

Table I: Tribometer for Sliding, Slip – Rolling and Fretting Wear

	Type of wear	Sliding Wear			Slip – Rolling Wear			Fretting Wear	
	Tribometer	Mean temperature tribometer MT1, MT2	High temperature tribometer HT1, HT2	Ultrahigh temperature tribometer UHTT	Four Ball Apparatus (SHELL)	Amsler wear test machine A 135 I and II	Twin Disk	Homat	Pibrac
Structure of Tribosystem	Body 1	pin ball	pin disc	disc	balls	disc ring	disc ring	Ball cylinder	Ball sonotrode
	Body 2, Counter body ¹¹⁾	disc	disc	disc	ball	disc ring	disc ring	disc flat	disc flat
	Body 3 ¹²⁾ Lubricant	liquid solid	- -	- solid	liquid -	liquid dry	liquid dry	liquid dry	dry
	Surrounding medium	laboratory-air	laboratory-air steam	laboratory air, N ₂ , Ar, vacuum	laboratory air humidity	laboratory air humidity	laboratory air humidity	laboratory air humidity	laboratory air
	Type of friction	boundary lubrication	solid body friction	solid body friction	boundary lubrication	EHD solid body friction boundary lubrication mixed lubrication	EHD boundary lubrication mixed lubrication dry	EHD boundary lubrication mixed lubrication dry	dry
Stressing Matrix	Type of movement	sliding	sliding	sliding rolling ²⁾	rolling/ sliding	rolling ⁹⁾	rolling sliding 0 – 100 % slip	rolling, sliding (depending on type of drive)	sliding
	Course of movement	continuous -	continuous -	continuous reversing	continuous -	continuous -	continuous -	Continuous rolling, Reversing fretting	Reversing
	Amplitude of oscillation [°]; [mm]	-	-	± 270° ⁸⁾	-	-	-	0,001 – 10 3.000 – 1	0,005 – 0,001 38.000
	Frequency [s ⁻¹]	-	-	10	-	-	-		
	Normal Force ¹⁾ [N] min max	0,5 100	0,5 40	5 50	80 4.900	>10 ⁴⁾ 2.000 ⁴⁾	100 5.000	5 100	0,5 10
	Rotations [min ⁻¹]	up to 3.000	up to 6.000	up to 100	1.500	200 or 400	up to 3.000	up to 2.000	
	max. rel. velocity [m/s]	5	10 (15)	1	0,57	1,6			
	Temperature [°C] ¹³⁾	23 ... 300	23 ... 1.000	23 ... 1.450 ¹⁶⁾	23	23 ... 120	23 ... 120	23(heater can be implemented)	- 40 – 100

Foot notes see Table III

Table II: Tribometer for Sliding Wear

	Type of wear	Sliding Wear								
	Tribometer	Low temperature tribometer CT 2	Low temperature tribometer CT 3	Low temperature tribometer CT 4	Low temperature tribometer CT 5	High-load cryotribometer CT 6	Vacuum-tribometer VT 1	Vacuum-tribometer VT 2	PT 1	Wazau Pin on Disk
Structure of Tribosystem	Body 1	pin ball	pin ball	Pin Ball	pin ball	Flat	Pin ball	pin ball	ball	pin ball
	Body 2, Counter body ¹¹⁾	disc	disc	Disc	disc	Flat	disc	disc	flat	disc
	Body 3 ¹²⁾	-	-	-	-	-	-	-	air, H ₂ , CH ₄ , LCH ₄ , inert gases,	
	Lubricant	-	-	-	-	-	-	-	low and high humidity; pressure: 10 ⁻⁶ ... 130 bar	
	Environmental medium	air, LHe, LN ₂ LH ₂ , high vacuum	air, LHe, LN ₂ , LH ₂ , CH ₄ , LCH ₄ , high vacuum, inert gases	air, LN ₂ , high vacuum, inert gases	LN ₂ , LHe	air, LHe, LN ₂ , high vacuum, inert gases	air, N ₂ , H ₂ (max. 10 mbar), high vacuum, inert gases	air, N ₂ , H ₂ , high vacuum, inert gases		laboratory air; low and high humidity
	Type of friction	dry	dry	dry	dry	dry	dry	dry	dry	dry, boundary lubrication
Stressing Matrix	Type of movement	sliding	sliding	sliding	sliding	sliding	sliding	sliding	sliding	sliding
	Course of movement	continuous, reciprocating	continuous reciprocating	reciprocating	continuous	reciprocating	continuous	continuous	reciprocating	continuous
	Amplitude of oscillation [°]; [mm]	1 ... 40 mm	1 ... 40 mm	2 mm	-	2 mm	1 ... 40	-	0.0001 ... 0.5 mm	-
	Frequency [s ⁻¹]	≤ 10	≤ 10	≤ 10	-	-	25	-	0.1 ... 20	-
	Normal Force ¹⁾ [N] min max	5 1.000	5 10,000	1 20	1 10	3,000 150,000	1 500	1 50	1 10	20 2000
	Rotations [min ⁻¹] min.rel. velocity [m/s] max.rel. velocity [m/s]	≤ 3.000 10 ⁻⁵ 10	≤ 3,000 10 ⁻⁵ 10	- - 0.06	≤ 50 - 1	10 ⁻⁴ 10 ⁻³	≤ 3,000 10 ⁻⁵ 10	≤ 1000 - 5	-	≤ 3000 0.01 5
	Temperature [°C] ¹³⁾	-269 ... 23	-269 ... 23	-196 ... 23	-269, -196	-269 ... 23	-80, 600	23	23	23

