



► Global Player. Local Partner.

Hydraulic
& Pneumatic
Components
made by
ASO Group



ASO HYDRAULICS &
PNEUMATICS
/ASO CROMSTEEL
/ASO SPS

ASO Hydraulics & Pneumatics VISION

By leading an industrial revolution that impacts the perception of hydraulic & pneumatic products, we force the innovation.

ASO Hydraulics & Pneumatics MISSION

We invest 100% of our efforts in continuous improvement by up-grading systems, processes and technology, applying marketing & sales customized strategies and by building a safe and proper environment for innovation.

How is all that possible?

Because we engage our employees through a culture of life, responsibility, values and courage.

Like this we contribute to our customers' success





ASO Siderurgica SPA is a leading manufacturer of forge ingots that has managed to maintain its top-ranking market position thanks to its policy of providing regular personnel training, continuous improvement in manufacturing processes and heavy well-targeted investments, all in view of achieving the highest possible quality, in complete safety and respecting the environment.

ASO draws up plans and adopts methods to provide a more effective and more efficient customer service in terms of rapid examination of inquiries, advice on metallurgical matters, in-time deliveries and assessment of the supply results.

This method of operation has become routine and involves all the departments throughout the organisation.

Aldo Artioli



As part of its policy to expand its presence in different business sectors, the ASO Group has improved its versatility and strengthened its international presence by focusing on producing the special steel grades and alloys for high-tech applications

ASO GROUP Board of Shareholders



Intro

ASO GROUP is a Manufacturing company originated from **ASO Acciai Speciali Ospitaletto**, established in 1971 by **Aldo Artioli**.

Aldo was a metallurgical chemistry expert with a strong business acumen.

Over the years, **ASO GROUP** has pursued a growth strategy through acquisition to become today one of the largest leading group on the international markets specializing in steel products, hydraulics&pneumatics components, power and industrial transformers, forgings and switchboards for industrial electric power distribution.

In 2011 **ASO GROUP** took over SPS S.p.A, a company founded in 1992 in Italy near Verona.

more than 20 years

of experience in chrome plated bars

Having more than 20 years of experience in chrome plated bars production for hydraulic cylinders, automotive and earth moving machinery, the merger has brought a new type of business to **ASO GROUP**. The acquisition of **SPS SpA** by **ASO GROUP** paved the way to new business opportunities on the Hydraulics & Pneumatics Market.

In 2014, **ASO GROUP** merged with **Cromsteel Industries SA**, one of the biggest players in the field of manufacturing high technology products for hydraulics & pneumatics, chrome plated bars and tubes plus linear shafts.

With this strategic move, **ASO GROUP** finalized the creation of **ASO Hydraulics & Pneumatics** formed from **ASO SPS** and **ASO CROMSTEEL**.

230.000 m²

of production area

Now, **ASO Hydraulics & Pneumatics** is the world Market leader in terms of output capacity, product range and turnover for the Hydraulic & Pneumatic Industry employing more than **650 people** in 2 countries, that are working in premises of around **230.000 m²** (other constructions in progress), distributing in **78 countries** products and services for its Customers.

This numbers are the results of the prime quality standards, a consolidated sales experience with an excellent customer service, being a highly reliable partner for our Customers.

Research & Development /

Due to ongoing global development, our industry has adapted to meet new client demands.

Collaborating with our customers has allowed us better insight to their needs, growth and quality. One of our most important mission is our focus on research and development of innovative technological solutions. This mission brings to our customers the best performance through Innovative Automatization Processes.

Our commitment to innovative research and development is supported by a remarkable integration of the processes involved both in equipment design and production stages.

An in-depth knowledge of processes and plants structure has allowed us to design not only in-house parts of our equipment but also all production lines for chrome plating, skiving and roller burnishing or honing. Our production team works with a smart 3D computer modeling system which is used to evaluate the correct equipment design, mechanical resistance as well as the main characteristics of the product — such as weight, volume and cost.

Our constant attention to customer demands has encouraged us to respond with innovative new products, services, new steel grades and machines.

ASO Hydraulics & Pneumatics is recognized as a thought leader in the chrome plating manufacturing industry providing the widest range of products along with the largest production plants throughout Europe.

Our product line is split into three main categories:

A-CHROME series

Chrome plated steel bars

A-TUBE series

Chrome plated steel tubes

A- LINE series

Linear Shafts & Chrome plated linear shafts



These categories are also divided in subcategories arriving to a total of around 3000 articles.

In Targoviste, Romania, where ASO CROMSTEEL is located, 95% of the chroming process is made through continuous chroming process. Why is this important? Firstly, because of the environment implication - very well controlled and secondly, because the resulted first class products are the image reflected in the eyes of our Customers. The production numbers are our guarantee, because ASO CROMSTEEL is capable of producing 13.500 meters of chromed products in Targoviste and ASO SPS can produce 3.500 meters in Verona daily. Why is this important? Because when you are a supplier for the most important OEM's and Distributors of Chrome plated products you need to have the capabilities to provide big quantities of products as soon as possible.

As the firm continues to grow, our facilities will help develop production capabilities even more. This will allow us to widen our product range by introducing a brand new chroming line that will provide a higher diameter range where no other company has gone before.



Chroming TECHNOLOGY /



ASO Hydraulics & Pneumatics has the biggest chrome plating capacity in Europe: in any given moment, more than 200 (bars, tubes and linear shafts) are simultaneously chrome plated in our two plants from Romania and Italy.

Small and medium size bars, tubes and linear shafts are chrome plated in fully automatic Continuous Horizontal Multi-Layer Chrome Plating lines – 80% of our chrome plated products. Bigger sizes and special small series are produced in Traditional Plating Baths (20% of our chrome plated products) with Automation Control and Multi-Layer features.

Multi-Layer Chrome Plating lines

80% of our chrome plated products

In collaboration with the world's biggest experts in this industry, the entire production conception has been redesigned in the past years: Peeling & Rolling, Laser Controlled Grinding, Multi-Layer Chrome Plating Technology, Laser Controlled Grinding-Polishing. This new conception is intensely increasing productivity and now combined with the best global raw material sourcing has led to first-class competitiveness.

Multi-Layer Chrome Plating is a Technology that consists in creating a layer of chrome from several overlapped substrates.

On certain diameters, we have reached the performance to apply 8 overlapped substrates of Chrome that are forming one of the best chrome layers from the Market.

This technology is helping us providing to our worldwide customers not only standard products but also products with custom made chrome layer thickness.

Advantages:

These substrates guarantee that the chrome micro-cracked structure does not let external agents such as water, humidity, corrosive moisture penetrate through the porous and uneven chrome surface and initiate corrosion. See below the comparison between 25 μm of "Single-Layer Chrome Plating Technology" and 25 μm "Multi-Layer Chrome Plating Technology" photographed under the microscope.

Traditional Single-Layer Chrome Plating Technology



Continues Multi-Layer Chrome Plating Technology



As shown in the pictures, with "Single-Layer Chrome Plating Technology" the single chrome layer deposit has open cracks, penetrating all the way through until the base steel underneath. This doesn't create an effective barrier for the protection of the steel rod underneath. On the other hand, while micro-cracks are also present with "Multi-Layer Chrome Plating Technology", the higher the number of chrome layers, the greater the guarantee that overlapping substrates create a perfect barrier between the base steel and the external agents. Imagine what we are doing here with 8 overlapped substrates (for certain diameters)

8 overlapped substrates of Chrome

Moreover, the particular micrographic structure of this chrome layer is different from all other producers in the world and can always be recognized under the microscope. We can say that is like having a fingerprint of the chroming process.

Another advantage is given by the perfectly circular anodes (used in the Continuous Chroming process). Due to this circularity a completely homogeneous and concentric chrome overlay is guaranteed all around, eliminating the need for additional grinding steps.

OUR QUALITY, YOUR GUARANTEE

One of the most important steps taken by the Division Management has been the adoption of TQS (Total Quality System) together with "all in-house" production, allowing strict quality controls and immediate identification of critical points in every step of the process.

Having two very well defined quality departments is helping to have a complete process control:

■ **Quality Assurance - QA**

■ **Quality Control - QC**

Kayzen Management Process

ASO Hydraulics & Pneumatics Quality Assurance Team is dealing with the creation of procedural and administrative activities in order to have a Kayzen Management Process. All of these are implemented into a quality system in order to fulfill not only the goals and the requirements of the product but also the entire service that is provided to the Customer.

- **Our products should fit for the intended purpose**
- **Errors must be eliminated**

In the Quality Assurance we respect two very important principles:

- Our products should fit for the intended purpose
- Errors must be eliminated

QA Team deals with the management of the raw materials, services related to production, assemblies and inspection of the processes used in controlling the production.

Our QA Team is assuring the procedures to follow in order to have the quality of the production processes and our QC Team enters inside the process and is doing all the necessary controls.

QC – quality control is a process by which entities review the quality of all factors involved in production. Quality Control is only "A part of quality management focused on fulfilling quality requirements"



Quality checkpoints:

1 - Raw material check list:

- visual examination
- tolerance
- roundness
- straightness
- length
- macroscopic analysis
- microscopic analysis
- hardness
- chemical composition

2 - Output quality checklist for the Peeling & Rolling line:

- diameter tolerance
- roundness
- laser diameter control
- visual examination
- straightness

3 - Output quality checklist for the Induction Hardening lines:

- diameter tolerance
- hardening depth
- visual examination
- surface hardness OF induction depth

4 - Output quality checklist for the Grinding lines:

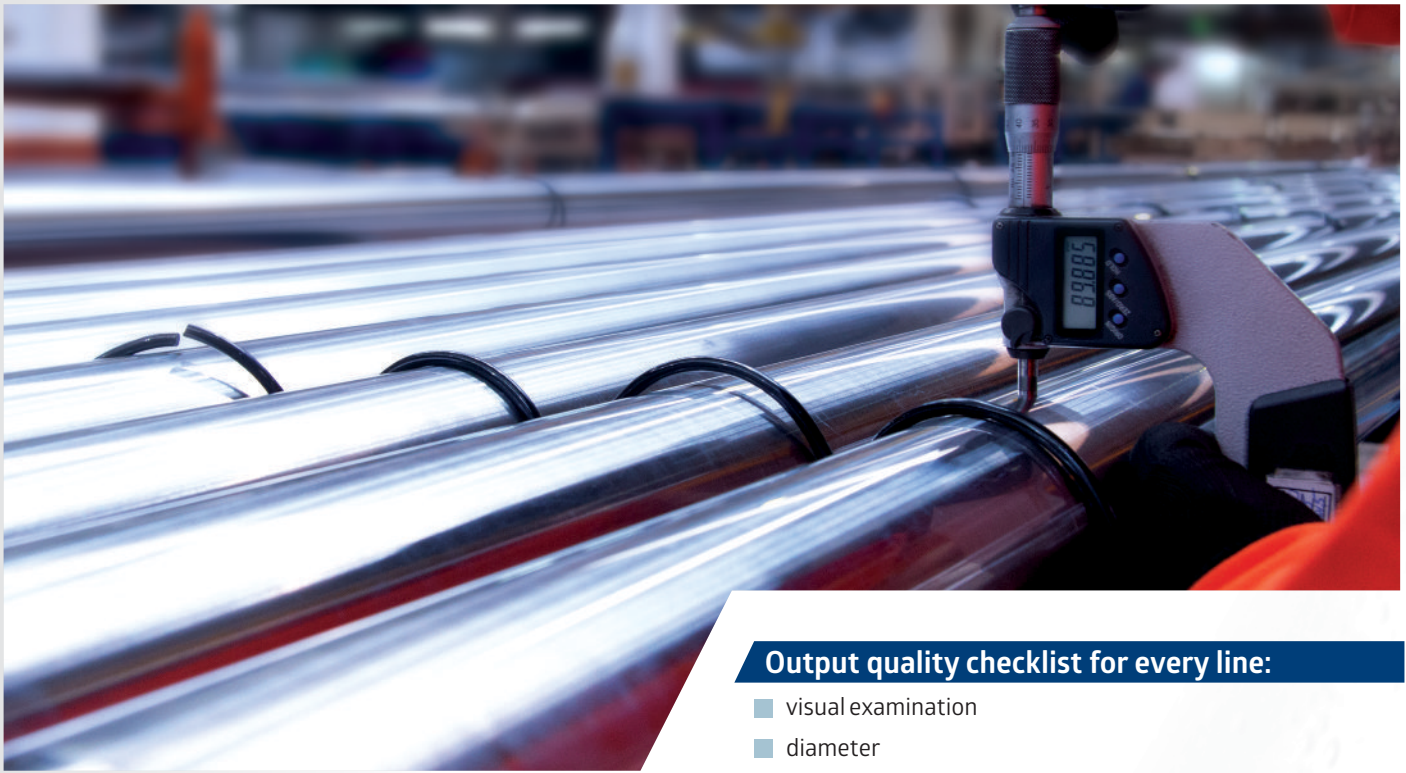
- diameter tolerance
- visual examination
- laser diameter control
- roundness
- straightness
- Ra and Rz surface roughness
- (on request : Rt, Tp, Rz max, Rk)

5 - Output quality checklist for every chrome plating line:

- visual examination
- chrome layer thickness
- diameter

6 - Quality checklist for every production lot:

- visual examination
- diameter tolerance
- chrome thickness
- magnetism
- chrome multi-layer structural integrity
- (all analysis results are registered)
- chrome micro-crack consistency
- chrome layer hardness
- metallographic structure
- corrosion resistance in Neutral Salt Spray (NSS) tests



Output quality checklist for every line:

- visual examination
- diameter
- Ra and Rt surface roughness
- roundness
- concentricity / eccentricity, wall thickness

Over 120 electronic and 180 mechanical units of Mitutoyo, Fischer & Vogel state of the art measuring instruments guarantee precision on all the quality control parameters.

Over 120 electronic and 180 mechanical units of Mitutoyo, Fischer & Vogel

The instrument setup is made at the beginning of every shift by fully trained quality department personnel.

During the manufacturing process and all the way down to customers' warehouse, the Quality Assurance System ensures full raw material traceability for each production lot.

For a full traceability, each product is marked individually on the plastic/paper tube with information about the date, product series, diameter, tolerance, resistance at saltwater spray test, heat no, production order and so on. The batch has a label with information regarding: Order no, Item no, Heat no., Steel Grade, total length of the batch, Weight, no of pieces in the batch.



Corrosion resistance

Corrosion resistance is tested According to ISO 9227 and evaluated acc. ISO 10289. These international standards describe the methods and the equipment to be used for corrosion resistance tests.

Upon request, the tests can be performed according to ASTM standards as the following: NSS according to ASTM B117; AASS according to ASTM B287; CASS according to ASTM B368.

ISO 9227 / ISO 10289 indicates three types of testing, progressively more aggressive:

NSS - Neutral Salt Spray (according to ASTM B117) (standard)

AASS - Acetic Acid Salt Spray according to ASTM B287 (upon request)

CASS - Copper Accelerated Acetic Acid Salt Spray according to ASTM B368 (upon request)

Procedure:

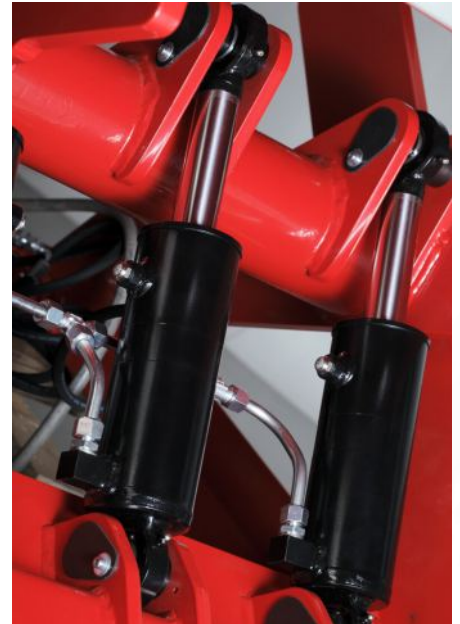
Corrosion resistance tests are conducted in special chambers. The products are positioned in the chamber and exposed to the corrosive action of the spray using an angle of 22 degrees. Before beginning, the samples are prepared and identified with all traceability information. The start date and hour of the test are also recorded. Each day our chemists are verifying the rating of the samples. After the reach of the desired test (?), the samples are rinsed with water and examined according to the ISO 10289 norm, which regulates the evaluation of the results, assigning a "rating" to the surface under examination. A "Rating 9" means that corrosion has appeared on 0.1 % of the total sample surface. A "Rating 10" means no corrosion at all. All the tests results are registered in our database.

Chrome plating solution control

Chemical analysis are performed in our laboratory, by chemist, according to our internal procedures. We pay a special attention to these tests because our plating lines produce over 20.000 m of chrome products every day in our plants. All analysis results are registered.

