Homologation

Fixtured Spindle

Model: 2BD-2B110A-2K1D-2ZB

Serial no.: 1015968

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Homologation: 2BD-2B110A-2K1D-2ZB SN: 1015968

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Test sheet no. 2

Machine Capability Study 30 %

Multi-stage tightening system	☑	Speed 50 rpm	5,62 %
Single-stage tightening system	☐	Speed 100 %	890 rpm

Manufacturer: Apex Tool Group Serial no: **1015968**

Test torque: Tq min. + 0.3 (Tq max. - Tq min.) 40,70 Nm

Hard joint (H)	246,77	Nm / Revolution	Angle degree	30°
Soft joint (L)	20,42	Nm / Revolution	Angle degree	360°

		H	L
a)	Tolerance down / up	37,85 43,55 Nm	37,85 - 43,55 Nm
	Tolerance down / up	7	7 %
	Average torque	41,13	40,84 Nm
	Standard deviation	0,08	0,07 Nm
	Torque scatter (99,73%)	0,47	0,42 Nm
	C_m	12,12	13,46
	C_{mk}	10,29	12,79

b)	Min. C_m hard/soft (lowest value)	12,12
	Min. C_{mk} hard/soft (lowest value)	10,29

Capability is reached if minimum C_{mk} value ≥1.67

Note:

Machine Capability Study
Control System

Cleco Production Tools

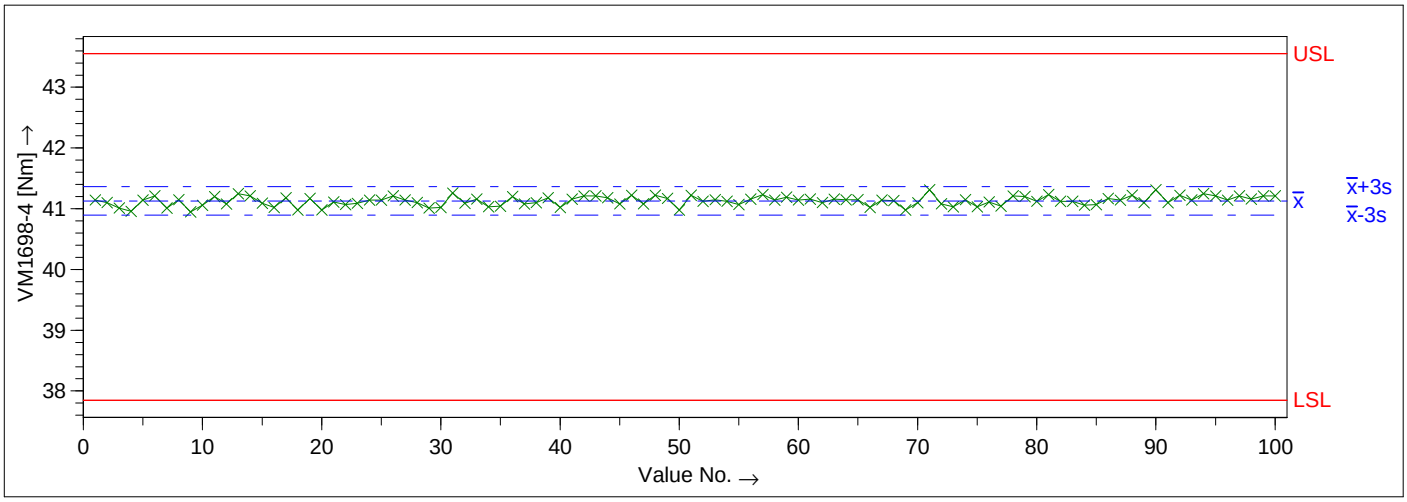
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.03.2022		

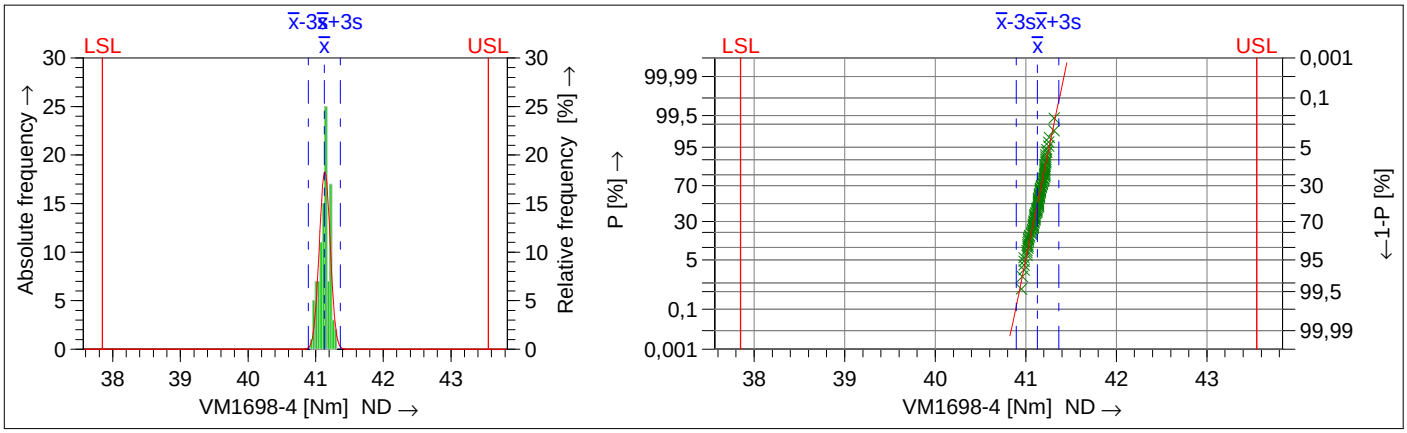
Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015968_d	Char.Descr.	VM1698-4	Inspection Val. 40,70 2,85	USL 43,55
		Serial No.	1024210	Unit Nm -2,85	LSL 37,85
Char.Type	variable			Tolerance value 7 %	Decimal Pl. 2

Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	50 / 1024729	nges.	100

Evaluation from 09.03.2022 14:20:50 to 09.03.2022 14:36:37

Rem. TQ 30% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.191 Nm/A; Speed 890/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	40.70			$\bar{x}$	41.1289
LSL	37.85	x_{min}	40.95	$\bar{x}$-3s	40.8937
USL	43.55	x_{max}	41.31	$\bar{x}$+3s	41.3641
T	5.70	R	0.36	6s	0.4704
		$n_{<T>}$	100	$p_{<T>}$	100.00000 %
		$n_{>USL}$	0	$p_{>USL}$	0.00000%
		$n_{<LSL}$	0	$p_{<LSL}$	0.00000%
		n_{eff}	100		
		n_{tot}	100		

Model distribution			Normal Distribution
Calculation method			M1 1.4 $\hat{\sigma} = s_{tot}$
Potential Capability index	=	C_m	12.12
Critical capability index	=	C_{mk}	10.29

The requirements were met (C_m,C_{mk})

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_d	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	VM1698-4	Inspection Val.	40,70
Ord. No.	2BD110T1S-A	Ser.No.	1024210	LSL	37,85
				USL	43,55
Remark	TQ 30% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.191 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
1024210	VM1698-4	41,14	41,10	41,01	40,96	41,14	41,21	41,01	41,15	40,95	41,06
1024210	VM1698-4	30,00	30,75	29,75	31,00	30,75	31,00	30,25	30,50	30,50	30,50

Char.No	Char.Descr.	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
1024210	VM1698-4	41,20	41,08	41,25	41,21	41,09	41,02	41,18	40,98	41,17	40,98
1024210	VM1698-4	31,00	31,00	31,25	30,75	30,00	30,50	30,25	30,00	30,50	30,25

Char.No	Char.Descr.	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
1024210	VM1698-4	41,11	41,07	41,09	41,14	41,14	41,21	41,14	41,10	41,01	41,02
1024210	VM1698-4	30,25	30,25	30,25	30,25	30,50	30,50	30,75	30,50	30,25	30,75

Char.No	Char.Descr.	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
1024210	VM1698-4	41,26	41,09	41,16	41,03	41,04	41,20	41,08	41,10	41,18	41,02
1024210	VM1698-4	30,50	30,50	30,25	30,50	30,00	30,25	30,25	30,25	30,25	30,50

Char.No	Char.Descr.	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
1024210	VM1698-4	41,16	41,21	41,21	41,18	41,08	41,22	41,08	41,22	41,17	40,98
1024210	VM1698-4	30,50	30,50	30,50	30,25	30,75	30,50	31,00	30,75	30,75	30,50

Char.No	Char.Descr.	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
1024210	VM1698-4	41,22	41,12	41,15	41,12	41,07	41,16	41,23	41,14	41,19	41,14
1024210	VM1698-4	30,00	30,00	29,50	30,00	29,75	29,50	30,25	30,00	30,00	30,00

Char.No	Char.Descr.	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
1024210	VM1698-4	41,16	41,10	41,16	41,15	41,15	41,02	41,14	41,13	40,98	41,10
1024210	VM1698-4	29,75	29,75	29,75	30,25	30,00	30,25	30,00	30,00	30,00	30,50

Char.No	Char.Descr.	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
1024210	VM1698-4	41,31	41,08	41,03	41,15	41,03	41,11	41,04	41,21	41,20	41,12
1024210	VM1698-4	30,25	29,75	30,00	30,00	29,75	30,25	29,75	29,50	30,00	30,00

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_d	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	VM1698-4	Inspection Val.	40,70
Ord. No.	2BD110T1S-A	Ser.No.	1024210	LSL	37,85
				USL	43,55
Remark	TQ 30% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.191 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
1024210	VM1698-4	41,23	41,12	41,12	41,06	41,07	41,17	41,14	41,22	41,10	41,31
1024210	VM1698-4	30,00	30,25	30,00	30,25	30,00	29,75	30,00	30,50	30,50	30,00

Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
1024210	VM1698-4	41,10	41,22	41,14	41,25	41,21	41,14	41,21	41,16	41,21	41,21
1024210	VM1698-4	30,00	30,50	30,00	30,50	30,00	30,00	30,00	30,25	30,25	29,75

Machine Capability Study
Tool System

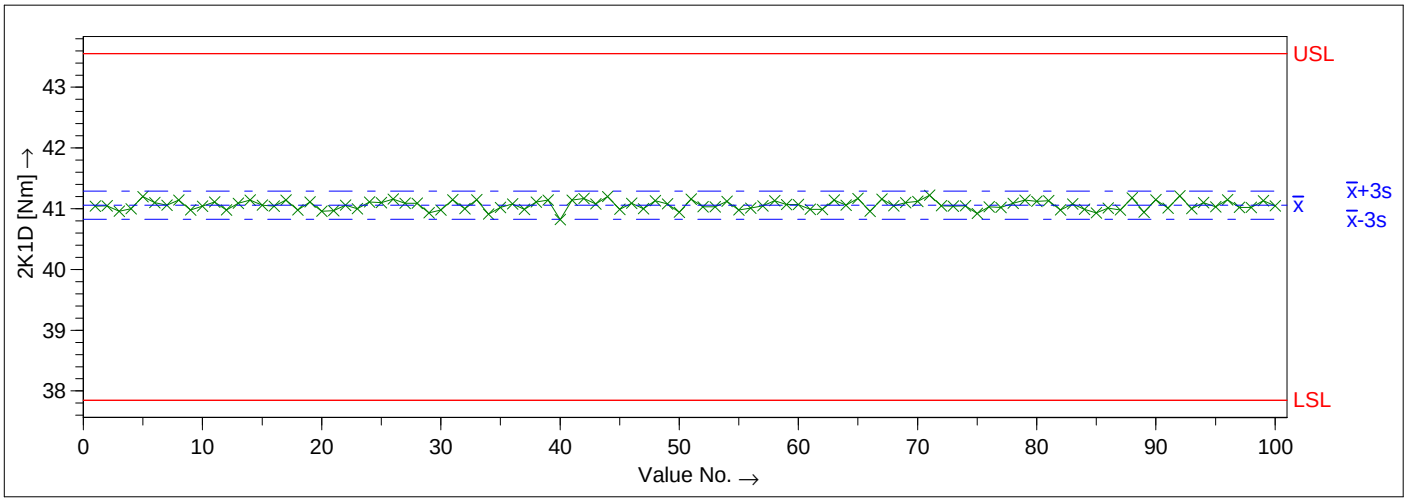
Cleco Production Tools

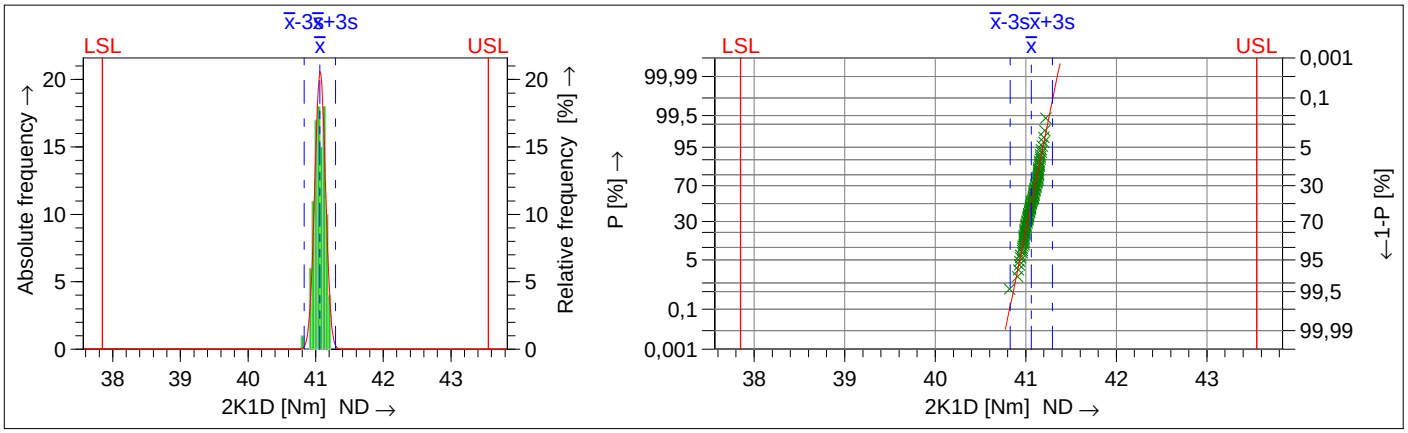
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.03.2022		

Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015968_d	Char.Descr.	2K1D	Inspection Val. 40,70 2,85	USL 43,55
		Serial No.	204569	Unit Nm -2,85	LSL 37,85
Char.Type	variable			Tolerance value 7 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	50 / 1024729	nges.	100

Evaluation from 09.03.2022 14:20:50 to 09.03.2022 14:36:37

Rem. TQ 30% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.191 Nm/A; Speed 890/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	40.70			$\bar{x}$	41.0602
LSL	37.85	x_{min}	40.82	$\bar{x}$-3s	40.8279
USL	43.55	x_{max}	41.22	$\bar{x}$+3s	41.2925
T	5.70	R	0.40	6s	0.4646
		$n_{<T>}$	100	$p_{<T>}$	100.00000 %
		$n_{>USL}$	0	$p_{>USL}$	0.00000%
		$n_{<LSL}$	0	$p_{<LSL}$	0.00000%
		n_{eff}	100		
		n_{tot}	100		

Model distribution			Normal Distribution
Calculation method			$M1_{1.4}$ $\hat{\sigma} = s_{tot}$
Potential Capability index	=	C_m	12.27
Critical capability index	=	C_{mk}	10.72

The requirements were met (C_m,C_{mk})

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Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_d	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	40,70
Ord. No.	2BD110T1S-A	Ser.No.	204569	LSL	37,85
				USL	43,55
Remark	TQ 30% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.191 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
204569	2K1D	41,04	41,05	40,96	41,00	41,20	41,10	41,06	41,14	40,98	41,04
204569	2K1D	30,00	31,00	30,00	31,00	31,00	31,00	30,00	31,00	31,00	30,00

Char.No	Char.Descr.	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
204569	2K1D	41,11	40,98	41,09	41,14	41,06	41,04	41,14	40,98	41,11	40,96
204569	2K1D	31,00	31,00	31,00	31,00	30,00	30,00	30,00	30,00	30,00	30,00

Char.No	Char.Descr.	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204569	2K1D	40,97	41,06	41,00	41,11	41,10	41,16	41,09	41,09	40,93	40,98
204569	2K1D	30,00	30,00	30,00	30,00	30,00	31,00	30,00	30,00	31,00	30,00

Char.No	Char.Descr.	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
204569	2K1D	41,15	41,00	41,15	40,91	41,02	41,08	40,99	41,11	41,14	40,82
204569	2K1D	30,00	30,00	30,00	30,00	30,00	30,00	30,00	30,00	30,00	30,00

Char.No	Char.Descr.	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204569	2K1D	41,14	41,17	41,08	41,20	40,99	41,09	41,00	41,13	41,08	40,94
204569	2K1D	30,00	30,00	30,00	30,00	30,00	30,00	31,00	30,00	31,00	30,00

Char.No	Char.Descr.	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
204569	2K1D	41,16	41,03	41,03	41,12	40,98	41,01	41,05	41,13	41,07	41,07
204569	2K1D	30,00	30,00	29,00	30,00	30,00	30,00	30,00	30,00	30,00	30,00

Char.No	Char.Descr.	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
204569	2K1D	40,99	40,99	41,14	41,06	41,17	40,96	41,16	41,05	41,10	41,12
204569	2K1D	29,00	30,00	30,00	30,00	30,00	30,00	30,00	30,00	31,00	30,00

Char.No	Char.Descr.	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
204569	2K1D	41,22	41,05	41,04	41,05	40,92	41,03	41,02	41,09	41,14	41,12
204569	2K1D	30,00	30,00	30,00	30,00	30,00	30,00	30,00	29,00	30,00	30,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_d	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	40,70
Ord. No.	2BD110T1S-A	Ser.No.	204569	LSL	37,85
				USL	43,55
Remark	TQ 30% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.191 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
204569	2K1D	41,13	40,98	41,08	40,99	40,93	41,01	40,98	41,18	40,94	41,15
204569	2K1D	30,00	30,00	30,00	30,00	30,00	29,00	30,00	30,00	31,00	30,00

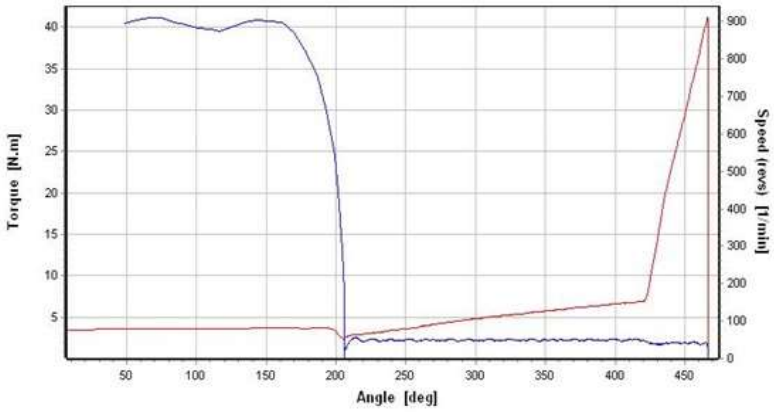
Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204569	2K1D	41,01	41,21	41,00	41,10	41,03	41,15	41,02	41,02	41,13	41,05
204569	2K1D	30,00	30,00	30,00	30,00	30,00	30,00	30,00	30,00	30,00	30,00

Torque graphs

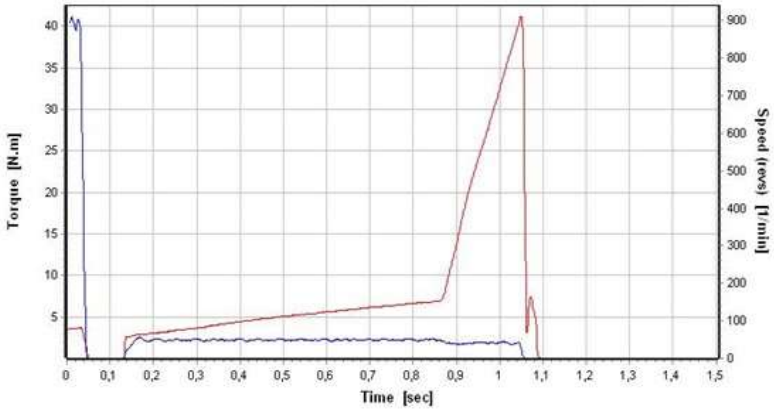
Model: **2BD-2B110A-2K1D-2ZB**
Serial no: **1015968**

Machine Capability Study 30 %

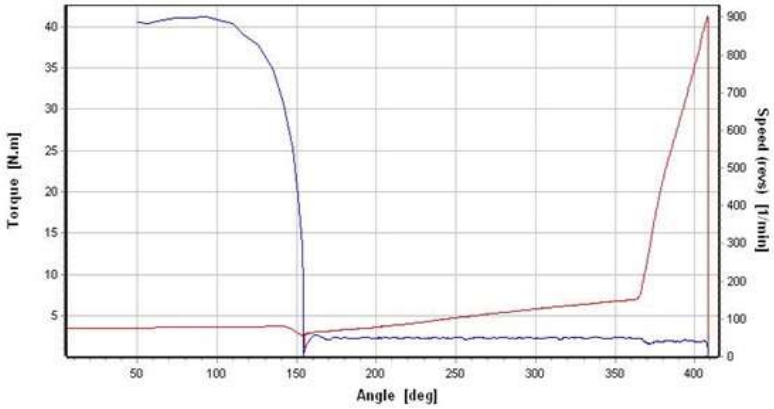
Angle degree: **30°**
Test torque: **40,7 Nm**



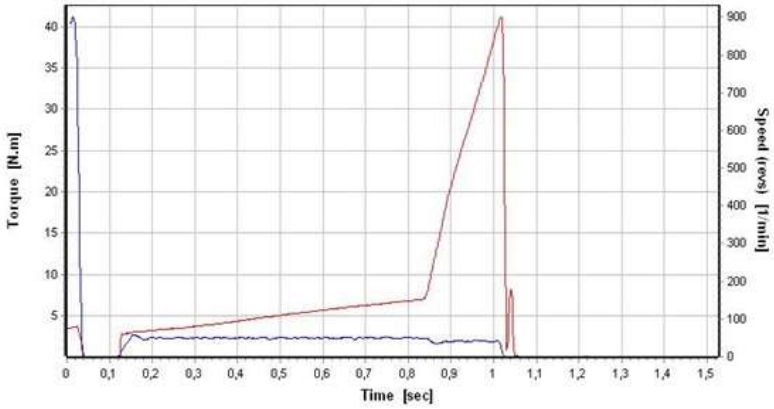
Value no. 1
Graph
Torque / Angle / Speed



Value no. 1
Graph
Torque / Time / Speed



Value no. 100
Graph
Torque / Angle / Speed



Value no. 100
Graph
Torque / Time / Speed

Machine Capability Study
Control System

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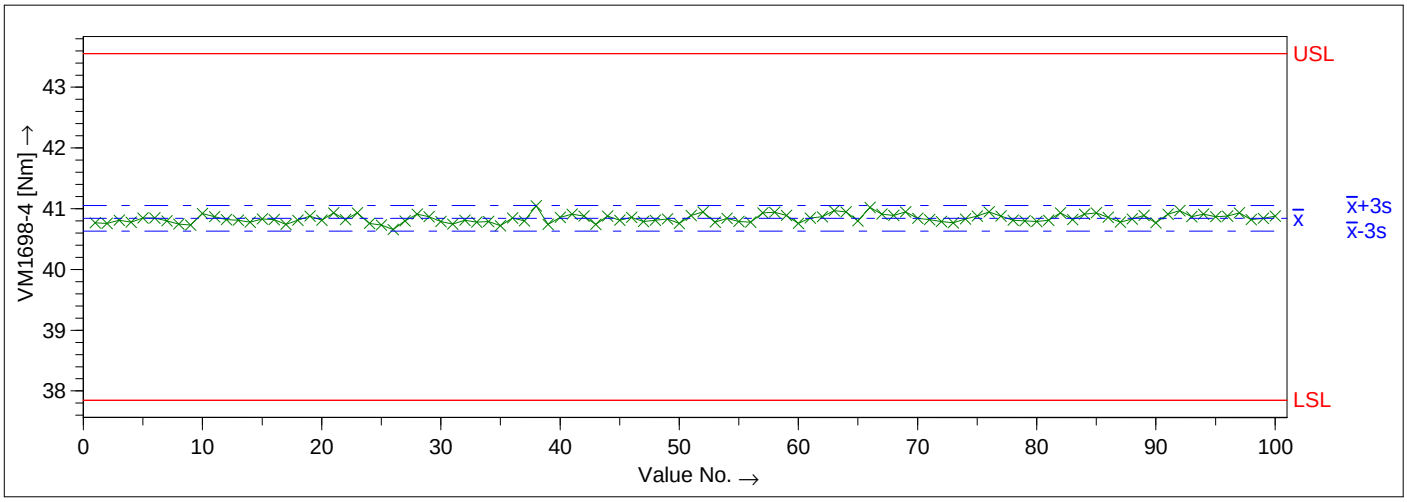
Plant ATG Westhausen		Operator Name Sünder	Date 09.03.2022

