DP+ – The right solution for all requirements

The DP+ planetary gearbox was specially developed for use in Delta robotics applications. Various characteristics allow use of the gearbox in dry, spray and wet areas (HDP+). In addition to an optimized sealing system, this drive solution includes advantages such as improved dynamics due to the optimized moment of inertia. The DP+ is available in four sizes and covers a ratio range of i = 16 – 55.

Product highlights

Reliability Extremely reliable gearboxes prevent cost-intensive machine breakdowns

Positioning accuracy Minimal backlash and extreme rigidity ensure maximum positioning accuracy at the tool center point

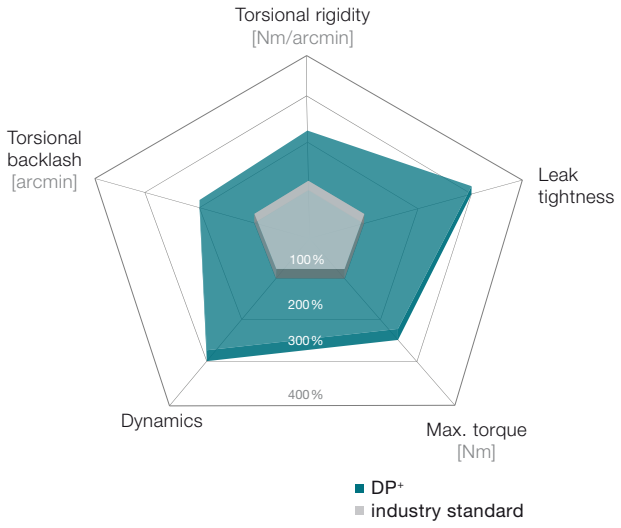
Speed Highest speeds increase machine output

Maintenance Highest quality standards guarantee a long service life and extend maintenance intervals

Consistently high performance Constant backlash throughout the service life of the gearbox ensures a consistently high performance

Low inertia Use of an servo actuator further reduces inertia

The DP+ compared to the industry standard



Dry area

DP+

premo® TP Line

Fields of application: Secondary packaging, Handling, Mounting, Intralogistics …

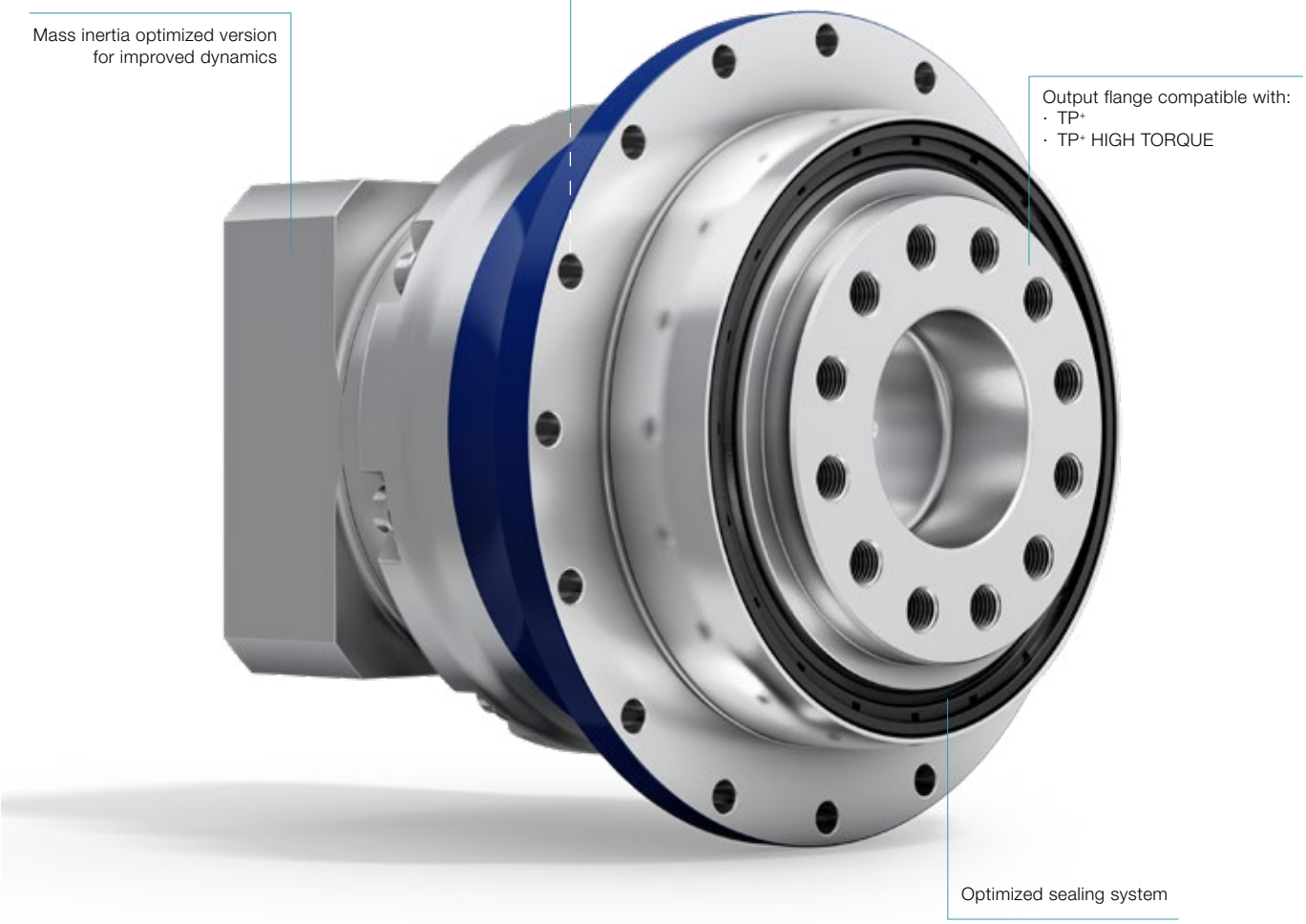
Spray area (close to the process)

DP+ (painted)

DP+ (unpainted)

Fields of application: Pharmaceutical industry, Medical technology, Primary packaging without hygiene design requirements, Clean room…

More information on Delta robotics: simply scan the QR code with your smartphone.



Wet area (integrated in the process)

HDP+

Fields of application: Primary packaging with hygiene design requirements

We are happy to advise you on individual solutions for your project-specific requirements.

Custom solutions

				2-stage									
Ratio			*i*	**16**	**20**	**21**	**25**	**28**	**31**	**32**	**35**	**40**	**50**
Max. torque [a) b)]			*Nm*	57	57	60	72	57	50	57	72	57	72
			T_{2a}	*in.lb*	507	507	533	634	507	442	507	634	507	634
Max. acceleration torque [b)] (max. 1000 cycles per hour)			*Nm*	57	57	48	66	57	48	57	66	57	66
			T_{2B}	*in.lb*	507	507	425	584	507	425	507	584	507	584
Nominal torque (at n_{1N})			*Nm*	39	41	32	41	45	36	39	45	46	48
			T_{2N}	*in.lb*	342	365	286	361	403	320	343	399	406	421
Emergency stop torque [a) b)] (permitted 1000 times during the service life of the gearbox)			*Nm*	100	100	100	100	100	100	100	100	100	100
			T_{2Not}	*in.lb*	885	885	885	885	885	885	885	885	885	885
Permitted average input speed (at T_{2N} and 20 °C ambient temperature) [d)]			n_{1N}	*rpm*	4000	4000	4000	4000	4000	4000	4000	4000	4000	4800
Max. input speed			n_{1Max}	*rpm*	7500	7500	7500	7500	7500	7500	7500	7500	7500	7500
Mean no load running torque [b)] (at n_1 = 3000 rpm and 20 °C gearbox temperature)			*Nm*	0.28	0.23	0.24	0.22	0.21	0.22	0.21	0.17	0.18	0.17
			T_{012}	*in.lb*	2.5	2.0	2.1	1.9	1.9	1.9	1.9	1.5	1.6	1.5
Max. backlash			j_t	*arcmin*	Standard ≤ 4 / Reduced ≤ 2									
Torsional rigidity [b)]			*Nm/arcmin*	12	12	10	12	12	9	12	12	11	12
			C_{t21}	*in.lb/arcmin*	106	106	89	106	106	80	106	106	97	106
Tilting rigidity			*Nm/arcmin*	85									
			C_{2K}	*in.lb/arcmin*	752									
Max. axial force [c)]			*N*	2119									
			F_{2AMax}	lb_f	477									
Max. tilting moment			*Nm*	110									
			M_{2KMax}	*in.lb*	974									
Efficiency at full load			η	%	94									
Service life			L_h	*h*	> 20000									
Weight (incl. standard adapter plate)			*kg*	1.5									
			m	lb_m	3.3									
Operating noise (at reference ratio and reference speed – ratio-specific values available in cymex®)			L_{PA}	*dB(A)*	≤ 54									
Max. permitted housing temperature				*°C*	+90									
				F	194									
Ambient temperature				*°C*	–15 to +40									
				F	5 to 104									
Lubrication					Lubricated for life									
Direction of rotation					In- and output same direction									
Protection class					IP 65									
Metal bellows coupling (recommended product type – validate sizing with cymex®)					-									
Bore diameter of coupling on the application side				*mm*	-									
Mass moment of inertia (relates to the drive)	B	11	J_1	*kgcm²*	0.078	0.070	0.074	0.068	0.062	0.072	0.062	0.061	0.057	0.057
				10^{-3} *in.lb.s²*	0.069	0.062	0.065	0.060	0.055	0.064	0.055	0.054	0.050	0.050
Clamping hub diameter [mm]														
Optimized mass inertia version available on request	C	14	J_1	*kgcm²*	0.17	0.17	0.17	0.16	0.16	0.17	0.16	0.16	0.15	0.15
				10^{-3} *in.lb.s²*	0.15	0.15	0.15	0.15	0.14	0.15	0.14	0.14	0.14	0.14

Please use our sizing software cymex® for a detailed sizing **– www.wittenstein-cymex.com**

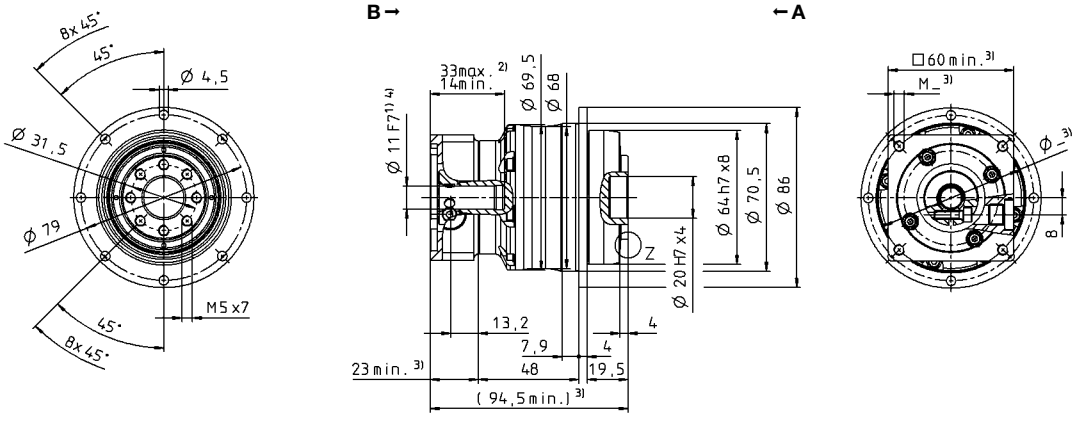
[a)] At max. 10 % M_{2KMax}
[b)] Valid for standard clamping hub diameter
[c)] Refers to center of the output shaft or flange
[d)] Please reduce input speed at higher ambient temperatures

View A | View B

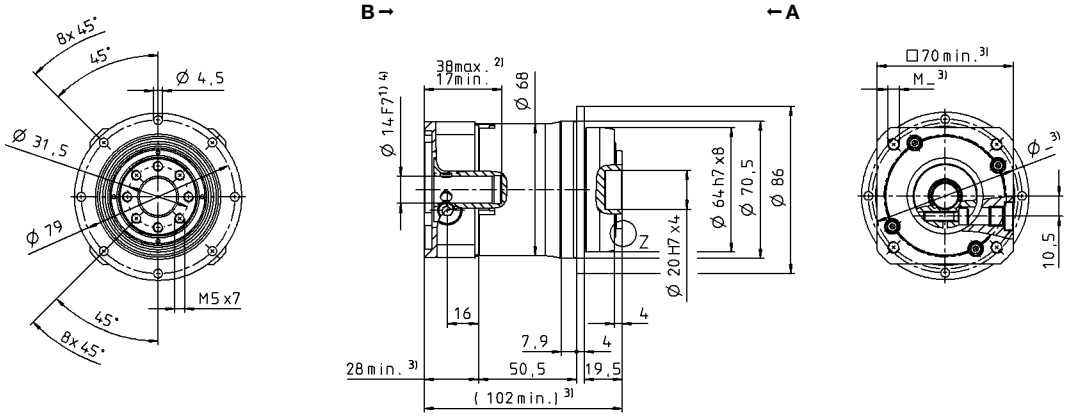
2-stage

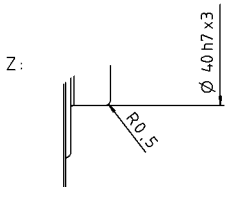
Motor shaft diameter [mm]

up to 11 [4] (B)[5] clamping hub diameter



up to 14 [4] (C) clamping hub diameter





Non-tolerated dimensions are nominal dimensions

[1] Check motor shaft fit

[2] Min./Max. permissible motor shaft length. Longer motor shafts are possible, please contact alpha.

[3] The dimensions depend on the motor

[4] Smaller motor shaft diameter is compensated by a bushing with a minimum thickness of 1 mm

[5] Standard clamping hub diameter

					2-stage									
Ratio			i		**16**	**20**	**21**	**25**	**28**	**31**	**32**	**35**	**40**	**50**
Max. torque [a) b)]			T_{2a}	*Nm*	157	126	133	158	157	121	157	158	154	158
				in.lb	1392	1118	1174	1398	1392	1071	1392	1398	1363	1398
Max. acceleration torque [b)] (max. 1000 cycles per hour)			T_{2B}	*Nm*	157	126	120	158	157	121	157	158	154	158
				in.lb	1392	1113	1062	1398	1392	1071	1392	1398	1363	1398
Nominal torque (at n_{1N})			T_{2N}	*Nm*	106	101	96	124	107	87	119	126	112	126
				in.lb	935	895	850	1097	945	770	1053	1118	987	1118
Emergency stop torque [a) b)] (permitted 1000 times during the service life of the gearbox)			T_{2Not}	*Nm*	251	251	251	251	251	251	251	251	251	251
				in.lb	2222	2222	2222	2222	2222	2222	2222	2222	2222	2222
Permitted average input speed (at T_{2N} and 20 °C ambient temperature) [d)]			n_{1N}	*rpm*	3500	3500	3500	3500	3500	3500	3500	3500	3500	3800
Max. input speed			n_{1Max}	*rpm*	7500	7500	7500	7500	7500	7500	7500	7500	7500	7500
Mean no load running torque [b)] (at n_1 = 3000 rpm and 20 °C gearbox temperature)			T_{012}	*Nm*	0.56	0.48	0.47	0.44	0.40	0.40	0.40	0.28	0.32	0.32
				in.lb	5.0	4.2	4.2	3.9	3.5	3.5	3.5	2.5	2.8	2.8
Max. backlash			j_t	*arcmin*	Standard ≤ 3 / Reduced ≤ 1									
Torsional rigidity [b)]			C_{t21}	*Nm/arcmin*	32	32	26	32	31	24	31	32	30	30
				in.lb/arcmin	283	283	230	283	274	212	274	283	266	266
Tilting rigidity			C_{2K}	*Nm/arcmin*	225									
				in.lb/arcmin	1991									
Max. axial force [c)]			F_{2AMax}	*N*	2795									
				lb$_f$	629									
Max. tilting moment			M_{2KMax}	*Nm*	270									
				in.lb	2390									
Efficiency at full load			η	*%*	94									
Service life			L_h	*h*	> 20000									
Weight (incl. standard adapter plate)			m	*kg*	3.6									
				lb$_m$	8.0									
Operating noise (at reference ratio and reference speed – ratio-specific values available in cymex®)			L_{PA}	*dB(A)*	≤ 55									
Max. permitted housing temperature				*°C*	+90									
				F	194									
Ambient temperature				*°C*	–15 to +40									
				F	5 to 104									
Lubrication					Lubricated for life									
Direction of rotation					In- and output same direction									
Protection class					IP 65									
Metal bellows coupling (recommended product type – validate sizing with cymex®)					-									
Bore diameter of coupling on the application side				*mm*	-									
Mass moment of inertia (relates to the drive) Clamping hub diameter [mm] Optimized mass inertia version available on request	B	11	J_1	*kgcm²*	0.17	0.14	0.15	0.13	0.11	0.14	0.11	0.10	0.09	0.09
				10^{-3} in.lb.s²	0.15	0.12	0.13	0.12	0.10	0.12	0.10	0.09	0.08	0.08
	C	14	J_1	*kgcm²*	0.24	0.21	0.22	0.20	0.18	0.21	0.18	0.18	0.17	0.17
				10^{-3} in.lb.s²	0.21	0.19	0.20	0.18	0.16	0.18	0.16	0.16	0.15	0.15
	E	19	J_1	*kgcm²*	0.56	0.53	0.55	0.53	0.51	0.53	0.51	0.50	0.49	0.49
				10^{-3} in.lb.s²	0.50	0.47	0.48	0.47	0.45	0.47	0.45	0.44	0.43	0.43

Please use our sizing software cymex® for a detailed sizing – **www.wittenstein-cymex.com**

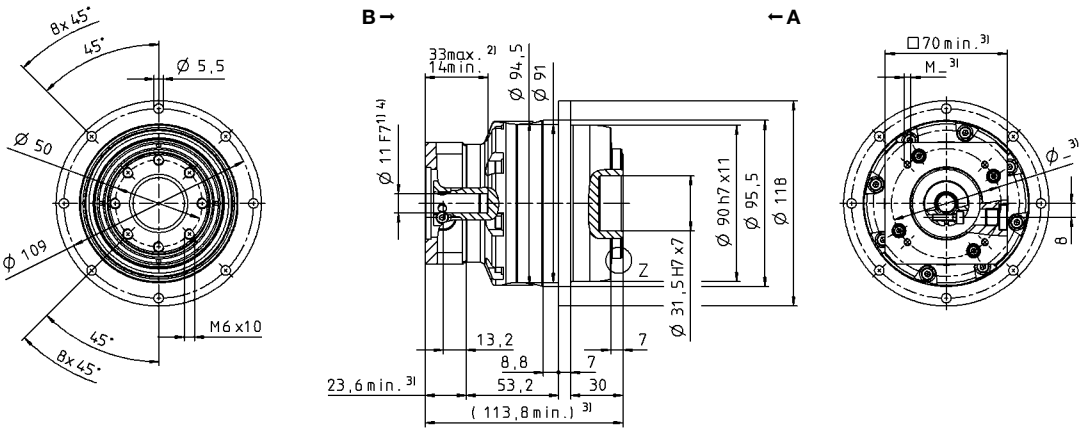
[a)] At max. 10 % M_{2KMax}
[b)] Valid for standard clamping hub diameter
[c)] Refers to center of the output shaft or flange
[d)] Please reduce input speed at higher ambient temperatures

View A | View B

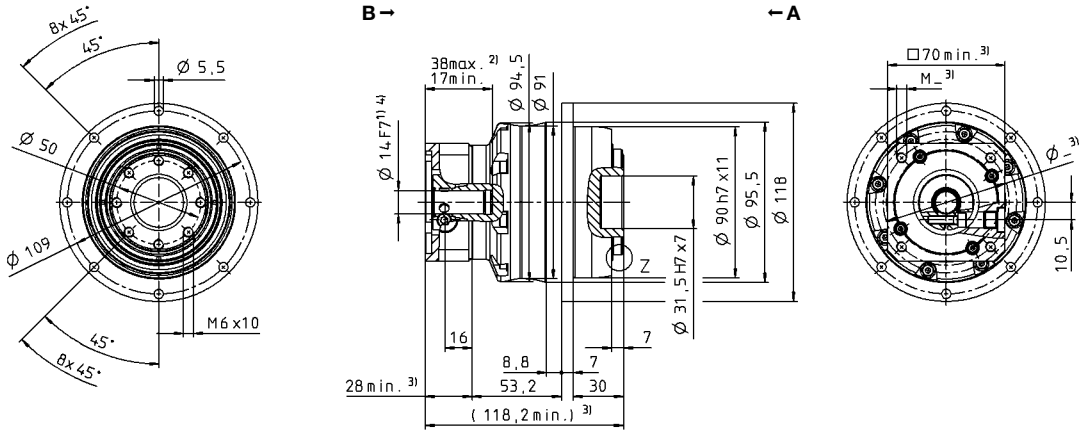
2-stage

Motor shaft diameter [mm]

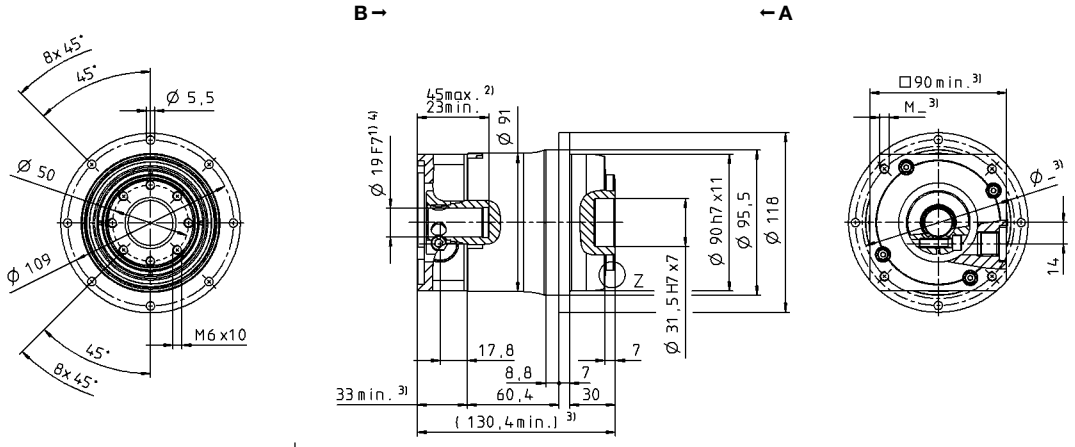
up to 11 [4] (B) clamping hub diameter

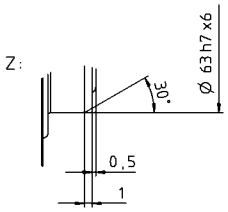


up to 14 [4] (C) [5] clamping hub diameter



up to 19 [4] (E) clamping hub diameter





Non-tolerated dimensions are nominal dimensions

[1] Check motor shaft fit

[2] Min./Max. permissible motor shaft length. Longer motor shafts are possible, please contact alpha.

