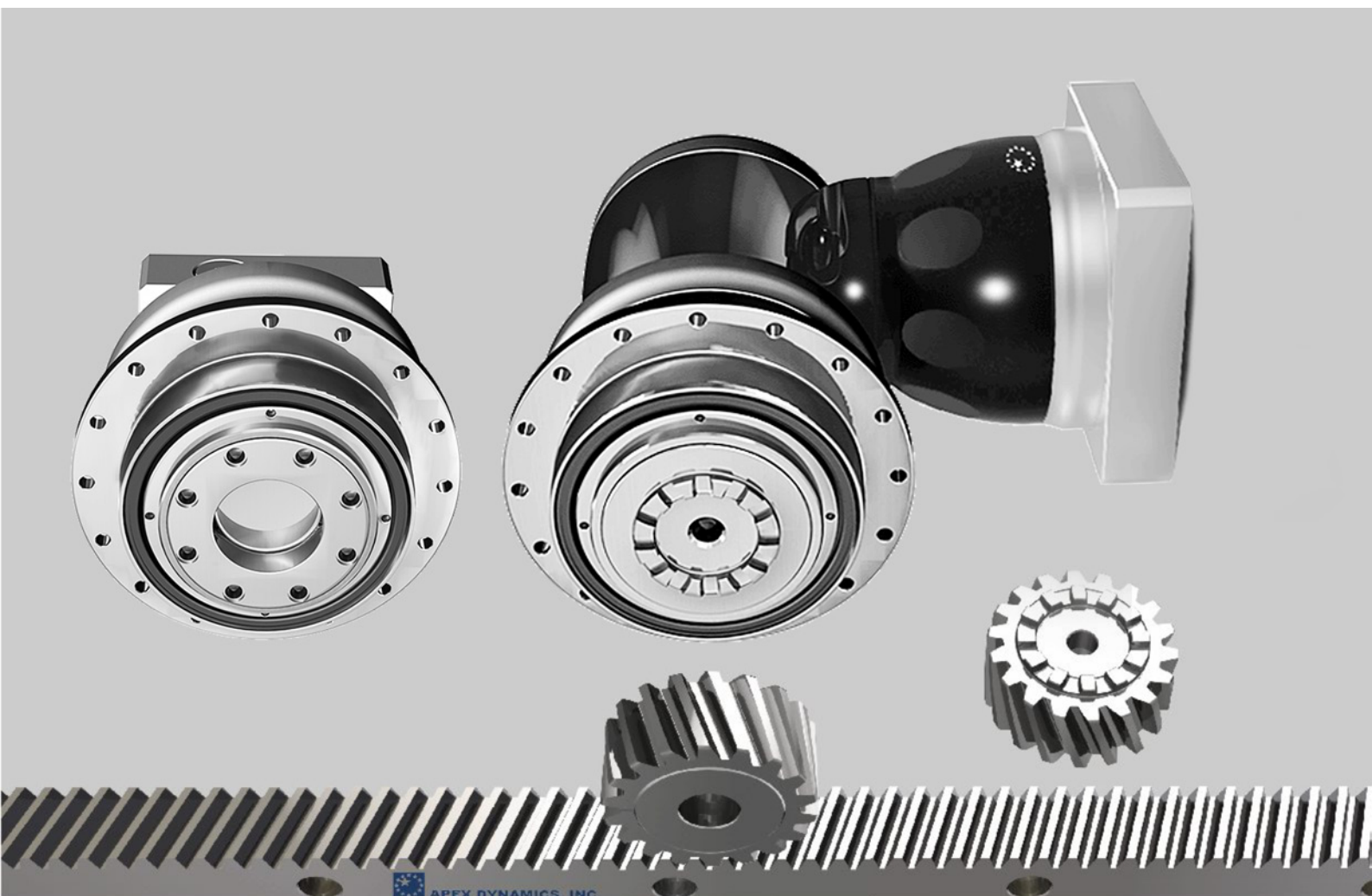




APEX DYNAMICS, INC.

**High Torque
High Precision
Planetary Gearbox**

**AP / APK
APC / APCK - SERIES**



Gearbox Series - AP / APK / APC / APCK

► Features:

- High Torque
- Optimized Output Torque & Inertia Moment
- High Precision
- Long Service Life
- Low Noise
- Limited Temperature Rise
- Support Flange/Curvic Interface
- Suitable for Rack & Pinion Applications



AP



APC



APK



APCK

Order Code

AP090	—	005.5⁽¹⁾	/	MOTOR
APK090	—	005.5⁽¹⁾	/	MOTOR
				Motor Type
				Ratio
				Gearbox Size

Gearbox Size

AP 090 / 110 / 140 / 200 / 255 / 285 / 355 / 450

APC 090 / 110 / 140 / 200 / 255 / 285 / 355 / 450

APK 090 / 110 / 140 / 200 / 255 / 285 / 355 / 450

APCK 090 / 110 / 140 / 200 / 255 / 285 / 355 / 450

Ratio

AP/APC (1 Stg.) 4 / 5.5

AP/APC (2 Stg.) 16 / 20 / 22 / 27.5 / 28 / 38.5 / 40 / 55

AP/APC (3 Stg.) 64 / 88 / 100 / 110 / 140 / 154 / 160 / 200 / 220 / 280 / 400

APK/APCK (2 Stg.) 4 / 5.5 / 8 / 11

APK/APCK (2 Stg.) 16 / 20 / 22 / 27.5 / 28 / 38.5 / 40 / 55

APK/APCK (3 Stg.) 64 / 88 / 100 / 110 / 137.5 / 140 / 154 / 160 / 200 / 220 / 280 / 385

**APK/APCK (4 Stg.) 400 / 440 / 500 / 550 / 700 / 770 / 1000 / 1078 / 1400 / 1540 / 1600
2000 / 2695 / 2800 / 3850 / 4000 / 5500**

Motor Type : Manufacturer and Model

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



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Performance - AP / APC Gearbox

Model No.	Stage	Ratio ⁽¹⁾	AP 090 APC 090	AP 110 APC 110	AP 140 APC 140	AP 200 APC 200	AP 255 APC 255	AP 285 APC 285	AP 355 APC 355	AP 450 APC 450
Nominal Output Torque T _{2N}	1	4	205	460	790	1,700	2,580	4,875	-	-
		5.5	200	370	645	1,430	2,175	4,060	-	-
		16	255	470	800	1,730	2,625	4,955	-	-
		20	255	470	805	1,735	2,630	4,965	-	-
		22	200	375	650	1,445	2,200	4,100	6,995	13,810
		27.5	200	375	655	1,445	2,200	4,105	7,000	13,825
		28	250	470	805	1,735	2,635	4,970	-	-
		38.5	200	375	655	1,450	2,200	4,110	7,010	13,845
	2	40	95	225	650	1,610	2,640	4,980	-	-
		55	130	315	655	1,450	2,205	4,110	7,020	13,855
		64	260	470	805	1,740	2,640	4,985	-	-
		88	200	380	655	1,450	2,205	4,115	7,025	13,865
		100	260	470	805	1,745	2,645	4,990	-	-
		110	200	380	655	1,450	2,205	4,115	7,025	13,870
		140	260	470	810	1,745	2,645	4,990	-	-
		154	200	380	655	1,450	2,205	4,120	7,030	13,875
	3	160	210	385	810	1,745	2,645	4,990	-	-
		200	260	475	810	1,745	2,645	4,990	-	-
		220	200	380	655	1,450	2,205	4,120	7,030	13,875
		280	260	475	810	1,745	2,645	4,990	-	-
		400	95	225	650	1,610	2,645	4,995	-	-
Emergency Stop Torque T _{2NOT}	Nm	1,2,3	4~400	3 times T _{2N}						
Max. Acceleration Torque T _{2B}	Nm	1,2,3	4~400	1.5 times T _{2N}						
No Load Running Torque ⁽²⁾	Nm	1	4~5.5	1.5	2.5	7.1	14	22	28	-
		2	16~55	0.6	1.1	3.7	8	12	18	17
		3	64~400	0.35	0.7	1.6	4	4.5	6.5	6
Backlash ⁽³⁾	arcmin	1	4~5.5	≤ 1						
		2,3	16~400	≤ 2						
Torsional Rigidity	Nm/arcmin	1,2,3	4~400	42	95	205	650	1,200	1,800	2,850
Nominal Input Speed n _{1N}	rpm	1	4~5.5	3,600	3,600	3,000	2,700	2,400	2,100	-
		2	16~55	4,600	4,600	4,000	3,700	3,400	3,100	2,500
		3	64~400	5,000	5,000	4,600	4,000	3,700	3,400	3,100
Max. Input Speed n _{1B}	rpm	1	4~5.5	6,000	6,000	5,000	4,500	4,000	3,500	-
		2	16~55	7,000	7,000	6,000	5,500	5,000	4,500	4,000
		3	64~400	7,000	7,000	7,000	6,000	5,500	5,000	4,500
Max. Axial Load F _{2a} ⁽⁴⁾	N	1,2,3	4~400	2,220	4,070	8,530	17,000	26,900	39,200	101,500
Max. Tilting Moment M _{2K} ⁽⁴⁾	Nm	1,2,3	4~400	280	480	1,310	3,530	5,920	9,230	29,100
Service Life ⁽⁵⁾	hr	1,2,3	4~400	20,000						
Operating Temp.	°C	1,2,3	4~400	-10° C ~ 90° C						
Degree of Gearbox Protection		1,2,3	4~400	IP65						
Lubrication		1,2,3	4~400	Synthetic lubrication grease						
Mounting Position		1,2,3	4~400	All directions						
Running Noise ⁽²⁾	dB(A)	1	4~5.5	≤ 59	≤ 64	≤ 66	≤ 66	≤ 68	≤ 68	-
		2	16~55	≤ 60	≤ 62	≤ 64	≤ 66	≤ 67	≤ 67	≤ 68
		3	64~400	≤ 60	≤ 62	≤ 64	≤ 66	≤ 67	≤ 67	≤ 68
Efficiency η	%	1	4~5.5	≥ 97%						
		2	16~55	≥ 94%						
		3	64~400	≥ 92%						

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

(2) These values are measured by gearbox with ratio = 5.5 (1-stage), 55 (2-stage) or 220 (3-stage) at 3,000 rpm without load.

