Homologation

Fixtured Spindle

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

Serial no.: 1016283

Contents

Homologation: 4BD-4B500A-4K2D-4ZA SN: 1016283

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Test sheet no. 2

Machine Capability Study 30 %

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

Manufacturer: Apex Tool Group Serial no: **1016283**

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

Hard joint (H)	1126,56	Nm / Revolution	Angle degree	30°
Soft joint (L)	92,89	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	187,76	185,78 Nm
	Standard deviation	0,51	0,40 Nm
	Torque scatter (99,73%)	3,07	2,42 Nm
	C_m	8,43	10,69
	C_{mk}	6,63	10,04

b)	Min. C_m hard/soft (lowest value)	8,43
	Min. C_{mk} hard/soft (lowest value)	6,63

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

Note:

Machine Capability Study
Control System

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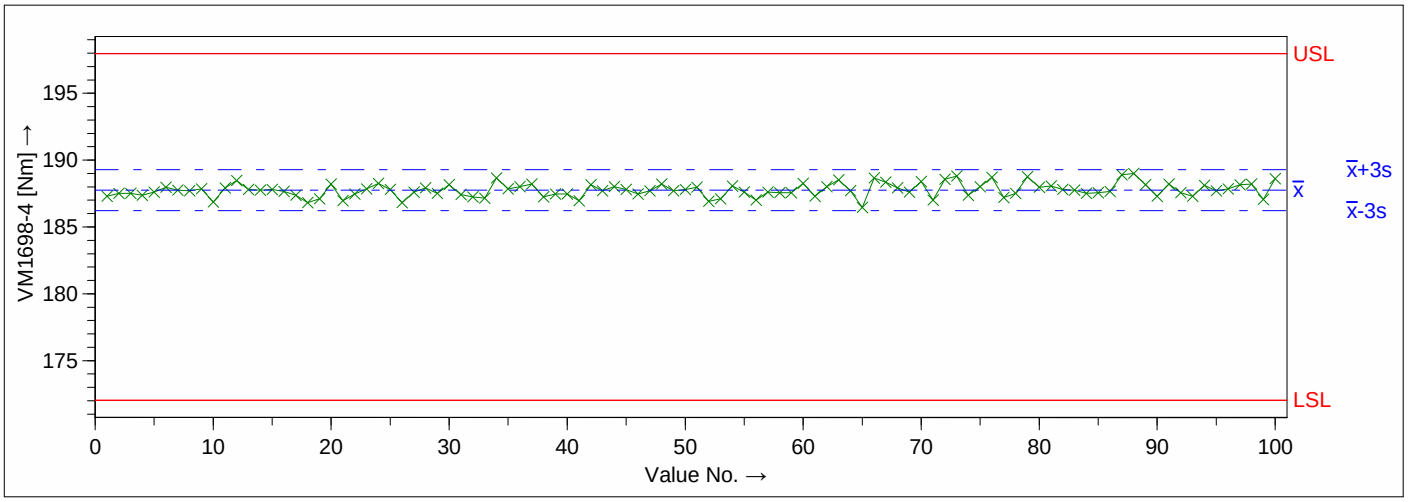
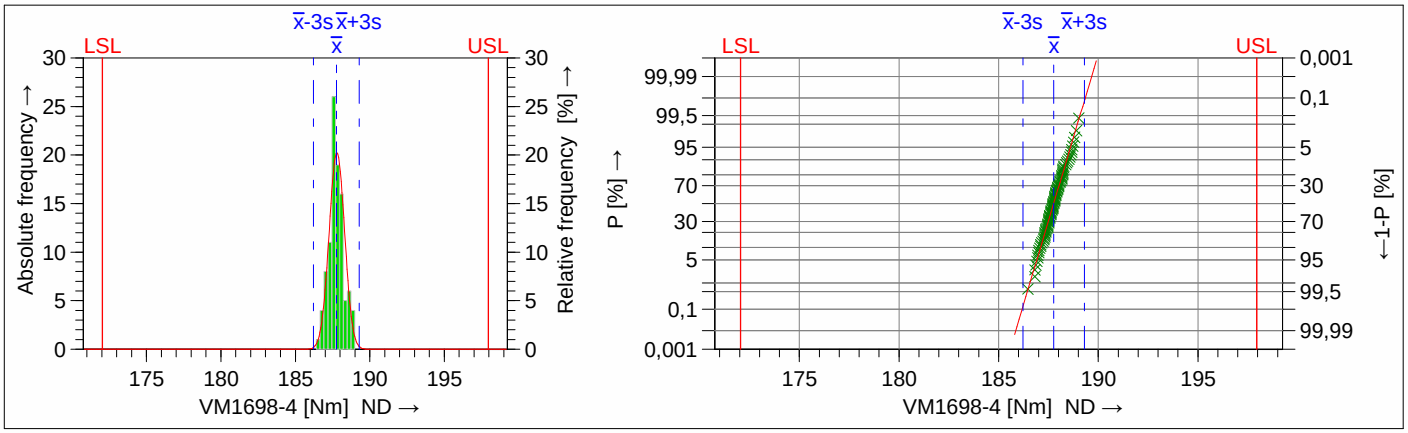
Plant	ATG Westhausen	Operator Name	Sünder
Date	06.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016283_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 06.05.2022 09:26:49 to 06.05.2022 09:41:37

Rem. TQ 30% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.962 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	185.00			$\bar{x}$	187.7605
LSL	172.05	x_{min}	186.46	$\bar{x}$-3s	186.2238
USL	197.95	x_{max}	189.01	$\bar{x}$+3s	189.2972
T	25.90	R	2.55	6s	3.0735
		$n_{<T>}$	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	8.43
Critical capability index	=	C_{mk}	6.63

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

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 06.05.2022

Serial No.	1016283_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.: 9.962 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	187,31	187,51	187,51	187,36	187,61	187,96	187,76	187,71	187,86	186,86
1024210	VM1698-4	Grad	29,50	30,00	29,75	29,75	29,75	29,75	29,00	32,00	30,50	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	187,91	188,46	187,81	187,76	187,81	187,66	187,36	186,81	187,11	188,21
1024210	VM1698-4	Grad	29,00	29,00	29,00	28,25	29,00	30,00	28,75	28,75	31,75	29,50

Char.No.	Char.Descr.	Unit	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
1024210	VM1698-4	Nm	186,96	187,46	187,86	188,26	187,81	186,81	187,61	187,91	187,51	188,16
1024210	VM1698-4	Grad	29,00	29,50	29,00	29,50	29,00	29,00	29,00	29,50	29,25	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}
1024210	VM1698-4	Nm	187,41	187,26	187,16	188,66	187,86	188,01	188,21	187,26	187,46	187,46
1024210	VM1698-4	Grad	32,25	29,50	29,00	29,50	29,00	33,00	29,50	28,75	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	186,96	188,16	187,71	188,01	187,81	187,46	187,71	188,21	187,71	187,81
1024210	VM1698-4	Grad	28,75	30,75	28,50	30,25	28,25	28,75	33,00	30,00	28,75	32,75

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	187,96	186,91	187,11	188,06	187,61	187,01	187,61	187,56	187,56	188,26
1024210	VM1698-4	Grad	32,00	30,25	28,75	32,25	28,00	30,25	28,00	31,75	29,00	28,25

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	187,31	188,01	188,51	187,71	186,46	188,66	188,36	187,91	187,61	188,41
1024210	VM1698-4	Grad	28,00	28,50	28,50	28,50	28,50	28,50	29,00	32,00	32,25	29,50

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	187,01	188,56	188,81	187,36	188,01	188,71	187,21	187,51	188,76	187,96
1024210	VM1698-4	Grad	31,75	29,25	30,00	28,25	32,25	29,75	32,75	30,00	28,75	29,00

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 06.05.2022

Serial No.	1016283_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.: 9.962 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	188,06	187,81	187,76	187,51	187,56	187,66	188,91	189,01	188,16	187,31
1024210	VM1698-4	Grad	28,00	29,50	28,25	32,25	29,25	29,25	29,50	32,25	29,25	29,75

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	188,21	187,56	187,31	188,11	187,71	187,86	188,16	188,21	187,06	188,61
1024210	VM1698-4	Grad	28,75	29,50	28,25	29,75	29,00	32,50	29,25	29,50	31,75	29,50

Machine Capability Study
Tool System

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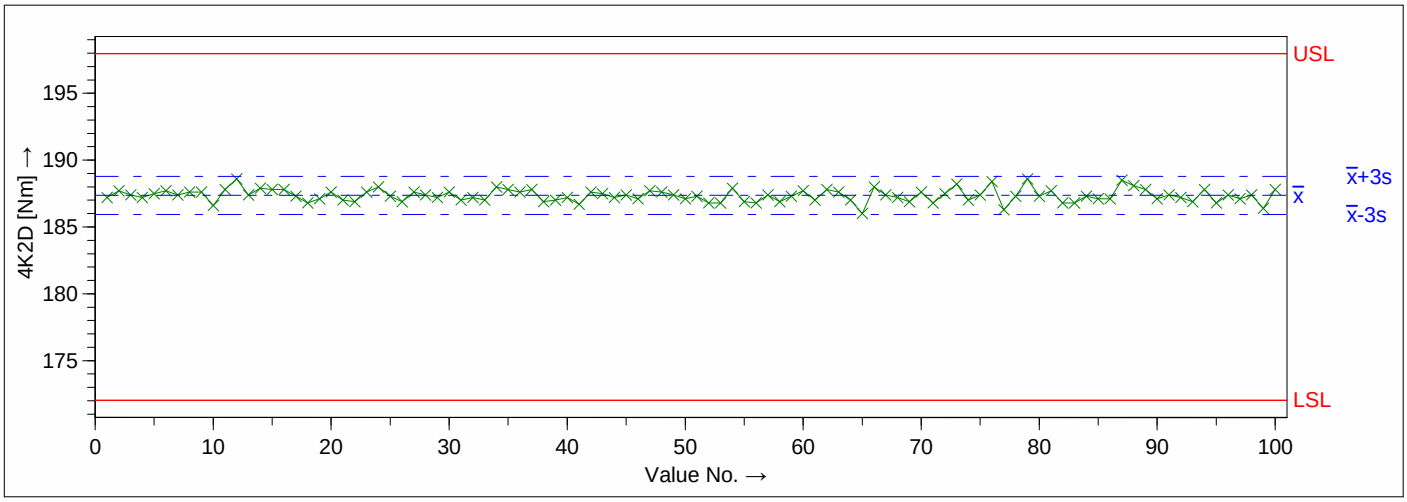
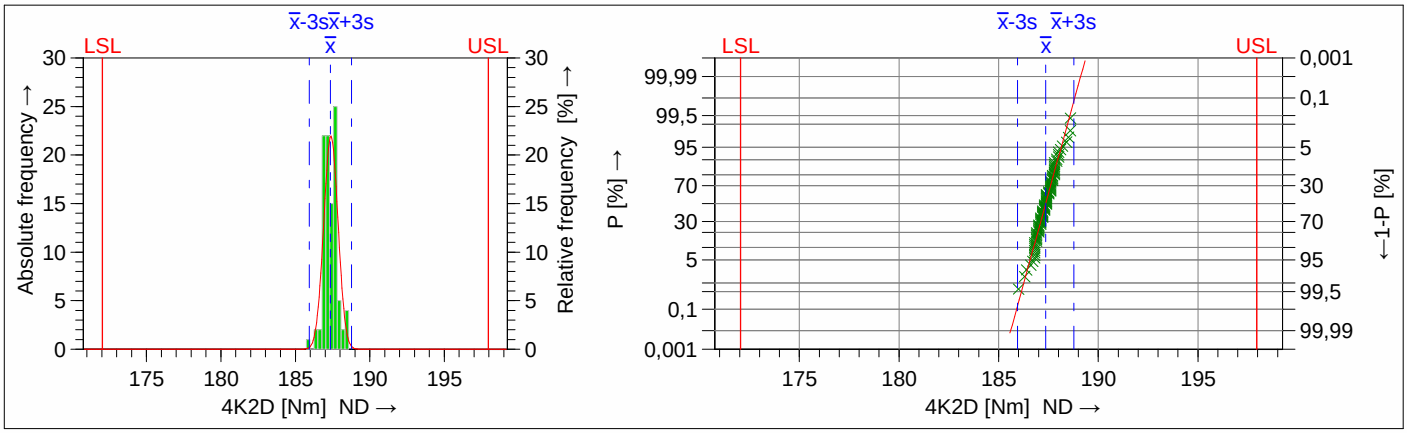
Plant	ATG Westhausen	Operator Name	Sünder
Date	06.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016283_d	Char.Descr.	4K2D	Nom.val.	185,00 12,95 USL 197,95
		Serial No.	204576	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 06.05.2022 09:26:51 to 06.05.2022 09:41:39

Rem. TQ 30% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.962 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	185.00			$\bar{x}$	187.3590
LSL	172.05	x_{min}	186.00	$\bar{x}$-3s	185.9428
USL	197.95	x_{max}	188.60	$\bar{x}$+3s	188.7752
T	25.90	R	2.60	6s	2.8324
		$n_{<T>}$	100	$p_{<T>}$	100.00000 %
		$n_{>USL}$	0	$p_{>USL}$	0.00000%
		$n_{<LSL}$	0	$p_{<LSL}$	0.00000%
		n_{eff}	100		
		n_{tot}	100		

Model distribution			Normal Distribution
Calculation method			M1 1.4 $\hat{\sigma}$ = S_{tot}
Potential Capability index	=	C_m	9.14
Critical capability index	=	C_{mk}	7.48

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

APEX VDI/VDE 2647 V0.1

Apex Tool Group GmbH \\htwe0006\Appdata\QW\QWE\Messwert\2022\1016283_d1.DFD

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 06.05.2022

Serial No.	1016283_d	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	185,00
Ord. No.	4BD500T1S-A	Serial No.	204576	LSL	172,05
				USL	197,95
Remark	TQ 30% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.962 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}
204576	4K2D	Nm	187,20	187,70	187,40	187,20	187,50	187,70	187,40	187,60	187,60	186,60
204576	4K2D	Grad	30,00	30,00	30,00	30,00	30,00	30,00	30,00	32,00	31,00	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}
204576	4K2D	Nm	187,80	188,60	187,40	187,90	187,80	187,80	187,30	186,80	187,10	187,60
204576	4K2D	Grad	29,00	30,00	30,00	30,00	30,00	32,00	29,00	29,00	33,00	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}
204576	4K2D	Nm	187,00	186,90	187,60	188,00	187,30	186,90	187,60	187,40	187,20	187,60
204576	4K2D	Grad	30,00	30,00	29,00	30,00	30,00	30,00	30,00	30,00	30,00	34,00

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}
204576	4K2D	Nm	187,00	187,20	187,00	188,00	187,80	187,60	187,80	186,90	187,00	187,20
204576	4K2D	Grad	33,00	30,00	30,00	30,00	30,00	34,00	30,00	29,00	30,00	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}
204576	4K2D	Nm	186,70	187,60	187,50	187,20	187,40	187,10	187,70	187,60	187,40	187,10
204576	4K2D	Grad	29,00	32,00	29,00	31,00	29,00	29,00	34,00	30,00	29,00	33,00

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}
204576	4K2D	Nm	187,30	186,80	186,80	187,90	186,90	186,80	187,40	186,90	187,30	187,70
204576	4K2D	Grad	33,00	31,00	29,00	33,00	29,00	31,00	29,00	33,00	30,00	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}
204576	4K2D	Nm	187,00	187,80	187,60	187,00	186,00	188,00	187,40	187,20	186,90	187,60
204576	4K2D	Grad	29,00	29,00	29,00	29,00	29,00	29,00	30,00	32,00	33,00	30,00

Char.No.	Char.Descr.	Unit	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
204576	4K2D	Nm	186,80	187,50	188,20	187,00	187,40	188,40	186,30	187,30	188,60	187,30
204576	4K2D	Grad	32,00	30,00	31,00	29,00	33,00	31,00	33,00	31,00	29,00	30,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 06.05.2022

Serial No.	1016283_d	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	185,00
Ord. No.	4BD500T1S-A	Serial No.	204576	LSL	172,05
				USL	197,95
Remark	TQ 30% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.962 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}
204576	4K2D	Nm	187,70	186,80	186,80	187,30	187,10	187,10	188,50	188,10	187,80	187,10
204576	4K2D	Grad	28,00	30,00	29,00	33,00	30,00	30,00	30,00	32,00	30,00	30,00

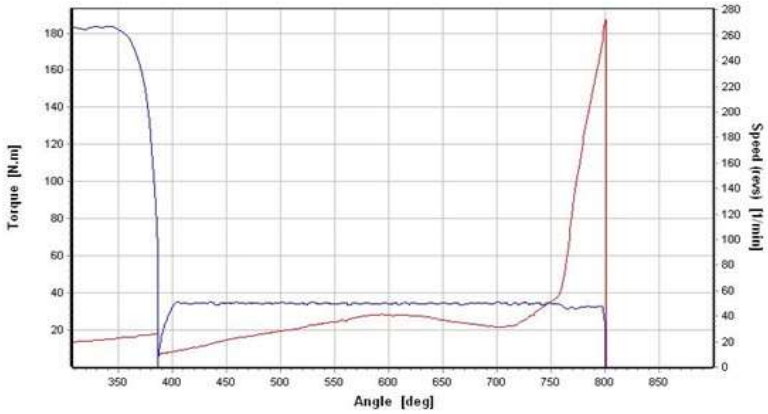
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204576	4K2D	Nm	187,40	187,20	186,90	187,80	186,80	187,40	187,10	187,40	186,40	187,80
204576	4K2D	Grad	29,00	30,00	29,00	31,00	29,00	33,00	30,00	30,00	32,00	30,00

Torque graphs

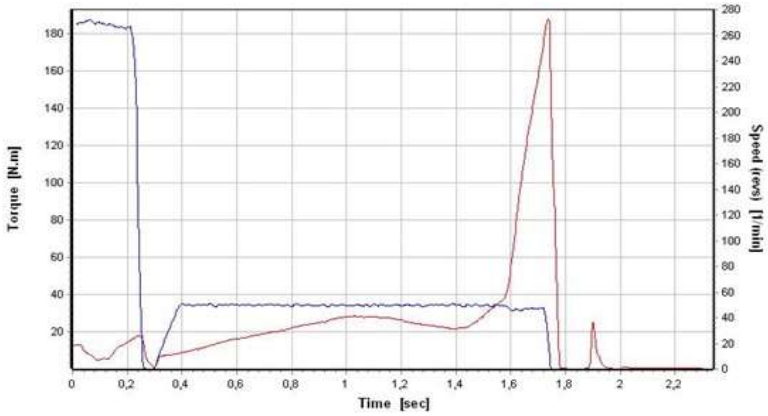
Machine Capability Study 30 %

Model: **4BD-4B500A-4K2D-4ZA**
Serial no: **1016283**

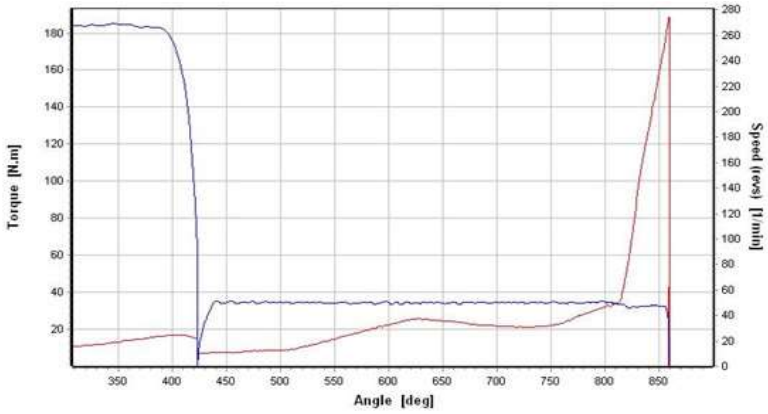
Angle degree: **30°**
Test torque: **185,0 Nm**



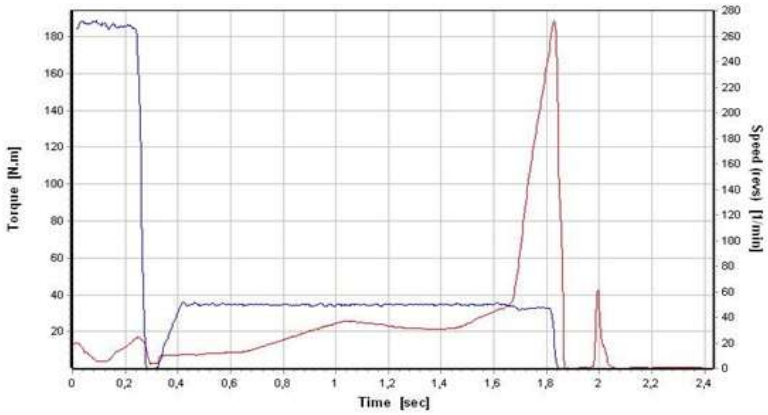
Value no. 1
Graph
Torque / Angle / Speed



