	NC46	114.3	6.88	119.1	152.4	85.7	177.8	254	145.26	22.5
2-3/8"	6.65	E	EU	NC26	60.32	7.11	65.1	85.7	44.5	177.8	203.2	82.95	10.45
2-3/8"	6.65	X, G	EU	NC26	60.32	7.11	65.1	85.7	44.5	177.8	203.2	82.95	10.58
2-7/8"	10.40	E	EU	NC31	73.02	9.19	81	104.8	54	177.8	228.6	100.41	16.25
2-7/8"	10.40	X, G	EU	NC31	73.02	9.19	81	104.8	50.8	177.8	228.6	100.41	16.5
2-7/8"	10.40	S	EU	NC31	73.02	9.19	81	111.1	41.3	177.8	228.6	100.41	17.19
3-1/2"	13.30	E	EU	NC38	88.9	9.35	98.4	120.7	68.3	203.2	266.7	116.28	20.77
3-1/2"	13.30	X	EU	NC38	88.9	9.35	98.4	127	65.1	203.2	266.7	116.28	21.76
3-1/2"	13.30	G	EU	NC38	88.9	9.35	98.4	127	61.9	203.2	266.7	116.28	21.9
3-1/2"	13.30	S	EU	NC38	88.9	9.35	98.4	127	54	203.2	266.7	116.28	22.22
4	14.00	X	EU	NC46	101.6	8.38	114.3	152.4	82.6	177.8	254	145.26	24.12
4	14.00	G	EU	NC46	101.6	8.38	114.3	152.4	76.2	177.8	254	145.26	24.46
4-1/2"	16.60	E	EU	NC50	114.3	8.56	127	168.3	95.3	177.8	254	153.99	27.51
4-1/2"	16.60	X, G	EU	NC50	114.3	8.56	127	168.3	95.3	177.8	254	153.99	28.07
4-1/2"	16.60	S	EU	NC50	114.3	8.56	127	168.3	88.9	177.8	254	153.99	28.47
4-1/2"	20.00	E	EU	NC50	114.3	10.92	127	168.3	82.1	177.8	254	153.99	32.93
4-1/2"	20.00	X, G	EU	NC50	114.3	10.92	127	168.3	88.9	177.8	254	153.99	33.63
4-1/2"	16.60	X, G	IEU	NC46	114.3	8.56	119.1	158.8	76.2	177.8	254	145.26	27.73
4-1/2"	16.60	S	IEU	NC46	114.3	8.56	119.1	158.8	69.9	177.8	254	145.26	28.04
5	19.50	G	IEU	NC50	127	9.19	130.2	168.3	82.6	177.8	254	153.99	32.95
5	19.50	S	IEU	NC50	127	9.19	130.2	168.3	69.9	177.8	254	153.99	33.6
5	19.50	E	IEU	5 1/2 FH	127	9.19	130.2	177.8	95.3	203.2	254	170.66	33.22
5	19.50	X, G	IEU	5 1/2 FH	127	9.19	130.2	177.8	95.3	203.2	254	170.66	33.61
5	19.50	S	IEU	5 1/2 FH	127	9.19	130.2	184.2	88.9	203.2	254	170.66	34.89
5-1/2"	21.90	X	IEU	5 1/2 FH	139.7	9.17	144.5	177.8	95.3	203.2	254	170.66	36.36
5-1/2"	21.90	G	IEU	5 1/2 FH	139.7	9.17	144.5	184.2	88.9	203.2	254	170.66	37.61
5-1/2"	21.90	S	IEU	5 1/2 FH	139.7	9.17	144.5	190.5	76.2	203.2	254	180.18	39.27
5-1/2"	24.70	E	IEU	5 1/2 FH	139.7	10.54	144.5	177.8	101.6	203.2	254	170.66	39.19
6-5/8"	25.20	E	IEU	6 5/8 FH	168.28	8.38	176.2	203.2	127	203.2	279.4	195.66	41.03
6-5/8"	25.20	X	IEU	6 5/8 FH	168.28	8.38	176.2	203.2	127	203.2	279.4	195.66	41.03
6-5/8"	25.20	G	IEU	6 5/8 FH	168.28	8.38	176.2	209.6	120.7	203.2	279.4	195.66	42.6
6-5/8"	25.20	S	IEU	6 5/8 FH	168.28	8.38	176.2	215.9	108	203.2	279.4	195.66	44.73

Designations are shown for the purpose of identification in ordering.

