AF, AFW and AFL Hollow-shaft Gearboxes

For combining with squirrel-cage brake motors, slip-ring rotor and DC motors, and microspeed drive units.

Demag hollow-shaft gearboxes are supplied as complete units.

Advantages

- Rapid, easy fitting
- Enclosed unit, compact and space-saving
- Quiet-running
- Alternative output shaft positions
- Minimum maintenance due to long-term lubrication
- No constraining forces on the transmission.

Squirrel-cage brake motors:

The universal motor for all drive requirements features instant integral braking and high switching frequencies.
Pole-changing versions are also available.
Technical data: 202 549 44, 714 **IS** 911.

Slip-ring rotor motors:

For the smooth acceleration of large masses, or for variable electrical braking.
With predetermined starting current, or acceleration values, very high starting frequencies can be obtained.
Technical data: 202 535 44, 714 **IS** 911.

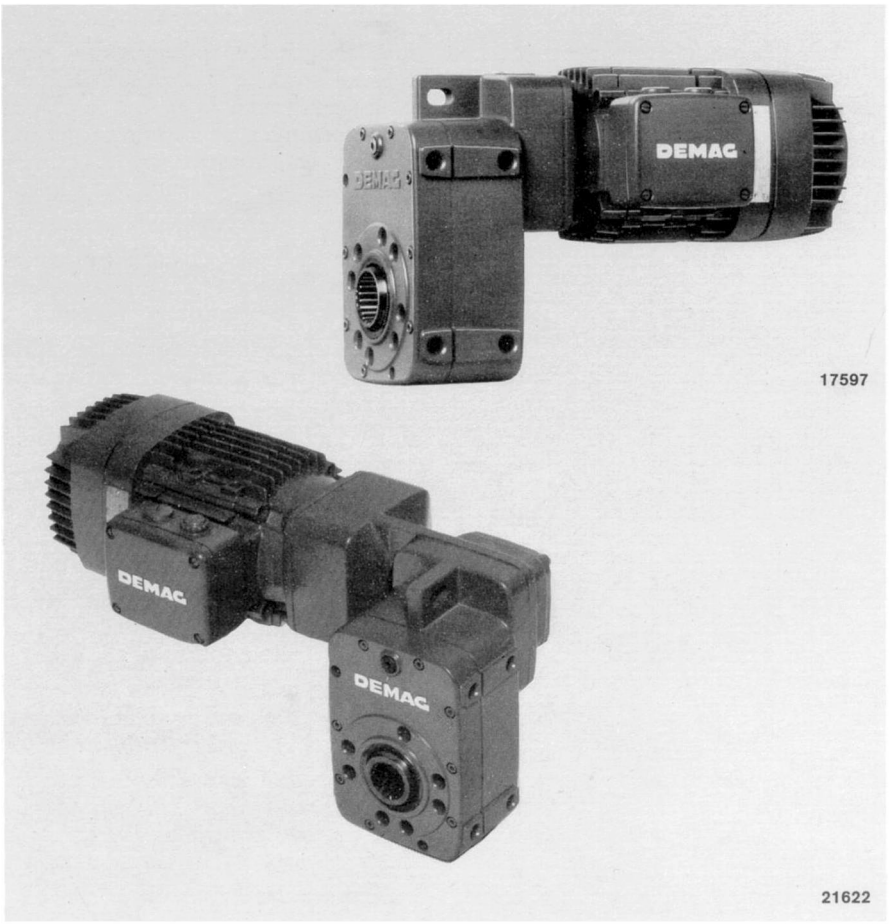
DC motors:

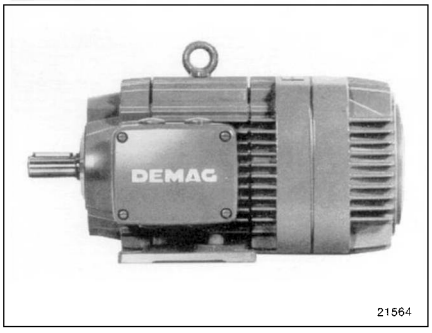
For accurate speed regulation and acceleration control independent of the load, and rapid changes of speed and direction of rotation. Static converters provide wide control range.
Technical data: 202 566 44, 714 **IS** 914.

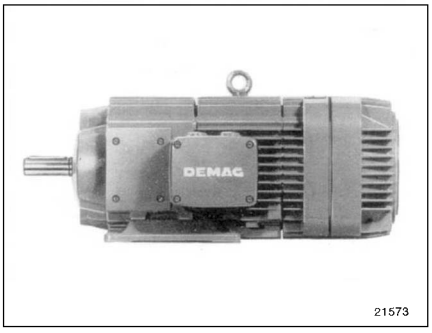
Microspeed drives

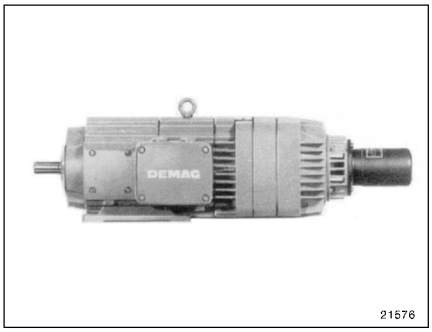
For applications requiring precise positioning and feeding. Combining the gear unit with pole-changing, slip-ring, DC or other microspeed motors, provides additional microspeeds, or microspeed ranges.

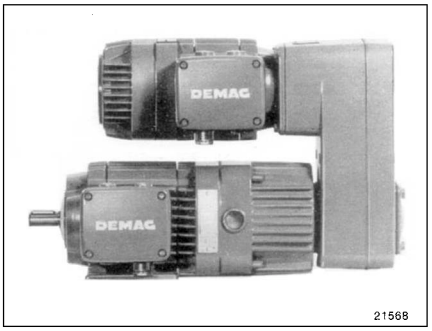
Component parts lists
AFW 05, order no. 222 296 44
AFW 06, order no. 222 280 44
AFW 08, order no. 222 281 44
AFW 10, order no. 222 282 44
AFW 12, order no. 222 299 44
AFL 04, order no. 222 269 44
AF 04, order no. 222 270 44









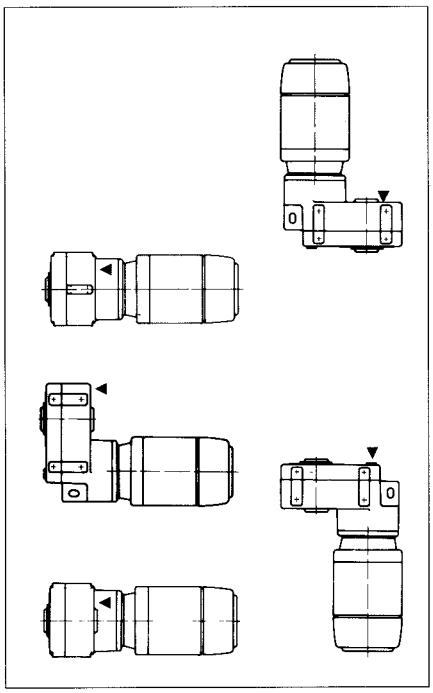


AF 05 to 06, order no. 222 051 44
AF 08 to 12, order no. 222 140 44
AF 18, order no. 222 358 44
AFR 06, order no. 222 345 44,
721 **IS** 913.20

Literature accompanying products

Operating Instructions AFL 04
Order no. 206 339 44
AF 04–AF 18 and AFW 05–AFW 12
Order no. 206 142 44, 720 **IS** 913.20

Design and fitting information



▼ Vent plug in the uppermost position of the gearbox.
All mounting positions shown can be supplied as shaft-mounted, flange-mounted and foot-mounted gears, with and without shaft extensions.

Description of design

Hollow-shaft reduction gears are mounted directly onto the driven shaft. For this reason, the output shaft of the gearbox has a hollow involute spline.
If required, key connections and, in addition, shrink discs are available for AF/AFW 05 to 12 and AF 18 gearboxes.

The gearbox housing is restrained by a statically determined torque arm. The rubber mountings absorb dynamic forces and reduce vibrations and the transmission of noise to the mounting structure.

The gearbox and motor shaft are connected by a coupling which allows axial displacement of the motor shaft.

If required, foot or flange-mounted gearboxes are also available for AF/AFL 04, AF/AFW 05 to AF/AFW 12, and AF 18.

Reduction gear conversion

The gearboxes are assembled in our works to suit the customer's requirements.

It is possible to alter the model at a later date, by specifying one of the following: M – torque bracket
B 3, B 6, B 7, B 8, V 5, V 6 – foot mounting plate design
B 5, B 14, V 1, V 3 – flange mounting

Once the particular model has been determined, consideration must be given to the basic variant of the gearbox (and to the mounting position in the "M" model) as, in some cases, it will be necessary to fit an alternative rotor return spring and to provide different lubricants.

The position of the terminal box can also be changed by rotating the motor end cap.

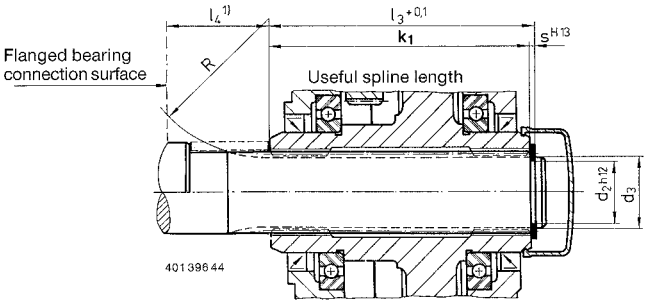
Importance of the particular model

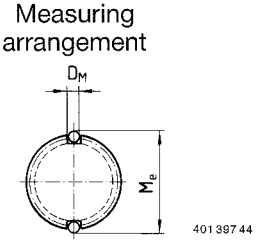
The gearbox must be mounted according to the model ordered, as the rotor return spring of the brake motor is dependent on the model or the basic position + mounting position in the case of the "M" model.

Drive shaft designs in Tables 1–3

Table 1

Spline shaft connection for AFL 04/AF 04, AF/AFW 05 to AF/AFW 12 and AF 18



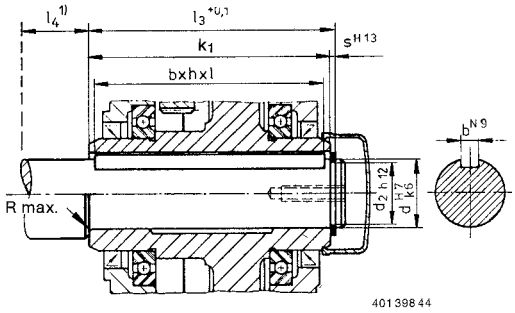


Gearbox type	Spline shaft [2] DIN 5480	d_2h_{12}	d_3	K_1	l_3	l_4 [1]	R	s	Measuring roller dia. D_M	Check dimension M_e
AFL 04/AF 04	W 25 x 1.25 x 18	21	22	106	107.7	–	40	1.2	2.75	28.027 –0.016
	W 30 x 1.25 x 22 [3]	24.9	26						2.75	33.1 –0.02
AF/AFW 05	W 30 x 1.25 x 22	24.9	26	105	106.7	20	40	1.2	2.75	33.1 –0.02
	W 35 x 2 x 16	28.6	30	105	106.7	20	40	1.6	4	38.87 –0.03
AF/AFW 06	W 30 x 1.25 x 22	24.9	26	121	123	20	40	1.2	2.75	33.1 –0.02
	W 35 x 2 x 16	28.6	30	121	123	20	40	1.6	4	38.87 –0.03
	W 45 x 2 x 21	37.5	40	121	123	20	57.5	1.85	4	48.75 –0.03
AF/AFW 08	W 45 x 2 x 21	37.5	40	155	157	36	57.5	1.85	4	48.75 –0.03
	W 50 x 2 x 24	39.5	42	155	157	36	57.5	1.85	4	54.07 –0.035
AF/AFW 10	W 65 x 2 x 31	55	58	207.5	209.8	42.5	57.5	2.15	4	68.882–0.04
AF/AFW 12	W 65 x 2 x 31 [4]	55 [4]	58	255	257.3	42.5	57.5	2.15	4	68.882–0.04
	W 85 x 3 x 27	72	75	255	257.8	40.5	57.5	2.65	6	91 –0.04
AF 18	W 110 x 3 x 35	96.5	100	325	328.5	72.5	55	3.15	6	116.036–0.03

[1]) Only in conjunction with RAM/RN wheel sets
[2]) Flank centred
[3]) Not possible with gear ratio 14.5; 11.2; 7.97; 6.3; 4.64
[4]) Only in conjunction with RS 400 wheel block

Table 2

Key connection
for AFL 04/AF 04
AF/AFW 05
to AF/AFW 12
AF 18

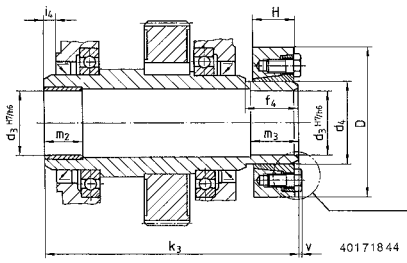


Gearbox	d	DIN 6885 page 1 w x h x l	k_1	l_3	l_4 1)	s	$d_2 h_{12}$	R_{max}
AFL 04/AF 04	24	A 8 x 7 x 100	106	107.3	–	1.3	22.9	1
AF/AFW 05	32	A 10 x 8 x 100	105	106.7	20	1.6	30.3	1
AF/AFW 06	40	A 12 x 8 x 110	121	123	20	1.85	37.5	1
AF/AFW 08	50	A 14 x 9 x 140	155	157.3	36	2.15	47	1
AF/AFW 10	60	A 18 x 11 x 180	207.5	209.8	42.5	2.15	57	1
AF/AFW 12	75	A 20 x 12 x 220	255	257.8	40.5	2.65	72	1
AF 18	100	A 28 x 16 x 280	325	328.5	72.5	3.15	96.5	2.5

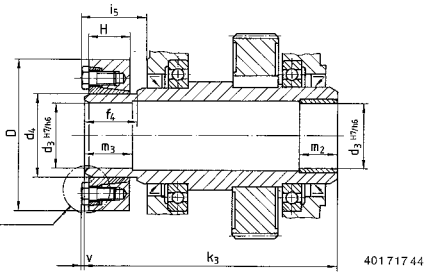
1) Only in conjunction with RAM/RN wheel sets

Table 3

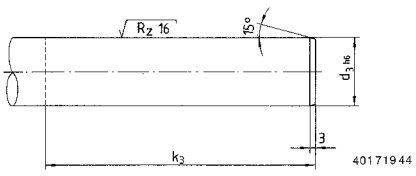
Shrink disc, motor side
Standard design for AF 05 to AF 18
AFW 05 to AFW 12



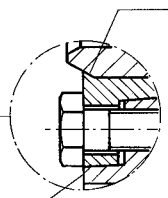
Shrink disc, cover side
Special design for AF 05 to AF 18
AFW 05 to AFW 12



Dimensions for drive shaft design



Mechanical stop



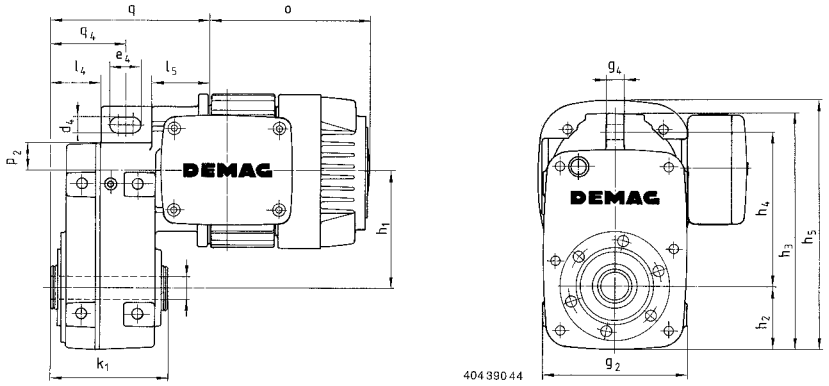
The screws have been tightened to the correct torque when the end faces of the inner and outer rings are flush.

Gearbox	Part no.	Weight kg	J kg m²	D	d_3	d_4	f_4	H	i_4	i_5	k_3	m_2	m_3	v
AF/AFW 05	716 189 44 N	0.6	0.0006	78	35	44	28	23	5	37.5	134	20	23	4.5
AF/AFW 06	716 289 44 N	0.8	0.00106	90	40	50	32	24.5	5	43	153	30	30	4.5
AF/AFW 08	716 389 44 N	1.3	0.00259	110	50	62	35	26.5	5	44	190	40	30	4.5
AF/AFW 10	716 489 44 N	1.7	0.00521	138	60	75	39	29	7.5	49.5	244	40	33	5.5
AF/AFW 12	716 589 44 N	4.7	0.02285	170	75	100	50	39.5	8.5	60	302	60	45	5.5
AF 18	716 689 44 N	8.3	0.07085	215	100	130	60	49	11.5	78	385	60	55	6.5

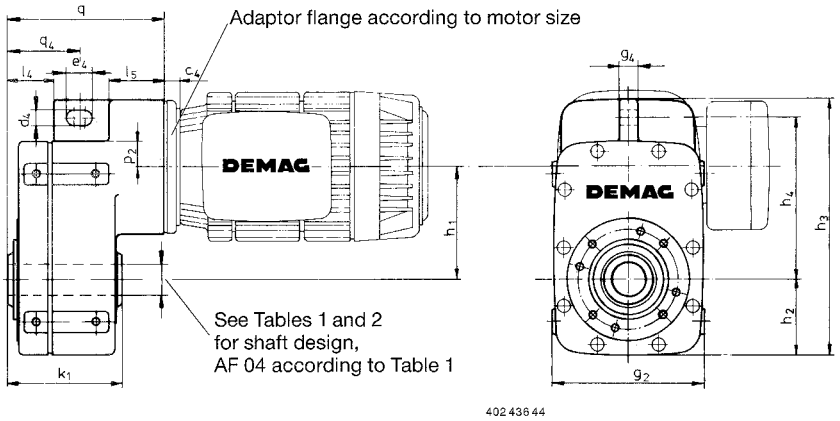
AF hollow-shaft gearboxes

Dimensions in mm

AFL 04 hollow-shaft gearboxes



AF 04, AF 05, AF 06 and AF 08 hollow-shaft gearboxes



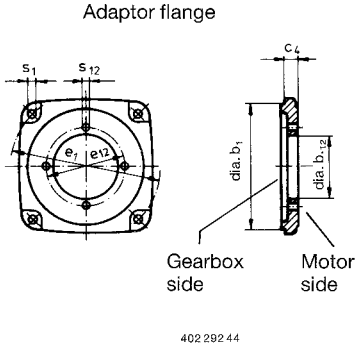


Table 4

Size Gear-box	Motor	c_4	d_4	e_4	g_2	g_4	h_1	h_2	h_3	h_4	h_5	k_1	l_4	l_5	o	p_2	q	q_4	b_1	b_{12}	e_1	e_{12}	s_1	s_{12}	Weight in kg [1]
AFL 04	KBV 71 A	–	14	21	134	16	100	56.5	214.5	142.5	226.5	106	45	52	192	26.5	142.5	66.5	–	–	–	–	–	–	5.5
	KBV 71 B										–				212										
AF 04	KB 71	11.5	14																130	70	140	85	6.6	7	5.5
	KB 80	13.5													–					80		100		9	
AF 05	KB 71	11.5	14	24	141	16	105	70	238	150	–	105	41.5	51	–	23	145	67	115	70	140	85	9	7	6
	KB 80	13.5																		80		100		9	
	KB 90																								
AF 06	KB 71	11.5	14	24	165	20	125	76	271	175	–	121	46	50	–	29	157	67	125	70	160	85	9	7	10
	KB 80	13.5																		80		100		9.5	
	KB 90																			80		100		9.5	
	KB 100	16																		110		130		11	
AF 08	KB 80	15.5	18	18	209	24	160	98	358	230	–	155	73.5	74	–	38	213	99	180	80	223.5	100	11	9	37.5
	KB 90																			80		100		9	
	KB 100	18																		110		130		11	
	KB 112	33																		110		130		11	
	KB 125	35																		125		150		14	

