







Performance of tools according to VDI/VDE 2647

General information		
Operator name:	Jean-Yves Loyer	
Testing date:	02/04/2026	
Report number:	020420261	
General information about tool		
Manufacturer:	Desoutter	
Machine type:	CVI3 Tool	
Model:	EADS14-940-4Q	
Part number:	6151663390	
Square:	Hex. 1/4"	
Maximum speed:	940 rpm	
Minimal torque	4 Nm	2,9504 ft,lb
Nominal torque:	14 Nm	10,3264 ft,lb
Maximum torque:	14 Nm	10,3264 ft,lb
Serial number:	26B0610700B03	
Calibration date :	1/1/2010	
Calibration value :	9.499	
Power consumption :	110W	
Operating voltage :	230V 3~	
Ambient conditions :	Temperature : 22 °C	Humidity : 60%
Picture of tool		
		

Performance of tools according to VDI/VDE 2647

Battery-operated tool		Accessory	
Manufacturer:	NA	Manufacturer:	No accessory
Rated capacity:	NA	Model :	NA
Battery voltage:	NA	Serial number:	NA
Serial number:	NA	Part number:	NA
Part number:	NA		
Battery type:	No batterie		
Picture of battery		Picture of accessory	
			
Controller tool			
Controller type:	AXON	Serial number:	25A0000949H02
Manufacturer:	Desoutter	Part number:	6159327800
Power:	3.7kVA peak	Manufacturer date:	06/2025
CVi3 firmware:	2.8.1.0	CPU board:	2.8.1.0
CPLD:	2.8.1.0	Front panel:	2.8.1.0
LCD driver:	2.8.1.0	Servo-driver 1:	2.8.1.0
OS version:	2.8.1.0	Ac line:	100-120/220-240V~ 50/60Hz
Picture of controller			
			
Cable tool			
Cable type:	Tool cable 5m	Serial number:	29012500053
Manufacturer:	Desoutter	Part number:	6159178360
Lenght:	5m		
Picture of cable			
			

Performance of tools according to VDI/VDE 2647

<i>Joint simulator</i>			
Manufacturer:	BLM	Serial number:	3860.615
Model type:	JSB 3860 AD 300 ISO	Part number:	8059098857
<i>Transducers torques</i>			
Cell #1:	2 N.m	Cell #2:	10 N.m
Cell #3:	50 N.m	Cell #4:	500 N.m
Cell #5:	2000 N.m		
<i>Validity date of transducers</i>			
Cell #1:	1/19/2027	Cell #2:	1/19/2027
Cell #3:	1/19/2027	Cell #4:	1/19/2027
Cell #5:	-		
<i>Picture of joint simulator</i>			
			
<i>Picture of test bench</i>			
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Performance of tools according to VDI/VDE 2647

Tightening at torque

Value for the duration of break between cycles					
0% soft:	5	0 % hard:	5		
30% soft:	5	30 % hard:	5		
100% soft:	45	100 % hard:	45		
Number of tightenings for the test					
0 % of the torque range:	100				
30 % of the torque range:	100				
100 % of the torque range:	100				
Number of free speed					
All torque range:	4				
Torque test - test point specification					
Torque and torsion tested					
P1: 0 % of the torque range:	4.0 N.m	Soft:	30°	Hard:	360°
P2: 30 % of the torque range:	7.0 N.m	Soft:	30°	Hard:	360°
P3: 100 % of the torque range:	14.0 N.m	Soft:	30°	Hard:	360°
Revolutions per minute					
0 % of the torque range					
Hard	Rundown speed (Rpm):	50 Rpm	Downshift speed (Rpm):	32 Rpm	
Soft	Rundown speed (Rpm):	50 Rpm	Downshift speed (Rpm):	32 Rpm	
30 % of the torque range					
Hard	Rundown speed (Rpm):	50 Rpm	Downshift speed (Rpm):	50 Rpm	
Soft	Rundown speed (Rpm):	50 Rpm	Downshift speed (Rpm):	50 Rpm	
100 % of the torque range					
Hard	Rundown speed (Rpm):	50 Rpm	Downshift speed (Rpm):	50 Rpm	
Soft	Rundown speed (Rpm):	50 Rpm	Downshift speed (Rpm):	50 Rpm	
Torsion angle start moment (Angle threshold)					
0 % of the torque range:	Soft:	2.0 N.m	Hard:	2.0 N.m	
30 % of the torque range:	Soft:	3.5 N.m	Hard:	3.5 N.m	
100 % of the torque range:	Soft:	7.0 N.m	Hard:	7.0 N.m	
Downshift torque					
0 % of the torque range:	Soft:	0.32 N.m	Hard:	0.32 N.m	
30 % of the torque range:	Soft:	0.56 N.m	Hard:	0.56 N.m	
100 % of the torque range:	Soft:	1.12 N.m	Hard:	1.12 N.m	
Information for tightening with a battery tool					
Numbers of battery used for the tightening					
0 % of the torque range:	Soft:	0	Hard:	0	
30 % of the torque range:	Soft:	0	Hard:	0	
100 % of the torque range:	Soft:	0	Hard:	0	
Temperature maximum of tool at 80% of the torque range (360°)					
Angle head:	Start:	20	End:	20	
Motor:	Start:	20	End:	20	
Handle:	Start:	20	End:	20	

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Tightening at angle

Value for the duration of break between cycles			
30°	5		
180°	30		
Number of tightening for the test			
Tightening hard	100		
Tightening soft	100		
Number of free speed			
All tightening:	4		
Rotation angle test - test points specification			
Rotation angle			
Hard of 50 at 100% of tightening	30°		
Soft of 50 at 100% of tightening	180°		
Revolutions per minute			
30 °			
Rundown speed (Rpm):	50 Rpm	Downshift speed (Rpm):	50 Rpm
180°			
Rundown speed (Rpm):	50 Rpm	Downshift speed (Rpm):	50 Rpm
Torsion angle start moment (Angle threshold)			
30° (20% of torque range)	2.8 N.m		
180° (20% of the torque range)	2.8 N.m		
Target torque			
30° (60 % of the torque range)	8.4 N.m		
180° (80 % of the torque range)	11.2 N.m		
Information for tightening with a battery tool			
Numbers of battery used for the tightening			
30°			
180°			

Performance of tools according to VDI/VDE 2647

Torque tightening test

Test point	0%		30%		100%	
Test torque	4.0 N.m		7.0 N.m		14.0 N.m	
Joints (of 50 at 100% of tightening)	hard (30°) (±5°)	soft (360°) (±15°)	hard (30°) (±5°)	soft (360°) (±15°)	hard (30°) (±5°)	soft (360°) (±15°)
Torque tolerance upper limit (N.m)	4.28	4.28	7.49	7.49	14.98	14.98
Torque tolerance lower limit (N.m)	3.72	3.72	6.51	6.51	13.02	13.02
Tolerance interval * (±)	7%	7%	7%	7%	7%	7%
Mean torque (N.m)	4.05	4.01	7.07	7.05	14.14	14.04
Min torque (N.m)	4.0	3.96	6.97	6.99	13.9	13.91
Max torque (N.m)	4.11	4.05	7.17	7.12	14.36	14.18
$6\sigma/\bar{X}$	3.74%	2.86%	3.58%	2.43%	4.22%	2.63%
Standard deviation	0.025	0.019	0.042	0.029	0.100	0.061
$C_m > 2,45$ *	3.70	4.88	3.87	5.72	3.28	5.31
$C_{mk} > 2,07$ *	3.09	4.67	3.31	5.11	2.82	5.07

Angle tightening test

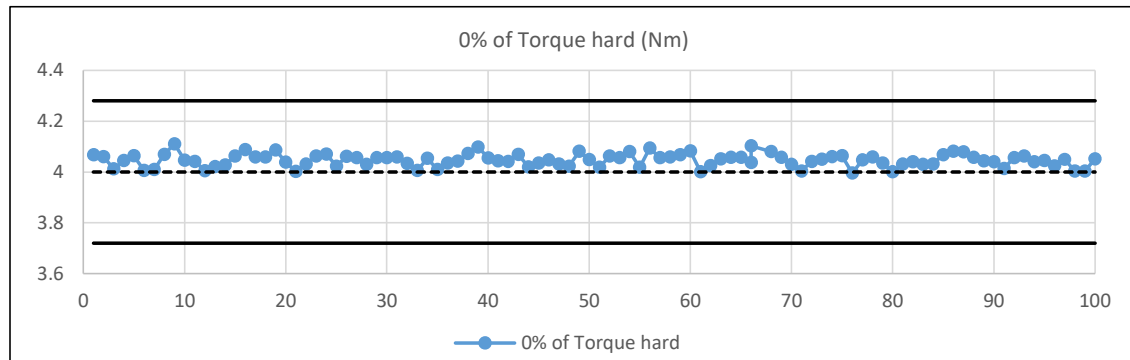
	hard	soft
Angle tested (of 50 at 100% of tightening)	30°	180°
Target torque	8.4 N.m	11.2 N.m
Tolérance (torque)	6.0%	4.6%
IT (±) (torque) < 7%*	3.0%	2.3%
Tolérance (angle)	2.5 °	4.5 °
IT (±) (angle) <i>Hard < 5° *</i> <i>Soft < 15° *</i>	1.2 °	2.2 °

(*) Informations for reference

Performance of tools according to VDI/VDE 2647

0 % of the torque range	Lower limit (Nm)	Target torque (Nm)	Upper limit (Nm)	Tolerance (±)
	3.72	4.0	4.28	7%

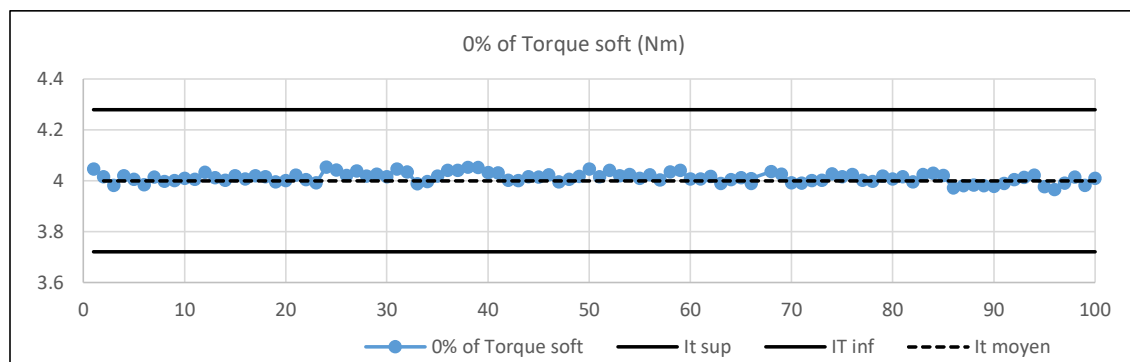
Tightening hard



Cm **3.70**

Cmk **3.09**

Tightening soft



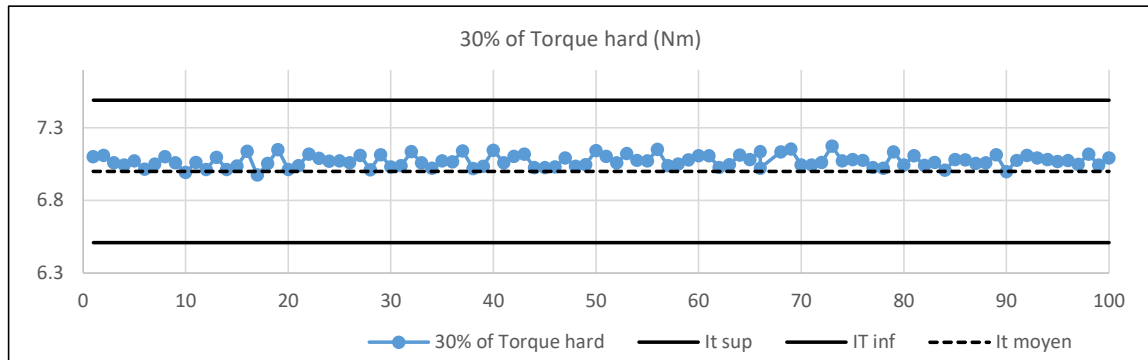
Cm **4.88**

Cmk **4.67**

Performance of tools according to VDI/VDE 2647

30 % of the torque range	Lower limit (Nm)	Target torque (Nm)	Upper limit (Nm)	Tolerance (±)
	6.51	7.0	7.49	7%

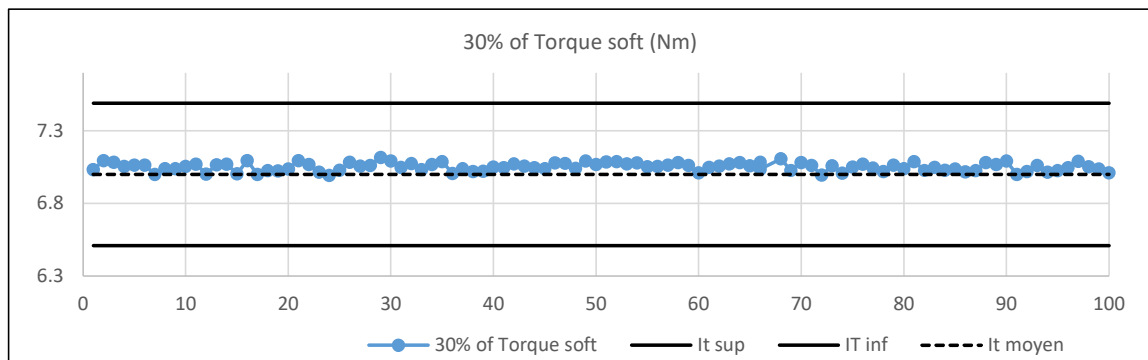
Tightening hard



Cm **3.87**

Cmk **3.31**

Tightening soft



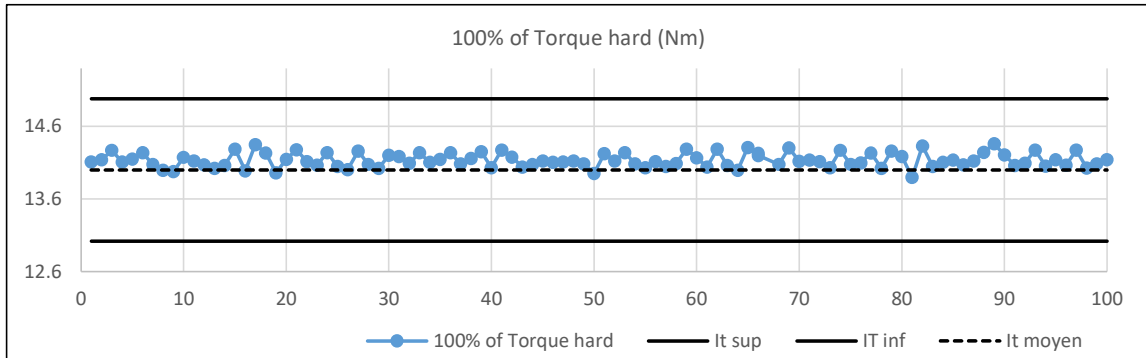
Cm **5.72**

Cmk **5.11**

Performance of tools according to VDI/VDE 2647

100 % of the torque range	Lower limit (Nm)	Target torque (Nm)	Upper limit (Nm)	Tolerance (±)
	13.02	14.0	14.98	7%

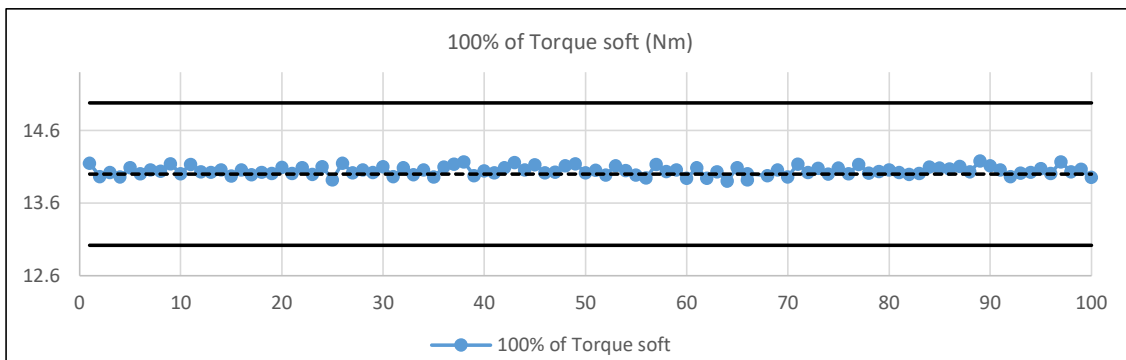
Tightening hard



Cm **3.28**

Cmk **2.82**

Tightening soft

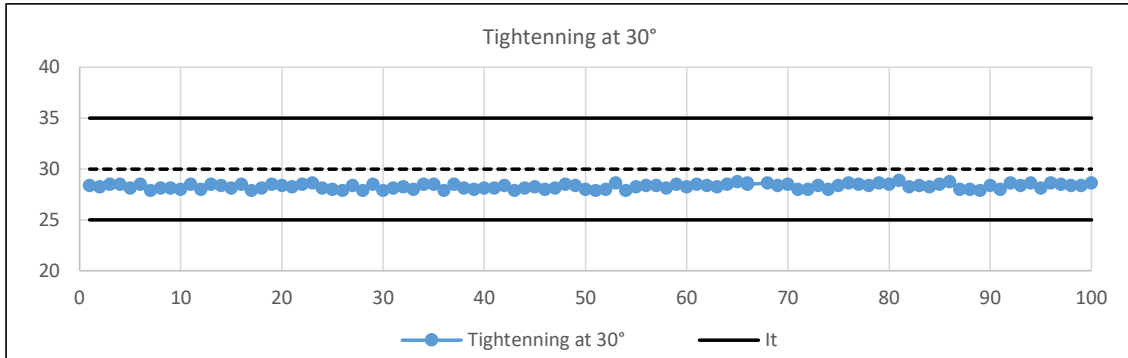


Cm **5.31**

Cmk **5.07**

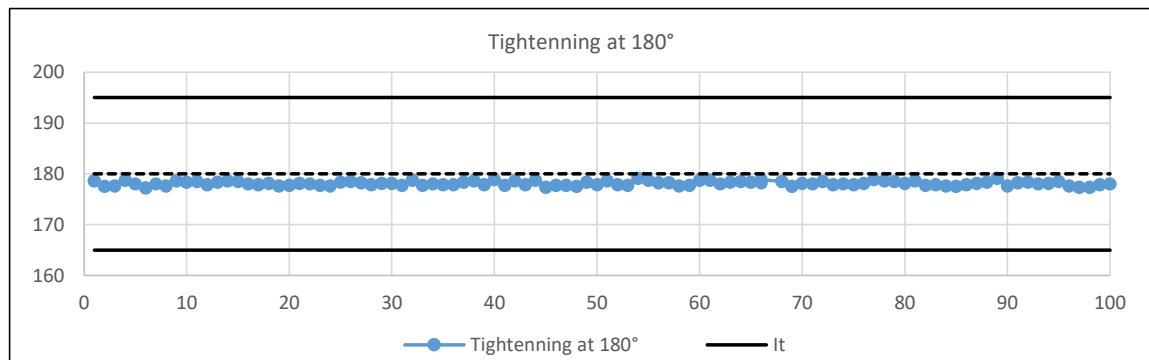
Performance of tools according to VDI/VDE 2647

Tightenning at 30°	Lower limit (°)	Target angle (°)	Upper limit (°)	Tolerance (±)
	35°	30°	25°	5°



IT (±)	1.2 °
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Tightenning at 180°	Lower limit (°)	Target angle (°)	Upper limit (°)	Tolerance (±)
	165°	180°	195°	15°



IT (±)	2.2 °
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Performance of tools according to VDI/VDE 2647

0 % of the torque range (hard)

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
1	4.07	29	4.02	28	0.05	0.6
2	4.06	30	4.03	29	0.03	0.4
3	4.01	29	4.02	28	0.0	0.6
4	4.05	30	4.01	29	0.04	0.9
5	4.06	29	4.01	28	0.05	0.7
6	4.01	28	4.02	27	0.01	0.8
7	4.01	28	4.0	27	0.01	0.7
8	4.07	30	4.01	29	0.06	0.9
9	4.11	30	4.01	29	0.1	0.7
10	4.05	29	4.0	28	0.05	0.6
11	4.04	29	4.01	28	0.03	1.0
12	4.01	28	4.01	27	0.01	1.1
13	4.02	28	4.01	28	0.01	0.8
14	4.03	29	4.01	28	0.02	0.8
15	4.06	29	4.01	28	0.05	1.1
16	4.09	29	4.02	29	0.07	0.5
17	4.06	29	4.02	29	0.04	0.7
18	4.06	29	4.02	28	0.04	0.4
19	4.09	29	4.0	29	0.08	0.8
20	4.04	29	4.01	27	0.03	1.0
21	4.0	28	4.01	27	0.01	0.8
22	4.03	28	4.01	27	0.02	0.9
23	4.06	29	4.02	28	0.04	0.9
24	4.07	30	4.01	29	0.06	0.8
25	4.02	29	4.01	28	0.01	0.7
26	4.06	29	4.02	27	0.04	1.1
27	4.06	29	4.02	28	0.03	0.9
28	4.03	29	4.01	28	0.02	0.8
29	4.06	30	4.03	29	0.03	0.5
30	4.06	29	4.0	28	0.05	1.2
31	4.06	29	4.01	28	0.05	0.4
32	4.03	28	4.01	28	0.02	0.8
33	4.01	28	4.01	27	0.0	0.9
34	4.05	29	4.01	28	0.04	1.1
35	4.01	29	4.01	28	0.0	0.6
36	4.03	28	4.02	28	0.01	0.5
37	4.04	28	4.01	27	0.03	1.1
38	4.07	29	4.03	28	0.04	0.7
39	4.1	30	4.02	29	0.08	0.6
40	4.05	29	4.01	28	0.04	0.6
41	4.04	29	4.02	28	0.02	1.0
42	4.04	29	4.01	28	0.03	0.5
43	4.07	29	4.03	28	0.04	0.6
44	4.02	28	4.01	27	0.01	1.0
45	4.03	29	4.01	28	0.02	1.2
46	4.05	29	4.04	27	0.01	1.2
47	4.03	29	4.03	28	0.0	0.7
48	4.02	29	4.01	28	0.01	0.7
49	4.08	29	4.0	28	0.08	0.7
50	4.05	29	4.01	28	0.04	0.7

