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APEX-2017-09-AF/AFR Series - 1.0V

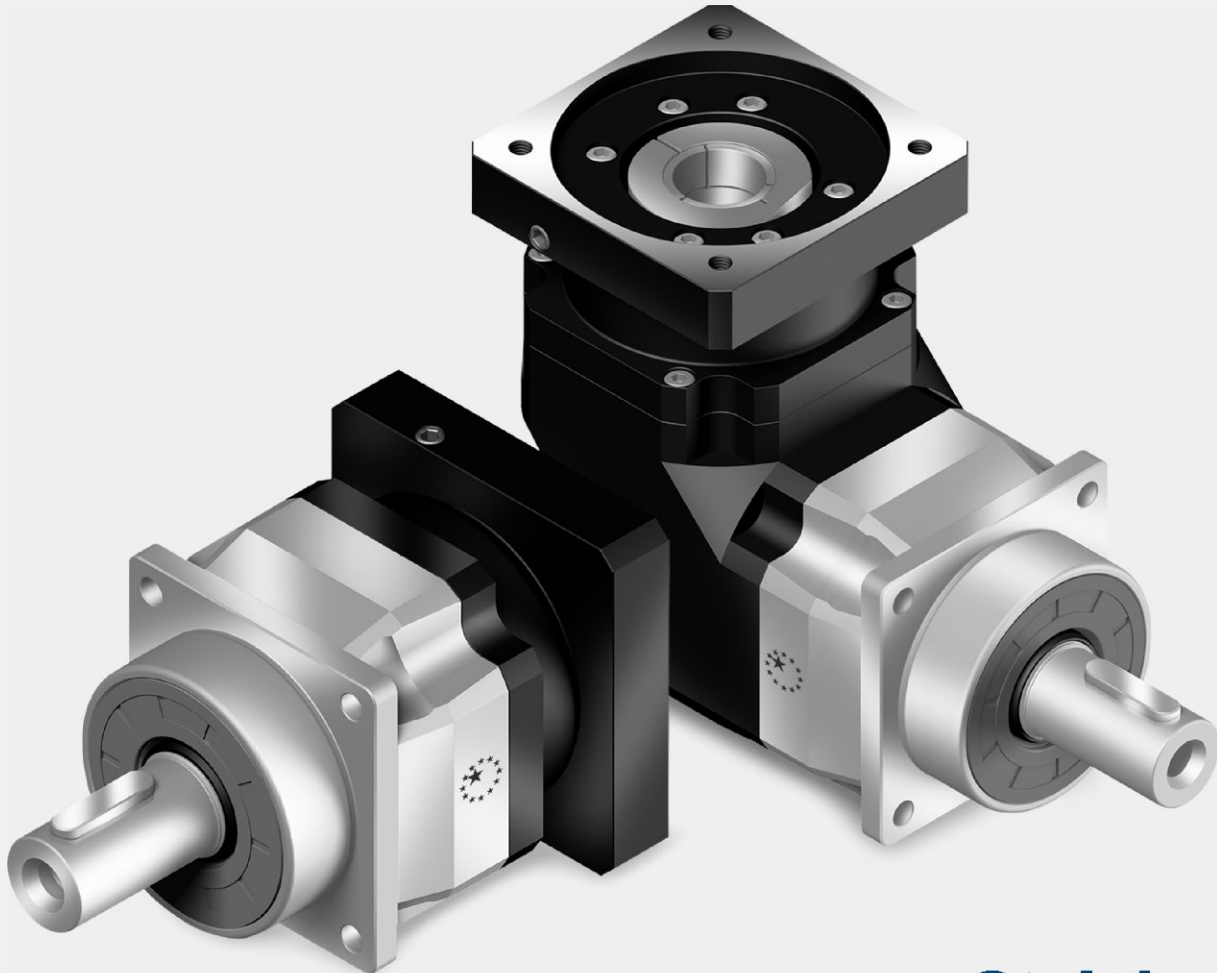
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APEX DYNAMICS, INC.