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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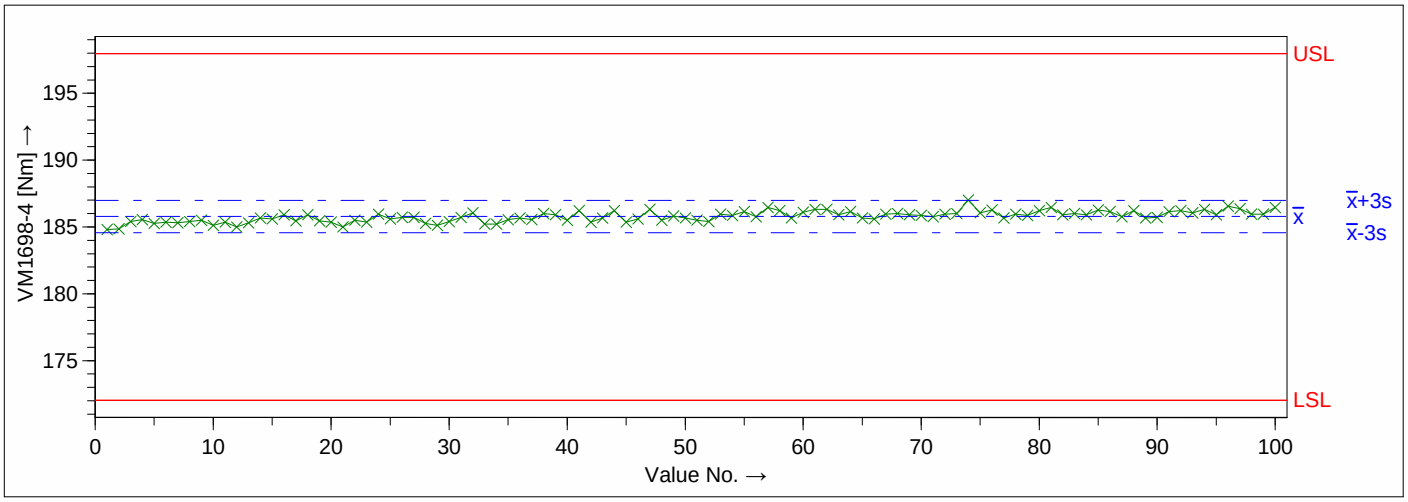
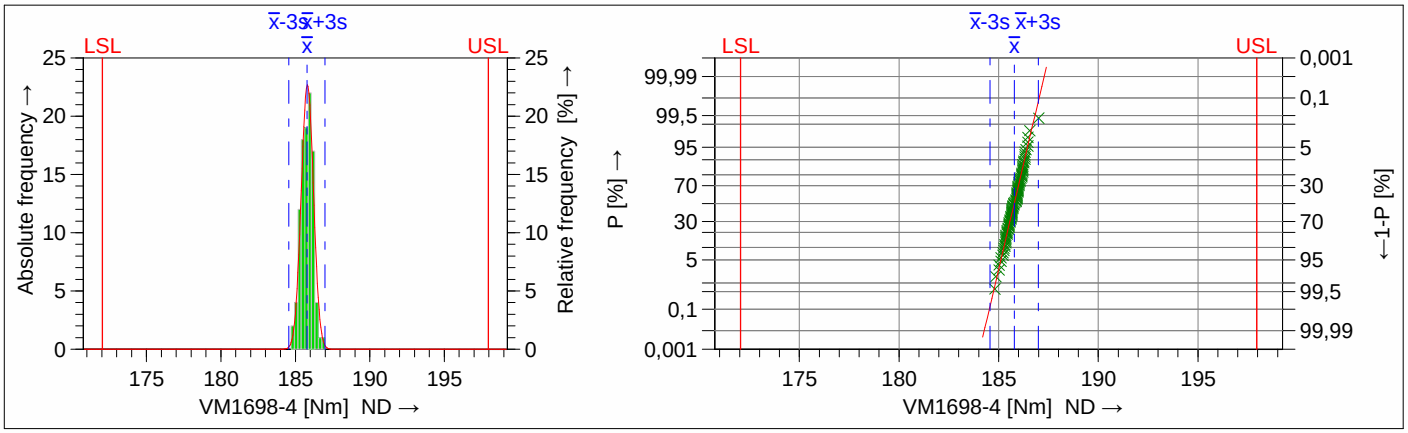
Plant	ATG Westhausen	Operator Name	Sünder
Date	06.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016283_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 06.05.2022 09:45:59 to 06.05.2022 10:04:59

Rem. TQ 30% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.962 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	185.00			$\bar{x}$	185.7794
LSL	172.05	x_{min}	184.80	$\bar{x}$-3s	184.5678
USL	197.95	x_{max}	187.01	$\bar{x}$+3s	186.9910
T	25.90	R	2.21	6s	2.4233
		$n_{<T>}$	100	$p_{<T>}$	100.00000 %
		$n_{>USL}$	0	$p_{>USL}$	0.00000%
		$n_{<LSL}$	0	$p_{<LSL}$	0.00000%
		n_{eff}	100		
		n_{tot}	100		

Model distribution			Normal Distribution
Calculation method			M1.1.4 $\hat{\sigma} = S_{tot}$
Potential Capability index	=	C_m	10.69
Critical capability index	=	C_{mk}	10.04

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 06.05.2022

Serial No.	1016283_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.: 9.962 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	184,80	184,86	185,41	185,56	185,26	185,36	185,31	185,41	185,51	185,11
1024210	VM1698-4	Grad	360,00	359,50	360,00	355,75	366,00	355,50	353,25	350,00	362,50	340,50

Char.No.	Char.Descr.	Unit	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
1024210	VM1698-4	Nm	185,36	185,01	185,31	185,66	185,61	185,91	185,46	185,91	185,46	185,36
1024210	VM1698-4	Grad	357,25	353,75	347,00	361,00	345,75	346,75	352,50	356,25	352,00	363,75

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	185,01	185,51	185,36	185,96	185,61	185,71	185,71	185,26	185,11	185,41
1024210	VM1698-4	Grad	345,50	354,25	347,50	350,00	357,00	345,25	349,50	363,50	345,75	339,25

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	185,71	186,06	185,21	185,21	185,56	185,66	185,56	186,01	185,91	185,51
1024210	VM1698-4	Grad	364,00	346,75	360,50	344,00	356,25	362,75	347,25	363,25	349,50	358,00

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	186,21	185,36	185,66	186,21	185,36	185,61	186,31	185,51	185,81	185,66
1024210	VM1698-4	Grad	352,25	356,75	360,00	347,50	361,50	362,50	349,00	360,25	356,50	358,25

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	185,51	185,41	185,96	185,86	186,16	185,76	186,46	186,21	185,66	186,11
1024210	VM1698-4	Grad	342,25	358,00	351,50	360,00	347,75	345,75	358,50	342,75	357,00	344,25

Char.No.	Char.Descr.	Unit	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
1024210	VM1698-4	Nm	186,31	186,31	185,91	186,16	185,66	185,61	185,96	186,01	185,91	185,86
1024210	VM1698-4	Grad	367,25	341,00	363,75	344,25	363,75	343,50	372,25	341,00	364,50	359,50

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	185,76	185,96	186,01	187,01	186,06	186,26	185,66	185,96	185,86	186,21
1024210	VM1698-4	Grad	343,25	357,00	365,50	360,50	359,25	357,00	354,75	361,50	356,25	362,75

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 06.05.2022

Serial No.	1016283_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.: 9.962 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	186,46	185,91	186,01	185,91	186,26	186,16	185,76	186,21	185,66	185,71
1024210	VM1698-4	Grad	362,50	348,00	366,50	352,25	367,00	358,50	343,75	354,00	362,50	351,25

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	186,16	186,21	186,06	186,31	185,91	186,56	186,36	185,96	185,96	186,46
1024210	VM1698-4	Grad	359,00	365,00	352,00	366,25	361,75	356,50	349,25	358,25	361,75	366,75

Machine Capability Study
Tool System

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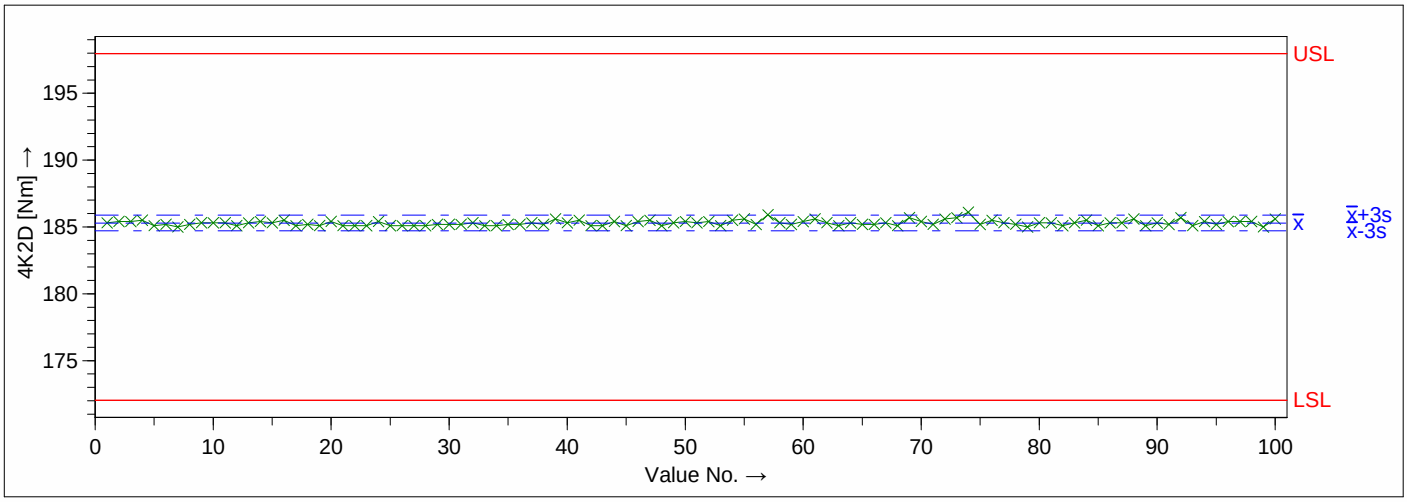
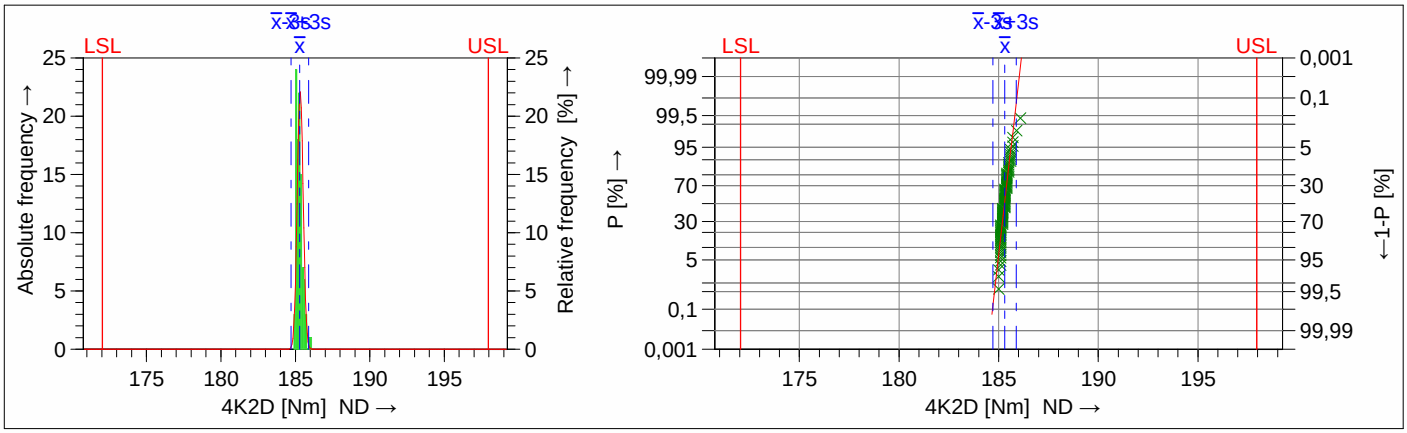
Plant	ATG Westhausen	Operator Name	Sünder
Date	06.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016283_c	Char.Descr.	4K2D	Nom.val.	185,00 12,95
		Serial No.	204576	Unit	Nm -12,95
USL	197,95	LSL	172,05		
Char.Type	variable	Tolerance value	7 %	Decimal Pl.	2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	250 / 5537037	nges.	100

Evaluation from 06.05.2022 09:46:01 to 06.05.2022 10:05:01

Rem. TQ 30% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.962 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	185.00			$\bar{x}$	185.2980
LSL	172.05	x_{min}	185.00	$\bar{x}$-3s	184.7057
USL	197.95	x_{max}	186.10	$\bar{x}$+3s	185.8903
T	25.90	R	1.10	6s	1.1847
		$n_{<T>}$	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	21.86
Critical capability index	=	C_{mk}	21.36

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

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 06.05.2022

Serial No.	1016283_c	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	185,00
Ord. No.	4BD500T1S-A	Serial No.	204576	LSL	172,05
				USL	197,95
Remark	TQ 30% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.962 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}
204576	4K2D	Nm	185,30	185,40	185,40	185,50	185,10	185,20	185,00	185,20	185,30	185,30
204576	4K2D	Grad	365,00	365,00	362,00	358,00	369,00	357,00	355,00	352,00	365,00	343,00

Char.No.	Char.Descr.	Unit	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
204576	4K2D	Nm	185,30	185,10	185,30	185,40	185,30	185,50	185,10	185,20	185,10	185,40
204576	4K2D	Grad	359,00	357,00	350,00	363,00	348,00	348,00	353,00	358,00	355,00	366,00

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}
204576	4K2D	Nm	185,10	185,10	185,10	185,40	185,10	185,10	185,10	185,10	185,20	185,20
204576	4K2D	Grad	349,00	356,00	351,00	353,00	358,00	347,00	351,00	369,00	350,00	343,00

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}
204576	4K2D	Nm	185,20	185,30	185,10	185,10	185,20	185,20	185,30	185,20	185,60	185,30
204576	4K2D	Grad	366,00	348,00	364,00	347,00	358,00	365,00	352,00	363,00	354,00	359,00

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}
204576	4K2D	Nm	185,50	185,10	185,10	185,40	185,10	185,40	185,50	185,10	185,30	185,40
204576	4K2D	Grad	354,00	359,00	361,00	350,00	364,00	365,00	351,00	363,00	358,00	360,00

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}
204576	4K2D	Nm	185,30	185,40	185,10	185,50	185,60	185,20	185,90	185,30	185,20	185,40
204576	4K2D	Grad	345,00	360,00	354,00	361,00	349,00	347,00	360,00	344,00	358,00	346,00

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}
204576	4K2D	Nm	185,60	185,30	185,10	185,30	185,20	185,20	185,30	185,10	185,70	185,40
204576	4K2D	Grad	368,00	342,00	366,00	347,00	367,00	345,00	375,00	342,00	367,00	362,00

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}
204576	4K2D	Nm	185,20	185,60	185,70	186,10	185,20	185,50	185,30	185,20	185,00	185,30
204576	4K2D	Grad	347,00	361,00	368,00	361,00	361,00	359,00	357,00	362,00	357,00	365,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 06.05.2022

Serial No.	1016283_c	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	185,00
Ord. No.	4BD500T1S-A	Serial No.	204576	LSL	172,05
				USL	197,95
Remark	TQ 30% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.962 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}
204576	4K2D	Nm	185,30	185,10	185,30	185,50	185,10	185,30	185,30	185,60	185,10	185,30
204576	4K2D	Grad	363,00	349,00	369,00	355,00	367,00	359,00	346,00	357,00	365,00	355,00

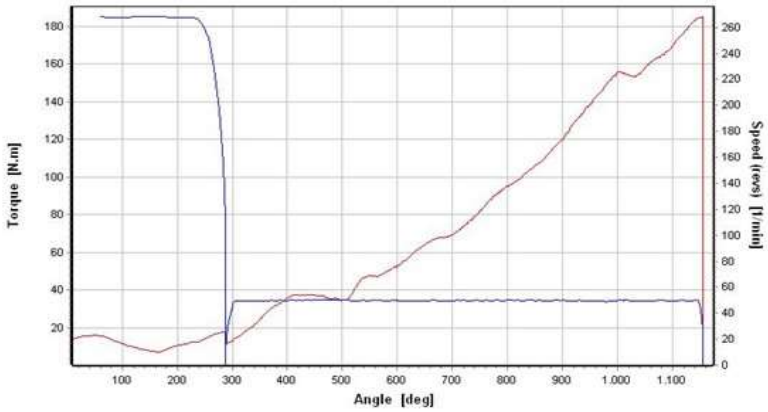
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204576	4K2D	Nm	185,20	185,70	185,10	185,40	185,20	185,40	185,40	185,40	185,00	185,60
204576	4K2D	Grad	361,00	368,00	354,00	369,00	363,00	357,00	350,00	360,00	363,00	369,00

Torque graphs

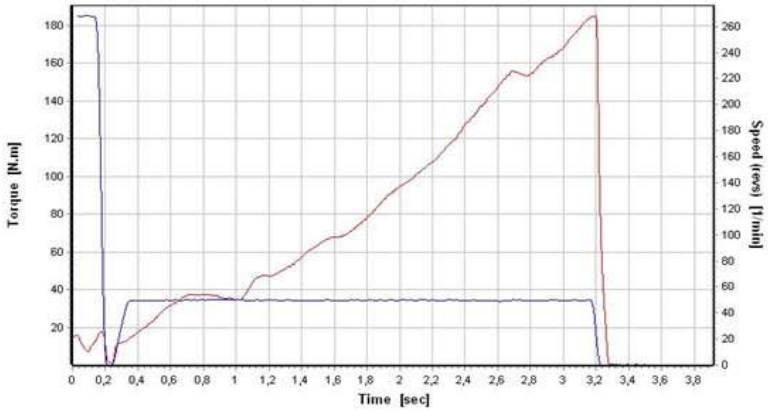
Machine Capability Study 30 %

Model: **4BD-4B500A-4K2D-4ZA**
Serial no: **1016283**

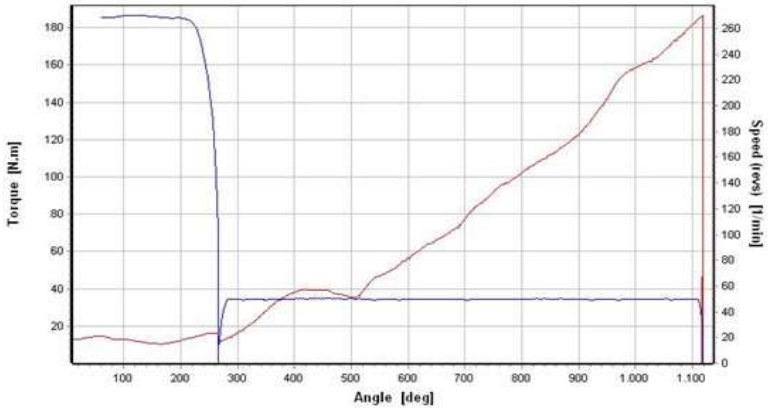
Angle degree: **360°**
Test torque: **185,0 Nm**



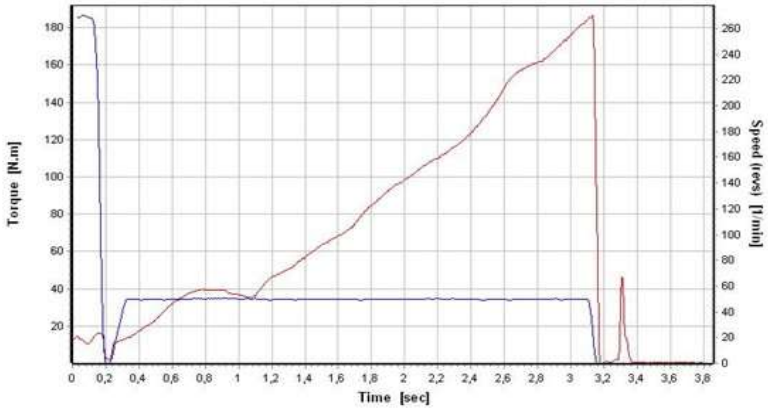
Value no. 1
Graph
Torque / Angle / Speed



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: **1016283**

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

Hard joint (H)	2464,50	Nm / Revolution	Angle degree	30°
Soft joint (L)	205,17	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	410,75	410,34 Nm
	Standard deviation	0,71	0,78 Nm
	Torque scatter (99,73%)	4,26	4,69 Nm
	C_m	13,48	12,24
	C_{mk}	13,13	12,10

b)	Min. C_m hard/soft (lowest value)	12,24
	Min. C_{mk} hard/soft (lowest value)	12,10

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

Note:

Machine Capability Study
Control System

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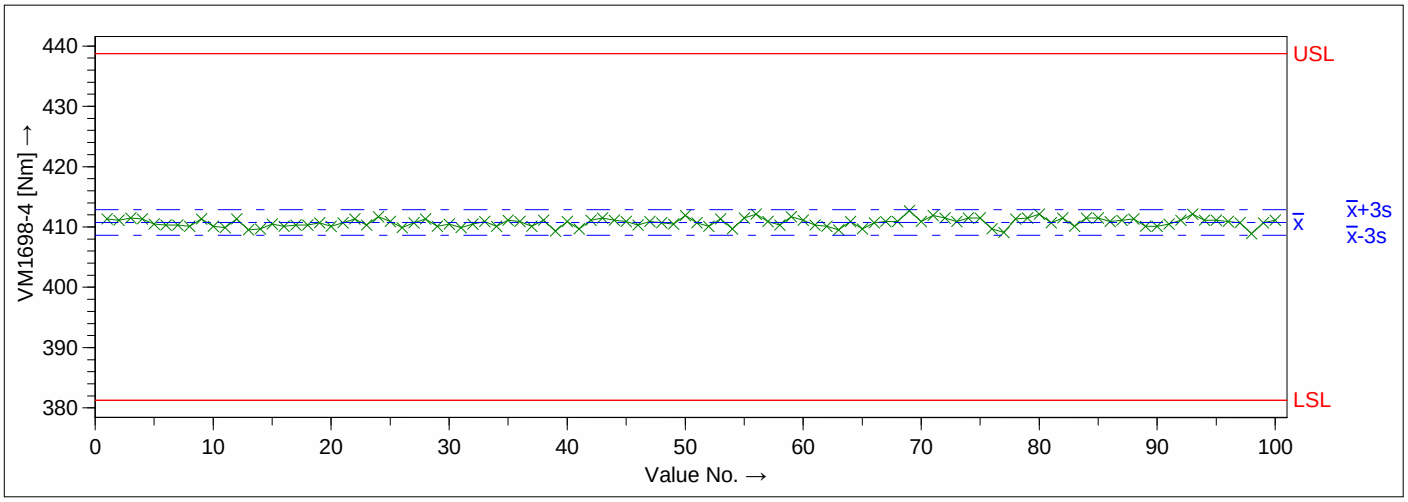
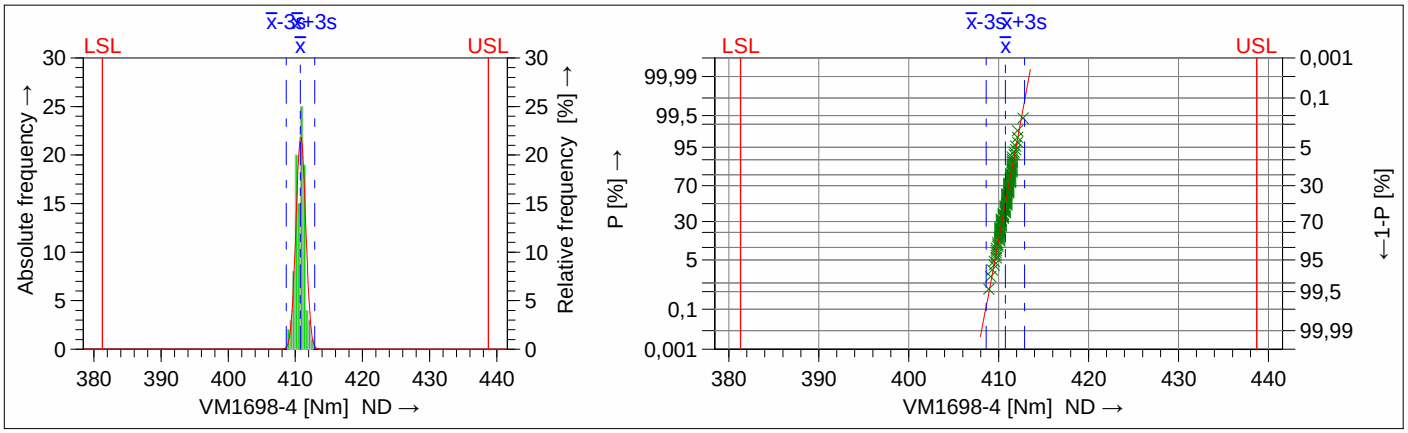
Plant	ATG Westhausen	Operator Name	Sünder
Date	05.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016283_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 05.05.2022 07:29:52 to 05.05.2022 07:45:04

