

Coupling description



General Description

ROTEX® GS – couplings are designed to transmit torque between drive and driven components with zero-backlash via curved jaw hubs and elastomeric elements, commonly known as spiders. The combination of these components provides dampening and accommodation of misalignment. This product is available in a variety of metals, elastomers and mounting configurations to meet your specific needs.

Function and Design

ROTEX® GS - couplings suitable for horizontal or vertical applications are constructed from a variety of materials and geometries, providing a torsionally flexible zero-backlash platform optimizing the balance between inertia, coupling performance and application requirements. The machined concaved jaws provide a pocket to preload the spider legs, allowing the spiders to articulate freely while accommodating misalignment, minimizing restoring forces, dampen shock and vibration, while providing failsafe zero-backlash torque transmission. The symmetrical relationship of the hubs allows for a variety of accessories to accommodate different shaft distances.

The unique geometry of the ROTEX® GS coupling minimizes spider expansion due to deformation at excessive speeds/loads as illustrated. In addition, a variety of spider materials and durometers contribute to the dampening characteristics of the system. Unlike rigid couplings, ROTEX® GS couplings not only provide adequate torsional stiffness, they also provide dampening to the system. System tuning is achieved by proper spider selection, balancing torque capacity and dampening characteristics of the coupling.

Interlocking curved jaws with a variety of standard clamping options accommodates shafts up to 3.625 inches and a maximum nominal torque of 21,242 lb-in while still accommodating blind assembly. As defined by the spider, ROTEX® GS couplings are suitable for moderate temperature ranges. Together these features reduce the maintenance required during the life-cycle of the coupling.

Explosion protection use

ROTEX® GS couplings are suitable for power transmission in hazardous areas. The couplings are certified and conform to EC standard 94/9/EC (ATEX 95) as units of category 2G/2D and are suitable for use in hazardous areas of zone 1, 2, 21 and 22. Please read through the information included in our Type Examination Certificate and the operating and installation instructions at www.ktr.com.

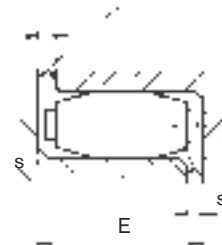
Selection: When used in hazardous areas, the clamping ring hubs / hubs without keyway for use in category 3 must be selected with a minimum safety factor of $s = 2$ between the peak application torque (including all operating parameters) and both the nominal torque and transmittable frictional torque of the coupling.

Curved jaws prevent spider from extruding at higher speeds



Support to the axis of rotation

Electric isolation due to gap dimension "s"

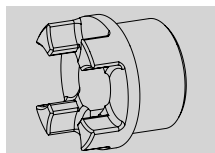


Spider						
Description of spider hardness [Shore]	Identification Color	Material	Permissible temperature range [° F]		Available for coupling size	Typical applications
			Max. Continuous	Max. peak		
80 Sh A-GS		Polyurethane	-58 to +176	-76 to +248	size 5 to 24	– drives of electric measuring systems
92 Sh A-GS		Polyurethane	-40 to +194	-58 to +248	size 5 to 55	– drives of electric measuring and control systems
95/98 Sh A-GS		Polyurethane	-22 to +194	-40 to +248	size 5 to 75	– positioning drives – main spindle drives – high load
64 Sh D-H-GS		Hytrel	-58 to +248	-76 to +302	size 7 to 38	– planetary gears / backlash-free gears – heighten torsional stiffness / high load – high ambient temperatures / resistant to hydrolysis
64 Sh D-GS		Polyurethane	-4 to +230	-22 to +248	size 42 to 75	– planetary gears / backlash-free gears – heighten torsional stiffness / high load – high ambient temperatures / resistant to hydrolysis
72 Sh D-H-GS		Hytrel	-58 to +248	-76 to +302	size 24 to 38	– very high torsional stiffness – very high load
72 Sh D-GS		Polyurethane	-4 to +230	-22 to +248	size 42 to 55	– very high torsional stiffness – very high load

Hub designs

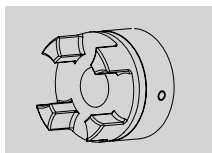
The ROTEX® GS is suitable for many applications and mounting requirements and comes in a variety of hub designs. These designs offer keyed or frictionally engaged (zero-backlash) connections in addition to unique connections like hollow shafts.

Design 1.0 with keyway and setscrew



Positive torque transmission. Transmittable torque is dependent on surface pressure on the keyway only. Not suitable for zero-backlash reversing applications.

Design 1.1 without keyway, with setscrew



Limited torque transmission. Transmittable torque is dependent on setscrew to shaft displacement. Suitable for zero-backlash transmission with very small torques. Typically used on smaller coupling sizes.

(Only for ATEX category 3)

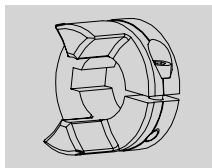
Design 2.0 clamping hub, single slotted, without keyway



Frictionally engaged shaft-hub-connection. Transmittable torque depends on the bore size. Design 2.0 standard up to size 14.

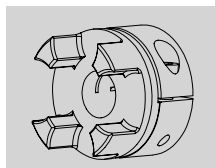
(Only for ATEX category 3)

Design 2.1 clamping hub, single slotted, with keyway



Positive torque transmission frictionally engaged shaft-hub-connection. The frictional connection reduces reversal backlash and keyway surface pressure. Positive power transmission with additional frictional engaged shaft connection. Reduced surface pressure on keyway. Design 2.1 standard up to size 14

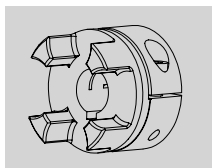
Design 2.5 clamping hub, double slotted, without keyway



Frictionally engaged shaft-hub-connection. Transmittable torque depends on the bore size. Design 2.5 standard from size 19.

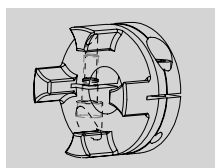
(Only for ATEX category 3)

Design 2.6 clamping hub, double slotted, with keyway



Positive power transmission with additional frictional engaged shaft connection. The frictional connection reduces reversal backlash and keyway surface pressure. Concentric jaw location due to symmetrical clamp. Design 2.6 standard from size 19

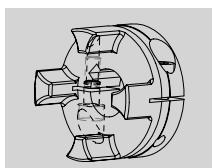
Design 2.8 short clamping hub with axial slots without keyway



Frictionally engaged shaft-hub-connection. Concentric jaw location due to symmetrical clamp. Design 2.8 standard for compact hubs up to size 24.

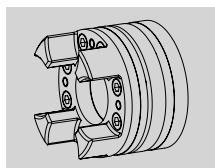
(Only for ATEX category 3)

Design 2.9 short clamping hub with axial slots and keyway



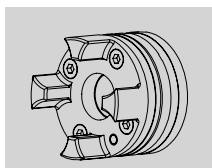
Positive power transmission with additional frictional engaged shaft connection. The frictional connection reduces reversal backlash and keyway surface pressure. Concentric jaw location due to symmetrical clamp. Design 2.9 standard on compact series from size 24.

Design 6.0 clamping ring hub



Integrated concentric locking ring. Transmittable torque depends on the bore size. Excellent concentric properties due to locking ring. Mounting screws from jaw face of hub. Suitable for high speeds.

Design 6.0 P precision clamping ring hub



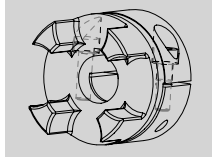
Similar to Design 6.0, but highly accurate machining. Suitable for higher speeds

Design 7.5 axially split clamping hub without keyway for double-cardanic connections



Frictionally engaged shaft-hub connection for radial assembly of couplings. Transmittable torque is dependent on bore size.

Design 7.6 axially split clamping hub with keyway for double-cardanic connections



Frictionally engaged shaft-hub connection for radial assembly of couplings. Positive power transmission with additional frictional engaged shaft connection. The frictional connection reduces reversal backlash and keyway surface pressure.

Design 7.8 shell clamping hub without feather keyway for single-cardanic connection

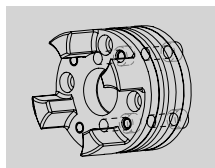


Design 7.9 shell clamping hub with feather keyway for single-cardanic connection



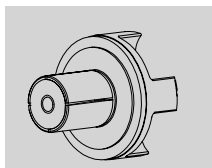
Special designs on request of customers

Design 6.5 clamping ring hub



Integrated concentric locking ring. Transmittable torque depends on the bore size.

Design 9.0 Expansion hub



Frictionally engaged connection for hollow shaft. Transmittable torque depends on the bore diameter and the hollow shaft.

