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Catalogue

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You have high expectations. So do we!

For many years, tectos has been synonymous with the research, development, analysis and production of costumer-specific NVH solutions (noise, vibration, harshness) for powertrains, and the associated task formuations for combustion and electric engines, in particular for prototypes and test bed applications.

Our motto has always been ”We’ll either find a way or we’ll make one”. This is also reflected in our continuously growing and innovative product portfolio, which is trusted by renowned OEMs all over the world and considered corporate standard by our customers.

The tectos core areas of simulation, measurements and NVH constitute the basis of our product solutions and our proprietary developments, as summarized in the chapter ”tectos test systems”.

From the design process, all the way to test bed hardware, couplings, drive shafts, docking systems, intermediate bearings and much more, tectos products stand for maximum reliability, minimal set-up times, straightforward maintenance as well as the highest level of cost efficiency.

Whether electric combustion engines – you and your products will benefit from the many years’ experience and the professional expertise of the tectos team with every single one of our product solutions.

Do you have any questions about our products, or do you require a customized solution?

The tectos team is happy to assist you with any additional information you may need.

Yours sincerely

Dipl.-Ing. Dr. Dieter Höfler CEO
tectos gmbh

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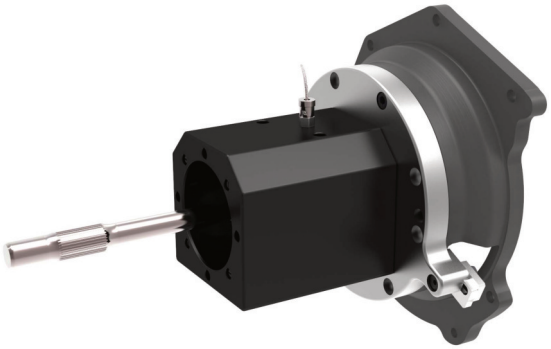
GEARBOX DUMMIES AND SEPARATOR COUPLINGS



Applications	Engines with low cylinder count	Motor sport engines	Engines with dual mass flywheels[1]	Passenger car engines	Commercial vehicles and mid range engines	Heavy-duty engines	E-mobility
tEVA110	✓	✓	✓	✓	✓		
tLEA	✓	✓	✓	✓	✓		

[1] Dual mass flywheel or original vehicle clutch

tEVA110 – COMPACT GEARBOX DUMMY

Description

The tEVA110 is a gearbox dummy with changeable quill shaft, used in test beds for engines with original vehicle clutch or clutch dummies.

The modular design with replaceable quill shaft allows quick adaptation to different engines and couplings. The gearbox dummy comprises a solid housing with sensors for bearing temperature monitoring, an integrated bearing and a quill shaft. The torsional stiffness can be optimized by modifying the torsion bar geometry.

Operating range

Torque: up to 1000 Nm
Speed: up to 10000 rpm

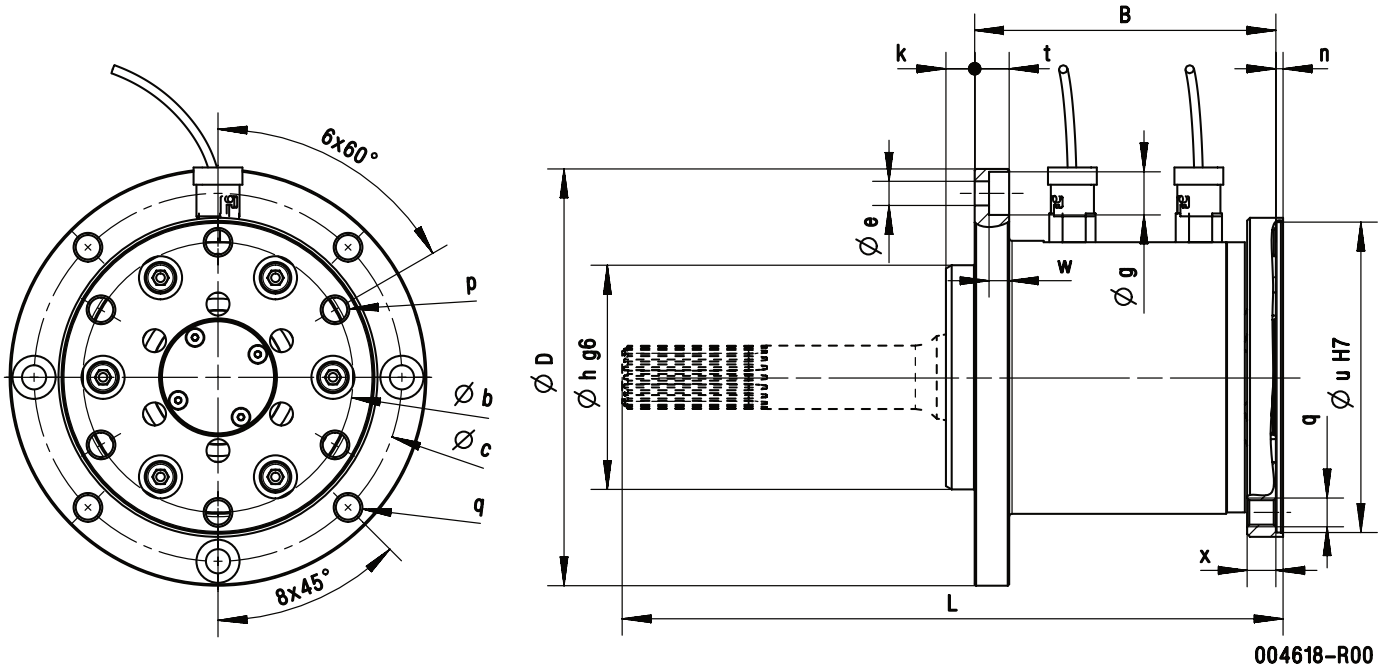
Benefits

- modular design
- fast exchange of quill shaft
- direct interface to the clutch
- adaptable clutch actuation
- integrated temperature monitoring
- compact design

integrated pilot bearing optionally available

Gearbox dummy	m [kg]	n_{max} [rpm]	T_{max} [Nm]	c_T [Nm/rad]	J [kgm^2]	ϑ_{min} [°C]	ϑ_{max} [°C]
tEVA110	2.96	10000	1000	4500	customer-specific	-30	+100

m - mass
n_{max} - maximum speed
T_{max}[2] - maximum torque
c_T - minimum torsional stiffness[3]
J - inertia
ϑ_{min} - minimum operating temperature
ϑ_{max} - maximum operating temperature



The quill shaft geometry and composition is dependent on customer requirements. The quill shaft (drawn with dashed lines) is only shown for clarity.

Gearbox dummy	Flange	D [mm]	B [mm]	b [mm]	c [mm]	e [mm]	g [mm]	h (g6) [mm]	k [mm]	n [mm]	p [-]	q [-]	t [mm]	u (H7) [mm]	w [mm]	x [mm]
tEVA110	CV05	145	104.8	74	128	8.4	15	78	10	4.5	M8	M10	12	86	7	10
	CV15			94						2.5	M10			108		

The installed length L is dependent on the application and is limited by the type of design, the quill shaft and maximum speed.

[2]The maximum torque must be the same as or larger than the maximum torque of the internal combustion engine, and is dependent on the geometry and the quill shaft material.
[3]The stiffness is dependent on the geometry and the material of the quill shaft

tLEA – MODULAR GEARBOX DUMMY

Description

The modular tLEA, gearbox dummy is the answer to increased complexity of the interaction between an internal combustion engine and gearbox. You can use the tLEA to measure the engine in the test bed without the gearbox influencing the results. The connection is made using the original gearbox interfaces.

The tLEA gearbox dummy can be supplemented by an optional operating unit.

Operating range

Torque: up to 1200 Nm
Speed: up to 10000 rpm

Higher torques and speeds are available on request.

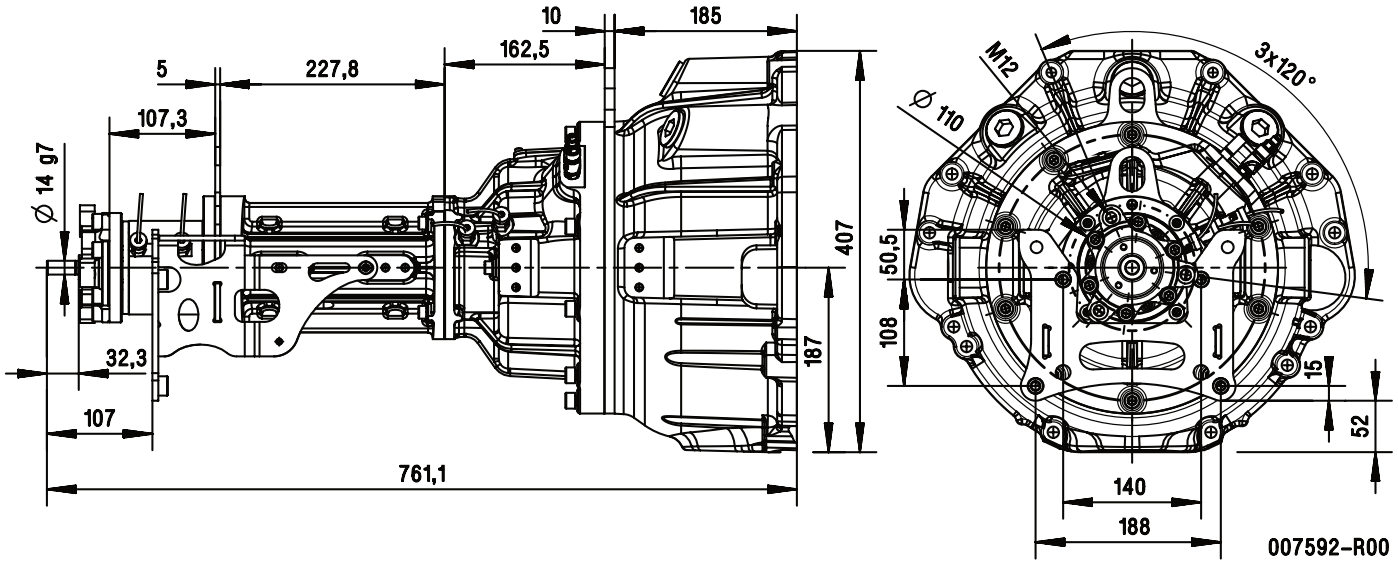
Benefits

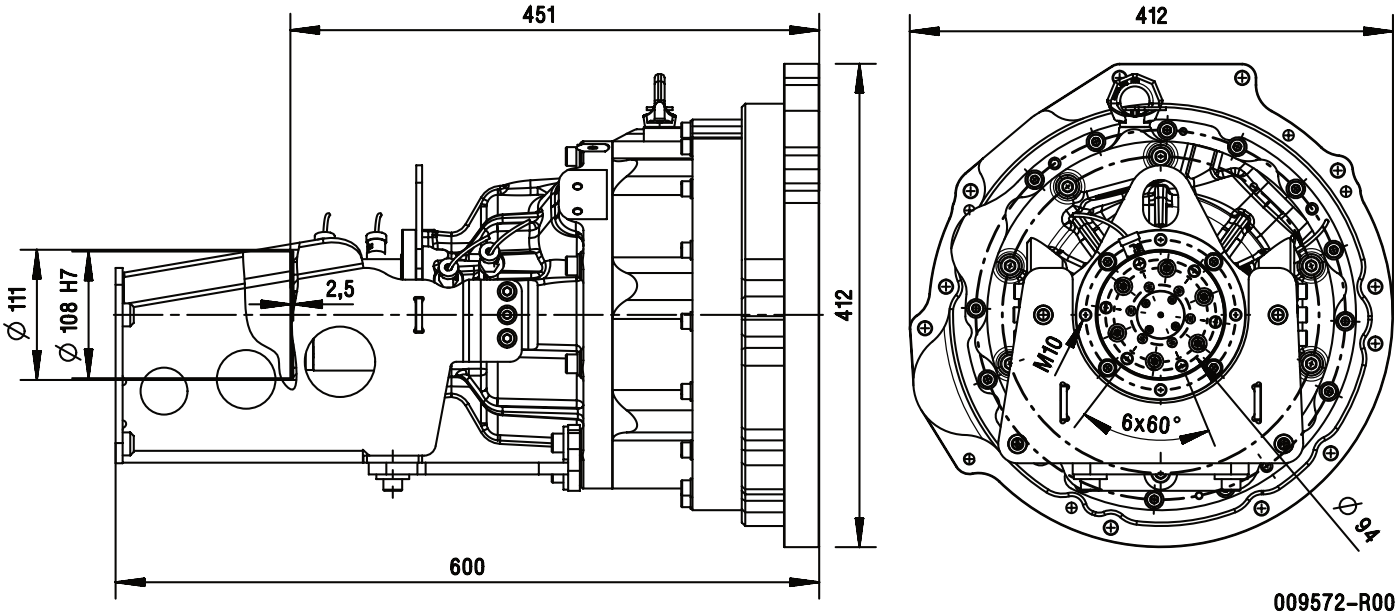
- modular design
- direct interface to the clutch
- adaptable clutch actuation
- integrated temperature monitoring
- mechanical separation of the drive train during operation is possible
- options for longitudinal and traverse drive are available

Operating unit for start-stop-tests optionally available

Gearbox dummy	L [mm]	H [mm]	B [mm]	m [kg]	T_{max} [Nm]	n_{max} [rpm]	J [kgm^2]	ϑ_{min} [°C]	ϑ_{max} [°C]	ϑ_{Bmax} [°C]
tLEA (long)	761.1	407	452	45.0	1200	10000	1.69E-01	-20	+80	+60
tLEA (short)	600	412	412	74.2	800	8500	1.51E-01	-20	+80	+60

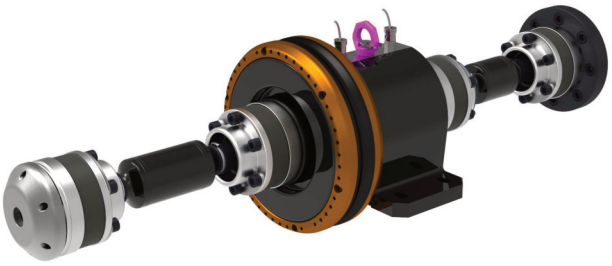
L - length
H - height
B - width
m - mass
T_{max} - maximum torque
n_{max} - maximum speed
J - inertia
ϑ_{min} - minimum operating temperature
ϑ_{max} - maximum operating temperature
ϑ_{Bmax} - maximum bearing temperature





The technical data and the measurements drawings provided are for illustrative purposes only.
Each tLEA gearbox dummy is adapted to **customer-specific needs**.

COUPLINGS



Applications	Engines with low cylinder count	Motor sport engines	Engines with dual mass flywheels[4]	Passenger car engines	Commercial vehicles and mid range engines	Heavy-duty engines	E-mobility
t650					✓	✓	
t1000-400		✓					✓
t1000-800	✓	✓	✓	✓			✓
t1000-1500	✓	✓	✓	✓			✓
t1000-4000					✓	✓	
t2100	✓	✓	✓	✓			✓
t2200	✓	✓	✓	✓			✓
t2300	✓		✓	✓	✓		
t2400	✓				✓		
t2500	✓				✓	✓	

[4]Dual mass flywheel or original vehicle clutch

t650 – ELASTIC COUPLING

Description

The t650 was designed for testing engines of commercial vehicles and heavy duty applications. This coupling is characterized by its low weight, high damping and low maintenance requirements.

Naming

The product is named according to the following convention:

t650-tttt-cccc-CVxx

- xx: joint size
- cccc: dynamic stiffness [Nm/rad]
- tttt: nominal torque [Nm]
- t650: series designation

Example: t650-2500-5200-CV21

Operating range

Torque: up to 8000 Nm
Speed: up to 5000 rpm

Benefits

- weight optimized design
- high damping
- low maintenance
- modular design

Function

As with all tectos products, the t650 follows a modular design principle, which separates the different functions.

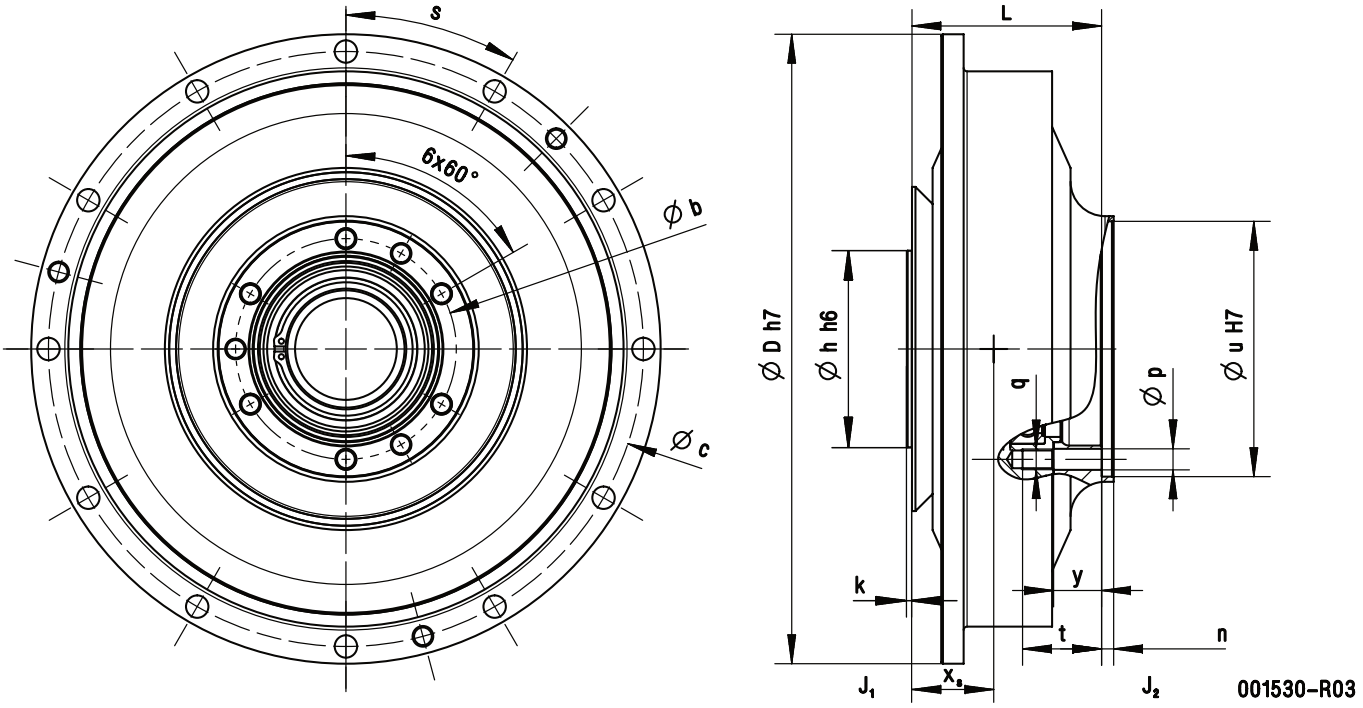
The elastic part of the coupling is used to decouple and damp the torsional vibrations.

The modular design consisting of a stable bearing cartridge, the customer-specific adapter flange and the elastomer, allows assemblies with the most diverse specifications to be configured in a modular manner.

The standard t650 specifications cover a nominal torque range of 2500 - 8000 Nm for a torsional stiffness of 5200 - 24500 Nm/rad.

Coupling	Flange	T_{KN} [Nm]	c_{Tdyn} [Nm/rad]	T_{Kmax} [Nm]	T_{KW} [Nm]	n_{max} [rpm]	m [kg]	x_s [mm]	J_1 [kgm^2]	J_2 [kgm^2]	Ψ [-]
t650-2500-5200	CV21	2500	5200	7500	850	5000	16.06	47.3	1.13E-01	6.42E-02	0.4
	CV30						16.43	46.8	1.14E-01	6.73E-02	
t650-3500-11000	CV21	3500	11000	10500	1100	5000	17.46	52.2	9.22E-02	7.34E-02	0.4
	CV30						18.23	47.4	9.77E-02	7.88E-02	
	CV32						17.72	48.3	9.92E-02	7.71E-02	
t650-4000-14500	CV30	4000	14500	12000	1200	5000	19.69	50.9	1.04E-01	8.90E-02	0.4
	CV32						17.98	51.0		8.40E-02	
t650-5000-15700	CV32	5000	15700	15000	1650	5000	25.48	44.0	3.27E-01	1.47E-01	0.6
t650-8000-24500	CV32	8000	24500	24000	2600	5000	35.13	67.5	4.98E-01	2.25E-01	0.4

T_{KN} - nominal torque[5]
c_{Tdyn} - torsional stiffness
T_{Kmax} - maximum torque
Ψ - relative damping
T_{KW} - maximum alternating torque
n_{max} - maximum speed
m - mass
x_s - center of gravity flange-side
J_1 - inertia flange-side
J_2 - inertia shaft-side

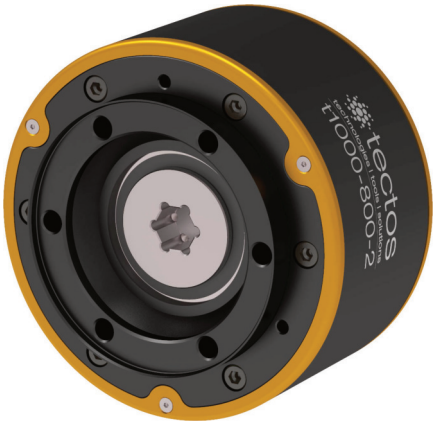


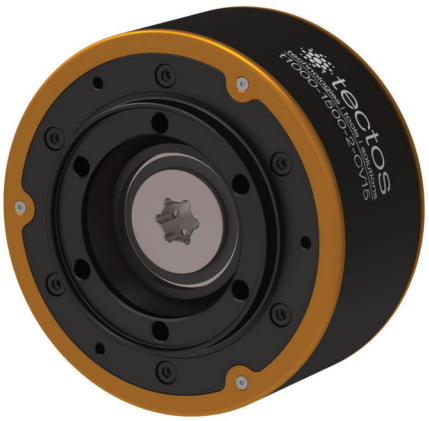
Coupling	Flange	D (h7) [mm]	L [mm]	b [mm]	c [mm]	n [mm]	h(h6) [mm]	k [mm]	p [mm]	q [-]	s [°]	t [mm]	u (H7) [mm]	y [mm]
t650-2500-5200	CV21	388	108.15	108.0	370	7.0	114	5	12.2	M12	16x22.5°	53.30	128	23.00
	CV30		108.62	128.0		6.4		3				44.50	148	26.50
t650-3500-11000	CV21	365	108.15	108.0	345	7.0	114	5	12.2	M12	12x30°	53.30	128	23.00
	CV30		109.95	128.0				3				45.83	148	27.83
	CV32		114.30	155.5					16.2	M16		62.15	180	30.15
t650-4000-14500	CV30	365	111.92	128.0	345	7.0	114	3	12.2	M12	12x30°	47.80	148	29.80
	CV32		114.30	155.5					16.2	M16		62.15	180	30.15
t650-5000-15700	CV32	466.7	114.00	155.5	438.2	7.0	114	3	16.2	M16	16x22.5°	61.85	180	29.85
t650-8000-24500	CV32	466.7	114.00	155.5	438.2	7.0	114	3	16.2	M16	16x22.5°	61.85	180	29.85

Other dimensions available on request.

