alform® WELDING SYSTEM
by voestalpine

On-target welding solutions

The world's first system for high-strength and ultra-high-strength welded structures

voestalpine
ONE STEP AHEAD.

alform® WELDING SYSTEM
by voestalpine

High-strength and ultra-high-strength structures on the cutting edge

Safe

- Higher manufacturing reliability through extended welding range
- Tested system solution that guarantees optimum attribute profiles of the component
- Consistently excellent steel and filler metal quality

Simple

- Highly competent contact partner for steel and filler metal
- Simplified system implementation facilitated by tested process parameters and mechanical-technological variables
- Accelerated process testing

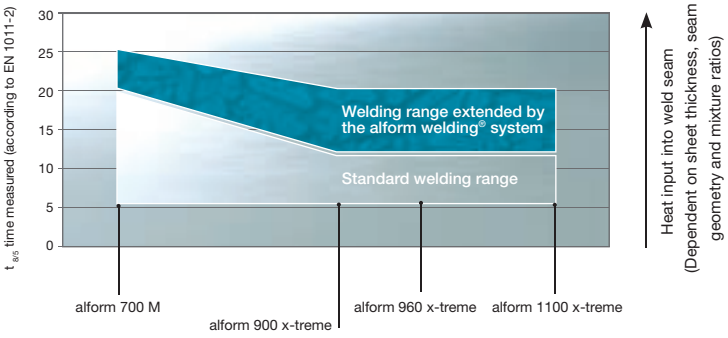
Efficient

- Easier handling, reduced error rate and cost advantages based on extended welding range
- Quicker product introduction through access to available database
- Availability of comprehensive processing expertise



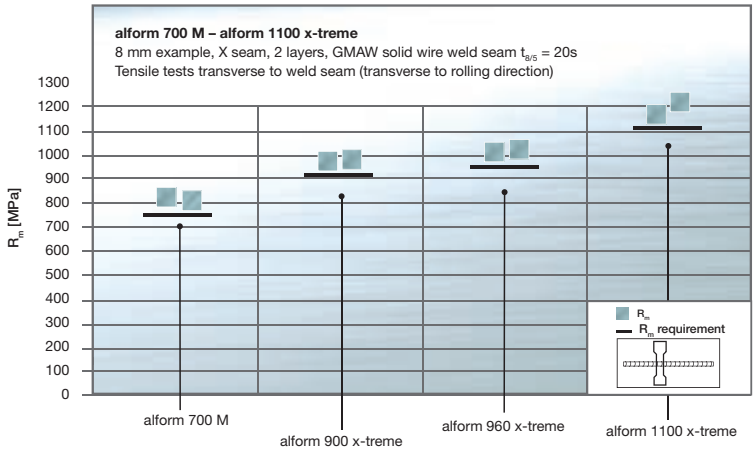

Highest quality and process reliability for hot-rolled steel strip

Process reliability and economic feasibility



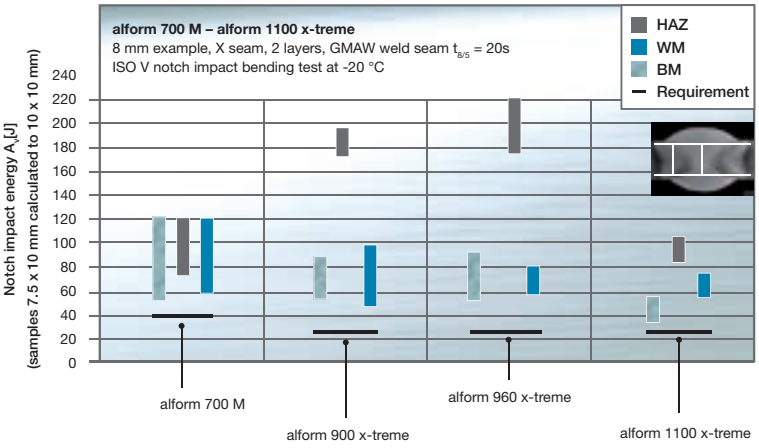
The base material properties were taken into consideration in the design of the filler metals. In combination with tempering-resistant base materials, property profiles occur in the welded joints that allow substantial extension of the welding ranges. The heat input is tendentially higher (longer $t_{8/5}$ time), increases process reliability (e.g. lower danger of fusion defects) and lowers manufacturing costs because of the increased deposition rate.