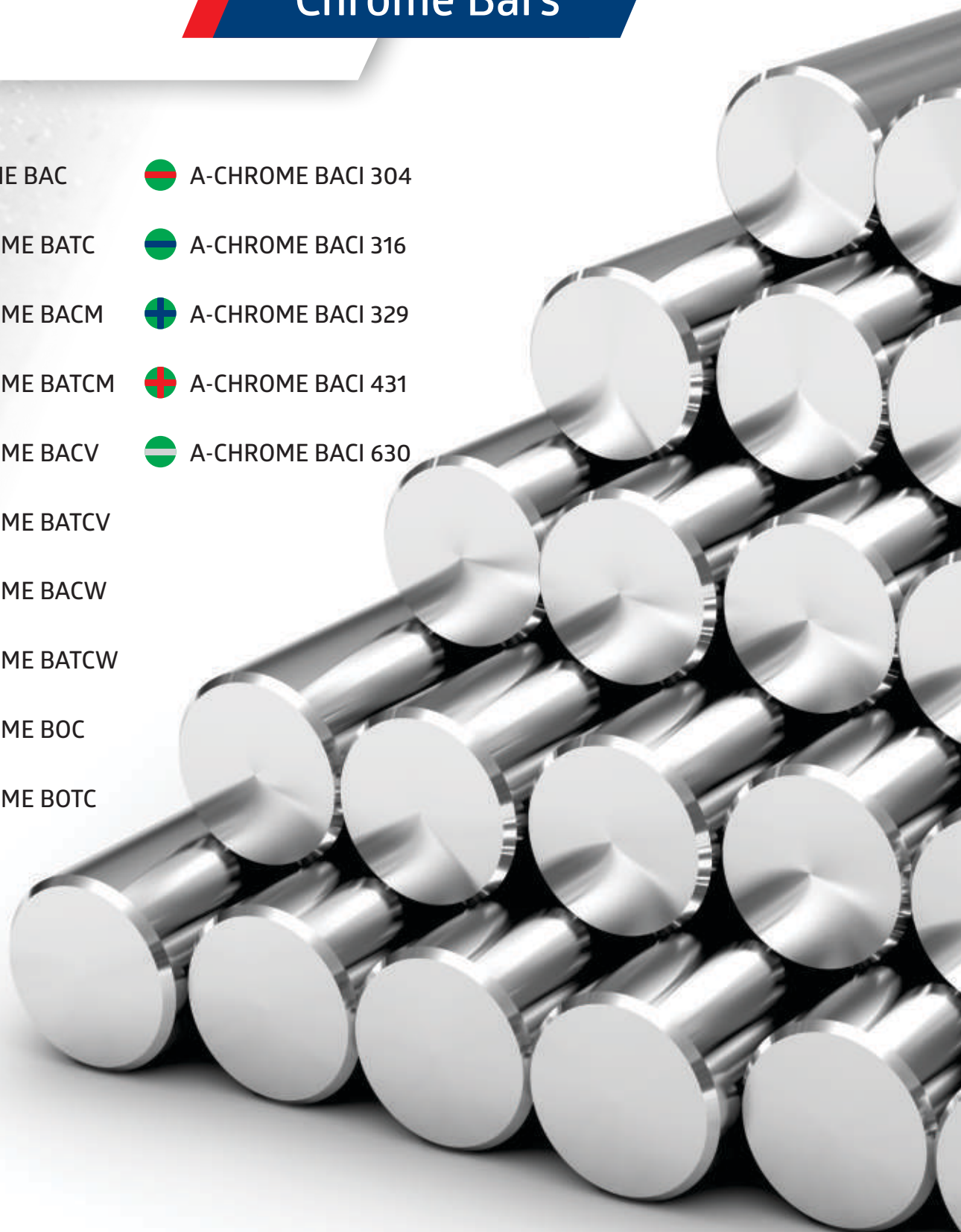
Certifications

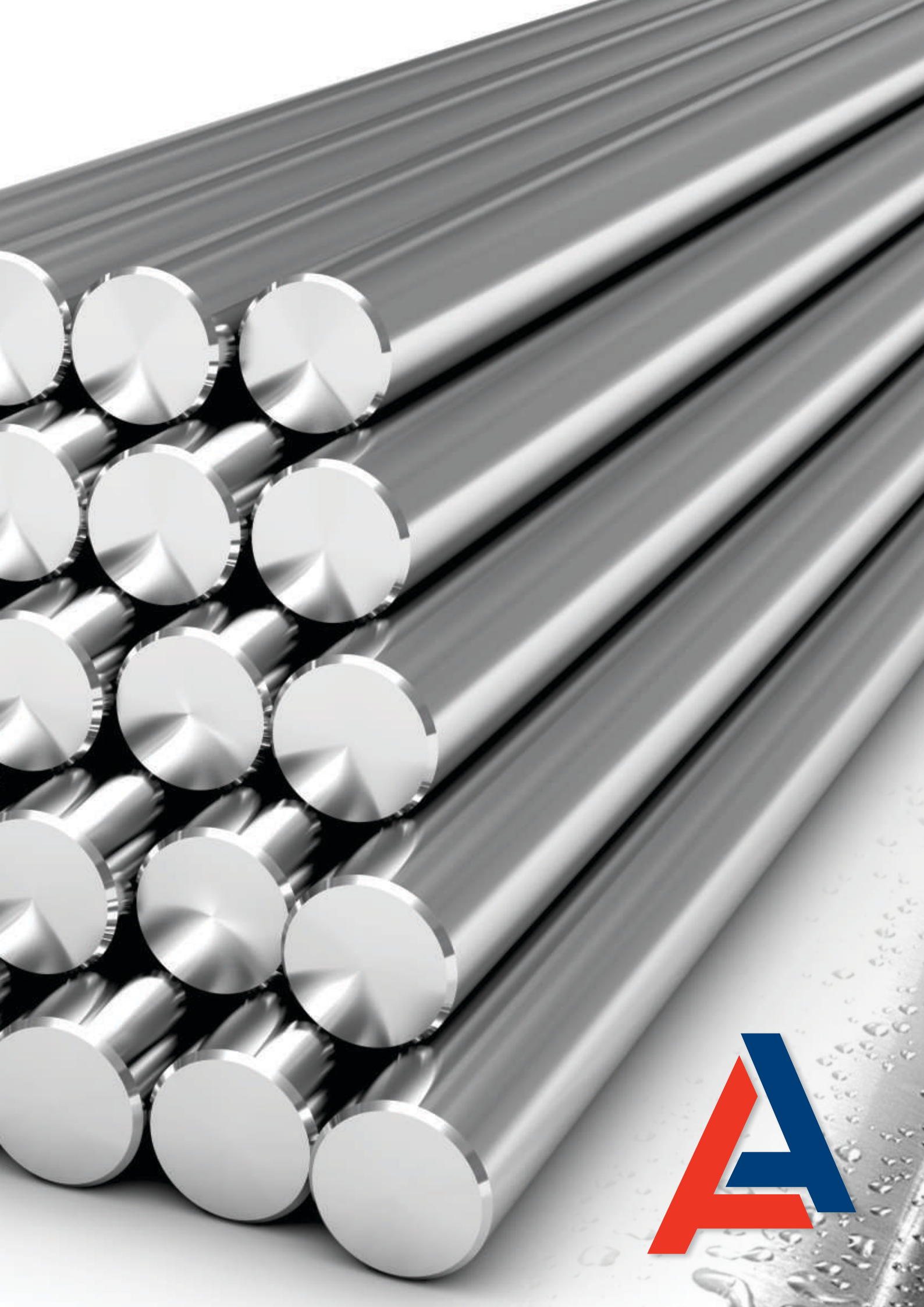




ASO HYDRAULICS & PNEUMATICS
 /ASO CROMSTEEL
 /ASO SPS

- | | |
|------------------|---------------------|
| ● A-CROME BAC | ● A-CHROME BACI 304 |
| ● A-CHROME BATC | ● A-CHROME BACI 316 |
| ● A-CHROME BACM | ● A-CHROME BACI 329 |
| ● A-CHROME BATCM | ● A-CHROME BACI 431 |
| ● A-CHROME BACV | ● A-CHROME BACI 630 |
| ● A-CHROME BATCV | |
| ● A-CHROME BACW | |
| ● A-CHROME BATCW | |
| ● A-CHROME BOC | |
| ● A-CHROME BOTC | |





General Chromed Bars Properties

ASO Hydraulics & Pneumatics chromed plated steel bars are manufactured from a first class steels having the following properties:



Steel grade correspondents

ASO GROUP	EN	DIN	BS	AFNOR	ASTM
A-CHROME BAC A-CHROME BATC	C45E	CK 45	080N45	XC45	1045
A-CHROME BACM A-CHROME BATCM	20MnV6	1.5217	55M	E420	A572
A-CHROME BACV A-CHROME BATCV	38MnVS6	38MnVS5	-	30MV6	1045V
A-CHROME BACW A-CHROME BATCW	CW85*	-	-	-	-
A-CHROME BOC A-CHROME BOTC	42CrMo4+QT	42CrMo4V	708M40	42CD4	4140

*CW85 internally developed high quality alloy steel with
 $CE(\%) = C + (Mn/6) + (Cr+Mo+V)/5 + (Ni+Cu)/15$

Table 1: Corresponding standards for the steel used

Chemical Composition

Steel grade	C	Si	Mn	P	S	Cr	Mo	Ni	V	N
C45E	0.42-0.50	max. 0.40	0.50-0.80	max. 0.030	max. 0.035	max. 0.40	max. 0.10	max. 0.40	-	-
20MnV6	0.17-0.22	0.15-0.80	1.20-1.60	max. 0.025	0.02-0.06	max. 0.30	-	0.08-0.2	max. 0.1	max. 0.1
38MnVS6	0.34-0.41	0.15-0.80	1.20-1.60	max. 0.025	0.020-0.060	max. 0.30	max. 0.08	-	0.08-0.20	max. 0.1
CW85*	0.36-0.40	0.30-0.50	1.10-1.40	max. 0.035	0.020-0.035	-	-	-	0.11-0.16	max. 0.1
42CrMo4	0.38-0.45	Max 0.40	0.60-0.90	max. 0.025	max. 0.035	0.90-1.20	0.15-0.30	-	-	-

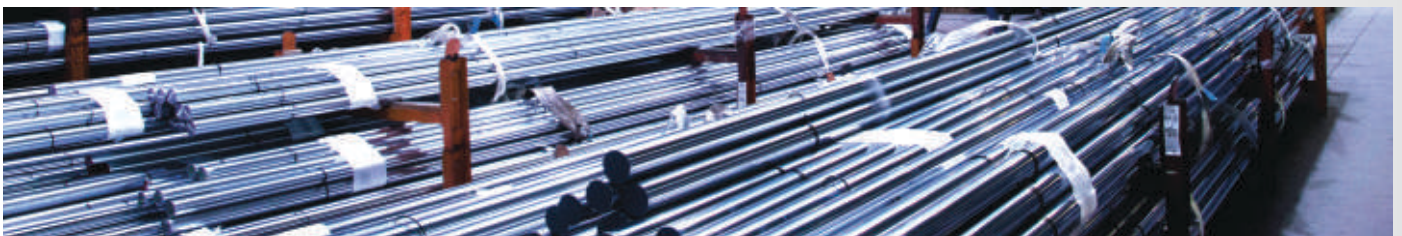
*CW85 internally developed high quality alloy steel with $CE(\%) = C + (Mn/6) + (Cr+Mo+V)/5 + (Ni+Cu)/15$

Table 2: Chemical composition in % by weight

Mechanical Properties

Product	Steel grade	Diameter	Tensile Strength	Yield Point	Elongation	Hardness Brinell
		Ø [mm]	Rm [N/mm²]	Rp _{0.2} [N/mm²]	A5 [%]	HB
A-CHROME BAC A-CHROME BATC	C45E	Ø≤16	min. 710	min. 500	min. 6	200
		16<Ø≤19.05	min. 650	min. 410	min. 7	200
		20<Ø≤100	min. 580	min. 305	min. 16	180-225
		100<Ø≤200	min. 560	min. 275	min. 16	180-225
A-CHROME BACM A-CHROME BATCM	20MnV6	6<Ø<19	min. 700	620	min. 10	200
		19≤Ø≤70	min. 600	450	min. 18	163-200
		70<Ø<160	min. 550	420	min. 18	163-220
A-CHROME BACV A-CHROME BATCV	38MnVS6	Ø<20	min.850	min. 600	min. 6	min. 250
		20≤Ø≤200	min. 800	min. 520	min. 12	min. 230
A-CHROME BACW A-CHROME BATCW	CW85	20<Ø≤140	850-1000	min. 580	min. 14	min. 250
A-CHROME BOC A-CHROME BOTC	42CrMo4	Ø≤16	1100-1200	750	min. 8	298-359
		16<Ø≤40	1000-1200	750	min. 11	298-359
		40<Ø≤100	900-1100	700	min. 12	271-331
		100<Ø≤200	800-950	550	min. 13	225-271

Table 3: Mechanical Properties for the steels used



Stainless Steel Chromed Bars Properties

ASO Hydraulics & Pneumatics chromed plated stainless steel bars are manufactured from a first class stainless steels having the following properties:

Stainless Steel grade correspondents

ASO GROUP	EN	DIN	W	BS	AFNOR	ASTM
A-Chrome BACI 304	X5CrNi18-10	X5CrNi18-10	1.4301	304S17	Z7CN18-09	AISI 304
A-Chrome BACI 316	X5CrNi17-12-2	X5CrNi17-12-2	1.4404	316S11	Z3CND-11-02	AISI 316
A-Chrome BACI329	X3CrNiMoN27-5-2	X3CrNiMoN27-5-2	1.4460	BS1501 PT3.90	Z5 CND-27-05 AZ	AISI 329
A-Chrome BACI 431	X17CrNi16-2	X17CrNi16-2	1.4057	431S29	-	AISI 431
A-Chrome BACI 630	X5CrNiCuNb16-4	X5CrNiCuNb16-4	1.4542	-	Z5 CNU-16-04	AISI 630

Table 4: Corresponding standards of the stainless steel used

Chemical Composition

Steel grade	C	Si _{max}	Mn _{max}	P _{max}	S _{max}	Cr	Mo	Ni	N _{max}	Cu	Nb
X5CrNi18-10	max. 0.07	1.00	2.00	0.045	0.03	18.0-20.0	-	8.0-10.50	0.11	-	-
X5CrNi17-12-2	max. 0.07	1.00	2.00	0.045	0.03	16.5-18.5	2.0-2.5	10.0-13.0	0.11	-	-
X3CrNiMoN27-5-2	max. 0.05	1.00	2.00	0.035	0.015	25.0-28.0	2.5-3.5	4.5-6.5	0.05-0.20	-	-
X17CrNi16-2	0.12-0.22	1.00	1.5	0.040	0.03	15.0-17.0	-	1.50-2.50	-	-	-
X5CrNiCuNb16-4	max. 0.07	0.70	1.5	0.040	0.0015	15.0-17.0	-	3.0-5.0	-	3.0-5.0	5% C

Table 5: Chemical composition in % by weight

Mechanical Properties

Product	Delivery Condition	Yield Point	Tensile Strength	Elongation	Hardness Brinell	Impact Energy
	-	R _{p0.2} [N/mm ²]	R _m [N/mm ²]	A5 [%]	HB	KV +20 (L) [J]
A-Chrome BACI 304	+A 20÷40	190	600-850	30	-	min. 100
	+A 40÷63	190	580-850	30	-	
	+A 63÷160	190	500-700	45	-	
A-Chrome BACI 316	+A 20÷63	min. 200	500-830	min. 30	max. 215	min. 100
	+A 63÷160	min. 200	500-700	min. 40		
A-Chrome BACI 329	+A	min. 450	620-800	min. 20	max 260	min. 85
A-Chrome BACI 431	Qt800	min. 600	800-950	min. 14	-	min. 25
	Qt900	min. 700	900-1050	min. 10	-	min. 20
A-Chrome BACI 630	Qt930	min. 720	930-1000	min 16	-	min 40

Table 6: Mechanical Properties for the steels used

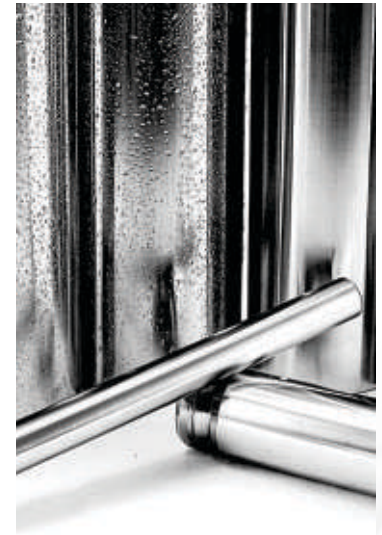
Dimensional Properties

ASO Hydraulics & Pneumatics chromed plated steel/stainless steel bars have the following standard dimensions:

A-CHROME	DIAMETER RANGE** [mm]	STANDARD LENGTH* [mm]	A-CHROME	DIAMETER RANGE** [mm]	STANDARD LENGTH* [mm]	A-CHROME	DIAMETER RANGE** [mm]	STANDARD LENGTH* [mm]
A-CHROME BAC	5 ÷ 57 60 ÷ 200	5.600 ÷ 6.200 6.200 ÷ 7.200	A-CHROME BATCV	20 ÷ 28 30 ÷ 115	5.600 ÷ 6.200 6.200 ÷ 7.200	A-CHROME BACI 304	8 ÷ 100	5.600 ÷ 6.200
A-CHROME BATC	5 ÷ 57 60 ÷ 200	5.600 ÷ 6.200 6.200 ÷ 7.200	A-CHROME BACW	22 ÷ 57 60 ÷ 115	5.600 ÷ 6.200 6.200 ÷ 7.200	A-CHROME BACI 316	8 ÷ 100	5.600 ÷ 6.200
CHROME BACM	5 ÷ 57 60 ÷ 200	5.600 ÷ 6.200 6.200 ÷ 7.200	A-CHROME BATCW	22 ÷ 57 60 ÷ 115	5.600 ÷ 6.200 6.200 ÷ 7.200	A-CHROME BACI 329	20 ÷ 100	5.600 ÷ 6.200
A-CHROME BATCM	5 ÷ 57 60 ÷ 200	5.600 ÷ 6.200 6.200 ÷ 7.200	A-CHROME BOC	5 ÷ 57 60 ÷ 200	5.600 ÷ 6.200 6.200 ÷ 7.200	A-CHROME BACI 431	20 ÷ 100	5.600 ÷ 6.200
A-CHROME BACV	20 ÷ 28 30 ÷ 115	5.600 ÷ 6.200 6.200 ÷ 7.200	A-CHROME BOTC	5 ÷ 57 60 ÷ 200	5.600 ÷ 6.200 6.200 ÷ 7.200	A-CHROME BACI 630	20 ÷ 100	5.600 ÷ 6.200

*Lengths may vary depending on the Chroming process used / **Some diameters may be subject to a minimum quantity requested

***Other diameters, lengths/cut lengths can be provided at premium price



**ACHROME****BAC****Chrome plated Steel bar**

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / C45E

Rod end will
be printed
in blue

Properties

Residual Magnetism Standard

max. 50 Gauss

**Special magnetism can be provided at premium price*

Surface Roughness

Ra: max. 0.20 [μm]

Surface Hardness

Chrome Layer hardness: min. 900 HV 0.1

Diameter tolerance

Standard ISO-f7

**Special Tolerance can be provided at premium price*

Chrome Layer thickness

Ø ≤ 19.05 [mm] | 15 [μm]

Ø > 20 [mm] | 20 [μm]

Straightness

Ø < 20 [mm] | max. 0.3 [mm]/1000 [mm]

Ø ≥ 20 [mm] | max. 0.2 [mm]/1000 [mm]

Roundness

max. ½ from diameter tolerance

Marking

For a full traceability each bar is marked individually on the plastic/paper tube with info about the date, product series, diameter, tolerance, resistance at saltwater spray test, heat no, production order and so on. The batch has a label with information regarding: Order no, Item no, Heat no., Steel Grade; total length of the batch, Weight, no of pieces in the batch.

Corrosion Resistance

Based on a salt spray test following the ISO 9227 standard combined with the ISO 10289 for the evaluation of the rating

ISO9227	ASTM	DIN50021	Salt Spray Test
NSS	B117	SS	Neutral Salt Spray
AASS	B287	ESS	Acetic Acid Salt Spray
CASS	B368	CASS	Cooper-accelerated acetic acid salt spray

A-CHROME

Standard Corrosion resistance for Ø < 20 R9/120h NSS; for Ø ≥ 20 R10/120h NSS and R9/200h NSS.

