

Test report: Machinery capability investigation  
from industry screwdriver



C. & E. FEIN GmbH  
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Hans-Fein-Str. 81, D-73529 Schwäbisch Gmünd-Bargau

Maschine typ :  Date :

Model variant :

Manufacturer :

Development No. :

Stage of development

MCI - Typ :

Number of steps :

Test bench - ID :



Screw connection class :

Fitting tolerance :

1	2	3	4	5	6
5,0%	10,0%	12,0%	15,0%	20,0%	25,0%

Torque range :  $M_{min} =$   Nm

$M_{max} =$   Nm

Idle speed :  $n =$   min<sup>-1</sup>

Weight incl. Battery :  $m =$   kg

Battery voltage :  $U =$   V

Sound pressure level :  $L_{pA} =$   dB(A)

Battery capacity :  $Q =$   mAh

Undervoltage detection :

Torque range investigation :

Testing machine :  Stück

$M_{max} =$ 
 30% → M30% =  $M_{min} + 30\% \times (M_{max} - M_{min}) =$  2,50 Nm  
 80% → M80% =  $M_{min} + 80\% \times (M_{max} - M_{min}) =$  5,00 Nm  
 100% → M100% =  $M_{min} + 100\% \times (M_{max} - M_{min}) =$  6,00 Nm

Information on all 3 test items

Load level		30%		80%		100%	
Test torque	$M_d =$	2,50		5,00		6,00	
Joints		hard	soft	hard	soft	hard	soft
		30°	360°	30°	360°	30°	360°
$C_{m, min} =$		1,812	2,451	2,604	2,525	2,597	3,030
$C_{mk, min} =$		1,674	2,069	2,505	2,030	2,307	2,662

		Name :	Date :
Carried out by	:	Mück	29.05.2017
Test report prepared by	:	Mück	04.07.2017

**A1 General information on the test item 1**

**Manufacturer :** C.&E. Fein GmbH **Model:** 18-6 / PC **Ident-No. :** 2017-05.013224

**Modell variant:** ASW **begin:** 09:00 **Serial-No. :** 7021  
**end:** 11:00

Torque range from $M_{min} =$	1,00	Nm	to $M_{max} =$	6,00	Nm
Weight incl. Battery :	1,450	kg	Sound pressure level :	<81	dB(A)
Battery voltage :	18,00	V	Undervoltage detection :	<input checked="" type="checkbox"/>	
Battery capacity :	2500	mAh	Idle speed :	575	min <sup>-1</sup>

Number of screwed connections with battery at 100% rated power		
Turn rate low (soft) :	1118	LC
Turn rate high (hard) :	1891	LC

Temperature measurement for power tools at 80% rated power 360° soft joint		
	beginn:	end:
On the handle :	27,4 °C	34,8 °C

**A2 General information test equipment and test conditions**

Description of test equipment, design and function:

Schatz cerTest 2.5 5413-5392/303

Brake 10 Nm	0
ASM firmly and positively clamped	
2 sec. wait between two load changes	

Measurability test	No.:	V-49199	Date:	04.04.2017
Certificate according to VDI/VDE 2646				

**A3.1 Data per test item**

Torque-range	from $M_{min} =$	1,00	Nm	to $M_{max} =$	6,00	Nm
Test torque 30%	$M_{30\%} =$	2,50	Nm			
Test torque 80%	$M_{80\%} =$	5,00	Nm			
Test torque 100%	$M_{100\%} =$	6,00	Nm			
Fitting tolerance	2	in %	±	10,0%		

Load level		30%	80%	100%				
Test torque	$M_d =$	2,50	5,00	6,00	Nm			
Joints		hard	soft	hard	soft			
		30°	360°	30°	360°			
Tolerance : Upper limit	: $M_{zul max} =$	2,75	5,50	6,60	Nm			
Tolerance : Lower limit	: $M_{zul min} =$	2,25	4,50	5,40	Nm			
Medium torque	: $M_q =$	2,52	2,48	5,02	4,91	5,93	5,84	Nm
Standard deviation	: $s =$	0,05	0,03	0,06	0,05	0,08	0,04	Nm
6s torque scattering	: $6s/M_q =$	10,96%	8,22%	7,65%	6,24%	7,79%	4,52%	
Ability index	: $c_m =$	1,81	2,45	2,60	3,27	2,60	4,55	
Ability index	: $c_{mk} =$	1,67	2,28	2,51	2,65	2,31	3,33	
Mean speed	: $n =$	584	585	586	603	590	573	min <sup>-1</sup>

**A1 General information on the test item 2**

**Manufacturer :** C.&E. Fein GmbH **Model:** 18-6 / PC **Ident-No. :** 2017-05.013228

**Modell variant:** ASW **begin:** 11:00 **Serial-No. :** 7021  
**end:** 13:00

Torque range from $M_{min} =$	1,00	Nm	to $M_{max} =$	6,00	Nm
Weight incl. Battery :	1,450	kg	Sound pressure level :	<81	dB(A)
Battery voltage :	18,00	V	Undervoltage detection :	<input checked="" type="checkbox"/>	
Battery capacity :	2500	mAh	Idle speed :	575	min <sup>-1</sup>

Number of screwed connections with battery at 100% rated power		
Turn rate low (soft) :	1118	LC
Turn rate high (hard) :	1891	LC

Temperature measurement for power tools at 80% rated power 360° soft joint		
	beginn:	end:
On the handle :	27,4 °C	34,8 °C

**A2 General information test equipment and test conditions**

Description of test equipment, design and function:

Schatz cerTest 2.5 5413-5392/303

Brake 10 Nm

ASM firmly and positively clamped

2 sec. wait between two load changes

Measurability test	No.:	V-49199	Date:	04.04.2017
Certificate according to VDI/VDE 2646				

**A3.1 Data per test item**

Torque-range	from $M_{min} =$	1,00	Nm	to $M_{max} =$	6,00	Nm
Test torque 30%	$M_{30\%} =$	2,50	Nm			
Test torque 80%	$M_{80\%} =$	5,00	Nm			
Test torque 100%	$M_{100\%} =$	6,00	Nm			
Fitting tolerance	2	in %	±	10,0%		

Load level		30%	80%	100%				
Test torque	$M_d =$	2,50	5,00	6,00	Nm			
Joints		hard	soft	hard	soft			
		30°	360°	30°	360°			
Tolerance : Upper limit	: $M_{zul max} =$	2,75	5,50	6,60	Nm			
Tolerance : Lower limit	: $M_{zul min} =$	2,25	4,50	5,40	Nm			
Medium torque	: $M_q =$	2,50	2,48	5,08	4,93	5,99	5,86	Nm
Standard deviation	: $s =$	0,04	0,03	0,05	0,05	0,07	0,05	Nm
6s torque scattering	: $6s/M_q =$	9,61%	6,05%	6,38%	6,33%	6,61%	5,32%	
Ability index	: $c_m =$	2,08	3,33	3,09	3,21	3,03	3,09	
Ability index	: $c_{mk} =$	2,06	3,05	2,62	2,74	2,98	2,07	
Mean speed	: $n =$	560	570	579	557	564	581	min <sup>-1</sup>

**A1 General information on the test item 3**

**Manufacturer :** C.&E. Fein GmbH **Model:** 18-6 / PC **Ident-No. :** 2017-05.013229

**Modell variant:** ASW **begin:** 14:00 **Serial-No. :** 7021  
**end:** 16:00

Torque range from $M_{min} =$	1,00	Nm	to $M_{max} =$	6,00	Nm
Weight incl. Battery :	1,450	kg	Sound pressure level :	<81	dB(A)
Battery voltage :	18,00	V	Undervoltage detection :	<input checked="" type="checkbox"/>	
Battery capacity :	2500	mAh	Idle speed :	575	min <sup>-1</sup>

Number of screwed connections with battery at 100% rated power		
Turn rate low (soft) :	1118	LC
Turn rate high (hard) :	1891	LC

Temperature measurement for power tools at 80% rated power 360° soft joint		
	beginn:	end:
On the handle :	27,4 °C	34,8 °C

**A2 General information test equipment and test conditions**

Description of test equipment, design and function:

Schatz cerTest 2.5 5413-5392/303

Brake 10 Nm

ASM firmly and positively clamped

2 sec. wait between two load changes

Measurability test	No.:	V-49199	Date:	04.04.2017
Certificate according to VDI/VDE 2646				

**A3.1 Data per test item**

Torque-range	from $M_{min} =$	1,00	Nm	to $M_{max} =$	6,00	Nm
Test torque 30%	$M_{30\%} =$	2,50	Nm			
Test torque 80%	$M_{80\%} =$	5,00	Nm			
Test torque 100%	$M_{100\%} =$	6,00	Nm			
Fitting tolerance	2	in %	±	10,0%		

Load level		30%	80%	100%				
Test torque	$M_d =$	2,50	5,00	6,00	Nm			
Joints		hard	soft	hard	soft			
		30°	360°	30°	360°			
Tolerance : Upper limit	: $M_{zul max} =$	2,75	5,50	6,60	Nm			
Tolerance : Lower limit	: $M_{zul min} =$	2,25	4,50	5,40	Nm			
Medium torque	: $M_q =$	2,50	2,43	4,97	4,90	6,02	5,93	Nm
Standard deviation	: $s =$	0,04	0,03	0,06	0,07	0,07	0,07	Nm
6s torque scattering	: $6s/M_q =$	8,89%	7,16%	7,37%	8,08%	6,48%	6,68%	
Ability index	: $c_m =$	2,25	2,87	2,73	2,53	3,08	3,03	
Ability index	: $c_{mk} =$	2,23	2,07	2,54	2,03	2,97	2,66	
Mean speed	: $n =$	571	574	589	597	578	591	min <sup>-1</sup>

Testbench Measuring				MCS for FEIN-Project : 7021		Homologation		Date: 04.07.2017							
ASW 18-6 / PC				ScrewdriverType ASW		Accuracy-Class 10,0%		Class : 2		f <sub>mess</sub> = 300 Hz		M <sub>min</sub>		M <sub>max</sub>	
				Variant : 18-6 / PC						M <sub>range</sub> = 1,00 up to 6,00 Nm		n <sub>given</sub> = 575 rpm		U = 18,00 V	
										cycles: 100					
MCSs	M <sub>d</sub> [Nm]	Angle [°]	M <sub>q</sub> [Nm]	ΔM <sub>q 1/2</sub> [Nm]	s [Nm]	C <sub>m</sub> [1]	C <sub>mk</sub> [1]	n [min <sup>-1</sup> ]	Remarks						
1	2,50	360°	2,483		0,034	2,451	2,284	585	2017-05.013224	30%					
1	2,50	30°	2,519	0,036	0,046	1,812	1,674	584							
1	5,00	360°	4,905		0,051	3,268	2,647	603		80%					
1	5,00	30°	5,019	0,114	0,064	2,604	2,505	586							
1	6,00	360°	5,840		0,044	4,545	3,333	573		100%					
1	6,00	30°	5,933	0,093	0,077	2,597	2,307	590							
2	2,50	360°	2,479		0,025	3,333	3,053	570	2017-05.013228	30%					
2	2,50	30°	2,497	0,018	0,040	2,083	2,058	560							
2	5,00	360°	4,927		0,052	3,205	2,737	557		80%					
2	5,00	30°	5,075	0,148	0,054	3,086	2,623	579							
2	6,00	360°	5,860		0,052	3,846	2,949	581		100%					
2	6,00	30°	5,990	0,130	0,066	3,030	2,980	564							
3	2,50	360°	2,430		0,029	2,874	2,069	574	2017-05.013229	30%					
3	2,50	30°	2,497	0,067	0,037	2,252	2,225	571							
3	5,00	360°	4,902		0,066	2,525	2,030	597		80%					
3	5,00	30°	4,965	0,063	0,061	2,732	2,541	589							
3	6,00	360°	5,927		0,066	3,030	2,662	591		100%					
3	6,00	30°	6,020	0,093	0,065	3,077	2,974	578							

Start of measurement: 09:00  
End of measurement: 16:00

**Homologation** : 3 Machines out of a series, each 30%, 80% and 100% the torque-ranges.

Waitingtime between Load changes 2 sec.

Series of measurement per machine, Nominal Torque and Screwinghardness each 100 Load changes (LW).

Measurement based on VDI 2647 February 2013

C <sub>m min</sub> = 1,812	C <sub>m q</sub> = 2,908	C <sub>m max</sub> = 4,545	S <sub>cm</sub> = 0,621		C <sub>m min</sub> = C <sub>m</sub> - Minimum Value	
C <sub>mk min</sub> = 1,674	C <sub>mk q</sub> = 2,536	C <sub>mk max</sub> = 3,333	n <sub>MFU</sub> = 18		C <sub>mk min</sub> = C <sub>m</sub> - Minimum Value	
Name: Mück		Project: 7021 : ASW 18-6 / PC			C <sub>m q</sub> = C <sub>m</sub> - Mid Value	
		C. & E. FEIN GmbH Schwäbisch Gmünd		Stage of Development : Series		C <sub>mk q</sub> = C <sub>m</sub> - Mid Value
						C <sub>m max</sub> = C <sub>m</sub> - Maximum Value
S <sub>cm</sub> = C <sub>m</sub> - Standard deviation S <sub>cmk</sub> = C <sub>mk</sub> - Standard deviation n <sub>MCS</sub> = No. of Machine Capability Study (MCS) c = correction Value						

