



# ▶ 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 upgrading 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.

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## more than 20 years

of experience in chrome plated bars

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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**.

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## 230.000 m2

of production area

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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 Skived & Rolled  
Burnished / Honed tubes

## A- LINE series

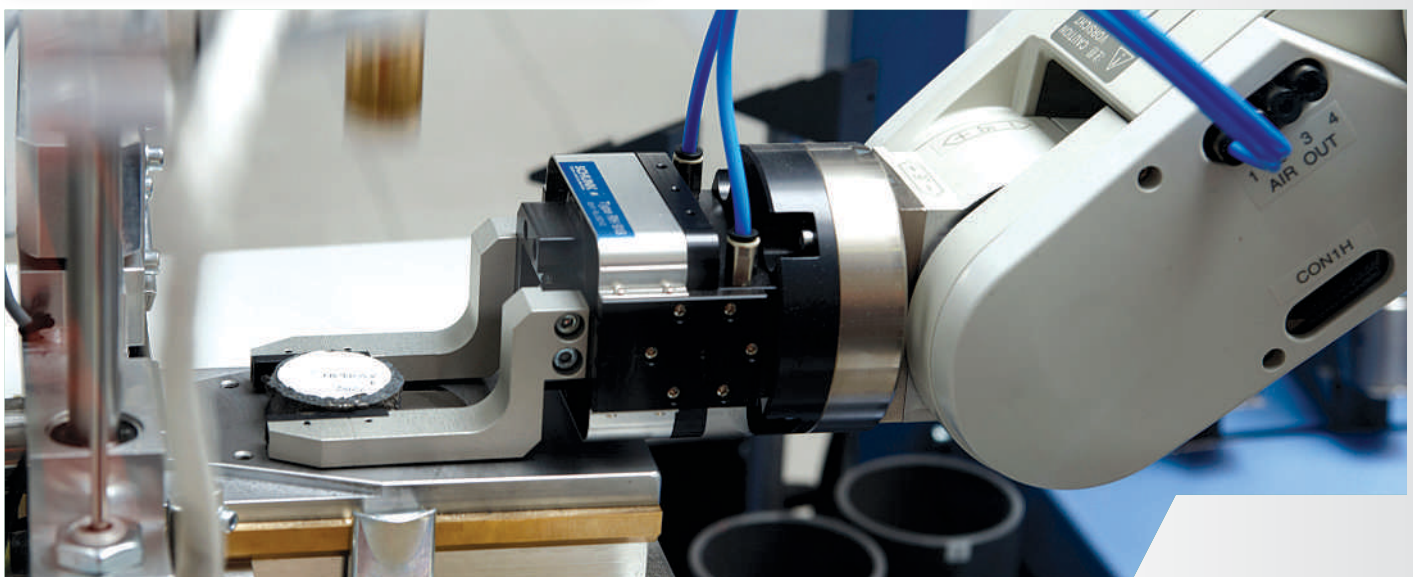
Linear Shafts & Chrome plated linear shafts



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 up to 250 mm.



# 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 up to 8 overlapped substrates of Chrome that are forming one of the best chrome layers on 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*



*Continuous Multi-Layer Chrome Plating Technology*



As shown in the pictures above, single layer chroming technology doesn't provide an effective barrier for the protection of the steel rod underneath.

"Multi-Layer Chrome Plating Technology", through higher number of chrome layers, grants a guarantee that overlapping substrates create a perfect barrier between the base steel and the external agents

With our technology we create up to 8 overlapped substrates of Chrome for certain diameters and applications

## Up to 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**

## Kaizen Management Process

ASO Hydraulics & Pneumatics Quality Assurance Team is dealing with the creation of procedural and administrative activities in order to have a Kaizen 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:

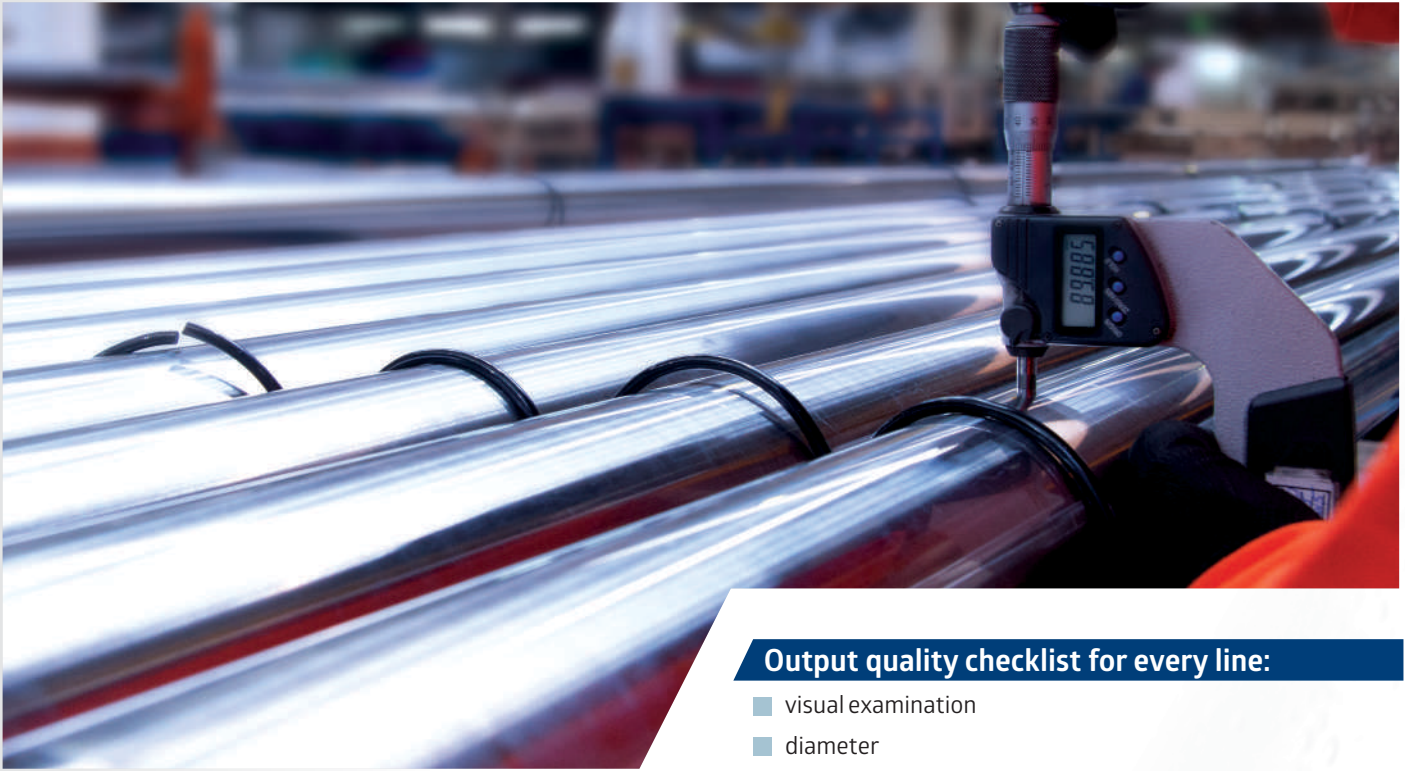
- diameter tolerance
- visual examination
- laser diameter control
- roundness
- straightness
- Ra and Rz surface roughness
- (on request : Rt, Tp, Rz max, Rk)

### 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 chemists, according to our internal procedures. We pay a special attention to these tests because our plating lines produce over 17.000 m of chrome products every day in our plants. All analysis results are registered.