[1]) Without motor

AF 10, AF 12 and AF 18 hollow-shaft gearboxes

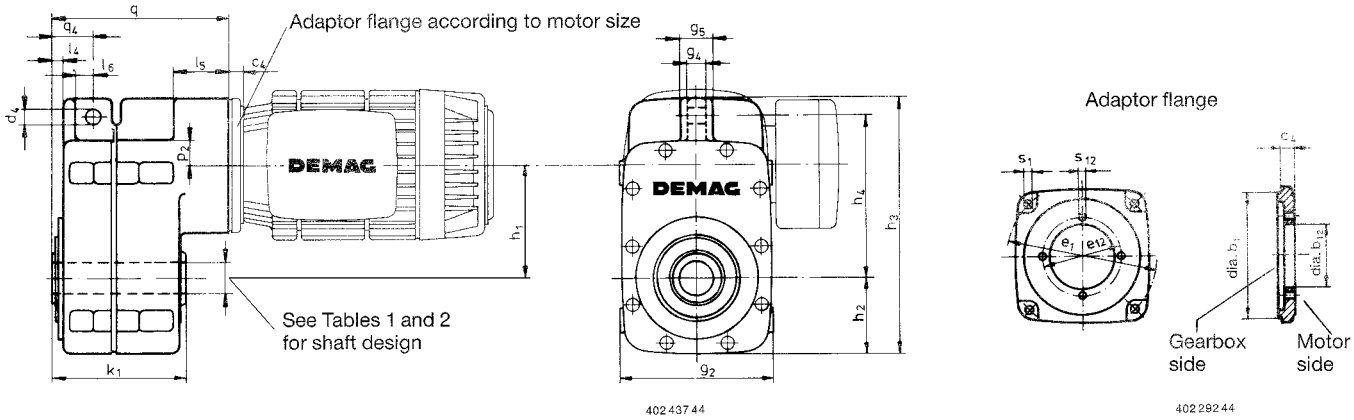


Table 5

Size Gearbox	Motor	c_4	d_4	g_2	g_4	g_5	h_1	h_2	h_3	h_4	k_1	l_4	l_5	l_6	p_2	q	q_4	b_1	b_{12}	e_1	e_{12}	s_1	s_{12}	Weight in kg [1]
AF 10	KB 80	18.5	22	274	25	45	200	127	452	297	207.5	22.5	73	37.5	51	261	72.5	224	80	280	100	14	9	77
	KB 90																		80		100		9	
	KB 100	21																	110		130		11	
	KB 112	36																	110		130		11	
	KB 125	38																	125		150		14	
	KB 140																							
AF 12	KB 90	18.5	22	346	32	55	250	160	568	360	255	26.5	77	33	55	306.5	74.5	280	80	355	100	18	9	130
	KB 100	21																	110		130		11	
	KB 112	36																	110		130		11	
	KB 125	38																	125		150		14	
	KB 140																							
	KB 160	74																	155		190		18	
AF 18	KB 100	46	26	434	40	90	320	200	710	465	325	31.5	83	50	70	362	101.5	350	110	424	130	22	11	350
	KB 112																							
	KB 125	48																	125		150		14	
	KB 140																							
	KB 160	74																	155		190		18	
	KB 180																							
	KB 200	87																	200		236		18	
	KB 225																							

[1] Without motor

AFW hollow-shaft spur and bevel gearboxes

Dimensions in mm

AFW 05 to 08 hollow-shaft spur and bevel gearboxes

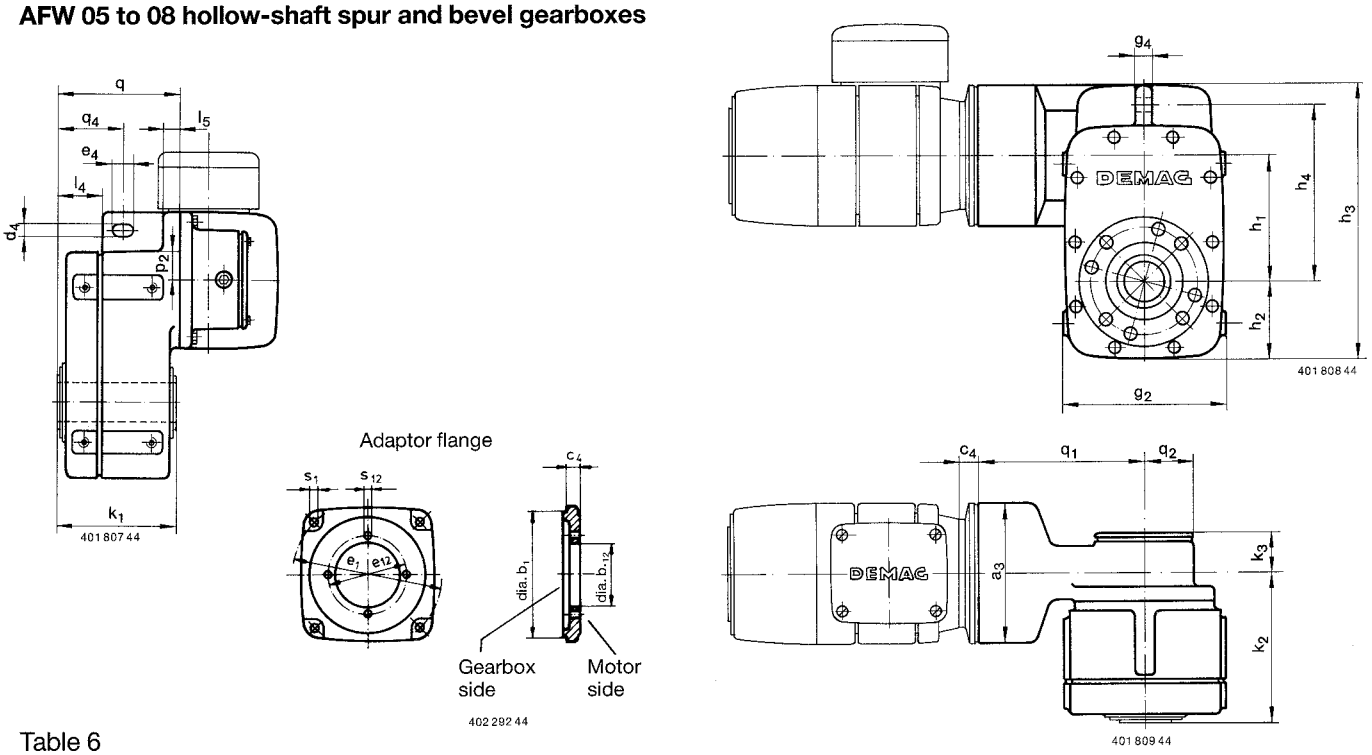


Table 6

Size Gearbox	Size Motor	c_4	a_3	d_4	e_4	g_2	g_4	h_1	h_2	h_3	h_4	k_1	k_2	k_3	l_4
AFW 05	KB 71	11.5	125	14	24	140	16	105	70.5	238	150	105	128.5	37	41.5
	KB 80	13.5													
	KB 90														
AFW 06	KB 71	11.5	140	14	24	164	16	125	76	271	175	121	152	43	46
	KB 80	13.5													
	KB 90														
	KB 100	16													
AFW 08	KB 80	15.5	200	18	18	204	24	160	98	358	230	155	211.5	53	73.5
	KB 90														
	KB 100	18													
	KB 112	33													
	KB 125	35													

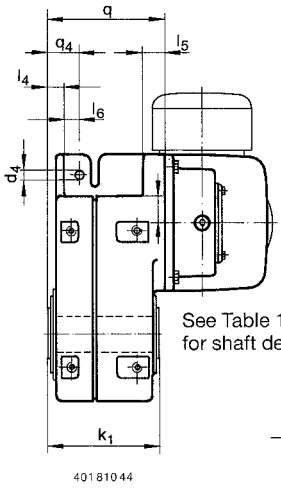
Size Gearbox	Size Motor	l_5	p_2	q	q_1	q_2	q_4	b_1	b_{12}	e_1	e_{12}	s_1	s_{12}	Weight in kg[1])
AFW 05	KB 71	12	23	106	150	42.5	67	115	70	140	85	9	7	9
	KB 80								80		100		9	
	KB 90													
AFW 06	KB 71	17.3	29	124	170	50	67	125	70	160	85	9	7	14
	KB 80								80		100		9.5	
	KB 90								80		100		9.5	
	KB 100								110		130		11	
AFW 08	KB 80	37.5	38	176.5	210	75	99	180	80	223.5	100	11	9	46
	KB 90								80		100		9	
	KB 100								110		130		11	
	KB 112								110		130		11	
	KB 125								125		150		14	

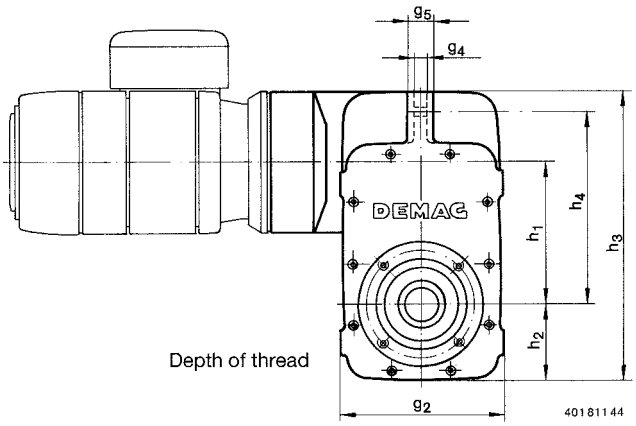
[1]) Without motor

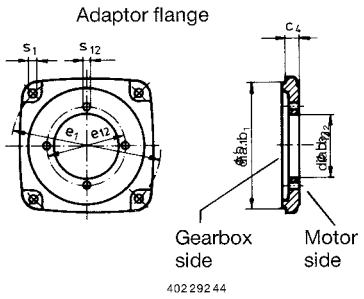
AFW hollow-shaft spur and bevel gearboxes

Dimensions in mm

AFW 10, AFW 12 hollow-shaft spur and bevel gearboxes







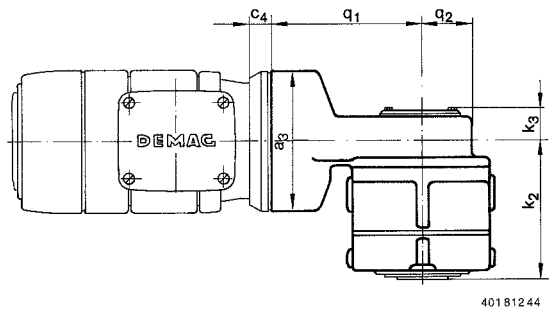


Table 7

Size Gearbox	Motor	c_4	a_3	d_4	g_2	g_4	g_5	h_1	h_2	h_3	h_4	k_1	k_2	k_3	l_4
AFW 10	KB 80	18.5	250	22	268	25	45	200	127	452	297	207.5	270.5	60	22.5
	KB 90														
	KB 100	21													
	KB 112	36													
	KB 125	38													
	KB 140														
AFW 12	KB 90	18.5	315	22	340	32	55	250	160	568	360	255	327	70	26.5
	KB 100	21													
	KB 112	36													
	KB 125	38													
	KB 140														
	KB 160	74													

Size Gearbox	Motor	l_5	l_6	p_2	q	q_1	q_2	q_4	b_1	b_{12}	e_1	e_{12}	s_1	s_{12}	Weight in kg[1])
AFW 10	KB 80	36	37.5	51	224.5	265	95	72.5	224	80	280	100	14	9	100
	KB 90									80		100		9	
	KB 100									110		130		11	
	KB 112									110		130		11	
	KB 125									125		150		14	
	KB 140														
AFW 12	KB 90	43	33	55	273	300	120	74.5	280	80	355	100	18	9	160
	KB 100									110		130		11	
	KB 112									110		130		11	
	KB 125									125		150		14	
	KB 140									125		150		14	
	KB 160									155		190		18	

[1]) Without motor

AF-Ex hollow-shaft gearboxes

Dimensions and characteristics

Hollow-shaft gearboxes with explosion-proof motors, available in type of enclosure EEx de IIBT4 or EEx de IICT4, AF 04, AF 05, AF 06, AF 08

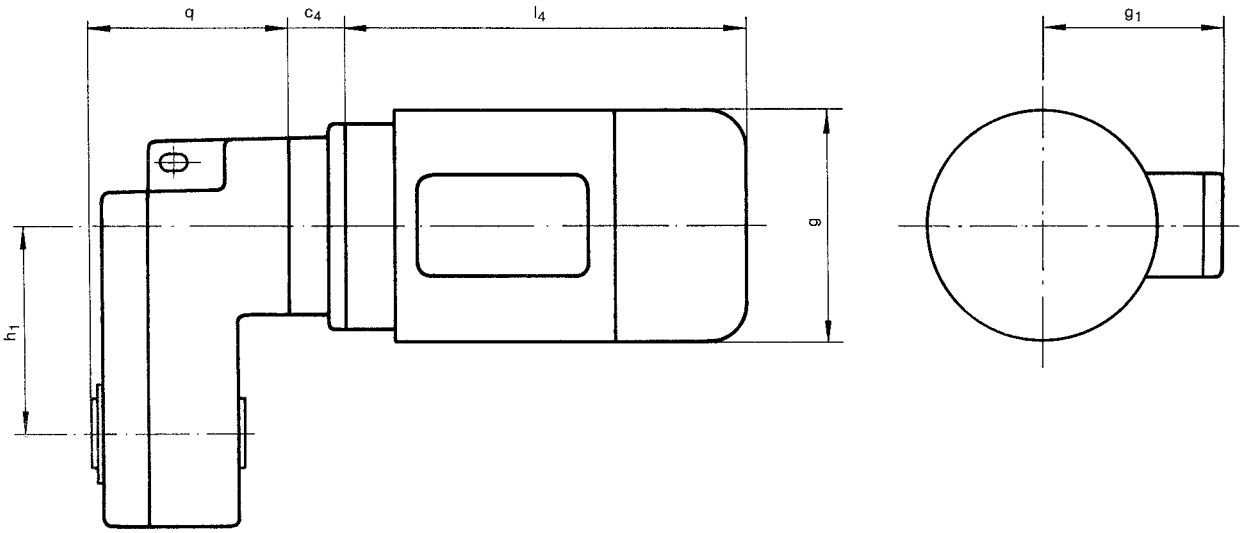


Table 8

40181344

Gearbox	Size Motor	P KW	% CDF	n rpm	Moment of inertia ΣJ kg m² [1]	c_4	g	g_1	h_1	l_4	q
AF 04	2 A 05/505 Ex	0.32	40	2540	0.005886	52	157	175	100	268	142.5
	2/8 A 05/505 Ex	0.32/0.06	40/20	2540/500							
AF 05	2 A 05/505 Ex	0.32	40	2540		42	157	175	105	268	145
	2/8 A 05/505 Ex	0.32/0.06	40/20	2540/500							
AF 06	2 A 08/515 Ex	0.68	40	2840	0.009211	42	180	183	125	319	157
	2/8 A 08/515 Ex	0.68/0.15	40/20	2840/620							
AF 08	2 A 1/505 Ex	1.2	40	2780	0.018791	45	200	193	160	359	213
	2/8 A 1/505 Ex	1.2/0.25	40/20	2780/580							

[1] ΣJ = Moment of inertia of motor (SBr) + heavy coupling half (HT) + inertia mass.