A-CHROME EXTRA

Standard Corrosion resistance for Ø ≥ 20-140 R10/120h NSS and for Ø ≥ 20-140 R9/500h NSS.

A-CHROME EXTRA PLUS

Standard Corrosion resistance for Ø ≥ 20-140 R10/500h NSS.

** DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE*

Weldability & Machinability

Weldability - good using conventional or friction welding.

Machinability - good compare to the other steel grades and can achieve a good cutting speed using the proper coated carbide tools

Packaging

A-CHROME products can be supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes (depending on the diameter size)

Special requirements with additional cost – Seaworthy protected – aluminum foil or vacuum bags.

Extra protection with additional cost – wooden boxes



A-CHROME

BATC

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / C45E+IH

Rod end will
be printed
in blue with
a green line

/ Chrome plated Steel bar (induction hardening)

Properties

Residual Magnetism Standard

max. 50 Gauss

**Special magnetism can be provided at premium price*

Surface Roughness

Ra: max. 0.20 [μm]

Surface Hardness

Chrome Layer hardness: min 900 HV 0.1

Chrome Layer thickness

Ø≤19.05 [mm] | 15 [μm]

Ø>20 [mm] | 20 [μm]

Diameter tolerance

Standard ISO-f7

**Special Tolerance can be provided at premium price*

Straightness

Ø<20 [mm] | max. 0.3 [mm]/1000 [mm]

Ø≥20 [mm] | max. 0.2 [mm]/1000 [mm]

Roundness

max. ½ from diameter tolerance



Corrosion Resistance

Based on a salt spray test following the ISO 9227 standard combined with the ISO 10289 for the evaluation of the rating

ISO9227 ASTM DIN50021 Salt Spray Test

NSS	B117	SS	Neutral Salt Spray
AASS	B287	ESS	Acetic Acid Salt Spray
CASS	B368	CASS	Cooper-accelerated acetic acid salt spray

A-CHROME

Standard Corrosion resistance for Ø<20 R9/120hNSS; for Ø≥20 R10/120h NSS and R9/200h NSS.

A-CHROME EXTRA

Standard Corrosion resistance for Ø≥20-140 R10/120h NSS and for Ø≥20-140 R9/500h NSS.

A-CHROME EXTRA PLUS

Standard Corrosion resistance for Ø≥20-140 R10/500h NSS.

** DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE*

Hardening Depth:

Ø [mm]	SHD [mm]	Ø [mm]	SHD [mm]
6	0.5-0.8	25	1.5-1.7
8	0.6-0.9	28	1.5-1.8
10	0.7-1.0	30-38	1.5-1.9
12-14	0.8-1.2	40-45	1.6-2.0
14	0.9-1.3	50-85	2.2-2.6
15	1.0-1.4	90-100	2.2-3.2
16-18	1.1-1.5	105-140	2.4-3.3
20-22	1.2-1.5	150-203.2	2.5-3.5
24	1.4-1.6		

Surface Hardness: Steel-grade C45E IH: Min 55HRC

Weldability & Machinability

Weldability - good**Machinability** - good

Packaging

A-CHROME products can be supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes (depending on the diameter size)**Special requirements with additional cost** – Seaworthy protected – aluminum foil or vacuum bags.**Extra protection with additional cost** – wooden boxes

Marking

For a full traceability each bar is marked individually on the plastic/paper tube with info about the date, product series, diameter, tolerance, resistance at saltwater spray test, heat no, production order and so on. The batch has a label with information regarding: Order no, Item no, Heat no., Steel Grade; total length of the batch, Weight, no of pieces in the batch.

**A-CHROME****BACM****Chrome plated Steel bar**

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / 20MnV6

Rod end will
be printed
in red**Properties****Residual Magnetism Standard**

max. 50 Gauss

Special magnetism can be provided at premium price*Surface Roughness**

Ra: max. 0.20 [µm]

Surface Hardness

Chrome Layer hardness: min. 900 HV 0.1

Diameter tolerance

Standard ISO-f7

Special Tolerance can be provided at premium price*Chrome Layer thickness**

Ø ≤ 19.05 [mm] | 15 [µm]

Ø > 20 [mm] | 20 [µm]

Straightness

Ø < 20 [mm] | max. 0.3 [mm]/1000 [mm]

Ø ≥ 20 [mm] | max. 0.2 [mm]/1000 [mm]

Roundness

max. ½ from diameter tolerance

Marking

For a full traceability each bar is marked individually on the plastic/paper tube with info about the date, product series, diameter, tolerance, resistance at saltwater spray test, heat no, production order and so on. The batch has a label with information regarding: Order no, Item no, Heat no., Steel Grade; total length of the batch, Weight, no of pieces in the batch.

Corrosion Resistance

Based on a salt spray test following the ISO 9227 standard combined with the ISO 10289 for the evaluation of the rating

ISO9227	ASTM	DIN50021	Salt Spray Test
NSS	B117	SS	Neutral Salt Spray
AASS	B287	ESS	Acetic Acid Salt Spray
CASS	B368	CASS	Cooper-accelerated acetic acid salt spray

A-CHROME

Standard Corrosion resistance for Ø < 20 R9/120h NSS; for Ø ≥ 20 R10/120h NSS and R9/200h NSS.

A-CHROME EXTRA

Standard Corrosion resistance for Ø ≥ 20-140 R10/120h NSS and for Ø ≥ 20-140 R9/500h NSS.

A-CHROME EXTRA PLUS

Standard Corrosion resistance for Ø ≥ 20-140 R10/500h NSS.

** DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE***Weldability & Machinability****Weldability** - excellent**Machinability** - – excellent

Strong at low temperatures

Packaging

A-CHROME products can be supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes (depending on the diameter size)

Special requirements with additional cost – Seaworthy protected – aluminum foil or vacuum bags.

Extra protection with additional cost – wooden boxes



A-CHROME

BATCM

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / 20MnV6+IH

Rod end will
be printed
in red with
a green line

/ Chrome plated Steel bar (induction hardening)

Properties

Residual Magnetism Standard

max. 50 Gauss

**Special magnetism can be provided at premium price*

Surface Roughness

Ra: max. 0.20 [μm]

Surface Hardness

Chrome Layer hardness: min. 900 HV 0.1

Chrome Layer thickness

Ø≤19.05 [mm] | 15 [μm]

Ø>20 [mm] | 20 [μm]

Diameter tolerance

Standard ISO-f7

**Special Tolerance can be provided at premium price*

Straightness

Ø<20 [mm] | max. 0.3 [mm]/1000 [mm]

Ø≥20 [mm] | max. 0.2 [mm]/1000 [mm]

Roundness

max ½ from diameter tolerance



Corrosion Resistance

Based on a salt spray test following the ISO 9227 standard combined with the ISO 10289 for the evaluation of the rating

ISO9227 ASTM DIN50021 Salt Spray Test

NSS	B117	SS	Neutral Salt Spray
AASS	B287	ESS	Acetic Acid Salt Spray
CASS	B368	CASS	Cooper-accelerated acetic acid salt spray

A-CHROME

Standard Corrosion resistance for Ø<20 R9/120hNSS;
for Ø≥20 R10/120h NSS and R9/200h NSS.

A-CHROME EXTRA

Standard Corrosion resistance for Ø≥20-140 R10/120h NSS
and for Ø≥20-140 R9/500h NSS.

A-CHROME EXTRA PLUS

Standard Corrosion resistance for Ø≥20-140 R10/500h NSS.

** DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE*

Hardening Depth:

Ø [mm]	SHD [mm]	Ø [mm]	SHD [mm]
6	0.5-0.8	25	1.5-1.7
8	0.6-0.9	28	1.5-1.8
10	0.7-1.0	30-38	1.5-1.9
12-14	0.8-1.2	40-45	1.6-2.0
14	0.9-1.3	50-85	2.2-2.6
15	1.0-1.4	90-100	2.2-3.2
16-18	1.1-1.5	105-140	2.4-3.3
20-22	1.2-1.5	150-203.2	2.5-3.5
24	1.4-1.6		

Surface Hardness: Steel-grade 20MnV6 IH: min. 42HRC

Weldability & Machinability

Weldability - excellent**Machinability** - - excellent

Strong at low temperatures

Packaging

A-CHROME products can be supplied in 3 different packaging options:

Standard - plastic sleeves or paper tubes (depending on the diameter size)**Special requirements with additional cost** - Seaworthy protected - aluminum foil or vacuum bags.**Extra protection with additional cost** - wooden boxes

Marking

For a full traceability each bar is marked individually on the plastic/paper tube with info about the date, product series, diameter, tolerance, resistance at saltwater spray test, heat no., production order and so on. The batch has a label with information regarding: Order no, Item no, Heat no., Steel Grade; total length of the batch, Weight, no of pieces in the batch.

**A-CHROME****BACV****Chrome plated Steel bar**

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / 38MnVS6

Rod end will
be printed
in violet**Properties****Residual Magnetism Standard**

max. 50 Gauss

Special magnetism can be provided at premium price*Surface Roughness**

Ra: max. 0.20 [µm]

Surface Hardness

Chrome Layer hardness: min. 900 HV 0.1

Diameter tolerance

Standard ISO-f7

Special Tolerance can be provided at premium price*Chrome Layer thickness**

Ø ≤ 19.05 [mm] | 15 [µm]

Ø > 20 [mm] | 20 [µm]

Straightness

Ø < 20 [mm] | max 0.3 [mm]/1000 [mm]

Ø ≥ 20 [mm] | max 0.2 [mm]/1000 [mm]

Roundness

max. ½ from diameter tolerance

Marking

For a full traceability each bar is marked individually on the plastic/paper tube with info about the date, product series, diameter, tolerance, resistance at saltwater spray test, heat no, production order and so on. The batch has a label with information regarding: Order no, Item no, Heat no., Steel Grade; total length of the batch, Weight, no of pieces in the batch.

Corrosion Resistance

Based on a salt spray test following the ISO 9227 standard combined with the ISO 10289 for the evaluation of the rating

ISO9227	ASTM	DIN50021	Salt Spray Test
NSS	B117	SS	Neutral Salt Spray
AASS	B287	ESS	Acetic Acid Salt Spray
CASS	B368	CASS	Cooper-accelerated acetic acid salt spray

A-CHROME

Standard Corrosion resistance for Ø < 20 R9/120hNSS; for Ø ≥ 20 R10/120h NSS and R9/200h NSS.

A-CHROME EXTRA

Standard Corrosion resistance for Ø ≥ 20-140 R10/120h NSS and for Ø ≥ 20-140 R9/500h NSS.

A-CHROME EXTRA PLUS

Standard Corrosion resistance for Ø ≥ 20-140 R10/500h NSS.

** DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE***Weldability & Machinability****Weldability** - good**Machinability** - good

The chemical composition confers mechanical properties compared with medium carbon steels QT

Packaging

A-CHROME products can be supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes (depending on the diameter size)

Special requirements with additional cost – Seaworthy protected – aluminum foil or vacuum bags.

Extra protection with additional cost – wooden boxes

**A-CHROME****BATCV****/ Chrome plated Steel bar (induction hardening)**

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / 38MnVS6+IH

Rod end will
be printed
in violet with
a green line**Properties****Residual Magnetism Standard**

max. 50 Gauss

Special magnetism can be provided at premium price*Surface Roughness**

Ra: max. 0.20 [µm]

Surface Hardness

Chrome Layer hardness: min 900 HV 0.1

Chrome Layer thickness

Ø≤19.05 [mm] | 15 [µm]

Ø>20 [mm] | 20 [µm]

Diameter tolerance

Standard ISO-f7

Special Tolerance can be provided at premium price*Straightness**

Ø<20 [mm] | max 0.3 [mm]/1000 [mm]

Ø≥20 [mm] | max 0.2 [mm]/1000 [mm]

Roundness

max. ½ from diameter tolerance

Corrosion Resistance

Based on a salt spray test following the ISO 9227 standard combined with the ISO 10289 for the evaluation of the rating

ISO9227 ASTM DIN50021 Salt Spray Test

NSS	B117	SS	Neutral Salt Spray
AASS	B287	ESS	Acetic Acid Salt Spray
CASS	B368	CASS	Cooper-accelerated acetic acid salt spray

A-CHROME

Standard Corrosion resistance for Ø<20 R9/120hNSS; for Ø≥20 R10/120h NSS and R9/200h NSS.

A-CHROME EXTRA

Standard Corrosion resistance for Ø≥20-140 R10/120h NSS and for Ø≥20-140 R9/500h NSS.

A-CHROME EXTRA PLUS

Standard Corrosion resistance for Ø≥20-140 R10/500h NSS.

** DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE***Hardening Depth:**

Ø [mm]	SHD [mm]	Ø [mm]	SHD [mm]
6	0.5-0.8	24	1.4-1.6
8	0.6-0.9	25	1.5-1.7
10	0.7-1.0	28	1.5-1.8
12-14	0.8-1.2	30-38	1.5-1.9
14	0.9-1.3	40-45	1.6-2.0
15	1.0-1.4	50-85	2.2-2.6
16-18	1.1-1.5	90-100	2.2-3.2
20-22	1.2-1.5	105-140	2.4-3.3

Surface Hardness: Steel-grade 38MnVS6 IH: Min 55HRC**Weldability & Machinability****Weldability** - good**Machinability** - good

The chemical composition confers mechanical properties compared with medium carbon steels QT

Packaging

A-CHROME products can be supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes (depending on the diameter size)**Special requirements with additional cost** – Seaworthy protected – aluminum foil or vacuum bags.**Extra protection with additional cost** – wooden boxes**Marking**

For a full traceability each bar is marked individually on the plastic/paper tube with info about the date, product series, diameter, tolerance, resistance at saltwater spray test, heat no production order and so on. The batch has a label with information regarding: Order no, Item no, Heat no., Steel Grade; total length of the batch, Weight, no of pieces in the batch.

**A CHROME****BACW****Chrome plated Steel bar**

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / CW85

Rod end will
be printed
in half violet,
half white

Properties

Residual Magnetism Standard

max. 50 Gauss

**Special magnetism can be provided at premium price*

Surface Roughness

Ra: max 0.20 [µm]

Surface Hardness

Chrome Layer hardness: min 900 HV 0.1

Diameter tolerance

Standard ISO-f7

**Special Tolerance can be provided at premium price*

Chrome Layer thickness

Ø>20 [mm] | 20 [µm]

Straightness

Ø≥20 [mm] | max 0.2 [mm]/1000 [mm]

Roundness

max. ½ from diameter tolerance

Marking

For a full traceability each bar is marked individually on the plastic/paper tube with info about the date, product series, diameter, tolerance, resistance at saltwater spray test, heat no, production order and so on. The batch has a label with information regarding: Order no, Item no, Heat no., Steel Grade; total length of the batch, Weight, no of pieces in the batch.

Corrosion Resistance

Based on a salt spray test following the ISO 9227 standard combined with the ISO 10289 for the evaluation of the rating

ISO9227	ASTM	DIN50021	Salt Spray Test
NSS	B117	SS	Neutral Salt Spray
AASS	B287	ESS	Acetic Acid Salt Spray
CASS	B368	CASS	Cooper-accelerated acetic acid salt spray

A-CHROME

Standard Corrosion resistance for Ø<20 R9/120hNSS; for Ø≥20 R10/120h NSS and R9/200h NSS.

A-CHROME EXTRA

Standard Corrosion resistance for Ø≥20-140 R10/120h NSS and for Ø≥20-140 R9/500h NSS.

A-CHROME EXTRA PLUS

Standard Corrosion resistance for Ø≥20-140 R10/500h NSS.

** DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE*

Weldability & Machinability

Weldability - excellent

Machinability - excellent

The chemical composition confers mechanical properties compared with medium carbon steels QT

Packaging

A-CHROME products can be supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes (depending on the diameter size)

Special requirements with additional cost – Seaworthy protected – aluminum foil or vacuum bags.

Extra protection with additional cost– wooden boxes



A-CHROME

BATCW

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / CW85+IH

Rod end will
be printed
in half violet,
half white
with a green line



/ Chrome plated Steel bar (induction hardening)

Properties

Residual Magnetism Standard

max. 50 Gauss

**Special magnetism can be provided at premium price*

Surface Roughness

Ra: max. 0.20 [µm]

Surface Hardness

Chrome Layer hardness: min 900 HV 0.1

Diameter tolerance

Standard ISO-f7

**Special Tolerance can be provided at premium price*

Chrome Layer thickness

Ø>20 [mm] | 20 [µm]

Straightness

Ø≥20 [mm] | max 0.2 [mm]/1000 [mm]

Roundness

max. ½ from diameter tolerance



Corrosion Resistance

Based on a salt spray test following the ISO 9227 standard combined with the ISO 10289 for the evaluation of the rating

ISO9227 ASTM DIN50021 Salt Spray Test

NSS	B117	SS	Neutral Salt Spray
AASS	B287	ESS	Acetic Acid Salt Spray
CASS	B368	CASS	Cooper-accelerated acetic acid salt spray

A-CHROME

Standard Corrosion resistance for Ø<20 R9/120hNSS;
for Ø≥20 R10/120h NSS and R9/200h NSS.

A-CHROME EXTRA

Standard Corrosion resistance for Ø≥20-140 R10/120h NSS
and for Ø≥20-140 R9/500h NSS.

A-CHROME EXTRA PLUS

Standard Corrosion resistance for Ø≥20-140 R10/500h NSS.

** DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE*

Hardening Depth:

Ø [mm]	SHD [mm]
20-22	1.2-1.5
24	1.4-1.6
25	1.5-1.7
28	1.5-1.8
30-38	1.5-1.9
40-45	1.6-2.0
50-85	2.2-2.6
90-100	2.2-3.2
105-140	2.4-3.3

Surface Hardness: Steel-grade CW85 IH: Min 55HRC

Weldability & Machinability

Weldability - excellent**Machinability** - excellent

The chemical composition confers mechanical properties compared with medium carbon steels QT

Packaging

A-CHROME products can be supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes (depending on the diameter size)

Special requirements with additional cost – Seaworthy protected – aluminum foil or vacuum bags.

Extra protection with additional cost – wooden boxes

Marking

For a full traceability each bar is marked individually on the plastic/paper tube with info about the date, product series, diameter, tolerance, resistance at saltwater spray test, heat no production order and so on. The batch has a label with information regarding: Order no, Item no, Heat no., Steel Grade; total length of the batch, Weight, no of pieces in the batch.

