sicam®

CHROMED BARS AND TUBES

Registered Sales Office:

Via Fatebenefratelli, 15
20121 Milano

Tel. 0039 02 42 41 421
Fax 0039 02 47 71 93 72

E-mail: venditemilano@sicamtubi.com

Headoffice and warehouse:

Via Marziana, 21
27020 Parona Lomellina (PV)

Tel. 0039 0384 20 21
Fax 0039 0384 99 763

E-mails:
vendite@sicamtubi.com
acquisti@sicamtubi.com
amministrazione@sicamtubi.com

Internet:
http://www.sicamtubi.com
http://www.sicamtubi.net
http://www.gruppobianco.com

Branch office:

VENETO

Via Tiziano Aspetti, 248
35133 Padova

Tel. 0039 049 86 49 498
Fax 0039 049 86 49 491

E-mail: venditepadova@sicamtubi.com

SOCIETÀ ITALIANA COMMERCIO ACCIAI E METALLI

Head office and warehouse in Parona Lomellina


OMIS

CHROMED BARS

Round steel bars, rectified and successively chromed by electrochemical process **Hexavalent Chromium free (CrVI free).** Main feature of this product is a high dimensional precision, in order to meet requirements of tolerance f7 according to EN ISO 286-2. In the meantime the chrome layer provides a high surface microhardness and resistance to external agents, indispensable properties for obtainment of piston rods for hydraulic cylinders, which are components undergoing to friction.
The solid bars chosen for chroming process could be hot rolled bars, according to EN 10083, or bright steel products (drawn, turned, ground bars), according to EN10277.

APPLICATIONS

The chromed bars are mainly intended for oleodinamic sector, for the obtainment of piston rods for hydraulic cylinders, however this product could also be applied to other sectors where dimensional precision and resistance to friction are required.

NORMS

EN 10083-1/2/3 properties of non-alloyed and alloyed steels for quenching and tempering.
EN 10277-1/5 bright steels, general features and properties of steels for quenching and tempering.
EN ISO 286-2 reference norm for precision diameter tolerance.

STEELS TABLE

The chromed bars could be manufactured starting from solid bars in different steel grades: for example with low carbon content, steel grades for quenching and tempering with high carbon content or alloyed steel grades for quenching and tempering. Different steel grades allow to choose the product with the most suitable mechanical properties for the specific application (see also "stock facility" section at page 10 to know steel grades always available ready-on-stock).

CHEMICAL ANALYSIS

Reference norm	Steel grade	Chemical elements (% on mass)																
		C		Si		Mn		P	S		Cr		Mo		Ni	V		
		min.	max.	min.	max.	min.	max.	max.	min.	max.	min.	max.	min.	max.	max.	min.	max.
EN 10083-2 EN 10277-5	C45[2]	0.42	0.50	-	0.40	0.50	0.80	0.045	-	0.045	-	0.40	-	0.10	0.40	-	-
	C45E[2]	0.42	0.50	-	0.40	0.50	0.80	0.030	-	0.035	-	0.40	-	0.10	0.40	-	-
	C45R[2]	0.42	0.50	-	0.40	0.50	0.80	0.030	0.020	0.040	-	0.40	-	0.10	0.40	-	-
NA[1]	20MnV6	0.16	0.22	0.10	0.50	1.30	1.70	0.035	-	0.035	-	-	-	-	-	0.10	0.20
EN 10083-3	42CrMo4	0.38	0.45	-	0.40	0.60	0.90	0.025	-	0.035	0.90	1.20	0.15	0.30	-	-	-

[2] Cr + Ni + Mo ≤ 0.63%.

MECHANICAL PROPERTIES

Reference norm	Steel grade	Delivery condition	Yield strength min. ReH (N/mm²=Mpa)					Tensile strength min./max. Rm (N/mm²=Mpa)					Longitudinal elongation min. %				
			For diameters in mm														
			≤16	>16 ≤40	>40 ≤100	>100 ≤160	>160 ≤250	≤16	>16 ≤40	>40 ≤100	>100 ≤160	>160 ≤250	≤16	>16 ≤40	>40 ≤100	>100 ≤160	>160 ≤250
EN 10083-2 EN 10277-5	C45 C45E C45R	+N*	340	305	305	275	275	620	580	580	560	560	14	16	16	16	16
		+QT*	490	430	370	-	-	700 850	650 800	630 780	-	-	14	16	17	-	-
NA[1]	20MnV6	+AR	450	440	400	-	-	600 750	560 710	530 680	-	-	19	19	19	-	-
EN 10083-3	42CrMo4	+QT	900	750	650	550	500	1100 1300	1000 1200	900 1100	800 950	750 900	10	11	12	13	14

[1]This steel grade is not regulated by a norm, chemical and mechanical properties indicated in this catalogue are not compulsory, but they could be subjected to minimum changes.

