







## Performance of tools according to VDI/VDE 2647

General information		
Operator name:	Jean-Yves Loyer	
Testing date:	31/03/2026	
Report number:	310320261	
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:	26B0610600B03	
Calibration date :	1/1/2010	
Calibration value :	9.5083	
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	
<b>Manufacturer:</b>	NA	<b>Manufacturer:</b>	No accessory
<b>Rated capacity:</b>	NA	<b>Model :</b>	NA
<b>Battery voltage:</b>	NA	<b>Serial number:</b>	NA
<b>Serial number:</b>	NA	<b>Part number:</b>	NA
<b>Part number:</b>	NA		
<b>Battery type:</b>	No batterie		
Picture of battery		Picture of accessory	
			
Controller tool			
<b>Controller type:</b>	AXON	<b>Serial number:</b>	25A0000949H02
<b>Manufacturer:</b>	Desoutter	<b>Part number:</b>	6159327800
<b>Power:</b>	3.7kVA peak	<b>Manufacturer date:</b>	06/2025
<b>CVi3 firmware:</b>	2.8.1.0	<b>CPU board:</b>	2.8.1.0
<b>CPLD:</b>	2.8.1.0	<b>Front panel:</b>	2.8.1.0
<b>LCD driver:</b>	2.8.1.0	<b>Servo-driver 1:</b>	2.8.1.0
<b>OS version:</b>	2.8.1.0	<b>Ac line:</b>	100-120/220-240V~ 50/60Hz
Picture of controller			
			
Cable tool			
<b>Cable type:</b>	Tool cable 5m	<b>Serial number:</b>	29012500053
<b>Manufacturer:</b>	Desoutter	<b>Part number:</b>	6159178360
<b>Lenght:</b>	5m		
Picture of cable			
			

## Performance of tools according to VDI/VDE 2647

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

## 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	

## Performance of tools according to VDI/VDE 2647

### 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)	4.06	4.02	7.1	7.03	14.11	13.97
Min torque (N.m)	3.99	3.98	6.99	6.97	13.92	13.84
Max torque (N.m)	4.11	4.07	7.21	7.1	14.44	14.17
$6\sigma/\bar{X}$	4.25%	2.73%	4.10%	2.55%	4.49%	3.10%
Standard deviation	0.029	0.018	0.049	0.030	0.106	0.072
$C_m > 2,45$ *	3.25	5.09	3.36	5.47	3.09	4.52
$C_{mk} > 2,07$ *	2.58	4.64	2.65	5.12	2.76	4.41

### Angle tightening test

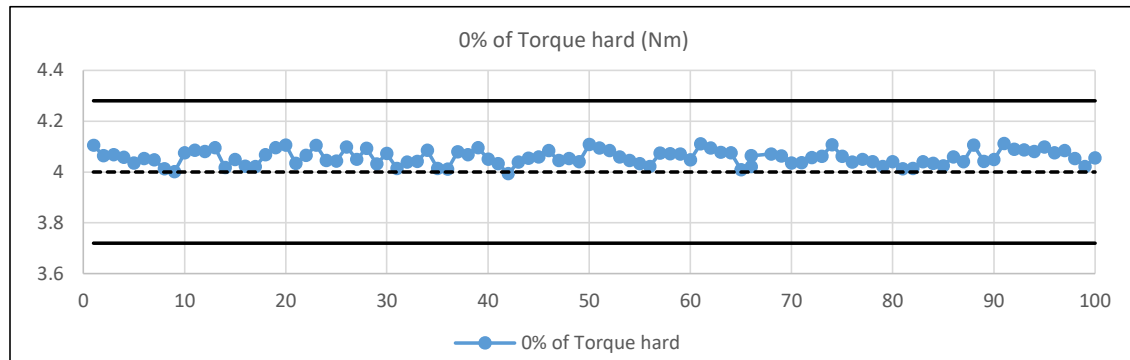
	hard	soft
Angle tested (of 50 at 100% of tightening)	30°	180°
Target torque	8.4 N.m	11.2 N.m
Tolérance (torque)	6.4%	5.0%
IT (±) (torque) < 7%*	3.2%	2.5%
Tolérance (angle)	3.1 °	4.0 °
IT (±) (angle) <i>Hard &lt; 5° *</i> <i>Soft &lt; 15° *</i>	1.6 °	2.0 °

(\*) 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%

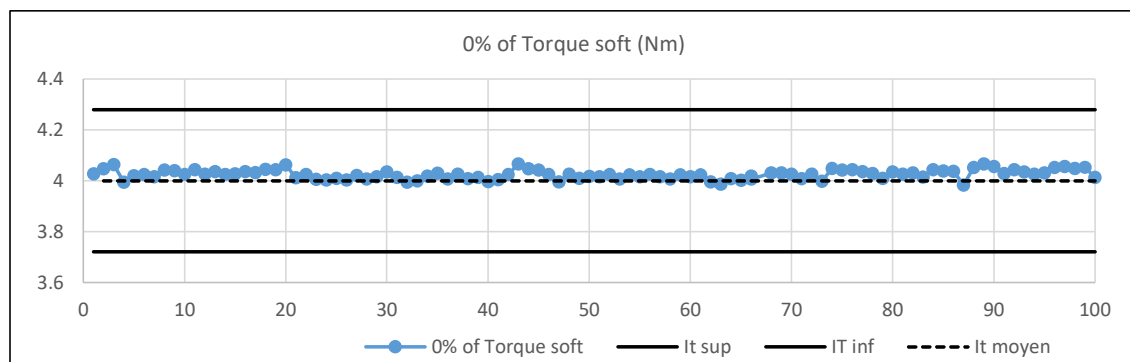
### Tightening hard



**Cm** **3.25**

**Cmk** **2.58**

### Tightening soft



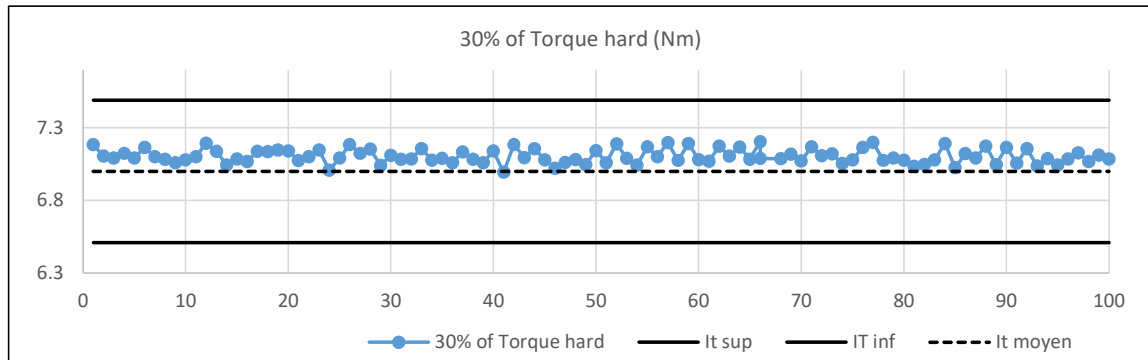
**Cm** **5.09**

**Cmk** **4.64**

## 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%

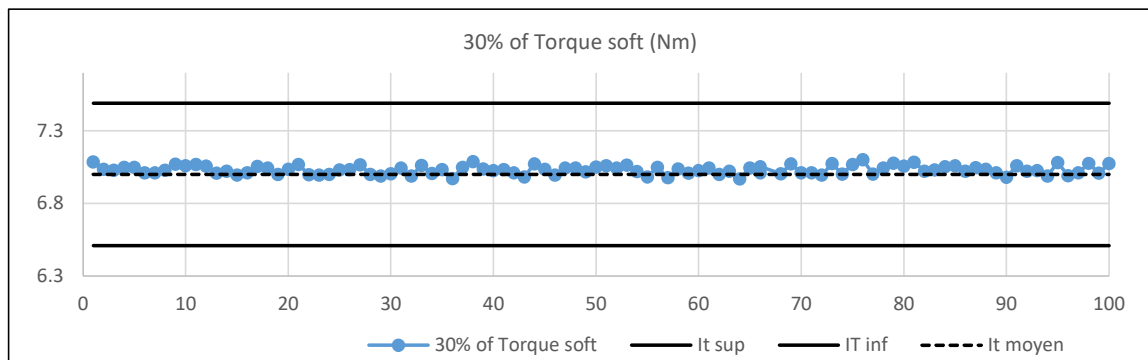
### Tightening hard



**Cm** **3.36**

**Cmk** **2.65**

### Tightening soft



**Cm** **5.47**

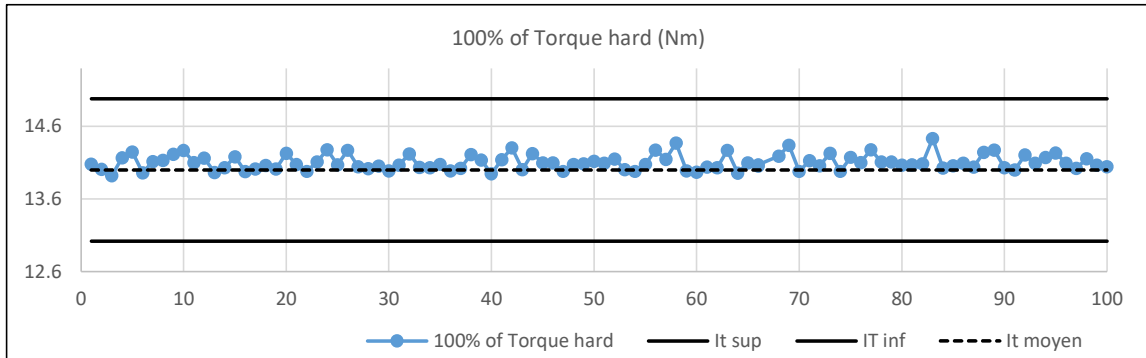
**Cmk** **5.12**



## 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%

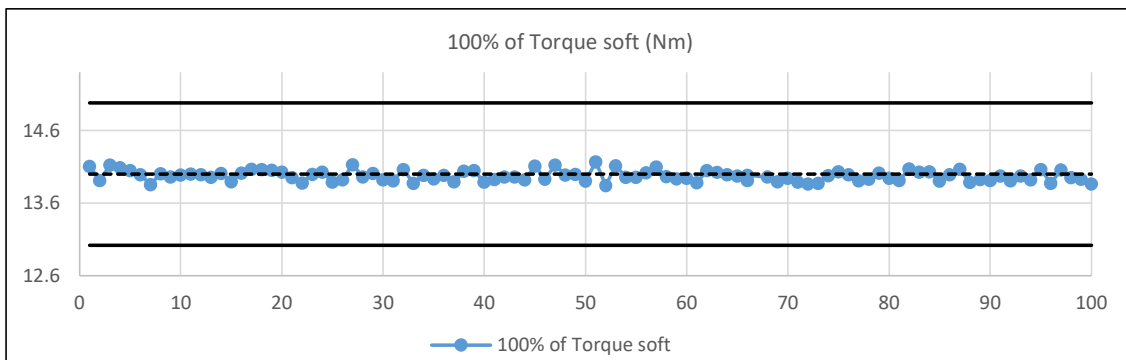
### Tightening hard



**Cm** **3.09**

**Cmk** **2.76**

### Tightening soft

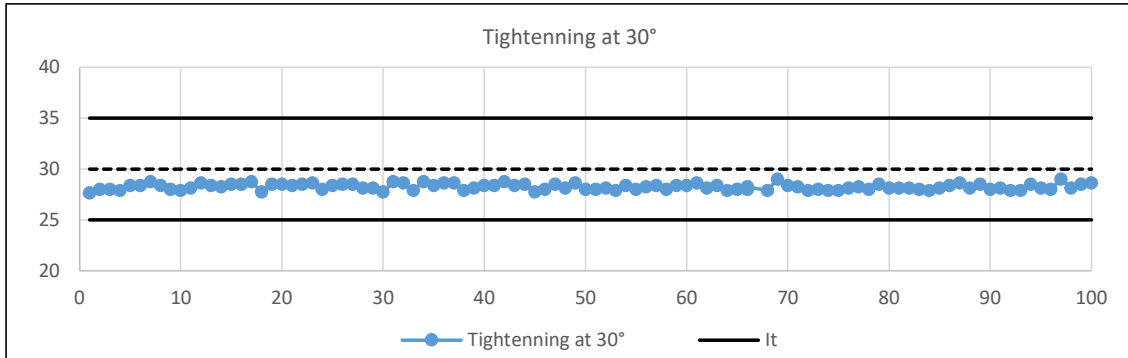


**Cm** **4.52**

**Cmk** **4.41**

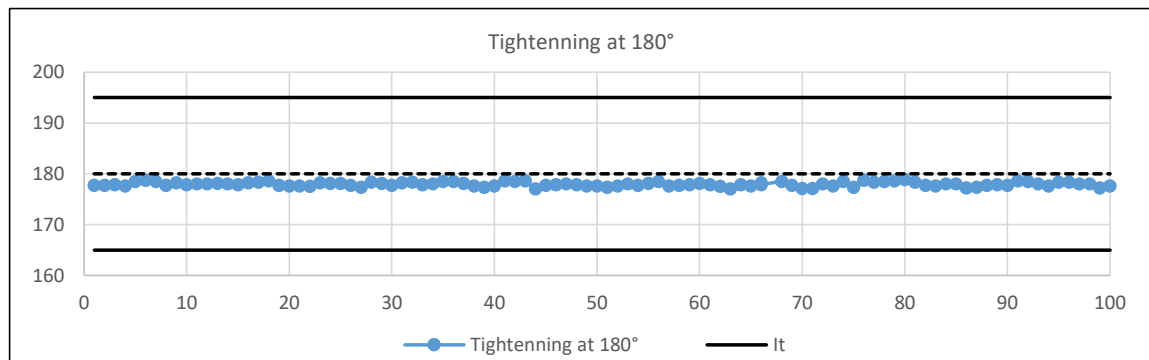
## Performance of tools according to VDI/VDE 2647

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



IT (±)	1.6 °
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Tightenning at 180°	Lower limit (°)	Target angle (°)	Upper limit (°)	Tolerance (±)
	165°	180°	195°	15°



IT (±)	2.0 °
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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	4.1	30	4.02	29	0.08	1.0
2	4.06	29	4.02	28	0.04	0.9
3	4.07	30	4.01	29	0.06	0.6
4	4.06	30	4.0	29	0.06	0.9
5	4.04	28	4.02	27	0.01	1.0
6	4.05	29	4.02	28	0.03	0.9
7	4.05	29	4.04	29	0.01	0.8
8	4.01	29	4.0	28	0.01	0.7
9	4.0	28	4.01	27	0.01	0.8
10	4.08	29	4.01	29	0.06	0.5
11	4.08	29	4.01	28	0.07	0.8
12	4.08	29	4.01	28	0.07	1.1
13	4.09	30	4.02	29	0.07	0.8
14	4.02	29	4.0	28	0.02	0.7
15	4.05	29	4.02	27	0.03	1.3
16	4.02	29	4.02	28	0.01	1.2
17	4.02	28	4.01	27	0.01	0.9
18	4.07	30	4.03	29	0.04	0.5
19	4.1	31	4.02	31	0.08	0.8
20	4.11	30	4.02	29	0.09	1.0
21	4.03	29	4.01	27	0.03	1.2
22	4.07	30	4.03	29	0.04	1.0
23	4.11	29	4.01	29	0.1	0.9
24	4.05	29	4.03	28	0.02	0.8
25	4.04	30	4.01	29	0.03	0.7
26	4.1	31	4.02	29	0.08	1.1
27	4.05	28	4.02	27	0.03	1.2
28	4.09	29	4.02	29	0.07	0.7
29	4.03	29	4.01	29	0.02	0.6
30	4.07	30	4.0	29	0.07	1.0
31	4.01	28	4.01	27	0.0	1.0
32	4.04	30	4.02	29	0.02	1.1
33	4.04	28	4.02	27	0.02	1.2
34	4.08	30	4.0	29	0.08	0.8
35	4.01	28	4.0	27	0.01	0.8
36	4.01	29	4.0	28	0.01	1.1
37	4.08	31	4.01	30	0.07	1.2
38	4.07	28	4.0	27	0.07	1.0
39	4.09	30	4.03	28	0.06	1.1
40	4.05	29	4.02	28	0.03	0.9
41	4.03	29	4.0	27	0.03	1.0
42	3.99	29	4.01	27	0.02	1.0
43	4.04	29	4.01	29	0.03	0.5
44	4.05	29	4.01	28	0.04	0.8
45	4.06	30	4.01	28	0.05	1.2
46	4.08	30	4.01	29	0.07	1.1
47	4.04	29	4.01	29	0.03	0.4
48	4.05	30	4.01	29	0.04	1.0
49	4.04	28	4.02	27	0.02	1.3
50	4.11	30	4.01	29	0.1	0.5

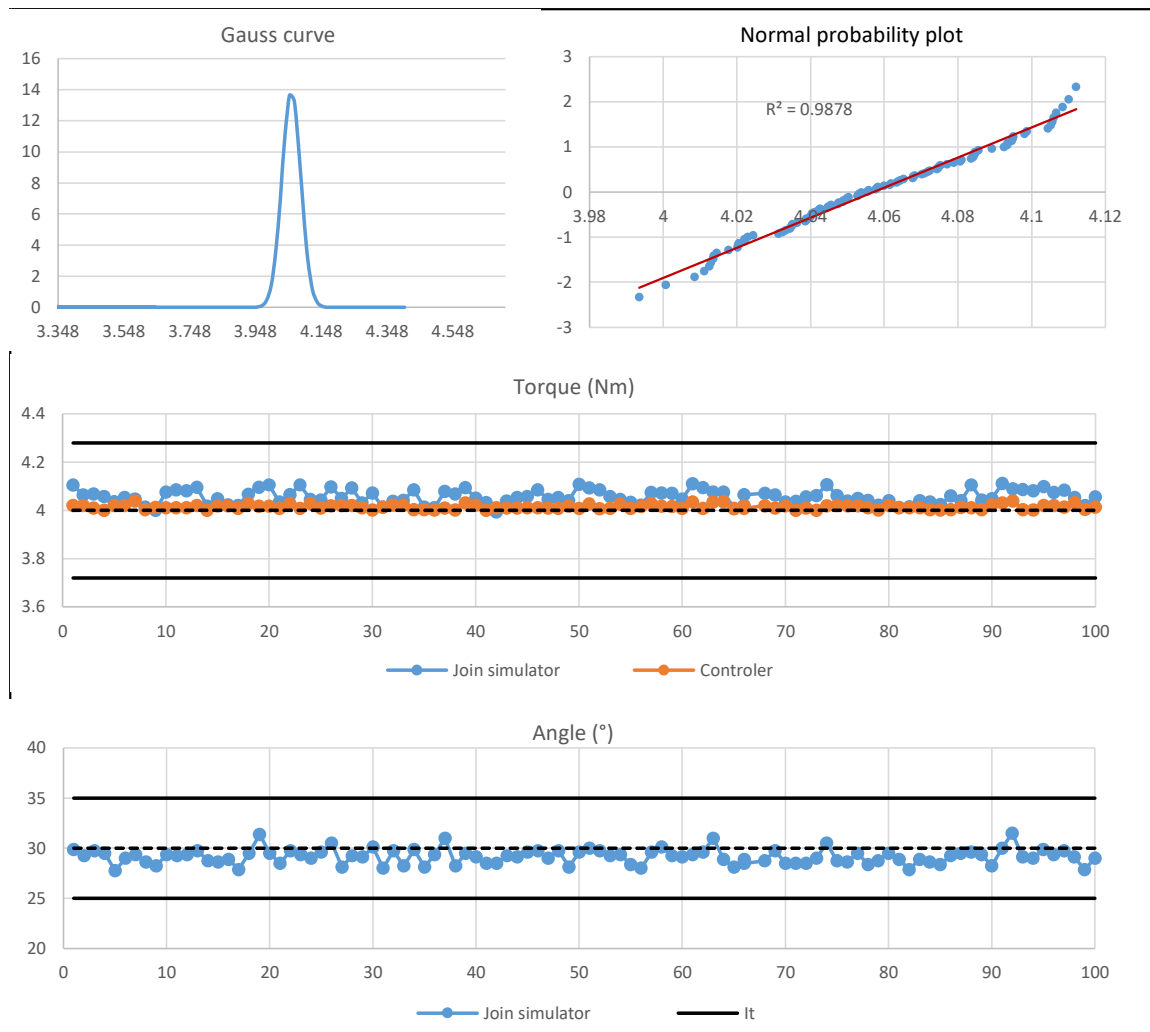
## Performance of tools according to VDI/VDE 2647

