www.peninsulardevastagos.es | info@peninsulardevastagos.es
Tel: (+34) 954 25 90 22 - Fax: (+34) 954 67 63 15

Steel tubes for precision applications – seamless cold drawn tubes **Material data sheet**

Steel designation:	Name	Material-No.
	E235	**1.0308**
	E355	**1.0580**

Scope

This data sheet applies for seamless cold drawn steel tubes of circular cross section for precision applications with specified outside diameter $D \leq 380$ mm.

Application

These steels are standard for vehicle construction, furniture industry and general engineering.

Chemical composition (Heat analysis in %)[1)]

Steel grade	C	Si	Mn	P	S[2)]	Al_{total}[3)]
E235	≤ 0.17	≤ 0.35	≤ 1.20	≤ 0.025	≤ 0.025	≥ 0.015
E355	≤ 0.22	≤ 0.55	≤ 1.60	≤ 0.025	≤ 0.025	≥ 0.020

1) Elements not included in this table (but see footnote 3)) shall not be intentionally added to the steel without the agreement of the purchaser, except for elements which may be added for the purposes of deoxidation and/or nitrogen binding. All appropriate measures shall be taken to prevent the addition of undesirable elements from scrap or other materials used in the steel making process.

2) See option 2.

3) This requirement is not applicable provided the steel contains a sufficient amount of other nitrogen binding elements, such as Ti, Nb or V. When using titanium, the manufacturer shall verify that (Al + Ti/2) ≥ 0,020. Additions of Nb, Ti and V are permitted at the discretion of the manufacturer. The content of these elements shall be reported.

Option 2: For the steel grades E235 and E355 a controlled sulfur content of 0.015 % to 0.040 % is specified to support machinability. It shall be obtained by resulfurizing the steel after maximum desulfurization or alternatively by using a low oxygen process.

Mechanical properties at room temperature

Steel grade	Minimum values for the delivery condition[1)]											
	+C[2)]		+LC[3)]		+SR			+A[4)]		+N		
	R_m N/mm²	A %	R_m N/mm²	A %	R_m N/mm²	R_{eH} N/mm²	A %	R_m N/mm²	A %	R_m N/mm²	R_{eH} N/mm²	A %
E235	480	6	420	10	420	350	16	315	25	340 - 480	235	25
E355	640	4	580	7	580	450[5)]	10	450	22	490 - 630	355	22

1) +C = cold drawn/hard; +LC = cold drawn/soft; +SR = cold drawn and stress released; +A = soft annealed; +N = normalized; R_m = tensile strength; R_{eH} = upper yield strength; A = elongation after fracture

2) Depending on the degree of cold work in the finishing pass the yield strength may nearly be as high as the tensile strength. For calculation purposes the following relationships are recommended:
- for delivery condition +C: $R_{eH} \geq 0.8\ R_m$
- for delivery condition +LC: $R_{eH} \geq 0.7\ R_m$

3) For calculation purposes the following relationship is recommended: $R_{eH} \geq 0.5\ R_m$

4) For tubes with outside diameter ≤ 30 mm and wall thickness ≤ 3 mm the R_{eH} minimum values are 10 N/mm² lower than the values given in this table.

5) For tubes with outside diameter > 160 mm: $R_{eH} \geq 480$ N/mm²

www.peninsulardevastagos.es | info@peninsulardevastagos.es
Tel: (+34) 954 25 90 22 - Fax: (+34) 954 67 63 15

Reference data for some physical properties

Density at 20 °C	Modulus of elasticity kN/mm² at				Thermal conductivity at 20 °C	spec. thermal capacity at 20 °C	spec. electrical resistivity at 20 °C
Kg/dm³	20 °C	100 °C	200 °C	300 °C	W/m K	J/kg K	Ω mm²/m
7,85	210	205	197	190	54	461	0,15

Linear coefficient 10^{-6} K^{-1} of thermal expansion between 20 °C and

100 °C	200 °C	300 °C
11,1	12,1	12,9

Hot forming / Heat treatment (for guidance only)

Hot forming		Heat treatment		
Temperature °C	Type of cooling	Normalizing [1]	Stress relieving anneal [2]	Type of cooling
700-750	Air	850 – 950 °C	580 – 630 °C	Air

[1] Normalizing: Holding time 1 minute per mm wall thickness, minimum 30 minutes

[2] Stress relieving anneal: Holding time 1-2 minutes per mm wall thickness, minimum 30 minutes

Processing / Welding

Standard welding processes for these steel grades are:

TIG– welding
MAG– welding massive wire
MAG– welding cored wire
Arc welding (E)
Submerged arc welding (SAW)

For these steel grades as filler metal the following electrodes and welding wires are recommended:

Process	Filler metal	
TIG	Union I 52	
MAG solid wire	Union K 52 Union K56	
MAG cored wire	Union MV 70 Union BA 70 (Union RV 71)	
Arc welding (E)	Phoenix 120K Phoenix Special D	
SAW	Wire	Powder
	Union S 2 (Union S 2)	UV 400 (UV 306)

www.peninsulardevastagos.es | info@peninsulardevastagos.es
Tel: (+34) 954 25 90 22 - Fax: (+34) 954 67 63 15

These steels can be welded within all thickness ranges according to the afore mentioned welding processes considering the general rules of technology by hand and automatically welding.

The mentioned filler metals apply for highest demands. The details in brackets are for lower demands.
Burning, preheating, welding and stress relieving annealing should occur under consideration of Stahl-Eisen-Material bulletin 088.

Specifications and standards concerning stress relieving annealing have to be observed.

Remark
The material is magnetizable.

References
DIN EN 10305-1:2010-05
ThyssenKrupp

Important Hint
Information given in this data sheet about property or applicability of materials respective products are no assurance of characteristics but serve for description.

Information, with which we like to advise you, relate to the experience of the producers and our own. Warranty for the results of the treatment and application of the products cannot be granted.