



## **BUMAX® STARTS** WHERE STANDARD ENDS



BUMAX IS BUFAB'S REGISTERED TRADEMARK, KNOWN AS THE STRONGEST STAINLESS STEEL FASTENER IN THE WORLD. BUMAX IS MANUFACTURED IN BUFAB'S OWN PLANTS IN SWEDEN AND MEETS THE REQUIREMENTS OF HIGH DEMANDING CUSTOMERS. WHEN IT COMES TO QUALITY, CORROSION RESISTANCE, HIGH STRENGTH, FATIGUE STRENGTH, TRACEABILITY AND HEAT RESISTANCE, WE DELIVER SAFETY AND RELIABILITY.

Our customers can be found in oil and gas, pulp and paper, marine, petrochemical, energy and many other industries where standard fasteners simply cannot do the job.

Some of the products in the Bumax-family are completely unique and cannot be found anywhere else on the market. All Bumax products have full traceability (3.1 certificates available for each item) and are sourced solely from premium European stainless steel manufacturers according to rigid specifications.

We work constantly to find the best fastener solutions with our customers and are eager to participate and contribute at an early stage in our customers development projects. Thanks to our expertise in fasteners and material we have developed many extraordinary nuts and bolts for special uses. Your problem is our challenge!

## **OUR MARKET SEGMENTS**





## OIL- & GAS

Safety and reliability are crucial factors in the oil & gas industry. Our products are used in a large number of critical applications, especially off-shore where demand for extreme corrosions resistance and life expectancy are very high.



## CHEMICAL PROCESS INDUSTRY

Chemical process industry involves often very aggressive and corrosive environments that puts special requirements regarding material selection. Bumax has a wide range of alloys for every type of environment. Bumax 88 can also be delivered with a pre-approval for use in PED applications.



### **MARINE**

We supply products for ship yards and component manufacturer all over the world. Our products are used in naval defence industry, in pumps for chemical tankers and in marine applications with extreme demands on quality and reliability. Bumax is used in for instance water jets, bow thrusters and other propulsion systems.



## **AUTOMOTIVE**

Our products are commonly used in applications where excellent heat resistance is required. Bumax can handle temperatures up to 800 C. Our high strength products with tensile strength up to 17.9 are also of great interest in this industry. Our products can for example be found in turbo chargers and combustion systems.



## **ENERGY**

Bumax is a popular choice in many windmill parks, especially off-shore, because of it's corrosion resistance, high strength and excellent fatigue properties. Bumax is also used as critical components in many other energy applications like hydro power plants, fusion and nuclear reactors and wave power mills.



## PULP- & PAPER

In pulp & paper industry the corrosion resistance is very important. In some applications standard A4 is not enough to ensure long service life. Bumax can be supplied in a wide range of materials that ensures high reliability and service life offering lower life cycle cost compared to standard materials. Our PED approved Bumax 88 is also highly appreciated in this industry.



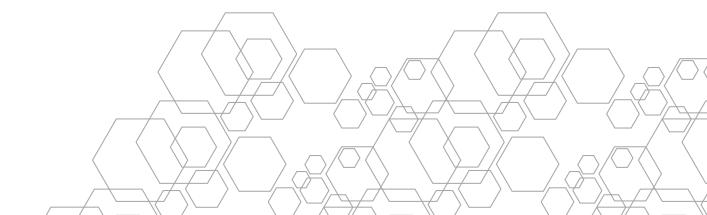
## GENERAL ENGINEERING

Bumax stainless steel fasteners are often a very interesting alternative to normal carbon steel fasteners. Not only because of it's corrosion resistance but also because of it's unique mechanical properties. Bumax can be delivered in strength class from 8.8 to 17.9 but yet very ductile and not sensible for hydrogen embritlement. Duplex fasteners are also very interesting from a fatigue point of view since it offers high strength combined with supreme fatigue properties compared to commonly used materials.



## **CONSTRUCTION**

The use of stainless steel in the construction business is increasing world-wide. Austenitic and duplex steel often offers lower life cycle cost and new solutions due to its strength. Bumax products can be supplied in all types of duplex grades including Lean Duplex, which is an economic alternative to many other building material and offers high strength and good corrosion resistance. Duplex grades can be designed to have a life span of over 100 years. Bumax 88 can also be delivered CE marked according to EN 15048.