### 0 % of the torque range (hard)

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
51	4.09	30	4.03	29	0.07	1.0
52	4.08	30	4.01	29	0.08	1.1
53	4.06	29	4.01	28	0.05	1.0
54	4.04	29	4.02	28	0.02	0.9
55	4.03	28	4.01	27	0.03	1.1
56	4.02	28	4.02	27	0.01	1.0
57	4.07	30	4.03	29	0.05	0.7
58	4.07	30	4.02	29	0.06	0.7
59	4.07	29	4.02	28	0.06	0.9
60	4.05	29	4.01	28	0.04	1.2
61	4.11	29	4.03	29	0.08	0.6
62	4.09	30	4.01	29	0.09	0.7
63	4.08	31	4.03	30	0.04	1.0
64	4.07	29	4.04	28	0.04	0.9
65	4.01	28	4.01	27	0.0	0.6
66	4.02	29	4.02	28	0.0	1.1
67	4.06	29	4.01	27	0.06	1.2
68	4.07	29	4.02	28	0.05	0.6
69	4.06	30	4.01	29	0.05	0.5
70	4.03	29	4.02	27	0.02	1.3
71	4.04	29	4.0	27	0.04	1.3
72	4.06	29	4.01	27	0.05	1.3
73	4.06	29	4.0	28	0.06	0.8
74	4.11	31	4.02	29	0.09	1.0
75	4.06	29	4.02	28	0.04	1.1
76	4.04	29	4.02	28	0.02	0.7
77	4.05	30	4.02	29	0.03	0.9
78	4.04	28	4.01	27	0.03	1.0
79	4.02	29	4.0	28	0.02	0.8
80	4.04	30	4.02	29	0.02	0.8
81	4.01	29	4.01	28	0.0	1.2
82	4.01	28	4.01	27	0.0	0.9
83	4.04	29	4.01	28	0.03	1.2
84	4.03	29	4.0	28	0.03	0.5
85	4.02	28	4.0	27	0.02	1.0
86	4.06	29	4.0	28	0.06	1.3
87	4.04	30	4.01	29	0.03	0.2
88	4.11	30	4.01	29	0.09	1.0
89	4.04	29	4.0	29	0.04	0.8
90	4.05	28	4.02	27	0.03	1.1
91	4.11	30	4.03	29	0.08	0.7
92	4.09	32	4.04	31	0.05	0.9
93	4.09	29	4.0	28	0.08	0.9
94	4.08	29	4.0	28	0.08	0.8
95	4.1	30	4.02	29	0.08	0.7
96	4.07	29	4.02	28	0.05	1.0
97	4.08	30	4.01	29	0.07	0.9
98	4.05	29	4.03	29	0.02	0.6
99	4.02	28	4.0	27	0.02	1.2
100	4.06	29	4.01	28	0.04	0.6
Standard deviation					0.026	0.233

## 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	4.03	362	4.01	361	0.02	0.5
2	4.05	366	4.0	360	0.04	6.1
3	4.06	364	4.01	360	0.05	3.4
4	3.99	350	4.0	346	0.01	3.6
5	4.02	359	4.01	358	0.01	0.5
6	4.02	356	4.0	358	0.02	1.3
7	4.02	352	4.0	351	0.01	1.7
8	4.04	360	4.01	357	0.03	2.2
9	4.04	359	4.0	357	0.04	1.9
10	4.03	361	4.0	360	0.02	1.1
11	4.04	361	4.0	359	0.04	2.1
12	4.03	355	4.0	349	0.02	5.7
13	4.04	360	4.0	357	0.03	3.1
14	4.03	360	4.01	358	0.01	1.6
15	4.03	359	4.01	358	0.01	1.2
16	4.04	359	4.0	359	0.03	0.3
17	4.03	359	4.0	357	0.03	1.8
18	4.04	361	4.0	359	0.04	1.1
19	4.04	364	4.0	367	0.04	3.0
20	4.06	367	4.01	368	0.05	0.9
21	4.01	360	4.0	353	0.01	7.1
22	4.02	361	4.0	357	0.02	3.7
23	4.0	357	4.0	358	0.0	1.4
24	4.0	357	4.01	358	0.01	1.5
25	4.01	358	4.0	357	0.01	1.1
26	4.0	358	4.0	358	0.0	0.8
27	4.02	358	4.0	357	0.02	1.1
28	4.01	358	4.01	357	0.01	0.4
29	4.02	359	4.0	358	0.01	0.4
30	4.04	362	4.0	360	0.03	1.2
31	4.01	357	4.0	357	0.01	0.1
32	3.99	357	4.0	356	0.01	0.4
33	4.0	357	4.0	357	0.0	0.2
34	4.02	360	4.0	362	0.01	2.6
35	4.03	360	4.01	358	0.02	1.2
36	4.01	359	4.0	357	0.0	1.4
37	4.03	360	4.0	357	0.02	3.1
38	4.01	357	4.0	358	0.01	0.8
39	4.01	358	4.0	359	0.01	0.4
40	4.0	356	4.0	355	0.01	1.2
41	4.0	363	4.0	359	0.0	3.3
42	4.02	359	4.0	358	0.02	1.1
43	4.07	368	4.0	368	0.06	0.8
44	4.05	363	4.0	359	0.04	4.4
45	4.04	361	4.0	360	0.04	0.5
46	4.02	359	4.0	359	0.02	0.2
47	4.0	354	4.0	350	0.01	4.0
48	4.03	363	4.01	363	0.01	0.4
49	4.01	358	4.0	357	0.0	1.4
50	4.02	360	4.01	362	0.01	2.2

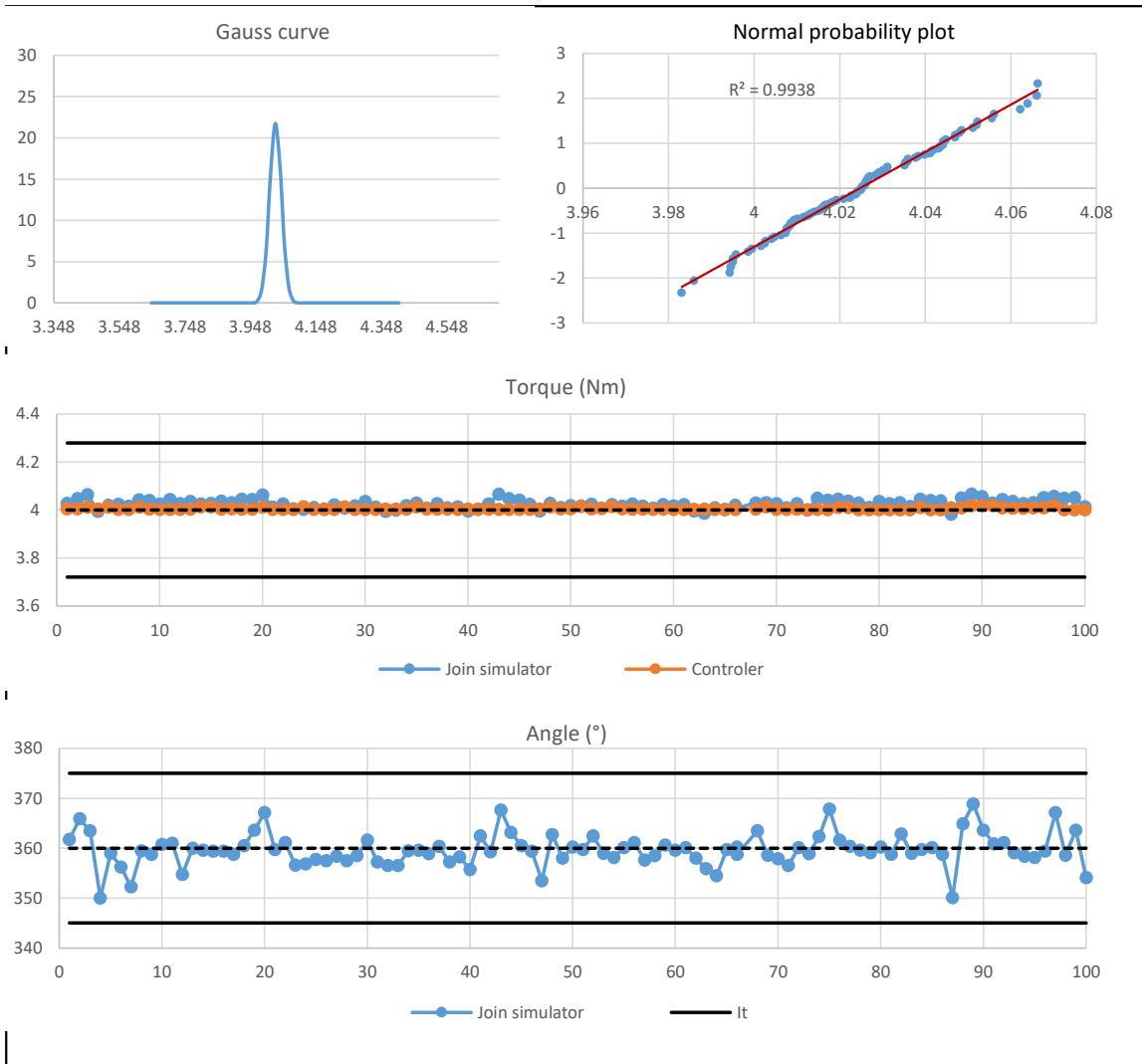
## Performance of tools according to VDI/VDE 2647

### 0 % of the torque range (soft)

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
51	4.02	360	4.01	359	0.0	0.7
52	4.02	363	4.01	360	0.02	2.7
53	4.01	359	4.01	358	0.0	0.6
54	4.02	358	4.01	357	0.01	1.2
55	4.02	360	4.0	360	0.01	0.4
56	4.03	361	4.0	364	0.02	2.4
57	4.02	358	4.0	356	0.01	1.4
58	4.01	359	4.0	358	0.0	0.8
59	4.02	361	4.0	361	0.02	0.2
60	4.02	360	4.0	360	0.01	0.3
61	4.02	360	4.0	360	0.02	0.5
62	4.0	358	4.0	358	0.01	0.1
63	3.99	356	4.0	356	0.02	0.1
64	4.01	355	4.0	355	0.01	0.3
65	4.0	360	4.0	359	0.0	0.3
66	4.02	360	4.0	357	0.02	3.2
67	4.01	359	4.0	358	0.0	0.3
68	4.03	364	4.0	363	0.03	0.5
69	4.03	359	4.01	359	0.02	0.3
70	4.03	358	4.0	357	0.02	1.0
71	4.01	357	4.0	357	0.01	0.3
72	4.03	360	4.0	363	0.02	2.6
73	4.0	359	4.0	358	0.0	1.1
74	4.05	362	4.0	366	0.05	3.2
75	4.04	368	4.0	368	0.04	0.0
76	4.04	362	4.01	361	0.03	0.5
77	4.04	360	4.01	359	0.03	1.4
78	4.03	360	4.0	359	0.03	0.6
79	4.01	359	4.0	358	0.01	1.3
80	4.04	360	4.0	359	0.04	1.0
81	4.03	359	4.0	357	0.03	1.5
82	4.03	363	4.0	361	0.03	2.0
83	4.01	359	4.0	358	0.01	0.7
84	4.04	360	4.01	359	0.03	0.7
85	4.04	360	4.0	359	0.04	1.3
86	4.04	359	4.0	357	0.04	2.0
87	3.98	350	4.01	349	0.02	1.5
88	4.05	365	4.01	359	0.04	5.5
89	4.07	369	4.02	369	0.05	0.1
90	4.06	364	4.02	367	0.04	3.0
91	4.03	361	4.02	360	0.01	0.4
92	4.04	361	4.01	361	0.04	0.4
93	4.04	359	4.01	359	0.03	0.4
94	4.03	358	4.01	358	0.02	0.1
95	4.03	358	4.01	358	0.02	0.2
96	4.05	359	4.01	358	0.04	1.0
97	4.06	367	4.02	367	0.04	0.6
98	4.05	359	4.0	357	0.05	1.7
99	4.05	364	4.0	363	0.05	0.2
100	4.01	354	4.0	357	0.01	3.0
Standard deviation					0.015	1.416

## 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	7.19	30	7.05	29	0.13	1.1
2	7.1	29	7.06	28	0.04	0.9
3	7.09	29	7.04	28	0.05	1.4
4	7.12	30	7.02	29	0.1	1.1
5	7.09	30	7.02	28	0.08	1.2
6	7.17	30	7.03	29	0.13	1.1
7	7.1	29	7.06	28	0.04	1.1
8	7.08	29	7.03	28	0.06	1.3
9	7.06	29	7.06	28	0.0	1.2
10	7.08	29	7.03	28	0.05	1.3
11	7.1	30	7.02	28	0.09	1.0
12	7.19	30	7.05	29	0.15	1.3
13	7.14	30	7.02	29	0.12	0.8
14	7.04	28	7.04	27	0.01	1.4
15	7.08	29	7.02	28	0.07	1.1
16	7.07	28	7.05	27	0.02	1.3
17	7.14	29	7.03	28	0.11	1.0
18	7.14	30	7.01	29	0.13	1.0
19	7.15	30	7.05	29	0.1	0.8
20	7.14	30	7.03	29	0.11	0.9
21	7.07	29	7.04	27	0.03	1.5
22	7.1	30	7.04	29	0.06	1.1
23	7.15	30	7.04	29	0.11	0.9
24	7.01	29	7.03	27	0.02	1.5
25	7.09	29	7.04	28	0.05	1.2
26	7.18	30	7.03	29	0.15	1.1
27	7.12	30	7.06	29	0.07	1.1
28	7.15	30	7.04	29	0.11	1.0
29	7.04	29	7.07	28	0.03	1.5
30	7.11	29	7.03	29	0.08	0.7
31	7.08	29	7.03	28	0.05	1.0
32	7.09	29	7.05	28	0.04	1.3
33	7.16	30	7.01	29	0.15	0.8
34	7.08	29	7.03	28	0.05	1.1
35	7.09	29	7.03	28	0.06	0.9
36	7.06	29	7.04	28	0.02	1.3
37	7.13	29	7.04	28	0.09	0.8
38	7.08	29	7.03	28	0.05	1.1
39	7.06	29	7.04	27	0.02	1.4
40	7.14	30	7.04	29	0.1	1.0
41	6.99	29	7.01	28	0.02	1.1
42	7.18	30	7.07	29	0.12	1.2
43	7.1	29	7.03	28	0.06	1.2
44	7.16	29	7.04	28	0.12	1.0
45	7.08	29	7.04	28	0.04	1.0
46	7.02	28	7.04	27	0.02	1.5
47	7.06	29	7.04	28	0.02	1.1
48	7.08	30	7.02	28	0.06	1.5
49	7.05	29	7.02	28	0.03	1.5
50	7.14	29	7.02	28	0.12	1.1

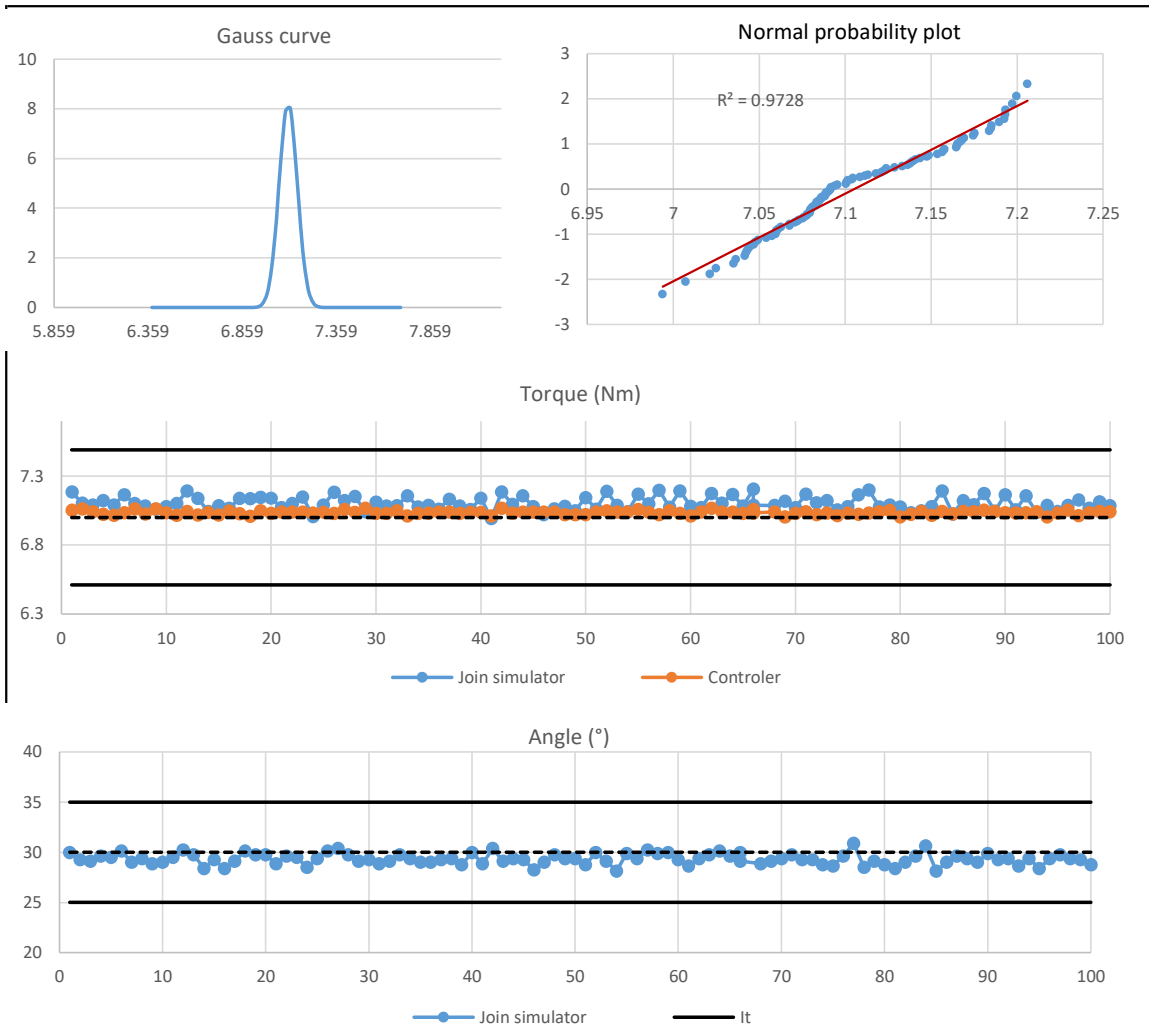
## Performance of tools according to VDI/VDE 2647

### 30 % of the torque range (hard)

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
51	7.06	29	7.04	28	0.02	1.1
52	7.19	30	7.05	29	0.14	1.1
53	7.09	29	7.04	28	0.05	1.2
54	7.04	28	7.04	27	0.0	1.2
55	7.17	30	7.06	29	0.11	0.9
56	7.1	29	7.04	28	0.06	1.0
57	7.2	30	7.02	29	0.18	1.1
58	7.08	30	7.05	29	0.03	1.1
59	7.19	30	7.03	29	0.16	1.3
60	7.08	29	7.01	28	0.07	1.0
61	7.07	29	7.04	28	0.03	0.8
62	7.18	29	7.07	29	0.11	0.8
63	7.1	30	7.04	29	0.06	0.9
64	7.17	30	7.04	29	0.13	0.9
65	7.08	30	7.03	28	0.05	1.3
66	7.21	30	7.06	29	0.15	1.1
67	7.09	29	7.03	28	0.06	1.3
68	7.09	29	7.04	28	0.05	0.9
69	7.12	29	7.0	28	0.11	0.7
70	7.07	29	7.03	28	0.04	1.7
71	7.17	30	7.04	29	0.13	1.2
72	7.11	29	7.02	29	0.09	0.7
73	7.12	29	7.03	28	0.09	0.9
74	7.05	29	7.01	27	0.04	1.3
75	7.08	29	7.03	27	0.05	1.2
76	7.17	30	7.02	29	0.14	1.1
77	7.2	31	7.03	30	0.17	1.1
78	7.08	29	7.04	27	0.03	1.1
79	7.09	29	7.05	28	0.04	0.9
80	7.08	29	7.01	28	0.07	1.0
81	7.04	28	7.02	27	0.01	1.4
82	7.05	29	7.04	28	0.0	1.5
83	7.08	30	7.02	29	0.06	0.7
84	7.19	31	7.04	30	0.15	1.1
85	7.03	28	7.03	27	0.0	1.5
86	7.12	29	7.04	28	0.08	0.7
87	7.09	30	7.04	28	0.05	1.5
88	7.17	29	7.05	28	0.12	1.2
89	7.05	29	7.04	27	0.0	1.6
90	7.16	30	7.03	29	0.13	0.8
91	7.06	29	7.03	28	0.02	1.3
92	7.16	29	7.03	28	0.12	1.2
93	7.04	29	7.04	28	0.01	0.9
94	7.09	29	7.01	28	0.08	0.9
95	7.04	28	7.03	27	0.01	1.5
96	7.09	29	7.05	29	0.03	0.8
97	7.13	30	7.01	29	0.11	0.9
98	7.07	29	7.03	28	0.03	1.2
99	7.11	29	7.04	28	0.07	1.1
100	7.09	29	7.04	28	0.04	1.0
Standard deviation					0.046	0.225

