Optimal Shaft Counterfaces for Radial Shaft Seals – Plunge Grinding

IMA-TechSheet #104170 V1

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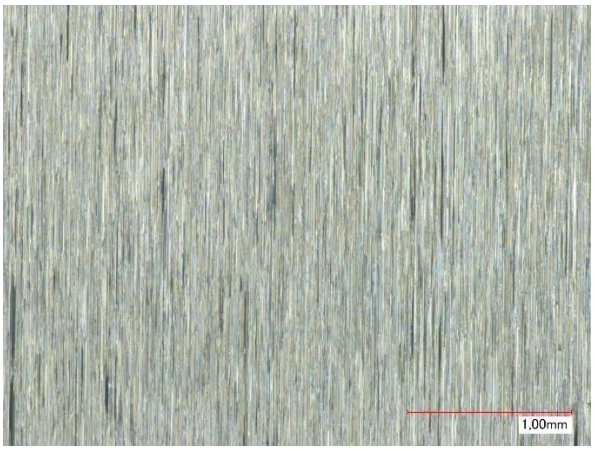
Details:

The surface condition of a shaft counterface influences the tribological system „radial shaft seal“ to a considerable extent. Shaft counterfaces, that are too smooth lead to poor running-in behaviour of the rotary shaft seal and prevents the required build-up of a fluid film in the sealing contact. This can lead to high excess temperatures, which can cause thermal damage to the system components. On the other hand, shaft counterfaces that are too rough can lead to increased wear of the system components.

In addition, surface structures (lead) that are actively pumping fluid during the operation, can either cause leakage or an insufficent lubrication of the sealing contact.

Shaft counterfaces that are optimally suited for sealing are plunge ground lead-free with a rotating grinding wheel. They have a uniform surface structure with a defined roughness and with stochastically distributed and on average circumferentially oriented grinding grooves (no micro-lead). In addition, there must be no discernible periodicity in the axial and circumferential direction of the surface (no macro-lead).

Compliance with the following specifications generally results in suitable shaft counterfaces for radial shaft seals. The following pages also show measurement reports of an optimum shaft counterface for further clarification.



Microscopic image of a plunge ground shaft counteface

DIN-Specifications:

Roughness:

Rz	1 … 5	µm
Ra	0,2 … 0,8	µm
Rmax	< 6,3	µm

IMA-Specifications:

Roughness:

Rz	2,5 … 5	µm
Ra	0,4 … 0,7	µm
Rmax	< 6,3	µm
W_t	< 1,0	µm
$W_{t,10}$	< 1,3	µm

Macro Lead MBN31007-7:

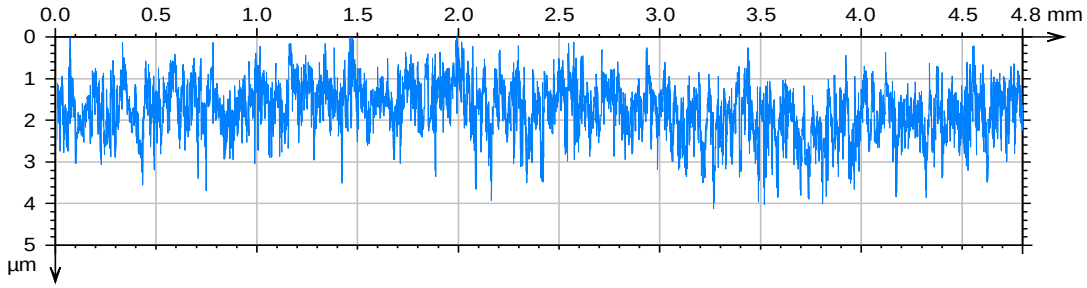
Both grids (360°/36°) must be measured and should show consistent results.

