



PSP 00203 Cold Drawn Seamless Steel Tubes
for Hydraulic Cylinder Barrels



Quality System Certified
n. 110950

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Product description and application

Tenaris produces a wide dimensional range of cold drawn seamless tubes suitable for manufacturing of hydraulic cylinder barrels according to Tenaris Specification PSP00203*.

The tubes are manufactured with a new single dimensional range of tight tolerances suitable for subsequent processing to produce cylinder barrels. The wide range of different steel grades supplied in two conditions + N (Normalized) or +SR (Stress Relieved) with improved mechanical and toughness properties.

1. Order definition

Details

TN [Specification] [Grade] [Dimensions]

[Non destructive testing level] [Optional: SB]

Where:

TN	Stands for "Tenaris"
[Specification]	PSP00203/001 - specification code
[Grade]	HCxxx, where xxx is the minimum guaranteed yield strength in MPa. Grades covered by this specification are listed in Section 3.
[Dimensions]	yyy.yy x zzz.zz where yyy.yy and zzz.zz are the tube outside and inside diameters respectively, in mm
[Non destructive testing]	NDTw, where w is the type of non - destructive control and the calibration standard applied - See Section 6
[Optional: SB]	If SB is stated, tubes are required skived and burnished process on the ID after cold drawing

Examples:

TN PSP00203/001 HC355M 150.00 x 130.00 NDT4
Tubes produced according to PSP00203, in grade HC355M, with improved machinability option M, and an outer diameter of 150.00 mm and inside diameter of 130.00 mm, and a non destructive testing level NDT4.

TN PSP00203/001 HC540 250.00 x 220.00 NDT2 SB
Tubes produced according to PSP00203, in grade HC540, outer diameter of 250.00 mm and inside diameter of 220.00 mm, non destructive testing level NDT2, skived and burnished on the ID.

2. Standards of reference

EN 10305-1	Steel tubes for precision applications
EN 10020	Definition and classification of grades of
EN ISO 377	Steel and steel products - Location and preparation of samples and test pieces for mechanical
EN 10002-1	Metallic materials - Tensile testing : Method of test at room temperature
EN 10045-1	Metallic materials - Charpy impact test: test method
EN 10246-3	Non destructive testing of steel tubes - Part 3: Automatic eddy current testing of seamless and welded steel tubes for the detection of imperfections
EN 10246-5	Non destructive testing of steel - Part 5: Automatic full peripheral magnetic transducer/flux leakage testing of seamless and welded ferromagnetic steel tubes for the detection of longitudinal imperfections
EN 10246-6	Non destructive testing of steel tubes - Part 6: Automatic full peripheral ultrasonic testing of seamless and welded steel tubes for the detection of transversal imperfections
EN 10246-7	Non destructive testing of steel tubes - Part 7: Automatic full peripheral ultrasonic testing of seamless and welded steel tubes for the detection of longitudinal imperfections
EN 10246-14	Non destructive testing of steel tubes - Part 14: Automatic full peripheral ultrasonic testing of seamless and welded steel tubes for the detection of laminar imperfections
EN 10204	Metallic products - Types of inspection documents
ISO 286-2	ISO system of limits and fits - Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts

* - Tenaris only guarantees only the characteristics listed in this specification.
Cylinder Design is the customer's responsibility .

- Replaces TN008

3. Steel grades

CHEMICAL COMPOSITION % ⁽¹⁾⁽²⁾⁽³⁾						
GRADE	C	Mn	Si	P	S	Ceq ⁽⁴⁾
HC355	≤ 0,20	≤ 1,55	≤ 0,50	≤ 0,020	≤ 0,010	≤ 0,49
HC355M	≤ 0,20	≤ 1,55	≤ 0,50	≤ 0,025	0,020 - 0,040	≤ 0,49
HC460	≤ 0,21	≤ 1,70	≤ 0,50	≤ 0,025	≤ 0,010	≤ 0,54
HC460M	≤ 0,21	≤ 1,70	≤ 0,50	≤ 0,025	0,020 - 0,040	≤ 0,59
HC520	≤ 0,20	≤ 1,55	≤ 0,50	≤ 0,020	≤ 0,010	≤ 0,49
HC520M	≤ 0,20	≤ 1,55	≤ 0,50	≤ 0,025	0,020 - 0,040	≤ 0,49
HC540	≤ 0,21	≤ 1,70	≤ 0,50	≤ 0,025	≤ 0,010	≤ 0,54
HC620	≤ 0,21	≤ 1,70	≤ 0,50	≤ 0,025	≤ 0,010	≤ 0,54
HC620M	≤ 0,21	≤ 1,70	≤ 0,50	≤ 0,025	0,020 - 0,040	≤ 0,59
HC650	≤ 0,18	≤ 1,70	≤ 0,50	≤ 0,020	≤ 0,008	≤ 0,45