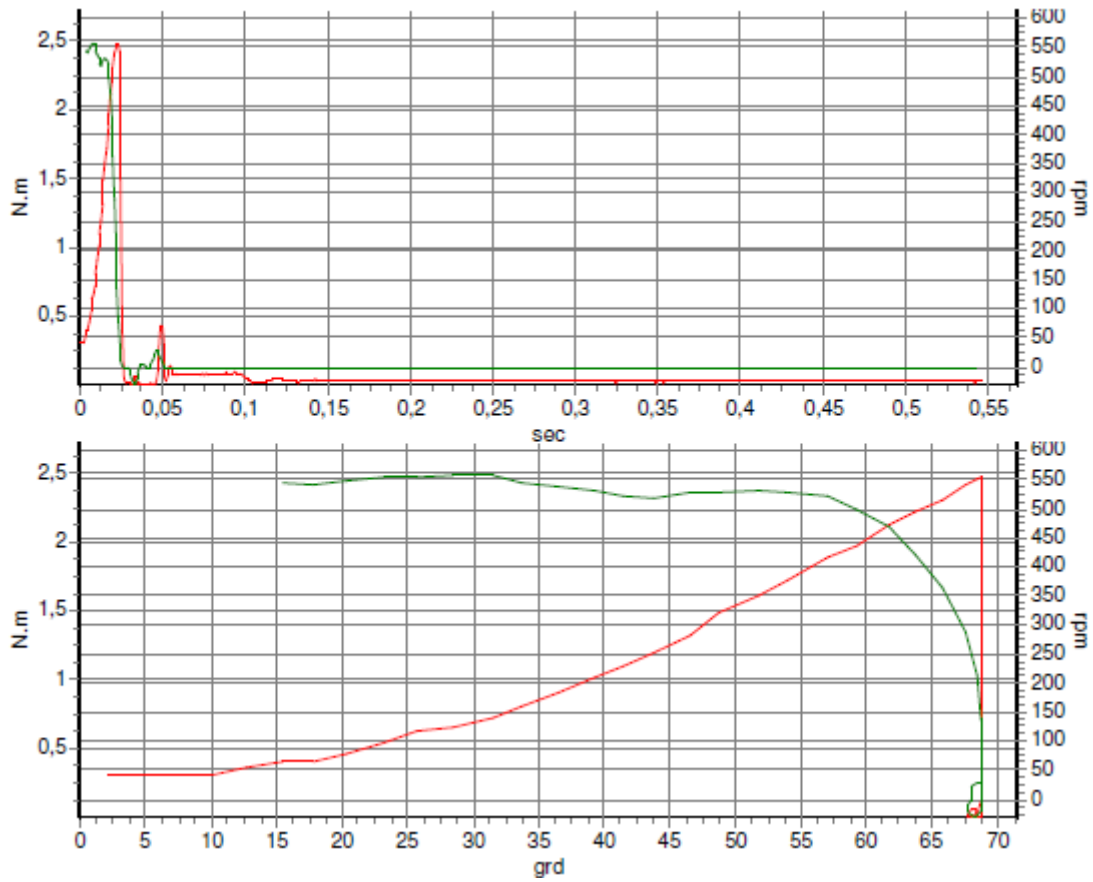


Illustration 1: 30° hard joint 2,5 Nm before load change machine 2017-05.013224

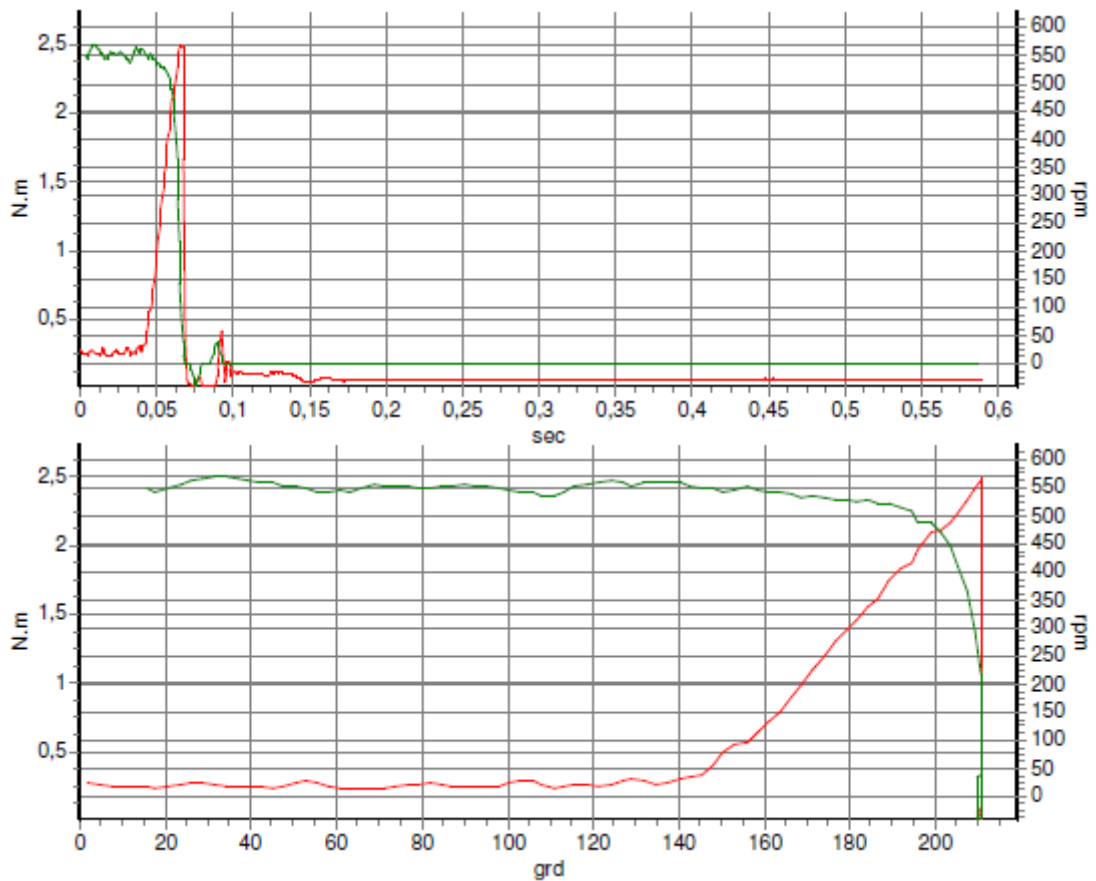


Illustration2: 30° hard joint 2,5 Nm after load change machine 2017-05.013224

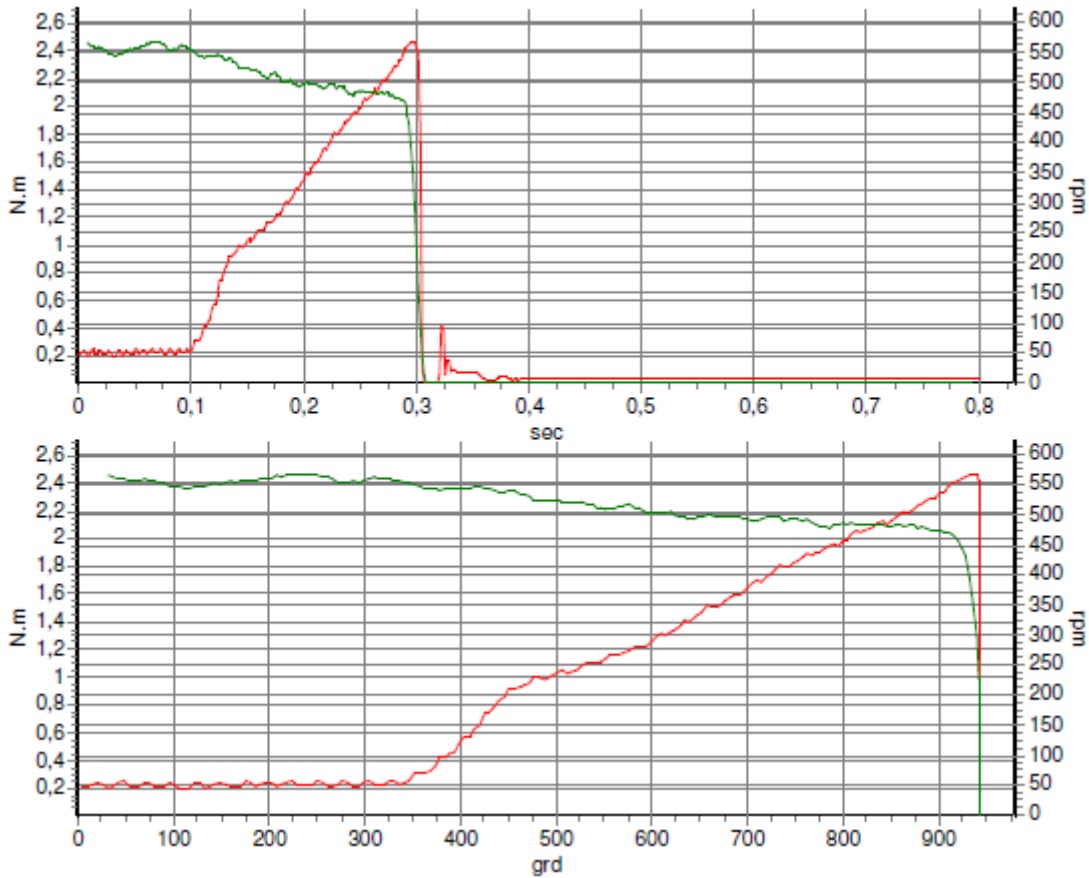


Illustration 3: 360° soft joint 2,5 Nm before load change machine 2017-05.013224

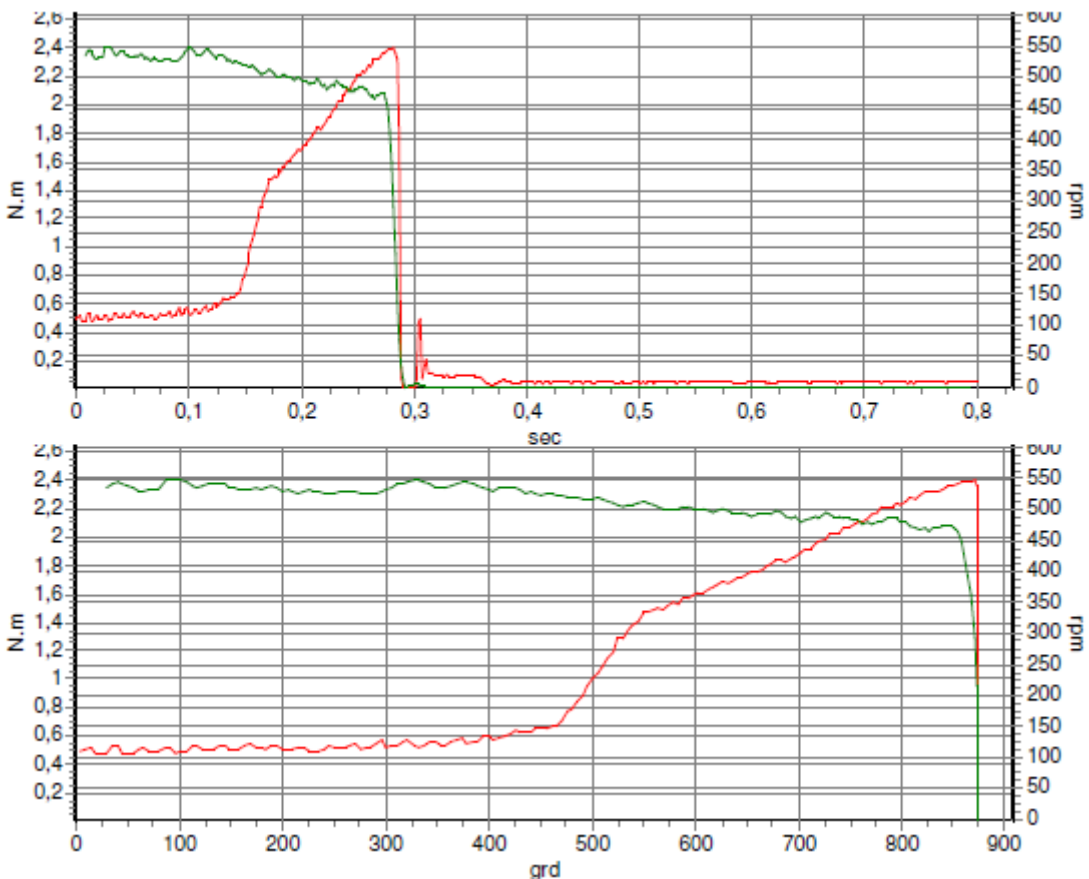


Illustration 4: 360° soft joint 2,5 Nm after Load change Machine 2017-05.013224

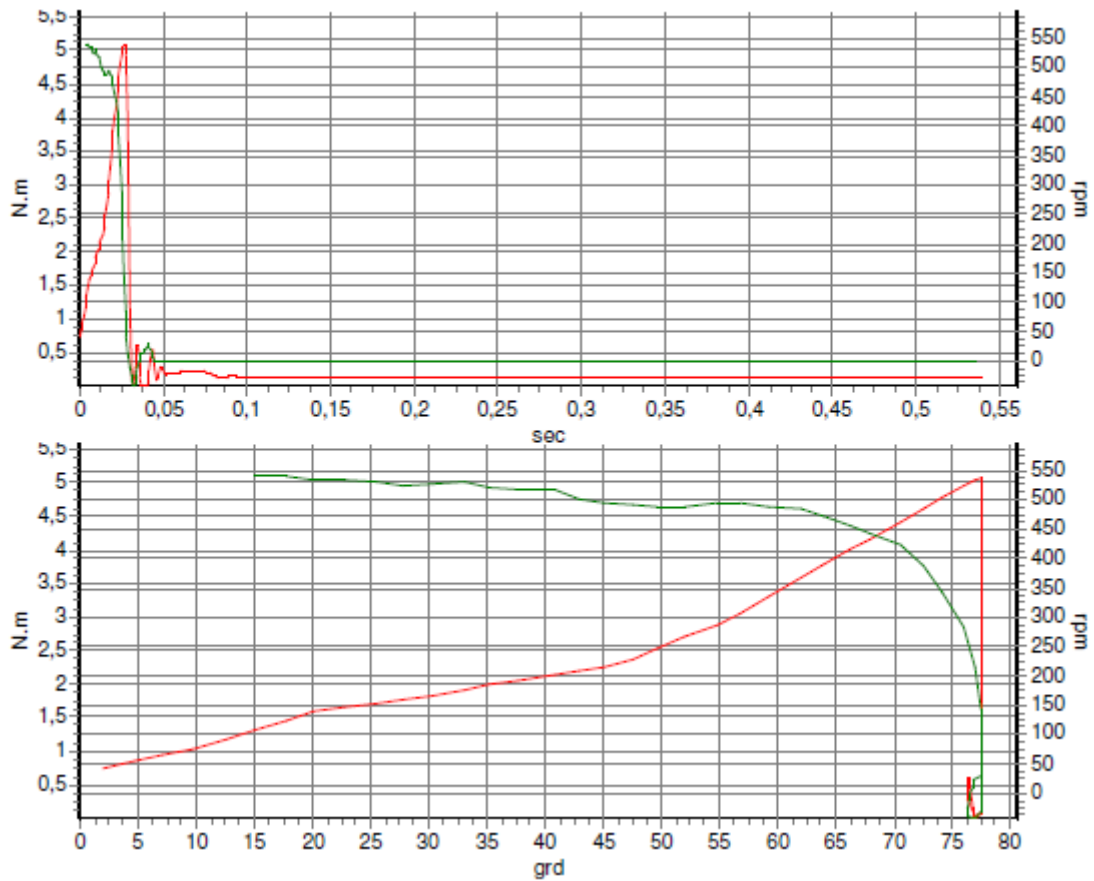


Illustration 5: 30° hard joint 5,0 Nm before Load change Machine 2017-05.013224

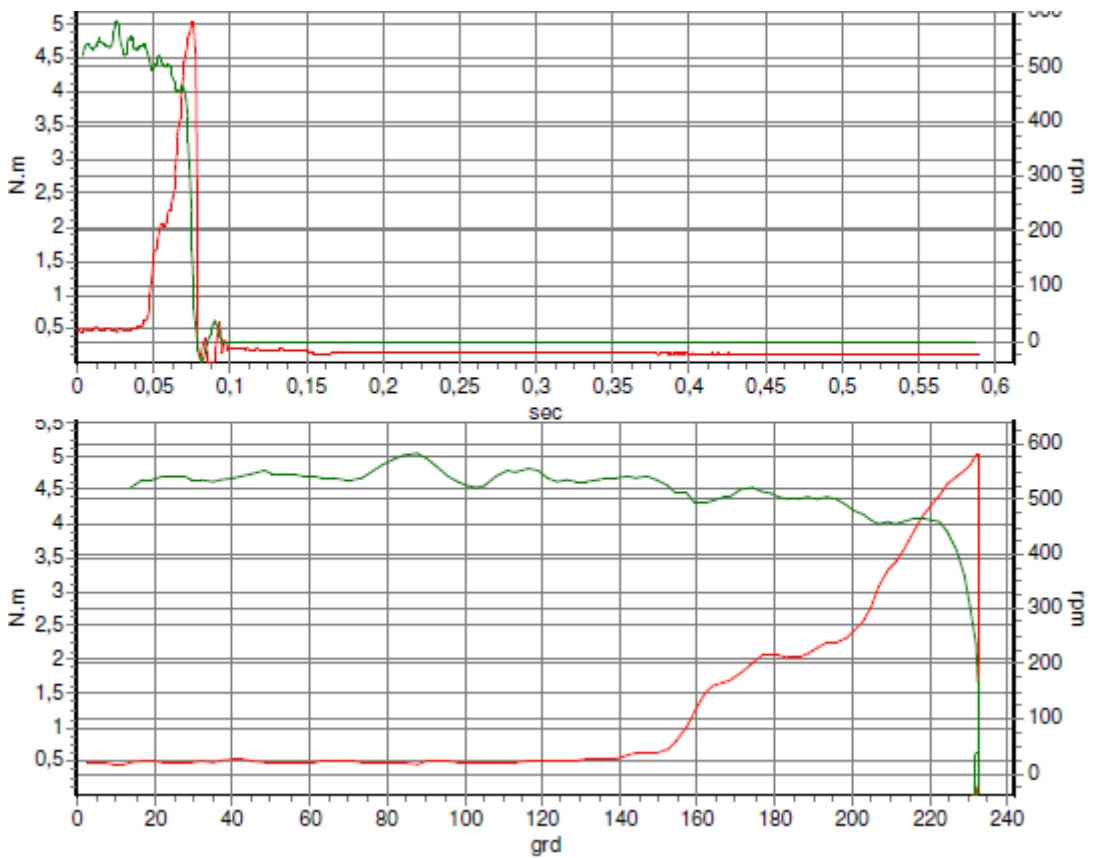


Illustration 6: 30° hard joint 5,0 Nm after Load change Machine 2017-05.013224