***NOTE for steel grades for quenching and tempering C45, C45E and C45R the standard product is supplied in untreated condition (+AR), but relevant norms foresee limit values only for normalized (+N) and quenched and tempered (+QT) delivery conditions. For this reason the results of mechanical properties on certificates, as specified on documents themselves, are referred to sample in the same condition of the product, for information purposes only. Otherwise are referred to samples previously subjected to heat treatment.**

TECHNICAL SPECIFICATIONS AND TOLERANCES

TOLERANCES

DIAMETER: tolerance f7 according to EN ISO 286-2, see dimensional table at page 9. Upon request it is possible to supply chromed bars with diameter according to tolerance h7 according to EN ISO 286-2.

STRAIGHTNESS: maximum 0.3 mm/m on the total length of the bar.

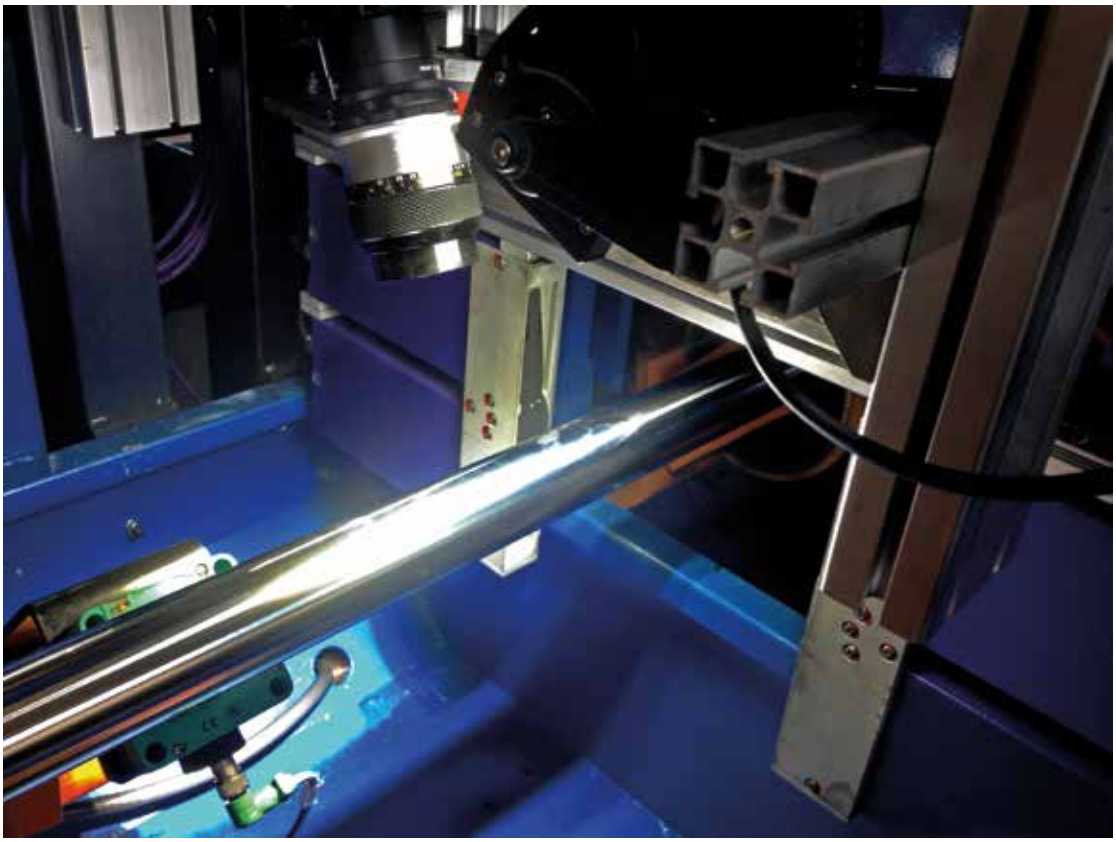
TECHNICAL SPECIFICATIONS

THICKNESS OF CHROMIUM LAYER: for bars with diameter from 8 to 16 mm, 20 ± 5 µm
for bars with diameter from 18 to 200 mm, 25 ± 5 µm
The coating is always Hexavalent Chromium free (CrVI free).

