ATN Tagung, Bad Sachsa, 17. Februar 2016

TTZH

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Seit 2004

3 Business Areas

Tribotechnology	*Triboanalysis*	*Tribomaterials*
PVD coating technology LST – laser surface texturing	Tribotesting Grease testing Structure analysis Elemental analysis Phase analysis Mechanical characterisation Surface characterisation	Ceramics Tungsten carbide PVD coating materials Lubes and greases

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PVD Coating Technology. Equipment

S 2.2

PVD Coating Center, incl. technology, main and peripheral equipment and all required infrastructure for implementation of TTZH coating services in industry. PVD equipment enables deposition of high performance metallurgical coatings, such as titanium nitride TiN, titanium carbo-nitride Ti(C,N) and aluminium titanium nitride AlTiN, aluminium chromium nitride AlCrN, Si — doped coatings TiSiN, AlTiSiN, AlCrSiN, AlTiCrSiN, solid lubricants, etc. for various tribology applications.

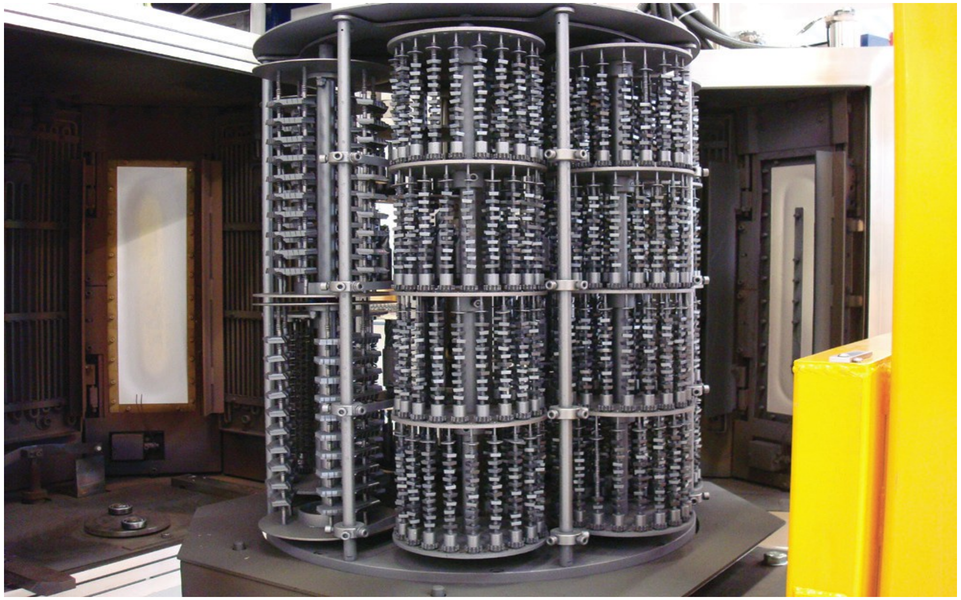
M 3.2

The coatings are evaporated onto a variety of cutting tools, dies and moulds, wear components and consumer products made of high speed steel, tungsten carbide and other materials for a temperature range between 180°C up to 500° C. Hybrid PVD technologies and equipment involve cathodic arc evaporation, magnetron sputtering and HIPIMS.

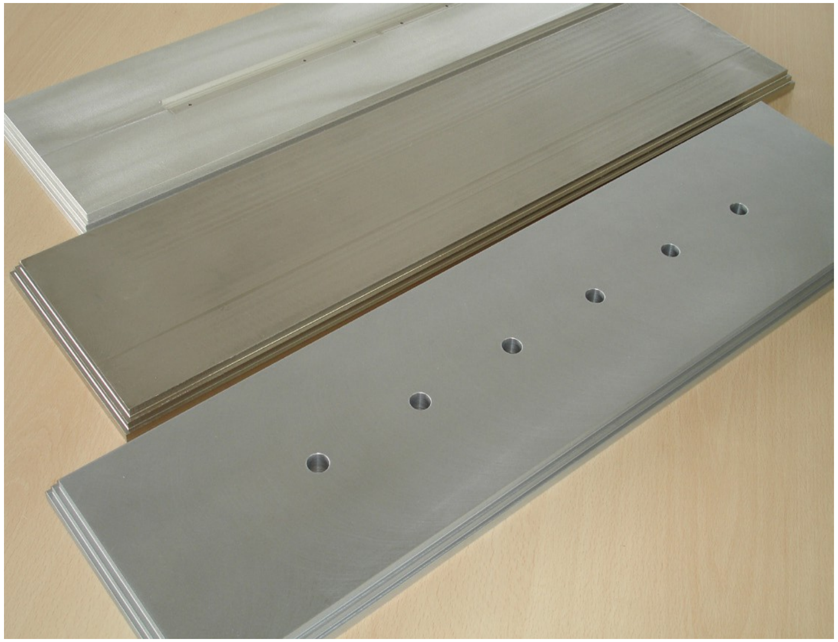
M 4.3

Quelle: PVT

PVD Coating Technology



Rotary platform with two large area arc evaporators



Large area metal and alloy targets for arc evaporator

Quelle: PVT

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Cathodes, Targets, Components

Chromium and alloys (99.9 – 99.995)

