

Test report: Machinery capability investigation
from industry screwdriver



C. & E. FEIN GmbH
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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^{-1} 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% = $M_{min} + 30\% \times (M_{max} - M_{min}) =$ 9,60 Nm
 80% → M80% = $M_{min} + 80\% \times (M_{max} - M_{min}) =$ 15,60 Nm
 100% → M100% = $M_{min} + 100\% \times (M_{max} - M_{min}) =$ 18,00 Nm

Information on all 3 test items

Load level		30%		80%		100%	
Test torque	$M_d =$	9,60		15,60		18,00	
Joints		hard	soft	hard	soft	hard	soft
		30°	360°	30°	360°	30°	360°
$C_{m min} =$		1,818	2,092	1,844	2,453	1,835	2,500
$C_{mk min} =$		1,782	1,728	1,752	2,381	1,707	2,386

		Name :	Date :
Carried out by	:	Mück	31.05.2017
Test report prepared by	:	Mück	04.07.2017

A1 General information on the test item 1

Manufacturer : C.&E. Fein GmbH **Model:** 18-18 / PC **Ident-No. :** 2017-05.021100

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

Torque range from $M_{min} =$	6,00	Nm	to $M_{max} =$	18,00	Nm
Weight incl. Battery :	1,650	kg	Sound pressure level :	<81	dB(A)
Battery voltage :	18,00	V	Undervoltage detection :	<input checked="" type="checkbox"/>	
Battery capacity :	2500	mAh	Idle speed :	375	min ⁻¹

Number of screwed connections with battery at 100% rated power		
Turn rate low (soft) :	425	LC
Turn rate high (hard) :	1142	LC

Temperature measurement for power tools at 80% rated power 360° soft joint		
	beginn:	end:
On the handle :	27,2 °C	36,1 °C

A2 General information test equipment and test conditions

Description of test equipment, design and function:

Schatz cerTest 2.5 5413-5392/303

Brake 50 Nm	Brake 10 Nm	2
ASM firmly and positively clamped		
2 sec. wait between two load changes		

Measurability test	No.:	V-49200	Date:	04.04.2017
Certificate according to VDI/VDE 2646		V-49199	Date:	04.04.2017

A3.1 Data per test item

Torque-range	from $M_{min} =$	6,00	Nm	to $M_{max} =$	18,00	Nm
Test torque 30%	$M_{30\%} =$	9,60	Nm			
Test torque 80%	$M_{80\%} =$	15,60	Nm			
Test torque 100%	$M_{100\%} =$	18,00	Nm			
Fitting tolerance	2	in %	±	10,0%		

Load level		30%	80%	100%				
Test torque	$M_d =$	9,60	15,60	18,00	Nm			
Joints		hard	soft	hard	soft			
		30°	360°	30°	360°			
Tolerance : Upper limit	: $M_{zul max} =$	10,56	17,16	19,80	Nm			
Tolerance : Lower limit	: $M_{zul min} =$	8,64	14,04	16,20	Nm			
Medium torque	: $M_q =$	9,58	9,35	15,68	15,55	17,97	17,78	Nm
Standard deviation	: $s =$	0,18	0,13	0,28	0,21	0,28	0,22	Nm
6s torque scattering	: $6s/M_q =$	11,02%	8,60%	10,79%	8,18%	9,18%	7,46%	
Ability index	: $c_m =$	1,82	2,39	1,84	2,45	2,18	2,71	
Ability index	: $c_{mk} =$	1,78	1,75	1,75	2,38	2,15	2,39	
Mean speed	: $n =$	328	334	331	332	329	335	min ⁻¹

A1 General information on the test item 2

Manufacturer : C.&E. Fein GmbH **Model:** 18-18 / PC **Ident-No. :** 2017-05.021095

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

Torque range from $M_{min} =$	6,00	Nm	to $M_{max} =$	18,00	Nm
Weight incl. Battery :	1,650	kg	Sound pressure level :	<81	dB(A)
Battery voltage :	18,00	V	Undervoltage detection :	<input checked="" type="checkbox"/>	
Battery capacity :	2500	mAh	Idle speed :	375	min ⁻¹

Number of screwed connections with battery at 100% rated power		
Turn rate low (soft) :	425	LC
Turn rate high (hard) :	1142	LC

Temperature measurement for power tools at 80% rated power 360° soft joint		
	beginn:	end:
On the handle :	27,2 °C	36,1 °C

A2 General information test equipment and test conditions

Description of test equipment, design and function:

Schatz cerTest 2.5 5413-5392/303

Brake 50 Nm	Brake 10 Nm
ASM firmly and positively clamped	
2 sec. wait between two load changes	

Measurability test	No.:	V-49200	Date:	04.04.2017
Certificate according to VDI/VDE 2646		V-49199	Date:	04.04.2017

A3.1 Data per test item

Torque-range	from $M_{min} =$	6,00	Nm	to $M_{max} =$	18,00	Nm
Test torque 30%	$M_{30\%} =$	9,60	Nm			
Test torque 80%	$M_{80\%} =$	15,60	Nm			
Test torque 100%	$M_{100\%} =$	18,00	Nm			
Fitting tolerance	2	in %	±	10,0%		

Load level		30%	80%	100%				
Test torque	$M_d =$	9,60	15,60	18,00	Nm			
Joints		hard	soft	hard	soft			
		30°	360°	30°	360°			
Tolerance : Upper limit	: $M_{zul\ max} =$	10,56	17,16	19,80	Nm			
Tolerance : Lower limit	: $M_{zul\ min} =$	8,64	14,04	16,20	Nm			
Medium torque	: $M_q =$	9,67	9,47	15,65	15,55	17,96	17,96	Nm
Standard deviation	: $s =$	0,15	0,14	0,28	0,20	0,33	0,24	Nm
6s torque scattering	: $6s/M_q =$	9,25%	9,00%	10,58%	7,87%	10,92%	8,02%	
Ability index	: $c_m =$	2,15	2,25	1,88	2,55	1,83	1,88	
Ability index	: $c_{mk} =$	2,00	1,94	1,82	2,46	1,79	1,73	
Mean speed	: $n =$	325	329	333	333	333	333	min ⁻¹

A1 General information on the test item 3

Manufacturer : C.&E. Fein GmbH **Model:** 18-18 / PC **Ident-No. :** 2017-05.021093

Modell variant: ASW **begin:** 13:00 **Serial-No. :** 7021
end: 16:00

Torque range from $M_{min} =$	6,00	Nm	to $M_{max} =$	18,00	Nm
Weight incl. Battery :	1,650	kg	Sound pressure level :	<81	dB(A)
Battery voltage :	18,00	V	Undervoltage detection :	<input checked="" type="checkbox"/>	
Battery capacity :	2500	mAh	Idle speed :	375	min ⁻¹

Number of screwed connections with battery at 100% rated power		
Turn rate low (soft) :	425	LC
Turn rate high (hard) :	1142	LC

Temperature measurement for power tools at 80% rated power 360° soft joint		
	beginn:	end:
On the handle :	27,2 °C	3561 °C

A2 General information test equipment and test conditions

Description of test equipment, design and function:

Schatz cerTest 2.5 5413-5392/303

Brake 50 Nm	Brake 10 Nm
ASM firmly and positively clamped	
2 sec. wait between two load changes	

Measurability test	No.:	V-49200	Date:	04.04.2017
Certificate according to VDI/VDE 2646		V-49199	Date:	04.04.2017

A3.1 Data per test item

Torque-range	from $M_{min} =$	6,00	Nm	to $M_{max} =$	18,00	Nm
Test torque 30%	$M_{30\%} =$	9,60	Nm			
Test torque 80%	$M_{80\%} =$	15,60	Nm			
Test torque 100%	$M_{100\%} =$	18,00	Nm			
Fitting tolerance	2	in %	±	10,0%		

Load level		30%	80%	100%				
Test torque	$M_d =$	9,60	15,60	18,00	Nm			
Joints		hard	soft	hard	soft			
		30°	360°	30°	360°			
Tolerance : Upper limit	: $M_{zul max} =$	10,56	17,16	19,80	Nm			
Tolerance : Lower limit	: $M_{zul min} =$	8,64	14,04	16,20	Nm			
Medium torque	: $M_q =$	9,54	9,43	15,62	15,42	18,16	17,87	Nm
Standard deviation	: $s =$	0,15	0,15	0,28	0,16	0,32	0,23	Nm
6s torque scattering	: $6s/M_q =$	9,63%	9,73%	10,60%	6,38%	10,61%	7,79%	
Ability index	: $c_m =$	2,09	2,09	1,88	3,17	1,87	2,59	
Ability index	: $c_{mk} =$	1,95	1,73	1,86	2,81	1,71	2,40	
Mean speed	: $n =$	333	335	332	336	335	335	min ⁻¹

Testbench Measuring				MCS for FEIN-Project : 7021		Homologation		Date: 04.07.2017			
ASW 18-18 / PC		ScrewdriverType	ASW	Accuracy-Class	10,0%	Class	: 2	$f_{\text{mess}} = 300 \text{ Hz}$	M_{min}	M_{max}	
		Variant	:	18-18 / PC		$M_{\text{range}} =$	6,00	up to	18,00	Nm	
						$n_{\text{given}} = 375 \text{ rpm}$	U = 18,00		V		
								cycles:		100	
MCSs	M_d [Nm]	Angle [°]	M_q [Nm]	$\Delta M_{q1/2}$ [Nm]	s [Nm]	C_m [1]	C_{mk} [1]	n [min ⁻¹]	Remarks		
1	9,60	360°	9,345	0,236	0,134	2,388	1,754	334	2017-05.021100	30%	
	1	9,60	30°		9,581	0,176	1,818	1,782			328
1	15,60	360°	15,554	0,124	0,212	2,453	2,381	332		2017-05.021100	80%
	1	15,60	30°		15,678	0,282	1,844	1,752			
1	18,00	360°	17,782	0,191	0,221	2,715	2,386	335	2017-05.021100		100%
	1	18,00	30°		17,973	0,275	2,182	2,149			
2	9,60	360°	9,467	0,198	0,142	2,254	1,941	329		2017-05.021095	30%
	2	9,60	30°		9,665	0,149	2,148	2,002			
2	15,60	360°	15,546	0,108	0,204	2,549	2,461	333	2017-05.021095		80%
	2	15,60	30°		15,654	0,276	1,884	1,819			
2	18,00	360°	17,961	0,001	0,240	2,500	2,446	333		2017-05.021095	100%
	2	18,00	30°		17,960	0,327	1,835	1,794			
3	9,60	360°	9,433	0,102	0,153	2,092	1,728	335	2017-05.021093		30%
	3	9,60	30°		9,535	0,153	2,092	1,950			
3	15,60	360°	15,423	0,194	0,164	3,171	2,811	336		2017-05.021093	80%
	3	15,60	30°		15,617	0,276	1,884	1,864			
3	18,00	360°	17,870	0,286	0,232	2,586	2,399	335	2017-05.021093		100%
	3	18,00	30°		18,156	0,321	1,869	1,707			

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

$C_{m \text{ min}} = 1,818$	$C_{m \text{ q}} = 2,237$	$C_{m \text{ max}} = 3,171$	$s_{cm} = 0,364$		$C_{m \text{ min}} =$	C_m - Minimum Value
$C_{mk \text{ min}} = 1,707$	$C_{mk \text{ q}} = 2,063$	$C_{mk \text{ max}} = 2,811$	$n_{MFU} = 18$		$C_{mk \text{ min}} =$	C_m - Minimum Value
Name: Mück	Project: 7021 : ASW 18-18 / PC		Stage of Development :		$C_{m \text{ q}} =$	C_m - Mid Value
	C. & E. FEIN GmbH Schwäbisch Gmünd		Series	$C_{mk \text{ q}} =$	C_m - Mid Value	
				$C_{m \text{ max}} =$	C_m - Maximum Value	
				$C_{mk \text{ max}} =$	C_m - Maximum Value	
				$s_{cm} =$	C_m - Standard deviation	
				$s_{cmk} =$	C_{mk} - Standard deviation	
				$n_{MCS} =$	No. of Machine Capability Study (MCS)	
				$C_{\text{correction}} =$	correction Value	

