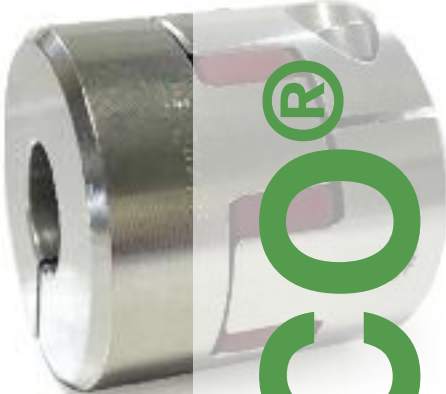


TRASCO® ES: "0" Backlash Coupling



# TRASCO® ES

## Contents

<b>TRASCO® ES “0” Backlash Coupling</b>	<b>Page</b>
Description	43
Advantages	44
ATEX Directive	44
Technical characteristics - Misalignments	45
Installation and maintenance	46
Selection according to DIN740.2	47
Example for selection and load check	48
TRASCO® ES executions	49
• Standard type execution	50
• “MC” compact execution with clamp hubs	51
• “M” execution with clamp hubs	52 - 53
• “2M” execution with clamp hubs	54
• “A” type - shrink disc execution	55
• “AP” type - shrink disc execution according to DIN 69002	56
• “GESS” double cardanic execution	57
• “GES LR1” execution with intermediate shaft	58
• “GES LR3” execution with intermediate shaft	59 - 60
Technical data for intermediate shaft couplings “GES LR1 - GES LR3”	60



## TRASCO® ES: “0” backlash coupling

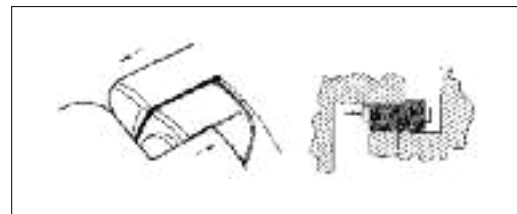
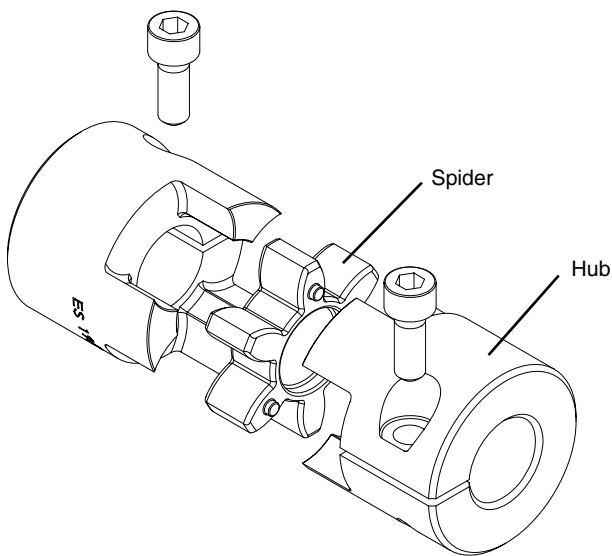
TRASCO® ES is our zero backlash coupling designed to compensate for misalignment and vibration dampening for

indexing applications. The compact design of TRASCO® ES makes it the right choice for all precise motion applications.

### Description

The TRASCO® ES consists of two hubs, which are either made of high-strength aluminum (up to the 38/45 size) or steel (from size 42) that are connected with an elastic element. The precise dimensional characteristics of TRASCO® ES are obtained through our accurate machining process. The special compound polyurethane elastic element, developed through extensive research and laboratory testing, is made through a press-forming process which guarantees high dimensional accuracy.

The element is available in 4 different hardnesses: **80 Sh. A (blue)**, **92 Sh. A (yellow)**, **98 Sh. A (red)**, **64 Sh. D (green)**. Coupling performance depends on the type of element selected (see “**Technical characteristics**”). Other element hardnesses are available upon request to meet special operating conditions, such as high temperatures and/or high torques, and for providing a high degree of vibration dampening capability. Please contact our Engineering Office for help in selecting the appropriate element hardness.



### Operation

When the polyurethane element is installed in its special seats between the hubs, it becomes precompressed, thereby providing the zero backlash feature which characterizes the transmission performance of this coupling.

With zero backlash, the coupling remains torsionally rigid within the range of the precompression load, but does permit the

absorption of radial, angular, and axial misalignments as well as undesired vibrations.

The significantly wide precompressed area of the flexible element keeps the contact pressure against the elastic element low. Therefore, the element teeth can be overloaded many times without undergoing any wear or taking a permanent set.



## Advantages

The TRASCO® ES coupling provides the following advantages:

- “zero-backlash” motion transmission
- dampening (up to 80%) of vibrations from motor shaft
- low heat and electrical conductivity
- easy and fast installation
- perfect balance (A & AP type)
- low moment of inertia (due to compact design and types of materials used).

## Main applications

TRASCO® ES couplings are most frequently used with:

- servomotors
- robotics
- sliding tables
- spindle controls for drilling and grinding mandrels
- ball-bearing screws

## Operating Temperature Range

The operating temperature range for the TRASCO® ES depends on the type of element. For the **92° Sh. A (yellow)**, the range is **between -40 and +90 °C**, and for the **98° Sh.A (red)**, the range is **between -30 and +90 °C**. Peak temperatures as high as 120 °C can be tolerated for brief instances.

High operating temperatures can cause the elastic element to lose a considerable amount of elasticity, thus substantially lowering the torque handling capacity.

Therefore, when selecting a coupling, the operating temperature must be carefully considered (see “**Technical characteristics**”).

## ATEX Directive 2014/34/EU

It is possible to ask for specific certification for use in hazardous area according to EC standard **94/9/EC**. TRASCO® ES couplings are available with specific mounting/operating

instruction manual and conformity.

For information, please contact our technical office.



## Technical characteristics

The following technical characteristics apply to all types of TRASCO® ES couplings.

When using the M, A and AP versions, check the torque values given in the table against the allowable hub transmission values for the respective versions given in the pertinent sections.

TRASCO® ES couplings can withstand axial, radial, and angular misalignment.

Even after operating for an extended period with a misalignment, there is still zero backlash because the elastic element is only stressed by pressure loads.

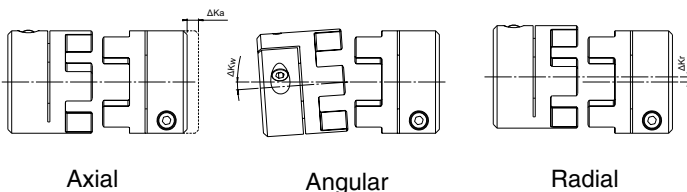
When an application causes a high degree of misalignment, a double flexing type coupling can be provided which avoids the formation of reaction forces.

Please contact our Engineering Office.