**A CHROME****BOC**

/ Chrome plated Steel bar

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / 42CrMo4+QT

Rod end will
be printed
in purple

Properties

Residual Magnetism Standard

max. 50 Gauss

**Special magnetism can be provided at premium price*

Surface Roughness

Ra: max. 0.20 [μm]

Surface Hardness

Chrome Layer hardness: min 900 HV 0.1

Diameter tolerance

Standard ISO-f7

**Special Tolerance can be provided at premium price*

Chrome Layer thickness

Ø ≤ 19.05 [mm] | 15 [μm]

Ø > 20 [mm] | 20 [μm]

Straightness

Ø < 20 [mm] | max 0.3 [mm]/1000 [mm]

Ø ≥ 20 [mm] | max 0.2 [mm]/1000 [mm]

Roundness

max ½ from diameter tolerance

Marking

For a full traceability each bar is marked individually on the plastic/paper tube with info about the date, product series, diameter, tolerance, resistance at saltwater spray test, heat no, production order and so on. The batch has a label with information regarding: Order no, Item no, Heat no., Steel Grade; total length of the batch, Weight, no of pieces in the batch.

Corrosion Resistance

Based on a salt spray test following the ISO 9227 standard combined with the ISO 10289 for the evaluation of the rating

ISO9227	ASTM	DIN50021	Salt Spray Test
NSS	B117	SS	Neutral Salt Spray
AASS	B287	ESS	Acetic Acid Salt Spray
CASS	B368	CASS	Cooper-accelerated acetic acid salt spray

A-CHROME

Standard Corrosion resistance for Ø < 20 R9/120hNSS; for Ø ≥ 20 R10/120h NSS and R9/200h NSS.

A-CHROME EXTRA

Standard Corrosion resistance for Ø ≥ 20-140 R10/120h NSS and for Ø ≥ 20-140 R9/500h NSS.

A-CHROME EXTRA PLUS

Standard Corrosion resistance for Ø ≥ 20-140 R10/500h NSS.

** DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE*

Weldability & Machinability

Weldability - limited due to crack risk. Only with preheating process. Chromed bars preheating temperature max 250-300° C
Sensitive to overheating

Packaging

A-CHROME products can be supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes (depending on the diameter size)

Special requirements with additional cost – Seaworthy protected – aluminum foil or vacuum bags.

Extra protection with additional cost – wooden boxes



A-CHROME

BOTC

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / 42CrMo4+QT+IH

Rod end will
be printed
in purple
with a green line

/ Chrome plated Steel bar (induction hardening)

Properties

Residual Magnetism Standard

Max. 50 Gauss

**Special magnetism can be provided at premium price*

Surface Roughness

Ra: max 0.20 [µm]

Surface Hardness

Chrome Layer hardness: min 900 HV 0.1

Chrome Layer thickness

Ø≤19.05 [mm] | 15 [µm]

Ø>20 [mm] | 20 [µm]

Diameter tolerance

Standard ISO-f7

**Special Tolerance can be provided at premium price*

Straightness

Ø<20 [mm] | max 0.3 [mm]/1000 [mm]

Ø≥20 [mm] | max 0.2 [mm]/1000 [mm]

Roundness

max. ½ from diameter tolerance



Corrosion Resistance

Based on a salt spray test following the ISO 9227 standard combined with the ISO 10289 for the evaluation of the rating

ISO9227 ASTM DIN50021 Salt Spray Test

NSS	B117	SS	Neutral Salt Spray
AASS	B287	ESS	Acetic Acid Salt Spray
CASS	B368	CASS	Cooper-accelerated acetic acid salt spray

A-CHROME

Standard Corrosion resistance for Ø<20 R9/120hNSS;
for Ø≥20 R10/120h NSS and R9/200h NSS.

A-CHROME EXTRA

Standard Corrosion resistance for Ø≥20-140 R10/120h NSS
and for Ø≥20-140 R9/500h NSS.

A-CHROME EXTRA PLUS

Standard Corrosion resistance for Ø≥20-140 R10/500h NSS.

** DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE*

Hardening Depth:

Ø [mm]	SHD [mm]	Ø [mm]	SHD [mm]
6	0.5-0.8	25	1.5-1.7
8	0.6-0.9	28	1.5-1.8
10	0.7-1.0	30-38	1.5-1.9
12-14	0.8-1.2	40-45	1.6-2.0
14	0.9-1.3	50-85	2.2-2.6
15	1.0-1.4	90-100	2.2-3.2
16-18	1.1-1.5	105-140	2.4-3.3
20-22	1.2-1.5	150-203.2	2.5-3.5
24	1.4-1.6		

Surface Hardness: Steel-grade 42CrMo4+QT+ IH: Min 55HRC

Weldability & Machinability

Weldability - limited due to crack risk. Only with preheating process.
Chromed bars preheating temperature max 250-300° C

Sensitive to overheating

Packaging

A-CHROME products can be supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes (depending on the diameter size)**Special requirements with additional cost** – Seaworthy protected – aluminum foil or vacuum bags.**Extra protection with additional cost** – wooden boxes

Marking

For a full traceability each bar is marked individually on the plastic/paper tube with info about the date, product series, diameter, tolerance, resistance at saltwater spray test, heat no production order and so on. The batch has a label with information regarding: Order no, Item no, Heat no., Steel Grade; total length of the batch, Weight, no of pieces in the batch.



A-CHROME

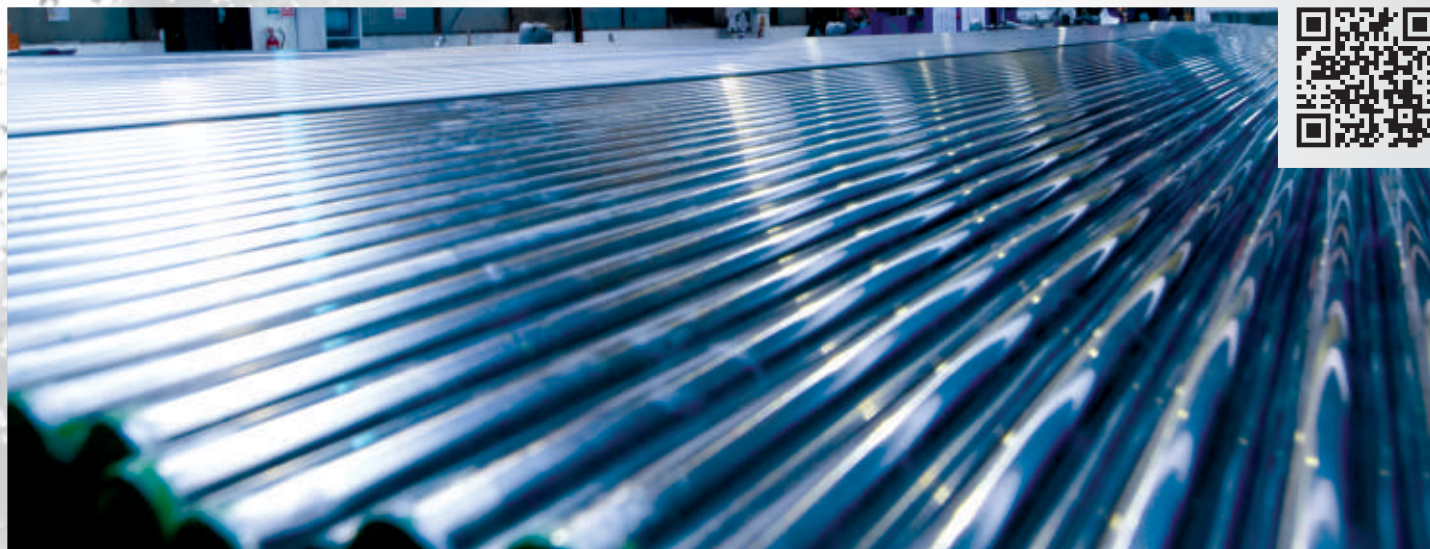
BACI 304

Chrome plated Stainless Steel bar

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / AISI 304

Rod end will
be printed
in green
with a red line.



Properties

Residual Magnetism Standard

max. 50 Gauss

**Special magnetism can be provided at premium price*

Surface Roughness

Ra: max. 0.20 [µm]

Surface Hardness

Chrome Layer hardness: min 900 HV 0.1

Diameter tolerance

Standard ISO-f7

**Special Tolerance can be provided at premium price*

Chrome Layer thickness

Ø ≤ 20 [mm] | 15 [µm]

Ø > 20 [mm] | 20 [µm]

Straightness

Ø ≤ 20 [mm] | max 0.3 [mm]/1000 [mm]

Ø > 20 [mm] | max 0.2 [mm]/1000 [mm]

Roundness

max. ½ from diameter tolerance

Marking

For a full traceability each bar is marked individually on the plastic/paper tube with info about the date, product series, diameter, tolerance, resistance at saltwater spray test, heat no, production order and so on. The batch has a label with information regarding: Order no, Item no, Heat no., Steel Grade; total length of the batch, Weight, no of pieces in the batch.

Corrosion Resistance

A-CHROME

Standard Corrosion resistance for Ø < 20 R9/120h NSS; for Ø ≥ 20 R10/120h NSS and R9/200h NSS.

A-CHROME EXTRA

Standard Corrosion resistance for Ø ≥ 20-140 R10/120h NSS and for Ø ≥ 20-140 R9/500h NSS.

A-CHROME EXTRA PLUS

Standard Corrosion resistance for Ø ≥ 20-140 R10/500h NSS and R9/1000h NSS.

** DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE*

Packaging

A-CHROME products can be supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes (depending on the diameter size)

Special requirements with additional cost – Seaworthy protected – aluminum foil or vacuum bags.

Extra protection with additional cost – wooden boxes





A-CHROME

BACI 316

Chrome plated Stainless Steel bar

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / AISI 316

Rod end
will be
printed in
green with
a blue line



Properties

Residual Magnetism Standard

max. 50 Gauss

**Special magnetism can be provided at premium price*

Surface Roughness

Ra: max. 0.20 [μm]

Surface Hardness

Chrome Layer hardness: min 900 HV 0.1

Diameter tolerance

Standard ISO-f7

**Special Tolerance can be provided at premium price*

Chrome Layer thickness

Ø ≤ 20 [mm] | 15 [μm]

Ø > 20 [mm] | 20 [μm]

Straightness

Ø ≤ 20 [mm] | max 0.3 [mm]/1000 [mm]

Ø > 20 [mm] | max 0.2 [mm]/1000 [mm]

Roundness

max. ½ from diameter tolerance

Marking

For a full traceability each bar is marked individually on the plastic/paper tube with info about the date, product series, diameter, tolerance, resistance at saltwater spray test, heat no, production order and so on. The batch has a label with information regarding: Order no, Item no, Heat no., Steel Grade; total length of the batch, Weight, no of pieces in the batch.

Corrosion Resistance

A-CHROME

Standard Corrosion resistance for Ø < 20 R9/120h NSS; for Ø ≥ 20 R10/120h NSS and R9/200h NSS.

A-CHROME EXTRA

Standard Corrosion resistance for Ø ≥ 20-140 R10/120h NSS and for Ø ≥ 20-140 R9/500h NSS.

A-CHROME EXTRA PLUS

Standard Corrosion resistance for Ø ≥ 20-140 R10/500h NSS and R9/1000h NSS.

** DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE*

Packaging

A-CHROME products can be supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes (depending on the diameter size)

Special requirements with additional cost – Seaworthy protected – aluminum foil or vacuum bags.

Extra protection with additional cost – wooden boxes





A-CHROME

BACI 329

Chrome plated Stainless Steel bar

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / AISI 329

Rod end
will be
printed in
green with
a blue cross



Properties

Residual Magnetism Standard

max. 50 Gauss

**Special magnetism can be provided at premium price*

Surface Roughness

Ra: max. 0.20 [μm]

Surface Hardness

Chrome Layer hardness: min 900 HV 0.1

Diameter tolerance

Standard ISO-f7

**Special Tolerance can be provided at premium price*

Chrome Layer thickness

$\varnothing \geq 20$ [mm] | 20 [μm]

Straightness

$\varnothing \geq 20$ [mm] | max 0.2 [mm]/1000 [mm]

Roundness

max. $\frac{1}{2}$ from diameter tolerance

Marking

For a full traceability each bar is marked individually on the plastic/paper tube with info about the date, product series, diameter, tolerance, resistance at saltwater spray test, heat no, production order and so on. The batch has a label with information regarding: Order no, Item no, Heat no., Steel Grade; total length of the batch, Weight, no of pieces in the batch.

Corrosion Resistance

A-CHROME

Standard Corrosion resistance for $\varnothing < 20$ R9/120hNSS; for $\varnothing \geq 20$ R10/120h NSS and R9/200h NSS.

A-CHROME EXTRA

Standard Corrosion resistance for $\varnothing \geq 20$ -140 R10/120h NSS and for $\varnothing \geq 20$ -140 R9/500h NSS.

A-CHROME EXTRA PLUS

Standard Corrosion resistance for $\varnothing \geq 20$ -140 R10/500h NSS and R9/1000h NSS.

** DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE*

Packaging

A-CHROME products can be supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes (depending on the diameter size)

Special requirements with additional cost – Seaworthy protected – aluminum foil or vacuum bags.

Extra protection with additional cost – wooden boxes





A-CHROME

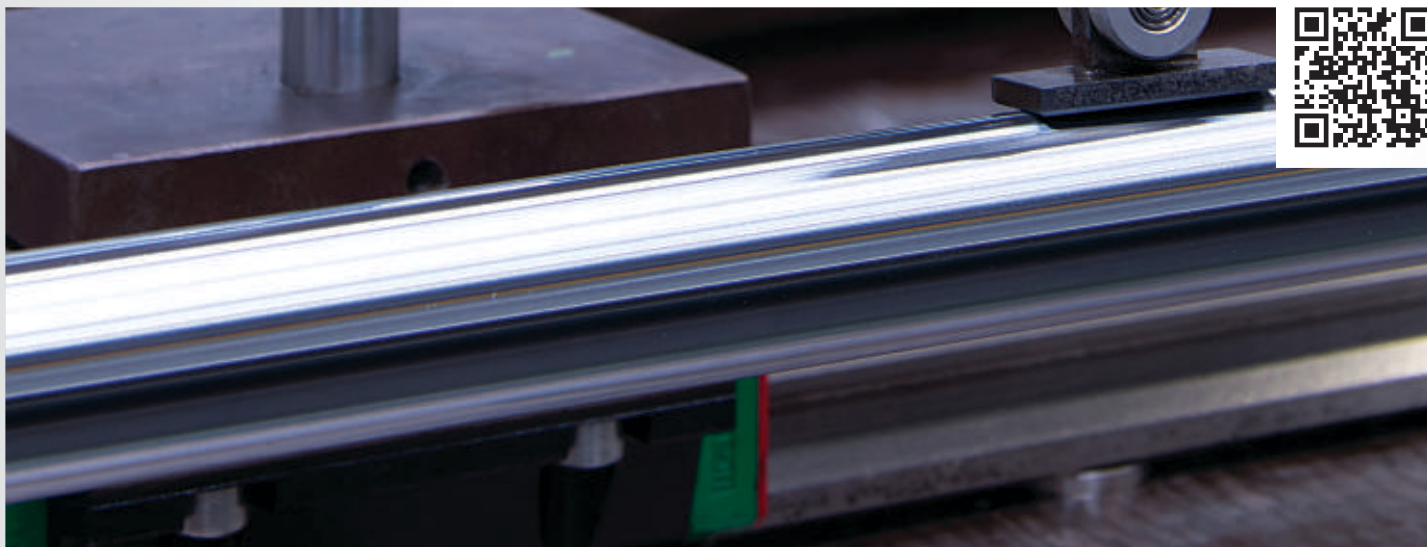
BACI 431

Chrome plated Stainless Steel bar

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / AISI 431

Rod end
will be
printed in
green with
a red cross



Properties

Residual Magnetism Standard

max. 50 Gauss

**Special magnetism can be provided at premium price*

Surface Roughness

Ra: max. 0.20 [μm]

Surface Hardness

Chrome Layer hardness: min 900 HV 0.1

Diameter tolerance

Standard ISO-f7

**Special Tolerance can be provided at premium price*

Chrome Layer thickness

$\varnothing \geq 20$ [mm] | 20 [μm]

Straightness

$\varnothing \geq 20$ [mm] | max 0.2 [mm]/1000 [mm]

Roundness

max. $\frac{1}{2}$ from diameter tolerance

Marking

For a full traceability each bar is marked individually on the plastic/paper tube with info about the date, product series, diameter, tolerance, resistance at saltwater spray test, heat no, production order and so on. The batch has a label with information regarding: Order no, Item no, Heat no., Steel Grade; total length of the batch, Weight, no of pieces in the batch.

Corrosion Resistance

A-CHROME

Standard Corrosion resistance for $\varnothing < 20$ R9/120hNSS;
for $\varnothing \geq 20$ R10/120h NSS and R9/200h NSS.

A-CHROME EXTRA

Standard Corrosion resistance for $\varnothing \geq 20$ -140 R10/120h NSS
and for $\varnothing \geq 20$ -140 R9/500h NSS.

A-CHROME EXTRA PLUS

Standard Corrosion resistance for $\varnothing \geq 20$ -140 R10/500h NSS and
R9/1000h NSS.

** DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE*

Packaging

A-CHROME products can be supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes (depending on the diameter size)

Special requirements with additional cost – Seaworthy protected – aluminum foil or vacuum bags.

Extra protection with additional cost – wooden boxes





A-CHROME

BACI 630

Chrome plated Stainless Steel bar

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / AISI 630

Rod end
will be
printed in
green with
a grey line



Properties

Residual Magnetism Standard

max. 50 Gauss

**Special magnetism can be provided at premium price*

Surface Roughness

Ra: max. 0.20 [μm]

Surface Hardness

Chrome Layer hardness: min 900 HV 0.1

Diameter tolerance

Standard ISO-f7

**Special Tolerance can be provided at premium price*

Chrome Layer thickness

$\varnothing \geq 20$ [mm] | 20 [μm]

Straightness

$\varnothing \geq 20$ [mm] | max 0.2 [mm]/1000 [mm]

Roundness

max. $\frac{1}{2}$ from diameter tolerance

Marking

For a full traceability each bar is marked individually on the plastic/paper tube with info about the date, product series, diameter, tolerance, resistance at saltwater spray test, heat no, production order and so on. The batch has a label with information regarding: Order no, Item no, Heat no., Steel Grade; total length of the batch, Weight, no of pieces in the batch.

Corrosion Resistance

A-CHROME

Standard Corrosion resistance for $\varnothing < 20$ R9/120hNSS; for $\varnothing \geq 20$ R10/120h NSS and R9/200h NSS.