Coupling chamber and gearbox flange

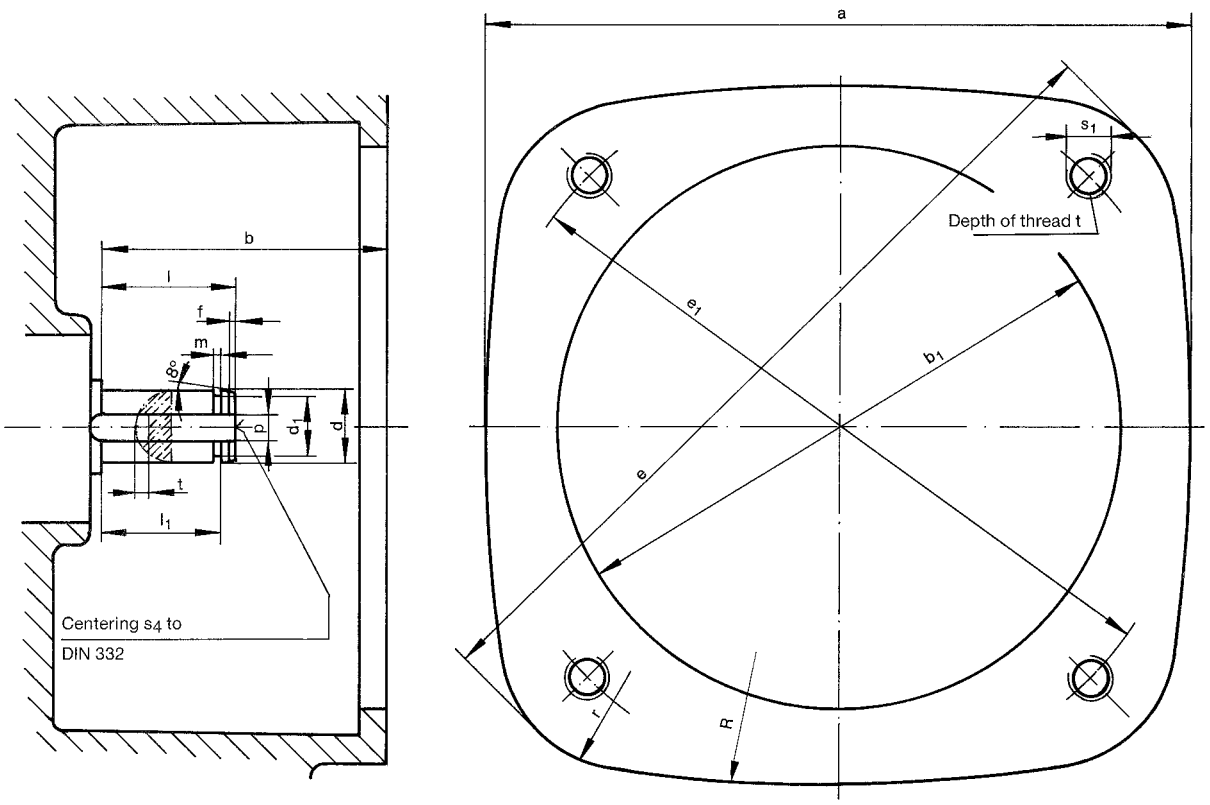
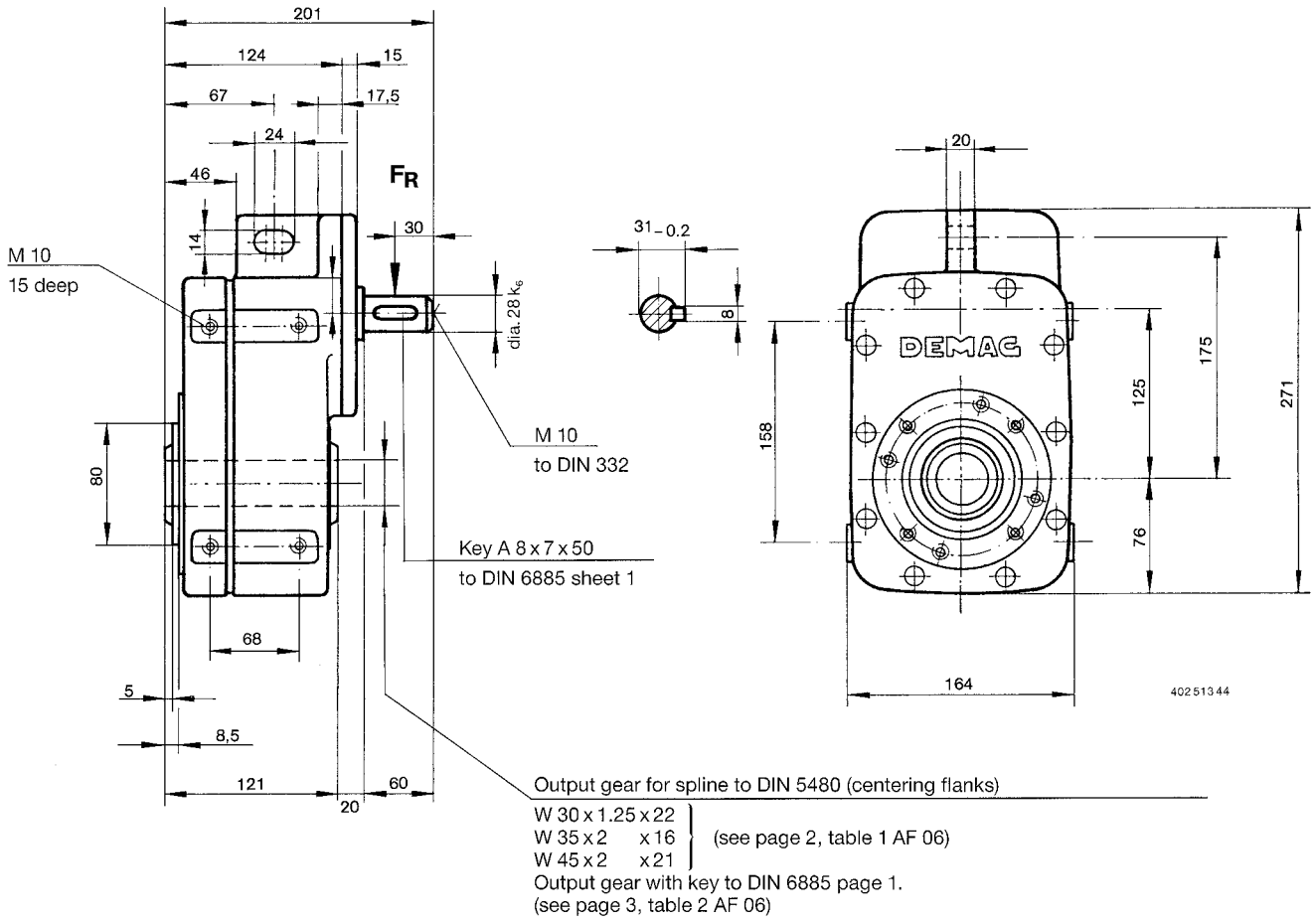


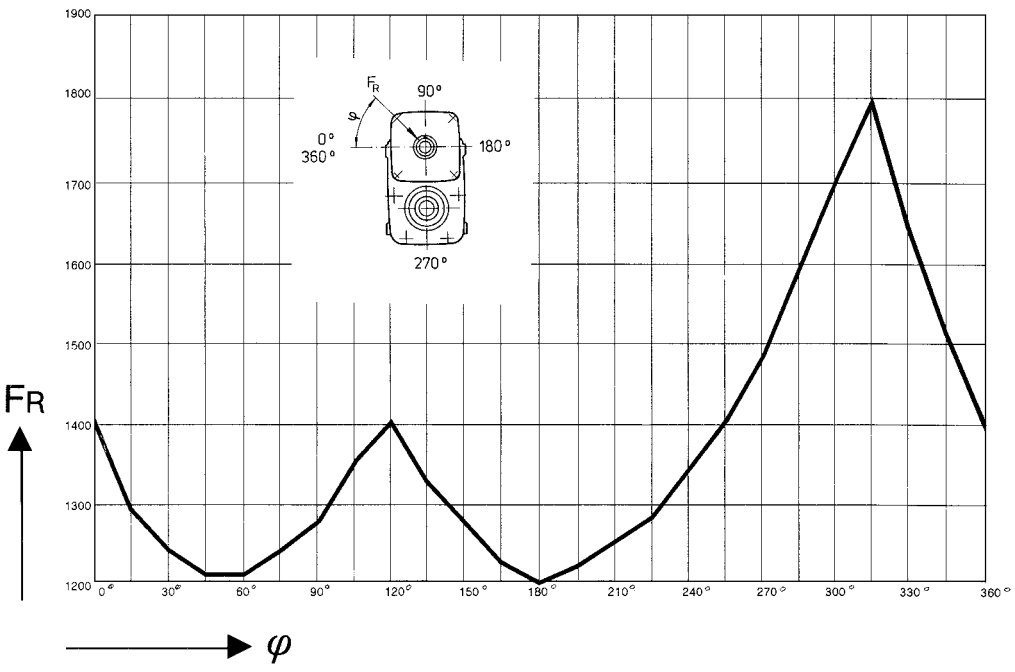
Table 9

Gearbox	Shaft dimensions									Flange dimensions								
	d_{k6}	d_{1h11}	f	l	$l_1^{+0,1}$	m^{H13}	p^{P9}	t	s_4	a	$b^{\pm 0.3}$	b_1^{H7}	e	e_1	r	R	s_1	t_1
AFL 04 AF 04	12	11.5	1	25	22.1	1.1	4	$2.5^{+0.1}$	M 4	140	43	130	165	140	35.5	224	M 6	10
AF 05 AFW 05	12	11.5	1	25	22.1	1.1	4	$2.5^{+0.1}$	M 4	125	53	115	159	140	16	625	M 8	15
AF 06 AFW 06	16	15.2	1	25	22.1	1.1	5	$3^{+0.1}$	M 5	140	53	125	178	160	16	625	M 8	15
AF 08 AFW 08	24	22.9	1	37	34.3	1.3	8	$4^{+0.2}$	M 8	200	63	180	255	224	25	1000	M 10	21
AF 10 AFW 10	24	22.9	2	37.5	34.3	1.3	8	$4^{+0.2}$	M 8	250	60	224	318	180	32	1250	M 12	25
AF 12 AFW 12	24	22.9	2	37.5	34.3	1.3	8	$4^{+0.2}$	M 8	315	60	280	401	355	40	1600	M 16	32
AF 18	32	30.3	1.5	47.5	44.6	1.6	10	$5^{+0.2}$	M 12	380	60	350	486	425	45	2000	M 20	40
AFG 06	16	15.2	1	25	22.1	1.1	5	$3^{+0.1}$	M 5	125	53	115	159	140	16	625	M 8	15
AFG 08	24	22.9	1	25	22.3	1.3	8	$4^{+0.2}$	M 8	160	49	140	204	180	20	800	M 10	17
AFG 10	24	22.9	2	37.5	34.3	1.3	8	$4^{+0.2}$	M 8	200	63	180	255	224	25	1000	M 10	20

AFR 06 hollow-shaft gearboxes



Permissible radial load on the drive shaft
as a function of the angle of incidence φ



AFG 06, AFG 08, AFG 10 hollow-shaft gearboxes

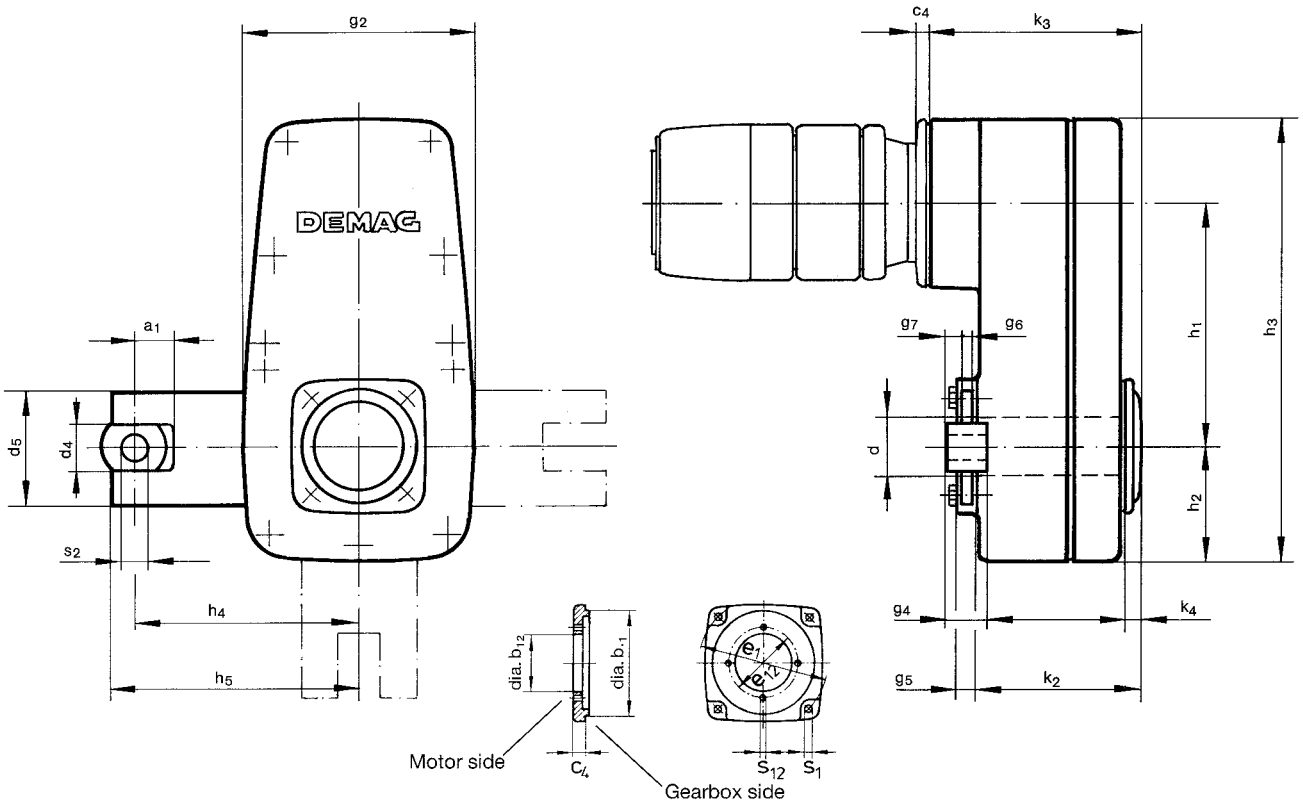


Table 10

401815 44 401817 44

Size Gearbox	Size Motor	d	Key DIN 6885 page 1 w x h x l	d_1	c_4	d_4	d_5	g_2	g_4	g_5	g_6	g_7	h_1	h_2	h_3	h_4
AFG 06	KB 71	32	A 10 x 8 x 110	22	11.5	25	90	140	37	12.2	8	14.5	176	70	313	150
	KB 80				13.5											
	KB 90															
AFG 08	KB 71	50	A 14 x 9 x 145	37	15.5	45	110	220	40	17	15	12.5	231	110	423	210
	KB 80				17.5											
	KB 90															
	KB 100				20											
AFG 10	KB 90	60	A 18 x 11 x 220	57	15.5	70	190	310	88	17.7	18	35	351	155	608	350
	KB 100				18											
	KB 112				33											
	KB 125				35											
	KB 140															

Size Gearbox	Size Motor	h_5	k_1	k_2	k_3	k_4	k_5	k_6	k_7	s_2	b_1	b_{12}	e_1	e_{12}	s_1	s_{12}	Weight in kg [1]
AFG 06	KB 71	168	114.5	101	162	18	2.8	10.7	1.5	12	115	70	140	85	9	7	9
	KB 80											80		100		9	
	KB 90																
AFG 08	KB 71	233	147.5	140	206	20	1.2	8.7	7	25	140	70	180	85	11	7	41
	KB 80											80		100		9	
	KB 90																
	KB 100											110		130		11	
AFG 10	KB 90	384	224.5	219	312	29	3.2	8.7	9	40	180	80	223.5	100	11	9	120
	KB 100											110		130		11	
	KB 112																
	KB 125											125		150		14	
	KB 140																

[1]) Without motor

Characteristics with input speed n = 2800 rpm AFG 06, AFG 08, AFG 10 hollow-shaft gearboxes

Table 11

Gearbox		AFG 06				AFG 08				AFG 10			
Sizes of motors which may be fitted		71 80 90				71 80 90 100				90 100 112 125 140			
M_{G2} in Nm		700				3100				13500			
i_{Nenn}	n_2 rpm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm
125	22.4	127	2.0	0.6	234.1	123	9.0	2.6	1040	–	–	–	–
121	22.4	–	–	–	–	–	–	–	–	121	35.5	10.4	4046
100	28	102	2.3	0.7	217.0	98.4	11.2	3.3	1040	97.4	41.2	12.1	3778
90	31.5	–	–	–	–	85.6	12.9	3.8	1040	–	–	–	–
80	35.5	82.6	2.6	0.8	202.8	78	14.2	4.2	1040	78.6	49.2	14.4	3636
71	40	–	–	–	–	68.8	16.1	4.7	1040	–	–	–	–
63	45	63.4	3.0	0.9	178.8	59.7	18.1	5.3	1015	63.3	57.5	16.8	3421
56	50	–	–	–	–	54.5	19.1	5.6	977	–	–	–	–
50	56	50.9	3.5	1.0	166.2	49.4	16.0	4.7	743	47.5	69.5	20.4	3111
45	63	46.9	3.8	1.1	167.8	47.3	20.6	6.0	917	–	–	–	–
40	71	41.1	4.0	1.2	153.3	37.3	21.2	6.2	744	40	78.1	22.9	2944
35.5	80	35.4	4.2	1.2	140.1	34.5	21.2	6.2	687	–	–	–	–
31.5	90	30.7	4.6	1.3	131.8	30.7	21.2	6.2	611	31.6	91.2	26.7	2713
28	100	28.5	4.9	1.4	131.3	28.1	28.7	8.4	758	–	–	–	–
25	112	24.8	5.3	1.5	122.7	25	26.9	7.9	632	25.1	84.0	24.6	1983
22.4	125	22.7	5.7	1.6	121.6	–	–	–	–	–	–	–	–
20	140	19.7	6.1	1.8	113.6	19.2	31.3	9.2	566	19.7	109.0	31.9	2015
18	160	17.9	6.7	2.0	112.4	17.8	31.9	9.3	533	–	–	–	–
16	180	15.5	7.2	2.1	105.0	15.8	32.5	9.5	484	15.7	126.0	37.0	1868
14	200	14.1	7.6	2.2	101.2	14.3	29.8	8.7	399	–	–	–	–
12.5	224	12.9	6.4	1.9	78.0	12.4	32.3	9.5	378	12.5	129.5	38.0	1526
11.2	250	11.2	7.1	2.1	70.1	11.2	31.3	9.2	331	–	–	–	–
10	280	10.2	7.5	2.2	72.2	9.87	34.3	10.0	318	9.95	136.4	40.0	1277
9	315	8.88	8.0	2.4	67.1	9.24	30.3	8.9	264	–	–	–	–
8	355	8.08	8.8	2.6	66.5	7.79	35.9	10.5	263	7.85	141.8	41.6	1048
7.1	400	7.11	8.7	2.6	58.3	7.19	37.3	10.9	252	–	–	–	–
6.3	450	6.35	9.9	2.9	59.1	6.4	37.1	10.9	223	6.23	146.4	42.9	859
5.6	500	5.61	10.2	3.0	54.1	5.8	33.7	9.9	184	–	–	–	–
5	560	4.99	11.6	3.4	54.5	4.96	38.3	11.2	178	4.91	150.0	43.9	693
4	710	3.99	13.0	3.8	49.0	4.02	39.1	11.4	148	3.87	153.6	45.0	560

M_{G2} = Max. permissible gear torque limit
i_{Nenn} = Rated gearbox transmission
n_2 = Gearbox output speed
i_{vorh} = Actual gearbox transmission
M_{N1} = Rated gearbox input torque
P_{N1} = Rated gearbox input power
M_{N2} = Rated gearbox output torque

Characteristics with input speed n = 1400 rpm AFG 06, AFG 08, AFG 10 hollow-shaft gearboxes