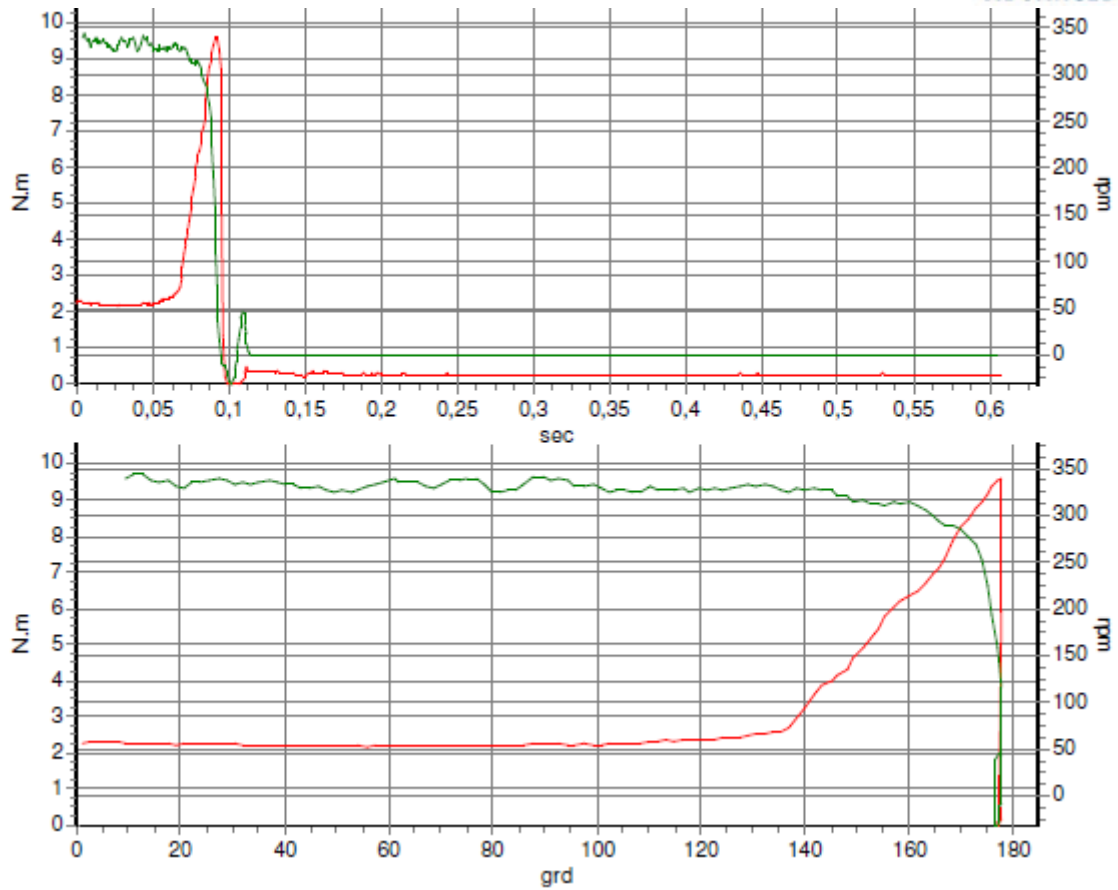


Illustration 1: 30° hard joint 9,6 Nm before load change machine T7021-05.021100

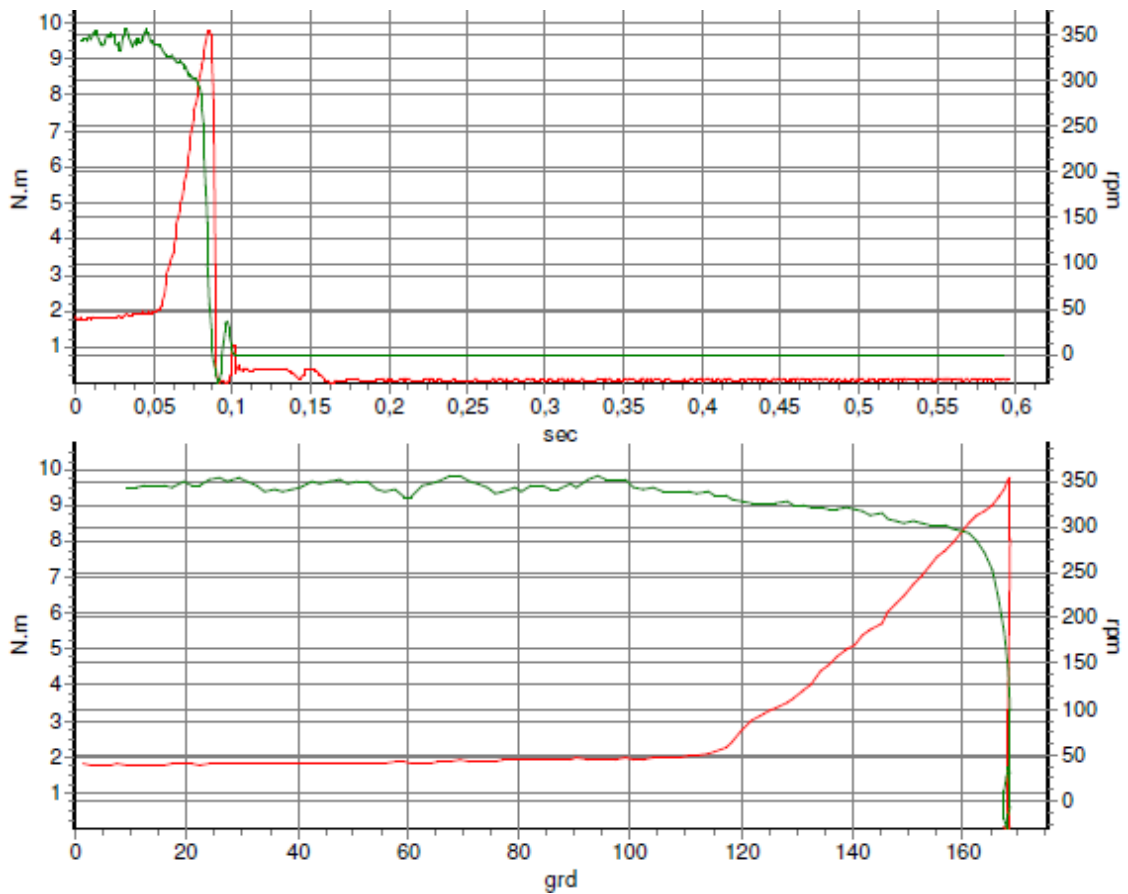


Illustration 2: 30° hard joint 9,6 Nm after load change machine T7021-05.021100

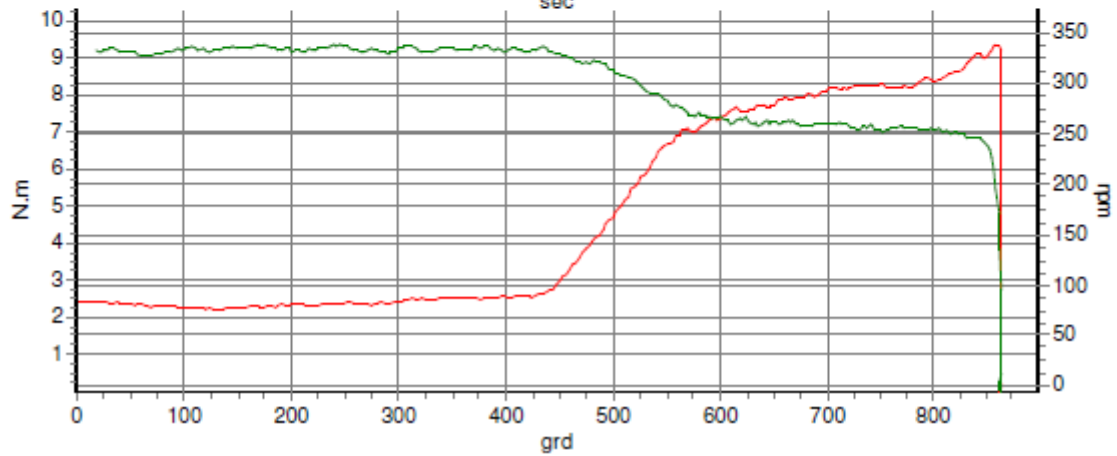
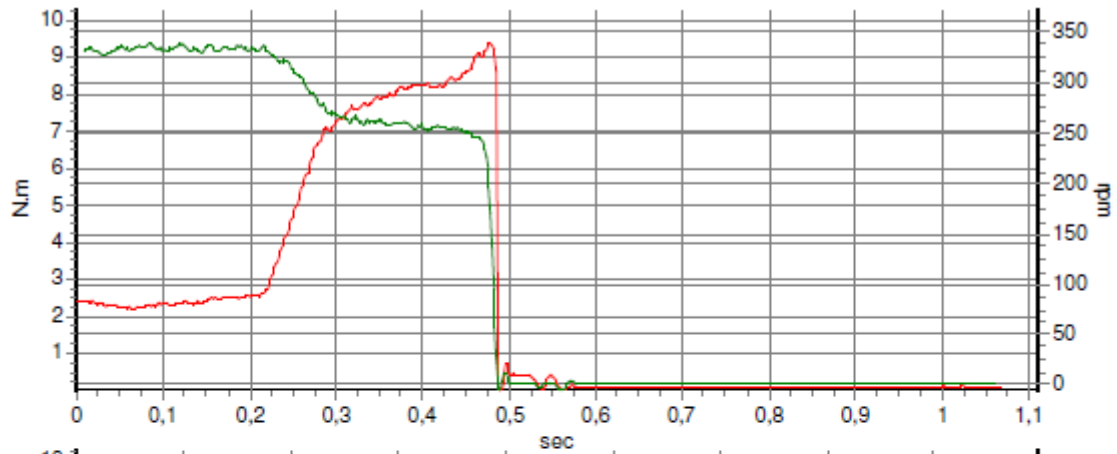


Illustration 3: 360° soft joint 9,6 Nm before load change machine T7021-05.021100

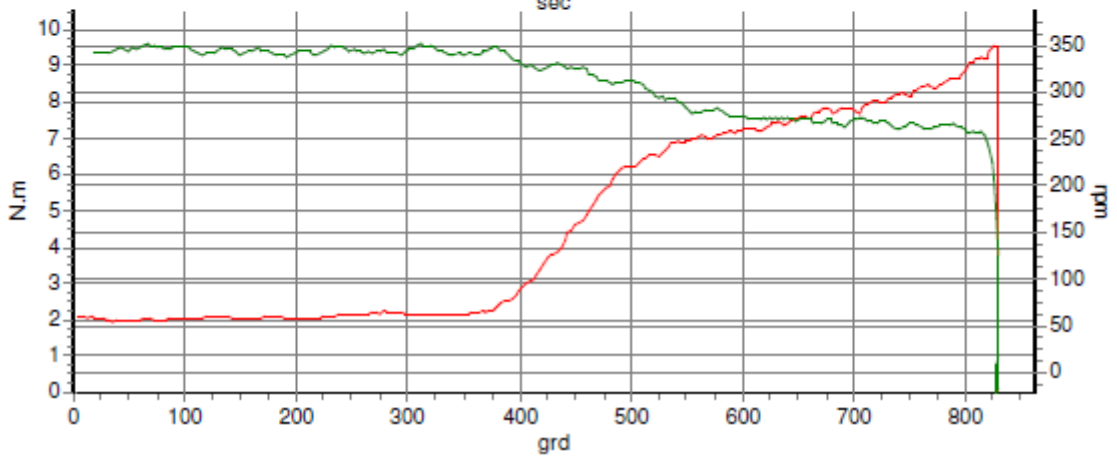
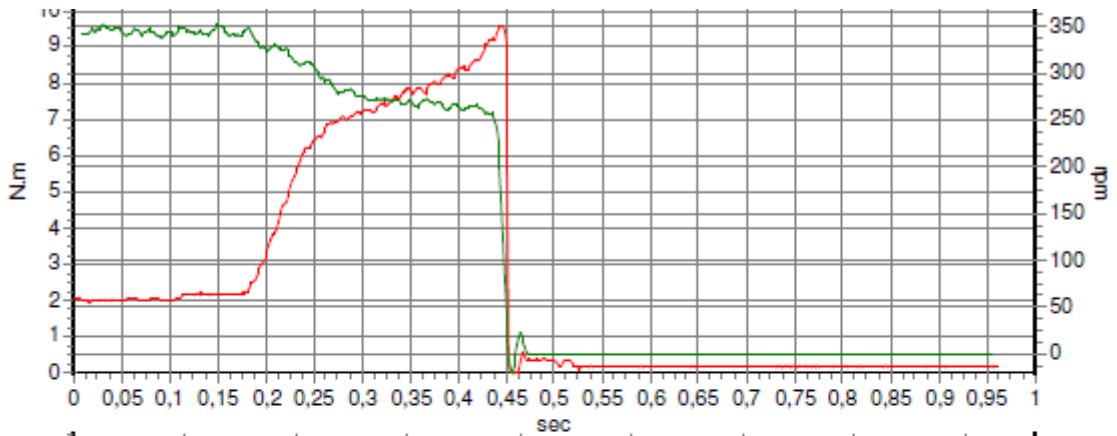


Illustration 4: 360° soft joint 9,6 Nm after Load change Machine T7021-05.021100

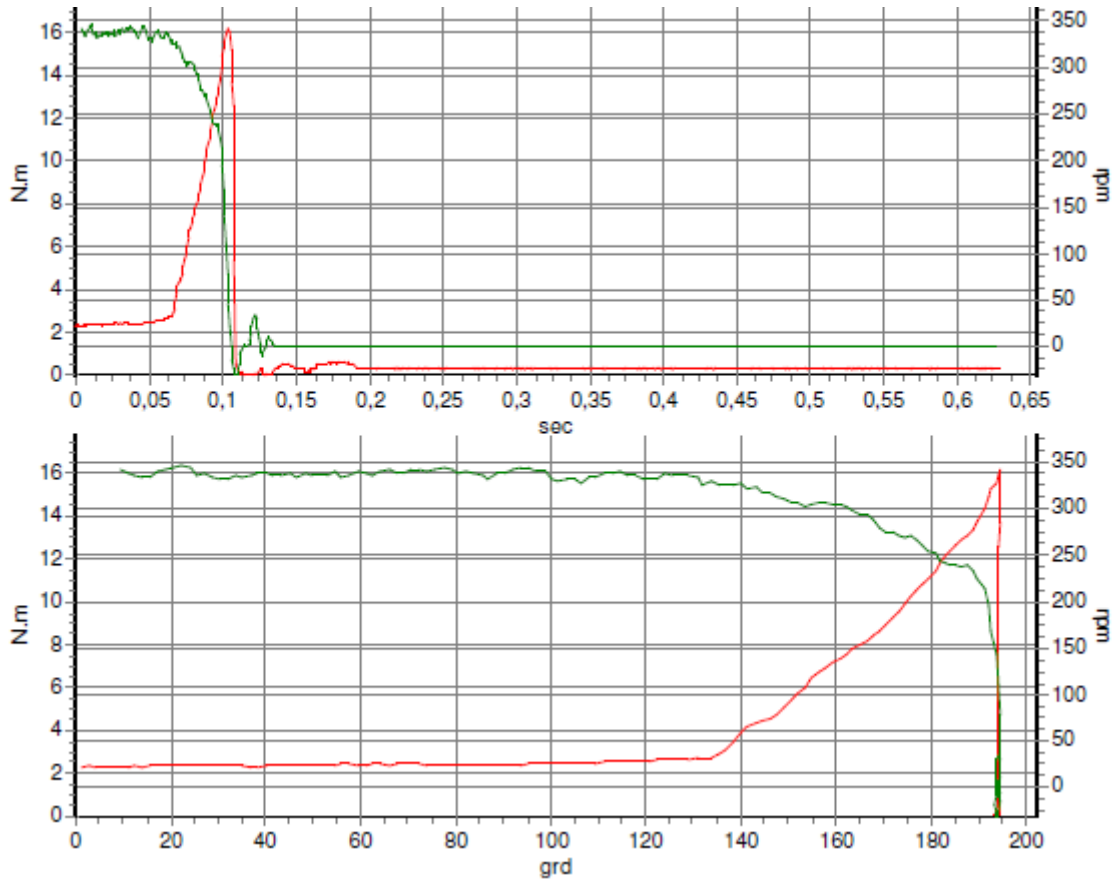


Illustration 5: 30° hard joint 15,6 Nm before Load change Machine T7021-05.021100

