

BUMAX is Bufab's registered trademark, known as the strongest stainless steel fastener in the world.

BUMAX is manufactured in Sweden and meets the highest customer demands in terms of quality, corrosion resistance, high strength, fatigue strength, traceability and heat resistance. We deliver safety and reliability.

Some of the products in the BUMAX range are completely unique and cannot be found elsewhere on the market. All our products have full traceability (3.1 or 3.2 certificates available for each item upon request) with raw materials only sourced from premium European stainless steel manufacturers according to our rigid specifications.

INTRODUCING BUMAX® ULTRA

BUMAX® ULTRA is the world's strongest fastener – and it's stainless. BUMAX® ULTRA ensures ultra-high strength and good corrosion resistance by drawing on Nobel Prize winning quasi-crystalline precipitate technology. The BUMAX technique uses strain hardening followed by precipitation hardening, which significantly increases the strength of the stainless steel by ensuring the crystal structure reinforces the material. This method has been specifically designed for extremely demanding

applications where ultra-high strength combined with high ductility is required.

BUMAX® ULTRA can be used at service temperatures of between -50 to 450°C with retained mechanical properties.



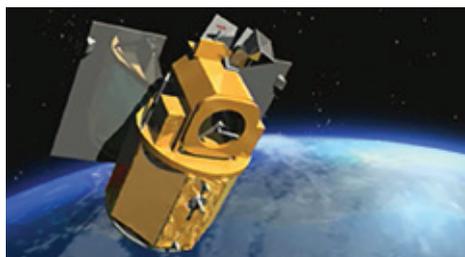
APPLICATIONS

BUMAX® ULTRA is suitable for applications that require:

- Very high clamping load
- Super high strength combined with good ductility
- Good corrosion resistance and resilience against hydrogen embrittlement
- Excellent mechanical properties up to 450°C (840°F)
- Low relaxation even at elevated temperatures

- Excellent fatigue resistance
- New design opportunities, fastener down-sizing without compromising strength

Examples of applications where the world's strongest fastener has made a crucial difference include: lock systems, construction, aerospace, premium end bicycles, valves, defense equipment and pumps.



CHEMICAL COMPOSITION & PHYSICAL PROPERTIES

Nominal wt%

| GRADES | UNS | C max | Cr | Ni | Mo | Others | PRE ¹⁾ |
|--------------|--------|-------|----|----|----|------------|-------------------|
| BUMAX® ULTRA | S46910 | 0.02 | 12 | 9 | 4 | Al, Ti, Cu | 25 |

¹⁾ PRE (Pitting Resistance Equivalent) = %Cr + 3.3x%Mo + 16x%N

BUMAX® ULTRA has a martensitic microstructure, which makes the material magnetic. The martensitic microstructure has a much lower constant of thermal expansion compared to an austenitic stainless steel,

which can offer design advantages and is beneficial for bolted joints at elevated temperatures.

Constant of thermal expansion, mean values in temperature ranges (x10⁻⁶) per °C

| Grade | 20 to 100°C | 20 to 200°C | 20 to 300°C | 20 to 400°C |
|----------------------------|-------------|-------------|-------------|-------------|
| BUMAX® ULTRA | 11.5 | 12.0 | 12.0 | 12.5 |
| High strength carbon steel | 11.5 | 12.5 | 13.0 | 13.5 |
| A4 (316L) | 16.5 | 17.5 | 18.0 | 18.0 |

Constant of thermal expansion, mean values in temperature ranges (x10⁻⁶) per °F

| Grade | 70 to 200°F | 70 to 400°F | 70 to 600°F | 70 to 700°F |
|----------------------------|-------------|-------------|-------------|-------------|
| BUMAX® ULTRA | 6.5 | 6.5 | 7.0 | 7.0 |
| High strength carbon steel | 6.5 | 7.0 | 7.5 | 7.5 |
| A4 (316L) | 9.5 | 9.5 | 10.0 | 10.0 |





MECHANICAL PROPERTIES

BUMAX® ULTRA achieves its super high strength from strain hardening and precipitation hardening. Precipitation hardening increases the tensile and yield strength significantly. Small adjustments in the heat treatment cycle can offer unique opportunities to tailor the properties to fulfil a specific customer need.