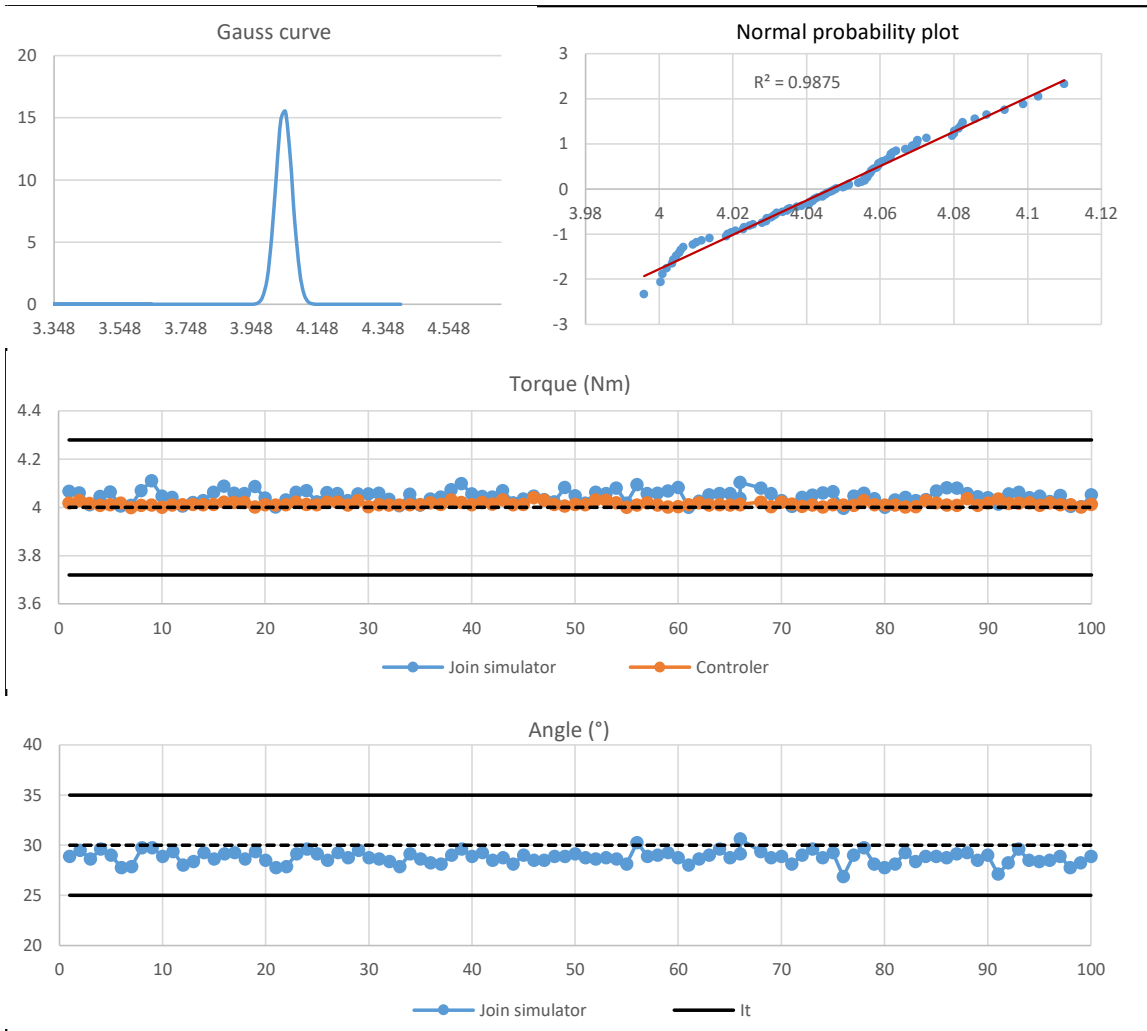
Performance of tools according to VDI/VDE 2647

0 % of the torque range (hard)

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
51	4.02	29	4.01	28	0.01	0.8
52	4.06	29	4.03	27	0.03	1.5
53	4.06	29	4.03	28	0.03	0.7
54	4.08	29	4.02	28	0.06	0.6
55	4.02	28	4.0	27	0.02	0.7
56	4.09	30	4.01	29	0.08	1.0
57	4.06	29	4.02	28	0.04	0.7
58	4.06	29	4.01	28	0.05	0.6
59	4.07	29	4.0	28	0.07	0.9
60	4.08	29	4.0	28	0.08	0.6
61	4.0	28	4.01	27	0.01	0.6
62	4.03	29	4.02	28	0.01	0.5
63	4.05	29	4.01	28	0.04	0.8
64	4.06	30	4.01	29	0.05	0.6
65	4.06	29	4.01	28	0.05	0.9
66	4.04	29	4.01	28	0.03	1.0
67	4.1	31	4.01	30	0.09	0.7
68	4.08	29	4.02	28	0.06	0.9
69	4.06	29	4.0	28	0.05	0.6
70	4.03	29	4.02	28	0.01	1.0
71	4.0	28	4.01	27	0.01	0.9
72	4.04	29	4.0	28	0.04	0.9
73	4.05	30	4.01	29	0.04	1.1
74	4.06	29	4.0	28	0.06	0.8
75	4.06	29	4.01	28	0.05	1.1
76	4.0	27	4.01	26	0.01	0.7
77	4.05	29	4.01	28	0.04	0.9
78	4.06	30	4.03	29	0.03	1.2
79	4.04	28	4.01	27	0.02	1.0
80	4.0	28	4.01	27	0.01	0.7
81	4.03	28	4.01	27	0.02	0.7
82	4.04	29	4.0	28	0.04	1.0
83	4.03	28	4.0	28	0.03	0.8
84	4.03	29	4.03	28	0.0	0.9
85	4.07	29	4.02	28	0.05	1.1
86	4.08	29	4.01	28	0.07	0.8
87	4.08	29	4.01	28	0.07	1.0
88	4.06	29	4.04	28	0.02	0.9
89	4.04	29	4.01	27	0.04	1.3
90	4.04	29	4.02	28	0.02	0.6
91	4.01	27	4.03	26	0.02	0.7
92	4.06	28	4.02	28	0.04	0.7
93	4.06	30	4.02	28	0.05	1.3
94	4.04	29	4.02	28	0.02	0.7
95	4.05	28	4.01	28	0.04	0.5
96	4.02	29	4.02	27	0.01	1.1
97	4.05	29	4.01	28	0.04	0.9
98	4.0	28	4.01	27	0.01	1.0
99	4.0	28	4.0	27	0.0	0.8
100	4.05	29	4.01	28	0.04	0.8
Standard deviation					0.023	0.216

Performance of tools according to VDI/VDE 2647

0 % of the torque range (hard)



Performance of tools according to VDI/VDE 2647

0 % of the torque range (soft)

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
1	4.05	368	4.0	367	0.04	0.4
2	4.01	359	4.01	358	0.01	0.2
3	3.98	357	4.01	357	0.03	0.8
4	4.02	359	4.02	359	0.0	0.1
5	4.01	351	4.01	351	0.0	0.0
6	3.98	350	4.01	359	0.02	8.8
7	4.01	359	4.01	362	0.01	3.1
8	4.0	352	4.0	357	0.01	5.4
9	4.0	350	4.0	356	0.0	5.9
10	4.01	361	4.0	360	0.01	0.5
11	4.0	353	4.0	358	0.0	4.6
12	4.03	363	4.0	362	0.03	0.4
13	4.01	360	4.0	360	0.01	0.2
14	4.0	356	4.0	356	0.0	0.5
15	4.02	358	4.0	360	0.02	2.0
16	4.01	354	4.0	358	0.0	3.9
17	4.02	357	4.01	359	0.01	1.8
18	4.02	360	4.0	360	0.01	0.8
19	3.99	355	4.0	359	0.01	4.1
20	4.0	356	4.0	359	0.0	2.8
21	4.02	359	4.01	360	0.01	1.9
22	4.0	357	4.0	357	0.0	0.4
23	3.99	353	4.0	359	0.01	5.6
24	4.05	361	4.02	359	0.04	2.1
25	4.04	362	4.01	360	0.04	1.5
26	4.02	356	4.0	359	0.02	3.1
27	4.04	362	4.0	360	0.03	1.2
28	4.02	355	4.01	354	0.0	0.8
29	4.03	358	4.0	359	0.02	0.9
30	4.02	355	4.0	356	0.01	1.7
31	4.05	359	4.01	358	0.04	0.3
32	4.03	359	4.01	359	0.03	0.2
33	3.99	352	4.01	350	0.02	1.7
34	4.0	356	4.01	360	0.01	3.7
35	4.02	358	4.02	359	0.0	0.9
36	4.04	358	4.01	358	0.03	0.1
37	4.04	361	4.01	359	0.03	1.8
38	4.05	361	4.02	359	0.04	1.8
39	4.05	362	4.01	360	0.04	1.5
40	4.03	360	4.02	359	0.01	0.3
41	4.03	357	4.02	360	0.01	2.7
42	4.0	356	4.0	356	0.0	0.4
43	4.0	354	4.01	355	0.01	1.3
44	4.02	355	4.01	353	0.01	1.3
45	4.01	354	4.02	354	0.0	0.3
46	4.02	358	4.02	359	0.01	1.0
47	4.0	355	4.01	358	0.01	2.7
48	4.01	356	4.01	357	0.0	1.5
49	4.02	355	4.0	360	0.02	4.8
50	4.05	362	4.01	368	0.04	5.8

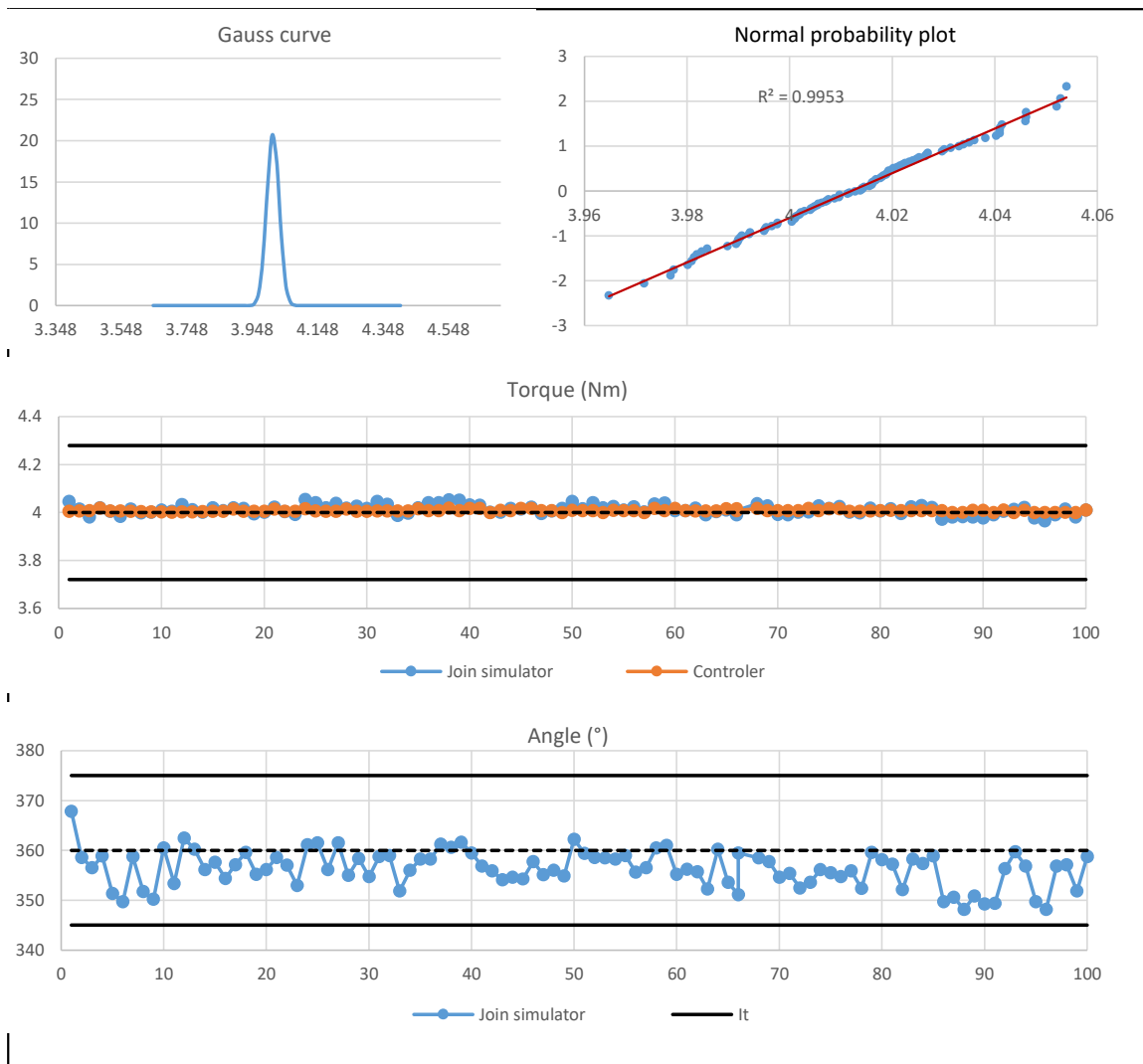
Performance of tools according to VDI/VDE 2647

0 % of the torque range (soft)

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
51	4.02	359	4.01	360	0.01	0.3
52	4.04	359	4.01	359	0.03	0.0
53	4.02	359	4.0	359	0.02	0.1
54	4.02	358	4.01	359	0.02	0.5
55	4.01	359	4.01	358	0.0	0.6
56	4.02	356	4.01	358	0.02	2.6
57	4.0	357	4.0	357	0.0	0.1
58	4.03	361	4.02	359	0.02	1.1
59	4.04	361	4.01	360	0.03	0.9
60	4.01	355	4.02	355	0.01	0.4
61	4.01	356	4.01	359	0.0	2.9
62	4.02	356	4.01	356	0.01	0.5
63	3.99	352	4.01	358	0.02	6.1
64	4.0	360	4.01	360	0.0	0.3
65	4.01	354	4.02	359	0.0	5.0
66	3.99	351	4.02	350	0.03	1.3
67	4.01	360	4.01	362	0.0	2.6
68	4.04	359	4.02	359	0.02	0.3
69	4.03	358	4.01	359	0.02	1.0
70	3.99	355	4.01	360	0.01	5.3
71	3.99	355	4.01	358	0.02	2.3
72	4.0	353	4.01	356	0.01	3.6
73	4.0	354	4.02	357	0.01	3.0
74	4.03	356	4.01	360	0.02	3.6
75	4.02	356	4.02	355	0.0	0.7
76	4.03	355	4.02	358	0.01	3.3
77	4.0	356	4.0	359	0.0	3.0
78	4.0	352	4.0	351	0.01	1.8
79	4.02	360	4.01	361	0.01	1.8
80	4.01	358	4.01	358	0.0	0.1
81	4.02	357	4.01	361	0.01	4.0
82	4.0	352	4.01	351	0.01	1.5
83	4.02	358	4.01	359	0.02	1.0
84	4.03	357	4.01	358	0.02	0.4
85	4.02	359	4.01	360	0.01	0.8
86	3.97	350	4.01	351	0.04	0.9
87	3.98	351	4.0	351	0.02	0.0
88	3.98	348	4.0	349	0.02	0.6
89	3.98	351	4.01	358	0.03	7.4
90	3.98	349	4.01	356	0.03	6.3
91	3.99	349	4.0	349	0.01	0.1
92	4.0	356	4.01	357	0.0	0.8
93	4.01	360	4.0	360	0.01	0.1
94	4.02	357	4.01	359	0.01	2.2
95	3.98	350	4.0	357	0.02	7.0
96	3.96	348	4.0	348	0.04	0.0
97	3.99	357	4.0	358	0.01	0.8
98	4.01	357	4.0	357	0.01	0.2
99	3.98	352	4.0	359	0.02	6.8
100	4.01	359	4.01	360	0.0	1.0
Standard deviation					0.011	2.007

Performance of tools according to VDI/VDE 2647

0 % of the torque range (soft)



Performance of tools according to VDI/VDE 2647

30 % of the torque range (hard)

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
1	7.1	29	7.03	28	0.07	1.1
2	7.11	29	7.02	28	0.09	1.1
3	7.06	29	7.02	28	0.04	1.0
4	7.04	29	7.03	28	0.01	1.2
5	7.07	29	7.05	28	0.02	1.1
6	7.02	28	7.01	28	0.0	0.7
7	7.05	30	7.05	29	0.0	0.9
8	7.1	29	7.03	28	0.07	1.0
9	7.06	29	7.04	28	0.02	1.1
10	6.99	28	7.02	27	0.03	0.8
11	7.06	29	7.05	28	0.01	1.3
12	7.01	28	7.04	27	0.03	1.1
13	7.1	30	7.03	29	0.07	0.8
14	7.01	29	7.01	28	0.0	0.7
15	7.04	29	7.03	28	0.01	1.0
16	7.14	29	7.05	28	0.09	0.9
17	6.97	28	7.05	27	0.08	0.8
18	7.05	29	7.05	28	0.01	1.1
19	7.15	29	7.06	28	0.09	0.8
20	7.01	28	7.02	27	0.0	1.4
21	7.04	30	7.03	28	0.01	1.4
22	7.12	29	7.05	28	0.07	1.1
23	7.09	29	7.01	29	0.08	0.6
24	7.07	29	7.01	28	0.06	0.9
25	7.07	29	7.04	28	0.03	1.3
26	7.06	29	7.05	29	0.01	0.6
27	7.11	29	7.03	29	0.08	0.6
28	7.01	28	7.0	27	0.01	0.8
29	7.12	29	7.04	28	0.08	0.9
30	7.03	28	7.03	27	0.0	0.9
31	7.04	29	7.04	28	0.0	1.3
32	7.14	30	7.05	29	0.09	0.9
33	7.06	29	7.01	28	0.05	0.9
34	7.02	28	7.03	27	0.01	1.2
35	7.07	29	7.01	28	0.06	0.8
36	7.07	29	7.06	28	0.01	1.2
37	7.14	29	7.06	28	0.08	0.9
38	7.02	29	7.03	28	0.01	1.0
39	7.03	29	7.05	28	0.01	1.2
40	7.15	30	7.02	29	0.13	1.0
41	7.06	29	7.05	28	0.01	1.2
42	7.1	29	7.06	28	0.04	0.9
43	7.12	29	7.04	28	0.08	1.0
44	7.03	28	7.02	27	0.01	1.1
45	7.03	29	7.02	28	0.01	0.9
46	7.03	30	7.06	28	0.02	1.0
47	7.09	29	7.06	27	0.04	1.3
48	7.04	29	7.03	28	0.01	1.1
49	7.05	28	7.05	27	0.0	0.9
50	7.14	29	7.04	28	0.11	1.0

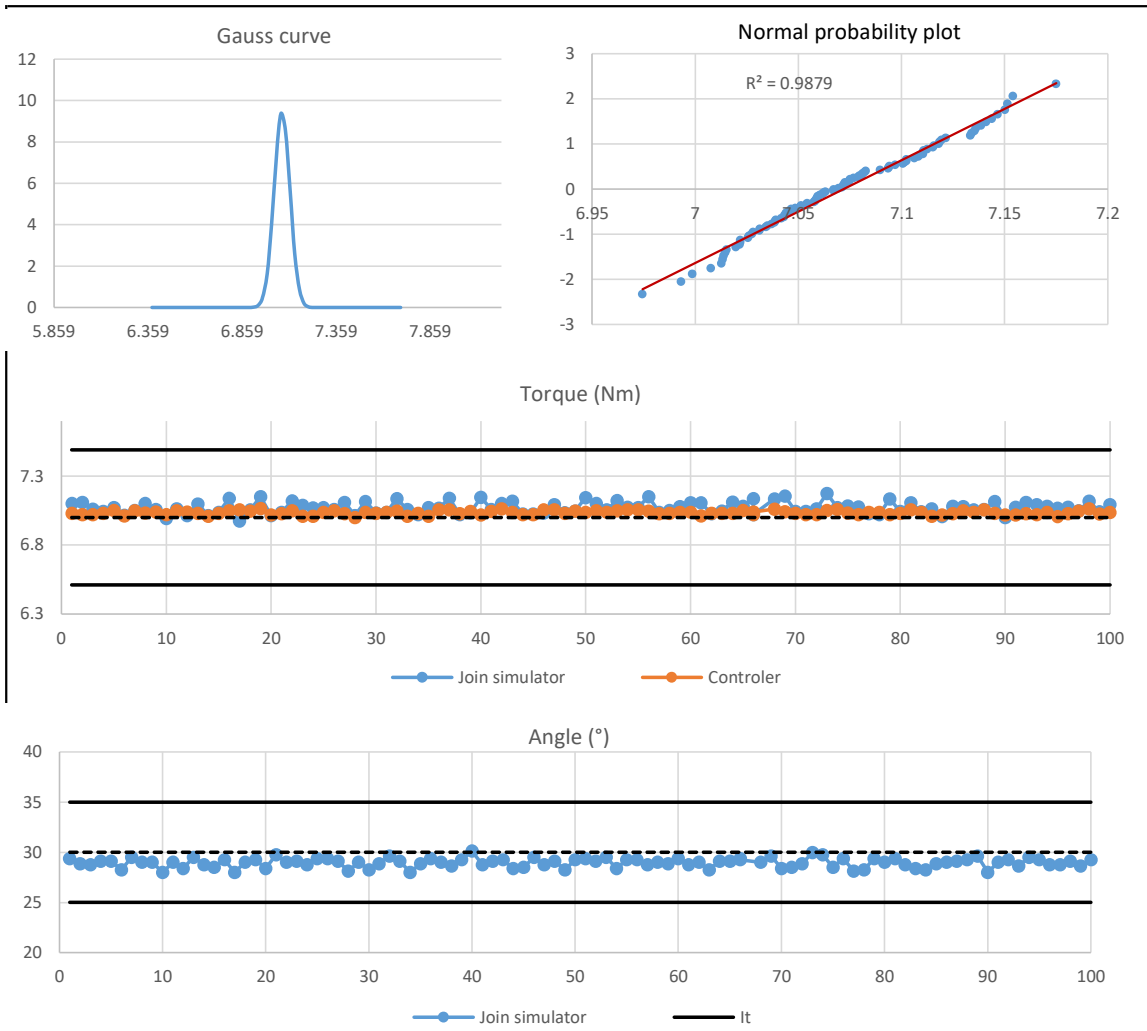
Performance of tools according to VDI/VDE 2647