SURFACE MICROHARDNESS: 1000 ± 100 Vickers.

SURFACE ROUGHNESS: Ra 0,15 ± 0,05 µm.

RESISTANCE TO CORROSION: 200 h rating 9 according to ISO 9227 (tested by salt spray).



SIZE RANGE

Diameter mm	Diameter inches	Mass Kg/m	Tolerance on diameter mm	
			f7	h7
8	-	0.39	- 0.013 - 0.028	+ 0 - 0.015
10	-	0.61		
12		0.88	- 0.016 - 0.034	+ 0 - 0.018
12.7	½	0.99		
14	-	1.21		
15	-	1.39		
15.88	5/8	1.55		
16		1.58		
18	-	2.00		
19	-	2.22	- 0.020 - 0.041	+ 0 - 0.021
19.05	¾	2.24		
20	-	2.46		
22	-	2.98		
22.22	7/8	3.04		
24	-	3.55		
25	-	3.85		
25.40	1	3.98		
28	-	4.83		
28.57	1 1/8	5.03		
30	-	5.55		
31.75	1 ¼	6.21	- 0.025 - 0.050	+ 0 - 0.025
32	-	6.31		
34.92	1 3/8	7.51		
35	-	7.55		
36	-	7.99		
38	-	8.90		
38.10	1 ½	8.95		
40	-	9.86		
42	-	10.87		
44.45	1 ¾	12.18		
45	-	12.48		
48	-	14.19		
50	-	15.41		

Diameter mm	Diameter pollici	Mass Kg/m	Tolerance on diameter mm	
			f7	h7
50.80	2	15.90	- 0.030 - 0.060	+ 0 - 0.030
55	-	18.64		
56	-	19.32		
57.15	2 ¼	20.13		
60	-	22.18		
63	-	24.46		
63.50	2 ½	24.85		
65	-	26.04		
69.85	2 ¾	30.07		
70	-	30.20		
75	-	34.66		
76.20	3	35.78		
80	-	39.44		
82.55	3 ¼	41.99	- 0.036 - 0.071	+ 0 - 0.035
85	-	44.52		
88.9	3 ½	48.69		
90	-	49.91		
95	-	55.60		
100	-	61.62		
101.60	4	63.61		
105	-	67.92		
110	-	74.56		
114.3	4 ½	80.49		
115	-	81.48		
120	-	88.74		
125	-	96.29	- 0.043 - 0.083	+ 0 - 0.040
130	-	104.33		
140	-	120.76		
150	-	138.62		
160	-	157.72		
170	-	178.05		
180	-	190.62		
200	-	246.44	- 0.050 - 0.096	+ 0 - 0.072

CHROMED BARS

STOCK FACILITY

STEEL GRADES

The standard stock of chromed bars consists of steel grades C45 or C45E or C45R and 20MnV6, in untreated delivery condition (+AR), and 42CrMo4 in quenched and tempered delivery condition (+QT).

DELIVERY CONDITIONS

The solid bars subjected to chroming process are available in different delivery conditions, in order to obtain specific properties:

NORMALIZATION: heat treatment consisting in heating process followed by gradual cooling in controlled atmosphere. Thanks to this process, the steel structure becomes more "refined" and improves its impact properties (Perlitic structure).

INDUCTION HARDENING: the surface of the steel bar is heated by electric induction followed by fast cooling. This process leads to a high surface hardness, but also to fragility and low impact values (Martensite surface structure).

QUENCHING AND TEMPERING: quenching process followed by tempering. This process leads to a good hardness and resistance and it reduces its fragility in comparison to induction hardening (Sorbite structure).

SURFACE PROTECTIONS
All chromed bars are individually protected from casual damages due to handling and/or crashes by an extruded polypropylene envelope, cardboard or other suitable covers. This allows to protect and keep intact the chromed surface during handling and storage.

PACKAGING
The material, both in random lengths and fixlengths, is supplied in bundles closed with iron straps (adding protective material) or reinforced adhesive taper according to weight and dimensions.
Tubes cut to fixed lengths are supplied with polyester bands too, in order to make handling operations easier.
Upon request it is possible to arrange special packing: wooden boxes, pallets etc.