RSC Tipi: *The RSC Type indicates the size and the style of the applicable rotary shouldered connection.*

IU: *Internal Upset.* **EU:** *External Upset.* **IEU:** *Internal and External Upset.*

LONGITUDINALLY WELDED PIPES

Consturction	
DIN 1626-84 (EN 10217-1)	ST 37.00
	ST 44.0
	ST 52.0

ASTM A 671 Class 10 Class 43	
Pipe Grade	
CA 55	ASTM A 285 Grade C
CC 60	ASTM A 516 Grade 60
CC 65	ASTM A 285 Grade C
CC 70	ASTM A 285 Grade C
CD 70	ASTM A 285 Grade C

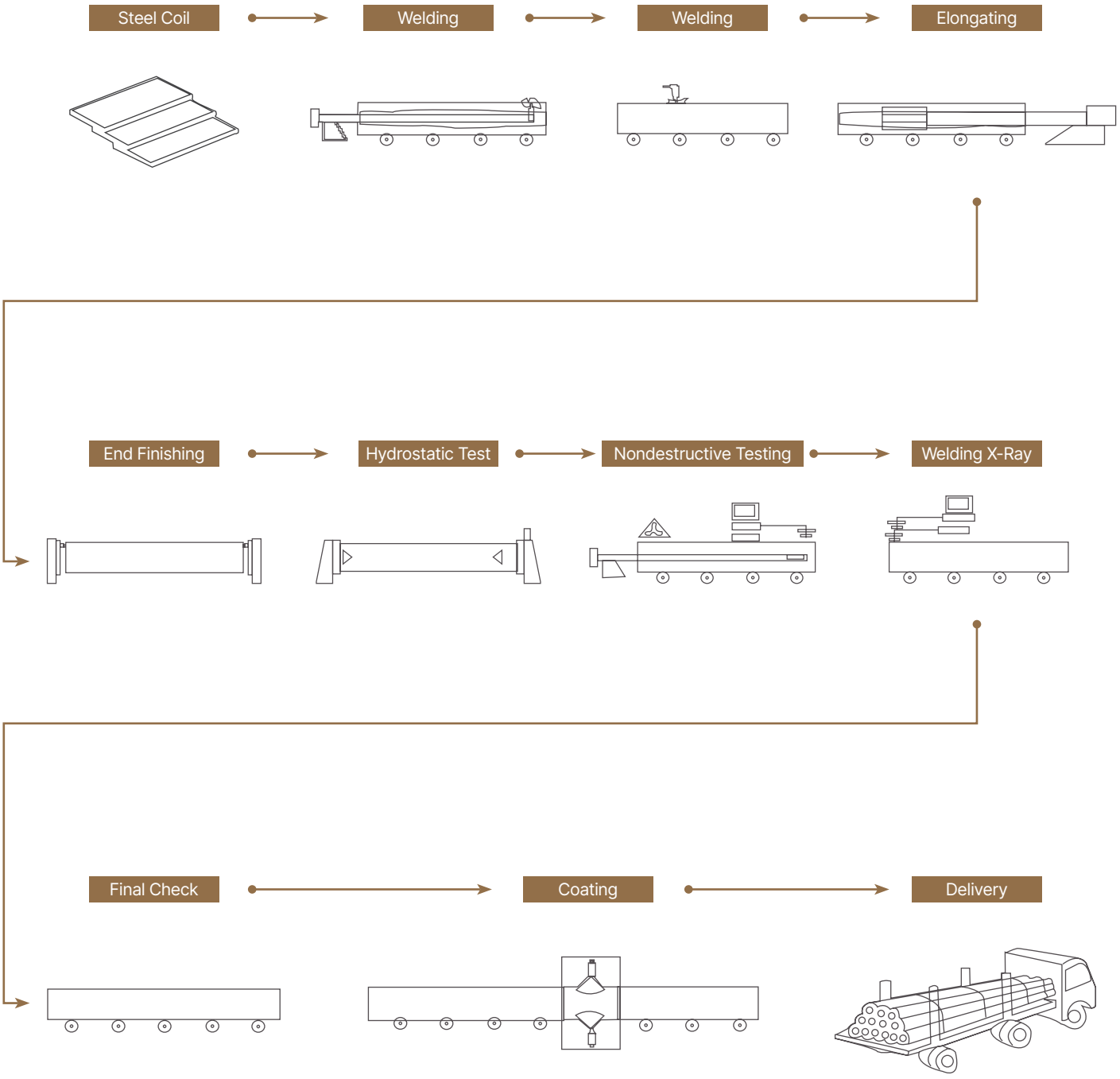
ASTM A 672 Class 10 Class 43	
Pipe Grade	
A 45	ASTM A 285 Grade A
A 50	ASTM A 285 Grade B
A 55	ASTM A 285 Grade C
C 55	ASTM A 516 Grade 55
C 60	ASTM A 516 Grade 60
C 65	ASTM A 516 Grade 65
C 70	ASTM A 516 Grade 70
D 70	ASTM A 537 Grade 1

