Homologation

Fixtured Spindle

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

Serial no.: 1016282

Contents

Homologation: 4BD-4B500A-4K2D-4ZA SN: 1016282

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Test sheet no. 2

Machine Capability Study 30 %

Multi-stage tightening system	☑	Speed 50 rpm	18,59 %
Single-stage tightening system	☐	Speed 100 %	269 rpm

Manufacturer: Apex Tool Group Serial no: **1016282**

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

Hard joint (H)	1123,72	Nm / Revolution	Angle degree	30°
Soft joint (L)	92,99	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	187,29	185,99 Nm
	Standard deviation	0,30	0,33 Nm
	Torque scatter (99,73%)	1,80	1,99 Nm
	C_m	14,42	13,03
	C_{mk}	11,88	12,04

b)	Min. C_m hard/soft (lowest value)	13,03
	Min. C_{mk} hard/soft (lowest value)	11,88

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

Note:

Machine Capability Study
Control System

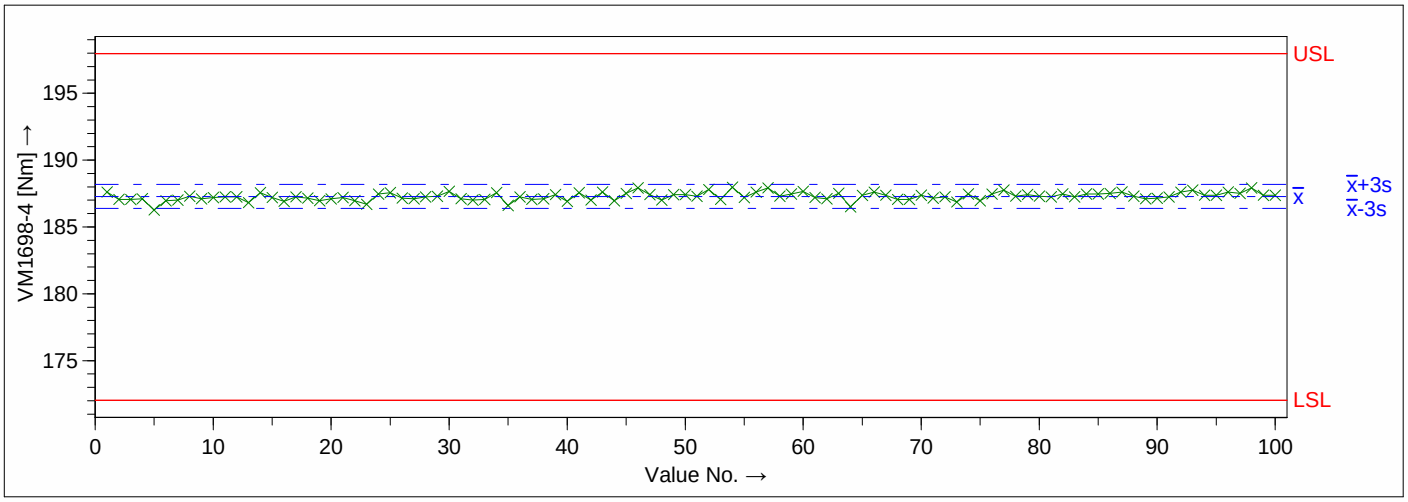
Cleco Production Tools

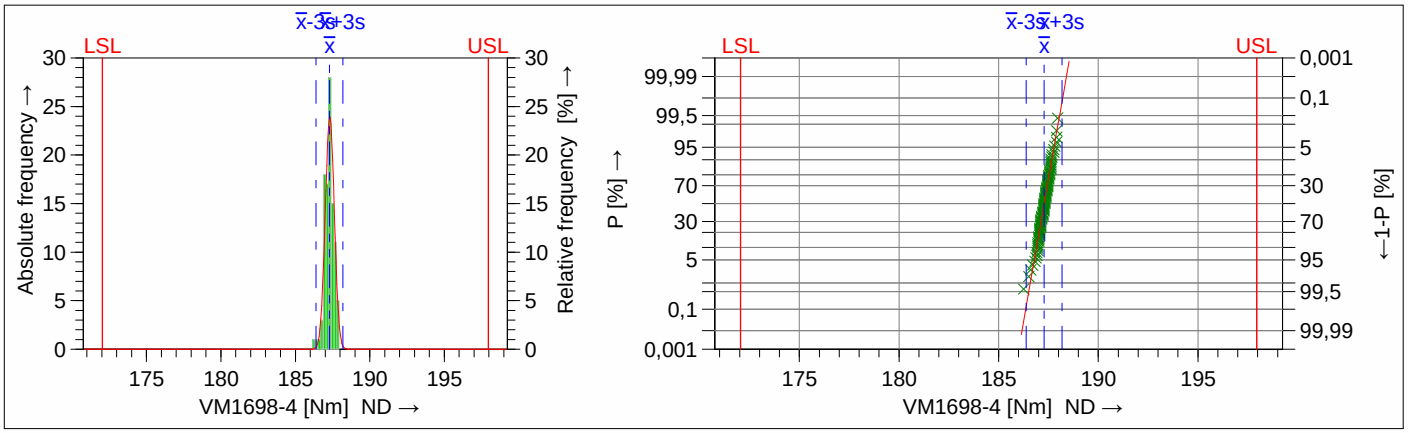
Plant	ATG Westhausen	Operator Name	Sünder
Date	03.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016282_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 03.05.2022 11:18:57 to 03.05.2022 11:33:22

Rem. TQ 30% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.830 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	185.00			$\bar{x}$	187.2860
LSL	172.05	x_{min}	186.26	$\bar{x}$-3s	186.3882
USL	197.95	x_{max}	187.96	$\bar{x}$+3s	188.1838
T	25.90	R	1.70	6s	1.7957
		$n_{<T>}$	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	14.42
Critical capability index	=	C_{mk}	11.88

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

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 03.05.2022

Serial No.	1016282_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.: 9.830 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	187,61	187,06	187,06	187,11	186,26	186,96	187,01	187,31	187,11	187,21
1024210	VM1698-4	Grad	28,25	28,25	29,50	34,25	33,00	29,25	29,50	27,50	33,25	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}
1024210	VM1698-4	Nm	187,26	187,26	186,81	187,56	187,21	186,91	187,26	187,16	186,96	187,11
1024210	VM1698-4	Grad	27,50	33,25	32,25	27,00	28,00	27,25	27,50	27,00	33,50	27,25

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	187,21	186,96	186,71	187,46	187,56	187,16	187,11	187,26	187,31	187,66
1024210	VM1698-4	Grad	30,25	33,25	27,50	26,75	32,75	27,50	27,75	32,50	27,75	32,50

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	187,11	187,01	187,06	187,56	186,61	187,26	187,06	187,11	187,41	186,91
1024210	VM1698-4	Grad	27,75	33,25	27,50	33,50	32,00	29,50	33,00	29,00	32,25	27,25

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	187,56	187,01	187,61	186,96	187,51	187,91	187,41	187,01	187,41	187,41
1024210	VM1698-4	Grad	32,75	33,25	25,50	26,50	26,50	26,00	32,50	32,25	28,00	27,25

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	187,31	187,81	187,06	187,96	187,21	187,61	187,91	187,31	187,46	187,66
1024210	VM1698-4	Grad	32,25	26,75	27,00	32,50	26,75	26,50	32,75	31,25	31,50	33,25

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	187,21	187,11	187,51	186,51	187,36	187,61	187,36	187,06	187,06	187,36
1024210	VM1698-4	Grad	30,50	27,75	32,50	27,75	32,00	32,75	27,00	31,50	26,75	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	187,16	187,26	186,86	187,46	186,96	187,46	187,76	187,31	187,41	187,31
1024210	VM1698-4	Grad	26,00	32,00	31,00	28,00	26,25	26,75	29,00	32,25	32,00	27,75

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 03.05.2022

Serial No.	1016282_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.: 9.830 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	187,26	187,46	187,26	187,46	187,46	187,51	187,61	187,31	187,11	187,16
1024210	VM1698-4	Grad	33,00	27,50	33,00	27,75	33,25	28,00	32,25	32,00	28,25	32,75

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	187,26	187,61	187,76	187,36	187,36	187,61	187,51	187,91	187,36	187,36
1024210	VM1698-4	Grad	28,25	32,50	31,50	31,25	27,75	26,75	29,00	32,00	30,00	27,50

Machine Capability Study
Tool System

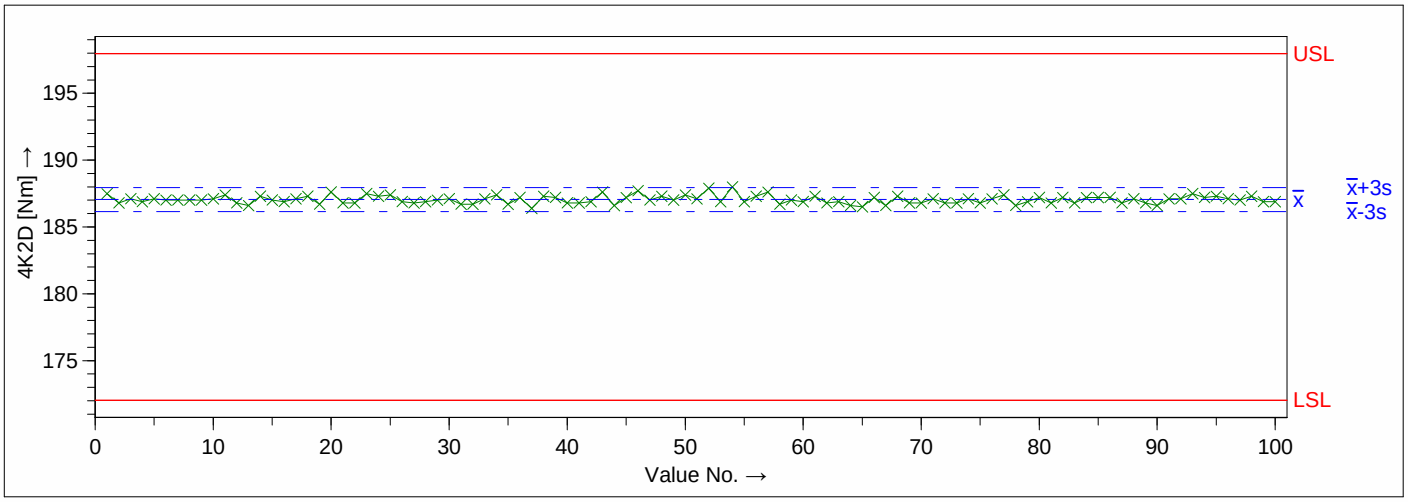
Plant	ATG Westhausen	Operator Name	Sünder
Date	03.05.2022		

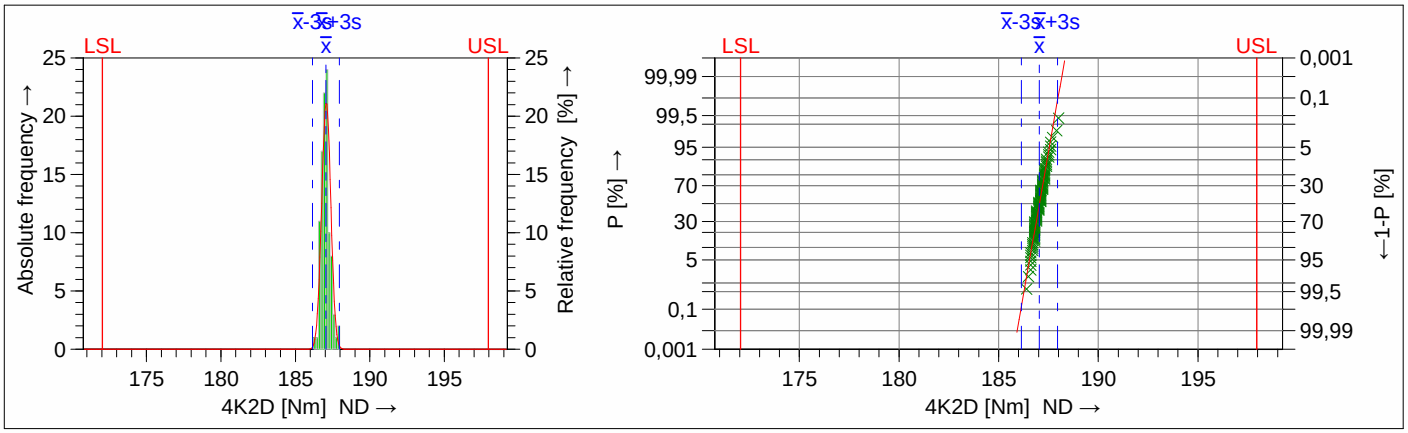
Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016282_d	Char.Descr.	4K2D	Nom.val.	185,00
		Serial No.	204575	Unit	Nm
				USL	197,95
					12,95
					-12,95
				LSL	172,05
Char.Type	variable			Tolerance value	7 %
Decimal Pl.	2				

Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	250 / 5537037	nges.	100

Evaluation from 03.05.2022 11:18:57 to 03.05.2022 11:33:22

Rem. TQ 30% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.830 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	185.00			$\bar{x}$	187.0470
LSL	172.05	x_{min}	186.40	$\bar{x}$-3s	186.1440
USL	197.95	x_{max}	188.00	$\bar{x}$+3s	187.9500
T	25.90	R	1.60	6s	1.8060
		$n_{<T>}$	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	14.34
Critical capability index	=	C_{mk}	12.07

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 03.05.2022

Serial No.	1016282_d	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	185,00
Ord. No.	4BD500T1S-A	Serial No.	204575	LSL	172,05
				USL	197,95
Remark	TQ 30% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.830 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}
204575	4K2D	Nm	187,50	186,80	187,10	186,90	187,10	187,00	187,00	187,00	187,00	187,10
204575	4K2D	Grad	29,00	29,00	30,00	35,00	34,00	30,00	30,00	28,00	34,00	30,00

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}
204575	4K2D	Nm	187,40	186,80	186,60	187,30	187,00	186,90	187,10	187,30	186,70	187,60
204575	4K2D	Grad	28,00	33,00	32,00	28,00	29,00	28,00	28,00	28,00	34,00	29,00

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}
204575	4K2D	Nm	186,80	186,80	187,50	187,30	187,40	186,90	186,80	186,90	187,00	187,10
204575	4K2D	Grad	31,00	34,00	28,00	27,00	33,00	28,00	28,00	34,00	28,00	33,00

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}
204575	4K2D	Nm	186,70	186,70	187,10	187,40	186,70	187,20	186,40	187,30	187,20	186,80
204575	4K2D	Grad	28,00	34,00	28,00	34,00	33,00	30,00	33,00	30,00	33,00	28,00

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}
204575	4K2D	Nm	186,80	186,90	187,60	186,60	187,20	187,70	187,00	187,30	187,00	187,40
204575	4K2D	Grad	33,00	34,00	27,00	27,00	28,00	27,00	33,00	33,00	29,00	28,00

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}
204575	4K2D	Nm	187,10	187,90	186,90	188,00	186,90	187,30	187,60	186,70	187,00	186,90
204575	4K2D	Grad	32,00	28,00	28,00	33,00	27,00	27,00	33,00	32,00	32,00	34,00

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}
204575	4K2D	Nm	187,30	186,80	186,90	186,60	186,50	187,20	186,60	187,30	186,80	186,80
204575	4K2D	Grad	33,00	28,00	33,00	29,00	32,00	34,00	28,00	32,00	27,00	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}
204575	4K2D	Nm	187,10	186,80	186,80	187,10	186,80	187,10	187,40	186,60	186,90	187,20
204575	4K2D	Grad	27,00	33,00	32,00	28,00	28,00	27,00	30,00	33,00	32,00	28,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 03.05.2022

Serial No.	1016282_d	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	185,00
Ord. No.	4BD500T1S-A	Serial No.	204575	LSL	172,05
				USL	197,95
Remark	TQ 30% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.830 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}
204575	4K2D	Nm	186,80	187,20	186,80	187,20	187,20	187,20	186,80	187,10	186,80	186,60
204575	4K2D	Grad	34,00	29,00	34,00	28,00	33,00	28,00	33,00	32,00	29,00	33,00

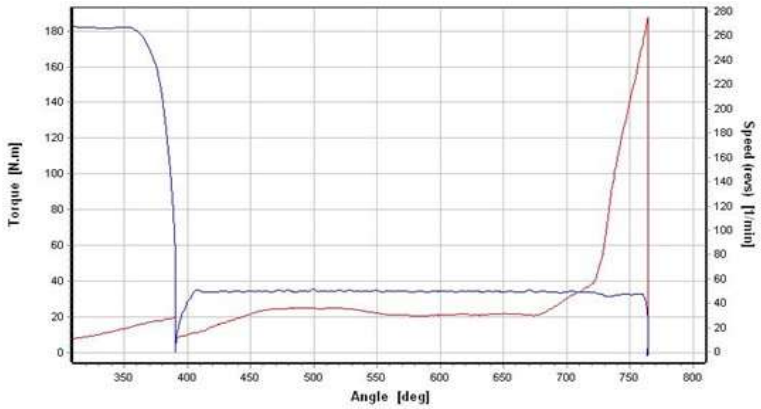
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204575	4K2D	Nm	187,10	187,10	187,50	187,20	187,30	187,10	187,00	187,30	186,90	186,90
204575	4K2D	Grad	29,00	32,00	32,00	31,00	28,00	28,00	30,00	33,00	32,00	28,00

Torque graphs

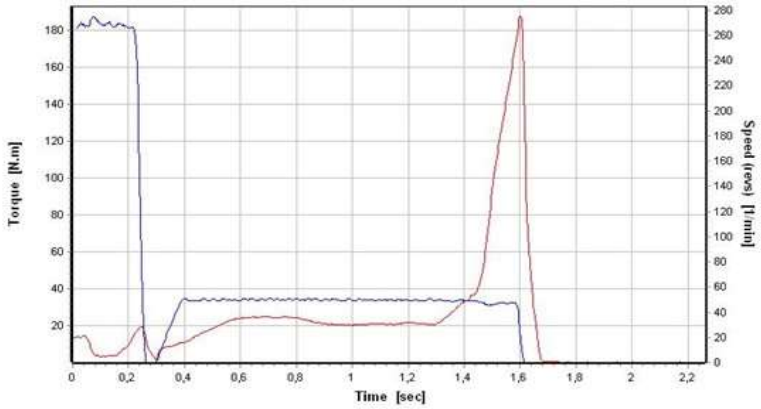
Machine Capability Study 30 %

Model: **4BD-4B500A-4K2D-4ZA**
Serial no: **1016282**

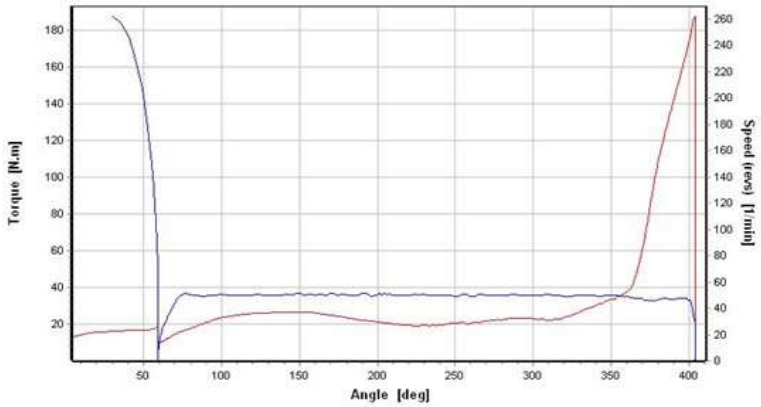
Angle degree: **30°**
Test torque: **185,0 Nm**



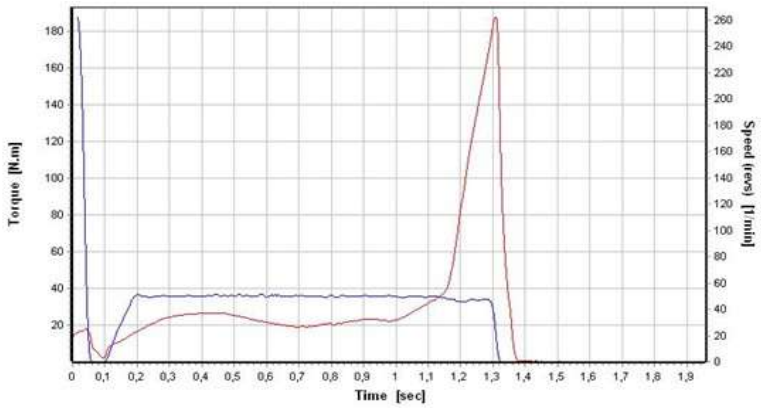
Value no. 1
Graph
Torque / Angle / Speed



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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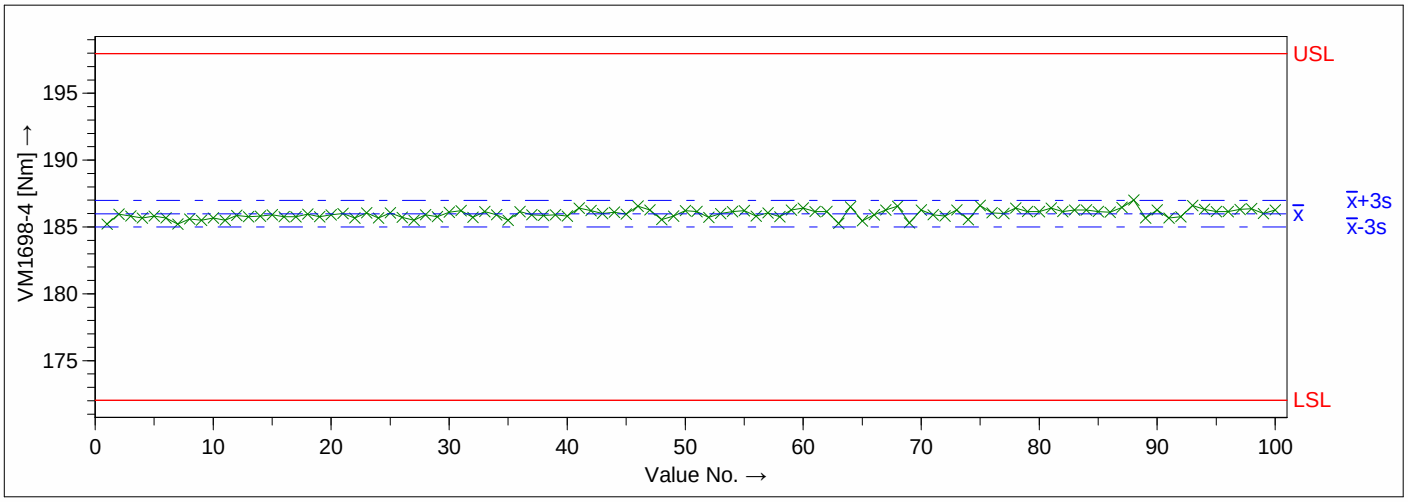
Plant ATG Westhausen		Operator Name Sünder	Date 03.05.2022

