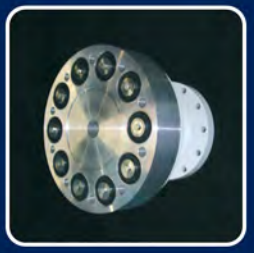
Rubber Design

vibration and noise control

Photography: Roger van der Kraan

Propulsion Equipment



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DOCUMENTATION SHEET

Propulsion Equipment

PROPULSION EQUIPMENT

General

Vessels like rescue boats, patrol boats and anchor handling boats have to show 100 percent performance, even in the most extreme conditions. These so called ' special seagoing conditions ' require propulsion equipment that withstands the test.

Rubber Design is a leading specialist when it comes to offering a range of anti-vibration solutions and associated marine propulsion equipment. Especially for the specific part of the maritime industry that relies on performance, even when running on top speed, in heavy weather and without compromising the comfort of the passengers.

We design, produce, test and deliver custom made solutions. In a very early stage of the development of the vessel we take part in the building process, enabling us to come up with solutions that perform in to all the conditions a client may think of.

The range of propulsion equipment consists of TT (Thrust Torque) mountings, gearbox mountings, marine and flexible couplings and thrust bearings. Rubber Design can perform a complete dynamic analysis of a vessel's propulsion system in order to select the correct coupling and engine mountings for each application. CAD drawings (2D/3D) of the thrust blocks and ERD marine couplings are available in different formats and can be easily imported into the CAD drawing of the complete propeller shaft installation. All thrust blocks and ERD marine couplings can be delivered with the required classification approval.

Types

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DOCUMENTATION SHEET

Propulsion Equipment
TT-Mounting

PROPULSION EQUIPMENT

General

The TT mountings are especially developed for the high powered / low weight, close coupled engine / gearbox combinations. The unique mounting design characteristics enables to transmit both Thrust and Torque forces whilst ensuring an excellent vibration isolation. The TT mountings have a linear stiffness over a wide load range varying from compression (–) to extension (+) necessary to maintain the optimum isolation properties of the Mass-Spring system formed by engine / gearbox and mountings. The close coupled gearbox reduces the engine rpm's and as a consequence, magnifies the engine torque. The reaction torque is being transferred over the TT mountings to the foundation as additional compression or extension forces which requires the TT mountings unique linear (compression / extension) stiffness to maintain the same high degree of isolation.

Specification

The stiffness ration from Vertical (Z) to Longitudinal (X) is selected such to minimize displacements of the installation and connected equipment in this direction, which for instance is beneficial for shaft seals. The thrust capacity per mount, related to the actual mount load (FZ) can be taken from the capacity curves. The height adjustable TT mountings are produced in a light-weight, seawater resistant aluminium and among others feature slotted / threaded holes to secure the mountings during transportation and, or alignment of the engine installation. The castings are designed such as to protect the interchangeable rubber inserts from contamination. The central threaded stud enables easy installation and in the case of a thrust transferring application of the TT mountings, the recommended tightening torques should be kept. The TT mountings have an integrated limiter which limits the displacements in the vertical direction to +3.1 and –11.5 mm for the TT1 mount. In the horizontal direction the TT1 mount is limited to + or –5 mm.
The standard rubber mix NR39 is available from 45° Sh.A up to 70° Sh.A and can be used up to 90° C continuous and 110° C peak temperature, furthermore it will ensure low creep values. The NR 11 mix is available in 45° to 75° Sh.A, which can be used up to 70° C continuous and 90° C peak temperature and will ensure higher load capacities. All TT mountings are marked with the rubber hardness derived from the individual stiffness test on one side of the top casting.

Selection

The mount selection for a Thrust and Torque transferring propulsion installation can generally be made according to the following guidelines and is based solely on mount loads. The selection made according to these guidelines will prevent overloading of the mountings.

1) Calculate the vertical (Z) static load per mount position.

2) Select mount type (1,2 or 3) and rubber hardness, not exceeding initial static load limit in the appropriate load / deflection graph.

3) Calculate the additional torque forces (+ and –) in the full load situation per mount position.

4) Add the load per mount as found under 1 with the torque forces per mount as found under 3. Check the calculated maximum and minimum vertical load points on the initial chosen load deflection curves to be within the allowed deflection range.

5) Determine the maximum thrust loads from the appropriate graph, based on the maximum and minimum vertical load and rubber mix.

6) Determine the total horizontal (X) thrust load for the installation and check against the total maximum thrust load of all mountings together. Select a different rubber hardness if required.