HCXXXM steels have controlled level of sulphur S (0,020-0,0040%) to improve the machinability.

- (1) For grade HC355 (-M) and HC520 (-M) the elements Nb, Ti and V may be added up to a combined maximum of 0.10 %, at the manufacturer's discretion
(2) For other grades not listed in note (1) elements such as Nb, Ti and V are normally added up to a combined maximum of 0.22 %.
(3) For other grades not listed in note (1) some of the following elements: Cr, Mo, Ni, V are normally added up to a combined maximum of 2.0 % in order to improve mechanical properties, the content of these elements will be indicated.
(4) $Ceq = C + Mn/6 + (Cr+Mo+V)/5 + (Ni+Cu)/15$

MECHANICAL PROPERTIES					
GRADE	DELIVERY CONDITION	MINIMUM YIELD STRENGTH (Rp 0.2%) MPa		TENSILE STRENGTH MPa	MINIMUM ELONGATION (%) Lo = 5,65 √ S0
		WT ≤ 16 mm	WT > 16 mm		
HC355	+N	355	355	490 - 630	22
HC355M	+N	355	355	490 - 630	22
HC460	+N	460	460	560 - 730	22
HC460M	+N	460	460	560 - 730	22
HC520	+SR	520	490	Min 600	15
HC520M	+SR	520	490	Min 600	15
HC540	+SR	540	540	640 - 840	15
HC620	+SR	620	590	Min 700	15
HC620M	+SR	620	590	Min 700	15
HC650	+SR	650	630	690 - 890	15

Steel grades for which an impact test at -20 °C is guaranteed

IMPACT REQUIREMENTS		
GRADE	LONGITUDINAL (J)	TRANSVERSAL (J)
HC355	40	27
HC460	40	27
HC540	40	27
HC650	110	75

Charpy V-notch 10x10 mm at -20 °C. Minimum Average Energy (Joules)

O.D. DIAMETERS AND TOLERANCES			
O.D.	TOLERANCES ± (mm)	O.D.	TOLERANCES ± (mm)
≤ 30	0.08	≤ 120	0.50
≤ 40	0.15	≤ 140	0.70
≤ 50	0.20	≤ 160	0.80
≤ 60	0.25	≤ 180	0.90
≤ 70	0.30	≤ 200	1.00
≤ 80	0.35	≤ 240	1.20
≤ 90	0.40	≤ 280	1.30
≤ 100	0.45		

These tolerances are compliant with EN 10305-1.

4. Dimensions & Tolerances

Nominal dimensions are understood to mean the dimensions of the finished cylinder barrel after ID machining.

Tubes are produced with tolerances on O.D. and I.D. having controlled concentricity.

For all grades the O.D. and I.D. tolerances are shown in the following tables.

