APEX DYNAMICS, INC.

AF-Series

High Precision
High Speed
Planetary Gearboxes

Stainless

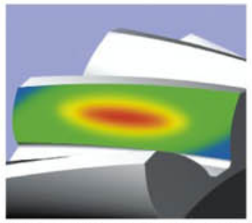
AF Series
Characteristic Highlights

Equipped with ***solid uncaged needle roller bearings,*** provides maximum contact points to increase stiffness and generates high output torque.

True Helical Gear Design
Precision helical gearing increases tooth to tooth contact ratio by over 33% vs spur gearing. The helix angle produces smooth and quiet operation with decreased backlash (less than 1 arc-minutes and $\leq$ 56dB).

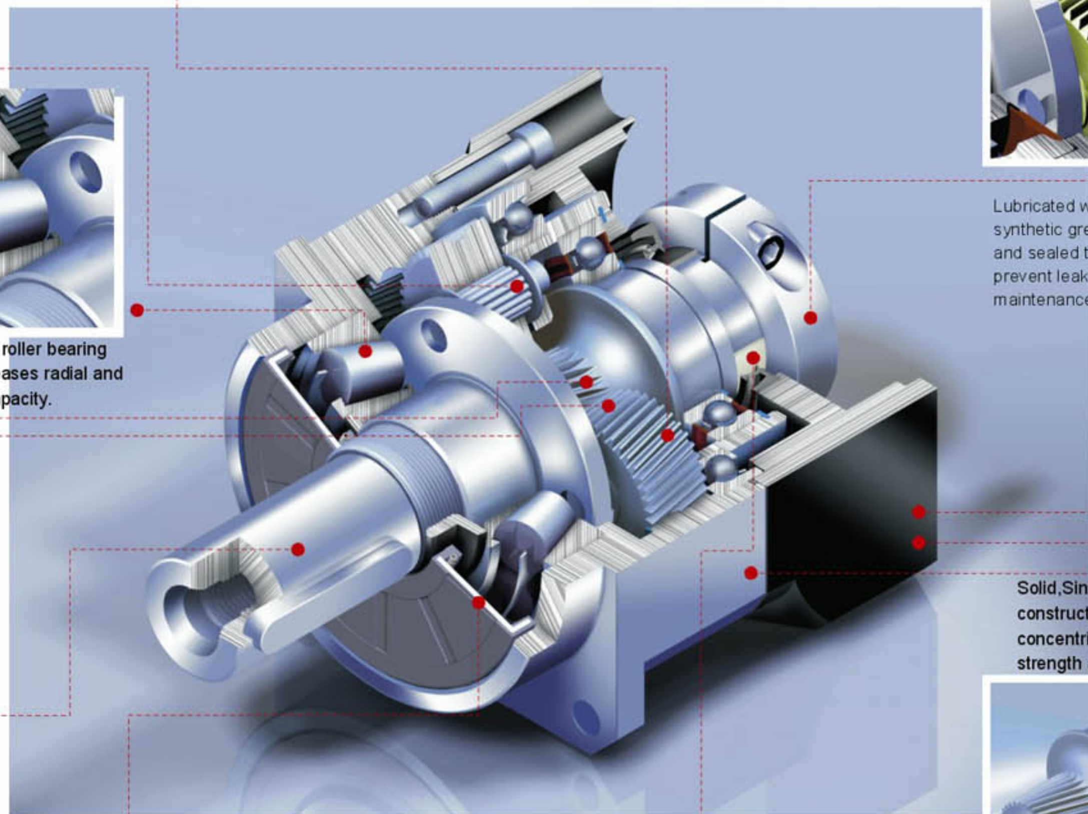
Patented planet carrier design places the sun gear bearing directly into the planet carrier. This ingenious concept eliminates gear misalignment and gains the highest accuracy on the market. Less than 1 arc-minutes backlash !

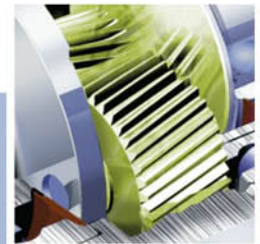
Triple split collet with dynamic balanced set collar clamping system provides backlash free power transmission and eliminates slippage. 100% concentricity allows for smooth rotation and higher input speed capability.