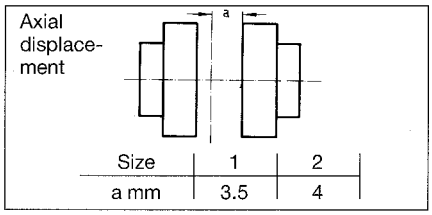
Table 12

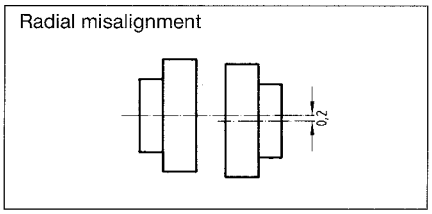
Gearbox		AFG 06				AFG 08				AFG 10			
Sizes of motors which may be fitted		71 80 90				71 80 90 100				90 100 112 125 140			
M_{G2} in Nm		700				3100				13500			
i_{Nenn}	n_2 rpm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm
125	11.2	127	2.2	0.3	263	123	9.0	1.3	1040	–	–	–	–
121	11.2	–	–	–	–	–	–	–	–	121	44.2	6.5	5041
100	14	102	2.7	0.4	263	98.4	11.2	1.6	1040	97.4	50.8	7.4	4652
90	16	–	–	–	–	85.6	12.9	1.9	1040	–	–	–	–
80	18	82.6	3.3	0.5	255.6	78	14.2	2.1	1040	78.6	60.5	8.9	4477
71	20	–	–	–	–	68.8	16.1	2.4	1040	–	–	–	–
63	22.4	63.4	3.8	0.6	225.3	59.7	18.5	2.7	1040	63.3	68.7	10.1	4088
56	25	–	–	–	–	54.5	20.3	3.0	1040	–	–	–	–
50	28	50.9	4.4	0.6	209.4	49.4	20.2	3.0	936	47.5	85.6	12.5	3829
45	31.5	46.9	4.8	0.7	211.7	47.3	23.4	3.4	1040	–	–	–	–
40	35.5	41.1	5.0	0.7	195.0	37.3	26.7	3.9	938	40	94.0	13.7	3542
35.5	40	35.4	5.3	0.8	177.6	34.5	26.7	3.9	866	–	–	–	–
31.5	45	30.7	6.0	0.9	170.1	30.7	26.7	3.9	771	31.6	108.9	15.9	3239
28	50	28.5	6.2	0.9	165.4	28.1	36.2	5.3	955	–	–	–	–
25	56	24.8	6.6	1.0	154.6	25	33.9	5.0	796	25.1	116.4	17.0	2747
22.4	63	22.7	7.2	1.1	153.2	–	–	–	–	–	–	–	–
20	71	19.7	7.7	1.1	143.2	19.2	39.4	5.8	713	19.7	145.0	21.2	2690
18	80	17.9	8.4	1.2	141.6	17.8	40.2	5.9	671	–	–	–	–
16	90	15.5	9.0	1.3	132.3	15.8	41.0	6.0	610	15.7	159.0	23.3	2354
14	100	14.1	9.7	1.4	128.0	14.3	37.5	5.5	503	–	–	–	–
12.5	112	12.9	8.0	1.2	96.9	12.4	40.7	5.9	477	12.5	163.1	23.9	1922
11.2	125	11.2	9.4	1.4	110.2	11.2	39.4	5.8	417	–	–	–	–
10	140	10.2	9.0	1.4	90.1	9.87	43.2	6.3	402	9.95	172.0	25.2	1610
9	160	8.88	10.0	1.5	83.2	9.24	41.0	6.0	356	–	–	–	–
8	180	8.08	11.0	1.6	83.8	7.79	45.2	6.6	331	7.85	178.6	26.2	1320
7.1	200	7.11	11.0	1.6	73.5	7.19	45.9	6.7	310	–	–	–	–
6.3	224	6.35	12.4	1.8	74.4	6.4	46.8	6.9	281	6.23	184.5	27.0	1082
5.6	250	5.61	12.9	1.9	68.1	5.8	42.5	6.2	232	–	–	–	–
5	280	4.99	14.9	2.2	69.7	4.96	48.2	7.1	225	4.91	200.0	29.3	924
4	355	3.99	16.4	2.4	61.7	4.02	49.3	7.2	186	3.87	200.0	29.3	728

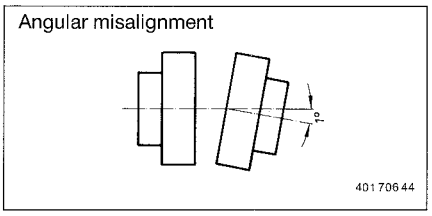
M_{G2} = Max. permissible gear torque limit
i_{Nenn} = Rated gearbox transmission
n_2 = Gearbox output speed
i_{vorh} = Actual gearbox transmission
M_{N1} = Rated gearbox input torque
P_{N1} = Rated gearbox input power
M_{N2} = Rated gearbox output torque

Demag roller couplings

H couplings for KBV and GD motors
HT couplings for KBF and SBA motors







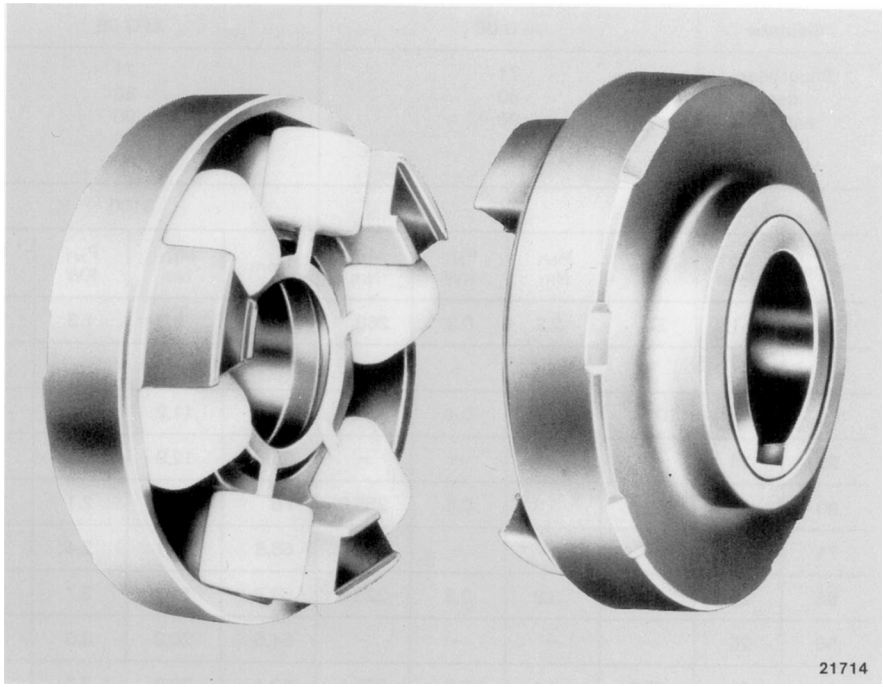


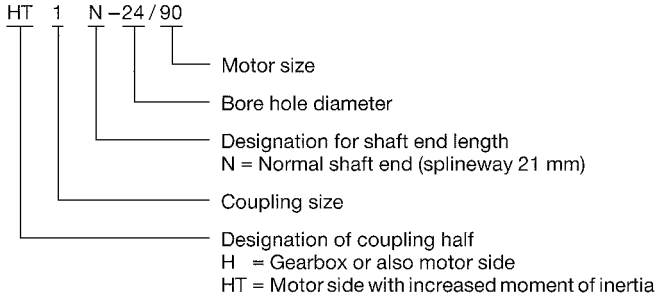
Table 13

Motor size \ Gearbox		AF 04	AF 05 AFW 05	AF 06 AFW 06 AFG 06	AF 08 AFW 08 AFG 08	AF 10 AFW 10 AFG 10	AF 12 AFW 12	AF 18
KBV 71	G	H 1 N–12	H 1 N–12	H 1 N–16	H 1 N–24	–	–	–
	M	H 1 N–14 HT 1 N–14/71	H 1 N–14 HT 1 N–14/71	H 1 N–14 HT 1 N–14/71	H 1 N–14 HT 1 N–14/71	–	–	–
71	G	H 1 N–12	H 1 N–12	H 1 N–16	H 1 N–24	–	–	–
	M	H 1 N–16 HT 1 N–16/71	H 1 N–16 HT 1 N–16/71	H 1 N–16 HT 1 N–16/71	H 1 N–16 HT 1 N–16/71	–	–	–
80	G	H 1 N–12	H 1 N–12	H 1 N–16	H 1 N–24	H 1 N–24	–	–
	M	H 1 N–19 HT 1 N–19/71	H 1 N–19 HT 1 N–19/80	H 1 N–19 HT 1 N–19/80	H 1 N–19 HT 1 N–19/ 80	H 1 N–19 HT 1 N–19/ 80	–	–
90	G	–	H 1 N–12	H 1 N–16	H 1 N–24	H 1 N–24	H 1 N–24	–
	M	–	H 1 N–24 HT 1 N–24/80	H 1 N–24 HT 1 N–24/90	H 1 N–24 HT 1 N–24/ 90	H 1 N–24 HT 1 N–24/ 90	H 1 N–24 HT 1 N–24/ 90	–
100	G	–	–	H 1 N–16	H 1 N–24	H 1 N–24	H 1 N–24	H 2 N–32
	M	–	–	H 1 N–24 HT 1 N–24/90	H 1 N–24 HT 1 N–24/100	H 1 N–24 HT 1 N–24/100	H 1 N–24 HT 1 N–24/100	H 2 N–24 K
112	G	–	–	–	H 2 N–24	H 2 N–24	H 2 N–24	H 2 N–32
	M	–	–	–	H 2 N–28 HT 2 N–28/112	H 2 N–28 HT 2 N–28/112	H 2 N–28 HT 2 N–28/112	H 2 N–28 HT 2 N–28/112
125	G	–	–	–	H 2 N–24	H 2 N–24	H 2 N–24	H 2 N–32
	M	–	–	–	H 2 N–32 HT 2 N–32/125	H 2 N–32 HT 2 N–32/125	H 2 N–32 HT 2 N–32/125	H 2 N–32 HT 2 N–32/125
140	G	–	–	–	–	H 2 N–24	H 2 N–24	H 2 N–32
	M	–	–	–	–	H 2 N–32 HT 2 N–32/140	H 2 N–32 HT 2 N–32/140	H 2 N–32 HT 2 N–32/140
160	G	–	–	–	–	–	–	H 3 ND–32
	M	–	–	–	–	–	–	H 3 ND–42
180	G	–	–	–	–	–	–	H 3 ND–32
	M	–	–	–	–	–	–	H 3 ND–48
200	G	–	–	–	–	–	–	H 3 ND–32
	M	–	–	–	–	–	–	H 3 ND–55 L
225	G	–	–	–	–	–	–	H 3 ND–32
	M	–	–	–	–	–	–	H 3 ND–60 L

G = Gearbox side M = motor side

Demag roller couplings

Designation



Example:

AF 06 gearbox: H 1 N–16
KBF 90 A 8/2 motor: HT 1 N–24/90
Also 1 roller spider for H 1 coupling size

Weights and moments of inertia

Coupling halves Motor side (M)	+ gearbox side (G)	J [1] kg m²	G [1] kg
H 1 N–12 to H 1 N–24	+ H 1 N–	0.00026	0.5
HT 1 N–14/71, HT 1 N–19/71	+ H 1 N–	0.0019	1.3
HT 1 N–19/80, HT 1 N–24/80	+ H 1 N–	0.0024	1.45
HT 1 N–24/90	+ H 1 N–	0.0038	1.8
HT 1 N–24/100	+ H 1 N–	0.0084	3.0
H 2 N–24 to H 2 N–32	+ H 2 N–	0.0024	1.7
HT 2 N–28/112	+ H 2 N–	0.0154	4.2
HT 2 N–32/125	+ H 2 N–	0.0231	5.0
HT 2 N–32/140	+ H 2 N–	0.0311	6.4
H 3 ND–28 to H 3 ND–60	+ H 3 ND–	0.0111	6.5

[1] including roller spider
H = Light coupling
HT = Heavy coupling with increased moment of inertia of coupling half on motor side (M)

Characteristics with input speed n = 2800 rpm
AFL 04 and AF 04 to AF 18 hollow-shaft gearboxes

Table 14 *** The permissible gear torque limits mentioned ($M_{G\,2\,zul}$) are minimum values which may increase by up to 15% depending on the drive shaft type. Information on request.**

Gearbox		AFL 04				AF 04				AF 05/AFW 05				AF 06/AFW 06				AF 08/AFW 08			
Sizes of motors which may be fitted		KBV 71				71 80				71 80 (90) [1]				71 80 90 (100) [1]				80 90 100 112 (125) [1]			
M_{G2} in Nm*		400 to 450 [2]				400 to 450 [2]				950 (880) [4]				1700 (1000) [5]				3250			
i_{Nenn}	n_2 rpm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm
450	6.3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
400	7.1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
355	8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
315	9	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
280	10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
250	11.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
224	12.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
200	14	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
180	16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
160	18	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
140	20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	142	9.3	2.7	1240
125	22.4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	130	10.2	3.0	1240
112	25	–	–	–	–	–	–	–	–	106	3.5	1.0	345	110	6.2	1.8	640	114	11.6	3.4	1240
100	28	–	–	–	–	–	–	–	–	97.7	3.6	1.1	335	101	6.8	2.0	640	104	12.7	3.7	1240
90	31.5	–	–	–	–	–	–	–	–	91.3	3.8	1.1	330	88.4	7.7	2.3	640	91.4	14.4	4.2	1230
80	35.5	–	–	–	–	–	–	–	–	80	4.2	1.2	315	74.8	9.2	2.7	640	83.6	15.3	4.5	1200
71	40	–	–	–	–	–	–	–	–	72	4.5	1.3	300	71.4	9.4	2.7	630	72.6	15.4	4.5	1050
63	45	–	–	–	–	–	–	–	–	62.5	4.9	1.4	290	60.1	10.5	3.1	610	67.5	17.7	5.2	1120
56	50	57.9	3.3	1.0	180	57.9	3.3	1.0	180	54.3	5.4	1.6	275	53.4	11.5	3.4	585	58.6	18.1	5.3	1000
50	56	49.9	3.9	1.1	180	49.9	3.9	1.1	180	51.6	5.6	1.6	270	48.5	12.3	3.6	560	53.6	20.7	6.1	1040
45	63	44.8	4	1.2	160	44.8	4	1.2	160	44.6	6.1	1.8	260	44.8	10.6	3.1	445	46.5	21.4	6.3	935
40	71	38.5	4.6	1.4	160	38.5	4.6	1.4	160	39.4	6.6	1.9	245	40.6	10.6	3.1	405	42.3	24.2	7.1	960
35.5	80	35.1	5	1.5	160	35.1	5	1.5	160	35.7	7.1	2.1	235	35.5	10.6	3.1	355	36.9	21.4	6.3	740
31.5	90	31.8	5.7	1.7	170	31.8	5.7	1.7	170	32.3	7.6	2.2	230	30.4	14.5	4.2	410	33.3	27.7	8.1	870
28	100	27.4	6.6	1.9	170	27.4	6.6	1.9	170	29.3	8.1	2.4	220	27.1	15.9	4.7	405	29.1	25.7	7.5	705
25	112	25.9	6.8	1.9	160	25.9	6.3	1.9	100	25.5	8.9	2.6	210	24.5	16	4.7	370	26.4	27.8	8.1	690
22.4	125	22.3	7.3	2.1	150	22.3	7.2	2.1	150	23	9.5	2.8	205	21.5	15.9	4.7	320	23	25.6	7.5	555
20	140	20.3	7.6	2.2	140	20.3	7.6	2.2	140	20.4	10.3	3.0	200	20	20.3	6.0	380	20.8	27.7	8.1	540
18	160	17.9	7.7	2.3	130	17.9	7.7	2.3	130	18.5	10.9	3.2	190	18.1	21.3	6.2	360	18.2	29.8	8.7	510
16	180	15.5	8.5	2.5	120	15.5	8.5	2.5	120	16	12.1	3.5	180	15.8	21.8	6.4	330	16.8	29.8	8.7	475
14[3]	200	14.5	9	2.6	125	14.5	9	2.6	125	14.5	12.9	3.8	175	13.6	24.2	7.1	315	14.4	34	10	460
11.2[3]	250	11.2	11.2	3.3	120	11.2	11.2	3.3	120	9.6	11.7	3.4	108	9.6	18.8	5.5	177	–	–	–	–
8[3]	355	7.97	14.4	4.2	110	7.97	14.4	4.2	110	7.8	13.7	4	102	7.6	23	6.7	165	–	–	–	–
6.3[3]	425	6.48	16.6	4.9	100	6.48	16.2	4.8	100	–	–	–	–	–	–	–	–	–	–	–	–
5.6	530	5.18	19.1	5.6	95	5.18	18.9	5.5	95	–	–	–	–	–	–	–	–	–	–	–	–
4.5[3]	600	4.64	18.6	5.5	80	4.64	16.2	4.7	70	–	–	–	–	–	–	–	–	–	–	–	–
3.55	750	3.72	21.9	6.4	80	3.72	18.8	5.5	65	–	–	–	–	–	–	–	–	–	–	–	–

M_{G2} = Max. permissible gear torque limit
i_{Nenn} = Rated gearbox transmission
n_2 = Gearbox output speed
i_{vorh} = Actual gearbox transmission
M_{N1} = Rated gearbox input torque
P_{N1} = Rated gearbox input power
M_{N2} = Rated gearbox output torque

[1]) The moments for the motors in brackets should be checked exactly.
[2]) M_{G2} 400 Nm for i_{Nenn} from 3.55 to 18
M_{G2} 450 Nm for i_{Nenn} from 20 to 56
[3]) On size 04 hollow shaft only with W 25
[4]) M_{G2} 880 Nm for i_{vorh} 7.8
[5]) M_{G2} 1000 Nm for i_{vorh} 7.6

and AFW 05 to AFW 12 hollow-shaft spur and bevel gearboxes

*** The permissible gear torque limits mentioned ($M_{G\,2\,zul}$) are minimum values which may increase by up to 15% depending on the drive shaft type. Information on request.**

Gearbox		AF 10/AFW 10				AF 12/AFW 12				AF 18			
Sizes of motors which may be fitted		80 90 100 112 125 (140) [1]				90 100 112 125 140 (160) [1]				100 160 112 180 125 200 140 225			
M_{G2} in Nm*		6600				13500				31000			
i_{Nenn}	n_2 rpm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm
450	6.3	–	–	–	–	–	–	–	–	–	–	–	–
400	7.1	–	–	–	–	–	–	–	–	–	–	–	–
355	8	–	–	–	–	–	–	–	–	–	–	–	–
315	9	–	–	–	–	–	–	–	–	–	–	–	–
280	10	–	–	–	–	–	–	–	–	–	–	–	–
250	11.2	–	–	–	–	–	–	–	–	–	–	–	–
224	12.5	–	–	–	–	–	–	–	–	–	–	–	–
200	14	–	–	–	–	–	–	–	–	–	–	–	–
180	16	180	13.5	4.0	2290	175	18.8	5.5	3110	181	66	19.4	11190
160	18	164	14.7	4.3	2260	160	20.5	6.0	3080	–	–	–	–
140	20	140	18.8	5.5	2480	137	37	10.8	4730	145	80	23.5	10950
125	22.4	128	20	5.9	2430	135	39	11.5	4630	–	–	–	–
112	25	113	21.7	6.4	2300	110	41	12.1	4270	115	101	29.6	10945
100	28	105	21.8	6.4	2140	102	46	13.6	4470	–	–	–	–
90	31.5	90.6	25.3	7.4	2160	88.3	52	15.3	4330	87	128	37.6	10510
80	35.5	84.3	26	7.6	2070	82.1	54	15.9	4200	–	–	–	–
71	40	73.2	66.2	7.7	1800	71.3	62	18.2	4170	69	153	44.8	10054
63	45	66.9	30.5	8.9	1920	66.3	63	18.5	3950	–	–	–	–
56	50	58.1	31.6	9.3	1730	57.6	72	21.2	3930	55.5	179	52.6	9347
50	56	53.1	35.6	10.4	1780	52.7	75	21.9	3700	–	–	–	–
45	63	46.1	37.2	10.9	1610	45.7	86	25	3680	44	197	57.7	8156
40	71	41.9	42	12.2	1640	41.6	88	25.9	3460	–	–	–	–
35.5	80	36.4	46	13.4	1560	36.1	101	29.7	3440	34.7	197	57.7	6432
31.5	90	33.6	48	14.1	1520	31.5	111	32.8	3310	–	–	–	–
28	100	28.9	52	15.2	1400	28.7	105	30.8	2840	29.4	208	60.9	5745
25	112	26.7	54	16	1370	25	114	33.4	2680	–	–	–	–
22.4	125	22.8	59	17.4	1270	22.6	105	30.8	2240	–	–	–	–
20	140	20	63	18.5	1180	20.5	105	30.8	2030	–	–	–	–
18	160	18.7	67	19.8	1190	17.9	114	33.4	1920	–	–	–	–
16	180	16.3	72	21.1	1100	15.8	131	39.6	1950	–	–	–	–
14	200	14.5	80	23.5	1090	14.3	131	38.6	1770	–	–	–	–
11.2	250	–	–	–	–	–	–	–	–	–	–	–	–
8	355	–	–	–	–	–	–	–	–	–	–	–	–
6.3	425	–	–	–	–	–	–	–	–	–	–	–	–
5.6	530	–	–	–	–	–	–	–	–	–	–	–	–
4.5	600	–	–	–	–	–	–	–	–	–	–	–	–
3.55	750	–	–	–	–	–	–	–	–	–	–	–	–

M_{G2} = Max. permissible gear torque limit
i_{Nenn} = Rated gearbox transmission
n_2 = Gearbox output speed
i_{vorh} = Actual gearbox transmission
M_{N1} = Rated gearbox input torque
P_{N1} = Rated gearbox input power
M_{N2} = Rated gearbox output torque

[1]) The moments for the motors in brackets should be checked exactly.

