GDAŃSK UNIVERSITY OF TECHNOLOGY

Faculty of Mechanical Engineering and Ship Technology

Institute of Naval Architecture and Ocean Engineering

GdańskTech Tribology Lab

2nd divison – „marine”

since 1998

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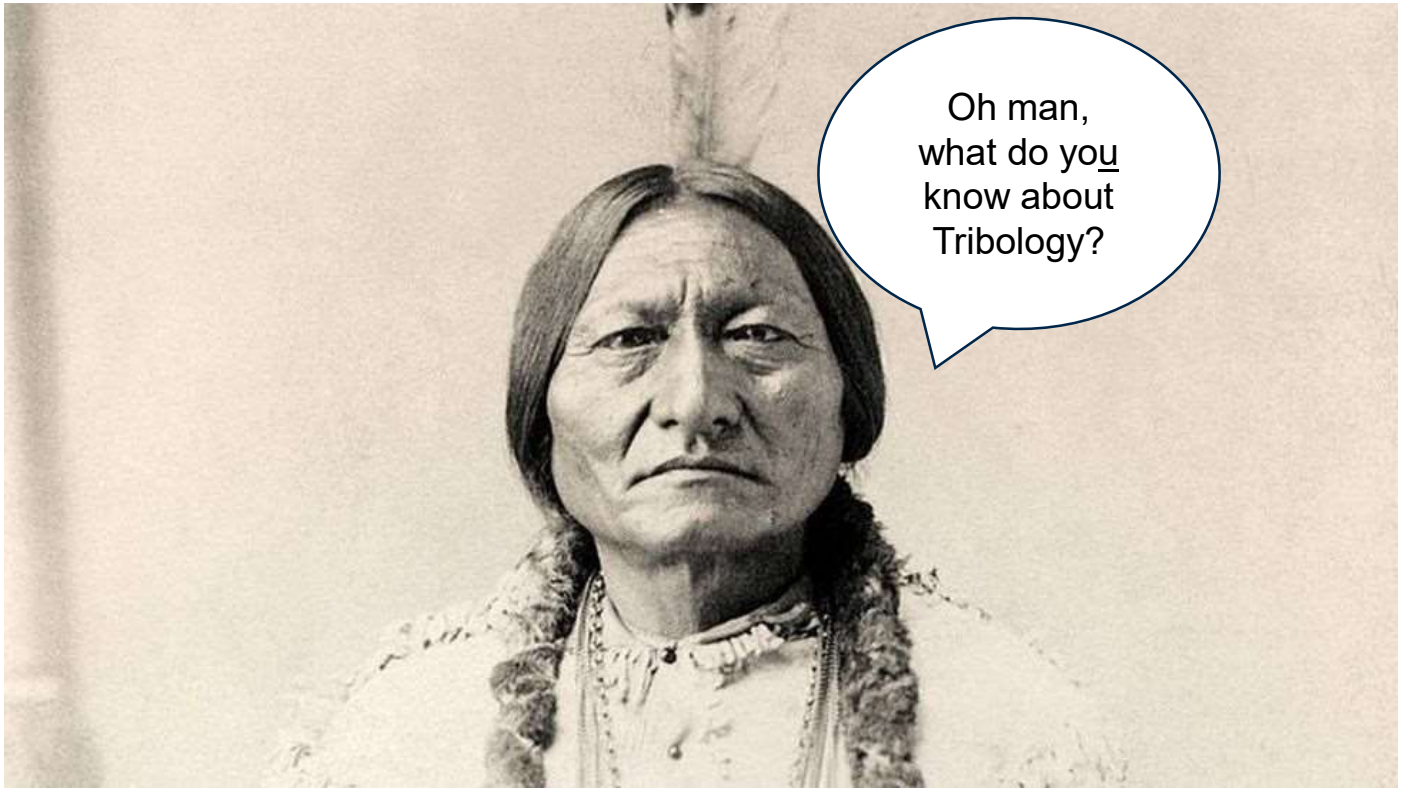
Tribology

Tribology is the science and engineering of interacting surfaces in relative motion. It includes the study and application of the principles of friction, lubrication and wear.



PERSONS

Michał Wasilczuk Professor
Head of the Department of Machine Design and Vehicles

https://mostwiedzy.pl/mwasilczuk

Wojciech Litwin Ph.D., D.Sc., Associate Professor
Head of the Department of Marine Mechatronics

https://mostwiedzy.pl/mlitwin

TRIBOLOGY ON MOST WIEDZY

https://mostwiedzy.pl/tribology

LINKS TO THE BUSINESS SERVICE POINT

Al. Zwycięstwa 27, 80-219 Gdańsk
tel.: +48 58 348 66 40
email: biznes@pg.edu.pl

MOST WIEDZY
mostwiedzy.pl

most@pg.edu.pl

European Funds Digital Poland

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European Union
European Regional Development Fund

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Early begings

Experimental tests of water lubricated bearings with installation-ready propeller shaft and stern tube in 2000 – just before installation on small fishing vessel

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Facility and five test rigs

- System of three multipurpose test rigs
- High power test rig
- Rudder bearings test rig

Our lab building was fully renovated in 2018

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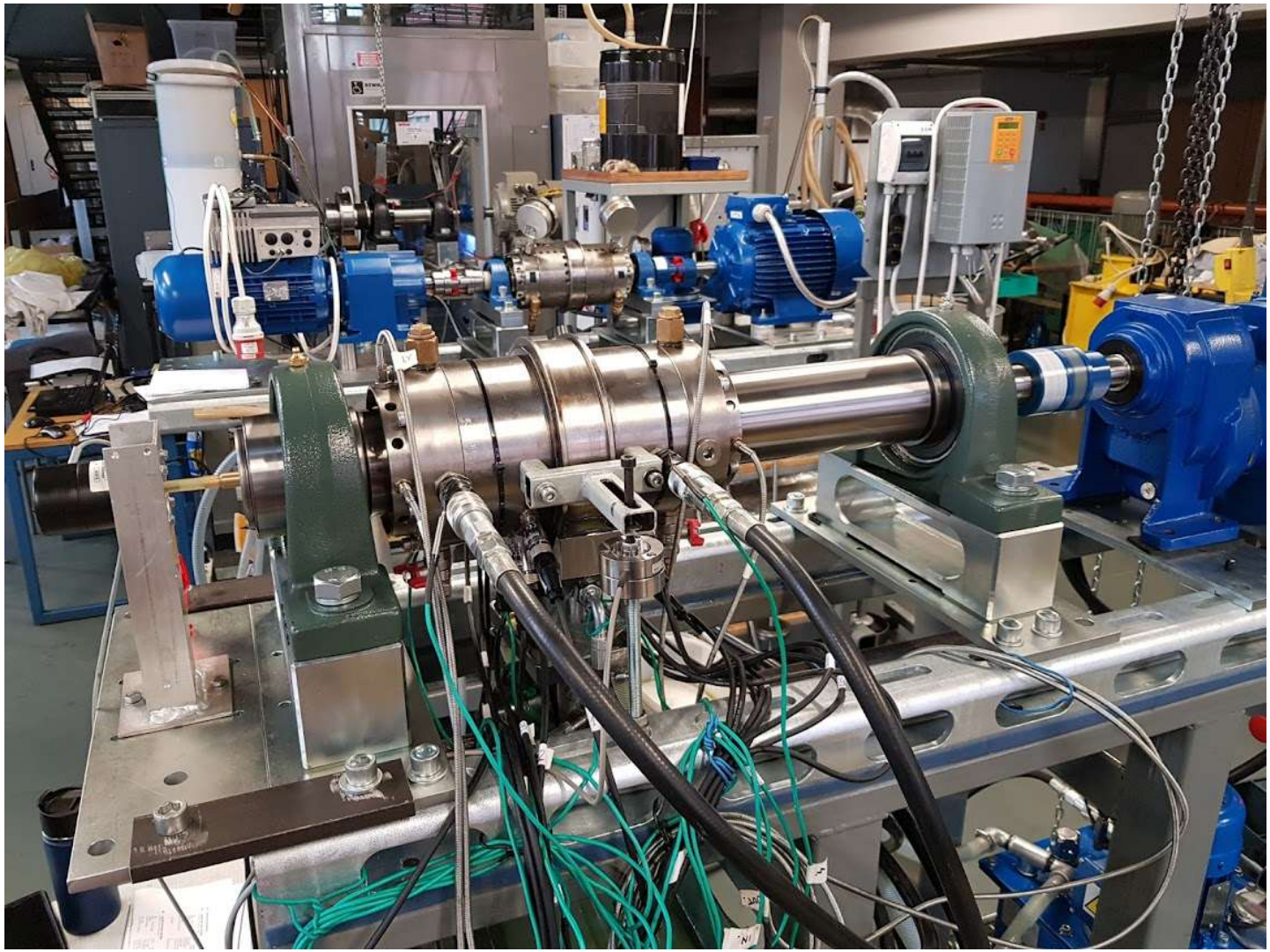
System of three multipurpose test rigs