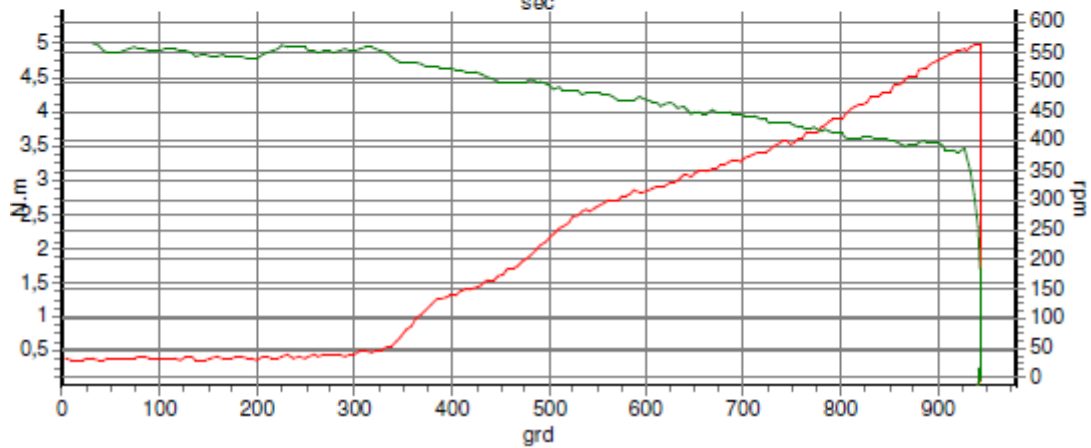
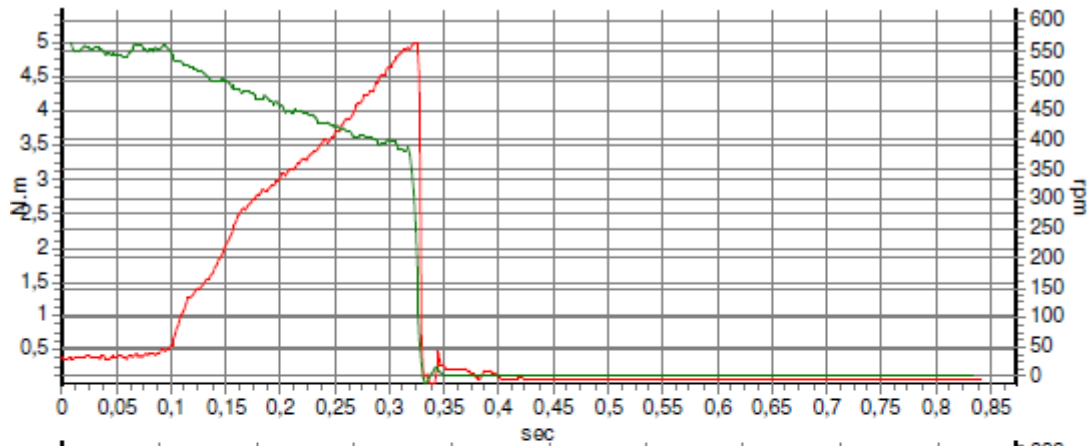


Illustration 7: 360° soft joint 5,0 Nm before Load change Machine 2017-05.013224

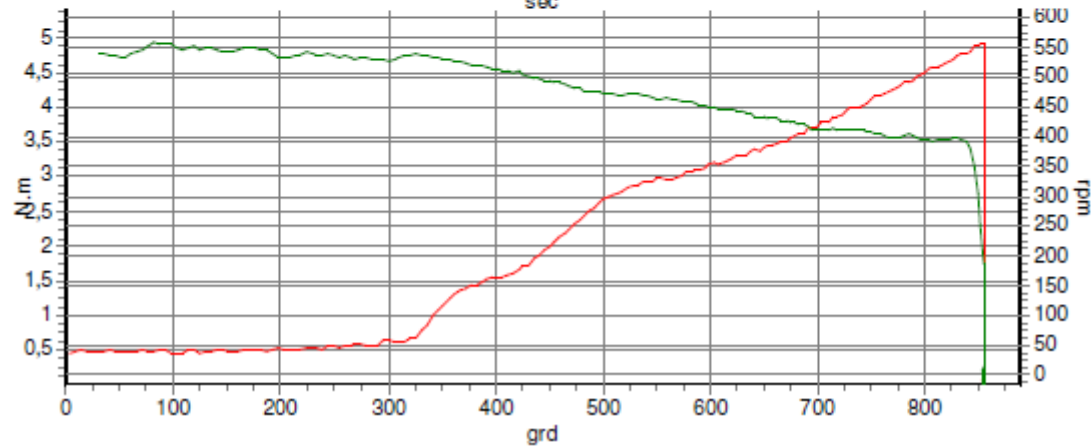
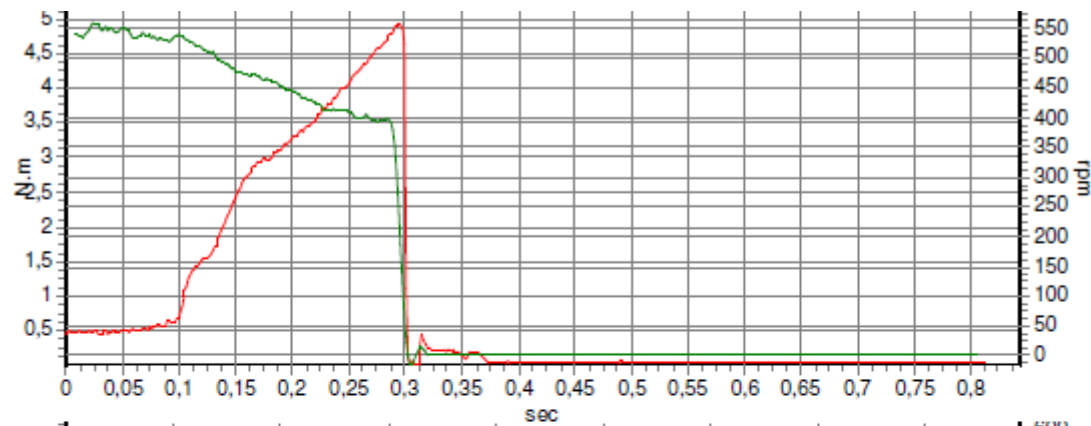


Illustration 8: 360° soft joint 5,0 Nm after Load change Machine 2017-05.013224

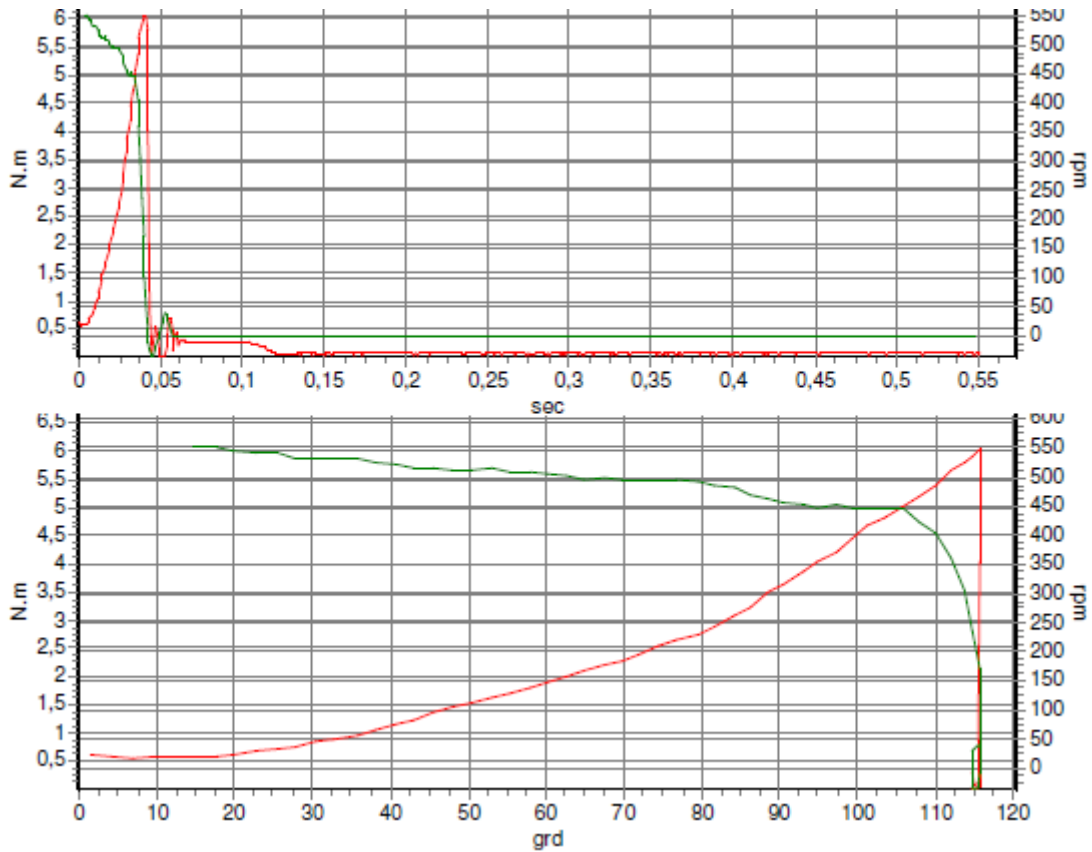


Illustration 9: 30° hard joint 6,0 Nm before Load change Machine 2017-05.013224

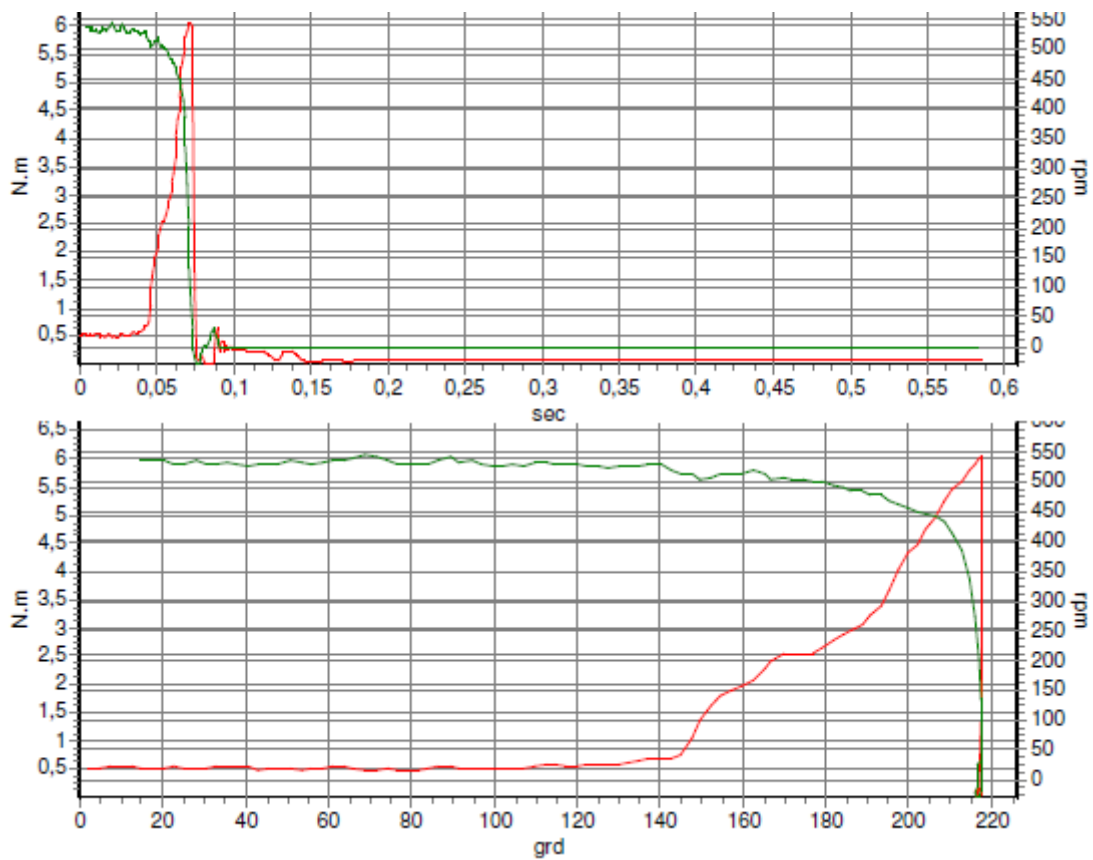


Illustration 10: 30° hard joint 6,0 Nm after Load change Machine 2017-05.013224

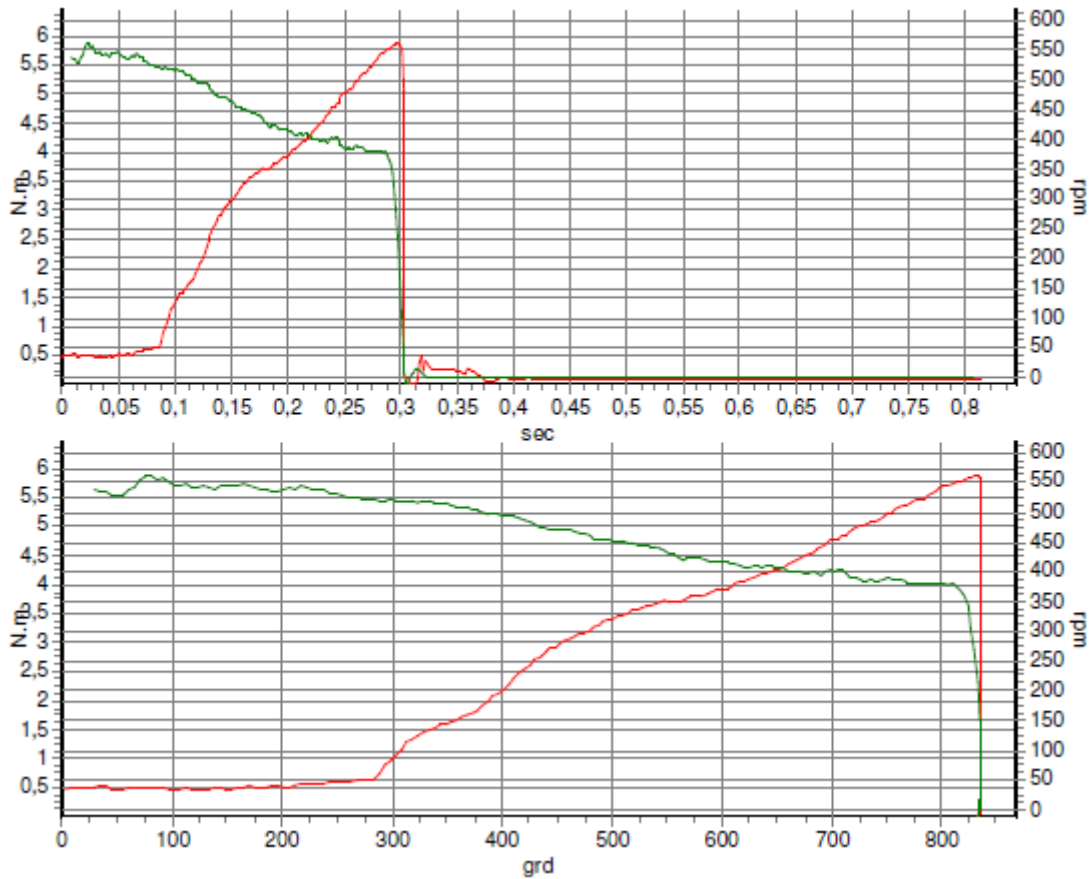


Illustration 11: 360° soft joint 6,0 Nm before Load change Machine 2017-05.013224

