EN 10305-1

Steel name	E355*				
Chemical composition*	C	Si	Mn	P	S[b]
	≤ 0.22	≤ 0.55	≤ 1.60	≤ 0.025	≤ 0.025

* Additions of Nb, Ti and V are permitted at the discretion of the manufacturer. The content of these elements shall be reported.
[b] A controlled sulphur content of 0.015% e 0.040% is specified to support machinability.

DELIVERY CONDITIONS

+C	no heat treatment after the final cold drawing process
+LC	after the final heat treatment there is a suitable drawing pass
+SR	after the final cold drawing process there is a stress relief heat treatment in a controlled atmosphere
+A	after the final cold drawing process the tubes are annealed in a controlled atmosphere
+N	after the final cold drawing operation the tubes are normalized in a controlled atmosphere

MECHANICAL PROPERTIES

	+C	+LC	+SR	+A	+N
Tensile strength (R_m) (Mpa) min	640	580	580	450	490 a 630
Yield strength (R_{eH}) (Mpa) min	≥ 0.8 R_m	≥ 0.7 R_m	450*	450	355*
Elongation %	4	7	10	22	22

*For tubes with outside diameter ≤ 30 mm and wall thickness ≤ 3 mm the R_{eH} minimum values are 10Mpa lower than the values given in this table

TOLERANCES

Outside diameter D(mm)	+C +LC	see Table 6	
	Per +SR +A +N is function of Wt/D***		
	≥ 0.05	< 0.05 ≥ 0.025	< 0.025
	1 * val ue tab.6	1.5 * value tab.6	2 * value tab.6
	The tolerances of the outside diameter shall be in accordance with this table divided by 2, with a minimum of ± 0.05 mm ***The diameter tolerances shall be unilateral, with the corresponding range specified in this table		
Inside diameter d(mm)	see Table 6		
Wall thickness Wt(mm)	± 10 % o 0 0.1 mm (whichever is the greater)		

Length L(mm)						
	random length	min. 3m e max.8m (max. range 2m per order item)				
	approximate length	± 500 mm				
	exact length	≤ 500	>500 ≤2000	>2000 ≤5000	>5000 ≤8000	>8000
		*	+3 0	+5 0	+10 0	*

*an agreed unilateral tolerance is specified

STRAIGHTNESS *

	R_{eH} £ 500	R_{eH} > 500
D > 15 mm	0.0015*L	0.002*L
D < 15 mm	Straightness and the inspection method may be agreed at the time of enquiry and order	

* Short exact lengths below 1000mm may have a limit deviation from straightness of 0.003 L

INSPECTION DOCUMENTS (in accordance with EN 10204)

Test report	2.2
Inspection certificate	3.1.B
	3.1.A - 3.1.C The purchaser shall supply to the manufacturer the name and address of the organization or person nominated to carry out the inspection and to issue and validate the inspection document

FREQUENCY OF TESTS

Tensil test	one sample per batch

*A test unit shall comprise not more than 3000m o 500 tubes whichever is the greater mass of the same steel grade and dimensions continuously manufactured by the same process and in the same delivery condition, heat treated, where applicable, in the same batch and the same heat treatment facility Residu al quantities of less than 50 tubes may be added to test units evenly
Option **The test unit shall only contain tubes from one cast.

MARKING

Manufacturer's name	Specified dimensions	The number of this EN (EN 10305 - 1)
Steel name	The cast number, when option ** applies	The delivery condition including the surface condition (symbol)
In case of specific inspection, an identification number which permits the correlation of the product or delivery unit to the related document		

DIN 2391

Steel name	St 52				
Chemical composition*	C	Si	Mn	P	S
	≤ 0.22	≤ 0.55	≤ 1.60	≤ 0.025	≤ 0.025

* The following alloying elements may be added : Nb ≤ 0.03%, Ti ≤ 0.03%, V ≤ 0.05%, Nb+Ti+V≤ 0.05%

DELIVERY CONDITIONS

BK	Tubes do not undergo heat treatment following the final cold forming and, thus, have a rather high resistance to deformation.
BKW	The final heat treatment is followed by cold drawing involving limited deformation. Appropriate further processing allows a certain degree of cold forming (e.g. bending, expanding).
BKS	Heat treatment is applied following the last cold forming process. Subject to appropriate processing conditions, the increase in the residual stresses involved enables both forming and machining to a certain degree
GBK	The last cold forming process is followed by annealing in a controlled atmosphere.
NBK	The last cold forming process is followed by annealing above the upper transformation point in a controlled atmosphere.

MECHANICAL PROPERTIES

	BK	BKS	BKW	GBK	NBK
Tensile strength (R_m) (Mpa) min	640	580	580	490	490 - 630
Yield strength (R_{eH}) (Mpa) min	≥ 80% R_m	≥ 70% R_m	420	≥ 50% R_m	355
Elongation %	4	7	10	22	22

For tubes with D ≤ 30mm e Wt ≤ 3mm the minimum yield strength may be 10N/mm² lower.