Technical data

Size	Spider Shore-GS	Shore range	Max. speed [rpm] for hub design				Torque [lb-in]		Static torsion spring stiffness ¹⁾ [lb-in/rad]	Dynamic torsion spring stiffness ¹⁾ [lb-in/rad]	Radial stiffness C _r [lbf/in]	Weight [lb]		Mass moment of inertia J [lb-in-sec ²]	
			2.0 / 2.1 2.5 / 2.6	1.0/1.1	6.0 ²⁾	6.0 P ²⁾	T _{KN}	T _{K max}				each hub ³⁾	spider	each hub ³⁾	spider
5	70	A	38,000	4,700			1.8	2.66	15.75	44.26	246	0.002	0.0004	1.33 x 10 ⁻⁷	1.77 x 10 ⁻⁸
	80	A					2.7	5.31	27.88	88.51	468				
	92	A					4.4	8.85	45.67	141.62	879				
	98	A					8.0	15.05	73.46	221.28	1,690				
	80	A					6.2	12.39	76.12	230.13	651				
7	92	A	27,000	34,100			11	21	127	381	1,938	0.007	0.0011	7.52 x 10 ⁻⁷	8.85 x 10 ⁻⁷
	98	A					18	35	203	611	3,726				
	64	D					21	42	304	912	5,576				
	80	A					16	32	152	460	1,106				
9	92	A	19,000	23,800			27	53	279	841	2,319	0.020	0.0037	4.25 x 10 ⁻⁶	7.52 x 10 ⁻⁷
	98	A					44	89	457	1,372	4,585				
	64	D					53	106	660	1,983	6,541				
	80	A					27	53	746	2,230	2,425				
12	92	A	15,200	19,100			44	89	1,420	4,266	4,160	0.044	0.0051	1.33 x 10 ⁻⁵	1.23 x 10 ⁻⁶
	98	A					80	159	2,130	6,355	7,488				
	64	D					106	212	2,902	8,692	10,603				
	80	A					35	71	533	1,593	1,354				
14	92	A	12,700	15,900	32,000	47,700	66	133	1,014	3,045	2,974	0.044	0.0104	2.48 x 10 ⁻⁵	4.51 x 10 ⁻⁶
	98	A					111	221	1,521	4,541	5,789				
	64	D					142	283	2,073	6,213	7,576				
	80	A					43	87	5,470	9,426	5,151				
19	92	A	9,550	11,900	24,000	35,800	89	177	9,648	16,065	9,913	0.198	0.0154	1.73 x 10 ⁻⁴	1.19 x 10 ⁻⁵
	98	A					150	301	13,383	22,482	17,791				
	64	D					186	372	22,659	33,722	25,933				
	92	A					310	620	20,180	35,493	13,099				
24	98	A	6,950	8,650	17,000	26,000	531	1,062	32,218	52,929	22,659	0.441	0.0441	7.25 x 10 ⁻⁴	5.93 x 10 ⁻⁵
	64	D					664	1,328	44,521	96,432	32,713				
	72 ³⁾	D					859	1,717	88,014	151,308	51,327				
	92	A					841	1,682	36,112	59,700	28,323				
28	98	A	5,850	7,350	15,000	22,000	1,416	2,832	56,735	87,802	28,323	0.662	0.0662	1.63 x 10 ⁻³	1.31 x 10 ⁻⁴
	64	D					1,770	3,540	90,811	178,587	38,484				
	72 ³⁾	D					2,301	4,603	190,527	323,477	69,710				
	92	A					1,682	3,363	57,753	97,804	13,421				
38	98	A	4,750	5,950	12,000	17,900	2,877	5,753	104,442	151,883	25,128	1.323	0.1103	4.80 x 10 ⁻³	3.49 x 10 ⁻⁴
	64	D					3,585	7,169	232,781	376,300	36,973				
	72 ³⁾	D					4,647	9,294	394,613	630,014	101,123				
	92	A					2,346	4,691	96,210	138,784	21,508				
42	98	A	4,000	5,000	10,000 8,050 ⁴⁾	15,000	3,983	7,966	191,128	333,612	49,300	5.92	0.1764	2.48 x 10 ⁻²	7.52 x 10 ⁻⁴
	64	D					4,957	9,913	326,248	554,073	64,347				
	72 ³⁾	D					6,444	12,887	518,669	830,224	86,439				
	92	A					2,744	5,488	114,780	162,858	22,836				
48	98	A	3,600	4,550	9,100 7,200 ⁴⁾	13,600	4,647	9,294	227,993	403,783	52,486	7.277	0.1985	4.17 x 10 ⁻²	1.19 x 10 ⁻³
	64	D					5,797	11,595	510,083	882,887	73,233				
	72 ³⁾	D					7,541	15,082	708,080	1,212,127	100,539				
	92	A					3,629	7,258	137,031	189,190	17,019				
55	98	A	3,150	3,950	6,350 ⁴⁾	11,900	6,063	12,126	372,778	544,779	38,184	11.246	0.2646	8.37 x 10 ⁻²	2.03 x 10 ⁻³
	64	D					7,302	14,604	935,816	1,152,400	52,815				
	72 ³⁾	D					9,488	18,977	1,327,650	1,854,550	81,854				
	95	A					8,320	16,640	429,451	634,263	56,806				
65	64	D	2,800	3,500	5,650 ⁴⁾	11,000	10,400	20,800	1,048,932	1,674,512	78,508	14.774	0.4410	1.34 x 10 ⁻¹	3.87 x 10 ⁻¹
	72 ³⁾	D					13,515	27,031	1,416,160	2,743,810	104,760				
75	95	A	2,350	2,950	4,750 ⁴⁾	8,950	16,994	33,988	700,557	1,331,633	76,561	23.153	0.6615	2.90 x 10 ⁻¹	1.04 x 10 ⁻²
	64	D					21,242	42,485	1,613,714	2,800,253	105,530				
90	95	A	1,900	2,380	3800 ⁴⁾	-	3,600	7,200	204,500	302,900	10,700	40.131	1.3230	7.71 x 10 ⁻¹	2.98x 10 ⁻²
	64	D					4,500	9,000	429,450	908,700	14,700				

¹⁾ Static and dynamic torsional stiffness with 0.5 x T_{KN} ²⁾ Higher max speeds available on request, contact KTR engineering

³⁾ With use of the 72 Sh-D spider we would recommend to use hubs from steel

⁴⁾ Clamping ring hubs 6.0 from steel

⁵⁾ Hubs with average bore type 1.0

The coupling selection per KTR recommendations (page 123). Coupling load must not exceed allowable load in any operating condition. The torques T_{KN}/T_{Kmax} mentioned refer to the spider. The shaft-hub-connection has to be investigated by the customer.

1. Definitions for coupling selection

T _{KN}	Rated torque of coupling - Torque which can be transmitted continuously over the entire permissible speed range, taking into account the operating factors (S _t , S _d).
T _{Kmax}	Maximum torque of coupling - Torque which can be transmitted during the full service life of the coupling as dynamic load ≥ 10 ⁵ or as alternating load 5 · 10 ⁴ , taking into account the operating factors (S _t , S _d , S _A).
T _R	Friction torque - Torque which can be transmitted by the frictionally engaged shaft-hub-connection.
T _{AN}	Constant driving torque as per the data indicated by the driver manufacturer
T _{AS}	Maximum driving torque as per the data indicated by the driver manufacturer As in case of shock loads when driving with A. C. motor, for example during acceleration or breakdown torque of the A. C. motor.
T _S	Peak torque [lb-in] Peak torque on the coupling, calculated from max driving torque T _{AS} , rotational inertia coefficient m _A or m _L and operating factor S _A .
S _t	Temperature factor - Factor used when considering the lower loading capacity or larger deformation of an elastomer part under load as a result of elevated ambient temperatures. If ambient temperatures exceed 175°F (80 °C) we recommend to using the RADEX®-NC (see page 148).

S _d	Torsional stiffness factor - Factor used when considering the different amounts of torsional stiffness and fatigue strength of the coupling for reversing applications and couplings with 64 Sh D-GS hubs made of aluminum. For positioning drives with increased demand on torsional stiffness we would recommend the use of the TOOLFLEX® or RADEX®-NC (see page 141 and 148).
S _A	Operating factor - Factor used when considering the occurring shock loads such as starts each minute, depending on the use
m _{A(L)}	Rotational inertia coefficient of driving side (load side) Factor used when considering the distribution of masses in case of drive and load side shocks and vibration excitation.

Coupling selection

2. Factors

Temperature factor S_t [°F]				
	-22 °F +86 °F	+104 °F	+140 °F	+176 °F
S_t	1.0	1.2	1.4	1.8

See note on page 121.

Torsional stiffness factor S_d		
Main spindle drive of machine tool	Positioning drive (x - y axis)	Shaft encoders Angle encoders
2 - 5*	3 - 8*	10 →

See note on page 121

*When using the 64 Sh D-GS spider at least factor 4

Operating factor S_A		
main spindle drive	positioning drive*	S_A
light shock loads	≤ 60	1.0
average shock loads	≥ 60 ≤ 300	1.4
heavy shock loads	≤ 300	1.8

*Starts/minute

3. Calculation formula

The size of the coupling must be selected so that the following conditions are met.

$$T_{KN} \geq T_N \cdot S_t \cdot S_d$$

and

$$T_{KN} \geq T_S \cdot S_t \cdot S_d$$

For the factors please see the tables at the top.

Peak torque

$$\begin{aligned} T_S &= T_{AS} \times m_A \times S_A \\ T_S &= T_{LS} \times m_L \times S_L \end{aligned}$$

$$\begin{aligned} m_A &= \frac{J_L}{J_A + J_L} & J_A &= \text{Moment of inertia of driving side} \\ m_L &= \frac{J_A}{J_A + J_L} & J_L &= \text{Moment of inertia of load side} \end{aligned}$$

4. Calculation example (positioning drive)

Given: Details of driving side

Servo motor
Rated torque T_{AN} = 380 lb-in
Max. drive torque T_{AS} = 1,275 lb-in
Moment of inertia J_{Mot} = 0.096 lb-in-sec²
Drive shaft d = 1.250 in k6 without keyway

Details of driven side

Ball screw J_{Sp} = 0.034 lb-in-sec²
Screw pitch s = 0.394 in
Driven shaft d = 1.125 in k6 without keyway
Mass of table and work piece m_{Schl} = 2271 lb

Ambient temperature t = 104 °F → S_t = 1.4
60 starts/minute required → S_A = 1.0



required:
high torsional stiffness → S_d = 4

Preliminary consideration:

ROTEX® GS clamping ring hub - axial plug-in zero-backlash jaw coupling with frictionally engaged shaft-hub-connection.

1 Moment of inertia of table and work piece reduced to drive axis.

$$J_{Schl} = m_{Schl} \cdot 2.681 \frac{\text{sec}^2}{\text{lb}_m} \left(\frac{s}{2 \cdot p} \right)^2 = [\text{lb-in-sec}^2] \quad J_{Schl} = 2,271 \text{ lb} \cdot 2.681 \frac{\text{sec}^2}{\text{lb}_m} \left(\frac{0.394 \text{ in}}{2 \cdot p} \right)^2 = 0.023 \text{ lb-in-sec}^2$$

Coupling selection

1 Selection according to rated torque (pre-selection)

$$T_{KN} \geq T_{AN} \cdot S_t \cdot S_d \quad T_{KN} \geq 380 \text{ lb-in} \cdot 1.2 \cdot 4 \quad T_{KN} \geq 1,824 \text{ lb-in}$$

1 Coupling selection: ROTEX® GS 38 - 98 Sh A-GS - clamping hub design T_{KN} 2,876 lb-in

1 Review of max. driving torque

$$\begin{aligned} T_{KN} &\geq T_S \cdot S_t \cdot S_d \\ T_S &= T_{AS} \cdot m_A \cdot S_A \\ m_A &= \frac{J_L}{J_A + J_L} = \frac{0.065}{0.104 + 0.065} = 0.385 \\ J_L &= (J_{Sp} + J_{Schl} + \frac{1}{2} J_K) = 0.034 + 0.023 + 0.008 = 0.065 \text{ lb-in-sec}^2 \\ J_A &= J_{Mot} + \frac{1}{2} J_K = 0.096 + 0.008 = 0.104 \text{ lb-in-sec}^2 \\ T_S &= 1,274 \text{ lb-in} \cdot 0.385 \cdot 1.0 = 490.5 \text{ lb-in} \\ T_{KN} &\geq 490.5 \text{ lb-in} \cdot 1.2 \cdot 4 \\ \text{ROTEX® GS 38 - 98 Sh A-GS } T_{KN} &= 2,876 \text{ lb-in} \\ T_{KN} &\geq 2,354.4 \text{ lb-in} \end{aligned}$$

1 Check of torque transmission of clamping ring hub for shaft diameter Ø 1.125 in

$$T_R > T_{AS} \quad \text{Figures for } T_R \text{ see table on catalog page 133.} \\ \text{Transmittable torque } T_R \text{ Ø 1.125 in H7/k6} = 3,523 \text{ lb-in} > 1,274 \text{ lb-in}$$

ROTEX® GS part numbers

ROTEX® GS Hubs - Part numbers by product size and material (design 2.0, 2.5)							
Inch Bore	5	7	9	12	14	19	24
	Aluminum						
1/8	BA550057150370	BA550077150370					
3/16	BA550057150470	BA550077150470	BA550097150470	BA550127150470	BA550147150470		
1/4		BA550077150670	BA550097150670	BA550127150670	BA550147150670	BA550197150670	
5/16		BA550077150770	BA550097150770	BA550127150770	BA550147150770	BA550197150770	
3/8			BA550097150970	BA550127150970	BA550147150970	BA550197150970	BA550247150970
7/16				BA550127151170	BA550147151170	BA550197151170	BA550247151170
1/2					BA550147151270	BA550197151270	BA550247151270
9/16					BA550147151470	BA550197151470	BA550247151470
5/8					BA550147151570	BA550197151570	BA550247151570
11/16						BA550197151770	BA550247151770
3/4						BA550197151970	BA550247151970
13/16							BA550247152070
7/8							BA550247152270
15/16							BA550247152370
1							BA550247152570

