BAUMÜLLER



DSH1

Technical documentation
Three-phase synchronous motors DSH1 45-100

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Technical data, motor components, declaration of conformity

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1. Three-phase synchronous motors DSH1-45-100



The DSH motors are the ideal addition in the modular system of the Baumüller servo motors due to the hardly noticeable detent torque. By its very high scalability, speeds up to 6000 1/min and the excellent concentricity properties the DSH series is the perfect solution for several applications such as robotics, flexographic printing machines as well as label printing machines.

1.1. General technical data

Version:	IM B5	Horizontal mounting acc. to EN 60034-7
	IM V1	Vertical mounting, shaft end at the bottom acc. to EN 60034-7
	IM V3	Vertical mounting, shaft end at the top acc. to EN 60034-7 (Note: In the case of IP64 shaft ends, protection against the ingress of water and dust must be ensured.)
Degree of protection:	IP64	Standard: without shaft seal ring, with opposing plugs fitted
	IP65	Option: with shaft seal ring, with opposing plugs fitted
	IP65	Without consideration of shaft bushing with opposing plugs fitted
	IP67	Without consideration of the shaft bushing for IC410, fitted with mating connectors
Anschluss	Main connection	Turnable connector socket Speedtec 8-pole
	Encoder connection	Socket turnable 12- or 17-pole, 9-pole for EnDat 2.2
		Main-, encoder- and fan connection in the Speedtec design
	Brake	Connection in the main connection
	Temperature sensor	Standard in the main connection and optional in the encoder socket
Temperature sensor	PT1000	Linear temperature sensor for the analysis in the controller
Cooling type	IC 410	Size 045-100 surface-cooled without fan
Temperature rise	$\Delta\vartheta$ = 105 K	Insulation class F acc. to EN 60034
Environmental conditions for running	Class 3K3/3Z12 as per DIN EN 60721-3-3:1995, however: temperature range 0-40 °C	Represents 0 to 40 °C at 5 % to 85 % rel. humidity and an absolute humidity of 1 g/m³ to 25 g/m³ and an installation height up to approx. 1,400 m.
Environmental conditions for long-term storage	Class 1K2/1M1 DIN EN 60721-3-1:1995, however: temperature range -15-60 °C	Represents -15 to 60 °C at 5 % to 85 % rel. humidity and an absolute humidity of 1 g/m³ to 25 g/m³;
Environmental conditions for transport	Class 2K2/2M1 DIN EN 60721-3-2:1995, however: temperature range -15-60 °C	Represents -15 to 60 °C at 5 % to 85 % rel. humidity and an absolute humidity of 1 g/m³ to 25 g/m³;
Paint	Black matt	RAL 9005
Bearings	Drive end	Standard: Ball bearings. Optional: Roller bearings (for size 56-100)
	Non-drive end	Ball bearings, locating bearings
Bearing service life	L_{10h} 20.000h	Approximate value, rolling-contact bearings with long-term grease lubrication
Balance quality	A	Acc. to DIN EN 60034-14 (VDE 0530 Part 14): 2004-09
	B	On request (for ball bearing only)
True running	N	Standard: Normal acc. to DIN 42955
	R	Option: Reduced according to DIN 42955 (only at ball bearings)

Vibration-resistant up to	radial 3g / axial 0,5g**	10 Hz to 100 Hz acc. to EN 60068-2-6
Flange	as per standard IEC standard	Centralization diameter: tolerance j6
Shaft end	Cylindrical	Smooth acc. to DIN 748 (also available with key DIN 6885)
		Centralization with female thread as per DIN 332 Form D
Holding brake	Option	Zero play permanent magnet brake
Speed actual value encoder	Resolver	Standard, see Chapter 3.2
	Encoder Sincos	Optional, see Chapter 3.2
	Digital encoder	Optional, see Chapter 3.2
Approvals	CE; cULus; UKCA; CEL	Standard

*) DIN EN 50347:2003-09 inapplicable, because for AC standard motors applicable, only.

**) If there are increased vibrational load, then measuring must be made locally.
Based on these constructive workings will take place as well as evaluations with the company Baumüller

1.2. General safety instructions

The standard versions of the motors are unsuitable for operation in salty or aggressive atmospheres and are not suitable for erection outdoors. When using an air-cooled motor and the air is contaminated with dust particles or similar substances that cannot be filtered out by the existing motor filters, consultation with the motor manufacturer is advised.

Suitable steps to reduce bearing currents are to be taken before commissioning the motor, depending on the application and system. The motor manufacturer must be consulted in this regard.

Caution:
With allocation of the motor in a specific protection class, it is a standardized brief test procedure. This can vary considerably depending on the actual environmental conditions at the site of installation.
Depending on the environmental conditions, such as the chemical consistency of the dust materials or the cooling media being used at the site of installation, evaluation of the suitability of the motor based on the type of protection is only possible to a limited extent (e.g., electrically conducting dust materials or aggressive coolant vapors or coolant fluids). In these cases, the motor must additionally be protected by appropriate measures on the machine side.

1.3. Winding insulation and warming

The motors were designed for the operation of converters and DC link voltages up to 640 V.

Higher DC link voltages up to 800 V are possible if voltage peaks at the motor terminals are limited to values < 1200 V by suitable filters.

1.4. Explanation of motor data

n_N	Rated speed [rpm]
M_0	Nominal torque [Nm] with speeds ≥ 1 [rpm] without time limit
I_0	nominal current [A] at M_0
$M_{0,max}$	Maximum static torque [Nm] with maximum current [A] and speed = 0, momentarily
$I_{0,max}$	Static current [A] at $M_{o,\ max}$; I_{0max} is the effective value
P_N	Rated output [kW] with M_N and n_N (see Performance definition)
M_N	Rated torque [Nm]
I_N	Rated effective current [A]
$k_{E\ /\ cold}$	Voltage constant (EMF) to [V per 1000 rpm]
f_N	Rated frequency [Hz]
J	Rotor inertia incl. resolver without holding brake [kgm²]
m	Motor mass [kg]

When the converter is operating, the specified rated outputs and torques at the rated speed are achieved with a clocking frequency of ≥ 4 kHz in the power divider. We recommend a cycle frequency of > 6 kHz.
All converters scheduled for use must have the option of field weakening as a mandatory requirement.

The field weakening option is preassumed at the converters which are used.
The drive configurator **sizemaXX** is provided on www.baumueller.de to design the motors as well as the entire drive system.

1.5. Type key

DSH1-XXXXXXXX-XX-XX-XXX-XXX-X-XX-X-XXX	**Typ**
DSH1-**XXX**XXXXX-XX-XX-XXX-XXX-X-XX-X-XXX	**Overall size** 045 056 071 100
DSH1-XXX**XX**XXX-XX-XX-XXX-XXX-X-XX-X-XXX	**Overall length** KO SO MO
DSH1-XXXXX**XX**X-XX-XX-XXX-XXX-X-XX-X-XXX	**Degree of protection** 64 - Degree of protection IP64 65 - Degree of protection IP65
DSH1-XXXXXXX**X**-XX-XX-XXX-XXX-X-XX-X-XXX	**Cooling type** U - Without fan
DSH1-XXXXXXXX-**XX**-XX-XXX-XXX-X-XX-X-XXX	**Nominal speed class** 10 - 1000 rmp 20 - 2000 rmp 30 - 3000 rmp 40 - 4000 rmp

DSH1-XXXXXXXX-XX-**XX**-XXX-XXX-X-XX-X-XXX	**Uzk_ DC** 54 - 540 V
DSH1-XXXXXXXX-XX-XX-**X**XX-XXX-X-XX-X-XXX	**Encoder type** O – No encoder A - Resolver D - SRS50 E - SRM50 F - ECN1313 G - EQN1325 H - ECN1325 I - EQN1337 M - Resolver (Safety) N - SRS50-S (Safety) Q - SRM50-S (Safety) X - EQI1331 Y - ECI1319 5 - ECN1325-S (Safety) 6 - EQN1337-S (Safety) g - EFS50 Hiperface DSL (21 bit) h - EFM50 Hiperface DSL (21 bit) p - ECI1319-S (Safety) q - EQI1331-S (Safety) r - EES37 Hiperface DSL s - EEM37 Hiperface DSL t - SEK37 u - SEL37 *On request
DSH1-XXXXXXXX-XX-XX-X**X**X-XXX-X-XX-X-XXX	**Brake** O – Without brake B – With PE-brake
DSH1-XXXXXXXX-XX-XX-XX**X**-XXX-X-XX-X-XXX	**Shaft options** A - Smooth shaft B - With parallel key
DSH1-XXXXXXXX-XX-XX-XXX-**X**XX-X-XX-X-XXX	**Main connection type** B – Connector socket Speedtec (PT1000 on main connection) D – Connector socket Speedtec (PT1000 on the encoder socket)
DSH1-XXXXXXXX-XX-XX-XXX-X**X**X-X-XX-X-XXX	**Main outlet port** T - Top L - Left with a view toward drive end on shaft end R - Right with a view toward drive end on shaft end D - DE (A-end) N - NDE (B-end) P - Pivoted (turnable)

DSH1-XXXXXXXX-XX-XX-XXX-XX**X**-X-XX-X-XXX	**Encoder connection outlet** T - Top L - Left with a view toward drive end on shaft end R - Right with a view toward drive end on shaft end D - DE (drive end) N - NDE (non-drive-end) P – Pivoted
DSH1-XXXXXXXX-XX-XX-XXX-XXX-**X**-XX-X-XXX	**Bearing** K - Ball bearing drive end R - Roller bearing drive end
DSH1-XXXXXXXX-XX-XX-XXX-XXX-X-**X**X-X-XXX	**Vibration level** A - Vibration level A B - Vibration level B
DSH1-XXXXXXXX-XX-XX-XXX-XXX-X-X**X**-X-XXX	**True running** N - Normal R - Reduced
DSH1-XXXXXXXX-XX-XX-XXX-XXX-X-XX-**X**-XXX	**Gear box / pump mounting** O - Without transmission mount and without pump A - BPE - Gear box B - BPEF - Gear box C - BPEA - Gear box D - BPN - Gear box E - BPNA - Gear box F - BPNF - Gear box G - BPV - Gear box H - BPVF - Gear box
DSH1-XXXXXXXX-XX-XX-XXX-XXX-X-XX-X-**XXX**	**Expanded version** 000 - No special version DA1 – Standard shaft seal ring XXX - Special version (internal coding) Special coding is made alphanumeric

Example configuration: DSH1-071SO64U-10-54-AOA-BPP-K-AN-O-000

2. Technical data

2.1. DSH1-045

3 AC 400 V mains voltage for converters with unregulated supply

Motor type	Nom. speed n_N min^{-1}	Stand-still torque[1] M_0 Nm	Stand-still current[1] I_0 A	max. static torque $M_{0.max}$ Nm	Max. static current $I_{0.max}$ A	Rated out-put[1] P_N kW	Rated torque[1] M_N Nm	Rated current[1] I_N A	Voltage constant $k_{E/cold}$ $V/_{10001/min}$	Rated fre-quency f_N Hz	Rotor inertia (motor)[2] J kgcm^2	Weight[3] m kg
DSH1-045KO64U-20-54	2000	2.5	1.24	7.8	4.5	0.51	2.4	1.21	145	166.6	1.3	3.2
DSH1-045SO64U-20-54	2000	4.4	1.94	15	8.2	0.84	4	1.79	159	166.6	2.16	4.4
DSH1-045MO64U-20-54	2000	6.1	2.6	23	11.9	1.09	5.2	2.2	163	166.6	3.02	5.5
DSH1-045KO64U-30-54	3000	2.5	1.77	7.8	6.4	0.71	2.2	1.61	102	250.0	1.3	3.2
DSH1-045SO64U-30-54	3000	4.4	2.8	15	11.9	1.08	3.4	2.3	109	250.0	2.16	4.4
DSH1-045MO64U-30-54	3000	6.1	3.7	23	17.4	1.28	4.1	2.6	112	250.0	3.02	5.5
DSH1-045KO64U-40-54	4000	2.5	2.3	7.8	8.3	0.77	1.8	1.74	78.4	333.3	1.3	3.2
DSH1-045SO64U-40-54	4000	4.4	3.8	15	15.9	1.11	2.6	2.4	81.7	333.3	2.16	4.4
DSH1-045MO64U-40-54	4000	6.1	4.8	23	22.2	1.31	3.1	2.6	87.8	333.3	3.02	5.5

[1] Coil overtemperature Δ T < 105K; direct flange mounting (mounting plate 250 x 250 x 10 mm)

[2] Rotor inertia moment with PE brake: +1.0 kgcm²

[3] Weight with PE brake: +1.0 kg

2.2. DSH1-056

3 AC 400 V mains voltage for converters with unregulated supply

Motor type	Nom. speed n_N min^{-1}	Stand-still torque[1] M_0 Nm	Stand-still current[1] I_0 A	max. static torque $M_{0.max}$ Nm	Max. static current $I_{0.max}$ A	Rated out-put[1] P_N kW	Rated torque[1] M_N Nm	Rated current[1] I_N A	Voltage constant $k_{E/cold}$ $V/_{10001/min}$	Rated fre-quency f_N Hz	Rotor inertia (motor)[2] J kgcm²	Weight[3] m kg
DSH1-056KO64U-10-54	1000	5.7	1.58	15	4.9	0.58	5.5	1.54	244	83.3	4.2	5.8
DSH1-056SO64U-10-54	1000	10	2.4	30	8.3	1.02	9.8	2.3	287	83.3	7.5	9.8
DSH1-056MO64U-10-54	1000	13	2.9	44	11.8	1.31	13	2.8	303	83.3	10.8	13.8
DSH1-056KO64U-20-54	2000	5.7	2.8	15	8.7	1.08	5.2	2.6	136	166.6	4.2	5.8
DSH1-056SO64U-20-54	2000	10,2	4.6	30	15.9	1.83	8.8	4	150	166.6	7.5	9.8
DSH1-056MO64U-20-54	2000	13	5.5	44	22	2.4	11	4.8	162	166.6	10.8	13.8
DSH1-056KO64U-30-54	3000	5.7	4	15	12.3	1.47	4.7	3.3	96.4	250.0	4.2	5.8
DSH1-056SO64U-30-54	3000	10	6.6	29	22.9	2.4	7.6	5	104	250.0	7.5	9.8
DSH1-056MO64U-30-54	3000	13	7.7	44	31.8	3	9.5	5.8	112	250.0	10.8	13.8
DSH1-056KO64U-40-54	4000	5.7	5	15	15.3	1.69	4	3.6	77.7	333.3	4.2	5.8
DSH1-056SO64U-40-54	4000	10	8.2	29	28.6	2.6	6.2	5.1	83.3	333.3	7.5	9.8

[1] Coil overtemperature $\Delta T < 105K$; direct flange mounting (mounting plate 450 x 400 x 30 mm)

[2] Rotor inertia moment with PE brake: +2.9 kgcm²

[3] Weight with PE brake: +2.0 kg

2.3. DSH1-071

3 AC 400 V mains voltage for converters with unregulated supply

Motor type	Nom. speed n_N min^{-1}	Stand-still torque[1] M_0 Nm	Stand-still current[1] I_0 A	max. static torque $M_{0.max}$ Nm	Max. static current $I_{0.max}$ A	Rated out-put[1] P_N kW	Rated torque[1] M_N Nm	Rated current[1] I_N A	Voltage constant $k_{E/cold}$ $V/_{10001/min}$	Rated fre-quency f_N Hz	Rotor inertia (motor)[2] J kgcm^2	Weight[3] m kg
DSH1-071KO64U-10-54	1000	11	2.8	27	7.6	1.15	11	2.7	284	83.3	12.6	9.5
DSH1-071SO64U-10-54	1000	21	4.6	54	14.1	2.1	20	4.3	309	83.3	21.5	13.5
DSH1-071MO64U-10-54	1000	27	5.7	78	19.7	2.6	25	5.3	322	83.3	30.4	17.5
DSH1-071KO64U-20-54	2000	11	5.1	27	14.1	2.2	10	4.7	154	166.6	12.6	9.5
DSH1-071SO64U-20-54	2000	21	8.7	53	26.7	3.8	18	7.6	163	166.6	21.5	13.5
DSH1-071MO64U-20-54	2000	27	11	77	37.6	4.6	22	9	168	166.6	30.4	17.5
DSH1-071KO64U-30-54	3000	11	7.4	26	20.6	3.1	9.8	6.6	106	250.0	12.6	9.5
DSH1-071SO64U-30-54	3000	21	12.2	53	39.3	4.8	15	9.8	111	250.0	21.5	13.5
DSH1-071MO64U-30-54	3000	27	15.9	77	55	5.7	18	11	116	250.0	30.4	17.5
DSH1-071KO64U-40-54	4000	11	9.8	26	27.3	3.6	8.5	7.7	79.6	333.3	12.6	9.5
DSH1-071SO64U-40-54	4000	21	16.1	53	49.5	4.6	11	9	87.8	333.3	21.5	13.5

[1] Coil overtemperature $\Delta T < 105K$; direct flange mounting (mounting plate 450 x 400 x 30 mm³)

[2] Rotor inertia moment with PE brake: +7.9 kgcm²

[3] Weight with PE brake: +3.0 kg

2.4. DSH1-100

3 AC 400 V mains voltage for converters with unregulated supply

Motor type	Nom. speed	Stand-still torque[1)]	Stand-still current[1)]	max. static torque	Max. static current	Rated out-put[1)]	Rated torque[1)]	Rated current[1)]	Voltage constant	Rated fre-quency	Rotor inertia (motor)[2)]	Weight[3)]
	n_N	M_0	I_0	$M_{0.max}$	$I_{0.max}$	P_N	M_N	I_N	$k_{E/cold}$	f_N	J	m
	min^{-1}	Nm	A	Nm	A	kW	Nm	A	$V/_{10001/min}$	Hz	$kgcm^2$	kg
DSH1-100KO64U-10-54	1000	21	6.2	40	13.3	2.1	20	6	242	83,3	40,9	18,2
DSH1-100SO64U-10-54	1000	41	9.9	84	23.1	4	38	9,3	289	83,3	67,8	25,1
DSH1-100MO64U-10-54	1000	57	12.5	125	31.8	5.3	51	11,3	315	83,3	94,7	32
DSH1-100KO64U-20-54	2000	21	12	40	26.3	3.9	18	10,8	122	166,6	40,9	18,2
DSH1-100SO64U-20-54	2000	41	18.2	84	42.4	6.9	33	14,8	158	166,6	67,8	25,1
DSH1-100MO64U-20-54	2000	57	25	125	64	8.2	39	17,6	158	166,6	94,7	32
DSH1-100KO64U-30-54	3000	21	16.1	40	34.7	4.4	14	11	92,6	250,0	40,9	18,2
DSH1-100SO64U-30-54	3000	41	27.2	83	64	7.8	25	16,9	105	250,0	67,8	25,1

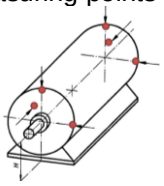
[1)] Coil overtemperature Δ T < 105K; direct flange mounting (mounting plate 450 x 400 x 30 mm)

[2)] Rotor inertia moment with PE brake: +17.6 $kgcm^2$

[3)] Weight with PE brake: +6.0 kg

2.5. Vibration load

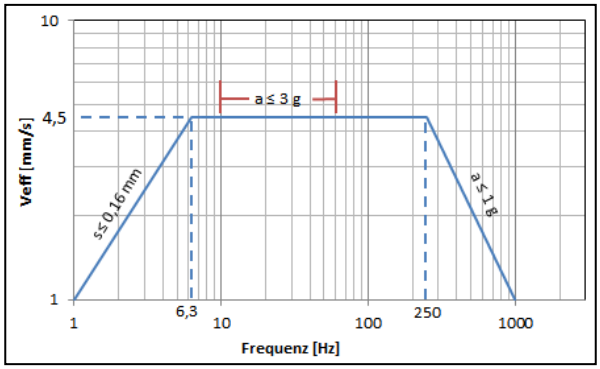
The vibration response of the total system at the operation site, due to output elements, mounting circumstances, alignment and installation as well as by influences of external vibrations, can lead to an increase of the vibration values at the motor.
Perhaps a complete balancing of the rotor with the output element is required.
In order to achieve a proper functioning and service life, the specified vibration values compliant to DIN ISO 10816 may not be increased at the specified measuring points of the motor (refer to figure below).



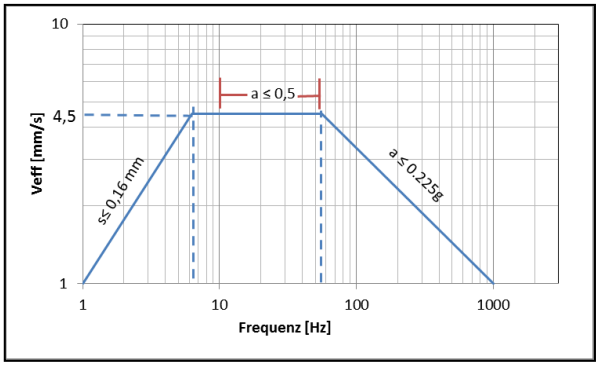
Measuring points for the vibration measuring

The specified radial and axial vibration values must be complied with, as well They are valid for substructures that are to be designated as flexible A flexible substructure is, if the lowest proper frequency of the total system in measuring direction is at least 25% under the basic excitation frequency of the total system (machine and base). All of the other substructures are to be designated solid. At solid substructures the manufacturer must be contacted.

Maximum <u>radial</u> vibration load:		**Maximum <u>axial</u> vibration load:**	
Peak vibration acceleration 1 g	> 250 Hz	Peak vibration acceleration 0,225 g	> 55 Hz
Peak vibration displacement ≤ 0,16 mm	< 6,3 Hz	Peak vibration displacement ≤ 0,16 mm	< 6,3 Hz
Effect. vibration speed ≤ 4,5 mm/s	6,3 Hz - 250 Hz	Effect. vibration speed ≤ 4,5 mm/s	6,3 Hz - 55 Hz



Zulässige radiale Schwingbelastung



Zulässige axiale Schwingbelastung

Additional resistance to vibration:
Vibration acceleration 3 g radial and 0,5g axial 10 Hz to 55 Hz
The motor additionally withstands the specified vibrations. However, the lifetime of the parts subject to wear (for example the storage) can be reduced.

Shock load:
If the vibration loads in the form of shocks are present then measuring at the installed machine is required.
On the base of this, constructive reviews and evaluation with the company Baumüller are required.

In order to evaluate the vibration speed the measuring equipment must meet the requirements of the ISO 2954.
The evaluation of the vibration acceleration is executed in the time range within the frequency range between 10 Hz and 2 kHz.
Provided that considerable vibratory excitations over 2kHz such as meshing frequencies are to be expected, the measuring range must be correspondingly adjusted. The permitted maximum values thereby do not change.

2.6. Radial force diagrams

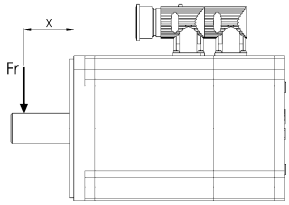
All bearings are designed for a service life of 20,000 h L_{10h}. The load values specified below may thereby not be exceeded. The permissible radial forces F_R are valid only for the horizontal installation of the motor without additional axial forces.
Furthermore, the specified average speeds must be adhered to reach the grease consumption period of 20,000 h under the following conditions:

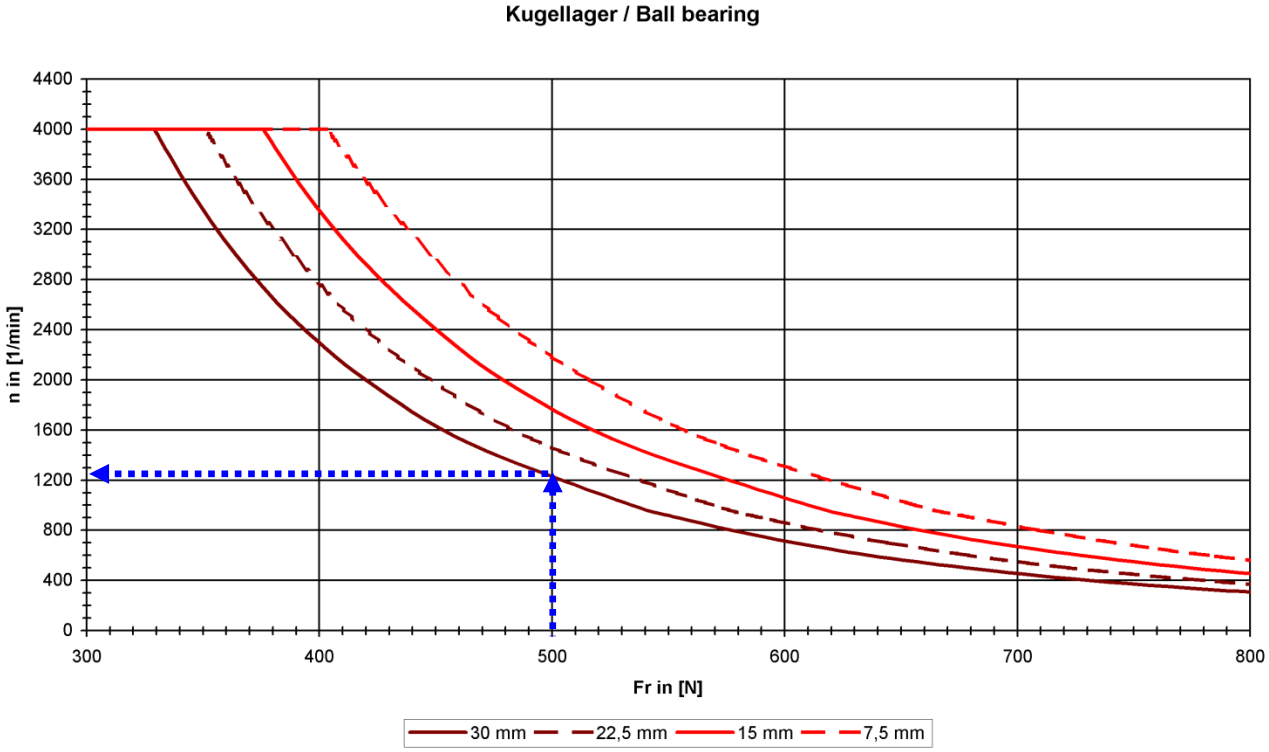
- low-vibration applications
- horizontal installation
- oscillatory bearing motion in which at least one pivot angle of 180° is performed
- Continuous bearing temperatures <120° C.

Axial loading on the motor shaft is generally not permitted.
No axial forces may develop when mounting clutches, pulleys, etc. on the motor shaft!

2.6.1. Sample diagram

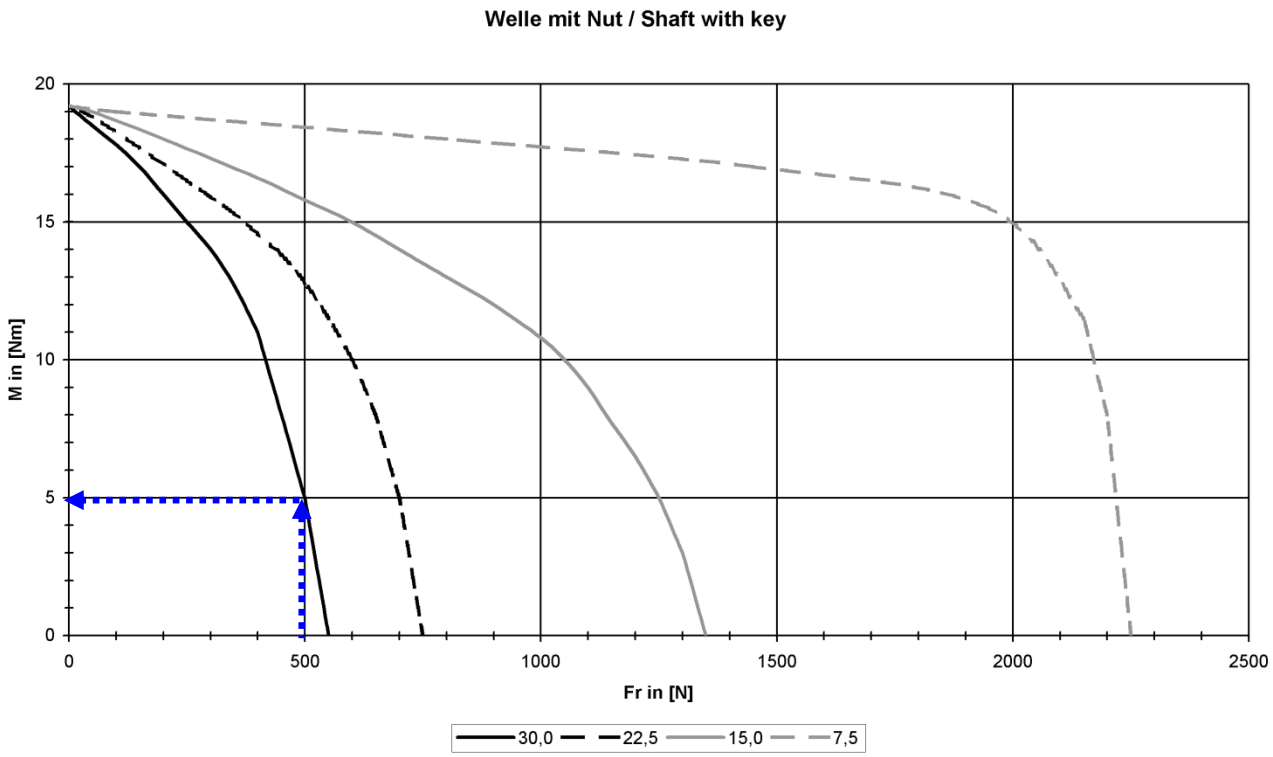
Sample diagrams:
Driving forces x = 30 mm from the shaft shoulder
Bearing service life 20,000 h, shaft with parallel key groove





Explanation of the sample chart:

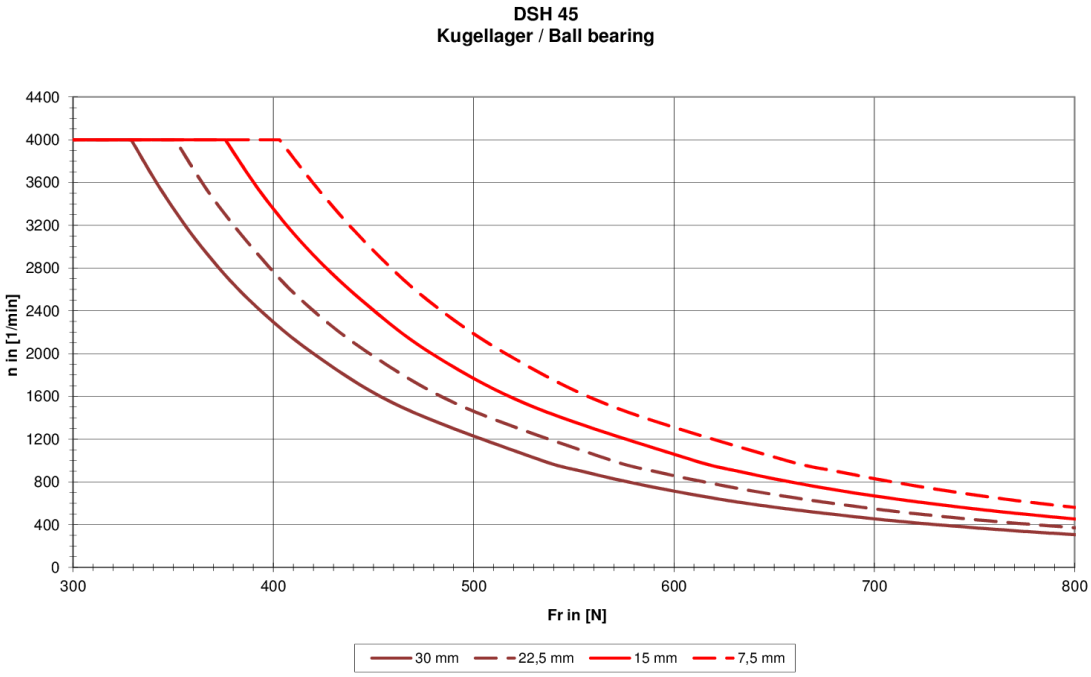
The potential maximum speed of the bearing can be calculated via radial force Fr of the application in characteristic "ball bearing".
At a radial force of 500 N with a driving force point of x = 30 mm from the shaft shoulder, a maximum speed of 1200 rpm results.



Explanation regarding the sample diagram:

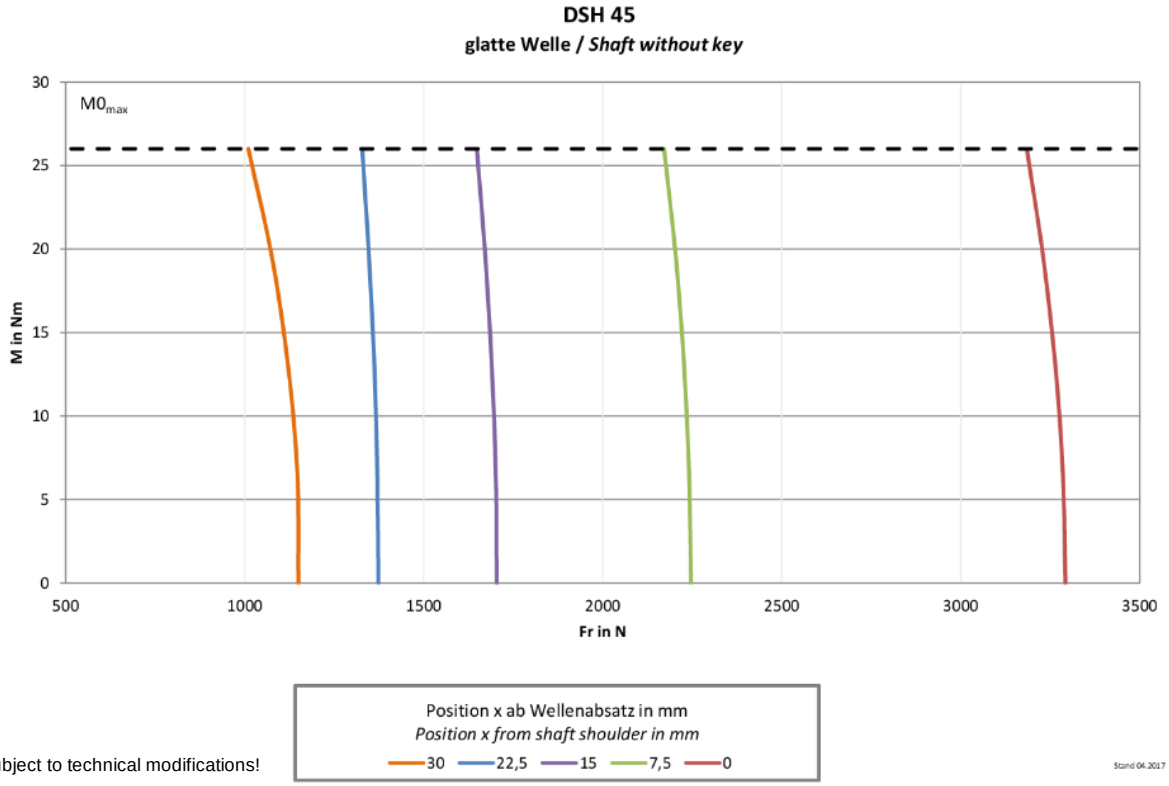
The maximum applicably torque results from the characteristic „Shaft“.
At a radial force of 500 N with a force application x = 30 mm of the shaft shoulder with an applicably torque of 5Nm still results.