A-CHROME EXTRA

Standard Corrosion resistance for $\varnothing \geq 20$ -140 R10/120h NSS and for $\varnothing \geq 20$ -140 R9/500h NSS.

A-CHROME EXTRA PLUS

Standard Corrosion resistance for $\varnothing \geq 20$ -140 R10/500h NSS and R9/1000h NSS.

** DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE*

Packaging

A-CHROME products can be supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes (depending on the diameter size)

Special requirements with additional cost – Seaworthy protected – aluminum foil or vacuum bags.

Extra protection with additional cost – wooden boxes



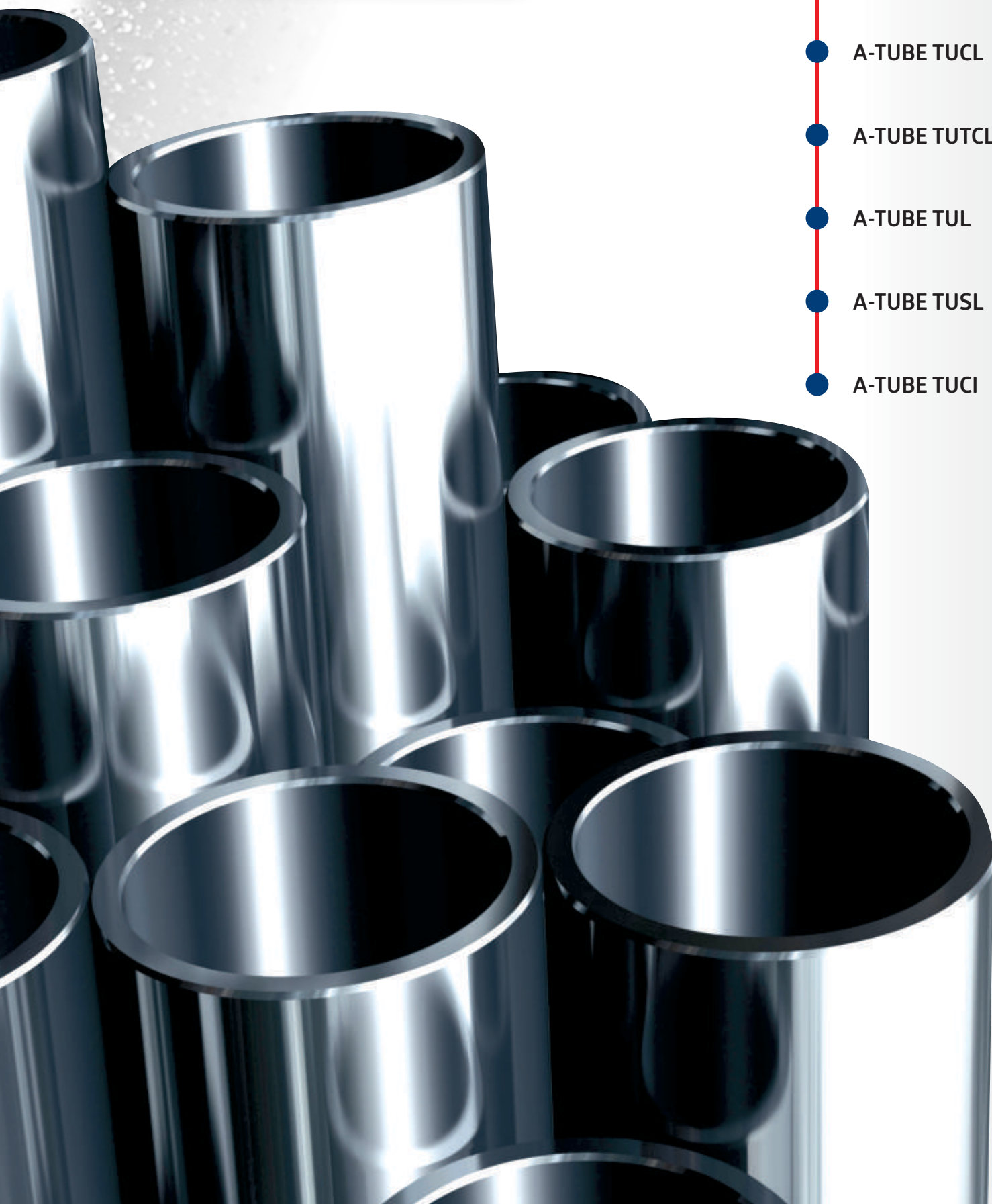


ASO HYDRAULICS &
PNEUMATICS
/ASO CROMSTEEL
/ASO SPS



Cylinder Tubes

- A-TUBE TUC
- A-TUBE TUTC
- A-TUBE TUCL
- A-TUBE TUTCL
- A-TUBE TUL
- A-TUBE TUSL
- A-TUBE TUCI



General Cylinder Tubes Properties

ASO Hydraulics & Pneumatics tubes are made from a first class raw material having the following properties:

Chemical Composition of the Steels

EN 10305-1	W	DIN		C %	Si %	Mn %	P %	S %	Al %	V %	Ti %
E355	1.0580	St52	min. ▶	–	–	–	–	0.020	–	–	– ◀ min.
			max. ▶	0.22	0.55	1.60	0.025	0.040	0.02	–	– ◀ max.
E410	1.0509	–	min. ▶	0.16	0.10	1.30	–	–	0.01	0.08	– ◀ min.
			max. ▶	0.22	0.50	1.70	0.030	0.035	0.06	0.15	0.05 ◀ max.

*CEV calculated with the formula: $\% C + Mn/6 + Ni/0.15 + Cr/5 + Mo/4 + V/4 \leq 0.45$

Mechanical Characteristic

Steel grade		Delivery Condition	Rp0.2 [N/mm2]	Rm [N/mm2]	A [%]	Kv [J, -20°C]
EN10305-1;2			EN6892-1		ISO148-1	
E355	1.0580	+SR	min. 520	min. 620	min. 15	min. 27
		+C	min. 520	min. 620	min. 7*	–
E410	1.0509	+SR	min. 590	min. 690	min. 12	min. 27

*Aiming to min. 10%

Lengths

A-TUBE	DIAMETER** [mm]	WALL THICKNESS [mm]	STANDARD LENGTH* [mm]
A-TUBE TUC A-TUBE TUTC	12 to 200	2.0 – 20.0	6500÷6700 mm
A-TUBE TUCL A-TUBE TUTCL	40 to 200	4.76 to 12.5	5000÷7000 mm
A-TUBE TUL	40 to 300	4.76 to 27.5	7000÷8000 mm
A-TUBE TUSL	40 to 230	4.76 to 12.5	5000÷7000 mm
A-TUBE TUCI	40 to 300	4.76 to 27.5	2000÷2500 mm

*Lengths may vary depending on the Chroming process used

**Some diameters may be subject to a minimum quantity requested

***Other diameters, lengths/cut lengths can be provided at premium price





Properties

Surface Roughness – OD

Ra = max. 0.20 [µm]

Surface Hardness

Chrome Layer hardness: min 900 HV 0.1

Diameter tolerance

Standard ISO-f7

**Special Tolerance can be provided at premium price*

Straightness

OD<20 [mm] | max 0.3 [mm]/1000 [mm]

OD≥20 [mm] | max 0.2 [mm]/1000 [mm]

Chrome Layer thickness

min. 20 [µm]

**Special chroming layer at premium price*

Ovality

max. ½ from OD diameter tolerance

Eccentricity

max. ±10% of the wall thickness

Marking

For a full traceability each tube is marked individually on the plastic/paper tube with info about the date, heat no production order tolerance and so on. The batch has a label with the following information: Order no, Item no, Heat no., Steel Grade, OD x ID; total length of the batch, Weight, no of pieces in the batch

Corrosion Resistance

based on a salt spray test following the ISO 9227 standard combined with the ISO 10289 for the evaluation of the rating

ISO9227 ASTM DIN50021 Salt Spray Test

NSS	B117	SS	Neutral Salt Spray
AASS	B287	ESS	Acetic Acid Salt Spray
CASS	B368	CASS	Cooper-accelerated acetic acid salt spray

A-CHROME

Standard Corrosion resistance for Ø<20 R9/120hNSS; for Ø≥20 R10/120h NSS and R9/200h NSS.

A-CHROME EXTRA

Standard Corrosion resistance for Ø≥20-140 R10/120h NSS and for Ø≥20-140 R9/500h NSS.

A-CHROME EXTRA PLUS

Standard Corrosion resistance for Ø≥20-140 R10/500h NSS.

** DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE*

Weldability & Machinability

Weldability - excellent

Machinability - excellent

Packaging

A-TUBE products can be supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes (depending on the diameter size)

Special requirements with additional cost – Seaworthy protected – aluminum foil or vacuum bags.

Extra protection with additional cost – wooden boxes



Properties

Surface Hardness

Steel-grade E355 IH: min. 35HRC
Hardness Depth: From 1.0 -4.0 [mm]
Chrome Layer hardness: min. 900 HV 0.1

Surface Roughness – OD

Ra = max. 0.20 [µm]

Diameter tolerance

Standard ISO-f7

**Special Tolerance can be provided at premium price*

Straightness

OD<20 [mm] | max. 0.3 [mm]/1000 [mm]
OD≥20 [mm] | max. 0.2 [mm]/1000 [mm]

Chrome Layer thickness

min. 20 [µm]

**Special chroming layer at premium price*

Ovality

max. ½ from OD diameter tolerance

Eccentricity

max ±10% of the wall thickness

Marking

For a full traceability each tube is marked individually on the plastic/paper tube with info about the date, heat no production order tolerance and so on. The batch has a label with the following information: Order no, Item no, Heat no., Steel Grade, OD x ID; total length of the batch, Weight, no of pieces in the batch

Corrosion Resistance

based on a salt spray test following the ISO 9227 standard combined with the ISO 10289 for the evaluation of the rating

ISO9227	ASTM	DIN50021	Salt Spray Test
NSS	B117	SS	Neutral Salt Spray
AASS	B287	ESS	Acetic Acid Salt Spray
CASS	B368	CASS	Cooper-accelerated acetic acid salt spray

A-CHROME

Standard Corrosion resistance for Ø<20 R9/120hNSS; for Ø≥20 R10/120h NSS and R9/200h NSS.

A-CHROME EXTRA

Standard Corrosion resistance for Ø≥20-140 R10/120h NSS and for Ø≥20-140 R9/500h NSS.

A-CHROME EXTRA PLUS

Standard Corrosion resistance for Ø≥20-140 R10/500h NSS.

** DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE*

Weldability & Machinability

Weldability - excellent

Machinability - excellent

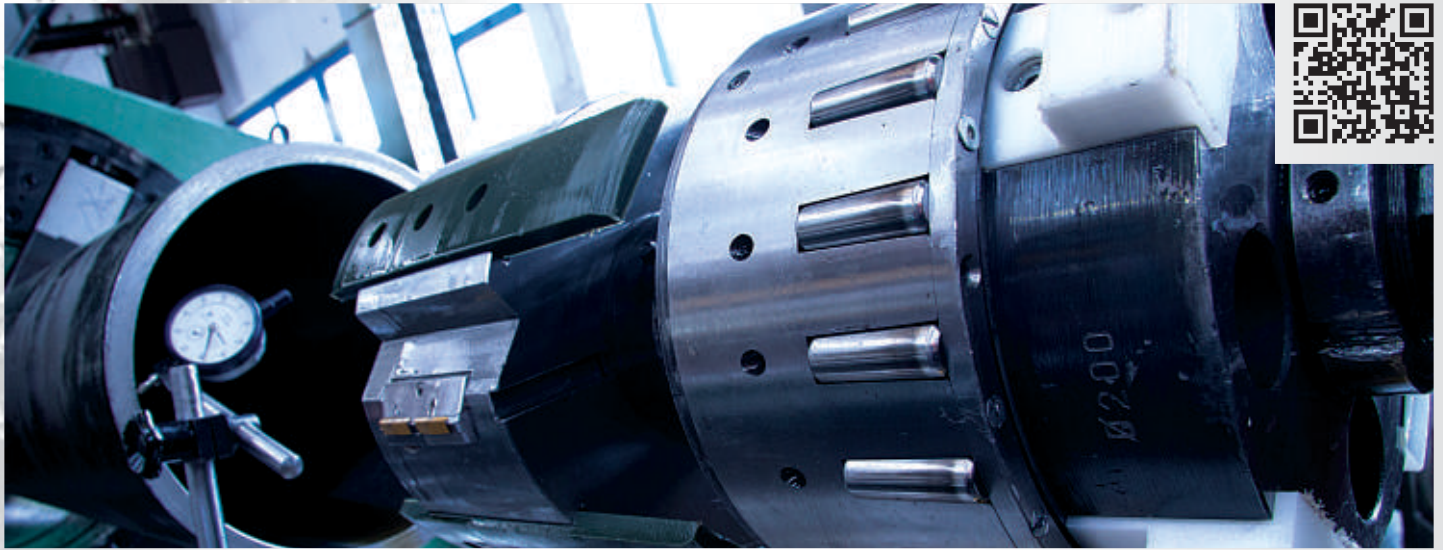
Packaging

A-TUBE products can be supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes (depending on the diameter size)

Special requirements with additional cost – Seaworthy protected – aluminum foil or vacuum bags.

Extra protection with additional cost – wooden boxes



Properties

Surface Roughness

- OD $R_{\text{max}} = 0.20 \text{ } [\mu\text{m}]$
- ID $R_{\text{max}} = 0.25 \text{ } [\mu\text{m}]$
- ID $R_{\text{max}} = 0.40 \text{ } [\mu\text{m}]$ for honed tubes

Surface Hardness

Chrome Layer hardness: min 900 HV 0.1

Diameter tolerance

OD: ISO-f7

ID: ISO-H8/H9 depending on the wall thickness

**Special Tolerance can be provided at premium price*

Straightness

max. $0.2 \text{ } [\text{mm}]/1000 \text{ } [\text{mm}]$ for diameter $\varnothing > 40 \text{ } [\text{mm}]$

Chrome Layer thickness

min. $20 \text{ } [\mu\text{m}]$

**Special chroming layer at premium price*

Ovality

max. $\frac{1}{2}$ from OD diameter tolerance

For ID - within the limits of its tolerance

Eccentricity

max. 3% of the wall thickness according to EN 10305-2

Marking

For a full traceability each tube is marked individually on the plastic/paper tube with info about the date, heat no production order tolerance and so on. The batch has a label with the following information: Order no, Item no, Heat no., Steel Grade, OD x ID; total length of the batch, Weight, no of pieces in the batch

Corrosion Resistance

based on a salt spray test following the ISO 9227 standard combined with the ISO 10289 for the evaluation of the rating

ISO9227	ASTM	DIN50021	Salt Spray Test
NSS	B117	SS	Neutral Salt Spray
AASS	B287	ESS	Acetic Acid Salt Spray
CASS	B368	CASS	Cooper-accelerated acetic acid salt spray

A-CHROME

Standard Corrosion resistance for $\varnothing < 20 \text{ R9/120hNSS}$; for $\varnothing \geq 20 \text{ R10/120h NSS}$ and R9/200h NSS .

A-CHROME EXTRA

Standard Corrosion resistance for $\varnothing \geq 20\text{-}140 \text{ R10/120h NSS}$ and for $\varnothing \geq 20\text{-}140 \text{ R9/500h NSS}$.

A-CHROME EXTRA PLUS

Standard Corrosion resistance for $\varnothing \geq 20\text{-}140 \text{ R10/500h NSS}$.

** DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE*

Weldability & Machinability

Weldability - excellent

Machinability - excellent

Packaging

A-TUBE products can be supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes (depending on the diameter size)

Special requirements with additional cost – Seaworthy protected – aluminum foil or vacuum bags.

Extra protection with additional cost – wooden boxes



Properties

Surface Hardness

Steel-grade E355 IH: min. 35HRC
Hardness Depth: From 1.0 -4.0 [mm]
Chrome Layer hardness: min. 900 HV 0.1

Surface Roughness

- OD $R_{max} = 0.20 \text{ } [\mu\text{m}]$
- ID $R_{max} = 0.25 \text{ } [\mu\text{m}]$
- ID $R_{max} = 0.40 \text{ } [\mu\text{m}]$ for honed tubes

Diameter tolerance

OD: ISO-f7
ID: ISO-H9 depending on the wall thickness
**Special Tolerance can be provided at premium price*

Straightness

max. 0.2 [mm]/1000 [mm] for diameter $\varnothing > 40 \text{ [mm]}$

Chrome Layer thickness

min. 20 $[\mu\text{m}]$
**Special chroming layer at premium price*

Ovality

max. $\frac{1}{2}$ from OD diameter tolerance
For ID - within the limits of its tolerance

Eccentricity

max. 3% of the wall thickness according to EN 10305-2

Marking

For a full traceability each tube is marked individually on the plastic/paper tube with info about the date, heat no production order tolerance and so on. The batch has a label with the following information: Order no, Item no, Heat no., Steel Grade, OD x ID; total length of the batch, Weight, no of pieces in the batch.

Corrosion Resistance

based on a salt spray test following the ISO 9227 standard combined with the ISO 10289 for the evaluation of the rating

ISO9227	ASTM	DIN50021	Salt Spray Test
NSS	B117	SS	Neutral Salt Spray
AASS	B287	ESS	Acetic Acid Salt Spray
CASS	B368	CASS	Cooper-accelerated acetic acid salt spray

A-CHROME

Standard Corrosion resistance for $\varnothing < 20 \text{ R9/120hNSS}$; for $\varnothing \geq 20 \text{ R10/120h NSS}$ and R9/200h NSS .

A-CHROME EXTRA

Standard Corrosion resistance for $\varnothing \geq 20\text{-}140 \text{ R10/120h NSS}$ and for $\varnothing \geq 20\text{-}140 \text{ R9/500h NSS}$.

A-CHROME EXTRA PLUS

Standard Corrosion resistance for $\varnothing \geq 20\text{-}140 \text{ R10/500h NSS}$.

** DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE*

Weldability & Machinability

Weldability - excellent

Machinability - excellent

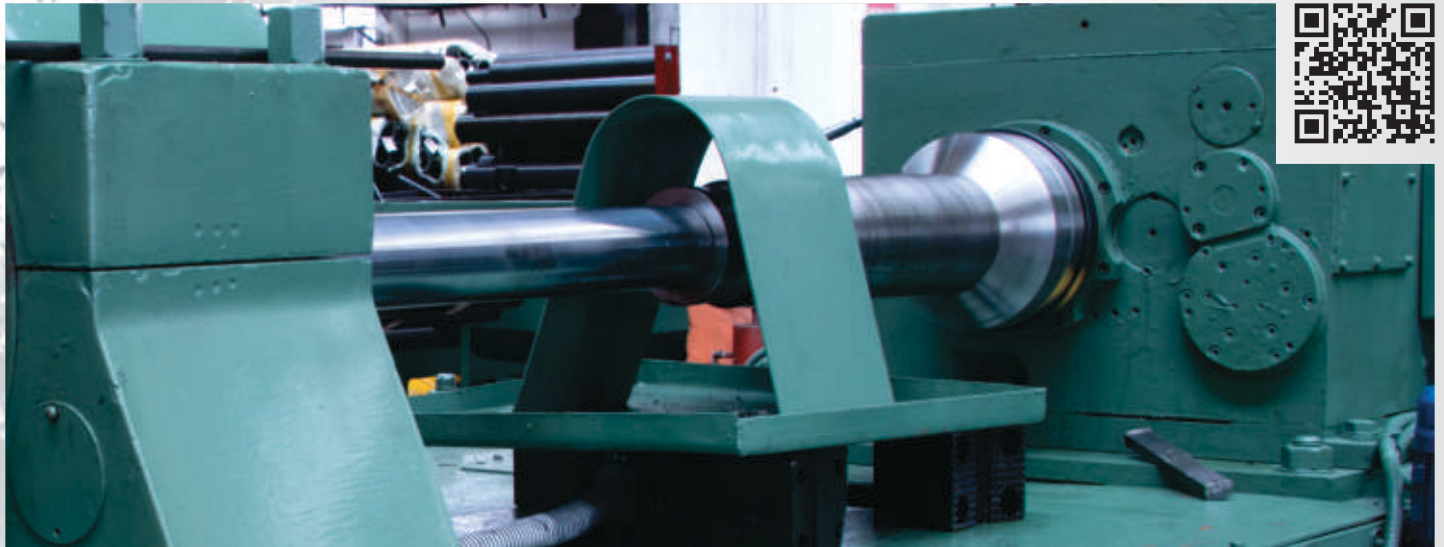
Packaging

A-TUBE products can be supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes (depending on the diameter size)

Special requirements with additional cost – Seaworthy protected – aluminum foil or vacuum bags.

Extra protection with additional cost – wooden boxes



Properties

Straightness

- max. 1.0 [mm] / 1000 [mm]
- max. 3.5 [mm] / 6000 [mm]
- max. 4.0 [mm] / 7000 [mm]
- max. 4.5 [mm] / 8000 [mm]

Surface Roughness

- ID $R_{\text{max}} = 0.25 \text{ } [\mu\text{m}]$
- ID $R_{\text{max}} = 0.40 \text{ } [\mu\text{m}]$ for honed tubes

Eccentricity

max. 10% of the wall thickness according to EN 10305-1

Ovality

within the limits of ID tolerance

Diameter tolerance

ID: ISO H8 (EN ISO 286-2)

**Special Tolerance can be provided at premium price*

Weldability & Machinability

Weldability - excellent

Machinability - excellent

Packaging

A-TUBE products are supplied in standard bundles oiled inside and closed with end caps

Special requirements with additional cost – Seaworthy protected – aluminum foil or vacuum bags.

Extra protection with additional cost – wooden boxes, pallets for cut and machined parts, special oil for higher protection.



Marking

For a full traceability each tube is marked individually on the plastic/paper tube with info regarding the product name, steel grade, norm, OD x ID, heat no. The batch has a label with the following information: Order no, Item no, Heat no., Steel Grade, OD x ID; total length of the batch, Weight, no of pieces in the batch.



Properties

Straightness

- max. 1.0 [mm] / 1000 [mm]
- max. 3.5 [mm] / 6000 [mm]
- max. 4.0 [mm] / 7000 [mm]

Surface Roughness

- ID $R_{\text{max}} = 0.25 \text{ } [\mu\text{m}]$
- ID $R_{\text{max}} = 0.40 \text{ } [\mu\text{m}]$ for honed tubes

Eccentricity

max. 3.0-3.5% of the wall thickness according to EN 10305-2

Ovality

within the limits of ID tolerance

Diameter tolerance

ID: ISO H8 (EN ISO 286-2)

**Special Tolerance can be provided at premium price*

Weldability & Machinability

Weldability - excellent

Machinability - excellent

Packaging

A-TUBE products are supplied in standard bundles oiled inside and closed with end caps

Special requirements with additional cost – Seaworthy protected – aluminum foil or vacuum bags.

Extra protection with additional cost– wooden boxes, pallets for cut and machined parts, special oil for higher protection.



Marking

For a full traceability each tube is marked individually on the plastic/paper tube with info regarding the product name, steel grade, norm, OD x ID, heat no. The batch has a label with the following information: Order no, Item no, Heat no., Steel Grade, OD x ID; total length of the batch, Weight, no of pieces in the batch.



Properties

Surface Roughness – ID

$R_{\text{max}} = 0.40 \text{ } [\mu\text{m}]$

Surface Hardness

Chrome Layer hardness: min. 900 HV 0.1

Diameter tolerance

min. ID 35 [mm]
ID: ISO-H9 (EN ISO 286-2)

Straightness

max. 1.0 [mm] / 1000 [mm]

Eccentricity

max. 10% of the wall thickness according to EN 10305-1

Ovality

within the limits of ID tolerance

Chrome Layer thickness

min. 20 $[\mu\text{m}]$

**Special chroming layer at premium price*

For special applications: concrete pumps, cylinders

max. 200 $[\mu\text{m}]$ at premium price

Marking

For a full traceability each batch has a label with the following information: Order no, Item no, Heat no., Steel Grade, Outside Diameter x Inside Diameter OD x ID; total length of the batch, Weight, no of pieces in the batch.

Corrosion Resistance

based on a salt spray test following the ISO 9227 standard combined with the ISO 10289 for the evaluation of the rating

ISO9227	ASTM	DIN50021	Salt Spray Test
NSS	B117	SS	Neutral Salt Spray
AASS	B287	ESS	Acetic Acid Salt Spray
CASS	B368	CASS	Cooper-accelerated acetic acid salt spray

A-CHROME

Standard Corrosion resistance for $\varnothing \geq 40$ R9/200h NSS.

A-CHROME EXTRA

Standard Corrosion resistance for $\varnothing \geq 40$ -140 R9/500h NSS.

** DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE*

Weldability & Machinability

Weldability - excellent

Machinability - excellent

Packaging

A-TUBE products are supplied in standard bundles oiled inside and closed with end caps








Special requirements with additional cost – Seaworthy protected – aluminum foil or vacuum bags.

Extra protection with additional cost – wooden boxes, pallets for cut and machined parts, special oil for higher protection.



ASO HYDRAULICS & PNEUMATICS
/ASO CROMSTEEL
/ASO SPS

Linear Shafts

- | | |
|--|---|
|  A-Line W |  A-Line WRA |
|  A-Line WZ |  A-Line WRAZ |
|  A-Line WV |  A-Line WRB |
|  A-Line WVZ |  A-Line WRBZ |
| A-Line WH |  A-Line WRBV |
| A-Line WHV | |



A-LINE – Precision Hard Ground Shafts

ASO Hydraulics & Pneumatics precision shafts are induction hardened shafts according to the steel quality, diameter and hardness depth needed.

A-LINE products are manufactured from steels having the following properties:

Steel grade correspondents

ASO GROUP	EN	DIN	BS	W	AFNOR	ASTM
A-LINE W						
A-LINE WZ	C53	Cf53	070MS	1.1213	XC48TS	1024
A-LINE WV						
A-LINE WVZ						
A-LINE WH	C60	C60	60HS	1.0601	1C60	1060
A-LINE WHZ						
A-LINE WRA	X90CrMoV18	X90CrMoV18	–	1.4112	–	440B
A-LINE WRAZ						
A-LINE WRB	X46Cr13	X46Cr13	–	1.4034	Z44Cr13	420C
A-LINE WRBZ						
A-LINE WRBV						

Table 1: Corresponding standards for the steel used

Chemical Composition

Steel grade	C	Si	Mn	Pmax	Smax	Cr	Ni	Mo	V
Cf53	0.50-0.57	0.15-0.35	0.40-0.70	0.025	0.035	–	–	–	–
C60	0.57-0.65	max 0.40	0.60-0.90	0.030	0.035	max 0.40	max 0.40	max 0.10	–
X90CrMoV18	0.85-0.95	max 1.0	max 1.0	0.040	0.015	17.0-19.0	–	0.9-1.3	0.07-0.12
X46Cr13	0.42-0.50	max 1.0	max 1.0	0.045	0.030	12.5-14.4	–	–	–

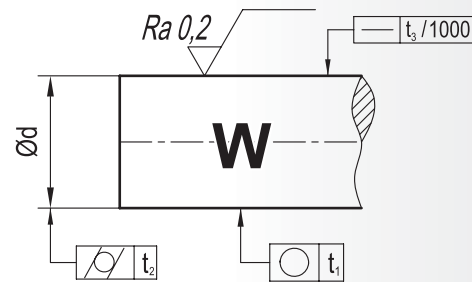
Table 2: Chemical composition in % by weight

Mechanical Properties

Product	Steel grade	Diameter/ Nominal Thickness	Tensile Strength	Yield Point	Elongation	Hardness Brinell
		Ø [mm]/ s [mm]	Rm [N/mm²]	Rp _{0.2} [N/mm²]	A5 [%]	HB
A-LINE W	Cf53	Ø < 18*	700-850	min. 475	min. 10	223
A-LINE WZ		18 < Ø < 100**	610-760	min. 340	min. 16	
A-LINE WV		Ø > 100**	min. 560	min. 275	min. 16	
A-LINE WVZ	C60	≠ < 16	min 720	min. 390	min. 11	241
A-LINE WH		16 < ≠ < 40	min 700	min. 350	min. 12	
A-LINE WHZ		40 < ≠ < 80	min. 670	min. 240	min. 12	
A-LINE WRA	X90CrMoV18	Ø < 60	–	–	–	max. 265
A-LINE WRAZ						
A-LINE WRB	X46Cr13	Ø < 60	max. 800	–	–	max. 245
A-LINE WRBZ						
A-LINE WRBV						

Table 3: Mechanical Properties for the steels used





Dimensional Properties:

Shaft Diameter** d	Weight per meter	Shaft part number	Standard length	Hardening depth SHD DIN 15787	Standard tolerance ISO h6	Roundness (circular) t1	Parallelism (cylindric) t2	Straightness t3
[mm]	[kg]		[mm]	[mm]	[µm]	[µm]	[µm]	[mm/m]
4	0.10	W 4	4000	0.5 - 0.8	0/-8	4	6	0.16
5	0.16	W 5	6000	0.5 - 0.8	0/-8	4	6	0.16
6	0.23	W 6	6000	0.5 - 0.8	0/-8	4	6	0.16
8	0.40	W 8	6000	0.6 - 0.9	0/-9	4	6	0.16
10	0.62	W 10	6000	0.7 - 1.0	0/-9	4	6	0.12
12	0.89	W 12	6000	0.8 - 1.2	0/-11	5	8	0.12
13	1.04	W 13	6000	0.8 - 1.2	0/-11	5	8	0.12
14	1.21	W 14	6000	0.9 - 1.3	0/-11	5	8	0.12
15	1.39	W 15	6000	1.0 - 1.4	0/-11	5	8	0.12
16	1.58	W 16	6000	1.1 - 1.5	0/-11	5	8	0.1
18	2.00	W 18	6000	1.1 - 1.5	0/-11	5	8	0.1
20	2.47	W 20	6000	1.2 - 1.5	0/-13	6	8	0.1
22	2.98	W 22	6000	1.2 - 1.5	0/-13	6	8	0.1
24	3.55	W 24	6000	1.4 - 1.6	0/-13	6	8	0.1
25	3.85	W 25	6000	1.5 - 1.7	0/-13	6	9	0.1
28	4.83	W 28	6000	1.5 - 1.8	0/-13	6	9	0.1
30	5.55	W 30	6000	1.5 - 1.9	0/-13	6	9	0.1
32	6.31	W 32	6000	1.5 - 1.9	0/-16	7	11	0.1
35	7.55	W 35	6000	1.5 - 1.9	0/-16	7	11	0.1
40	9.87	W 40	6000	1.6 - 2.0	0/-16	7	11	0.1
45	12.50	W 45	6000	1.6 - 2.0	0/-16	7	11	0.1
50	15.40	W 50	6000	2.2 - 2.6	0/-16	7	11	0.1
55	18.64	W 55	6000	2.2 - 2.6	0/-19	8	13	0.1
60	22.20	W 60	7000	2.2 - 2.6	0/-19	8	13	0.1
65	26.03	W 65	7000	2.2 - 2.6	0/-19	8	13	0.1
70	30.20	W 70	7000	2.2 - 2.6	0/-19	8	13	0.1
75	34.70	W 75	7000	2.2 - 2.6	0/-19	8	13	0.1
80	39.50	W 80	7000	2.2 - 2.6	0/-19	8	13	0.1
90	49.92	W 90	7000	2.2 - 3.2	0/-22	9	13	0.2
100	61.62	W 100	7000	2.2 - 3.2	0/-22	9	13	0.2
120	88.73	W 120	7000	2.5 - 4.0	0/-22	10	16	0.2

*Other diameters, lengths/cut lengths can be provided at premium price / **Some diameters may be subject to a minimum quantity requested

Properties

Surface Hardness Cf53:
62±2HRC

Surface Roughness
Ra = max. 0.20 [µm]

Length tolerance:
0/+200 [mm]

Diameter tolerance
Standard ISO-h6

*Special Tolerance can be provided at premium price

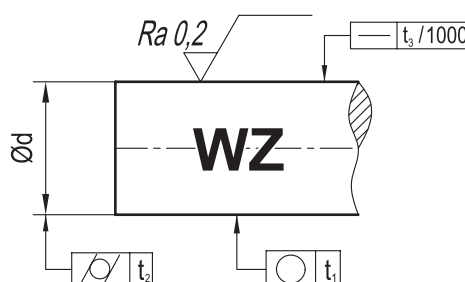
Packaging

Linear shafts are degreased and oiled, placed in bundles that are wrapped in wax paper and raffia

Extra protection with additional cost– wooden boxes

Marking

For full traceability, each batch has a label that contains info about: manufacturing date, product name, diameter, tolerance range, number of linear shafts, heat no.



Dimensional Properties:

Shaft Diameter	Shaft Diameter d**	Weight per meter	Shaft part number	Standard length	Hardening depth SHD DIN 15787	Standard tolerance Class "L"	Roundness (circular) t1	Parallelism (cylindrical) t2	Straightness t3
[in]	[mm]	[kg]		[in]	[mm]	[in]	[in]	[in]	[in/m]
1/4	6.35	0.25	WZ 6	237	0.019-0.031	-0.0005/-0.001	0.0002	0.0002	0.008
3/8	9.525	0.56	WZ 9	237	0.027-0.039	-0.0005/-0.001	0.0002	0.0002	0.008
1/2	12.7	0.99	WZ 12	237	0.031-0.047	-0.0005/-0.001	0.0002	0.0003	0.008
5/8	15.875	1.55	WZ 15	237	0.043-0.059	-0.0005/-0.001	0.0002	0.0003	0.008
3/4	19.05	2.24	WZ 19	237	0.047-0.059	-0.0005/-0.001	0.0002	0.0004	0.008
1	25.4	3.97	WZ 25	237	0.059-0.066	-0.0005/-0.001	0.0002	0.0004	0.008
1 ¼	31.75	6.22	WZ 31	237	0.059-0.074	-0.0005/-0.001	0.0003	0.0004	0.004
1 ½	38.1	8.95	WZ 38	237	0.062-0.078	-0.0006/-0.0011	0.0003	0.0004	0.004
2	50.8	15.91	WZ 50	237	0.086-0.102	-0.0006/-0.0013	0.0003	0.0004	0.004
2 ¼	57.15	20.13	WZ 57	237	0.086-0.102	-0.0007/-0.0015	0.0003	0.0005	0.004
2 ½	63.5	24.85	WZ 63	276	0.086-0.102	-0.0007/-0.0015	0.0003	0.0005	0.004
3	76.2	35.78	WZ 76	276	0.086-0.102	-0.0008/-0.0017	0.0003	0.0005	0.004

*Other diameters, lengths/cut lengths can be provided at premium price / **Some diameters may be subject to a minimum quantity requested

Properties

Surface Hardness Cf53:
62±2HRC

Surface Roughness
Ra = max. 0.20 [µm]

Length tolerance:
0/+8 [in] (0/+200 [mm])

Diameter tolerance
Standard Class "L"

*Special Tolerance can be provided at premium price

Packaging

Linear shafts are degreased and oiled, placed in bundles that are wrapped in wax paper and raffia

Extra protection with additional cost – wooden boxes

Marking

For full traceability, each batch has a label that contains info about: manufacturing date, product name, diameter, tolerance range, number of linear shafts, heat no.



