


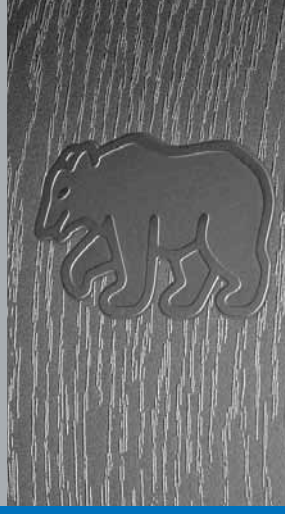

Data and Facts

Concerning Steel Belts

Continuous Reliability

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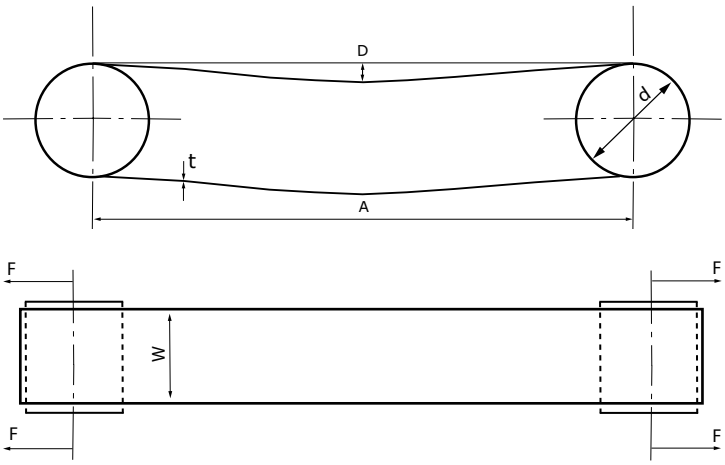
berndorf BAND

Introduction

Continuous improvement, innovative manufacturing methods and new materials make it possible to adapt belt characteristics to special customer requirements.

The following information provides a basis for technical designs containing standard and empirical values, as well as easy formulas for calculations.
This brochure is dedicated both to steel belt users and equipment manufacturers.
It should be used as a guide to avoid mistakes and thus extend the life of a steel belt.

The sketch below shows a base structure of a steel belt system and is used as a reference point for further explanations.



Explanation

A ..... Centre to centre distance
d ..... Drum diameter
w ..... Width of the steel belt
t ..... Thickness of the steel belt
F ..... Tensioning force
D ..... Sag

Notes:

Belt deflection

Every endless steel belt is directed by drums or guiding and supporting sheaves; sometimes further support by idler rollers or skid bars is necessary.
Attention should be paid to the following:

Deflection diameter

If the thickness (t) of the steel belt is known (data in mm), Berndorf Band recommends a deflection diameter of 1000 x t as a general rule.

In the event that a smaller deflection diameter is used, it would be necessary to calculate the tension forces in detail. Otherwise the steel belt may suffer damage at an early stage. Steel belt specialists from Berndorf Band are happy to provide you with advice.
Planar contact of the steel belt against the drum or roller coating causes a high bending stress at the product surface when deflecting. This bending stress can be calculated as below:

$$\sigma_b = \frac{E \cdot t}{d}$$

Explanation

σ_b ..... Bending stress N/mm²
E ..... Modulus of elasticity of the belt material in N/mm²
t ..... Thickness of the steel belt in mm
d ..... Drum diameter in mm

When using guiding and supporting sheaves, the same formula is valid.

Notes:

Belt tension

In order to transmit the rotation of the drum or guiding and supporting sheaves to the steel belt it is necessary to pre-tension the steel belt. This leads to a tension within the steel belt. Where clamping forces are known, calculation is as below:

See sketch on page 2

$$\sigma_z = \frac{F}{t \cdot w}$$

If the steel belt is already installed in a conveyor, the tensioning force F and the belt pre-tension can be calculated as follows:

$$F = \frac{A^2 \cdot w \cdot t \cdot \gamma \cdot g}{8 \cdot D}$$

$$\sigma_z = \frac{A^2 \cdot \gamma \cdot g}{8 \cdot D}$$

Explanation

σ_z ..... Belt pre-tension in N/mm²
F ..... Pretensioning force in N
t ..... Thickness of the steel belt in mm
w ..... Width of the steel belt in mm
A ..... Centre to centre distance in mm
D ..... Sag in mm
γ ..... Density of belt material in kg/dm³
g ..... Gravity acceleration in m/s²