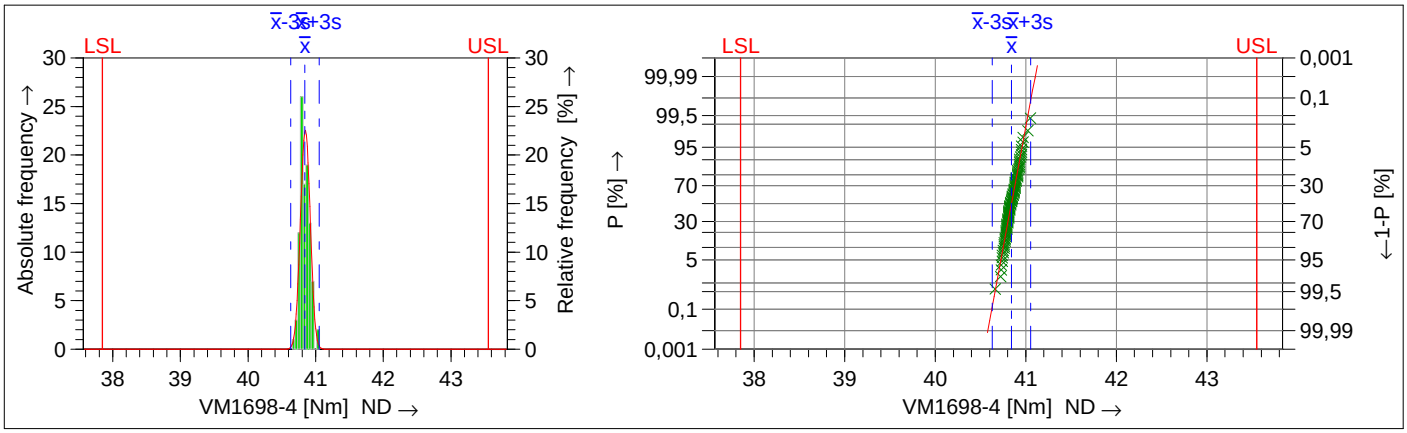
Ord. No. 2BD110T1S-A	Part type 2BD-2B110A-2K1D-2ZB				Contr.item yes
Serial No. 1015968_c	Char.Descr. VM1698-4	Inspection Val.	40,70	2,85	USL 43,55
	Serial No. 1024210	Unit	Nm	-2,85	LSL 37,85
Char.Type variable		Tolerance value	7 %		Decimal Pl. 2

Cust.Name Cleco	Reference System VM1698-4	Test Electronic MPRO400GCD-P
Contr.No. Homologation	Reference Transducer 50 / 1024729	nges. 100

Evaluation from 09.03.2022 14:39:47 to 09.03.2022 14:59:07

Rem. TQ 30% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.191 Nm/A; Speed 890/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	40.70			$\bar{x}$	40.8414
LSL	37.85	x_{min}	40.66	$\bar{x}$-3s	40.6297
USL	43.55	x_{max}	41.05	$\bar{x}$+3s	41.0531
T	5.70	R	0.39	6s	0.4235
		$n_{<T>}$	100	$p_{<T>}$	100.00000 %
		$n_{>USL}$	0	$p_{>USL}$	0.00000%
		$n_{<LSL}$	0	$p_{<LSL}$	0.00000%
		n_{eff}	100		
		n_{tot}	100		

Model distribution			Normal Distribution
Calculation method			$M1_{1,4}$ $\hat{\sigma} = s_{tot}$
Potential Capability index	=	C_m	13.46
Critical capability index	=	C_{mk}	12.79

The requirements were met (C_m,C_{mk})

APEX VDI/VDE 2647 V0.1

Apex Tool Group GmbH \\htwe0006\AppData\QW\QWE\MessWert\2022\1015968_cM.DFD

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_c	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	VM1698-4	Inspection Val.	40,70
Ord. No.	2BD110T1S-A	Ser.No.	1024210	LSL	37,85
				USL	43,55
Remark	TQ 30% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.191 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
1024210	VM1698-4	40,77	40,76	40,81	40,78	40,85	40,85	40,80	40,75	40,73	40,92
1024210	VM1698-4	364,75	368,25	365,00	362,25	365,25	366,50	363,00	368,00	361,00	367,50

Char.No	Char.Descr.	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
1024210	VM1698-4	40,87	40,82	40,81	40,78	40,83	40,82	40,74	40,81	40,88	40,81
1024210	VM1698-4	367,75	365,75	368,25	369,00	359,75	360,00	360,50	361,50	364,00	357,50

Char.No	Char.Descr.	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
1024210	VM1698-4	40,93	40,82	40,93	40,76	40,73	40,66	40,80	40,91	40,87	40,79
1024210	VM1698-4	363,00	360,25	360,25	359,75	363,75	356,50	362,75	363,25	360,75	357,50

Char.No	Char.Descr.	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
1024210	VM1698-4	40,75	40,81	40,78	40,79	40,72	40,85	40,80	41,05	40,74	40,86
1024210	VM1698-4	359,75	361,25	362,00	359,25	366,00	361,75	361,25	366,50	361,25	369,25

Char.No	Char.Descr.	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
1024210	VM1698-4	40,91	40,88	40,74	40,88	40,81	40,86	40,79	40,81	40,83	40,76
1024210	VM1698-4	368,50	367,25	364,75	364,75	359,00	365,00	364,50	363,00	363,00	362,25

Char.No	Char.Descr.	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
1024210	VM1698-4	40,89	40,95	40,78	40,84	40,79	40,78	40,93	40,94	40,89	40,76
1024210	VM1698-4	362,00	366,00	362,00	360,50	364,50	365,00	366,00	363,75	366,75	363,50

Char.No	Char.Descr.	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
1024210	VM1698-4	40,85	40,87	40,97	40,95	40,80	41,02	40,91	40,89	40,95	40,84
1024210	VM1698-4	362,00	366,75	370,50	366,00	365,50	368,25	362,75	361,75	355,50	356,50

Char.No	Char.Descr.	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
1024210	VM1698-4	40,82	40,79	40,77	40,83	40,88	40,95	40,88	40,81	40,80	40,79
1024210	VM1698-4	355,75	358,50	356,75	358,75	361,00	362,25	360,25	356,50	360,75	359,50

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_c	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	VM1698-4	Inspection Val.	40,70
Ord. No.	2BD110T1S-A	Ser.No.	1024210	LSL	37,85
				USL	43,55
Remark	TQ 30% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.191 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
1024210	VM1698-4	40,81	40,93	40,82	40,91	40,93	40,86	40,78	40,83	40,89	40,77
1024210	VM1698-4	356,25	355,50	357,50	359,00	360,75	359,00	358,75	361,75	362,00	358,50

Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
1024210	VM1698-4	40,91	40,97	40,87	40,91	40,87	40,88	40,93	40,82	40,84	40,88
1024210	VM1698-4	362,25	359,75	357,00	360,50	362,75	360,50	359,00	361,00	364,50	357,50

Machine Capability Study
Tool System

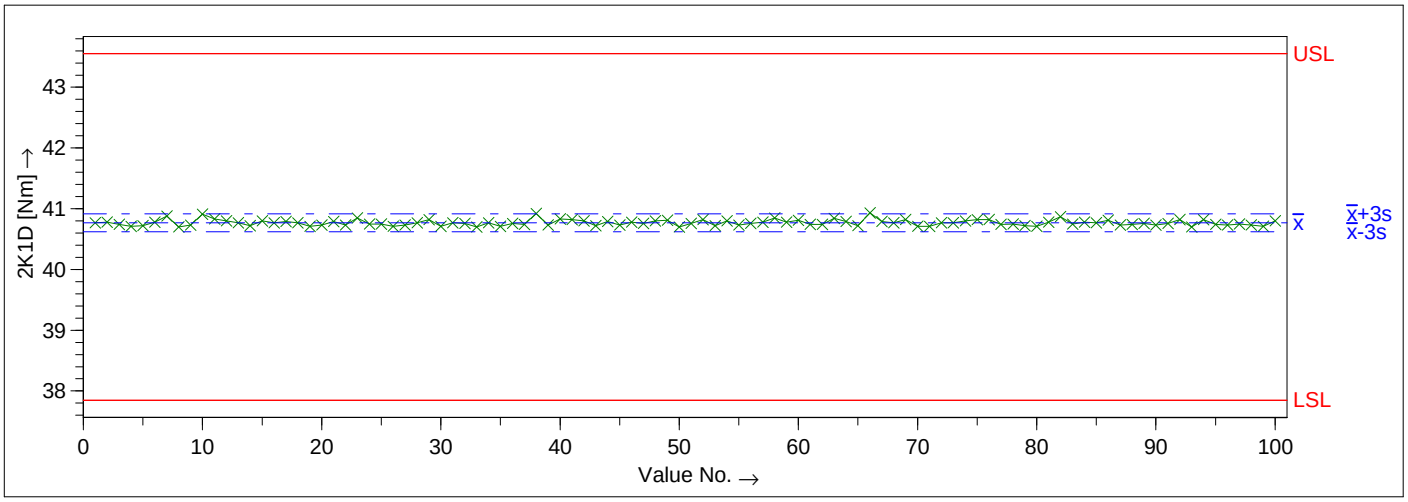
Cleco Production Tools

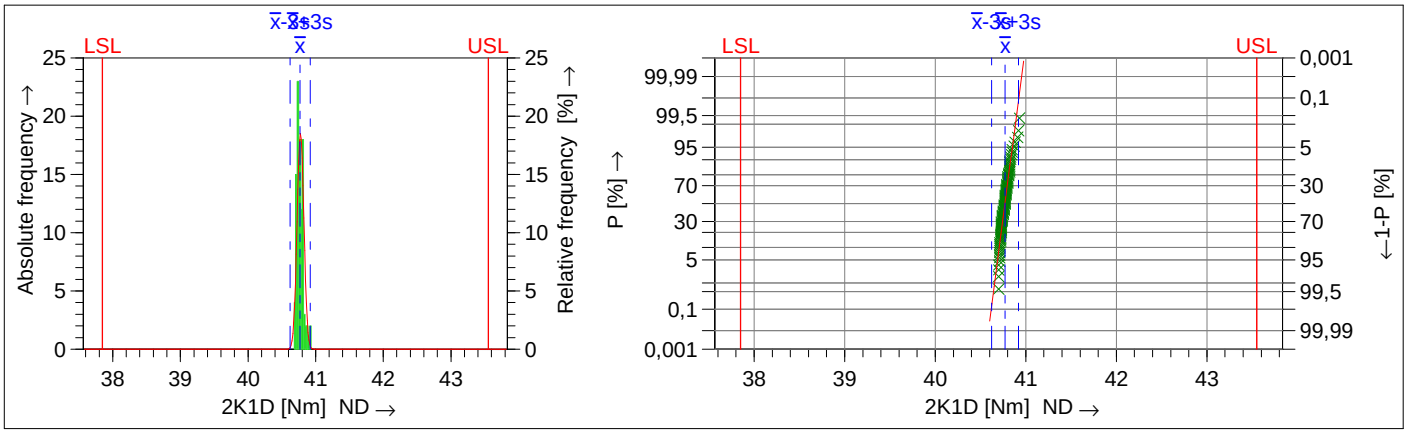
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.03.2022		

Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015968_c	Char.Descr.	2K1D	Inspection Val. 40,70 2,85	USL 43,55
		Serial No.	204569	Unit Nm -2,85	LSL 37,85
Char.Type	variable			Tolerance value 7 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	50 / 1024729	nges.	100

Evaluation from 09.03.2022 14:39:47 to 09.03.2022 14:59:07

Rem. TQ 30% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.191 Nm/A; Speed 890/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	40.70			$\bar{x}$	40.7697
LSL	37.85	x_{min}	40.70	$\bar{x}$-3s	40.6213
USL	43.55	x_{max}	40.93	$\bar{x}$+3s	40.9181
T	5.70	R	0.23	6s	0.2967
		$n_{<T>}$	100	$p_{<T>}$	100.00000 %
		$n_{>USL}$	0	$p_{>USL}$	0.00000%
		$n_{<LSL}$	0	$p_{<LSL}$	0.00000%
		n_{eff}	100		
		n_{tot}	100		

Model distribution			Normal Distribution
Calculation method			$M1_{1.4}$ $\hat{\sigma} = s_{tot}$
Potential Capability index	=	C_m	19.21
Critical capability index	=	C_{mk}	18.74

The requirements were met (C_m,C_{mk})

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_c	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	40,70
Ord. No.	2BD110T1S-A	Ser.No.	204569	LSL	37,85
				USL	43,55
Remark	TQ 30% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.191 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
204569	2K1D	40,77	40,78	40,74	40,71	40,72	40,78	40,88	40,70	40,73	40,91
204569	2K1D	364,00	367,00	364,00	361,00	361,00	365,00	362,00	366,00	361,00	367,00

Char.No	Char.Descr.	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
204569	2K1D	40,83	40,80	40,77	40,72	40,80	40,77	40,79	40,77	40,71	40,73
204569	2K1D	367,00	365,00	363,00	368,00	357,00	359,00	358,00	359,00	362,00	357,00

Char.No	Char.Descr.	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204569	2K1D	40,79	40,73	40,85	40,75	40,75	40,71	40,73	40,77	40,82	40,71
204569	2K1D	363,00	356,00	358,00	358,00	363,00	355,00	362,00	361,00	359,00	357,00

Char.No	Char.Descr.	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
204569	2K1D	40,77	40,76	40,70	40,77	40,71	40,76	40,74	40,92	40,73	40,83
204569	2K1D	359,00	359,00	361,00	357,00	364,00	361,00	359,00	363,00	359,00	369,00

Char.No	Char.Descr.	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204569	2K1D	40,82	40,80	40,72	40,79	40,73	40,78	40,76	40,80	40,81	40,70
204569	2K1D	366,00	364,00	363,00	363,00	357,00	364,00	363,00	362,00	362,00	360,00

Char.No	Char.Descr.	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
204569	2K1D	40,76	40,82	40,72	40,80	40,73	40,76	40,78	40,85	40,78	40,81
204569	2K1D	361,00	363,00	361,00	358,00	362,00	363,00	363,00	363,00	364,00	362,00

Char.No	Char.Descr.	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
204569	2K1D	40,74	40,74	40,84	40,79	40,72	40,93	40,79	40,77	40,82	40,71
204569	2K1D	363,00	365,00	367,00	364,00	364,00	366,00	361,00	361,00	354,00	356,00

Char.No	Char.Descr.	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
204569	2K1D	40,71	40,77	40,77	40,80	40,82	40,82	40,74	40,75	40,72	40,71
204569	2K1D	353,00	356,00	357,00	358,00	360,00	361,00	360,00	355,00	360,00	354,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_c	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	40,70
Ord. No.	2BD110T1S-A	Ser.No.	204569	LSL	37,85
				USL	43,55
Remark	TQ 30% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.191 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
204569	2K1D	40,78	40,87	40,75	40,78	40,77	40,81	40,73	40,74	40,76	40,73
204569	2K1D	357,00	354,00	355,00	355,00	358,00	359,00	356,00	361,00	357,00	357,00

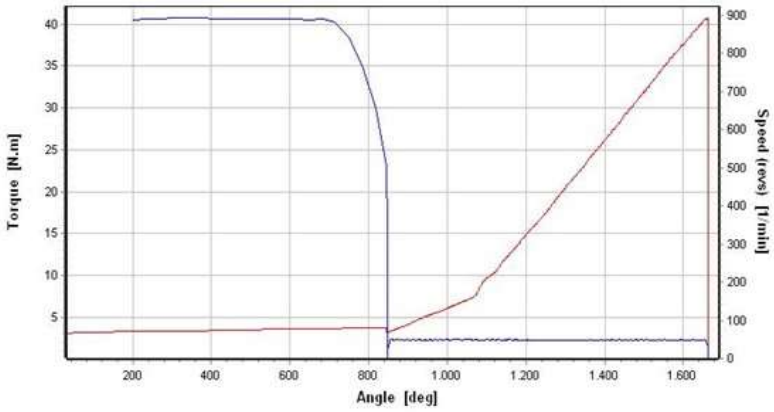
Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204569	2K1D	40,76	40,82	40,70	40,82	40,74	40,73	40,75	40,73	40,71	40,80
204569	2K1D	360,00	360,00	356,00	356,00	360,00	358,00	357,00	360,00	363,00	357,00

Torque graphs

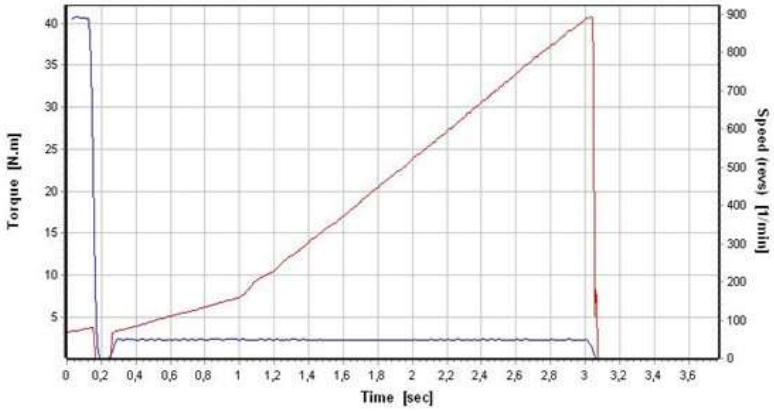
Machine Capability Study 30 %

Model: **2BD-2B110A-2K1D-2ZB**
Serial no: **1015968**

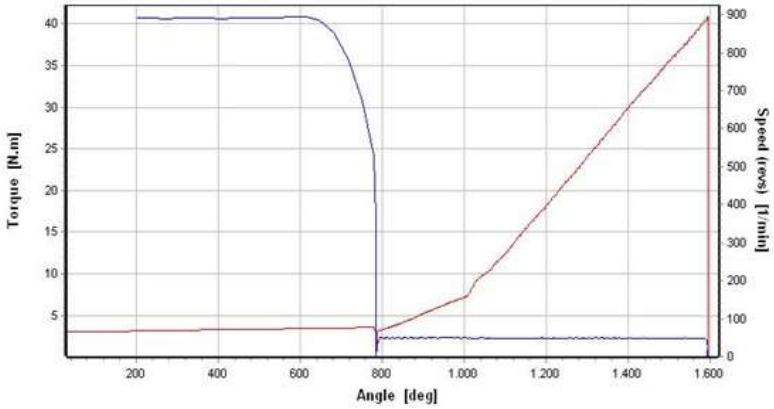
Angle degree: **360°**
Test torque: **40,7 Nm**



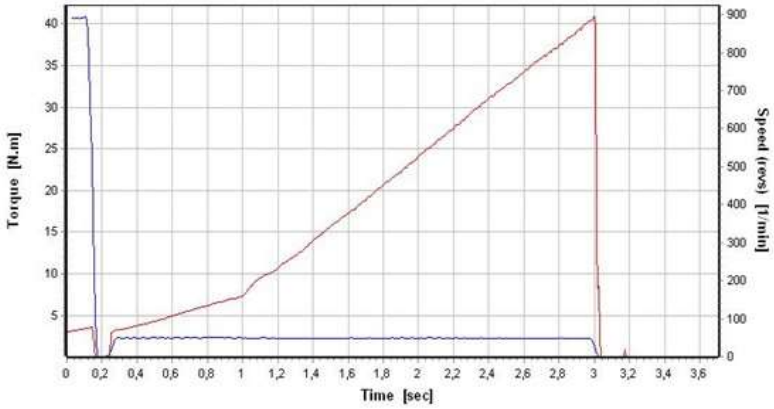
Value no. 1
Graph
Torque / Angle / Speed



Value no. 1
Graph
Torque / Time / Speed



Value no. 100
Graph
Torque / Angle / Speed



Value no. 100
Graph
Torque / Time / Speed

Test sheet no. 3

Machine Capability Study 80 %

Multi-stage tightening system	☑	Speed 50 rpm	5,6 %
Single-stage tightening system	☐	Speed 100 %	890 rpm

Manufacturer: Apex Tool Group Serial no: **1015968**

Test torque: Tq min. + 0.8 (Tq max. - Tq min.) 90,20 Nm

Hard joint (H)	545,01	Nm / Revolution	Angle degree	30°
Soft joint (L)	45,19	Nm / Revolution	Angle degree	360°

		H	L
a)	Tolerance down / up	83,89 96,51 Nm	83,89 - 96,51 Nm
	Tolerance down / up	7	7 %
	Average torque	90,83	90,37 Nm
	Standard deviation	0,19	0,12 Nm
	Torque scatter (99,73%)	1,15	0,74 Nm
	C_m	10,99	16,99
	C_{mk}	9,88	16,53

b)	Min. C_m hard/soft (lowest value)	10,99
	Min. C_{mk} hard/soft (lowest value)	9,88

Capability is reached if minimum C_{mk} value ≥1.67

Note:

Machine Capability Study
Control System

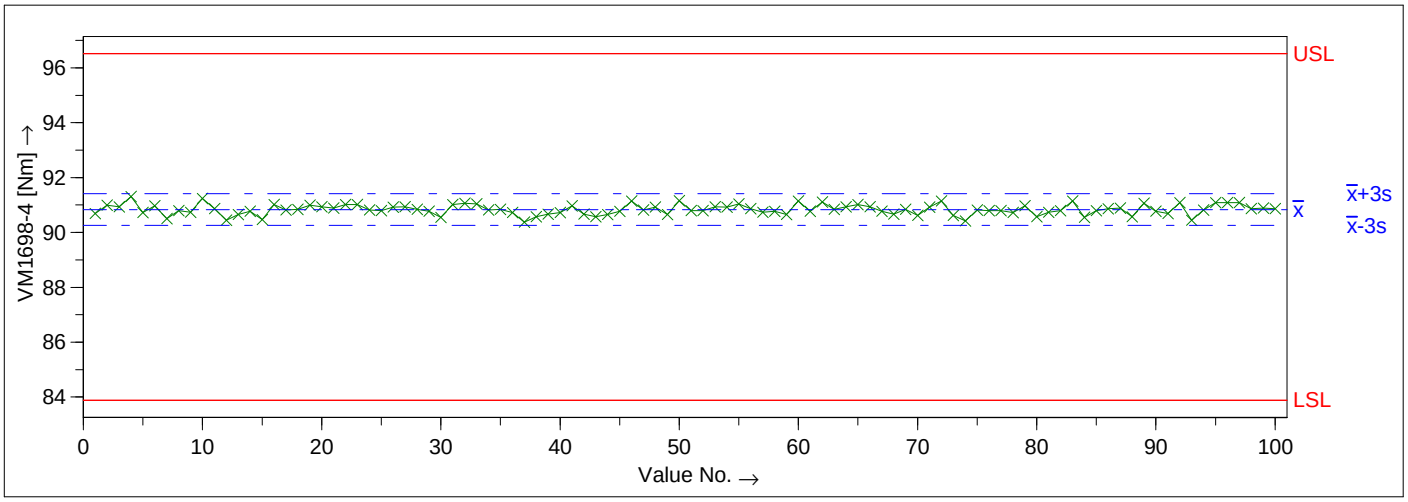
Page 1 / 1

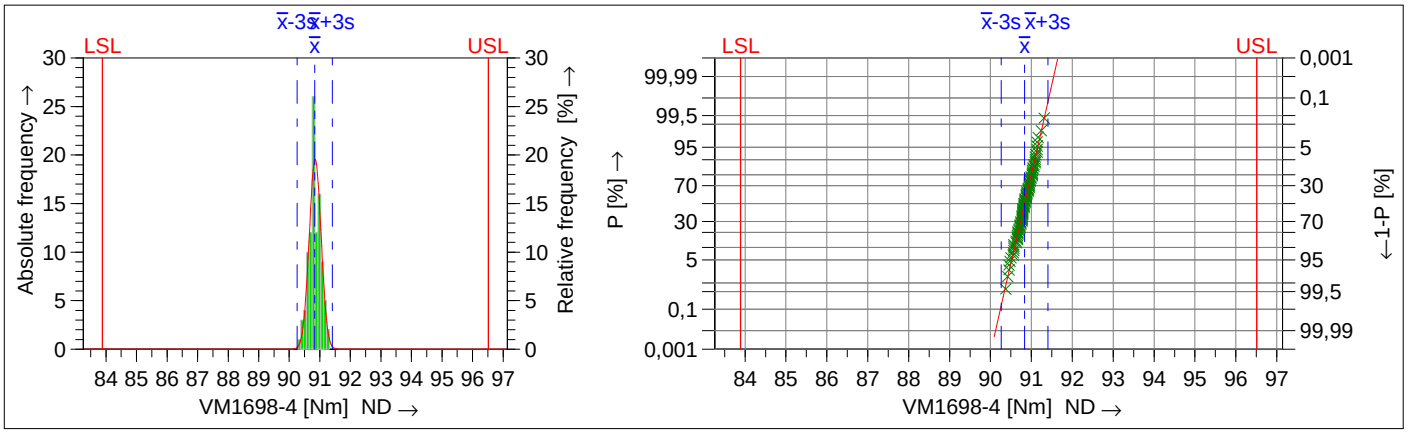
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.03.2022		

Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015968_h	Char.Descr.	VM1698-4	Inspection Val. 90,20 6,31	USL 96,51
		Serial No.	1024210	Unit Nm -6,31	LSL 83,89
Char.Type	variable			Tolerance value 7 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	120 / 1019923	nges.	100

Evaluation from 09.03.2022 11:31:44 to 09.03.2022 11:46:27

Rem. TQ 80% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.148 Nm/A; Speed 890/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	90.20			$\bar{x}$	90.8347
LSL	83.89	x_{min}	90.37	$\bar{x}$-3s	90.2605
USL	96.51	x_{max}	91.31	$\bar{x}$+3s	91.4089
T	12.62	R	0.94	6s	1.1484
		$n_{<T>}$	100	$p_{<T>}$	100.00000 %
		$n_{>USL}$	0	$p_{>USL}$	0.00000%
		$n_{<LSL}$	0	$p_{<LSL}$	0.00000%
		n_{eff}	100		
		n_{tot}	100		

Model distribution			Normal Distribution
Calculation method			$M1_{1.4}$ $\hat{\sigma} = s_{tot}$
Potential Capability index	=	C_m	10.99
Critical capability index	=	C_{mk}	9.88

The requirements were met (C_m,C_{mk})

APEX VDI/VDE 2647 V0.1

Apex Tool Group GmbH \\htwe0006\AppData\QW\QWE\MessWert\2022\1015968_hM.DFD

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_h	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	VM1698-4	Inspection Val.	90,20
Ord. No.	2BD110T1S-A	Ser.No.	1024210	LSL	83,89
				USL	96,51
Remark	TQ 80% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.148 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
1024210	VM1698-4	90,69	90,99	90,94	91,31	90,72	90,97	90,50	90,79	90,74	91,24
1024210	VM1698-4	29,75	30,25	31,00	30,50	30,50	29,75	29,50	31,25	29,75	31,00

Char.No	Char.Descr.	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
1024210	VM1698-4	90,87	90,45	90,65	90,77	90,47	91,02	90,82	90,84	90,99	90,94
1024210	VM1698-4	29,25	30,25	30,50	29,75	30,25	31,00	31,00	29,25	29,75	30,75

Char.No	Char.Descr.	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
1024210	VM1698-4	90,89	91,02	91,02	90,82	90,79	90,92	90,94	90,84	90,77	90,55
1024210	VM1698-4	29,75	30,75	29,25	29,75	30,75	29,75	29,25	29,75	30,00	30,50

Char.No	Char.Descr.	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
1024210	VM1698-4	91,02	91,06	91,04	90,82	90,84	90,72	90,37	90,57	90,67	90,72
1024210	VM1698-4	30,25	29,75	30,00	30,50	29,50	29,75	30,50	30,25	30,00	31,25

Char.No	Char.Descr.	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
1024210	VM1698-4	90,97	90,67	90,57	90,65	90,77	91,14	90,82	90,92	90,65	91,16
1024210	VM1698-4	29,75	29,25	30,25	29,75	30,25	29,50	30,25	30,00	29,50	29,50

Char.No	Char.Descr.	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
1024210	VM1698-4	90,79	90,79	90,94	90,92	91,04	90,87	90,74	90,77	90,65	91,14
1024210	VM1698-4	29,75	30,00	29,75	31,00	29,25	30,75	30,00	30,00	29,25	30,50

Char.No	Char.Descr.	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
1024210	VM1698-4	90,77	91,11	90,84	90,94	91,02	90,94	90,77	90,67	90,84	90,62
1024210	VM1698-4	29,00	30,25	29,75	31,25	30,50	30,00	30,75	30,25	29,50	29,00

Char.No	Char.Descr.	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
1024210	VM1698-4	90,92	91,14	90,62	90,42	90,82	90,79	90,79	90,72	90,97	90,57
1024210	VM1698-4	30,25	29,75	22,50	30,50	29,50	30,50	30,50	30,75	29,75	29,75

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_h	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	VM1698-4	Inspection Val.	90,20
Ord. No.	2BD110T1S-A	Ser.No.	1024210	LSL	83,89
				USL	96,51
Remark	TQ 80% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.148 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
1024210	VM1698-4	90,74	90,79	91,14	90,55	90,79	90,87	90,89	90,57	91,06	90,77
1024210	VM1698-4	30,25	30,00	30,25	29,75	30,25	29,75	30,75	31,25	31,00	31,50

Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
1024210	VM1698-4	90,69	91,09	90,45	90,82	91,09	91,09	91,09	90,87	90,89	90,87
1024210	VM1698-4	29,75	29,25	29,75	29,25	30,00	29,25	29,00	30,00	31,00	29,00

Machine Capability Study
Tool System

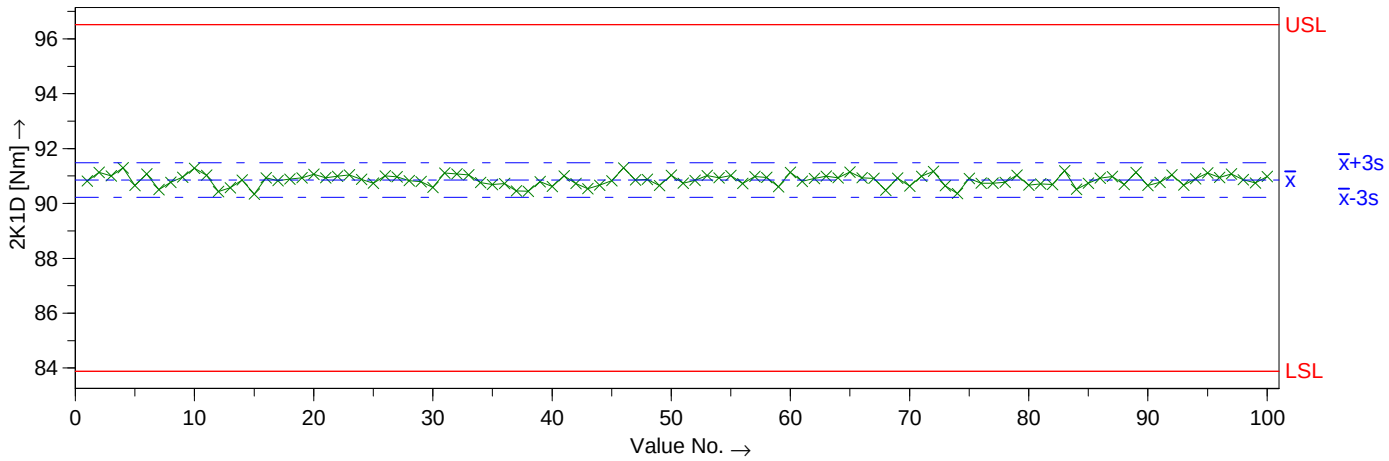
Page 1 / 1

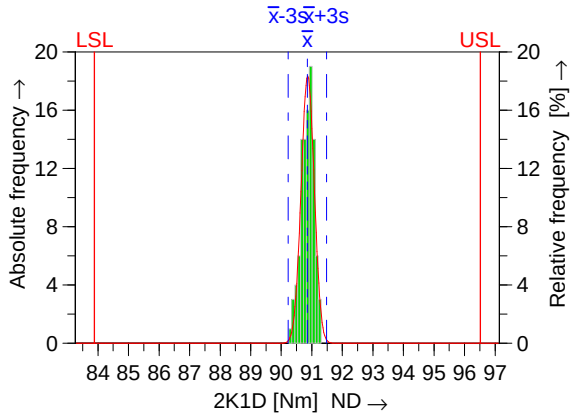
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.03.2022		

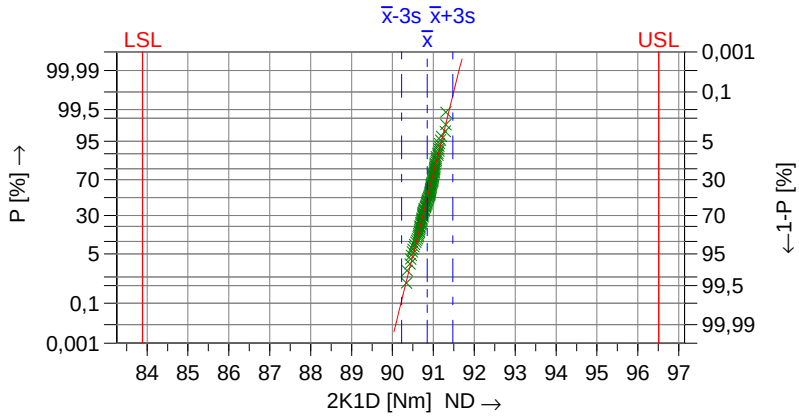
Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015968_h	Char.Descr.	2K1D	Inspection Val. 90,20 6,31	USL 96,51
		Serial No.	204569	Unit Nm -6,31	LSL 83,89
Char.Type	variable			Tolerance value 7 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	120 / 1019923	nges.	100

Evaluation from 09.03.2022 11:31:44 to 09.03.2022 11:46:27

Rem. TQ 80% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.148 Nm/A; Speed 890/50 rpm;







Drawing Values		Collected Values		Statistics	
T_m	90.20			$\bar{x}$	90.8528
LSL	83.89	x_{min}	90.34	$\bar{x}$-3s	90.2270
USL	96.51	x_{max}	91.30	$\bar{x}$+3s	91.4786
T	12.62	R	0.96	6s	1.2516
		$n_{<T>}$	100	$p_{<T>}$	100.00000 %
		$n_{>USL}$	0	$p_{>USL}$	0.00000%
		$n_{<LSL}$	0	$p_{<LSL}$	0.00000%
		n_{eff}	100		
		n_{tot}	100		

Model distribution			Normal Distribution
Calculation method			$M1_{1.4}$ $\hat{\sigma} = s_{tot}$
Potential Capability index	=	C_m	10.08
Critical capability index	=	C_{mk}	9.04

The requirements were met (C_m,C_{mk})

APEX VDI/VDE 2647 V0.1

Apex Tool Group GmbH \\htwe0006\AppData\QW\QWE\MessWert\2022\1015968_h1.DFD

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_h	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	90,20
Ord. No.	2BD110T1S-A	Ser.No.	204569	LSL	83,89
				USL	96,51
Remark	TQ 80% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.148 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
204569	2K1D	90,82	91,13	91,01	91,30	90,65	91,07	90,50	90,77	90,96	91,29
204569	2K1D	30,00	31,00	32,00	31,00	31,00	30,00	30,00	31,00	30,00	31,00

Char.No	Char.Descr.	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
204569	2K1D	91,03	90,43	90,57	90,85	90,34	90,94	90,83	90,89	90,93	91,06
204569	2K1D	30,00	30,00	31,00	30,00	30,00	31,00	31,00	30,00	30,00	31,00

Char.No	Char.Descr.	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204569	2K1D	90,93	90,99	91,04	90,88	90,74	91,00	90,97	90,83	90,80	90,58
204569	2K1D	30,00	31,00	30,00	30,00	31,00	30,00	30,00	30,00	30,00	31,00

Char.No	Char.Descr.	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
204569	2K1D	91,11	91,07	91,04	90,76	90,69	90,72	90,46	90,44	90,80	90,62
204569	2K1D	30,00	30,00	30,00	31,00	30,00	30,00	31,00	31,00	30,00	31,00

Char.No	Char.Descr.	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204569	2K1D	91,00	90,72	90,54	90,67	90,83	91,30	90,85	90,88	90,65	91,03
204569	2K1D	30,00	30,00	31,00	30,00	31,00	30,00	31,00	30,00	30,00	30,00

Char.No	Char.Descr.	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
204569	2K1D	90,74	90,84	91,02	90,94	91,02	90,72	90,98	90,95	90,61	91,13
204569	2K1D	30,00	30,00	30,00	31,00	30,00	31,00	30,00	30,00	30,00	31,00

Char.No	Char.Descr.	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
204569	2K1D	90,81	90,91	90,99	90,93	91,15	90,94	90,91	90,48	90,92	90,63
204569	2K1D	30,00	30,00	30,00	32,00	31,00	30,00	31,00	31,00	30,00	30,00

Char.No	Char.Descr.	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
204569	2K1D	90,99	91,17	90,64	90,36	90,91	90,74	90,74	90,77	91,03	90,67
204569	2K1D	31,00	30,00	23,00	31,00	30,00	31,00	31,00	31,00	30,00	30,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_h	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	90,20
Ord. No.	2BD110T1S-A	Ser.No.	204569	LSL	83,89
				USL	96,51
Remark	TQ 80% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.148 Nm/A; Speed 890/50 rpm;				

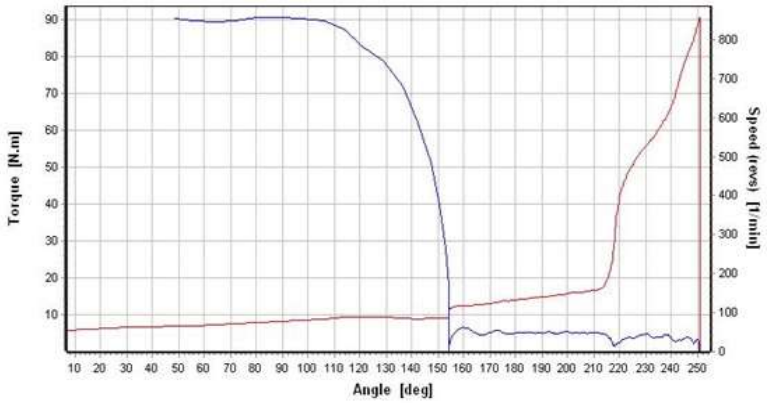
Char.No	Char.Descr.	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
204569	2K1D	90,71	90,69	91,19	90,52	90,74	90,92	90,98	90,69	91,13	90,66
204569	2K1D	31,00	30,00	31,00	30,00	31,00	30,00	31,00	32,00	32,00	32,00

Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204569	2K1D	90,77	91,04	90,67	90,90	91,11	90,95	91,07	90,86	90,75	90,98
204569	2K1D	30,00	30,00	30,00	30,00	30,00	30,00	30,00	31,00	31,00	30,00

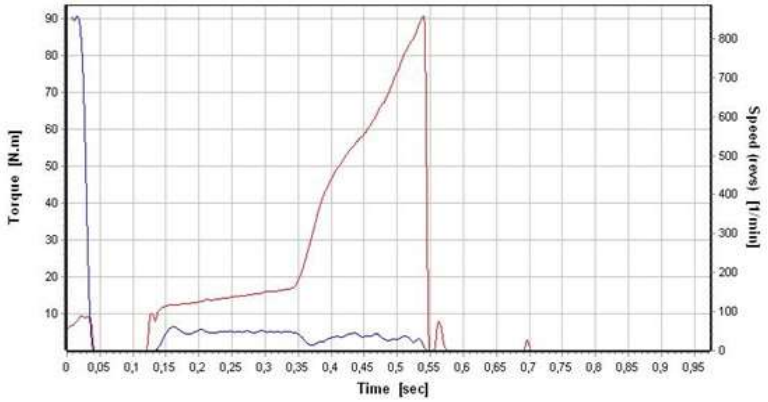
Torque graphs

Model: **2BD-2B110A-2K1D-2ZB**
Serial no: **1015968**

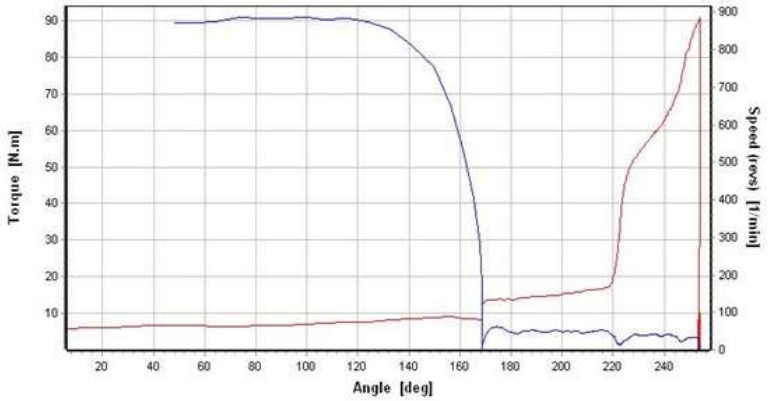
Machine Capability Study 80 %
Angle degree: **30°**
Test torque: **90,2 Nm**



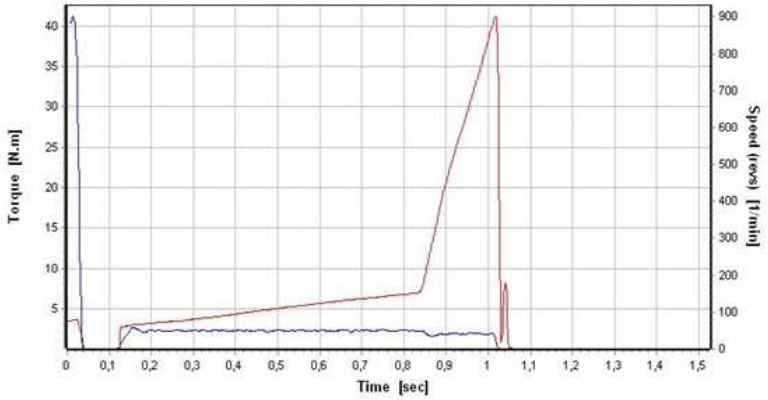
Value no. 1
Graph
Torque / Angle / Speed



Value no. 1
Graph
Torque / Time / Speed



Value no. 100
Graph
Torque / Angle / Speed



Value no. 100
Graph
Torque / Time / Speed

Machine Capability Study
Control System

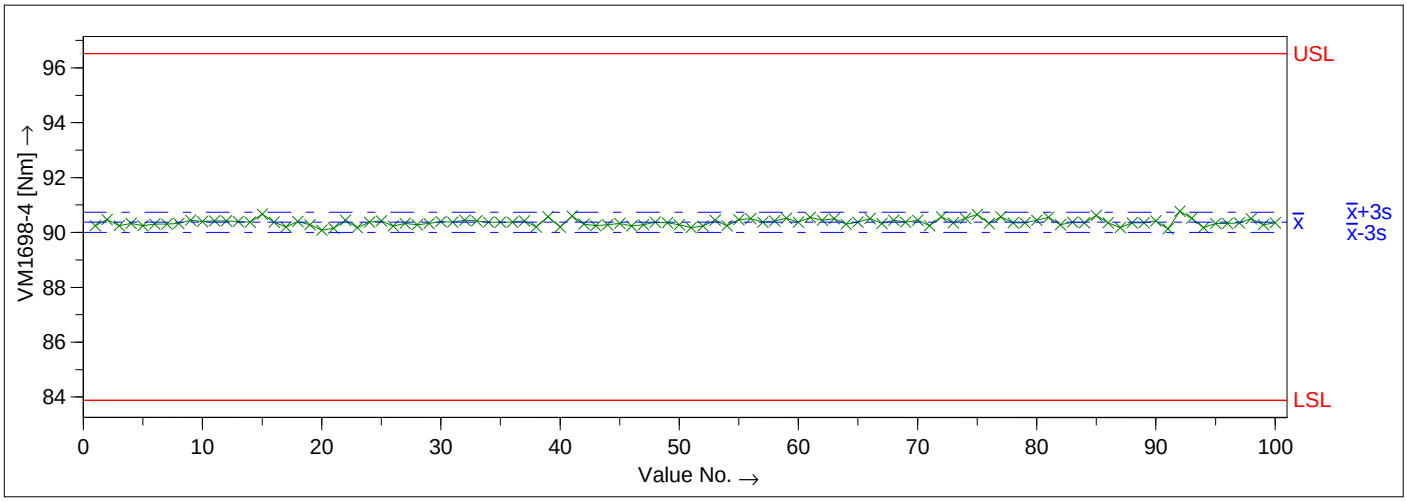
Cleco Production Tools

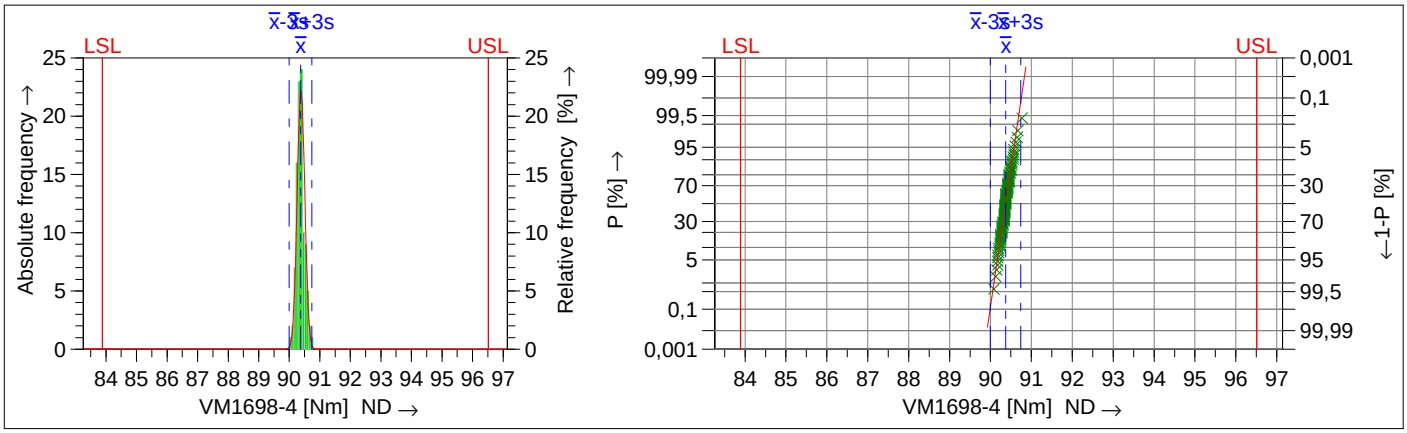
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.03.2022		

Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015968_g	Char.Descr.	VM1698-4	Inspection Val. 90,20 6,31	USL 96,51
		Serial No.	1024210	Unit Nm -6,31	LSL 83,89
Char.Type	variable			Tolerance value 7 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	120 / 1019923	nges.	100

Evaluation from 09.03.2022 11:55:58 to 09.03.2022 12:39:27

Rem. TQ 80% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.148 Nm/A; Speed 890/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	90.20			$\bar{x}$	90.3707
LSL	83.89	x_{min}	90.08	$\bar{x}$-3s	89.9993
USL	96.51	x_{max}	90.77	$\bar{x}$+3s	90.7421
T	12.62	R	0.69	6s	0.7427
		$n_{<T>}$	100	$p_{<T>}$	100.00000 %
		$n_{>USL}$	0	$p_{>USL}$	0.00000%
		$n_{<LSL}$	0	$p_{<LSL}$	0.00000%
		n_{eff}	100		
		n_{tot}	100		

Model distribution			Normal Distribution
Calculation method			$M1_{1.4}$ $\hat{\sigma} = s_{tot}$
Potential Capability index	=	C_m	16.99
Critical capability index	=	C_{mk}	16.53

