Homologation

Fixtured Spindle

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

Serial no.: 1015969

Contents

Homologation: 2BD-2B110A-2K1D-2ZB SN: 1015969

		Page
Cover sheet		1
Contents		2
Test sheet no. 2 (torque determination 30 %)		3
Machine Capability Study, Control System	30 % hard	4
Machine Capability Study, Tool System	30 % hard	7
Curves of the 1st and 100th measurement	30 % hard	10
Machine Capability Study, Control System	30 % soft	11
Machine Capability Study, Tool System	30 % soft	14
Curves of the 1st and 100th measurement	30 % soft	17
Test sheet no. 3 (torque determination 80 %)		18
Machine Capability Study, Control System	80 % hard	19
Machine Capability Study, Tool System	80 % hard	22
Curves of the 1st and 100th measurement	80 % hard	25
Machine Capability Study, Control System	80 % soft	26
Machine Capability Study, Tool System	80 % soft	29
Curves of the 1st and 100th measurement	80 % soft	32
Test sheet no. 4 (torque determination 100 %)		33
Machine Capability Study, Control System	100 % hard	34
Machine Capability Study, Tool System	100 % hard	37
Curves of the 1st and 100th measurement	100 % hard	40
Machine Capability Study, Control System	100 % soft	41
Machine Capability Study, Tool System	100 % soft	44
Curves of the 1st and 100th measurement	100 % soft	47
Annex 3 (ability contemplation at 40° / 60 %)	**without angle correction**	48
Graphical representation	40° / 60 %	50
Machine Capability Study, Control System	40° / 60 %	51
Machine Capability Study, Tool System	40° / 60 %	54
Curves of the 1st and 100th measurement	40° / 60 %	57
Annex 3 (ability contemplation at 180° / 80 %)	**without angle correction**	58
Graphical representation	180° / 80 %	60
Machine Capability Study, Control System	180° / 80 %	61
Machine Capability Study, Tool System	180° / 80 %	64
Curves of the 1st and 100th measurement	180° / 80 %	67

Test sheet no. 2

Machine Capability Study 30 %

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

Manufacturer: Apex Tool Group Serial no: **1015969**

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

Hard joint (H)	245,68	Nm / Revolution	Angle degree	30°
Soft joint (L)	20,35	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	40,95	40,70 Nm
	Standard deviation	0,08	0,06 Nm
	Torque scatter (99,73%)	0,47	0,36 Nm
	C_m	12,13	16,03
	C_{mk}	11,09	16,01

b)	Min. C_m hard/soft (lowest value)	12,13
	Min. C_{mk} hard/soft (lowest value)	11,09

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

Note:

Machine Capability Study
Control System

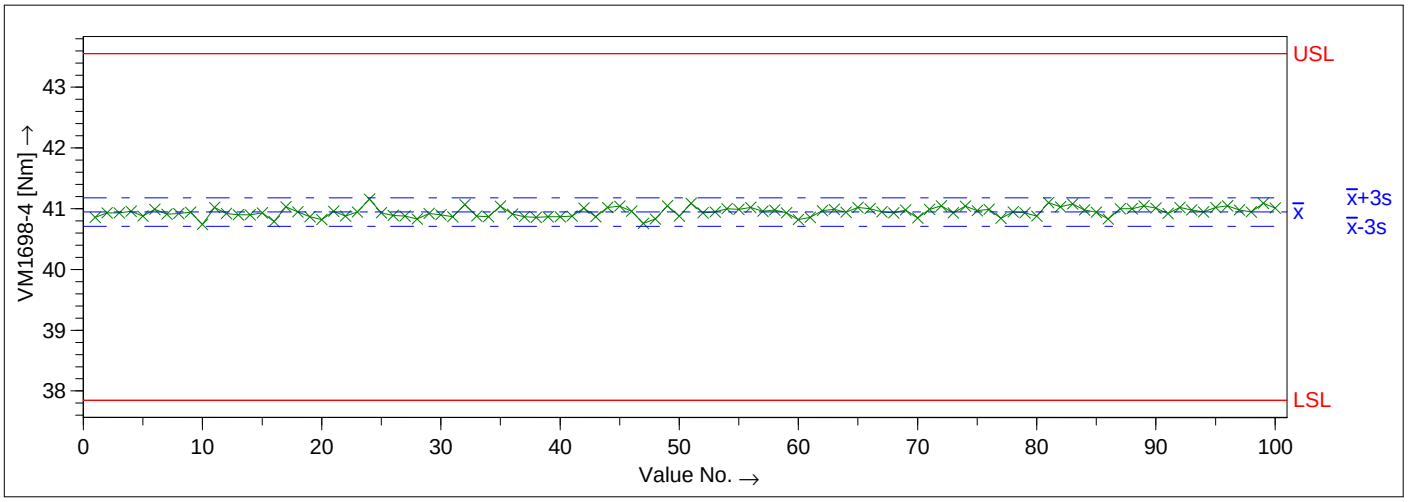
Cleco Production Tools

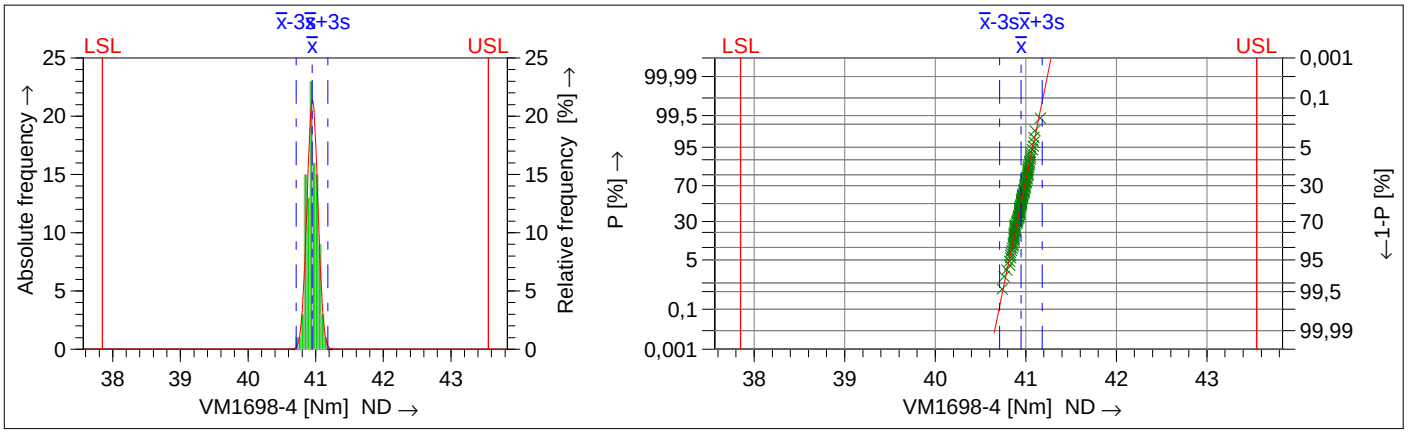
Plant	ATG Westhausen	Operator Name	Sünder
Date	08.03.2022		

Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015969_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 08.03.2022 14:01:23 to 08.03.2022 14:17:27

Rem. TQ 30% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.210 Nm/A; Speed 890/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	40.70			$\bar{x}$	40.9462
LSL	37.85	x_{min}	40.74	$\bar{x}$-3s	40.7113
USL	43.55	x_{max}	41.16	$\bar{x}$+3s	41.1811
T	5.70	R	0.42	6s	0.4697
		$n_{<T>}$	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	12.13
Critical capability index	=	C_{mk}	11.09

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 08.03.2022

Ser.No.	1015969_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.: 3.210 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	40,86	40,93	40,93	40,96	40,88	40,99	40,91	40,92	40,94	40,74
1024210	VM1698-4	29,75	29,75	30,50	29,75	30,25	30,25	30,00	30,25	30,75	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}
1024210	VM1698-4	41,02	40,92	40,90	40,90	40,93	40,79	41,03	40,95	40,87	40,82
1024210	VM1698-4	30,75	30,75	30,25	31,00	30,75	30,00	31,00	30,50	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	40,96	40,88	40,95	41,16	40,93	40,89	40,88	40,83	40,92	40,90
1024210	VM1698-4	30,75	29,00	31,00	31,00	30,75	31,00	30,00	30,25	30,25	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	40,87	41,07	40,88	40,87	41,04	40,91	40,87	40,86	40,87	40,87
1024210	VM1698-4	30,25	30,75	30,00	30,00	30,25	30,50	28,50	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	40,88	41,01	40,87	41,02	41,04	40,96	40,76	40,83	41,05	40,88
1024210	VM1698-4	30,50	30,25	30,50	30,50	30,50	30,00	30,00	30,50	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	41,09	40,93	40,95	41,00	40,99	41,02	40,96	40,98	40,93	40,82
1024210	VM1698-4	30,50	30,25	30,25	30,00	30,25	30,50	30,50	30,50	30,75	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	40,86	40,97	40,99	40,94	41,02	41,00	40,95	40,93	40,98	40,85
1024210	VM1698-4	30,25	30,25	30,75	30,25	30,25	30,50	30,00	30,25	30,50	30,25

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	40,99	41,05	40,93	41,04	40,97	40,99	40,84	40,95	40,93	40,88
1024210	VM1698-4	30,00	30,50	30,50	30,25	30,25	30,75	30,50	30,25	30,75	30,75

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.03.2022

Ser.No.	1015969_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.: 3.210 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	41,10	41,03	41,08	40,98	40,94	40,83	41,00	41,00	41,05	41,01
1024210	VM1698-4	30,25	30,50	30,50	30,25	30,25	30,25	30,50	30,75	30,50	30,75

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	40,92	41,02	40,98	40,95	41,02	41,05	40,98	40,95	41,09	41,01
1024210	VM1698-4	30,75	30,50	30,00	30,50	30,75	30,25	30,50	30,75	30,50	30,50

Machine Capability Study
Tool System

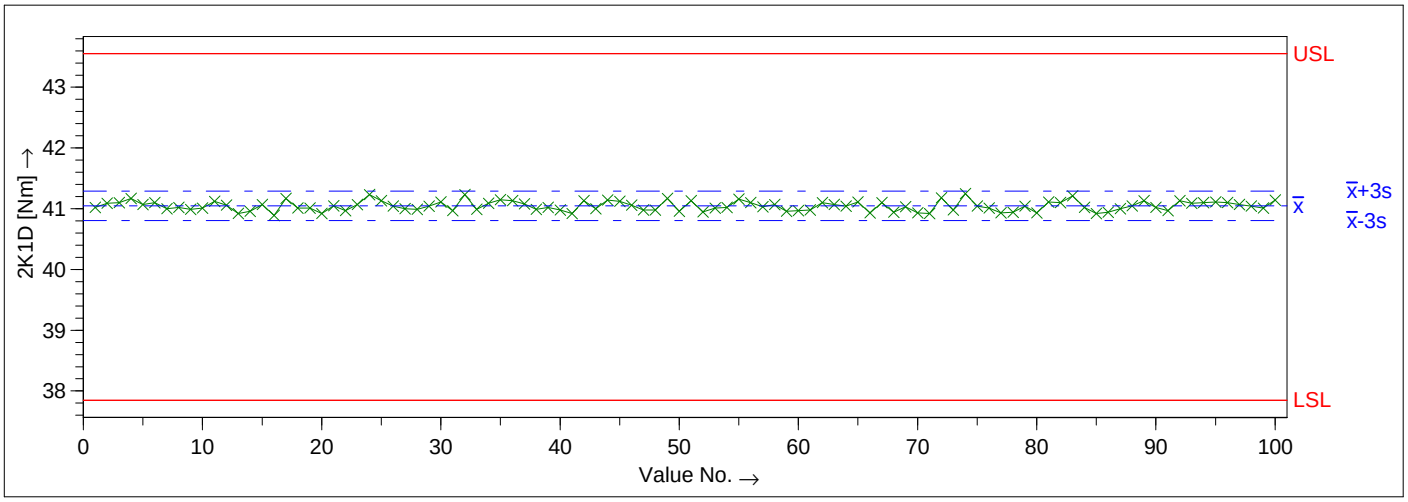
Page 1 / 1

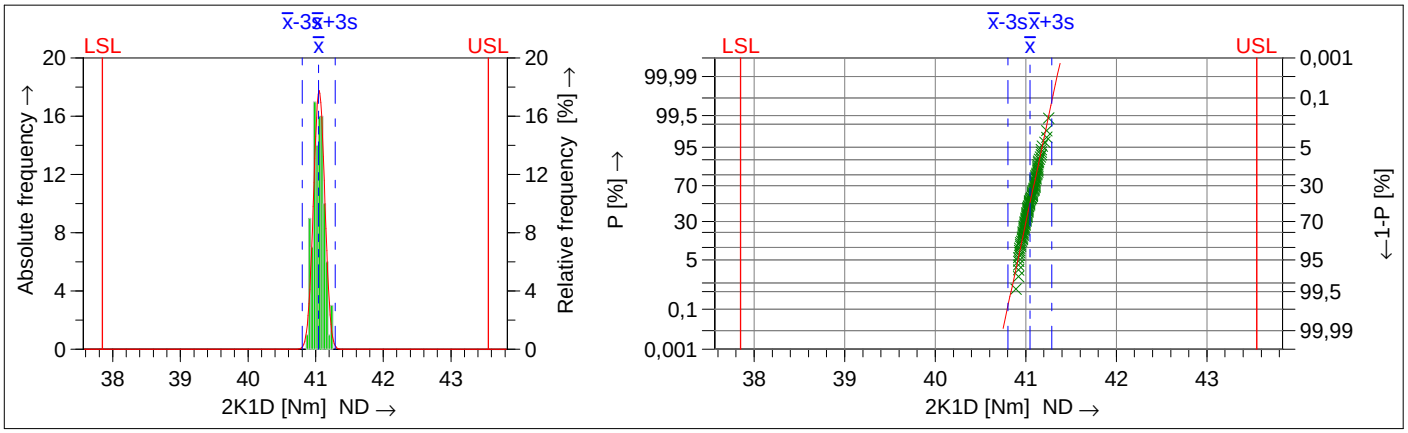
Plant ATG Westhausen		Operator Name Sünder	Date 08.03.2022

Ord. No. 2BD110T1S-A	Part type 2BD-2B110A-2K1D-2ZB				Contr.item yes
Serial No. 1015969_d	Char.Descr. 2K1D	Inspection Val.	40,70	2,85	USL 43,55
	Serial No. 204571	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 08.03.2022 14:01:23 to 08.03.2022 14:17:27

Rem. TQ 30% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.210 Nm/A; Speed 890/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	40.70			$\bar{x}$	41.0453
LSL	37.85	x_{min}	40.89	$\bar{x}$-3s	40.8028
USL	43.55	x_{max}	41.25	$\bar{x}$+3s	41.2878
T	5.70	R	0.36	6s	0.4849
		$n_{<T>}$	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	11.75
Critical capability index	=	C_{mk}	10.33

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 08.03.2022

Ser.No.	1015969_d	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	40,70
Ord. No.	2BD110T1S-A	Ser.No.	204571	LSL	37,85
				USL	43,55
Remark	TQ 30% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.210 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}
204571	2K1D	41,02	41,09	41,10	41,17	41,07	41,10	41,00	41,02	40,99	41,01
204571	2K1D	30,00	30,00	30,00	30,00	31,00	30,00	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}
204571	2K1D	41,12	41,06	40,92	40,96	41,07	40,89	41,17	41,01	41,01	40,92
204571	2K1D	31,00	31,00	30,00	31,00	31,00	30,00	31,00	31,00	31,00	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}
204571	2K1D	41,05	40,97	41,07	41,23	41,13	41,04	41,00	40,99	41,04	41,11
204571	2K1D	31,00	31,00	31,00	31,00	31,00	31,00	30,00	31,00	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}
204571	2K1D	40,97	41,23	40,99	41,09	41,15	41,13	41,08	40,99	41,02	40,98
204571	2K1D	30,00	31,00	30,00	30,00	30,00	31,00	30,00	30,00	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}
204571	2K1D	40,92	41,13	41,00	41,14	41,12	41,06	40,98	40,98	41,17	40,96
204571	2K1D	30,00	30,00	30,00	30,00	31,00	30,00	30,00	31,00	31,00	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}
204571	2K1D	41,13	40,95	41,01	41,02	41,16	41,10	41,03	41,07	40,96	40,97
204571	2K1D	31,00	30,00	31,00	30,00	31,00	30,00	31,00	30,00	31,00	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}
204571	2K1D	40,98	41,10	41,07	41,04	41,11	40,93	41,10	40,94	41,03	40,93
204571	2K1D	30,00	30,00	31,00	31,00	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}
204571	2K1D	40,92	41,18	40,98	41,25	41,04	41,01	40,93	40,94	41,04	40,93
204571	2K1D	30,00	31,00	31,00	31,00	30,00	31,00	30,00	30,00	31,00	30,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.03.2022

Ser.No.	1015969_d	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	40,70
Ord. No.	2BD110T1S-A	Ser.No.	204571	LSL	37,85
				USL	43,55
Remark	TQ 30% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.210 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}
204571	2K1D	41,11	41,10	41,21	41,02	40,92	40,94	41,00	41,05	41,13	41,02
204571	2K1D	30,00	31,00	31,00	30,00	30,00	30,00	30,00	31,00	30,00	30,00

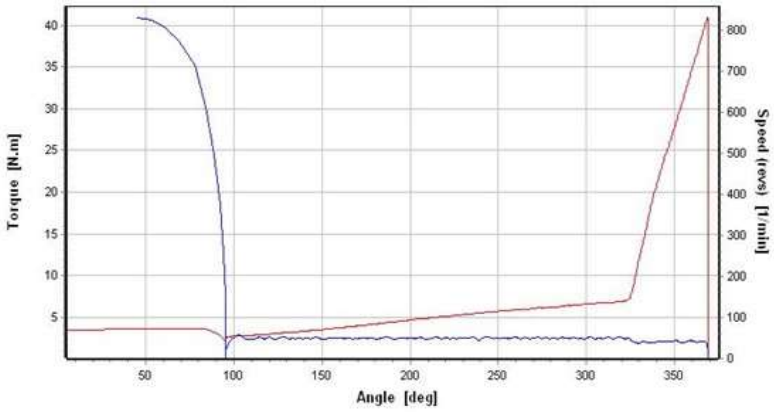
Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204571	2K1D	40,97	41,13	41,09	41,10	41,11	41,10	41,07	41,04	41,01	41,14
204571	2K1D	30,00	30,00	30,00	30,00	31,00	31,00	31,00	31,00	31,00	31,00

Torque graphs

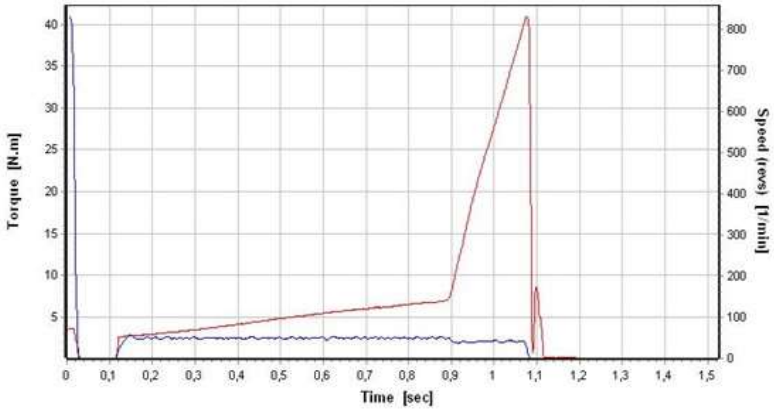
Machine Capability Study 30 %

Model: **2BD-2B110A-2K1D-2ZB**
Serial no: **1015969**

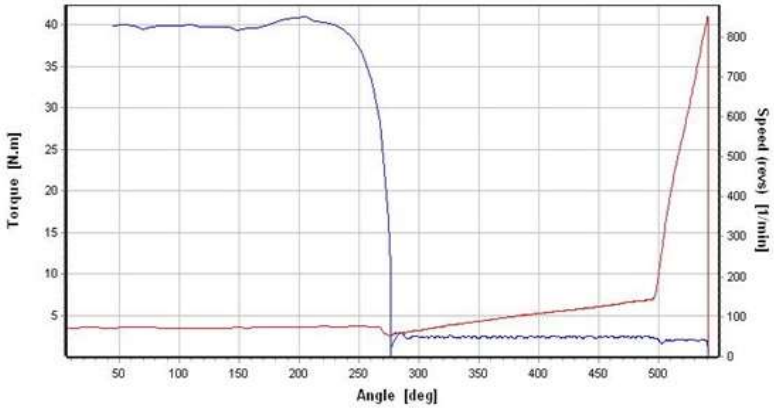
Angle degree: **30°**
Test torque: **40,7 Nm**



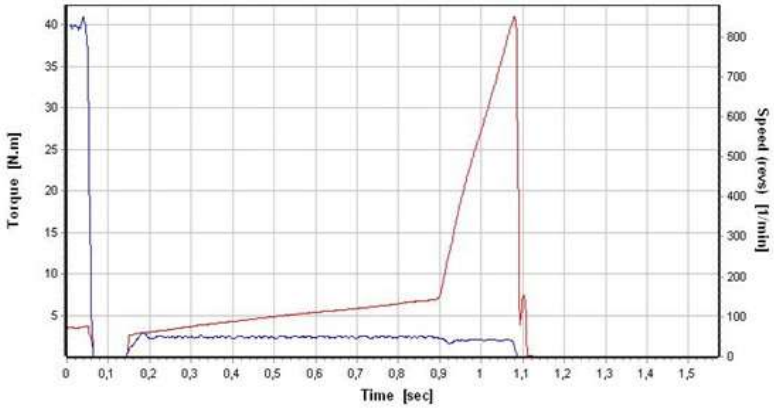
Value no. 1
Graph
Torque / Angle / Speed