**HIGH PRECISION
HIGH SPEED
PLANETARY GEARBOX**

AF / AFR Series



Stainless

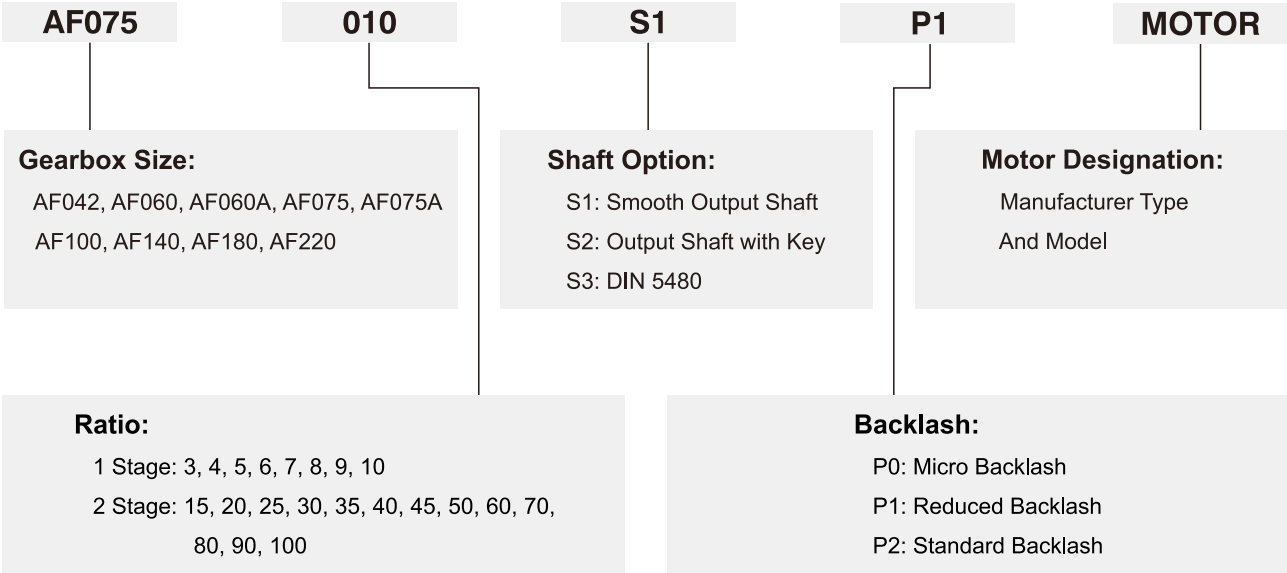
AF Series



Apex Dynamics, Inc. is the world’s most productive manufacturer of servomotor drive planetary gearboxes for precision automation machinery. From our 800,000+ square foot ISO 9001:2008 manufacturing facility, based in Taichung, Taiwan, we manufacture to stock using the newest precision machine tools and quality test and inspection equipment. Complete focus on quality and precision allows us to produce our high quality gearheads at precision levels down to less than 1 arc minute (1/60 th of a degree), with consistency and high reliability.

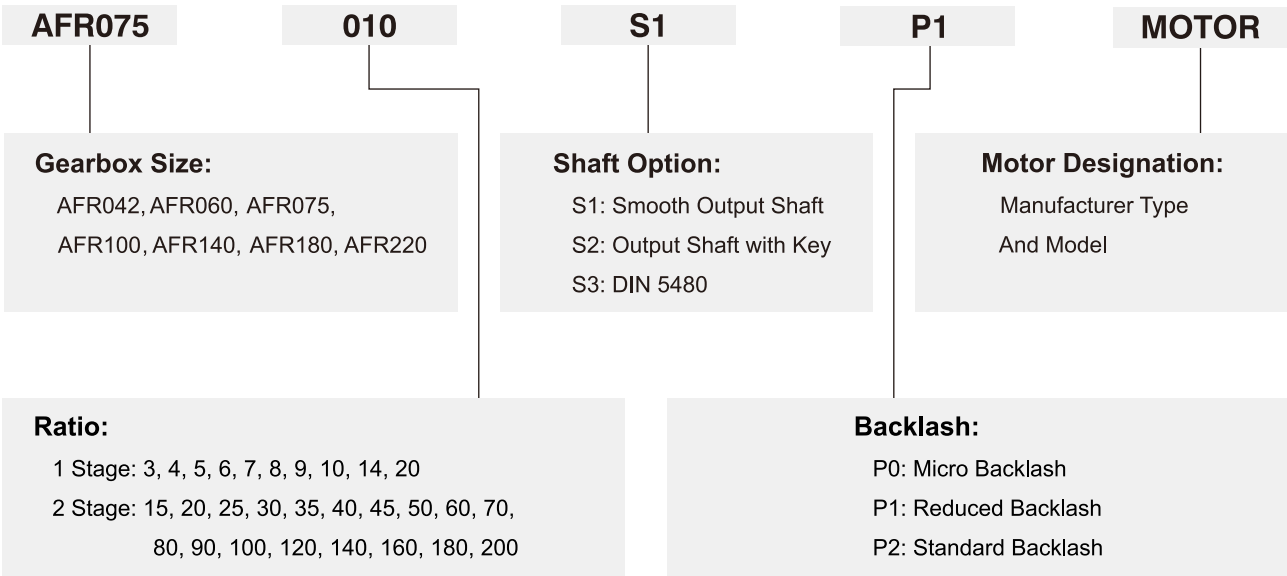
Based on more than twenty years of accumulated manufacturing and marketing experience, plus the highest level of technical production capabilities, Apex Dynamics, Inc. designs and builds technically advanced, high speed, low backlash servo application planetary gearboxes. Our Break through patented technology (over 6 patents), provides the customer with the optimum high precision helical reducer at a reasonable price. We are continuously improving processes, finding proper and effective methods to provide customers new solutions for difficult applications, and developing new products.

The primary focus in daily operation is quality. We pride ourselves on our dedication to quality; our duty - is customer satisfaction.