Inch bores machined to AGMA Class 1

Bores with keyway and non standard bores available. Consult KTR Engineering

ROTEX® GS Hubs - Part numbers by product size and material (design 2.0, 2.5)							
Metric Bore	5	7	9	12	14	19	24
	Aluminum						
2	BA550057150250						
3	BA550057150350	BA550077150350					
4	BA550057150450	BA550077150450	BA550097150450	BA550127150450			
5	BA550057150550	BA550077150550	BA550097150550	BA550127150550	BA550147150550		
6		BA550077150650	BA550097150650	BA550127150650	BA550147150650		
7		BA550077150750	BA550097150750	BA550127150750	BA550147150750		
8			BA550097150850	BA550127150850	BA550147150850	BA550197150850	
9			BA550097150950	BA550127150950	BA550147150950	BA550197150950	
10			BA550097151050	BA550127151050	BA550147151050	BA550197151050	BA550247151050
11			BA550097151150	BA550127151150	BA550147151150	BA550197151150	BA550247151150
12				BA550127151250	BA550147151250	BA550197151250	BA550247151250
14					BA550147151450	BA550197151450	BA550247151450
15					BA550147151550	BA550197151550	BA550247151550
16					BA550147151650	BA550197151650	BA550247151650
18						BA550197151850	BA550247151850
19						BA550197151950	BA550247151950
20						BA550197152050	BA550247152050
22							BA550247152250
24							BA550247152450
25							BA550247152550
28							BA550247152850
30							
32							
35							
38							

Metric bores machined to H7

Bores with keyway and non standard bores available. Consult KTR Engineering

ROTEX® GS part numbers

ROTEX® GS Hubs - Part numbers by product size (design 6.0 light)							
Inch Bore	14	19	24	28	38	42	48
Aluminum jaw hub / Aluminum clamping ring							
1/4	BA550147160691						
5/16	BA550147160791						
3/8	BA550147160991	BA550197150991	BA550247150991				
7/16	BA550147161191	BA550197151191	BA550247151191				
1/2	BA550147161291	BA550197151291	BA550247151291				
5/8		BA550197151591	BA550247151591	BA550287151591	BA550387151591		
3/4		BA550197151991	BA550247151991	BA550287151991	BA550387151991		
7/8			BA550247152291	BA550287152291	BA550387152291	BA550427152291	
1			BA550247152591	BA550287152591	BA550387152591	BA550427152591	BA550487152591
1 1/8				BA550287152891	BA550387152891	BA550427152891	BA550487152891
1 1/4				BA550287153191	BA550387153191	BA550427153191	BA550487153191
1 3/8				BA550287153491	BA550387153491	BA550427153491	BA550487153491
1 1/2				BA550287153891	BA550387153891	BA550427153891	BA550487153891
1 5/8					BA550387154191	BA550427154191	BA550487154191
1 3/4					BA550387154491	BA550427154491	BA550487154491
1 7/8						BA550427154791	BA550487154791
2						BA550427155091	BA550487155091
2 1/8							BA550487155391

Bores machined to H7 and from 1.969 in G7

Additional bore sizes available. Consult KTR Engineering

ROTEX® GS Hubs - Part numbers by product size (design 6.0 light)							
Metric Bore	14	19	24	28	38	42	48
Aluminum jaw hub / Aluminum clamping ring							
6	BA550147160690						
10	BA550147161090	BA550197151090					
11	BA550147161190	BA550197151190					
14	BA550147161490	BA550197151490	BA550247151490				
15		BA550197151590	BA550247151590	BA550287151590			
16		BA550197151690	BA550247151690	BA550287151690			
18		BA550197151890	BA550247151890	BA550287151890			
19		BA550197151990	BA550247151990	BA550287151990			
20		BA550197152090	BA550247152090	BA550287152090	BA550387152090		
22			BA550247152290	BA550287152290	BA550387152290		
24			BA550247152490	BA550287152490	BA550387152490		
25			BA550247152590	BA550287152590	BA550387152590	BA550427152590	
28			BA550247152890	BA550287152890	BA550387152890	BA550427152890	
30				BA550287153090	BA550387153090	BA550427153090	BA550487153090
32				BA550287153290	BA550387153290	BA550427153290	BA550487153290
35				BA550287153590	BA550387153590	BA550427153590	BA550487153590
38				BA550287153890	BA550387153890	BA550427153890	BA550487153890
40					BA550387154090	BA550427154090	BA550487154090
42					BA550387154290	BA550427154290	BA550487154290
45					BA550387154590	BA550427154590	BA550487154590
48						BA550427154890	BA550487154890
50						BA550427155090	BA550487155090
55							BA550487155590

Bores machined to H7 and from 50 mm G7

Additional bore sizes available. Consult KTR Engineering

ROTEX® GS Spiders - Part numbers by product size and material									
Type / Hardness	Color	Material	5	7	9	12	14	19	24
80 SH A-GS	Blue	Polyurethane	550051000003	550071000003	550091000003	550121000003	550141000003	550191000003	
92 SH A-GS	Yellow	Polyurethane	550051000001	550071000001	550091000001	550121000001	550141000001	550191000001	550241000001
95/98 SH A-GS	Red	Polyurethane	550051000002	550071000002	550091000002	550121000002	550141000002	550191000002	550241000002
64 SH D-H-GS	Green	Hytrel	550051000025	550071000025	550091000025	550121000025	550141000025	550191000025	550241000025

ROTEX® GS part numbers

ROTEX® GS Hubs - Part numbers by product size and clamping design (Design 2.5)							
Inch Bore	28	38	42	48	55	65	75
	Aluminum		Steel				
1/2	BA550287151270						
9/16	BA550287151470	BA550387151470					
5/8	BA550287151570	BA550387151570					
11/16	BA550287151770	BA550387151770					
3/4	BA550287151970	BA550387151970					
13/16	BA550287152070	BA550387152070	BA550425052070				
7/8	BA550287152270	BA550387152270	BA550425052270				
15/16	BA550287152370	BA550387152370	BA550425052370				
1	BA550287152570	BA550387152570	BA550425052570	BA550485052570			
1 1/8	BA550287152870	BA550387152870	BA550425052870	BA550485052870	BA550555052870		
1 1/4	BA550287153170	BA550387153170	BA550425053170	BA550485053170	BA550555053170		
1 3/8	BA550287153470	BA550387153470	BA550425053470	BA550485053470	BA550555053470	BA550655053470	
1 1/2	BA550287153870	BA550387153870	BA550425053870	BA550485053870	BA550555053870	BA550655053870	BA550755053870
1 5/8		BA550387154170	BA550425054170	BA550485054170	BA550555054170	BA550655054170	BA550755054170
1 3/4		BA550387154470	BA550425054470	BA550485054470	BA550555054470	BA550655054470	BA550755054470
1 7/8				BA550485054770	BA550555054770	BA550655054770	BA550755054770
2				BA550485055070	BA550555055070	BA550655055070	BA550755055070
2 1/8					BA550555055370	BA550655055370	BA550755055370
2 1/4					BA550555055770	BA550655055770	BA550755055770
2 3/8					BA550555056070	BA550655056070	BA550755056070
2 1/2					BA550555056370	BA550655056370	BA550755056370
2 5/8						BA550655056670	BA550755056670
2 3/4						BA550655056970	BA550755056970
2 7/8							BA550755057370
3							BA550755057670
3 1/8							BA550755057970

Inch bores machined to AGMA Class 1

Bores with keyway and non standard bores available. Consult KTR Engineering

ROTEX® GS Hubs - Part numbers by product size and material (Design 2.5)							
Metric Bore	28	38	42	48	55	65	75
	Aluminum		Steel				
14	BA550287151450						
15	BA550287151550	BA550387151550					
16	BA550287151650	BA550387151650					
18	BA550287151850	BA550387151850					
19	BA550287151950	BA550387151950					
20	BA550287152050	BA550387152050	BA550425052050				
22	BA550287152250	BA550387152250	BA550425052250				
24	BA550287152450	BA550387152450	BA550425052450				
25	BA550287152550	BA550387152550	BA550425052550	BA550485052550			
28	BA550287152850	BA550387152850	BA550425052850	BA550485052850			
30	BA550287153050	BA550387153050	BA550425053050	BA550485053050			
32	BA550287153250	BA550387153250	BA550425053250	BA550485053250	BA550555053250		
35	BA550287153550	BA550387153550	BA550425053550	BA550485053550	BA550555053550	BA550655053550	
38	BA550287153850	BA550387153850	BA550425053850	BA550485053850	BA550555053850	BA550655053850	
40		BA550387154050	BA550425054050	BA550485054050	BA550555054050	BA550655054050	
42		BA550387154250	BA550425054250	BA550485054250	BA550555054250	BA550655054250	BA550755054250
45		BA550387154550	BA550425054550	BA550485054550	BA550555054550	BA550655054550	BA550755054550
48			BA550425054850	BA550485054850	BA550555054850	BA550655054850	BA550755054850
50			BA550425055050	BA550485055050	BA550555055050	BA550655055050	BA550755055050
55				BA550485055550	BA550555055550	BA550655055550	BA550755055550
60					BA550555056050	BA550655056050	BA550755056050
65					BA550555056550	BA550655056550	BA550755056550
70						BA550655057050	BA550755057050
75							BA550755057550
80							BA550755058050

Metric bores machined to H7

Bores with keyway and non standard bores available. Consult KTR Engineering

ROTEX® GS part numbers

ROTEX® GS Hubs - Part numbers by product size (Design 6.0 steel)							
Inch Bore	28	38	42	48	55	65	75
	Steel jaw hub / Steel clamping ring						
5/8	BA550285151581	BA550385151581					
3/4	BA550285151981	BA550385151981					
7/8	BA550285152281	BA550385152281	BA550425052281				
1	BA550285152581	BA550385152581	BA550425052581	BA550485052581			
1 1/8	BA550285152881	BA550385152881	BA550425052881	BA550485052881			
1 1/4	BA550285153181	BA550385153181	BA550425053181	BA550485053181	BA550555053181		
1 3/8	BA550285153481	BA550385153481	BA550425053481	BA550485053481	BA550555053481		
1 1/2	BA550285153881	BA550385154381	BA550425053881	BA550485053881	BA550555053881	BA550655053881	
1 5/8		BA550385154181	BA550425054181	BA550485054181	BA550555054181	BA550655054181	
1 3/4		BA550385154481	BA550425054481	BA550485054481	BA550555054481	BA550655054481	BA550755054481
1 7/8			BA550425054781	BA550485054781	BA550555054781	BA550655054781	BA550755054781
2			BA550425055081	BA550485055081	BA550555055081	BA550655055081	BA550755055081
2 1/8				BA550485055381	BA550555055381	BA550655055381	BA550755055381
2 1/4					BA550555055781	BA550655055781	BA550755055781
2 3/8					BA550555056081	BA550655056081	BA550755056081
2 1/2					BA550555056381	BA550655056381	BA550755056381
2 5/8					BA550555056681	BA550655056681	BA550755056681
2 3/4					BA550555056981	BA550655056981	BA550755056981
2 7/8							BA550755057381
3							BA550755057681
3 1/8							BA550755057981

Bores machined to H7 and from 1.969 in G7

Additional bore sizes available. Consult KTR Engineering

ROTEX® GS Hubs - Part numbers by product size (Design 6.0 steel)							
Metric Bore	28	38	42	48	55	65	75
15	550285151580						
16	550285151680						
18	550285151880						
19	550285151980						
20	550285152080	550385152080					
22	550285152280	550385152280					
24	550285152480	550385152480					
25	550285152580	550385152580	550425052580				
28	550285152880	550385152880	550425052880				
30	550285153080	550385153080	550425053080	550485053080			
32	550285153280	550385153280	550425053280	550485053280			
35	550285153580	550385153580	550425053580	550485053580	550555053580		
38	550285153880	550385153880	550425053880	550485053880	550555053880		
40		550385154080	550425054080	550485054080	550555054080	550655054080	
42		550385154280	550425054280	550485054280	550555054280	550655054280	
45		550385154580	550425054580	550485054580	550555054580	550655054580	550755054580
48			550425054880	550485054880	550555054880	550655054880	550755054880
50			550425055080	550485055080	550555055080	550655055080	550755055080
55				550485055580	550555055580	550655055580	550755055580
60					550555056080	550655056080	550755056080
65					550555056580	550655056580	550755056580
70					550555057080	550655057080	550755057080
80							550755058080

