Homologation

Fixtured Spindle

Model: 4BD-4B500A-4K2D-4ZA

Serial no.: 1016284

Contents

Homologation: 4BD-4B500A-4K2D-4ZA SN: 1016284

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Test sheet no. 2

Machine Capability Study 30 %

Multi-stage tightening system	☑	Speed 50 rpm	18,6 %
Single-stage tightening system	☐	Speed 100 %	269 rpm

Manufacturer: Apex Tool Group Serial no: **1016284**

Test torque: Tq min. + 0.3 (Tq max. - Tq min.) 185,00 Nm

Hard joint (H)	1127,21	Nm / Revolution	Angle degree	30°
Soft joint (L)	93,16	Nm / Revolution	Angle degree	360°

		H	L
a)	Tolerance down / up	172,05 197,95 Nm	172,05 - 197,95 Nm
	Tolerance down / up	7	7 %
	Average torque	187,87	186,32 Nm
	Standard deviation	0,54	0,53 Nm
	Torque scatter (99,73%)	3,26	3,20 Nm
	C_m	7,95	8,10
	C_{mk}	6,19	7,28

b)	Min. C_m hard/soft (lowest value)	7,95
	Min. C_{mk} hard/soft (lowest value)	6,19

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

Note:

Machine Capability Study
Control System

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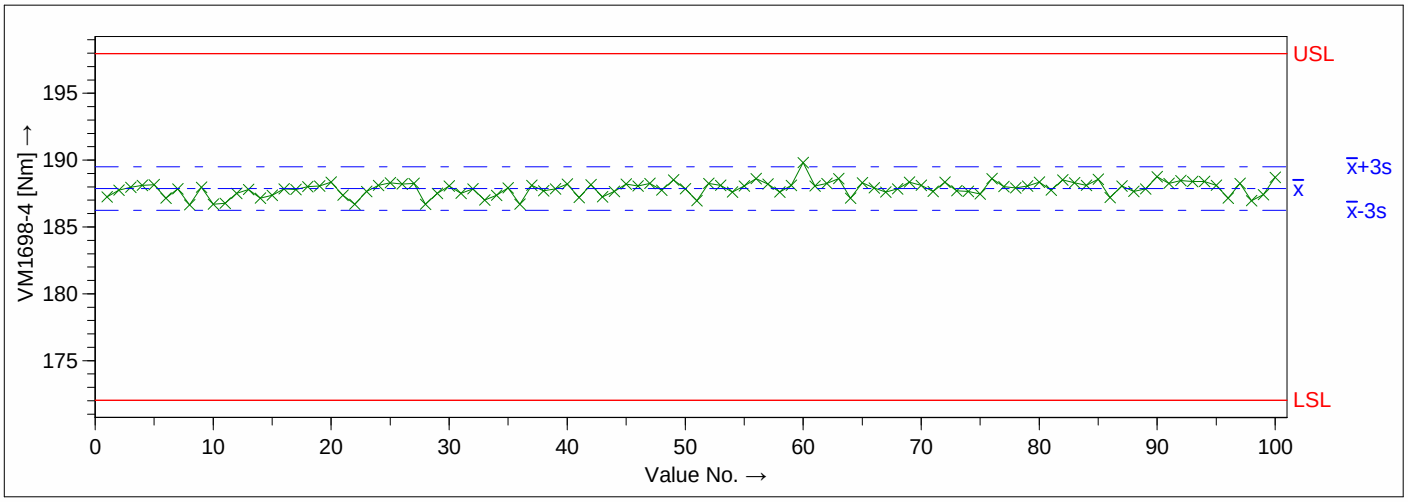
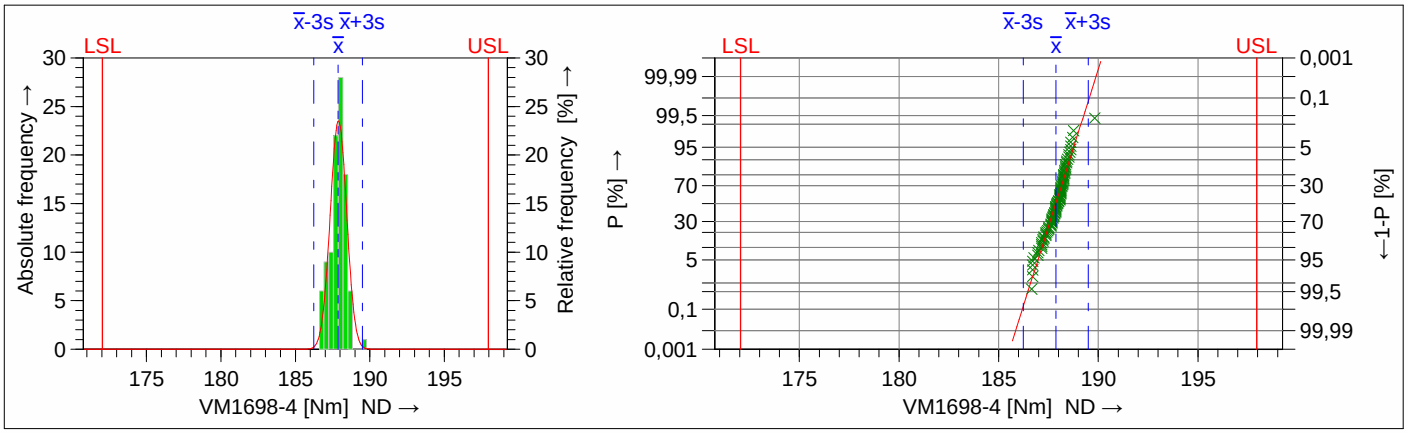
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016284_d	Char.Descr.	VM1698-4	Nom.val. 185,00 12,95	USL 197,95
		Serial No.	1024210	Unit Nm -12,95	LSL 172,05
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	250 / 5537037	nges.	100

Evaluation from 09.05.2022 12:48:01 to 09.05.2022 12:59:22

Rem. TQ 30% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 10.037 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	185.00			$\bar{x}$	187.8675
LSL	172.05	x_{min}	186.66	$\bar{x}$-3s	186.2393
USL	197.95	x_{max}	189.81	$\bar{x}$+3s	189.4957
T	25.90	R	3.15	6s	3.2564
		$n_{<T>}$	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	7.95
Critical capability index	=	C_{mk}	6.19

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

APEX VDI/VDE 2647 V0.1

Apex Tool Group GmbH \\htwe0006\Appdata\QW\QWE\Messwert\2022\1016284_dM.DFD

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_d	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	185,00
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	172,05
				USL	197,95
Remark	TQ 30% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 10.037 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
1024210	VM1698-4	Nm	187,26	187,76	187,96	188,11	188,16	187,16	187,86	186,66	187,96	186,71
1024210	VM1698-4	Grad	29,75	29,50	29,75	29,50	29,00	29,75	29,25	28,75	28,75	28,25

Char.No.	Char.Descr.	Unit	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
1024210	VM1698-4	Nm	186,76	187,51	187,81	187,16	187,36	187,86	187,81	188,01	188,06	188,36
1024210	VM1698-4	Grad	28,25	29,00	28,00	28,25	28,75	28,75	28,50	28,50	28,75	29,50

Char.No.	Char.Descr.	Unit	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
1024210	VM1698-4	Nm	187,36	186,71	187,66	188,11	188,31	188,21	188,26	186,71	187,51	188,06
1024210	VM1698-4	Grad	28,75	29,00	29,50	32,50	29,75	29,25	29,00	28,25	28,75	29,50

Char.No.	Char.Descr.	Unit	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
1024210	VM1698-4	Nm	187,51	187,86	187,01	187,36	187,91	186,71	188,11	187,71	187,86	188,21
1024210	VM1698-4	Grad	29,25	29,50	32,75	29,75	29,75	29,50	29,25	29,00	28,75	29,75

Char.No.	Char.Descr.	Unit	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
1024210	VM1698-4	Nm	187,21	188,16	187,26	187,66	188,21	188,06	188,26	187,76	188,51	187,86
1024210	VM1698-4	Grad	29,25	33,75	29,75	29,50	32,75	33,25	29,50	29,00	29,25	30,00

Char.No.	Char.Descr.	Unit	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
1024210	VM1698-4	Nm	186,96	188,26	188,11	187,61	188,06	188,61	188,21	187,61	188,11	189,81
1024210	VM1698-4	Grad	29,50	33,25	29,25	29,25	29,00	30,00	32,50	29,75	29,50	32,75

Char.No.	Char.Descr.	Unit	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
1024210	VM1698-4	Nm	188,06	188,26	188,61	187,16	188,31	187,91	187,61	187,86	188,36	188,11
1024210	VM1698-4	Grad	29,50	33,00	29,25	29,25	32,00	29,25	31,50	28,75	28,50	31,75

Char.No.	Char.Descr.	Unit	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
1024210	VM1698-4	Nm	187,66	188,36	187,71	187,66	187,46	188,61	188,01	187,91	188,06	188,36
1024210	VM1698-4	Grad	29,25	32,00	28,00	28,00	28,75	28,75	29,50	29,50	29,50	29,00

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_d	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	185,00
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	172,05
				USL	197,95
Remark	TQ 30% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 10.037 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
1024210	VM1698-4	Nm	187,76	188,51	188,31	188,11	188,56	187,21	188,06	187,66	187,86	188,76
1024210	VM1698-4	Grad	28,75	29,50	33,00	29,75	31,00	29,75	29,50	32,00	29,75	30,25

Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
1024210	VM1698-4	Nm	188,26	188,46	188,41	188,41	188,11	187,16	188,26	186,96	187,41	188,71
1024210	VM1698-4	Grad	30,00	32,25	30,00	28,75	32,00	29,50	32,75	29,50	28,50	32,75

Machine Capability Study
Tool System

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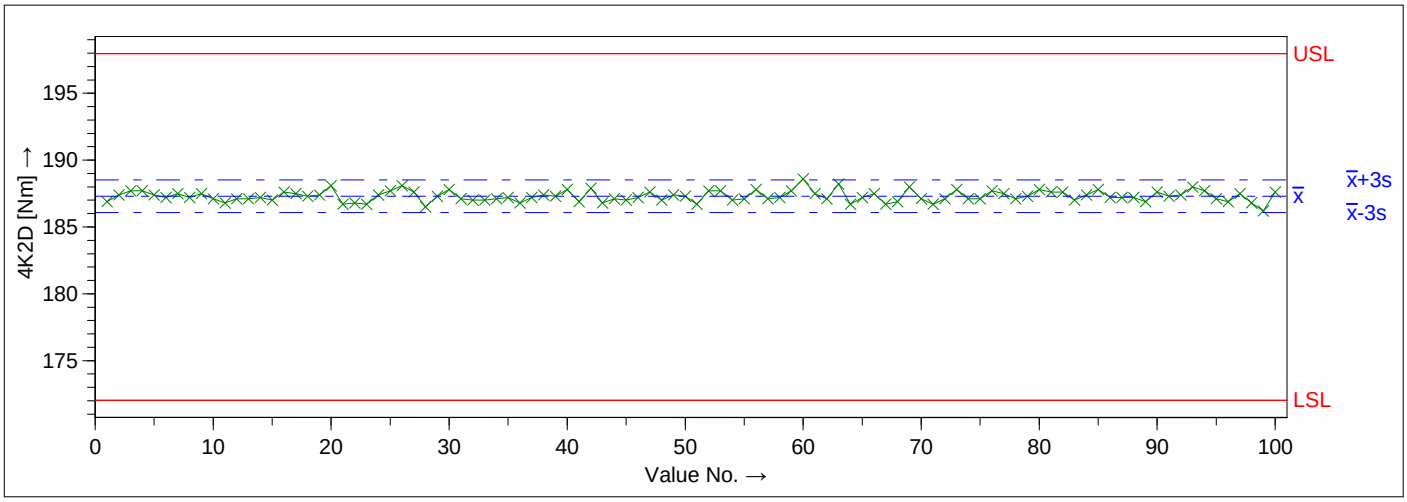
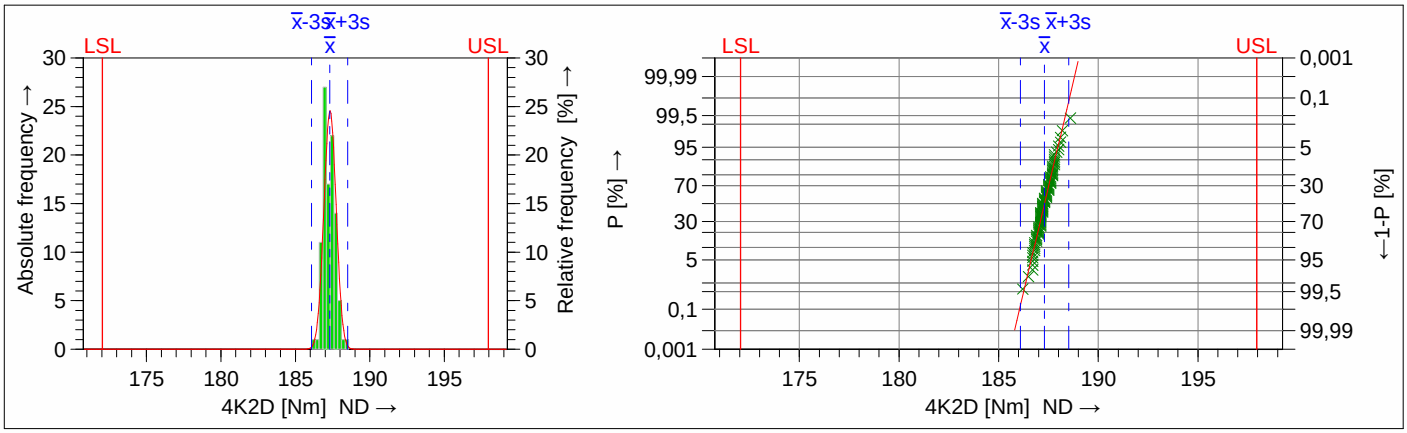
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016284_d	Char.Descr.	4K2D	Nom.val. 185,00 12,95	USL 197,95
		Serial No.	204574	Unit Nm -12,95	LSL 172,05
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	250 / 5537037	nges.	100

Evaluation from 09.05.2022 12:48:01 to 09.05.2022 12:59:23

Rem. TQ 30% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 10.037 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	185.00			$\bar{x}$	187.3010
LSL	172.05	x_{min}	186.20	$\bar{x}$-3s	186.0841
USL	197.95	x_{max}	188.60	$\bar{x}$+3s	188.5179
T	25.90	R	2.40	6s	2.4338
		$n_{<T>}$	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	10.64
Critical capability index	=	C_{mk}	8.75

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

APEX VDI/VDE 2647 V0.1

Apex Tool Group GmbH \\htwe0006\Appdata\QW\QWE\Messwert\2022\1016284_d1.DFD

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_d	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	185,00
Ord. No.	4BD500T1S-A	Serial No.	204574	LSL	172,05
				USL	197,95
Remark	TQ 30% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 10.037 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
204574	4K2D	Nm	186,90	187,40	187,70	187,70	187,40	187,20	187,50	187,20	187,50	187,10
204574	4K2D	Grad	30,00	30,00	30,00	30,00	29,00	30,00	30,00	29,00	29,00	29,00

Char.No.	Char.Descr.	Unit	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
204574	4K2D	Nm	186,80	187,10	187,10	187,20	187,00	187,60	187,50	187,30	187,40	188,10
204574	4K2D	Grad	29,00	29,00	28,00	29,00	29,00	29,00	29,00	29,00	29,00	30,00

Char.No.	Char.Descr.	Unit	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204574	4K2D	Nm	186,70	186,80	186,70	187,40	187,70	188,10	187,60	186,50	187,30	187,80
204574	4K2D	Grad	29,00	30,00	30,00	32,00	30,00	30,00	30,00	29,00	29,00	30,00

Char.No.	Char.Descr.	Unit	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
204574	4K2D	Nm	187,10	187,00	187,00	187,10	187,20	186,80	187,20	187,40	187,30	187,80
204574	4K2D	Grad	30,00	30,00	33,00	30,00	30,00	30,00	30,00	30,00	30,00	31,00

Char.No.	Char.Descr.	Unit	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204574	4K2D	Nm	186,90	187,90	186,80	187,10	187,00	187,20	187,60	187,00	187,40	187,30
204574	4K2D	Grad	30,00	34,00	30,00	30,00	32,00	33,00	30,00	29,00	30,00	30,00

Char.No.	Char.Descr.	Unit	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
204574	4K2D	Nm	186,70	187,70	187,70	187,00	187,10	187,80	187,10	187,20	187,70	188,60
204574	4K2D	Grad	30,00	34,00	30,00	30,00	29,00	31,00	33,00	30,00	30,00	33,00

Char.No.	Char.Descr.	Unit	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
204574	4K2D	Nm	187,50	187,10	188,20	186,70	187,20	187,50	186,70	186,90	188,00	187,10
204574	4K2D	Grad	30,00	33,00	29,00	30,00	32,00	30,00	32,00	29,00	29,00	32,00

Char.No.	Char.Descr.	Unit	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
204574	4K2D	Nm	186,70	187,10	187,80	187,10	187,10	187,70	187,50	187,10	187,30	187,80
204574	4K2D	Grad	30,00	32,00	29,00	29,00	29,00	29,00	30,00	30,00	30,00	30,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_d	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	185,00
Ord. No.	4BD500T1S-A	Serial No.	204574	LSL	172,05
				USL	197,95
Remark	TQ 30% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 10.037 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
204574	4K2D	Nm	187,60	187,60	187,00	187,40	187,80	187,20	187,20	187,20	186,90	187,60
204574	4K2D	Grad	29,00	30,00	33,00	30,00	31,00	30,00	30,00	33,00	30,00	31,00

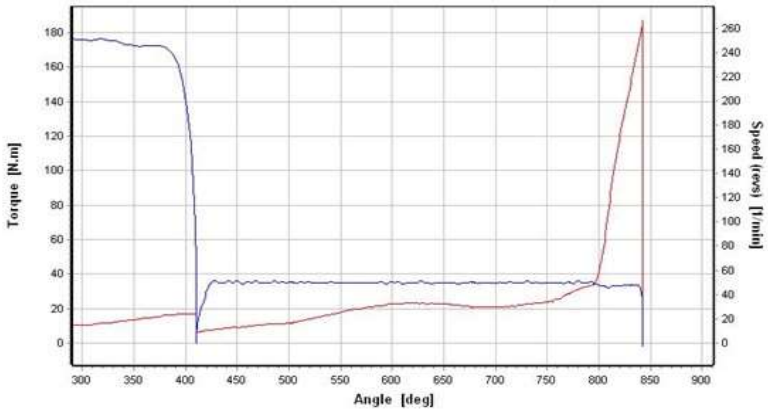
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204574	4K2D	Nm	187,30	187,40	188,00	187,70	187,10	186,90	187,50	186,80	186,20	187,60
204574	4K2D	Grad	30,00	32,00	31,00	29,00	33,00	30,00	33,00	30,00	29,00	33,00

Torque graphs

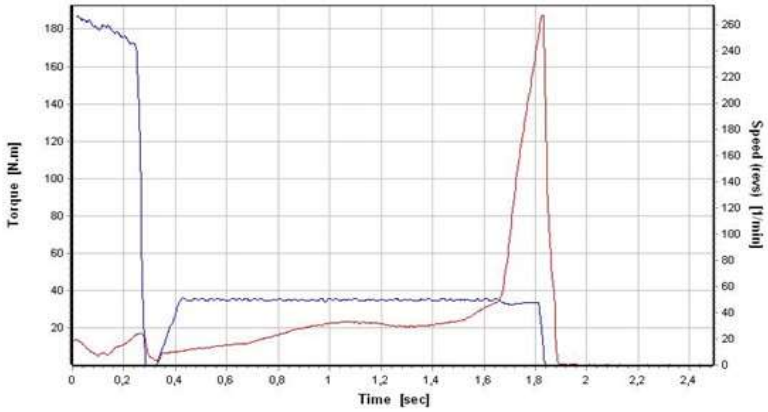
Machine Capability Study 30 %

Model: **4BD-4B500A-4K2D-4ZA**
Serial no: **1016284**

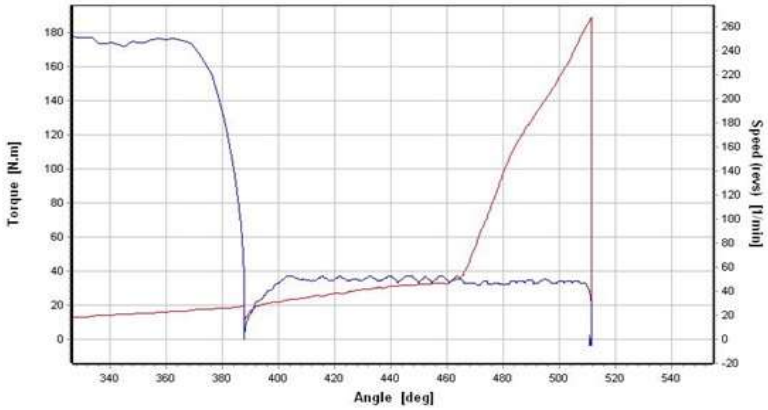
Angle degree: **30°**
Test torque: **185,0 Nm**



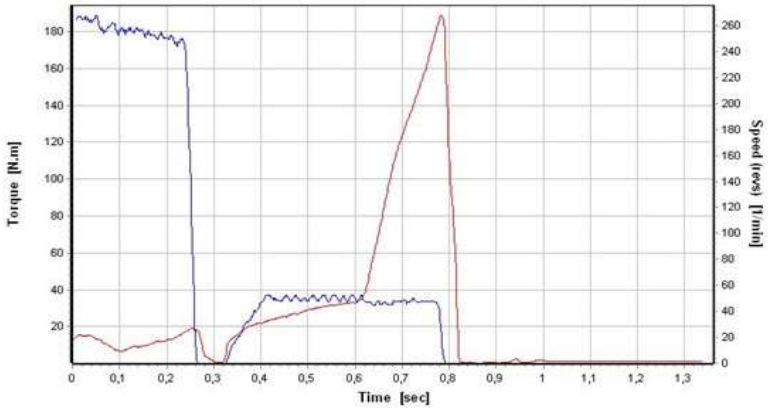
Value no. 1
Graph
Torque / Angle / Speed