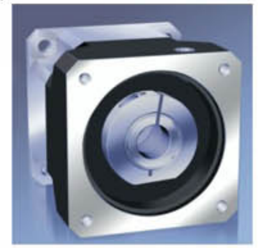
A high setting gear performance is achieved by using the ***HeliTopo technology.*** This ***eases off the tooth profile*** and ***crowns the lead of each tooth.*** This optimizes the gear mesh alignment and overlap to achieve maximum tooth surface contact.

Precision taper roller bearing support to increases radial and axial loading capacity.

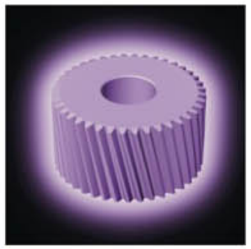




Lubricated with ***Nyogel 792D*** synthetic grease(Smart Grease) and sealed to ***IP65*** standards prevent leakage and is maintenance free.

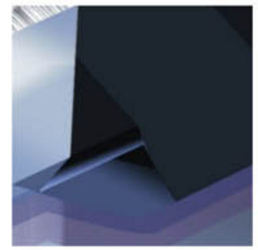


The unique ***motor adapter*** and ***bushing module system design*** allows for quick and easy mounting of any motor.



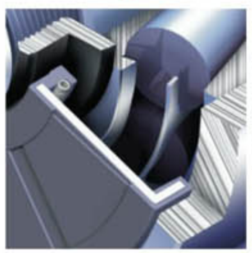
Our in house plasma nitriding heat treatment process maintains the tooth surface hardness at ***840Hv*** for superior wear-resistance and a core hardness at ***30HRc*** for toughness.

Solid,Single piece sun gear construction obtains precise concentricity with increased strength and rigidity.

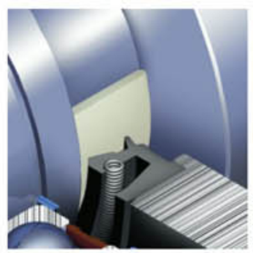


A special non-electrolysis nickel surface treatment on the output housing and ***black anodized*** aluminum input adapter are provided for the most extreme environmental conditions.

Single Piece planet carrier with extended taper roller bearing design provides maximum radial load capacity and increases system reliability and stiffness.



NEW - Patented output sealing systems design eliminates friction and heat generation which is accomplished by applying our hi-tech coating to all output contact surfaces. This coating reaches a hardness of ***3700Hv*** and is ground to R_a 0.2 μm finish to ensure sealing.



NEW - Patented input sealing system design eliminates break away torque and decreases friction/heat. The hi-tech coating bushing (***3700 Hv***, R_a 0.2 μm finish) interfaces with our proprietary seal which decreases wear and erosion of both sealing surfaces. This new patent prevents leakage and has a service life of over 20,000 hours.

Helical Internal ring gear is machined directly into a single piece of steel. Maximized diameter and number of teeth to improve overall performance and torque capacity.