Size	Shore	T <sub>KN</sub> [Nm]	T <sub>Kmax</sub> [Nm]	C <sub>T</sub> stat. [Nm/rad]	C <sub>T</sub> din. [Nm/rad]	C <sub>r</sub> [N/mm]	ΔK <sub>a</sub> [mm]	ΔK <sub>r</sub> [mm]	ΔK <sub>w</sub> [°]
7	80° Sh.A (Blue)	0,7	1,4	8	26	114	0,6	0,15	1,1
	92° Sh.A (yellow)	1,2	2,4	14	43	219	0,6	0,10	1,0
	98° Sh.A (red)	2	4	22	69	421	0,6	0,10	0,9
9	80° Sh.A (Blue)	1,8	3,6	16	52	125	0,8	0,20	1,1
	92° Sh.A (yellow)	3	6	29	95	262	0,8	0,15	1,0
	98° Sh.A (red)	5	10	55	155	518	0,8	0,10	0,9
	64° Sh.D (green)	6	12	75	225	740	0,8	0,08	0,8
12	80° Sh.A (Blue)	3	6	85	250	275	0,9	0,20	1,1
	92° Sh.A (yellow)	5	10	165	480	470	0,9	0,15	1,0
	98° Sh.A (red)	9	18	240	720	845	0,9	0,08	0,9
	64° Sh.D (green)	12	24	330	980	1200	0,9	0,05	0,8
14	80° Sh.A (Blue)	4	8	60	180	153	1,0	0,21	1,1
	92° Sh.A (yellow)	8	15	115	344	336	1,0	0,15	1,0
	98° Sh.A (red)	13	25	170	513	604	1,0	0,09	0,9
	64° Sh.D (green)	16	32	235	702	856	1,0	0,06	0,8
19/24	80° Sh.A (Blue)	5	10	370	1120	740	1,2	0,15	1,1
	92° Sh.A (yellow)	10	20	820	1920	1260	1,2	0,10	1,0
	98° Sh.A (red)	17	34	990	2350	2210	1,2	0,06	0,9
	64° Sh.D (green)	21	42	2500	3800	2970	1,2	0,04	0,8
24/28	80° Sh.A (Blue)	17	34	860	1390	840	1,4	0,18	1,1
	92° Sh.A (yellow)	35	70	2.300	5.130	1.900	1,4	0,14	1,0
	98° Sh.A (red)	60	120	3.700	8.130	2.940	1,4	0,10	0,9
	64° Sh.D (green)	75	150	5.000	11.000	3.700	1,4	0,07	0,8
28/38	80° Sh.A (Blue)	46	92	1.370	2.350	990	1,5	0,20	1,1
	92° Sh.A (yellow)	95	190	3.800	7.270	2.100	1,5	0,15	1,0
	98° Sh.A (red)	160	320	4.200	10.800	3.680	1,5	0,11	0,9
	64° Sh.D (green)	200	400	10.000	20.000	4.400	1,5	0,08	0,8
38/45	80° Sh.A (Blue)	95	190	3.000	6.100	1.400	1,8	0,22	1,1
	92° Sh.A (yellow)	190	380	5.600	12.000	2.900	1,8	0,17	1,0
	98° Sh.A (red)	325	650	8.140	21.850	5.040	1,8	0,12	0,9
	64° Sh.D (green)	405	810	25.000	40.000	6.500	1,8	0,09	0,8
42	80° Sh.A (Blue)	130	270	4.500	9.600	1.950	2,0	0,24	1,1
	92° Sh.A (yellow)	265	530	9.800	20.500	4.100	2,0	0,19	1,0
	98° Sh.A (red)	450	900	15.180	34.200	5.940	2,0	0,14	0,9
	64° Sh.D (green)	560	1.120	37.000	70.000	7.300	2,0	0,10	0,8
48	80° Sh.A (blue)	150	300	5.500	11.200	2.100	2,1	0,27	1,1
	92° Sh.A (yellow)	310	620	12.000	22.800	4.500	2,1	0,23	1,0
	98° Sh.A (red)	525	1.050	16.600	49.400	6.820	2,1	0,16	0,9
	64° Sh.D (green)	655	1.310	57.000	100.000	8.300	2,1	0,11	0,8
55	80° Sh.A (blue)	200	400	6.000	11.000	1.500	2,2	0,28	1,1
	92° Sh.A (yellow)	410	820	13.000	23.100	3.200	2,2	0,24	1,0
	98° Sh.A (red)	685	1.370	24.000	63.400	7.100	2,2	0,17	0,9
	64° Sh.D (green)	825	1.650	100.000	130.000	9.200	2,2	0,12	0,8
65	92° Sh.A (yellow)	625	1.250	23.500	35.000	6.410	2,6	0,25	1,0
	98° Sh.A (red)	900	1.800	48.000	71.500	6.620	2,6	0,18	0,9
	64° Sh.D (green)	1.040	2.080	118000	190000	8850	2,6	0,13	0,8
75	98° Sh.A (red)	1.920	3.840	79.150	150.450	8.650	3,0	0,21	0,9
	64° Sh.D (green)	2.400	4.800	182.000	315.000	12.000	3,0	0,15	0,8

All the technical data in the catalogue are valid for rotation speeds of 1500 rpm and a working temperature of 30 °C. For linear speed over 30 m/s, dynamic balancing is recommended.

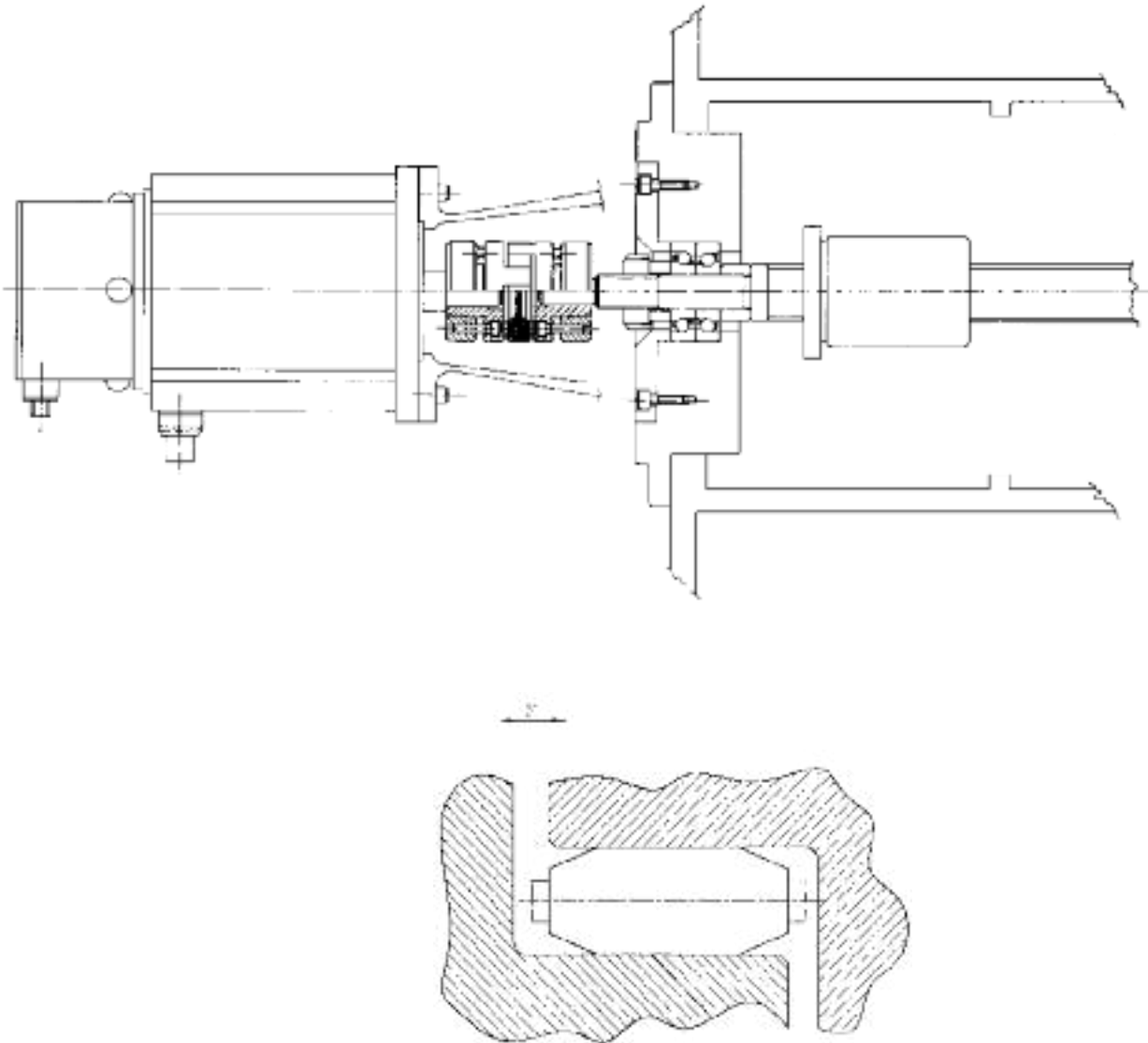
### Misalignments



T <sub>KN</sub>	Coupling nominal torque	Nm
T <sub>Kmax</sub>	Coupling maximum torque	Nm
C <sub>T</sub>	Torsional rigidity	Nm/rad
C <sub>r</sub>	Radial stiffness	N/mm
ΔK <sub>a</sub>	Maximum axial misalignment	mm
ΔK <sub>r</sub>	Maximum radial misalignment	mm
ΔK <sub>w</sub>	Maximum angular misalignment	°

## Installation and maintenance

1. Carefully clean the shafts
2. Insert the hubs onto shafts being connected. With the M, A and AP versions, be sure to tighten the screws with the Ms torque value given in the catalogue. Be careful with the A and AP versions to tighten the screws uniformly and crosswise to the recommended torque
3. Position the element in one of the two coupling hubs
4. Fit together the two coupling halves, making sure the “s” dimension is properly observed. This must be done to insure proper elastic element function and long service life, as well as to assure the coupling is properly insulated electrically



With the A and AP versions, mounting the hubs can be facilitated by lubricating the shaft contact surfaces with an oil, but **do not use a molybdenum bisulphide based oils.**

When mounting the TRASCO® ES coupling an axial thrust is generated which disappears when the mounting has been com-

pleted to avoid putting axial loads on the bearings.

Lubrication of the elastic element will reduce the amount of axial force required during installation

Note: All rotating parts must be guarded.

## Selection in according to DIN 740.2

The coupling must be chosen so the applied working loads do not exceed the allowable values whatever the working conditions are.