Density of belt material

Steel: 7,85 kg/dm³

Titan: 4,53 kg/dm³

Notes:

Belt tension

Recommended belt tension

In general Berndorf Band recommends a minimum belt pre-tension of 10 N/mm² in order to securely transmit the rotation of the drum, resp. of the guiding and supporting sheaves to the steel belt.

Depending on the belt material and specification, the following maximum belt tension in N/mm², as a principle, is acceptable:

Endless welded steel belts:

	CARBO	NICRO	TITAN
Belt without vee-ropes over drum up to	100 N/mm²	100 N/mm²	35 N/mm²
Belt with vee-ropes over guiding and supporting sheaves up to	20 N/mm²	20 N/mm²	20 N/mm²

Endless steel belts with rivet joints:

A maximum belt tension of 15 N/mm² applies to all steel belts, independent of the material used.

In case a higher tension stress seems to be necessary, we recommend consulting Berndorf Band.

Notes:

Surface qualities

Berndorf Band offers steel belts with the following standard surfaces:
Mill finished, gound finished, polished, chromium plated, textured
Special surface treatment (e.g. blasted, PTFE-coated, ...) is available upon request.

Depending on the application, we choose the appropriate surface for the product side and the inner side of the steel belt. Certain surface treatments at the product side may determine certain treatments of the inner side and vice versa.

Mill finished

Surface finish is in accordance with process 2R per DIN EN 10028, resp. 2B per ASTM, resp. MA per DIN EN 1039. Smooth and clean, metallically clean, minor surface defects are admissible.

Typical roughness values for ground and polished surfaces

	ground finished			polished		
Description	**G-4,0**	**G-2,5**	**G-0,63**	**P-GW 0,3**	**P-GW 0,12**	**P-C**
Rt in micrometer	6,3	4,0	1,0	0,4	0,16	0,063
Rz in micrometer	**4,0**	**2,5**	**0,63**	**0,3**	**0,12**	**0,05**
Ra in micrometer	0,60	0,40	0,08	0,04	0,02	0,007

Rt ... max. Roughness depth Rz ≡ Rtm ... averaged roughness depth Ra ≡ AA ≡ CLA ... mean roughness index

Roughness values for **chrome plated surfaces** upon agreement.

Notes:

Standard tolerances

Steel belts from Berndorf Band are - besides other features - specified by length, width and thickness.
With regards to the above, the following tolerances are standard:

Length
Steel belts up to and including 60.000 mm: +/- 50 mm
Steel belts with more than 60.000 mm: +/- 100 mm

Width
Width of steel belts without longitudinal welding seam: +/- 1 mm
Width of steel belts with longitudinal welding seam: +/- 2 mm

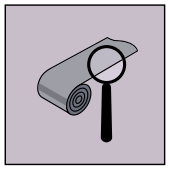
Thickness
Mill finished steel belts, open, excluding area of welding seam:
+/- 10% of the nominal thickness.

Welding seam area
Thickness deviation up to 0,1 mm to adjacent area.

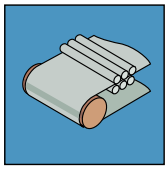
Special agreements for mill finished, ground and polished steel belts upon request.