AF Series

Specifications

Gearbox Performance

Model No.		Stages	Ratio[1]	AF042	AF060	AF075	AF100	AF140	AF180	AF220
Nominal Output Torque T_{2N}	Nm	1	3	20	55	130	208	342	588	1,140
			4	19	50	140	290	542	1,050	1,700
			5	22	60	160	330	650	1,200	2,000
			6	20	55	150	310	600	1,100	1,900
			7	19	50	140	300	550	1,100	1,800
			8	17	45	120	260	500	1,000	1,600
			9	14	40	100	230	450	900	1,500
			10	14	40	100	230	450	900	1,500
		2	15	20	55	130	208	342	588	1,140
			20	19	50	140	290	542	1,050	1,700
			25	22	60	160	330	650	1,200	2,000
			30	20	55	150	310	600	1,100	1,900
			35	19	50	140	300	550	1,100	1,800
			40	17	45	120	260	500	1,000	1,600
			45	14	40	100	230	450	900	1,500
			50	22	60	160	330	650	1,200	2,000
			60	20	55	150	310	600	1,100	1,900
			70	19	50	140	300	550	1,100	1,800
			80	17	45	120	260	500	1,000	1,600
			90	14	40	100	230	450	900	1,500
			100	14	40	100	230	450	900	1,500
Max. Output Torque T_{2B}	Nm	1,2	3~100	3 times of Nominal Output Torque						
Nominal Input Speed n_{1N}	rpm	1,2	3~100	5,000	5,000	4,000	4,000	3,000	3,000	2,000
Max. Input Speed n_{1B}	rpm	1,2	3~100	10,000	10,000	8,000	8,000	6,000	6,000	4,000
Micro Backlash P0	arcmin	1	3~10	–	–	≤1	≤1	≤1	≤1	≤1
		2	15~100	–	–	–	≤3	≤3	≤3	≤3
Reduced Backlash P1	arcmin	1	3~10	≤3	≤3	≤3	≤3	≤3	≤3	≤3
		2	15~100	≤5	≤5	≤5	≤5	≤5	≤5	≤5
Standard Backlash P2	arcmin	1	3~10	≤5	≤5	≤5	≤5	≤5	≤5	≤5
		2	15~100	≤7	≤7	≤7	≤7	≤7	≤7	≤7
Torsional Rigidity	Nm/arcmin	1,2	3~100	3	7	14	25	50	145	225
Max. Radial Load F_{2rB}[2]	N	1,2	3~100	610	1,400	4,100	9,200	14,000	18,000	33,000
Max. Axial Load F_{2aB}[2]	N	1,2	3~100	302	605	3,700	5,800	11,400	19,500	25,000
Service Life	hr	1,2	3~100	30,000*						
Efficiency η	%	1	3~10	≥97%						
		2	15~100	≥94%						
Weight	kg	1	3~10	0.6	1.3	3.7	6.9	13.7	28	48
		2	15~100	0.8	1.5	4.1	8.1	16.6	33	59
Operating Temperature	°C	1,2	3~100	-10°C~+90°C						
Lubrication		1,2	3~100	synthetic gear grease (NYOGEL 792D)						
Degree of Gearbox Protection		1,2	3~100	IP65						
Mounting Position		1,2	3~100	all directions						
Noise Level (n_1=3000rpm)	dB	1,2	3~100	≤56	≤58	≤60	≤63	≤65	≤67	≤70