2.6.2. Diagram DSH1-045

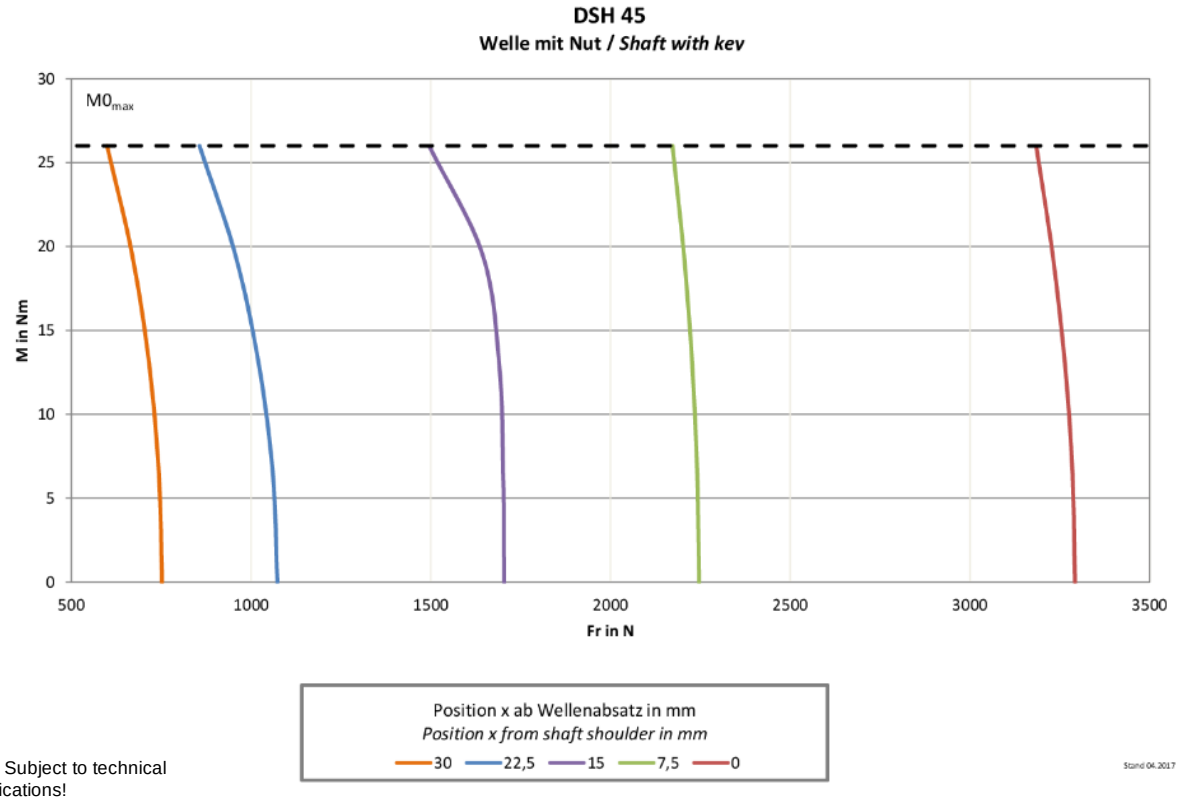


Note: Subject to technical modifications!

20,000h grease consumption duration at $n_{effective} \leq$ 4,000 rpm

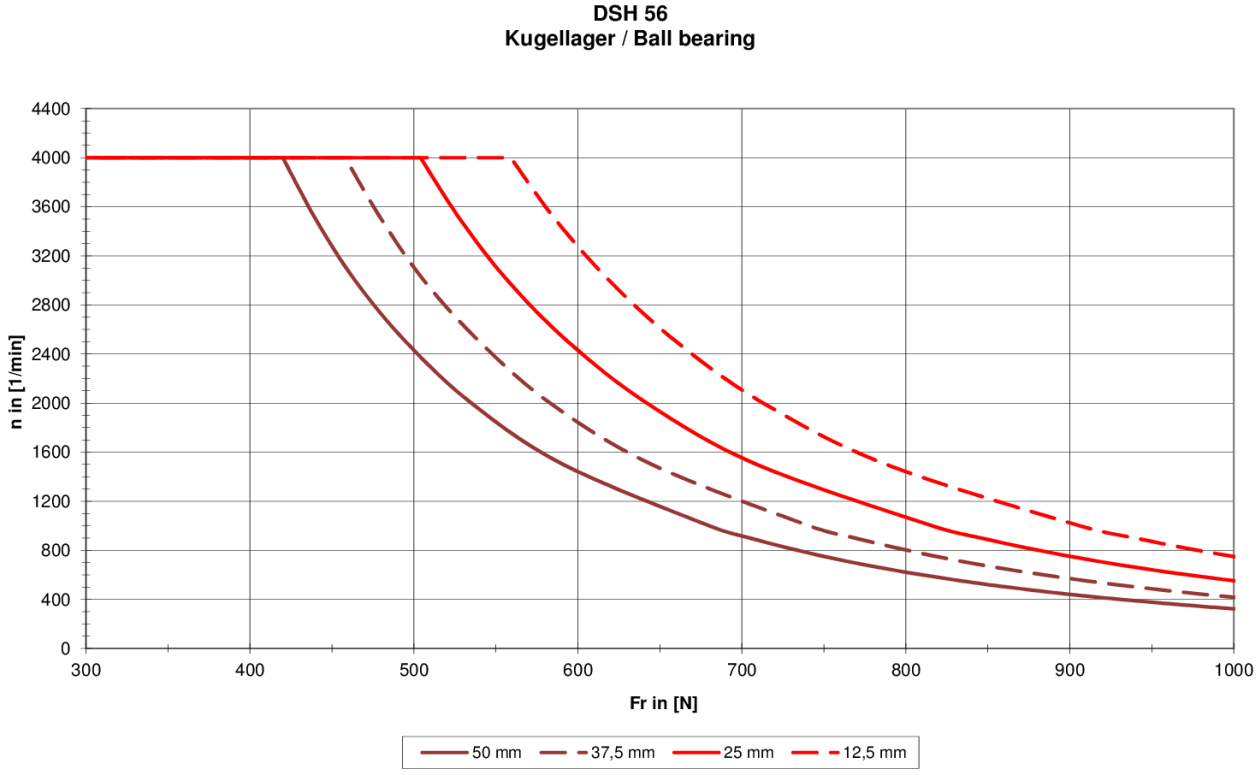


Note: Subject to technical modifications!



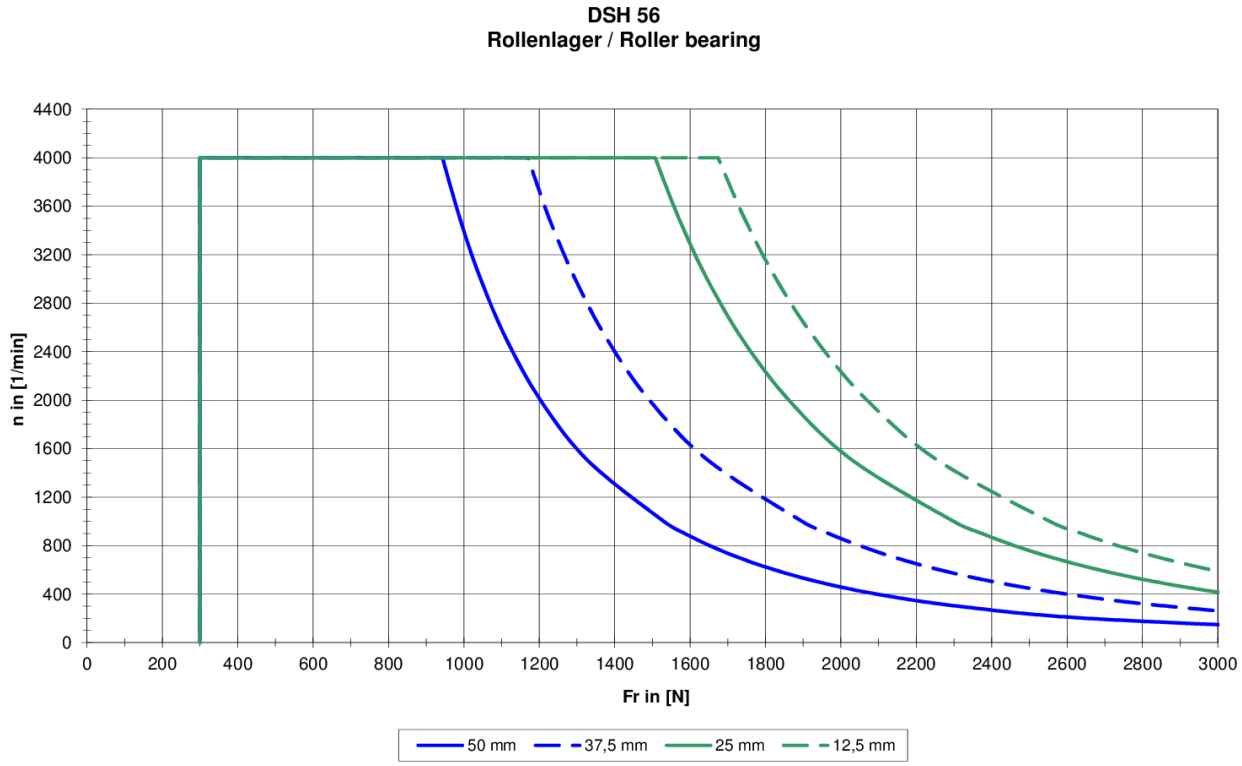
Note: Subject to technical modifications!

2.6.3. Diagram DSH1-056



Note: Subject to technical modifications!

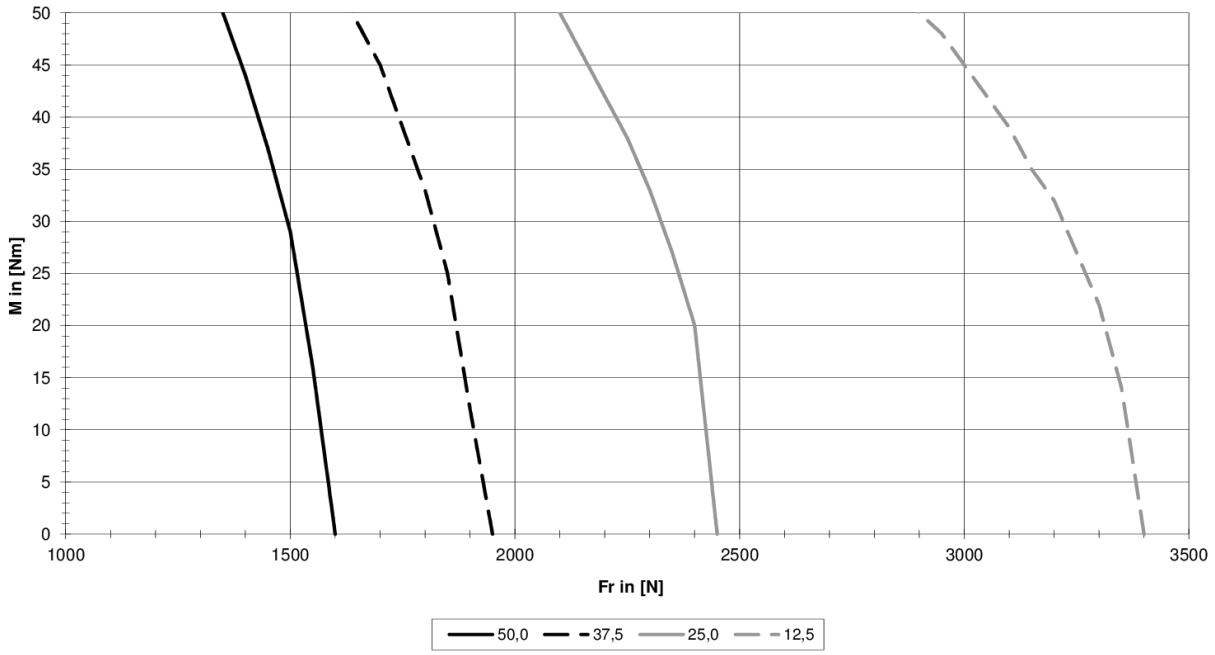
20,000h grease consumption duration at $n_{effective} \leq$ 4,000 rpm



20.000h Fettgebrauchsdauer bei n_{mittel} <=1500 min^{-1}

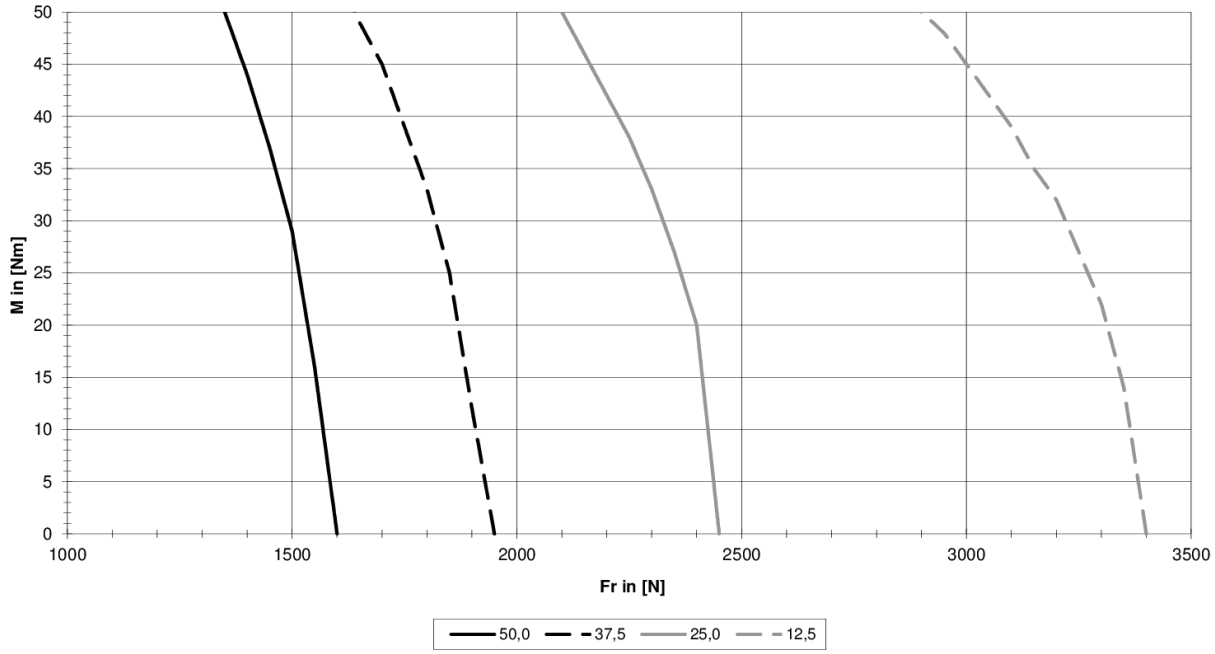
Note: Subject to technical modifications!

DSH 56
Welle mit Nut / Shaft with key



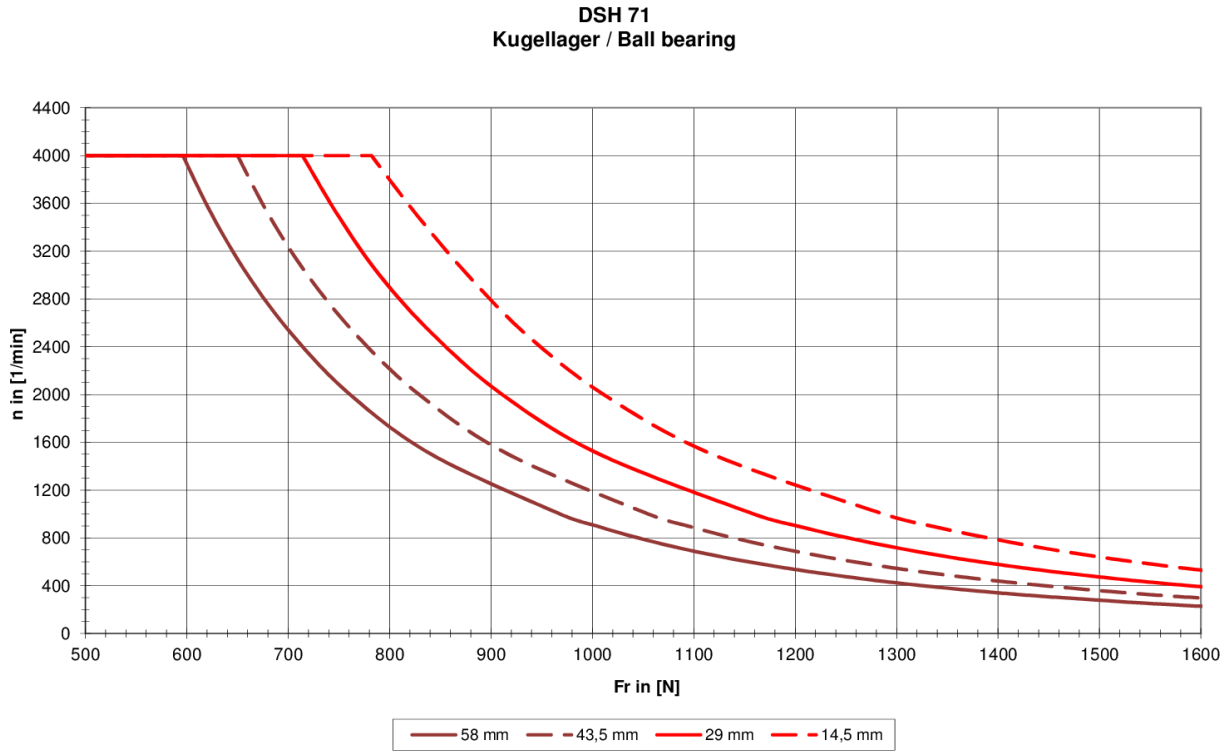
Note: Subject to technical modifications!

DSH 56
glatte Welle / Shaft without key



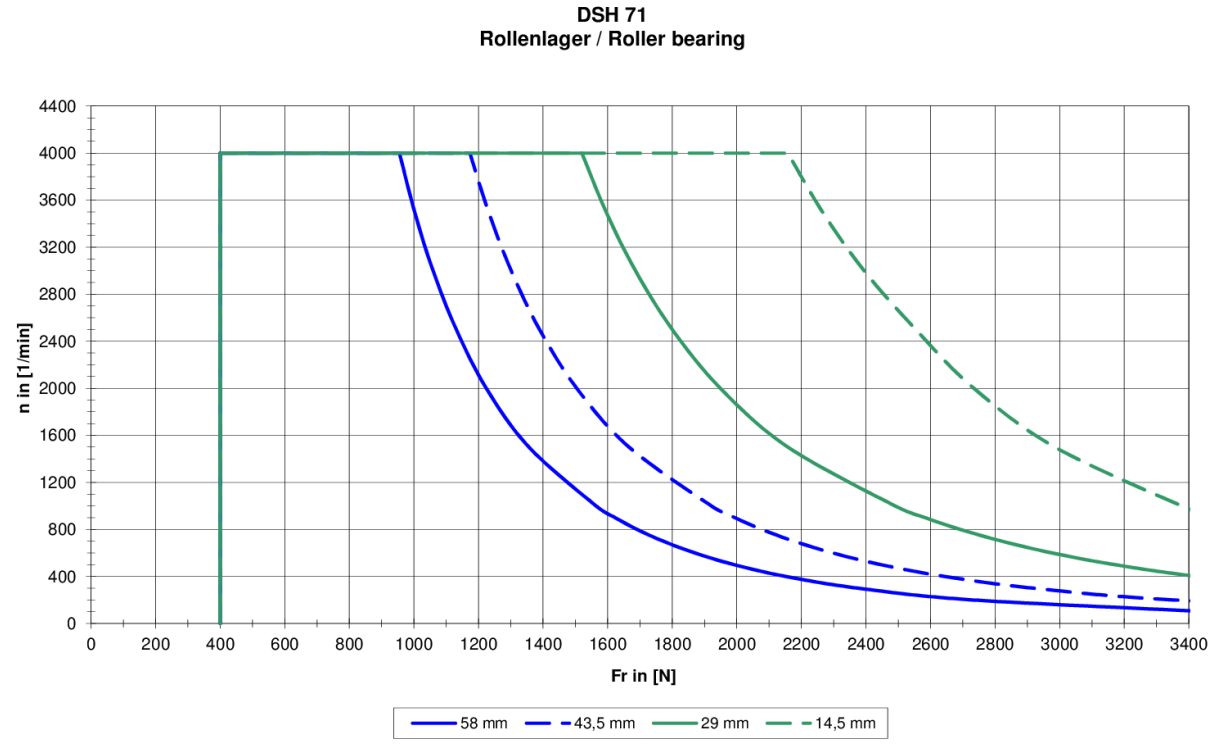
Note: Subject to technical modifications!

2.6.4. Diagram DSH1-071



Note: Subject to technical modifications!

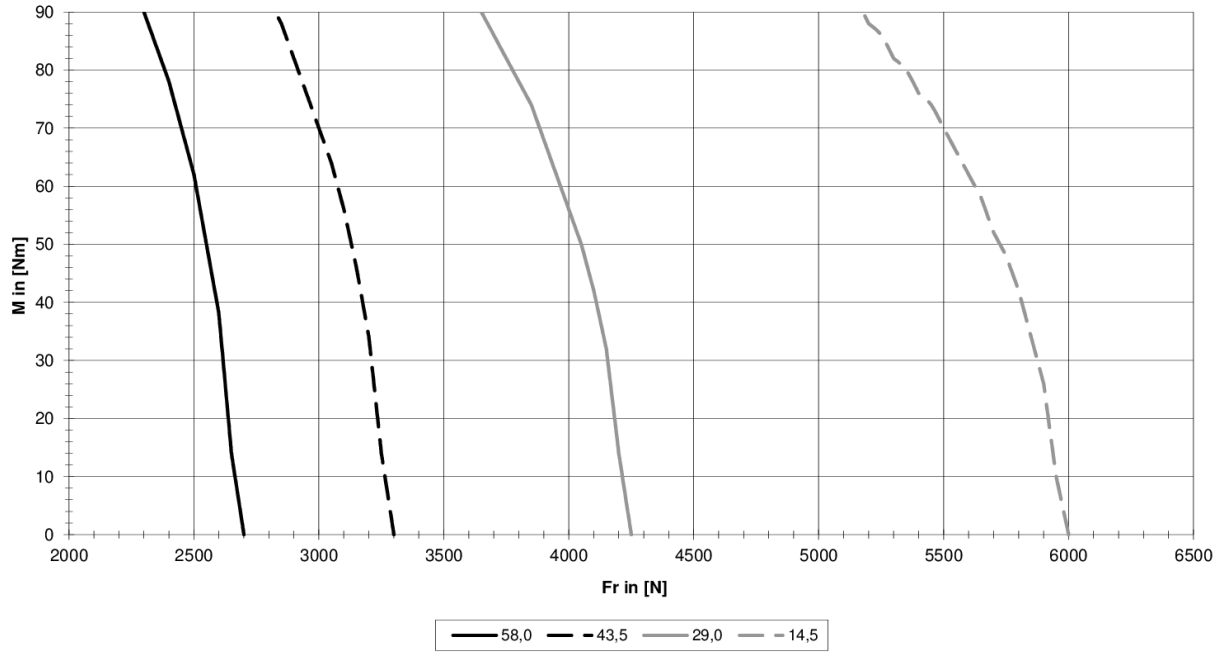
20,000h grease consumption duration at $n_{effective} \leq$ 4,000 rpm



20.000h Fettgebrauchsdauer bei n_{mittel} <=1150 min^{-1}

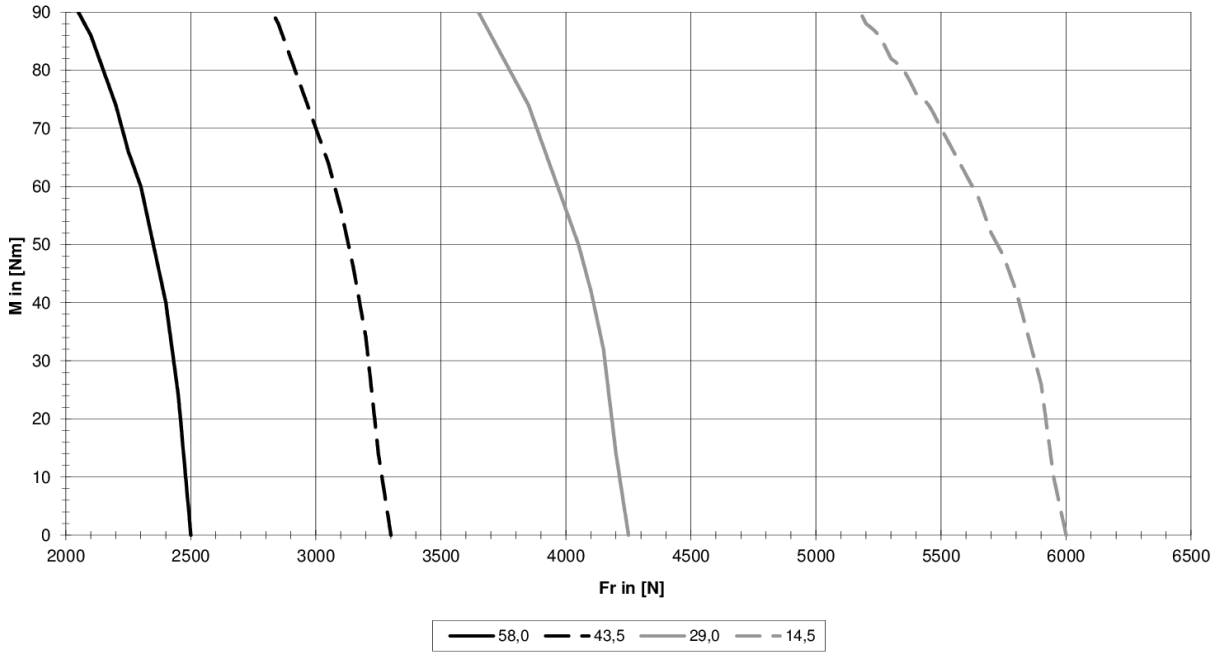
Note: Subject to technical modifications!

DSH 71
glatte Welle / Shaft without key



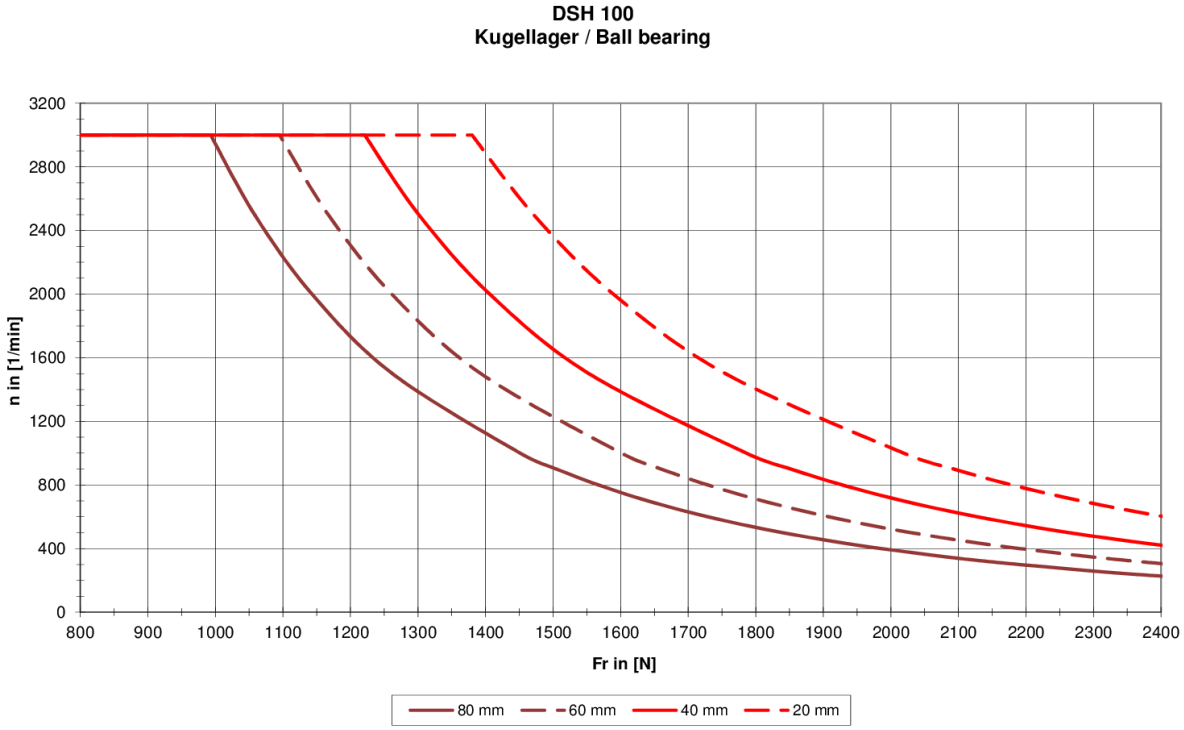
Note: Subject to technical modifications!

DSH 71
Welle mit Nut / Shaft with key



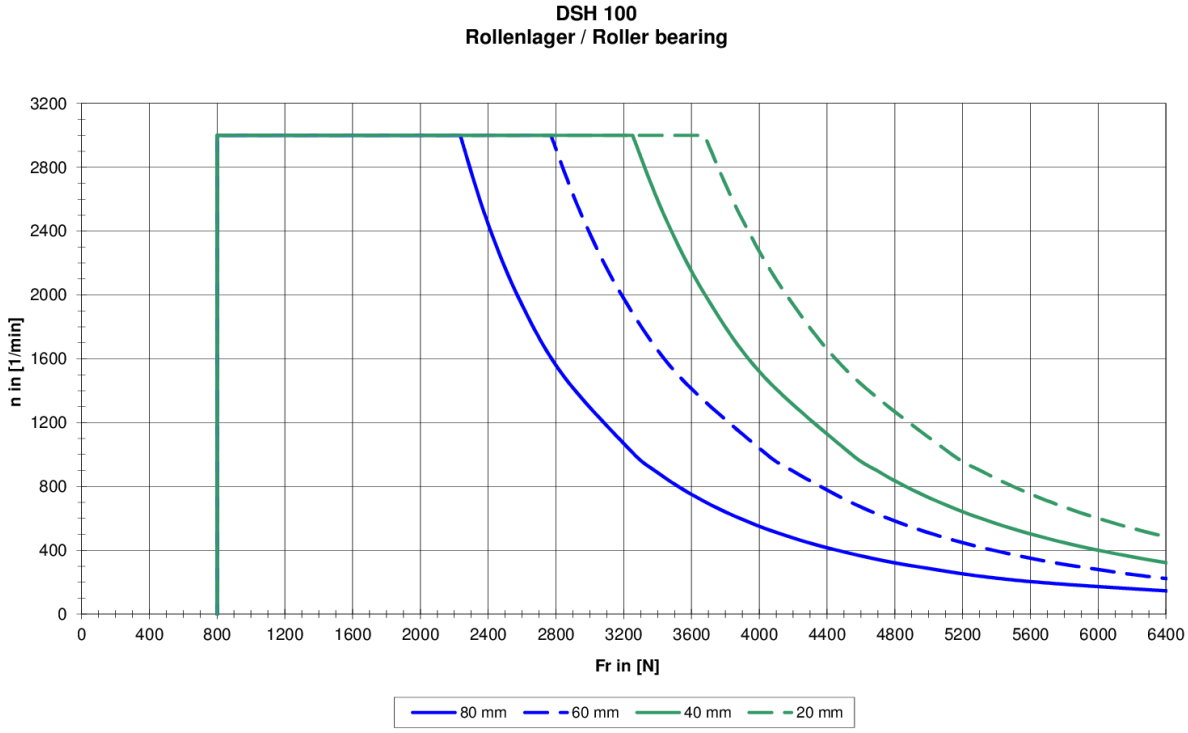
Note: Subject to technical modifications!

2.6.5. Diagram DSH1-100



Note: Subject to technical modifications!