Cr-2Ta, Cr-0.2Ti-0.3V-1Y, Cr-2.5Ti-0.5Zr, Cr-0.2Zr-1Y, Cr-32Ni-1.5W-0.3Ti-0.3V, Cr/Al (Al44Cr56 and Al67Cr33), Cr/Co, Cr/Cu, Cr/Fe, Cr/Ga, Cr/Gd, Cr/Ge, Cr/Hf, Cr/Ir, Cr/Mn, Cr/Mo, Cr/Nb, Cr/Ni, Cr/Pd, Cr/Pt, Cr/Re, Cr/Ru, Cr/Ta, Cr/Ti, Cr/V, Cr/Y, Cr/Zr

Molybdenum and alloys (99.9 - 99.999)

Mo-0.5Ti, Mo-1Ti-0.3Zr(TZC), Mo-0.5Ti-0.1Zr(TZM), Mo-1.2Hf(MHC), Mo-1.5Hf-0.5Zr-0.2C(ZHM), Mo-30W, Mo-25W-1Hf(HWM-25), Mo-1Ti-0.6Zr-1.5Nb, Mo-5Re, Mo-41.5Re, Mo-47.5Re, Mo/Re/W, Mo/Co, Mo/Cr, Mo/Fe, Mo/Hf, MoLa, Mo/Ni, Mo/Pt, Mo/Re, Mo/Ta, Mo/Ti, Mo/V, Mo/Zr

Tungsten and alloys (99.9 – 99.999)

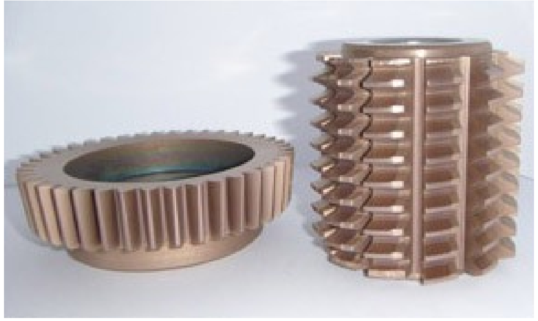
Doped AKS Tungsten, W-(1-2)ThO2, W-15Mo, W-3Re, W-4Re-0.5Hf, W-25Re, W-25Re-30Mo, W-35Mo-15Ta-15V, W/Co, W/Fe, W/Hf, W/Mo, W/Nb, W/Ni, W/Os, W/Ru, W/Ta, W/Ti, W/Zr, W/Mo/Re, W/Mo/Hf/Re, W/Ta/Re

PVD Coating Technology. Some Applications

Rotary platform

Al-based coatings

Cr-based coatings



Si-doped coatings

Quelle: PVT

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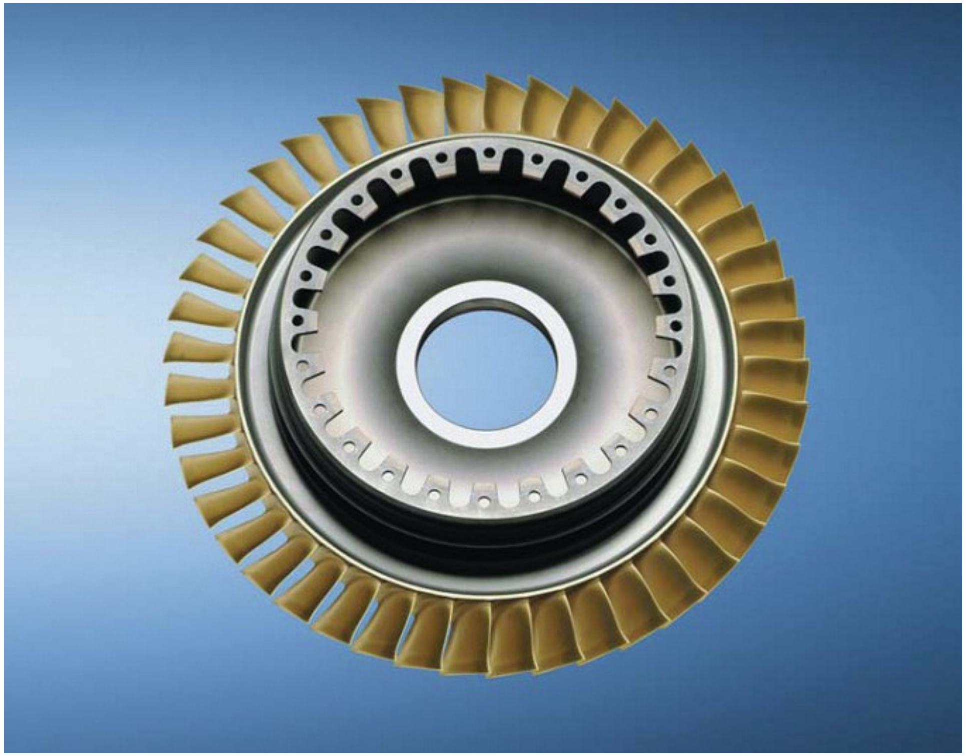
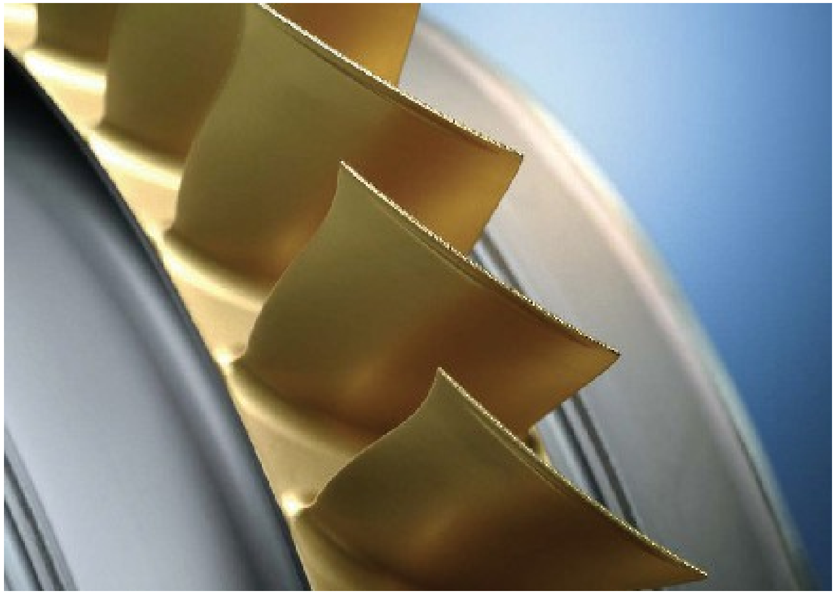
PVD Coating Technology. Some Applications

