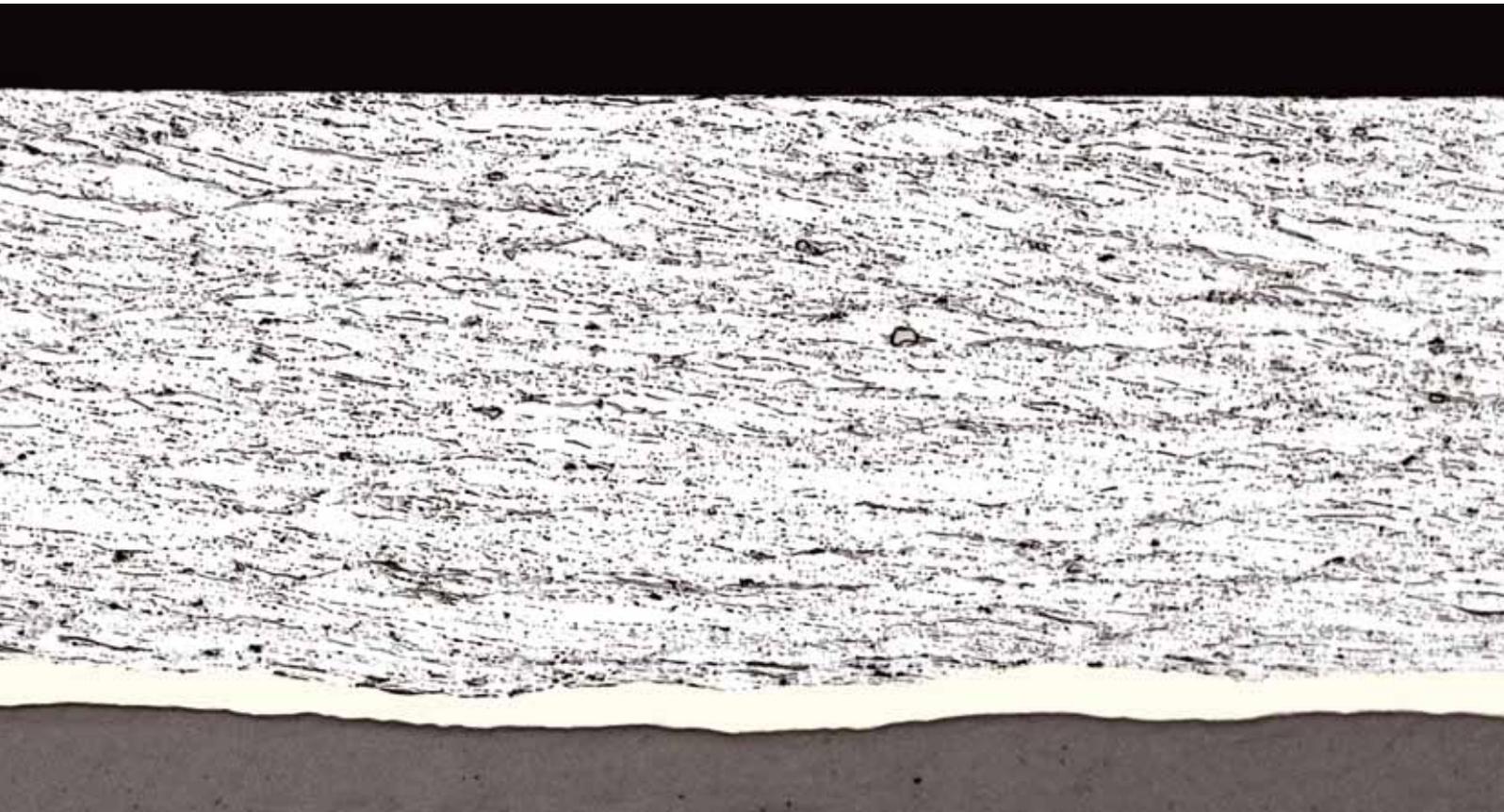


KOLBENSCHMIDT PIERBURG GROUP



KS R21

Lead-free Steel-Aluminum
Composite Material for
Main Bearings



GLEITLAGER

Brief description of the sliding material

Plain bearings made from steel/aluminum composite materials are widely used as main bearings in gasoline and diesel engines.

KS R21 is a robust bearing material. Compared to KS R20 this material has an improved load carrying capacity without losing the other characteristics, like good embedding capability and adaptability. Due to this characteristics bearing shells and thrust washers can be used in bi-material designs. KS R21 is insensitive to oil corrosion.

With its specific load carrying capacity up to 55 MPa, this material is suited for application in engines subject to medium loads. In the present chemical composition, KSR21 complies with the requirements of the EU Directive 2000/53/EC on End-of-Life Vehicles.