Rem. TQ 80% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 10.224 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	410.00			$\bar{x}$	410.7500
LSL	381.30	x_{min}	408.90	$\bar{x}$-3s	408.6208
USL	438.70	x_{max}	412.70	$\bar{x}$+3s	412.8792
T	57.40	R	3.80	6s	4.2585
		$n_{<T>}$	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	13.48
Critical capability index	=	C_{mk}	13.13

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 05.05.2022

Serial No.	1016283_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.: 10.224 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	411,30	411,10	411,50	411,30	410,50	410,30	410,30	410,10	411,30	410,10
1024210	VM1698-4	Grad	26,50	31,25	30,75	29,25	29,75	30,25	29,75	30,25	30,25	30,75

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	409,90	411,30	409,50	409,70	410,50	410,10	410,30	410,30	410,70	410,10
1024210	VM1698-4	Grad	30,00	30,25	29,75	30,00	30,25	29,75	29,75	29,50	30,75	30,25

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	410,70	411,30	410,30	411,70	410,90	409,90	410,70	411,30	410,10	410,50
1024210	VM1698-4	Grad	30,50	31,00	30,00	30,25	31,00	30,50	30,25	30,50	30,00	29,25

Char.No.	Char.Descr.	Unit	x_{31}	x_{32}	x_{33}	x_{34}	x_{35}	x_{36}	x_{37}	x_{38}	x_{39}	x_{40}
1024210	VM1698-4	Nm	409,90	410,50	410,90	410,10	411,10	410,90	410,10	411,10	409,30	410,90
1024210	VM1698-4	Grad	30,50	31,50	31,00	31,25	30,50	29,00	29,75	30,00	29,75	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}
1024210	VM1698-4	Nm	409,70	411,10	411,50	411,10	410,90	410,30	410,90	410,70	410,50	411,90
1024210	VM1698-4	Grad	30,50	30,00	29,50	29,75	30,25	29,25	29,75	29,25	29,75	29,00

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	410,70	410,10	411,30	409,70	411,50	412,10	410,90	410,30	411,70	411,10
1024210	VM1698-4	Grad	30,25	30,25	29,50	30,00	30,50	31,25	31,00	30,25	30,00	30,25

Char.No.	Char.Descr.	Unit	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
1024210	VM1698-4	Nm	410,30	410,10	409,50	410,90	409,70	410,70	410,90	410,90	412,70	410,90
1024210	VM1698-4	Grad	29,50	29,25	29,75	29,75	29,50	29,00	30,50	29,00	29,00	28,75

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	411,90	411,50	410,90	411,50	411,50	409,70	409,10	411,30	411,50	412,10
1024210	VM1698-4	Grad	30,50	30,00	30,75	29,25	29,50	29,25	30,50	30,00	29,50	30,00

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 05.05.2022

Serial No.	1016283_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.: 10.224 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
1024210	VM1698-4	Nm	410,70	411,50	410,10	411,50	411,50	410,90	411,10	411,30	410,10	410,10
1024210	VM1698-4	Grad	29,25	29,75	30,50	29,50	28,25	30,25	30,00	30,25	30,00	29,50

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	410,50	411,10	412,10	411,10	411,10	410,90	410,70	408,90	410,70	411,10
1024210	VM1698-4	Grad	29,25	29,75	29,75	29,75	29,25	29,25	29,75	29,25	30,25	30,50

Machine Capability Study
Tool System

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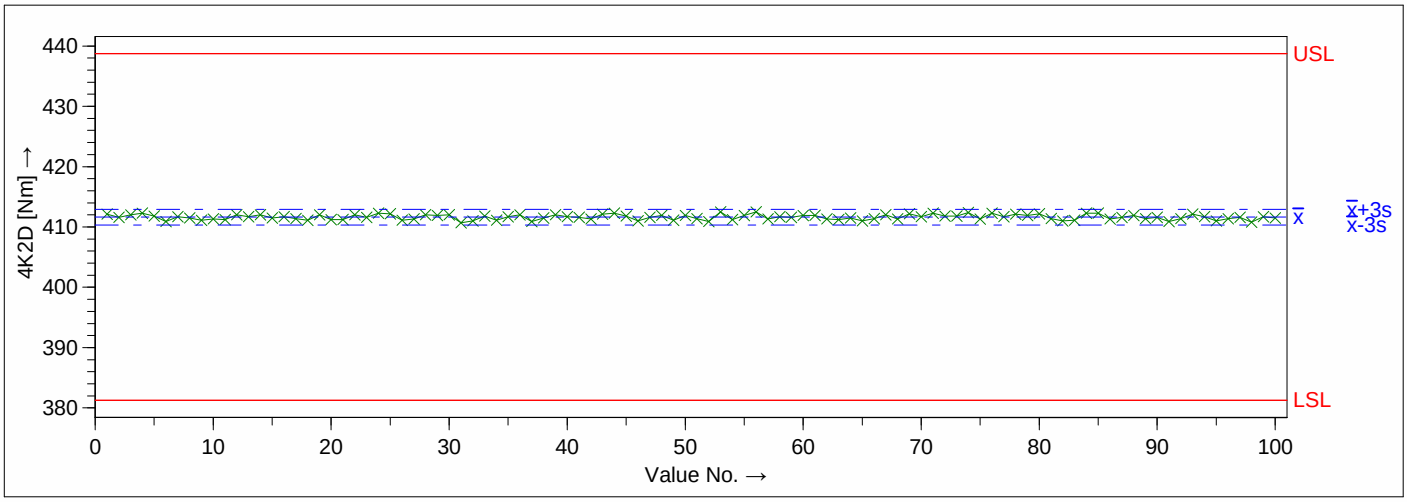
Plant	ATG Westhausen	Operator Name	Sünder
Date	05.05.2022		

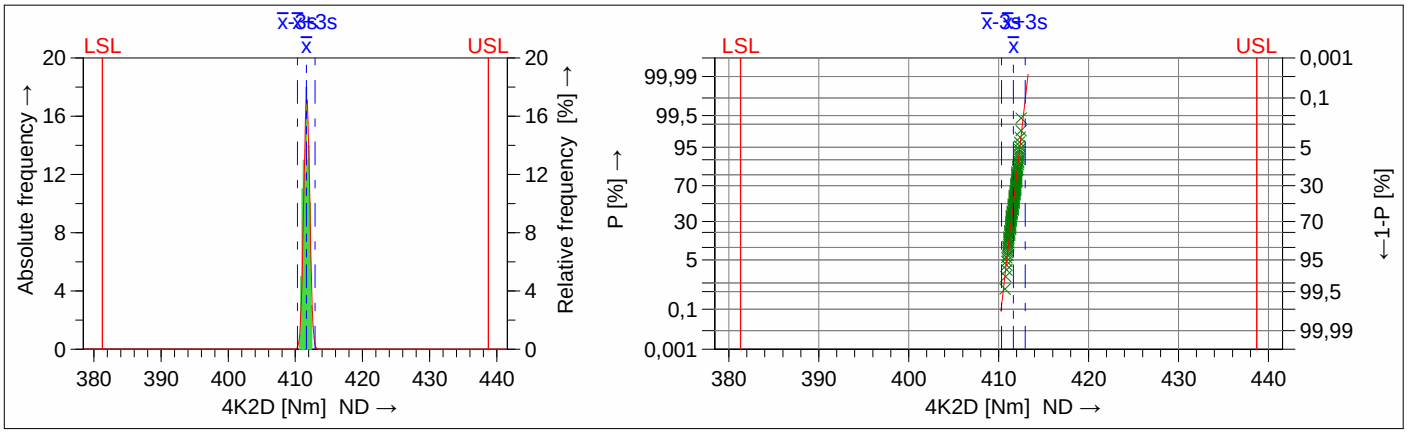
Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016283_h	Char.Descr.	4K2D	Nom.val. 410,00 28,70	USL 438,70
		Serial No.	204576	Unit Nm -28,70	LSL 381,30
Char.Type	variable			Tolerance value 7 %	Decimal Pl. 2

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

Evaluation from 05.05.2022 07:29:53 to 05.05.2022 07:45:05

Rem. TQ 80% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 10.224 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	410.00			$\bar{x}$	411.6290
LSL	381.30	x_{min}	410.70	$\bar{x}$-3s	410.3194
USL	438.70	x_{max}	412.50	$\bar{x}$+3s	412.9386
T	57.40	R	1.80	6s	2.6192
		$n_{<T>}$	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	21.91
Critical capability index	=	C_{mk}	20.67

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 05.05.2022

Serial No.	1016283_h	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	410,00
Ord. No.	4BD500T1S-A	Serial No.	204576	LSL	381,30
				USL	438,70
Remark	TQ 80% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 10.224 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}
204576	4K2D	Nm	412,10	411,60	412,00	412,30	411,80	410,90	411,70	411,50	411,10	411,30
204576	4K2D	Grad	27,00	32,00	32,00	30,00	31,00	31,00	31,00	31,00	31,00	31,00

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}
204576	4K2D	Nm	411,20	412,00	411,70	412,00	411,50	411,70	411,40	411,10	412,00	411,20
204576	4K2D	Grad	31,00	31,00	30,00	31,00	31,00	30,00	31,00	31,00	31,00	31,00

Char.No.	Char.Descr.	Unit	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204576	4K2D	Nm	411,20	412,00	411,60	412,30	412,20	411,10	411,30	412,00	411,90	412,00
204576	4K2D	Grad	31,00	32,00	31,00	31,00	32,00	31,00	31,00	31,00	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}
204576	4K2D	Nm	410,70	411,00	411,80	411,10	411,70	412,00	410,90	411,50	412,00	411,70
204576	4K2D	Grad	31,00	32,00	31,00	32,00	31,00	30,00	30,00	31,00	30,00	31,00

Char.No.	Char.Descr.	Unit	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204576	4K2D	Nm	411,60	411,30	412,10	412,30	411,80	411,00	411,60	411,90	411,10	411,90
204576	4K2D	Grad	31,00	31,00	30,00	31,00	31,00	30,00	30,00	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}
204576	4K2D	Nm	411,40	410,90	412,50	411,20	411,90	412,50	411,30	411,70	411,60	411,90
204576	4K2D	Grad	31,00	31,00	30,00	31,00	31,00	31,00	32,00	31,00	31,00	31,00

Char.No.	Char.Descr.	Unit	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
204576	4K2D	Nm	411,90	411,30	411,20	411,50	411,00	411,40	412,00	411,30	412,20	411,70
204576	4K2D	Grad	31,00	30,00	31,00	30,00	30,00	30,00	31,00	30,00	30,00	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}
204576	4K2D	Nm	412,30	411,80	411,80	412,40	411,30	412,30	411,70	412,10	411,90	412,20
204576	4K2D	Grad	31,00	31,00	31,00	30,00	30,00	30,00	31,00	30,00	30,00	31,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 05.05.2022

Serial No.	1016283_h	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	410,00
Ord. No.	4BD500T1S-A	Serial No.	204576	LSL	381,30
				USL	438,70
Remark	TQ 80% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 10.224 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}
204576	4K2D	Nm	411,40	411,00	411,10	412,30	412,30	411,30	411,60	411,90	411,40	411,60
204576	4K2D	Grad	30,00	30,00	31,00	31,00	29,00	30,00	31,00	31,00	30,00	30,00

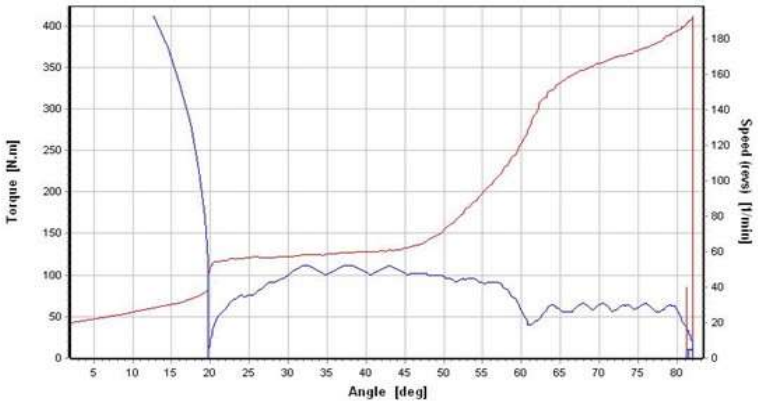
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204576	4K2D	Nm	410,90	411,40	412,10	411,70	411,00	411,40	411,60	410,80	411,70	411,50
204576	4K2D	Grad	31,00	30,00	30,00	31,00	30,00	30,00	30,00	30,00	31,00	31,00

Torque graphs

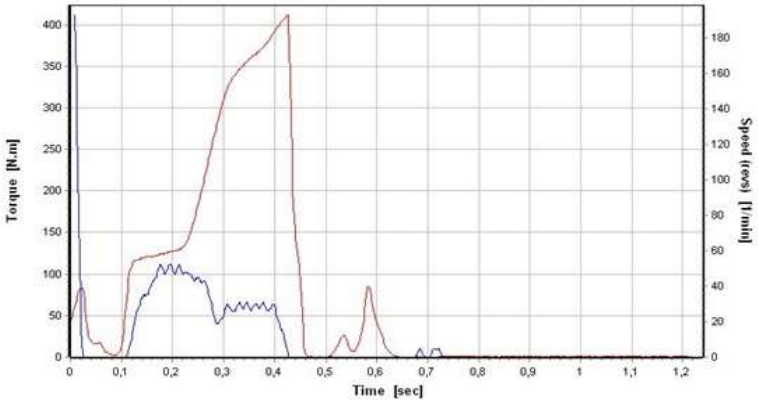
Machine Capability Study 80 %

Model: **4BD-4B500A-4K2D-4ZA**
Serial no: **1016283**

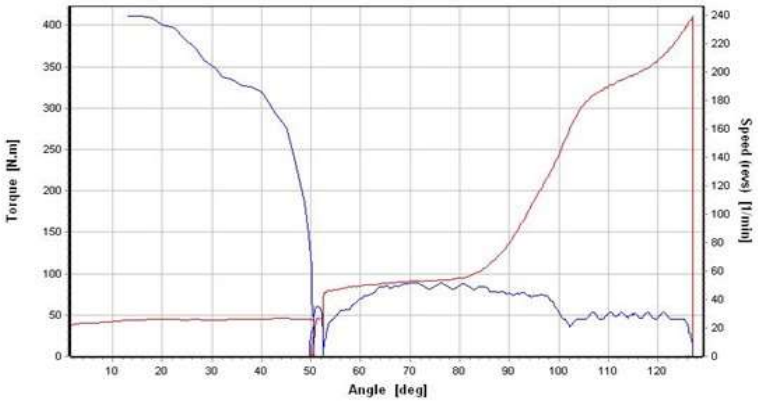
Angle degree: **30°**
Test torque: **410,0 Nm**



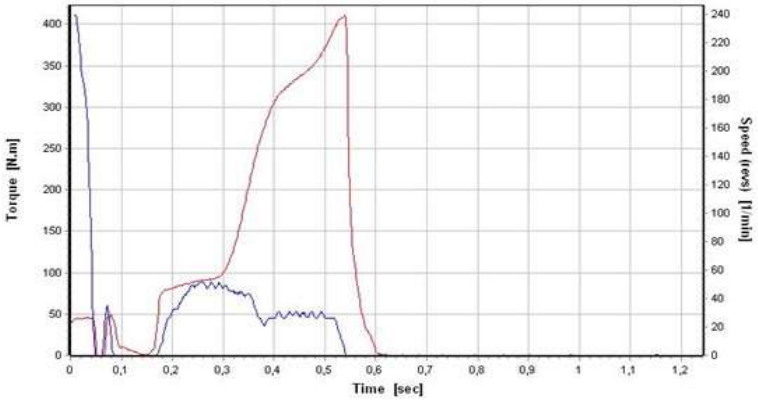
Value no. 1
Graph
Torque / Angle / Speed



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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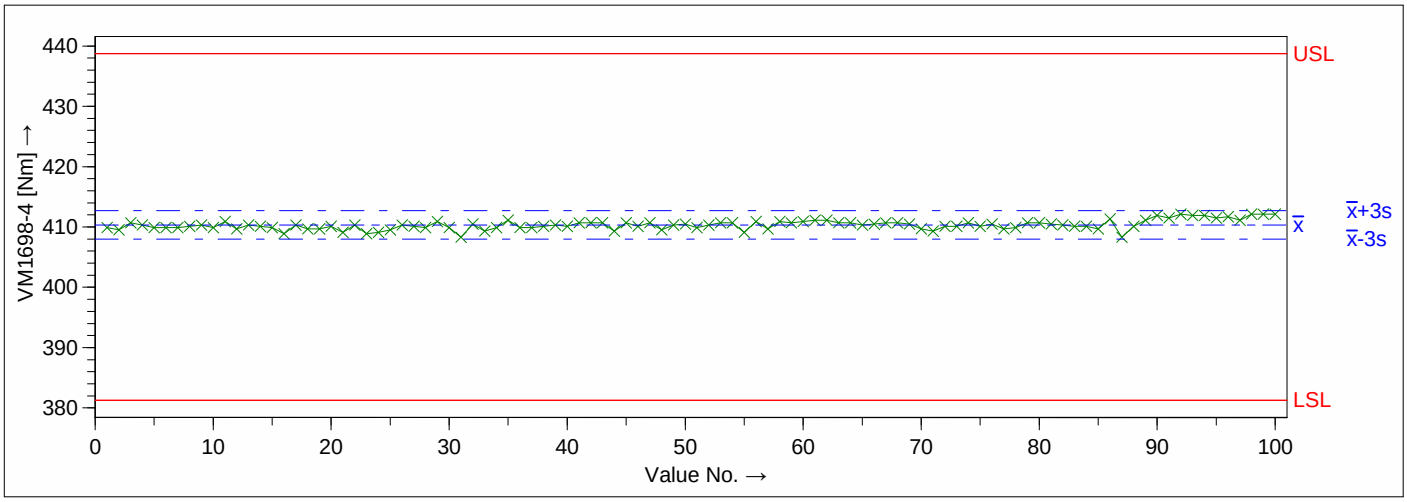
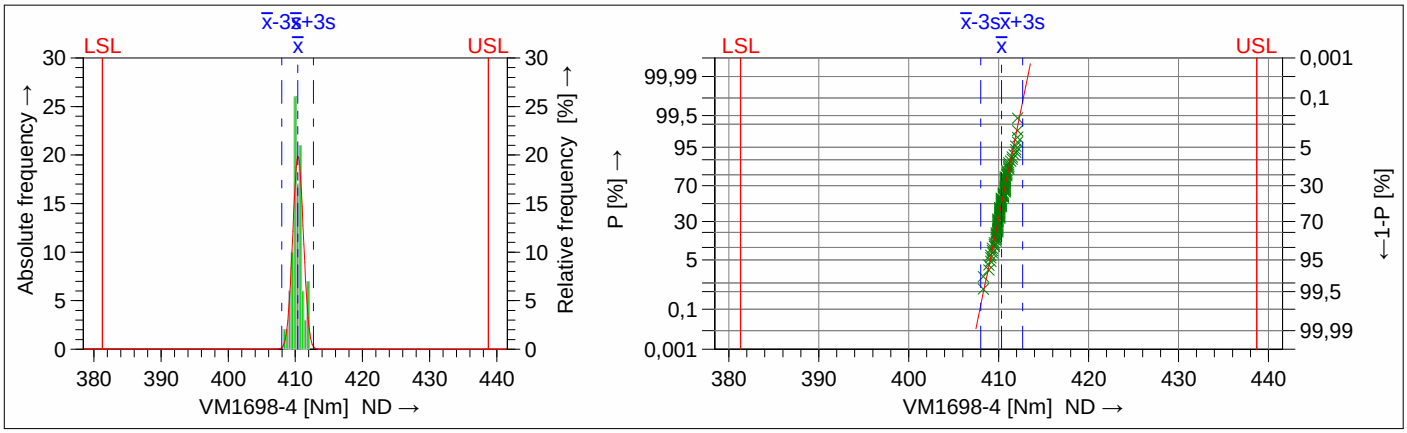
Plant	ATG Westhausen	Operator Name	Sünder
Date	05.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016283_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 05.05.2022 08:53:13 to 05.05.2022 10:32:23

Rem. TQ 80% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 10.224 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	410.00			$\bar{x}$	410.3360
LSL	381.30	x_{min}	408.30	$\bar{x}$-3s	407.9921
USL	438.70	x_{max}	412.10	$\bar{x}$+3s	412.6799
T	57.40	R	3.80	6s	4.6877
		$n_{<T>}$	100	$p_{<T>}$	100.00000 %
		$n_{>USL}$	0	$p_{>USL}$	0.00000%
		$n_{<LSL}$	0	$p_{<LSL}$	0.00000%
		n_{eff}	100		
		n_{tot}	100		

Model distribution		Normal Distribution	
Calculation method		M1.1.4 $\hat{\sigma} = s_{tot}$	
Potential Capability index	=	C_m	12.24
Critical capability index	=	C_{mk}	12.10

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 05.05.2022

Serial No.	1016283_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.: 10.224 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}
1024210	VM1698-4	Nm	409,90	409,50	410,70	410,30	409,90	409,90	409,90	410,10	410,30	409,90
1024210	VM1698-4	Grad	378,25	368,25	364,50	357,25	392,00	379,25	367,75	378,25	357,75	312,75

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	410,90	409,70	410,30	410,10	409,90	408,90	410,30	409,70	409,70	410,10
1024210	VM1698-4	Grad	346,75	357,75	362,50	355,00	351,75	379,00	351,25	368,50	340,50	363,25

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	409,10	410,30	408,90	409,10	409,50	410,30	410,10	409,90	410,90	409,90
1024210	VM1698-4	Grad	348,00	356,75	365,25	367,50	360,00	356,50	365,50	357,50	367,00	351,25

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	408,30	410,50	409,30	409,90	411,10	409,90	409,90	410,10	410,30	410,10
1024210	VM1698-4	Grad	367,00	372,50	364,25	354,25	365,00	366,00	358,25	356,50	368,75	358,50

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	410,70	410,70	410,70	409,30	410,70	410,10	410,70	409,50	410,30	410,50
1024210	VM1698-4	Grad	352,75	358,00	365,75	363,75	354,25	360,00	363,50	356,75	348,50	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	409,90	410,30	410,70	410,70	409,10	410,90	409,70	410,90	410,70	410,90
1024210	VM1698-4	Grad	349,25	357,75	367,75	384,75	354,00	359,75	377,50	350,00	365,25	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}
1024210	VM1698-4	Nm	411,10	411,10	410,70	410,70	410,30	410,50	410,70	410,70	410,50	409,70
1024210	VM1698-4	Grad	365,50	360,50	350,00	377,25	360,25	381,50	375,75	334,00	363,50	366,75