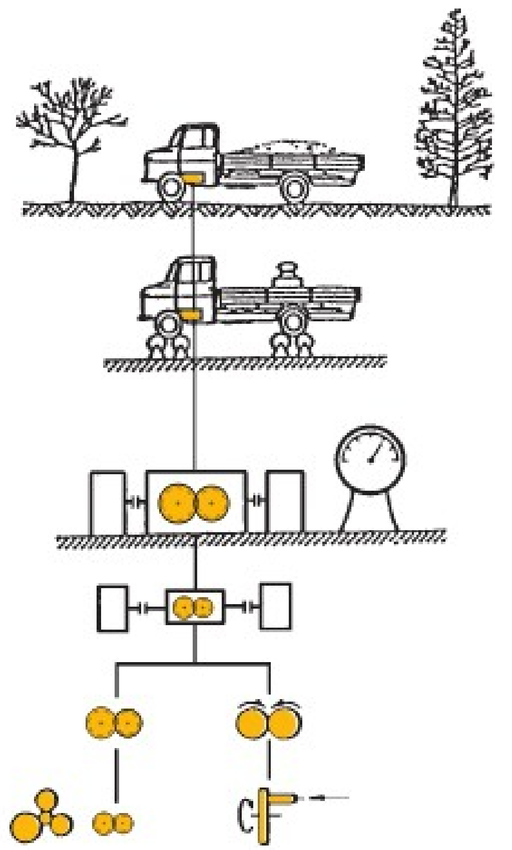




PVD multilayer coated jet engine components

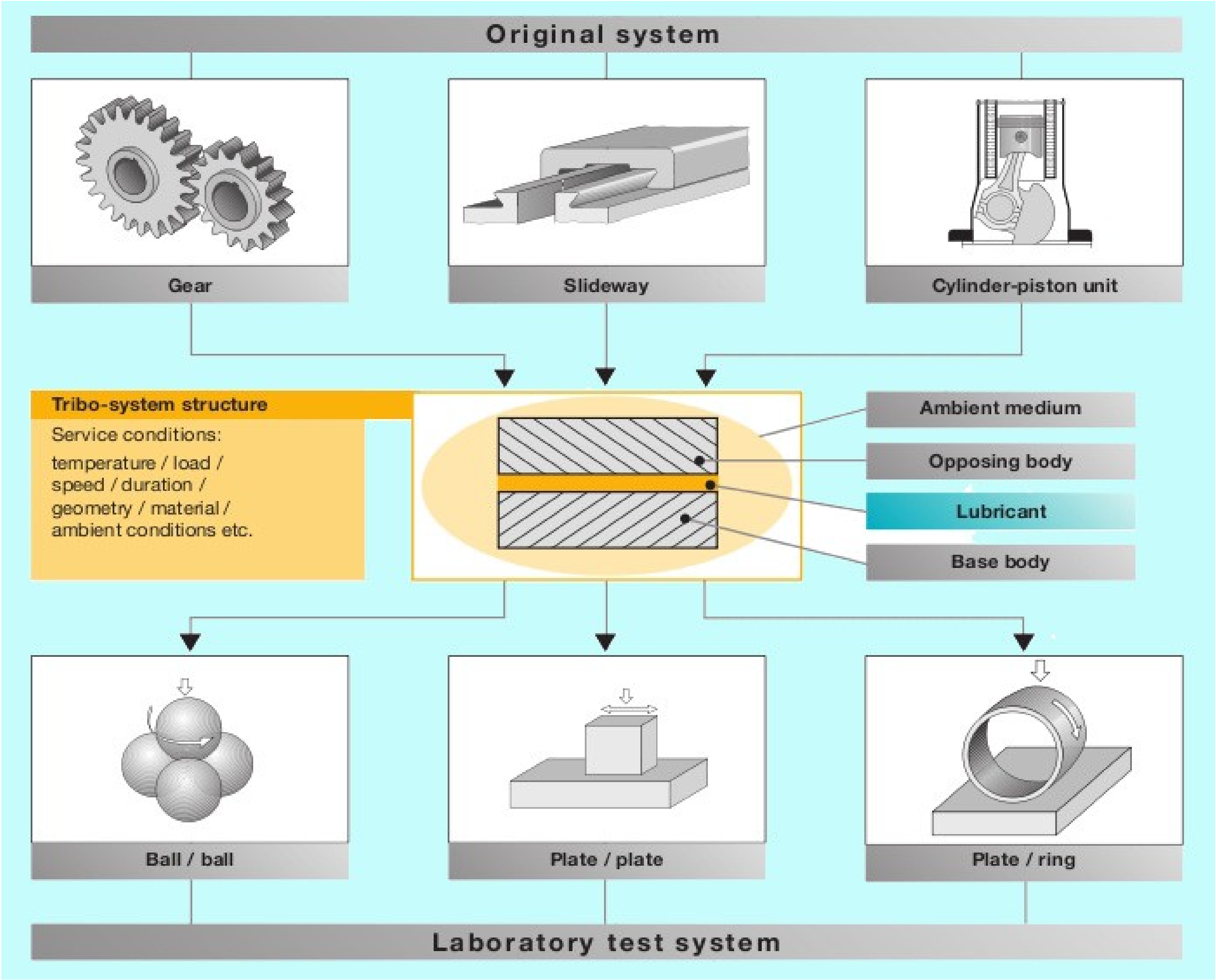
Quelle: MTU+PVT

Categories of mechano-dynamical tests according to DIN 50322

Category	Type of test		Symbol
I	Operating conditions or conditions similar to actual use	Practical test (field test)	
II		Test rig	
III		Component test	
IV	Test with model system	Test with unchanged component or scaled down unit	
V		Test with specimens subjected to loads similar to actual use	
VI		Model test with simple specimens	

Quelle: GFT - Klüber

Modelling of the original by analysing the tribosystem



Quelle: Klüber

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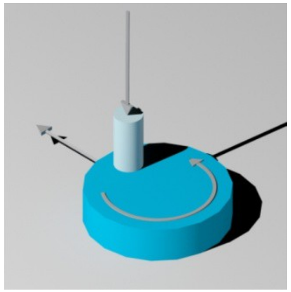
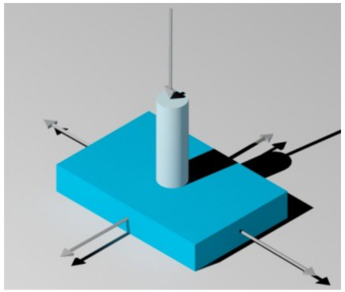
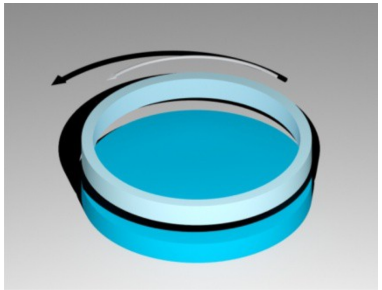
Tribotesting: selected schemes



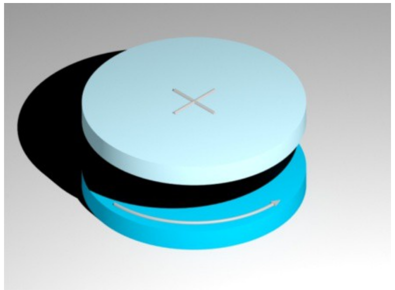