Notes:

Production of endless steel belts



Incoming inspection



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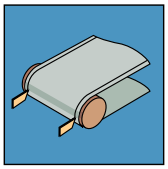

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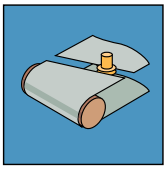
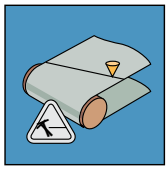
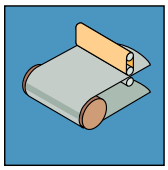


Milling belt ends



Laser welding



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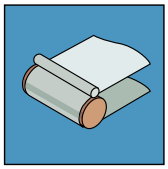
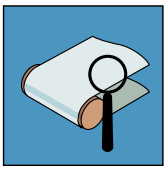
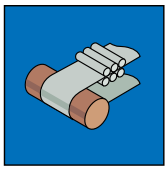
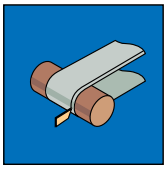


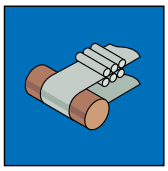
Polishing



Final inspection







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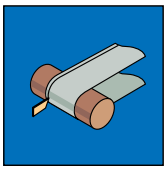

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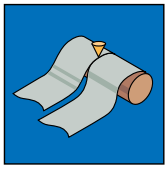
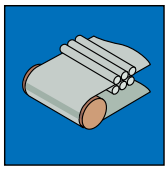


Longitudinal welding



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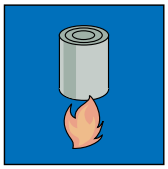
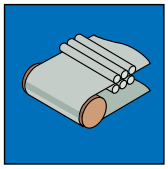


Thermal treatment



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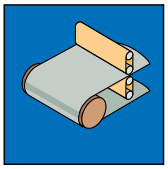

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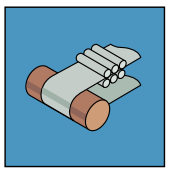

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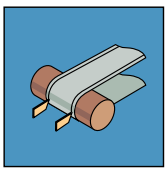

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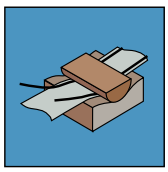
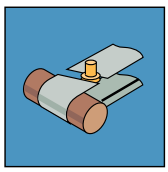
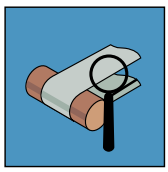


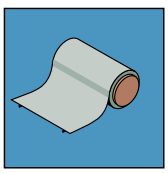
Vulcanising vee-ropes



Milling belt ends



Final inspection



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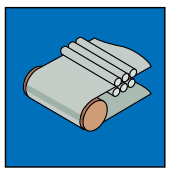

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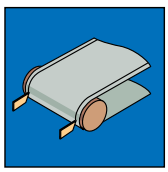

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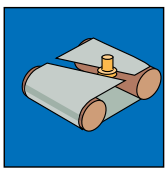
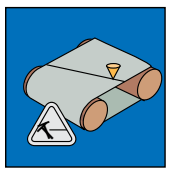
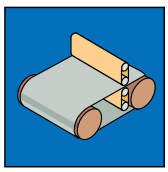


Milling belt ends



Laser welding



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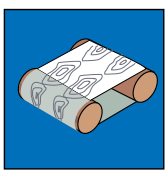
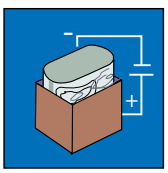


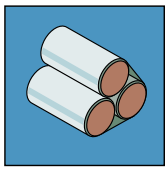
Texturing



Chrome plating

During each production step in our workshop, ALL steel belts run in endless condition between two drums. The result of this production method is perfect tracking and optimum belt straightness.

For you as a customer this means less downtime as a result of tracking problems and longer belt life due to less belt damage. Furthermore steel belts from Berndorf Band offer excellent flatness, leading to improved product quality.