Bores machined to H7 and from 50 mm G7

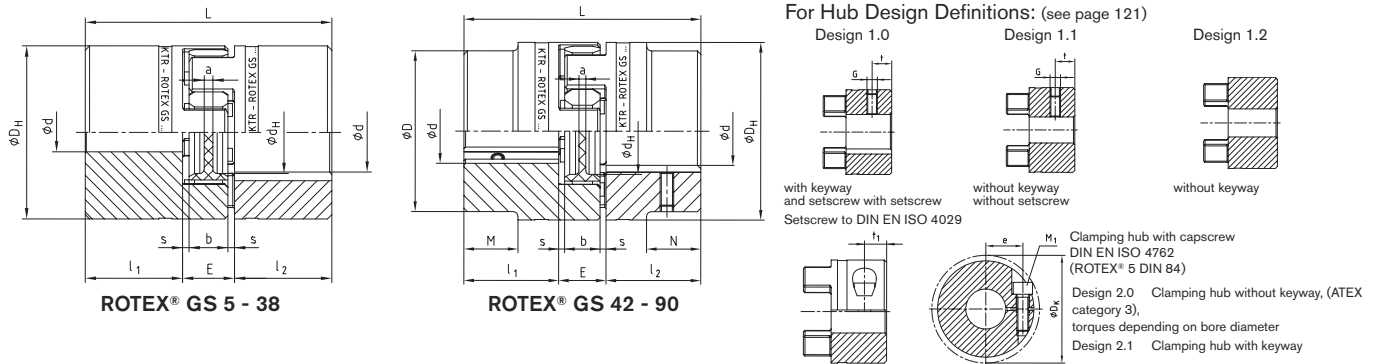
Additional bore sizes available. Consult KTR Engineering

ROTEX® GS Spiders - Part numbers by product size and material									
Type / Hardness	Color	Material	28	38	42	48	55	65	75
92 SH A-GS	Yellow	Polyurethane	550281000001	550381000001	550421000001	550481000001	550551000001		
95/98 SH A-GS	Red	Polyurethane	550281000002	550381000002	550421000002	550481000002	550551000002	550651000002	550751000002
64 SH D-GS	Green	Polyurethane	550281000005	550381000005	550421000005	550481000005	550551000005	550651000005	550751000005

Standard Designs



- 1 Zero-backlash, reduced maintenance, blind assembly
- 1 Multiple spider hardnesses available, torsionally flexible/vibration-damping
- 1 High grade machined aluminum hubs – Low inertia, good dynamic properties and reduced spider wear
- 1 Suited for measuring drives require zero-backlash connection in small envelope
- 1 approved to EC Standard 94/9/EC (designs 1.0 and 2.1)
- 1 Installation instructions available at www.ktr.com



ROTEX® GS Standard Designs																							
Size	TKN 95/98 Sh-A ¹⁾ [lb-in]	Maximum Finish Bore per hub design			Dimensions [in]											Setscrew design 1.0/1.1 DIN EN ISO 4029		Clamping screw design 2.0/2.1/2.5/2.6 DIN EN ISO 4762 (ROTEX® 5 DIN 84)					
		1.0-1.1	2.0/2.5	2.1/2.6 ³⁾	D	D _H	d _H	L	L ₁ /L ₂	M,N	E	b	s	a	G	t	M ₁	t ₁	e	ØD _K	T _A [lb-in]		
5	8	0.188	0.188	0.188	-	0.39	—	0.59	0.20	-	0.20	0.16	0.02	0.16	M2	0.10	M1.2	0.10	0.14	0.45	—		
7	18	0.250	0.250	0.250	-	0.55	—	0.87	0.28	-	0.31	0.24	0.04	0.24	M3	0.14	M2	0.14	0.20	0.65	3.3		
9	44	0.375	0.375	0.375	-	0.79	0.28	1.18	0.39	-	0.39	0.31	0.04	0.06	M4	0.20	M2.5	0.20	0.30	0.92	6.7		
12	80	0.438	0.438	0.438	-	0.98	0.33	1.34	0.43	-	0.47	0.39	0.04	0.14	M4	0.20	M3	0.20	0.35	1.08	11.9		
14	111	0.625	0.625	0.625	-	1.18	0.41	1.38	0.43	-	0.51	0.39	0.06	0.08	M4	0.20	M3	0.20	0.45	1.27	11.9		
19	151	0.938	0.938	0.938	-	1.57	0.71	2.60	0.98	-	0.63	0.47	0.08	0.12	M5	0.39	M6	0.43	0.57	1.81	92.9		
24	531	1.125	1.125	1.125	-	2.17	1.06	3.07	1.18	-	0.71	0.55	0.08	0.12	M5	0.39	M6	0.41	0.79	2.26	92.9		
28	1,416	1.500	1.500	1.500	-	2.56	1.18	3.54	1.38	-	0.79	0.59	0.10	0.16	M8	0.59	M8	0.45	0.98	2.87	221		
38	2,877	1.750	1.750	1.750	-	3.15	1.50	4.49	1.77	-	0.94	0.71	0.12	0.16	M8	0.59	M8	0.61	1.18	3.29	221		
42	3,983	2.188	1.938	1.938	3.35	3.74	1.81	4.96	1.97	1.10	1.02	0.79	0.12	0.16	M8	0.79	M10	0.71	1.26	3.68	611		
48	4,647	2.438	2.188	2.188	3.74	4.13	2.01	5.51	2.20	1.26	1.10	0.83	0.14	0.16	M8	0.79	M12	0.83	1.42	4.13	1,062		
55	6,063	2.938	2.688	2.688	4.33	4.72	2.36	6.30	2.56	1.46	1.18	0.87	0.16	0.18	M10	0.79	M12	1.02	1.67	4.70	1,062		
65	10,400	3.125	2.750	2.750	4.53	5.31	2.68	7.28	2.95	1.85	1.38	1.02	0.18	0.18	M10	0.79	M12	1.30	1.77	4.88	1,062		
75	16,994	3.750	3.125	3.125	5.31	6.30	3.15	8.27	3.35	2.09	1.57	1.18	0.20	0.20	M10	0.98	M16	1.42	2.01	5.81	2,611		
90	31,864	4.313	3.563	3.563	6.30	7.87	4.09	9.65	3.94	2.44	1.77	1.34	0.22	0.26	M12	1.18	M20	1.57	2.36	7.56	5,134		

¹⁾ For further spiders/selection see 122/123 ²⁾ tightening torque T_A not defined ³⁾ from Ø65 keyway opposite to the clamping screw ⁴⁾ clamping hub single slotted 2 x clamping screw M4 and dimension e=15

Inch bores and the corresponding transmittable torques of the clamping hub design 2.0 [lb-in]													
Size	0.125	0.188	0.219	0.250	0.281	0.313	0.375	0.406	0.438	0.500	0.563	0.594	0.625
7	7.5	8.4	8.9	9.3									
9		19.0	19.8	20.5	21.3	22.1	23.6						
12		33.4	34.6	35.7	36.9	38.0	40.4	41.5	42.7				
14			41.9	43.1	44.2	45.4	47.7	48.9	50.0	52.4	54.7	55.9	57.0

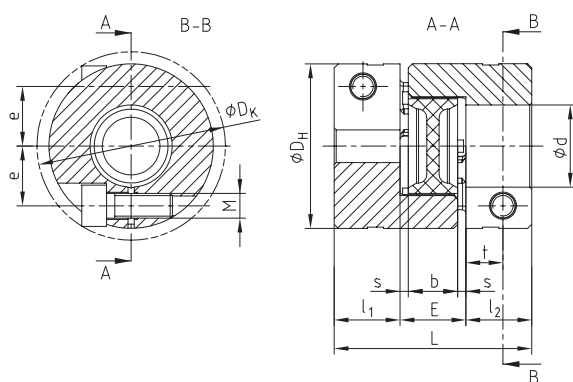
Inch bores and the corresponding transmittable torques of the clamping hub design 2.5 [lb-in]																													
Size	0.250	0.375	0.438	0.500	0.563	0.625	0.688	0.750	0.813	0.875	0.938	1.000	1.125	1.188	1.281	1.438	1.500	1.563	1.688	1.750	1.938	2.000	2.188	2.375	2.563	2.875	3.000	3	3.625
19	211	230	240	249	259	268	278	287	297	306	315																		
24		296	305	315	324	334	343	353	362	372	381	391	410																
28				687	704	721	739	756	774	791	808	826	861	878	904	947	965												
38					814	831	848	866	883	901	918	935	970	987	1,014	1,057	1,074	1,092	1,127	1,144									
42									1,472	1,499	1,526	1,555	1,610	1,638	1,679	1,748	1,776	1,803	1,859	1,886	1,969								
48												3,491	3,605	3,662	3,747	3,890	3,946	4,004	4,117	4,174	4,345	4,401	4,572						
55															4,213	4,356	4,412	4,470	4,583	4,640	4,811	4,867	5,038	5,209	5,380				
65																4,535	4,591	4,649	4,763	4,819	4,990	5,047	5,217	5,388	5,559	5,843			
75																		9,808	9,915	10,238	10,345	10,667	10,990	11,312	11,850	12,065	1		
90																			17,935	18,102	18,609	18,776	19,282	19,788	20,293	21,136	21,474	2	23,160

Order form:	ROTEX® GS 14	80 Sh A-GS	1.0	—	Ø 12	2.0	—	Ø 10
	Coupling size	Spider hardness	Hub design		Bore	Hub design		Bore

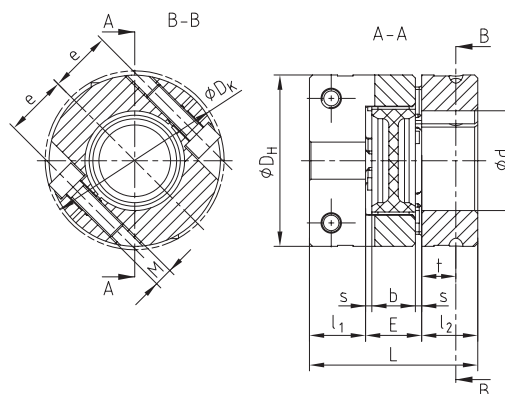
Compact



- 1 Zero-backlash, reduced maintenance, blind assembly
- 1 Multiple spider hardnesses available, torsionally flexible / vibration-damping
- 1 High grade machined aluminum hubs up to size 38, – Low inertia, good dynamic properties and reduced spider wear
- 1 High grade machined steel hubs from size 42, – High strength, good dynamic properties and reduced spider wear
- 1 approved to EC Standard 94/9/EC (without key according to category 3)
- 1 Installation instructions available at www.ktr.com