a) pin-on-disk



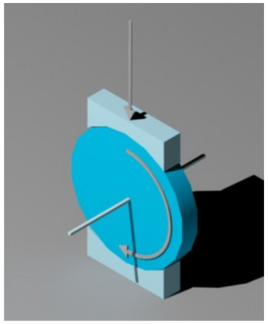
b) pin-on-plate



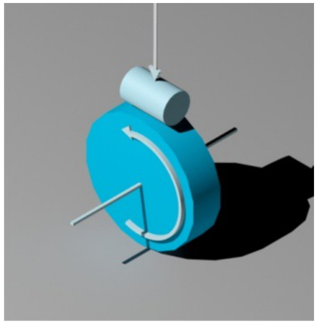
c) ring-on-disk



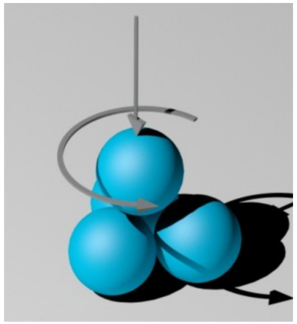
d) disk-on-disk



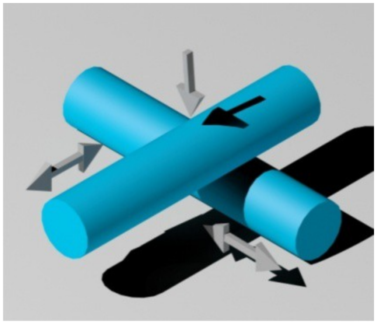
e) block-on-ring



f) cylinder-on-ring



g) 4-ball



h) crossing cylinders

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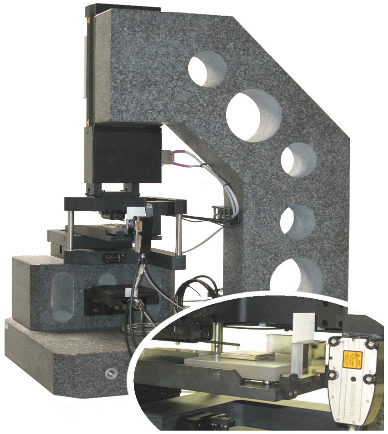
3D optical surface profilometers

TriboProfiler TP-222

Standard and special surface profiling systems, built to advanced specifications

Powerful and expandable standard instruments. Our high precision TP-series of profilometers are the most flexible systems on the market. Special instruments and custom systems. Owing to modular technology we can adapt our standard instruments to meet special requirements and build customed systems.