DP	> 0,15	mm
1:	DG = 0, D_t < 0,4	µm
2:	DG ≠ 0; D_t < 0,2	µm

IMA-Microlead®Analysis:

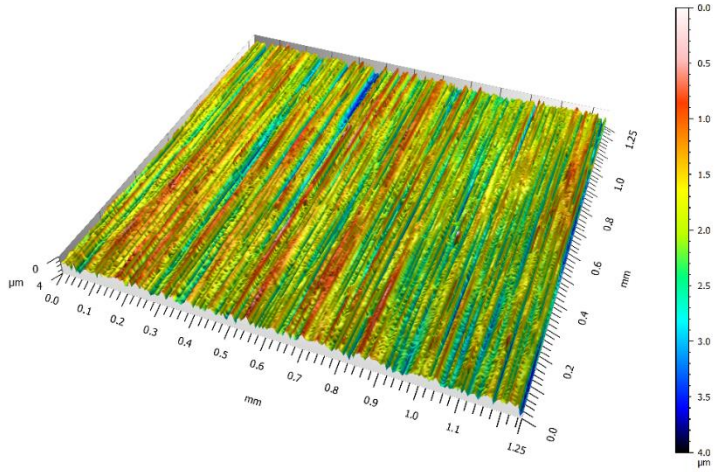
$Sd_{median,S}$	0±0,05	°
$Sd_{median,V}$	0±0,05	°
Sd_{Std}	> 0,3	°

2D-roughness:



		Kontext	Mittelwert	Std.-Abw.	Min	Max
ISO 4287						
Amplituden-Parameter - Rauheitsprofil						
Ra	µm	*Gauß-Filter, 0.8 mm*	0.435	0.0147	0.406	0.453
Rz	µm	*Gauß-Filter, 0.8 mm*	3.70	0.0974	3.55	3.86
Rt	µm	*Gauß-Filter, 0.8 mm*	4.21	0.189	3.99	4.56
Amplituden-Parameter - Welligkeitsprofil						
Wt	µm	*Gauß-Filter, 0.8 mm*	0.803	0.0781	0.696	0.932
Andere 2D-Parameter						
Rauheitsprofil-Parameter						
Rmax	µm	*Gauß-Filter, 0.8 mm*	4.04	0.150	3.85	4.30

