

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.

## 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.

## 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 0.25 mm (0.0098 in.), are shown in the table.

Thickness		Ra		Rmax	
mm	in.	µm	µin.	µm	µin.
≤0.508	≤0.020	0.13	5.2	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 µm (80 µin.) maximum is allowed for thicknesses up to 0.508 mm (0.020 inch) and 3 µm (120 µin.) maximum for thicker material. The maximum scratch depth allowed is as follows:

Thickness		Max. allowed depth	
mm	in.	µm	µin.
≤0.203	≤0.008	0.5	20
>0.203-≤0.508	>0.008-≤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
≥-<20	≥0.315-<0.787	2.0	0.072
≥20-<50	≥0.787-<1.969	1.5	0.054
≥50-<125	≥1.969-<4.921	1.25	0.045
≥125	≥4.921	1.0	0.036

## Mechanical properties

Proof strength		Tensile strength		Elongation		
R <sub>p0.05</sub>	R <sub>p0.2</sub>	R <sub>m</sub>				
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 ±60 MPa (±8.7 ksi).




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

The fatigue strength of Freeflex™ compressor valve steel in reversed bending is ±1100 MPa (±160 ksi) at a failure rate of 50%.

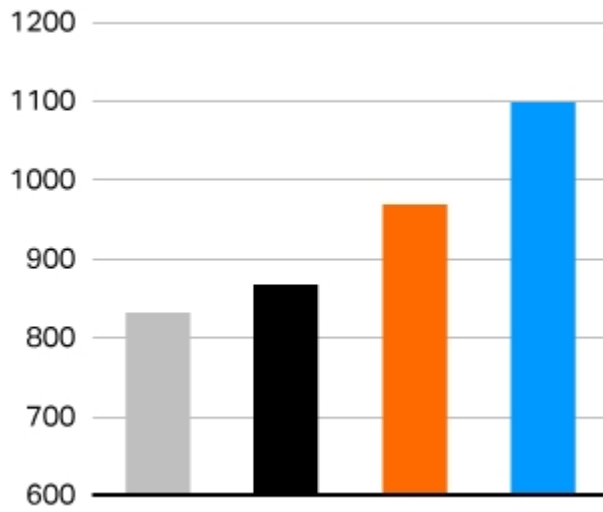
### Fluctuating bending fatigue (minimum stress = 0)

Fluctuating bending fatigue strength for Freeflex™ has been calculated from reversed bending values at a 50% failure rate. Goodmans formula gives 712±712 MPa. Gerbers formula gives 888±888 MPa.

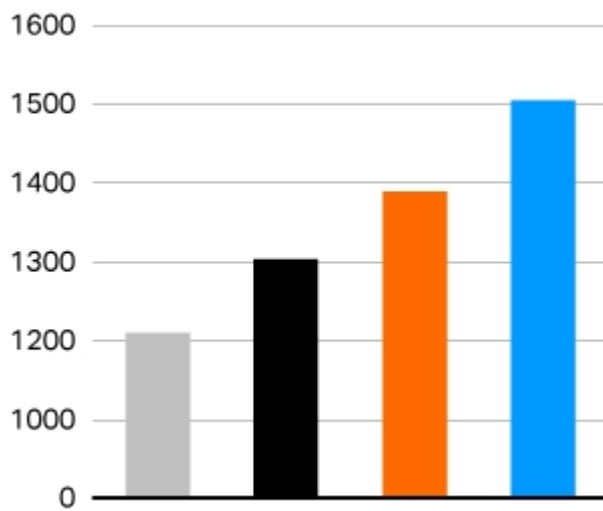
### Comparison with other steel grades

	Alleima® 20C
	Alleima® 7C27Mo2
	Hiflex®
	Freeflex™

### Bending fatigue strength, MPa

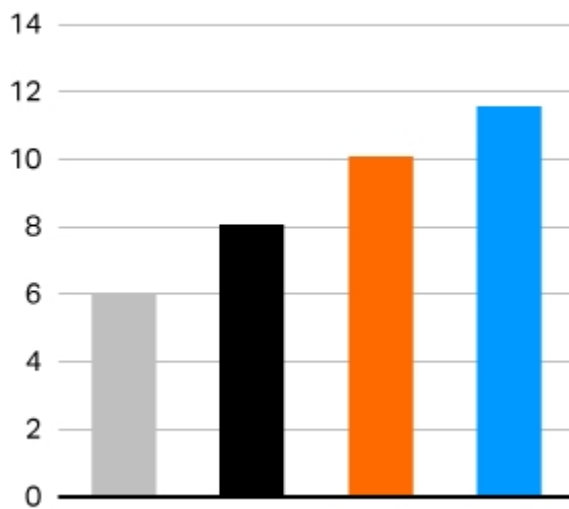


### Fluctuating tensile strength, MPa



### Impact fatigue limit, indexed

### Impact fatigue limit, MPa



## 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

**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.