(3) Backlash is measured at 2% of Nominal Output Torque T_{2N}.

(4) Applied to the output flange/curvic center at 100 rpm. The calculation formula please refer to Fig. 1.

(5) Continuous operation is not recommended.

$$\text{Max. Tilting Moment } M_{2K} = \frac{F_{2a} * Y + F_{2r} * (X + Z_2)}{1000}$$

M_{2K} : [Nm]

F_{2a}, F_{2r} : [N]

X, Y, Z₂ : [mm]

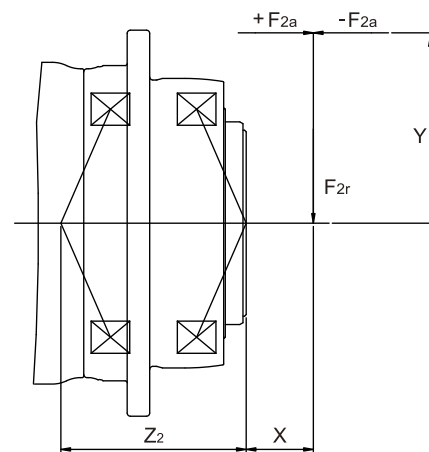


Fig. 1

AP / APK	090	110	140	200	255	285	355	450
Z ₂ [mm]	84.5	106.2	90	122.8	133.2	175.5	220.6	275.3

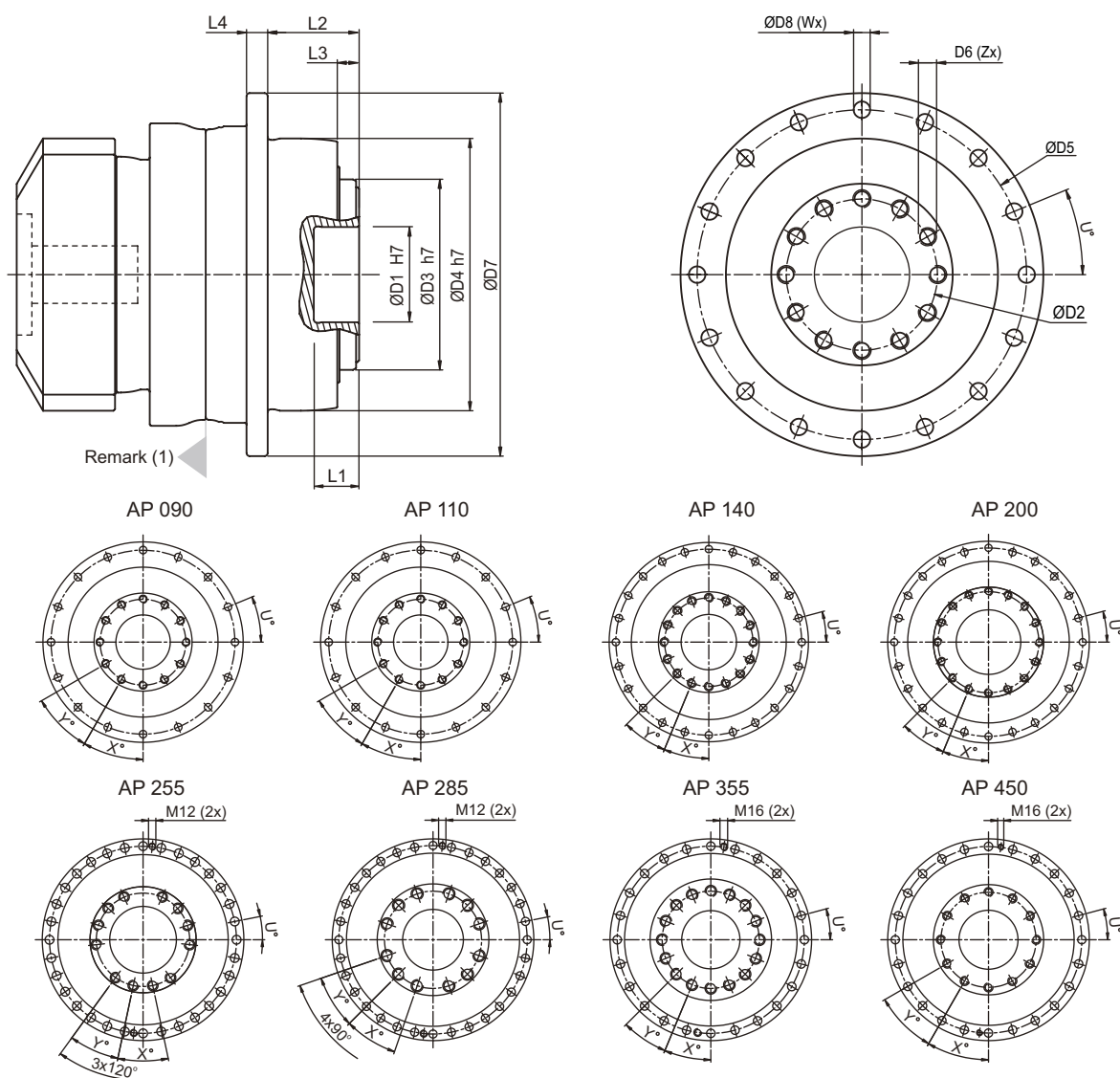
Inertia - AP / APC Gearbox

Model No.		AP/APC 090			AP/APC 110			AP/APC 140			AP/APC 200			AP/APC 255		
Ø ^(A)	Stage	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
11	kg.cm ²	-	-	0.16	-	-	-	-	-	-	-	-	-	-	-	-
14		0.42	0.21	0.19	-	-	0.21	-	-	-	-	-	-	-	-	-
19		0.66	0.6	-	1.84	0.66	0.6	-	-	0.66	-	-	-	-	-	-
24		3.94	-	-	4.11	3.94	-	4.61	4.11	3.94	-	-	4.11	-	-	-
28		-	-	-	5.48	-	-	6.14	5.48	-	-	-	5.48	-	-	6.14
32		-	-	-	7.36	-	-	8.17	7.36	-	-	8.17	7.36	-	-	8.17
35		-	-	-	14.04	-	-	15.54	14.04	-	17.75	15.54	14.04	-	17.75	15.54
38		-	-	-	16.71	-	-	18.19	16.71	-	20.17	18.19	16.71	-	20.17	18.19
42		-	-	-	-	-	-	23.2	-	-	25.4	23.2	-	28.88	25.4	-
48		-	-	-	-	-	-	52.42	-	-	55.18	52.42	-	58.64	55.18	-
55		-	-	-	-	-	-	-	-	-	-	-	-	92.48	-	-
60		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Model No.		AP/APC 285			AP/APC 355		AP/APC 450	
Ø ^(A)	Stage	1	2	3	2	3	2	3
11	kg.cm ²	-	-	-	-	-	-	-
14		-	-	-	-	-	-	-
19		-	-	-	-	-	-	-
24		-	-	-	-	-	-	-
28		-	-	-	-	-	-	-
32		-	-	-	-	-	-	-
35		-	-	17.75	-	-	-	-
38		-	23.66	20.17	-	20.17	-	23.66
42		-	28.88	25.4	28.79	25.4	-	28.95
48		69.78	58.64	55.18	92.76	55.18	106.06	58.64
55		104.22	92.48	-	105.41	-	118.67	-
60		127.69	-	-	-	-	127.37	-

(A) Ø = Input shaft diameter.

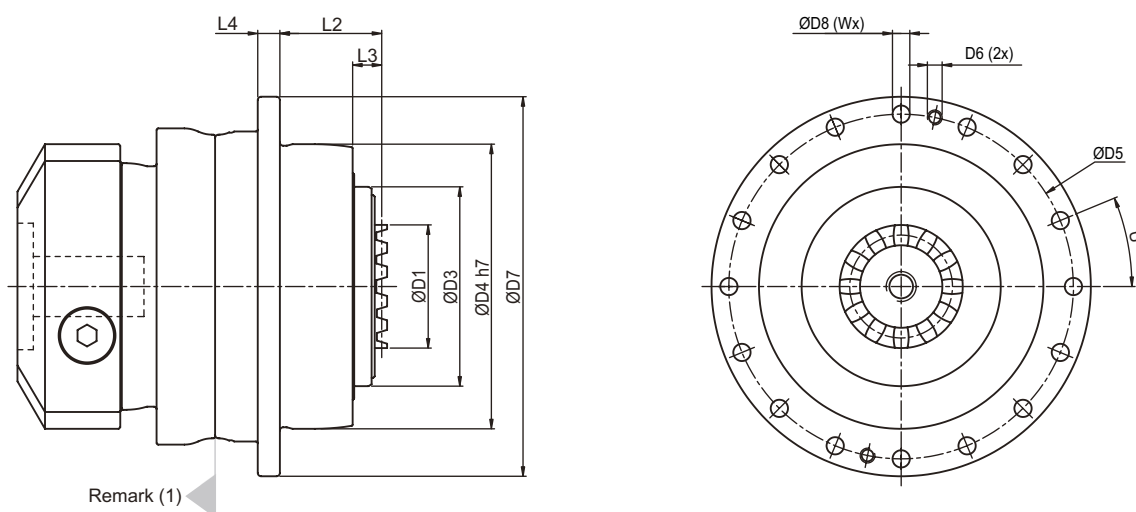
Dimension - AP Gearbox



Dimension	AP 090	AP 110	AP 140	AP 200	AP 255	AP 285	AP 355	AP 450
D1 H7	31.5	40	50	80	100	100	120	155
D2	50	63	80	125	140	160	200	250
D3 h7	63	80	100	160	180	200	250	315
D4 h7	90	110	140	200	255	285	355	450
D5	109	135	168	233	280	310	385	490
D6 x Pitch x Deep	M6x1Px11	M8x1.25Px12	M8x1.25Px15	M10x1.5Px20	M16x2Px25	M24x3Px37	M24x3Px32	M30x3.5Px40
D7	120	147	180	249.5	302	332	415	530
D8	5.5	5.5	6.6	9	13.5	13.5	17.5	22
L1	15	15	15	16	16	16	35	24
L2	30	29	38	50	66	75	80	85
L3	7	7	7.5	8.5	13.5	16.5	20	20
L4	7	8	10	12	18	20	45	60
X in Degree	30	30	22.5	22.5	24	26	22.5	30
Y in Degree	30	30	22.5	22.5	24	26	22.5	30
Z	12	12	16	16	12	12	16	12
U in Degree	22.5	22.5	15	15	11.25	11.25	15	15
W	16	16	24	24	32	32	24	24

(1) Dimensions are related to motor interface. Please contact APEX for details.