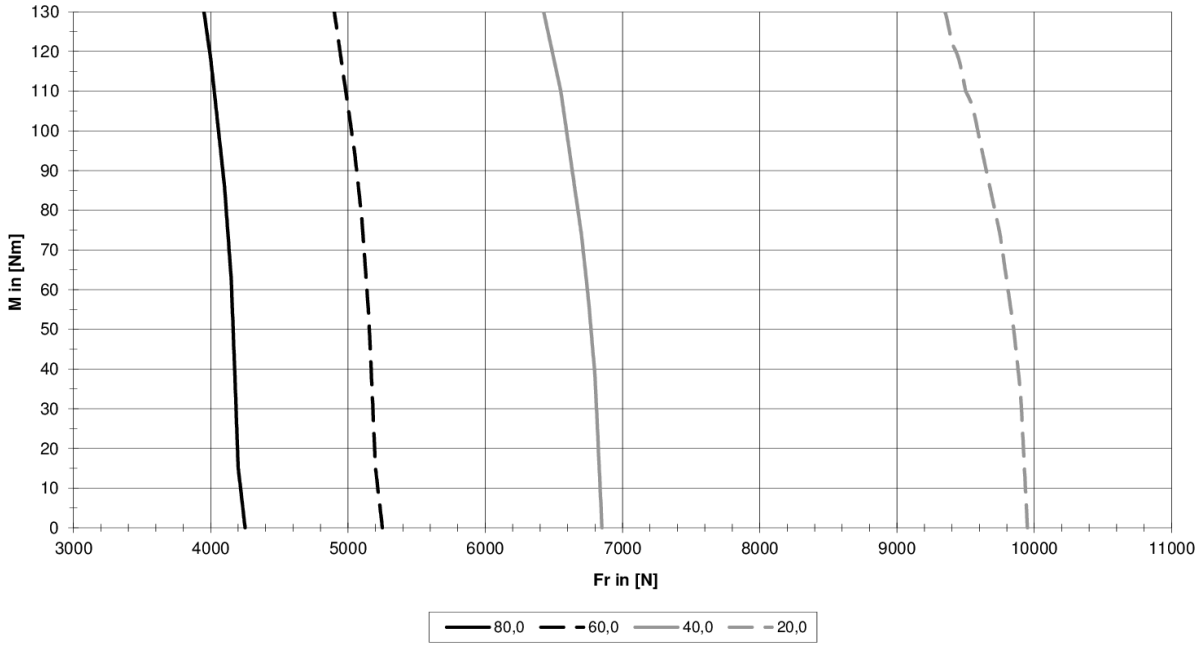
20,000h grease consumption duration at $n_{effective} \leq$ 3,000 rpm



Note: Subject to technical modifications!

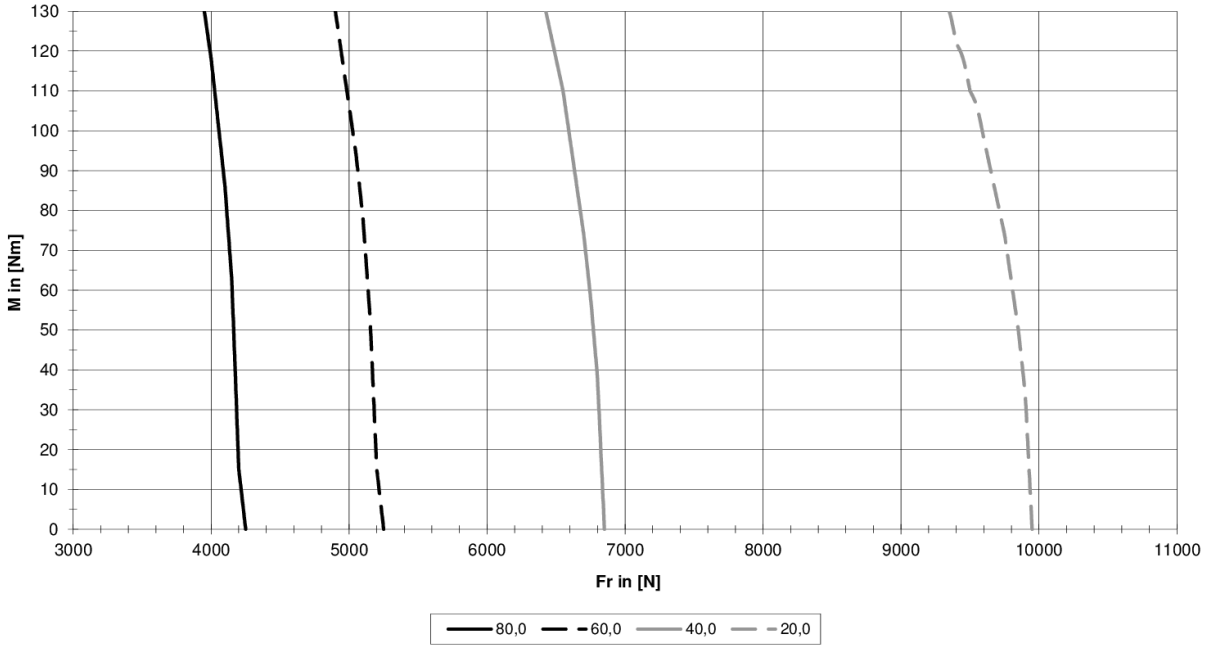
20,000h grease consumption duration at $n_{effective} \leq$ 850 rpm

DSH 100
glatte Welle / Shaft without key



Note: Subject to technical modifications!

DSH 100
Welle mit Nut / Shaft with key



Note: Subject to technical modifications!

3. Motor components (options)

3.1. Holding brake

The motors can be optionally equipped with a holding brake. The holding brake is a backlash-free permanent magnetic brake. The brakes work according to the closed current principle, i.e. the brake is applied when switched off (or at a failure of the operating voltage). The brakes are designed for an operating voltage of 24 VDC. The specifications by the brake manufacturer apply at room temperature.

The motors are available with the following holding brakes:

Motor type	DSH1-045	DSH1-056	DSH1-071	DSH1-100
Minimal static holding torque [Nm] at 120 °C.	10	20	45	105
Nominal dynamic holding torque [Nm] at 120 °C.	8	18	25	45
Maximum switching energy [J] per braking from n = 3,000 rpm	270	320	1400	2800
Connection values [V] (+6 % / -10 %)	24	24	24	24
Power consumption [W]	18	20	28	50
Moment of inertia [$kgcm^2$]	0,6	2,9	7,9	17,6
Switching time On [ms] Ventilation; with basic air gap	40	65	100	200
Switching time Off [ms] Braking; with basic air gap	20	30	40	50

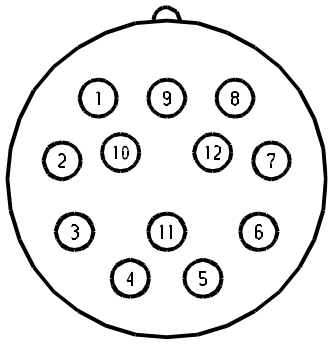
All brakes are not fail safe brakes in the sense that a torque reduction cannot occur due to uninfluenceable malfunction factors. Depending on the application, the relevant accident prevention regulations, as well as basic health and safety requirements of Annex I of the Machinery Directive and the harmonized European standards must be observed.
For emergency stops or power failures, approximately 2,000 brake processes can be performed.
(Condition: maximum external inertia = motor inertia and n_{max} type-related;
Max. braking / hour <20; evenly distributed).

3.2. Encoder

3.2.1. Resolver

Pole pair number	1
Transmission ratio	0.5 ± 0.05
Frequency	5 kHz
Nominal input voltage	7 V_{rms}
Effective input power at no-load speed	112 mW
Current consumption at no-load speed	70 mA
Max. output voltage at no-load speed	3.5 V ± 10%
Voltage constant	61 mV/°
Rotor resistance	48 Ω ± 10%
Stator resistance	31 Ω ± 15%
Rotor impedance at no-load speed	70 + j 74Ω ± 15%
Rotor impedance with short circuit	62 + j 66Ω ± 15%
Stator impedance at no-load speed with minimum coupling	108 + j 206Ω ± 15%
Stator impedance with short circuit and maximum coupling	97 + j 183Ω ± 15%
Phase shift	8° ± 3°
Zero voltage	30 mV
Angle error in relation to $(\Delta\varphi_{max}+\Delta\varphi_{min})/2$	± 6’
Shock as of DIN EN 60068-2-27 (11ms)	≤ 1000 m/s²
Vibration as of DIN EN 60068-2-6 (55 – 2000Hz)	≤ 500 m/s²

Resolver connection



Pin	Signal	Option for allocation PT1000 (R1/R2) or KTY (K+/K-)on encoder socket
1	cos –	cos –
2	-	-
3	-	-
4	-	-
5	sin -	sin -
6	sin +	sin +
7	-	K - or R2
8	cos +	cos +
9	-	K + or R1
10	ref +	ref +
11	-	-
12	ref -	ref -

View on the contact side of the receptacle

NOTE:
Use only at low demands on the true running characteristics of the motor.
The specifications are information by the encoder manufacturer.

3.2.2. Resolver for safety-related applications

Pole pair number	1
Transmission ratio	0.5 ± 0.05
Frequency	5 kHz
Safety integrity level	SIL 3 (IEC 61508) in combination with b maXX5000
Performance Level	PL e (EN ISO 13849) in combination with b maxx5000
Maximum angular acceleration	100.000 rad/s²
Effective input power at no-load speed	112 mW
Nominal input voltage	7 V_{rms}
Current consumption at no-load speed	70 mA
Max. output voltage at no-load speed	3.5 V ± 10%
Voltage constant	61 mV/°
Rotor resistance	48 Ω ± 10%
Stator resistance	31 Ω ± 15%
Rotor impedance at no-load speed	70 + j 74Ω ± 15%
Rotor impedance with short circuit	62 + j 66Ω ± 15%
Stator impedance at no-load speed with minimum coupling	108 + j 206Ω ± 15%
Stator impedance with short circuit and maximum coupling	97 + j 183Ω ± 15%
Phase shift	8° ± 3°
Zero voltage	30 mV
Angle error related to $(\Delta\varphi_{max}+\Delta\varphi_{min})/2$	± 6’
Shock DIN EN 60068-2-27 (11ms)	≤ 1000 m/s²
Vibration as of DIN EN 60068-2-6 (55 – 2000Hz)	≤ 500 m/s²

Resolver connection



View of the contact side of the receptacle

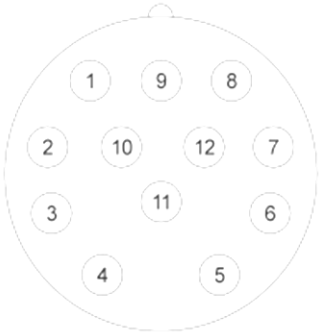
Pin	Signal	Option for allocation PT1000 (R1/R2) or KTY (K+/K-) at encoder socket
1	cos -	cos -
2	-	-
3	-	-
4	-	-
5	sin -	sin -
6	sin +	sin +
7	-	K - or R2
8	cos +	cos +
9	-	K + or R1
10	ref +	ref +
11	-	-
12	ref -	ref -

NOTE:
Use only at low demands on the true running characteristics of the motor.
The technical data is the specifications of the encoder manufacturer.
The configuration options for the safety encoders with different engine versions can be found in the product configurator.

3.2.3. SINCOS SEK/SEL37 (SICK)

Motor size	DSH1-045-100	
	SEK37	SEL37
Number of sine-, cosine periods per revolution	16	
Measuring step at interpolation of the sine-, cosine period with 12 bits for example	20“	
Number of the absolutely completed revolutions	1	4.096
Code type of the absolute value	binary	
Error limit at evaluation of the sine-, cosine period; integral non-linearity	+/- 288“	
Non-linearity within a sine-, cosine period; differential non-linearity at rated position +/- 0,1mm	+/- 144“	
Operating speed up to which the absolute position can be made	6.000 1/min	
Maximum operating speed	12.000 1/min	
Output signal	serial RS 485,asynchronous, half-duplex	
Operational voltage range	7-12 V	
max. operating current without load	50 mA	
Shock according to DIN EN 60068-2-27 (10 ms)	100 g	
	50 g	

SEK/SEL37 connection



Pin	Signal	Assignment option PT1000 (R1/R2) on the encoder socket
1	cos -	cos -
2	+ 485	+ 485
3	-	R1
4	-	R2
5	sin +	sin +
6	sin -	sin -
7	- 485	- 485
8	cos +	cos +
9	-	-
10	GND	GND
11	-	-
12	+ U	+ U

View on the contact side of the receptacle

NOTE:

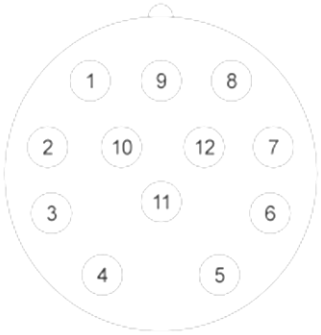
SEK/SEL37 – with mechanical adaption	The notch position is 0° (identical to SEK/SEL52 encoders)
SEK/SEL37 – without mechanical adaption	The notch position offset is stored in the encoder memory

This encoder is a component susceptible to ESD.
The technical data is specification from the encoder manufacturer.

3.2.4. SINCOS SRS/SRM50 (SICK)

	SRS50	SRM50
Number of sine, cosine periods per revolution	1024	
Step number per revolution	32768	
Number of the absolute resolved revolutions	1	1
Code type for the absolute value	binary	
Output frequency of the sine-, cosine signals	0-200 kHz	
Error limits at the evaluation of sine-, cosine signals, integral non-linearity	+/- 45‘‘	
Non-linearity within a sine-, cosine cycle, differential non-linearity in a normalized condition	+/- 7‘‘	
Operating speed up to which the absolute position can be generated	6000 1/min	
Maximum operating speed	12000 1/min	
Output signals, 2x90° sinusoidally offset signals	1 V_{ss}	
Output signal	serial RS 485, asynchronous, half-duplex	
Operational voltage range	7-12 V	
Operational current without load	80 mA	
Shock according to DIN EN 60068-2-27 (10 ms)	100 g (10 ms)	
Vibration acordant to DIN EN 60068-2-6 (10-2000 Hz)	20 g	

SRS/SRM50 Connection



Pin	Signal	Option for allocation at PT1000 (R1/R2) on encoder socket
1	cos -	cos -
2	+ 485	+ 485
3	-	R1
4	-	R2
5	sin +	sin +
6	sin -	sin -
7	- 485	- 485
8	cos +	cos +
9	-	-
10	GND	GND
11	-	-
12	+ U	+ U

View on the contact side of the receptacle

NOTE:
This encoder is a component susceptible to ESD.
The technical data is specification from the encoder manufacturer.

3.2.5. SINCOS SRS/SRM50-S (SICK)

	SRS50-S	SRM50-S
Safety integrity level	SIL2 (IEC 61508), SILCL2 (IEC 62061)	
Category	3 (EN ISO 13849)	
Performance Level	PL d (EN ISO 13849)	
Maximum angular acceleration	200.000 rad/s^2	
Number of sine, cosine periods per revolution	1,024	
Number of steps per revolution	32,768	
Number of absolute revolutions	1	4.096
Code type for the absolute value	binary	
Output frequency of the sine, cosine signals	0-200 kHz	
Fault limits in evaluation of the sine, cosine signals. Integral non-linearity in the relaxed state	+/- 45“	
Non-linearity within a sine or cosine period. Differential non-linearity	+/- 7“	
Working speed up to which the absolute position can be formed	6,000 1/min	
Maximum operating speed	12,000 1/min	
Output signals; 2x90° offset sinusoidal signals	1 V_{ss}	
Output signal	serial RS 485 asynchronous, half duplex	
Operating voltage range	7-12 V	
Operating current without load	80 mA	
Shock according to DIN EN 60068-2-27 (10 ms)	100 g	
Vibration according to DIN EN 60068-2-6 (10-2000 Hz)	20 g	

SKS/SKM36-S and SRS/SRM50-S connection



Pin	Signal	Option for allocation PT1000 (R1/R2) at encoder socket
1	cos -	cos -
2	+ 485	+ 485
3	-	R1
4	-	R2
5	sin +	sin +
6	sin -	sin -
7	- 485	- 485
8	cos +	cos +
9	-	-
10	GND	GND
11	-	-
12	+ U	+ U

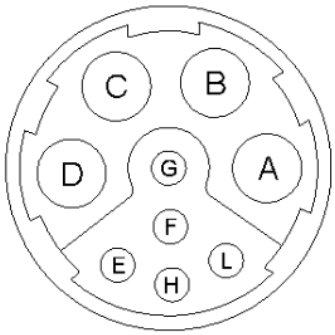
View of the contact side of the receptacle

NOTE:
This encoder is a component susceptible to ESD. The technical data is the specifications of the encoder manufacturer. The configuration options for the safety encoders with different engine versions can be found in the product configurator. The combination SRS/SRM50-S with add-on gearbox is available by request. ECN1313 / EQN1325 (the company Heidenhain). These encoders are not available for uncooled motors with means ≥ 3,000 rpm.

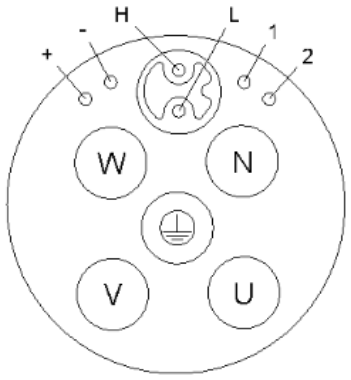
3.2.6. EES37/EEM37 Hiperface DSL® (SICK)

	EES37	EEM37
Number of the absolutely completed revolutions	1 (15 bit)	4096 (15 bit)
Code type of the absolute value	Binary	
Interface signals	Digital, RS-485	
Positioning values / revolution	32.768	
Maximum angular acceleration	500.000 rad/s²	
Maximum operating speed	12.000 1/min	
Voltage supply	7…12 V	
Current consumption without load	≤ 150 mA	
Shock as of DIN EN 60068-2-27 (6 ms)	100 g	
Vibration as of DIN EN 60068-2-6 (10-2000 Hz)	50 g	
Operating temperature	-40°C…+115°C	

Connection EES37/EEM37 DSL Hiperface

	Pin	Signal
	A B C D E F G H L	U V W GN / GE blue white Inner shield encoder DSL+ GND / DSL-

View on the contact side of the socket size 1

	Pin	Signal
	U V W N ⏚ + - 1 2 H L	U V W / GN/GE blau weiß Innenschirm / +U / DSL+ GND / DSL-

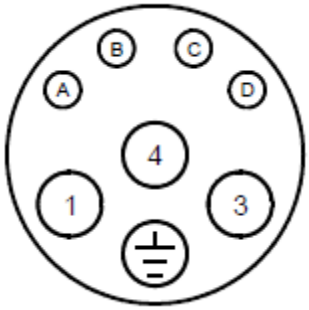
View on the contact side of the socket size 1.5

The configuration options of the Hiperface DSL encoder with various motor versions are to be taken from the product configurator. The encoder can be used up to a cable length of 60 m.

3.2.7. EFS50/EFM50 Hiperface DSL® (SICK)

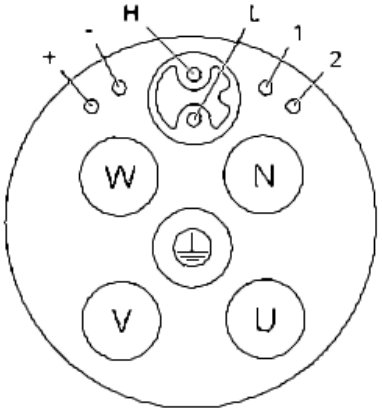
	EFS50	EFM50
Number of absolute completed revolutions	1 (21 bit)	4096 (21 bit)
Code type for the absolute value	Binary	
Interface signals Digital	Digital, RS-485	
Position values / revolution	2.097.152	
Maximum angular acceleration	200,000 wheel/s²	
Maximum operating speed	12,000 1/min	9,000 1/min
Power supply	7…12 V	
Current consumption without load	≤ 150 mA	
Shock according to DIN EN 60068-2-27 (6 ms)	100 g	
Vibration as of DIN EN 60068-2-6 (10-2000 Hz)	20 g	
Working temperature	-20°C…+120°C	

Connection EFS50/EFM50 Hiperface DSL



Pin	Signal
1	U
3	V
4	W
⏚	GN / GE
A	B+
B	B-
C	DSL+
D	DSL-

View on the contact side of the socket size 1



Pin	Signal
U	U
V	V
W	W
N	/
⏚	GN/GE
+	B+
-	B-
1	/
2	/
H	DSL+
L	DSL-

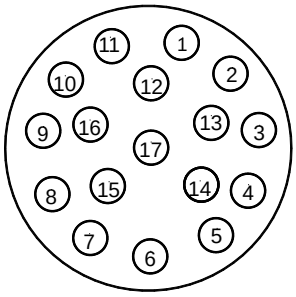
View on the contact side of the socket size 1.5

The configuration option of the Hiperface DSL encoder with various motor versions are to be taken from the product configurator. The encoder can be used up to a cable length of 60 m.

3.2.8. ECN1313/EQN1325 (Heidenhain)

	ECN 1313	EQN 1325
Number of sine-, cosine-periods per revolution	2048	
System accuracy	± 20“	
Number of the absolutely completed revolutions	1	4096 (12 bit)
Codetype of the absolute value	EnDat 2.1	
Sampling frequency and limit frequency	0-200 kHz	
Positioning values / revolution	8192 (13 bit)	
Operating speed up to which the absolute position can be made	12000 1/min	
Maximum operating speed (1/min)	12000 1/min	
Voltage supply	3,6-14 V	
Current consumption without load	≤ 160 mA	≤ 200 mA
Shock as of DIN EN 60068-2-27 (6 ms)	≤ 2000 m/s²	
Vibration as of DIN EN 60068-2-6 (55-2000 Hz)	≤ 300 m/s²	

ECN1313/EQN1325 connection



Pin	Signal	Assignment option PT1000 (R1/R2) on encoder socket
1	U_p	U_p
2	-	-
3	-	-
4	0V	0V
5	-	R1
6	-	R2
7	U_p	U_p
8	Clock	Clock
9	Clock inv.	Clock inv.
10	0V	0V
11	-	-
12	B +	B +
13	B –	B –
14	Data	Data
15	A +	A +
16	A –	A –
17	Data inv.	Data inv.

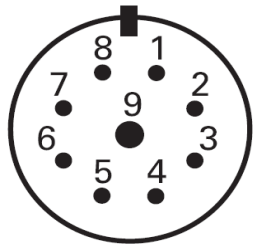
View on contact side of the socket

NOTE:
This encoder is an ESD-sensitive part.
The technical data is a information given by the encoder manufacturer.

3.2.9. ECI1319/EQI1331 (Heidenhain)

Motor size	DSH1-056-100	
	ECI 1319	EQI 1331
Number of lines	-	
System accuracy	± 65“	
Number of absolute completed revolutions	1	4096 (12 bit)
Code type for the absolute value	EnDat 2.2	
Position values/revolution	524 288 (19 bit)	
Maximum speed at which the absolute position can be defined	15000 1/min	
Maximum operating speed	15000 1/min	12000 1/min
Power supply	3.6…14 V	
Current consumption without load	95 mA	115 mA
Shock according to DIN EN 60068-2-27(6 ms)	≤ 2000 m/s²	
Vibration according to DIN EN 60068-2-6 (55-2000 Hz)	≤ 400 m/s²	

ECN1319/EQN1331 connection



Pin	Signal
1	Clock
2	Clock inv.
3	U_p
4	0V
5	Data
6	Data inv.
7	Sensor U_p
8	Sensor 0V
9	-

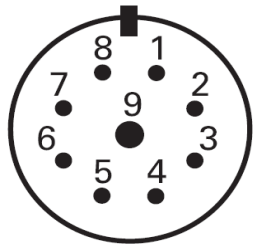
View on the contact side of the receptacle

NOTE:
This encoder is a component susceptible to ESD.
The technical data is specification from the encoder manufacturer.

3.2.10. ECI1319/EQI1331-S (Heidenhain)

Motor size	DSH1-056-100	
	ECI 1319-S	EQI 1331-S
Number of lines	-	
System accuracy	± 65“	
Number of absolute completed revolutions	1	4096 (12 bit)
Code type for the absolute value	EnDat 2.2	
Position values/revolution	524 288 (19 bit)	
Maximum speed at which the absolute position can be defined	15000 1/min	
Maximum operating speed	15000 1/min	12000 1/min
Power supply	3.6…14 V	
Current consumption without load	95 mA	115 mA
Shock according to DIN EN 60068-2-27(6 ms)	≤ 2000 m/s²	
Vibration according to DIN EN 60068-2-6 (55-2000 Hz)	≤ 400 m/s²	

ECN1319/EQN1331-S connection



Pin	Signal
1	Clock
2	Clock inv.
3	U_p
4	0V
5	Data
6	Data inv.
7	Sensor U_p
8	Sensor 0V
9	-

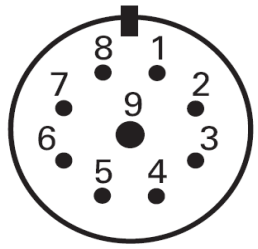
View on the contact side of the receptacle

NOTE:
This encoder is a component susceptible to ESD.
The technical data is specification from the encoder manufacturer.

3.2.11. ECN1325 / EQN1337 (Heidenhain)

	ECN 1325	EQN 1337
Number of lines	2048	
System accuracy	± 20“	
Number of absolute completed revolutions	1	4096 (12 bit)
Code type for the absolute value	EnDat 2.2	
Position values/revolution	33554432 (25 bit)	
Maximum speed at which the absolute position can be defined	12000 rpm	
Maximum operating speed	12000 rpm	
Power supply	3.6…14 V	
Current consumption without load	≤ 160 mA	≤ 200 mA
Shock according to DIN EN 60068-2-27(6 ms)	≤ 2000 m/s²	
Vibration according to DIN EN 60068-2-6 (55-2000 Hz)	≤ 300 m/s²	

ECN1325/EQN1337 connection



Pin	Signal
1	Clock
2	Clock inv.
3	U_p
4	0V
5	Data
6	Data inv.
7	Sensor U_p
8	Sensor 0V
9	-

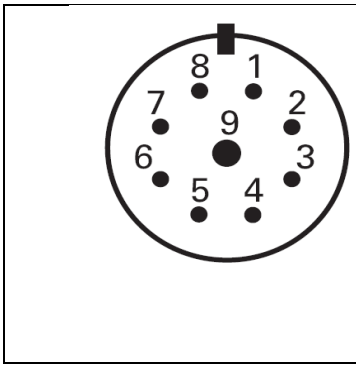
View on the contact side of the receptacle

NOTE:
This encoder is a component susceptible to ESD.
The technical data is specification from the encoder manufacturer.

3.2.12. ECN1325/EQN1337-S (Heidenhain)

	ECN1325-S	EQN1337-S
Safety integrity level	SIL 2 according to EN 61508	
Category	3 (EN ISO 13849)	
Performance Level	PL d (EN ISO 13849)	
Maximum angular acceleration	50.000 rad/s^2	
System accuracy	± 20“	
Number of absolute completed revolutions	1	4.096 (12bit)
Code type for the absolute value	EnDat 2.2	
Position values / revolution	33,554,432 (25 bit)	
Maximum speed at which the absolute position can be defined	12,000 1/min	
Maximum operating speed	12,000 1/min	
Power supply	3.6…14 V	
Current consumption without load	≤ 160mA	≤ 200mA
Shock according to DIN EN 60068-2-27 (6 ms)	≤ 2000 m/s^2	
Vibration according to DIN EN 60068-2-6 (55-2000 Hz)	≤ 300 m/s^2	

ECN1325/EQN1337-S connection



Pin	Signal
1	Clock
2	Clock inv.
3	U_p
4	0V
5	Data
6	Data inv.
7	Sensor U_p
8	Sensor 0V
9	-

View of the contact side of the receptacle

NOTE:
This encoder is a component susceptible to ESD.
The technical data is the specifications of the encoder manufacturer.

The configuration options for the safety encoders with different engine versions can be found in the product configurator.
The combination ECN1325/EQN1337-S with add-on gearbox is available by request. These encoders are not available for uncooled motors with nmeans ≥ 3,000 rpm.

3.3. Encoder cables for b maXX 4000

General Information

A prefabricated encoder cable is used for all encoder systems. The connection at the motor end consists of a 12-pole circular signal connector on resolvers and Hyperface® – encoders, a 17-pole circular signal connector on ECN1313/EQN1325 and a 9-pole circular signal connector on ECN1325/EQN1337. The connection at the controller side consists of a 15-pole D-Sub connector. Alternatively, the signal connector on the motor side is available for Speedtec versions with trailing cables.

The dragable cable is suitable for mobile applications such as drag chains, for example. Unlike non-dragable cables made from PVC, the cable sheath is made from durable PU (suitable for environments where acids and bases are present).

3.3.1. Technical data

Technical description - non-dragable for resolver/ SinCos Hiperface®-interface / SinCos - and TTL - incremental encoder

- LiYCY, 5x (2x0.14mm²) + 2 x 0.5mm² copper strand, twisted pairs
- PVC sheath, grey; inscription with Baumüller logo, black
- 1st side: 12-pole circular signal plug connector with 12 socket contacts
- 2nd side: 15-pole D-Sub plug connector with pin contacts and locking screws 4-40UNC
- Outer diameter 9.0 mm (+/- 0.3mm)
- Bending radius: $r \geq 60$ mm (fixed routing), $r \geq 135$ mm (flexible use)
- Nominal voltage: $250V_{AC}$

Technical description - dragable for resolver/ SinCos Hiperface®-interface / SinCos - and TTL - incremental encoder

- Li12YC11Y, 5x (2x0.14mm²) + 2 x 0.5mm² copper strand, twisted pairs
- PU sheath, black; inscription with Baumüller logo, white
- 1st side: 12-pole circular signal plug connector with 12 socket contacts
- 2nd side: 15-pole D-Sub plug connector with pin contacts and locking screws 4-40UNC
- Outer diameter 9.0 mm (+/- 0.3mm)
- Bending radius: $r \geq 70$ mm (fixed routing), $r \geq 100$ mm (flexible use)
- Nominal voltage: $300V_{AC}$

Technical description - non-dragable for EnDat® 2.1-interface

- LiYCY, 5x (2x0.14mm²) + 2 x 0.5mm² copper strand, twisted pairs
- PVC sheath, grey; inscription with Baumüller logo, black
- 1st side: 17-pole circular signal plug connector with 17 socket contacts
- 2nd side: 15-pole D-Sub plug connector with pin contacts and locking screws 4-40UNC
- Outer diameter 9.0 mm (+/- 0.3mm)
- Bending radius: $r \geq 60$ mm (fixed routing), $r \geq 135$ mm (flexible use)
- Nominal voltage: $250V_{AC}$

Technical description - dragable for EnDat® 2.1-interface

- Li12YC11Y, 5x (2x0.14mm²) + 2 x 0.5mm² copper strand, twisted pairs
- PU sheath, black; inscription with Baumüller logo, white
- 1st side: 17-pole circular signal plug connector with 17 socket contacts
- 2nd side: 15-pole D-Sub plug connector with pin contacts and locking screws 4-40UNC
- Outer diameter 9.0 mm (+/- 0.3mm)
- Bending radius: r ≥ 70 mm (fixed routing), r ≥ 100 mm (flexible use)
- Nominal voltage: $300V_{AC}$

Technical description - dragable for EnDat® 2.2-interface

- PUR sheath, 1x(4x0.14mm²) + (4x0.34mm²)
- 1 twisted foursome 0.14mm^2, 4 wires 0.34mm^2, copper, tin-plated
- Total shield CuSn, inscription Heidenhain
- 1st side: 9-pole circular signal plug connector with 8 socket contacts
- 2nd side: 15-pole D-Sub plug connector with pin contacts and locking screws 4-40UNC
- Outer diameter 6.0 mm
- Bending radius: r ≥ 20 mm (fixed routing), r ≥ 75 mm (flexible use)
- Dielectric strength wire/wire and wire/shield: 0.5kV at 50Hz, 1 minute

3.3.2. Application references

- **Operating temperature of encoder cable resolver/ SinCos Hiperface®-interface / SinCos - and TTL - incremental encoder / EnDat® 2.1**

	Dragable	Not dragable
Limit temperature	on the surface	on the surface
Static use/minimal movement	- 40 °C to + 80 °C	- 30 °C to + 80 °C
Permanent movement	- 30 °C to + 80 °C	- 5 °C to + 70 °C

- **Operating temperature of encoder cable EnDat® 2.2**

	Dragable
Limit temperature	on the surface
Static use/minimal movement	- 40 °C to + 80 °C
Permanent movement	- 10 °C to + 80 °C

- **Routing of cable on motor**

The cables must not touch the surface of the motor.

3.3.3. Order information for encoder cables

Encoder cables for resolver/ SinCos Hiperface®-interface / SinCos - and TTL - incremental encoder - prefabricated cables with connector

Not dragable, prefabricated
Cable 5 x (2x0.14mm^2) + 2 x 0.5 mm^2 with plug connector

Length in m	Item Number
1	243601
2	211338
3	219333
4	231166
5	209879
6	220197
7	216455
8	220429
10	210052
15	215716
20	218568
25	218569
30	217094
35	216444
40	217095
45	217567
50	217568
55	217569
60	217570
70	232088

Dragable, prefabricated
Cable 5 x (2x0.14mm^2) + 2 x 0.5 mm^2 with plug connector

Length in m	Item Number	Item Number (Speedtec)
3	246658	448944
4	243379	448945
5	239540	448948
6	242954	448946
8	239541	448949
10	239542	448956
15	239543	448962
20	239544	448967
25	239545	448970
30	239546	448971
35	239547	448973
40	240520	448976
45	240521	448978
50	240522	448980
55	244033	448981
60	245484	448982

Encoder cables for EnDat® 2.1- prefabricated cables with plug connector

Not dragable, prefabricated
Cable 5 x (2x0.14mm^2) + 2 x 0.5 mm^2 with plug connector

Length in m	Item Number
2	383152
3	383923
5	393885
7	389445
8	380138
9	389446
10	393886
15	388505
20	388418
25	393887
30	393888
35	387958
40	382006
50	388419
70	384473
90	387391

Dragable, prefabricated
Cable 5 x (2x0.14mm^2) + 2 x 0.5 mm^2 with plug connector

Length in m	Item Number	Item Number (Speedtec)
2	393889	448816
3	369864	448817
5	394014	448818
7	389807	448819
8	393890	448820
9	389808	448821
10	393891	448822
15	393892	448823
17	371494	448824
20	393893	448825
25	393894	448826
30	380358	448827
35	391216	448828
40	382005	448830
50	378022	448832

Encoder cables for EnDat® 2.2 - prefabricated cables with plug connector

Dragable, prefabricated
cable 1x4x0.14 + 4x0.34 PUR Ø 6mm with plug connector

Length in m	Item Number	Item Number (Speedtec)
2	434056	459031
3	434057	459032
5	434058	459033
10	434059	459035
15	434060	459036
20	434061	459037
25	434062	459038
50	434063	459042

3.4. Encoder cables for b maXX 5000

A prefabricated encoder cable is used for all encoder systems. The connection at the motor end consists of a 12-pole circular signal connector on resolvers and Hyperface® encoder, a 17-pole circular signal connector on ECN1313/EQN1325. The connection at the controller side consists of a 26-pole D-Sub connector. Alternatively, the signal connector on the motor side is available in a Speedtec version.