Excellent weld seam strength



The optimized system of tempering-resistant steel grades and adapted filler metals guarantees strength values in the welded joint across a wide range of parameters. These values meet the demands of the respective base materials.

Excellent toughness, even at low application temperatures



The steel grades and filler metals in the system reliably meet the toughness requirements in the welded joint (heat-affected zone and weld metal). The excellent values guarantee high operating safety at low temperatures under complex loading conditions.

Processing information: Hot-rolled steel strip

Material	Process	Filler materials	Protective gas	Recommended preheating [°C]	Interpass temperatures [°C]	$t_{8/5}$ Range [s] 4)
alform 700 M	GMAW	**BÖHLER alform 700-IG** **BÖHLER alform 700-MC** ER 110 S-G wires (acc. to AWS A 5.28)	**M21** **(e.g. Corgon 18, ...)** **M20** **(e.g. Corgon 10, ...)**	_1), 2)	_3)	**5 – 25**
		e.g. **BÖHLER X70-IG, ...** ER 110 S-G wires (acc. to AWS A 5.28)				**5 – 20**
alform 900 x-treme	GMAW	**BÖHLER alform 900-IG** **BÖHLER alform 900-MC** ER 120 S-G wires (acc. to AWS A 5.28)	**M21** **(e.g. Corgon 18, ...)** **M20** **(e.g. Corgon 10, ...)**	_1), 2)	_3)	**5 – 20**
		e.g. **BÖHLER X90-IG, Union X96, ...** ER 120 S-G wires (acc. to AWS A 5.28)				**5 – 12**
alform 960 x-treme	GMAW	**BÖHLER alform 960-IG** ER 120 S-G wires (acc. to AWS A 5.28)	**M21** **(e.g. Corgon 18, ...)** **M20** **(e.g. Corgon 10, ...)**	_1), 2)	_3)	**5 – 20**
		e.g. **Union X96, BÖHLER X90-IG, ...** ER 120 S-G wires (acc. to AWS A 5.28)				**5 – 12**
alform 1100 x-treme	GMAW	**BÖHLER alform 1100-IG** No standard filler materials available	**M21** **(e.g. Corgon 18, ...)** **M20** **(e.g. Corgon 10, ...)**	_1), 2)	_3)	**5 – 20**

1) Edge drying is recommended at 80 °C directly before welding.
2) Pre-heating according to EN 1011-2 is recommended for complex welded structures (such as out-of-position welds, high number of weld seams, ...).
3) It is recommended that the interpass temperature be set so that the maximum measured $t_{8/5}$ time is not exceeded.
4) Cooling time between 800 °C and 500 °C, measured according to EN 1011-2 (Annex D.8).