ROTEX® GS 7 - 19 Compact
single slotted design 2.8



ROTEX® GS 24 - 38 Compact
axially slotted design 2.8

ROTEX® GS Compact															
Size	Torques [lb-in]			Dimensions											TA [lb-in]
	92Sh A	98Sh A	64Sh D	d _{max.}	D _H	D _K	L	l ₁ , l ₂	E	b	s	t	e	M	
Single slotted hub design 2.8/2.9															
7	11	18	21	0.250	0.55	0.65	0.71	0.20	0.31	0.24	0.04	0.10	0.20	M2	3.3
9	27	44	53	0.313	0.79	0.84	0.94	0.28	0.39	0.31	0.04	0.14	0.79	M2.5	6.7
12	44	80	106	0.438	0.98	1.03	1.02	0.28	0.47	0.39	0.04	0.14	0.98	M3	12
14	66	111	142	0.625 ²	1.18	1.20	1.26	0.37	0.51	0.39	0.06	0.18	1.18	M4	26
19	89	150	186	0.9375 ²	1.57	1.77	1.97	0.67	0.63	0.47	0.08	0.35	0.55	M6	89
Axially slotted hub design 2.8/2.9															
24	310	531	664	1.25	2.17	2.26	2.13	0.71	0.71	0.55	0.08	0.43	.79	M6	89
28	841	1416	1770	1.38	2.56	2.72	2.44	0.83	0.79	0.59	0.10	0.47	.94	M8	221
38	1682	2877	3585	1.75	3.15	3.39	2.99	1.02	0.94	0.71	0.12	0.63	1.20	M10	434

Inch equivalent bores and the transmittable torques of the clamping hub design 2.8 [lb-in]																			
Size	0.118	0.157	0.197	0.236	0.276	0.315	0.354	0.394	0.433	0.472	0.551	0.591	0.630	0.709	0.748	0.787	0.945	0.984	1.102
Single slotted hub design 2.8/2.9																			
7	7	8	9	9	10														
9		17	18	19	19	20	21												
12		30	32	33	35	36	37	39	41	42									
14			63	65	68	71	73	75	78	81	51	52	54						
19						215	221	227	233	239	251	257	263	283	301	336	354	372	451
Axially slotted hub design 2.8/2.9																			
24								186	204	221	266	283	301	336	354	372	451	469	522
28										478	513	549	620	655	690	823	859	965	1,027
38											814	876	982	1,036	1,089	1,310	1,363	1,531	1,637

¹⁾ For further spiders/selection, see 122/123 ²⁾ Size 14 with screw M3 and dimension e = 10.4, size 19 with screw M5 and dimension e = 15.5
2.8 = without key 2.9 = with key Over 12mm & up = M3 Over 20mm = M5

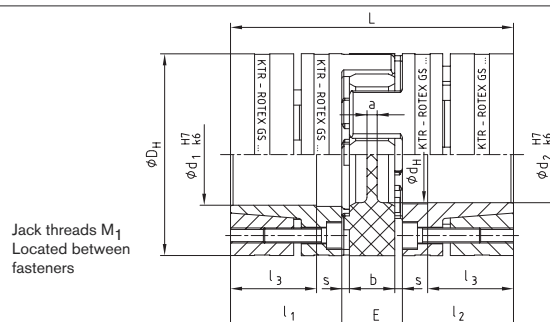
Order form:

ROTEX® GS 38	Compact	98 Sh-A-GS	d28	2.8 – Ø 28	2.8 – Ø 45
Coupling size	Type	Spider hardness	Optional: bore diameter in spider	Hub design	Bore
				Hub design	Bore

Clamping ring hubs: 6.0 Steel



- 1 Zero-backlash, reduced maintenance, blind assembly
- 1 Multiple spider hardnesses available, torsionally flexible / vibration-damping
- 1 Machined hubs with integrated frictional clamp – Low inertia and high frictional torque capacity
- 1 Easy installation with fasteners in the jaw pocket
- 1 Well suited for spindle drives, or high torque keyless applications
- 1 Peripheral speeds up to 130 ft/s
- 1 approved to EC Standard 94/9/EC (review the selection for "ATEX" explosion protection use)
- 1 Installation instructions available at www.ktr.com



Hub and clamping ring material – Steel (St-H)																			
Size	Nominal Torque per spider type T _{KN} [Nm] ¹⁾			Max bore	Dimensions [in]									Clamping bolts				Weight per hub with max. bore [lb]	Mass moment of inertia per hub with max. bore [lb-in-sec ²]
	98 Sh-A	64 Sh-D	72 Sh-D		D _H ³⁾	d _H	L	l ₁ ; l ₂	l ₃	E	b	s	a	M	numberz	T _A [lb-in	M ₁		
19	150	186	-	0.813	1.57	0.71	2.60	0.98	0.71	0.63	0.47	0.08	0.12	M4	6	36	M4	0.39	4
24	531	664	859	1.125	2.17	1.06	3.07	1.18	0.87	0.71	0.55	0.08	0.12	M5	4	75	M5	0.88	17
28	1,416	1,770	2,301	1.500	2.56	1.18	3.54	1.38	1.06	0.79	0.59	0.10	0.16	M5	8	75	M5	1.31	37
38	2,877	3,585	4,647	1.875	3.15	1.50	4.49	1.77	1.38	0.94	0.71	0.12	0.16	M6	8	124	M6	2.70	114
42	3,983	4,957	6,444	2.000	3.74	1.81	4.96	1.97	1.38	1.02	0.79	0.12	0.16	M8	4	310	M8	5.07	281
48	4,647	5,787	7,541	2.188	4.13	2.01	5.51	2.20	1.61	1.10	0.83	0.14	0.16	M10	4	611	M10	6.79	460
55	6,063	7,302	9,488	2.750	4.72	2.36	6.30	2.56	1.77	1.18	0.87	0.16	0.18	M10	4	611	M10	10.30	912
65	8,320	10,400	13,515	2.750	5.31	2.68	7.28	2.95	2.17	1.38	1.02	0.18	0.18	M12	4	1062	M12	14.77	1,691
75	16,994	21,212	-	3.125	6.30	3.15	8.27	3.35	2.48	1.57	1.18	0.20	0.20	M12	5	1062	M12	21.83	3,512
90	31,864	39,830	-	4.125	7.87	4.09	9.65	3.94	2.95	1.77	1.34	0.22	0.26	M16	5	2611	M12	39.03	10,055

¹⁾ Please note coupling selection on pages 122-123.

²⁾ Figures for 95 Sh A - GS

³⁾ For high speed applications add 0.08 into diameter value to consider spider growth.

Inch equivalent bores d ₁ /d ₂ and the corresponding transmittable friction torques T _R of clamping ring hub in [lb-in] ¹⁾																									
Size	0.394	0.433	0.551	0.591	0.630	0.748	0.787	0.945	0.984	1.102	1.181	1.260	1.378	1.496	1.575	1.654	1.772	1.890	1.969	2.165	2.362	2.559	2.756	3.150	
19	239	283	611	743	505	832	974																		
24			620	770	496	859	1,009	1,027	1,177	1,699															
28				956	1,159	1,832	1,310	2,239	2,523	2,788	3,381	2,921	3,832	4,452											
38							1,841	3,124	3,496	3,886	4,700	4,098	5,337	5,249	6,098	7,019	6,868								
42									3,169	3,523	4,275	3,682	4,841	4,744	5,532	5,054	6,231	7,532	7,656						
48											5,452	6,231	7,957	9,117	8,515	10,267	12,206	10,816	13,657						
55													7,638	7,576	8,771	8,125	9,904	9,825	11,037	11,303	14,799	14,206	17,773		
65															12,799	11,993	14,489	14,471	16,171	16,702	21,499	20,959	25,933		
75																15,135	18,171	18,224	20,304	21,101	26,907	26,403	32,430	36,714	
90																				34,032	37,608	42,432	51,849	52,221	62,276

The transmittable torques of the clamping connection are calculated with shaft fit k6 / bore H7 and from 1.969" in / G7, increased clearance will result in reduction of the transmittable torque.

Shaft material – steel or ductile iron with a minimum yield strength of 250 N/mm² (36,360 psi) required.

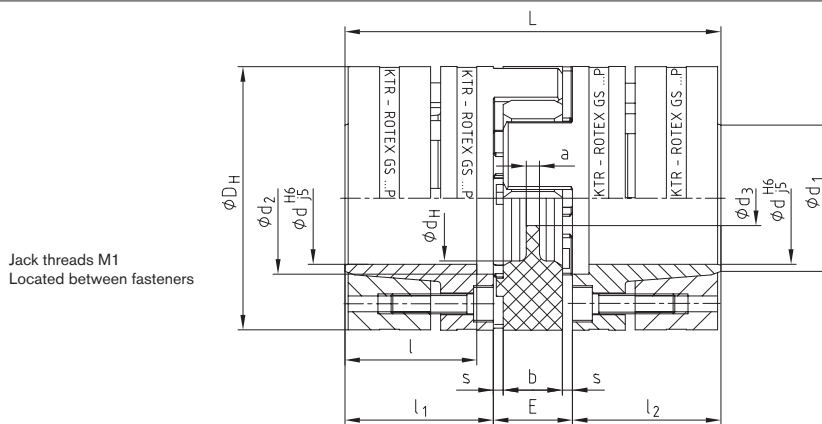
For the stiffness calculation of the shaft/hollow shaft see KTR standard 45510 at our webpage www.ktr.com

Order form:	ROTEX® GS 24		98 Sh A-GS		6.0 – Ø 24		6.0 – Ø 20	
	Coupling size		Spider hardness		Hub design		Bore	

Design P according to DIN 69002



- 1 Zero-backlash, reduced maintenance, blind assembly
- 1 Multiple spider hardnesses available, torsionally flexible / vibration-damping
- 1 Machined hubs with integrated frictional clamp – Low inertia and high frictional torque capacity
- 1 Easy installation with fasteners in the jaw pocket
- 1 Designed for spindle drive applications to DIN69002, accommodates central coolant lines
- 1 Peripheral speeds up to 164 ft/s
- 1 ATEX approved to EC Standard 94/9/EC (review the selection for "ATEX" explosion protection use)
- 1 Installation instructions available at www.ktr.com



Hub material – Steel										Clamping ring material – Steel							Transmittable torque of clamping ring hub Ø d [lb-in] ¹⁾	Tightening torque of clamping screws T _A [lb-in]	Weight per hub with bore Ø d norm [lb]	Mass moment of inertia with bore Ø d norm [lb-in-sec ²]
Size	Nominal Torque by spider type T _{KN} [lb-in] ¹⁾		Dimensions [in]																	
			98 Sh-A	64 Sh-D	d ¹⁾	D _H ³⁾	d _H	L	l ₁ /l ₂	l	E	b	s	a	d ₁	d ₂				
14 P	111	142	0.55	1.26	0.41	1.97	0.73	0.61	0.51	0.39	0.06	0.08	0.67	0.67	0.33	221	17	0.18	9.74 x 10 ⁻⁵	
19 P 37,5	124	150	0.63	1.48	0.71	2.60	0.98	0.83	0.63	0.47	0.08	0.12	0.79	0.75	0.37	531	27	0.35	3.27 x 10 ⁻⁴	
19 P	150	186	0.75	1.57	0.71	2.60	0.98	0.83	0.63	0.47	0.08	0.12	0.91	0.87	0.37	628	27	0.42	4.07 x 10 ⁻⁴	
24 P 50	381	478	0.94	1.97	1.06	3.07	1.18	0.98	0.71	0.55	0.08	0.12	1.10	1.14	0.49	956	43	0.73	1.20 x 10 ⁻³	
24 P	531	664	0.98	2.17	1.06	3.07	1.18	0.98	0.71	0.55	0.08	0.12	1.18	1.18	0.49	1,505	75	0.97	1.78 x 10 ⁻³	
28 P	1,416	1,770	1.38	2.56	1.18	3.54	1.38	1.18	0.79	0.59	0.10	0.16	1.57	1.57	0.57	4,479	75	1.41	3.88 x 10 ⁻³	
38 P	2,877	3,585	1.57	3.15	1.50	4.49	1.77	1.57	0.94	0.71	0.12	0.16	1.81	1.81	0.65	7,267	124	2.91	1.17 x 10 ⁻³	
42 P	3,983	4,957	1.65	3.74	1.81	4.96	1.97	1.77	1.02	0.79	0.12	0.16	2.05	2.17	0.73	6,275	310	4.92	2.66 x 10 ⁻²	
48 P	4,647	5,797	1.77	4.13	2.01	5.51	2.20	1.97	1.10	0.83	0.14	0.16	2.05	2.36	0.81	11,860	611	6.81	4.46 x 10 ⁻²	
55 P	6,063	7,302	1.97	4.72	2.36	6.30	2.56	2.28	1.18	0.87	0.16	0.18	2.17	2.83	0.89	13,365	611	10.45	8.87 x 10 ⁻²	

¹⁾ * Standard spindle shaft diameter · ²⁾ Please note coupling selection on pages 122-123 ·

³⁾ For high speed applications add 0.08 in. to diameter value to consider spider growth. For the stiffness calculation of the shaft/hollow shaft see KTR standard 45510 at www.ktr.com.

