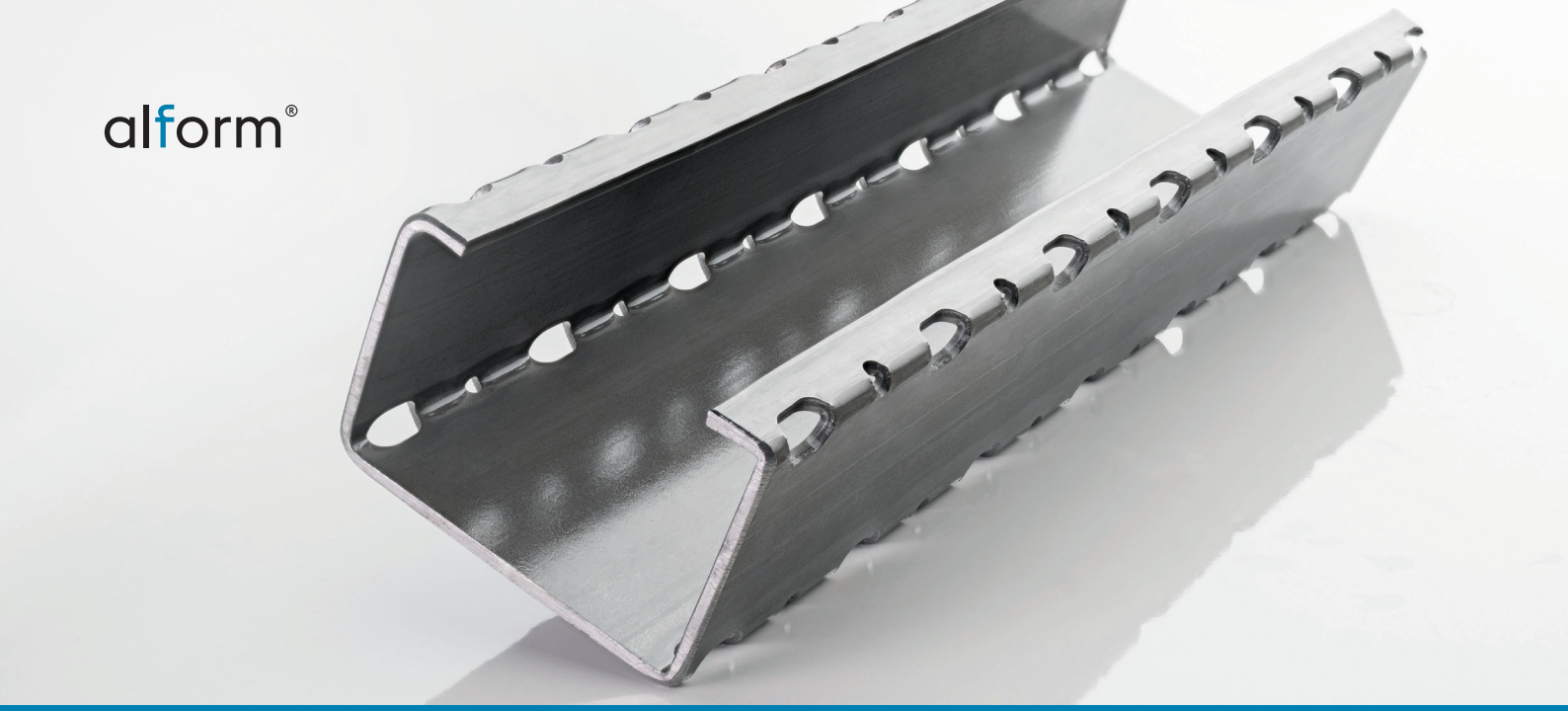
alform®



alform® MU-series

Material & Performance Facts

The steel grades combined in the alform® MU series are microalloyed, thermomechanically rolled and characterized by excellent cold formability of stamped edges. For the alform® MU steels, mechanicaltechnological properties are guaranteed within narrower limits than for comparable steels pursuant to EN10149-2.