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

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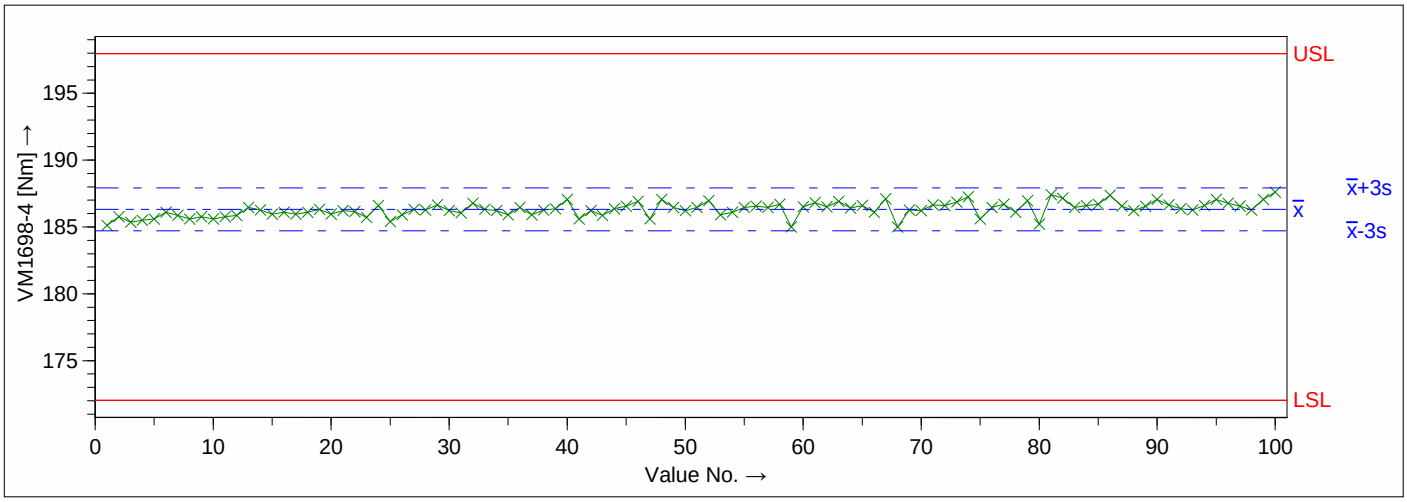
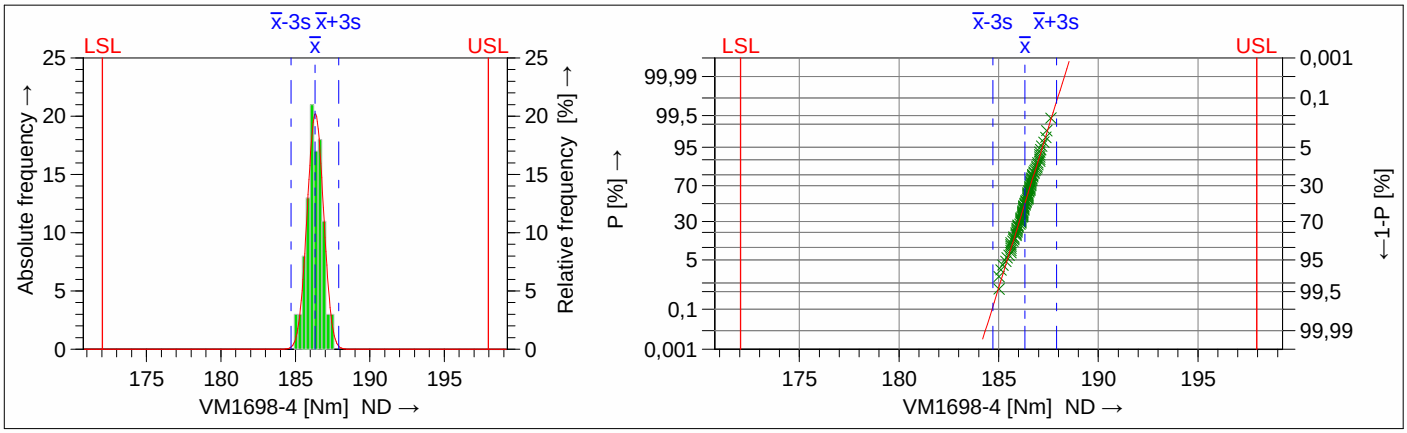
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016284_c	Char.Descr.	VM1698-4	Nom.val. 185,00 12,95	USL 197,95
		Serial No.	1024210	Unit Nm -12,95	LSL 172,05
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	250 / 5537037	nges.	100

Evaluation from 09.05.2022 13:03:59 to 09.05.2022 13:19:50

Rem. TQ 30% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 10.037 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	185.00			$\bar{x}$	186.3150
LSL	172.05	x_{min}	185.01	$\bar{x}$-3s	184.7166
USL	197.95	x_{max}	187.61	$\bar{x}$+3s	187.9134
T	25.90	R	2.60	6s	3.1967
		$n_{<T>}$	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	8.10
Critical capability index	=	C_{mk}	7.28

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

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_c	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	185,00
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	172,05
				USL	197,95
Remark	TQ 30% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 10.037 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
1024210	VM1698-4	Nm	185,11	185,76	185,36	185,51	185,61	186,11	185,86	185,61	185,76	185,61
1024210	VM1698-4	Grad	356,00	355,00	355,75	362,25	352,50	353,00	337,50	349,25	340,75	341,50

Char.No.	Char.Descr.	Unit	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
1024210	VM1698-4	Nm	185,76	185,86	186,46	186,26	185,96	186,11	185,96	186,11	186,31	185,96
1024210	VM1698-4	Grad	342,00	358,25	351,75	357,00	349,75	359,00	357,50	361,00	354,25	357,75

Char.No.	Char.Descr.	Unit	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
1024210	VM1698-4	Nm	186,21	186,16	185,71	186,61	185,41	185,91	186,31	186,26	186,66	186,21
1024210	VM1698-4	Grad	347,00	349,00	361,75	345,50	343,50	354,00	349,00	341,25	353,25	358,25

Char.No.	Char.Descr.	Unit	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
1024210	VM1698-4	Nm	186,06	186,76	186,31	186,21	185,91	186,46	185,91	186,26	186,36	187,06
1024210	VM1698-4	Grad	360,00	352,50	359,00	369,75	339,75	368,00	367,00	350,50	358,00	362,25

Char.No.	Char.Descr.	Unit	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
1024210	VM1698-4	Nm	185,61	186,21	185,86	186,36	186,56	186,91	185,61	187,06	186,46	186,21
1024210	VM1698-4	Grad	341,00	343,75	367,50	347,50	344,25	366,50	353,25	367,00	361,25	359,75

Char.No.	Char.Descr.	Unit	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
1024210	VM1698-4	Nm	186,46	186,96	185,91	186,11	186,46	186,56	186,46	186,71	185,01	186,51
1024210	VM1698-4	Grad	350,00	362,25	372,25	374,75	360,25	361,00	383,50	359,00	362,00	351,25

Char.No.	Char.Descr.	Unit	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
1024210	VM1698-4	Nm	186,81	186,51	186,91	186,41	186,61	186,11	187,11	185,01	186,26	186,21
1024210	VM1698-4	Grad	349,25	341,50	366,50	365,50	358,00	349,25	349,00	346,50	352,00	355,00

Char.No.	Char.Descr.	Unit	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
1024210	VM1698-4	Nm	186,66	186,61	186,86	187,26	185,61	186,46	186,71	186,11	186,96	185,21
1024210	VM1698-4	Grad	356,75	361,00	355,75	362,00	360,75	350,50	366,00	359,25	360,00	356,75

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_c	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	185,00
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	172,05
				USL	197,95
Remark	TQ 30% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 10.037 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
1024210	VM1698-4	Nm	187,41	187,16	186,46	186,61	186,71	187,36	186,56	186,21	186,56	187,06
1024210	VM1698-4	Grad	365,50	348,25	359,00	365,00	358,75	366,00	369,50	357,25	357,75	359,50

Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
1024210	VM1698-4	Nm	186,66	186,36	186,26	186,61	187,06	186,76	186,56	186,26	187,06	187,61
1024210	VM1698-4	Grad	360,25	359,25	365,25	349,50	358,00	354,75	358,50	354,75	345,50	360,00

Machine Capability Study
Tool System

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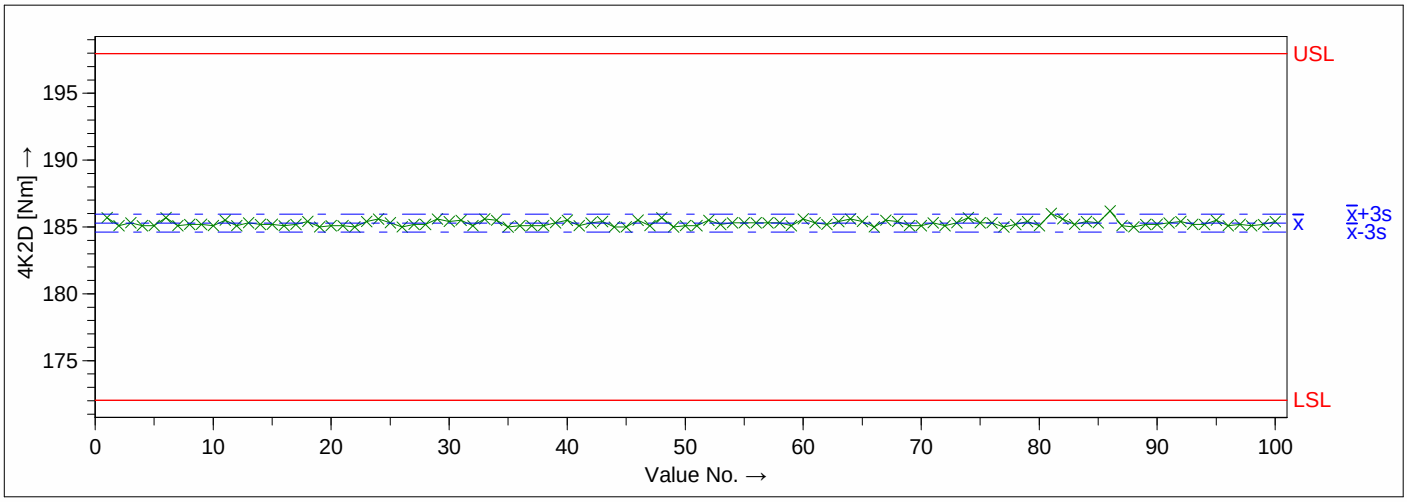
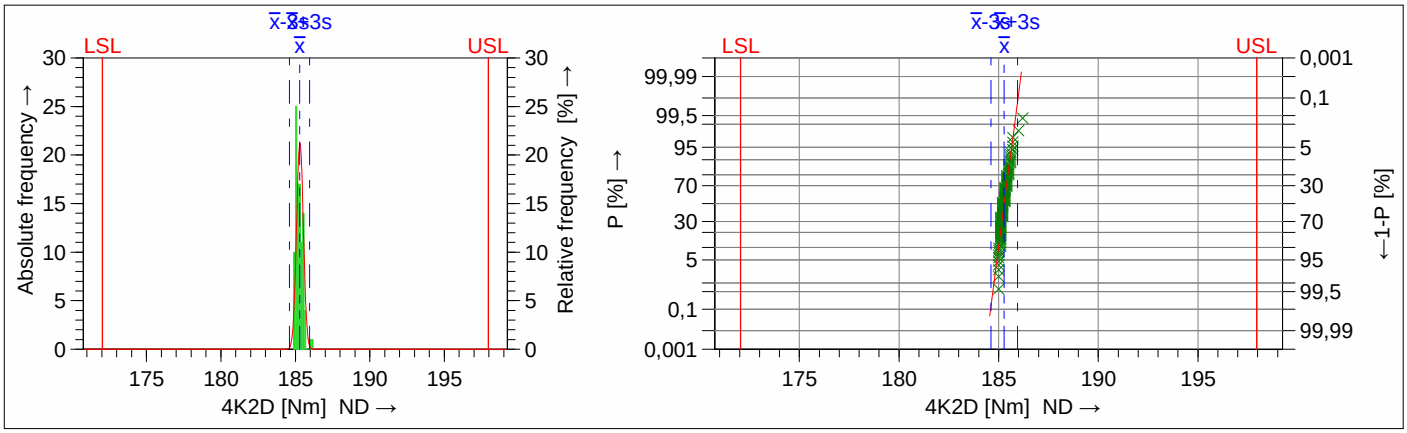
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016284_c	Char.Descr.	4K2D	Nom.val.	185,00 12,95
		Serial No.	204574	Unit	Nm -12,95
USL	197,95	LSL	172,05		
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	250 / 5537037	nges.	100

Evaluation from 09.05.2022 13:03:59 to 09.05.2022 13:19:50

Rem. TQ 30% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 10.037 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	185.00			$\bar{x}$	185.2800
LSL	172.05	x_{min}	185.00	$\bar{x}$-3s	184.6099
USL	197.95	x_{max}	186.20	$\bar{x}$+3s	185.9501
T	25.90	R	1.20	6s	1.3403
		$n_{<T>}$	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	19.32
Critical capability index	=	C_{mk}	18.91

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

APEX VDI/VDE 2647 V0.1

Apex Tool Group GmbH \\htwe0006\Appdata\QW\QWE\Messwert\2022\1016284_c1.DFD

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_c	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	185,00
Ord. No.	4BD500T1S-A	Serial No.	204574	LSL	172,05
				USL	197,95
Remark	TQ 30% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 10.037 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
204574	4K2D	Nm	185,70	185,10	185,30	185,10	185,10	185,70	185,10	185,20	185,20	185,10
204574	4K2D	Grad	361,00	353,00	359,00	362,00	352,00	354,00	336,00	351,00	342,00	343,00

Char.No.	Char.Descr.	Unit	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
204574	4K2D	Nm	185,50	185,10	185,30	185,20	185,20	185,10	185,20	185,40	185,00	185,10
204574	4K2D	Grad	344,00	358,00	352,00	356,00	349,00	359,00	358,00	362,00	353,00	360,00

Char.No.	Char.Descr.	Unit	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204574	4K2D	Nm	185,10	185,00	185,40	185,60	185,30	185,00	185,20	185,20	185,60	185,40
204574	4K2D	Grad	346,00	349,00	364,00	345,00	347,00	354,00	348,00	341,00	350,00	360,00

Char.No.	Char.Descr.	Unit	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
204574	4K2D	Nm	185,50	185,10	185,60	185,50	185,00	185,10	185,10	185,10	185,30	185,50
204574	4K2D	Grad	361,00	352,00	359,00	370,00	340,00	367,00	368,00	350,00	355,00	361,00

Char.No.	Char.Descr.	Unit	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204574	4K2D	Nm	185,10	185,30	185,40	185,00	185,00	185,50	185,10	185,70	185,00	185,10
204574	4K2D	Grad	343,00	344,00	369,00	342,00	344,00	366,00	357,00	366,00	361,00	359,00

Char.No.	Char.Descr.	Unit	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
204574	4K2D	Nm	185,10	185,50	185,20	185,30	185,30	185,30	185,30	185,30	185,10	185,60
204574	4K2D	Grad	350,00	362,00	375,00	374,00	356,00	361,00	382,00	360,00	365,00	352,00

Char.No.	Char.Descr.	Unit	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
204574	4K2D	Nm	185,30	185,20	185,40	185,60	185,40	185,00	185,50	185,40	185,10	185,10
204574	4K2D	Grad	348,00	341,00	366,00	367,00	357,00	346,00	348,00	351,00	351,00	356,00

Char.No.	Char.Descr.	Unit	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
204574	4K2D	Nm	185,30	185,10	185,30	185,70	185,30	185,30	185,00	185,20	185,40	185,10
204574	4K2D	Grad	355,00	361,00	355,00	361,00	363,00	351,00	363,00	361,00	360,00	360,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_c	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	185,00
Ord. No.	4BD500T1S-A	Serial No.	204574	LSL	172,05
				USL	197,95
Remark	TQ 30% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 10.037 Nm/A; Speed: 269/50 rpm;				

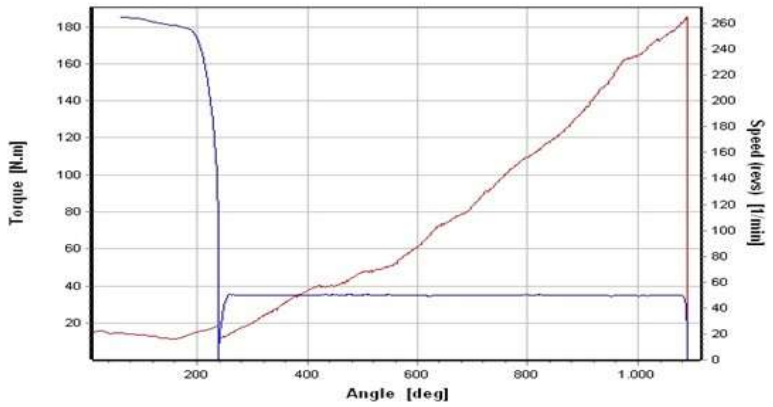
Char.No.	Char.Descr.	Unit	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
204574	4K2D	Nm	186,00	185,60	185,20	185,40	185,30	186,20	185,10	185,00	185,20	185,20
204574	4K2D	Grad	365,00	348,00	359,00	365,00	358,00	365,00	369,00	358,00	358,00	358,00

Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204574	4K2D	Nm	185,30	185,40	185,20	185,20	185,50	185,10	185,20	185,10	185,20	185,40
204574	4K2D	Grad	361,00	361,00	366,00	350,00	357,00	353,00	356,00	355,00	345,00	359,00

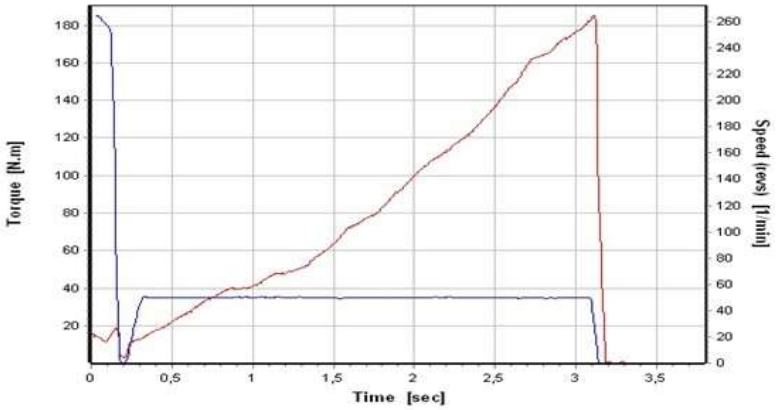
Torque graphs

Model: **4BD-4B500A-4K2D-4ZA**
Serial no: **1016284**

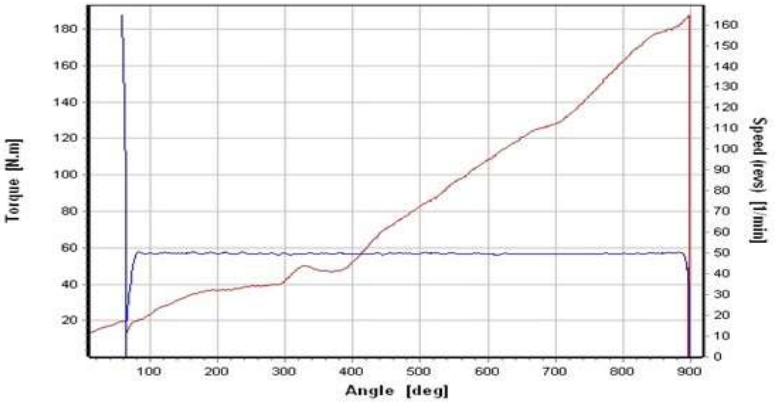
Machine Capability Study 30 %
Angle degree: **360°**
Test torque: **185,0 Nm**



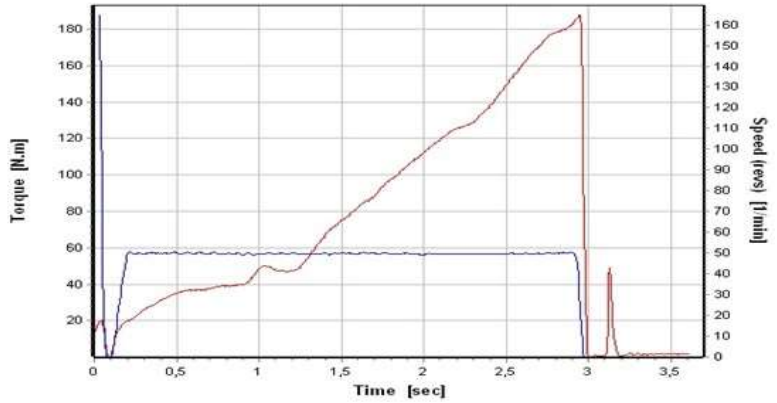
Value no. 1
Graph
Torque / Angle / Speed



Value no. 1
Graph
Torque / Time / Speed



Value no. 100
Graph
Torque / Angle / Speed



Value no. 100
Graph
Torque / Time / Speed

Test sheet no. 3

Machine Capability Study 80 %

Multi-stage tightening system	☑	Speed 50 rpm	18,6 %
Single-stage tightening system	☐	Speed 100 %	269 rpm

Manufacturer: Apex Tool Group

Serial no: **1016284**

Test torque: Tq min. + 0.8 (Tq max. - Tq min.) 410,00 Nm

Hard joint (H)	2470,93	Nm / Revolution	Angle degree	30°
Soft joint (L)	205,32	Nm / Revolution	Angle degree	360°

		H	L
a)	Tolerance down / up	381,30 438,70 Nm	381,30 - 438,70 Nm
	Tolerance down / up	7	7 %
	Average torque	411,82	410,63 Nm
	Standard deviation	0,86	0,52 Nm
	Torque scatter (99,73%)	5,16	3,15 Nm
	C_m	11,11	18,25
	C_{mk}	10,41	17,84

b)	Min. C_m hard/soft (lowest value)	11,11
	Min. C_{mk} hard/soft (lowest value)	10,41

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

Note:

Machine Capability Study
Control System

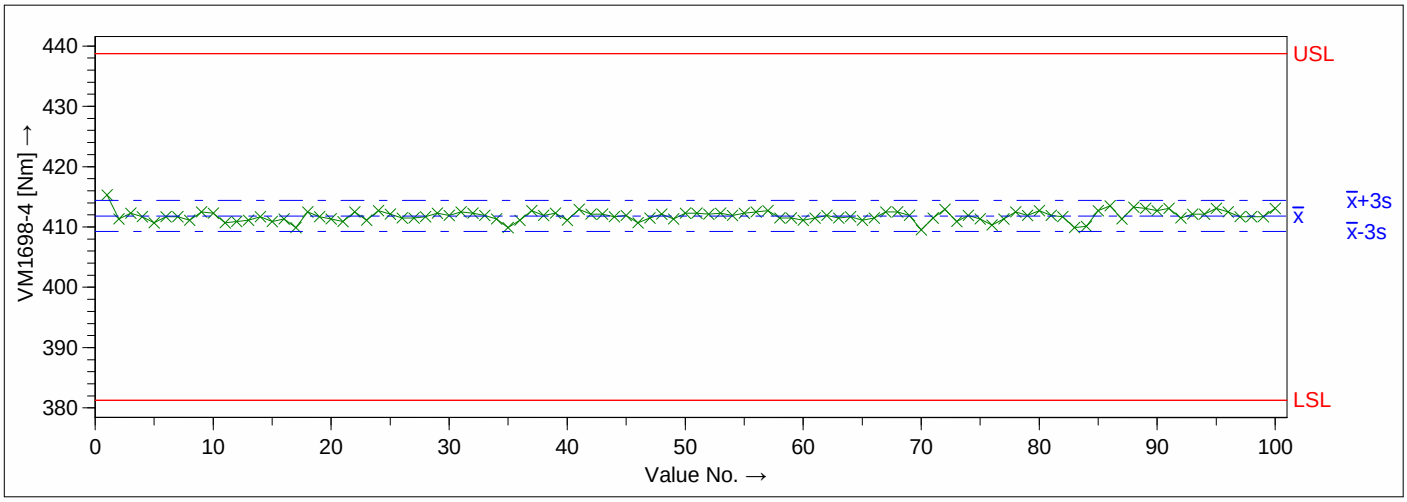
Cleco Production Tools

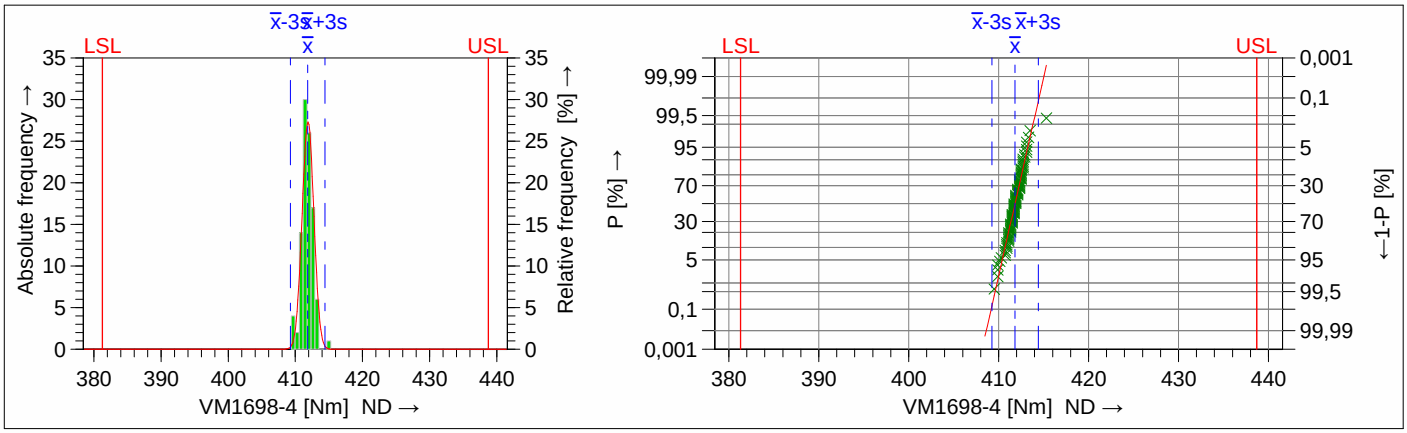
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016284_h	Char.Descr.	VM1698-4	Nom.val.	410,00 28,70
		Serial No.	1024210	Unit	Nm -28,70
				USL	438,70
				LSL	381,30
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	1000 / 1030939	nges.	100

