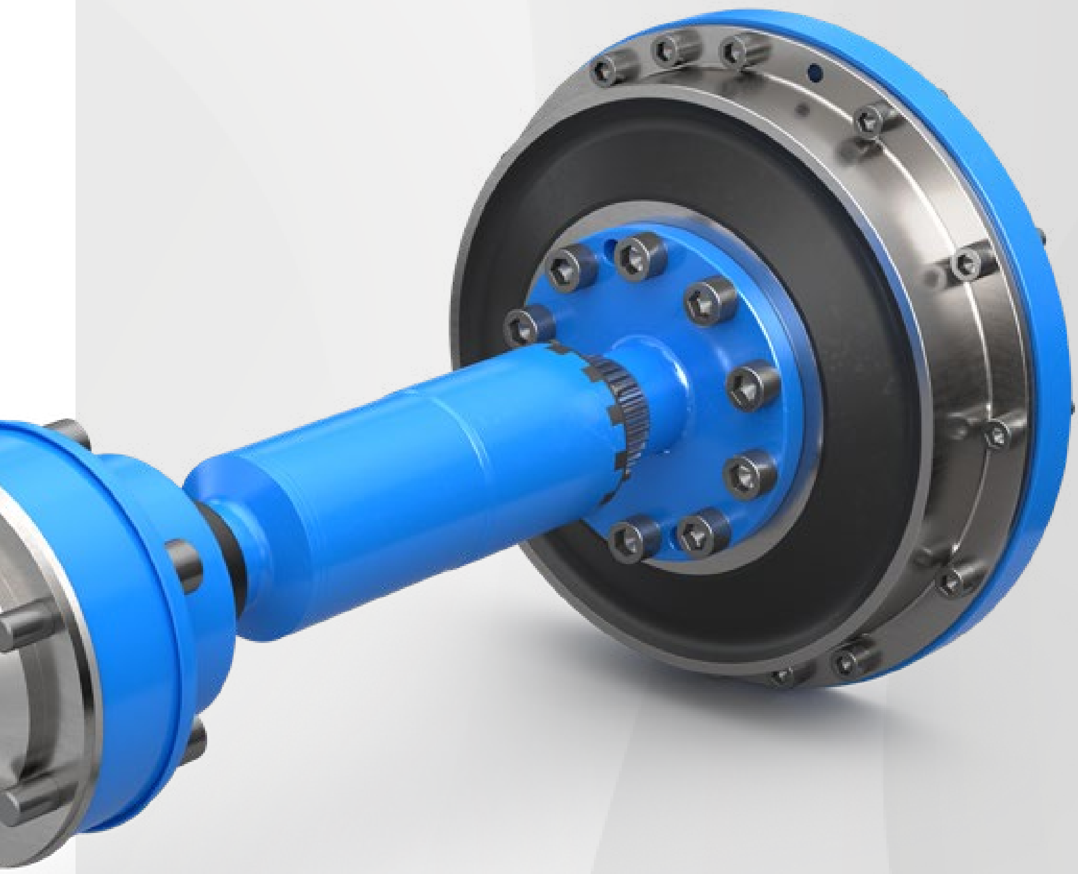
Designed to Customer

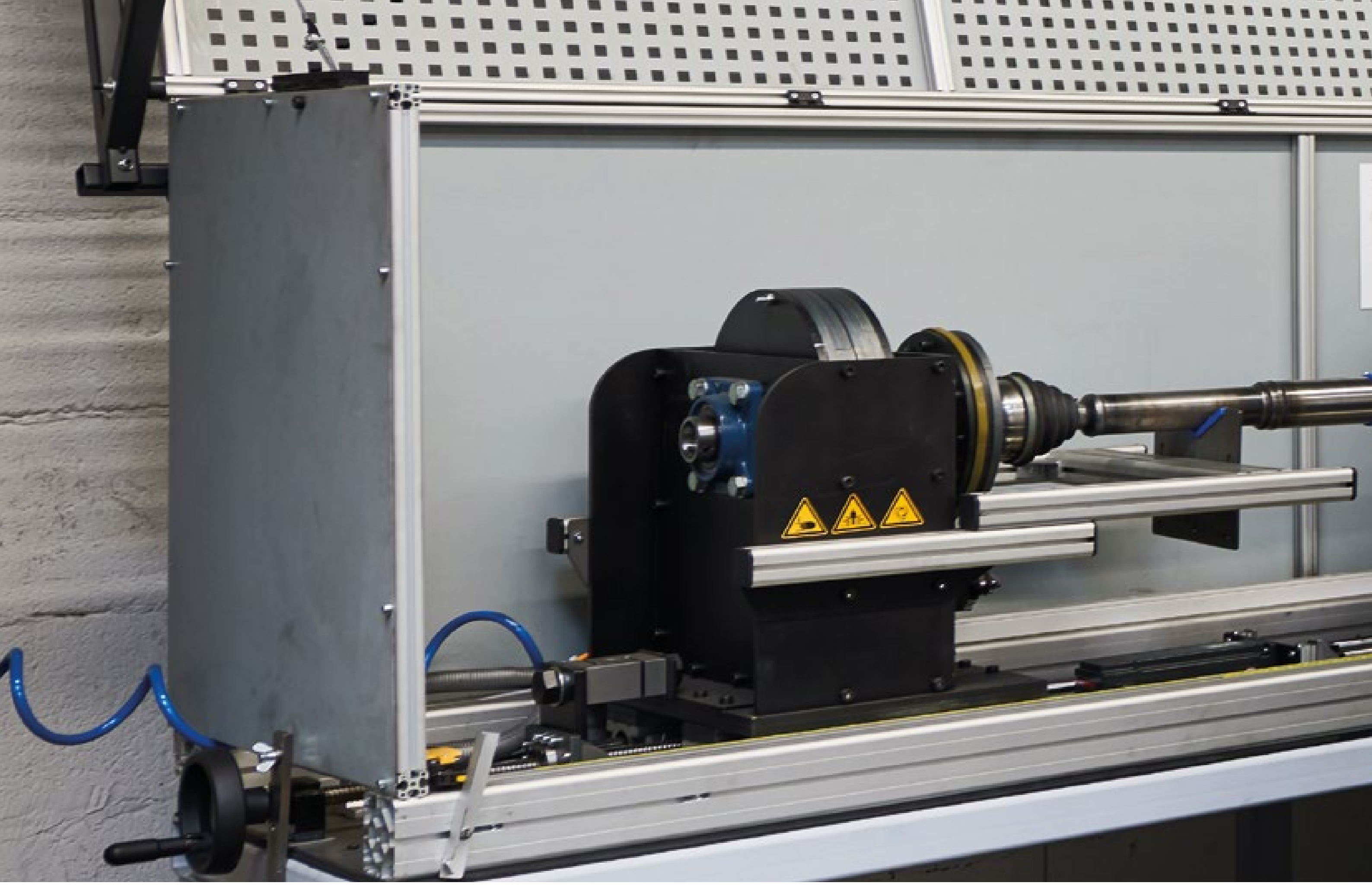


TOK DOCKING SYSTEM

Quick-Connection-System for Engine Testing

www.reich-kupplungen.com

SIMPLY **POWERFUL.**



D2C – Designed to Customer

The guiding principle of Designed to Customer is the recipe for success behind REICH. In addition to the catalogue products, we supply our customers with couplings developed to their specific requirements. The designs are mainly based on modular components to provide effective and efficient customer solutions. The special nature of our close cooperation with our partners ranges from; consulting, development, design, manufacture and integration to existing environments, to customer-specific production, logistics concepts and after-sales service - worldwide. This customer-oriented concept applies to both standard products and production in small batch sizes.

The company policy at REICH embraces, first and foremost, principles such as customer satisfaction, flexibility, quality, prompt delivery and adaptability to the requirements of our customers.

REICH supplies not only a coupling, but a solution:
Designed to Customer – SIMPLY **POWERFUL.**

D2C
Designed to Customer

TOK DOCKING SYSTEM

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TOK DOCKING SYSTEM

General technical description

TOK DOCKING SYSTEM

More productivity, shorter set-up times, lower operating costs – the REICH Docking System increases the efficiency of engine test benches.

The aim of the TOK Docking System is to significantly increase the efficiency of engine testing. The available test time is maximised by largely automating the changing of test specimens. Our modular docking system enables the seamless connection of engines of different sizes to a dynamometer, making engine testing much easier. The docking system is available in three sizes and two designs to achieve the optimum conditions for testing operations.