[5]The nominal torque must be equal to or greater than the maximum combustion engine torque

t1000 – STANDARD CLAW COUPLING





Description

The t1000 standard claw coupling has been specially developed for use in motor sport, two-wheel applications, and special applications, for example tests with dual mass flywheels or original vehicle clutches. This coupling is characterized by its relatively low weight, very robust design, high damping capability and easy maintenance.

The development aim of this coupling (to transfer very high alternating torques at low stiffness) was achieved in various designs.

The design principle of the coupling allows the torsional stiffness to be adjusted for different requirements by using elastomers of varying hardness.

The t1000 claw coupling is available in 2 sizes.

Naming

The product is named according to the following convention:

t1000-xxxx-y-CVzz-ee
- ee: elastomer type
- zz: joint size
- y: number of elastomers
- xxxx: maximum torque [Nm]
- t1000: series designation

Example: t1000-800-1-CV05-SN

Operating range

Torque: up to 1500 Nm
Speed: up to 10000 rpm

Benefits

- for high dynamic loads
- compact and modular design
- no elastomer failure when overloaded
- no shaft damage when elastomer fails
- fast exchange of the elastomer
- high damping and long lifetime
- stiffness adjustment by elastomer placement

Function

The design provides a strongly non-linear coupling characteristic. The special design allows problem-free adaptation to new applications and a short downtime when exchanging the elastomers.

Coupling	T_{KN} [Nm]	T_{Kmax} [Nm]	T_{KW} [Nm]	n_{max} [rpm]	Ψ [-]	ϑ [°C]	z [-]
t1000-800	800	1500	700	10000	0.1 - 0.35	+80	64
t1000-1500	1500	2450	950	10000	0.1 - 0.35	+80	64

T_{Kmax} - maximum torque
T_{KW} - maximum alternating torque
ϑ - operating temperature for elastomer made of natural rubber[6]
Ψ - relative damping
n_{max} - maximum speed
z - number of toothed ring teeth[7] shaft-side
T_{KN} - nominal torque[8]

Coupling	Flange	m [kg]	x_s [mm]	$\Delta\varphi_{max}$ [°]	J_1 [kgm^2]	J_2 [kgm^2]	c_{Tdyn} [Nm/rad]
t1000-800-1	CV05	2.51	29.9	±7.5	2.26E-03	3.54E-03	2000 - 12000
	CV15	2.50	28.9		2.32E-03	3.52E-03	
t1000-800-2	CV05	3.89	46.6	±15.0	3.70E-03	5.28E-03	1000 - 6000
	CV15	3.87	45.6		3.80E-03	5.26E-03	
t1000-800-3	CV05	5.26	63.0	±22.5	5.06E-03	6.97E-03	700 - 3000
	CV15	5.25	62.0		5.12E-03	6.96E-03	
t1000-1500-1	CV15	3.08	29.7	±7.5	3.92E-03	6.84E-03	2000 - 12000
t1000-1500-2	CV15	4.67	46.3	±15.0	5.75E-03	1.17E-02	1000 - 6000
	CV21	5.31	48.1		6.58E-03	1.20E-02	
t1000-1500-3	CV15	6.26	62.5	±22.5	7.04E-03	1.53E-02	670 - 4000

m - mass
x_s - center of gravity flange-side
c_{Tdyn} - torsional stiffness
$\Delta\varphi_{max}$ - maximum torsional angle
J_1 - inertia flange-side
J_2 - inertia shaft-side

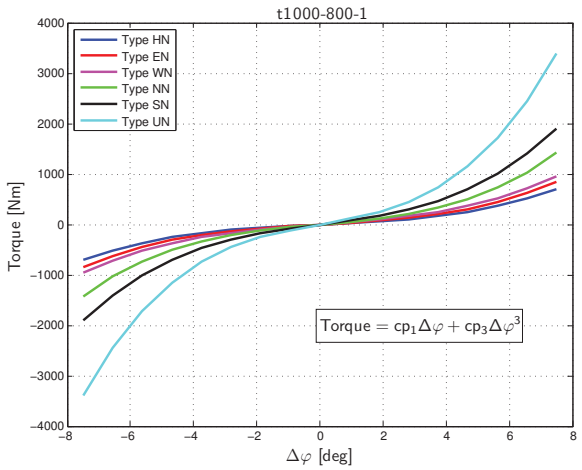
elastomer type	t1000-800-1			t1000-800-2			t1000-800-3		
	cp_1 [Nm/rad]	cp_3 [Nm/rad^3]	Ψ [-]	cp_1 [Nm/rad]	cp_3 [Nm/rad^3]	Ψ [-]	cp_1 [Nm/rad]	cp_3 [Nm/rad^3]	Ψ [-]
HN	1622	217894	0.10	811	27237	0.10	541	8070	0.10
EN	2043	259170	0.10	1022	32396	0.10	681	9599	0.10
WN	2696	270138	0.15	1348	33767	0.15	899	10005	0.15
NN	3144	449459	0.25	1572	56182	0.25	1048	16647	0.25
SN	4617	581122	0.30	2309	72640	0.30	1539	21523	0.30
UN	6484	1136191	0.35	3242	142024	0.35	2161	42081	0.35

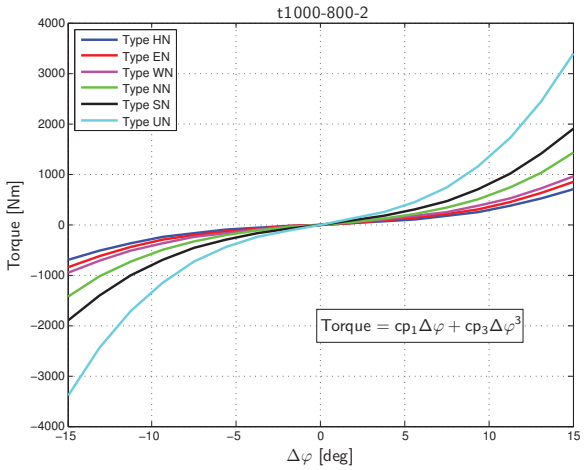
cp_1 - Linear stiffness coefficient
cp_3 - Non-linear stiffness coefficient
Ψ - relative damping

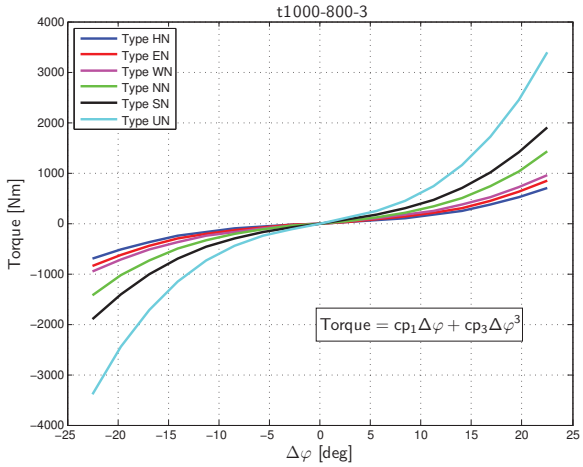
elastomer type	t1000-1500-1			t1000-1500-2			t1000-1500-3		
	cp_1 [Nm/rad]	cp_3 [Nm/rad^3]	Ψ [-]	cp_1 [Nm/rad]	cp_3 [Nm/rad^3]	Ψ [-]	cp_1 [Nm/rad]	cp_3 [Nm/rad^3]	Ψ [-]
HN	1857	326860	0.10	929	40858	0.10	619	12106	0.10
EN	2339	388778	0.10	1169	48597	0.10	780	14399	0.10
WN	3086	405231	0.15	1543	50654	0.15	1029	15009	0.15
NN	3599	674229	0.25	1799	84279	0.25	1200	24971	0.25
SN	5286	871735	0.30	2643	108967	0.30	1762	32286	0.30
UN	7422	1704387	0.35	3711	213048	0.35	2474	63125	0.35

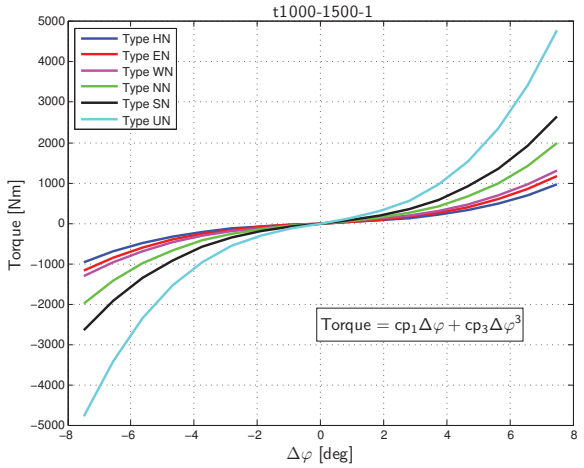
cp_1 - Linear stiffness coefficient
cp_3 - Non-linear stiffness coefficient
Ψ - relative damping

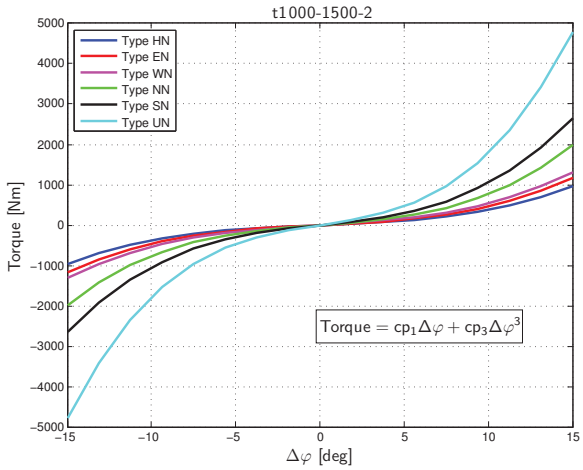
[6]Elastomers made of silicone for higher operating temperatures are available on request.
[7]Toothed rings for rotational speed measurement available as an option.
[8]The nominal torque must be equal to or greater than the maximum combustion engine torque

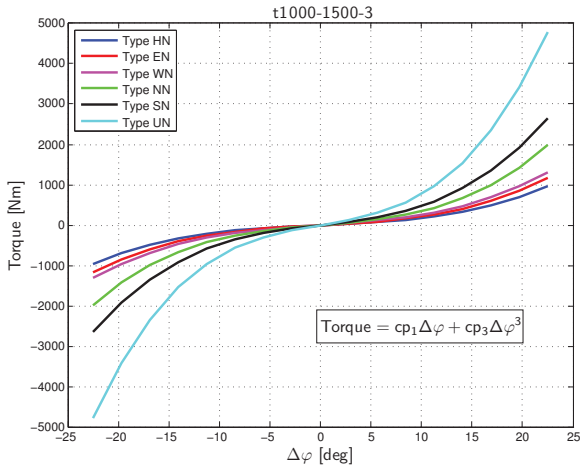




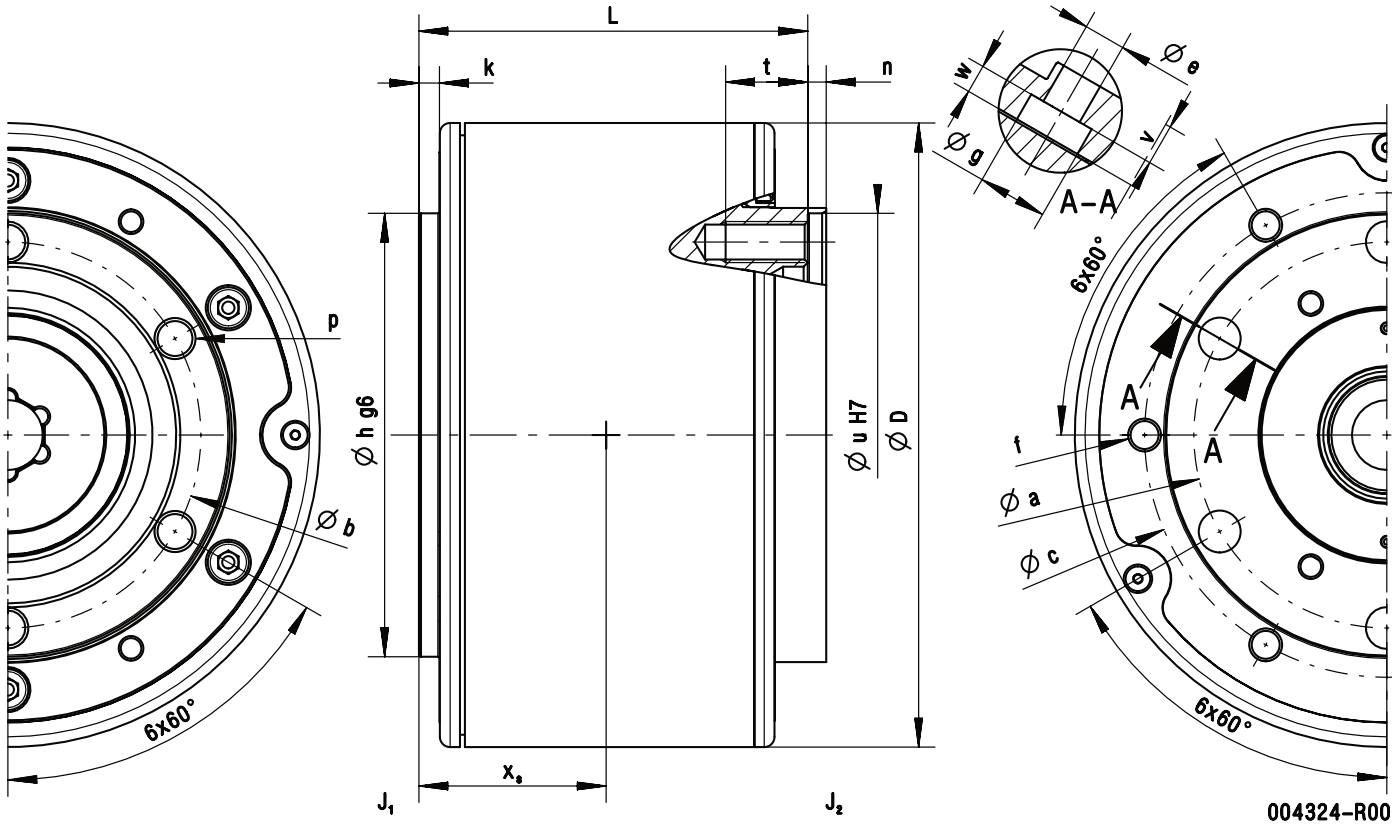








Elastomer type	Material	Shore hardness
HN	Natural rubber	45 - 50° Shore A
EN		50 - 55° Shore A
WN		53 - 58° Shore A
NN		63 - 68° Shore A
SN (Standard)		73 - 78° Shore A
UN		83 - 88° Shore A



Coupling	Flange	D	L	a	b	c	e	f	g	h (g6)	k	n	p	t	u (H7)	v	w
		[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[-]	[mm]	[mm]	[mm]	[mm]	[-]	[mm]	[mm]	[mm]	[mm]
t1000-800-1	CV05	152	62.6	74	74	118	8.2	M8	15	86	5	10.5	M8	16	86	10.0	7.0
	CV15			94	94		10.2		17	108		4.5	M10	20	108		
t1000-800-2	CV05	152	94.7	74	74	118	8.2	M8	15	86	5	10.5	M8	16	86	10.0	7.0
	CV15			94	94		10.2		17	108		4.5	M10	20	108		
t1000-800-3	CV05	152	126.8	74	74	118	8.2	M8	15	86	5	10.5	M8	16	86	10.0	7.0
	CV15			94	94		10.2		17	108		4.5	M10	20	108		
t1000-1500-1	CV15	174	62.6	94	94	124	10.2	M10	17	108	5	4.5	M10	22	108	10.0	7.0
t1000-1500-2	CV15	174	94.7	94	94	124	10.2	M10	17	108	5	4.5	M10	22	108	10.0	7.0
	CV21		100.7	108	108	–	13.0	–	20	128	6	5.5	M12	31	128	11.4	7.6
t1000-1500-3	CV15	174	126.8	94	94	124	10.2	M10	17	108	5	4.5	M10	22	108	10.0	7.0

Other dimensions available on request.

t1000-400 – HIGH-SPEED CLAW COUPLING

Description

The t1000-400 is a single-row elastomer claw coupling for high-speed applications. This coupling is characterized by its relatively low weight, very robust design, high damping capability and easy maintenance.

The design principle of the coupling allows the torsional stiffness to be adjusted for different requirements by using elastomers of varying hardness.

Operating range

Torque: up to 450 Nm
Speed: up to 18000 rpm

Benefits

- suitable for high dynamic loads
- compact and modular design allows fast exchange of the elastomer
- elastomer failure practically eliminated
- high damping and long lifetime
- stiffness adjustment by elastomer placement

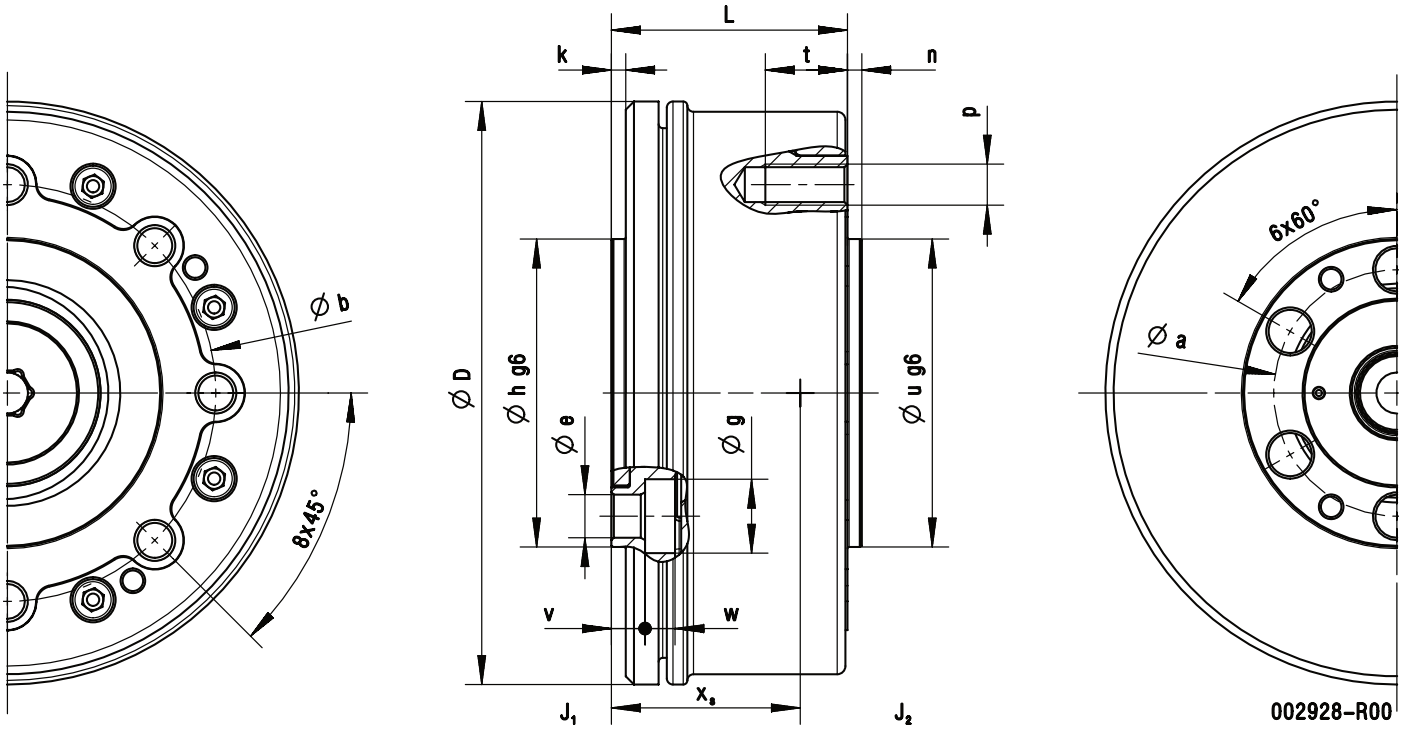
Function

The design provides a strongly non-linear coupling characteristic. The special design allows problem-free adaptation to new applications.