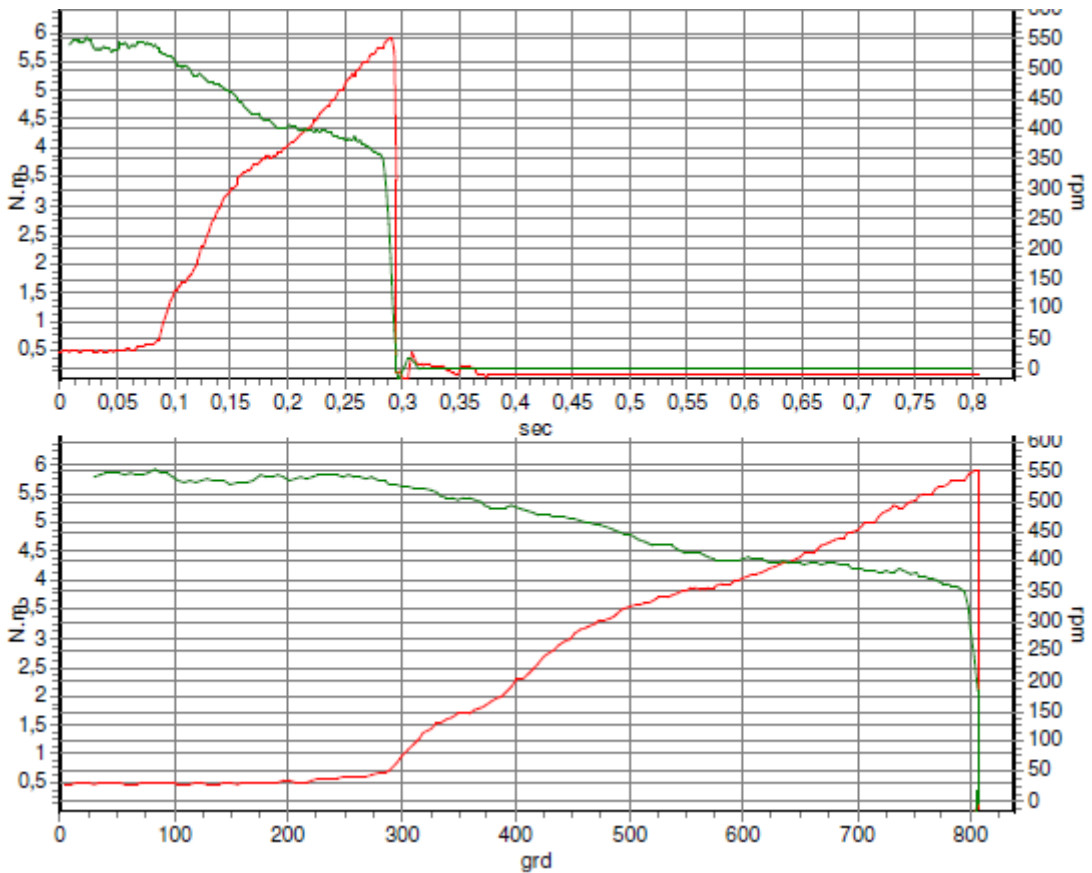


Illustration 12: 360° soft joint 6,0 Nm after load change machine 2017-05.013224

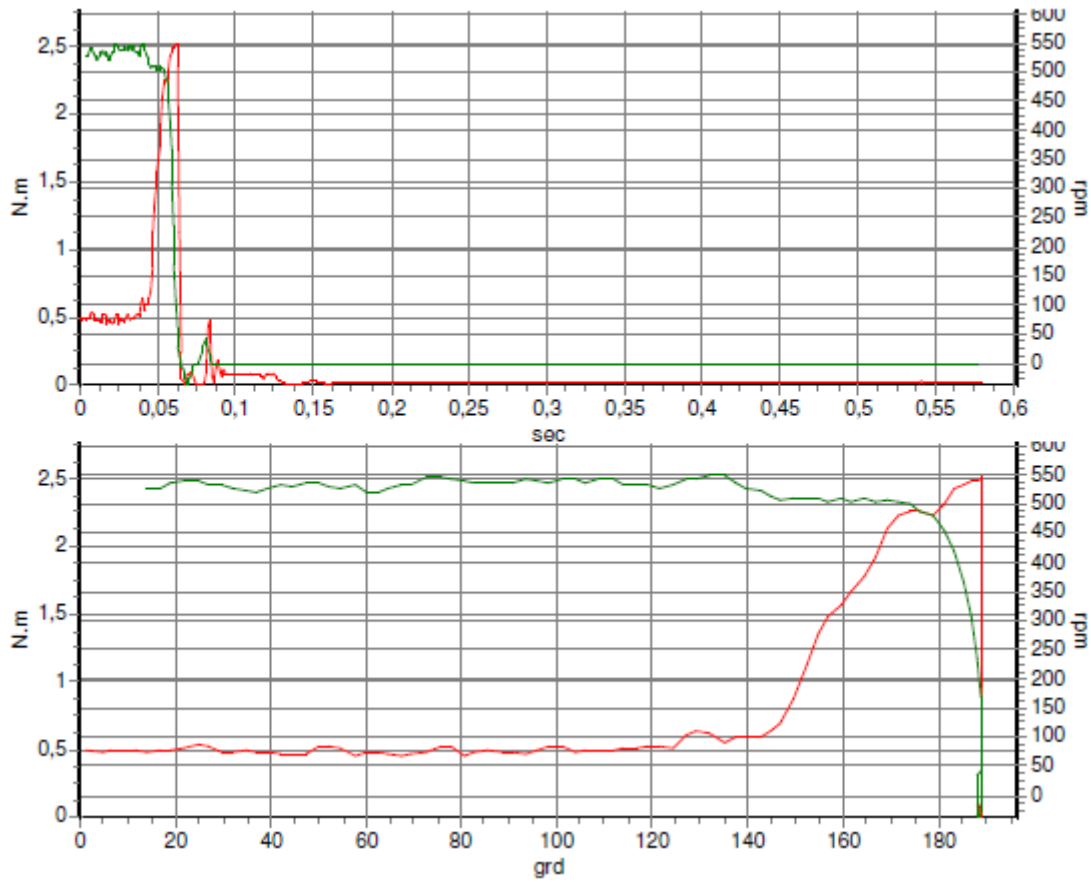


Illustration 13: 30° hard joint 2,5 Nm before load change machine 2017-05.013228

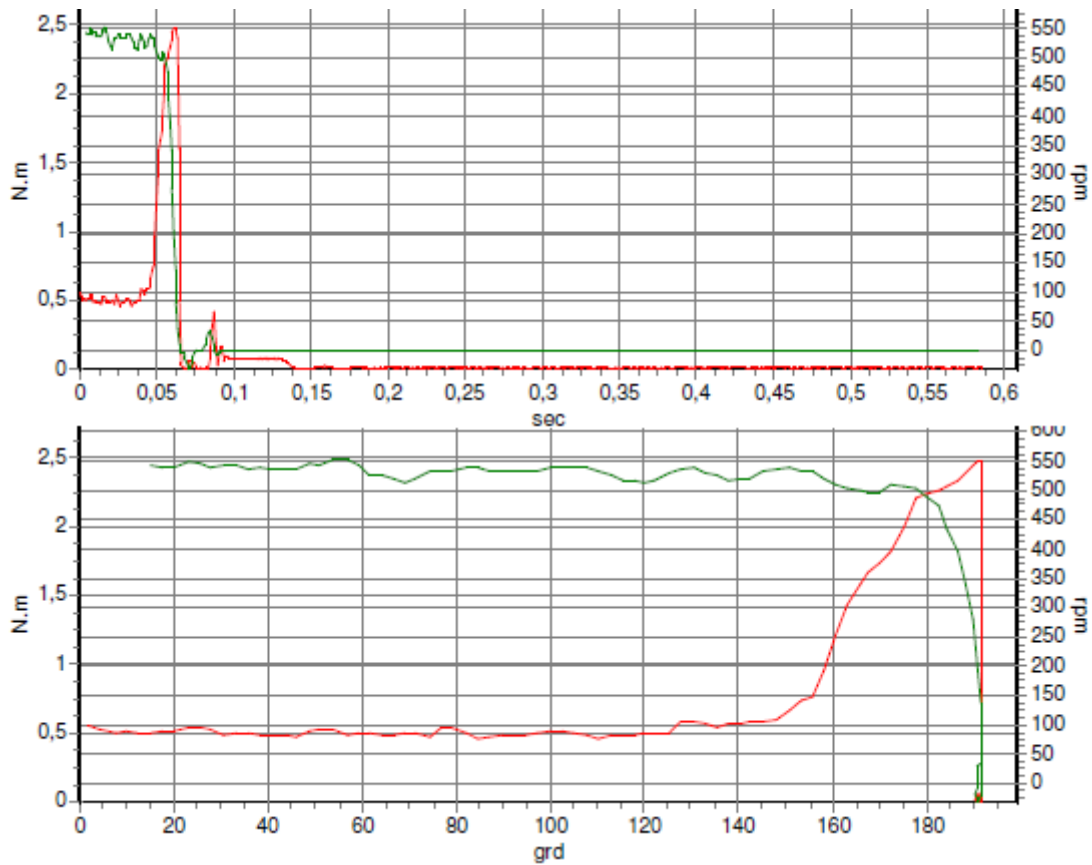


Illustration 14: 30° hard joint 2,5 Nm after load change machine 2017-05.013228

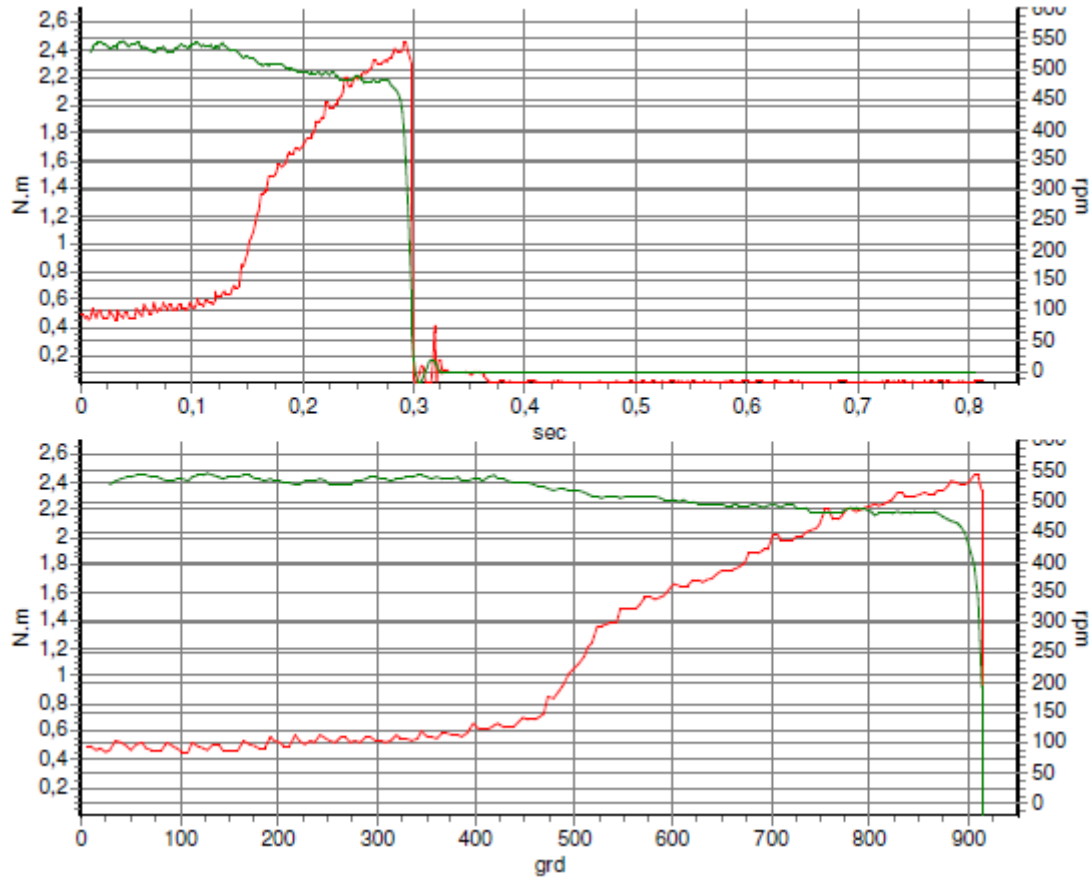


Illustration 15: 360° soft joint 2,5 Nm before load change machine 2017-05.013228