Processing information: Heavy plates

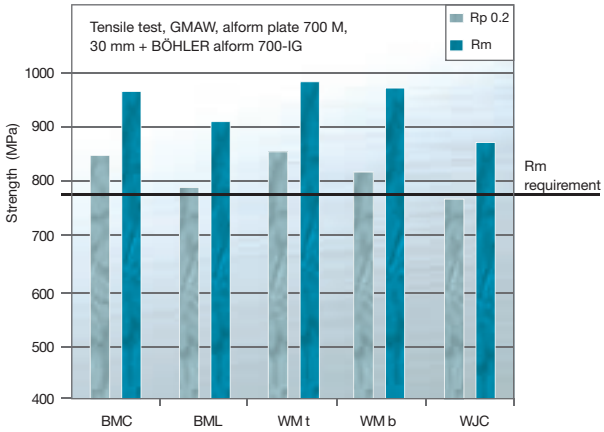
Material	Process	Filler materials	Protective gas	Recommended preheating [°C] 1), 2)	Interpass temperatures [°C] 3)	$t_{8/5}$ Range [s] 4)
alform plate 700 M	GMAW	**BÖHLER alform 700-IG** ER 110 S-G wires (acc. to AWS A 5.28)	M21 (e.g. Corgon 18, ...)	60 – 150	≤150	3 – 15
		e.g. **BÖHLER X70-IG, Union X85, ...** ER 110 S-G wires (acc. to AWS A 5.28)				
	SAW	**BÖHLER alform 700-UP** **+ BÖHLER alform BB 700** F10 A 4-EM(mod.) M4 (acc. to AWS A 5.23) F69 A 4-EM(mod.) M4 ((acc. to AWS A 5.23)	---			
		e.g. **Union S3 NiMoCr + UV 421 TT** F11A8-EG-F6 (acc. to AWS A 5.23)				
	SMAW	**e.g. BÖHLER FOX alform 700, ...** E 11018-GH4R electrodes (acc. to AWS A 5.5)				
		e.g. **Phönix SHNi2K 100, ...** E11018-G-electrodes (acc. to AWS A 5.5)				
alform plate 960 M x-treme	GMAW	**BÖHLER alform 960-IG** ER 120 S-G wires (acc. to AWS A 5.28)	M21 (e.g. Corgon 18, ...)	60 – 150	≤150	3 – 12
		e.g. **Union X96, Union X90-IG, ...** ER 120 S-G wires (acc. to AWS A 5.28)				
	SMAW	e.g. **BÖHLER FOX EV 100, ...** E 12018-G electrodes (acc. to AWS A 5.5)	---			
		e.g. **Phönix SHNi2K 130, ...** E12018-G electrodes (acc. to AWS A 5.5)				

1) Edge drying is recommended at 60 °C directly before welding, see also Technical Terms of Delivery of voestalpine Grobblech GmbH.
2) Pre-heating according to EN 1011-2 is recommended for complex welded structures (such as out-of-position welds, high number of weld seams, ...), depending on plate thickness and H_2 consumption.
3) An interpass temperature below 150 °C is recommended for special requirements in strength and toughness of the weld metal and in the weld joint.
4) Measured cooling time $t_{8/5}$ (seconds) by means of thermocouple submerged into the melt.

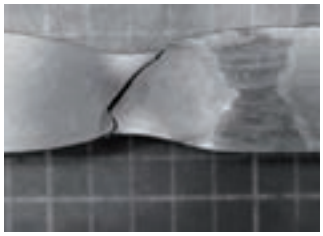
Best strength and toughness in heavy plates

The alform® welding system provides best results during the GMAW welding of heavy plates. The welded joint in thermomechanically rolled base materials and high-strength filler metals guarantees high strength and excellent toughness.