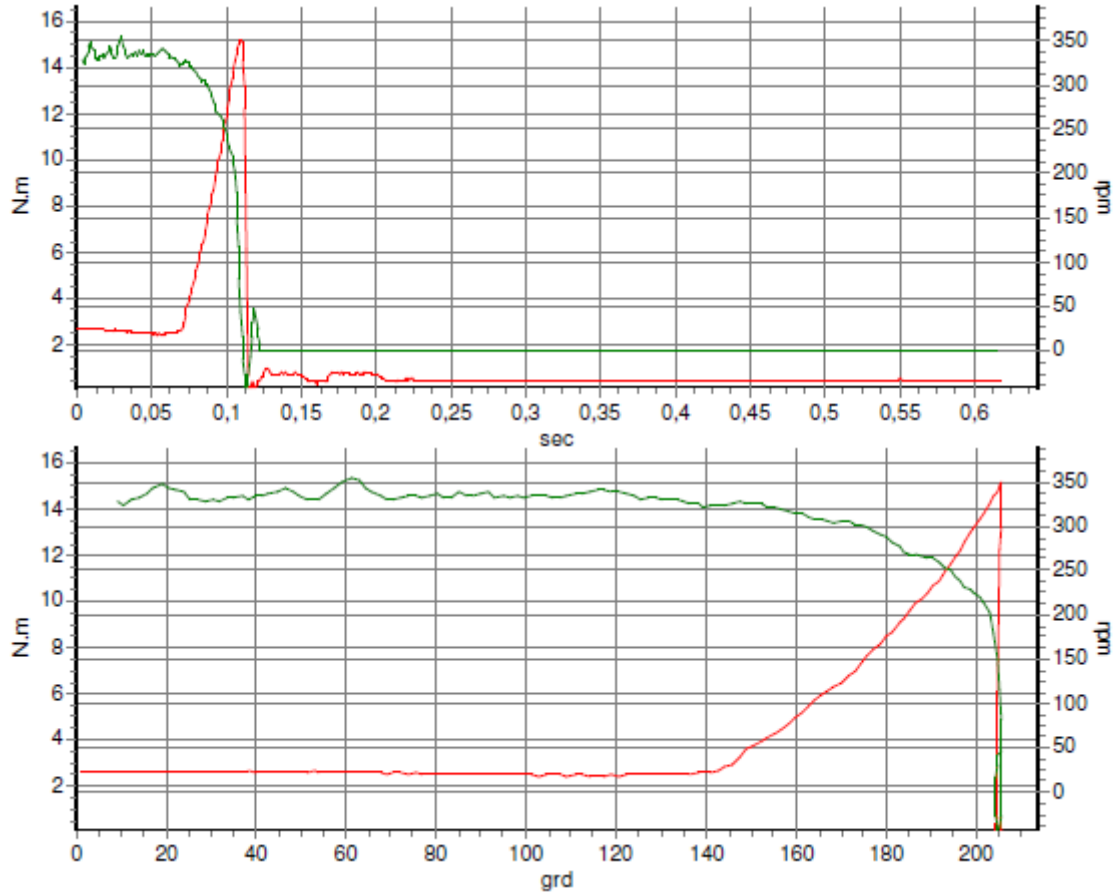


Illustration 6: 30° hard joint 15,6 Nm after Load change Machine T7021-05.021100

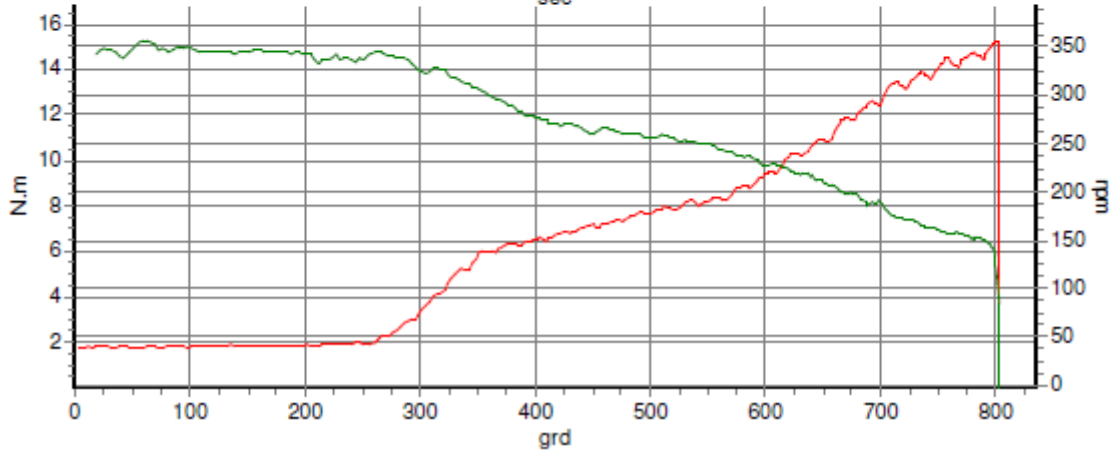
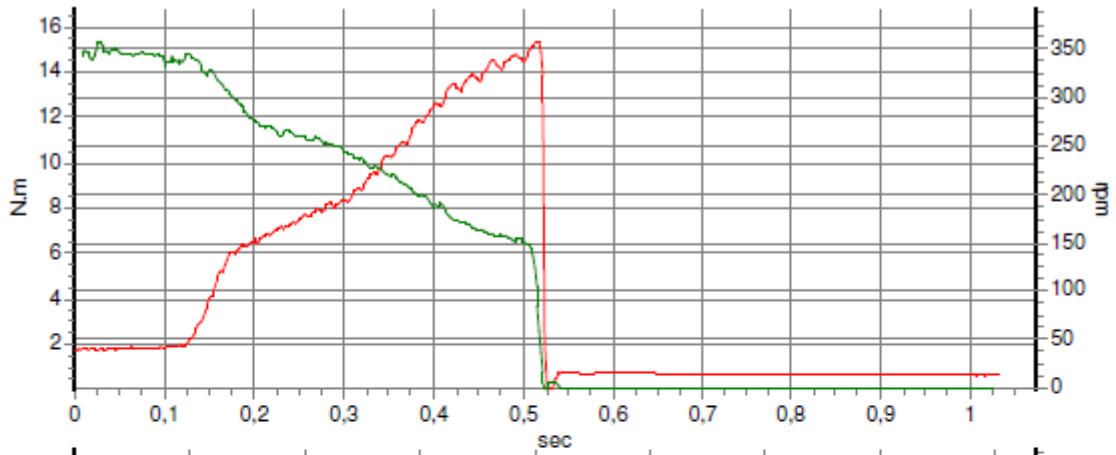


Illustration 7: 360° soft joint 15,6 Nm before Load change Machine T7021-05.021100

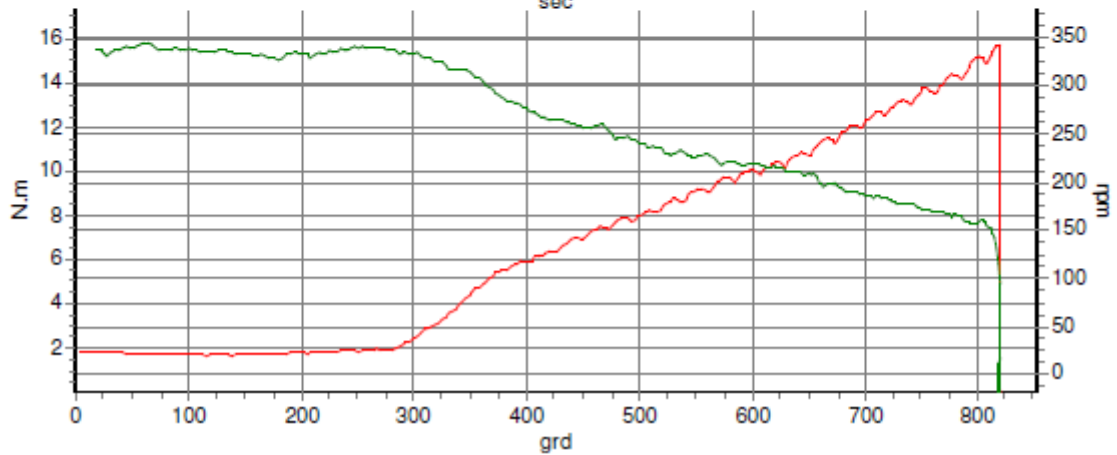
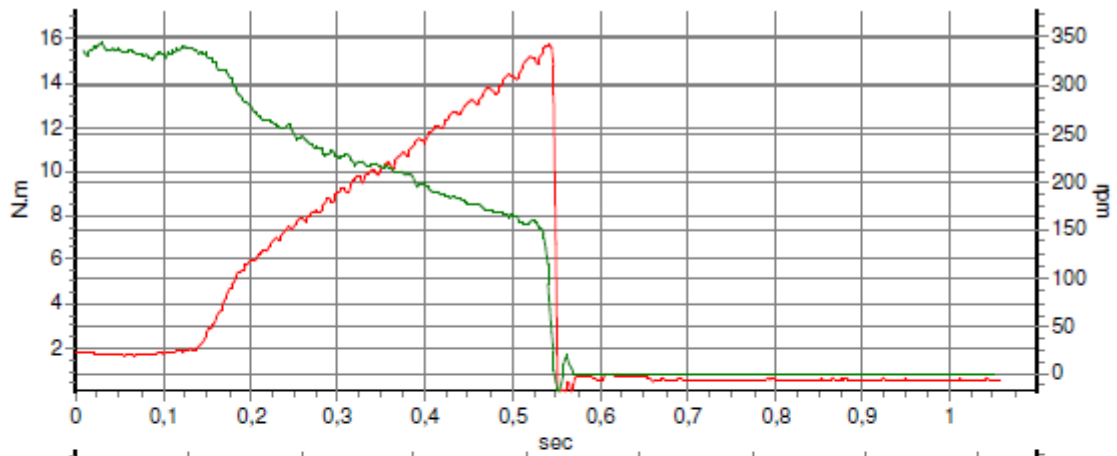


Illustration 8: 360° soft joint 15,6 Nm after Load change Machine T7021-05.021100

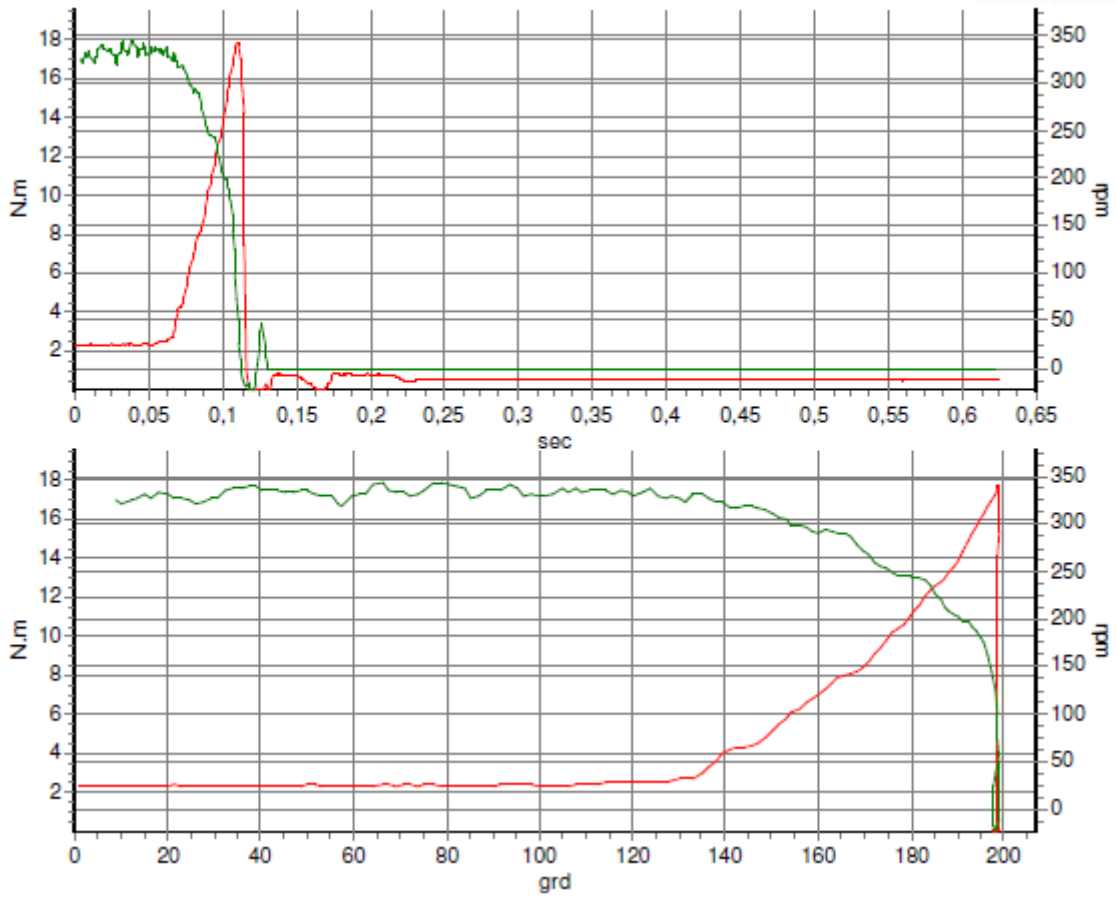


Illustration 9: 30° hard joint 18,0 Nm before Load change Machine T7021-05.021100

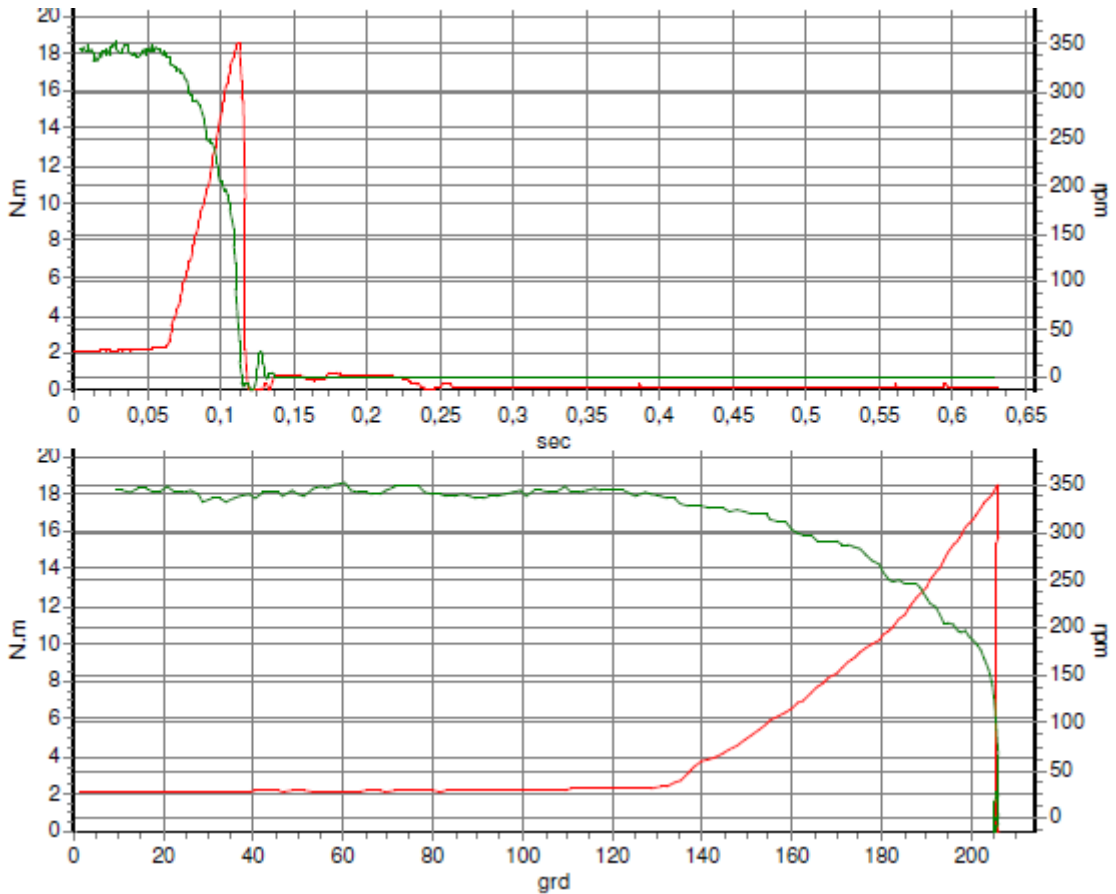


Illustration 10: 30° hard joint 18,0 Nm after Load change Machine T7021-05.021100

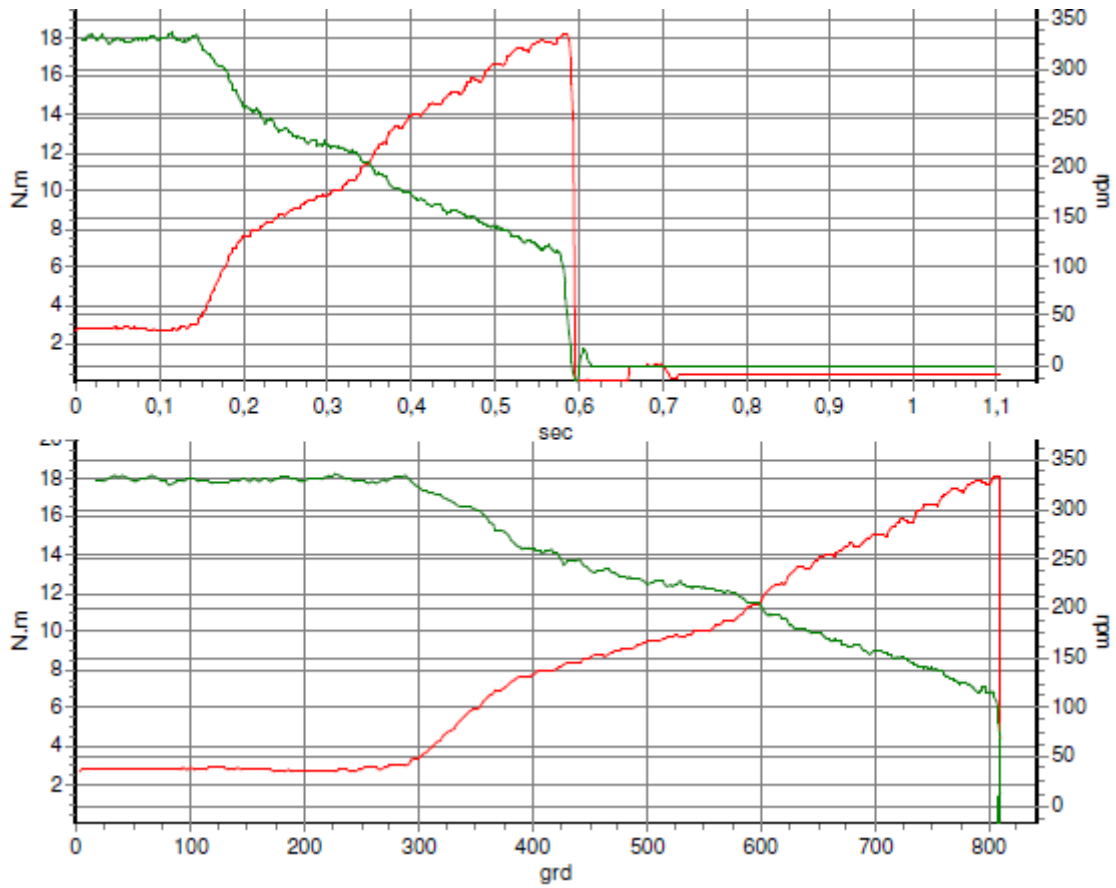


Illustration 11: 360° soft joint 18,0 Nm before Load change Machine T7021-05.021100