## 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	7.09	368	7.03	360	0.05	7.1
2	7.04	368	7.01	363	0.03	5.0
3	7.03	367	7.02	365	0.01	2.6
4	7.05	367	7.01	360	0.04	7.2
5	7.05	369	7.02	361	0.03	7.9
6	7.01	363	7.02	358	0.01	4.6
7	7.01	362	7.02	360	0.01	1.7
8	7.03	363	7.02	362	0.01	0.9
9	7.07	370	7.01	363	0.06	6.7
10	7.06	373	7.02	372	0.05	0.2
11	7.07	373	7.02	372	0.05	1.5
12	7.06	373	7.01	373	0.05	0.6
13	7.01	365	7.01	362	0.0	2.9
14	7.02	364	7.02	362	0.01	2.5
15	7.0	357	7.01	356	0.02	0.8
16	7.01	361	7.0	360	0.01	0.6
17	7.05	367	7.0	367	0.05	0.1
18	7.04	368	7.0	369	0.04	1.0
19	7.0	366	7.01	364	0.01	1.7
20	7.04	370	7.02	373	0.01	3.3
21	7.07	370	7.0	369	0.07	0.5
22	7.0	359	7.0	359	0.0	0.6
23	6.99	360	7.01	359	0.02	0.9
24	7.0	363	7.0	360	0.0	2.6
25	7.03	368	7.0	366	0.03	1.8
26	7.03	368	7.0	369	0.03	1.3
27	7.07	373	7.02	371	0.04	1.7
28	7.0	366	7.01	361	0.01	4.8
29	6.99	362	7.03	358	0.04	3.3
30	7.0	360	7.01	359	0.01	1.4
31	7.04	366	7.02	360	0.02	5.5
32	6.99	362	7.02	362	0.03	0.5
33	7.06	372	7.0	371	0.06	1.0
34	7.01	366	7.01	362	0.01	4.4
35	7.03	372	7.0	370	0.03	1.9
36	6.97	361	7.0	360	0.03	1.3
37	7.05	365	7.0	360	0.05	4.3
38	7.09	368	7.02	370	0.07	1.9
39	7.04	367	7.02	364	0.02	2.8
40	7.03	370	7.0	365	0.02	4.9
41	7.03	370	7.01	370	0.02	0.8
42	7.01	365	7.0	363	0.01	1.3
43	6.98	365	7.0	363	0.02	2.3
44	7.07	371	7.01	371	0.06	0.8
45	7.04	369	7.01	371	0.02	1.8
46	7.0	361	7.01	362	0.02	0.6
47	7.04	369	7.01	370	0.03	0.4
48	7.05	370	7.0	370	0.04	0.3
49	7.02	366	7.04	365	0.02	1.6
50	7.05	377	7.003	375	0.05	1.7

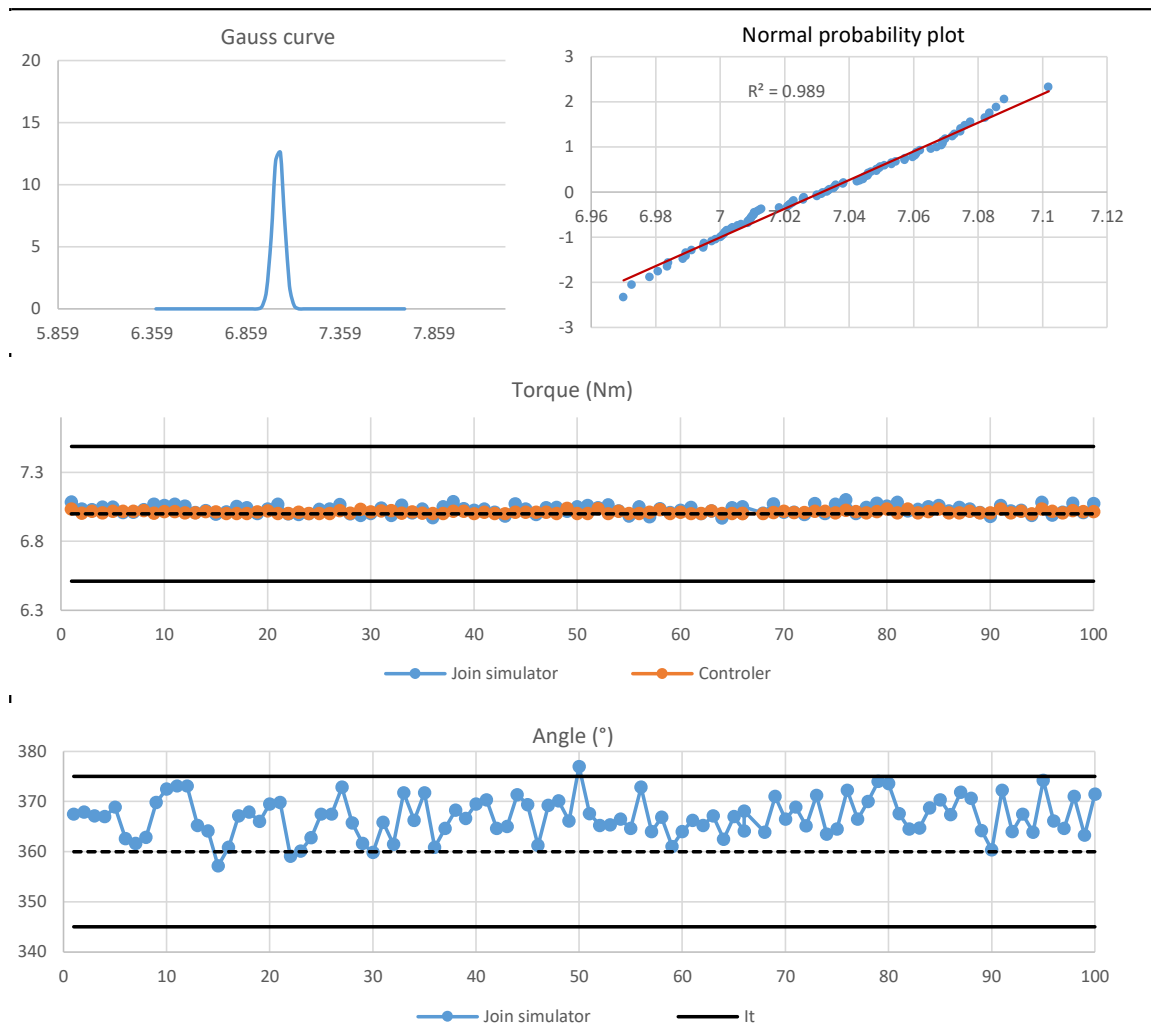
## Performance of tools according to VDI/VDE 2647

### 30 % of the torque range (soft)

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
51	7.06	368	7.0	371	0.06	3.6
52	7.04	365	7.04	361	0.0	4.7
53	7.07	365	7.0	362	0.06	3.4
54	7.02	367	7.02	364	0.0	2.8
55	6.98	365	7.0	364	0.02	0.7
56	7.05	373	7.0	372	0.05	1.3
57	6.98	364	7.01	360	0.03	3.7
58	7.04	367	7.03	363	0.01	4.3
59	7.01	361	7.0	357	0.01	4.4
60	7.03	364	7.01	360	0.01	3.8
61	7.05	366	7.0	364	0.04	1.8
62	7.0	365	7.0	360	0.0	4.9
63	7.02	367	7.02	365	0.0	2.6
64	6.97	363	7.0	361	0.03	1.1
65	7.04	367	7.0	362	0.04	5.4
66	7.01	364	7.0	362	0.01	2.5
67	7.05	368	7.0	363	0.05	5.4
68	7.01	364	7.0	361	0.0	2.4
69	7.07	371	7.01	371	0.06	0.1
70	7.01	367	7.02	364	0.01	2.4
71	7.01	369	7.01	362	0.0	6.9
72	6.99	365	7.01	362	0.01	3.0
73	7.07	371	7.02	371	0.06	0.1
74	7.0	364	7.02	362	0.01	1.6
75	7.07	365	7.01	359	0.06	5.5
76	7.1	372	7.03	371	0.08	1.7
77	7.0	367	7.02	364	0.01	2.2
78	7.05	370	7.01	373	0.04	2.5
79	7.08	374	7.02	372	0.06	1.8
80	7.06	374	7.04	374	0.02	0.2
81	7.08	368	7.01	369	0.08	1.5
82	7.02	365	7.03	360	0.01	4.7
83	7.03	365	7.01	361	0.02	3.9
84	7.05	369	7.02	368	0.04	0.8
85	7.06	370	7.03	370	0.02	0.5
86	7.02	367	7.01	362	0.01	5.3
87	7.05	372	7.01	371	0.04	0.8
88	7.04	371	7.02	370	0.02	0.7
89	7.01	364	7.01	360	0.0	4.0
90	6.98	360	7.01	359	0.03	1.1
91	7.06	372	7.04	369	0.02	3.1
92	7.02	364	7.01	362	0.01	1.8
93	7.03	368	7.02	362	0.01	5.5
94	6.99	364	7.0	361	0.01	2.5
95	7.08	374	7.04	371	0.05	3.2
96	6.99	366	7.02	363	0.03	2.9
97	7.01	365	7.01	360	0.0	4.7
98	7.08	371	7.02	368	0.05	3.5
99	7.01	363	7.02	361	0.01	2.3
100	7.07	372	7.02	370	0.06	1.6
Standard deviation					0.021	1.869

## 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	14.08	33	14.06	31	0.02	1.1
2	14.01	32	14.06	31	0.05	1.3
3	13.92	32	14.06	31	0.14	0.9
4	14.17	33	14.03	31	0.14	1.5
5	14.25	33	14.05	32	0.2	1.2
6	13.96	32	14.06	31	0.1	0.8
7	14.12	32	14.06	31	0.06	1.7
8	14.13	32	14.08	31	0.05	0.9
9	14.22	34	14.05	32	0.16	1.0
10	14.27	34	14.17	32	0.1	1.3
11	14.1	32	14.08	30	0.02	1.4
12	14.16	33	14.05	31	0.12	1.8
13	13.97	31	14.07	30	0.11	1.0
14	14.03	32	14.06	31	0.03	1.4
15	14.19	32	14.1	31	0.08	1.0
16	13.98	32	14.06	31	0.08	0.9
17	14.02	32	14.08	31	0.07	1.0
18	14.06	32	14.08	31	0.02	1.0
19	14.02	32	14.1	31	0.09	1.0
20	14.23	33	14.09	32	0.14	1.2
21	14.07	32	14.05	31	0.03	1.0
22	13.98	32	14.05	31	0.07	1.5
23	14.11	33	14.06	32	0.06	1.1
24	14.28	33	14.02	32	0.26	1.1
25	14.07	32	14.07	30	0.01	1.5
26	14.27	33	14.07	32	0.2	1.1
27	14.04	32	14.03	31	0.02	1.1
28	14.02	32	14.08	31	0.06	1.2
29	14.05	32	14.13	32	0.07	0.8
30	13.99	31	14.08	31	0.1	0.6
31	14.07	32	14.1	30	0.03	1.0
32	14.22	33	14.09	32	0.13	0.9
33	14.04	32	14.02	31	0.02	1.3
34	14.03	32	14.07	31	0.03	0.9
35	14.08	31	14.11	31	0.03	0.6
36	13.99	32	14.03	31	0.04	1.4
37	14.02	32	14.02	31	0.0	0.8
38	14.21	33	14.07	32	0.14	1.0
39	14.14	32	14.06	31	0.07	1.3
40	13.95	31	14.06	31	0.11	0.6
41	14.14	32	14.03	31	0.11	1.6
42	14.31	33	14.11	32	0.2	0.8
43	14.01	32	14.06	32	0.05	0.3
44	14.23	33	14.05	32	0.18	1.5
45	14.1	32	14.11	30	0.01	1.4
46	14.1	32	14.06	31	0.04	0.6
47	13.98	31	14.09	30	0.11	1.0
48	14.08	32	14.06	31	0.02	0.9
49	14.09	32	14.06	31	0.02	1.5
50	14.12	32	14.12	32	0.0	0.8

## Performance of tools according to VDI/VDE 2647

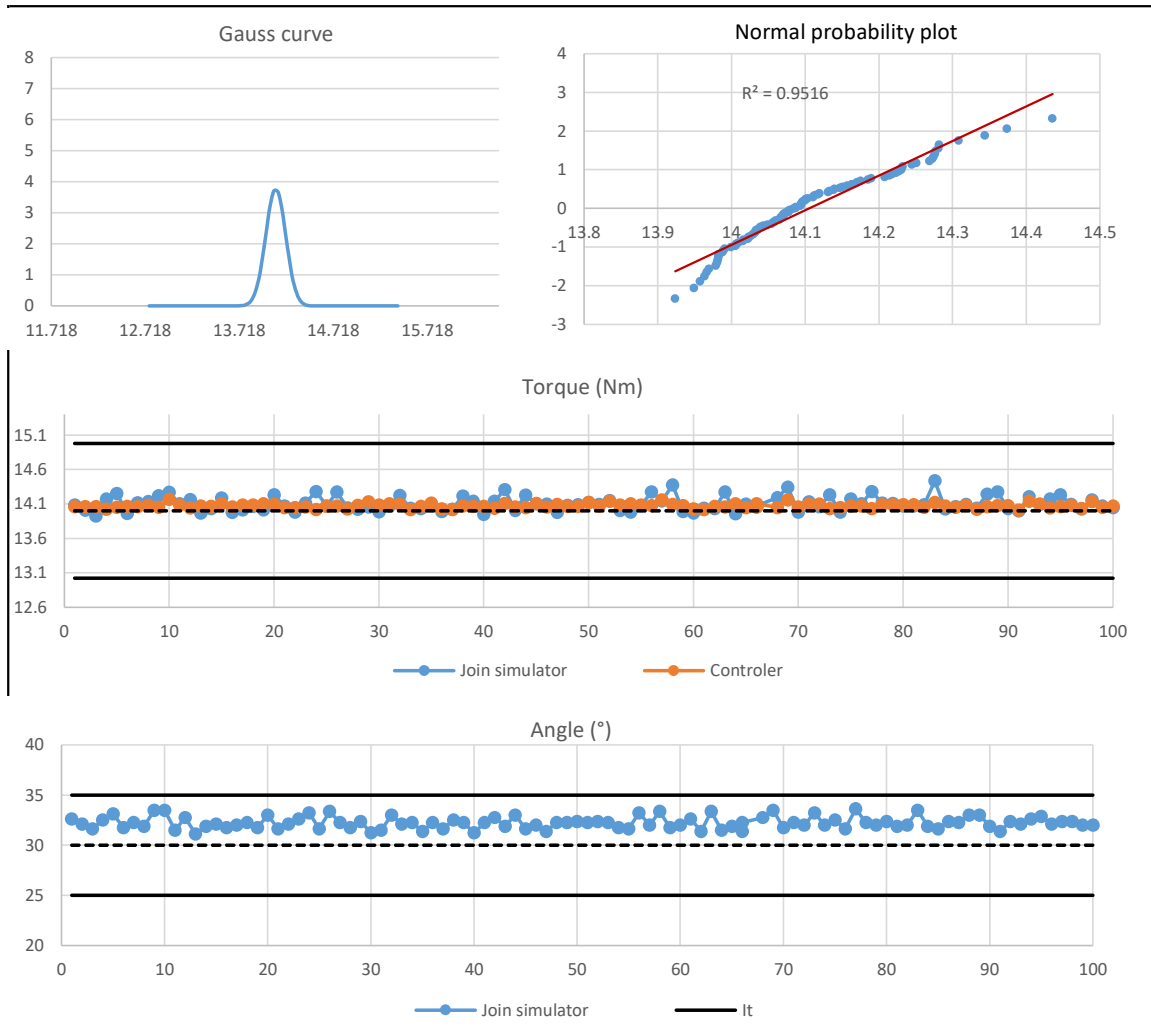
### 100 % of the torque range (hard)

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
51	14.09	32	14.07	31	0.02	1.4
52	14.15	32	14.14	32	0.01	0.8
53	14.01	32	14.08	31	0.08	0.9
54	13.98	32	14.1	31	0.12	0.7
55	14.08	32	14.08	31	0.01	0.8
56	14.28	33	14.07	32	0.2	1.0
57	14.15	32	14.16	31	0.01	0.6
58	14.37	33	14.09	32	0.28	1.1
59	13.99	32	14.07	31	0.08	0.8
60	13.97	32	14.03	31	0.06	1.3
61	14.04	33	14.02	31	0.02	1.4
62	14.03	31	14.07	30	0.03	0.9
63	14.27	33	14.06	32	0.22	1.1
64	13.96	32	14.1	31	0.15	0.8
65	14.1	32	14.05	30	0.05	1.5
66	14.06	31	14.06	31	0.0	0.7
67	14.07	32	14.1	31	0.03	1.0
68	14.19	33	14.05	31	0.14	1.4
69	14.34	34	14.16	33	0.18	1.0
70	13.98	32	14.06	31	0.08	0.7
71	14.13	32	14.1	31	0.04	1.3
72	14.06	32	14.1	31	0.04	1.1
73	14.23	33	14.03	32	0.2	0.9
74	13.98	32	14.05	31	0.07	0.6
75	14.18	33	14.07	32	0.11	0.9
76	14.1	32	14.07	31	0.03	0.6
77	14.28	34	14.03	33	0.25	1.1
78	14.11	32	14.09	31	0.02	0.9
79	14.11	32	14.09	31	0.02	1.3
80	14.07	32	14.09	31	0.02	1.5
81	14.07	32	14.09	31	0.02	0.7
82	14.09	32	14.05	31	0.04	1.1
83	14.44	34	14.12	32	0.31	1.1
84	14.03	32	14.07	31	0.04	0.7
85	14.06	32	14.05	30	0.01	1.4
86	14.09	32	14.08	32	0.02	0.6
87	14.04	32	14.02	31	0.02	1.3
88	14.24	33	14.06	32	0.19	1.0
89	14.28	33	14.08	32	0.2	1.2
90	14.03	32	14.08	31	0.05	1.2
91	14.0	31	14.01	30	0.01	1.1
92	14.21	32	14.14	31	0.07	0.9
93	14.1	32	14.1	31	0.0	0.8
94	14.17	33	14.04	32	0.13	0.8
95	14.23	33	14.06	32	0.17	0.8
96	14.1	32	14.08	31	0.02	1.0
97	14.03	32	14.03	31	0.01	1.4
98	14.16	32	14.14	32	0.02	0.8
99	14.07	32	14.05	31	0.02	0.8
100	14.05	32	14.07	31	0.02	1.2
Standard deviation					0.072	0.294



## 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	14.11	361	14.06	358	0.04	2.8
2	13.91	352	14.02	350	0.1	2.0
3	14.12	365	14.01	360	0.12	5.7
4	14.09	372	14.05	372	0.04	0.2
5	14.05	359	14.02	358	0.02	1.4
6	13.99	370	14.04	372	0.04	2.0
7	13.85	353	14.0	354	0.15	0.5
8	14.01	364	14.01	360	0.0	4.0
9	13.96	360	14.04	359	0.08	1.0
10	13.99	362	14.03	360	0.04	2.7
11	14.0	366	14.07	369	0.07	2.9
12	13.99	358	14.01	357	0.02	1.2
13	13.96	362	14.04	359	0.08	3.3
14	14.01	357	14.02	357	0.01	0.5
15	13.9	365	14.03	364	0.13	0.7
16	14.01	363	14.04	360	0.02	3.1
17	14.07	374	14.05	371	0.02	2.3
18	14.06	363	14.01	359	0.05	3.7
19	14.05	365	14.04	359	0.01	6.0
20	14.03	360	14.05	358	0.02	1.5
21	13.95	362	14.01	360	0.06	2.5
22	13.88	358	14.01	357	0.13	0.6
23	14.0	361	14.0	358	0.01	2.4
24	14.03	370	14.08	370	0.05	0.7
25	13.89	354	14.0	353	0.11	0.7
26	13.92	365	14.02	361	0.1	3.3
27	14.13	360	14.02	357	0.11	2.7
28	13.96	360	14.05	359	0.08	1.3
29	14.01	359	14.09	357	0.08	1.7
30	13.92	369	14.01	367	0.09	2.1
31	13.91	356	14.05	355	0.14	1.3
32	14.06	376	14.06	374	0.0	1.5
33	13.87	361	14.03	359	0.15	1.2
34	13.98	362	14.02	359	0.04	2.9
35	13.94	359	14.04	358	0.11	0.8
36	13.98	357	14.02	358	0.04	1.6
37	13.89	363	14.04	360	0.15	2.5
38	14.04	360	14.05	358	0.01	1.8
39	14.05	367	14.1	369	0.05	2.7
40	13.89	355	14.01	349	0.13	5.3
41	13.93	367	14.02	365	0.09	2.2
42	13.96	360	14.06	358	0.1	1.4
43	13.96	363	14.04	360	0.08	3.2
44	13.92	360	14.01	359	0.09	1.7
45	14.11	376	14.04	374	0.07	1.7
46	13.93	361	14.05	359	0.12	2.0
47	14.13	373	14.11	372	0.01	0.6
48	13.98	364	14.02	369	0.04	5.1
49	14.0	359	14.01	357	0.01	1.4
50	13.91	362	14.05	360	0.14	2.0