Flexible docking and centering fixture

The special feature of the docking system is its self-docking and self-centering fixture. It comprises a straight-toothed socket set screw and a corresponding sleeve. These are each combined with a TOK coupling element specially matched to the engine and a constant velocity joint.

Efficient retrofitting during the testing process

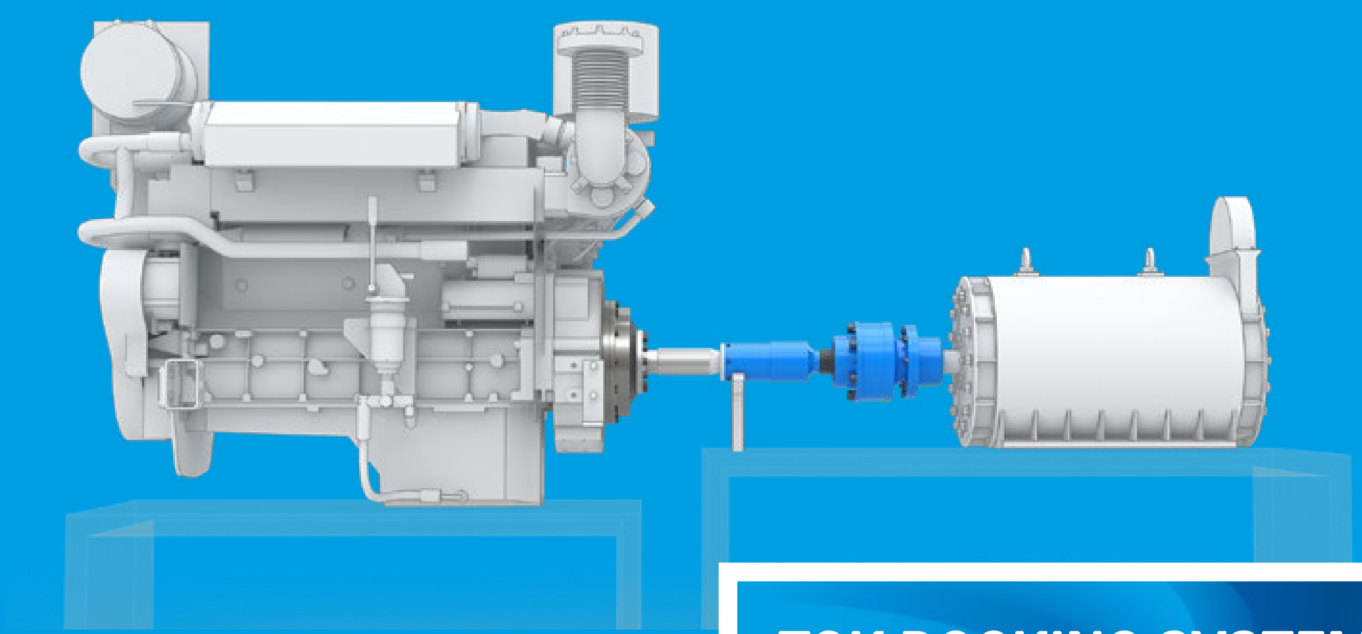
The docking system allows other engines to be prepared for the next test procedures while one engine is still being tested. Depending on the design, retrofitting involves either fitting the appropriate coupling with a toothed socket set screw or fitting the constant velocity joint to the engine. Given that this work is performed outside the test cell, retrofitting times are minimised in the test cell.

Self-alignment and self-centering

Thanks to the cleverly designed centring devices of the docking system, radial and angular misalignments are automatically compensated for during the docking process. The engine approaches the system mounted on the dynamo side with the docking aid mounted on the engine side. The pin and the sleeve of the docking system automatically centre themselves, resulting in a precision-guided drive train.

TOK coupling system:

REICH offers the right coupling shafts and highly torsionally flexible couplings tailored to the widest variety of engines.
Their high torsional elasticity and torque transmission capacity make them suitable for demanding applications on test benches. More documents are available on request.