The analysis of the disturbing – versus natural frequencies of the mounting system should confirm the mount selection.

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Propulsion Equipment

TT-Mounting type 1

TT1

	Initial load limit [N]	Max. Vertical load [N]		Max. Thrust load [N]
	at 4mm vertical compression (-) (static load)	Compresion (-)	Tensile (+)	
45°Sh.A	4000	8000	3000	15000
50°Sh.A	5000	10000	3750	18500
55°Sh.A	5750	11000	4250	20750
60°Sh.A	6750	13500	5000	22000
65°Sh.A	9250	18250	7000	27500
70°Sh.A	13250	26750	10000	29750
75°Sh.A	25000	50000	18750	38000

CHARACTERISTICS

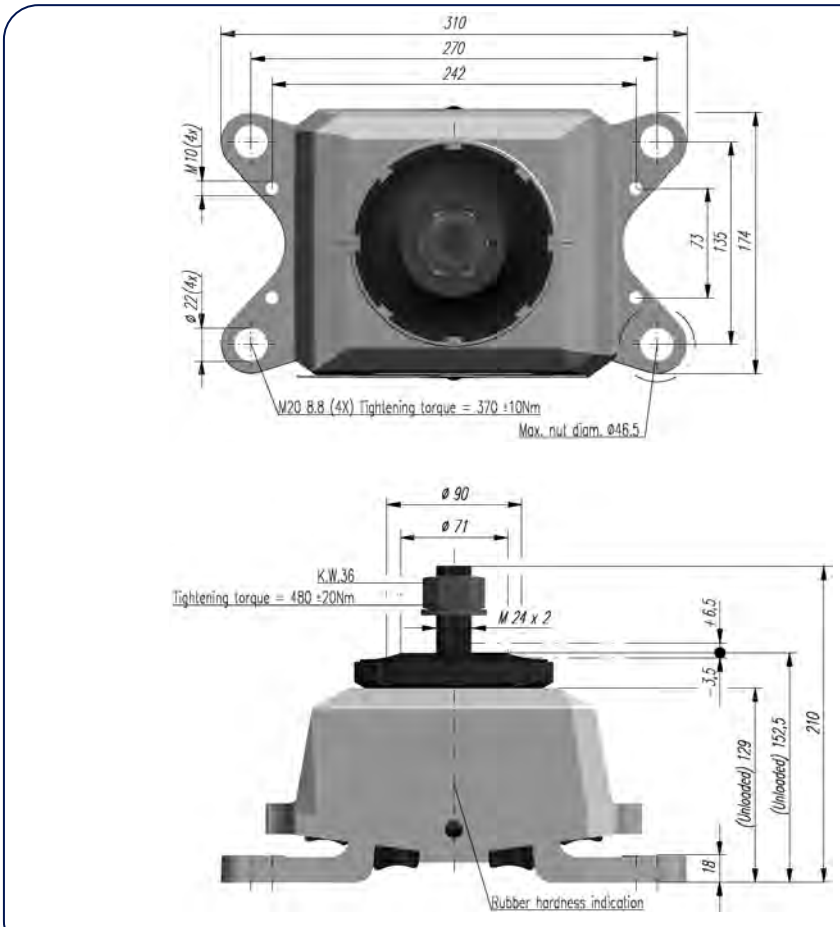
	Direction	Vertical up (+)	Vertical down (-)
Displacement limiter clearance [mm]		3,1	11,5

Vertical clearance at unloaded condition

CLEARANCE

	Direction	Fz +	Fz -	Fy + or -	Fx + or -
Max Shockload (kN)		75	200	60	85

SHOCKLOADS



DIMENSIONS

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DOCUMENTATION SHEET

Propulsion Equipment

TT-Mounting type 3

TT3

	Initial load limit [N] at 4mm vertical compression (-) (static load)	Max. Vertical load [N] Compression (-)	Tensile (+)	Max. Thrust load [N]
45°Sh.A	2250	4000	2000	8500
50°Sh.A	2550	5500	2500	12000
55°Sh.A	3750	7250	3250	13500
60°Sh.A	4750	8750	4500	15500
65°Sh.A	6000	12500	6000	17750
70°Sh.A	8500	18000	9000	19000