[3] The dimensions depend on the motor

[4] Smaller motor shaft diameter is compensated by a bushing with a minimum thickness of 1 mm

[5] Standard clamping hub diameter

					2-stage									
Ratio			i		**16**	**20**	**21**	**25**	**28**	**31**	**32**	**35**	**40**	**50**
Max. torque [a) b)]			T_{2a}	*Nm*	352	352	352	380	352	352	352	380	352	380
				in.lb	3115	3115	3115	3363	3115	3115	3115	3363	3115	3363
Max. acceleration torque [b)] (max. 1000 cycles per hour)			T_{2B}	*Nm*	352	352	330	380	352	330	352	380	352	380
				in.lb	3115	3115	2921	3363	3115	2921	3115	3363	3115	3363
Nominal torque (at n_{1N})			T_{2N}	*Nm*	250	267	211	265	282	231	251	294	282	304
				in.lb	2213	2366	1872	2348	2492	2047	2220	2598	2492	2691
Emergency stop torque [a) b)] (permitted 1000 times during the service life of the gearbox)			T_{2Not}	*Nm*	625	625	625	625	625	625	625	625	625	625
				in.lb	5532	5532	5532	5532	5532	5532	5532	5532	5532	5532
Permitted average input speed (at T_{2N} and 20 °C ambient temperature) [d)]			n_{1N}	*rpm*	2800	2800	2800	2800	2800	2800	2800	2800	2800	3100
Max. input speed			n_{1Max}	*rpm*	7500	7500	7500	7500	7500	7500	7500	7500	7500	7500
Mean no load running torque [b)] (at n_1 = 3000 rpm and 20 °C gearbox temperature)			T_{012}	*Nm*	1.2	1.0	1.1	0.90	0.80	0.84	0.80	0.60	0.59	0.50
				in.lb	10	8.9	9.9	8.0	7.1	7.4	7.1	5.3	5.2	4.4
Max. backlash			j_t	*arcmin*	Standard ≤ 3 / Reduced ≤ 1									
Torsional rigidity [b)]			C_{t21}	*Nm/arcmin*	81	81	70	83	80	54	80	82	76	80
				in.lb/arcmin	717	717	620	735	708	478	708	726	673	708
Tilting rigidity			C_{2K}	*Nm/arcmin*	550									
				in.lb/arcmin	4868									
Max. axial force [c)]			F_{2AMax}	*N*	4800									
				lb$_f$	1080									
Max. tilting moment			M_{2KMax}	*Nm*	440									
				in.lb	3894									
Efficiency at full load			η	*%*	94									
Service life			L_h	*h*	> 20000									
Weight (incl. standard adapter plate)			m	*kg*	6.7									
				lb$_m$	14.8									
Operating noise (at reference ratio and reference speed – ratio-specific values available in cymex®)			L_{PA}	*dB(A)*	≤ 58									
Max. permitted housing temperature				*°C*	+90									
				F	194									
Ambient temperature				*°C*	–15 to +40									
				F	5 to 104									
Lubrication					Lubricated for life									
Direction of rotation					In- and output same direction									
Protection class					IP 65									
Metal bellows coupling (recommended product type – validate sizing with cymex®)					-									
Bore diameter of coupling on the application side				*mm*	-									
Mass moment of inertia (relates to the drive) Clamping hub diameter [mm] Optimized mass inertia version available on request	C	14	J_1	*kgcm²*	0.66	0.55	0.60	0.53	0.44	0.55	0.44	0.43	0.38	0.38
				10^{-3} in.lb.s²	0.58	0.48	0.53	0.47	0.39	0.49	0.39	0.38	0.34	0.33
	E	19	J_1	*kgcm²*	0.83	0.71	0.77	0.70	0.61	0.72	0.61	0.60	0.55	0.55
				10^{-3} in.lb.s²	0.73	0.63	0.68	0.62	0.54	0.64	0.54	0.53	0.49	0.48
	G	24	J_1	*kgcm²*	2.20	2.08	2.14	2.07	1.98	2.09	1.98	1.97	1.92	1.92
				10^{-3} in.lb.s²	1.95	1.84	1.89	1.83	1.75	1.85	1.75	1.74	1.70	1.70
	H	28	J_1	*kgcm²*	2.00	1.91	1.96	1.89	1.82	1.85	1.89	1.81	1.76	1.76
				10^{-3} in.lb.s²	1.77	1.69	1.73	1.67	1.61	1.64	1.67	1.60	1.56	1.56

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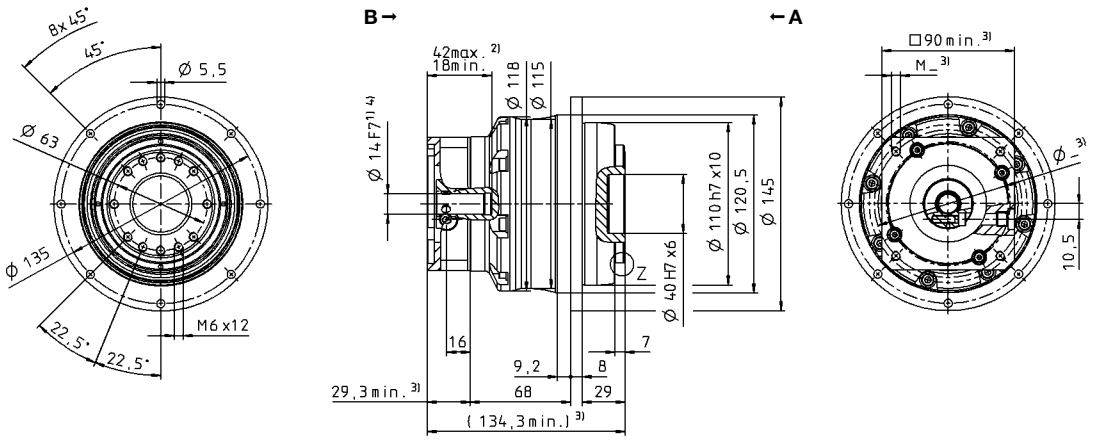
[a)] At max. 10 % M_{2KMax}
[b)] Valid for standard clamping hub diameter
[c)] Refers to center of the output shaft or flange
[d)] Please reduce input speed at higher ambient temperatures

View A | View B

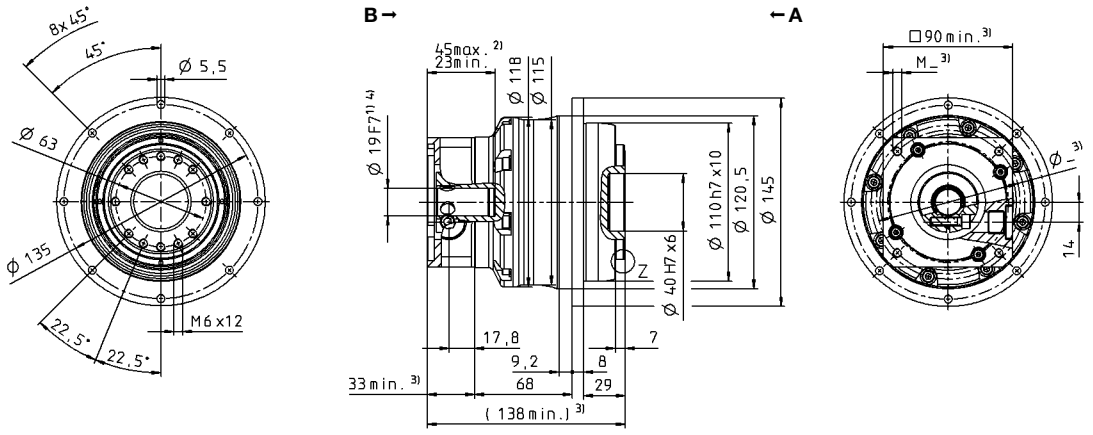
2-stage

Motor shaft diameter [mm]

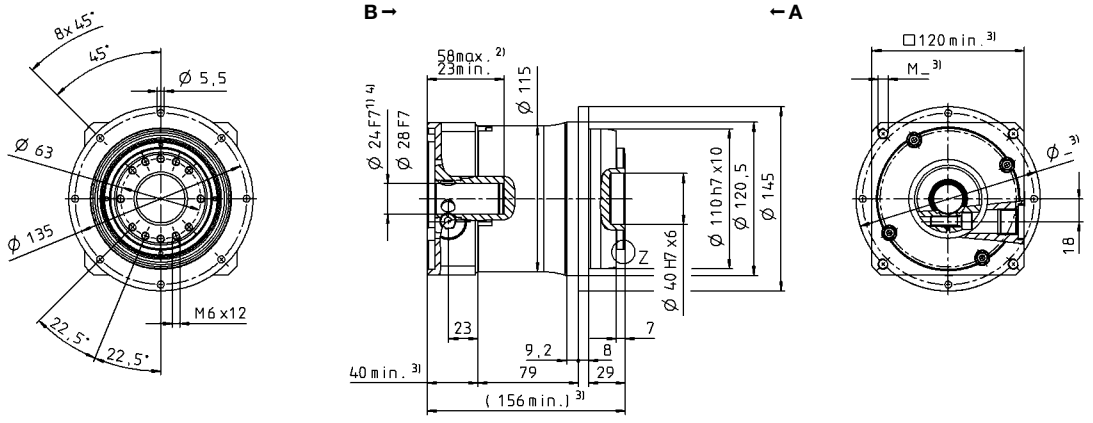
up to 14 [4] (C) clamping hub diameter

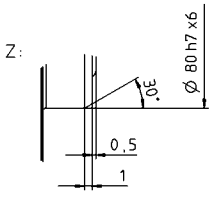


up to 19 [4] (E) [5] clamping hub diameter



up to 24/28 [4] (G/H) clamping hub diameter





Non-tolerated dimensions are nominal dimensions

[1] Check motor shaft fit

[2] Min./Max. permissible motor shaft length. Longer motor shafts are possible, please contact alpha.

[3] The dimensions depend on the motor

[4] Smaller motor shaft diameter is compensated by a bushing with a minimum thickness of 1 mm

[5] Standard clamping hub diameter

				2-stage									
Ratio			*i*	**16**	**20**	**21**	**25**	**28**	**31**	**32**	**35**	**40**	**50**
Max. torque [a) b)]			T_{2a}	*Nm*	825	825	660	825	825	682	825	825	825	825
				in.lb	7302	7302	5842	7302	7302	6036	7302	7302	7302	7302
Max. acceleration torque [b)] (max. 1000 cycles per hour)			T_{2B}	*Nm*	825	825	660	825	825	682	825	825	825	825
				in.lb	7302	7302	5842	7302	7302	6036	7302	7302	7302	7302
Nominal torque (at n_{1N})			T_{2N}	*Nm*	461	493	393	489	545	431	464	541	607	585
				in.lb	4078	4361	2476	4332	4824	3812	4104	4792	5370	5179
Emergency stop torque [a) b)] (permitted 1000 times during the service life of the gearbox)			T_{2Not}	*Nm*	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250
				in.lb	11064	11064	11064	11064	11064	11064	11064	11064	11064	11064
Permitted average input speed (at T_{2N} and 20 °C ambient temperature) [d)]			n_{1N}	*rpm*	2900	2900	2900	2900	2900	2900	2900	2900	2900	3200
Max. input speed			n_{1Max}	*rpm*	6250	6250	6250	6250	6250	6250	6250	6250	6250	6250
Mean no load running torque [b)] (at n_1 = 3000 rpm and 20 °C gearbox temperature)			T_{012}	*Nm*	2.8	2.4	2.2	2.6	2.0	1.9	2.0	1.5	1.5	1.2
				in.lb	25	22	20	23	17	17	17	14	13	11
Max. backlash			j_t	*arcmin*	Standard ≤ 3 / Reduced ≤ 1									
Torsional rigidity [b)]			C_{t21}	*Nm/arcmin*	180	185	145	180	180	130	180	175	175	175
				in.lb/arcmin	1593	1637	1283	1593	1593	1151	1593	1549	1549	1549
Tilting rigidity			C_{2K}	*Nm/arcmin*	560									
				in.lb/arcmin	4956									
Max. axial force [c)]			F_{2AMax}	*N*	6130									
				lb_f	1379									
Max. tilting moment			M_{2KMax}	*Nm*	1379									
				in.lb	11816									
Efficiency at full load			η	%	94									
Service life			L_h	*h*	> 20000									
Weight (incl. standard adapter plate)			*m*	*kg*	14.1									
				lb_m	31.2									
Operating noise (at reference ratio and reference speed – ratio-specific values available in cymex®)			L_{PA}	*dB(A)*	≤ 60									
Max. permitted housing temperature				°C	+90									
				F	194									
Ambient temperature				°C	–15 to +40									
				F	5 to 104									
Lubrication					Lubricated for life									
Direction of rotation					In- and output same direction									
Protection class					IP 65									
Metal bellows coupling (recommended product type – validate sizing with cymex®)					-									
Bore diameter of coupling on the application side				*mm*	-									
Mass moment of inertia (relates to the drive) Clamping hub diameter [mm] Optimized mass inertia version available on request	E	19	J_1	*kgcm²*	2.53	2.08	2.30	2.01	1.67	2.12	1.67	1.64	1.44	1.42
				10⁻³ in.lb.s²	2.24	1.84	2.04	1.78	1.48	1.88	1.48	1.45	1.27	1.26
	G	24	J_1	*kgcm²*	3.22	2.77	2.99	2.70	2.37	2.81	2.37	2.33	2.13	2.12
				10⁻³ in.lb.s²	2.85	2.45	2.65	2.39	2.10	2.49	2.10	2.06	1.89	1.88
	K	38	J_1	*kgcm²*	10.3	9.83	10.1	9.77	9.43	9.88	9.43	9.40	9.20	9.18
				10⁻³ in.lb.s²	9.12	8.70	8.94	8.65	8.35	8.74	8.35	8.32	8.14	8.12

Please use our sizing software cymex® for a detailed sizing – **www.wittenstein-cymex.com**

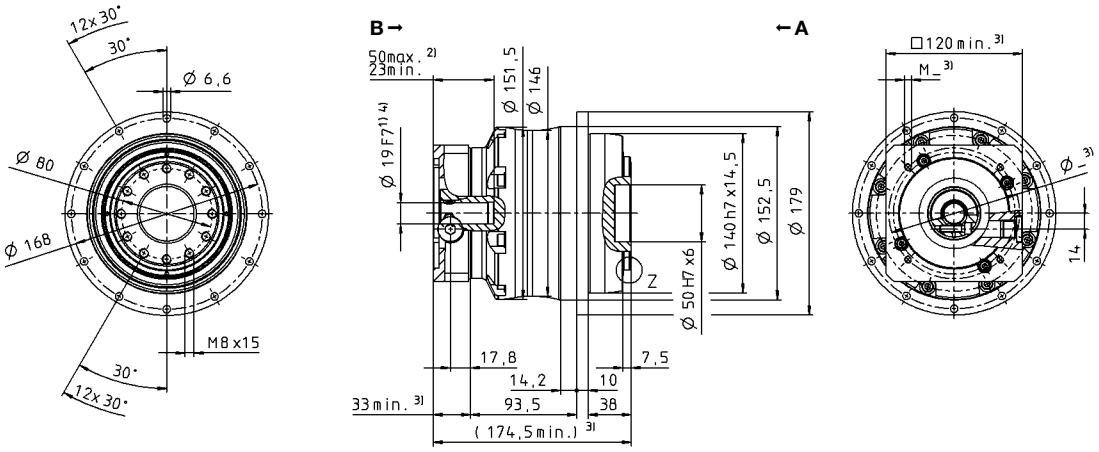
[a)] At max. 10 % M_{2KMax}
[b)] Valid for standard clamping hub diameter
[c)] Refers to center of the output shaft or flange
[d)] Please reduce input speed at higher ambient temperatures

View A | View B

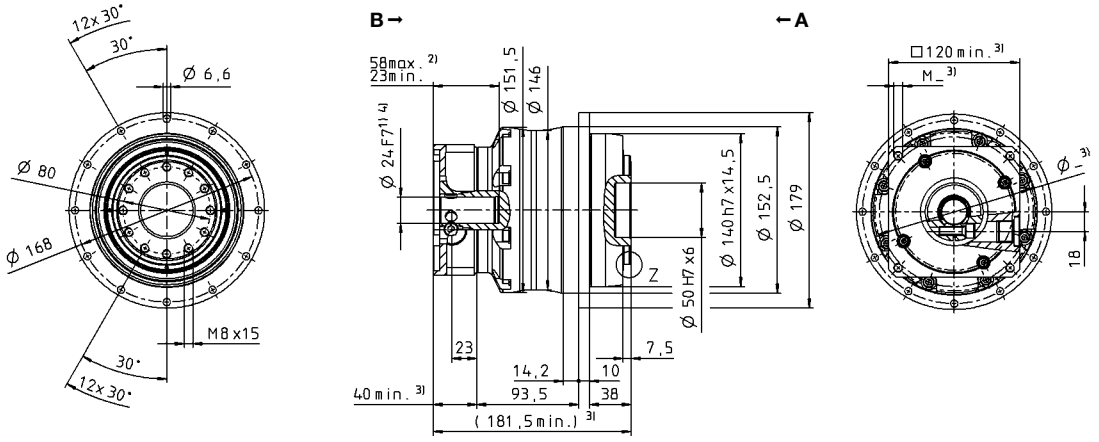
2-stage

Motor shaft diameter [mm]

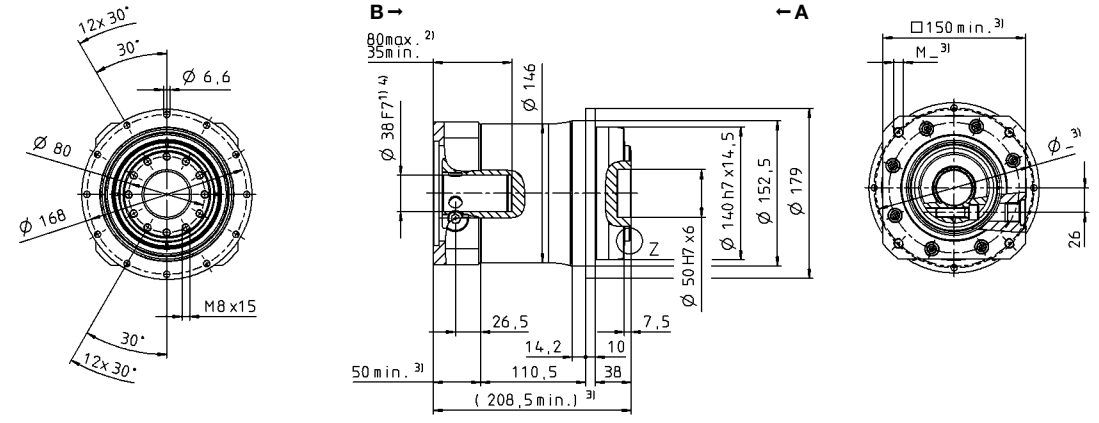
up to 19 [4] (E) clamping hub diameter

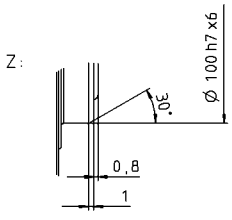


up to 24 [4] (G) [5] clamping hub diameter



up to 38 [4] (K) clamping hub diameter





Non-tolerated dimensions are nominal dimensions

[1] Check motor shaft fit

[2] Min./Max. permissible motor shaft length. Longer motor shafts are possible, please contact alpha.