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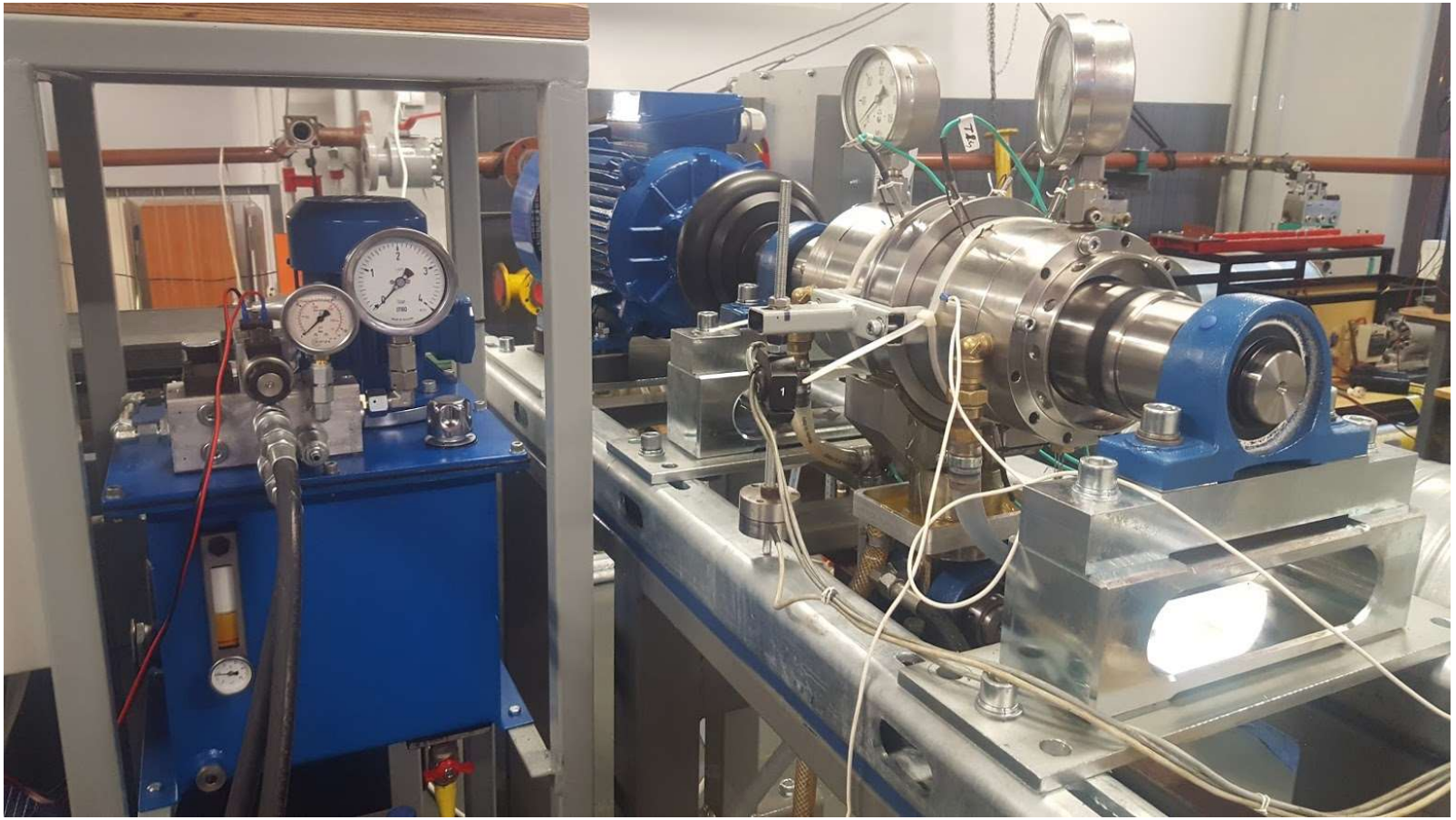
Bearings properties tests



Water lubricated bearings test rig, with possibility of testing water / bio / water base liquids
Shaft diameter 100 mm, bearing specific pressure up to 2 MPa, speed 0 ÷ 3000 rpm

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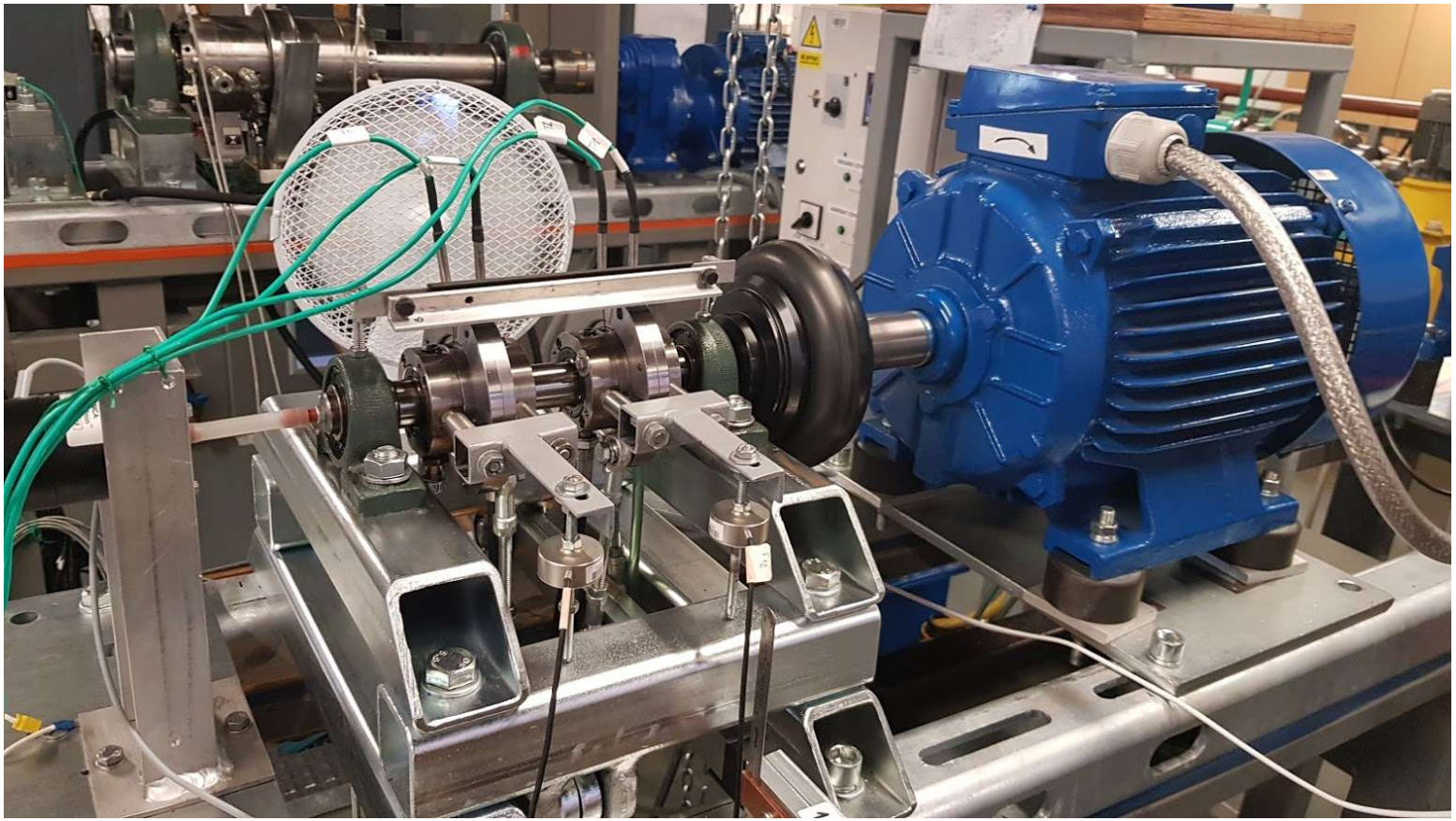
Wear tests