Dimension - APC Gearbox



Dimension	APC 090	APC 110	APC 140	APC 200	APC 255	APC 285	APC 355	APC 450
D1	36	46	60	80	90	120	120	132
D3	63	80	100	160	180	200	250	315
D4 h7	90	110	140	200	255	285	355	450
D5	109	135	168	233	280	310	385	490
D6	-	-	-	-	M12	M12	M16	M16
D7	120	147	180	249.5	302	332	415	530
D8	5.5	5.5	6.6	9	13.5	13.5	17.5	22
L2	32.5	31.5	40.5	52.5	68.5	77.5	82.5	87.5
L3	9.5	9.5	10	11	16	19	22.5	22.5
L4	7	8	10	12	18	20	45	60
U in Degree	22.5	22.5	15	15	11.25	11.25	15	15
W	16	16	24	24	32	32	24	24

(1) Dimensions are related to motor interface. Please contact APEX for details.

Performance - APK / APCK Gearbox

Model No.		Stage	Ratio ⁽¹⁾	APK 090 APCK 090	APK 110 APCK 110	APK 140 APCK 140	APK 200 APCK 200	APK 255 APCK 255	APK 285 APCK 285	APK 355 APCK 355	APK 450 APCK 450
Nominal Output Torque T_{2N}		2	16	255	470	805	1,735	2,015	3,935	-	-
			20	255	470	805	1,735	2,015	3,935	-	-
			22	200	375	655	1,445	2,200	4,110	7,010	-
			27.5	200	375	655	1,445	2,200	4,110	7,015	-
			28	240	470	805	1,740	1,870	3,600	-	-
			38.5	200	375	655	1,450	2,200	4,110	7,020	-
			40	95	225	650	1,610	1,725	2,880	-	-
			55	130	315	655	1,450	2,205	3,960	7,025	-
		3	64	-	470	805	1,740	2,640	4,985	-	-
			88	-	380	655	1,450	2,205	4,115	7,025	13,870
			100	-	470	810	1,745	2,645	4,990	-	-
			110	-	380	655	1,450	2,205	4,115	7,025	13,870
			137.5	-	380	655	1,450	2,205	4,120	7,030	13,875
			140	-	470	810	1,745	2,645	4,990	-	-
			154	-	380	655	1,450	2,205	4,120	7,030	13,875
			160	-	475	810	1,745	2,645	4,990	-	-
			200	-	475	810	1,745	2,645	4,990	-	-
			220	-	380	655	1,450	2,205	4,120	7,030	13,200
			280	-	475	810	1,745	2,645	4,995	-	-
			385	-	380	655	1,450	2,205	4,120	7,030	13,880
		4	400	-	475	810	1,745	2,645	4,995	-	-
			440	-	380	655	1,450	2,205	4,120	7,030	13,880
			500	-	475	810	1,745	2,645	4,995	-	-
			550	-	380	655	1,450	2,210	4,120	7,030	13,880
			700	-	475	810	1,745	2,645	4,995	-	-
			770	-	380	655	1,450	2,210	4,120	7,030	13,880
			1,000	-	475	810	1,745	2,645	4,995	-	-
			1,078	-	380	655	1,450	2,210	4,120	7,035	13,880
			1,400	-	475	810	1,745	2,645	4,995	-	-
			1,540	-	380	655	1,450	2,210	4,120	7,035	13,200
			1,600	-	475	810	1,745	2,645	4,995	-	-
			2,000	-	475	810	1,745	2,645	4,995	-	-
			2,695	-	380	655	1,450	2,210	4,120	7,035	13,885
			2,800	-	475	810	1,745	2,645	4,995	-	-
			3,850	-	380	655	1,450	2,210	4,120	7,035	13,885
			4,000	-	225	650	1,610	2,645	4,995	-	-
			5,500	-	315	655	1,450	2,210	4,120	7,035	14,010
Emergency Stop Torque T_{2NOT}	Nm	2,3,4	16~5,500	2 times T_{2N}							
Max. Acceleration Torque T_{2B}	Nm	2,3,4	16~5,500	1.5 times T_{2N}							
No Load Running Torque ⁽²⁾	Nm	2	16~55	1.3	2	3.1	6	13	16	20	-
		3	64~385	-	1.4	2.4	4.6	7	8.5	10.5	13
		4	400~5,500	-	0.2	0.3	0.6	0.9	1.2	1.8	2.5
Backlash ⁽³⁾	arcmin	2,3,4	16~5,500	≤ 2							
Torsional Rigidity	Nm/arcmin	2	16~55	27	56	112	389	642	1,275	2,500	-
		3	64~385	-	56	112	389	642	1,275	2,500	5,100
		4	400~5,500	-	45	85	310	535	1,050	1,700	2,700
Nominal Input Speed n_{1N}	rpm	2	16~55	3,000	2,800	2,700	2,200	2,100	2,000	1,600	-
		3	88~385	3,000	3,000	2,800	2,700	2,200	2,100	2,100	2,000
		4	400~5,500	5,500	5,500	4,600	4,600	4,000	3,700	3,700	3,400
Max. Input Speed n_{1B}	rpm	2	16~55	6,000	6,000	4,500	4,500	4,000	3,000	2,500	-
		3	64~385	6,000	6,000	6,000	4,500	4,500	4,000	4,000	3,000
		4	400~5,500	7,000	7,000	7,000	7,000	6,000	5,500	5,500	5,000
Max. Axial Load F_{2a} ⁽⁴⁾	N	2,3,4	16~5,500	2,220	4,070	8,530	17,000	26,900	39,200	101,500	143,700
Max. Tilting Moment M_{2k} ⁽⁴⁾	Nm	2,3,4	16~5,500	280	480	1,310	3,530	5,920	9,230	29,100	63,300
Service Life ⁽⁵⁾	hr	2,3,4	16~5,500	20,000							
Operating Temp.	°C	2,3,4	16~5,500	-10° C ~ 90° C							
Degree of Gearbox Protection		2,3,4	16~5,500	IP65							
Lubrication		2,3,4	16~5,500	Synthetic lubrication grease							
Mounting Position		2,3,4	16~5,500	All directions							
Running Noise ⁽²⁾	dB(A)	2,3,4	16~5,500	≤ 68	≤ 68	≤ 68	≤ 70	≤ 70	≤ 72	≤ 74	≤ 76
Efficiency η	%	2	16~55	$\geq 94\%$							
		3	64~385	$\geq 92\%$							
		4	400~5,500	$\geq 90\%$							

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

(2) These values are measured by gearbox with ratio = 55 (2-stage), 385 (3-stage) or 5,500 (4-stage) at 3,000 rpm without load.

(3) Backlash is measured at 2% of Nominal Output Torque T_{2N} .

(4) Applied to the output flange/curvic center at 100 rpm. The calculation formula please refer to page (3)

(5) Continuous operation is not recommended.

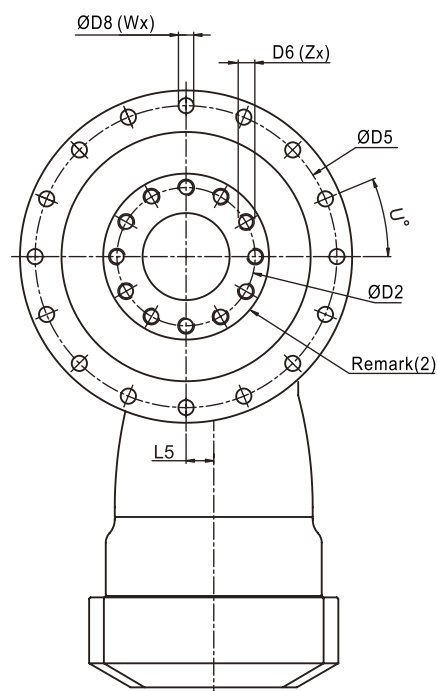
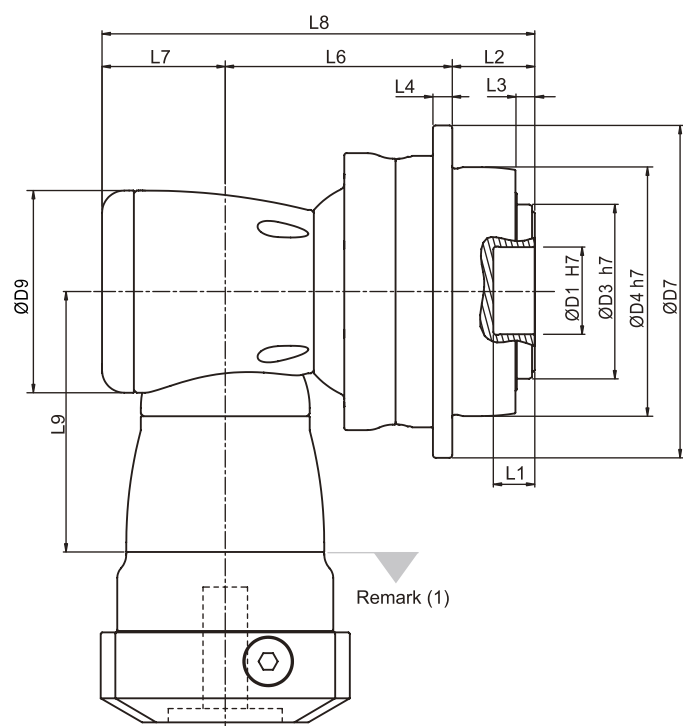
Inertia - APK / APCK Gearbox