## RELIABLE AND RESISTANT



## SOME OF THE PRODUCTS IN THE BUMAX-FAMILY ARE UNIQUE AND CANNOT BE FOUND ANYWHERE ELSE ON THE MARKET TODAY.

#### Corrosion

Corrosion can be defined as the degradation of a material due to a reaction with its environment. Metals corrode because we use them in environments where they are chemically unstable. Degradation implies deterioration of physical properties of the material and can cause severe failures. We have the knowledge and products to give you a safe, reliable and long lasting fastener solution for every application and corrosive environment.

#### **Temperature resistance**

All metals have different mechanical properties at different temperatures. Fracture toughness and strength are especially effected. Bumax fasteners can be custom made and, dependent on grade, handle operating temperatures between -200°C to 800°C.

#### Magnetic permeability

Relative permeability refers to a materials ability to attract and conduct magnetic lines of flux. The more conductive a material is to magnetic fields, the higher its permeability. Bumax fasteners can be supplied with extremely low permeability and are often used in advanced applications like nuclear, fusion reactors or particle accelerators. Of course we can also supply fasteners with very high magnetic permeability and low coercive field strength and high saturation magnetization.

#### Strength

We have delivered fasteners with a strength exceeding class 15.9 for applications where down sizing, clamping force and strength are critical. In our product range we offer stainless fasteners ranging from strength class 8.8 to 16.9. Despite the high strength our unique materials offers a unique combination of ultra-high strength and good ductility.

#### Fatigue strength

Fatigue fracture occurs when a fastener is subjected to repeated cyclic loading. Even maximum stresses below the materials yield point can lead to the formation of microscopic cracks that eventually lead to a failure. The starting point of a fatigue fracture is often stress concentration in inclusions, slags or surface defects. Test shows that Bumax material has superior fatigue resistance compared to commodity fasteners. High quality raw material made with the best metallurgical processes together with good surface properties and high strength guarantees excellent fatigue strength.

## QUALITY AND ENVIRONMENT



The majority of our fasteners are cold forged in our own facilities in Sweden where we have made cold forged stainless fasteners since 1926. Cold forging gives a superior product with increased strength and improved fatigue resistance. Raw material is sourced from premium suppliers in Europe with rigid specifications regarding chemical composition with low content of trace elements as well as low inclusion and slag content. All our products are delivered with full traceability and 3.1 certificate. Bumax 88 can also be delivered with PED approval under the European Union's pressure equipment directive (PED97/23) as well as with CE marking as structural bolt according to EN 15048. Our facilities are approved according ISO 9001 and 14001.

**BUMAX 88** offers better corrosion resistance than standard A4 due to higher molybdenum content. Bumax 88 is a very consistent material that offers higher yield strength and lower amount of inclusion than standard A4 fasteners, that gives superior mechanical properties and fatigue resistance. Bumax 88 fasteners are used in many applications that demands very low magnetic permeability, it has lower magnetic permeability and less variation from batch to batch compared to standard A4 fasteners.

**BUMAX 109** is the strongest A4 bolt on the market. Same material as Bumax 88 but higher strength due to special manufacturing process.

**BUMAX Nitro**, austenitic stainless steel with high nitrogen content, characterized by very high strength and fatigue resistance, in combination with good corrosion resistance. Excellent material for marine application and can be supplied in strength class 12.9 up to M42.

**BUMAX Super Austenite (SA)**, high-alloy austenitic stainless steel for seawater and other aggressive chloride bearing medias. Excellent resistance to general, crevice, pitting and stress corrosion.

**BUMAX Lean Duplex (LDX)** offers economical solution for high strength fasteners in medium corrosive environments.

**BUMAX Duplex (DX)** are characterized by excellent strength, ductility and fatigue resistance in combination with good general, pitting, crevice and stress corrosion properties.

**BUMAX Super Duplex (SDX)** are characterized by excellent mechanical properties and very good corrosion resistance. Excellent resistance to general crevice, pitting and stress corrosion in chloride bearing medias.

**BUMAX Hyper Duplex (HDX)**, a groundbreaking alloy used in the most demanding applications. Suited for use in severe corrosive environments such as hot chlorinated sea-water and for aggressive acidic chloride containing media in chemical, oil/gas, marine and petrochemical industry.

**BUMAX Ultra**, a unique precipitation hardenable stainless steel that can be delivered in ultra high strength levels. Strongest stainless steel fastener on the market. Good corrosion resistance in chloride environments.

