

# RIBE®

FASTENING SYSTEMS



RIBE-ALUFORM®  
FOR LIGHT AND EASY CONNECTIONS



Light metals are used increasingly in all areas of technology and accordingly require connections of suitable materials.

For applications with magnesium or aluminum, fasteners of aluminum alloys offer definite advantages over steel screws. These include substantial weight savings, high connection strength, avoidance of galvanic corrosion and appreciable potential for saving costs.

RIBE® with its Aluform® screws is the market leader in the aluminum screws segment. Our technical innovations and many years of experience combined with heat treatment and surface technologies developed especially for aluminum alloys create products that are unique throughout the world. This is why RIBE-Aluform® screws are used in many of today's automotive engineering applications, mainly in gearboxes and engines.



### Light connections

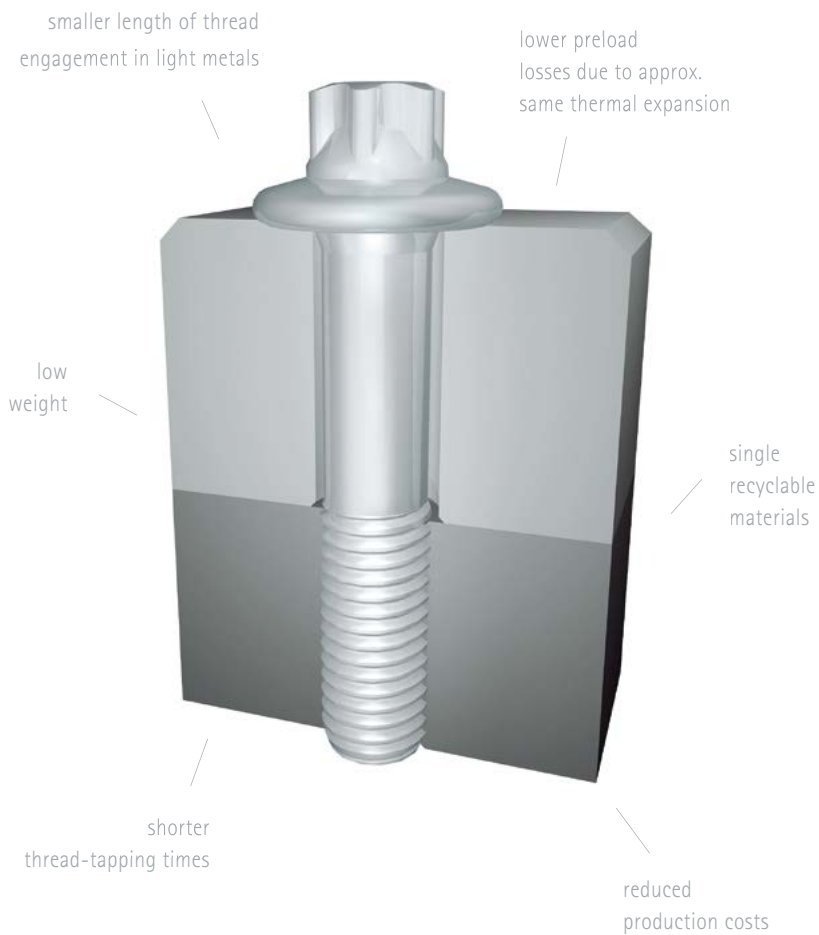
The RIBE-Aluform® screw is approx. 65 % lighter than a steel screw of the same design. The smaller length of thread engagement of the screw reduces the amount of material used for the connection, which also offers extra weight advantages. For example, the use of RIBE-Aluform® screws in a gearbox can save up to 500 g in weight. This reduced weight means lower mass forces, lower energy consumption, more space for other components, reduced forces and weight on other components, and easier handling.



## Advantages of RIBE-Aluform® screws

Aluminum, magnesium and RIBE-Aluform® screws respond very similarly to temperature changes due to their approximately equal coefficients of thermal expansion, so the quality of the connection remains virtually unchanged, even at increased operating temperatures.

These advantages more than offset the slightly higher production costs of RIBE-Aluform® screws. The outstanding application properties of RIBE-Aluform® are the result of extensive development work and tests in cooperation with many users.