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

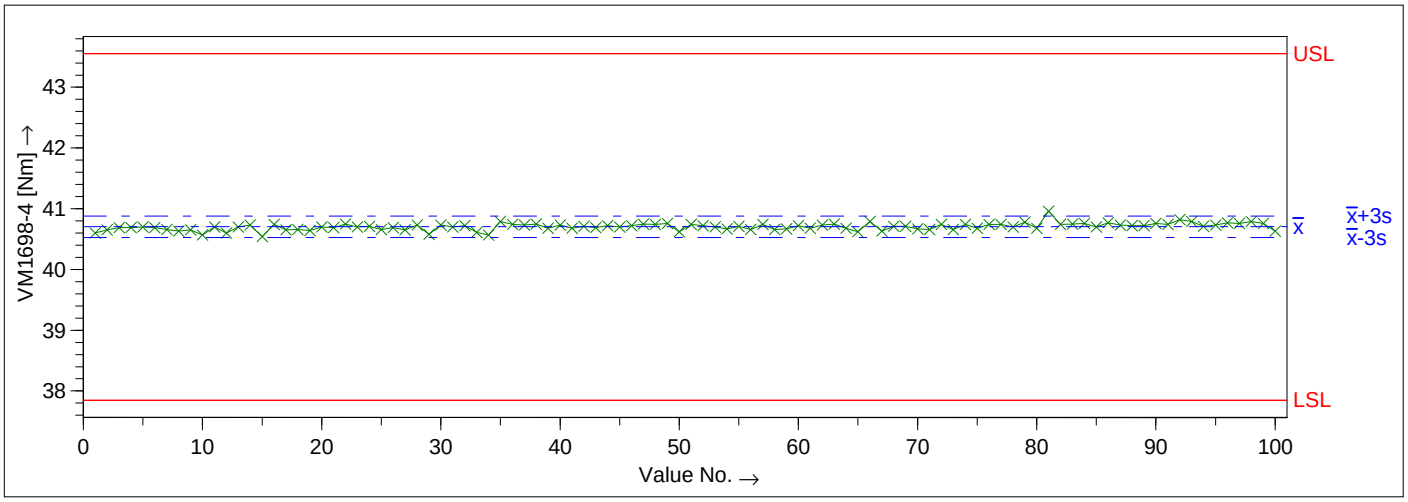
Page 1 / 1

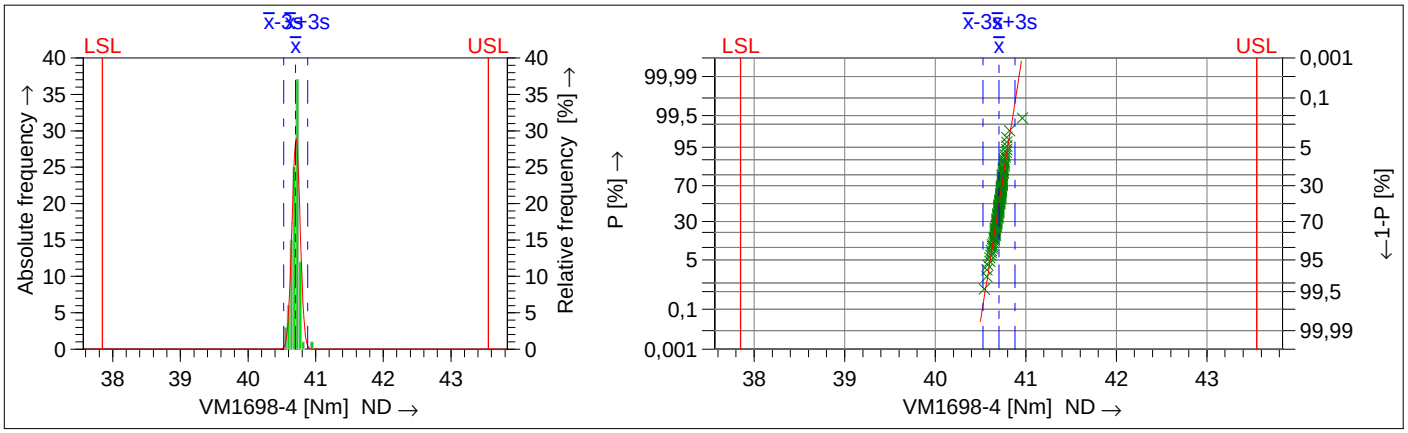
Plant	ATG Westhausen	Operator Name	Sünder
Date	08.03.2022		

Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015969_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 08.03.2022 14:20:18 to 08.03.2022 14:39:37

Rem. TQ 30% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.210 Nm/A; Speed 890/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	40.70			$\bar{x}$	40.7038
LSL	37.85	x_{min}	40.54	$\bar{x}$-3s	40.5260
USL	43.55	x_{max}	40.96	$\bar{x}$+3s	40.8816
T	5.70	R	0.42	6s	0.3556
		$n_{<T>}$	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	16.03
Critical capability index	=	C_{mk}	16.01

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

APEX VDI/VDE 2647 V0.1

Apex Tool Group GmbH \\htwe0006\AppData\QW\QWE\MessWert\2022\1015969_cM.DFD

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.03.2022

Ser.No.	1015969_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.: 3.210 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	40,60	40,65	40,69	40,69	40,70	40,69	40,66	40,63	40,65	40,57
1024210	VM1698-4	363,50	359,75	367,00	364,00	366,50	369,00	364,75	372,25	372,00	365,25

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	40,70	40,60	40,70	40,73	40,54	40,74	40,65	40,66	40,64	40,70
1024210	VM1698-4	371,25	366,75	367,50	363,00	360,50	363,75	365,00	363,50	361,50	360,75

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	40,69	40,75	40,70	40,71	40,66	40,69	40,65	40,73	40,58	40,73
1024210	VM1698-4	362,50	362,50	363,75	364,50	362,50	362,00	360,50	367,00	360,75	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}
1024210	VM1698-4	40,70	40,72	40,61	40,57	40,79	40,74	40,73	40,75	40,68	40,73
1024210	VM1698-4	364,00	361,00	362,75	360,75	365,75	363,25	364,50	363,25	362,75	365,50

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	40,68	40,71	40,69	40,72	40,70	40,72	40,75	40,74	40,76	40,62
1024210	VM1698-4	363,25	362,25	366,75	366,00	364,25	363,25	367,00	365,50	369,25	364,75

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	40,74	40,72	40,70	40,67	40,71	40,66	40,74	40,66	40,67	40,72
1024210	VM1698-4	368,25	367,25	371,50	354,25	365,75	356,25	359,00	358,50	363,00	358,00

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	40,68	40,73	40,75	40,68	40,62	40,79	40,63	40,71	40,71	40,67
1024210	VM1698-4	358,00	360,00	358,75	360,25	358,25	362,50	357,00	362,75	361,00	360,25

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	40,66	40,74	40,66	40,74	40,68	40,74	40,74	40,70	40,78	40,68
1024210	VM1698-4	357,00	363,50	362,00	360,25	357,75	361,25	357,75	363,00	362,25	363,50

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.03.2022

Ser.No.	1015969_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.: 3.210 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	40,96	40,74	40,75	40,76	40,70	40,77	40,73	40,72	40,72	40,76
1024210	VM1698-4	364,50	362,75	362,50	361,50	357,25	365,00	360,25	361,25	362,75	362,00

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	40,74	40,82	40,79	40,71	40,73	40,77	40,76	40,79	40,76	40,63
1024210	VM1698-4	361,50	362,50	362,75	362,00	360,25	363,00	362,00	365,50	362,75	359,00

Machine Capability Study
Tool System

Page 1 / 1

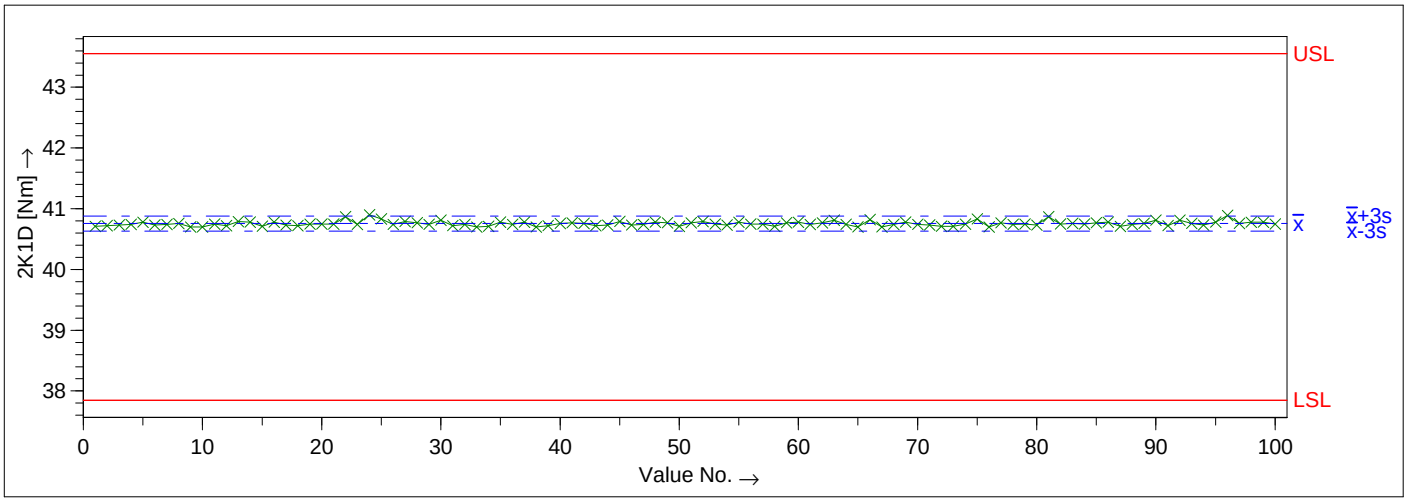
Plant ATG Westhausen		Operator Name Sünder	Date 08.03.2022

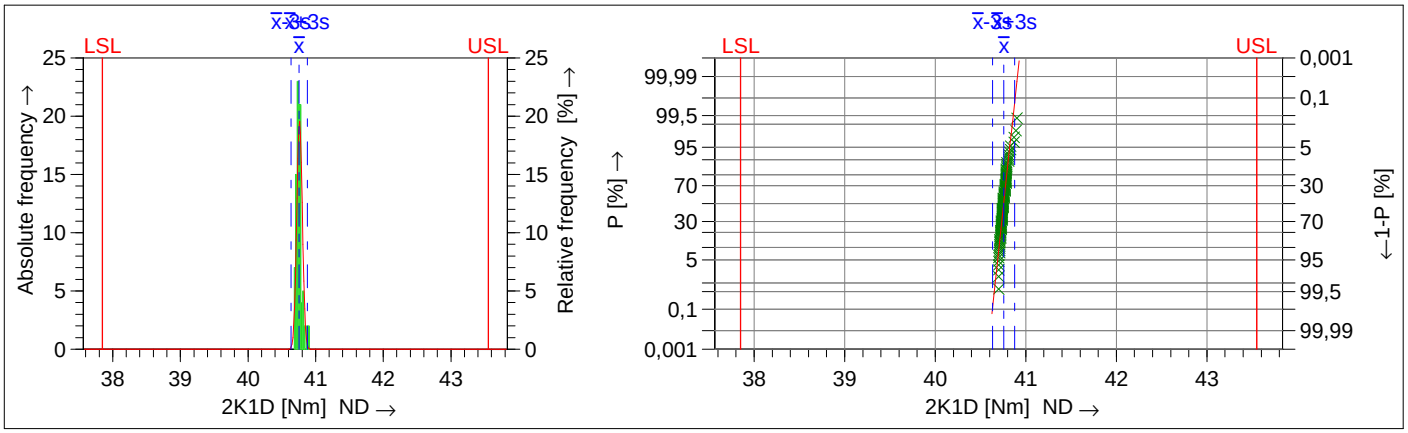
Ord. No. 2BD110T1S-A	Part type 2BD-2B110A-2K1D-2ZB				Contr.item yes
Serial No. 1015969_c	Char.Descr. 2K1D	Inspection Val.	40,70	2,85	USL 43,55
	Serial No. 204571	Unit	Nm	-2,85	LSL 37,85
Char.Type variable		Tolerance value	7 %		Decimal Pl. 2

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

Evaluation from 08.03.2022 14:20:18 to 08.03.2022 14:39:37

Rem. TQ 30% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.210 Nm/A; Speed 890/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	40.70			$\bar{x}$	40.7558
LSL	37.85	x_{min}	40.70	$\bar{x}$-3s	40.6340
USL	43.55	x_{max}	40.90	$\bar{x}$+3s	40.8776
T	5.70	R	0.20	6s	0.2436
		$n_{<T>}$	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	23.40
Critical capability index	=	C_{mk}	22.94

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

APEX VDI/VDE 2647 V0.1

Apex Tool Group GmbH \\htwe0006\AppData\QW\QWE\MessWert\2022\1015969_c1.DFD

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.03.2022

Ser.No.	1015969_c	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	40,70
Ord. No.	2BD110T1S-A	Ser.No.	204571	LSL	37,85
				USL	43,55
Remark	TQ 30% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.210 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}
204571	2K1D	40,71	40,72	40,73	40,74	40,78	40,73	40,74	40,76	40,70	40,70
204571	2K1D	364,00	361,00	368,00	365,00	366,00	369,00	363,00	373,00	372,00	365,00

Char.No	Char.Descr.	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
204571	2K1D	40,75	40,72	40,79	40,78	40,71	40,78	40,73	40,72	40,75	40,75
204571	2K1D	370,00	366,00	369,00	362,00	360,00	363,00	364,00	365,00	361,00	360,00

Char.No	Char.Descr.	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204571	2K1D	40,75	40,87	40,74	40,90	40,83	40,74	40,79	40,77	40,74	40,81
204571	2K1D	362,00	362,00	363,00	365,00	362,00	362,00	360,00	365,00	361,00	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}
204571	2K1D	40,72	40,74	40,70	40,71	40,78	40,74	40,78	40,70	40,72	40,76
204571	2K1D	362,00	361,00	363,00	363,00	366,00	362,00	364,00	361,00	364,00	364,00

Char.No	Char.Descr.	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204571	2K1D	40,77	40,76	40,72	40,73	40,79	40,73	40,74	40,78	40,77	40,71
204571	2K1D	364,00	363,00	363,00	365,00	364,00	363,00	366,00	365,00	368,00	365,00

Char.No	Char.Descr.	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
204571	2K1D	40,77	40,79	40,75	40,73	40,78	40,75	40,75	40,71	40,77	40,78
204571	2K1D	368,00	368,00	371,00	354,00	365,00	356,00	357,00	357,00	363,00	358,00

Char.No	Char.Descr.	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
204571	2K1D	40,74	40,77	40,81	40,74	40,70	40,82	40,70	40,74	40,78	40,74
204571	2K1D	358,00	359,00	358,00	361,00	357,00	362,00	360,00	361,00	361,00	360,00

Char.No	Char.Descr.	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
204571	2K1D	40,73	40,71	40,71	40,75	40,83	40,70	40,77	40,74	40,75	40,73
204571	2K1D	357,00	363,00	362,00	359,00	358,00	359,00	358,00	363,00	361,00	363,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.03.2022

Ser.No.	1015969_c	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	40,70
Ord. No.	2BD110T1S-A	Ser.No.	204571	LSL	37,85
				USL	43,55
Remark	TQ 30% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.210 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}
204571	2K1D	40,87	40,75	40,76	40,75	40,77	40,78	40,71	40,74	40,76	40,81
204571	2K1D	364,00	362,00	361,00	361,00	358,00	364,00	360,00	360,00	363,00	361,00

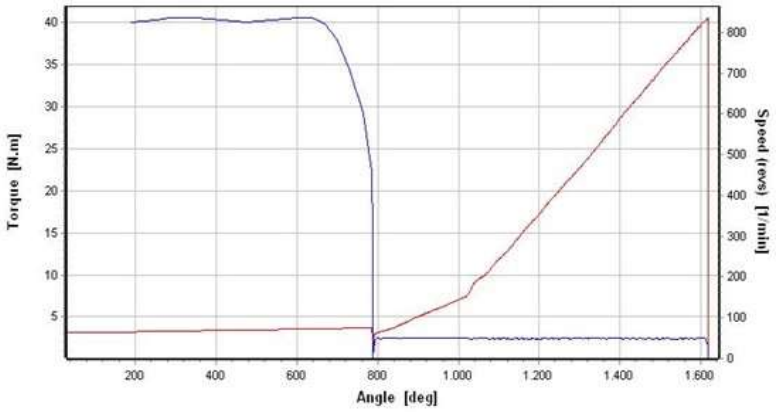
Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204571	2K1D	40,72	40,81	40,76	40,73	40,78	40,89	40,76	40,78	40,78	40,75
204571	2K1D	360,00	362,00	363,00	360,00	361,00	362,00	361,00	364,00	364,00	358,00

Torque graphs

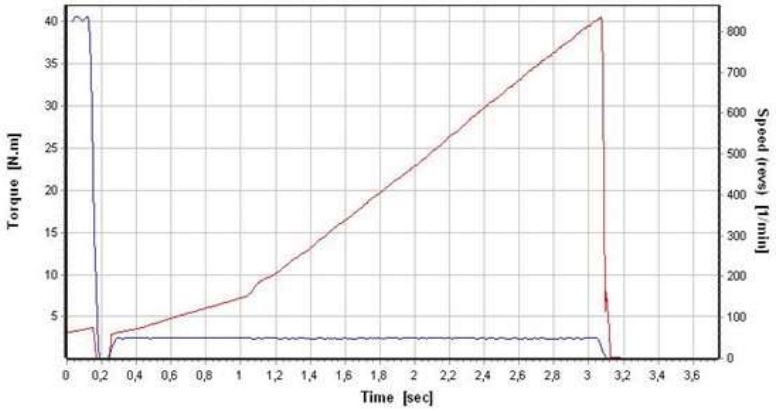
Machine Capability Study 30 %

Model: **2BD-2B110A-2K1D-2ZB**
Serial no: **1015969**

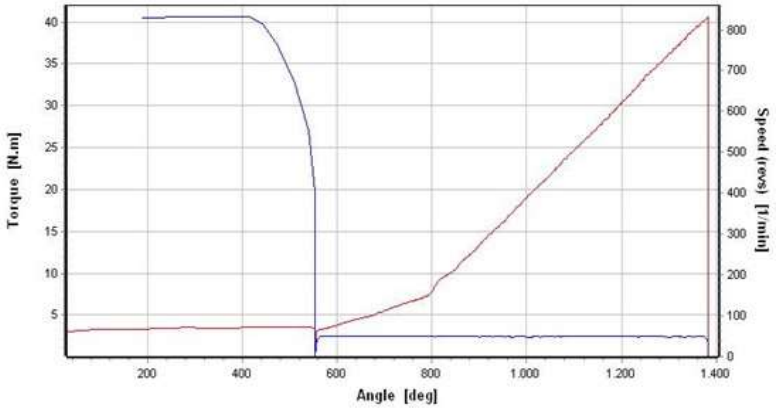
Angle degree: **360°**
Test torque: **40,7 Nm**



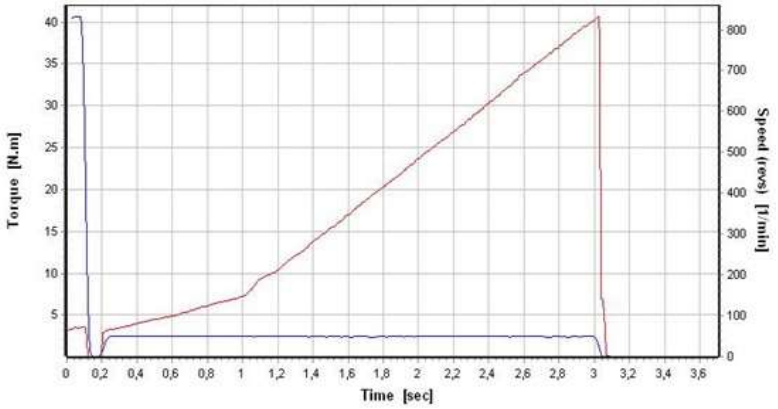
Value no. 1
Graph
Torque / Angle / Speed



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: **1015969**

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

Hard joint (H)	543,38	Nm / Revolution	Angle degree	30°
Soft joint (L)	45,09	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	90,56	90,19 Nm
	Standard deviation	0,18	0,11 Nm
	Torque scatter (99,73%)	1,10	0,66 Nm
	C_m	11,44	19,12
	C_{mk}	10,78	19,09

b)	Min. C_m hard/soft (lowest value)	11,44
	Min. C_{mk} hard/soft (lowest value)	10,78

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

Note:

Machine Capability Study
Control System

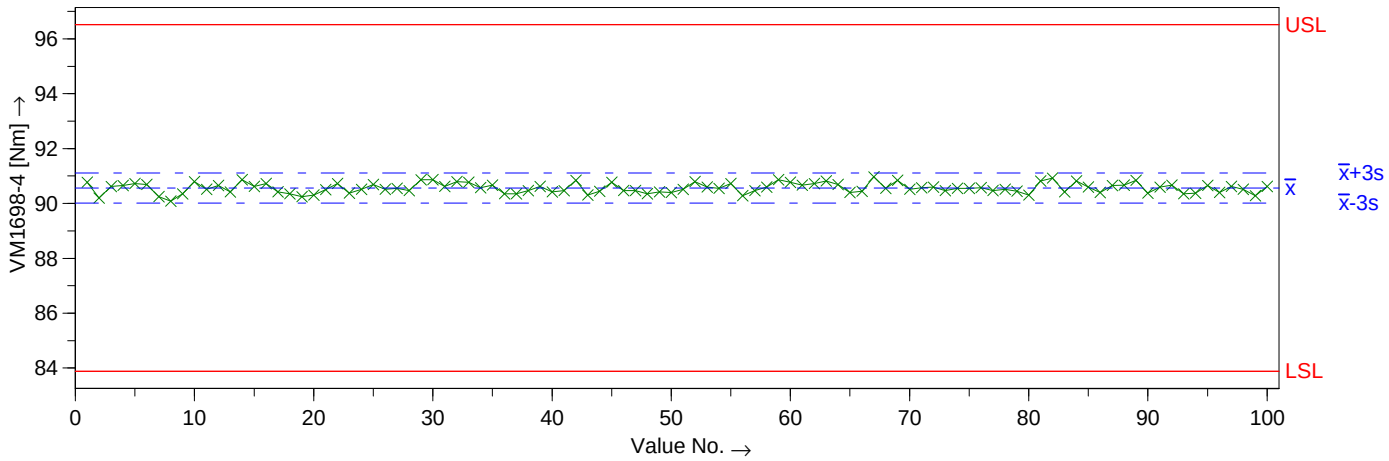
Page 1 / 1

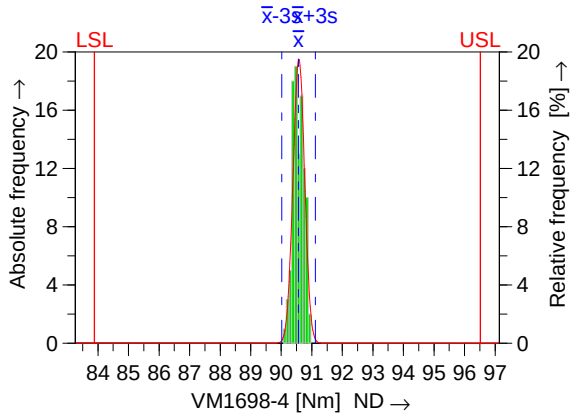
Plant	ATG Westhausen	Operator Name	Sünder
Date	08.03.2022		