Long time wear tests – constant speed or start – stop cycle
EAL / water base liquids wear test
Shaft diameter 30 mm, bearing specific pressure up to 5 MPa, speed 0 – 3000 rpm

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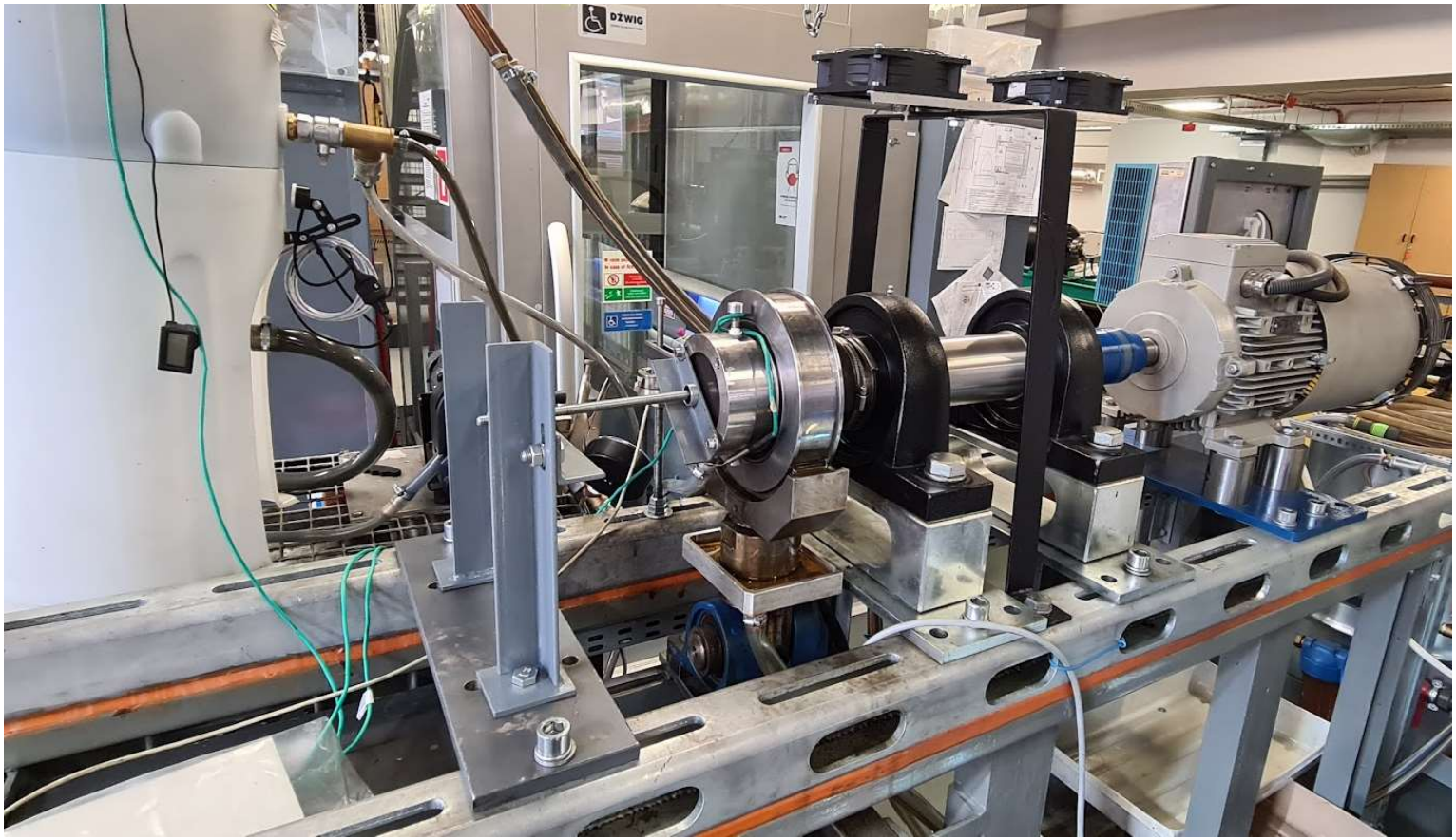
Wear tests – water with particles



Long time wear tests – constant speed or start – stop cycle
Contaminated lubrciant with particles
Shaft diameter 60 ÷ 70 mm, bearing specific pressure up to 2 MPa, speed 0 – 3000 rpm