CHARACTERISTICS

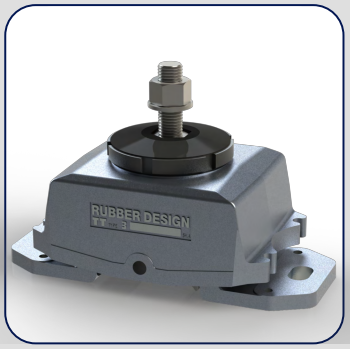
Direction	Vertical up (+)	Vertical down (-)
Displacement limiter clearance [mm]	3,3	9,0

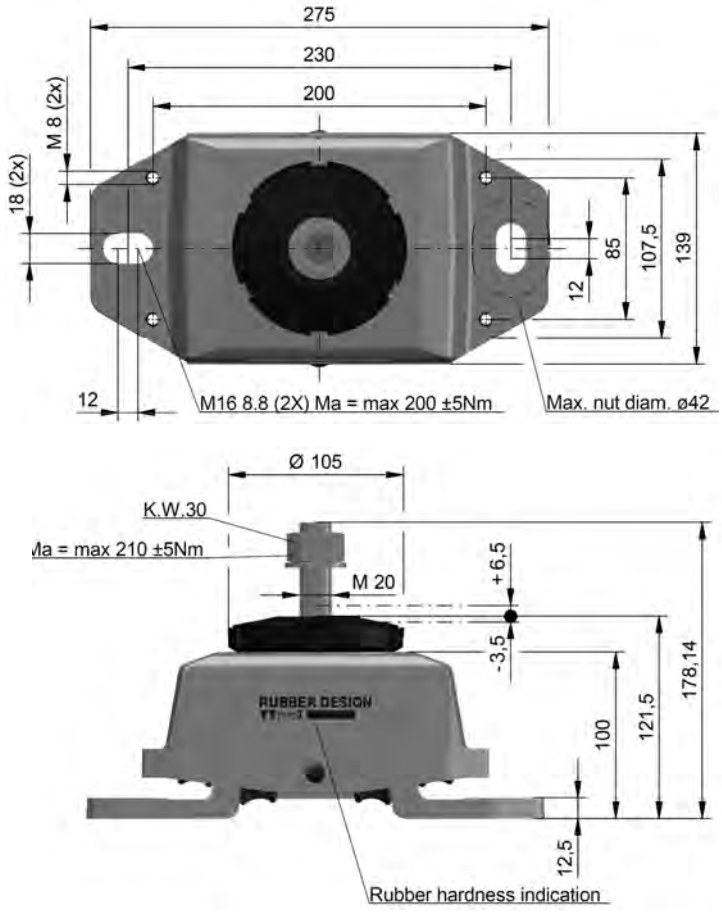
Vertical clearance at unloaded condition

CLEARANCE

Direction	Fz +	Fz -	Fy + or -	Fx + or -
Max Shockload (kN)	50	200	40	65

SHOCKLOADS





DIMENSIONS

DOCUMENTATION SHEET

Propulsion Equipment

TT-Mounting type 2

TT2

	Initial load limit [N]	Max. Vertical load [N]		Max. Thrust load [N]
	at 2mm vertical compression (-) (static load)	Compresion (-)	Tensile (+)	
45°Sh.A	1000	1750	1250	5000
50°Sh.A	1250	2500	1750	6250
55°Sh.A	1500	3000	2250	7000
60°Sh.A	2000	3750	2750	7000
65°Sh.A	3000	5750	4250	9000
70°Sh.A	3750	7500	5500	10000
75°Sh.A	5250	10500	7750	14250

