Curved-tooth spindle couplings®
GS series
The curved-tooth spindle coupling®

For decades, curved-tooth couplings have proved themselves in practice all over the world. With the curved-tooth spindle coupling®, RENK has taken this technology one step further and developed a shaft connection that is torsionally rigid and yet movable in all directions. The special shape of the curved tooth allows a purely mechanical mobility without any elastic transmission elements, so that the spindle coupling establishes an entirely positive connection.

Thanks to this mobility in all directions, the curved-tooth spindle coupling® is able to compensate axial, angular and parallel shaft misalignments without any loss of the load-bearing capacity of the teeth flanks, which results in its exceptionally high performance. In order to achieve the smallest tip circle possible at a compact and solid tooth, RENK always uses Fellows Stub teeth for spindle couplings.

Curved-tooth spindle couplings® are primarily used whenever high torques must be transmitted at the smallest outside diameter while at the same time, larger misalignments have to be compensated. This applies especially to hot and cold rolling mills, continuous casting installations, straightening presses and rotary kilns.

With its wide range of possible coupling head designs, this driving link is not only the perfect choice for original equipment manufacturers but also ideal for conversions of upgrades of existing facilities.

In addition to the sizes listed in this brochure, curved-tooth spindle couplings® can be custom built to size 800. The technical data listed in the tables below and the designs shown in the drawings should only be seen as a guideline.

The optimum design for the specific application can be provided by adapting the geometric dimensions, selecting a different kind of sealing or choosing other materials.

Other options include a modification of the tooth system, the use of other hardening methods or the selection of different lubricants. All of these factors can have a significant influence on the final design of the individual curved-tooth spindle coupling®, which is always rated, calculated and built to the customer's specifications.

With decades of experience and the close collaboration between our design, development and sales departments, we are able to offer you almost any special solution conceivable. Some design examples can be found on the following pages.
Design and construction

Design and construction of each curved-tooth spindle coupling® are tailored to the specific requirements, based on rating using advanced technologies such as the Finite Element Method (FEM).

All curved-tooth spindle couplings® are made of hardened and tempered steel alloys with high yield strengths. The curved teeth of the hubs and the internal toothing are hardened and therefore highly resistant to wear. Also the axially loaded thrust plates and the thrust buttons in the spindle coupling heads are hardened.

The typical meshing behavior of curved teeth in combination with the straight internal toothing results in an exceptionally favorable load-bearing performance which is maintained even at maximum shaft misalignments. Since the points of contact of the tooth flanks are always near the tooth center, the applied torque is always transmitted by a large number of teeth. This not only reduces the loading of the individual tooth, it also ensures a very smooth rotary motion. Especially in rolling mill applications, this has beneficial effects on the quality of the rolled products. A load dependent self-centering – a combination of tooth tip/tooth flank centering – contributes to the excellent running behavior, particularly at higher speeds.

For today’s operators, high availability and a simple and fast replacement of key components are important factors. Moreover, a high degree of standardization of conversion parts offers the advantage of low inventory carrying cost.

Lubrication and sealing

Curved-tooth spindle couplings® can be lubricated with oil or with grease, allowing a flexible response to the specific requirements of the plant operator. The type of lubrication has a direct impact on the design of the spindle coupling.

For oil lubrication, we recommend sealing the spindle coupling with a rubber diaphragm. That diaphragm not only prevents oil from leaking out but also foreign matter or rolling emulsion from entering.

For grease lubrication, usually a slide ring with an O-ring seal is selected. The slide ring permits larger misalignments thanks to its radial mobility and thus reduces the churning work inside the O-ring. The selected location of the filler necks ensures that the lubricant can be easily introduced in every operating position.

Curved-tooth spindle couplings® can be lubricated with oil or with grease, allowing a flexible resp transmit highest torques in the most demanding environments. Therefore, the selection of the best suited lubricant deserves special attention. The use of the right lubricant can significantly extend the useful life of the spindle coupling.

A general preselection of the lubricant can be made on the basis of the list of recommended lubricants that is attached to all operating manuals. RENK will be pleased to help plant operators select the lubricant that is optimally suited for the specific requirements.
Considering all application factors, the nominal coupling torque must be higher than the nominal plant torque. The nominal coupling torque $T_{KN}$ therefore must be:

$$T_{KN} \geq T_N \cdot K_1 \cdot K_W$$

with

- $T_N$ = nominal plant torque [Nm]
- $K_1$ = service factor according to Table 1
- $K_W$ = alternating load factor according to Table 2

If known, also the peak torques or a possible short-circuit torque should be considered for the selection of the coupling.