[3] The dimensions depend on the motor

[4] Smaller motor shaft diameter is compensated by a bushing with a minimum thickness of 1 mm

[5] Standard clamping hub diameter

				2-stage			
Ratio			i	**22**	**27.5**	**38.5**	**55**
Max. torque [a) b)]			T_{2a}	*Nm*	315	315	315	315
				in.lb	2788	2788	2788	2788
Max. acceleration torque [b)] (max. 1000 cycles per hour)			T_{2B}	*Nm*	230	230	230	230
				in.lb	2036	2036	2036	2036
Nominal torque (at n_{1N})			T_{2N}	*Nm*	140	137	139	147
				in.lb	1242	1213	1230	1303
Emergency stop torque [a) b)] (permitted 1000 times during the service life of the gearbox)			T_{2Not}	*Nm*	525	525	525	525
				in.lb	4647	4647	4647	4647
Permitted average input speed (at T_{2N} and 20 °C ambient temperature) [d)]			n_{1N}	*rpm*	4000	4000	4000	4000
Max. input speed			n_{1Max}	*rpm*	7500	7500	7500	7500
Mean no load running torque [b)] (at n_1 = 3000 rpm and 20 °C gearbox temperature)			T_{012}	*Nm*	0.52	0.47	0.41	0.38
				in.lb	4.6	4.2	4.0	3.4
Max. backlash			j_t	*arcmin*	≤ 1			
Torsional rigidity [b)]			C_{t21}	*Nm/arcmin*	43	43	43	42
				in.lb/arcmin	381	381	381	372
Tilting rigidity			C_{2K}	*Nm/arcmin*	225			
				in.lb/arcmin	1991			
Max. axial force [c)]			F_{2AMax}	*N*	2795			
				lb_f	629			
Max. tilting moment			M_{2KMax}	*Nm*	400			
				in.lb	3540			
Efficiency at full load			η	%	94			
Service life			L_h	*h*	> 20000			
Weight (incl. standard adapter plate)			m	*kg*	3.2			
				lb_m	7.1			
Operating noise (at reference ratio and reference speed – ratio-specific values available in cymex®)			L_{PA}	*dB(A)*	≤ 56			
Max. permitted housing temperature				*°C*	+90			
				F	194			
Ambient temperature				*°C*	–15 to +40			
				F	5 to 104			
Lubrication					Lubricated for life			
Direction of rotation					In- and output same direction			
Protection class					IP 65			
Metal bellows coupling (recommended product type – validate sizing with cymex®)					-			
Bore diameter of coupling on the application side				*mm*	-			
Mass moment of inertia (relates to the drive)	C	14	J_1	*kgcm²*	0.21	0.18	0.16	0.14
				10⁻³ in.lb.s²	0.19	0.16	0.14	0.12
Clamping hub diameter [mm]								
Optimized mass inertia version available on request	E	19	J_1	*kgcm²*	0.52	0.50	0.47	0.46
				10⁻³ in.lb.s²	0.46	0.44	0.42	0.41

Please use our sizing software cymex® for a detailed sizing **– www.wittenstein-cymex.com**

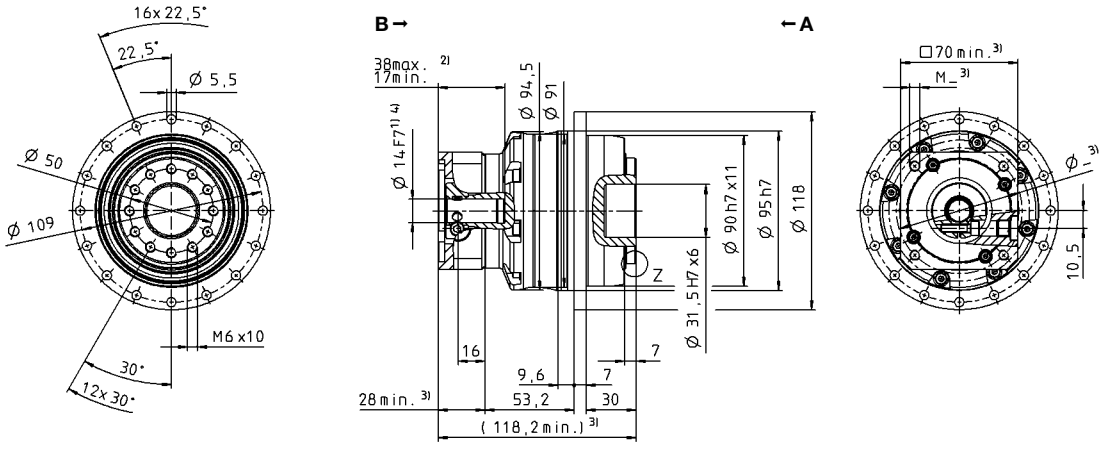
[a)] At max. 10 % M_{2KMax}
[b)] Valid for standard clamping hub diameter
[c)] Refers to center of the output shaft or flange
[d)] Please reduce input speed at higher ambient temperatures

View A | View B

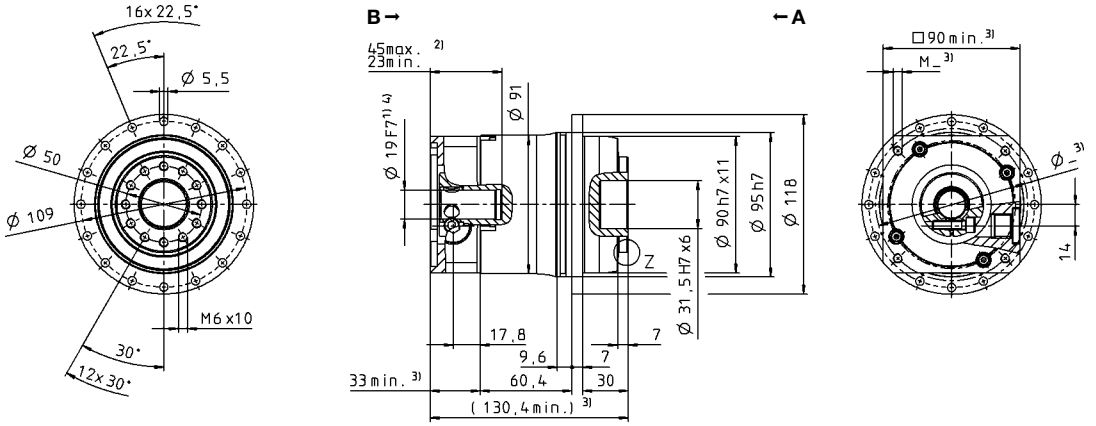
2-stage

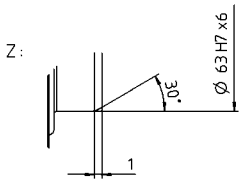
Motor shaft diameter [mm]

up to 14 [4] (C) [5] clamping hub diameter



up to 19 [4] (E) clamping hub diameter





Non-tolerated dimensions are nominal dimensions

1) Check motor shaft fit
2) Min./Max. permissible motor shaft length. Longer motor shafts are possible, please contact alpha.
3) The dimensions depend on the motor
4) Smaller motor shaft diameter is compensated by a bushing with a minimum thickness of 1 mm
5) Standard clamping hub diameter

				2-stage			
Ratio			i	**22**	**27.5**	**38.5**	**55**
Max. torque [a) b)]			T_{2a}	*Nm*	583	583	583	583
				in.lb	5160	5160	5160	5160
Max. acceleration torque [b)] (max. 1000 cycles per hour)			T_{2B}	*Nm*	530	530	530	530
				in.lb	4691	4691	4691	4691
Nominal torque (at n_{1N})			T_{2N}	*Nm*	312	314	371	413
				in.lb	2762	2775	3286	3652
Emergency stop torque [a) b)] (permitted 1000 times during the service life of the gearbox)			T_{2Not}	*Nm*	1200	1200	1200	1200
				in.lb	10621	10621	10621	10621
Permitted average input speed (at T_{2N} and 20 °C ambient temperature) [d)]			n_{1N}	*rpm*	3500	3500	3500	3500
Max. input speed			n_{1Max}	*rpm*	7500	7500	7500	7500
Mean no load running torque [b)] (at n_1 = 3000 rpm and 20 °C gearbox temperature)			T_{012}	*Nm*	1.0	0.87	0.78	0.70
				in.lb	9.2	7.7	6.9	6.2
Max. backlash			j_t	*arcmin*	≤ 1			
Torsional rigidity [b)]			C_{t21}	*Nm/arcmin*	105	105	105	100
				in.lb/arcmin	929	929	929	885
Tilting rigidity			C_{2K}	*Nm/arcmin*	550			
				in.lb/arcmin	4868			
Max. axial force [c)]			F_{2AMax}	*N*	4800			
				lb_f	1080			
Max. tilting moment			M_{2KMax}	*Nm*	550			
				in.lb	4868			
Efficiency at full load			η	*%*	94			
Service life			L_h	*h*	> 20000			
Weight (incl. standard adapter plate)			m	*kg*	5.6			
				lb_m	12.4			
Operating noise (at reference ratio and reference speed – ratio-specific values available in cymex®)			L_{PA}	*dB(A)*	≤ 58			
Max. permitted housing temperature				*°C*	+90			
				F	194			
Ambient temperature				*°C*	–15 to +40			
				F	5 to 104			
Lubrication					Lubricated for life			
Direction of rotation					In- and output same direction			
Protection class					IP 65			
Metal bellows coupling (recommended product type – validate sizing with cymex®)					-			
Bore diameter of coupling on the application side				*mm*	-			
Mass moment of inertia (relates to the drive)	E	19	J_1	*kgcm²*	0.87	0.70	0.60	0.55
				10^{-3} in.lb.s²	0.77	0.62	0.53	0.49
Clamping hub diameter [mm]	G	24	J_1	*kgcm²*	2.39	2.22	2.12	2.07
Optimized mass inertia version available on request				*10^{-3} in.lb.s²*	2.12	1.96	1.88	1.83

Please use our sizing software cymex® for a detailed sizing **– www.wittenstein-cymex.com**

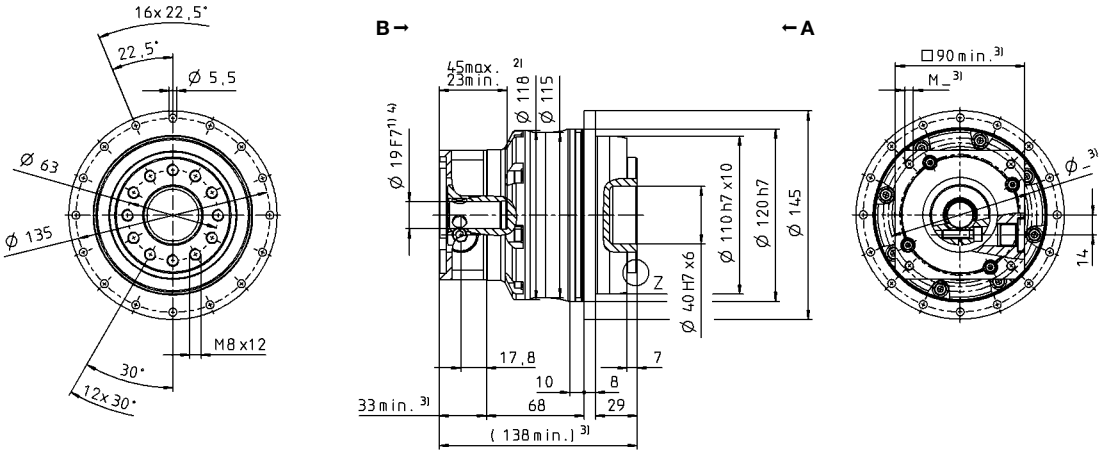
[a)] At max. 10 % M_{2KMax}
[b)] Valid for standard clamping hub diameter
[c)] Refers to center of the output shaft or flange
[d)] Please reduce input speed at higher ambient temperatures

View A | View B

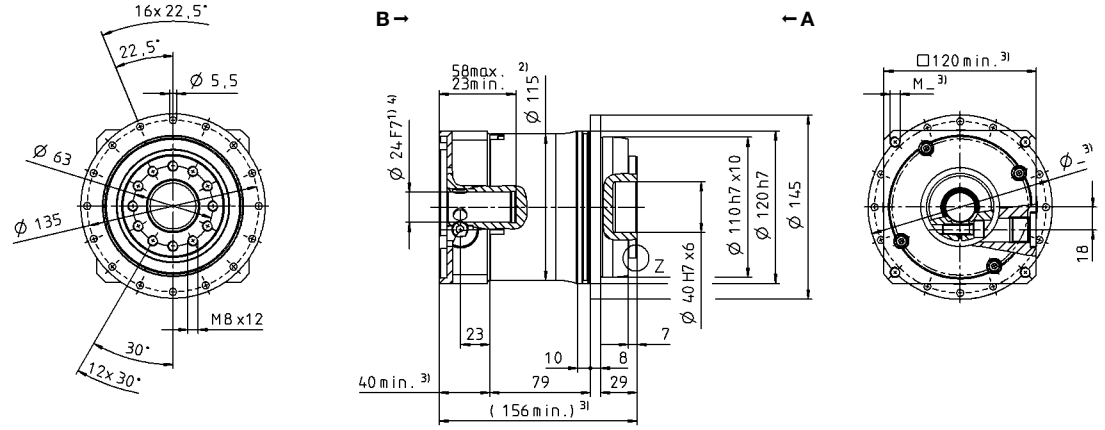
2-stage

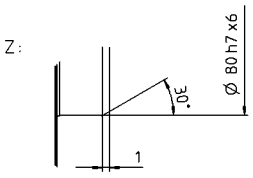
Motor shaft diameter [mm]

up to 19 [4] (E) [5] clamping hub diameter



up to 24 [4] (G) clamping hub diameter





Non-tolerated dimensions are nominal dimensions

1) Check motor shaft fit
2) Min./Max. permissible motor shaft length. Longer motor shafts are possible, please contact alpha.
3) The dimensions depend on the motor
4) Smaller motor shaft diameter is compensated by a bushing with a minimum thickness of 1 mm
5) Standard clamping hub diameter

				2-stage			
Ratio			i	**22**	**27.5**	**38.5**	**55**
Max. torque [a) b)]			T_{2a}	*Nm*	1402	1402	1402	1402
				in.lb	12406	12406	12406	12406
Max. acceleration torque [b)] (max. 1000 cycles per hour)			T_{2B}	*Nm*	992	992	992	992
				in.lb	8780	8780	8780	8780
Nominal torque (at n_{1N})			T_{2N}	*Nm*	523	566	638	717
				in.lb	4632	5005	5649	6348
Emergency stop torque [a) b)] (permitted 1000 times during the service life of the gearbox)			T_{2Not}	*Nm*	2375	2375	2375	2375
				in.lb	21021	21021	21021	21021
Permitted average input speed (at T_{2N} and 20 °C ambient temperature) [d)]			n_{1N}	*rpm*	3000	3000	3000	3000
Max. input speed			n_{1Max}	*rpm*	6250	6250	6250	6250
Mean no load running torque [b)] (at n_1 = 3000 rpm and 20 °C gearbox temperature)			T_{012}	*Nm*	2.7	2.4	2.1	1.7
				in.lb	23.9	21.2	18.9	15.0
Max. backlash			j_t	*arcmin*	≤ 1			
Torsional rigidity [b)]			C_{t21}	*Nm/arcmin*	220	220	220	220
				in.lb/arcmin	1947	1947	1947	1947
Tilting rigidity			C_{2K}	*Nm/arcmin*	560			
				in.lb/arcmin	4956			
Max. axial force [c)]			F_{2AMax}	*N*	6130			
				lb_f	1379			
Max. tilting moment			M_{2KMax}	*Nm*	1335			
				in.lb	11816			
Efficiency at full load			η	%	94			
Service life			L_h	*h*	> 20000			
Weight (incl. standard adapter plate)			m	*kg*	12.5			
				lb_m	27.6			
Operating noise (at reference ratio and reference speed – ratio-specific values available in cymex®)			L_{PA}	*dB(A)*	≤ 60			
Max. permitted housing temperature				*°C*	+90			
				F	194			
Ambient temperature				*°C*	–15 to +40			
				F	5 to 104			
Lubrication					Lubricated for life			
Direction of rotation					In- and output same direction			
Protection class					IP 65			
Metal bellows coupling (recommended product type – validate sizing with cymex®)					-			
Bore diameter of coupling on the application side				*mm*	-			
Mass moment of inertia (relates to the drive)	G	24	J_1	*kgcm²*	3.80	3.33	3.00	2.80
				10^{-3} in.lb.s²	3.36	2.95	2.66	2.48
Clamping hub diameter [mm]								
Optimized mass inertia version available on request	K	38	J_1	*kgcm²*	10.7	10.3	9.90	9.70
				10^{-3} in.lb.s²	9.47	9.12	8.76	8.58

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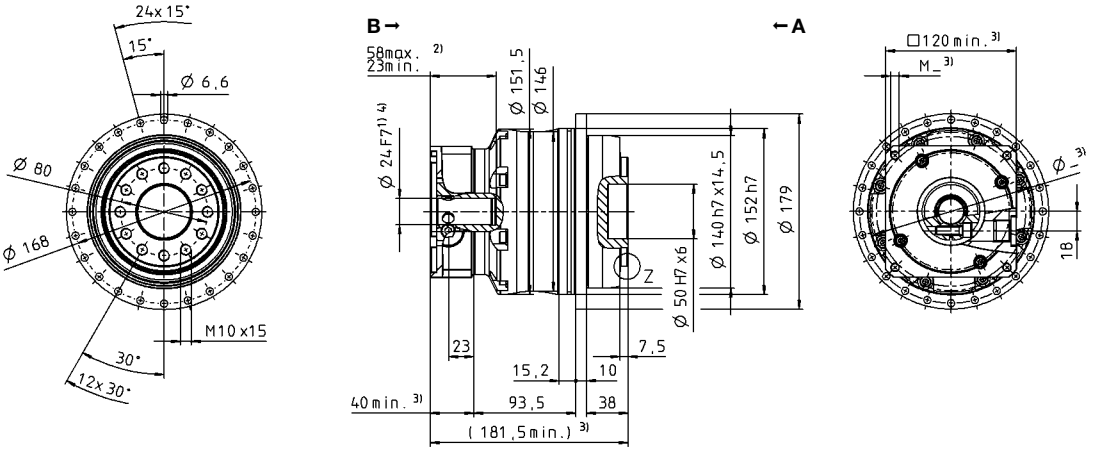
[d)] Please reduce input speed at higher ambient temperatures

View A View B

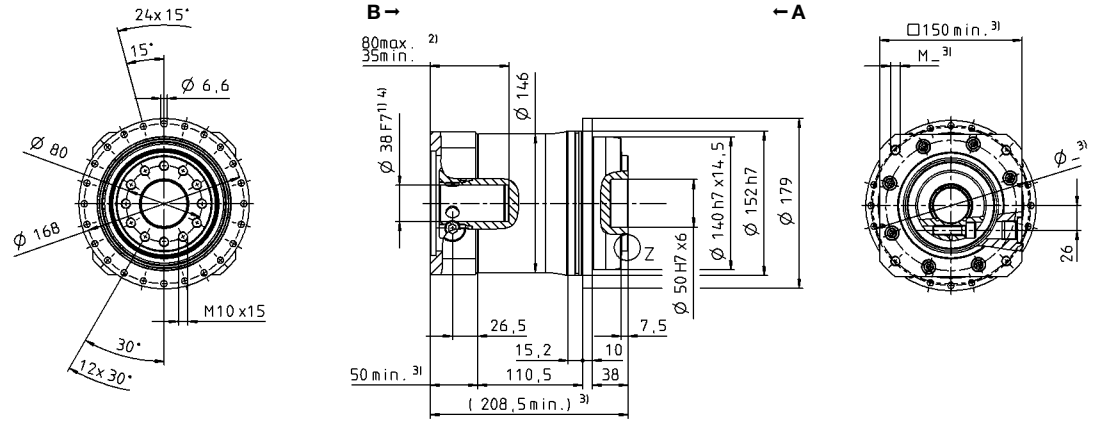
2-stage

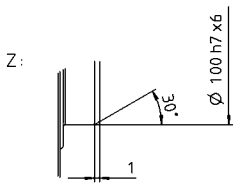
Motor shaft diameter [mm]

up to 24 [4] (G)[5] clamping hub diameter



up to 38 [4] (K) clamping hub diameter





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[1] Check motor shaft fit

[2] Min./Max. permissible motor shaft length. Longer motor shafts are possible, please contact alpha.