Selection for stub spindles						
Spindle drive	ROTEX® GS P Size	Dimensions				
		d	D _H	l ₁ ; l ₂	L	E
25 x 20	14 P	0.55	1.26	0.73	1.97	0.51
32k x 25	19 P37.5	0.63	1.48	0.98	2.60	0.63
32g x 30	19 P	0.75	1.57	0.98	2.60	0.63
40 x 35	24 P50	0.94	1.97	1.18	3.07	0.71
50 x 45	24 P	0.98	2.17	1.18	3.07	0.71
63 x 55	28 P	1.38	2.56	1.38	3.54	0.79
80 x 75	28 P	1.57	3.15	1.77	4.49	0.94



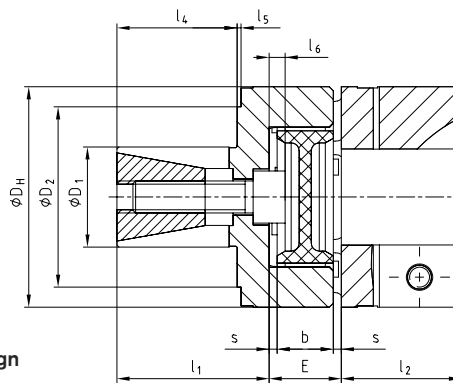
ROTEX® GS type P with central coolant supply for stub spindles and multiple spindle heads

Order form:	ROTEX® GS 24	P	98 Sh A-GS	6.0	-	25	6.0	-	25
	Coupling size	Design	Spider hardness	Hub-design	Bore		Hub-design	Bore	

Expansion hub for hollow shaft connection



- 1 Zero-backlash shaft coupling with integrated clamping system for hollow shaft connections
- 1 Short design
- 1 Electric insulation
- 1 Quick assembly
- 1 Good concentricity
- 1 Can be combined with various hub designs
- 1 Self-centering clamping connection



ROTEX® GS expansion hub design
9.0 with clamping hub ¹⁾

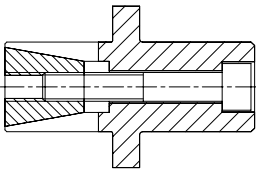
ROTEX® GS expansion hub															
Size	Torque [lb-in]					Dimensions [in]									
	80 Sh-A	92 Sh-A	98 Sh-A	64 Sh-D	72 Sh-D	D ₁	D ₂	D _H	l ₁	l ₄	l ₅	l ₆	E	b	s
9	16	27	44	53	-	0.375	-	0.79	0.79	0.43	-	0.00	0.39	0.31	0.04
12	27	44	80	106	-	0.375	0.79	0.98	0.75	0.55	0.06	0.08	0.47	0.39	0.04
14	35	66	111	142	-	0.438	0.94	1.18	0.73	0.49	0.12	0.08	0.51	0.39	0.06
19	43	89	150	186	-	0.813	1.38	1.57	1.10	0.79	0.04	0.00	0.63	0.47	0.08
24	-	310	531	664	859	1.000	1.77	2.17	1.50	1.18	0.04	0.16	0.71	0.55	0.08
28	-	841	1,416	1,770	2,301	1.375	2.17	2.56	1.73	1.42	0.04	0.20	0.79	0.59	0.10

¹⁾ Expansion hub can be combined with other hub designs as a counter side, too. l₂ depending on hub design. For further hub designs see page 121

²⁾ For selection see page 122-123.

Transmittable friction torques for D₁ on request (depending on the hollow shaft)

Special type



Shaft extension



ROTEX GS hub with CLAMPEX KTR 150



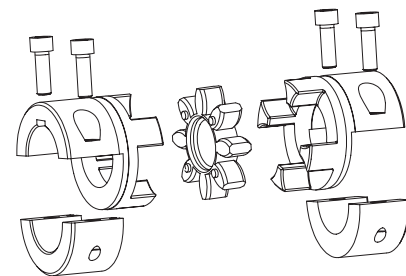
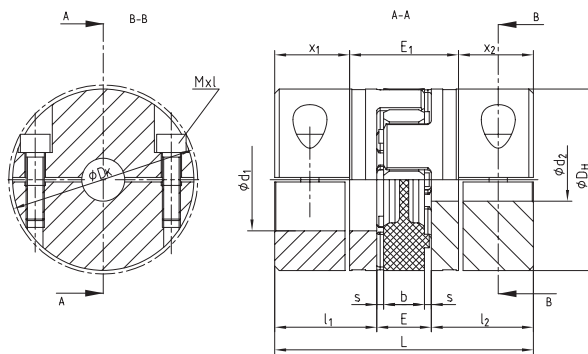
Order form:

ROTEX® GS 24	98 Sh A-GS	d20	2.8	-	28	2.8	-	45
Coupling size	Spider Hardness	Optional: Bore diameter in spider	Hub-design	Bore	Hub-design	Bore		

Drop-out center design coupling Design A-H



- 1 Zero-backlash, reduced maintenance, blind assembly
- 1 Multiple spider hardnesses available, torsionally flexible / vibration-damping
- 1 High grade machined aluminum, – Low inertia, good dynamic properties and reduced spider wear
- 1 Maintenance-free, easy to check visually
- 1 Different elastomer hardness of spiders
- 1 Complete installation and removal using only 4 fasteners
- 1 Restoring forces are reduced to a minimum
- 1 $\checkmark$ approved according to EC Standard 94/9/EC (type 7.8 shell clamping hub w/o feather key according to category 3)\
- 1 Installation instructions available at www.ktr.com



Please note:
The feather keys are offset to each other by approx. 5°!
Hub material: Al-H
Hub design: 7.8 shell clamping hub without keyway
Hub design: 7.9 shell clamping hub with keyway

ROTEX® GS Designs A-H

Size	Max. finish bore	Dimensions [in]									Hub fastener DIN EN ISO 4762	
		D _H	D _k	L	l ₁ ; l ₂	E	b	s	x ₁ /x ₂	E ₁	MxI	T _A
19	0.813	1.57	1.81	2.60	0.98	0.63	0.47	0.08	0.69	1.22	M6x16	89
24	1.125	2.17	2.26	3.07	1.18	0.71	0.55	0.08	0.87	1.34	M6x20	89
28	1.500	2.56	2.87	3.54	1.38	0.79	0.59	0.10	0.98	1.57	M8x25	221
38	1.750	3.15	3.29	4.49	1.77	0.94	0.71	0.12	1.30	1.89	M8x30	221
42	1.938	3.74	3.68	4.96	1.97	1.02	0.79	0.12	1.54	1.89	M10x30	434

Technical Data

Size	Spider Shore GS ¹⁾	Shore Range	Max speed [rpm]	Torque [lb-in]		Static Torsion	Weight of each hub	Mass moment of inertia		Size	Spider Shore GS ¹⁾	Shore Range	Max speed [rpm]	Torque [lb-in]		Static Torsion	Weight of each hub	Mass moment of inertia
				TKN	TKmax									TKN	TKmax			
19	80	A	9550	43	87	5,470	0.17	1.73 x 10 ⁻⁴		38								
	92	A		89	177	9,648												
	98	A		150	301	13,383												
	64	D		186	372	22,659												
24	92	A	6950	310	620	20,180	0.36	6.84 x 10 ⁻⁴		42	92	A	4000	2,346	4,691	96,210	3.90	2.13 x 10 ⁻³
	98	A		531	1,062	32,218					98	A		3,983	7,996	191,128		
	64	D		664	1,328	44,521					64	D		4,957	9,913	326,248		
28	92	A	5850	841	1,682	36,112	0.53	1.53 x 10 ⁻³										
	98	A		1,416	2,832	56,735												
	64	D		1,770	3,540	90,811												

Inch equivalent bore d₁/d₂ and the corresponding transmittable friction torques T_R of clamping ring hub in [lb-in]

Size	0.315	0.394	0.433	0.551	0.591	0.630	0.709	0.748	0.787	0.866	0.945	0.984	1.102	1.181	1.260	1.378	1.496	1.575	1.654	1.772	1.811	1.890	1.969
19	150	186	204	266	283	301	336	354	372														
24		186	204	266	283	301	336	354	372	416	451	469	522										
28				478	513	549	620	655	690	761	823	859	965	876	898	1,204	1,310						
38							620	655	690	761	823	859	965	986	1,008	1,204	1,310	1,381	1,443	1,549			
42										1,204	1,319	1,372	1,540	2,302	2,351	1,921	2,080	2,195	2,301	2,469	2,523	2,629	2,744

Order form:

ROTEX® GS 38	A-H	98 Sh A-GS	7.8	-	38	7.9	-	30
Coupling size	Design	Spider hardness	Components		Finish Bore	Hub Design		Finish Bore

Design DKM (double-cardanic)



- 1 Zero-backlash, reduced maintenance, blind assembly
- 1 Multiple spider hardnesses available, torsionally flexible / vibration-damping
- 1 High grade machined aluminum, – Low inertia, good dynamic properties and reduced spider wear
- 1 3-piece double-cardanic design, for greater shaft misalignment capacity
- 1 Restoring forces are reduced to a minimum
- 1 ⚠ approved to EC Standard 94/9/EC (Explosion Certificate ATEX 95)
- 1 Installation instructions available at www.ktr.com



ROTEX® GS DKM Spacer material aluminum/hub material depends on hub design

Size	Nominal torque T_{KN} [lb-in] ¹⁾		Dimensions [in]													
	98 Sh-A	64 Sh-D	$d_{max.}^{2)}$	D	D_H	d_H	d_{H1}	$l_1; l_2$	M; N	l_{11}	l_{12}	L_{DKM}	E	b	s	a
5	8	—	0.188	—	0.39	—	—	0.20	—	0.12	0.51	0.91	0.20	0.16	0.02	0.16
7	18	21	0.250	—	0.55	—	—	0.28	—	0.16	0.79	1.34	0.31	0.24	0.04	0.24
9	44	53	0.375	—	0.79	0.28	—	0.39	—	0.20	0.98	1.77	0.39	0.31	0.04	0.06
12	80	106	0.438	—	0.98	0.33	—	0.43	—	0.24	1.18	2.05	0.47	0.12	0.04	0.14
14	111	142	0.625	—	1.18	0.41	—	0.48	—	0.31	1.34	2.20	0.51	0.12	0.06	0.08
19	151	186	0.938	—	1.57	0.71	0.71	0.98	—	0.39	1.65	3.62	0.63	0.47	0.08	0.12
24	531	664	1.125	—	2.17	1.06	1.06	1.18	—	0.63	2.05	4.41	0.71	0.55	0.08	0.12
28	1,416	1,770	1.500	—	2.56	1.18	1.18	1.38	—	0.71	2.28	5.04	0.79	0.59	0.10	0.16
38	2,877	3,585	1.750	—	3.15	1.50	1.50	1.77	—	0.79	2.68	6.22	0.94	0.71	0.12	0.16
42	3,983	4,957	2.188	3.35	3.74	1.81	1.81	1.97	1.10	0.87	2.91	6.85	1.02	0.79	0.12	0.16
48	4,647	5,797	2.438	3.74	4.13	2.01	2.01	2.20	1.26	0.94	3.15	7.56	1.10	0.83	0.14	0.16
55	6,063	7,302	2.938	4.33	4.72	2.36	2.36	2.56	1.46	1.10	3.46	8.58	1.18	0.87	0.16	0.18