CHARACTERISTICS

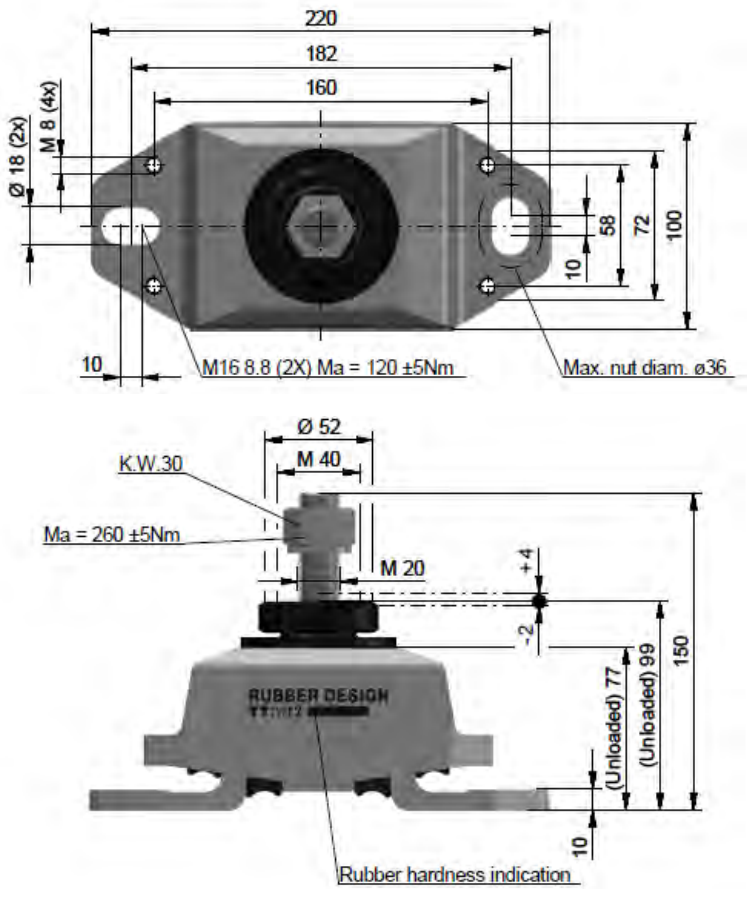
Direction	Vertical up (+)	Vertical down (-)
Displacement limiter clearance [mm]	3,3	7,3

Vertical clearance at unloaded condition

CLEARANCE

Direction	Fz +	Fz -	Fy + or -	Fx + or -
Max Shockload (kN)	25	200	20	50

SHOCKLOADS



DIMENSIONS

DOCUMENTATION SHEET

Propulsion Equipment
Gearbox mounting

PROPULSION EQUIPMENT

General

TG（Torque Gearbox）or so called Semi Elastic suspensions were designed specially for free standing gearboxes and/or close coupled high speed engines/gearboxes where the mountings have to absorb the torque reaction in combination with full propeller thrust. The TG mountings provides sufficient load capacity combined with long service life. Although originally designed for gearboxes and close coupled engines/gearboxes mounting arrangements are particularly versatile and can be used for many other applications.

Specification

The characteristics of the TG mountings are provided by inner and outer precision metal sleeves, which are strongly bonded together by vulcanization between rubber and metal surfaces. The TG mountings damp radial and axial vibrations and withstand torsion and cardanic deflection. Load ranges up to 85 kN each mounting. The rubber elements are manufactured standard in two ‘standard’ rubber mixes: 50NR11, 60NR11. Applicable up to 70°C continuous and 90°C peak temperatures.

Mounting selection

The selection chart is ideal for initial selection; however, it is advisable to seek expert advise before finalizing an installation design. Rubber Design is eager to support you by making 6 degrees of freedom calculations as a service, to ensure a proper functioning resilient mounting system.

Engineering

More detailed drawings and installation instructions, as well as specific mounting versions with alternative connection dimensions, tailored to your needs, can be provided upon request

Remarks

It is our intention to maintain the excellent standard of our products. Modifications and improvements may be made from time to time and it is therefore advisable to contact us before ordering against the specifications given in this booklet.

Specials

Besides the single TG mounting, there is also a double and triple or more bush versions.

DOCUMENTATION SHEET

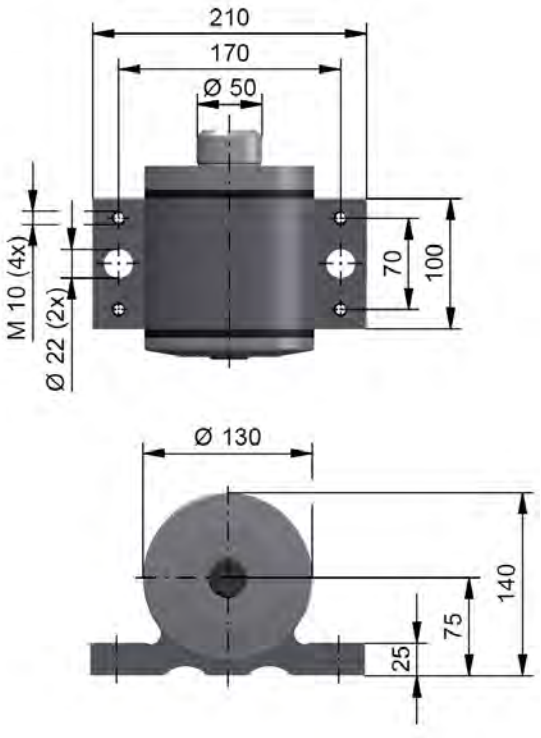
Propulsion Equipment
Gearbox mounting

GEARBOX MOUNTING

	Hardness [°Sh. A]	Max. load [kN]	Max static defl. [mm]
TG095	60	85	0,9
TG095	50	58	0,9
TG360	60	42	1,7