Evaluation from 09.05.2022 08:29:30 to 09.05.2022 08:44:39

Rem. TQ 80% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.889 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	410.00			$\bar{x}$	411.8220
LSL	381.30	x_{min}	409.50	$\bar{x}$-3s	409.2397
USL	438.70	x_{max}	415.30	$\bar{x}$+3s	414.4043
T	57.40	R	5.80	6s	5.1646
		$n_{<T>}$	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	11.11
Critical capability index	=	C_{mk}	10.41

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

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_h	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	410,00
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	381,30
				USL	438,70
Remark	TQ 80% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.889 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
1024210	VM1698-4	Nm	415,30	411,30	412,30	411,70	410,70	411,70	411,70	411,10	412,50	412,30
1024210	VM1698-4	Grad	29,00	30,00	29,50	29,00	30,75	30,25	29,00	30,75	29,50	31,25

Char.No.	Char.Descr.	Unit	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
1024210	VM1698-4	Nm	410,70	410,90	411,10	411,70	410,90	411,30	409,90	412,50	411,70	411,30
1024210	VM1698-4	Grad	29,75	29,75	29,50	29,50	29,50	30,50	29,25	31,50	29,75	30,75

Char.No.	Char.Descr.	Unit	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
1024210	VM1698-4	Nm	410,90	412,50	411,10	412,70	412,10	411,50	411,50	411,70	412,30	411,90
1024210	VM1698-4	Grad	29,00	29,75	30,00	30,00	30,50	29,75	30,50	28,75	29,25	29,25

Char.No.	Char.Descr.	Unit	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
1024210	VM1698-4	Nm	412,50	412,30	411,90	411,30	409,90	411,10	412,70	411,90	412,30	411,10
1024210	VM1698-4	Grad	30,50	30,75	30,25	29,25	30,00	31,25	29,75	30,00	30,50	29,50

Char.No.	Char.Descr.	Unit	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
1024210	VM1698-4	Nm	412,90	412,10	412,10	411,70	411,90	410,70	411,50	412,10	411,30	412,30
1024210	VM1698-4	Grad	30,00	30,50	30,75	29,00	30,00	30,00	29,50	30,50	30,00	29,50

Char.No.	Char.Descr.	Unit	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
1024210	VM1698-4	Nm	412,30	412,10	412,30	411,90	412,30	412,50	412,70	411,50	411,50	411,10
1024210	VM1698-4	Grad	30,25	30,25	29,50	29,75	29,00	30,25	30,00	29,75	29,75	29,50

Char.No.	Char.Descr.	Unit	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
1024210	VM1698-4	Nm	411,50	411,90	411,50	411,70	411,10	411,50	412,50	412,50	411,90	409,50
1024210	VM1698-4	Grad	30,50	29,00	29,00	29,25	29,25	29,00	31,00	30,00	30,00	31,25

Char.No.	Char.Descr.	Unit	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
1024210	VM1698-4	Nm	411,50	412,90	410,90	411,90	411,30	410,30	411,30	412,50	411,90	412,70
1024210	VM1698-4	Grad	29,75	30,50	30,75	29,00	29,25	31,75	29,50	28,75	31,50	29,00

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_h	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	410,00
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	381,30
				USL	438,70
Remark	TQ 80% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.889 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
1024210	VM1698-4	Nm	411,90	411,70	409,90	410,10	412,70	413,50	411,30	413,30	413,10	412,70
1024210	VM1698-4	Grad	30,50	30,00	29,75	31,50	29,75	29,00	31,75	30,00	29,00	30,75

Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
1024210	VM1698-4	Nm	413,10	411,50	412,10	412,10	413,10	412,50	411,70	411,70	411,70	413,10
1024210	VM1698-4	Grad	30,25	30,50	30,25	29,75	28,75	31,00	30,75	29,25	30,00	29,50

Machine Capability Study
Tool System

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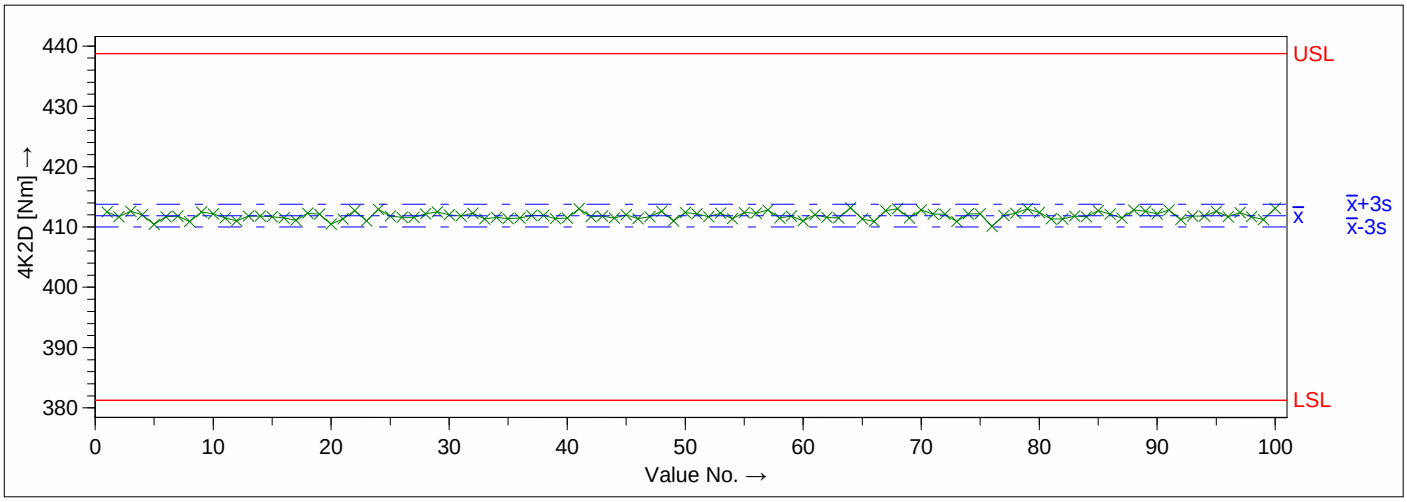
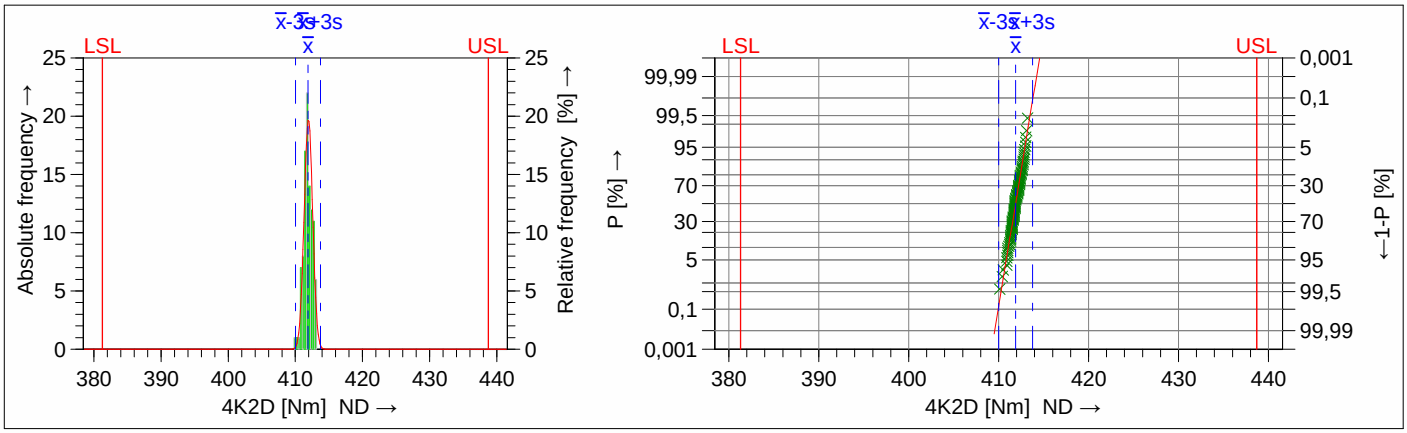
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016284_h	Char.Descr.	4K2D	Nom.val.	410,00 28,70
		Serial No.	204574	Unit	Nm -28,70
USL	438,70	LSL	381,30		
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	1000 / 1030939	nges.	100

Evaluation from 09.05.2022 08:29:30 to 09.05.2022 08:44:40

Rem. TQ 80% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.889 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	410.00			$\bar{x}$	411.8830
LSL	381.30	x_{min}	410.10	$\bar{x}$-3s	410.0039
USL	438.70	x_{max}	413.20	$\bar{x}$+3s	413.7621
T	57.40	R	3.10	6s	3.7582
		$n_{<T>}$	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	15.27
Critical capability index	=	C_{mk}	14.27

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

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_h	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	410,00
Ord. No.	4BD500T1S-A	Serial No.	204574	LSL	381,30
				USL	438,70
Remark	TQ 80% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.889 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
204574	4K2D	Nm	412,50	411,70	412,60	412,00	410,40	411,70	411,80	410,90	412,50	412,20
204574	4K2D	Grad	29,00	30,00	30,00	29,00	31,00	31,00	30,00	32,00	30,00	32,00

Char.No.	Char.Descr.	Unit	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
204574	4K2D	Nm	411,50	411,00	411,80	411,80	411,70	411,50	411,10	412,30	412,10	410,50
204574	4K2D	Grad	30,00	31,00	30,00	30,00	30,00	31,00	30,00	32,00	30,00	31,00

Char.No.	Char.Descr.	Unit	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204574	4K2D	Nm	411,30	412,70	411,00	412,90	411,80	411,60	411,60	412,20	412,50	412,00
204574	4K2D	Grad	29,00	31,00	31,00	31,00	31,00	30,00	32,00	29,00	30,00	30,00

Char.No.	Char.Descr.	Unit	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
204574	4K2D	Nm	411,80	412,30	411,30	411,60	411,40	411,50	411,90	411,90	411,40	411,50
204574	4K2D	Grad	31,00	31,00	31,00	30,00	31,00	32,00	30,00	31,00	31,00	30,00

Char.No.	Char.Descr.	Unit	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204574	4K2D	Nm	413,00	411,70	411,80	411,50	412,00	411,40	411,70	412,60	411,00	412,40
204574	4K2D	Grad	31,00	32,00	31,00	30,00	31,00	30,00	30,00	32,00	31,00	30,00

Char.No.	Char.Descr.	Unit	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
204574	4K2D	Nm	412,20	411,70	412,30	411,40	412,40	412,30	412,80	411,50	411,80	411,00
204574	4K2D	Grad	31,00	31,00	30,00	30,00	30,00	31,00	30,00	30,00	31,00	30,00

Char.No.	Char.Descr.	Unit	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
204574	4K2D	Nm	412,00	411,60	411,50	413,20	411,30	410,90	412,70	413,00	411,50	412,80
204574	4K2D	Grad	31,00	29,00	30,00	31,00	30,00	30,00	33,00	30,00	30,00	32,00

Char.No.	Char.Descr.	Unit	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
204574	4K2D	Nm	412,10	412,10	410,90	412,20	412,20	410,10	411,90	412,30	413,00	412,40
204574	4K2D	Grad	30,00	31,00	31,00	30,00	31,00	33,00	31,00	30,00	32,00	30,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_h	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	410,00
Ord. No.	4BD500T1S-A	Serial No.	204574	LSL	381,30
				USL	438,70
Remark	TQ 80% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.889 Nm/A; Speed: 269/50 rpm;				

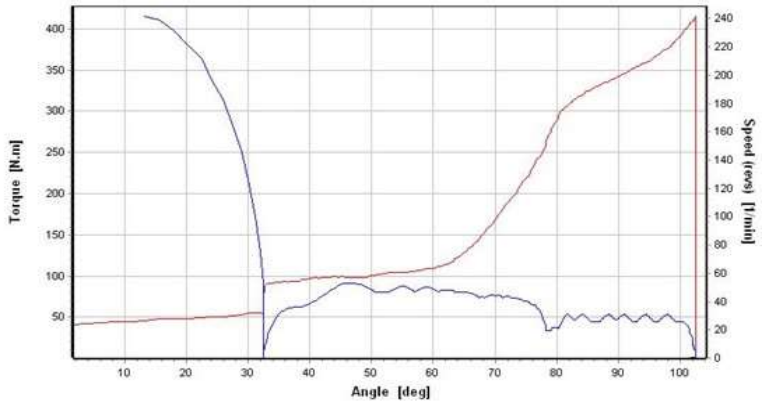
Char.No.	Char.Descr.	Unit	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
204574	4K2D	Nm	411,30	411,30	411,80	411,70	412,70	412,10	411,50	412,80	412,60	412,20
204574	4K2D	Grad	31,00	31,00	30,00	32,00	30,00	30,00	32,00	31,00	30,00	32,00

Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204574	4K2D	Nm	412,80	411,20	411,80	411,80	412,60	411,70	412,40	411,70	411,20	413,10
204574	4K2D	Grad	31,00	31,00	32,00	30,00	30,00	32,00	31,00	30,00	30,00	30,00

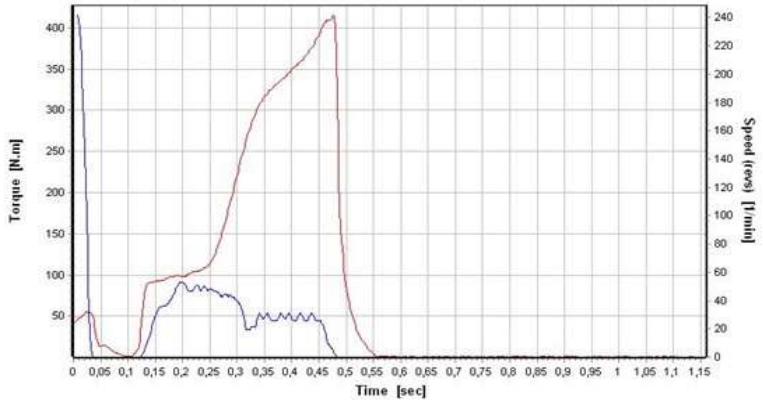
Torque graphs

Model: **4BD-4B500A-4K2D-4ZA**
Serial no: **1016284**

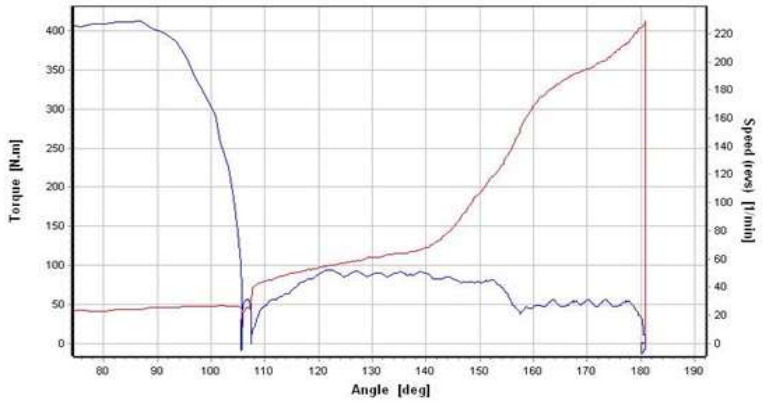
Machine Capability Study 80 %
Angle degree: **30°**
Test torque: **410,0 Nm**



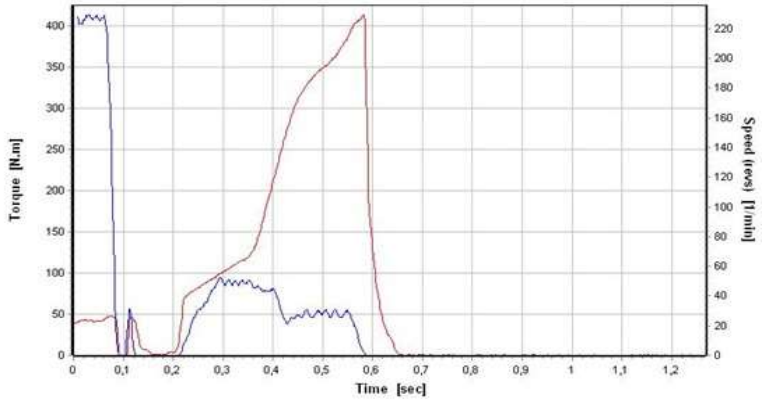
Value no. 1
Graph
Torque / Angle / Speed



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

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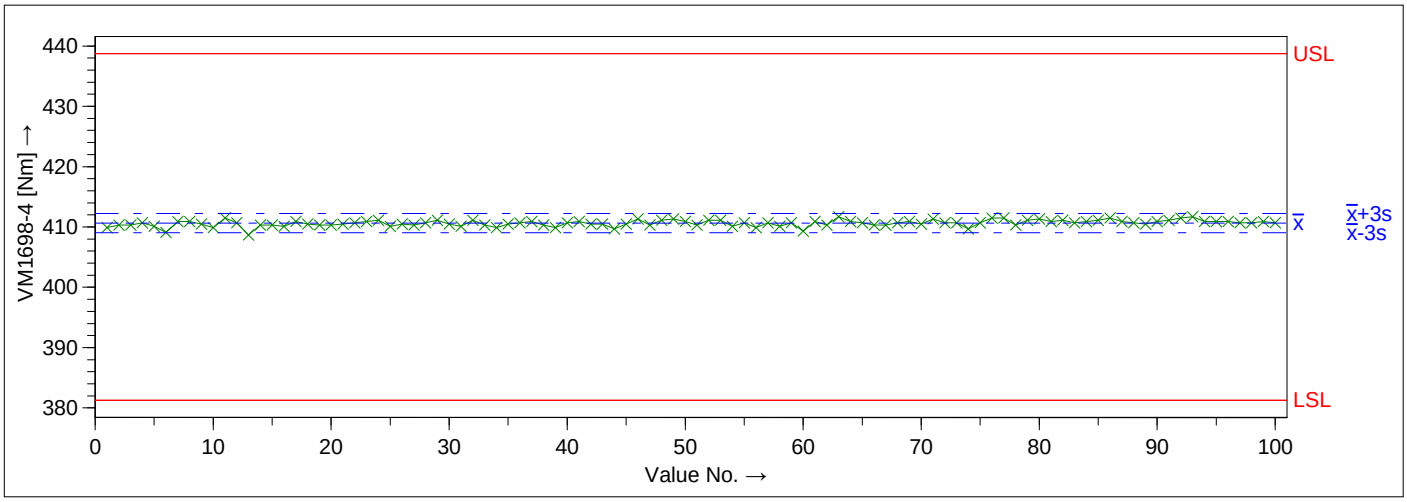
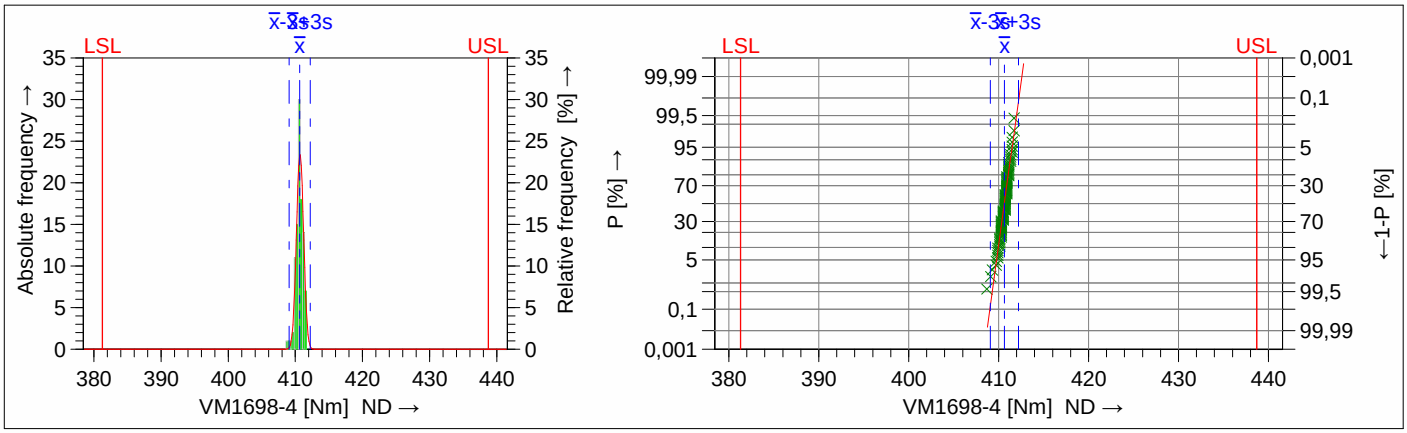
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016284_g	Char.Descr.	VM1698-4	Nom.val. 410,00 28,70	USL 438,70
		Serial No.	1024210	Unit Nm -28,70	LSL 381,30
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	1000 / 1030939	nges.	100

Evaluation from 09.05.2022 09:18:28 to 09.05.2022 10:52:37

Rem. TQ 80% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.889 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	410.00			$\bar{x}$	410.6320
LSL	381.30	x_{min}	408.70	$\bar{x}$-3s	409.0590
USL	438.70	x_{max}	411.70	$\bar{x}$+3s	412.2050
T	57.40	R	3.00	6s	3.1460
		$n_{<T>}$	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	18.25
Critical capability index	=	C_{mk}	17.84

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

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_g	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	410,00
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	381,30
				USL	438,70
Remark	TQ 80% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.889 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
1024210	VM1698-4	Nm	409,90	410,30	410,30	410,70	410,10	409,10	410,90	410,90	410,50	409,90
1024210	VM1698-4	Grad	350,75	336,50	343,00	315,25	338,75	341,00	339,25	322,25	335,25	249,25

Char.No.	Char.Descr.	Unit	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
1024210	VM1698-4	Nm	411,50	410,70	408,70	410,30	410,30	410,10	410,90	410,50	410,30	410,30
1024210	VM1698-4	Grad	311,00	334,50	268,75	312,00	343,50	245,25	316,25	343,75	259,50	315,00

Char.No.	Char.Descr.	Unit	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
1024210	VM1698-4	Nm	410,50	410,70	410,90	411,10	410,10	410,50	410,30	410,70	411,10	410,50
1024210	VM1698-4	Grad	343,50	327,00	341,75	346,50	312,25	346,50	326,25	355,25	326,00	349,00

Char.No.	Char.Descr.	Unit	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
1024210	VM1698-4	Nm	410,10	411,10	410,30	409,90	410,50	410,70	410,90	410,30	409,90	410,70
1024210	VM1698-4	Grad	258,75	325,25	358,25	334,75	349,25	346,50	344,00	263,00	332,75	335,75