Coupling	T_{KN} [Nm]	T_{Kmax} [Nm]	T_{KW} [Nm]	n_{max} [rpm]	c_{Tdyn} [Nm/rad]	Ψ [-]	J_1 [kgm^2]	J_2 [kgm^2]	m [kg]	x_s [mm]	φ_{max} [°]	ϑ [°C]
t1000-400	450	800	400	18000	400 - 2400	0.3	2.23E-03	3.44E-03	2.55	46.0	6	+80

T_{KN} - nominal torque[9]
c_{Tdyn} - torsional stiffness
T_{Kmax} - maximum torque
n_{max} - maximum speed
m - mass
x_s - center of gravity flange-side
J_1 - inertia flange-side
J_2 - inertia shaft-side
Ψ - relative damping
ϑ - operating temperature[10]
φ_{max} - maximum torsional angle

Elastomer type	Material	Shore hardness
HN	Natural rubber	45 - 50° Shore A
EN		50 - 55° Shore A
WN		53 - 58° Shore A
NN		63 - 68° Shore A
SN (Standard)		73 - 78° Shore A
UN		83 - 88° Shore A



Coupling	D [mm]	L [mm]	a [mm]	b [mm]	e [mm]	g [mm]	h (g6) [mm]	k [mm]	n [mm]	p [-]	t [mm]	u (g6) [mm]	v [mm]	w [mm]
t1000-400	142	57.5	60	101.5	10.5	18	75	3.5	3.5	M10	20	75	8.2	7.3

Other dimensions available on request.

[9]The nominal torque must be equal to or greater than the maximum combustion engine torque
[10]Operating temperature for elastomers made of natural rubber, elastomer made of silicone for higher operating temperatures are available on request

t1000-1000 – HIGH-SPEED CLAW COUPLING

Description

The t1000-HS has been especially developed for use in high-speed drive trains. This coupling is characterized by its relatively low weight, very robust design, high damping capability and easy maintenance.
The development aim of this coupling, to transfer very high alternating torques ot low stiffnes, was achieved.

The design principle of the coupling allows the torsional stiffness to be adjusted for different requirements by using elastomers of varying hardness.

Operating range

Torque: up to 1000 Nm
Speed: up to 25000 rpm

Benefits

- suitable for high dynamic loads
- compact and modular design allows fast exchange of elastomer
- elastomer failure practically eliminated
- high damping and long lifetime
- stiffness adjusment by elastomer placement

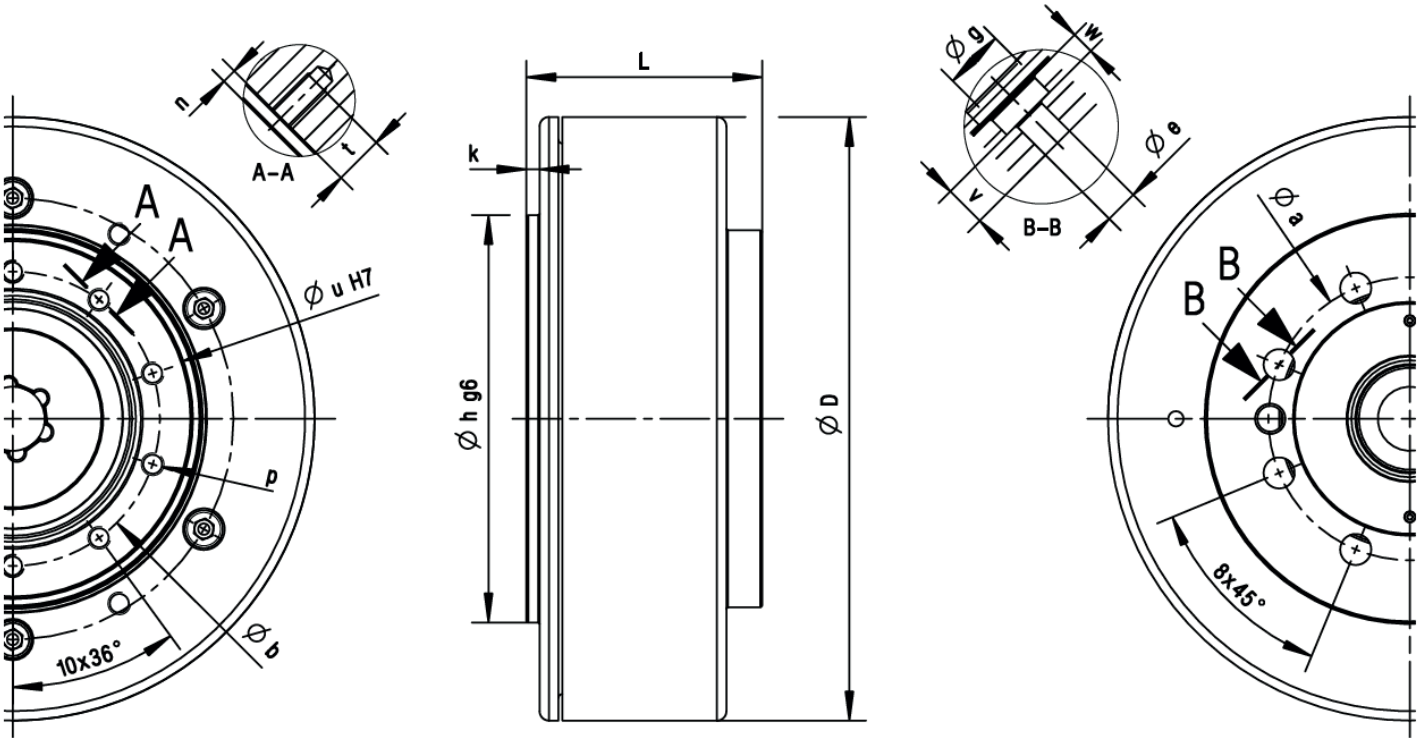
Function

The design provides a strongly non-linear coupling characteristic. The special design allows problem-free adaptation to new applications.

Coupling	T_{KN} [Nm]	T_{Kmax} [Nm]	T_{KW} [Nm]	n_{max} [Nm]	Ψ [-]	ϑ [°C]
t1000-1000	1000	1500	700	25000	0.1 - 0.35	+80

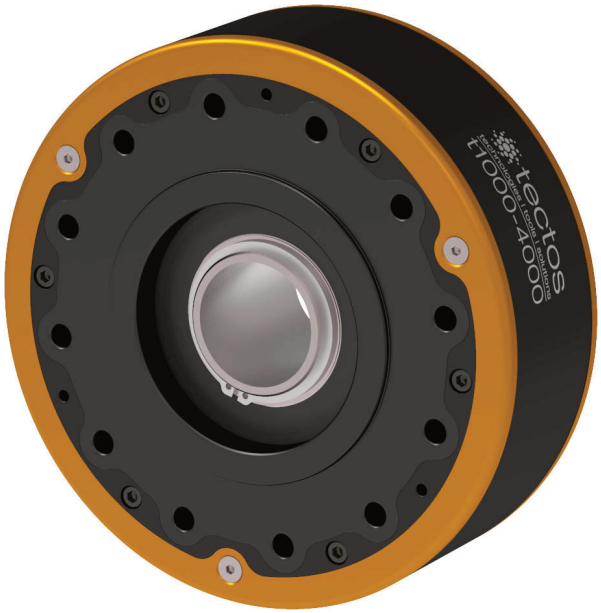
T_{KN} - nominal torque[9] T_{Kmax} - maximum torque n_{max} - maximum speed
Ψ - relative damping ϑ - operating temperature[10]

Elastomer type	Material	Shore hardness
HN	Natural rubber	45 - 50° Shore A
EN		50 - 55° Shore A
WN		53 - 58° Shore A
NN		63 - 68° Shore A
SN (Standard)		73 - 78° Shore A
UN		83 - 88° Shore A



Coupling	Joint	D [mm]	L [mm]	a [mm]	b [mm]	e [mm]	g [mm]	h (g6) [mm]	k [mm]	n [mm]	p [-]	t [mm]	u (H7) [mm]	v [mm]	w [mm]
t1000-1000	HK10	160	62.5	75	78	8.2	14.5	108	3.5	3.5	M6	12	95	10	5.5

t1000-4000 – HEAVY-DUTY CLAW COUPLING



Description

The t1000-4000 is a single-row elastomer claw coupling for test beds with a nominal torque of 4000 Nm, and is particularly suited for wheel hub drives. This coupling is characterized by its relatively low weight, very robust design, high damping capability and easy maintenance.

By using elastomers of different hardness grades, the damping characteristics can be adapted to various requirements.

Operating range

Torque: up to 4000 Nm
Speed: up to 4000 rpm

Benefits

- suitable for high dynamic loads
- compact and modular design allows fast exchange of the elastomer
- no shaft damage when elastomer fails
- high damping and long lifetime
- stiffness adjustment by elastomer placement

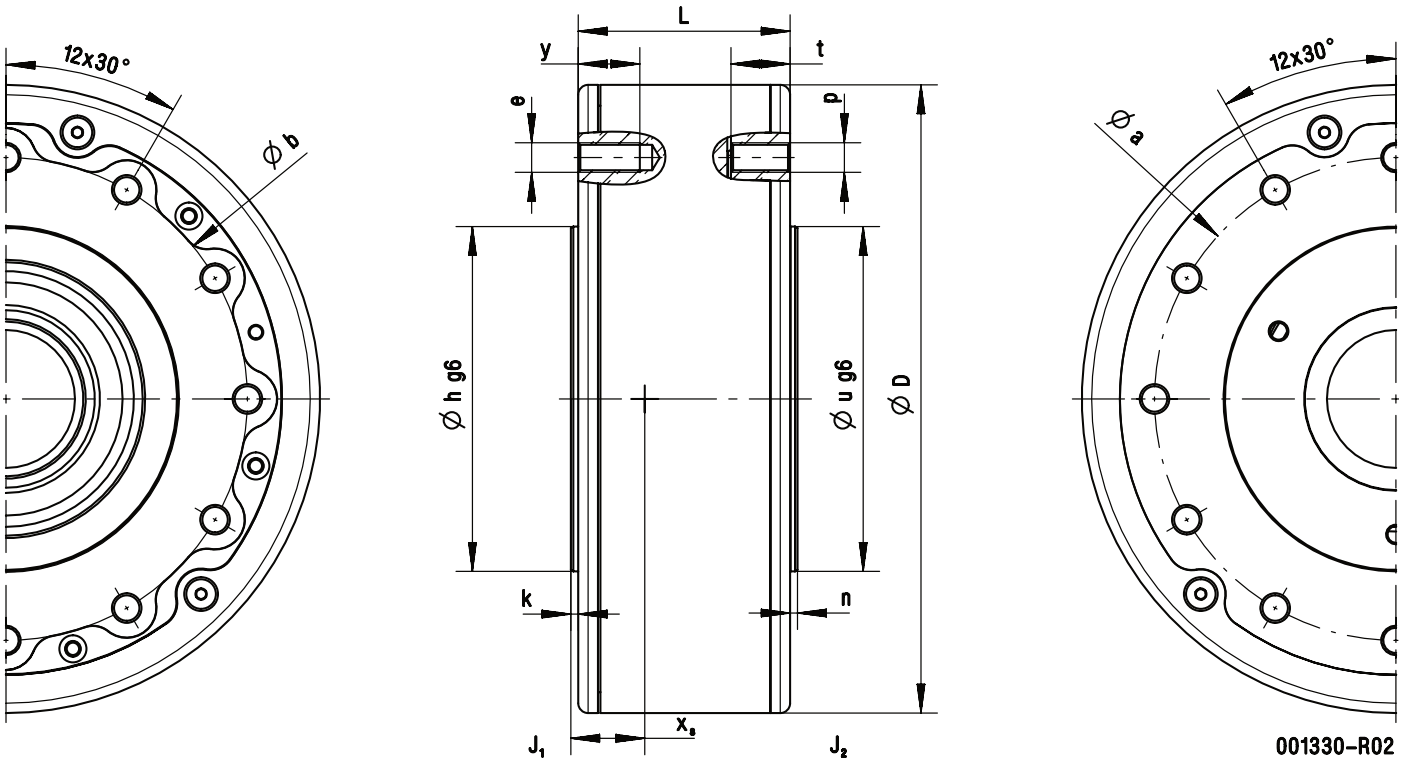
Function

The design provides a strongly non-linear coupling characteristic. The special design allows problem-free adaptation to new applications and a short downtime when exchanging the elastomers.

Coupling	T_{KN} [Nm]	T_{Kmax} [Nm]	T_{KW} [Nm]	n_{max} [rpm]	c_{Tdyn} [Nm/rad]	Ψ [-]	J_1 [kgm^2]	J_2 [kgm^2]	m [kg]	x_s [mm]	φ_{max} [°]	ϑ [°C]
t1000-4000	4000	1600	4000	4000	55000 - 110000	0.3	3.13E-02	5.21E-02	10.66	30.3	6	+80

T_{KN} - nominal torque[11]
c_{Tdyn} - torsional stiffness
T_{Kmax} - maximum torque
n_{max} - maximum speed
m - mass
x_s - center of gravity flange-side
J_1 - inertia flange-side
J_2 - inertia shaft-side
Ψ - relative damping
ϑ - operating temperature[12]
φ_{max} - maximum torsional angle

Elastomer type	Material	Shore hardness
HN	Natural rubber	45 - 50° Shore A
EN		50 - 55° Shore A
WN		53 - 58° Shore A
NN		63 - 68° Shore A
SN (Standard)		73 - 78° Shore A
UN		83 - 88° Shore A



Coupling	D [mm]	L [mm]	a [mm]	b [mm]	e [-]	h (g6) [mm]	k [mm]	n [mm]	p [-]	t [mm]	u (g6) [mm]	y [mm]
t1000-4000	255	86	196	196	M12	140	3	3	M12	24	140	25

Other dimensions available on request.

[11] The nominal torque must be equal to or greater than the maximum combustion engine torque
[12] Operating temperature for elastomer made of natural rubber, elastomer made of silicone for higher operating temperatures are available on request

t2x00 – ARC SPRING COUPLING

Description

The t2x00 are arc spring couplings designed especially for deployment in test beds and work like a dual mass flywheel. Because of its modular spring design, it is possible to tailor its stiffness behavior to the unit under test.

Naming

The product is named according to the following convention:

t2x00-ttt-cccc-CVxx

- xx – joint size
- cccc – dynamic stiffness [Nm/rad]
- ttt – nominal torque [Nm]
- t2x00 – series designation

Example: t2200-510-630-CV15

Operating range

Torque: up to 3400 Nm
Speed: up to 10000 rpm
Stiffness: 200 – 4000 Nm/rad

Benefits

- suitable for high dynamic loads
- high damping and long lifetime
- wide stiffness range

Function

As for a vehicle dual mass flywheel, the test bed dual mass flywheel boasts exceptional damping behavior.

Stiffness adjustment is achieved by using different spring configurations in the arc spring coupling. The standard t2x00 specifications cover a nominal torque range of 160 – 3400 Nm for a torsional stiffness of 200 – 4000 Nm/rad.

t2100 – ARC SPRING COUPLING

The t2100 is suitable for small passenger car engines and two-wheel engines. The standard t2100 specifications cover a nominal torque range of 160 - 400 Nm for a torsional stiffness of 200 - 500 Nm/rad.

t2200 – ARC SPRING COUPLING

The t2200 is suitable for passenger car engines and two-wheel engines. The standard t2200 specifications cover a nominal torque range of 160 - 800 Nm for a torsional stiffness of 200 - 1000 Nm/rad.

t2300 – ARC SPRING COUPLING

The t2300 is suitable for passenger car engines and mid-range engines. The standard t2300 specifications cover a nominal torque range of 580 - 740 Nm for a torsional stiffness of 720 - 920 Nm/rad.

t2400 – ARC SPRING COUPLING

The t2400 is suitable for mid-range engines. The standard t2400 specifications cover a nominal torque range of 1500 - 2000 Nm for a torsional stiffness of 1800 - 2500 Nm/rad.

t2500 – ARC SPRING COUPLING

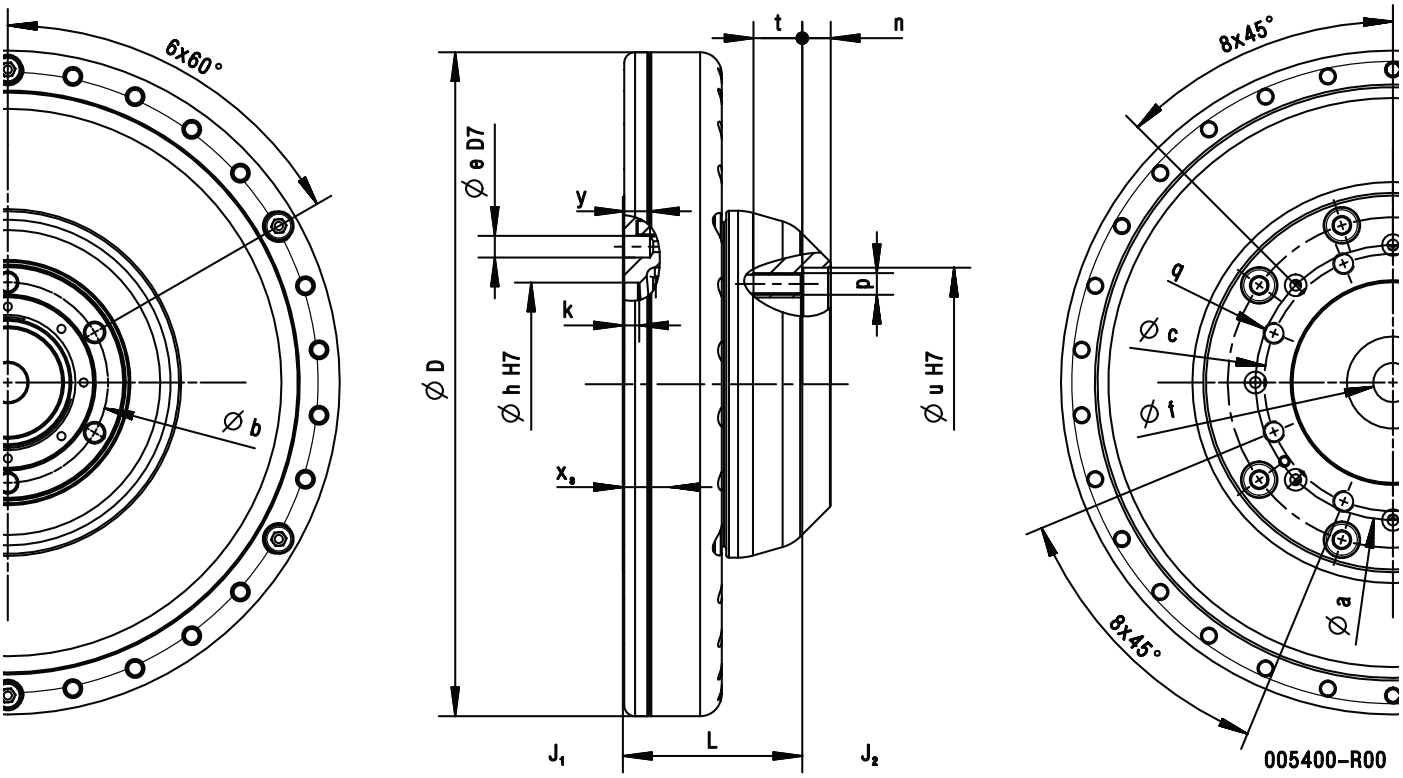
The t2500 is suitable for heavy-duty engines. The standard t2500 specifications cover a nominal torque range of 1600 - 3400 Nm for a torsional stiffness of 2000 - 4000 Nm/rad.