Gearbox Inertia

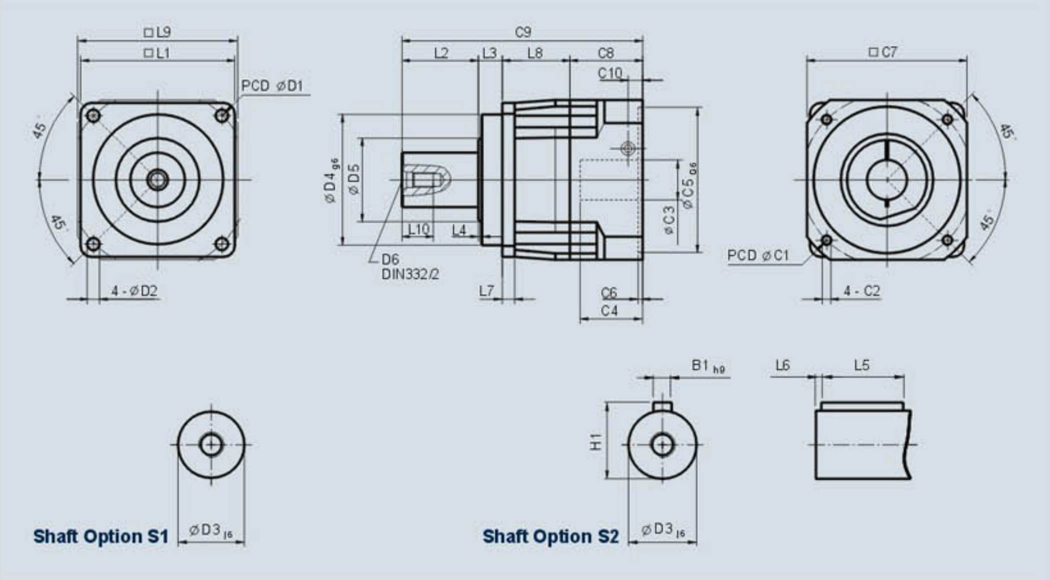
Model No.		Stages	Ratio[1]	AF042	AF060	AF075	AF100	AF140	AF180	AF220
Mass Moments of Inertia J_1	kg · cm²	1	3	0.03	0.16	0.61	3.25	9.21	28.98	69.61
			4	0.03	0.14	0.48	2.74	7.54	23.67	54.37
			5	0.03	0.13	0.47	2.71	7.42	23.29	53.27
			6	0.03	0.13	0.45	2.65	7.25	22.75	51.72
			7	0.03	0.13	0.45	2.62	7.14	22.48	50.97
			8	0.03	0.13	0.44	2.58	7.07	22.59	50.84
			9	0.03	0.13	0.44	2.57	7.04	22.53	50.63
			10	0.03	0.13	0.44	2.57	7.03	22.51	50.56
		2	15	0.03	0.03	0.13	0.47	2.71	7.42	23.29
			20	0.03	0.03	0.13	0.47	2.71	7.42	23.29
			25	0.03	0.03	0.13	0.47	2.71	7.42	23.29
			30	0.03	0.03	0.13	0.47	2.71	7.42	23.29
			35	0.03	0.03	0.13	0.47	2.71	7.42	23.29
			40	0.03	0.03	0.13	0.47	2.71	7.42	23.29
			45	0.03	0.03	0.13	0.47	2.71	7.42	23.29
			50	0.03	0.03	0.13	0.44	2.57	7.03	22.51
			60	0.03	0.03	0.13	0.44	2.57	7.03	22.51
			70	0.03	0.03	0.13	0.44	2.57	7.03	22.51
			80	0.03	0.03	0.13	0.44	2.57	7.03	22.51
			90	0.03	0.03	0.13	0.44	2.57	7.03	22.51
			100	0.03	0.03	0.13	0.44	2.57	7.03	22.51

1. Ratio ($i=N_{in} / N_{out}$)

*S1 service life 15,000 hrs

2. F_{2rB} · F_{2aB} applied to the output shaft center @100 rpm

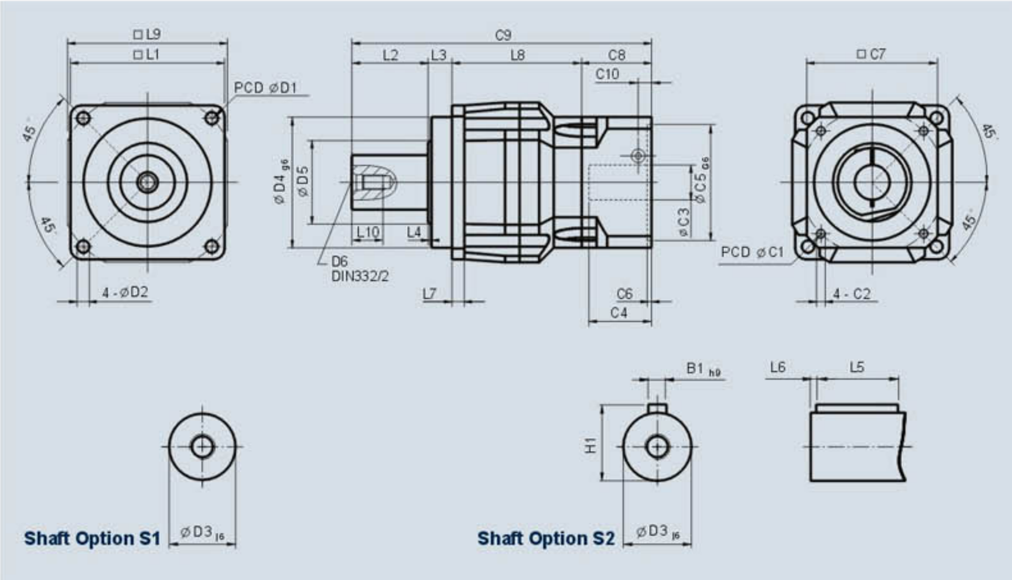
Dimensions (1-stage, Ratio i=3~10)