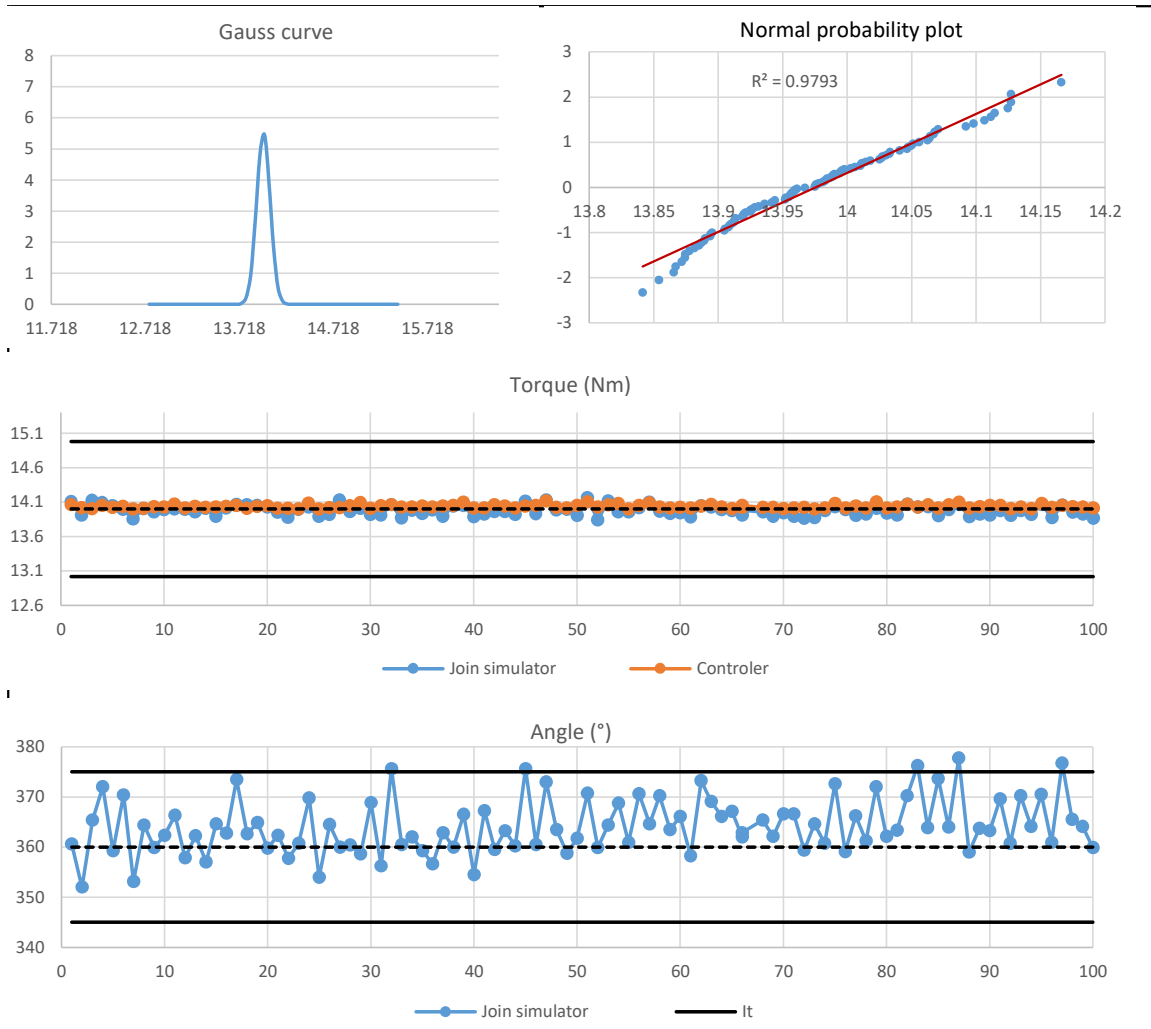
## Performance of tools according to VDI/VDE 2647

### 100 % of the torque range (soft)

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
51	14.17	371	14.1	370	0.06	0.7
52	13.84	360	14.03	359	0.19	0.7
53	14.11	364	14.06	359	0.06	5.3
54	13.96	369	14.08	371	0.12	2.7
55	13.96	361	14.0	362	0.05	1.2
56	14.02	371	14.05	371	0.03	0.5
57	14.1	365	14.09	360	0.01	4.9
58	13.97	370	14.03	370	0.06	0.2
59	13.94	364	14.01	362	0.08	1.5
60	13.94	366	14.02	364	0.08	2.6
61	13.88	358	14.01	360	0.13	2.1
62	14.05	373	14.04	372	0.01	1.4
63	14.03	369	14.07	371	0.04	2.2
64	13.99	366	14.03	360	0.04	6.4
65	13.98	367	14.0	371	0.03	4.1
66	13.91	362	14.02	360	0.11	2.1
67	13.98	363	14.05	360	0.07	3.1
68	13.96	365	14.02	363	0.06	1.9
69	13.89	362	14.02	361	0.13	1.2
70	13.94	367	14.0	365	0.06	1.5
71	13.89	367	14.01	366	0.12	0.8
72	13.87	359	14.02	357	0.15	2.6
73	13.87	365	14.0	364	0.13	0.5
74	13.98	361	14.01	359	0.03	1.8
75	14.03	373	14.08	372	0.05	0.1
76	13.99	359	14.01	358	0.02	0.9
77	13.91	366	14.04	364	0.13	2.2
78	13.93	361	14.01	360	0.09	0.8
79	14.01	372	14.11	373	0.09	1.1
80	13.94	362	14.01	361	0.07	1.0
81	13.91	363	14.03	360	0.12	3.1
82	14.07	370	14.07	371	0.0	0.6
83	14.03	376	14.03	376	0.0	0.5
84	14.03	364	14.06	359	0.03	4.5
85	13.9	374	14.01	372	0.11	1.3
86	13.99	364	14.06	359	0.07	4.6
87	14.07	378	14.1	376	0.03	2.0
88	13.89	359	14.01	358	0.13	0.5
89	13.93	364	14.03	359	0.11	4.3
90	13.91	363	14.05	362	0.14	0.9
91	13.98	370	14.05	370	0.08	0.1
92	13.91	361	14.01	360	0.1	1.2
93	13.98	370	14.02	365	0.05	4.9
94	13.92	364	14.01	364	0.08	0.4
95	14.06	371	14.08	368	0.02	2.5
96	13.87	361	14.02	360	0.15	1.0
97	14.06	377	14.05	375	0.0	2.2
98	13.95	366	14.03	366	0.08	0.8
99	13.93	364	14.02	359	0.1	5.0
100	13.87	360	14.01	358	0.15	1.5
Standard deviation					0.046	1.472

## 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	8.38	28	8.31	27	0.07	0.3
2	8.39	28	8.31	27	0.09	0.6
3	8.49	28	8.46	27	0.03	0.7
4	8.43	28	8.33	27	0.1	0.6
5	8.42	28	8.39	27	0.03	1.0
6	8.39	28	8.25	27	0.14	1.1
7	8.51	29	8.45	27	0.06	1.5
8	8.53	28	8.41	27	0.13	1.1
9	8.47	28	8.46	27	0.01	0.8
10	8.45	28	8.31	27	0.15	0.6
11	8.5	28	8.44	27	0.06	0.8
12	8.37	29	8.35	27	0.02	1.3
13	8.45	28	8.41	27	0.04	1.0
14	8.49	28	8.46	27	0.03	1.0
15	8.42	29	8.29	27	0.13	1.3
16	8.43	29	8.35	27	0.08	1.1
17	8.51	29	8.48	27	0.03	1.5
18	8.4	28	8.3	27	0.11	0.4
19	8.31	29	8.19	27	0.11	1.0
20	8.48	29	8.46	27	0.02	1.2
21	8.38	28	8.3	27	0.08	1.1
22	8.42	29	8.36	27	0.06	1.1
23	8.45	29	8.4	27	0.05	1.3
24	8.4	28	8.25	27	0.15	0.7
25	8.35	28	8.17	27	0.19	1.0
26	8.48	29	8.44	27	0.04	1.2
27	8.37	29	8.32	27	0.05	1.2
28	8.38	28	8.29	27	0.1	0.7
29	8.42	28	8.27	27	0.15	0.8
30	8.33	28	8.31	27	0.02	0.3
31	8.48	29	8.44	27	0.05	1.4
32	8.44	29	8.32	27	0.13	1.3
33	8.44	28	8.47	27	0.03	0.6
34	8.51	29	8.38	27	0.13	1.5
35	8.41	28	8.28	27	0.13	1.1
36	8.42	29	8.38	27	0.05	1.2
37	8.44	29	8.39	27	0.05	1.2
38	8.4	28	8.27	27	0.13	0.6
39	8.42	28	8.23	27	0.19	0.8
40	8.46	28	8.42	27	0.05	1.0
41	8.44	28	8.3	27	0.14	1.1
42	8.46	29	8.4	27	0.06	1.4
43	8.48	28	8.45	27	0.02	1.1
44	8.46	29	8.36	27	0.09	1.2
45	8.43	28	8.36	27	0.06	0.4
46	8.48	28	8.3	27	0.18	0.7
47	8.42	29	8.36	27	0.06	1.1
48	8.47	28	8.43	27	0.04	0.7
49	8.48	29	8.41	27	0.07	1.3
50	8.39	28	8.25	27	0.14	0.7

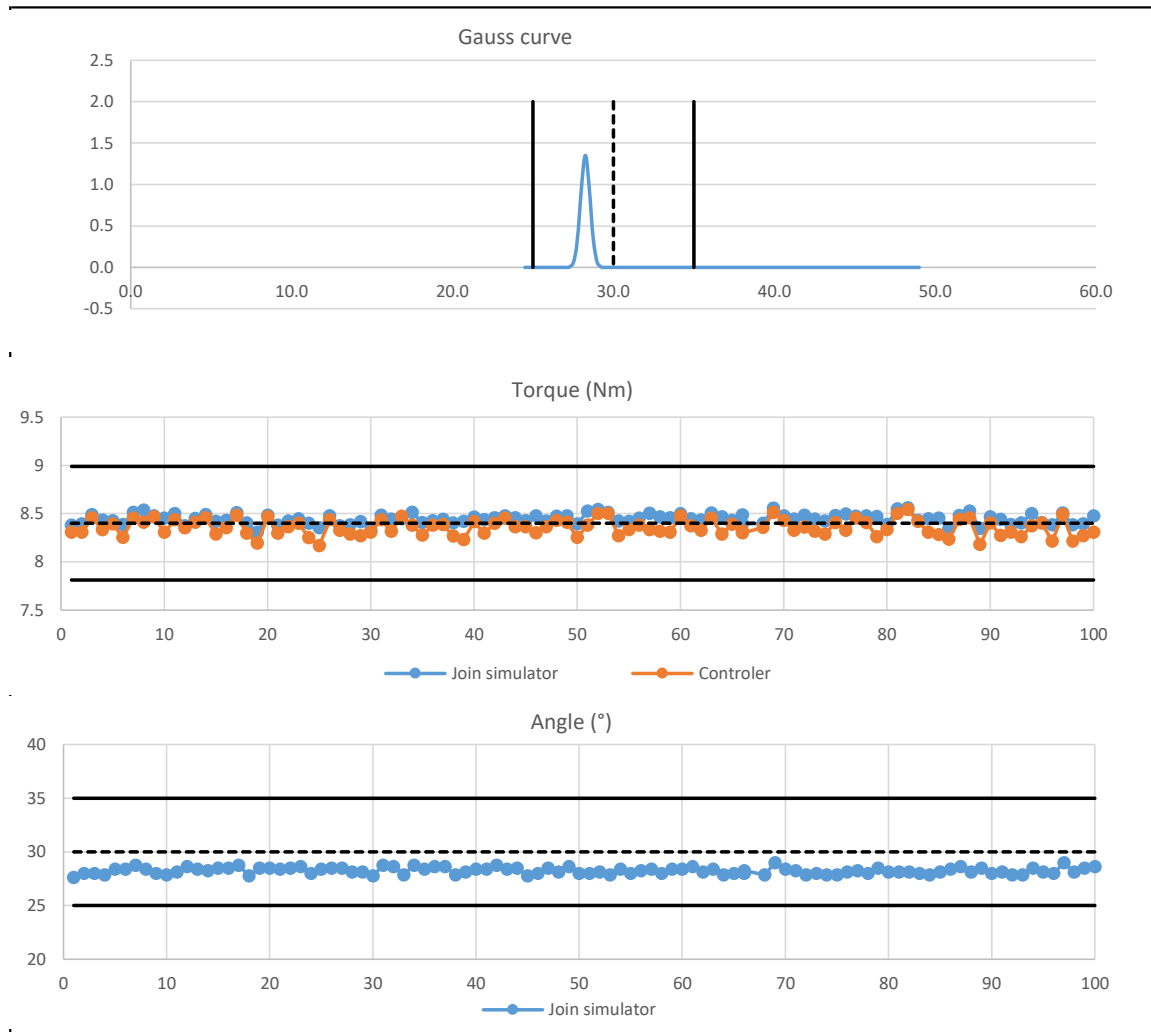
## Performance of tools according to VDI/VDE 2647

### Tightening at 30°

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
51	8.52	28	8.38	27	0.14	0.6
52	8.54	28	8.5	27	0.04	0.8
53	8.51	28	8.5	27	0.01	0.6
54	8.42	28	8.27	27	0.15	1.0
55	8.42	28	8.33	27	0.09	0.6
56	8.45	28	8.38	27	0.07	1.0
57	8.5	28	8.33	27	0.17	1.0
58	8.47	28	8.32	27	0.15	0.7
59	8.46	28	8.31	27	0.15	1.1
60	8.5	28	8.47	27	0.02	1.0
61	8.45	29	8.37	27	0.07	1.2
62	8.43	28	8.33	27	0.11	0.7
63	8.51	28	8.45	27	0.05	1.0
64	8.47	28	8.29	27	0.18	0.6
65	8.43	28	8.39	27	0.04	0.5
66	8.48	28	8.32	27	0.17	0.7
67	8.39	28	8.3	27	0.1	0.9
68	8.4	28	8.35	27	0.05	0.5
69	8.56	29	8.51	27	0.05	1.6
70	8.48	28	8.43	27	0.05	1.1
71	8.44	28	8.32	27	0.12	0.8
72	8.48	28	8.36	27	0.12	0.5
73	8.44	28	8.32	27	0.12	0.6
74	8.42	28	8.29	27	0.14	0.4
75	8.48	28	8.41	27	0.07	0.5
76	8.49	28	8.32	27	0.17	0.8
77	8.47	28	8.45	27	0.02	0.8
78	8.48	28	8.41	27	0.07	0.7
79	8.47	29	8.26	27	0.21	1.2
80	8.39	28	8.33	27	0.05	0.7
81	8.55	28	8.5	27	0.04	0.7
82	8.56	28	8.54	27	0.02	0.8
83	8.43	28	8.42	27	0.01	0.6
84	8.45	28	8.31	27	0.14	0.5
85	8.45	28	8.28	27	0.17	0.8
86	8.34	28	8.23	27	0.11	0.9
87	8.48	29	8.44	27	0.04	1.2
88	8.53	28	8.46	27	0.07	0.7
89	8.35	29	8.18	27	0.17	1.1
90	8.46	28	8.4	27	0.06	0.5
91	8.44	28	8.27	27	0.17	0.7
92	8.39	28	8.31	27	0.08	0.5
93	8.4	28	8.26	27	0.14	0.5
94	8.5	29	8.37	27	0.13	1.2
95	8.41	28	8.4	27	0.01	0.7
96	8.38	28	8.21	27	0.17	0.6
97	8.51	29	8.49	27	0.01	1.6
98	8.38	28	8.21	27	0.17	0.8
99	8.39	29	8.27	27	0.12	1.1
100	8.47	29	8.31	27	0.17	1.3
Standard deviation					0.054	0.310

## 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	11.19	178	11.04	177	0.14	0.5
2	11.11	178	11.03	177	0.07	0.5
3	11.17	178	11.15	177	0.02	0.7
4	11.09	178	11.02	177	0.07	0.4
5	11.06	179	11.13	177	0.07	1.3
6	11.25	179	11.33	177	0.08	1.6
7	11.23	179	11.22	177	0.01	1.3
8	11.15	178	11.07	177	0.08	0.5
9	11.11	178	10.97	177	0.14	1.1
10	11.03	178	10.96	177	0.07	0.6
11	11.05	178	10.95	177	0.1	0.8
12	11.03	178	11.06	177	0.04	0.7
13	11.15	178	11.19	177	0.05	0.9
14	11.17	178	11.17	177	0.0	0.7
15	11.11	178	10.93	177	0.18	0.7
16	11.12	178	11.14	177	0.02	1.0
17	11.11	178	11.15	177	0.04	1.2
18	11.14	179	11.17	177	0.03	1.4
19	11.11	178	10.92	177	0.19	0.5
20	11.19	178	11.22	177	0.03	0.4
21	11.12	178	11.04	177	0.08	0.4
22	11.0	178	10.84	177	0.16	0.2
23	11.03	178	10.96	177	0.07	1.1
24	11.21	178	11.26	177	0.04	1.0
25	11.22	178	11.22	177	0.0	0.9
26	11.13	178	10.93	177	0.2	0.5
27	11.07	177	10.89	177	0.18	0.1
28	11.1	178	11.17	177	0.07	1.2
29	11.07	178	11.12	177	0.06	0.9
30	10.99	178	10.92	177	0.07	0.5
31	11.12	178	11.12	177	0.0	1.0
32	11.2	178	11.26	177	0.06	1.2
33	11.12	178	11.13	177	0.01	0.7
34	10.98	178	10.99	177	0.01	0.7
35	11.13	179	11.24	177	0.11	1.2
36	11.11	179	11.14	177	0.03	1.2
37	11.25	178	11.29	177	0.04	1.0
38	11.24	178	11.23	177	0.01	0.4
39	11.11	177	11.12	177	0.0	0.2
40	11.19	178	11.03	177	0.15	0.4
41	11.1	179	11.15	177	0.05	1.4
42	11.08	179	11.15	177	0.07	1.2
43	11.13	179	11.17	177	0.04	1.4
44	11.14	177	11.0	177	0.14	0.2
45	11.08	178	11.02	177	0.06	0.5
46	11.06	178	10.9	177	0.17	0.6
47	11.0	178	10.91	177	0.1	0.7
48	11.0	178	10.96	177	0.04	0.6
49	11.1	178	10.97	177	0.13	0.4
50	11.04	178	11.03	177	0.02	0.3



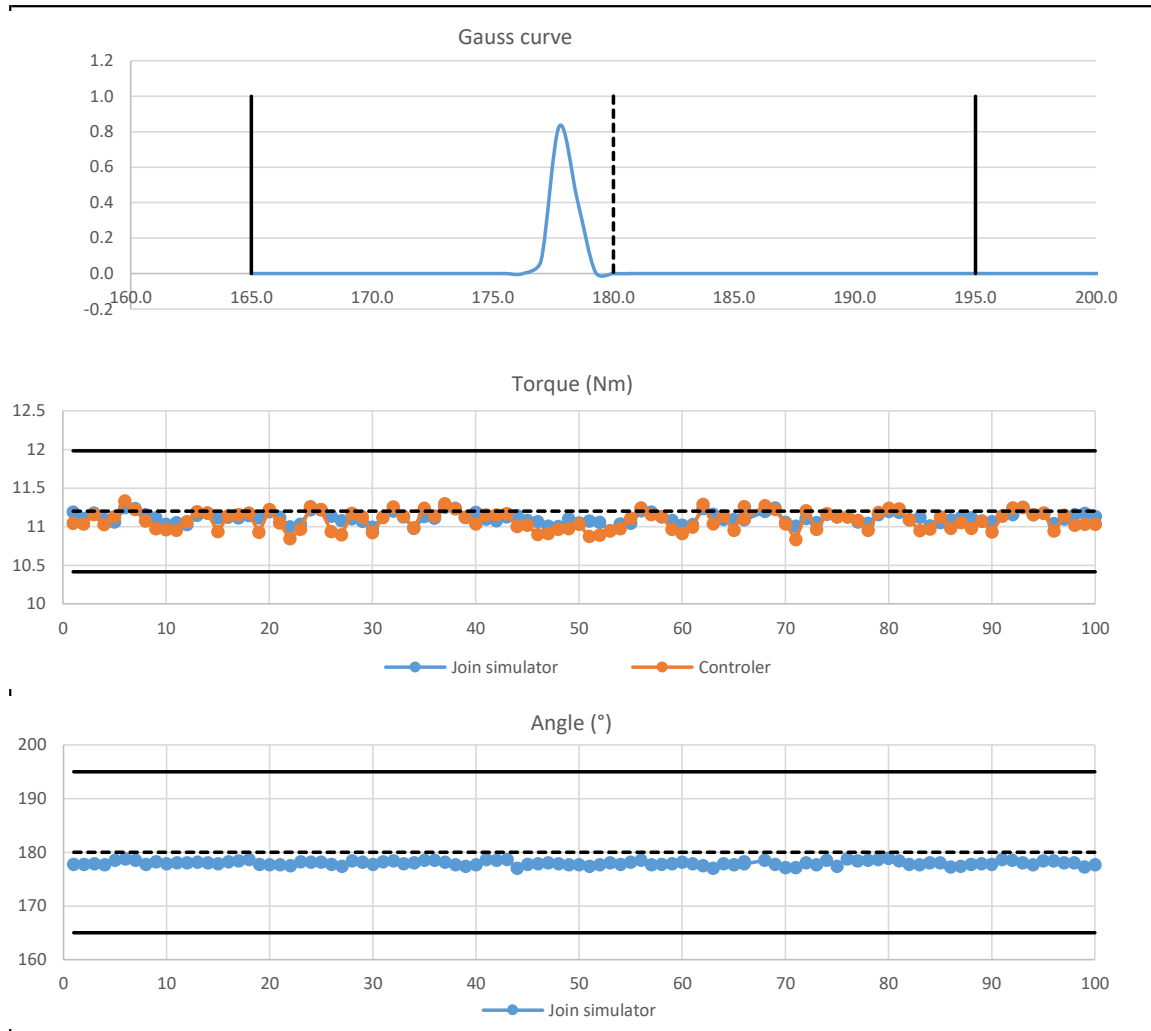
## Performance of tools according to VDI/VDE 2647

