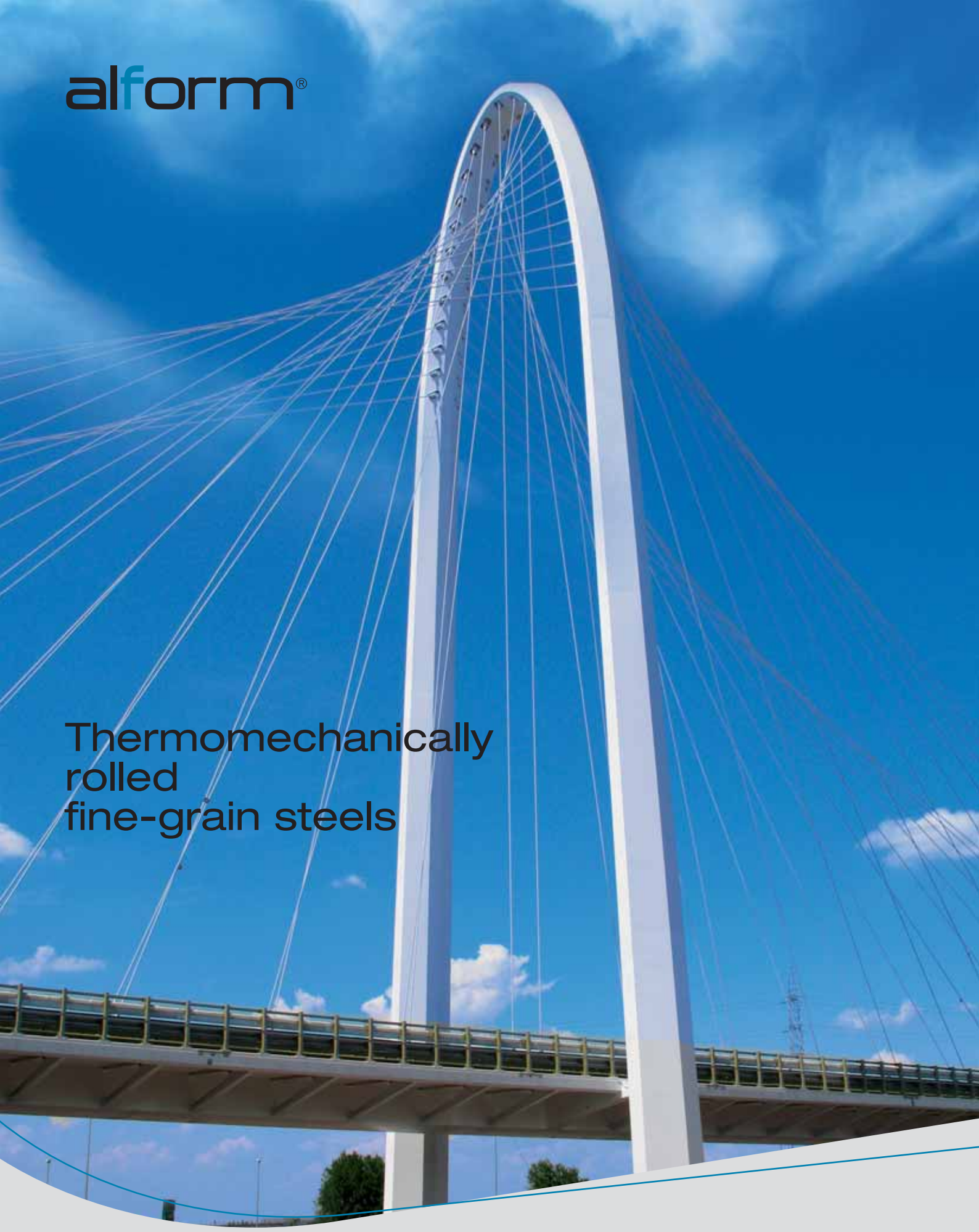
alform®



Thermomechanically rolled fine-grain steels

voestalpine Grobblech GmbH
www.voestalpine.com/grobblech

voestalpine
ONE STEP AHEAD.

alform®

Thermomechanically rolled fine-grain steels with best processing properties.

ALFORM® stands for micro-alloyed, thermomechanically rolled steels of voestalpine Grobblech GmbH with the following advantages compared to conventional quenched and tempered steels:

- excellent edging properties due to an extremely fine-grained and homogenous microstructure
- best weldability due to a low carbon equivalent and low carbon content
- excellent surface appearance due to a uniform thin layer of secondary scale

ALFORM® has been used successfully in various fields, such as crane and vehicle construction, where weight and optical appearance play an important role.