**BUMAX Heat (HE)**, high temperature resistant material for applications requiring high strength and good oxidation resistance at temperatures up to 700°C. Can be precipitation hardened.

**BUMAX Heat Plus (HEP)**, precipitation hardenable high temperature resistant material with excellent oxidation resistance and high tensile and creep properties at temperatures up to 815°C.

## CHEMICAL COMPOSITION Nominal wt%

GRADE	EN	UNS	Microstructure	C max	Cr	Ni	Мо	Other	PRE <sup>1)</sup>
BUMAX 88	1.4432, 1.4436, 1.4435	S31603	Austenitic	0.03	17	11.5	2.7		27
BUMAX 109	1.4432, 1.4436, 1.4435	S31603	Austenitic	0.03	17	11.5	2.7		27
BUMAX Nitro		S31675	Austenitic	0.035	20.5	10	2.4	N 0.4	35
BUMAX SA	1.4547	S31254	Austenitic	0.01	20	18	6.2	N, Cu	43
BUMAX LDX <sup>2)</sup>	1.4162	S32101	Ferrite-Austenitic		21.5	1.5	0.3	N 0.22, Mn 5	26
BUMAX DX	1.4462	S31803, S32205	Ferrite-Austenitic	0.03	22	5.2	3.2	N 0.18	36
BUMAX SDX	1.4410	S32750	Ferrite-Austenitic	0.03	25	7	4	N 0.3	42
BUMAX HDX	1.4658	S32707	Ferrite-Austenitic	0.03	27	6.5	4.8	N 0.4, Co	49
BUMAX Ultra		S46910	Martensitic	0.02	12	9	4	Al, Ti, Cu	25
BUMAX HE	1.4980	S66286	Austenitic	0.08	15	26	1.5	Ti, V	
BUMAX HEP	2.4952	N07080	Austenitic	0.10	19	>65	-	Al, Ti, Co	

 $<sup>^{1}</sup>$  PRE (Pitting Resistance Equivalent) number shows the pitting corrosion resistance of stainless steels. A higher PRE number indicates better corrosion resistance. The PRE is defined as, in weight-%: PRE = % Cr + 3.3 x % Mo + 16 x % N

 $<sup>^{2}</sup>$  Standard offer for Bumax Lean Duplex is 1.4162 (PRE 26), but we have also the possibility to supply 1.4661 (PRE 33)

## MECHANICAL PROPERTIES in as delivered condition

		Strength							
Grade	Dimension	_	Screws a	nd stud bolts				Nuts	Washers
			Tensile s	trength	Yield strength R <sub>p0.2</sub> , min		Elongation, min	Stress under proof load, min	Hardness, min
	mm		MPa	ksi	MPa	ksi	mm	MPa	HV
BUMAX 88	M3 - M36	88	800	116	640	92	0.3 d	800	200
BUMAX 88, PED	M6 - M30	88	800	116	640	92	0.4 d	800	200
BUMAX 109	M3 - m12 > M12	109 109	1000 1000	145 145	900 800	130 116	0.2 d	1000	300
BUMAX Nitro	≤ M42	109 129	1000 1200	145 174	900 1080	130 156	0.2 d	2)	2)
BUMAX SA	≤ M42	88 109	800 1000	116 145	640 800	92 116	0.2 d	2)	2)
BUMAX LDX	≤ M42	88 109 129	800 1000 1200	116 145 174	640 900 1080	92 130 156	0.3 d	2)	2)
BUMAX DX	≤ M42	88 109 129	800 1000 1200	116 145 174	640 900 1080	92 130 156	0.3 d	2)	2)
BUMAX SDX	≤ M42	88 109 129	800 1000 1200	116 145 174	640 900 1080	92 130 156	0.3 d	2)	2)
BUMAX HDX	≤ M8	88 109 129	800 1000 1200	116 145 174	640 900 1080	92 130 156	0.3 d	2)	2)
BUMAX Ultra <sup>1)</sup>	≤ M16	149 159 169	1400 1500 1600	203 217 232	1260 1350 1440	182 195 208	0.2 d	2)	2)

<sup>&</sup>lt;sup>1</sup>Bumax Ultra is a grade that is tailor made to solve customer needs in regards of strength, ductility, fatigue and wear resistance. Values in the table are typical strength values, but even higher strength levels can be achieved on some designs and dimension, up to tensile strength levels of 2500 MPa.