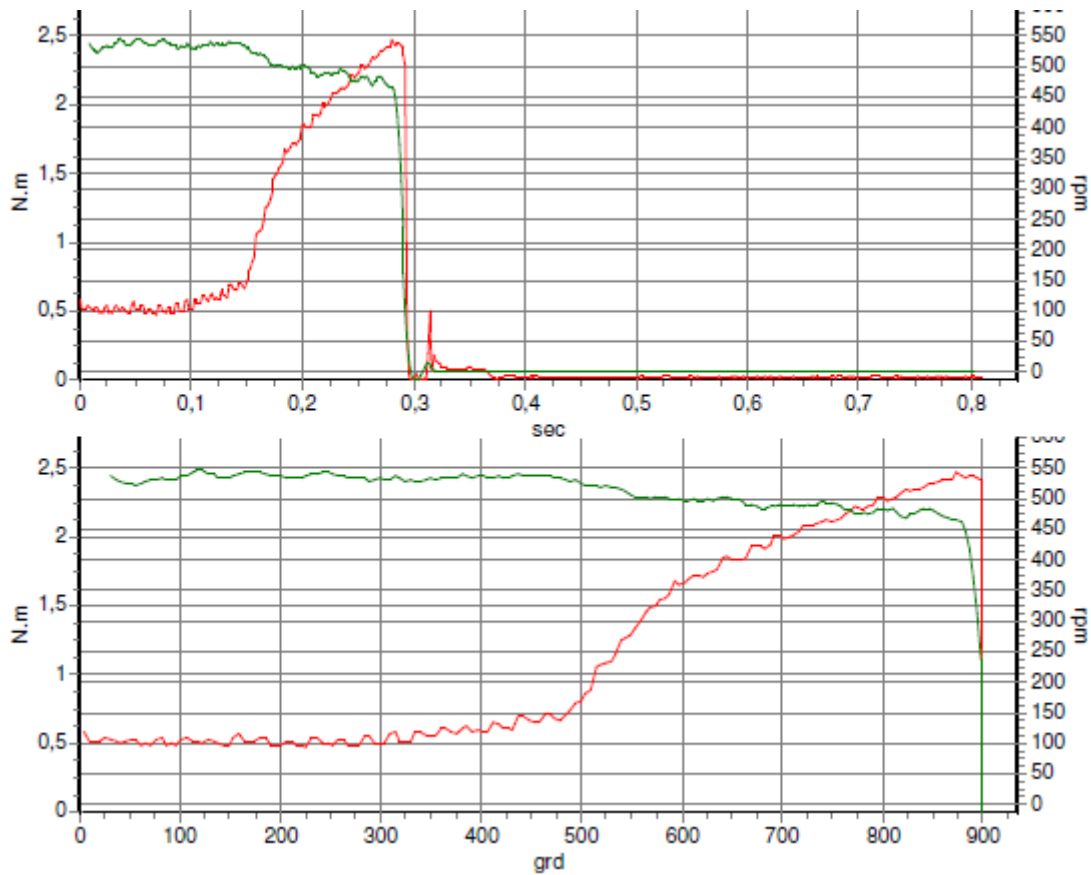


Illustration 16: 360° soft joint 2,5 Nm after load change machine 2017-05.013228

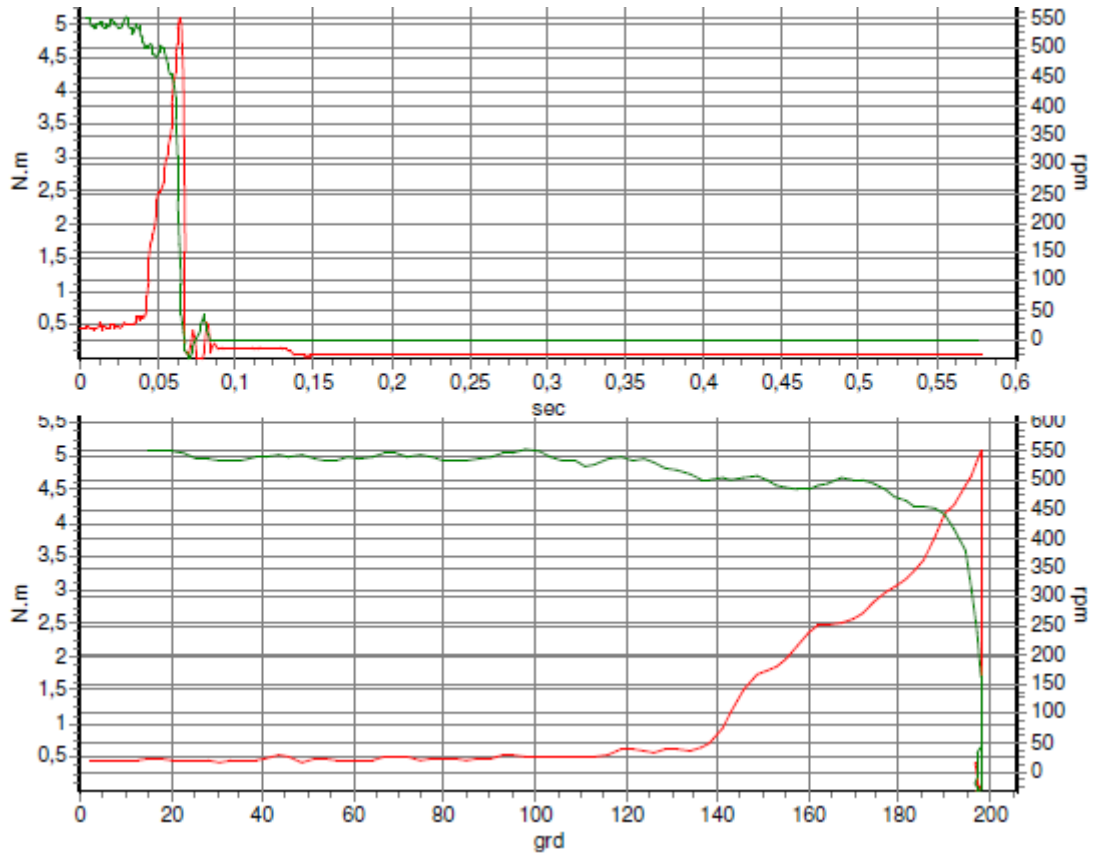


Illustration 17: 30° hard joint 5,0 Nm before load change machine 2017-05.013228

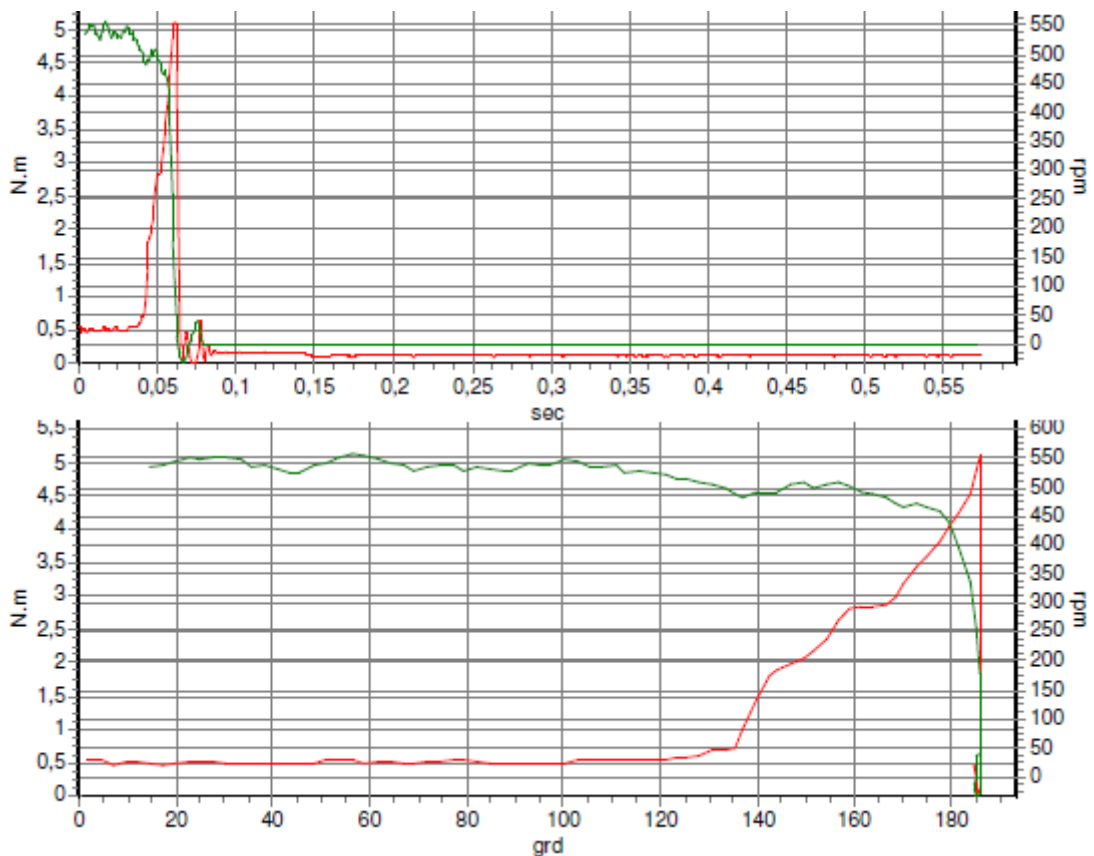


Illustration 18: 30° hard joint 5,0 Nm after load change machine 2017-05.013228

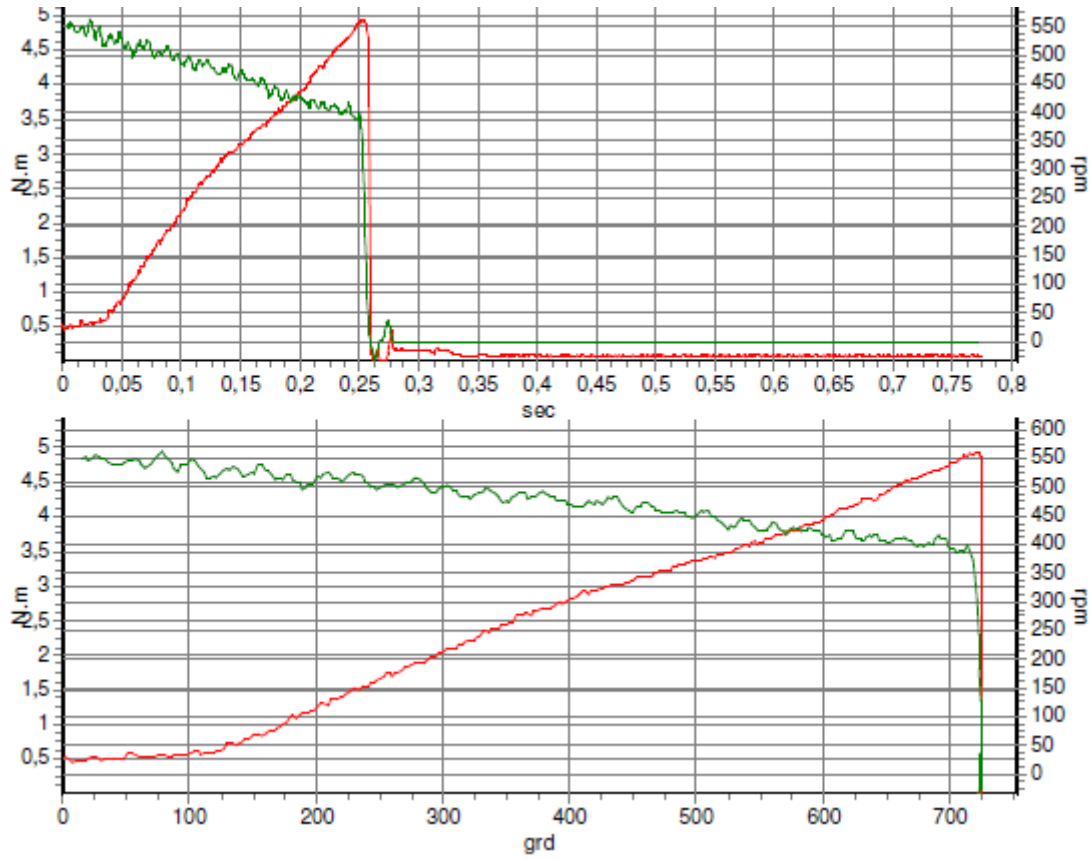


Illustration 19: 360° soft joint 5,0 Nm before load change machine 2017-05.013228