API Standart / DIN EN ISO 3183
Pipe Grade
API 5 L Grade B / L 245
API 5 L X 42 / L 290
API 5 L X 46 / L 320
API 5 L X 52 / L 360
API 5 L X 56 / L 390
API 5 L X 60 / L 415
API 5 L X 65 / L 450
API 5 L X 70 / L 485

DIN EN- Material Grades	
S 235 AR – J2 + N	DIN EN 10025-2
S 275 JR + N	DIN EN 10025-
S 355 J2	DIN EN 10025-2
S 235 J2W – S 355 J2W	DIN EN 10025-5(Corten)
P 235 GH – P 355 GH	DIN EN 10028-2
P 275 NH – P 460 NH	DIN EN 10028-3
P 275 NL 1 – P 460 NL 2	DIN EN 10028-3
16 Mo 3	DIN EN 10028-2
13 Cr Mo 4-5	DIN EN 10028-2
10 Cr Mo 9-10	DIN EN 10028-2
X 12 Cr Mo 5	DIN EN 10028-2

Wall Thickness	inch	0.20	0.25	0.28	0.31	0.38	0.43	0.50	0.56	0.63	0.75	0.87	1.00	1.13	1.18	1.38	1.57	1.77	1.97	2.17	2.36	2.56	2.76	2.95	3.15	3.35	3.54	3.74	3.94	4.13
	mm	5.00	6.35	7.1	7.92	9.53	11	12.7	14.2	15.88	19	22	25.4	28.6	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
Diameter																														
406.4	16																													
457.2	18																													
508.0	20																													
558.8	22																													
609.6	24																													
660.4	26																													
711.2	28																													
762.0	30																													
812.8	32																													
863.6	34																													
914.4	36																													
965.2	38																													
1016.0	40																													
1066.8	42																													
1117.6	44																													
1168.4	46																													
1219.2	48																													
1270.0	50																													
1320.8	52																													
1371.6	54																													
1422.4	56																													
1473.2	58																													
1524.0	60																													
1574.8	62																													
1625.6	64																													
1676.4	66																													
1727.2	68																													
1778.0	70																													
1828.8	72																													
1879.6	74																													
1930.4	76																													
1981.2	78																													
2032.0	80																													
2082.8	82																													
2133.6	84																													
2184.4	86																													
2235.2	88																													
2286.0	90																													
2336.8	92																													
2387.6	94																													
2438.4	96																													
2489.2	98																													
2540.0	100																													
2590.8	102																													
2641.6	104																													
2692.4	106																													
2743.2	108																													
2794.0	110																													
2844.8	112																													
2895.6	114																													
2946.4	116																													
2997.2	118																													
3048.0	120																													
3098.8	122																													
3149.6	124																													
3200.4	126																													
3251.2	128																													
3302.0	130																													
3352.8	132																													
3403.6	134																													
3454.4	136																													
3556.0	140																													
3606.8	142																													
3657.6	144																													
3708.4	146																													
3759.2	148																													
3810.0	150																													
3860.8	152																													
3911.6	154																													
3962.4	156																													
4013.2	158																													
4064.0	160																													
4114.8	162																													
4165.6	164																													
4216.4	166																													
4267.2	168																													
4318.0	170																													
4368.8	172																													
4419.6	174																													
4470.4	176																													
4521.2	178																													