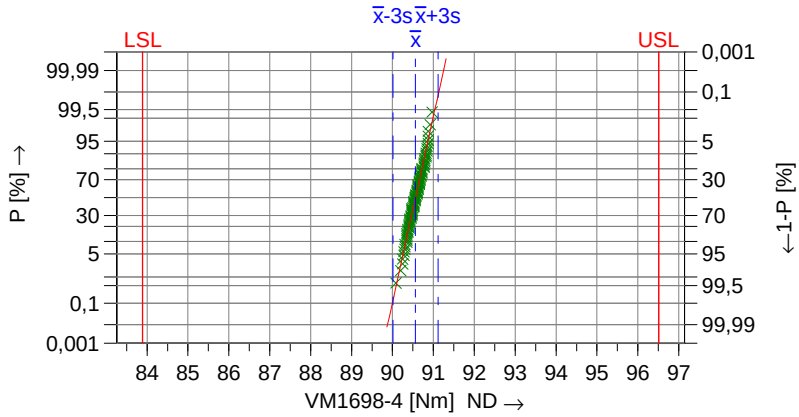
Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015969_h	Char.Descr.	VM1698-4	Inspection Val. 90,20 6,31	USL 96,51
		Serial No.	1024210	Unit Nm -6,31	LSL 83,89
Char.Type	variable			Tolerance value 7 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	120 / 1019923	nges.	100

Evaluation from 08.03.2022 09:48:36 to 08.03.2022 10:03:42

Rem. TQ 80% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.233 Nm/A; Speed 890/50 rpm;







Drawing Values		Collected Values		Statistics	
T_m	90.20			$\bar{x}$	90.5633
LSL	83.89	x_{min}	90.08	$\bar{x}$-3s	90.0119
USL	96.51	x_{max}	90.97	$\bar{x}$+3s	91.1147
T	12.62	R	0.89	6s	1.1029
		$n_{<T>}$	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	11.44
Critical capability index	=	C_{mk}	10.78

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

APEX VDI/VDE 2647 V0.1

Apex Tool Group GmbH \\htwe0006\AppData\QW\QWE\MessWert\2022\1015969_hM.DFD

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.03.2022

Ser.No.	1015969_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.: 3.233 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	90,77	90,20	90,62	90,65	90,72	90,69	90,25	90,08	90,35	90,79
1024210	VM1698-4	29,50	30,00	30,25	30,75	30,00	31,00	30,00	29,25	30,25	30,25

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	90,52	90,65	90,42	90,87	90,62	90,72	90,42	90,35	90,25	90,30
1024210	VM1698-4	30,00	30,00	30,25	30,50	29,75	29,75	29,50	29,25	30,00	29,50

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	90,50	90,72	90,37	90,52	90,69	90,52	90,55	90,47	90,87	90,87
1024210	VM1698-4	29,25	29,75	30,25	30,00	29,75	30,00	29,50	30,50	30,00	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}
1024210	VM1698-4	90,62	90,79	90,77	90,57	90,67	90,35	90,35	90,47	90,62	90,42
1024210	VM1698-4	29,50	30,00	29,25	30,00	30,75	29,75	29,50	29,50	29,25	29,75

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	90,47	90,84	90,30	90,45	90,77	90,47	90,47	90,35	90,42	90,40
1024210	VM1698-4	30,50	30,00	30,00	30,50	30,50	29,50	30,25	29,25	29,25	29,25

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	90,52	90,79	90,60	90,55	90,72	90,28	90,47	90,60	90,87	90,77
1024210	VM1698-4	29,50	30,00	29,75	29,25	30,25	29,50	30,25	30,50	29,50	29,25

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	90,67	90,72	90,82	90,69	90,40	90,45	90,97	90,55	90,84	90,52
1024210	VM1698-4	30,00	30,50	31,00	30,50	30,00	30,00	30,00	30,00	30,75	29,75

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	90,57	90,60	90,47	90,55	90,55	90,57	90,47	90,52	90,45	90,30
1024210	VM1698-4	31,00	30,50	30,00	30,25	30,25	29,50	30,25	29,50	30,00	29,75

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.03.2022

Ser.No.	1015969_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.: 3.233 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	90,82	90,92	90,42	90,82	90,60	90,40	90,65	90,67	90,84	90,37
1024210	VM1698-4	29,00	30,25	30,00	30,25	29,75	29,75	30,75	30,50	30,50	29,75

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	90,60	90,67	90,35	90,37	90,65	90,40	90,62	90,52	90,28	90,62
1024210	VM1698-4	30,50	30,00	30,25	29,00	30,00	30,50	30,25	30,25	29,75	30,00

Machine Capability Study
Tool System

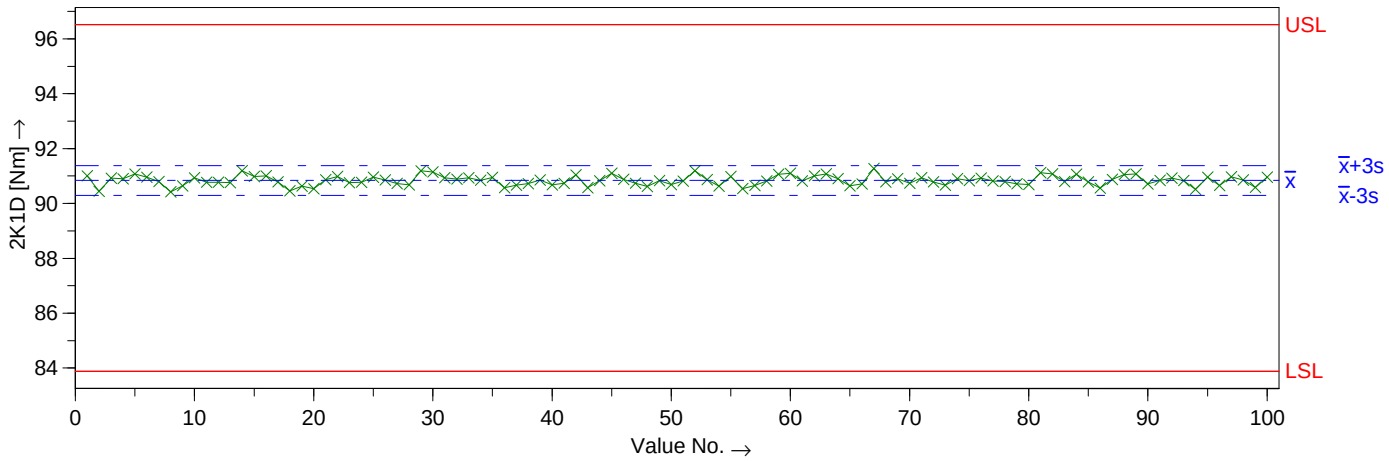
Page 1 / 1

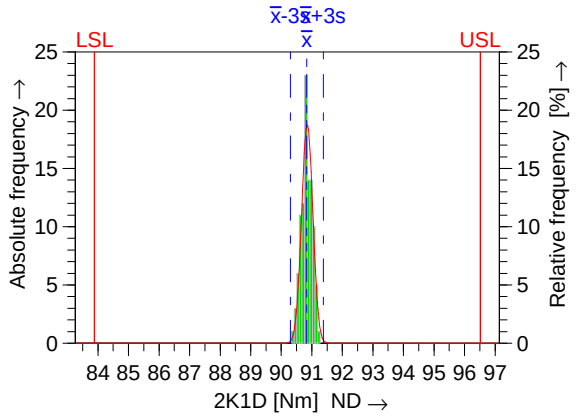
Plant ATG Westhausen		Operator Name Sünder	Date 08.03.2022

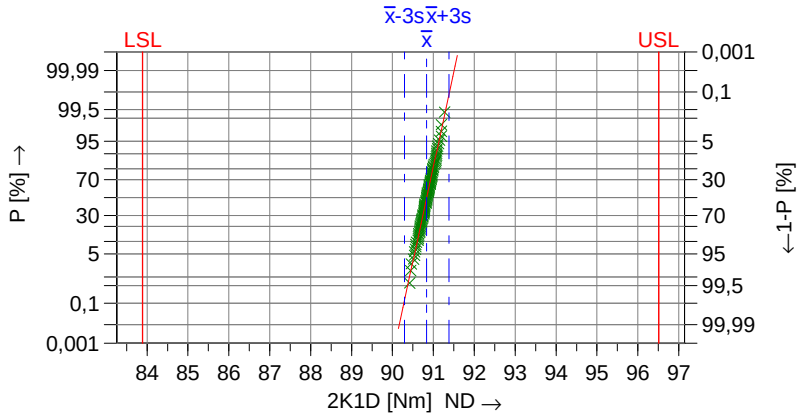
Ord. No. 2BD110T1S-A	Part type 2BD-2B110A-2K1D-2ZB				Contr.item yes
Serial No. 1015969_h	Char.Descr. 2K1D	Inspection Val.	90,20	6,31	USL 96,51
	Serial No. 204571	Unit	Nm	-6,31	LSL 83,89
Char.Type variable		Tolerance value	7 %		Decimal Pl. 2
Cust.Name Cleco	Reference System VM1698-4	Test Electronic MPRO400GCD-P			
Contr.No. Homologation	Reference Transducer 120 / 1019923	nges. 100			

Evaluation from 08.03.2022 09:48:37 to 08.03.2022 10:03:42

Rem. TQ 80% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.233 Nm/A; Speed 890/50 rpm;







Drawing Values		Collected Values		Statistics	
T_m	90.20			$\bar{x}$	90.8373
LSL	83.89	x_{min}	90.42	$\bar{x}$-3s	90.2957
USL	96.51	x_{max}	91.27	$\bar{x}$+3s	91.3789
T	12.62	R	0.85	6s	1.0832
		$n_{<T>}$	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	11.65
Critical capability index	=	C_{mk}	10.47

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

APEX VDI/VDE 2647 V0.1

Apex Tool Group GmbH \\htwe0006\AppData\QW\QWE\MessWert\2022\1015969_h1.DFD

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.03.2022

Ser.No.	1015969_h	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	90,20
Ord. No.	2BD110T1S-A	Ser.No.	204571	LSL	83,89
				USL	96,51
Remark	TQ 80% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.233 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}
204571	2K1D	91,00	90,44	90,92	90,90	91,07	90,96	90,79	90,42	90,64	90,94
204571	2K1D	30,00	30,00	30,00	31,00	31,00	31,00	30,00	30,00	31,00	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}
204571	2K1D	90,77	90,77	90,76	91,19	90,98	91,01	90,78	90,46	90,63	90,54
204571	2K1D	30,00	30,00	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}
204571	2K1D	90,87	90,98	90,76	90,77	90,96	90,85	90,73	90,68	91,19	91,15
204571	2K1D	30,00	31,00	31,00	30,00	30,00	30,00	30,00	31,00	31,00	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}
204571	2K1D	90,94	90,89	90,93	90,84	90,95	90,57	90,67	90,72	90,85	90,68
204571	2K1D	30,00	31,00	30,00	31,00	31,00	31,00	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}
204571	2K1D	90,74	91,04	90,57	90,83	91,10	90,88	90,74	90,62	90,83	90,69
204571	2K1D	31,00	31,00	30,00	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}
204571	2K1D	90,82	91,19	90,87	90,63	90,98	90,54	90,66	90,82	91,06	91,10
204571	2K1D	30,00	30,00	31,00	30,00	31,00	30,00	31,00	31,00	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}
204571	2K1D	90,82	91,00	91,08	90,90	90,64	90,71	91,27	90,78	90,90	90,74
204571	2K1D	30,00	31,00	32,00	31,00	30,00	31,00	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}
204571	2K1D	90,93	90,78	90,67	90,90	90,83	90,92	90,82	90,79	90,71	90,69
204571	2K1D	32,00	31,00	31,00	31,00	31,00	30,00	31,00	30,00	31,00	30,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.03.2022

Ser.No.	1015969_h	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	90,20
Ord. No.	2BD110T1S-A	Ser.No.	204571	LSL	83,89
				USL	96,51
Remark	TQ 80% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.233 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}
204571	2K1D	91,12	91,08	90,79	91,06	90,78	90,56	90,88	91,05	91,08	90,71
204571	2K1D	30,00	31,00	30,00	30,00	30,00	31,00	31,00	31,00	32,00	30,00

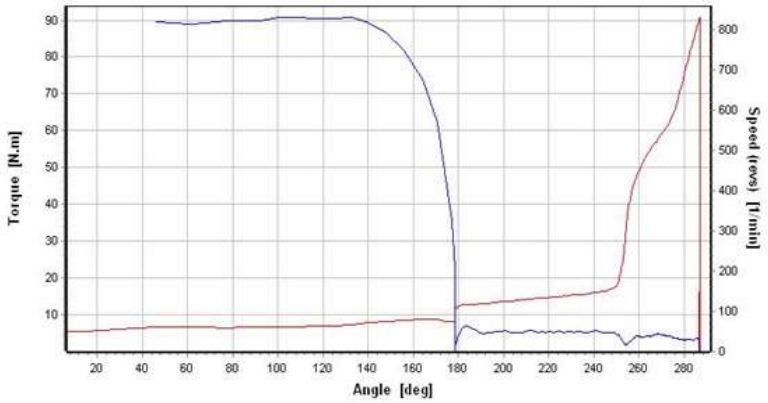
Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204571	2K1D	90,84	90,92	90,83	90,51	90,96	90,66	90,97	90,85	90,58	90,96
204571	2K1D	31,00	31,00	31,00	30,00	30,00	31,00	31,00	31,00	31,00	30,00

Torque graphs

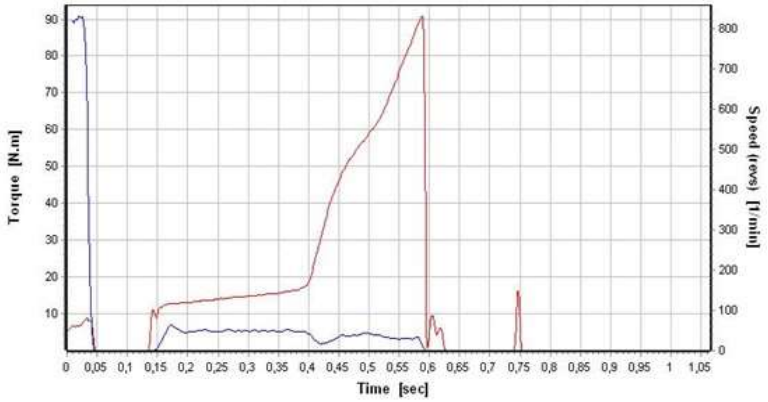
Machine Capability Study 80 %

Model: **2BD-2B110A-2K1D-2ZB**
Serial no: **1015969**

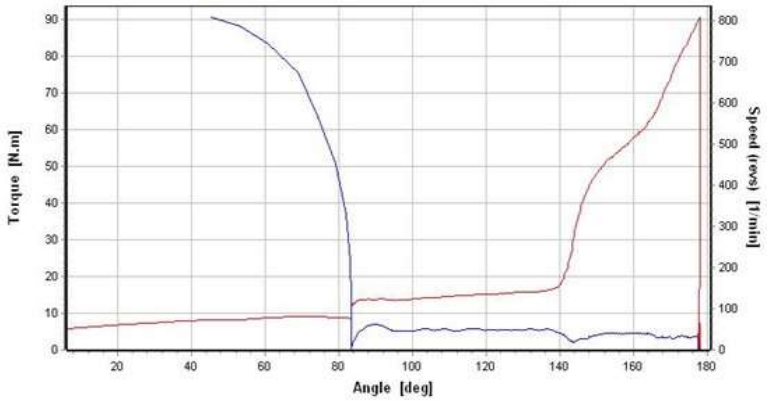
Angle degree: **30°**
Test torque: **90,2 Nm**



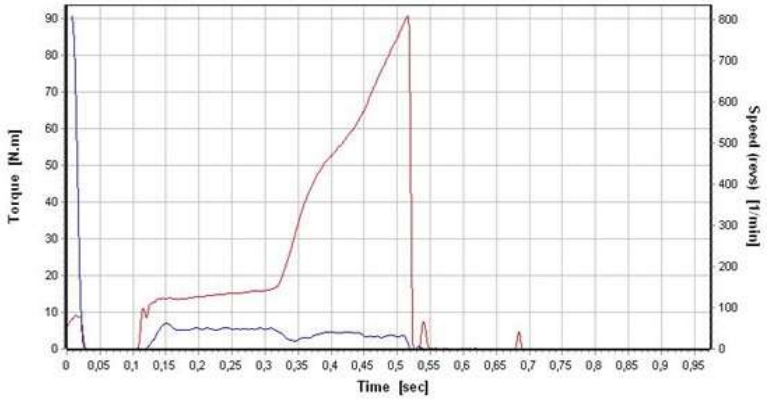
Value no. 1
Graph
Torque / Angle / Speed



Value no. 1
Graph
Torque / Time / Speed



Value no. 100
Graph
Torque / Angle / Speed



Value no. 100
Graph
Torque / Time / Speed

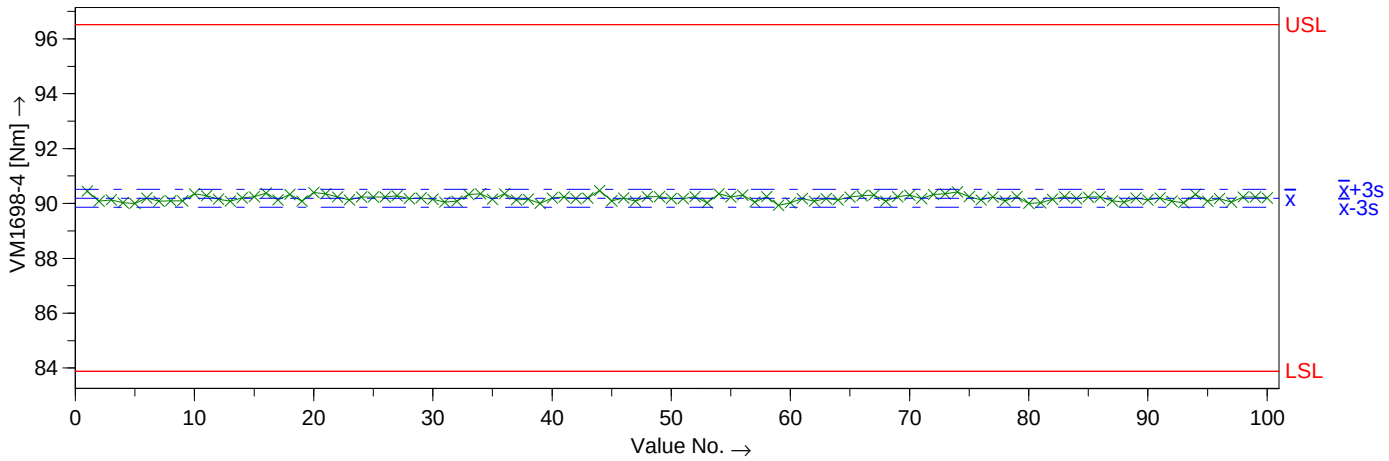
Machine Capability Study
Control System

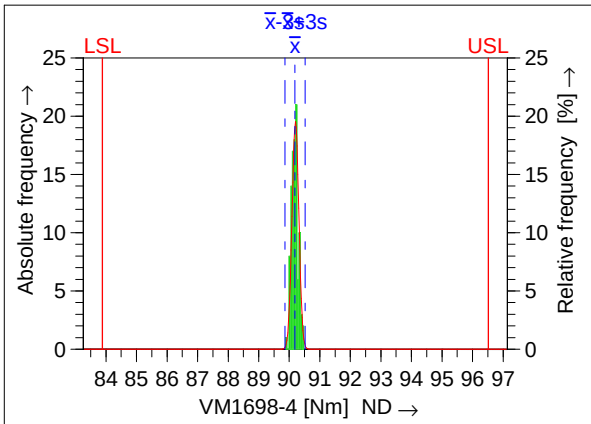
Plant	ATG Westhausen	Operator Name	Sünder
Date	08.03.2022		

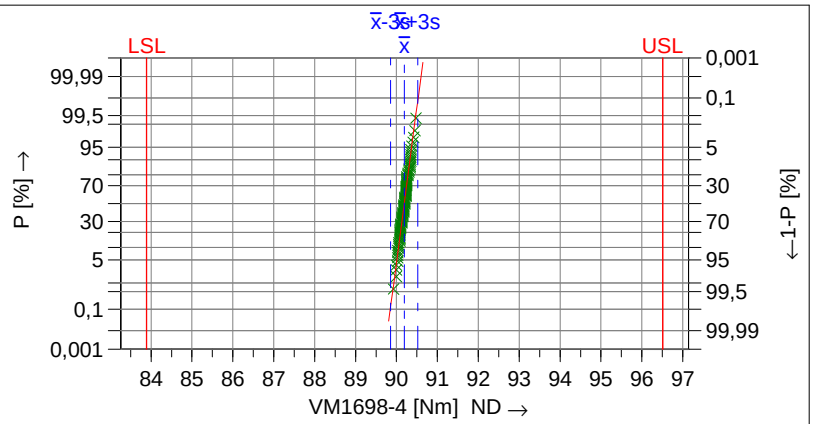
Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015969_g	Char.Descr.	VM1698-4	Inspection Val. 90,20 6,31	USL 96,51
		Serial No.	1024210	Unit Nm -6,31	LSL 83,89
Char.Type	variable			Tolerance value 7 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	120 / 1019923	nges.	100

Evaluation from 08.03.2022 11:16:45 to 08.03.2022 12:00:42

Rem. TQ 80% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.233 Nm/A; Speed 890/50 rpm;