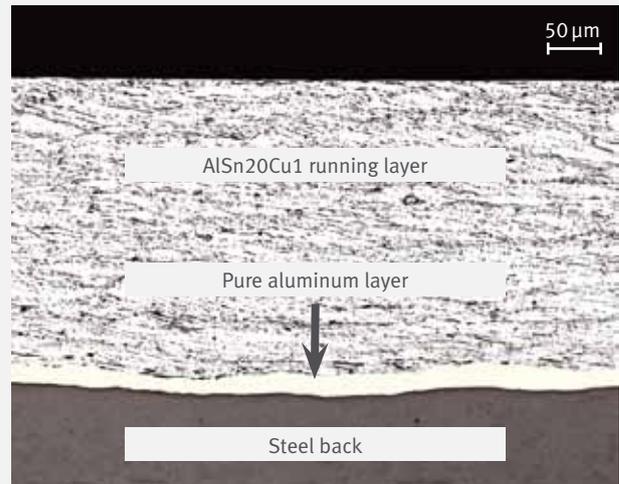
Bearing structure

KS R21 bearings comprise a steel back, an intermediate layer made from pure aluminum and an aluminum-tin-copper running layer.

The steel quality used is normally grade DC04 with a hardness in the range of 150–220 HB.

The thickness of the steel layer is defined as a function of the application. Usually, it ranges between 1.0 and 3.0 mm. The intermediate layer made from pure aluminum provides the metallic bond between the steel and the aluminum running layer. Its thickness varies between 0.01 and 0.05 mm.

On the finished sliding element, the aluminum-tin-copper alloy that forms the running layer to the sliding partner exhibits a thickness of 0.2–0.5 mm and a hardness of up to 40–60 HB.



Micrograph of the composite



Bi-material: steel / aluminum bearings

Material characteristics

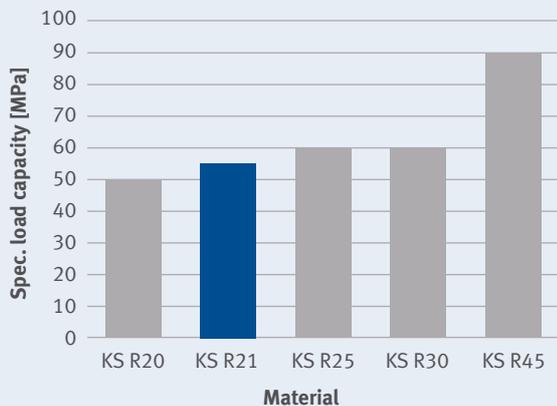
Characteristics, limit loads	Unit	KS R21
Tensile strength	MPa	> 165
Yield point	MPa	> 140
Young's modulus	GPa	63
Coefficient of thermal expansion	k^{-1}	$24 \cdot 10^{-6}$
Thermal conductivity	$W (m \cdot k)^{-1}$	50

Chemical composition of the running layer

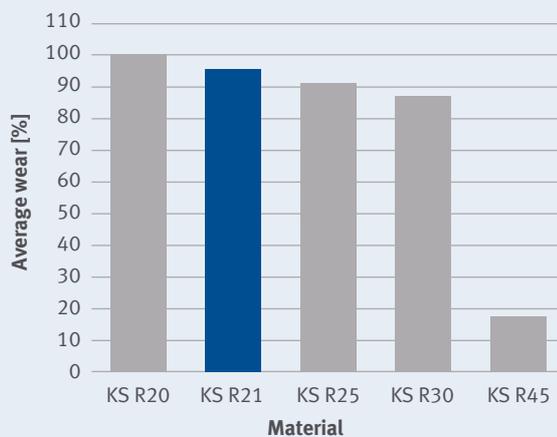
mass-%	Element	Content
	Sn	16.5 to 22.5 %
	Cu	0.7 to 1.3 %
	Si	max. 0.7 %
	Ti	max. 0.2 %
	Ni	max. 0.1 %
	Fe	max. 0.7 %
	Mn	max. 0.7 %
	others combined	max. 0.5 %
	Al	rest

The hardness of the running layer is in the range of 40–60 HB

Comparison of the specific load carrying capacity



Comparison of wear behavior



Test conditions

- Bearing shell diameter: 47.8 mm
- Wall thickness (approx.): 1.4 mm
- Sliding velocity: 0.25 m/sec
- Spec. static load: 6.2 MPa
- Test duration: 3.0 h

Manufacture of the sliding material

The aluminum alloy is manufactured in vertical continuous casting. Mechanical processing of the strand surface as well as the specific heat treatment steps prepare the material for plating. The so-called pre-composite results from plating a pure aluminum foil (Al 99.5) on the strand. Roll cladding is used to apply the pre-composite onto the steel. Selective thermomechanical treatment steps give the desired material characteristics.

Plain bearing manufacture

KS R21 strip is used to manufacture sliding elements by punching and forming. The final wall thickness of the bearing shells and the design of the inside surface is achieved by machining.

Application

Sliding elements made from KS R21 are characterized by their excellent anti seizure property, good embedding capability and adaptability. With these properties and an improved wear resistance as compared to KS R20 they are thus suited for use as main bearings in medium-load engines.

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