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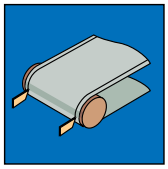

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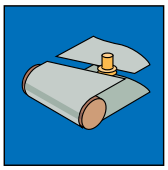
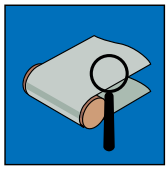
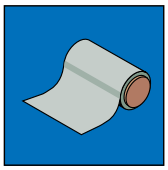


Milling belt ends



Final inspection



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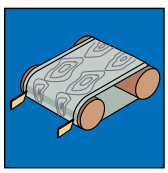

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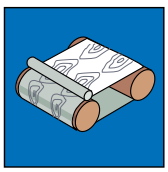
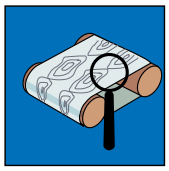


Gloss



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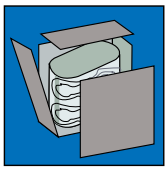


Packing

Flatness

Following standards apply to steel belts from Berndorf Band; excluding the cross welding seam:

Longitudinal welding seam	vee-rope	NICRO 12.1 NICRO 22 NICRO 22V	NICRO 31 NICRO 52	NICRO 52.6 NICRO 62.5	CARBO 13 CARBO 24	TITAN
no	no	1:350	1:350	1:200	1:350	1:350
no	yes	1:200	1:350	1:200	1:350	1:350
yes	no	1:250	1:250	1:200	1:250	-
yes	yes	1:200	1:250	1:200	1:250	-
perforated steel belts		1:200	1:200	1:200	1:200	-

Regarding cross welding seams, please refer to below chart:

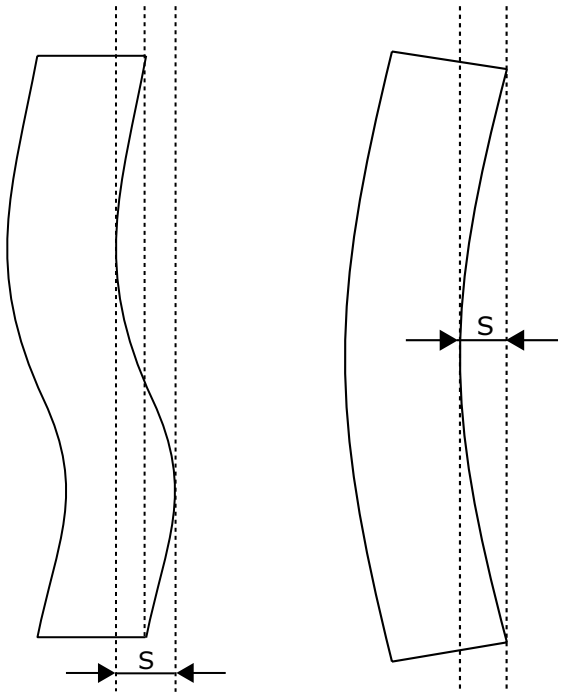
Longitudinal welding seam	vee-rope	NICRO 12.1 NICRO 22 NICRO 22V	NICRO 31 NICRO 52	NICRO 52.6 NICRO 62.5	CARBO 13 CARBO 24	TITAN
no	no	1:250	1:250	1:200	1:200	1:250
no	yes	1:200	1:250	1:200	1:200	1:250
yes	no	1:250	1:250	1:200	1:200	-
yes	yes	1:200	1:250	1:200	1:200	-
perforated steel belts		1:200	1:200	1:200	1:200	-

Notes:

Straightness

This term describes the longitudinal alignment of the belt. It shows the deviation of a steel belt with regards to the ideal straight line. Please refer to the sketches below.

Due to the production in endless condition, steel belts from Berndorf Band are characterised by excellent straightness.



As a standard, the straightness deviation „s" can be up to 2/10000 of the steel belt's length, but 20 mm at the maximum. Special agreements upon request.

Notes:

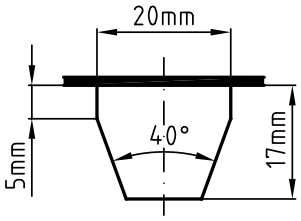
Vee-ropes and retaining strips

Both process and transport belts can be provided with vee-ropes and/or product retaining strips. Berndorf Band guarantees perfect adhesion of vee-ropes and product retaining strips within a wide range of mechanical demands and operating temperatures. This qualifies Berndorf Band steel belts with vee-ropes and/or product retaining strips to be an ideal base for various applications.