TOK DOCKING SYSTEM

Nominal torques from 200 Nm to 5 000 Nm

TOK DOCKING SYSTEM
Advantages and Uses

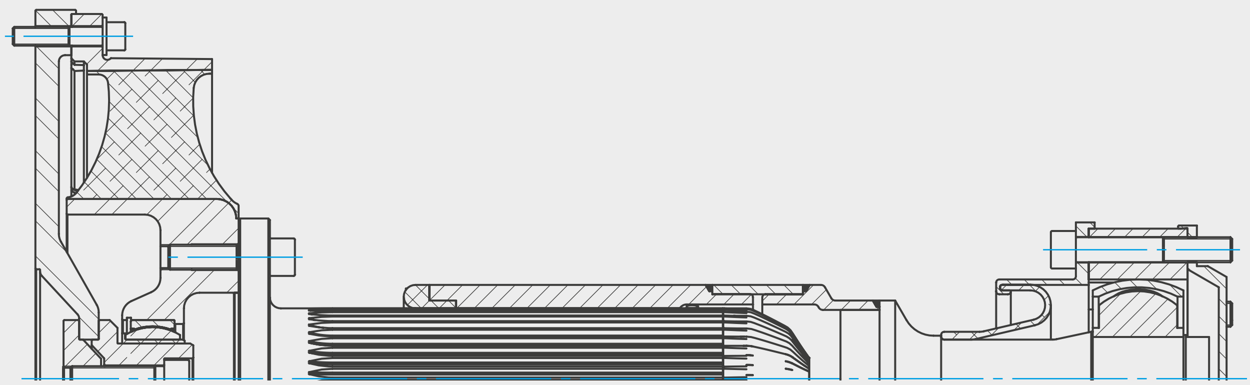
Key features and benefits of the TOK Docking System:

→ Modular type	→ Optimum cost-benefit ratio by using standard parts. System expandability enables future customisation
→ Automatic alignment	→ Minimal work effort in the test cell. Minimised risk of misalignment
→ Set-up outside the test cell	→ Maximising the efficiency of the test bench by minimising the set-up time within the test cell
→ Compatibility in any turning position	→ All the toothed system components fit together in any turning position while maintaining good balance
→ Interchangeability of wearing parts	→ Easy replacement of the threading aid ensures consistent and reliable system performance
→ Rotational speeds of up to 6 000 min^{-1}	→ High speed range for compatibility with a wide range of engines

TOK Docking System

Types

Standard Design



Input side coupling assembly

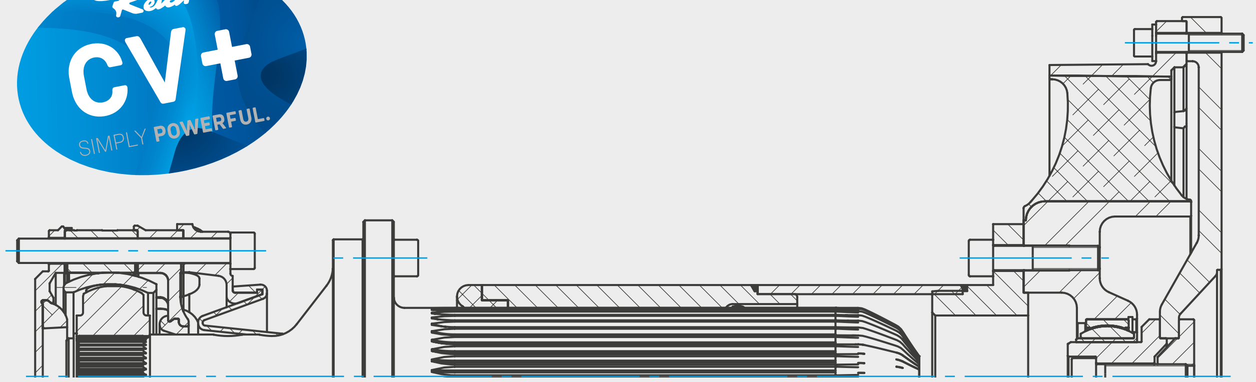
When mounting the coupling on the engine side, the TOK coupling is mounted on the engine with the socket set screw outside the test cell, while the constant velocity joint is attached to the dynamometer with the sleeve. The flexion of the constant velocity joint is absorbed by a support inside the test cell.

This configuration is particularly suitable for testing operations where there is frequent testing of different engines. The docking system is supplied with various coupling elements.

Advantage: Maximum variance in testing operations. Optimal coupling for every test specimen

Special types

Reich CV+ SIMPLY POWERFUL.