Char.No.	Char.Descr.	Unit	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
1024210	VM1698-4	Nm	410,90	410,50	410,50	409,70	410,50	411,30	410,30	411,10	411,30	410,90
1024210	VM1698-4	Grad	357,75	340,00	276,25	348,75	359,75	364,00	336,00	349,00	380,75	363,75

Char.No.	Char.Descr.	Unit	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
1024210	VM1698-4	Nm	410,30	411,10	411,10	410,10	410,70	409,90	410,70	410,10	410,70	409,30
1024210	VM1698-4	Grad	357,75	363,00	345,50	342,50	349,75	358,25	347,00	346,75	347,25	349,75

Char.No.	Char.Descr.	Unit	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
1024210	VM1698-4	Nm	410,90	410,30	411,70	410,90	410,70	410,30	410,30	410,70	410,90	410,50
1024210	VM1698-4	Grad	388,50	358,00	385,50	345,00	353,50	350,75	374,25	349,50	373,00	346,25

Char.No.	Char.Descr.	Unit	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
1024210	VM1698-4	Nm	411,30	410,70	410,70	409,70	410,70	411,50	411,50	410,30	411,10	411,30
1024210	VM1698-4	Grad	348,50	348,50	392,75	346,75	379,50	352,75	376,50	344,00	342,00	362,75

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_g	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	410,00
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	381,30
				USL	438,70
Remark	TQ 80% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.889 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
1024210	VM1698-4	Nm	410,90	411,10	410,70	410,90	411,10	411,50	410,90	410,70	410,50	410,90
1024210	VM1698-4	Grad	356,00	350,50	347,25	339,75	339,50	395,25	349,50	343,75	303,25	342,25

Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
1024210	VM1698-4	Nm	411,10	411,50	411,70	410,90	410,90	410,90	410,70	410,70	410,90	410,70
1024210	VM1698-4	Grad	352,00	347,50	365,75	346,25	365,50	345,25	351,25	381,50	356,50	370,25

Machine Capability Study
Tool System

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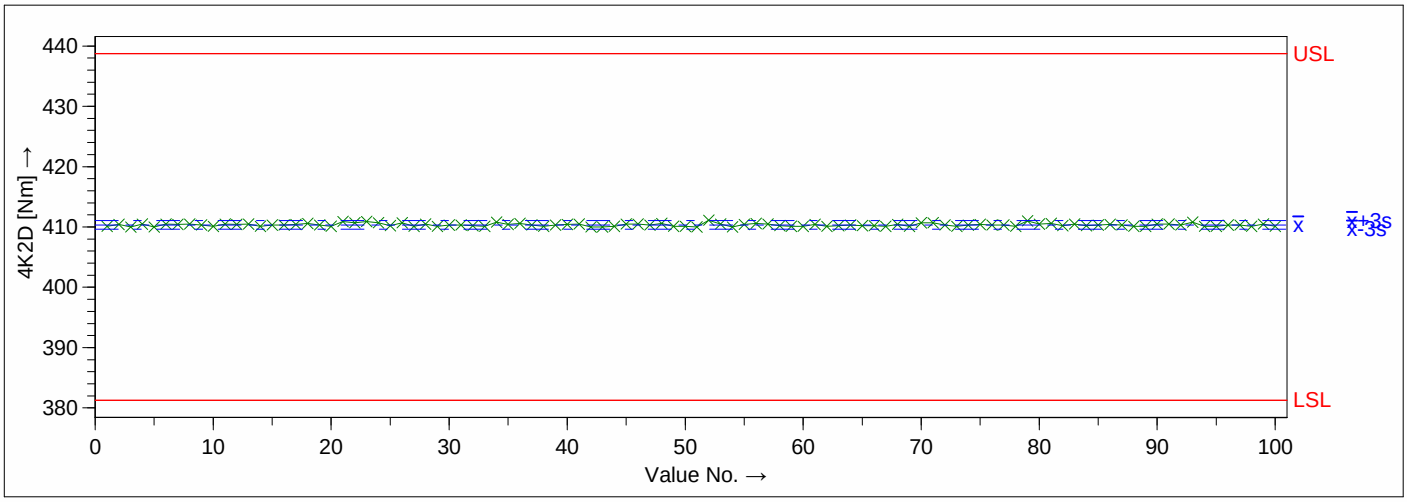
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.05.2022		

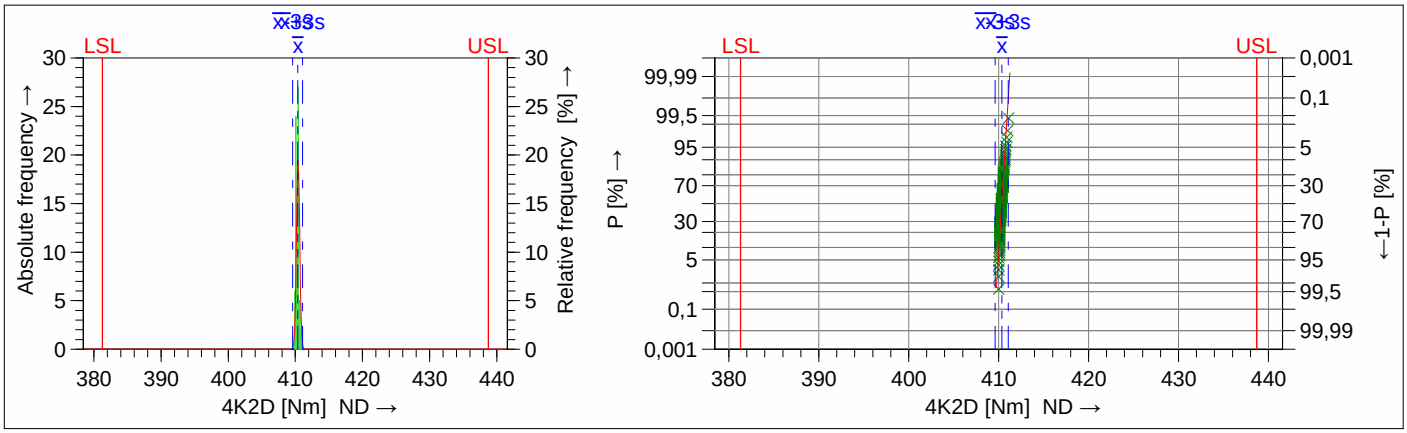
Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016284_g	Char.Descr.	4K2D	Nom.val. 410,00 28,70	USL 438,70
		Serial No.	204574	Unit Nm -28,70	LSL 381,30
Char.Type	variable			Tolerance value 7 %	Decimal Pl. 2

Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	1000 / 1030939	nges.	100

Evaluation from 09.05.2022 09:18:29 to 09.05.2022 10:52:38

Rem. TQ 80% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.889 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	410.00			$\bar{x}$	410.3410
LSL	381.30	x_{min}	410.00	$\bar{x}$-3s	409.6173
USL	438.70	x_{max}	411.10	$\bar{x}$+3s	411.0647
T	57.40	R	1.10	6s	1.4475
		$n_{<T>}$	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	39.65
Critical capability index	=	C_{mk}	39.18

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

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_g	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	410,00
Ord. No.	4BD500T1S-A	Serial No.	204574	LSL	381,30
				USL	438,70
Remark	TQ 80% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.889 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
204574	4K2D	Nm	410,10	410,40	410,00	410,50	410,00	410,50	410,40	410,50	410,30	410,10
204574	4K2D	Grad	352,00	338,00	344,00	316,00	341,00	346,00	341,00	323,00	335,00	251,00

Char.No.	Char.Descr.	Unit	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
204574	4K2D	Nm	410,50	410,40	410,50	410,10	410,30	410,30	410,40	410,60	410,30	410,10
204574	4K2D	Grad	312,00	335,00	283,00	313,00	344,00	248,00	319,00	344,00	260,00	317,00

Char.No.	Char.Descr.	Unit	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204574	4K2D	Nm	410,90	410,70	410,90	410,70	410,20	410,70	410,10	410,50	410,10	410,30
204574	4K2D	Grad	345,00	328,00	347,00	346,00	318,00	347,00	329,00	357,00	328,00	351,00

Char.No.	Char.Descr.	Unit	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
204574	4K2D	Nm	410,30	410,20	410,10	410,80	410,40	410,60	410,30	410,10	410,30	410,40
204574	4K2D	Grad	260,00	327,00	359,00	336,00	350,00	347,00	349,00	265,00	336,00	337,00

Char.No.	Char.Descr.	Unit	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204574	4K2D	Nm	410,50	410,00	410,00	410,10	410,50	410,50	410,30	410,60	410,10	410,10
204574	4K2D	Grad	359,00	344,00	277,00	353,00	360,00	365,00	339,00	352,00	382,00	363,00

Char.No.	Char.Descr.	Unit	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
204574	4K2D	Nm	410,00	411,10	410,50	410,00	410,40	410,60	410,50	410,20	410,10	410,10
204574	4K2D	Grad	362,00	363,00	346,00	343,00	350,00	359,00	346,00	349,00	348,00	351,00

Char.No.	Char.Descr.	Unit	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
204574	4K2D	Nm	410,40	410,10	410,20	410,30	410,20	410,20	410,10	410,40	410,10	410,70
204574	4K2D	Grad	389,00	362,00	386,00	346,00	354,00	351,00	374,00	351,00	374,00	350,00

Char.No.	Char.Descr.	Unit	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
204574	4K2D	Nm	410,70	410,30	410,10	410,30	410,40	410,30	410,30	410,10	411,00	410,50
204574	4K2D	Grad	350,00	349,00	393,00	351,00	380,00	354,00	378,00	345,00	349,00	363,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_g	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	410,00
Ord. No.	4BD500T1S-A	Serial No.	204574	LSL	381,30
				USL	438,70
Remark	TQ 80% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.889 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
204574	4K2D	Nm	410,60	410,20	410,50	410,20	410,30	410,40	410,30	410,10	410,10	410,50
204574	4K2D	Grad	362,00	351,00	350,00	344,00	342,00	396,00	352,00	345,00	306,00	347,00

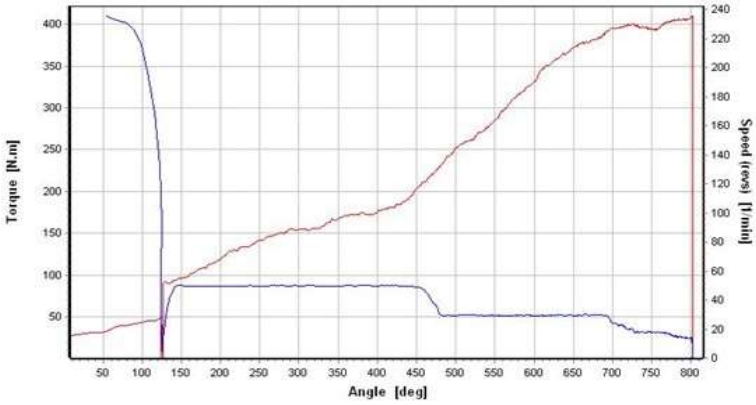
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204574	4K2D	Nm	410,50	410,30	410,80	410,10	410,10	410,30	410,30	410,10	410,50	410,10
204574	4K2D	Grad	353,00	348,00	366,00	347,00	365,00	350,00	352,00	383,00	360,00	365,00

Torque graphs

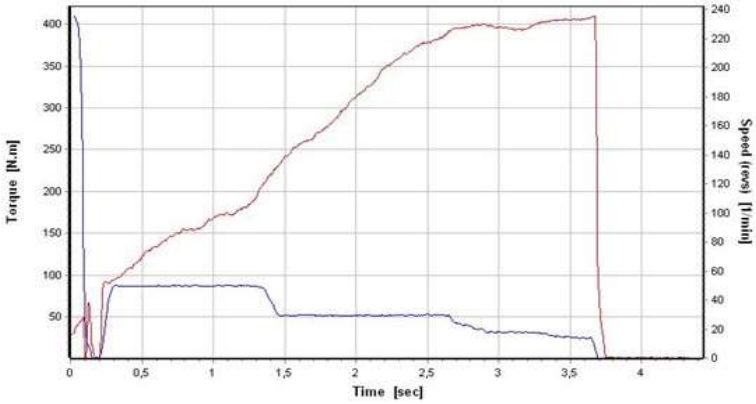
Machine Capability Study 80 %

Model: **4BD-4B500A-4K2D-4ZA**
Serial no: **1016284**

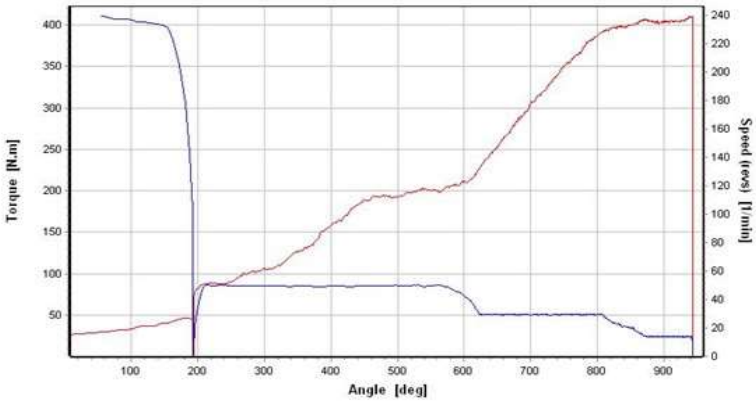
Angle degree: **360°**
Test torque: **410,0 Nm**



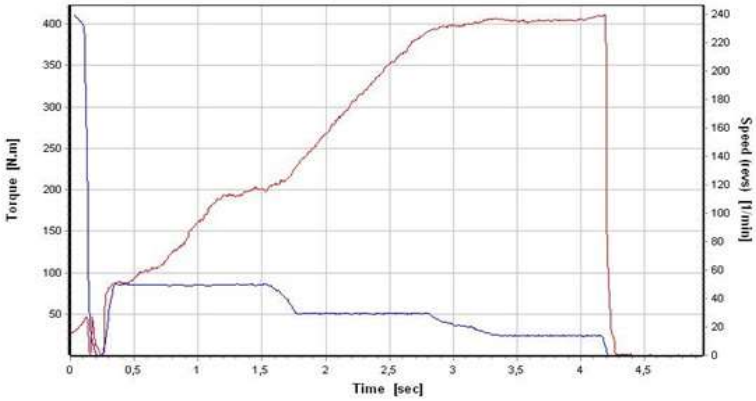
Value no. 1
Graph
Torque / Angle / Speed



Value no. 1
Graph
Torque / Time / Speed



Value no. 100
Graph
Torque / Angle / Speed



Value no. 100
Graph
Torque / Time / Speed

Test sheet no. 4

Machine Capability Study 100 %

Multi-stage tightening system	☑	Speed 50 rpm	18,6 %
Single-stage tightening system	☐	Speed 100 %	269 rpm

Manufacturer: Apex Tool Group

Serial no: **1016284**

Test torque: Tq max. 500,00 Nm

Hard joint (H)	3008,30	Nm / Revolution	Angle degree	30°
Soft joint (L)	249,94	Nm / Revolution	Angle degree	360°

		H	L
a)	Tolerance down / up	465,00 535,00 Nm	465,00 - 535,00 Nm
	Tolerance down / up	7	7 %
	Average torque	501,38	499,87 Nm
	Standard deviation	1,06	0,98 Nm
	Torque scatter (99,73%)	6,36	5,88 Nm
	C_m	11,01	11,90
	C_{mk}	10,58	11,86

b)	Min. C_m hard/soft (lowest value)	11,01
	Min. C_{mk} hard/soft (lowest value)	10,58

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

Note:

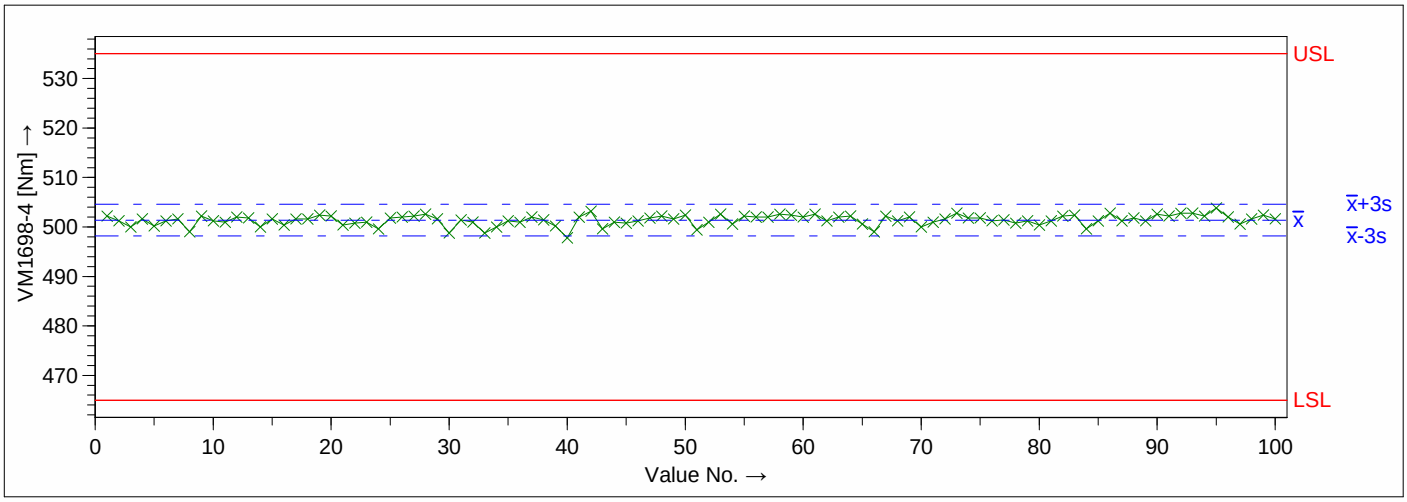
Machine Capability Study
Control System

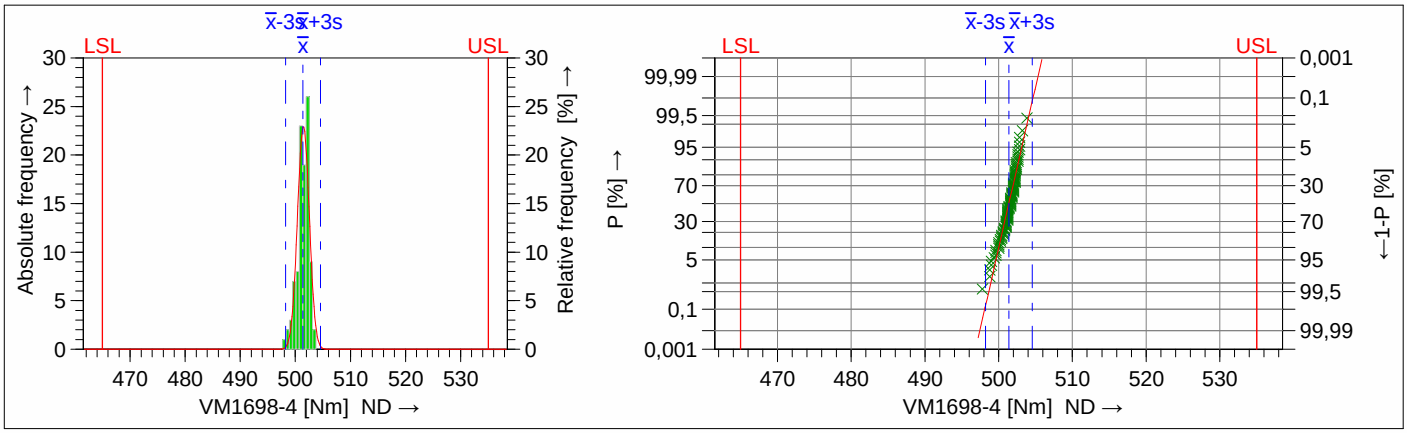
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016284_b	Char.Descr.	VM1698-4	Nom.val. 500,00 35,00	USL 535,00
		Serial No.	1024210	Unit Nm -35,00	LSL 465,00
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	1000 / 1030939	nges.	100

Evaluation from 09.05.2022 07:45:36 to 09.05.2022 08:00:47

Rem. TQ 100% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.379 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	500.00			$\bar{x}$	501.3840
LSL	465.00	x_{min}	497.80	$\bar{x}$-3s	498.2060
USL	535.00	x_{max}	503.80	$\bar{x}$+3s	504.5620
T	70.00	R	6.00	6s	6.3559
		$n_{<T>}$	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	11.01
Critical capability index	=	C_{mk}	10.58

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

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_b	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	500,00
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	465,00
				USL	535,00
Remark	TQ 100% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.379 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
1024210	VM1698-4	Nm	502,20	501,20	500,00	501,60	500,20	501,20	501,60	499,00	502,20	501,20
1024210	VM1698-4	Grad	32,75	34,00	31,50	32,00	32,75	31,75	33,00	32,25	31,00	32,75

Char.No.	Char.Descr.	Unit	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
1024210	VM1698-4	Nm	501,00	502,00	501,80	500,00	501,60	500,40	501,60	501,60	502,40	502,20
1024210	VM1698-4	Grad	33,00	31,00	33,25	31,00	30,75	30,75	30,00	32,50	30,50	32,25

Char.No.	Char.Descr.	Unit	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
1024210	VM1698-4	Nm	500,40	500,80	501,00	499,60	501,80	502,00	502,20	502,60	501,60	498,80
1024210	VM1698-4	Grad	31,75	29,50	32,75	28,25	29,50	31,00	30,50	30,75	30,50	29,75

Char.No.	Char.Descr.	Unit	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
1024210	VM1698-4	Nm	501,40	501,00	498,80	500,00	501,20	501,00	502,00	501,40	500,20	497,80
1024210	VM1698-4	Grad	30,00	31,75	33,25	30,00	30,75	29,50	30,00	31,25	28,00	31,00

Char.No.	Char.Descr.	Unit	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
1024210	VM1698-4	Nm	502,00	503,20	499,60	501,00	500,80	501,20	501,80	502,20	501,60	502,40
1024210	VM1698-4	Grad	29,75	31,25	29,25	28,75	32,00	30,75	28,50	31,25	29,00	30,50

Char.No.	Char.Descr.	Unit	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
1024210	VM1698-4	Nm	499,40	501,00	502,60	500,60	502,20	502,00	502,00	502,60	502,40	502,00
1024210	VM1698-4	Grad	29,25	27,75	31,00	29,75	31,75	29,00	32,00	28,25	33,50	30,25

Char.No.	Char.Descr.	Unit	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
1024210	VM1698-4	Nm	502,60	501,20	502,00	502,20	500,60	499,00	502,20	501,20	502,00	500,00
1024210	VM1698-4	Grad	30,75	30,50	32,50	28,50	31,50	29,00	31,25	28,00	32,00	30,00

Char.No.	Char.Descr.	Unit	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
1024210	VM1698-4	Nm	501,00	501,60	502,80	501,80	501,80	501,20	501,40	500,80	501,20	500,40
1024210	VM1698-4	Grad	31,50	28,25	32,50	28,75	30,75	29,75	30,75	30,25	30,00	28,00

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_b	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	500,00
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	465,00
				USL	535,00
Remark	TQ 100% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.379 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
1024210	VM1698-4	Nm	501,20	502,20	502,40	499,60	501,20	502,80	501,20	501,80	501,20	502,60
1024210	VM1698-4	Grad	31,00	27,75	29,25	29,25	28,75	32,00	29,25	31,75	29,25	31,50

Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
1024210	VM1698-4	Nm	502,20	502,80	502,80	502,20	503,80	502,00	500,60	501,60	502,40	501,60
1024210	VM1698-4	Grad	27,75	30,00	29,00	32,00	29,75	30,25	30,00	30,00	30,50	29,25