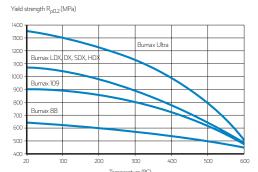
## PROPERTIES AT LOW AND HIGH TEMPERATURES



It is important to understand what happens with the fastener material when operating at elevated temperatures for prolonged times. Properties such as thermal expansion, strength, ductility, corrosion resistance and fatigue resistance are affected by high temperatures and its effect on the jointed application must be considered from case to case. The diagram to the right shows typical yield strength losses that instantly occur in the material when exposed to high temperatures. Property changes during prolonged service at elevated temperature must also be considered. Gas corrosion at high temperature is totally different compared to wet corrosion at lower temperatures. Furthermore, changes in mechanical properties might gradually change over time due to ageing and creep deformation. Ageing that occurs in all stainless steel material over time is enhanced by high stresses in the material in combination with high temperature or temperature fluctuations, and can lead to ductility losses in the material. Creep deformation is a slow plastic deformation under the influence of mechanical stresses. It can occur as a result of long-term exposure to stresses that are still under the yield strength of the material and the effect increases at higher temperatures. Bumax HE and Bumax HEP are high temperature resistant grades optimized for high temperature conditions and are much more stable against ageing, gas oxidation, creeping and strength losses compared to regular stainless steels.

An increased brittleness at subzero and especially cryogenic temperatures is characteristic of all steels and metals in general. Some steel grades become more brittle than others at cryogenic temperatures below -150°C. This depends mainly on microstructure, chemical composition and internal stress. Austenitc stainless steels has generally better impact strength at very low temperatures than Duplex, Ferritic and Martensitic stainless steel.

To understand the environment and application requirements is therefore crucial. Your local Burnax sales representative will help you selecting the right material.



Temperature (°C)
Fig 1. Typical yield strength losses at elevated temperature for stainless stee

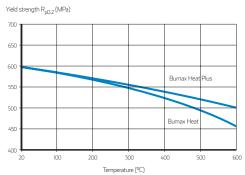


Fig 2. Typical yield strength losses at elevated for heat resistant grades

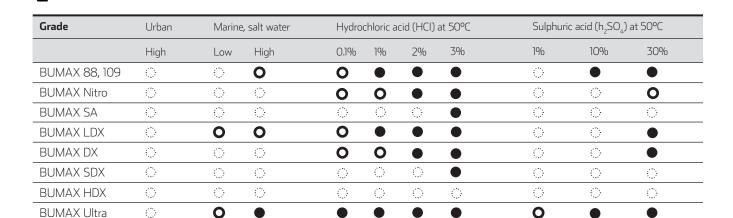
<sup>&</sup>lt;sup>2</sup>On request

The data shown in the table are typical and are representative for the majority of standard fasteners. May be subject to alterations, depending on size and design.

## PHYSICAL PROPERTIES at 20°C, unless stated otherwise

Grade	Thermal expansion, mean values in temperature ranges (x10-6) per °C							
	20 to 100°C	20 to 200°C	20 to 300°C	20 to 400°C	20 to 500°C	20 to 600°C		
BUMAX 88	16.5	17	17.5	17.5	18	18	1.006	
BUMAX 109	16.5	17	17.5	17.5	18	18	1.007	
BUMAX Nitro	15	15.5	16	16.5	17	17	1.003	
BUMAX SA	16	16	16.5	16.5	17	17	1.003	
BUMAX LDX	12.5	13	13.5	13.5	14	14.5	100	
BUMAX DX	12.5	13	13.5	13.5	14	14.5	100	
BUMAX SDX	12.5	13	13.5	13.5	14	14.5	100	
BUMAX HDX	12.5	13	13.5	13.5	14	14.5	100	
BUMAX Ultra	11.5	12	12	12.5	12.5	13	1000	
BUMAX HE	16.5	16.5	17	17	17.5	17.5	1.007	
BUMAX HEP	12	13	13	13.5	13.5	14	1.001	

## CORROSION RESISTANCE



- No corrosion under normal conditions
- O Not suitable, corrosion is likely to occur
- Possible risk of corrosion, but the steel grade might be suitable depending on requirement, environment, design and maintenance.