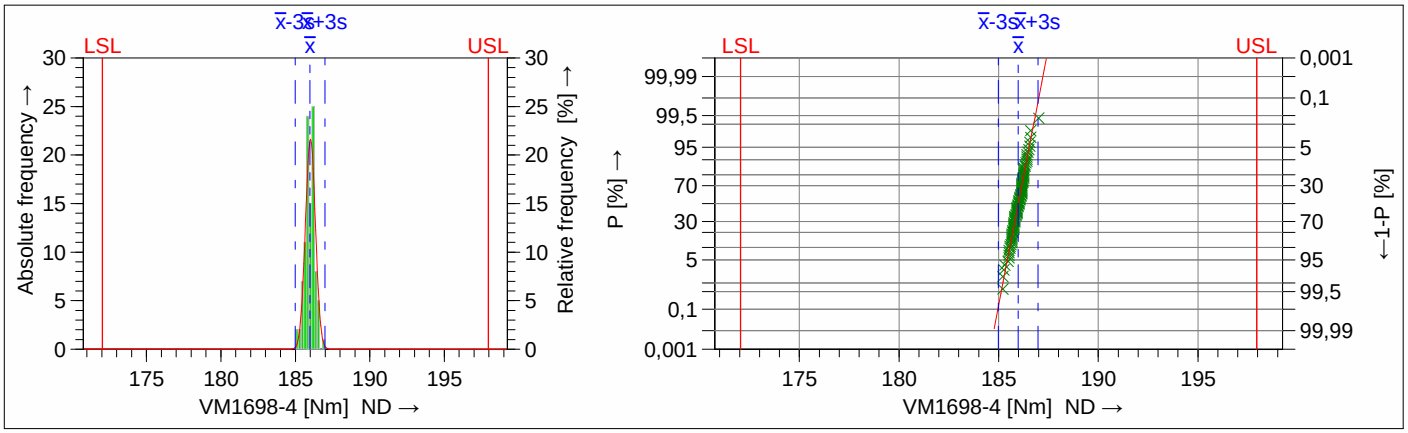
Ord. No. 4BD500T1S-A	Part type 4BD-4B500A-4K2D-4ZA				Contr.item yes
Serial No. 1016282_c	Char.Descr. VM1698-4	Nom.val.	185,00	12,95	USL 197,95
	Serial No. 1024210	Unit	Nm	-12,95	LSL 172,05
Char.Type variable		Tolerance value	7 %		Decimal Pl. 2

Cust.Name Cleco	Reference System VM1698-4	Test Electronic MPRO400GCD-P
Contr.No. Homologation	Reference Transducer 250 / 5537037	nges. 100

Evaluation from 03.05.2022 11:48:39 to 03.05.2022 12:07:53

Rem. TQ 30% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.830 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	185.00			$\bar{x}$	185.9850
LSL	172.05	x_{min}	185.21	$\bar{x}$-3s	184.9910
USL	197.95	x_{max}	187.01	$\bar{x}$+3s	186.9790
T	25.90	R	1.80	6s	1.9879
		$n_{<T>}$	100	$p_{<T>}$	100.00000 %
		$n_{>USL}$	0	$p_{>USL}$	0.00000%
		$n_{<LSL}$	0	$p_{<LSL}$	0.00000%
		n_{eff}	100		
		n_{tot}	100		

Model distribution			Normal Distribution
Calculation method			M1.1.4 $\hat{\sigma} = s_{tot}$
Potential Capability index	=	C_m	13.03
Critical capability index	=	C_{mk}	12.04

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 03.05.2022

Serial No.	1016282_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.: 9.830 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	185,21	185,96	185,81	185,66	185,81	185,66	185,21	185,61	185,51	185,66
1024210	VM1698-4	Grad	351,00	367,25	340,50	346,25	326,50	367,75	335,00	366,25	355,50	357,00

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}
1024210	VM1698-4	Nm	185,51	185,86	185,76	185,81	185,91	185,76	185,76	185,96	185,76	185,91
1024210	VM1698-4	Grad	329,75	359,25	329,75	365,25	383,50	349,75	380,75	356,25	363,75	356,50

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	186,01	185,66	186,06	185,66	186,06	185,71	185,51	185,91	185,76	186,11
1024210	VM1698-4	Grad	358,25	346,00	361,75	336,25	349,50	349,25	349,75	346,75	331,25	350,00

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	186,21	185,71	186,16	185,91	185,51	186,16	185,91	185,86	185,91	185,81
1024210	VM1698-4	Grad	347,50	355,25	358,75	337,75	354,50	362,50	385,00	364,00	352,00	341,75

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	186,41	186,21	186,01	186,11	185,96	186,56	186,26	185,56	185,81	186,21
1024210	VM1698-4	Grad	349,50	365,50	371,75	363,00	342,00	353,75	335,25	383,25	375,50	365,50

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	186,16	185,71	186,01	186,16	186,21	185,81	186,06	185,76	186,26	186,41
1024210	VM1698-4	Grad	378,25	368,00	354,25	353,25	357,00	347,75	352,50	380,25	388,50	370,75

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	186,16	186,16	185,26	186,51	185,46	185,91	186,26	186,56	185,31	186,26
1024210	VM1698-4	Grad	395,25	359,75	352,75	379,25	375,75	356,25	364,75	354,75	359,50	362,25

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	185,91	185,81	186,26	185,56	186,61	186,06	186,01	186,41	186,16	186,16
1024210	VM1698-4	Grad	360,50	378,50	355,50	393,50	398,25	358,00	347,75	384,50	365,25	364,50

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 03.05.2022

Serial No.	1016282_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.: 9.830 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	186,41	186,16	186,26	186,26	186,16	186,11	186,46	187,01	185,66	186,26
1024210	VM1698-4	Grad	336,75	353,00	362,00	402,00	348,25	361,00	348,50	352,50	378,25	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}
1024210	VM1698-4	Nm	185,66	185,76	186,61	186,31	186,16	186,16	186,31	186,36	186,01	186,26
1024210	VM1698-4	Grad	375,00	346,75	363,75	373,75	394,25	349,00	361,50	393,00	357,00	379,00

Machine Capability Study
Tool System

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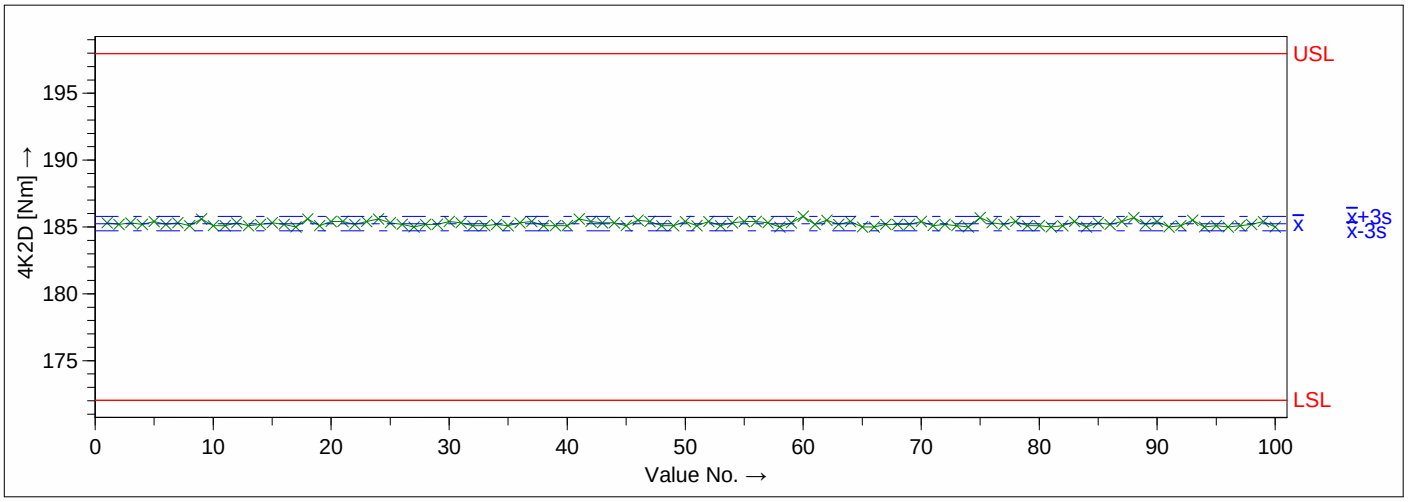
Plant ATG Westhausen		Operator Name Sünder	Date 03.05.2022

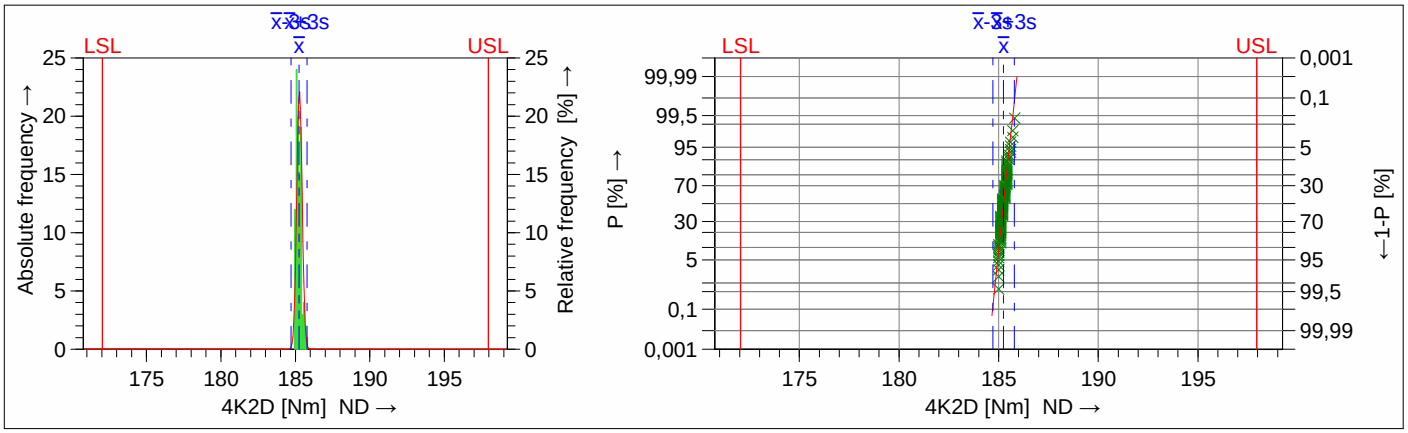
Ord. No. 4BD500T1S-A	Part type 4BD-4B500A-4K2D-4ZA				Contr.item yes
Serial No. 1016282_c	Char.Descr. 4K2D	Nom.val.	185,00	12,95	USL 197,95
	Serial No. 204575	Unit	Nm	-12,95	LSL 172,05
Char.Type variable		Tolerance value	7 %		Decimal Pl. 2

Cust.Name Cleco	Reference System VM1698-4	Test Electronic MPRO400GCD-P
Contr.No. Homologation	Reference Transducer 250 / 5537037	nges. 100

Evaluation from 03.05.2022 11:48:39 to 03.05.2022 12:07:53

Rem. TQ 30% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.830 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	185.00			$\bar{x}$	185.2460
LSL	172.05	x_{min}	185.00	$\bar{x}$-3s	184.7076
USL	197.95	x_{max}	185.80	$\bar{x}$+3s	185.7844
T	25.90	R	0.80	6s	1.0768
		$n_{<T>}$	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	24.05
Critical capability index	=	C_{mk}	23.60

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 03.05.2022

Serial No.	1016282_c	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	185,00
Ord. No.	4BD500T1S-A	Serial No.	204575	LSL	172,05
				USL	197,95
Remark	TQ 30% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.830 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}
204575	4K2D	Nm	185,30	185,20	185,30	185,20	185,40	185,20	185,30	185,10	185,60	185,10
204575	4K2D	Grad	352,00	368,00	345,00	348,00	328,00	370,00	341,00	368,00	361,00	362,00

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}
204575	4K2D	Nm	185,10	185,30	185,10	185,20	185,30	185,20	185,00	185,60	185,10	185,40
204575	4K2D	Grad	335,00	360,00	333,00	367,00	392,00	352,00	383,00	360,00	365,00	358,00

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}
204575	4K2D	Nm	185,40	185,20	185,40	185,60	185,30	185,20	185,00	185,20	185,20	185,40
204575	4K2D	Grad	360,00	351,00	363,00	341,00	352,00	354,00	353,00	348,00	338,00	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}
204575	4K2D	Nm	185,30	185,10	185,10	185,20	185,10	185,30	185,40	185,10	185,10	185,10
204575	4K2D	Grad	355,00	357,00	359,00	343,00	355,00	365,00	400,00	364,00	353,00	343,00

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}
204575	4K2D	Nm	185,60	185,40	185,30	185,30	185,10	185,50	185,40	185,10	185,10	185,40
204575	4K2D	Grad	351,00	366,00	374,00	366,00	346,00	354,00	349,00	391,00	378,00	367,00

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}
204575	4K2D	Nm	185,10	185,40	185,10	185,30	185,40	185,40	185,30	185,00	185,30	185,80
204575	4K2D	Grad	379,00	379,00	356,00	355,00	374,00	359,00	356,00	381,00	390,00	371,00

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}
204575	4K2D	Nm	185,20	185,50	185,20	185,40	185,00	185,00	185,20	185,20	185,20	185,40
204575	4K2D	Grad	405,00	362,00	356,00	380,00	385,00	357,00	366,00	355,00	367,00	363,00

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}
204575	4K2D	Nm	185,10	185,20	185,10	185,00	185,70	185,30	185,20	185,40	185,10	185,10
204575	4K2D	Grad	362,00	381,00	357,00	401,00	402,00	361,00	349,00	391,00	363,00	366,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 03.05.2022

Serial No.	1016282_c	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	185,00
Ord. No.	4BD500T1S-A	Serial No.	204575	LSL	172,05
				USL	197,95
Remark	TQ 30% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.830 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}
204575	4K2D	Nm	185,00	185,10	185,40	185,00	185,30	185,20	185,40	185,70	185,20	185,40
204575	4K2D	Grad	338,00	354,00	363,00	404,00	349,00	363,00	353,00	353,00	386,00	394,00

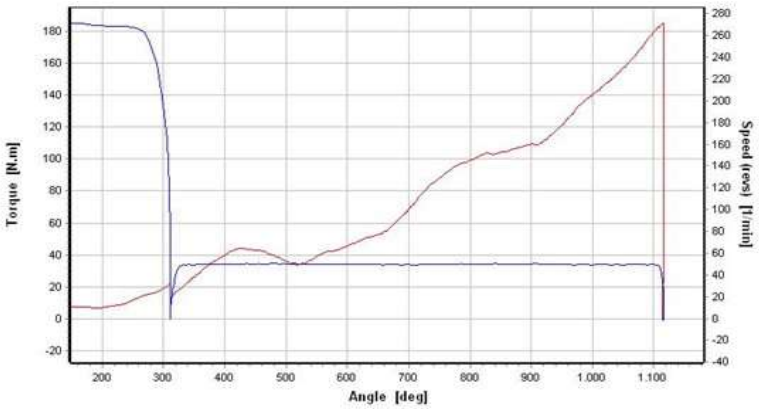
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204575	4K2D	Nm	185,00	185,10	185,50	185,00	185,10	185,00	185,10	185,20	185,40	185,00
204575	4K2D	Grad	380,00	352,00	364,00	377,00	396,00	352,00	362,00	394,00	358,00	381,00

Torque graphs

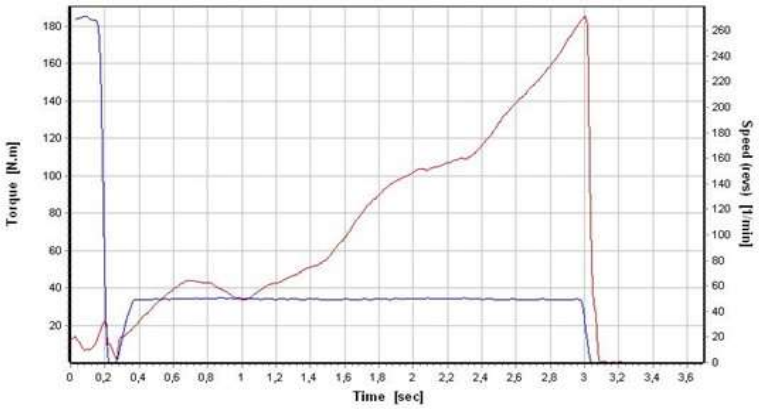
Machine Capability Study 30 %

Model: **4BD-4B500A-4K2D-4ZA**
Serial no: **1016282**

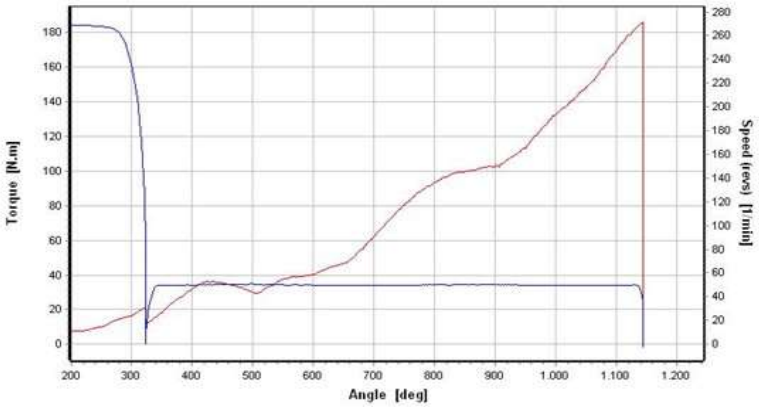
Angle degree: **360°**
Test torque: **185,0 Nm**



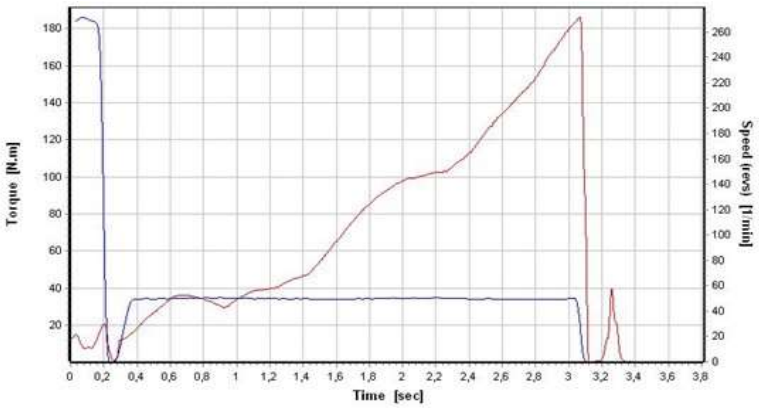
Value no. 1
Graph
Torque / Angle / Speed



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: **1016282**

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

Hard joint (H)	2481,64	Nm / Revolution	Angle degree	30°
Soft joint (L)	205,61	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	413,61	411,22 Nm
	Standard deviation	0,63	0,86 Nm
	Torque scatter (99,73%)	3,75	5,16 Nm
	C_m	15,29	11,13
	C_{mk}	13,37	10,65

b)	Min. C_m hard/soft (lowest value)	11,13
	Min. C_{mk} hard/soft (lowest value)	10,65

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

Note:

Machine Capability Study
Control System

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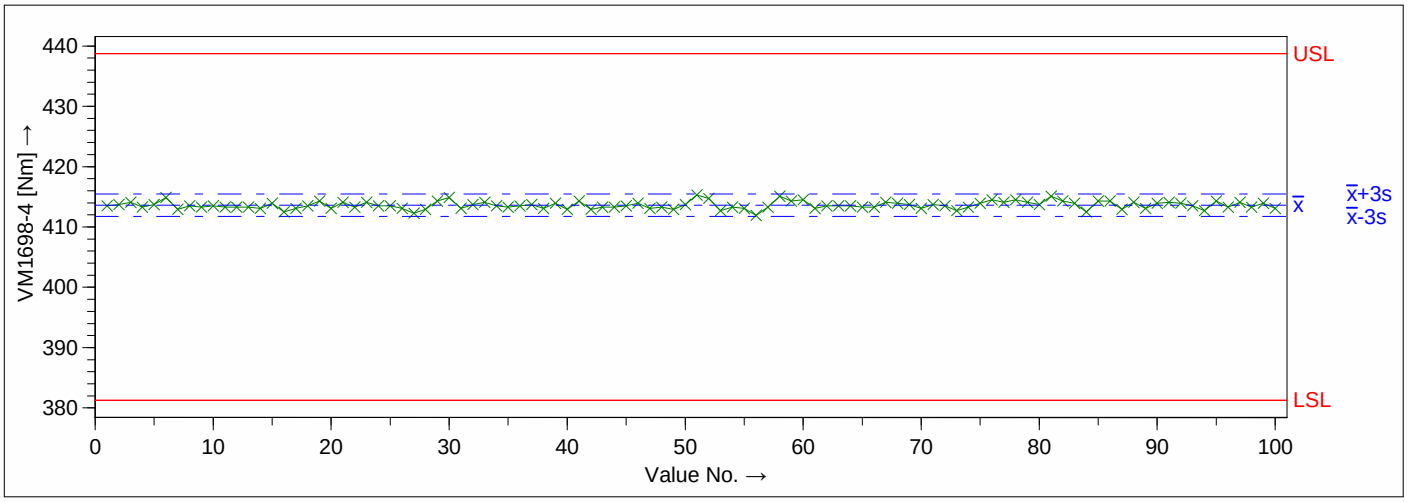
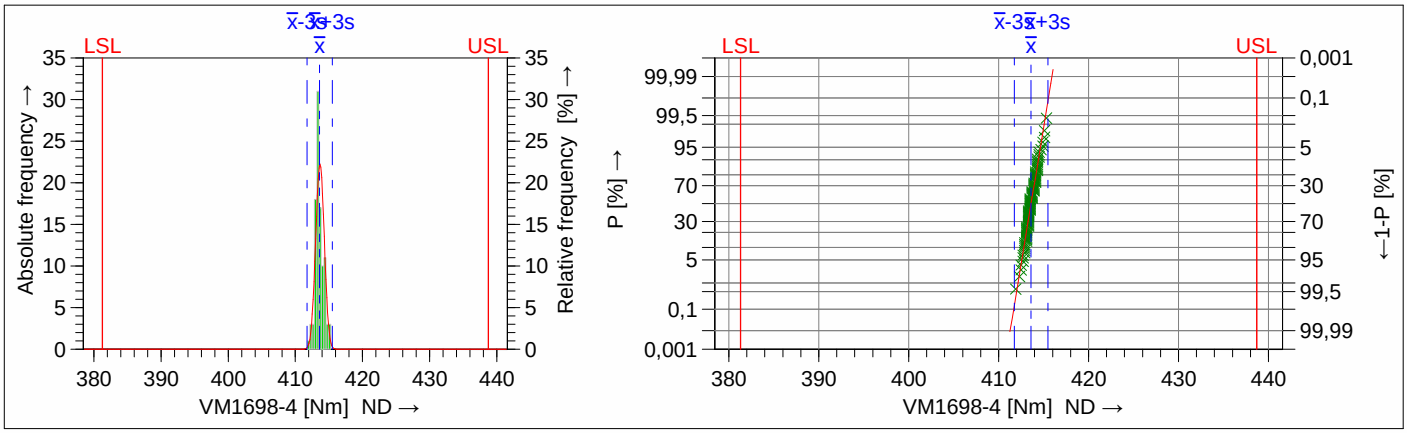
Plant	ATG Westhausen	Operator Name	Sünder
Date	04.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016282_h	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 04.05.2022 12:55:30 to 04.05.2022 13:10:20

Rem. TQ 80% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.377 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	410.00			$\bar{x}$	413.6060
LSL	381.30	x_{min}	411.90	$\bar{x}$-3s	411.7290
USL	438.70	x_{max}	415.30	$\bar{x}$+3s	415.4830
T	57.40	R	3.40	6s	3.7541
		$n_{<T>}$	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	15.29
Critical capability index	=	C_{mk}	13.37

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 04.05.2022

Serial No.	1016282_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.: 9.377 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	413,50	413,70	414,10	413,30	413,70	414,90	412,90	413,50	413,30	413,50
1024210	VM1698-4	Grad	29,75	30,00	30,25	29,50	29,25	29,50	30,00	30,00	30,25	28,75

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	413,30	413,30	413,30	413,10	413,90	412,50	413,10	413,50	414,30	413,10
1024210	VM1698-4	Grad	30,00	29,00	29,50	30,75	29,25	29,50	31,50	30,50	27,75	28,50

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	414,10	413,30	414,10	413,50	413,50	413,10	412,30	412,90	414,30	414,90
1024210	VM1698-4	Grad	28,50	30,25	29,25	29,25	29,75	31,00	30,00	30,00	31,00	28,75

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	413,10	413,70	414,10	413,50	413,30	413,50	413,70	413,10	413,90	412,90
1024210	VM1698-4	Grad	30,50	30,00	28,00	29,50	30,00	29,25	30,50	29,25	29,50	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	414,30	412,90	413,30	413,30	413,50	413,90	413,10	413,30	412,90	413,70
1024210	VM1698-4	Grad	30,75	30,50	28,50	30,00	30,75	30,50	30,00	29,00	29,25	29,75

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	415,30	414,70	412,70	413,30	413,10	411,90	413,30	415,10	414,30	414,50
1024210	VM1698-4	Grad	28,75	31,00	28,75	29,75	30,00	29,25	28,75	29,25	29,75	29,00

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	413,10	413,50	413,50	413,50	413,30	413,30	414,10	413,90	413,70	413,10
1024210	VM1698-4	Grad	29,00	30,75	31,50	29,75	30,75	31,00	29,50	29,00	31,00	30,25

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	413,70	413,50	412,70	413,30	413,90	414,50	414,10	414,50	414,10	413,70
1024210	VM1698-4	Grad	29,50	29,50	30,25	31,25	29,50	29,75	29,00	30,00	31,25	29,00

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 04.05.2022

Serial No.	1016282_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.: 9.377 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	415,10	414,30	413,90	412,50	414,30	414,30	412,90	414,10	413,10	413,90
1024210	VM1698-4	Grad	28,00	29,25	30,25	29,50	30,50	30,75	31,50	29,75	31,25	31,25

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	414,10	413,90	413,50	412,70	414,30	413,30	414,10	413,30	413,90	413,10
1024210	VM1698-4	Grad	28,25	29,75	30,00	30,25	30,75	28,75	30,75	29,50	28,50	30,50

Machine Capability Study
Tool System

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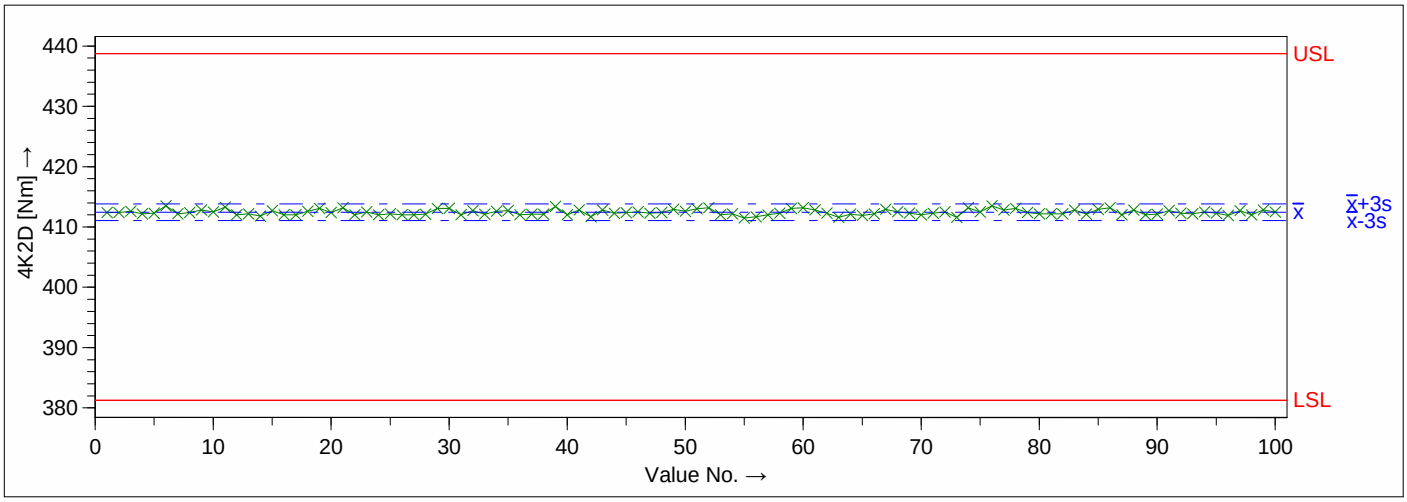
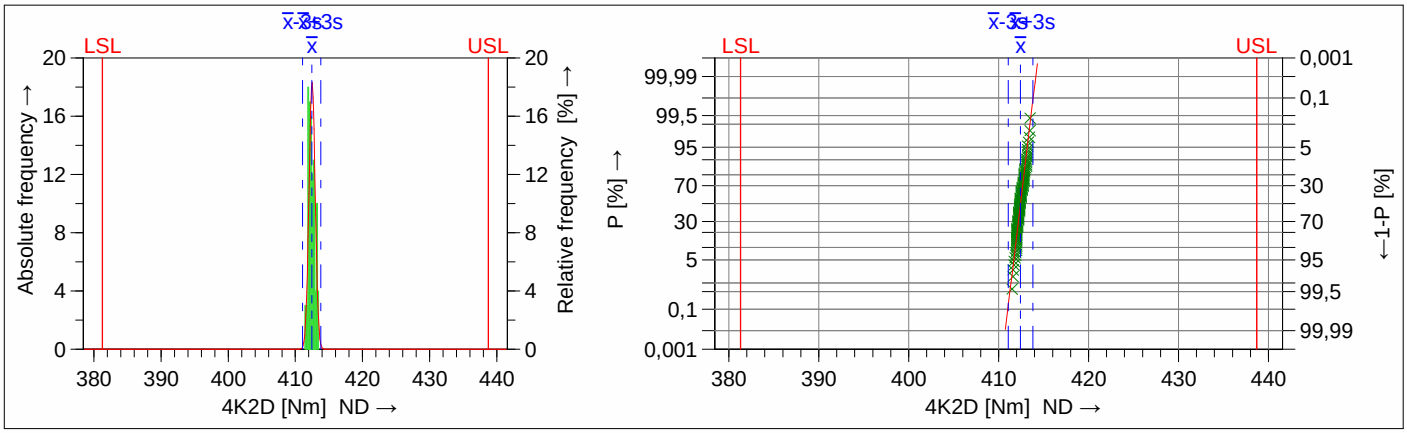
Plant	ATG Westhausen	Operator Name	Sünder
Date	04.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016282_h	Char.Descr.	4K2D	Nom.val. 410,00 28,70	USL 438,70
		Serial No.	204575	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 04.05.2022 12:55:31 to 04.05.2022 13:10:21

Rem. TQ 80% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.377 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	410.00			$\bar{x}$	412.4310
LSL	381.30	x_{min}	411.50	$\bar{x}$-3s	411.0667
USL	438.70	x_{max}	413.50	$\bar{x}$+3s	413.7953
T	57.40	R	2.00	6s	2.7286
		$n_{<T>}$	100	$p_{<T>}$	100.00000 %
		$n_{>USL}$	0	$p_{>USL}$	0.00000%
		$n_{<LSL}$	0	$p_{<LSL}$	0.00000%
		n_{eff}	100		
		n_{tot}	100		

Model distribution		Normal Distribution	
Calculation method		M1.1.4 $\hat{\sigma} = S_{tot}$	
Potential Capability index	=	C_m	21.04
Critical capability index	=	C_{mk}	19.25

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 04.05.2022

Serial No.	1016282_h	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	410,00
Ord. No.	4BD500T1S-A	Serial No.	204575	LSL	381,30
				USL	438,70
Remark	TQ 80% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.377 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}
204575	4K2D	Nm	412,40	412,40	412,60	412,20	412,30	413,50	412,20	412,40	412,80	412,50
204575	4K2D	Grad	31,00	30,00	31,00	30,00	30,00	30,00	31,00	30,00	31,00	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}
204575	4K2D	Nm	413,30	412,00	412,20	411,80	412,70	412,00	412,00	412,60	413,10	412,40
204575	4K2D	Grad	31,00	30,00	30,00	31,00	30,00	30,00	32,00	31,00	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}
204575	4K2D	Nm	413,20	412,00	412,50	412,00	412,20	412,00	412,00	412,10	413,10	413,10
204575	4K2D	Grad	30,00	31,00	30,00	30,00	30,00	32,00	31,00	30,00	31,00	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}
204575	4K2D	Nm	412,00	412,70	412,10	412,60	412,70	412,00	412,10	412,10	413,40	412,00
204575	4K2D	Grad	31,00	32,00	29,00	30,00	30,00	30,00	31,00	30,00	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}
204575	4K2D	Nm	412,80	411,70	412,80	412,30	412,40	412,50	412,30	412,40	412,90	412,60
204575	4K2D	Grad	31,00	31,00	29,00	31,00	31,00	31,00	31,00	30,00	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}
204575	4K2D	Nm	413,00	413,20	412,00	412,20	411,50	411,70	412,00	412,30	413,10	413,20
204575	4K2D	Grad	30,00	32,00	29,00	30,00	31,00	30,00	29,00	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}
204575	4K2D	Nm	412,80	412,30	411,60	412,10	411,90	412,20	412,90	412,50	412,30	412,00
204575	4K2D	Grad	30,00	31,00	32,00	30,00	32,00	32,00	30,00	29,00	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}
204575	4K2D	Nm	412,30	412,50	411,60	413,20	412,50	413,50	412,80	413,10	412,40	412,20
204575	4K2D	Grad	30,00	30,00	31,00	32,00	30,00	31,00	29,00	31,00	31,00	30,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 04.05.2022

Serial No.	1016282_h	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	410,00
Ord. No.	4BD500T1S-A	Serial No.	204575	LSL	381,30
				USL	438,70
Remark	TQ 80% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.377 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}
204575	4K2D	Nm	412,20	412,20	412,80	412,10	412,90	413,20	412,00	412,80	412,00	412,10
204575	4K2D	Grad	29,00	31,00	31,00	30,00	31,00	32,00	32,00	31,00	31,00	32,00

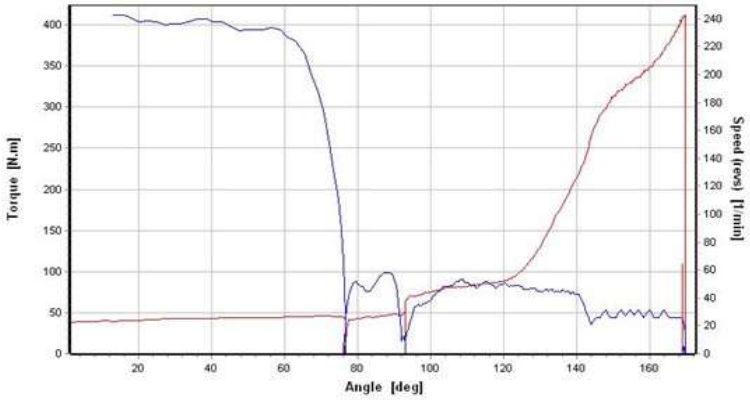
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204575	4K2D	Nm	412,70	412,30	412,20	412,50	412,30	411,90	412,70	412,00	412,80	412,50
204575	4K2D	Grad	29,00	30,00	31,00	31,00	31,00	30,00	31,00	30,00	30,00	32,00

Torque graphs

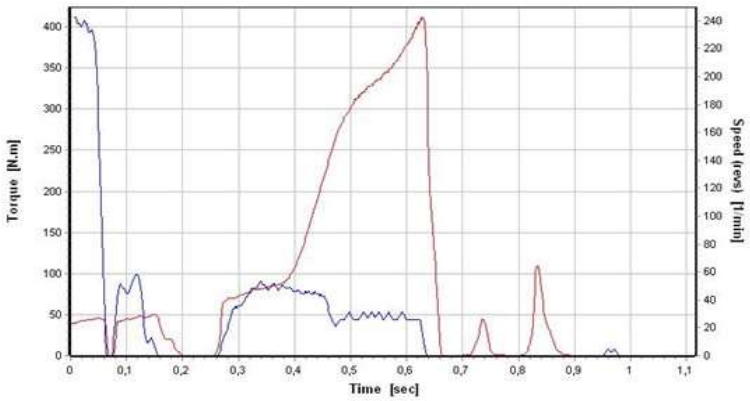
Machine Capability Study 80 %

Model: **4BD-4B500A-4K2D-4ZA**
Serial no: **1016282**

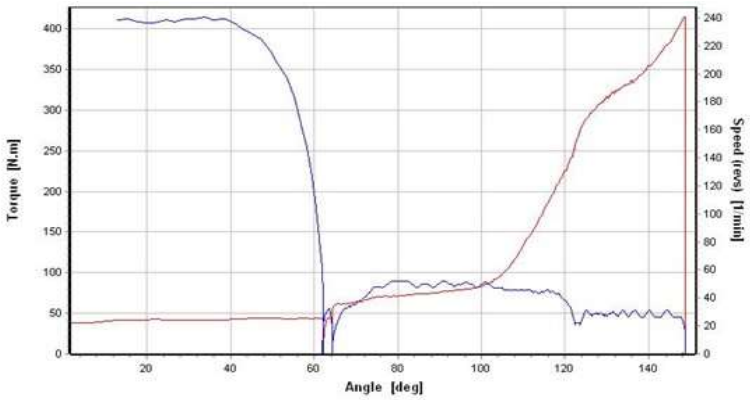
Angle degree: **30°**
Test torque: **410,0 Nm**



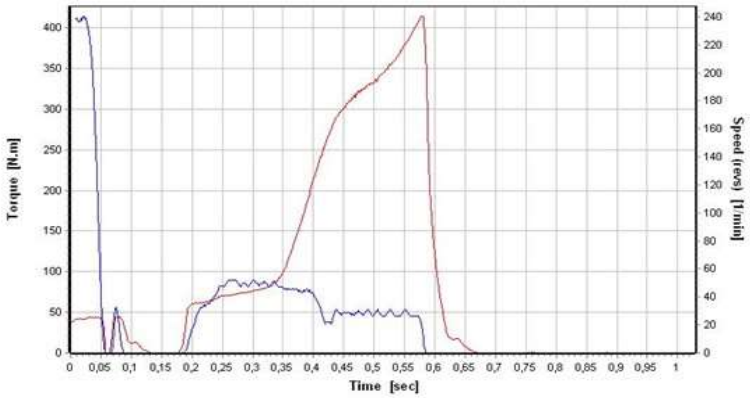
Value no. 1
Graph
Torque / Angle / Speed



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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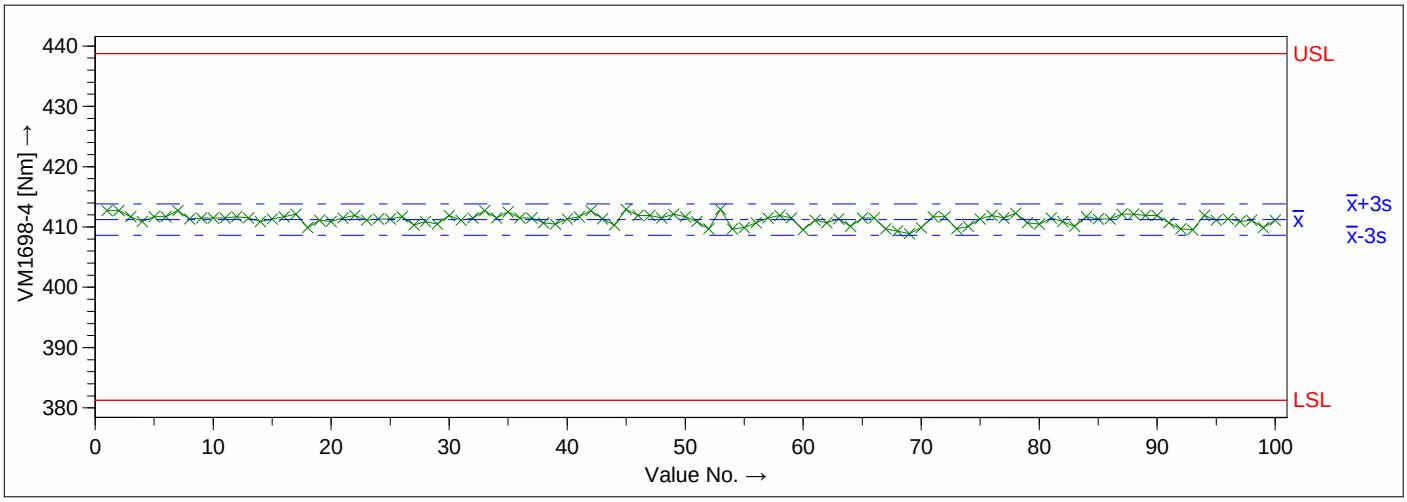
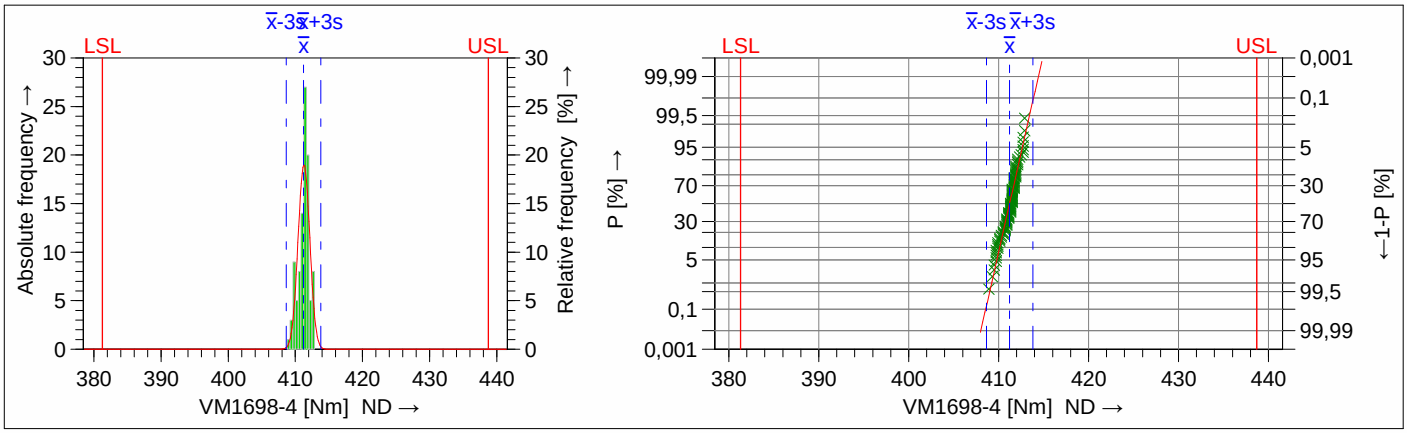
Plant	ATG Westhausen	Operator Name	Sünder
Date	03.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016282_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 03.05.2022 15:45:45 to 03.05.2022 17:36:33

Rem. TQ 80% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.377 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	410.00			$\bar{x}$	411.2180
LSL	381.30	x_{min}	408.90	$\bar{x}$-3s	408.6382
USL	438.70	x_{max}	412.90	$\bar{x}$+3s	413.7978
T	57.40	R	4.00	6s	5.1595
		$n_{<T>}$	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	11.13
Critical capability index	=	C_{mk}	10.65