Coupling	Flange	T_{KN} [Nm]	c_{Tdyn} [Nm/rad]	T_{Kmax} [Nm]	n_{max} [rpm]	m [kg]	x_s [mm]	J_1 [kgm^2]	J_2 [kgm^2]	Ψ [-]	d [Nms/rad]	φ_{max} [°]
t2100-160-200	CV05	160	200	200	10000	6.90	22.0	3.61E-02	6.38E-03	0.8	2	57
t2100-260-315	CV10	260	315	315	10000	7.04	20.9	3.69E-02	7.50E-03	0.8	2	57
	CV15					7.10	21.3		7.87E-03			
t2100-400-500	CV10	400	500	500	10000	7.10	21.0	3.72E-02	7.75E-03	0.8	2	57
	CV15					7.16	21.3	3.77E-02	7.70E-03			
t2200-260-315	CV10	260	315	315	8500	10.15	30.3	6.94E-02	8.10E-03	0.8	2	57
t2200-510-630	CV05	510	630	630	8500	11.56	33.8	1.27E-02	7.74E-02	0.8	2	57
	CV10					11.68	33.9	1.31E-02	7.90E-02			
	CV15					11.33	33.1	1.92E-02	7.81E-02			
t2200-800-1000	CV10	800	1000	1000	8500	11.76	34.0	1.32E-02	7.78E-02	0.8	2	57
	CV15					11.62	33.9	1.41E-02	1.69E-02			
t2300-740-920	CV10	740	920	920	8000	13.17	31.5	1.08E-01	2.39E-02	0.8	2	57
	CV15					13.09	31.4		2.38E-02			
t2400-1800-2200	CV21	1800	2200	2200	5000	37.17	71.0	4.05E-01	5.10E-02	0.8	2	57
	CV30					37.10			5.18E-02			
t2400-2000-2500	CV21	2000	2500	2500	5000	37.25	71.0	4.15E-01	5.10E-02	0.8	2	57
	CV30					37.18			5.18E-02			
t2500-3200-6000	CV21	3200	6000	6000	5000	53.26	0	2.55E-01	6.29E-01	0.8	2	57
	CV30					53.00	0	2.61E-01	6.19E-01			
	CV32					51.20	0	2.46E-01	6.34E-01			
	CV42					51.50	0	2.08E-01	6.55E-01			

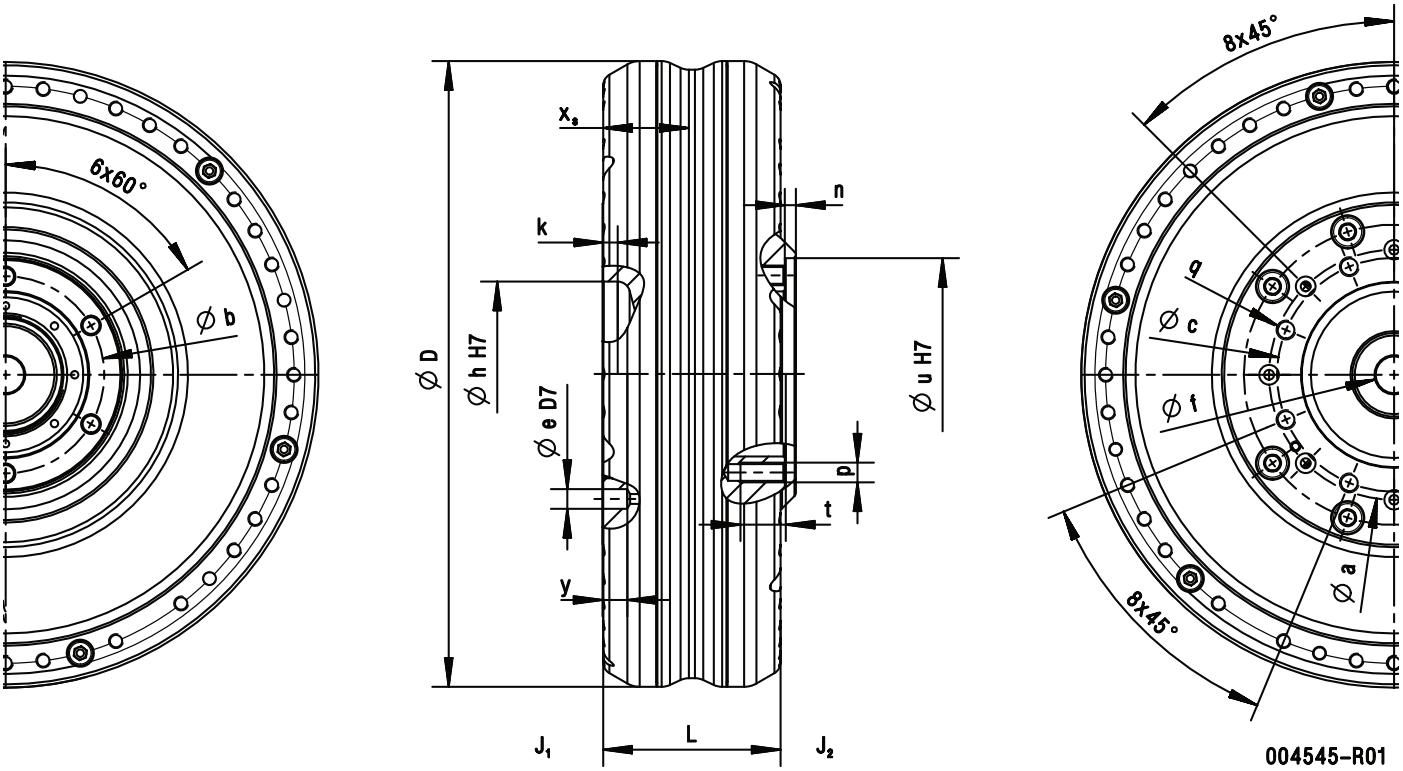
T_{KN} - nominal torque[13]
c_{Tdyn} - torsional stiffness
T_{Kmax} - maximum torque
n_{max} - maximum speed
m - mass
x_s - center of gravity flange-side
J_1 - inertia flange-side
J_2 - inertia shaft-side
Ψ - relative damping
d - damping
φ_{max} - maximum torsional angle

Other dimensions available on request.

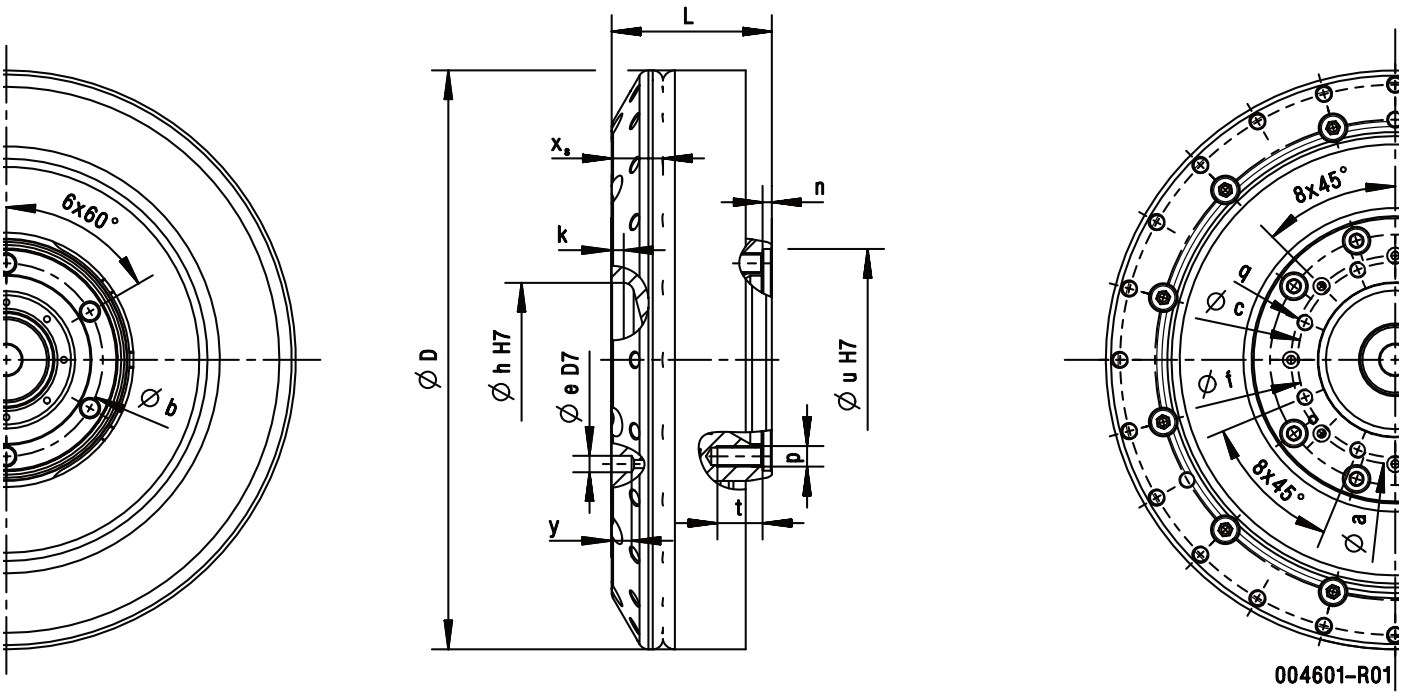
[13]The nominal torque must be equal to or greater than the maximum combustion engine torque



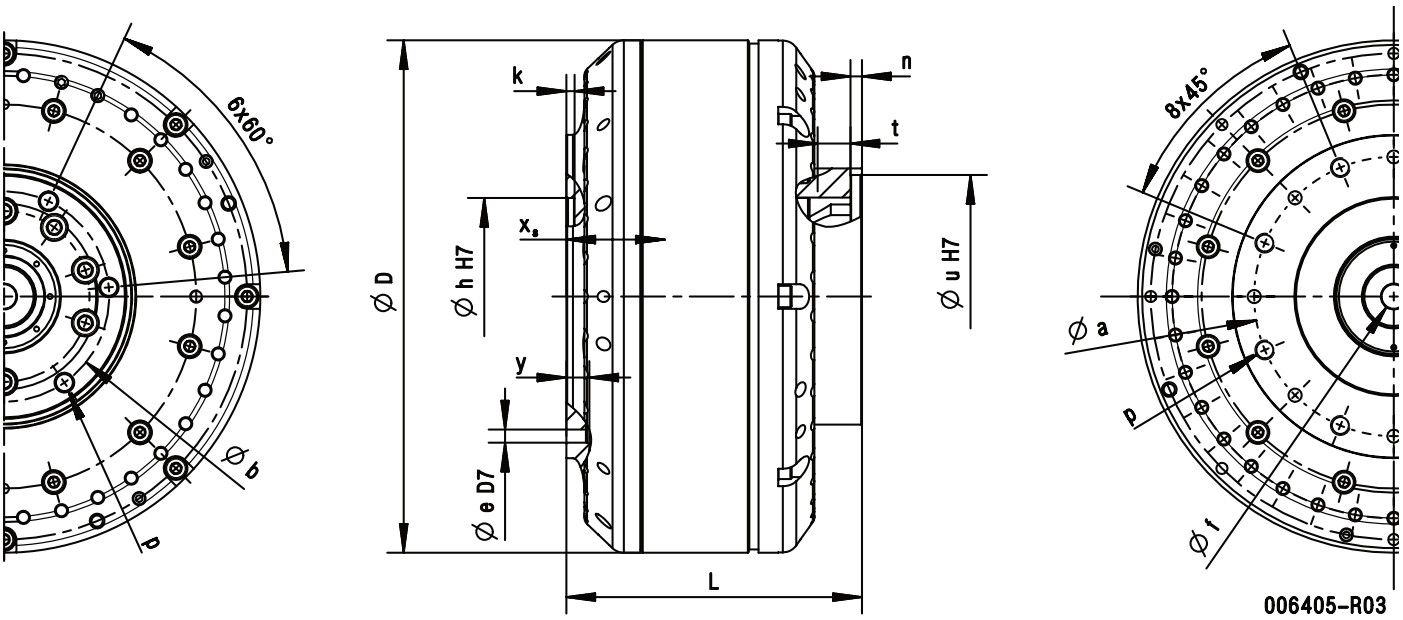
Coupling	Flange	D [mm]	L [mm]	a [mm]	b [mm]	c [mm]	e (D7) [mm]	f [mm]	h (H7) [mm]	k [mm]	n [mm]	p [-]	q [-]	t [mm]	u (H7) [mm]	y [mm]
t2100	CV05	245	66	101.5	74	95	8	14.5	75	6	10.5	M8	M8	18	86	10
	CV10				80						4.5				94	
	CV15				94							M10		22	108	



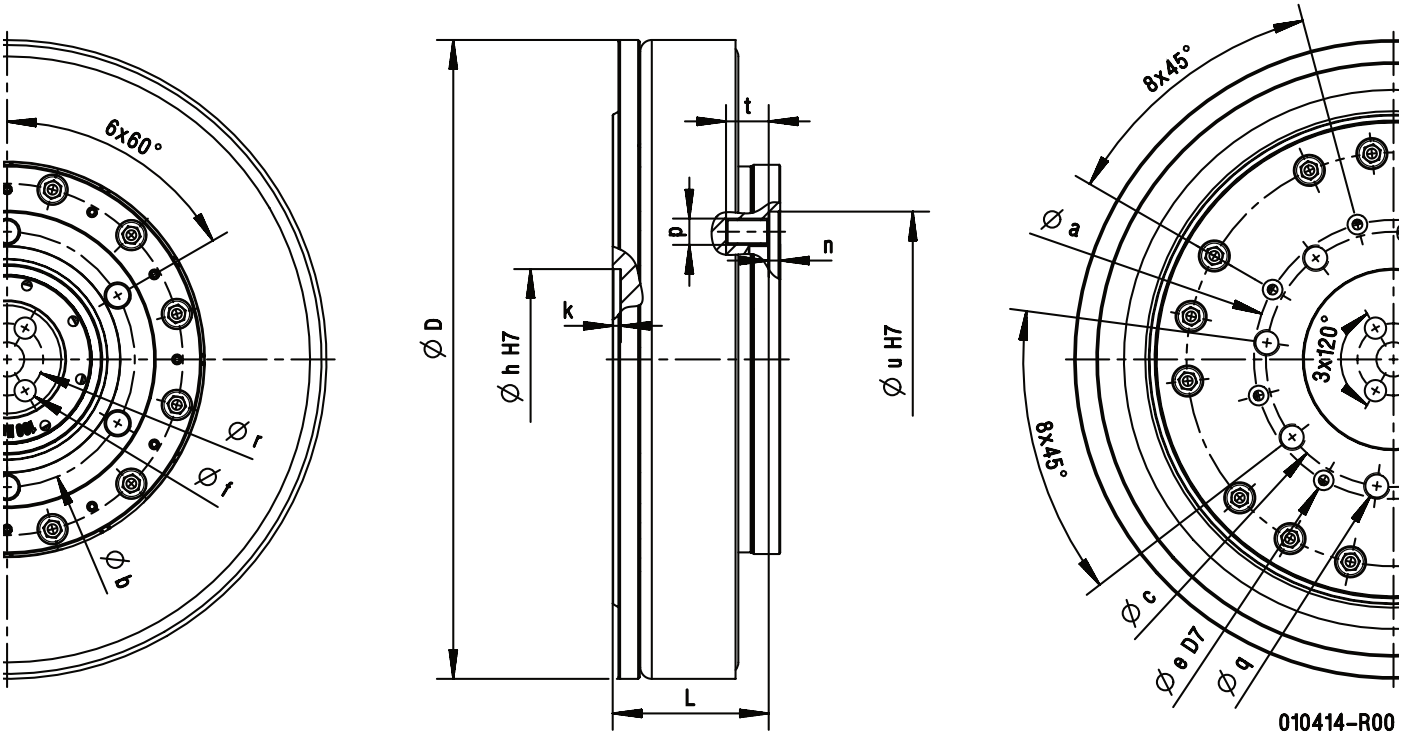
Coupling	Flange	D [mm]	L [mm]	a [mm]	b [mm]	c [mm]	e (D7) [mm]	f [mm]	h (H7) [mm]	k [mm]	n [mm]	p [-]	q [-]	t [mm]	u (H7) [mm]	y [mm]
t2200	CV10	254	74	101.5	80	95	8	14.5	75	6	4.5	M8	M8	18	94	10
	CV15				94							M10		22	108	



Coupling	Flange	D [mm]	L [mm]	a [mm]	b [mm]	c [mm]	e (D7) [mm]	f [mm]	h (H7) [mm]	k [mm]	n [mm]	p [-]	q [-]	t [mm]	u (H7) [mm]	y [mm]
t2300	CV10	282	74	101.5	80	95	8	14.5	75	6	4.5	M8	M8	18	94	10
	CV15				94							M10		22	108	



Coupling	Flange	D [mm]	L [mm]	a [mm]	b [mm]	e (D7) [mm]	f [mm]	h (H7) [mm]	k [mm]	n [mm]	p [-]	t [mm]	u (H7) [mm]	y [mm]
t2400	CV21	312	180	170	108	8	15	120	5	6	M12	20	128	14
	CV30				128					7			148	



Coupling	Flange	D [mm]	L [mm]	a [mm]	b [mm]	c [mm]	e (D7) [mm]	f [mm]	h (H7) [mm]	k [mm]	n [mm]	p [-]	q [-]	r [mm]	t [mm]	u (H7) [mm]
t2500	CV30	389	95	170	128.0	155.5	12	21	110	5.0	7	M12	M16	44	26	148
	CV32				155.5			22		4.5		M16				180

JOINT SHAFTS

Applications	Engines with low cylinder count	Motor sport engines	Engines with dual mass flywheels[14]	Passenger car engines	Commercial vehicles and mid range engines	Heavy-duty engines	E-mobility
t700	✓	✓	✓	✓	✓	✓	✓
t701	✓		✓	✓	✓	✓	✓
t702	✓	✓	✓	✓			✓
t703		✓					
t704							✓
t710	✓		✓	✓	✓		✓
t790		✓					✓

[14] Dual mass flywheel or original vehicle clutch

t70x – CV JOINT SHAFTS

Description

The t70x series is a family of shafts with constant velocity joints (CV joints). The various types are specially optimized for their particular application. The design of a t70x shaft is determined not only by the maximum torque and the length, but also by the type of application. All shafts in this family offer a high level of longitudinal and angular compensation.

Naming

The product is named according to the following convention:

t70x-CVyy-llll
- llll: length [mm]
- yy: joint size
- x: series designation

Example: t701-CV15-0303

Operating range

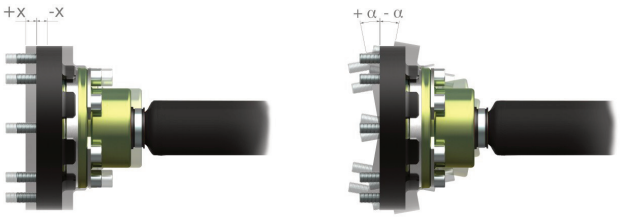
Torque: up to 40000 Nm
Speed: up to 10000 rpm

Benefits

- outstanding vibration decoupling
- low weight
- integrated load-insensitive longitudinal compensation
- precise concentricity

Function

The CV joint takes up the longitudinal, angular and axial displacement without adding any higher order speed or torque fluctuations to the drive train.



t700 – CV JOINT SHAFT

The t700 is a CV joint bar shaft in a particularly compact and space-saving form. This design enables angular and axial compensation in confined spaces. The bar shaft is designed for optimum performance and manufactured with high strength materials.

t701 – CV TUBULAR SHAFT

Due to its universal deployment capability, the t701 CV tubular shaft covers a wide range of standard applications. Compared with the t700 bar shaft, its welded tube allows longer installation lengths.

t702 – CV PRECISION TUBULAR SHAFT

The high quality, high precision t702 CV tubular shaft exhibits exceptionally precise concentricity with unsurpassed balance, due to its glued steel tube design. It is particularly suited for long installation lengths running at high speed.

t703 – CV TUBULAR SHAFT CFR

The t703 CV tubular shaft with a tube made from carbon-fiber reinforced plastic (CFP) is suitable for special motor sports and machine construction applications. The use of carbon fiber provides high stiffness, but at low weight.

t704 – CV TUBULAR SHAFT GFR

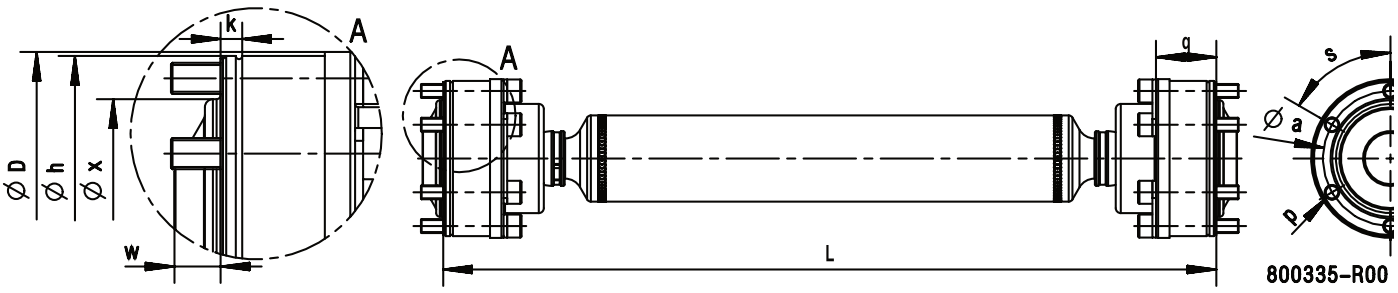
The t704 tubular shaft with a tube made from glass-fiber reinforced plastic (GFP) is used predominantly for e-mobility applications. Due to the non-conductive properties of GFP, the two shat ends of the t704 are electrically fully separated from each other. This means that the aggregate to be tested may be completely decoupled from the test bed with regards to electric and electromagnetic compatibility (EMC).

Shaft	Joint	T_{max} [Nm]	n_{max} [rpm]	X [mm]	G [-]	α [°]	ϑ_{min} [°C]	ϑ_{max} [°C]
t700	CV05	1000	10000	±16	6.3	±10	-40	+110
	CV10	1500		±12				
	CV13	1300		±22				
	CV15	2500		±16				
	CV21	3500		±24				
	CV30	6600	5000	±25				
	CV32	8000						
	CV42	19700	3000	±24				
	CV48	22000		±25				
	CV60	40000	2000	±30		±3		
t701	CV05	580	10000	±16	6.3	±10	-40	+80
	CV10	1300		±12				
	CV13	1300		±22				
	CV15	2500		±16				
	CV21	3500		±24				
	CV30	3500	5000	±25				
	CV32	6000						
	CV42	10500	3000	±24				
	CV48	22000		±25				
	CV60	40000	2000	±30		±3		

T_{max} - maximum torque
n_{max} - maximum speed
X - maximum longitudinal compensation
G - balance quality
α - maximum angular displacement
ϑ_{min} - minimum operating temperature
ϑ_{max} - maximum operating temperature[15]

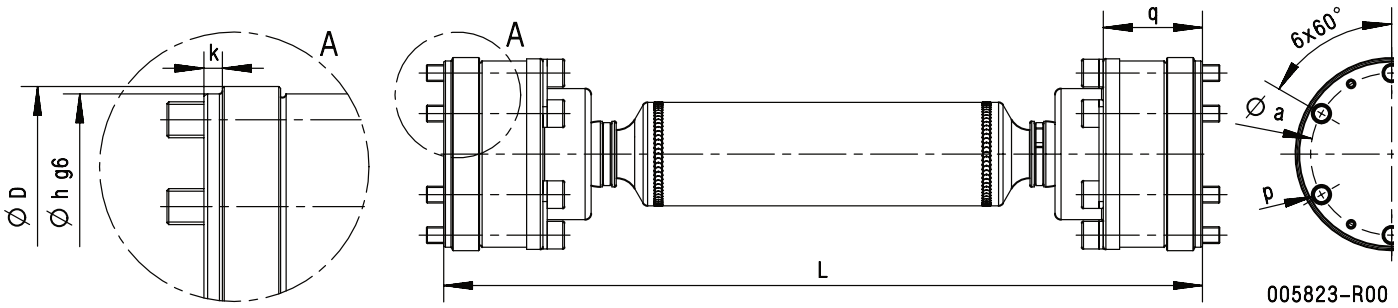
Technical specifications for other versions of the t70x series are available on request.

[15] The t701 may be operated at up to 100°C for a short period.