[unit: mm]

Dimension	AF042	AF060	AF075	AF100	AF140	AF180	AF220
D1	50	68	85	120	165	215	250
D2	3.4	5.5	6.8	9	11	13	17
D3 $_{j6}$	13	16	22	32	40	55	75
D4 $_{g6}$	35	60	70	90	130	160	180
D5	22	45	60	80	75	95	115
D6	M4 x 0.7P	M5 x 0.8P	M8 x 1.25P	M12 x 1.75P	M16 x 2P	M20 x 2.5P	M20 x 2.5P
L1	42	62	76	105	142	180	220
L2	19.5	28.5	36	58	82	82	105
L3	6.5	20	20	30	30	30	33
L4	1	1.5	2	2	3	3	3
L5	16	25	32	40	63	70	90
L6	2	2	3	5	5	6	7
L7	4	6	7	10	12	15	20
L8	31	23.5	56	48.5	62	80.5	93
L9	42	60	90	115	142	180	220
L10	10	12.5	19	28	36	42	42
C1[3]	46	70	100	130	165	215	235
C2[3]	M4 x 0.7P	M5 x 0.8P	M6 x 1P	M8 x 1.25P	M10 x 1.5P	M12 x 1.75P	M12 x 1.75P
C3[3]	≤11	*≤14 / ≤16	*≤19 / ≤24	≤32	≤38	≤48	≤55
C4[3]	25	30	40	50	60	82	82
C5[3] $_{G6}$	30	50	80	110	130	180	200
C6[3]	3.5	4	4	5	6	6	6
C7[3]	42	60	90	115	142	190	220
C8[3]	29.5	41.5	48	61	71	96	100
C9[3]	86.5	113.5	160	197.5	245	288.5	331
C10[3]	8.75	10	11.25	13.5	16	18.25	20
B1 $_{h9}$	5	5	6	10	12	16	20
H1	15	18	24.5	35	43	59	79.5

3. C1~C10 are motor specific dimensions (metric std shown). Refer to Apexdyna.com and Design Tool to view your specific motor mounting system.
*AF060 ratio 5,10 provides C3 ≤ 16 option. *AF075 ratio 3~10 provides C3 = 24 option without ceramic bushing.