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	409,30	410,10	410,10	410,70	410,10	410,50	409,70	409,90	410,70	410,70
1024210	VM1698-4	Grad	358,75	378,50	354,00	343,50	363,75	349,00	358,75	370,00	358,50	338,25

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 05.05.2022

Serial No.	1016283_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.: 10.224 Nm/A; Speed: 269/50 rpm;				

Char.No.	Char.Descr.	Unit	x_{81}	x_{82}	x_{83}	x_{84}	x_{85}	x_{86}	x_{87}	x_{88}	x_{89}	x_{90}
1024210	VM1698-4	Nm	410,50	410,30	410,10	410,10	409,70	411,30	408,30	410,10	411,10	411,90
1024210	VM1698-4	Grad	381,00	369,50	360,25	346,75	346,25	359,75	362,25	368,75	371,25	359,75

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	411,50	412,10	411,90	411,90	411,50	411,70	411,10	412,10	412,10	412,10
1024210	VM1698-4	Grad	353,25	362,00	367,25	345,25	349,50	351,75	338,25	389,00	360,50	346,25

Machine Capability Study
Tool System

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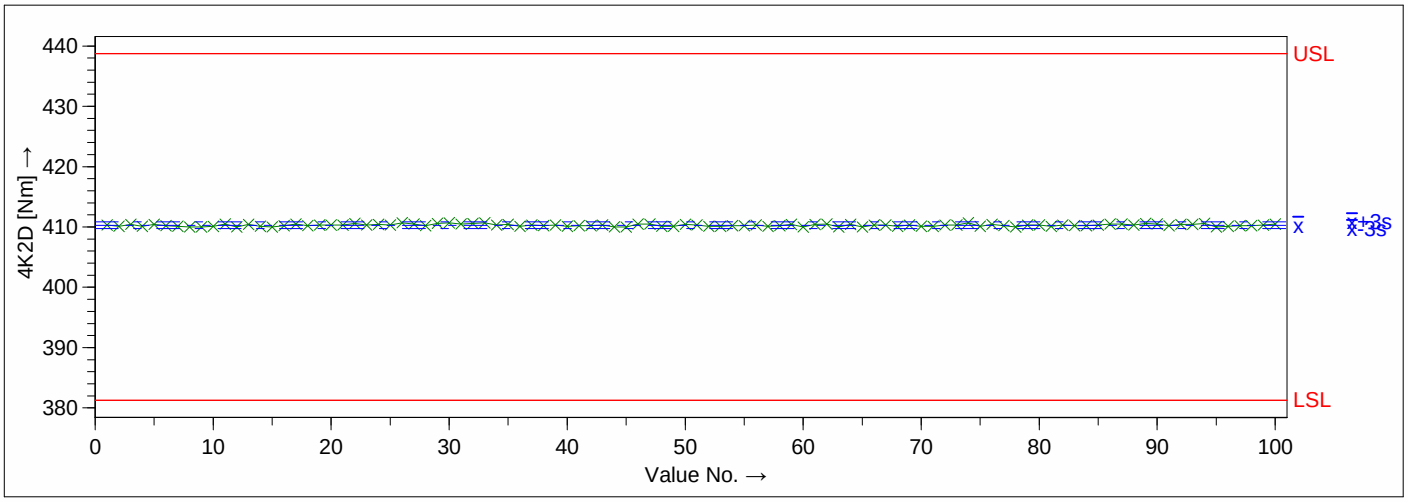
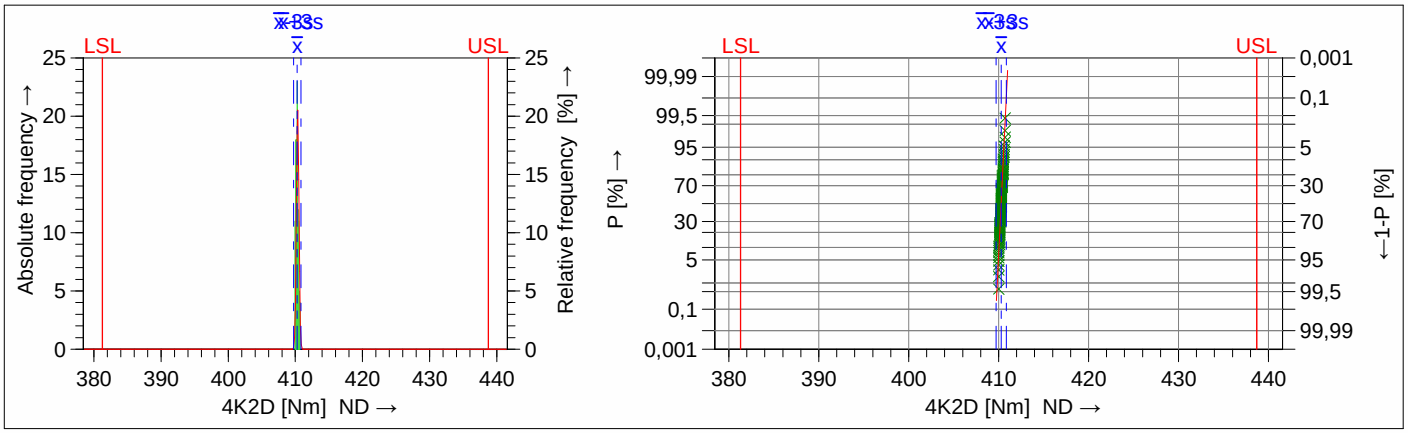
Plant	ATG Westhausen	Operator Name	Sünder
Date	05.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016283_g	Char.Descr.	4K2D	Nom.val. 410,00 28,70	USL 438,70
		Serial No.	204576	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 05.05.2022 08:53:13 to 05.05.2022 10:32:24

Rem. TQ 80% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 10.224 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	409.7175
USL	438.70	x_{max}	410.70	$\bar{x}$+3s	410.8425
T	57.40	R	0.70	6s	1.1249
		$n_{<T>}$	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	51.03
Critical capability index	=	C_{mk}	50.53

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 05.05.2022

Serial No.	1016283_g	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	410,00
Ord. No.	4BD500T1S-A	Serial No.	204576	LSL	381,30
				USL	438,70
Remark	TQ 80% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 10.224 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}
204576	4K2D	Nm	410,30	410,10	410,40	410,10	410,40	410,20	410,10	410,00	410,00	410,10
204576	4K2D	Grad	379,00	369,00	369,00	359,00	393,00	379,00	371,00	379,00	358,00	312,00

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}
204576	4K2D	Nm	410,50	410,00	410,40	410,10	410,00	410,20	410,50	410,20	410,30	410,30
204576	4K2D	Grad	347,00	359,00	374,00	355,00	354,00	382,00	356,00	370,00	343,00	363,00

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}
204576	4K2D	Nm	410,30	410,60	410,30	410,40	410,30	410,70	410,50	410,20	410,60	410,70
204576	4K2D	Grad	359,00	359,00	376,00	371,00	366,00	361,00	368,00	359,00	368,00	357,00

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}
204576	4K2D	Nm	410,50	410,60	410,70	410,30	410,40	410,10	410,30	410,20	410,30	410,10
204576	4K2D	Grad	371,00	378,00	367,00	355,00	369,00	367,00	359,00	358,00	371,00	361,00

Char.No.	Char.Descr.	Unit	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204576	4K2D	Nm	410,20	410,20	410,30	410,00	410,00	410,50	410,50	410,10	410,10	410,40
204576	4K2D	Grad	356,00	359,00	367,00	367,00	354,00	361,00	364,00	358,00	349,00	366,00

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}
204576	4K2D	Nm	410,30	410,10	410,10	410,20	410,20	410,30	410,10	410,20	410,40	410,00
204576	4K2D	Grad	352,00	358,00	370,00	384,00	361,00	360,00	382,00	351,00	366,00	365,00

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}
204576	4K2D	Nm	410,40	410,50	410,00	410,40	410,00	410,30	410,30	410,10	410,30	410,10
204576	4K2D	Grad	371,00	362,00	352,00	380,00	361,00	382,00	382,00	334,00	364,00	368,00

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}
204576	4K2D	Nm	410,10	410,30	410,30	410,70	410,10	410,40	410,20	410,00	410,30	410,30
204576	4K2D	Grad	360,00	382,00	357,00	344,00	365,00	350,00	369,00	374,00	365,00	341,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 05.05.2022

Serial No.	1016283_g	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	410,00
Ord. No.	4BD500T1S-A	Serial No.	204576	LSL	381,30
				USL	438,70
Remark	TQ 80% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 10.224 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}
204576	4K2D	Nm	410,10	410,30	410,20	410,20	410,30	410,50	410,50	410,30	410,60	410,50
204576	4K2D	Grad	381,00	369,00	361,00	349,00	348,00	360,00	366,00	368,00	343,00	359,00

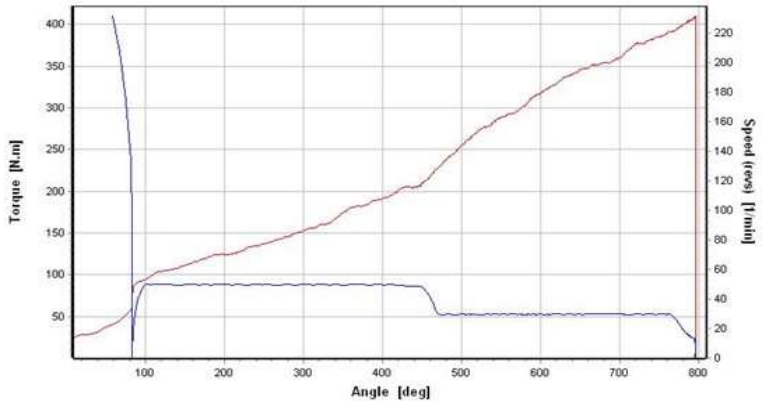
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204576	4K2D	Nm	410,20	410,40	410,40	410,60	410,00	410,10	410,20	410,20	410,30	410,50
204576	4K2D	Grad	354,00	364,00	365,00	342,00	350,00	352,00	338,00	391,00	360,00	347,00

Torque graphs

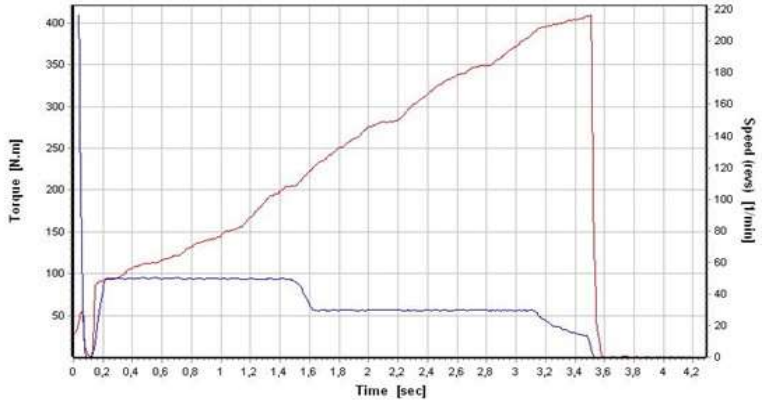
Machine Capability Study 80 %

Model: **4BD-4B500A-4K2D-4ZA**
Serial no: **1016283**

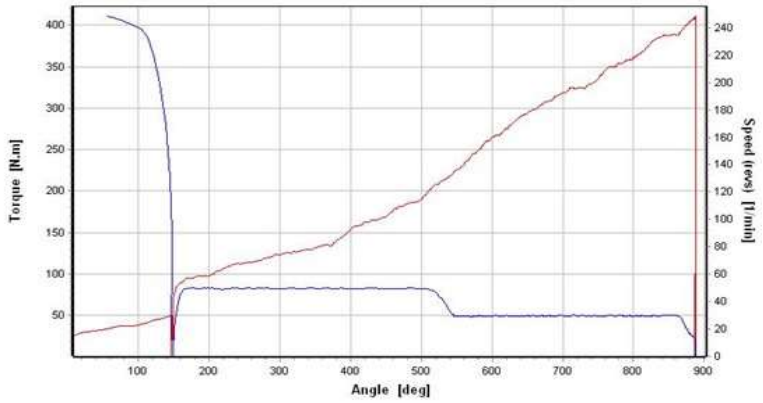
Angle degree: **360°**
Test torque: **410,0 Nm**



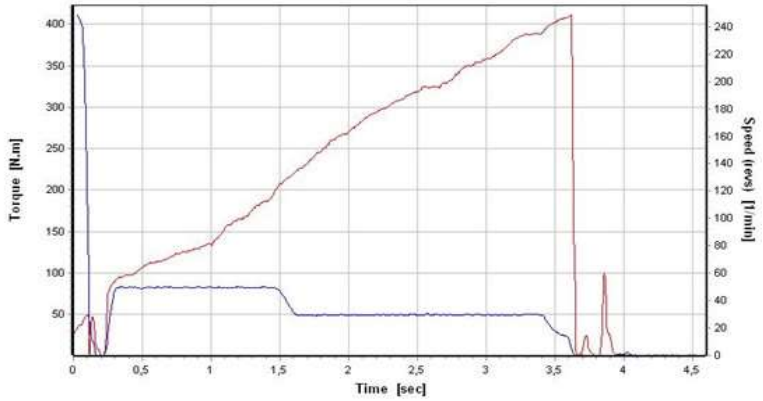
Value no. 1
Graph
Torque / Angle / Speed



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: **1016283**

Test torque: Tq max. 500,00 Nm

Hard joint (H)	3021,53	Nm / Revolution	Angle degree	30°
Soft joint (L)	250,60	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	503,59	501,21 Nm
	Standard deviation	0,97	0,89 Nm
	Torque scatter (99,73%)	5,84	5,34 Nm
	C_m	11,99	13,12
	C_{mk}	10,76	12,67

b)	Min. C_m hard/soft (lowest value)	11,99
	Min. C_{mk} hard/soft (lowest value)	10,76

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

Note:

Machine Capability Study
Control System

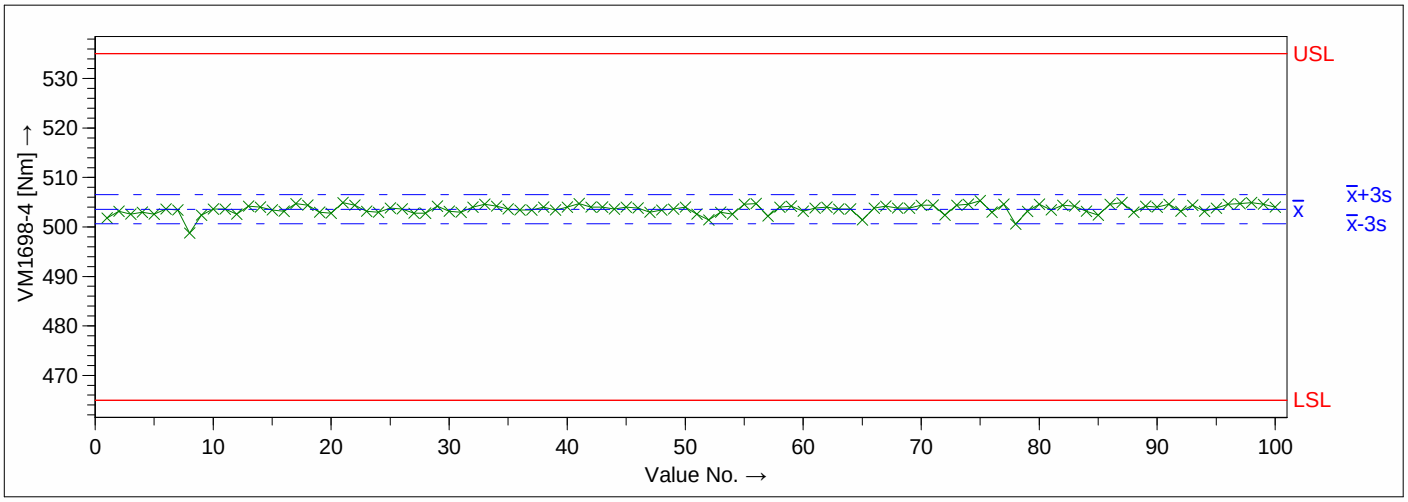
Cleco Production Tools

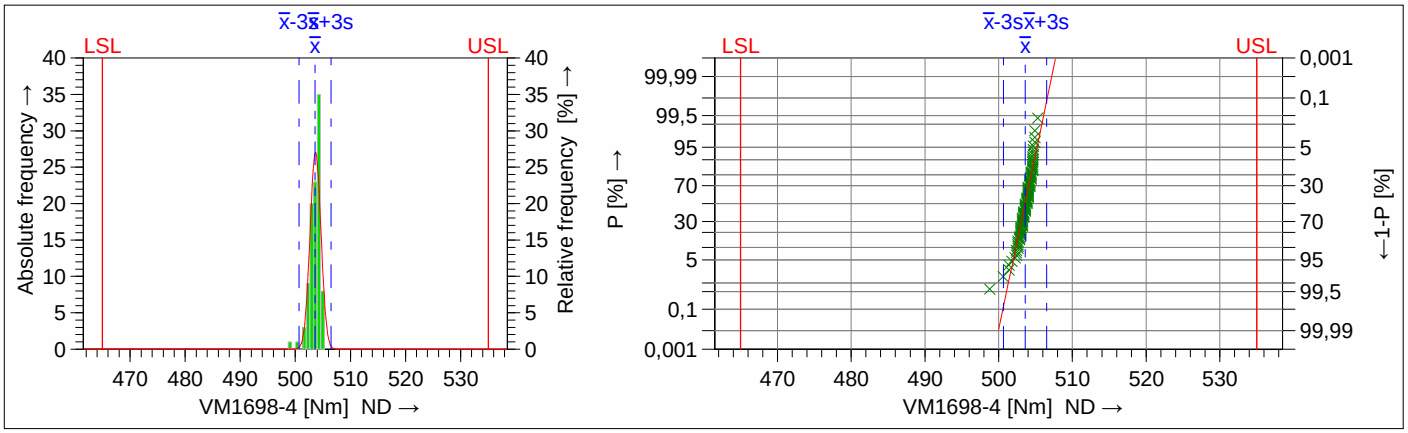
Plant	ATG Westhausen	Operator Name	Sünder
Date	04.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016283_b	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 14:19:24 to 04.05.2022 14:34:21

Rem. TQ 100% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.9446 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	500.00			$\bar{x}$	503.5880
LSL	465.00	x_{min}	498.80	$\bar{x}$-3s	500.6687
USL	535.00	x_{max}	505.30	$\bar{x}$+3s	506.5073
T	70.00	R	6.50	6s	5.8386
		$n_{<T>}$	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	11.99
Critical capability index	=	C_{mk}	10.76

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.	1016283_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.: 9.9446 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	501,80	503,20	502,60	503,00	502,60	503,60	503,40	498,80	502,40	503,60
1024210	VM1698-4	Grad	33,75	33,00	30,50	31,00	30,50	30,25	31,50	32,00	31,25	32,50

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	503,60	502,60	504,20	504,00	503,40	503,20	504,70	504,40	503,00	502,80
1024210	VM1698-4	Grad	30,50	30,75	31,50	30,50	30,75	32,75	30,25	30,50	31,75	30,50

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	504,90	504,40	503,20	503,00	503,80	503,60	502,80	502,80	504,20	503,20
1024210	VM1698-4	Grad	31,00	32,25	31,50	29,50	31,25	31,25	30,75	30,50	31,00	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	503,00	504,00	504,60	504,20	503,60	503,40	503,40	504,00	503,40	504,00
1024210	VM1698-4	Grad	29,50	31,50	31,75	30,75	30,50	30,75	32,25	31,00	31,75	30,75

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	504,70	504,00	504,00	503,60	504,00	503,80	503,00	503,40	503,60	504,00
1024210	VM1698-4	Grad	31,00	30,00	30,75	31,25	30,50	30,25	30,50	30,50	30,50	30,00

Char.No.	Char.Descr.	Unit	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
1024210	VM1698-4	Nm	502,60	501,40	503,00	502,60	504,60	504,70	502,20	504,00	504,20	503,20
1024210	VM1698-4	Grad	31,25	29,50	31,25	32,00	29,25	30,25	30,00	29,50	32,25	31,25

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	503,80	504,00	503,60	503,60	501,40	503,80	504,20	503,80	503,80	504,40
1024210	VM1698-4	Grad	33,00	32,25	30,75	31,00	29,75	31,25	29,25	29,75	32,00	30,75

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	504,40	502,40	504,40	504,60	505,30	503,00	504,60	500,60	503,20	504,60
1024210	VM1698-4	Grad	31,25	30,50	33,25	29,00	31,75	29,25	29,25	30,75	32,00	28,50

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 04.05.2022

Serial No.	1016283_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.: 9.9446 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	504,40	504,20	503,20	502,40	504,60	504,90	503,00	504,20	504,00
1024210	VM1698-4	Grad	29,25	30,75	29,25	29,00	29,50	31,75	29,25	29,50	28,75	28,25

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	504,60	503,20	504,40	503,20	503,80	504,60	504,70	504,90	504,60	504,00
1024210	VM1698-4	Grad	29,50	28,75	30,50	29,75	29,25	31,25	30,75	31,75	30,50	31,00