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

AFR Series



Ordering Example: AFR075-010-S1-P1 / SIEMENS 1FT6 041-4AF71

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Specifications / AF Series

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

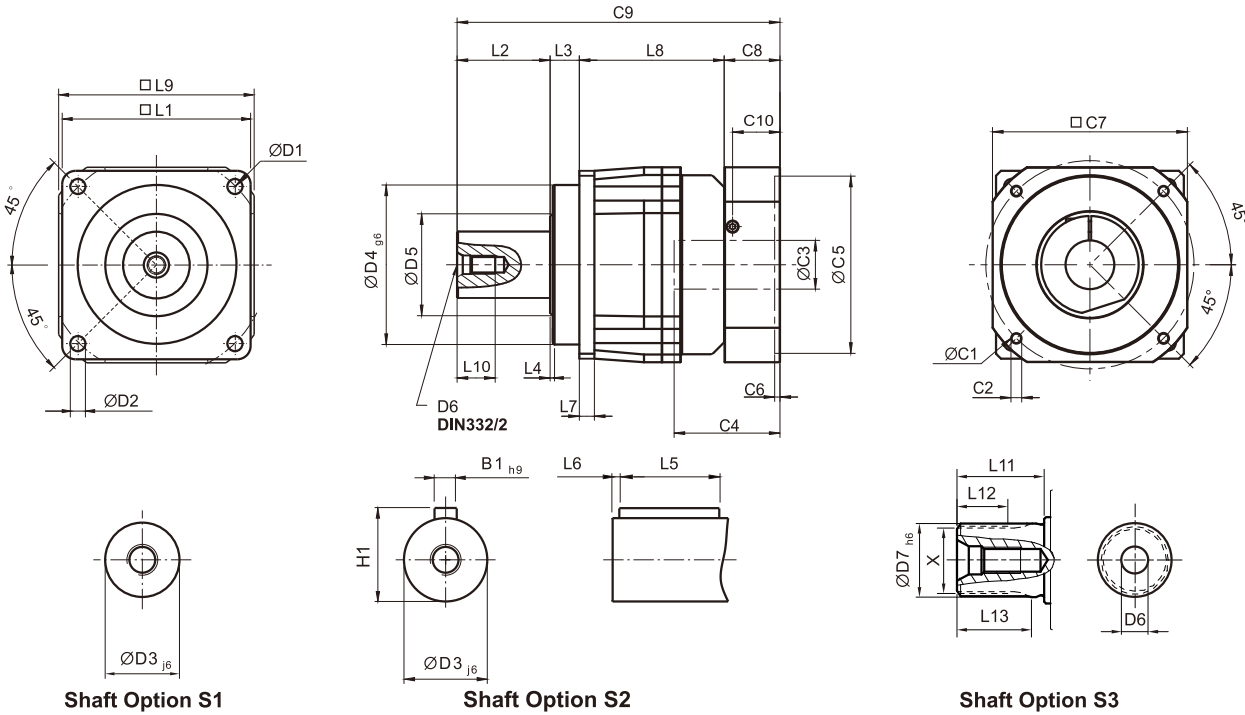
Gearbox Performance

Model No.	Stage	Ratio ^A	AF042	AF060	AF060A	AF075	AF075A	AF100	AF140	AF180	AF220
Nominal Output Torque T _{2N}	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
		15	20	55	55	130	130	208	342	588	1,140
		20	19	50	50	140	140	290	542	1,050	1,700
	2	25	22	60	60	160	160	330	650	1,200	2,000
		30	20	55	55	150	150	310	600	1,100	1,900
		35	19	50	50	140	140	300	550	1,100	1,800
		40	17	45	45	120	120	260	500	1,000	1,600
		45	14	40	40	100	100	230	450	900	1,500
		50	22	60	60	160	160	330	650	1,200	2,000
		60	20	55	55	150	150	310	600	1,100	1,900
		70	19	50	50	140	140	300	550	1,100	1,800
		80	17	45	45	120	120	260	500	1,000	1,600
		90	14	40	40	100	100	230	450	900	1,500
		100	14	40	40	100	100	230	450	900	1,500
Emergency Stop Torque T _{2NOT} ^B	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	5,000	4,000	4,000	4,000	3,000	3,000
Max. Input Speed n _{1B}	rpm	1,2	3~100	10,000	10,000	10,000	8,000	8,000	8,000	6,000	6,000
Micro Backlash P0	arcmin	1	3~10	-	-	-	≤1	-	≤1	≤1	≤1
		2	15~100	-	-	-	≤3	-	≤3	≤3	≤3
Reduced Backlash P1	arcmin	1	3~10	≤3	≤3	-	≤3	-	≤3	≤3	≤3
		2	15~100	≤5	≤5	≤5	≤5	≤5	≤5	≤5	≤5
Standard Backlash P2	arcmin	1	3~10	≤5	≤5	-	≤5	-	≤5	≤5	≤5
		2	15~100	≤7	≤7	≤7	≤7	≤7	≤7	≤7	≤7
Torsional Rigidity	Nm/arcmin	1,2	3~100	3	7	7	14	14	25	50	145
Max. Radial Load F _{2rB} ^C	N	1,2	3~100	610	1,400	1,400	4,100	4,100	9,200	14,000	18,000
Max. Axial Load F _{2aB} ^C	N	1,2	3~100	320	1,100	1,100	3,700	3,700	5,820	11,400	19,500
Service Life ^D	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
		2	15~100	0.8	1.5	2	4.1	5.5	8.1	16.6	33
Operating Temperature	°C	1,2	3~100	-10°C~90°C							
Lubrication				Synthetic lubrication oils							
Degree of Gearbox Protection		1,2	3~100	IP65							
Mounting Position		1,2	3~100	all directions							
Noise (n ₁ =3000rpm, i=10, No load) ^E	dB(A)	1,2	3~100	≤56	≤58	≤60	≤60	≤63	≤63	≤65	≤67

Gearbox Inertia

Model No.	Stage	Ratio ^A	AF042	AF060	AF060A	AF075	AF075A	AF100	AF140	AF180	AF220
Mass Moments of Inertia J _i	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	0.13	0.47	0.47	2.71	7.42	23.29
		20	0.03	0.03	0.13	0.13	0.47	0.47	2.71	7.42	23.29
		25	0.03	0.03	0.13	0.13	0.47	0.47	2.71	7.42	23.29
		30	0.03	0.03	0.13	0.13	0.47	0.47	2.71	7.42	23.29
		35	0.03	0.03	0.13	0.13	0.47	0.47	2.71	7.42	23.29
		40	0.03	0.03	0.13	0.13	0.47	0.47	2.71	7.42	23.29
		45	0.03	0.03	0.13	0.13	0.47	0.47	2.71	7.42	23.29
		50	0.03	0.03	0.13	0.13	0.44	0.44	2.57	7.03	22.51
		60	0.03	0.03	0.13	0.13	0.44	0.44	2.57	7.03	22.51
		70	0.03	0.03	0.13	0.13	0.44	0.44	2.57	7.03	22.51
		80	0.03	0.03	0.13	0.13	0.44	0.44	2.57	7.03	22.51
		90	0.03	0.03	0.13	0.13	0.44	0.44	2.57	7.03	22.51
		100	0.03	0.03	0.13	0.13	0.44	0.44	2.57	7.03	22.51