Machine Capability Study
Tool System

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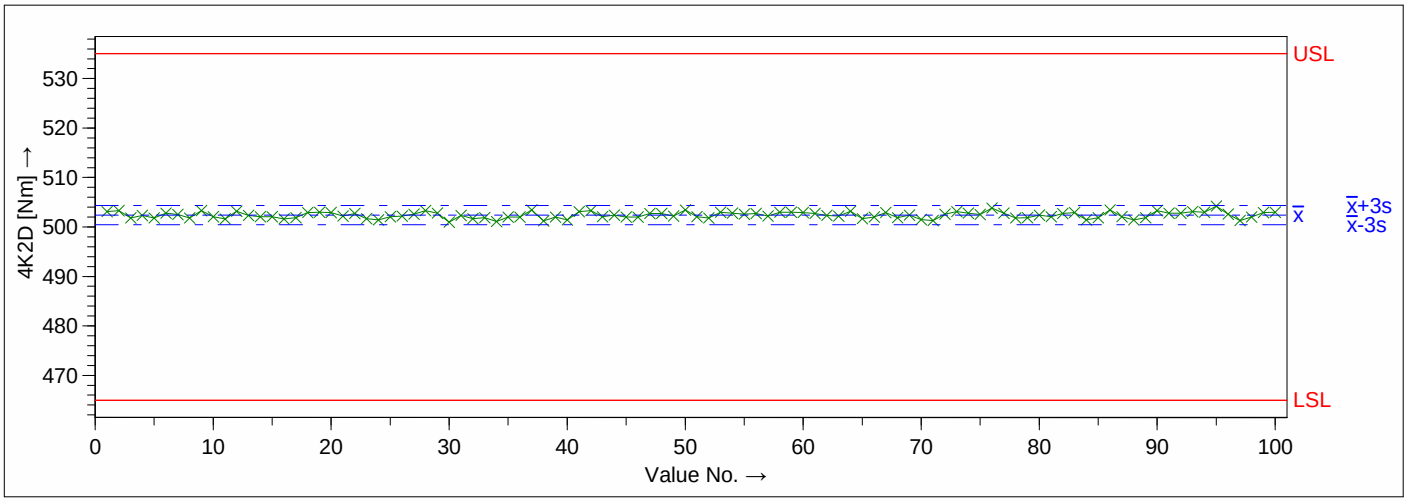
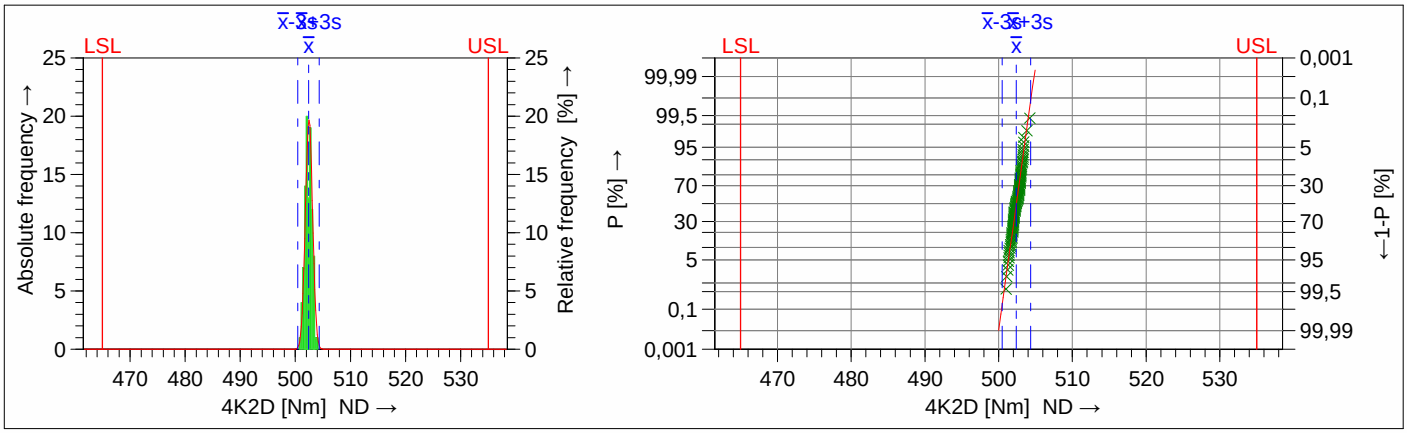
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016284_b	Char.Descr.	4K2D	Nom.val.	500,00 35,00
		Serial No.	204574	Unit	Nm -35,00
				USL	535,00
				LSL	465,00
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	1000 / 1030939	nges.	100

Evaluation from 09.05.2022 07:45:37 to 09.05.2022 08:00:48

Rem. TQ 100% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.379 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	500.00			$\bar{x}$	502.4000
LSL	465.00	x_{min}	501.00	$\bar{x}$-3s	500.4591
USL	535.00	x_{max}	504.20	$\bar{x}$+3s	504.3409
T	70.00	R	3.20	6s	3.8819
		$n_{<T>}$	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	18.03
Critical capability index	=	C_{mk}	16.80

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

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_b	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	500,00
Ord. No.	4BD500T1S-A	Serial No.	204574	LSL	465,00
				USL	535,00
Remark	TQ 100% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.379 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
204574	4K2D	Nm	503,10	503,30	501,80	502,30	501,80	502,80	502,50	501,80	503,30	502,10
204574	4K2D	Grad	34,00	36,00	33,00	32,00	34,00	33,00	34,00	34,00	32,00	34,00

Char.No.	Char.Descr.	Unit	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
204574	4K2D	Nm	501,60	503,20	502,30	502,10	502,10	501,60	501,90	502,90	503,00	502,90
204574	4K2D	Grad	33,00	32,00	33,00	32,00	31,00	31,00	31,00	33,00	31,00	33,00

Char.No.	Char.Descr.	Unit	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204574	4K2D	Nm	502,20	502,70	501,70	501,40	502,10	502,20	502,60	503,30	502,80	501,00
204574	4K2D	Grad	33,00	30,00	34,00	29,00	30,00	32,00	31,00	32,00	31,00	31,00

Char.No.	Char.Descr.	Unit	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
204574	4K2D	Nm	502,30	501,70	501,90	501,10	502,00	502,00	503,40	501,20	502,00	501,40
204574	4K2D	Grad	30,00	33,00	34,00	31,00	32,00	30,00	31,00	32,00	29,00	32,00

Char.No.	Char.Descr.	Unit	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204574	4K2D	Nm	503,10	503,30	502,10	502,40	502,00	502,00	502,70	502,70	502,20	503,40
204574	4K2D	Grad	30,00	32,00	30,00	30,00	33,00	31,00	30,00	32,00	30,00	32,00

Char.No.	Char.Descr.	Unit	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
204574	4K2D	Nm	502,10	501,80	503,00	502,80	502,60	502,70	502,20	503,00	503,00	502,90
204574	4K2D	Grad	30,00	29,00	32,00	31,00	33,00	30,00	33,00	30,00	34,00	31,00

Char.No.	Char.Descr.	Unit	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
204574	4K2D	Nm	502,70	502,30	502,20	503,20	501,70	502,00	502,90	501,90	502,40	501,50
204574	4K2D	Grad	32,00	31,00	33,00	29,00	32,00	30,00	32,00	30,00	32,00	31,00

Char.No.	Char.Descr.	Unit	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
204574	4K2D	Nm	501,30	502,60	503,10	502,80	502,50	503,80	502,80	501,80	501,90	502,40
204574	4K2D	Grad	33,00	29,00	33,00	29,00	31,00	31,00	31,00	31,00	31,00	29,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_b	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	500,00
Ord. No.	4BD500T1S-A	Serial No.	204574	LSL	465,00
				USL	535,00
Remark	TQ 100% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.379 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
204574	4K2D	Nm	502,10	502,70	502,90	501,40	501,90	503,40	502,10	501,40	501,90	503,30
204574	4K2D	Grad	32,00	29,00	30,00	30,00	30,00	33,00	30,00	33,00	30,00	32,00

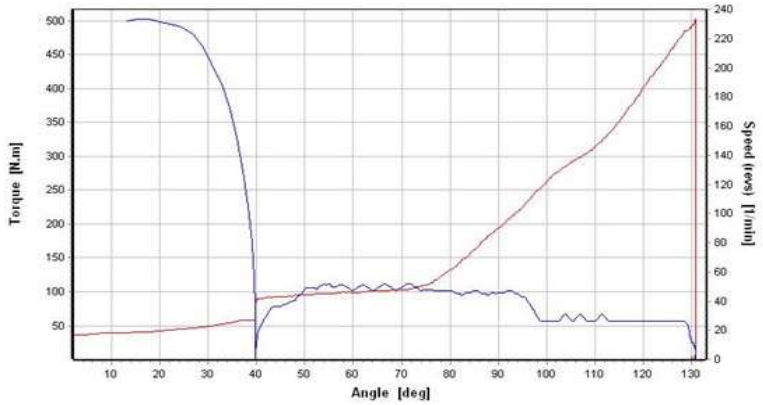
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204574	4K2D	Nm	502,80	502,80	503,10	503,00	504,20	502,60	501,30	502,00	502,90	503,00
204574	4K2D	Grad	28,00	31,00	29,00	33,00	31,00	31,00	31,00	31,00	31,00	30,00

Torque graphs

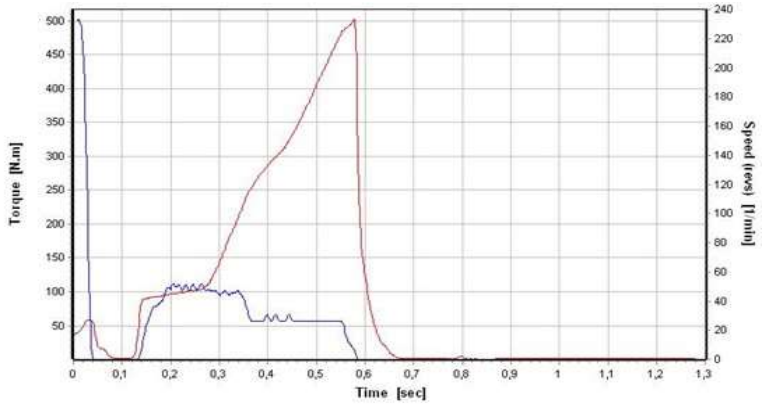
Machine Capability Study 100 %

Model: **4BD-4B500A-4K2D-4ZA**
Serial no: **1016284**

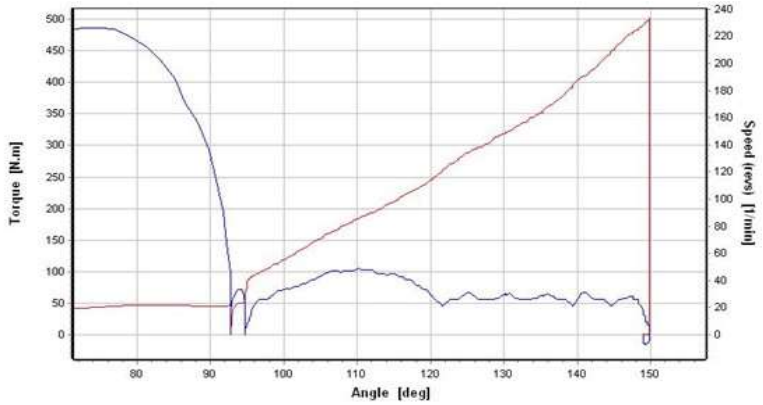
Angle degree: **30°**
Test torque: **500,0 Nm**



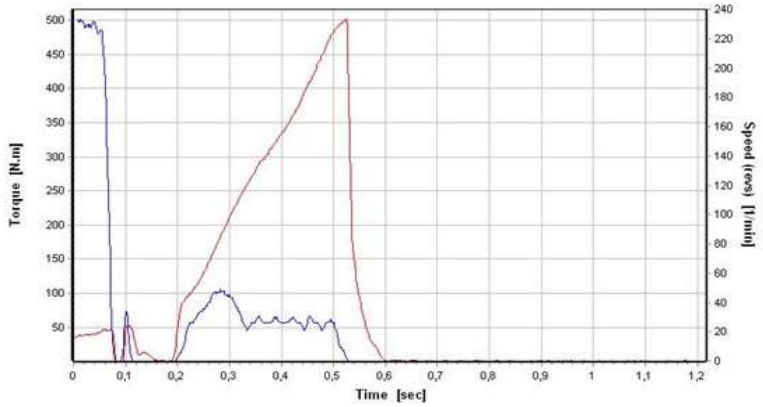
Value no. 1
Graph
Torque / Angle / Speed



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

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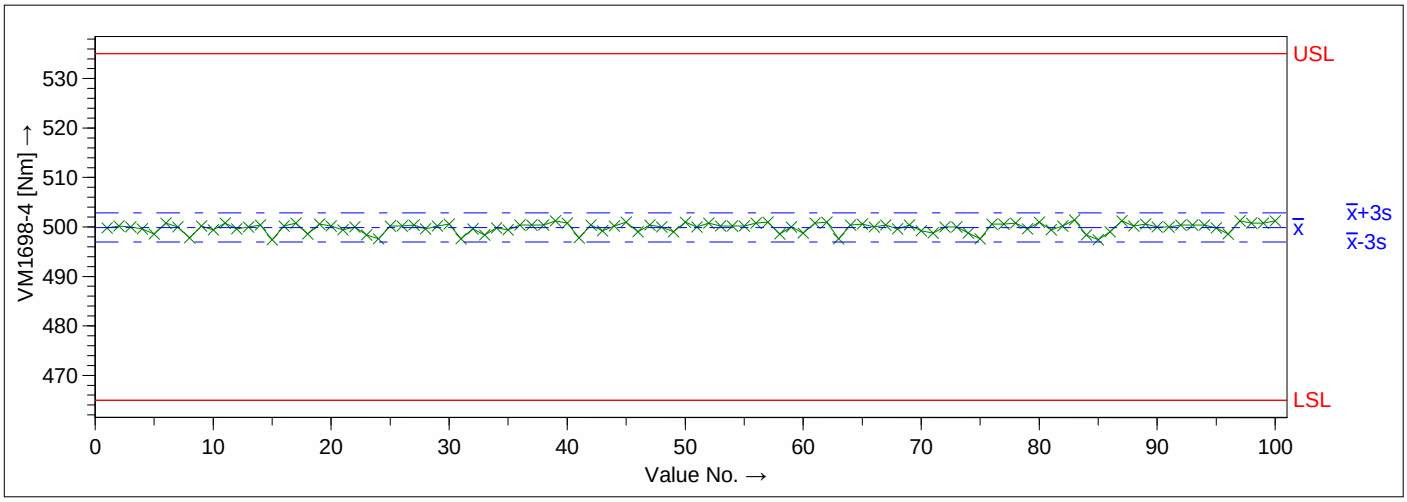
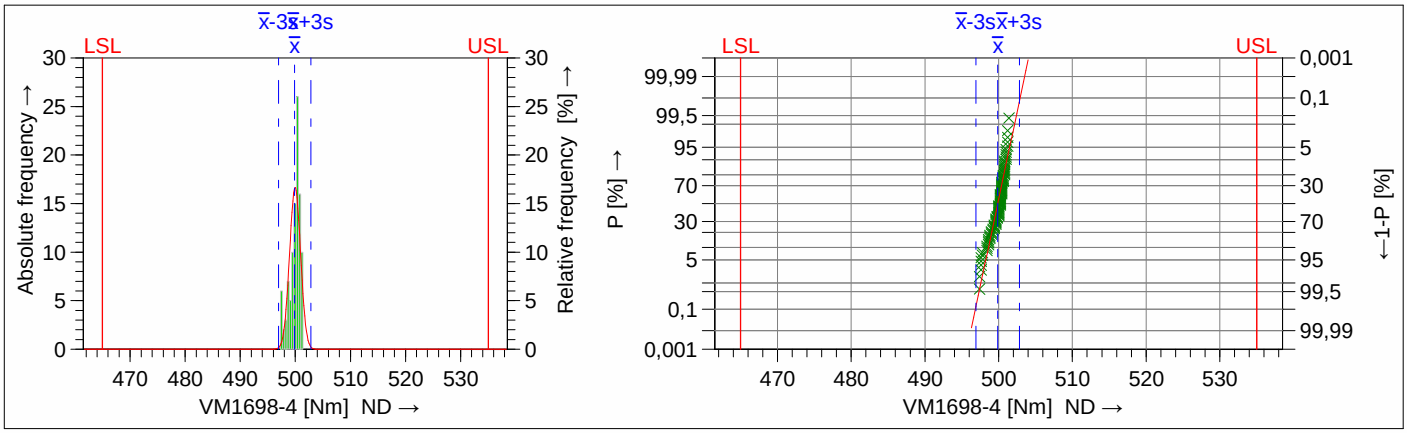
Plant	ATG Westhausen	Operator Name	Sünder
Date	06.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016284_a	Char.Descr.	VM1698-4	Nom.val.	500,00 35,00
		Serial No.	1024210	Unit	Nm -35,00
				USL	535,00
				LSL	465,00
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	1000 / 1030939	nges.	100

Evaluation from 06.05.2022 14:28:33 to 06.05.2022 17:57:49

Rem. TQ 100% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.379 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	500.00			$\bar{x}$	499.8740
LSL	465.00	x_{min}	497.40	$\bar{x}$-3s	496.9326
USL	535.00	x_{max}	501.40	$\bar{x}$+3s	502.8154
T	70.00	R	4.00	6s	5.8829
		$n_{<T>}$	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	11.90
Critical capability index	=	C_{mk}	11.86

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 06.05.2022

Serial No.	1016284_a	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	500,00
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	465,00
				USL	535,00
Remark	TQ 100% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.379 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
1024210	VM1698-4	Nm	499,80	500,20	500,00	499,60	498,60	500,80	500,00	497,80	500,20	499,40
1024210	VM1698-4	Grad	359,00	363,50	358,75	365,75	360,75	355,00	365,75	349,50	360,75	334,25

Char.No.	Char.Descr.	Unit	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
1024210	VM1698-4	Nm	500,80	499,60	500,00	500,40	497,40	500,20	500,80	498,60	500,60	500,20
1024210	VM1698-4	Grad	351,00	346,25	355,50	356,25	355,75	362,75	349,75	347,00	349,00	327,25

Char.No.	Char.Descr.	Unit	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
1024210	VM1698-4	Nm	499,40	500,00	498,40	497,60	500,20	500,20	500,40	499,60	500,20	500,60
1024210	VM1698-4	Grad	344,50	346,50	345,25	349,25	347,50	354,00	353,25	360,25	339,25	363,00

Char.No.	Char.Descr.	Unit	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
1024210	VM1698-4	Nm	497,60	499,60	498,40	499,80	499,40	500,40	500,40	500,40	501,20	500,80
1024210	VM1698-4	Grad	361,25	358,25	350,25	360,50	366,25	358,25	381,00	359,00	349,00	356,00

Char.No.	Char.Descr.	Unit	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
1024210	VM1698-4	Nm	497,80	500,40	499,20	500,20	501,00	499,00	500,40	500,00	499,00	501,00
1024210	VM1698-4	Grad	357,50	387,00	348,25	347,25	368,75	361,00	358,50	336,00	342,00	361,25

Char.No.	Char.Descr.	Unit	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
1024210	VM1698-4	Nm	500,00	500,80	500,20	500,20	500,20	500,80	501,00	498,60	500,00	498,80
1024210	VM1698-4	Grad	355,25	352,00	361,75	346,75	359,75	358,75	369,75	357,25	359,75	354,00

Char.No.	Char.Descr.	Unit	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
1024210	VM1698-4	Nm	500,80	501,00	497,60	500,40	500,60	500,00	500,40	499,60	500,40	499,20
1024210	VM1698-4	Grad	350,75	362,75	350,50	357,00	391,25	342,25	359,50	352,50	366,50	356,50

Char.No.	Char.Descr.	Unit	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
1024210	VM1698-4	Nm	498,80	500,00	500,00	498,80	497,60	500,60	500,60	500,80	499,60	501,00
1024210	VM1698-4	Grad	360,25	353,75	365,00	350,00	339,50	345,75	357,25	365,75	363,75	357,75

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 06.05.2022

Serial No.	1016284_a	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	500,00
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	465,00
				USL	535,00
Remark	TQ 100% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.379 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
1024210	VM1698-4	Nm	499,40	500,20	501,40	498,40	497,40	499,00	501,20	500,20	500,60	500,00
1024210	VM1698-4	Grad	370,50	352,50	327,00	358,50	347,25	350,50	359,25	347,75	352,50	386,50

Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
1024210	VM1698-4	Nm	500,00	500,40	500,40	500,40	499,80	498,60	501,20	500,80	500,80	501,20
1024210	VM1698-4	Grad	366,00	352,50	411,50	366,00	335,50	354,00	369,25	380,25	361,50	364,25

Machine Capability Study
Tool System

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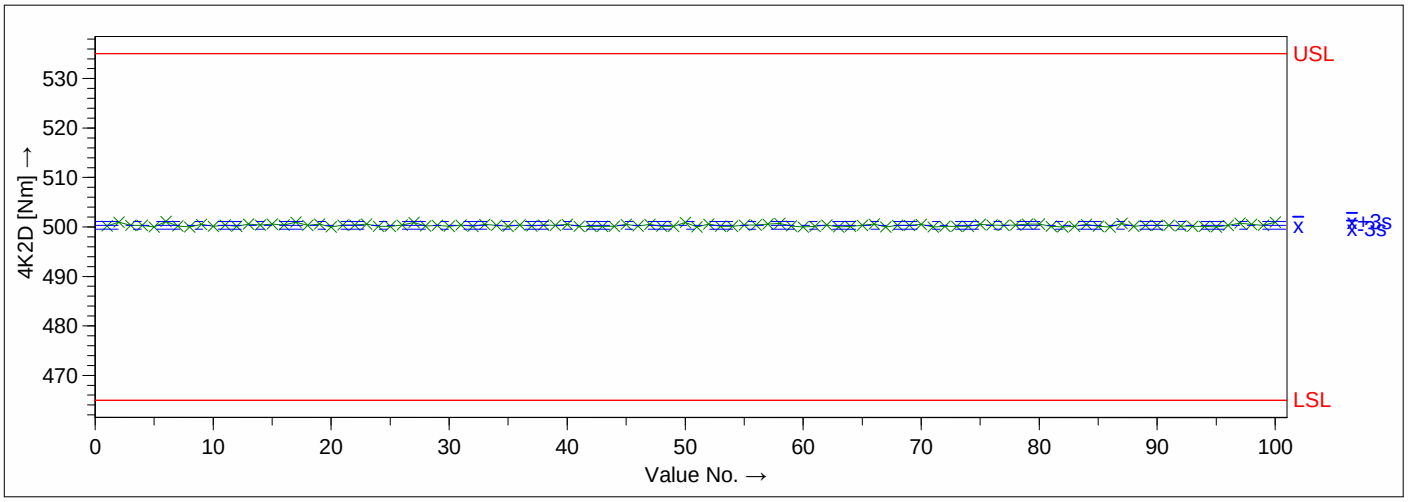
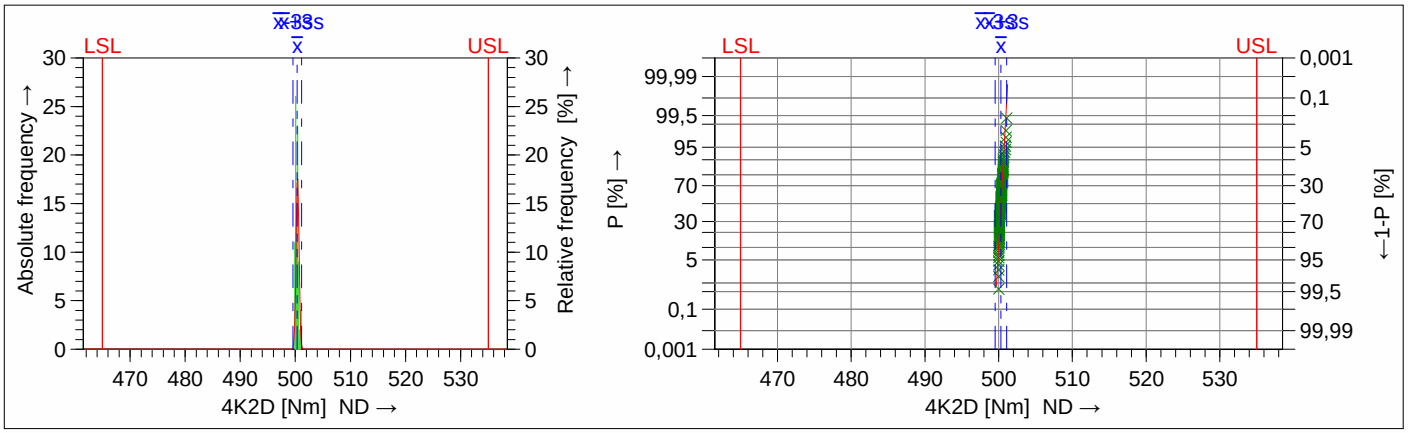
Plant	ATG Westhausen	Operator Name	Sünder
Date	06.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016284_a	Char.Descr.	4K2D	Nom.val.	500,00 35,00
		Serial No.	204574	Unit	Nm -35,00
				USL	535,00
				LSL	465,00
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	1000 / 1030939	nges.	100