Characteristics with input speed n = 1400 rpm
AFL 04 and AF 04 to AF 18 hollow-shaft gearboxes

Table 15 *** The permissible gear torque limits mentioned ($M_{G\,2\,zul}$) are minimum values which may increase by up to 15% depending on the drive shaft type. Information on request.**

Gearbox		AFL 04				AF 04				AF 05/AFW 05				AF 06/AFW 06				AF 08/AFW 08			
Sizes of motors which may be fitted		71				71 80				71 80 (90) [1]				71 80 90 (100) [1]				80 90 100 112 (125) [1]			
M_{G2} in Nm*		400 to 450 [2]				400 to 450 [2]				950 (880) [3]				1700 (1000) [4]				3250			
i_{Nenn}	n_2 rpm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm
450	3.15	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
400	3.55	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
355	4.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
315	4.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
280	5.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
250	5.6	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
224	6.3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
200	7.1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
180	8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
160	9	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
140	10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	142	9.3	1.4	1240
125	11.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	130	10.2	1.5	1240
112	12.5	–	–	–	–	–	–	–	–	106	3.6	0.5	360	110	6.2	0.9	640	114	11.6	1.7	1240
100	14	–	–	–	–	–	–	–	–	97.7	3.9	0.6	360	101	6.8	1.0	640	104	12.7	1.8	1240
90	16	–	–	–	–	–	–	–	–	91.3	4.2	0.6	360	88.4	7.7	1.1	640	91.4	14.4	2.1	1240
80	18	–	–	–	–	–	–	–	–	80	4.8	0.7	360	74.8	9.2	1.3	640	83.6	15.8	2.3	1240
71	20	–	–	–	–	–	–	–	–	72	5.3	0.8	360	71.4	9.6	1.4	640	72.6	18.2	2.7	1240
63	22.4	–	–	–	–	–	–	–	–	62.5	6.1	0.9	360	60.1	11.4	1.7	640	67.5	19.5	2.9	1240
56	25	57.9	3.3	0.5	180	57.9	3.3	0.5	180	54.3	6.8	1.0	345	53.4	12.8	1.9	640	58.6	22.5	3.3	1240
50	28	49.9	3.9	0.6	180	49.9	3.9	0.6	180	51.6	7.0	1.0	340	48.5	14.1	2.1	640	53.6	24.6	3.6	1240
45	31.5	44.8	4	0.6	160	44.8	4	0.6	160	44.6	7.7	1.1	325	44.8	13.4	2.0	560	46.5	27.3	4.0	1190
40	35.5	38.5	4.6	0.7	160	38.5	4.6	0.7	160	39.4	8.4	1.2	310	40.6	13.4	2.0	510	42.3	30.5	4.5	1210
35.5	40	35.1	5.1	0.7	160	35.1	5.1	0.7	160	35.7	8.9	1.3	300	35.5	13.4	2.0	445	36.9	27.3	4.0	950
31.5	45	31.8	5.7	0.8	170	31.8	5.7	0.8	170	32.3	9.5	1.4	290	30.4	18.3	2.7	520	33.3	35.5	5.2	1110
28	50	27.4	6.6	1	170	27.4	6.6	1.0	170	29.3	10.2	1.5	280	27.1	20	2.9	510	29.1	32.8	4.8	900
25	56	25.9	7.3	1.1	170	25.9	7.3	1.1	170	25.5	11.2	1.6	270	24.5	20.2	2.9	465	26.4	35.5	5.2	880
22.4	63	22.3	8.4	1.2	170	22.3	8.4	1.2	170	23	11.9	1.7	260	21.5	20	2.9	405	23	32.8	4.8	710
20	71	20.3	9.2	1.4	170	20.3	9.2	1.4	170	20.4	12.9	1.9	250	20	25.6	3.7	480	20.8	35	5.2	690
18	80	17.9	9.7	1.4	160	17.9	9.7	1.4	160	18.5	13.8	2.0	240	18.1	26.8	3.9	460	18.2	38	5.6	650
16	90	15.5	10.7	1.6	150	15.5	10.7	1.6	150	16	15.2	2.2	230	15.8	27.7	4.0	415	16.8	38	5.6	600
14	100	14.5	11.3	1.7	160	14.5	11.3	1.7	160	14.5	16.2	2.4	220	13.6	30.7	4.5	395	14.4	43	6.4	590
11.2	125	11.2	14.1	2.1	150	11.2	14.1	2.1	150	9.6	15	2.2	139	9.8	23.9	3.5	225	–	–	–	–
8	180	7.97	18.2	2.7	140	7.97	18.2	2.7	140	7.8	17.7	2.6	131	7.6	29.5	4.3	211	–	–	–	–
6.3	212	6.48	19.5	2.9	120	6.48	20.4	3	125	–	–	–	–	–	–	–	–	–	–	–	–
5.6	265	5.18	23.7	3.5	120	5.18	23.7	3.5	120	–	–	–	–	–	–	–	–	–	–	–	–
4.5	300	4.64	23.6	3.5	100	4.64	20.4	3	90	–	–	–	–	–	–	–	–	–	–	–	–
3.55	375	3.72	27.5	4	100	3.72	23.8	3.5	85	–	–	–	–	–	–	–	–	–	–	–	–

M_{G2} = Max. permissible gear torque limit
i_{Nenn} = Rated gearbox transmission
n_2 = Gearbox output speed
i_{vorh} = Actual gearbox transmission
M_{N1} = Rated gearbox input torque
P_{N1} = Rated gearbox input power
M_{N2} = Rated gearbox output torque

[1]) The moments for the motors in brackets should be checked exactly.
[2]) M_{G2} 400 Nm for i_{Nenn} from 3.55 bis 18
M_{G2} 450 Nm for i_{Nenn} from 20 bis 56
[3]) M_{G2} 880 Nm for i_{vorh} 7.8
[4]) M_{G2} 1000 Nm for i_{vorh} 7.6

and AFW 05 to AFW 12 hollow-shaft spur and bevel gearboxes

*** The permissible gear torque limits mentioned ($M_{G\,2\,zul}$) are minimum values which may increase by up to 15% depending on the drive shaft type. Information on request.**

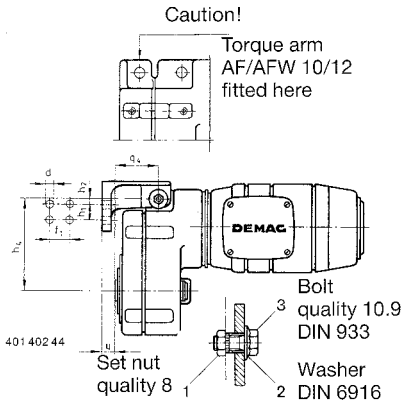
Gearbox		AF 10/AFW 10				AF 12/AFW 12				AF 18			
Sizes of motors which may be fitted		80 90 100 112 125 (140) [1]				90 100 112 125 140 (160) [1]				100 160 112 180 125 200 140 225			
M_{G2} in Nm*		6600				13500				31000			
i_{Nenn}	n_2 rpm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm
450	3.15	–	–	–	–	–	–	–	–	–	–	–	–
400	3.55	–	–	–	–	–	–	–	–	–	–	–	–
355	4.0	–	–	–	–	–	–	–	–	–	–	–	–
315	4.5	–	–	–	–	–	–	–	–	–	–	–	–
280	5.0	–	–	–	–	–	–	–	–	–	–	–	–
250	5.6	–	–	–	–	–	–	–	–	–	–	–	–
224	7.3	–	–	–	–	–	–	–	–	–	–	–	–
200	7.1	–	–	–	–	–	–	–	–	–	–	–	–
180	8	180	14.7	2.2	2480	175	23.7	3.5	3920	181	66	9.7	11190
160	9	164	16.1	2.4	2480	160	25.8	3.8	3880	–	–	–	–
140	10	140	18.8	2.7	2480	137	39	5.8	5070	145	82	12	11190
125	11.2	128	20.5	3.0	2480	125	43	6.3	5070	–	–	–	–
112	12.5	113	23.4	3.4	2480	110	49	7.2	5070	115	103	15.1	11190
100	14	105	25.2	3.7	2480	102	53	7.7	5070	–	–	–	–
90	16	90.6	29.1	4.3	2480	88.3	61	9.0	5070	87	137	20.1	11190
80	18	84.3	31.3	4.6	2480	82.1	66	9.6	5070	–	–	–	–
71	20	73.2	36.1	5.3	2480	71.3	76	11.1	5070	69	167	24.4	10950
63	22.4	66.9	38.5	5.6	2420	66.3	78	11.4	4850	–	–	–	–
56	25	58.1	42	6.2	2300	57.6	89	13	4820	55.5	209	30.6	10878
50	28	53.1	45	6.6	2240	52.7	92	13.4	4540	–	–	–	–
45	31.5	46.1	48	7.0	2080	45.7	105	15.4	4520	44	253	37	10463
40	35.5	41.9	52	7.7	2070	41.6	108	15.9	4240	–	–	–	–
35.5	40	36.4	57	8.4	1970	36.1	124	18.2	4220	34.7	251	36.7	8205
31.5	45	33.6	61	8.9	1920	31.5	137	20.1	4070	–	–	–	–
28	50	28.9	65	9.5	1770	28.7	134	19.7	3630	29.8	265	38.8	7328
25	56	26.7	68	10.0	1720	25	146	21.4	3420	–	–	–	–
22.4	63	22.8	74	10.9	1600	22.6	134	19.7	2860	–	–	–	–
20	71	20	79	11.6	1490	20.5	134	19.7	2590	–	–	–	–
18	80	18.7	85	12.5	1500	17.9	146	21.3	2450	–	–	–	–
16	90	16.3	90	13.3	1390	15.8	168	24.6	2490	–	–	–	–
14	100	14.5	101	14.8	1380	14.3	168	24.7	2260	–	–	–	–
11.2	125	–	–	–	–	–	–	–	–	–	–	–	–
9	156	–	–	–	–	–	–	–	–	–	–	–	–
7.1	197	–	–	–	–	–	–	–	–	–	–	–	–
5.6	250	–	–	–	–	–	–	–	–	–	–	–	–
4.5	311	–	–	–	–	–	–	–	–	–	–	–	–
3.55	395	–	–	–	–	–	–	–	–	–	–	–	–

M_{G2} = Max. permissible gear torque limit
i_{Nenn} = Rated gearbox transmission
n_2 = Gearbox output speed
i_{vorh} = Actual gearbox transmission
M_{N1} = Rated gearbox input torque
P_{N1} = Rated gearbox input power
M_{N2} = Rated gearbox output torque

[1]) The moments for the motors in brackets should be checked exactly.

Torque arms for connecting AF/AFL 04, AF 05–AF 12 hollow-shaft gearboxes and AFW 05–AFW 12 hollow-shaft spur and bevel gearboxes

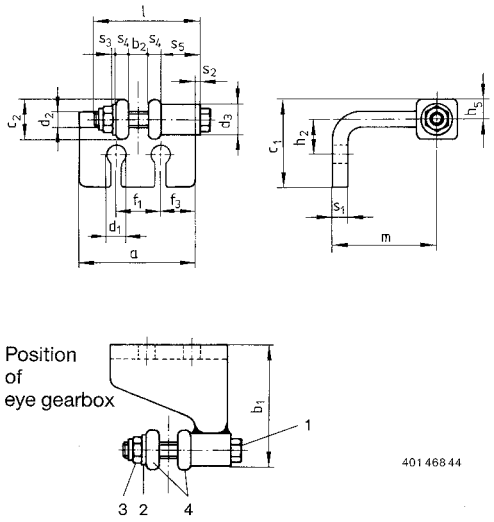
Table 16 Data for connection to adjoining structure



AF, AFW gearboxes	Size	Bolt Quantity	Bolt Tightening torque	Bore hole pattern d^{H11}	$f_1 \pm 0.3$	h_1	h_2	h_4	q_4	u
AF/AFL 04	M 12	2	121 Nm	14.5	35	–	27.5	142.5	66.5	17
05	M 12	4	121 Nm	14.5	35	25	10	150	67	12 to 28
06	M 12	4		14.5	35	25	10	175	67	12 to 28
08	M 16	4	300 Nm	18.5	65	60	20	230	99	25 to 47
10	M 16	4		18.5	65		88	297	72.5	32 to 54
12	M 16	4	300 Nm	18.5	65	60	88	360	74.5	32 to 52

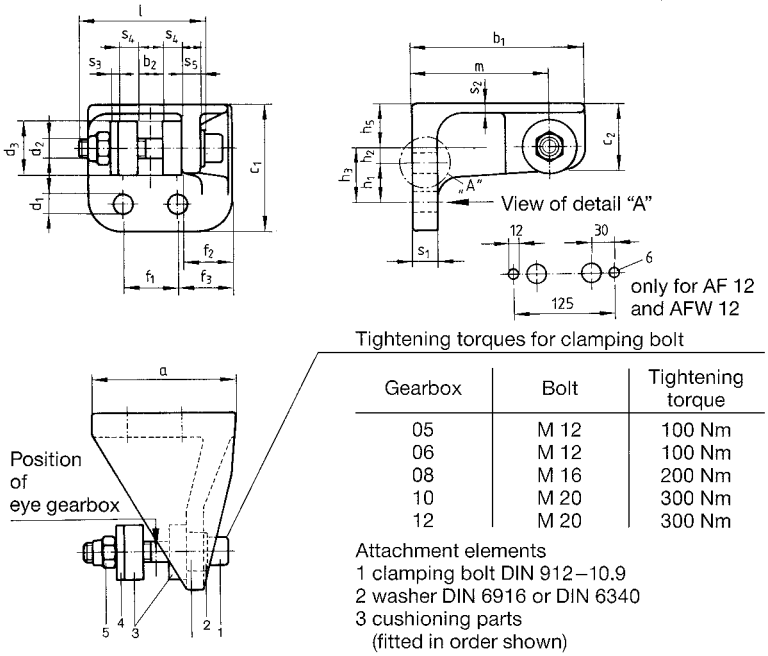
Table 17 Data for connection to gearbox

For gearbox types AF 04/AFL 04
Material: St 37-2



AF 04 gearbox clamping bolt M 12
Tightening torque 50 Nm
Attachment elements:
1 clamping bolt DIN 931–8.8
2 washer DIN 7349
3 lock nut DIN 980–8
4 cushioning parts
(fitted in order shown)

For gearbox types AF 05 to AF 12 and AFW 05 to AFW 12
Material: spheroidal graphite cast iron



The paint thickness between the torque arm and the mating surface should not exceed 60 microns.

Tightening torques for clamping bolt

Gearbox	Bolt	Tightening torque
05	M 12	100 Nm
06	M 12	100 Nm
08	M 16	200 Nm
10	M 20	300 Nm
12	M 20	300 Nm

Attachment elements
1 clamping bolt DIN 912–10.9
2 washer DIN 6916 or DIN 6340
3 cushioning parts
(fitted in order shown)
4 washer DIN 6340
5 lock nut DIN 980–8
6 splint pins, dia. 12 x 45 DIN 1481
(only for AF 12 and AFW 12)

Table 18 Torque arm, dimensions and part numbers [1])

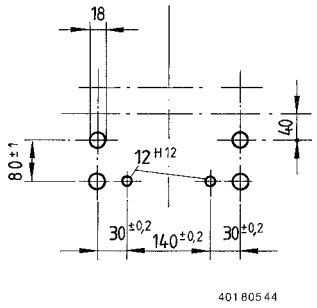
AF, AFW gearbox	Part no. [1])	Dimensions in mm a	b_1	b_2	c_1	c_2	d_1	d_2	d_3	f_1	f_2	f_3	h_1	h_2	h_3	h_5	l	m	s_1	s_2	s_3	s_4	s_5	Weight in kg
AF/AFL 04	811 950 44	90	96	16	68	31	14	M 12	25	35	–	27.5	–	27.5	–	15.5	85	83.5	12	2.5	6	9.5	30	1
05	811 205 44	91	110	16	80	42.5	13	M 12	35	35	32.5	35	25	10	35	28	80	79 to 95	15	5	5	12	12	1.5
06	811 206 44			20																		10		1.5
08	811 208 44	135	163	24	145	63	17	M 16	45	65	60.5	50	60	20	80	45	90	124 to 146	25	7	6	10	15	4
10	811 210 44	160	152	25	230	84		M 20	50		44	47.5		88	143	63	130	104 to 126		10		23.5	18	8.5
12	811 212 44	160	152	32	230	84	17	M 20	50	65	44	47.5	60	88	148	63	130	106 to 126	25	10	6	20	18	8.5

[1]) Part no. includes torque arm and attaching parts for adjoining structure and gearbox connection.