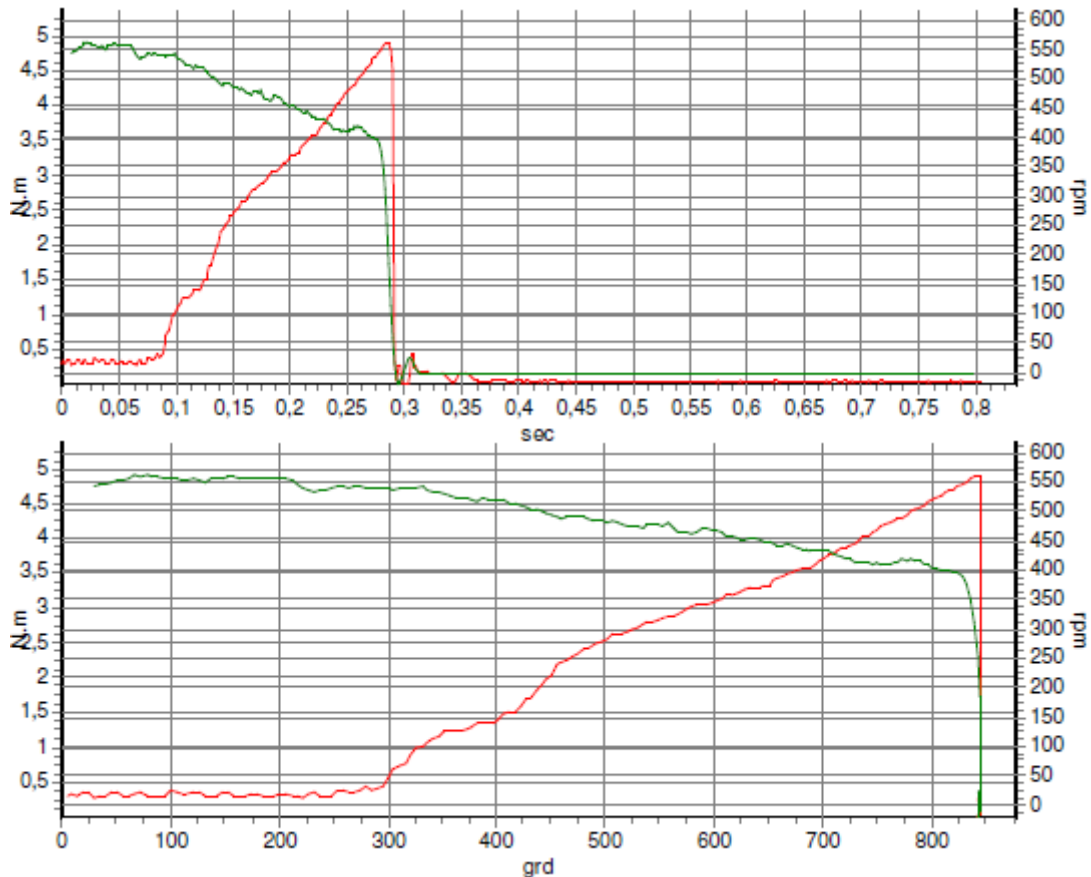


Illustration 20: 360° soft joint 5,0 Nm after load change machine 2017-05.013228



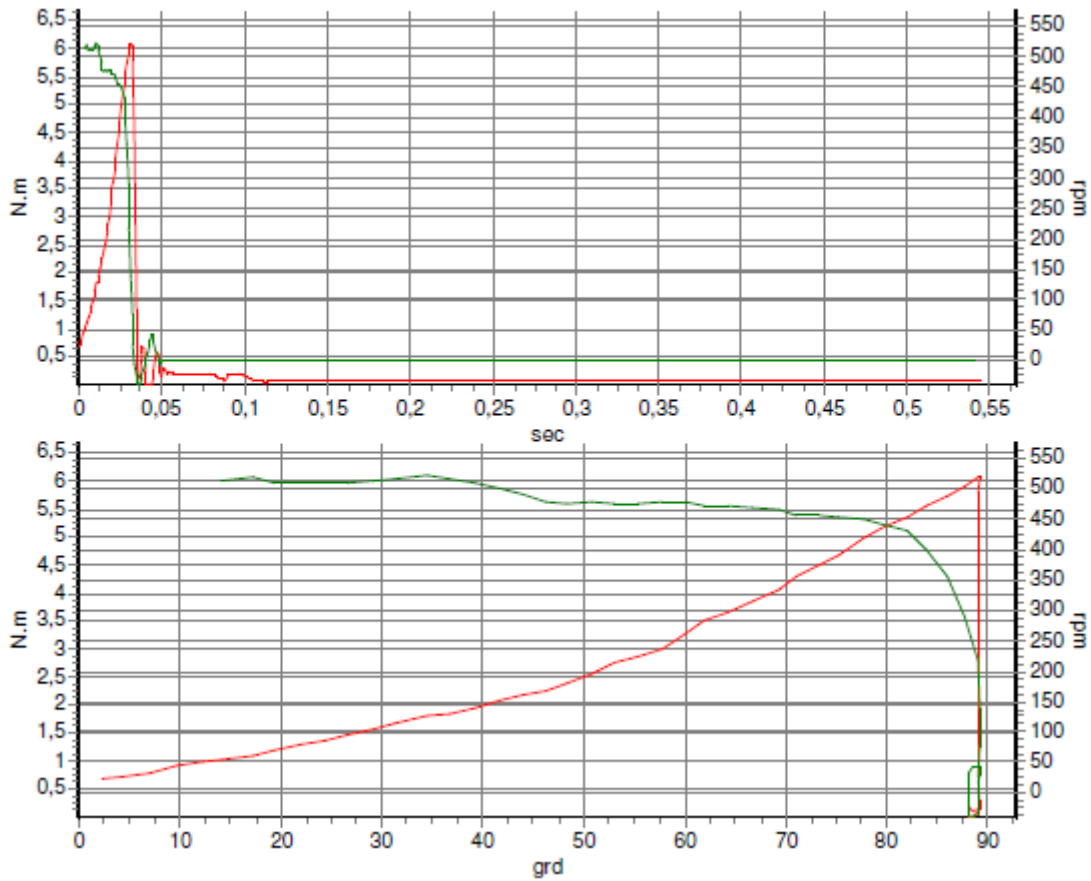


Illustration 21: 30° hard joint 6,0 Nm before load change machine 2017-05.013228

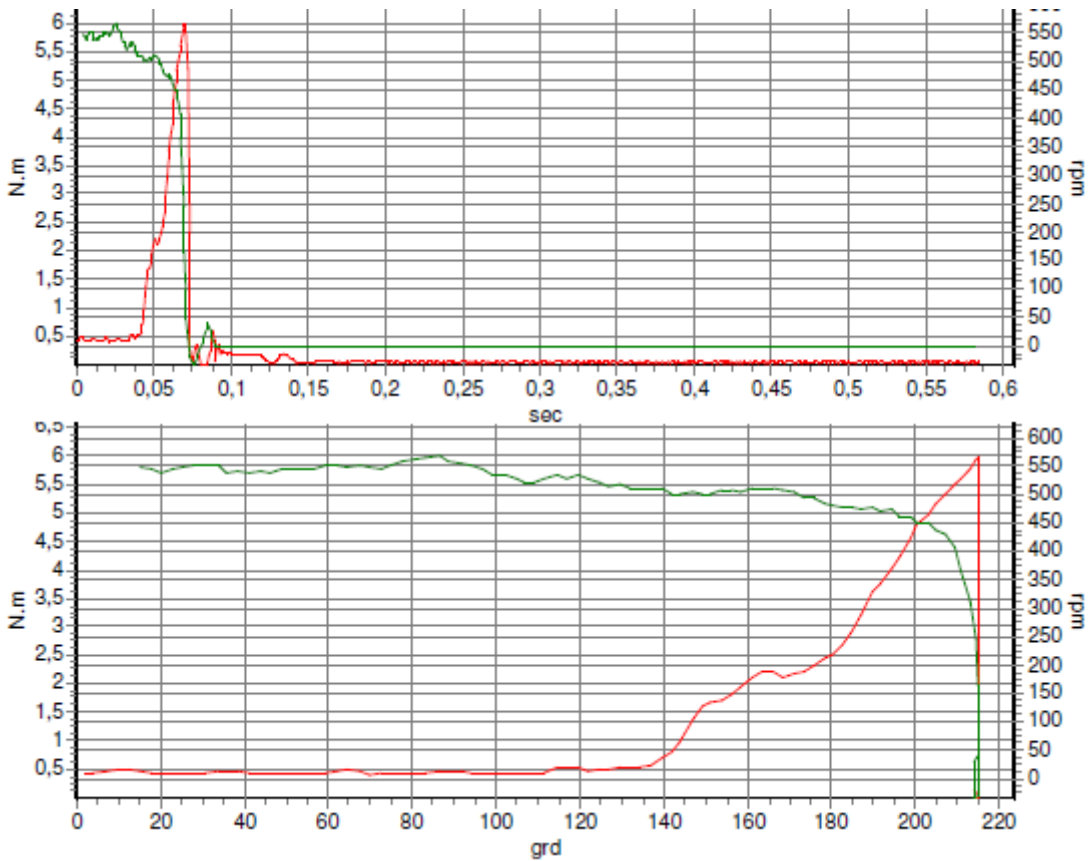


Illustration 22: 30° hard joint 6,0 Nm after load change machine 2017-05.013228



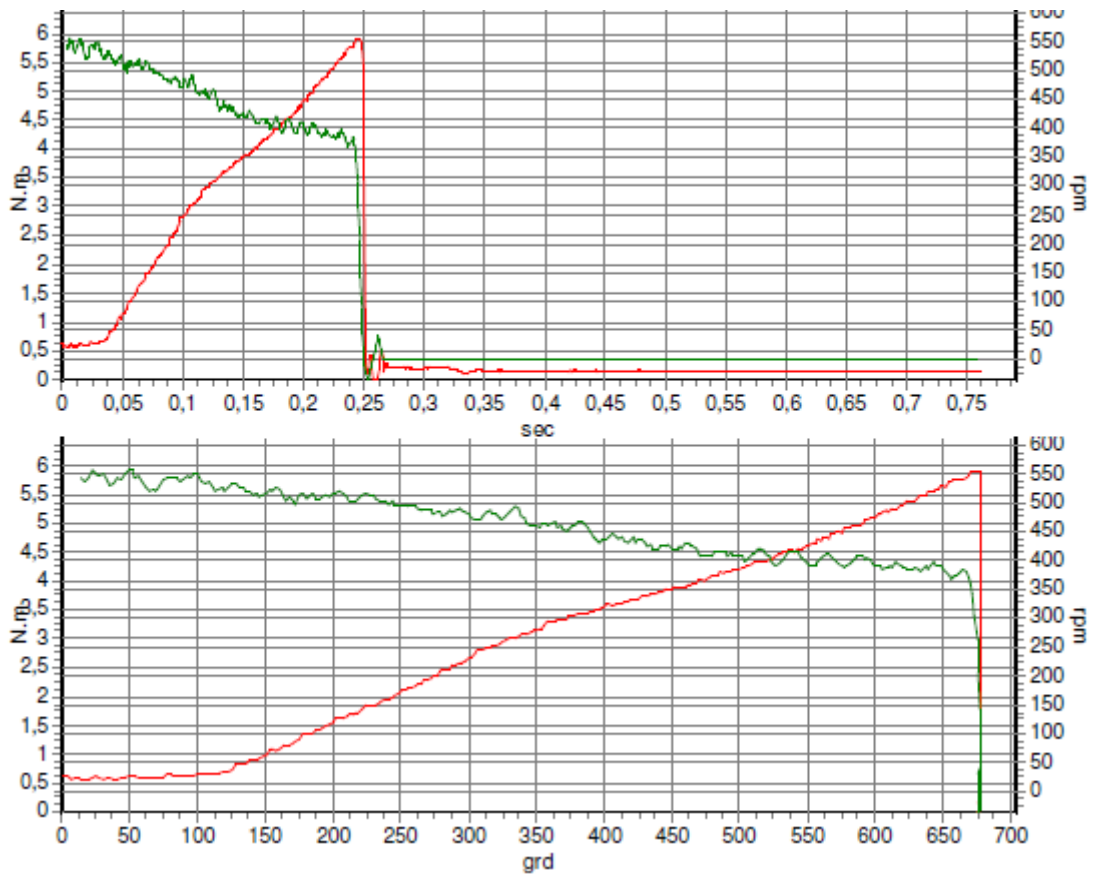


Illustration 23: 360° soft joint 6,0 Nm before load change machine 2017-05.013228