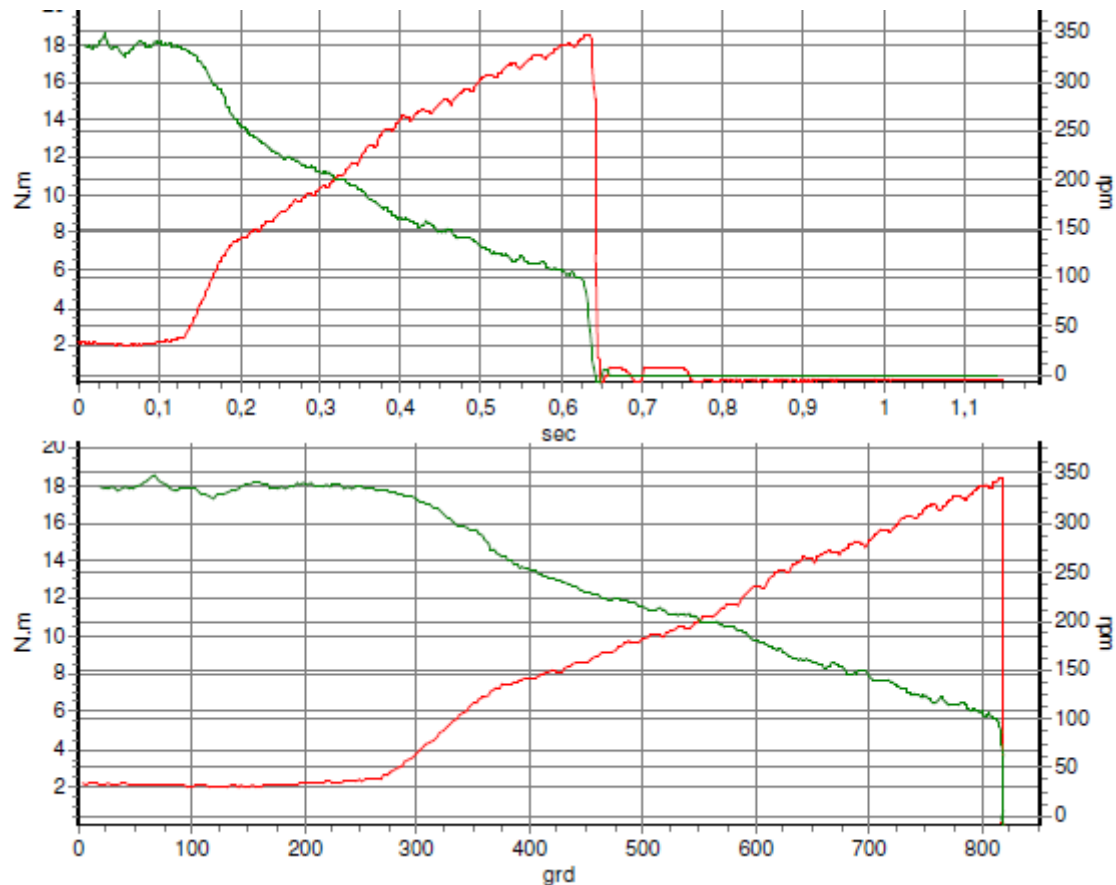


Illustration 12: 360° soft joint 18,0 Nm after load change machine T7021-05.021100

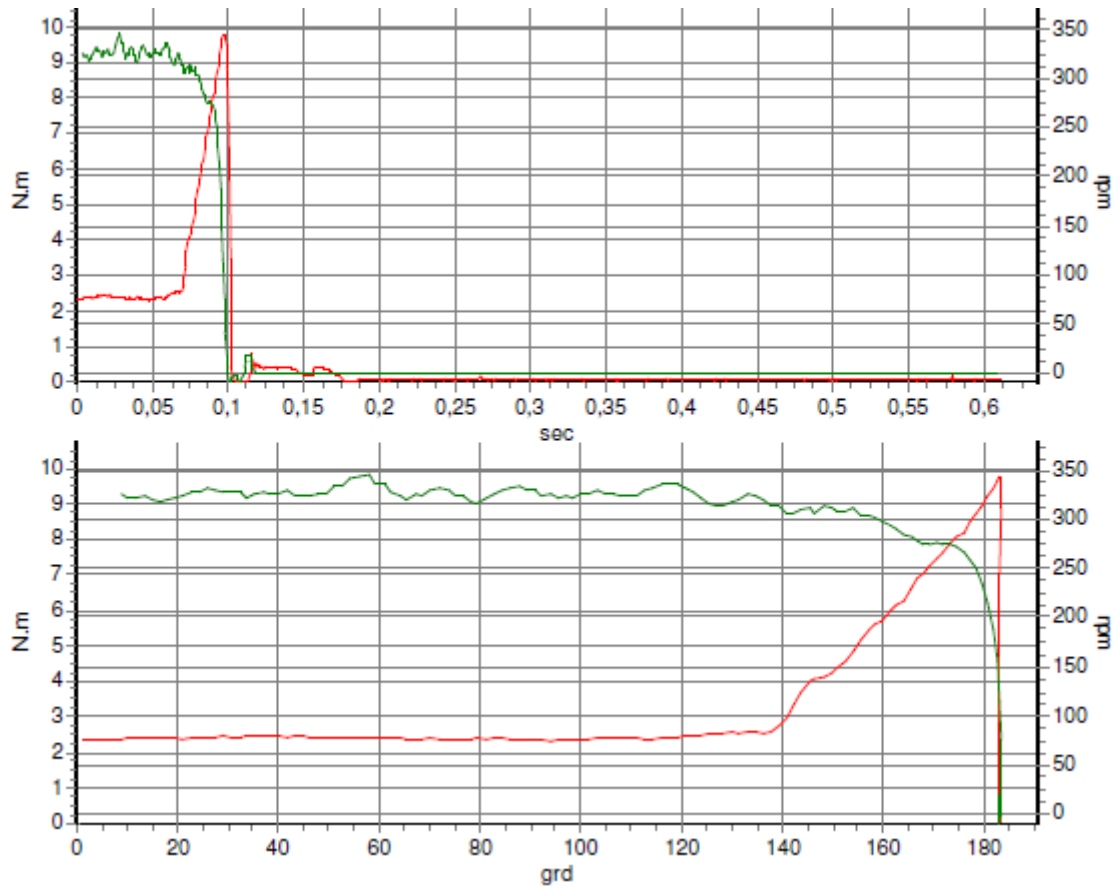


Illustration 13: 30° hard joint 9,6 Nm before load change machine T7021-05.021095

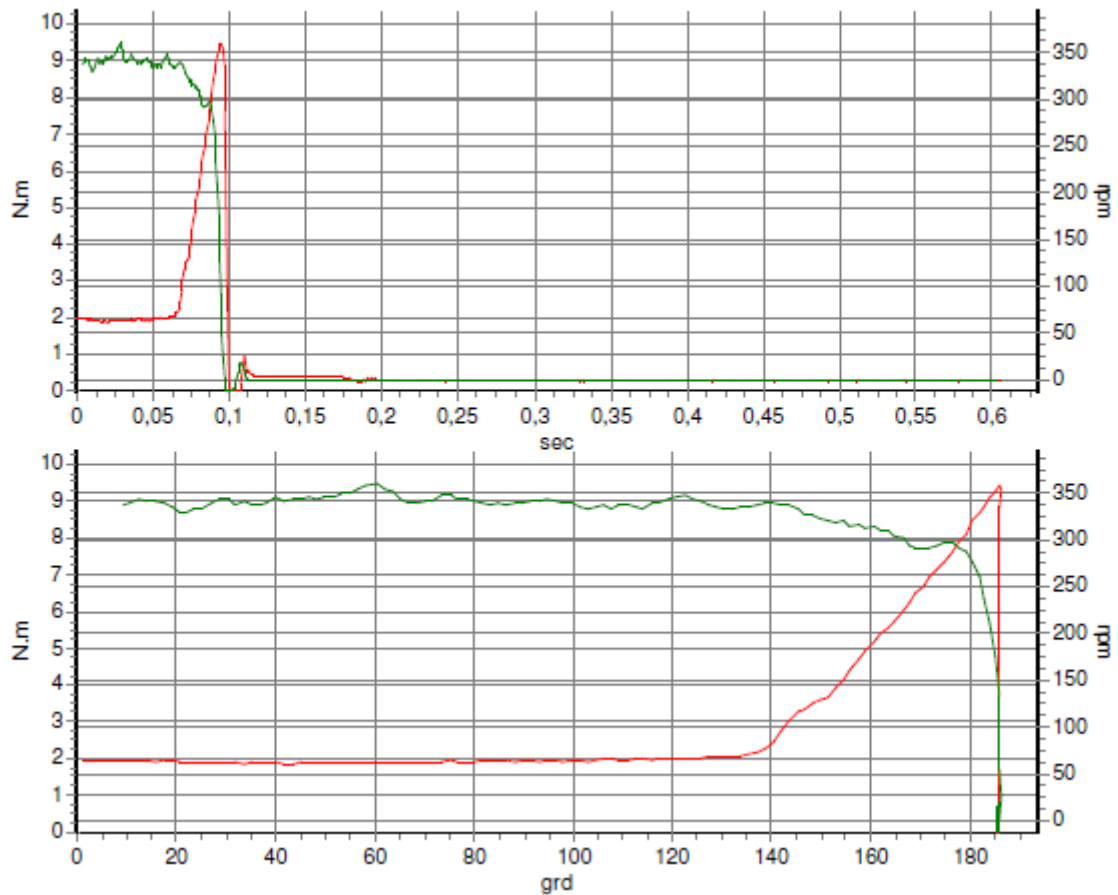


Illustration 14: 30° hard joint 9,6 Nm after load change machine T7021-05.021095

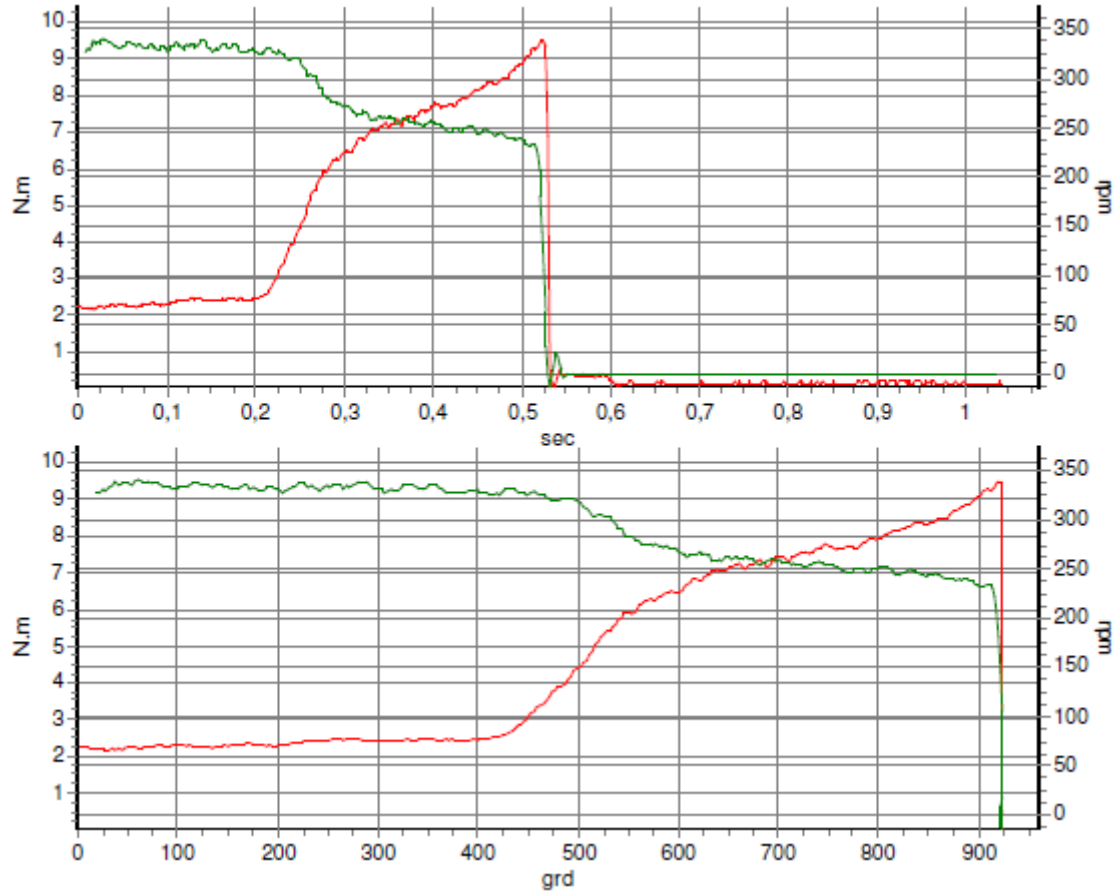


Illustration 15: 360° soft joint 9,6 Nm before load change machine T7021-05.021095

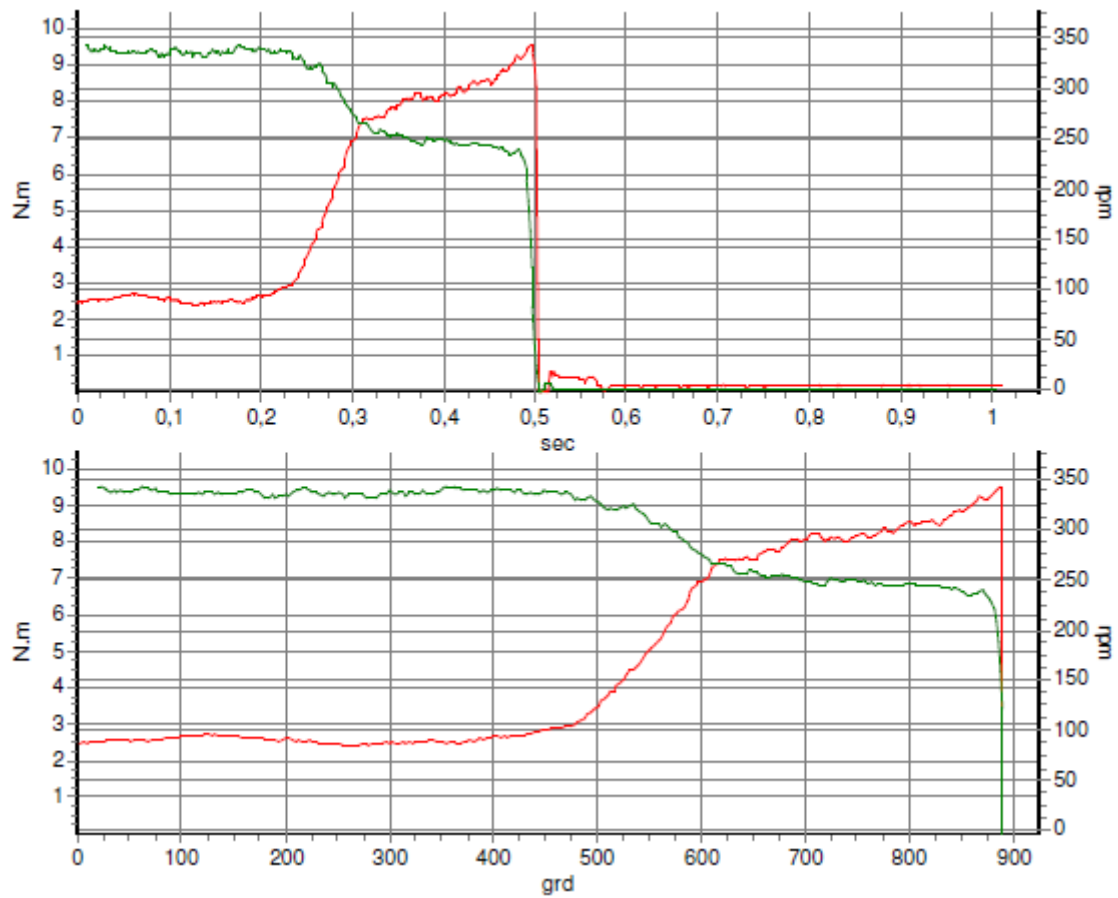


Illustration 16: 360° soft joint 9,6 Nm after load change machine T7021-05.021095