Drawing Values		Collected Values		Statistics	
T_m	90.20			$\bar{x}$	90.1894
LSL	83.89	x_{min}	89.93	$\bar{x}$-3s	89.8593
USL	96.51	x_{max}	90.47	$\bar{x}$+3s	90.5195
T	12.62	R	0.54	6s	0.6601
		$n_{<T>}$	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	19.12
Critical capability index	=	C_{mk}	19.09

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 08.03.2022

Ser.No.	1015969_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.: 3.233 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	90,45	90,08	90,13	90,03	90,00	90,20	90,08	90,10	90,10	90,35
1024210	VM1698-4	338,50	345,25	365,25	350,50	323,00	316,75	356,75	356,00	356,25	344,75

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	90,28	90,15	90,08	90,20	90,25	90,37	90,13	90,33	90,08	90,40
1024210	VM1698-4	361,50	356,25	340,25	334,25	354,50	343,00	339,00	342,75	356,00	350,00

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	90,35	90,23	90,13	90,23	90,23	90,23	90,28	90,18	90,20	90,15
1024210	VM1698-4	357,00	351,50	370,25	359,75	363,25	366,25	344,00	363,75	349,75	351,75

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	90,05	90,08	90,33	90,35	90,15	90,35	90,13	90,15	90,00	90,20
1024210	VM1698-4	340,50	342,50	332,75	357,75	351,00	348,50	368,75	360,50	357,00	357,00

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	90,23	90,18	90,20	90,47	90,10	90,20	90,08	90,25	90,25	90,18
1024210	VM1698-4	372,50	368,50	361,50	366,50	356,75	340,25	356,50	327,75	361,50	336,75

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	90,25	90,03	90,35	90,23	90,30	90,05	90,25	89,93	90,03
1024210	VM1698-4	343,00	377,25	383,75	377,75	355,25	354,75	362,25	366,75	369,25	353,25

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	90,18	90,08	90,18	90,13	90,23	90,28	90,30	90,08	90,25	90,30
1024210	VM1698-4	341,50	361,75	360,50	349,00	345,25	334,50	360,75	359,50	372,00	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	90,18	90,33	90,35	90,42	90,25	90,13	90,23	90,10	90,25	90,00
1024210	VM1698-4	352,50	371,00	359,00	358,50	345,25	364,75	367,75	350,75	372,50	351,00

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.03.2022

Ser.No.	1015969_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.: 3.233 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	90,03	90,15	90,25	90,18	90,23	90,23	90,10	90,05	90,20	90,13
1024210	VM1698-4	369,25	372,25	363,00	348,50	381,25	358,50	373,00	375,75	352,50	367,75

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	90,20	90,08	90,03	90,33	90,08	90,18	90,05	90,23	90,23	90,20
1024210	VM1698-4	350,75	358,00	341,75	352,75	339,25	356,50	362,25	381,75	366,50	347,75

Machine Capability Study
Tool System

Page 1 / 1

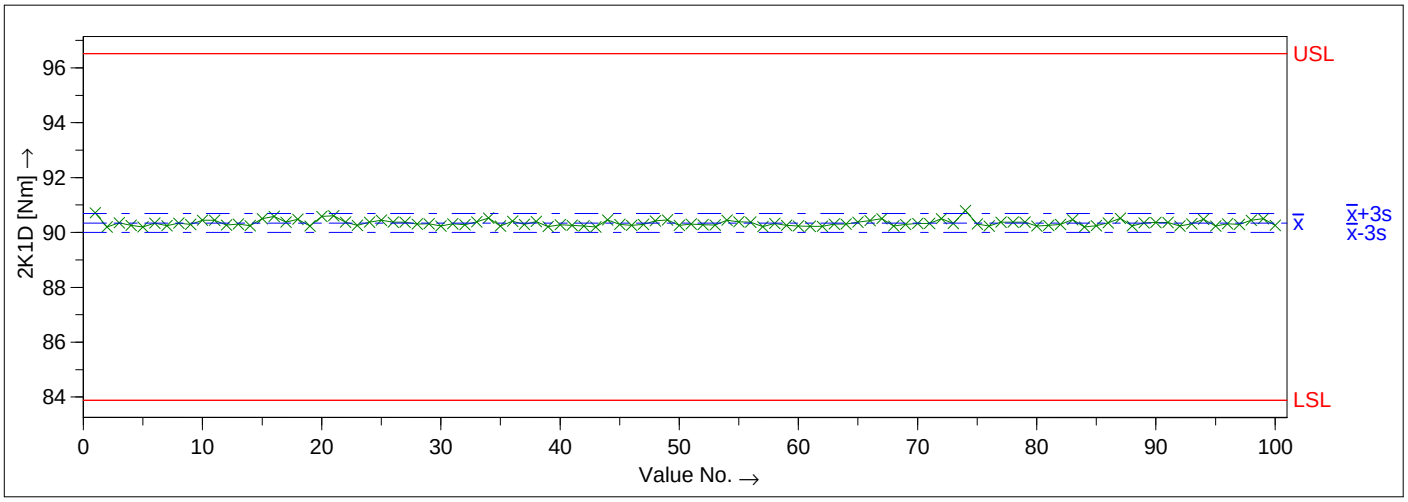
Plant ATG Westhausen		Operator Name Sünder	Date 08.03.2022

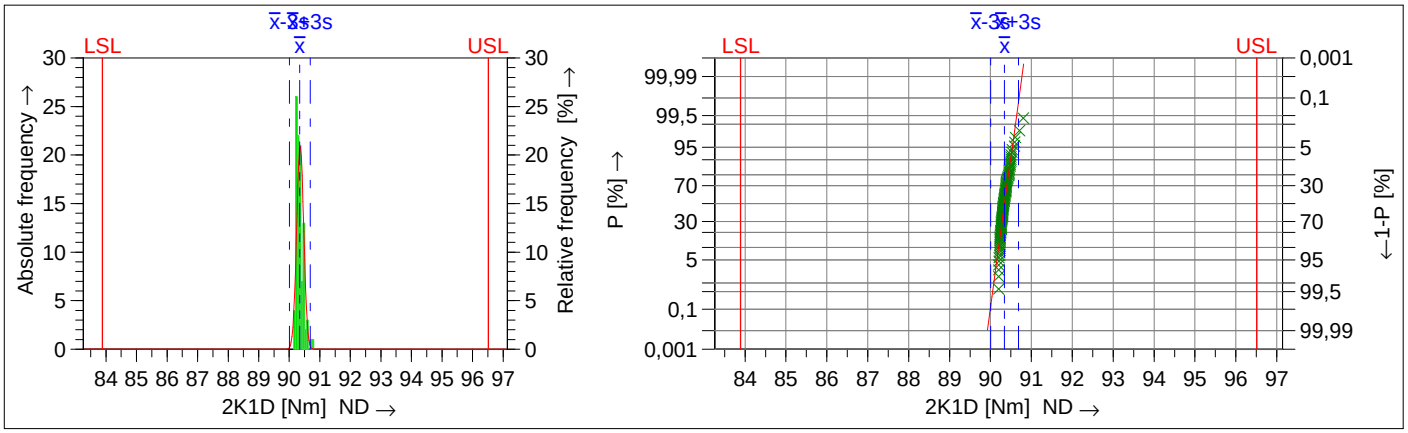
Ord. No. 2BD110T1S-A	Part type 2BD-2B110A-2K1D-2ZB				Contr.item yes
Serial No. 1015969_g	Char.Descr. 2K1D	Inspection Val.	90,20	6,31	USL 96,51
	Serial No. 204571	Unit	Nm	-6,31	LSL 83,89
Char.Type variable		Tolerance value	7 %		Decimal Pl. 2

Cust.Name Cleco	Reference System VM1698-4	Test Electronic MPRO400GCD-P
Contr.No. Homologation	Reference Transducer 120 / 1019923	nges. 100

Evaluation from 08.03.2022 11:16:45 to 08.03.2022 12:00:42

Rem. TQ 80% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.233 Nm/A; Speed 890/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	90.20			$\bar{x}$	90.3444
LSL	83.89	x_{min}	90.20	$\bar{x}$-3s	90.0021
USL	96.51	x_{max}	90.80	$\bar{x}$+3s	90.6867
T	12.62	R	0.60	6s	0.6847
		$n_{<T>}$	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	18.43
Critical capability index	=	C_{mk}	18.01

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 08.03.2022

Ser.No.	1015969_g	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	90,20
Ord. No.	2BD110T1S-A	Ser.No.	204571	LSL	83,89
				USL	96,51
Remark	TQ 80% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.233 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}
204571	2K1D	90,71	90,20	90,35	90,26	90,20	90,34	90,25	90,34	90,29	90,44
204571	2K1D	339,00	350,00	366,00	353,00	324,00	318,00	358,00	359,00	360,00	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}
204571	2K1D	90,45	90,27	90,31	90,25	90,50	90,59	90,38	90,48	90,23	90,58
204571	2K1D	362,00	357,00	343,00	335,00	357,00	344,00	340,00	343,00	357,00	351,00

Char.No	Char.Descr.	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204571	2K1D	90,61	90,38	90,26	90,37	90,45	90,38	90,38	90,30	90,32	90,23
204571	2K1D	358,00	352,00	371,00	361,00	364,00	366,00	344,00	365,00	352,00	353,00

Char.No	Char.Descr.	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
204571	2K1D	90,32	90,28	90,39	90,53	90,23	90,41	90,29	90,40	90,21	90,28
204571	2K1D	344,00	344,00	334,00	359,00	352,00	349,00	371,00	363,00	359,00	359,00

Char.No	Char.Descr.	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204571	2K1D	90,26	90,23	90,20	90,46	90,29	90,26	90,29	90,42	90,46	90,26
204571	2K1D	374,00	372,00	366,00	366,00	361,00	340,00	357,00	330,00	362,00	337,00

Char.No	Char.Descr.	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
204571	2K1D	90,30	90,28	90,27	90,45	90,39	90,37	90,21	90,33	90,26	90,23
204571	2K1D	342,00	378,00	385,00	380,00	356,00	359,00	363,00	368,00	371,00	354,00

Char.No	Char.Descr.	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
204571	2K1D	90,22	90,22	90,30	90,30	90,37	90,43	90,50	90,23	90,29	90,33
204571	2K1D	342,00	363,00	362,00	352,00	347,00	336,00	362,00	360,00	373,00	355,00

Char.No	Char.Descr.	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
204571	2K1D	90,33	90,50	90,33	90,80	90,31	90,23	90,37	90,38	90,37	90,23
204571	2K1D	356,00	371,00	360,00	360,00	346,00	366,00	369,00	352,00	375,00	352,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.03.2022

Ser.No.	1015969_g	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	90,20
Ord. No.	2BD110T1S-A	Ser.No.	204571	LSL	83,89
				USL	96,51
Remark	TQ 80% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.233 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}
204571	2K1D	90,26	90,29	90,47	90,20	90,25	90,35	90,52	90,23	90,35	90,36
204571	2K1D	371,00	372,00	366,00	352,00	382,00	359,00	376,00	377,00	353,00	369,00

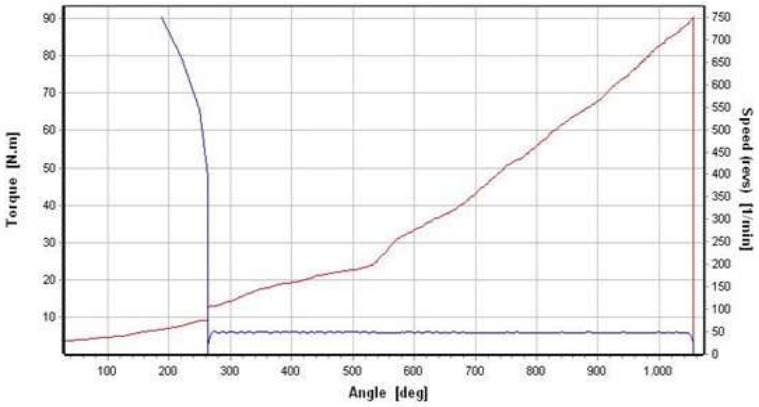
Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204571	2K1D	90,36	90,24	90,32	90,48	90,24	90,32	90,29	90,45	90,50	90,26
204571	2K1D	352,00	361,00	344,00	355,00	341,00	360,00	364,00	383,00	368,00	352,00

Torque graphs

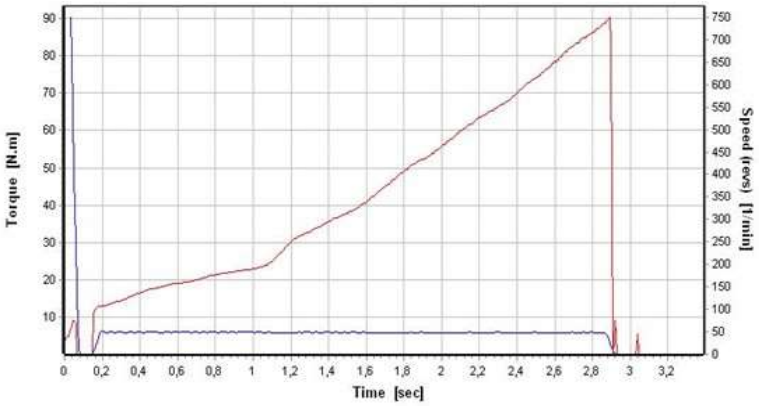
Machine Capability Study 80 %

Model: **2BD-2B110A-2K1D-2ZB**
Serial no: **1015969**

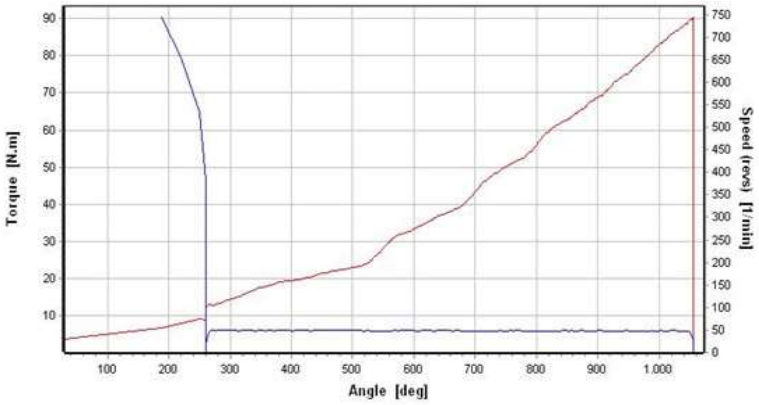
Angle degree: **360°**
Test torque: **90,2 Nm**



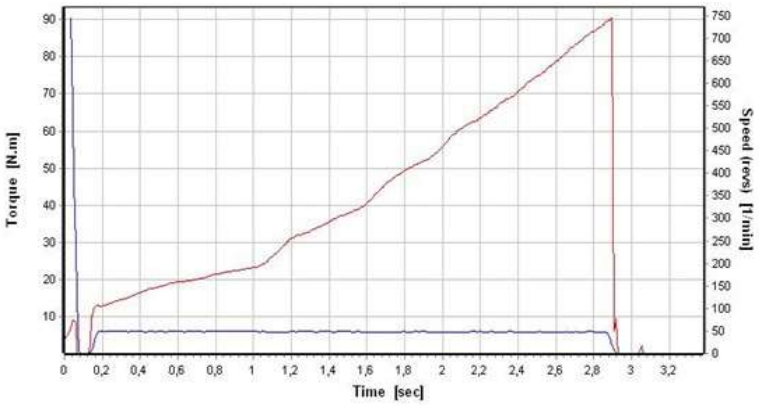
Value no. 1
Graph
Torque / Angle / Speed



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: **1015969**

Test torque: Tq max. 110,00 Nm

Hard joint (H)	662,55	Nm / Revolution	Angle degree	30°
Soft joint (L)	54,93	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	110,43	109,86 Nm
	Standard deviation	0,24	0,12 Nm
	Torque scatter (99,73%)	1,43	0,73 Nm
	C_m	10,75	21,21
	C_{mk}	10,15	20,82

b)	Min. C_m hard/soft (lowest value)	10,75
	Min. C_{mk} hard/soft (lowest value)	10,15

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

Note:

Machine Capability Study
Control System

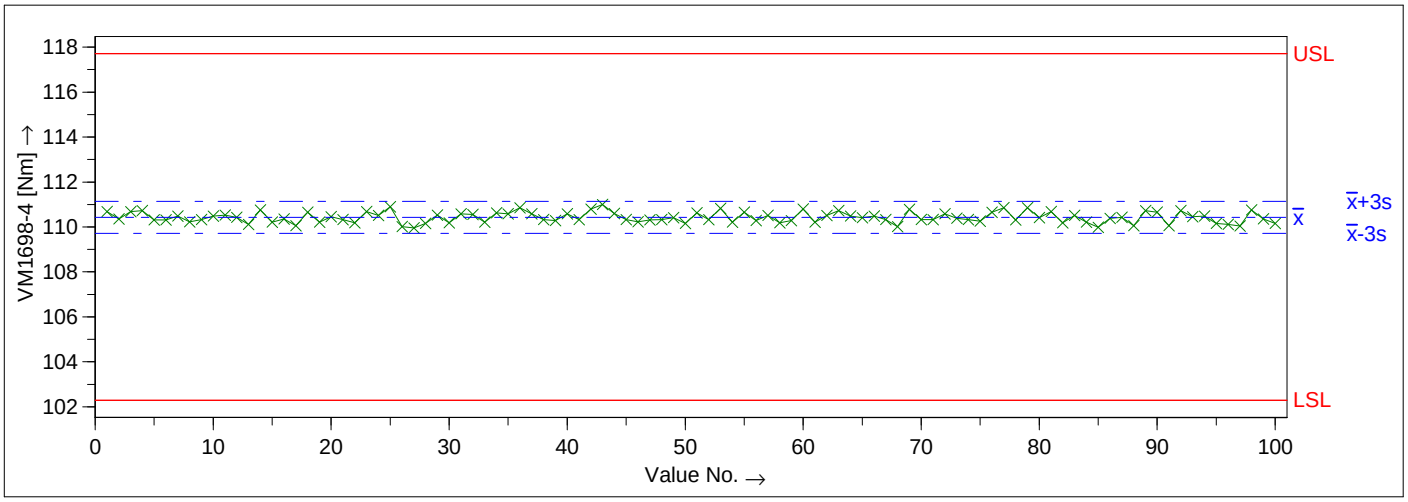
Cleco Production Tools

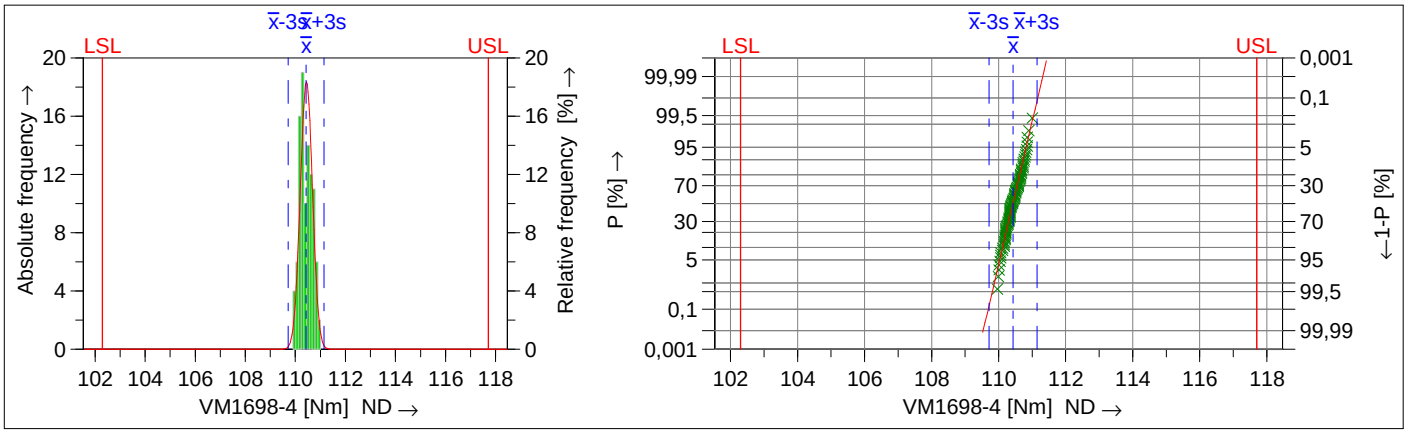
Plant	ATG Westhausen	Operator Name	Sünder
Date	08.03.2022		

Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015969_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 08.03.2022 12:36:31 to 08.03.2022 12:51:57

Rem. TQ 100% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.166 Nm/A; Speed 890/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	110.00			$\bar{x}$	110.4256
LSL	102.30	x_{min}	109.96	$\bar{x}$-3s	109.7092
USL	117.70	x_{max}	111.00	$\bar{x}$+3s	111.1420
T	15.40	R	1.04	6s	1.4328
		$n_{<T>}$	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	10.75
Critical capability index	=	C_{mk}	10.15

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 08.03.2022

Ser.No.	1015969_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.: 3.166 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	110,68	110,36	110,68	110,73	110,31	110,31	110,48	110,23	110,33	110,48
1024210	VM1698-4	33,75	33,25	33,50	34,50	33,50	33,50	33,00	33,25	34,00	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}
1024210	VM1698-4	110,53	110,43	110,11	110,75	110,21	110,36	110,06	110,65	110,21	110,46
1024210	VM1698-4	24,25	33,25	32,75	24,00	31,75	24,50	33,00	33,25	33,25	31,75

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	110,33	110,19	110,68	110,51	110,90	110,01	109,96	110,16	110,53	110,19
1024210	VM1698-4	25,50	33,50	33,00	33,75	24,00	32,50	33,00	33,25	32,75	23,25

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	110,58	110,55	110,21	110,63	110,58	110,85	110,58	110,33	110,28	110,58
1024210	VM1698-4	33,00	22,75	32,75	32,00	33,25	23,25	32,75	32,00	32,75	33,00

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	110,33	110,80	111,00	110,60	110,33	110,23	110,31	110,33	110,41	110,16
1024210	VM1698-4	32,25	32,00	23,50	24,25	33,00	25,00	33,50	33,25	24,00	33,50

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	110,63	110,33	110,83	110,21	110,65	110,28	110,51	110,19	110,28	110,80
1024210	VM1698-4	33,50	33,00	32,50	32,50	33,00	32,75	33,00	32,50	32,50	32,25