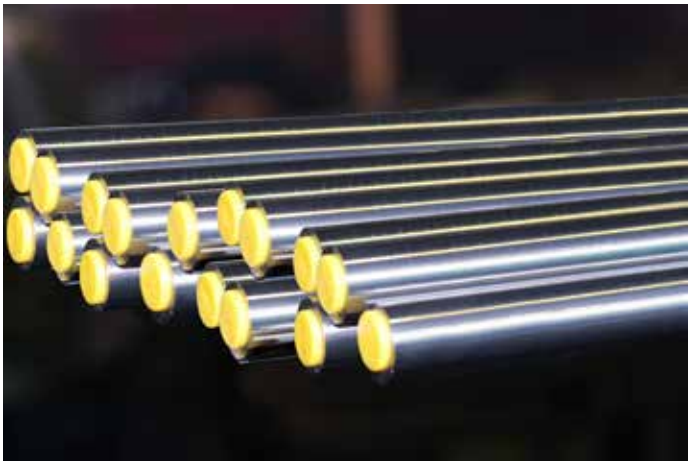
CERTIFICATES AND MARKINGS
All supplies can be completed by mill test certificates type 3.1 according to EN 10204. Traceability is granted by labels or paint marking on the protective envelope.

LENGTHS
RANDOM LENGTHS: up to diameter 19 mm lengths from 4 to 5 m, from diameter 20 mm lengths from 6 to 7 m.
FIXLENGTHS: all bars can be supplied cut to fixlength, the quick delivery and the quality of the service are granted by modern automatic cutting machines with band saws.
The standard tolerance on fixlength is -0 / +5 mm, more restrictive tolerances can be agreed at the moment of the order.

DELIVERIES
Inland, through carriers.

SEAMLESS CHROMED TUBES SUITABLE FOR SHAFTS

SEAMLESS tubes EN 10305-1 externally rectified and chromed **Hexavalent Chromium free (CrVI free),** specifically intended for production of hollow piston rods for hydraulic cylinders.
The outside chromium layer grants to this product high surface microhardness properties and resistance to corrosion, combined to an high level of dimensional precision of the outside diameter.
The same chroming process, upon request, could be applied to welded cold drawn tubes (EN 10305-2) too.



NORMS

EN 10305-1 seamless cold drawn tubes (standard stock).
EN 10305-2 welded cold drawn tubes (upon request).
EN ISO 286-2 reference norm for precision diameter.

APPLICATIONS

The main purpose of these tubes is production of hollow piston rods, in all situations where the weight saving is an indispensable objective (see also scheme at page 15).
Some of the components that can be built with this product are shafts for cylinders and linear actuators of every type and equipment, such as heavy machines, agricultural machines, lifting equipments, hydraulic platforms and industrial machines of different kinds.

STEELS TABLE

Mechanical and chemical properties of steel grades, as well as their possible delivery conditions, are according to norm of feedstock tubes subjected to chroming process.
Feedstock tubes are manufactured by cold drawing process, which provides needed dimensional precision, while different delivery conditions are foreseen to help reaching various levels of mechanical properties, according to specific needs.
Our standard product is in steel grade E355+SR, always ready-on-stock. Thanks to "stress relieved" delivery condition it offers a good compromise of the mechanical properties and the rigidity needed for obtainment of a shaft, reaching in the meanwhile impact properties of a minimum average value of 27 Joule at -20°C*.

CHEMICAL ANALYSIS

Reference norm	Steel grade	Chemical elements (% on mass)					
		C max.	Si max.	Mn max.	P max.	S max.	Al min.
EN 10305-1	**E215**	0.10	0.05	0.70	0.025	0.025	0.025
	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
EN 10305-2	**E155**	0.11	0.35	0.70	0.025	0.025	0.015
	E195	0.15	0.35	0.70	0.025	0.025	0.015
	E235	0.17	0.35	1.20	0.025	0.025	0.015
	E275	0.21	0.35	1.40	0.025	0.025	0.015
	E355	0.22	0.55	1.60	0.025	0.025	0.020