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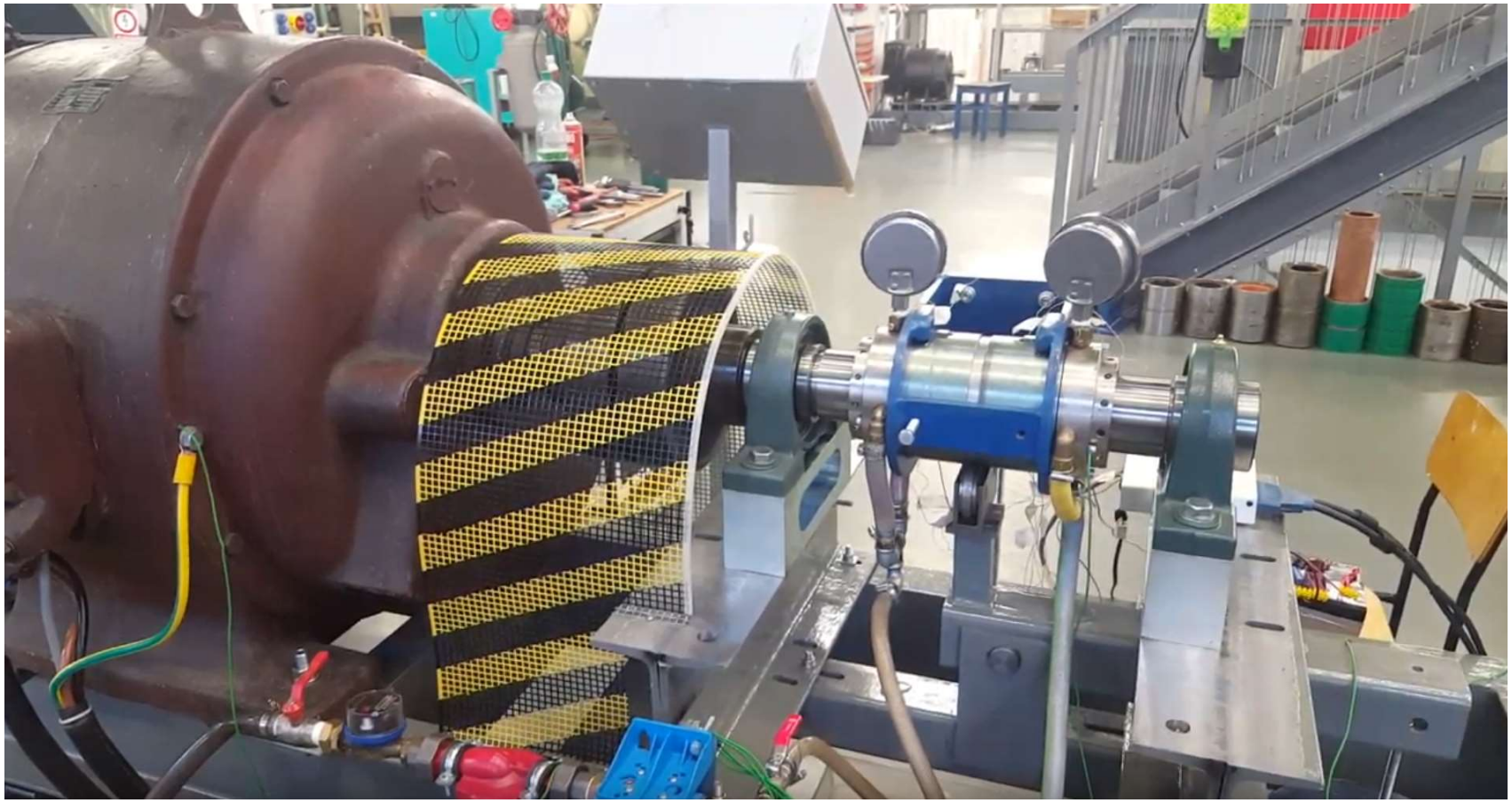
Destructive tests - lack of lubricant flow etc.



High power water lubricated bearings test rig (240kW), With possibility of testing bio / water base liquids, Shaft diameter 100 mm, bearing specific pressure up to 1 MPa, speed 0 – 12 rev/s

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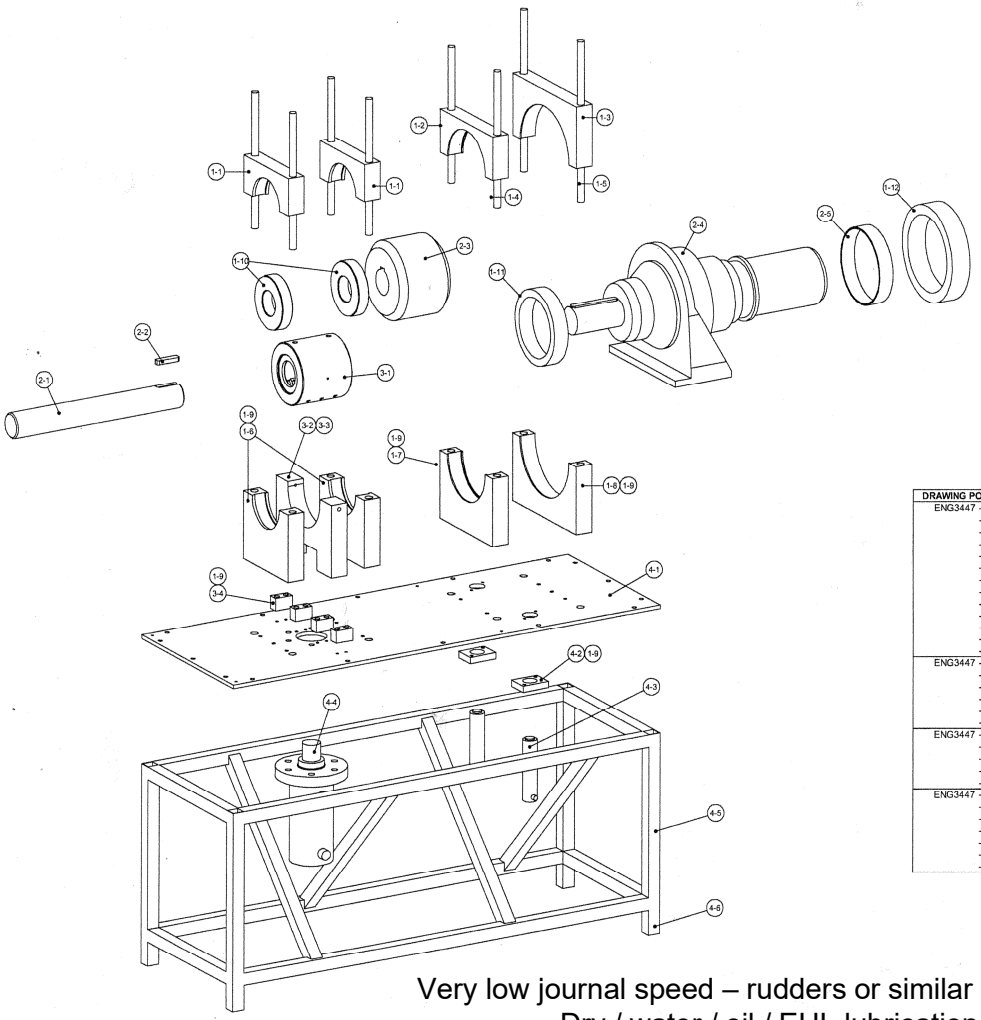
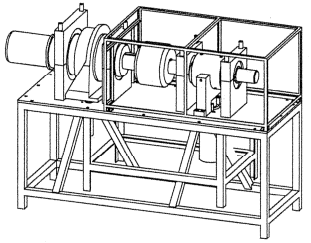
Rudder bearings



NOTES:

1. ALL DIMENSIONS IN MILLIMETRES
2. TOLERANCES, UNLESS OTHERWISE STATED.
   - LINEAR ±0.25
   - ANGULAR ±1°
3. ASSEMBLY: TABLE TOP TO BE BOLTED TO TABLE FRAME USING M16 NUTS AND BOLTS (HOLES TO BE DRILLED IN FRAME AT WÄRTSILÄ). HYDRAULIC RAMS TO BE SCREWED/BOLTED TO UNDERSIDE OF TABLE TOP. HOUSING CRADLE PADS TO BE SCREWED TO TABLE TOP. GEARBOX AND HOUSING ROLLER BEARING SUPPORT FRAMES TO BE LOOSELY SCREWED IN PLACE. GEARBOX SLEEVE TO BE HEATED UP AND PUSHED ONTO BACK END OF GEARBOX - ROLLER BEARINGS TO THEN BE SLID OVER SLEEVE AND TURNED DIAMETER AT THE FRONT END OF GEARBOX. GEARBOX WITH ROLLER BEARINGS FITTED TO BE PLACED INTO LOWER ROLLER BEARING SUPPORTS. UPPER SUPPORTS FOR GEARBOX ROLLER BEARINGS TO BE ADDED (M27 STUDBAR AND NUTS TO BE USED TO SECURE THEM). COUPLING TO BE ADDED TO END OF GEARBOX SHAFT.

SHAFT TO BE PLACED INSIDE OF HOUSING ASSEMBLY AND THE TWO ROLLER BEARINGS SLID INTO PLACE OVER SHAFT - THIS TO THEN BE PLACED ON TOP OF ROLLER BEARING LOWER SUPPORTS AND HOUSING CRADLE (ALREADY PLACED ONTO TABLE TOP). HOUSING TO BE SECURED TO HOUSING CRADLE USING M8 SCREWS. SHAFT TO BE COUPLED TO GEARBOX. ROLLER BEARING UPPER SUPPORTS TO BE ADDED TO ASSEMBLY AND SECURED USING M27 STUDBAR AND NUTS. SHAFT/GEARBOX/HOUSING ALIGNMENT TO BE CHECKED AND ONCE ACCEPTABLE SCREWS FROM UNDERSIDE OF TABLE TOP TO BE TIGHTENED, ONCE PROPERLY ALIGNED.