3.4.1. Technical data

Technical description - dragable for resolver

- Li9YC, 1 x (2 x 0,25) + Li9Y, 2 x (2x0,25) + Li9YC11Y, 1 x (2 x 0,34), copper strand, twisted pairs
- PUR sheat, green; inscription with Baumüller Nürnberg and encoder cable Resolver
- 1st side: 12-pole circular signal plug connector with 12 socket contacts
- 2nd side: 26-pole D-Sub plug connector with pin contacts and locking screws 4-40UNC
- Outer diameter 7.3 mm (+/- 0.3mm)
- Bending radius: $r \geq 4 \times D$ (fixed routing), $r \geq 10 \times D$ (flexible use)

Technical description - dragable for SinCos Hiperface®-interface und SinCos - and TTL - incremental encoder

- Li9YC, 3 x (2 x 0,25) , + Li9Y, 3 x (2 x 0,25) + Li9YC11Y, 1 x (2x0,34), copper strand, twisted pairs
- PUR sheat, green; inscription with Baumüller Nürnberg and encoder cable Hyperface or Incremental
- 1st side: 12-pole circular signal plug connector with 12 socket contacts
- 2nd side: 26-pole D-Sub plug connector with pin contacts and locking screws 4-40UNC
- Outer diameter 9.6 mm (+/- 0.3mm)
- Bending radius: $r \geq 4 \times D$ (fixed routing), $r \geq 10 \times D$ (flexible use)

Technical description – dragable for EnDat® 2.1-interface

- Li9YC, 3 x (2 x 0,25) , + Li9Y, 3 x (2 x 0,25) + Li9YC11Y, 1 x (2x0,34), copper strand, twisted pairs
- PUR sheat, green; inscription with Baumüller Nürnberg and encoder cable Endat 2.1
- 1st side: 17-pole circular signal plug connector with 17 socket contacts
- 2nd side: 26-pole D-Sub plug connector with pin contacts and locking screws 4-40UNC
- Outer diameter 9.6 mm (+/- 0.3mm)
- Bending radius: $r \geq 4 \times D$ (fixed routing), $r \geq 10 \times D$ (flexible use)

Technical description – Draggable hybrid cable for Hiperface DSL®

- Hybrid cable
- Shielding braid Copper wires, tinned
- PUR sheath, orange, flame-retardant, self-extinguishing
- 1st side: metal round plug Speedtec M23 hybrid socket 8-pole for wire with 4G1.5 and 4G2.5
  metal round plug Speedtec M40 hybrid socket 5+4-pole + 2 -pole insulating body for wire with 4G2.5, 4G4 and 4G6
- 2nd side: Metal 45°-D-Sub plug, 26-pole with electronics
- Ready-for-use cable for bmaXX 5300
- Cable for bmaXX 5500 being prepared

3.4.2. Application references

- **Operating temperature of encoder cable resolver/ SinCos Hiperface®-interface / SinCos - and TTL - incremental encoder / EnDat® 2.1**

Limit temperature	on the surface
Static use/minimal movement	- 40 °C to + 80 °C
Permanent movement	- 20 °C to + 60 °C

Routing of cable on motor

The cables must not touch the surface of the motor.

3.4.3. Order information for encoder cables

Encoder cable - prefabricated with plug

For resolver

Length in m	Item Number	Item Number (Speedtec)
1	429914	448746
2	429915	448747
3	429916	448748
5	429917	448749
7	429918	448750
10	429919	448751
15	429920	448752
20	429921	448753
25	429922	448754
30	429923	448755
35	429924	448756
40	429925	448757
50	429926	448758
75	429927	448759

For SinCos Hiperface® - interface

Length in m	Item Number	Art. Nr. (Speedtec)
1	429958	448761
2	429959	448762
3	429960	448763
5	429961	448764
7	429962	448765
10	429963	448766
15	429964	448767
20	429965	448768
25	429966	448769
30	429967	448770
35	429968	448772
40	429969	448773
50	429970	448774
75	429971	448775

For SinCos - and TTL - incremental encoder

Length in m	Item No.	Item No. (Speedtec)
1	430015	448777
2	430016	448778
3	430017	448779
5	430018	448780
7	430019	448781
10	430020	448782
15	430021	448783
20	430022	448784
25	430023	448785
30	430024	448786
35	430025	448787
40	430026	448788
50	430027	448789
75	430028	448790

For SinCos EnDat® 2.1 - interface

Length in m	Item No.	Item No. (Speedtec)
1	429986	448796
2	429987	448797
3	429988	448798
5	429989	448799
7	429990	448800
10	429991	448801
15	429992	448802
20	429993	448803
25	429994	448804
30	429995	448805
35	429996	448806
40	429997	448807
50	429998	448808
75	429999	448809

For Hiperface DSL® hybrid cables size 1 for bmaXX 5300[1)]

	Rated current 15A 4G1.5+(2x0.75)+ (2x22AWG)	Rated current 20A 4G2.5+(2x1.0)+(2x22AWG)
Length [m]	Item No.	Item No.
3	464201	464217
5	464202	464218
7	464203	464219
10	464204	464220
15	464205	464221
20	464206	464222
25	464207	464223
30	464208	464224
35	464209	464225
40	464210	464226
50	464211	464227
60	464212	464228

For Hiperface DSL® hybrid cables size 1.5 for bmaXX 5300[1)]

	Rated current 21A 4G2.5+(2x1.0)+(2x22AWG)	Rated current 28A 4G4.0+(2x1.0)+(2x22AWG)	Rated current 36A 4G6.0+(2x1.0)+(2x22AWG)
Length [m]	Item No.	Item No.	Item No.
3	464235	448798	464278
5	464236	448799	464279
7	464237	448800	464280
10	464238	448801	464281
15	464239	448802	464282
20	464240	448803	464283
25	464241	448804	464284
30	464242	448805	464285
35	464243	448806	464286
40	464244	448807	464287
50	464245	448808	464288
60	464246	448809	464289

[1)] Cables are being prepared for bmaXX 5500

3.5. Motor cables

The motor cables are highly flexible trailing cables with overall shielding. They comply with VDE, UL and CSA regulations. The control cables are integrated as star quads. The brake control and the temperature sensor are connected via the main connector. The cables are particularly suited for the optimum use of cable racks thanks to their small cross-section, low weight, and non-impeding surface. As a result, they can be used efficiently in trailing chains. The overall shielding with an optical coverage of more than 85% makes the cable non-critical from an EMC perspective.

3.5.1. Technical data

- Sheath resistance to media such as coolants and machine and gearbox oils
- Abrasion resistance thanks to a special surface in cable racks and trailing chains
- Highly flexible trailing cable, minimum bending radius for flexible use: 12 x D
- Non-blocking sheath surface with satin finish
- Shield made of tinned copper braid with optical coverage of ≥ 85%
- Core insulation made from TPE or polyester, sheath material: Halogen-free PUR
- Cable is CFC and silicone-free
- Behavior in the event of fire: Fire-inhibiting, halogen-free
- Cable color RAL 1028, melon yellow
- Label features Baumüller logo and VDE, UL and CSA marks

Rated voltage
- Uo/U 600/1.000 V (power cores)
- U 24 V DC (control cores)

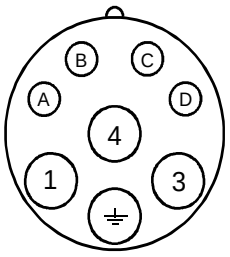
Core labeling
- Power cores U, VV, WWW
- Colored control cable pairs as star quads in red, white, black, yellow

Assignment of pairs: (note the polarity)
- Red – black (brake)
- white – yellow (temperature)

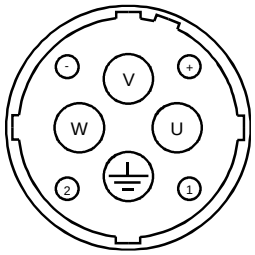
3.5.2. Main connection via connector

Note:
The connector size is determined by the standstill current I_0 of the motor used.
Motors with a standstill current of ≤ 20A feature a size 1 main connector.
For standstill currents of 20 A< I_0 ≤ 36 A, a size 1.5 main connector is used.
A terminal box must be used at a I_0 > 36A.

Poles of the female main connectors:

		Pin	Signal	Color/labeling
Size 1 I_0 ≤ 20 A		1	Phase U	U
		⏚	PE	Green/yellow
		3	Phase V	V V
		4	Phase W	W W W
		A	B+	Red
		B	B-	Black
		C	K-	White
		D	K+	Yellow

View of contact side of female connector

		Pin	Signal	Color/labeling
Size 1.5 $I_0 \leq 36$ A		U V W ⏚ + - 1 2	Phase U Phase V Phase W PE B+ B- K- K+	U V V W W W green / yellow Red Black White Yellow

View of contact side of female connector

Cable cross-section [2)]	**Rated current [A][1) 2)]**	**Connector 540 V Size [2)]**	**Cable diameter [2)] [mm]**
4×1.5 mm² + 4×0.75 mm²	15	1	11.7–12.3
4×2.5 mm² + 4×0.75 mm²	20	1	12.7–14.6
4×4 mm² + 4×0.75 mm²	28	1.5	14.2–15.4
4×6 mm² + 4×0.75 mm²	36	1.5	16.6–17.9
4x10 mm² + 4x0.75 mm²	50	1.5	20.5–21.5
4x16 mm² + 4x0.75 mm²	66	-	23.0-25.8
4x25 mm² + 2x(2x1.5 mm²)	84	-	26.3-29.7
4x35 mm² + 2x(2x1.5 mm²)	104	-	30.8-32.5

1) Current carrying capacity acc, to Table 5, laying type C or E (VDE 0113/EN 60 204 Part 1 issue 1997)
Ambient temperature 40 °C
2) Deviating regulations apply for c UL us approved motors

3.5.3. Application notes

Operating temperature
The cables can be operated within a temperature range of between -20 °C and +80 °C,

Cable laying at the motor
The cables must not touch the motor surface,

Smallest permissible bending radii
12x outer cable diameter,

3.5.4. Ordering data for main connection cables

Rated current: 15 A
Cable 4 x 1,5 mm² + 4 x 0,75 mm²
With connector size 1

Length in m	Item Number	Item Number Speedtec
5	324781	445872
7	324782	445887
10	324783	445889
15	324784	447675
20	324785	447676
25	324786	447677
30	324787	447678
35	324788	447679
40	324789	447680
50	324790	447681
75	324791	447682
100	324792	447683

Rated current: 28 A
Cable 4 x 4 mm² + 4x 0,75 mm²
With connector size 1,5

Length in m	Item Number	Item Number Speedtec
5	326589	448063
7	326591	448064
10	326592	448065
15	326593	448066
20	326594	448067
25	326596	448069
30	326597	448070
35	326598	448071
40	326599	448072

Rated current: 20 A
Cable 4 x 2,5 mm² + 4x 0,75 mm²
With connector size 1

Length in m	Item Number	Item Number Speedtec
5	414840	447684
7	380967	447687
10	413410	447688
15	414841	447692
20	414842	447698
25	414843	447852
30	414846	447853
35	414848	447854
40	414849	447855
50	414850	447856
75	414851	447857
100	414852	447858

Rated current 36 A
Cable 4 x 6 mm² + 4x 0,75 mm²
With connector size 1,5

Length in m	Item Number	Item Number Speedtec
5	326600	448080
7	326601	448118
10	326602	448119
15	326603	448120
20	326604	448121
25	326605	448122
30	326606	448123
35	326607	448124
40	326608	448125

Rated current: 21 A
Cable 4 x 2,5 mm² + 4x 0,75 mm²
With connector size 1,5

Length in m	Article number	Item Number Speedtec
5	326577	447686
7	326578	447689
10	326579	447690
15	326580	447691
20	326581	447693
25	326582	447694
30	326583	447695
35	326584	447696
40	326585	447697
50	326586	447699
75	326587	448060
100	326588	448061

Rated current: 50 A
Cable 4 x 10 mm² + 4x 0,75 mm²
With connector size 1,5

Length in m	Article number	Item Number Speedtec
5	326609	448129
7	326610	448131
10	326611	448132
15	326612	448133
20	326613	448134
25	326614	448135
30	326615	448136
35	326616	448137
40	326617	448138

Mating Plug

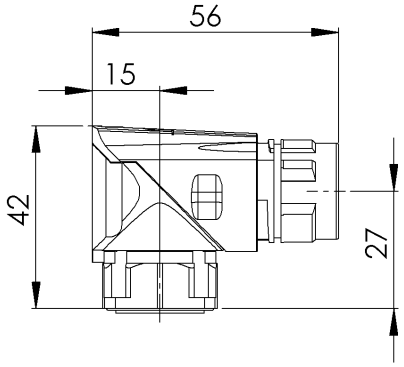
Type		Art. Nr.	Art. Nr. Speedtec
Gr. 1	4x1,5mm² o. x2,5mm²	261740	445486
Gr. 1	4x2,5mm² bis 4x4mm²		500064
Gr. 1,5	4x2,5mm² bis 4x6mm²	326574	445487
Gr. 1,5	4x10mm²	326569	445488

Deviating regulations apply for cULus approved motors.

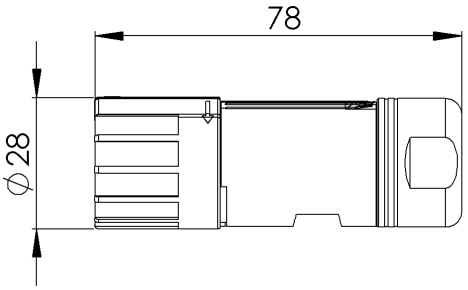
3.6. Dimensional drawings for equipment socket and plug

3.6.1. Main connection

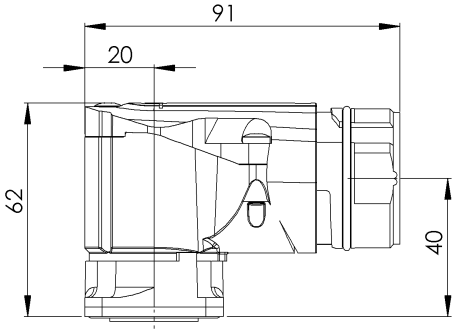
Speedtec - rotary angle socket
(Size 1 for Current I_0 up to 20 A)
or hybrid socket DSL Hiperface



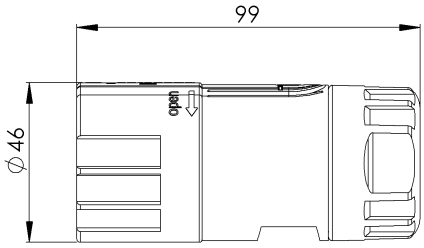
Speedtec - mating connector
(Size 1 for Current I_0 up to 20 A)



Speedtec - rotary angle socket
(Size 1,5 for Current I0 up to 36 A)
or hybrid socket DSL Hiperface

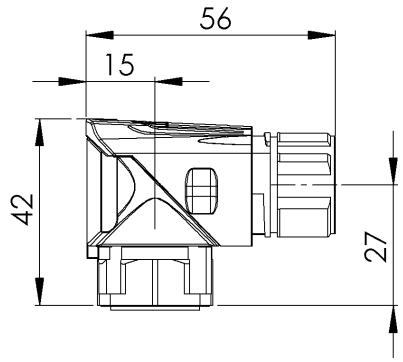


Speedtec - mating connector
(Size 1,5 for Current I0 up to 36 A)

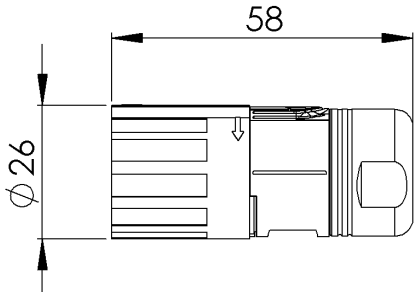


Encoder connection

Speedtec - rotary angle socket

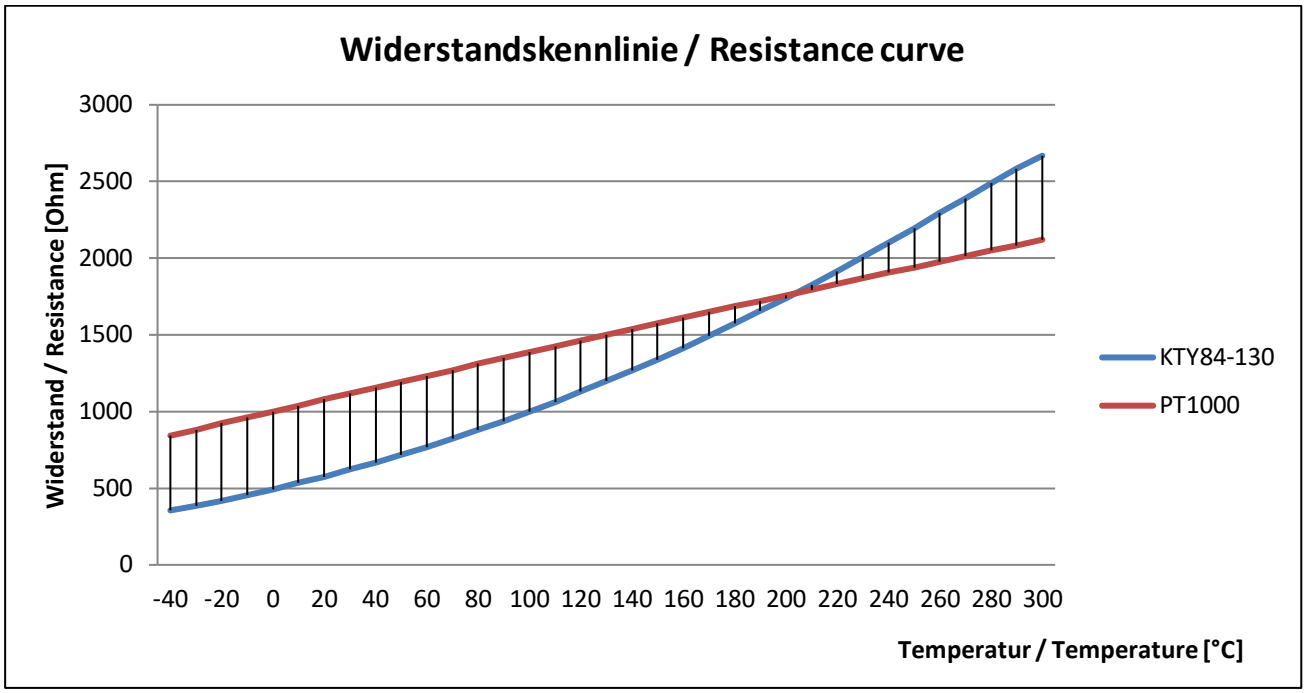


Speedtec - mating connector



3.7. Temperature sensor

The temperature sensor is connected via the main connection, Optionally, connection via the encoder box is possible. The respective execution must be marked in the order code.

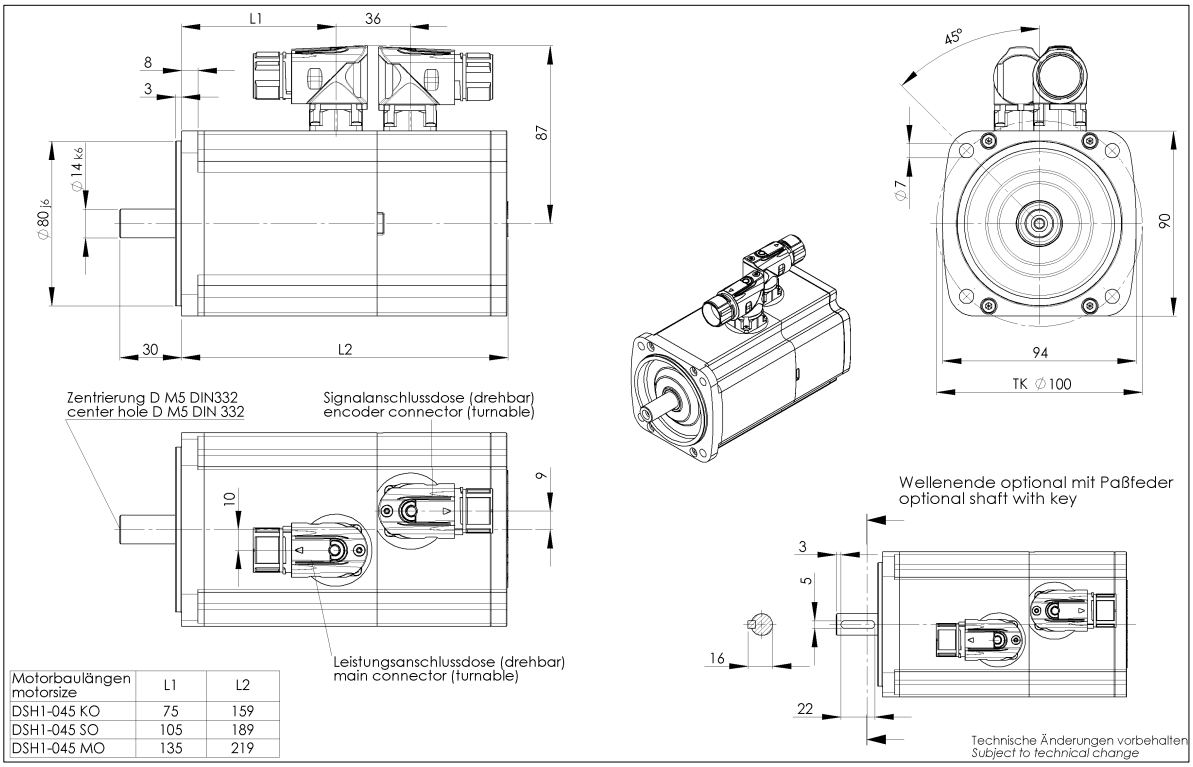


The temperature sensor PT1000 continuously monitors the motor temperature. If the sensor is supplied with a measured current of 2 mA the above shown resistance curve results.

4. Dimension drawings

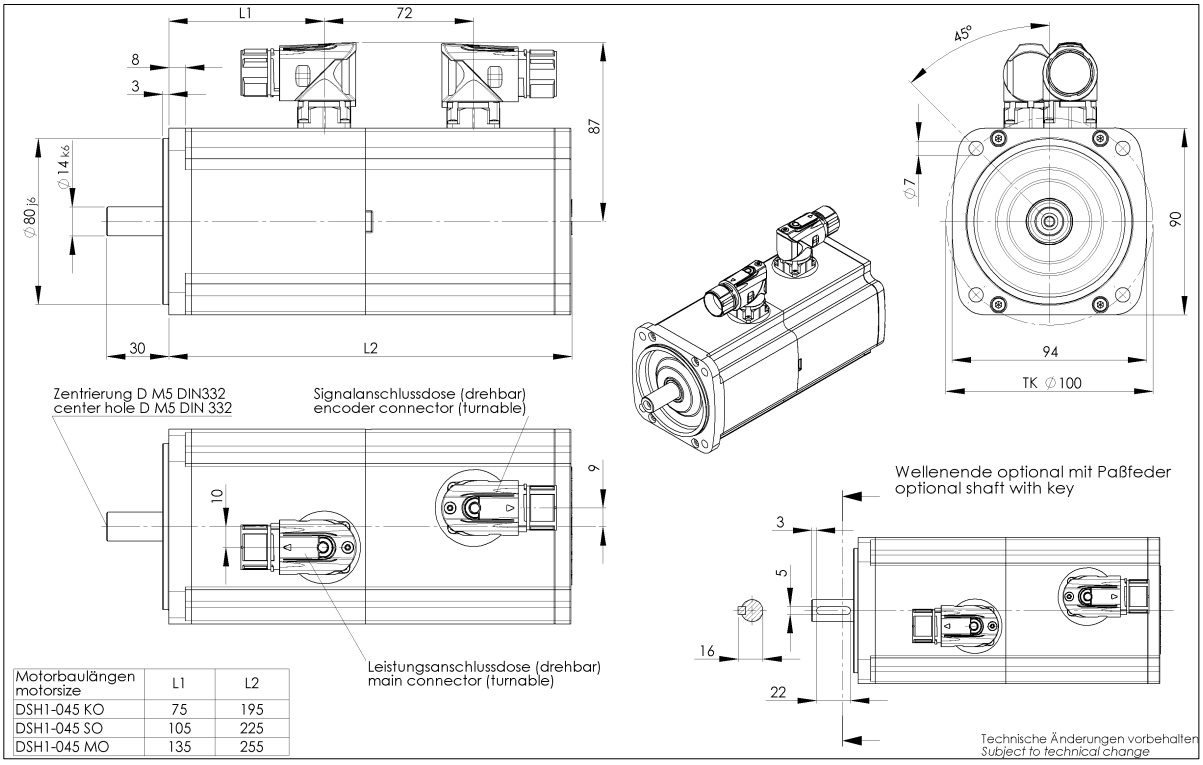
4.1. Dimension drawings DSH1-045

Dimension drawing DSH1-045….U-..-..-.O.-.PP-.-..-O-000
Version IM B5



Motorbaulängen motorsize	L1	L2
DSH1-045 KO	75	159
DSH1-045 SO	105	189
DSH1-045 MO	135	219

Dimension drawing DSH1-045….U-..-..-.B.-.PP-.-..-O-000
Version IM B5

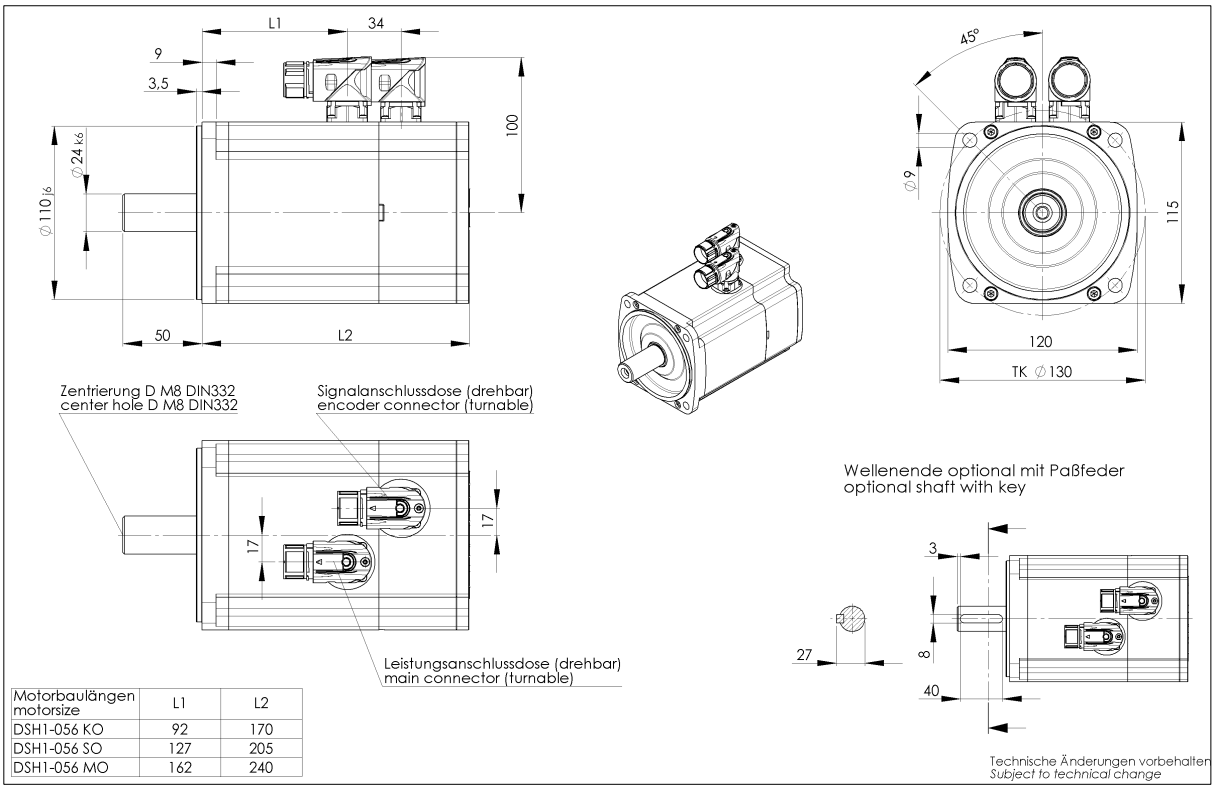


Motorbaulängen motorsize	L1	L2
DSH1-045 KO	75	195
DSH1-045 SO	105	225
DSH1-045 MO	135	255

4.2. Dimension drawings DSH1-056

Dimension drawing DSH1-056….U-..-..-.O.-.PP-.-..-O-000

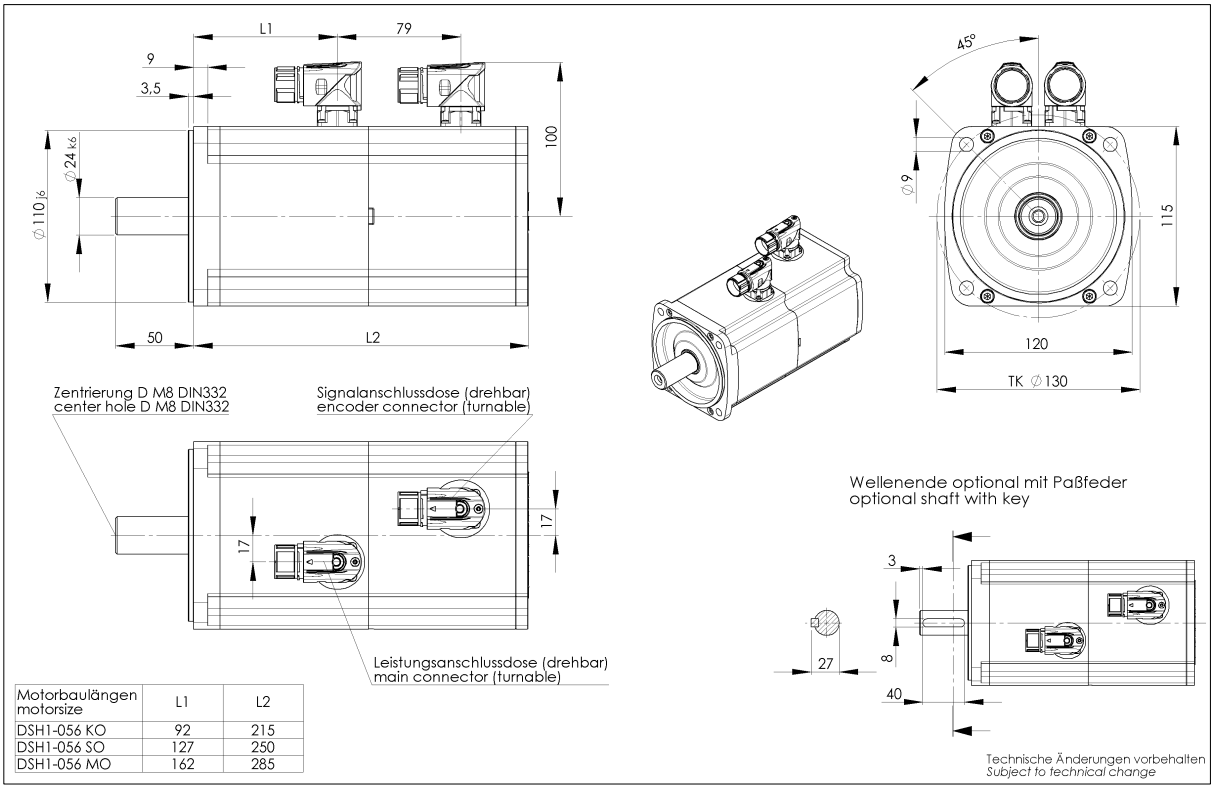
Version IM B5



Motorbaulängen motorsize	L1	L2
DSH1-056 KO	92	170
DSH1-056 SO	127	205
DSH1-056 MO	162	240