WELDED PIPE PRODUCTION FLOW CHART



EFFECTS OF ALLOY ELEMENTS ON STEELS

Iron carbon alloys containing a maximum of 2.06% carbon are called steel. Steels still constitute the most widely used material group today. Steels can be plain carbon or contain low alloyed elements to improve various properties. Some elements in steel are willingly added alloying elements, and the elements that are desired to be removed because of adversely affecting the properties. The alloying elements of steels and their effects are:

Carbon (C):

Carbon, the fundamental alloying element of steels, takes its place in the structure during the production processes of steels. The amount of carbon is the factor that mainly affects the mechanical properties of steel. Carbon increases steel's yield and tensile strength and reduces percentage elongation, formability, and weldability. In steels where processability is at the forefront, the carbon amount should be kept low, and in cases where the endurance values need to be high, the carbon content of the steel should be higher.

The most significant problem that may occur during the shaping of low-carbon mild steels is blue brittleness. This phenomenon is caused by the easy diffusion of carbon (and/or nitrogen) atoms due to their small diameter and creates brittleness during processing. Blue Brittleness: If mild steels are shaped between 270-350 0C, small-scale atoms diffuse rapidly. Diffusing atoms lock the dislocations, raising the yield point of their material. Therefore, the material behaves more brittle. This phenomenon is called blue embrittlement since the steel acquires blue colour within the mentioned temperatures.

Manganese (Mn):

Manganese, like carbon, is an element in the steel structure that appears during production processes and boosts the strength of the steel. In addition, it grows hardenability and weldability and is an austenite stabilizing element. The primary feature of manganese is that it makes an MnS compound with sulfur and precludes the formation of an iron-sulfur FeS compound. FeS yields hot brittleness.

Silicon (Si):

Since silicon is used as a deoxidizer, it is included in the steel. It increases the yield, tensile strength, and elasticity of the steel. As the silicon amount in the steel structure decreases, the descaling rate increases. Silicon is a cheap alloying element, and widely used in spring steels that require high elasticity. It is also an element that prevents electrical current loss. Wire rods with a high silicon content are difficult to be reduced to fractional diameters, because silicon hardens the wire, which is made into material wire, and causes breakage. Therefore, low silicon in wire rods is preferred.

Phosphorus (P):

Phosphorus increases the yield-tensile strength of the steel, worsens the percentage elongation and bending properties too much, creates cold brittleness, and enhances the machining operation capacity. Phosphorus is an element left over in steel after the production processes and is extracted from the structure as much as possible due to its undesirable properties. The maximum amount of phosphorus in quality tempered steels is 0.035 %.

Sulphur (S):

It has scarcely any effect on yield and tensile strength but an immense influence on the percentage elongation and material toughness. Sulfur significantly reduces the toughness and ductility of the material. It also adversely affects weldability. Sulfur combines with iron and forms the FeS phase. Since this phase has a low melting temperature, it melts at the rolling temperature and generates hot brittleness. This unfavorable effect is prevented by combining sulfur with manganese.