MECHANICAL PROPERTIES

Reference norm	Steel grade	Delivery condition **+C**		Delivery condition **+LC**		Delivery condition **+SR**			Delivery condition **+A**		Delivery condition **+N**		
		Rm Mpa	All. %	Rm Mpa	All. %	ReH Mpa	Rm Mpa	All. %	Rm Mpa	All. %	ReH Mpa	Rm Mpa	All. %
EN 10305-1	**E215**	430	8	380	12	280	380	16	280	30	215	290-430	30
	E235	480	6	420	10	350	420	16	315	25	235	340-480	25
	E355	640	4	580	7	450[1]	580	10	450	22	355	490-630	22
EN 10305-2	**E155**	400	6	350	10	245	350	18	260	28	155	270-410	28
	E195	420	6	370	10	260	370	18	290	28	195	300-440	28
	E235	490	6	440	10	325	440	14	315	25	235	340-480	25
	E275	560	5	510	8	375	510	12	390	22	275	410-550	22
	E355	640	4	590	6	435	590	10	450	22	355	490-630	22

[1] For tubes with outside diameter > 160 mm ReH≥420 Mpa.
* For specimen with longitudinal orientation and standard dimension 10x10x55 mm.

STEEL COMPARISON

Here below are summarized indicative comparisons between expired steels and norms designations respect to current ones.

EN norms		UNI norms	DIN norms	AFNOR norms
EN 10305-1	EN 10305-2			
E215		Fe280 UNI 7945	St 30Si DIN 2391	Tu37b NF A 49-310
E235		Fe360 UNI 7945	St 35 DIN 2391	-
E355		Fe490 UNI 7945	St 52 DIN 2391	Tu52b NF A 49-310
	E155	Fe280 UNI 7946	-	-
	E195	Fe320 UNI 7946	RSt 34.2 DIN 2393	-
	E235	Fe360 UNI 7946	RSt 37.2 DIN 2393	-
	E275	-	-	-
	E355	Fe490 UNI 7946	St 52.3 DIN 2393	-

TECHNICAL SPECIFICATIONS AND TOLERANCES

TOLERANCES

OUTSIDE DIAMETER: tolerance f7 according to EN ISO 286-2, see following dimensional table. Upon request it is possible to supply chromed tubes with outside diameter according to tolerance h7 EN ISO 286-2.

INSIDE DIAMETER: according to EN 10305-1.

WALL THICKNESS: ± 10 % with a minimum of ± 0.1 mm.

ECCENTRICITY: $\frac{\text{W.T. max.} - \text{W.T. min.}}{\text{W.T. max.} + \text{W.T. min.}} \times 100 \leq 10\ \%$

STRAIGHTNESS: maximum deviation 0.3 mm/m on the total length of the tube.

TECHNICAL SPECIFICATION

THICKNESS OF THE CHROMIUM LAYER: for tubes with outside diameter from 8 to 16 mm, 20 ± 5 µm
for tubes with outside diameter from 18 to 200 mm, 25 ± 5 µm
The coating is always Hexavalent Chromium free (CrVI free).

SURFACE MICROHARDNESS: 1000 ± 100 Vickers

SURFACE ROUGHNESS: Ra 0,15 ± 0,05 µm

RESISTANCE TO CORROSION: 72 h rating 9 according to ISO 9227 (tested by salt spray).

Outside diameter			Wall thickness (mm)				
Nominal Value (mm)	Tolerance f7 (mm)	Tolerance h7 (mm)	3.0	4.0	5.0	7.5	10.0
			Mass (Kg/m)				
18	-0.016 /-0.034	+0 /-0.018	1.11				
20	-0.020 / -0.041	+0 / -0.021	1.26	1.58			
22			1.40	1.78			
25			1.63	2.47			
30			2.00	2.56	3.08	4.16	
35	-0.025 / -0.050	+0 / -0.025	2.37	3.06	3.70	4.09	
40					4.32	6.01	7.40
45					4.93	6.94	8.63
50					5.55	7.86	9.86
55	-0.030 / -0.060	+0 / -0.030			6.16	8.79	11.10
60					6.78	9.71	12.33
65					7.40	10.64	13.56
70					8.01	11.56	14.80
75					8.50	12.48	16.03
80					9.25	13.41	17.26
85	-0.036 / -0.071	+0 / -0.036			9.86	14.33	18.50
90					10.48	15.26	19.73
100					11.71	17.11	22.20
110					12.95	18.96	24.66
120					14.18	20.81	27.13

WEIGHT SAVING

The tube section optimizes the ratio between mass and stability. The following figures highlight that the ratio section modulus-stability " W : G" (stability feature) is better for a hollow section rather than for a solid bar.

Figure 1
Stability feature W : G of the solid bar and of the hollow bar.