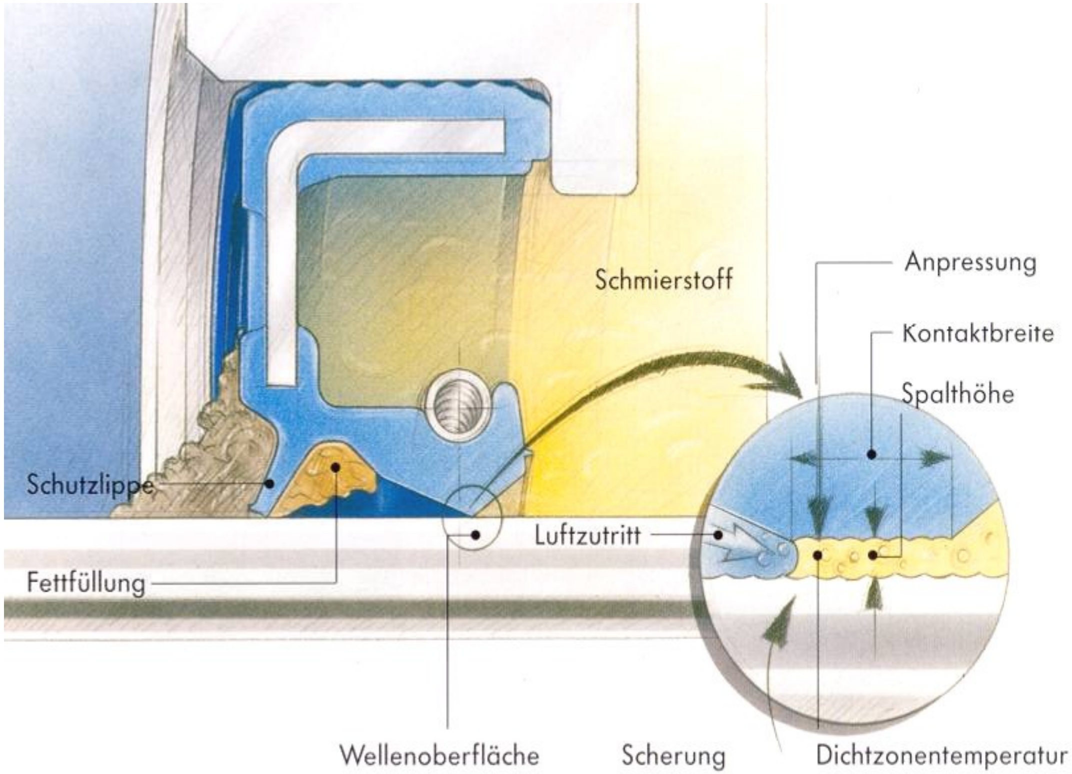


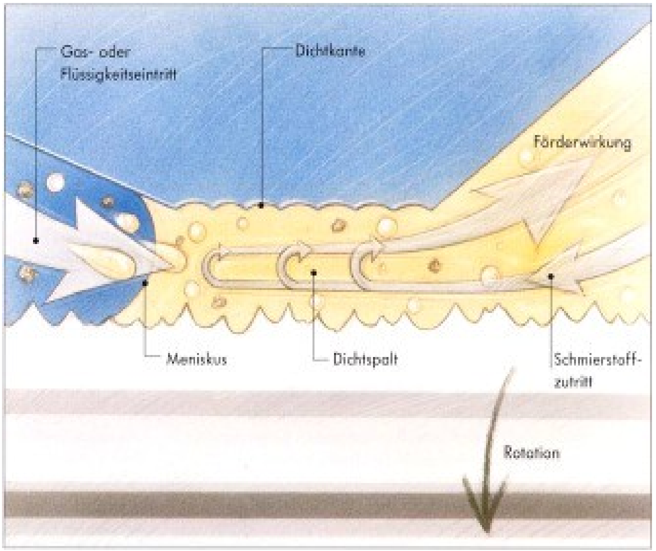
TP-series profilometers provide full 3D functionality and incorporate parameters, defined in ISO 25178.

- Contact and non-contact surface metrology
- Stroke: 200 x 200 x 200 mm & rotary axes
- Measuring range from 100µm up to 27mm
- Vertical resolution down to 1 nm
- Outstanding Mountains® surface analyses techniques

Radial shaft seal ring / radial sealing:

The radial shaft seal ring is the most common of shaft sealings. Also for difficult applications of bearing sealings, this radial shaft is used. By use of a garter spring the radial loss of power on the elastomer through aging, bulking or thermal stress/impact can be compensated.





Spies, K.H., Tagung: „Wälzlager im Umbruch“, HdT 16./17. April 2008, Anforderungen in modernen Konstruktionen, Bock, E., Dichtsysteme für Wälzlager, Poll, G., Wälzlagergerechte Konzeption von Produkten.