Dyno side coupling assembly

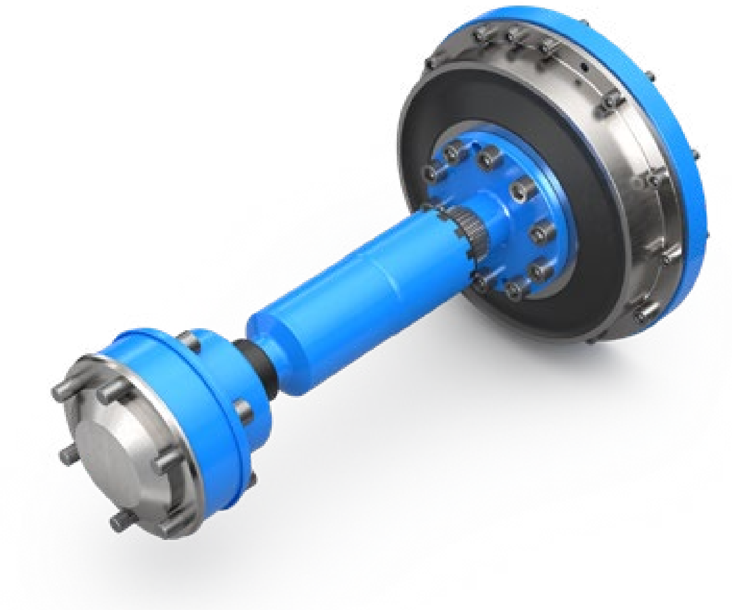
When mounting the coupling on the dyno side, the TOK coupling is attached to the dynamometer using the sleeve. Outside the test cell, the constant velocity joint is mounted on the engine with the socket set screw. The deflection angle is limited within the constant velocity joint, which means that no support is required in the test cell.

This configuration is particularly suitable for testing operations where tests are carried out with the same coupling element over a long period of time.

Advantage: no engine heat on the coupling element. No support required due to the internal support in the constant velocity joint.

TOK Docking System

Overview of Sizes and Technical Data



Standard version

Docking System Size	Coupling size[1)]	Nominal torque T_{KN} [Nm]	Maximum torque $T_{K\,max}$ [Nm]	Continuous fatigue torque T_{KW} [Nm]	CV[2)] Connection	Maximum speed n_{max} [min^{-1}]
TD 45	TOK 250 TOK 350 TOK 500 TOK 600 TOK 700 TOK 1000	250 350 500 600 700 1000	625 875 1250 1500 1750 2500	80 135 170 200 230 330	CV 21	6000
TD 65	TOK 1600 TOK 2200 TOK 3400	1600 2200 3400	4000 5500 8500	510 690 1000	CV 32	3000
TD 90	TOK 5000	5000	12500	1650	CV 42	3000

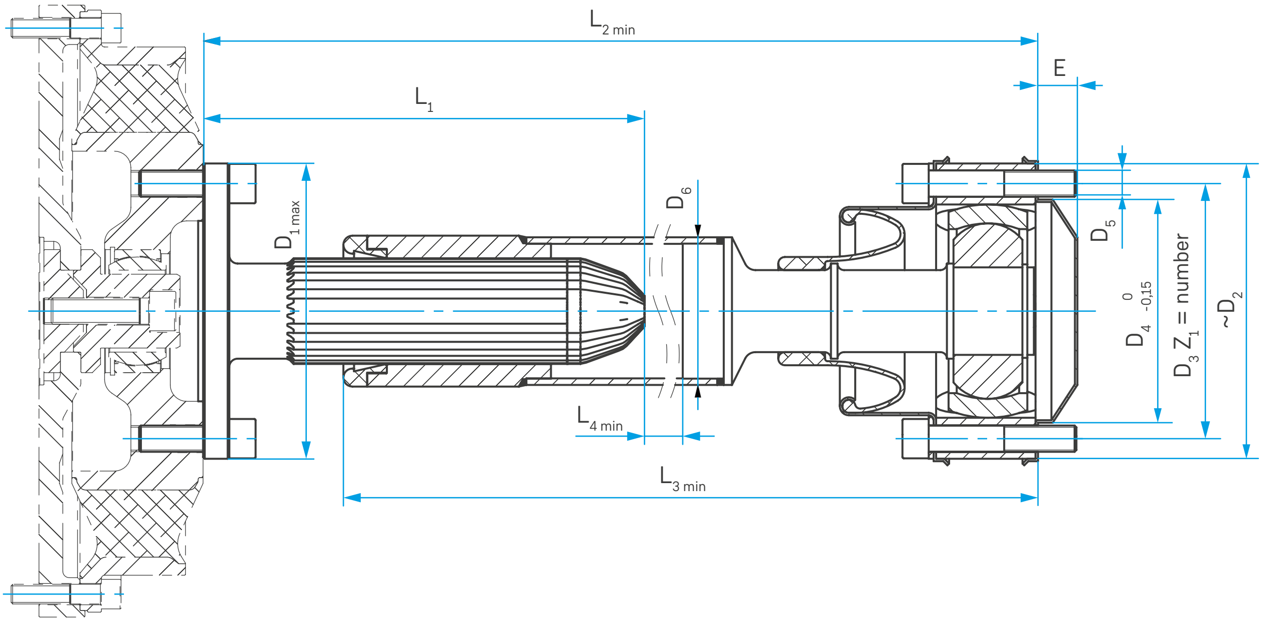
1) Coupling element available in different stiffnesses