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 03.05.2022

Serial No.	1016282_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.: 9.377 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	412,70	412,70	411,70	410,90	411,70	411,70	412,70	411,30	411,50	411,50
1024210	VM1698-4	Grad	347,75	355,50	354,50	358,75	368,00	348,00	352,75	359,75	353,75	348,00

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}
1024210	VM1698-4	Nm	411,50	411,70	411,50	410,90	411,30	411,70	412,10	409,90	411,10	410,90
1024210	VM1698-4	Grad	355,00	354,25	352,50	331,25	359,75	365,75	346,50	355,50	356,50	350,50

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	411,50	411,90	411,10	411,30	411,30	411,70	410,30	410,90	410,50	411,90
1024210	VM1698-4	Grad	344,00	375,25	361,25	353,50	370,50	366,25	359,25	371,25	360,75	361,00

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	411,10	411,50	412,70	411,50	412,50	411,50	411,50	410,70	410,50	411,30
1024210	VM1698-4	Grad	362,25	345,25	372,75	347,50	358,75	364,00	358,00	350,25	354,00	355,50

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	411,70	412,70	411,30	410,30	412,90	411,90	411,90	411,50	412,10	411,70
1024210	VM1698-4	Grad	360,50	363,50	344,00	347,50	352,00	364,00	365,50	371,25	339,25	350,50

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	410,90	409,70	412,90	409,70	409,90	410,70	411,50	411,90	411,50	409,50
1024210	VM1698-4	Grad	353,75	346,25	350,00	348,50	351,75	350,75	383,00	369,25	341,50	351,75

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	411,10	410,70	411,30	410,10	411,50	411,50	409,70	409,30	408,90	409,90
1024210	VM1698-4	Grad	345,00	361,50	369,75	352,50	357,50	362,75	348,00	355,25	349,00	349,25

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	411,70	411,70	409,70	410,10	411,30	411,90	411,50	412,30	410,70	410,50
1024210	VM1698-4	Grad	362,25	345,25	350,25	352,75	358,25	361,75	352,25	356,75	353,00	356,50

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 03.05.2022

Serial No.	1016282_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.: 9.377 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	411,50	410,90	410,10	411,70	411,30	411,30	412,10	412,10	411,90	411,90
1024210	VM1698-4	Grad	357,00	362,25	356,50	357,50	358,50	358,00	348,00	353,50	367,25	352,75

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	410,70	409,70	409,50	411,90	411,10	411,30	410,90	411,10	409,90	411,10
1024210	VM1698-4	Grad	369,75	347,50	354,75	340,50	368,00	349,50	354,00	361,25	340,75	333,25

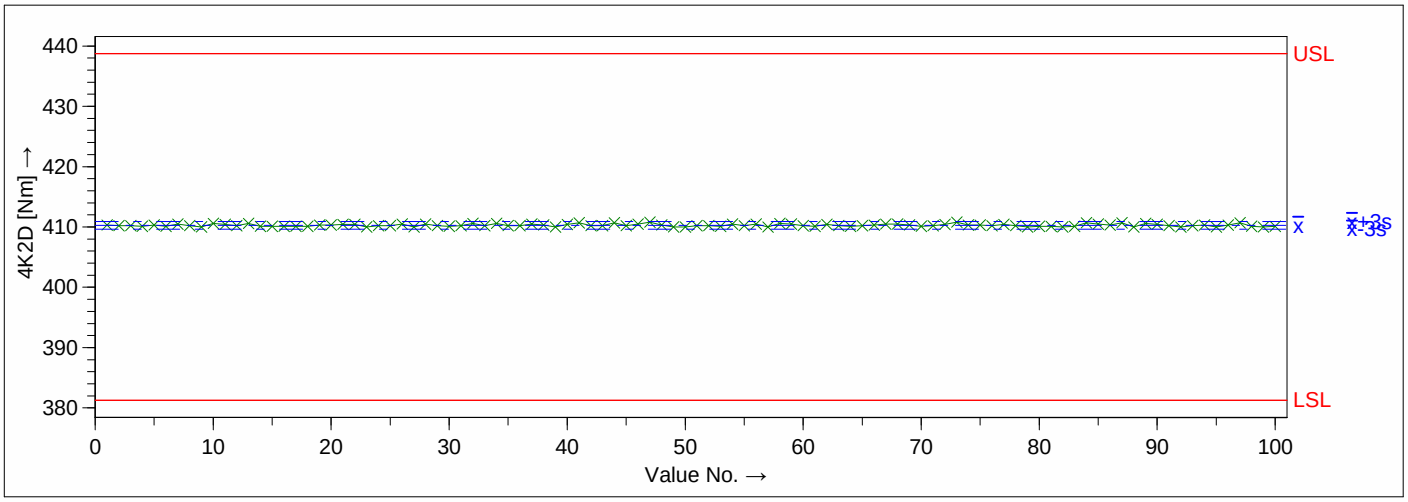
Machine Capability Study
Tool System

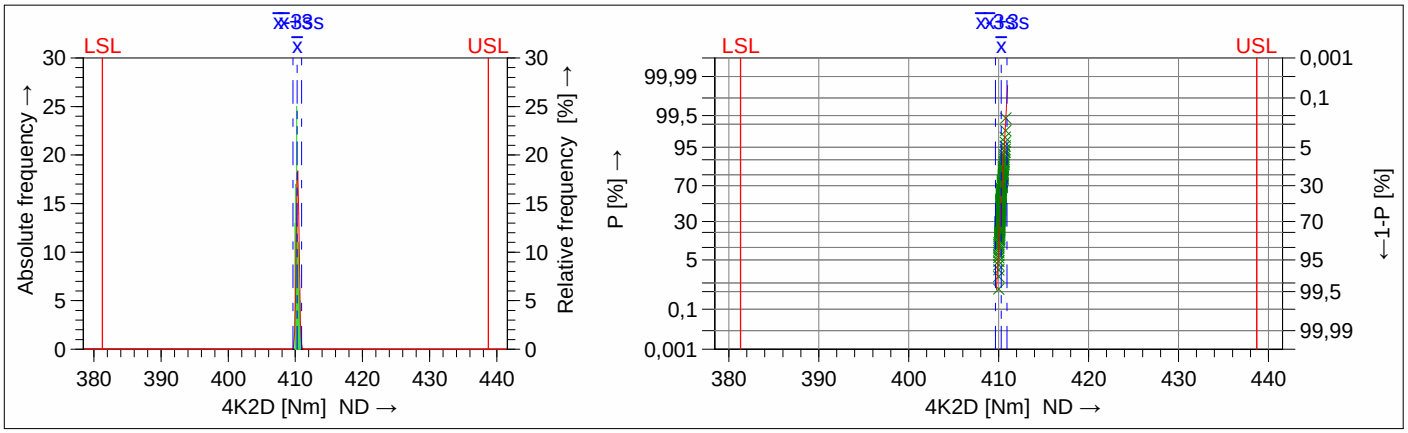
Plant	ATG Westhausen	Operator Name	Sünder
Date	03.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016282_g	Char.Descr.	4K2D	Nom.val. 410,00 28,70	USL 438,70
		Serial No.	204575	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 03.05.2022 15:45:45 to 03.05.2022 17:36:33

Rem. TQ 80% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.377 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	410.00			$\bar{x}$	410.2800
LSL	381.30	x_{min}	410.00	$\bar{x}$-3s	409.6461
USL	438.70	x_{max}	410.80	$\bar{x}$+3s	410.9139
T	57.40	R	0.80	6s	1.2678
		$n_{<T>}$	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	45.28
Critical capability index	=	C_{mk}	44.83

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 03.05.2022

Serial No.	1016282_g	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	410,00
Ord. No.	4BD500T1S-A	Serial No.	204575	LSL	381,30
				USL	438,70
Remark	TQ 80% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.377 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}
204575	4K2D	Nm	410,30	410,20	410,20	410,10	410,30	410,10	410,50	410,20	410,00	410,60
204575	4K2D	Grad	349,00	359,00	356,00	359,00	368,00	350,00	356,00	363,00	353,00	352,00

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}
204575	4K2D	Nm	410,40	410,20	410,60	410,10	410,10	410,10	410,10	410,10	410,30	410,30
204575	4K2D	Grad	358,00	356,00	361,00	332,00	360,00	366,00	346,00	360,00	366,00	367,00

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}
204575	4K2D	Nm	410,40	410,40	410,00	410,20	410,20	410,50	410,00	410,50	410,20	410,10
204575	4K2D	Grad	345,00	375,00	367,00	367,00	370,00	367,00	365,00	377,00	361,00	362,00

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}
204575	4K2D	Nm	410,20	410,60	410,20	410,60	410,20	410,20	410,50	410,30	410,00	410,40
204575	4K2D	Grad	363,00	347,00	373,00	348,00	359,00	365,00	361,00	357,00	355,00	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}
204575	4K2D	Nm	410,70	410,20	410,20	410,70	410,20	410,50	410,80	410,30	410,00	410,00
204575	4K2D	Grad	365,00	361,00	348,00	352,00	352,00	364,00	366,00	372,00	343,00	354,00

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}
204575	4K2D	Nm	410,20	410,20	410,10	410,50	410,20	410,50	410,00	410,60	410,50	410,20
204575	4K2D	Grad	355,00	349,00	351,00	352,00	354,00	352,00	386,00	371,00	343,00	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}
204575	4K2D	Nm	410,10	410,40	410,20	410,10	410,20	410,30	410,50	410,50	410,30	410,10
204575	4K2D	Grad	348,00	367,00	372,00	356,00	361,00	364,00	353,00	358,00	353,00	352,00

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}
204575	4K2D	Nm	410,20	410,40	410,80	410,30	410,30	410,20	410,40	410,20	410,00	410,10
204575	4K2D	Grad	362,00	347,00	358,00	353,00	360,00	364,00	355,00	357,00	360,00	360,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 03.05.2022

Serial No.	1016282_g	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	410,00
Ord. No.	4BD500T1S-A	Serial No.	204575	LSL	381,30
				USL	438,70
Remark	TQ 80% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.377 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}
204575	4K2D	Nm	410,10	410,00	410,10	410,70	410,50	410,30	410,70	410,00	410,60	410,40
204575	4K2D	Grad	357,00	364,00	357,00	357,00	359,00	355,00	350,00	361,00	369,00	354,00

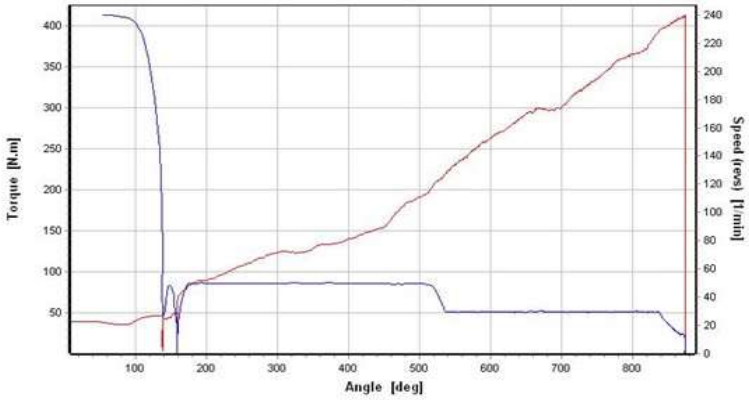
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204575	4K2D	Nm	410,20	410,00	410,20	410,30	410,00	410,30	410,70	410,10	410,00	410,10
204575	4K2D	Grad	371,00	353,00	363,00	343,00	369,00	351,00	358,00	376,00	354,00	343,00

Torque graphs

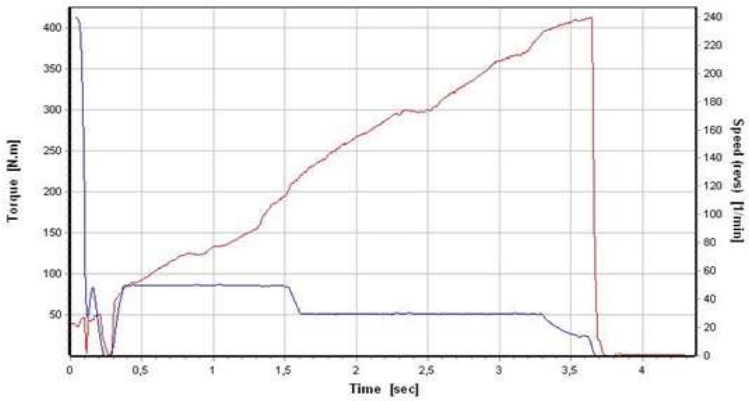
Machine Capability Study 80 %

Model: **4BD-4B500A-4K2D-4ZA**
Serial no: **1016282**

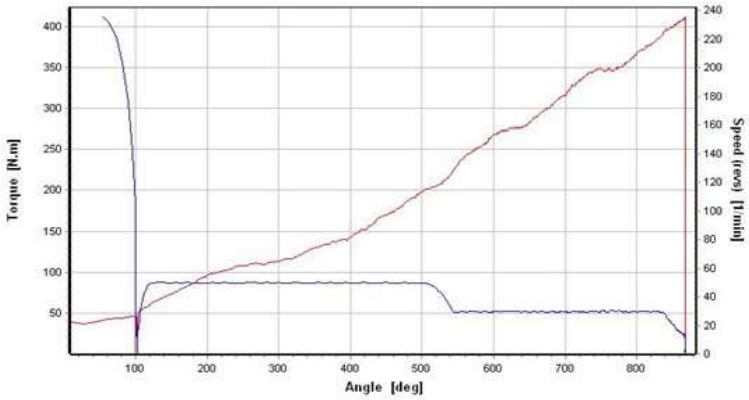
Angle degree: **360°**
Test torque: **410,0 Nm**



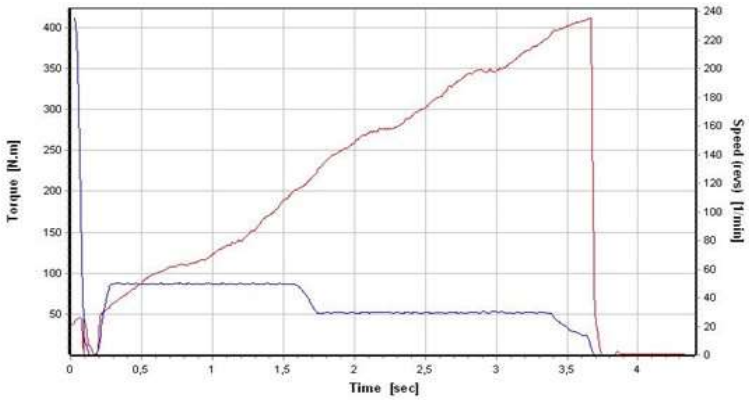
Value no. 1
Graph
Torque / Angle / Speed



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: **1016282**

Test torque: Tq max. 500,00 Nm

Hard joint (H)	3017,50	Nm / Revolution	Angle degree	30°
Soft joint (L)	250,43	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	502,92	500,85 Nm
	Standard deviation	0,79	0,74 Nm
	Torque scatter (99,73%)	4,74	4,46 Nm
	C_m	14,76	15,70
	C_{mk}	13,53	15,31

b)	Min. C_m hard/soft (lowest value)	14,76
	Min. C_{mk} hard/soft (lowest value)	13,53

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

Note:

Machine Capability Study
Control System

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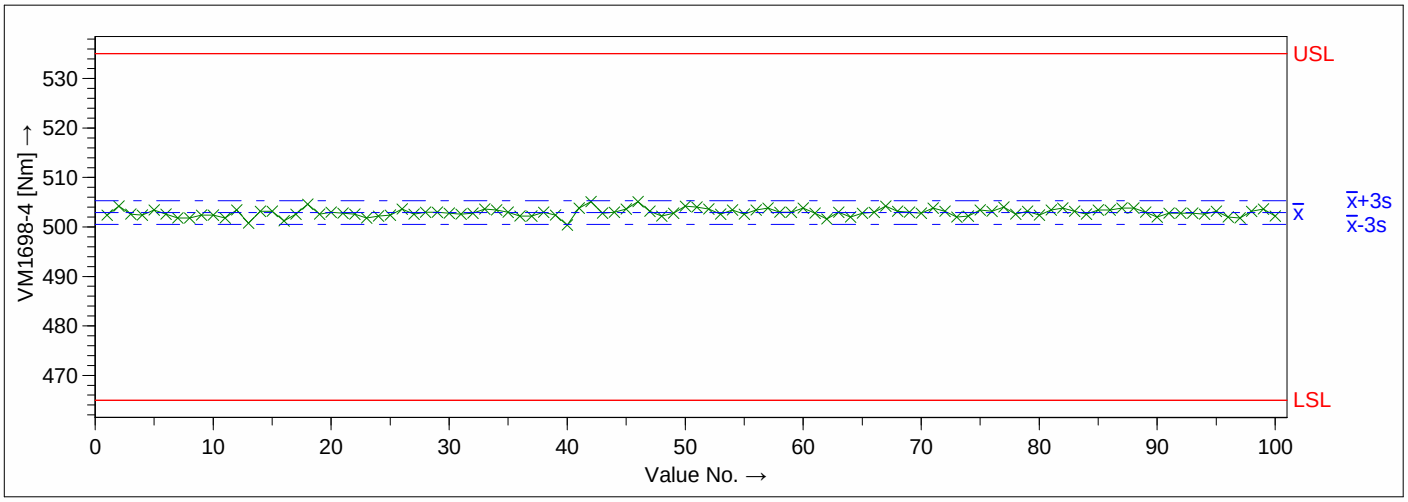
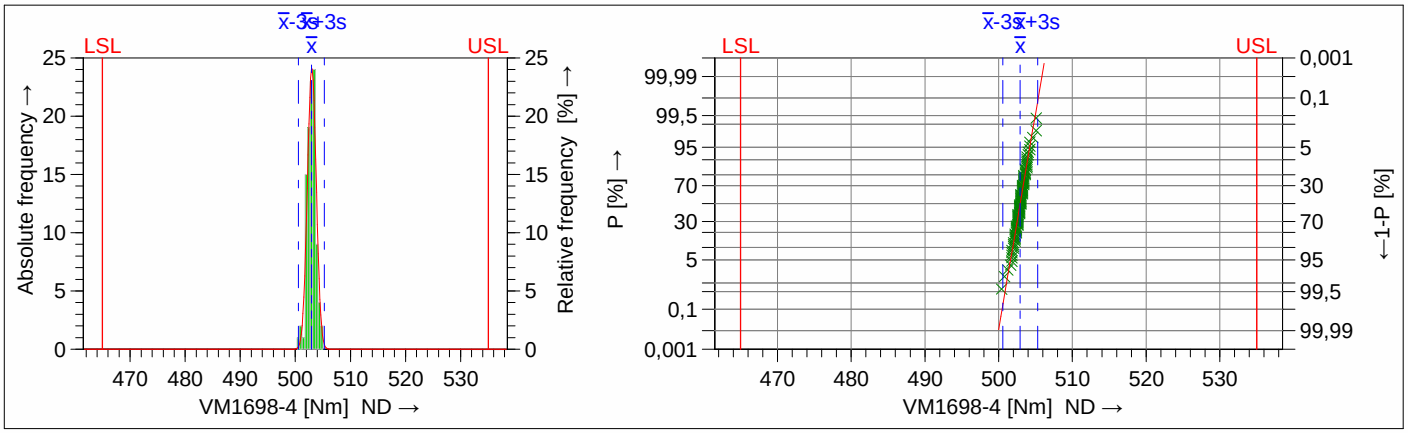
Plant	ATG Westhausen	Operator Name	Sünder
Date	04.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016282_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 04.05.2022 08:08:39 to 04.05.2022 08:23:29

Rem. TQ 100% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.446 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	500.00			$\bar{x}$	502.9160
LSL	465.00	x_{min}	500.40	$\bar{x}$-3s	500.5451
USL	535.00	x_{max}	505.10	$\bar{x}$+3s	505.2869
T	70.00	R	4.70	6s	4.7419
		$n_{<T>}$	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	14.76
Critical capability index	=	C_{mk}	13.53

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

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 04.05.2022

Serial No.	1016282_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.: 9.446 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	502,40	504,20	502,60	502,40	503,40	502,60	501,80	501,80	502,40	502,40
1024210	VM1698-4	Grad	29,75	30,25	29,00	29,25	29,75	28,75	30,00	31,75	29,00	29,75

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	501,80	503,40	500,80	503,20	503,20	501,20	502,60	504,60	502,60	503,00
1024210	VM1698-4	Grad	30,00	29,75	29,50	29,75	29,50	30,00	29,00	28,75	30,25	29,00

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	502,80	502,60	501,80	502,20	502,40	503,60	502,60	503,00	503,00	502,80
1024210	VM1698-4	Grad	30,75	28,50	31,25	28,00	30,75	30,25	28,00	29,75	28,50	30,25

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	502,60	502,80	503,60	503,40	503,00	502,20	502,20	503,00	502,40	500,40
1024210	VM1698-4	Grad	30,00	30,00	29,00	30,00	28,75	31,50	29,25	31,00	28,50	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	503,80	505,10	502,80	503,00	503,60	505,10	503,20	502,20	502,80	504,20
1024210	VM1698-4	Grad	28,50	29,25	29,25	30,00	28,00	30,25	28,75	28,75	30,00	29,25

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	504,00	503,60	502,60	503,40	502,60	503,40	503,80	503,00	503,00	503,80
1024210	VM1698-4	Grad	29,75	29,50	30,75	28,00	29,75	29,00	29,50	29,00	30,00	28,50

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	502,80	501,60	503,00	502,00	502,80	503,00	504,20	503,20	503,00	502,80
1024210	VM1698-4	Grad	30,75	28,00	30,75	29,00	30,50	28,75	30,00	28,75	30,25	28,50

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	503,80	503,20	502,00	502,20	503,40	503,20	504,00	502,60	503,20	502,40
1024210	VM1698-4	Grad	30,75	28,75	30,00	29,25	30,25	28,75	28,00	29,50	28,50	29,50