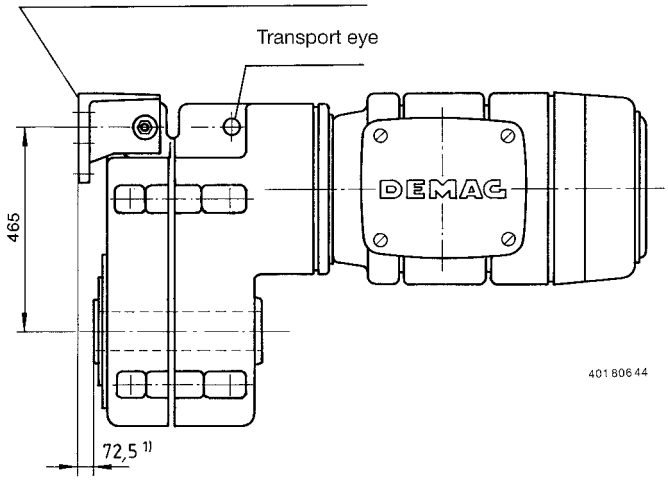
Fitting torque arm to AF 18
Torque arm D 2

Table 19 Data for fitting to the supporting structure

Drilling pattern in the supporting structure

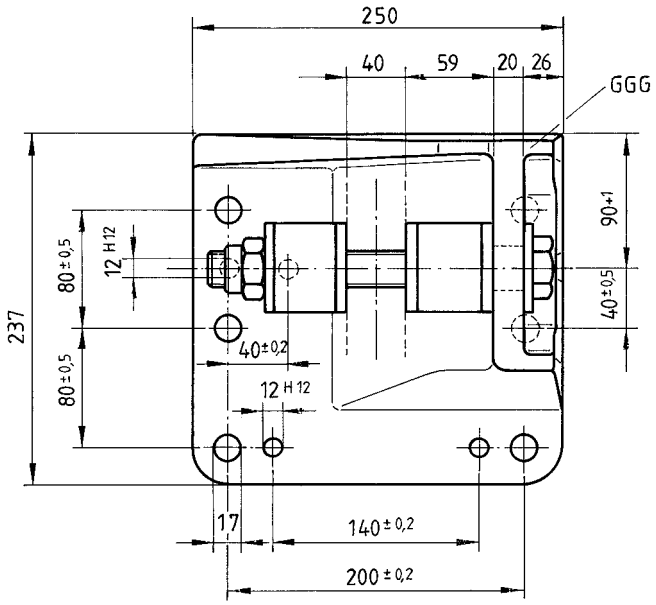


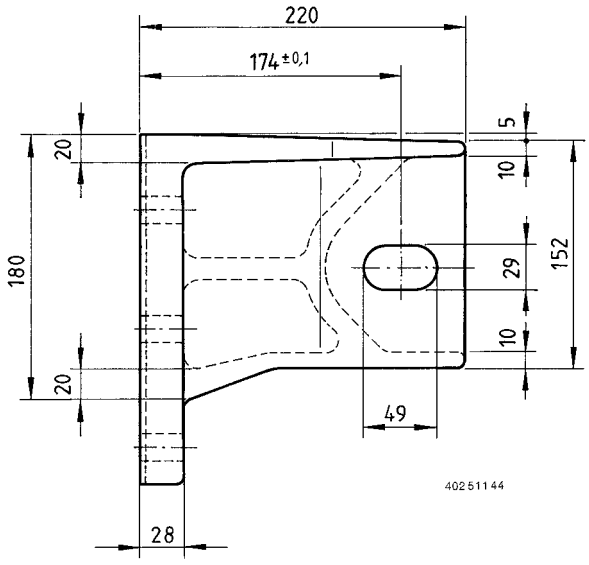
The paint thickness between torque arm and the mating surface should not exceed 60 microns



1) If the shrink disc is used, the dimension decreases to 12 mm

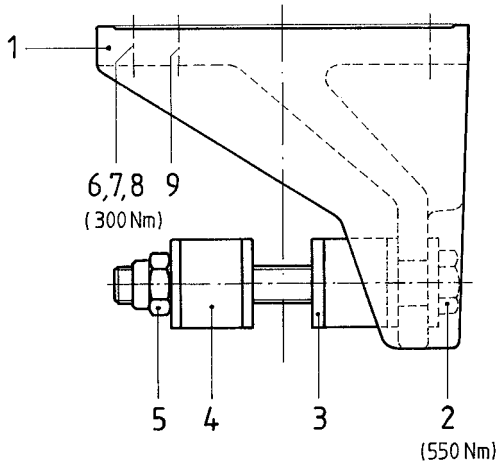
Dimensions, component parts, part no. 2)





Arm material: spheroidal graphite cast iron

Weight 18 kg



2) Part no. includes arm and mounting parts for supporting structure and gearbox connection

Item	Qty.	Designation	Part no.
1	1	Torque arm, complete Item 2–9	811 763 44
2	1	Hex. head bolt M 24 x 220 DIN 931–10.9	309 558 99
3	5	Washer 25 x 60 x 8 DIN 6340	160 626 99
4	2	Spring element 26 x 60 x 43	811 781 44
5	1	Hex. nut V M 24–8 DIN 980	334 618 44
6	4	Hex. head bolt M 16 x 70 DIN 933–10.9	309 699 99
7	4	Washer 17 x 30 x 4 DIN 6916	316 218 99
8	4	Set nut M 16–8	002 972 98
9	2	Split sleeve M 12 x 45 DIN 1481	345 200 99

Diagrams for determining hollow-shaft gearboxes

Diagram 1
Travel wheel slipping torque M_{pu}
Only for travel wheels of spheroidal graphite cast iron GGG 65

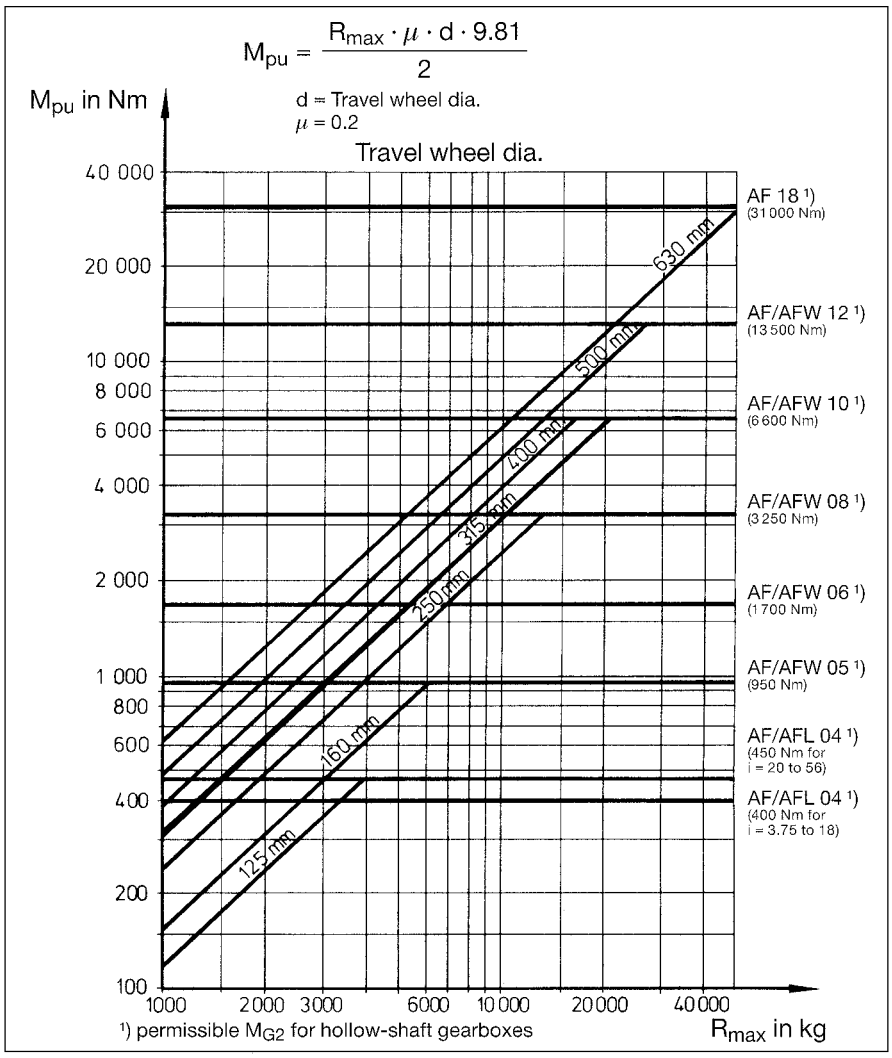


Diagram 2
Gearbox service life factor

β_1

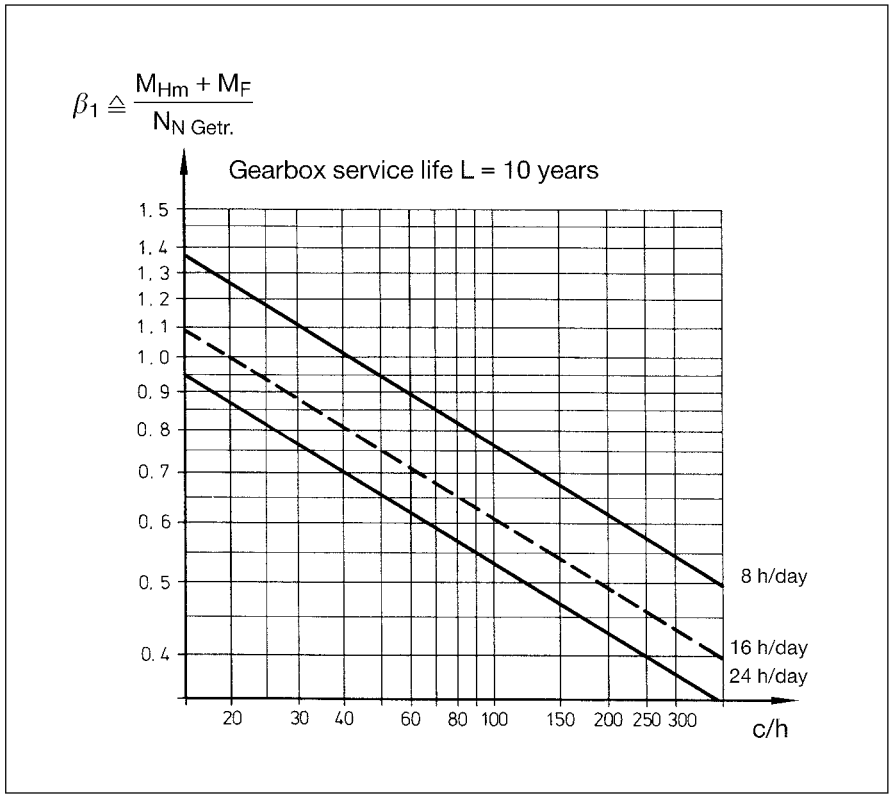


Diagram 3
Gearbox service life factor

$f_{c/h}$

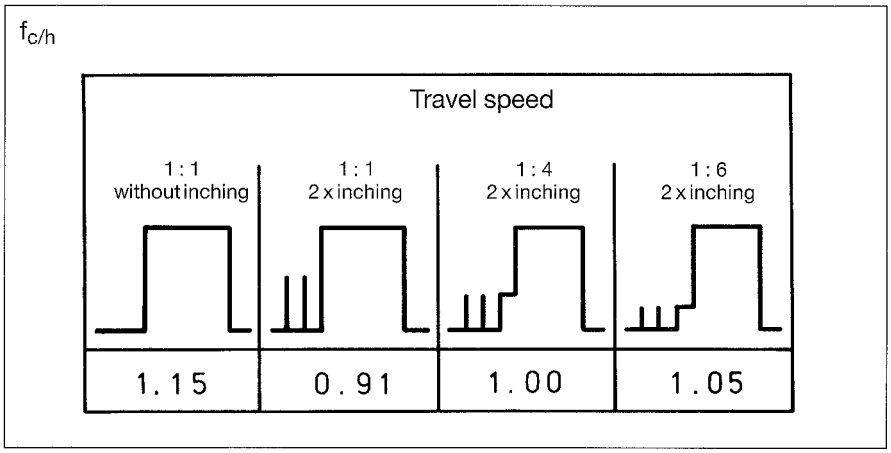


Diagram 4
Gearbox service life factor

f_{aH}

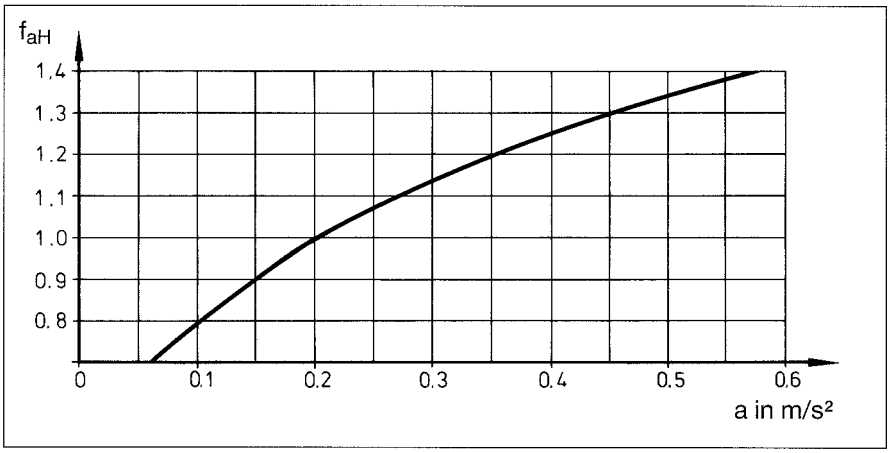
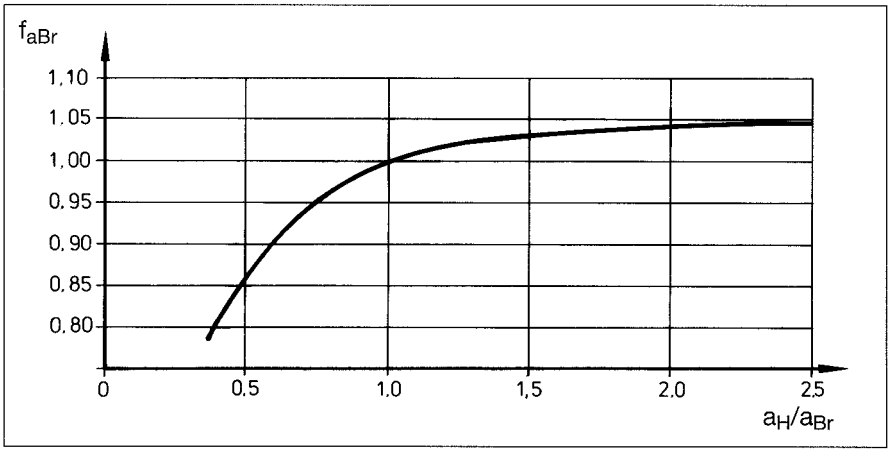


Diagram 5
Gearbox service life factor

f_v

Diagram 6
Gearbox service life factor

f_{aBr}



Calculation and selection of travel unit gearboxes

Example 1

The gearboxes for the travel motors determined in example 1 in the chapter for squirrel-cage rotor motor travel drive units are to be determined.

1.1 Given data

for a 10 t double-girder crane with a span of 18 m.

Weight of the crane	m_{Kr}	= 6 300 kg
Crab weight	m_{Ka}	= 1 200 kg
SWL	m_L	= 10 000 kg
Total number of wheels	z_{ges}	= 4
Crab approach dimension	l_{an}	= 0.75 m
Span	l_{Kr}	= 18 m
Travel wheel diameter	d_1	= 400 mm
Travel speed	v_1/v_2	= 10/40 m/min
Motor speed	n	= 700/2800 rpm
Switching frequency	c/h	= 200/100
Single-shift operation		= 8 hours/day
Motors determined		= 2 x KBF 90 A 8/2

1.2 Calculation of the maximum wheel load

The maximum wheel load is calculated from the given data as follows:

$$R_{max} = \frac{m_{Kr}}{z_{ges}} + \frac{2}{z_{ges}} \cdot (m_{Ka} + m_L) \cdot \frac{l_{Kr} - l_{an}}{l_{Kr}}$$

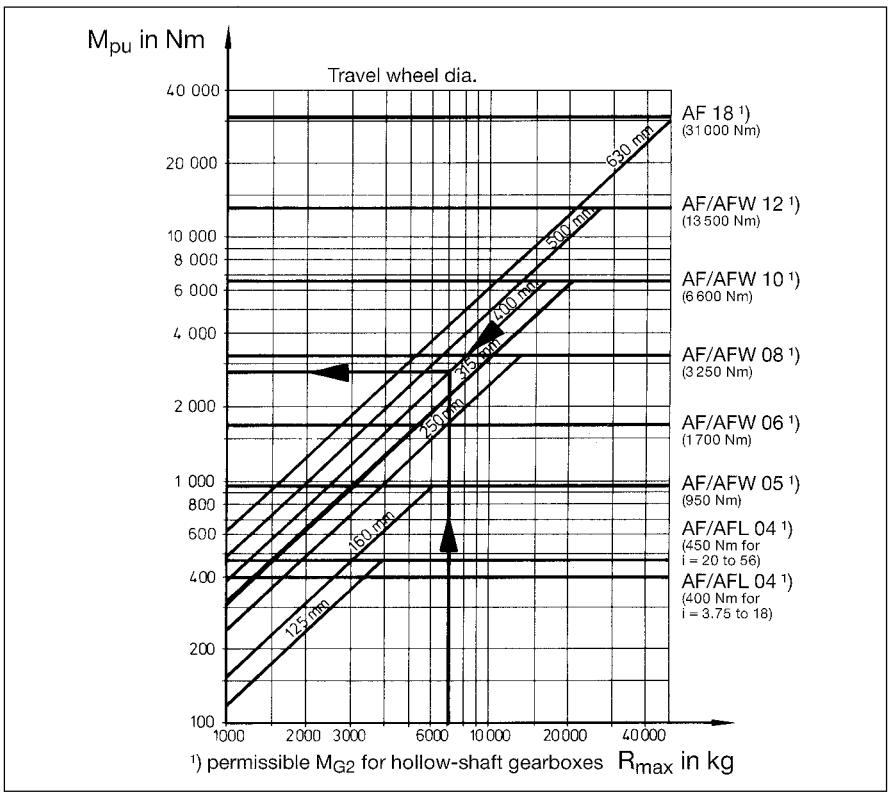
$$= \frac{6\,300}{4} + \frac{2}{4} \cdot (1\,200 + 10\,000) \cdot \frac{18 - 0.75}{18} = 6\,942 \text{ kg}$$

1.3 Travel wheel slipping torque

With R_{max} = 6 942 kg and travel wheel dia. d_1 = 400 mm, M_{pu} = 2700 Nm according to diagram 1.

Diagram 1

Travel wheel slipping torque M_{pu} – only for spheroidal graphite cast iron travel wheels



This corresponds to the AF 08 gearbox size.

1.4 Gearbox transmission ratio

With v_1/v_2 = 10/40 m/min, n = 700/2800 rpm and travel wheel dia. d_1 = 400 mm, a gearbox ratio of 90 : 1 is required according to Table 20.