DRAWING POSn	DESCRIPTION	MATERIAL
ENG3447 -1	ROLLER BEARINGS AND SUPPORTS	EPOXY GLASS
-1-1	SMALL ROLLER BEARING SUPPORT UPPER - H95170	COMPOSITE
-1-2	MIDDLE ROLLER BEARING SUPPORT UPPER - H95172	COMPOSITE
-1-3	LARGE ROLLER BEARING SUPPORT UPPER - H95174	COMPOSITE
-1-4	STUDDING M27 x 550 LONG	STAINLESS STEEL
-1-5	STUDDING M27 x 650 LONG	STAINLESS STEEL
-1-6	SMALL ROLLER BEARING SUPPORT LOWER - H95169	COMPOSITE
-1-7	MIDDLE ROLLER BEARING SUPPORT LOWER - H95171	COMPOSITE
-1-8	LARGE ROLLER BEARING SUPPORT LOWER - H95173	COMPOSITE
-1-9	SOCKET SCREW M12 x 35 LONG	STAINLESS STEEL
-1-10	ROLLER BEARING - FAG 20320-MB	STAINLESS STEEL
-1-11	ROLLER BEARING - FAG NA4848	STAINLESS STEEL
-1-12	ROLLER BEARING - FAG NA4860	STAINLESS STEEL
ENG3447 -2	SHAFT ASSY	STAINLESS STEEL
-2-1	Ø100 SHAFT - H95184	STAINLESS STEEL
-2-2	SHAFT KEY - H95185	STAINLESS STEEL
-2-3	COUPLING - RENOLD C122BB K CHAINFLEX	
-2-4	GEARBOX - BONFIGLIONI 310 L4 FOR MOD SEE ENG3449	
-2-5	GEARBOX SLEEVE - H95183	COMPOSITE
ENG3447 -3	HOUSING ASSY	EPOXY GLASS
-3-1	HOUSING ASSY - ENG3448	COMPOSITE
-3-2	HOUSING CRADLE - H95179	STAINLESS STEEL
-3-3	SOCKET SCREW M8 x 30 LONG	STAINLESS STEEL
-3-4	HOUSING CRADLE PAD - H95180	COMPOSITE
ENG3447 -4	BASE	STEEL
-4-1	TABLE TOP - H95164	STEEL
-4-2	HYDRAULIC CYLINDER MOUNTING BLOCK "ENERPAC RB-10" SEE DRAWING ENG3450	STAINLESS STEEL
-4-3	HYDRAULIC CYLINDER ENERPAC RC-106	STEEL
-4-4	MAIN HYDRAULIC RAM	STAINLESS STEEL
-4-5	TABLE FRAME - H95165	STEEL
-4-6	TABLE FEET - RS 688-228 (M20, OD: 160)	

1ST ANGLE:	ACCESS CODE: -1	OWNER: -	YARD: -	CUSTOMER: -
WÄRTSILÄ	VESSEL NAME: -	USED ON: -	REF/FUNC. LOC.: -	
	DRAWN BY: R. STINCKLAND	CHECKED BY: G. SPILLER	MAX. MASS: 0,0 kg	
	DRAWN DATE: 28 Sep 2012	DATE REVISED: -	SHEET: 1 OF 1	
Wärtsilä UK Ltd., 4, Marples Way, Havant, Hampshire, PO9 1NX, UK	SEAL CODE/BASED ON: -			
The information contained in this document is the property of Wärtsilä UK Ltd and must not be disclosed without written consent. Title or information is neither sold or transferred and document is subject to return upon demand. Values in the document are not binding. Right of alteration reserved. © 2012 Registered Number: 1004616 Registered Office: Wärtsilä UK Ltd, Havant, Hampshire, UK	TITLE: SLOUGH RUDDER BEARING TEST RIG - GENERAL ASSEMBLY			
	SIZE: A1	DRAWING NUMBER: ENG3447		REV: 1

Very low journal speed – rudders or similar application
Dry / water / oil / EHL lubrication

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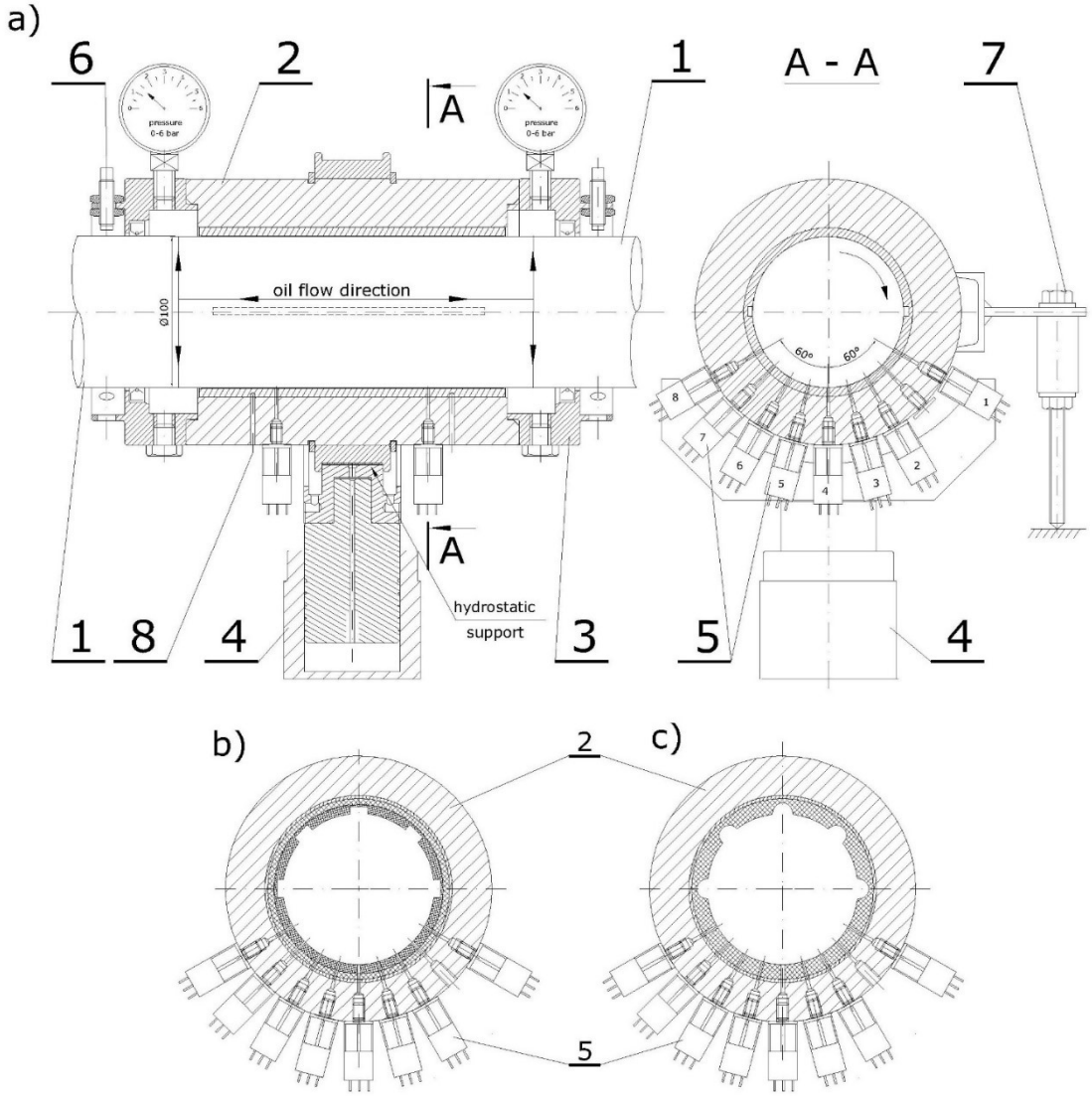
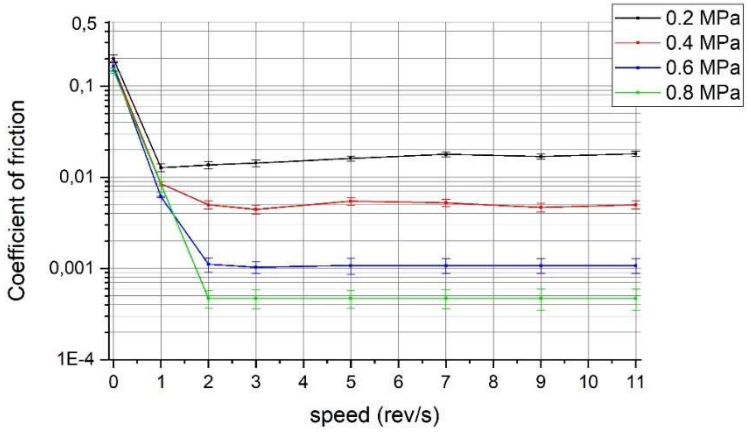
EXAMPLE 1: Friction measurements



