



PLASTIC
MOULD STEEL

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BÖHLER M310 |
ISOPLAST®

CORROSION RESISTANT TOOL STEELS

BÖHLER brand					
	Standards (Examples)	Conventional quality	Remelted steels (ESR, PESR, VMR)	PM-brands	AM-powder
>58 HRc	1.4108		BÖHLER M380 ISOPLAST®	BÖHLER M398 MICROCLEAN® BÖHLER M390 MICROCLEAN®	
~54 HRc	1.4125 1.4528 1.4112	BÖHLER N695 BÖHLER N690 BÖHLER N685	BÖHLER M340 ISOPLAST®	BÖHLER M368 MICROCLEAN®	
~50 HRc	1.2083		BÖHLER M333 ISOPLAST® BÖHLER M310 ISOPLAST® BÖHLER M789 VMR®		BÖHLER M789 AMPO
~40 HRc	1.2316 1.4542	BÖHLER M303 EXTRA HIGH HARD	BÖHLER M303 ISOPLAST® HIGH HARD BÖHLER N700		BÖHLER N700 AMPO
~30 HRc	1.2316 1.2085	BÖHLER M303 EXTRA BÖHLER M315 EXTRA BÖHLER M314 EXTRA	BÖHLER M303 ISOPLAST®		

MATERIAL PROPERTIES

BÖHLER brand	Corrosion resistance	Machinability in delivery condition	Polishability	Toughness	Wear resistance
BÖHLER N690	★	★★	★	★	★★★★
BÖHLER M310 ISOPLAST®	★★★★	★★★★	★★	★★	★★
BÖHLER M333 ISOPLAST®	★★★★★	★★★★	★★★★★	★★★★★	★★
BÖHLER M340 ISOPLAST®	★★★	★★★	★★	★★	★★★
BÖHLER M368 MICROCLEAN®	★★★★	★★★	★★★★	★★★	★★★
BÖHLER M380 ISOPLAST®	★★★★	★★★★	★★★★★	★★★★	★★★
BÖHLER M390 MICROCLEAN®	★★	★	★★★	★★	★★★★
BÖHLER M398 MICROCLEAN®	★★	★	★★★	★★	★★★★★

Corrosion resistance – highly tempered, aging test in 20% boiling acetic acid, 24h

Polishability – ranking was carried out in cooperation with the polishing expert JOKE Technologies

A STEEL WITH A WIDE RANGE OF PERFORMANCE

Properties

Advanced stainless, martensitic chromium steel for plastic molds. With electroslag remelting and the optimization of the chemical composition, **BÖHLER M310 ISOPLAST** offers you many advantages.

- » High gloss polishability
- » Good corrosion resistance
- » Good photo-etchability
- » Good machinability
- » High wear resistance

Application

- » Components for the food industry
- » Extrusion of plastics
- » Consumer goods
- » Medical technology
- » Components for displays
- » Hot runner systems
- » Manufacturers of standard parts
- » General components for mechanical engineering
- » Packaging industry
- » Electronic industry
- » Injection molding
- » Blow molding
- » Headlights for the automotive industry
- » Camera lenses
- » Screws and cylinders

Chemical composition (average %)

C	Si	Mn	Cr	V
0.38	0.70	0.45	14.30	0.20

Standards

DIN	EN	AISI	JIS	AFNOR
~ 1.2083	X40Cr14	~ 420	~ SUS 420J2	~ Z40C14

Condition of delivery

annealed to max. 225HB

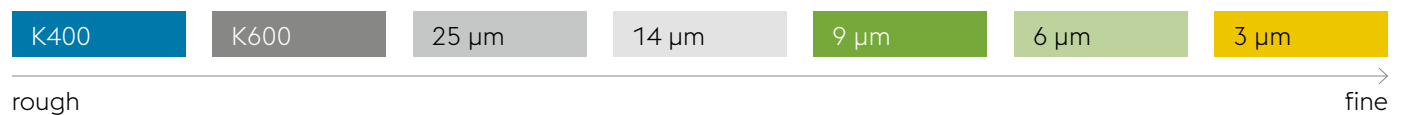
MATERIAL PROPERTIES

POLISHABILITY

BÖHLER brand	Polishability
BÖHLER M310 ISOPLAST®	★ ★ ★
BÖHLER M333 ISOPLAST®	★ ★ ★ ★ ★
BÖHLER M340 ISOPLAST®	★ ★
BÖHLER M368 MICROCLEAN®	★ ★ ★ ★
BÖHLER M380 ISOPLAST®	★ ★ ★ ★ ★
BÖHLER M390 MICROCLEAN®	★ ★ ★
BÖHLER N685	★