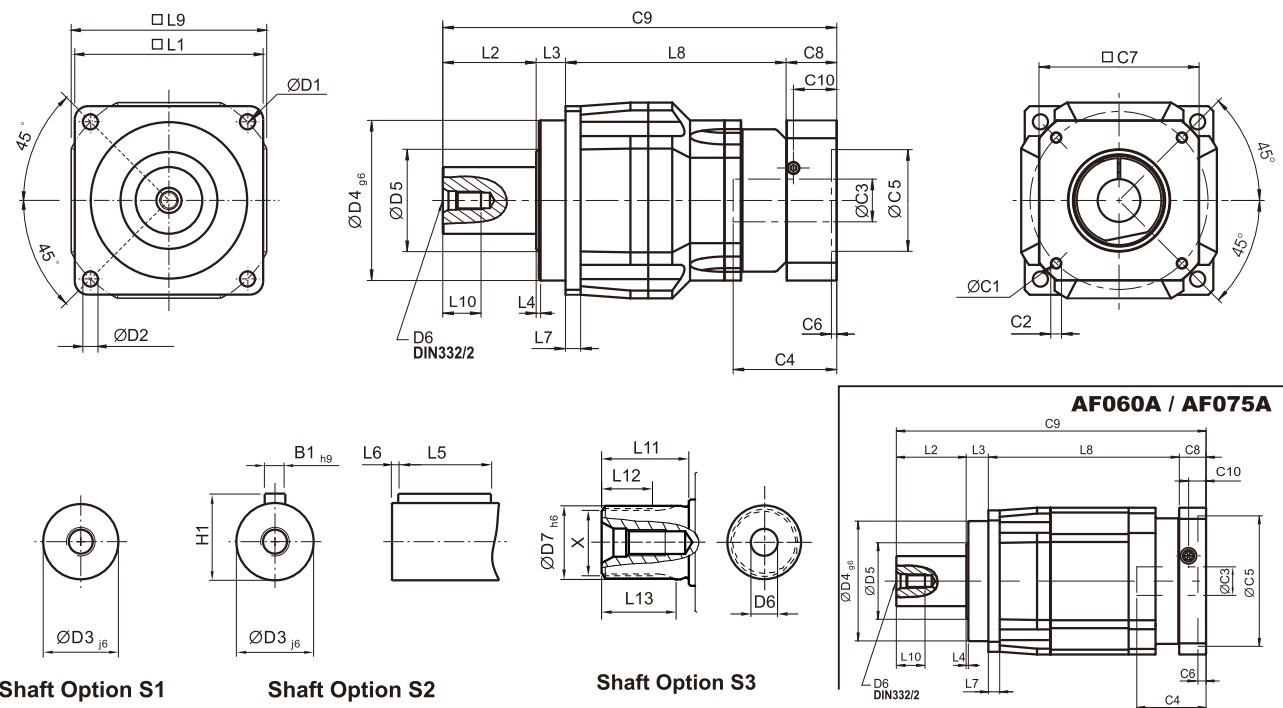
A. Ratio (i=N_{in}/ N_{out})
B. Max. acceleration torque T_{2B} = 60% of T_{2NOT}
C. Applied to the output shaft center at 100 rpm
D. For continuous operation, the service life time is less than 15,000 hrs
E. These values are measured by gearbox with ratio = 10 (1-stage) or ratio = 100 (2-stage) at 3,000 rpm no loading
By ratio less than 10, the noise value would be 3~5 dB higher



[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
D7 _{h6}	-	16	22	32	40	55	75
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	54.5	86.5	89.5	110	150	163.5
L9	42	60	90	115	142	180	220
L10	10	12.5	19	28	36	42	42
L11	-	26	26	26	40	41.5	52
L12	-	15	15	15	20	21.5	28
L13	-	21	22.5	23	33.5	33.5	45
C1 ¹	46	70	100	130	165	215	235
C2 ¹	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 ¹	≤11 / ≤12 ²	≤14 / ≤16 ²	≤19 / ≤24	≤32	≤38	≤48	≤55
C4 ¹	25	34	40	50	60	85	116
C5 ¹	30	50	80	110	130	180	200
C6 ¹	3.5	8	4	5	6	6	6
C7 ¹	42	60	90	115	142	190	220
C8 ¹	29.5	19	17	19.5	22.5	29	63
C9 ¹	86.5	122	159.5	197	244.5	291	364.5
C10 ¹	8.75	13.5	10.75	13	15	20.75	53
B1 _{h9}	5	5	6	10	12	16	20
H1	15	18	24.5	35	43	59	79.5
X DIN5480	-	W16x0.8x 30x18x6m	W22x1.25x 30x16x6m	W32x1.25x 30x24x6m	W40x2x 30x18x6m	W55x2x 30x26x6m	W70x2x 30x34x6m

1. C1~C10 are motor specific dimensions (metric std shown). Refer to www.apexdyna.com and Design Tool to view your specific motor mounting system.
2. AF042 ratio 5, 10 offers C3 ≤ 12 option; AF062 ratio 5, 10 offers C3 ≤ 16 option.

Dimensions (2-stage, Ratio i=15~100) / AF Series



[unit: mm]

Dimension	AF042	AF060	AF060A	AF075	AF075A	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		M12x1.75P	M16x2P	M20x2.5P	M20x2.5P
D7 h6	-	16		22		32	40	55	75
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	65.5	91.5	119.5	134.5	131	166.5	205.5	248
L9	42	60		90		115	142	180	220
L10	10	12.5		19		28	36	42	42
L11	-	26		26		26	40	41.5	52
L12	-	15		15		15	20	21.5	28
L13	-	21		22.5		23	33.5	33.5	45
C1 ³	46	46	70	70	100	100	130	165	215
C2 ³	M4 x 0.7P	M4 x 0.7P	M5 x 0.8P	M5 x 0.8P	M6 x 1P	M6 x 1P	M8 x 1.25P	M10 x 1.5P	M12 x 1.75P
C3 ³	≤11 / ≤12	≤11 / ≤12	≤14 / ≤16	≤14 / ≤15.875 / ≤16	≤19 / ≤24	≤19 / ≤24	≤32	≤38	≤48
C4 ³	25	25	34	34	40	40	50	60	85
C5 ³	30	30	50	50	80	80	110	130	180
C6 ³	3.5	3.5	8	8	4	4	5	6	6
C7 ³	42	42	60	60	90	90	115	142	190
C8 ³	29.5	29.5	19	19	17	17	19.5	22.5	29
C9 ³	114	143.5	159	194.5	207.5	236	298	340	415
C10 ³	8.75	8.75	13.5	13.5	10.75	10.75	13	15	20.75
B1 h9	5	5	5	6	6	10	12	16	20
H1	15	18	18	24.5	24.5	35	43	59	79.5
X DIN5480	-	W16x0.8x 30x18x6m		W22x1.25x 30x16x6m		W32x1.25x 30x24x6m	W40x2x 30x18x6m	W55x2x 30x26x6m	W70x2x 30x34x6m