- Precise friction measurements possible thanks to hydrostatic support
- Measurements of lip seal friction for precise measurements



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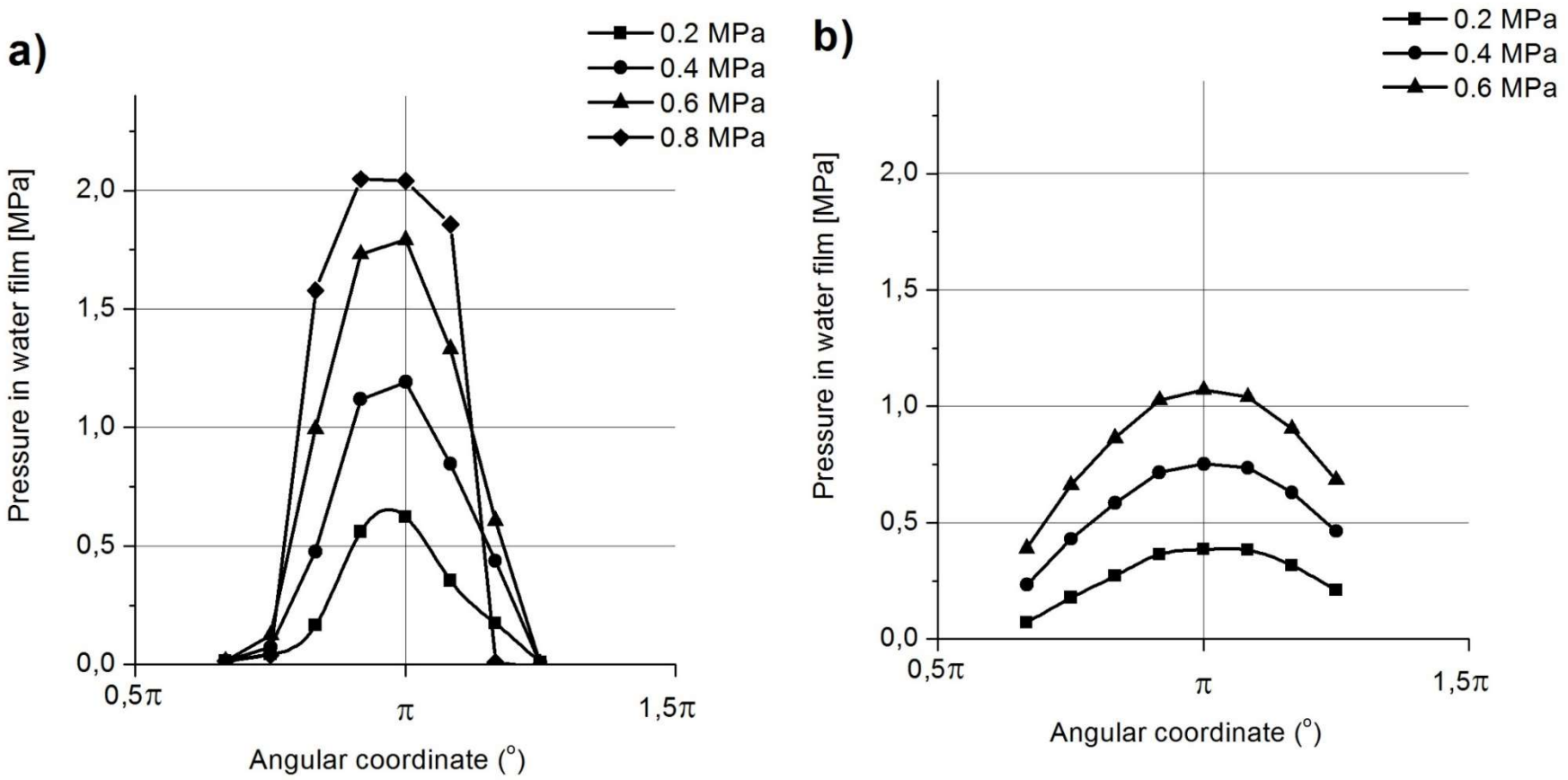
EXAMPLE 2: Measured hydrodynamic pressure distribution