Shaft	Joint	D [mm]	a [mm]	$h^{+0.00}_{-0.05}$ [mm]	k [mm]	p [-]	q [mm]	s [°]	w [mm]	x [mm]
t70x	CV05	88.40	74.0	86.00	10.5	M8	22.80	6x60°	14.50	64.00
	CV10	96.00	80.0	94.00	6.0		33.80		15.00	
	CV13	101.33	86.0	99.73	5.0		33.60		10.95	67.30
	CV15	110.50	94.0	108.00	6.0	M10	42.00		14.40	81.00
	CV21	132.00	108.0	128.00		M12	47.90		18.10	90.00
	CV30	150.20	128.0	148.00	7.0		53.90		22.00	112.00
	CV32	188.00	155.5	180.00		M16	57.80		24.50	136.00
	CV42	199.80	165.0	192.00	10.0		79.35	8x45°	29.70	144.40
	CV48	224.00	196.0	220.00			52.50		19.00	160.00
	CV60	284.80	245.0	275.00	15.0	M20	105.00		25.00	214.46

The length L is dependent on the application and is limited by the type of design and maximum speed.
Higher speeds are available on request.



Shaft	Joint	D [mm]	a [mm]	h (g6) [mm]	k [mm]	p [-]	q [mm]
t70x	CV10	98	80.0	94.00	5.5	M8	48.00
	CV15	112	94.0	108.00	5.0	M10	57.50
	CV21	134	108.0	128.00	6.5	M12	67.15
	CV30	154	128.0	148.00	8.0		78.10
	CV32	188	155.5	180.00	7.5	M16	82.80

The length L is dependent on the application and is limited by the type of design and maximum speed.
Higher speeds are available on request.

t710 – MANUAL TELESCOPIC SHAFT

Description

The t710 is a special shaft for use in test beds for which a large amount of longitudinal compensation is required. A sophisticated displacement principle allows different changes in length depending on the maximum speed, installed length and joint size. The CV joints provide the t710 telescopic shaft with all advantages associated with the t70x series.

Naming

The product is named according to the following convention:

t710-xxxx-yyyy-zzzz
- zzzz: displacement length [mm]
- yyyy: minimum length [mm]
- xxxx: joint size
- t710: series designation

Example: t710-CV15-0420-0100

Operating range

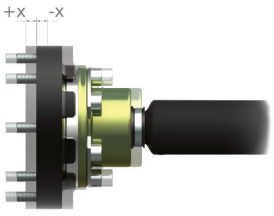
Torque: up to 6000 Nm
Speed: up to 10000 rpm

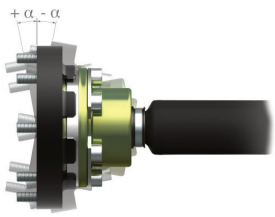
Benefits

- large longitudinal compensation
- long lifespan
- low maintenance

Function

The CV joint takes up the longitudinal, angular and axial displacement without adding any higher order speed or torque fluctuations to the drive train.

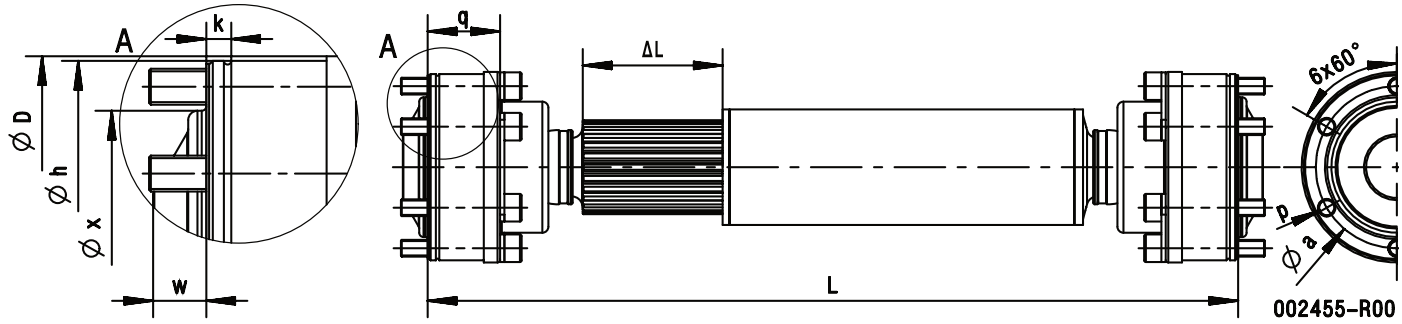




Shaft	Joint	T_{max} [Nm]	n_{max} [rpm]	X [mm]	α [°]	ϑ_{min} [°C]	ϑ_{max} [°C]
t710	CV05	580	10000	±16	±10	-40	+80
	CV10	1300		±12			
	CV15	2500		±16			
	CV21	3500		±24			
	CV30	3500	5000	±25			
	CV32	6000					

T_{max} - maximum torque
n_{max} - maximum speed
X - maximum longitudinal compensation
α - maximum angular displacement
ϑ_{min} - minimum operating temperature
ϑ_{max} - maximum operating temperature[16]

The maximum speed is dependent on the design and the installed length and can vary from the values specified.



Shaft	Joint	D [mm]	a [mm]	$h^{+0.00}_{-0.05}$ [mm]	k [mm]	p [-]	q [mm]	w [mm]	x [mm]
t710	CV05	88.4	74.0	86	10.5	M8	22.8	14.50	65.00
	CV10	96.0	80.0	94	6.0		33.8	15.00	64.00
	CV15	110.5	94.0	108		M10	42.0	14.40	81.00
	CV21	132.0	108.0	128		M12	47.9	18.10	90.00
	CV30	150.2	128.0	148	7.0		53.9	22.00	112.00
	CV32	188.0	155.5	180		M16	57.8	24.50	136.00

The length L is dependent on the application and is limited by the type of design and maximum speed.
Higher speeds are available on request.

[16]The t710 may be operated at up to 100°C for a short period.

t790 – TORSION BAR SHAFT

Description

The t790 is a special shaft for use in highly dynamic applications such as motor sports test beds. The shaft comprises two CV joints and an encapsulated torsion bar, which runs on bearings inside a guide tube. It therefore benefits from a very good relationship between bending frequency to torsional stiffness. The special design allows low stiffness without having to compromise on the desirable high rotational speed.

The t790 is available in with CV joint sizes from CV05 to CV21. Special designs are also available on request.

Each t790 shaft is tailored to customer requirements.

The t790 is also available as a t890 high-speed variant.

Naming

The product is named according to the following convention:

t790-cccc-CVxx-llll
- llll – length [mm]
- xx – joint size
- cccc – dynamic stiffness [Nm/rad]
- t790 – series designation

Example: t790-3500-CV15-0755

Operating range

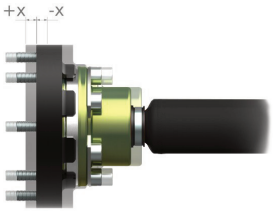
Torque: up to 3500 Nm
Speed: up to 12000 rpm

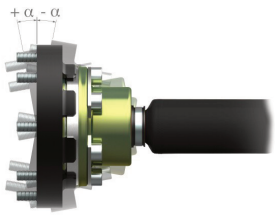
Benefits

- suitable for very high speeds
- compact design
- long lifespan
- low maintenance

Function

The CV joint takes up the longitudinal, angular and axial displacement without adding any higher order speed or torque fluctuations to the drive train.





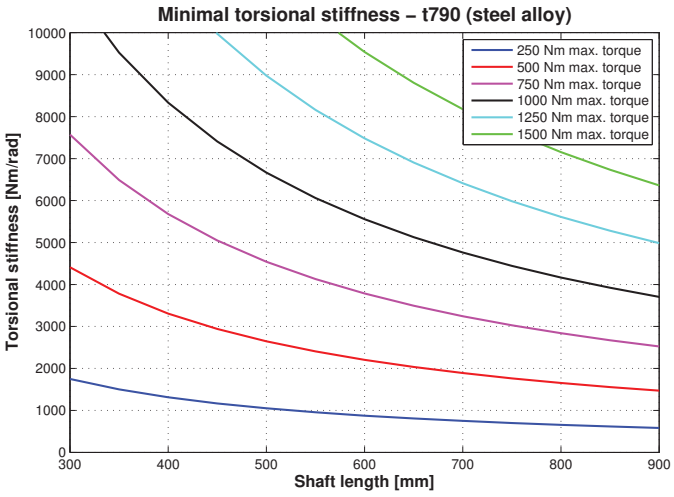
Shaft	T_{max} [Nm]	n_{max} [rpm]	c_{Tdyn} [Nm/rad]	ϑ_{min} [°C]	ϑ_{max} [°C]	L_{max} [mm]
t790	3500	15000	500	-40	+80	900

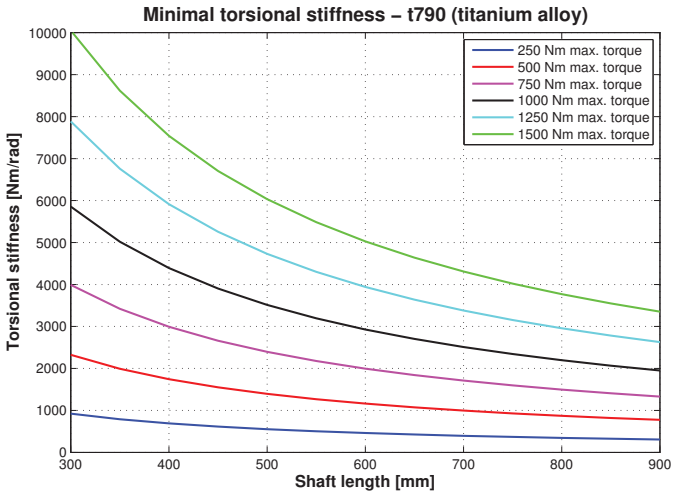
T_{max} - maximum torque
ϑ_{min} - minimum operating temperature
L_{max} - maximum length (CV15)

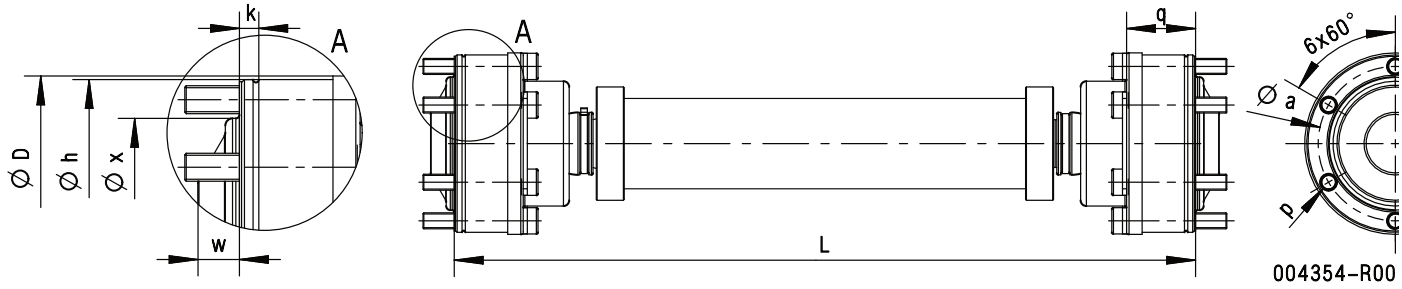
n_{max} - maximum speed
ϑ_{max} - maximum operating temperature

c_{Tdyn} - minimum torsional stiffness
ϑ_{max} - maximum operating temperature[17]

If you need a t790 shaft for a certain speed, you should be aware that the minimum length of the shaft is dependent on the torsional stiffness. This dependence is represented in the following diagrams for for the two typical torsion bar materials: steel (left) and titanium (right). The encapsulation in an aluminum tube shifts the usual problems associated with the bending frequency of a torsion bar into a much higher speed range. That means the t790 shaft can be operated up to speeds of 15000 rpm.







Shaft	Joint	D [mm]	a [mm]	$h^{+0.00}_{-0.05}$ [mm]	k [mm]	p [-]	q [mm]	w [mm]	x [mm]
t790	CV05	88.40	74.0	86.00	10.5	M8	22.80	14.5	65.0
	CV10	96.00	80.0	94.00	6.0		33.80	15.0	64.0
	CV15	110.50	94.0	108.00		M10	42.00	14.4	81.0
	CV21	132.00	108.0	128.00		M12	47.90	18.1	90.0

The installed length L is dependent on the application and is limited by the type of design and maximum speed.

[17] The t790 may be operated at up to 100°C for a short period.

HIGH-SPEED COMPONENTS

Applications	Engines with low cylinder count	Motor sport engines	Engines with dual mass flywheels[18]	Passenger car engines	Commercial vehicles and mid range engines	Heavy-duty engines	E-mobility
t800	✓	✓	✓	✓	✓	✓	✓
t801	✓		✓	✓	✓	✓	✓
t802	✓	✓	✓	✓			✓
t803		✓					
t804							✓

[18] Dual mass flywheel or original vehicle clutch

t80x – HIGH-SPEED SHAFTS

Description

The t80x high-speed shafts have particularly light, homokinetic joints (HK). The design of the t80x shaft is determined not only by the maximum torque and the length, but also by the type of application. All shafts in this family offer a high level of longitudinal and angular compensation.

Naming

The product is named according to the following convention:

t80x-HKyy-llll
- llll: length [mm]
- yy: joint type
- t80x: series designation

Example: t800-HK10-0500

Operating range

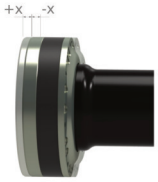
Torque: up to 1000 Nm
Speed: up to 20000 rpm

Benefits

- low weight
- integrated load-insensitive longitudinal compensation
- precise concentricity
- modifiable angular compensation
- very low reaction forces

Function

The high-speed shaft achieves the longitudinal, angular and axial displacement without generating higher order speed or torque moments.



t800 – HK ROD SHAFT

The t800 is a HK joint bar shaft in a particularly compact and space-saving design. This design enables angular and axial compensation in confined spaces. The bar shaft is designed for optimum performance and manufactured with high-strength materials.

t801 – HK TUBULAR SHAFT

Due to its universal deployment capability, the t801 HK tubular shaft covers a wide range of standard applications. Compared with the t800 bar shaft, its welded tube allows longer installation lengths and higher speeds.

t802 – HK PRECISION TUBULAR SHAFT

The high-quality t802 HK precision tubular shaft can be adjusted for stiffness, thanks to its glued steel tube. It is particularly suited for long installation lengths running at high speed.

t803 – HK CARBON FIBER COMPOSITE TUBULAR SHAFT

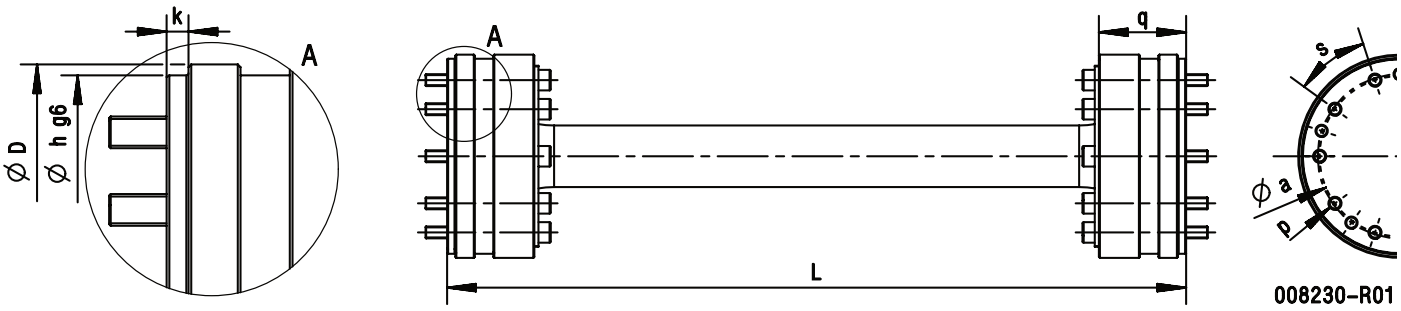
The t803 HK tubular shaft as a carbon-fiber composite tube and is ideal for applications with weight-sensitive test objects and dynos as well as other special mechanical engineering applications. The use of carbon fiber provides high stiffness, but at low weight.

t804 – HK GLASS FIBER COMPOSITE TUBULAR SHAFT

The t804 HK tubular shaft witha tube made from glass-fiber reinforced plastic (GFP) is used predominantly for e-mobility applications. Due to the non-conductive properties of GFP, the two shaft ends of the 804 are electrically fully separated from each other. This means that the aggregate to be tested may be completely decoupled from the test bed with regards to electric and electromagnetic compatibility (EMC).

Shaft	Joint	T_{max} [Nm]	n_{max} [rpm]	X [mm]	G [-]	α [°]	ϑ_{min} [°C]	ϑ_{max} [°C]
t80x	HK06	300	25000	±6	1	±3	-40	+80
	HK08	600		±3				
	HK10	1000						

T_{max} - maximum torque
n_{max} - maximum speed
X - maximum longitudinal compensation
G - balance quality
α - maximum angular displacement
ϑ_{min} - minimum operating temperature
ϑ_{max} - maximum operating temperature[19]

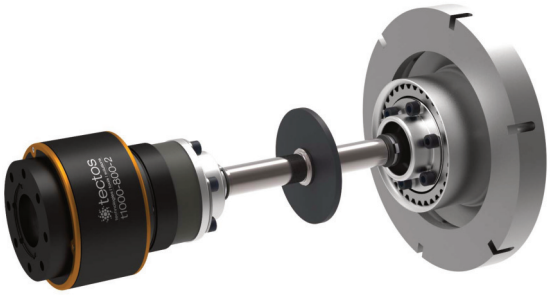


Shaft	Joint	D [mm]	a [mm]	h (g6) [mm]	k [mm]	p [-]	q [mm]	s [°]
t80x	HK06	68	54	65	4	M6	39.5	6x60°
	HK08	83	65	80			42.5	8x45°
	HK10	99	78	95			44.5	10x36°

The length L is dependent on the application and is limited by the type of design and maximum speed.
Higher speeds are available on request.

[19]The t80x may be operated at up to 100°C for a short period.

DOCKING SYSTEMS



Applications	Engines with low cylinder count	Motor sport engines	Engines with dual mass flywheels[20]	Passenger car engines	Commercial vehicles and mid range engines	Heavy-duty engines	E-mobility
tDock900	✓	✓	✓	✓			✓
tDock1000				✓	✓	✓	✓
tDock1500				✓	✓	✓	✓
t715 docking shaft				✓	✓	✓	✓

[20] Dual mass flywheel or original vehicle clutch

tDock900 – AUTOMATIC DOCKING SYSTEM

Description

The tDock900 is an automatic docking system for engines and transmission systems. This docking system combines the high alignment capability of CV joints with the reliable functionality provided by a splined docking mechanism. This unique docking system enables efficient docking and guarantees extremely smooth running of the test bed.

Operating range

Torque: up to 800 Nm
Speed: up to 10000 rpm

Benefits

- low maintenance
- compact and modular design
- long lifespan
- fast and easy exchange of the unit under test
- reduced backlash ensures smooth running
- universal engine and transmission adapter

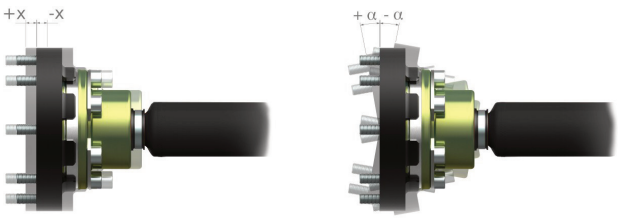
Function

The female adapter is mounted onto the drive shaft and is fixed to the test bed, while the male adapter is fixed to the unit under test. To achieve optimal docking, the joint is automatically locked in this position and the male adapter is aligned with the drive shaft.

During docking, the male adapter engages into the female adapter. When the final operating position has been reached, the joint is unlocked and automatically opened. To achieve an ideal connection, the engine is pressed against the drive shaft.

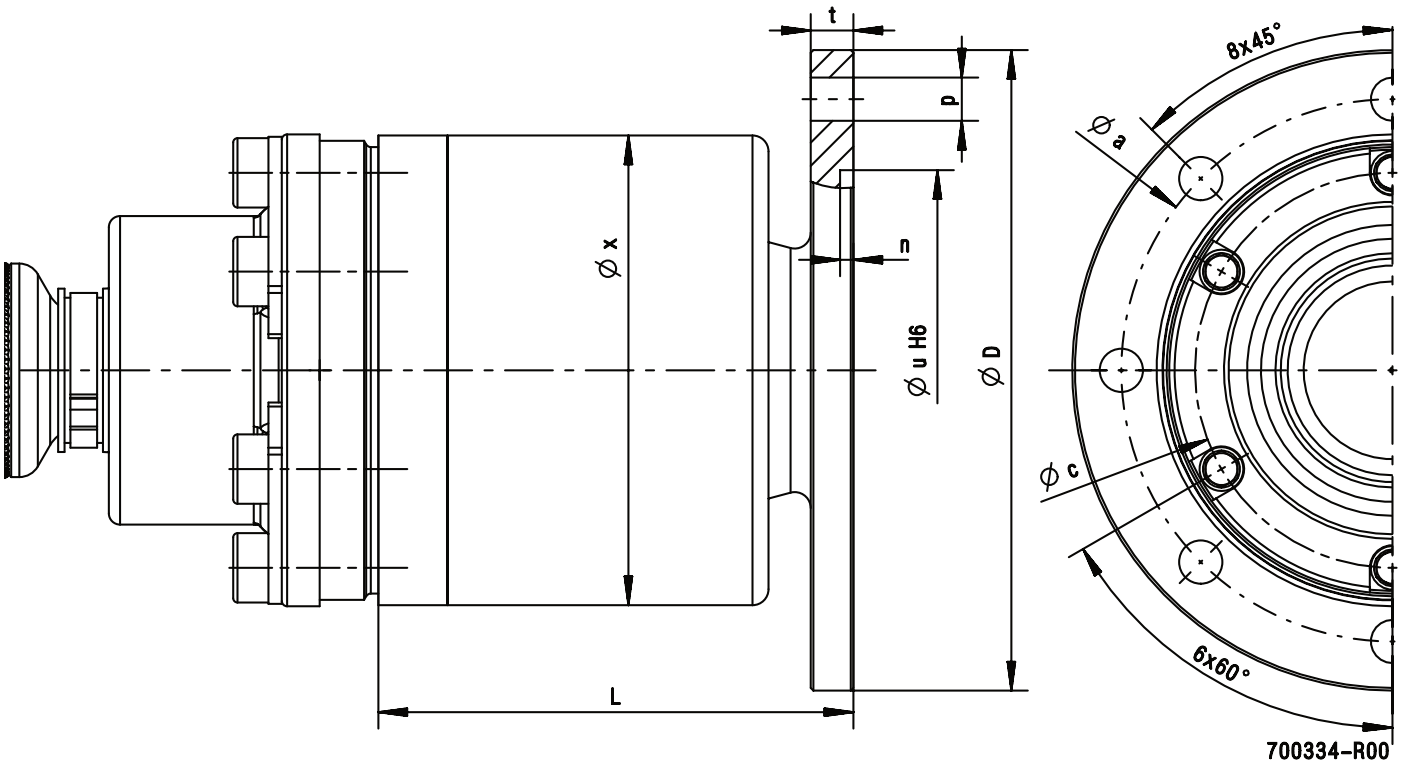
During operation, the articulated assembly allows axial, radial and angular movement without interfering with the test bed.