Model No.		APK/APCK 090			APK/APCK 110			APK/APCK 140			APK/APCK 200			APK/APCK 255			APK/APCK 285		
Ø ^(A)	Stage	2	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4		
8	kg.cm ²	-	-	-	0.17	-	-	-	-	-	-	-	-	-	-	-	-		
11		-	-	-	0.17	-	-	-	-	-	-	-	-	-	-	-	-		
14		0.37	-	0.37	-	-	-	0.42	-	-	-	-	-	-	-	-	-		
19		0.6	1.61	0.6	-	-	1.61	0.66	-	-	1.83	-	-	-	-	-	-		
24		-	3.9	-	-	4.01	3.9	3.94	-	4.01	4.11	-	-	4.61	-	-	-		
28		-	-	-	-	5.53	5.15	-	-	5.53	-	-	5.61	6.14	-	-	-		
32		-	-	-	-	7.57	-	-	8.11	7.57	-	-	8.11	8.17	-	-	-		
35		-	-	-	-	14.95	-	-	15.32	14.95	-	15.32	15.32	15.54	-	15.32	15.54		
38		-	-	-	-	17.58	-	-	17.72	17.58	-	17.72	17.72	18.19	18.52	17.72	18.19		
42		-	-	-	-	-	-	-	22.95	-	-	22.95	-	-	23.74	22.95	23.2		
48		-	-	-	-	-	-	-	52.74	-	-	52.74	-	-	53.49	52.74	52.42		
55		-	-	-	-	-	-	-	-	-	-	-	-	-	87.34	-	-		

Model No.		APK/APCK 355			APK/APCK 450	
Ø ^(A)	Stage	2	3	4	3	4
8	kg.cm ²	-	-	-	-	-
11		-	-	-	-	-
14		-	-	-	-	-
19		-	-	-	-	-
24		-	-	-	-	-
28		-	-	-	-	-
32		-	-	-	-	-
35		-	-	15.54	-	17.76
38		-	17.72	18.19	18.52	20.17
42		25.5	22.95	23.2	23.74	25.4
48		55.14	52.74	52.42	53.49	55.18
55		89.59	-	-	-	-

(A) Ø = Input shaft diameter.

Dimension - APK (2 Stage) Gearbox (Ratio i = 16 ~ 55)

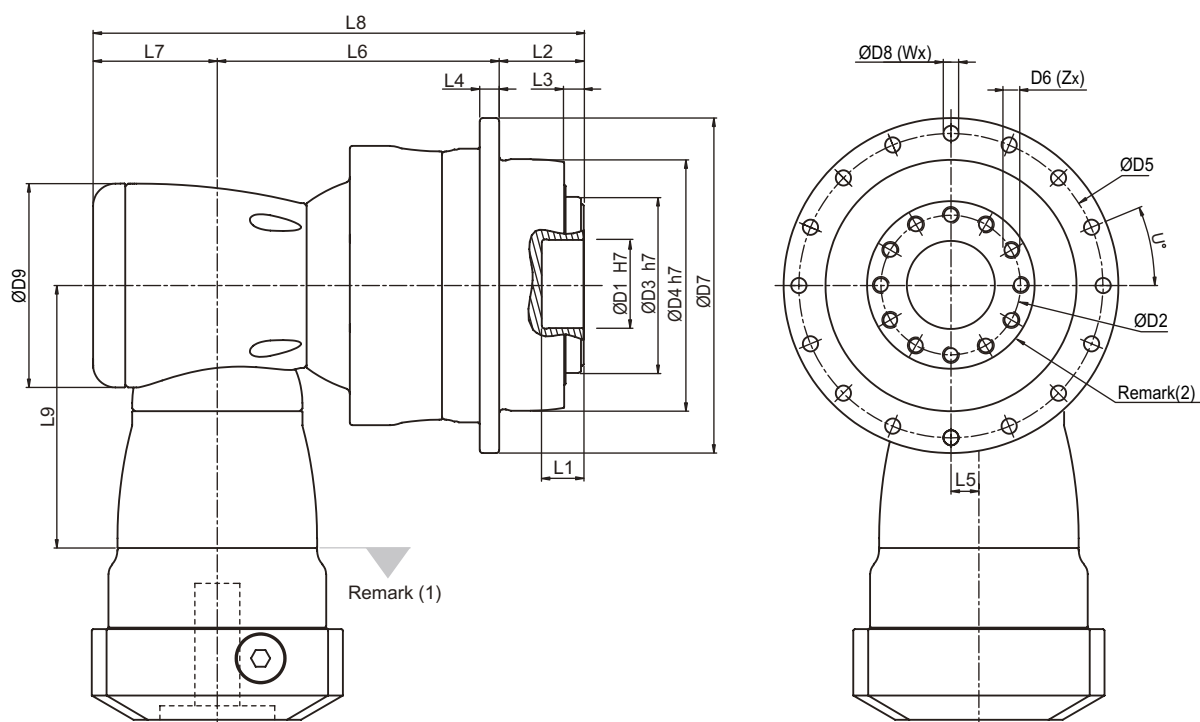


Dimension	APK 090	APK 110	APK 140	APK 200	APK 255	APK 285	APK 355
D1 H7	31.5	40	50	80	100	100	120
D2	50	63	80	125	140	160	200
D3 h7	63	80	100	160	180	200	250
D4 h7	90	110	140	200	255	285	355
D5	109	135	168	233	280	310	385
D6 x Pitch x Deep	M6x1Px11	M8x1.25Px12	M8x1.25Px15	M10x1.5Px20	M16x2Px25	M24x3Px37	M24x3Px32
D7	120	147	180	249.5	302	332	415
D8	5.5	5.5	6.6	9	13.5	13.5	17.5
D9	94	116	163	210	210	255	300
L1	15	15	15	16	16	16	35
L2	30	29	38	50	66	75	80
L3	7	7	7.5	8.5	13.5	16.5	20
L4	7	8	10	12	18	20	45
L5	13	17	25	31	31	36	43
L6	90.5	114	147.5	175	191.5	249.5	290
L7	53	68.3	89	115	115	131	165
L8	173.5	211.3	274.5	340	372.5	455.5	535
L9	114.5	129	173.5	228	228	265.5	294.5
X in Degree	30	30	22.5	22.5	24	26	22.5
Y in Degree	30	30	22.5	22.5	24	26	22.5
Z	12	12	16	16	12	12	16
U in Degree	22.5	22.5	15	15	11.25	11.25	15
W	16	16	24	24	32	32	24

(1) Dimensions are related to motor interface. Please contact APEX for details.

(2) Flange Interface, please refer to page (5).

Dimension - APK (3 Stage) Gearbox (Ratio i = 64 ~ 385)

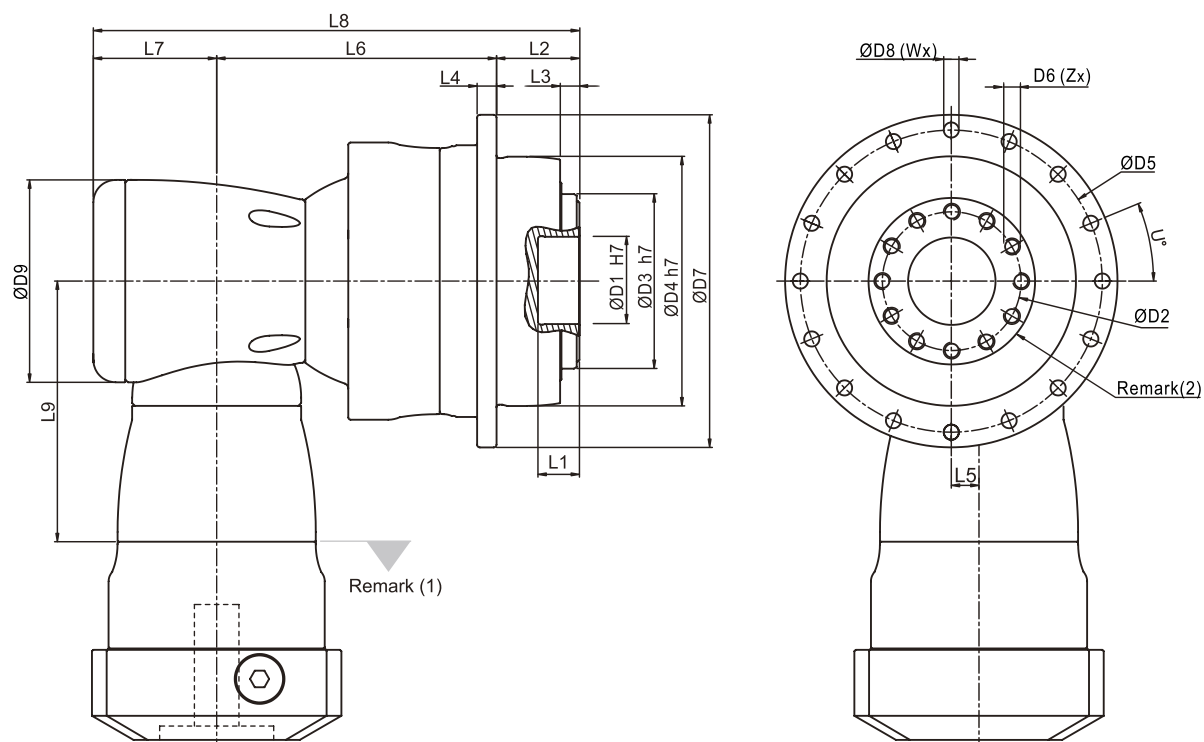


Dimension	APK 110	APK 140	APK 200	APK 255	APK 285	APK 355	APK 450
D1 H7	40	50	80	100	100	120	155
D2	63	80	125	140	160	200	250
D3 h7	80	100	160	180	200	250	315
D4 h7	110	140	200	255	285	355	450
D5	135	168	233	280	310	385	490
D6 x Pitch x Deep	M8x1.25Px12	M8x1.25Px15	M10x1.5Px20	M16x2Px25	M24x3Px37	M24x3Px32	M30x3.5Px40
D7	147	180	249.5	302	332	415	530
D8	5.5	6.6	9	13.5	13.5	17.5	22
D9	94	116	163	210	210	210	255
L1	15	15	16	16	16	35	24
L2	29	38	50	66	75	80	85
L3	7	7.5	8.5	13.5	16.5	20	20
L4	8	10	12	18	20	45	60
L5	13	17	25	31	31	31	36
L6	132	164	216.5	254.5	300	332	447.5
L7	53	68.3	89	115	115	115	131
L8	214	270.3	355.5	435.5	490	527	663.5
L9	114.5	129	173.5	228	228	228	265.5
X in Degree	30	22.5	22.5	24	26	22.5	30
Y in Degree	30	22.5	22.5	24	26	22.5	30
Z	12	16	16	12	12	16	12
U in Degree	22.5	15	15	11.25	11.25	15	15
W	16	24	24	32	32	24	24

(1) Dimensions are related to motor interface. Please contact APEX for details.