Evaluation from 06.05.2022 14:28:34 to 06.05.2022 17:57:49

Rem. TQ 100% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.379 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	500.00			$\bar{x}$	500.3210
LSL	465.00	x_{min}	500.00	$\bar{x}$-3s	499.5367
USL	535.00	x_{max}	501.10	$\bar{x}$+3s	501.1053
T	70.00	R	1.10	6s	1.5685
		$n_{<T>}$	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	44.63
Critical capability index	=	C_{mk}	44.22

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 06.05.2022

Serial No.	1016284_a	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	500,00
Ord. No.	4BD500T1S-A	Serial No.	204574	LSL	465,00
				USL	535,00
Remark	TQ 100% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.379 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
204574	4K2D	Nm	500,20	501,00	500,30	500,30	500,00	501,10	500,20	500,00	500,50	500,10
204574	4K2D	Grad	361,00	365,00	360,00	370,00	362,00	358,00	367,00	353,00	362,00	335,00

Char.No.	Char.Descr.	Unit	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
204574	4K2D	Nm	500,40	500,10	500,60	500,40	500,60	500,40	501,00	500,30	500,60	500,00
204574	4K2D	Grad	352,00	347,00	357,00	357,00	360,00	364,00	351,00	349,00	350,00	328,00

Char.No.	Char.Descr.	Unit	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204574	4K2D	Nm	500,40	500,40	500,60	500,10	500,10	500,40	500,90	500,20	500,30	500,10
204574	4K2D	Grad	346,00	348,00	347,00	352,00	348,00	355,00	354,00	362,00	341,00	364,00

Char.No.	Char.Descr.	Unit	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
204574	4K2D	Nm	500,40	500,10	500,50	500,30	500,10	500,40	500,20	500,40	500,30	500,50
204574	4K2D	Grad	369,00	358,00	352,00	362,00	368,00	360,00	381,00	360,00	352,00	357,00

Char.No.	Char.Descr.	Unit	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204574	4K2D	Nm	500,10	500,10	500,10	500,10	500,50	500,20	500,50	500,10	500,10	500,90
204574	4K2D	Grad	360,00	387,00	350,00	349,00	369,00	363,00	360,00	341,00	343,00	362,00

Char.No.	Char.Descr.	Unit	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
204574	4K2D	Nm	500,00	500,60	500,10	500,10	500,40	500,40	500,60	500,70	500,20	500,00
204574	4K2D	Grad	356,00	353,00	363,00	347,00	361,00	359,00	370,00	359,00	360,00	358,00

Char.No.	Char.Descr.	Unit	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
204574	4K2D	Nm	500,10	500,40	500,00	500,10	500,30	500,60	500,00	500,30	500,30	500,50
204574	4K2D	Grad	351,00	364,00	354,00	358,00	392,00	343,00	360,00	354,00	367,00	358,00

Char.No.	Char.Descr.	Unit	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
204574	4K2D	Nm	500,00	500,10	500,10	500,10	500,50	500,40	500,30	500,40	500,60	500,60
204574	4K2D	Grad	364,00	354,00	366,00	353,00	344,00	347,00	357,00	366,00	366,00	359,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 06.05.2022

Serial No.	1016284_a	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	500,00
Ord. No.	4BD500T1S-A	Serial No.	204574	LSL	465,00
				USL	535,00
Remark	TQ 100% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.379 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
204574	4K2D	Nm	500,10	500,00	500,10	500,50	500,10	500,00	500,70	500,10	500,30	500,30
204574	4K2D	Grad	372,00	354,00	325,00	360,00	349,00	357,00	360,00	349,00	354,00	390,00

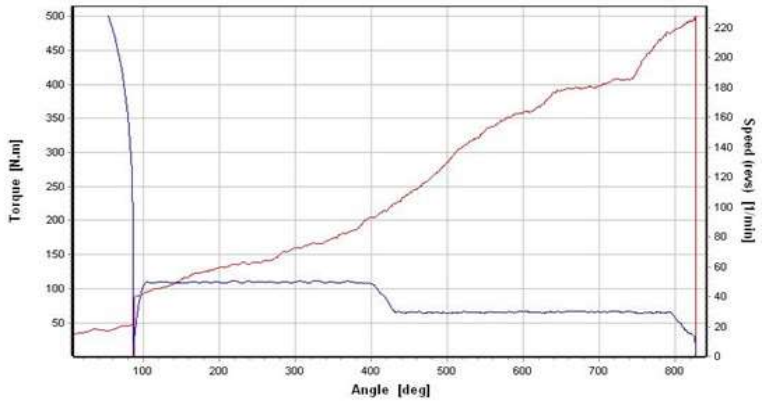
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204574	4K2D	Nm	500,30	500,20	500,10	500,10	500,00	500,30	500,80	500,50	500,30	501,00
204574	4K2D	Grad	369,00	354,00	398,00	367,00	336,00	356,00	370,00	382,00	363,00	366,00

Torque graphs

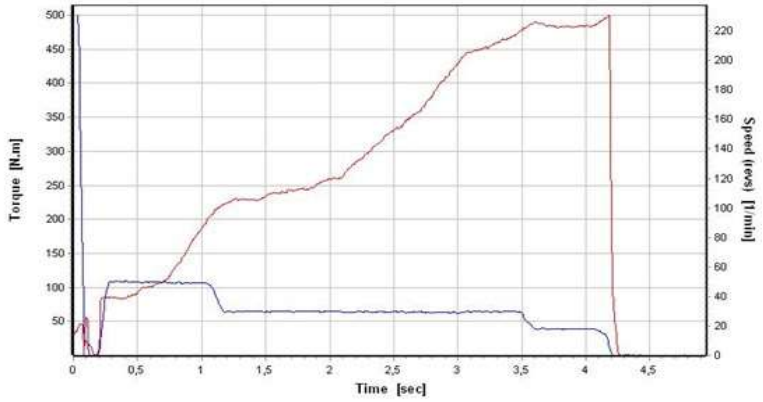
Machine Capability Study 100 %

Model: **4BD-4B500A-4K2D-4ZA**
Serial no: **1016284**

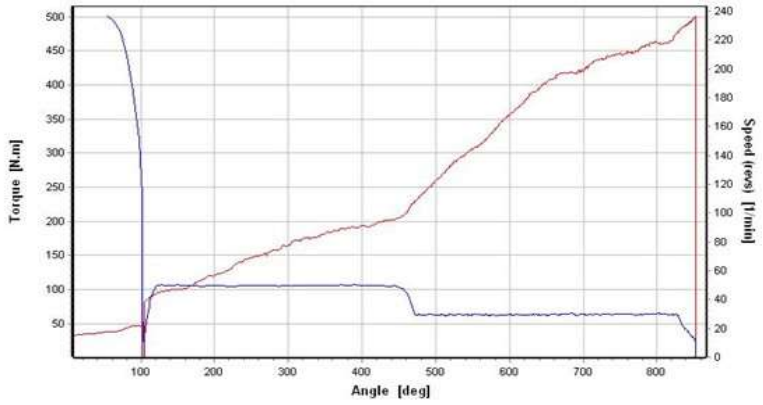
Angle degree: **360°**
Test torque: **500,0 Nm**



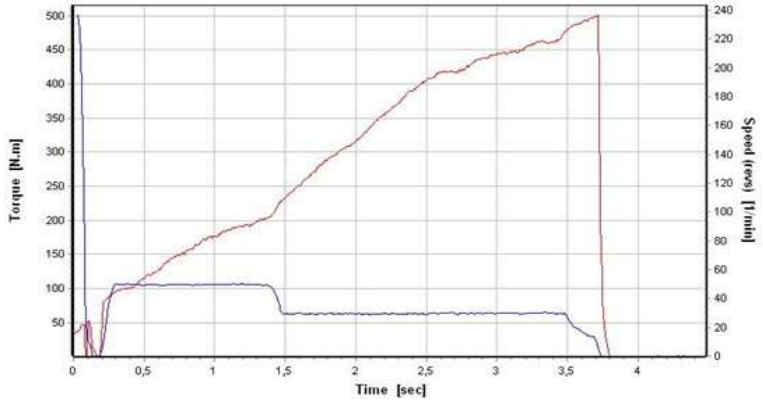
Value no. 1
Graph
Torque / Angle / Speed



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: 4BD-4B500A-4K2D-4ZA **Serial no:** 1016284

Torque range: **50 Nm to 500 Nm**

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

Capability examination

Snugfit value: 100 Nm **Torque tolerance ±** 7 %

Target torque: 300 Nm Tolerance: 1,45 % ± **0,73 %**

Angle degree: 40° Tolerance: 6,0° ± **3,0°**

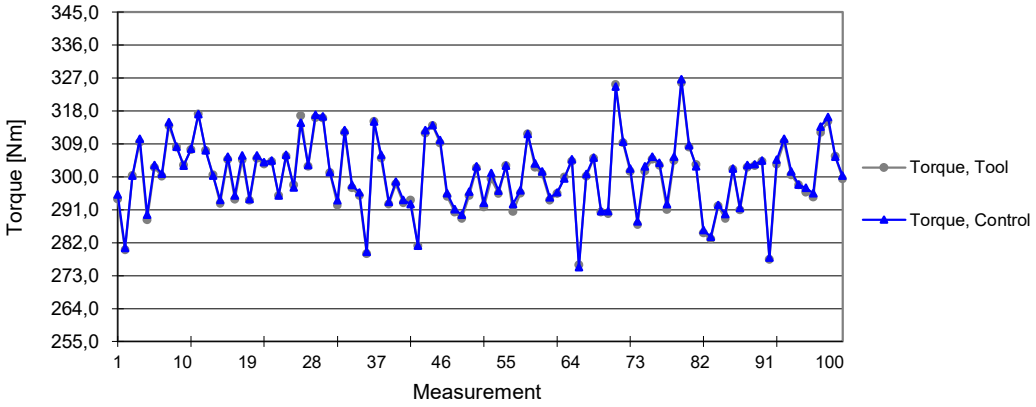
Formula derivation: $C_m = \frac{T}{6\,s}$ $T = C_m * 6\,s$

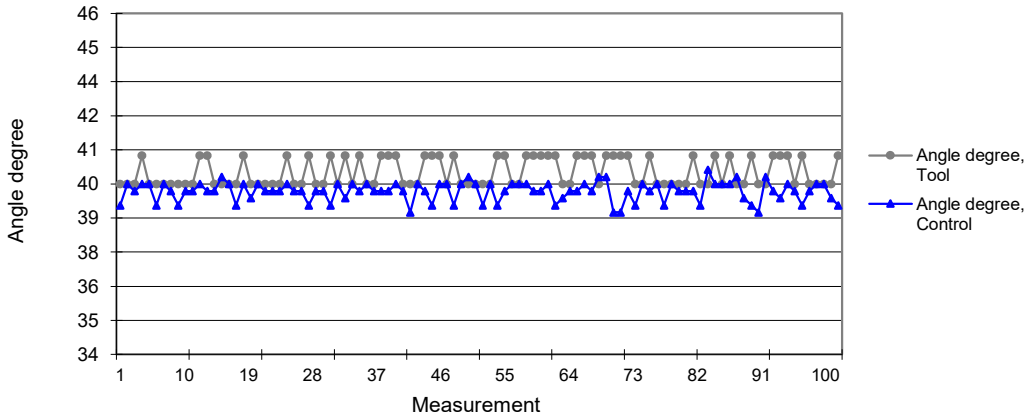
Tool without angle correction

Measurement	Tool data		Control data		Difference	
No.	Torque	Angle	Torque	Angle	Torque	Angle
1	293,90	40,00	295,10	39,25	1,20	0,75
2	280,00	40,00	280,50	40,00	0,50	0,00
3	300,30	40,00	300,30	39,75	0,00	0,25
4	309,40	41,00	310,40	40,00	1,00	1,00
5	288,20	40,00	289,60	40,00	1,40	0,00
6	302,50	40,00	303,20	39,25	0,70	0,75
7	300,10	40,00	300,80	40,00	0,70	0,00
8	313,90	40,00	314,90	39,75	1,00	0,25
9	308,10	40,00	308,20	39,25	0,10	0,75
10	303,20	40,00	303,00	39,75	0,20	0,25
11	307,40	40,00	307,60	39,75	0,20	0,25
12	317,10	41,00	317,10	40,00	0,00	1,00
13	307,20	41,00	307,20	39,75	0,00	1,25
14	300,50	40,00	300,30	39,75	0,20	0,25
15	292,70	40,00	293,70	40,25	1,00	0,25
16	304,70	40,00	305,40	40,00	0,70	0,00
17	293,80	40,00	294,90	39,25	1,10	0,75
18	304,60	41,00	305,80	40,00	1,20	1,00
19	293,50	40,00	293,90	39,50	0,40	0,50
20	305,00	40,00	305,80	40,00	0,80	0,00
21	303,50	40,00	304,00	39,75	0,50	0,25
22	304,10	40,00	304,40	39,75	0,30	0,25
23	294,80	40,00	294,90	39,75	0,10	0,25
24	305,60	41,00	306,00	40,00	0,40	1,00
25	297,70	40,00	297,10	39,75	0,60	0,25
26	316,70	40,00	314,70	39,75	2,00	0,25
27	302,80	41,00	303,20	39,25	0,40	1,75
28	316,10	40,00	316,90	39,75	0,80	0,25
29	316,00	40,00	316,50	39,75	0,50	0,25
30	301,10	41,00	301,20	39,25	0,10	1,75
31	292,20	40,00	293,50	40,00	1,30	0,00
32	312,10	41,00	312,70	39,50	0,60	1,50
33	296,90	40,00	297,70	40,00	0,80	0,00
34	294,80	41,00	295,70	39,75	0,90	1,25
35	278,90	40,00	279,50	40,00	0,60	0,00
36	315,10	40,00	315,10	39,75	0,00	0,25
37	305,10	41,00	306,00	39,75	0,90	1,25
38	292,50	41,00	293,10	39,75	0,60	1,25
39	298,00	41,00	298,70	40,00	0,70	1,00
40	292,90	40,00	293,70	39,75	0,80	0,25
41	293,60	40,00	292,50	39,00	1,10	1,00
42	281,10	40,00	281,10	40,00	0,00	0,00
43	311,90	41,00	312,70	39,75	0,80	1,25
44	314,00	41,00	314,10	39,25	0,10	1,75
45	309,20	41,00	310,00	40,00	0,80	1,00
46	294,60	40,00	295,50	40,00	0,90	0,00
47	290,30	41,00	291,10	39,25	0,80	1,75
48	288,60	40,00	289,60	40,00	1,00	0,00
49	294,80	40,00	295,90	40,25	1,10	0,25
50	302,40	40,00	302,80	40,00	0,40	0,00
51	291,70	40,00	292,90	39,25	1,20	0,75
52	299,40	40,00	301,00	40,00	1,60	0,00
53	295,40	41,00	296,10	39,25	0,70	1,75
54	303,00	41,00	303,00	39,75	0,00	1,25
55	290,50	40,00	292,50	40,00	2,00	0,00
56	295,50	40,00	296,30	40,00	0,80	0,00
57	311,70	41,00	311,70	40,00	0,00	1,00
58	302,50	41,00	303,60	39,75	1,10	1,25
59	300,70	41,00	301,40	39,75	0,70	1,25
60	293,60	41,00	294,30	40,00	0,70	1,00
61	295,40	41,00	295,70	39,25	0,30	1,75
62	299,90	40,00	299,50	39,50	0,40	0,50
63	304,20	40,00	304,80	39,75	0,60	0,25
64	275,90	41,00	275,30	39,75	0,60	1,25
65	300,10	41,00	300,70	40,00	0,60	1,00
66	305,00	41,00	305,20	39,75	0,20	1,25
67	290,30	40,00	290,60	40,25	0,30	0,25
68	289,90	41,00	290,60	40,25	0,70	0,75
69	325,20	41,00	324,60	39,00	0,60	2,00
70	309,30	41,00	309,60	39,00	0,30	2,00
71	301,40	41,00	302,20	39,75	0,80	1,25
72	286,90	40,00	287,80	39,25	0,90	0,75
73	301,50	40,00	302,80	40,00	1,30	0,00
74	304,80	41,00	305,40	39,75	0,60	1,25
75	303,10	40,00	303,80	40,00	0,70	0,00
76	291,00	40,00	292,50	39,25	1,50	0,75
77	304,40	40,00	305,40	40,00	1,00	0,00
78	325,70	40,00	326,60	39,75	0,90	0,25
79	308,10	40,00	308,60	39,75	0,50	0,25
80	303,30	41,00	302,80	39,75	0,50	1,25
81	284,60	40,00	285,40	39,25	0,80	0,75
82	283,00	40,00	283,60	40,50	0,60	0,50
83	292,00	41,00	292,30	40,00	0,30	1,00
84	288,60	40,00	289,80	40,00	1,20	0,00
85	302,00	41,00	302,20	40,00	0,20	1,00
86	290,90	40,00	291,50	40,25	0,60	0,25
87	302,60	40,00	303,20	39,50	0,60	0,50
88	303,00	41,00	303,40	39,25	0,40	1,75
89	304,20	40,00	304,40	39,00	0,20	1,00
90	277,40	40,00	277,90	40,25	0,50	0,25
91	303,40	41,00	304,60	39,75	1,20	1,25
92	309,50	41,00	310,40	39,50	0,90	1,50
93	300,50	41,00	301,40	40,00	0,90	1,00
94	297,70	40,00	297,90	39,75	0,20	0,25
95	295,80	41,00	296,90	39,25	1,10	1,75
96	294,40	40,00	295,50	39,75	1,10	0,25
97	312,10	40,00	313,70	40,00	1,60	0,00
98	315,10	40,00	316,30	40,00	1,20	0,00
99	305,60	40,00	305,40	39,50	0,20	0,50
100	299,40	41,00	300,30	39,25	0,90	1,75
				Standard deviation:	**0,435**	**0,598**

Graphical representation

Model:	**4BD-4B500A-4K2D-4ZA**	Serial no:	**1016284**
Target torque:	**300,00 Nm**	60 % of max. torque	
Angle degree:	**40°**	Tool without angle correction	





Machine Capability Study
Control System

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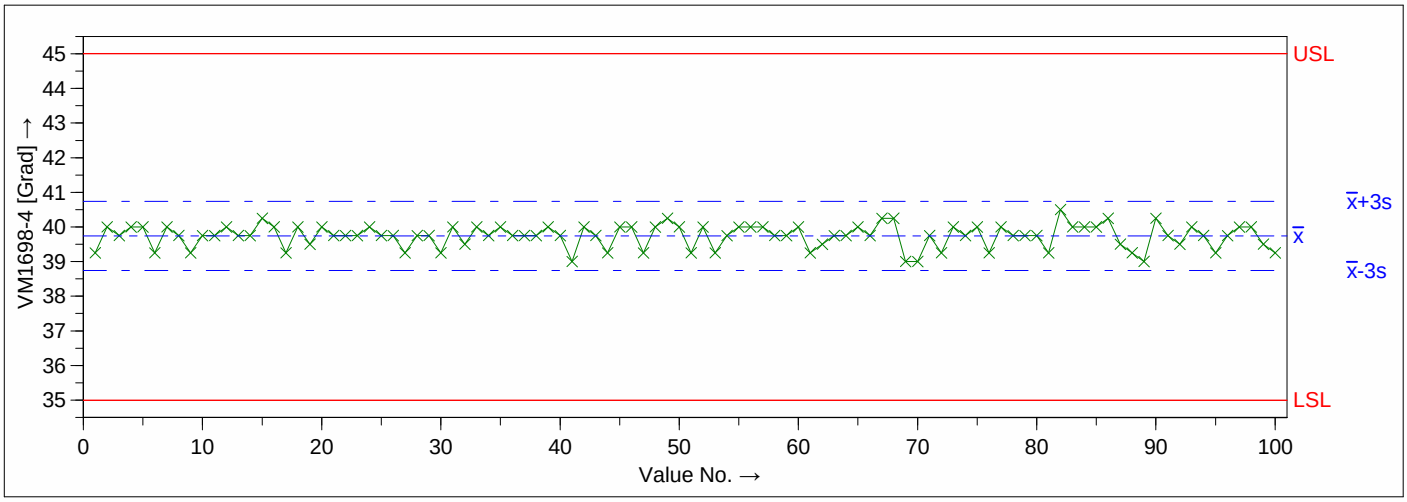
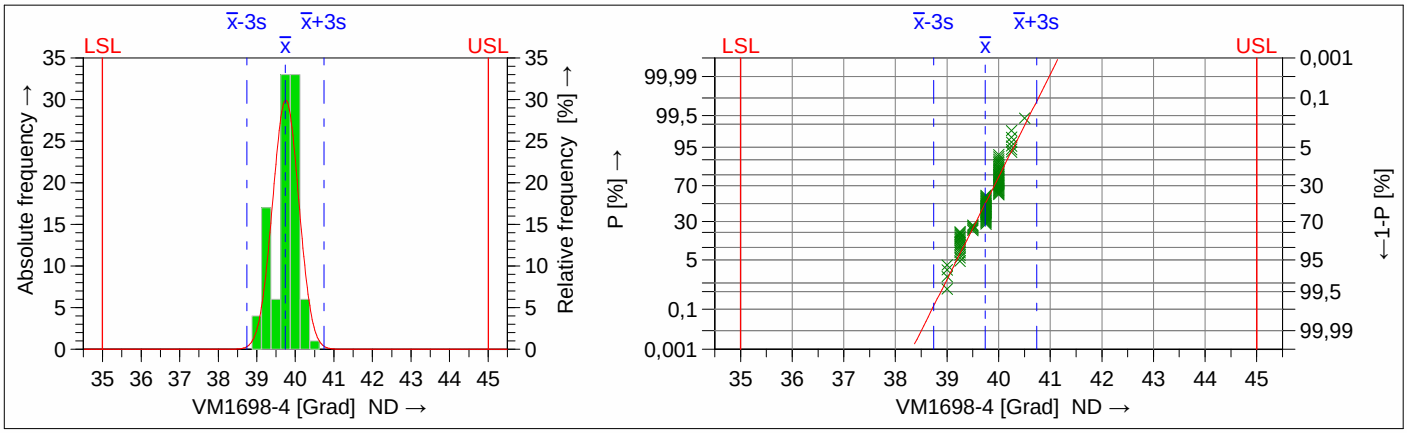
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016284_k	Char.Descr.	VM1698-4	Nom.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	1000 / 1030939	nges.	100