Table 20

Selection table: travel wheel diameter – travel speed – rated gearbox transmission ratio

Motor speed rpm	Travel speed m/min												
4 pole 1400	5	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80
2 pole 2800	10	12.5	16	20[1]	25	31.5	40[1]	50	63[1]	80[1]	100	125	160
Travel wheel dia. mm	Rated gearbox transmission ratio												
125	112	90	71	56	45	35	28	22.4	18	14	11.2	9	7.1
160		112	90	71	56	45	35.5	28	22.4	18	14		
250			140	112	90	71	56	45	35.5	28	22.4	18	14
400				180	140	112	90	71	56	45	35.5	28	22.4
500					180	140	112	90	71	56	45	35.5	28
630		450	355	280	224	180	140	112	90	71	56	45	35.5

[1]) Recommended travel speed

1.5 Determining the mean mass

In the majority of cases the load distribution is unknown.
For the purposes of calculations, the following assumption can be made for the mean mass:

$$m = m_{Kr} + m_{Ka} + \frac{m_L}{2}$$

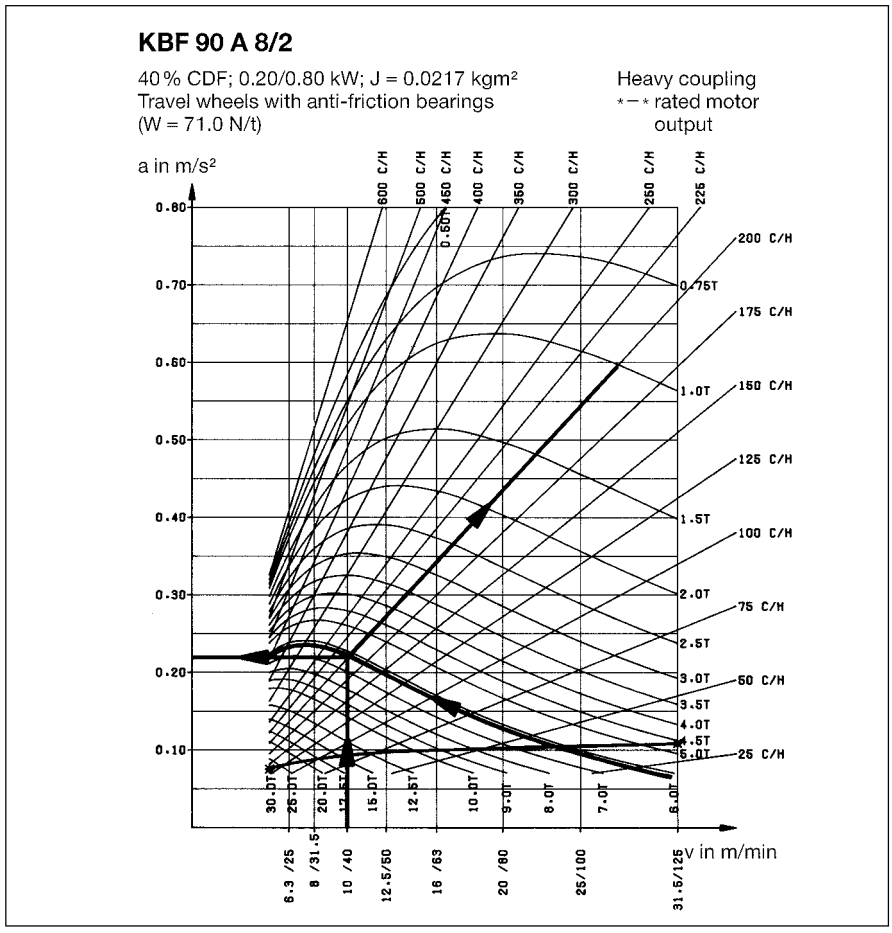
$$= 6\,300 + 1\,200 + \frac{10\,000}{2} = 12\,500 \text{ kg}$$

1.6 Calculation of the acceleration

With the motor KBF 90 A 8/2, a mean mass per motor of m′ = 6 250 kg and travel speeds of v_1/v_2 = 10/40 m/min, an acceleration of a_H = 0.22 m/s² is obtained according to Diagram 7 (for further diagrams, see the chapter on squirrel-cage brake motors).

Diagram 7

Acceleration values and switching frequencies

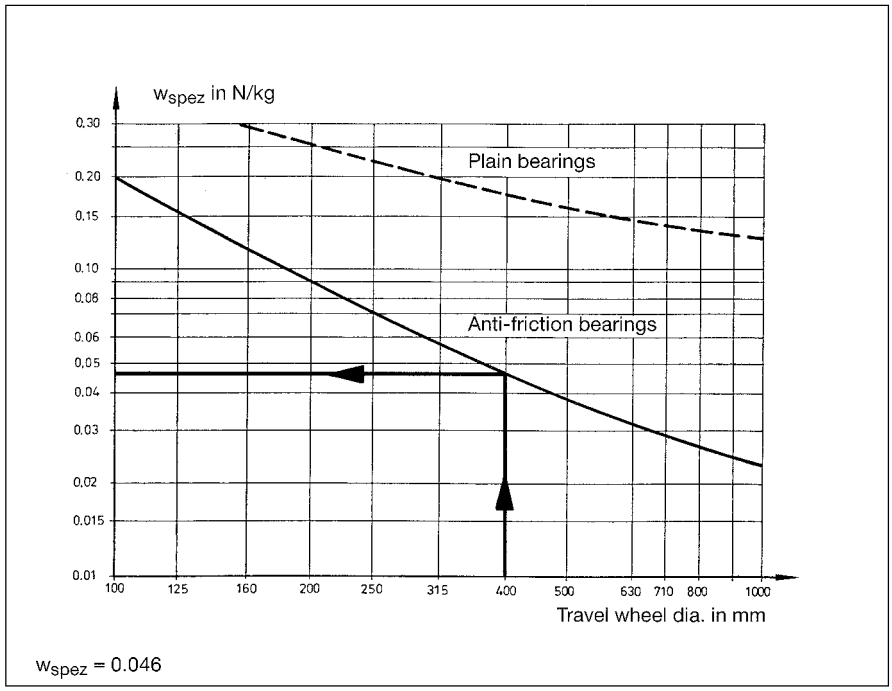


1.7 Determining the specific traction resistance

With the 400 mm travel wheel with anti-friction bearings, a specific traction resistance of 0.046 N/kg is obtained from Diagram 8.

Diagram 8

Traction resistance w_{spez}



1.8 Calculation of the gearbox input torque

Using the data:
m' = 6 250 kg mean mass per motor
a_H = 0.22 m/s²
w_{spez} = 0.046 N/kg
v_2 = 40 m/min
n = 2800 rpm
and the mechanical efficiency factor η = 0.85,
the reduction gear input torque is obtained as follows:

$$M_{N1} = \frac{m' \cdot (a_H + w_{spez}) \cdot v_2}{6.28 \cdot \eta \cdot n}$$

$$= \frac{6\,250 \cdot (0.22 + 0.046) \cdot 40}{6.28 \cdot 0.85 \cdot 2\,800} = 4.45 \text{ Nm}$$

1.9 Calculation of the required rated gearbox torque for 10 years service life

First the required $M_{N\,Getr}$ is calculated for 10 years service life.

Using the data:

M_{N1}	= 4.45 Nm	(1.8)
c/h	= 200/100	(1.1)
Speed ratio	= 1 : 4	(1.1)
a_H	= 0.22 m/s²	(1.6)
v_1/v_2	= 10/40 m/min	(1.1)

and on the assumption that the deceleration a_{Br} is also 0.22 m/s², the factors according to the Diagrams 2–6 give:

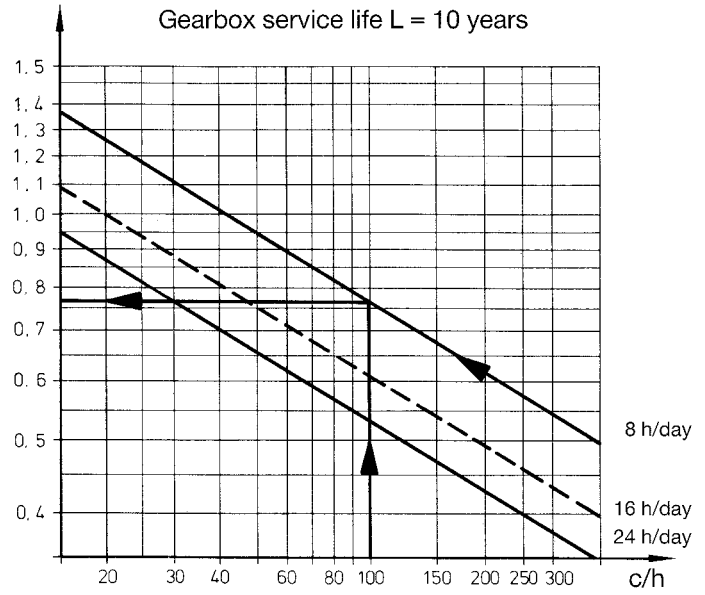
$$M_{N\,Getr} = \frac{M_{N\,an}}{\beta_1 \cdot f_{c/h} \cdot f_{aH} \cdot f_v \cdot f_{aBr}}$$

$$= \frac{4.45}{0.76 \cdot 1.0 \cdot 1.02 \cdot 1.0 \cdot 1.0} = 5.74 \text{ Nm}$$

Factors for the gearbox service life (Diagrams 2–6)

Diagram 2 β_1

$$\beta_1 \triangleq \frac{M_{Hm} + M_F}{M_{N\,Getr}}$$



β_1 = 0.76

Diagram 3

$f_{c/h}$

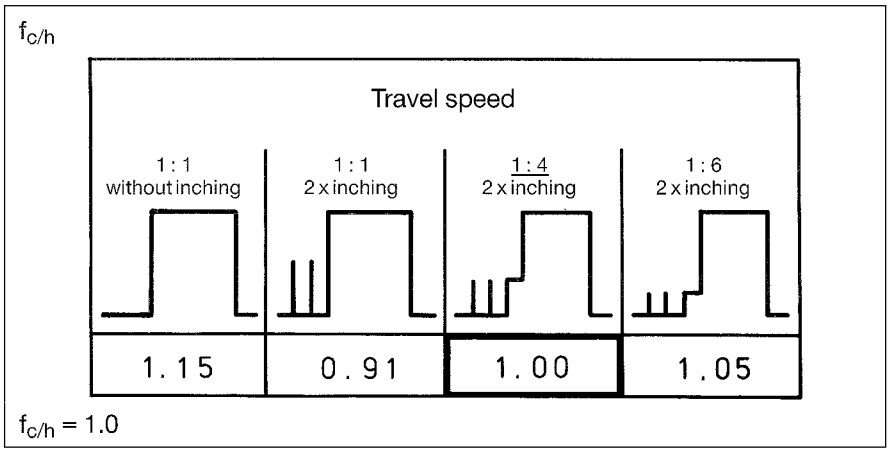


Diagram 4

f_{aH}

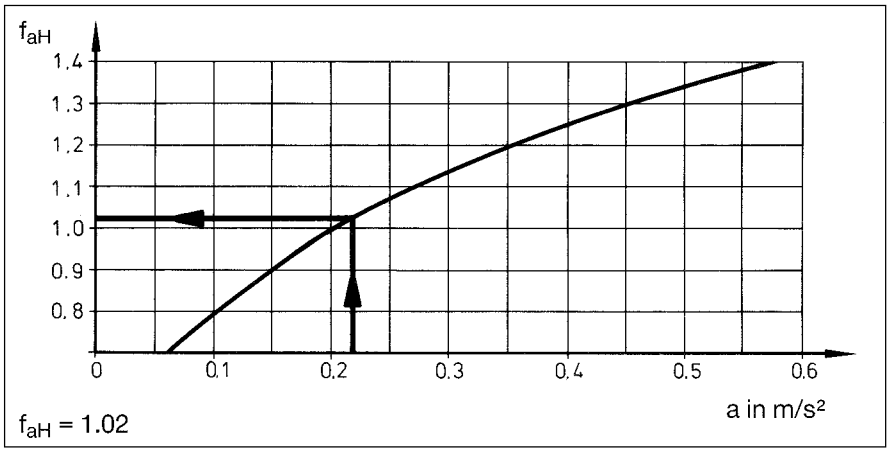


Diagram 5

f_v

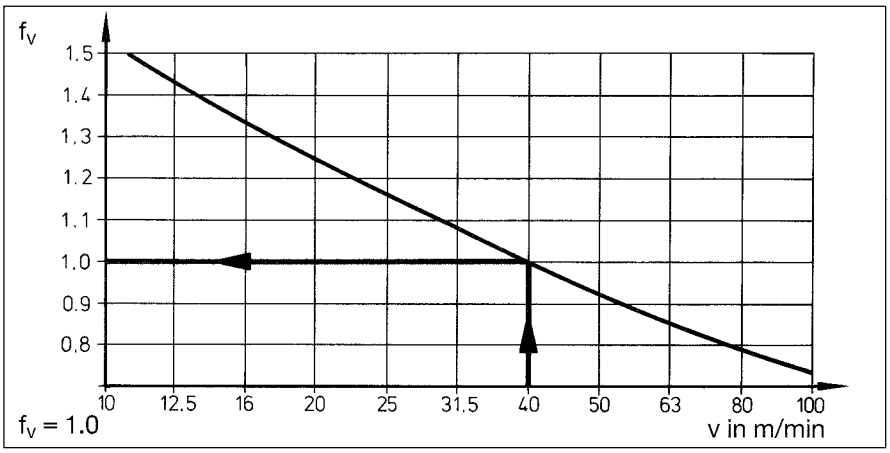
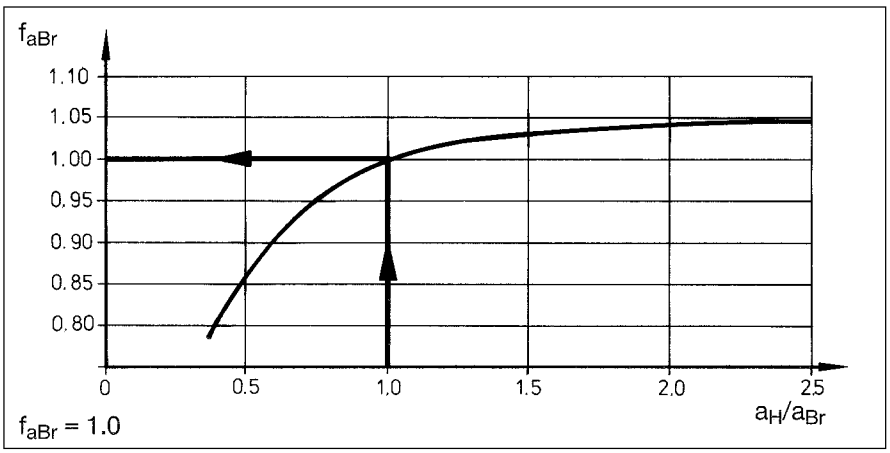


Diagram 6

f_{aBr}



1.10 Selecting the gearbox

On the basis of the calculated rated gearbox torque $M_{N\,Getr}$ = 5.74 Nm, an AF 06 gearbox with the characteristics M_{N1} = 7.7 Nm at n_1 = 2 800 rpm and $i_{vorh.}$ = 88.4 is required according to Table 14.

Owing to the required travel wheel slipping torque M_{pu} = 2 700 Nm, an AF 08 gearbox with a permissible gear torque limit M_{G2} = 3 250 Nm is required as shown in Diagram 1.

AFL 04 and AF 04 to AF 18 hollow-shaft gearboxes
Characteristics with input speed n = 2800 rpm
Extract from Table 14, page 16

Gearbox		AFL 04				AF 04				AF 05/AFW 05				AF 06/AFW 06				AF 08/AFW 08			
Sizes of motors which may be fitted		KBV 71				71 80				71 80 (90) [1]				71 80 90 (100) [1]				80 90 100 112 (125) [1]			
M_{G2} in Nm		400 to 450				400 to 450				950				1700				3250			
i_{Nenn}	n_2 rpm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm
200	14	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
180	16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
160	18	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
140	20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	142	9.3	2.7	1240
125	22.4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	130	10.2	3.0	1240
112	25	–	–	–	–	–	–	–	–	106	3.5	1.0	345	110	6.2	1.8	640	114	11.6	3.4	1240
100	28	–	–	–	–	–	–	–	–	97.7	3.6	1.1	335	101	6.8	2.0	640	104	12.7	3.7	1240
90	31.5	–	–	–	–	–	–	–	–	91.3	3.8	1.1	330	88.4	7.7	2.3	640	91.4	14.4	4.2	1230
80	35.5	–	–	–	–	–	–	–	–	80	4.2	1.2	315	74.8	9.2	2.7	640	83.6	15.3	4.5	1200
71	40	–	–	–	–	–	–	–	–	72	4.5	1.3	300	71.4	9.4	2.7	630	72.6	15.4	4.5	1050
63	45	–	–	–	–	–	–	–	–	62.5	4.9	1.4	290	60.1	10.5	3.1	610	67.5	17.7	5.2	1120
56	50	57.9	3.3	1.0	180	57.9	3.3	1.0	180	54.3	5.4	1.6	275	53.4	11.5	3.4	585	58.6	18.1	5.3	1000
50	56	49.9	3.9	1.1	180	49.9	3.9	1.1	180	51.6	5.6	1.6	270	48.5	12.3	3.6	560	53.6	20.7	6.1	1040
45	63	44.8	4	1.2	160	44.8	4	1.2	160	44.6	6.1	1.8	260	44.8	10.6	3.1	445	46.5	21.4	6.3	935
40	71	38.5	4.6	1.4	160	38.5	4.6	1.4	160	39.4	6.6	1.9	245	40.6	10.6	3.1	405	42.3	24.2	7.1	960
35.5	80	35.1	5	1.5	160	35.1	5	1.5	160	35.7	7.1	2.1	235	35.5	10.6	3.1	355	36.9	21.4	6.3	740

[1]) The moments for the motors in brackets should be checked exactly.

Characteristics of the AF 08 gearbox:

i_{vorh} = 91.4

M_{N1} = 14.4 Nm

M_{G2} = 3 250 Nm

1.11 Calculation of the service life

Since the AF 08 gearbox has a permissible rated gearbox torque M_{N1} = 14.4 Nm according to 1.10, and as the required gearbox torque $M_{N\,Getr}$ is only 5.74 Nm, an exact calculation of the service life which may be achieved is not required.

The approximate, theoretical service life can be calculated with the following data:

M_{N1} = 14.4 Nm (1.10)

$M_{N\,Getr}$ = 5.74 Nm (10 years) (1.9)

to give: $10 \cdot \left(\frac{14.4}{5.74}\right)^3$ = 157.9 years.

Calculation and selection of the travel unit gearboxes

Example 2

Exact calculation of the theoretical service life

2. Gearbox for a transfer car

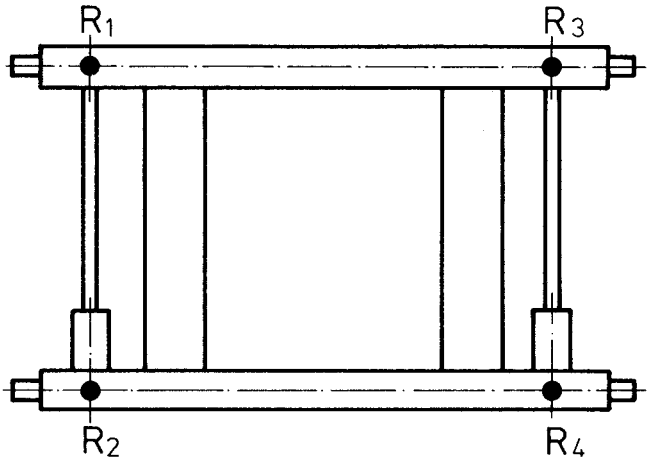
The acceleration and braking shall be approx. 1.0 m/s² during no-load operation. For this reason it is intended that all 4 wheels shall be driven.