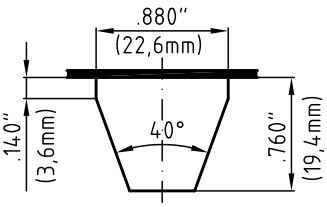
Vee-ropes-material	Product retaining strips-material
Nitrile rubber for operating temperatures from -20°C to +100°C *Natural rubber* for operating temperatures from -60°C to +60°C *Spiral vee-rope made of stainless steel* for operating temperatures exceeding +100°C	*Nitrile rubber* for operating temperatures from -20°C to +100°C *Natural rubber* for operating temperatures from -60°C to +60°C *Silicone rubber* for operating temperatures from -80°C to +200°C

Standard Profile

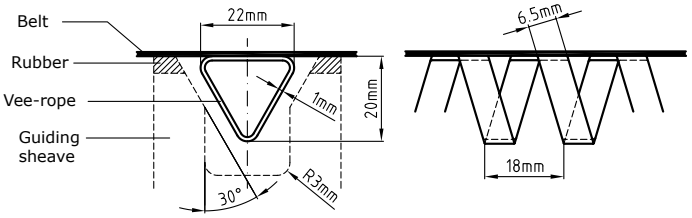
EU Profile



USA Profile



Spiral vee-rope



Notes:

Steel belts from Berndorf Band are a reliable base for various products:

Application	Key Products	Process	Belt Material	Criteria
Constructional & Furniture Panels	Particleboards MDF OSB LVL	Pressing	CARBO 13 CARBO 24 NICRO 52.6 NICRO 62.5	Flatness Axial straightness Strength Uniform thickness
Decorative & Technical Laminates	Laminates, Floorings MFC, CCL	Pressing	NICRO 12.1 NICRO 52	Strength Individual textures Uniform thickness Flatness
Food	Baked Goods	Baking	CARBO 13	Uniform dark surface Optimal energy-efficiency Flatness Straight tracking
Food	Meat, Meat Products Fish, Fish Products Dairy Products Vegetables, Fruits	Transporting Deep Freezing Drying Cooling	NICRO 12.1 NICRO 22 NICRO 31	Hygienic Easy to clean Flatness Perfect adhesion of vee-ropes
Food	Pet Food	Steaming	NICRO 12.1 NICRO 22	Hygienic Easy to clan Corrosion resistant
		Baking	CARBO 13	Uniform dark surface Optimal energy-efficiency Flatness
Semi Luxuries	Confectionary Coffee Powder Chocolate Powder Caramel Tobacco Sheets	Transporting Cooling Drying Freeze-Drying	CARBO 13 CARBO 32 NICRO 12.1 NICRO 31 NICRO 52	Hygienic Easy to clean Straight tracking Perfect adhesion of vee-ropes Good weldability
Chemical Raw Materials	Resins Waxes Powder Paint Hot Melt Adhesives Sulphur	Cooling Pastillating	NICRO 12.1 NICRO 22 NICRO 31 TITAN	Smooth surface Perfect adhesion of vee-ropes Flatness Corrosion resistance
Fibre-reinforced Polymers	GMT Ski Coating Container Panels	Polymerizing Pressing	NICRO 12.1 NICRO 52.6 NICRO 62.5	Surface quality Uniform thickness Thermal conductivity
Homogenous Cast Films, Foils & Plates	TAC PA, PI, PC, PVA PMMA Artificial Marble	Casting Polymerizing	NICRO 22V NICRO 31 NICRO 52	High mirror polished surface Uniform thickness Flatness Corrosion resistance Perfect adhesion of vee-ropes
Rubber & Plastics	Rubber Sheets Synthetic Sheets Floorings Raw Rubber	Vulcanizing Laminating Cooling	NICRO 12.1 NICRO 31 NICRO 52.6 NICRO 62.5	Surface quality Uniform thickness Flatness
Pulp & Papier	Paper Cardboard	Drying	NICRO 52.6	Uniform thickness High fatigue strength Straight tracking
Fibres & Wool	Synthetic Fibres Mineral Rock Wool	Pressing Washing Accumulating	NICRO 12.1 NICRO 31 NICRO 52.6 NICRO 62.5	Suitable perforation High fatigue strength
Sorting Lines	Parcels Unit Load	Sorting	CARBO 13 CARBO 24 NICRO 12.1	High operating safety Straight tracking Smooth surface
Bulky Material & Unit Load	Limestone Bricks Bricks Minerals Metal Filings	Transporting	CARBO 13 CARBO 24 CARBO 32 NICRO 12.1	Long lifetime Hard surface

Steel grades

Physical and mechanical properties. Typical values.