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	110,51	110,73	110,48	110,41	110,48	110,33	110,01	110,78	110,33
1024210	VM1698-4	32,75	33,00	33,00	24,00	24,00	32,75	33,25	32,75	23,75	32,75

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	110,33	110,58	110,38	110,33	110,26	110,65	110,85	110,31	110,85	110,41
1024210	VM1698-4	32,25	32,75	32,50	24,00	32,25	31,50	32,00	23,25	32,75	23,00

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.03.2022

Ser.No.	1015969_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.: 3.166 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	110,19	110,51	110,21	109,99	110,38	110,43	110,06	110,73	110,65
1024210	VM1698-4	32,00	32,00	24,75	32,75	32,50	33,25	23,50	33,50	23,00	33,50

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	110,06	110,73	110,46	110,48	110,16	110,11	110,04	110,75	110,36	110,16
1024210	VM1698-4	24,50	24,75	32,50	33,75	33,00	32,75	24,25	31,75	32,00	32,75

Machine Capability Study
Tool System

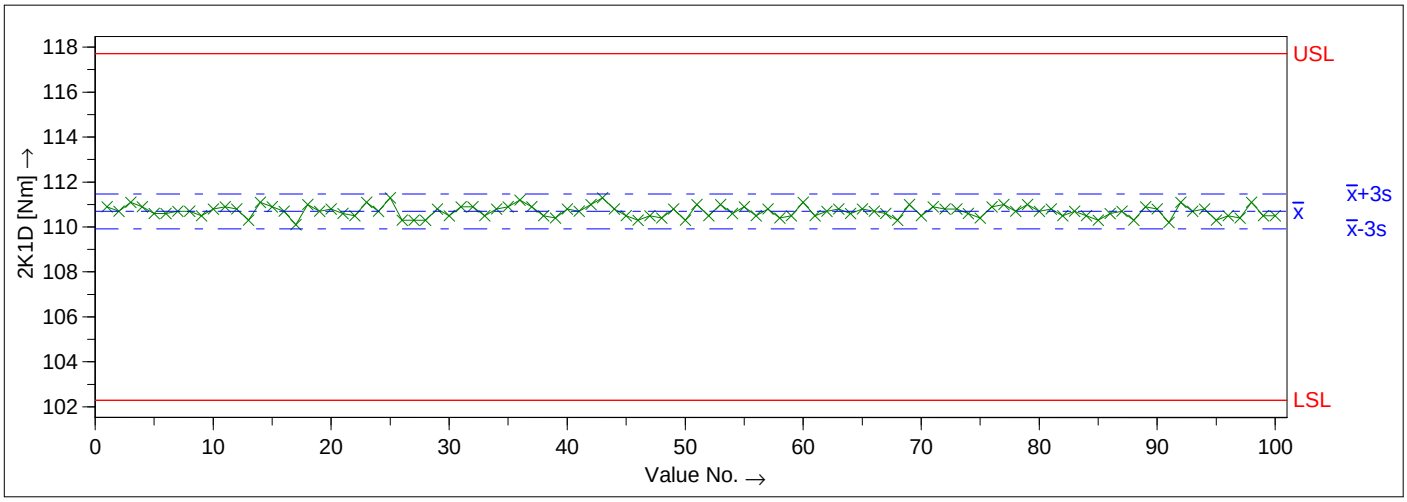
Page 1 / 1

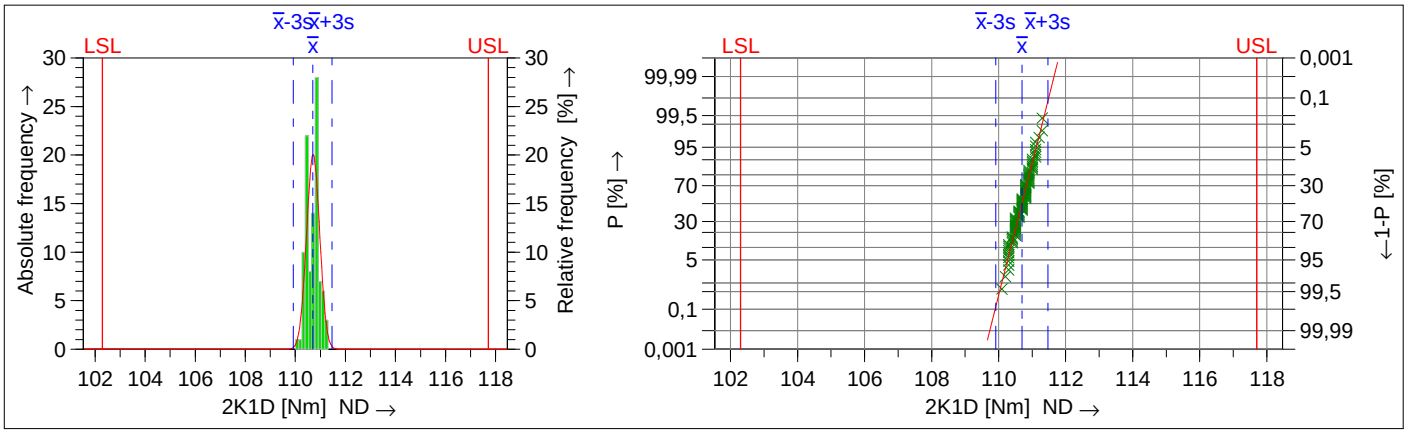
Plant	ATG Westhausen	Operator Name	Sünder
Date	08.03.2022		

Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015969_b	Char.Descr.	2K1D	Inspection Val. 110,00 7,70	USL 117,70
		Serial No.	204571	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 08.03.2022 12:36:32 to 08.03.2022 12:51:58

Rem. TQ 100% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.166 Nm/A; Speed 890/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	110.00			$\bar{x}$	110.6940
LSL	102.30	x_{min}	110.10	$\bar{x}$-3s	109.9184
USL	117.70	x_{max}	111.30	$\bar{x}$+3s	111.4696
T	15.40	R	1.20	6s	1.5511
		$n_{<T>}$	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	9.93
Critical capability index	=	C_{mk}	9.03

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

APEX VDI/VDE 2647 V0.1

Apex Tool Group GmbH \\htwe0006\AppData\QW\QWE\MessWert\2022\1015969_b1.DFD

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.03.2022

Ser.No.	1015969_b	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	110,00
Ord. No.	2BD110T1S-A	Ser.No.	204571	LSL	102,30
				USL	117,70
Remark	TQ 100% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.166 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}
204571	2K1D	110,90	110,70	111,10	110,90	110,60	110,60	110,70	110,70	110,50	110,80
204571	2K1D	34,00	34,00	34,00	34,00	34,00	34,00	33,00	34,00	34,00	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}
204571	2K1D	110,90	110,80	110,30	111,10	110,90	110,70	110,10	111,00	110,70	110,80
204571	2K1D	24,00	34,00	33,00	24,00	33,00	25,00	34,00	34,00	35,00	33,00

Char.No	Char.Descr.	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204571	2K1D	110,60	110,50	111,10	110,70	111,30	110,30	110,30	110,30	110,80	110,50
204571	2K1D	26,00	33,00	34,00	34,00	24,00	33,00	33,00	34,00	33,00	24,00

Char.No	Char.Descr.	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
204571	2K1D	110,90	110,90	110,50	110,80	110,90	111,20	110,90	110,50	110,40	110,80
204571	2K1D	33,00	23,00	34,00	33,00	34,00	24,00	33,00	32,00	33,00	33,00

Char.No	Char.Descr.	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204571	2K1D	110,70	111,00	111,30	110,80	110,50	110,30	110,50	110,40	110,80	110,30
204571	2K1D	33,00	33,00	24,00	24,00	33,00	25,00	34,00	34,00	25,00	34,00

Char.No	Char.Descr.	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
204571	2K1D	111,00	110,50	111,00	110,60	110,90	110,50	110,80	110,40	110,50	111,10
204571	2K1D	34,00	33,00	33,00	33,00	33,00	33,00	33,00	33,00	33,00	33,00

Char.No	Char.Descr.	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
204571	2K1D	110,50	110,70	110,80	110,60	110,80	110,70	110,60	110,30	111,00	110,50
204571	2K1D	34,00	33,00	34,00	24,00	25,00	33,00	33,00	33,00	25,00	33,00

Char.No	Char.Descr.	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
204571	2K1D	110,90	110,80	110,80	110,60	110,40	110,90	111,00	110,70	111,00	110,70
204571	2K1D	33,00	33,00	33,00	25,00	33,00	33,00	33,00	24,00	33,00	24,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.03.2022

Ser.No.	1015969_b	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	110,00
Ord. No.	2BD110T1S-A	Ser.No.	204571	LSL	102,30
				USL	117,70
Remark	TQ 100% hard +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.166 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}
204571	2K1D	110,80	110,50	110,70	110,50	110,30	110,60	110,70	110,30	110,90	110,80
204571	2K1D	32,00	33,00	25,00	34,00	33,00	34,00	24,00	34,00	24,00	34,00

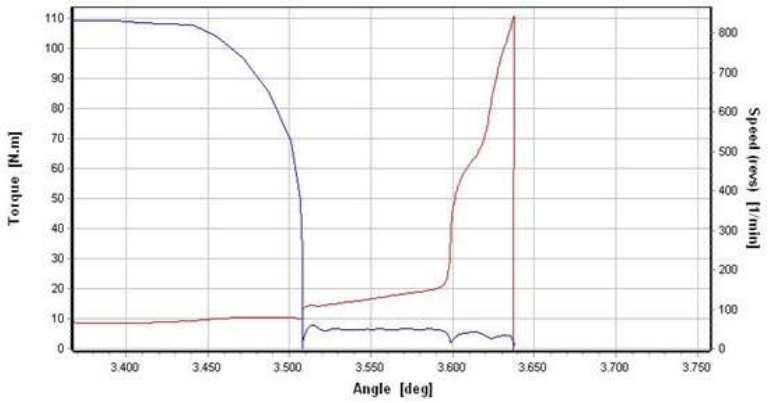
Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204571	2K1D	110,20	111,10	110,70	110,80	110,30	110,50	110,40	111,10	110,50	110,50
204571	2K1D	25,00	26,00	33,00	35,00	34,00	33,00	25,00	32,00	33,00	34,00

Torque graphs

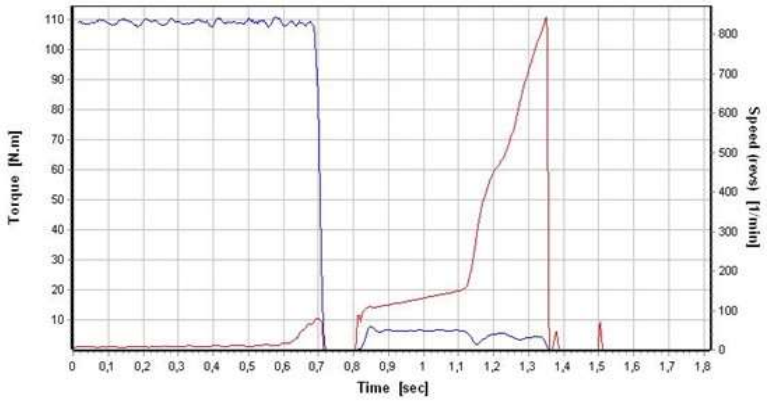
Machine Capability Study 100 %

Model: **2BD-2B110A-2K1D-2ZB**
Serial no: **1015969**

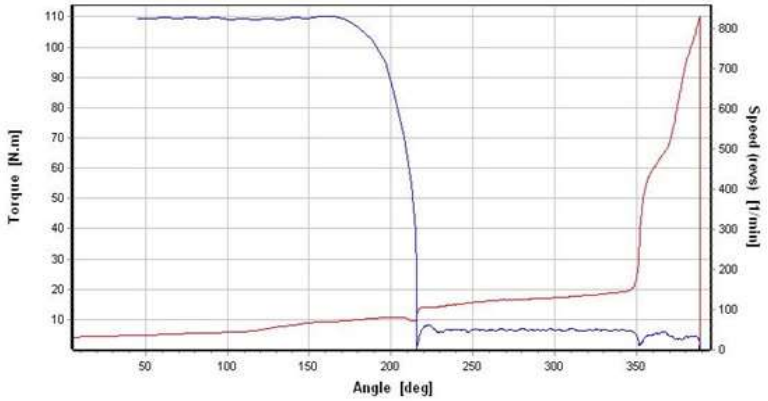
Angle degree: **30°**
Test torque: **110,0 Nm**



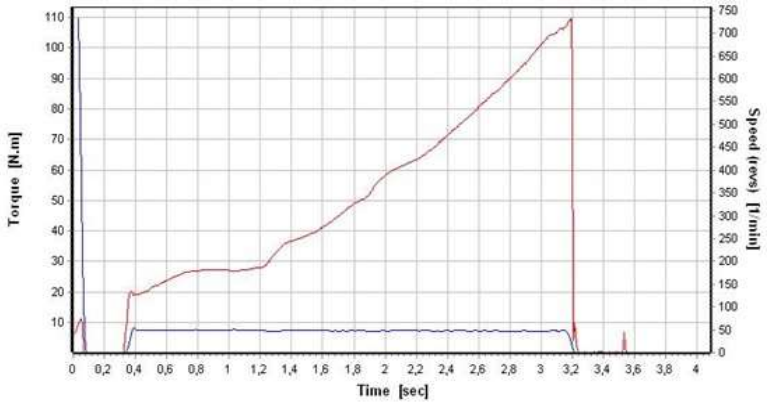
Value no. 1
Graph
Torque / Angle / Speed



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

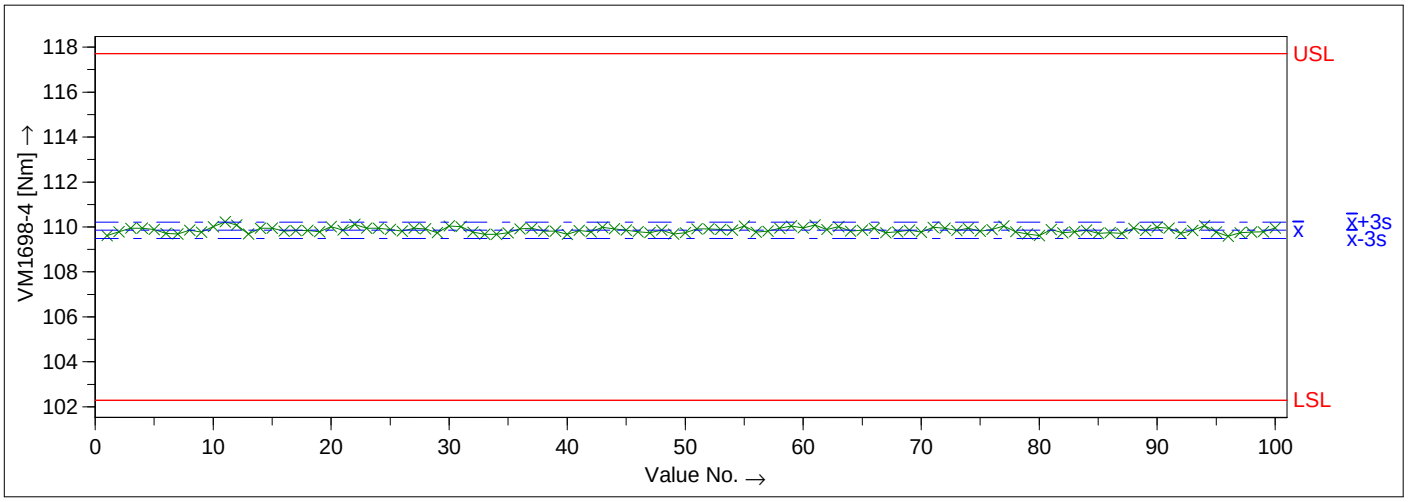
Page 1 / 1

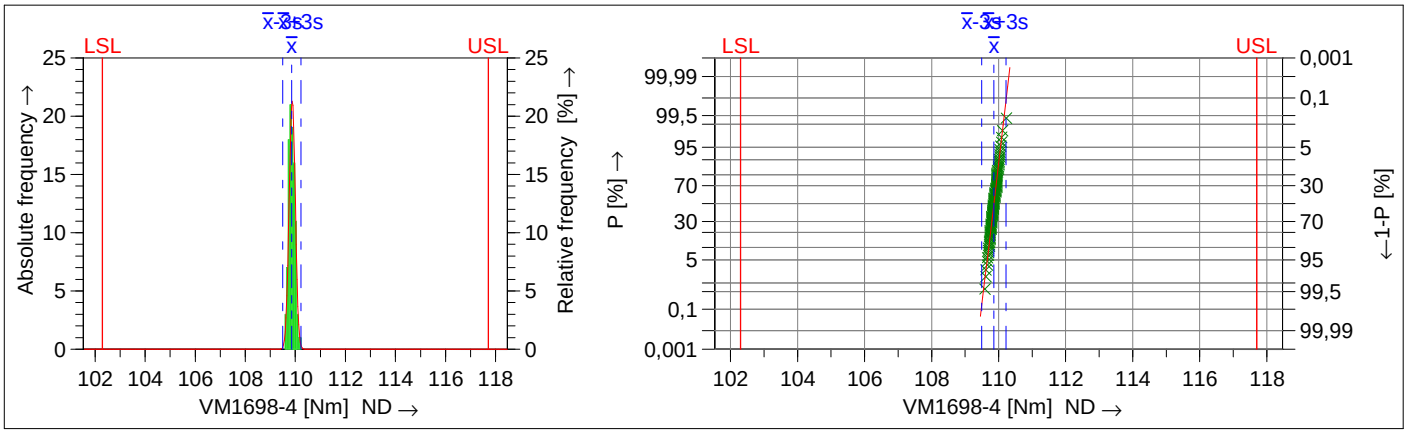
Plant	ATG Westhausen	Operator Name	Sünder
Date	08.03.2022		

Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015969_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 08.03.2022 15:10:55 to 08.03.2022 16:30:11

Rem. TQ 100% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.166 Nm/A; Speed 890/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	110.00			$\bar{x}$	109.8572
LSL	102.30	x_{min}	109.59	$\bar{x}$-3s	109.4942
USL	117.70	x_{max}	110.23	$\bar{x}$+3s	110.2202
T	15.40	R	0.64	6s	0.7259
		$n_{<T>}$	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	21.21
Critical capability index	=	C_{mk}	20.82

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 08.03.2022

Ser.No.	1015969_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.: 3.166 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	109,62	109,79	109,94	109,94	109,89	109,72	109,69	109,86	109,77	110,01
1024210	VM1698-4	350,00	361,50	347,50	344,25	352,75	344,25	360,00	334,25	339,25	329,75

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	110,23	110,09	109,69	109,94	109,94	109,82	109,84	109,84	109,79	110,01
1024210	VM1698-4	341,25	346,75	349,75	351,00	353,00	339,25	351,00	343,00	354,50	351,25

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	109,86	110,11	109,94	109,94	109,89	109,82	109,94	109,91	109,74	110,04
1024210	VM1698-4	356,00	380,50	368,25	355,00	367,75	345,50	346,75	345,50	351,50	359,00

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	110,01	109,77	109,67	109,67	109,74	109,91	109,94	109,82	109,82	109,67
1024210	VM1698-4	363,00	357,50	364,50	355,25	362,75	350,00	361,25	364,00	348,00	355,75

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	109,84	109,79	109,99	109,91	109,86	109,79	109,74	109,86	109,69	109,74
1024210	VM1698-4	356,75	343,25	373,00	366,50	349,75	347,00	358,75	370,25	351,00	354,75

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	109,91	109,91	109,89	109,86	110,04	109,77	109,82	109,94	110,04	109,96
1024210	VM1698-4	356,50	356,75	346,00	370,00	363,75	351,00	356,75	358,75	358,25	334,00

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	110,09	109,89	110,01	109,82	109,86	109,94	109,74	109,79	109,86	109,77
1024210	VM1698-4	347,25	358,25	364,75	339,00	376,25	354,50	355,25	366,00	353,00	353,75

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	109,99	109,94	109,84	109,94	109,82	109,89	110,04	109,79	109,69	109,62
1024210	VM1698-4	350,00	350,50	346,50	366,25	347,50	355,00	368,00	366,50	361,75	352,00

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.03.2022

Ser.No.	1015969_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.: 3.166 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	109,89	109,74	109,79	109,86	109,72	109,74	109,72	109,94	109,84	109,99
1024210	VM1698-4	355,25	355,25	354,75	352,75	354,75	359,25	357,25	361,00	362,25	356,75

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	109,94	109,72	109,84	110,06	109,77	109,59	109,74	109,77	109,79	109,96
1024210	VM1698-4	354,00	363,00	358,50	366,25	357,75	382,50	359,25	344,25	362,00	361,75