Machine Capability Study
Tool System

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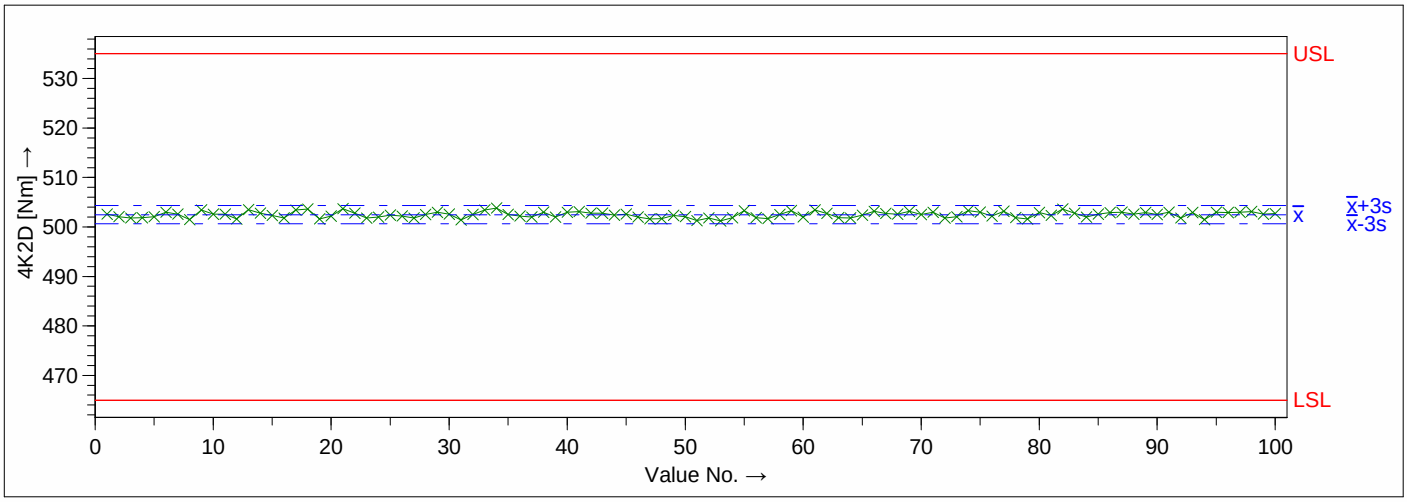
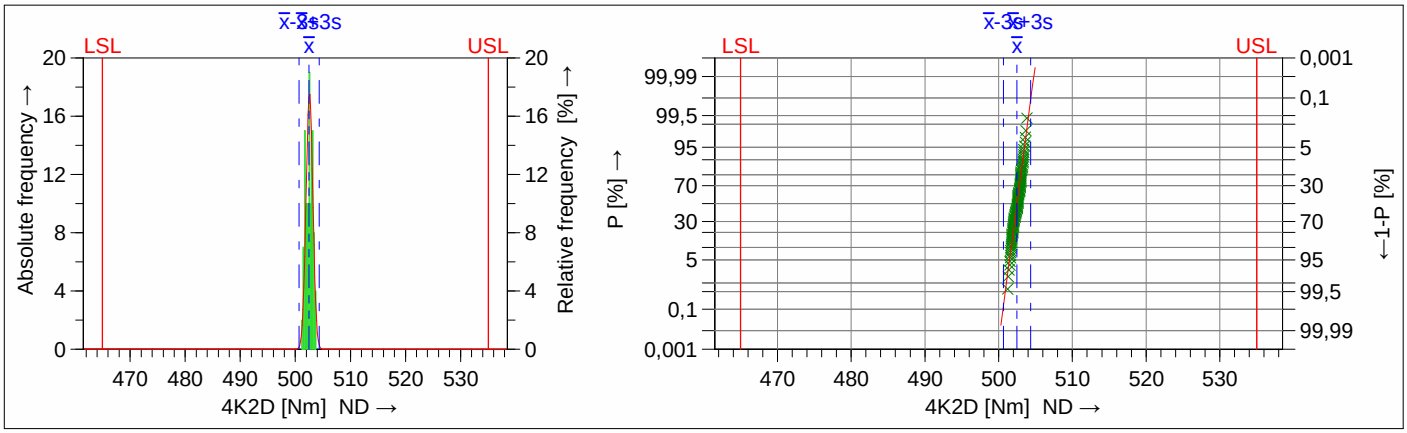
Plant	ATG Westhausen	Operator Name	Sünder
Date	04.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016283_b	Char.Descr.	4K2D	Nom.val.	500,00 35,00
		Serial No.	204576	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 14:19:25 to 04.05.2022 14:34:21

Rem. TQ 100% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.9446 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	500.00			$\bar{x}$	502.4900
LSL	465.00	x_{min}	501.20	$\bar{x}$-3s	500.6537
USL	535.00	x_{max}	503.80	$\bar{x}$+3s	504.3263
T	70.00	R	2.60	6s	3.6725
		$n_{<T>}$	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	19.06
Critical capability index	=	C_{mk}	17.70

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.	1016283_b	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	500,00
Ord. No.	4BD500T1S-A	Serial No.	204576	LSL	465,00
				USL	535,00
Remark	TQ 100% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.9446 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}
204576	4K2D	Nm	502,60	502,10	501,80	501,90	502,10	503,00	502,60	501,50	503,40	502,60
204576	4K2D	Grad	35,00	34,00	32,00	31,00	32,00	31,00	33,00	33,00	33,00	34,00

Char.No.	Char.Descr.	Unit	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	x_{16}	x_{17}	x_{18}	x_{19}	x_{20}
204576	4K2D	Nm	502,60	501,60	503,50	502,80	502,30	501,80	503,40	503,60	501,60	502,20
204576	4K2D	Grad	31,00	32,00	32,00	32,00	31,00	33,00	31,00	32,00	32,00	32,00

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}
204576	4K2D	Nm	503,70	502,80	501,80	502,00	502,40	502,20	501,80	502,50	503,00	502,60
204576	4K2D	Grad	31,00	33,00	32,00	30,00	32,00	32,00	32,00	31,00	32,00	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}
204576	4K2D	Nm	501,40	502,50	503,40	503,80	502,50	502,20	502,00	503,00	502,00	503,00
204576	4K2D	Grad	30,00	32,00	33,00	32,00	31,00	31,00	33,00	32,00	33,00	32,00

Char.No.	Char.Descr.	Unit	x_{41}	x_{42}	x_{43}	x_{44}	x_{45}	x_{46}	x_{47}	x_{48}	x_{49}	x_{50}
204576	4K2D	Nm	503,10	502,80	502,80	502,40	502,60	502,00	501,60	501,70	502,30	502,10
204576	4K2D	Grad	32,00	31,00	32,00	32,00	31,00	31,00	32,00	31,00	31,00	31,00

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}
204576	4K2D	Nm	501,30	501,80	501,20	501,90	503,30	501,90	501,70	502,50	503,30	502,00
204576	4K2D	Grad	32,00	31,00	32,00	33,00	30,00	30,00	31,00	30,00	34,00	32,00

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}
204576	4K2D	Nm	503,40	502,70	501,90	501,80	502,40	503,20	502,70	502,60	503,20	502,50
204576	4K2D	Grad	33,00	34,00	32,00	32,00	31,00	32,00	30,00	31,00	33,00	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}
204576	4K2D	Nm	503,00	501,80	502,10	503,30	503,00	502,20	503,20	501,90	501,60	502,90
204576	4K2D	Grad	32,00	32,00	34,00	29,00	32,00	30,00	30,00	33,00	32,00	30,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 04.05.2022

Serial No.	1016283_b	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	500,00
Ord. No.	4BD500T1S-A	Serial No.	204576	LSL	465,00
				USL	535,00
Remark	TQ 100% hard +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.9446 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}
204576	4K2D	Nm	502,30	503,60	502,80	502,00	502,60	502,90	503,00	502,60	502,90	502,50
204576	4K2D	Grad	30,00	32,00	31,00	30,00	31,00	33,00	30,00	30,00	30,00	30,00

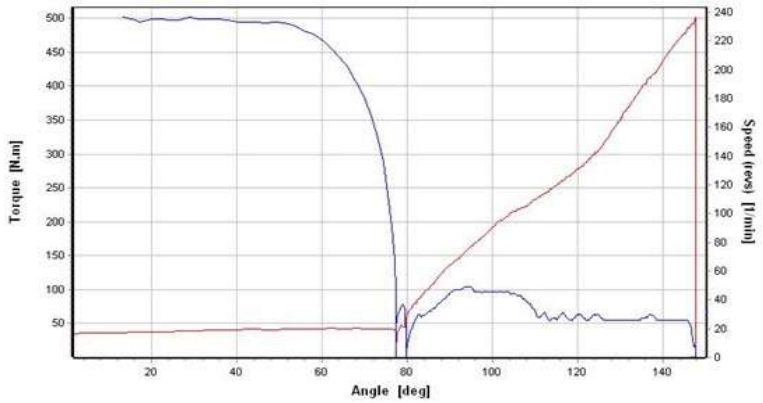
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204576	4K2D	Nm	503,00	501,80	502,90	501,50	503,00	502,90	503,00	503,10	502,60	502,70
204576	4K2D	Grad	30,00	30,00	31,00	30,00	30,00	33,00	33,00	33,00	31,00	32,00

Torque graphs

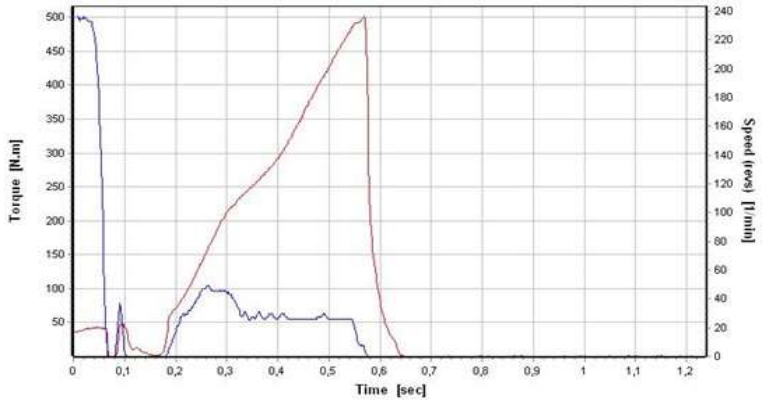
Machine Capability Study 100 %

Model: **4BD-4B500A-4K2D-4ZA**
Serial no: **1016283**

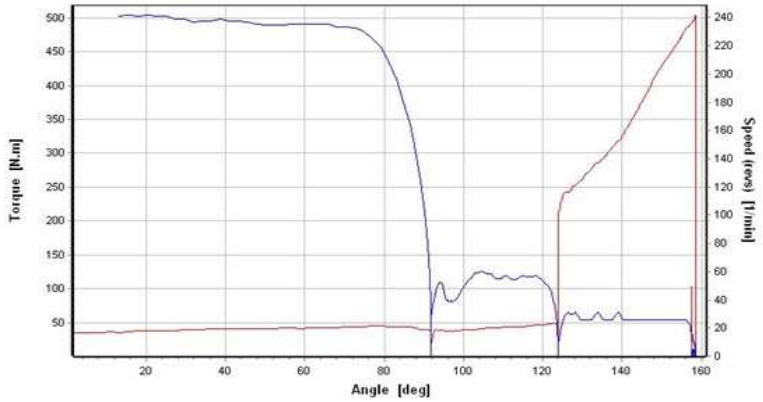
Angle degree: **30°**
Test torque: **500,0 Nm**



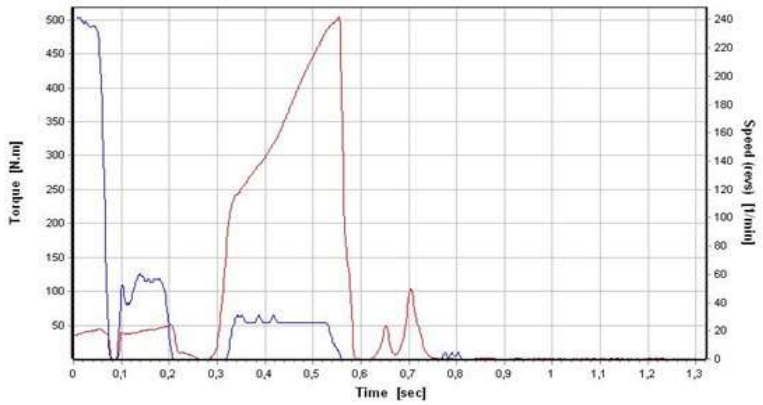
Value no. 1
Graph
Torque / Angle / Speed



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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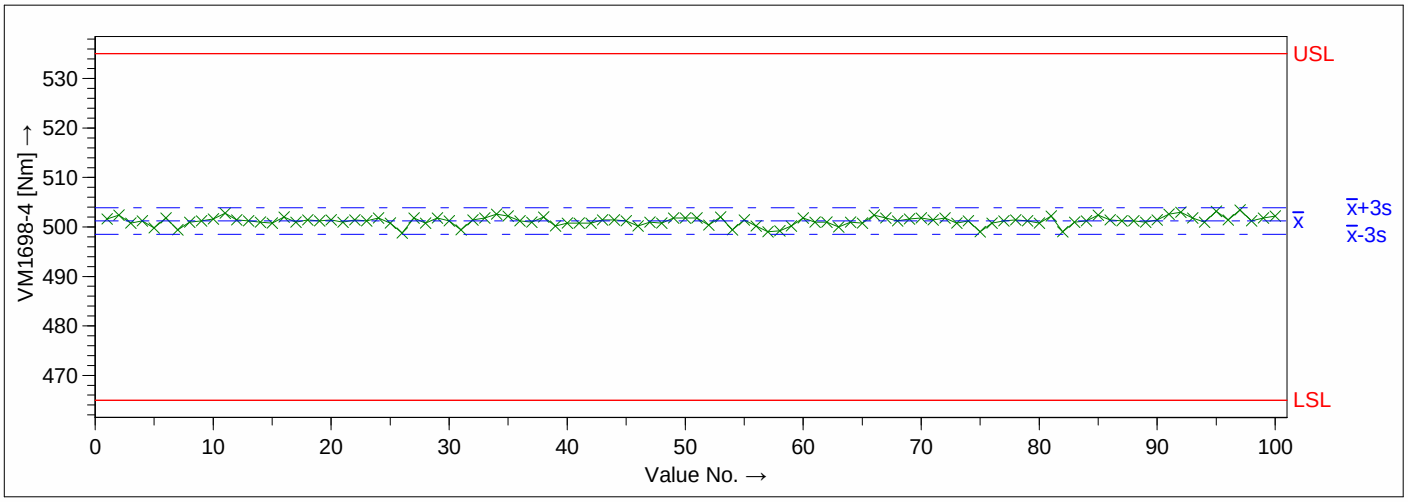
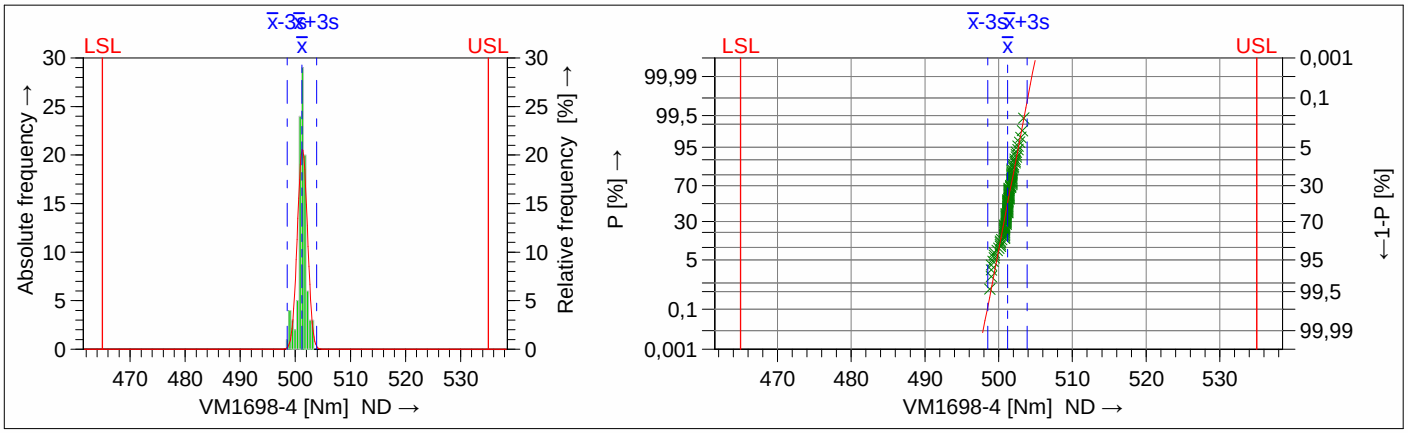
Plant	ATG Westhausen	Operator Name	Sünder
Date	04.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016283_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 15:30:05 to 04.05.2022 17:53:26

Rem. TQ 100% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.9446 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	500.00			$\bar{x}$	501.2060
LSL	465.00	x_{min}	498.80	$\bar{x}$-3s	498.5384
USL	535.00	x_{max}	503.40	$\bar{x}$+3s	503.8736
T	70.00	R	4.60	6s	5.3352
		$n_{<T>}$	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	13.12
Critical capability index	=	C_{mk}	12.67

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.	1016283_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.: 9.9446 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	501,60	502,40	500,80	501,20	499,80	501,80	499,40	501,00	501,20	501,60
1024210	VM1698-4	Grad	346,00	341,00	343,50	346,25	347,75	339,00	339,00	344,25	339,75	351,25

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	502,80	501,40	501,20	501,00	500,80	502,00	501,00	501,40	501,20	501,40
1024210	VM1698-4	Grad	316,50	349,25	335,25	340,00	337,00	346,25	333,00	348,00	362,00	342,25

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	501,00	501,40	501,20	501,80	500,80	498,80	501,80	500,80	501,80	501,20
1024210	VM1698-4	Grad	343,50	353,75	366,75	362,75	356,50	329,75	342,00	351,25	346,00	353,75

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	499,40	501,40	501,80	502,60	502,20	501,20	501,00	502,00	500,20	500,80
1024210	VM1698-4	Grad	366,50	356,50	355,50	352,25	349,50	367,00	355,50	361,50	344,25	362,75

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	500,80	500,80	501,40	501,40	501,20	500,20	501,00	500,80	501,80	501,80
1024210	VM1698-4	Grad	355,00	367,50	365,25	363,00	358,75	351,50	359,75	350,00	346,75	365,00

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	501,80	500,40	502,00	499,40	501,40	500,20	499,00	499,20	500,20	501,80
1024210	VM1698-4	Grad	346,75	366,75	359,00	357,50	349,75	349,00	373,50	373,00	353,75	360,25

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	501,00	501,00	500,00	501,00	500,80	502,40	501,80	501,20	501,60	501,80
1024210	VM1698-4	Grad	360,50	360,50	368,50	368,00	365,50	365,50	352,00	364,25	358,25	364,00

Char.No.	Char.Descr.	Unit	x_{71}	x_{72}	x_{73}	x_{74}	x_{75}	x_{76}	x_{77}	x_{78}	x_{79}	x_{80}
1024210	VM1698-4	Nm	501,40	501,80	500,80	501,20	499,00	500,80	501,20	501,40	501,20	500,80
1024210	VM1698-4	Grad	362,75	365,00	364,25	371,75	361,50	371,75	371,00	352,25	369,25	373,75

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 04.05.2022

Serial No.	1016283_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.: 9.9446 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	502,20	499,00	501,00	501,20	502,40	501,40	501,20	501,20	501,00	501,40
1024210	VM1698-4	Grad	376,50	356,00	348,25	339,50	335,00	354,00	349,00	368,50	376,25	374,25

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	502,60	503,00	501,80	501,00	503,20	501,40	503,40	501,20	501,80	502,20
1024210	VM1698-4	Grad	358,75	351,00	343,75	345,25	373,50	360,00	350,50	340,50	360,50	361,00

Machine Capability Study
Tool System

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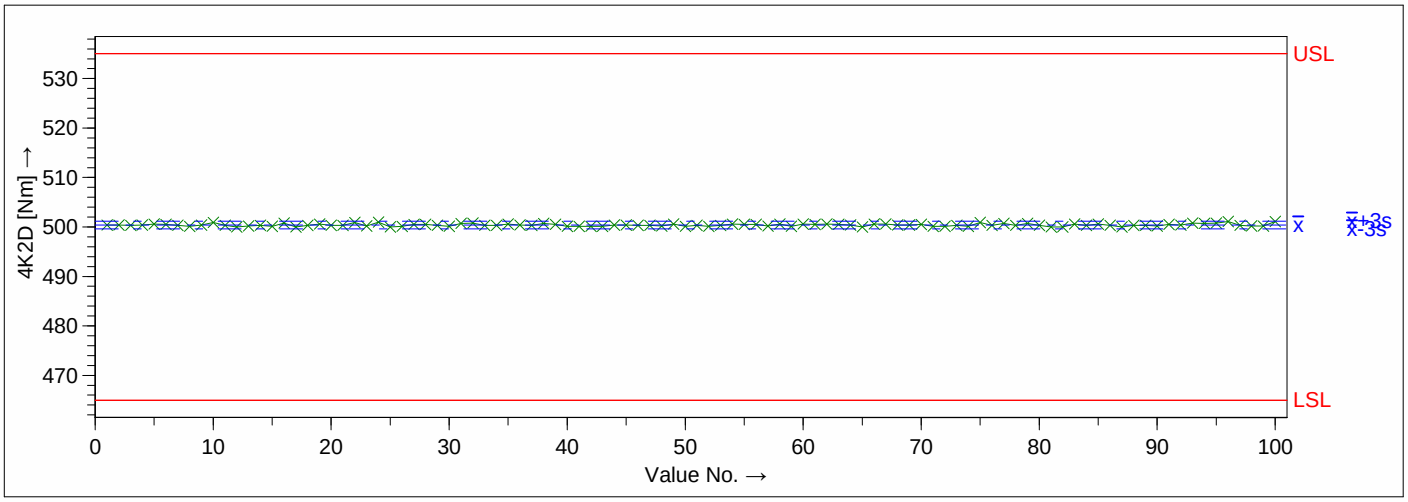
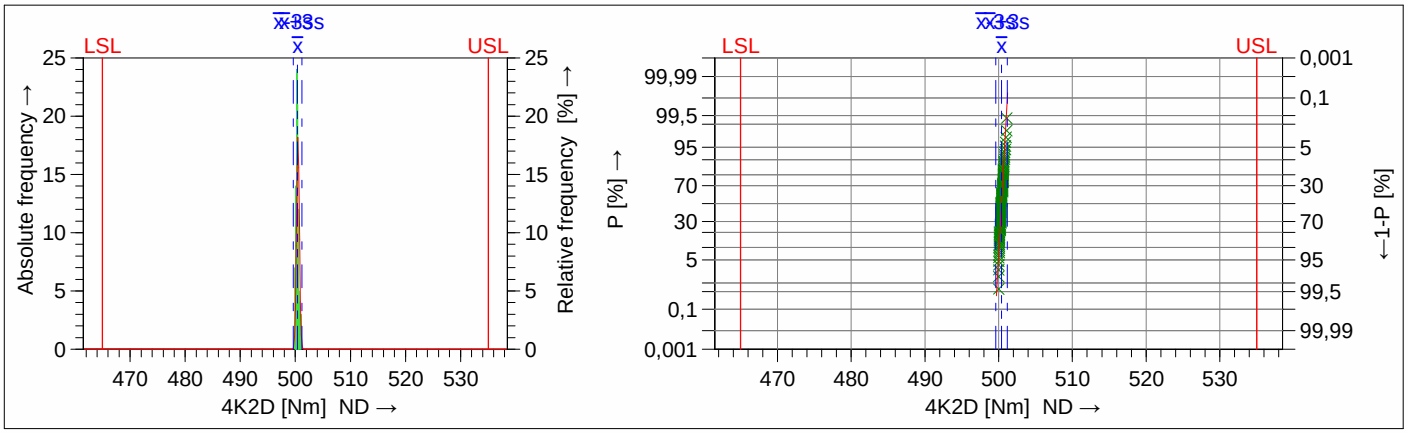
Plant	ATG Westhausen	Operator Name	Sünder
Date	04.05.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016283_a	Char.Descr.	4K2D	Nom.val. 500,00 35,00	USL 535,00
		Serial No.	204576	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 15:30:06 to 04.05.2022 17:53:27

Rem. TQ 100% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.9446 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	500.00			$\bar{x}$	500.3920
LSL	465.00	x_{min}	500.00	$\bar{x}$-3s	499.6143
USL	535.00	x_{max}	501.10	$\bar{x}$+3s	501.1697
T	70.00	R	1.10	6s	1.5555
		$n_{<T>}$	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	45.00
Critical capability index	=	C_{mk}	44.50