2) Constant velocity shaft

REICH can also develop an optimised solution for special types following the principle “D2C – Designed to Customer”.

TOK Docking System

Standard Design



The dimensions of the coupling element can be found in the product catalogue for the selected coupling. Please do not hesitate to contact us if you have any queries.

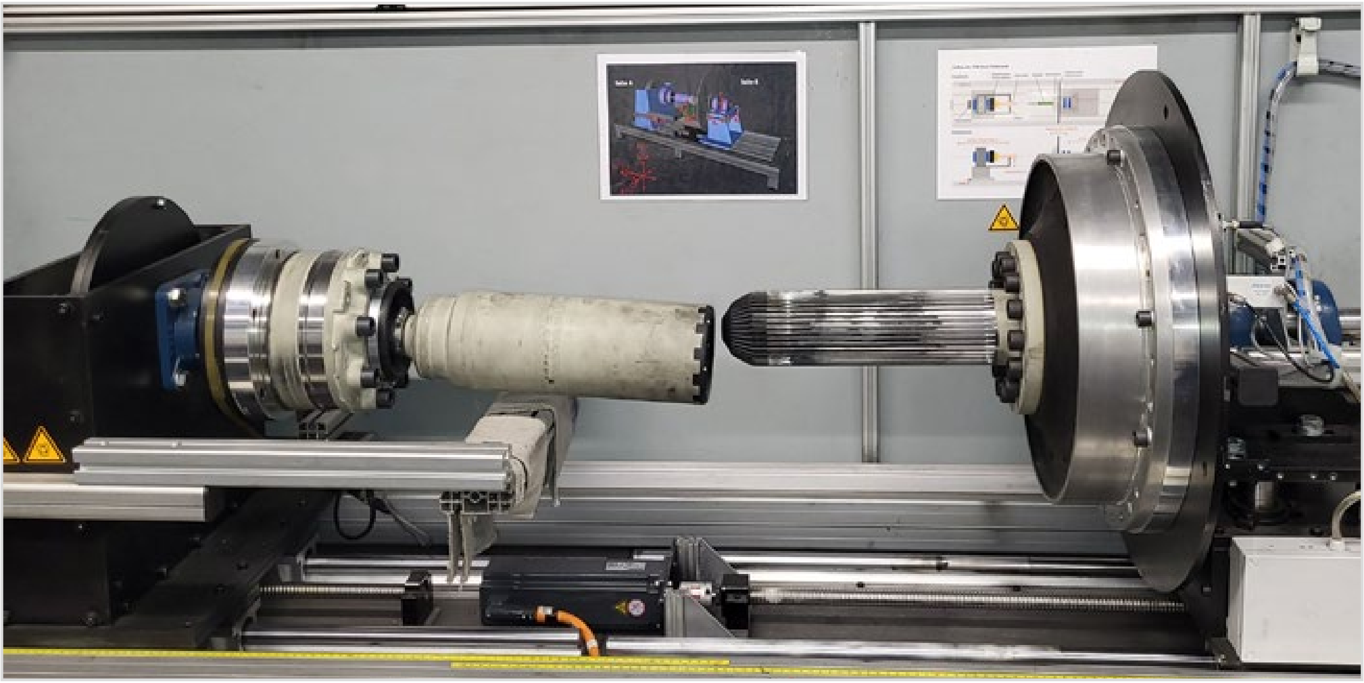
Coupling details

Coupling size	$D_{1\,max}$ [mm]	L_1 [mm]	Joint size CV shaft	D_2 [mm]	D_3 [mm]	Z_1	D_4 [mm]	D_5 [mm]	D_6 [mm]	E [mm]	$L_{2\,min}$ [mm]	$L_{3\,min}$ [mm]	$L_{4\,min}$ [mm]
TD 45	121	180	CV21	128	108	6	90	12.2	70	19	355	332.6	10
TD 65	205	269	CV32	180	155.5	6	136	16.2	90	24	469.5	420	10
TD 90	205	365	CV42	196	165	6	144	16.2	120	22.6	603	507.5	10