Evaluation from 09.05.2022 11:39:23 to 09.05.2022 11:52:23

Rem. TQ 60% Angle 40° +/-5° * TQ-Cal.: 500 Nm; Cur-Cal.: 9.723 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	40.00			$\bar{x}$	39.7400
LSL	35.00	x_{min}	39.00	$\bar{x}$-3s	38.7405
USL	45.00	x_{max}	40.50	$\bar{x}$+3s	40.7395
T	10.00	R	1.50	6s	1.9991
		$n_{<T>}$	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	5.00
Critical capability index	=	C_{mk}	4.74

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

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_k	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	302,95
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	220,24
				USL	396,72
Remark	TQ 60% Angle 40°+/-5°* TQ-Cal.: 500 Nm; Cur -Cal.: 9.723 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
1024210	VM1698-4	Nm	295,10	280,50	300,30	310,40	289,60	303,20	300,80	314,90	308,20	303,00
1024210	VM1698-4	Grad	39,25	40,00	39,75	40,00	40,00	39,25	40,00	39,75	39,25	39,75

Char.No.	Char.Descr.	Unit	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
1024210	VM1698-4	Nm	307,60	317,10	307,20	300,30	293,70	305,40	294,90	305,80	293,90	305,80
1024210	VM1698-4	Grad	39,75	40,00	39,75	39,75	40,25	40,00	39,25	40,00	39,50	40,00

Char.No.	Char.Descr.	Unit	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
1024210	VM1698-4	Nm	304,00	304,40	294,90	306,00	297,10	314,70	303,20	316,90	316,50	301,20
1024210	VM1698-4	Grad	39,75	39,75	39,75	40,00	39,75	39,75	39,25	39,75	39,75	39,25

Char.No.	Char.Descr.	Unit	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
1024210	VM1698-4	Nm	293,50	312,70	297,70	295,70	279,50	315,10	306,00	293,10	298,70	293,70
1024210	VM1698-4	Grad	40,00	39,50	40,00	39,75	40,00	39,75	39,75	39,75	40,00	39,75

Char.No.	Char.Descr.	Unit	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
1024210	VM1698-4	Nm	292,50	281,10	312,70	314,10	310,00	295,50	291,10	289,60	295,90	302,80
1024210	VM1698-4	Grad	39,00	40,00	39,75	39,25	40,00	40,00	39,25	40,00	40,25	40,00

Char.No.	Char.Descr.	Unit	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
1024210	VM1698-4	Nm	292,90	301,00	296,10	303,00	292,50	296,30	311,70	303,60	301,40	294,30
1024210	VM1698-4	Grad	39,25	40,00	39,25	39,75	40,00	40,00	40,00	39,75	39,75	40,00

Char.No.	Char.Descr.	Unit	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
1024210	VM1698-4	Nm	295,70	299,50	304,80	275,30	300,70	305,20	290,60	290,60	324,60	309,60
1024210	VM1698-4	Grad	39,25	39,50	39,75	39,75	40,00	39,75	40,25	40,25	39,00	39,00

Char.No.	Char.Descr.	Unit	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
1024210	VM1698-4	Nm	302,20	287,80	302,80	305,40	303,80	292,50	305,40	326,60	308,60	302,80
1024210	VM1698-4	Grad	39,75	39,25	40,00	39,75	40,00	39,25	40,00	39,75	39,75	39,75

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_k	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	302,95
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	220,24
				USL	396,72
Remark	TQ 60% Angle 40°+/-5°* TQ-Cal.: 500 Nm; Cur -Cal.: 9.723 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
1024210	VM1698-4	Nm	285,40	283,60	292,30	289,80	302,20	291,50	303,20	303,40	304,40	277,90
1024210	VM1698-4	Grad	39,25	40,50	40,00	40,00	40,00	40,25	39,50	39,25	39,00	40,25

Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
1024210	VM1698-4	Nm	304,60	310,40	301,40	297,90	296,90	295,50	313,70	316,30	305,40	300,30
1024210	VM1698-4	Grad	39,75	39,50	40,00	39,75	39,25	39,75	40,00	40,00	39,50	39,25

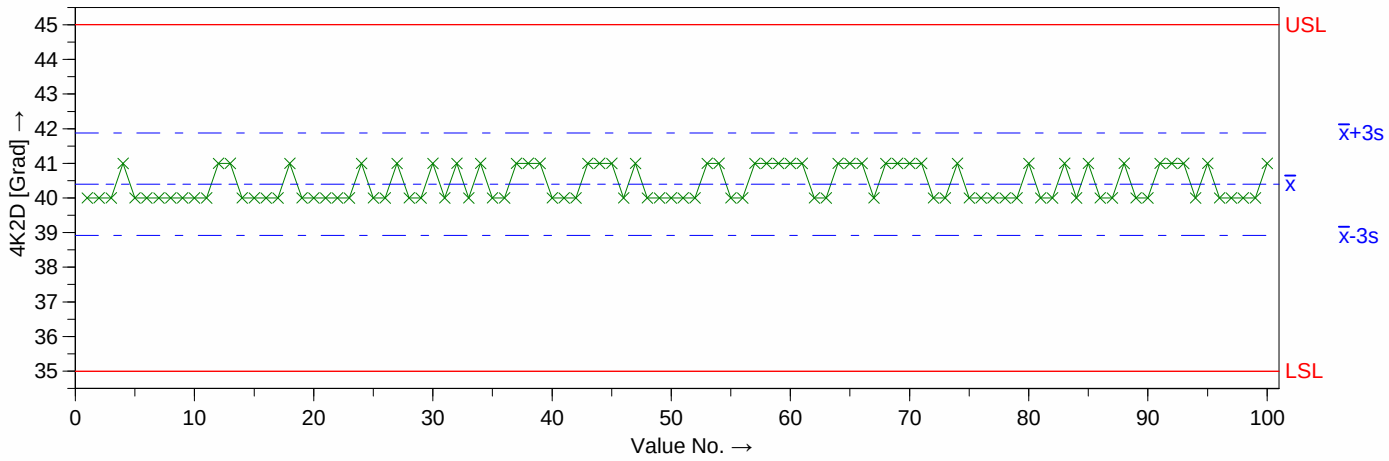
Machine Capability Study
Tool System

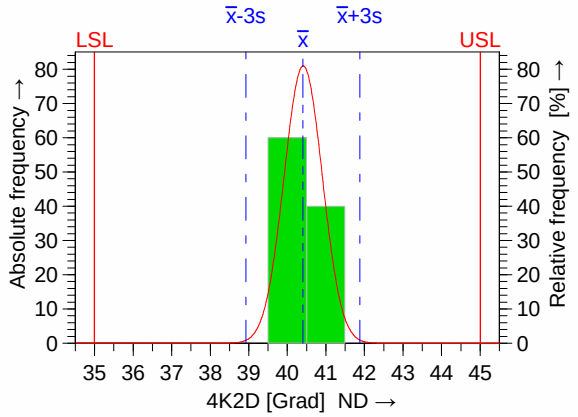
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.05.2022		

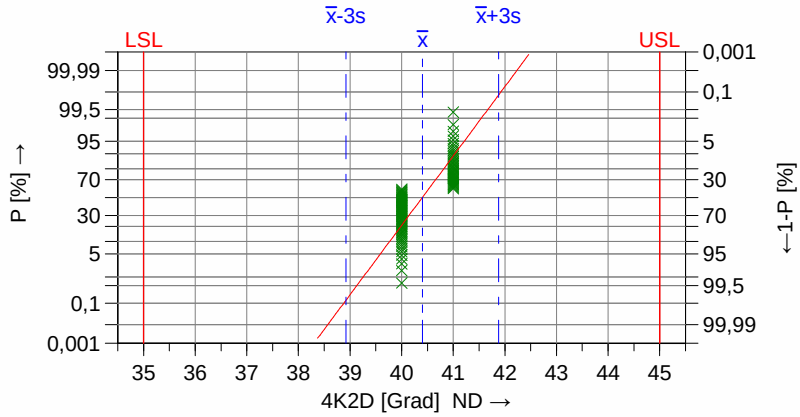
Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA		Contr.item yes
Serial No.	1016284_k	Char.Descr.	4K2D	Nom.val. 40,00	5,00 USL 45,00
		Serial No.	204574	Unit Grad	-5,00 LSL 35,00
Char.Type	variable			Tolerance value 12 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	1000 / 1030939	nges.	100

Evaluation from 09.05.2022 11:39:23 to 09.05.2022 11:52:23

Rem. TQ 60% Angle 40° +/-5° * TQ-Cal.: 500 Nm; Cur-Cal.: 9.723 Nm/A; Speed: 269/50 rpm;







Drawing Values		Collected Values		Statistics	
T_m	40.00			$\bar{x}$	40.4000
LSL	35.00	x_{min}	40.00	$\bar{x}$-3s	38.9229
USL	45.00	x_{max}	41.00	$\bar{x}$+3s	41.8771
T	10.00	R	1.00	6s	2.9542
		$n_{<T>}$	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	3.39
Critical capability index	=	C_{mk}	3.11

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

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

Serial No.	1016284_k	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	165,30
Ord. No.	4BD500T1S-A	Serial No.	204574	LSL	0,00
				USL	396,72
Remark	TQ 60% Angle 40°+/-5°* TQ-Cal.: 500 Nm; Cur -Cal.: 9.723 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
204574	4K2D	Nm	293,90	280,00	300,30	309,40	288,20	302,50	300,10	313,90	308,10	303,20
204574	4K2D	Grad	40,00	40,00	40,00	41,00	40,00	40,00	40,00	40,00	40,00	40,00

Char.No.	Char.Descr.	Unit	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
204574	4K2D	Nm	307,40	317,10	307,20	300,50	292,70	304,70	293,80	304,60	293,50	305,00
204574	4K2D	Grad	40,00	41,00	41,00	40,00	40,00	40,00	40,00	41,00	40,00	40,00

Char.No.	Char.Descr.	Unit	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204574	4K2D	Nm	303,50	304,10	294,80	305,60	297,70	316,70	302,80	316,10	316,00	301,10
204574	4K2D	Grad	40,00	40,00	40,00	41,00	40,00	40,00	41,00	40,00	40,00	41,00

Char.No.	Char.Descr.	Unit	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
204574	4K2D	Nm	292,20	312,10	296,90	294,80	278,90	315,10	305,10	292,50	298,00	292,90
204574	4K2D	Grad	40,00	41,00	40,00	41,00	40,00	40,00	41,00	41,00	41,00	40,00

Char.No.	Char.Descr.	Unit	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204574	4K2D	Nm	293,60	281,10	311,90	314,00	309,20	294,60	290,30	288,60	294,80	302,40
204574	4K2D	Grad	40,00	40,00	41,00	41,00	41,00	40,00	41,00	40,00	40,00	40,00

Char.No.	Char.Descr.	Unit	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
204574	4K2D	Nm	291,70	299,40	295,40	303,00	290,50	295,50	311,70	302,50	300,70	293,60
204574	4K2D	Grad	40,00	40,00	41,00	41,00	40,00	40,00	41,00	41,00	41,00	41,00

Char.No.	Char.Descr.	Unit	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
204574	4K2D	Nm	295,40	299,90	304,20	275,90	300,10	305,00	290,30	289,90	325,20	309,30
204574	4K2D	Grad	41,00	40,00	40,00	41,00	41,00	41,00	40,00	41,00	41,00	41,00

Char.No.	Char.Descr.	Unit	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
204574	4K2D	Nm	301,40	286,90	301,50	304,80	303,10	291,00	304,40	325,70	308,10	303,30
204574	4K2D	Grad	41,00	40,00	40,00	41,00	40,00	40,00	40,00	40,00	40,00	41,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.05.2022

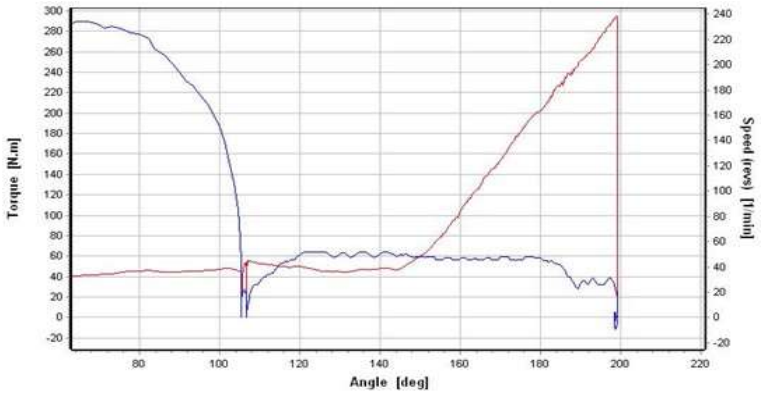
Serial No.	1016284_k	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	165,30
Ord. No.	4BD500T1S-A	Serial No.	204574	LSL	0,00
				USL	396,72
Remark	TQ 60% Angle 40°+/-5°* TQ-Cal.: 500 Nm; Cur -Cal.: 9.723 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
204574	4K2D	Nm	284,60	283,00	292,00	288,60	302,00	290,90	302,60	303,00	304,20	277,40
204574	4K2D	Grad	40,00	40,00	41,00	40,00	41,00	40,00	40,00	41,00	40,00	40,00

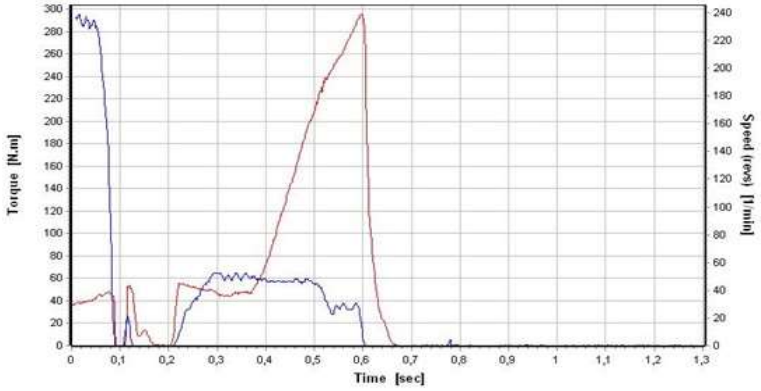
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204574	4K2D	Nm	303,40	309,50	300,50	297,70	295,80	294,40	312,10	315,10	305,60	299,40
204574	4K2D	Grad	41,00	41,00	41,00	40,00	41,00	40,00	40,00	40,00	40,00	41,00

Torque graphs

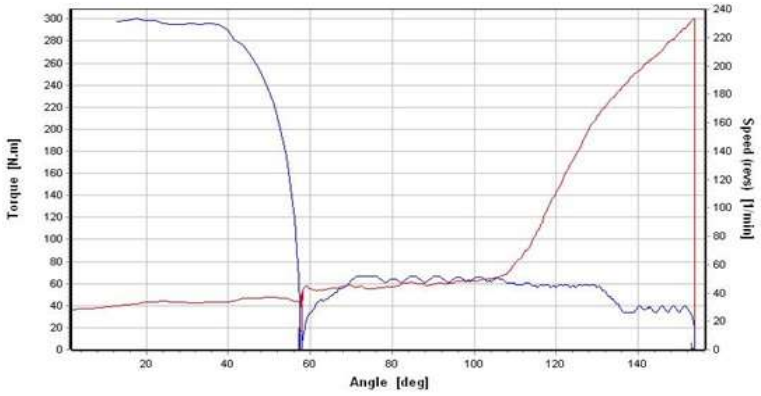
Model:	**4BD-4B500A-4K2D-4ZA**	Serial no:	**1016284**
Target torque:	**300,00 Nm**	60 % of max. torque	
Angle degree:	**40°**	Tool without angle correction	



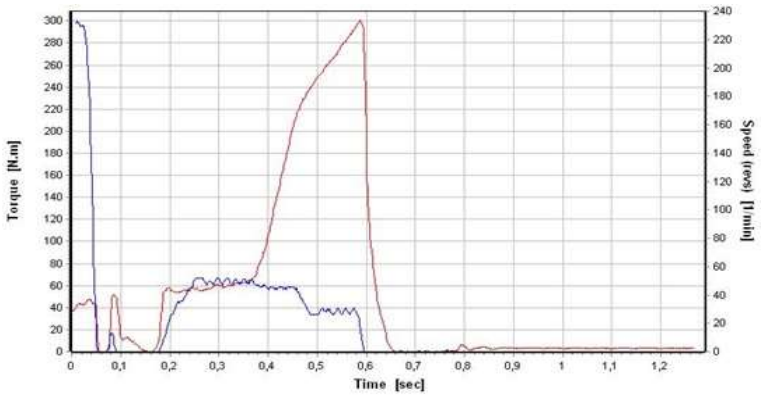
Value no. 1
Graph
Torque / Angle / Speed



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: 4BD-4B500A-4K2D-4ZA **Serial no:** 1016284

Torque range: **50 Nm to 500 Nm**

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

Capability examination

Snugfit value: 100 Nm **Torque tolerance ±** 7 %

Target torque: 400 Nm Tolerance: 1,02 % ± **0,51 %**

Angle degree: 180° Tolerance: 5,8° ± **2,9°**

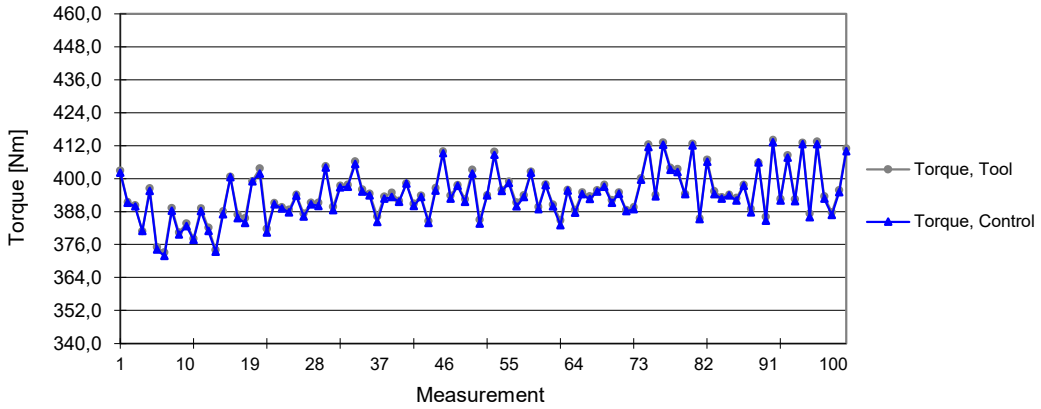
Formula derivation: $C_m = \frac{T}{6\,s}$ $T = C_m * 6\,s$

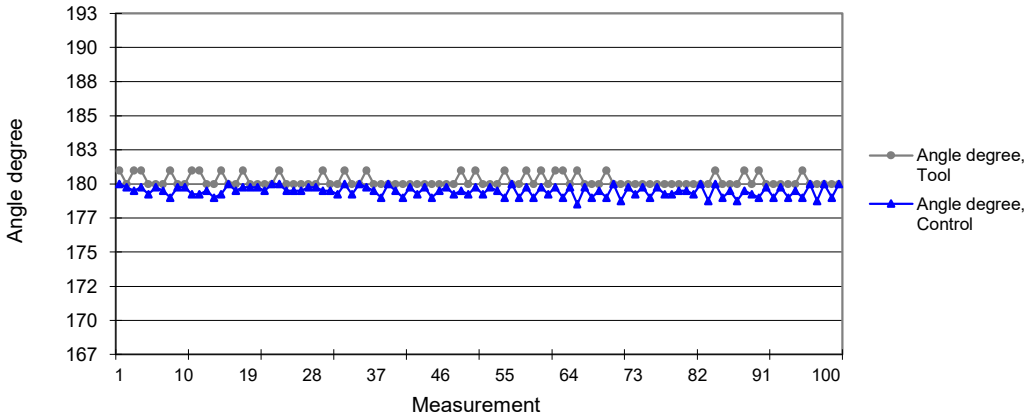
Tool without angle correction

Measurement	Tool data		Control data		Difference	
No.	Torque	Angle	Torque	Angle	Torque	Angle
1	402,90	181,00	402,20	180,00	0,70	1,00
2	391,40	180,00	391,20	179,75	0,20	0,25
3	390,30	181,00	389,90	179,50	0,40	1,50
4	380,90	181,00	381,00	179,75	0,10	1,25
5	396,40	180,00	395,50	179,25	0,90	0,75
6	375,10	180,00	374,20	179,75	0,90	0,25
7	373,10	180,00	371,90	179,50	1,20	0,50
8	389,30	181,00	388,30	179,00	1,00	2,00
9	380,40	180,00	379,60	179,75	0,80	0,25
10	383,70	180,00	382,70	179,75	1,00	0,25
11	378,20	181,00	377,70	179,25	0,50	1,75
12	389,20	181,00	388,10	179,25	1,10	1,75
13	382,10	180,00	381,00	179,50	1,10	0,50
14	374,00	180,00	373,40	179,00	0,60	1,00
15	388,00	181,00	387,00	179,25	1,00	1,75
16	400,70	180,00	400,50	180,00	0,20	0,00
17	386,90	180,00	385,60	179,50	1,30	0,50
18	385,60	181,00	383,90	179,75	1,70	1,25
19	399,10	180,00	399,00	179,75	0,10	0,25
20	403,70	180,00	401,90	179,75	1,80	0,25
21	381,70	180,00	380,40	179,50	1,30	0,50
22	391,10	180,00	390,60	180,00	0,50	0,00
23	389,60	181,00	389,10	180,00	0,50	1,00
24	388,70	180,00	387,70	179,50	1,00	0,50
25	394,10	180,00	393,70	179,50	0,40	0,50
26	387,30	180,00	386,20	179,50	1,10	0,50
27	391,20	180,00	390,60	179,75	0,60	0,25
28	391,20	180,00	390,10	179,75	1,10	0,25
29	404,50	181,00	404,00	179,50	0,50	1,50
30	389,80	180,00	388,50	179,50	1,30	0,50
31	397,40	180,00	396,80	179,25	0,60	0,75
32	397,70	181,00	397,00	180,00	0,70	1,00
33	406,20	180,00	405,30	179,25	0,90	0,75
34	396,10	180,00	395,30	180,00	0,80	0,00
35	394,50	181,00	393,90	179,75	0,60	1,25
36	386,20	180,00	384,30	179,50	1,90	0,50
37	393,40	180,00	392,80	179,00	0,60	1,00
38	394,90	180,00	393,30	180,00	1,60	0,00
39	391,90	180,00	391,60	179,50	0,30	0,50
40	398,30	180,00	398,20	179,00	0,10	1,00
41	390,80	180,00	390,10	179,75	0,70	0,25
42	393,80	180,00	393,30	179,25	0,50	0,75
43	384,50	180,00	383,90	179,75	0,60	0,25
44	396,50	180,00	395,70	179,00	0,80	1,00
45	409,90	180,00	409,20	179,50	0,70	0,50
46	393,80	180,00	392,80	179,75	1,00	0,25
47	397,60	180,00	397,40	179,25	0,20	0,75
48	392,50	181,00	391,60	179,50	0,90	1,50
49	403,20	180,00	401,90	179,25	1,30	0,75
50	385,00	181,00	383,70	179,75	1,30	1,25
51	393,90	180,00	393,90	179,25	0,00	0,75
52	409,80	180,00	408,60	179,75	1,20	0,25
53	395,90	180,00	395,50	179,50	0,40	0,50
54	399,00	181,00	398,40	179,00	0,60	2,00
55	391,30	180,00	389,90	180,00	1,40	0,00
56	393,90	180,00	393,30	179,00	0,60	1,00
57	402,50	181,00	402,20	179,75	0,30	1,25
58	389,70	180,00	388,90	179,00	0,80	1,00
59	397,90	181,00	397,60	179,75	0,30	1,25
60	390,50	180,00	389,90	179,25	0,60	0,75
61	384,80	181,00	383,10	179,75	1,70	1,25
62	395,90	181,00	395,70	179,00	0,20	2,00
63	388,60	180,00	387,50	179,75	1,10	0,25
64	395,00	181,00	394,30	178,50	0,70	2,50
65	393,50	180,00	392,60	179,75	0,90	0,25
66	395,80	180,00	395,30	179,00	0,50	1,00
67	397,70	180,00	397,00	179,50	0,70	0,50
68	392,20	181,00	391,20	179,00	1,00	2,00
69	395,00	180,00	394,50	180,00	0,50	0,00
70	388,60	180,00	388,10	178,75	0,50	1,25
71	389,60	180,00	388,90	179,75	0,70	0,25
72	400,10	180,00	399,50	179,25	0,60	0,75
73	412,40	180,00	411,50	179,75	0,90	0,25
74	394,00	180,00	393,50	179,00	0,50	1,00
75	413,20	180,00	412,30	179,75	0,90	0,25
76	403,90	180,00	403,20	179,25	0,70	0,75
77	403,50	180,00	402,40	179,25	1,10	0,75
78	394,40	180,00	394,30	179,50	0,10	0,50
79	412,70	180,00	412,10	179,50	0,60	0,50
80	385,50	180,00	385,20	179,25	0,30	0,75
81	406,90	180,00	406,10	180,00	0,80	0,00
82	395,40	180,00	394,30	178,75	1,10	1,25
83	393,30	181,00	392,80	180,00	0,50	1,00
84	394,10	180,00	393,90	179,00	0,20	1,00
85	393,00	180,00	392,00	179,50	1,00	0,50
86	397,70	180,00	397,40	178,75	0,30	1,25
87	389,00	181,00	387,70	179,50	1,30	1,50
88	405,80	180,00	405,90	179,25	0,10	0,75
89	386,10	181,00	384,60	179,00	1,50	2,00
90	414,10	180,00	413,30	179,75	0,80	0,25
91	392,60	180,00	392,00	179,00	0,60	1,00
92	408,50	180,00	407,70	179,75	0,80	0,25
93	392,50	180,00	391,80	179,00	0,70	1,00
94	413,10	180,00	412,50	179,50	0,60	0,50
95	387,30	181,00	386,00	179,00	1,30	2,00
96	413,50	180,00	412,50	180,00	1,00	0,00
97	393,50	180,00	392,80	178,75	0,70	1,25
98	387,70	180,00	386,80	180,00	0,90	0,00
99	395,80	180,00	395,10	179,00	0,70	1,00
100	411,00	180,00	410,00	180,00	1,00	0,00
				Standard deviation:	**0,409**	**0,575**