30 % of the torque range (hard)

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
51	7.1	29	7.05	29	0.05	0.8
52	7.06	29	7.04	28	0.02	1.2
53	7.12	30	7.05	29	0.07	0.9
54	7.08	28	7.06	27	0.02	1.1
55	7.07	29	7.06	29	0.02	0.7
56	7.15	29	7.05	28	0.11	0.9
57	7.04	29	7.03	28	0.01	0.8
58	7.05	29	7.03	28	0.02	0.9
59	7.08	29	7.04	28	0.04	1.0
60	7.11	29	7.04	29	0.07	0.6
61	7.11	29	7.01	28	0.09	0.9
62	7.03	29	7.03	28	0.0	0.8
63	7.05	28	7.03	27	0.02	1.0
64	7.11	29	7.03	29	0.08	0.6
65	7.08	29	7.05	28	0.03	1.1
66	7.14	29	7.02	29	0.11	0.8
67	7.02	29	7.04	28	0.02	1.1
68	7.13	29	7.06	28	0.07	0.8
69	7.15	30	7.04	29	0.11	0.9
70	7.04	28	7.03	28	0.01	0.7
71	7.05	29	7.02	27	0.02	1.0
72	7.06	29	7.02	28	0.04	1.0
73	7.17	30	7.05	29	0.13	0.9
74	7.07	30	7.06	29	0.01	1.2
75	7.08	29	7.03	27	0.05	1.3
76	7.08	29	7.02	28	0.05	1.0
77	7.03	28	7.04	27	0.01	1.0
78	7.02	28	7.04	27	0.02	0.9
79	7.13	29	7.02	28	0.11	0.9
80	7.04	29	7.03	28	0.01	1.2
81	7.11	29	7.06	29	0.05	0.7
82	7.04	29	7.04	27	0.0	1.4
83	7.06	28	7.01	28	0.05	0.8
84	7.01	28	7.02	27	0.01	1.1
85	7.08	29	7.03	28	0.05	1.0
86	7.08	29	7.05	28	0.03	0.9
87	7.05	29	7.04	28	0.02	1.1
88	7.06	29	7.06	28	0.0	1.1
89	7.12	30	7.03	29	0.09	1.0
90	7.0	28	7.02	27	0.02	1.3
91	7.07	29	7.02	28	0.06	0.7
92	7.11	29	7.03	28	0.08	1.2
93	7.09	29	7.02	28	0.07	1.1
94	7.08	30	7.04	29	0.04	0.9
95	7.07	29	7.01	28	0.06	1.0
96	7.07	29	7.03	27	0.05	1.4
97	7.05	29	7.05	28	0.0	0.9
98	7.12	29	7.06	28	0.06	0.8
99	7.04	29	7.02	27	0.02	1.1
100	7.09	29	7.04	28	0.06	1.3
Standard deviation					0.035	0.200

Performance of tools according to VDI/VDE 2647

30 % of the torque range (hard)



Performance of tools according to VDI/VDE 2647

30 % of the torque range (soft)

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
1	7.03	365	7.01	364	0.03	1.7
2	7.1	371	7.01	368	0.09	2.5
3	7.08	374	7.01	371	0.08	2.2
4	7.05	368	7.01	365	0.05	3.7
5	7.07	370	7.01	364	0.06	5.1
6	7.06	366	7.01	360	0.05	6.0
7	7.0	359	7.0	356	0.0	2.8
8	7.04	363	7.03	361	0.01	1.2
9	7.04	368	7.01	362	0.03	5.6
10	7.06	370	7.01	365	0.04	5.0
11	7.07	375	7.03	371	0.04	3.6
12	7.0	364	7.01	362	0.01	1.9
13	7.07	372	7.01	366	0.05	5.5
14	7.07	367	7.01	361	0.06	6.0
15	7.01	362	7.01	359	0.01	2.9
16	7.1	369	7.02	370	0.08	0.8
17	7.0	362	7.0	362	0.0	0.4
18	7.03	366	7.0	365	0.03	1.2
19	7.02	367	7.0	361	0.02	6.7
20	7.04	371	7.01	370	0.03	1.7
21	7.1	378	7.01	374	0.08	3.8
22	7.07	370	7.0	367	0.06	2.5
23	7.02	363	7.0	361	0.01	2.1
24	6.99	359	7.02	357	0.03	1.9
25	7.03	365	7.01	361	0.02	4.2
26	7.08	375	7.01	371	0.08	3.8
27	7.06	371	7.01	369	0.05	2.0
28	7.06	373	7.01	367	0.05	5.9
29	7.12	375	7.03	372	0.09	2.4
30	7.09	376	7.0	372	0.09	3.7
31	7.05	368	7.01	365	0.04	3.3
32	7.07	371	7.0	370	0.07	0.5
33	7.03	366	7.01	362	0.03	4.8
34	7.07	370	7.01	371	0.06	1.2
35	7.09	371	7.02	369	0.07	1.2
36	7.01	368	7.0	365	0.01	3.3
37	7.04	370	7.02	366	0.02	4.1
38	7.02	369	7.0	363	0.02	6.0
39	7.02	367	7.01	365	0.01	2.0
40	7.05	371	7.02	373	0.03	2.4
41	7.05	370	7.01	371	0.04	1.3
42	7.07	368	7.01	368	0.06	0.0
43	7.06	369	7.02	369	0.04	0.6
44	7.05	371	7.01	366	0.04	5.0
45	7.04	370	7.01	366	0.03	3.6
46	7.08	374	7.01	371	0.07	2.6
47	7.08	375	7.01	372	0.07	2.6
48	7.04	372	7.0	365	0.04	6.9
49	7.09	377	7.01	372	0.08	5.6
50	7.07	369	7.009	365	0.06	4.0

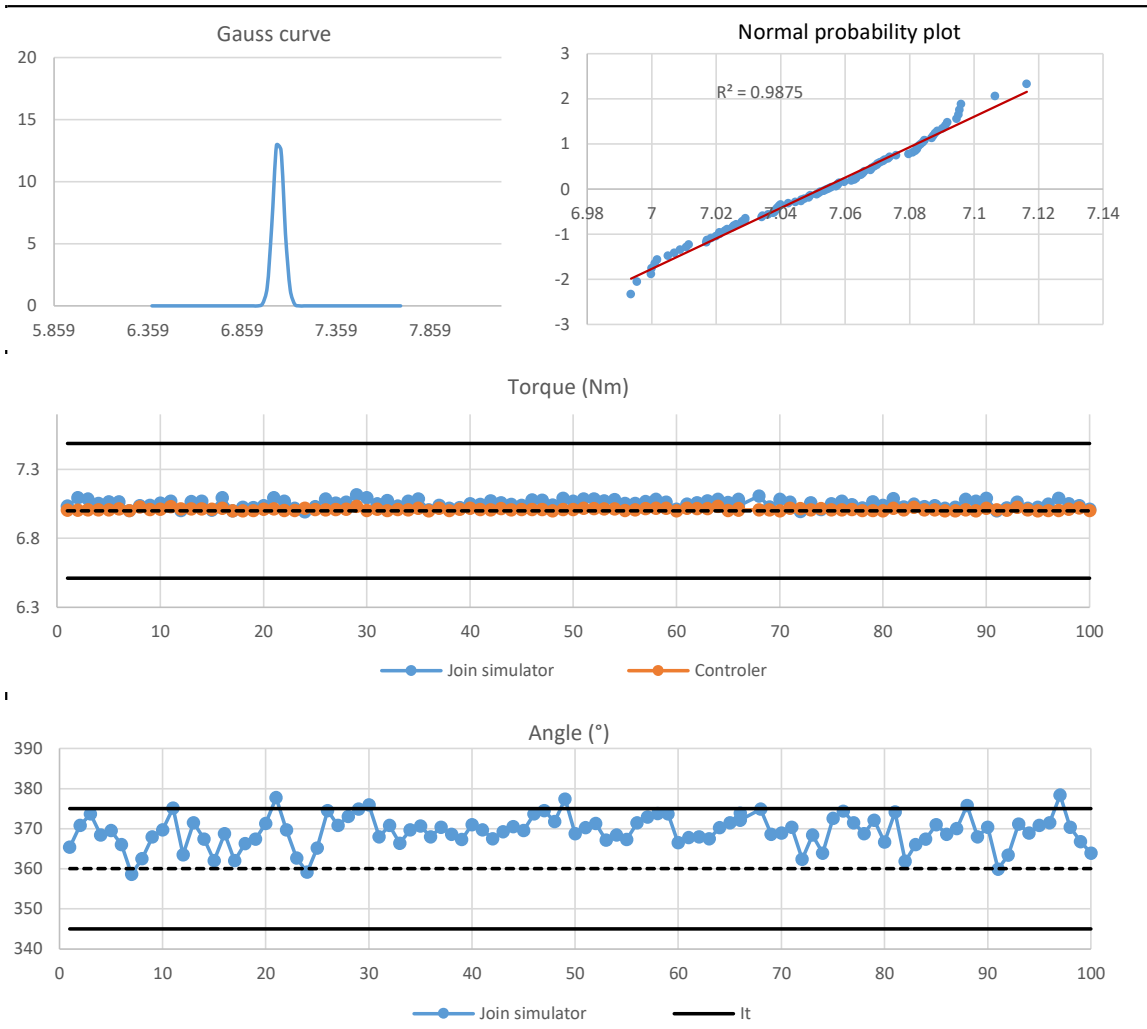
Performance of tools according to VDI/VDE 2647

30 % of the torque range (soft)

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
51	7.09	370	7.02	371	0.07	0.9
52	7.09	371	7.02	371	0.07	0.3
53	7.07	367	7.01	363	0.06	4.3
54	7.08	368	7.01	366	0.07	2.3
55	7.05	367	7.0	363	0.05	4.0
56	7.05	371	7.01	367	0.05	3.9
57	7.07	373	7.02	370	0.05	3.3
58	7.08	374	7.02	367	0.07	6.6
59	7.06	374	7.02	367	0.05	7.1
60	7.01	367	7.0	363	0.01	3.9
61	7.05	368	7.02	365	0.03	2.6
62	7.06	368	7.02	364	0.04	4.4
63	7.07	368	7.01	360	0.06	7.6
64	7.08	370	7.03	368	0.05	1.9
65	7.06	372	7.0	370	0.06	1.9
66	7.08	374	7.01	371	0.07	3.0
67	7.04	372	7.01	366	0.03	5.7
68	7.11	375	7.01	373	0.1	1.7
69	7.03	369	7.01	365	0.02	3.6
70	7.08	369	7.0	364	0.08	5.2
71	7.06	370	7.02	363	0.04	7.3
72	7.0	362	7.02	360	0.02	2.7
73	7.06	368	7.01	368	0.05	0.4
74	7.01	364	7.02	360	0.01	4.2
75	7.05	373	7.01	368	0.05	4.4
76	7.07	374	7.01	372	0.06	2.3
77	7.04	372	7.01	365	0.04	6.1
78	7.02	369	7.0	365	0.02	4.0
79	7.06	372	7.0	372	0.06	0.0
80	7.04	367	7.0	362	0.04	4.5
81	7.09	374	7.02	373	0.07	1.2
82	7.03	362	7.01	359	0.02	2.5
83	7.05	366	7.03	365	0.02	0.8
84	7.03	367	7.01	366	0.02	1.2
85	7.04	371	7.01	368	0.03	2.6
86	7.02	369	7.0	366	0.02	2.9
87	7.03	370	7.0	365	0.03	5.1
88	7.08	376	7.01	374	0.07	2.0
89	7.07	368	7.0	364	0.07	4.2
90	7.09	370	7.02	370	0.07	0.8
91	7.0	360	7.01	360	0.01	0.4
92	7.02	363	7.01	360	0.02	3.1
93	7.06	371	7.02	367	0.04	4.3
94	7.02	369	7.01	368	0.01	0.9
95	7.03	371	7.0	368	0.03	3.0
96	7.05	372	7.0	367	0.05	4.8
97	7.09	378	7.0	374	0.09	4.1
98	7.05	370	7.01	368	0.04	2.4
99	7.04	367	7.02	363	0.02	3.3
100	7.01	364	7.0	361	0.01	2.6
Standard deviation					0.024	1.852

Performance of tools according to VDI/VDE 2647

30 % of the torque range (soft)



Performance of tools according to VDI/VDE 2647

100 % of the torque range (hard)

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
1	14.11	32	14.08	31	0.03	1.0
2	14.14	33	14.05	31	0.09	1.3
3	14.27	33	14.11	32	0.16	1.1
4	14.11	32	14.02	31	0.09	1.2
5	14.15	33	14.04	32	0.11	1.0
6	14.24	32	14.04	31	0.2	0.8
7	14.08	32	14.05	31	0.03	0.8
8	14.0	32	14.04	30	0.05	1.2
9	13.98	32	14.03	31	0.05	0.7
10	14.18	33	14.09	32	0.09	1.2
11	14.13	32	14.09	31	0.04	0.9
12	14.07	32	14.06	32	0.01	0.7
13	14.02	31	14.05	30	0.03	1.3
14	14.06	32	14.04	31	0.02	0.8
15	14.29	33	14.12	32	0.17	1.1
16	13.99	32	14.02	30	0.03	1.2
17	14.35	33	14.11	32	0.24	1.2
18	14.23	33	14.11	32	0.12	0.8
19	13.96	31	14.05	30	0.09	1.3
20	14.15	32	14.1	31	0.05	0.8
21	14.28	32	14.04	31	0.24	1.0
22	14.12	33	14.08	32	0.04	0.8
23	14.07	32	14.08	31	0.01	0.8
24	14.24	33	14.09	32	0.16	1.1
25	14.05	32	14.04	31	0.01	1.0
26	14.01	32	14.08	31	0.07	0.7
27	14.26	33	14.02	31	0.24	1.1
28	14.08	31	14.07	30	0.01	1.3
29	14.02	32	14.07	30	0.04	1.4
30	14.2	32	14.03	31	0.17	0.7
31	14.19	32	14.06	31	0.13	1.5
32	14.1	32	14.07	31	0.03	0.8
33	14.24	32	14.12	32	0.12	0.8
34	14.1	32	14.08	31	0.03	1.2
35	14.15	32	14.06	31	0.09	0.8
36	14.24	33	14.08	32	0.16	0.9
37	14.09	32	14.05	31	0.04	0.9
38	14.16	32	14.06	31	0.1	1.1
39	14.25	33	14.08	32	0.17	1.0
40	14.03	32	14.05	31	0.02	1.0
41	14.28	33	14.06	32	0.22	1.0
42	14.18	32	14.01	31	0.17	1.2
43	14.04	32	14.06	31	0.02	1.3
44	14.07	31	14.09	30	0.01	1.5
45	14.12	31	14.04	30	0.08	1.5
46	14.11	32	14.07	31	0.04	0.6
47	14.11	32	14.05	31	0.06	1.0
48	14.13	32	14.1	31	0.03	1.2
49	14.09	31	14.04	30	0.05	1.0
50	13.95	32	14.08	31	0.13	0.7

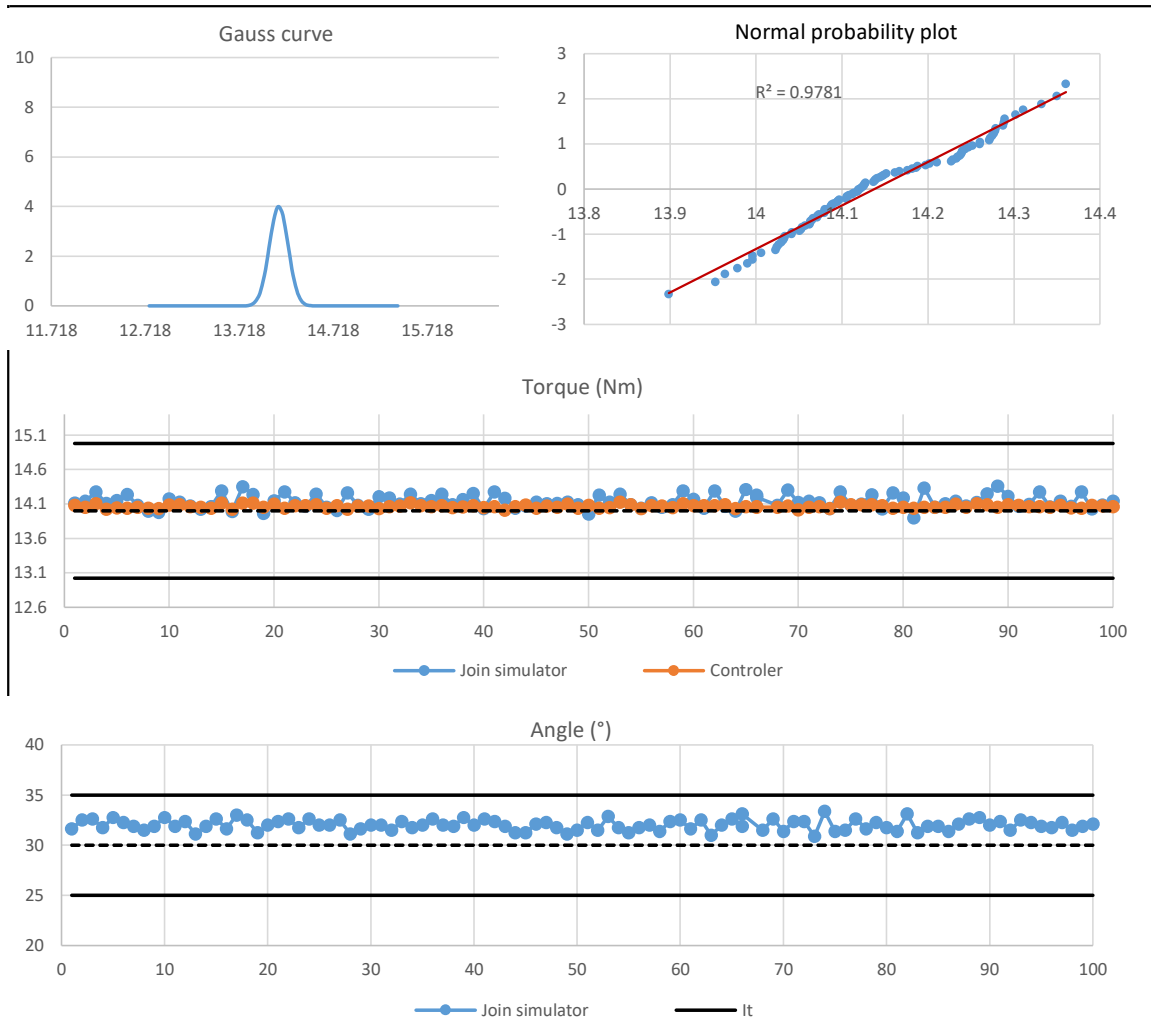
Performance of tools according to VDI/VDE 2647

100 % of the torque range (hard)

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
51	14.23	32	14.04	31	0.19	1.2
52	14.13	32	14.05	30	0.08	1.5
53	14.24	33	14.12	32	0.12	1.0
54	14.09	32	14.09	31	0.0	1.2
55	14.03	31	14.03	30	0.0	1.1
56	14.12	32	14.08	30	0.04	1.4
57	14.05	32	14.07	31	0.02	0.7
58	14.09	31	14.05	30	0.04	1.1
59	14.29	32	14.11	31	0.18	0.9
60	14.17	33	14.08	31	0.09	1.0
61	14.04	32	14.08	30	0.04	1.2
62	14.29	33	14.08	31	0.21	1.1
63	14.06	31	14.09	30	0.03	0.6
64	14.0	32	14.03	31	0.04	0.7
65	14.31	33	14.06	32	0.25	1.0
66	14.23	32	14.06	31	0.17	1.0
67	14.2	33	14.05	32	0.15	1.0
68	14.08	32	14.05	31	0.03	0.8
69	14.3	33	14.07	31	0.23	1.2
70	14.12	31	14.01	30	0.11	1.1
71	14.14	32	14.05	31	0.09	0.9
72	14.12	32	14.06	31	0.06	0.9
73	14.03	31	14.03	30	0.0	1.0
74	14.27	33	14.13	33	0.15	0.8
75	14.08	31	14.09	30	0.01	1.0
76	14.1	32	14.09	31	0.01	0.9
77	14.23	33	14.09	32	0.14	1.1
78	14.03	32	14.08	31	0.05	1.0
79	14.26	32	14.04	31	0.22	0.9
80	14.19	32	14.05	31	0.13	1.0
81	13.9	31	14.03	31	0.14	0.6
82	14.33	33	14.05	32	0.28	0.9
83	14.05	31	14.05	30	0.0	1.3
84	14.11	32	14.05	31	0.05	0.9
85	14.14	32	14.1	31	0.04	0.9
86	14.07	31	14.05	31	0.02	0.7
87	14.12	32	14.11	31	0.02	0.9
88	14.25	33	14.09	32	0.16	0.7
89	14.36	33	14.05	32	0.31	1.0
90	14.21	32	14.09	31	0.12	0.9
91	14.06	32	14.08	31	0.02	0.9
92	14.09	32	14.06	30	0.03	1.0
93	14.27	33	14.06	31	0.21	1.0
94	14.06	32	14.05	31	0.0	1.2
95	14.14	32	14.08	31	0.06	0.8
96	14.07	32	14.04	31	0.02	0.9
97	14.28	32	14.03	31	0.24	1.0
98	14.03	32	14.08	31	0.05	0.6
99	14.09	32	14.07	31	0.01	1.2
100	14.14	32	14.06	31	0.08	1.3
Standard deviation					0.077	0.217