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.	1016283_a	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	500,00
Ord. No.	4BD500T1S-A	Serial No.	204576	LSL	465,00
				USL	535,00
Remark	TQ 100% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.9446 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}
204576	4K2D	Nm	500,40	500,40	500,30	500,40	500,60	500,50	500,30	500,10	500,40	500,90
204576	4K2D	Grad	347,00	341,00	344,00	348,00	351,00	340,00	342,00	345,00	340,00	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}
204576	4K2D	Nm	500,30	500,00	500,20	500,30	500,10	500,80	500,00	500,30	500,60	500,30
204576	4K2D	Grad	316,00	350,00	337,00	342,00	341,00	347,00	333,00	349,00	367,00	343,00

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}
204576	4K2D	Nm	500,30	500,90	500,20	501,00	500,00	500,10	500,50	500,50	500,30	500,10
204576	4K2D	Grad	345,00	355,00	368,00	363,00	357,00	334,00	342,00	355,00	347,00	357,00

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}
204576	4K2D	Nm	500,70	500,80	500,30	500,30	500,60	500,40	500,30	500,70	500,50	500,10
204576	4K2D	Grad	375,00	358,00	356,00	352,00	350,00	367,00	356,00	361,00	346,00	364,00

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}
204576	4K2D	Nm	500,10	500,10	500,10	500,40	500,40	500,30	500,30	500,20	500,60	500,10
204576	4K2D	Grad	356,00	369,00	366,00	364,00	359,00	353,00	361,00	351,00	346,00	366,00

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}
204576	4K2D	Nm	500,30	500,10	500,30	500,60	500,50	500,50	500,20	500,60	500,10	500,60
204576	4K2D	Grad	348,00	368,00	359,00	361,00	350,00	352,00	378,00	379,00	355,00	361,00

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}
204576	4K2D	Nm	500,50	500,60	500,50	500,40	500,00	500,60	500,60	500,40	500,40	500,50
204576	4K2D	Grad	361,00	361,00	370,00	370,00	366,00	367,00	352,00	366,00	359,00	365,00

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}
204576	4K2D	Nm	500,10	500,10	500,30	500,10	500,90	500,30	500,70	500,30	500,70	500,30
204576	4K2D	Grad	364,00	366,00	367,00	372,00	366,00	374,00	372,00	353,00	371,00	376,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 04.05.2022

Serial No.	1016283_a	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	500,00
Ord. No.	4BD500T1S-A	Serial No.	204576	LSL	465,00
				USL	535,00
Remark	TQ 100% soft +/-7% * TQ-Cal.: 500 Nm; Cur-Cal.: 9.9446 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}
204576	4K2D	Nm	500,00	500,00	500,60	500,30	500,60	500,30	500,00	500,30	500,30	500,20
204576	4K2D	Grad	376,00	359,00	349,00	341,00	333,00	355,00	350,00	370,00	377,00	379,00

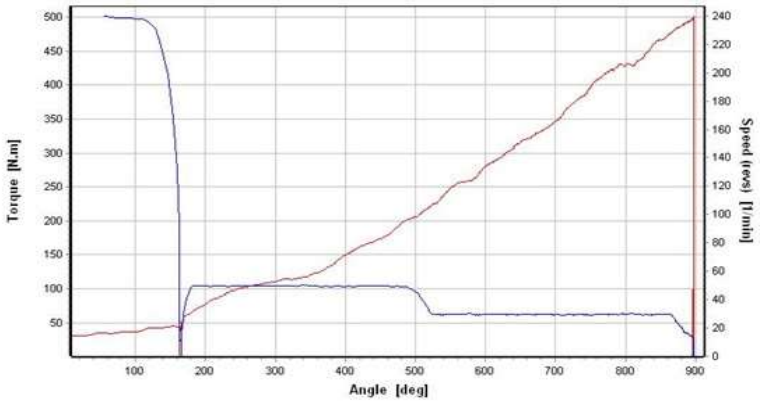
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204576	4K2D	Nm	500,50	500,40	500,80	500,70	500,80	501,10	500,30	500,20	500,20	501,10
204576	4K2D	Grad	359,00	350,00	344,00	346,00	374,00	361,00	351,00	341,00	361,00	361,00

Torque graphs

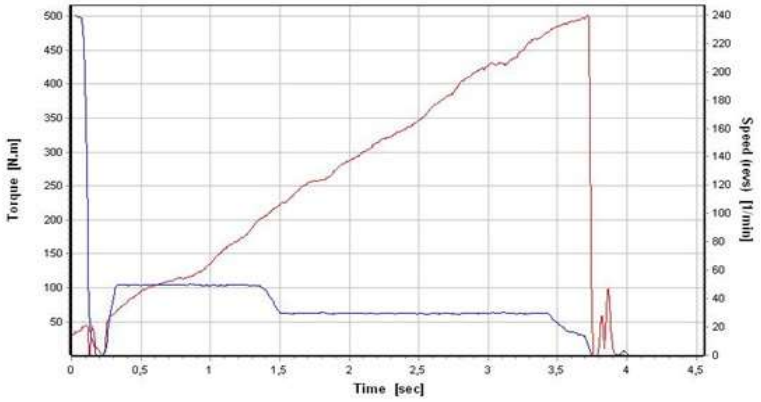
Machine Capability Study 100 %

Model: **4BD-4B500A-4K2D-4ZA**
Serial no: **1016283**

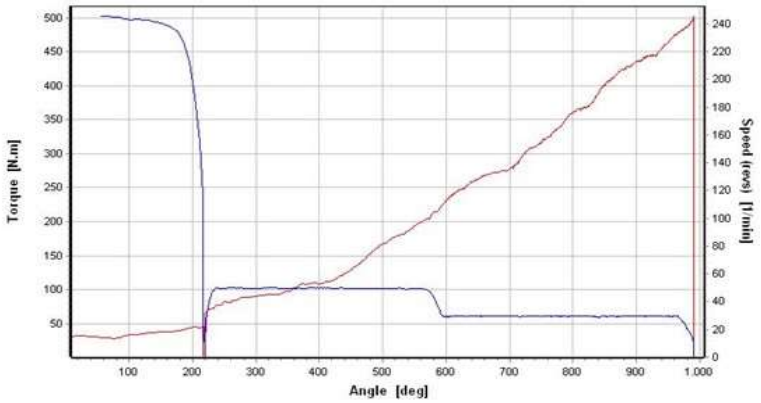
Angle degree: **360°**
Test torque: **500,0 Nm**



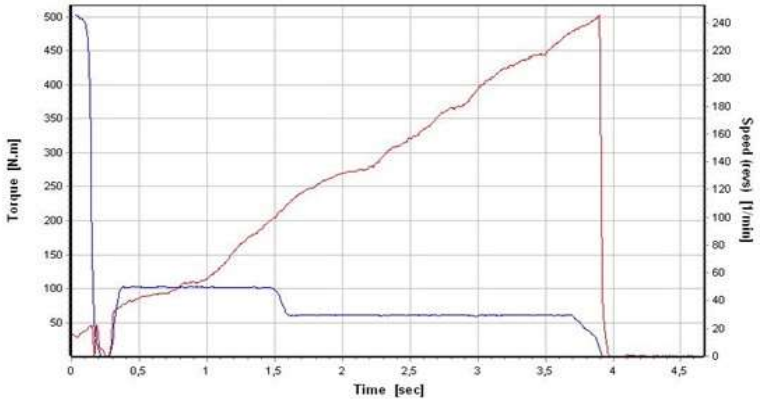
Value no. 1
Graph
Torque / Angle / Speed



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:** 1016283

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: 1,76 % ± **0,88 %**

Angle degree: 40° Tolerance: 5,1° ± **2,5°**

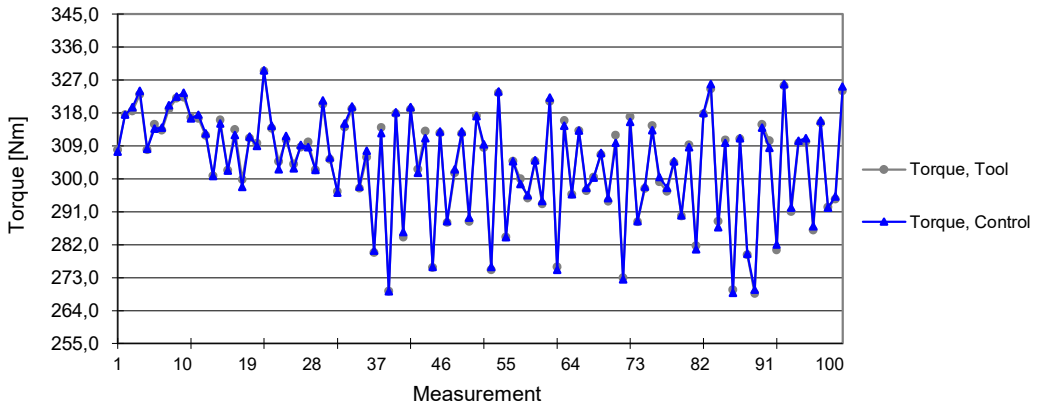
Formula derivation: $C_m = \frac{T}{6\,s}$ $T = C_m * 6\,s$

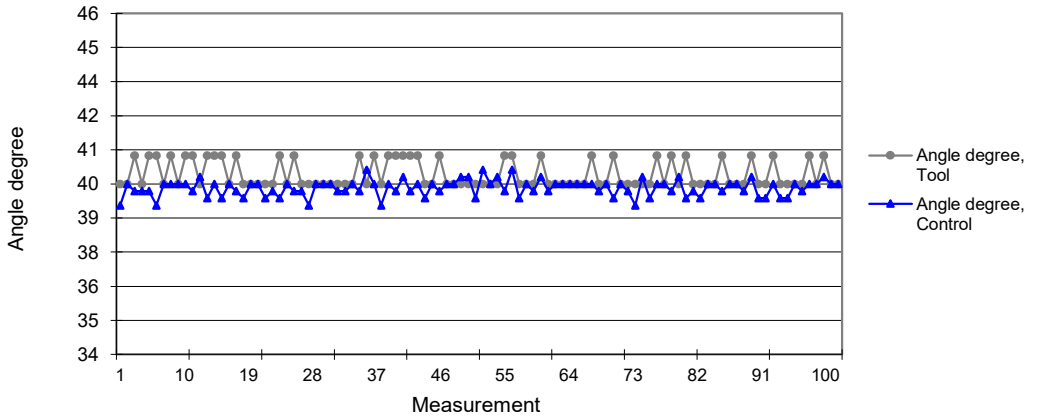
Tool without angle correction

Measurement	Tool data		Control data		Difference	
No.	Torque	Angle	Torque	Angle	Torque	Angle
1	307,90	40,00	307,40	39,25	0,50	0,75
2	317,50	40,00	317,50	40,00	0,00	0,00
3	318,50	41,00	319,50	39,75	1,00	1,25
4	323,00	40,00	324,00	39,75	1,00	0,25
5	307,90	41,00	308,20	39,75	0,30	1,25
6	314,90	41,00	313,70	39,25	1,20	1,75
7	313,30	40,00	313,90	40,00	0,60	0,00
8	319,00	41,00	320,10	40,00	1,10	1,00
9	322,00	40,00	322,40	40,00	0,40	0,00
10	322,30	41,00	323,40	40,00	1,10	1,00
11	316,70	41,00	316,50	39,75	0,20	1,25
12	316,50	40,00	317,50	40,25	1,00	0,25
13	311,80	41,00	312,30	39,50	0,50	1,50
14	300,80	41,00	300,70	40,00	0,10	1,00
15	316,00	41,00	315,10	39,50	0,90	1,50
16	302,30	40,00	302,20	40,00	0,10	0,00
17	313,40	41,00	311,90	39,75	1,50	1,25
18	299,80	40,00	297,70	39,50	2,10	0,50
19	311,10	40,00	311,50	40,00	0,40	0,00
20	309,70	40,00	309,00	40,00	0,70	0,00
21	329,40	40,00	329,60	39,50	0,20	0,50
22	313,80	40,00	314,50	39,75	0,70	0,25
23	304,70	41,00	302,60	39,50	2,10	1,50
24	310,60	40,00	311,70	40,00	1,10	0,00
25	304,00	41,00	302,80	39,75	1,20	1,25
26	308,60	40,00	309,20	39,75	0,60	0,25
27	310,00	40,00	308,60	39,25	1,40	0,75
28	302,40	40,00	302,40	40,00	0,00	0,00
29	320,30	40,00	321,40	40,00	1,10	0,00
30	305,30	40,00	305,80	40,00	0,50	0,00
31	296,50	40,00	296,10	39,75	0,40	0,25
32	314,10	40,00	315,10	39,75	1,00	0,25
33	319,10	40,00	319,70	40,00	0,60	0,00
34	297,40	41,00	297,90	39,75	0,50	1,25
35	305,90	40,00	307,60	40,50	1,70	0,50
36	279,80	41,00	280,30	40,00	0,50	1,00
37	314,00	40,00	312,50	39,25	1,50	0,75
38	269,30	41,00	269,20	40,00	0,10	1,00
39	317,80	41,00	318,10	39,75	0,30	1,25
40	284,00	41,00	285,40	40,25	1,40	0,75
41	318,90	41,00	319,50	39,75	0,60	1,25
42	302,60	41,00	301,60	40,00	1,00	1,00
43	313,00	40,00	311,10	39,50	1,90	0,50
44	275,70	40,00	275,90	40,00	0,20	0,00
45	312,50	41,00	312,90	39,75	0,40	1,25
46	288,00	40,00	288,40	40,00	0,40	0,00
47	301,60	40,00	302,60	40,00	1,00	0,00
48	312,30	40,00	312,90	40,25	0,60	0,25
49	288,30	40,00	289,40	40,25	1,10	0,25
50	317,20	40,00	317,10	39,50	0,10	0,50
51	308,50	40,00	309,40	40,50	0,90	0,50
52	275,10	40,00	275,90	40,00	0,80	0,00
53	323,40	40,00	323,80	40,25	0,40	0,25
54	284,10	41,00	284,00	39,75	0,10	1,25
55	304,80	41,00	304,80	40,50	0,00	0,50
56	300,00	40,00	298,50	39,50	1,50	0,50
57	294,70	40,00	295,50	40,00	0,80	0,00
58	304,80	40,00	305,00	39,75	0,20	0,25
59	293,10	41,00	293,90	40,25	0,80	0,75
60	321,10	40,00	322,20	39,75	1,10	0,25
61	275,90	40,00	275,10	40,00	0,80	0,00
62	315,90	40,00	314,50	40,00	1,40	0,00
63	295,70	40,00	295,70	40,00	0,00	0,00
64	313,10	40,00	313,10	40,00	0,00	0,00
65	296,70	40,00	297,50	40,00	0,80	0,00
66	300,40	41,00	300,30	40,00	0,10	1,00
67	306,60	40,00	307,00	39,75	0,40	0,25
68	293,80	40,00	294,70	40,00	0,90	0,00
69	311,90	41,00	309,80	39,50	2,10	1,50
70	272,90	40,00	272,50	40,00	0,40	0,00
71	316,90	40,00	315,50	39,75	1,40	0,25
72	288,20	40,00	288,40	39,25	0,20	0,75
73	297,30	40,00	297,90	40,25	0,60	0,25
74	314,50	40,00	313,30	39,50	1,20	0,50
75	299,10	41,00	300,50	40,00	1,40	1,00
76	296,60	40,00	297,50	40,00	0,90	0,00
77	304,40	41,00	304,80	39,75	0,40	1,25
78	289,80	40,00	290,00	40,25	0,20	0,25
79	309,20	41,00	308,60	39,50	0,60	1,50
80	281,70	40,00	280,70	39,75	1,00	0,25
81	317,70	40,00	317,90	39,50	0,20	0,50
82	324,50	40,00	325,80	40,00	1,30	0,00
83	288,40	40,00	286,80	40,00	1,60	0,00
84	310,60	41,00	309,80	39,75	0,80	1,25
85	269,60	40,00	268,80	40,00	0,80	0,00
86	310,90	40,00	311,10	40,00	0,20	0,00
87	279,20	40,00	279,50	39,75	0,30	0,25
88	268,60	41,00	269,60	40,25	1,00	0,75
89	314,80	40,00	313,90	39,50	0,90	0,50
90	310,40	40,00	308,40	39,50	2,00	0,50
91	280,50	41,00	282,00	40,00	1,50	1,00
92	325,40	40,00	325,80	39,50	0,40	0,50
93	291,00	40,00	292,10	39,50	1,10	0,50
94	309,80	40,00	310,40	40,00	0,60	0,00
95	310,10	40,00	311,10	39,75	1,00	0,25
96	286,00	41,00	287,00	40,00	1,00	1,00
97	315,20	40,00	315,90	40,00	0,70	0,00
98	292,20	41,00	292,10	40,25	0,10	0,75
99	294,40	40,00	295,10	40,00	0,70	0,00
100	324,00	40,00	325,20	40,00	1,20	0,00
				Standard deviation:	**0,527**	**0,507**

Graphical representation

Model:	**4BD-4B500A-4K2D-4ZA**	Serial no:	**1016283**
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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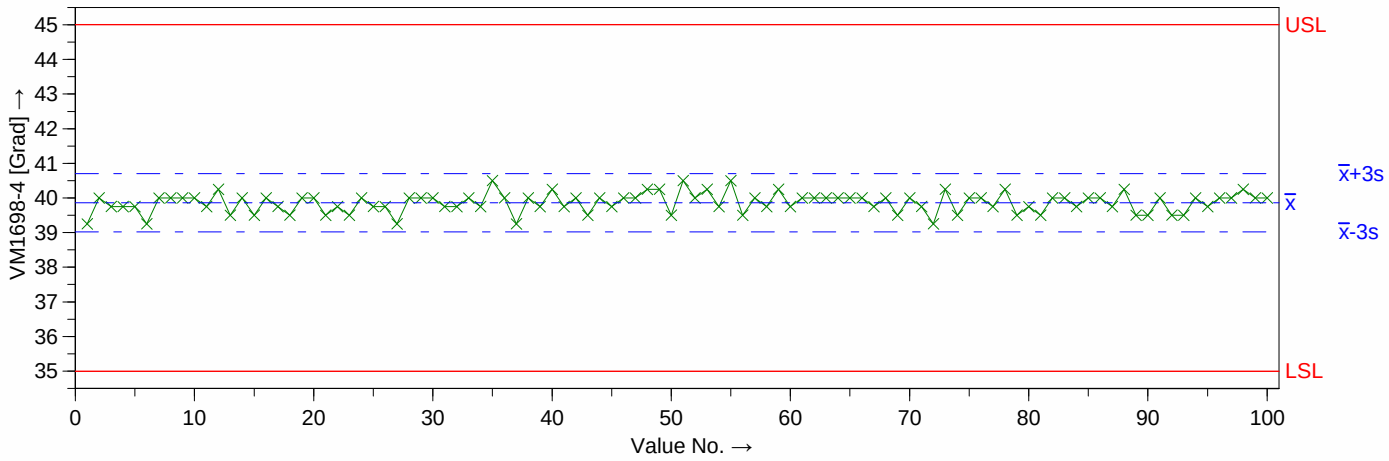
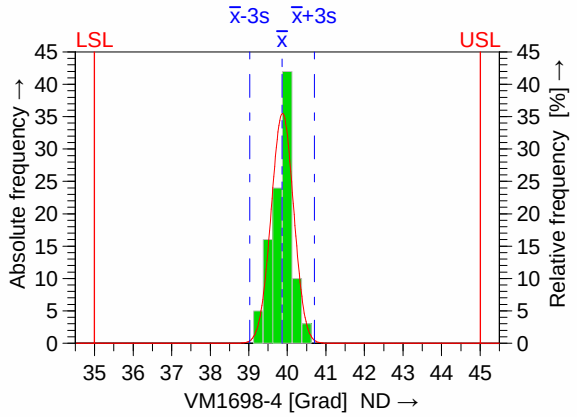
Plant	ATG Westhausen	Operator Name	Sünder
Date	06.05.2022		

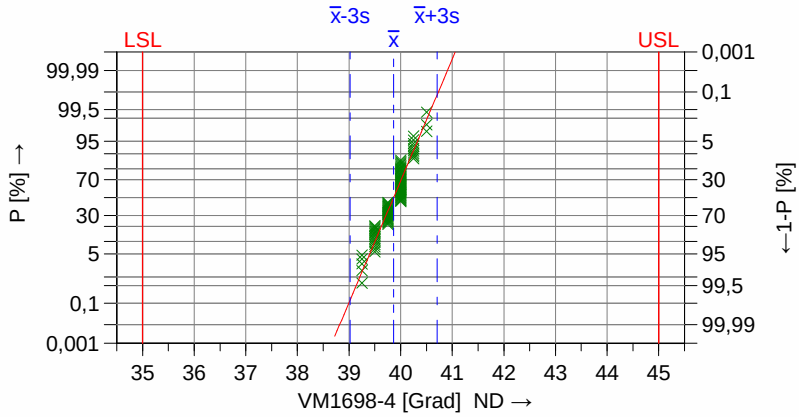
Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016283_k	Char.Descr.	VM1698-4	Nom.val. 40,00 5,00	USL 45,00
		Serial No.	1024210	Unit Grad -5,00	LSL 35,00
Char.Type	variable			Tolerance value 12 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	1000 / 1030939	nges.	100

Evaluation from 06.05.2022 07:36:30 to 06.05.2022 07:51:31

Rem. TQ 60% Angle 40° +/-5° * TQ-Cal.: 500 Nm; Cur-Cal.: 9.737 Nm/A; Speed: 269/50 rpm;







Drawing Values		Collected Values		Statistics	
T_m	40.00			$\bar{x}$	39.8625
LSL	35.00	x_{min}	39.25	$\bar{x}$-3s	39.0206
USL	45.00	x_{max}	40.50	$\bar{x}$+3s	40.7044
T	10.00	R	1.25	6s	1.6838
		$n_{<T>}$	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	5.94
Critical capability index	=	C_{mk}	5.78

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

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 06.05.2022

Serial No.	1016283_k	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	294,65
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	207,76
				USL	395,52
Remark	TQ 60% Angle 40°+/-5°* TQ-Cal.: 500 Nm; Cur -Cal.: 9.737 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	307,40	317,50	319,50	324,00	308,20	313,70	313,90	320,10	322,40	323,40
1024210	VM1698-4	Grad	39,25	40,00	39,75	39,75	39,75	39,25	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}
1024210	VM1698-4	Nm	316,50	317,50	312,30	300,70	315,10	302,20	311,90	297,70	311,50	309,00
1024210	VM1698-4	Grad	39,75	40,25	39,50	40,00	39,50	40,00	39,75	39,50	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}
1024210	VM1698-4	Nm	329,60	314,50	302,60	311,70	302,80	309,20	308,60	302,40	321,40	305,80
1024210	VM1698-4	Grad	39,50	39,75	39,50	40,00	39,75	39,75	39,25	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}
1024210	VM1698-4	Nm	296,10	315,10	319,70	297,90	307,60	280,30	312,50	269,20	318,10	285,40
1024210	VM1698-4	Grad	39,75	39,75	40,00	39,75	40,50	40,00	39,25	40,00	39,75	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	319,50	301,60	311,10	275,90	312,90	288,40	302,60	312,90	289,40	317,10
1024210	VM1698-4	Grad	39,75	40,00	39,50	40,00	39,75	40,00	40,00	40,25	40,25	39,50