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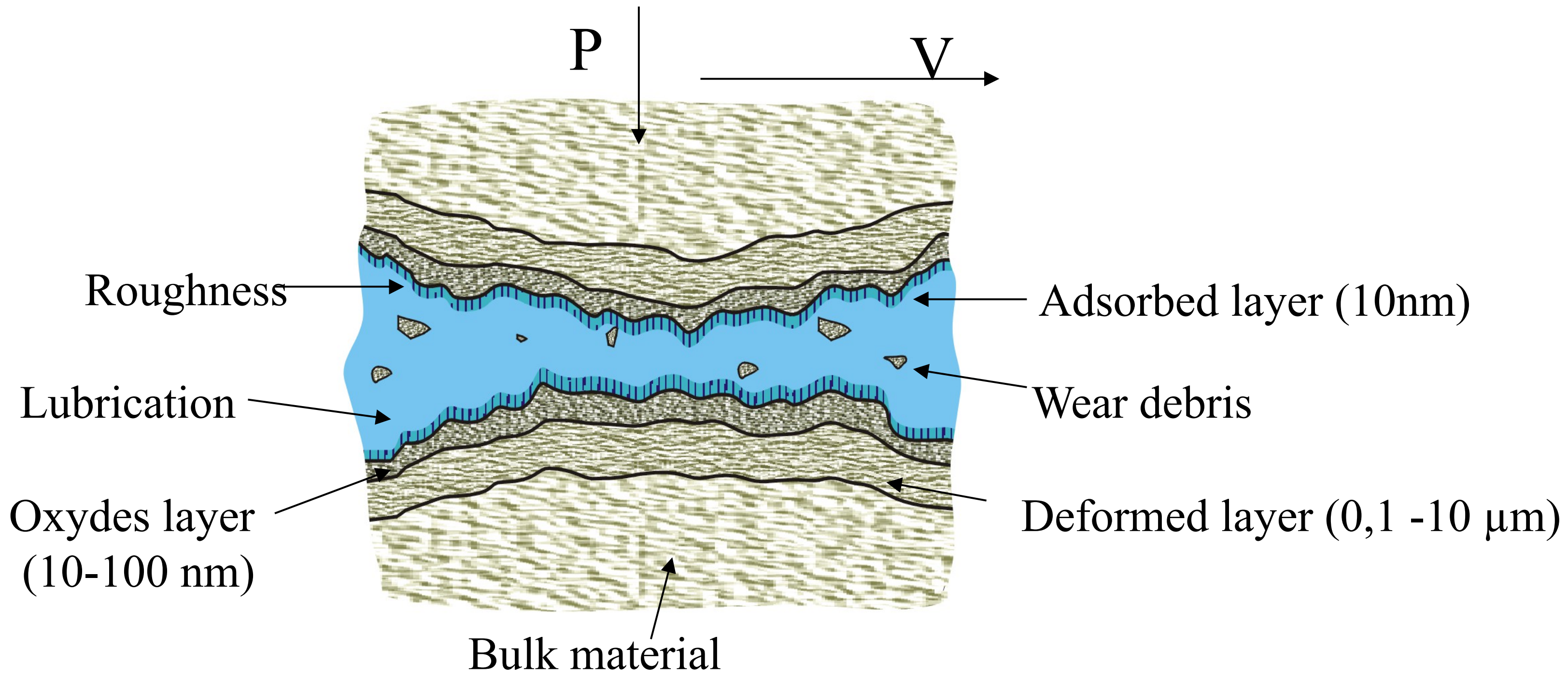
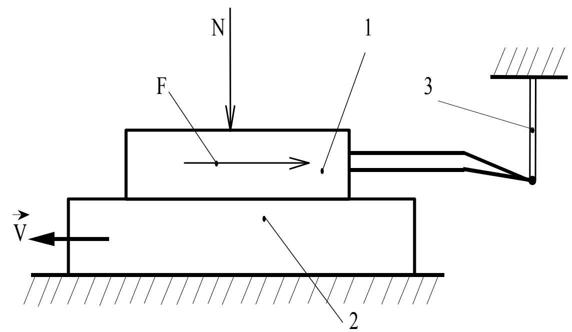
Scheme of a frictional contact and a tribometer



1 - specimen
2 - counterbody
3 – force sensor



Source: IPM+SamGTU

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Roll Stability Tests

Standard: ASTM D 1831

Lubricating grease is undergone to stresses similar to those in the ball bearings.
Cone penetration acc. to ISO 2137 reveal changes in the shear stability of the lubricating grease and allow an assessment of its
-durability
-determine the oil separation
-change in consistency.
Depending on the test programme the typical duration of the tests could be 2 h, 50 h, 100 h.

Testing temperature 80°C

For greases with a density of 0,9 g/cm^3 filling quantity is 55 cm^3 or 50 g

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Roll Stability Tests

Standard: ASTM D 1831

Features:

•Designed for long test runs at temperatures up to 200° C
•High accuracy digital temperature controller
•Easy-to-use digital timer with two presets allows unattended operation
•Low noise operation
•Uniform heat distribution provided by aluminum fan and shielded heaters
•Protection against overheating

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Roll Stability Tests

Specifications:

•Rotary speed: 165 rpm (ASTM D 1831)
10-200 rpm (MIL-G-10924)
•Test temperature: up to 200° C
•Test stations: 4
•Test time: from 10 min. till 99 h
•Voltage: 220 V / 240 V, 50 Hz – EU Execution
230 V / 60 Hz – US Execution
115 V / 60 Hz – US Execution

Included accessories:

•4 steel test cylinders with end caps and seals
•4 test rollers (5 kg +/- 50 g)
•Tool for closing and opening the cylinders

Optional:

•Adjustable rotary speed of cylinders (100–200rpm)
•Test cylinders and rollers made of stainless steel

Roll Stability Tests

Provided is piping a controllable flow of gas through the test cylinders during their rotation. Thus an adjustable testing atmosphere in direct contact with the grease sample is achieved.