Performance of tools according to VDI/VDE 2647

100 % of the torque range (hard)



Performance of tools according to VDI/VDE 2647

100 % of the torque range (soft)

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
1	14.15	367	14.07	360	0.08	7.1
2	13.97	356	14.01	356	0.04	0.4
3	14.02	360	14.01	357	0.01	3.2
4	13.96	357	14.0	359	0.04	1.8
5	14.09	356	14.03	351	0.06	4.7
6	14.01	367	14.05	367	0.04	0.3
7	14.06	364	14.02	360	0.04	3.3
8	14.04	370	14.03	365	0.02	5.7
9	14.14	361	14.01	355	0.13	5.9
10	14.01	366	14.01	363	0.0	3.2
11	14.13	361	14.05	355	0.09	5.9
12	14.03	366	14.01	364	0.02	2.5
13	14.03	356	14.01	355	0.02	1.4
14	14.06	364	14.03	362	0.03	1.7
15	13.97	357	14.02	354	0.04	3.7
16	14.06	366	14.01	360	0.05	6.1
17	13.99	356	14.03	351	0.04	4.6
18	14.02	366	14.01	363	0.01	3.5
19	14.01	361	14.05	359	0.04	1.8
20	14.1	369	14.02	361	0.07	8.1
21	14.01	360	14.03	356	0.02	3.9
22	14.09	371	14.03	366	0.06	4.9
23	14.0	367	14.01	369	0.01	2.2
24	14.1	369	14.01	361	0.09	8.3
25	13.92	365	14.0	361	0.08	4.1
26	14.15	371	14.03	371	0.12	0.5
27	14.02	366	14.02	359	0.0	6.6
28	14.05	363	14.02	357	0.03	5.9
29	14.02	366	14.02	360	0.0	5.6
30	14.1	362	14.03	359	0.07	2.9
31	13.97	365	14.0	362	0.03	3.1
32	14.09	360	14.03	355	0.06	5.2
33	13.99	364	14.01	361	0.01	3.3
34	14.06	360	14.01	357	0.05	2.2
35	13.96	363	14.05	360	0.09	3.3
36	14.1	362	14.01	358	0.09	4.0
37	14.14	373	14.1	370	0.03	3.5
38	14.17	365	14.05	359	0.11	6.2
39	13.98	364	14.02	359	0.04	5.6
40	14.05	362	14.01	358	0.04	3.7
41	14.01	365	14.03	359	0.01	5.5
42	14.09	361	14.05	358	0.04	3.0
43	14.16	372	14.04	371	0.12	1.5
44	14.05	360	14.0	356	0.05	3.6
45	14.13	376	14.05	373	0.07	2.4
46	14.02	360	14.02	356	0.0	3.9
47	14.03	368	14.02	364	0.01	4.3
48	14.11	364	14.05	358	0.06	6.5
49	14.14	376	14.04	374	0.1	1.5
50	14.02	364	14.01	361	0.01	2.7

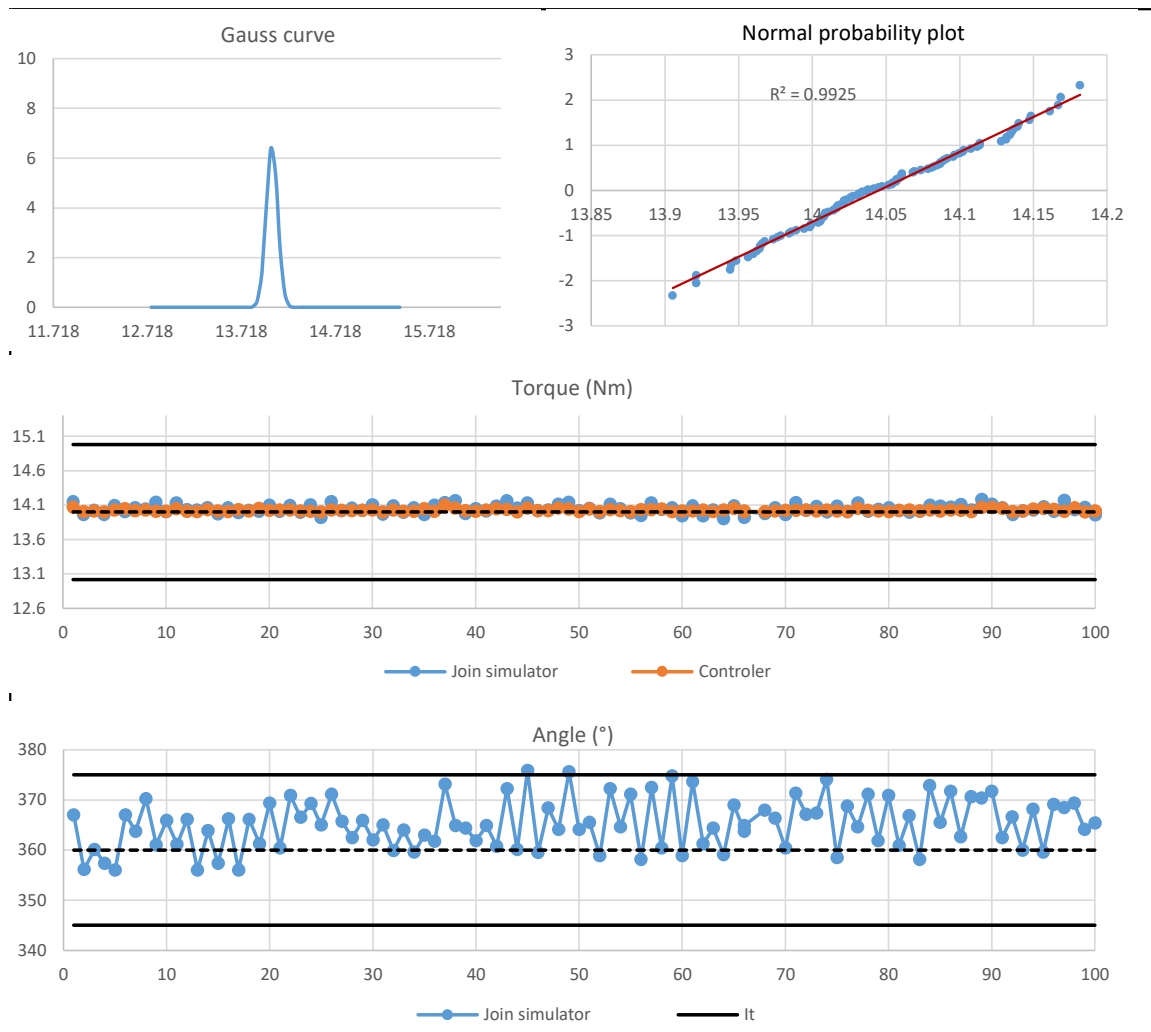
Performance of tools according to VDI/VDE 2647

100 % of the torque range (soft)

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
51	14.05	366	14.04	360	0.01	5.9
52	13.99	359	14.01	357	0.02	1.7
53	14.11	372	14.03	370	0.08	2.6
54	14.05	365	14.02	361	0.03	4.0
55	13.98	371	14.01	373	0.02	1.7
56	13.95	358	14.03	355	0.09	2.9
57	14.13	373	14.03	369	0.1	3.2
58	14.04	360	14.04	357	0.01	3.8
59	14.06	375	14.01	368	0.05	6.6
60	13.94	359	14.02	357	0.07	2.2
61	14.09	374	14.02	370	0.07	3.2
62	13.94	361	14.02	361	0.08	0.7
63	14.03	364	14.01	361	0.02	3.0
64	13.91	359	14.02	361	0.12	1.4
65	14.09	369	14.05	362	0.04	7.4
66	13.92	364	14.01	361	0.09	2.3
67	14.0	365	14.0	361	0.0	3.4
68	13.98	368	14.0	369	0.03	1.4
69	14.06	366	14.01	360	0.04	6.0
70	13.96	360	14.02	359	0.06	1.2
71	14.14	371	14.02	369	0.11	2.1
72	14.02	367	14.03	371	0.01	3.8
73	14.08	367	14.01	360	0.07	7.3
74	14.0	374	14.03	375	0.03	1.2
75	14.08	359	14.01	356	0.07	2.9
76	14.01	369	14.0	363	0.0	5.3
77	14.13	365	14.05	360	0.08	4.5
78	14.01	371	14.02	366	0.01	5.1
79	14.04	362	14.01	357	0.02	4.7
80	14.06	371	14.0	371	0.06	0.1
81	14.02	361	14.02	357	0.0	3.6
82	14.0	367	14.03	363	0.03	4.2
83	14.01	358	14.01	354	0.0	3.7
84	14.1	373	14.03	371	0.07	2.0
85	14.08	366	14.01	362	0.07	3.3
86	14.07	372	14.03	371	0.04	1.0
87	14.11	363	14.02	358	0.09	4.2
88	14.03	371	14.0	368	0.03	2.3
89	14.18	370	14.07	368	0.11	2.6
90	14.11	372	14.07	370	0.05	1.9
91	14.06	363	14.05	358	0.01	4.1
92	13.96	367	14.0	361	0.04	5.3
93	14.01	360	14.01	357	0.0	3.4
94	14.03	368	14.04	361	0.01	6.9
95	14.07	360	14.05	358	0.02	1.3
96	14.01	369	14.04	369	0.03	0.2
97	14.17	369	14.01	362	0.16	7.0
98	14.03	369	14.06	368	0.02	1.3
99	14.07	364	14.0	360	0.07	4.1
100	13.96	365	14.01	362	0.06	3.2
Standard deviation					0.035	1.919

Performance of tools according to VDI/VDE 2647

100 % of the torque range (soft)



Performance of tools according to VDI/VDE 2647

Tightening at 30°

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
1	8.47	28	8.41	27	0.06	0.9
2	8.42	28	8.36	27	0.06	0.8
3	8.4	29	8.29	27	0.12	1.1
4	8.49	29	8.46	27	0.02	1.1
5	8.41	28	8.31	27	0.1	0.6
6	8.46	29	8.41	27	0.05	1.2
7	8.46	28	8.36	27	0.1	0.6
8	8.46	28	8.47	27	0.02	0.7
9	8.54	28	8.5	27	0.04	0.8
10	8.45	28	8.4	27	0.05	0.5
11	8.48	29	8.37	27	0.11	1.2
12	8.5	28	8.32	27	0.18	0.7
13	8.43	29	8.32	27	0.11	1.1
14	8.51	28	8.48	27	0.03	1.0
15	8.52	28	8.51	27	0.01	0.7
16	8.5	29	8.42	27	0.08	1.1
17	8.47	28	8.36	27	0.11	0.4
18	8.52	28	8.39	27	0.13	0.7
19	8.46	29	8.44	27	0.02	1.2
20	8.53	28	8.43	27	0.09	1.0
21	8.41	28	8.35	28	0.06	0.7
22	8.51	29	8.48	27	0.04	1.1
23	8.53	29	8.41	27	0.11	1.2
24	8.52	28	8.47	27	0.05	0.7
25	8.5	28	8.43	27	0.07	0.7
26	8.5	28	8.38	27	0.12	0.5
27	8.45	28	8.38	27	0.07	1.0
28	8.47	28	8.42	27	0.05	0.5
29	8.57	29	8.47	27	0.1	1.2
30	8.47	28	8.3	27	0.17	0.5
31	8.53	28	8.36	27	0.17	0.9
32	8.51	28	8.44	27	0.07	0.8
33	8.49	28	8.4	27	0.09	0.6
34	8.49	29	8.44	27	0.05	1.1
35	8.5	29	8.44	27	0.06	1.1
36	8.49	28	8.39	27	0.1	0.5
37	8.52	29	8.5	27	0.02	1.1
38	8.53	28	8.49	27	0.04	0.6
39	8.48	28	8.38	27	0.11	0.7
40	8.5	28	8.37	27	0.13	0.8
41	8.53	28	8.46	27	0.07	0.7
42	8.45	28	8.35	27	0.1	1.0
43	8.52	28	8.45	27	0.07	0.5
44	8.55	28	8.4	27	0.15	0.8
45	8.53	28	8.42	27	0.1	0.9
46	8.51	28	8.42	27	0.09	0.6
47	8.52	28	8.42	27	0.1	0.7
48	8.45	29	8.33	27	0.11	1.1
49	8.48	28	8.37	27	0.12	1.0
50	8.53	28	8.45	27	0.08	0.7

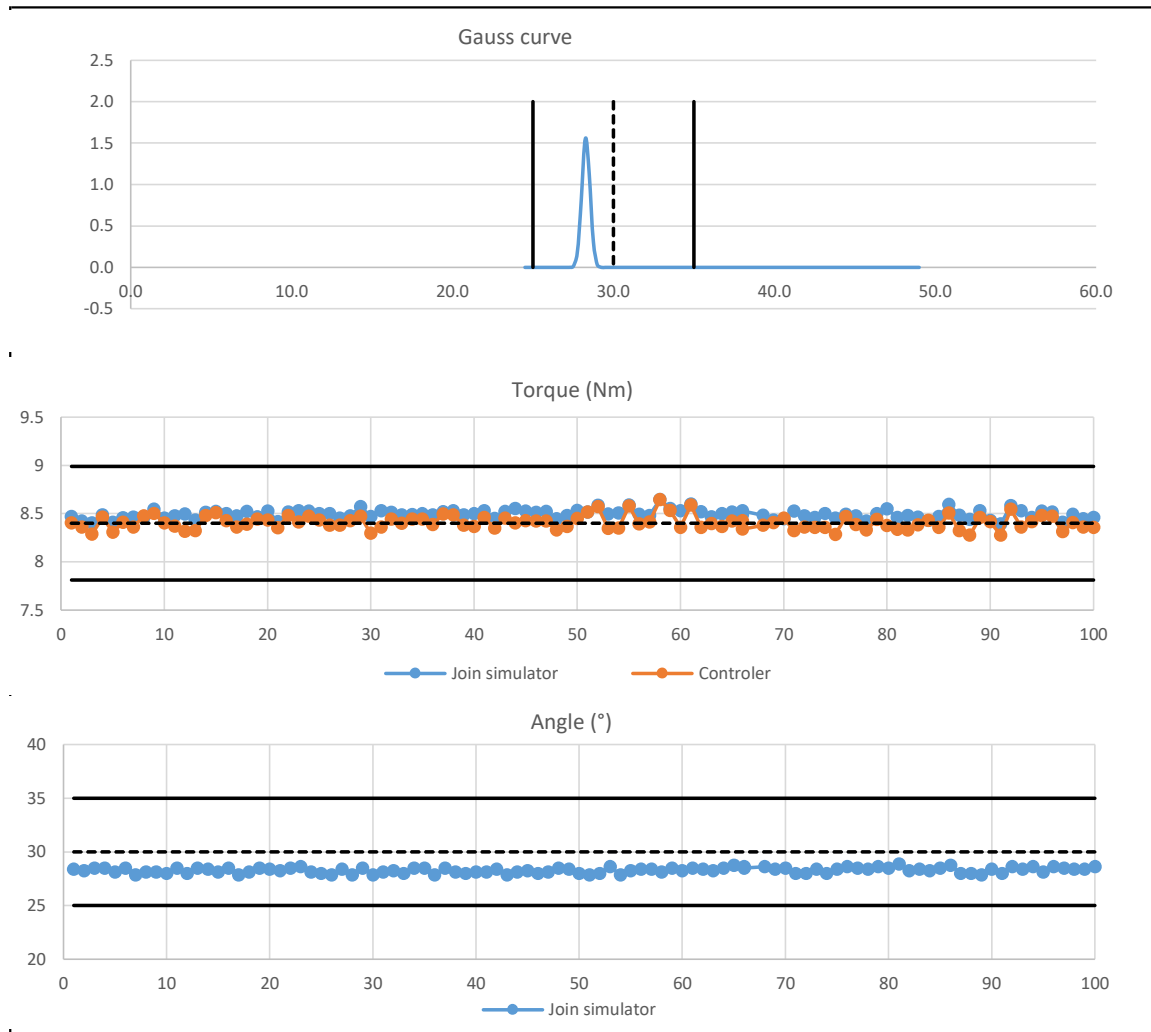
Performance of tools according to VDI/VDE 2647

Tightening at 30°

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
51	8.51	28	8.52	27	0.0	0.5
52	8.59	28	8.57	27	0.02	0.7
53	8.49	29	8.35	27	0.15	1.3
54	8.51	28	8.35	27	0.16	0.5
55	8.59	28	8.58	27	0.01	0.9
56	8.49	28	8.39	27	0.1	1.0
57	8.48	28	8.41	27	0.07	0.9
58	8.65	28	8.64	27	0.0	0.8
59	8.55	29	8.53	27	0.02	1.0
60	8.53	28	8.36	27	0.17	0.8
61	8.6	29	8.59	27	0.01	1.2
62	8.52	28	8.36	27	0.16	0.9
63	8.47	28	8.39	27	0.07	0.9
64	8.5	29	8.37	27	0.13	1.2
65	8.52	29	8.42	27	0.09	1.3
66	8.49	29	8.42	27	0.06	1.2
67	8.53	29	8.34	27	0.19	1.2
68	8.48	29	8.38	27	0.11	1.2
69	8.43	28	8.41	27	0.03	0.9
70	8.45	29	8.45	27	0.01	1.0
71	8.53	28	8.32	27	0.21	0.6
72	8.48	28	8.36	27	0.12	0.6
73	8.46	28	8.36	27	0.1	1.0
74	8.5	28	8.36	27	0.14	0.6
75	8.45	28	8.28	27	0.17	0.9
76	8.49	29	8.47	27	0.02	1.3
77	8.47	29	8.39	27	0.09	1.0
78	8.42	28	8.33	27	0.09	0.9
79	8.5	29	8.44	27	0.06	1.2
80	8.55	29	8.37	27	0.18	1.1
81	8.46	29	8.34	27	0.12	1.5
82	8.48	28	8.33	27	0.15	0.9
83	8.46	28	8.38	27	0.08	0.9
84	8.43	28	8.43	27	0.0	0.8
85	8.47	29	8.36	27	0.11	1.1
86	8.59	29	8.51	27	0.09	1.3
87	8.48	28	8.32	27	0.16	0.6
88	8.44	28	8.27	27	0.17	0.6
89	8.53	28	8.46	27	0.07	0.5
90	8.43	28	8.42	27	0.01	0.9
91	8.39	28	8.28	27	0.12	0.6
92	8.58	29	8.55	27	0.04	1.2
93	8.53	28	8.36	27	0.17	1.1
94	8.46	29	8.42	27	0.04	1.1
95	8.52	28	8.48	27	0.04	0.7
96	8.52	29	8.47	27	0.04	1.3
97	8.41	29	8.31	28	0.1	1.0
98	8.49	28	8.41	27	0.08	0.9
99	8.45	28	8.36	27	0.09	0.9
100	8.46	29	8.36	27	0.1	1.2
Standard deviation					0.050	0.247

Performance of tools according to VDI/VDE 2647

Tightening at 30°



Performance of tools according to VDI/VDE 2647

Tightening at 180°

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
1	11.16	179	11.1	177	0.05	1.4
2	11.1	178	11.05	177	0.05	0.1
3	11.02	178	10.9	177	0.12	0.4
4	11.09	179	11.01	177	0.08	1.6
5	11.12	178	11.05	177	0.06	0.8
6	11.11	177	10.91	177	0.2	0.1
7	11.09	178	11.04	177	0.05	0.7
8	10.99	178	10.84	177	0.15	0.5
9	11.07	179	11.05	177	0.02	1.3
10	11.05	178	10.91	177	0.14	1.2
11	11.21	179	11.17	177	0.04	1.4
12	11.1	178	10.94	177	0.16	0.7
13	11.08	178	11.1	177	0.01	1.1
14	11.06	179	11.06	177	0.01	1.5
15	11.02	179	10.92	177	0.1	1.4
16	11.16	178	11.11	177	0.05	0.9
17	11.17	178	11.11	177	0.06	0.7
18	10.98	178	10.97	177	0.01	0.9
19	10.98	178	11.0	177	0.03	0.4
20	11.04	178	11.04	177	0.0	0.6
21	11.17	178	11.21	177	0.04	0.9
22	11.2	178	11.22	177	0.01	0.9
23	11.11	178	11.03	177	0.08	0.6
24	11.11	178	11.08	177	0.03	0.4
25	11.04	178	11.01	177	0.03	1.2
26	11.03	179	10.92	177	0.11	1.3
27	11.2	178	11.21	177	0.01	1.1
28	11.15	178	11.1	177	0.05	0.6
29	11.07	178	11.03	177	0.03	0.9
30	10.96	178	11.01	177	0.04	0.8
31	11.03	178	11.0	177	0.02	0.4
32	11.06	179	11.04	177	0.01	1.6
33	11.1	178	10.96	177	0.15	0.6
34	11.2	178	11.06	177	0.14	0.9
35	11.02	178	11.01	177	0.01	0.7
36	10.97	178	10.92	177	0.05	0.6
37	11.08	178	10.97	177	0.11	1.2
38	11.01	179	10.93	177	0.09	1.5
39	11.1	178	10.98	177	0.11	0.7
40	11.22	179	11.2	177	0.02	1.7
41	11.06	178	11.04	177	0.01	0.6
42	11.01	179	11.01	177	0.01	1.3
43	11.02	178	11.03	177	0.01	0.6
44	11.12	179	11.13	177	0.01	1.5
45	11.02	177	10.9	177	0.12	0.2
46	11.19	178	11.09	177	0.11	0.5
47	11.04	178	11.03	177	0.01	0.5
48	10.99	178	10.98	177	0.01	0.2
49	11.14	178	11.1	177	0.05	1.2
50	11.09	178	11.0	177	0.09	0.7