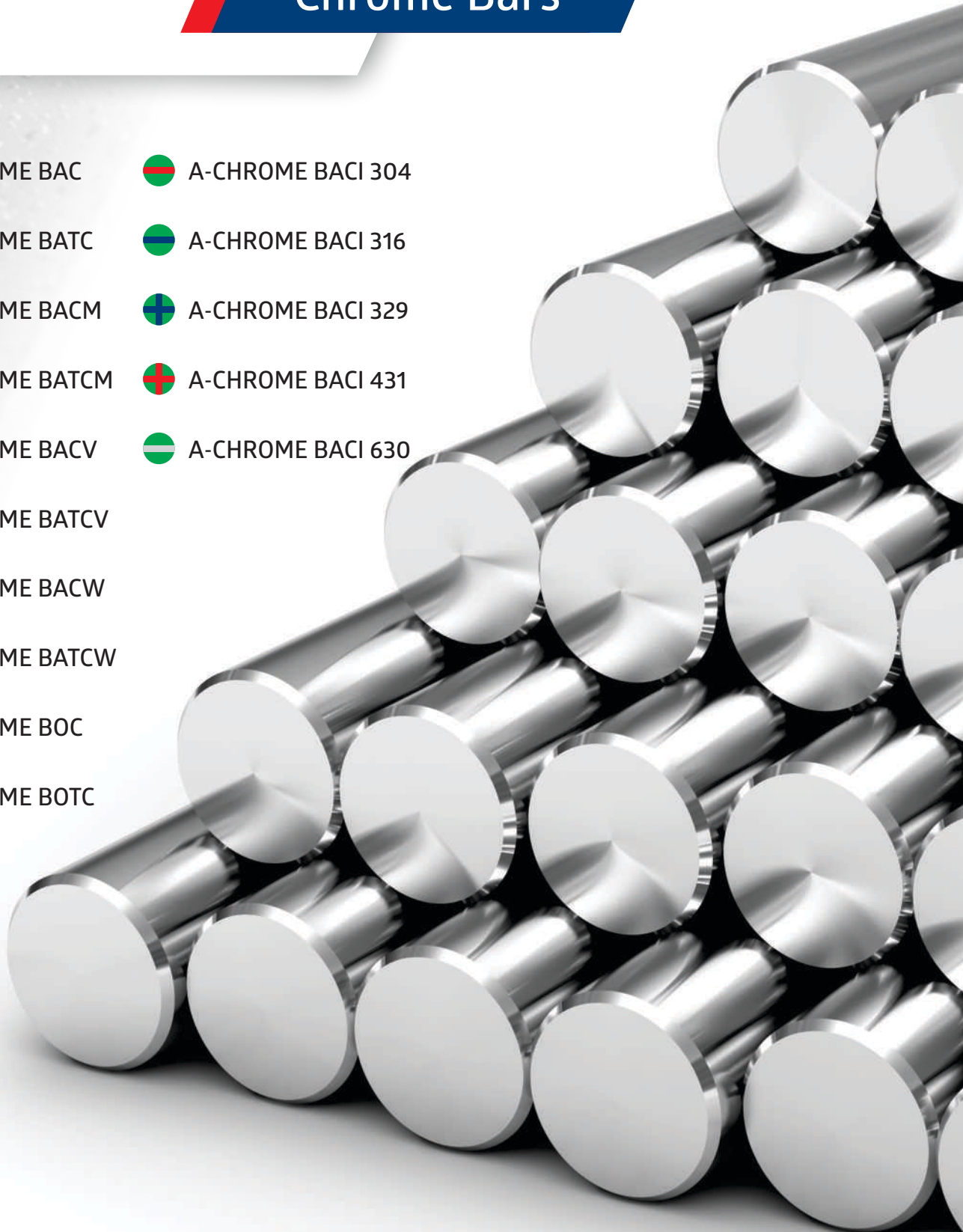


# Certifications



**ASO** HYDRAULICS & PNEUMATICS  
/ ASO CROMSTEEL  
/ ASO SPS

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





# General Chromed Bars Properties

ASO Hydraulics & Pneumatics chrome 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	-	-	0.08-0.20	max. 0.10
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. 0.10
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. 0.10
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	-	-	-

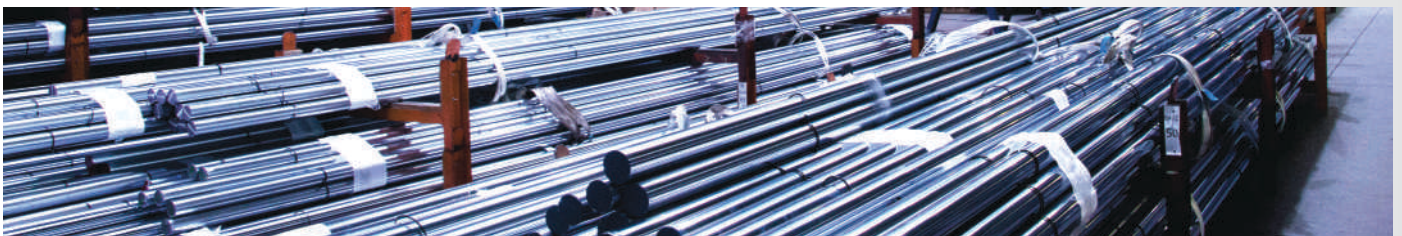
\*CW85 internally developed high quality alloy steel with  $CE(\%) = C + (Mn/6) + (Cr+Mo+V)/5 + (Ni+Cu)/15$

Table 2: Chemical composition in % by weight

## Mechanical Properties

Product	Steel grade	Diameter Ø [mm]	Tensile Strength	Yield Point	Elongation	Hardness Brinell
			Rm [N/mm <sup>2</sup> ]	Rp <sub>0.2</sub> [N/mm <sup>2</sup> ]	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	min. 620	min. 10	200
		19≤Ø≤70	min. 600	min. 450	min. 18	163-200
		70<Ø<160	min. 550	min. 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	min. 750	min. 8	298-359
		16<Ø≤40	1000-1200	min. 750	min. 11	298-359
		40<Ø≤100	900-1100	min. 700	min. 12	271-331
		100<Ø≤200	800-950	min. 550	min. 13	225-271

Table 3: Mechanical Properties for the steels used



# Stainless Steel Chromed Bars Properties

ASO Hydraulics & Pneumatics chrome 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	X5CrNiMo17-12-2	X5CrNiMo17-12-2	1.4404	316S11	Z3CND-11-02	AISI 316
A-Chrome BACI 329	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 <sub>max</sub>	Mn <sub>max</sub>	P <sub>max</sub>	S <sub>max</sub>	Cr	Mo	Ni	N <sub>max</sub>	Cu	Nb
X5CrNi18-10 (AISI 304)	max. 0.07	1.00	2.00	0.045	0.03	18.0-20.0	-	8.0-10.50	0.11	-	-
X5CrNiMo17-12-2 (AISI 316)	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 (AISI 329)	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 (AISI 431)	0.12-0.22	1.00	1.50	0.040	0.03	15.0-17.0	-	1.50-2.50	-	-	-
X5CrNiCuNb16-4 (AISI 630)	max. 0.07	0.70	1.50	0.040	0.03	15.0-17.0	-	3.0-5.0	-	3.0-5.0	5x%C

Table 5: Chemical composition in % by weight

## Mechanical Properties

Product	Delivery Condition	Yield Point	Tensile Strength	Elongation	Hardness Brinell	Impact Energy
	-	R <sub>p0.2</sub> [N/mm <sup>2</sup> ]	R <sub>m</sub> [N/mm <sup>2</sup> ]	A5 [%]	HB	KV +20 (L) [J]
A-Chrome BACI 304	+A 20÷40	min. 190	600-850	min. 30	max. 201	min. 100
	+A 40÷63	min. 190	580-850	min. 30		
	+A 63÷160	min. 190	500-700	min. 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 chrome 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

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

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



CHROME

BAC

Chrome plated Steel bar

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / C45E

Rod end will be painted in blue



### Properties

#### Residual Magnetism Standard

max. 50 Gauss

*\*Special magnetism can be provided at premium price*

#### Surface Roughness

Ra: max. 0.20 [ $\mu\text{m}$ ]

#### 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

$\varnothing \leq 19.05$  [mm] | min. 15 [ $\mu\text{m}$ ]

$\varnothing \geq 20$  [mm] | min. 20 [ $\mu\text{m}$ ]

#### Straightness

$\varnothing < 20$  [mm] | max. 0.3 [mm]/1000 [mm]

$\varnothing \geq 20$  [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 etc. 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 Copper-accelerated acetic acid salt spray

#### A-CHROME

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

*\* 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 painted 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] | min. 15 [µm]

Ø≥20 [mm] | min. 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	Copper-accelerated acetic acid salt spray

#### A-CHROME

Standard Corrosion resistance for Ø<20 R9/120hNSS; for Ø≥20 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		

### 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

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



### 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 etc. 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.



**CHROME**

**BACM**

Chrome plated Steel bar

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / 20MnV6

Rod end will be painted 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] | min. 15 [µm]

Ø ≥ 20 [mm] | min. 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 etc. 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 Copper-accelerated acetic acid salt spray

#### A-CHROME

Standard Corrosion resistance for Ø < 20 R9/120hNSS; for Ø ≥ 20 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 painted 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] | min. 15 [µm]

Ø≥20 [mm] | min. 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	Copper-accelerated acetic acid salt spray

A-CHROME

Standard Corrosion resistance for Ø<20 R9/120hNSS; for Ø≥20 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 etc.. 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 painted 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] | min. 15 [µm]