The requirements were met (C_m,C_{mk})

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_g	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	VM1698-4	Inspection Val.	90,20
Ord. No.	2BD110T1S-A	Ser.No.	1024210	LSL	83,89
				USL	96,51
Remark	TQ 80% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.148 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
1024210	VM1698-4	90,25	90,47	90,25	90,33	90,25	90,30	90,30	90,33	90,45	90,40
1024210	VM1698-4	358,25	334,50	365,25	339,00	333,50	355,75	344,50	361,25	351,00	331,75

Char.No	Char.Descr.	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
1024210	VM1698-4	90,42	90,42	90,40	90,37	90,67	90,37	90,20	90,40	90,28	90,08
1024210	VM1698-4	342,00	337,75	355,75	347,00	342,50	340,50	325,00	348,25	343,25	349,00

Char.No	Char.Descr.	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
1024210	VM1698-4	90,15	90,45	90,18	90,37	90,42	90,23	90,33	90,28	90,33	90,40
1024210	VM1698-4	332,25	346,00	337,50	357,75	349,50	361,25	354,75	353,75	368,75	366,00

Char.No	Char.Descr.	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
1024210	VM1698-4	90,37	90,45	90,42	90,37	90,37	90,37	90,42	90,20	90,57	90,20
1024210	VM1698-4	365,75	349,00	362,75	370,25	343,00	352,50	366,25	372,50	360,00	372,25

Char.No	Char.Descr.	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
1024210	VM1698-4	90,60	90,30	90,25	90,28	90,33	90,23	90,28	90,37	90,35	90,28
1024210	VM1698-4	373,25	340,25	363,25	361,50	353,00	344,75	329,25	347,00	355,50	344,75

Char.No	Char.Descr.	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
1024210	VM1698-4	90,18	90,23	90,45	90,25	90,47	90,50	90,37	90,42	90,52	90,37
1024210	VM1698-4	368,00	362,00	347,25	357,25	377,00	351,75	352,50	352,75	353,75	361,00

Char.No	Char.Descr.	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
1024210	VM1698-4	90,55	90,45	90,50	90,30	90,37	90,50	90,33	90,45	90,37	90,45
1024210	VM1698-4	351,75	354,25	355,75	352,50	371,25	341,75	353,25	355,50	381,75	354,25

Char.No	Char.Descr.	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
1024210	VM1698-4	90,25	90,57	90,35	90,52	90,65	90,33	90,57	90,35	90,35	90,45
1024210	VM1698-4	361,50	375,50	358,25	347,50	373,00	374,50	352,75	362,50	359,50	355,25

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_g	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	VM1698-4	Inspection Val.	90,20
Ord. No.	2BD110T1S-A	Ser.No.	1024210	LSL	83,89
				USL	96,51
Remark	TQ 80% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.148 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
1024210	VM1698-4	90,55	90,28	90,37	90,35	90,62	90,35	90,18	90,35	90,35	90,42
1024210	VM1698-4	349,50	359,75	346,50	377,50	359,50	363,00	377,00	372,25	351,25	360,50

Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
1024210	VM1698-4	90,13	90,77	90,52	90,18	90,33	90,33	90,35	90,50	90,28	90,35
1024210	VM1698-4	360,00	352,00	368,50	353,00	362,25	340,50	364,75	367,75	349,75	355,25

Machine Capability Study
Tool System

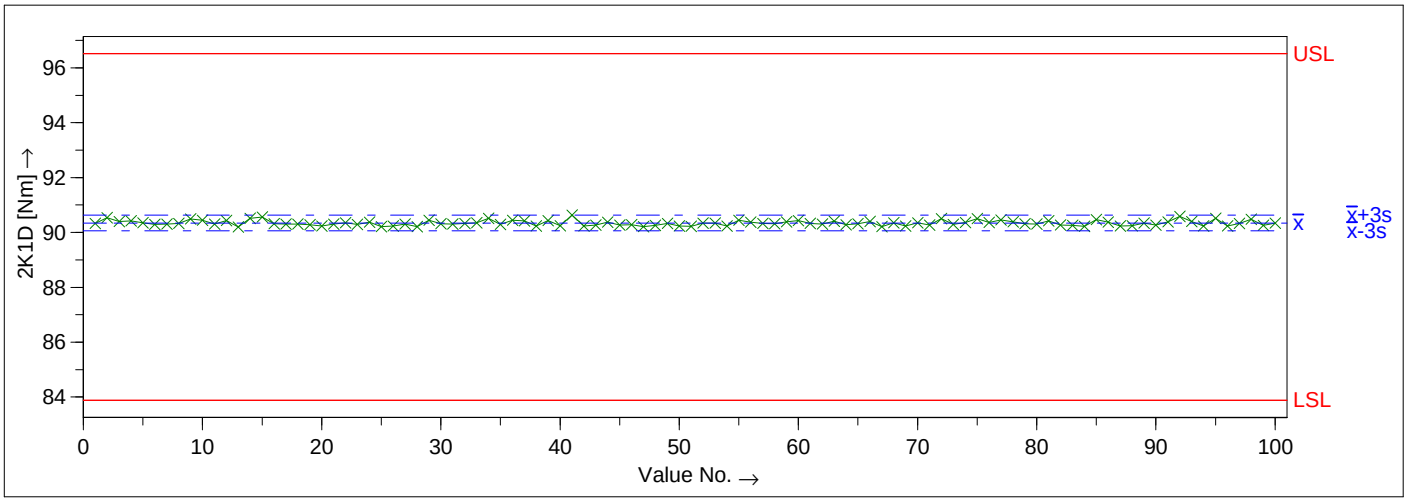
Cleco Production Tools

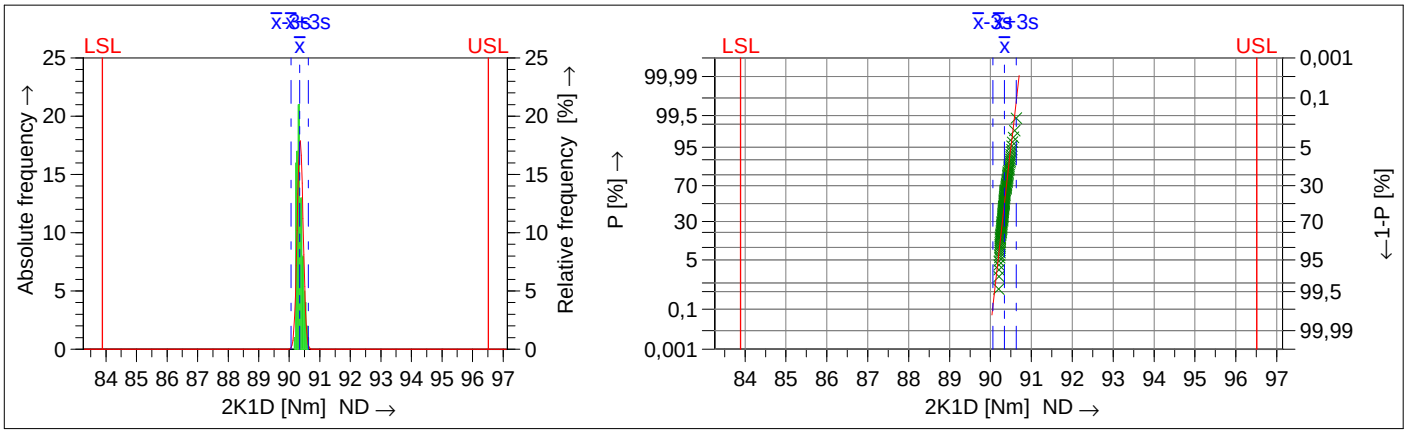
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.03.2022		

Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015968_g	Char.Descr.	2K1D	Inspection Val. 90,20 6,31	USL 96,51
		Serial No.	204569	Unit Nm -6,31	LSL 83,89
Char.Type	variable			Tolerance value 7 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	120 / 1019923	nges.	100

Evaluation from 09.03.2022 11:55:58 to 09.03.2022 12:39:28

Rem. TQ 80% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.148 Nm/A; Speed 890/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	90.20			$\bar{x}$	90.3433
LSL	83.89	x_{min}	90.20	$\bar{x}$-3s	90.0579
USL	96.51	x_{max}	90.63	$\bar{x}$+3s	90.6287
T	12.62	R	0.43	6s	0.5707
		$n_{<T>}$	100	$p_{<T>}$	100.00000 %
		$n_{>USL}$	0	$p_{>USL}$	0.00000%
		$n_{<LSL}$	0	$p_{<LSL}$	0.00000%
		n_{eff}	100		
		n_{tot}	100		

Model distribution			Normal Distribution
Calculation method			$M1_{1.4}$ $\hat{\sigma} = s_{tot}$
Potential Capability index	=	C_m	22.11
Critical capability index	=	C_{mk}	21.61

The requirements were met (C_m,C_{mk})

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_g	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	90,20
Ord. No.	2BD110T1S-A	Ser.No.	204569	LSL	83,89
				USL	96,51
Remark	TQ 80% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.148 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
204569	2K1D	90,33	90,54	90,40	90,42	90,35	90,29	90,30	90,33	90,49	90,44
204569	2K1D	359,00	335,00	365,00	340,00	334,00	357,00	345,00	361,00	351,00	333,00

Char.No	Char.Descr.	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
204569	2K1D	90,30	90,43	90,20	90,51	90,56	90,32	90,31	90,31	90,28	90,23
204569	2K1D	343,00	337,00	356,00	347,00	342,00	341,00	325,00	347,00	344,00	349,00

Char.No	Char.Descr.	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204569	2K1D	90,30	90,35	90,29	90,38	90,21	90,24	90,31	90,21	90,45	90,32
204569	2K1D	334,00	347,00	338,00	358,00	350,00	362,00	354,00	354,00	370,00	367,00

Char.No	Char.Descr.	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
204569	2K1D	90,31	90,33	90,35	90,52	90,29	90,45	90,42	90,23	90,43	90,25
204569	2K1D	366,00	349,00	363,00	370,00	343,00	355,00	367,00	374,00	360,00	373,00

Char.No	Char.Descr.	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204569	2K1D	90,63	90,23	90,27	90,38	90,27	90,28	90,21	90,26	90,33	90,23
204569	2K1D	374,00	340,00	363,00	362,00	354,00	344,00	329,00	347,00	356,00	346,00

Char.No	Char.Descr.	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
204569	2K1D	90,22	90,34	90,34	90,24	90,45	90,38	90,33	90,32	90,39	90,43
204569	2K1D	368,00	362,00	347,00	357,00	377,00	352,00	354,00	353,00	356,00	361,00

Char.No	Char.Descr.	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
204569	2K1D	90,33	90,30	90,41	90,28	90,32	90,40	90,21	90,35	90,24	90,35
204569	2K1D	352,00	353,00	355,00	353,00	371,00	340,00	353,00	356,00	381,00	352,00

Char.No	Char.Descr.	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
204569	2K1D	90,27	90,50	90,29	90,36	90,50	90,36	90,46	90,39	90,32	90,30
204569	2K1D	362,00	377,00	362,00	347,00	373,00	375,00	352,00	360,00	361,00	356,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_g	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	90,20
Ord. No.	2BD110T1S-A	Ser.No.	204569	LSL	83,89
				USL	96,51
Remark	TQ 80% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.148 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
204569	2K1D	90,42	90,27	90,26	90,22	90,47	90,37	90,23	90,25	90,34	90,27
204569	2K1D	349,00	361,00	347,00	379,00	357,00	362,00	378,00	373,00	352,00	360,00

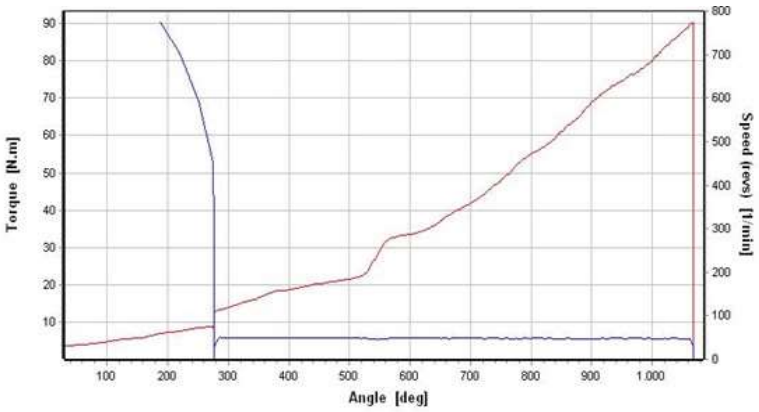
Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204569	2K1D	90,39	90,59	90,40	90,23	90,52	90,24	90,33	90,48	90,26	90,34
204569	2K1D	365,00	352,00	369,00	354,00	366,00	340,00	364,00	368,00	351,00	355,00

Torque graphs

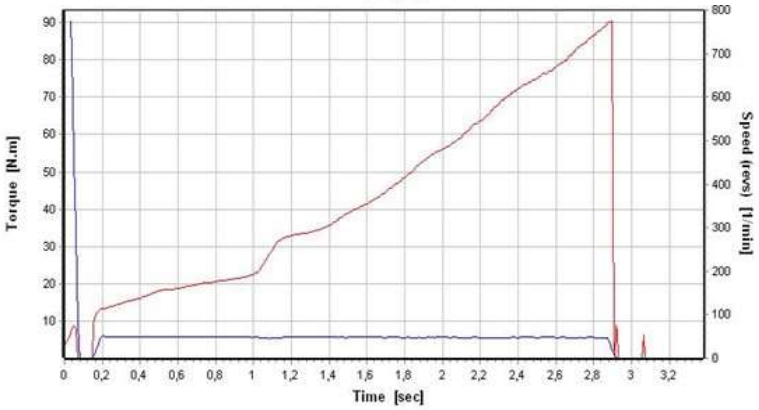
Machine Capability Study 80 %

Model: **2BD-2B110A-2K1D-2ZB**
Serial no: **1015968**

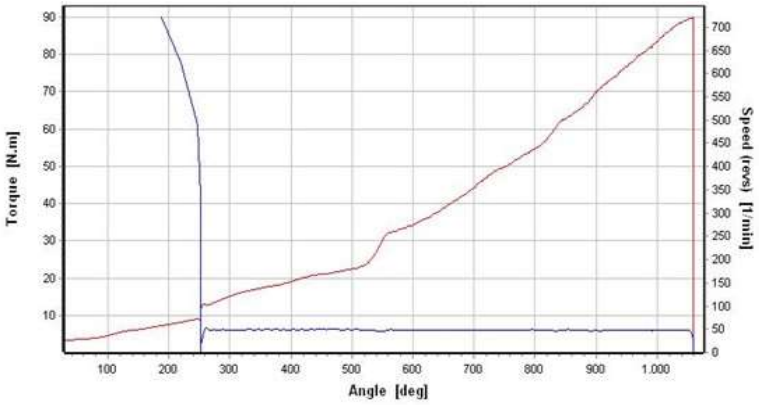
Angle degree: **360°**
Test torque: **90,2 Nm**



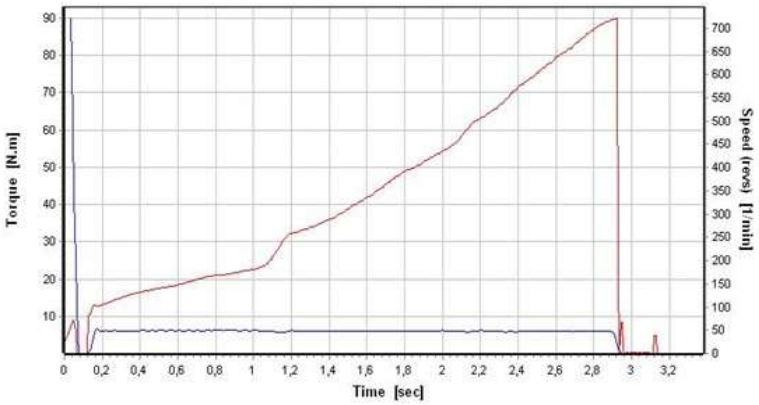
Value no. 1
Graph
Torque / Angle / Speed



Value no. 1
Graph
Torque / Time / Speed



Value no. 100
Graph
Torque / Angle / Speed



Value no. 100
Graph
Torque / Time / Speed

Test sheet no. 4

Machine Capability Study 100 %

Multi-stage tightening system	☑	Speed 50 rpm	5,6 %
Single-stage tightening system	☐	Speed 100 %	890 rpm

Manufacturer: Apex Tool Group

Serial no: **1015968**

Test torque: Tq max. 110,00 Nm

Hard joint (H)	664,13	Nm / Revolution	Angle degree	30°
Soft joint (L)	55,11	Nm / Revolution	Angle degree	360°

		H	L
a)	Tolerance down / up	102,30 117,70 Nm	102,30 - 117,70 Nm
	Tolerance down / up	7	7 %
	Average torque	110,69	110,21 Nm
	Standard deviation	0,25	0,15 Nm
	Torque scatter (99,73%)	1,48	0,91 Nm
	C_m	10,43	17,01
	C_{mk}	9,50	16,54

b)	Min. C_m hard/soft (lowest value)	10,43
	Min. C_{mk} hard/soft (lowest value)	9,50

Capability is reached if minimum C_{mk} value ≥1.67

Note:

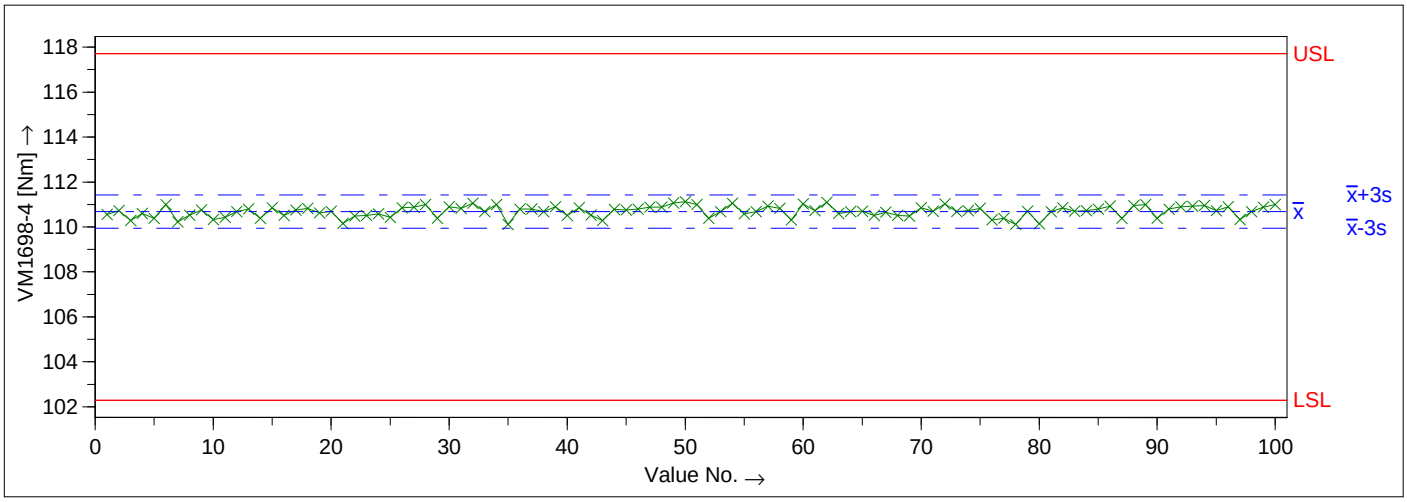
Machine Capability Study
Control System

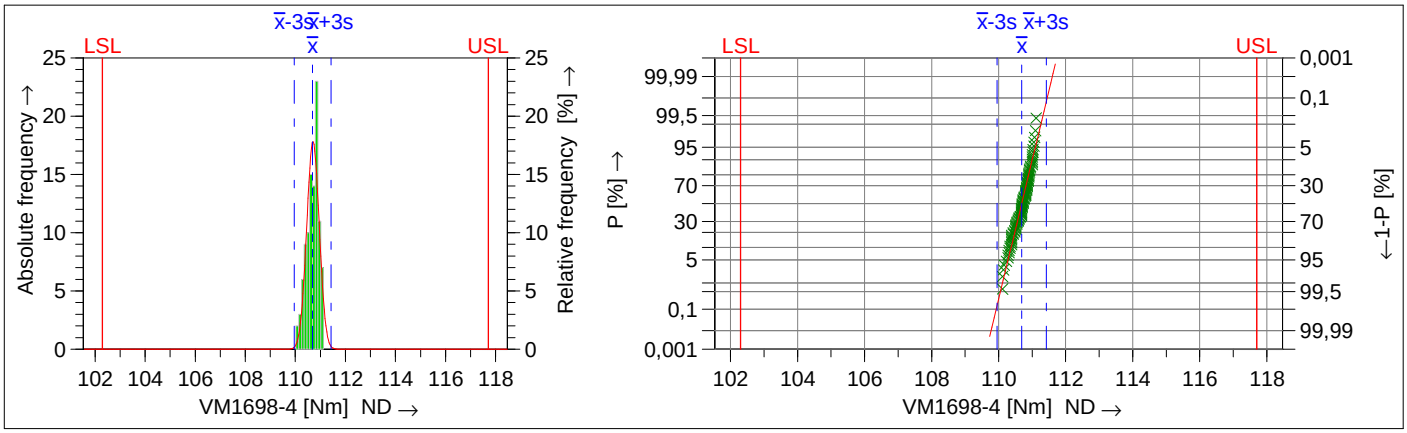
Plant	ATG Westhausen	Operator Name	Sünder
Date	10.03.2022		

Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015968_b	Char.Descr.	VM1698-4	Inspection Val. 110,00 7,70	USL 117,70
		Serial No.	1024210	Unit Nm -7,70	LSL 102,30
Char.Type	variable			Tolerance value 7 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	120 / 1019923	nges.	100

Evaluation from 10.03.2022 07:23:24 to 10.03.2022 07:38:11

Rem. TQ 100% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.113 Nm/A; Speed 890/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	110.00			$\bar{x}$	110.6875
LSL	102.30	x_{min}	110.11	$\bar{x}$-3s	109.9490
USL	117.70	x_{max}	111.12	$\bar{x}$+3s	111.4260
T	15.40	R	1.01	6s	1.4770
		$n_{<T>}$	100	$p_{<T>}$	100.00000 %
		$n_{>USL}$	0	$p_{>USL}$	0.00000%
		$n_{<LSL}$	0	$p_{<LSL}$	0.00000%
		n_{eff}	100		
		n_{tot}	100		

Model distribution			Normal Distribution
Calculation method			$M1_{1.4}$ $\hat{\sigma} = s_{tot}$
Potential Capability index	=	C_m	10.43
Critical capability index	=	C_{mk}	9.50

The requirements were met (C_m,C_{mk})

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 10.03.2022

Ser.No.	1015968_b	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	VM1698-4	Inspection Val.	110,00
Ord. No.	2BD110T1S-A	Ser.No.	1024210	LSL	102,30
				USL	117,70
Remark	TQ 100% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.113 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
1024210	VM1698-4	110,55	110,73	110,28	110,60	110,38	111,00	110,23	110,53	110,75	110,33
1024210	VM1698-4	32,50	33,00	32,25	32,00	31,50	33,25	32,00	32,25	32,25	32,50

Char.No	Char.Descr.	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
1024210	VM1698-4	110,43	110,68	110,80	110,38	110,85	110,51	110,75	110,83	110,63	110,70
1024210	VM1698-4	32,75	31,50	32,75	33,00	31,50	32,00	31,50	31,50	31,75	31,50

Char.No	Char.Descr.	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
1024210	VM1698-4	110,16	110,48	110,51	110,58	110,43	110,85	110,88	111,00	110,38	110,90
1024210	VM1698-4	31,50	32,25	31,75	32,50	32,00	32,00	31,50	33,25	31,50	32,75

Char.No	Char.Descr.	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
1024210	VM1698-4	110,83	111,05	110,68	111,00	110,11	110,80	110,80	110,68	110,90	110,51
1024210	VM1698-4	31,75	31,00	31,50	31,50	31,75	32,00	31,00	31,75	31,25	31,25

Char.No	Char.Descr.	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
1024210	VM1698-4	110,85	110,53	110,28	110,78	110,75	110,80	110,88	110,88	111,07	111,12
1024210	VM1698-4	31,25	31,25	30,25	31,00	32,75	31,75	31,00	31,25	31,25	31,00