2.1 Given data

Transfer car

Dead weight	m_1	= 1 000 kg
Dead weight + load	m_2	= 2 000 kg
Travel wheel dia.	d_1	= 160 mm, anti-friction bearings
Travel speed	v_1/v_2	= 8/31.5 m/min
Cycles/h		= transfer of 140 casting boxes
Transfer distance	s	= 2 m
Number of motors	A_M	= 2
Total number of wheels	z_{ges}	= 4
Number of driven wheels	z_{an}	= 4
Double-shift operation		= 16 hours/day

Distribution of the wheel loads in kg



	R_1	R_2	R_3	R_4
at minimum weight m_1:	240	260	240	260
at max. weight m_2:	490	510	490	510

2.2 Data of the motors already determined

2 x KBF 80 A 8/2

Cyclic duration factor	CDF	= 40 %
Output	P	= 0.13/0.50 kW
Rated speed	n_1/n_2	= 630/2710 rpm
Starting torque	M_A	= 4.6/4.5 Nm
Acceleration torque	M_H	= 4.1/3.8 Nm
Moment of inertia	$\Sigma J = L_{Br + HT}$	= 0.0052 kgm²
Braking torque	M_{Br}	= 3.2 Nm
Braking spring	F_{Fe}	= 56 N
Switching frequency factor	A	= 900/400

2.3 Requirements

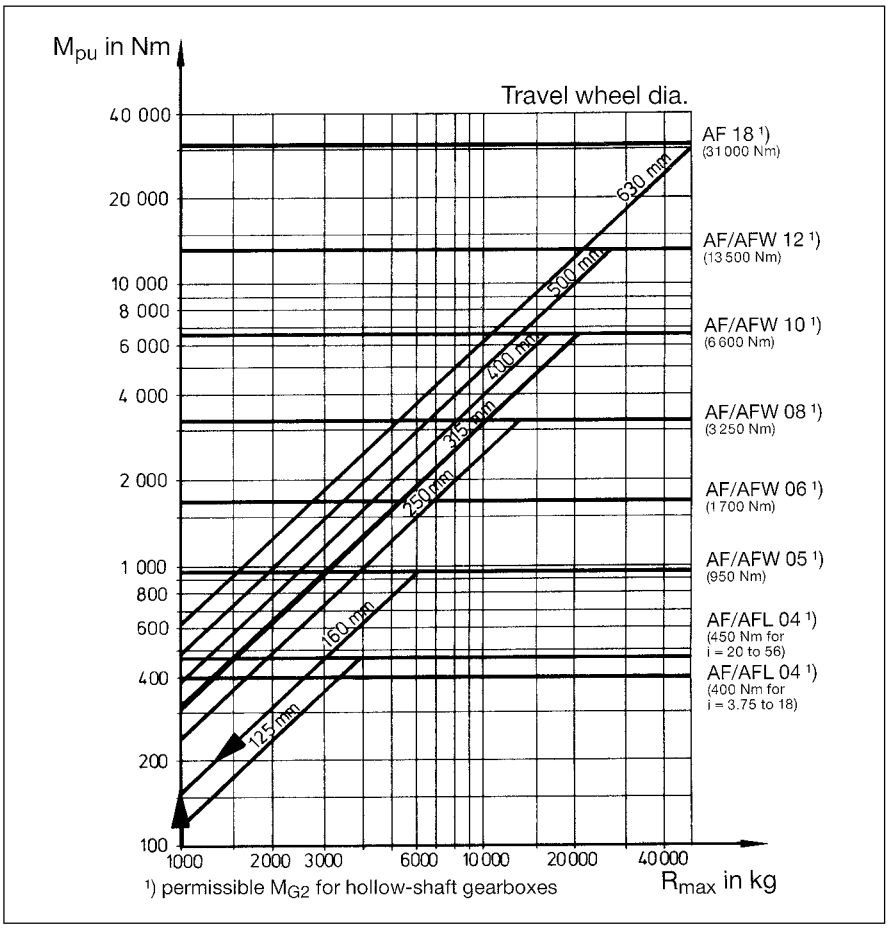
140 casting boxes must be transported per hour, i. e. the transfer car must carry out 140 runs with dead weight m_1 = 1 000 kg, and 140 runs with dead weight plus load m_2 = 2 000 kg.

2.4 Calculation of the travel wheel slipping torque

With R_{max} = 490 + 510 = 1 000 kg and travel wheel dia. = 160 mm, the travel wheel slipping torque M_{pu} = 160 Nm according to Diagram 1.

Diagram 1

Travel wheel slipping torque M_{pu} – only for spheroidal graphite cast iron travel wheels



2.5 Calculation of the required gearbox ratio

With $v_2 = 31.5$ m/min, n = 2 800 rpm and travel wheel dia. $d_1 = 160$ mm, a gearbox ratio of $i_{Nenn} = 45$ is required according to Table 20.

Table 20

Selection table:
travel wheel diameter – travel speed – gearbox transmission ratio

Motor-speed in rpm	Travel speed in m/min												
4pole 1400	5	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80
2pole 2800	10	12.5	16	20[2]	25	31.5	40[2]	50	63[2]	80[2]	100	125	160
Travel wheel dia. mm	**Gearbox transmission ratio**												
125	112	90	71	56	46	35	28	22.4	18	14	11.2	9	7.1
160		112	90	71	56	45	35.5	28	22.4	18	14		
250			140	112	90	71	56	45	35.5	28	22.4	18	14
400				180	140	112	90	71	56	45	35.5	28	22.4
500					180	140	112	90	71	56	45	35.5	28
630		450	355	280	224	180	140	112	90	71	56	45	35.5

[2]) Recommended travel speed

2.6 Determining the reduction gear

With the travel wheel slipping torque $M_{pu} = 160$ Nm, an AF 05 gearbox with a rated transmission according to Table 10 of $i_{Nenn} = 45$ is required according to Diagram 1.

AFL 04 and AF 04 to AF 18 hollow-shaft gearboxes
Characteristics with input speed n = 2800 rpm
Extract from Table 14, page 16

Gearbox		AFL 04				AF 04				AF 05/AFW 05				AF 06/AFW 06				AF 08/AFW 08			
Sizes of motors which may be fitted		KBV 71				71 80				71 80 (90) [1])				71 80 90 (100) [1])				80 90 100 112 (125) [1])			
M_{G2} in Nm		400 to 450				400 bis 450				950				1700				3250			
i_{Nenn}	n_2 rpm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm	i_{vorh}	M_{N1} Nm	P_{N1} KW	M_{N2} Nm
140	20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	142	9.3	2.7	1240
125	22.4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	130	10.2	3.0	1240
112	25	–	–	–	–	–	–	–	–	106	3.5	1.0	345	110	6.2	1.8	640	114	11.6	3.4	1240
100	28	–	–	–	–	–	–	–	–	97.7	3.6	1.1	335	101	6.8	2.0	640	104	12.7	3.7	1240
90	31.5	–	–	–	–	–	–	–	–	91.3	3.8	1.1	330	88.4	7.7	2.3	640	91.4	14.4	4.2	1230
80	35.5	–	–	–	–	–	–	–	–	80	4.2	1.2	315	74.8	9.2	2.7	640	83.6	15.3	4.5	1200
71	40	–	–	–	–	–	–	–	–	72	4.5	1.3	300	71.4	9.4	2.7	630	72.6	15.4	4.5	1050
63	45	–	–	–	–	–	–	–	–	62.5	4.9	1.4	290	60.1	10.5	3.1	610	67.5	17.7	5.2	1120
56	50	57.9	3.3	1.0	180	57.9	3.3	1.0	180	54.3	5.4	1.6	275	53.4	11.5	3.4	585	58.6	18.1	5.3	1000
50	56	49.9	3.9	1.1	180	49.9	3.9	1.1	180	51.6	5.6	1.6	270	48.5	12.3	3.6	560	53.6	20.7	6.1	1040
45	63	44.8	4	1.2	160	44.8	4	1.2	160	44.6	6.1	1.8	260	44.8	10.6	3.1	445	46.5	21.4	6.3	935
40	71	38.5	4.6	1.4	160	38.5	4.6	1.4	160	39.4	6.6	1.9	245	40.6	10.6	3.1	405	42.3	24.2	7.1	960
35.5	80	35.1	5	1.5	160	35.1	5	1.5	160	35.7	7.1	2.1	235	35.5	10.6	3.1	355	36.9	21.4	6.3	740

[1]) The moments for the motors in brackets should be checked exactly.

The characteristics for the AF 05 gearbox are as given in Table 10:

$i_{vorh} = 44.6$

$M_{N1} = 6.1$ Nm

$M_{G2} = 950$ Nm

2.7 Determining the mean mass

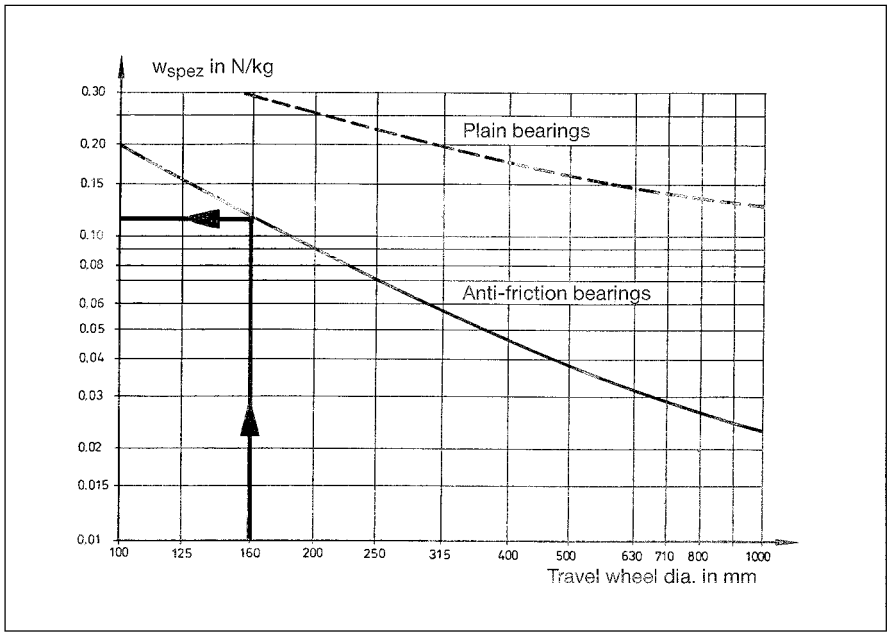
With this particular application, there are two types of loading.
1. Travel with dead weight only m_1 = 1 000 kg.
2. Travel with dead weight plus load m_2 = 2 000 kg.
The theoretical service life can, therefore, be calculated with sufficient accuracy using the dead weight and half the load m = 1 500 kg.

2.8 Calculation of the acceleration and deceleration

The acceleration a_H and the deceleration a_{Br} are calculated using the motor data according to 2.2 and the weight m = 1 500 kg according to 2.7.
The gearbox efficiency factor η is 0.85.
With a travel wheel dia. of 160 mm and anti-friction bearings, the specific traction resistance w_{spez} = 0.11 N/kg according to Diagram 8.

Diagram 8

Specific traction resistance w_{spez}



$m = 1\,500$ kg

$w = m_1 \cdot w_{spez} = 1500 \cdot 0.11 = 165$ N

Motor mass:

$$m_M = \frac{1}{91.2} \cdot A_M \cdot J_M \cdot \frac{n^2 \cdot 3\,600}{v_2^2} = \frac{1}{91.2} \cdot 2 \cdot 0.0052 \cdot \frac{2\,800^2 \cdot 3\,600}{31.5^2} = 3\,243 \text{ kg}$$

$$m_{MH} = m_M \cdot \eta = 3243 \cdot 0.85 = 2\,757 \text{ kg}$$

$$m_{M\,Br} = \frac{m_M}{\eta} = \frac{3\,243}{0.85} = 3\,815 \text{ kg}$$

Driving force:

$$F_A = A_M \cdot M_H \cdot \frac{n \cdot 60}{v} \cdot \frac{\pi}{30} \cdot \eta = 2 \cdot 3.8 \cdot \frac{2\,800 \cdot 60}{31.5} \cdot \frac{\pi}{30} \cdot 0.85 = 3\,608 \text{ N}$$

Braking force:

$$F_{Br} = \frac{A_M \cdot M_{Br}}{\eta} \cdot \frac{n \cdot 60}{v_2} \cdot \frac{\pi}{30} = \frac{2 \cdot 3.2}{0.85} \cdot \frac{2\,800 \cdot 60}{31.5} \cdot \frac{\pi}{30} = 4\,205 \text{ N}$$

Acceleration:

$$a_H = \frac{F_A - w}{m_{MH} + m} = \frac{3\,608 - 165}{2\,757 + 1\,500} = 0.809 \text{ m/s}^2$$

Deceleration:

$$a_{Br} = \frac{F_{Br} + w}{m_{M\,Br} + m} = \frac{4\,205 + 165}{3\,815 + 1\,500} = 0.822 \text{ m/s}^2$$

2.9 Calculation of torques

Using the figures obtained in 2.8, the acceleration torque M_{Hm}, travel torque M_F and braking torque M_{Br} which the gearbox shall be subjected to are calculated.

$$M_{Hm} = \frac{a_H \cdot m \cdot v_2}{6.28 \cdot \eta \cdot n \cdot A_M} = \frac{0.809 \cdot 1500 \cdot 31.5}{6.28 \cdot 0.85 \cdot 2800 \cdot 2} = 1.28 \text{ Nm}$$

$$M_F = \frac{m \cdot w_{spez} \cdot v_2}{6.28 \cdot \eta \cdot n \cdot A_M} = \frac{1500 \cdot 0.11 \cdot 31.5}{6.28 \cdot 0.85 \cdot 2800 \cdot 2} = 0.17 \text{ Nm}$$

$$M_{Br} = \frac{a_{Br} \cdot m \cdot v_2 \cdot \eta}{6.28 \cdot n \cdot A_M} = \frac{0.822 \cdot 1500 \cdot 31.5 \cdot 0.85}{6.28 \cdot 2800 \cdot 2} = 0.94 \text{ Nm}$$

2.10 Obtaining the Cyclic Duration Factor

Without taking into account the acceleration a_H and deceleration a_{Br}, the Cyclic Duration Factor CDF is as follows for a travel path s_2 of 1.8 m at $v_2 = 31.5$ m/min and $s_1 = 0.2$ m at $v_1 = 8$ m/min and for the required 140 runs in the one direction and 140 runs in the other direction:

$$CDF = \frac{\left(\frac{s_2 \cdot 60}{v_2} + \frac{s_1 \cdot 60}{v_1}\right) \cdot c/h}{3600} \cdot 100 = \frac{\left(\frac{1.8 \cdot 60}{31.5} + \frac{0.2 \cdot 60}{8}\right) \cdot 280}{3600} \cdot 100 = 38.3\%$$

40% is, therefore, taken as the CDF in further calculations.

2.11 Determining starting, braking and travel times

The total starting time t_A, braking time t_{Br} and travel time t_F are calculated using the acceleration $a_H = 0.809$ m/s² and deceleration $a_{Br} = 0.822$ m/s² obtained in 2.8 and the 40% Cyclic Duration Factor obtained in 2.10 on the basis of 280 starts per hour.

$$t_A = \frac{1}{60 \cdot a_H} \cdot (2 \cdot v_1 + v_2) \cdot c/h = \frac{1}{60 \cdot 0.809} \cdot (2 \cdot 8 + 31.5) \cdot 280 = 274 \text{ s}$$

$$t_{Br} = \frac{1}{60 \cdot a_{Br}} \cdot (2 \cdot v_1 + v_2) \cdot c/h = \frac{1}{60 \cdot 0.822} \cdot (2 \cdot 8 + 31.5) \cdot 280 = 270 \text{ s}$$

$$t_F = 3600 \cdot \frac{CDF}{100} - t_A - t_{Br} = 3600 \cdot \frac{40}{100} - 274 - 270 = 896 \text{ s}$$

2.12 Calculation of the cubic mean

The cubic mean is calculated using the rated gearbox torque M_{N1} = 6.1 Nm as in 2.6, the torques calculated in 2.9 M_{Hm} = 1.28 Nm, M_F = 0.17 Nm and M_{Br} = 0.94 Nm and the times determined in 2.11, t_A = 274 s, t_F = 896 s and t_{Br} = 270 s. The Cyclic Duration Factor is 40% according to 2.10.

$$\beta_1 = \frac{M_{Hm} + M_F}{M_{N1}} = \frac{1.28 + 0.17}{6.1} = 0.2377$$

$$\beta_2 = \frac{M_F}{M_{N1}} = \frac{0.17}{6.1} = 0.0279$$

$$\beta_3 = \frac{M_{Brm}}{M_{N1}} = \frac{0.94}{6.1} = 0.1541$$

$$t = 3\,600 \cdot \frac{CDF}{100} = 3\,600 \cdot \frac{40}{100} = 1\,440 \text{ s}$$

$$t_1 = \frac{t_A}{t} = \frac{274}{1\,440} = 0.19$$

$$t_2 = \frac{t_F}{t} = \frac{896}{1\,440} = 0.622$$

$$t_3 = \frac{t_{Br}}{t} = \frac{270}{1\,440} = 0.188$$

$$K^3 = \beta_1^3 \cdot t_1 + \beta_2^3 \cdot t_2 + \beta_3^3 \cdot t_3 = 0.2377^3 \cdot 0.19 + 0.0279^3 \cdot 0.622 + 0.1541^3 \cdot 0.188$$
$$= 0.00255176 + 0.00001351 + 0.00068796$$
$$= 0.0032531$$

2.13 Determining the theoretical gearbox service life

250 working days per year are taken as the basis for calculating the theoretical gearbox service life L. Using the figures for double-shift operation = 16 h/day according to 2.1, the Cyclic Duration Factor = 40% according to 2.10 and the cubic mean K^3 = 0.0032531 according to 2.12, the theoretical gearbox service life is calculated as follows:

$$L = \frac{1\,600}{\text{h/day} \cdot \frac{CDF}{100} \cdot 250 \cdot K^3} = \frac{1\,600}{16 \cdot \frac{40}{100} \cdot 250 \cdot 0.0032531} = 307 \text{ years}$$

A theoretical service life of 288 years for the components of the AF 05 gearbox determined according to 2.6 can be expected for the intended application, the service life being dependent on the cube of the load.

Subject to alterations

Printed in West Germany Ba/0489/3T