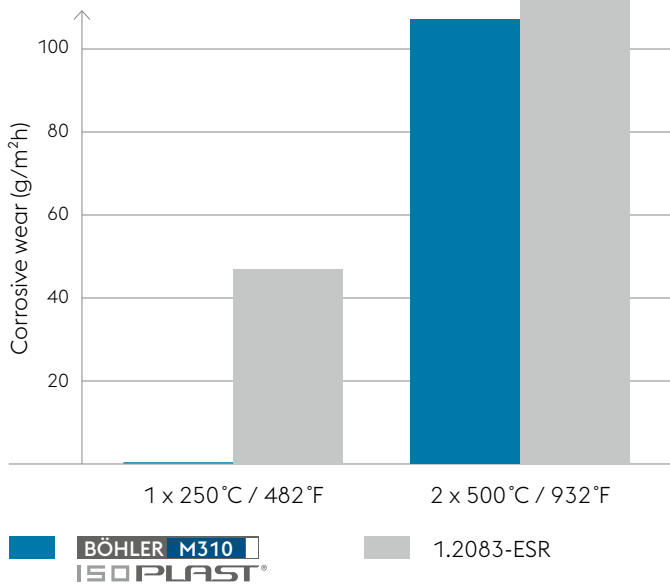
The comparison of the BÖHLER grades illustrates the effort required to achieve a high-gloss polished surface with Ra = 0,04 starting from a pre-ground surface.

Polishing steps

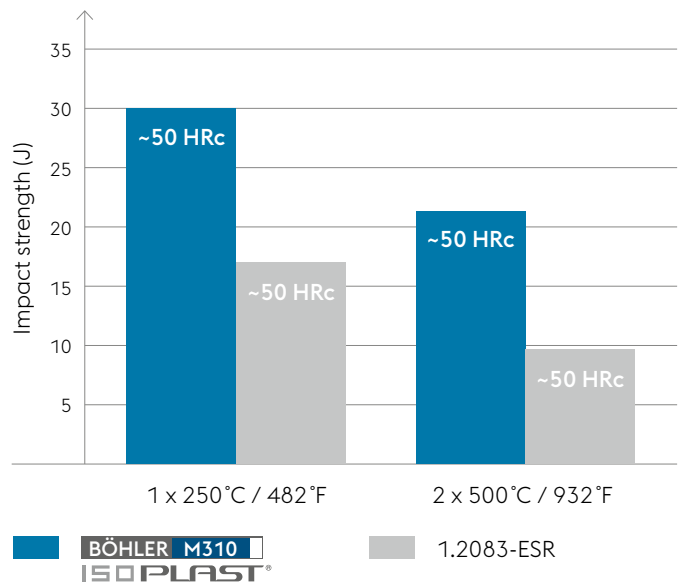




Corrosion resistance (without subzero cooling)



Toughness (without subzero cooling)



Heat treatment

Austenitizing at 1025°C / 1877°F (20 min./5 bar)

Tempering 1 x 250°C / 482°F or 2 x 500°C / 932°F

Weight Loss Test: Measured after 24 hours in 20% boiling acetic acid

Heat treatment

Austenitizing at 1025°C / 1877°F (20 min./5 bar)

Tempering 1 x 250°C / 482°F or 2 x 500°C / 932°F

HEAT TREATMENT

Stress relieving

- » ca. 650°C / 1202°F
- » After warming up completely, keep at the same temperature for 1 to 2 hours in a neutral atmosphere / slow furnace cooling