Dimension drawing DSH1-056….U-..-..-.B.-.PP-.-..-O-000

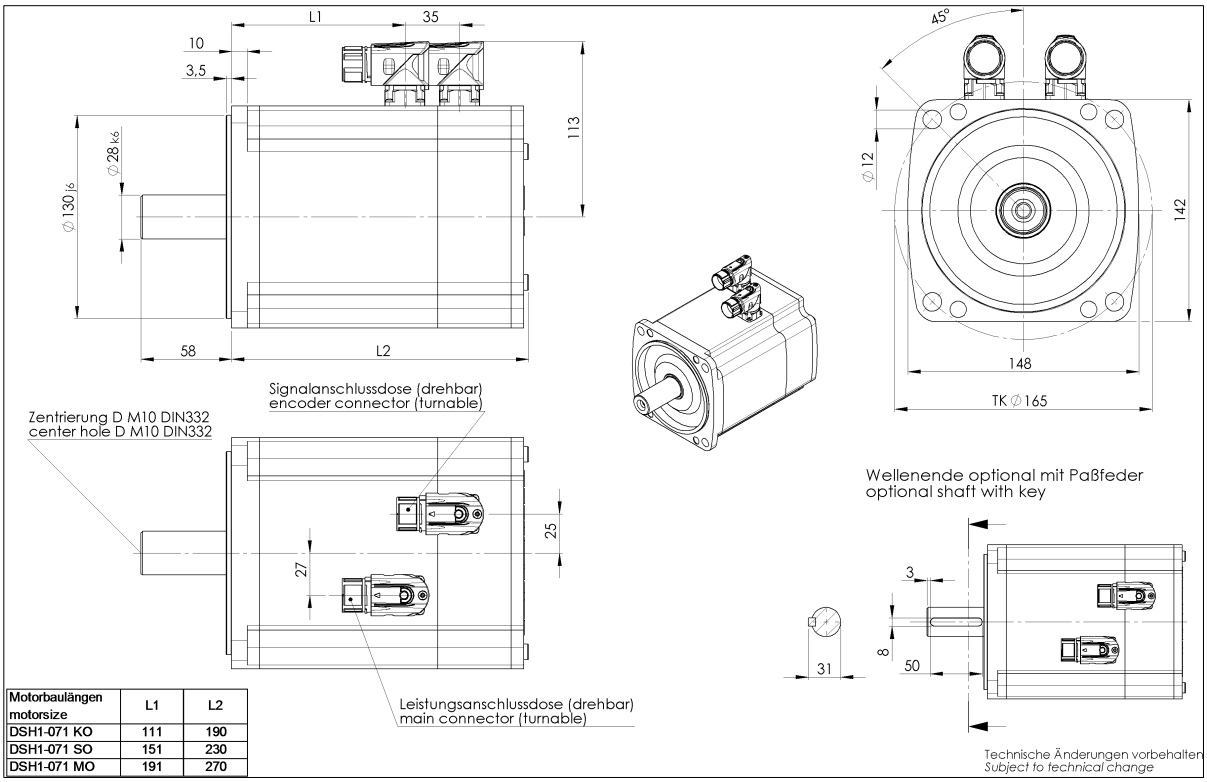
Version IM B5



Motorbaulängen motorsize	L1	L2
DSH1-056 KO	92	215
DSH1-056 SO	127	250
DSH1-056 MO	162	285

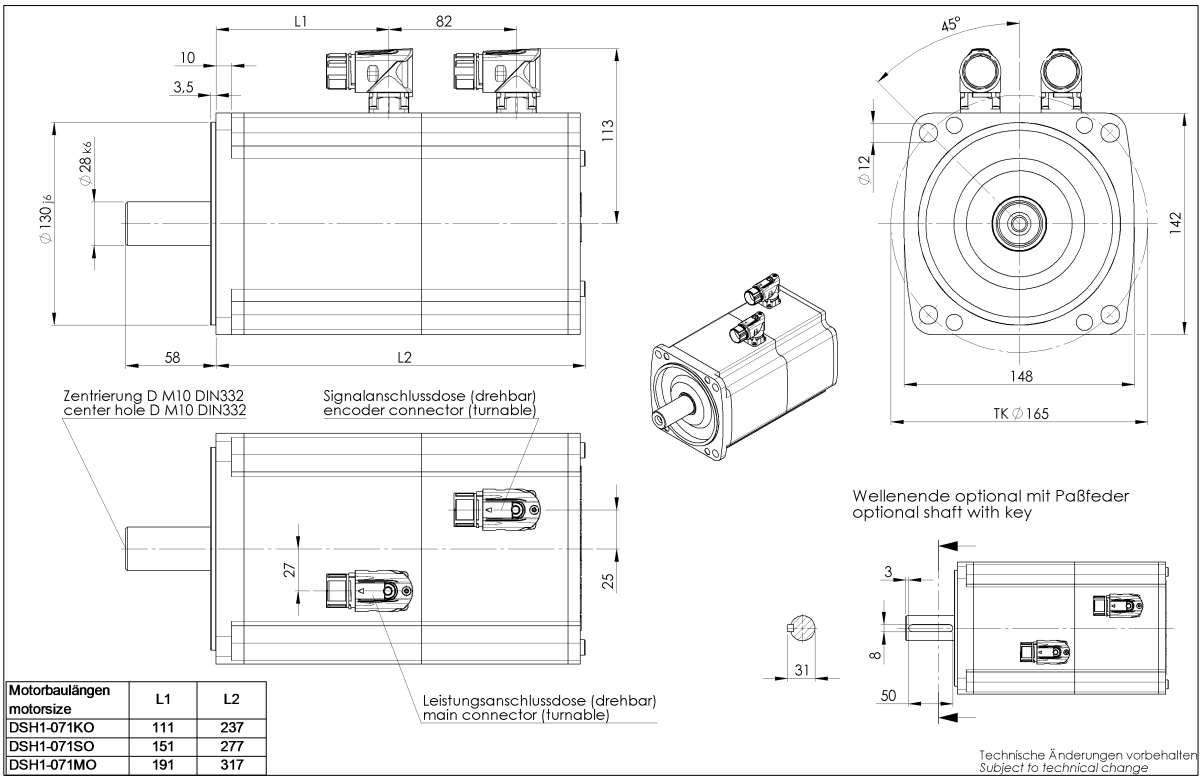
4.3. Dimension drawings DSH1-071

Dimension drawing DSH1-071….U-..-..-.O.-.PP-.-..-O-000
Version IM B5



Motorbaulängen motorsize	L1	L2
DSH1-071 KO	111	190
DSH1-071 SO	151	230
DSH1-071 MO	191	270

Dimension drawing DSH1-071….U-..-..-.B.-.PP-.-..-O-000
Version IM B5

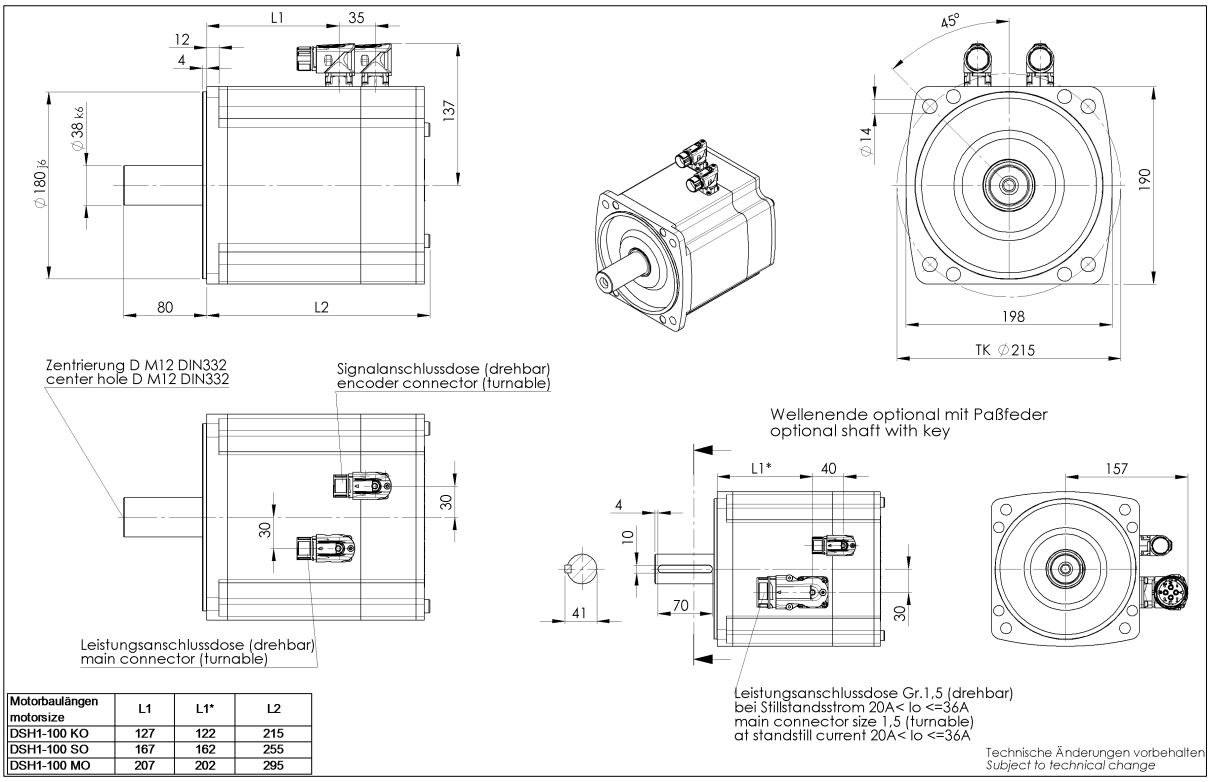


Motorbaulängen motorsize	L1	L2
DSH1-071KO	111	237
DSH1-071SO	151	277
DSH1-071MO	191	317

4.4. Dimension drawings DSH1-100

Dimension drawing DSH1-100….U-..-..-.O.-.PP-.-..-O-000

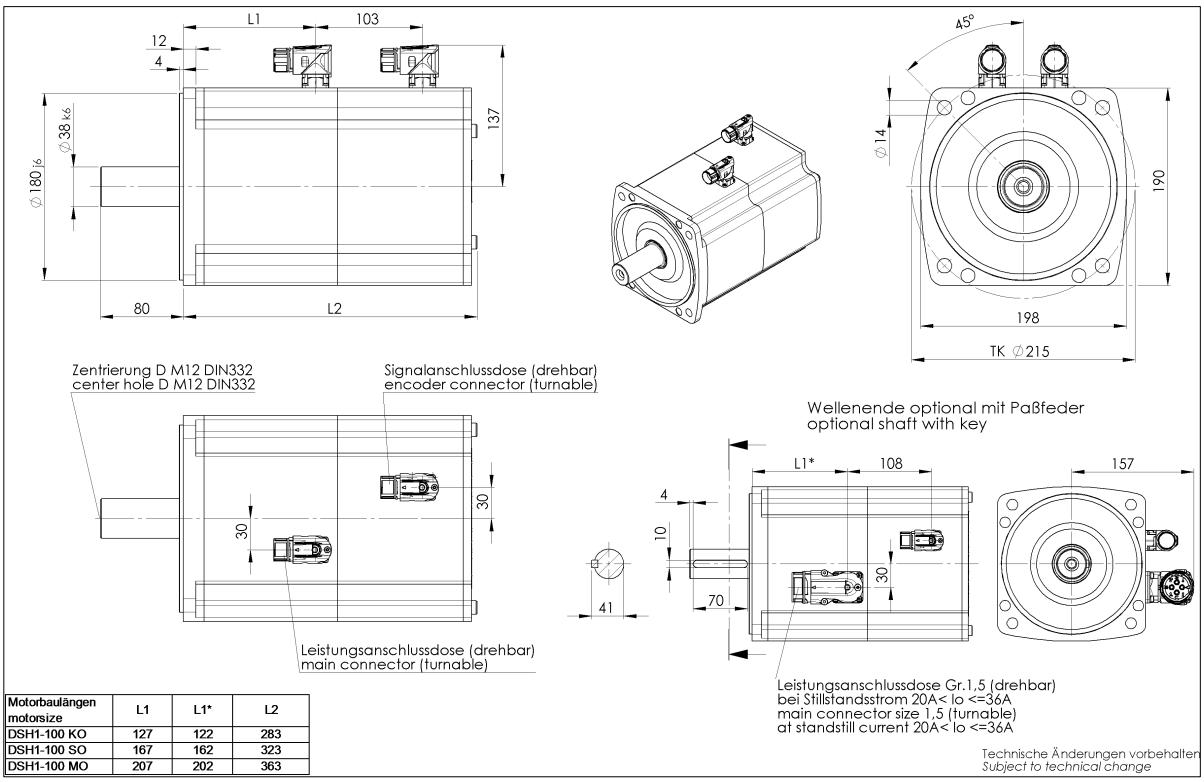
Version IM B5



Motorbaulängen motorsize	L1	L1*	L2
DSH1-100 KO	127	122	215
DSH1-100 SO	167	162	255
DSH1-100 MO	207	202	295

Dimension drawing DSH1-100….U-..-..-.B.-.PP-.-..-O-000

Version IM B5



Motorbaulängen motorsize	L1	L1*	L2
DSH1-100 KO	127	122	283
DSH1-100 SO	167	162	323
DSH1-100 MO	207	202	363

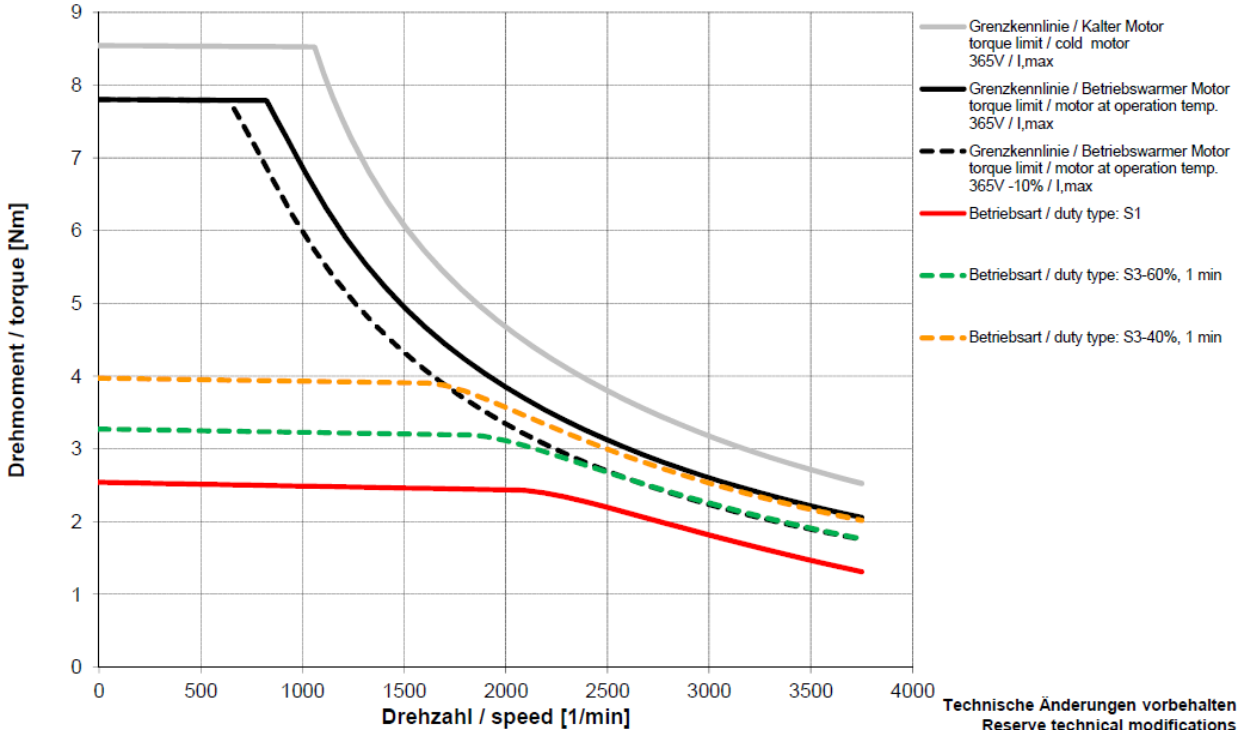
5. Motor characteristic curves

Definition

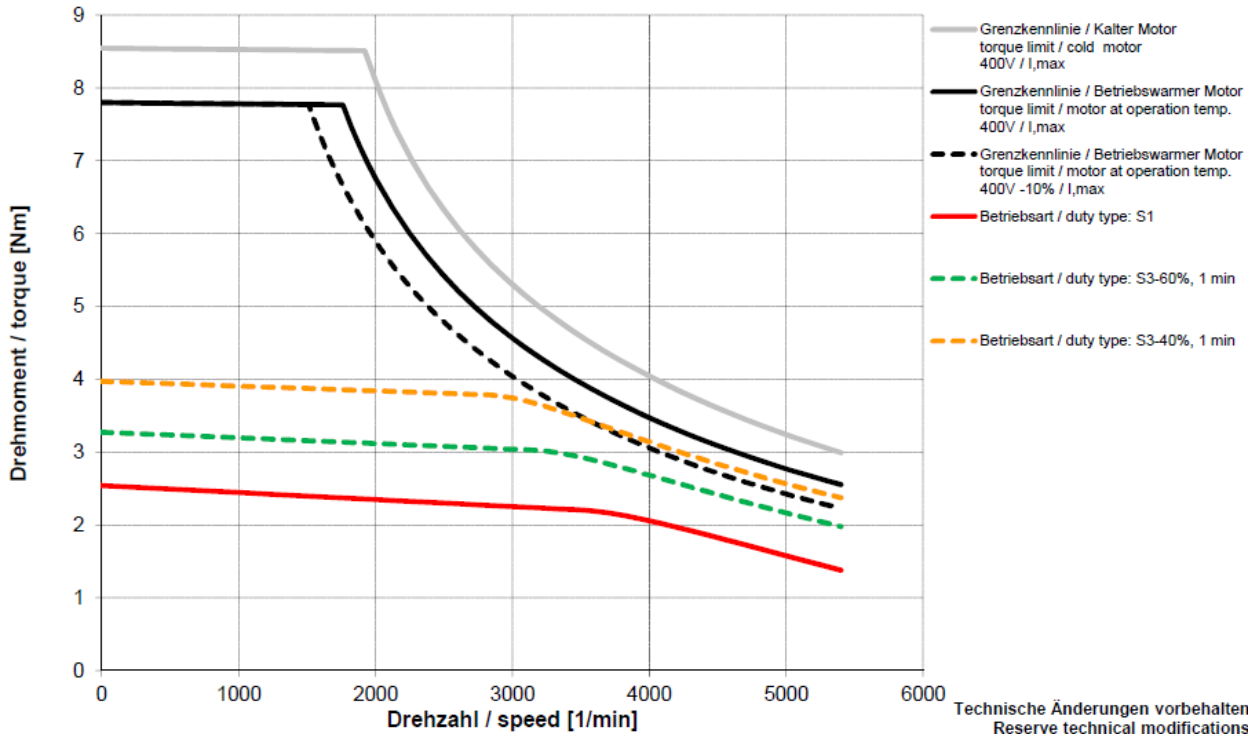
Cold motor	Environmental temperature (0°C up to 40°C)
Motor at operating temperature	Continuous operation (S1) with rated data of the motor or cyclical operation with accordant effective power --> Environmental temperature + Delta-heating (105K)

5.1. Characteristic curves DSH1-045

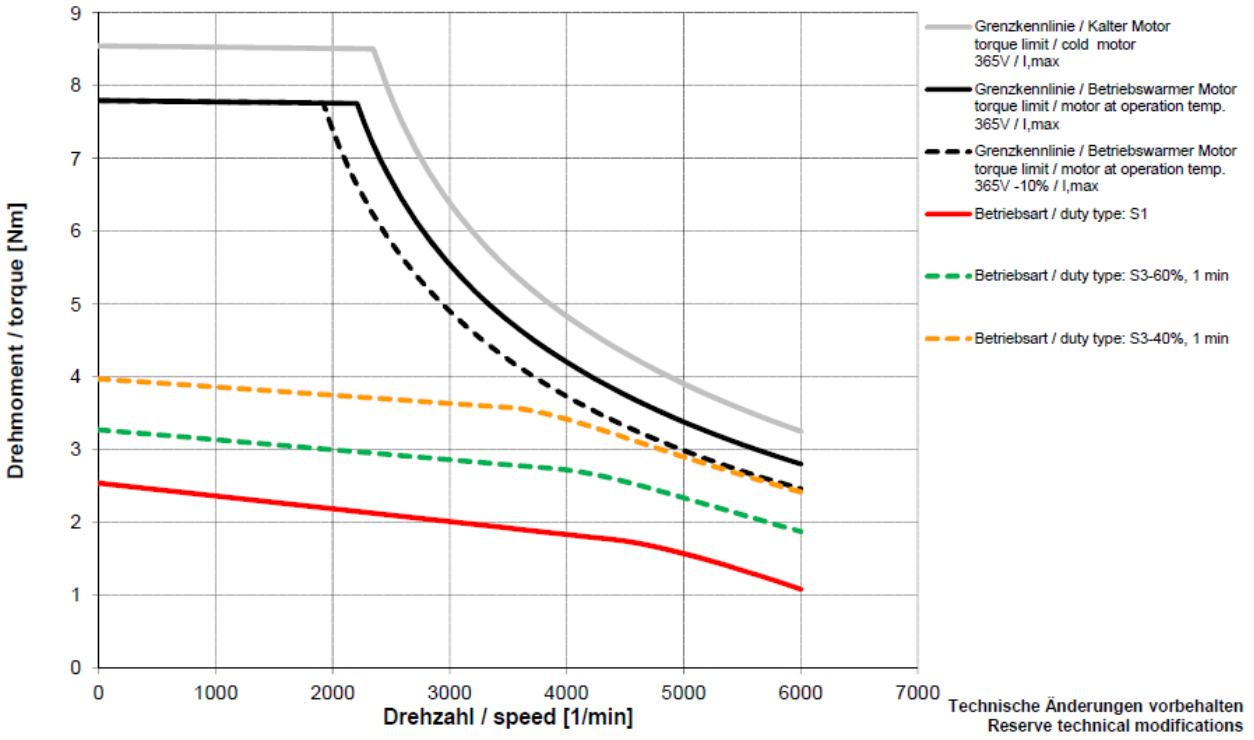
DSH1-045KO64U-20-54



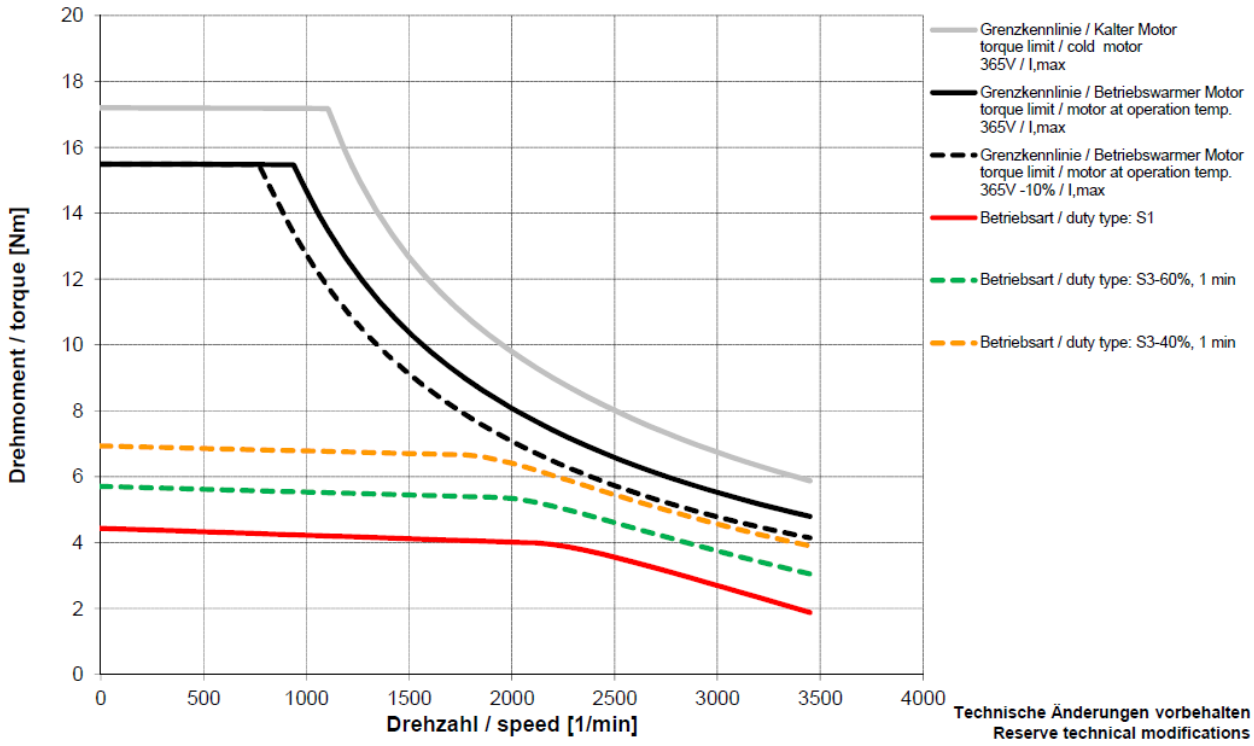
DSH1-045KO64U-30-54



DSH1-045KO64U-40-54



DSH1-045SO64U-20-54



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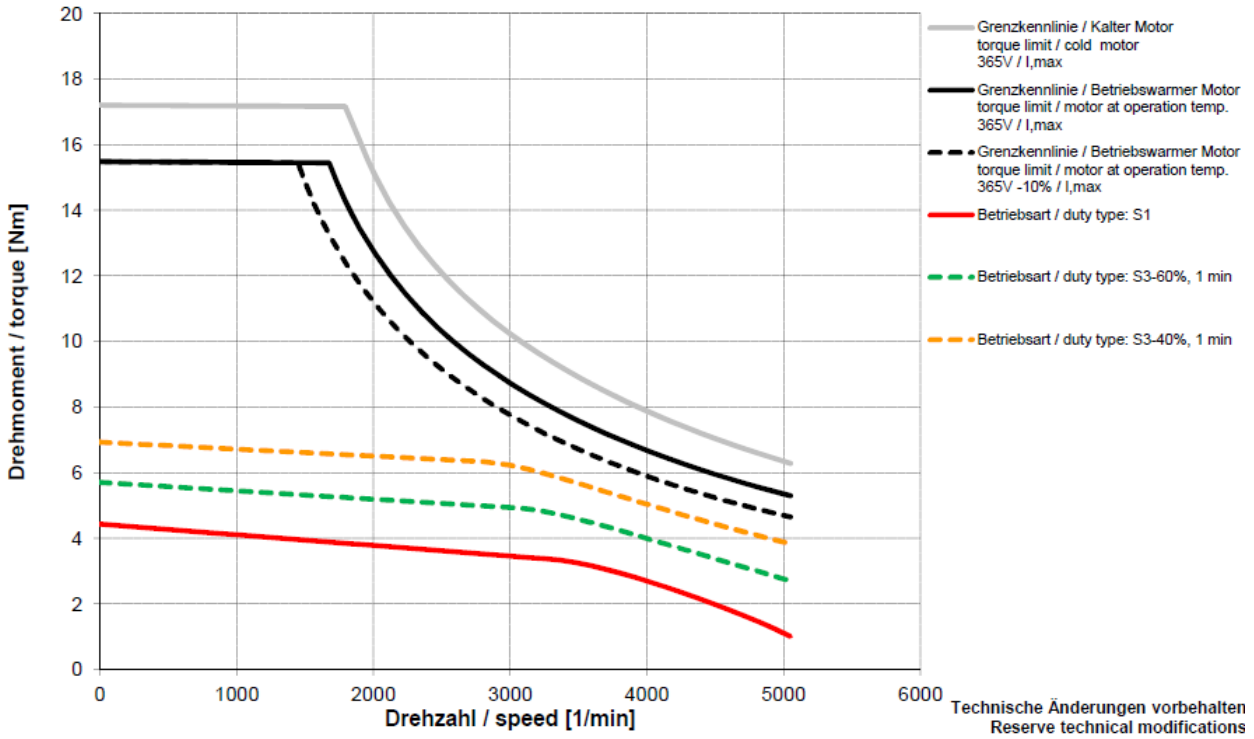

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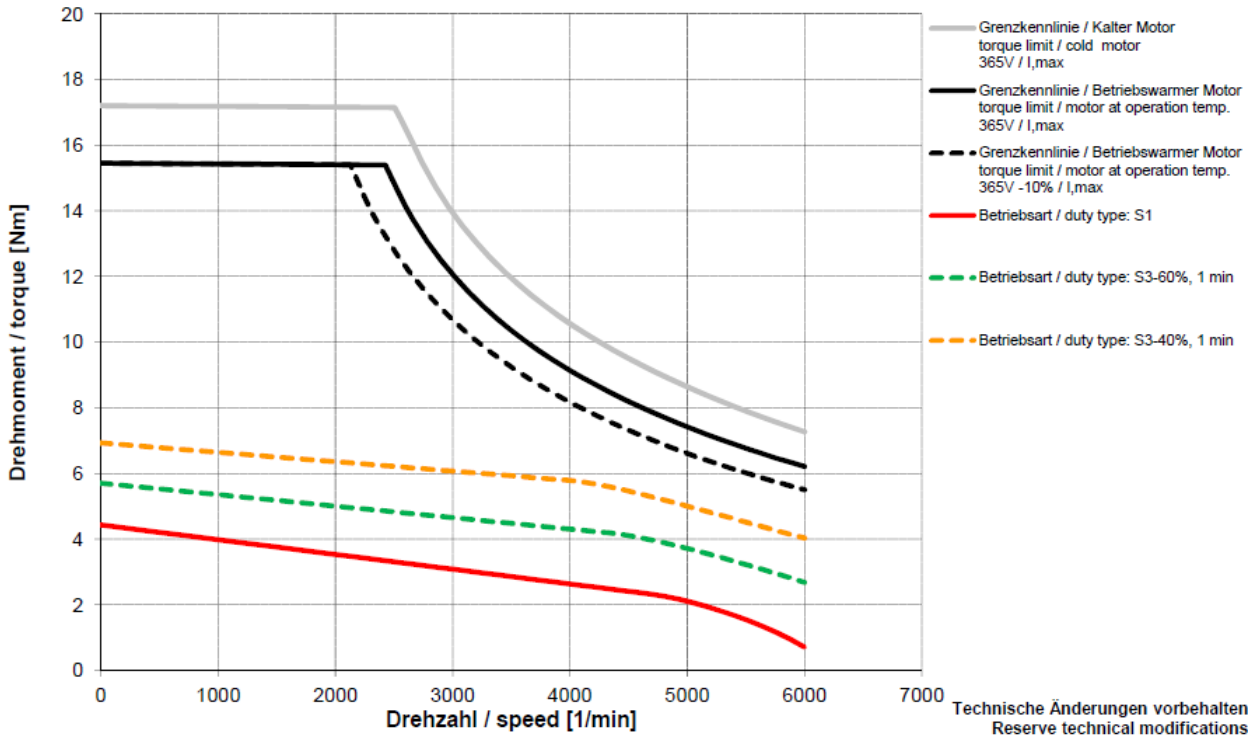
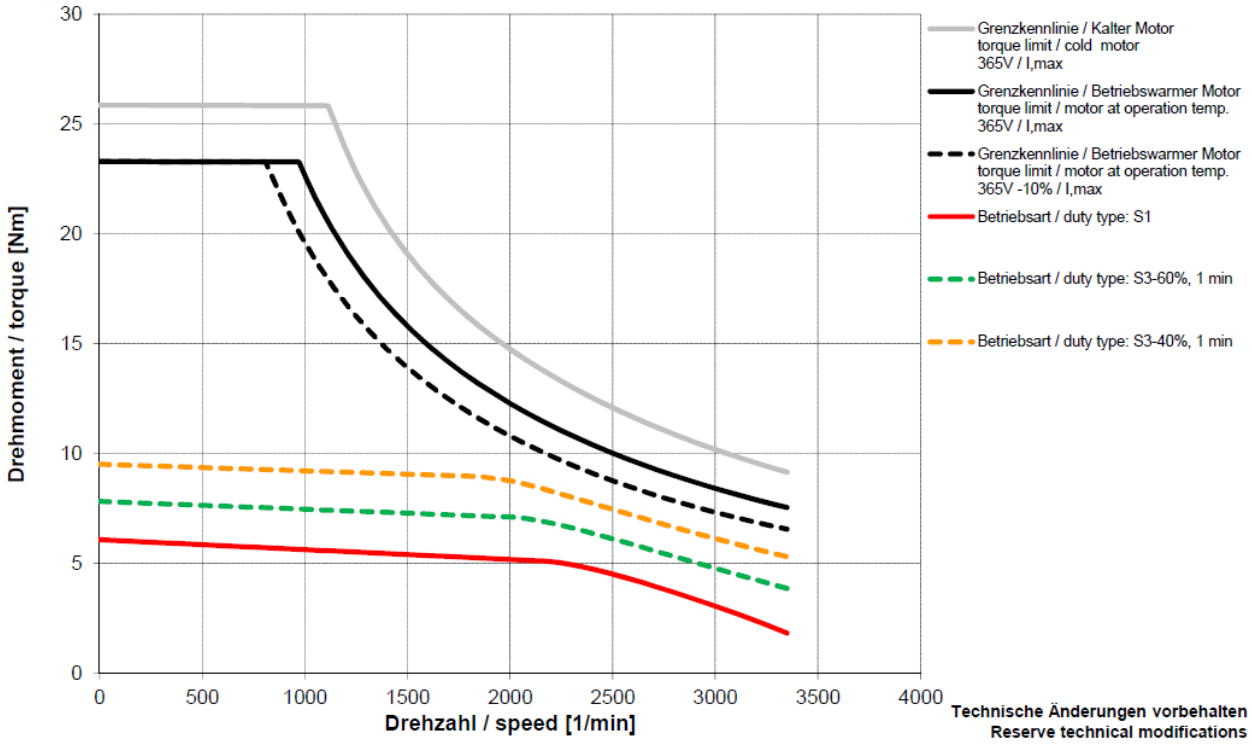
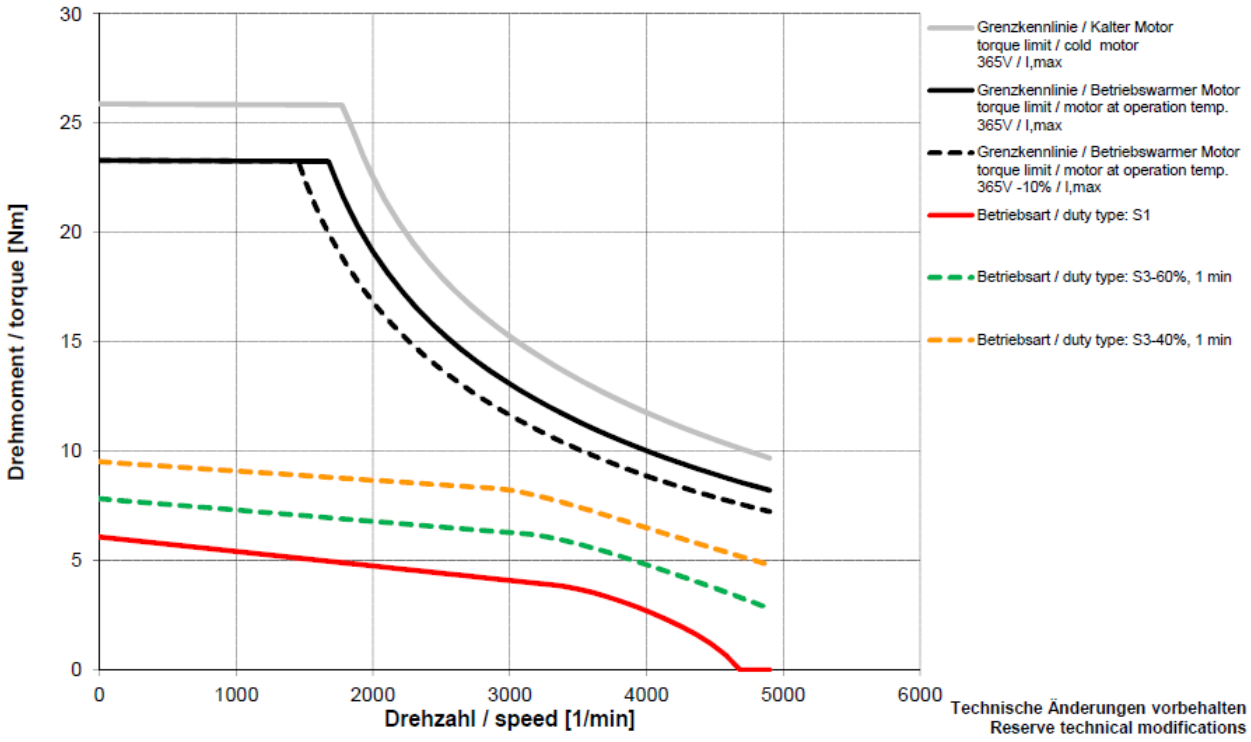