SIZES AND I.D. TOLERANCES

		WT										
		mm										
		5	6	7,5	10	12,5	15	17,5	20	22,5		
INSIDE DIAMETER	20	30	32	35	40							20
	25	35	37	40	45						ID TOLERANCES	25
	30	40	42	45	50						-0.15 ÷ -0.35	30
	32	42	44	47	52						-0.20 ÷ -0.40	32
	35	45	47	50	55						-0.20 ÷ -0.45	35
	40	50	52	55	60						-0.25 ÷ -0.55	40
	45	55	57	60	65	70					-0.30 ÷ -0.70	45
	50	60	62	65	70	75	80				-0.40 ÷ -0.70	50
	55	65	67	70	75	80	85				-0.50 ÷ -0.90	55
	60	70	72	75	80	85	90				-0.50 ÷ -1.00	60
	63	73	75	78	83	88	93				-0.60 ÷ -1.40	63
	65	75	77	80	85	90	95	100			-0.70 ÷ -1.40	65
	70	80	82	85	90	95	100	105			-0.80 ÷ -1.60	70
	75	85	87	90	95	100	105	110				75
	80	90	92	95	100	105	110	115				80
	85	95	97	100	105	110	115	120				85
	90	100	102	105	110	115	120	125				90
	95	105	107	110	115	120	125	130				95
	100	110	112	115	120	125	130	135	140	145		100
	105	115	117	120	125	130	135	140	145	150		105
110	120	122	125	130	135	140	145	150	155		110	
115	125	127	130	135	140	145	150	155	160		115	
120	130	132	135	140	145	150	155	160	165		120	
125	135	137	140	145	150	155	160	165	170		125	
130	140	142	145	150	155	160	165	170	175		130	
135	145	147	150	155	160	165	170	175	180		135	
140	150	152	155	160	165	170	175	180	185		140	
145	155	157	160	165	170	175	180	185	190		145	
150	160	162	165	170	175	180	185	190	195		150	
155	165	167	170	175	180	185	190	195	200		155	
160	170	172	175	180	185	190	195	200	205		160	
165	175	177	180	185	190	195	200	205	210		165	
170	180	182	185	190	195	200	205	210	215		170	
175	185	187	190	195	200	205	210	215	220		175	
180	190	192	195	200	205	210	215	220	225		180	
185	195	197	200	205	210	215	220	225	230		185	
190	200	202	205	210	215	220	225	230	235		190	
195	205	207	210	215	220	225	230	235	240		195	
200	210	212	215	220	225	230	235	240	245		200	
205			220	225	230	235	240	245	250		205	
210			225	230	235	240	245	250	255		210	
215			230	235	240	245	250	255	260		215	
220			235	240	245	250	255	260	265		220	
225			240	245	250	255	260	265	270		225	
230			245	250	255	260	265	270	275		230	
235			250	255	260	265	270	275	280		235	
240			255	260	265	270	275	280			240	
245			260	265	270	275	280				245	
250			265	270	275	280					250	
260			275	280							260	
265			280								265	
		5	6	7,5	10	12,5	15	17,5	20	22,5	mm	

WT

- For grade HC650 feasibility of sizes in the fields marked with a broken line has to be agreed.
- I.D. tolerances for HC650 grade for all sizes has to be agreed upon request
- The values inside the boxes represent the O.D.

Concentricity

The following concentricity values are guaranteed:

OUTSIDE DIAMETER	CONCENTRICITY*
≤ 125 mm	0.06
> 125 mm	0.07

* Concentricity is measured according to the formula:

$$\frac{(WT_{\max} - WT_{\min})}{(WT_{\max} + WT_{\min})}$$

Where WT_{max} and WT_{min} are understood to be measured on the same tube cross-section.

Ovality

Ovality is guaranteed within the diameter tolerances.

Straightness

Local deviation from straight line

max 1 mm per each meter length.

Total deviation from straightness:

max 3.5 mm for tubes with lengths of less than 6 m; for tubes with lengths greater than 6 m, the tolerance will be increased by 0.5 mm for each 1 m over 6 m.

5. Lengths

The manufacturing length range is from 5.5 m up to 14.5 m. The average production length varies according to tube dimensions. Each tube dimension has a range of 2 m.

It is also possible to manufacture and supply fixed lengths or multiple fixed lengths with tolerances of -0 + 100 mm. For special requests see Special Products paragraph.

6. Inspection and testing

The following tests are carried out:

- Tensile tests (according to those required by EN10305-1)
- Visual and dimensional control
- NDT

Each tube is checked using automatic non-destructive equipment. Different levels of NDT checks can be applied depending on the working conditions of the cylinder (e.g. maximum tube wall stress and expected fatigue life).

Depending on the required steel grade, available control levels are shown in the tables. The control level must be agreed between the customer and Tenaris at the time of enquiry or purchase order.