Graphical representation

Model:	**4BD-4B500A-4K2D-4ZA**	Serial no:	**1016284**
Target torque:	**400,00 Nm**	80 % of max. torque	
Angle degree:	**180°**	Tool without angle correction	





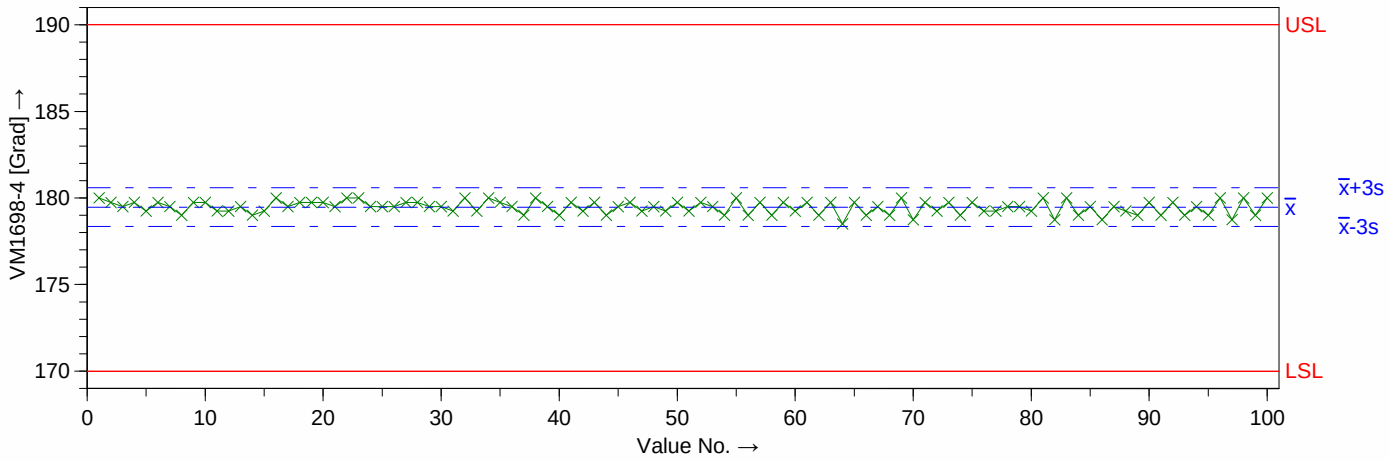
Machine Capability Study
Control System

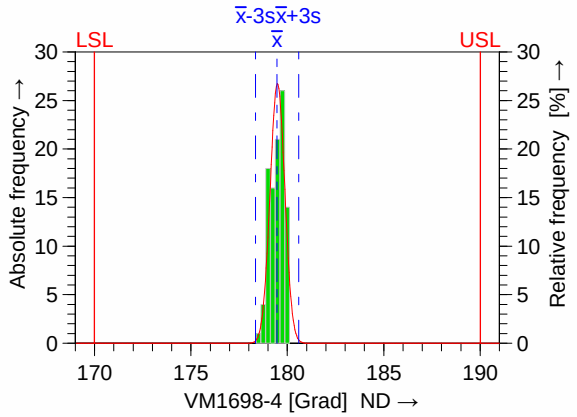
Plant	ATG Westhausen	Operator Name	Sünder
Date	08.06.2022		

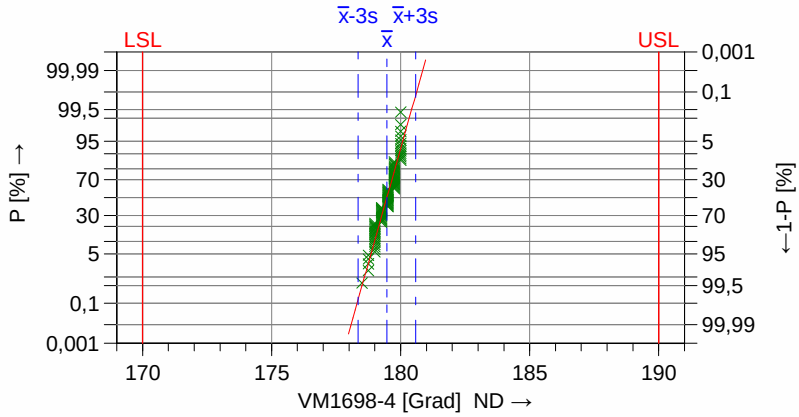
Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016284_l	Char.Descr.	VM1698-4	Nom.val. 180,00 10,00	USL 190,00
		Serial No.	1024210	Unit Grad -10,00	LSL 170,00
Char.Type	variable			Tolerance value 6 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	1000 / 1013265	nges.	100

Evaluation from 08.06.2022 11:04:45 to 08.06.2022 11:30:12

Rem. TQ 80% Angle 180° +/-10° * TQ-Cal.: 500 Nm; Cur-Cal.: 10.050 Nm/A; Speed: 269/50 rpm;







Drawing Values		Collected Values		Statistics	
T_m	180.00			$\bar{x}$	179.4650
LSL	170.00	x_{min}	178.50	$\bar{x}$-3s	178.3469
USL	190.00	x_{max}	180.00	$\bar{x}$+3s	180.5831
T	20.00	R	1.50	6s	2.2363
		$n_{<T>}$	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	8.94
Critical capability index	=	C_{mk}	8.46

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 08.06.2022

Serial No.	1016284_I	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	406,20
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	297,52
				USL	528,60
Remark	TQ 80% Angle 180°+/-10°* TQ-Cal.: 500 Nm; C ur-Cal.: 10.050 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
1024210	VM1698-4	Nm	402,20	391,20	389,90	381,00	395,50	374,20	371,90	388,30	379,60	382,70
1024210	VM1698-4	Grad	180,00	179,75	179,50	179,75	179,25	179,75	179,50	179,00	179,75	179,75

Char.No.	Char.Descr.	Unit	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
1024210	VM1698-4	Nm	377,70	388,10	381,00	373,40	387,00	400,50	385,60	383,90	399,00	401,90
1024210	VM1698-4	Grad	179,25	179,25	179,50	179,00	179,25	180,00	179,50	179,75	179,75	179,75

Char.No.	Char.Descr.	Unit	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
1024210	VM1698-4	Nm	380,40	390,60	389,10	387,70	393,70	386,20	390,60	390,10	404,00	388,50
1024210	VM1698-4	Grad	179,50	180,00	180,00	179,50	179,50	179,50	179,75	179,75	179,50	179,50

Char.No.	Char.Descr.	Unit	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
1024210	VM1698-4	Nm	396,80	397,00	405,30	395,30	393,90	384,30	392,80	393,30	391,60	398,20
1024210	VM1698-4	Grad	179,25	180,00	179,25	180,00	179,75	179,50	179,00	180,00	179,50	179,00

Char.No.	Char.Descr.	Unit	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
1024210	VM1698-4	Nm	390,10	393,30	383,90	395,70	409,20	392,80	397,40	391,60	401,90	383,70
1024210	VM1698-4	Grad	179,75	179,25	179,75	179,00	179,50	179,75	179,25	179,50	179,25	179,75

Char.No.	Char.Descr.	Unit	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
1024210	VM1698-4	Nm	393,90	408,60	395,50	398,40	389,90	393,30	402,20	388,90	397,60	389,90
1024210	VM1698-4	Grad	179,25	179,75	179,50	179,00	180,00	179,00	179,75	179,00	179,75	179,25

Char.No.	Char.Descr.	Unit	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
1024210	VM1698-4	Nm	383,10	395,70	387,50	394,30	392,60	395,30	397,00	391,20	394,50	388,10
1024210	VM1698-4	Grad	179,75	179,00	179,75	178,50	179,75	179,00	179,50	179,00	180,00	178,75

Char.No.	Char.Descr.	Unit	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
1024210	VM1698-4	Nm	388,90	399,50	411,50	393,50	412,30	403,20	402,40	394,30	412,10	385,20
1024210	VM1698-4	Grad	179,75	179,25	179,75	179,00	179,75	179,25	179,25	179,50	179,50	179,25

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.06.2022

Serial No.	1016284_I	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	406,20
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	297,52
				USL	528,60
Remark	TQ 80% Angle 180°+/-10°* TQ-Cal.: 500 Nm; C ur-Cal.: 10.050 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
1024210	VM1698-4	Nm	406,10	394,30	392,80	393,90	392,00	397,40	387,70	405,90	384,60	413,30
1024210	VM1698-4	Grad	180,00	178,75	180,00	179,00	179,50	178,75	179,50	179,25	179,00	179,75

Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
1024210	VM1698-4	Nm	392,00	407,70	391,80	412,50	386,00	412,50	392,80	386,80	395,10	410,00
1024210	VM1698-4	Grad	179,00	179,75	179,00	179,50	179,00	180,00	178,75	180,00	179,00	180,00

Machine Capability Study
Tool System

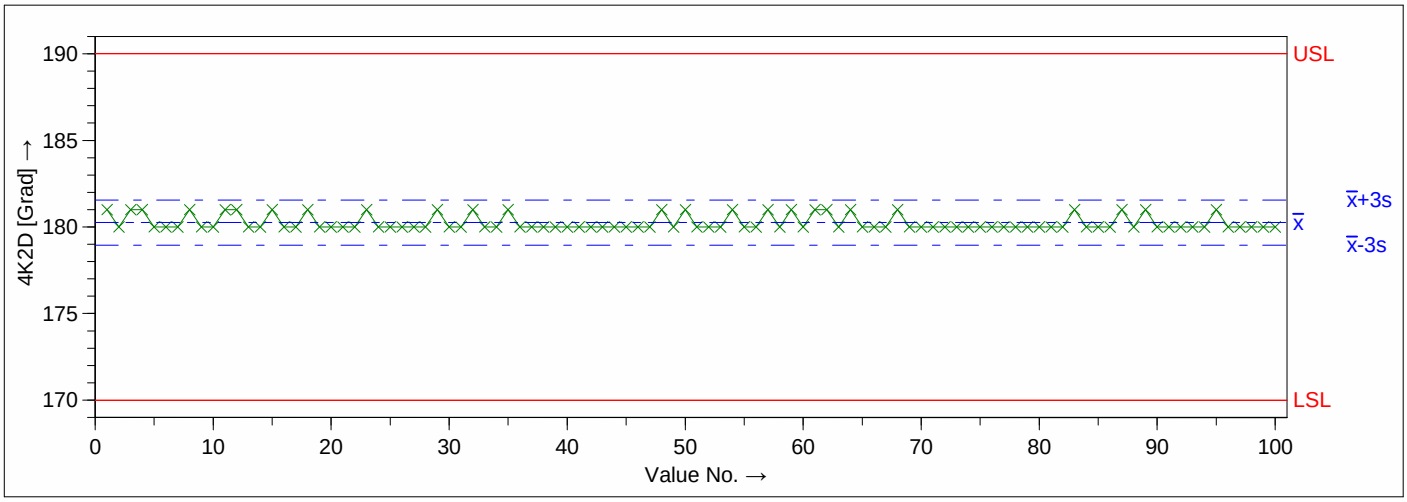
Plant	ATG Westhausen	Operator Name	Sünder
Date	08.06.2022		

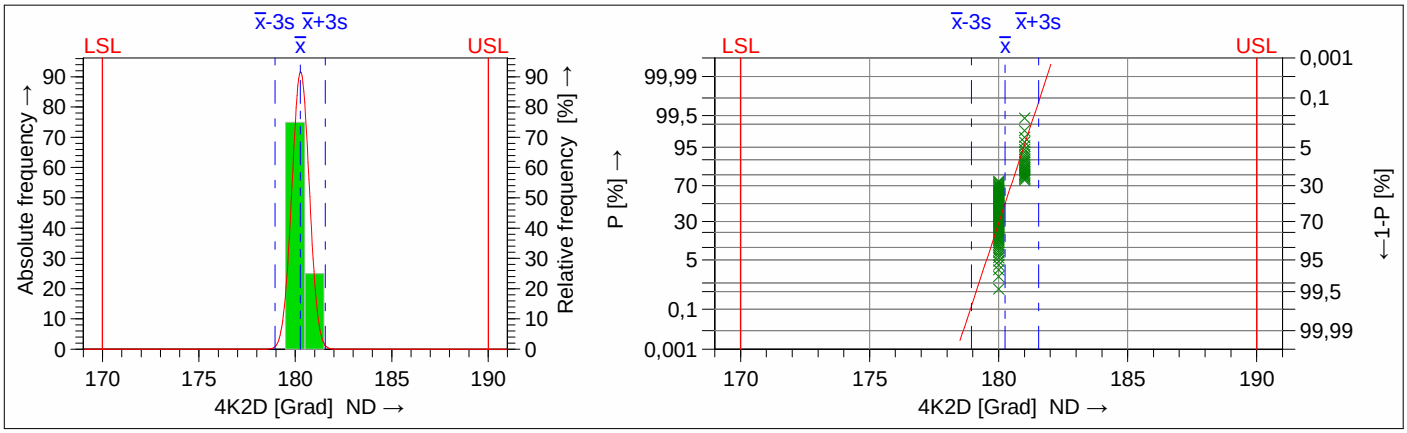
Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016284_l	Char.Descr.	4K2D	Nom.val. 180,00 10,00	USL 190,00
		Serial No.	204574	Unit Grad -10,00	LSL 170,00
Char.Type	variable			Tolerance value 6 %	Decimal Pl. 2

Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	1000 / 1013265	nges.	100

Evaluation from 08.06.2022 11:04:45 to 08.06.2022 11:30:12

Rem. TQ 80% Angle 180° +/-10° * TQ-Cal.: 500 Nm; Cur-Cal.: 10.050 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	180.00			$\bar{x}$	180.2500
LSL	170.00	x_{min}	180.00	$\bar{x}$-3s	178.9444
USL	190.00	x_{max}	181.00	$\bar{x}$+3s	181.5556
T	20.00	R	1.00	6s	2.6112
		$n_{<T>}$	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	7.66
Critical capability index	=	C_{mk}	7.47

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 08.06.2022

Serial No.	1016284_I	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	220,20
Ord. No.	4BD500T1S-A	Serial No.	204574	LSL	0,00
				USL	528,48
Remark	TQ 80% Angle 180°+/-10°* TQ-Cal.: 500 Nm; C ur-Cal.: 10.050 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
204574	4K2D	Nm	402,90	391,40	390,30	380,90	396,40	375,10	373,10	389,30	380,40	383,70
204574	4K2D	Grad	181,00	180,00	181,00	181,00	180,00	180,00	180,00	181,00	180,00	180,00

Char.No.	Char.Descr.	Unit	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
204574	4K2D	Nm	378,20	389,20	382,10	374,00	388,00	400,70	386,90	385,60	399,10	403,70
204574	4K2D	Grad	181,00	181,00	180,00	180,00	181,00	180,00	180,00	181,00	180,00	180,00

Char.No.	Char.Descr.	Unit	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204574	4K2D	Nm	381,70	391,10	389,60	388,70	394,10	387,30	391,20	391,20	404,50	389,80
204574	4K2D	Grad	180,00	180,00	181,00	180,00	180,00	180,00	180,00	180,00	181,00	180,00

Char.No.	Char.Descr.	Unit	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
204574	4K2D	Nm	397,40	397,70	406,20	396,10	394,50	386,20	393,40	394,90	391,90	398,30
204574	4K2D	Grad	180,00	181,00	180,00	180,00	181,00	180,00	180,00	180,00	180,00	180,00

Char.No.	Char.Descr.	Unit	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204574	4K2D	Nm	390,80	393,80	384,50	396,50	409,90	393,80	397,60	392,50	403,20	385,00
204574	4K2D	Grad	180,00	180,00	180,00	180,00	180,00	180,00	180,00	181,00	180,00	181,00

Char.No.	Char.Descr.	Unit	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
204574	4K2D	Nm	393,90	409,80	395,90	399,00	391,30	393,90	402,50	389,70	397,90	390,50
204574	4K2D	Grad	180,00	180,00	180,00	181,00	180,00	180,00	181,00	180,00	181,00	180,00

Char.No.	Char.Descr.	Unit	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
204574	4K2D	Nm	384,80	395,90	388,60	395,00	393,50	395,80	397,70	392,20	395,00	388,60
204574	4K2D	Grad	181,00	181,00	180,00	181,00	180,00	180,00	180,00	181,00	180,00	180,00

Char.No.	Char.Descr.	Unit	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
204574	4K2D	Nm	389,60	400,10	412,40	394,00	413,20	403,90	403,50	394,40	412,70	385,50
204574	4K2D	Grad	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 08.06.2022

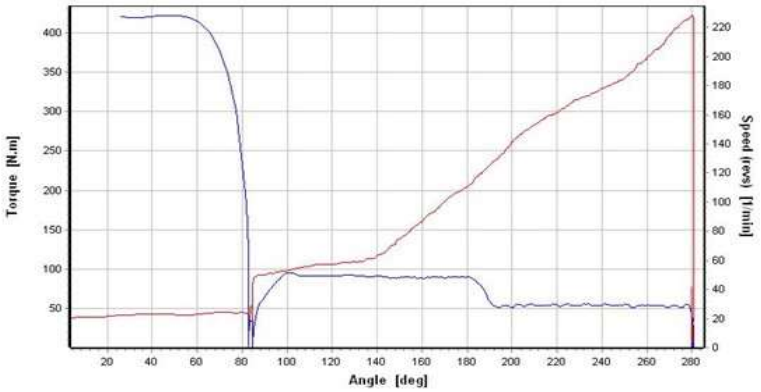
Serial No.	1016284_I	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	220,20
Ord. No.	4BD500T1S-A	Serial No.	204574	LSL	0,00
				USL	528,48
Remark	TQ 80% Angle 180°+/-10°* TQ-Cal.: 500 Nm; C ur-Cal.: 10.050 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
204574	4K2D	Nm	406,90	395,40	393,30	394,10	393,00	397,70	389,00	405,80	386,10	414,10
204574	4K2D	Grad	180,00	180,00	181,00	180,00	180,00	180,00	181,00	180,00	181,00	180,00

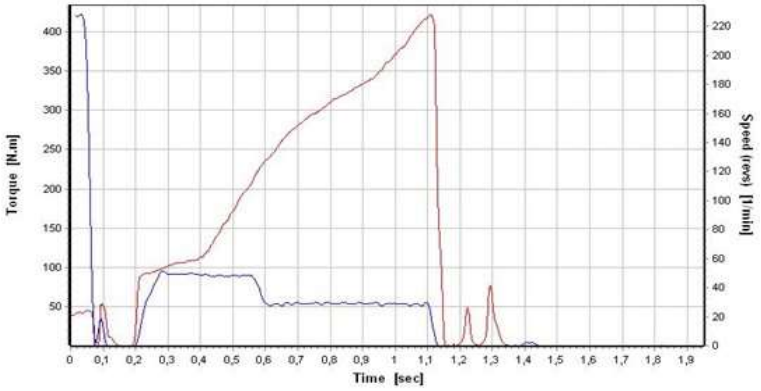
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204574	4K2D	Nm	392,60	408,50	392,50	413,10	387,30	413,50	393,50	387,70	395,80	411,00
204574	4K2D	Grad	180,00	180,00	180,00	180,00	181,00	180,00	180,00	180,00	180,00	180,00

Torque graphs

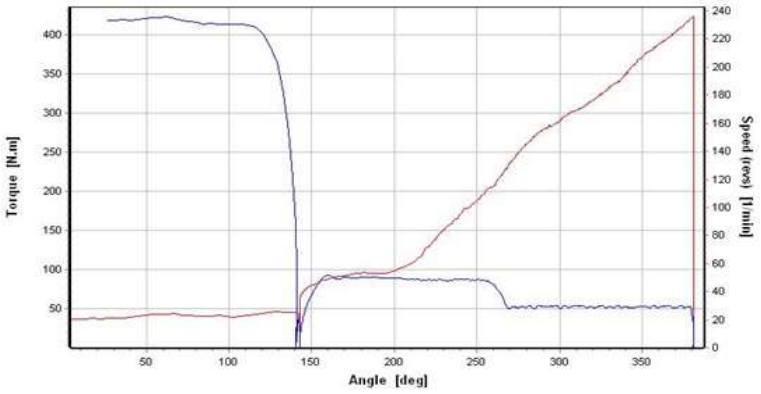
Model:	**4BD-4B500A-4K2D-4ZA**	Serial no:	**1016284**
Target torque:	**400,00 Nm**	80 % of max. torque	
Angle degree:	**180°**	Tool without angle correction	



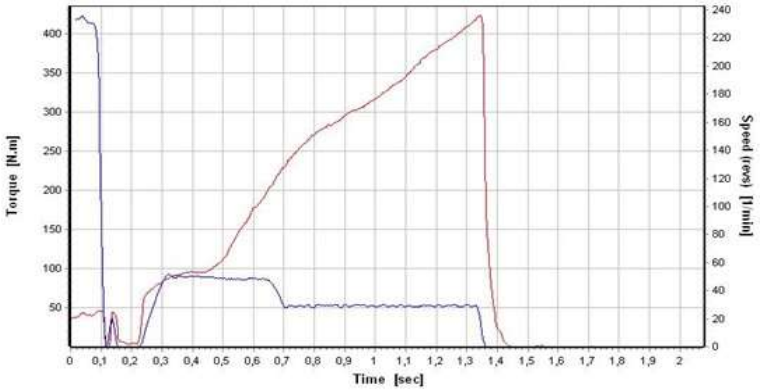
Value no. 1
Graph
Torque / Angle / Speed



Value no. 1
Graph
Torque / Time / Speed



Value no. 100
Graph
Torque / Angle / Speed



Value no. 100
Graph
Torque / Time / Speed