The alform® MU steels have low carbon contents and thus exhibit very good weldability. The optimized production route leads to a good limitation of non metallic inclusions and a finegrained, homogeneous microstructure. The alform® MU steels have their advantages in particularly challenging forming operations. A good combination of cold formability and damage tolerance on stamped edges ensures increased production reliability. Improved notched bar impact energy is also achieved when compared to conventional microalloyed steels.

Convincing advantages

- Narrow limits for mechanical properties
- Very good cold formability with the narrowest bending radii, even in stamped edges
- High damage tolerance in challenging forming operations such as flanges an collars
- Best weldability resulting from low C equivalent
- Excellent notched bar impact energy

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Premium quality
with reduced carbon footprint

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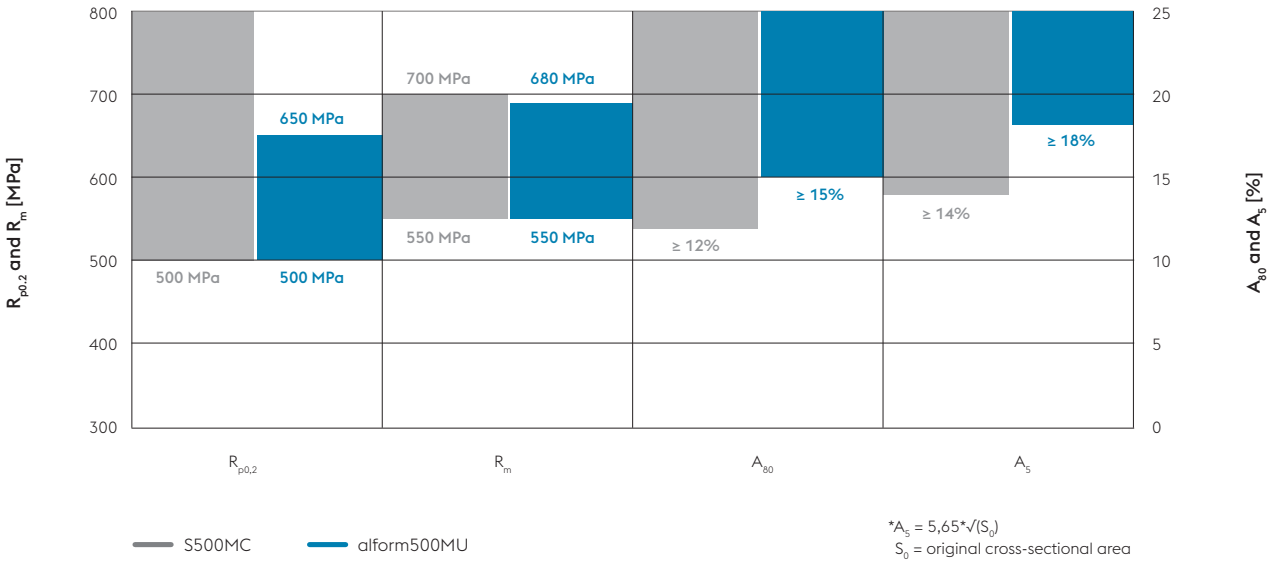
Narrow limits for mechanical properties

Optimized production lends alform® MU steels a very good cleanliness as well as a fine-grained and homogeneous microstructure. When compared with conventional thermomechanically rolled steels according to EN10149-2, mechanical properties within significantly narrower limits can be guaranteed. During processing, this results for example in highly consistent bending force and elastic springback.

The following diagram compares the specified mechanical and technological properties of a conventional S500MC with alform 500 MU made by voestalpine.