Sulfur is an element left over in steel after steel production and is released from the structure as much as possible due to the above-mentioned undesirable properties. The amount of sulfur is kept high only in free-cutting steels appropriate for machining. The maximum amount of sulfur in quality tempered steels is 0.045 %, and in basic tempered steels, it is 0.035 %.

Chromium (Cr):

Chromium is the fundamental alloying element of stainless steel. Chromium gives resistance to corrosion and oxidation and increases hardenability. It increases wear resistance in high-carbon steels. Together with chromium carbon, it reduces the amount of chromium in the grain boundaries below the corrosion limit of 12%. This compound is easily formed by the acceleration of carbon diffusion at high temperatures, causing weld distortions in welded stainless steels near the welded scam.

Nickel (Ni):

Nickel increases impact toughness and strength in annealed steels. Nickel is the second most essential alloying element in austenitic stainless steels, following chromium. The nickel content in austenitic stainless steels is between 7-20%. Nickel is a stabilizing element, and the lattice structure of austenitic stainless steels, even at room temperature, as its very name signifies, is KYM. KYM lattice structure gives high formability to austenitic stainless steel.

Molybdenum (Mo):

It prevents grain growth and increases its hardening ability. In tempering temperatures, carbide precipitation occurs at the grain boundaries of some alloys from slow cooling, resulting in brittleness. Molybdenum eliminates this adverse effect. In addition, molybdenum increases the creep strength and wear resistance of steels. It is an essential alloying element in alloy tool steels. It significantly increases corrosion resistance, notably preventing plowing corrosion in stainless steel. In some micro-alloyed steels, molybdenum, the alloying element that forms nitride or carbonitrides, is used.

Cobalt (Co):

It is an alloying element used in alloy tool steels. It is used to maintain the hardness of tool steels in the heat.

Wolfram (W):

It is an alloying element that increases wear resistance and maintains hardness in hot weather. It is an alloying element widely used in alloy tool steels, especially speed steels.

Vanadium (V):

It considerably increases the yield and tensile strength of steels by making a grain refinement effect. It also has positive effects on hardenability, damascening, and second hardening. It is an alloying element that has use in alloy tool steels.

Vanadium is a microalloying element used together with niobium and titanium in micro-alloyed steels due to its grain refining and carbide-forming impact. The sum of alloying elements in micro-alloy steels does not exceed 0.25%. These elements not only refine the grain size with the carbonitride precipitates they form in the microstructure in single, double, and triple compositions but augment the strength with the precipitation hardening mechanism.

Feature	C	Mn	Si	Cr	Ni	W	Mo	V	Co	Ti
Tensile Strength	++	+	+	+	+	+	+	+	+	V
Stretch	-	V	-	V	+	-	0	0	-	+
Hardenability	++	+	0	0	0	+	0	0	0	V
Roughness	++	+	+	+	+	+	+	+	+	+
Thermal Resistance	+	+	+	+	+	++	++	++	+	+
Corrosion Resistance	-	+	+	++	++	0	+	+	+	+
Malleabilization	-	V	--	0	0	-	-	-	0	-
Cold Formability	--	-	--	--	--	-	V	V	0	0
Machinability	-	-	-	-	-	-	-	-	0	-
Weldability	-	V	-	V	V	0	-	-	0	+

Signs

- **V** *Variable*
- **++** *More incentive*
- **+** *Incentive*
- **0** *No effect*
- **-** *Reducer*
- **--** *More reducer*

TECHNICAL DATA AND CONVERSION TABLE

The Carbon Equivalent Content (CE) is used to understand how different alloying elements affect the hardness and weldability of steel.

$$CE = \%C + \frac{(\%M + \%Si)}{6} + \frac{(\%Cr + \%Mo + \%V)}{5} + \frac{(\%Cu + \%Ni)}{15}$$

Equivalent Carbon	Weldability
< 35	Excellent
0,36-0,40	Very Good
0,41-0,45	Good
0,46-0,50	Average
50 <	Poor