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	309,40	275,90	323,80	284,00	304,80	298,50	295,50	305,00	293,90	322,20
1024210	VM1698-4	Grad	40,50	40,00	40,25	39,75	40,50	39,50	40,00	39,75	40,25	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	275,10	314,50	295,70	313,10	297,50	300,30	307,00	294,70	309,80	272,50
1024210	VM1698-4	Grad	40,00	40,00	40,00	40,00	40,00	40,00	39,75	40,00	39,50	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}
1024210	VM1698-4	Nm	315,50	288,40	297,90	313,30	300,50	297,50	304,80	290,00	308,60	280,70
1024210	VM1698-4	Grad	39,75	39,25	40,25	39,50	40,00	40,00	39,75	40,25	39,50	39,75

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 06.05.2022

Serial No.	1016283_k	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	294,65
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	207,76
				USL	395,52
Remark	TQ 60% Angle 40°+/-5°* TQ-Cal.: 500 Nm; Cur -Cal.: 9.737 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	317,90	325,80	286,80	309,80	268,80	311,10	279,50	269,60	313,90	308,40
1024210	VM1698-4	Grad	39,50	40,00	40,00	39,75	40,00	40,00	39,75	40,25	39,50	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	282,00	325,80	292,10	310,40	311,10	287,00	315,90	292,10	295,10	325,20
1024210	VM1698-4	Grad	40,00	39,50	39,50	40,00	39,75	40,00	40,00	40,25	40,00	40,00

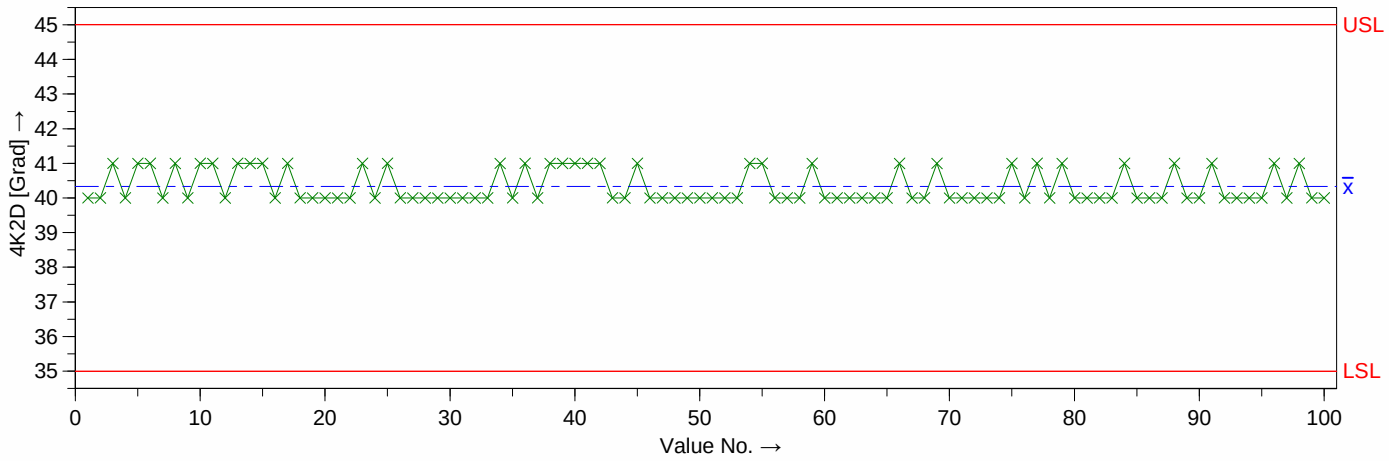
Machine Capability Study
Tool System

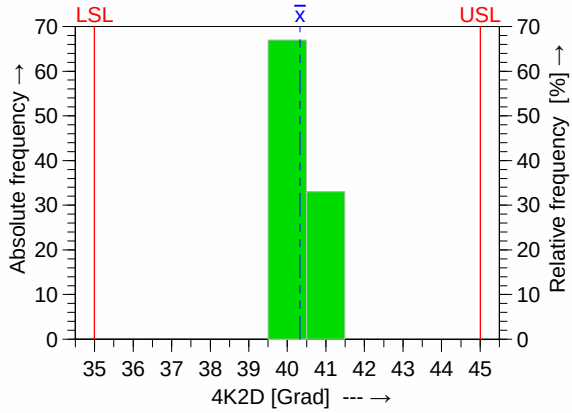
Plant	ATG Westhausen	Operator Name	Sünder
Date	06.05.2022		

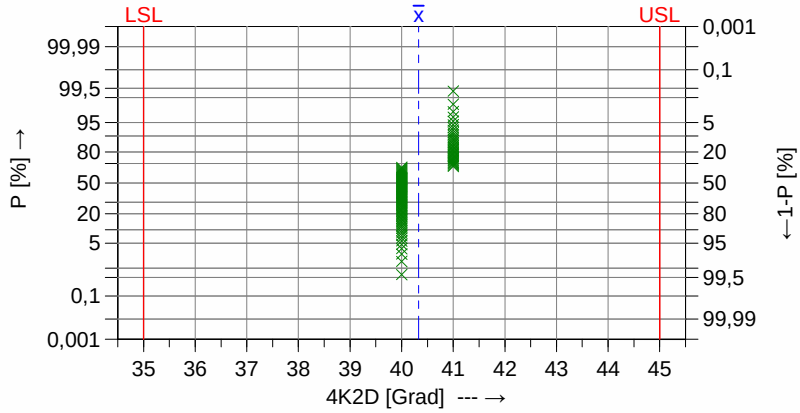
Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016283_k	Char.Descr.	4K2D	Nom.val. 40,00	5,00 USL 45,00
		Serial No.	204576	Unit Grad	-5,00 LSL 35,00
Char.Type	variable			Tolerance value 12 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	1000 / 1030939	nges.	100

Evaluation from 06.05.2022 07:36:30 to 06.05.2022 07:51:31

Rem. TQ 60% Angle 40° +/-5° * TQ-Cal.: 500 Nm; Cur-Cal.: 9.737 Nm/A; Speed: 269/50 rpm;







Drawing Values		Collected Values		Statistics	
T_m	40.00			$\bar{x}$	40.3300
LSL	35.00	x_{min}	40.00		
USL	45.00	x_{max}	41.00		
T	10.00	R	1.00		
		$n_{<T>}$	100	$p_{<T>}$	---
		$n_{>USL}$	0	$p_{>USL}$	---
		$n_{<LSL}$	0	$p_{<LSL}$	---
		n_{eff}	100		
		n_{tot}	100		

Model distribution			no distribution
Calculation method			M-VW
Potential Capability index	=	C_m	8.33
Critical capability index	=	C_{mk}	4.54

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

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 06.05.2022

Serial No.	1016283_k	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	164,70
Ord. No.	4BD500T1S-A	Serial No.	204576	LSL	0,00
				USL	395,28
Remark	TQ 60% Angle 40°+/-5°* TQ-Cal.: 500 Nm; Cur -Cal.: 9.737 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}
204576	4K2D	Nm	307,90	317,50	318,50	323,00	307,90	314,90	313,30	319,00	322,00	322,30
204576	4K2D	Grad	40,00	40,00	41,00	40,00	41,00	41,00	40,00	41,00	40,00	41,00

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}
204576	4K2D	Nm	316,70	316,50	311,80	300,80	316,00	302,30	313,40	299,80	311,10	309,70
204576	4K2D	Grad	41,00	40,00	41,00	41,00	41,00	40,00	41,00	40,00	40,00	40,00

Char.No.	Char.Descr.	Unit	x_{21}	x_{22}	x_{23}	x_{24}	x_{25}	x_{26}	x_{27}	x_{28}	x_{29}	x_{30}
204576	4K2D	Nm	329,40	313,80	304,70	310,60	304,00	308,60	310,00	302,40	320,30	305,30
204576	4K2D	Grad	40,00	40,00	41,00	40,00	41,00	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}
204576	4K2D	Nm	296,50	314,10	319,10	297,40	305,90	279,80	314,00	269,30	317,80	284,00
204576	4K2D	Grad	40,00	40,00	40,00	41,00	40,00	41,00	40,00	41,00	41,00	41,00

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}
204576	4K2D	Nm	318,90	302,60	313,00	275,70	312,50	288,00	301,60	312,30	288,30	317,20
204576	4K2D	Grad	41,00	41,00	40,00	40,00	41,00	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}
204576	4K2D	Nm	308,50	275,10	323,40	284,10	304,80	300,00	294,70	304,80	293,10	321,10
204576	4K2D	Grad	40,00	40,00	40,00	41,00	41,00	40,00	40,00	40,00	41,00	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}
204576	4K2D	Nm	275,90	315,90	295,70	313,10	296,70	300,40	306,60	293,80	311,90	272,90
204576	4K2D	Grad	40,00	40,00	40,00	40,00	40,00	41,00	40,00	40,00	41,00	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}
204576	4K2D	Nm	316,90	288,20	297,30	314,50	299,10	296,60	304,40	289,80	309,20	281,70
204576	4K2D	Grad	40,00	40,00	40,00	40,00	41,00	40,00	41,00	40,00	41,00	40,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 06.05.2022

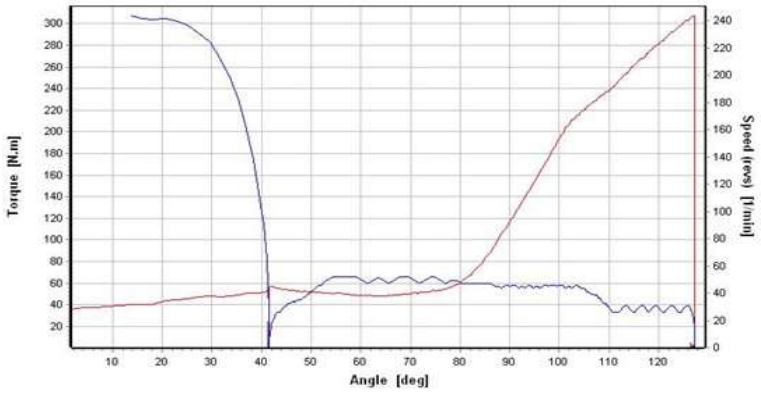
Serial No.	1016283_k	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	164,70
Ord. No.	4BD500T1S-A	Serial No.	204576	LSL	0,00
				USL	395,28
Remark	TQ 60% Angle 40°+/-5°* TQ-Cal.: 500 Nm; Cur -Cal.: 9.737 Nm/A; Speed: 269/50 rpm;				

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}
204576	4K2D	Nm	317,70	324,50	288,40	310,60	269,60	310,90	279,20	268,60	314,80	310,40
204576	4K2D	Grad	40,00	40,00	40,00	41,00	40,00	40,00	40,00	41,00	40,00	40,00

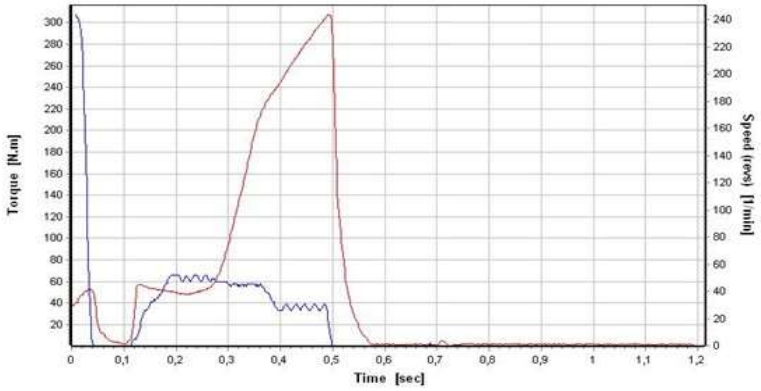
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204576	4K2D	Nm	280,50	325,40	291,00	309,80	310,10	286,00	315,20	292,20	294,40	324,00
204576	4K2D	Grad	41,00	40,00	40,00	40,00	40,00	41,00	40,00	41,00	40,00	40,00

Torque graphs

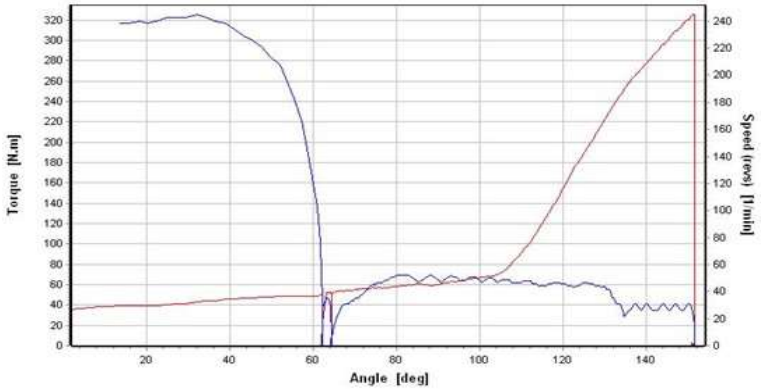
Model:	**4BD-4B500A-4K2D-4ZA**	Serial no:	**1016283**
Target torque:	**300,00 Nm**	60 % of max. torque	
Angle degree:	**40°**	Tool without angle correction	



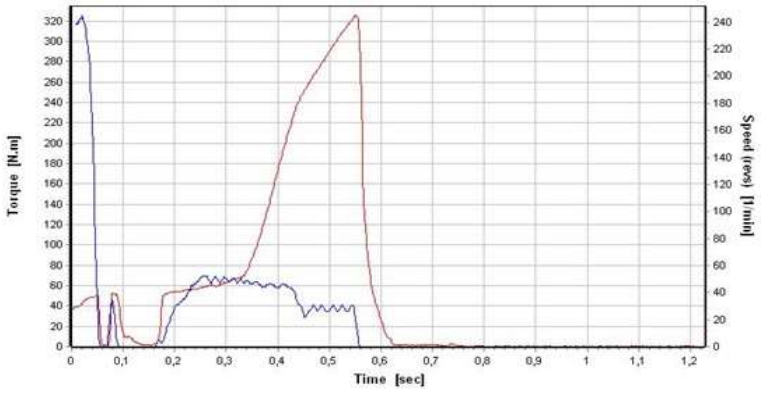
Value no. 1
Graph
Torque / Angle / Speed



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:** 1016283

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: 0,96 % ± **0,48 %**

Angle degree: 180° Tolerance: 6,0° ± **3,0°**

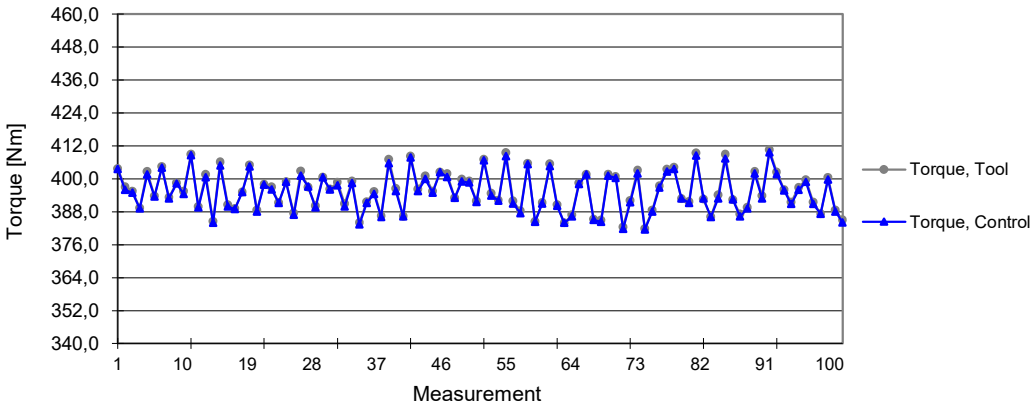
Formula derivation: $C_m = \frac{T}{6\,s}$ $T = C_m * 6\,s$

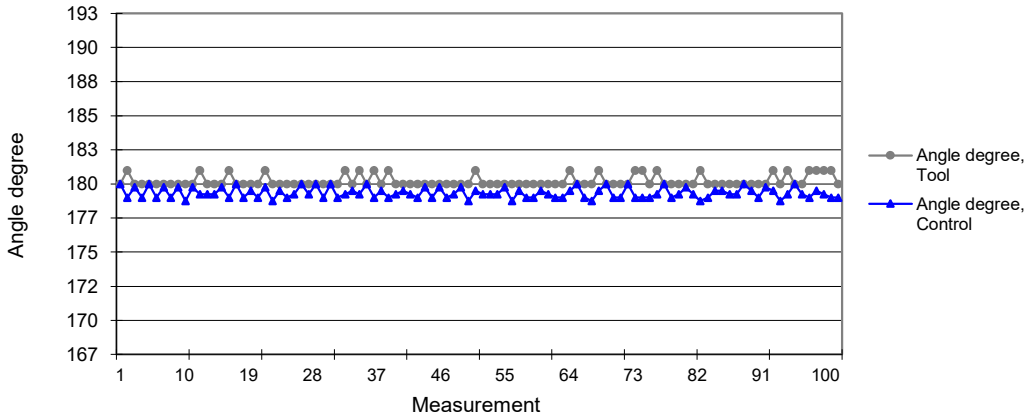
Tool without angle correction

Measurement	Tool data		Control data		Difference	
No.	Torque	Angle	Torque	Angle	Torque	Angle
1	403,70	180,00	403,60	180,00	0,10	0,00
2	397,00	181,00	395,90	179,00	1,10	2,00
3	395,40	180,00	394,90	179,75	0,50	0,25
4	389,30	180,00	389,10	179,00	0,20	1,00
5	402,60	180,00	401,50	180,00	1,10	0,00
6	393,70	180,00	393,50	179,00	0,20	1,00
7	404,40	180,00	404,00	179,75	0,40	0,25
8	393,20	180,00	392,80	179,00	0,40	1,00
9	398,40	180,00	398,20	179,75	0,20	0,25
10	395,40	180,00	394,50	178,75	0,90	1,25
11	408,90	180,00	408,60	179,75	0,30	0,25
12	389,80	181,00	389,50	179,25	0,30	1,75
13	401,50	180,00	400,50	179,25	1,00	0,75
14	384,50	180,00	383,90	179,25	0,60	0,75
15	406,10	180,00	404,80	179,75	1,30	0,25
16	390,50	181,00	389,90	179,00	0,60	2,00
17	389,10	180,00	388,90	180,00	0,20	0,00
18	395,10	180,00	395,10	179,00	0,00	1,00
19	405,00	180,00	404,40	179,50	0,60	0,50
20	388,60	180,00	388,10	179,00	0,50	1,00
21	397,90	181,00	397,80	179,75	0,10	1,25
22	397,00	180,00	396,10	178,75	0,90	1,25
23	391,30	180,00	391,20	179,50	0,10	0,50
24	398,90	180,00	398,80	179,00	0,10	1,00
25	387,50	180,00	386,80	179,25	0,70	0,75
26	402,80	180,00	401,10	180,00	1,70	0,00
27	396,90	180,00	397,20	179,25	0,30	0,75
28	390,10	180,00	389,50	180,00	0,60	0,00
29	400,60	180,00	400,50	179,00	0,10	1,00
30	396,20	180,00	396,10	180,00	0,10	0,00
31	398,70	180,00	397,60	179,00	1,10	1,00
32	390,90	181,00	389,90	179,25	1,00	1,75
33	399,10	180,00	398,40	179,50	0,70	0,50
34	384,00	181,00	383,30	179,25	0,70	1,75
35	391,60	180,00	391,20	180,00	0,40	0,00
36	395,30	181,00	394,50	179,00	0,80	2,00
37	386,40	180,00	386,00	179,50	0,40	0,50
38	407,00	181,00	405,70	179,00	1,30	2,00
39	396,40	180,00	395,50	179,25	0,90	0,75
40	386,30	180,00	386,20	179,50	0,10	0,50
41	408,20	180,00	407,70	179,25	0,50	0,75
42	396,20	180,00	395,50	179,00	0,70	1,00
43	400,90	180,00	399,90	179,75	1,00	0,25
44	395,40	180,00	394,90	179,00	0,50	1,00
45	402,40	180,00	402,40	179,75	0,00	0,25
46	401,80	180,00	400,70	179,00	1,10	1,00
47	393,00	180,00	393,00	179,25	0,00	0,75
48	399,80	180,00	399,00	179,75	0,80	0,25
49	399,10	180,00	398,60	178,75	0,50	1,25
50	391,80	181,00	391,60	179,50	0,20	1,50
51	407,00	180,00	406,70	179,25	0,30	0,75
52	394,70	180,00	393,90	179,25	0,80	0,75
53	392,10	180,00	392,00	179,25	0,10	0,75
54	409,50	180,00	408,20	179,75	1,30	0,25
55	391,80	180,00	391,00	178,75	0,80	1,25
56	388,30	180,00	387,50	179,50	0,80	0,50
57	405,60	180,00	405,30	179,00	0,30	1,00
58	384,40	180,00	384,30	179,00	0,10	1,00
59	391,30	180,00	391,00	179,50	0,30	0,50
60	405,40	180,00	404,60	179,25	0,80	0,75
61	390,50	180,00	390,10	179,00	0,40	1,00
62	383,90	180,00	383,90	179,00	0,00	1,00
63	386,80	181,00	386,20	179,50	0,60	1,50
64	398,40	180,00	398,00	180,00	0,40	0,00
65	401,50	180,00	401,50	179,00	0,00	1,00
66	385,30	180,00	385,00	178,75	0,30	1,25
67	384,90	181,00	384,30	179,50	0,60	1,50
68	401,60	180,00	401,10	180,00	0,50	0,00
69	400,80	180,00	400,30	179,00	0,50	1,00
70	382,40	180,00	381,70	179,00	0,70	1,00
71	392,00	180,00	391,40	180,00	0,60	0,00
72	403,10	181,00	401,90	179,00	1,20	2,00
73	381,80	181,00	381,50	179,00	0,30	2,00
74	388,60	180,00	388,10	179,00	0,50	1,00
75	397,40	181,00	396,80	179,25	0,60	1,75
76	403,50	180,00	402,60	180,00	0,90	0,00
77	404,10	180,00	403,60	179,00	0,50	1,00
78	392,70	180,00	392,80	179,25	0,10	0,75
79	391,70	180,00	391,20	179,75	0,50	0,25
80	409,40	180,00	408,40	179,25	1,00	0,75
81	392,50	181,00	392,80	178,75	0,30	2,25
82	386,10	180,00	386,00	179,00	0,10	1,00
83	394,10	180,00	392,80	179,50	1,30	0,50
84	408,90	180,00	407,30	179,50	1,60	0,50
85	392,30	180,00	392,40	179,25	0,10	0,75
86	387,10	180,00	386,20	179,25	0,90	0,75
87	389,50	180,00	389,10	180,00	0,40	0,00
88	402,60	180,00	401,90	179,50	0,70	0,50
89	393,80	180,00	392,80	179,00	1,00	1,00
90	410,50	180,00	409,60	179,75	0,90	0,25
91	402,40	181,00	401,70	179,50	0,70	1,50
92	396,00	180,00	395,70	178,75	0,30	1,25
93	391,50	181,00	390,80	179,25	0,70	1,75
94	396,80	180,00	395,90	180,00	0,90	0,00
95	399,60	180,00	398,80	179,25	0,80	0,75
96	391,50	181,00	390,80	179,00	0,70	2,00
97	387,20	181,00	387,20	179,50	0,00	1,50
98	400,50	181,00	399,70	179,25	0,80	1,75
99	388,60	181,00	388,10	179,00	0,50	2,00
100	385,00	180,00	384,10	179,00	0,90	1,00
				Standard deviation:	**0,385**	**0,601**