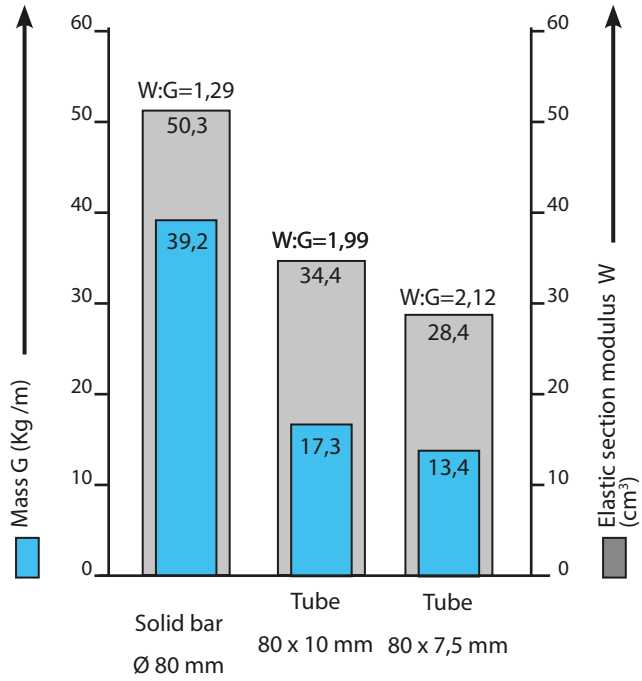
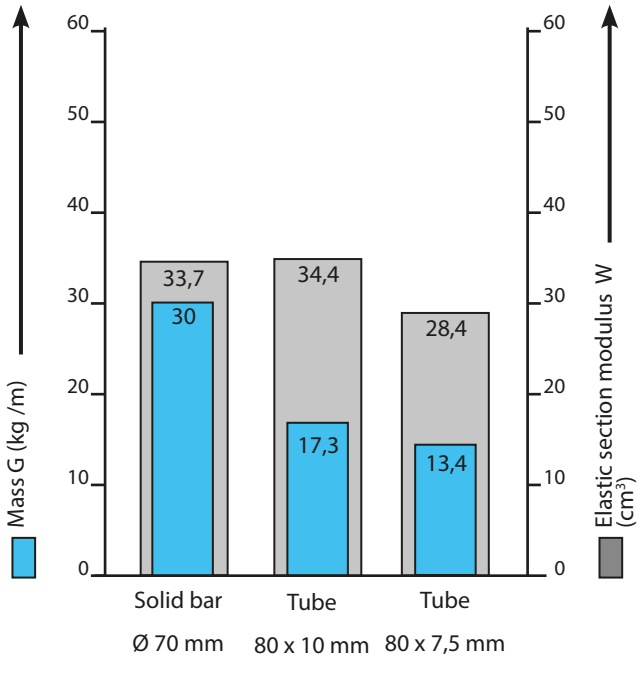


Figure 2
Replacement of a 70 mm dia solid bar with a 80 mm OD hollow bar.



SEAMLESS CHROMED TUBES SUITABLE FOR SHAFTS

STOCK FACILITY

STEEL GRADES

Our standard stock of outside chromed tubes for shafts consists of steel grade E355, according to EN 10305-1, in delivery condition "stress relieved" (+SR).
Upon request and with conditions and quantities to be agreed, it is possible to provide tubes in other steel grades and delivery conditions among the ones described in this catalogue.

DELIVERY CONDITIONS

Outside chromed tubes for shafts can be obtained starting from feedstock tubes in steel grades with different possible delivery conditions, detailed as follows:

COLD DRAWN / HARD (+C acc. EN 10305 / BK acc. DIN 2391): no heat treatment after final cold drawing. This delivery condition allows to reach considerably high mechanical properties, but with residual stress of metal due to cold deformation process.

COLD DRAWN / SOFT (+LC acc. EN 10305 / BKW acc. DIN 2391): the final heat treatment is followed by a suitable drawing pass (limited reduction of area). With this process high mechanical properties are anyway obtained, but partially reducing residual stress of metal respect to material in condition +C.

STRESS RELIEVED (+SR acc. EN 10305 / BK+S acc. DIN 2391): after final cold drawing process, tubes are stress relieved by heat treatment in controlled atmosphere, in order to further reduce residual stress due to cold deformation process, preserving in the meanwhile high mechanical properties and rigidity. This process also allows to reach good impact properties too.