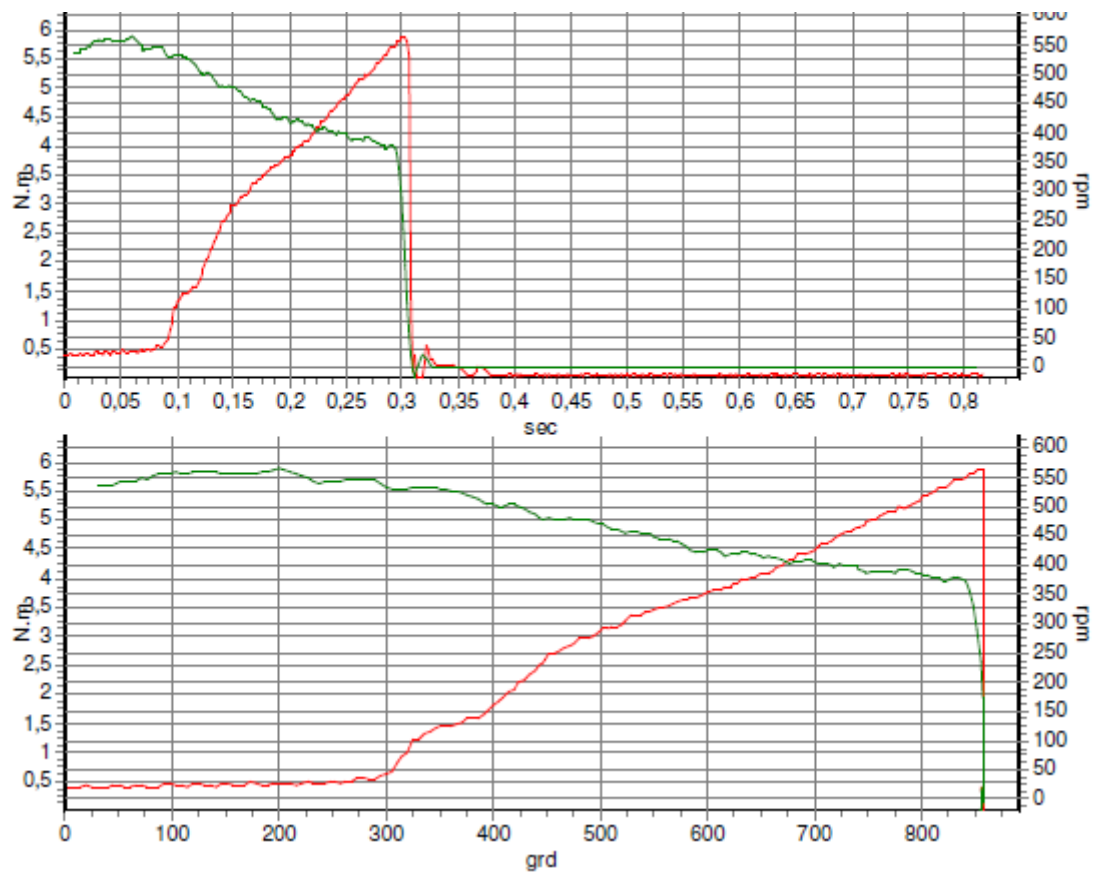


Illustration 24: 360° soft joint 6,0 Nm after load change machine 2017-05.013228

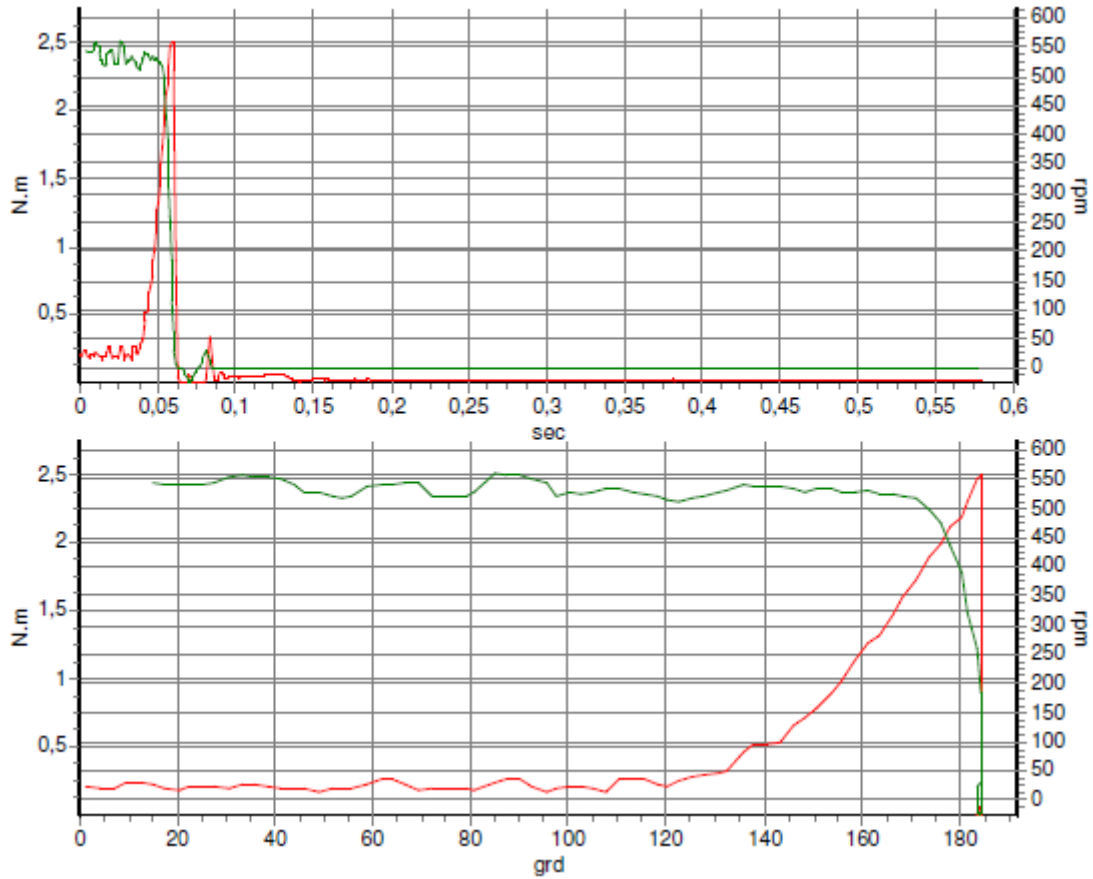


Illustration 25: 30° hard joint 2,5 Nm before load change machine 2017-05.013229

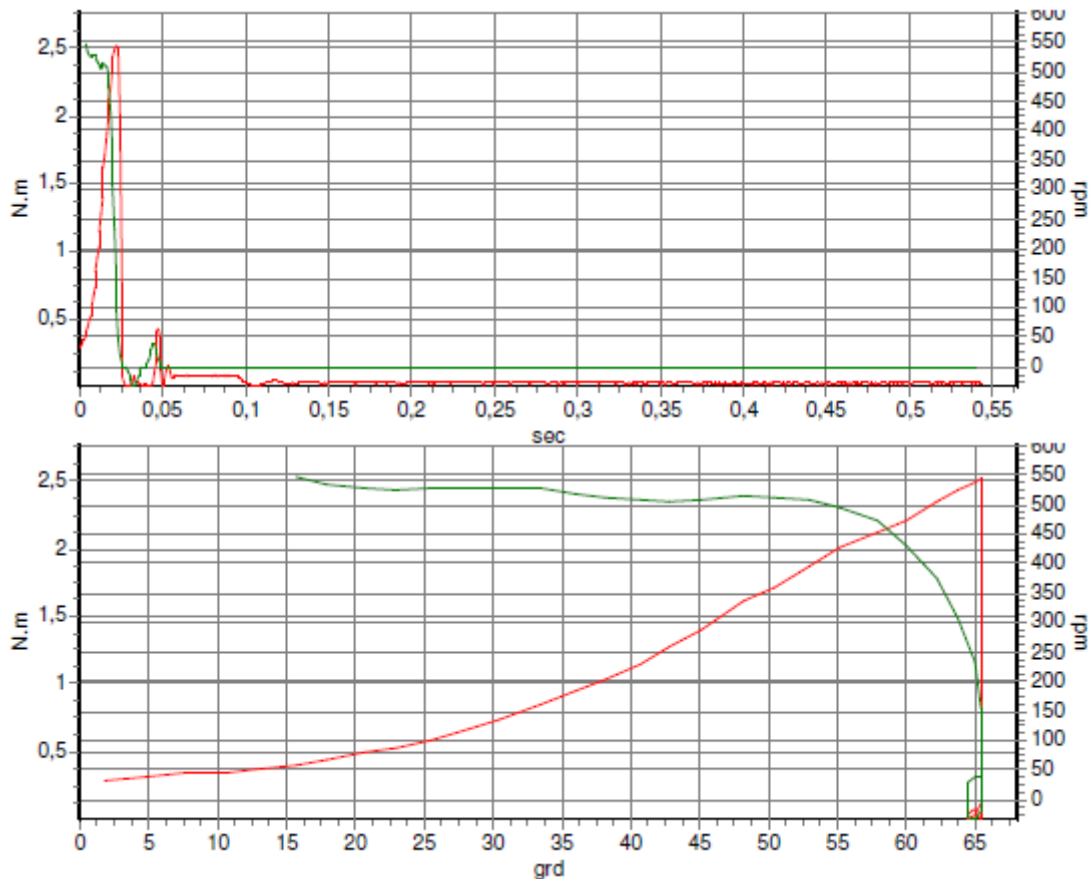


Illustration 26: 30° hard joint 2,5 Nm after load change machine 2017-05.013229

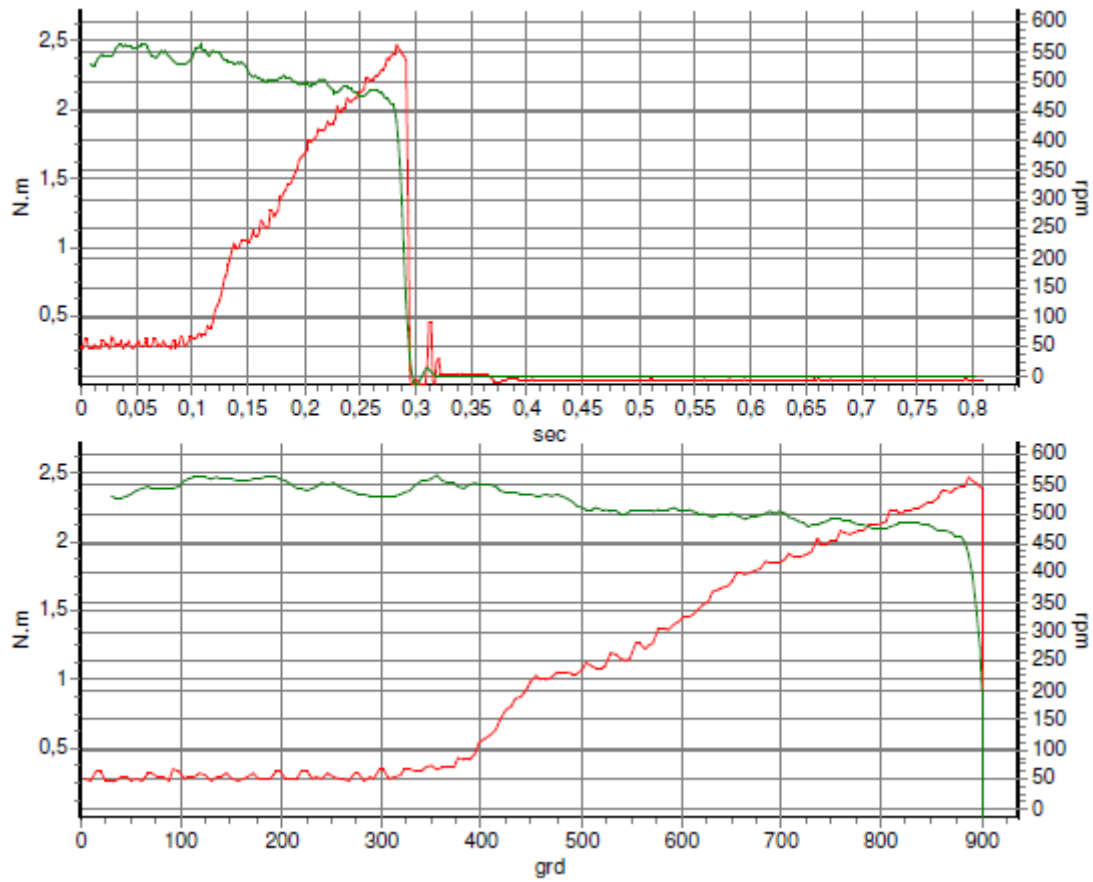


Illustration 27: 360° soft joint 2,5 Nm before load change machine 2017-05.013229

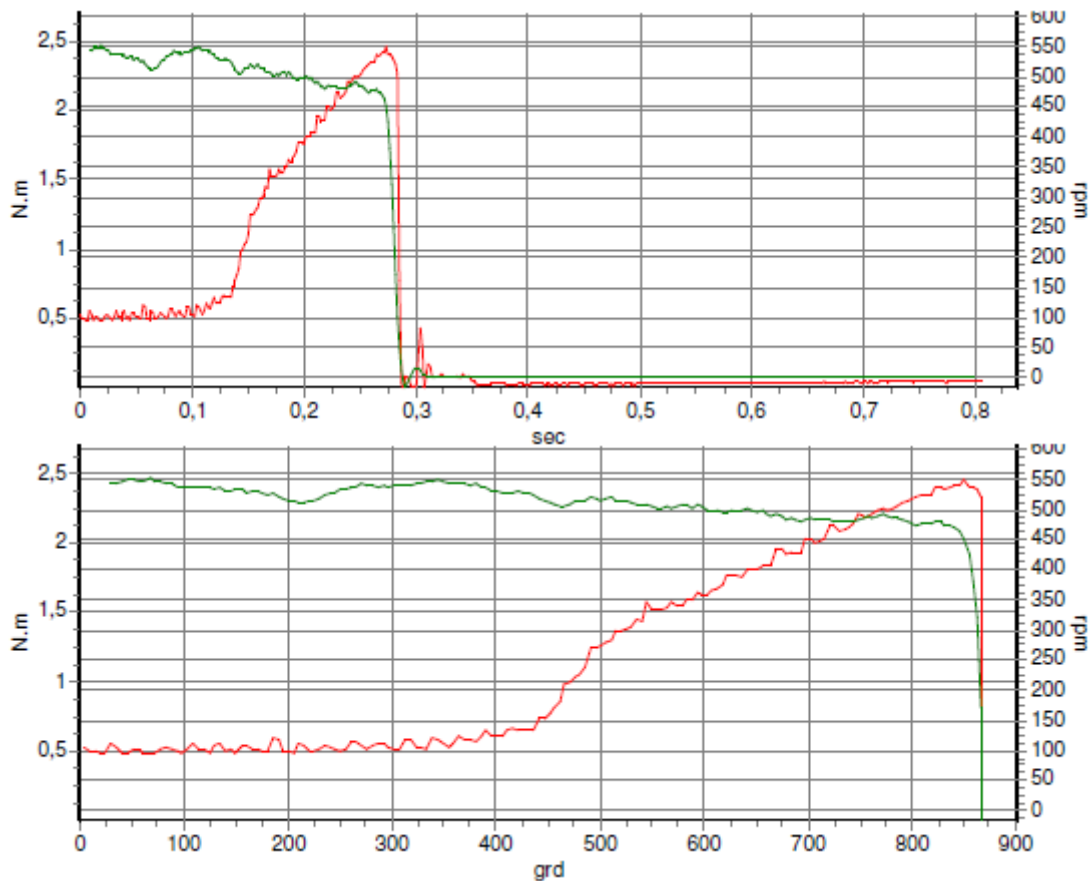


Illustration 28: 360° soft joint 2,5 Nm after load change machine 2017-05.013229

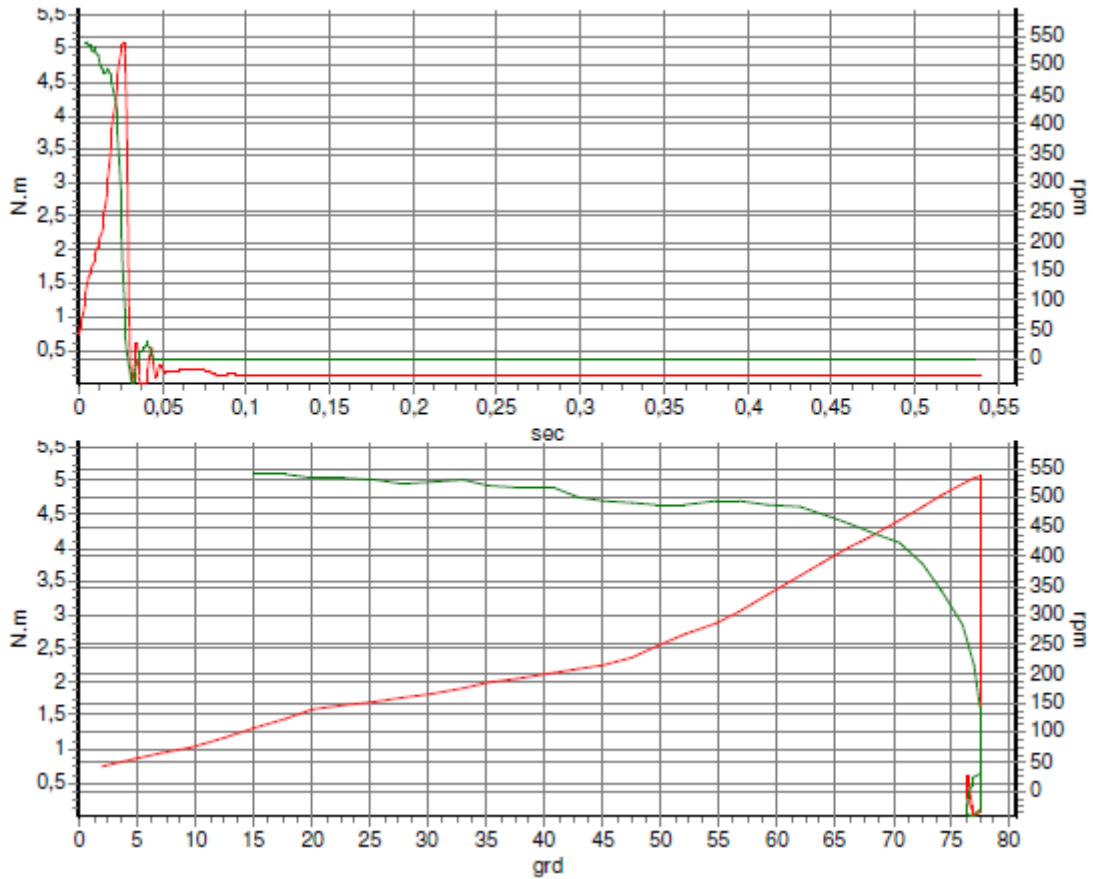


Illustration 29: 30° hard joint 5,0 Nm before load change machine 2017-05.013229

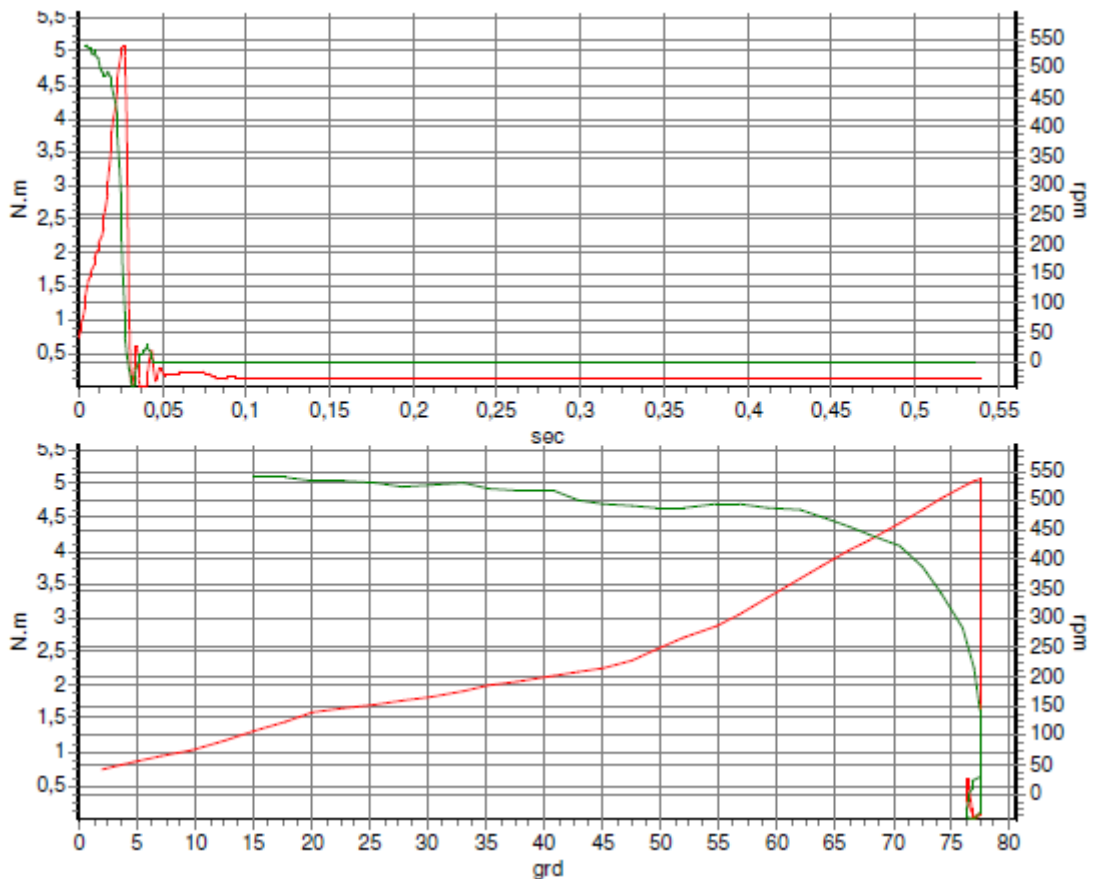


Illustration 30: 30° hard joint 5,0 Nm after load change machine 2017-05.013229

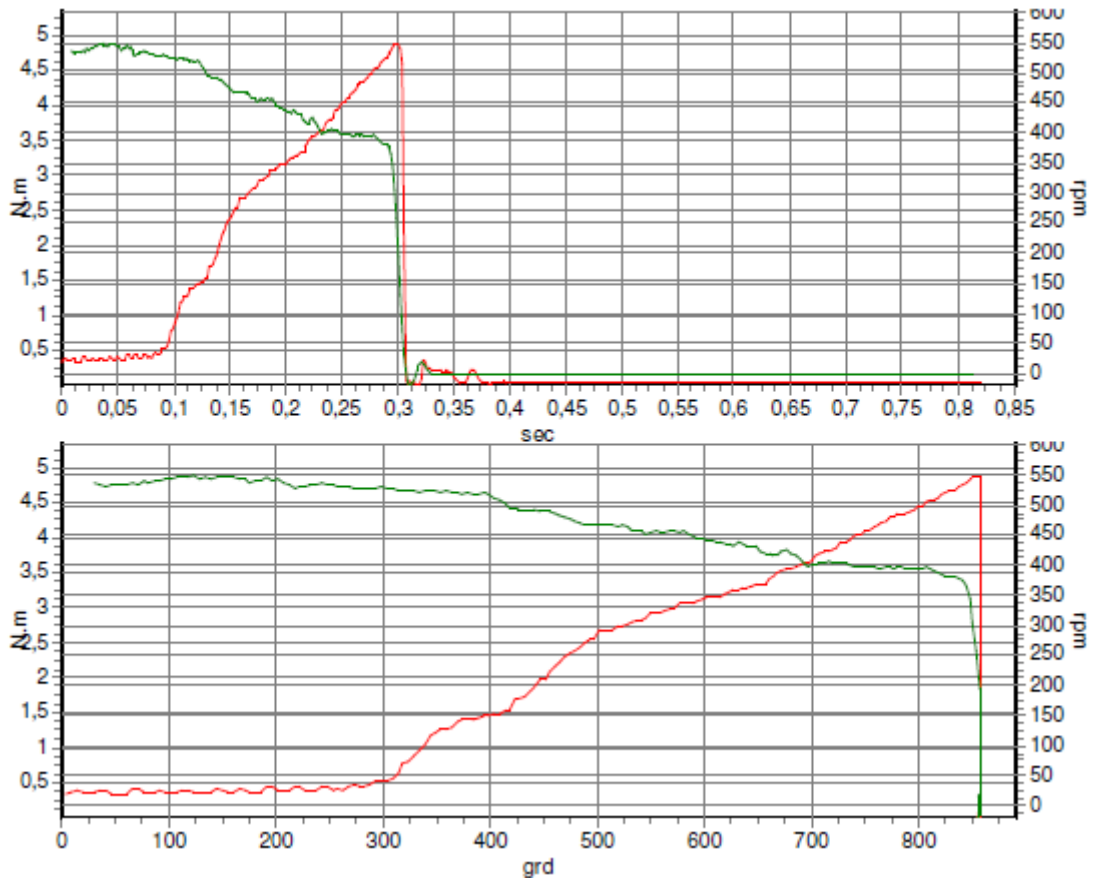


Illustration 31: 360° soft joint 5,0 Nm before load change machine 2017-05.013229