BUMAX® ULTRA 159 can be considered as ULTRA standard. The product is offered in strength class 15.9 and combines the best of both

worlds in terms of strength and ductility. Find more information in the table below.

On customer request, we have produced BUMAX® ULTRA in yield strength levels from min 1080 MPa to min 1600 MPa. What is possible depends mainly on dimension and fastener design. Contact your local BUMAX sales representative for more information on what is possible.

| Grade | Strength Class | Dimension | Tensile strength R _m , min | | Yield strength R _{p0.2} , min | |
|------------------|----------------|-----------|--|-----|---|-----|
| | | | MPa | ksi | MPa | ksi |
| BUMAX® ULTRA 159 | 15.9 | M3 - M12 | 1500 | 217 | 1350 | 195 |

Typical hardness on a BUMAX® ULTRA 159 fastener is in the range of HV 430 – 500

FATIGUE RESISTANCE

Fatigue fracture occurs when a fastener is subjected to repeated cyclic loading. Even maximum stresses below the material's yield point can lead to the formation of microscopic cracks that eventually result in failure. The starting point of a fatigue fracture is often a stress concentration in inclusions, slags or surface defects.

BUMAX® ULTRA has good fatigue properties due to its very high yield strength in combination with good ductility. BUMAX® ULTRA offers a solution where other fasteners have failed.

CORROSION RESISTANCE

What makes BUMAX® ULTRA unique compared to other precipitation hardened grades is that it combines ultra-high strength with good corrosion resistance.

BUMAX® ULTRA has better corrosion resistance than austenitic stainless steel grade ASTM 304L (A2) and superior corrosion resistance to commonly used martensitic stainless steels or martensitic precipitation

hardened stainless steels on the market such as ASTM 410, 420, UNS S17400 (17-4 PH) and UNS S13800 (PH 13-8 Mo).

BUMAX® ULTRA is resilient to hydrogen embrittlement, and in several cases has successfully substituted high strength alloy steel fasteners in strength class 12.9 and 14.9 when those grades have failed due to hydrogen embrittlement or corrosion resistance.

PRODUCT OFFERING

The dimension range for BUMAX® ULTRA is M3-M12 or 0.125"-0.5".

BUMAX® ULTRA is not a stock standard product but most screw and bolt designs can be made to order. Contact your local BUMAX sales representative for more information.

BUMAX® ULTRA fasteners are delivered in precipitation hardened condition. The heat treatment might cause a slightly dull finish even though the heat treatment occurs in vacuum. It is possible on request to electropolish or chemically passivate the fasteners to achieve an improved surface finish, which will also slightly enhance the corrosion resistance.

Marking

All BUMAX® ULTRA fasteners are marked with BUMAX plus ULTRA or BUMAX, ULTRA and the strength class.

Fasteners of M5 or smaller are not marked due to space restrictions. We can also provide individual marking according to special customer requests.

Packing



Our products are packed in high quality sturdy boxes and are marked according to a color coded system. We guarantee full traceability for all our products in sealed boxes. Our boxes are labeled with product data for full traceability.

BUMAX® ULTRA is as standard coated with our special tailor-made wax to guarantee low and consistent friction to minimize the risk of galling. Recommended preload and tightening torque data can be found at www.bumax-fasteners.com.

BUMAX® ULTRA is manufactured at the BUMAX factory in Sweden. Our own production facility enables us to produce small quantity prototype orders and other 'special' products according to specific customer needs while maintaining a very high level of service. We continuously work to improve the properties of our products.

Contact the BUMAX sales team to find out how we can help you.



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