TOK Docking System

Threading Aid for the TOK Docking System

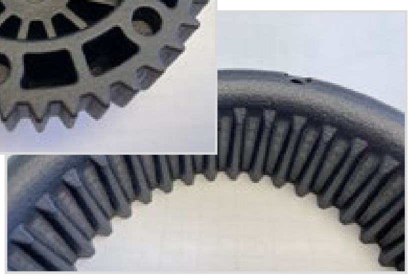
The threading aid is the central component of the TOK Docking System and ensures that the precisely toleranced gear pairing aligns and slides into each other during the docking process.



In specific iteration steps, a suitable threading aid was developed for each TOK Docking System size. Additive manufacturing processes were used to produce components with a wide range of geometries and materials during the development process. These were tested on the specially designed TOK docking test bench and the optimum combination was developed. The TOK docking test bench was installed to test the functionality and durability of the TOK Docking System. Thanks to extensive adjustment options on both sides of the drive train, it enables boundary conditions to be implemented that approximate very closely to real operation.
The final threading aid is robust and durable with good positioning and sliding properties.

Threading aid for size TD 90 after more than 120 000 docking operations.

- ➜ Radial extensions up to 15 mm
- ➜ Angular misalignments up to 1.5°
- ➜ Travelling speeds of up to 225 mm/s



TOK

Data Required For Coupling Size Selection

For the customised configuration of the TOK Docking System, we require detailed information about the engines to be tested, the dynamometers to be used and the installation situation.

In addition to the system component parameters, an overview of the tests to be carried out (e.g. emission tests, cold tests, hot tests, cylinder or bench shutdowns, etc.) is required to ensure that critical resonance speeds are optimally defined. The main resonance speed is usually well below the idling speed of the engine. Therefore, possible operating states below idling speed (e.g. starter speeds, flushing processes, etc.) in which the engine is coupled to the dynamometer must also be specified.

The required coupling sizes are defined using the data provided and, if possible, limited to the smallest possible number. Please note that the coupling selection will only be correct if the input data is accurate and complete. A definition that is technically and commercially optimised can only be made if all relevant data is available. A clear summary of the data in tabular form is helpful.

General

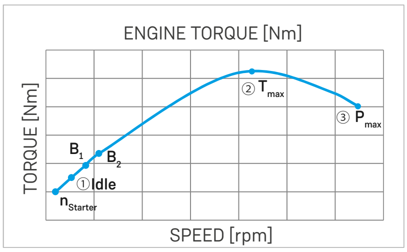
1. Project: ______
2. Place of use/installation: ______ Ambient temperature: ______ [°C]
3. Number of docking processes per day: ______
4. Operating time per day: ______
5. Docking process — Please tick
   Manual ☐ Automatic ☐ Axial force monitoring available ☐

Displacement during docking process	Symbol	Value	Unit
Radial displacement	K_r		[mm]
Angular displacement	K_w		[*]

Operational displacements	Symbol	Value	Unit
Radial displacement	K_r		[mm]
Angular displacement	K_w		[*]

Engine side

Please mark with a cross	Diesel	Petrol	Gas	Turbo	Biturbo	Other information	Cylinder deactivation*	
							yes	no
Type/designation/ manufacturer								



Designation	Please mark with a cross	Duration [s]	Symbol	Value		Unit
Start using dyno			T_{Start}			[Nm]
E-Starter			$n_{E\text{-}starter}$			[min⁻¹]
Stop using dyno			T_{Stop}			[Nm]
Stop by running down			-	-		-