CHARACTERISTICS

SPECIALS



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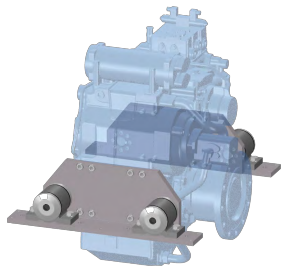
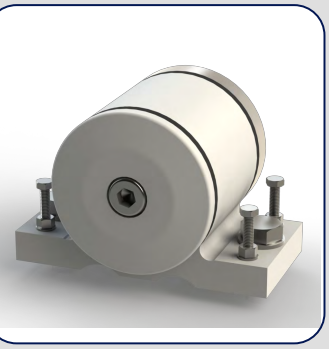




DOCUMENTATION SHEET

Propulsion Equipment
Thrust bearing

PROPULSION EQUIPMENT

General thrust bearing

Rubber Design has developed a compact range of thrust blocks (or thrust bearings) in combination with their ERD Marine Couplings for high performance operation in ships and yachts.
The advantage of using a thrust lock is that the propeller thrust load is not taken by the engine -gearbox, this enables an optimized flexible mounting system of engine-gearbox to be used. This gives the best results for vibration isolation and reduction of structure borne noise from engine-gearbox to the foundation (hull of the ship).

Specification

To obtain the best results in the reduction of structure borne noise, the thrust block has a further option to be flexible mounted with a minimum deflection in the longitudinal direction.
An advantage of using the ERD marine coupling is that torsional vibrations and noise transmission from the engine-gearbox to the thrust block will be reduced. The thrust block a can be equipped with a additional cooling module to ensure optimum service temperature.

Engineering

During assembly the thrust shaft is accurately aligned and fixed with transit bolts before dispatch to the customer.
CAD drawings (2D/3D) of the thrust blocks and ERD marine couplings are available in different formats so that this geometry can be easily imported into the CAD drawing of the complete propeller shaft installation. All thrust blocks and ERD marine couplings can be delivered with the required classification approval.

DOCUMENTATION SHEET

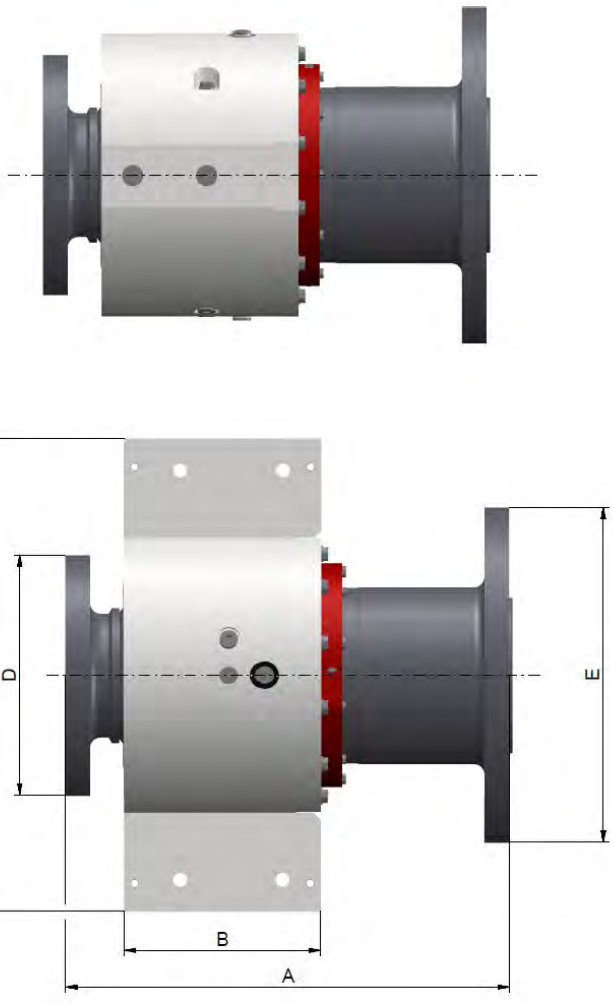
Propulsion Equipment

Type Thrust bearing

THRUST BEARING

	Dimensions					Max Thrust load	
	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	200 rpm [kN]	1200 rpm [kN]
SLB 1	381	186	421	200	Depends on coupling size	70,0	40,0
SLB 2	464	228	490	235		97,5	67,5
SLB 3	525	245	580	320		142,5	85,0
SLB 4	629	279	670	340		192,5	112,5
SLB 5	710	327	730	390		250,0	147,5
SLB 6	810	350	820	530		310,0	182,5
SLB 7	1080	440	1060	545		460,0	270,0