### Tightening at 180°

Tightening	Joint simulator		Controller		Delta	
	Torques	Angles	Torques	Angles	Torques	Angles
	Nm	°	Nm	°	Nm	°
51	11.04	178	11.03	177	0.02	0.3
52	11.07	177	10.87	177	0.2	0.1
53	11.05	178	10.89	177	0.17	0.4
54	10.95	178	10.94	177	0.0	0.8
55	11.03	178	10.97	177	0.06	0.5
56	11.04	178	11.11	177	0.07	0.9
57	11.2	179	11.24	177	0.04	1.3
58	11.19	178	11.16	177	0.03	0.4
59	11.12	178	11.13	177	0.01	0.5
60	11.08	178	10.96	177	0.12	0.7
61	11.02	178	10.91	177	0.11	0.9
62	11.02	178	10.99	177	0.03	0.6
63	11.23	178	11.29	177	0.06	0.4
64	11.16	177	11.04	177	0.12	0.2
65	11.09	178	11.14	177	0.05	0.6
66	11.09	178	10.95	177	0.14	0.4
67	11.13	178	11.26	177	0.13	1.0
68	11.08	178	11.1	177	0.02	0.7
69	11.2	179	11.27	177	0.07	1.2
70	11.24	178	11.22	177	0.02	0.6
71	11.05	177	11.04	177	0.02	0.1
72	11.01	177	10.83	177	0.18	0.1
73	11.1	178	11.2	177	0.1	0.7
74	11.05	178	10.96	177	0.09	0.3
75	11.16	179	11.17	177	0.01	1.3
76	11.12	177	11.13	177	0.0	0.2
77	11.13	179	11.13	177	0.0	1.5
78	11.06	178	11.08	177	0.02	1.1
79	11.04	179	10.95	177	0.09	1.2
80	11.15	179	11.18	177	0.03	1.4
81	11.2	179	11.24	177	0.04	1.7
82	11.18	178	11.23	177	0.05	1.2
83	11.09	178	11.09	177	0.0	0.5
84	11.12	178	10.95	177	0.17	0.4
85	11.01	178	10.97	177	0.04	0.8
86	11.05	178	11.12	177	0.07	0.7
87	11.09	177	10.98	177	0.11	0.1
88	11.12	177	11.05	177	0.06	0.1
89	11.11	178	10.98	177	0.13	0.5
90	11.07	178	11.07	177	0.0	0.5
91	11.06	178	10.93	177	0.13	0.5
92	11.14	179	11.14	177	0.0	1.4
93	11.15	179	11.24	177	0.08	1.3
94	11.25	178	11.25	177	0.0	0.8
95	11.15	178	11.15	177	0.0	0.4
96	11.17	178	11.17	177	0.0	1.1
97	11.04	178	10.94	177	0.1	1.1
98	11.1	178	11.15	177	0.05	0.7
99	11.15	178	11.02	177	0.13	0.8
100	11.17	177	11.03	177	0.14	0.0
Standard deviation					0.056	0.404

## Performance of tools according to VDI/VDE 2647

### Tightening at 180°

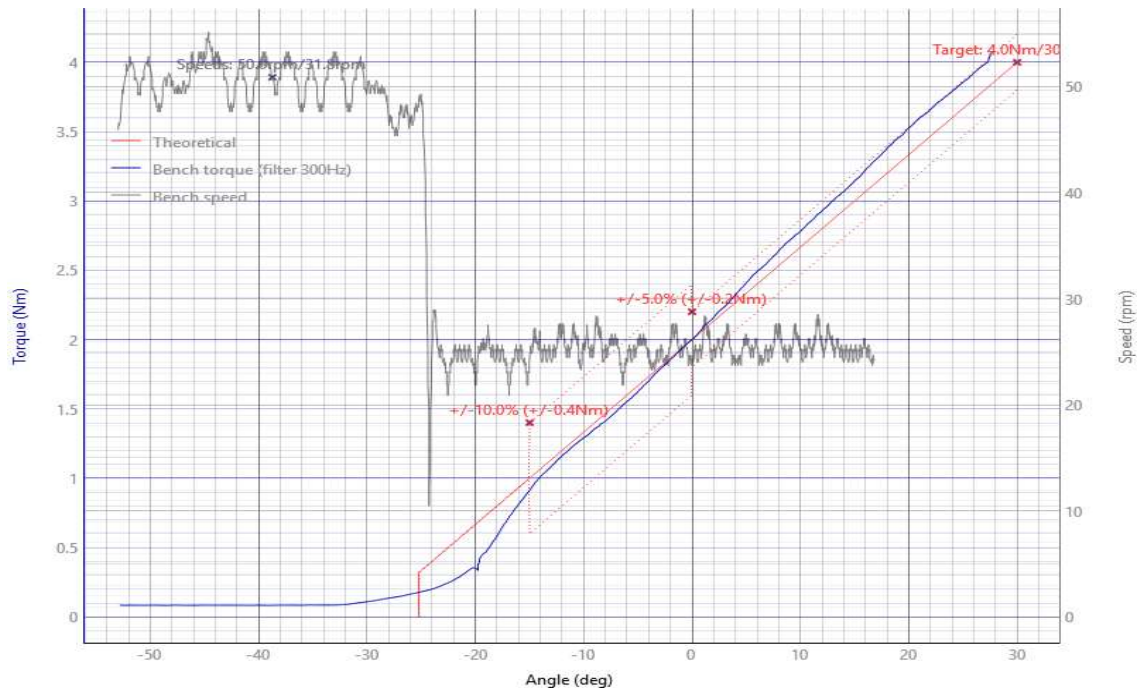


## Performance of tools according to VDI/VDE 2647

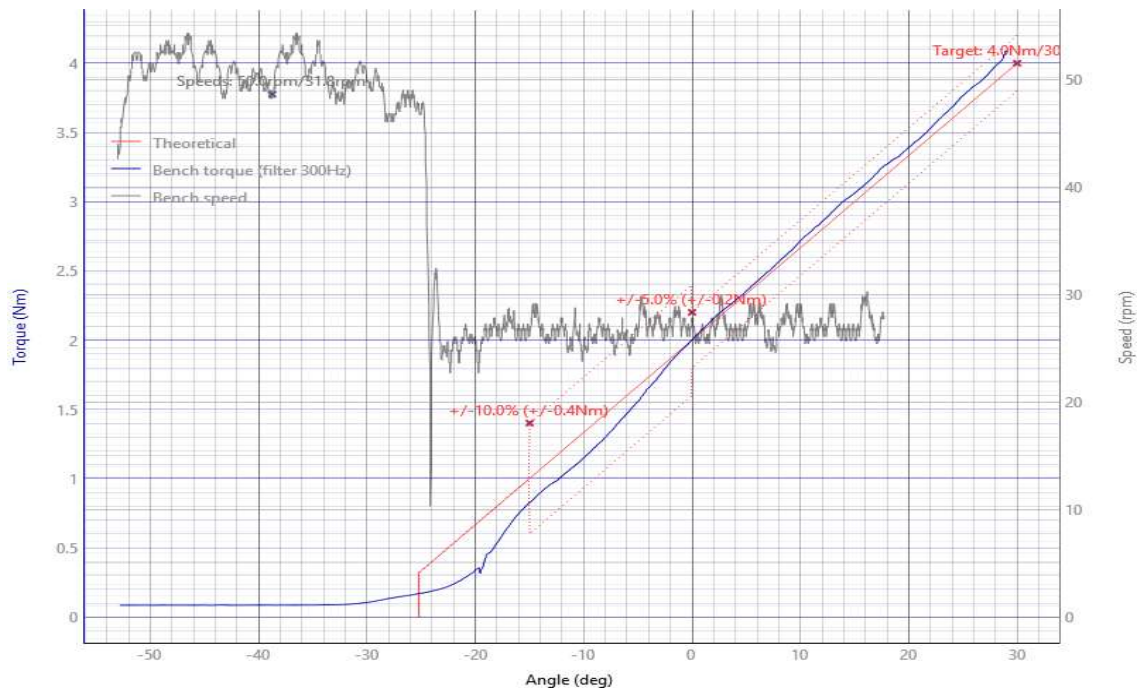
**0 % of the torque range (hard)**

**Curve (torque/Angle)**

**Start**



**End**

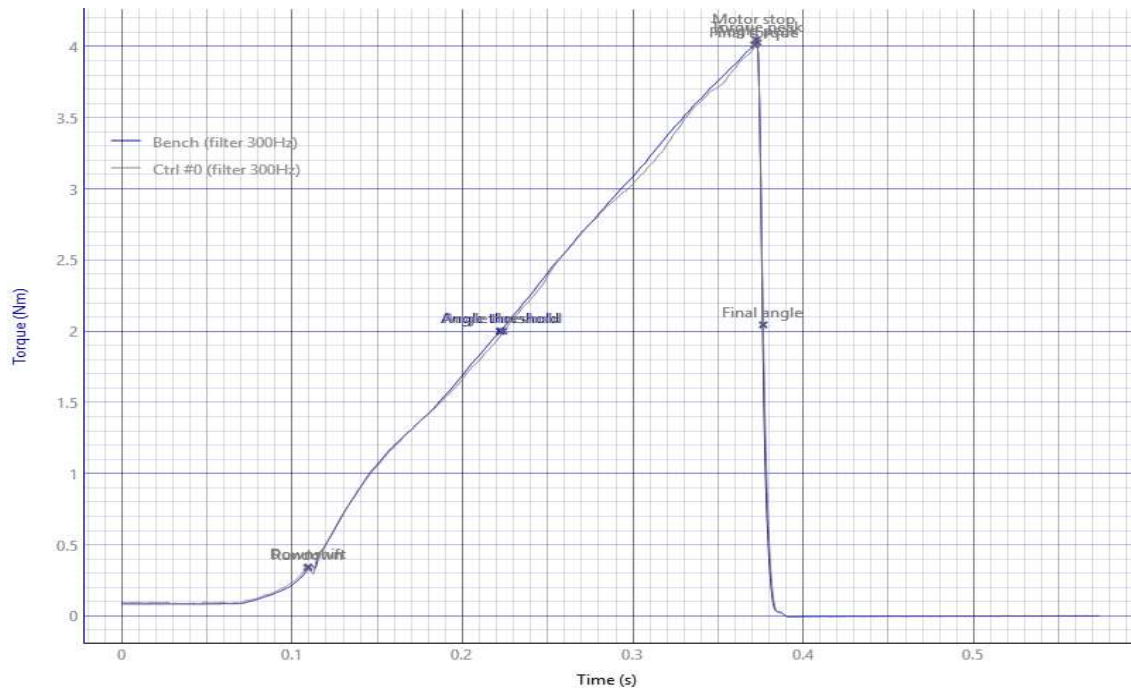


## Performance of tools according to VDI/VDE 2647

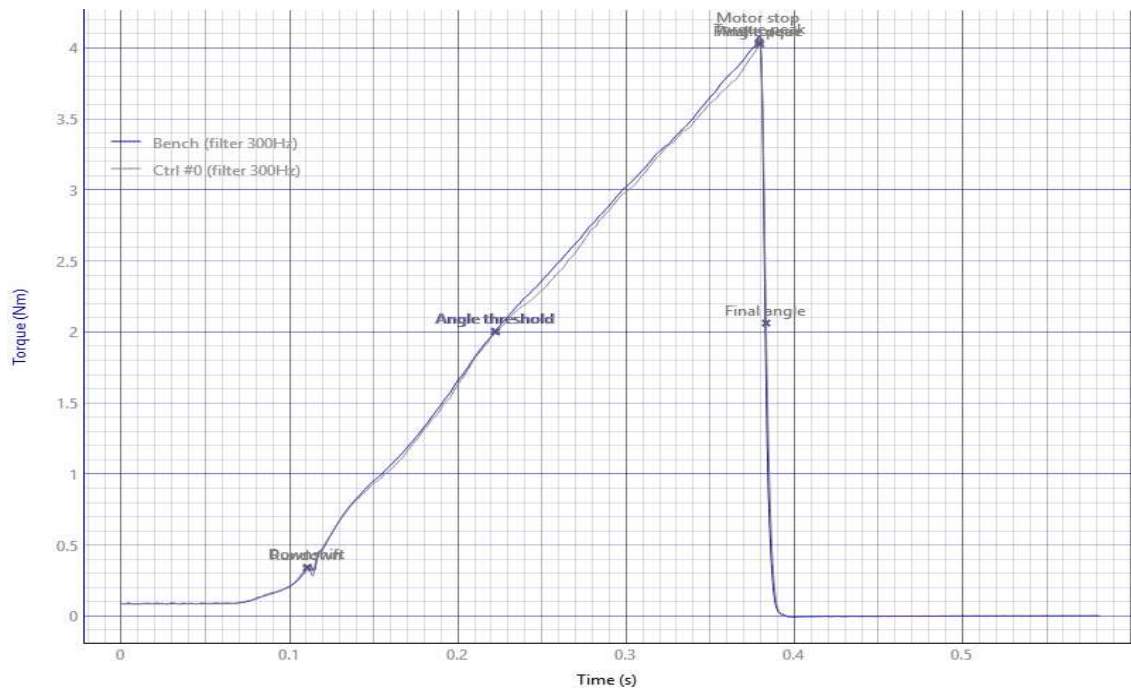
0 % of the torque range (hard)

Curve (torque/Time)

Start



End



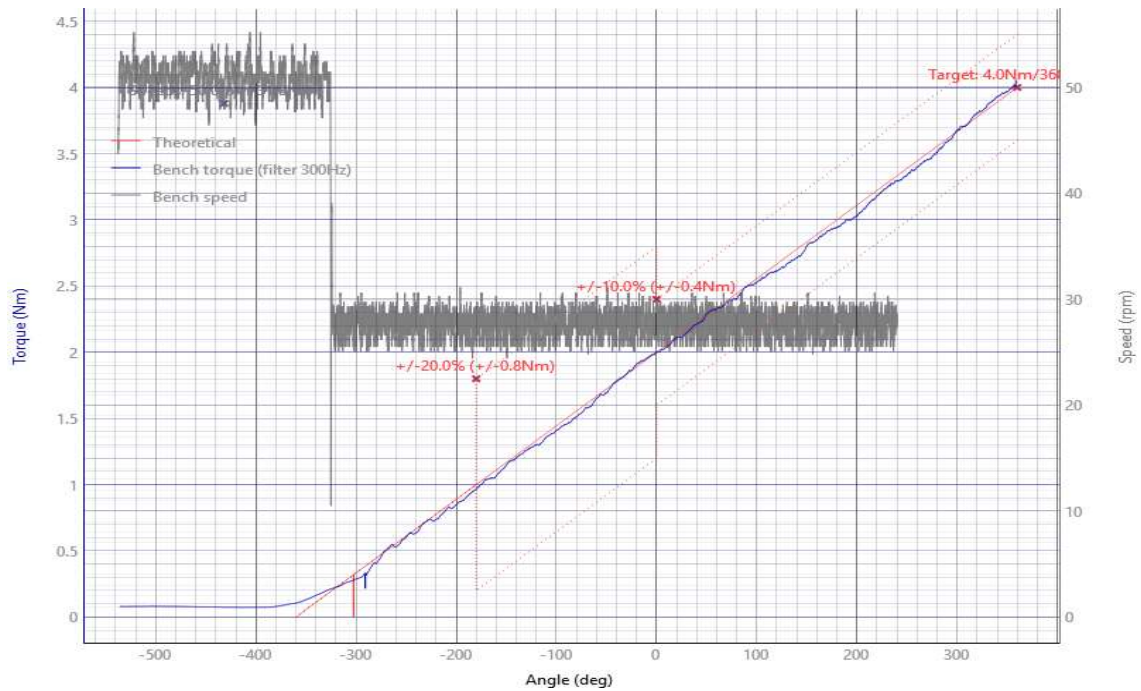


## Performance of tools according to VDI/VDE 2647

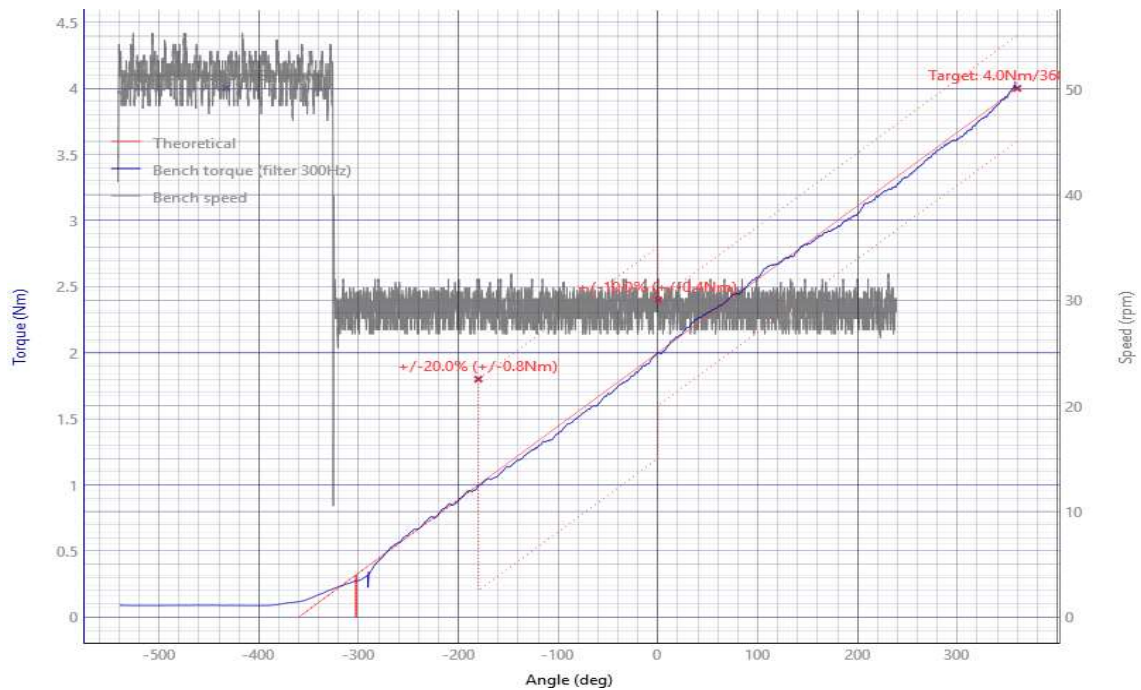
0 % of the torque range (soft)

Curve (torque/Angle)