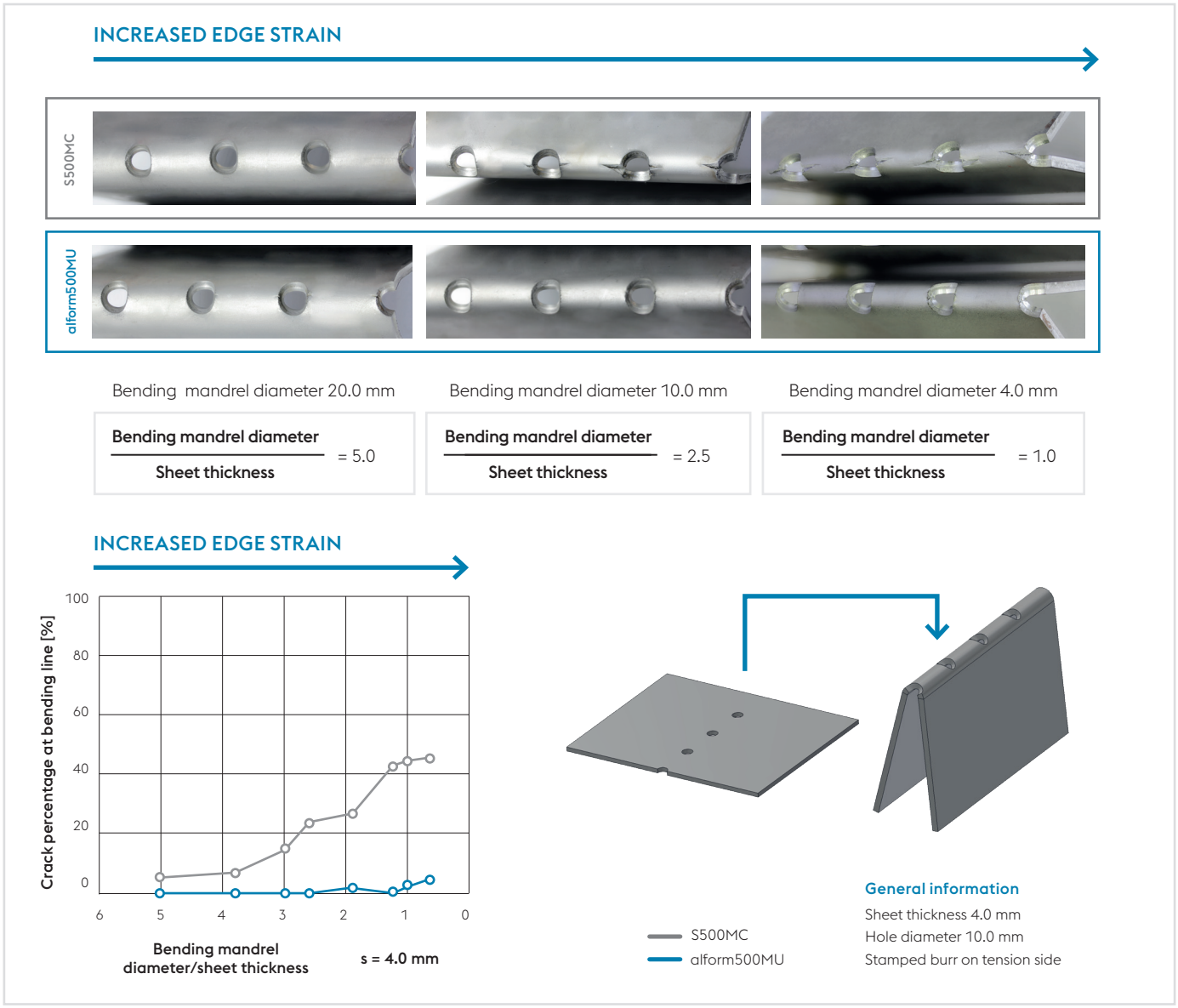
Specified mechanical and technological properties of an S500MC pursuant to EN10149-2:2013 and an alform 500 MU made by voestalpine



Very good cold formability with the narrowest bending radii, even in stamped edges

Crack-free bending of stamped edges poses major challenges for conventional thermomechanically rolled steel strip. The alform® MU steels with their improved microstructure have a significantly reduced sensitivity to edge cracking. This leads to increased production reliability during processing, for example in critical bending processes. The following comparison illustrates this advantage of alform® MU steels over conventional grades when bending the stamped edges of S500MC as compared to alform 500 MU made by voestalpine.