### 1. Check the load with respect to the nominal torque

The nominal coupling torque must be greater than or equal to the nominal torque of the drive machine for all working temperatures.

$$T_{KN} \geq T_K \cdot S_\theta \cdot S_D$$

### 2. Check the load with respect to the torque peak values

The maximum coupling torque must be greater than or equal to the torque peaks that occur during operation for all working temperatures.

$$T_{Kmax} \geq T_S \cdot S_Z \cdot S_\theta + T_K \cdot S_\theta \cdot S_D$$

Motor-side peaks:  $T_S = T_{AS} \cdot \frac{1}{m+1} \cdot S_A + T_L^{(1)}$

Driven-side peaks:  $T_S = T_{LS} \cdot \frac{m}{m+1} \cdot S_L + T_L^{(1)}$

### 3. Check the load with respect to periodic torque inversions

*By means of resonance*

When the resonance frequency is passed rapidly below the operational interval a few torque peaks will be seen. The generated alternating loads must be compared with the maximum torque the coupling can support.

$$T_{Kmax} \geq T_S \cdot S_Z \cdot S_\theta + T_K \cdot S_\theta \cdot S_D$$

Motor-side peaks:  $T_S = T_{AI} \cdot \frac{1}{m+1} \cdot V_R + T_L^{(1)}$

Driven-side peaks:  $T_S = T_{LI} \cdot \frac{m}{m+1} \cdot V_R + T_L^{(1)}$

### 4. Check the load with respect to nonperiodic torque inversions

To check the load with respect to nonperiodic torque inversions, the following equations must be satisfied:

$$0,25 T_{KN} = T_{KW} \geq T_W \cdot S_\theta \cdot S_f \cdot S_D$$

Motor-side peaks:  $T_W = T_{AI} \cdot \frac{1}{m+1} \cdot V_{fi}$

Driven-side peaks:  $T_W = T_{LI} \cdot \frac{m}{m+1} \cdot V_{fi}$

(1)  $T_L$  to be added if a torque peak occurs during acceleration.

## Calculation coefficients

#### $S_\theta$ = Temperature factor

T [°C]	-30/+30	+40	+60	+80
$S_\theta$	1	1,2	1,4	1,8

#### $S_v$ = Starting frequency factor

S/h	0-100	101-200	201-400	401-800	801-1.600
$S_Z$	1	1,2	1,4	1,6	1,8

#### $S_f$ = Frequency factor

f in Hz	≤10	>10
$S_f$	1	$\sqrt{f/10}$

#### $S_D$ = Torsional rigidity factor

Tooling machines	Positioning system	Speed and angular acceleration indicator
2-5	3-8	10 ≥

#### $S_L$ o $S_A$ = Shock factor

Type of impact	$S_L$ o $S_A$
Light	1,5
Medium	1,8
Strong	2,2

$$V_{fi} = \text{Torque-Amplification factor} = \sqrt{\frac{1 + \left(\frac{\Psi}{2\pi}\right)^2}{\left(1 - \frac{n^2}{n_R^2}\right)^2 + \left(\frac{\Psi}{2\pi}\right)^2}}$$

$$n_R = \text{Resonance frequency} = \frac{30}{\pi} \sqrt{C_{Tdin} \frac{J_A + J_L}{J_A \cdot J_L}} \quad [\text{min}^{-1}]$$

$$m = \text{Mass factor} = \frac{J_A}{J_L}$$



## Example of selection

### Application

Servomotor driving a recirculating ball screw on a machine tool

Nominal Torque	$T_K = 10,0 \text{ Nm}$	Shock Type	Light
Peak Torque	$T_{AS} = 22,0 \text{ Nm}$	Table Moment of Inertia	$J_3 = 0,0038 \text{ kg}\cdot\text{m}^2$
Rpm	$n = 3.000 \text{ 1/min}$	Driven Shaft	$d_c = 20 \text{ mm h6 (without keyway)}$
Moment of Inertia	$J_1 = 0,0058 \text{ kg}\cdot\text{m}^2$	Motor Shaft	$d_m = 24 \text{ mm h6 (without keyway)}$
Temperature	$T = +40 \text{ }^\circ\text{C}$		

### Selection

24/28 "A" type ES coupling with "Red" elastic element (98 Sh. A)

Standard coupling torque:	$T_{KN} = 60 \text{ [Nm]}$
Maximum torque:	$T_{Kmax} = 120 \text{ [Nm]}$
Hub Moment of Inertia:	$J_2 = 0,000135 \text{ [kg}\cdot\text{m}^2]$
Couple Transmitted by taper locking ring:	$T_{cal} = \begin{cases} 92 \text{ [Nm] bore 20 [mm]} \\ 113 \text{ [Nm] bore 24 [mm]} \end{cases}$

### Load check

$$T_{KN} = T_K \cdot S_\theta \cdot S_D = 10 \cdot 1,2 \cdot 4 = 48,0 \text{ [Nm]}$$

$$T_{KN} = 48,0 \text{ Nm} < T_{cal}$$

$$m = \frac{J_A}{J_L} \quad J_A = J_1 + J_2 \quad J_L = J_3 + J_2 \quad m = 1,5$$

$$T_S = T_{AS} \cdot \frac{1}{m+1} \cdot S_A = 22,0 \cdot \frac{1}{1,5+1} \cdot 1,5 = 13,2 \text{ [Nm]}$$

$$T_{Kmax} = T_S \cdot S_Z \cdot S_\theta + T_K \cdot S_\theta \cdot S_D = 13,2 \cdot 1,6 \cdot 1,2 + 12,5 \cdot 1,2 \cdot 4 = 85,34 \text{ [Nm]}$$

$$T_{Kmax} = 85,34 \text{ Nm} < T_{cal}$$

$T_{KN}$	Coupling nominal torque	Nm	$n_R$	Resonance speed	$\text{min}^{-1}$
$T_K$	Motor-side nominal torque	Nm	$C_T$	Torsional rigidity	Nm/rad
$T_{Kmax}$	Coupling maximum torque	Nm	$M_T$	Transmissible torque moment	Nm
$T_S$	Motor peak torque	Nm	$S_A$	Motor-side shock factor	
$T_{AS}/T_{AI}$	Driver-side peak torque	Nm	$S_L$	Driven-side shock factor	
$T_L$	Acceleration delivered torque	Nm	$S_Z$	Start frequency factor	
$T_{LS}/T_{LI}$	Driven-side peak torque	Nm	$S_\theta$	Temperature factor	
$V_R$	Resonance factor		$S_D$	Torsional rigidity factor	
$V_{fi}$	Torque amplification factor		$S_f$	Frequency factor	
$m$	Mass factor		$T_W$	Torque with reversal of the machine	Nm
$J_A$	Motor-side inertia	$\text{kgm}^2$	$T_{KW}$	Torque with reversal transmissible by the coupling	Nm
$J_L$	Driven-side inertia	$\text{kgm}^2$	$T_{cal}$	Hub-shaft connection maximum torque	Nm
$\Psi$	Dampening factor				



## TRASCO® ES executions

### FINISHED BORE HUBS EXECUTION

#### GESF execution



From size 7 to 9.  
Hub execution with finish bores,  
and two setscrew.

#### GESF C execution



From size 14.  
Hub execution with finish bore,

### CLAMP HUBS EXECUTION

#### GESM execution



Clamping hub execution.

#### GESM...C execution



Clamping hub execution with double slot and keyway.

#### GESMC execution



Compact clamping hub execution.

#### GES2M execution



Split clamping hub execution for radial assembly of the coupling torque depends on bore diameter.

### SHRINK DISC EXECUTION

#### GESA execution



Execution with locking ring. This execution is suitable for high speed and high torque. Screws mounting from spider side. Transmissible torque depends on bore diameter.

#### GESAP execution



Execution with locking ring with high machining accuracy: design suitable for application on spindles according to DIN 69002.

# Standard type

SIT coupling hubs are available from stock with either solid hub or with finished bores of standard shaft diameters. The setscrews of our finished bore execution are positioned 120 degrees from each other with one positioned 180 degrees from

the keyway. Both the solid hub and bored hub coupling are generally available from stock for quick delivery. **Approved according to ATEX Directive.**