Material			NICRO 12.1	NICRO 22	NICRO 22 V	NICRO 31	NICRO 52	NICRO 52.6
Type Similar material		DIN AISI	CrNi 17 7 1.4310 301	CrNiMo 17 12 2 1.4401 316	CrNiMo 17 12 2 1.4401 316	CrNiTi 13 4 1.4313 -	CrNiCuTi 15 7 - -	CrNiCuTi 15 7 - -
Tensile strength 0,2%-yield offset strength	RT RT	N/mm² N/mm²	1150 950	1100 970	1.130 1.000	1080 1050	1150 1100	1550 1500
Hardness		Rockwell HRC Vickers HV 10	37,0 360	33,0 330	33,0 330	33,5 330	37,0 360	48,0 480
Elongation 50 mm		%	18	12	12	5	8	6
Welding factor			0,70	0,65	0,70	0,95	0,95	0,80
Fatigue strength under reversed bending stress*)	RT	N/mm²	480	440	440	480	500	700
Modulus of elasticity	at 20 °C at 200 °C	N/mm² N/mm²	200.000 180.000	200.000 180.000	200.000 180.000	205.000 -	200.000 188.000	200.000 188.000
Density		kg/dm³	7,90	7,95	7,95	7,70	7,74	7,74
Mean coefficient of thermal expansion	20-100 °C 20-200 °C 20-300 °C 20-400 °C	10⁻⁶m/m°C 10⁻⁶m/m°C 10⁻⁶m/m°C 10⁻⁶m/m°C	16,0 17,0 - -	16,5 17,5 - -	16,5 17,5 - -	10,8 11,2 11,7 -	10,9 11,5 11,7 -	10,9 11,5 11,7 -
Specific heat Thermal conductivity	 at 20 °C	J/g°C W/m°C	0,50 15	0,50 15	0,50 15	0,46 21	0,50 16	0,50 16
Specific electric resistance	at 20 °C	Ohm mm²/m	0,73	0,75	0,75	0,60	0,80	0,80
Max. permissible operating temp.		°C °F	250 480	250 480	250 480	350 660	350 660	350 660
Tensile strength at max. permissible operating temp.		N/mm²	940	870	900	970	900	1250
0,2%-yield offset strength at max. permissible operating temperature		N/mm²	770	770	800	930	830	1180

Every belt material has its own special properties offering lots of advantages to the user when applied properly.

Berndorf Band's steel belt specialists are at your disposal to select the perfect material for your application.

Steel grades

Physical and mechanical properties. Typical values.