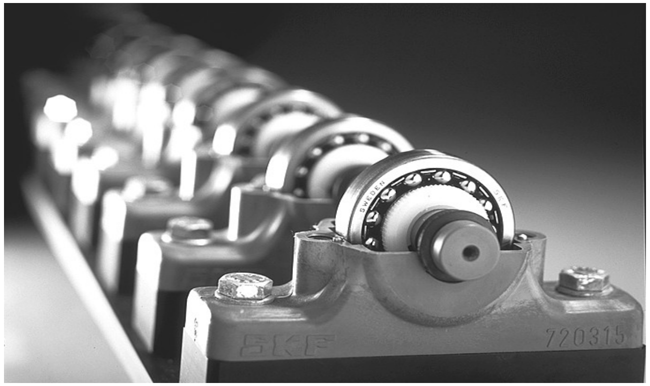
Combining mechanical stresses and adjustable atmosphere creates realistic conditions for examining various grease properties and thereby a unique possibility for analysing the degradation process of grease.

Taking samples and/or using gas analysis a closer look at the chemical processes (oxidation, decomposition, etc.) ocurring in the test is possible.

Dynamic Rust Tests. EMCOR Method

Determination of the anticorrosion properties of greases when steel bearings have a contact with water or condensed humidity

Standards:
DIN 51802, ISO 11007, BS 2000 (IP 220), NFT 60-135, ASTM D6138, etc.



Source: SKF

Specimen: normally 1306K/236725 special bearing with stamped steel cage (sometimes polyamide cage).

Test conditions:
Total duration of the test 168 hours (one week) includes 80 rpm speed during the first 8 hours followed by a stop.
The sequence is as follows: 8 h run, 16 h stop, 8 h run, 16 h stop, 8 h run and finally 108 h ± 2 h stop. No loads applied and the tests run under ambient temperature.
Two bearings in test are run the tester partially immersed in water.
Grease fill: 11 cm^3 or 10 g
Test medium: distilled water, brine or other acqueous media.

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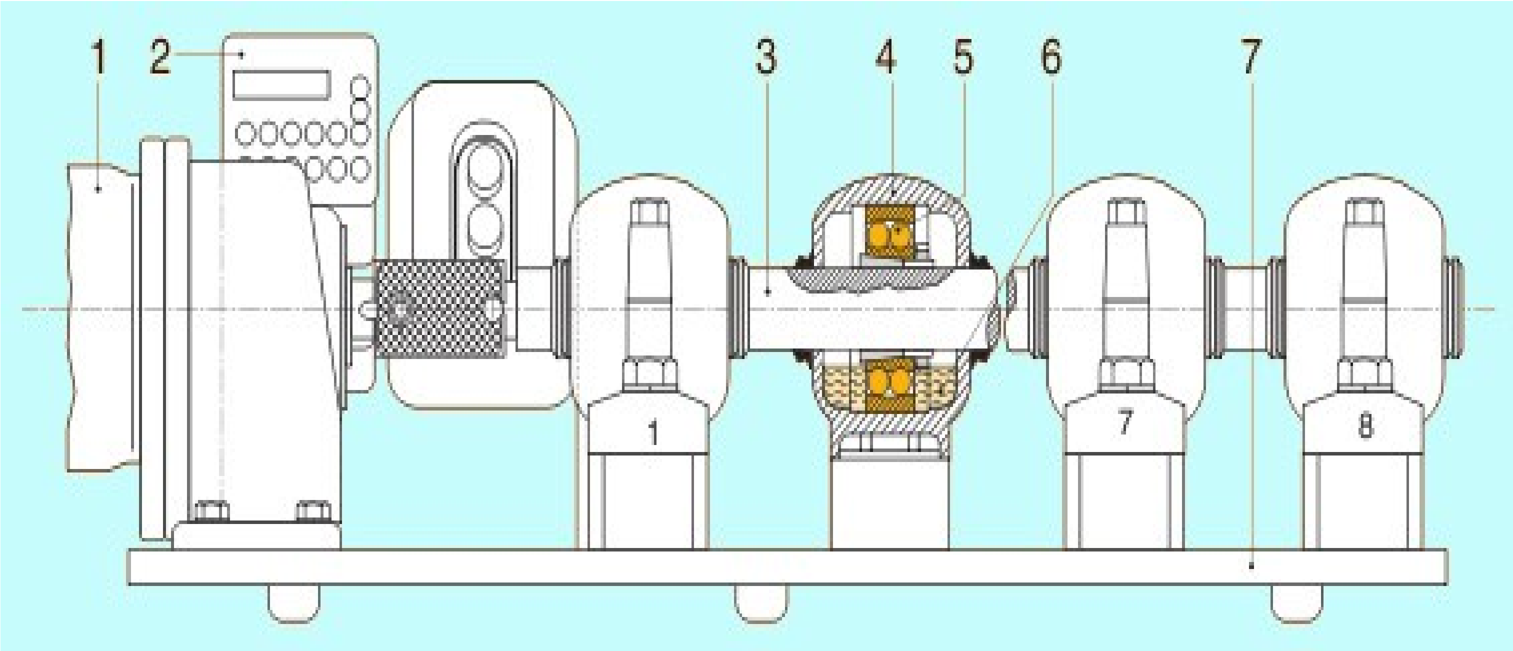
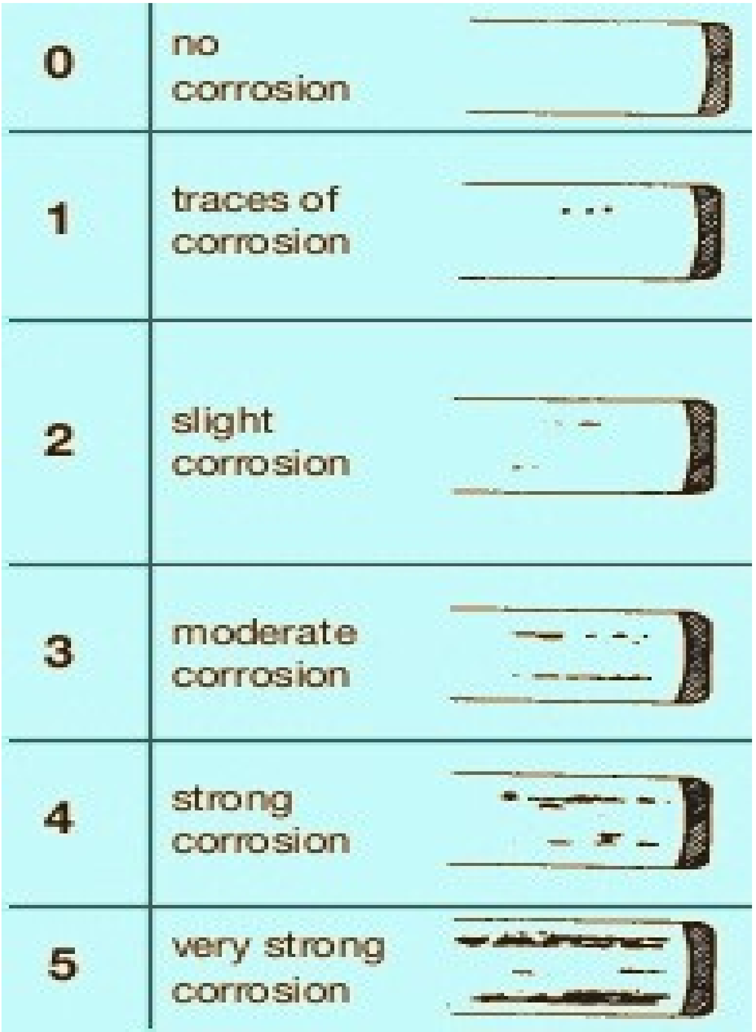
Dynamic Rust Tests. EMCOR Machine