Ø ≥ 20 [mm] | min. 20 [µm]

#### Straightness

Ø < 20 [mm] | max 0.3 [mm]/1000 [mm]

Ø ≥ 20 [mm] | max 0.2 [mm]/1000 [mm]

#### Roundness

max. 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 etc. 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 Copper-accelerated acetic acid salt spray

#### A-CHROME

Standard Corrosion resistance for Ø < 20 R9/120hNSS; for Ø ≥ 20 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



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] | min. 15 [µm]

Ø≥20 [mm] | min. 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. 1/2 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	Copper-accelerated acetic acid salt spray

A-CHROME

Standard Corrosion resistance for Ø<20 R9/120hNSS; for Ø≥20 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 etc. 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 painted 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] | min. 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 etc. 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	Copper-accelerated acetic acid salt spray

#### A-CHROME

Standard Corrosion resistance for Ø<20 R9/120h NSS; for Ø≥20 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 painted 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] | min. 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	Copper-accelerated acetic acid salt spray

A-CHROME

Standard Corrosion resistance for Ø<20 R9/120h NSS; for Ø≥20 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

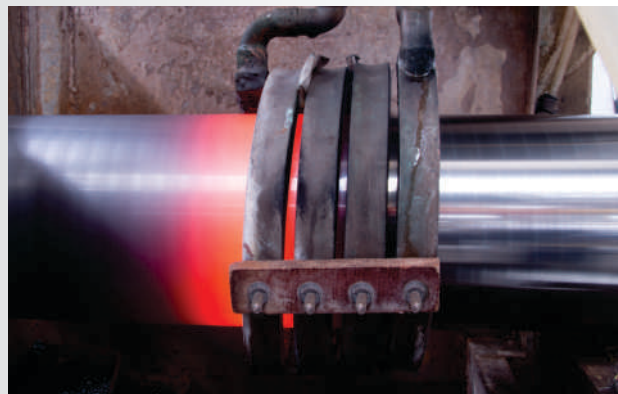
Standard Corrosion resistance for Ø≥20-140 R10/500h NSS.

\* 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 etc. 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.



CHROME

BOC

Chrome plated Steel bar

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / 42CrMo4+QT

Rod end will be painted 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] | min. 15 [µm]

Ø ≥ 20 [mm] | min. 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 etc. 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 Copper-accelerated acetic acid salt spray

#### A-CHROME

Standard Corrosion resistance for Ø < 20 R9/120h NSS; for Ø ≥ 20 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 painted 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] | min. 15 [µm]

Ø≥20 [mm] | min. 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]

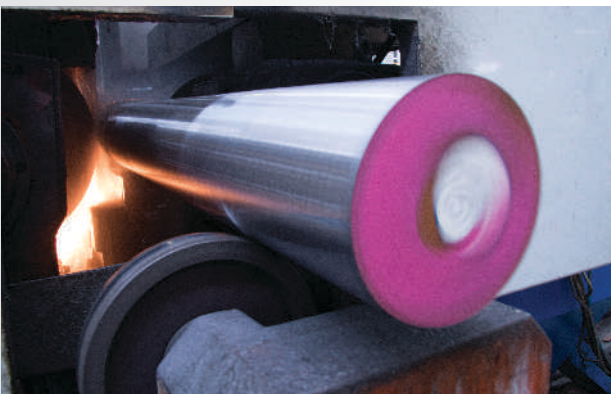
#### Roundness

max. ½ from diameter tolerance

### 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



### 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	Copper-accelerated acetic acid salt spray

#### A-CHROME

Standard Corrosion resistance for Ø<20 R9/120h NSS; for Ø≥20 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

### 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

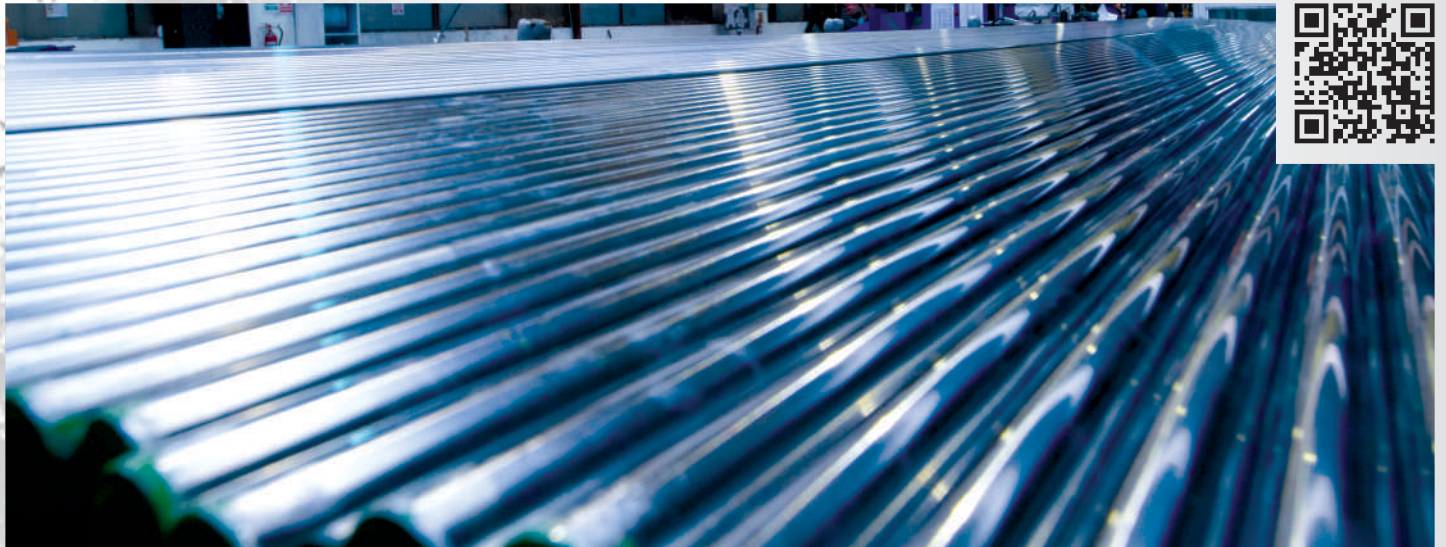
BACI 304

Chrome plated Stainless Steel bar

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / AISI 304

Rod end will be painted 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] | min. 15 [µm]

Ø ≥ 20 [mm] | min. 20 [µm]

#### Straightness

Ø ≤ 20 [mm] | max 0.3 [mm]/1000 [mm]

Ø > 20 [mm] | max 0.2 [mm]/1000 [mm]

#### Roundness

max. 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 etc. 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 – R9/1200h NSS

For reference only.

*\* 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

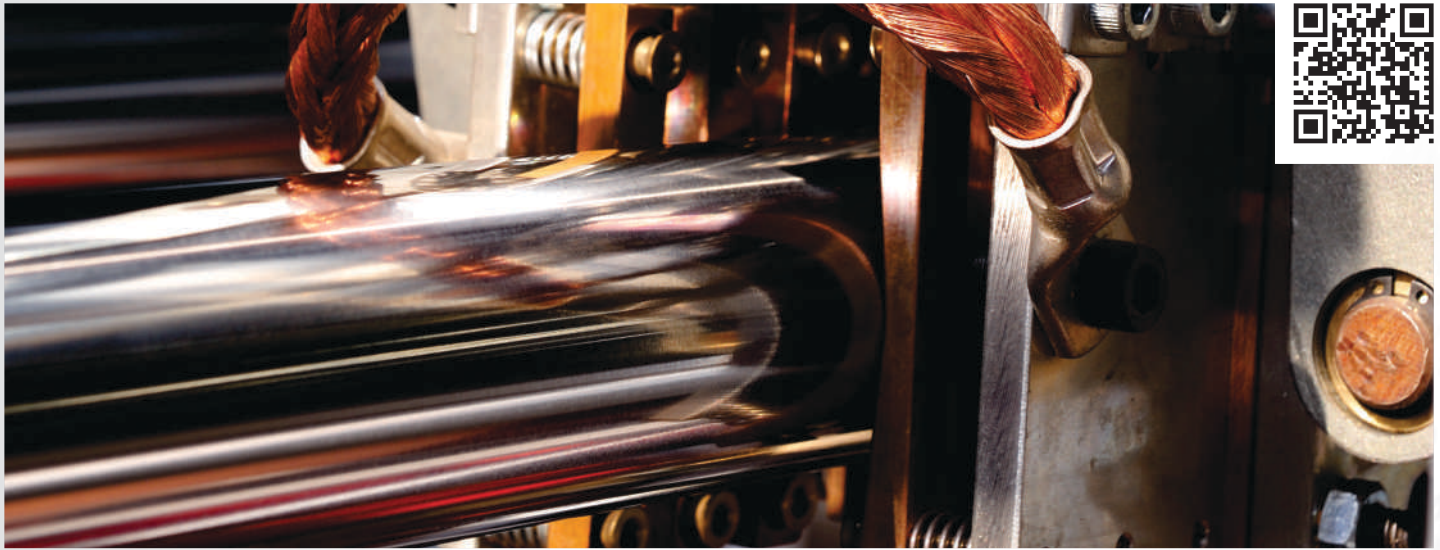
BACI 316

Chrome plated Stainless Steel bar

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / AISI 316

Rod end will be painted 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] | min. 15 [µm]

Ø ≥ 20 [mm] | min. 20 [µm]

#### Straightness

Ø ≤ 20 [mm] | max 0.3 [mm]/1000 [mm]

Ø > 20 [mm] | max 0.2 [mm]/1000 [mm]

#### Roundness

max. 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 etc. 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 – R9/1440h NSS

For reference only.