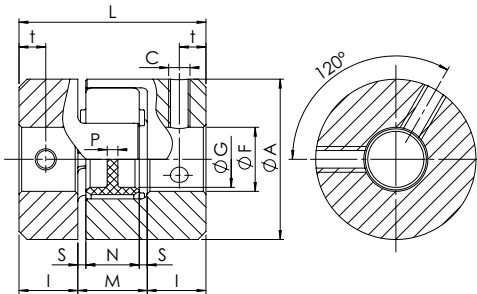


Fig. 1

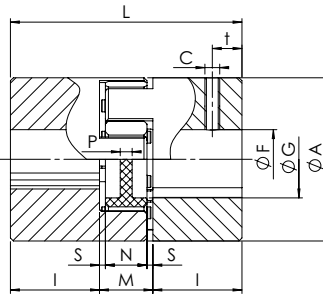


Fig. 2

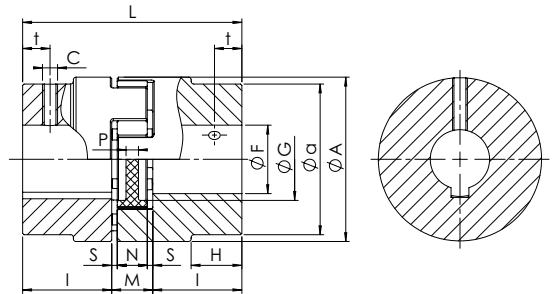


Fig. 3

Size	F min [mm]	F max [mm]	Mozzo		n <sub>max</sub> [min <sup>-1</sup> ]
			W [kg]	J [kgm <sup>2</sup> ]	
<b>ALUMINUM HUBS</b>					
7	3	7	0,003	0,085 x 10 <sup>-6</sup>	40.000
9	4	10	0,008	0,48 x 10 <sup>-6</sup>	28.000
12	4	12	0,015	1,5 x 10 <sup>-6</sup>	22.000
14	4	16	0,019	2,7 x 10 <sup>-6</sup>	19.000
19/24	6	24	0,066	20,4 x 10 <sup>-6</sup>	14.000
24/28	8	32	0,140	74,5 x 10 <sup>-6</sup>	10.600
28/38	10	38	0,253	200,3 x 10 <sup>-6</sup>	8.500
38/45	12	45	0,455	400,6 x 10 <sup>-6</sup>	7.100
<b>STEEL HUBS</b>					
42	14	55	2,000	2.246 x 10 <sup>-6</sup>	6.000
48	20	60	2,520	3.786 x 10 <sup>-6</sup>	5.600
55	25	70	4,100	9.986 x 10 <sup>-6</sup>	5.000
65	25	80	5,900	18.352 x 10 <sup>-6</sup>	4.600
75	30	95	6,900	27.402 x 10 <sup>-6</sup>	3.700

A [mm]	G [mm]	H-a [mm]	L [mm]	I [mm]	M [mm]	N [mm]	S [mm]	P [mm]	c	Ms [Nm]	t [mm]	Fig.
<b>ALUMINUM HUBS</b>												
14	-	-	22	7	8	6	1,0	6,0	M3	0,3	3,5	1
20	7,2	-	30	10	10	8	1,0	2,0	M3	0,3	5	1
25	8,5	-	34	11	12	10	1,0	3,0	M4	1,5	5	2
30	10,5	-	35	11	13	10	1,5	2,0	M4	1,5	5	2
40	18	-	66	25	16	12	2,0	3,5	M5	2	10	2
55	27	-	78	30	18	14	2,0	4,0	M5	2	10	2
65	30	-	90	35	20	15	2,5	5,2	M6	4	15	2
80	38	-	114	45	24	18	3,0	5,6	M8	10	15	2
<b>STEEL HUBS</b>												
95	46	-	126	50	26	20	3,0	5,6	M8	10	20	2
105	51	-	140	56	28	21	3,5	6,0	M8	10	25	2
120	60	-	160	65	30	22	4,0	9,0	M10	17	20	2
135	68	-	185	75	35	26	4,5	8,3	M10	17	20	2
160	80	53-135	210	85	40	30	5,0	8,3	M10	17	25	3

Bore tolerance: H7 - JS9 (DIN 6885/1) keyway

## Order form

Hub **GESF 24/28 F20**

GESP: solid hub  
 GESF: bore + keyway + set-screw

Size

F...: bore diameter

Spider **AES 24/28 R**

TRASCO® ES spider

Size

B: 80 Sh A (blue)  
 G: 92 Sh A (yellow)  
 R: 98 Sh A (red)  
 V: 64 Sh D (green)

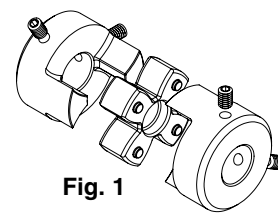


Fig. 1

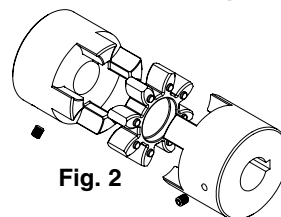


Fig. 2

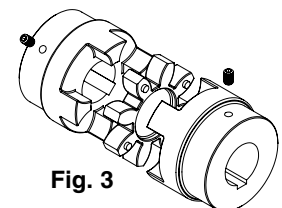
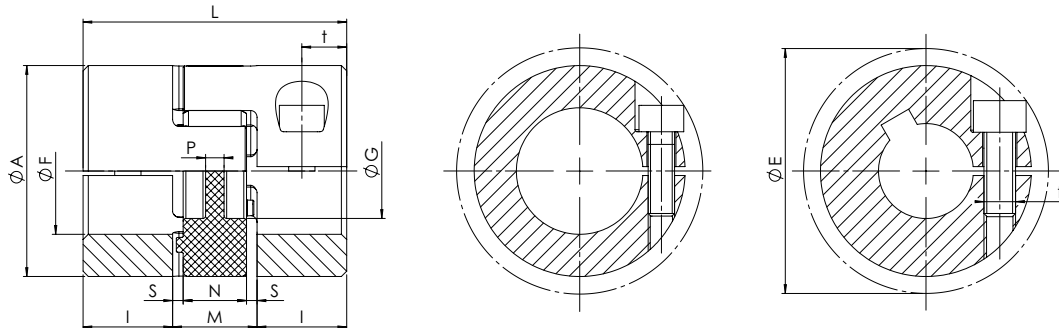


Fig. 3

M <sub>S</sub>	Screw tightening torque	Nm
W	Weight	kg
J	Moment of inertia	kgm <sup>2</sup>
n <sub>max</sub>	Maximum rpm	min <sup>-1</sup>

## “MC” execution with clamp hubs - compact execution

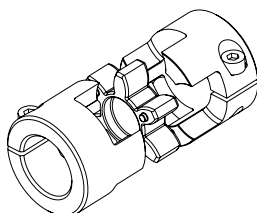
Compact version with reduced overall length. They guarantee the same performances as the normal version with reduced overall dimensions.



Size	F min [mm]	F max [mm]	C	Ms [Nm]	n <sub>max</sub> [min <sup>-1</sup> ]	A [mm]	L [mm]	I [mm]	M [mm]	N [mm]	S [mm]	P [mm]	t [mm]	E [mm]
<b>ALUMINUM HUBS</b>														
7	3	7	M2	0,6	40.000	14	18	5	8	6	1,0	6	2,5	16,6
9	4	10	M2,5	1,0	28.000	20	24	7	10	8	1,0	2	3,5	21,3
12	4	12	M3	1,4	22.000	25	26	7	12	10	1,0	3	3,5	26,2
14	6	16 <sup>(1)</sup>	M4	2,9	19.000	30	32	9,5	13	10	1,5	2	4,8	30,5
19/24	10	24 <sup>(1)</sup>	M6	11,0	14.000	40	50	17	16	12	2,0	3,5	8,5	45,0 <sup>(1)</sup>
24/28	10	32	M6	11,0	10.600	55	54	18	18	14	2,0	4	9,0	57,5
28/38	14	35	M8	25,0	8.500	65	62	21	20	15	2,5	5,2	10,5	69,0
38/45	18	45	M10	49,0	7.100	80	76	26	24	18	3,0	5,6	13,0	86,0

<sup>(1)</sup> Size 14 up to bore Ø screw 12 M4 , over screw M3 . size 19/24 up to bore Ø 20 screw M6, over screw M5 (Ø E= 46,7 mm)

Size	Recommended M coupling Type Hub Bore Dia. [mm] and Transmissible Torque [Nm], valid for shaft tolerances k6																										
	3	4	5	6	7	8	9	10	11	12	14	15	16	18	19	20	22	24	25	28	30	32	35	38	40	42	45
7	0,8	0,9	1,0	1,0	1,1																						
9		2,1	2,2	2,3	2,5	2,6	2,7	2,8																			
12		3,4	3,6	3,8	3,9	4,1	4,3	4,4	4,6	4,8																	
14			7,1	7,4	7,7	8,0	8,3	8,6	8,9	9,2	5,8	6,0	6,1														
19						24,4	25,1	25,8	26,5	27,1	28,5	29,2	29,9	31,2	31,9	32,6	25,4	26,3									
24								23	25	27	32	34	36	41	43	45	50	54	57	63	68	72					
28											58	62	66	75	79	83	91	100	104	116	124	133	145				
38												99	105	119	125	132	145	158	165	184	198	211	230	250	263	277	296



n<sub>max</sub> Maximum rpm

min<sup>-1</sup>

## “M” execution with clamp hubs

This type of coupling permits quick, positive mounting, without any shaft-hub backlash. With the keyless coupling type, the torque applied for tightening

down the screws (Ms) must be as given in the table. **The M coupling type is available with or without keyway. Approved according to ATEX Directive.**