CHARACTERISTICS



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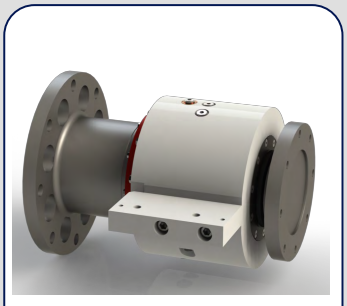


SLB Thrust bearing

DOCUMENTATION SHEET

Propulsion Equipment
Marine coupling

PROPULSION EQUIPMENT

General

Pre-compressed rubber blocks form the basis of all ERD coupling designs. The blocks accommodate movement in all directions, making ERD couplings exceptionally tolerant of relative propeller shaft displacements in combination with flexible mounted propulsion engine and providing controlled torsional vibration excitation.

Advantages of a ERD marine coupling

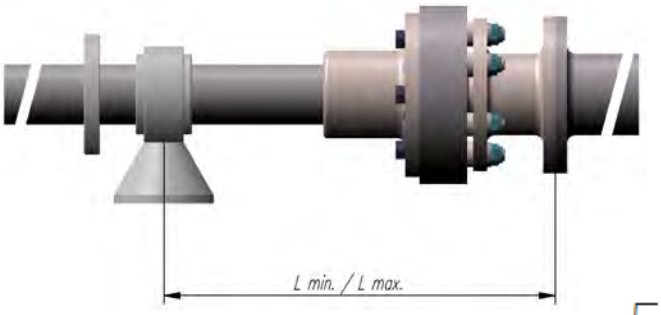
- Reduction of torque fluctuations
- Damping of torsional vibrations
- Reduction of resonance symptoms
- Compensating of radial, axial and angular shaft displacements
- Isolation of vibration and noise transmission

Specification

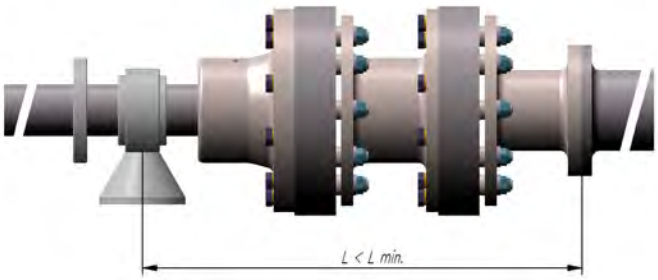
The ERD couplings are standard manufactured in steel and seawater resisting aluminum. Other materials e.g. non-magnetic stainless steel can be supplied if required. They can be supplied with or without propeller thrust capacity and will maintain drive in the event of damage occurring to the rubber elements. All ERD Marine Couplings can be supplied with an Adaptor flange or Adaptor shaft, to fit any available reduction gearboxes brand worldwide.
All types can be supplied in a "Single" or "Twin" unit configuration. In addition to the standard range, heavy duty and special couplings can be made to meet particular requirements .

Coupling selection, single or twin marine coupling?

When using a "Single" coupling, the free shaft end - the distance between the output flange of the reverse gear and the centre of the first propeller shaft bearing - must have a length between Lmin and Lmax (d=diameter propeller shaft [cm])



$$L_{min} = 20 \times (d - 0{,}9)\ [cm] \qquad L_{max} = 2900 \times \sqrt{\frac{d}{n}}\ [cm]$$



$$L_{min} = 20 \times (d - 0{,}9)\ [cm]$$

If the distance is less than the minimal required length a Twin (Cardanic) Coupling must be used, the first propellor shaft bearing should then be positioned directly behind the coupling. We advice you to contact our technical staff in doubtfull cases.
The technical data for the individual coupling sizes are listed in this catalogue.