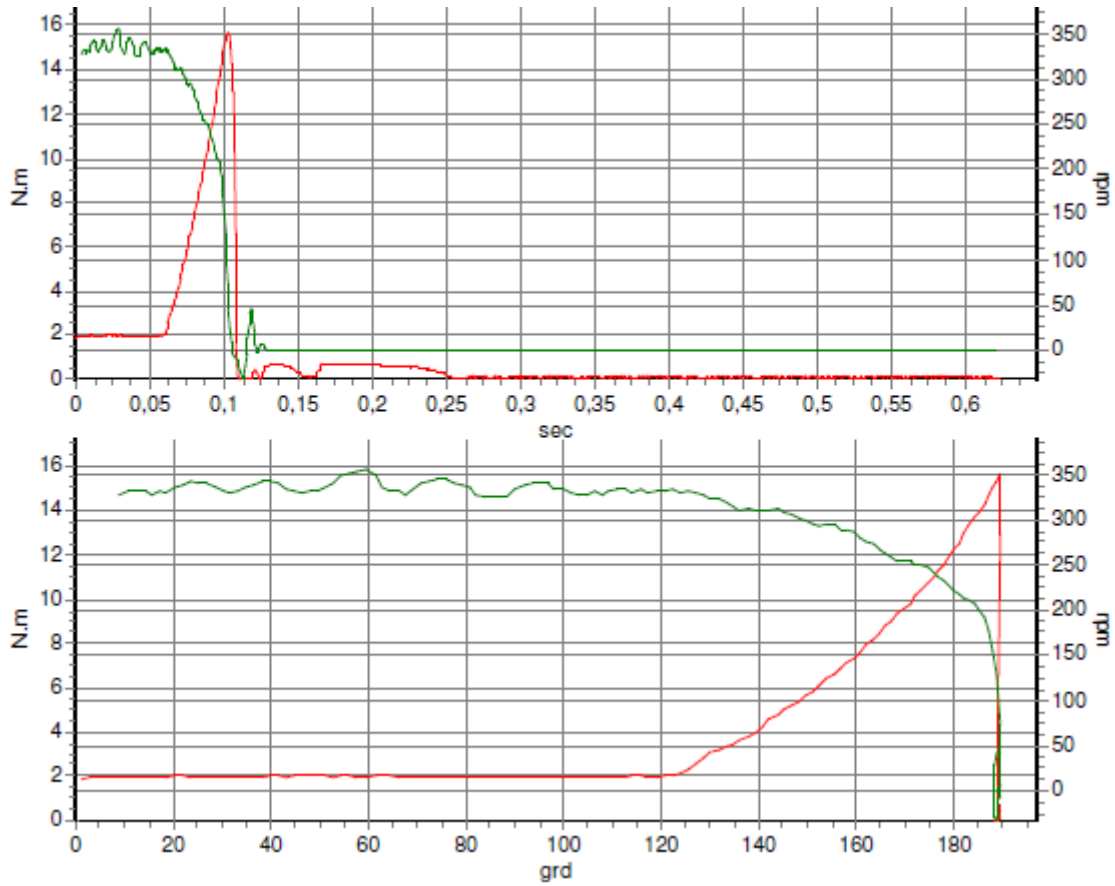


Illustration 17: 30° hard joint 15,6 Nm before load change machine T7021-05.021095

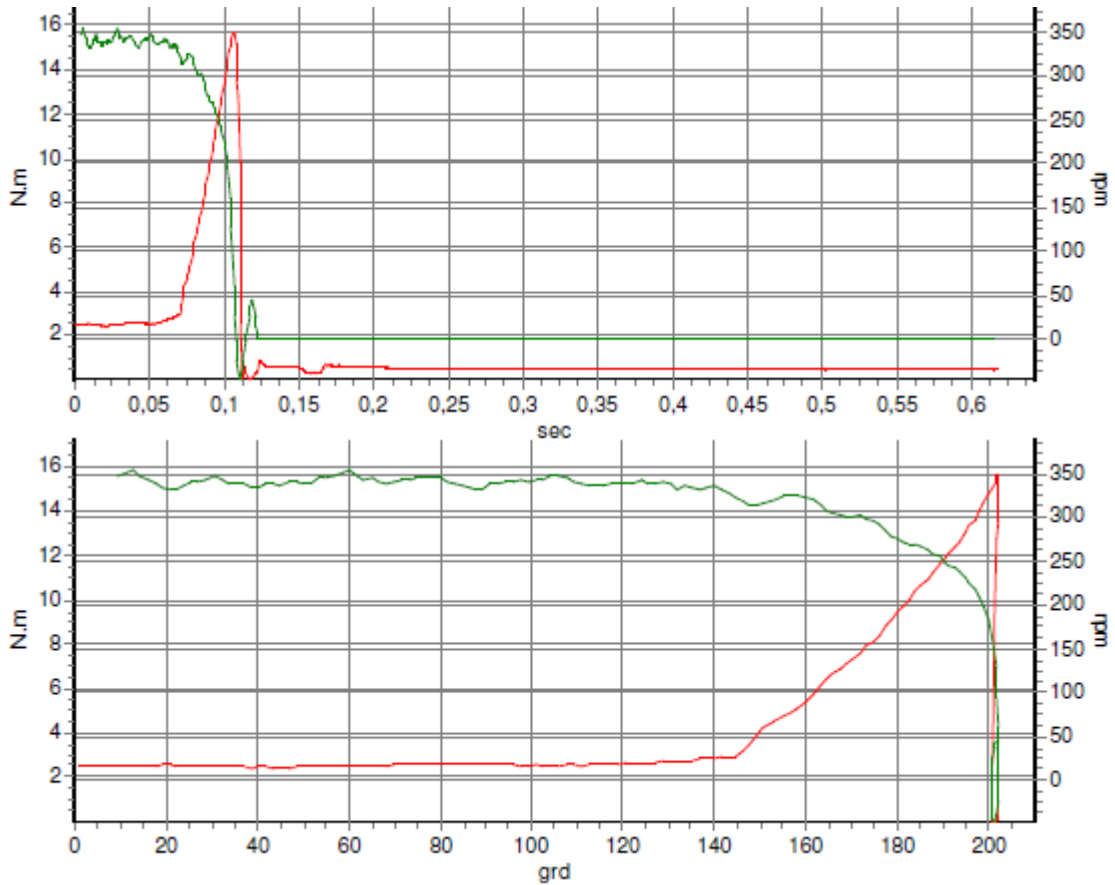


Illustration 18: 30° hard joint 15,6 Nm after load change machine T7021-05.021095

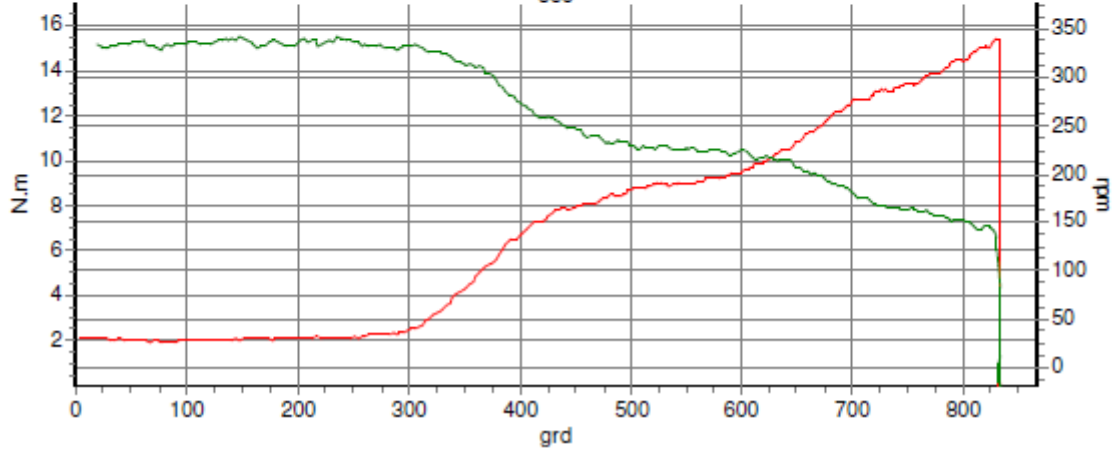
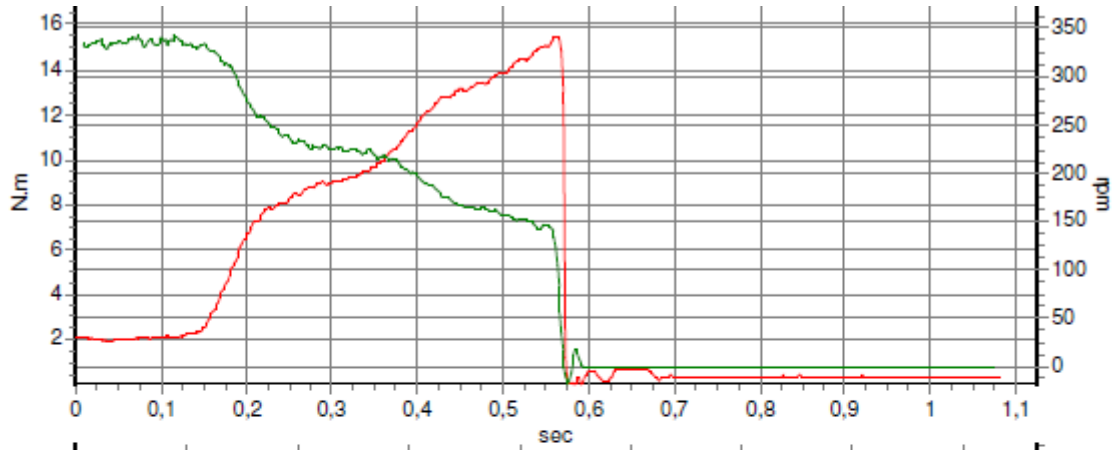


Illustration 19: 360° soft joint 15,6 Nm before load change machine T7021-05.021095

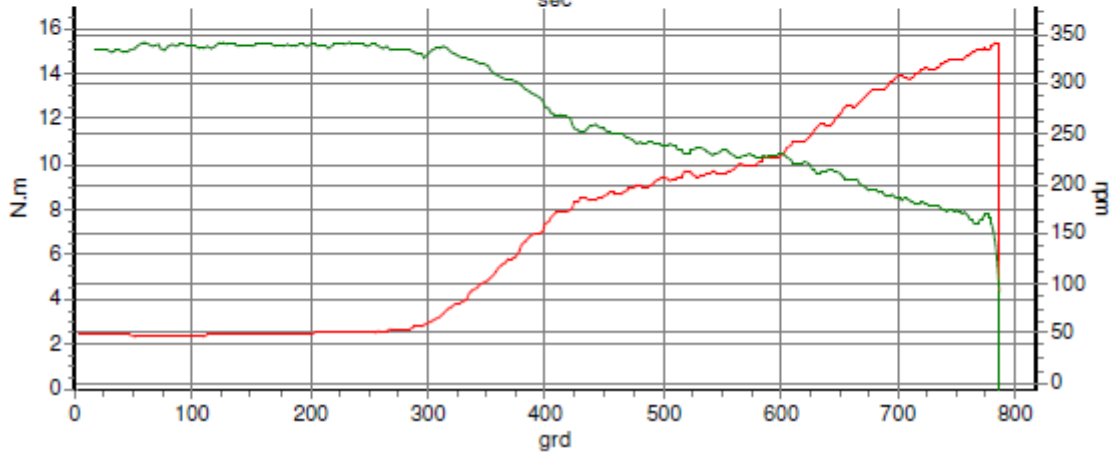
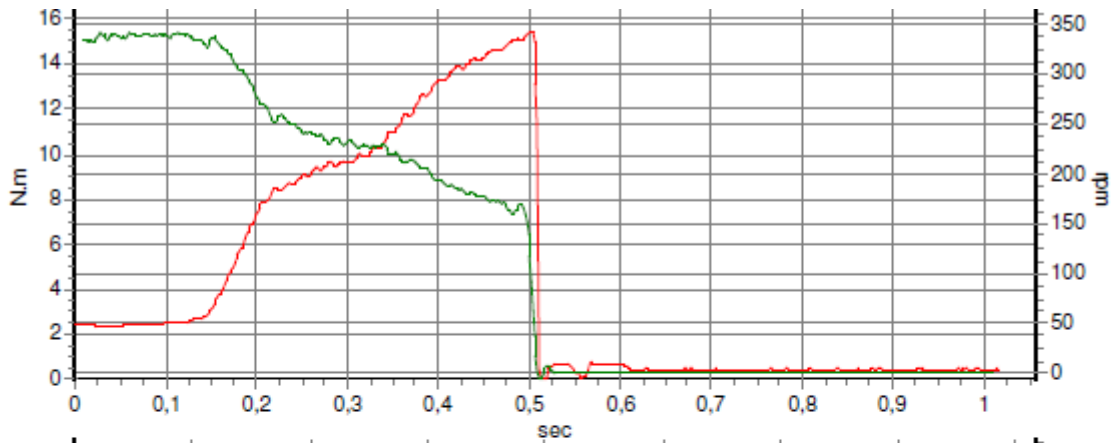


Illustration 20: 360° soft joint 15,6 Nm after load change machine T7021-05.021095

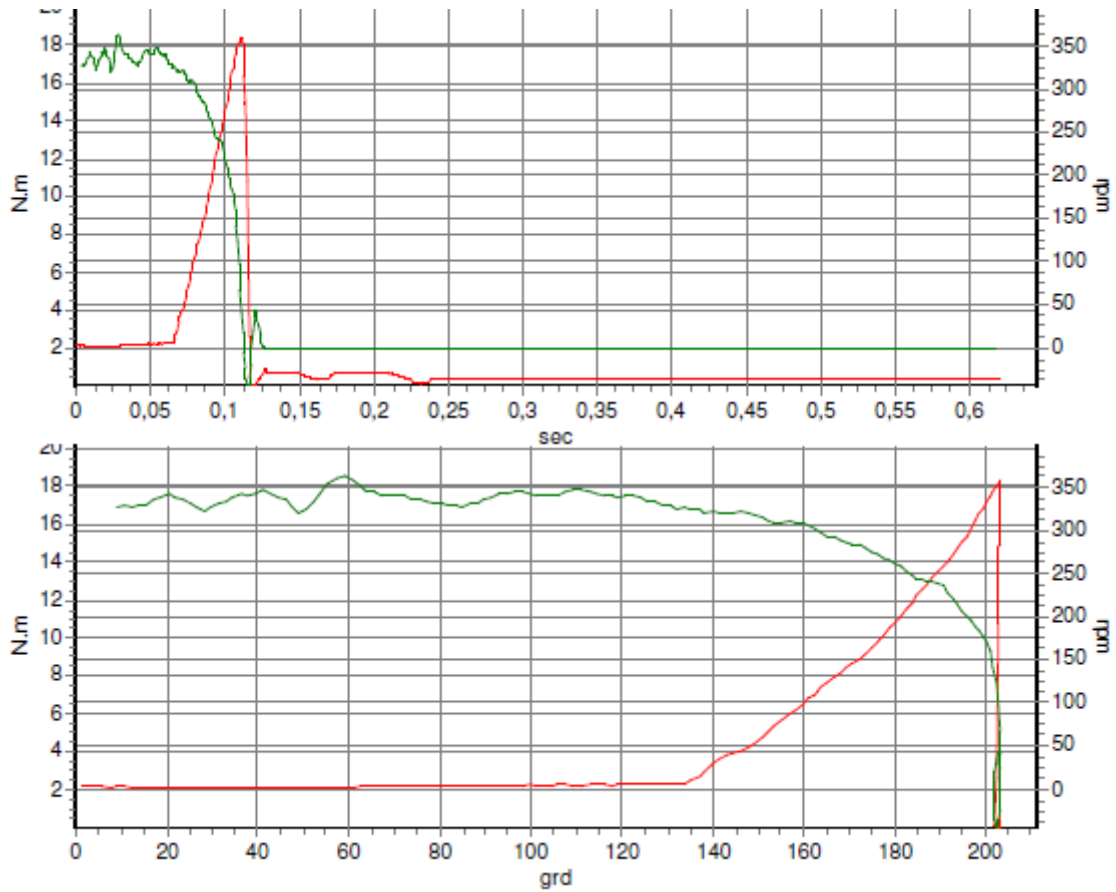


Illustration 21: 30° hard joint 18,0 Nm before load change machine T7021-05.021095