The same operational conditions – stiff vs. elastic bearing bush

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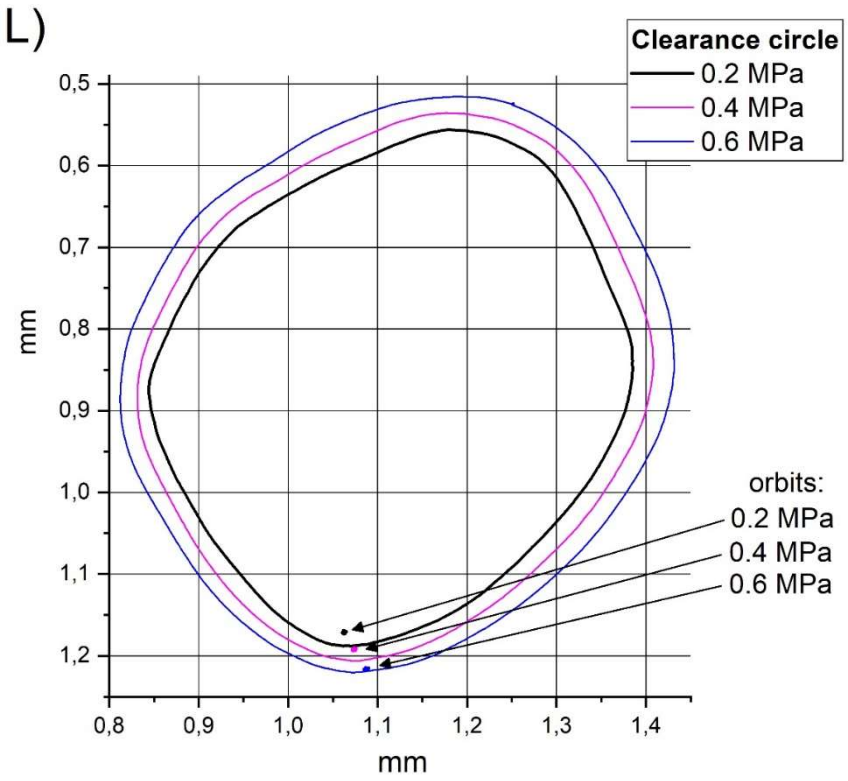
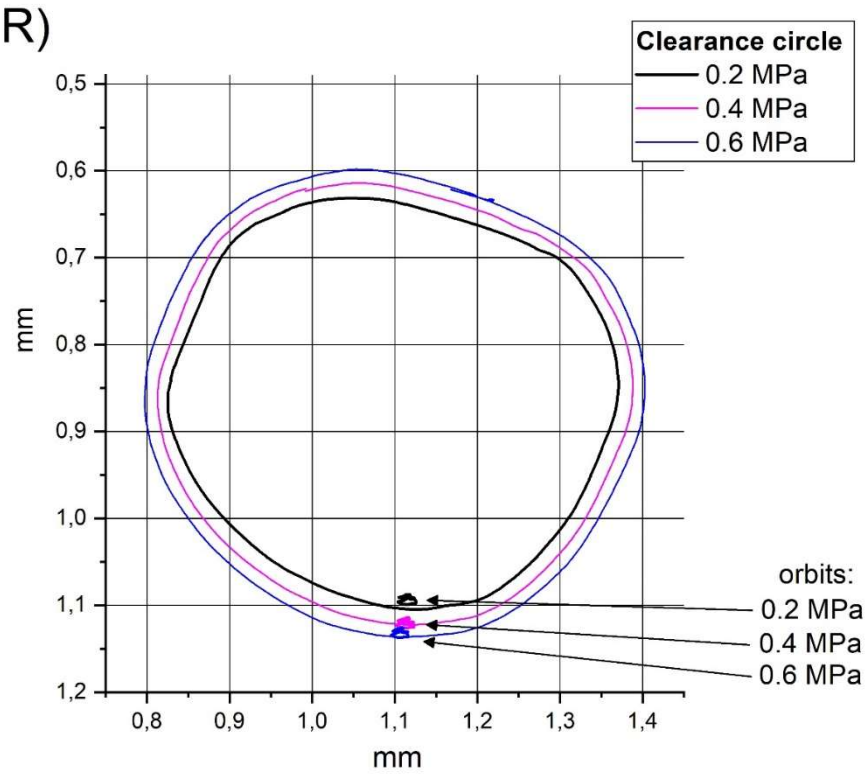
EXAMPLE 3: Shaft orbits and clearance circles – unique possibity of film thicknes estimation





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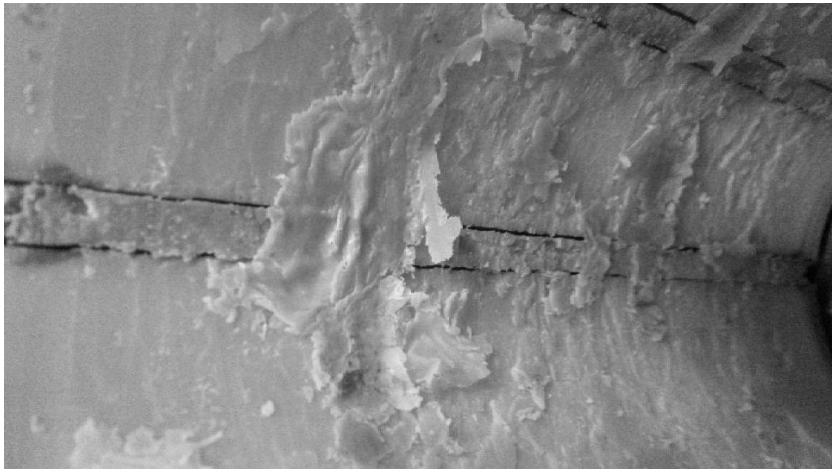
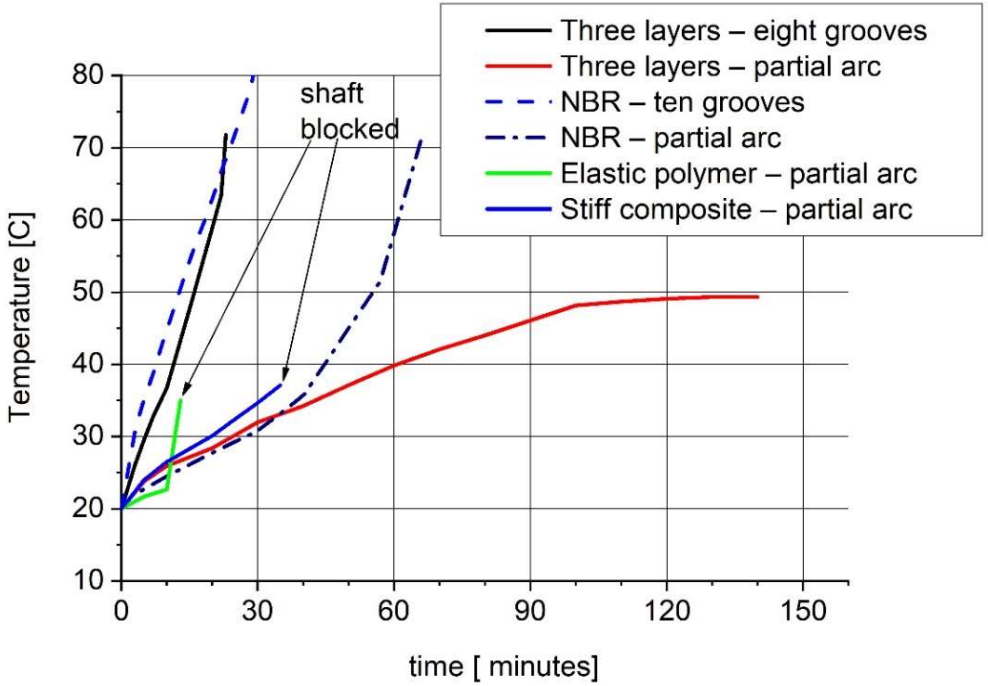
EXAMPLE 4: INSUFFICIENT LUBRICATION – lack of flow or others





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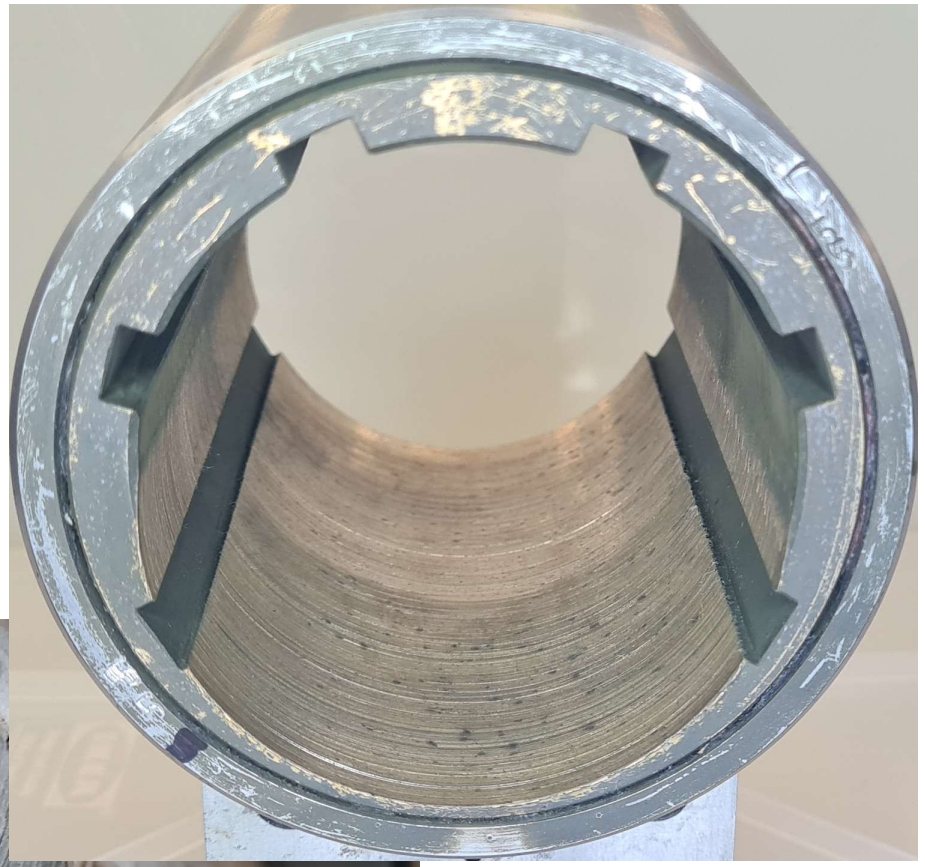
EXAMPLE 5: Bearing bush wear measurements