DOCUMENTATION SHEET

Propulsion Equipment
Marine coupling

PROPULSION EQUIPMENT

Nominal torque TN

The nominal torque TN is the mean torque occuring in continuous service and calculated as follows:
PN - Nominal output in kW
nN - Nominal shaftspeed in min-1
TN - Nominal torque in kNm

Maximum torque TM

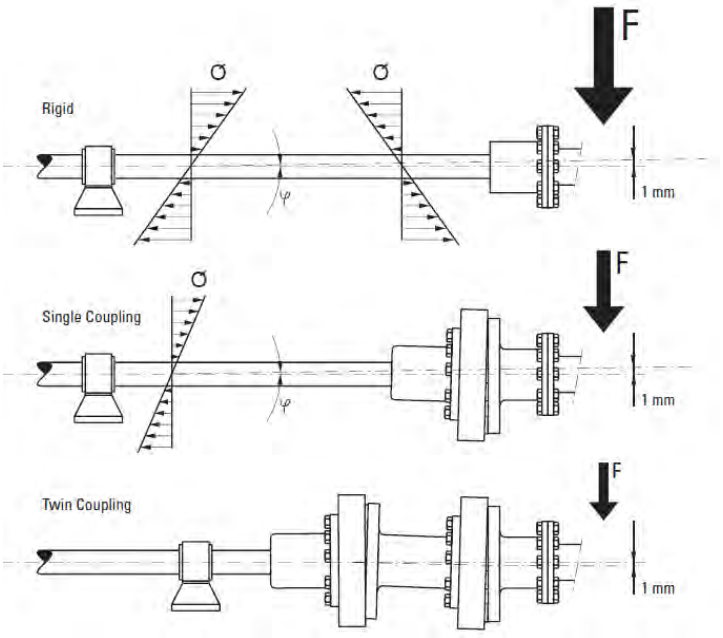
The maximum torque TM is the highest torque occuring during any normal drive condition, e.g. during starting, shock load, passing through criticals. For all applications a service factor must be taken into account. If a service factor greater than three is required, the initial selection should be made on the basis of the expected maximum torque.

Service factor for combustion engines

	Number of cylinders					
	<6			≥6		
	Engine RPM			Engine RPM		
	<1200	1200-1800	>1800	<1200	1200-1800	>1800
River Yachts	2,50	2,25	2,00	2,25	2,00	1,75
Small Workboats	2,75	2,50	2,25	2,50	2,25	2,00
Small Sea Yachts	2,75	2,50	2,25	2,50	2,25	2,00
Large Sea Yachts	3,00	2,75	2,50	2,75	2,50	2,25
Large Work Boats	3,50	3,25	3,00	3,25	3,00	2,75