Machine Capability Study
Tool System

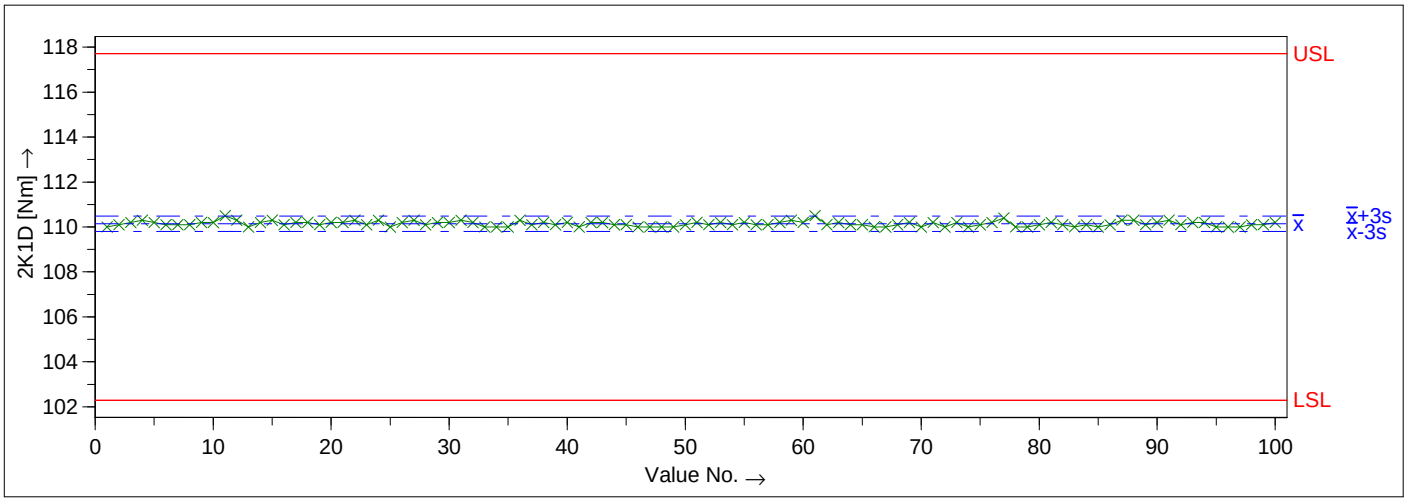
Page 1 / 1

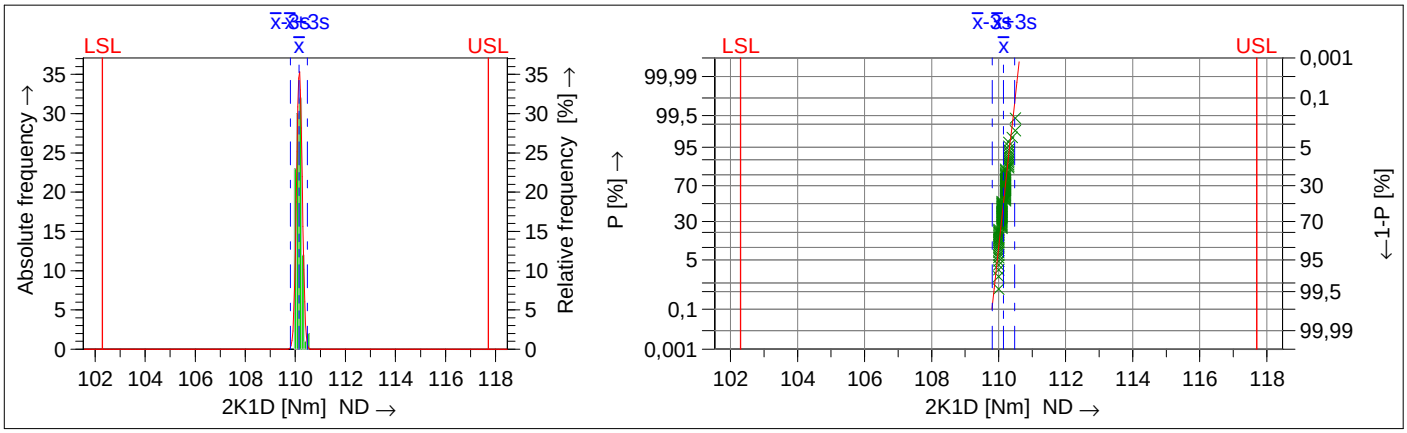
Plant	ATG Westhausen	Operator Name	Sünder
Date	08.03.2022		

Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015969_a	Char.Descr.	2K1D	Inspection Val. 110,00 7,70	USL 117,70
		Serial No.	204571	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 08.03.2022 15:10:56 to 08.03.2022 16:30:18

Rem. TQ 100% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.166 Nm/A; Speed 890/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	110.00			$\bar{x}$	110.1440
LSL	102.30	x_{min}	110.00	$\bar{x}$-3s	109.8074
USL	117.70	x_{max}	110.50	$\bar{x}$+3s	110.4806
T	15.40	R	0.50	6s	0.6732
		$n_{<T>}$	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	22.87
Critical capability index	=	C_{mk}	22.45

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 08.03.2022

Ser.No.	1015969_a	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	110,00
Ord. No.	2BD110T1S-A	Ser.No.	204571	LSL	102,30
				USL	117,70
Remark	TQ 100% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.166 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}
204571	2K1D	110,00	110,10	110,20	110,30	110,20	110,10	110,10	110,10	110,20	110,20
204571	2K1D	355,00	364,00	347,00	346,00	355,00	345,00	362,00	335,00	341,00	330,00

Char.No	Char.Descr.	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
204571	2K1D	110,50	110,30	110,00	110,20	110,30	110,10	110,20	110,20	110,10	110,20
204571	2K1D	342,00	348,00	351,00	352,00	355,00	341,00	353,00	344,00	355,00	353,00

Char.No	Char.Descr.	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204571	2K1D	110,20	110,30	110,10	110,30	110,00	110,20	110,30	110,10	110,20	110,20
204571	2K1D	357,00	381,00	370,00	356,00	367,00	346,00	347,00	347,00	353,00	359,00

Char.No	Char.Descr.	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
204571	2K1D	110,30	110,20	110,00	110,00	110,00	110,30	110,10	110,20	110,10	110,20
204571	2K1D	365,00	359,00	365,00	357,00	363,00	351,00	363,00	365,00	347,00	356,00

Char.No	Char.Descr.	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204571	2K1D	110,00	110,20	110,20	110,10	110,10	110,00	110,00	110,00	110,00	110,10
204571	2K1D	357,00	345,00	375,00	367,00	350,00	348,00	359,00	370,00	352,00	356,00

Char.No	Char.Descr.	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
204571	2K1D	110,20	110,10	110,20	110,10	110,20	110,10	110,10	110,20	110,30	110,20
204571	2K1D	358,00	359,00	347,00	369,00	366,00	352,00	357,00	361,00	360,00	334,00

Char.No	Char.Descr.	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
204571	2K1D	110,50	110,10	110,20	110,10	110,10	110,00	110,00	110,10	110,20	110,00
204571	2K1D	348,00	362,00	365,00	340,00	377,00	356,00	356,00	367,00	353,00	354,00

Char.No	Char.Descr.	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
204571	2K1D	110,20	110,00	110,20	110,00	110,10	110,20	110,40	110,00	110,00	110,10
204571	2K1D	351,00	351,00	349,00	367,00	348,00	357,00	368,00	367,00	363,00	353,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.03.2022

Ser.No.	1015969_a	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	110,00
Ord. No.	2BD110T1S-A	Ser.No.	204571	LSL	102,30
				USL	117,70
Remark	TQ 100% soft +/-7% * TQ-Cal.: 110 Nm; Cur-Cal.: 3.166 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}
204571	2K1D	110,20	110,10	110,00	110,10	110,00	110,10	110,30	110,30	110,10	110,20
204571	2K1D	356,00	356,00	356,00	353,00	355,00	361,00	359,00	361,00	363,00	357,00

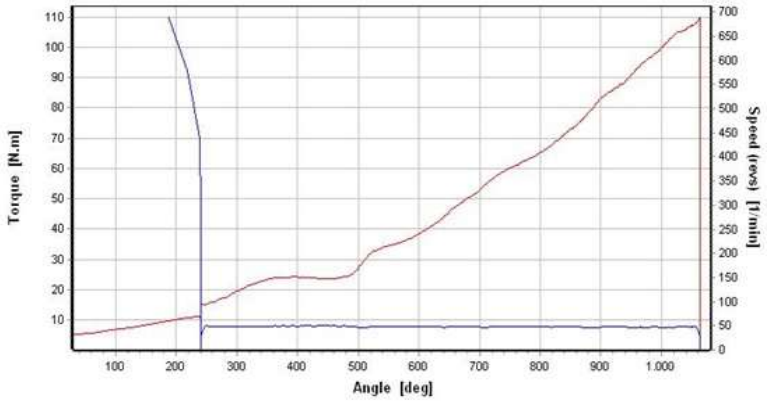
Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204571	2K1D	110,30	110,10	110,20	110,20	110,00	110,00	110,00	110,10	110,10	110,20
204571	2K1D	355,00	364,00	359,00	367,00	359,00	384,00	360,00	345,00	362,00	364,00

Torque graphs

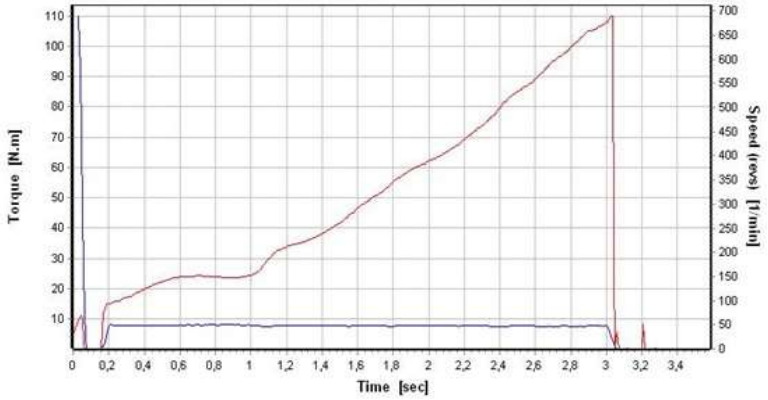
Machine Capability Study 100 %

Model: **2BD-2B110A-2K1D-2ZB**
Serial no: **1015969**

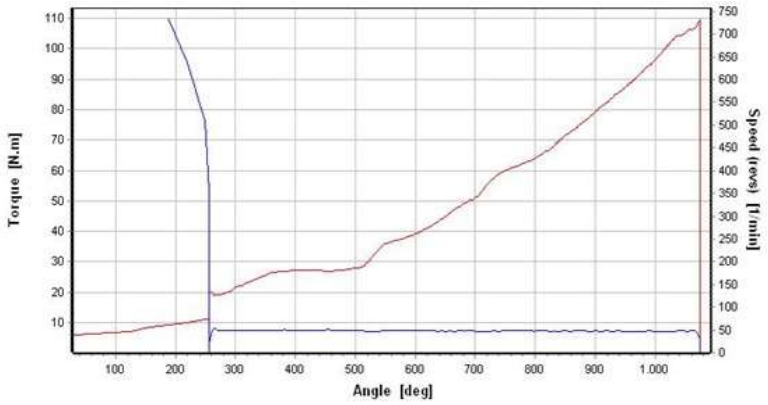
Angle degree: **360°**
Test torque: **110,0 Nm**



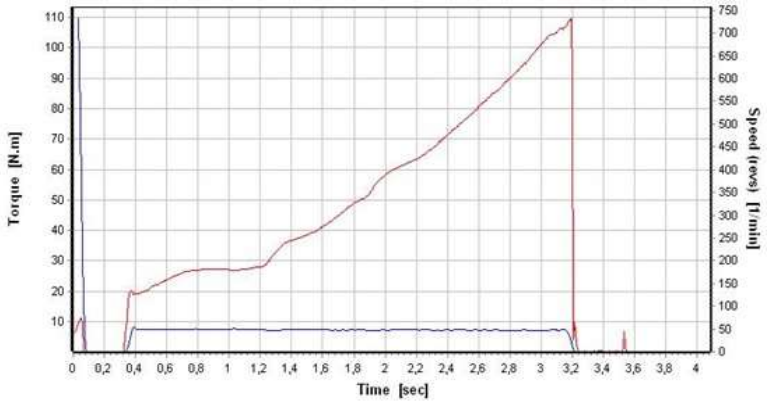
Value no. 1
Graph
Torque / Angle / Speed



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:** 1015969

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: 1,54 % ± **0,77 %**

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

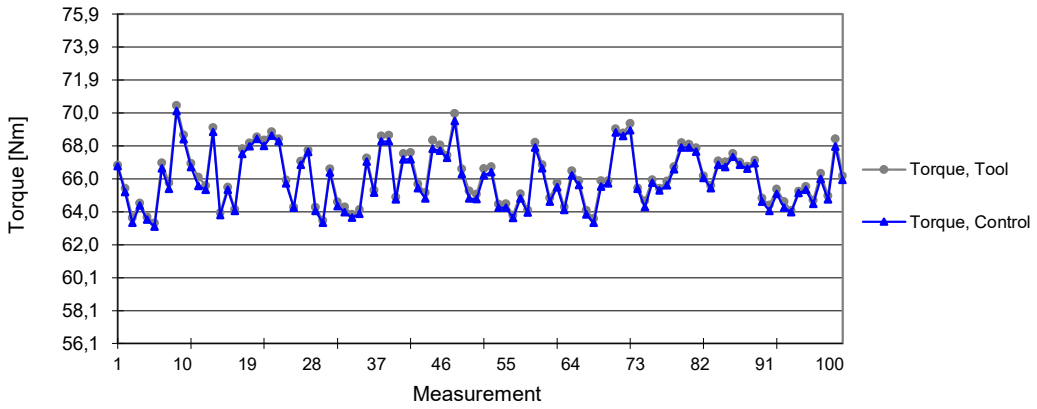
Formula derivation: $C_m = \frac{T}{6\,s}$ $T = C_m * 6\,s$

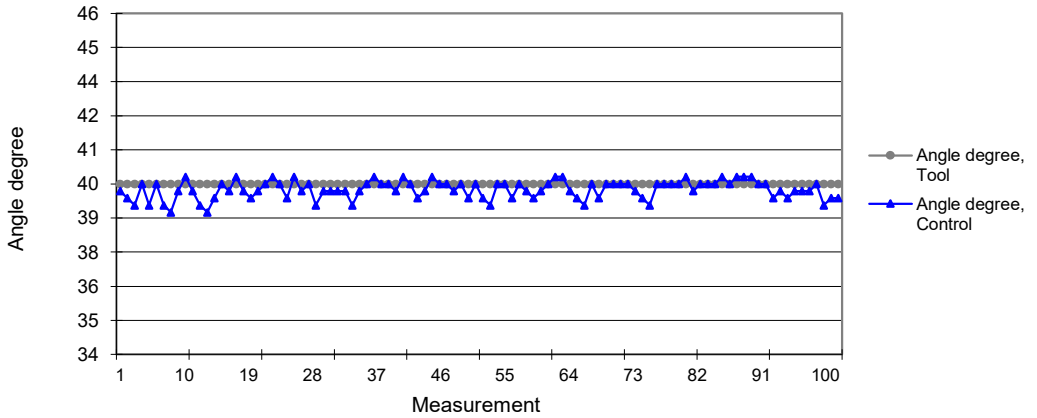
Tool without angle correction

Measurement	Tool data		Control data		Difference	
No.	Torque	Angle	Torque	Angle	Torque	Angle
1	66,81	40,00	66,74	39,75	0,07	0,25
2	65,42	40,00	65,19	39,50	0,23	0,50
3	63,65	40,00	63,34	39,25	0,31	0,75
4	64,53	40,00	64,40	40,00	0,13	0,00
5	63,69	40,00	63,54	39,25	0,15	0,75
6	63,34	40,00	63,12	40,00	0,22	0,00
7	66,96	40,00	66,62	39,25	0,34	0,75
8	65,76	40,00	65,39	39,00	0,37	1,00
9	70,41	40,00	70,07	39,75	0,34	0,25
10	68,63	40,00	68,37	40,25	0,26	0,25
11	66,92	40,00	66,70	39,75	0,22	0,25
12	66,09	40,00	65,56	39,25	0,53	0,75
13	65,58	40,00	65,34	39,00	0,24	1,00
14	69,08	40,00	68,81	39,50	0,27	0,50
15	63,95	40,00	63,81	40,00	0,14	0,00
16	65,48	40,00	65,34	39,75	0,14	0,25
17	64,16	40,00	64,06	40,25	0,10	0,25
18	67,80	40,00	67,48	39,75	0,32	0,25
19	68,16	40,00	67,95	39,50	0,21	0,50
20	68,51	40,00	68,40	39,75	0,11	0,25
21	68,32	40,00	67,98	40,00	0,34	0,00
22	68,82	40,00	68,59	40,25	0,23	0,25
23	68,39	40,00	68,25	40,00	0,14	0,00
24	65,91	40,00	65,71	39,50	0,20	0,50
25	64,29	40,00	64,26	40,25	0,03	0,25
26	67,05	40,00	66,84	39,75	0,21	0,25
27	67,70	40,00	67,61	40,00	0,09	0,00
28	64,28	40,00	64,06	39,25	0,22	0,75
29	63,49	40,00	63,34	39,75	0,15	0,25
30	66,59	40,00	66,38	39,75	0,21	0,25
31	64,61	40,00	64,35	39,75	0,26	0,25
32	64,30	40,00	63,99	39,75	0,31	0,25
33	63,86	40,00	63,66	39,25	0,20	0,75
34	64,14	40,00	63,89	39,75	0,25	0,25
35	67,24	40,00	67,04	40,00	0,20	0,00
36	65,31	40,00	65,17	40,25	0,14	0,25
37	68,57	40,00	68,25	40,00	0,32	0,00
38	68,61	40,00	68,25	40,00	0,36	0,00
39	64,89	40,00	64,75	39,75	0,14	0,25
40	67,51	40,00	67,16	40,25	0,35	0,25
41	67,57	40,00	67,16	40,00	0,41	0,00
42	65,68	40,00	65,44	39,50	0,24	0,50
43	65,16	40,00	64,82	39,75	0,34	0,25
44	68,32	40,00	67,80	40,25	0,52	0,25
45	68,03	40,00	67,68	40,00	0,35	0,00
46	67,41	40,00	67,26	40,00	0,15	0,00
47	69,93	40,00	69,46	39,75	0,47	0,25
48	66,59	40,00	66,28	40,00	0,31	0,00
49	65,26	40,00	64,82	39,50	0,44	0,50
50	65,07	40,00	64,77	40,00	0,30	0,00
51	66,60	40,00	66,20	39,50	0,40	0,50
52	66,71	40,00	66,40	39,25	0,31	0,75
53	64,48	40,00	64,26	40,00	0,22	0,00
54	64,49	40,00	64,26	40,00	0,23	0,00
55	63,79	40,00	63,64	39,50	0,15	0,50
56	65,08	40,00	64,82	40,00	0,26	0,00
57	64,13	40,00	63,96	39,75	0,17	0,25
58	68,18	40,00	67,88	39,50	0,30	0,50
59	66,85	40,00	66,62	39,75	0,23	0,25
60	64,85	40,00	64,63	40,00	0,22	0,00
61	65,75	40,00	65,49	40,25	0,26	0,25
62	64,31	40,00	64,11	40,25	0,20	0,25
63	66,47	40,00	66,20	39,75	0,27	0,25
64	65,89	40,00	65,61	39,50	0,28	0,50
65	64,10	40,00	63,86	39,25	0,24	0,75
66	63,60	40,00	63,34	40,00	0,26	0,00
67	65,89	40,00	65,54	39,50	0,35	0,50
68	65,87	40,00	65,73	40,00	0,14	0,00
69	69,00	40,00	68,77	40,00	0,23	0,00
70	68,75	40,00	68,57	40,00	0,18	0,00
71	69,32	40,00	68,91	40,00	0,41	0,00
72	65,44	40,00	65,39	39,75	0,05	0,25
73	64,67	40,00	64,28	39,50	0,39	0,50
74	65,93	40,00	65,76	39,25	0,17	0,75
75	65,41	40,00	65,29	40,00	0,12	0,00
76	65,85	40,00	65,59	40,00	0,26	0,00
77	66,72	40,00	66,57	40,00	0,15	0,00
78	68,17	40,00	67,88	40,00	0,29	0,00
79	68,07	40,00	67,88	40,25	0,19	0,25
80	67,85	40,00	67,63	39,75	0,22	0,25
81	66,18	40,00	66,05	40,00	0,13	0,00
82	65,59	40,00	65,44	40,00	0,15	0,00
83	67,07	40,00	66,84	40,00	0,23	0,00
84	67,00	40,00	66,70	40,25	0,30	0,25
85	67,52	40,00	67,31	40,00	0,21	0,00
86	66,98	40,00	66,84	40,25	0,14	0,25
87	66,75	40,00	66,60	40,25	0,15	0,25
88	67,10	40,00	66,92	40,25	0,18	0,25
89	64,83	40,00	64,63	40,00	0,20	0,00
90	64,42	40,00	64,06	40,00	0,36	0,00
91	65,38	40,00	65,09	39,50	0,29	0,50
92	64,62	40,00	64,26	39,75	0,36	0,25
93	64,09	40,00	63,99	39,50	0,10	0,50
94	65,24	40,00	65,14	39,75	0,10	0,25
95	65,54	40,00	65,32	39,75	0,22	0,25
96	64,71	40,00	64,50	39,75	0,21	0,25
97	66,32	40,00	65,98	40,00	0,34	0,00
98	64,97	40,00	64,75	39,25	0,22	0,75
99	68,39	40,00	67,93	39,50	0,46	0,50
100	66,17	40,00	65,93	39,50	0,24	0,50
				Standard deviation:	**0,101**	**0,260**

Graphical representation

Model:	**2BD-2B110A-2K1D-2ZB**	Serial no:	**1015969**
Target torque:	**66,00 Nm**	60 % of max. torque	
Angle degree:	**40°**	Tool without angle correction	





Machine Capability Study
Control System

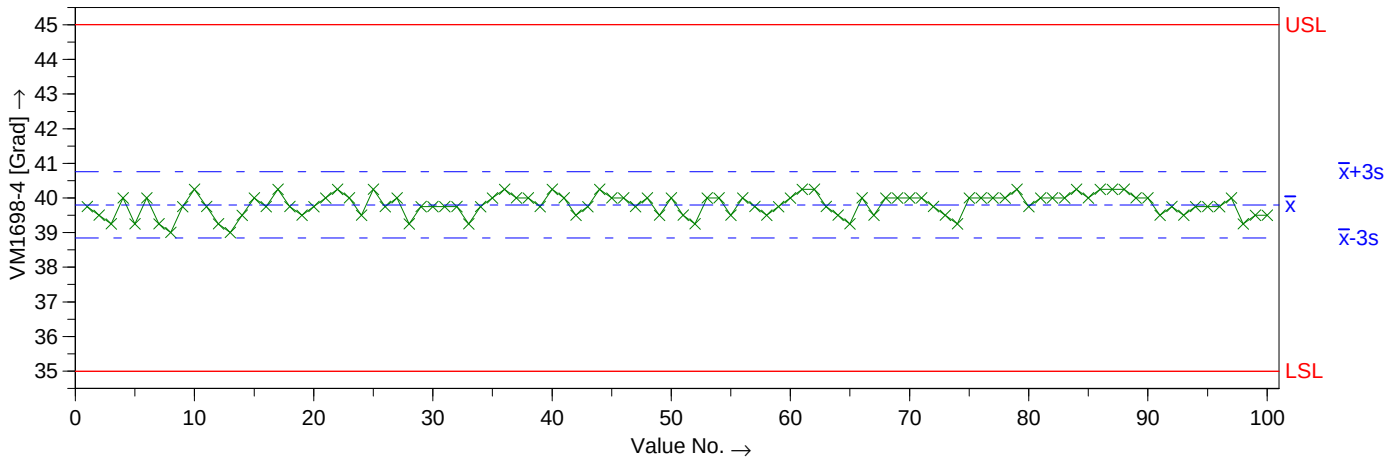
Page 1 / 1

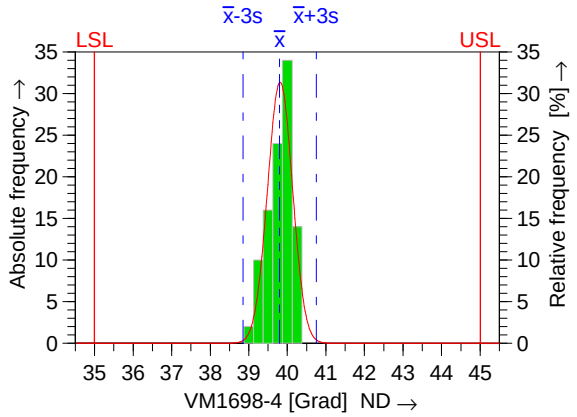
Plant	ATG Westhausen	Operator Name	Sünder
Date	08.03.2022		