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

Specifications / AFR Series

Gearbox Performance

Model No.		Stages	Ratio ^A	AFR042	AFR060	AFR075	AFR100	AFR140	AFR180	AFR220
Nominal Output Torque T _{2N}	Nm	1	3	9	36	90	195	342	588	1,140
			4	12	48	120	260	520	1,040	1,680
			5	15	60	150	325	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	60	150	325	650	1,200	2,000
			14	—	42	140	300	550	1,100	1,800
			20	—	40	100	230	450	900	1,500
	2	15	14	—	—	—	—	—	—	
		20	14	—	—	—	—	—	—	
		25	15	60	150	325	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	1,100	1,600	
		45	14	40	100	230	450	900	1,500	
		50	14	60	100	230	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			
120	—	—	150	310	600	1,100	1,900			
140	—	—	140	300	550	1,100	1,800			
160	—	—	120	260	550	1,000	1,600			
180	—	—	100	230	450	900	1,500			
200	—	—	100	230	450	900	1,500			
Emergency Stop Torque T _{2NOT} ^B	Nm	1,2	3~200	3 times of Nominal Output Torque						
Nominal Input Speed n _{1N}	rpm	1,2	3~200	5,000	5,000	4,000	4,000	3,000	3,000	2,000
Max. Input Speed n _{1B}	rpm	1,2	3~200	10,000	10,000	8,000	8,000	6,000	6,000	4,000
Micro Backlash P0	arcmin	1	3~20	—	—	≤2	≤2	≤2	≤2	≤2
		2	25~200	—	—	≤4	≤4	≤4	≤4	≤4
Reduced Backlash P1	arcmin	1	3~20	≤4	≤4	≤4	≤4	≤4	≤4	≤4
		2	25~200	≤7	≤7	≤7	≤7	≤7	≤7	≤7
Standard Backlash P2	arcmin	1	3~20	≤6	≤6	≤6	≤6	≤6	≤6	≤6
		2	25~200	≤9	≤9	≤9	≤9	≤9	≤9	≤9
Torsional Rigidity	Nm/arcmin	1,2	3~200	3	7	14	25	50	145	225
Max. Radial Load F _{2rB} ^C	N	1,2	3~200	610	1,400	4,100	9,200	14,000	18,000	33,000
Max. Axial Load F _{2aB} ^C	N	1,2	3~200	320	1,100	3,700	5,800	11,400	19,500	16,300
Service Life ^D	hr	1,2	3~200	30,000						
Efficiency η	%	1	3~20	≥95%						
		2	25~200	≥92%						
Weight	kg	1	3~20	0.9	2.1	6.4	13.9	23.7	50	83
		2	25~200	1.2	1.5	7.8	15.1	26.7	54	95
Operating Temp	°C	1,2	3~200	-10°C~90°C						
Lubrication				Synthetic lubrication oils						
Degree of Gearbox Protection		1,2	3~200	IP65						
Mounting Position		1,2	3~200	all directions						
Noise (n _i =3000rpm, i=10, No load) ^E	dB(A)	1,2	3~200	≤61	≤63	≤65	≤68	≤70	≤72	≤74

Gearbox Inertia

Model No.	Stages	Ratio ^A	AFR042	AFR060	AFR075	AFR100	AFR140	AFR180	AFR220
Mass Moments of Inertia J _i	1	3~10	0.09	0.35	2.25	6.84	23.4	68.9	135.4
		14	-	0.07	1.87	6.25	21.8	65.6	119.8
		20	-	0.07	1.87	6.25	21.8	65.6	119.8
	2	15	0.09	-	-	-	-	-	-
		20	0.09	-	-	-	-	-	-
		25~100	0.09	0.09	0.35	2.25	6.84	23.4	68.9
		120~200	-	-	0.31	1.87	6.25	21.8	65.6