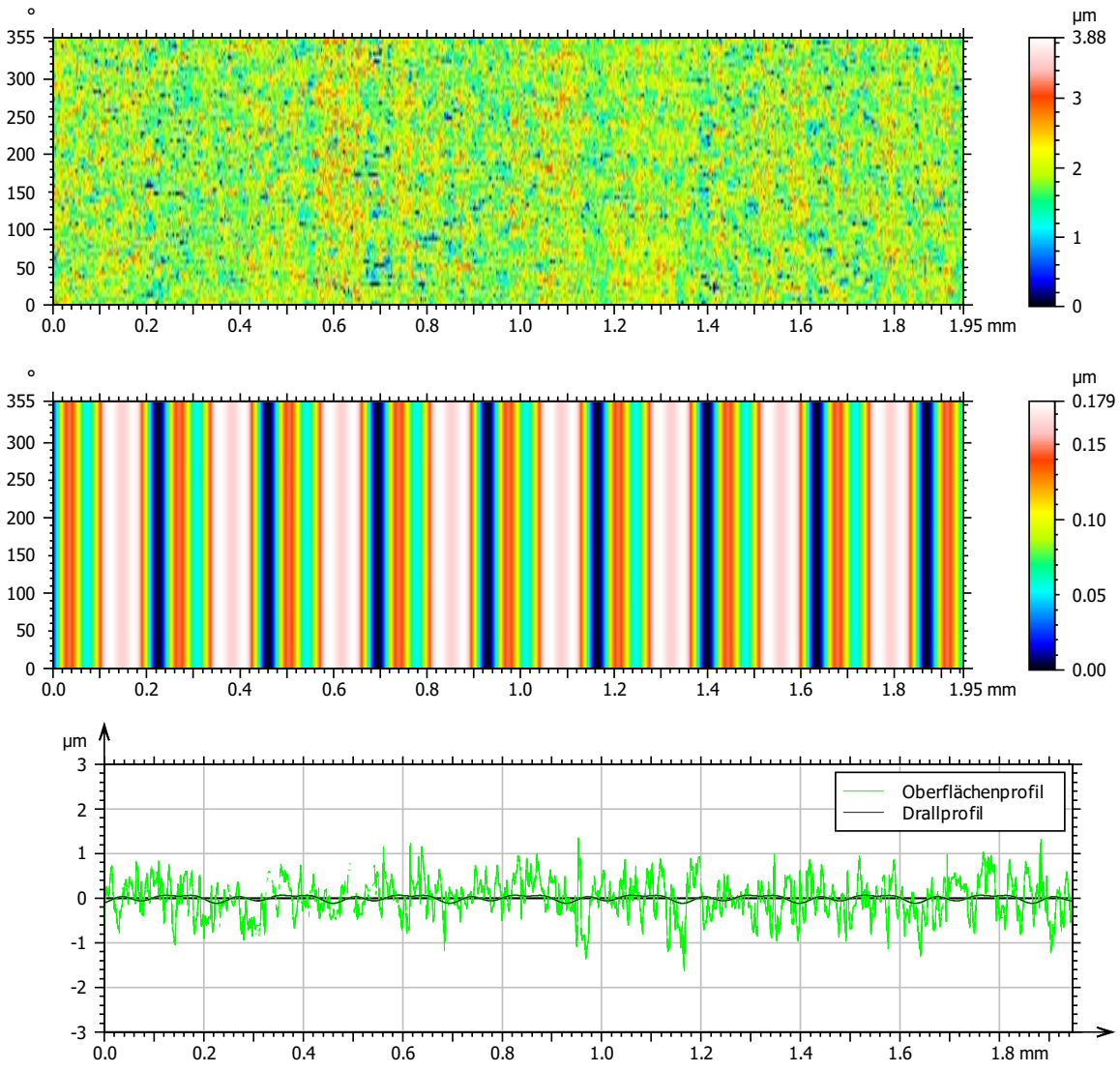
3D-roughness:



ISO 25178		
Höhen-Parameter		
Sa	0.432	µm
Sz	4.03	µm
Addon		
Addon Family IMA		
Sz_IMA	3.83	µm