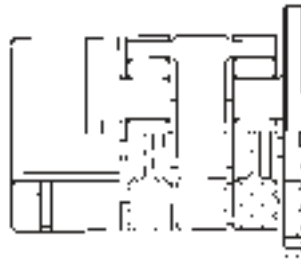
¹⁾ For further spiders/selection see page 122/123

²⁾ Dependent on hub clamping design, see page 121

Other designs:



ROTEX® GS - DKM hollow shaft design



ROTEX® GS - CF - DKM

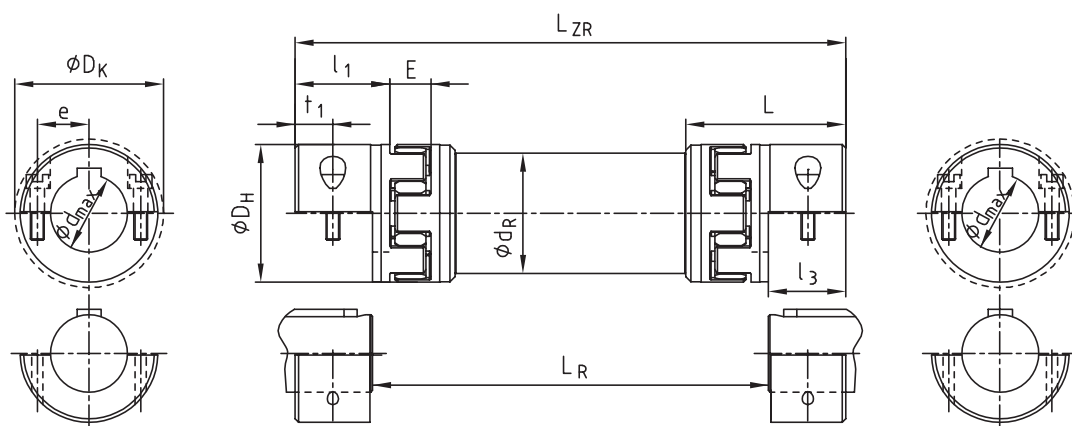


ROTEX® GS - DKM in combination with torque limiter KTR-RU

Order form:

ROTEX® GS 24	DKM	92 Sh A-GS	1.0	-	38	2.5	-	32
Coupling size	Design	Spider hardness	Hub-design	Bore	Hub-design	Bore		

- 1 Zero-backlash, reduced maintenance, blind assembly
- 1 Multiple spider hardnesses available, torsionally flexible / vibration-damping
- 1 High grade machined aluminum hubs – Low inertia, good dynamic properties and reduced spider wear
- 1 3-piece double-cardanic design, for greater shaft misalignment capacity, and shaft gaps (DBSE)
- 1 Restoring forces are reduced to a minimum
- 1 Design 7.5/7.6 allows for radial removal using only 4 fasteners
- 1 Installation instructions available at www.ktr.com



ROTEX® GS Design ZR3																	
Size	Dimensions [in]																
	Bore		General												Fastener DIN EN ISO 4762		
			D _H	l ₁	L	l ₃	E	L _R		L _{ZR}		d _R	D _K	t ₁			e
	min.	max.						min.	max.								
	19	0.313	0.813	1.57	0.98	1.93	0.69	0.63	3.86	117	5.24	118	1.57	1.81	0.31	0.57	M6
24	0.375	1.125	2.17	1.18	2.32	0.87	0.71	4.45	136	6.18	138	1.97	2.26	0.41	0.79	M6	89
28	0.563	1.500	2.56	1.38	2.64	0.98	0.79	5.16	156	7.13	157	2.36	2.87	0.45	0.98	M8	221
38	0.688	1.750	3.15	1.77	3.29	1.30	0.94	6.42	155	9.02	157	2.76	3.29	0.61	1.18	M8	221
42	0.875	1.938	3.74	1.97	3.66	1.44	1.02	7.09	155	9.96	157	3.15	3.68	0.71	1.26	M10	434
48	0.875	2.188	4.13	2.20	3.94	1.56	1.10	7.95	154	11.06	157	3.94	4.13	0.73	1.42	M12	761

Technical data of Design ZR3 with a spider 98 Sh-A-GS													
Size	Coupling torques [lb-in]		Mass moment of inertia [lb-in-sec ²]			stat. torsion spring stiffness [lb-ft ² /rad]	Size	Coupling torques [lb-in]		Mass moment of inertia [lb-in-sec ²]			stat. torsion spring stiffness [lb-ft ² /rad]
	T _{KN}	T _{K max.}	Hub ²⁾	ZR-hub	Pipe/fit	ZW C ₂ ³⁾		T _{KN}	T _{K max.}	Hub ²⁾	ZR-Hub	Pipe/fit	ZW C ₂ ³⁾
19	150	301	0.00018	0.00012	0.00108	7,853	38	2,877	5,753	0.00446	0.00228	0.00975	70,912
24	531	1,062	0.00067	0.00040	0.00221	16,056	42	3,983	7,966	0.00993	0.00489	0.01496	108,775
28	1,416	2,832	0.00156	0.00097	0.00393	28,602	48	4,647	9,294	0.01656	0.01047	0.03035	220,694

Inch equivalent bores and the corresponding transmittable torques of clamping hub design 2.0/2.8 [lb-in]																								
Size	0.315	0.394	0.433	0.551	0.591	0.630	0.709	0.748	0.787	0.866	0.945	0.984	1.102	1.181	1.260	1.378	1.496	1.575	1.654	1.772	1.811	1.890	1.969	2.165
19	150	186	204	266	283	301	336	354	372															
24		186	204	266	283	301	336	354	372	416	451	469	522											
28				478	513	549	620	655	690	761	823	859	965	1,036	1,098	1,204	1,310							
38							620	655	690	761	823	859	965	1,036	1,098	1,204	1,310	1,381	1,443	1,549				
42										1,204	1,319	1,372	1,540	1,646	1,752	1,921	2,080	2,195	2,301	2,469	2,523	2,629	2,744	
48										1,761	1,921	2,000	2,239	2,399	2,567	2,806	3,045	3,204	3,363	3,602	3,682	3,841	4,001	4,408

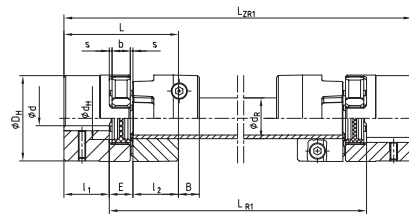
¹⁾ For further spiders/selection, see page 122/123 ²⁾ At max diameter ³⁾ Torsional spring stiffness with an intermediate pipe of a length of 1 m, (39.37in.) $L_{Pipe} \text{ being} = L_{ZR} \cdot 2 \cdot L$
For inquiries and orders, please specify the shaft distance dimension L_R along with the maximum speed to review the critical whipping speed. The intermediate pipe could be combined with other hub designs, but in that case it can no longer be radially disassembled. Please indicate the required shaft distance dimension in your order.
Hub design 7.5 shell clamping hub without keyway Hub design 7.6 shell clamping hub with keyway

Order form:	ROTEX® GS 24	ZR3	1200 mm	98 Sh A-GS	7.5	-	24	7.5	-	24
	Coupling size	Design	Shaft distance dimension (L _P)	Spider hardness	Hub design	Bore		Hub design	Bore	

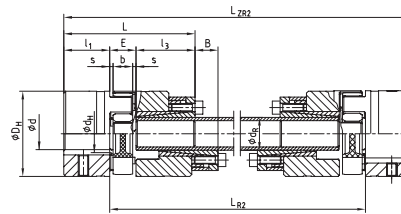
Intermediate shaft coupling



- 1 Zero-Backlash, reduced maintenance, blind assembly
- 1 Multiple spider hardnesses available, torsionally flexible / vibration-damping
- 1 High grade machined aluminum hubs, – Low inertia, good dynamic properties and reduced spider wear
- 1 3-piece double-cardanic design for greater shaft misalignment capacity and shaft gaps (DBSE)
- 1 Restoring forces are reduced to a minimum
- 1 Installation instructions available at www.ktr.com



Design ZR1



Design ZR2

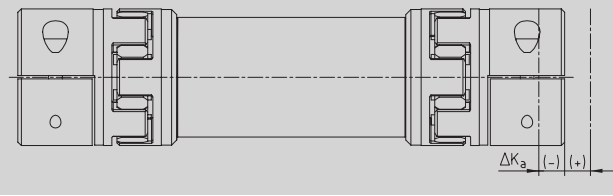
ROTEX® GS Design ZR2																				
Size	Nominal Torque TKN [lb-in]		Max. Bore	Dimensions [in]								Precision tube [in] lb.-ft ² rad				Clamping set size	Fasteners DIN EN ISO 4762-12.9 μtot. = 0.14	Tightening torque		
	98 Sh-A	64 Sh-							b	s	B	LR ₂	LR ₂ min.	LZR ₂	d _R				C ₂	
14 ZR2	111	142	0.625	1.18	0.43	1.02	1.97	0.51	0.39	0.06	0.45	Please mention for inquiries and orders	4.29	LR2+0.87	0.39	0.08	165	10x16	M4x10	46
19 ZR2	151	301	0.938	1.57	0.98	1.02	2.64	0.63	0.47	0.08	0.55		4.72	LR2+1.97	0.47	0.08	315	12x18	M4x10	46
24 ZR2	531	664	1.125	2.17	1.18	1.50	3.39	0.71	0.55	0.08	0.63		6.14	LR2+236	0.79	0.12	2,312	20x28	M6x18	150
28 ZR2	1,416	1,770	1.500	2.56	1.38	1.77	3.94	0.79	0.59	0.10	0.69		6.97	LR2+276	0.98	0.10	4,384	25x34	M6x18	150
38 ZR2	2,877	3,585	1.750	3.15	1.77	1.77	4.49	0.94	0.71	0.12	0.83		7.56	LR2+354	1.26	0.14	12,509	32x43	M6x18	150
42 ZR2	3,983	4,957	2.188	3.74	1.97	2.05	5.04	1.02	0.79	0.12	0.91		8.43	LR2+394	1.57	0.16	28,737	40x53	M6x18	150
48 ZR2	4,647	5,797	2.438	4.13	2.20	2.76	6.06	1.10	0.83	0.14	0.96		10.28	LR2+441	1.77	0.16	42,334	45x59	M8x22	363
55 ZR2	6,063	7,302	2.938	4.72	2.56	3.15	6.89	1.18	0.87	0.16	1.02		11.34	LR2+512	2.17	0.16	81,208	55x71	M8x22	363
65 ZR2	8,320	10,400	3.125	5.31	2.95	3.15	7.28	1.38	1.02	0.18	1.20		15.24	LR2+591	2.56	0.16	107,400	60x77	M8x22	363

¹⁾ For inquiries and orders please mention the shaft distance dimension L_{R1}/L_{R2} along with the maximum speed to review the critical whipping speed.