Foot notes see Table III

Table III: Tribometer for Fretting

Type of Wear		Fretting Wear						
Tribometer		Linear Tribometer TKLA	Linear Tribometer TKLB	Rotation Tribometer TKRD	High Temperature Fretting Tribometer SRV III	Hot steam Fretting Tribometer SRV IV (HD)	High Temperature Fretting Tribometer SRV 5	Fretting Tribometer Frett III
Structure of Tribosystem	Body 1	pin ball cylinder	pin ball cylinder	pin ball cylinder	ball cylinder ring	ball cylinder ring	ball cylinder ring	pin ball cylinder
	Body 2 Counter body	disc/ ring	disc/ ring	flat	flat	flat	flat	disc/ ring
	Body 3 ¹²⁾ lubricant	liquid -	liquid -	liquid -	liquid -	-	liquid -	liquid -
	Surrounding medium	laboratory air humidity	laboratory air humidity synthetic gases low vacuum	laboratory air humidity	laboratory air synthetic gases	laboratory air synthetic gases hot steam	laboratory air synthetic gases	laboratory air humidity
	Type of friction	solid body friction boundary friction mixed lubrication	solid body friction boundary friction mixed lubrication	solid body friction boundary friction mixed lubrication	solid body friction	solid body friction	solid body friction	solid body friction boundary friction mixed lubrication
Beanspruchungskollektiv	Type of movement	sliding	sliding	sliding	sliding	sliding	sliding	sliding
	Course of movement	reversing	reversing	reversing	reversing	reversing	reversing	reversing
	Amplitude [mm]	0,02 ... 1,6	0,5 ... 10	0,2 ... 2,5	up to 4,5	up to 4,5	up to 5	0,2 ... 7
	Frequency < [s ⁻¹]	1 ... 20	1 ... 20	5 ... 20	up to 500	up to 500	up to 500	1 ... 80
	Normal force ¹⁾ [N] min max	0,1 50	0,1 50	2 50	10 2.000	10 2.000	10 2.000	0,1 50
	Rotations [min ⁻¹]	-	-	-	-	-	-	-
	max. rel. velocity [m/s]	0,015	0,025	0,025	< 0,1	< 0,1	< 0,1	0,04
	Temperature [°C] ¹³⁾	23 ¹⁰⁾ ... 120	- 40 ¹⁰⁾ ... 120	23 ¹⁰⁾	- 55 ¹⁰⁾ ... 800	23 ¹⁰⁾ ... 700	23 ¹⁰⁾ ... 800	23

Foot notes

- 1) Static load
- 2) also pulsing (0,1-100 Hz) u. dynamic load
- 3) Vacuum down to 10⁻⁶ mbar
- 4) also pulsing
- 5) rolling with steerable slip
- 6) slip fixed
- 7) humidity (rel. 0 and 30-70%)
- 8) 30° means rotation angle of the disc. Angle and frequency depend on each other.

- 9) Rolling with constant slip of 10 %
- 10) Humidity (rel. 5-95%)
- 11) Disc max. 70 mm diameter
- 12) If not other statements, then solid body friction
- 13) Temperature is that of lubricant or of surrounding medium without lubrication
- 14) Rolling velocity of driving ball in the contact point
- 15) DIN 51834
- 16) max. test duration at 1.450°C: 20 minutes