Length	
feet (ft)	0,3048 meter (m)
feet (ft)	meter (m)
inch (in)	25,4 milimeter (mm)
inch (in)	milimeter (mm)
yard (yd)	0,9144 meter (m)
yard (yd)	meter (m)
mile (USA)	1.609 meter (m)
mile (USA)	meter (m)
meter (m)	3,28 feet (ft)
meter (m)	feet (ft)
meter (m)	39,37 inch (in)
meter (m)	inch (in)
meter (m)	10.936 yard (yd)
meter (m)	yard (yd)

Temperature	
9/5 x °C + 32	°F (Fahrenheit)
5/9 x (°F - 32)	°C (Celcius)

Volume	
feet cube (ft^3)	0,02832 metercube (m^3)
cubic feet (ft^3)	cubic meter (m^3)
inch cube (in^3)	16.387 santimeter cube (m^3)
cubic inch (in^3)	cubic centimeter (m^3)
gallon (English)	4.546 litre (dm^3)
gallon (GB)	liter (dm^3)
gallon (USA)	3.785 litre (dm^3)
gallon (USA)	liter (dm^3)
metercube (m^3)	35,31 feet cube (ft^3)
cubic meter (m^3)	cubic feet (ft^3)
litre (dm^3).	61.024 inch cube (in^3)
liter (dm^3)	cubic inch (in)
litre (dm^3).	0,22 gallon (English)
liter (dm^3)	gallon (GB)
litre ().Barrel Petrol	0,2642 gallon (USA)
liter ()	gallon (USA)
US Gallon	159 litre
Barrel Petrol (42 US Gallon)	liter

Weight	
Pound or Libre. (lb.)	0,4536 kg
Pound or Libre (lb.)	kg
lb/ft^3.	16,02 kg/m^3
lb/in^3	27.680 kg/m^3
kg/m^2	0,0624 lb/ft^3
kg/dm^3	62,4 lb/ft^3
kg/dm^3	0,036 lb/in^3
lb/gallon (USA)	119,83 kg/m^3
lb/yard cube	0,5933 kg/m^3
ton, long (22.401 bs)	1.016 kg
tonne, long (22.401 bs)	kg
ton, short (20.000 lbs)	907,2 kg
tonne, short (20.000 lbs)	kg
ton, metric	1.000 kg
tonne, metric	kg

Force	
Kilogramforce (kgf)	9,81 Newton (N)
Kilogramforce (kgf)	Newton (N)
Newton (N)	0,102 Kilogramforce (kgf)
Newton (N)	Kilogramforce (kgf)

Pressure	
Pascal (Pa)	1 (Newton/metersquare (N/m^2)
Pascal (Pa)	(Newton/squaremeter (N/m^2)
Pascal (Pa)	0,001 kiloPascal (kPa)
kg/cm^2	98.066 kPa
kg/cm^2	9,81 Pa
kg/m^2	9,81 Pa
	100 Pa
	0,0102 kg/cm^2

Flow	
ft/seconds	0,02832 m^3/seconds
ft/second	m^3/second
ft/seconds	1700 litre/minika
ft/second	liter/min
in /min	2,73x10 m^3/seconds
in^3/min	m^3/second
in /min	2,73x10 litre/seconds
in^3/min	liter/second
m^3/hour	0,588 ft/min (cfm)
m^3/h	ft^3/min (cfm)
m^3/hour	4.404 gallon/min (gpm),USA
m^3/h	gallon/min (gpm), USA

Area	
feet square (ft^2)	0,0929 meter (m^2)
square feet (ft)	square meter (m^2)
inch square (in^2)	0,0006451 meter square
square inch (in)	(m^2)
yard square (yd^2)	square meter (m^2)
square yard (yd)	0,8361 meter square (m^2)
meter square (m^2)	square meter (m^2)
square meter (m^2)	10,76 feet square (ft^2)
meter square (m^2)	square feet (ft)
square meter (m^2)	1550 inch square (in^2)
meter square (m^2)	square inch (in)
square meter (m^2)	1.196 yard square (yd^2)
Ar	square yard (yd^2)
Ar	100 meter square (m^2)