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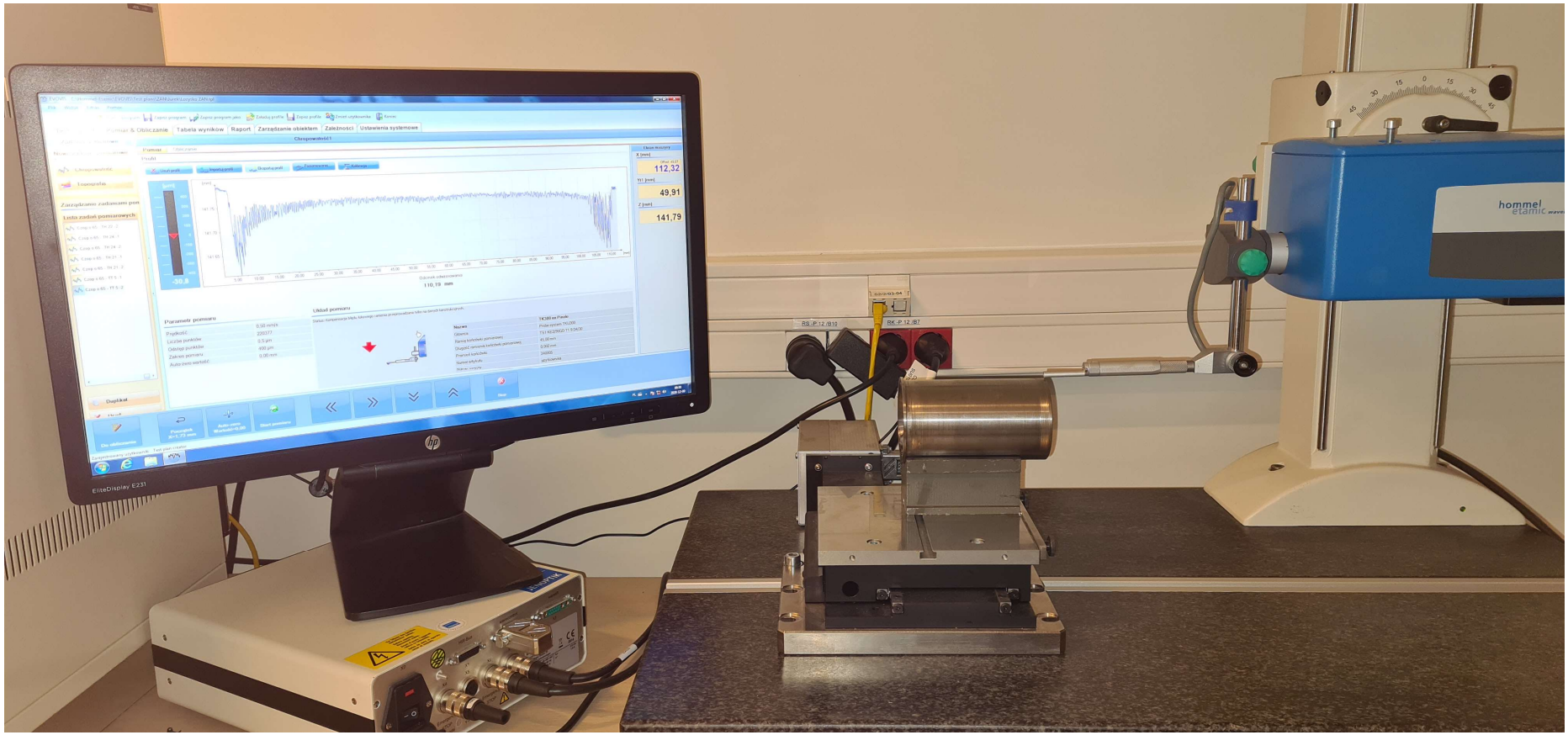
EXAMPLE 5: Shaft wear measurements



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International cooperation

TU Delft

ISA | RWTH AACHEN UNIVERSITY

Lignum-Vitae
Water Lubricated Bearings

AEGIR Marine

MIKASA

acm
COMPOSITE
BEARINGS

DEVA & FederalMogul

KEMEL

KLÜBER
LUBRICATION

TENNECO

THORDON
THORDON BEARINGS INC.

WÄRTSILÄ

TENMAT

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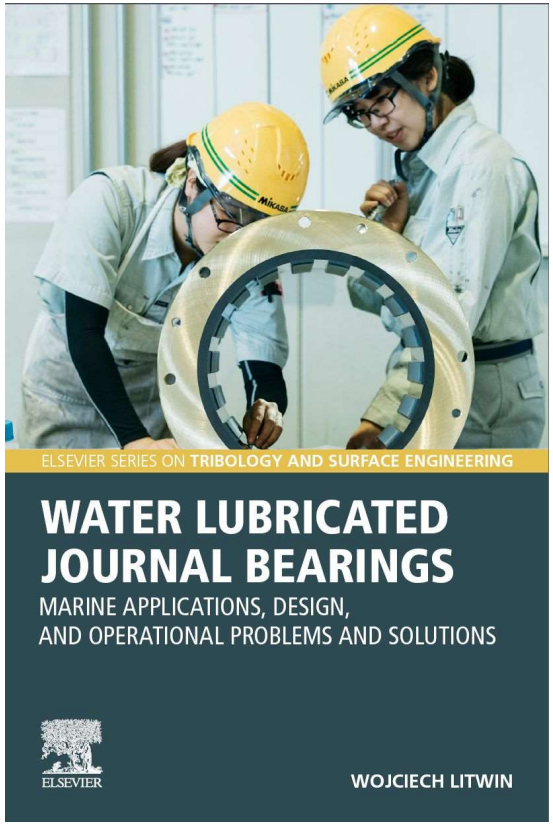
Results of scientyfic work

Publications in high rank scientyfic journals like: Wear, Tribology International, Tribology Transactions

Papers published in 2023:

- “Experimental comparison of the transition speed of a hydrodynamic journal bearing lubricated with oil and magnetorheological fluid”, Tribology International, vol. 189, 2023r
- “Environmentally acceptable lubricants (EAL) compared with a reference mineral oil as marine stern tube bearing lubricant – Experimental and theoretical investigations”, Tribology International, vol. 189, nr. 11, 2023r
- “Sliding bearings with sintered bronze bush lubricated by contaminated water with solid particles – Theoretical and experimental studies”, Wear, nr. 11, 2023r
- “Comparative wear test of journal sliding bearings with sintered bronze and Babbitt alloy bushes lubricated by environmentally acceptable/adapted lubricants (EAL)”, Tribology Transactions, vol. 66, nr 3, 2023r.
- “The influence of polymer bearing material and lubricating grooves layout on wear of journal bearings lubricated with contaminated water”, Tribology International, vol. 179, 2023r.



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