Start



End

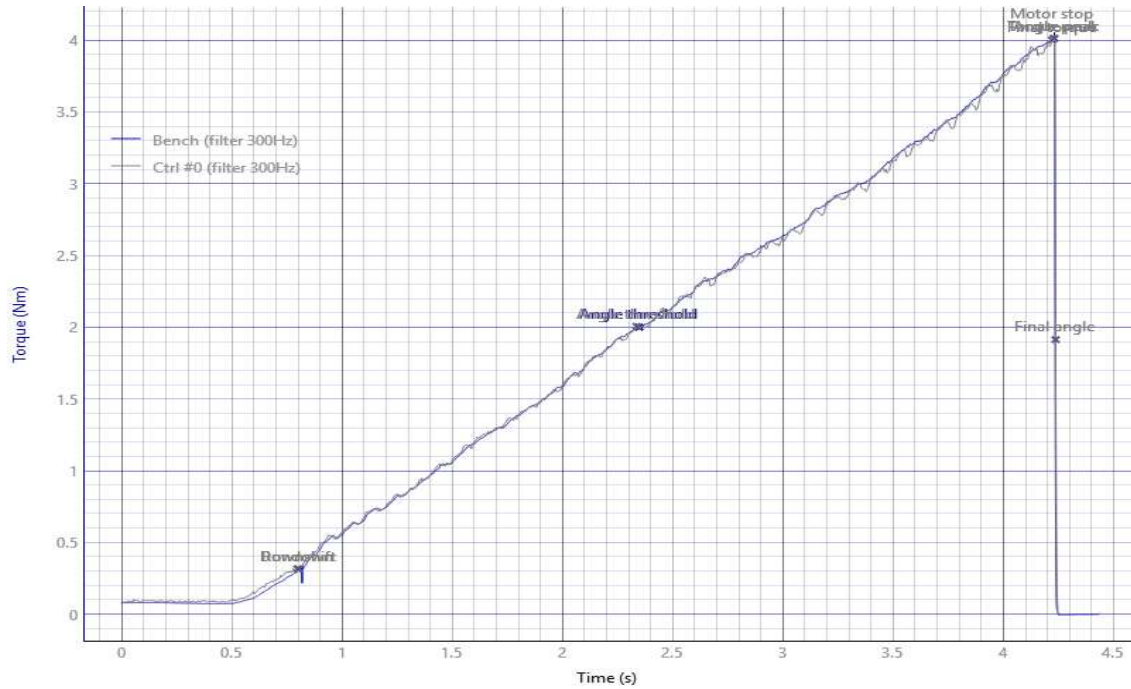


## Performance of tools according to VDI/VDE 2647

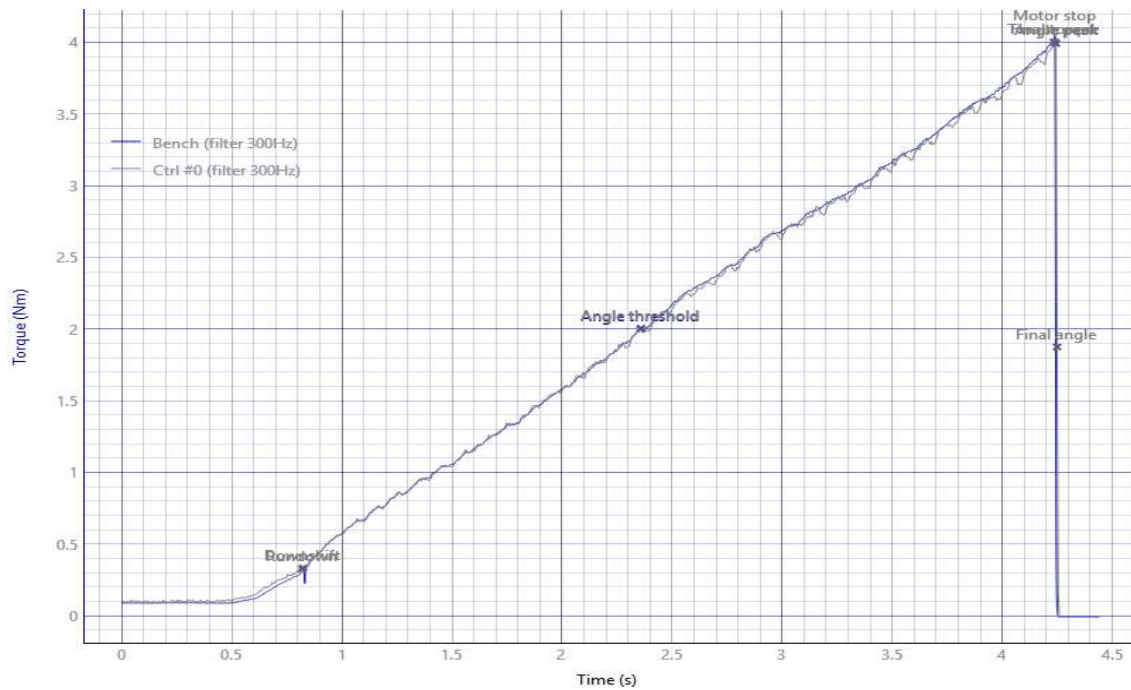
0 % of the torque range (soft)

Curve (torque/Time)

Start



End

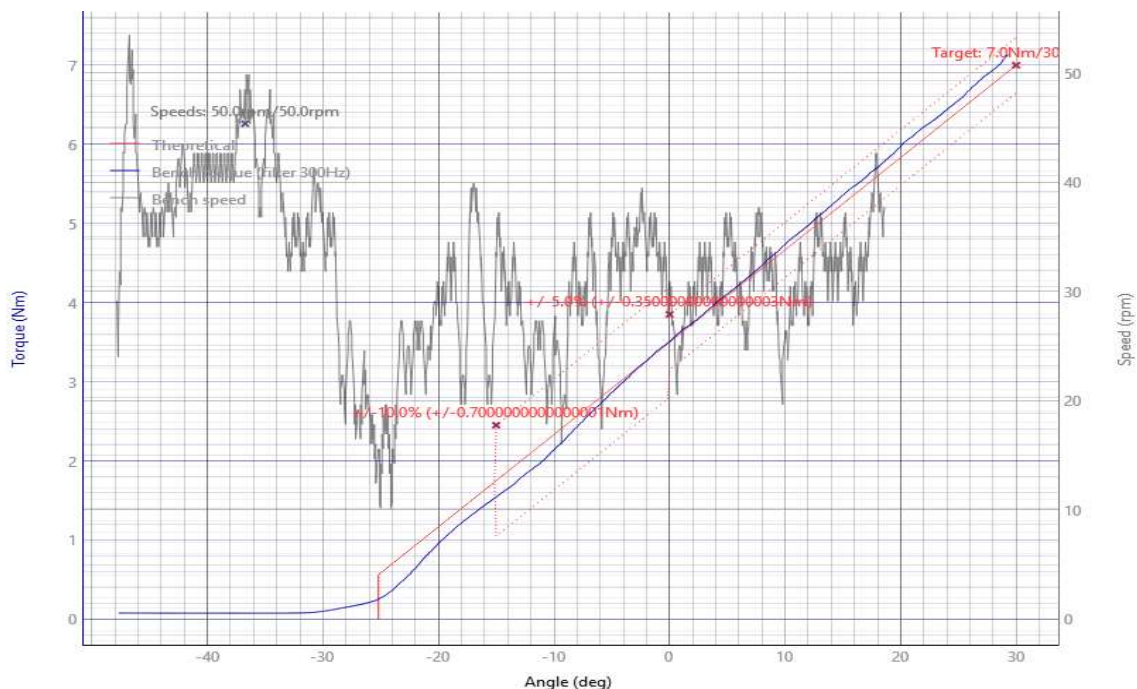


## Performance of tools according to VDI/VDE 2647

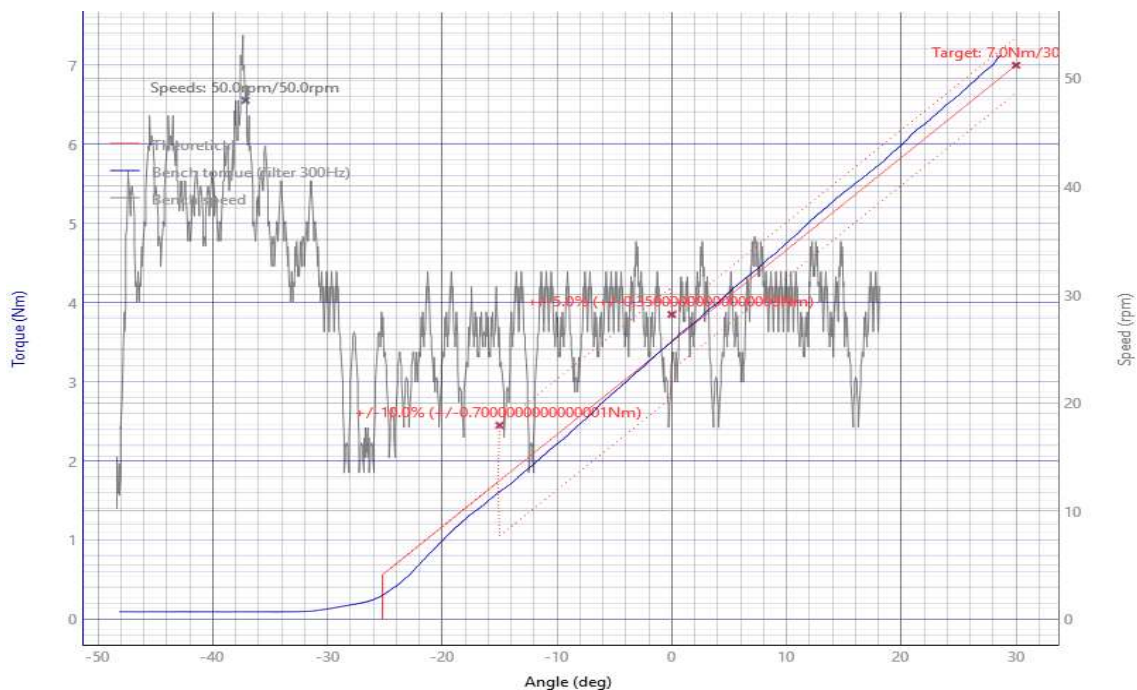
**30 % of the torque range (hard)**

Curve (torque/Angle)

## Start



**End**



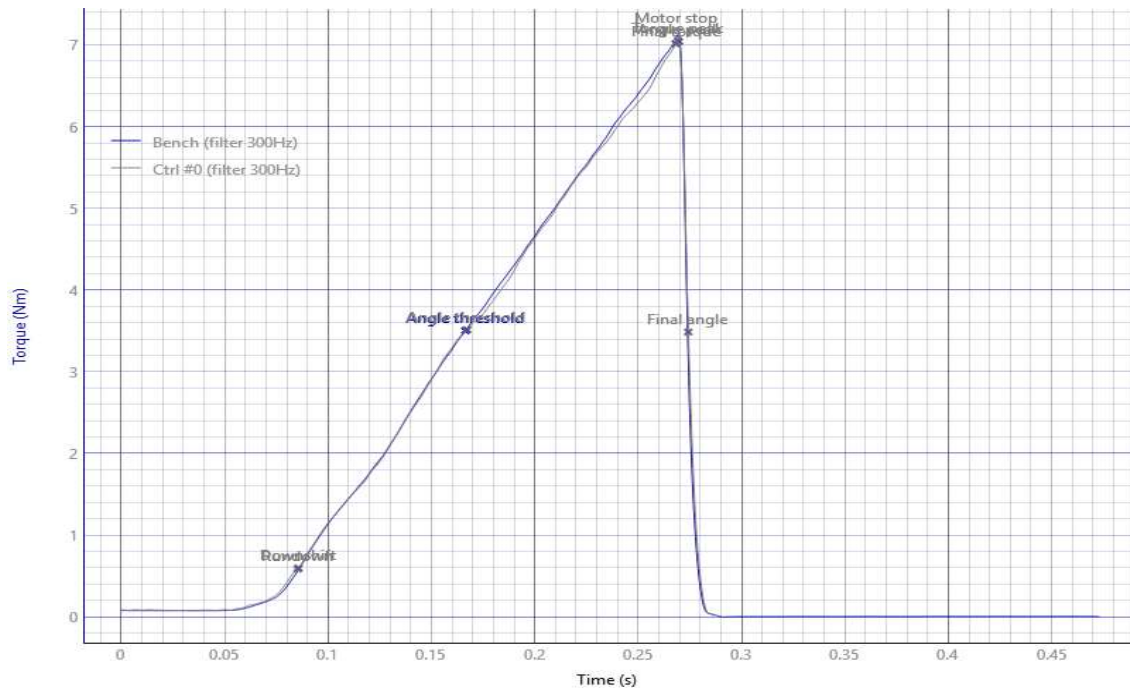


## Performance of tools according to VDI/VDE 2647

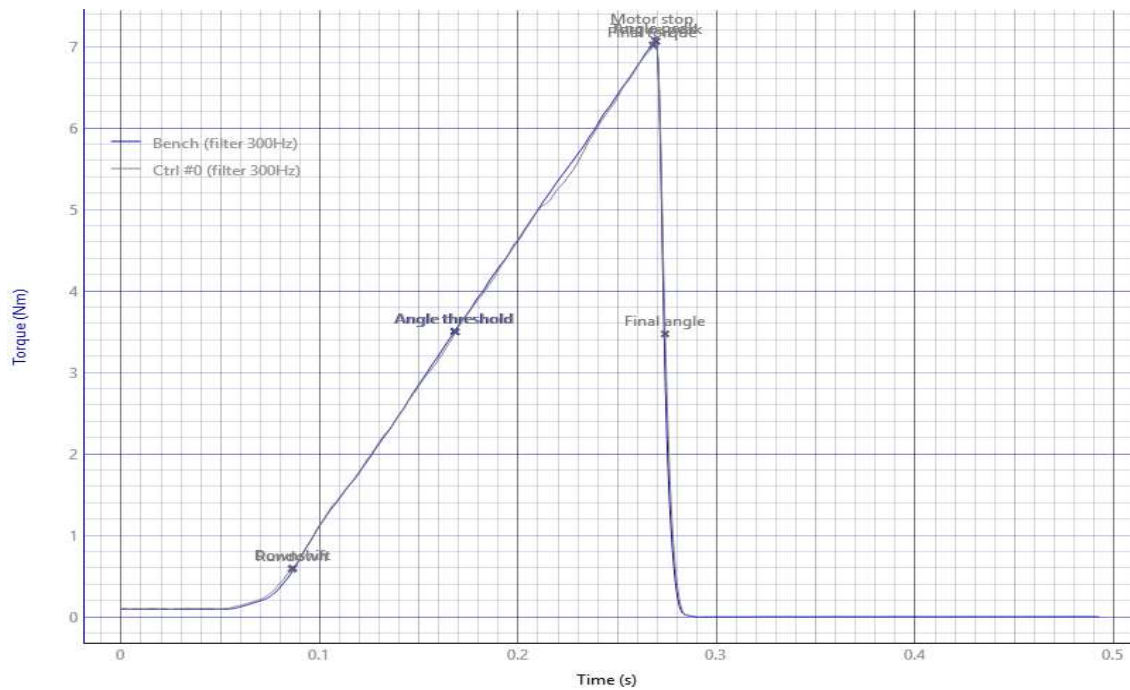
**30 % of the torque range (hard)**

Curve (torque/Time)

**Start**



**End**



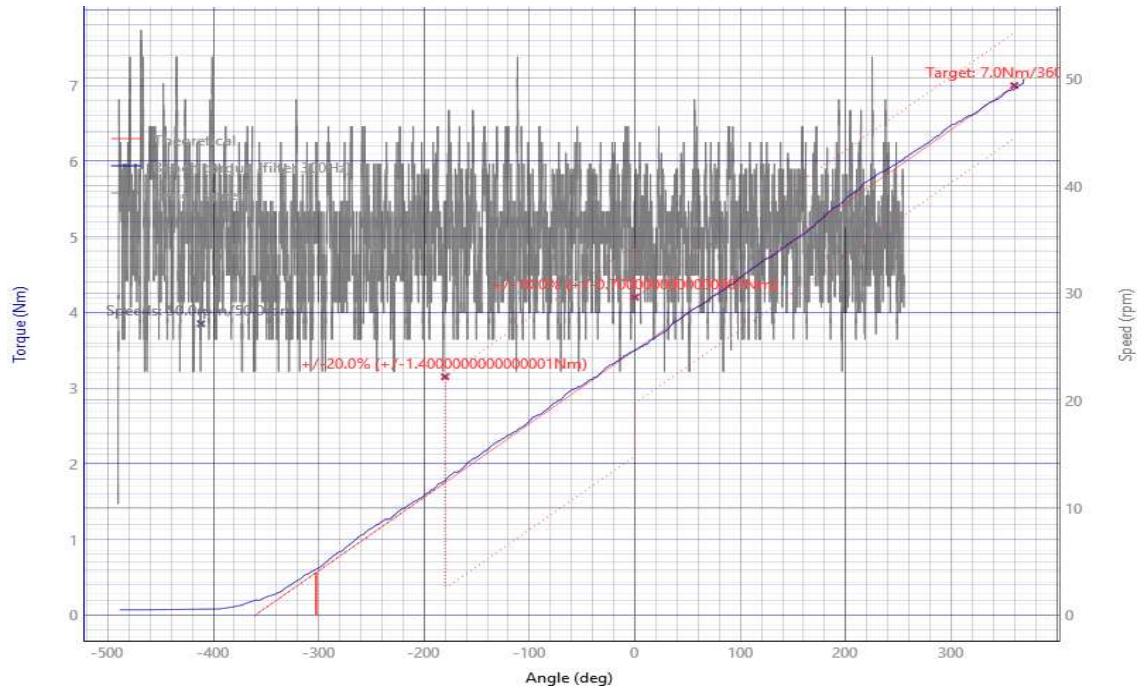


## Performance of tools according to VDI/VDE 2647

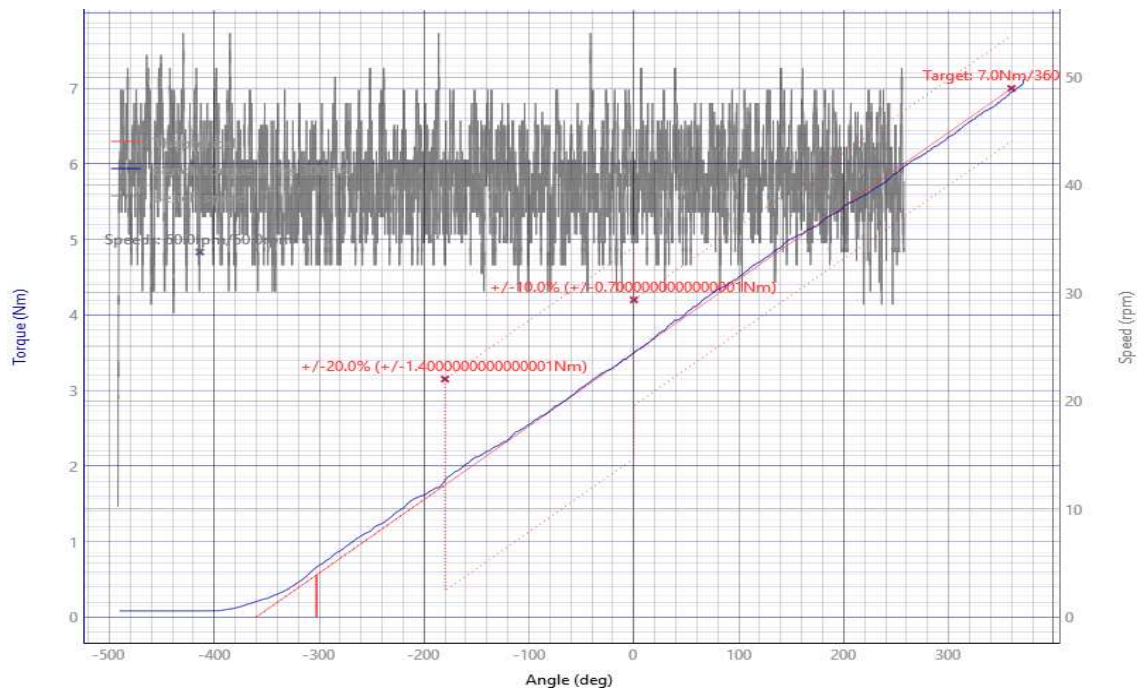
**30 % of the torque range (soft)**

Curve (torque/Angle)