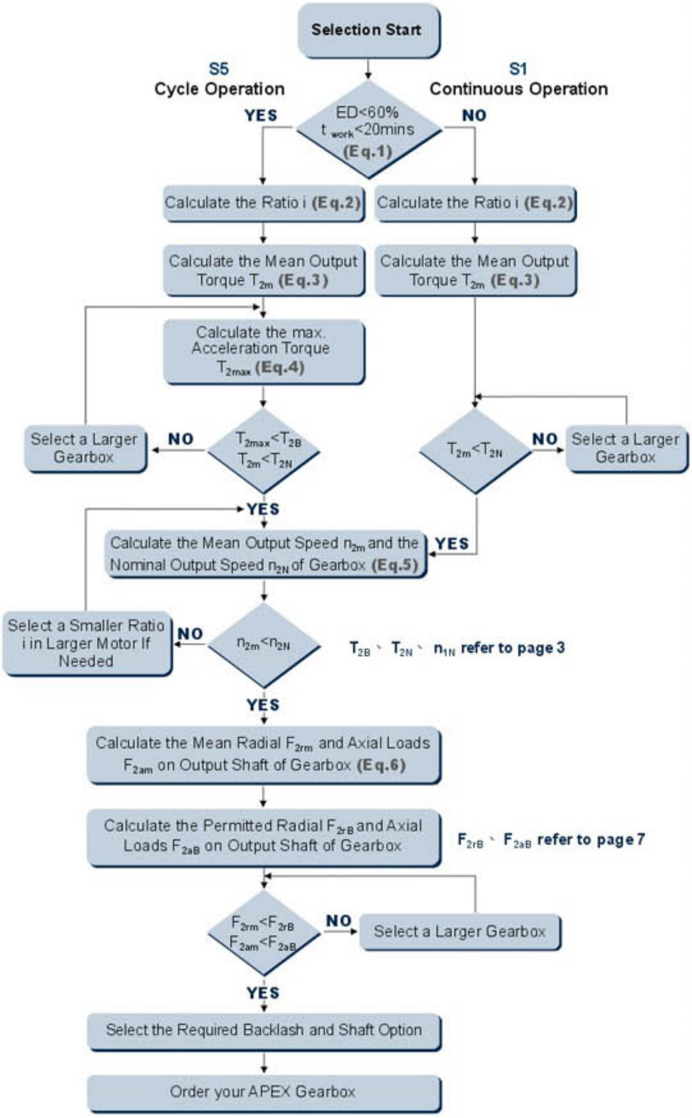


[unit: mm]

Dimension	AF042	AF060	AF075	AF100	AF140	AF180	AF220
D1	50	68	85	120	165	215	250
D2	3.4	5.5	6.8	9	11	13	17
D3 j6	13	16	22	32	40	55	75
D4 g6	35	60	70	90	130	160	180
D5	22	45	60	80	75	95	115
D6	M4 x 0.7P	M5 x 0.8P	M8 x 1.25P	M12 x 1.75P	M16 x 2P	M20 x 2.5P	M20 x 2.5P
L1	42	62	76	105	142	180	220
L2	19.5	28.5	36	58	82	82	105
L3	6.5	20	20	30	30	30	33
L4	1	1.5	2	2	3	3	3
L5	16	25	32	40	63	70	90
L6	2	2	3	5	5	6	7
L7	4	6	7	10	12	15	20
L8	58.5	60.5	93.5	100.5	125.5	157.5	178.5
L9	42	60	90	115	142	180	220
L10	10	12.5	19	28	36	42	42
C1[4]	46	46	70	100	130	165	215
C2[4]	M4 x 0.7P	M4 x 0.7P	M5 x 0.8P	M6 x 1P	M8 x 1.25P	M10 x 1.5P	M12 x 1.75P
C3[4]	≤11	*≤11 / ≤12	*≤14 / ≤15.875 / ≤16	*≤19 / ≤24	≤32	≤38	≤48
C4[4]	25	25	30	40	50	60	82
C5[4] G6	30	30	50	80	110	130	180
C6[4]	3.5	3.5	4	4	5	6	6
C7[4]	42	42	60	90	115	142	190
C8[4]	29.5	29.5	41.5	48	61	71	96
C9[4]	114	138.5	191	236.5	298.5	340.5	412.5
C10[4]	8.75	8.75	10	11.25	13.5	16	18.25
B1 h9	5	5	6	10	12	16	20
H1	15	18	24.5	35	43	59	79.5

4. C1~C10 are motor specific dimensions (metric std shown). Refer to Apexdyna.com and Design Tool to view your specific motor mounting system.

∗AF060 ratio 15~50 provides C3 ≤ 12 option ∗AF075 ratio 15~50 provides C3 ≤ 15.875 / ≤16 option ∗AF100 ratio 15~100 provides C3 = 24 without ceramic bushing.



Recommended (for S5 Cycle Operation)

The general design is given for

$$\frac{J_L}{i^2} \leq 4 \times J_m$$

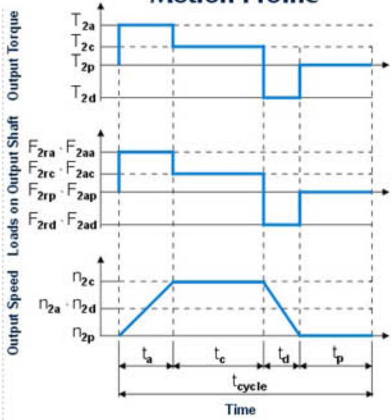
The optimal design is given for

$$\frac{J_L}{i^2} \cong J_m$$

J_L Load Inertia

J_m Motor Inertia

Motion Profile



1. $ED = \frac{t_a + t_c + t_d}{t_{cycle}} \times 100\%,\ t_{work} = t_a + t_c + t_d$