DSH1-045MO64U-20-54



DSH1-045MO64U-30-54



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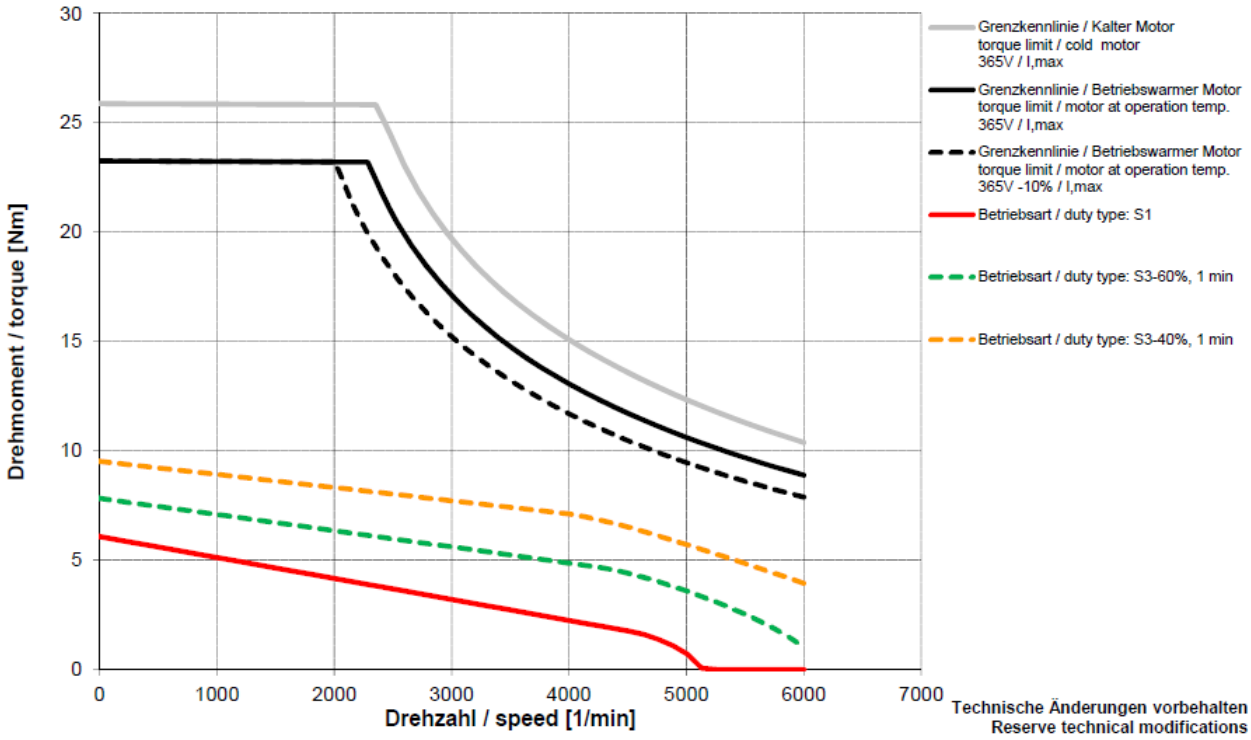
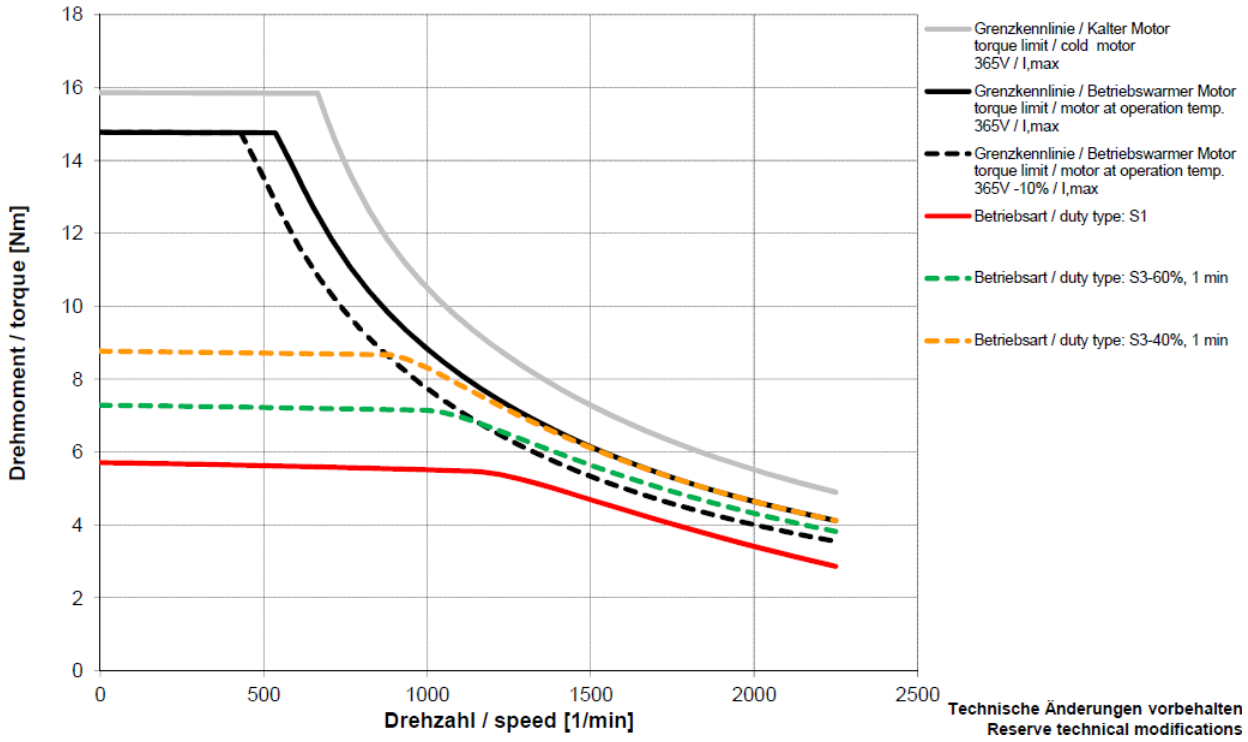


5.2. Kennlinien DSH1-056

DSH1-056KO64U-10-54



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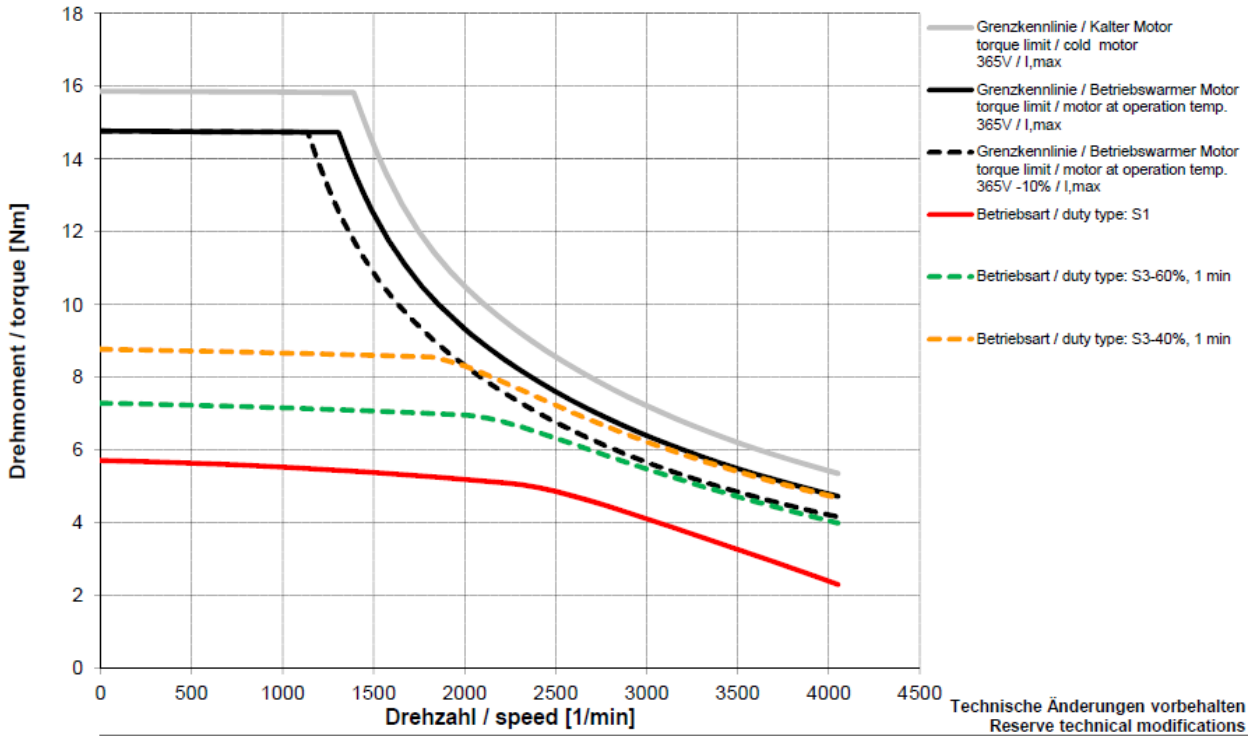

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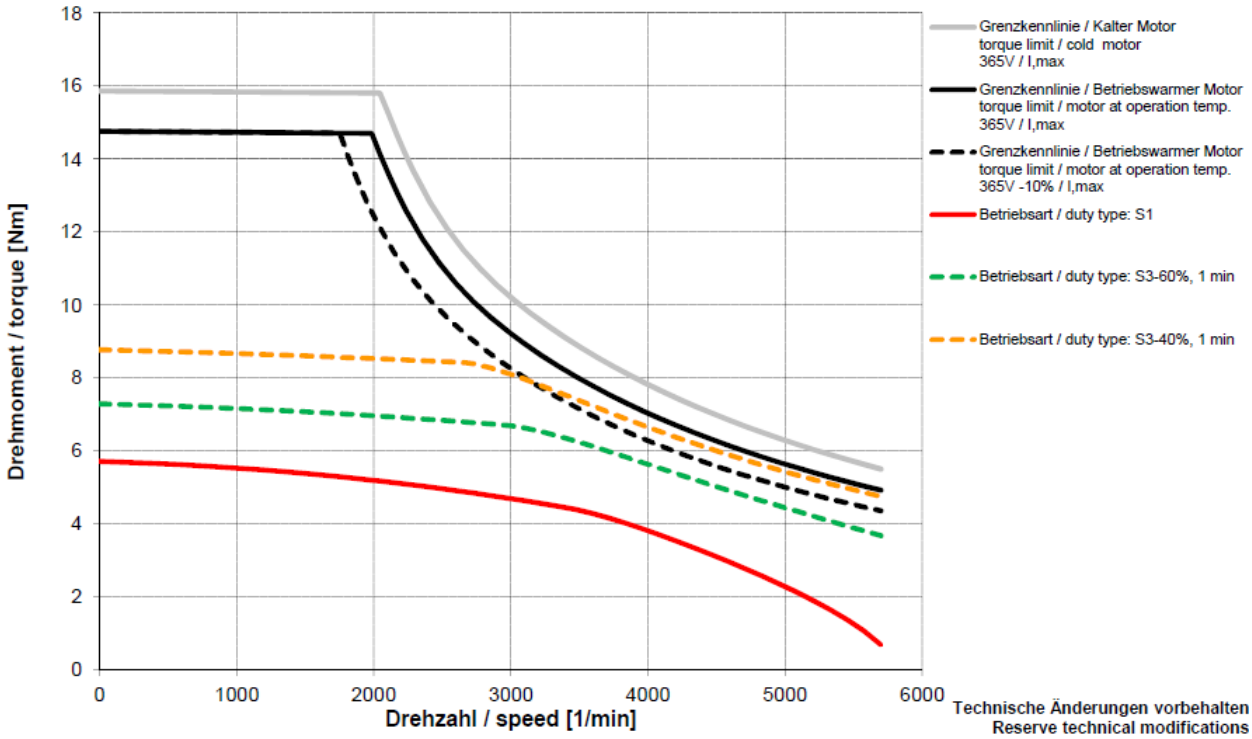

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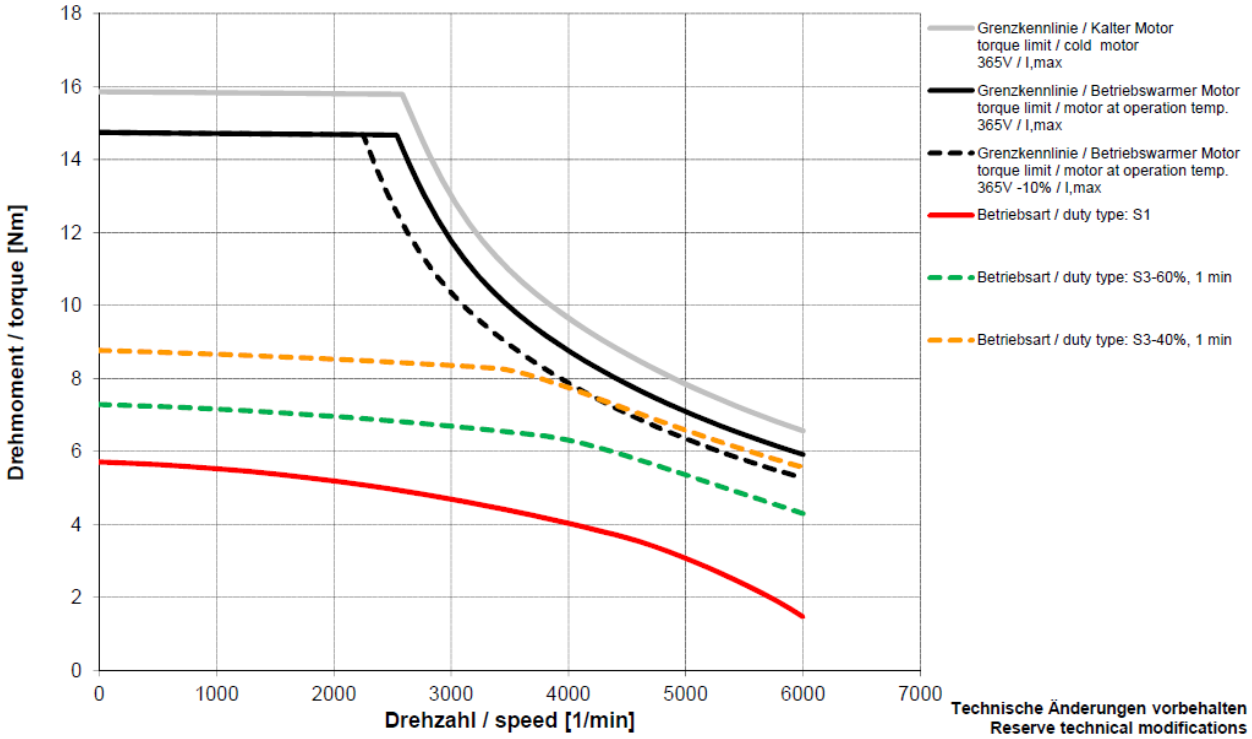

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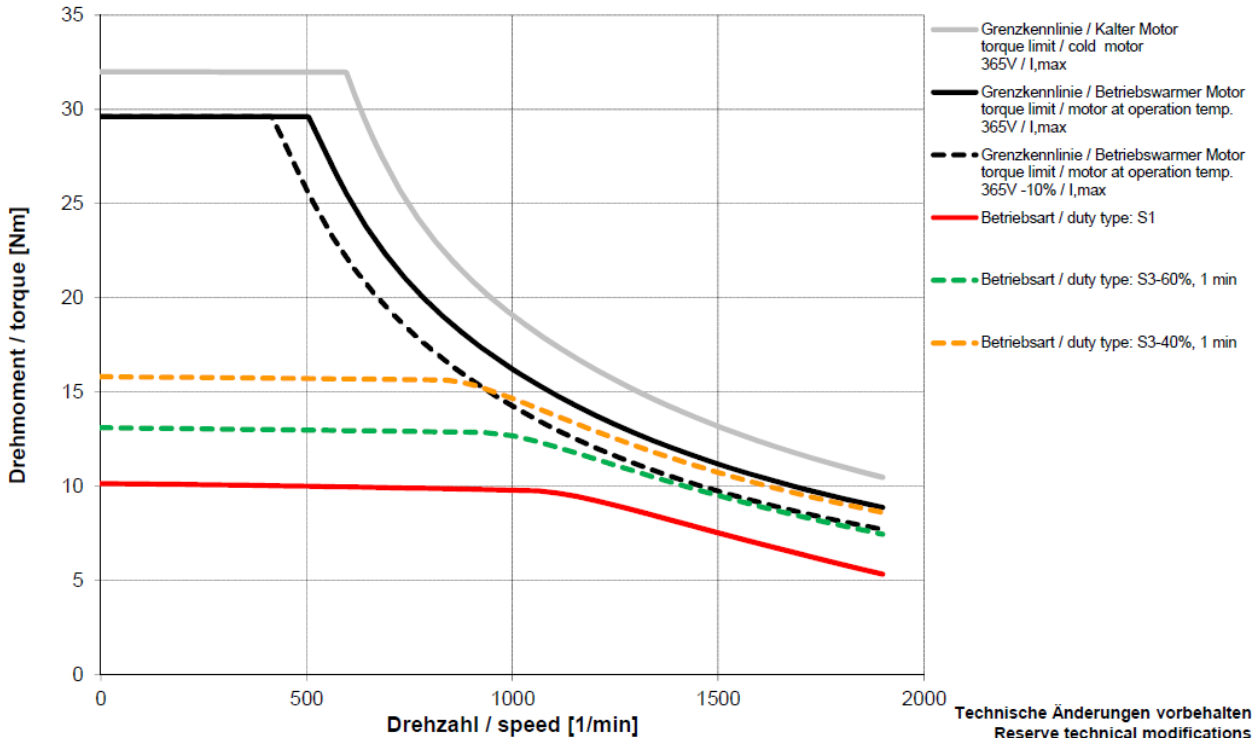

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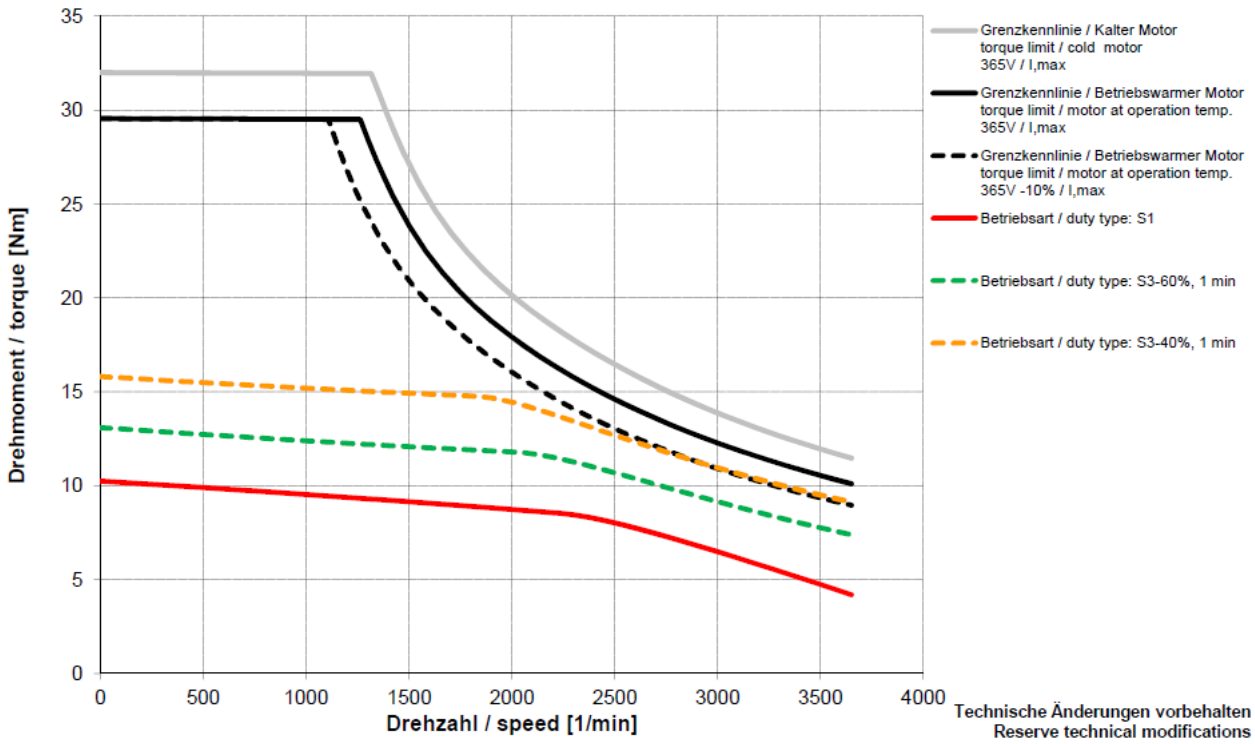

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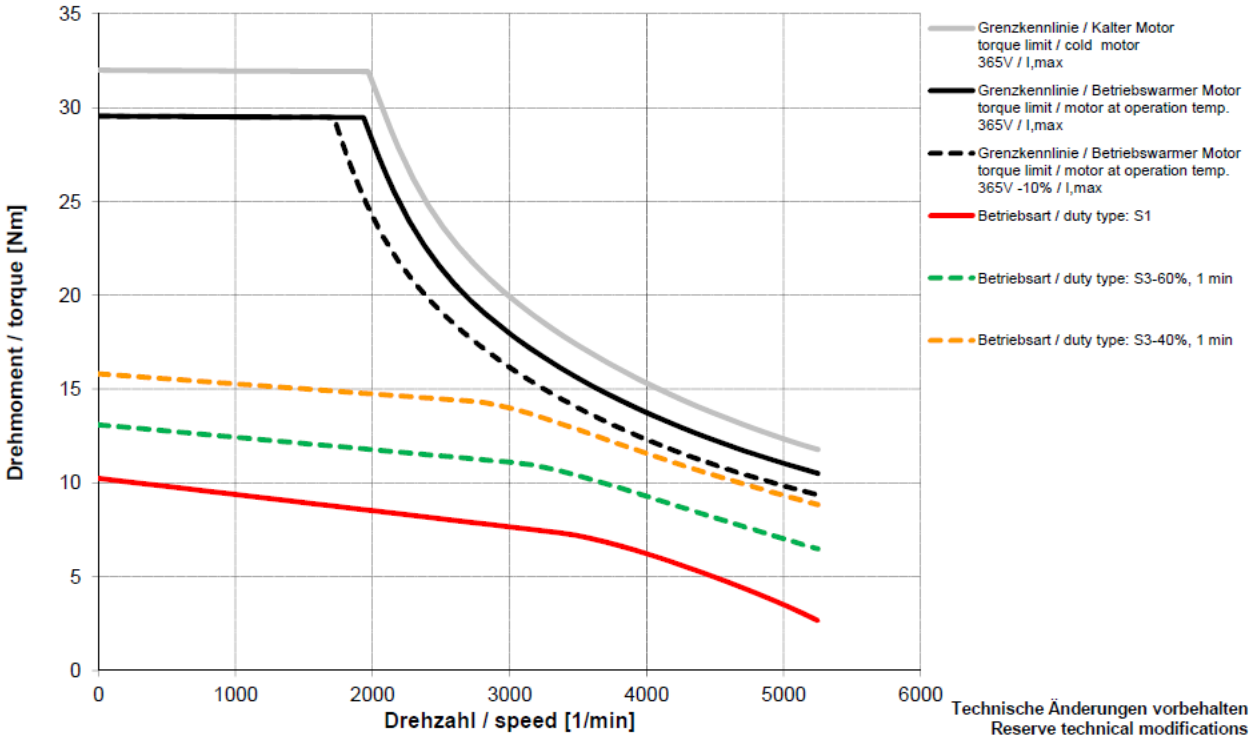

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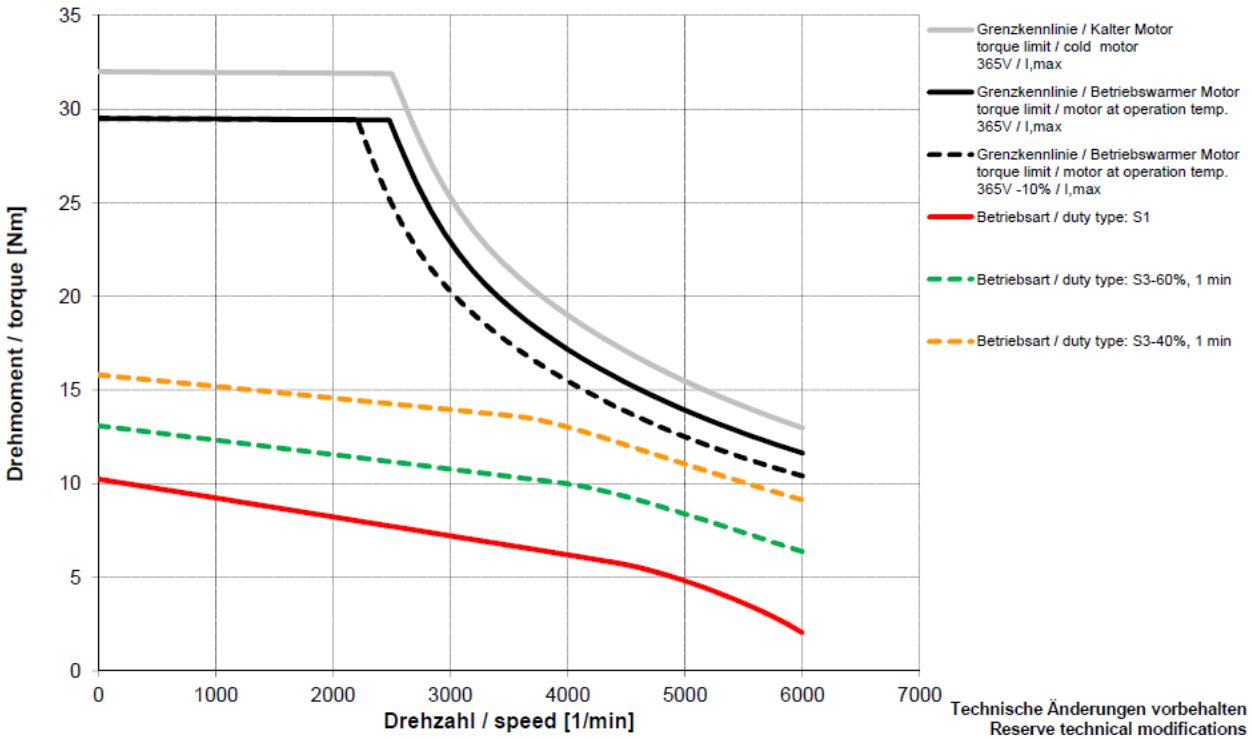

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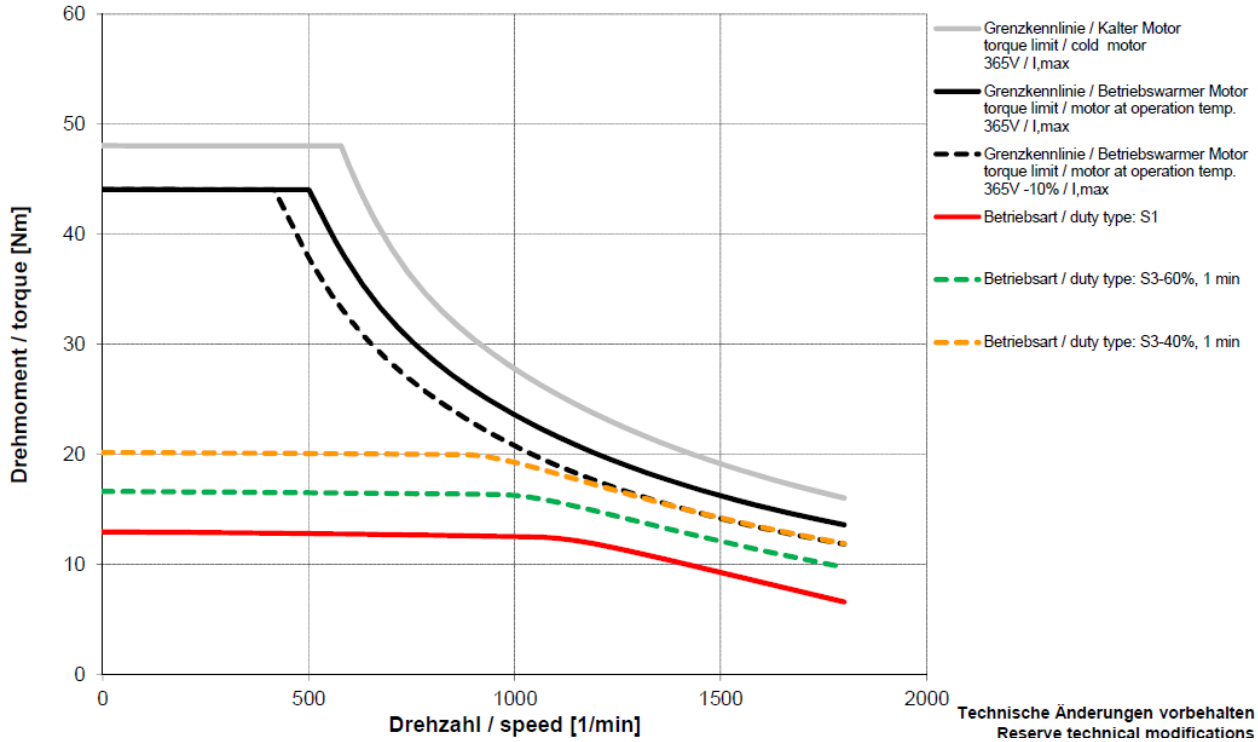

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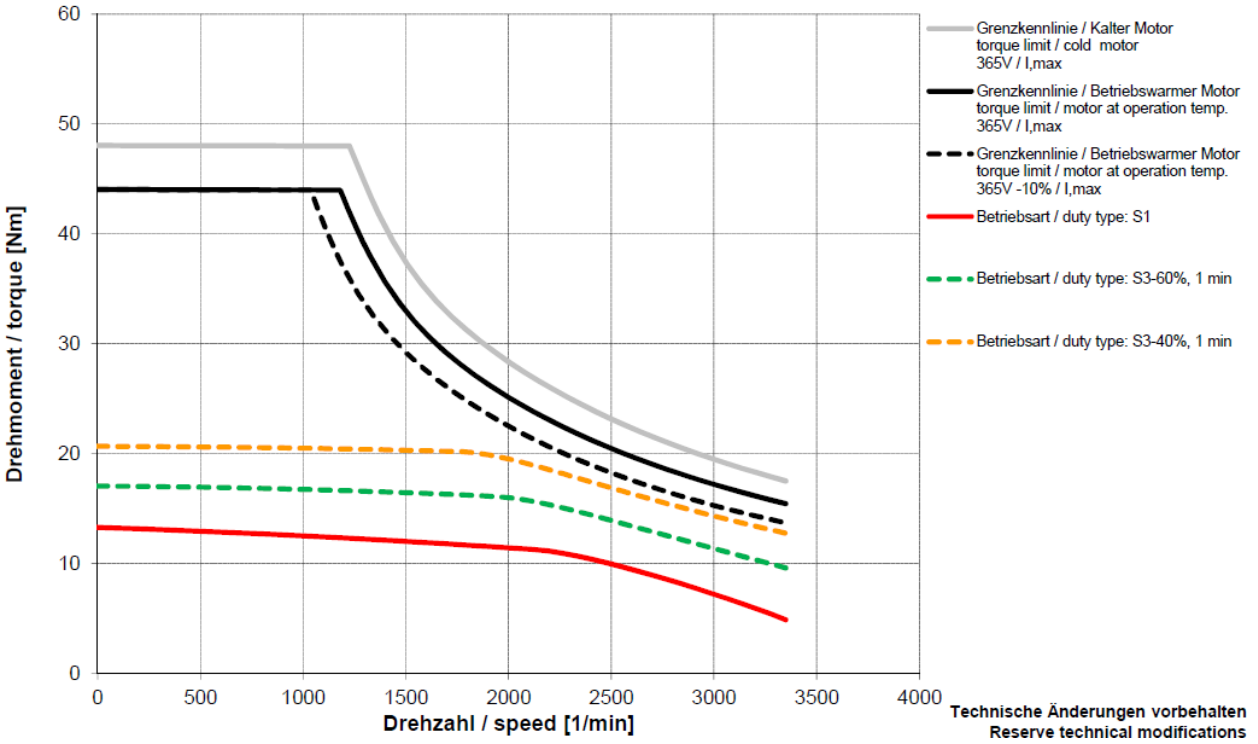