ALINE

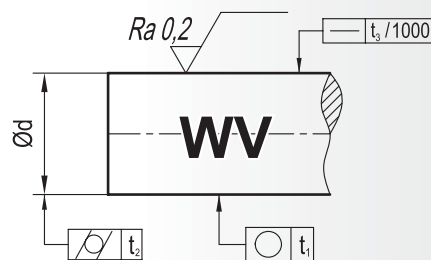
WV

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / CF53

Rod end will
be printed
in green

/ Chromed Induction Hardened and ground steel shafts



Dimensional Properties:

Shaft Diameter** d	Weight per meter	Shaft part number	Standard length	Hardening depth SHD DIN 15787	Standard tolerance ISO h7	Roundness (circular) t1	Parallelism (cylindric) t2	Straightness t3
[mm]	[kg]		[mm]	[mm]	[µm]	[µm]	[µm]	[mm/m]
4	0.10	WV 4	4000	0.5-0.8	0/-12	6	10	0.16
5	0.16	WV 5	6000	0.5-0.8	0/-12	6	10	0.16
6	0.23	WV 6	6000	0.5-0.8	0/-12	6	10	0.16
8	0.40	WV 8	6000	0.6-0.9	0/-15	6	10	0.16
10	0.62	WV 10	6000	0.7-1.0	0/-15	6	10	0.12
12	0.89	WV 12	6000	0.8-1.2	0/-18	8	12	0.12
14	1.21	WV 14	6000	0.9-1.3	0/-18	8	12	0.12
15	1.39	WV 15	6000	1.0-1.4	0/-18	8	12	0.12
16	1.58	WV 16	6000	1.1-1.5	0/-18	8	12	0.1
18	2.00	WV 18	6000	1.1-1.5	0/-18	8	12	0.1
20	2.47	WV 20	6000	1.2-1.5	0/-21	9	12	0.1
22	2.98	WV 22	6000	1.2-1.5	0/-21	9	12	0.1
24	3.55	WV 24	6000	1.4-1.6	0/-21	9	12	0.1
25	3.85	WV 25	6000	1.5-1.7	0/-21	9	12	0.1
28	4.83	WV 28	6000	1.5-1.8	0/-21	9	12	0.1
30	5.55	WV 30	6000	1.5-1.9	0/-21	11	12	0.1
32	6.31	WV 32	6000	1.5-1.9	0/-25	11	15	0.1
35	7.55	WV 35	6000	1.5-1.9	0/-25	11	15	0.1
40	9.87	WV 40	6000	1.6-2.0	0/-25	11	15	0.1
45	12.50	WV 45	6000	1.6-2.0	0/-25	11	15	0.1
50	15.40	WV 50	6000	2.2-2.6	0/-25	11	15	0.1
55	18.64	WV 55	6000	2.2-2.6	0/-30	12	15	0.1
60	22.20	WV 60	7000	2.2-2.6	0/-30	12	15	0.1
65	26.03	WV 65	7000	2.2-2.6	0/-30	12	15	0.1
70	30.20	WV 70	7000	2.2-2.6	0/-30	12	15	0.1
75	34.70	WV 75	7000	2.2-2.6	0/-30	12	15	0.1
80	39.50	WV 80	7000	2.2-2.6	0/-30	12	15	0.1
90	49.92	WV 90	7000	2.2-3.2	0/-35	14	17	0.2
100	61.62	WV 100	7000	2.2-3.2	0/-35	14	17	0.2
120	88.73	WV 120	7000	2.5-4.0	0/-35	14	17	0.2

*Other diameters, lengths/cut lengths can be provided at premium price / **Some diameters may be subject to a minimum quantity requested

***Lengths may vary depending on the Chroming process used

Properties

Chrome Layer: min. 10 [µm], usually 15 [µm]**Chrome Layer Hardness:** 900 HV 0.1 min.

*Special chroming layer at premium price

Surface Hardness Cf53: 62±2HRC**Surface Roughness:** Ra = max. 0.20 [µm]**Length tolerance:** 0/+200 [mm]**Diameter tolerance**

Standard ISO-h7

*Special Tolerance can be provided at premium price

Packaging

Chromed Linear shafts supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes.**Special requirements with additional cost** – Seaworthy protected – aluminum foil or vacuum bags.**Extra protection with additional cost** – wooden boxes

Marking

For a full traceability each bar is marked individually on the plastic/paper tube with info about the date, product series, diameter, tolerance, resistance at saltwater spray test, heat no., production order and so on. The batch has a label with information regarding: Order no, Item no, Heat no., Steel Grade; total length of the batch, Weight, no of pieces in the batch.

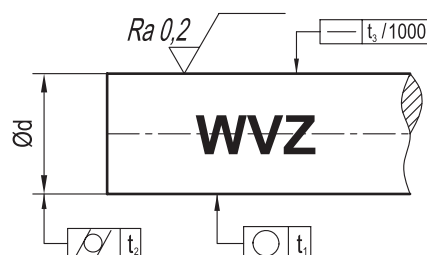


ALINE

WVZ

/ Chromed plated Induction Hardened and ground steel shafts

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Imperial Steel grade / ASTM-1024
or EN-CF53Rod end will
be printed
in green
with a white line

Dimensional Properties:

Shaft Diameter** d	Shaft Diameter** d	Weight per meter	Shaft part number	Standard length	Hardening depth SHD DIN 15787	Standard Tolerance ISO h7	Roundness (circular) t1	Parallelism (cylindrical) t2	Straightness t3
[in]	[mm]	[kg]		[in]	[in]	[in]	[in]	[in]	[in/m]
1/4	6.35	0.25	WVZ 6	237	0.019-0.031	0/-0.000591	0.0002	0.0004	0.008
3/8	9.525	0.56	WVZ 9	237	0.027-0.039	0/-0.000591	0.0002	0.0004	0.008
1/2	12.7	0.99	WVZ 12	237	0.031-0.047	0/-0.000709	0.0003	0.0005	0.008
5/8	15.875	1.55	WVZ 15	237	0.043-0.059	0/-0.000709	0.0004	0.0005	0.008
3/4	19.05	2.24	WVZ 19	237	0.047-0.059	0/-0.000827	0.0004	0.0005	0.004
1	25.4	3.97	WVZ 25	237	0.059-0.066	0/-0.000827	0.0004	0.0005	0.004
1 ¼	31.75	6.22	WVZ 31	237	0.059-0.074	0/-0.000984	0.0004	0.0006	0.004
1 ½	38.1	8.95	WVZ 38	237	0.062-0.078	0/-0.000984	0.0004	0.0006	0.004
2	50.8	15.91	WVZ 50	237	0.086-0.102	0/-0.001181	0.0004	0.0006	0.004
2 ¼	57.15	20.13	WVZ 57	237	0.086-0.102	0/-0.001181	0.0005	0.0006	0.004
2 ½	63.5	24.85	WVZ 63	276	0.086-0.102	0/-0.001181	0.0005	0.0006	0.004
3	76.2	35.78	WVZ 76	276	0.086-0.102	0/-0.001181	0.0005	0.0006	0.004

*Lengths may vary depending on the Chroming process used

**Some diameters may be subject to a minimum quantity requested

***Other diameters, lengths/cut lengths can be provided at premium price

Properties

Chrome Layer: min. 10 [µm], usually 15 [µm]**Chrome Layer Hardness:** 900 HV 0.1 min.

*Special chroming layer at premium price

Surface Hardness Cf53: 62±2HRC**Surface Roughness:** Ra = max. 0.20 [µm]**Length tolerance:** 0/+8 [in] (0/+200 [mm])**Diameter tolerance**

Standard ISO-h7

*Special Tolerance can be provided at premium price including Class L

Packaging

Chromed Linear shafts supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes.**Special requirements with additional cost** – Seaworthy protected – aluminum foil or vacuum bags.**Extra protection with additional cost** – wooden boxes

Marking

For a full traceability each bar is marked individually on the plastic/paper tube with info about the date, product series, diameter, tolerance, resistance at saltwater spray test, heat no., production order and so on. The batch has a label with information regarding: Order no, Item no, Heat no., Steel Grade; total length of the batch, Weight, no of pieces in the batch.



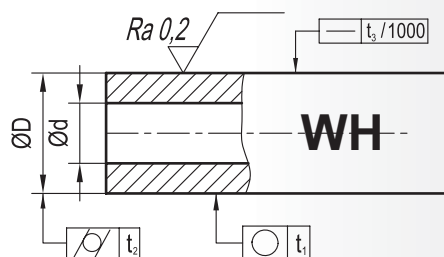
ALINE

WH

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / C60

/ Induction Hardened and ground hollow shaft

**Dimensional Properties:**

Out Dia. ØD	Inner Dia. Ød	Weight per meter	Shaft part number	Standard length	Hardening depth SHD DIN 15787	Standard Tolerance ISO h6	Roundness (circular) t1	Parallelism (cylindrical) t2	Straightness t3
[mm]	[mm]	[kg]		[mm]	[mm]	[µm]	[µm]	[µm]	[mm/m]
12	4.0	0.79	WH 12	6000	0.6-1.3	0/-11	5	8	0.12
14	7.0	0.91	WH 14	6000	0.6-1.3	0/-11	5	8	0.12
16	7.0	1.28	WH 16	6000	0.6-1.6	0/-11	5	8	0.12
20	14.0	1.25	WH 20	6000	0.9-1.6	0/-13	6	9	0.1
25	15.6	2.35	WH 25	6000	0.9-1.8	0/-13	6	9	0.1
30	18.3	3.50	WH 30	6000	0.9-2.0	0/-13	6	9	0.1
40	28.0	4.99	WH 40	6000	1.5-2.5	0/-16	7	11	0.1
50	29.7	9.91	WH 50	6000	1.5-3.0	0/-16	7	11	0.1
60	36.0	14.20	WH 60	6000	2.2-3.0	0/-19	8	13	0.1

*Other diameters, lengths/cut lengths can be provided at premium price

**Some diameters may be subject to a minimum quantity requested

Properties**Surface Roughness:** Ra = max. 0.20 [µm]**Surface Hardness C60:** 62±2HRC**Length tolerance:** 0/+200 [mm]**Diameter tolerance**

Standard ISO-h6

*Special Tolerance can be provided at premium price

Packaging

Tube Linear shafts are degreased (OD and ID), oiled OD, placed in bundles that are wrapped in wax paper and raffia.

Special requirements with additional cost – Seaworthy protected – aluminum foil or vacuum bags.**Extra protection with additional cost** – wooden boxes**Marking**

For full traceability, each batch has a label that contains info about: manufacturing date, product name, diameter, tolerance range, number of linear shafts, heat no.



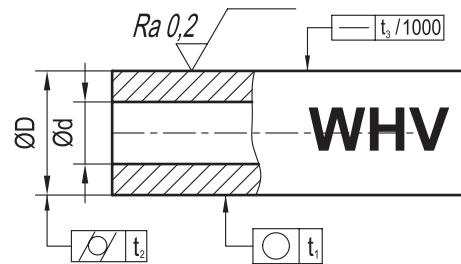
ALINE

WHV

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steel grade / C60

/ Chrome Plated - Induction Hardened and ground hollow shaft

**Dimensional Properties:**

Out Dia. ØD	Inner Dia. Ød	Weight per meter	Shaft part number	Standard length	Hardening depth SHD DIN 15787	Standard Tolerance ISO h7	Roundness (circular) t1	Parallelism (cylindrical) t2	Straightness t3
[mm]	[mm]	[kg]		[mm]	[mm]	[µm]	[µm]	[µm]	[mm/m]
12	4.0	0.79	WHV 12	6000	0.6-1.3	0/-18	8	12	0.12
14	7.0	0.91	WHV 14	6000	0.6-1.3	0/-18	8	12	0.12
16	7.0	1.28	WHV 16	6000	0.6-1.6	0/-18	8	12	0.12
20	14.0	1.25	WHV 20	6000	0.9-1.6	0/-21	9	12	0.1
25	15.6	2.35	WHV 25	6000	0.9-1.8	0/-21	9	12	0.1
30	18.3	3.50	WHV 30	6000	0.9-2.0	0/-21	9	12	0.1
40	28.0	4.99	WHV 40	6000	1.5-2.5	0/-25	11	15	0.1
50	29.7	9.91	WHV 50	6000	1.5-3.0	0/-25	11	15	0.1
60	36.0	14.20	WHV 60	6000	2.2-3.0	0/-30	12	15	0.1

*Lengths may vary depending on the Chroming process used

**Some diameters may be subject to a minimum quantity requested

***Other diameters, lengths/cut lengths can be provided at premium price

Properties**Chrome Layer:** min 10 [µm], usually 15 [µm]**Chrome Layer Hardness:** 900 HV 0.1 min

*Special chroming layer at premium price

Surface Hardness C60: 62±2HRC**Surface Roughness:** Ra = max 0.20 [µm]**Diameter tolerance**

Standard ISO-h7

*Special Tolerance can be provided at premium price

Packaging

Chromed Linear shafts supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes**Special requirements with additional cost** – Seaworthy protected – aluminum foil or vacuum bags.**Extra protection with additional cost** – wooden boxes**Marking**

For a full traceability each bar is marked individually on the plastic/paper tube with info about the date, product series, diameter, tolerance, resistance at saltwater spray test, heat no, production order and so on. The batch has a label with information regarding: Order no, Item no, Heat no., Steel Grade; total length of the batch, Weight, no of pieces in the batch.



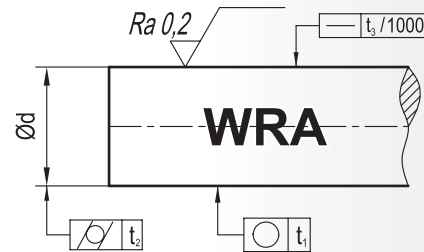
ALINE

WRA

Induction Hardened and ground Stainless Steel shafts

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / X90CrMoV18

Rod end will
be printed
in black
with a white line

Dimensional Properties:

Shaft Diameter d	Weight per meter	Shaft part number	Standard length	Hardening depth SHD DIN 15787	Standard tolerance ISO h6	Roundness (circular) t1	Parallelism (cylindric) t2	Straightness t3
[mm]	[kg]		[mm]	[mm]	[µm]	[µm]	[µm]	[mm/m]
5	0.16	WRA 5	5000	0.5-0.8	0/-8	4	5	0.16
6	0.23	WRA 6	6000	0.5-0.8	0/-8	4	6	0.16
8	0.40	WRA 8	6000	0.6-0.9	0/-9	4	6	0.16
10	0.62	WRA 10	6000	0.7-1.0	0/-9	4	6	0.16
12	0.89	WRA 12	6000	0.8-1.2	0/-11	5	8	0.12
14	1.21	WRA 14	6000	0.9-1.3	0/-11	5	8	0.12
15	1.39	WRA 15	6000	1.1-1.5	0/-11	5	8	0.12
16	1.58	WRA 16	6000	1.1-1.5	0/-11	5	8	0.12
20	2.47	WRA 20	6000	1.2-1.5	0/-13	6	9	0.1
25	3.85	WRA 25	6000	1.5-1.7	0/-13	6	9	0.1
30	5.55	WRA 30	6000	1.5-1.9	0/-13	6	9	0.1
40	9.87	WRA 40	6000	1.6-2.0	0/-16	7	11	0.1
50	15.40	WRA 50	6000	2.2-2.6	0/-16	7	11	0.1
60	22.20	WRA 60	6000	2.9-3.3	0/-19	8	13	0.1

*Other diameters, lengths/cut lengths can be provided at premium price

**Some diameters may be subject to a minimum quantity requested

Properties

Surface Hardness X90CrMoV18: 56±3HRC

Surface Roughness : Ra = max 0.20 [µm]

Length tolerance: 0/+200 [mm]

Diameter tolerance

Standard ISO-h6

*Special Tolerance can be provided at premium price

Packaging

Linear shafts are degreased and oiled, placed in bundles that are wrapped in wax paper and raffia

Extra protection with additional cost – wooden boxes

Marking

For full traceability, each batch has a label that contains info about: manufacturing date, product name, diameter, tolerance range, number of linear shafts, heat no.

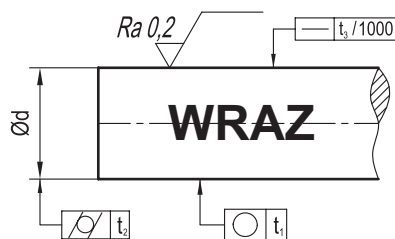


ALINE

WRAZ

Induction Hardened and ground Stainless Steel shafts

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Imperial Steel grade / ASTM - 440B
or EN - X90CrMoV18Rod end
will be
printed
in black
with a white cross

Dimensional Properties:

Shaft Diameter	Shaft Diameter d**	Weight per meter	Shaft part number	Standard length	Hardening depth SHD DIN 15787	Standard tolerance Class "L"	Roundness (circular) t1	Parallelism (cylindrical) t2	Straightness t3
[in]	[mm]	[kg]		[in]	[mm]	[in]	[in]	[in]	[in/m]
1/4	6.35	0.25	WRAZ 6	237	0.019-0.031	-0.0005/-0.001	0.0002	0.0002	0.008
3/8	9.525	0.56	WRAZ 9	237	0.027-0.039	-0.0005/-0.001	0.0002	0.0002	0.008
1/2	12.7	0.99	WRAZ 12	237	0.031-0.047	-0.0005/-0.001	0.0002	0.0003	0.008
5/8	15.875	1.55	WRAZ 15	237	0.043-0.059	-0.0005/-0.001	0.0002	0.0003	0.008
3/4	19.05	2.24	WRAZ 19	237	0.047-0.059	-0.0005/-0.001	0.0002	0.0004	0.004
1	25.4	3.97	WRAZ 25	237	0.059-0.066	-0.0005/-0.001	0.0002	0.0004	0.004
1 1/4	31.75	6.22	WRAZ 31	237	0.059-0.074	-0.0005/-0.001	0.0002	0.0004	0.004
1 1/2	38.1	8.95	WRAZ 38	237	0.094-0.114	-0.0006/-0.0011	0.0003	0.0004	0.004
2	50.8	15.91	WRAZ 50	237	0.106-0.125	-0.0006/-0.0013	0.0003	0.0005	0.004
2 1/4	57.15	20.13	WRAZ 57	237	0.114-0.129	-0.0007/-0.0015	0.0003	0.0005	0.004

*Other diameters, lengths/cut lengths can be provided at premium price

**Some diameters may be subject to a minimum quantity requested

Properties

Surface Hardness X90CrMoV18:

56±3HRC

Surface Roughness

Ra = max 0.20 [µm]

Length tolerance:

0/+8 [in] (0/+200 [mm])

Diameter tolerance

Standard Class "L"

*Special Tolerance can be provided at premium price

Packaging

Linear shafts are degreased and oiled, placed in bundles that are wrapped in wax paper and raffia

Extra protection with additional cost – wooden boxes

Packaging

Marking

For full traceability, each batch has a label that contains info about: manufacturing date, product name, diameter, tolerance range, number of linear shafts, heat no.



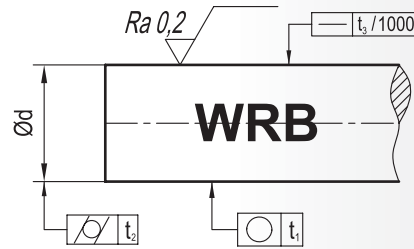
ALINE

WRB

Induction Hardened and ground Stainless Steel shafts

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / X46Cr13

Rod end will
be printed
in white
with a black line

Dimensional Properties:

Shaft Diameter d	Weight per meter	Shaft part number	Standard length	Hardening depth SHD DIN 15787	Standard tolerance ISO h6	Roundness (circular) t1	Parallelism (cylindric) t2	Straightness t3
[mm]	[kg]		[mm]	[mm]	[µm]	[µm]	[µm]	[mm/m]
5	0.16	WRB 5	6000	0.5-0.8	0/-8	4	5	0.16
6	0.23	WRB 6	6000	0.5-0.8	0/-8	4	6	0.16
8	0.40	WRB 8	6000	0.6-0.9	0/-9	4	6	0.16
10	0.62	WRB 10	6000	0.7-1.0	0/-9	4	6	0.16
12	0.89	WRB 12	6000	0.8-1.2	0/-11	5	8	0.12
14	1.21	WRB 14	6000	0.9-1.3	0/-11	5	8	0.12
15	1.39	WRB 15	6000	1.1-1.5	0/-11	5	8	0.12
16	1.58	WRB 16	6000	1.1-1.5	0/-11	5	8	0.12
20	2.47	WRB 20	6000	1.2-1.5	0/-13	6	9	0.1
25	3.85	WRB 25	6000	1.5-1.7	0/-13	6	9	0.1
30	5.55	WRB 30	6000	1.5-1.9	0/-13	6	9	0.1
40	9.87	WRB 40	6000	1.6-2.0	0/-16	7	11	0.1
50	15.40	WRB 50	6000	2.2-2.6	0/-16	7	11	0.1
60	22.20	WRB 60	6000	2.9-3.3	0/-19	8	13	0.1

*Other diameters, lengths/cut lengths can be provided at premium price

**Some diameters may be subject to a minimum quantity requested

Properties

Surface Hardness X46Cr13: 55±3HRC

Surface Roughness : Ra = max 0.20 [µm]

Length tolerance: 0/+200 [mm]

Diameter tolerance

Standard ISO-h6

*Special Tolerance can be provided at premium price

Packaging

Linear shafts are degreased and oiled, placed in bundles that are wrapped in wax paper and raffia

Extra protection with additional cost – wooden boxes

Marking

For full traceability, each batch has a label that contains info about: manufacturing date, product name, diameter, tolerance range, number of linear shafts, heat no.