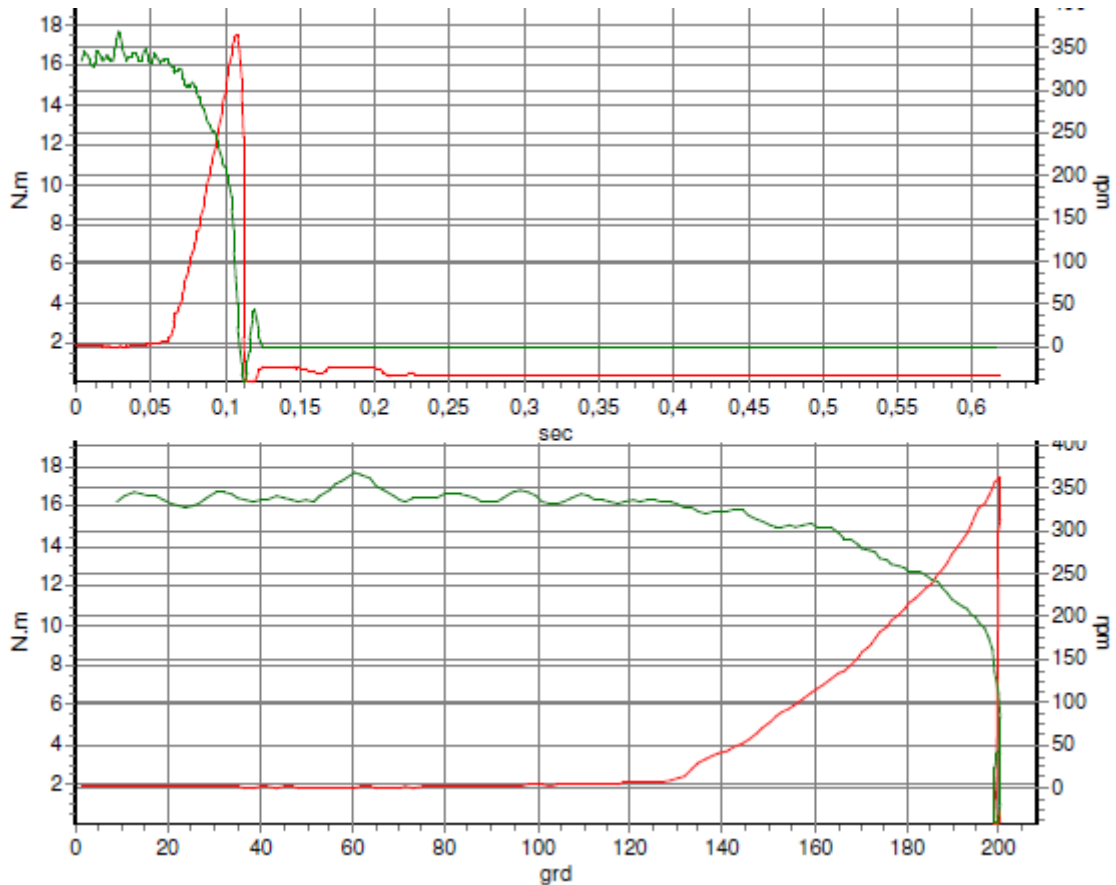


Illustration 22: 30° hard joint 18,0 Nm after load change machine T7021-05.021095

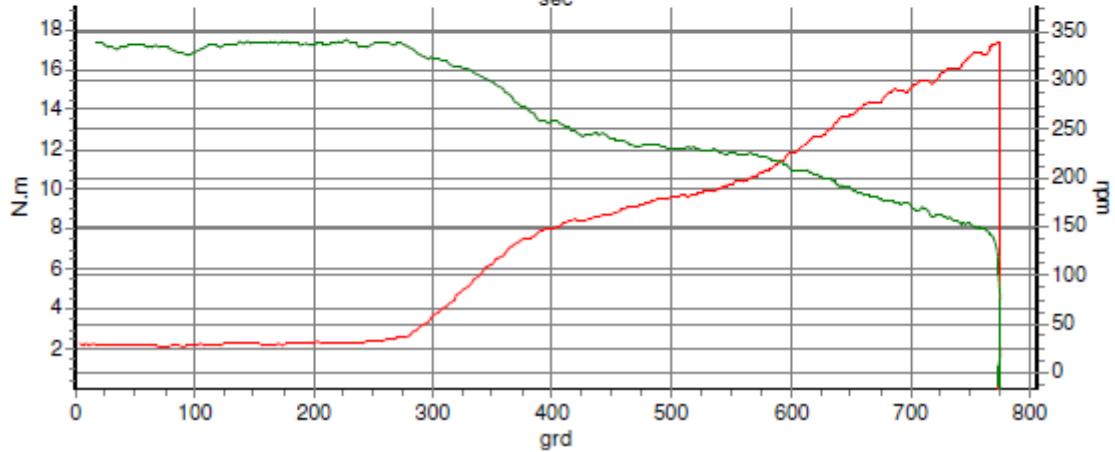
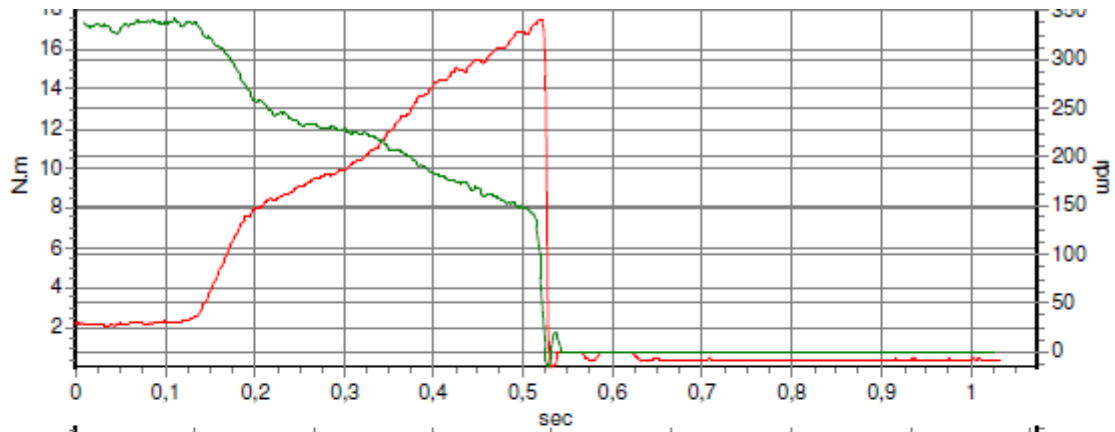


Illustration 23: 360° soft joint 18,0 Nm before load change machine T7021-05.021095

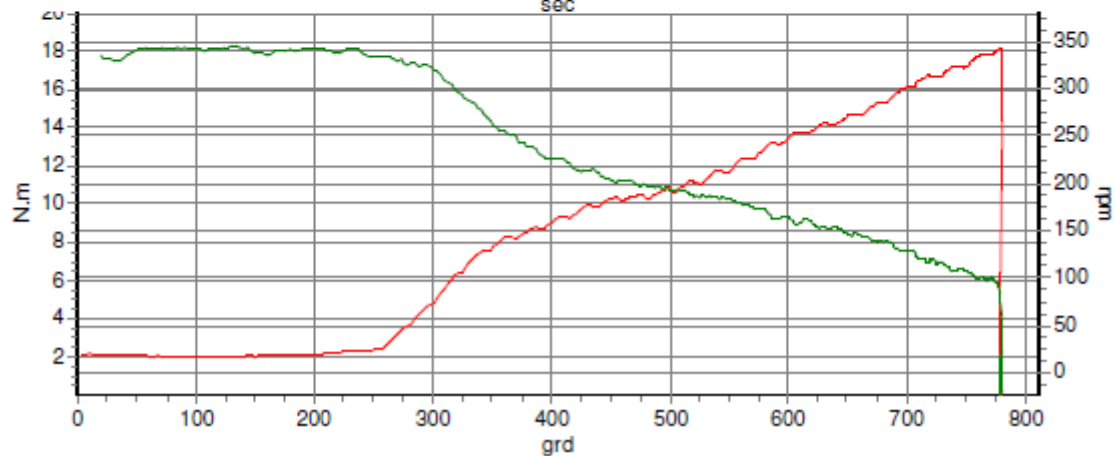
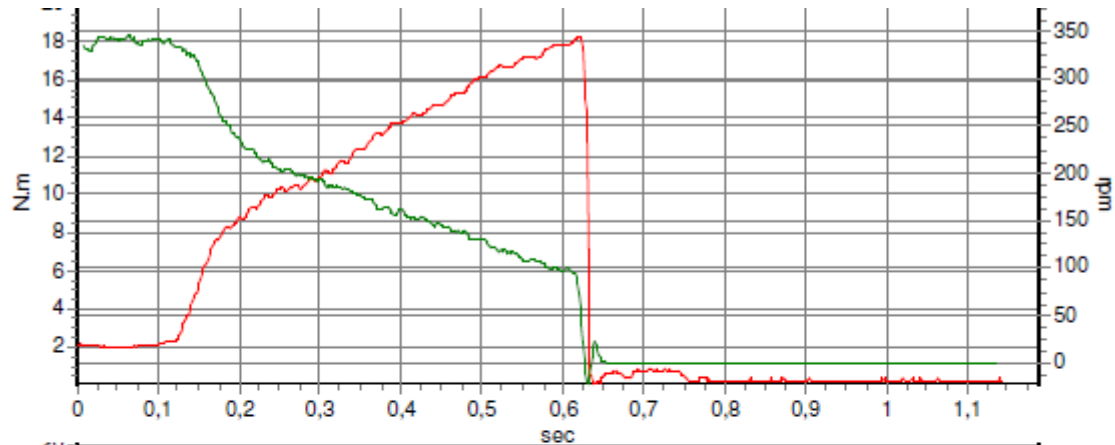


Illustration 24: 360° soft joint 18,0 Nm after load change machine T7021-05.021095

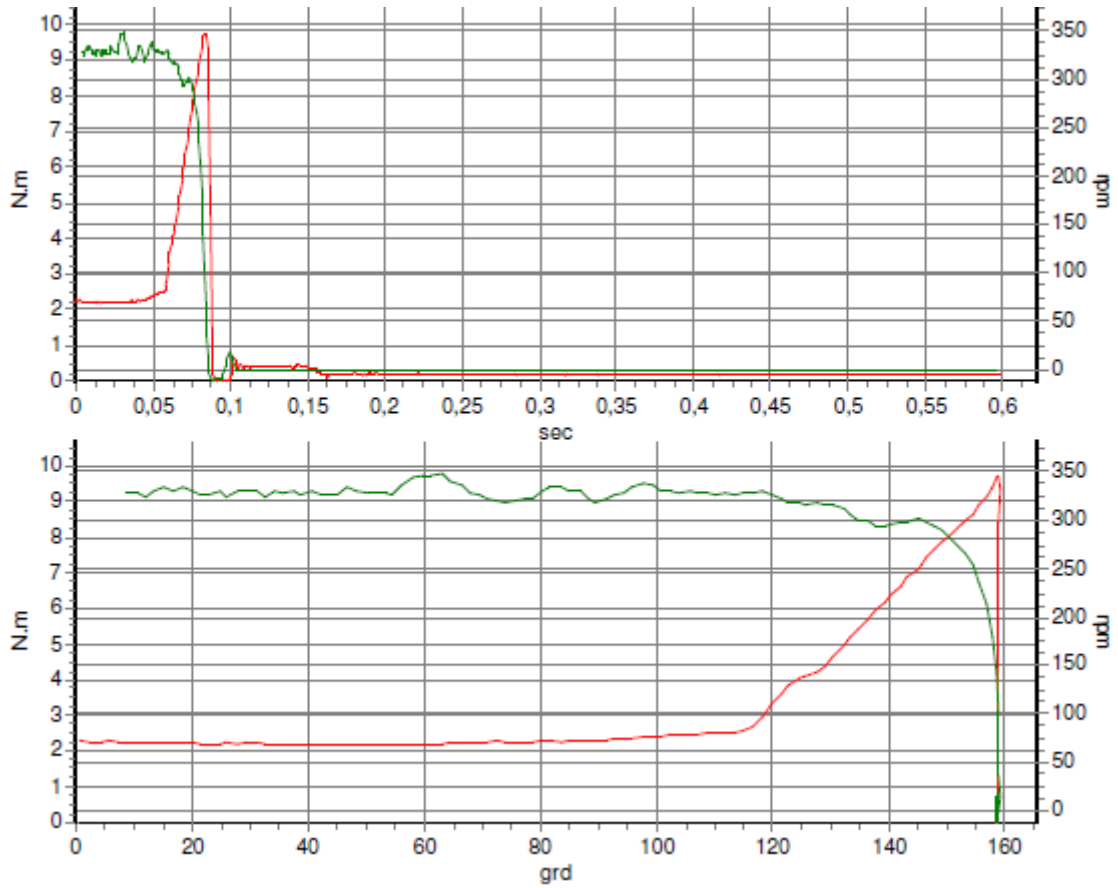


Illustration 25: 30° hard joint 9,6 Nm before load change machine T7021-05.021093