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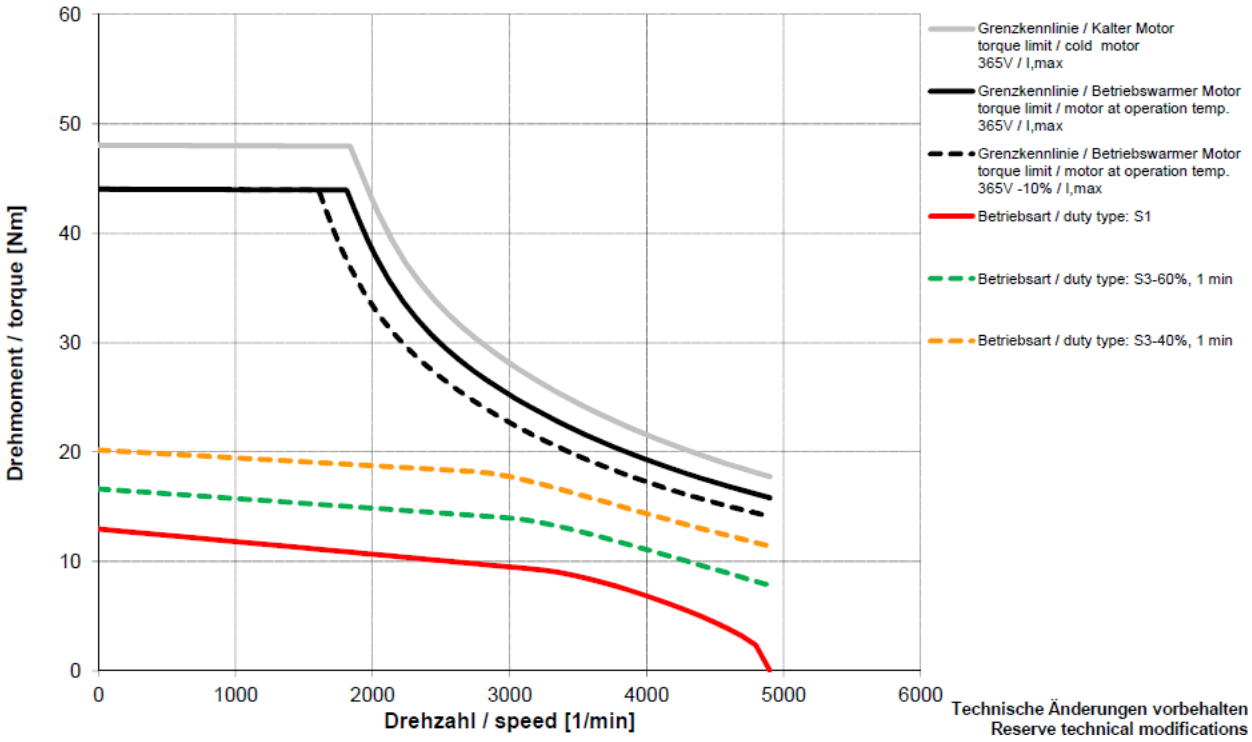
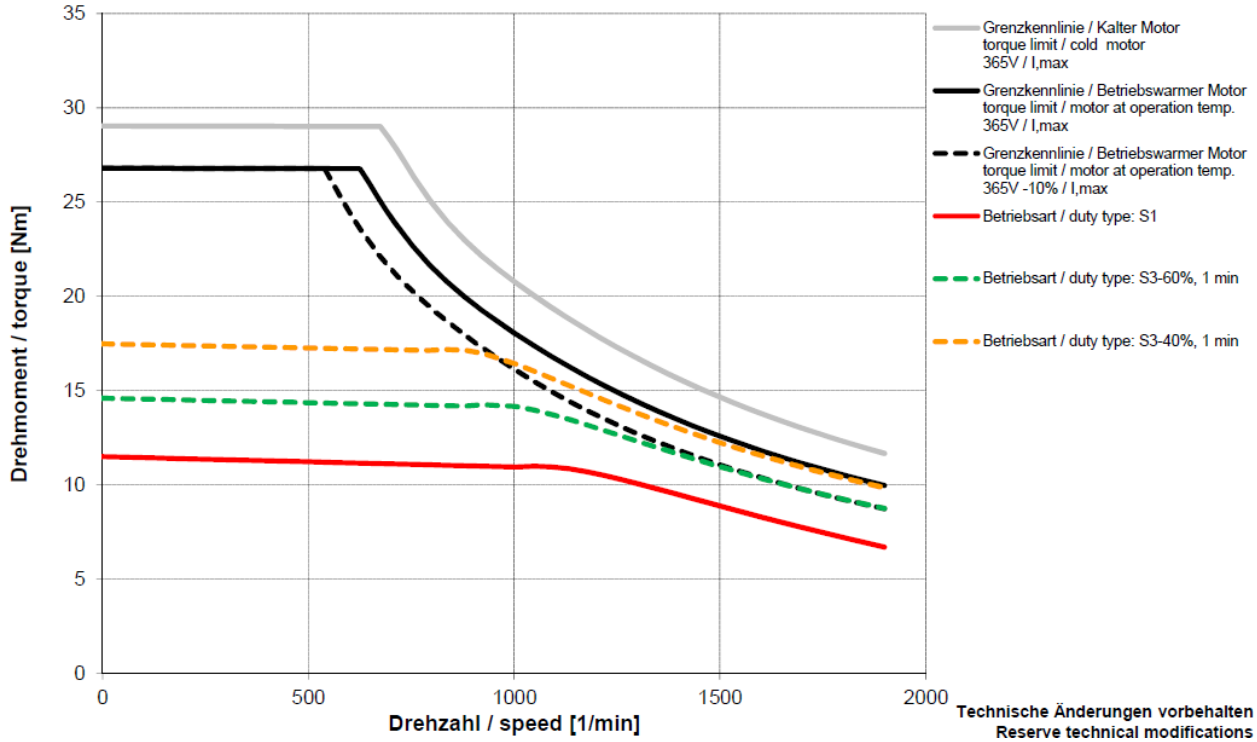


5.3. Characteristic curves DSH1-071

DSH1-071KO64U-10-54



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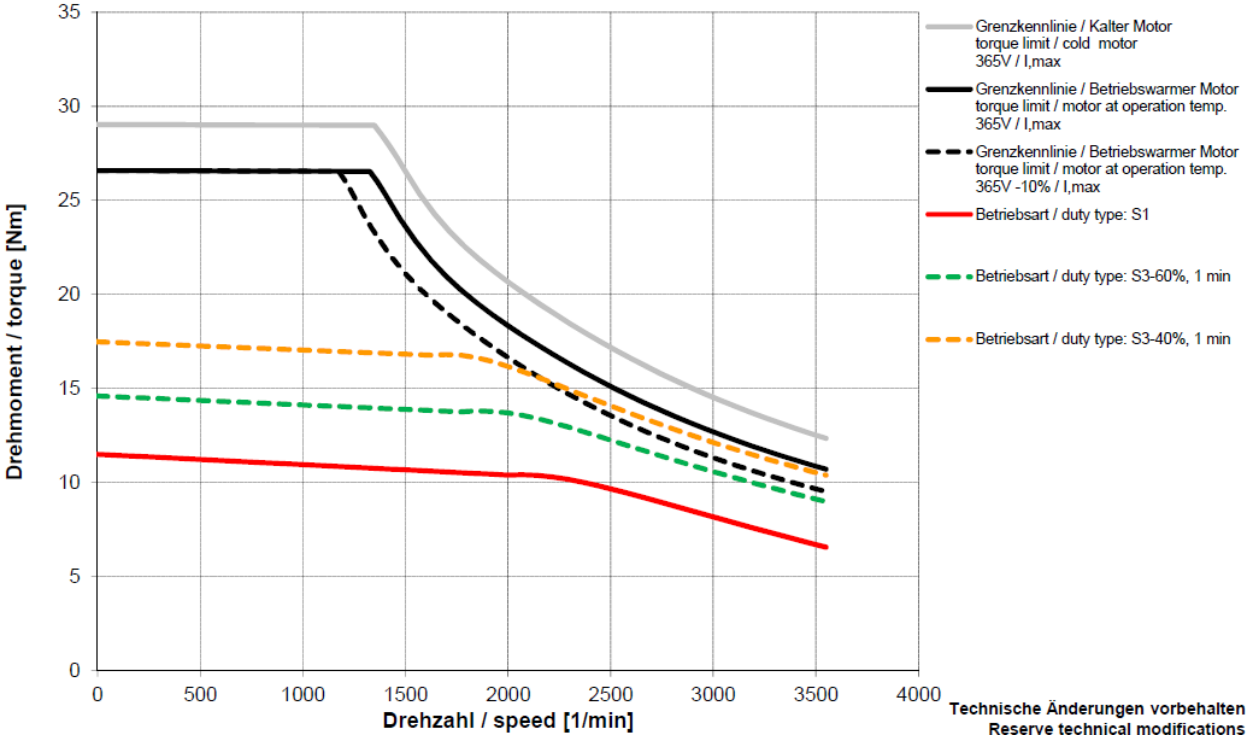
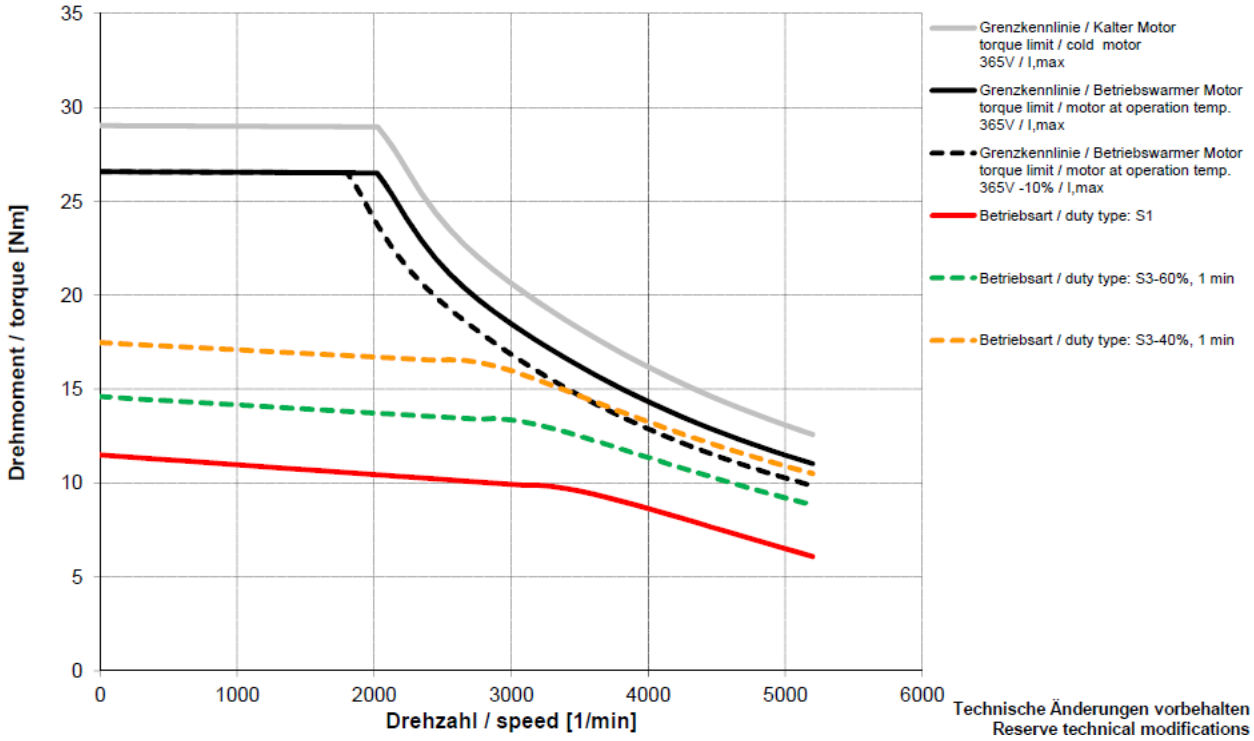
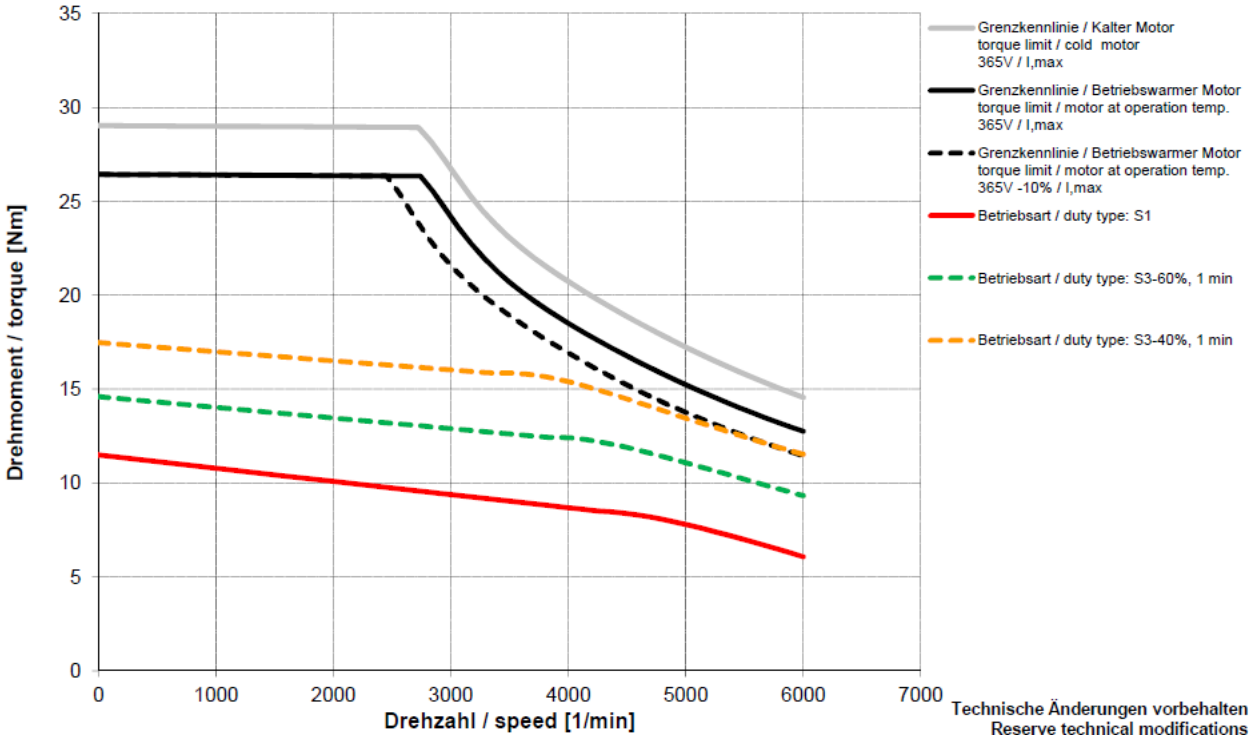


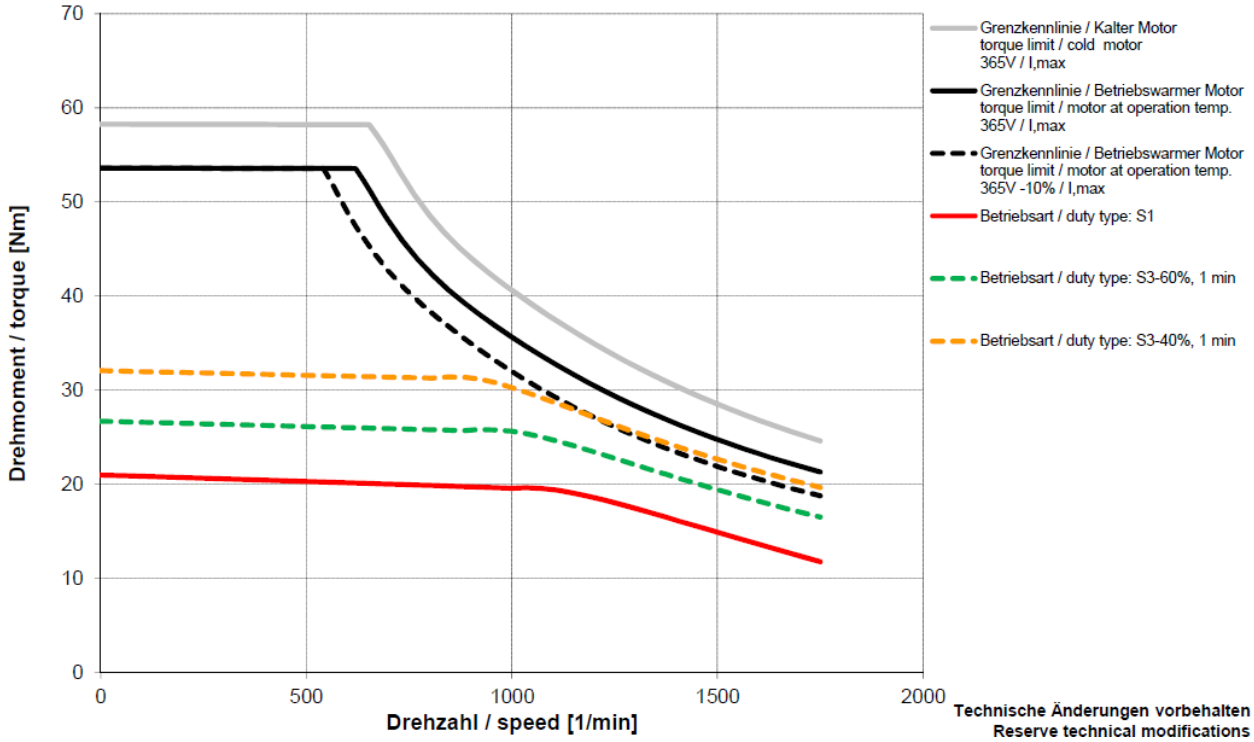
DSH1-071KO64U-30-54



DSH1-071KO64U-40-54



DSH1-071SO64U-10-54



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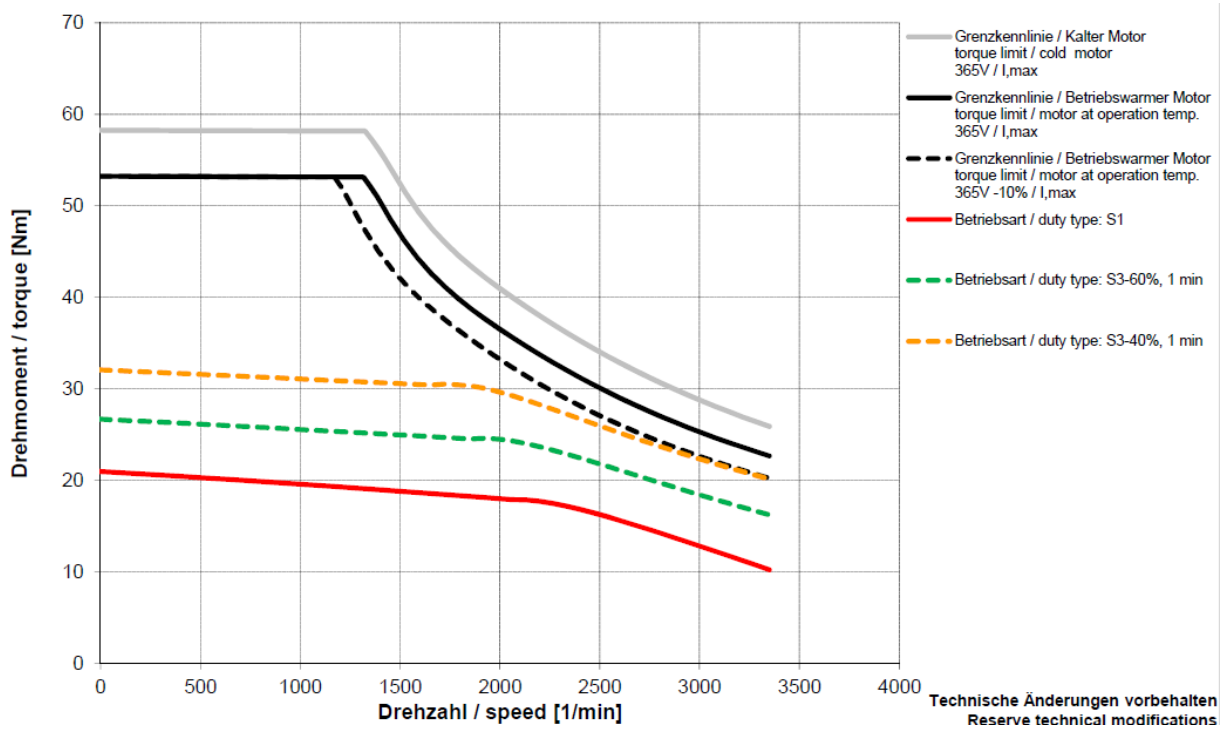
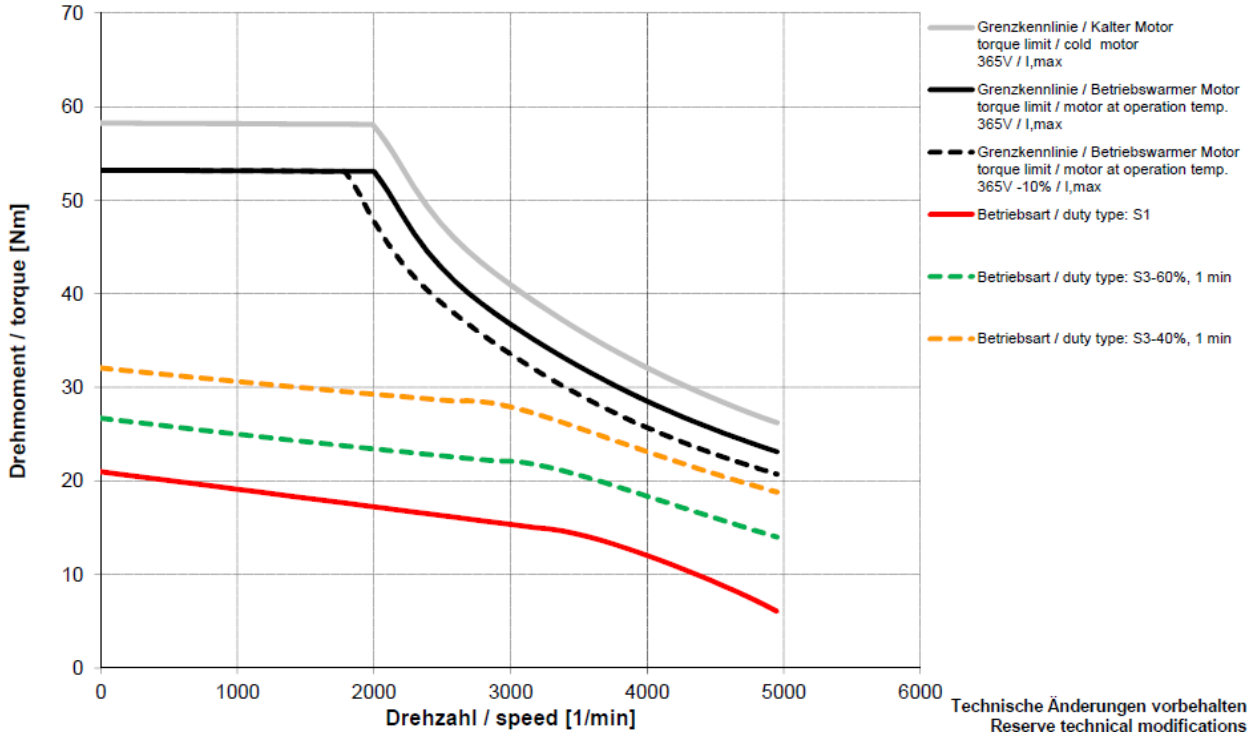


DSH1-071SO64U-30-54



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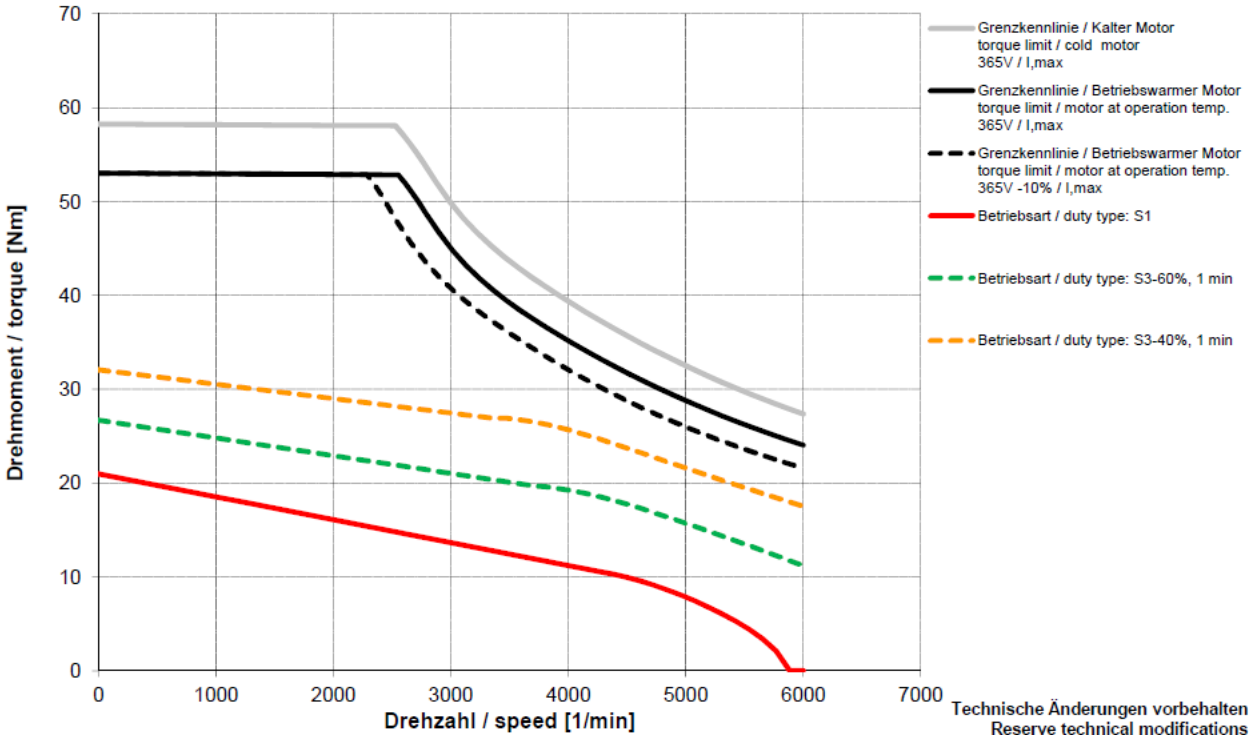
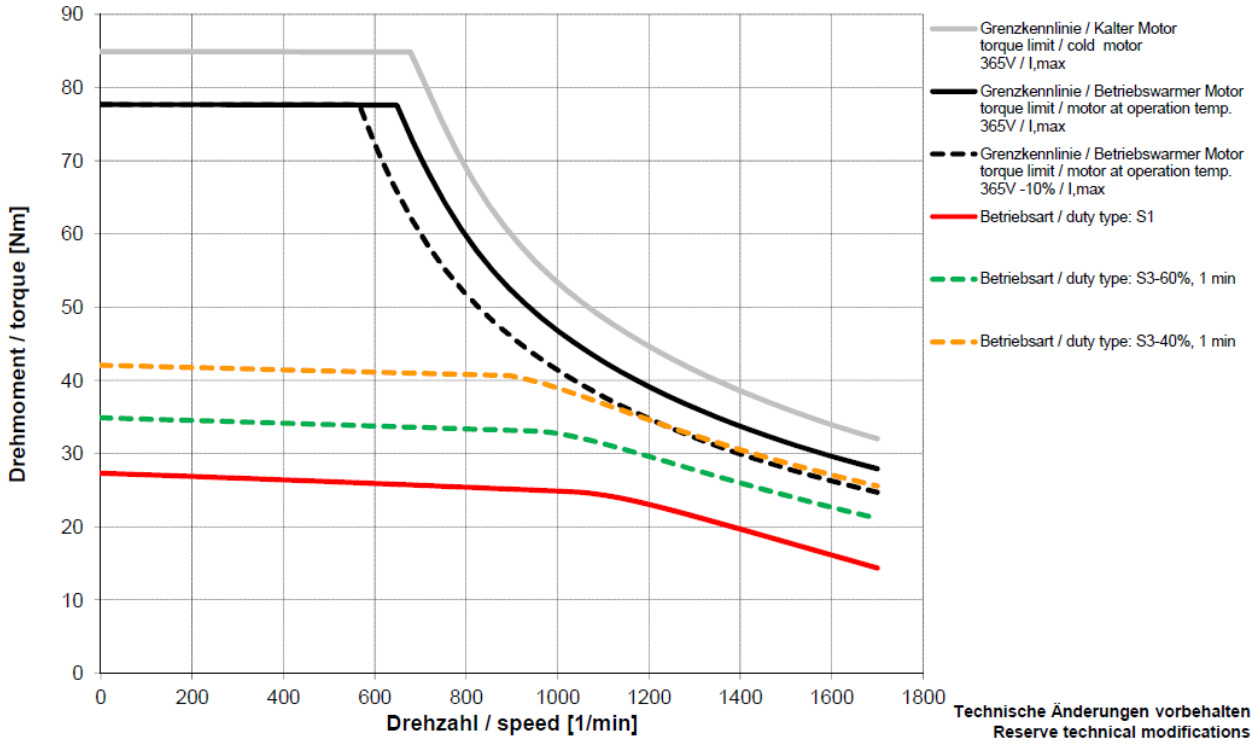
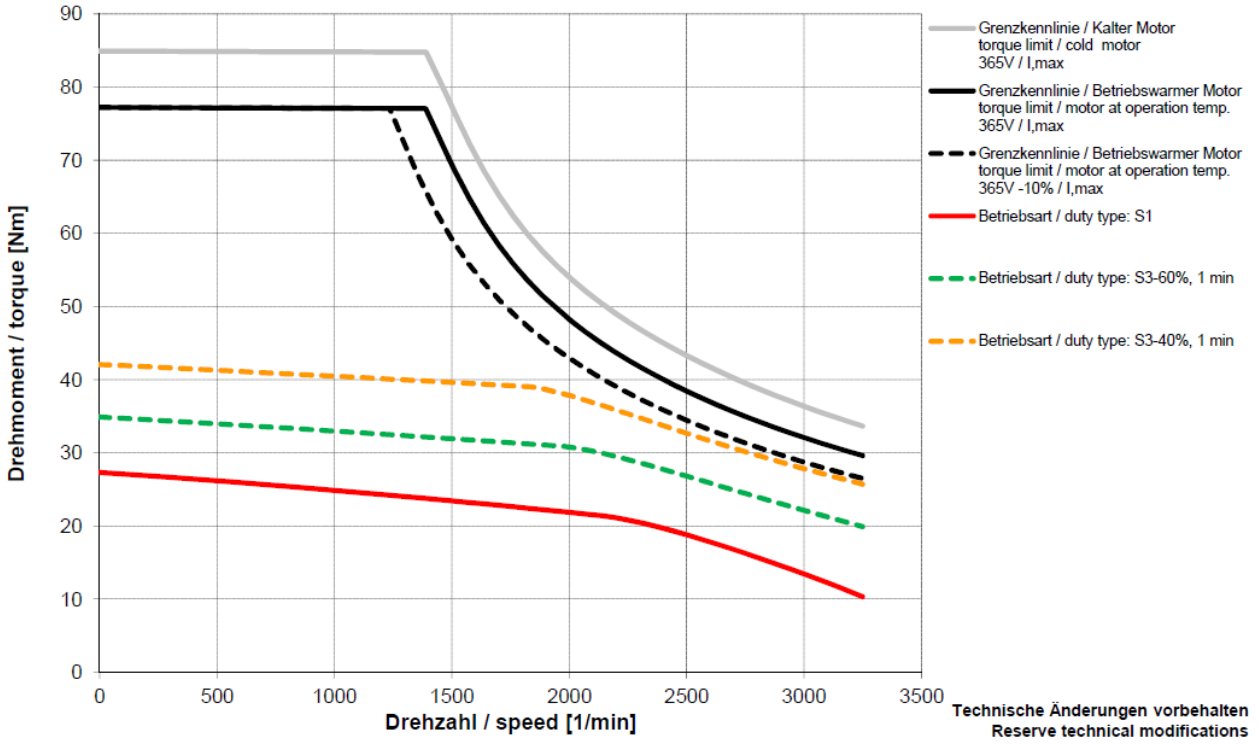