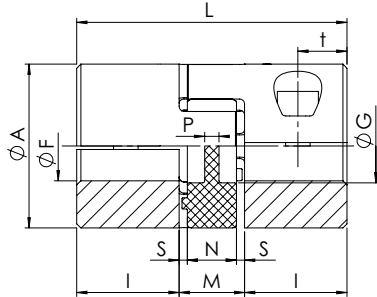


Fig. 1

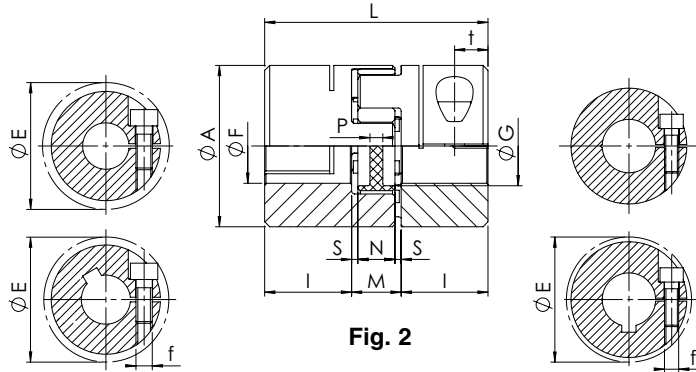
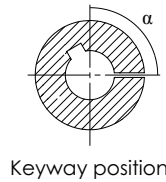


Fig. 2



Keyway position

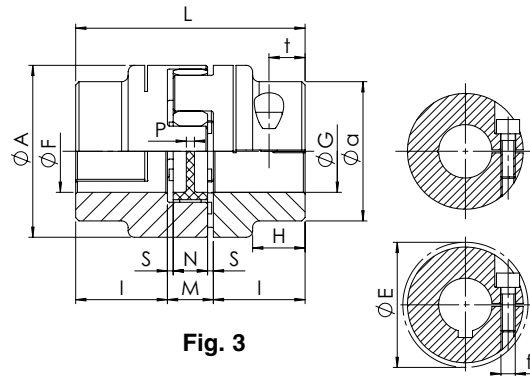


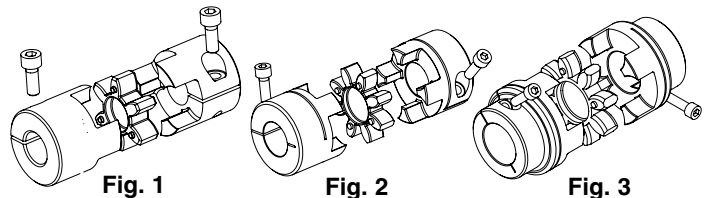
Fig. 3

Size	F min [mm]	F max [mm]	f	Ms [Nm]	Hub		n <sub>max</sub> [min <sup>-1</sup> ]
					W [kg]	J [kgm <sup>2</sup> ]	
<b>ALUMINUM HUBS</b>							
7	3	7	M2	0,35	0,003	0,085 x 10 <sup>-6</sup>	40.000
9	4	10	M2,5	0,75	0,007	0,42 x 10 <sup>-6</sup>	28.000
12	4	12	M3	1,4	0,015	1,4 x 10 <sup>-6</sup>	22.000
14	6	16	M3	1,4	0,018	2,6 x 10 <sup>-6</sup>	19.000
19/24	10	24 <sup>(1)</sup>	M5	11	0,071	18,1 x 10 <sup>-6</sup>	14.000
24/28	10	32	M6	11	0,156	74,9 x 10 <sup>-6</sup>	10.600
28/38	14	38	M8	25	0,240	163,9 x 10 <sup>-6</sup>	8.500
38/45	18	45	M8	25	0,440	465,5 x 10 <sup>-6</sup>	7.100
<b>STEEL HUBS</b>							
42	25	50	M10	70	2,100	3.095 x 10 <sup>-6</sup>	6.000
48	25	55	M12	120	2,900	5.160 x 10 <sup>-6</sup>	5.600
55	35	70	M12	120	4,000	9.737 x 10 <sup>-6</sup>	5.000
65	40	80	M14	190	5,800	17.974 x 10 <sup>-6</sup>	4.600
75	40	80	M16	295	8,100	29.304 x 10 <sup>-6</sup>	2.950

Keyway position α	A [mm]	G [mm]	H-a [mm]	L [mm]	I [mm]	M [mm]	N [mm]	S [mm]	P [mm]	t [mm]	E [mm]	Fig.
-	14	-	-	22	7	8	6	1,0	6	4	15,0	1
-	20	7,2	-	30	10	10	8	1,0	2	5	23,4	1
180°	25	8,5	-	34	11	12	10	1,0	3	5	27	1
180°	30	10,5	-	35	11	13	10	1,5	2	5,5	32,2	1
120°	40	18	-	66	25	16	12	2,0	3,5	12	45,7 <sup>(1)</sup>	1
90°	55	27	-	78	30	18	14	2,0	4	12	57,5	2
90°	65	30	-	90	35	20	15	2,5	5,2	13,5	72,6	2
90°	80	38	-	114	45	24	18	3,0	5,6	16	83,3	2
<b>STEEL HUBS</b>												
-	95	46	-	126	50	26	20	3,0	5,6	20	78,8	2
-	105	51	-	140	56	28	21	3,5	6	21	108,0	2
-	120	60	-	160	65	30	22	4,0	9	26	122,0	2
-	135	68	-	185	75	35	26	4,5	8,3	27,5	139,0	2
-	160	80	53-135	210	85	40	30	5,0	8,3	30	147,5	3

<sup>(1)</sup> Size 19/24 up to bore Ø 20 screw M6, over M5 screw (Ø E= 46,7 mm)  
 From size 7 to 19/24: single slot execution  
 From size 24/28 to 65: double slot execution  
 Bore tolerance: F7 - JS9 (DIN 6885/1) keyway

M <sub>s</sub>	Screw tightening torque	Nm
W	Weight	kg
J	Coupling moment of inertia	kgm <sup>2</sup>
n <sub>max</sub>	Maximum rpm	min <sup>-1</sup>



**Hub** **GESM 48 F50**

GESM: TRASCO® ES hub

Size

F...: bore diameter  
F...C: bore diameter and keyway

**Spider** **AES 24/28 R**

TRASCO® ES spider

Size

B: 80° Sh A (blue)  
G: 92° Sh A (yellow)  
R: 98° Sh A (red)  
V: 64° Sh D (green)

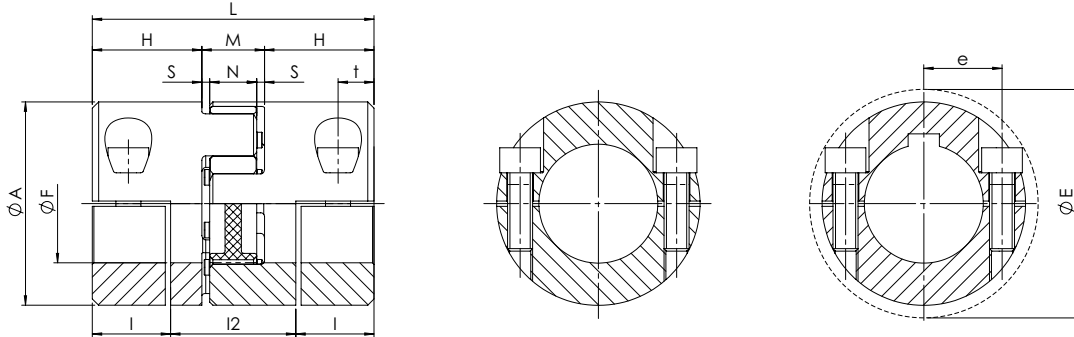
Using hub execution **M** without keyway, the maximum transmissible torque is the minor between the clamp-hub transmissible torque and the value stated in the section “**Technical characteristics**”.

Size	Recommended M coupling Type Hub Bore Dia. [mm] and Transmissible Torque [Nm], valid for shaft tolerances k6																																					
	3	4	5	6	7	8	9	10	11	12	14	15	16	18	19	20	22	24	25	28	30	32	35	38	40	42	45	48	50	55	60	65	70	75	80			
7	0,9	1,0	1,0	1,1	1,2																																	
9		2,1	2,3	2,4	2,5	2,6	2,7																															
12		4,1	4,2	4,4	4,6	4,8	5,0	5,2	5,4	5,5																												
14			5,0	5,2	5,4	5,5	5,7	5,9	6,1	6,3	6,7	6,8	7,0																									
19/24								28	29	29	31	31	32	34	34	35	30	32																				
24/28								24	27	29	34	37	39	44	46	49	54	59	61	68	73	78																
28/38											58	62	66	75	79	83	91	100	104	116	124	133	145															
38/45												62	66	75	79	83	91	100	104	116	124	133	145	158	166	174	187											
42																139	153	167	174	195	209	223	243	264	278	292	313	334	348									
48																		254	285	305	326	356	387	407	428	458	489	509	560									
55																						326	356	387	407	428	458	489	509	560	611	662	713					
65																							488	530	558	586	628	670	697	767	837	907	976	1046	1116			
75																								769	808	865	923	961	1057	1154	1250	1346	1442	1538				

TRASCO® ES

## “2M” execution with clamp hubs

Split clamping hub execution for radial assembly of the coupling torque depends on bore diameter.