The CV joint takes up the longitudinal, angular and axial displacement without adding any higher order speed or torque fluctuations to the drive train.



Docking system	Joint	T_{max}	n_{max}	m_A	J_A	m_B	J_B
		[Nm]	[rpm]	[kg]	[kgm^2]	[kg]	[kgm^2]
tDock900	CV05	800	10000	1.31	1.84E-03	2.35	3.28E-03

T_{max} - maximum torque
n_{max} - maximum speed
m_A - mass (female adapter only)
m_B - total mass (without shaft)
J_A - inertia (female adapter only)
J_B - total mass inertia (without shaft)



Docking system	Joint	L	D	a	c	n	p	t	u (H7)	x
		[mm]	[mm]	[mm]	[mm]	[mm]	[-]	[mm]	[mm]	[mm]
tDock900	CV05	89	120	101.6	74	2.5	M8	8	75	88

Other dimensions available on request.

tDock1x00 – AUTOMATIC DOCKING SYSTEMS

Description

The tDock1x00 docking system has been designed for fast automatic docking of engines for quality control and production testing. This docking system combines the high alignment capability of CV joints with the reliable functionality provided by a splined docking mechanism. This unique docking system enables efficient docking and guarantees extremely smooth running of the test bed.

Operating range

Torque: up to 1500 Nm
Speed: up to 10000 rpm

Benefits

- direct mounting on engine flange allows easy attachment to the engine
- engine adapter can be individually customized and is easy to change
- inertia value similar to the original engine flywheel
- play-free and self-centering
- low-noise, low-vibration and low-maintenance
- secure and easy docking
- compact and modular design
- long lifespan
- reduction of docking time

Function

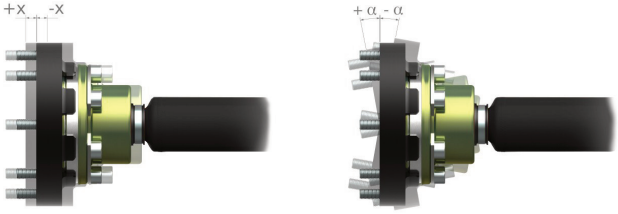
The female spline connector is mounted on the engine in the setup area while the male spline is fixed on the test bed shaft. To achieve optimal docking, the joint is automatically locked in this position and the male spline is aligned with the drive shaft.

During the docking procedure, the docking system slides with the shaft easily into the female spline connector .

For an ideal engagement of the engine to the test bed, the shaft is pressed onto the engine, whereby in the final operating position, the joint unlocks itself.

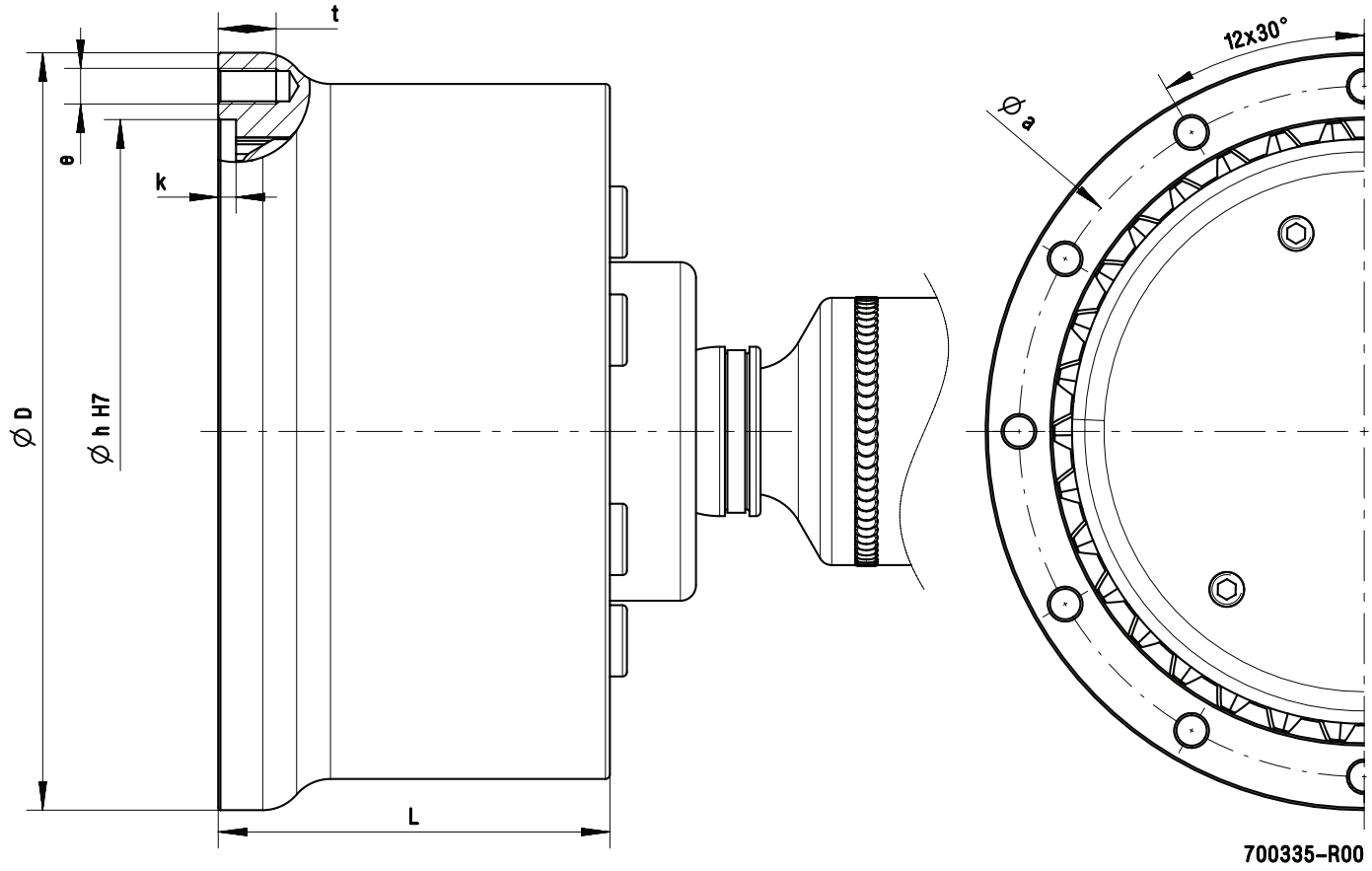
During operation, the articulated assembly allows axial, radial and angular movement without interfering with the test bed.

The CV joint takes up the longitudinal, angular and axial displacement without adding any higher order speed or torque fluctuations to the drive train.



Docking system	Joint	T_{max} [Nm]	n_{max} [rpm]	m [kg]	J [kgm^2]
tDock1000	CV10	1500	10000	7.01	2.02E-02
tDock1500	CV15	1500	10000	10.21	3.42E-02

T_{max} - maximum torque
n_{max} - maximum speed
m - mass (without customer-specific adapter)
J - inertia (without customer-specific adapter)



Docking system	Joint	L [mm]	D [mm]	a [mm]	e [-]	h (H7) [mm]	k [mm]	t [mm]
tDock1000	CV10	96	148	132	M8	120	3.6	12
tDock1500	CV15	88	170	155	M8	140	4	13

Other dimensions available on request.

t715 – DOCKING SHAFT

Description

The t715 docking shaft complements the automatic docking systems tDock1x00. This ensures fast automatic docking of engines for quality control and production testing.

The advantage is the high alignment capability of CV joints with the high reliability of a spline connection.

This unique docking system enables efficient docking and guarantees extremely smooth running of the test bed.

Naming

The product is named according to the following convention:

t715-yyyy-llll
- llll: length [mm]
- yyyy: joint size
- t715: series designation

Example: t715-CV15-0303

Operating range

Torque: up to 2500 Nm
Speed: up to 10000 rpm

Benefits

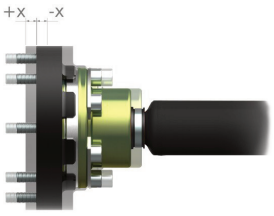
- low-noise, low-vibration and low-maintenance
- compact and modular design
- reduction of docking time
- outstanding vibration decoupling
- integrated longitudinal and angular compensation
- precise concentricity

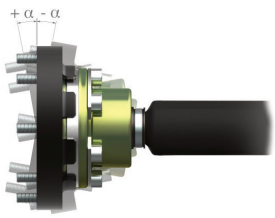
Function

The female spline connector is mounted on the engine in the set-up area while the male spline is fixed on the docking shaft.

During the docking procedure, the docking system slides with the shaft easily into the female spline connector.

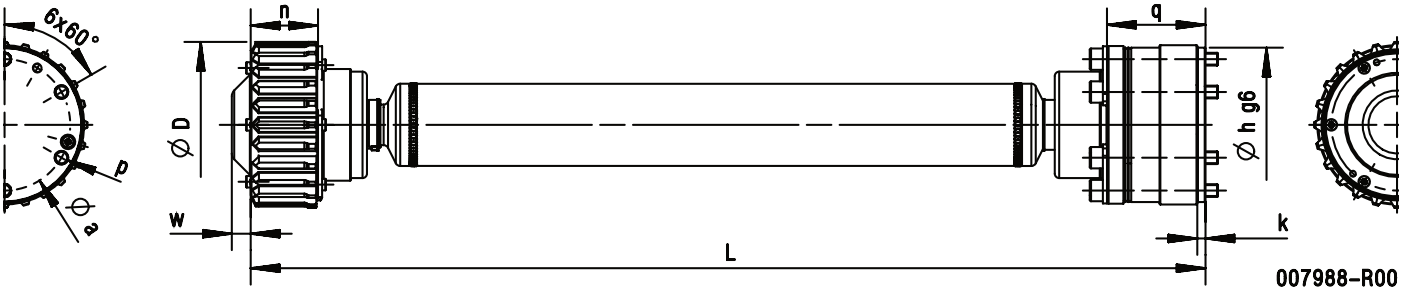
During operation, the articulated assembly allows axial, radial and angular movement without interfering with the test bed.





Shaft	Joint	T_{max} [Nm]	n_{max} [rpm]	X [mm]	G [-]	α [°]	ϑ_{min} [°C]	ϑ_{max} [°C]
t715	CV10	1300	10000	±12	6.3	±10	-40	+80
	CV15	2500		±16				

T_{max} - maximum torque
n_{max} - maximum speed
X - maximum longitudinal compensation
G - balance quality
α - maximum angular displacement
ϑ_{min} - minimum operating temperature
ϑ_{max} - maximum operating temperature[21]

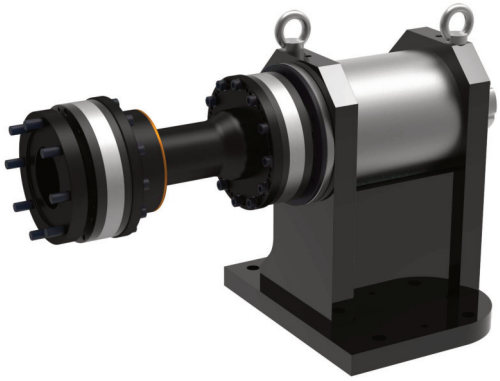


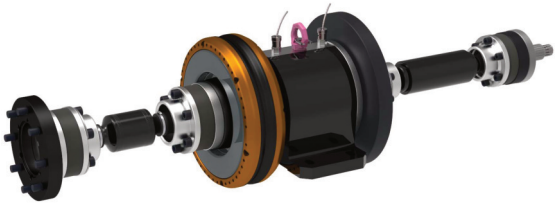
Shaft	Joint	D [mm]	a [mm]	h (g6) [mm]	k [mm]	n [mm]	p [-]	q [mm]	w [mm]
t715	CV10	101	80	94	5.5	40	M8	60.0	11.5
	CV15	141	94	108	5.0	74	M10	57.5	14.4

The length L is dependent on the application and is limited by the type of design and maximum speed.
Higher speeds are available on request.

[21] The t715 docking shaft may be operated at up to 100°C for a short period.

INTERMEDIATE BEARINGS





Applications	Engines with low cylinder count	Motor sport engines	Engines with dual mass flywheels[22]	Passenger car engines	Commercial vehicles and mid range engines	Heavy-duty engines	E-mobility
tZLE600	✓	✓	✓	✓	✓		✓
tZLE800	✓	✓	✓	✓	✓		✓
tZLE950		✓		✓			✓

[22] Dual mass flywheel or original vehicle clutch

tZLE600 – STANDARD INTERMEDIATE BEARING

Description

The tZLE600 bears the support loads, thereby reducing the loading on the rest of the test bed. The high-quality bearings used guarantee precise running. The exchangeable adapters of the tZLE600 allow direct coupling of multiple shafts types from the t70x series, and couplings from the t600 and t1x00 series, without further adaptation. The modular design allows the intermediate bearing to be tailored to individual customer requirements.

Naming

The product is named according to the following convention:

tZLE600-CVxx
- joint size
- series designation

Example: tZLE600-CV15

Operating range

Torque: up to 6600 Nm
Speed: up to 10000 rpm

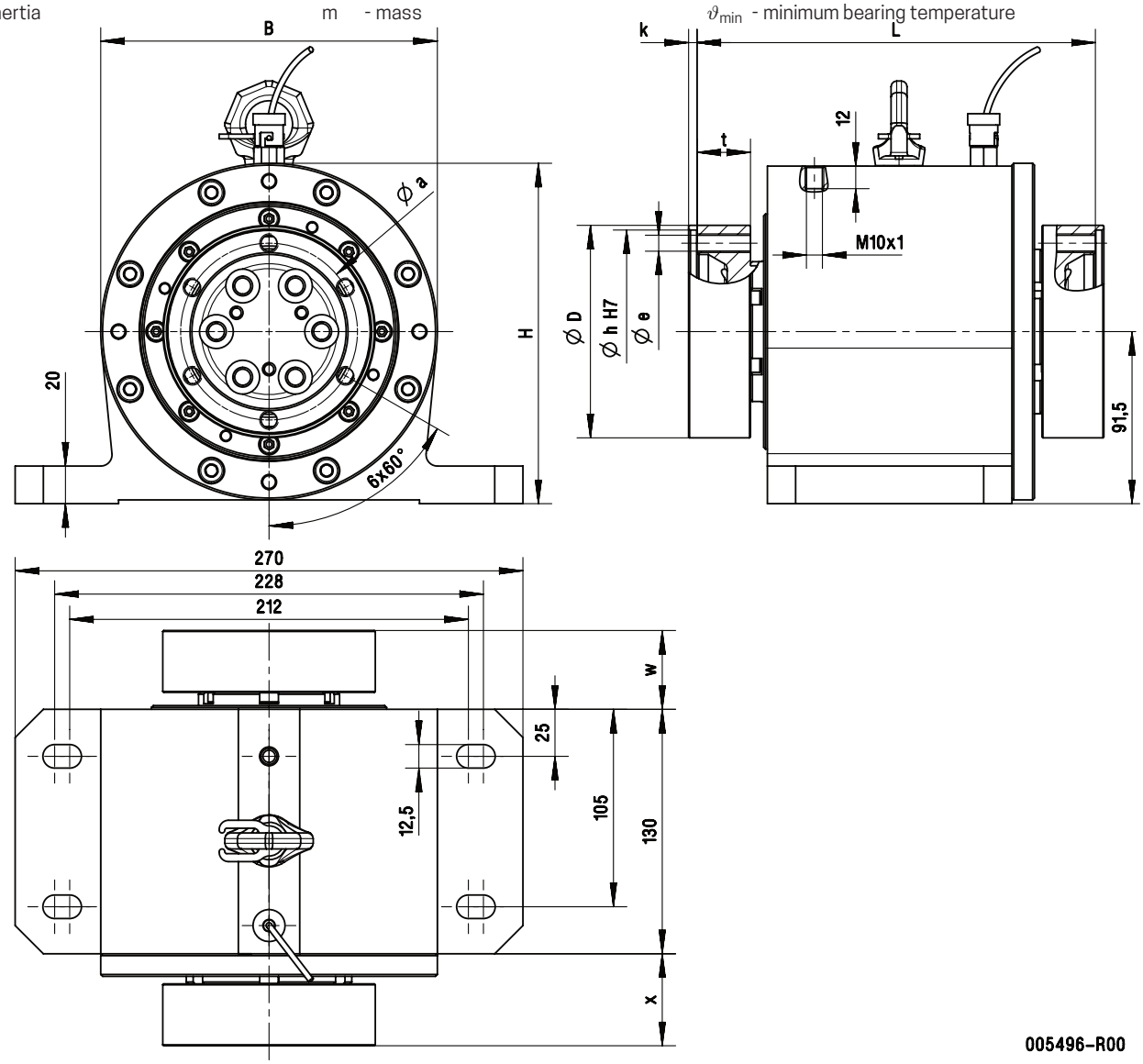
Benefits

- high speeds
- precise running
- reduced stress on unit under test and dynamometer
- exchangeable flanges for different CV-shaft sizes and coupling types
- permanently lubricated bearing
- integrated temperature measurement points

substructure for vibration isolation optionally available

Intermediate bearing	Flange	T_{max} [Nm]	n_{max} [rpm]	J [kgm^2]	m [kg]	ϑ_{max} [°C]	ϑ_{min} [°C]
tZLE600	CV05	1000	10000	9.98E-03	32.7	+60	-40
	CV10	1500		1.05E-02	32.9		
	CV15	2500		1.06E-02	33.5		
	CV21	3500		2.29E-02	36.0		
	CV30	6600	5000	3.38E-02	37.8		

T_{max} - maximum torque
J - inertia
n_{max} - maximum speed
m - mass
ϑ_{max} - maximum bearing temperature
ϑ_{min} - minimum bearing temperature



Intermediate bearing	Flange	B [mm]	D [mm]	H [mm]	L [mm]	a [mm]	e [-]	h (H7) [mm]	k [mm]	t [mm]	w [mm]	x [mm]
tZLE600	CV05	179	90	179.5	212	74	M8	86	10.5	28.5	37.5	44.5
	CV10		97			80		94	4.5			
	CV15		113			94	M10	108				
	CV21		134		218	108	M12	128	5.5	31.5	40.5	47.5
	CV30		154		224	128		148	6.0	34.5	43.5	50.5

Other flange dimensions or mixed CV sizes available on request.

tZLE800 – HIGH-SPEED INTERMEDIATE BEARING

Description

The tZLE800 bears the support loads, thereby reducing the loading on the rest of the test bed. The high-quality bearings used guarantee precise running. The available flanges of the tZLE800 allow the direct application of shaft types of the t70x and t80x series, and couplings from the t600, t1x00 and t2x00 series, without further adaptations. The tempered variant of the tZLE800 is suitable for use at temperatures from -40°C to +150°C.