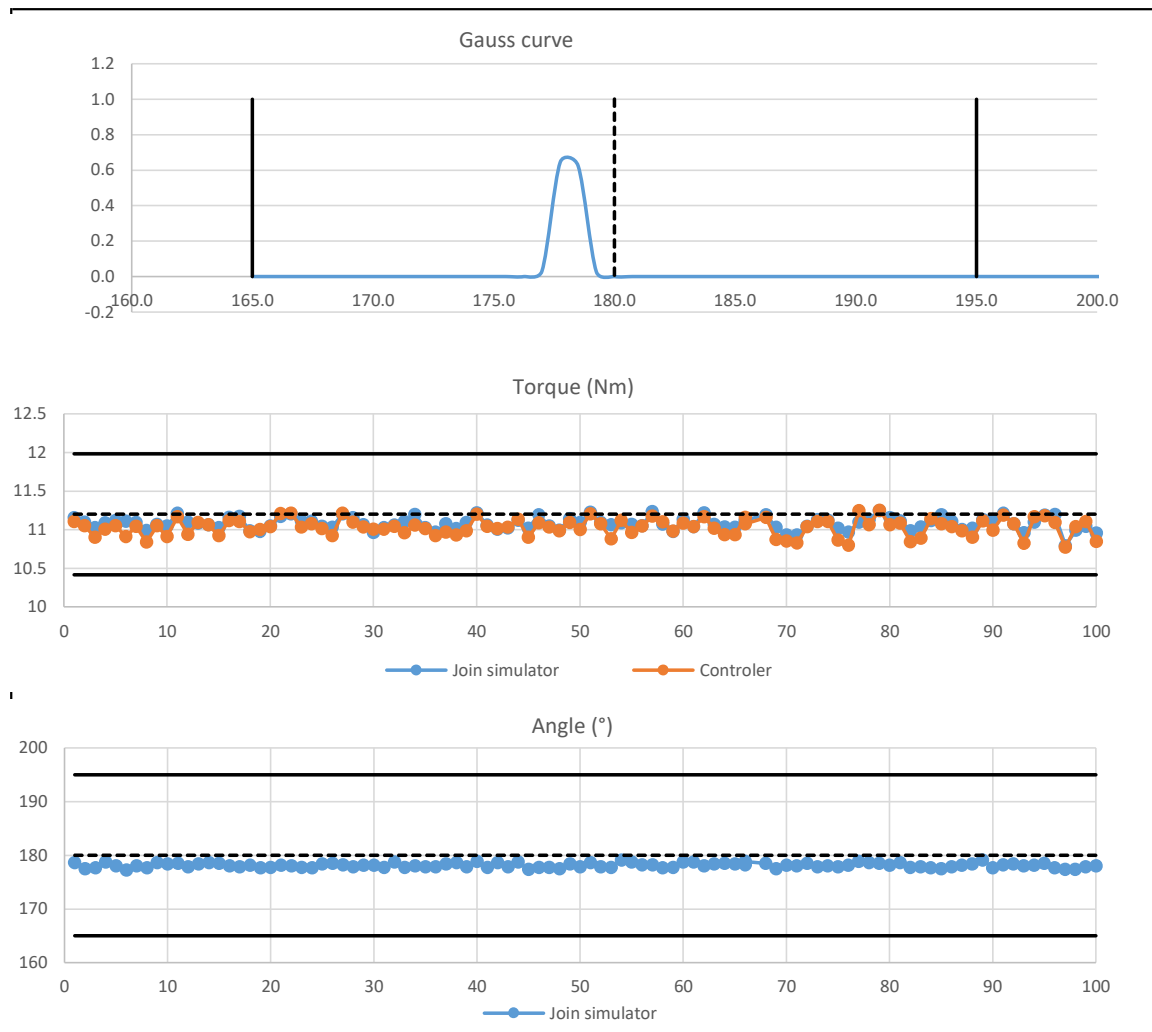
Performance of tools according to VDI/VDE 2647

Tightening at 180°

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
51	11.09	178	11.0	177	0.09	0.7
52	11.23	179	11.2	177	0.02	1.5
53	11.1	178	11.07	177	0.02	0.6
54	11.06	178	10.88	177	0.18	0.5
55	11.09	179	11.12	177	0.03	2.0
56	11.07	179	10.96	177	0.11	1.6
57	11.05	178	11.05	177	0.01	0.9
58	11.23	178	11.18	177	0.06	1.0
59	11.07	178	11.1	177	0.03	0.3
60	10.98	178	10.98	177	0.0	0.5
61	11.14	179	11.08	177	0.05	1.6
62	11.04	179	11.04	177	0.0	1.5
63	11.22	178	11.17	177	0.05	0.9
64	11.07	178	11.02	177	0.05	1.3
65	11.03	179	10.93	177	0.1	1.2
66	11.03	178	10.93	177	0.1	1.4
67	11.12	178	11.16	177	0.04	1.1
68	11.12	179	11.07	177	0.05	1.7
69	11.19	179	11.16	177	0.04	1.3
70	11.03	178	10.87	177	0.16	0.4
71	10.93	178	10.85	177	0.07	0.9
72	10.93	178	10.83	177	0.1	0.7
73	11.04	179	11.04	177	0.0	1.2
74	11.13	178	11.1	177	0.03	0.6
75	11.12	178	11.11	177	0.02	0.7
76	11.02	178	10.86	177	0.15	0.7
77	10.96	178	10.8	177	0.17	0.9
78	11.1	179	11.24	177	0.15	1.6
79	11.13	179	11.07	177	0.06	1.4
80	11.25	179	11.25	177	0.0	1.3
81	11.15	178	11.06	177	0.09	0.8
82	11.11	179	11.08	177	0.03	1.3
83	10.98	178	10.84	177	0.14	0.6
84	11.04	178	10.89	177	0.15	0.8
85	11.11	178	11.14	177	0.03	0.4
86	11.19	178	11.08	177	0.12	0.3
87	11.1	178	11.04	177	0.06	0.7
88	11.0	178	10.98	177	0.02	0.9
89	11.02	178	10.9	177	0.12	1.2
90	11.13	179	11.11	177	0.02	2.0
91	11.13	178	10.99	177	0.14	0.5
92	11.21	178	11.19	177	0.02	1.1
93	11.08	178	11.08	177	0.0	1.1
94	10.96	178	10.83	177	0.13	0.9
95	11.1	178	11.17	177	0.07	0.9
96	11.19	179	11.18	177	0.01	1.3
97	11.2	178	11.09	177	0.1	0.5
98	10.79	177	10.77	177	0.02	0.1
99	10.99	177	11.04	177	0.05	0.1
100	11.04	178	11.1	177	0.06	0.6
Standard deviation					0.051	0.445

Performance of tools according to VDI/VDE 2647

Tightening at 180°

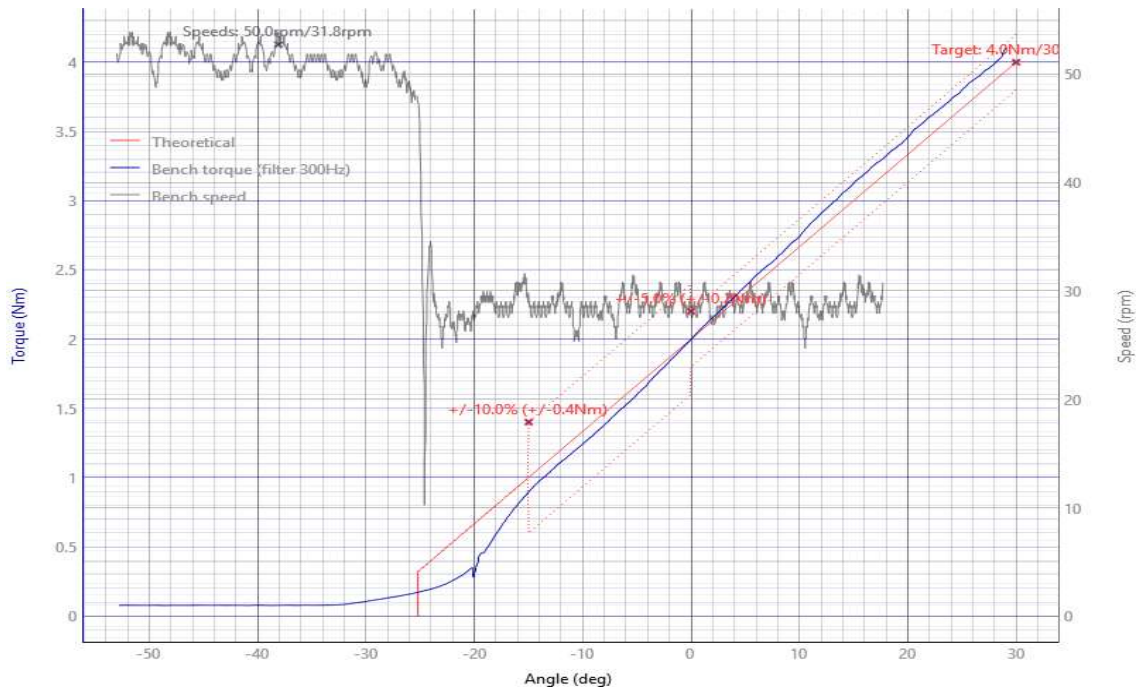


Performance of tools according to VDI/VDE 2647

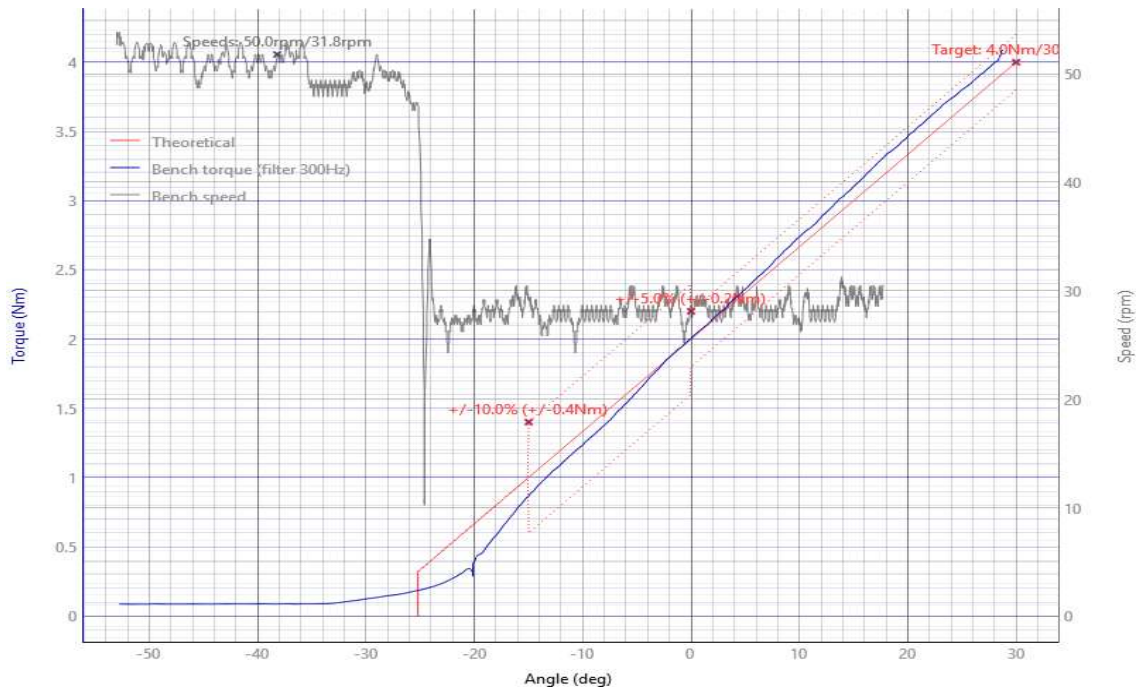
0 % of the torque range (hard)

Curve (torque/Angle)

Start



End

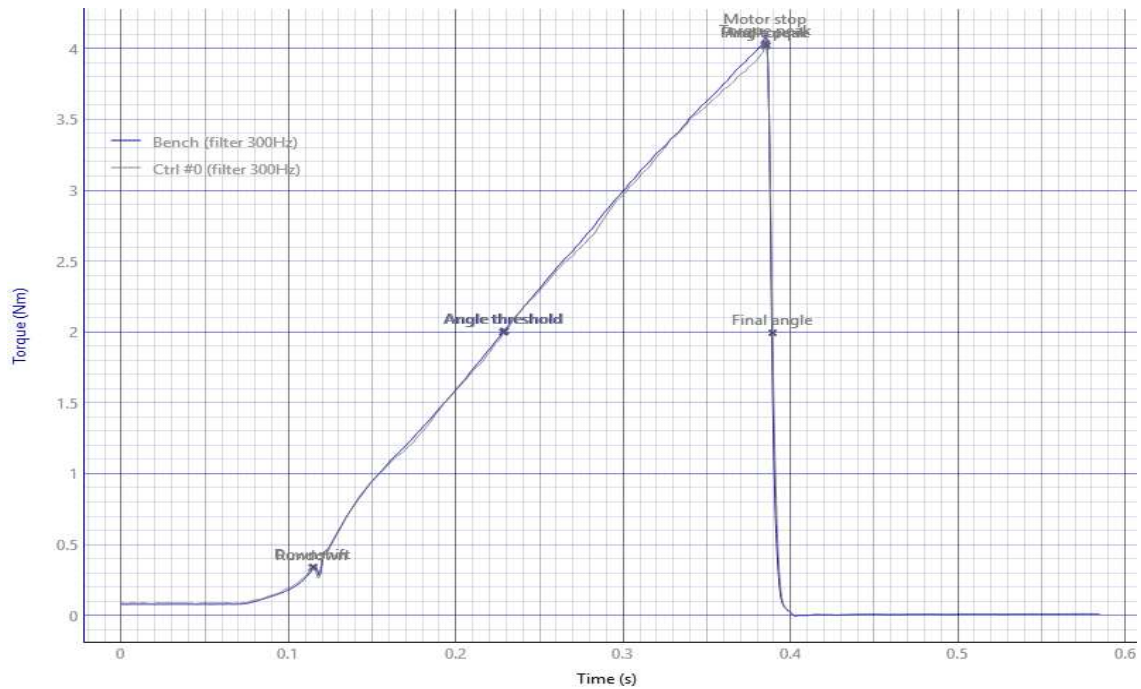


Performance of tools according to VDI/VDE 2647

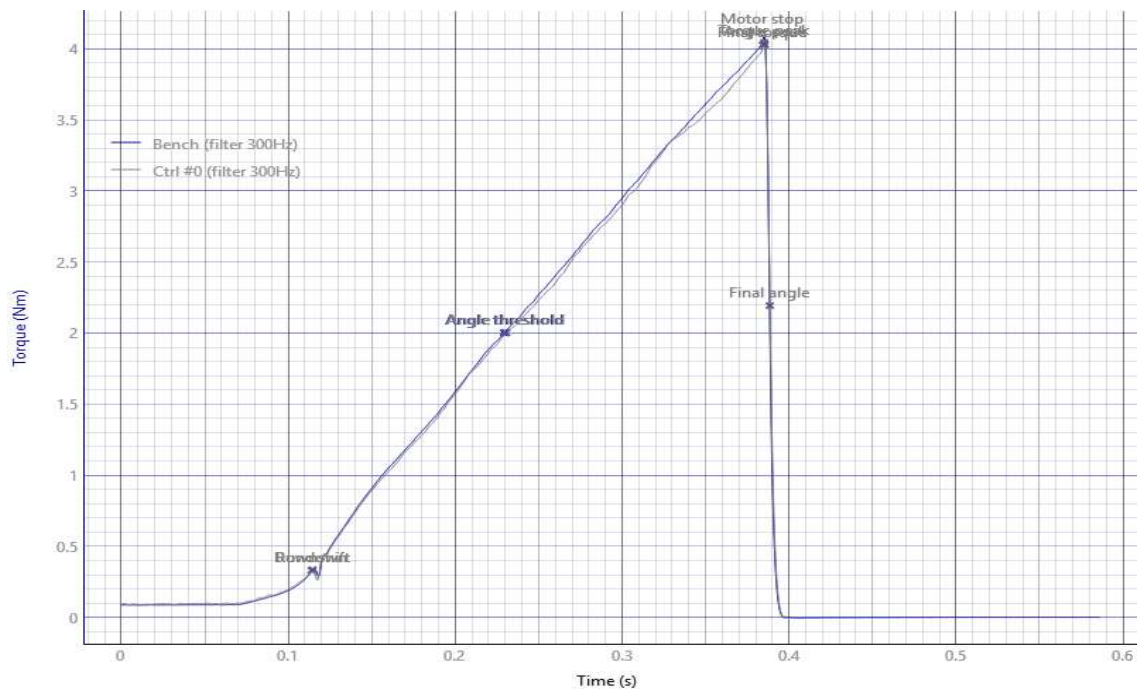
0 % of the torque range (hard)

Curve (torque/Time)

Start



End

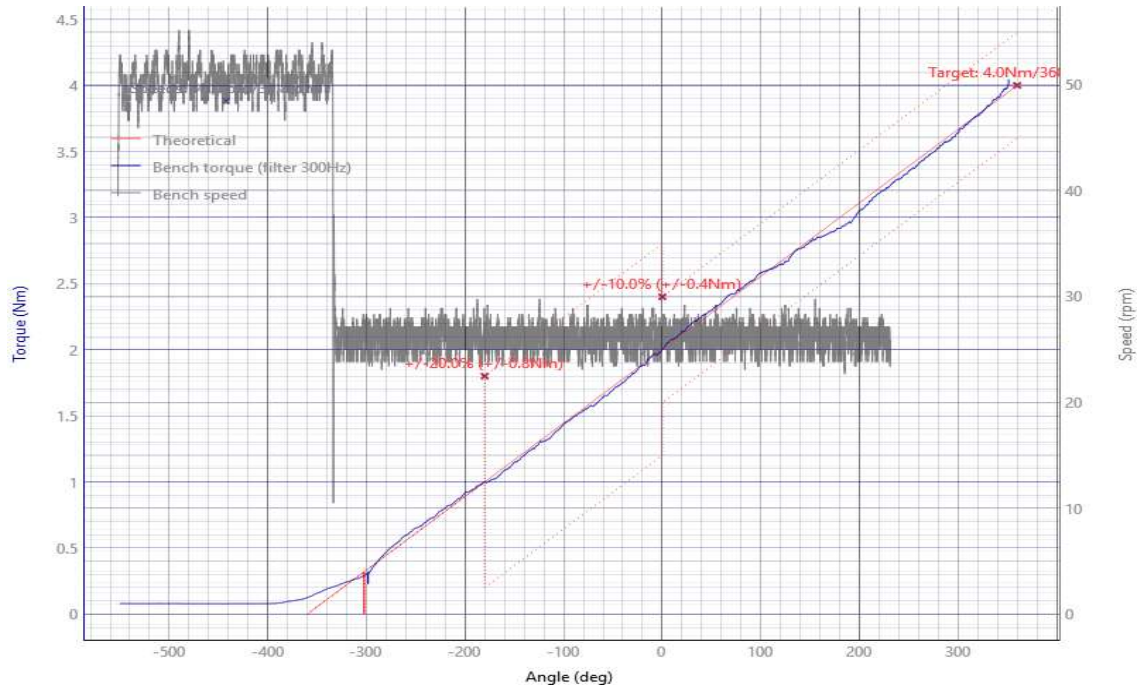


Performance of tools according to VDI/VDE 2647

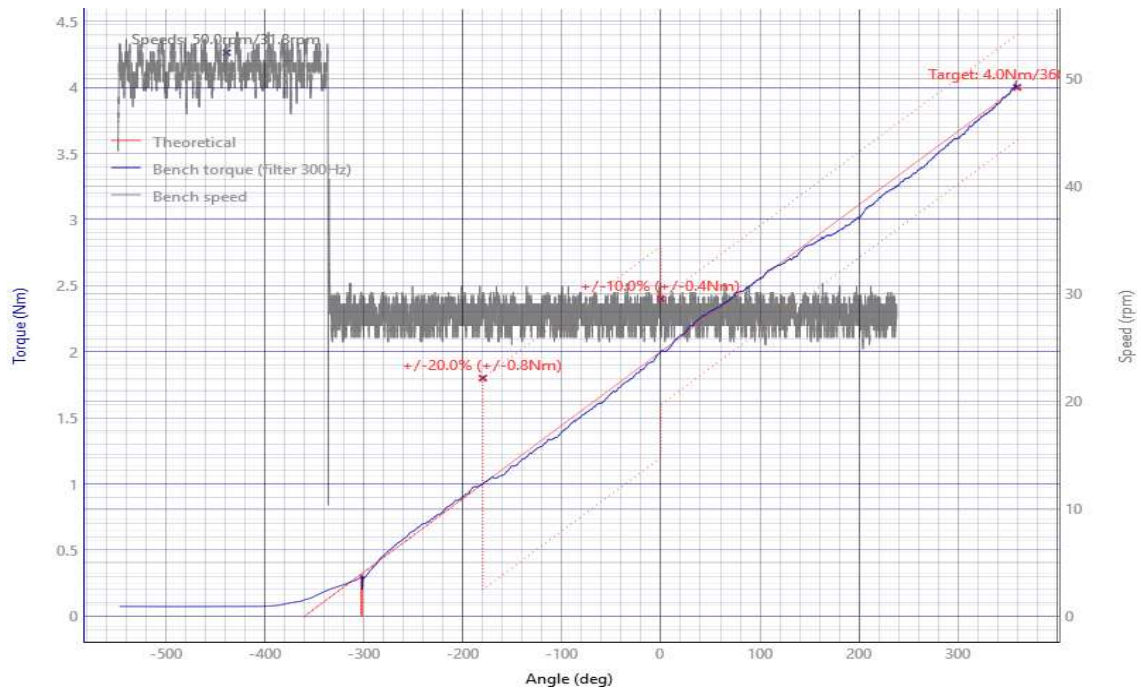
0 % of the torque range (soft)