CHARACTERISTICS

Function single or twin coupling compared to rigid



DOCUMENTATION SHEET

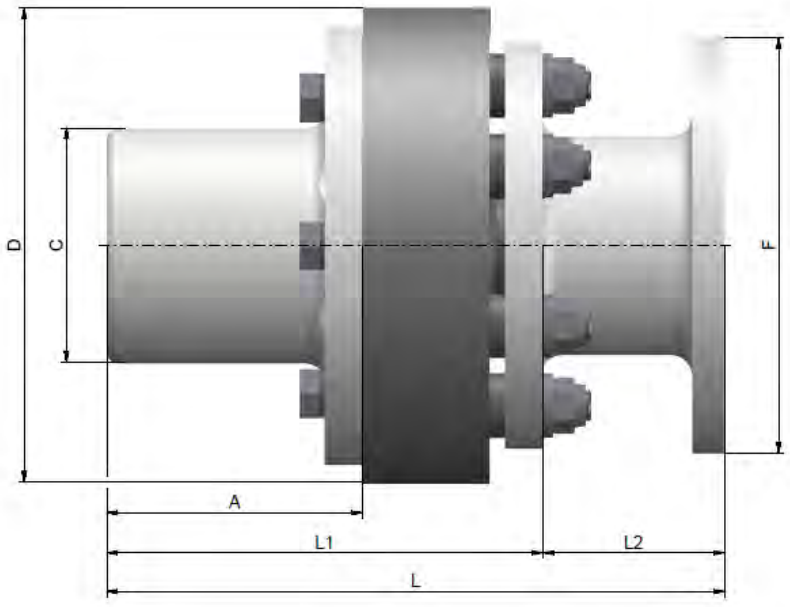
Propulsion Equipment

Type Single marine coupling

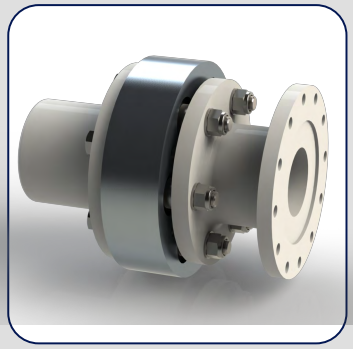
MARINE COUPLING

	Dimensions [mm]							Nominal torque	Max Torque	Max Thrust capacity	Max speed
	A	C	D	L1	L2	F	L	[kNm]	[kNm]	[kN]	[rpm]
ERD 102	100	90	220	194	To be determined	To be determined	L1 + L2	0,75	2,25	30	6000
ERD 103	115	105	245	209				1,25	3,75	30	5400
ERD 104	150	130	295	244				2,20	6,60	30	4500
ERD 105	160	145	345	254				3,35	10,05	60	3875
ERD 106	175	160	345	269				4,05	12,15	60	3875
ERD 107	180	170	370	333				5,60	16,90	90	3600
ERD 108	180	180	395	333				7,30	21,90	90	3300
ERD 109	235	200	445	388				11,20	33,60	90	3000
ERD 110	240	220	445	410				16,20	48,60	125	3000
ERD 111	245	240	490	415				24,50	73,50	125	2700
ERD 112	290	275	600	460				40,50	121,50	150	2200
ERD 113	295	335	685	470				60,47	181,40	n.a.	2000
ERD 114	350	375	825	530				88,20	264,60	n.a.	1800
ERD 115	Under construction							119,50	358,60	n.a.	1600

CHARACTERISTICS



EXAMPLE



DOCUMENTATION SHEET

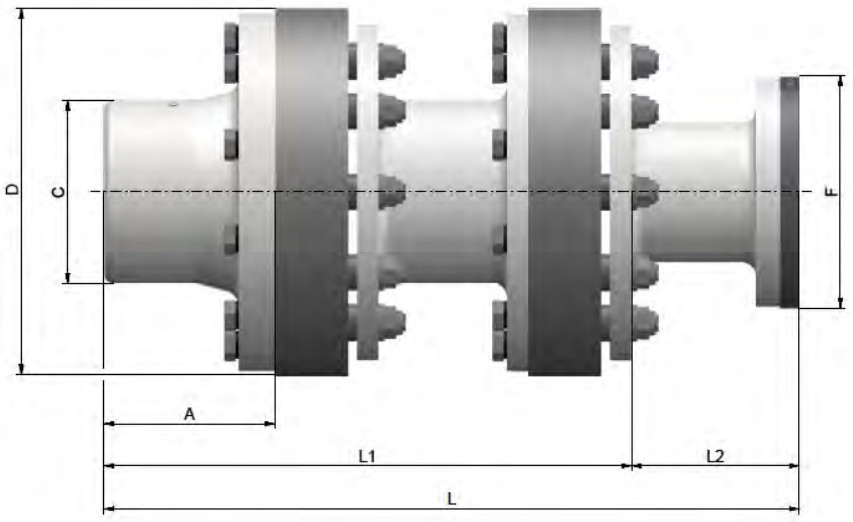
Propulsion Equipment

Type Twin marine coupling

MARINE COUPLING

	Dimensions [mm]							Nominal torque	Max Torque	Max Thrust capacity	Max speed
	A	C	D	L1	L2	F	L	[kNm]	[kNm]	[kN]	[rpm]
ERD 202	100	90	220	391	To be determined	To be determined	L1 + L2	0,75	2,25	n.a.	4500
ERD 203	115	105	245	416				1,25	3,75	n.a.	4050
ERD 204	150	130	295	461				2,20	6,60	n.a.	3375
ERD 205	160	145	345	481				3,35	10,05	n.a.	2900
ERD 206	175	160	345	506				4,05	12,15	n.a.	2900
ERD 207	180	170	370	630				5,60	16,90	n.a.	2700
ERD 208	180	180	395	681				7,30	21,90	n.a.	2475
ERD 209	235	200	445	741				11,2	33,60	n.a.	2250
ERD 210	240	220	445	860				16,2	48,60	n.a.	2250
ERD 211	245	240	490	870				24,5	73,50	n.a.	2025
ERD 212	290	275	600	875				40,5	121,50	n.a.	1650
ERD 213	295	335	685	1014				60,47	181,40	n.a.	1400
ERD 214	350	375	825	1075				88,20	264,60	n.a.	1200
ERD 215	Under construction							119,50	358,60	n.a.	1000

CHARACTERISTICS



EXAMPLE