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 04.05.2022

Serial No.	1016282_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.: 9.446 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	503,40	503,80	503,20	502,60	503,40	503,40	503,80	503,80	503,00	502,00
1024210	VM1698-4	Grad	30,00	30,00	28,50	30,50	29,00	31,00	29,75	30,25	28,25	30,00

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}
1024210	VM1698-4	Nm	502,80	502,80	502,80	502,60	503,20	502,00	501,80	503,20	503,60	502,20
1024210	VM1698-4	Grad	29,75	31,00	30,50	28,75	31,50	30,00	31,50	29,75	28,25	31,50

Machine Capability Study
Tool System

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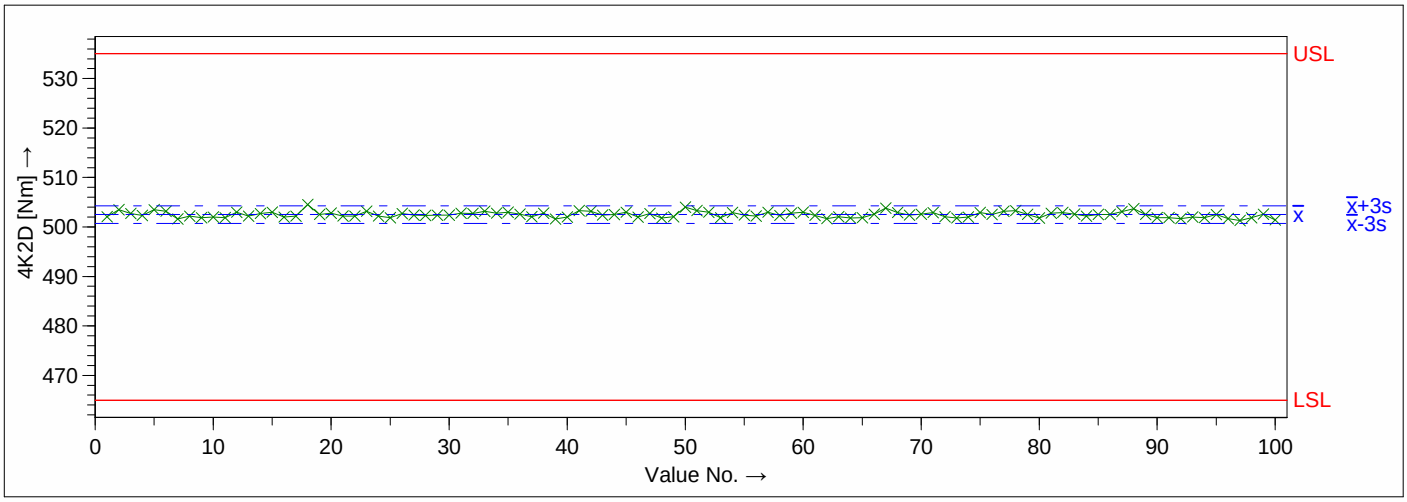
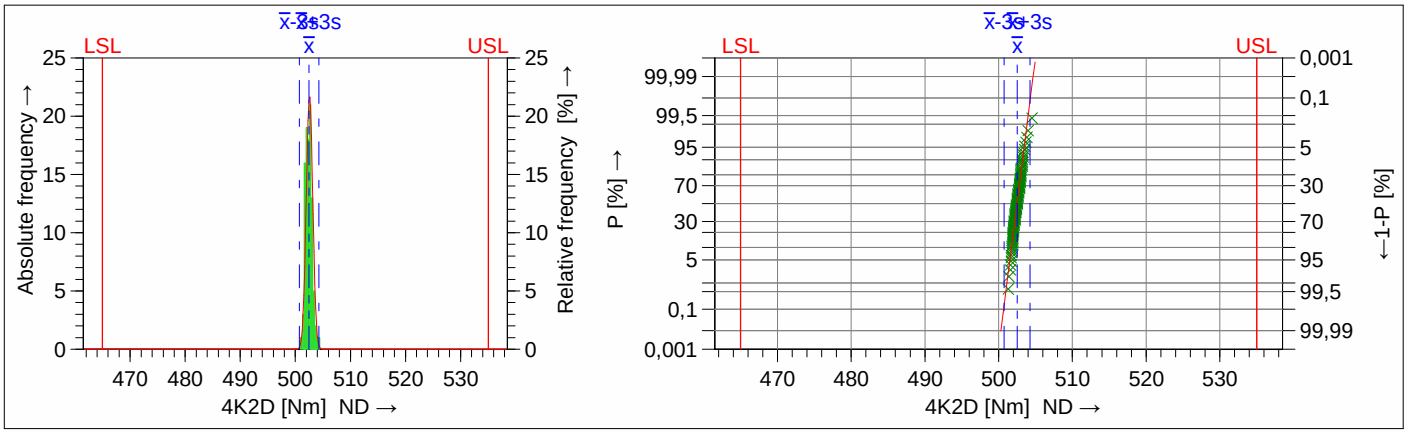
Plant	ATG Westhausen	Operator Name	Sünder
Date	04.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016282_b	Char.Descr.	4K2D	Nom.val.	500,00 35,00
		Serial No.	204575	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 04.05.2022 08:08:39 to 04.05.2022 08:23:30

Rem. TQ 100% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.446 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	500.00			$\bar{x}$	502.4980
LSL	465.00	x_{min}	501.30	$\bar{x}$-3s	500.7378
USL	535.00	x_{max}	504.50	$\bar{x}$+3s	504.2582
T	70.00	R	3.20	6s	3.5203
		$n_{<T>}$	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	19.88
Critical capability index	=	C_{mk}	18.47

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 04.05.2022

Serial No.	1016282_b	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	500,00
Ord. No.	4BD500T1S-A	Serial No.	204575	LSL	465,00
				USL	535,00
Remark	TQ 100% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.446 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}
204575	4K2D	Nm	502,10	503,50	502,70	502,30	503,50	503,20	501,60	502,20	501,90	502,00
204575	4K2D	Grad	30,00	31,00	30,00	31,00	31,00	30,00	31,00	33,00	30,00	30,00

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}
204575	4K2D	Nm	501,90	503,00	502,20	502,70	503,00	502,00	502,20	504,50	502,50	502,80
204575	4K2D	Grad	31,00	30,00	30,00	31,00	30,00	31,00	31,00	29,00	31,00	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}
204575	4K2D	Nm	502,20	502,20	503,20	502,20	501,90	502,70	502,40	502,30	502,40	502,40
204575	4K2D	Grad	32,00	29,00	32,00	29,00	32,00	31,00	29,00	30,00	29,00	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}
204575	4K2D	Nm	502,80	502,70	503,20	502,80	503,00	502,60	502,10	502,80	501,60	502,00
204575	4K2D	Grad	31,00	31,00	30,00	31,00	30,00	32,00	30,00	31,00	29,00	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}
204575	4K2D	Nm	503,30	503,20	502,40	502,50	503,00	502,00	502,70	501,80	502,10	504,00
204575	4K2D	Grad	29,00	30,00	31,00	31,00	29,00	31,00	30,00	30,00	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}
204575	4K2D	Nm	503,30	503,00	501,90	502,90	502,40	502,20	503,00	502,30	502,80	503,00
204575	4K2D	Grad	31,00	31,00	31,00	29,00	30,00	30,00	31,00	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}
204575	4K2D	Nm	502,30	501,70	502,10	501,80	501,90	502,60	503,80	502,90	502,40	502,60
204575	4K2D	Grad	32,00	29,00	31,00	29,00	31,00	29,00	31,00	29,00	31,00	29,00

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}
204575	4K2D	Nm	502,90	502,10	501,80	502,00	502,90	502,50	503,20	503,30	502,50	501,80
204575	4K2D	Grad	31,00	29,00	31,00	30,00	31,00	29,00	29,00	31,00	29,00	30,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 04.05.2022

Serial No.	1016282_b	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	500,00
Ord. No.	4BD500T1S-A	Serial No.	204575	LSL	465,00
				USL	535,00
Remark	TQ 100% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.446 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}
204575	4K2D	Nm	502,80	502,90	502,60	502,20	502,50	502,50	503,10	503,70	502,50	501,90
204575	4K2D	Grad	31,00	31,00	30,00	31,00	30,00	32,00	30,00	31,00	30,00	31,00

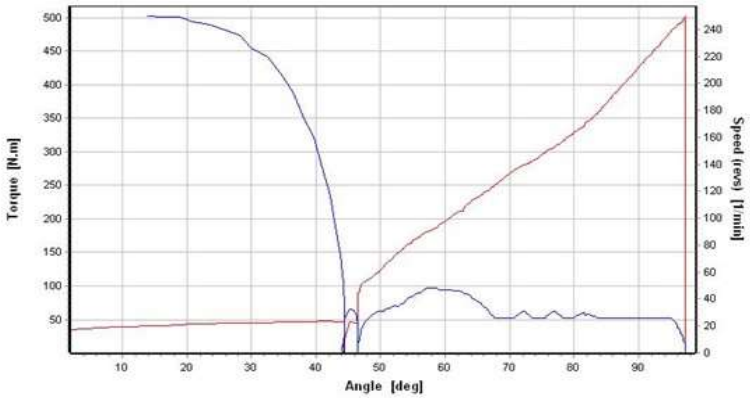
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204575	4K2D	Nm	501,90	501,70	502,00	501,90	502,50	501,70	501,30	501,90	502,60	501,40
204575	4K2D	Grad	31,00	32,00	31,00	30,00	32,00	31,00	32,00	31,00	29,00	32,00

Torque graphs

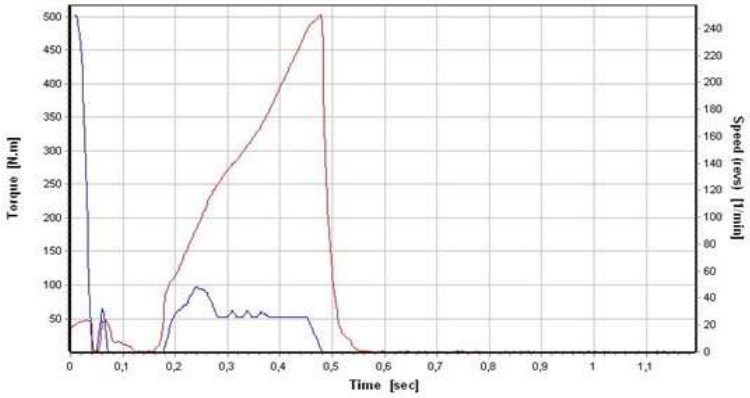
Machine Capability Study 100 %

Model: **4BD-4B500A-4K2D-4ZA**
Serial no: **1016282**

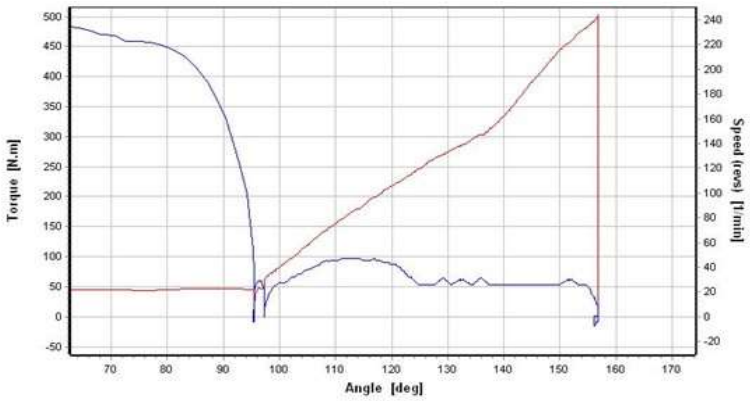
Angle degree: **30°**
Test torque: **500,0 Nm**



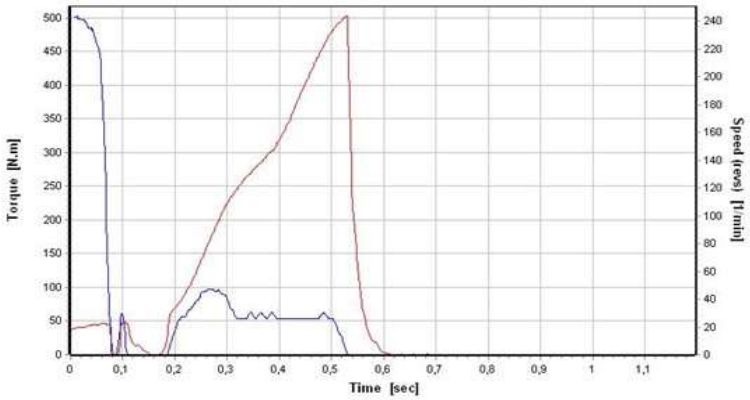
Value no. 1
Graph
Torque / Angle / Speed



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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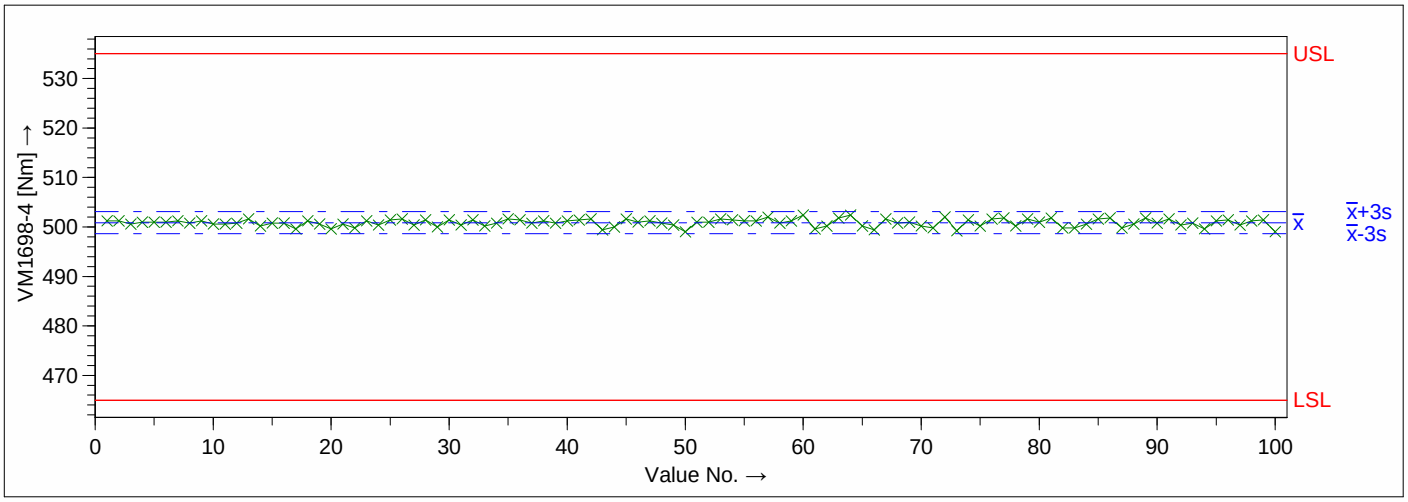
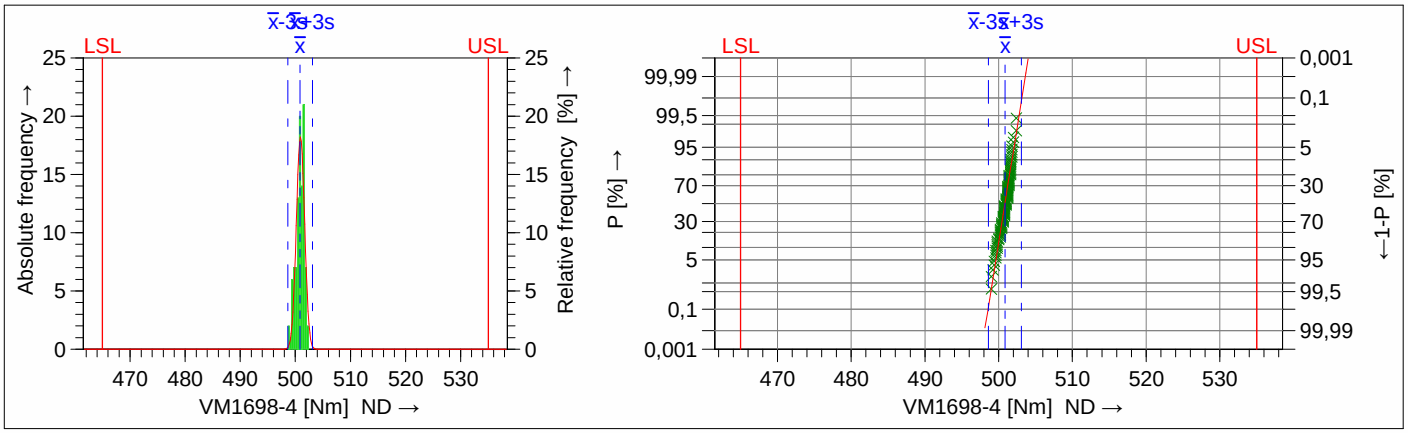
Plant	ATG Westhausen	Operator Name	Sünder
Date	04.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016282_a	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 04.05.2022 10:03:25 to 04.05.2022 12:17:39

Rem. TQ 100% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.446 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	500.00			$\bar{x}$	500.8520
LSL	465.00	x_{min}	499.00	$\bar{x}$-3s	498.6223
USL	535.00	x_{max}	502.40	$\bar{x}$+3s	503.0817
T	70.00	R	3.40	6s	4.4595
		$n_{<T>}$	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	15.70
Critical capability index	=	C_{mk}	15.31

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 04.05.2022

Serial No.	1016282_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.: 9.446 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	501,20	501,20	500,60	501,00	501,00	501,00	501,20	500,80	501,20	500,60
1024210	VM1698-4	Grad	336,00	349,25	353,75	358,00	338,00	350,00	338,25	362,50	344,25	343,50

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	500,60	500,80	501,60	500,20	500,80	500,80	499,60	501,20	500,60	499,60
1024210	VM1698-4	Grad	355,50	362,00	360,00	355,25	345,00	362,25	355,25	340,75	358,25	348,75

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	500,60	499,80	501,20	500,40	501,40	501,60	500,40	501,40	500,00	501,40
1024210	VM1698-4	Grad	368,00	366,75	368,00	366,00	342,00	371,00	338,50	344,75	375,00	352,25

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	500,40	501,40	500,20	500,80	501,60	501,40	500,80	501,20	500,80	501,20
1024210	VM1698-4	Grad	394,50	365,00	361,50	375,00	364,75	356,25	352,25	358,25	357,50	353,25

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	501,40	501,60	499,40	500,00	501,60	501,00	501,20	500,80	500,40	499,00
1024210	VM1698-4	Grad	353,00	364,50	361,00	362,25	370,50	346,00	360,50	347,75	343,50	350,75

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	501,00	501,00	501,60	501,40	501,20	501,20	502,00	500,80	501,20	502,40
1024210	VM1698-4	Grad	374,50	368,50	365,25	367,25	371,25	361,50	371,00	354,00	364,25	362,00

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	499,60	500,20	501,80	502,40	500,20	499,40	501,60	500,80	501,00	500,20
1024210	VM1698-4	Grad	358,00	352,25	355,50	355,25	361,25	350,00	340,00	351,00	358,00	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}
1024210	VM1698-4	Nm	499,80	502,00	499,20	501,40	500,20	501,60	501,80	500,20	501,60	501,00
1024210	VM1698-4	Grad	350,00	352,75	345,25	363,00	350,25	363,75	374,75	352,25	352,25	385,00

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 04.05.2022

Serial No.	1016282_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.: 9.446 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	501,80	499,80	499,80	500,60	501,60	501,80	499,80	500,60	501,80	500,80
1024210	VM1698-4	Grad	366,25	353,25	368,75	347,00	373,50	356,75	370,75	369,25	355,75	365,25

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	501,60	500,40	500,80	499,60	501,20	501,40	500,40	501,20	501,40	499,00
1024210	VM1698-4	Grad	364,25	361,50	348,25	350,25	369,00	377,75	353,00	365,00	355,25	350,75

Machine Capability Study
Control System

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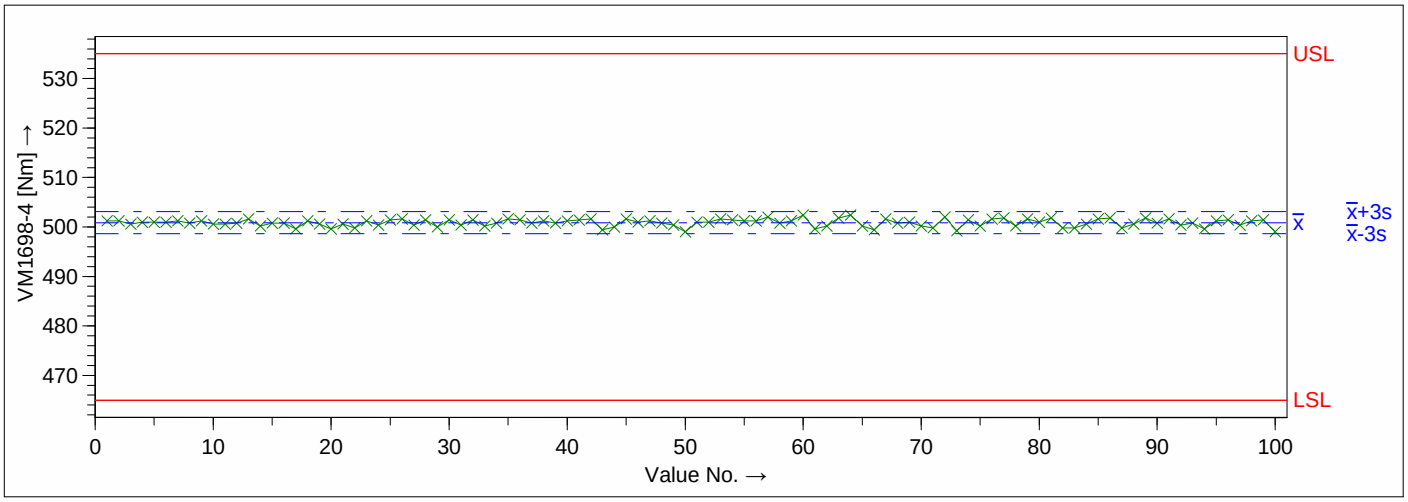
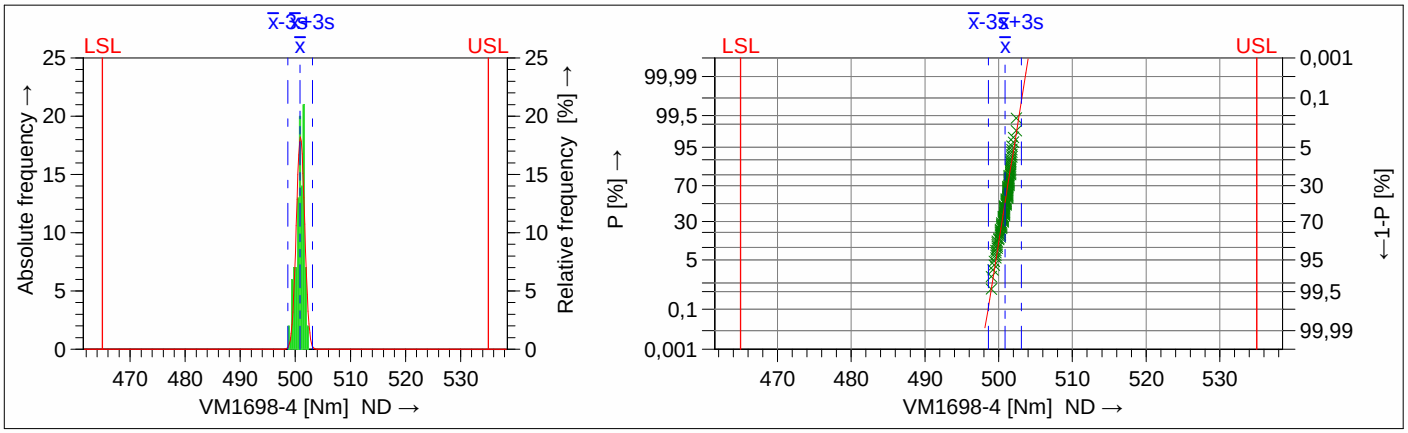
Plant	ATG Westhausen	Operator Name	Sünder
Date	04.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016282_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 04.05.2022 10:03:25 to 04.05.2022 12:17:39