NDT CONTROL LEVELS

NDT Control Level	Techn.	Orient.	Position	Nominal	Calibration standard			
					Max	Depth	Max	Max
					mm	mm	Length	Width
					mm	mm	mm	mm
NDT4	EC	Long.	Est.	5% WT	Nomin.	0.40	50	0.30
NDT3	EC	Long.	Est.	5% WT	0.90	0.30	50	0.30
	US	Long.	Int./Est.	5% WT	0.90	0.30	25	0.50
NDT2	EC	Long.	Est.	0.30 mm	0.30	0.30	50	0.30
	US	Long.	Est.	0.30 mm	0.30	0.30	25	0.50
	US	Long.	Int.	5% WT	0.70	0.30	25	0.50
	US	Tras.	Int./Est.	5% WT	0.70	0.30	25	0.50
NDT1	EC	Long.	Est.	0.30 mm	0.30	0.30	50	0.30
	US	Long.	Int./Est.	0.30 mm	0.30	0.30	25	0.50
	US	Tras.	Int./Est.	0.30 mm	0.30	0.30	25	0.50
	US	Lamination	Int.	30% WT	Nominal	Nominal	13	6

AVAILABLE COMBINATIONS OF NDT CONTROL LEVELS

STEEL GRADE	NDT4	NDT3	NDT2	NDT1
HC355	•	•		
HC355M	•	•		
HC460	•	•		
HC460M	•	•		
HC520	•	•		
HC520M	•	•		
HC540		•	•	•
HC620	•	•		
HC620M	•	•		
HC650		•	•	•

Eddy current tests are carried out in accordance with EN 10246- 3; ultrasonic tests are conducted according to EN 10246-6, EN 10246-7, and EN 10246-14.

If the level of checks is not specified by the customer, the minimum level for the applicable grade in accordance with the table will be used. As an example, for grade HC540, the default control level is NDT3.



7. Surface protection

Tubes are oiled internally and externally in order to provide temporary protection against rusting in a covered stock-yard for around 6 months.

8. Certification

The product is supplied with a 3.1 type certificate, in accordance with EN 10204 and ISO 10474. The certificate issued will contain at least the following information:

- Customer
- Manufacturer's Production Order
- Steel grade + Delivery condition
- Chemical Analysis
- Mechanical test result
- Conformance with NDT
- Sample test number

9. Identification and marking

Identification of tubes for cylinders is carried out through continuous marking, in indelible ink, along the tube's entire length, detailing at least the following information;

- Tenaris XX (where XX is the mill code)
- specification number
- steel grade + delivery condition
- nominal OD x ID in mm
- NDT control level
- cast number

10. Packaging

Tubes are packed in strapped bundles. If a sufficient number of tubes are ordered, hexagonal bundles will be used. The minimum weight is shown in the table. The maximum weight of the bundle is 6000 kg.

OUTSIDE DIAMETER	MINIMUM BUNDLE WEIGHT
30 - 100 mm	1500 kg
> 100 - 160 mm	2000 kg
> 160 mm	3000 kg and 4 pieces

11. Skived and burnished tubes

For steel grades up to and including HC620 it is possible to supply skived and burnished tubes with inside diameter tolerances in accordance with ISO Standard 286-2, with a maximum surface roughness on the worked surface of 0.3 micrometer Ra. The internal diameter tolerances are guaranteed as shown in the following table according to the internal diameter/wall thickness ratio.

ID/WT	ID TOLERANCES (ISO 286)
≤ 20	H8
$20 \div 25$	H9
$26 \div 28$	H10
> 28	H11

Special products

This specification covers a wide variety of alternatives.

Tenaris is able to discuss additional requirements or customization when requesting the order.

Components & Services

Tenaris is able to provide integrated solutions for its customers, from Logistic Services (JIT, Stocking and Consignment Stock etc) to the finished component, as well as basic operations such as cutting, drilling and chamfering.

Examples:

- Customized dimensions and tolerances: In particular, the Service Centers can provide cut lengths with tolerances of - 0 +5 mm or - 0 +3 mm and cut perpendicularity of 1.5 mm max.
- surface protection and special packaging for material handling and specific transportation:
 - a. Different bundle weight
 - b. Winding by sheets of polyethylene, End caps.

The Product Research & Development and the Commercial Teams are available for any further information as needed.



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