*\* DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE*

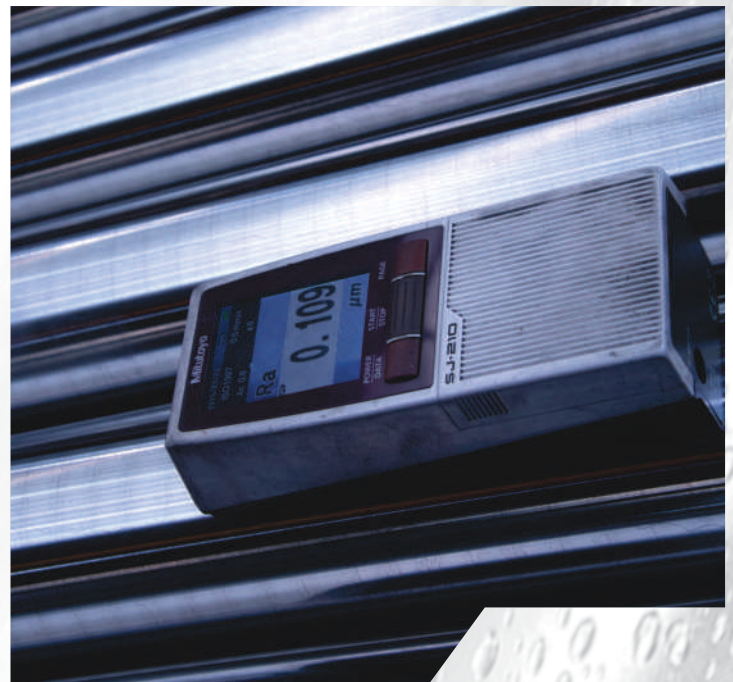
#### Packaging

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 painted 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

Ø≥20 [mm] | min. 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 etc. 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

Corrosion Resistance Performance provided on request.

*\* 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

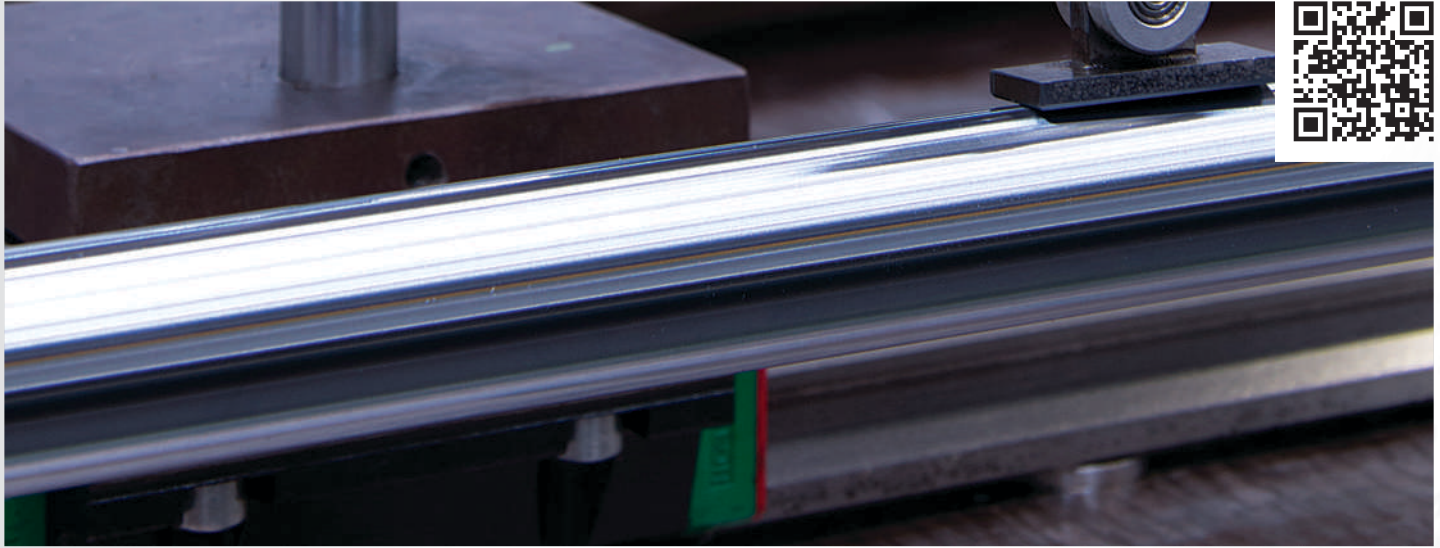
BACI 431

Chrome plated Stainless Steel bar

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / AISI 431

Rod end will be painted 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 [ $\mu\text{m}$ ]

#### 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

$\text{Ø} \geq 20$  [mm] | min. 20 [ $\mu\text{m}$ ]

#### Straightness

$\text{Ø} \geq 20$  [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 etc. 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 – R9/840h NSS

For reference only.

*\* 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

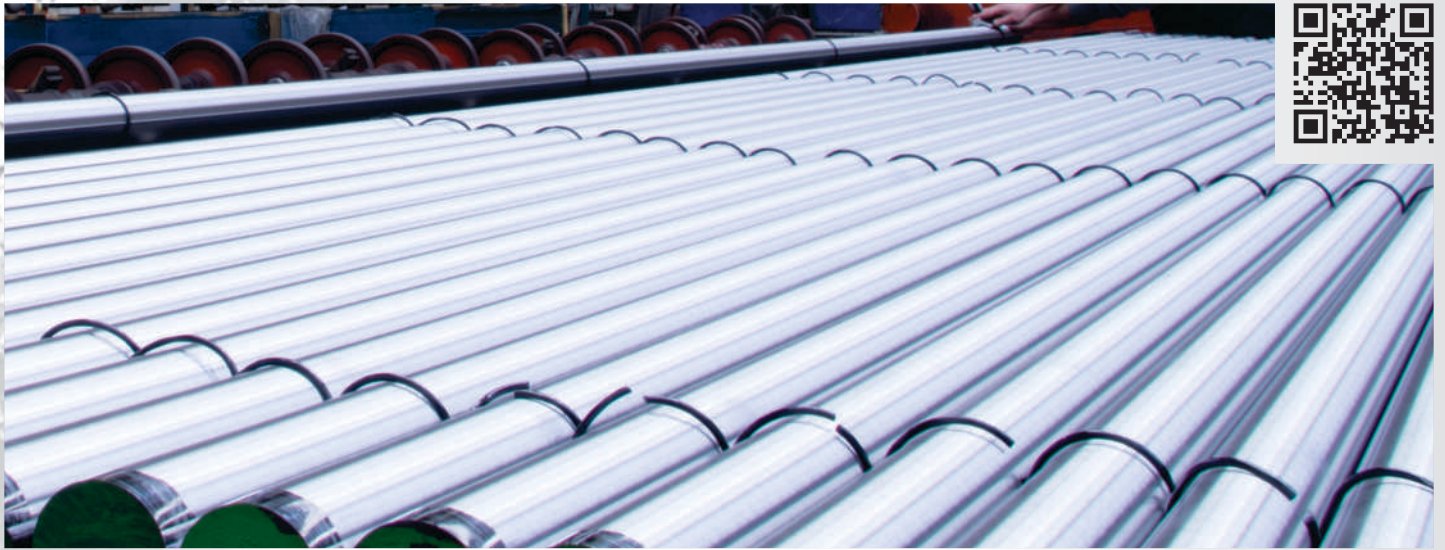
BACI 630

Chrome plated Stainless Steel bar

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / AISI 630

Rod end will be painted 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

Ø≥20 [mm] | min. 20 [µm]

#### Straightness

Ø≥20 [mm] | max 0.2 [mm]/1000 [mm]

#### Roundness

max. 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 etc. 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

Corrosion Resistance Performance provided on request.