Material			NICRO 62.5	NICRO 70	NICRO 85	CARBO 13	CARBO 24	CARBO 32	TITANIUM
Type Similar material		DIN AISI	CrNiCu 15 5 - -	NiCr 22Mo 9 Nb 2.4856 -	CrNiMoN 25 7 4 1.4410 -	Ck 67 1.1231 -	- - -	- - -	Grade 2 3.7035 -
Tensile strength 0,2%-yield offset strength	RT RT	N/mm² N/mm²	1450 1410	870 570	1350 1250	1200 970	1420 1320	1280 1220	390 275
Hardness		Rockwell HRC Vickers HV 10	46,0 460	24,0 260	39,0 380	36,0 350	44,5 440	42 410	- 160
Elongation 50 mm		%	8	25	6	8	6	5	20
Welding factor			0,75	0,75	0,70	0,80	0,75	0,80	0,95
Fatigue strength under reversed bending stress*)	RT	N/mm²	650	475	385	450	550	550	250
Modulus of elasticity	at 20 °C at 200 °C	N/mm² N/mm²	200.000 -	205.000 200.000	200.000 186.000	210.000 -	210.000 -	205.000 -	106.000 -
Density		kg/dm³	7,80	8,44	7,80	7,85	7,85	7,82	4,53
Mean coefficient of thermal expansion	20-100 °C 20-200 °C 20-300 °C 20-400 °C	10^{-6}m/m°C 10^{-6}m/m°C 10^{-6}m/m°C 10^{-6}m/m°C	10,8 10,8 11,3 -	12,8 13,1 13,3 -	13,0 13,5 14,0 -	11,1 11,9 12,5 12,9	12,0 12,5 12,9 -	11,8 12,4 12,6 12,9	8,5 8,9 - -
Specific heat Thermal conductivity	bei 20 °C	J/g°C W/m°C	0,42 16	0,41 9,80	0,50 15	0,46 46	0,45 40	0,46 38	0,52 20
Specific electric resistance	bei 20 °C	Ohm mm²/m	0,77	1,29	0,80	0,13	0,20	0,20	0,78
Max. permissible operating temp.		°C °F	300 570	300 570	250 480	400 750	250 480	350 660	250 480
Tensile strength at max. permissible operating temp.		N/mm²	1160	770	1070	850	1300	1100	225
0,2%-yield offset strength at max. permissible operating temperature		N/mm²	1130	420	1023	720	1100	1050	135

Special materials upon request.

*) 50 % of the test specimens withstand 2,000.000 load cycles.
If not otherwise specified, the values given apply at room temperature.
Subject to change due to technological progress. Errors and omissions excepted.

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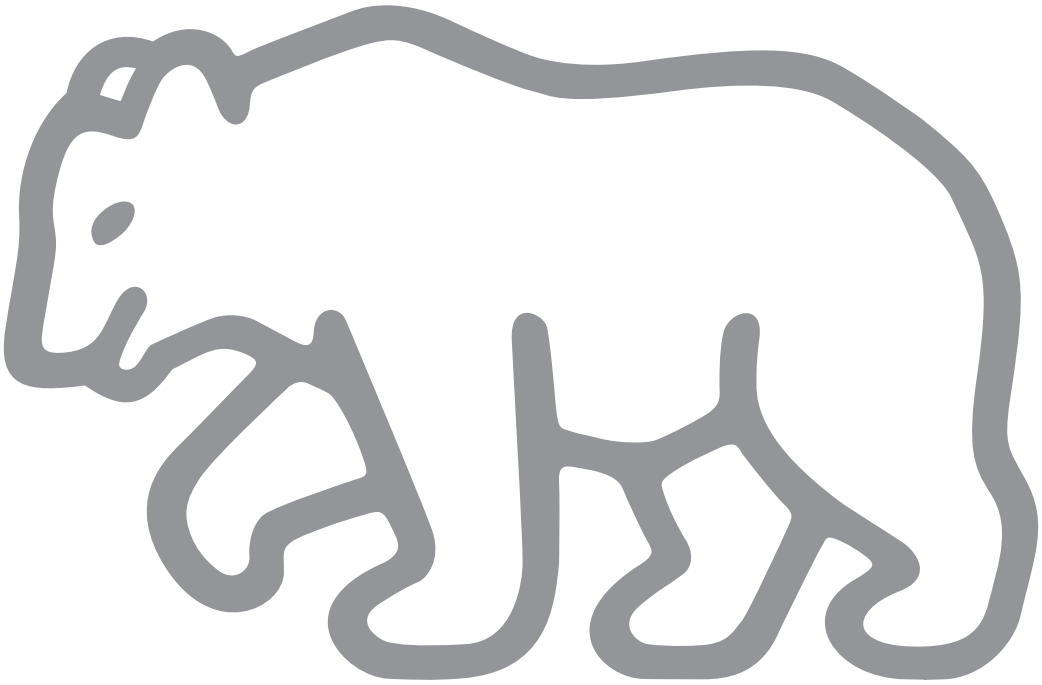

Austrian Quality

A 01/2014