ALINE

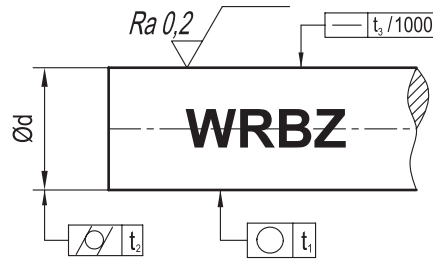
WRBZ

Induction Hardened and ground Stainless Steel shafts

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Imperial Steel grade / ASTM - 420C or EN - X46Cr13

Rod end will
be printed
in white
with a black cross



Dimensional Properties:

Shaft Diameter	Shaft Diameter d**	Weight per meter	Shaft part number	Standard length	Hardening depth SHD DIN 15787	Standard tolerance Class "L"	Roundness (circular) t1	Parallelism (cylindrical) t2	Straightness t3
[in]	[mm]	[kg]		[in]	[mm]	[in]	[in]	[in]	[in/m]
1/4	6.35	0.25	WRBZ 6	237	0.019-0.031	-0.0005/-0.001	0.0002	0.0002	0.008
3/8	9.525	0.56	WRBZ 9	237	0.027-0.039	-0.0005/-0.001	0.0002	0.0002	0.008
1/2	12.7	0.99	WRBZ12	237	0.031-0.047	-0.0005/-0.001	0.0002	0.0003	0.008
5/8	15.875	1.55	WRBZ15	237	0.043-0.059	-0.0005/-0.001	0.0002	0.0003	0.008
3/4	19.05	2.24	WRBZ 19	237	0.047-0.059	-0.0005/-0.001	0.0002	0.0004	0.004
1	25.4	3.97	WRBZ 25	237	0.059-0.066	-0.0005/-0.001	0.0002	0.0004	0.004
1 ¼	31.75	6.22	WRBZ 31	237	0.059-0.074	-0.0005/-0.001	0.0002	0.0004	0.004
1 ½	38.1	8.95	WRBZ 38	237	0.094-0.114	-0.0006/-0.0011	0.0003	0.0004	0.004
2	50.8	15.91	WRBZ 50	237	0.106-0.125	-0.0006/-0.0013	0.0003	0.0005	0.004
2 ¼	57.15	20.13	WRBZ 57	237	0.114-0.129	-0.0007/-0.0015	0.0003	0.0005	0.004

*Other diameters, lengths/cut lengths can be provided at premium price

**Some diameters may be subject to a minimum quantity requested

Properties

Surface Hardness X46Cr13:

55±3HRC

Surface Roughness

Ra = max 0.20 [µm]

Length tolerance:

0/+8 [in] (0/+200 [mm])

Diameter tolerance

Standard Class "L"

*Special Tolerance can be provided at premium price

Packaging

Linear shafts are degreased and oiled, placed in bundles that are wrapped in wax paper and raffia

Extra protection with additional cost– wooden boxes

Marking

For full traceability, each batch has a label that contains info about: manufacturing date, product name, diameter, tolerance range, number of linear shafts, heat no.



ALINE

WRBV

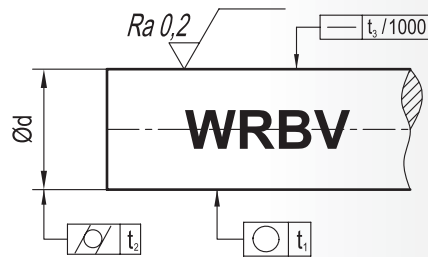
Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / X46Cr13

Rod end will
be printed
in green
with a yellow line



/ Chromed plated Induction Hardened and ground Stainless Steel shafts



Dimensional Properties:

Shaft Diameter d	Weight per meter	Shaft part number	Standard length	Hardening depth SHD DIN 15787	Standard tolerance ISO h7	Roundness (circular) t1	Parallelism (cylindric) t2	Straightness t3
[mm]	[kg]		[mm]	[mm]	[µm]	[µm]	[µm]	[mm/m]
5	0.16	WRBV 5	6000	0.5-0.8	0/-12	4	5	0.16
6	0.23	WRBV 6	6000	0.5-0.8	0/-12	4	6	0.16
8	0.40	WRBV 8	6000	0.6-0.9	0/-15	4	6	0.16
10	0.62	WRBV 10	6000	0.7-1.0	0/-15	4	6	0.16
12	0.89	WRBV 12	6000	0.8-1.2	0/-18	5	8	0.12
14	1.21	WRBV 14	6000	0.9-1.3	0/-18	5	8	0.12
15	1.39	WRBV 15	6000	1.1-1.5	0/-18	5	8	0.12
16	1.58	WRBV 16	6000	1.1-1.5	0/-18	5	8	0.12
20	2.47	WRBV 20	6000	1.2-1.5	0/-21	6	9	0.1
25	3.85	WRBV 25	6000	1.5-1.7	0/-21	6	9	0.1
30	5.55	WRBV 30	6000	1.5-1.9	0/-21	6	9	0.1
40	9.87	WRBV 40	6000	1.6-2.0	0/-25	7	11	0.1
50	15.40	WRBV 50	6000	2.2-2.6	0/-25	7	11	0.1
60	22.20	WRBV 60	6000	2.9-3.3	0/-30	8	13	0.1

*Other diameters, lengths/cut lengths can be provided at premium price

**Some diameters may be subject to a minimum quantity requested

***Special lengths/cut lengths can be provided at premium price

Properties

Chrome Layer: min 10 [µm], usually 15 [µm]**Chrome Layer Hardness:** 900 HV 0.1 min

*Special chroming layer at premium price

Surface Hardness X46Cr13: 55±3HRC**Surface Roughness:** Ra = max 0.20 [µm]**Length tolerance:** 0/+200 [mm]**Diameter tolerance**

Standard ISO-h7

*Special Tolerance can be provided at premium price

Packaging

Chromed Linear shafts supplied in 3 different packaging options:

Standard – plastic sleeves or paper tubes**Special requirements with additional cost** – Seaworthy protected – aluminum foil or vacuum bags.**Extra protection with additional cost** – wooden boxes

Marking

For a full traceability each bar is marked individually on the plastic/paper tube with info about the date, product series, diameter, tolerance, resistance at saltwater spray test, heat no, production order and so on. The batch has a label with information regarding: Order no, Item no, Heat no., Steel Grade; total length of the batch, Weight, no of pieces in the batch.

Customized Services

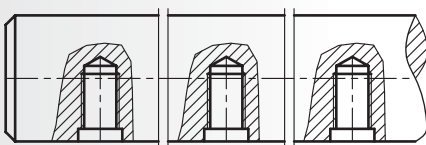
Luckily we are all different and we understand that also our Customers have different needs. That is why we are performing special customized operations in order to provide a wide range of custom-tailored finished or semi-finished products.

Here are only some examples of what we are capable of doing:

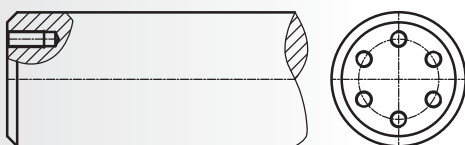
CUTTING AND DEBURRING



RADIAL DRILLING AND TAPPING



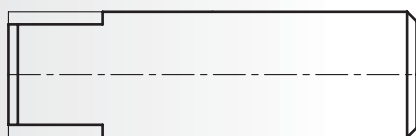
PITCH CIRCLE DRILLING AND TAPPING



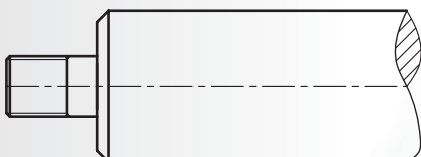
CIRCUMFERENCE GROOVE



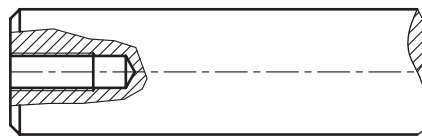
MILLED PLANES (FOR KEY)



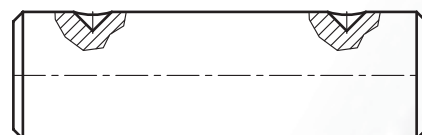
THREADED REDUCED DIAMETERS



AXIAL DRILLING AND TAPPING



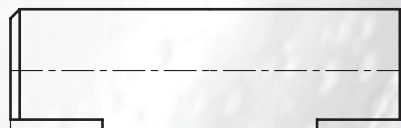
SCREW SEATS



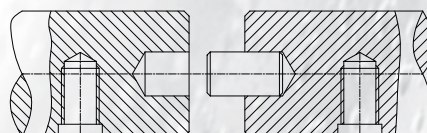
SNAP RING GROOVES



MILLED PLANES



SHAFT COUPLING



Applications for Standard conditions

These applications, which cover most of the industry consumption, need a strong demand for the perfect mix between quality, price competitiveness and production flexibility. We use the most common steel grades such as C45 and 20MnV6 induction hardened and non-induction hardened.

Products from this category:

Chromed bars A-CHROME BAC, A-CHROME BATC, A-CHROME BACM, A-CHROME BATCM and A-TUBE TUC; A-TUBE TUL; A-TUBE TUCI for tubes according to E355 EN 10305-1/-2 standards.

Product applications:

- quality hydraulic cylinders: H8 skived and rolled burnished tubes A-TUBE TUL, with chromed plated bars A-CHROME BAC, A-CHROME BATC, A-CHROME BACM, A-CHROME BATCM.
- long reach cylinders: we recommend the use of tubes A-TUBE TUL or A-TUBE TUSL that are the best option to build lighter cylinders. The standard characteristics can be improved by replacing the chrome plated bars used as piston of the cylinder with our A-TUBE TUL H8 tubes. This solution is decreasing the weight of the piston by 50-60%.
- telescopic cylinders: H8 ID skived and roller burnished and OD chromed f7 tolerance
- Concrete pumps, rotating cranes & platforms, chalk, plastic, rubber injection moulds, office chairs: we recommend inside chrome plated, skived and roller burnished tubes A-TUBE TUCI
- low speed & mostly agricultural cylinders: H9 ready to use tubes A-TUBE TUSL are good enough if $R_a < 0,80\mu m$ is acceptable, together with A-CHROME BAC, A-CHROME BATC (quality hydraulic cylinders)

Recommended Corrosion Resistance Coating:

Applications for standard conditions are defined as applications working in a non-particular corrosive environment. The choice must be made according to external factors like temperature, humidity and general weather conditions that vary from one environment to another. The choice can be critical for the product lifetime and great attention must be paid to it.

For standard or so called "multipurpose" hydraulic cylinders our Technical Department is recommending products with a corrosion resistance: R9/120hNSS and R9/200h NSS.

NSS test (according to ISO 9227) with rating 9 (according to ISO 10289)


R10/120h NSS, NSS test (according to ISO 9227) with rating 9 (according to ISO 10289) with rating 10 (according to ISO 10289) enhanced resistance.

Steel grade must be taken into consideration according to load withstand and mechanical properties required.

We recommend that customers discuss in detail all applications with **ASO Hydraulics & Pneumatics** Technical Department before proceed with production, in order to achieve the best possible solutions.



Recommended Materials / Products:

 TUBE TUC

 TUBE TUTC

 CHROME BAC

 TUBE TUCL

 CHROME BATC

 TUBE TUTCL

 CHROME BACM

 TUBE TUSL

 CHROME BATCM

 TUBE TUCI

Applications:

- Garbage Compactors
- Dump Trucks
- Articulated Dump Trucks
- Compact Track Loaders
- Materials Handling
- Mini Skid Steers
- Skidders
- Logging & Forest Control Machinery
- Rotating Cranes (Forestry crane loaders eta)
- Forwarders
- Agricultural Machinery
- Backhoe Attachments
- Telehandlers & Long Reach Arms
- Wheeled & Crawler Platforms
- Mobile & Stationary Cranes
- Wheeled & Crawler Cranes
- Materials Processing
- Pneumatic cylinders with pressure > 200 bar
- Injection molds for chalk, plastic, rubber
- Auto racks and street cleaning equipment
- Tippers
- Building lifts
- Fork Lifts
- Hook lifts
- Tail Lifts/Platforms
- Asphalt Milling
- Asphalt Recyclers
- Material Processors
- Pedestal Boom Systems
- Hydraulic Crushers & Scissors
- Ag Forks
- Bale Spears
- Brush Tined Grapples
- Mulching Heads
- Scrap Grapples
- Shock Absorbers
- Gas springs
- Pneumatic cylinders
- Fitness equipment
- Hydraulic Presses
- Directional Drills
- Truck Cranes



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Applications for Demanding conditions

In this strategic manufacturing part of the market, customers' request high quality products not only for corrosion resistance but also for specific steel characteristics. Most of the Raw Material used for this demanding applications presents an induction hardening heat treatment. Induction hardening of piston rods in hydraulic cylinders is performed in order to increase the resistance to damage from external impacts. Some applications for which such risk exists are: excavator piston rods, landscape loaders or power-steering cylinders and earth moving machinery in general. For these applications induction hardened bars are a must.

Products from this category:

The parts A-TUBE TUL & A-TUBE TUSL Hollow Rods TUC with high quality mechanical characteristics are ideally suited for manufacturing high-stress hydraulic cylinders. Quality of raw material ensures uniform mechanical properties together with good impact resistance in both longitudinal and radial direction, down to - 20°C

Recommended Corrosion Resistance Coating:

- R10/120h NSS with 120 hours of corrosion resistance in NSS test (according to ISO 9227) and rating 10 (according to ISO 10289) enhanced resistance.
- R9/500h NSS with 500 hours of corrosion resistance in NSS test (according to ISO 9227) and rating 9 (according to ISO 10289) enhanced resistance.
- R10/500h NSS with 500 hours of corrosion resistance in NSS test (according to ISO 9227) and rating 10 (according to ISO 10289) enhanced resistance.

Product applications:

For long reach cylinders we recommend hollow bars A-TUBE TUC as the best option to build lighter cylinders. They also improve the standard characteristics of the chrome bars, by decreasing weight up to 50-60%. Coating solutions can be chosen according to the customer needs.

Demanding applications are defined as those used in a heavy duty & corrosive environment. The choice must be made according to the work environment (external factors such as temperature, humidity and general weather conditions that vary from one geographical location or environment to another.)

Often times other factors might be taken into consideration, such as steel grade (according to load withstand) and mechanical properties of the steel used; in particular case, these properties have a critical impact on the application of the product.

The choice can be critical for the product's lifetime and attention to production details must be paid.

We recommend that customers discuss in detail all applications working in demanding conditions with **ASO Hydraulics & Pneumatics** Technical Department before proceed with production, in order to achieve the best possible solutions.



Recommended Materials / Products:

▲ CHROME BAC

▲ CHROME BATC

▲ CHROME BATCM

▲ CHROME BACV

▲ CHROME BOC

▲ CHROME BOTC

▲ CHROME BACI 431

▲ TUBE TUC

▲ TUBE TUTC

▲ TUBE TUCL

▲ TUBE TUTCL

▲ TUBE TUL

▲ TUBE TUCI

Applications:

- Excavators
- Snow Plows
- Drilling Equipment
- Mining Equipment
- Trenchers
- Long wall mining supports
- Garbage Compactors
- Dump Trucks
- Articulated Dump Trucks
- Compact Track Loaders
- Telehandlers & Long Reach Arms
- Mobile & Stationary Cranes
- Wheeled & Crawler Cranes
- Vacuum Trucks
- Tippers
- Tail Lifts/Platforms
- Crushers
- Wind Mills
- Crawler Dozers
- Crawler Loaders
- High Speed Dozers
- Landscape Loaders
- Voter Graders
- Skid Steers
- Wheel Loaders
- Feller Bunches
- Refuse Compactors
- Soil Compactors



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Applications for Extreme conditions

Extreme are those working environments, where the corrosion resistance required is far greater than the applications working in standard or demanding conditions.

Recommended Products for Extreme conditions:

A-CHROME BACI series with R9/1000h NSS - applicable on stainless steel AISI materials with 1000 hours of corrosion resistance in NSS test (according to ISO 9227) and rating 9 (according to ISO 10289) enhanced resistance.

The choice of the material can be critical for the product lifetime and great attention must be paid to it.

Applications working in extreme conditions:

- Chemical Industry with exposure to aggressive agents
- Mining Equipment
- Oil and Gas
- Power Generation
- Aerospace
- Marine Environment
- Boat Launch and Recovery systems

We recommend that customers discuss in detail all applications for extreme conditions with ASO Hydraulics & Pneumatics Technical Department before proceed with production, in order to achieve the best possible solutions.

Recommended Materials / Products:

A CHROME BACI 304

A CHROME BACI 316

A CHROME BACI 329

A CHROME BACI 431

A CHROME BACI 630

A TUBE TUL

A TUBE TUSL





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THE ROCK WAY OF CHROMING

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ASO CROMSTEEL S.A.

Laminorului 16, RO - 130089
Târgoviște (Dâmbovița) ROMANIA
e-mail: cromsteel@asogroup.it

ASO SPS

Via Antonio Salieri 32, IT - 37050
Oppeano Vallese (VR) ITALY
e-mail: sps@asogroup.it

Headquarter

ASO SIDERURGICA S.p.A. Unipersonale

Via Seriola 122, IT - 25035
Ospitaletto (BS) ITALY
e-mail: info@asogroup.it

www.asogroupsteel.com
www.cromsteel.ro