Index : a. Acceleration, c. Constant,

d. Deceleration, p. Pause **(Eq.1)**

2. $i \cong \frac{n_m}{n_{work}}$

n_m Output Speed of the Motor

n_{work} Working Speed **(Eq.2)**

3. $$T_{2m} = \sqrt[3]{\frac{n_{2a} \times t_a \times T_{2a}^3 + n_{2c} \times t_c \times T_{2c}^3 + n_{2d} \times t_d \times T_{2d}^3}{n_{2a} \times t_a + n_{2c} \times t_c + n_{2d} \times t_d}}$$ **(Eq.3)**

4. $T_{2max} = T_{mB} \times i \times k_s \times \eta$

where K_s is

K_s	No. of Cycles / hr
1.0	0~1,000
1.1	1,000 ~ 1,500
1.3	1,500 ~ 2,000
1.6	2,000 ~ 3,000
1.8	3,000 ~ 5,000

T_{mB} Max. Output Torque of the Motor

η Efficiency of the Gearbox **(Eq.4)**

5. $n_{2a} = n_{2d} = \frac{1}{2} \times n_{2c}$

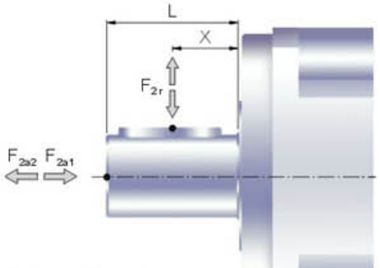
$$n_{2m} = \frac{n_{2a} \times t_a + n_{2c} \times t_c + n_{2d} \times t_d}{t_a + t_c + t_d}$$

$$n_{2N} = \frac{n_{1N}}{i}$$ **(Eq.5)**

6. $$F_{2rm} = \sqrt[3]{\frac{n_{2a} \times t_a \times F_{2ra}^3 + n_{2c} \times t_c \times F_{2rc}^3 + n_{2d} \times t_d \times F_{2rd}^3}{n_{2a} \times t_a + n_{2c} \times t_c + n_{2d} \times t_d}}$$

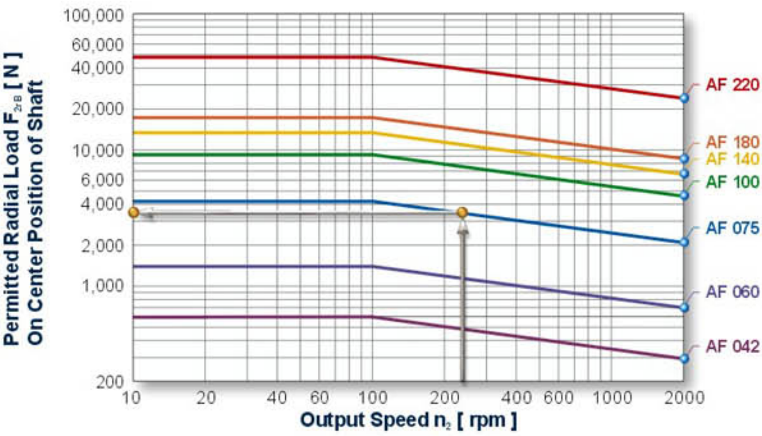
$$F_{2am} = \sqrt[3]{\frac{n_{2a} \times t_a \times F_{2aa}^3 + n_{2c} \times t_c \times F_{2ac}^3 + n_{2d} \times t_d \times F_{2ad}^3}{n_{2a} \times t_a + n_{2c} \times t_c + n_{2d} \times t_d}}$$ **(Eq.6)**