Low: Mild condition, such as low concentrations at low temperatures. High: Severe condition, such as high concentrations at elevated temperatures.

## PRELOAD AND TIGHTENING TORQUE

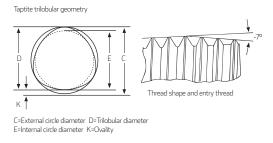
Preload is needed to keep the jointed part together and function correctly for long periods of time, resisting both static and dynamic loads. The combined stresses in the joint should normally not exceed the yield strength of the fastener. In practical use can the recommended pretension vary between 50-80% of the yield strength RpO.2. Tightening torque is needed to achieve the necessary preload. The recommended tightening torque depends on many parameters such as friction, fastener strength, thread diameter, screw type and tightening procedure. The recommendation used for Bumax products are based on a targeted preload of about 65-70% of the yield load and a friction coefficient of 0.14-0.16, which can only be obtained by a burr-free surface and using high quality lubrication.

Recommended preload and tightening torque data can be found at www.bumax.se.

## BUMAX® HARD TAPTITE BUMAX® GRADE **THREADFORMING**



Bumax Hard Taptite is a thread-forming screw which forms its own thread during assembly because of its trilobular shape, its conical entry thread and its excellent surface hardness. Bumax Hard Taptite is suitable for assembly in structural steel and cold rolled stainless steel with hardness up to 200 HV.



## BUMAX® HARD SELF-TAPPING SHEET METAL SCREW (ST)



Bumax Hard self-tapping screw with ST thread is designed for use in structural steel and cold rolled stainless steel with a maxi- mum hardness of approximately 200 HV.

All Bumax Hard products exhibits excellent surface hardness and are made with the same steel grade as Bumax 88. Bumax Hard is a great and cost-efficient solution for fitting to sheet metal and profiles.

## BUMAX® HARD TAPTITE THREADFORMING



Bumax Hard Taptite is a thread-forming screw which forms its own thread during assembly because of its trilobular shape, its conical entry thread and its excellent surface hardness. Bumax Hard Taptite is suitable for assembly in structural steel and cold rolled stainless steel with hardness up to 200 HV.

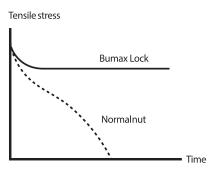
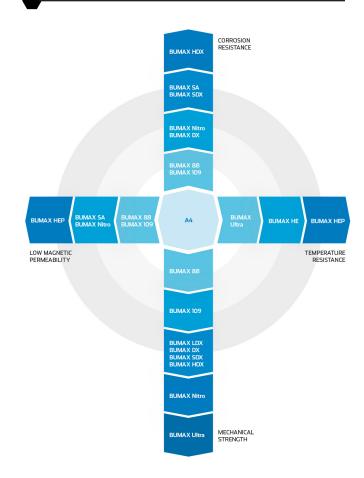


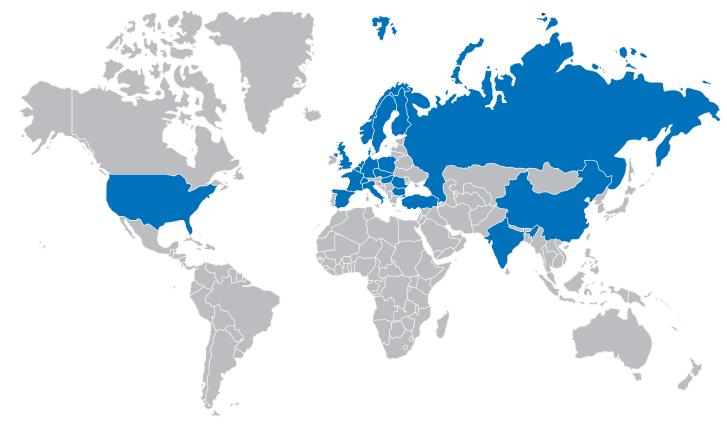
Fig 3. Residual stress

## **SELECTION CROSS**



Stainless steel fasters have properties which make them attractive choices for a wide range of applications. It is essential to consider the required properties such as corrosion resistance, temperature resistance, mechanical strength and magnetic permeability. Correctly chosen material will guarantee a trouble-free life time and low life cycle cost.

Grade selection cross helps you select the best material suited for your needs.



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# THE STRONGEST STAINLESS STEEL