Peak coupling torque ($T_{KP}$) (for $10^5$ changes of load)

$$T_{KP} = 1.5 \cdot T_{KN}$$

Maximum coupling torque ($T_{Kmax}$) (for $10^3$ changes of load)

$$T_{Kmax} = 3 \cdot T_{KN}$$

The vibratory torques and/or alternating directions of rotation are accounted for by the alternating load factor ($K_a$).

Additional information

The technical data in the tables of dimensions are based on an assumed misalignment of 1.5 degrees in operation and 3 degrees in standstill. The figures in the list of dimensions are valid for service temperatures from $-20$ °C to $+100$ °C.

For larger misalignments and/or other service temperatures, please contact RENK AG, Rheine plant.

### GS series with diaphragm seal for oil lubrication

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Total oil quantity l</th>
<th>Moment of inertia $I_{kgm^2}$</th>
<th>Weight kg</th>
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<tbody>
<tr>
<td>A mm</td>
<td>B mm</td>
<td>C mm</td>
<td>D mm</td>
</tr>
<tr>
<td>160</td>
<td>14,95</td>
<td>100</td>
<td>160</td>
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<td>180</td>
<td>26,0</td>
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<td>2,000</td>
<td>440</td>
<td>695</td>
</tr>
</tbody>
</table>

Angular misalignment during operation ±1.5 degrees, in standstill max. 3 degrees.

$^1$Weight and moment of inertia are based on the dimension $L_0 = 1,500$ mm.
**Design examples**

Curved-tooth spindle couplings® are tailored to the requirements of your plant. Apart from the various shaft connections and roll connections with flat journals or splines, a number of additional components are available.

**Version with hardened, replaceable angular gears (1) and a slide-ring seal (2) for grease lubrication**

**Version made of special case-hardened material for oil flow lubrication**

**Version with diaphragm seal (1), straightener (2), replaceable hardened steel jaws (3) and centering ring (4)**

**Flat journal profiles of the roll-side wobbler**

Flat journal profile produced by slotting, preferably used in bores that are large in relation to the outside diameter of the sleeve; exact guidance of the roll journal thanks to centering cams projecting into the inside diameter; optional nitrogen case hardening of the bore to increase the surface strength and wear resistance.

Flat journal profile with inserted hardened and ground steel jaws; high wear resistance against shock torque loads and damage of the coupling sleeve when changing the roll; steel jaws easily replaceable when required; low spare parts inventory carrying cost.

Flat journal profile with inserted jaws and guiding profiles made of hard plastic; high protection against fretting rust when aggressive coolants are used; low inventory carrying cost because only the plastic parts have to be kept available; simple replacement of wearing parts.

Other receptacles for the roll journals, e.g. gearing according to DIN 5480, multiple spline profiles or cloverleaf profiles are also possible.
Curved-tooth spindle coupling®

with HYGUARD® safety coupling

Overload protection devices in the drives of machinery primarily serve to protect valuable assets against damage due to unexpected overloads. Despite continuous modernization and technical advances in mechanical equipment, the risk of such damage has increased rather than decreased.

This can be explained by the rising competitive pressure exerted on the manufacturers who are forced to continuously optimize their equipment. Oversizing key components, which used to be common practice, is hardly applied any more. Modern calculation processes offer all opportunities to design key components in a way that they are continuously safe – despite the trend to lightweight construction.

Nevertheless, machine failures as a result of sudden unforeseeable overloads cannot be fully excluded, and a single damage may be much more expensive than the investment in an effective overload protection.

So appropriate safety devices are still required to protect the machinery. For drive systems, this primarily concerns safety couplings that are meanwhile available in a wide variety of designs. Yet, not all of these couplings are equally suited for every drive. For selecting the right coupling all of the factors that can result in a disruption of the operating process must be considered.

Because of their heavy-duty drives, rolling mills make especially high demands on torque limiting couplings. In case of an overload or a sudden blockage of the roll, the coupling will disengage immediately. This way, it avoids damage to the pinion stand that would otherwise be caused by the high moment of inertia of the drive motor.

The combination of the HYGUARD® system with the proven curved-tooth spindle coupling® acts like a safety coupling with torque limiter. The disengagement torque can be adjusted and remains constant over the entire service period – a reliable protection for valuable machinery and equipment.

Curved-tooth spindle couplings® in combination with a HYGUARD® safety coupling offer the following advantages:

- overload protection with adjustable limitation of the torque
- simple and fast re-starting after disengagement
- constant disengagement torque
- no interruption of the operation as a result of material fatigue
- low costs of downtime
- no costly stock keeping of spare parts.

Upon request, we shall gladly send you our HYGUARD® brochure with further details.