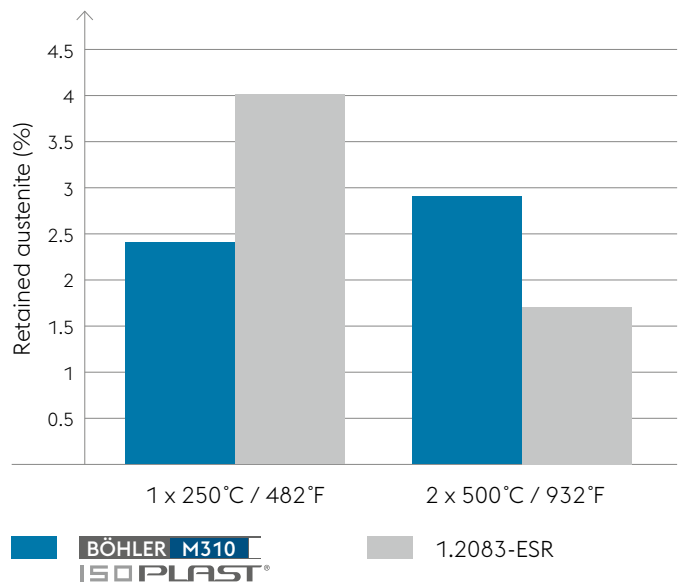
Hardening

- » 1025 to 1050°C / 1877 to 1922°F in a vacuum furnace
- » Hold for 15 to 30 minutes after warming up completely

Tempering

- » Slow heating to tempering temperature immediately after hardening / dwell time in the furnace 1 hour per 20 mm workpiece thickness, but at least 2 hours / air cooling.
- » Please refer to the tempering diagram for reference values for the hardness that can be achieved after tempering.

Retained austenite (without subzero cooling)