Char.No	Char.Descr.	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
1024210	VM1698-4	111,00	110,38	110,68	111,05	110,58	110,68	110,92	110,83	110,31	111,02
1024210	VM1698-4	31,00	30,50	30,50	31,00	30,50	31,25	30,75	30,25	29,50	31,00

Char.No	Char.Descr.	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
1024210	VM1698-4	110,73	111,10	110,60	110,68	110,70	110,51	110,65	110,51	110,48	110,85
1024210	VM1698-4	30,00	29,75	30,50	29,75	31,25	31,00	31,25	31,75	29,75	31,00

Char.No	Char.Descr.	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
1024210	VM1698-4	110,70	111,02	110,68	110,73	110,83	110,31	110,38	110,11	110,70	110,14
1024210	VM1698-4	31,25	31,50	31,00	30,50	31,75	30,75	30,50	29,75	30,25	30,25

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 10.03.2022

Ser.No.	1015968_b	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	VM1698-4	Inspection Val.	110,00
Ord. No.	2BD110T1S-A	Ser.No.	1024210	LSL	102,30
				USL	117,70
Remark	TQ 100% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.113 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
1024210	VM1698-4	110,68	110,85	110,70	110,73	110,80	110,92	110,38	110,95	111,00	110,38
1024210	VM1698-4	30,00	30,25	30,50	30,00	29,75	31,75	31,75	30,75	31,25	31,25

Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
1024210	VM1698-4	110,80	110,90	110,92	110,95	110,73	110,90	110,33	110,68	110,88	111,00
1024210	VM1698-4	30,75	31,25	30,00	30,25	30,25	30,25	31,75	29,25	30,25	29,50

Machine Capability Study
Tool System

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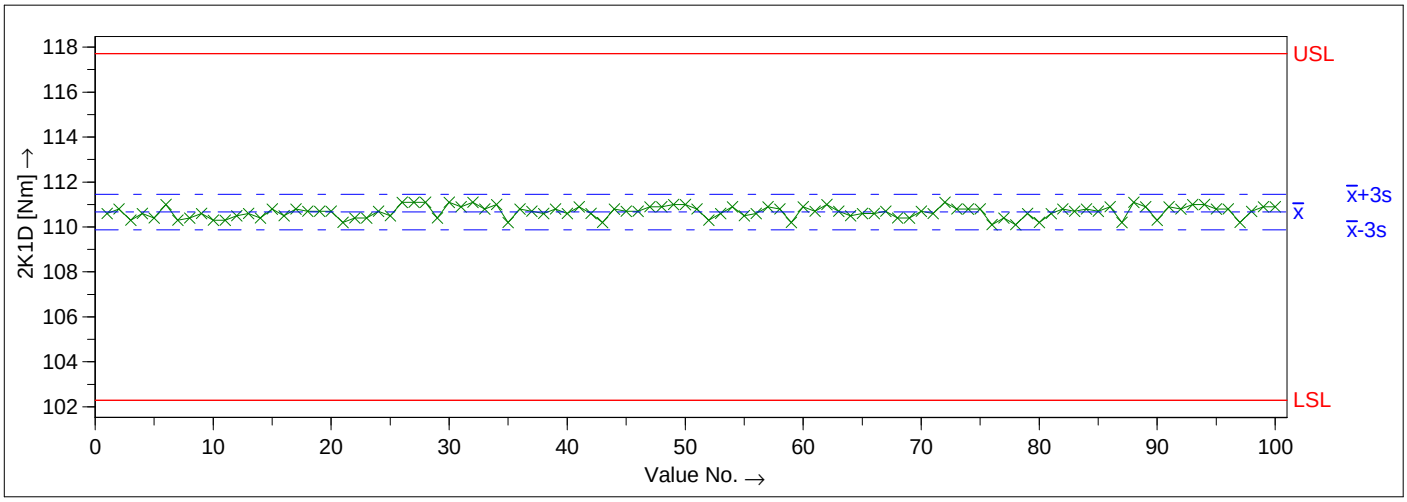
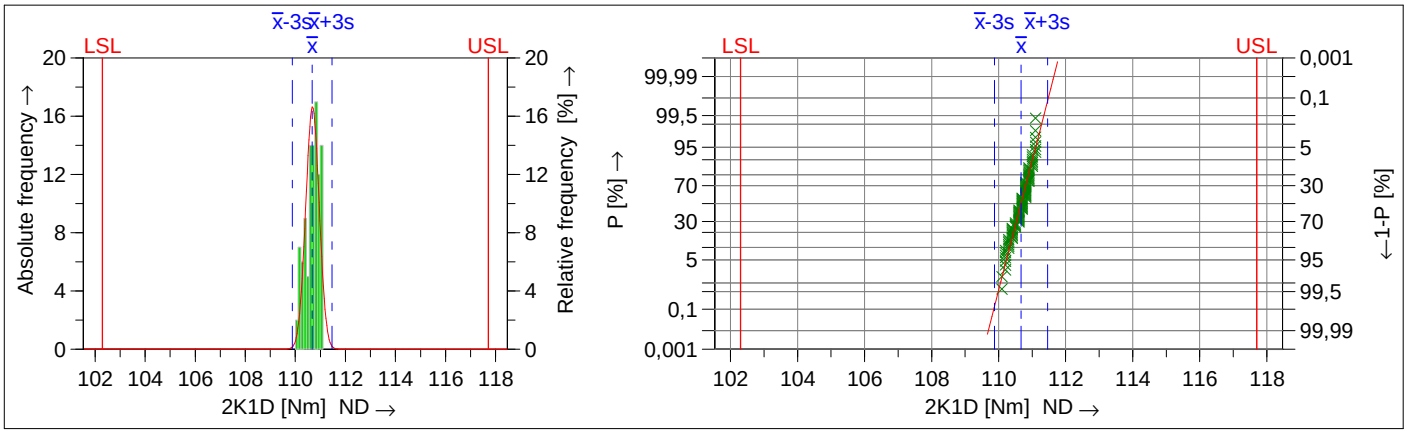
Plant ATG Westhausen		Operator Name Sünder	Date 10.03.2022

Ord. No. 2BD110T1S-A	Part type 2BD-2B110A-2K1D-2ZB				Contr.item yes
Serial No. 1015968_b	Char.Descr. 2K1D	Inspection Val.	110,00	7,70	USL 117,70
	Serial No. 204569	Unit	Nm	-7,70	LSL 102,30
Char.Type variable		Tolerance value	7 %		Decimal Pl. 2
Cust.Name Cleco	Reference System VM1698-4				Test Electronic MPRO400GCD-P
Contr.No. Homologation	Reference Transducer 120 / 1019923				nges. 100

Evaluation from 10.03.2022 07:23:24 to 10.03.2022 07:38:11

Rem. TQ 100% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.113 Nm/A; Speed 890/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	110.00			$\bar{x}$	110.6680
LSL	102.30	x_{min}	110.10	$\bar{x}$-3s	109.8773
USL	117.70	x_{max}	111.10	$\bar{x}$+3s	111.4587
T	15.40	R	1.00	6s	1.5814
		$n_{<T>}$	100	$p_{<T>}$	100.00000 %
		$n_{>USL}$	0	$p_{>USL}$	0.00000%
		$n_{<LSL}$	0	$p_{<LSL}$	0.00000%
		n_{eff}	100		
		n_{tot}	100		

Model distribution			Normal Distribution
Calculation method			$M1_{1.4}$ $\hat{\sigma} = s_{tot}$
Potential Capability index	=	C_m	9.74
Critical capability index	=	C_{mk}	8.89

The requirements were met (C_m,C_{mk})

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 10.03.2022

Ser.No.	1015968_b	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	110,00
Ord. No.	2BD110T1S-A	Ser.No.	204569	LSL	102,30
				USL	117,70
Remark	TQ 100% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.113 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
204569	2K1D	110,60	110,80	110,30	110,60	110,40	111,00	110,30	110,40	110,60	110,30
204569	2K1D	33,00	33,00	33,00	32,00	32,00	34,00	33,00	33,00	33,00	33,00

Char.No	Char.Descr.	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
204569	2K1D	110,30	110,50	110,60	110,40	110,80	110,50	110,80	110,70	110,70	110,70
204569	2K1D	33,00	32,00	33,00	34,00	32,00	32,00	32,00	32,00	32,00	32,00

Char.No	Char.Descr.	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204569	2K1D	110,20	110,40	110,40	110,70	110,50	111,10	111,10	111,10	110,40	111,10
204569	2K1D	32,00	32,00	32,00	33,00	33,00	32,00	32,00	34,00	32,00	33,00

Char.No	Char.Descr.	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
204569	2K1D	110,90	111,10	110,80	111,00	110,20	110,80	110,70	110,60	110,80	110,60
204569	2K1D	32,00	32,00	32,00	32,00	32,00	33,00	32,00	32,00	32,00	31,00

Char.No	Char.Descr.	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204569	2K1D	110,90	110,60	110,20	110,80	110,70	110,70	110,90	110,90	111,00	111,00
204569	2K1D	31,00	31,00	31,00	31,00	33,00	32,00	31,00	32,00	32,00	31,00

Char.No	Char.Descr.	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
204569	2K1D	110,80	110,30	110,60	110,90	110,50	110,60	110,90	110,80	110,20	110,90
204569	2K1D	31,00	31,00	31,00	32,00	31,00	31,00	31,00	31,00	30,00	31,00

Char.No	Char.Descr.	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
204569	2K1D	110,70	111,00	110,70	110,50	110,60	110,60	110,70	110,40	110,40	110,70
204569	2K1D	31,00	31,00	31,00	30,00	31,00	32,00	32,00	32,00	30,00	31,00

Char.No	Char.Descr.	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
204569	2K1D	110,60	111,10	110,80	110,80	110,80	110,10	110,40	110,10	110,60	110,20
204569	2K1D	32,00	32,00	32,00	31,00	32,00	31,00	31,00	30,00	30,00	30,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 10.03.2022

Ser.No.	1015968_b	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	110,00
Ord. No.	2BD110T1S-A	Ser.No.	204569	LSL	102,30
				USL	117,70
Remark	TQ 100% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.113 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
204569	2K1D	110,60	110,80	110,70	110,80	110,70	110,90	110,20	111,10	110,90	110,30
204569	2K1D	30,00	31,00	31,00	30,00	31,00	32,00	32,00	32,00	31,00	31,00

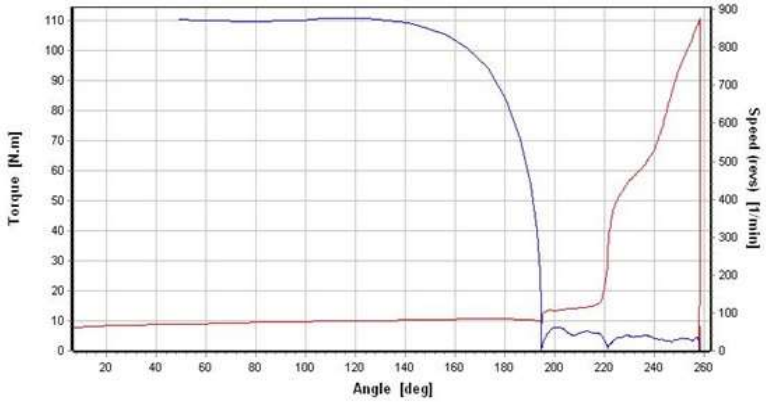
Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204569	2K1D	110,90	110,80	111,00	111,00	110,80	110,80	110,20	110,70	110,90	110,90
204569	2K1D	31,00	31,00	31,00	31,00	30,00	31,00	32,00	30,00	31,00	30,00

Torque graphs

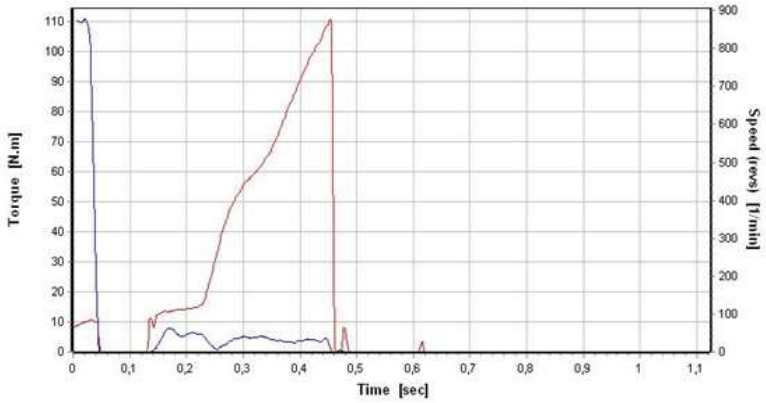
Machine Capability Study 100 %

Model: **2BD-2B110A-2K1D-2ZB**
Serial no: **1015968**

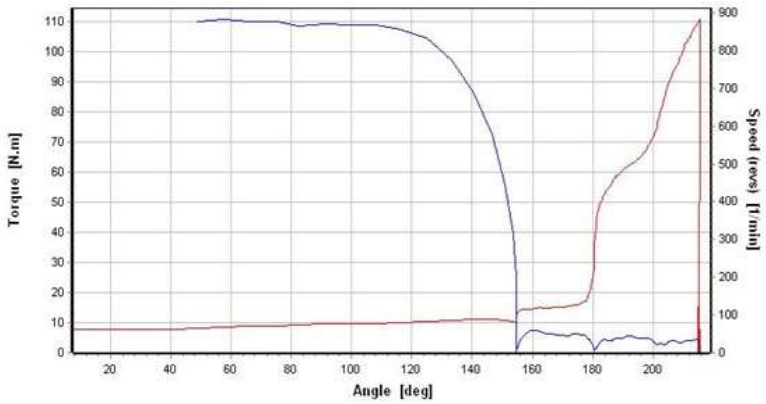
Angle degree: **30°**
Test torque: **110,0 Nm**



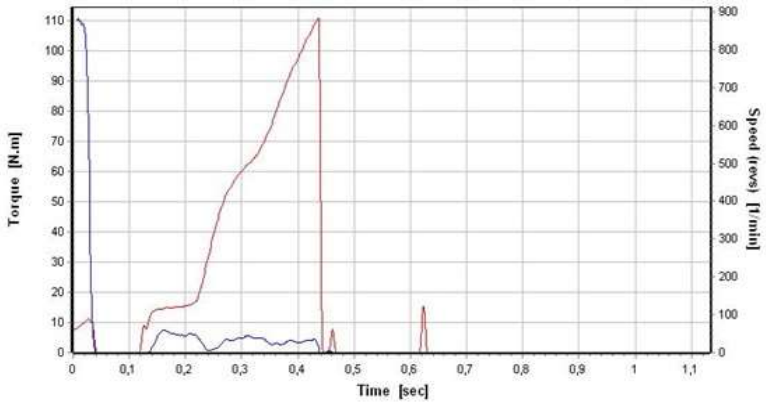
Value no. 1
Graph
Torque / Angle / Speed



Value no. 1
Graph
Torque / Time / Speed



Value no. 100
Graph
Torque / Angle / Speed



Value no. 100
Graph
Torque / Time / Speed

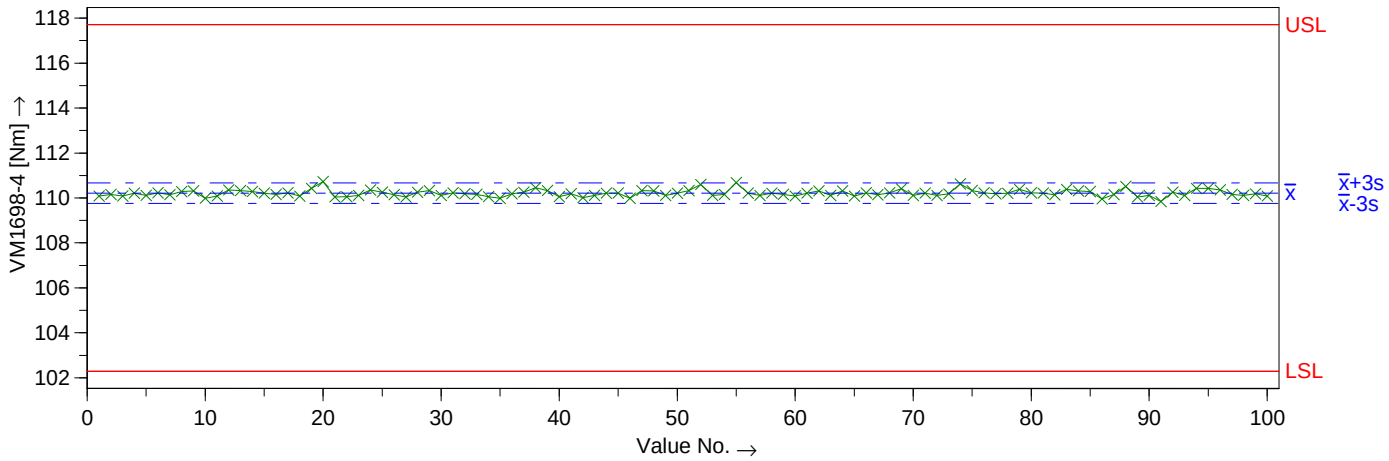
Machine Capability Study
Control System

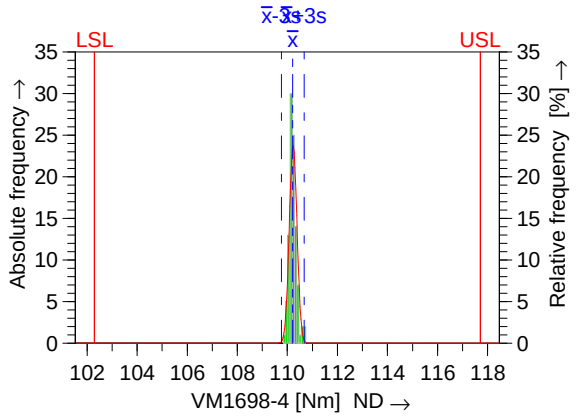
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.03.2022		

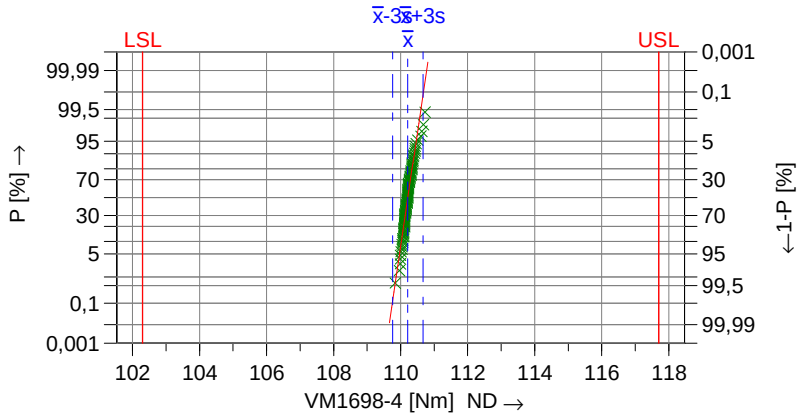
Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB			Contr.item	yes
Serial No.	1015968_a	Char.Descr.	VM1698-4	Inspection Val.	110,00	7,70	USL 117,70
		Serial No.	1024210	Unit	Nm	-7,70	LSL 102,30
Char.Type	variable			Tolerance value	7 %	Decimal Pl.	2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P		
Contr.No.	Homologation	Reference Transducer	120 / 1019923	nges.	100		

Evaluation from 09.03.2022 15:30:15 to 09.03.2022 17:20:04

Rem. TQ 100% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.113 Nm/A; Speed 890/50 rpm;







Drawing Values		Collected Values		Statistics	
T_m	110.00			$\bar{x}$	110.2144
LSL	102.30	x_{min}	109.84	$\bar{x}$-3s	109.7617
USL	117.70	x_{max}	110.73	$\bar{x}$+3s	110.6671
T	15.40	R	0.89	6s	0.9053
		$n_{<T>}$	100	$p_{<T>}$	100.00000 %
		$n_{>USL}$	0	$p_{>USL}$	0.00000%
		$n_{<LSL}$	0	$p_{<LSL}$	0.00000%
		n_{eff}	100		
		n_{tot}	100		

Model distribution			Normal Distribution
Calculation method			$M1_{1.4}$ $\hat{\sigma} = s_{tot}$
Potential Capability index	=	C_m	17.01
Critical capability index	=	C_{mk}	16.54

The requirements were met (C_m,C_{mk})

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_a	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	VM1698-4	Inspection Val.	110,00
Ord. No.	2BD110T1S-A	Ser.No.	1024210	LSL	102,30
				USL	117,70
Remark	TQ 100% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.113 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
1024210	VM1698-4	110,09	110,16	110,09	110,21	110,11	110,23	110,14	110,28	110,31	109,99
1024210	VM1698-4	369,00	343,75	359,00	333,25	339,00	347,50	339,50	322,50	339,00	344,00

Char.No	Char.Descr.	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
1024210	VM1698-4	110,09	110,36	110,33	110,28	110,21	110,16	110,23	110,09	110,43	110,73
1024210	VM1698-4	337,50	329,00	330,75	355,75	325,25	342,00	343,75	333,00	348,75	338,50

Char.No	Char.Descr.	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
1024210	VM1698-4	110,04	110,06	110,11	110,36	110,26	110,14	110,04	110,26	110,33	110,11
1024210	VM1698-4	360,00	350,75	345,50	357,50	339,75	347,00	343,25	338,75	339,75	326,25

Char.No	Char.Descr.	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
1024210	VM1698-4	110,23	110,19	110,16	110,06	109,99	110,19	110,26	110,46	110,33	110,06
1024210	VM1698-4	339,50	346,75	359,75	355,25	370,00	356,25	348,75	346,75	370,75	370,00

Char.No	Char.Descr.	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
1024210	VM1698-4	110,19	110,01	110,11	110,21	110,21	109,99	110,33	110,31	110,11	110,21
1024210	VM1698-4	371,00	351,50	357,50	334,75	350,00	358,00	380,75	369,75	370,50	352,25

Char.No	Char.Descr.	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
1024210	VM1698-4	110,33	110,60	110,11	110,16	110,68	110,21	110,11	110,21	110,16	110,09
1024210	VM1698-4	356,75	351,75	333,75	354,75	359,00	355,75	367,50	348,00	344,25	365,00

Char.No	Char.Descr.	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
1024210	VM1698-4	110,21	110,31	110,11	110,31	110,09	110,23	110,14	110,23	110,41	110,11
1024210	VM1698-4	361,75	345,00	376,50	342,75	348,50	346,00	352,00	359,00	370,00	358,50

Char.No	Char.Descr.	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
1024210	VM1698-4	110,21	110,11	110,19	110,63	110,33	110,23	110,19	110,21	110,38	110,23
1024210	VM1698-4	357,25	336,00	360,25	345,75	344,50	366,75	346,75	344,75	368,00	366,25

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_a	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	VM1698-4	Inspection Val.	110,00
Ord. No.	2BD110T1S-A	Ser.No.	1024210	LSL	102,30
				USL	117,70
Remark	TQ 100% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.113 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
1024210	VM1698-4	110,21	110,14	110,38	110,31	110,28	109,96	110,16	110,51	110,04	110,11
1024210	VM1698-4	367,75	358,75	368,75	368,00	379,00	380,50	376,50	358,50	366,25	344,25

Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
1024210	VM1698-4	109,84	110,26	110,11	110,43	110,43	110,36	110,16	110,11	110,19	110,09
1024210	VM1698-4	366,50	363,75	360,25	365,75	378,75	345,25	369,75	363,25	353,00	347,00