Curve (torque/Angle)

Start



End

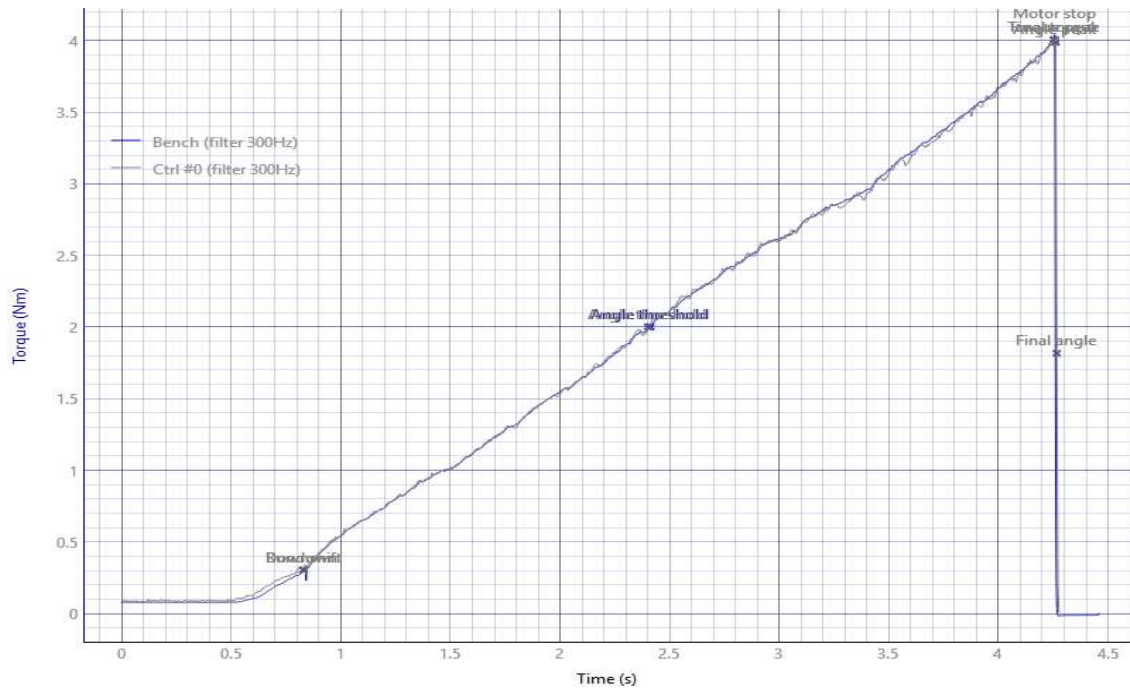


Performance of tools according to VDI/VDE 2647

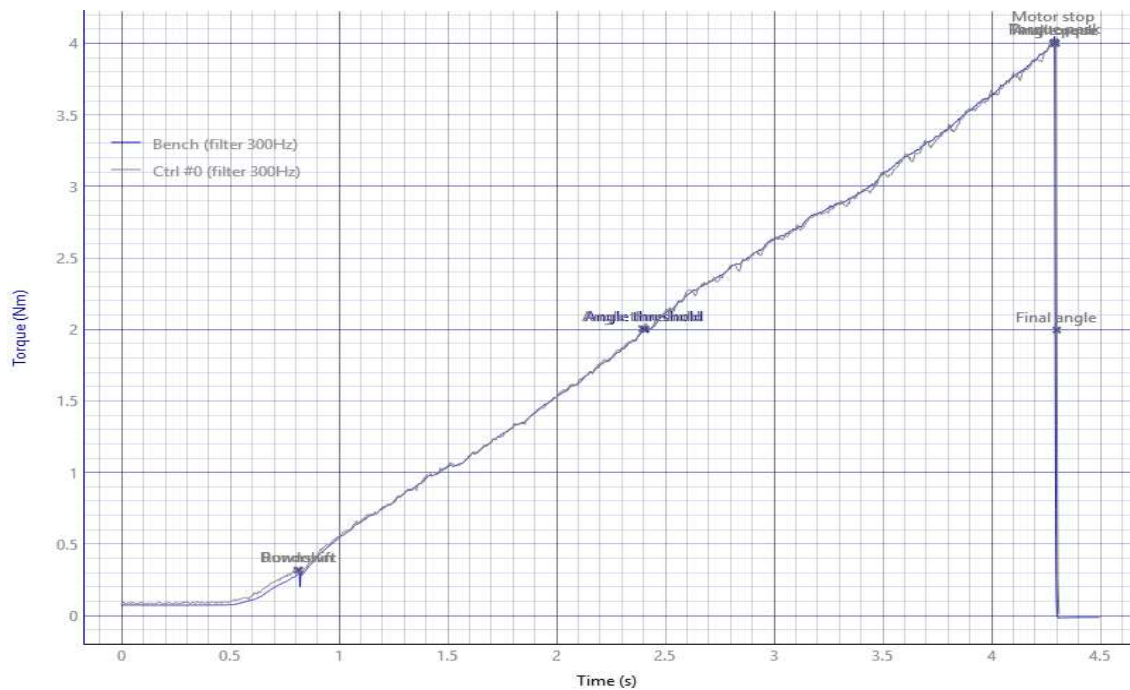
0 % of the torque range (soft)

Curve (torque/Time)

Start



End

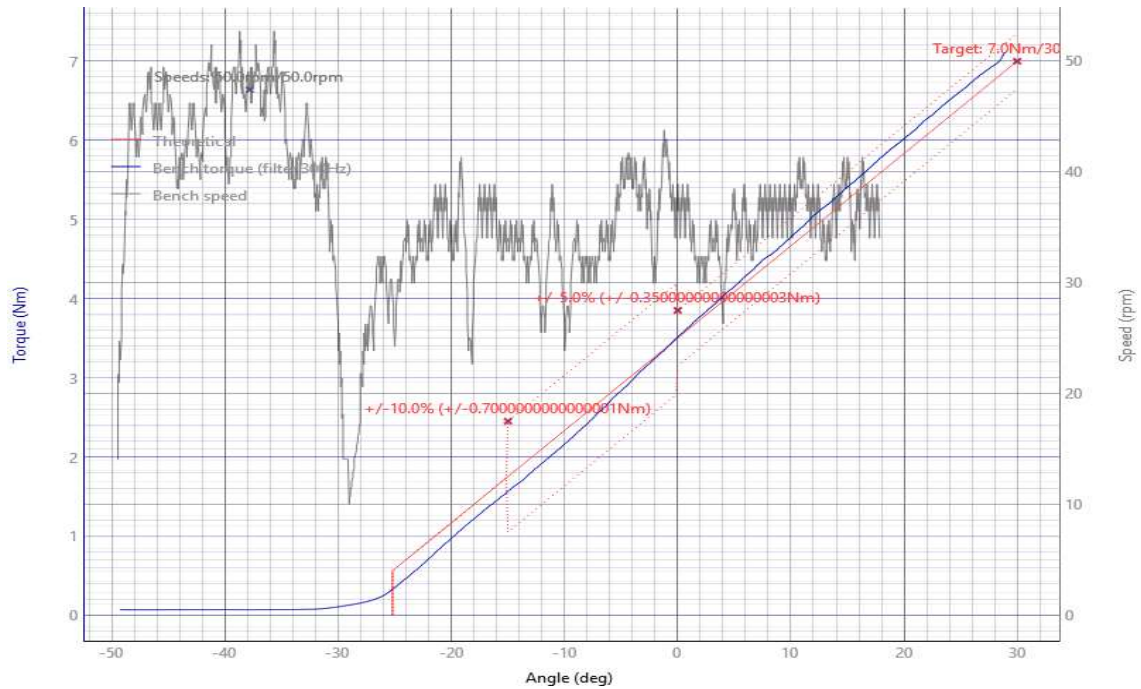


Performance of tools according to VDI/VDE 2647

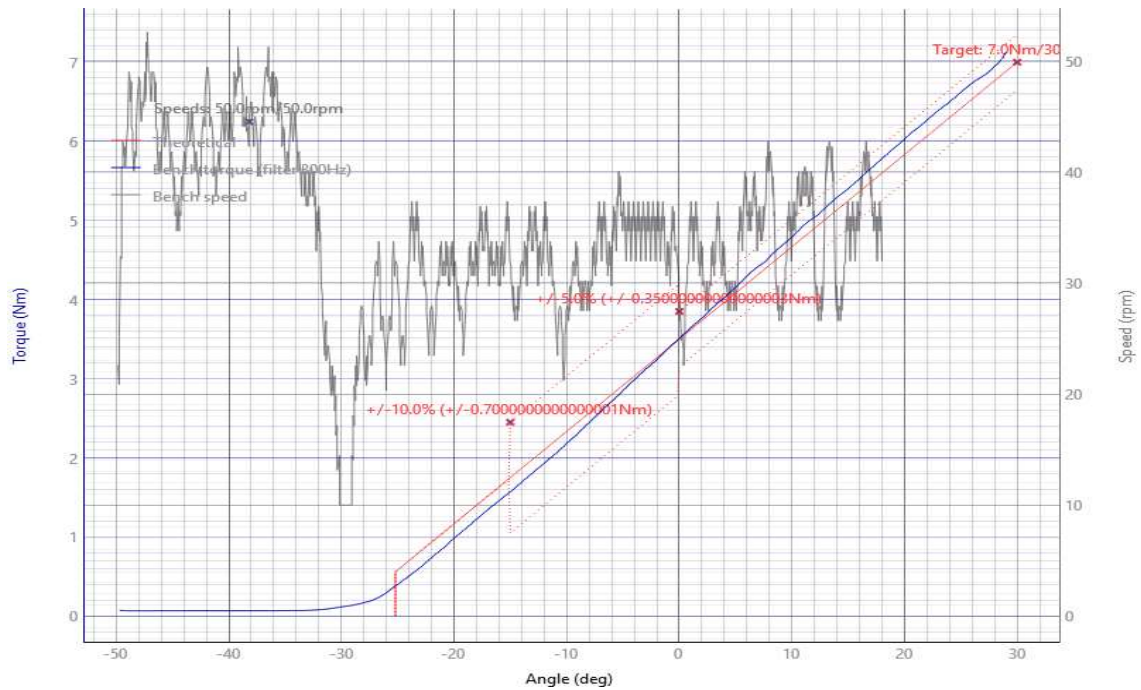
30 % of the torque range (hard)

Curve (torque/Angle)

Start



End

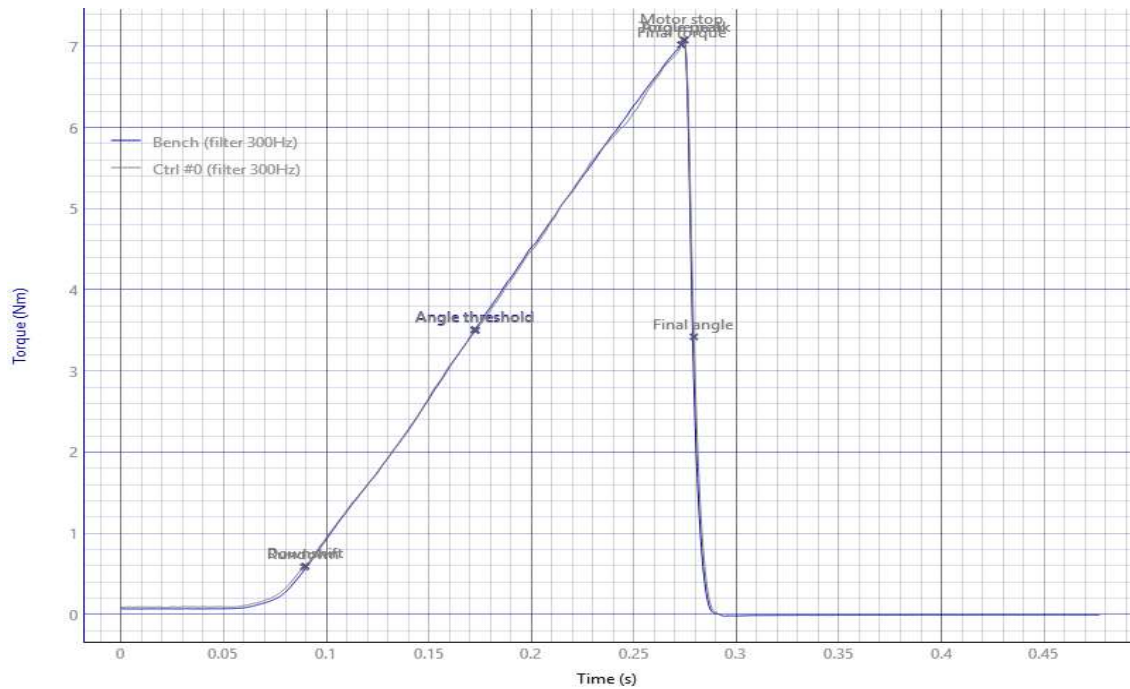


Performance of tools according to VDI/VDE 2647

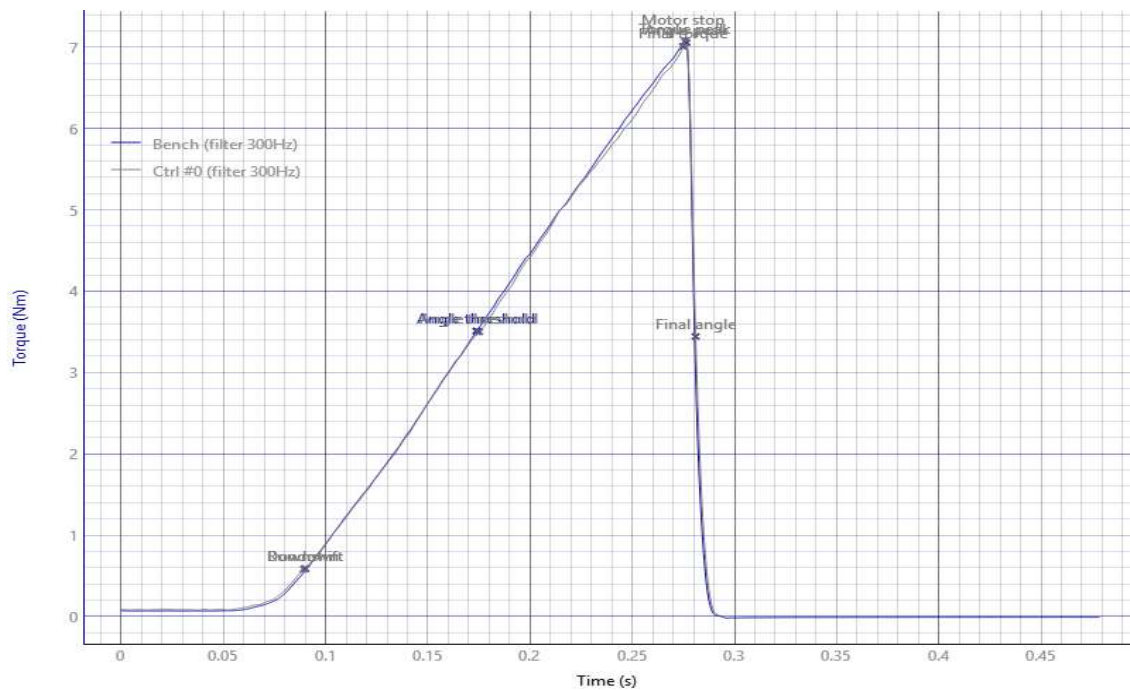
30 % of the torque range (hard)

Curve (torque/Time)

Start



End

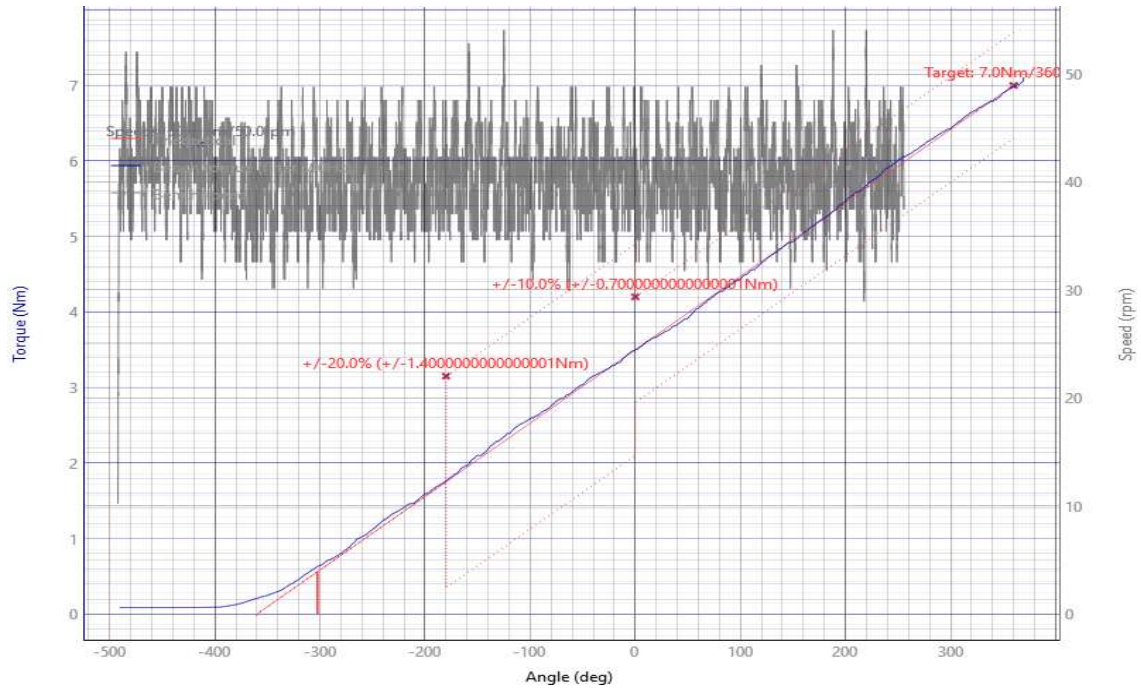


Performance of tools according to VDI/VDE 2647

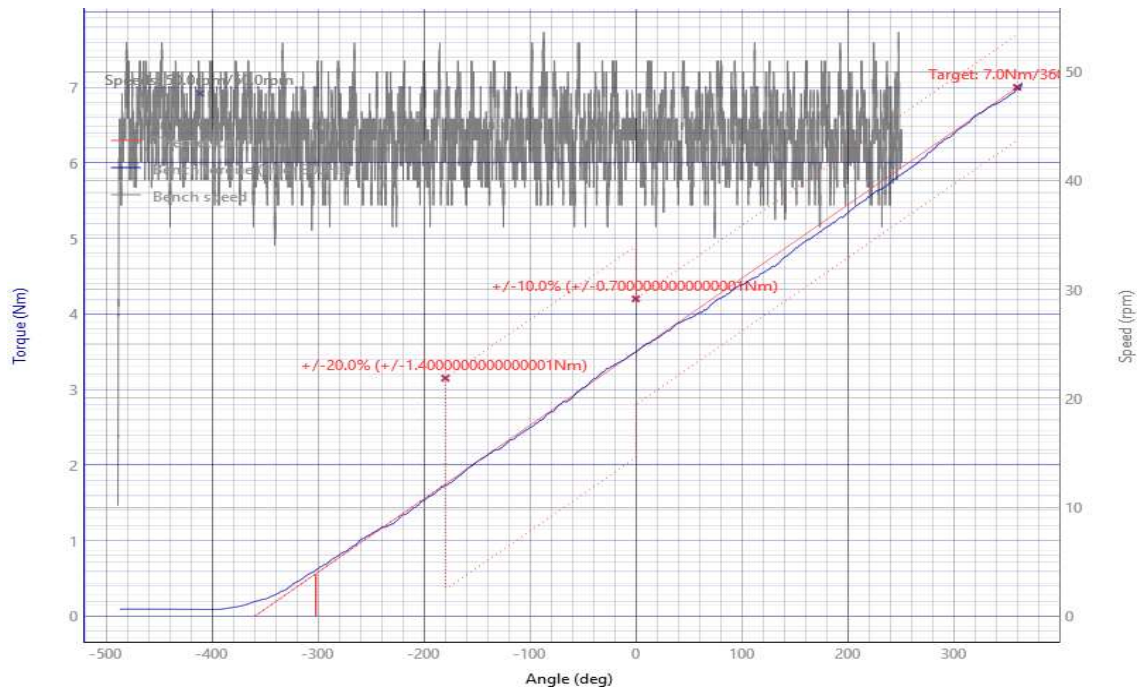
30 % of the torque range (soft)

Curve (torque/Angle)