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

B. Max. acceleration torque T_{2B} = 60% of T_{2NOT}

C. Applied to the output shaft center at 100 rpm

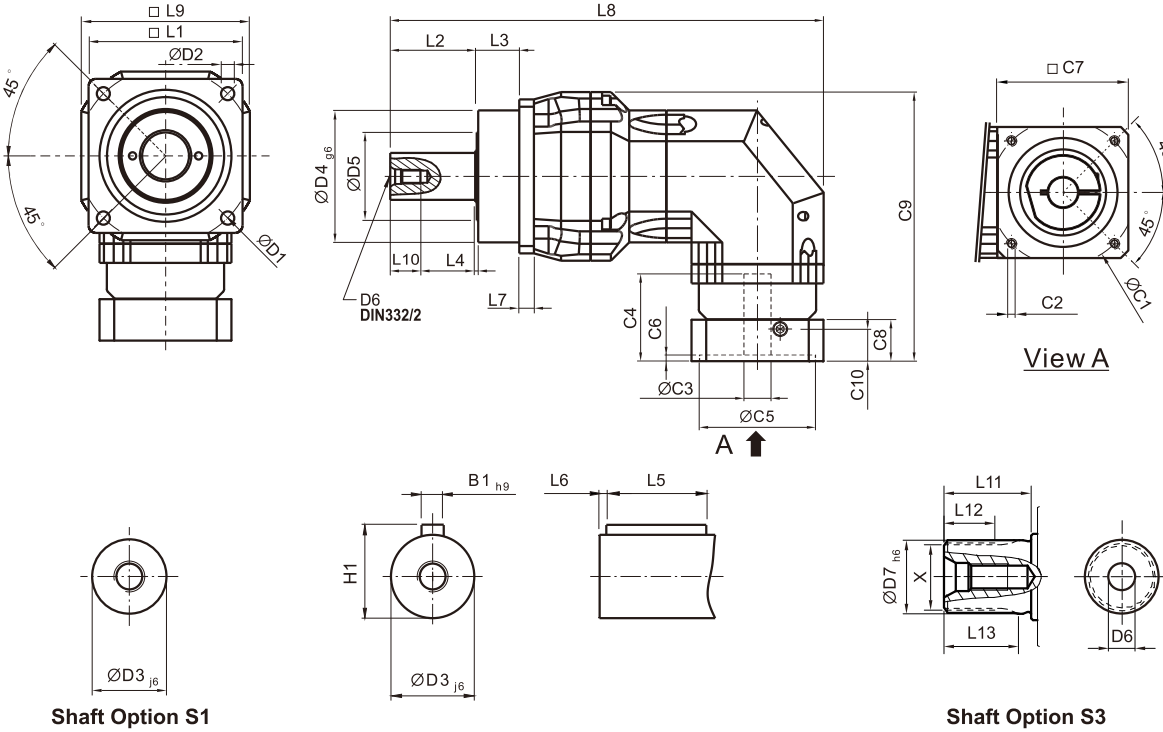
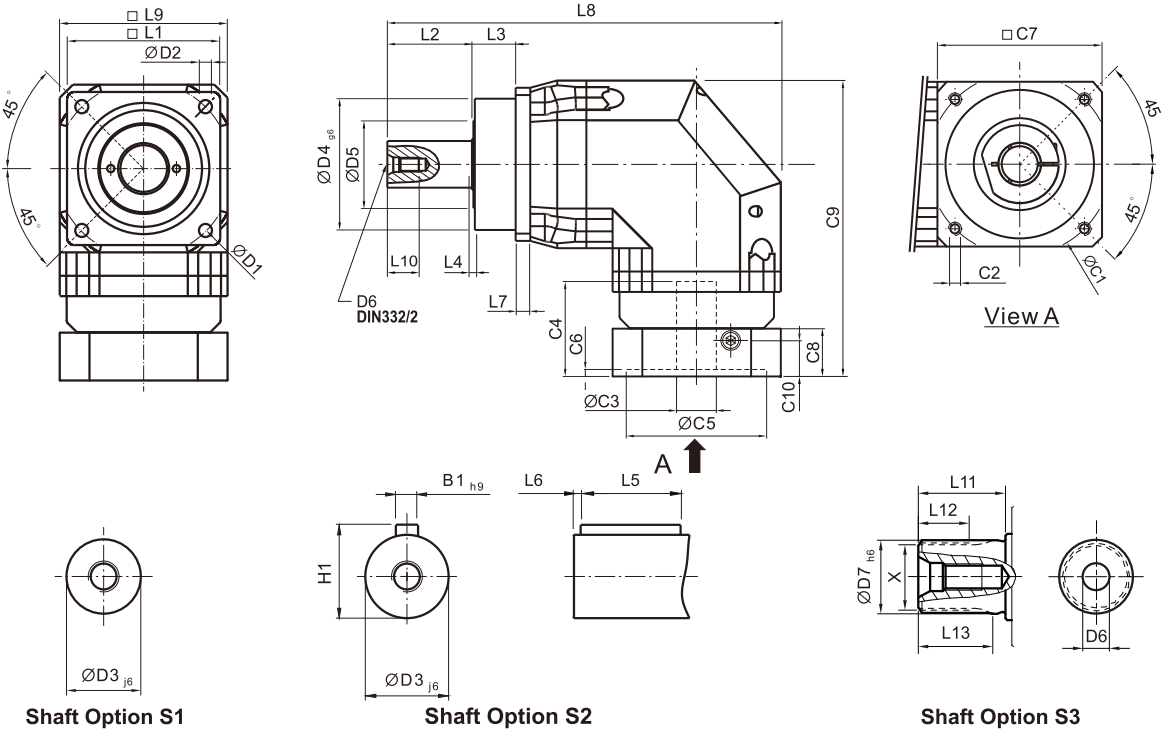
D. For continuous operation, the service life time is less than 15,000 hrs

E. These values are measured by gearbox with ratio = 10 (1-stage) or ratio = 100 (2-stage) at 3,000 rpm no loading

By ratio less than 10, the noise value would be 3~5 dB higher

Dimensions (1-stage, Ratio i=3~20) / AFR Series

Dimensions (2-stage, Ratio i=15~200) / AFR Series



[unit: mm]

Dimension	AFR042	AFR060	AFR075	AFR100	AFR140	AFR180	AFR220
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
D7 h6	-	16	22	32	40	55	75
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	111.5	150	219	269.5	338.5	397	484
L9	42	60	90	115	142	180	220
L10	10	12.5	19	28	36	42	42
L11	-	26	26	26	40	41.5	52
L12	-	15	15	15	20	21.5	28
L13	-	21	22.5	23	33.5	33.5	45
C1 ¹	46	70	100	130	165	215	235
C2 ¹	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 ¹	≤11 / ≤12	≤14 / ≤16	≤19 / ≤24	≤32	≤38	≤48	≤55
C4 ¹	25	34	40	50	60	85	116
C5 ¹	30	50	80	110	130	180	200
C6 ¹	3.5	8	4	5	6	6	6
C7 ¹	42	60	90	115	142	190	220
C8 ¹	29.5	19	17	19.5	22.5	29	63
C9 ¹	90.5	111.5	152.5	191.5	235.5	303.5	378.5
C10 ¹	8.75	13.5	10.75	13	15	20.75	53
B1 h9	5	5	6	10	12	16	20
H1	15	18	24.5	35	43	59	79.5
X DIN5480	-	W16x0.8x 30x18x6m	W22x1.25x 30x16x6m	W32x1.25x 30x24x6m	W40x2x 30x18x6m	W55x2x 30x26x6m	W70x2x 30x34x6m