Energy	
kiloWatthour (kWs)	3.600 kjoule (kJ)
kilo Watthour (kWh)	kjoule (kJ)
BTU	1.055 Joule (J)
Joule	0,24 calorie (cal)
Joule	calorie (cal)
Watthour (kWs)	3.600 Joule
Watthour (Wh)	Joule
Watt.seconds (W.s)	1 Joule
BTU	0,252 kilocalorie (kcal)
calorie (cal)	4,19 Joule
calorie (cal)	Joule
calorie (cal)	0,427 kgm
calorie (cal)	kgm
kilogrammeter (kgm)	9,81 Joule
kilogrammeter (kgm)	Joule
Joule/seconds (J/s)	1 Watt (W)
Joule/second (J/s)	Watt (W)
BTU/hour	0,293 Watt (W)
BTU/h	Watt (W)
cal/seconds	41.868 Watt (W)
cal/second	Watt (W)
kcal	1.163 Watt (W)
kcal	Watt (W)

TESTS

Tensile Test

Tensile testing is widely applied to specify essential design information about the material's strength and to classify materials according to their properties. The tensile test is the pulling of the sample prepared according to the standards in one axis, at a certain speed and at a steady temperature, until it breaks off. During the test, while a constantly increasing tensile force is applied to the standard sample, at the same time, the elongation of the piece is recorded.

Following the tensile test, below mechanical properties of the material represented by the sample can be found.

1. Modulus of elasticity
2. Elastic limit
3. Yield stress
4. Tensile strength
5. Toughness
6. % elongation
7. % reduction of area

Flattening Test

The compression test is the opposite of the tensile test in terms of operation. The compression test can also determine the mechanical properties of the materials. The compression test is notably beneficial for measuring the ductility of brittle and semi-brittle materials since the ductility of these materials cannot be measured precisely with the tensile test. The % elongation and % reduction of area values of these materials are almost zero in tensile.

The advantage of the compression test is that very spot samples can be used. This advantage is particularly beneficial when working with unaffordable materials or where very little material is available.

Hardness Measurement Test

The most common test performed on materials is the measurement of their hardness. The reason for this is a parallel relationship between the hardness of a material and its other mechanical properties.

Hardness is a relative measure and is defined as resistance to friction, scratching, cutting, and plastic deformation.

Hardness measurement generally consists of measuring the resistance of the material to the penetration of a standard bit into the material. A properly selected rough bit will leave a mark on the material when plunged into an applied load. In general terms, the hardness of the material is inversely proportional to the size of this mark.

Hardness measurement methods used in laboratories today are as follows:

1. Brinell Hardness Measurement method,
2. Rockwell Hardness Measurement method,
3. Vickers Hardness Measurement method,
4. Micro - hardness test.

Ultrasonic Test

The ultrasonic Test Method, which is applied to detect internal defects, is carried out by sending very short pulsed sound waves with a frequency of 0.1 - 15 MHz into the material. This method is applied to determine the thickness of the test object and cracks in the material or to monitor corrosion within the pipe.

The ultrasonic test is commonly applied to steel and other metals and alloys. An ultrasonic test is a form of non-destructive testing used in many industries, including the aerospace, automotive, and other transportation sectors.

Advantages;

1. Ensures detection of deep flaws.
2. Allows determination of micro flaws.
3. Accessibility of a surface is enough.
4. Produces righter result compared to other non-destructive methods.
5. Displays sizes and shapes of flaws delicately.

Aydın Boru Endüstrisi A.Ş.
Cevizli Mah. Tugay Yolu Cad. Ofisim İstanbul Sitesi A Blok
No:20A İç Kapı No:17 Maltepe/İstanbul

Tel: +90 216 593 16 00
(Pbx) Fax: +90 216 593 16 10