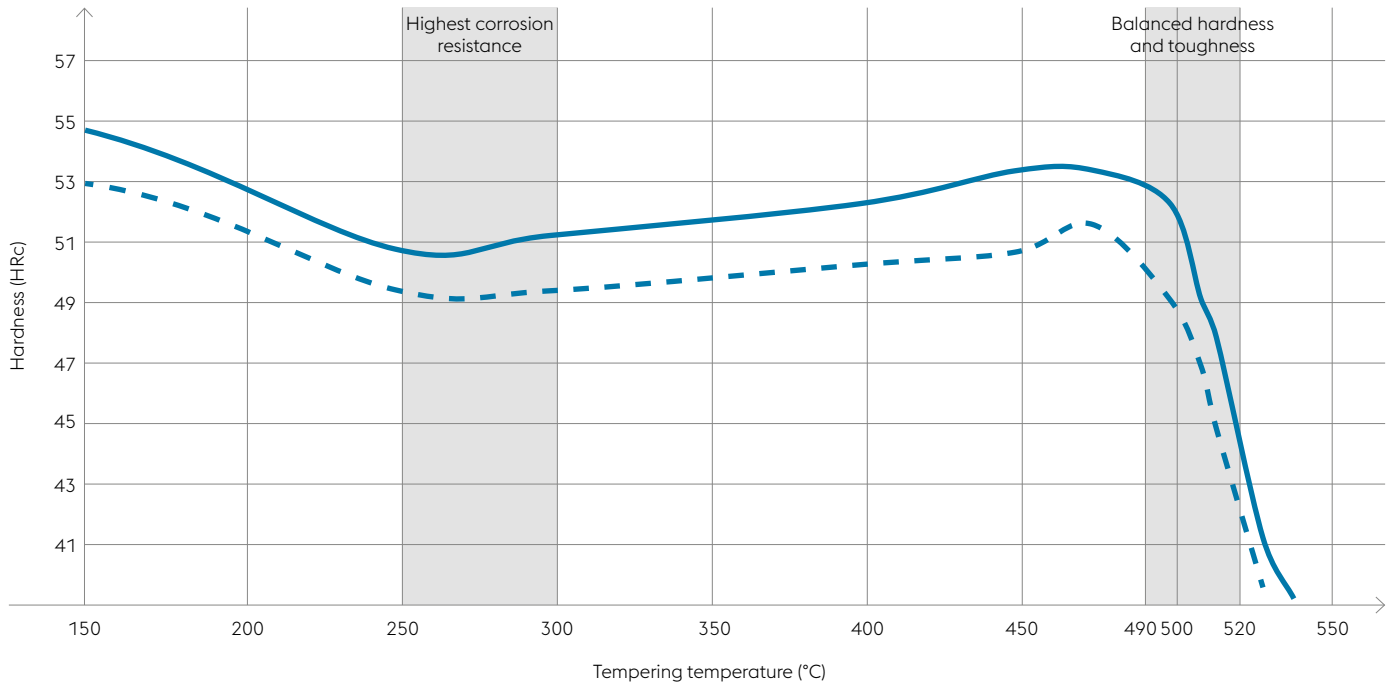


Heat treatment

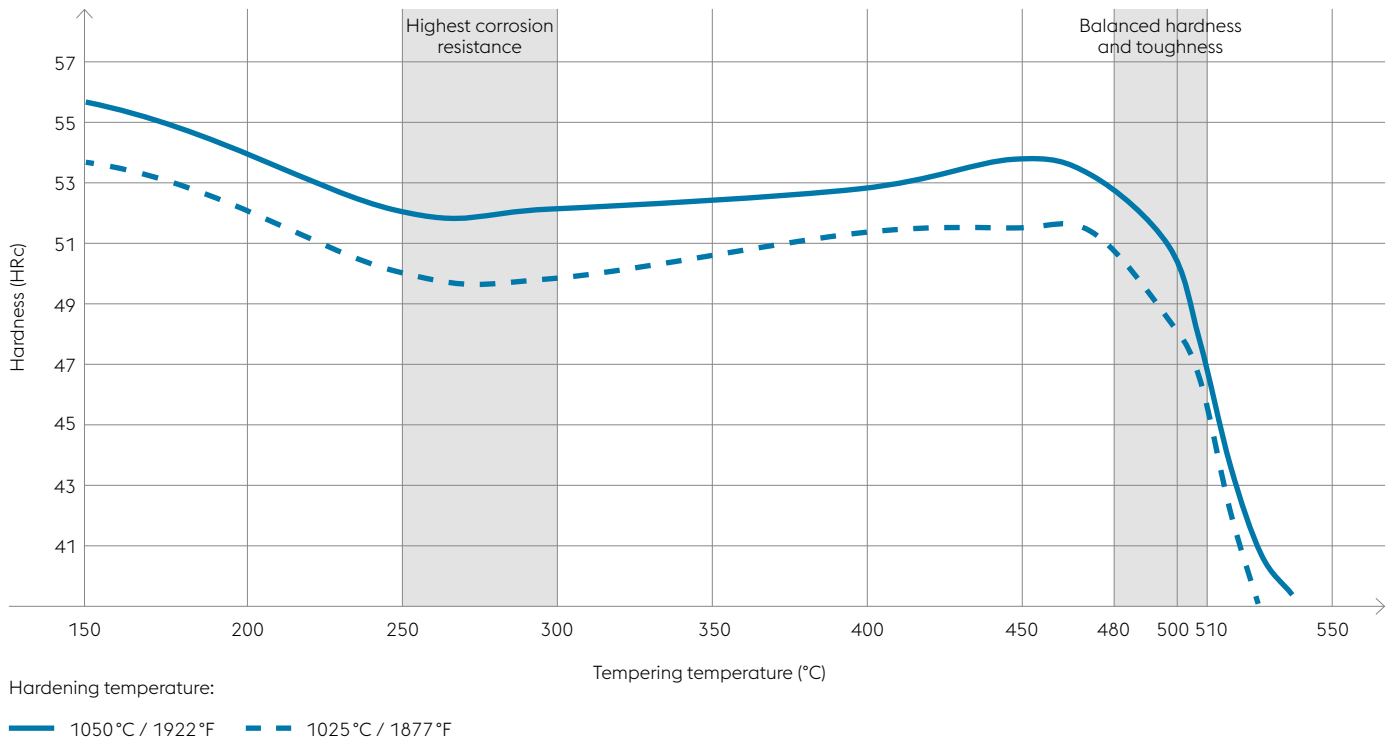
Austenitizing at 1025°C / 1877°F (20 min. / 5 bar)

Tempering 1 x 250°C / 482°F or 2 x 500°C / 932°F

Tempering diagram (vacuum heat treatment without subzero cooling)



Tempering diagram (vacuum heat treatment with subzero cooling)