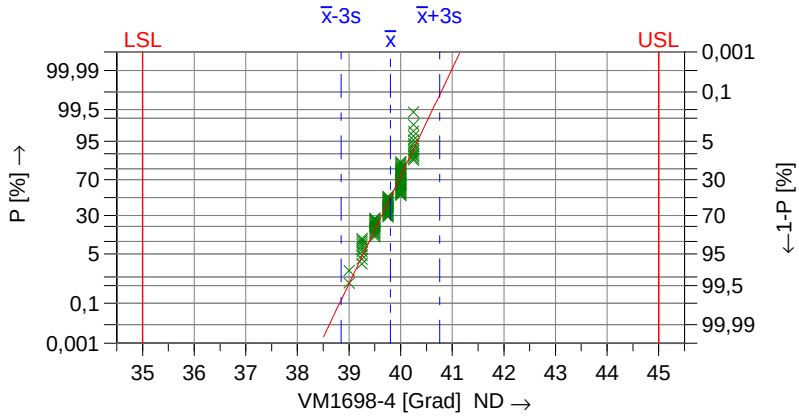
Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015969_k	Char.Descr.	VM1698-4	Inspection Val. 40,00 5,00	USL 45,00
		Serial No.	1024210	Unit Grad -5,00	LSL 35,00
Char.Type	variable			Tolerance value 12 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	120 / 1019923	nges.	100

Evaluation from 08.03.2022 13:18:37 to 08.03.2022 13:32:08

Rem. TQ 60% Angle 40° +/-5° * TQ-Cal.: 110 Nm; Cur-Cal.: 3.194 Nm/A; Speed 300/50 rpm;







Drawing Values		Collected Values		Statistics	
T_m	40.00			$\bar{x}$	39.8000
LSL	35.00	x_{min}	39.00	$\bar{x}$-3s	38.8465
USL	45.00	x_{max}	40.25	$\bar{x}$+3s	40.7535
T	10.00	R	1.25	6s	1.9069
		$n_{<T>}$	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	5.24
Critical capability index	=	C_{mk}	5.03

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

APEX VDI/VDE 2647 V0.1

Apex Tool Group GmbH \\htwe0006\AppData\QW\QWE\MessWert\2022\1015969_kM.DFD

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.03.2022

Ser.No.	1015969_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.: 3.194 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	66,74	65,19	63,34	64,40	63,54	63,12	66,62	65,39	70,07	68,37
1024210	VM1698-4	39,75	39,50	39,25	40,00	39,25	40,00	39,25	39,00	39,75	40,25

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	66,70	65,56	65,34	68,81	63,81	65,34	64,06	67,48	67,95	68,40
1024210	VM1698-4	39,75	39,25	39,00	39,50	40,00	39,75	40,25	39,75	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	67,98	68,59	68,25	65,71	64,26	66,84	67,61	64,06	63,34	66,38
1024210	VM1698-4	40,00	40,25	40,00	39,50	40,25	39,75	40,00	39,25	39,75	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	64,35	63,99	63,66	63,89	67,04	65,17	68,25	68,25	64,75	67,16
1024210	VM1698-4	39,75	39,75	39,25	39,75	40,00	40,25	40,00	40,00	39,75	40,25

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	67,16	65,44	64,82	67,80	67,68	67,26	69,46	66,28	64,82	64,77
1024210	VM1698-4	40,00	39,50	39,75	40,25	40,00	40,00	39,75	40,00	39,50	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}
1024210	VM1698-4	66,20	66,40	64,26	64,26	63,64	64,82	63,96	67,88	66,62	64,63
1024210	VM1698-4	39,50	39,25	40,00	40,00	39,50	40,00	39,75	39,50	39,75	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	65,49	64,11	66,20	65,61	63,86	63,34	65,54	65,73	68,77	68,57
1024210	VM1698-4	40,25	40,25	39,75	39,50	39,25	40,00	39,50	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}
1024210	VM1698-4	68,91	65,39	64,28	65,76	65,29	65,59	66,57	67,88	67,88	67,63
1024210	VM1698-4	40,00	39,75	39,50	39,25	40,00	40,00	40,00	40,00	40,25	39,75

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.03.2022

Ser.No.	1015969_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.: 3.194 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	66,05	65,44	66,84	66,70	67,31	66,84	66,60	66,92	64,63	64,06
1024210	VM1698-4	40,00	40,00	40,00	40,25	40,00	40,25	40,25	40,25	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}
1024210	VM1698-4	65,09	64,26	63,99	65,14	65,32	64,50	65,98	64,75	67,93	65,93
1024210	VM1698-4	39,50	39,75	39,50	39,75	39,75	39,75	40,00	39,25	39,50	39,50

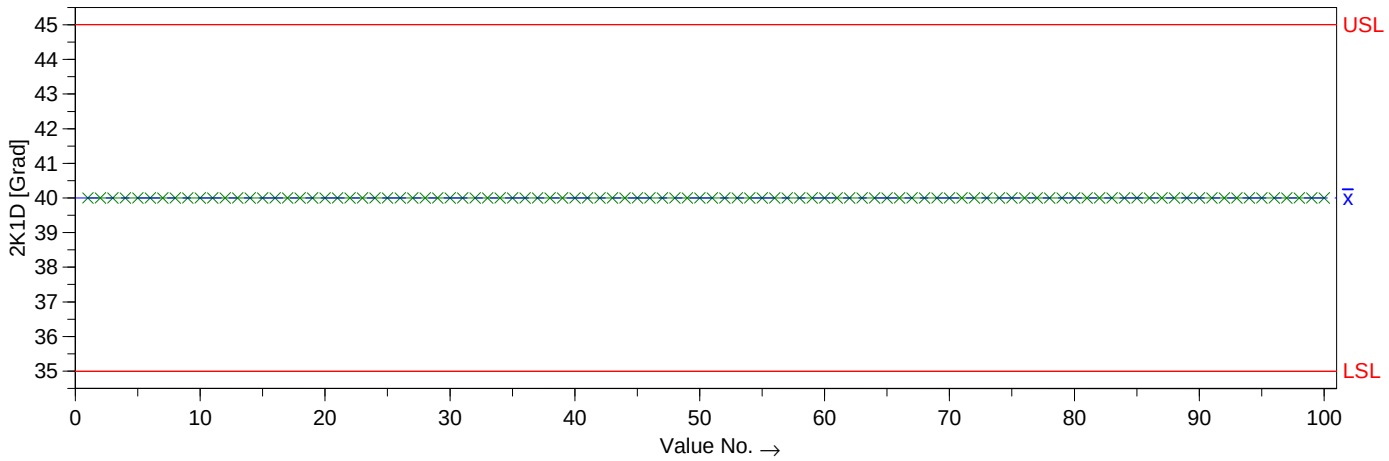
Machine Capability Study
Tool System

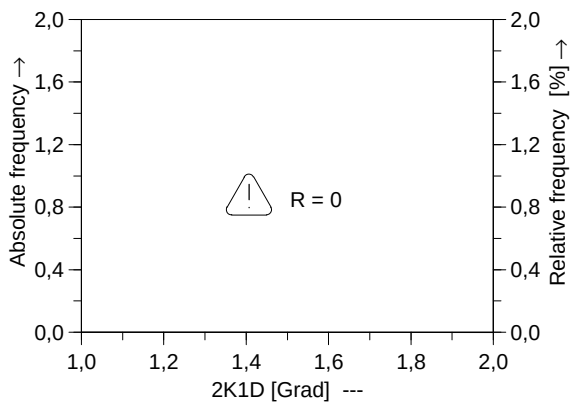
Plant	ATG Westhausen	Operator Name	Sünder
Date	08.03.2022		

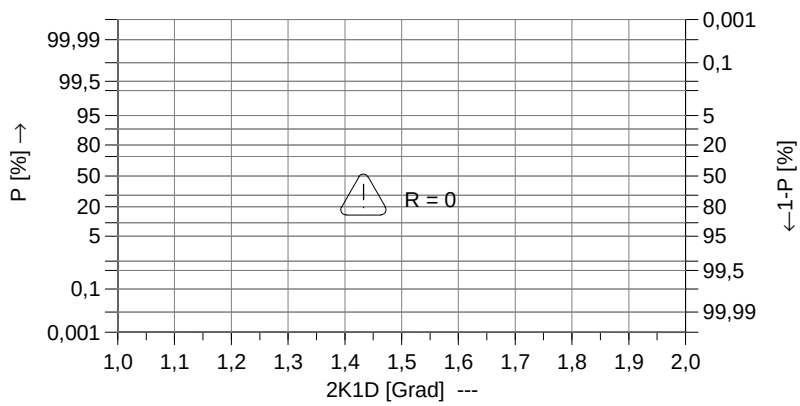
Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015969_k	Char.Descr.	2K1D	Inspection Val. 40,00 5,00	USL 45,00
		Serial No.	204571	Unit Grad -5,00	LSL 35,00
Char.Type	variable			Tolerance value 12 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	120 / 1019923	nges.	100

Evaluation from 08.03.2022 13:18:37 to 08.03.2022 13:32:07

Rem. TQ 60% Angle 40° +/-5° * TQ-Cal.: 110 Nm; Cur-Cal.: 3.194 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 08.03.2022

Ser.No.	1015969_k	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	66,00
Ord. No.	2BD110T1S-A	Ser.No.	204571	LSL	61,38
				USL	70,62
Remark	TQ 60% Angle 40°+/-5°* TQ-Cal.: 110 Nm; Cur -Cal.: 3.194 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}
204571	2K1D	66,81	65,42	63,65	64,53	63,69	63,34	66,96	65,76	70,41	68,63
204571	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}
204571	2K1D	66,92	66,09	65,58	69,08	63,95	65,48	64,16	67,80	68,16	68,51
204571	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}
204571	2K1D	68,32	68,82	68,39	65,91	64,29	67,05	67,70	64,28	63,49	66,59
204571	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}
204571	2K1D	64,61	64,30	63,86	64,14	67,24	65,31	68,57	68,61	64,89	67,51
204571	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}
204571	2K1D	67,57	65,68	65,16	68,32	68,03	67,41	69,93	66,59	65,26	65,07
204571	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}
204571	2K1D	66,60	66,71	64,48	64,49	63,79	65,08	64,13	68,18	66,85	64,85
204571	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}
204571	2K1D	65,75	64,31	66,47	65,89	64,10	63,60	65,89	65,87	69,00	68,75
204571	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}
204571	2K1D	69,32	65,44	64,67	65,93	65,41	65,85	66,72	68,17	68,07	67,85
204571	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 08.03.2022

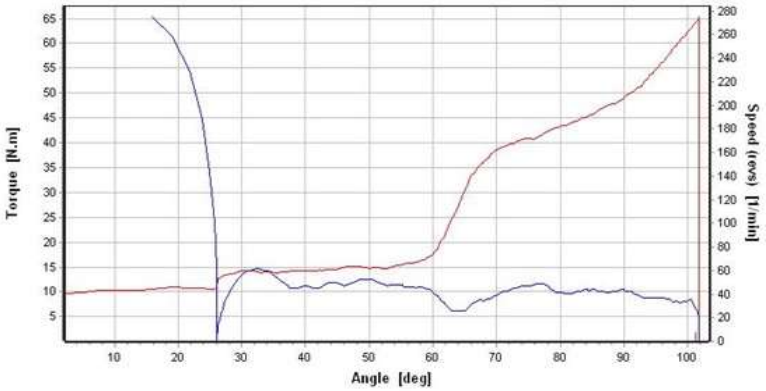
Ser.No.	1015969_k	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	66,00
Ord. No.	2BD110T1S-A	Ser.No.	204571	LSL	61,38
				USL	70,62
Remark	TQ 60% Angle 40°+/-5°* TQ-Cal.: 110 Nm; Cur -Cal.: 3.194 Nm/A; Speed 300/50 rpm;				

Char.No	Char.Descr.	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
204571	2K1D	66,18	65,59	67,07	67,00	67,52	66,98	66,75	67,10	64,83	64,42
204571	2K1D	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00

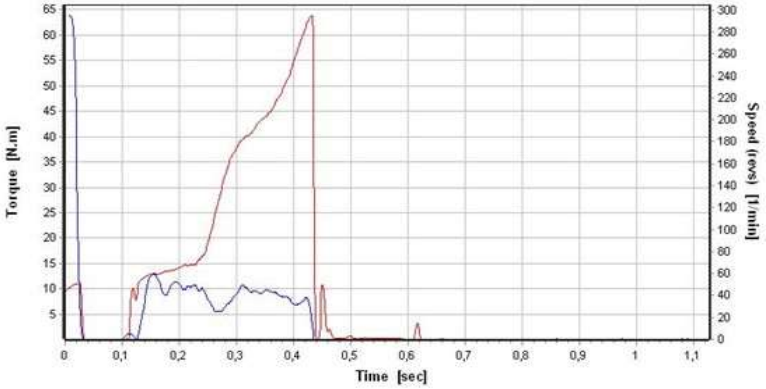
Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204571	2K1D	65,38	64,62	64,09	65,24	65,54	64,71	66,32	64,97	68,39	66,17
204571	2K1D	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00

Torque graphs

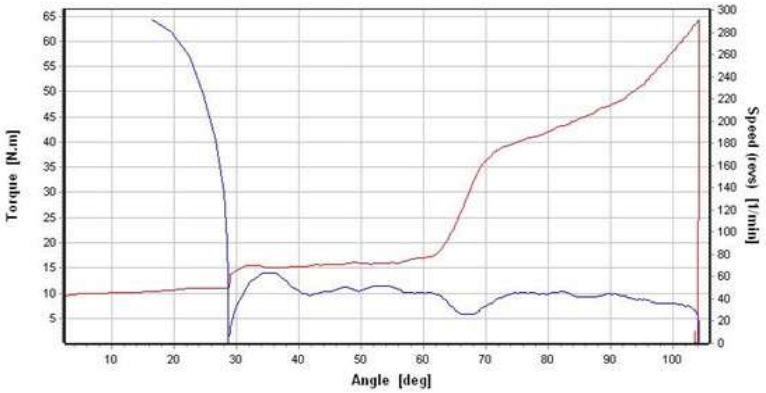
Model:	**2BD-2B110A-2K1D-2ZB**	Serial no:	**1015969**
Target torque:	**66,00 Nm**	60 % of max. torque	
Angle degree:	**40°**	Tool without angle correction	



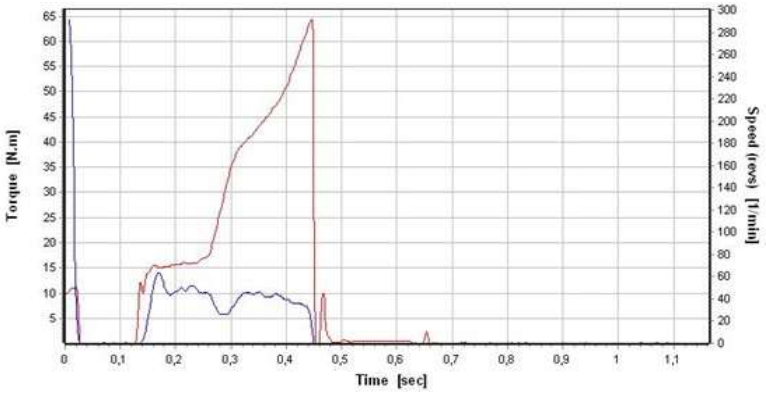
Value no. 1
Graph
Torque / Angle / Speed



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:** 1015969

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: 1,27 % ± **0,64 %**

Angle degree: 180° Tolerance: 5,0° ± **2,5°**

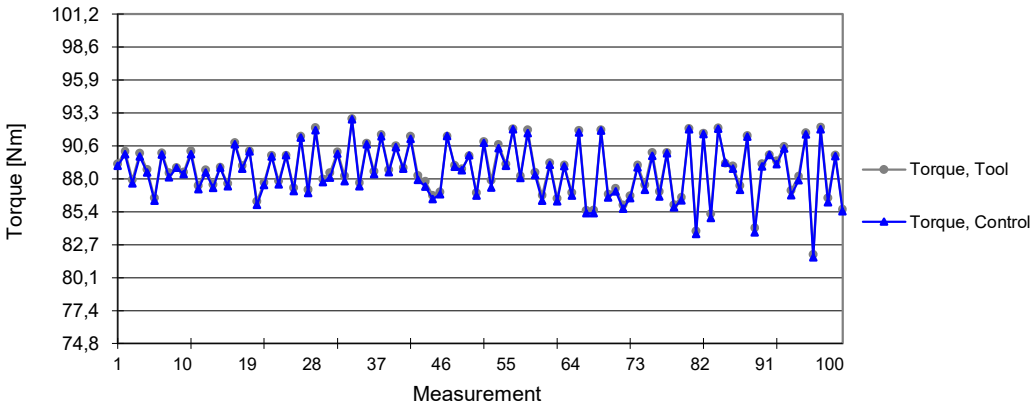
Formula derivation: $C_m = \frac{T}{6\,s}$ $T = C_m * 6\,s$