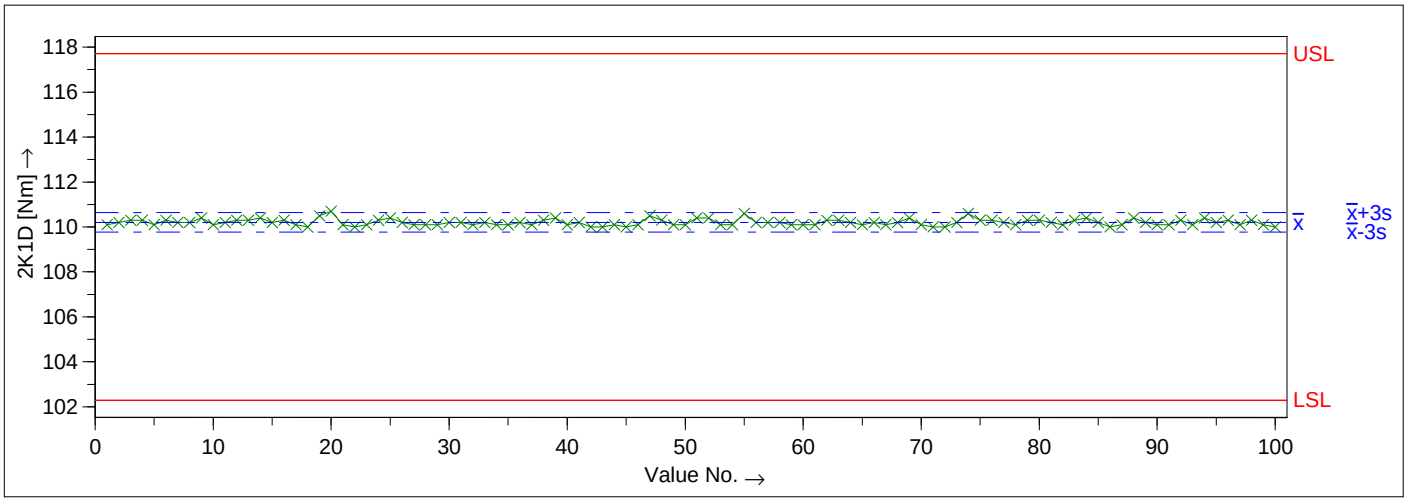
Machine Capability Study
Tool System

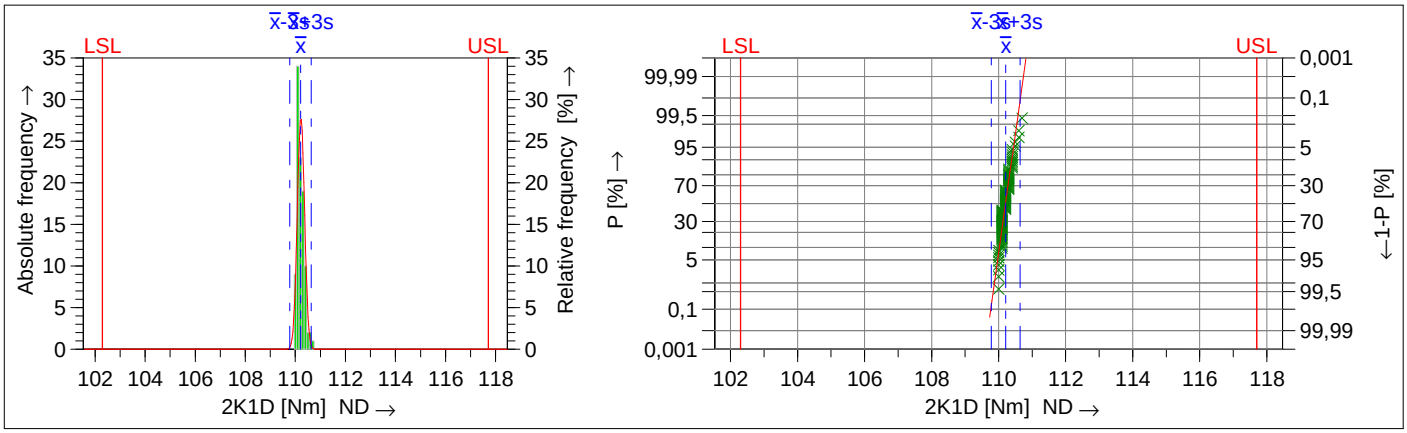
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.03.2022		

Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015968_a	Char.Descr.	2K1D	Inspection Val. 110,00 7,70	USL 117,70
		Serial No.	204569	Unit Nm -7,70	LSL 102,30
Char.Type	variable			Tolerance value 7 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	120 / 1019923	nges.	100

Evaluation from 09.03.2022 15:30:16 to 09.03.2022 17:20:04

Rem. TQ 100% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.113 Nm/A; Speed 890/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	110.00			$\bar{x}$	110.2060
LSL	102.30	x_{min}	110.00	$\bar{x}$-3s	109.7757
USL	117.70	x_{max}	110.70	$\bar{x}$+3s	110.6363
T	15.40	R	0.70	6s	0.8605
		$n_{<T>}$	100	$p_{<T>}$	100.00000 %
		$n_{>USL}$	0	$p_{>USL}$	0.00000%
		$n_{<LSL}$	0	$p_{<LSL}$	0.00000%
		n_{eff}	100		
		n_{tot}	100		

Model distribution			Normal Distribution
Calculation method			M1 1.4 $\hat{\sigma} = s_{tot}$
Potential Capability index	=	C_m	17.90
Critical capability index	=	C_{mk}	17.42

The requirements were met (C_m,C_{mk})

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_a	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	110,00
Ord. No.	2BD110T1S-A	Ser.No.	204569	LSL	102,30
				USL	117,70
Remark	TQ 100% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.113 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
204569	2K1D	110,10	110,20	110,30	110,30	110,10	110,30	110,20	110,20	110,40	110,10
204569	2K1D	371,00	344,00	360,00	332,00	337,00	348,00	339,00	324,00	339,00	346,00

Char.No	Char.Descr.	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
204569	2K1D	110,20	110,30	110,30	110,40	110,20	110,30	110,10	110,00	110,50	110,70
204569	2K1D	338,00	330,00	331,00	356,00	325,00	342,00	344,00	335,00	350,00	338,00

Char.No	Char.Descr.	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204569	2K1D	110,10	110,00	110,10	110,30	110,40	110,20	110,10	110,10	110,10	110,20
204569	2K1D	360,00	351,00	346,00	358,00	340,00	348,00	343,00	340,00	340,00	327,00

Char.No	Char.Descr.	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
204569	2K1D	110,20	110,10	110,20	110,10	110,10	110,20	110,10	110,30	110,40	110,10
204569	2K1D	339,00	346,00	357,00	356,00	369,00	356,00	348,00	345,00	370,00	370,00

Char.No	Char.Descr.	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204569	2K1D	110,20	110,00	110,00	110,10	110,00	110,10	110,50	110,30	110,10	110,10
204569	2K1D	371,00	350,00	357,00	336,00	349,00	358,00	381,00	368,00	371,00	352,00

Char.No	Char.Descr.	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
204569	2K1D	110,40	110,40	110,10	110,10	110,60	110,20	110,20	110,20	110,10	110,10
204569	2K1D	357,00	351,00	334,00	355,00	359,00	356,00	368,00	348,00	344,00	365,00

Char.No	Char.Descr.	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
204569	2K1D	110,10	110,30	110,30	110,20	110,10	110,20	110,10	110,20	110,40	110,10
204569	2K1D	361,00	344,00	379,00	342,00	347,00	344,00	353,00	359,00	371,00	359,00

Char.No	Char.Descr.	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
204569	2K1D	110,00	110,00	110,20	110,60	110,30	110,30	110,20	110,10	110,30	110,30
204569	2K1D	358,00	337,00	361,00	346,00	344,00	367,00	347,00	344,00	369,00	366,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_a	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	110,00
Ord. No.	2BD110T1S-A	Ser.No.	204569	LSL	102,30
				USL	117,70
Remark	TQ 100% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.113 Nm/A; Speed 890/50 rpm;				

Char.No	Char.Descr.	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
204569	2K1D	110,20	110,10	110,30	110,40	110,20	110,00	110,10	110,40	110,20	110,10
204569	2K1D	368,00	360,00	369,00	368,00	380,00	380,00	377,00	358,00	367,00	344,00

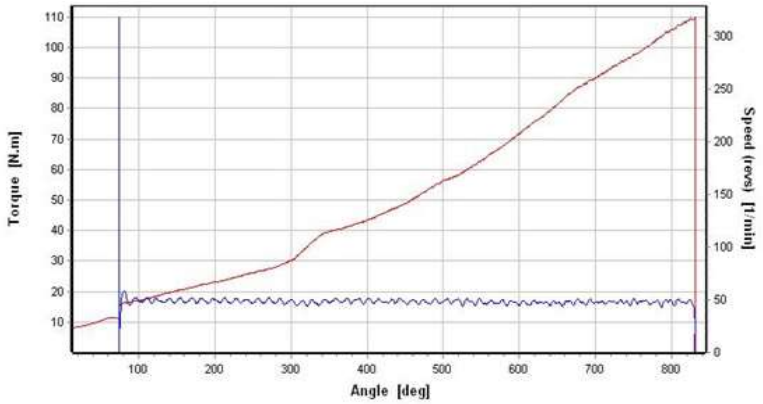
Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204569	2K1D	110,10	110,30	110,10	110,40	110,20	110,30	110,10	110,30	110,10	110,00
204569	2K1D	369,00	364,00	360,00	366,00	378,00	344,00	370,00	364,00	353,00	347,00

Torque graphs

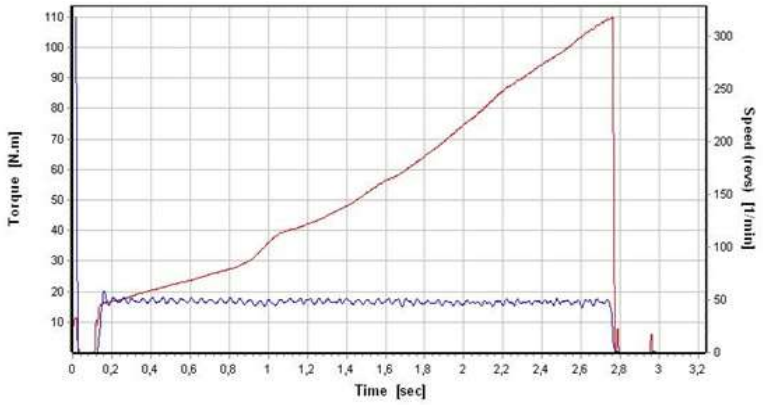
Machine Capability Study 100 %

Model: **2BD-2B110A-2K1D-2ZB**
Serial no: **1015968**

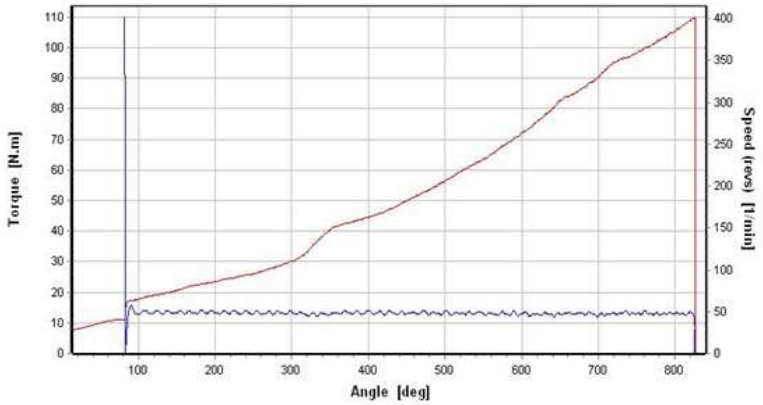
Angle degree: **360°**
Test torque: **110,0 Nm**



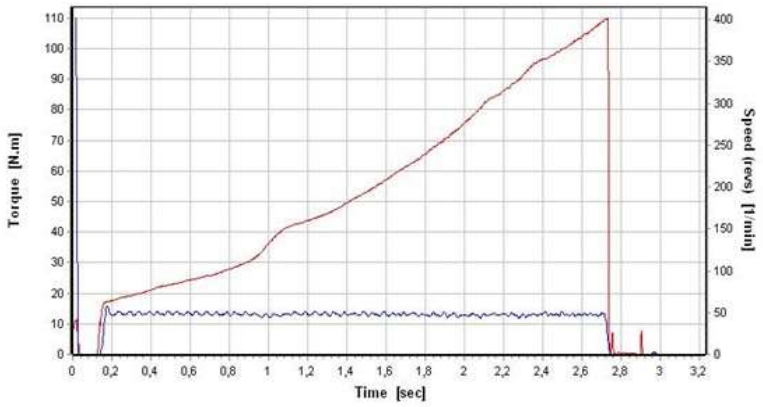
Value no. 1
Graph
Torque / Angle / Speed



Value no. 1
Graph
Torque / Time / Speed



Value no. 100
Graph
Torque / Angle / Speed



Value no. 100
Graph
Torque / Time / Speed

General Specifications

Manufacturer: Apex Tool Group **Tool type:** Fixtured Spindle

Model: 2BD-2B110A-2K1D-2ZB **Serial no:** 1015968

Torque range: **11 Nm to 110 Nm**

Difference evaluation: Reference/Tool at 40° / 60 %

Capability examination

Snugfit value: 22 Nm **Torque tolerance ±** 7 %

Target torque: 66 Nm Tolerance: 1,41 % ± **0,70 %**

Angle degree: 40° Tolerance: 2,6° ± **1,3°**

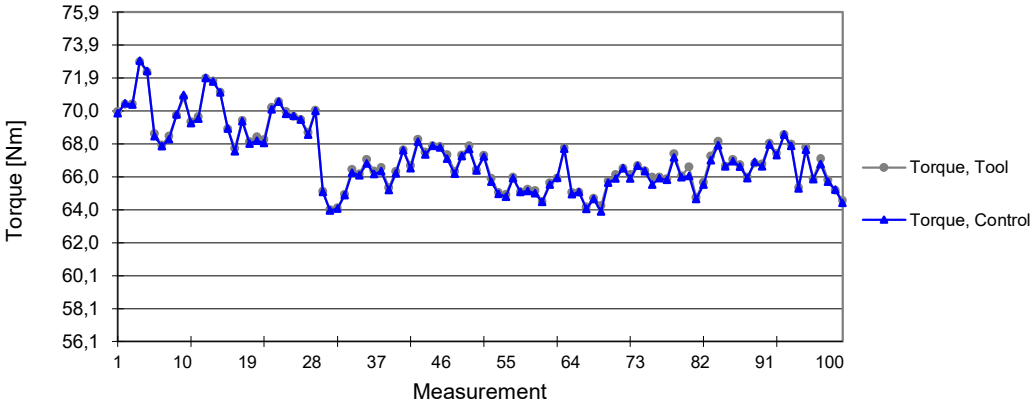
Formula derivation: $C_m = \frac{T}{6\,s}$ $T = C_m * 6\,s$

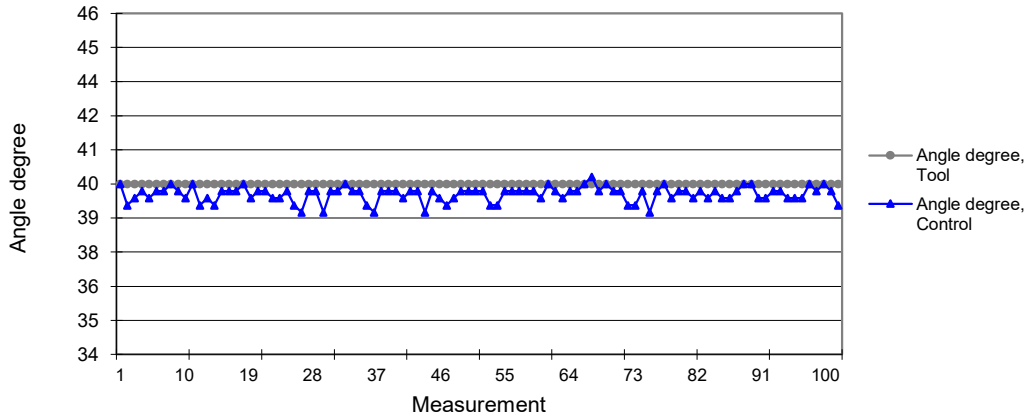
Tool without angle correction

Measurement	Tool data		Control data		Difference	
No.	Torque	Angle	Torque	Angle	Torque	Angle
1	69,92	40,00	69,82	40,00	0,10	0,00
2	70,36	40,00	70,42	39,25	0,06	0,75
3	70,37	40,00	70,34	39,50	0,03	0,50
4	72,91	40,00	72,98	39,75	0,07	0,25
5	72,29	40,00	72,36	39,50	0,07	0,50
6	68,58	40,00	68,42	39,75	0,16	0,25
7	67,89	40,00	67,83	39,75	0,06	0,25
8	68,44	40,00	68,25	40,00	0,19	0,00
9	69,71	40,00	69,73	39,75	0,02	0,25
10	70,75	40,00	70,91	39,50	0,16	0,50
11	69,31	40,00	69,23	40,00	0,08	0,00
12	69,61	40,00	69,50	39,25	0,11	0,75
13	71,93	40,00	71,94	39,50	0,01	0,50
14	71,74	40,00	71,72	39,25	0,02	0,75
15	71,08	40,00	71,08	39,75	0,00	0,25
16	68,87	40,00	68,89	39,75	0,02	0,25
17	67,70	40,00	67,53	39,75	0,17	0,25
18	69,39	40,00	69,33	40,00	0,06	0,00
19	68,10	40,00	68,00	39,50	0,10	0,50
20	68,39	40,00	68,17	39,75	0,22	0,25
21	68,23	40,00	68,03	39,75	0,20	0,25
22	70,16	40,00	70,05	39,50	0,11	0,50
23	70,52	40,00	70,51	39,50	0,01	0,50
24	69,91	40,00	69,78	39,75	0,13	0,25
25	69,63	40,00	69,65	39,25	0,02	0,75
26	69,43	40,00	69,43	39,00	0,00	1,00
27	68,67	40,00	68,52	39,75	0,15	0,25
28	69,99	40,00	69,95	39,75	0,04	0,25
29	65,12	40,00	65,09	39,00	0,03	1,00
30	64,02	40,00	63,96	39,75	0,06	0,25
31	64,13	40,00	64,08	39,75	0,05	0,25
32	64,94	40,00	64,90	40,00	0,04	0,00
33	66,44	40,00	66,23	39,75	0,21	0,25
34	66,18	40,00	66,10	39,75	0,08	0,25
35	67,04	40,00	66,79	39,25	0,25	0,75
36	66,33	40,00	66,15	39,00	0,18	1,00
37	66,56	40,00	66,33	39,75	0,23	0,25
38	65,34	40,00	65,19	39,75	0,15	0,25
39	66,32	40,00	66,20	39,75	0,12	0,25
40	67,61	40,00	67,58	39,50	0,03	0,50
41	66,66	40,00	66,50	39,75	0,16	0,25
42	68,25	40,00	68,10	39,75	0,15	0,25
43	67,46	40,00	67,34	39,00	0,12	1,00
44	67,86	40,00	67,85	39,75	0,01	0,25
45	67,82	40,00	67,76	39,50	0,06	0,50
46	67,33	40,00	67,09	39,25	0,24	0,75
47	66,32	40,00	66,18	39,50	0,14	0,50
48	67,31	40,00	67,24	39,75	0,07	0,25
49	67,85	40,00	67,66	39,75	0,19	0,25
50	66,41	40,00	66,38	39,75	0,03	0,25
51	67,29	40,00	67,21	39,75	0,08	0,25
52	65,90	40,00	65,69	39,25	0,21	0,75
53	65,06	40,00	64,97	39,25	0,09	0,75
54	64,92	40,00	64,80	39,75	0,12	0,25
55	65,97	40,00	65,91	39,75	0,06	0,25
56	65,08	40,00	65,09	39,75	0,01	0,25
57	65,24	40,00	65,14	39,75	0,10	0,25
58	65,16	40,00	65,00	39,75	0,16	0,25
59	64,51	40,00	64,48	39,50	0,03	0,50
60	65,63	40,00	65,54	40,00	0,09	0,00
61	65,92	40,00	65,93	39,75	0,01	0,25
62	67,73	40,00	67,68	39,50	0,05	0,50
63	65,05	40,00	64,95	39,75	0,10	0,25
64	65,07	40,00	65,09	39,75	0,02	0,25
65	64,17	40,00	64,06	40,00	0,11	0,00
66	64,70	40,00	64,65	40,25	0,05	0,25
67	64,25	40,00	63,91	39,75	0,34	0,25
68	65,74	40,00	65,64	40,00	0,10	0,00
69	66,12	40,00	65,88	39,75	0,24	0,25
70	66,51	40,00	66,50	39,75	0,01	0,25
71	66,13	40,00	65,88	39,25	0,25	0,75
72	66,66	40,00	66,65	39,25	0,01	0,75
73	66,35	40,00	66,33	39,75	0,02	0,25
74	65,97	40,00	65,54	39,00	0,43	1,00
75	65,98	40,00	65,91	39,75	0,07	0,25
76	65,89	40,00	65,81	40,00	0,08	0,00
77	67,38	40,00	67,16	39,50	0,22	0,50
78	66,04	40,00	65,96	39,75	0,08	0,25
79	66,58	40,00	66,05	39,75	0,53	0,25
80	64,75	40,00	64,65	39,50	0,10	0,50
81	65,66	40,00	65,51	39,75	0,15	0,25
82	67,24	40,00	66,99	39,50	0,25	0,50
83	68,12	40,00	67,90	39,75	0,22	0,25
84	66,63	40,00	66,62	39,50	0,01	0,50
85	67,03	40,00	66,94	39,50	0,09	0,50
86	66,72	40,00	66,60	39,75	0,12	0,25
87	65,98	40,00	65,91	40,00	0,07	0,00
88	66,81	40,00	66,89	40,00	0,08	0,00
89	66,77	40,00	66,62	39,50	0,15	0,50
90	68,01	40,00	67,93	39,50	0,08	0,50
91	67,40	40,00	67,29	39,75	0,11	0,25
92	68,53	40,00	68,52	39,75	0,01	0,25
93	67,96	40,00	67,85	39,50	0,11	0,50
94	65,34	40,00	65,29	39,50	0,05	0,50
95	67,77	40,00	67,63	39,50	0,14	0,50
96	65,89	40,00	65,86	40,00	0,03	0,00
97	67,09	40,00	66,77	39,75	0,32	0,25
98	65,81	40,00	65,69	40,00	0,12	0,00
99	65,18	40,00	65,22	39,75	0,04	0,25
100	64,58	40,00	64,43	39,25	0,15	0,75
				Standard deviation:	**0,093**	**0,255**

Graphical representation

Model:	**2BD-2B110A-2K1D-2ZB**	Serial no:	**1015968**
Target torque:	**66,00 Nm**	60 % of max. torque	
Angle degree:	**40°**	Tool without angle correction	





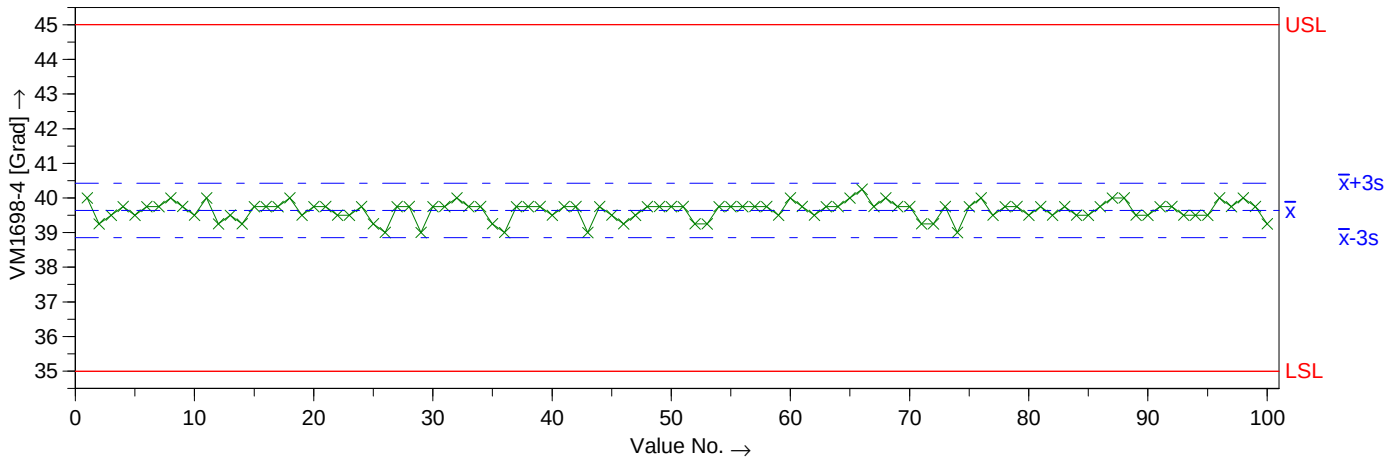
Machine Capability Study
Control System

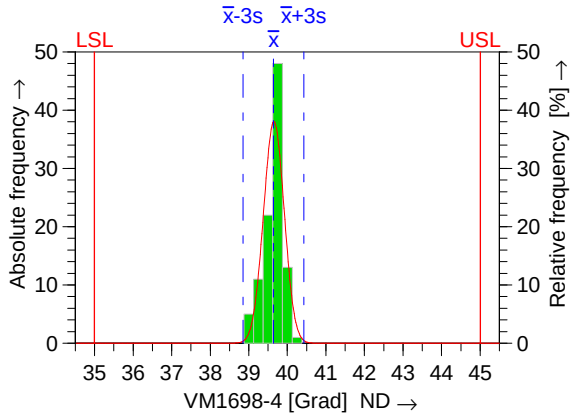
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.03.2022		