### RIBE-Aluform® users:



DAIMLERCHRYSLER



GETRAG



RIBE-Aluform®  
LIGHT, STRONG, DURABLE



## Excellent mechanical properties

RIBE-Aluform® screws are made from a special AlMgSiCu alloy. An optimum heat treatment process combines high mechanical strength with good ductility and high corrosion resistance.

RIBE® uses its state-of-the-art furnace technology for RIBE-Aluform® screws, which is unique throughout the world and guarantees excellent mechanical properties with minimum variations.

Both tensile strength and yield strength can also be limited to defined ranges within the given window of values, e.g. tensile strength 400 – 420 MPa, 420 – 440 MPa or > 440 MPa, which means RIBE-Aluform® screws can be ideally matched to the various customer applications.



## Corrosion-resistant connections

The very similar electrochemical potential of RIBE-Aluform® screws makes them perfect for light metal connections of all common aluminum and magnesium alloys.

In contrast to steel screws, additional corrosion and surface protection measures are mostly unnecessary. Appreciable cost reductions can therefore be achieved particularly with magnesium parts, as the surface sealings or washers necessary to prevent contact corrosion with steel screws can be dispensed with.



RIBE-Aluform® magnesium housing connection before and after a 24-h salt spray test

The alloy used is also not susceptible to stress corrosion cracking, which is very important for screws as notched parts under tensile load.

## Thermally stable connections

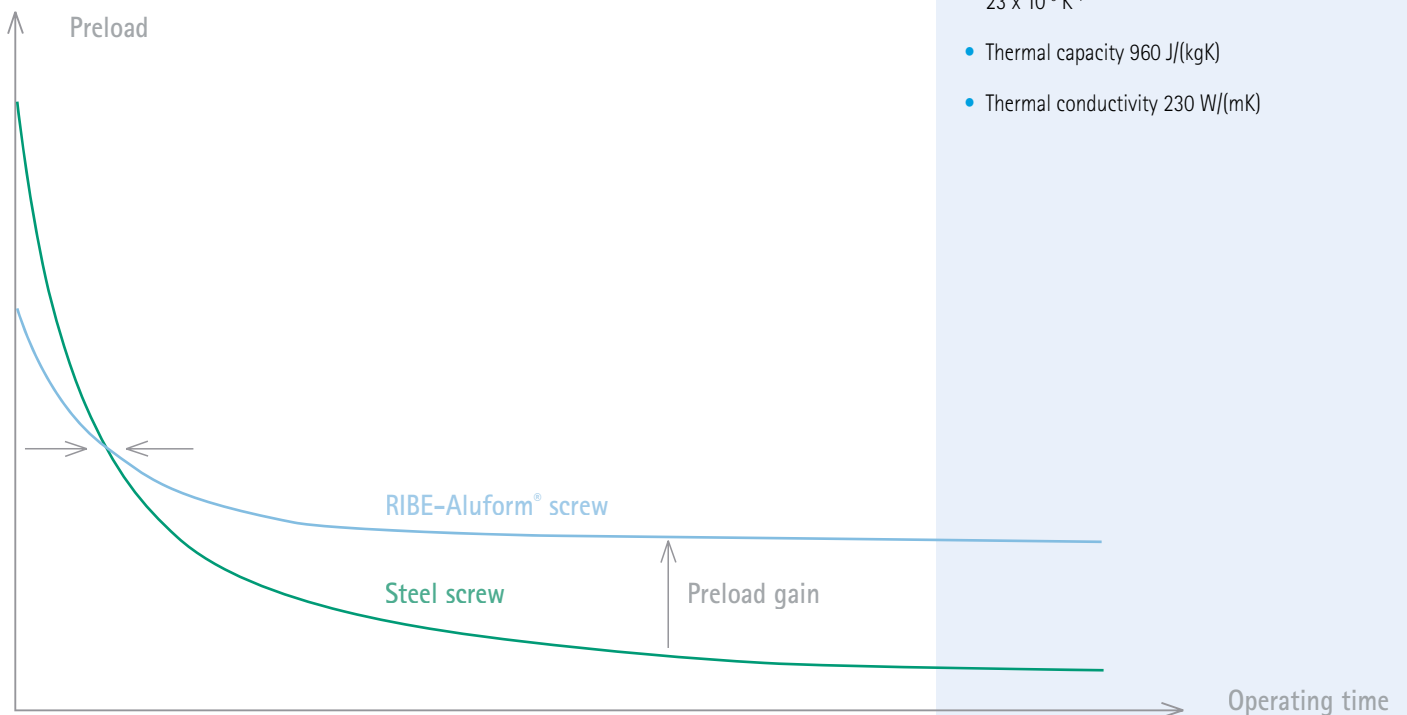
Light metals have a large coefficient of thermal expansion. If aluminum or magnesium parts are connected using a steel screw with a considerably lower coefficient of thermal expansion, a large additional load is exerted on the screw on heating up. This can lead to plastic deformation in the low-strength parts.