Graphical representation

Model:	**4BD-4B500A-4K2D-4ZA**	Serial no:	**1016283**
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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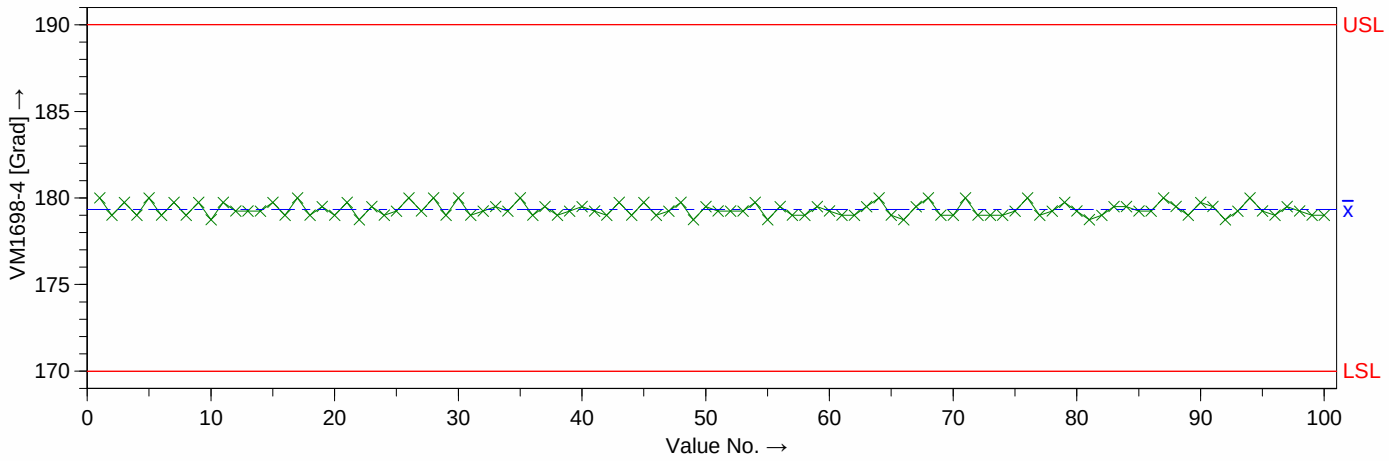
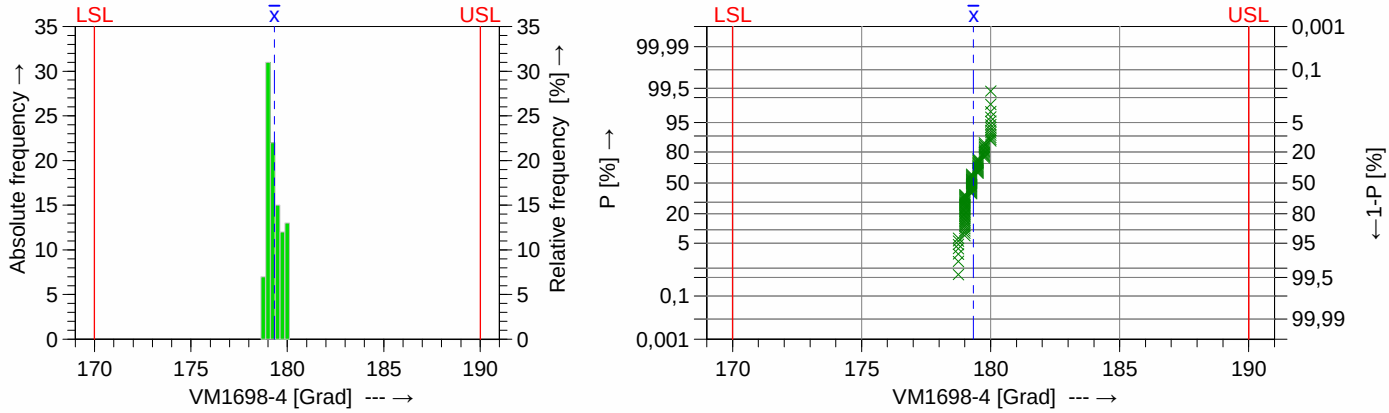
Plant	ATG Westhausen	Operator Name	Sünder
Date	08.06.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016283_l	Char.Descr.	VM1698-4	Nom.val. 180,00 10,00	USL 190,00
		Serial No.	1024210	Unit Grad -10,00	LSL 170,00
Char.Type	variable			Tolerance value 6 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	1000 / 1013265	nges.	100

Evaluation from 08.06.2022 12:04:50 to 08.06.2022 12:30:00

Rem. TQ 80% Angle 180° +/-10° * TQ-Cal.: 500 Nm; Cur-Cal.: 9.857 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	180.00			$\bar{x}$	179.3325
LSL	170.00	x_{min}	178.75		
USL	190.00	x_{max}	180.00		
T	20.00	R	1.25		
		$n_{<T>}$	100	$p_{<T>}$	---
		$n_{>USL}$	0	$p_{>USL}$	---
		$n_{<LSL}$	0	$p_{<LSL}$	---
		n_{eff}	100		
		n_{tot}	100		

Model distribution			no distribution
Calculation method			M-VW
Potential Capability index	=	C_m	13.32
Critical capability index	=	C_{mk}	12.28

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

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.06.2022

Serial No.	1016283_I	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	403,25
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	305,20
				USL	510,00
Remark	TQ 80% Angle 180°+/-10°* TQ-Cal.: 500 Nm; C ur-Cal.: 9.857 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	403,60	395,90	394,90	389,10	401,50	393,50	404,00	392,80	398,20	394,50
1024210	VM1698-4	Grad	180,00	179,00	179,75	179,00	180,00	179,00	179,75	179,00	179,75	178,75

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	408,60	389,50	400,50	383,90	404,80	389,90	388,90	395,10	404,40	388,10
1024210	VM1698-4	Grad	179,75	179,25	179,25	179,25	179,75	179,00	180,00	179,00	179,50	179,00

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	397,80	396,10	391,20	398,80	386,80	401,10	397,20	389,50	400,50	396,10
1024210	VM1698-4	Grad	179,75	178,75	179,50	179,00	179,25	180,00	179,25	180,00	179,00	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}
1024210	VM1698-4	Nm	397,60	389,90	398,40	383,30	391,20	394,50	386,00	405,70	395,50	386,20
1024210	VM1698-4	Grad	179,00	179,25	179,50	179,25	180,00	179,00	179,50	179,00	179,25	179,50

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	407,70	395,50	399,90	394,90	402,40	400,70	393,00	399,00	398,60	391,60
1024210	VM1698-4	Grad	179,25	179,00	179,75	179,00	179,75	179,00	179,25	179,75	178,75	179,50

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	406,70	393,90	392,00	408,20	391,00	387,50	405,30	384,30	391,00	404,60
1024210	VM1698-4	Grad	179,25	179,25	179,25	179,75	178,75	179,50	179,00	179,00	179,50	179,25

Char.No.	Char.Descr.	Unit	x_{61}	x_{62}	x_{63}	x_{64}	x_{65}	x_{66}	x_{67}	x_{68}	x_{69}	x_{70}
1024210	VM1698-4	Nm	390,10	383,90	386,20	398,00	401,50	385,00	384,30	401,10	400,30	381,70
1024210	VM1698-4	Grad	179,00	179,00	179,50	180,00	179,00	178,75	179,50	180,00	179,00	179,00

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	391,40	401,90	381,50	388,10	396,80	402,60	403,60	392,80	391,20	408,40
1024210	VM1698-4	Grad	180,00	179,00	179,00	179,00	179,25	180,00	179,00	179,25	179,75	179,25

Machine Capability Study
Control System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.06.2022

Serial No.	1016283_I	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	VM1698-4	Nom.val.	403,25
Ord. No.	4BD500T1S-A	Serial No.	1024210	LSL	305,20
				USL	510,00
Remark	TQ 80% Angle 180°+/-10°* TQ-Cal.: 500 Nm; C ur-Cal.: 9.857 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	392,80	386,00	392,80	407,30	392,40	386,20	389,10	401,90	392,80	409,60
1024210	VM1698-4	Grad	178,75	179,00	179,50	179,50	179,25	179,25	180,00	179,50	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	401,70	395,70	390,80	395,90	398,80	390,80	387,20	399,70	388,10	384,10
1024210	VM1698-4	Grad	179,50	178,75	179,25	180,00	179,25	179,00	179,50	179,25	179,00	179,00

Machine Capability Study
Tool System

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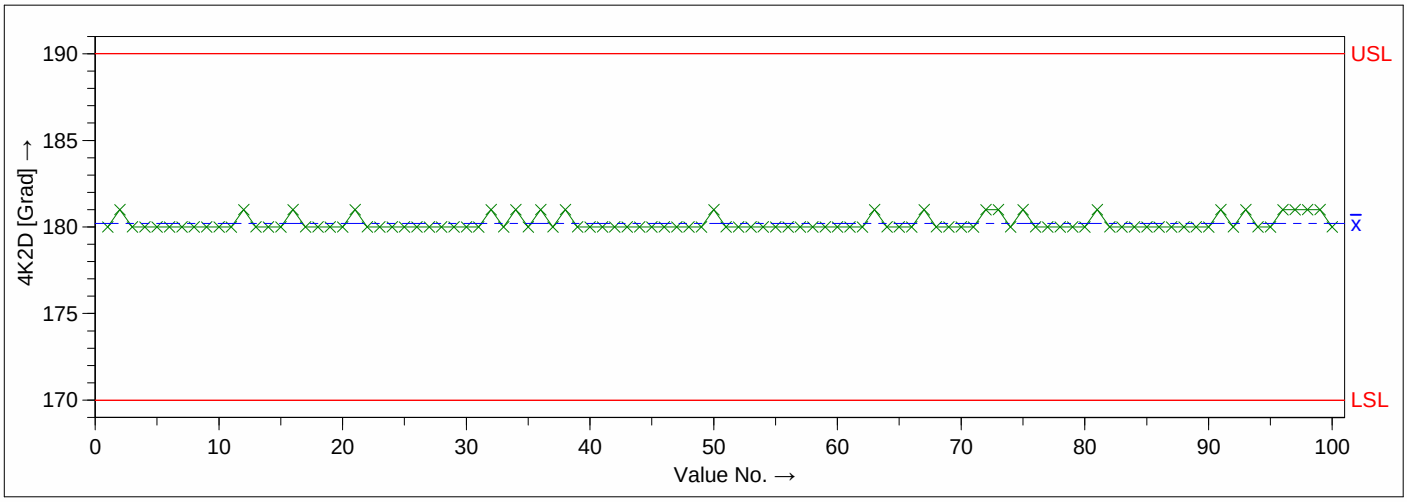
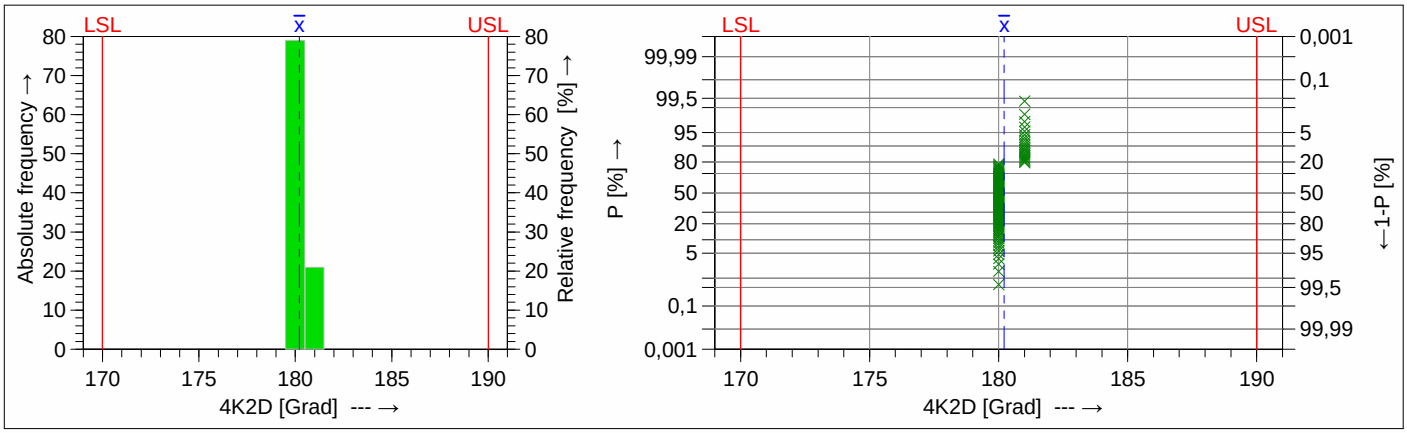
Plant	ATG Westhausen	Operator Name	Sünder
Date	08.06.2022		

Ord. No.	4BD500T1S-A	Part type	4BD-4B500A-4K2D-4ZA	Contr.item	yes
Serial No.	1016283_l	Char.Descr.	4K2D	Nom.val. 180,00 10,00	USL 190,00
		Serial No.	204576	Unit Grad -10,00	LSL 170,00
Char.Type	variable			Tolerance value 6 %	Decimal Pl. 2
Cust.Name	Cleco	Reference System	VM1698-4	Test Electronic	MPRO400GCD-P
Contr.No.	Homologation	Reference Transducer	1000 / 1013265	nges.	100

Evaluation from 08.06.2022 12:04:50 to 08.06.2022 12:30:00

Rem. TQ 80% Angle 180° +/-10° * TQ-Cal.: 500 Nm; Cur-Cal.: 9.857 Nm/A; Speed: 269/50 rpm;





Drawing Values		Collected Values		Statistics	
T_m	180.00			$\bar{x}$	180.2100
LSL	170.00	x_{min}	180.00		
USL	190.00	x_{max}	181.00		
T	20.00	R	1.00		
		$n_{<T>}$	100	$p_{<T>}$	---
		$n_{>USL}$	0	$p_{>USL}$	---
		$n_{<LSL}$	0	$p_{<LSL}$	---
		n_{eff}	100		
		n_{tot}	100		

Model distribution			no distribution
Calculation method			M-VW
Potential Capability index	=	C_m	16.65
Critical capability index	=	C_{mk}	9.09

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

APEX VDI/VDE 2647 V0.1

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.06.2022

Serial No.	1016283_I	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	212,50
Ord. No.	4BD500T1S-A	Serial No.	204576	LSL	0,00
				USL	510,00
Remark	TQ 80% Angle 180°+/-10°* TQ-Cal.: 500 Nm; C ur-Cal.: 9.857 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}
204576	4K2D	Nm	403,70	397,00	395,40	389,30	402,60	393,70	404,40	393,20	398,40	395,40
204576	4K2D	Grad	180,00	181,00	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}
204576	4K2D	Nm	408,90	389,80	401,50	384,50	406,10	390,50	389,10	395,10	405,00	388,60
204576	4K2D	Grad	180,00	181,00	180,00	180,00	180,00	181,00	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}
204576	4K2D	Nm	397,90	397,00	391,30	398,90	387,50	402,80	396,90	390,10	400,60	396,20
204576	4K2D	Grad	181,00	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}
204576	4K2D	Nm	398,70	390,90	399,10	384,00	391,60	395,30	386,40	407,00	396,40	386,30
204576	4K2D	Grad	180,00	181,00	180,00	181,00	180,00	181,00	180,00	181,00	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}
204576	4K2D	Nm	408,20	396,20	400,90	395,40	402,40	401,80	393,00	399,80	399,10	391,80
204576	4K2D	Grad	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	181,00

Char.No.	Char.Descr.	Unit	x_{51}	x_{52}	x_{53}	x_{54}	x_{55}	x_{56}	x_{57}	x_{58}	x_{59}	x_{60}
204576	4K2D	Nm	407,00	394,70	392,10	409,50	391,80	388,30	405,60	384,40	391,30	405,40
204576	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}
204576	4K2D	Nm	390,50	383,90	386,80	398,40	401,50	385,30	384,90	401,60	400,80	382,40
204576	4K2D	Grad	180,00	180,00	181,00	180,00	180,00	180,00	181,00	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}
204576	4K2D	Nm	392,00	403,10	381,80	388,60	397,40	403,50	404,10	392,70	391,70	409,40
204576	4K2D	Grad	180,00	181,00	181,00	180,00	181,00	180,00	180,00	180,00	180,00	180,00

Machine Capability Study
Tool System

Plant	ATG Westhausen		Operator Name	Sünder	Date 08.06.2022

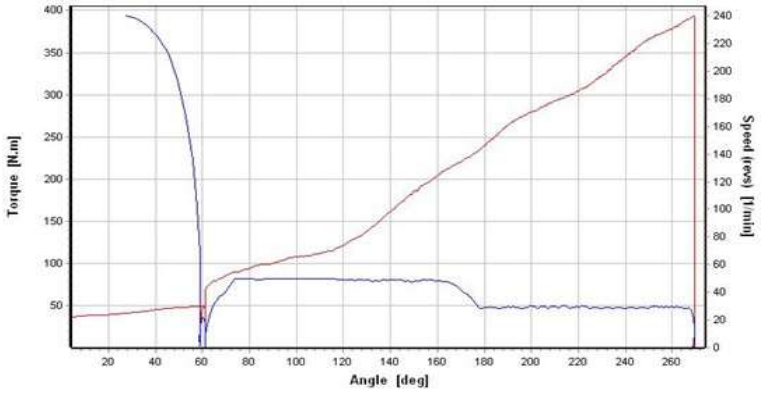
Serial No.	1016283_I	Characteristic			
Part type	4BD-4B500A-4K2D-4ZA	Char.Descr.	4K2D	Nom.val.	212,50
Ord. No.	4BD500T1S-A	Serial No.	204576	LSL	0,00
				USL	510,00
Remark	TQ 80% Angle 180°+/-10°* TQ-Cal.: 500 Nm; C ur-Cal.: 9.857 Nm/A; Speed: 269/50 rpm;				

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}
204576	4K2D	Nm	392,50	386,10	394,10	408,90	392,30	387,10	389,50	402,60	393,80	410,50
204576	4K2D	Grad	181,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00	180,00

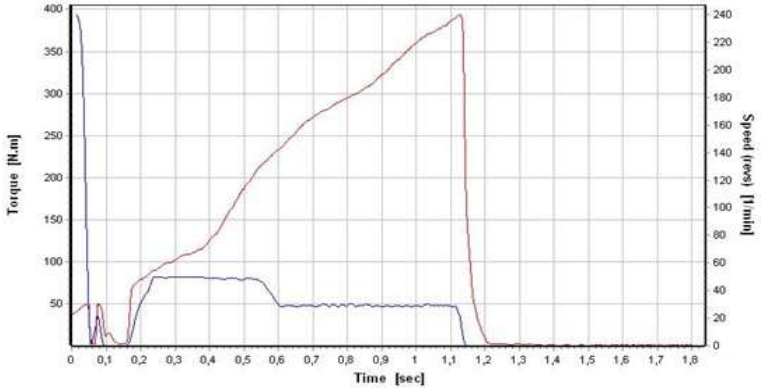
Char.No.	Char.Descr.	Unit	x_{91}	x_{92}	x_{93}	x_{94}	x_{95}	x_{96}	x_{97}	x_{98}	x_{99}	x_{100}
204576	4K2D	Nm	402,40	396,00	391,50	396,80	399,60	391,50	387,20	400,50	388,60	385,00
204576	4K2D	Grad	181,00	180,00	181,00	180,00	180,00	181,00	181,00	181,00	181,00	180,00

Torque graphs

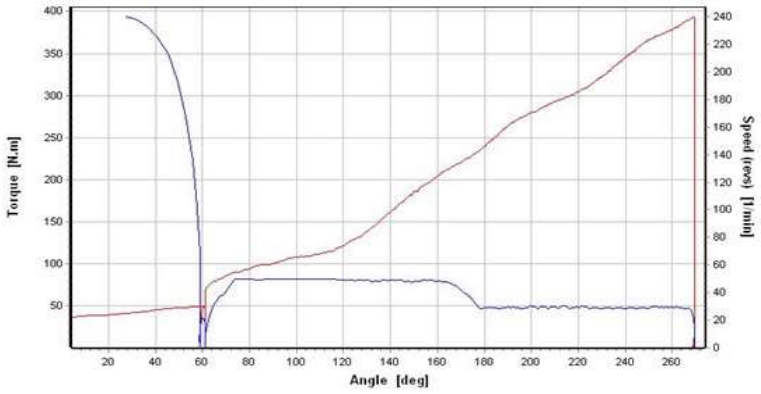
Model:	**4BD-4B500A-4K2D-4ZA**	Serial no:	**1016283**
Target torque:	**400,00 Nm**	80 % of max. torque	
Angle degree:	**180°**	Tool without angle correction	



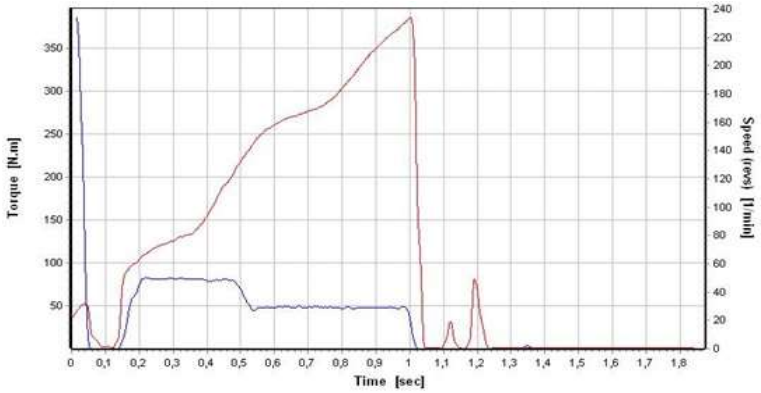
Value no. 1
Graph
Torque / Angle / Speed



Value no. 1
Graph
Torque / Time / Speed



Value no. 100
Graph
Torque / Angle / Speed



Value no. 100
Graph
Torque / Time / Speed