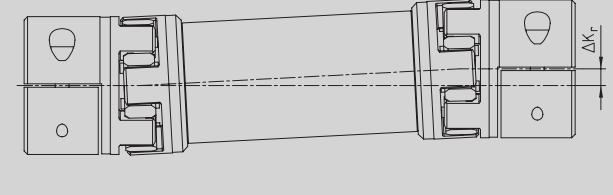
²⁾

Misalignments and technical data

Axial misalignments

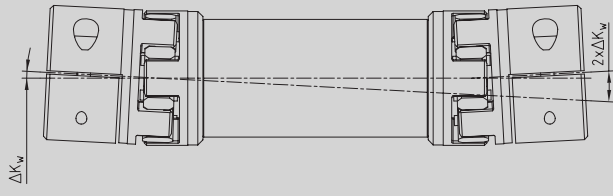


Radial misalignments



$$\Delta K_r = (L_{ZR} - 2 \cdot l_1 - E) \cdot \tan \alpha$$

Angular misalignments



Misalignments Design ZR1 and ZR2

ROTEX® GS Size with 98Sh A-GS	Axial ΔK_a [in]		Parallel ΔK_r ¹⁾ [in]	Angular α [degree]
	Compression	Elongation		
14	+0.039	-0.039	0.597	0.9°
19	+0.047	-0.039	0.578	0.9°
24	+0.055	-0.039	0.570	0.9°
28	+0.059	-0.055	0.563	0.9°
38	+0.071	-0.055	0.548	0.9°
42	+0.079	-0.079	0.541	0.9°
48	+0.083	-0.079	0.532	0.9°
55	+0.087	-0.079	0.519	0.9°
65	+0.102	-0.079	0.504	0.9°

¹⁾ Parallel misalignments based on coupling length $L_{ZR} = 1000$ mm (39.37 in.)

Calculation of total torsion spring stiffness:

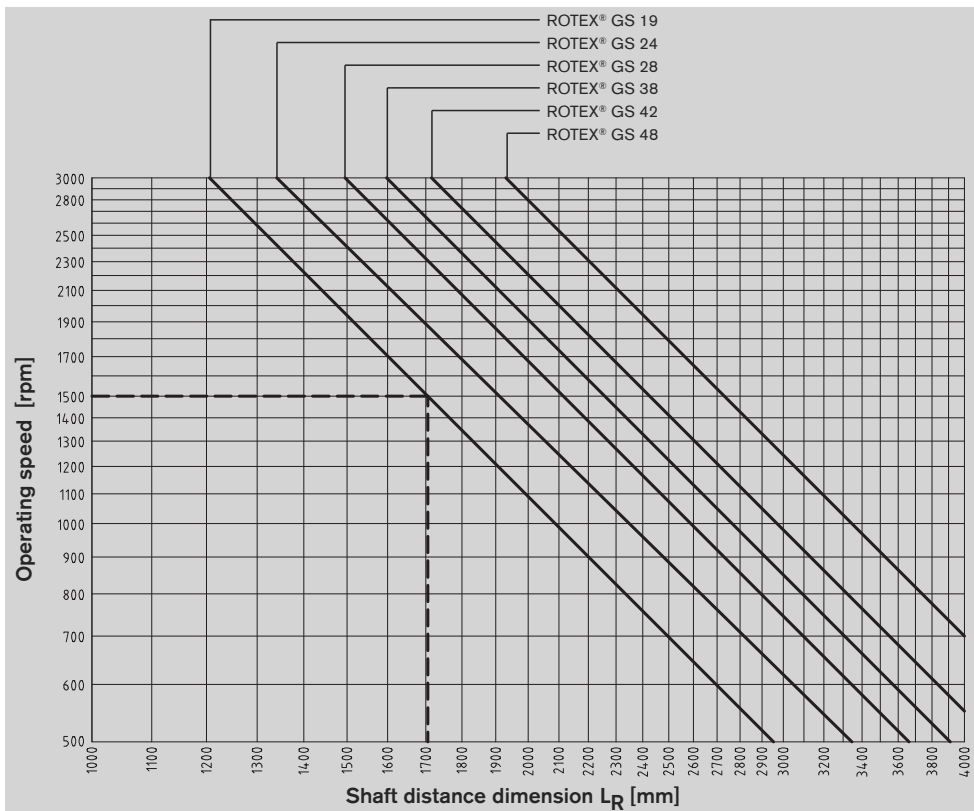
$$C_{\text{total}} = \frac{1}{2 \cdot \left(\frac{1}{C_1} + \frac{L_{\text{pipe}}}{C_2} \right)} \quad [\text{lb-in/rad}]$$

$$\text{with } L_{\text{pipe}} = \frac{L_{ZR} - 2 \cdot L}{12} \quad [\text{in}]$$

C_1 = torsion spring stiffness for spider page 121

C_2 = from table page 137/138

Chart of critical speeds for design ZR3



Example:

ROTEX® GS 19

Determine maximum shaft distance

Operating speed: 1,500 rpm

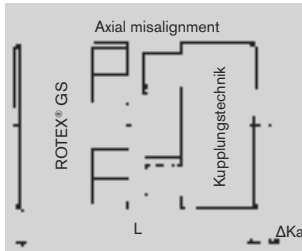
Operating speed = $n_{\text{krit}}/1.4$

From the table:

Maximum shaft distance L_R (DBSE): 1,700mm (66.92 in.)

Misalignments

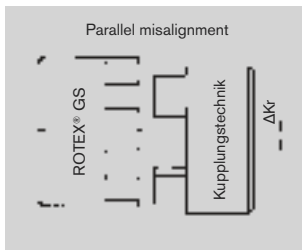
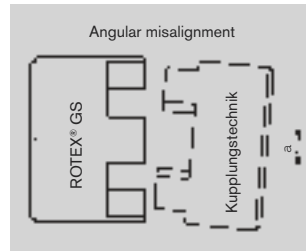
Utilizing the curve jaw design, ROTEX® GS accommodates axial, angular and parallel misalignment between shafts with minimal friction or wear. Due to the spider geometry and preload, the coupling will remain backlash-free throughout the coupling life.



Axial misalignment may result from thermal growth or endplay of the drive or driven shafts. The coupling must isolate the misalignment from each shaft to prevent shaft bearings from additional axial stress. Therefore, the coupling axial misalignment should be greater than the total amount possible

in the application in order to keep the reaction forces low.

Angular misalignment is the angle created by the theoretical bisecting lines of the shafts intersects in the middle of the coupling. The curved geometry of the coupling jaws allows for smooth articulation of the jaws relative to each other within the allowable limit. This misalignment occurs without extensive restoring forces.



Parallel misalignment is the distance between shafts in relation to each other created by manufacturing tolerances of piloted surfaces or mounting base plate variations. Parallel misalignment produces the largest restoring forces and consequently causes the highest stresses on adjacent components.

In applications with high misalignments (especially parallel misalignment) the ROTEX® GS DKM double-cardanic design may be used to avoid excessive restoring forces.

ROTEX® GS couplings accommodate parallel and angular misalignments, but with all coupling designs, accurate alignment of the shafts will increase the service life of the coupling.

Misalignment values for flexible ROTEX® GS couplings are at the rated torque T_{KN} of the coupling with an operating speed $n = 1,500$ RPM and ambient temperature of $+ 86$ °F. The misalignment figures may, in each case, be used individually; however, if they occur simultaneously, they may only be used in proportion to the total allowable misalignment.

Shaft misalignment ROTEX® GS design DKM

This design reduces the restoring forces arising with parallel misalignment to a minimum. The use of two jaw sets and increased distance between the hubs results in the couplings' ability to accommodate higher axial and angular misalignment.

²⁾ The Ka figures mentioned above have to be added to the length of the corresponding coupling design.

Misalignments							
Size	Spider GS	Misalignments standard			Misalignments DKM		
		[in] Axial $\Delta K_a^{2)}$	[in] Parallel ΔK_r	[degree] Angular α	[in] Axial $\Delta K_a^{2)}$	[in] Parallel ΔK_r	[degree] Angular α
5	70		0.006	1.2		0.007	1.2
	80	+0.016	0.005	1.1	+0.016	0.006	1.1
	92	-0.008	0.002	1.0	-0.016	0.006	1.0
	98		0.002	0.9		0.005	0.9
7	80		0.006	1.1		0.009	1.1
	92	+0.024	0.004	1.0	+0.024	0.008	1.0
	98	-0.012	0.002	0.9	-0.024	0.007	0.9
	64		0.002	0.8		0.007	0.8
9	80		0.007	1.1		0.011	1.1
	92	+0.031	0.005	1.0	+0.031	0.010	1.0
	98	-0.016	0.003	0.9	-0.031	0.009	0.9
	64		0.002	0.8		0.008	0.8
12	80		0.008	1.1		0.014	1.1
	92	+0.035	0.006	1.0	+0.035	0.013	1.0
	98	-0.016	0.003	0.9	-0.035	0.011	0.9
	64		0.002	0.8		0.010	0.8
14	80		0.008	1.1		0.016	1.1
	92	+0.039	0.006	1.0	+0.039	0.015	1.0
	98	-0.020	0.004	0.9	-0.039	0.013	0.9
	64		0.002	0.8		0.011	0.8
19	80		0.006	1.1		0.019	1.1
	92	+0.047	0.004	1.0	+0.047	0.018	1.0
	98	-0.020	0.002	0.9	-0.039	0.016	0.9
	64		0.002	0.8		0.014	0.8
24	92		0.006	1.0		0.023	1.0
	98	+0.055	0.004	0.9	+0.055	0.021	0.9
	64	-0.020	0.003	0.8	-0.039	0.019	0.8
	72		0.002	0.7		0.017	0.7
28	92		0.006	1.0		0.026	1.0
	98	+0.059	0.004	0.9	+0.059	0.024	0.9
	64	-0.028	0.003	0.8	-0.055	0.021	0.8
	72		0.002	0.7		0.018	0.7
38	92		0.007	1.0		0.030	1.0
	98	+0.071	0.005	0.9	+0.071	0.027	0.9
	64	-0.028	0.004	0.8	-0.055	0.024	0.8
	72		0.002	0.7		0.021	0.7
42	92		0.007	1.0		0.033	1.0
	98	+0.079	0.006	0.9	+0.079	0.030	0.9
	64	-0.039	0.004	0.8	-0.079	0.026	0.8
	72		0.002	0.7		0.023	0.7
48	92		0.009	1.0		0.036	1.0
	98	+0.083	0.006	0.9	+0.083	0.032	0.9
	64	-0.039	0.004	0.8	-0.079	0.029	0.8
	72		0.003	0.7		0.025	0.7
55	92		0.009	1.0		0.040	1.0
	98	+0.087	0.007	0.9	+0.087	0.036	0.9
	64	-0.039	0.005	0.8	-0.079	0.032	0.8
	72		0.004	0.7		0.028	0.7
65	95	+0.102	0.007	0.9	-	-	-
	64	-0.039	0.005	0.8	-	-	-
75	95	+0.118	0.008	0.9	-	-	-
	64	-0.059	0.006	0.8	-	-	-
90	95	+0.134	0.006	0.9	-	-	-
	64	-0.059	0.007	0.8	-	-	-