The connection is subject to a large preload loss after only a few temperature cycles, so that it becomes unstable and a risk to operational safety.

RIBE-Aluform® screws possess a coefficient of expansion that is approximately equal to that of the magnesium and aluminum parts to be connected, the increased preload due to thermal effects is extremely low and relaxation is reduced drastically.

## Properties of RIBE-Aluform®

- Aluminum alloy on AlMgSiCu basis
- Yield strength 350 MPa to 400 MPa
- Tensile strength 400 MPa to 450 MPa
- Elongation at fracture A5 (test rod) min. 10 %
- Elongation at fracture of whole screw min. 6 % (grip length 2d)
- Operating temperature up to 150 °C, short periods up to 180 °C
- Density 2.7 g/cm<sup>3</sup>
- Young's modulus 70,000 MPa
- Linear coefficient of thermal expansion  $23 \times 10^{-6} \text{ K}^{-1}$
- Thermal capacity 960 J/(kgK)
- Thermal conductivity 230 W/(mK)



Relaxation of steel screw and RIBE-Aluform® screw with magnesium parts and increased temperatures

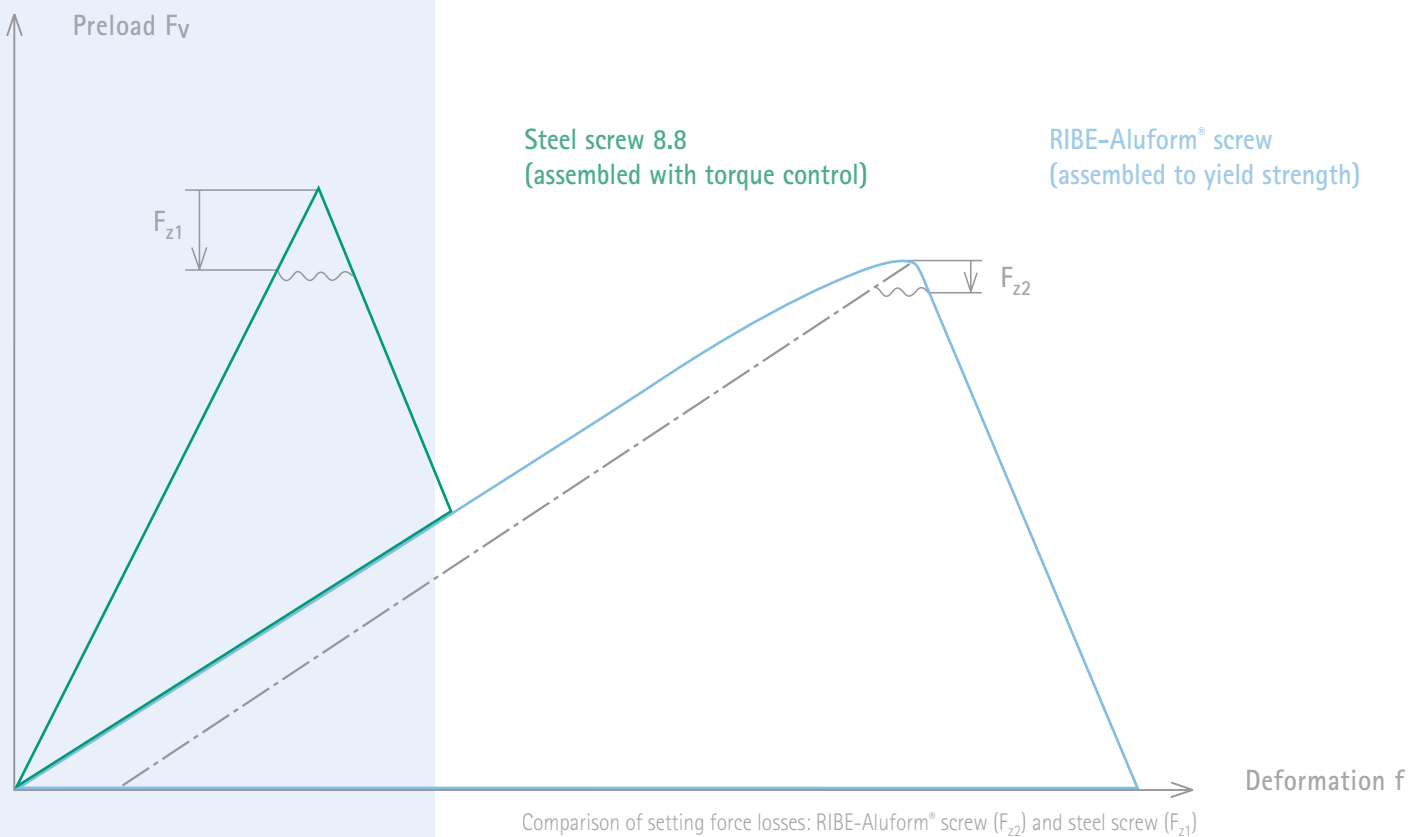
## Good connections

Due to the low E-modulus of aluminum ( $E_{Al} = 70,000$  MPa, compared with steel:  $E_{St} = 210,000$  MPa), the aluminum screw creates very flexible connections, which can only be approximately achieved by steel screws if high-strength friction grip screws with waisted shanks are used.