(2) Flange Interface, please refer to page (5).

Dimension - APK (4 Stage) Gearbox (Ratio i = 400 ~ 5,500)

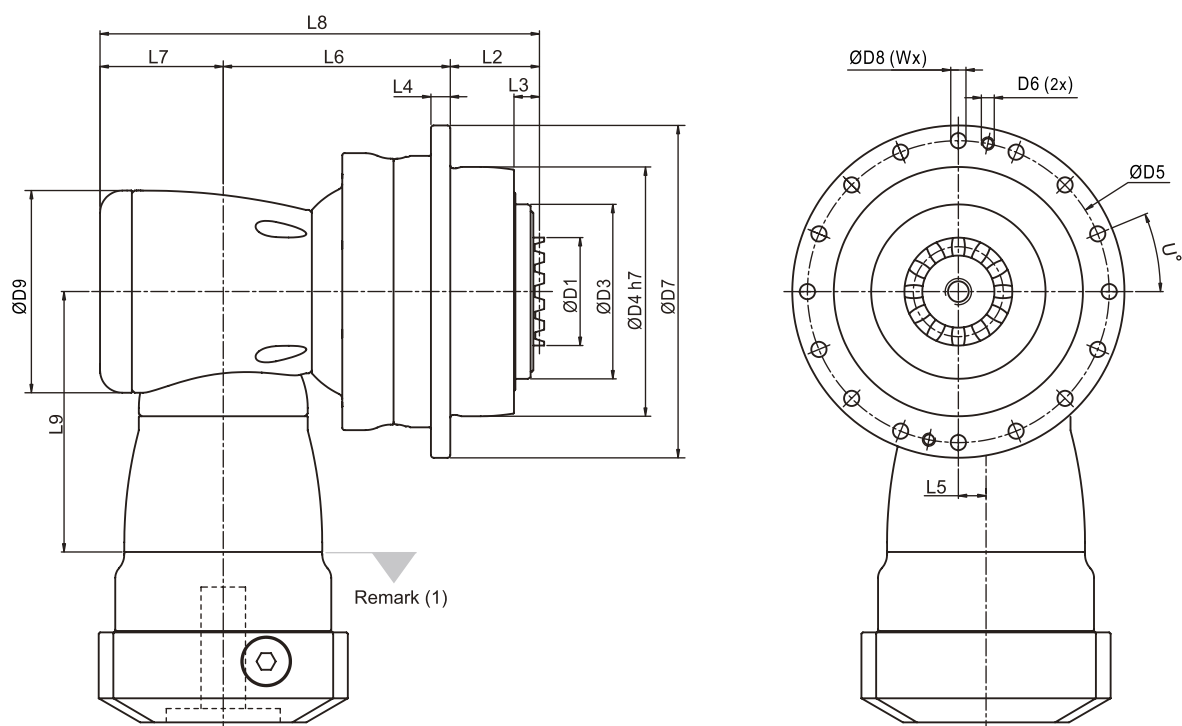


Dimension	APK 110	APK 140	APK 200	APK 255	APK 285	APK 355	APK 450
D1 H7	40	50	80	100	100	120	155
D2	63	80	125	140	160	200	250
D3 h7	80	100	160	180	200	250	315
D4 h7	110	140	200	255	285	355	450
D5	135	168	233	280	310	385	490
D6 x Pitch x Deep	M8x1.25Px12	M8x1.25Px15	M10x1.5Px20	M16x2Px25	M24x3Px37	M24x3Px32	M30x3.5Px40
D7	147	180	249.5	302	332	415	530
D8	5.5	6.6	9	13.5	13.5	17.5	22
D9	94	116	163	210	210	210	255
L1	15	15	16	16	16	35	24
L2	29	38	50	66	75	80	85
L3	7	7.5	8.5	13.5	16.5	20	20
L4	8	10	12	18	20	45	60
L5	13	17	25	31	31	31	36
L6	132	164	216.5	254.5	300	332	447.5
L7	53	68.3	89	115	115	115	131
L8	214	270.3	355.5	435.5	490	527	663.5
L9	114.5	129	173.5	228	228	228	265.5
X in Degree	30	22.5	22.5	24	26	22.5	30
Y in Degree	30	22.5	22.5	24	26	22.5	30
Z	12	16	16	12	12	16	12
U in Degree	22.5	15	15	11.25	11.25	15	15
W	16	24	24	32	32	24	24

(1) Dimensions are related to motor interface. Please contact APEX for details.

(2) Flange Interface, please refer to page (5).

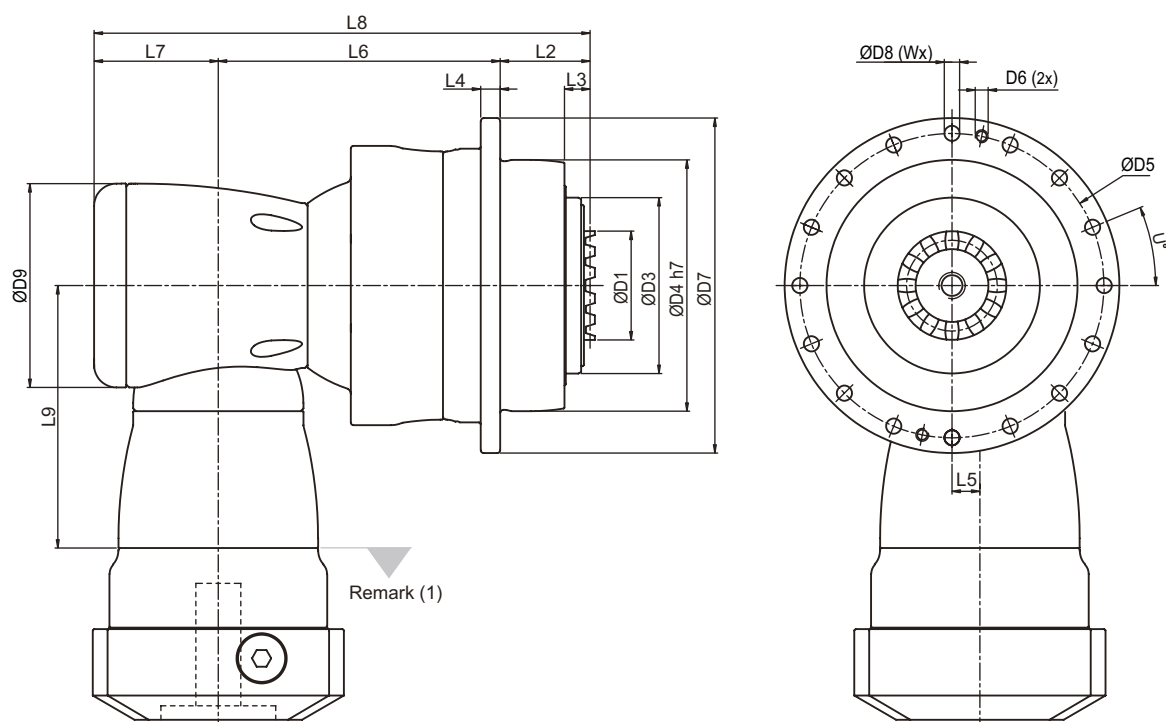
Dimension - APCK (2 Stage) Gearbox (Ratio i = 16 ~ 55)



Dimension	APCK 090	APCK 110	APCK 140	APCK 200	APCK 255	APCK 285	APCK 355
D1	36	46	60	80	90	120	120
D3	63	80	100	160	180	200	250
D4 h7	90	110	140	200	255	285	355
D5	109	135	168	233	280	310	385
D6	-	-	-	-	M12	M12	M16
D7	120	147	180	249.5	302	332	415
D8	5.5	5.5	6.6	9	13.5	13.5	17.5
D9	94	116	163	210	210	255	300
L2	32.5	31.5	40.5	52.5	68.5	77.5	82.5
L3	9.5	9.5	10	11	16	19	22.5
L4	7	8	10	12	18	20	45
L5	13	17	25	31	31	36	43
L6	90.5	114	147.5	175	191.5	249.5	290
L7	53	68.3	89	115	115	131	165
L8	176	213.8	277	342.5	375	458	537.5
L9	114.5	129	173.5	228	228	265.5	294.5
U in Degree	22.5	22.5	15	15	11.25	11.25	15
W	16	16	24	24	32	32	24

(I) Dimensions are related to motor interface. Please contact APEX for details.