Rem. TQ 100% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.446 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	500.00			$\bar{x}$	500.8520
LSL	465.00	x_{min}	499.00	$\bar{x}$-3s	498.6223
USL	535.00	x_{max}	502.40	$\bar{x}$+3s	503.0817
T	70.00	R	3.40	6s	4.4595
		$n_{<T>}$	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	15.70
Critical capability index	=	C_{mk}	15.31

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 04.05.2022

Serial No.	1016282_a	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	500,00
Ord. No.	4BD500T1S-A	Serial No.	204575	LSL	465,00
				USL	535,00
Remark	TQ 100% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.446 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}
204575	4K2D	Nm	500,90	500,70	500,30	500,40	500,60	501,10	500,70	500,00	500,40	500,20
204575	4K2D	Grad	337,00	353,00	354,00	358,00	340,00	351,00	340,00	363,00	347,00	346,00

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}
204575	4K2D	Nm	500,50	500,10	500,40	500,10	500,40	500,30	500,30	500,10	500,20	500,30
204575	4K2D	Grad	357,00	363,00	360,00	356,00	346,00	363,00	360,00	342,00	359,00	353,00

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}
204575	4K2D	Nm	500,20	500,70	500,10	500,30	500,50	501,30	500,40	501,00	500,10	500,60
204575	4K2D	Grad	369,00	370,00	369,00	367,00	343,00	372,00	340,00	346,00	380,00	353,00

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}
204575	4K2D	Nm	500,60	500,60	500,20	500,30	500,20	500,50	500,80	500,40	500,40	500,10
204575	4K2D	Grad	399,00	367,00	363,00	379,00	366,00	357,00	353,00	360,00	359,00	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}
204575	4K2D	Nm	500,20	500,10	500,20	500,80	500,90	500,40	500,50	500,30	500,30	500,10
204575	4K2D	Grad	354,00	366,00	363,00	367,00	369,00	349,00	361,00	350,00	345,00	352,00

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}
204575	4K2D	Nm	500,50	500,60	500,30	500,10	500,50	500,50	500,80	500,10	500,60	500,10
204575	4K2D	Grad	375,00	370,00	366,00	373,00	372,00	362,00	373,00	355,00	366,00	363,00

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}
204575	4K2D	Nm	500,30	500,50	500,40	500,60	500,00	500,20	500,30	500,80	500,40	500,50
204575	4K2D	Grad	363,00	354,00	356,00	357,00	367,00	354,00	351,00	352,00	358,00	361,00

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}
204575	4K2D	Nm	500,10	500,80	500,50	500,10	500,30	500,70	500,30	500,50	500,90	500,30
204575	4K2D	Grad	352,00	353,00	352,00	369,00	352,00	365,00	380,00	359,00	353,00	387,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 04.05.2022

Serial No.	1016282_a	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	500,00
Ord. No.	4BD500T1S-A	Serial No.	204575	LSL	465,00
				USL	535,00
Remark	TQ 100% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.446 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}
204575	4K2D	Nm	501,00	500,30	500,80	500,10	500,30	500,30	500,30	500,10	500,80	500,50
204575	4K2D	Grad	367,00	358,00	375,00	348,00	376,00	358,00	374,00	371,00	357,00	366,00

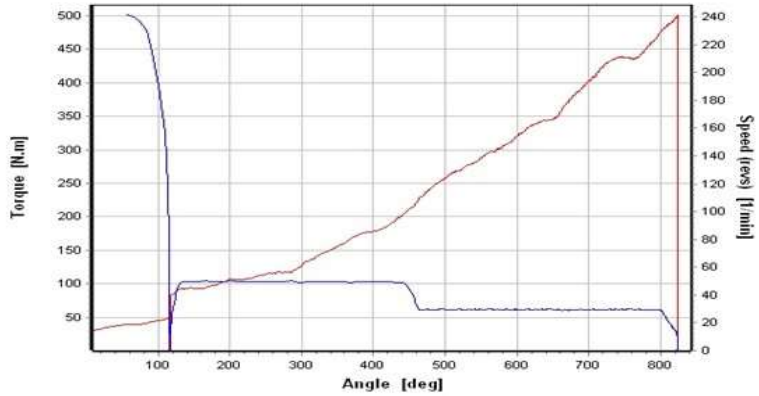
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204575	4K2D	Nm	500,60	500,20	500,70	500,20	500,20	500,60	500,20	500,40	500,80	500,20
204575	4K2D	Grad	367,00	363,00	350,00	352,00	370,00	379,00	355,00	366,00	357,00	355,00

Torque graphs

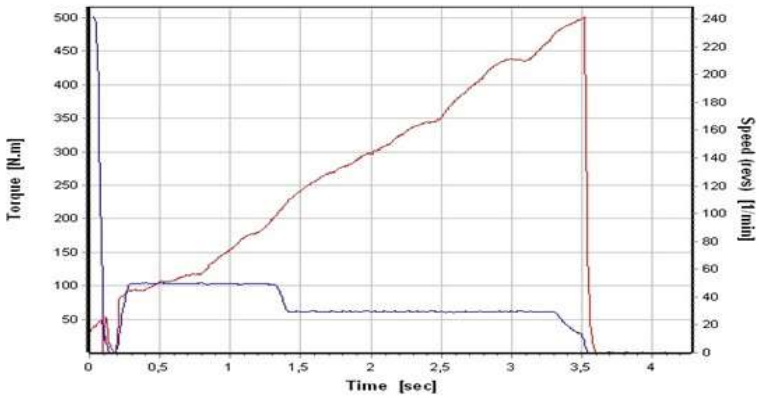
Machine Capability Study 100 %

Model: **4BD-4B500A-4K2D-4ZA**
Serial no: **1016282**

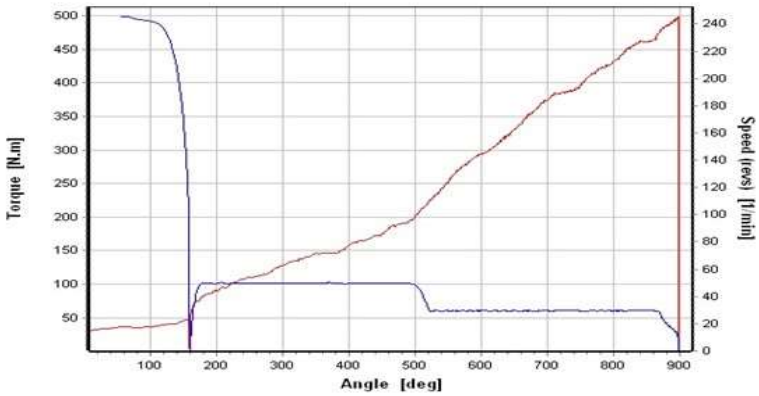
Angle degree: **360°**
Test torque: **500,0 Nm**



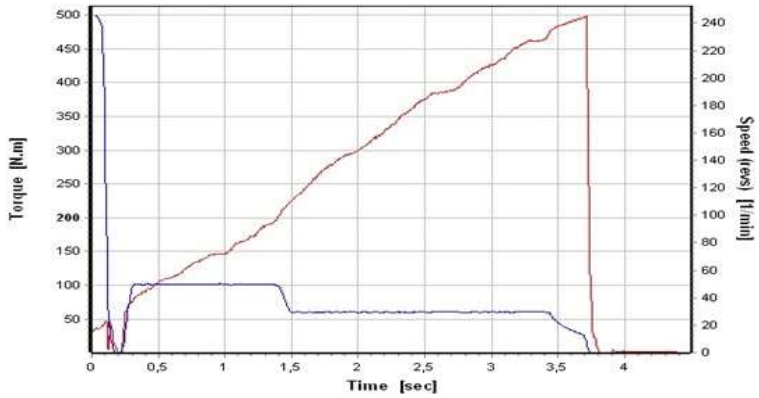
Value no. 1
Graph
Torque / Angle / Speed



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:** 1016282

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: 1,60 % ± **0,80 %**

Angle degree: 40° Tolerance: 2,8° ± **1,4°**

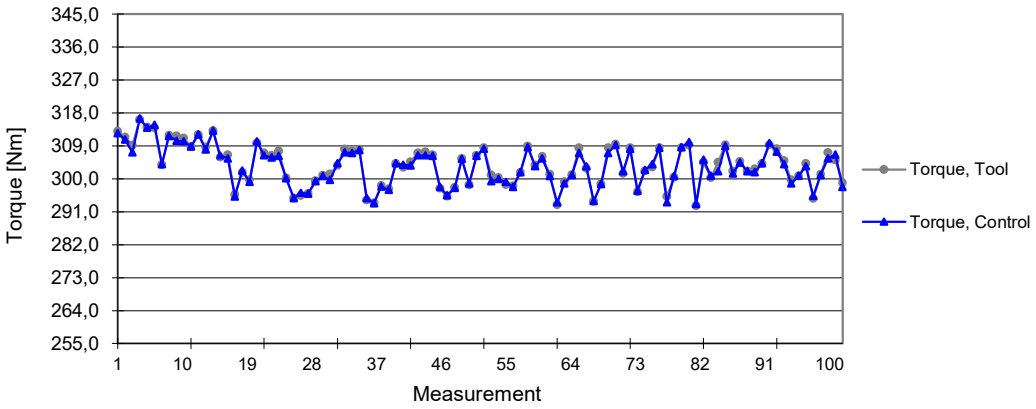
Formula derivation: $C_m = \frac{T}{6\,s}$ $T = C_m * 6\,s$

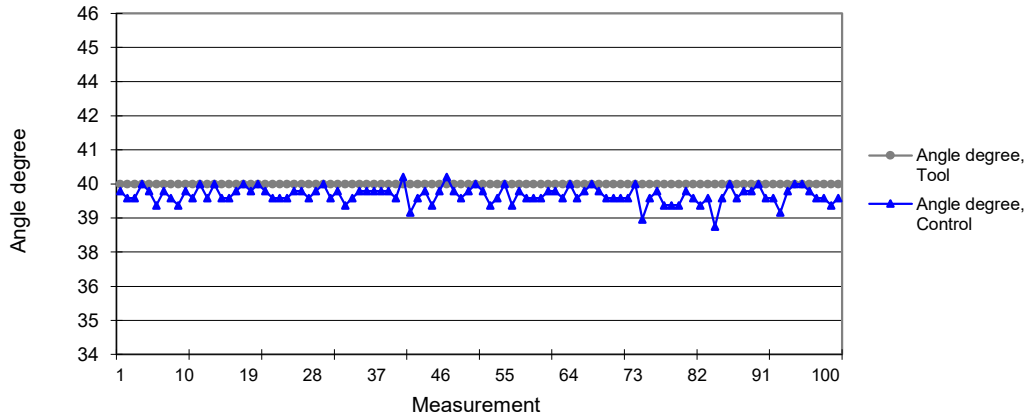
Tool without angle correction

Measurement	Tool data		Control data		Difference	
No.	Torque	Angle	Torque	Angle	Torque	Angle
1	313,00	40,00	312,50	39,75	0,50	0,25
2	311,30	40,00	310,70	39,50	0,60	0,50
3	309,10	40,00	307,20	39,50	1,90	0,50
4	316,20	40,00	316,50	40,00	0,30	0,00
5	314,10	40,00	313,90	39,75	0,20	0,25
6	313,90	40,00	314,70	39,25	0,80	0,75
7	303,80	40,00	304,00	39,75	0,20	0,25
8	311,80	40,00	311,70	39,50	0,10	0,50
9	311,70	40,00	310,40	39,25	1,30	0,75
10	311,10	40,00	310,20	39,75	0,90	0,25
11	308,80	40,00	308,80	39,50	0,00	0,50
12	312,00	40,00	312,10	40,00	0,10	0,00
13	308,60	40,00	308,00	39,50	0,60	0,50
14	313,10	40,00	313,10	40,00	0,00	0,00
15	305,90	40,00	306,40	39,50	0,50	0,50
16	306,50	40,00	305,60	39,50	0,90	0,50
17	295,60	40,00	295,10	39,75	0,50	0,25
18	301,70	40,00	302,20	40,00	0,50	0,00
19	299,70	40,00	299,10	39,75	0,60	0,25
20	309,80	40,00	310,20	40,00	0,40	0,00
21	307,00	40,00	306,40	39,75	0,60	0,25
22	306,40	40,00	305,80	39,50	0,60	0,50
23	307,50	40,00	306,20	39,50	1,30	0,50
24	300,20	40,00	300,10	39,50	0,10	0,50
25	294,70	40,00	294,70	39,75	0,00	0,25
26	295,40	40,00	296,10	39,75	0,70	0,25
27	295,90	40,00	295,90	39,50	0,00	0,50
28	299,40	40,00	299,30	39,75	0,10	0,25
29	300,90	40,00	300,70	40,00	0,20	0,00
30	301,30	40,00	299,70	39,50	1,60	0,50
31	303,60	40,00	304,20	39,75	0,60	0,25
32	308,10	40,00	307,20	39,25	0,90	0,75
33	307,60	40,00	307,00	39,50	0,60	0,50
34	308,00	40,00	307,80	39,75	0,20	0,25
35	294,20	40,00	294,70	39,75	0,50	0,25
36	293,40	40,00	293,30	39,75	0,10	0,25
37	298,10	40,00	297,90	39,75	0,20	0,25
38	297,20	40,00	296,90	39,75	0,30	0,25
39	304,10	40,00	304,20	39,50	0,10	0,50
40	303,10	40,00	303,80	40,25	0,70	0,25
41	304,60	40,00	303,60	39,00	1,00	1,00
42	307,00	40,00	306,40	39,50	0,60	0,50
43	307,30	40,00	306,40	39,75	0,90	0,25
44	306,50	40,00	306,20	39,25	0,30	0,75
45	297,40	40,00	297,70	39,75	0,30	0,25
46	295,20	40,00	295,50	40,25	0,30	0,25
47	297,60	40,00	297,50	39,75	0,10	0,25
48	305,50	40,00	305,40	39,50	0,10	0,50
49	298,30	40,00	298,70	39,75	0,40	0,25
50	306,40	40,00	306,20	40,00	0,20	0,00
51	308,50	40,00	308,20	39,75	0,30	0,25
52	301,00	40,00	299,30	39,25	1,70	0,75
53	300,30	40,00	299,90	39,50	0,40	0,50
54	298,40	40,00	299,10	40,00	0,70	0,00
55	298,00	40,00	297,70	39,25	0,30	0,75
56	301,70	40,00	301,80	39,75	0,10	0,25
57	308,90	40,00	308,60	39,50	0,30	0,50
58	303,70	40,00	303,40	39,50	0,30	0,50
59	306,10	40,00	305,60	39,50	0,50	0,50
60	301,20	40,00	300,70	39,75	0,50	0,25
61	292,90	40,00	293,50	39,75	0,60	0,25
62	299,20	40,00	298,70	39,50	0,50	0,50
63	301,10	40,00	301,00	40,00	0,10	0,00
64	308,40	40,00	307,00	39,50	1,40	0,50
65	302,80	40,00	303,40	39,75	0,60	0,25
66	293,80	40,00	293,90	40,00	0,10	0,00
67	298,50	40,00	298,50	39,75	0,00	0,25
68	308,50	40,00	307,00	39,50	1,50	0,50
69	309,40	40,00	309,20	39,50	0,20	0,50
70	301,40	40,00	302,00	39,50	0,60	0,50
71	308,40	40,00	308,20	39,50	0,20	0,50
72	296,40	40,00	296,70	40,00	0,30	0,00
73	302,10	40,00	302,40	38,75	0,30	1,25
74	303,20	40,00	304,00	39,50	0,80	0,50
75	308,50	40,00	308,40	39,75	0,10	0,25
76	295,10	40,00	293,50	39,25	1,60	0,75
77	300,40	40,00	300,70	39,25	0,30	0,75
78	308,50	40,00	308,60	39,25	0,10	0,75
79	309,20	40,00	310,00	39,75	0,80	0,25
80	292,60	40,00	293,10	39,50	0,50	0,50
81	304,50	40,00	305,20	39,25	0,70	0,75
82	300,30	40,00	300,80	39,50	0,50	0,50
83	304,50	40,00	302,00	38,50	2,50	1,50
84	309,30	40,00	309,00	39,50	0,30	0,50
85	302,10	40,00	301,40	40,00	0,70	0,00
86	304,70	40,00	304,40	39,50	0,30	0,50
87	302,10	40,00	302,00	39,75	0,10	0,25
88	302,70	40,00	301,80	39,75	0,90	0,25
89	304,10	40,00	304,20	40,00	0,10	0,00
90	309,30	40,00	309,80	39,50	0,50	0,50
91	308,20	40,00	307,40	39,50	0,80	0,50
92	304,90	40,00	304,00	39,00	0,90	1,00
93	299,70	40,00	298,70	39,75	1,00	0,25
94	300,70	40,00	300,80	40,00	0,10	0,00
95	304,10	40,00	303,40	40,00	0,70	0,00
96	294,60	40,00	295,30	39,75	0,70	0,25
97	301,20	40,00	301,00	39,50	0,20	0,50
98	307,20	40,00	305,60	39,50	1,60	0,50
99	305,10	40,00	306,60	39,25	1,50	0,75
100	298,90	40,00	297,70	39,50	1,20	0,50
				Standard deviation:	**0,479**	**0,276**

Graphical representation

Model:	**4BD-4B500A-4K2D-4ZA**	Serial no:	**1016282**
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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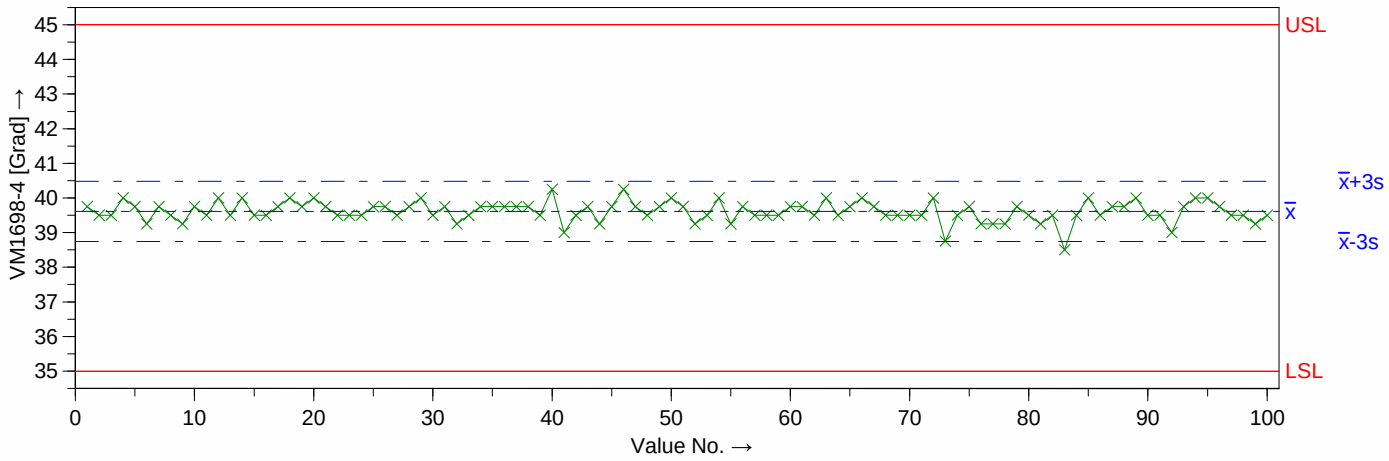
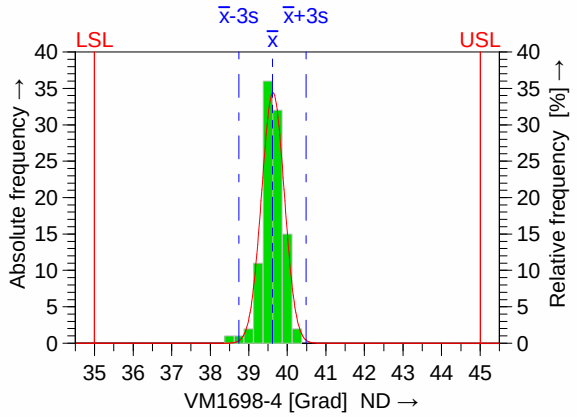
Plant	ATG Westhausen	Operator Name	Sünder
Date	03.05.2022		