*\* DOUBLE CHROME LAYER ON REQUEST AT PREMIUM PRICE*

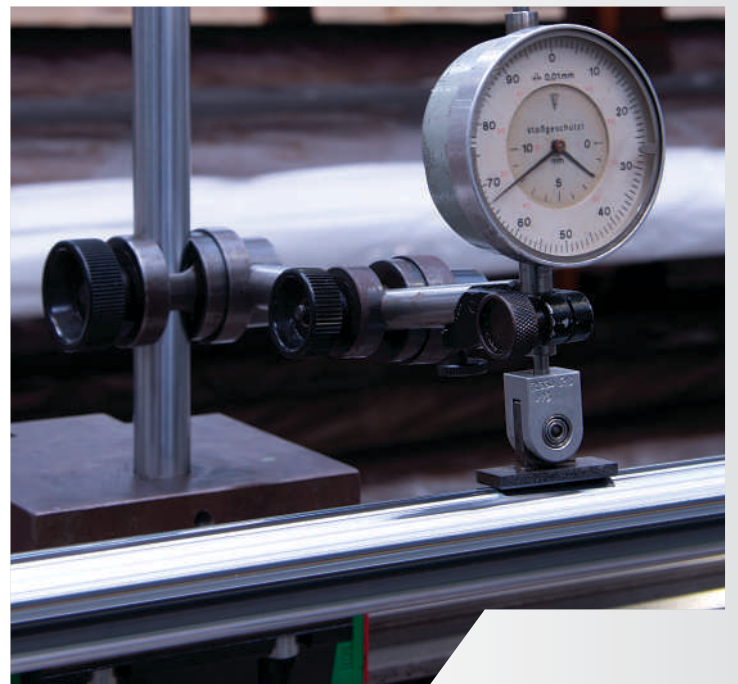
### Packaging

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

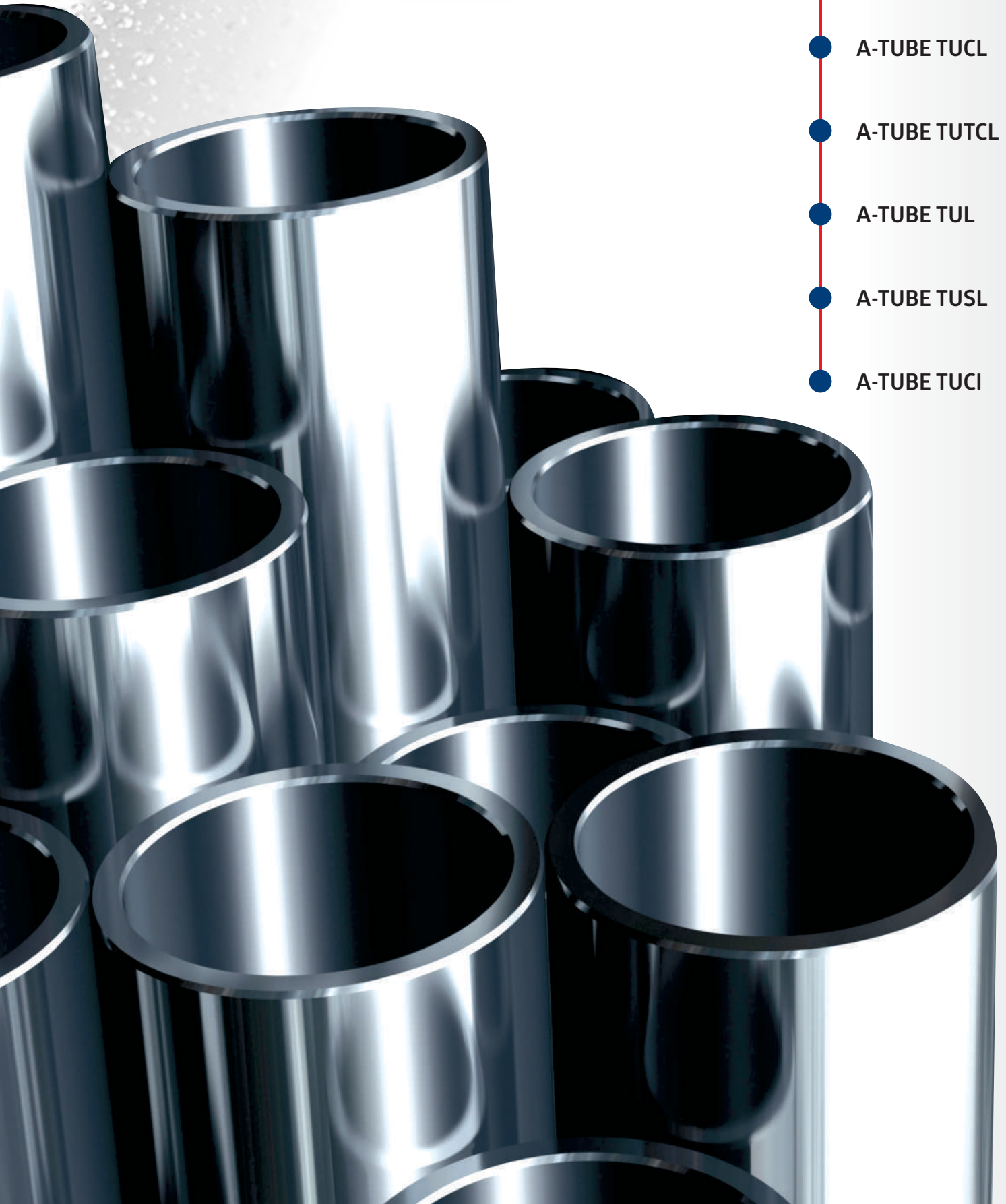
/ASO CROMSTEEL

/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	12 to 200	2.0 - 20.0	6500÷6700 mm
A-TUBE TUTC			
A-TUBE TUCL	40 to 200	4.76 to 12.5	5000÷7000 mm
A-TUBE TUTCL			
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





A TUBE

TUC

/ Cold drawn / OD Chrome plated tubes

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / E355 + SR, according to EN10305-1 / EN10305-2



### 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 etc. 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	Copper-accelerated acetic acid salt spray

#### A-CHROME

Standard Corrosion resistance for Ø < 20 R9/120h NSS; for Ø ≥ 20 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

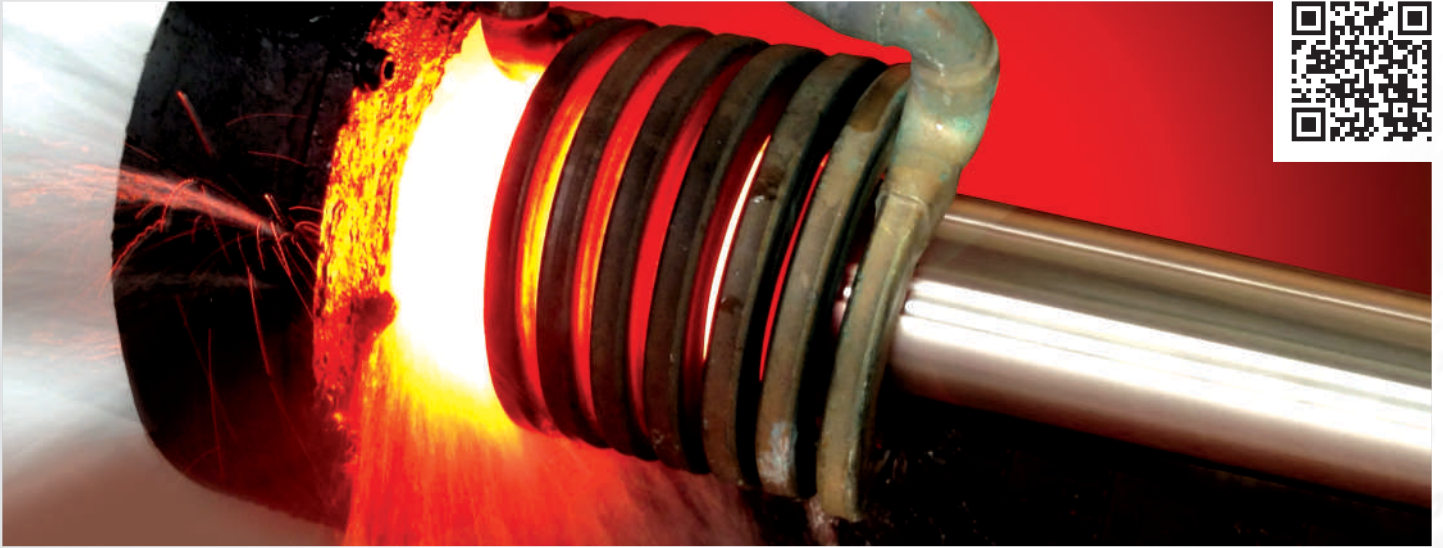
### Packaging

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, pallets for machined and cut parts.