[3] The dimensions depend on the motor

[4] Smaller motor shaft diameter is compensated by a bushing with a minimum thickness of 1 mm

[5] Standard clamping hub diameter

Basic Line gearbox overview

Product type		**CP**	**CPS**	**CPK**	**CPSK**	**CVH**	**CVS**
Version		MF	MF	MF	MF	MF / MT	MF / MT
Ratio [c]	min. *i* =	3	3	3	3	7	7
	max. *i* =	100	100	100	100	40	40
Max. torsional backlash [arcmin] [c]	Standard	≤ 12	≤ 12	≤ 13	≤ 15	≤ 15	≤ 15
	Reduced	–	–	–	–	–	–
Output shape							
Smooth shaft		x	x	x	x	–	x
Shaft with key [d]		x	x	x	x	–	x
Splined shaft (DIN 5480)		–	–	–	–	–	–
Blind hollow shaft		–	–	–	–	–	–
Hollow shaft interface		–	–	–	–	x	–
Keyed hollow shaft		–	–	–	–	x	–
Flanged hollow shaft		–	–	–	–	–	–
Flange		–	–	–	–	–	–
System output		–	–	–	–	–	–
Output on both sides		–	–	–	–	x	x
Input type							
Motor-mounted		x	x	x	x	x	x
Self-contained version [b]		–	–	–	–	–	–
Characteristic							
Flange with slotted holes		–	–	–	–	–	–
ATEX [a]		–	–	–	–	–	–
Food-grade lubrication [a] [b]		x	x	x	x	x	x
Corrosion resistant [a] [b]		–	–	–	–	–	–
Optimized mass inertia [a]		–	–	–	–	–	–
System solutions							
Linear system (rack / pinion)		–	–	–	–	–	–
Servo actuator		–	–	–	–	–	–
Accessories (please refer to the product pages for further options)							
Coupling		x	x	x	x	–	x
Shrink disc		–	–	–	–	x	–

[a] Power reduction: technical data available on request
[b] Please contact WITTENSTEIN alpha
[c] In relation to reference sizes
[d] Power reduction: Please use our sizing software cymex® for a detailed sizing – **www.wittenstein-cymex.com**

Value Line gearbox overview

Product type		NP	NPL	NPS	NPT	NPR	NPK	NPLK	NPSK	NPTK	NPRK	NVH	NVS	HDV
Version		MF / MA	MF / MA	MF / MA	MF / MA	MF / MA	MF	MF	MF	MF	MF	MF	MF	MF / MT
Ratio [c]	min. i =	3	3	3	3	3	3	3	3	3	3	4	4	4
	max. i =	100	100	100	100	100	100	100	100	100	100	400	400	100
Max. torsional backlash [arcmin] [c]	Standard	≤ 8	≤ 8	≤ 8	≤ 8	≤ 8	≤ 11	≤ 11	≤ 11	≤ 11	≤ 11	≤ 6	≤ 6	≤ 10
	Reduced	–	–	–	–	–	–	–	–	–	–	–	–	–
Output type														
Smooth shaft		x	x	x	–	x	x	x	x	–	x	–	x	x
Shaft with key [d]		x	x	x	–	x	x	x	x	–	x	–	x	x
Splined shaft (DIN 5480)		–	x	x	–	x	–	x	x	–	x	–	–	–
Blind hollow shaft		–	–	–	–	–	–	–	–	–	–	–	–	–
Hollow shaft interface		–	–	–	–	–	–	–	–	–	–	x	–	–
Keyed hollow shaft		–	–	–	–	–	–	–	–	–	–	x	–	–
Flanged hollow shaft		–	–	–	–	–	–	–	–	–	–	–	–	–
Flange		–	–	–	x	–	–	–	–	x	–	–	–	–
System output		–	–	–	–	–	–	–	–	–	–	–	–	–
Output on both sides		–	–	–	–	–	–	–	–	–	–	x	x	–
Input type														
Motor-mounted		x	x	x	x	x	x	x	x	x	x	x	x	x
Self-contained version [b]		–	–	–	–	–	–	–	–	–	–	–	–	–
Characteristic														
Flange with slotted holes		–	–	–	–	x	–	–	–	–	x	–	–	–
ATEX [a]		–	–	–	–	–	–	–	–	–	–	–	–	–
Food-grade lubrication [a] [b]		x	x	x	x	x	x	x	x	x	x	x	x	x
Corrosion resistant [a] [b]		–	–	–	–	–	–	–	–	–	–	x	x	x
Optimized mass inertia [a]		–	–	–	–	–	–	–	–	–	–	–	–	–
System solutions														
Linear system (rack / pinion)		x	x	x	–	x	x	x	x	–	x	–	x	–
Servo actuator		–	–	–	–	–	–	–	–	–	–	–	–	x
Accessories (please refer to the product pages for further options)														
Coupling		x	x	x	x	x	x	x	x	–	x	–	x	–
Shrink disc		–	–	–	–	–	–	–	–	–	–	x	–	–

[a] Power reduction: technical data available on request
[b] Please contact WITTENSTEIN alpha
[c] In relation to reference sizes
[d] Power reduction: Please use our sizing software cymex® for a detailed sizing – **www.wittenstein-cymex.com**

Advanced Line gearbox overview

Product type		SP+	SP+ HIGH SPEED	SP+ HIGH SPEED friction optimized	TP+	TP+ HIGH TORQUE	HG+	SK+	SPK+
Version		MF	MC	MC-L	MF	MA	MF	MF	MF
Catalog page		26	26	26	80	80	128	140	150
Ratio [c]	min. i =	3	3	3	4	22	3	3	12
	max. i =	100	100	10	100	302.5	100	100	10000
Max. torsional backlash [arcmin] [c]	Standard	≤ 3	≤ 4	≤ 4	≤ 3	≤ 1	≤ 4	≤ 4	≤ 4
	Reduced	≤ 1	≤ 2	≤ 2	≤ 1	–	–	–	≤ 2
Output shape									
Smooth shaft		x	x	x	–	–	–	x	x
Shaft with key [d]		x	x	x	–	–	–	x	x
Splined shaft (DIN 5480)		x	x	x	–	–	–	x	x
Blind hollow shaft		x	x	x	–	–	–	–	x
Hollow shaft interface		–	–	–	–	–	x	–	–
Keyed hollow shaft		–	–	–	–	–	–	–	–
Flanged hollow shaft		–	–	–	–	–	–	–	–
Flange		–	–	–	x	x	–	–	–
System output		–	–	–	x	x	–	–	–
Output on both sides		–	–	–	–	–	x	x	x
Input type									
Motor-mounted		x	x	x	x	x	x	x	x
Self-contained version [b]		x	–	–	x	–	–	–	–
Characteristic									
Flange with slotted holes		x	–	–	–	–	–	–	–
ATEX [a]		x	x	–	–	–	x	x	–
Food-grade lubrication [a] [b]		x	x	x	x	x	x	x	x
Corrosion resistant [a] [b]		x	x	x	x	x	x	x	x
Optimized mass inertia [a]		x	x	x	x	x	–	–	–
System solutions									
Linear system (rack / pinion)		x	x	–	x	x	–	x	x
Servo actuator		x	–	–	x	x	–	–	–
Accessories (please refer to the product pages for further options)									
Coupling		x	x	x	x	x	–	x	x
Shrink disc		x	x	x	–	–	x	–	x

[a] Power reduction: technical data available on request
[b] Please contact WITTENSTEIN alpha
[c] In relation to reference sizes
[d] Power reduction: Please use our sizing software cymex® for a detailed sizing – **www.wittenstein-cymex.com**

TK+	TPK+	TPK+ HIGH TORQUE	SC+	SPC+	TPC+	VH+	VS+	VT+	DP+	HDP+
MF	MF	MA	MF	MF	MF	MF	MF	MF	MF / MA	MA
178	188	188	228	238	248	262	272	280	292	308
3	12	66	1	4	4	4	4	4	16	22
100	10000	5500	2	20	20	400	400	400	55	55
≤ 4	≤ 4	≤ 1.3	≤ 4	≤ 4	≤ 4	≤ 3	≤ 3	≤ 3	≤ 3	≤ 1
–	≤ 2	–	–	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 1	–
–	–	–	x	x	–	–	x	–	–	–
–	–	–	x	x	–	–	x	–	–	–
–	–	–	–	x	–	–	x	–	–	–
–	–	–	–	x	–	–	–	–	–	–
–	–	–	–	–	–	x	–	–	–	–
–	–	–	–	–	–	x	–	–	–	–
x	–	–	–	–	–	–	–	x	–	–
–	x	x	–	–	x	–	–	–	x	x
–	x	x	–	–	x	–	–	–	–	–
x	x	x	–	–	–	x	x	–	–	–
x	x	x	x	x	x	x	x	x	x	x
–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–
x	–	–	–	–	–	–	–	–	–	–
x	x	x	x	x	x	x	x	x	x	x
x	x	x	–	–	–	x	x	x	x	x
–	–	–	–	–	–	–	–	–	x	x
x	x	x	x	x	x	–	x	x	–	–
–	–	–	–	–	–	–	–	–	–	–
x	x	x	x	x	x	–	x	x	–	–
–	–	–	–	x	–	x	–	–	–	–

Premium Line gearbox overview

Product type		**XP+**	**RP+**	**XPK+**	**RPK+**	**XPC+**	**RPC+**
Version		MF / MC	MF / MA	MF	MA	MF	MA
Ratio [c]	min. *i* =	3	22	12	48	4	22
	max. *i* =	100	220	1000	5500	20	55
Max. torsional backlash [arcmin] [c]	Standard	≤ 3	≤ 1	≤ 4	≤ 1.3	≤ 4	≤ 1.3
	Reduced	≤ 1	–	≤ 2	–	≤ 2	–
Output shape							
Smooth shaft		x	–	x	–	x	–
Shaft with key [d]		x	–	x	–	x	–
Splined shaft (DIN 5480)		x	–	x	–	x	–
Blind hollow shaft		x	–	x	–	x	–
Hollow shaft interface		–	–	–	–	–	–
Keyed hollow shaft		–	–	–	–	–	–
Flanged hollow shaft		–	–	–	–	–	–
Flange		–	x	–	x	–	x
System output		x	x	x	x	x	x
Output on both sides		–	–	–	–	–	–
Input type							
Motor-mounted		x	x	x	x	x	x
Self-contained version [b]		x	–	–	–	–	–
Characteristic							
Flange with slotted holes		x	x	x	x	x	x
ATEX [a]		–	–	–	–	–	–
Food-grade lubrication [a] [b]		x	x	x	x	x	x
Corrosion resistant [a] [b]		–	–	–	–	–	–
Optimized mass inertia [a]		x	x	–	–	–	–
System solutions							
Linear system (rack / pinion)		x	x	x	x	x	x
Servo actuator		x	x	–	–	–	–
Accessories (please refer to the product pages for further options)							
Coupling		x	–	x	–	x	–
Shrink disc		x	–	x	–	x	–

[a] Power reduction: technical data available on request
[b] Please contact WITTENSTEIN alpha
[c] In relation to reference sizes
[d] Power reduction: Please use our sizing software cymex® for a detailed sizing – **www.wittenstein-cymex.com**

Overview of gearbox variants

S P | 100 | **S** | – | M | F | 1 | – | 10 | – | 0 | G | 1 | – | 2 | S

Characteristic:
B = Modular output combination
C = Reverse centering
E = ATEX
F = Food grade lubrication
G = Grease
H = Food-grade grease
L = Friction optimized
R = Flange with slotted holes
S = Standard
W = Corrosion resistant

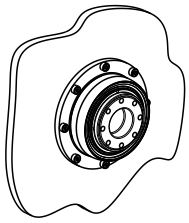
Explanation of variants deviating from the standard:

B = Modular output combination

An additional backward output type is available for hypoid gearboxes. See page 353 for details.

C = Reverse centering

To save space, this variant offers greater flexibility in mounting the product on the machine.



E = ATEX

Devices bearing the Ex symbol comply with EU Directive 2014/34/EN (ATEX) and are approved for use in defined explosion-prone zones. Performance data is limited and can be found in the operating instructions.

F = Food grade lubrication

These products are available with food-grade lubrication and can therefore be used in the food industry. Please note that the torque ratings in the catalog are reduced by 20 % (excluding V-Drive).

G = Grease

This variant allows you to lubricate selected products with grease instead of oil. Please note that the torque ratings in the catalog are reduced by 20 %.

H = Food-grade grease

This variant allows you to lubricate selected products with food-safe grease instead of oil. Please note that the torque ratings in the catalog are reduced by 40%.

L = Friction optimized

A friction-optimized variant is available for HIGH SPEED products.
Design changes allow the products to be used particularly in applications with high temperature sensitivity, high nominal speeds or long duty cycles.

R = Flange with slotted holes

This output type is designed for linear applications with rack and pinion or belt pulley. Integrated slotted holes enable easy positioning of the pinion or simple tensioning of the belt.

W = Corrosion resistant

These products can be used in corrosive environments, e.g. in the food industry, pharmaceutical industry or packaging industry. All external product areas have been designed to avoid corrosion. In addition the products are provided with food-grade grease lubrication. Please note that the torque ratings in the catalog are reduced by 20 % (excluding V-Drive).

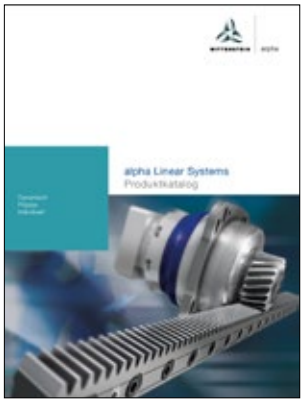
alpha Advanced Linear Systems

Strong performance in the advanced segment

Advanced Linaer Systems are adapted to applications with average to high demands in terms of smooth running, positioning accuracy and feed force. Different gearbox versions and options such as HIGH TORQUE or HIGH SPEED can be selected to utilize the most appropriate system for the application. Typical fields of application include wood, plastic and composite machining, machining centers and automation.

The alpha preferred linear system – The best of each segment

Our preferred linear systems in the Advanced Segment are always comprised of the perfect combination of gearbox, pinion, rack and lubrication system. The systems are optimized to achieve the required feed force, feed speed, rigidity and degree of utilization of the individual components.



For further information, refer to our alpha Linear Systems catalog and our website: www.wittenstein-alpha.com/linear-systems

For a wide range of applications

Linear systems from WITTENSTEIN alpha are suitable for a wide range of applications and industries. New standards and advantages have been achieved in the following areas:

- Smooth operation
- Positioning accuracy
- Feed force
- Power density
- Rigidity
- Easy installation
- Design options
- Scalability

Together with a comprehensive range of services, we pledge to support you from the initial concept to the design, installation and commissioning phase. We will also ensure a consistent supply of spare parts.

Your benefits at a glance

Perfectly adapted linear systems available with planetary, right-angle and worm gearboxes or as an actuator

Optionally with INIRA®

Large individual configuration range due to numerous pinion/gearbox combinations

INIRA®: The revolution in rack assembly

Simply scan the QR code using your smartphone to see INIRA® in action.

INIRA® combines our existing innovative concepts for the simple, safe and efficient installation of racks. INIRA® clamping, INIRA® adjusting and INIRA® pinning have already made the assembly process much faster, more accurate and more ergonomic. Available for the Advanced and Premium Linear Systems.

INIRA® clamping: Simply faster and more ergonomic

Previously, enormous effort was required to clamp racks to the machine bed using screw clamps. INIRA® clamping integrates the clamping device in the rack. The rack incorporates a mounting sleeve which is guided over the head of the fastening screw to ensure quick and ergonomic clamping.

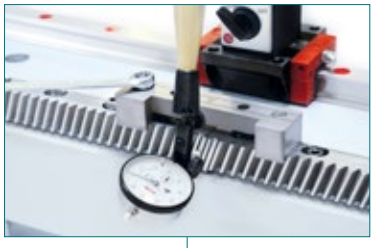
INIRA® adjusting: Simply safer and more precise

In combination with INIRA® clamping, INIRA® adjusting is the ideal solution for perfectly adjusting the transition between two rack segments. The innovative setting tool can adjust the transition extremely reliably and precisely, accurate to the micrometer.

INIRA® pinning: Simply better and more efficient

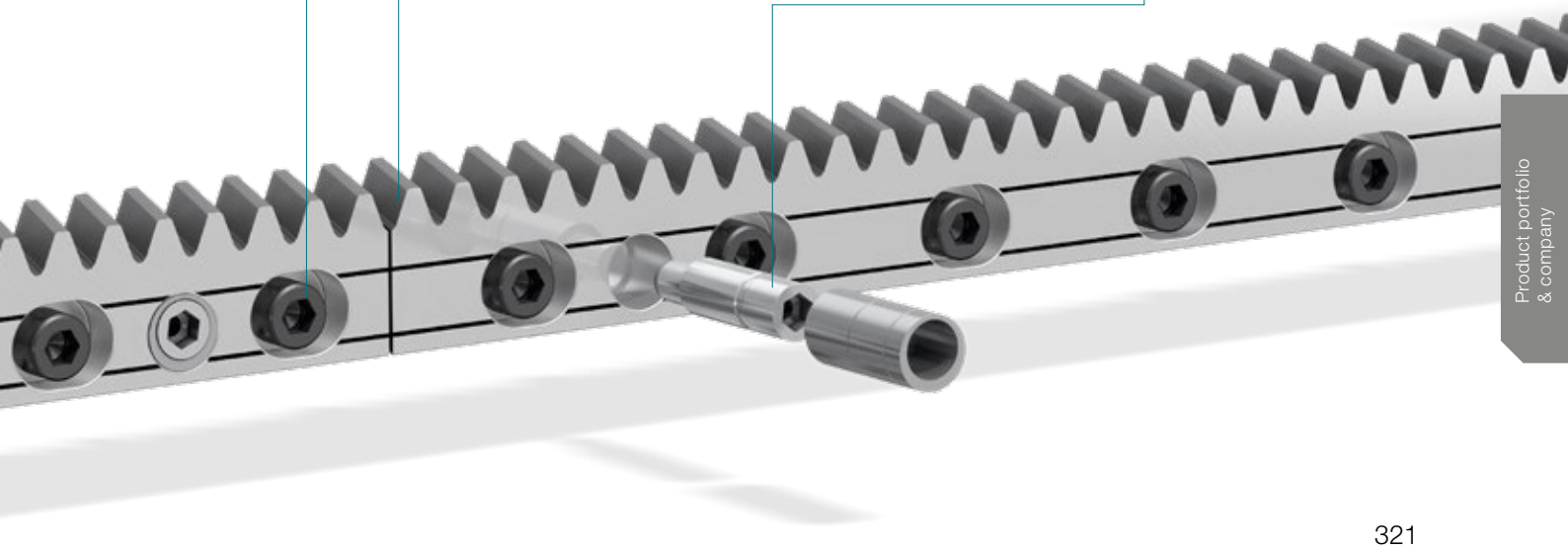
The previous method used for pinning racks was extremely time-consuming. Precision bores have to be drilled and the chips generated must be carefully removed from the assembly. INIRA® pinning now offers a completely new solution for the chipless pinning of racks, which reduces installation times considerably (time spent on each rack ~ 1 min).