1 - electric motor;
2 - automatic timer;
3 - shaft with nylon lining;
4 - pedestal plain bearings, 8 units;
5 - test bearings, 8 units;
6 - test medium;
7 - support

Source: Klüber-SKF

EMCOR Method. Qualification of corrosion degrees of rust inhibition



0 – unchanged;

1 – max. 3 corrosion spots with a diameter max. 1 mm;

2 – max. 1% of the surface is corroded, but more and larger corroded spots as with corrosion degree 1;

3 - >1% but not more, than 5% of the corroded surface;

4 - >5% but not more, than 10% of the corroded surface;

5 - >10% of the surface is corroded

Source: Klüber-SKF

Golden Medalists in Tribology

- **UK**

1972 David Tabor
1977 Frederick Thomas Barwell
1979 Duncan Dowson
1983 Alastair Cameron
1985 Kenneth Johnson
2004 Hugh Spikes

- **Netherlands**

1973 Harman Blok
2008 Stathis Ioannides

- **USA**

1974 Mayo Dyer Hersey
1976 Robert Lawrence Johnson
1978 Dudley Dean Fuller
1980 Mylon Eugene Merchant
1986 Ward Winer
1992 Herbert S Cheng
1993 Ken C Ludema
1998 Ernest Rabinowicz
2010 Frank Talke
2013 Jacob Israelachvili

- **USSR / Russia**

1975 Igor Kragelskii
1982 Georgi Vinogradov
1991 Avtandil Chichinadze
2002 Nikolai A Bushe
2005 Dmitrii Garkunov
2009 Irina Goryacheva

- **Japan**

1981 Norimune Soda
1987 Fujio Hirano
1990 Toshio Sakurai
2003 Yoshitsugu Kimura
2007 Koji Kato

- **Germany**

1984 Heinz Peeken
1989 Gerd Fleischer
2001 Wilfried J Bartz

- **France**

1988 Maurice Godet
1994 Jean Marie Georges
1999 Jean Frêne

- **Poland**

1995 Stanislaw Pytko

- **Romania**

1996 Virgiliu Nicolae Constantinescu

- **Sweden**

1997 Bo Olov Jacobson

- **Israel**

2000 Lou Rozeanu
2012 Jacob Klein

- **Italy**

2006 Roberto Bassani

- **China**

2011 Xue Qunji
2015 Shizhu Wen

- **Australia**

2014 Gwidon Stachowiak

Zielsetzung für 2016

- Dünnschichttribologie
- Extremalbedingungen
- Stillstandmarkierung
- Prüf- und Messtechnik
- Hydraulische Prüfstände
- Mathematisches Modellieren

Vielen Dank für Ihre Aufmerksamkeit!

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Sie kennen unsere Pferde. Erleben Sie unsere Stärken.