Continuous cooling CCT-curves

Austenitising temperature: 1025°C / 1877°F
 Holding time: 30 minutes

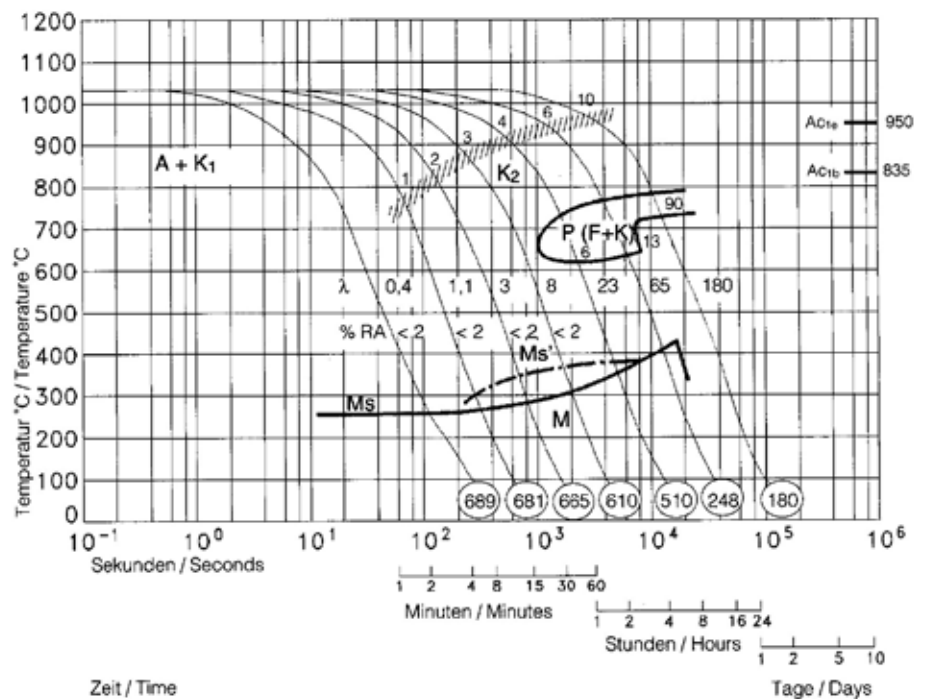
Hardness in HV

1...90 phase percentage in %
 0,4...180 cooling parameter,
 i.e. duration from cooling from
 800 – 500°C in $s \times 10^{-2}$ /
 1472 – 932°F in $s \times 10^{-2}$

K_1 carbides not dissolved during
 austenitization (8%)