INIRA® clamping



INIRA® adjusting

INIRA® pinning



Precision meets motion = premo® by WITTENSTEIN alpha

premo® is a new, powerful servo actuator platform that combines absolute precision with perfect movement. The central idea behind this first fully scalable servo actuator platform is uncompromising flexibility from the viewpoint of the user. Motors and gearboxes with application-related graduated performance characteristics can be configured modularly to individual servo actuators. The result is a highly versatile modular system with customizable power, designed for a wide variety of applications. The core of the servo actuator is a torsionally rigid precision gearbox with low backlash and excellent torque density combined with the equally powerful, permanent magnet servo motor with a split winding that guarantees low cogging and minimal velocity ripple.

premo® – clearly superior in performance

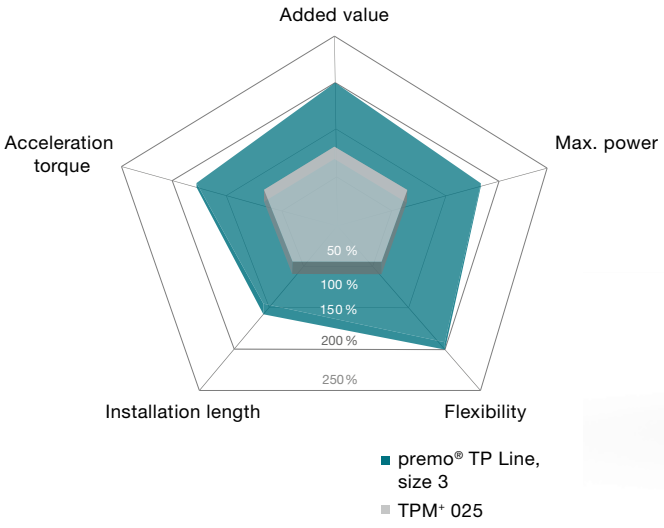
- Higher machine performance thanks to higher acceleration torque
- High torque density combined with a compact design allow for the realization of higher performance machines with significant space saving
- Improved connectivity to next generation controllers from leading system providers through the use of digital feedback (EnDat 2.2, DSL, HIPERFACE DSL®, DRIVE-CLiQ)
- Compatibility for high bus voltages up to 750 V DC
- Reduced wiring requirement through single-connector technology
- Improved reliability and safety through the use of more powerful brakes and SIL 2 encoders

Product highlights

Optimized power density for greater energy efficiency and productivity

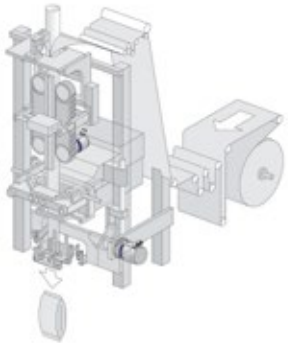
Flexible mechanical and electrical interfaces for high scalability

Variety of options for individually upgrading the basic configuration

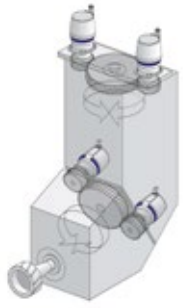


premo® application examples

Handling portal
premo® SP Line



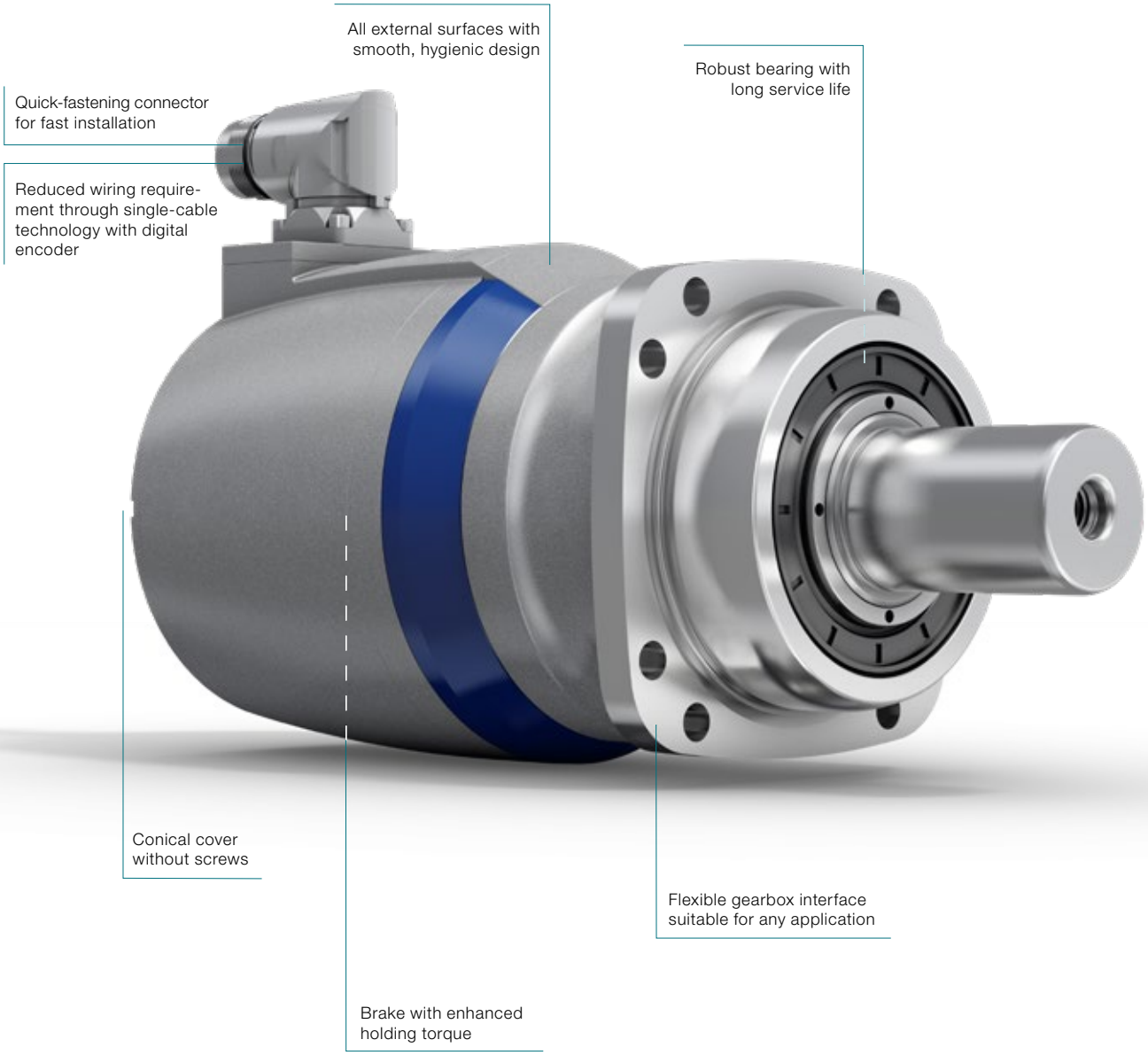
Fill and Seal machine
premo® TP Line



Milling cutter for a machining center
premo® XP Line

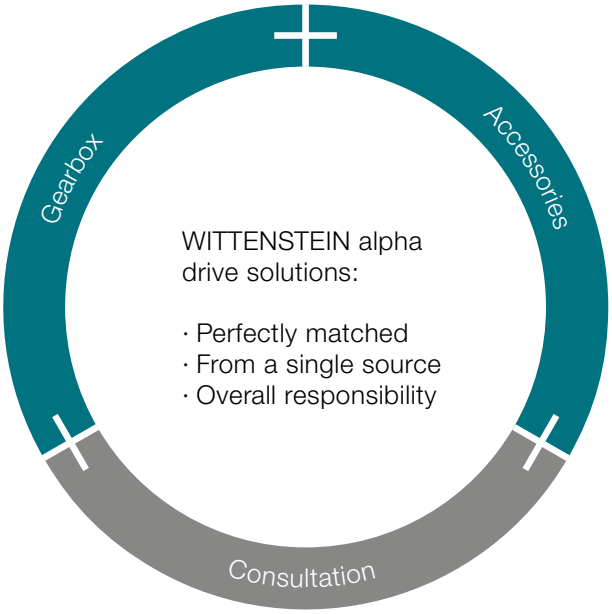
Typical fields of application and industry solutions

- Delta robot (axes 1–3, swivel axis)
- Handling portal (Z-axis, swivel / rotating axis)
- Machine tool reaming (rotating axes A–C, tool changer)
- Fill and Seal Machine (incl. jaw stroke, sealing jaw, blade)
- Folding carton packaging (incl. assembly / folding, filling valve)
- Plastic thermoform (tool axis)



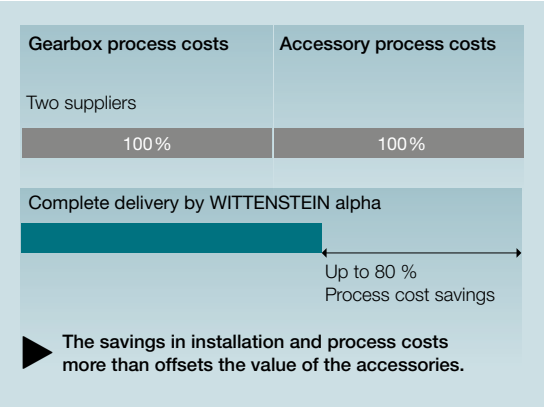
Accessories – smart additions for intelligent performance

Gearboxes, accessories and consulting from a single source



Optimization of your added value chain

Use the combination of gearbox and accessories in a complete package to streamline your internal processes.



Shrink disks

Shrink disks are frictional hub / shaft connections. Together with our hollow shaft or mounted shaft gearboxes for mounting directly on load shafts, machines can be designed to take up a minimal installation space.

The benefits:
· Simple mounting and removal
· Quick selection, easy and convenient
· Optional: corrosion resistant version

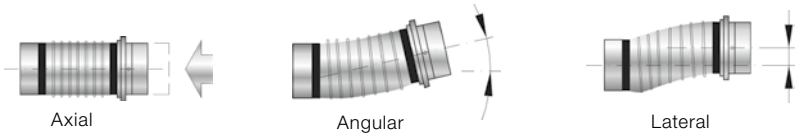
Preferred shrink disk series

To view a wide range of nickel-plated, stainless steel and other shrink disks as well as all the relevant technical data and dimensions, visit our homepage
www.wittenstein-alpha.com

Couplings

Couplings are used for compensating misalignment during assembly and material-related heat expansion

Compensation for shaft misalignment



Metal bellows coupling

- Compensation for shaft misalignment
- Completely backlash free
- Corrosion resistant version available as an option (BC2, BC3, BCT)
- High torsional rigidity

Elastomer coupling

- Compensation for shaft misalignment
- Completely backlash free
- Selectable torsional rigidity / damping
- Compact design
- Extremely simple installation (plug-in)

Torque limiter

- Compensation for shaft misalignment
- Completely backlash free
- Precise, preset overload protection (switch-off in 1 – 3 ms)
- Precise repeat accuracy
- Just one protection element per axis

Preferred coupling series

alpha Premium

alpha Advanced

alpha Value

alpha Basic

Preferred series are defined for the relevant gearbox segments to make selection easier. Preferred couplings are defined based on the maximum torque that the gearbox can transmit. Standard industrial conditions for the number of cycles (1000/h) and ambient temperature were adopted.

Please note that the coupling load is based on the torque that the gearbox can transmit and not the torque in your application. We recommend using our cymex®5 design software to create a more detailed design. (www.wittenstein-cymex.com)

For more coupling types, please visit
www.wittenstein-alpha.com

Support at each interaction stage

With the WITTENSTEIN alpha service concept, we are also setting new standards in the field of customer support.

Global presence

Our global consultation network will help you overcome your complex challenges through our extensive experience, a variety of design tools and individual engineering services.

Speed counts

Our speedline® team guarantees fast response times in the area of logistics. We provide on-site support during the installation and commissioning of mechanical systems to give you a sustained competitive edge.

Personal consultation

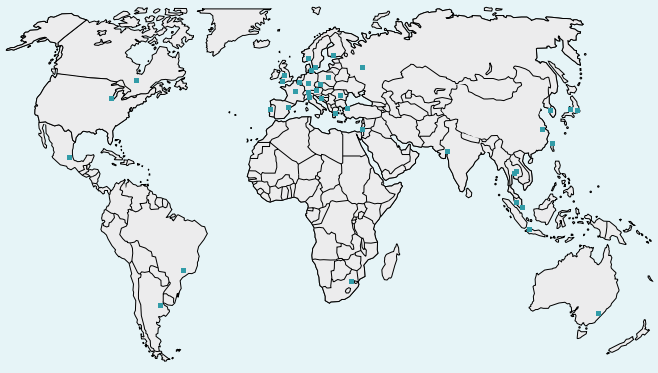
Our highly qualified and committed expert personnel will accompany you throughout the entire product lifecycle - around the clock. When it comes to customer support, you can count on us!

Design

Consultation
CAD POINT
SIZING ASSISTANT
Sizing software cymex®
Engineering

Installation

speedline® delivery
Installation on-site
Operating & installation instructions
Pick-up & return service



We are happy to advise you:

24 h service hotline: **+49 7931 493-12900**

No matter where you need us:
A comprehensive sales and service network provides quick availability and competent support worldwide.

Maintenance

24 h service hotline
Maintenance and inspection
Repair
cymex® statistics
Modernization

Training

Product training
Sizing training
Installation training
Service training

Support at each interaction stage

Design

Whatever your requirements are: we offer the right design methodology. Use the CAD POINT to gain easy access to CAD files, the SIZING ASSISTANT for creating simple designs, cymex® 5 for precise dimensioning and our engineering service for individual solutions.

Consultation

- Personal contact on-site
- Professional application calculations and drive design create the best solutions

Engineering

Catalog gearboxes:

- Advanced software tools for accurate calculation, simulation and analysis of the drive train
- Optimization of your productivity and reduction in development costs

Special gearboxes:

- Gearing design and development
- Development and production of special gearboxes
- Send all inquiries to: **sondergetriebe@wittenstein.de**

CAD POINT

- 3D data of selected solution
- Online comparison with motor geometry
- Transparent and simple selection of required components

SIZING ASSISTANT

- Efficient online design within seconds
- Convenient comparison function
- Automatic geometry adjustment

cymex® 5 sizing software

- Dimensioning, design and evaluation of the entire drive train
- Reliable, efficient design
- Optimization of drive system

Installation

All delivered products are perfectly matched to your application environment and fully operational right away.

Our service experts support you in the installation and commissioning of complex mechatronic systems, guaranteeing maximum availability of your plant.

speedline® delivery

Tel. +49 7931 493-10444

- Delivery of standard series in 24 or 48 hours ex works*
- Outstanding flexibility for fast deliveries at short notice

Operating and installation instructions

- Detailed explanations of how to use the product
- Motor installation videos
- Assembly videos on rack and pinion system

Installation on-site

- Professional installation
- Optimal integration of the system in your application
- Explanation of the drive function

Pick-up and return service

- Cost savings through minimization of downtimes
- Professional logistics organization
- Reduction of transport risks through customized, direct pick-up and delivery

* Non-binding delivery time depending on part availability.

Support at each interaction stage

Maintenance

WITTENSTEIN alpha guarantees fast repairs of the highest quality and precision – with short throughput times and intensive support. In addition, we will provide you with information about various measurements, material analyses and condition monitoring inspections. You can rely on short response times, unbureaucratic processing and individual support.

24 h service hotline

Tel. +49 7931 493-12900

- Available round the clock
- Personal, prompt service for resolving time-critical maintenance issues

Maintenance and inspection

- Documentation regarding condition and expected service life
- Maintaining required state
- Customized maintenance schedules

Repair

- Restoring to required state
- Short throughput times
- Immediate response in time-critical situations

cymex® statistics

- Systematic field data acquisition
- Reliability calculations (MTBF)
- Customized evaluations

Modernization

- Professional retrofitting
- Reliable compatibility testing of existing solutions

Training

Discover how our products function and how they can add value to your application. We offer you training courses at our premises or on-site at your plant. Benefit from practice-oriented learning methods and a highly skilled team of trainers.

Product training

Greater knowledge enables greater achievement. We will be pleased to share our expert knowledge with you: Profit from our many years of experience and learn more about the product portfolio of WITTENSTEIN alpha.

Installation training

We offer you individual training courses on-site for your system application of selected linear axes as well as professional installation.

Sizing training

Become a design expert! We will provide you with training courses on our design software, adapted to your requirements. Whether for beginners or experts, for occasional or regular users – we adapt our training course to your wishes and requirements.

Service training

Participation in a service training course is a prerequisite for sourcing spare parts at the parts list level. We offer you training courses at our premises or on-site at your plant. Moreover, we regularly host maintenance workshops at which the participants are instructed in safe handling during mounting of the motor to the gearbox as well as the independent replacement of wearing parts and gearbox assemblies.

The WITTENSTEIN group – The company and its fields of business

With approximately 2,900 employees worldwide, WITTENSTEIN SE stands for innovation, precision and excellence in the world of mechatronic drive technology, both nationally and internationally. The group is active in seven innovative fields of business. Furthermore, WITTENSTEIN SE is represented by some 60 subsidiaries in around 40 countries in all important technology and sales markets worldwide.