ANNEALED (+A acc. EN 10305 / GBK acc. DIN 2391): after final cold drawing process, tubes are annealed in controlled atmosphere. In this case residual stress due to cold deformation process is further reduced, but with a higher reduction of mechanical properties too.

NORMALIZED (+N acc. EN 10305 / NBK acc. DIN 2391): after final cold drawing process, tubes are normalized in controlled atmosphere at a temperature exceeding the austenizing temperature. This treatment almost completely reduces residual stress of metal considerably increasing impact properties, but yield and tensile properties are drastically reduced.

SURFACE PROTECTIONS

All chromed tubes are individually protected from casual damages due to handling and/or crashes by an extruded polypropylene envelope, cardboard or other suitable covers. This allows to protect and keep intact the chromed surface during handling and storage.

PACKAGING

The material, in random lengths and fixlengths, is supplied in bundles closed with iron straps (adding protective material) or reinforced adhesive taper according to weight and dimensions.
Tubes cut to fixlengths are supplied with also polyester bands, in order to make handling operations easier.
Upon request it is possible to arrange special packing: wooden boxes, pallets etc.

CERTIFICATES AND MARKINGS

All supplies can be completed by mill test certificates type 3.1 according to EN 10204. Traceability is granted by labels or paint marking on the protective envelope.

LENGTHS

RANDOM LENGTHS: from 5 to 7 m.
FIXEDLENGTHS: Chromed tubes can be cut to fixed length required by the customer by automatic band saw machines. Standard length tolerance is -0/+5 mm, more restrictive tolerances can be agreed at the moment of the order.

DELIVERIES

Inland, through carriers.

Lloyd's Register LRQA

CERTIFICATE OF APPROVAL

This is to certify that the Quality Management System of:

S.I.C.A.M. SpA
Via Marziana, 21
27020 Parona Lomellina (Pavia) – Italy

has been approved by Lloyd's Register Quality Assurance to the follow
Quality Management System Standards:

ISO 9001:2008

The Quality Management System is applicable to:

Stockholding of carbon steel pipes and tubes, hollow sections, hollow
bars, chrome plated bars and solid bars for Italian and foreign compan
active in the mechanical and lifting equipment industry, civil and
industrial construction industry, in the field of cylinders, pneumatics a
hydraulics and in the petrochemical and plant design industry.

This certificate forms part of the approval identified by certificate number LRC 0160006/QMS/UI

Approval Certificate
No. LRC 0160006/QMS/UI/EN/002

Original Approval: 12th December 1995
Current Certificate: 12th December 2016
Certificate Expiry: 14th September 2018

Issued by: Lloyd's Register Quality Assurance Italy Srl
for and on behalf of Lloyd's Register Quality Assurance Lim

Lloyd's Register LRQA

CERTIFICATO DI APPROVAZIONE

Si certifica che il Sistema di Gestione per la Qualità di:

S.I.C.A.M. SpA
Via Marziana, 21
27020 Parona Lomellina (Pavia) - Italia

è stato approvato dal Lloyd's Register Quality Assurance per conformità
alle seguenti norme di sistemi di gestione:

ISO 9001:2008

Il Sistema di Gestione per la Qualità si applica a:

Commercializzazione con deposito di tubi in acciaio al carbonio,
profilati cavi chiusi, barre forate, barre cromate e tondi, per aziende
operanti nei settori dell'industria meccanica, della cilindristica,
dell'oleodinamica e della pneumatica, dell'industria del petrolio, della
petrolchimica e dell'impiantistica, delle costruzioni meccaniche,
metalliche civili e industriali e del sollevamento, sia italiane che estere.

Questo certificato è parte integrante del Certificato di Approvazione numero: LRC 0160006/QMS/UIT.

Certificato di Approvazione
N.: LRC 0160006/QMS/UIT/002

Approvazione Originaria: 12 Dicembre 1995
Certificato Attuale: 12 Dicembre 2016
Scadenza Certificato: 14 Settembre 2018

Emesso da: Lloyd's Register Quality Assurance Italy Srl
in nome e per conto di Lloyd's Register Quality Assurance Limited

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SICAM S.p.A.

SOCIETA ITALIANA COMMERCIO ACCIAI E METALLI

This catalogue replaces the previous one.
Contents of this publication are given as indicative information without any responsibility from our side for any possible mistake.

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February 2017

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