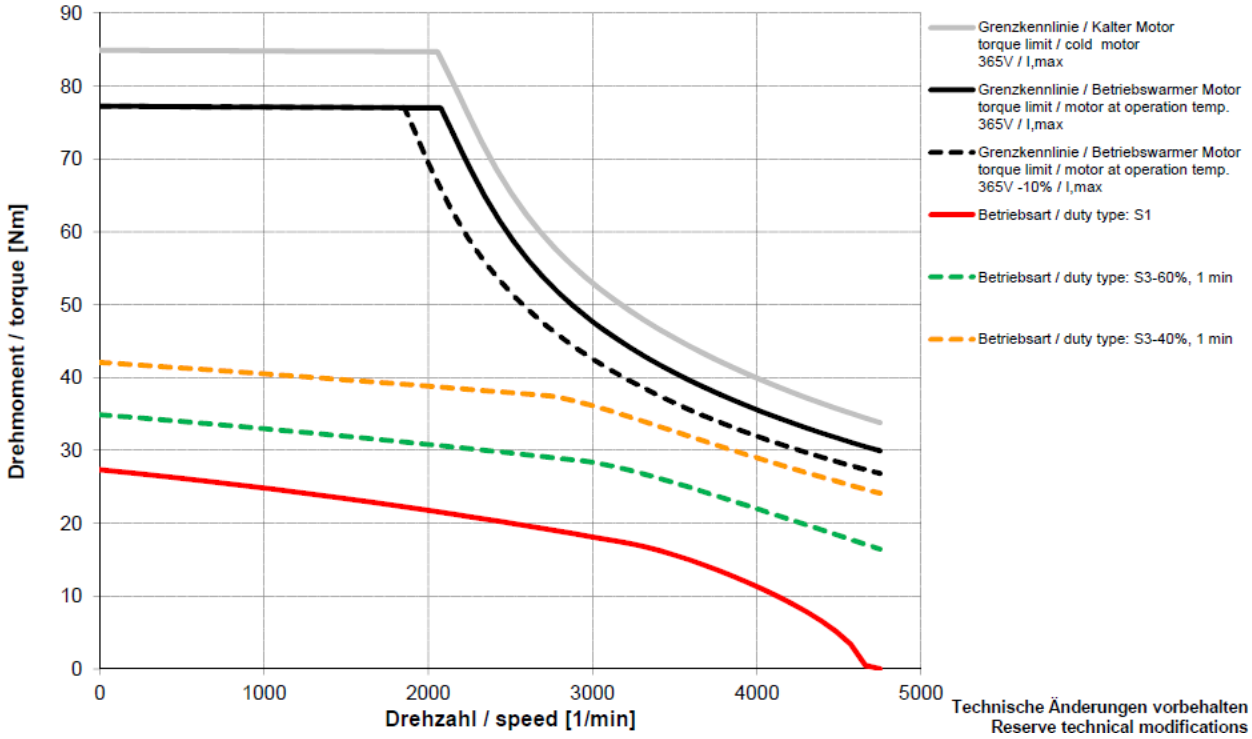
DSH1-071MO64U-10-54



DSH1-071MO64U-20-54

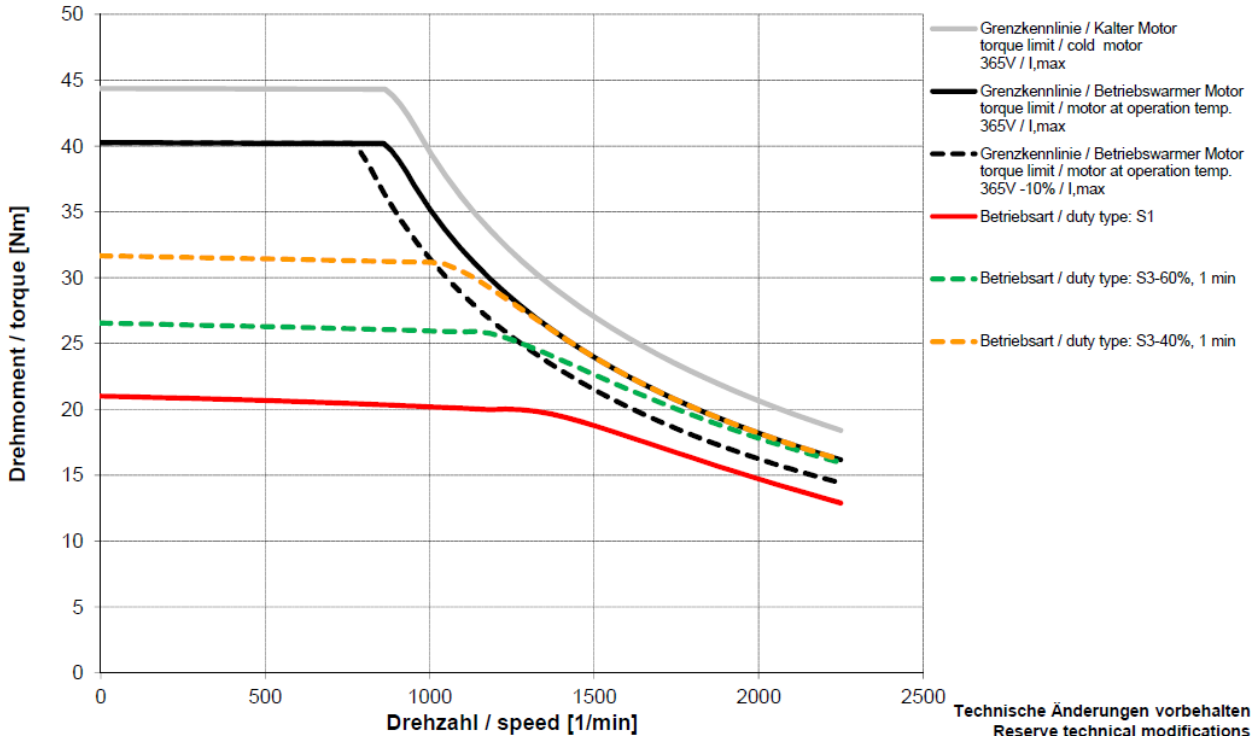


DSH1-071MO64U-30-54



5.4. Characteristic curves DSH1-100

DSH1-100KO64U-10-54



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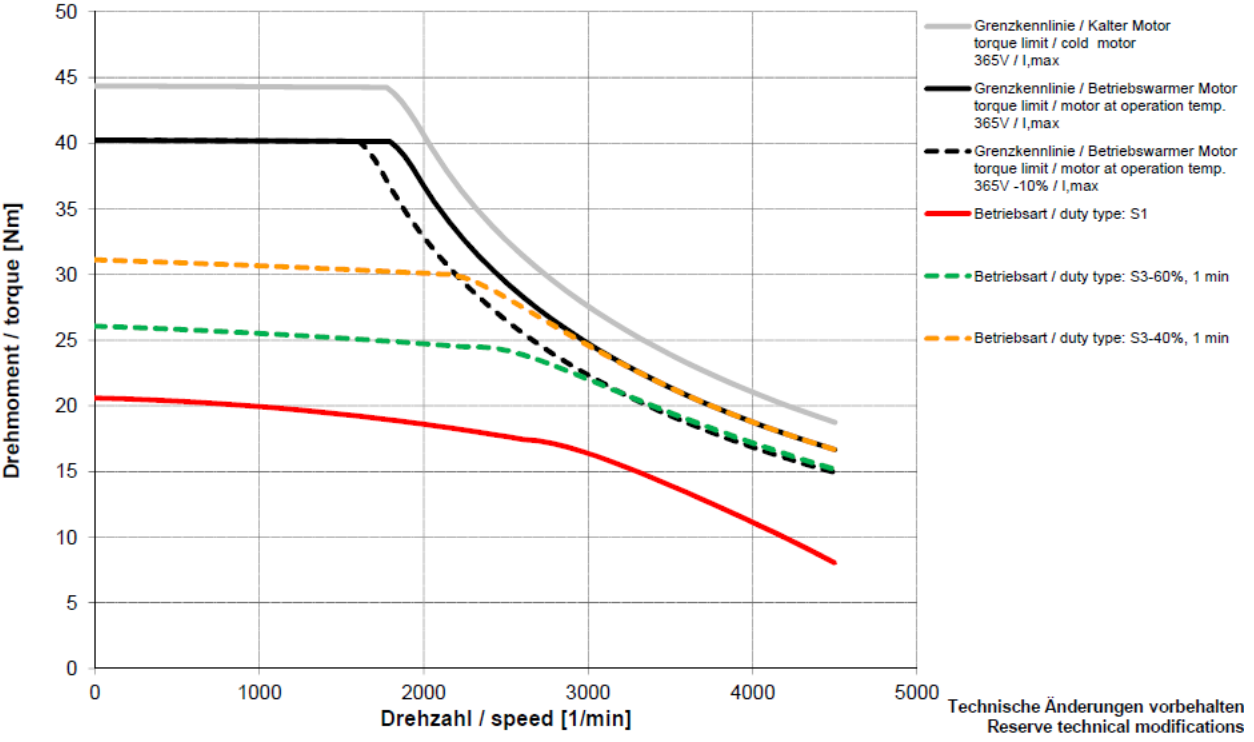

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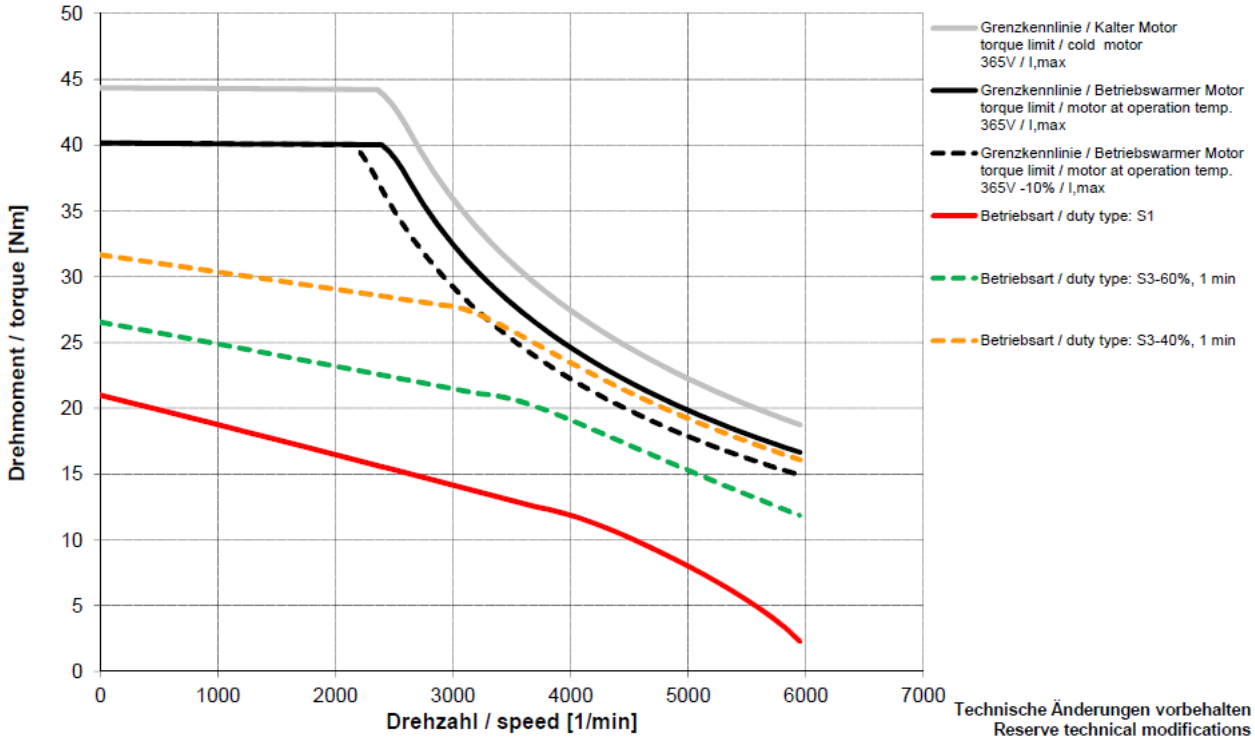

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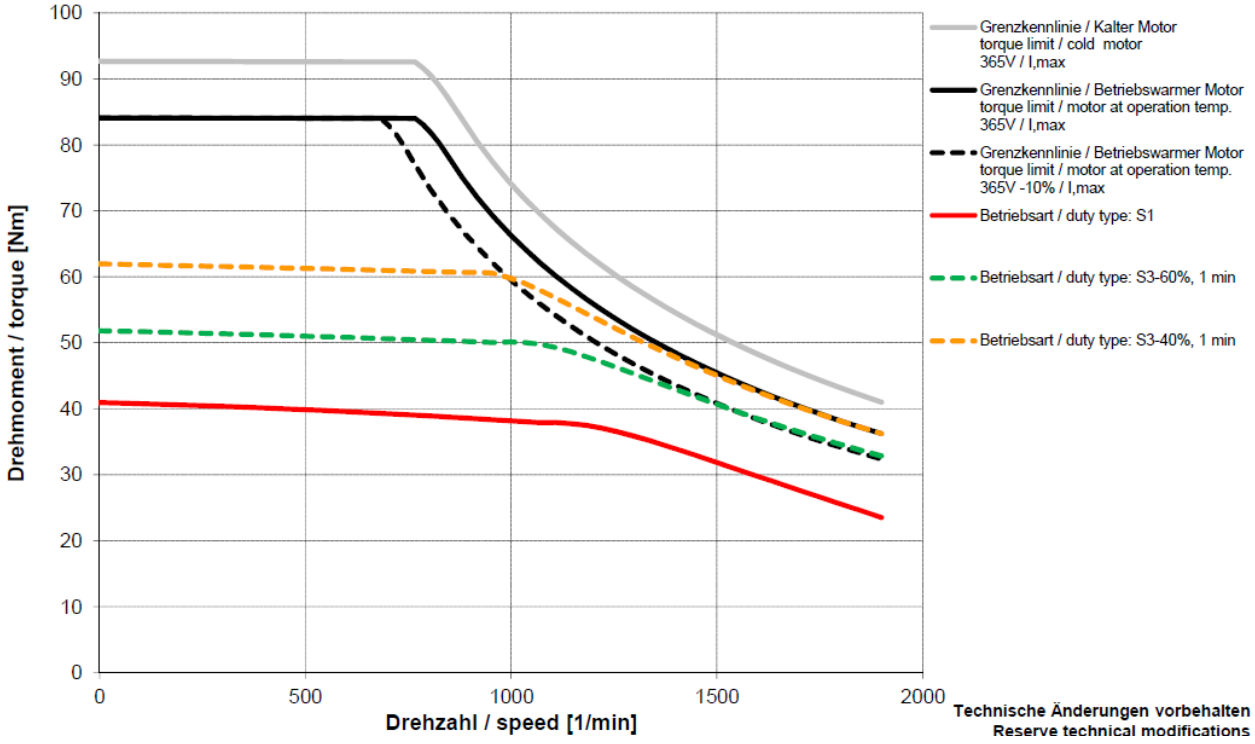
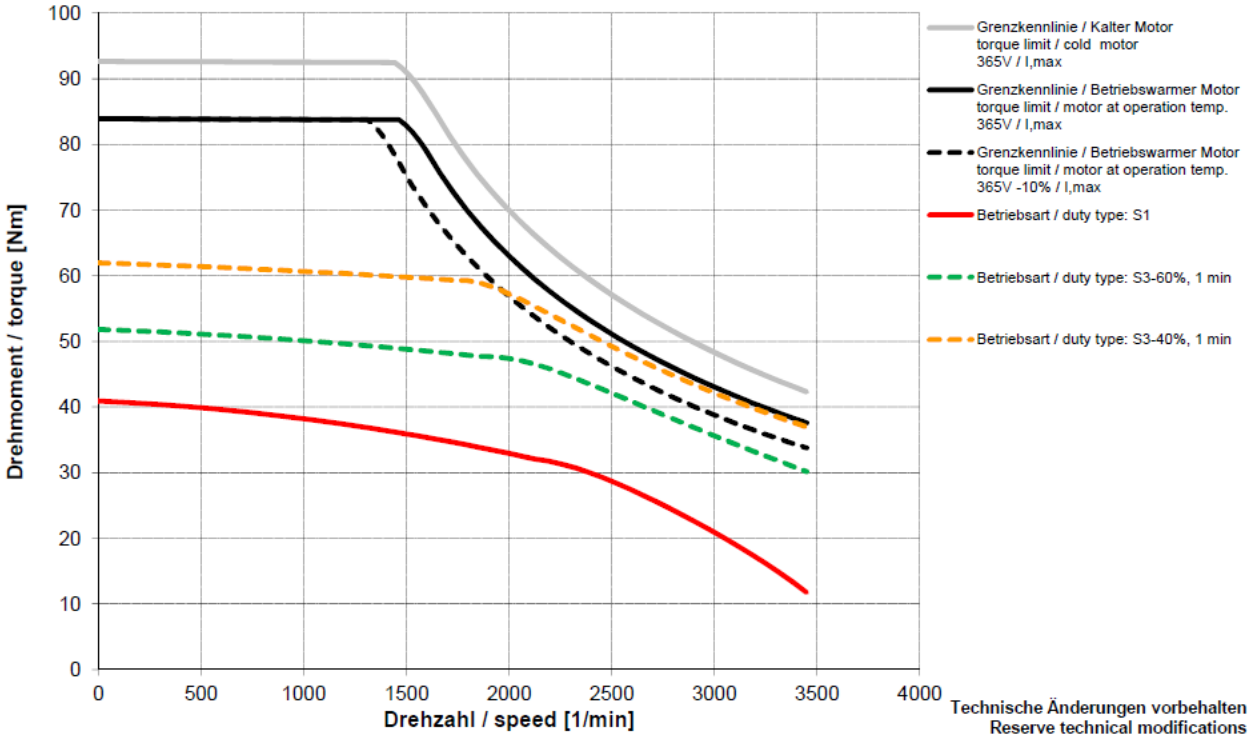


DSH1-100SO64U-20-54



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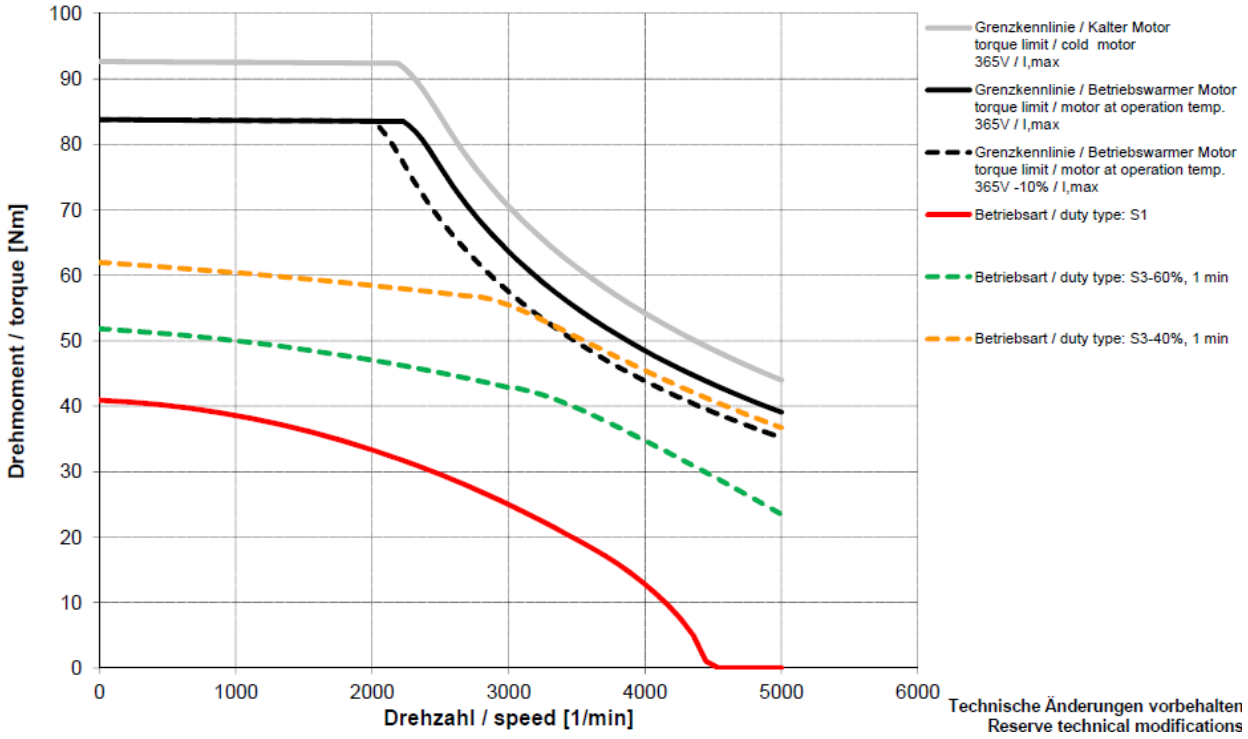

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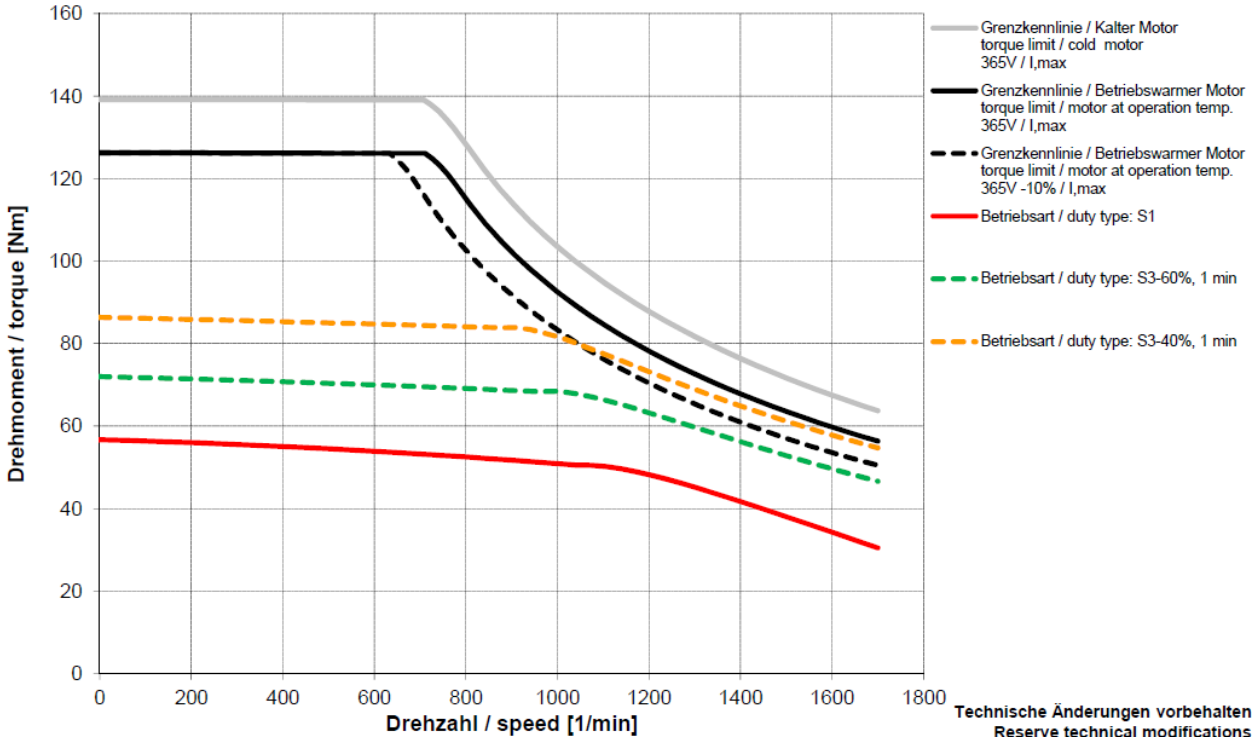

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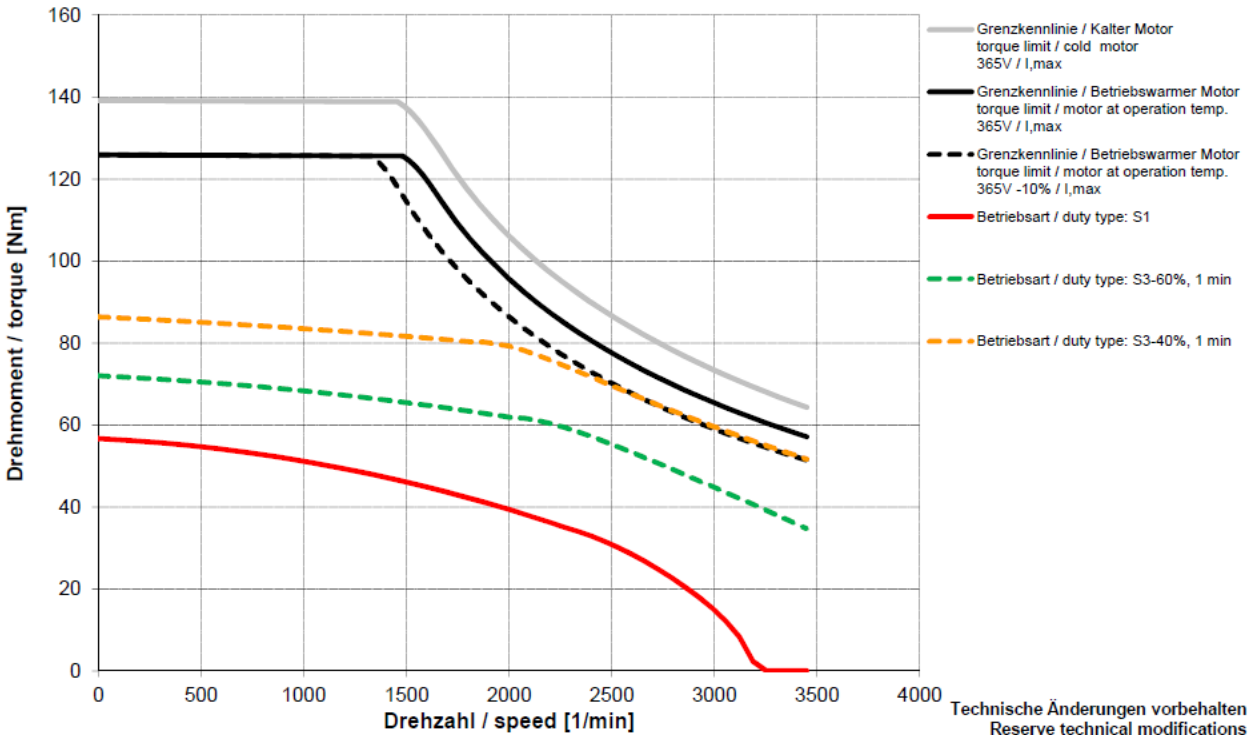

6. Commissioning and maintenance instructions

For information on commissioning the motors, please request a copy of our commissioning and maintenance instructions, quotion number 00682,

7. Declaration of Conformity

7.1. EU – Declaration of Conformity

CE

BAUMÜLLER

EU-Konformitätserklärung
gemäß

- **Richtlinie 2014/35/EU**
  (Niederspannungsrichtlinie)

  Richtlinie 2014/30/EU
  (EMV-Richtlinie)
  ausschließlich mit Geber, wenn im Motor integriert

Hersteller

Baumüller Nürnberg GmbH
Ostendstr. 80 - 90
90482 Nürnberg
Deutschland
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Fax: +49 9 11 54 32 - 1 30
E-Mail: mail@baumueller.de
Internet: www.baumueller.de

Hiermit erklären wir, dass die nachfolgend genannten Produkte aufgrund ihrer Konzeption, Konstruktion und Bauart in der von uns in Verkehr gebrachten Ausführung den Anforderungen der oben genannten Richtlinien einschließlich der zum Zeitpunkt der Erklärung geltenden Änderungen entsprechen.

Hinweise:

1. Bei Umbau oder Änderungen am Produkt verliert diese Erklärung mit sofortiger Wirkung ihre Gültigkeit.

2. Diese Erklärung bescheinigt die Übereinstimmung mit der genannten Richtlinie, stellt aber keine Zusicherung von darüber hinaus gehenden Produkteigenschaften dar.

3. Die alleinige Verantwortung für die Erstellung der Konformitätserklärung trägt der Hersteller.

Angewandte harmonisierte Normen:

- DIN EN 60034-1:2010
  Drehende elektrische Maschinen – Teil 1:
  Bemessung und Betriebsverhalten
- DIN EN 60034-5:2007-09
  Drehende elektrische Maschinen – Teil 5:
  Schutzarten aufgrund der Gesamtkonstruktion von drehenden elektrischen Maschinen (IP-Code) – Einteilung
- DIN EN 60034-6:1996-08
  Drehende elektrische Maschinen – Teil 6:
  Einteilung der Kühlverfahren (IC-Code)

(Wird fortgesetzt auf der nächsten Seite ...)

EU-Declaration of Conformity
according

- **Directive 2014/35/EU**
  (Low-voltage-directive)

  Directive 2014/30/EU
  (EMC-directive)
  only if there is a electronic feedback-device integrated in the motor

Manufacturer

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Germany
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Internet: www.baumueller.de

We declare, that the products referred to in the following conform in their concept, construction and design as lauched by us to the above mentioned directives and their respective changes which were valid at the point of declaration.

Notes:

1. By modifying or alternating the device(s) this declaration immediately becomes invalid.

2. This declaration confirms the compliance with the directive listed, but it is no covenant of any further product properties.

3. Only the manufacturer is responsible for the declaration of conformity.

Applied harmonised standards:

- DIN EN 60034-1:2010
  Rotating electrical machines – Part 1:
  Rating and performance
- DIN EN 60034-5:2007-09
  Rotating electrical machines – Part 5:
  Degree of protection provided by the integral design of rotating electrical machines (IP-Code) – Classification
- DIN EN 60034-6:1996-08
  Rotating electrical machines – Part 6:
  Methods of cooling (IC-Code)

(To be continued on the next page ...)

(... Fortsetzung von der vorherigen Seite)

- DIN EN 60034-9:2008-01
  Drehende elektrische Maschinen – Teil 9:
  Geräuschgrenzwerte
- DIN EN 60034-14:2008-03
  Drehende elektrische Maschinen – Teil 14:
  Mechanische Schwingungen von bestimmten Maschinen mit einer Achshöhe von 56 mm und höher – Messung, Bewertung und Grenzwerte der Schwingstärke
- DIN EN 61800-5-1:2015
  Elektrische Leistungsantriebssysteme mit einstellbarer Drehzahl – Teil 5-1:
  Anforderungen an die Sicherheit – Elektrische, thermische und energetische Anforderungen
- EN 60204-1:2006+A1:2009
  Sicherheit von Maschinen - Elektrische Ausrüstung von Maschinen - Teil 1:
  Allgemeine Anforderungen

(... continued from the previous page)

- DIN EN 60034-9:2008-01
  Rotating electrical machines – Part 9:
  Noise limits
- DIN EN 60034-14:2008-03
  Rotating electrical machines – Part 14:
  Mechanical vibration of certain machines with shaft heights 56 mm and higher – Measurement, evaluation and limits of vibration severity
- DIN EN 61800-5-1:2015-
  Adjustable speed electrical power drive systems – Part 5-1:
  Safety requirements – Electrical, thermal and energy
- EN 60204-1:2006+A1:2009
  Safety of machinery - Electrical equipment of machines - Part 1:
  General requirements

Produkt / Product	**Jahr der erstmaligen CE-Kennzeichnung / Year of first CE marking**
DSH1-045XXXXX-XX-XX-XXX-XXX-X-XX-X-XXX **DSH1-056XXXXX-XX-XX-XXX-XXX-X-XX-X-XXX** **DSH1-071XXXXX-XX-XX-XXX-XXX-X-XX-X-XXX** **DSH1-100XXXXX-XX-XX-XXX-XXX-X-XX-X-XXX**	**2016**

Nürnberg, 12.07.2016

i.V. Markus Gymnich

Leiter Entwicklung Motoren
Head of Motor Development

ppa. Stefan Budweg

Bereichsleiter Motoren
Business Unit Manager Motors

7.2. UKCA Declaration of Conformity

UK CA

BAUMÜLLER

UKCA-Declaration of Conformity according

- **Electrical Equipment Regulation 2016 (Statutory Instrument 2016/1101)**
- **Electromagnetic Compability Regulation 2016 (Statutory Instrument 2016/1091)**

Manufacturer

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Internet: www.baumueller-services.com/uk

We declare, that the products referred to in the following conform in their concept, construction and design as lauched by us to the above mentioned directives and their respective changes which were valid at the point of declaration.

Notes:

1. *By modifying or alternating the device(s) this declaration immediately becomes invalid.*
2. *This declaration confirms the compliance with the directive listed, but it is no covenant of any further product properties.*
3. *This declaration of conformity is issued under the sole responsibility of the manufacturer.*
4. *responsibility of the manufacturer This motor series isn't in scope of guideline 2005/32/EG*

Applied harmonised standards:

- **BS EN 60034-1:2010**
  Rotating electrical machines – Part 1:
  Rating and performance
- **BS EN 60034-5:2020**
  Rotating electrical machines – Part 5:
  Degrees of protection provided by the integral design of rotating electrical machines (IP code). Classification
- **BS EN 60034-6:1994**
  Rotating electrical machines – Part 6:
  Methods of cooling (IC-Code)
- **BS EN 60034-9:2005**
  Rotating electrical machines – Part 9:
  Noise limits
- **BS EN IEC 60034-14:2018**
  Rotating electrical machines – Part 14:
  Mechanical vibration of certain machines with shaft heights 56 mm and higher. Measurement, evaluation and limits of vibration severity. The following applies to roller bearing motors : Based on EN 60034-14 or requirements according to customer agreement.

(To be continued on the next page ...)

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(... continued from the previous page)

- **BS EN 61800-5-1:2007 + A11:2021**
  Adjustable speed electrical power drive systems – Part 5-1:
  Safety requirements – Electrical, thermal and energy

- **BS EN 60204-1:2018**
  Safety of machinery - Electrical equipment of machines - Part 1:
  General requirements

Brand Name: Baumüller
Product Name: AC motor

Produkt / Product (x): optionaler Buchstabe / optional character (x, y): alternative Buchstaben oder Zahlen / alternative characters	**Jahr der erstmaligen CE-Kennzeichnung / Year of first CE marking**
DS 3 Phase AC Servomotoren **DS (x)(x)-xxx-x-x-x** **GN(A,F)xxxx(S,M,L)N** **DSC1-XXXXXXXX-XX-XX-XXX-XXX-X-XX-X-XXX** **DSH1-XXXXXXXX-XX-XX-XXX-XXX-X-XX-X-XXX** **DSP1-XXXXXXXX-XX-XX-XXX-XXX-X-XX-X-XXX** **HYG1-XXXXXXXX-XX-XX-XXX-XXX-X-XX-X-XXX** **DS2--XXXXXXXX-XX-XX-XXX-XXX-X-XX-X-XXX** **DSD2-XXXXXXXX-XX-XX-XXX-XXX-X-XX-X-XXX** **DST2-XXXXXXXX-XX-XX-XXX-XXX-X-XX-X-XXX** **DA1- XXXXXXXX-XX-XX-XXX-XXX-X-XX-X-XXX**	**2022**

Nürnberg, 05.04.2022

Dr.-Ing. Michael Wengler
Director

ppa. Matthias Barth
Manager R&D

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Seite 2 von 2

HOUSE OF AUTOMATION



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