### 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 etc. 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	Copper-accelerated acetic acid salt spray

#### A-CHROME

Standard Corrosion resistance for Ø<20 R9/120h NSS;  
for Ø≥20 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

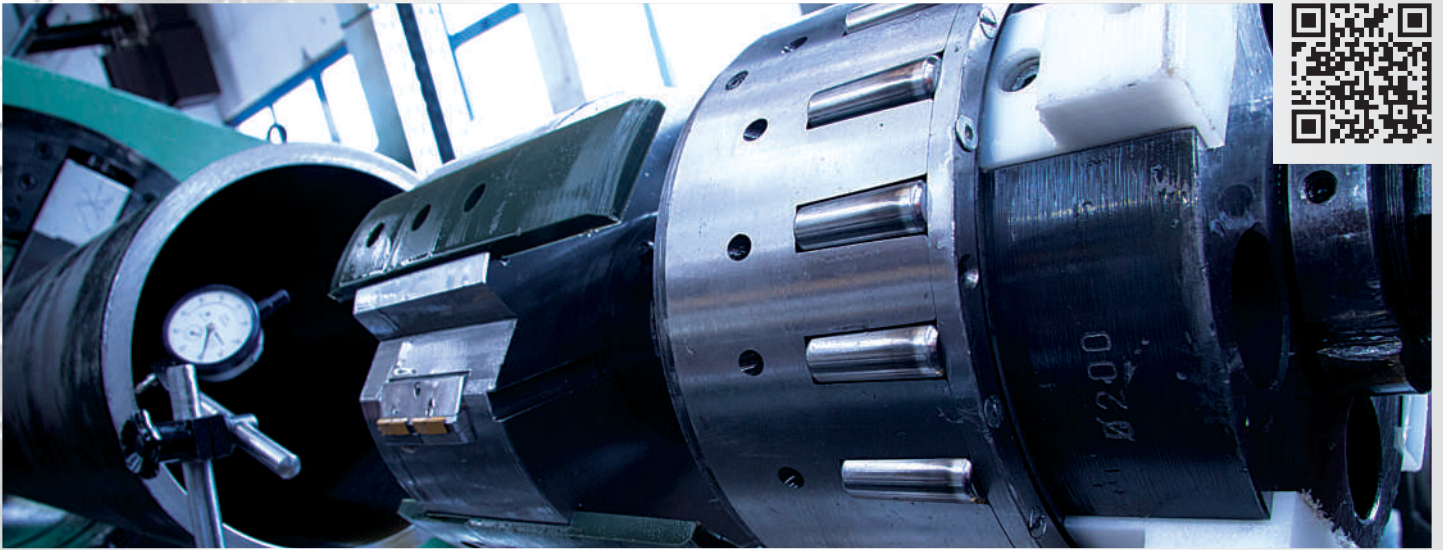
**Machinability** - excellent

### 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, pallets for machined and cut parts.



### Properties

#### 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

#### 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 [mm]/1000 [mm] for diameter  $\varnothing > 40$  [mm]

#### Chrome Layer thickness

min. 20 [μm]

*\*Special chroming layer at premium price*

#### Ovality

max. 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 etc. 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	Copper-accelerated acetic acid salt spray

#### A-CHROME

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

*\* 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), packed in 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.

*\* The oil used for the internal surface of the tubes is guaranteed for 6 months.*



### 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  $R_{max} = 0.20$  [ $\mu\text{m}$ ]
- ID  $R_{max} = 0.25$  [ $\mu\text{m}$ ]
- ID  $R_{max} = 0.40$  [ $\mu\text{m}$ ] 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  $\varnothing > 40$  [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 etc. 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	Copper-accelerated acetic acid salt spray

#### A-CHROME

Standard Corrosion resistance for  $\varnothing < 20$  R9/120hNSS; for  $\varnothing \geq 20$  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.

*\* 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), packed in 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.

*\* The oil used for the internal surface of the tubes is guaranteed for 6 months.*



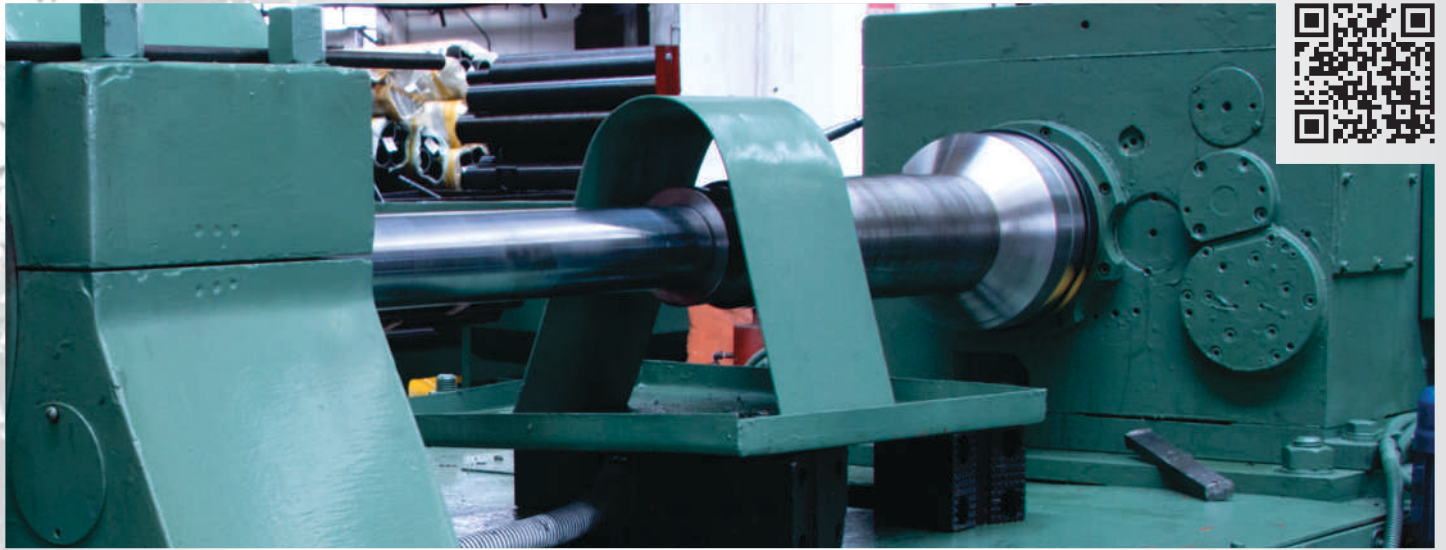
A TUBE

TUL

/ Cold drawn tubes / SRB finished or Honed

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / E355 + SR, according to EN10305-1



### 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 Roughnes

- ID  $R_{\text{amax}} = 0.25 [\mu\text{m}]$
- ID  $R_{\text{amax}} = 0.40 [\mu\text{m}]$  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*

### Marking

For a full traceability each tube is marked individually 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.