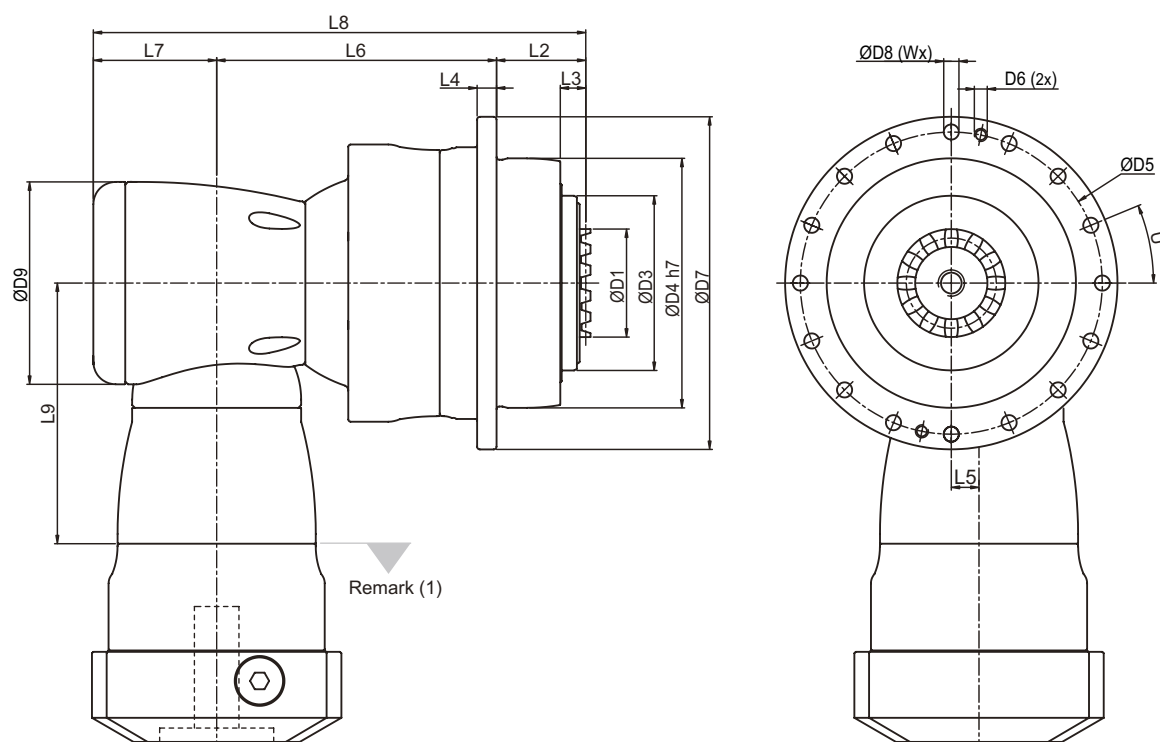
Dimension - APCK (3 Stage) Gearbox (Ratio i = 64 ~ 385)



Dimension	APCK 110	APCK 140	APCK 200	APCK 255	APCK 285	APCK 355	APCK 450
D1	46	60	80	90	120	120	132
D3	80	100	160	180	200	250	315
D4 h7	110	140	200	255	285	355	450
D5	135	168	233	280	310	385	490
D6	-	-	-	M12	M12	M16	M16
D7	147	180	249.5	302	332	415	530
D8	5.5	6.6	9	13.5	13.5	17.5	22
D9	94	116	163	210	210	210	255
L2	31.5	40.5	52.5	68.5	77.5	82.5	87.5
L3	9.5	10	11	16	19	22.5	22.5
L4	8	10	12	18	20	45	60
L5	13	17	25	31	31	31	36
L6	132	164	216.5	254.5	300	332	447.5
L7	53	68.3	89	115	115	115	131
L8	216.5	272.8	358	438	492.5	529.5	666
L9	114.5	129	173.5	228	228	228	265.5
U in Degree	22.5	15	15	11.25	11.25	15	15
W	16	24	24	32	32	24	24

(I) Dimensions are related to motor interface. Please contact APEX for details.

Dimension - APCK (4 Stage) Gearbox (Ratio i = 400 ~ 5,500)



Dimension	APCK 110	APCK 140	APCK 200	APCK 255	APCK 285	APCK 355	APCK 450
D1	46	60	80	90	120	120	132
D3	80	100	160	180	200	250	315
D4 h7	110	140	200	255	285	355	450
D5	135	168	233	280	310	385	490
D6	-	-	-	M12	M12	M16	M16
D7	147	180	249.5	302	332	415	530
D8	5.5	6.6	9	13.5	13.5	17.5	22
D9	94	116	163	210	210	210	255
L2	31.5	40.5	52.5	68.5	77.5	82.5	87.5
L3	9.5	10	11	16	19	22.5	22.5
L4	8	10	12	18	20	45	60
L5	13	17	25	31	31	31	36
L6	132	164	216.5	254.5	300	332	447.5
L7	53	68.3	89	115	115	115	131
L8	216.5	272.8	358	438	492.5	529.5	666
L9	114.5	129	173.5	228	228	228	265.5
U in Degree	22.5	15	15	11.25	11.25	15	15
W	16	24	24	32	32	24	24

(I) Dimensions are related to motor interface. Please contact APEX for details.

Performance - APK / APCK (2 Stage) Gearbox (Ratio = 4~11)

Model No.		Stage	Ratio ⁽¹⁾	APK 090 APCK 090	APK 110 APCK 110	APK 140 APCK 140	APK 200 APCK 200	APK 255 APCK 255	APK 285 APCK 285
Nominal Output Torque T_{2N}	Nm	2	4	75	465	790	1,710	2,595	4,920
			5.5	105	370	645	1,435	2,180	4,080
			8	150	470	800	1,580	2,610	4,955
			11	205	375	650	1,440	2,195	4,100
Emergency Stop Torque T_{2NOT}	Nm	2	4~11	2 times T_{2N}					
Max. Acceleration Torque T_{2B}	Nm	2	4~11	1.5 times T_{2N}					
No Load Running Torque ⁽²⁾	Nm	2	4~11	2.5	5.8	12	25	48	95
Backlash ⁽³⁾	arcmin	2	4~11	≤ 2					
Torsional Rigidity	Nm/arcmin	2	4~11	27	56	112	389	642	1,275
Nominal Input Speed n_{1N}	rpm	2	4~11	3,600	3,000	2,300	1,800	1,500	1,100
Max. Input Speed n_{1B}	rpm	2	4~11	6,000	5,500	4,500	3,500	3,000	2,200
Max. Axial Load F_{2a} ⁽⁴⁾	N	2	4~11	2,220	4,070	8,530	17,000	26,900	39,200
Max. Tilting Moment M_{2k} ⁽⁴⁾	Nm	2	4~11	280	480	1,310	3,530	5,920	9,230
Service Life ⁽⁵⁾	hr	2	4~11	20,000					
Operating Temp.	°C	2	4~11	-10° C ~ 90° C					
Degree of Gearbox Protection		2	4~11	IP65					
Lubrication		2	4~11	Synthetic lubrication grease					
Mounting Position		2	4~11	All directions					
Running Noise ⁽²⁾	dB(A)	2	4~11	≤ 68	≤ 68	≤ 70	≤ 70	≤ 72	≤ 74
Efficiency η	%	2	4~11	$\geq 95\%$					

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

(2) These values are measured by gearbox with ratio = 11 (2-stage) at 3,000 rpm without load.

(3) Backlash is measured at 2% of Nominal Output Torque T_{2N} .

(4) Applied to the output flange/curvic center at 100 rpm. The calculation formula please refer to page (3).

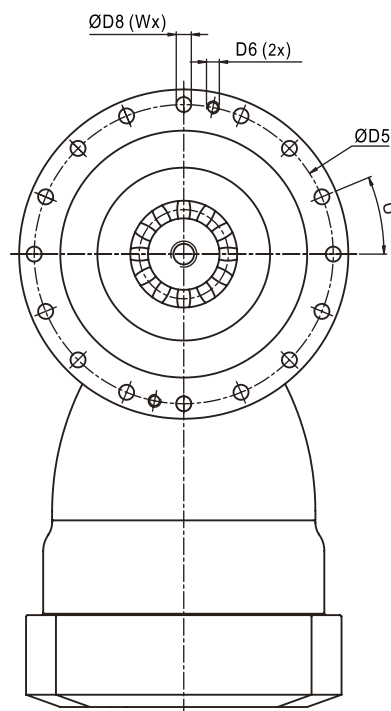
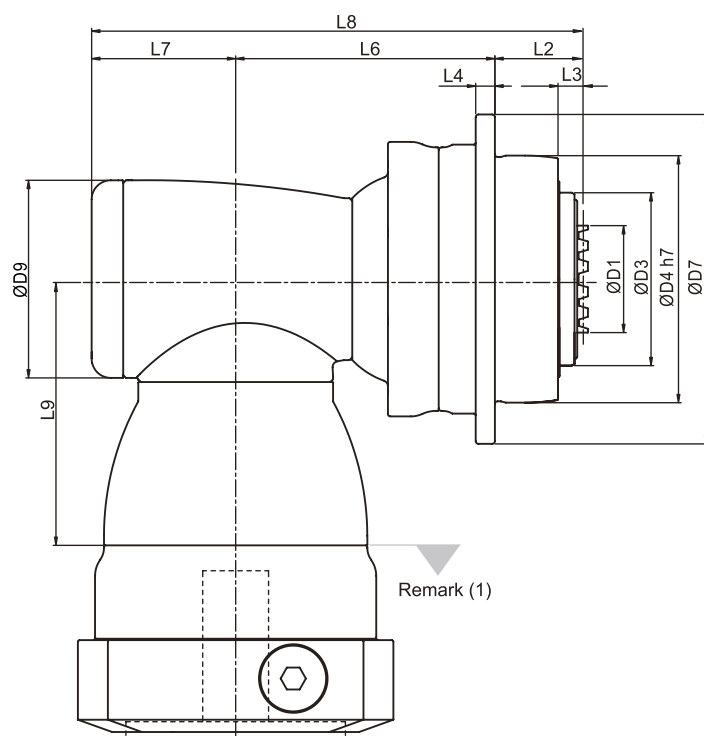
(5) Continuous operation is not recommended.

Inertia - APK / APCK (2 Stage) Gearbox (Ratio i = 4~11)

Model No.		APK/APCK 090	APK/APCK 110	APK/APCK 140	APK/APCK 200	APK/APCK 255	APK/APCK 285
$\varnothing^{(A)}$	Stage	2st	2st	2st	2st	2st	2st
11	kg.cm ²	0.41	-	-	-	-	-
14		0.41	-	-	-	-	-
19		1.61	1.61	-	-	-	-
24		3.9	4.01	5.61	-	-	-
28		-	5.53	5.61	-	-	-
32		-	7.57	8.11	-	-	-
35		-	14.95	15.32	15.32	-	-
38		-	17.58	17.72	17.72	-	-
42		-	-	22.95	22.95	23.74	-
48		-	-	52.74	52.74	53.49	55.14
55		-	-	-	-	87.34	89.59
60		-	-	-	-	-	113.06

(A) $\varnothing$ = Input shaft diameter.