Under the operation loads existing in the connection, the great flexibility reduces the additional loads exerted on the screw. This is particularly advantageous in case of vibration.

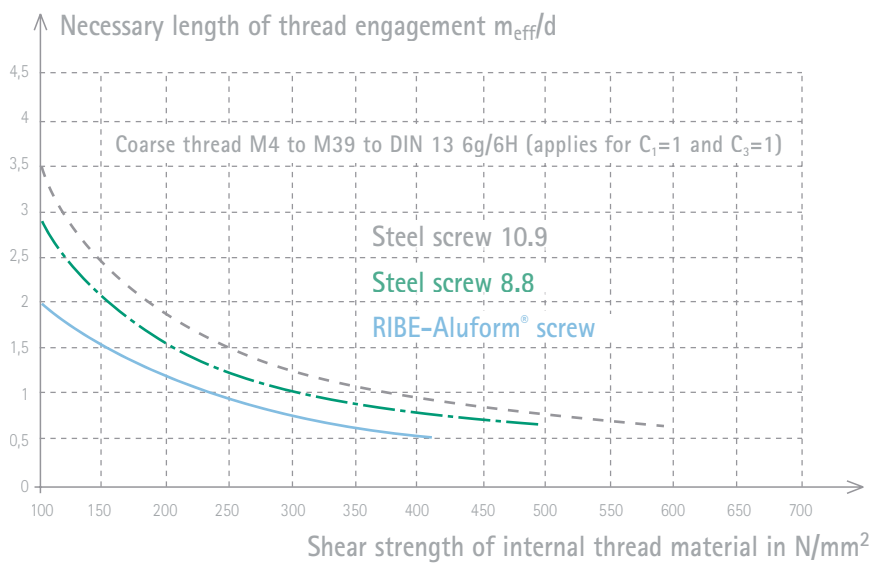
The flexible connection also has a lower preload loss during setting and creepage. This improves the reliability of the connection during assembly and operation.

The low E-modulus of RIBE-Aluform® screws means better surface adaptation of the head seating and thread flanks, which reduces the load on low-strength parts by reducing tensile load peaks.

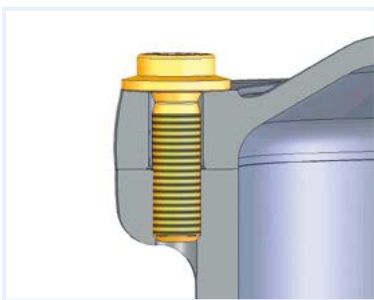


## RIBE-Aluform® reduces length of thread engagement

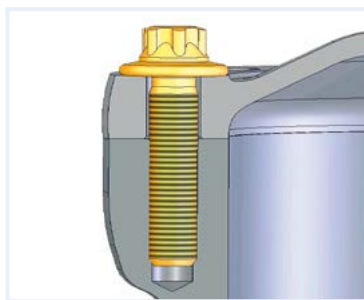
Screwed connections must be designed so that not even the highest possible tensile loads can strip the female thread. Modern assembly processes also require tightening to the yield strength to ensure a constant level of preload with minimized variation. Conventional steel screws allow high tensile loads, which require a correspondingly large length of thread engagement.