Size	F <sub>min</sub> [mm]	F <sub>max</sub> [mm]	f	Ms [Nm]	Hub		n <sub>max</sub> [min <sup>-1</sup> ]
					W [kg]	J [kgm <sup>2</sup> ]	
<b>ALUMINUM HUBS</b>							
14	5	16	M3	1,3	0,025	4,6 x 10 <sup>-6</sup>	12.700
19/24	8	20	M6	10	0,078	2,0 x 10 <sup>-6</sup>	9.550
24/28	10	28	M6	10	0,160	76,3 x 10 <sup>-6</sup>	6.950
28/38	14	38	M8	25	0,240	176,3 x 10 <sup>-6</sup>	5.850
38/45	18	45	M8	25	0,470	503,9 x 10 <sup>-6</sup>	4.750
42	22	50	M10	49	0,750	1.121,7 x 10 <sup>-6</sup>	4.000
48	22	55	M12	86	1,08	1.870,4 x 10 <sup>-6</sup>	3.600

A [mm]	H [mm]	I [mm]	I <sub>2</sub> [mm]	L [mm]	M [mm]	N [mm]	S [mm]	E [mm]	t [mm]	e [mm]
<b>ALUMINUM HUBS</b>										
30	18,5	14,5	21	50	13	10	1,5	32	7,5	11,5
40	25	17,5	31	66	16	12	2	47	8,0	14,5
55	30	22	34	78	18	14	2	57	10,5	20,0
65	35	25	40	90	20	15	2,5	73	11,5	25,0
80	45	33	48	114	24	18	3	84	15,5	30,0
95	50	36,5	53	126	26	20	3	94	18,0	36,0
105	56	39,5	61	140	28	21	3,5	105	18,5	36,0

Size	Recommended M coupling Type Hub Bore Dia. [mm] and Transmissible Torque [Nm], valid for shaft tolerances k6																											
	5	6	7	8	9	10	11	12	14	15	16	18	19	20	22	24	25	28	30	32	35	38	40	42	45	48	50	55
14	2,8	3,3	3,9	4,4	5,0	5,6	6,1	6,7	7,8	8,3	8,9																	
19/24				18	20	23	25	27	32	34	36	41	43	45														
24/28					23	25	27	32	34	36	41	43	45	50	54	57	63											
28/38								58	62	66	75	79	83	91	100	104	116	124	133	145	158							
38/45									62	66	75	79	83	91	100	104	116	124	133	145	158	166	174	187				
42														132	145	158	165	184	198	211	230	250	263	277	296	316	329	
48															212	231	241	270	289	308	337	366	385	404	433	462	481	529

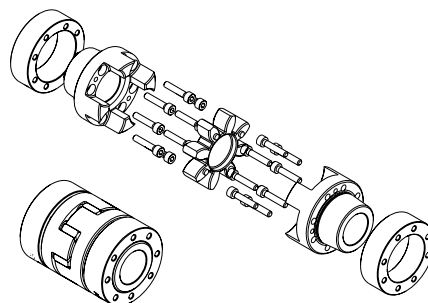
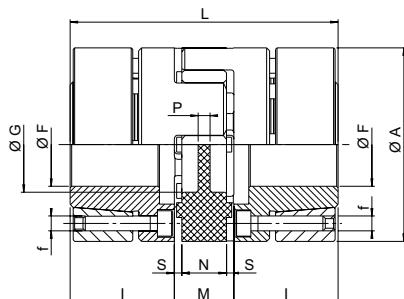
n<sub>max</sub> Maximum rpm min<sup>-1</sup>

## “A” type - Shrink disc execution

This type of coupling provides excellent kinetic uniformity. Furthermore, the absence of keys or set screws makes it a well-balanced coupling and greatly facilitates installation and removal. An exact radial/axial positioning is easy for those applications which require it. The absence of keyways also

avoids fretting corrosion and backlash between the shaft and the hub. This is the ideal type of coupling for applications requiring precision and/or high rotational speeds.

**Approved according to ATEX Directive.**



Size	F <sub>min</sub> [mm]	F <sub>max</sub> [mm]	f	Screws for locking elements	M <sub>s</sub> [Nm]	Hub		n <sub>max</sub> [min <sup>-1</sup> ]
						W [kg]	J [kgm <sup>2</sup> ]	
<b>ALUMINUM HUBS AND STEEL LOCKING ELEMENT</b>								
14	6	14	M3	4	1,3	0,049	7 x 10 <sup>-6</sup>	28.000
19/24	10	20	M4	6	2,9	0,120	30 x 10 <sup>-6</sup>	21.000
24/28	15	28	M5	4	6,0	0,280	135 x 10 <sup>-6</sup>	15.500
28/38	19	38	M5	8	6,0	0,450	315 x 10 <sup>-6</sup>	13.200
38/45	20	45	M6	8	10,0	0,950	960 x 10 <sup>-6</sup>	10.500
<b>STEEL HUBS AND LOCKING ELEMENT</b>								
42	28	50	M8	4	35,0	2,300	3.150 x 10 <sup>-6</sup>	9.000
48	35	60	M8	4	35,0	3,080	5.200 x 10 <sup>-6</sup>	8.000
55	35	65	M10	4	71,0	4,670	10.300 x 10 <sup>-6</sup>	6.300
65	40	70	M12	4	120,0	6,700	19.100 x 10 <sup>-6</sup>	5.600

A [mm]	G [mm]	L [mm]	I [mm]	M [mm]	N [mm]	S [mm]	P [mm]
<b>ALUMINUM HUBS AND STEEL LOCKING ELEMENT</b>							
30	10,5	50	18,5	13	10	1,5	2
40	18	66	25	16	12	2,0	3,5
55	27	78	30	18	14	2,0	4
65	30	90	35	20	15	2,5	5,2
80	38	114	45	24	18	3,0	5,6
<b>STEEL HUBS AND LOCKING ELEMENT</b>							
95	46	126	50	26	20	3,0	5,6
105	51	140	56	28	21	3,5	6
120	60	160	65	30	22	4	9
135	68	185	75	35	26	4,5	8,3

Size	Recommended A coupling Type Hub Bore Dia. [mm] and Transmissible Torque [Nm], valid for shaft tolerances k6																											
	Ø10	Ø11	Ø14	Ø15	Ø16	Ø17	Ø18	Ø19	Ø20	Ø22	Ø24	Ø25	Ø28	Ø30	Ø32	Ø35	Ø38	Ø40	Ø42	Ø45	Ø48	Ø50	Ø55	Ø60	Ø65	Ø70		
14	10	12	22																									
19/24	42	46	60	65	69	74	79	84	88																			
24/28				66	72	77	82	87	92	102	113	118	135															
28/38								175	185	205	225	235	266	287	308	339	373											
38/45									255	283	312	326	367	398	427	471	515	545	577	620								
42													420	460	500	563	627	670	714	790	850	880						
48																557	612	649	687	744	801	840	932	1033				
55																	986	1112	1140	1185	1284	1412	1420	1652	1680	1691		
65																		1531	1580	1772	1840	1960	2049	2438	2495	2590		

### Order form

Hub **GESA 48 F45**

GESA: TRASCO® ES hub - "A" execution

Size

F...: bore diameter

Spider

**AES 24/28 R**

TRASCO® ES spider

Size

B: blue; G: yellow; R: red; V: green

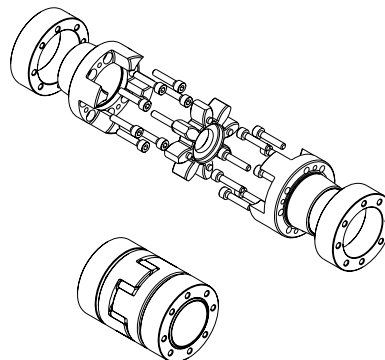
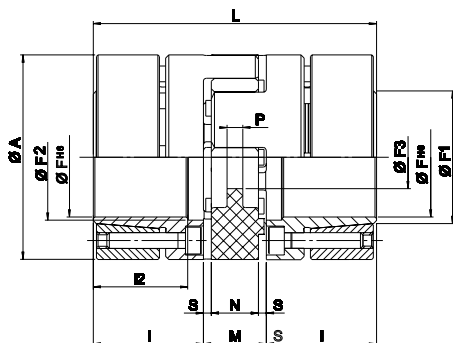
M <sub>s</sub>	Screw tightening torque	Nm
W	Weight	kg
J	Coupling moment of inertia	kgm <sup>2</sup>
n <sub>max</sub>	Maximum rpm	min <sup>-1</sup>



## “AP” type - Shrink disc execution according to DIN 69002

Precision “zero-backlash” coupling designed for multi spindle devices on machine tools or controls with reduced mass, such as short center spindles, multi-centers primary spindles in work sta-

tions, or joined to high speed bearings with limited tolerance range. It is suitable for very high speeds of rotation (up to speeds of 50 m/s).