**Start**



**End**

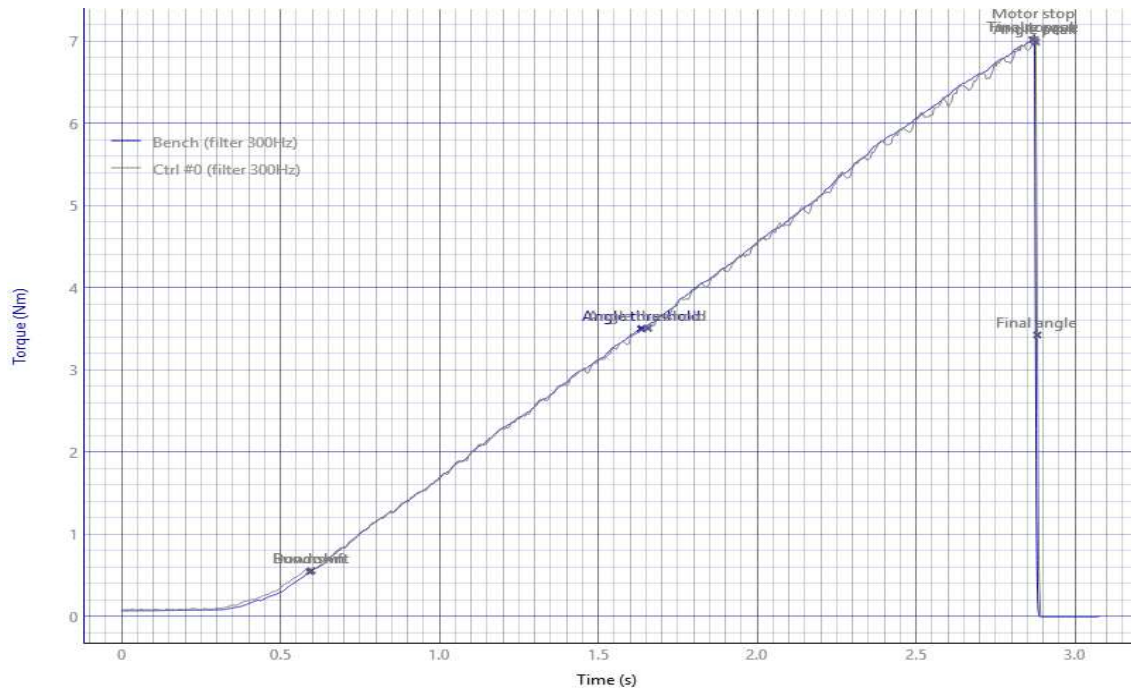


## Performance of tools according to VDI/VDE 2647

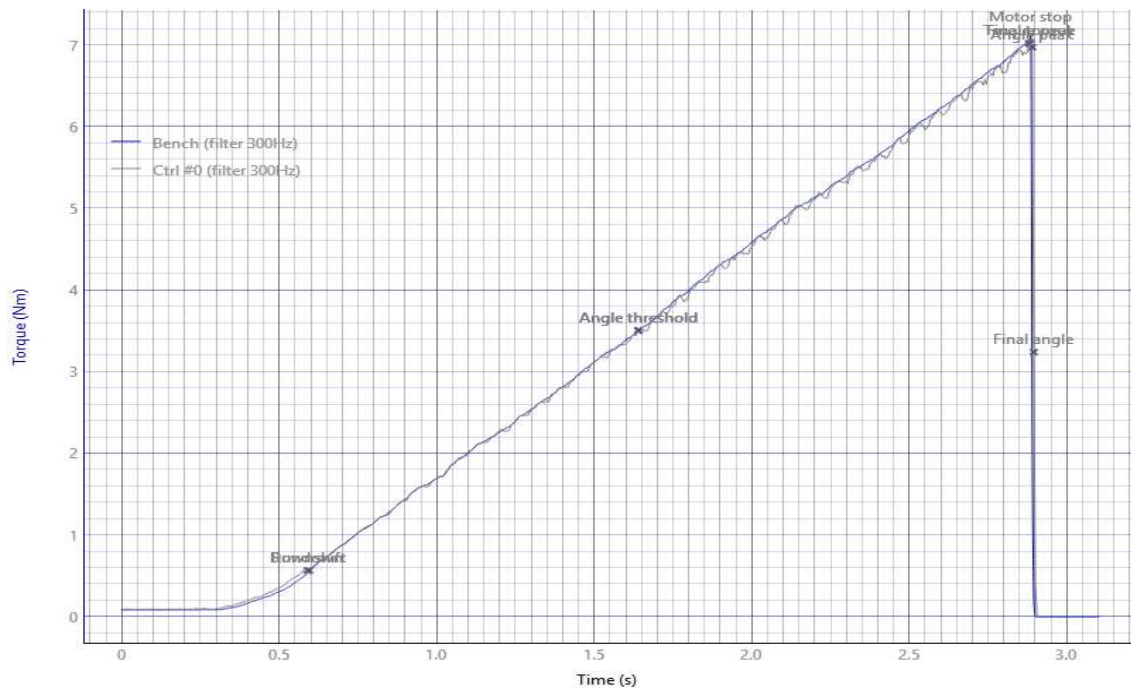
30 % of the torque range (soft)

Curve (torque/Time)

Start



End

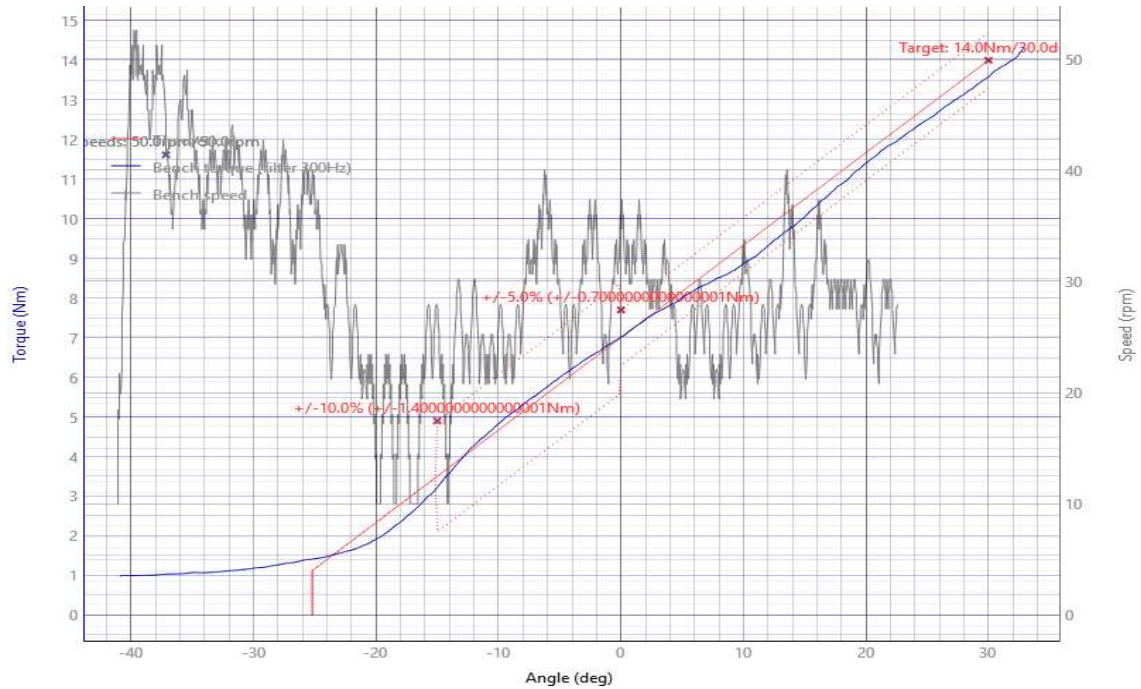


## Performance of tools according to VDI/VDE 2647

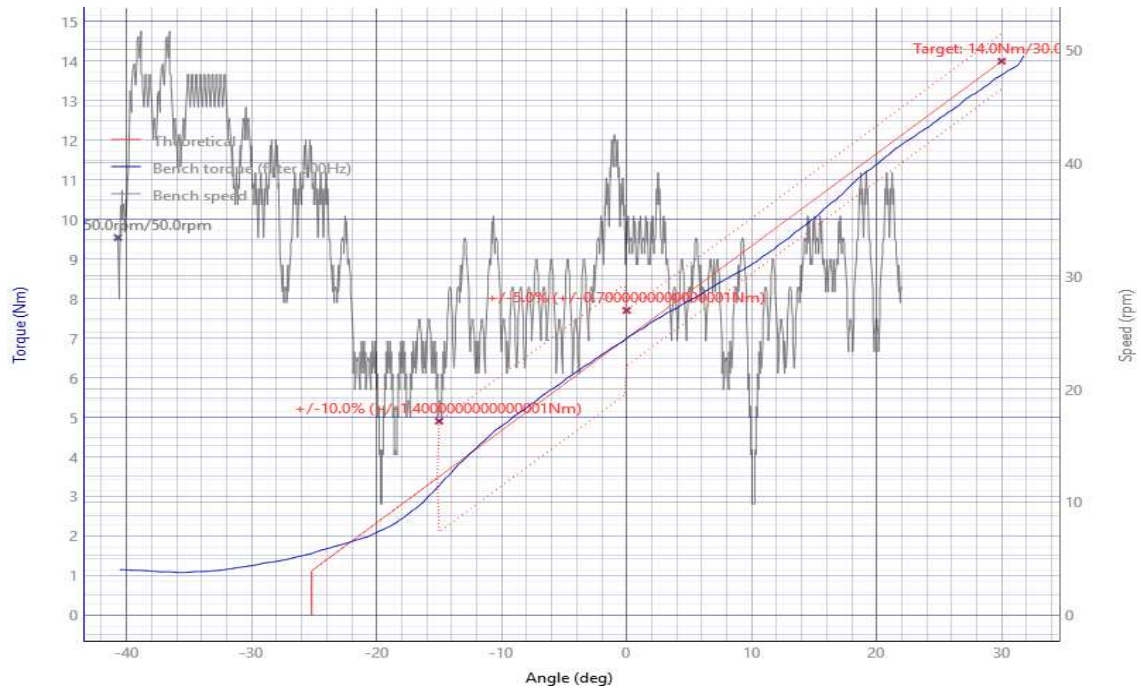
100 % of the torque range (hard)

Curve (torque/Angle)

Start



End



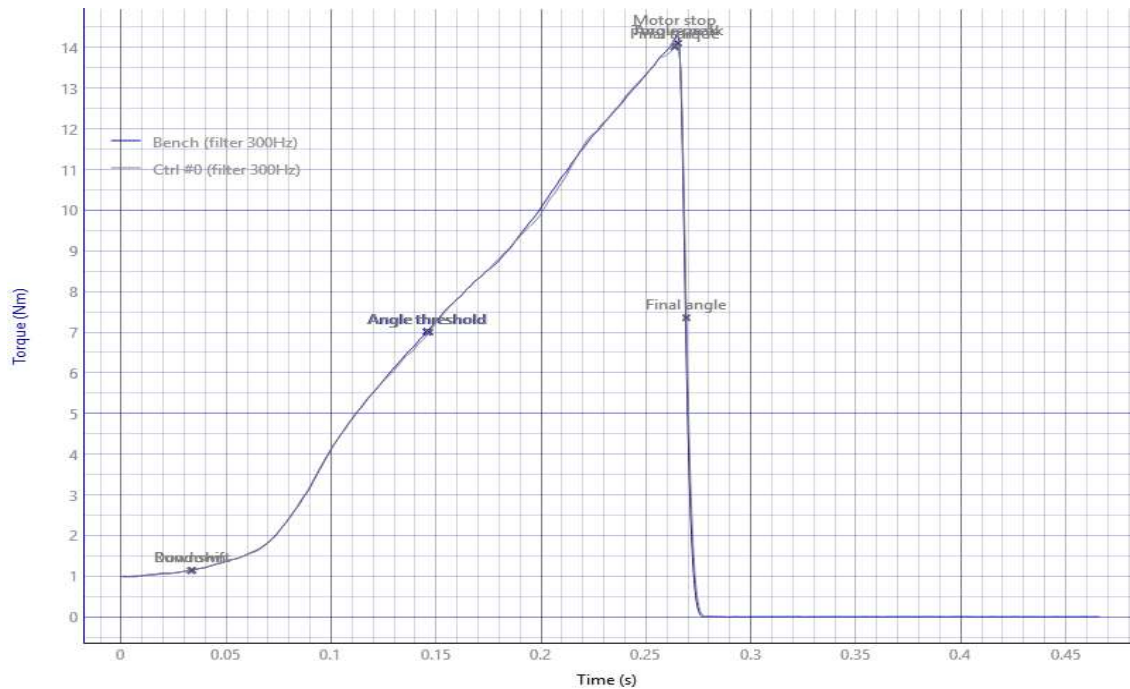


## Performance of tools according to VDI/VDE 2647

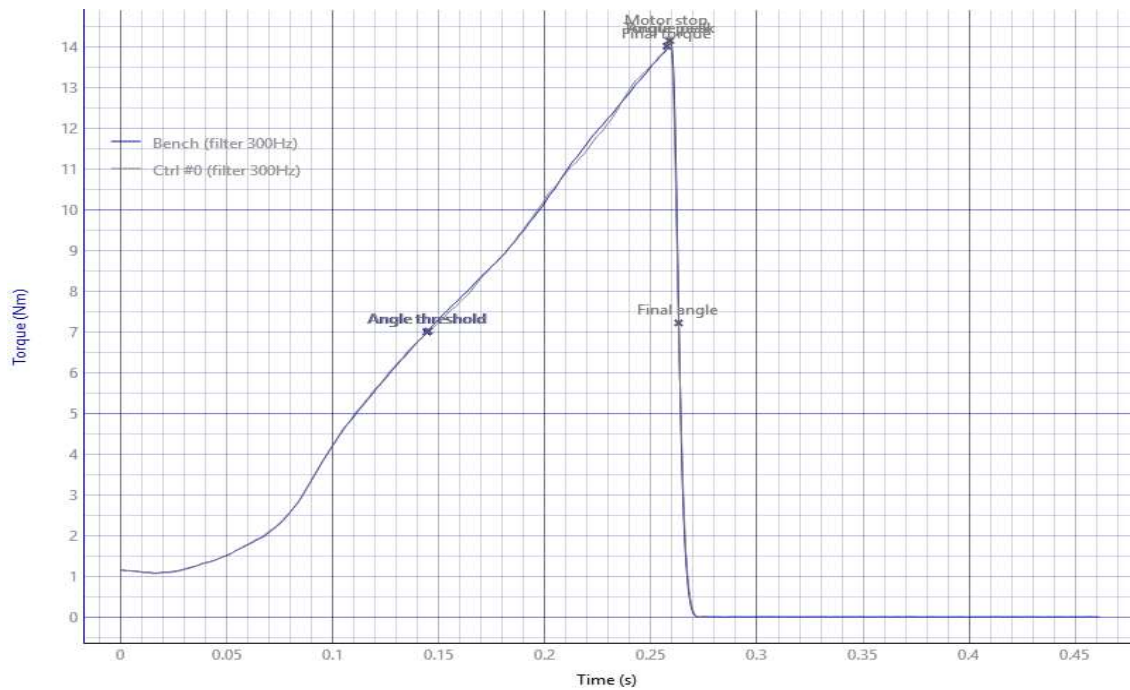
100 % of the torque range (hard)

Curve (torque/Time)

Start



End

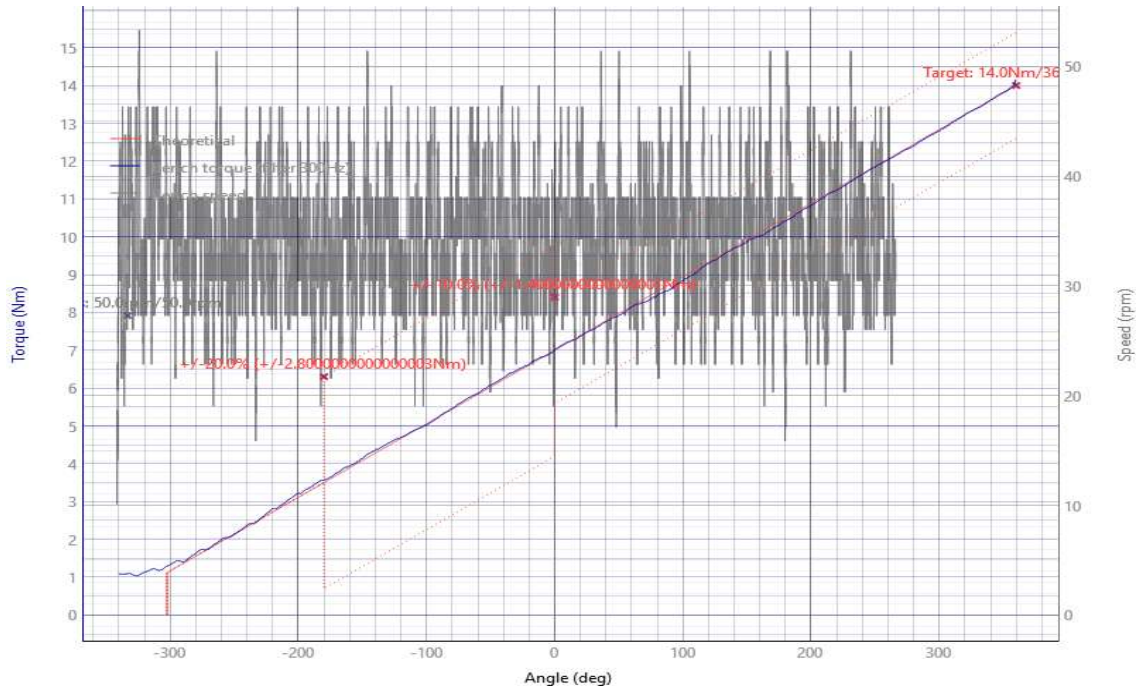


## Performance of tools according to VDI/VDE 2647

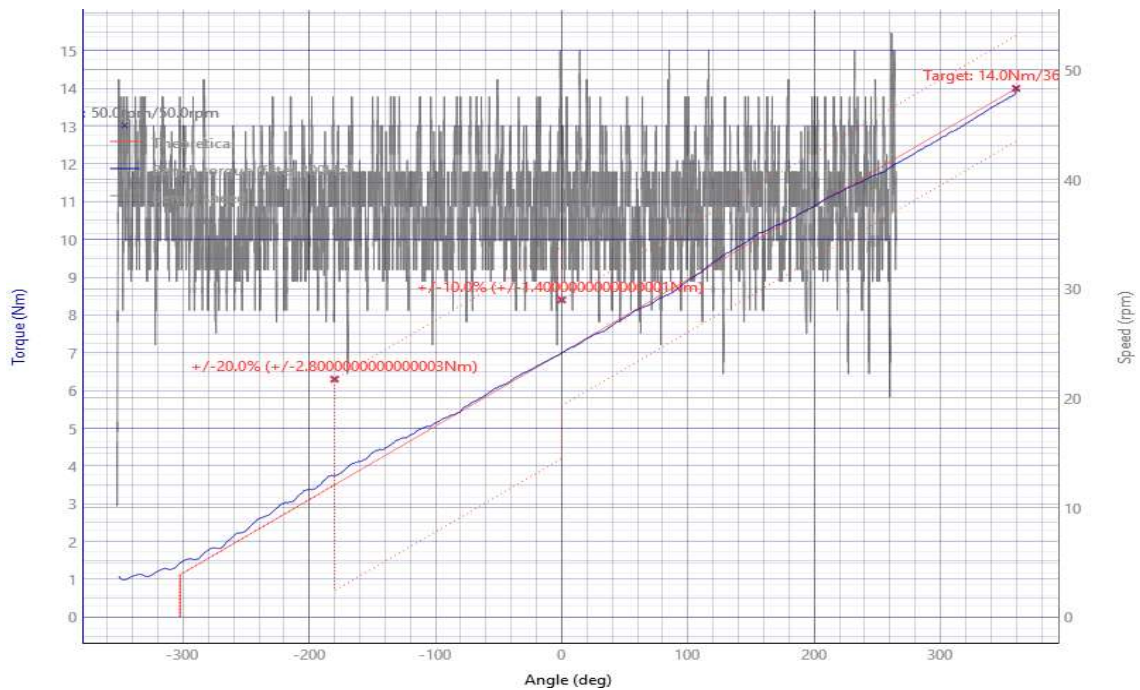
**100 % of the torque range (soft)**

**Curve (torque/Angle)**

**Start**



**End**

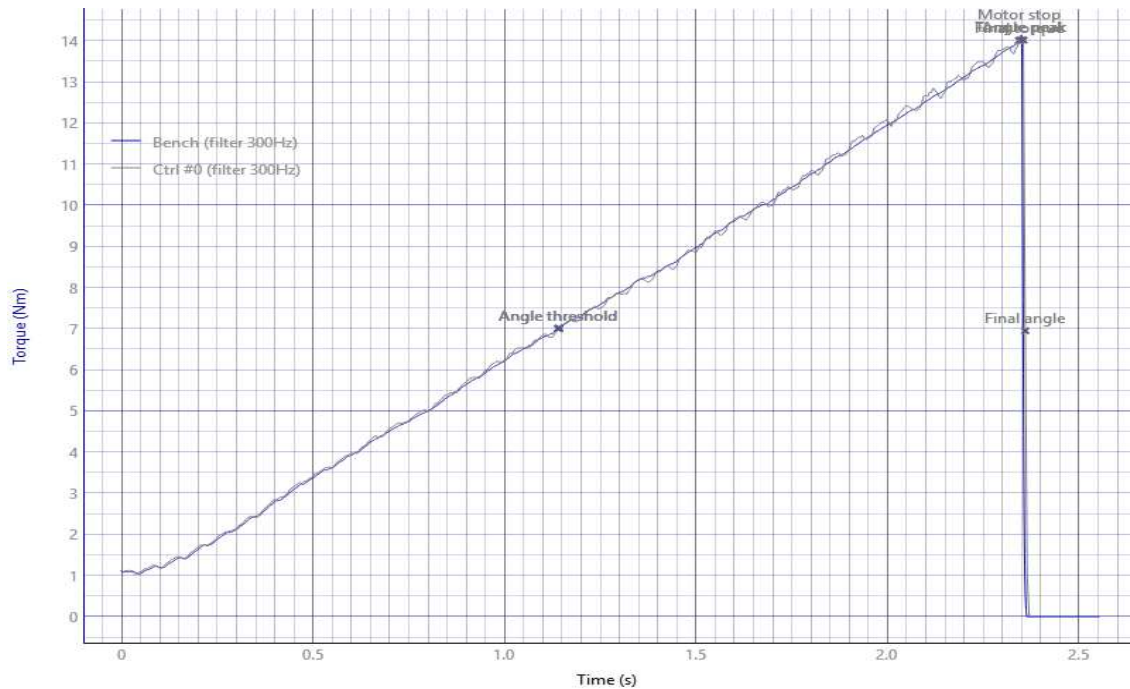


## Performance of tools according to VDI/VDE 2647

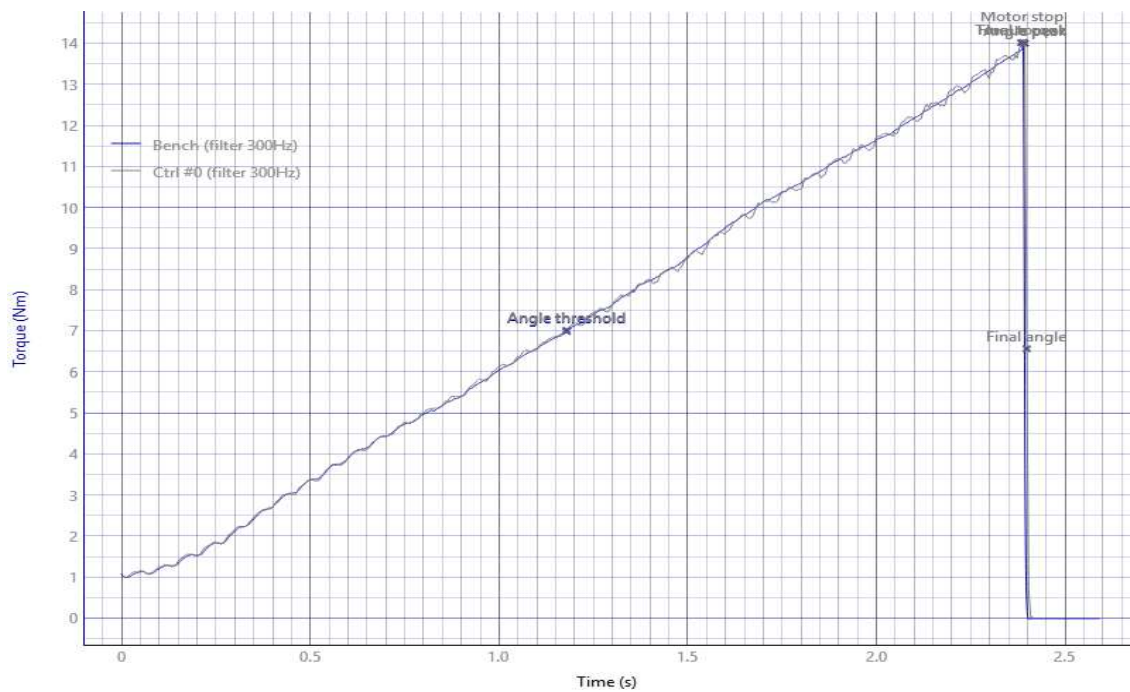
100 % of the torque range (soft)