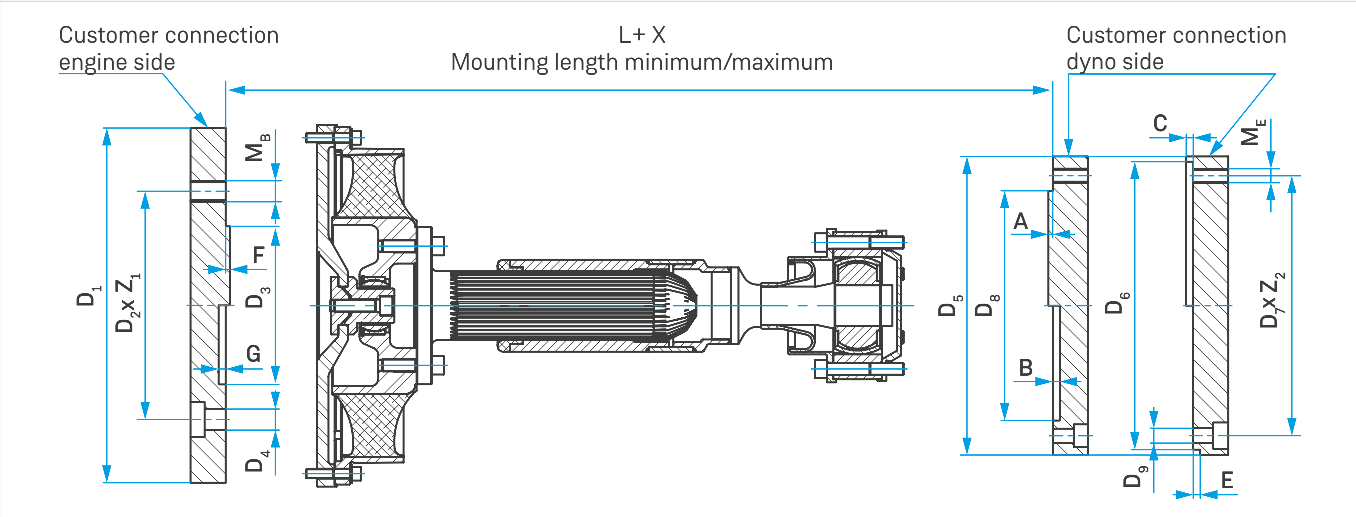
		Symbol	Value	Unit
1 Idle		n_{Idle}		[min^{-1}]
		T_{Idle}		[Nm]
		P_{Idle}		[kW]
2 T_{max}		n		[min^{-1}]
		$T_{max\ (nom)}$		[Nm]
3 P_{max}		$n_{max.}$		[min^{-1}]
		T		[Nm]
		P_{max}		[kW]
Inline/V (Angle xx°)		R/Vxx°		-
Number of cylinders		z		-
Engine harmonic main order		i		-
Firing order $z_1, z_2, z_3, ...z_n$				
Total stroke volume		V_H		[ccm]
Hub	[mm]	Bore		[mm]
Connecting rod length	[mm]	Connecting rod length ratio		
Oscillating mass per cylinder				[kg]
Moments of inertia (engine + flywheel)		J_{Mot}		[kgm^2]

Dual mass flywheel	yes/no		J_1		[kgm^2]	J_2		[kgm^2]	Ct	**	[Nm/rad]
Smallest operating point B1	n		[min^{-1}]	T		[Nm]	P	[kW]	t	[s]	Frequency/h
Second smallest operating point B2	n		[min^{-1}]	T		[Nm]	P	[kW]	t	[s]	Frequency/h
Lowest operating speed at full throttle	n		[min^{-1}]	Ambient temperature [°C]							

Dyno side

Number of test cells							
Dyno	EC	DC	AC	Please mark with a cross	Controller frequency		[Hz]
					Water brake		
					Miscellaneous		
Type/designation							
Mass moment of inertia reduced	J_{Brake}					[kgm^2]	

connection dimensions, customer



Engine side

Symbol	Value	Unit	Symbol	Value	Unit
D_1		[mm]	F		[mm]
D_2		[mm]	G		[mm]
Z_1					
D_4		[mm]	L		[mm]
M_E			X		[mm]
D_3		[mm]			

Dyno side

Symbol	Value	Unit	Symbol	Value	Unit
D_5		[mm]	D_8		[mm]
D_6		[mm]	A		[mm]
D_7		[mm]	B		[mm]
Z_2			C		[mm]
D_9		[mm]	E		[mm]
M_B					

TOK DOCKING SYSTEM

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Industrial solutions:

- Power generation
- Mobile applications
- Test benches
- Pumps & compressors
- Industry
- Marine engineering

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