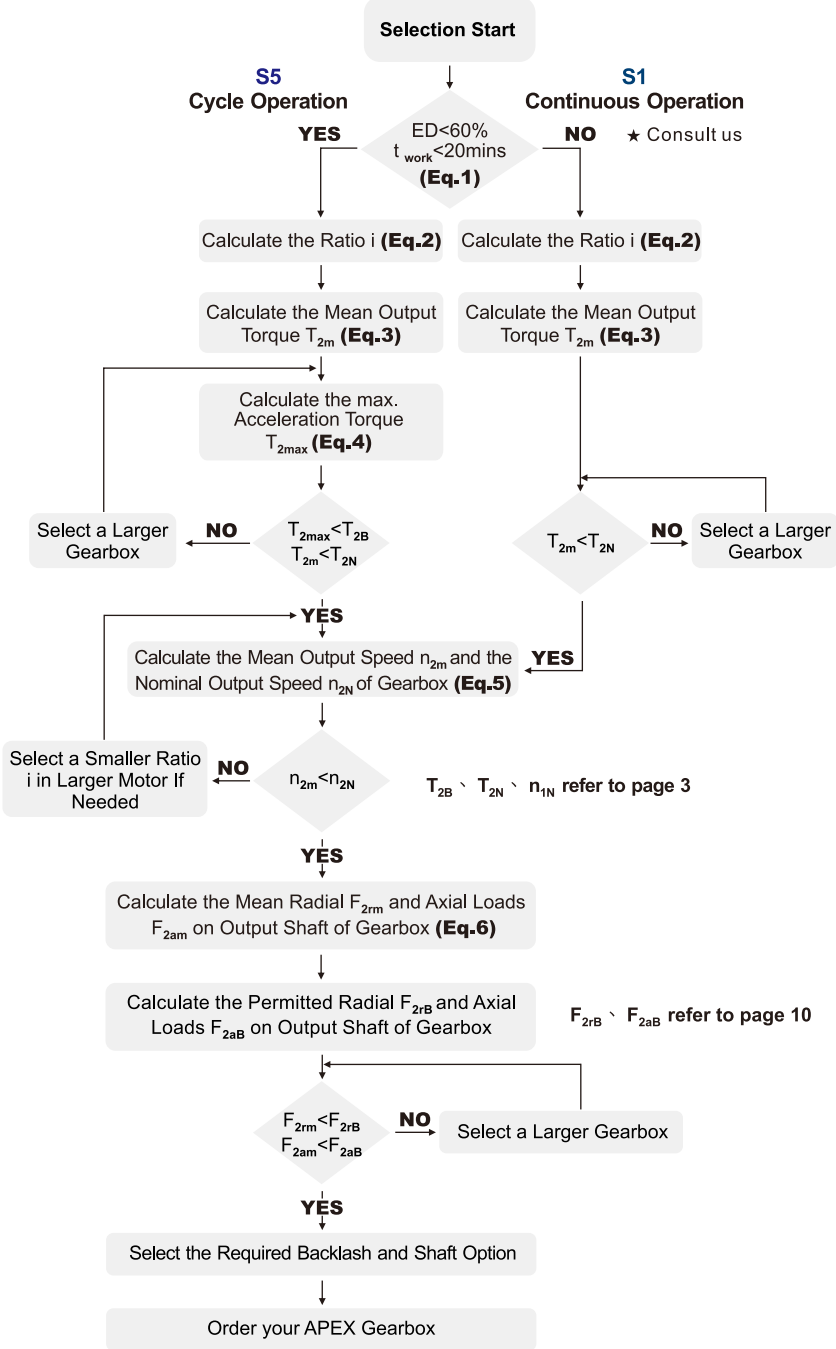
1. C1~C10 are motor specific dimensions (metric std shown). Refer to www.apexdyna.com and Design Tool to view your specific motor mounting system.

[unit: mm]

Dimension	AFR042	AFR060	AFR075	AFR100	AFR140	AFR180	AFR220
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
D7 h6	-	16	22	32	40	55	75
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	139	168.5	222.5	295.5	370.5	434	521
L9	42	60	90	115	142	180	220
L10	10	12.5	19	28	36	42	42
L11	-	26	26	26	40	41.5	52
L12	-	15	15	15	20	21.5	28
L13	-	21	22.5	23	33.5	33.5	45
C1 ²	46	46	70	100	130	165	215
C2 ²	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 ²	≤11 / ≤12	≤11 / ≤12	≤14 / ≤15.875 / ≤16	≤19 / ≤24	≤32	≤38	≤48
C4 ²	25	25	34	40	50	60	85
C5 ²	30	30	50	80	110	130	180
C6 ²	3.5	3.5	8	4	5	6	6
C7 ²	42	42	60	90	115	142	190
C8 ²	29.5	29.5	19	17	19.5	22.5	29
C9 ²	90.5	99.5	126.5	165	205	254.5	323.5
C10 ²	8.75	8.75	13.5	10.75	13	15	20.75
B1 h9	5	5	6	10	12	16	20
H1	15	18	24.5	35	43	59	79.5
X DIN5480	-	W16x0.8x 30x18x6m	W22x1.25x 30x16x6m	W32x1.25x 30x24x6m	W40x2x 30x18x6m	W55x2x 30x26x6m	W70x2x 30x34x6m

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

Selection of the Optimum Gearbox



Recommended (for S5 Cycle Operation)