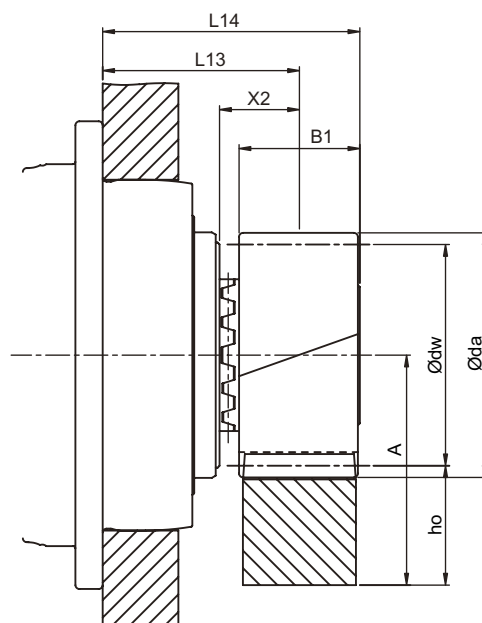
Dimension - APCK (2 Stage) Gearbox (Ratio i = 4 ~ 11)



Dimension	APCK 090	APCK 110	APCK 140	APCK 200	APCK 255	APCK 285
D1	36	46	60	80	90	120
D3	63	80	100	160	180	200
D4 h7	90	110	140	200	255	285
D5	109	135	168	233	280	310
D6	-	-	-	-	M12	M12
D7	120	147	180	249.5	302	332
D8	5.5	5.5	6.6	9	13.5	13.5
D9	92	116	156	156	195	240
L2	32.5	31.5	40.5	52.5	68.5	77.5
L3	9.5	9.5	10	11	16	19
L4	7	8	10	12	18	20
L6	100.5	124.5	175.5	185	199	265.5
L7	61.5	76	97.5	97.5	105.5	141
L8	194.5	232	313.5	335	373	484
L9	113.5	147.5	196.5	196.5	229	260
U in Degree	22.5	22.5	15	15	11.25	11.25
W	16	16	24	24	32	32

(I) Dimensions are related to motor interface. Please contact APEX for details.

Pinion with Curvic Coupling



Quality DIN4 / Alloy Steel

Tooth Thickness Tolerance : e24

Left - Hand Helical

Helical Angle $\beta = 19^\circ 31'42'' (19.5283^\circ)$

Pressure Angle $\alpha = 20^\circ$

Case - Hardened and Teeth Ground

$$A = h_o + \frac{\phi_{dw}}{2}$$

Gearbox Model	Mn	Z ⁽¹⁾	X ⁽²⁾	da ⁽³⁾	d ⁽⁴⁾	dw ⁽⁵⁾	B1	X2	L13	L14	L ⁽⁶⁾	Order Code
APC/APCK 090	3	17	0.441	62.76	54.113	56.76	31	20.5	50.5	66	170	A03L17
APC/APCK 110	3	20	0.3897	72	63.662	66	31	20.5	49.5	65	200	A03L20
APC/APCK 140	4	19	0.4102	91.92	80.639	83.92	41	25.5	63.5	84	253.335	A04L19
APC/APCK 200	5	19	0.4002	114.8	100.798	104.8	51	30.5	80.5	106	316.666	A05L19
APC/APCK 255	6	19	0.4035	137.8	120.958	125.8	61	35.5	101.5	132	380	A06L19
APC/APCK 285	8	19	0.4108	183.85	161.277	167.85	81	45.5	120.5	161	506.667	A08L19
APC/APCK 355	8	19	0.4108	183.85	161.277	167.85	81	45.5	125.5	166	506.667	A08L19
APC/APCK 450	10	18	0.4257	219.5	190.986	199.5	101	55.5	140.5	191	600	A10L18

(1) Number of teeth (2) Profile modification factor (3) Diameter of addendum circle (4) Pitch circle diameter (5) Working pitch circle diameter

(6) Pitch circle length $L = \pi \times d$

Pinion material carburized and quenched, surface hardness reached 60 HRC.

Teeth surface ground to reduce noise and improve wear resistance.

■ Table I. The max permitted torque and feed-force of rack and pinion.

Unit	Mn	Z ⁽¹⁾	dw ⁽²⁾	F _{2T} ⁽³⁾	T _{2B} ⁽⁴⁾	M
Gearbox Model	【mm】		【mm】	【N】	【Nm】	【kg】
APC/APCK 090	3	17	56.76	18,110	390	0.7
APC/APCK 110	3	20	66	18,535	590	0.92
APC/APCK 140	4	19	83.92	31,003	1,250	1.98
APC/APCK 200	5	19	104.8	48,612	2,450	3.81
APC/APCK 255	6	19	125.8	63,907	3,865	6.61
APC/APCK 285	8	19	167.85	131,265	10,585	15.49
APC/APCK 355 ⁽⁵⁾	8	19	167.85	131,761	10,625	15.49
APC/APCK 450 ⁽⁵⁾	10	18	199.5	204,308	19,510	28.13

(1) Number of teeth (2) Working pitch circle diameter (3) Maximal Feed-Force (4) Maximal Driving Torque (5) Calculated under the basis of speed 1.5 m/s

- In Table I, the max. permissible torque of the curvic plate pinion and the rack is calculated under the basis of speed 3 m/s. This condition is under providing good lubrication (using the automatic lubrication system or applied grease manually every day), the tooth root strength factor $SF \geq 1.4$, teeth surface strength coefficient $SH \geq 1$, the safety factor $SB \approx 1$ and the required service life of 20,000 hours. By higher speed, the max. permissible torque reduced. The user needs to increase the safety factor for the application. Please visit APEX website (www.apexdyna.com/) for the backlash value by different center height.