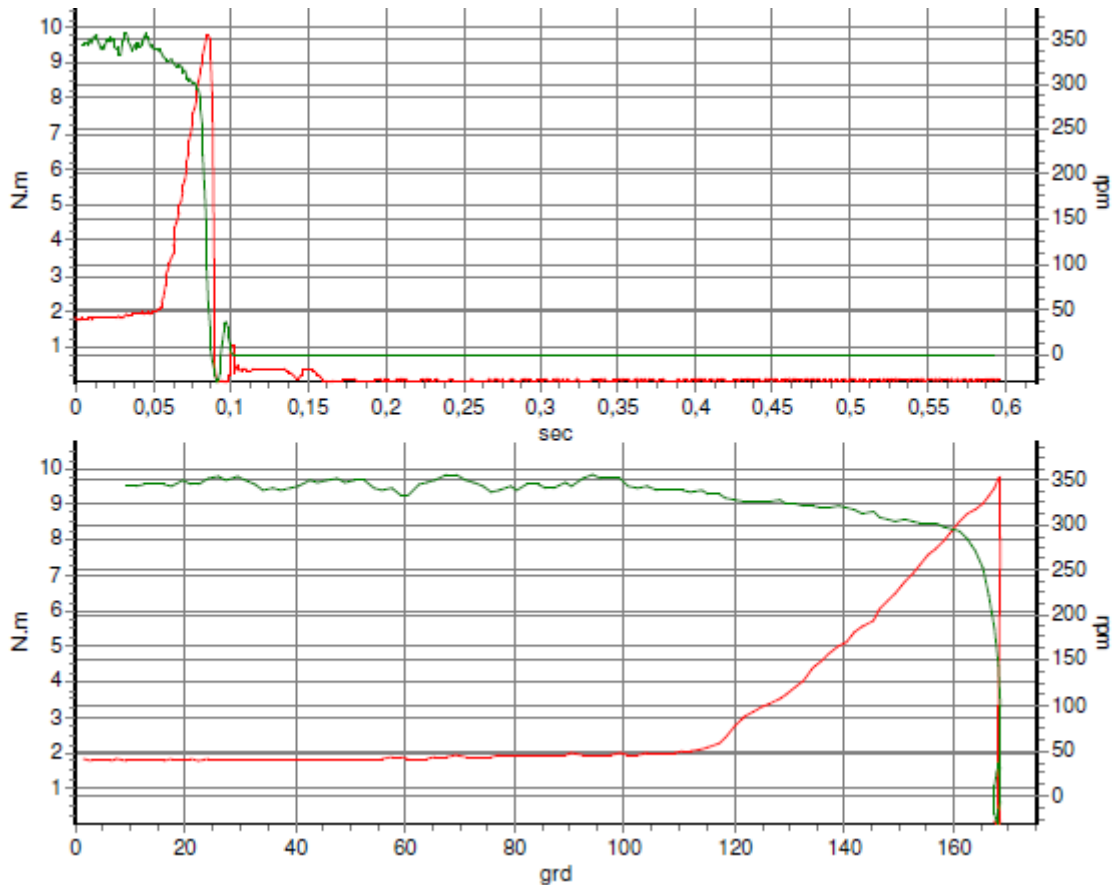


Illustration 26: 30° hard joint 9,6 Nm after load change machine T7021-05.021093

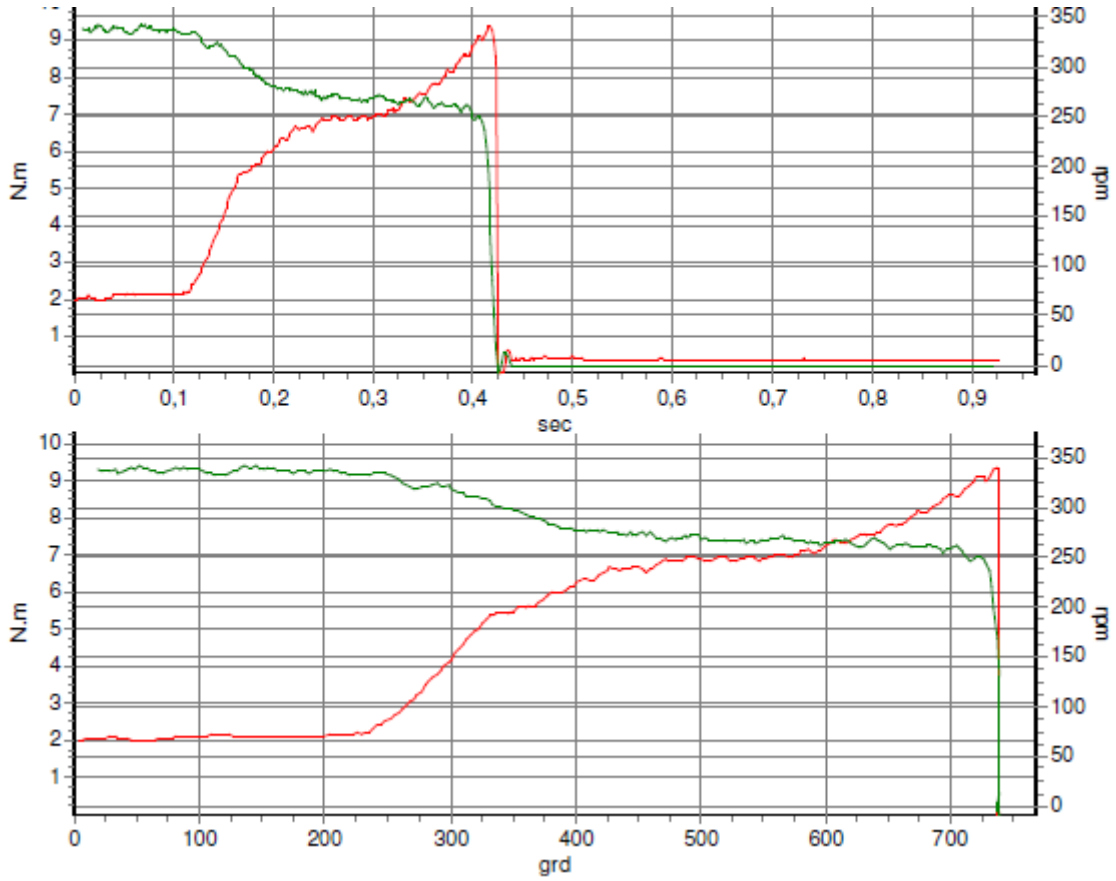


Illustration 27: 360° soft joint 9,6 Nm before load change machine T7021-05.021093

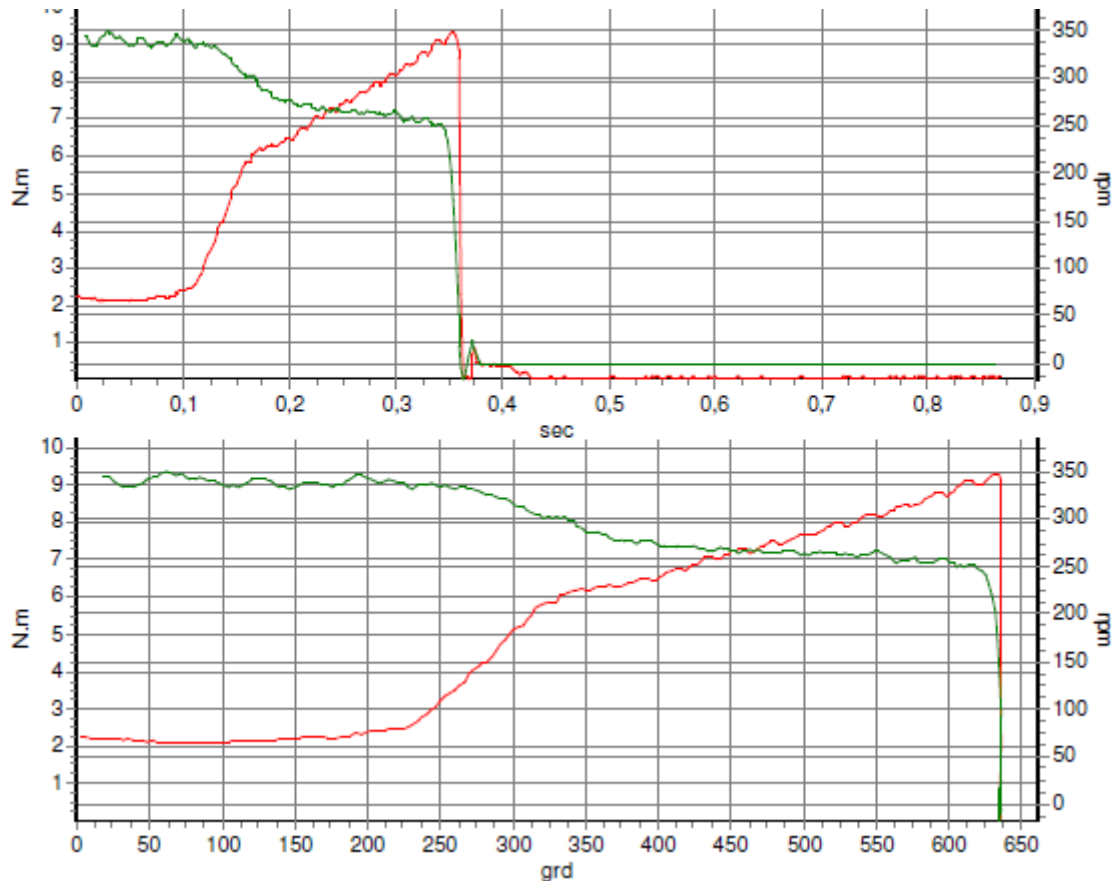


Illustration 28: 360° soft joint 9,6 Nm after load change machine T7021-05.021093

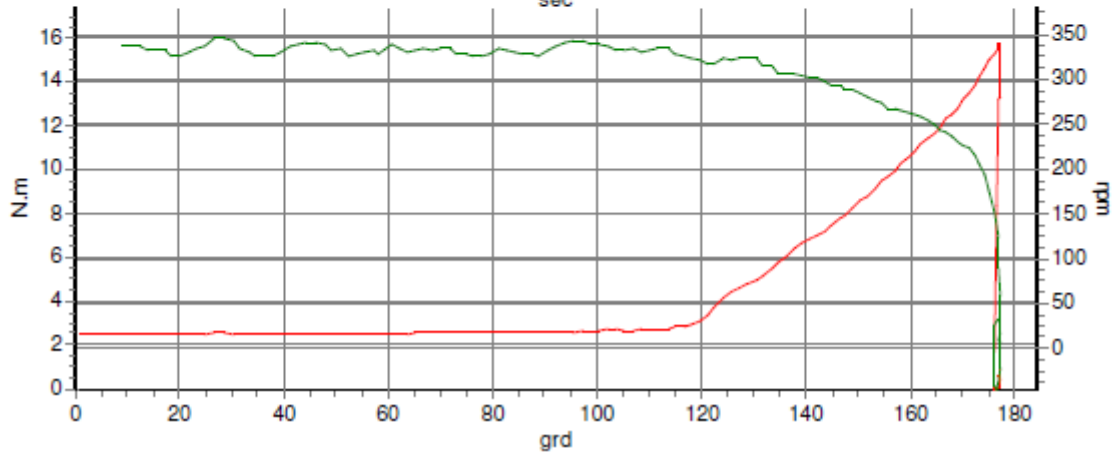
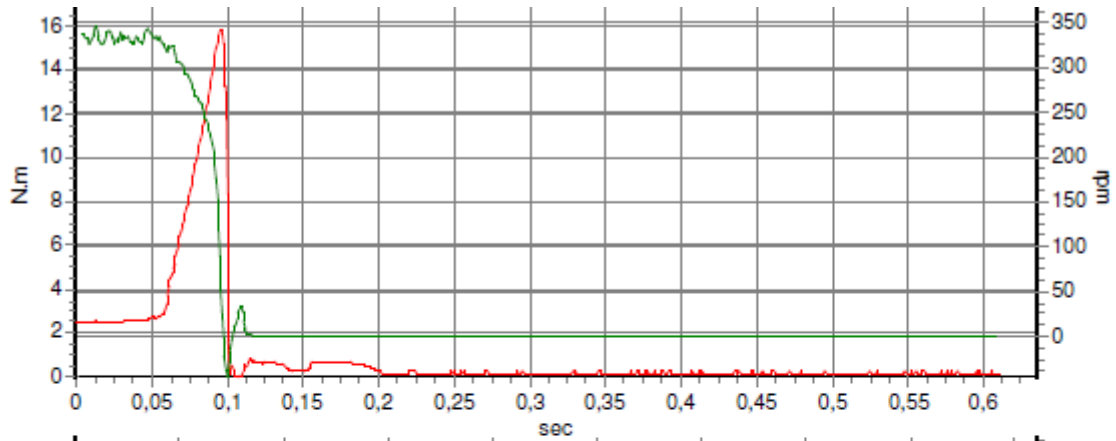


Illustration 29: 30° hard joint 15,6 Nm before load change machine T7021-05.021093

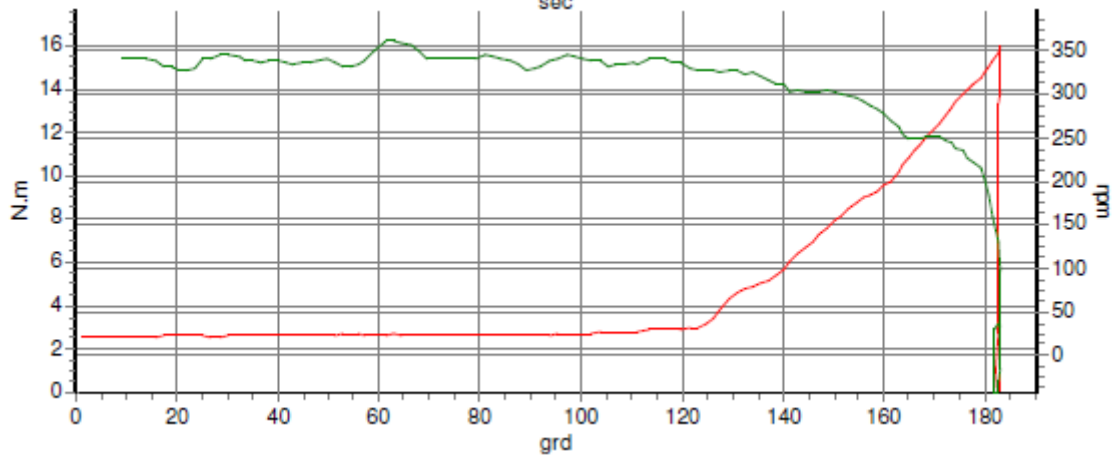
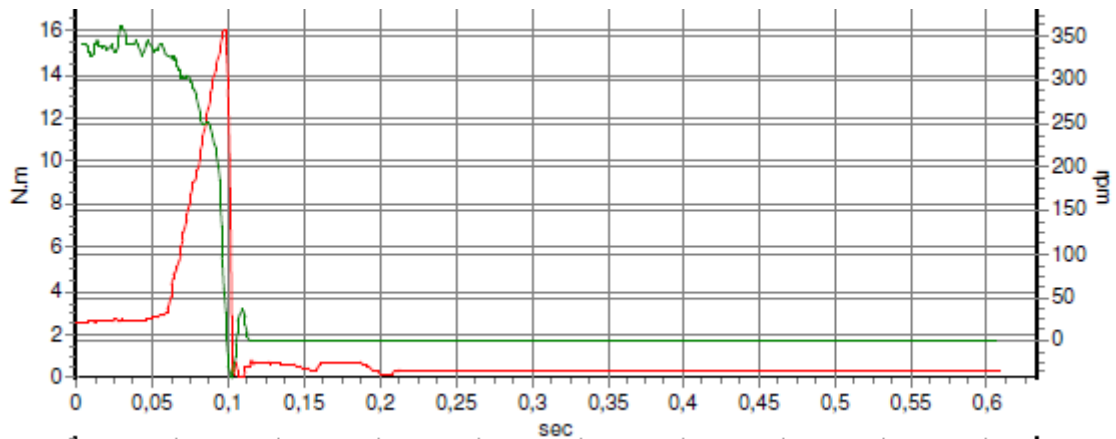


Illustration 30: 30° hard joint 15,6 Nm after load change machine T7021-05.021093

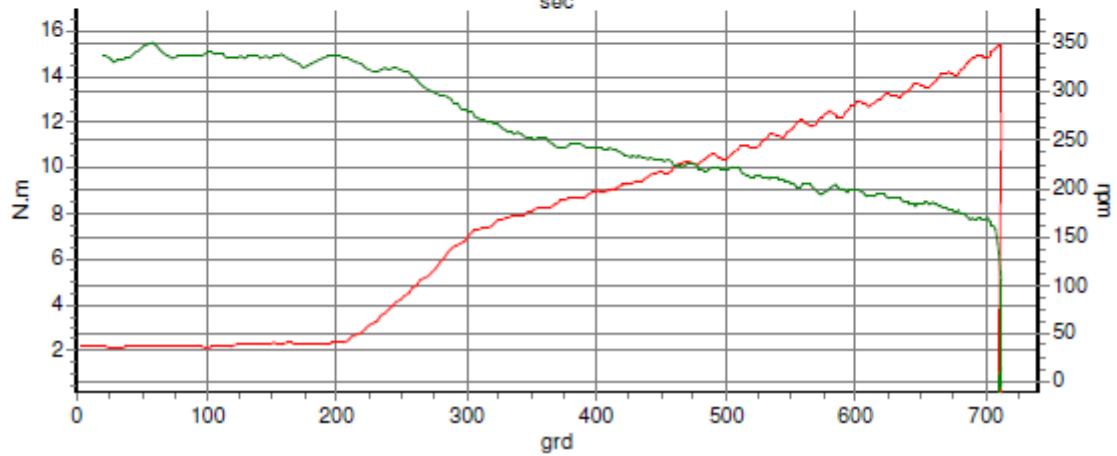
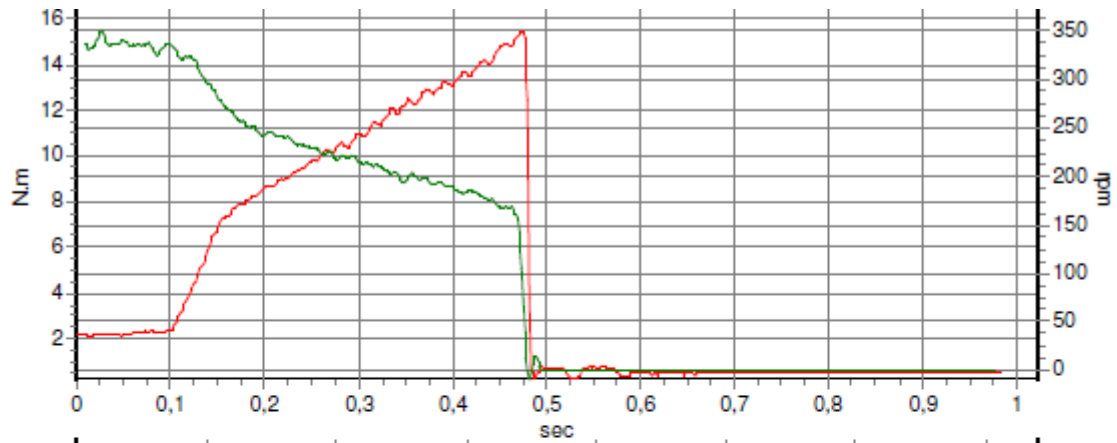


Illustration 31: 360° soft joint 15,6 Nm before load change machine T7021-05.021093