The Advantages

Edging:

- **Minimum edge radii**
  As a result of the fine grain size and the homogeneity of the thermomechanically rolled microstructure, ALFORM® steels have excellent toughness properties, which results in minimum edge radii.
- **Low crack sensitivity**
  ALFORM® steels are less susceptible to crack formation due to their excellent surface condition.

Welding:

- **Simple weld preparation**
  Weld edges can be prepared without preheating, using both oxyacetylene cutting and Laser or Plasma cutting. The cut edges do not require grinding due to minimum hardening.
- **Reduced preheating**
  The low carbon equivalent of ALFORM® steels allows easy welding at low preheating temperatures. Preheating is not necessery by using welding consumables with low hydrogen content.
- **Cold cracking resistance**
  Due to the special alloying concept (low carbon content and correlated micro-alloys) ALFORM® steels tend to harden less in the heat-affected zone (HAZ). This makes them highly resistant against cold cracking.
- **Excellent flame straightenability**
  During flame straightening by the oxyacetylene torch, which is characterised by surface-near heating, straightening temperature up to 700°C can be applied for short time, without strength and toughness falling below the guaranteed values. At these temperatures, excellent straightening effects can be achieved.

Surface:

- **Better optical appearance**
  ALFORM® steels show less scale pits on the pale surface leading to better optical appearance of painted components.
- **Quicker finish**
  The minimum amount of scale of ALFORM® steels is easier to remove than the scale of tempered steels.

Thermomechanical rolling

The combination of properties such as high strength and good toughness, optimum processability and excellent surface appearance of ALFORM® is based on the thermomechanical rolling technology of voestalpine Grobblech GmbH. By applying special alloying concepts a direct control of temperature and deformation is achieved during thermomechanical rolling. For high strength ALFORM® steels the desired material properties are obtained by accelerated cooling directly after thermomechanical rolling.

Chemical composition

The typical values of the chemical composition of ALFORM® steels are characterised by low C-contents and a balanced mixture of alloying elements. As a result, ALFORM® steels have particularly low carbon equivalent values.

Heat analysis (guaranteed values)

ALFORM® — mass in %

Steel grade	C max.	Si max.	Mn max.	P max.	S max.	Nb[1] max.	V[1] max.	Ti[1] max.	Cr max.	Ni max.	Cu max.
ALFORM 355 M	0.10	0.40	1.60	0.020	0.005	0.06	0.05	0.02	0.30	0.30	0.30
ALFORM 420 M	0.10	0.40	1.70	0.020	0.005	0.06	0.05	0.02	0.30	0.30	0.30
ALFORM 460 M	0.10	0.40	1.70	0.020	0.005	0.06	0.05	0.02	0.30	0.30	0.30
ALFORM 500 M	0.10	0.40	2.00	0.020	0.005	0.09	0.05	0.02	0.30	0.30	0.30
ALFORM 550 M	0.10	0.40	2.00	0.020	0.005	0.09	0.05	0.02	0.30	0.30	0.30

ALFORM® High-strength — mass in %

Steel grade	C max.	Si max.	Mn max.	P max.	S max.	$Al_{ges.}$ min.	Cr max.	Mo max.	Ni max.	V[1] max.	Nb[1] max.	Ti[1] max.	B max.
ALFORM 700 M	0.12	0.60	2.10	0.020	0.008	0.020	1.50	0.50	2.00	0.20	0.09	0.22	0.005

[1] the total of Nb, V and Ti may not exceed 0.22 %. Different elements are not alloyed.

Carbon equivalent (Standard values for carbon content and equivalent)

ALFORM® — mass in %

Steel grade	C	CEV[1]	CET[2]	PCM[3]
ALFORM 355 M	0.04	0.33	0.20	0.13
ALFORM 420 M	0.04	0.33	0.20	0.13
ALFORM 460 M	0.04	0.36	0.22	0.15
ALFORM 500 M	0.04	0.41	0.25	0.16
ALFORM 550 M	0.05	0.44	0.27	0.18

ALFORM® High-strength — mass in %

Steel grade	C	CEV[1]	CET[2]	PCM[3]
ALFORM 700 M	0.04	0.42	0.26	0.17

[1] CEV = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15, according to IIW