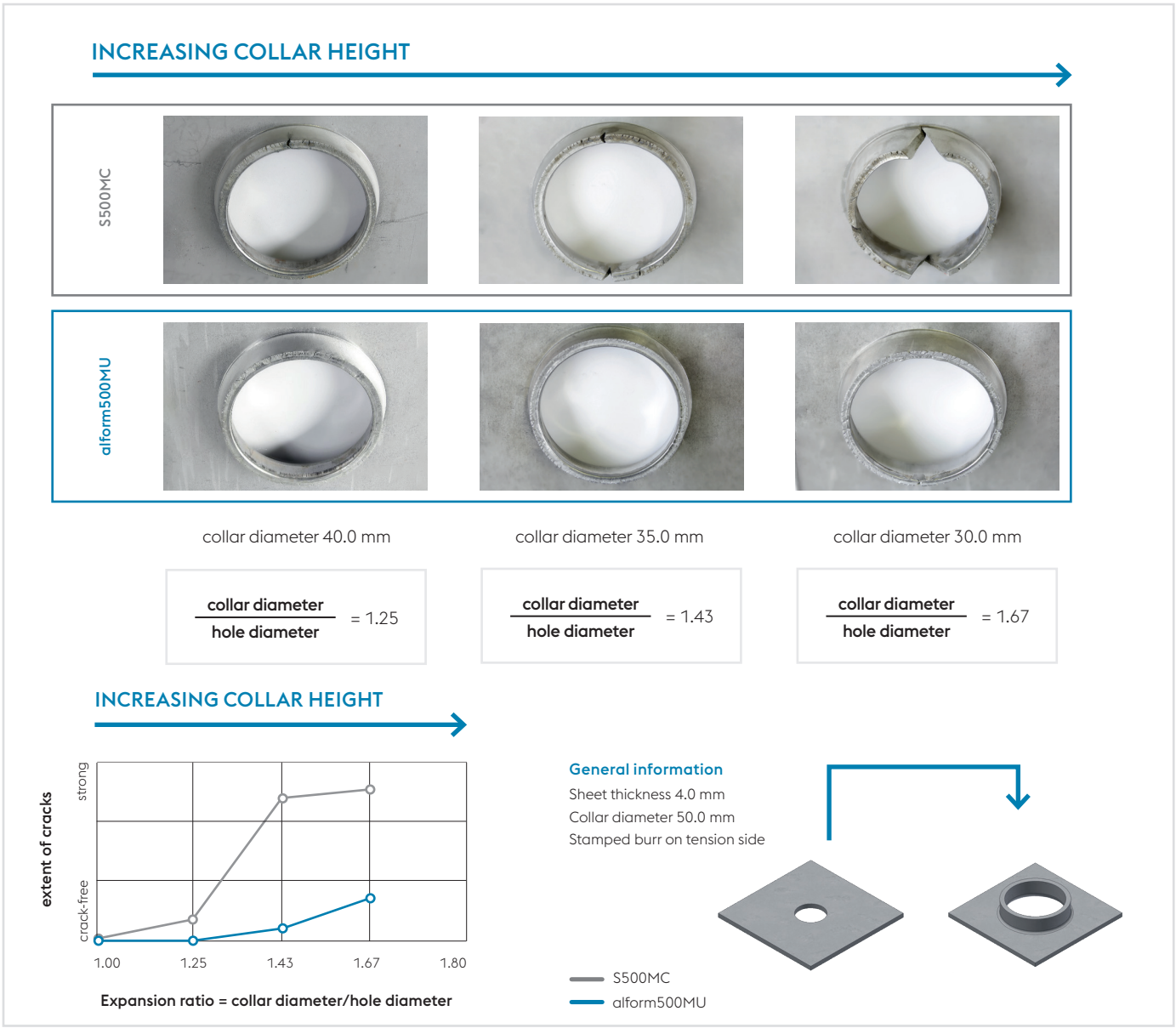
Behavior of S500MC and alform500MU when bending punched holes