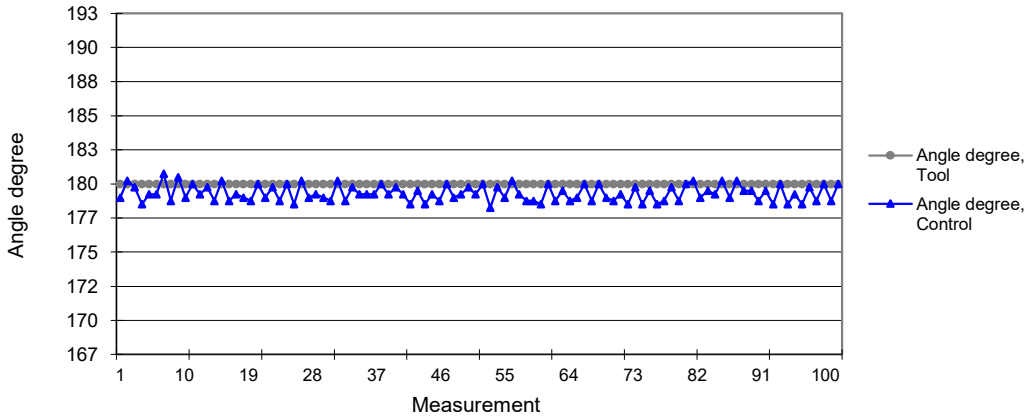
Tool without angle correction

Measurement	Tool data		Control data		Difference	
No.	Torque	Angle	Torque	Angle	Torque	Angle
1	89,18	180,00	89,04	179,00	0,14	1,00
2	90,18	180,00	89,96	180,25	0,22	0,25
3	87,92	180,00	87,64	179,75	0,28	0,25
4	90,03	180,00	89,78	178,50	0,25	1,50
5	88,74	180,00	88,50	179,25	0,24	0,75
6	86,46	180,00	86,24	179,25	0,22	0,75
7	90,06	180,00	89,93	180,75	0,13	0,75
8	88,47	180,00	88,13	178,75	0,34	1,25
9	88,90	180,00	88,87	180,50	0,03	0,50
10	88,52	180,00	88,35	179,00	0,17	1,00
11	90,20	180,00	89,96	180,00	0,24	0,00
12	87,44	180,00	87,17	179,25	0,27	0,75
13	88,70	180,00	88,50	179,75	0,20	0,25
14	87,52	180,00	87,27	178,75	0,25	1,25
15	88,92	180,00	88,90	180,25	0,02	0,25
16	87,62	180,00	87,39	178,75	0,23	1,25
17	90,90	180,00	90,77	179,25	0,13	0,75
18	89,04	180,00	88,80	179,00	0,24	1,00
19	90,22	180,00	90,18	178,75	0,04	1,25
20	86,19	180,00	85,91	180,00	0,28	0,00
21	87,69	180,00	87,49	179,00	0,20	1,00
22	89,88	180,00	89,78	179,75	0,10	0,25
23	87,83	180,00	87,54	178,75	0,29	1,25
24	89,88	180,00	89,86	180,00	0,02	0,00
25	87,27	180,00	87,02	178,50	0,25	1,50
26	91,41	180,00	91,29	180,25	0,12	0,25
27	87,13	180,00	86,85	179,00	0,28	1,00
28	92,09	180,00	91,90	179,25	0,19	0,75
29	87,97	180,00	87,71	179,00	0,26	1,00
30	88,49	180,00	88,08	178,75	0,41	1,25
31	90,14	180,00	90,00	180,25	0,14	0,25
32	88,22	180,00	87,81	178,75	0,41	1,25
33	92,80	180,00	92,76	179,75	0,04	0,25
34	87,68	180,00	87,39	179,25	0,29	0,75
35	90,85	180,00	90,77	179,25	0,08	0,75
36	88,59	180,00	88,35	179,25	0,24	0,75
37	91,53	180,00	91,41	180,00	0,12	0,00
38	88,71	180,00	88,53	179,25	0,18	0,75
39	90,63	180,00	90,52	179,75	0,11	0,25
40	88,86	180,00	88,80	179,25	0,06	0,75
41	91,41	180,00	91,19	178,50	0,22	1,50
42	88,26	180,00	87,91	179,50	0,35	0,50
43	87,78	180,00	87,37	178,50	0,41	1,50
44	86,65	180,00	86,38	179,25	0,27	0,75
45	86,93	180,00	86,73	178,75	0,20	1,25
46	91,41	180,00	91,43	180,00	0,02	0,00
47	89,07	180,00	88,95	179,00	0,12	1,00
48	88,79	180,00	88,67	179,25	0,12	0,75
49	89,82	180,00	89,88	179,75	0,06	0,25
50	86,86	180,00	86,65	179,25	0,21	0,75
51	90,97	180,00	90,87	180,00	0,10	0,00
52	87,86	180,00	87,29	178,25	0,57	1,75
53	90,75	180,00	90,45	179,75	0,30	0,25
54	89,16	180,00	89,04	179,00	0,12	1,00
55	91,99	180,00	91,95	180,25	0,04	0,25
56	88,20	180,00	88,06	179,25	0,14	0,75
57	91,91	180,00	91,66	178,75	0,25	1,25
58	88,50	180,00	88,30	178,75	0,20	1,25
59	86,67	180,00	86,24	178,50	0,43	1,50
60	89,27	180,00	89,12	180,00	0,15	0,00
61	86,42	180,00	86,19	178,75	0,23	1,25
62	89,08	180,00	88,99	179,50	0,09	0,50
63	86,89	180,00	86,65	178,75	0,24	1,25
64	91,88	180,00	91,71	179,00	0,17	1,00
65	85,46	180,00	85,22	180,00	0,24	0,00
66	85,49	180,00	85,25	178,75	0,24	1,25
67	91,91	180,00	91,85	180,00	0,06	0,00
68	86,75	180,00	86,51	179,00	0,24	1,00
69	87,23	180,00	87,00	178,75	0,23	1,25
70	85,88	180,00	85,59	179,25	0,29	0,75
71	86,64	180,00	86,43	178,50	0,21	1,50
72	89,08	180,00	88,92	179,75	0,16	0,25
73	87,51	180,00	87,12	178,50	0,39	1,50
74	90,10	180,00	89,83	179,50	0,27	0,50
75	86,98	180,00	86,56	178,50	0,42	1,50
76	90,10	180,00	90,03	178,75	0,07	1,25
77	85,90	180,00	85,69	179,75	0,21	0,25
78	86,51	180,00	86,26	178,75	0,25	1,25
79	92,02	180,00	91,95	180,00	0,07	0,00
80	83,81	180,00	83,57	180,25	0,24	0,25
81	91,64	180,00	91,58	179,00	0,06	1,00
82	85,19	180,00	84,86	179,50	0,33	0,50
83	92,07	180,00	92,00	179,25	0,07	0,75
84	89,24	180,00	89,29	180,25	0,05	0,25
85	89,02	180,00	88,80	179,00	0,22	1,00
86	87,44	180,00	87,10	180,25	0,34	0,25
87	91,45	180,00	91,36	179,50	0,09	0,50
88	84,06	180,00	83,70	179,50	0,36	0,50
89	89,18	180,00	88,97	178,75	0,21	1,25
90	89,92	180,00	89,91	179,50	0,01	0,50
91	89,42	180,00	89,17	178,50	0,25	1,50
92	90,57	180,00	90,42	180,00	0,15	0,00
93	87,06	180,00	86,68	178,50	0,38	1,50
94	88,19	180,00	87,86	179,25	0,33	0,75
95	91,68	180,00	91,56	178,50	0,12	1,50
96	81,93	180,00	81,70	179,75	0,23	0,25
97	92,12	180,00	91,95	178,75	0,17	1,25
98	86,47	180,00	86,09	180,00	0,38	0,00
99	89,90	180,00	89,81	178,75	0,09	1,25
100	85,55	180,00	85,40	180,00	0,15	0,00
				Standard deviation:	**0,112**	**0,502**

Graphical representation

Model:	**2BD-2B110A-2K1D-2ZB**	Serial no:	**1015969**
Target torque:	**88,00 Nm**	80 % of max. torque	
Angle degree:	**180°**	Tool without angle correction	





Machine Capability Study
Control System

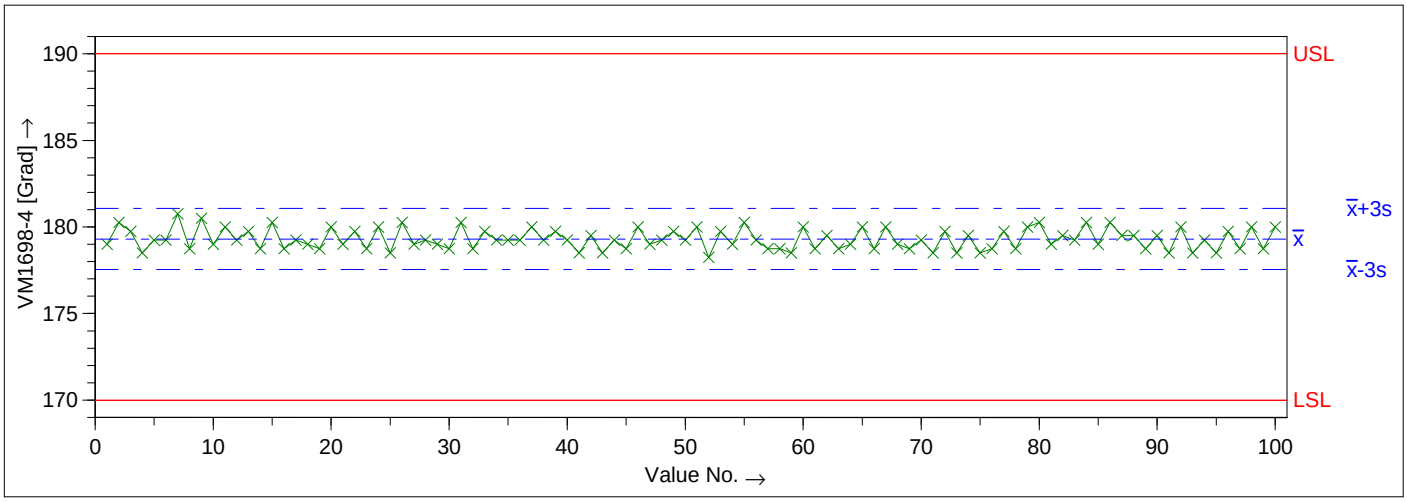
Page 1 / 1

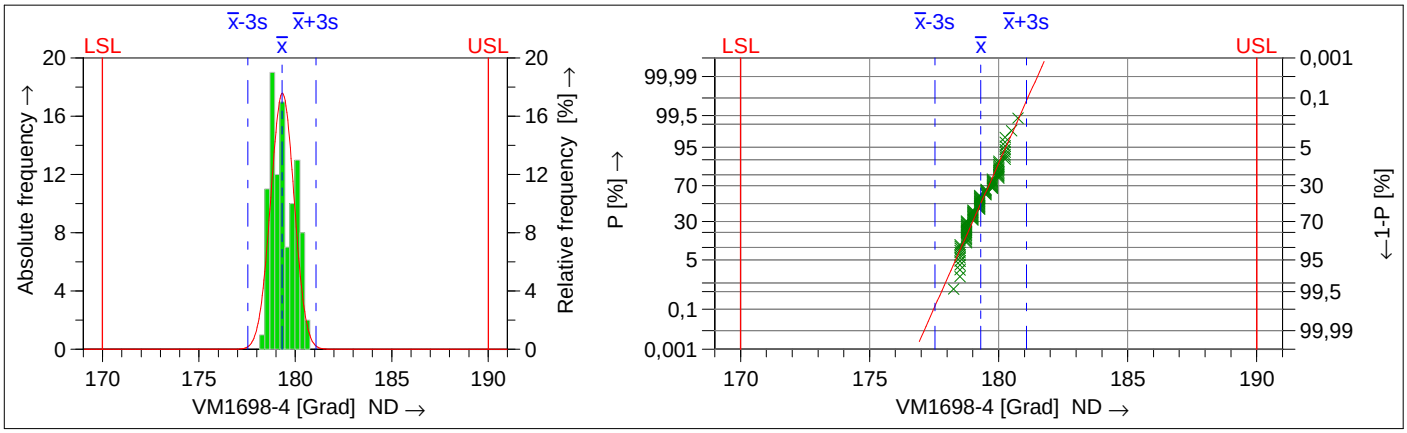
Plant	ATG Westhausen	Operator Name	Sünder
Date	08.03.2022		

Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015969_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 08.03.2022 13:36:37 to 08.03.2022 13:50:55

Rem. TQ 80% Angle 180° +/-10° * TQ-Cal.: 110 Nm; Cur-Cal.: 3.144 Nm/A; Speed 300/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	180.00			$\bar{x}$	179.3050
LSL	170.00	x_{min}	178.25	$\bar{x}$-3s	177.5354
USL	190.00	x_{max}	180.75	$\bar{x}$+3s	181.0746
T	20.00	R	2.50	6s	3.5393
		$n_{<T>}$	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	5.65
Critical capability index	=	C_{mk}	5.26

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

APEX VDI/VDE 2647 V0.1

Apex Tool Group GmbH \\htwe0006\AppData\QW\QWE\MessWert\2022\1015969_lM.DFD

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.03.2022

Ser.No.	1015969_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.: 3.144 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	89,04	89,96	87,64	89,78	88,50	86,24	89,93	88,13	88,87	88,35
1024210	VM1698-4	179,00	180,25	179,75	178,50	179,25	179,25	180,75	178,75	180,50	179,00

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	89,96	87,17	88,50	87,27	88,90	87,39	90,77	88,80	90,18	85,91
1024210	VM1698-4	180,00	179,25	179,75	178,75	180,25	178,75	179,25	179,00	178,75	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	87,49	89,78	87,54	89,86	87,02	91,29	86,85	91,90	87,71	88,08
1024210	VM1698-4	179,00	179,75	178,75	180,00	178,50	180,25	179,00	179,25	179,00	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	90,00	87,81	92,76	87,39	90,77	88,35	91,41	88,53	90,52	88,80
1024210	VM1698-4	180,25	178,75	179,75	179,25	179,25	179,25	180,00	179,25	179,75	179,25

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	91,19	87,91	87,37	86,38	86,73	91,43	88,95	88,67	89,88	86,65
1024210	VM1698-4	178,50	179,50	178,50	179,25	178,75	180,00	179,00	179,25	179,75	179,25

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	90,87	87,29	90,45	89,04	91,95	88,06	91,66	88,30	86,24	89,12
1024210	VM1698-4	180,00	178,25	179,75	179,00	180,25	179,25	178,75	178,75	178,50	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}
1024210	VM1698-4	86,19	88,99	86,65	91,71	85,22	85,25	91,85	86,51	87,00	85,59
1024210	VM1698-4	178,75	179,50	178,75	179,00	180,00	178,75	180,00	179,00	178,75	179,25

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	86,43	88,92	87,12	89,83	86,56	90,03	85,69	86,26	91,95	83,57
1024210	VM1698-4	178,50	179,75	178,50	179,50	178,50	178,75	179,75	178,75	180,00	180,25

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.03.2022

Ser.No.	1015969_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.: 3.144 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	91,58	84,86	92,00	89,29	88,80	87,10	91,36	83,70	88,97	89,91
1024210	VM1698-4	179,00	179,50	179,25	180,25	179,00	180,25	179,50	179,50	178,75	179,50

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	89,17	90,42	86,68	87,86	91,56	81,70	91,95	86,09	89,81	85,40
1024210	VM1698-4	178,50	180,00	178,50	179,25	178,50	179,75	178,75	180,00	178,75	180,00

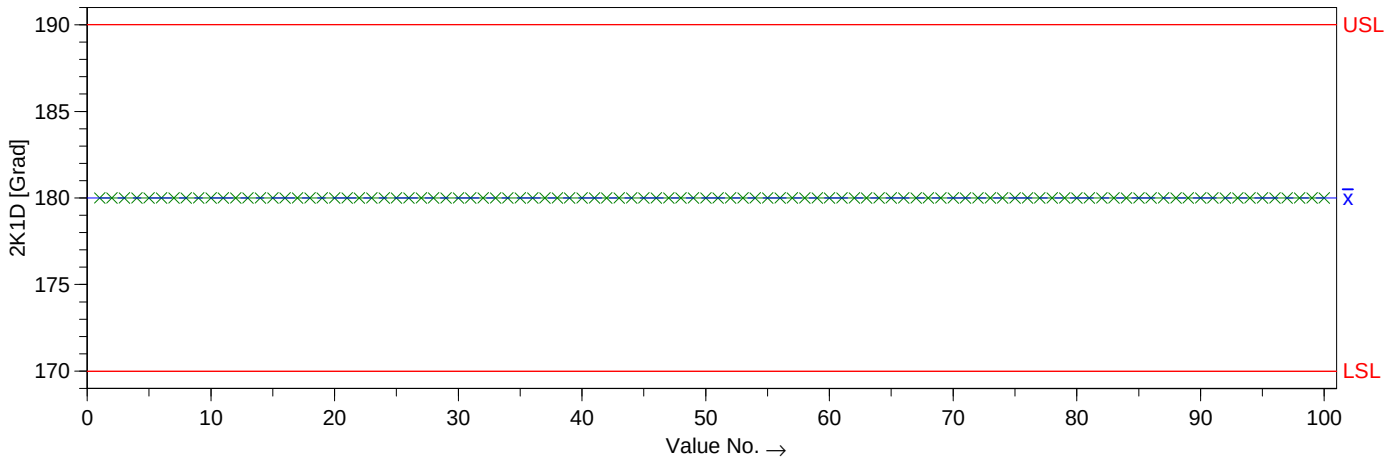
Machine Capability Study
Tool System

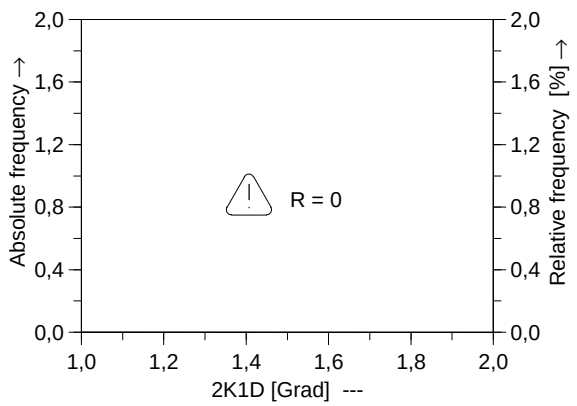
Plant	ATG Westhausen	Operator Name	Sünder
Date	08.03.2022		

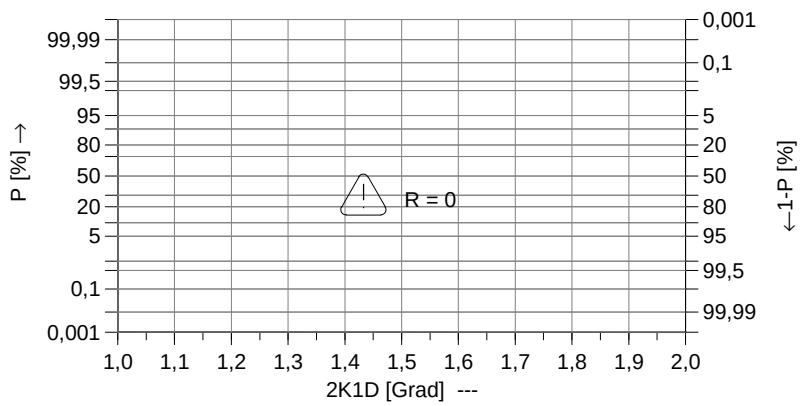
Ord. No.	2BD110T1S-A	Part type	2BD-2B110A-2K1D-2ZB	Contr.item	yes
Serial No.	1015969_l	Char.Descr.	2K1D	Inspection Val. 180,00 10,00	USL 190,00
		Serial No.	204571	Unit Grad -10,00	LSL 170,00
Char.Type	variable			Tolerance value 6 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	120 / 1019923	nges.	100

Evaluation from 08.03.2022 13:36:37 to 08.03.2022 13:50:54

Rem. TQ 80% Angle 180° +/-10° * TQ-Cal.: 110 Nm; Cur-Cal.: 3.144 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 08.03.2022

Ser.No.	1015969_l	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	88,00
Ord. No.	2BD110T1S-A	Ser.No.	204571	LSL	81,84
				USL	94,16
Remark	TQ 80% Angle 180°+/-10°* TQ-Cal.: 110 Nm; C ur-Cal.: 3.144 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}
204571	2K1D	89,18	90,18	87,92	90,03	88,74	86,46	90,06	88,47	88,90	88,52
204571	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}
204571	2K1D	90,20	87,44	88,70	87,52	88,92	87,62	90,90	89,04	90,22	86,19
204571	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}
204571	2K1D	87,69	89,88	87,83	89,88	87,27	91,41	87,13	92,09	87,97	88,49
204571	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}
204571	2K1D	90,14	88,22	92,80	87,68	90,85	88,59	91,53	88,71	90,63	88,86
204571	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}
204571	2K1D	91,41	88,26	87,78	86,65	86,93	91,41	89,07	88,79	89,82	86,86
204571	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}
204571	2K1D	90,97	87,86	90,75	89,16	91,99	88,20	91,91	88,50	86,67	89,27
204571	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}
204571	2K1D	86,42	89,08	86,89	91,88	85,46	85,49	91,91	86,75	87,23	85,88
204571	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}
204571	2K1D	86,64	89,08	87,51	90,10	86,98	90,10	85,90	86,51	92,02	83,81
204571	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 08.03.2022

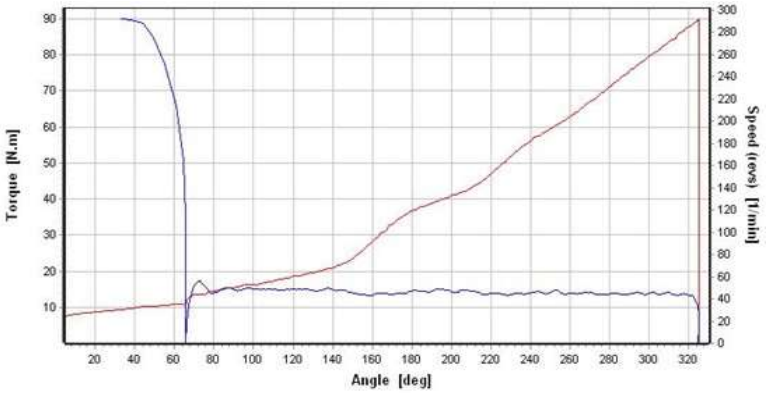
Ser.No.	1015969_I	Characteristic			
Type	2BD-2B110A-2K1D-2ZB	Char.Descr.	2K1D	Inspection Val.	88,00
Ord. No.	2BD110T1S-A	Ser.No.	204571	LSL	81,84
				USL	94,16
Remark	TQ 80% Angle 180°+/-10°* TQ-Cal.: 110 Nm; C ur-Cal.: 3.144 Nm/A; Speed 300/50 rpm;				

Char.No	Char.Descr.	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
204571	2K1D	91,64	85,19	92,07	89,24	89,02	87,44	91,45	84,06	89,18	89,92
204571	2K1D	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00

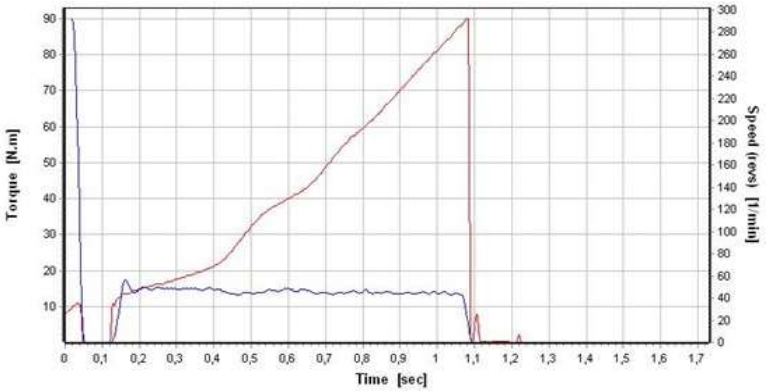
Char.No	Char.Descr.	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204571	2K1D	89,42	90,57	87,06	88,19	91,68	81,93	92,12	86,47	89,90	85,55
204571	2K1D	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00

Torque graphs

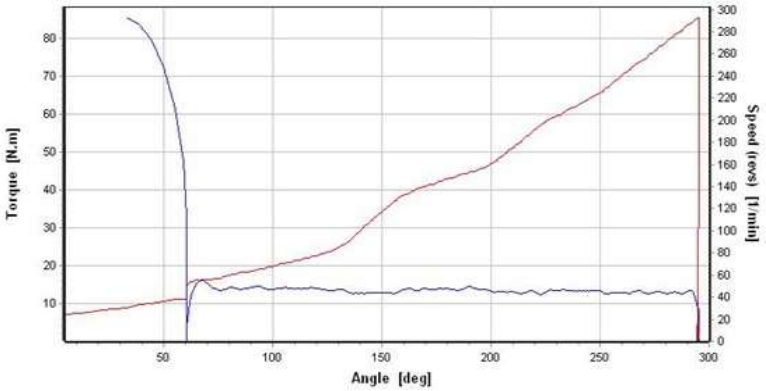
Model:	**2BD-2B110A-2K1D-2ZB**	Serial no:	**1015969**
Target torque:	**88,00 Nm**	80 % of max. torque	
Angle degree:	**180°**	Tool without angle correction	



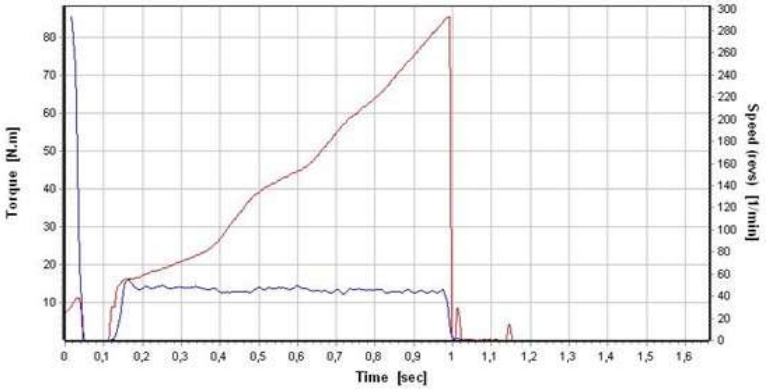
Value no. 1
Graph
Torque / Angle / Speed



Value no. 1
Graph
Torque / Time / Speed



Value no. 100
Graph
Torque / Angle / Speed



Value no. 100
Graph
Torque / Time / Speed