Rack with Helical Teeth

Quality 5 / Alloy Steel

Tooth Thickness Tolerance : $-15 \sim 0 \mu\text{m}$

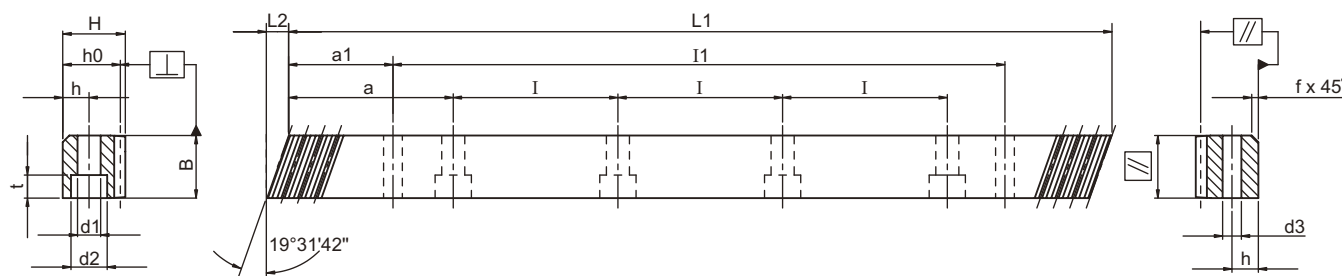
Right - Hand Helical

Helical Angle $\beta = 19^\circ 31'42'' (19.5283^\circ)$

Pressure Angle $\alpha = 20^\circ$

Material Carburized, Induction Hardened

Teeth Ground and all Sides Ground

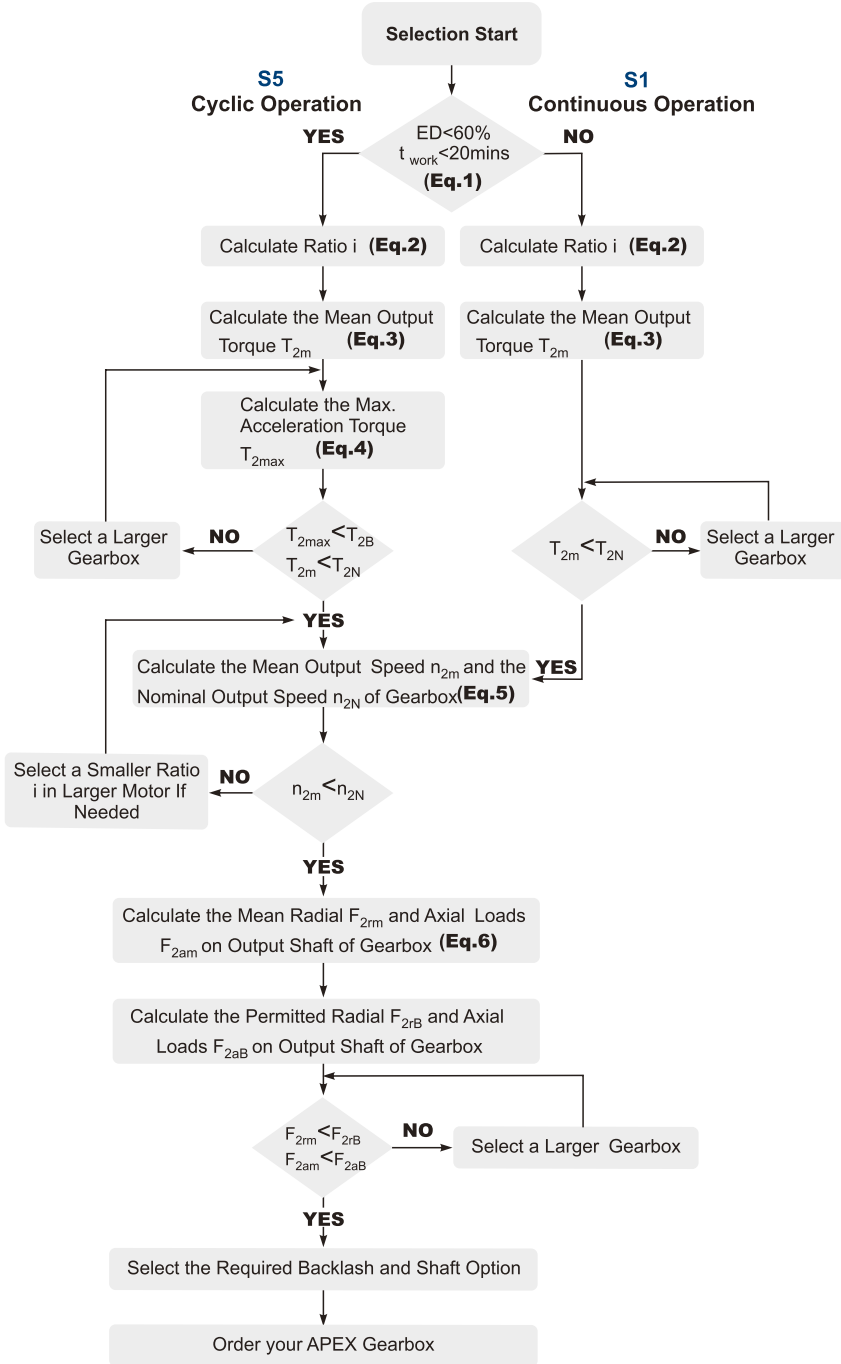


Mn	Pt ⁽¹⁾	LI	L2	Teeth No.	B	H	ho	f	a	l	Holes No.	h	d1	d2	t	a1	l1	d3	fp ⁽²⁾	Fp ⁽³⁾	Order Code
3	10.00002	500	10.3	50	29	29	26	2	62.5	125	4	9	10	15	9	35	430	7.7	0.006	0.023	0305R050M10
3	10.00002	1,000	10.3	100	29	29	26	2	62.5	125	8	9	10	15	9	35	930	7.7	0.006	0.026	0305R100M10
3	10.00002	1,250	10.3	125	29	29	26	2	62.5	125	10	9	10	15	9	35	1,180	7.7	0.006	0.026	0305R125M10
3	10.00002	1,500	10.3	150	29	29	26	2	62.5	125	12	9	10	15	9	35	1,430	7.7	0.006	0.026	0305R150M10
3	10.00002	1,750	10.3	175	29	29	26	2	62.5	125	14	9	10	15	9	35	1,680	7.7	0.006	0.026	0305R175M10
3	10.00002	2,000	10.3	200	29	29	26	2	62.5	125	16	9	10	15	9	35	1,930	7.7	0.007	0.03	0305R200M10
4	13.33335	506.67	13.8	38	39	39	35	3	62.5	125	4	12	10	15	9	33.3	433	7.7	0.007	0.025	0405R050C10
4	13.33335	1,000	13.8	75	39	39	35	3	62.5	125	8	12	10	15	9	33.3	933.4	7.7	0.007	0.028	0405R100C10
4	13.33335	1,000	13.8	75	39	39	35	3	62.5	125	8	12	14	20	13	33.3	933.4	11.7	0.007	0.028	0405R100CS0
4	13.33335	1,253.34	13.8	94	39	39	35	3	62.5	125	10	12	10	15	9	33.3	1186.7	7.7	0.007	0.028	0405R125C10
4	13.33335	1,506.67	13.8	113	39	39	35	3	62.5	125	12	12	10	15	9	33.3	1,433.4	7.7	0.007	0.028	0405R150C10
4	13.33335	1,506.67	13.8	113	39	39	35	3	62.5	125	12	12	14	20	13	33.3	1,433.4	11.7	0.007	0.028	0405R150CS0
4	13.33335	1,760	13.8	132	39	39	35	3	62.5	125	14	12	10	15	9	33.3	1,693.4	7.7	0.007	0.028	0405R175C10
4	13.33335	2,000	13.8	150	39	39	35	3	62.5	125	16	12	10	15	9	33.3	1,933.4	7.7	0.008	0.032	0405R200C10
4	13.33335	2,000	13.8	150	39	39	35	3	62.5	125	16	12	14	20	13	33.3	1,933.4	11.7	0.008	0.032	0405R200CS0
5	16.66669	1,000	17.4	60	49	39	34	3	62.5	125	8	12	14	20	13	37.5	925	11.7	0.007	0.028	0505R100C10
6	20.00003	1,000	20.9	50	59	49	43	3	62.5	125	8	16	18	26	17	37.5	925	15.7	0.007	0.028	0605R100C10
8	26.66671	960	28	36	79	79	71	3	60	120	8	25	22	33	21	120	720	19.7	0.008	0.031	0805R100C10
10	33.33339	1,000	35.1	30	99	99	89	3	62.5	125	8	32	33	48	32	125	750	19.7	0.008	0.031	1005R100C10

(1) Teeth Pitch $P_t = \text{Module} \times \pi / \cos \beta$ (2) $f_p = \text{Single Pitch Error}$ (3) $F_p = \text{Total Pitch Error}$

■ Please refer to APEX Rack & Pinion catalog for other models

Selection of the optimum gearbox



Recommended (for S5 Cycle Operation)

The general design is given for

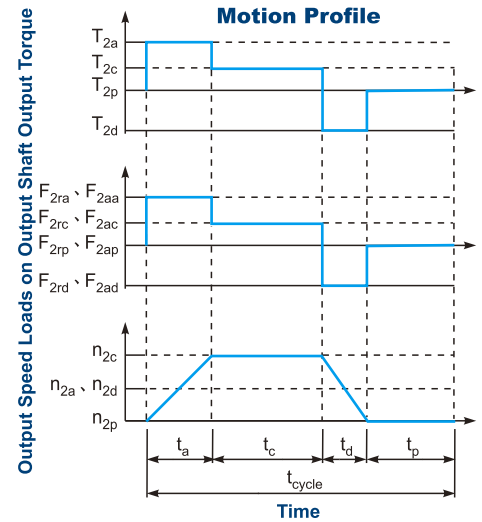
$$\frac{J_L}{i^2} \leq 4 \times J_m$$

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)

$$3. T_{2m} = 3 \sqrt{\frac{n_{2a} \times t_a \times T_{2a}^3 + n_{2c} \times t_c \times T_{2c}^3 + n_{2d} \times t_d \times T_{2d}^3}{n_{2a} \times t_a + n_{2c} \times t_c + n_{2d} \times t_d}}$$

(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)

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

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

$$n_{2N} = \frac{n_{1N}}{i}$$

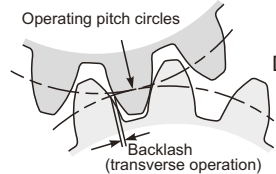
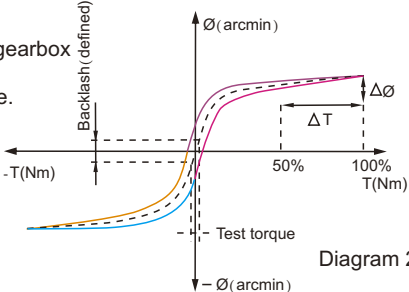
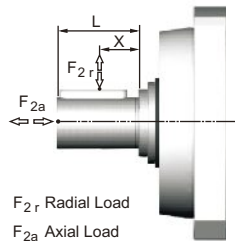
(Eq.5)

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

$$F_{2am} = 3 \sqrt{\frac{n_{2a} \times t_a \times F_{2aa}^3 + n_{2c} \times t_c \times F_{2ac}^3 + n_{2d} \times t_d \times F_{2ad}^3}{n_{2a} \times t_a + n_{2c} \times t_c + n_{2d} \times t_d}}$$

(Eq.6)

Glossary

Emergency Stop Torque T_{2NOT}	Nm	The Emergency Stop Torque is the maximum permitted torque at the output of gearbox. This may happen only occasionally and may not exceed 1,000 times during the whole service life.
Max. Acceleration Torque T_{2B}	Nm	Under the Cyclic Operation (S5), the Max. Acceleration Torque is the maximum torque which can be transmitted only briefly to the output of gearbox up to 1,000 cycles/hr.
No Load Running Torque	Nm	The No Load Running Torque is the min. torque to overcome the internal friction of a gearbox without loading*.
Nominal Input Speed n_{1N}	rpm	The Nominal Input Speed is the permitted input speed of gearbox by the Continuous Operation (S1) while the housing temperature does not exceed 90°C. This value is measured at environment temperature 25°C.
Max. Input Speed n_{1B}	rpm	The Max. Input Speed is the max. permitted input speed of gearbox by the Cyclic operation (S5). This value is measured at environment temperature 25°C and serves as the absolute limit of the gearbox.
Backlash	arcmin	The Backlash is the maximum angular measurement between two teeth of gears when the transverse operation occurs (refer to Diagram 1). The arcmin is the measurement unit for the backlash. One arcmin equals 1/ 60 degree, symbolized as 1'.  Diagram 1
Torsional Rigidity	Nm/arcmin	Torsional Rigidity is the quotient ($\Delta T / \Delta \theta$) between the applied torque and resulting torsion angle. This value indicates how much torque is needed on the gearbox to rotate the output shaft for 1 arcmin. The Torsional Rigidity can be determined by Hysteresis Curve.  Diagram 2 Hysteresis Curve When the input shaft is locked, increase torque at the output slowly up to T_{2B} in both directions and then release the torque gradually. According to the measured torque and torsion angle, a closed curve will be acquired as in the Diagram 2.
Radial Load And Axial Load	N	The permitted radial and axial loads on output shaft of the gearbox depend on the design of the gearbox supporting bearings. For more information, please refer to APEX website.  F_{2r} Radial Load F_{2a} Axial Load
Efficiency η	%	The transmission efficiency of the gears inside a gearbox (without friction).
Operating Temperature	° C	The Operating Temperature indicates the temperature of gearbox housing.
Degree of Protection		IP code stands for International Protection standard. The IP65 as example: the first IP number stands for protection degree against dust; the second IP number stands for protection against liquid.
Lubrication		APEX uses synthetic lubrication grease. Alternate greases are available, please contact APEX.
Running Noise	dB(A)	The Running Noise is measured depends on gearbox size, the ratio and the speed*. Higher speed usually induces higher noise level, while higher ratio induces lower noise level.
Moment of Inertia J_1	kg.cm ²	The Moment of Inertia J_1 is a measurement of the effort applied to an object to maintain its momentary condition at rest or rotating.
Breakaway Torque	Nm	The Breakaway Torque is the minimum torque to start the rotation from the input side of gearbox. A smaller size or a higher ratio gearbox requests less Breakaway Torque.
Back Driving Torque	Nm	The Back Driving Torque is the minimum torque to start the rotation from the output side of gearbox. A larger size or a higher ratio gearbox requires greater Back Driving Torque.

* This value is measured at environment temperature 25°C and the input speed 3,000 rpm. If the Nominal Input Speed n_{1N} of gearbox is lower than 3,000 rpm, this value is measured by that specific Nominal Input Speed.



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