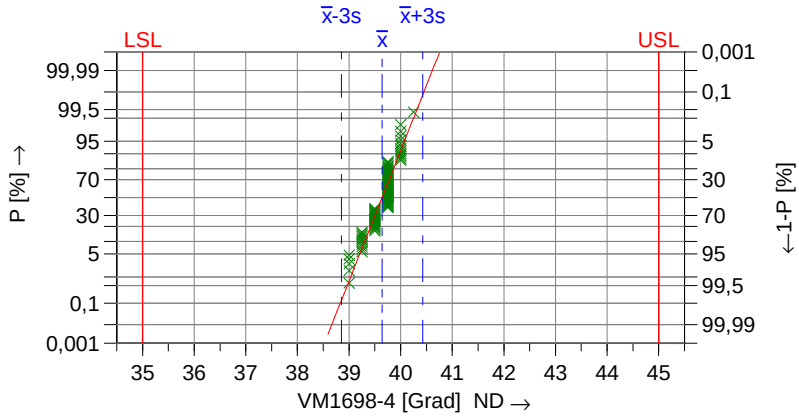
Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015968_k	Char.Descr.	VM1698-4	Inspection Val. 40,00 5,00	USL 45,00
		Serial No.	1024210	Unit Grad -5,00	LSL 35,00
Char.Type	variable			Tolerance value 12 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	120 / 1019923	nges.	100

Evaluation from 09.03.2022 13:34:44 to 09.03.2022 13:47:53

Rem. TQ 60% Angle 40° +/-5° * TQ-Cal.: 110 Nm; Cur-Cal.: 3.133 Nm/A; Speed 300/50 rpm;







Drawing Values		Collected Values		Statistics	
T_m	40.00			$\bar{x}$	39.6400
LSL	35.00	x_{min}	39.00	$\bar{x}$-3s	38.8543
USL	45.00	x_{max}	40.25	$\bar{x}$+3s	40.4257
T	10.00	R	1.25	6s	1.5713
		$n_{<T>}$	100	$p_{<T>}$	100.00000 %
		$n_{>USL}$	0	$p_{>USL}$	0.00000%
		$n_{<LSL}$	0	$p_{<LSL}$	0.00000%
		n_{eff}	100		
		n_{tot}	100		

Model distribution			Normal Distribution
Calculation method			$M1_{1.4}$ $\hat{\sigma} = s_{tot}$
Potential Capability index	=	C_m	6.36
Critical capability index	=	C_{mk}	5.91

The requirements were met (C_m,C_{mk})

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_k	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	VM1698-4	Inspection Val.	66,00
Ord. No.	2BD110T1S-A	Ser.No.	1024210	LSL	61,38
				USL	70,62
Remark	TQ 60% Angle 40°+/-5°* TQ-Cal.: 110 Nm; Cur -Cal.: 3.133 Nm/A; Speed 300/50 rpm;				

Char.No	Char.Descr.	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
1024210	VM1698-4	69,82	70,42	70,34	72,98	72,36	68,42	67,83	68,25	69,73	70,91
1024210	VM1698-4	40,00	39,25	39,50	39,75	39,50	39,75	39,75	40,00	39,75	39,50

Char.No	Char.Descr.	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
1024210	VM1698-4	69,23	69,50	71,94	71,72	71,08	68,89	67,53	69,33	68,00	68,17
1024210	VM1698-4	40,00	39,25	39,50	39,25	39,75	39,75	39,75	40,00	39,50	39,75

Char.No	Char.Descr.	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
1024210	VM1698-4	68,03	70,05	70,51	69,78	69,65	69,43	68,52	69,95	65,09	63,96
1024210	VM1698-4	39,75	39,50	39,50	39,75	39,25	39,00	39,75	39,75	39,00	39,75

Char.No	Char.Descr.	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
1024210	VM1698-4	64,08	64,90	66,23	66,10	66,79	66,15	66,33	65,19	66,20	67,58
1024210	VM1698-4	39,75	40,00	39,75	39,75	39,25	39,00	39,75	39,75	39,75	39,50

Char.No	Char.Descr.	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
1024210	VM1698-4	66,50	68,10	67,34	67,85	67,76	67,09	66,18	67,24	67,66	66,38
1024210	VM1698-4	39,75	39,75	39,00	39,75	39,50	39,25	39,50	39,75	39,75	39,75

Char.No	Char.Descr.	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
1024210	VM1698-4	67,21	65,69	64,97	64,80	65,91	65,09	65,14	65,00	64,48	65,54
1024210	VM1698-4	39,75	39,25	39,25	39,75	39,75	39,75	39,75	39,75	39,50	40,00

Char.No	Char.Descr.	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
1024210	VM1698-4	65,93	67,68	64,95	65,09	64,06	64,65	63,91	65,64	65,88	66,50
1024210	VM1698-4	39,75	39,50	39,75	39,75	40,00	40,25	39,75	40,00	39,75	39,75

Char.No	Char.Descr.	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
1024210	VM1698-4	65,88	66,65	66,33	65,54	65,91	65,81	67,16	65,96	66,05	64,65
1024210	VM1698-4	39,25	39,25	39,75	39,00	39,75	40,00	39,50	39,75	39,75	39,50

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_k	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	VM1698-4	Inspection Val.	66,00
Ord. No.	2BD110T1S-A	Ser.No.	1024210	LSL	61,38
				USL	70,62
Remark	TQ 60% Angle 40°+/-5°* TQ-Cal.: 110 Nm; Cur -Cal.: 3.133 Nm/A; Speed 300/50 rpm;				

Char.No	Char.Descr.	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
1024210	VM1698-4	65,51	66,99	67,90	66,62	66,94	66,60	65,91	66,89	66,62	67,93
1024210	VM1698-4	39,75	39,50	39,75	39,50	39,50	39,75	40,00	40,00	39,50	39,50

Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
1024210	VM1698-4	67,29	68,52	67,85	65,29	67,63	65,86	66,77	65,69	65,22	64,43
1024210	VM1698-4	39,75	39,75	39,50	39,50	39,50	40,00	39,75	40,00	39,75	39,25

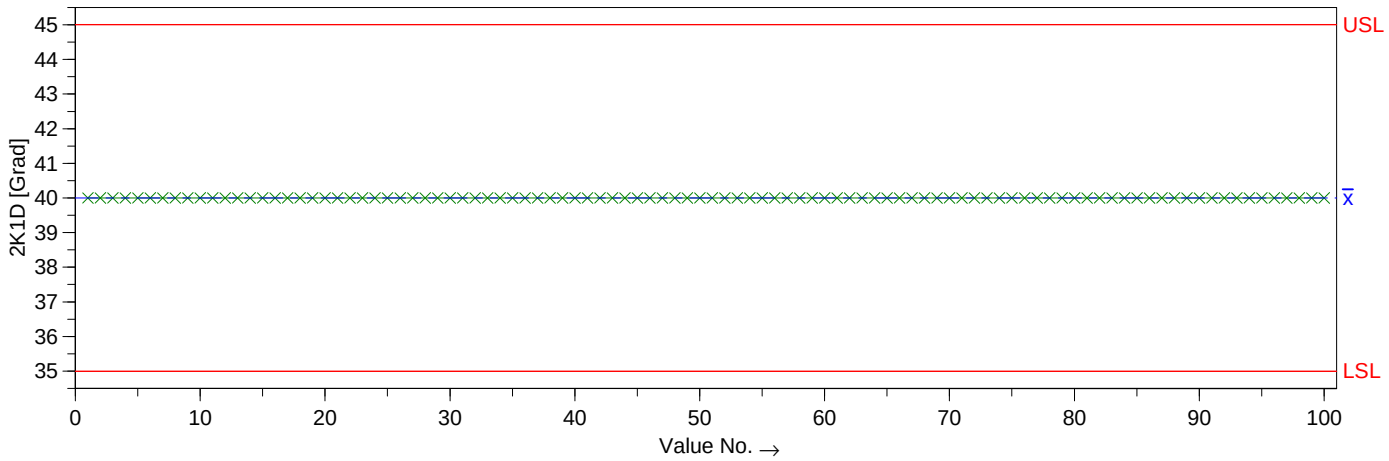
Machine Capability Study
Tool System

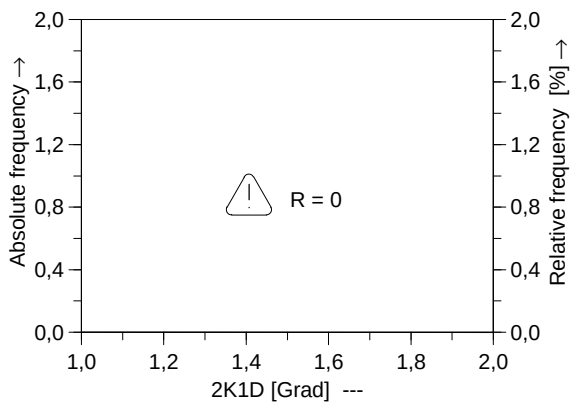
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.03.2022		

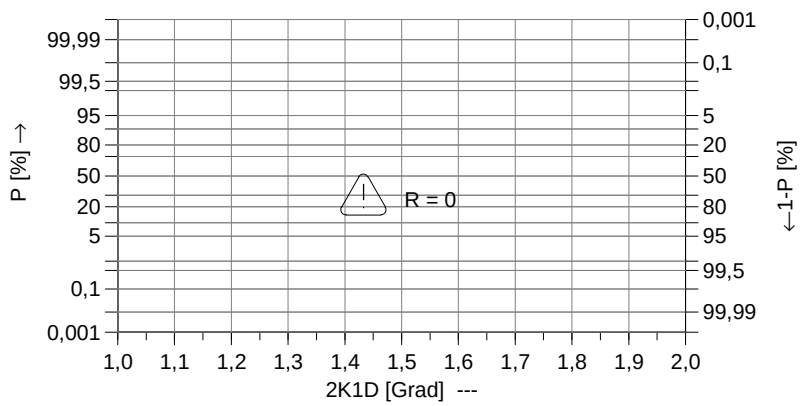
Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB			Contr.item yes
Serial No.	1015968_k	Char.Descr.	2K1D	Inspection Val.	40,00 5,00	USL 45,00
		Serial No.	204569	Unit	Grad -5,00	LSL 35,00
Char.Type	variable			Tolerance value	12 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P	
Contr.No.	Homologation	Reference Transducer	120 / 1019923	nges.	100	

Evaluation from 09.03.2022 13:34:44 to 09.03.2022 13:47:52

Rem. TQ 60% Angle 40° +/-5° * TQ-Cal.: 110 Nm; Cur-Cal.: 3.133 Nm/A; Speed 300/50 rpm;







Drawing Values		Collected Values		Statistics	
T_m	40.00			$\bar{x}$	40.0000
LSL	35.00	x_{min}	40.00		
USL	45.00	x_{max}	40.00		
T	10.00	R	0.00		
		$n_{<T>}$	100		
		$n_{>USL}$	0		
		$n_{<LSL}$	0		
		n_{eff}	100		
		n_{tot}	100		

--- R = 0 ---

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_k	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	66,00
Ord. No.	2BD110T1S-A	Ser.No.	204569	LSL	61,38
				USL	70,62
Remark	TQ 60% Angle 40°+/-5°* TQ-Cal.: 110 Nm; Cur -Cal.: 3.133 Nm/A; Speed 300/50 rpm;				

Char.No	Char.Descr.	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
204569	2K1D	69,92	70,36	70,37	72,91	72,29	68,58	67,89	68,44	69,71	70,75
204569	2K1D	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00

Char.No	Char.Descr.	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
204569	2K1D	69,31	69,61	71,93	71,74	71,08	68,87	67,70	69,39	68,10	68,39
204569	2K1D	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00

Char.No	Char.Descr.	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204569	2K1D	68,23	70,16	70,52	69,91	69,63	69,43	68,67	69,99	65,12	64,02
204569	2K1D	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00

Char.No	Char.Descr.	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
204569	2K1D	64,13	64,94	66,44	66,18	67,04	66,33	66,56	65,34	66,32	67,61
204569	2K1D	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00

Char.No	Char.Descr.	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204569	2K1D	66,66	68,25	67,46	67,86	67,82	67,33	66,32	67,31	67,85	66,41
204569	2K1D	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00

Char.No	Char.Descr.	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
204569	2K1D	67,29	65,90	65,06	64,92	65,97	65,08	65,24	65,16	64,51	65,63
204569	2K1D	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00

Char.No	Char.Descr.	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
204569	2K1D	65,92	67,73	65,05	65,07	64,17	64,70	64,25	65,74	66,12	66,51
204569	2K1D	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00

Char.No	Char.Descr.	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
204569	2K1D	66,13	66,66	66,35	65,97	65,98	65,89	67,38	66,04	66,58	64,75
204569	2K1D	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

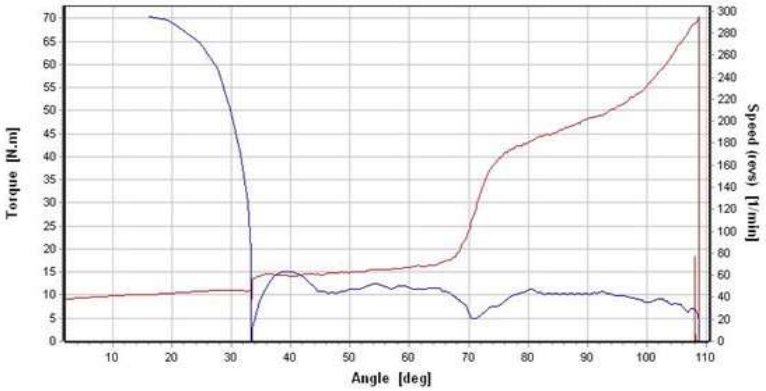
Ser.No.	1015968_k	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	66,00
Ord. No.	2BD110T1S-A	Ser.No.	204569	LSL	61,38
				USL	70,62
Remark	TQ 60% Angle 40°+/-5°* TQ-Cal.: 110 Nm; Cur -Cal.: 3.133 Nm/A; Speed 300/50 rpm;				

Char.No	Char.Descr.	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
204569	2K1D	65,66	67,24	68,12	66,63	67,03	66,72	65,98	66,81	66,77	68,01
204569	2K1D	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00

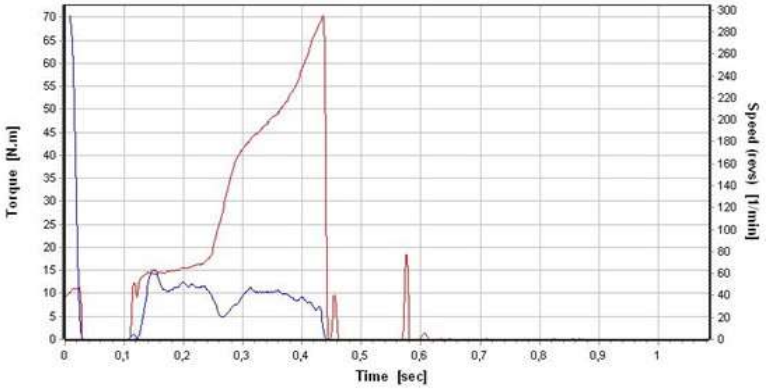
Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204569	2K1D	67,40	68,53	67,96	65,34	67,77	65,89	67,09	65,81	65,18	64,58
204569	2K1D	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00

Torque graphs

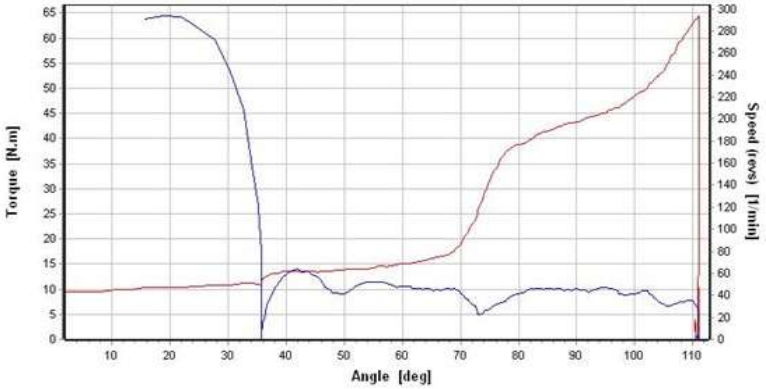
Model:	**2BD-2B110A-2K1D-2ZB**	Serial no:	**1015968**
Target torque:	**66,00 Nm**	60 % of max. torque	
Angle degree:	**40°**	Tool without angle correction	



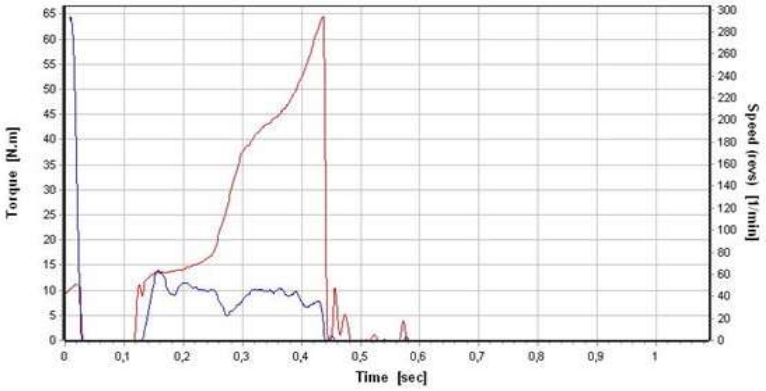
Value no. 1
Graph
Torque / Angle / Speed



Value no. 1
Graph
Torque / Time / Speed



Value no. 100
Graph
Torque / Angle / Speed



Value no. 100
Graph
Torque / Time / Speed

General Specifications

Manufacturer: Apex Tool Group **Tool type:** Fixtured Spindle

Model: 2BD-2B110A-2K1D-2ZB **Serial no:** 1015968

Torque range: **11 Nm to 110 Nm**

Difference evaluation: Reference/Tool at 180° / 80 %

Capability examination

Snugfit value: 22 Nm **Torque tolerance ±** 7 %

Target torque: 88 Nm Tolerance: 0,81 % ± **0,40 %**

Angle degree: 180° Tolerance: 4,5° ± **2,2°**

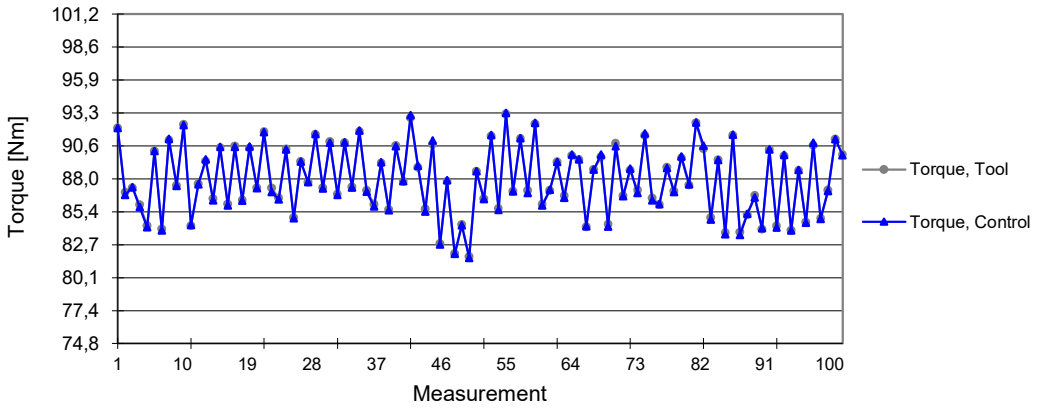
Formula derivation: $C_m = \frac{T}{6\,s}$ $T = C_m * 6\,s$