High damage tolerance in challenging forming operations such as throughputs, flanges and collar pulls

Flaring of stamped holes, flanging or collar drawing are among the most challenging forming operations on hot-rolled steels. Cracks occur during forming in conventional thermomechanically rolled strip, while alform® MU steels show their strength in this area. The fine, homogeneous microstructure and the very good cleanliness of alform® MU steels lead to high damage tolerance. This behavior is clearly illustrated in the following diagrams that compare conventional S500MC and alform 500 MU made by voestalpine.

Behavior of S500MC and alform 500 MU during collar forming on stamped holes



Best weldability

In the course of the production, alform® MU steels are microalloyed and thermomechanically rolled. The resulting fine-grained microstructure and precipitation hardening significantly strengthen the material. As a result it is possible to minimize the amount of carbon as well as that of other solid-solution-hardening and transformation-delaying elements.

This has a positive effect on the weldability of alform® MU steels because the carbon equivalents remain low. The associated lower hardening tendency in the heat-affected zone (HAZ) and the higher resistance to cold cracking are benefits during processing. Preheating is not required for any alform® MU steel [1].

Material	Thickness [mm]	typical C content [%]	typical CET 2) [%]	typical CEV [3] [%]	typ. PCM [4] [%]	Classification acc. to ISO/TR 15608
alform355MU	up to 10	0.08	0.14	0.19	0.11	1.2
alform380MU	up to 10	0.08	0.14	0.19	0.11	2.1
alform420MU	up to 10	0.08	0.16	0.22	0.12	2.1
alform460MU	up to 10	0.08	0.18	0.26	0.14	2.1
alform500MU	up to 10	0.08	0.23	0.35	0.16	2.2
alform550MU	up to 10	0.08	0.22	0.33	0.15	2.2

[1] This applies under the following conditions: Plates must be kept clean, dry and free from coatings, rust and scale in the area of the joint.
[2] CEV=C+Mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15
[3] CET=C+(Mn+Mo)/10+(Cr+Cu)/20+Ni/40
[4] PCM=C+Si/30+(Mn+Cu+Cr)/20+Ni/60+Mo/15+V/10+B·5

The following filler materials and shielding gases are recommended for the MAG welding of alform® MU steels in combination with a processing window in the $t_{8/5}$ range. The Welding Calculator App of voestalpine is ideal for coordinating the welding parameters and achieving optimum welding results.

Material	Welding process recommendations, MAG (135, 136)			
	Solid wire welding consumable	Cored wire welding consumable	Shielding gas	$t_{8/5}$ range [s] [5]
alform355MU	z.B. BÖHLER EMK 6, UNION K 52, ... G 42 4 M21 3Si1 (pursuant to EN ISO 14341-A)	z.B. BÖHLER Q 70 MC, BÖHLER Q 71 RC, ... T 46 3 M M21 1 H5 (pursuant to EN ISO 17632-A)	M21 (e.g. Corgon 18, ...)	5 – 25 s
alform380MU				
alform420MU	z.B. Pipeshield X 90, UNION MoNi, ... G 55 6 M21 Mn3Ni1Mo (pursuant to EN ISO 16834-A)	z.B. BÖHLER diamondspark Ni1 MC, BÖHLER diamondspark Ni1 RC, ... T 50 6 1 Ni M M21 1 H5 (pursuant to EN ISO 17632-A)		
alform460MU				
alform500MU				
alform550MU				

[5] The interpass temperature should be selected so that the respective recommended $t_{8/5}$ range is maintained.

voestalpine Welding Calculator now available free of charge
Get the free voestalpine Welding Calculator app on your smartphone or desktop! Register to benefit from additional benefits and to flexibly calculate your material parameters.