Naming

The product is named according to the following convention:

tZLE800-CVxx
- xx: joint size
- tZLE800-CV: series designation

Example: tZLE800-CV15

Operating range

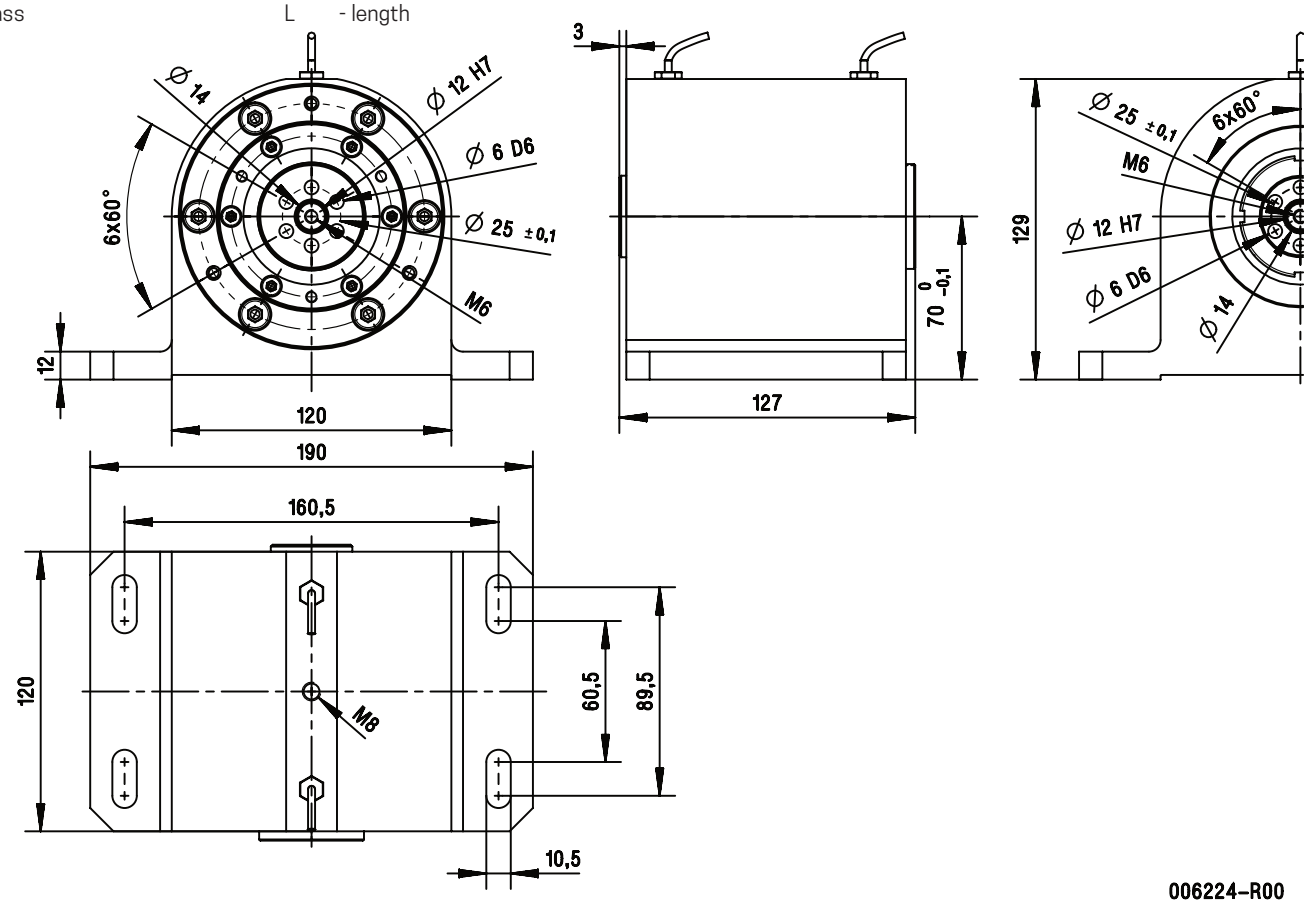
Torque: up to 450 Nm
Speed: up to 20000 rpm

Benefits

- high speeds
- precise running
- reduced stress on unit under test and dynamometer
- exchangeable flanges for different CV shaft sizes and coupling types
- permanently lubricated bearing
- integrated temperature measurement points

Intermediate bearing	L [mm]	m [kg]	n_{max} [rpm]	J [kgm^2]	ϑ_{Bmin} [°C]	ϑ_{Bmax} [°C]	ϑ_{Amin} [°C]	ϑ_{Amax} [°C]
Standard tZLE800	127	12.45	20000	3.73E-04	-30	+60	-30	+60
Tempered tZLE800	90	9.21	20000	2.84E-04	-30	+60	-40	+150

n_{max} - maximum speed
J - inertia
m - mass
ϑ_{Bmin} - minimum bearing temperature
ϑ_{Amin} - minimum ambient temperature
L - length
ϑ_{Bmax} - maximum bearing temperature
ϑ_{Amax} - maximum ambient temperature



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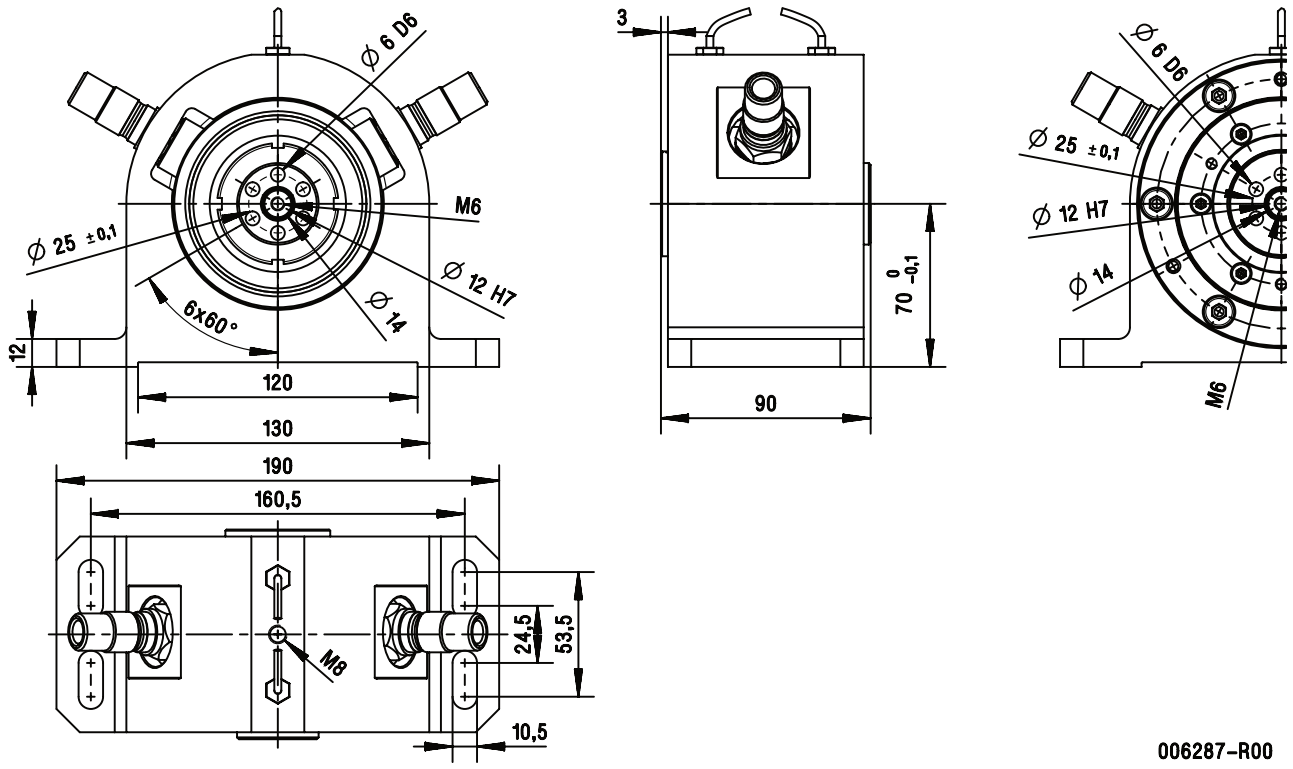

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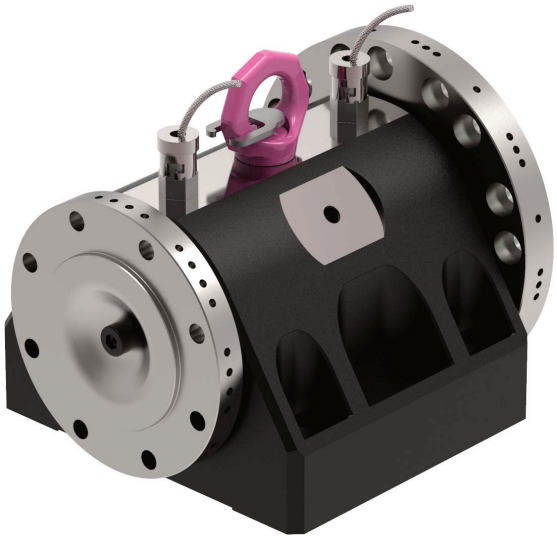
tZLE950 – HIGH-SPEED INTERMEDIATE BEARING



Description

The tZLE950 bears the support loads, thereby reducing the loading on the rest of the test bed. The high quality spindle bearings used guarantee precise running up to very high speeds. The customer-specific adapters allow the use of several shaft types of the t70x and t80x series and couplings from the t600, t1x00 and t2x00 series. The modular design allows the bearing to be tailored to individual customer requirements.

Operating range

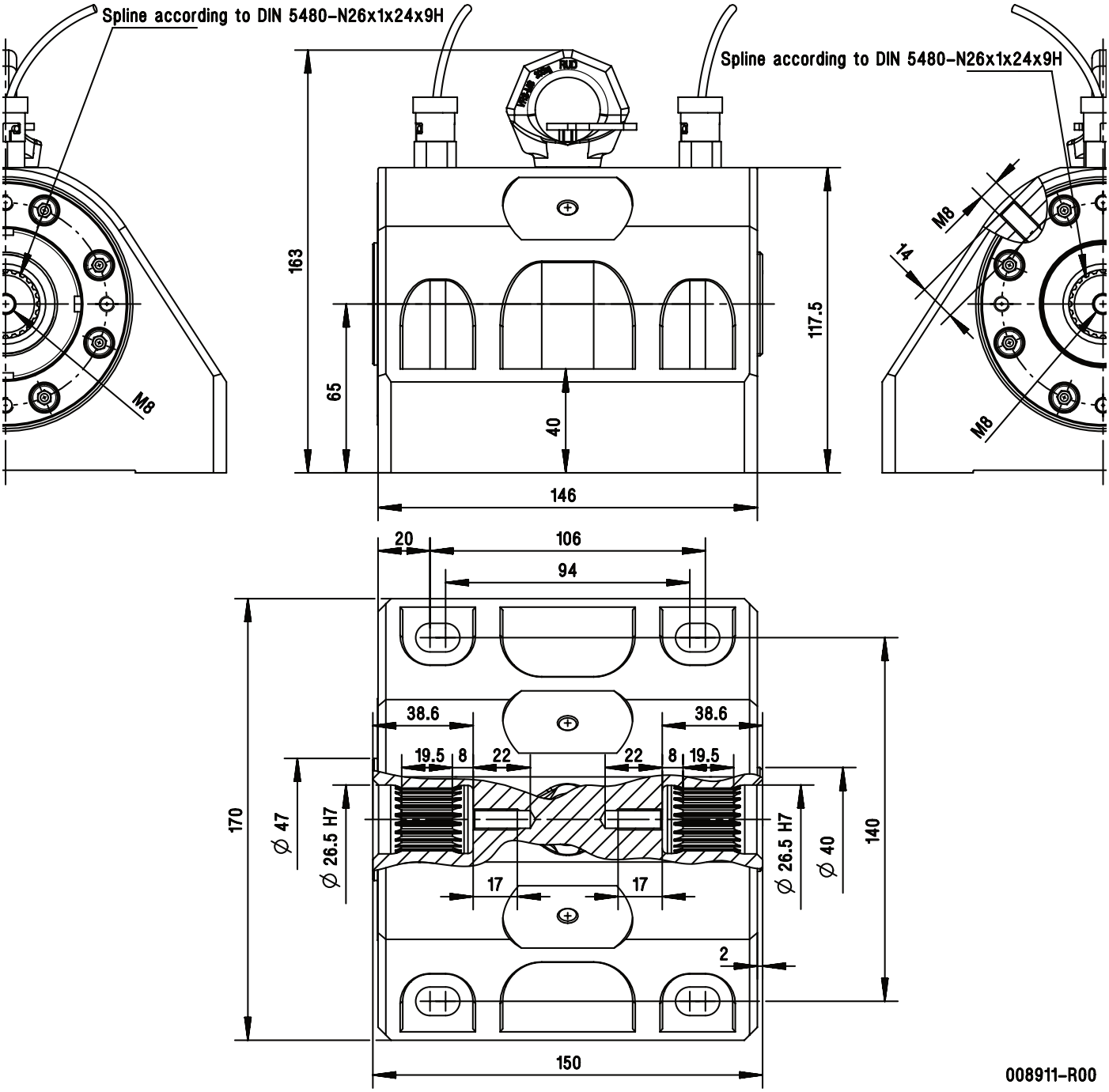
Torque: up to 1000 Nm
Speed: up to 25000 rpm

Benefits

- very high speeds
- highly precise running
- reduced stress on unit under test and dynamometer
- permanently lubricated bearing
- integrated temperature measurement points

Intermediate bearing	L [mm]	m [kg]	n_{max} [rpm]	T_{max} [Nm]	J [kgm^2]	ϑ_{min} [°C]	ϑ_{max} [°C]
tZLE950 pillow block bearing	150	15.83	25000	1000	6.95E-04	0	+80

n_{max} - maximum speed
J - inertia
T_{max} - maximum torque
ϑ_{min} - maximum operating temperature
m - mass
ϑ_{max} - maximum operating temperature
L - length



tGEAR – HIGH-SPEED GEARBOX

Description

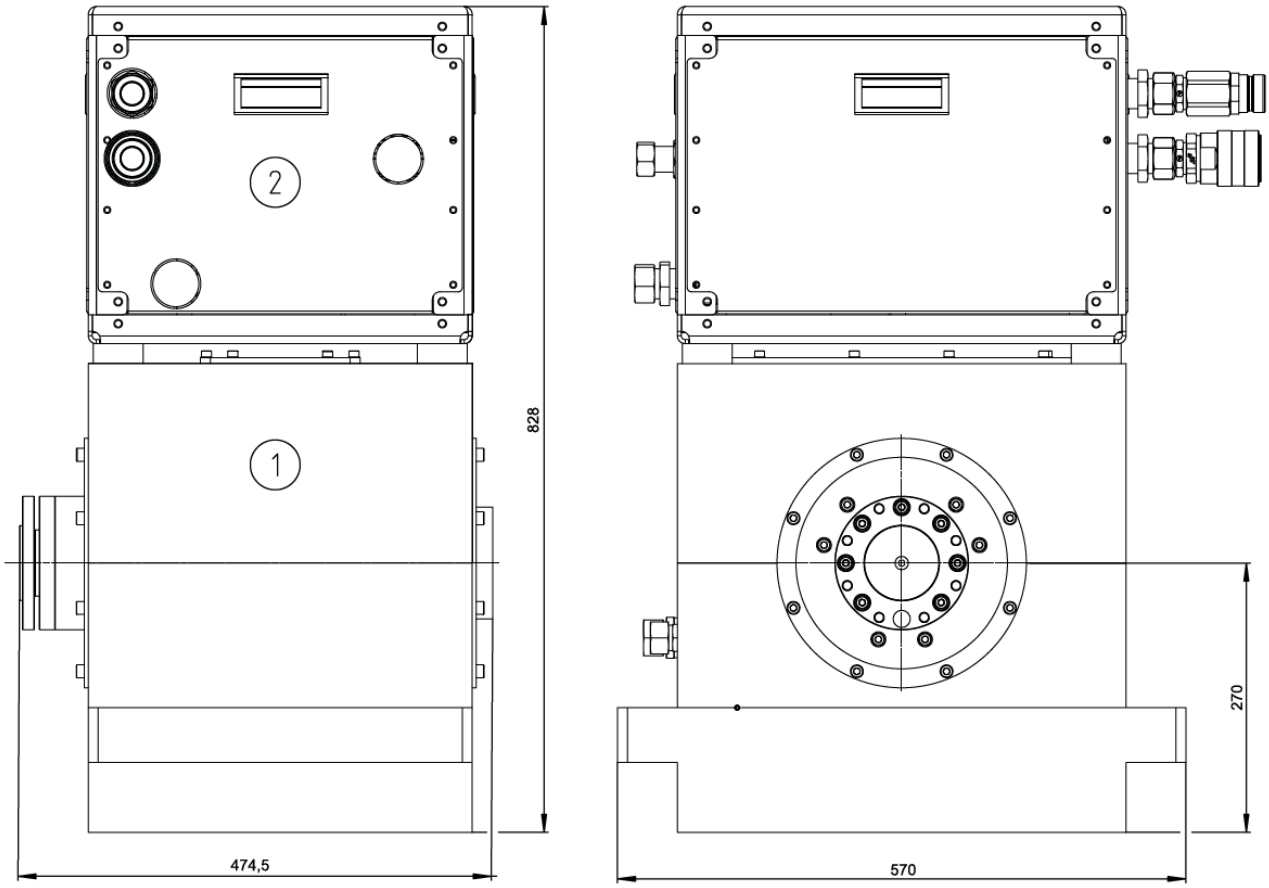
All WLTP test cycles for e-motors can be operated in full on your conventional testbed with tGEAR High-Speed Gearbox from tectos - including efficiency mapping.
By using tGEAR, the input speed is increased to the required speed of e-drives and therefore no e-testbed is needed for these test cycles.

Maximum flexibility is achieved by the 2-part design: Gearbox and oil supply are separated from each other, so the oil supply can be mounted in different positions.

Benefits

- **Short lead time**
  E-testing with your conventional test bed within 12 to 16 weeks from receipt of order.
- **Modular design**
  Fully compatible of tGEAR and eTraction components. Reuse of base frame, bearing block etc. for eTraction.
- **Flexibility**
  After implementation of eTraction you can return tGEAR to tectos or continue to use tGEAR as backup solution for e-mobility tests.
- **Cost efficiency**
  Depending on your operating hours of tGEAR you will receive a special discount on your eTraction in case of returning tGEAR to tectos.

tGEAR – High-Speed Gearbox	
Compatibility	All common conventional testbeds
Connection to dyno	CV-shaft and adapter
Mounting	Adapter plate on base frame
Max. output speed	25,000 to 30,000 rpm
Max. output torque	1,800 Nm
Transmission ratio	From 1:2 up to 1:7
Lubrication system	Closed oil circuit system Pump, filter and heat exchanger integrated Due to flexible design may be placed seperately, if required
Cooling interface	Domestic water supply
Operating lifetime	20,000 hours
Maintenance recommendation	Oil and filter changes every 2,000 hours and routine checks of clearance



Gearbox (1) and separate oil supply (2)

eTRACTION SYSTEM FOR E-MOBILITY TESTS

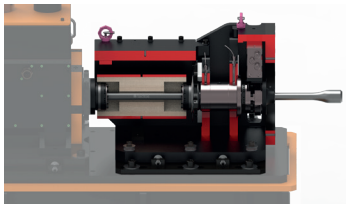
eTraction System for e-mobility tests by tectos is characterized by a 3-part basic design which consists of frame, bearing block and high-speed drivetrain. It offers maximum flexibility for a wide range of applications by switching the setup without need of changing the basic design.

Operating range

Speed: up to 30000rpm

Compatible with common automation systems, expandable to customer requirements and NVH proofed.

eTraction basic equipment (compatible with every setup):



Vibration optimized base frame with air spring damping

Steel frame with optional vibration damping filling made of composite material, integrated air springs, level control, compressed air maintenance unit with connection option to the building services, tubing and piping on frame.

Bearing block with integrated drive shaft

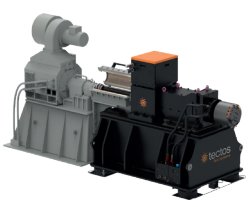
Perfect vibration decoupling by means of a system developed by tectos using damping elements, thus achieving vibration isolation and, in particular, galvanic isolation of the test equipment from the drive to be tested.

High-speed drivetrain with integrable torquemeter

High-speed drive perfectly matched for this system, preventing transmission of axial and radial forces.
Consisting of: High-speed intermediate bearing, high-speed CV shaft, adapter for UuT.

Application setups:

- E-Testing on conventional testbeds
- Traction testing
- Back-to-back testing
- E-axle and gear testing
- Customized solutions

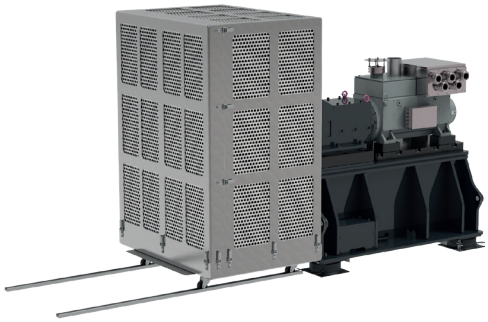


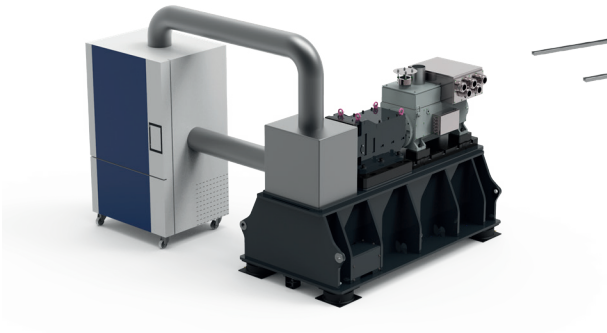
Benefits

- Independence systems compatible with all common automatization systems
- Using synergies from existing and new - thus reducing investments
- Time saving by using modular systems
- Easier planning of long-term investments and thus higher flexibility
- Keeping options free without compromising on quality and functionality

On request, tectos provides a complete system including assembly and commissioning for the respective setup including the following options:

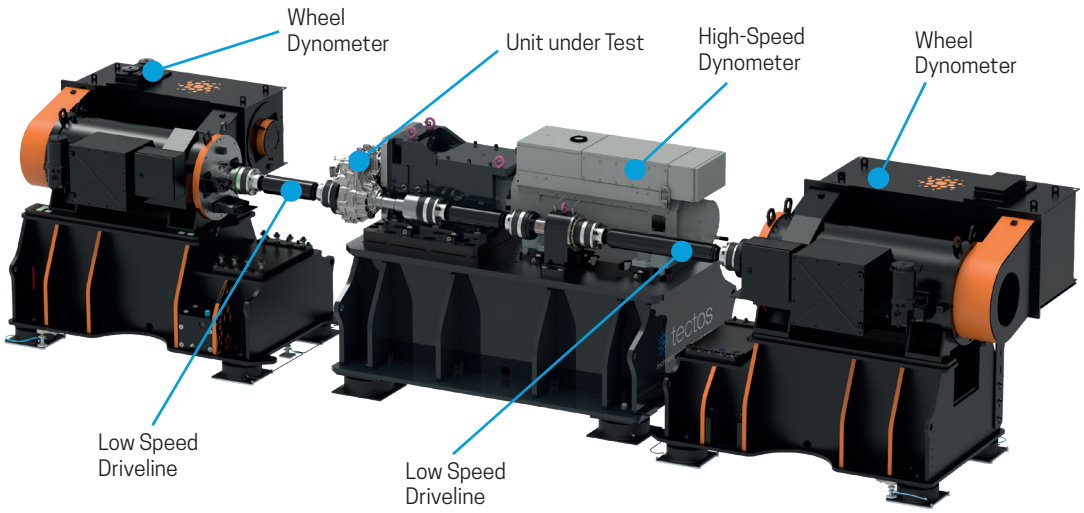
- Battery simulator, inverter technology and entire drive suite
- Automation system or integration into existing system
- Connection with measurement technology and periphery
- Safety PLC
- Climatic Chamber/Hood with Cooling Tube
- Acoustic Hood
- Special Requirements





Example: eTraction system extended for 3E e-mobility testbed

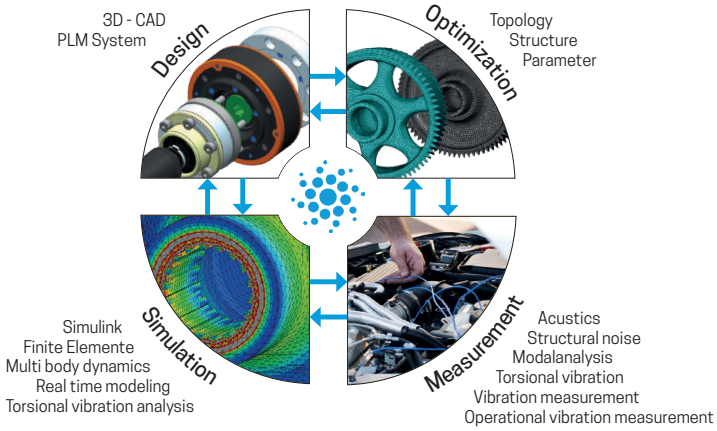
- New testbed system to be equipped with 2 dynos, 1 highspeed dyno including corresponding frequency converter
- Main criteria: highest flexibility for diverse applications and best vibration optimization
- Noise emissions of dynos as low as possible (target: 35 dB)
- Integration and connection to SPS system by interface



The secret of our success: tectos Engineering

Core competences of tectos are **NVH engineering services, simulation, measurement, analysis and development of customized solutions.**

In doing so tectos specialists are working closely together with the inhouse research and development department. **Finite elemente analysis, multi-body dynamics, torsional vibrations, real-time modeling, Simulink and Modelica** are daily business in this department.