Our fields of expertise

We provide know-how for a host of different sectors:

- Machine and plant construction
- Software development
- Aerospace
- Automotive & E-mobility
- Energy
- Oil & Gas Exploration and Production
- Medical technology
- Measurement and testing technology
- Nanotechnology
- Simulation

The WITTENSTEIN Group

WITTENSTEIN | alpha

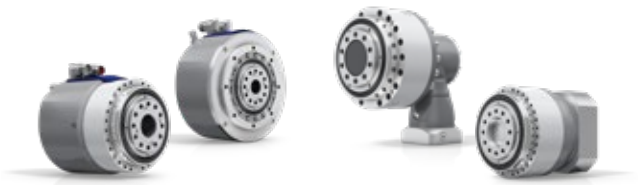
WITTENSTEIN alpha GmbH
High-precision servo drives and linear systems

WITTENSTEIN | cyber motor

WITTENSTEIN cyber motor GmbH
Highly dynamic servo motors and drive electronics

WITTENSTEIN | galaxie

WITTENSTEIN galaxie GmbH
Superior gearboxes and drive systems



WITTENSTEIN | motion control

WITTENSTEIN motion control GmbH
Customized linear and rotary servo systems

WITTENSTEIN | aerospace & simulation

WITTENSTEIN aerospace & simulation GmbH
Mechatronic drive systems for aerospace & simulation

attocube
WITTENSTEIN Group

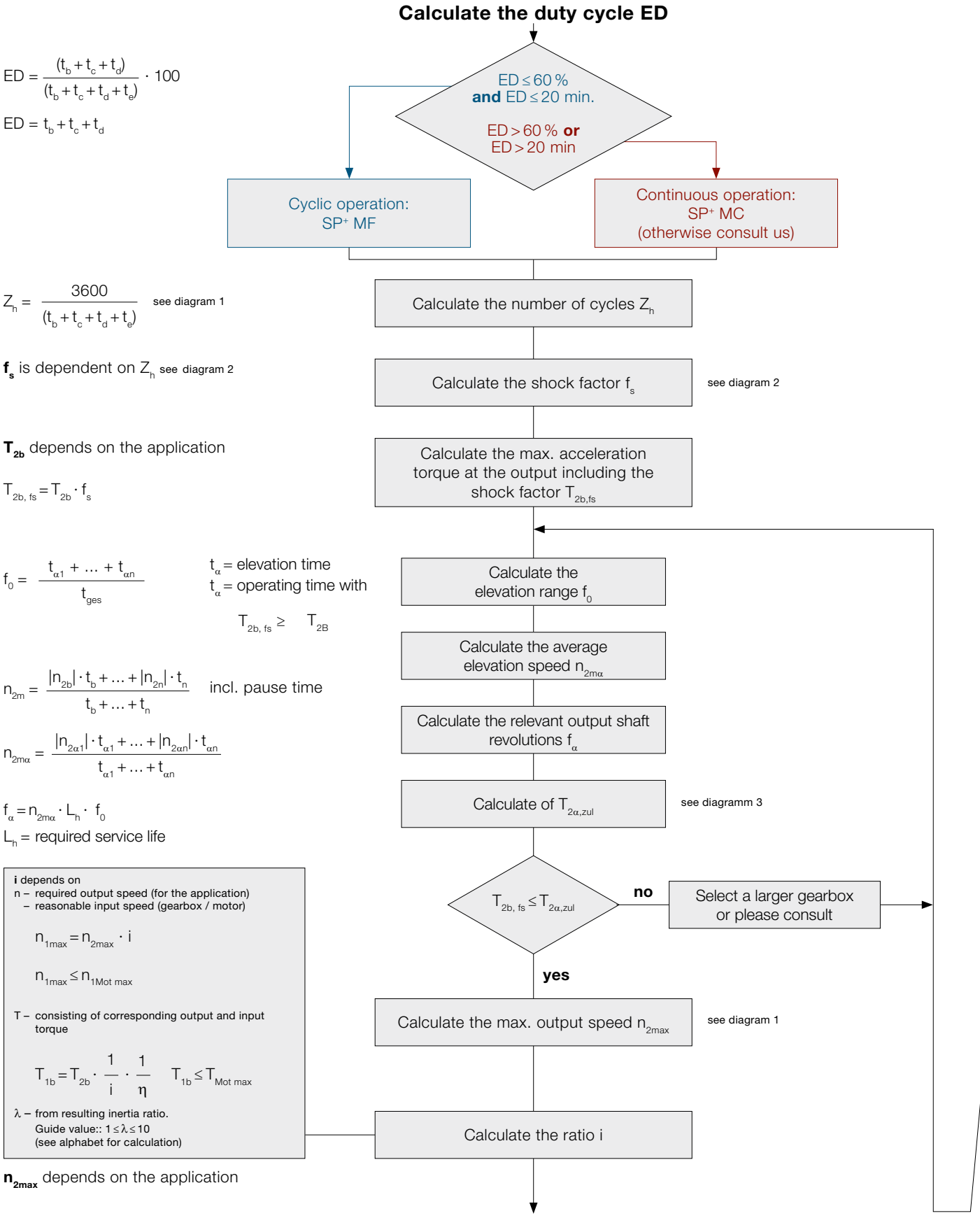
attocube systems AG
Nanoprecision drive and measurement technology solutions

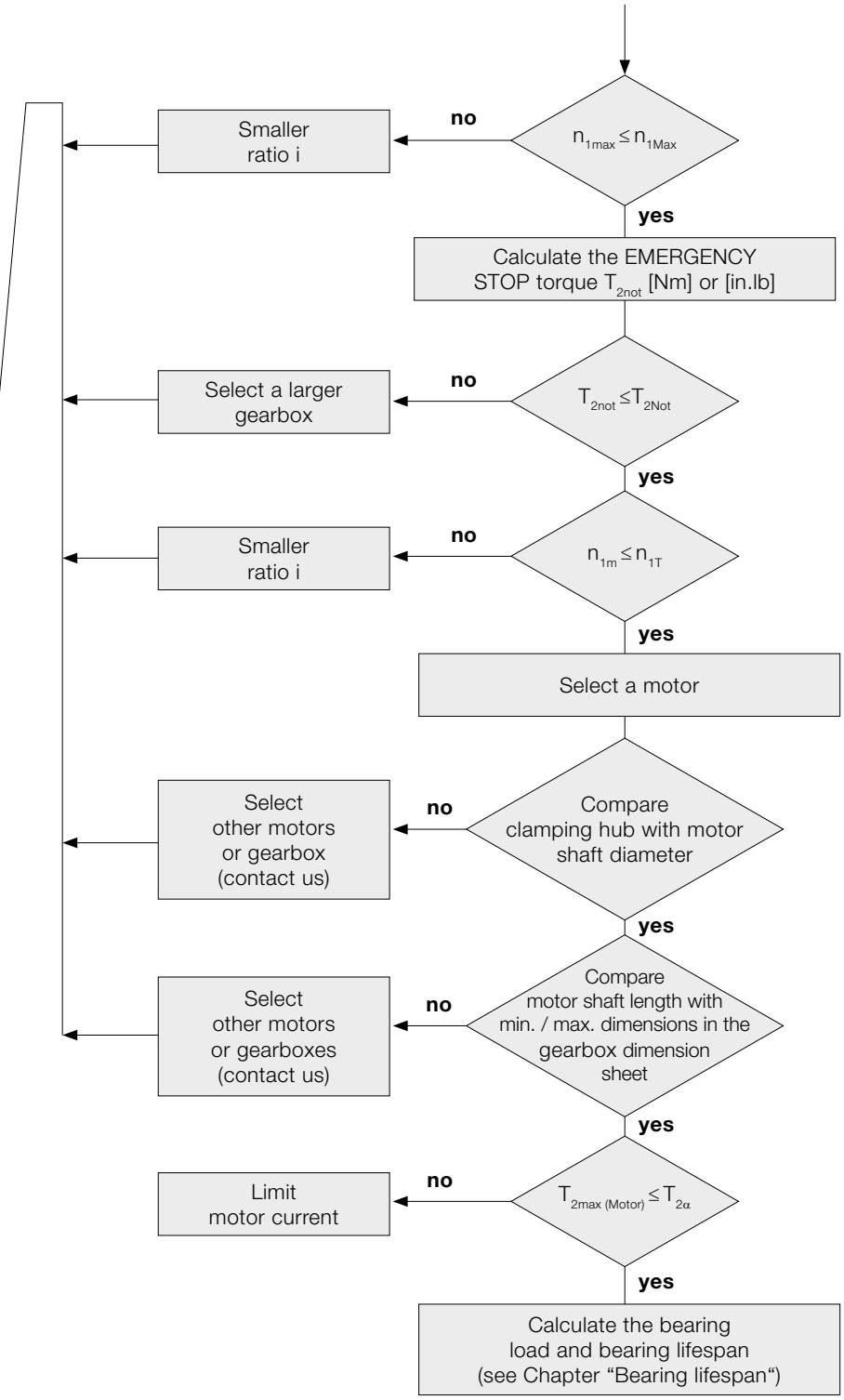
baramundi

baramundi software AG
Secure management of IT infrastructure in offices and production areas

Gearbox general – Detailed sizing

Cyclic operation **S5** and continuous operation **S1**





Please refer to the relevant technical data for information on the max. permissible characteristic values for your gearbox.

T_{2not} depends on the application

$n_{1m} = n_{2m} \cdot i$

$D_{W, Mot} \leq D_{clamping\ hub}$

The motor shaft must be inserted far enough into the clamping hub.

The motor shaft must protrude far enough into the clamping hub without making contact.

$T_{2max (Motor)} = T_{1max (Motor)} \cdot i \cdot \eta_{gearbox}$

The gearbox should not be damaged when the motor operates at full load, limit the motor current if necessary.

Diagram 1
Standard collective load at output. At input speeds up to rated speed n_{1N} or thermal speed limit n_{1T}, the temperature of the gearbox will not exceed 90 °C under average ambient conditions.

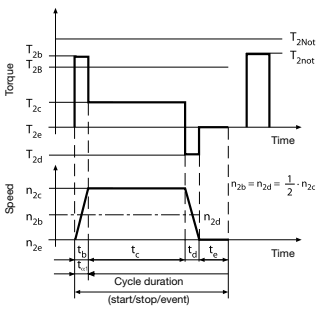


Diagram 2
Large number of cycles combined with short acceleration times may cause the drive train to vibrate. Use the shock factor f_s to include the resulting excess torque values in calculations.

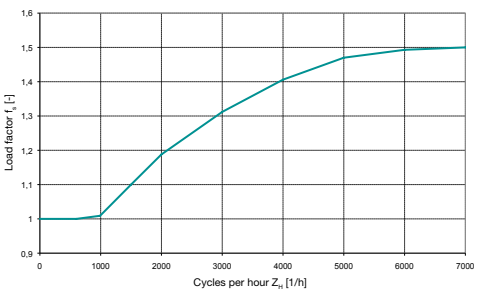
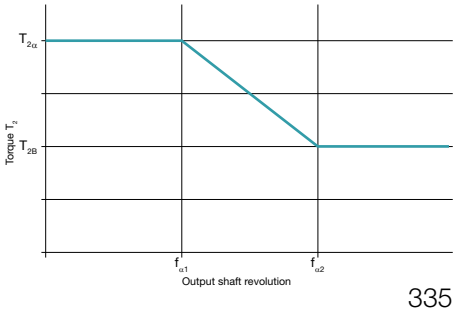
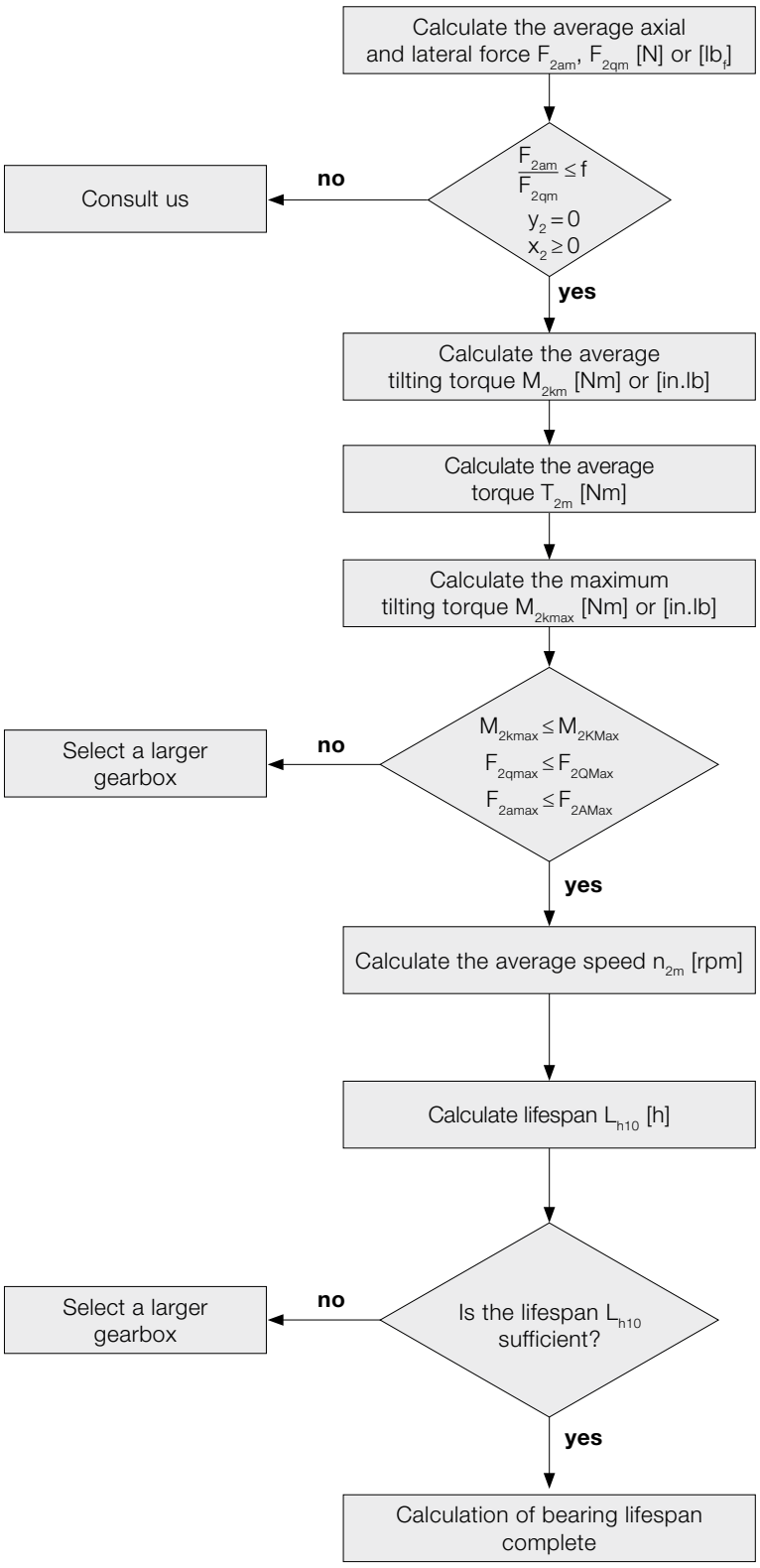


Diagram 3
The transmittable torque $T_{2\alpha,per}$ of the gearbox is dependent on the number of output shaft revolutions. In the lower output shaft revolution range, the fatigue strength range of the toothing can be fully utilized up to the maximum value $T_{2\alpha}$.



Gearbox general – Detailed sizing

Bearing lifespan L_{h10}



$$F_{2am} = \sqrt[3]{\frac{|n_{2b}| \cdot t_b \cdot |F_{2ab}|^3 + \ldots + |n_{2n}| \cdot t_n \cdot |F_{2an}|^3}{|n_{2b}| \cdot t_b + \ldots + |n_{2n}| \cdot t_n}}$$

$$F_{2qm} = \sqrt[3]{\frac{|n_{2b}| \cdot t_b \cdot |F_{2qb}|^3 + \ldots + |n_{2n}| \cdot t_n \cdot |F_{2qn}|^3}{|n_{2b}| \cdot t_b + \ldots + |n_{2n}| \cdot t_n}}$$

$$M_{2km} = \frac{F_{2am} \cdot y_2 + F_{2qm} \cdot (x_2 + z_2)}{W}$$ a)

$$T_{2m} = \sqrt[3]{\frac{|n_{2b}| \cdot t_b \cdot |T_{2b}|^3 + \ldots + |n_{2n}| \cdot t_n \cdot |T_{2n}|^3}{|n_{2b}| \cdot t_b + \ldots + |n_{2n}| \cdot t_n}}$$

$$M_{2kmax} = \frac{F_{2amax} \cdot y_2 + F_{2qmax} \cdot (x_2 + z_2)}{W}$$ a)

a) x, y, z in mm

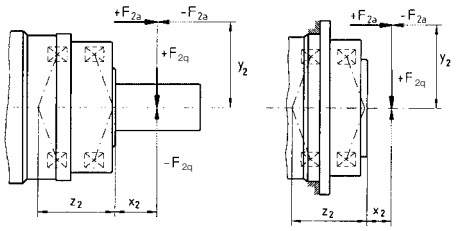
$$n_{2m} = \frac{n_{2b} \cdot t_b + \ldots + n_{2n} \cdot t_n}{t_b + \ldots + t_n}$$

$$L_{h10} = \frac{16666}{n_{2m}} \cdot \left[\frac{K1_2}{M_{2km}}\right]^{p_2}$$

	metric	inch
W	1000	1

	TP⁺/TPK⁺	SP⁺/SPK⁺
f	0.37	0.40

Example with output shaft and flange:



SP⁺/SPK⁺/SPC⁺		060	075	100	140	180	210	240
z_2	[mm]	42.2	44.8	50.5	63.0	79.2	94.0	99.0
	[in]	1.66	1.76	1.99	2.48	3.12	3.70	3.90
$K1_2$	[Nm]	795	1109	1894	3854	9456	15554	19521
	[in.lb]	7036	9815	16762	34108	83686	137653	172761
p_2		3.33	3.33	3.33	3.33	3.33	3.33	3.33

TP⁺/TPK⁺/ TPC⁺/DP⁺		004	010	025	050	110	300	500	2000	4000
z_2	[mm]	57.6	82.7	94.5	81.2	106.8	140.6	157	216	283
	[in]	2.27	3.26	3.72	3.20	4.21	5.48	6.12	8.50	11.1
$K1_2$	[Nm]	536	1325	1896	4048	9839	18895	27251	96400	184000
	[in.lb]	4744	11726	16780	35825	87075	167220	241171	853140	1628400
p_2		3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33

HDP⁺		010	025	050
z_2	[mm]	90.4	99.1	83.5
	[in]	3.56	3.90	3.29
$K1_2$	[Nm]	1325	1896	4048
	[in.lb]	11726	16780	35825
p_2		3.33	3.33	3.33

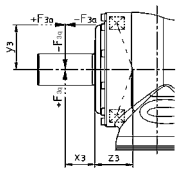
TK⁺/SK⁺/HG⁺/SC⁺/VH⁺/VS⁺/VT⁺: Calculation using cymex®.
Please contact us for further information.

Hypoid gearboxes – Detailed sizing

Gearbox types and sizes				TK+ 004 SK+ 060 HG+ 060	SPK+ 075 TPK+ 010 TPK+ 025 MA	TK+ 010 SK+ 075 HG+ 075	SPK+ 100 TPK+ 025 TPK+ 050 MA
Dimensions of rearward drive							
Solid shaft:	diameter	$øD_{k6}$	mm	16	16	22	22
	length	L	mm	28 ±0.15	28 ±0.15	36 ±0.15	36 ±0.15
Hollow shaft interface outer diameter		$øD_{h8}$	mm	18	18	24	24
Hollow shaft interface inner diameter		$ød_{h6}$	mm	15	15	20	20
Hollow shaft interface length		L_{hw}	mm	14	14	16	16
Distance from input axis		A	mm	42.9	42.9	52.6	52.6
Key dimensions (E = key as per DIN 6885, sheet 1, form A)		l	mm	25	25	32	32
		b_{h9}	mm	5	5	6	6
		a	mm	2	2	2	2
		h	mm	18	18	24.5	24.5
Output shaft threaded bore		B		M5x12.5	M5x12.5	M8x19	M8x19
Permissible load of rearward drive							
Max. acceleration torque [c]		$T_{3\alpha,zul}$		$= T_{2\alpha,zul}$ on the condition that $T_{2b,fs} + T_{3b,fs} \leq T_{2\alpha,zul}$	Please contact us	$= T_{2\alpha,zul}$ on the condition that $T_{2b,fs} + T_{3b,fs} \leq T_{2\alpha,zul}$	Please contact us
Nominal output torque [c]		T_{3N}		$= T_{2N} - T_{2n}$		$= T_{2N} - T_{2n}$	
EMERGENCY STOP torque [c]		T_{3Not}		$= T_{2Not} - T_{2not}$		$= T_{2Not} - T_{2not}$	
Max. axial force [b]		F_{3Amax}		1500	1500	1800	1800
Max. lateral force [b]		F_{3Qmax}		2300	2300	3000	3000
Max. tilting torque		M_{3Kmax}		60	60	100	100
Calculation of average tilting torque at the rearward drive							
Factor for tilting torque calculation		z_3	mm	11.9	11.9	15.6	15.6
Distance between axial force and center of gearbox		y_3	mm	Application-dependent			
Distance between lateral force and shaft collar		x_3	mm	Application-dependent			

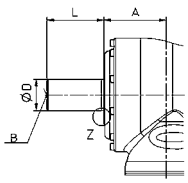
[a] Connection via shrink discs
[b] Refers to center of shaft
[c] See also page 336, “Detailed dimensioning – Gearbox“

Rearward drive:

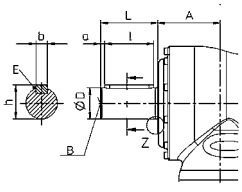


$$M_{3k} = F_{3a} \cdot y_3 + F_{3q} \cdot (x_3 + z_3)$$

Smooth shaft

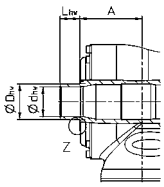


Shaft with key



TK+ 025 SK+ 100 HG+ 100	SPK+ 140 TPK+ 050 TPK+ 110 MA	TK+ 050 SK+ 140 HG+ 140	SPK+ 180 SPK+ 240 TPK+ 110 TPK+ 500 TPK+ 300 MA	TK+ 110 SK+ 180 HG+ 180	SPK+ 210 TPK+ 300 TPK+ 500 MA
32	32	40	40	55	55
58 ±0.15	58 ±0.15	82 ±0.15	82 ±0.15	82 ±0.15	82 ±0.15
36	36	50	50	68	68
30	30	40	40	55	55
20	20	25	25	25	25
63.5	63.5	87	87	107.8	107.8
50	50	70	70	70	70
10	10	12	12	16	16
4	4	5	5	6	6
35	35	43	43	59	59
M12x28	M12x28	M16x36	M16x36	M20x42	M20x42
= $T_{2\alpha,zul}$ on the condition that $T_{2b,fs} + T_{3b,fs} \leq T_{2\alpha,zul}$	Please contact us	= $T_{2\alpha,zul}$ on the condition that $T_{2b,fs} + T_{3b,fs} \leq T_{2\alpha,zul}$	Please contact us	= $T_{2\alpha,zul}$ on the condition that $T_{2b,fs} + T_{3b,fs} \leq T_{2\alpha,zul}$	Please contact us
= $T_{2N} - T_{2n}$		= $T_{2N} - T_{2n}$		= $T_{2N} - T_{2n}$	
= $T_{2Not} - T_{2not}$		= $T_{2Not} - T_{2not}$		= $T_{2Not} - T_{2not}$	
2000	2000	9900	9900	4000	4000
3300	3300	9500	9500	11500	11500
150	150	580	580	745	745
16.5	16.5	20	20	23.75	23.75
Application-dependent					
Application-dependent					

Hollow shaft interface [a)]



Hollow shaft

No connection possible

Cover

No connection possible

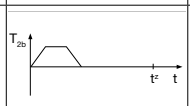
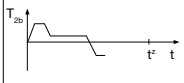
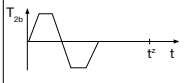
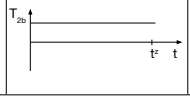
Worm gearboxes – Detailed sizing

A: Simplified sizing for servo motors based on the maximum motor torque: $\mathbf{M_{max} * i \leq T_{2\alpha}}$

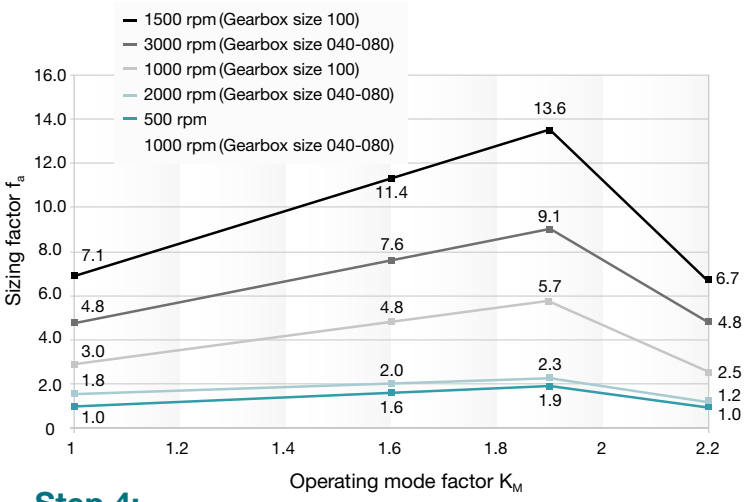
B: Sizing based on the application

Step 1:
Determine the application data
$\mathbf{T_{2b}}$= _____ **[Nm]** $\mathbf{n_{1n}}$= _____ **[rpm]**

Step 2:
Determine the operating mode factor $\mathbf{K_M}$= _____

Typical applications	Cycle	Torque characteristic	Operating mode factor K_M
Format changing, e.g. in packaging machines, drives for processing equipment, actuators etc.	**S5 operation:** Low duty cycle Small number of cycles Low dynamics		1.0
Tool changers with low dynamics, pick & place gantry axes, tire building machines etc.	**S5 operation:** Medium duty cycle Small number of cycles Medium dynamics		1.6
Linear axes in plasma, laser or water jet cutters, portals, tool changers with high dynamics	**S5 operation:** Medium duty cycle Medium number of cycles High dynamics		1.9
Roller drives in printing presses, star drives in rackers etc.	**S1 operation:** High duty cycle		2.2
cymex® 5 also allows sizing calculations for other applications / cycles!			

Step 3:
Determine the sizing factor f_a with the operating mode factor K_M $\mathbf{f_a}$= _____



Step 4:
Compare the equivalent application torque with the maximum gearbox $\mathbf{T_{2\alpha}}$ (see table, Step 5)

$\mathbf{T_{2\_eq} = f_a * T_{2b} \leq T_{2\alpha}}$

$\mathbf{T_{2\_eq}}$ = _____ * _____ ≤ $\mathbf{T_{2\alpha}}$

$\mathbf{T_{2\_eq}}$ = _____ **[Nm]** ≤ _____ **[Nm]**

We recommend using a vent screw for duty cycles ≥ 60 %, longer than 20 min (S1 operation) and n1N ≥ 3000 rpm.

Step 5: Quick selection of the technical data

			V-Drive Advanced				
			040	**050**	**063**	**080**	**100**
Ratio	i		4 - 400				
Maximum torque[a] (at n_1= 500 rpm)	$T_{2\alpha}$	Nm	74-106	165-204	319-372	578-785	1184-1505
		in.lb	655-938	1460-1805	2823-3292	5115-6947	10478-13319
Max. input speed	n_{1max}	rpm	6000	6000	4500	4000 / 4500[b]	3500 / 4000[b]
Max. lateral force	F_{2QMax}	N	2400	3800	6000	9000	14000
		lb_f	540	855	1350	2025	3150
Operating noise (with n_1 =3000 rpm no load)	L_{PA}	dB(A)	≤ 54	≤ 62	≤ 64	≤ 66	≤ 70
Max. torsional backlash	j_t	arcmin	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3
Service life (For calculation see "Information")	L_h	h	> 20000	> 20000	> 20000	> 20000	> 20000

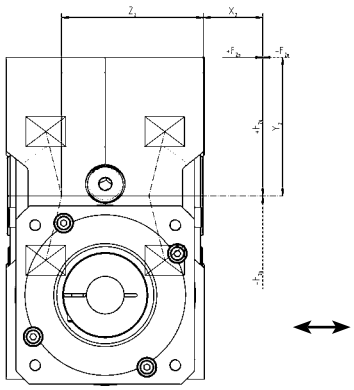
[a] The maximum torques depend on the ratio.
[b] First value for single-stage version, second value for two-stage version.

Account must be taken of the lateral and axial forces at the output:

Please also carry out steps 6 and 7 if forces are present at the output (e.g. if timing belt pulleys, pinions or levers are mounted there).

Step 6 (if external forces are present):

Determine the forces acting on the output and check the boundary conditions



Lateral force F_{2q} = _____ [N]
Lateral force distance x_2 = _____ [mm]
Axial force F_{2a} = _____ [N]
Axial force distance y_2 = _____ [mm]
(required if F_{2a} is present)

Conditions if axial force F_{2a} is present:

1. $F_{2a} \leq 0.25 * F_{2q} \Rightarrow$ (_____ ≤ 0.25 * _____) ☐ **Met** ☐ **Not met:** Sizing with cymex® 5

2. $y_2 \leq x_2 \Rightarrow$ (_____ ≤ _____) ☐ **Met** ☐ **Not met:** Sizing with cymex® 5

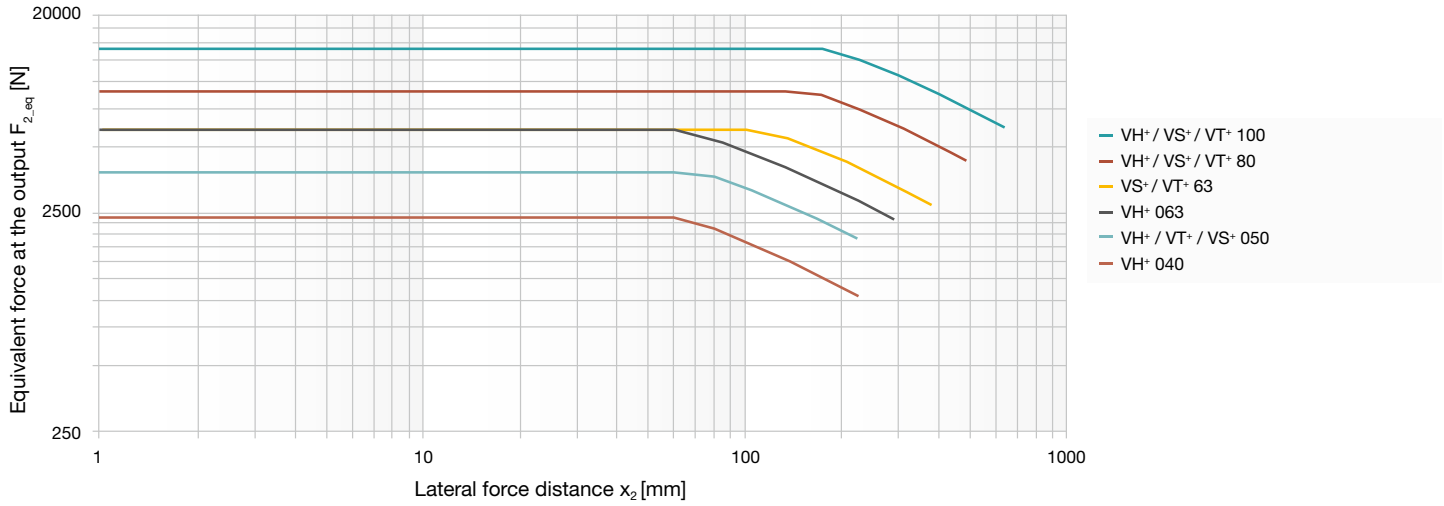
Step 7:

Determine the maximum equivalent force acting on the output F_{2_eq}

$F_{2\_eq} = F_{2q} + 0.25 * F_{2a} \leq F_{2QMax}$ (F_{2QMax} can be determined from the diagram below)

F_{2_eq} = _____ + 0.25 * _____ ≤ _____

F_{2_eq} = _____ [N] ≤ _____ [N] ☐ **Met** ☐ **Not met:** Sizing with cymex® 5



Glossary – the **alpha**bet

Adapter plate

WITTENSTEIN alpha uses a system of standardized adapter plates to connect the motor and the gearbox, making it possible to mount a WITTENSTEIN alpha gearbox to any desired motor without difficulty.

Angular minute

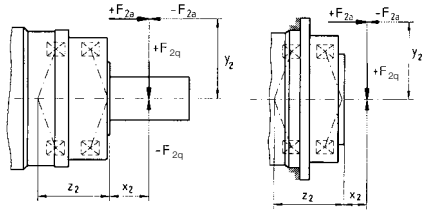
A degree is subdivided into 60 angular minutes (= 60 arcmin = 60‘).

Example:
If the torsional backlash is $j_t = 1$ arcmin, the output can be turned 1/60°. The repercussions for the application are determined by the arc length:
$b = 2 \cdot \pi \cdot r \cdot \alpha° / 360°$.
Example:
A pinion with a radius r = 50 mm mounted on a gearbox with torsional backlash $j_t = 3$ arcmin can be turned b = 0.04 mm.

Axial force (F_{2AMax})

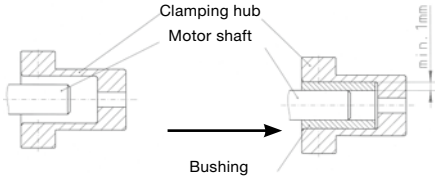
The axial force acting on a gearbox runs parallel to its output shaft or perpendicular to its output shaft. It may be applied with axial offset via a lever arm y_2 under certain circumstances, in which case it also generates a bending moment. If the axial force exceeds the permissible catalog values (max. axial force F_{2AMax}), additional design features (e.g. axial bearings) must be implemented to absorb these forces.

Example with output shaft and flange:



Bushing

If the motor shaft diameter is smaller than the **→ clamping hub**, a bushing is used to compensate the difference in diameter. The bushing must have a minimum thickness of 1 mm and a motor shaft diameter of 2 mm.



CAD POINT

Performance data, dimension sheets and CAD data for all types of gearbox can be found online in our CAD POINT together with comprehensive documentation of the selection.
(www.wittenstein-cad-point.com)

Clamping hub

The clamping hub ensures a frictional connection between the motor shaft and gearbox. A **→ bushing** is used as the connecting element if the motor shaft diameter is smaller than that of the clamping hub. Optionally, a positive connection via a parallel key is also possible.

Continuous operation (S1)

Continuous operation is defined by the **→ duty cycle**. If the duty cycle is greater than 60 % and / or longer than 20 minutes, this qualifies as continuous operation. **→ Operating modes**

Cyclic operation (S5)

Cyclic operation is defined via the **→ duty cycle**. If the duty cycle is less than 60 % and shorter than 20 minutes, it qualifies as cyclic operation **(→ operating modes)**.

cymex®

cymex® is the calculation software developed by our company for dimensioning complete drive trains. The software enables the precise simulation of motion and load variables. The software is available for download from our website (www.wittenstein-cymex.com). We can also provide training to enable you to make full use of all the possibilities provided by the software.

Degree of protection (IP)

The various degrees of protection are defined in DIN EN 60529 “Degrees of protection offered by enclosure (IP code)“. The IP degree of protection (International Protection) is represented by two digits. The first digit indicates the protection against the ingress of impurities and the second the protection against the ingress of water.

Example: **IP65**

Protection against the ingress of dust (dust-proof)	Protection against spray water

Duty cycle (DC)

The cycle determines the duty cycle DC. The times for acceleration (t_b), constant travel if applicable (t_c) and deceleration (t_d) combined yield the duty cycle in minutes. The duty cycle is expressed as a percentage with inclusion of the pause time t_e.

$$DC\ [\%] = \left[\frac{t_b + t_c + t_d}{t_b + t_c + t_d + t_e}\right] \cdot 100 \quad \frac{\text{Motion duration}}{\text{Cycle duration}}$$

$$DC\ [\text{min}] = t_b + t_c + t_d$$

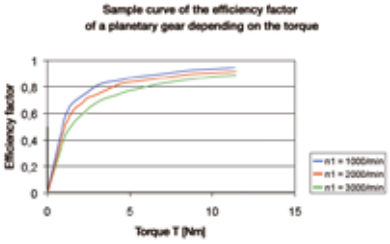
Emergency stop torque (T_{2Not})

The Emergency stop torque T_{2Not} is the maximum permissible torque at the gearbox output and must not be reached more than 1000 times during the life of the gearbox. It must never be exceeded!

Efficiency (η)

Efficiency [%] η is the ratio of output power to input power. Power lost through friction reduces efficiency to less than 1 or 100 %.

$$\eta = P_{off} / P_{on} = (P_{on} - P_{loss}) / P_{on}$$



WITTENSTEIN alpha always measures the efficiency of a gearbox during operation at full load. If the input power or torque are lower, the efficiency rating is also lower due to the constant no-load torque. Power losses do not increase as a result. A lower efficiency is also expected at high speeds (see illustration).

Ex symbol

Devices bearing the Ex symbol comply with EU Directive 94 / 9 / EC (ATEX) and are approved for use in defined explosion-hazardous zones.

Detailed information on explosion groups and categories, as well as further information on the relevant gearbox are available upon request.

Food-grade lubrication (F)

These products are designed with food-grade lubrication and can therefore be used in the food industry. Note the reduced torques compared to the standard products. (V-Drive excluded).
The exact torques can be found in cymex® 5 or CAD POINT.

HIGH SPEED (MC)

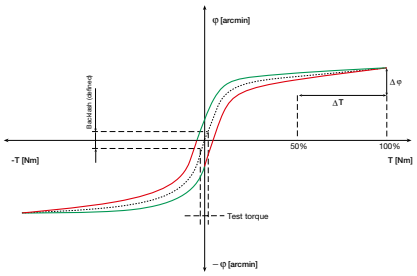
The HIGH SPEED version of our gearbox has been specially developed for applications in continuous operation at high input speeds, e.g. as found in the printing and packaging industries.

HIGH TORQUE (MA)

WITTENSTEIN alpha gearboxes are also available in a HIGH TORQUE version. These gearboxes are particularly suited to applications requiring extremely high torques and maximum stiffness.

Hysteresis curve

The hysteresis is measured to determine the torsional rigidity of a gearbox. The result of this measurement is known as the hysteresis curve.



If the input shaft is locked, the gearbox is continuously loaded and relieved at the output in both directions up to a defined torque. The torsional angle is plotted against the torque. This yields a closed curve from which the → **torsional backlash** and → **torsional rigidity** can be calculated.

Jerk (*j*)

Jerk is derived from acceleration and is defined as the change in acceleration within a unit of time. The term impact is used if the acceleration curve changes abruptly and the jerk is infinitely large.

Lateral force (F_{2QMax})

The max. lateral force F_{2QMax} [N] is the force component acting at right angles to the output shaft or parallel to the output flange. It acts perpendicular to the → axial force and can assume an axial distance of x_2 in relation to the shaft nut or shaft flange, which acts as a lever arm. The lateral force produces a bending moment (see also → axial force).

Mass inertia ratio (λ = Lambda)

The mass inertia ratio λ is the ratio of external inertia (application side) to internal inertia (motor and gearbox side). It is an important parameter determining the controllability of an application. Accurate control of dynamic processes becomes more difficult with differing mass moments of inertia and as λ becomes greater. WITTENSTEIN alpha recommends that a guideline value of $\lambda < 5$ is maintained. A gearbox reduces the external mass moment of inertia by a factor of $1/i^2$.

$$\lambda = \frac{J_{extern}}{J_{intern}}$$

J reduced externally at input:

$J'_{external} = J_{external} / i^2$

Simple applications ≤ 10

Dynamic applications ≤ 5

Highly dynamic applications ≤ 1

Mass moment of inertia (*J*)

The mass moment of inertia J [kg/cm²] is a measurement of the effort applied by an object to maintain its momentary condition (at rest or moving).

Mesh frequency (f_z)

The mesh frequency may cause problems regarding vibrations in an application, especially if the excitation frequency corresponds to a intrinsic frequency of the application. The mesh frequency can be calculated for planetary gearboxes from WITTENSTEIN alpha (exception: gearboxes with ratio i = 8) using the formula $f_z = 1.8 \cdot n_2$ [rpm] and on planetary gearboxes from WITTENSTEIN alpha, is independent of the ratio. If it does indeed become problematic, the intrinsic frequency of the system can be changed or another gearbox (e.g. hypoid gearbox) with a different mesh frequency can be selected.

No-load running torque (T_{012})

The no-load running torque T_{012} is the torque which must be applied to a gearbox in order to overcome the internal friction; it is therefore considered lost torque. The values specified in the catalog are calculated by WITTENSTEIN alpha at a speed of $n_1 = 3000$ rpm and an ambient temperature of 20 °C.

T_{012}: 0 (without load) 1→2 (from input side towards output side)

Idling torques decrease during operation.

NSF

Lubricants certified as grade H1 by the NSF (National Sanitation Foundation) can be used in the food sector where occasional unavoidable contact with food cannot be excluded.

Operating modes (continuous operation **S1** and cyclic operation **S5**)

Gearboxes are selected depending on whether the motion profile is characterized by frequent acceleration and deceleration phases in → **cyclic operation** (S5) as well as pauses, or whether it is designed for → **continuous operation** (S1), i.e. with long phases of constant motion.

Operating noise (L_{PA})

The gear ratio and speed affect the noise level. As a general rule: A higher speed means a higher noise level, while a higher ratio means a lower noise level. The values specified in our catalog are based on a reference ratio and speed. The reference speed is either n1= 3000 rpm or n1= 2000 rpm depending on the size of the gearbox. You can find ratio-specific values in cymex® – www.wittenstein-cymex.com.

Output shaft revolution (f_α)

Factor f_α determines the number of life time cycles for the required gearbox service life. It describes the number of revolutions at the output used to assess the torque permitted at the output.

→ Refer to this term for further details.

