

# Freeflex®

## Strip steel

### Datasheet

Freeflex® is a hardened and tempered martensitic stainless compressor valve steel alloyed with copper. The material is characterized by:

- Excellent combination of high strength and high ductility
- Extremely high fatigue strength under bending and impact stress
- Excellent surface finish
- Very high compressive residual surface stress
- Low level of non-metallic inclusions
- Very good wear resistance

Freeflex® compressor valve steel has excellent dimensional tolerances and flatness.

## Chemical composition (nominal)

Chemical composition (nominal) %

C	Si	Mn	P	S	Cr	Mo	Cu
0.53	0.40	0.68	≤0.025	≤0.010	14.0	1.00	0.70

## Applications

### Valve types:

- Flapper valves
- Reed valves
- Check valves

## Fabrication

### Tumbling

A good tumbling operation giving a round, smooth edge is necessary in order to minimize stress concentrations. Tumbling also increases the residual compressive surface stresses which gives a significant further improvement in fatigue properties.

## Finish

### Edges

Edges are slit and deburred. Shaved edges can be supplied on request.

### Flatness

Maximum out-of-flatness across and along the strip is 0.20% of the nominal strip width.

### Surfaces

Maximum surface roughness values, cut-off 0.80 mm (0.031 in.), are shown in the table.

Thickness [mm]	Thickness [in.]	Ra [ $\mu\text{m}$ ]	Ra [ $\mu\text{ in.}$ ]	Rmax [ $\mu\text{m}$ ]	Rmax [ $\mu\text{ in.}$ ]
< 0.152	<0.006	0.13	5.2	1.5	60
0.152 - 0.508	0.006 - 0.020	0.10	4.0	1.5	60
>0.508	>0.020	0.25	10.0	2.5	100

### Surface defects

A small number of surface defects, such as pits and roll marks, with a depth or height of 2  $\mu\text{m}$  (80  $\mu\text{in.}$ ) maximum is allowed for thicknesses up to 0.508 mm (0.020 inch) and 3  $\mu\text{m}$  (120  $\mu\text{in.}$ ) maximum for thicker material. The maximum scratch depth allowed is as follows:

Thickness		Max. allowed depth	
mm	in.	$\mu\text{m}$	$\mu\text{in.}$
$\leq 0.203$	$\leq 0.008$	0.5	20
$> 0.203 - \leq 0.508$	$> 0.008 - \leq 0.020$	0.8	32
$> 0.508$	$> 0.020$	1.0	40

### Straightness

Out-of-straightness is defined as the maximum deviation from a straight-edge of a specified length. The following values apply:

Strip width		Max. allowed deviation	
mm	in.	mm/m	in./3 feet
$\geq - < 20$	$\geq 0.315 - < 0.787$	2.0	0.072
$\geq 20 - < 50$	$\geq 0.787 - < 1.969$	1.5	0.054
$\geq 50 - < 125$	$\geq 1.969 - < 4.921$	1.25	0.045
$\geq 125$	$\geq 4.921$	1.0	0.036

## Mechanical properties

Proof strength				Tensile strength		Elongation
$R_{p0.05}$		$R_{p0.2}$		$R_m$		
MPa	ksi	MPa	ksi	MPa	ksi	%
nominal		nominal		nominal		
1380	200	1600	232	2020	293	≥7

The values are valid for thicknesses up to 0.60 mm (0.024 inch). The manufacturing tolerance for tensile strength is  $\pm 60$  MPa ( $\pm 8.7$  ksi).

### Reversed bending fatigue (mean stress = 0)

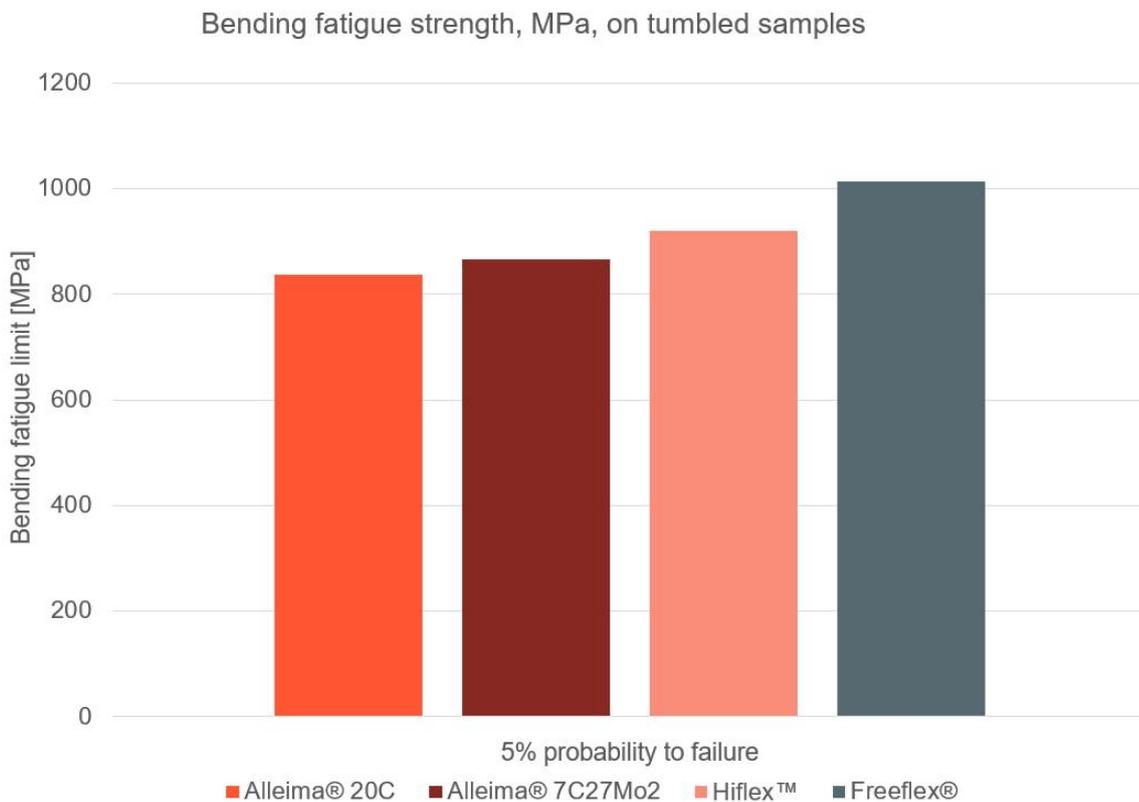
The fatigue strength of Freeflex® compressor valve steel in reversed bending is  $\pm 1010$  MPa ( $\pm 146$  ksi) at a failure rate of 5%.