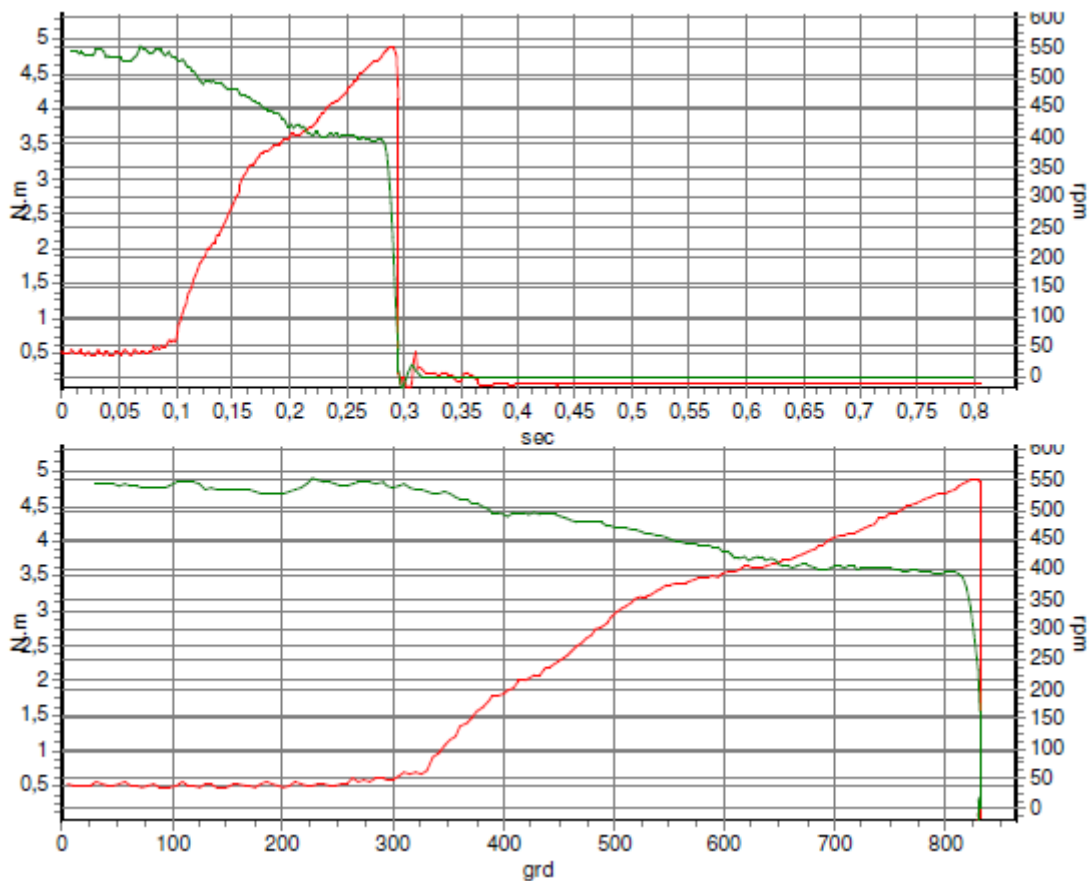


Illustration 32: 360° soft joint 5,0 Nm after load change machine 2017-05.013229

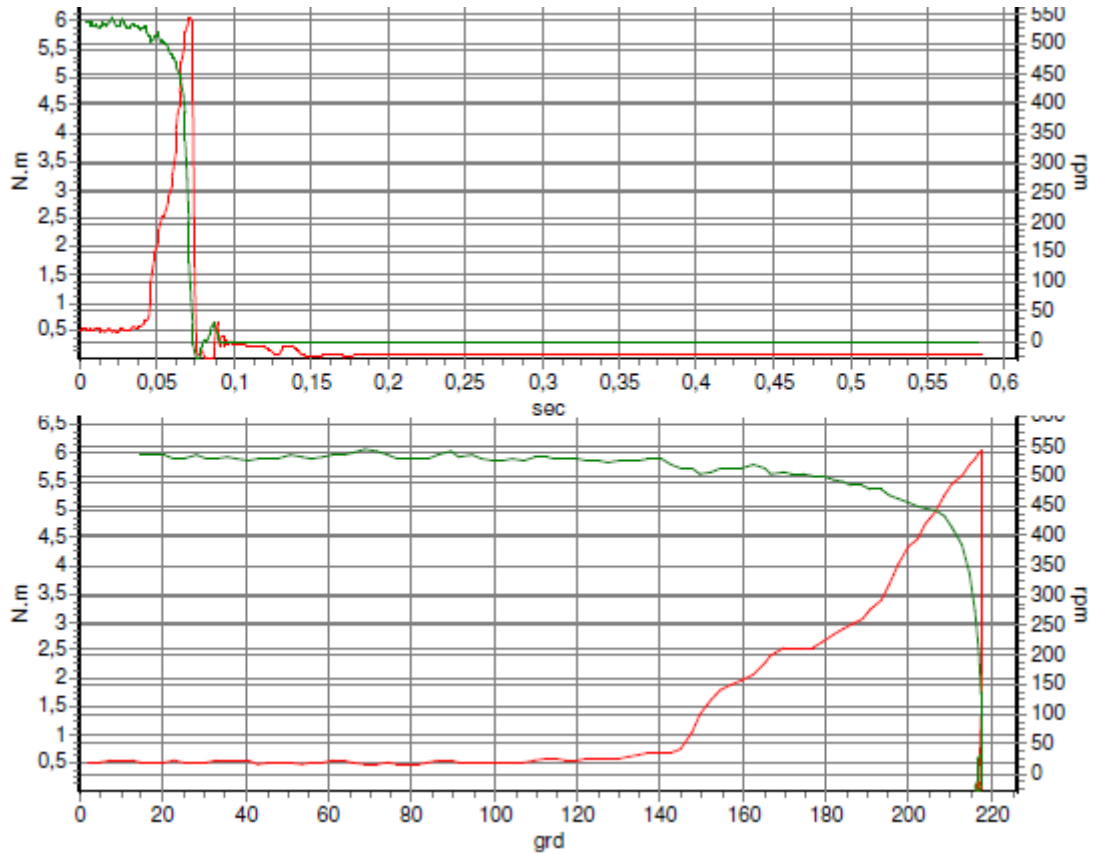


Illustration 33: 30° hard joint 6,0 Nm before load change machine 2017-05.013229

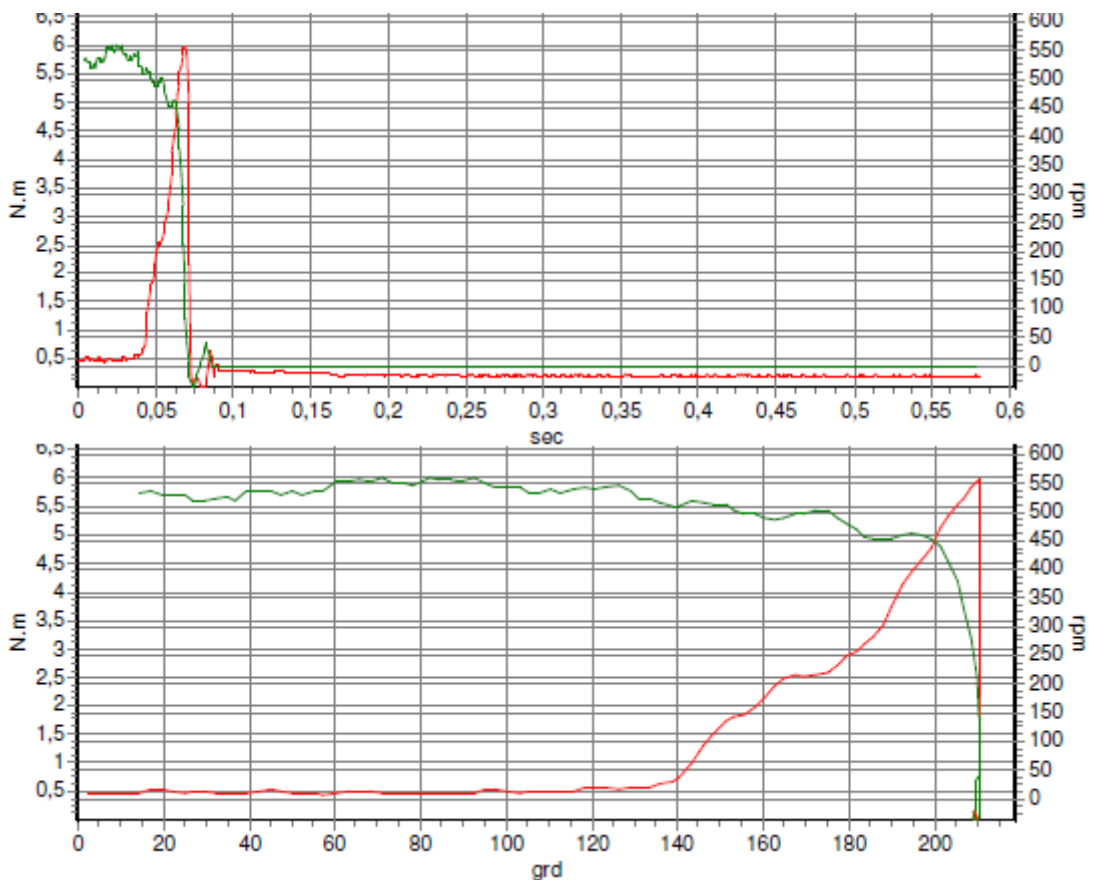


Illustration 34: 30° hard joint 6,0 Nm after load change machine 2017-05.013229

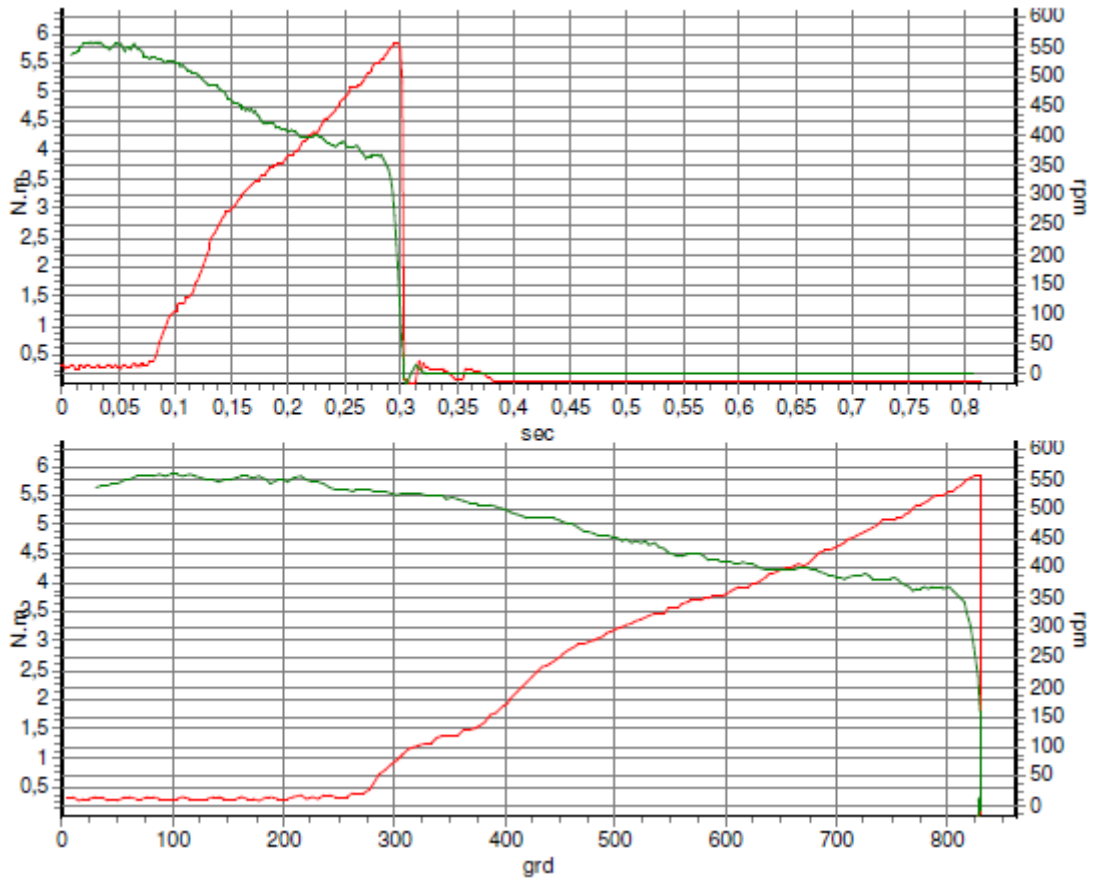


Illustration 35: 360° soft joint 6,0 Nm before load change machine 2017-05.013229

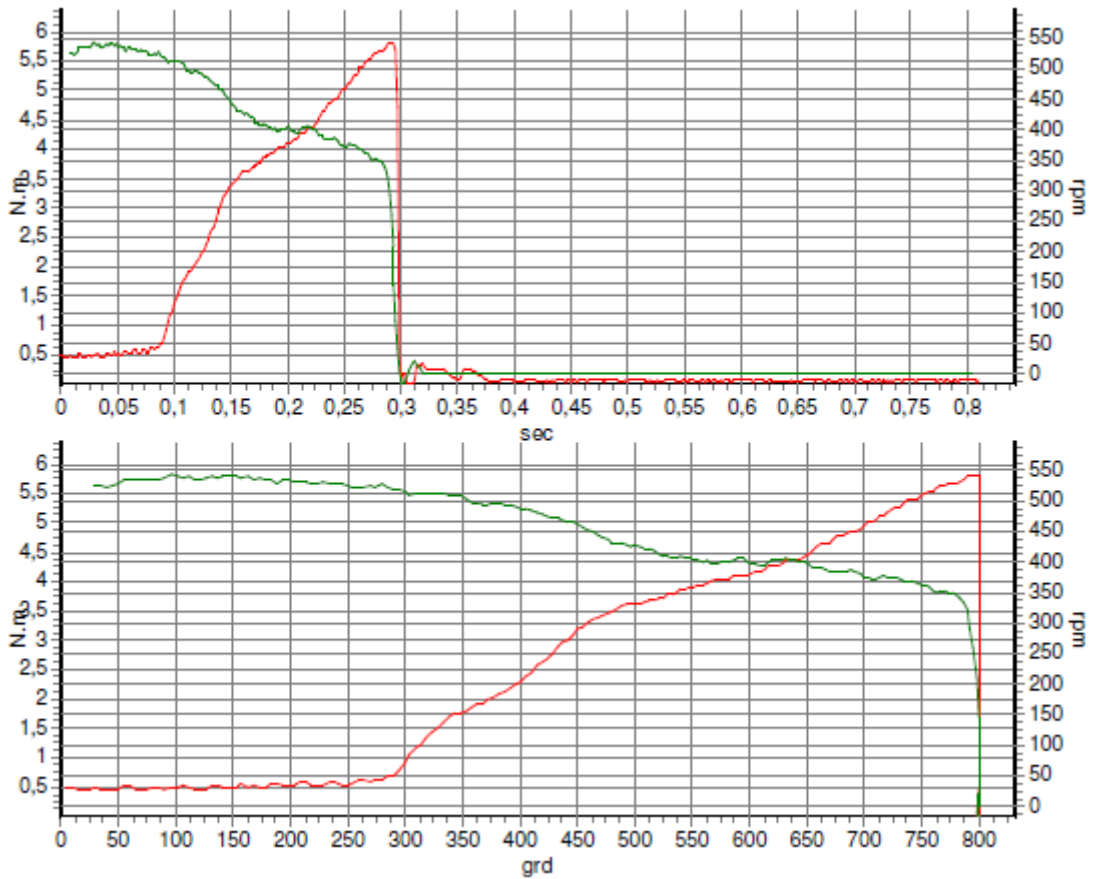


Illustration 36: 360° soft joint 6,0 Nm after load change machine 2017-05.013229