TOLERANCES

Outside diameter D(mm)	BK - BKW	see Table 2		
	For GBK – NBK – BKS is function of Wt *			
	≥ 0.05*D	< 0.05*D ≥ 0.025*D	< 0.025*D	
	1* value tab.2	1.5 * value tab.2	2 * value tab.2	
	If one of the limit deviations is to be zero, this shall be stated in the order, e.g. instead of (55±0.25) mm, either ($55^{+0.5}_{0}$) mm or ($55^{0}_{-0.5}$) mm * The dimensions given also apply to the inside diameter			
Inside diameter d(mm)	see Table 2			
Wall thickness Wt(mm)	± 10 %			

Length L(mm)						
	manufacturing lengths	random lengths between 4m and 7m The number of tubes in lengths from 2 m to below 4 m shall not exceed 15% of the quantity ordered and shall be supplied in separate bundles				
	cut lengths	± 500 mm of the length ordered Short lengths of 2000 mm or more being supplied in separate bundles up to a maximum of 10% of the quantity ordered				
	exact lengths	mm				
		≤ 500	> 500 ≤ 2000	> 2000 ≤ 5000	> 5000 ≤ 7000	> 7000
		+ 2 0	+ 3 0	+ 5 0	+ 10 0	to agree

STRAIGHTNESS *

D > 15 mm	0.25% of the total length 0.3 % of the total length for tubes with R_{eH} > 500 N/mm² 0.3 % of the total length for tubes of exact lengths
D < 15 mm	shall be subject to agreement

* Localized deviations shall not exceed 3mm/m

INSPECTION DOCUMENTS (in accordance with DIN 50049)

Without inspection document (quality grade A)	Inspection document	2.2 The manufacturer shall submit tubes to: a dimensional check, a surface inspection, a tensile test, a flatting test, a drift expanding test
With inspection document (quality grade C)	Inspection certificate	3.1B / 3.1A / 3.1C This shall be agreed upon at the time of ordering. The order shall state the type of document requested and the name the testing agency if the inspection is carried out by a third party

FREQUENCY OF TESTS

Tensile test	one sample per batch

Tubes shall be divided according to steel grade, final supply condition and size, into batches each comprising 200 units. Remainders of up to 20 units may be distributed uniformly across the other batches, remainders ranging from 20 to 200 units and consignments of less than 200 units being considered a whole batch

MARKING *

Manufacturer's mark	Technical delivery condition and quality grade	Steel grade
Supply condition (BK, BKW,…)	dimensions	Inspector's mark for tubes with inspection certificate

* A durable tag shall be securely attached to each bundle

UNI 7945:79

Steel name	Fe 490				
Chemical composition	C	Si	Mn	P	S
	≤ 0.23	≤ 0.35	≤ 1.5	≤ 0.050	≤ 0.050

DELIVERY CONDITIONS

GBK	the tubes are annealed in a controlled atmosphere
NBK	the tubes are normalized in a controlled atmosphere
BK	no heat treatment after the final cold drawing process
BKW	Heat treatment is applied following the last cold forming process. Subject to appropriate processing conditions, the increase in the residual stresses involved enables both forming and machining to a certain degree

MECHANICAL PROPERTIES

	BK	BKW	GBK	NBK
Tensile strength (R_m) (Mpa) min	600	550	480	490
Yield strength (R_{eH}) (Mpa) min	600	550	480	285
Elongation %	4	7	23	21

The tubes in the GBK or NBK are to be regarded as weldable. It should, however, be noted that the mechanical properties of cold drawn tubes are modified in the zone of the tube which has been subjected to heat

TOLERANCES

Outside diameter D(mm)	BK - BKW	see Table VII		
	Per GBK - NBK is function of Wt/D			
	≥ 1/20	< 1/20 ≥ 1/40	< 1/40 ≥ 1/60	< 1/60
	1* value table VII	1.5 * value table VII	2 * value table VII	2.5 * value table VII
Inside diameter d(mm)	see Table VII			
Wall thickness Wt(mm)	± 10 % with a minimum of 0.12 mm per 4 ≤ D ≤ 5 mm ± 20 % - per 6 ≤ D ≤ 8 mm ± 15 %			

Length L(mm)	Exact lengths				
	≤ 0.5 m	> 0.5 m ≤ 2 m	> 2 m ≤ 5 m	> 5 m ≤ 7 m	> 7 m
	+ 2 0	+ 3 0	+ 5 0	+ 10 0	to agree
	Manufacturing lengths				
	from 2m to 7m				

STRAIGHTNESS *

D > 15 mm	3 mm/m shall be measured as distance between the tubes surface and the chord linking two random points 1 m apart
	More stringent requirements regarding straightness shall be subject to agreement

* The tubes shall be straight

INSPECTION DOCUMENTS (in accordance with UNI 5447)

Without inspection document	Certificate of compliance with order
	Test report
With inspection document	Inspection certificate
	Inspection report

FREQUENCY OF TESTS

Tensile test	one sample per batch

Tubes shall be divided according to steel grade, final supply condition and size, into batches each comprising 200 units. Remainders of up to 20 units may be distributed uniformly across the other batches. Remainders ranging from 20 to 200 units and consignments of less than 200 units being considered a whole batch

MARKING *

Manufacturer's mark	The number of this norm - (UNI 7945)
Steel grade	Technical delivery condition

* A durable tag shall be securely attached to each bundle