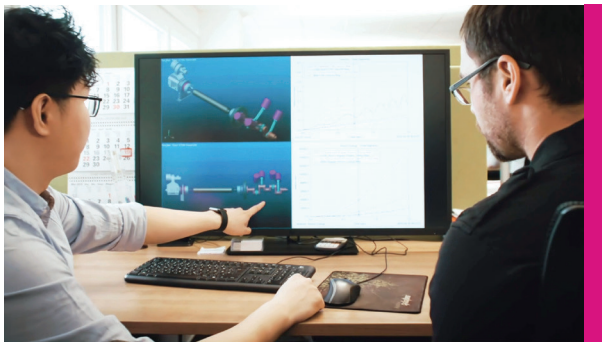
Analysis in combination with interpretation of the results by tectos engineeres and a profound recommendation leads to solutions which are **sustainable, practicable and efficient.**

Simulation

Simulation is **an essential element during the development process**. Generated models identify weak points and effects and can be optimized without using cost intensive ressources.

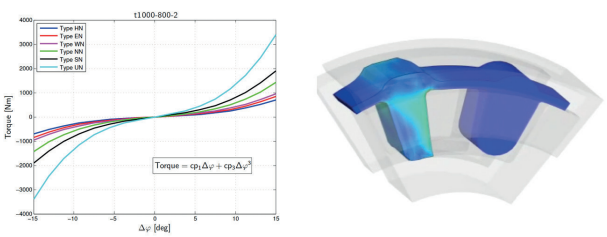
Methods used at tectos:

- Torsional Vibration Analysis
- Multi-Body Simulations
- Finite Elemente
- Fatigue Strength Calculations
- Real Time Models – SIL, HIL
- Parameter-Based and Parameter-Free Optimizations
- Time Domain Simulation with Modelica



Simulation by tectos means for you

- Solutions for versatile, sophisticated and complex tasks by working with state-of-the-art tools
- Cost and time efficiency due to a very early identification and optimization of weak points



Function development based on FEM elastomer contact simulation

Parameter-free optimization of a cylinder head

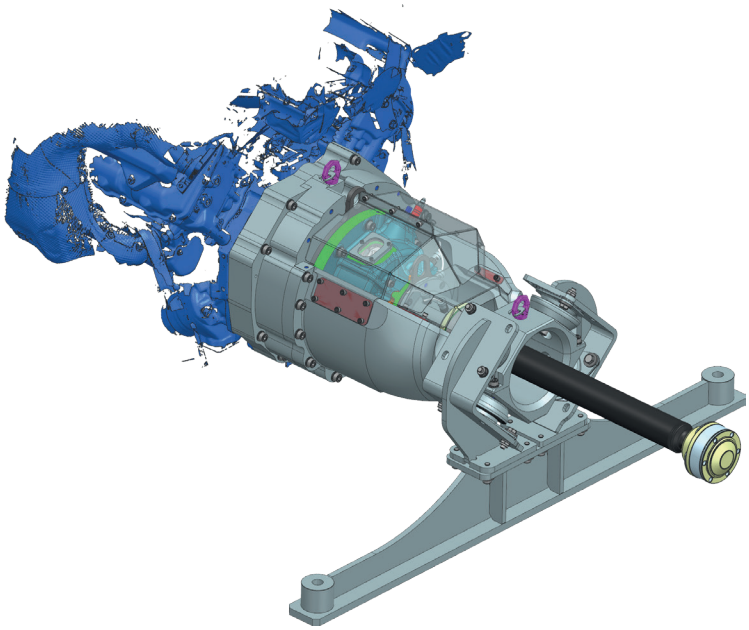
Design

Based on perceptions of the concept and physical boundaries the design specialists are transferring these insights into products.

tectos designers are characterized by **many years of experience and profound system understanding:** that is why function and **efficiency, usability and scalability** are taken into account at an very early stage.

Any tools required and their integration into the workplace may be provided on request and facilitate work when using system components developed by tectos.

tectos relies on Siemens Teamcenter as PLM system which meets the very high standards of OEMs and is also the essential basis of our data base.



Measurement

Together **with simulation**, measurements form an **unbeatable combination**:
The knowledge gained in the simulation is validated by measurement and – if necessary – used for further optimization.

Experienced and highly qualified engineers carry out these measurements and interpret the results – be it at tectos or directly on-site at the customer.

Examples are:

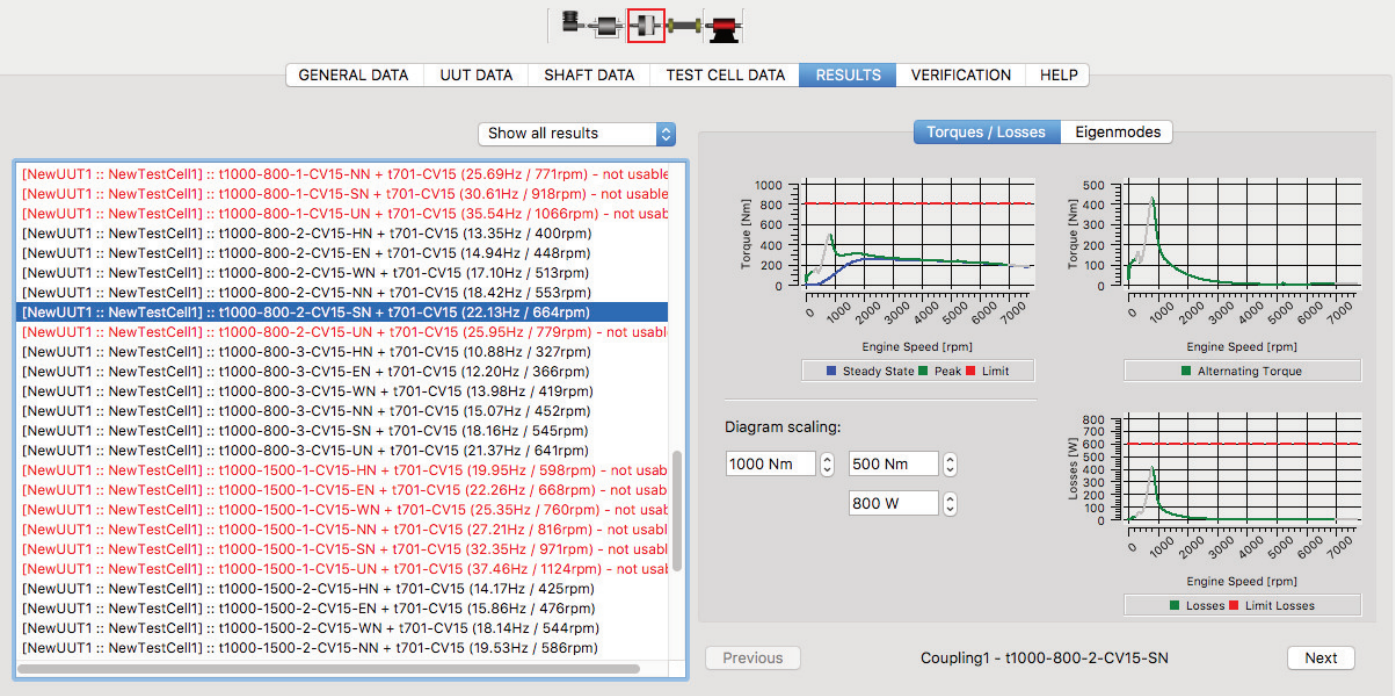
- Vibration Measurements
- Torsional Vibrations
- Structural Borne Noise
- Operational Vibration Analysis
- Modalanalysis
- Acustics
- and more

Experts Knowledge with passion

From highly specific engineering solutions to tailored testbed components: tectos represents engineering excellence in combination with individual solutions for powertrain components for prototypes and test beds.

Years of experience in the field of vibration optimization, dynamic behavior and environmental influences are benefits which customers worldwide rely on.

tShaft – SHAFT SELECTION AND VERIFICATION TOOL



Description

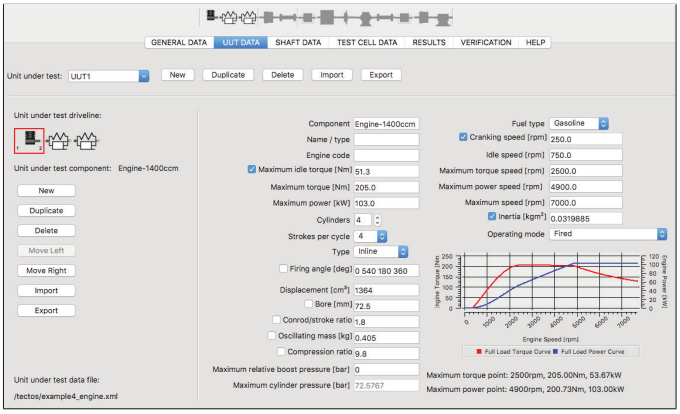
When a new engine is to be tested in a test bed, it is always a challenge to select a drive shaft with the correct properties. It is important not only to transfer the corresponding torque, but also to take into consideration the stiffness and distribution of the inertia values.

tShaft is a fast analysis tool which selects a drive shaft most suitable for a specific engine for a given test cell. All current engine types can be defined with just a few parameters. Integrated estimation algorithms are available for determining unknown quantities.

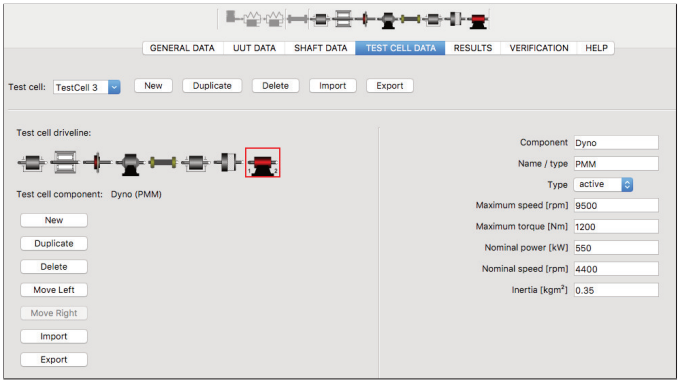
The analysis is achieved with a non-linear torsional vibration calculation. tShaft uses a shaft database, which contains details of all tectos drive shafts (e.g. t600, t650, t1x00 and t2x00 series, CV-shafts of the t70x series and HK high-speed shafts of the t80x series in various sizes). Information on customer-specific components may be added to the database at any time.

Features

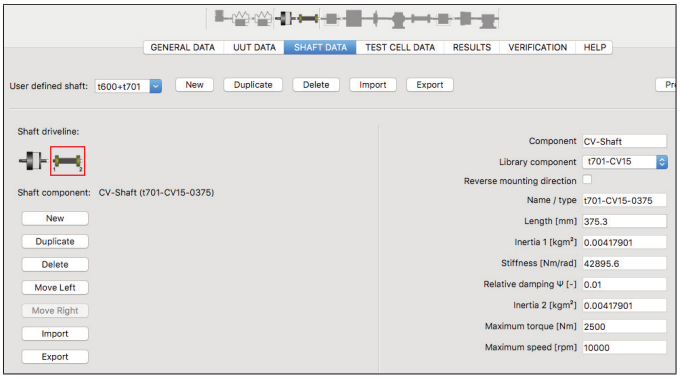
- support of various engine types: in-line, V-type, boxer
- estimation algorithms are provided for unavailable parameters
- modeling support for flywheels, dual-mass flywheels, clutches, quill shafts and transmissions
- administration of several test beds
- modeling of user-defined shafts
- pre-selection of available drive shaft in a test field
- PDF reporting with torque and loss curves, for individual shaft components
- calculator to evaluate inertia and stiffness from geometric data



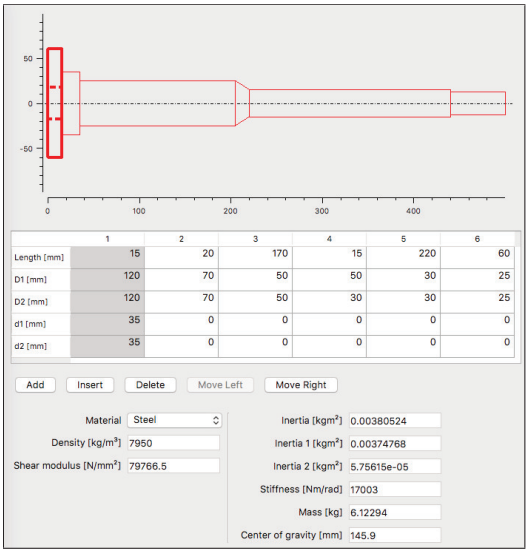
tShaft – unit under test parameters



tShaft – test cell parameters



tShaft – shaft parameters



tShaft – stiffness / inertia calculator

tShaft configurations	Lite	Standard	Advanced	Professional	
Base Version	✓	✓	✓	✓	Calculator tool for selecting and calculating shafts and couplings for use on engine test beds
Option: Extended reporting	✓	✓	✓	✓	Extension for comprehensive report generation
Option: User-defined shafts		✓	✓	✓	Extension for parameterizing additional shafts
Option: Stiffness and inertia calculation		✓	✓	✓	Extension for calculating stiffnesses and inertias from geometric data
Option: Extended drive line modeling			✓	✓	Extension for modeling drive lines and transmissions of a test cell
Option: Motorcycle transmission modeling			✓	✓	Extension for modeling motorcycle transmissions
Option: Measurement verification				✓	Extension for result verification with measured data

tShaft platforms	
Operating systems	MS Windows (minimum Windows 7), macOS (Minimum Yosemite), GNU/Linux 64-bit (Ubuntu 16.04)
Languages	Deutsch, English, 日本語, 简体中文, other languages on request

tDME100 – LOAD CELL

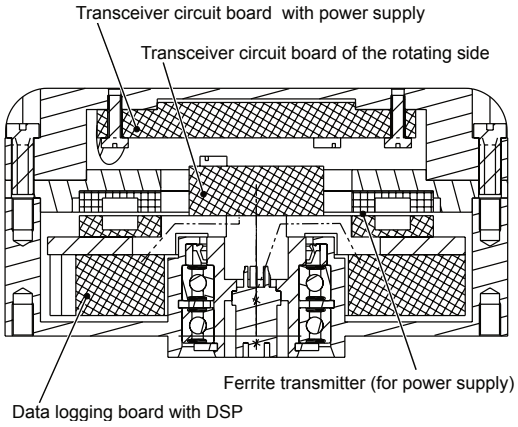
Description

The tDME100 was designed for torque measurement on installed intermediate shafts for vehicle tests. The torque is measured on the gear shaft using strain gauges (DMS). Transmission is done optically. The connection between the DMS and signal processing is pluggable.

Benefits

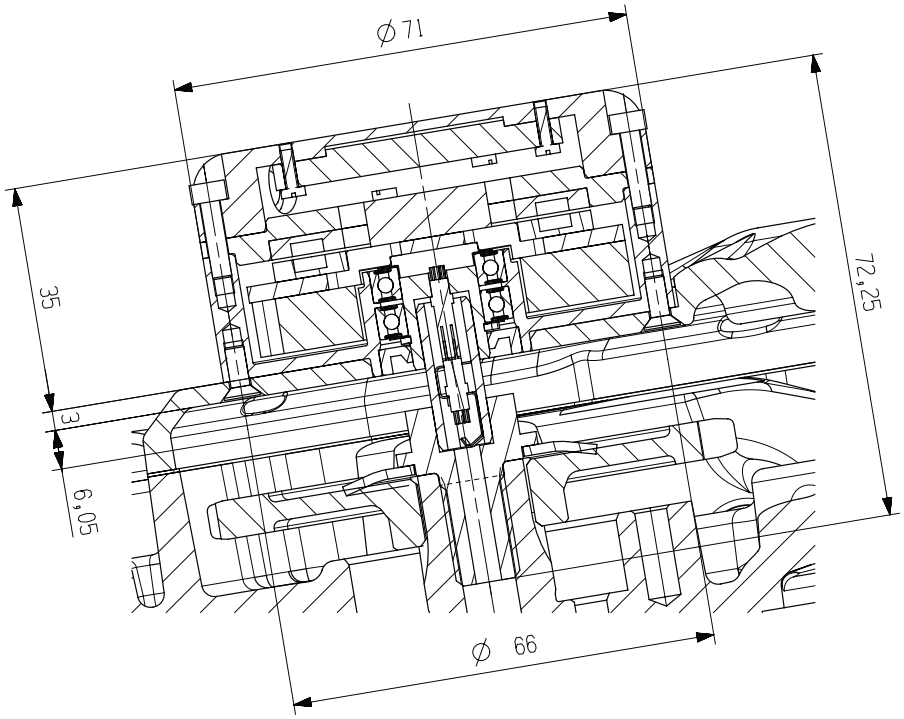
- compact design
- easy assembly
- plug-in signal processing
- optically signal transmission
- inductive energy transmission
- may be configured externally
- maintenance-free
- wear-free

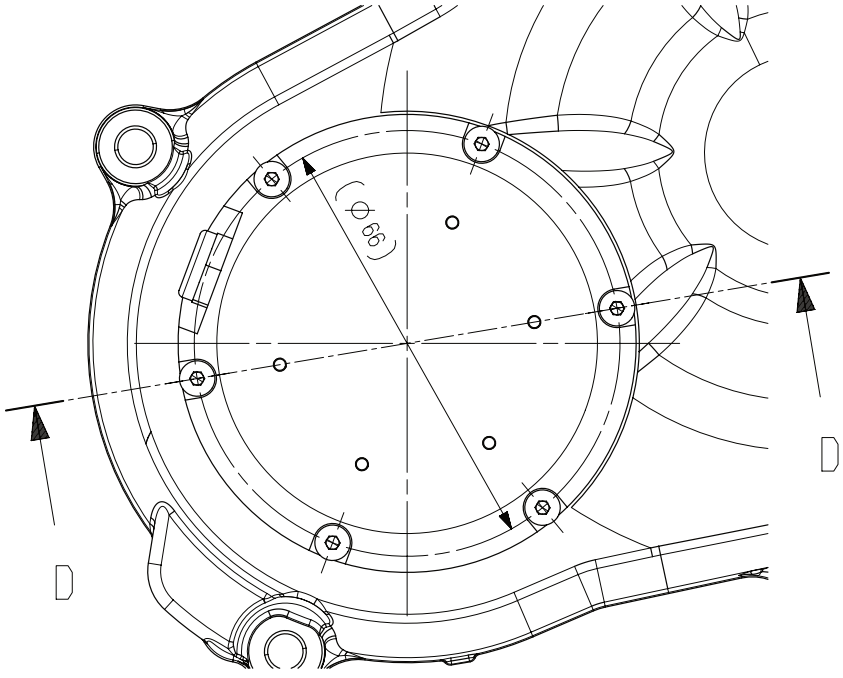
Function



With a bridge power supply of 10 V, the DMS bridge signals lie within a range of approx. ±20 mV. To prevent signal influences on this low voltage level, signal processing is done on the rotating side. To detect the signals, 24-bit transformers with a sampling rate of 32 kHz are used. An integrated DSP (Digital Signal Processor) controls the conversion rate and produces the desired output rate and resolution. The coupling of the digital data with the CAN transceiver on the stationary side is done optically. In addition to the measurement data output, the transceiver may also be used for complete system configuration. Thanks to the touch-free energy transfer, the system is maintenance- and wear-free.

tDME100		
Power supply	[V_{DC}]	10 - 18
Current input in operation (at 12 V)	[mA]	300
Bridge supply	[V]	10
Bridge resistance	[Ohm]	≥350
Input voltage range	[mV]	±250
Resolution	[Bit]	24
Maximum sampling rate	[kHz]	32
CAN bit rate	[kBit/s]	1000





We operate around the globe

Having a network of reliable partners is always an advantage. It is therefore no surprise that many renowned automotive manufacturers and development partners already rely on our services. Thanks to our network of sales partners, we are able to serve customers worldwide.

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