This length of thread engagement is particularly large for low-strength materials, such as magnesium, but quite the opposite for RIBE-Aluform®: This screw permits a particularly small length of thread engagement in aluminum and magnesium. This means less material used, shorter thread-tapping times, more compact design and more scope for the designer.



RIBE-Aluform® screw



Steel screw





## Geometric versions

All common screw designs are also possible for RIBE-Aluform® screws. Due to the lower face and edge pressure during torque transfer, we recommend screws with external or internal hexalobular drive.

If possible, RIBE-Aluform® screws should always be flange-type screws to reduce the surface pressure in the screw head.

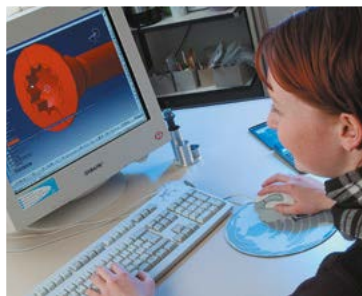
RIFIXX®, the screw-sleeve combination from RIBE® with significant assembly and logistic advantages, can also be supplied as RIBE-Aluform® RIFIXX®.



## Surfaces

RIBE-Aluform® screws are available with the following surfaces:

- bare, as cost-effective, heat-treated surface with no special visual requirements
- bare, brightened, for increased visual requirements
- hard anodized, for maximum mechanical load rating of surface
- yellow chromated, with improved corrosion properties
- color anodized, for decorative purposes and extra corrosion protection
- with all common sealing and adhesive thread-locking systems
- with colored head marking for reliably distinguishing from conventional screws





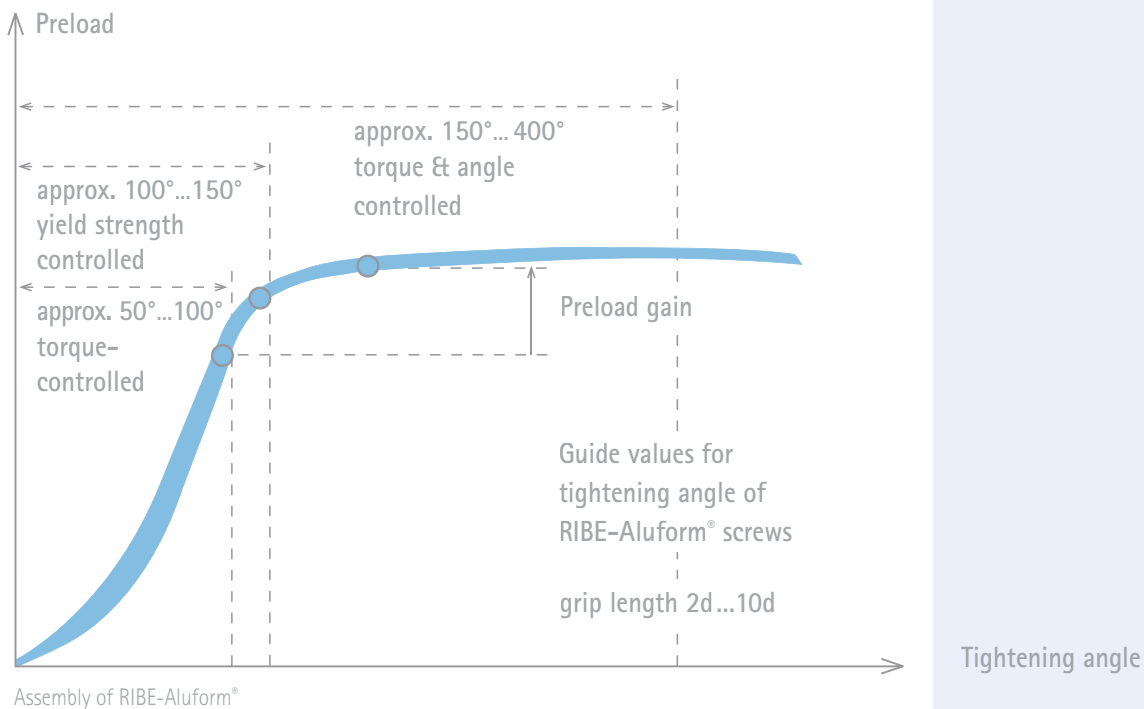
Other surface treatments are possible by arrangement, e.g. black, other colors or anodized surfaces. Special surfaces must be checked for possible effects on the mechanical and corrosive properties.