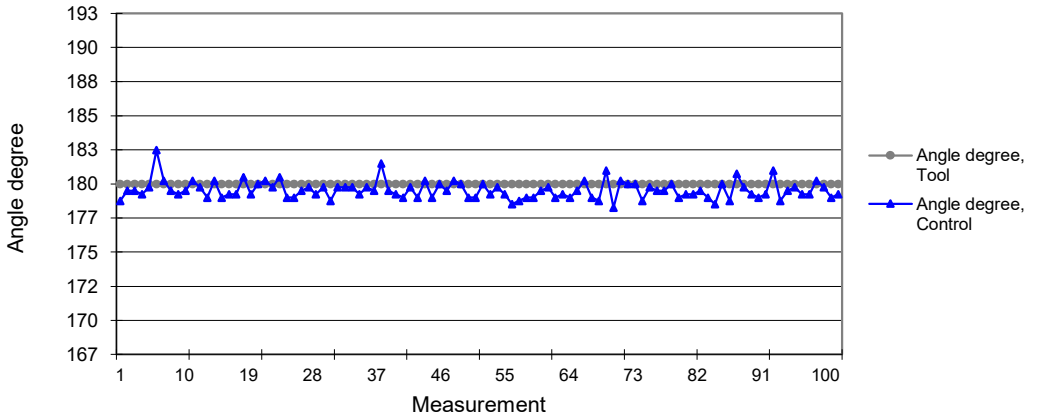
Tool without angle correction

Measurement	Tool data		Control data		Difference	
No.	Torque	Angle	Torque	Angle	Torque	Angle
1	92,06	180,00	92,07	178,75	0,01	1,25
2	86,91	180,00	86,70	179,50	0,21	0,50
3	87,27	180,00	87,32	179,50	0,05	0,50
4	85,91	180,00	85,72	179,25	0,19	0,75
5	84,23	180,00	84,09	179,75	0,14	0,25
6	90,20	180,00	90,20	182,50	0,00	2,50
7	83,97	180,00	83,84	180,25	0,13	0,25
8	91,08	180,00	91,19	179,50	0,11	0,50
9	87,45	180,00	87,42	179,25	0,03	0,75
10	92,33	180,00	92,30	179,50	0,03	0,50
11	84,22	180,00	84,29	180,25	0,07	0,25
12	87,59	180,00	87,54	179,75	0,05	0,25
13	89,41	180,00	89,54	179,00	0,13	1,00
14	86,40	180,00	86,28	180,25	0,12	0,25
15	90,48	180,00	90,55	179,00	0,07	1,00
16	85,98	180,00	85,87	179,25	0,11	0,75
17	90,62	180,00	90,55	179,25	0,07	0,75
18	86,30	180,00	86,24	180,50	0,06	0,50
19	90,44	180,00	90,57	179,25	0,13	0,75
20	87,27	180,00	87,22	180,00	0,05	0,00
21	91,77	180,00	91,73	180,25	0,04	0,25
22	87,25	180,00	86,92	179,75	0,33	0,25
23	86,47	180,00	86,33	180,50	0,14	0,50
24	90,38	180,00	90,33	179,00	0,05	1,00
25	84,89	180,00	84,83	179,00	0,06	1,00
26	89,39	180,00	89,39	179,50	0,00	0,50
27	87,72	180,00	87,71	179,75	0,01	0,25
28	91,56	180,00	91,58	179,25	0,02	0,75
29	87,27	180,00	87,20	179,75	0,07	0,25
30	90,98	180,00	90,89	178,75	0,09	1,25
31	86,77	180,00	86,70	179,75	0,07	0,25
32	90,89	180,00	90,92	179,75	0,03	0,25
33	87,33	180,00	87,29	179,75	0,04	0,25
34	91,78	180,00	91,85	179,25	0,07	0,75
35	87,06	180,00	86,95	179,75	0,11	0,25
36	85,95	180,00	85,77	179,50	0,18	0,50
37	89,25	180,00	89,32	181,50	0,07	1,50
38	85,52	180,00	85,47	179,50	0,05	0,50
39	90,66	180,00	90,60	179,25	0,06	0,75
40	87,78	180,00	87,81	179,00	0,03	1,00
41	92,90	180,00	93,08	179,75	0,18	0,25
42	88,92	180,00	89,04	179,00	0,12	1,00
43	85,56	180,00	85,37	180,25	0,19	0,25
44	90,76	180,00	91,06	179,00	0,30	1,00
45	82,79	180,00	82,71	180,00	0,08	0,00
46	87,79	180,00	87,89	179,50	0,10	0,50
47	81,98	180,00	81,97	180,25	0,01	0,25
48	84,34	180,00	84,26	180,00	0,08	0,00
49	81,76	180,00	81,65	179,00	0,11	1,00
50	88,60	180,00	88,60	179,00	0,00	1,00
51	86,40	180,00	86,36	180,00	0,04	0,00
52	91,43	180,00	91,48	179,25	0,05	0,75
53	85,60	180,00	85,50	179,75	0,10	0,25
54	93,19	180,00	93,28	179,25	0,09	0,75
55	87,00	180,00	87,00	178,50	0,00	1,50
56	91,22	180,00	91,24	178,75	0,02	1,25
57	87,05	180,00	86,85	179,00	0,20	1,00
58	92,41	180,00	92,47	179,00	0,06	1,00
59	85,96	180,00	85,84	179,50	0,12	0,50
60	87,06	180,00	87,10	179,75	0,04	0,25
61	89,34	180,00	89,34	179,00	0,00	1,00
62	86,64	180,00	86,46	179,25	0,18	0,75
63	89,84	180,00	89,93	179,00	0,09	1,00
64	89,52	180,00	89,54	179,50	0,02	0,50
65	84,14	180,00	84,19	180,25	0,05	0,25
66	88,73	180,00	88,72	179,00	0,01	1,00
67	89,75	180,00	89,93	178,75	0,18	1,25
68	84,35	180,00	84,17	181,00	0,18	1,00
69	90,83	180,00	90,60	178,25	0,23	1,75
70	86,63	180,00	86,58	180,25	0,05	0,25
71	88,67	180,00	88,80	180,00	0,13	0,00
72	87,07	180,00	86,85	180,00	0,22	0,00
73	91,47	180,00	91,61	178,75	0,14	1,25
74	86,44	180,00	86,28	179,75	0,16	0,25
75	85,92	180,00	85,94	179,50	0,02	0,50
76	88,91	180,00	88,85	179,50	0,06	0,50
77	87,00	180,00	86,92	180,00	0,08	0,00
78	89,66	180,00	89,78	179,00	0,12	1,00
79	87,49	180,00	87,54	179,25	0,05	0,75
80	92,49	180,00	92,52	179,25	0,03	0,75
81	90,41	180,00	90,65	179,50	0,24	0,50
82	84,89	180,00	84,71	179,00	0,18	1,00
83	89,51	180,00	89,51	178,50	0,00	1,50
84	83,68	180,00	83,55	180,00	0,13	0,00
85	91,47	180,00	91,53	178,75	0,06	1,25
86	83,72	180,00	83,48	180,75	0,24	0,75
87	85,12	180,00	85,18	179,75	0,06	0,25
88	86,66	180,00	86,51	179,25	0,15	0,75
89	83,94	180,00	84,04	179,00	0,10	1,00
90	90,33	180,00	90,33	179,25	0,00	0,75
91	84,21	180,00	84,07	181,00	0,14	1,00
92	89,83	180,00	89,91	178,75	0,08	1,25
93	83,86	180,00	83,87	179,50	0,01	0,50
94	88,65	180,00	88,70	179,75	0,05	0,25
95	84,53	180,00	84,46	179,25	0,07	0,75
96	90,68	180,00	90,89	179,25	0,21	0,75
97	84,82	180,00	84,78	180,25	0,04	0,25
98	87,08	180,00	87,02	179,75	0,06	0,25
99	91,17	180,00	91,16	179,00	0,01	1,00
100	89,94	180,00	89,88	179,25	0,06	0,75
				Standard deviation:	**0,071**	**0,446**

Graphical representation

Model:	**2BD-2B110A-2K1D-2ZB**	Serial no:	**1015968**
Target torque:	**88,00 Nm**	80 % of max. torque	
Angle degree:	**180°**	Tool without angle correction	





Machine Capability Study
Control System

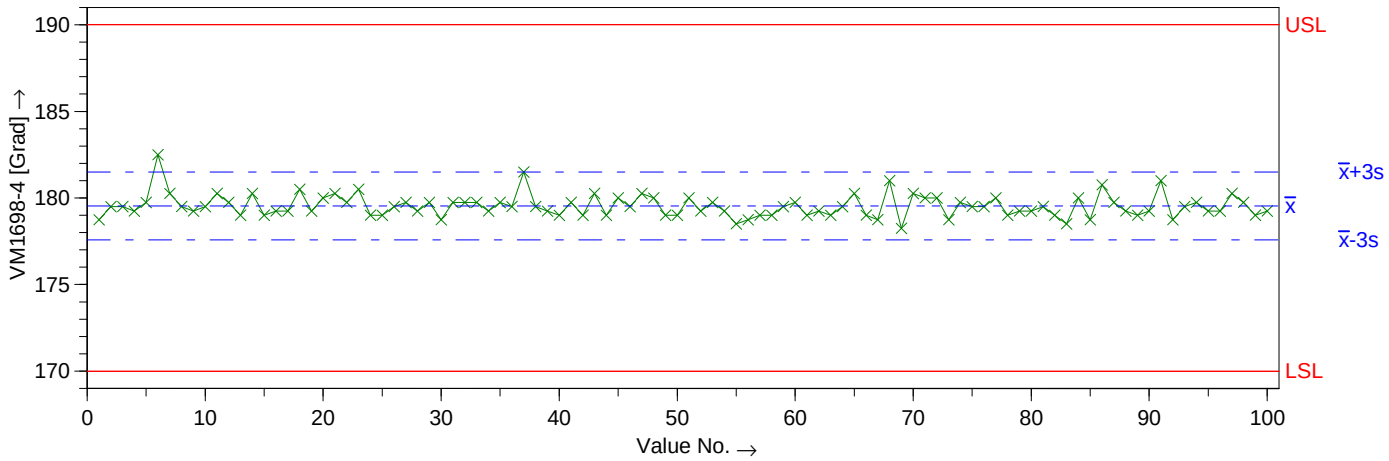
Cleco Production Tools

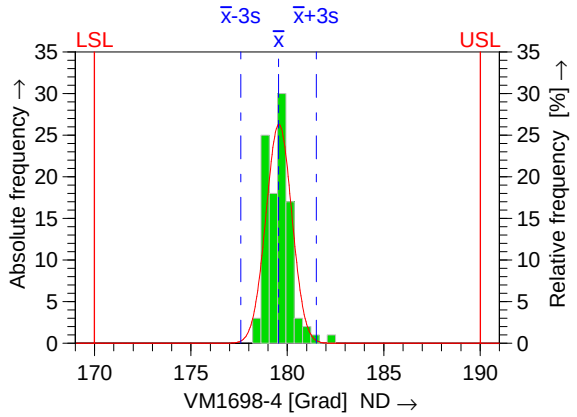
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.03.2022		

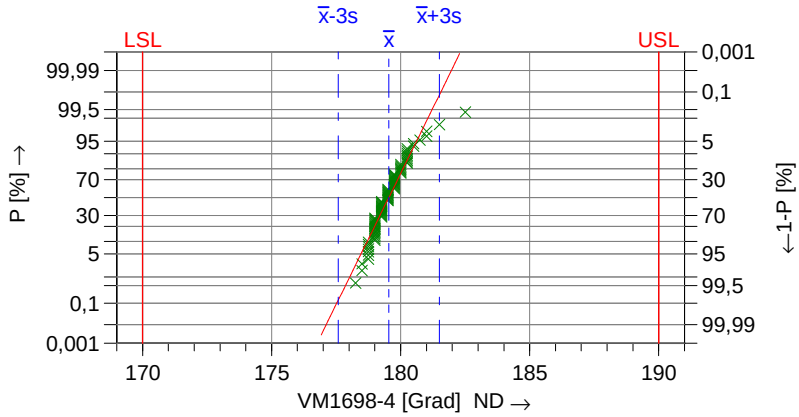
Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015968_l	Char.Descr.	VM1698-4	Inspection Val. 180,00 10,00	USL 190,00
		Serial No.	1024210	Unit Grad -10,00	LSL 170,00
Char.Type	variable			Tolerance value 6 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	120 / 1019923	nges.	100

Evaluation from 09.03.2022 13:56:08 to 09.03.2022 14:14:29

Rem. TQ 80% Angle 180° +/-10° * TQ-Cal.: 110 Nm; Cur-Cal.: 3.098 Nm/A; Speed 300/50 rpm;







Drawing Values		Collected Values		Statistics	
T_m	180.00			$\bar{x}$	179.5400
LSL	170.00	x_{min}	178.25	$\bar{x}$-3s	177.5839
USL	190.00	x_{max}	182.50	$\bar{x}$+3s	181.4961
T	20.00	R	4.25	6s	3.9122
		$n_{<T>}$	100	$p_{<T>}$	100.00000 %
		$n_{>USL}$	0	$p_{>USL}$	0.00000%
		$n_{<LSL}$	0	$p_{<LSL}$	0.00000%
		n_{eff}	100		
		n_{tot}	100		

Model distribution			Normal Distribution
Calculation method			$M1_{1.4}$ $\hat{\sigma} = s_{tot}$
Potential Capability index	=	C_m	5.11
Critical capability index	=	C_{mk}	4.88

The requirements were met (C_m,C_{mk})

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_l	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	VM1698-4	Inspection Val.	88,00
Ord. No.	2BD110T1S-A	Ser.No.	1024210	LSL	81,84
				USL	94,16
Remark	TQ 80% Angle 180°+/-10°* TQ-Cal.: 110 Nm; C ur-Cal.: 3.098 Nm/A; Speed 300/50 rpm;				

Char.No	Char.Descr.	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
1024210	VM1698-4	92,07	86,70	87,32	85,72	84,09	90,20	83,84	91,19	87,42	92,30
1024210	VM1698-4	178,75	179,50	179,50	179,25	179,75	182,50	180,25	179,50	179,25	179,50

Char.No	Char.Descr.	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
1024210	VM1698-4	84,29	87,54	89,54	86,28	90,55	85,87	90,55	86,24	90,57	87,22
1024210	VM1698-4	180,25	179,75	179,00	180,25	179,00	179,25	179,25	180,50	179,25	180,00

Char.No	Char.Descr.	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
1024210	VM1698-4	91,73	86,92	86,33	90,33	84,83	89,39	87,71	91,58	87,20	90,89
1024210	VM1698-4	180,25	179,75	180,50	179,00	179,00	179,50	179,75	179,25	179,75	178,75

Char.No	Char.Descr.	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
1024210	VM1698-4	86,70	90,92	87,29	91,85	86,95	85,77	89,32	85,47	90,60	87,81
1024210	VM1698-4	179,75	179,75	179,75	179,25	179,75	179,50	181,50	179,50	179,25	179,00

Char.No	Char.Descr.	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
1024210	VM1698-4	93,08	89,04	85,37	91,06	82,71	87,89	81,97	84,26	81,65	88,60
1024210	VM1698-4	179,75	179,00	180,25	179,00	180,00	179,50	180,25	180,00	179,00	179,00

Char.No	Char.Descr.	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
1024210	VM1698-4	86,36	91,48	85,50	93,28	87,00	91,24	86,85	92,47	85,84	87,10
1024210	VM1698-4	180,00	179,25	179,75	179,25	178,50	178,75	179,00	179,00	179,50	179,75

Char.No	Char.Descr.	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
1024210	VM1698-4	89,34	86,46	89,93	89,54	84,19	88,72	89,93	84,17	90,60	86,58
1024210	VM1698-4	179,00	179,25	179,00	179,50	180,25	179,00	178,75	181,00	178,25	180,25

Char.No	Char.Descr.	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
1024210	VM1698-4	88,80	86,85	91,61	86,28	85,94	88,85	86,92	89,78	87,54	92,52
1024210	VM1698-4	180,00	180,00	178,75	179,75	179,50	179,50	180,00	179,00	179,25	179,25

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_I	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	VM1698-4	Inspection Val.	88,00
Ord. No.	2BD110T1S-A	Ser.No.	1024210	LSL	81,84
				USL	94,16
Remark	TQ 80% Angle 180°+/-10°* TQ-Cal.: 110 Nm; C ur-Cal.: 3.098 Nm/A; Speed 300/50 rpm;				

Char.No	Char.Descr.	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
1024210	VM1698-4	90,65	84,71	89,51	83,55	91,53	83,48	85,18	86,51	84,04	90,33
1024210	VM1698-4	179,50	179,00	178,50	180,00	178,75	180,75	179,75	179,25	179,00	179,25

Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
1024210	VM1698-4	84,07	89,91	83,87	88,70	84,46	90,89	84,78	87,02	91,16	89,88
1024210	VM1698-4	181,00	178,75	179,50	179,75	179,25	179,25	180,25	179,75	179,00	179,25

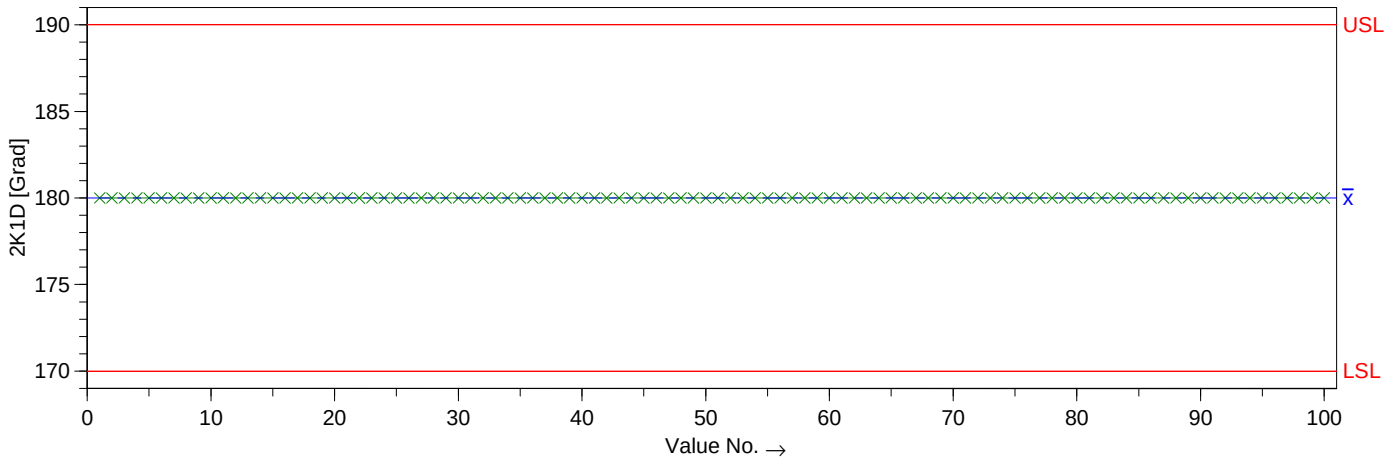
Machine Capability Study
Tool System

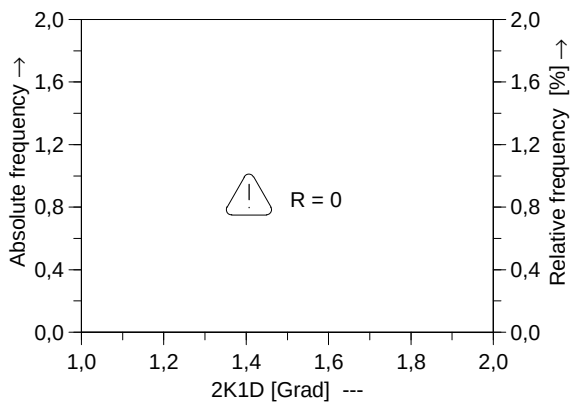
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.03.2022		

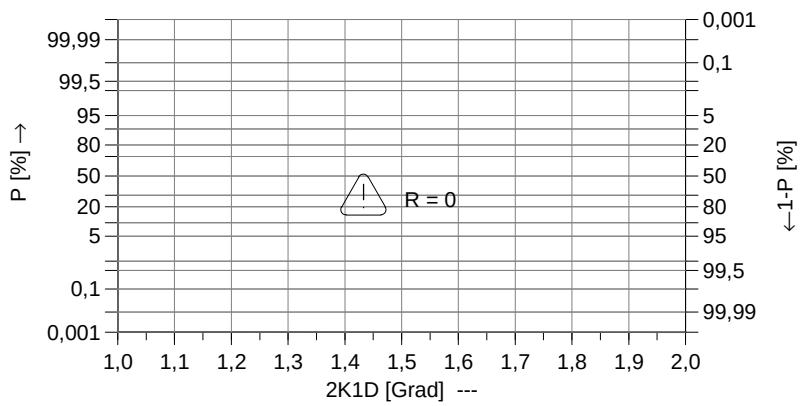
Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015968_l	Char.Descr.	2K1D	Inspection Val. 180,00 10,00	USL 190,00
		Serial No.	204569	Unit Grad -10,00	LSL 170,00
Char.Type	variable			Tolerance value 6 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	120 / 1019923	nges.	100

Evaluation from 09.03.2022 13:56:08 to 09.03.2022 14:14:29

Rem. TQ 80% Angle 180° +/-10° * TQ-Cal.: 110 Nm; Cur-Cal.: 3.098 Nm/A; Speed 300/50 rpm;







Drawing Values		Collected Values		Statistics	
T_m	180.00			$\bar{x}$	180.0000
LSL	170.00	x_{min}	180.00		
USL	190.00	x_{max}	180.00		
T	20.00	R	0.00		
		$n_{<T>}$	100		
		$n_{>USL}$	0		
		$n_{<LSL}$	0		
		n_{eff}	100		
		n_{tot}	100		

--- R = 0 ---

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

Ser.No.	1015968_l	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	88,00
Ord. No.	2BD110T1S-A	Ser.No.	204569	LSL	81,84
				USL	94,16
Remark	TQ 80% Angle 180°+/-10°* TQ-Cal.: 110 Nm; C ur-Cal.: 3.098 Nm/A; Speed 300/50 rpm;				

Char.No	Char.Descr.	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
204569	2K1D	92,06	86,91	87,27	85,91	84,23	90,20	83,97	91,08	87,45	92,33
204569	2K1D	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00

Char.No	Char.Descr.	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
204569	2K1D	84,22	87,59	89,41	86,40	90,48	85,98	90,62	86,30	90,44	87,27
204569	2K1D	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00

Char.No	Char.Descr.	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204569	2K1D	91,77	87,25	86,47	90,38	84,89	89,39	87,72	91,56	87,27	90,98
204569	2K1D	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00

Char.No	Char.Descr.	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
204569	2K1D	86,77	90,89	87,33	91,78	87,06	85,95	89,25	85,52	90,66	87,78
204569	2K1D	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00

Char.No	Char.Descr.	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204569	2K1D	92,90	88,92	85,56	90,76	82,79	87,79	81,98	84,34	81,76	88,60
204569	2K1D	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00

Char.No	Char.Descr.	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
204569	2K1D	86,40	91,43	85,60	93,19	87,00	91,22	87,05	92,41	85,96	87,06
204569	2K1D	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00

Char.No	Char.Descr.	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
204569	2K1D	89,34	86,64	89,84	89,52	84,14	88,73	89,75	84,35	90,83	86,63
204569	2K1D	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00

Char.No	Char.Descr.	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
204569	2K1D	88,67	87,07	91,47	86,44	85,92	88,91	87,00	89,66	87,49	92,49
204569	2K1D	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.03.2022

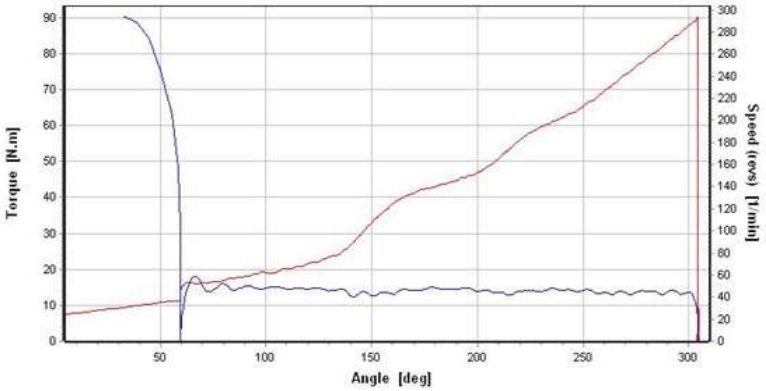
Ser.No.	1015968_l	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	88,00
Ord. No.	2BD110T1S-A	Ser.No.	204569	LSL	81,84
				USL	94,16
Remark	TQ 80% Angle 180°+/-10°* TQ-Cal.: 110 Nm; C ur-Cal.: 3.098 Nm/A; Speed 300/50 rpm;				

Char.No	Char.Descr.	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
204569	2K1D	90,41	84,89	89,51	83,68	91,47	83,72	85,12	86,66	83,94	90,33
204569	2K1D	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00

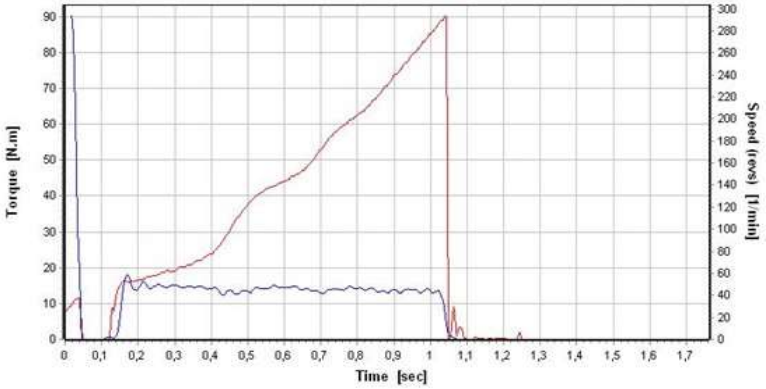
Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204569	2K1D	84,21	89,83	83,86	88,65	84,53	90,68	84,82	87,08	91,17	89,94
204569	2K1D	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00

Torque graphs

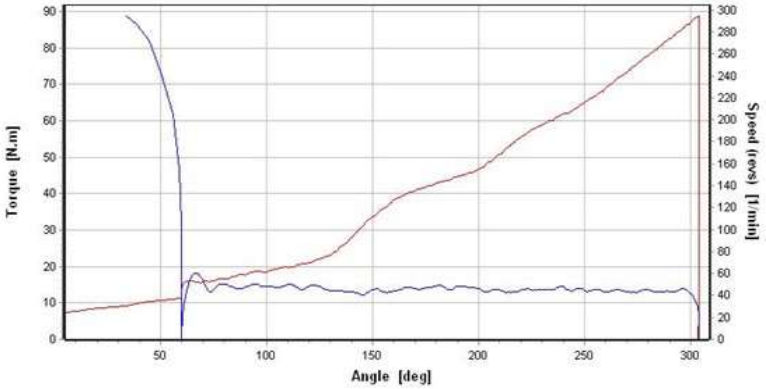
Model:	**2BD-2B110A-2K1D-2ZB**	Serial no:	**1015968**
Target torque:	**88,00 Nm**	80 % of max. torque	
Angle degree:	**180°**	Tool without angle correction	



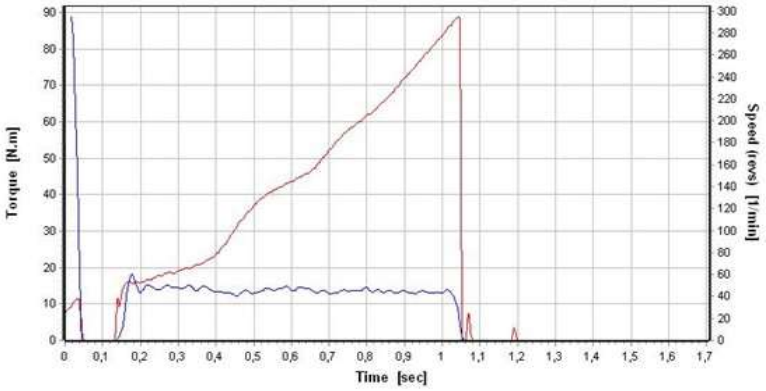
Value no. 1
Graph
Torque / Angle / Speed



Value no. 1
Graph
Torque / Time / Speed



Value no. 100
Graph
Torque / Angle / Speed



Value no. 100
Graph
Torque / Time / Speed