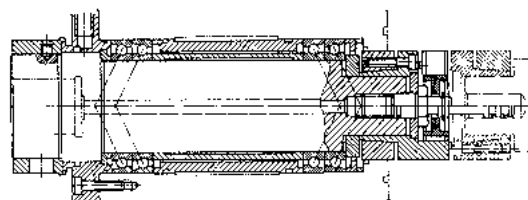


Size	F <sup>H6</sup> [mm]	M <sub>S</sub> [Nm]	Hub		n <sub>max</sub> [min <sup>-1</sup> ]
			W [kg]	J [kgm <sup>2</sup> ]	
<b>STEEL HUBS AND LOCKING ELEMENT</b>					
14	14	1,89	0,080	11 x 10 <sup>-6</sup>	28.000
19/24 - 37,5	16	3,05	0,160	37 x 10 <sup>-6</sup>	21.000
19/24	19	3,05	0,190	46 x 10 <sup>-6</sup>	21.000
24/28-50	24	4,90	0,330	136 x 10 <sup>-6</sup>	15.500
24/28	25	8,50	0,440	201 x 10 <sup>-6</sup>	15.500
28/38	35	8,50	0,640	438 x 10 <sup>-6</sup>	13.200
38/45	40	14,00	1,320	1.325 x 10 <sup>-6</sup>	10.500
42	42	35,00	2,230	3.003 x 10 <sup>-6</sup>	9.000
48	45	35,00	3,090	5.043 x 10 <sup>-6</sup>	8.000
55	50	71,00	4,740	10.020 x 10 <sup>-6</sup>	6.300

A [mm]	L [mm]	I [mm]	I <sub>2</sub> [mm]	M [mm]	N [mm]	S [mm]	P [mm]	F <sub>1</sub> [mm]	F <sub>2</sub> [mm]	F <sub>3</sub> [mm]
<b>STEEL HUBS AND LOCKING ELEMENT</b>										
32	50	18,5	15,5	13	10	1,5	2,0	17	17	8,5
37,5	66	25	21	16	12	2,0	3,5	20	19	9,5
40	66	25	21	16	12	2,0	3,5	23	22	9,5
50	78	30	25	18	14	2,0	4,0	30	29	12,5
55	78	30	25	18	14	2,0	4,0	32	30	12,5
65	90	35	30	20	15	2,5	5,2	42	40	14,5
80	114	45	40	24	18	3,0	5,6	49	46	16,5
95	126	50	45	26	20	3,0	5,6	54	55	18,5
105	140	56	50	28	21	3,5	6,0	65	60	20,5
120	160	65	58	30	22	4,0	9,0	65	72	22,5

Bore tolerance: H6

Spindle size	TRASCO® ES "AP"	98 Sh. A		64 sh. D	
		TKN [Nm]	TKmax [Nm]	TKN [Nm]	TKmax [Nm]
25 x 20	14	12,5	25	16	32
32 x 25	19/24 - 37,5	14	28	17	34
32 x 30	19/24	17	34	21	42
40 x 35	24/28 - 50	43	86	54	108
50 x 45	24/28	60	120	75	150
63 x 55	28/38	160	320	200	400



### Order form

Hub **GESAP 48 F45**

GESAP: TRASCO® ES hub - "AP" execution

Size

F...: bore diameter

### Spider

### AESP 24/28 R

TRASCO® ES spider - "AP" execution

Size

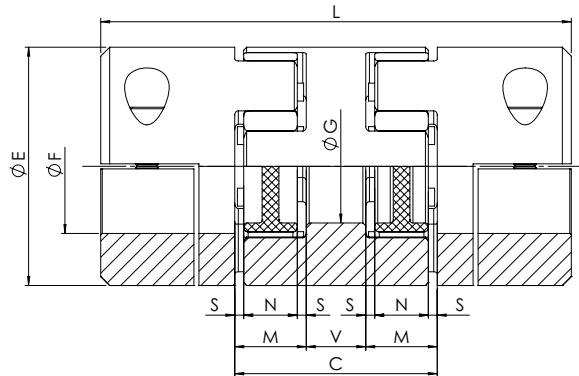
R: red; V: green

M <sub>S</sub>	Screw tightening torque	Nm
W	Weight	kg
J	Coupling moment of inertia	kgm <sup>2</sup>
n <sub>max</sub>	Maximum rpm	min <sup>-1</sup>

## “GESS” double cardanic execution

This execution allows higher misalignments. The 2 spiders allow a high vibration dampening providing a decrease in drive noise and longer life of related components (ex. bearings).

The intermediate element is made of aluminum alloy and may be used in combination **with any type of hub execution**.



Size	Fa max* [mm]			E [mm]	C [mm]	L [mm]			V [mm]	M [mm]	S [mm]	N [mm]	G [mm]
	GESF	GESM	GES2M			GESF	GESM	GES2M					
<b>ALUMINUM HUBS</b>						<b>ALUMINUM GESS</b>							
7	7	7	-	14	20	34	34	-	4	8	1	6	-
9	10	10	-	20	25	45	45	-	5	10	1	8	-
14	16	16	16	30	34	56	56	71	8	13	1,5	10	-
19/24	24	24	20	40	42	92	92	92	10	16	2	12	18
24/28	28	32	32	55	52	112	112	112	16	18	2	14	27
28/38	38	38	38	65	58	128	128	128	18	20	2,5	15	30
38/45	45	45	45	80	68	158	158	158	20	24	3	18	38
<b>ALUMINUM HUBS</b>						<b>ALUMINUM GESS</b>							
42	55	50	50	95	74	174	174	174	22	26	3	20	46
48	60	55	55	105	80	192	192	192	24	28	3,5	21	51
55	70	70	-	120	88	218	218	-	28	30	4	22	60
65	80	80	-	135	102	252	252	-	32	35	4,5	26	68

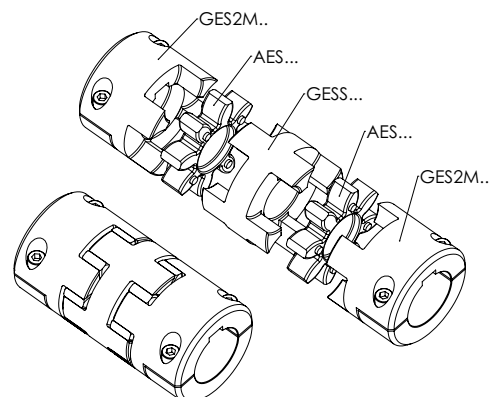
\* The max bore depends on the type of hub used

### Order form

Spacer element **GES** 24

GES: spacer element

Size: 24/28

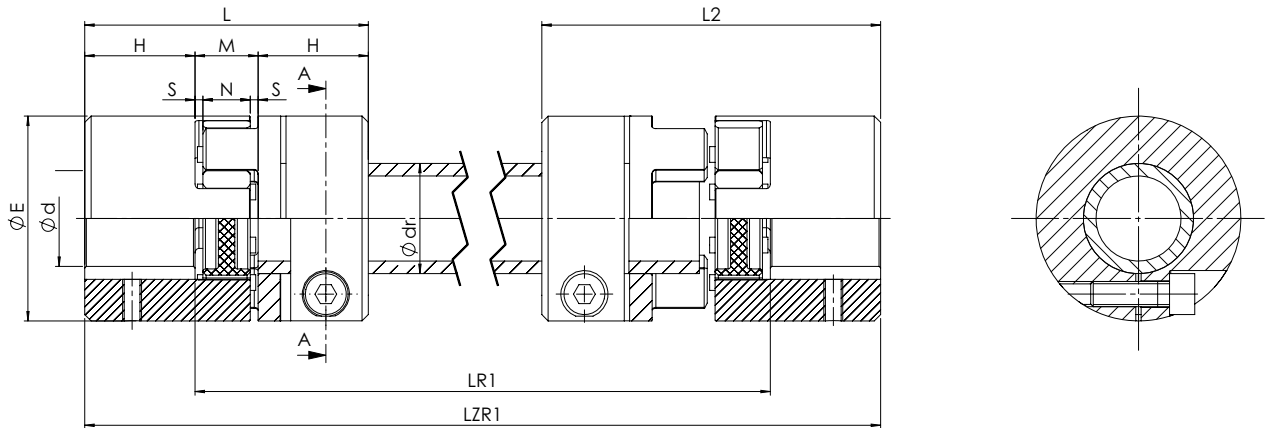


W	Weight	kg
J	Coupling moment of inertia	kgm <sup>2</sup>

## “GES LR1” execution with intermediate shaft

This zero backlash execution, allows connection to long distance shafts in applications such as lifting screw jacks, gantry robot etc. The intermediate shaft is made of steel but may be of different

material for specific need. The presence of 2 spiders, increases the dampening properties and allow high misalignments.