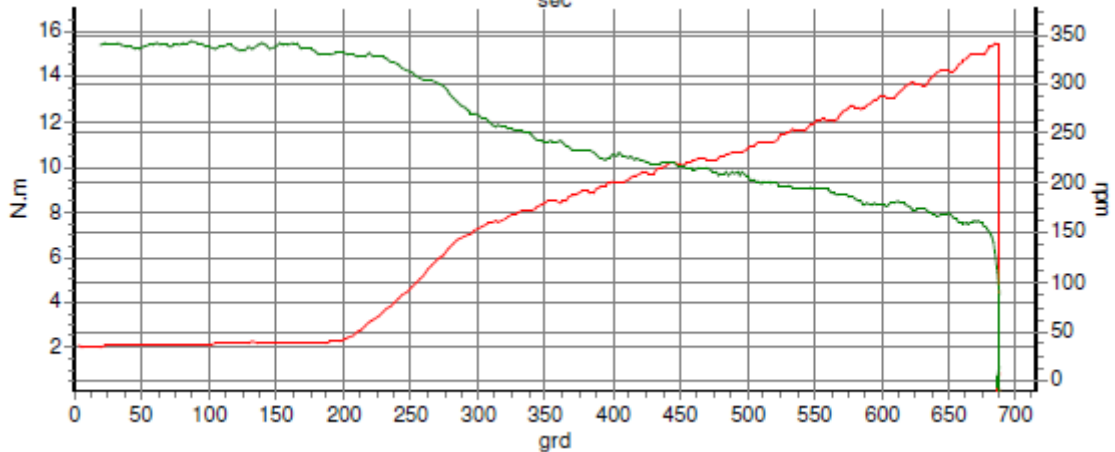
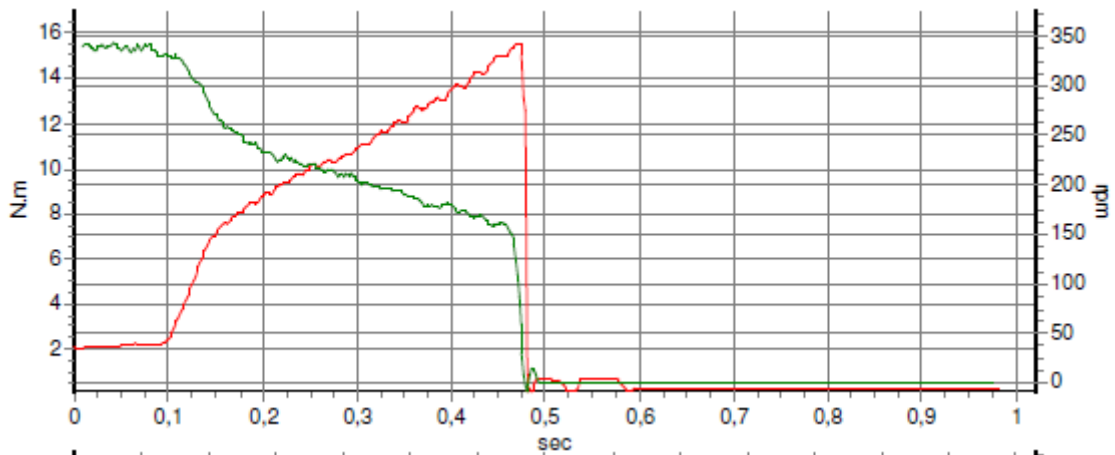


Illustration 32: 360° soft joint 15,6 Nm after load change machine T7021-05.021093

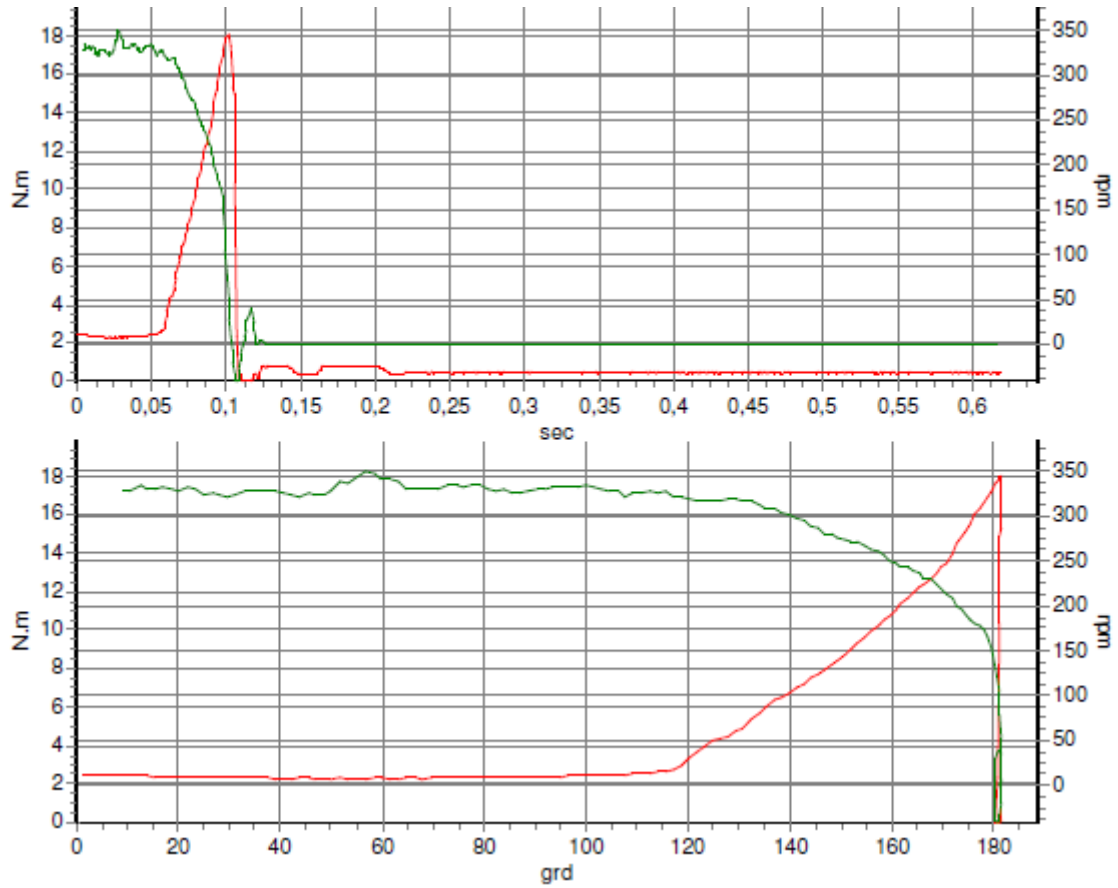


Illustration 33: 30° hard joint 18,0 Nm before load change machine T7021-05.021093

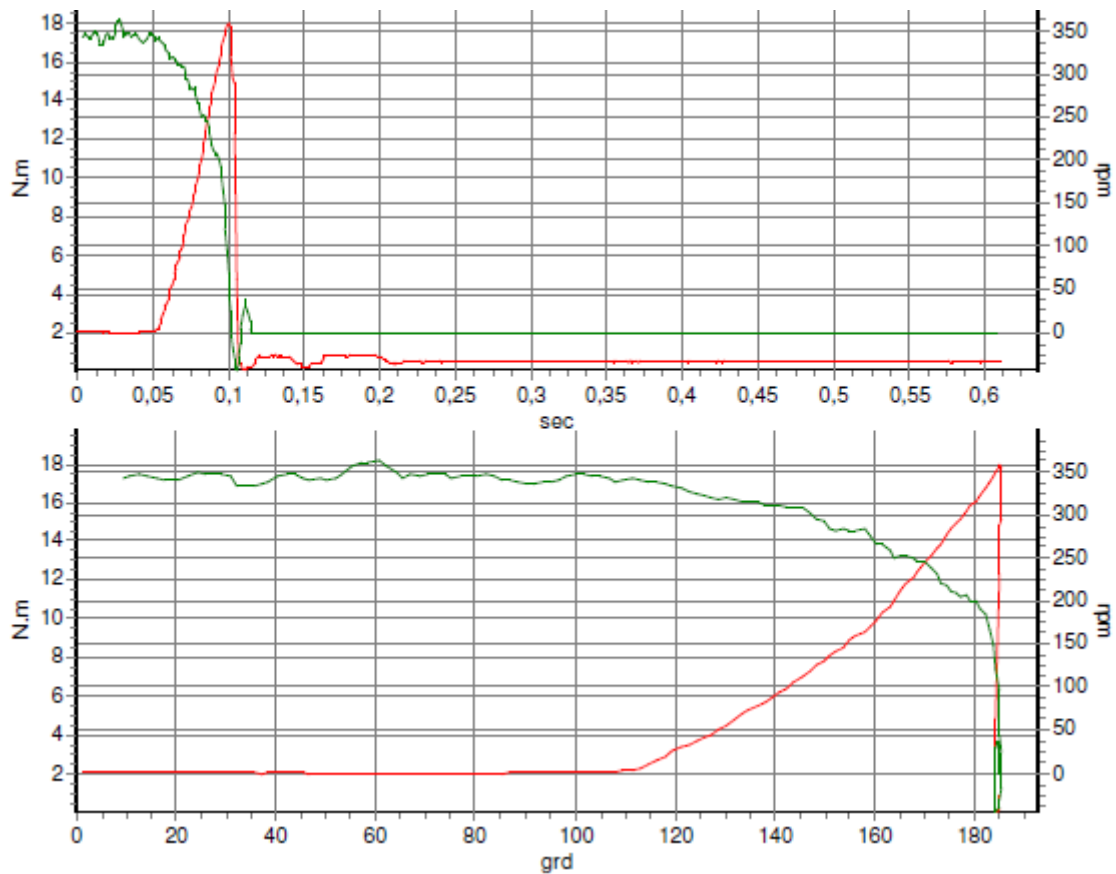


Illustration 34: 30° hard joint 18,0 Nm after load change machine T7021-05.021093

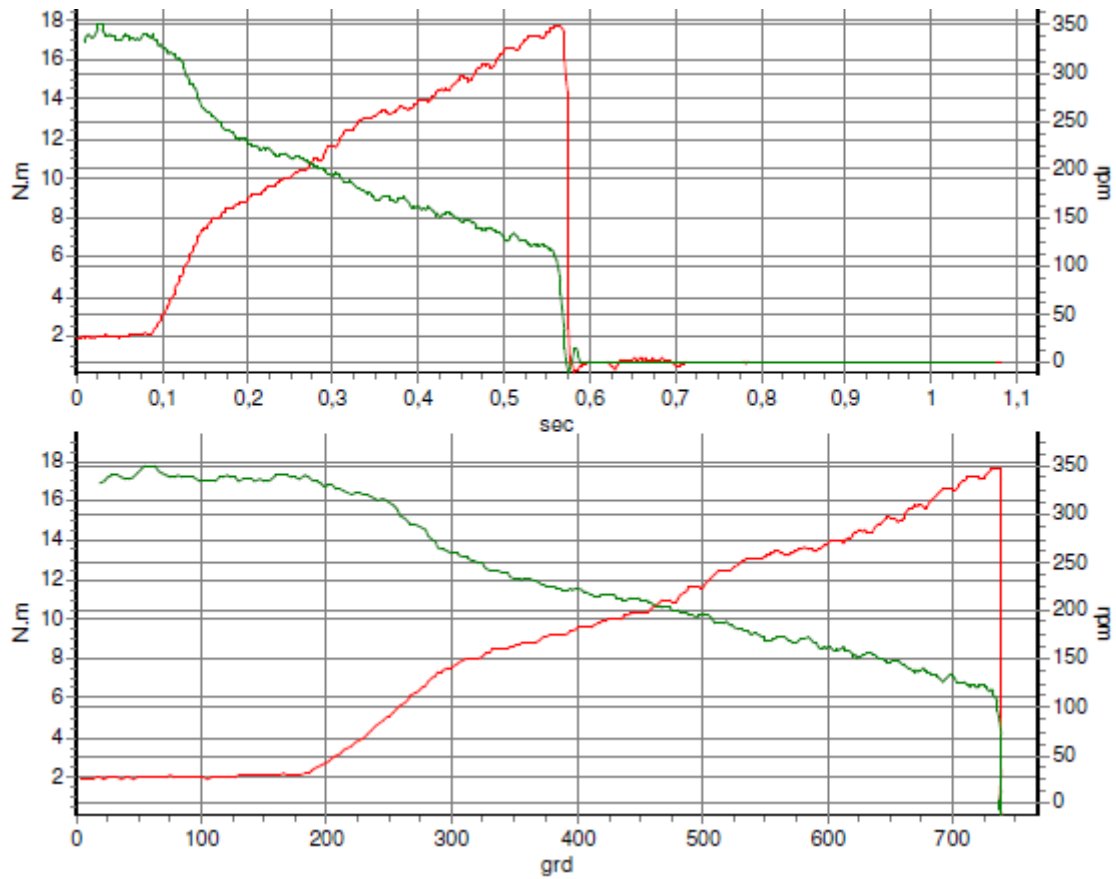


Illustration 35: 360° soft joint 18,0 Nm before load change machine T7021-05.021093

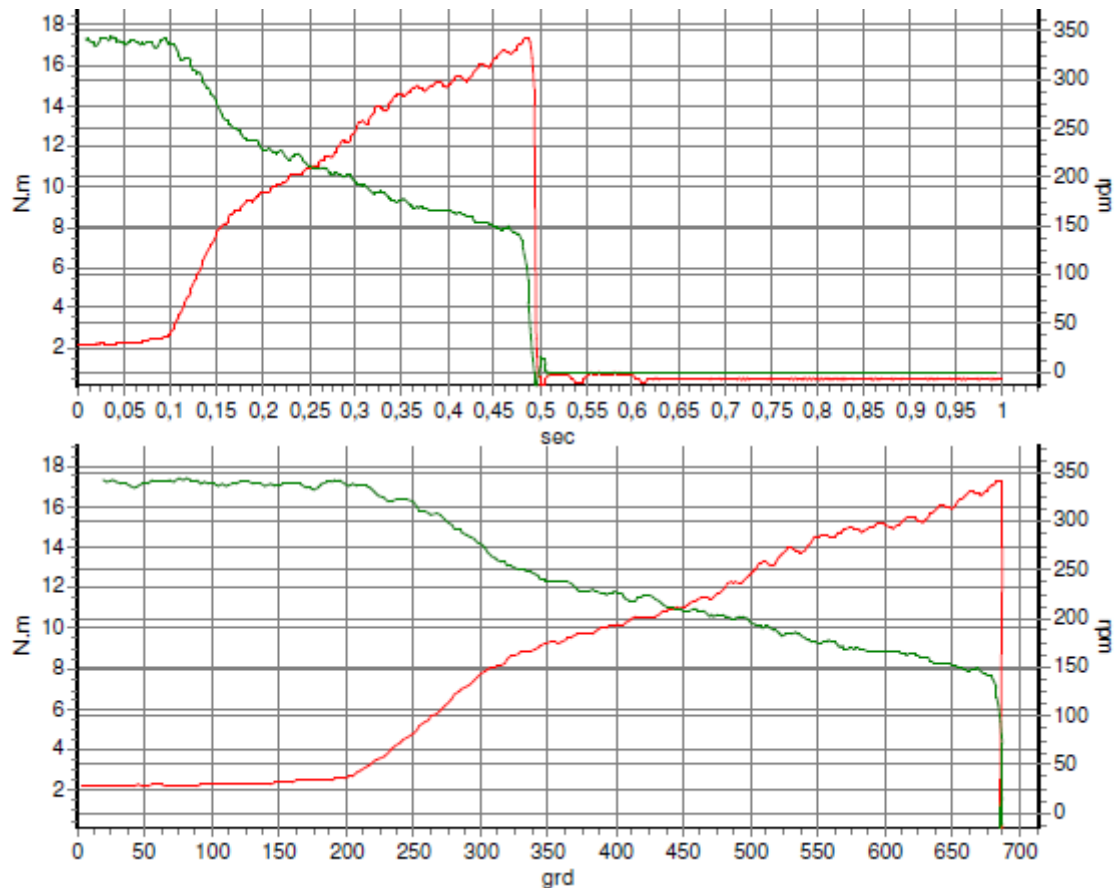


Illustration 36: 360° soft joint 18,0 Nm after load change machine T7021-05.021093