K_2 carbides newly formed
 during cooling

Ms - Ms' range of grain boundary
 martensite formation

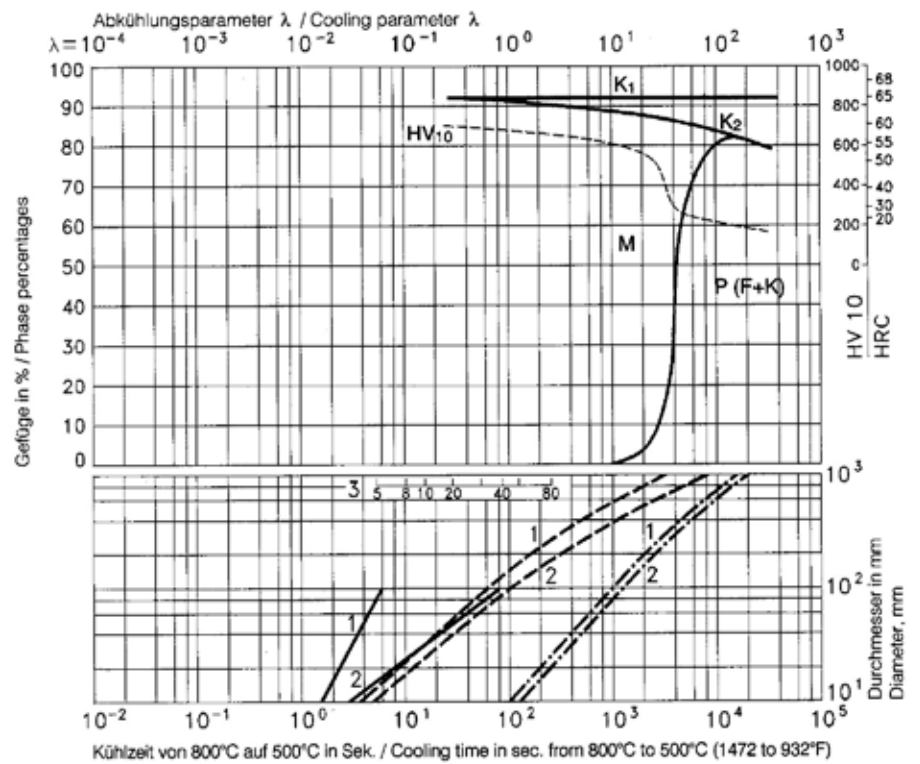




Quantitive phase diagram

- A Austenite
- F Ferrite
- K Carbide
- M Martensite
- P Pearlite

- 1 ... Surface
- 2 ... Core
- 3 ... Jominy test: distance from the face end



MACHINING GUIDELINES

Milling with carbide

	finishing	semi finishing	roughing
Cutting speed v_c m/min (f.p.m)	160 – 230 (520 – 750)	150 – 200 (490 – 655)	120 – 170 (390 – 550)
BOEHLERIT-carbide grade	BCH10M, BCP25M	BCH30M, BCP30M	BCH30M, BCP35M
ISO-Grade	H10, P25	H30, P30	H30, P35
F_z corner milling 90° (mm)	0.1 – 0.3	0.1 – 0.3	0.1 – 0.3
F_z plan milling 45° (mm)	0.15 – 0.4	0.15 – 0.6	0.15 – 0.6
F_z High speed machining (mm)	0.8 – 2.5	0.8 – 2.5	0.6 – 3.0

Turning with carbide

Cutting depth, mm (inches)	0.5 – 3 (.02 – .12)	1 – 4 (.04 – .16)	4 – 8 (.16 – .31)
Feed, mm/rev. (inches/rev.)	0.1 – 0.35 (.004 – .014)	0.2 – 0.4 (.008 – .016)	0.3 – 0.8 (.012 – .032)
BOEHLERIT-carbide grade	LCP15T	LCP15T, LCP25T	LCP25T, LC240F
ISO-Grade	P15	P15, P20	P20, P30
	Cutting speed v_c m/min (f.p.m)		
Indexable carbide inserts	180 – 260 (590 – 850)	120 – 220 (390 – 720)	70 – 140 (230 – 460)

Drilling with carbide

Drill diameter mm (inch)	3 – 8 (.12 – .31)	8 – 20 (.31 – .80)	20 – 40 (.80 – 1.6)
Feed, mm/rev. (inches/rev.)	0.02 – 0.05 (.001 – .002)	0.05 – 0.12 (.002 – .005)	0.12 – 0.18 (.005 – .007)
BOEHLERIT/ISO-Grade	K10 – K30		
Cutting speed v_c m/min (f.p.m)	50 – 120 (165 – 395)	50 – 120 (165 – 395)	50 – 120 (165 – 395)
Top angle	115° – 120°	115° – 120°	115° – 120°

Heat treatment condition annealed, average values



NUMBERS, FIGURES AND FACTS

Physical properties at 20°C / 68°F

Density	7.68 kg/dm ³ (0.277 lbs/in ³)
Thermal conductivity	19.5 W/(m.K) (11.27 Btu in/ft ² h°F)
Specific heat	460 J/(kg.K) (0.110 Btu/lb.°F)
Electrical resistivity	0.65 Ohm.mm ² /m
Modulus of elasticity	217 x 10 ³ N/mm ² (31.473 10 ³ ksi)
Magnetic properties	magnetic

Thermal expansion between 20°C / 68°F and ... °C (°F)

100 °C	200 °C	300 °C	400 °C	500 °C	
10.63	10.94	11.29	11.66	12.0	10 ⁻⁶ m/(m.K)
212 °F	392 °F	572 °F	752 °F	932 °F	
5.91	6.08	6.27	6.48	6.67	10 ⁻⁶ in/in.°F

Modulus of elasticity

100 °C	200 °C	300 °C	400 °C	500 °C	
213	206	198	190	181	10 ³ N/mm ²
212 °F	392 °F	572 °F	752 °F	932 °F	
30.9	29.9	28.7	27.6	26.3	ksi

Thermal conductivity

100 °C	200 °C	300 °C	400 °C	500 °C	
20.2	21.9	23.0	24.2	25.6	W/(m.K)
212 °F	392 °F	572 °F	752 °F	932 °F	
11.7	12.7	13.3	14.0	14.8	Btu/ft h.°F

As regards applications and processing steps that are not expressly mentioned in this product description/data sheet, the customer shall in each individual case be required to consult us.

The data contained in this brochure is merely for general information and therefore shall not be binding on the company. We may be bound only through a contract explicitly stipulating such data as binding. The manufacture of our products does not involve the use of substances detrimental to health or to the ozone layer.



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ONE STEP AHEAD.