Please find more information about the voestalpine Welding Calculator at:
www.voestalpine.com/alform/en/insights/voestalpine-welding-calculator-for-best-welding-results

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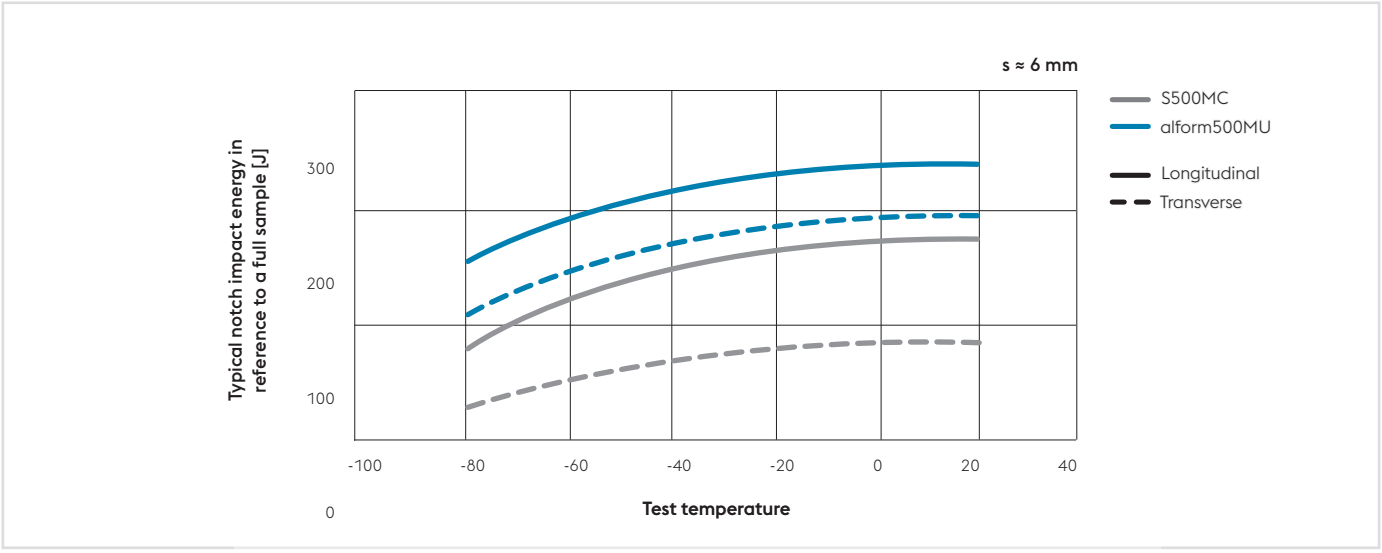
ONE STEP AHEAD.

Excellent notch impact energy

The steels of the alform® MU series are characterized by excellent notch impact energy. The fine-grained, thermomechanically rolled microstructure and the very good cleanliness result in excellent impact energy values in longitudinal and transverse directions as well as very low transition temperatures. The following comparison of conventional S500MC and alform 500 MU made by voestalpine exemplifies the good toughness properties of alform® MU steel grades.

Examples of impact energy values of S500MC and alform 500 MU



greentec steel

Premium quality with reduced carbon footprint

alform®

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Hot-rolled steel strip – greentec steek Edition
Max. carbon footprint 1.95 kg CO_2e per kg of steel [1]

[1] per EN 15804+A2 (EPD methodology) cradle-to-gate

All products, dimensions and steel grades listed in each voestalpine supply range are available as greentec steel Edition.

Learn more about the alform® material and performance facts and visit us at www.voestalpine.com/alform/en

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