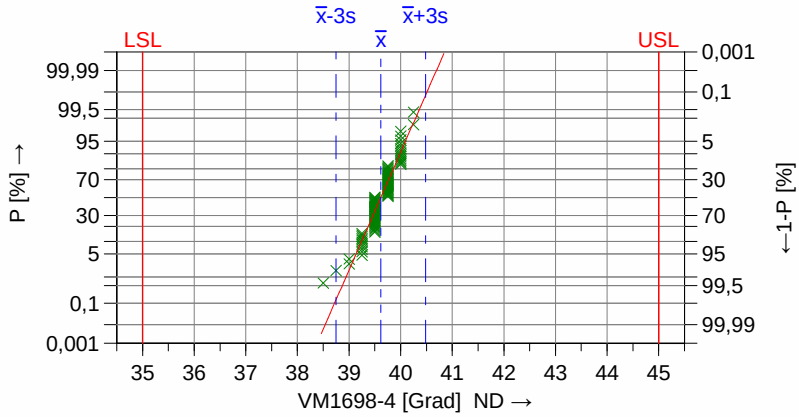
Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016282_k	Char.Descr.	VM1698-4	Nom.val. 40,00 5,00	USL 45,00
		Serial No.	1024210	Unit Grad -5,00	LSL 35,00
Char.Type	variable			Tolerance value 12 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	1000 / 1030939	nges.	100

Evaluation from 03.05.2022 13:32:48 to 03.05.2022 13:47:52

Rem. TQ 60% Angle 40° +/-5° * TQ-Cal.: 500 Nm; Cur-Cal.: 9.711 Nm/A; Speed: 269/50 rpm;







Drawing Values		Collected Values		Statistics	
T_m	40.00			$\bar{x}$	39.6150
LSL	35.00	x_{min}	38.50	$\bar{x}$-3s	38.7462
USL	45.00	x_{max}	40.25	$\bar{x}$+3s	40.4838
T	10.00	R	1.75	6s	1.7376
		$n_{<T>}$	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	5.76
Critical capability index	=	C_{mk}	5.31

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 03.05.2022

Serial No.	1016282_k	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	304,85
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	233,44
				USL	381,48
Remark	TQ 60% Angle 40°+/-5°* TQ-Cal.: 500 Nm; Cur -Cal.: 9.711 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	312,50	310,70	307,20	316,50	313,90	314,70	304,00	311,70	310,40	310,20
1024210	VM1698-4	Grad	39,75	39,50	39,50	40,00	39,75	39,25	39,75	39,50	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	308,80	312,10	308,00	313,10	306,40	305,60	295,10	302,20	299,10	310,20
1024210	VM1698-4	Grad	39,50	40,00	39,50	40,00	39,50	39,50	39,75	40,00	39,75	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	306,40	305,80	306,20	300,10	294,70	296,10	295,90	299,30	300,70	299,70
1024210	VM1698-4	Grad	39,75	39,50	39,50	39,50	39,75	39,75	39,50	39,75	40,00	39,50

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	304,20	307,20	307,00	307,80	294,70	293,30	297,90	296,90	304,20	303,80
1024210	VM1698-4	Grad	39,75	39,25	39,50	39,75	39,75	39,75	39,75	39,75	39,50	40,25

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	303,60	306,40	306,40	306,20	297,70	295,50	297,50	305,40	298,70	306,20
1024210	VM1698-4	Grad	39,00	39,50	39,75	39,25	39,75	40,25	39,75	39,50	39,75	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	308,20	299,30	299,90	299,10	297,70	301,80	308,60	303,40	305,60	300,70
1024210	VM1698-4	Grad	39,75	39,25	39,50	40,00	39,25	39,75	39,50	39,50	39,50	39,75

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	293,50	298,70	301,00	307,00	303,40	293,90	298,50	307,00	309,20	302,00
1024210	VM1698-4	Grad	39,75	39,50	40,00	39,50	39,75	40,00	39,75	39,50	39,50	39,50

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	308,20	296,70	302,40	304,00	308,40	293,50	300,70	308,60	310,00	293,10
1024210	VM1698-4	Grad	39,50	40,00	38,75	39,50	39,75	39,25	39,25	39,25	39,75	39,50

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 03.05.2022

Serial No.	1016282_k	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	304,85
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	233,44
				USL	381,48
Remark	TQ 60% Angle 40°+/-5°* TQ-Cal.: 500 Nm; Cur -Cal.: 9.711 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	305,20	300,80	302,00	309,00	301,40	304,40	302,00	301,80	304,20	309,80
1024210	VM1698-4	Grad	39,25	39,50	38,50	39,50	40,00	39,50	39,75	39,75	40,00	39,50

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	307,40	304,00	298,70	300,80	303,40	295,30	301,00	305,60	306,60	297,70
1024210	VM1698-4	Grad	39,50	39,00	39,75	40,00	40,00	39,75	39,50	39,50	39,25	39,50

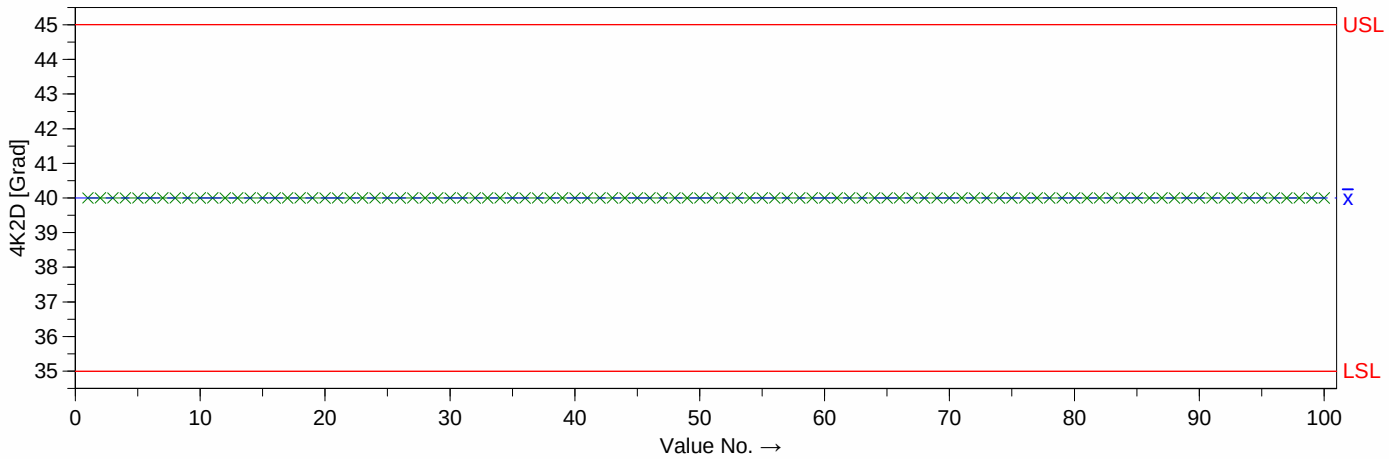
Machine Capability Study
Tool System

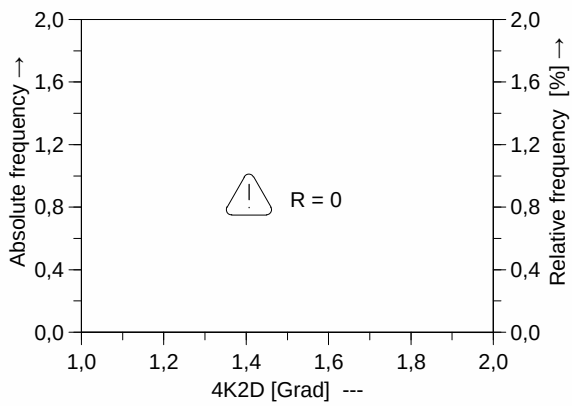
Plant	ATG Westhausen	Operator Name	Sünder
Date	03.05.2022		

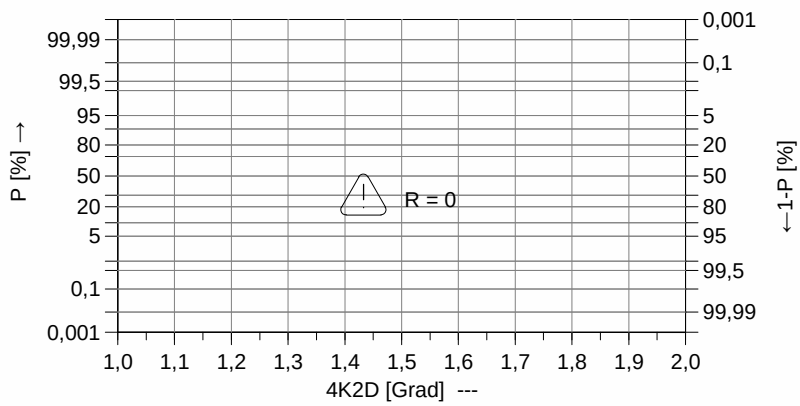
Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016282_k	Char.Descr.	4K2D	Nom.val. 40,00	5,00 USL 45,00
		Serial No.	204575	Unit Grad	-5,00 LSL 35,00
Char.Type	variable			Tolerance value 12 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	1000 / 1030939	nges.	100

Evaluation from 03.05.2022 13:32:50 to 03.05.2022 13:47:54

Rem. TQ 60% Angle 40° +/-5° * TQ-Cal.: 500 Nm; Cur-Cal.: 9.711 Nm/A; Speed: 269/50 rpm;







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

--- R = 0 ---

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 03.05.2022

Serial No.	1016282_k	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	158,95
Ord. No.	4BD500T1S-A	Serial No.	204575	LSL	0,00
				USL	381,48
Remark	TQ 60% Angle 40°+/-5°* TQ-Cal.: 500 Nm; Cur -Cal.: 9.711 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}
204575	4K2D	Nm	313,00	311,30	309,10	316,20	314,10	313,90	303,80	311,80	311,70	311,10
204575	4K2D	Grad	40,00	40,00	40,00	40,00	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}
204575	4K2D	Nm	308,80	312,00	308,60	313,10	305,90	306,50	295,60	301,70	299,70	309,80
204575	4K2D	Grad	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	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}
204575	4K2D	Nm	307,00	306,40	307,50	300,20	294,70	295,40	295,90	299,40	300,90	301,30
204575	4K2D	Grad	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00

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}
204575	4K2D	Nm	303,60	308,10	307,60	308,00	294,20	293,40	298,10	297,20	304,10	303,10
204575	4K2D	Grad	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	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}
204575	4K2D	Nm	304,60	307,00	307,30	306,50	297,40	295,20	297,60	305,50	298,30	306,40
204575	4K2D	Grad	40,00	40,00	40,00	40,00	40,00	40,00	40,00	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}
204575	4K2D	Nm	308,50	301,00	300,30	298,40	298,00	301,70	308,90	303,70	306,10	301,20
204575	4K2D	Grad	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	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}
204575	4K2D	Nm	292,90	299,20	301,10	308,40	302,80	293,80	298,50	308,50	309,40	301,40
204575	4K2D	Grad	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00

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}
204575	4K2D	Nm	308,40	296,40	302,10	303,20	308,50	295,10	300,40	308,50	309,20	292,60
204575	4K2D	Grad	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 03.05.2022

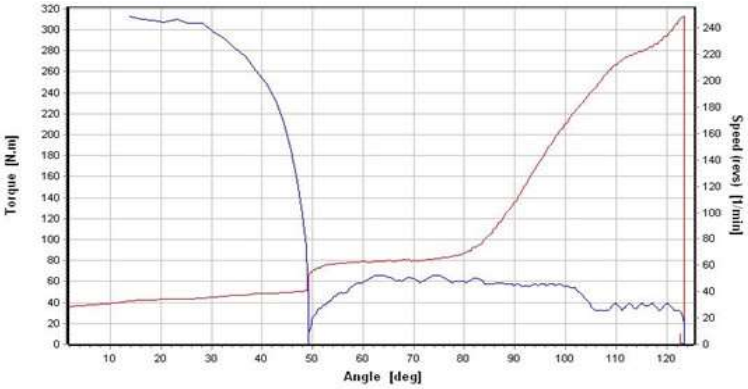
Serial No.	1016282_k	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	158,95
Ord. No.	4BD500T1S-A	Serial No.	204575	LSL	0,00
				USL	381,48
Remark	TQ 60% Angle 40°+/-5°* TQ-Cal.: 500 Nm; Cur -Cal.: 9.711 Nm/A; Speed: 269/50 rpm;				

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}
204575	4K2D	Nm	304,50	300,30	304,50	309,30	302,10	304,70	302,10	302,70	304,10	309,30
204575	4K2D	Grad	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00

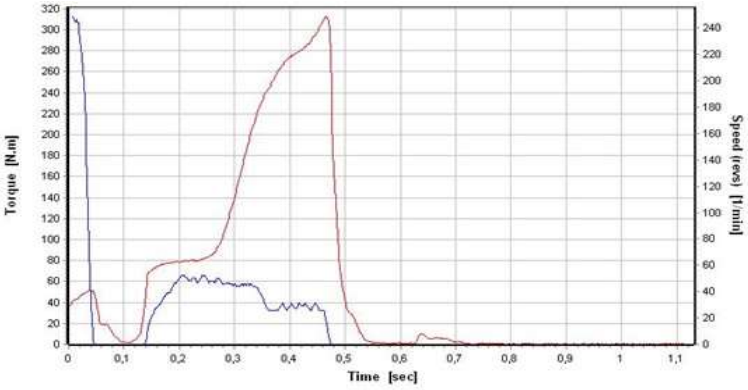
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204575	4K2D	Nm	308,20	304,90	299,70	300,70	304,10	294,60	301,20	307,20	305,10	298,90
204575	4K2D	Grad	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00	40,00

orque graphs

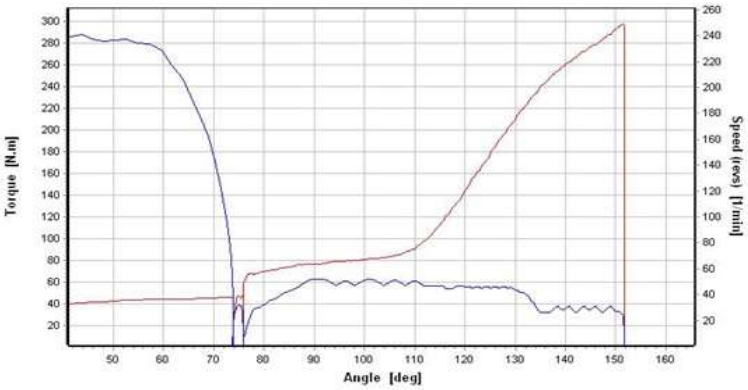
Model:	**4BD-4B500A-4K2D-4ZA**	Serial no:	**1016282**
Target torque:	**300,00 Nm**	60 % of max. torque	
Angle degree:	**40°**	Tool without angle correction	



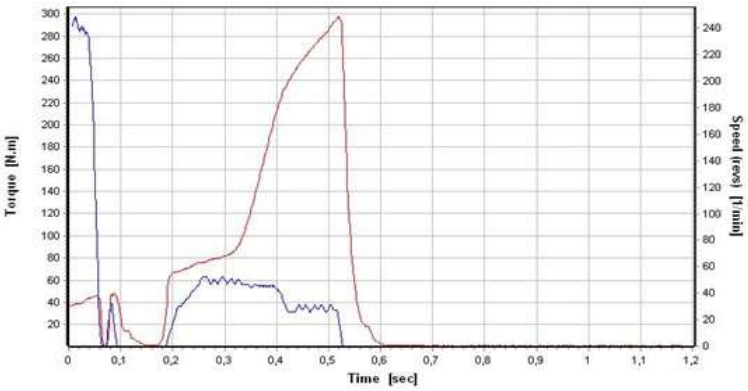
Value no. 1
Graph
Torque / Angle / Speed



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:** 1016282

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: 0,90 % ± **0,45 %**

Angle degree: 180° Tolerance: 4,0° ± **2,0°**

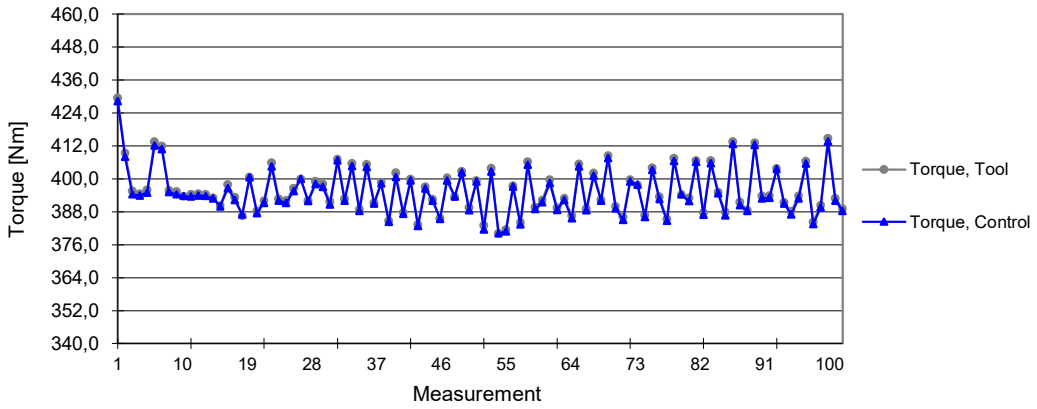
Formula derivation: $C_m = \frac{T}{6\,s}$ $T = C_m * 6\,s$

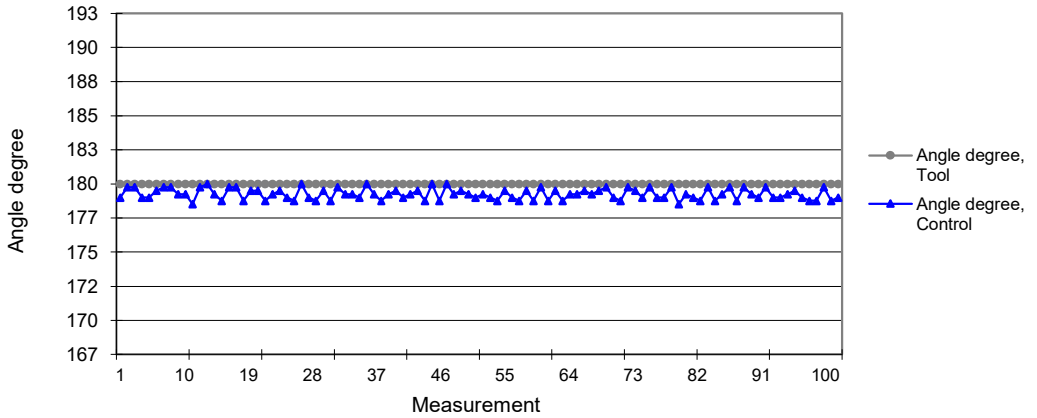
Tool without angle correction

Measurement	Tool data		Control data		Difference	
No.	Torque	Angle	Torque	Angle	Torque	Angle
1	429,40	180,00	428,20	179,00	1,20	1,00
2	409,30	180,00	407,90	179,75	1,40	0,25
3	395,50	180,00	394,30	179,75	1,20	0,25
4	394,50	180,00	393,90	179,00	0,60	1,00
5	395,90	180,00	394,90	179,00	1,00	1,00
6	413,40	180,00	412,10	179,50	1,30	0,50
7	411,90	180,00	410,80	179,75	1,10	0,25
8	395,70	180,00	395,10	179,75	0,60	0,25
9	395,20	180,00	394,30	179,25	0,90	0,75
10	393,60	180,00	393,70	179,25	0,10	0,75
11	394,30	180,00	393,50	178,50	0,80	1,50
12	394,50	180,00	393,90	179,75	0,60	0,25
13	394,30	180,00	393,70	180,00	0,60	0,00
14	393,00	180,00	392,80	179,25	0,20	0,75
15	390,20	180,00	389,90	178,75	0,30	1,25
16	397,80	180,00	396,60	179,75	1,20	0,25
17	393,20	180,00	392,20	179,75	1,00	0,25
18	386,50	180,00	387,00	178,75	0,50	1,25
19	400,60	180,00	400,50	179,50	0,10	0,50
20	388,20	180,00	387,50	179,50	0,70	0,50
21	391,90	180,00	391,20	178,75	0,70	1,25
22	405,80	180,00	404,40	179,25	1,40	0,75
23	392,60	180,00	392,00	179,50	0,60	0,50
24	392,00	180,00	391,20	179,00	0,80	1,00
25	396,50	180,00	395,50	178,75	1,00	1,25
26	399,90	180,00	399,90	180,00	0,00	0,00
27	391,90	180,00	391,80	179,00	0,10	1,00
28	399,00	180,00	398,00	178,75	1,00	1,25
29	398,00	180,00	397,00	179,50	1,00	0,50
30	391,60	180,00	390,60	178,75	1,00	1,25
31	407,00	180,00	406,70	179,75	0,30	0,25
32	392,60	180,00	392,00	179,25	0,60	0,75
33	405,50	180,00	404,60	179,25	0,90	0,75
34	388,80	180,00	388,30	179,00	0,50	1,00
35	405,20	180,00	404,20	180,00	1,00	0,00
36	391,20	180,00	391,00	179,25	0,20	0,75
37	398,70	180,00	398,20	178,75	0,50	1,25
38	384,60	180,00	384,30	179,25	0,30	0,75
39	402,10	180,00	400,70	179,50	1,40	0,50
40	387,70	180,00	387,20	179,00	0,50	1,00
41	399,80	180,00	399,30	179,25	0,50	0,75
42	383,20	180,00	382,70	179,50	0,50	0,50
43	397,00	180,00	396,40	178,75	0,60	1,25
44	392,40	180,00	392,00	180,00	0,40	0,00
45	385,60	180,00	385,40	178,75	0,20	1,25
46	400,30	180,00	399,30	180,00	1,00	0,00
47	393,40	180,00	393,50	179,25	0,10	0,75
48	402,70	180,00	402,20	179,50	0,50	0,50
49	389,40	180,00	388,50	179,25	0,90	0,75
50	399,30	180,00	399,00	179,00	0,30	1,00
51	382,90	180,00	381,50	179,25	1,40	0,75
52	403,80	180,00	402,60	179,00	1,20	1,00
53	380,00	180,00	380,00	178,75	0,00	1,25
54	381,40	180,00	380,80	179,50	0,60	0,50
55	397,40	180,00	397,20	179,00	0,20	1,00
56	384,00	180,00	383,30	178,75	0,70	1,25
57	406,20	180,00	405,00	179,50	1,20	0,50
58	389,60	180,00	388,90	178,75	0,70	1,25
59	392,10	180,00	391,40	179,75	0,70	0,25
60	399,60	180,00	398,40	178,75	1,20	1,25
61	389,30	180,00	388,70	179,50	0,60	0,50
62	392,80	180,00	392,20	178,75	0,60	1,25
63	386,50	180,00	385,60	179,25	0,90	0,75
64	405,30	180,00	404,40	179,25	0,90	0,75
65	389,00	180,00	388,50	179,50	0,50	0,50
66	402,00	180,00	401,10	179,25	0,90	0,75
67	392,20	180,00	392,00	179,50	0,20	0,50
68	408,40	180,00	407,50	179,75	0,90	0,25
69	389,90	180,00	389,10	179,00	0,80	1,00
70	385,90	180,00	385,00	178,75	0,90	1,25
71	399,60	180,00	399,00	179,75	0,60	0,25
72	397,70	180,00	397,80	179,50	0,10	0,50
73	386,70	180,00	386,00	179,00	0,70	1,00
74	403,90	180,00	403,20	179,75	0,70	0,25
75	393,40	180,00	392,60	179,00	0,80	1,00
76	385,30	180,00	384,60	179,00	0,70	1,00
77	407,40	180,00	406,50	179,75	0,90	0,25
78	394,20	180,00	394,30	178,50	0,10	1,50
79	392,90	180,00	391,80	179,25	1,10	0,75
80	406,60	180,00	406,10	179,00	0,50	1,00
81	387,60	180,00	386,80	178,75	0,80	1,25
82	406,60	180,00	405,70	179,75	0,90	0,25
83	395,00	180,00	394,70	178,75	0,30	1,25
84	387,80	180,00	386,60	179,25	1,20	0,75
85	413,40	180,00	412,70	179,75	0,70	0,25
86	391,50	180,00	390,40	178,75	1,10	1,25
87	388,50	180,00	388,30	179,75	0,20	0,25
88	413,00	180,00	412,30	179,25	0,70	0,75
89	393,70	180,00	392,80	179,00	0,90	1,00
90	393,80	180,00	393,00	179,75	0,80	0,25
91	403,70	180,00	403,60	179,00	0,10	1,00
92	391,40	180,00	391,00	179,00	0,40	1,00
93	388,10	180,00	387,00	179,25	1,10	0,75
94	393,70	180,00	392,80	179,50	0,90	0,50
95	406,40	180,00	405,50	179,00	0,90	1,00
96	384,20	180,00	383,50	178,75	0,70	1,25
97	390,30	180,00	389,50	178,75	0,80	1,25
98	414,70	180,00	413,50	179,75	1,20	0,25
99	392,80	180,00	392,00	178,75	0,80	1,25
100	389,00	180,00	388,30	179,00	0,70	1,00
				Standard deviation:	**0,359**	**0,400**