Glossary – the **alpha**bet

Positioning accuracy

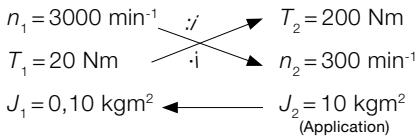
The positioning accuracy is determined by the angular deviation from a setpoint and equals the sum of the torsional angles due to load **→ (torsional rigidity and torsional backlash)** and kinetics **→ (synchronization error) occurring simultaneously in practise** .

Quality control

All Premium and Advanced gearboxes are subject to a final inspection before they leave the WITTENSTEIN alpha factory to ensure that they are all delivered within specification.

Ratio (*i*)

The gear ratio i indicates the factor by which the gearbox transforms the three relevant parameters of motion (speed, torque and mass moment of inertia). The factor is a result of the geometry of the gearing elements (Example: i = 10).



Safety note

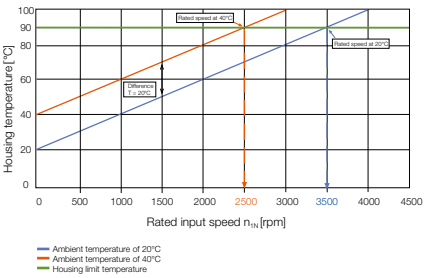
For applications with special safety requirements (e.g. vertical axes, clamped drives), we recommend exclusive use of our Premium and Advanced products (excluding V-Drive).

SIZING ASSISTANT

The online SIZING ASSISTANT from WITTENSTEIN alpha allows the efficient selection of a gearbox in seconds. You can use various motor or application entry options to select the right gearbox for your application in seconds (www.sizing-assistant.com).

Speed (*n*)

Two speeds are of relevance when dimensioning a gearbox: the maximum speed and the thermal speed limit at the input. The maximum permissible speed n_{1Max} must not be exceeded because it serves as the basis for dimensioning **→ cyclic operation**. The nominal speed n_{1N} must not be exceeded in **→ continuous operation**. The thermal speed limit n_{1T} at an ambient temperature of 20° C, is determined by the maximum gearbox temperature of T = 90° C at no-load. As can be seen in the diagram below, the temperature limit is reached more quickly in the presence of an elevated outside temperature. In other words: the nominal input speed must be reduced if the ambient temperature is high. The values applicable to your gearbox are available from WITTENSTEIN alpha on request.



Delivery of speedline®

If necessary, you can receive delivery of standard series in 24 or 48 hours ex works. Outstanding flexibility for fast deliveries at short notice

Synchronization

Synchronization refers to the measurable speed variation between the input and output during one revolution of the output shaft. It is caused by manufacturing tolerances and causes minute angular deviations and ratio fluctuations.

Technical data

You can download further technical data relating to the entire product portfolio from our website

Tilting rigidity

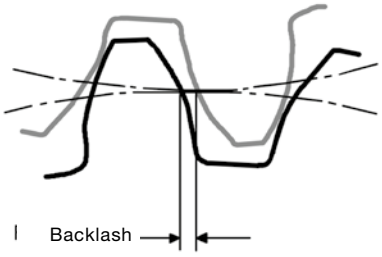
The tilting rigidity C_{2K} [Nm/arcmin] of the gearbox consists of the bending stiffness of the output or pinion shaft and the stiffness of the output bearing. It is defined as the quotient of tilting moment M_{2K} [Nm] and tilting angle Φ [arcmin] ($C_{2K} = M_{2K}/\Phi$).

Tilting torque (M_{2K})

The tilting torque M_{2K} is a result of the **→ axial and lateral forces** applied and their respective points of application in relation to the inner radial bearing on the output side.

Torsional backlash (j_t)

Torsional backlash j_t [arcmin] is the maximum angle of torsion of the output shaft in relation to the input. Simply put, the torsional backlash represents the gap between two tooth flanks.



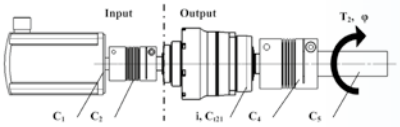
Torsional backlash is measured with the input shaft locked.

The output is then loaded with a defined test torque in order to overcome the internal gearbox friction. The main factor affecting torsional backlash is the face clearance between the gear teeth. The low torsional backlash of WITTENSTEIN alpha gearboxes is due to their high manufacturing accuracy and the specific combination of gear wheels.

Torsional rigidity (C_{t21})

Torsional rigidity [Nm/arcmin] C_{t21} is defined as the quotient of applied torque and resulting torsion angle ($C_{t21} = \Delta T/\Delta\Phi$). It shows the torque required to turn the output shaft by one angular minute. The torsional rigidity can be determined from the **→ hysteresis curve**.

Torsional rigidity C, angle of torsion Φ



Reduce all torsional rigidity values at the output:

$$C_{(n),out} = C_{(n),in} * i^2$$

with i = Gearbox ratio [-]

$C_{(n)}$ = Individual rigidity values [Nm/arcmin]

→ Refer to this term for further details.

Note: The torsional rigidity C_{t21} for the gearbox always relates to the output.

Series connection of torsional rigidity values

$1/C_{tot} = 1/C_{1,out} + 1/C_{2,out} + \ldots + 1/C_{(n)}$

Angle of torsion Φ [arcmin]

$\Phi = T_2 * 1/C_{tot}$
with T_2 = output torque [Nm]

Torque (*M*)

The torque is the actual driving force of a rotary motion. The force and lever arm combine to produce the torque that acts around the axis of rotation. $M = F \cdot l$

Torque ($T_{2\alpha}$)

$T_{2\alpha}$ represents the maximum torque transmitted by the gearbox. This value may decrease depending on the application-specific conditions and the precise evaluation of the movement profile.

Glossary – Formulae

Formulae

Torque [Nm]	$T = J \cdot \alpha$	J = Mass moment of inertia [kgm^2] α = Angular acceleration [1/s^2]
Torque [Nm]	$T = F \cdot l$	F = Force [N] l = Lever, length [m]
Acceleration force [N]	$F_b = m \cdot a$	m = Mass [kg] a = Linear acceleration [m/s^2]
Frictional force [N]	$F_{Reib} = m \cdot g \cdot \mu$	g = Acceleration due to gravity 9.81 m/s^2 μ = Coefficient of friction
Angular speed [1/s]	$\omega = 2 \cdot \pi \cdot n / 60$	n = Speed [rpm] π = PI = 3.14...
Linear speed [m/s]	$v = \omega \cdot r$	v = Linear speed [m/s] r = Radius [m]
Linear speed [m/s] (spindle)	$v_{sp} = \omega \cdot h / (2 \cdot \pi)$	h = Screw pitch [m]
Linear acceleration [m/s^2]	$a = v / t_b$	t_b = Acceleration time [s]
Angular acceleration [1/s^2]	$\alpha = \omega / t_b$	
Pinion path [mm]	$s = m_n \cdot z \cdot \pi / \cos \beta$	m_n = Normal module [mm] z = Number of teeth [-] β = Helix angle [°]

Conversion table

1 mm	= 0.039 in
1 Nm	= 8.85 in.lb
1 kgcm²	= 8.85 x 10^{-4} in.lb.s^2
1 N	= 0.225 lb_f
1 kg	= 2.21 lb_m

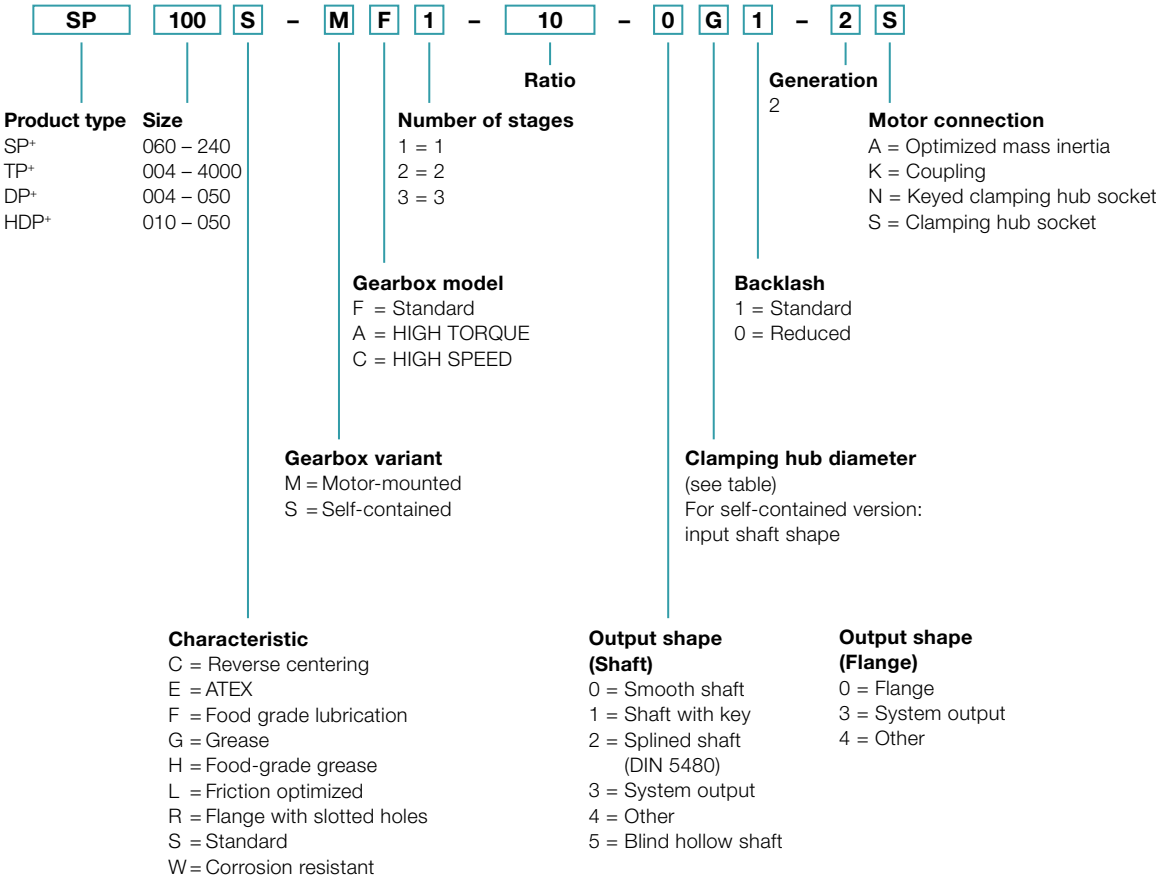
Symbol

Symbol	Unit	Designation
C	Nm/arcmin	Stiffness
ED	%, min	Duty cycle
F	N	Force
f_s	–	Load factor
f_e	–	Factor for duty cycle
i	–	Ratio
j	arcmin	Backlash
J	kgm^2	Mass moment of inertia
K1	Nm	Factor for bearing calculation
L	h	Service life
L_{PA}	dB(A)	Operating noise
m	kg	Mass
M	Nm	Torque
n	rpm	Speed
p	–	Exponent for bearing calculation
η	%	Efficiency
t	s	Time
T	Nm	Torque
v	m/min	Linear speed
z	1/h	Number of cycles

Index

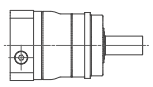
Index	Designation
Capital letter	Permissible values
Small letter	Actual values
1	Input
2	Output
A/a	Axial
B/b	Acceleration
c	Constant
d	Deceleration
e	Pause
h	Hours
K/k	Tilting
m	Mean
Max/max	Maximum
Mot	Motor
N	Nominal
Not/not	Emergency stop
0	No load
Q/q	Lateral
t	Torsional
T	Tangential

Ordering code – Planetary gearbox

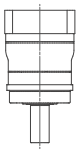


Mounting positions and clamping hub diameters

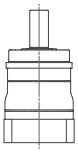
B5
Horizontal



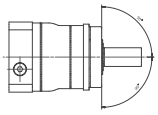
V1
Output vertical downwards



V3
Output vertical upwards



S
Can be tilted ±90° from a horizontal position



Clamping hub diameter
(see technical data sheet for possible diameters)

Code letter	mm	Code letter	mm
B	11	I	32
C	14	K	38
E	19	M	48
G	24	N	55
H	28	O	60

Intermediate sizes possible using bushings with a minimum thickness of 1 mm.

For information purposes only – not required when placing orders!

Exceptions:
- The mounting position of TP+ 2000 / 4000 must be specified.
- DP+ / HDP+ products are designed for mounting position B5 as standard!

If the mounting position is different, contact WITTENSTEIN alpha without fail.

Ordering code – Hypoid- / Bevel gearboxes

SPK+	100	S	–	M	F	2	–	50	–	0	E	1	–	1	K	0	1

Product type
SK+
SPK+
SC+
SPC+
HG+
TK+
TPK+
TPC+

Size
060 – 180
075 – 240
060 – 180
060 – 180
060 – 180
004 – 110
010 – 4000
004 – 180

Characteristic
B = Modular output combination
E = ATEX
F = Food grade lubrication
S = Standard
W = Corrosion resistant

Gearbox variant
M = Motor-mounted

Gearbox model
F = Standard
A = HIGH TORQUE

Number of stages
1 = 1
2 = 2
3 = 3
4 = 4

Ratio

Output shape (Shaft)
0 = Smooth shaft
1 = Shaft with key
2 = Splined shaft (DIN 5480)
3 = System output
4 = Other
5 = Blind hollow shaft

Clamping hub diameter
(see table)

Backlash
1 = Standard
0 = Reduced

Generation
1

Motor connection
K = Coupling
S = Clamping hub socket

Number of input stages
0 = 0
1 = 1

Number of output stages
0 = 0
1 = 1
2 = 2

Output shape (Flange)
0 = Flange
3 = System output
4 = Other
5 = Flanged hollow shaft

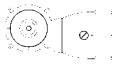
Output shape (Hollow shaft)
5 = Hollow shaft interface / Hollow shaft
6 = Hollow shaft interface / Hollow shaft interface

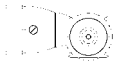
Mounting positions

B5 / V3
Output horizontal / motor shaft vertical upwards

B5 / V1
Output horizontal / motor shaft vertical downwards

V1 / B5
Output vertical downwards / motor shaft horizontal





V3 / B5
Output vertical upwards / motor shaft horizontal

B5 / B5
Output horizontal / motor shaft horizontal

Please note the orientation when placing your order.

Exceptions:
- The mounting position of TPK+ 2000 / 4000 must be specified.
- If the mounting position is different, contact WITTENSTEIN alpha without fail.

Characteristic: Modular output combination (B)

HG+ / SK+ / SPK+ / TK+ / TPK+

SK+ | 100 | **B** | – | M | F | 1 | – | 10 | – | **G** | E | 1 | / motor

Characteristic: **B = Modular output combination**
S = Standard

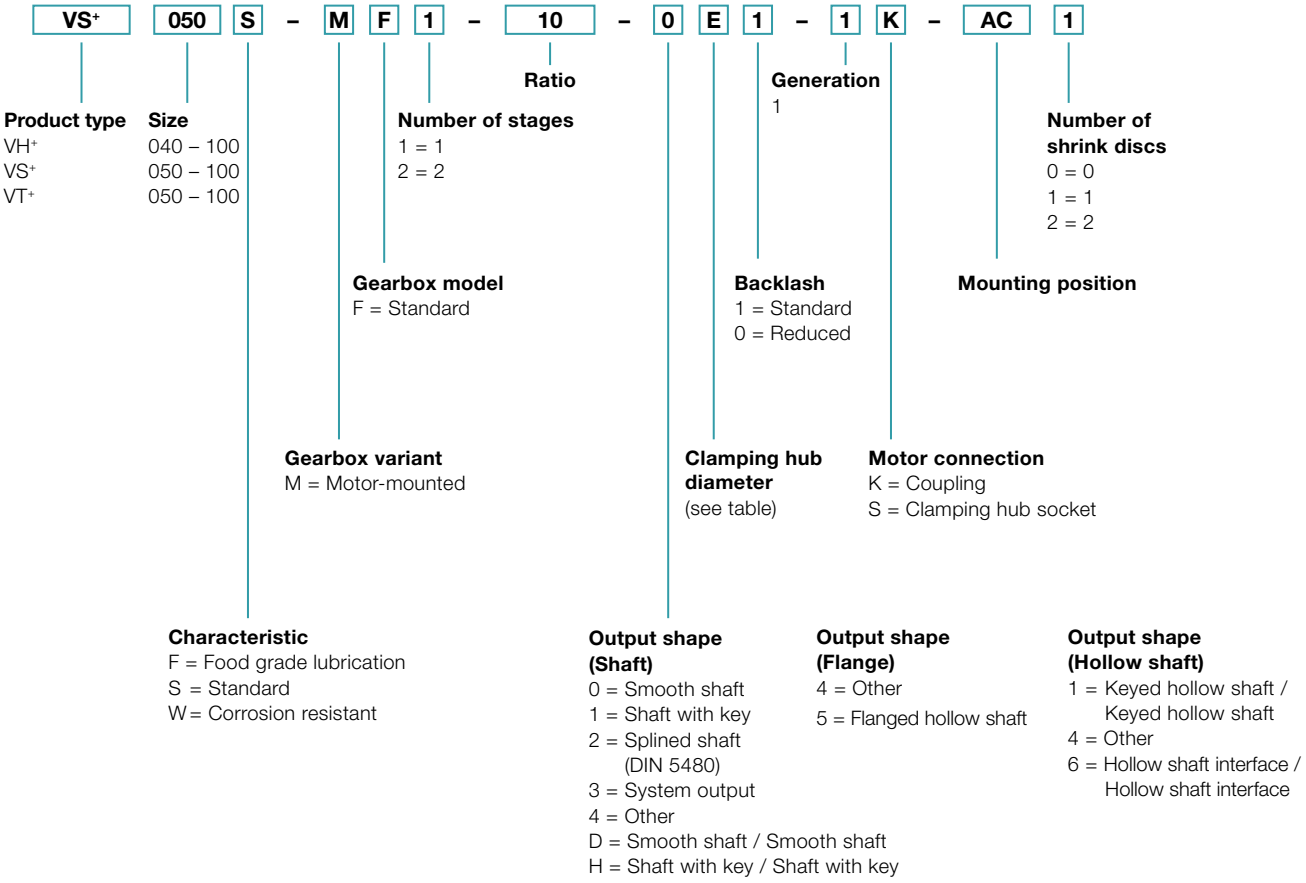
Output shape

When selecting an output combination from the modular system, please select the letter „B“ as the characteristic in the ordering code. The digit for the required output shape is the modular matrix system.
Example: If you opt for an SK+ with a smooth shaft and require an additional output in the form of a shaft with key, then select the letter „G“ and enter in the order key under „Output shape“.

	Backward / Output shape / Front	 Smooth shaft	 Shaft with key	 Hollow shaft interface	 Hollow shaft	 Cover
SK+ / SPK+	 Smooth shaft	**D**	**G**	**A**	**–**	**0***
SK+ / SPK+	 Shaft with key	**E**	**H**	**B**	**–**	**1***
SK+ / SPK+	 Splined shaft (DIN 5480)	**F**	**I**	**C**	**–**	**2***
SPK+	 Blind hollow shaft	**O**	**P**	**N**	**–**	**5***
TK+	 Flanged hollow shaft	**D**	**G**	**6**	**5***	**0**
TPK+	 Flange	**D**	**G**	**6**	**–**	**0***
HG+	 Hollow shaft	**D**	**G**	**6***	**5***	**0**

* Standard version: please specify characteristic „S“ in the order code

Ordering code – Worm gearboxes



Mounting positions and clamping hub diameters

Mounting position (only relevant for oil volume)

Output side A:
View of motor interface,
Output left
Only valid for VS+, VT+

AC


AF


AD


AG


AE


Output side B:
View of motor interface,
Output right
Only valid for VS+, VT+

BC


BF


BD


BG


BE


For VH+ and VS+ with dual-shaft output or hollow shaft, A and B in the mounting position must be replaced with 0 (zero).

Clamping hub diameter

(see technical data sheet for possible diameters)

Code letter	mm
B	11
C	14
E	19
G	24
H	28

Code letter	mm
I	32
K	38
M	48
N	55
O	60

Intermediate diameters possible in combination with a bushing with a minimum thickness of 1 mm.

YOUR NOTE

WITTENSTEIN alpha

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