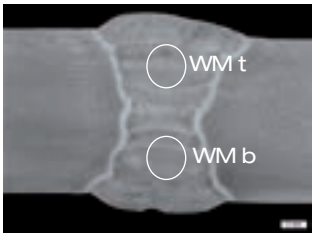
Strength

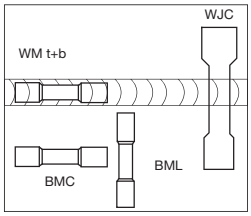


Position of fracture in cross-pass specimen:
Base material



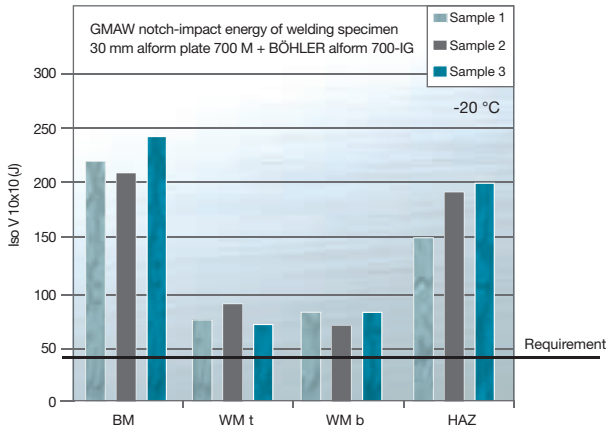
Weld metal specimen position



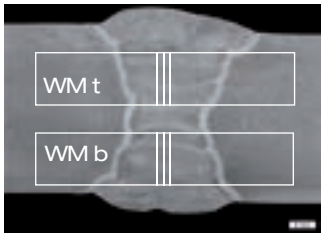


BML	Base material lengthwise in rolling direction
BMC	Base material crosswise in rolling direction
WM t	Weld metal top (lengthwise along the seam)
WM b	Weld metal bottom (lengthwise along the seam)
WJC	Welded joint crosswise to seam

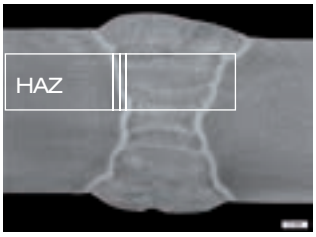
Toughness



Weld metal speci men position



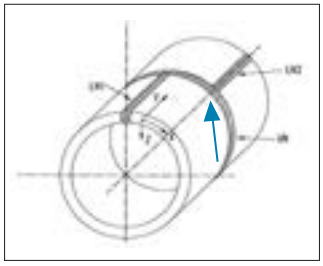
Heat-affected zone specimen position
(acc. to EN 875)



Welding data

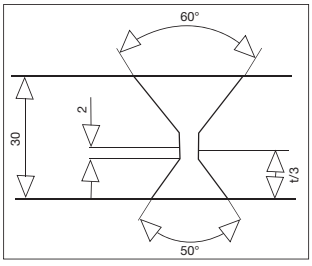
A circular pipe seam was welded
using the GMAW method.
Base material: alform plate 700 M
Weld metal: BÖHLER alform 700-IG
Thickness 30 mm
Weld shape: X
Welding position: PF
$t_{8/5}$(s) = 4,7

Welding position/application:



Circular pipe seam GMAW, (PF), such as assembly seam accessible from both sides

Weld seam preparation:



Root gap = 2 to 4 mm

The voestalpine Steel Division and Böhler Welding Group
Two strong partners for an optimized system

The alform® welding system was developed jointly by voestalpine Stahl and the voestalpine affiliate Böhler Welding. The world's first system to combine steel and filler metal opens new dimensions with respect to utilization of material potential.

The alform® steels of the voestalpine Steel Division are characterized by excellent forming behavior and best weldability. Strengths are increased in some grades by up to 100% and significant weight savings achieved in comparison to conventional structural steels. alform® steels are the ideal solution to a wide variety of applications.

The alform® filler metals made by Böhler Welding meet the highest requirements and guarantee the highest process reliability. Innovations such as the patented LaserSealed technology of Böhler Welding set new standards in quality, precision and cored wire.

06/2012

Technically more advanced. Successful together.

voestalpine and Böhler Welding

The alform® welding system is the world's first system tuned by two renowned experts: As a leading steelmaker, voestalpine also places a great deal of emphasis on steel research and development. Böhler Welding is an internationally recognized specialist in filler metals and has been developing innovative products in this field for decades.

The alform® welding system was developed in close collaboration with the following research institutes: University for Mining and Metallurgy in Leoben, Technical University of Graz, Upper Austrian University of Applied Sciences, BAM–Berlin, Materials Center Leoben, RWTH Aachen University.

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