### Weldability & Machinability

**Weldability** - excellent

**Machinability** - excellent

### Packaging

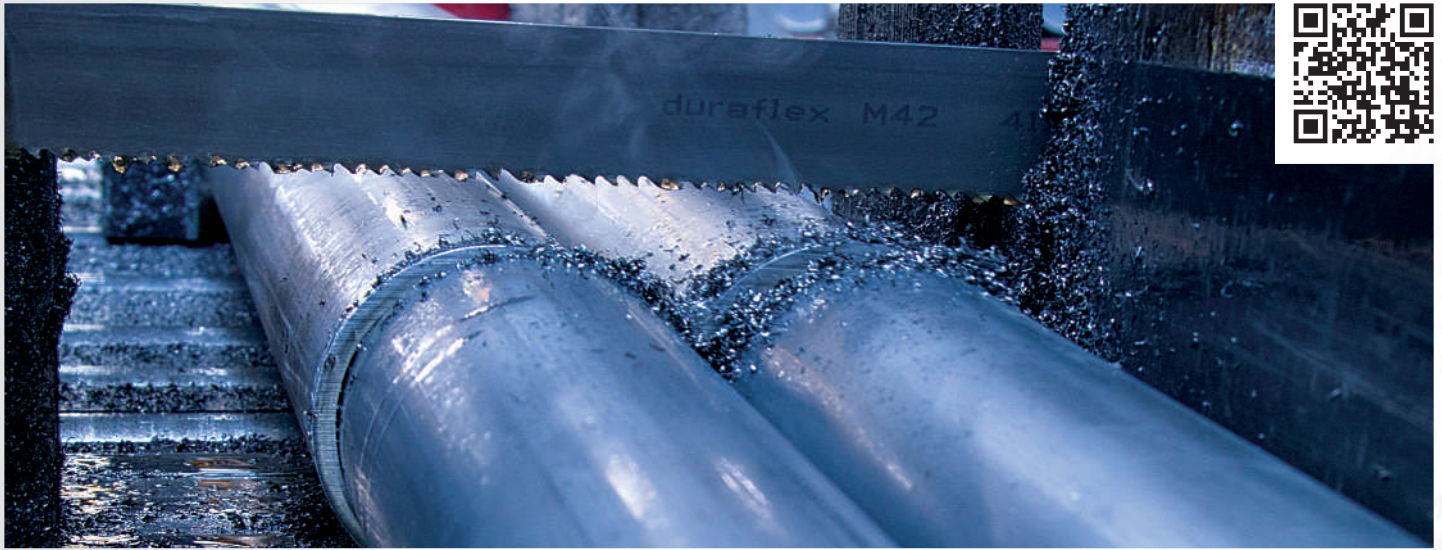
A-TUBE products are supplied in standard bundles oiled inside and closed with end caps

**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.

*\* The oil used for the internal surface of the tubes is guaranteed for 6 months.*





### Properties

#### Straightness

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

#### Surface Roughnes

- ID  $R_{\text{amax}} = 0.25 \text{ [}\mu\text{m]}$
- ID  $R_{\text{amax}} = 0.40 \text{ [}\mu\text{m]}$  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*

### Marking

For a full traceability each tube is marked individually 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.

### 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.

*\* The oil used for the internal surface of the tubes is guaranteed for 6 months.*





A TUBE

TUCI

/ Cold drawn tubes / ID honed and ID Chrome plated

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / E355 + SR, according to EN10305-1



### Properties

#### Surface Roughness – ID

R<sub>amax</sub> = 0.40 [µm]

#### 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 [µm]

*\*Special chroming layer at premium price*

*For special applications: concrete pumps, cylinders*

*max. 200 [µm] 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	Copper-accelerated acetic acid salt spray

#### A-CHROME

Standard Corrosion resistance for Ø≥40 R9/200h NSS.

#### A-CHROME EXTRA

Standard Corrosion resistance for Ø≥40-140 R9/500h 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), packed in 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.



**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						
A-LINE WRBZ	X46Cr13	X46Cr13	-	1.4034	Z44Cr13	420C
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]/ z [mm]	Rm [N/mm <sup>2</sup> ]	R <sub>p0.2</sub> [N/mm <sup>2</sup> ]	A5 [%]	HB
A-LINE W		Ø < 18*	700-850	min. 475	min. 10	
A-LINE WZ	Cf53	18 < Ø < 100**	610-760	min. 340	min.16	223
A-LINE WV						
A-LINE WVZ		Ø > 100**	min. 560	min. 275	min.16	
		z < 16	min 720	min. 390	min. 11	
A-LINE WH	C60	16 < z < 40	min 700	min. 350	min.12	241
A-LINE WHZ			40 < z < 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





ALINE

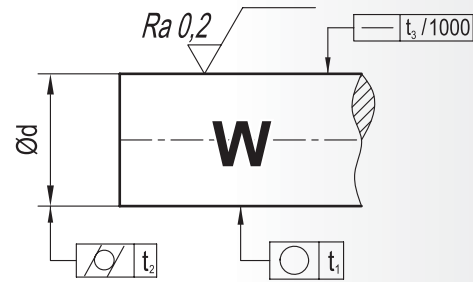
W

Induction Hardened and ground steel shafts

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / CF53

Rod end will be painted in yellow



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

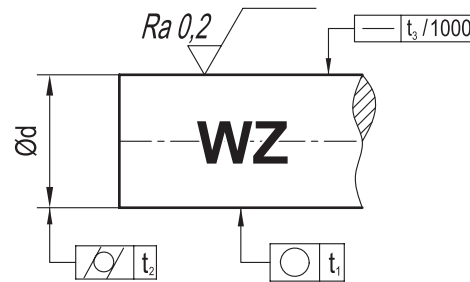
Packaging

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**

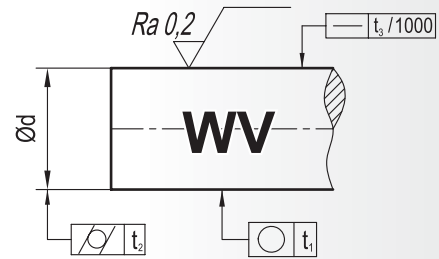
Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / CF53

Rod end will be painted 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**

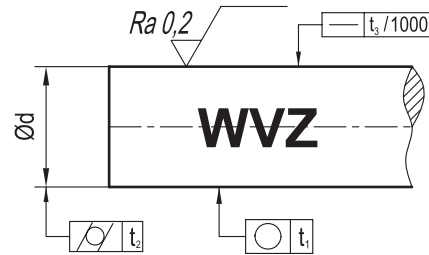
Standard ISO-h7

*\*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 etc. 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.



### 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 etc. 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.



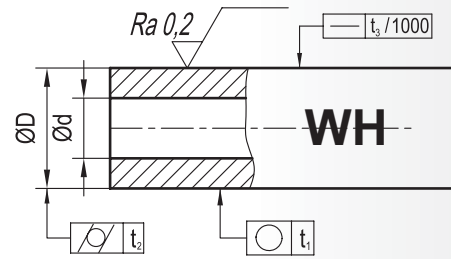
ALINE

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**

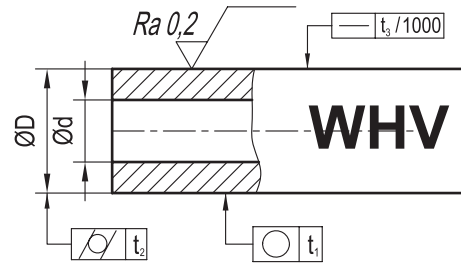
Tube Linear shafts are degreased (OD and ID), oiled OD, placed in bundles that are wrapped in wax paper and raffia.

**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.


**Dimensional Properties:**

Out Dia. $\varnothing D$	Inner Dia. $\varnothing d$	Weight per meter	Shaft part number	Standard length	Hardening depth SHD DIN 15787	Standard Tolerance ISO h7	Roundness (circular) $t_1$	Parallelism (cylindrical) $t_2$	Straightness $t_3$
[mm]	[mm]	[kg]		[mm]	[mm]	[ $\mu$ m]	[ $\mu$ m]	[ $\mu$ m]	[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 [ $\mu$ m], usually 15 [ $\mu$ m]

**Chrome Layer Hardness:** 900 HV 0.1 min

\*Special chroming layer at premium price

**Surface Hardness C60:** 62 $\pm$ 2HRC

**Surface Roughness:** Ra = max 0.20 [ $\mu$ m]

**Diameter tolerance**

Standard ISO-h7

\*Special Tolerance can be provided at premium price

**Packaging**

Chromed Linear shafts supplied in 3 different packaging options:

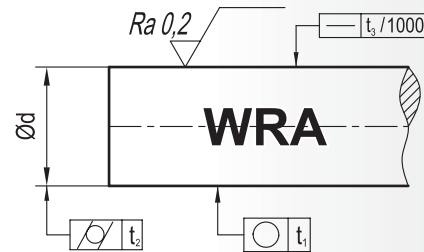
**Standard** – plastic sleeves or paper tubes

**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 etc. 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.


**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

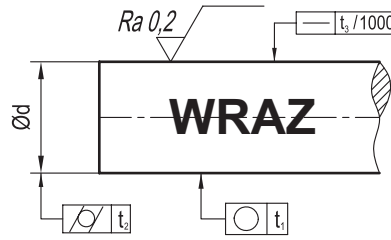
WRAZ

Induction Hardened and ground Stainless Steel shafts

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Imperial Steel grade / ASTM - 440B or EN - X90CrMoV18

Rod end will be painted 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 ¼	31.75	6.22	WRAZ 31	237	0.059-0.074	-0.0005/-0.001	0.0002	0.0004	0.004
1 ½	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 ¼	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

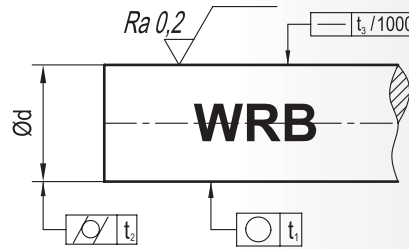
WRB

Induction Hardened and ground Stainless Steel shafts

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / X46Cr13

Rod end will be painted in white with a black line



Dimensional Properties:

Table with 9 columns: 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. Rows list diameters from 5 to 60 mm.