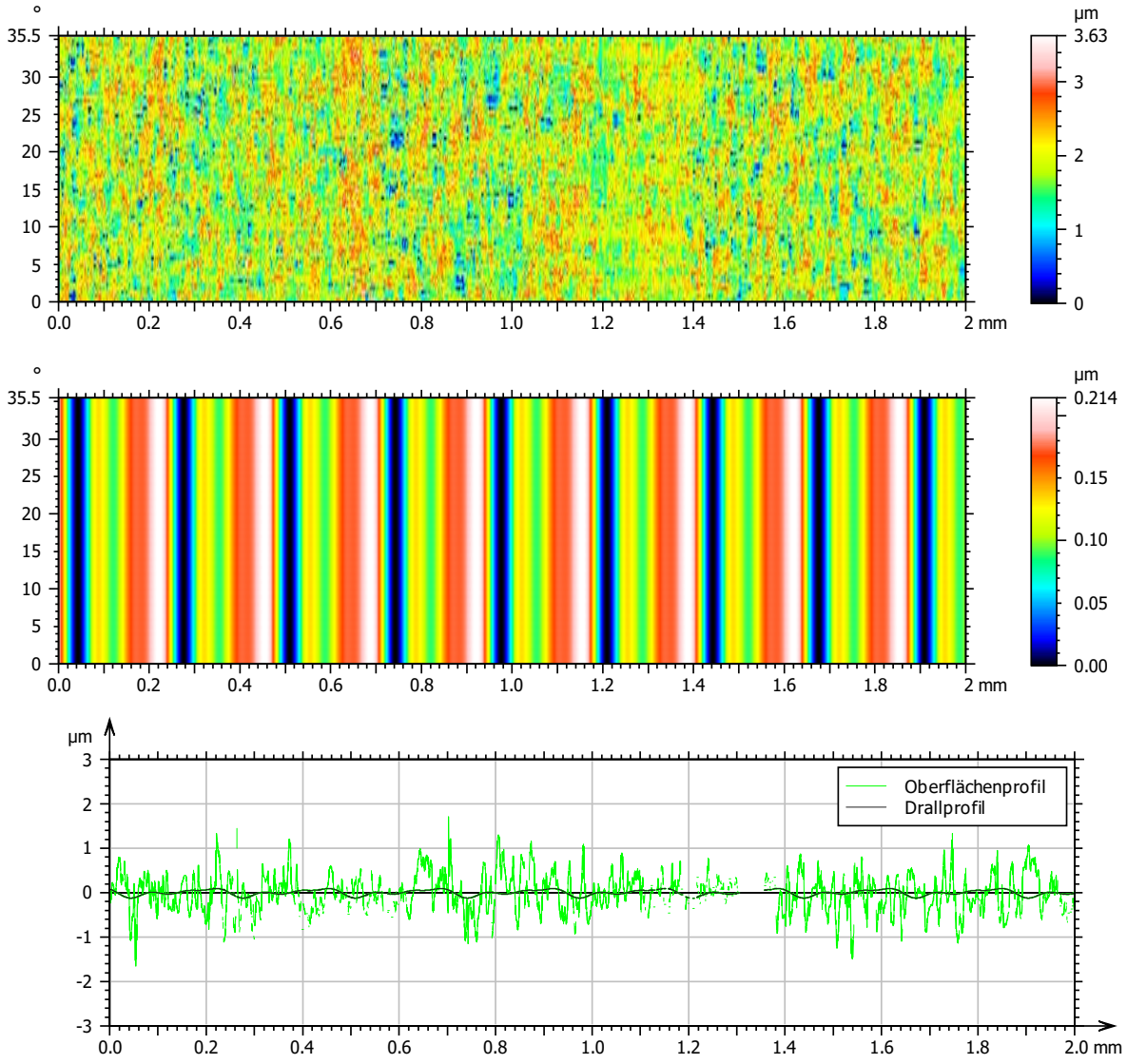
Protocol Maco-lead 360° Grid:

Parameter		Wert	Einheit	**Parameter**		Wert	Einheit
Durchmesser		65.0	mm	Periodenlänge	DP	0.234	mm
Messstrecke		2.00	mm	Theoretischer Förderquerschnitt	DF	15.4	µm²
Maximale Wellenlänge		0.400	mm	Theoretischer Förderquerschnitt pro Umdrehung	DFu	0.00	µm²/U
Gängigkeit	DG	0.00		Prozentuale Auflagelänge	DLu	100	%
Dralltiefe	Dt	0.179	µm	Drallwinkel	Dγ	0.00	°



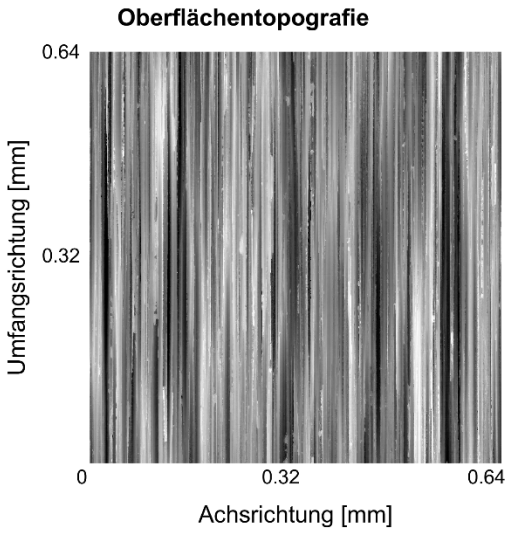
Protocol Macro-lead 36° Grid:

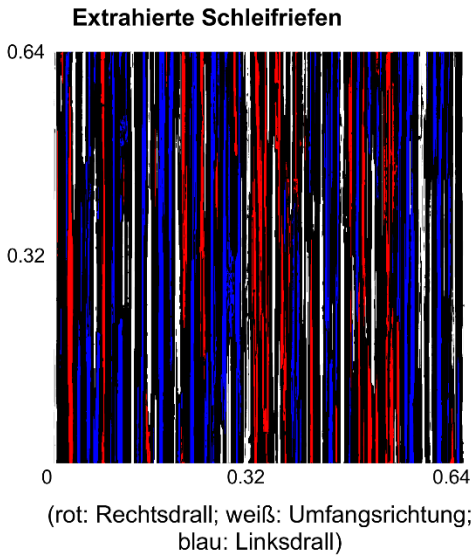
Parameter		Wert	Einheit	**Parameter**		Wert	Einheit
Durchmesser		65.0	mm	Periodenlänge	DP	0.233	mm
Messstrecke		2.00	mm	Theoretischer Förderquerschnitt	DF	20.9	µm²
Maximale Wellenlänge		0.400	mm	Theoretischer Förderquerschnitt pro Umdrehung	DFu	0.00	µm²/U
Gängigkeit	DG	0.00		Prozentuale Auflagelänge	DLu	100	%
Dralltiefe	Dt	0.214	µm	Drallwinkel	Dγ	0.00	°

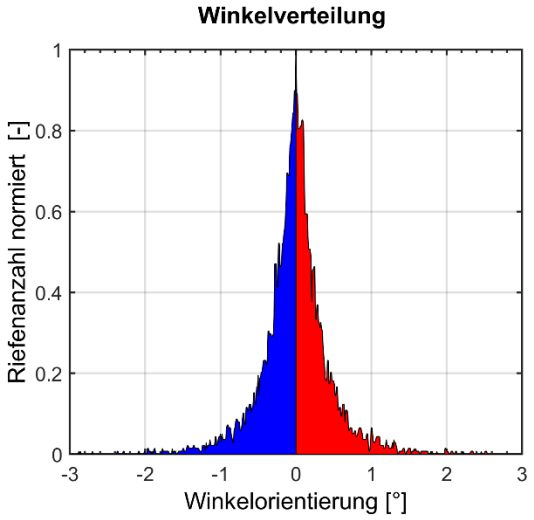


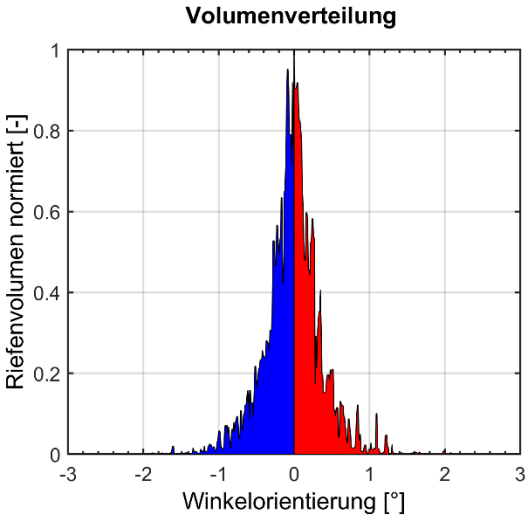
Protocol IMA-Microlead®Analysisi:

Bauteil:	IMA	Datum:	20-Aug-2019 13:56:29		
Bearbeiter :	IMA	Messsystem:	Confovis Drallmessplatz		
Kunde:	IMA	Version:	V3.2	Taumel:	









$Sd_{Sum,li}$ [%]	$Sd_{Sum,re}$ [%]	$Sd_{median,S}$ [°]	$Sd_{Vol,li}$ [%]	$Sd_{Vol,re}$ [%]	$Sd_{median,V}$ [°]
50	50	-0.01	51	49	-0.01

Sd_t [µm]	Sd_{Std} [µm]	$Sd_{Sum,tot}$ [$1/mm^2$]
0.59	0.37	362.79