Start



End

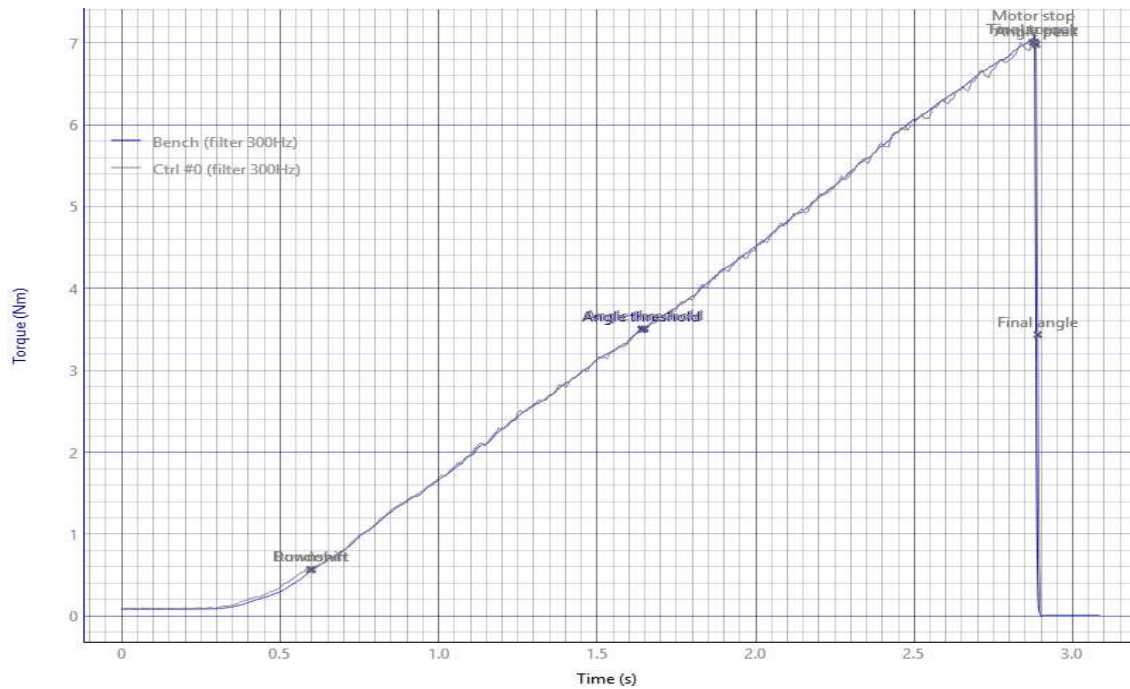


Performance of tools according to VDI/VDE 2647

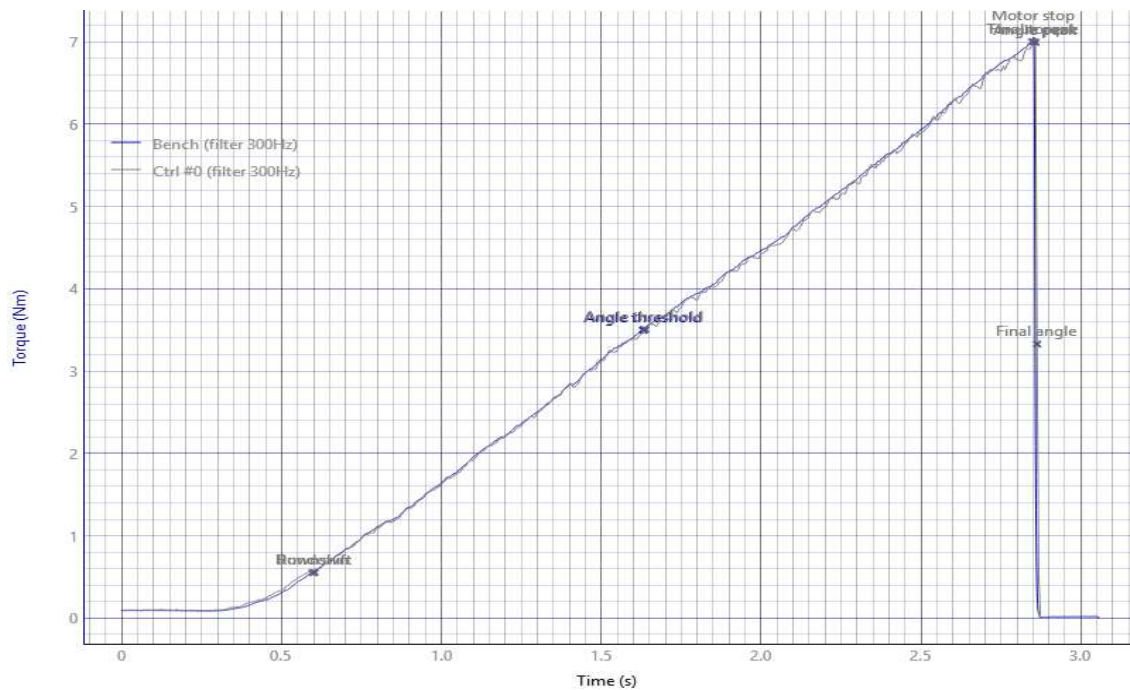
30 % of the torque range (soft)

Curve (torque/Time)

Start



End

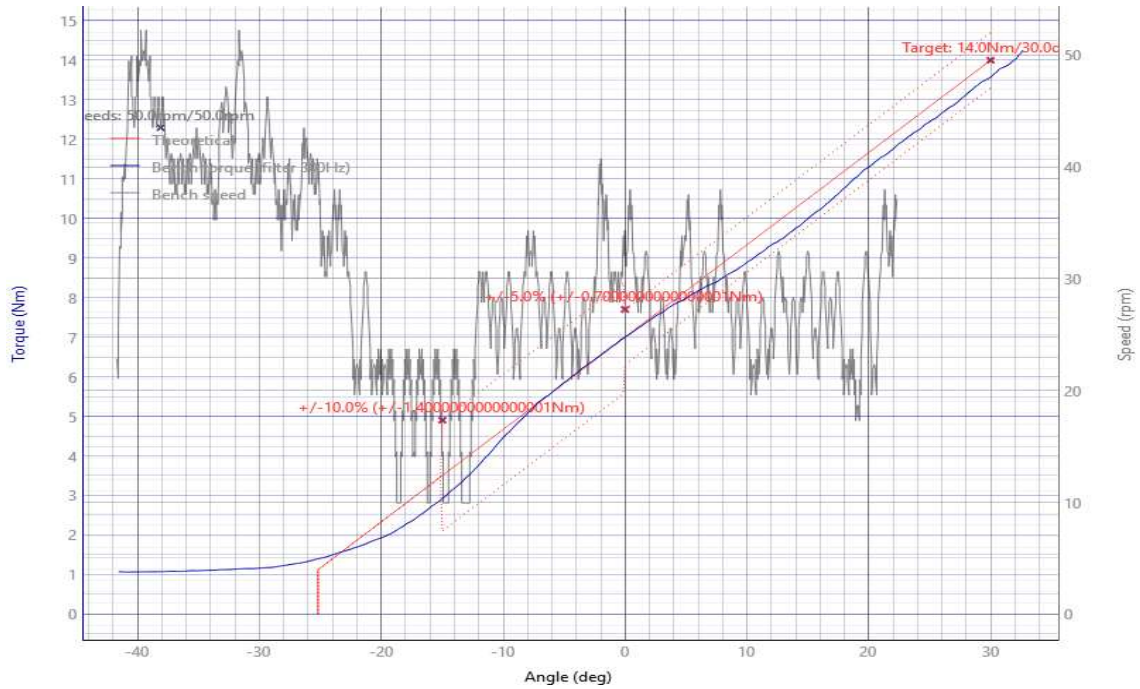


Performance of tools according to VDI/VDE 2647

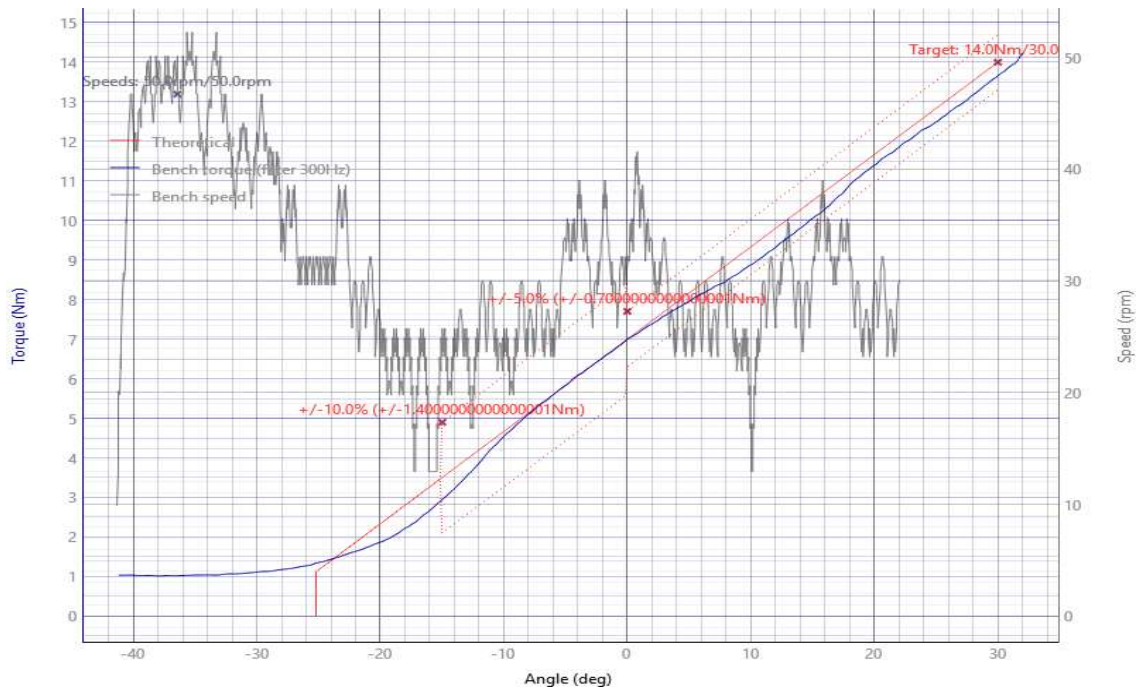
100 % of the torque range (hard)

Curve (torque/Angle)

Start



End

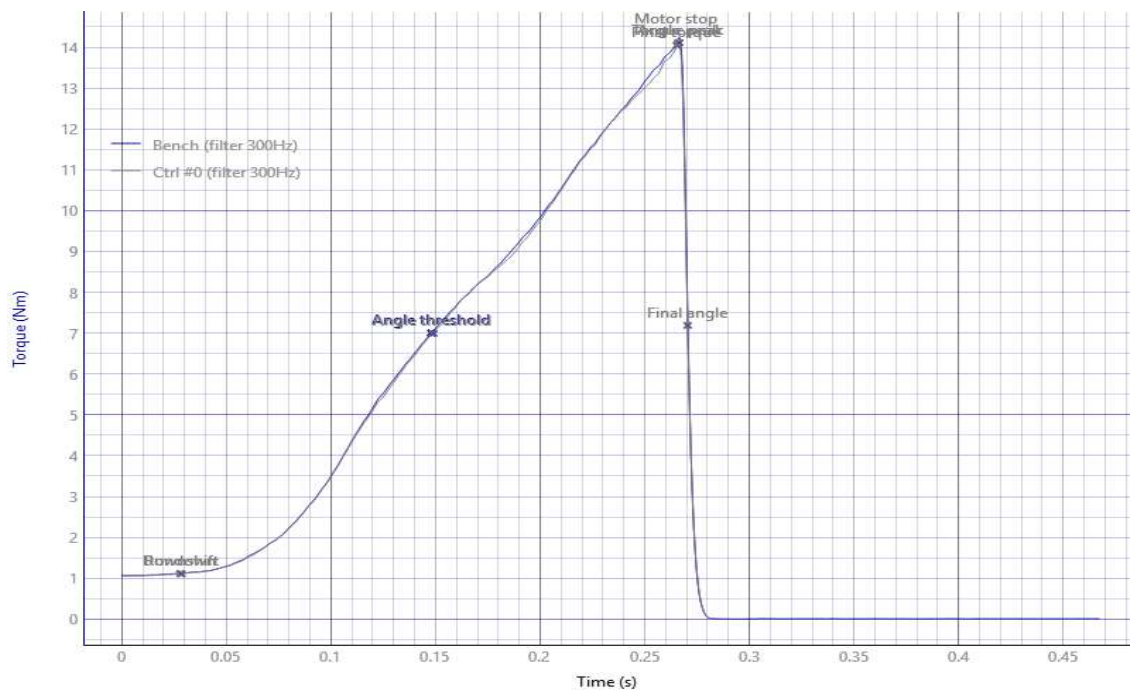


Performance of tools according to VDI/VDE 2647

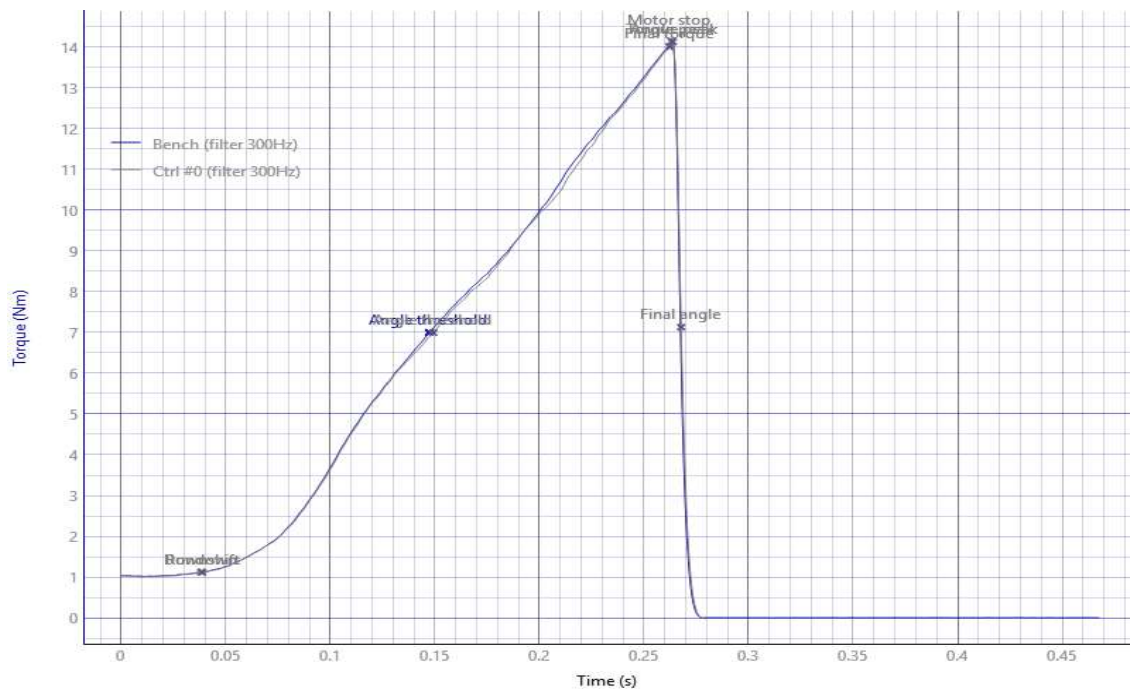
100 % of the torque range (hard)

Curve (torque/Time)

Start



End

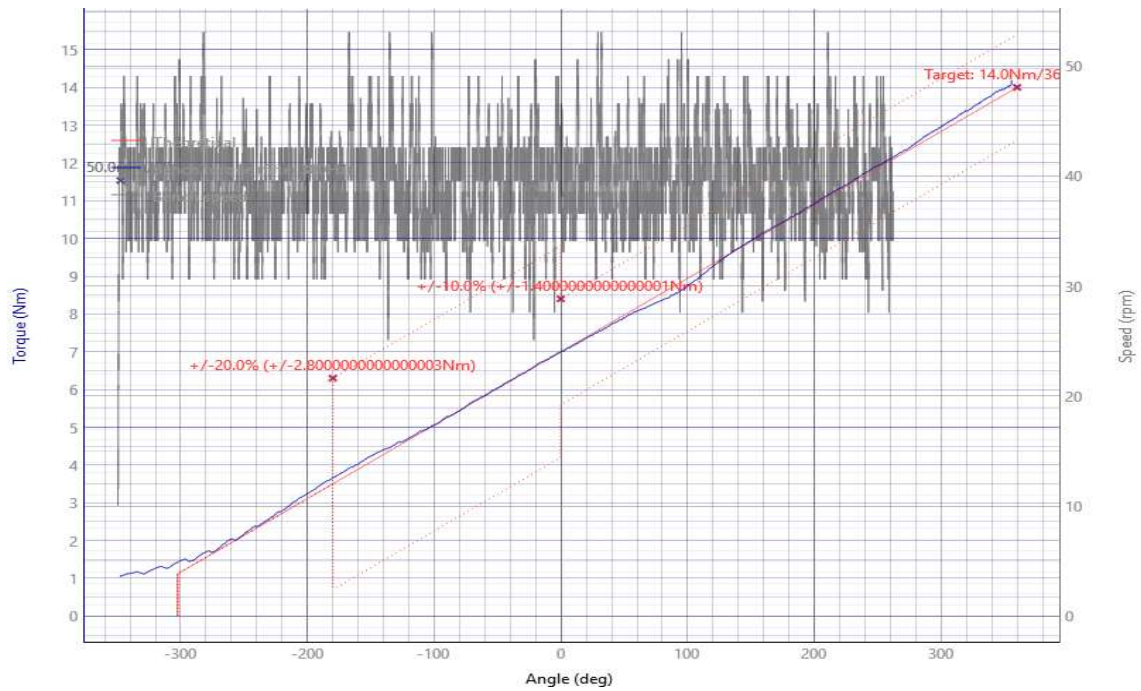


Performance of tools according to VDI/VDE 2647

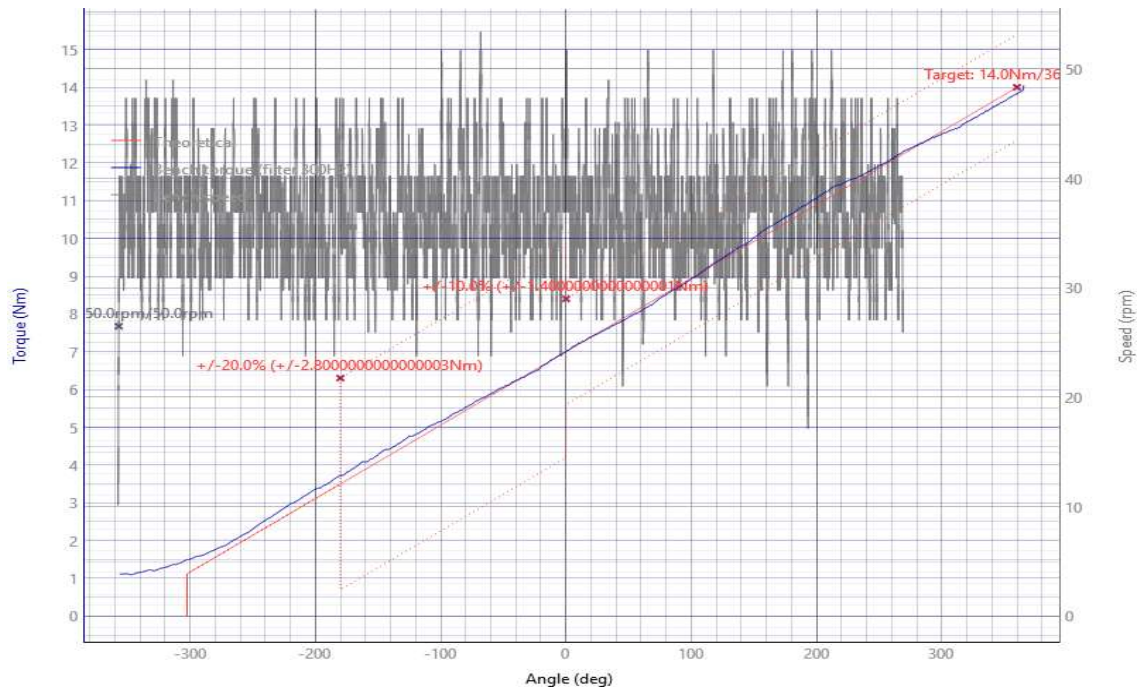
100 % of the torque range (soft)

Curve (torque/Angle)