## Assembly properties

The diagram shows the relationship between preload and tightening angle for a screwed connection in the grip length range shown. Yield strength controlled tightening ensures the screw can be reused and high preloads. Torque and angle controlled tightening is also possible for RIBE-Aluform® screws because of their large uniform elongation. Here the user has the advantage of high preloads.

RIBE-Aluform® screws can be used at temperatures up to 150 °C and for short periods up to 180 °C.

The greater sensitivity of aluminum screws to notching is counteracted by the specially designed head-shank transition, which prevents head shearing on overload. RIBE-Aluform® screws nevertheless fit into holes with usual diameter tolerance.





## Sizes, surfaces and grip faces of RIBE-Aluform®

Sizes	M4-M20
Surfaces	<ul style="list-style-type: none"> <li>• bare</li> <li>• bare, brightened</li> <li>• hard anodized</li> <li>• yellow chromated</li> <li>• color anodized</li> <li>• with all common sealing and adhesive thread-locking systems</li> </ul>
Grip faces	



## Guide values for tightening torques and preloads for RIBE-Aluform®

The table contains only guide values, as each assembly up to or beyond the yield strength is affected by parameters such as the screw strength, rigidity of the connection, grip length and local friction conditions.

The coefficient of friction must be determined to obtain a reliable connection with high preload. RIBE-Aluform® screws are coated with a dry-touch lubricant for this purpose.



**Guide values for screws with minimum yield strength of 350 MPa, 6g coarse thread, shoulder head and bearing face diameter 2d**

Size	Min. breaking torque $M_B$ (Nm)	Min. breaking tensile force $R_{mmin} \cdot A_{smin}$ (kN)	Coefficient of friction $\mu_{ges}$ (-)	Tightening torque* $M_A$ (Nm)	Snug torque** $M_F$ (Nm)	Preload*** $F_M$ (kN)
M5	4.0	5.3	0.08	3.6	2.4	5.1
			0.12	4.2	2.9	4.8
			0.16	4.9	3.3	4.6
M6	6.7	7.5	0.10	6.0	4.1	7.1
			0.13	7.1	4.9	6.8
			0.16	8.2	5.6	6.5
M7	11	11	0.10	9.8	6.7	10
			0.13	12	8.2	9.9
			0.16	14	9.4	9.5
M8	16	14	0.10	15	10	13
			0.13	17	12	12
			0.16	20	14	11
M9	28	18	0.10	21	15	17
			0.13	25	18	16
			0.16	29	20	15
M10	33	22	0.10	28	20	21
			0.13	34	24	20
			0.16	40	27	19
M11	47	27	0.10	39	27	26
			0.13	47	32	25
			0.16	54	37	24
M12	58	32	0.10	50	34	30
			0.13	60	41	28
			0.16	70	48	26
M14	94	44	0.10	79	54	41
			0.13	95	65	39
			0.16	110	76	37
M16	152	60	0.10	121	83	56
			0.13	147	101	54
			0.16	171	117	52

\* Data apply for tightening up to yield strength; values for torque-controlled tightening x0.9

\*\* Data apply for controlled tightening; additional tightening angle  $\theta = 90^\circ$  for grip length 1d to 5d;  $\theta = 180^\circ$  for grip length over 5d

\*\*\* Level achievable for angular controlled tightening; forces for yield strength controlled tightening x0.9; forces for torque-controlled tightening x0.8 (when using 90 % of yield strength)

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LIGHT, STRONG, DURABLE

# RIBE®

MADE TO **fit**

Richard Bergner Verbindungstechnik GmbH & Co. KG  
Bahnhofstr. 8-16 · 91126 Schwabach · Germany · Telephone +49 (0) 91 22 / 87-0 · Fax +49 (0) 91 22 / 87-1503  
Email [Verbindungstechnik@ribe.de](mailto:Verbindungstechnik@ribe.de) · Internet [www.ribe.de](http://www.ribe.de)

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