[2] CET = C + (Mn + Mo)/10 + (Cr + Cu)/20 + Ni/40, according to SEW 088

[3] PCM = C + Si/30 + (Mn + Cu + Cr)/20 + Ni/60 + Mo/15 + V/10 + 5*B, according to API 5L

Available dimensions

ALFORM®

Steel grade	Thickness [mm]	Max. width [mm]	Max. length [mm]
ALFORM 355/420 M	8 ≤ 50	3,000	18,000
ALFORM 460 M	8 ≤ 40	3,000	18,000
ALFORM 500/550 M	8 ≤ 30	3,000	18,000

ALFORM® High-strength

Steel grade	Thickness [mm]	Max. width [mm]	Max. length [mm]
ALFORM 700 M	8 ≤ 25	3,000	12,000

Other dimensions on request.

Mechanical properties

Guaranteed values

ALFORM®

Steel grade	Plate thickness[1] mm	Yield strength ReH[2] N/mm², min. Thickness mm 8 ≤ 16	> 16 ≤ 30	> 30 ≤ 40	> 40 ≤ 50	Tensile strength Rm[2] N/mm² Thickness mm 8 ≤ 30	> 30 ≤ 40	> 40 ≤ 50
ALFORM 355 M	8 ≤ 50	355	345	345	335	470 - 630	470 - 630	450 - 610
ALFORM 420 M	8 ≤ 50	420	400	400	390	520 - 680	520 - 680	500 - 660
ALFORM 460 M	8 ≤ 40	460	440	440	–	540 - 720	540 - 720	–
ALFORM 500 M	8 ≤ 30	500	480	–	–	550 - 750	–	–
ALFORM 550 M	8 ≤ 30	550	530	–	–	600 - 800	–	–

[1] Larger thicknesses on request.

[2] Tensile test in accordance with EN 10002 on transverse samples.

Notch impact energy and bending

Steel grade	Plate thickness mm	Fracture elongation $L_0 = 5.65 \sqrt{S_0}$ min. %	Notch impact energy[1] at -50 °C min. J	Bending test[2] bending angle 180° Mandrel diameter s = plate thickness	Admissible mimimum inner radius 90°-edging s =plate thickness
ALFORM 355 M	8 ≤ 50	24	27	0.5 s	1.0 s
ALFORM 420 M	8 ≤ 50	22	27	0.5 s	1.5 s
ALFORM 460 M	8 ≤ 40	20	27	1.0 s	1.5 s
ALFORM 500 M	8 ≤ 30	16	27	1.0 s	2.0 s
ALFORM 550 M	8 ≤ 30	14	27	1.5 s	2.0 s

[1] Notch impact bending test in accordance with EN 10045 on Charpy-V longitudinal samples at –50 °C.
The mean value from 3 individual sampels must reach the specified requirements. No individual value below 70 % of the guarantee mean value. For thicknesses < 10 mm, samples similar to Charpy-V with dimensions of 10x7.5 mm are tested. The guaranteed value is reduced in proportion to the sample cross-section.

[2] Bending test on transverse samples.

ALFORM® High-strength

Steel grade	Plate thickness mm	Yield strength Rp 0.2 min. N/mm²	Tensile strength[1] Rm N/mm²	Fracture elongation[1] $L_0 = 5.65 \sqrt{S_0}$ min. %	Notch impact energy[2] min. J	Bending test[3]
ALFORM 700 M	8 ≤ 15	700	750 - 1,050	10	40	2 s
	>15 ≤ 25	680	750 - 1,050	12	40	2 s

[1] Tensile test in accordance with EN 10002 on transverse samples.

[2] Notch impact bending test in accordance with EN 10045 on Charpy-V longitudinal samples at –40 °C.
The mean value from 3 individual sampels must reach the specified requirements. No individual value below 70 % of the guarantee mean value. For thicknesses < 10 mm, samples similar to Charpy-V with dimensions of 10x7.5 mm are tested. The guaranteed value is reduced in proportion to the sample cross-section.

[3] Bending angle 180°, mandrel diameter s = plate thickness, transverse samples.

More information you will find in our technical terms of delivery. Subject to change pursuant to further development. The current version is available in internet: www.voestalpine.com/grobblech

Medias 09/2007

voestalpine Grobblech GmbH
voestalpine-Straße 3
4020 Linz, Austria
T. +43/50304/15-9260
F. +43/50304/55-9260
grobblech@voestalpine.com
www.voestalpine.com/grobblech

voestalpine
ONE STEP AHEAD.