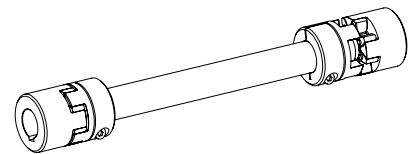


Size	External hub		Internal hub		
	Dimensions finished bores		Screws Din912-8.8 M-L	Ms [N·m]	M <sub>T</sub> [N·m]
	dmin [mm]	dmax [mm]			
14	4	15	M3x12	1,34	6,1
19/24	6	24	M6x18	10	34
24/28	8	28	M6x20	10	45
28/38	10	38	M8x25	25	105
38/45	12	45	M8x30	25	123

E [mm]	H [mm]	L [mm]	M [mm]	N [mm]	s [mm]	L2 [mm]	LR1 [mm]	LR1 min [mm]	LZR1 [mm]	d <sub>R</sub> x thickness [mm]
30	11	35	13	10	1,5	46,5	On request	65	LR1+22	14 x 2.0
40	25	66	16	12	2,0	80		85	LR1+50	20 x 3.0
55	30	78	18	14	2,0	94		96	LR1+60	25 x 2.5
65	35	90	20	15	2,5	107,5		111	LR1+70	35 x 4.0
80	45	114	24	18	3,0	135		126	LR1+90	40 x 4.0

### Coupling configurator

Coupling code	Item	Type	Execution	Bore diameter	Order example	
GESL38/45	Hub 1	GESP	-	-	GESF38/45F35	
		GESF	-	F...		
		GESM	F-C	F...		
		GESA	-	F...		
	Spider 1	AES	B-G-R-V	-	AES38/45V	
	Length LR1					LR1= 1200 mm
	Spider 2	AES	B-G-R-V	-	AES38/45V	
	Hub 2	GESP	-	-	GESF38/45F35	
		GESF	-	F...		
		GESM	F-C	F...		
GESA		-	F...			

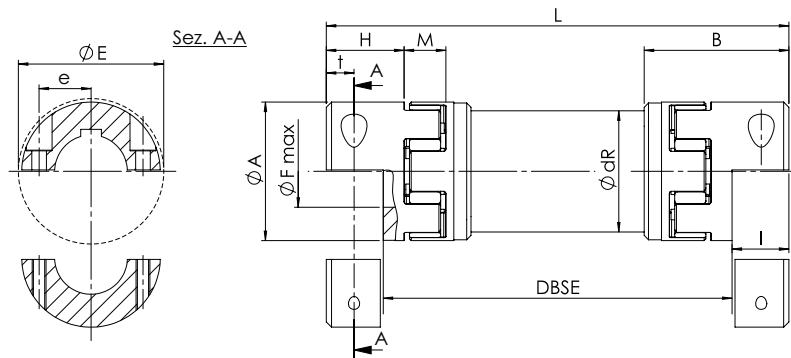


M<sub>S</sub> Screw tightening torque Nm  
M<sub>T</sub> Transmissible torque moment Nm

## “GES LR3” execution with intermediate shaft

Ideal execution for long distance shaft connections. Torque transmission is zero backlash. It is used in applications such as automatic machines, lifting machines, palletizing machines, and handling machines. Designed for length up to 4 m without

bearing support (depending on rotation speed). The double slot execution, allows spider mounting and replacement without driver/driven machine displacement. All aluminum alloy for a very low inertia.

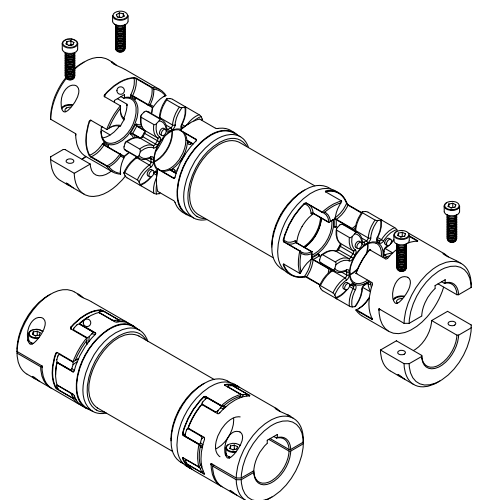


Size	Dimensions finished bores		Clamping		Moment of inertia [10 <sup>3</sup> kgm <sup>2</sup> ] with d <sub>max</sub> hub 1			Torsional rigidity
	d <sub>min</sub> [mm]	d <sub>max</sub> [mm]	Screws DIN 4762-8.8	Coppia di serraggio Ms [Nm]	Hub 1 J <sub>1</sub>	Hub 2 J <sub>2</sub>	Shaft J <sub>3</sub>	C <sub>T</sub> [Nm/rad]
14	5	16	M3	1,34	0,00406	0,00238	0,091	893
19/24	8	20	M6	10	0,02002	0,01304	0,329	3244
24/28	10	28	M6	10	0,07625	0,04481	0,0693	6632
28/38	14	38	M8	25	0,17629	0,1095	1,199	11814
38/45	18	45	M8	25	0,50385	0,2572	2,972	29290
42	22	50	M10	49	1,12166	0,5523	4,560	44930
48	22	55	M12	86	1,87044	1,1834	9,251	91158

A [mm]	H [mm]	I [mm]	B [mm]	M [mm]	DBSE min. [mm]	L [mm]	E [mm]	t [mm]	e [mm]	dR [mm]
30	18,5	14,5	36	13	72	DBSE + 29	32	7,5	11,5	27
40	25	17,5	49	16	98	DBSE + 35	47	8,0	14,5	40
55	30	22	59	18	121	DBSE + 44	57	10,5	20	50
65	35	25	67	20	137	DBSE + 50	73	11,5	25	60
80	45	33	83,5	24	169	DBSE + 66	84	15,5	30	70
95	50	36,5	93	26	180	DBSE + 73	94	18	36	80
105	56	39,5	103	28	202	DBSE + 79	105	18,5	36	100

### Coupling configurator

Coupling code	Item	Type	Execution	Bore diameter	Order example
GESLR38/45	Hub 1	GES2M	F-C	F...	GES2M38/45F35
	Spider 1	AES	B-G-R-V	-	AES38/45V
	Distance between shaft DBSE				DBSE= 1200 mm
	Spider 2	AES	B-G-R-V	-	AES38/45V
	Hub 2	GES2M	F-C	F...	GESM38/45F35

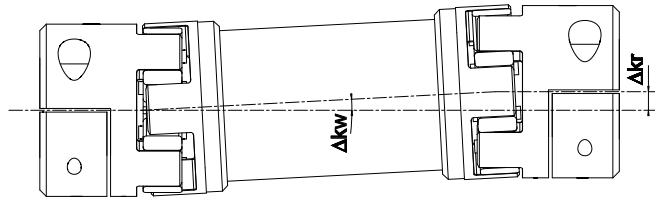


M <sub>S</sub>	Screw tightening torque	Nm
J	Coupling moment of inertia	kgm <sup>2</sup>
C <sub>T</sub>	Torsional rigidity	Nm/rad

Size	Bores and torques for friction with hub without keyway [Nm]																												
	5	6	7	8	9	10	11	12	14	15	16	18	19	20	22	24	25	28	30	32	35	38	40	42	45	48	50	55	
14	2,8	3,3	3,9	4,4	5,0	5,6	6,1	6,7	7,8	8,3	8,9																		
19/24				18	20	23	25	27	32	34	36	41	43	45															
24/28						23	25	27	32	34	36	41	43	45	50	54	57	63											
28/38									58	62	66	75	79	83	91	100	104	116	124	133	145	158							
38/45										62	66	75	79	83	91	100	104	116	124	133	145	158	166	174	187				
42															132	145	158	165	184	198	211	230	250	263	277	296	316	329	
48																212	231	241	270	289	308	337	366	385	404	433	462	481	529

## Technical data for intermediate shaft couplings (GES LR1 - GES LR3)

Size	Misalignment	
	Assial $\Delta K_a$ [mm]	Angular $\Delta K_w$ [°]
14	1,0	0,9
19/24	1,2	0,9
24/28	1,4	0,9
28/38	1,5	0,9
38/45	1,8	0,9



Radial misalignment

$$\Delta K_r = (L_z - 2 \cdot H - M) \cdot \tan(\Delta K_w) \quad [\text{mm}]$$

Angular misalignment = 0,9° for spider

$$C_{\text{Tot}} = \frac{1}{2 \cdot \frac{1}{C_{\text{T spider}}} + \frac{L_{\text{intermediate shaft}}}{C_{\text{T intermediate shaft}}}} \quad [\text{Nm/rad}]$$

$$L_{\text{intermediate shaft}} = \frac{L_{zw} - 2 \cdot L}{1000} \quad [\text{mm}]$$

with  $L_{zw}$  = total coupling length

### Selection diagram GES LR3 coupling