### Fluctuating bending fatigue (minimum stress = 0)

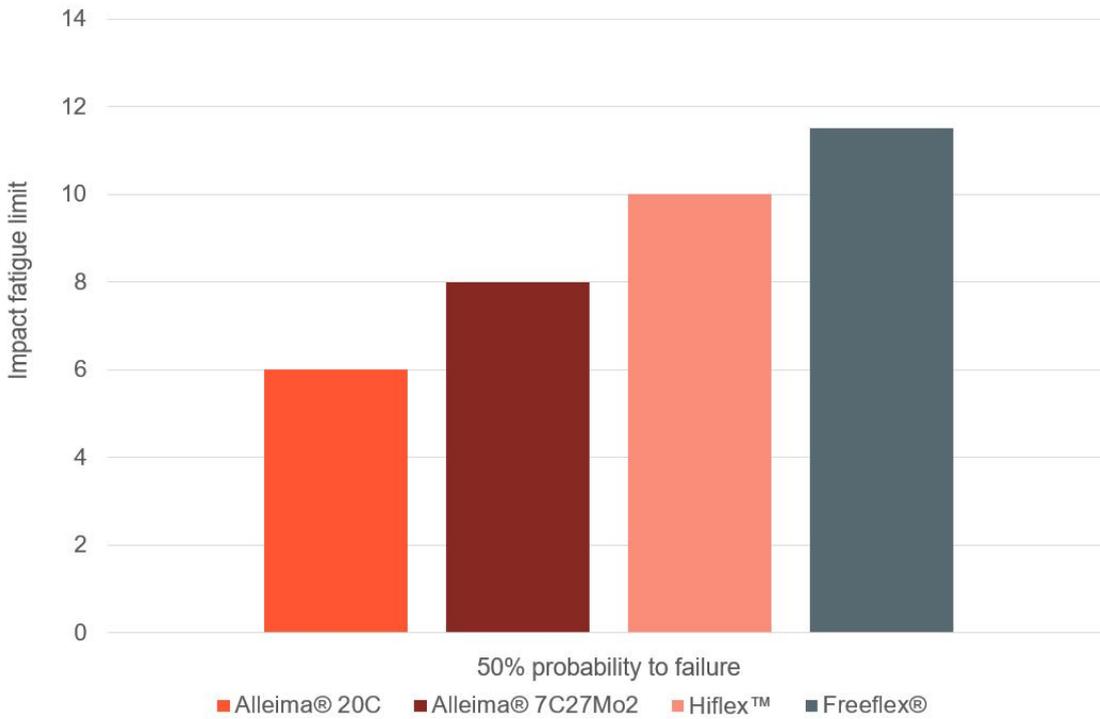
Fluctuating bending fatigue strength for Freeflex® has been calculated from reversed bending values at a 5% failure rate. Goodmans formula gives  $674 \pm 674$  MPa. Gerbers formula gives  $838 \pm 838$  MPa.

### Comparison with other steel grades

Bending fatigue strength, MPa on tumbled samples



Impact fatigue strength on tumbled samples



## Physical properties

Density, 7.7 g/cm<sup>3</sup>, 0.27 lb/in<sup>3</sup>

### Modulus of elasticity, static properties at 20°C (68°F)

MPa	210000
ksi	30500

## Forms of supply

### Conditions and forms of supply

Strip steel is supplied in labeled coils, or on labeled plastic spools, depending on weight and size. The label details the steel grade, heat, lot and coil number, and nominal size, allowing full material traceability. Material is protected against rust with oil.

## Dimensions

### Thickness

Freeflex® is supplied in standard thicknesses in accordance with the table. Customized thicknesses can be supplied on request.

Thickness		Tolerances	
Mm	in.	mm	in.

0.152	0.006	0.005	0.00020
0.178	0.007	0.005	0.00020
0.203	0.008	0.006	0.00024
0.254	0.010	0.007	0.00028
0.305	0.012	0.007	0.00028
0.381	0.015	0.008	0.00035
0.406	0.016	0.012	0.00047
0.457	0.018	0.012	0.00047
0.508	0.020	0.014	0.00055
0.600	0.0236	0.020	0.00079

## Width

Strip in standard thicknesses is stocked in widths up to 325 mm (12.8 in.), ready for slitting to the required width.

### Disclaimer:

Recommendations are for guidance only, and the suitability of a material for a specific application can be confirmed only when we know the actual service conditions. Continuous development may necessitate changes in technical data without notice. This datasheet is only valid for Alleima materials.