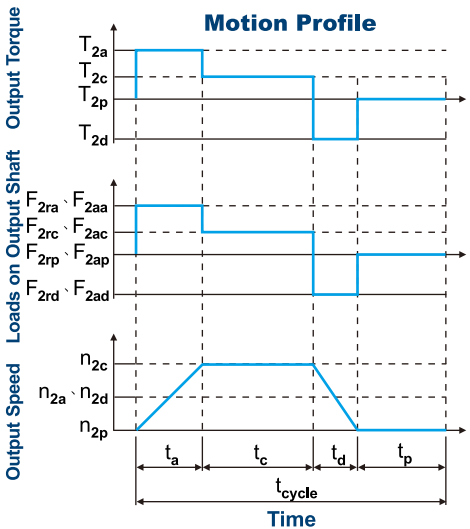
The general design is given for

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

The optimal design is given for

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

J_L Load Inertia
 J_m Motor Inertia



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

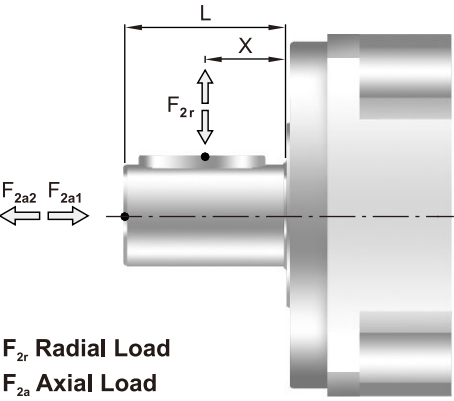
K_s	No. of Cycles / hr
1.0	0 ~ 1,000
1.1	1,000 ~ 1,500
1.3	1,500 ~ 2,000
1.6	2,000 ~ 3,000
1.8	3,000 ~ 5,000

T_{mB} Max. Output Torque of the Motor
 η Efficiency of the Gearbox (Eq.4)

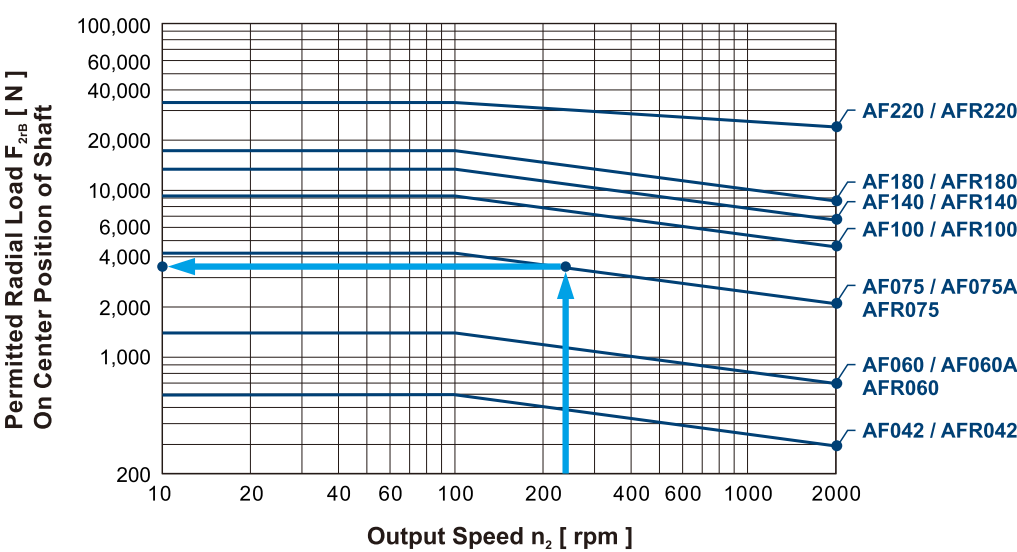
5. $n_{2a} = n_{2d} = \frac{1}{2} \times n_{2c}$
 $n_{2m} = \frac{n_{2a} \times t_a + n_{2c} \times t_c + n_{2d} \times t_d}{t_a + t_c + t_d}$
 $n_{2N} = \frac{n_{1N}}{i}$ (Eq.5)

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)

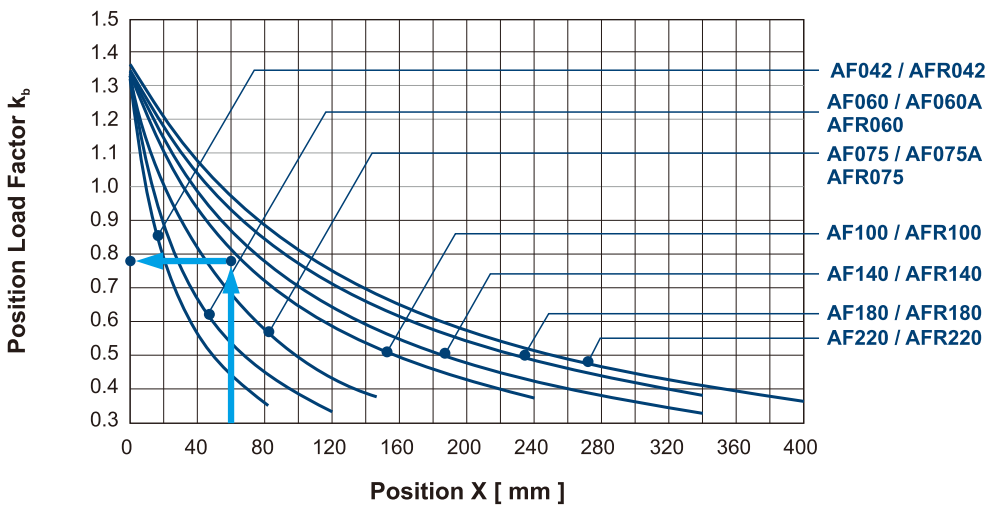
Permitted Radial and Axial Loads



The permitted radial and axial loads on output shaft of the gearbox depend on the design of the gearbox supporting bearings. APEX use the extension straddle oversized ball bearing design. It can take heavy load from both axes.



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.



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.

*S1 service life 15,000 hrs