Curve (torque/Time)

Start



End



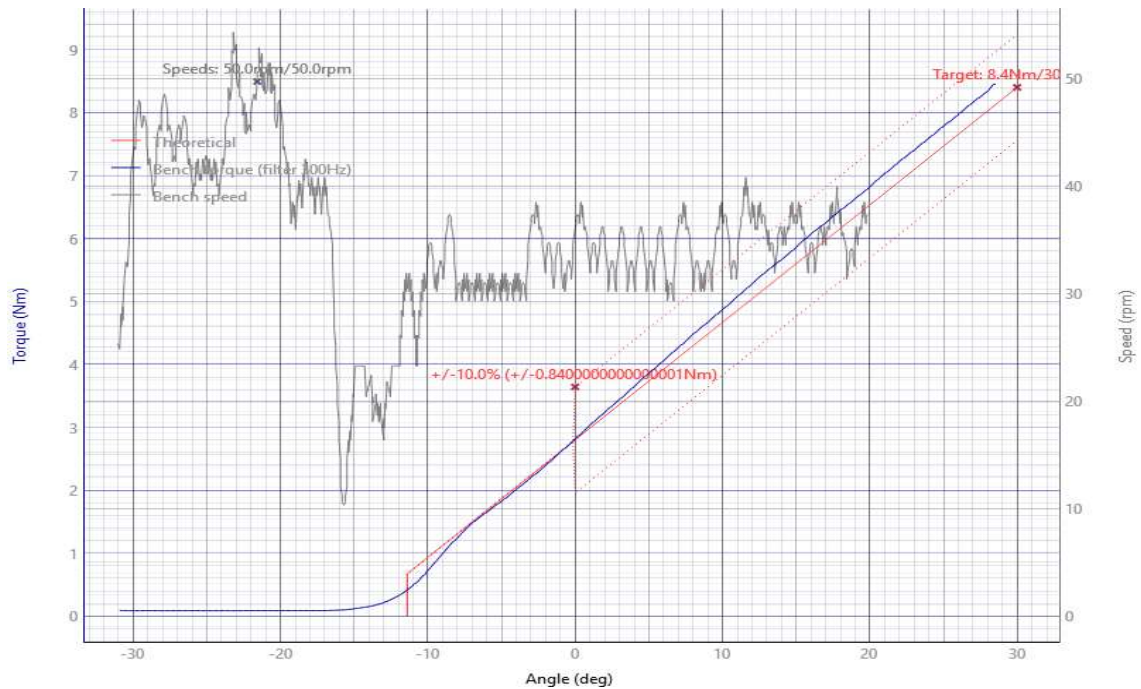


## Performance of tools according to VDI/VDE 2647

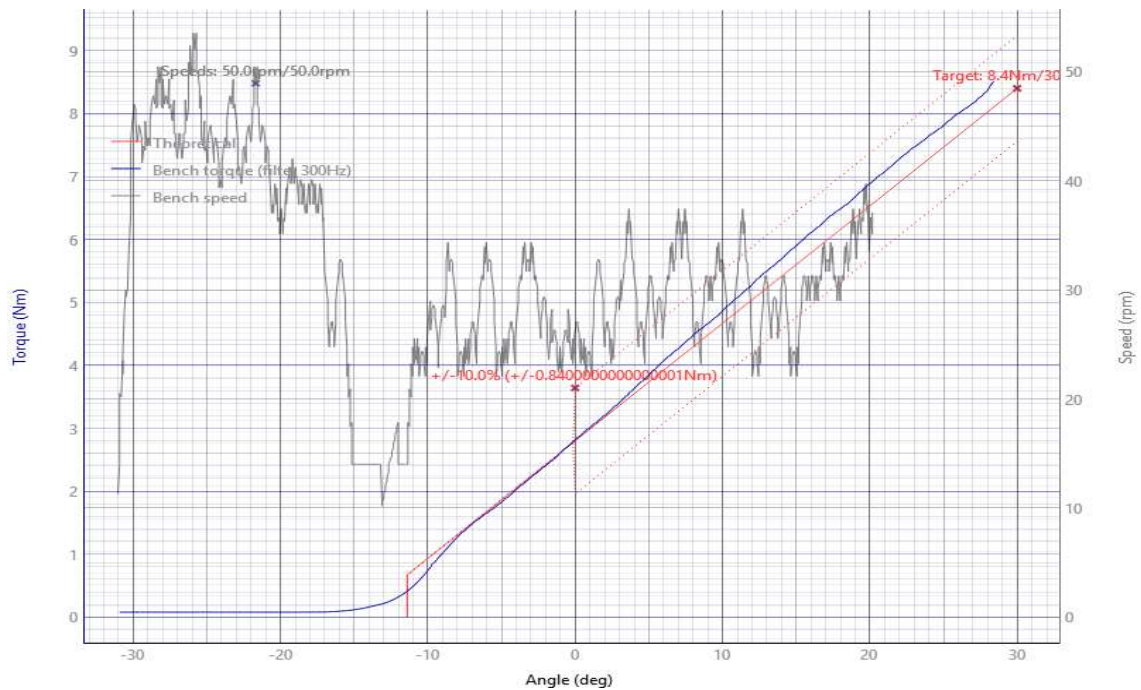
### Tightening at 30°

#### Curve (torque/Angle)

#### Start



#### End

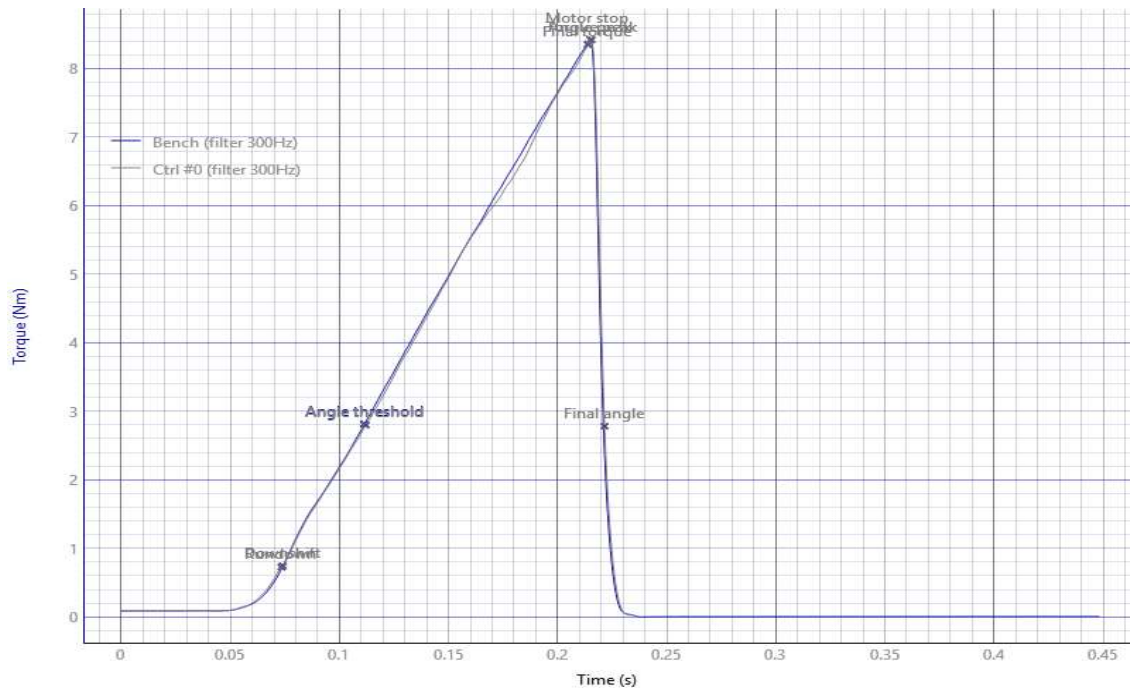


## Performance of tools according to VDI/VDE 2647

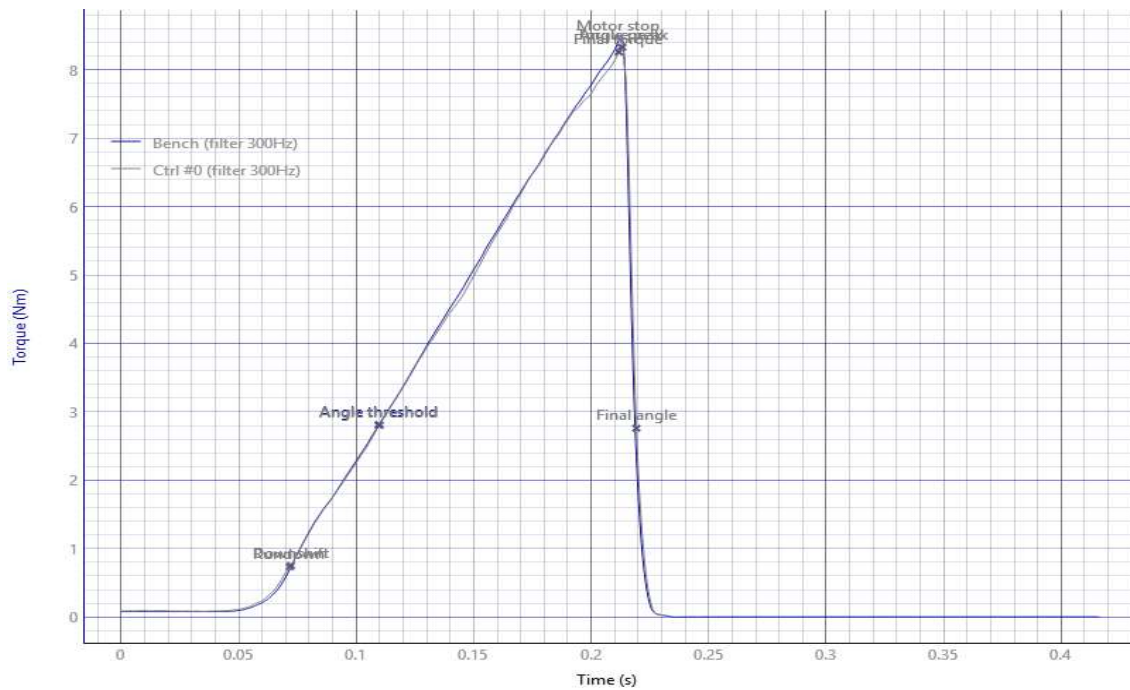
### Tightening at 30°

#### Curve (torque/Time)

#### Start



#### End



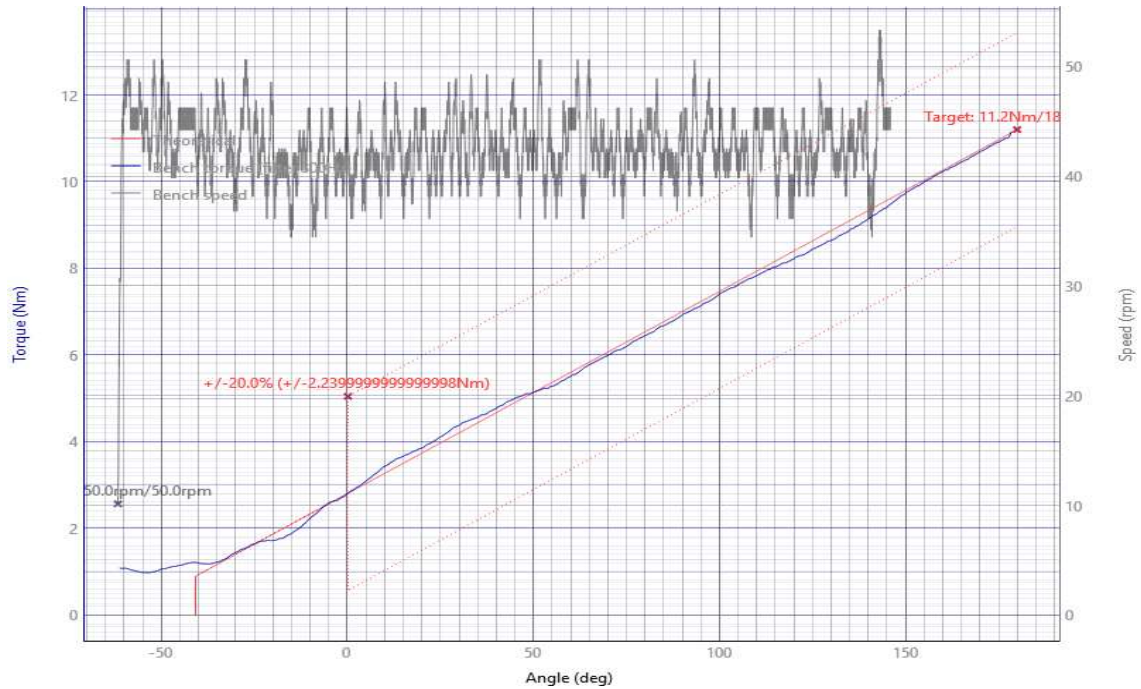


## Performance of tools according to VDI/VDE 2647

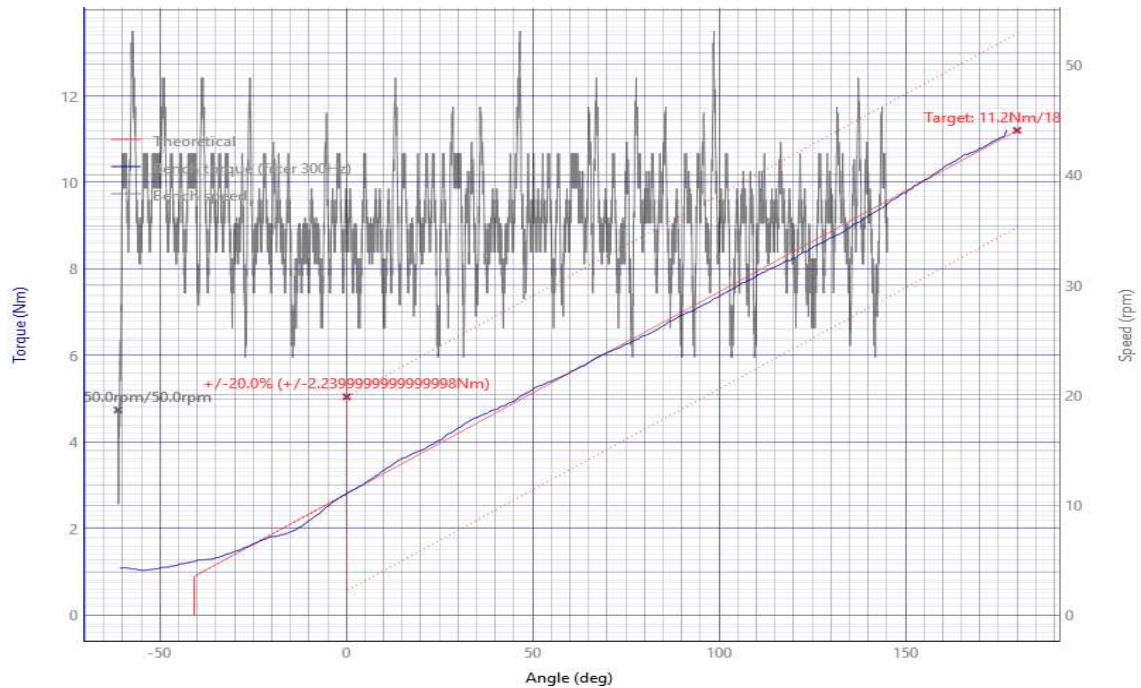
### Tightening at 180°

#### Curve (torque/Angle)

#### Start



#### End

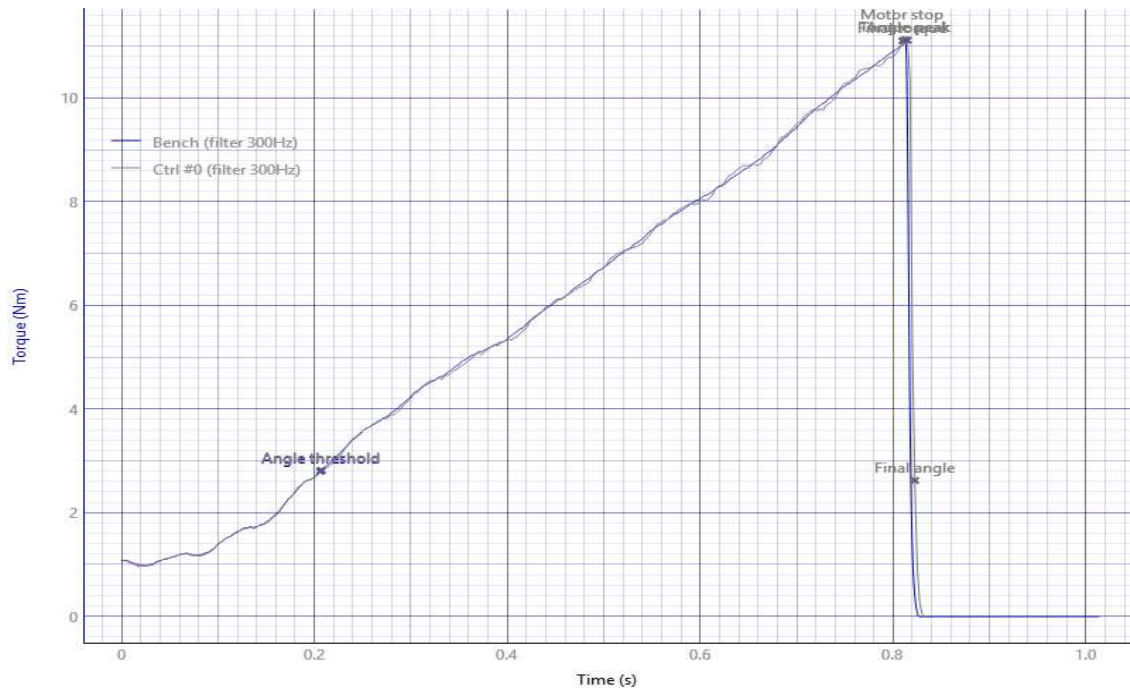


## Performance of tools according to VDI/VDE 2647

### Tightening at 180°

Curve (torque/Time)

#### Start



#### End