Permitted Radial and Axial Loads on Output Shaft of the Gearbox

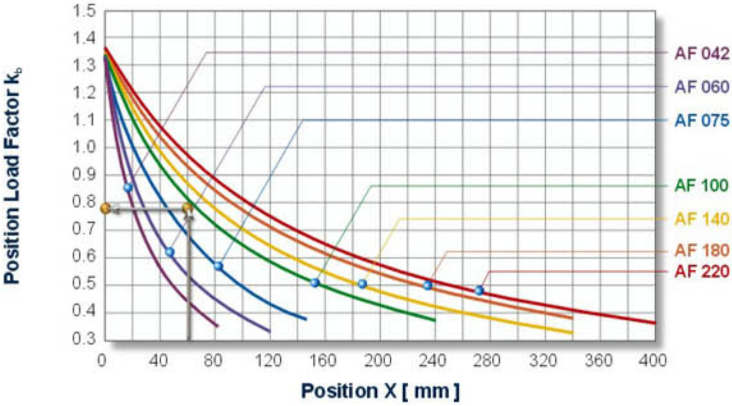


F_{2r} Radial Load
F_{2a} Axial Load

The permitted radial and axial loads on the output shaft of the gearbox depend on the design of the gearbox supporting bearings.
The oversized taper roller bearing straddle mount design accommodates high radial and axial loads with extensive life. Over 50% more load capacity than a standard angular contact bearing design.



If radial force F_{2r} is exerted on the center of the output shaft $X=1/2 \times L$.
Under various operating condition the lifetime is over 30,000 hours.*
The permitted radial load is given on left diagram.
The permitted axial load can be calculated by using the formula:
$F_{2a1B}=0.2 \times F_{2rB}$
$F_{2a2B}=0.1 \times F_{2rB}$



If radial force F_{2r} is not exerted on the center of the output shaft
$X<1/2 \times L$ or $X>1/2 \times L$
The permitted radial and axial loads can be calculated by the position load factor K_b on the left diagram.
Radial load:
$F'_{2rB}=k_b \times F_{2rB}$
Axial load:
$F'_{2a1B}=0.2 \times F'_{2rB}$
$F'_{2a2B}=0.1 \times F'_{2rB}$

* S1 service life 15,000 hrs

AF075 – 010 – S1 – P1 / MOTOR

Gearbox Size:
AF042, AF060, AF075
AF100, AF140, AF180
AF220

Shaft Option:
S1: Smooth Output Shaft
S2: Output Shaft with Key

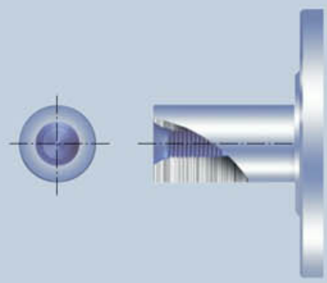
Motor Designation:
Manufacturer Type
And Model

Ratio:
1 Stage: 3, 4, 5, 6, 7, 8, 9, 10
2 Stages: 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100

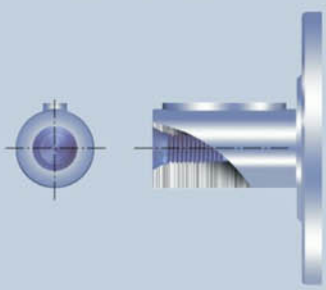
Backlash:
P0: Micro Backlash
P1: Reduced Backlash
P2: Standard Backlash

Ordering Example: AF075-010-S1-P1 / SIEMENS 1FT6 041-4AF71

S1 and S2 shaft options are shown below:

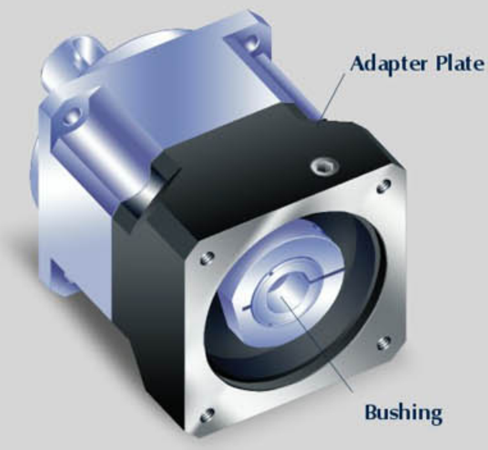


S1: Standard Output Shaft



S2: Output Shaft With Key

Keyway: Standard DIN 6885. Sheet 1



The dimensions of adapter plate depend on the motor.
Design on-line at www.apexdyna.com.
Download the specific motor / gearhead dxf or pdf.

AF Series

www.apexdyna.com

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APEX-2005-12-AF-1.5E