Graphical representation

Model:	**4BD-4B500A-4K2D-4ZA**	Serial no:	**1016282**
Target torque:	**400,00 Nm**	80 % of max. torque	
Angle degree:	**180°**	Tool without angle correction	





Machine Capability Study
Control System

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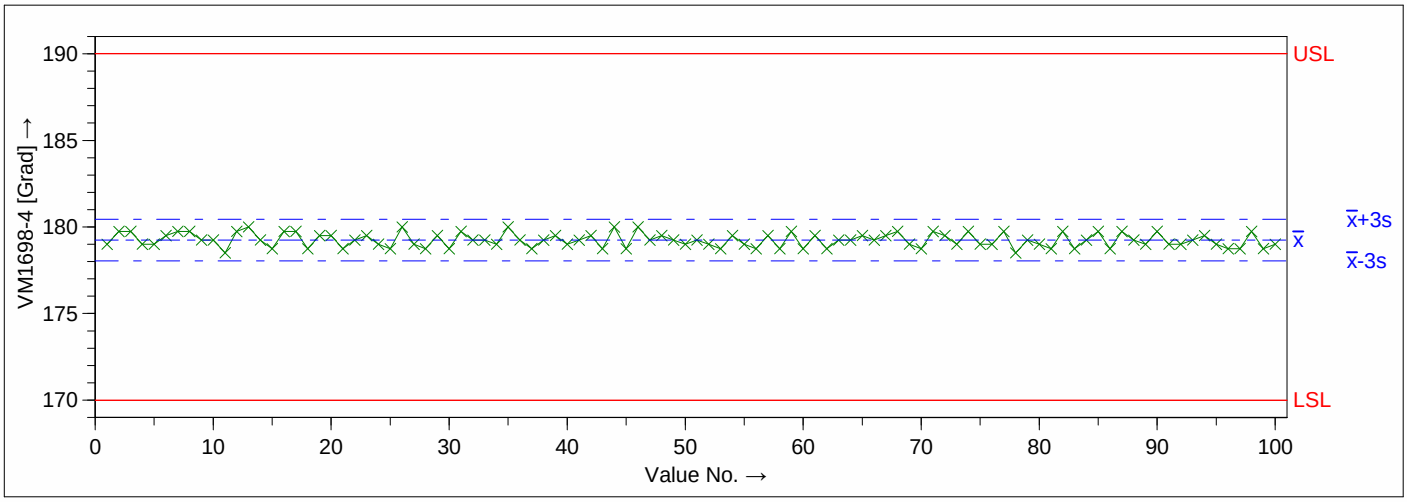
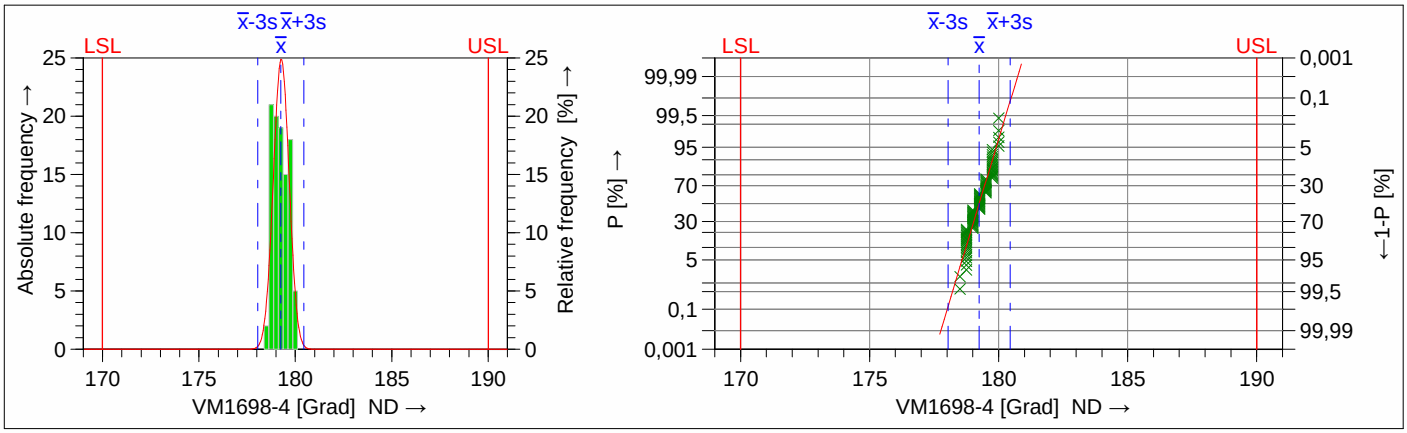
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.06.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016282_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 09.06.2022 09:46:26 to 09.06.2022 10:11:04

Rem. TQ 80% Angle 180° +/-10° * TQ-Cal.: 500 Nm; Cur-Cal.: 9.872 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	180.00			$\bar{x}$	179.2450
LSL	170.00	x_{min}	178.50	$\bar{x}$-3s	178.0438
USL	190.00	x_{max}	180.00	$\bar{x}$+3s	180.4462
T	20.00	R	1.50	6s	2.4025
		$n_{<T>}$	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	8.32
Critical capability index	=	C_{mk}	7.70

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 09.06.2022

Serial No.	1016282_I	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	413,45
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	304,00
				USL	536,28
Remark	TQ 80% Angle 180°+/-10°* TQ-Cal.: 500 Nm; C ur-Cal.: 9.872 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	428,20	407,90	394,30	393,90	394,90	412,10	410,80	395,10	394,30	393,70
1024210	VM1698-4	Grad	179,00	179,75	179,75	179,00	179,00	179,50	179,75	179,75	179,25	179,25

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	393,50	393,90	393,70	392,80	389,90	396,60	392,20	387,00	400,50	387,50
1024210	VM1698-4	Grad	178,50	179,75	180,00	179,25	178,75	179,75	179,75	178,75	179,50	179,50

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	391,20	404,40	392,00	391,20	395,50	399,90	391,80	398,00	397,00	390,60
1024210	VM1698-4	Grad	178,75	179,25	179,50	179,00	178,75	180,00	179,00	178,75	179,50	178,75

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	406,70	392,00	404,60	388,30	404,20	391,00	398,20	384,30	400,70	387,20
1024210	VM1698-4	Grad	179,75	179,25	179,25	179,00	180,00	179,25	178,75	179,25	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	399,30	382,70	396,40	392,00	385,40	399,30	393,50	402,20	388,50	399,00
1024210	VM1698-4	Grad	179,25	179,50	178,75	180,00	178,75	180,00	179,25	179,50	179,25	179,00

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	381,50	402,60	380,00	380,80	397,20	383,30	405,00	388,90	391,40	398,40
1024210	VM1698-4	Grad	179,25	179,00	178,75	179,50	179,00	178,75	179,50	178,75	179,75	178,75

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	388,70	392,20	385,60	404,40	388,50	401,10	392,00	407,50	389,10	385,00
1024210	VM1698-4	Grad	179,50	178,75	179,25	179,25	179,50	179,25	179,50	179,75	179,00	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	399,00	397,80	386,00	403,20	392,60	384,60	406,50	394,30	391,80	406,10
1024210	VM1698-4	Grad	179,75	179,50	179,00	179,75	179,00	179,00	179,75	178,50	179,25	179,00

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.06.2022

Serial No.	1016282_I	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	413,45
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	304,00
				USL	536,28
Remark	TQ 80% Angle 180°+/-10°* TQ-Cal.: 500 Nm; C ur-Cal.: 9.872 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	386,80	405,70	394,70	386,60	412,70	390,40	388,30	412,30	392,80	393,00
1024210	VM1698-4	Grad	178,75	179,75	178,75	179,25	179,75	178,75	179,75	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	403,60	391,00	387,00	392,80	405,50	383,50	389,50	413,50	392,00	388,30
1024210	VM1698-4	Grad	179,00	179,00	179,25	179,50	179,00	178,75	178,75	179,75	178,75	179,00

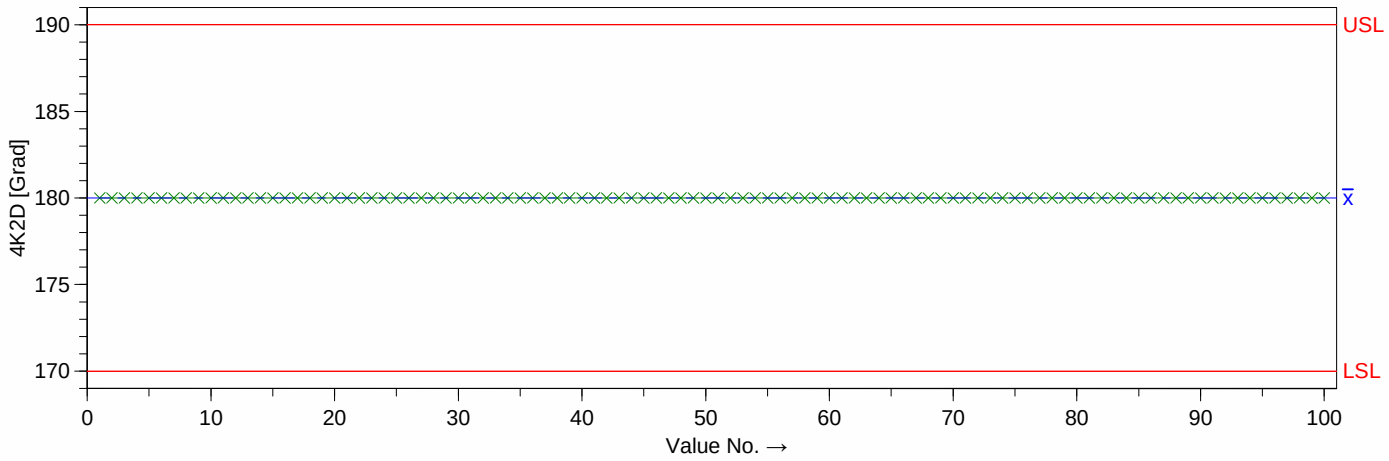
Machine Capability Study
Tool System

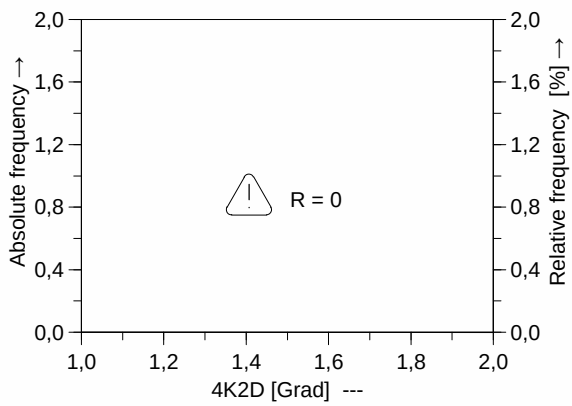
Plant	ATG Westhausen	Operator Name	Sünder
Date	09.06.2022		

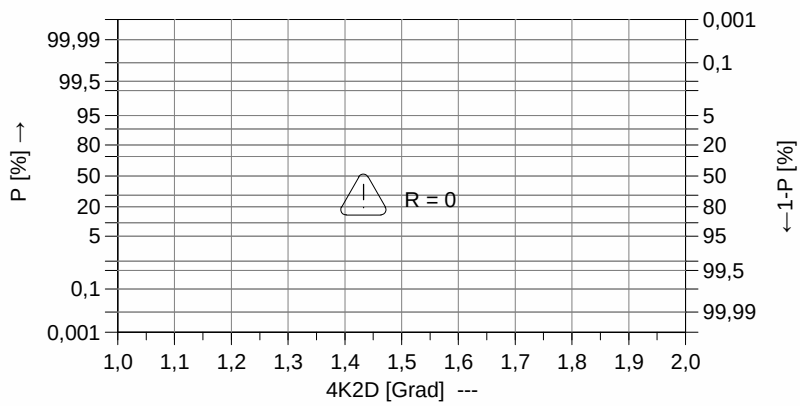
Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016282_l	Char.Descr.	4K2D	Nom.val. 180,00 10,00	USL 190,00
		Serial No.	204575	Unit Grad -10,00	LSL 170,00
Char.Type	variable			Tolerance value 6 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	1000 / 1013265	nges.	100

Evaluation from 09.06.2022 09:46:26 to 09.06.2022 10:11:04

Rem. TQ 80% Angle 180° +/-10° * TQ-Cal.: 500 Nm; Cur-Cal.: 9.872 Nm/A; Speed: 269/50 rpm;







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

--- R = 0 ---

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 09.06.2022

Serial No.	1016282_I	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	223,45
Ord. No.	4BD500T1S-A	Serial No.	204575	LSL	0,00
				USL	536,28
Remark	TQ 80% Angle 180°+/-10°* TQ-Cal.: 500 Nm; C ur-Cal.: 9.872 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}
204575	4K2D	Nm	429,40	409,30	395,50	394,50	395,90	413,40	411,90	395,70	395,20	393,60
204575	4K2D	Grad	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	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}
204575	4K2D	Nm	394,30	394,50	394,30	393,00	390,20	397,80	393,20	386,50	400,60	388,20
204575	4K2D	Grad	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	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}
204575	4K2D	Nm	391,90	405,80	392,60	392,00	396,50	399,90	391,90	399,00	398,00	391,60
204575	4K2D	Grad	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	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}
204575	4K2D	Nm	407,00	392,60	405,50	388,80	405,20	391,20	398,70	384,60	402,10	387,70
204575	4K2D	Grad	180,00	180,00	180,00	180,00	180,00	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}
204575	4K2D	Nm	399,80	383,20	397,00	392,40	385,60	400,30	393,40	402,70	389,40	399,30
204575	4K2D	Grad	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00

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}
204575	4K2D	Nm	382,90	403,80	380,00	381,40	397,40	384,00	406,20	389,60	392,10	399,60
204575	4K2D	Grad	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	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}
204575	4K2D	Nm	389,30	392,80	386,50	405,30	389,00	402,00	392,20	408,40	389,90	385,90
204575	4K2D	Grad	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	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}
204575	4K2D	Nm	399,60	397,70	386,70	403,90	393,40	385,30	407,40	394,20	392,90	406,60
204575	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 09.06.2022

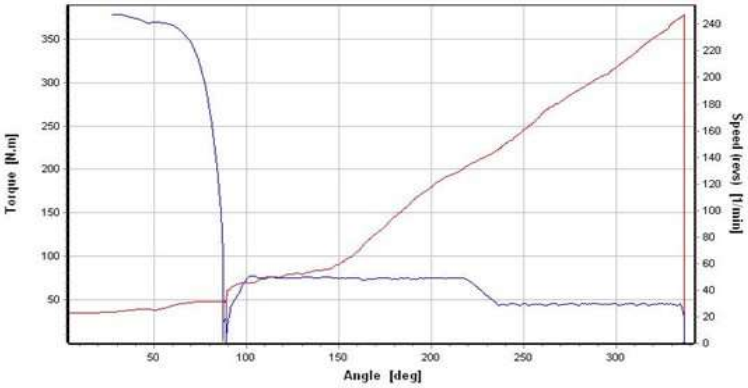
Serial No.	1016282_I	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	223,45
Ord. No.	4BD500T1S-A	Serial No.	204575	LSL	0,00
				USL	536,28
Remark	TQ 80% Angle 180°+/-10°* TQ-Cal.: 500 Nm; C ur-Cal.: 9.872 Nm/A; Speed: 269/50 rpm;				

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}
204575	4K2D	Nm	387,60	406,60	395,00	387,80	413,40	391,50	388,50	413,00	393,70	393,80
204575	4K2D	Grad	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00

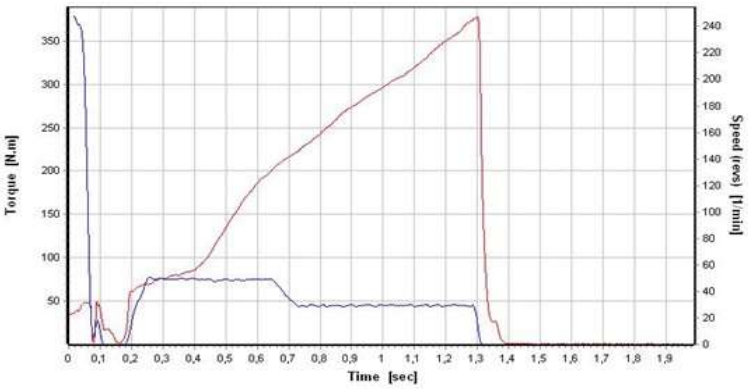
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204575	4K2D	Nm	403,70	391,40	388,10	393,70	406,40	384,20	390,30	414,70	392,80	389,00
204575	4K2D	Grad	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00

Torque graphs

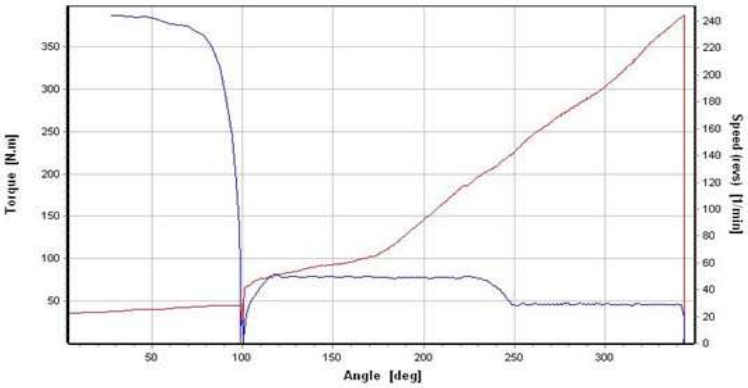
Model:	**4BD-4B500A-4K2D-4ZA**	Serial no:	**1016282**
Target torque:	**400,00 Nm**	80 % of max. torque	
Angle degree:	**180°**	Tool without angle correction	



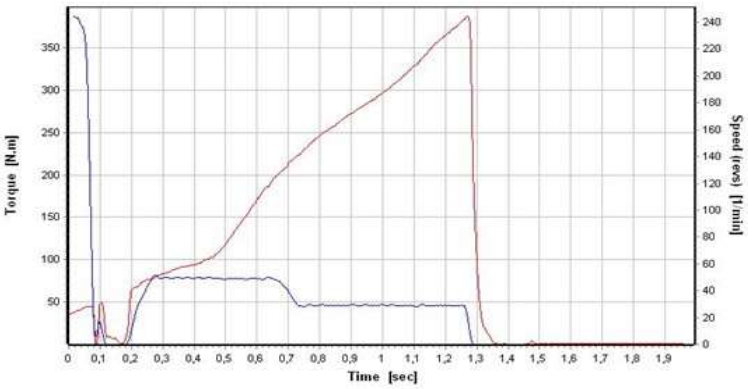
Value no. 1
Graph
Torque / Angle / Speed



Value no. 1
Graph
Torque / Time / Speed



Value no. 100
Graph
Torque / Angle / Speed



Value no. 100
Graph
Torque / Time / Speed