\*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

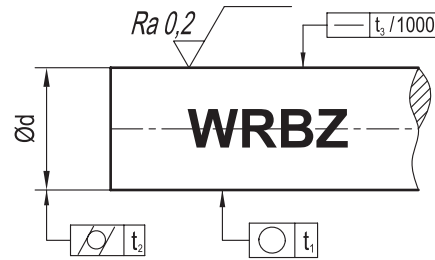
WRBZ

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 painted 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

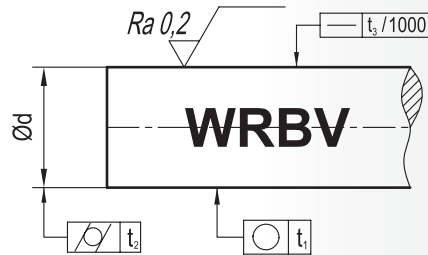
WRBV

Chromed plated Induction Hardened and ground Stainless Steel shafts

Certifications / ISO 9001 / ISO 14001 / OHSAS 18001

Steelgrade / X46Cr13

Rod end will be painted in green with a yellow line



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]	[ $\mu$ m]	[ $\mu$ m]	[ $\mu$ m]	[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 [ $\mu$ m], usually 15 [ $\mu$ m]

Chrome Layer Hardness: 900 HV 0.1 min  
\*Special chroming layer at premium price

Surface Hardness X46Cr13: 55 $\pm$ 3HRC

Surface Roughness: Ra = max 0.20 [ $\mu$ m]

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

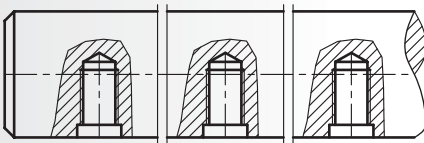
Luckily we are all different and we understand that also our Customers have different needs. That is why we are performing special customized operations in order to provide a wide range of custom finished or semi-finished products.

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

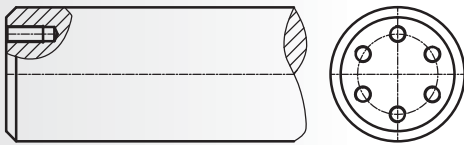
CUTTING AND DEBURRING



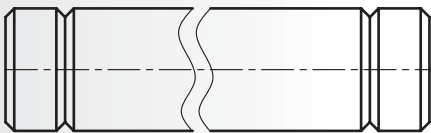
RADIAL DRILLING AND TAPPING



PITCH CIRCLE DRILLING AND TAPPING



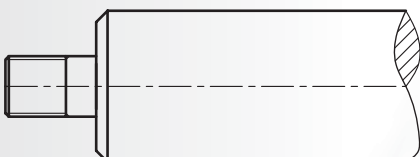
CIRCUMFERENCE GROOVE



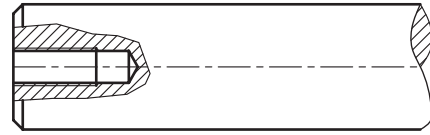
MILLED PLANES (FOR KEY)



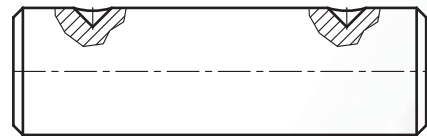
THREADED REDUCED DIAMETERS



AXIAL DRILLING AND TAPPING



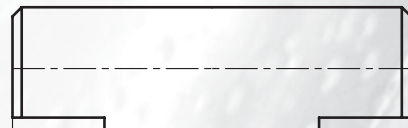
SCREW SEATS



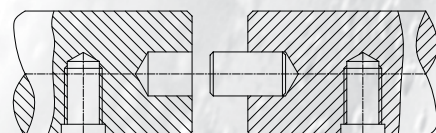
SNAP RING GROOVES



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 TUCL 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  $Ra < 0,80\mu m$  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:

A TUBE TUC

A TUBE TUTC

A CHROME BAC

A TUBE TUCL

A CHROME BATC

A TUBE TUTCL

A CHROME BACM

A TUBE TUSL

A CHROME BATCM

A 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 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
- Tipper
- 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

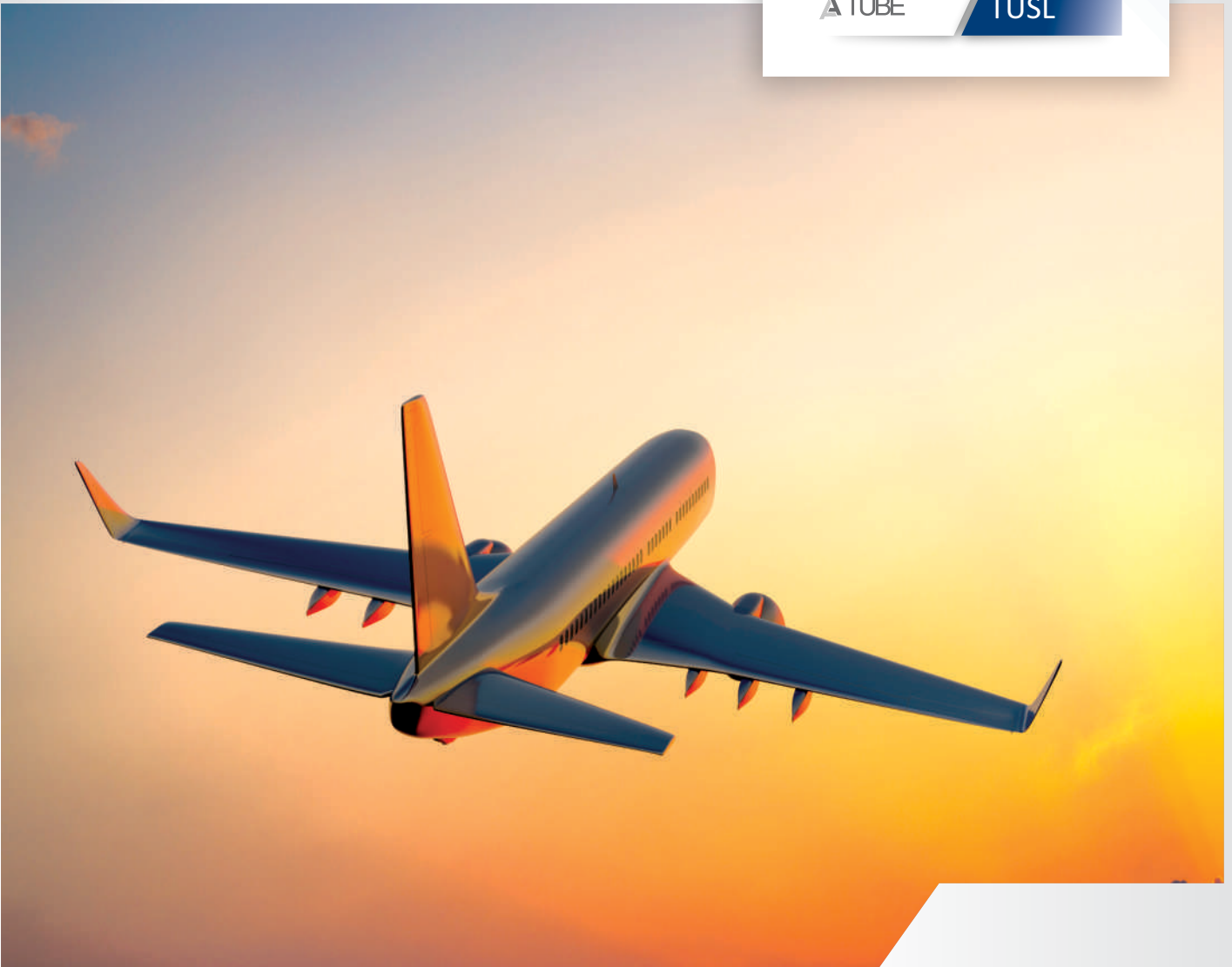
A CHROME / BACI 329

A CHROME / BACI 431

A CHROME / BACI 630

A TUBE / TUL

A TUBE / TUSL





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