Start



End

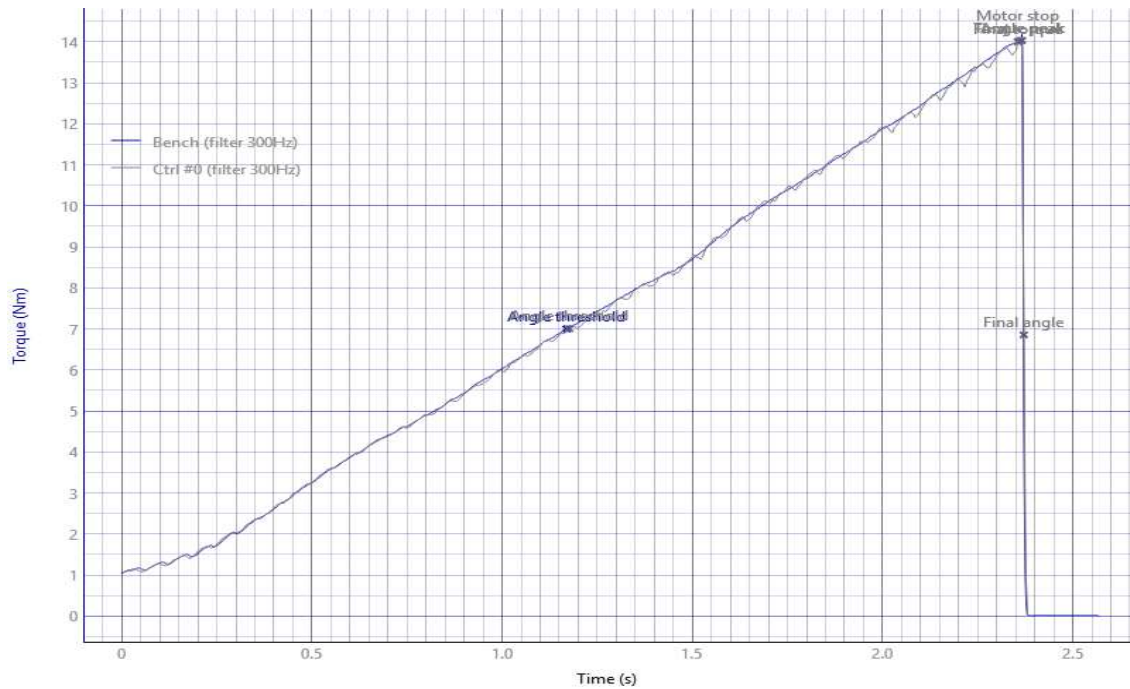


Performance of tools according to VDI/VDE 2647

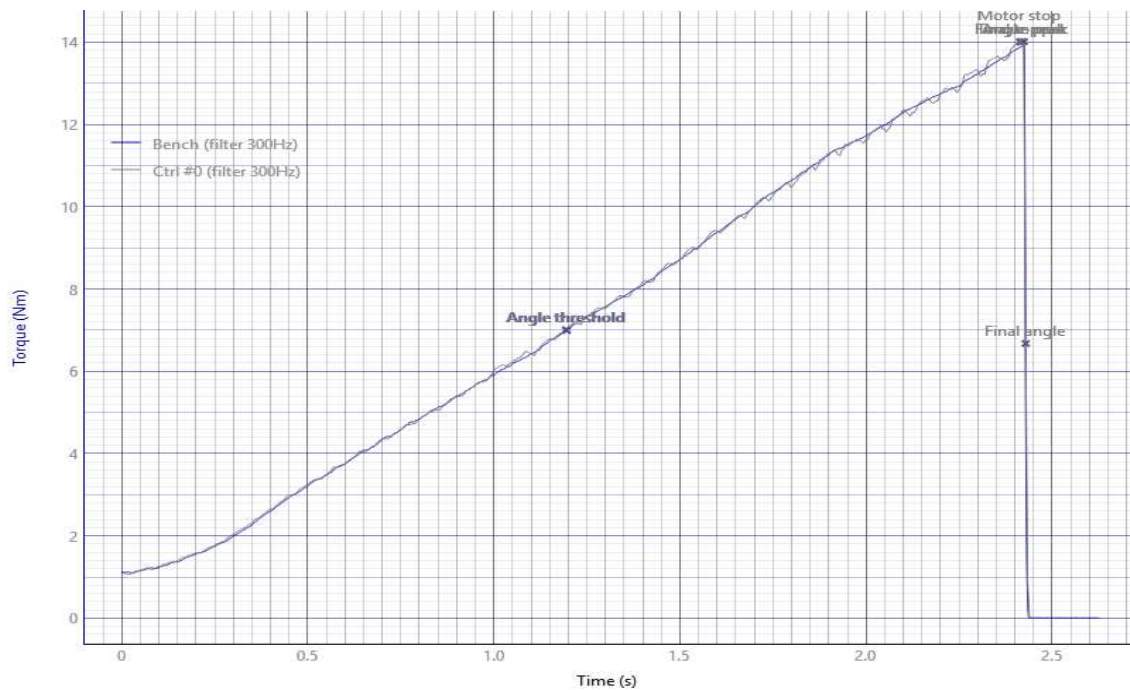
100 % of the torque range (soft)

Curve (torque/Time)

Start



End

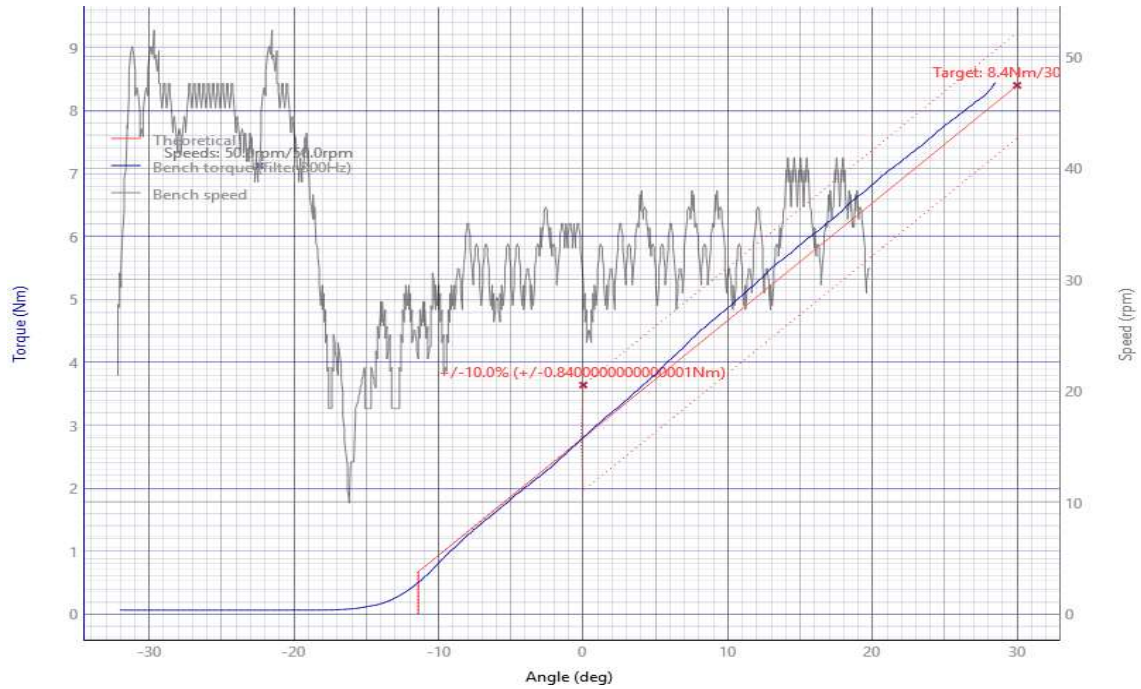


Performance of tools according to VDI/VDE 2647

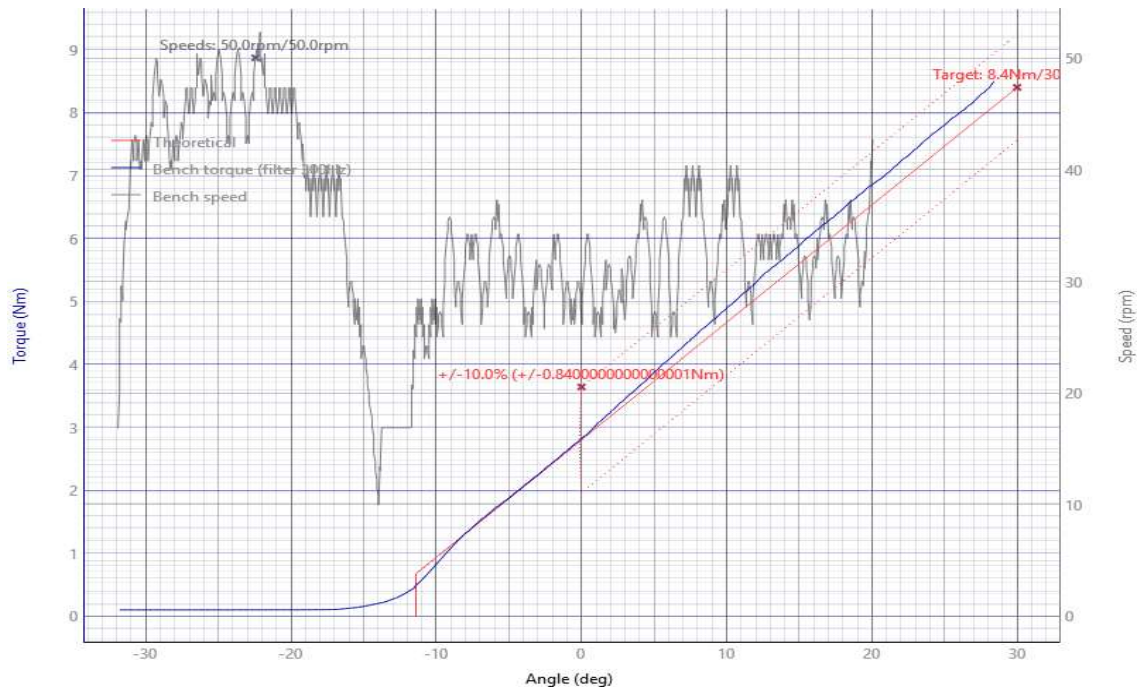
Tightening at 30°

Curve (torque/Angle)

Start



End

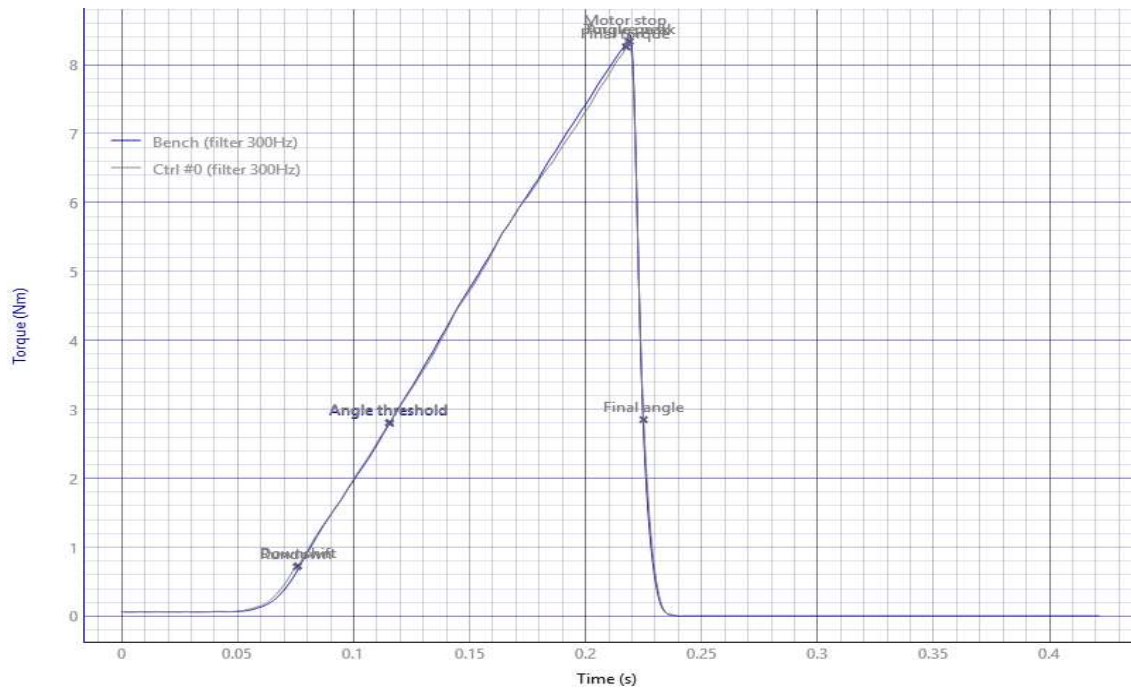


Performance of tools according to VDI/VDE 2647

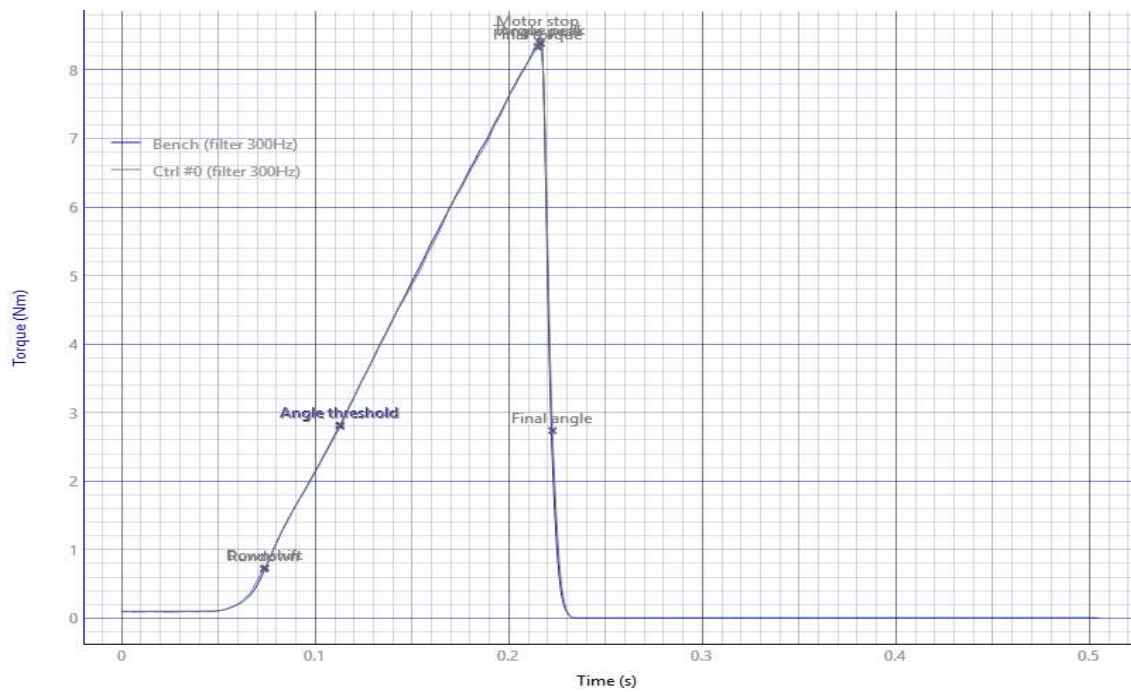
Tightening at 30°

Curve (torque/Time)

Start



End

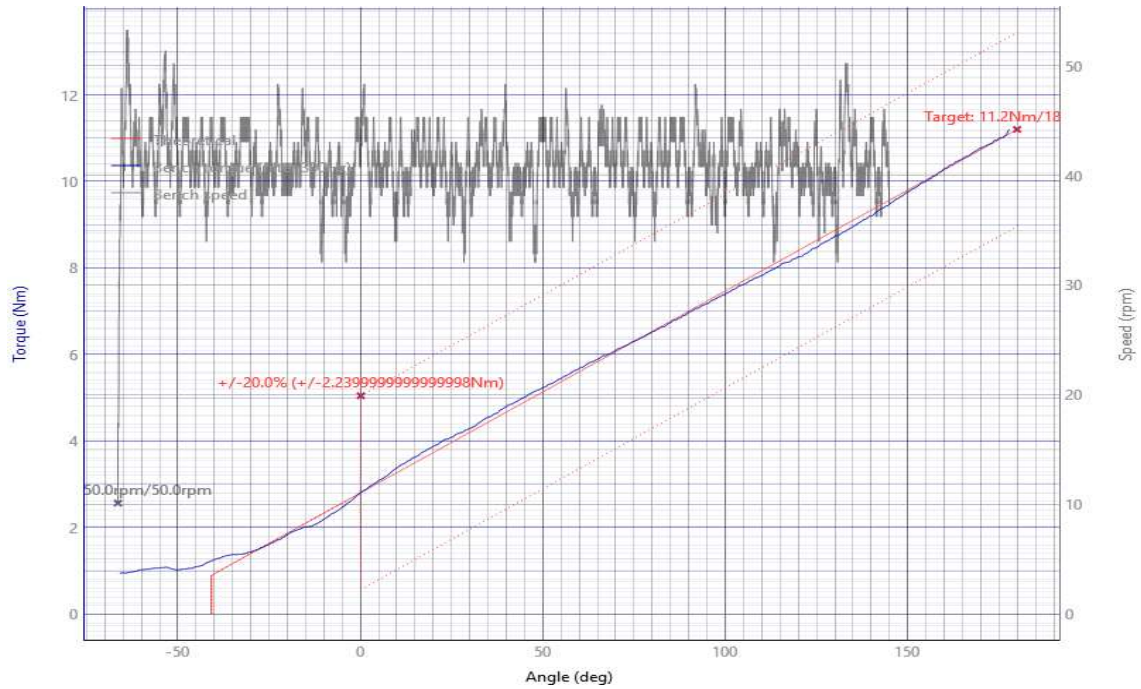


Performance of tools according to VDI/VDE 2647

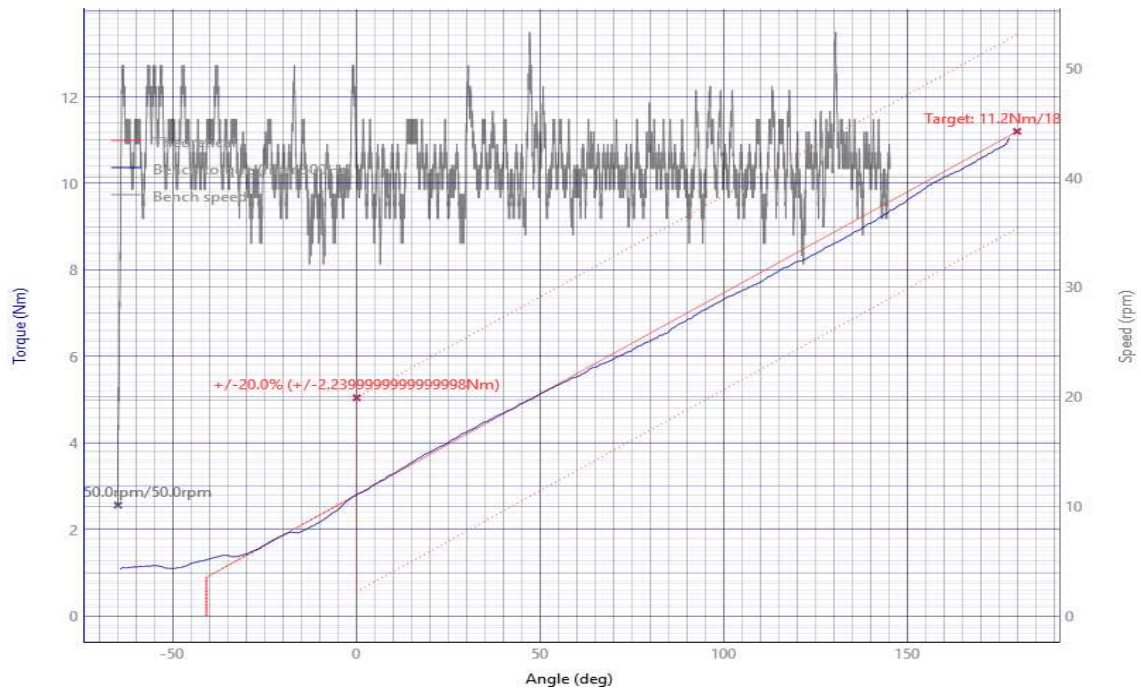
Tightening at 180°

Curve (torque/Angle)

Start



End

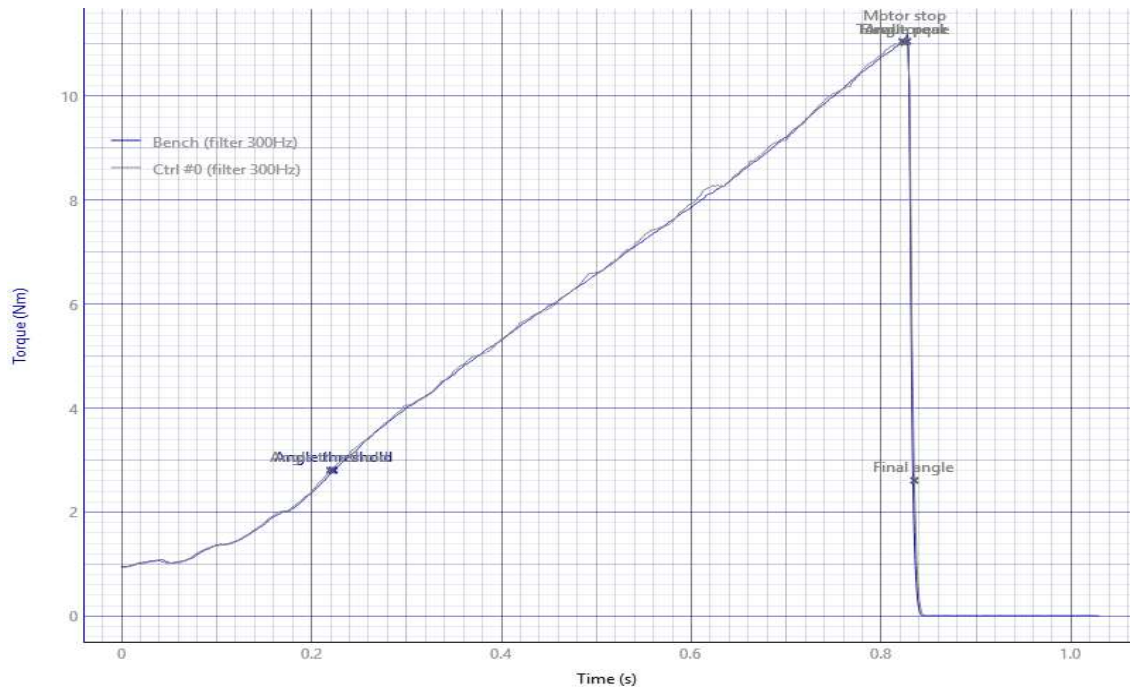


Performance of tools according to VDI/VDE 2647

Tightening at 180°

Curve (torque/Time)

Start



End

