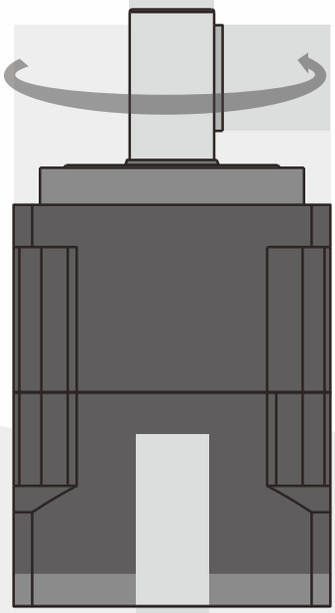
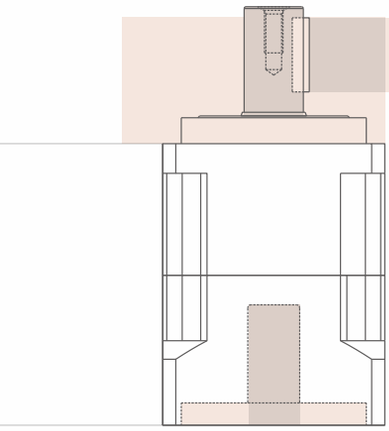
ZIPP®
GEAR

ZIPP PRECISION GEAR REDUCER

DRIVE YOU FURTHER





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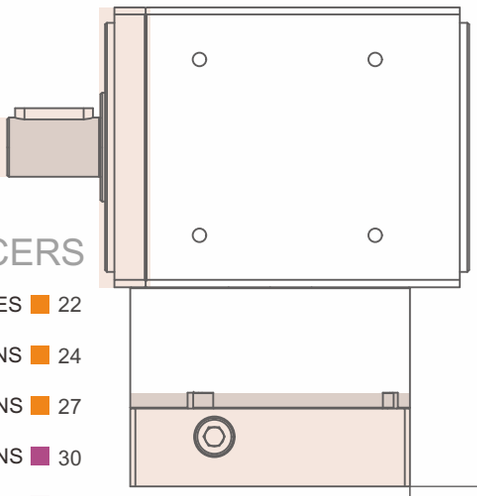
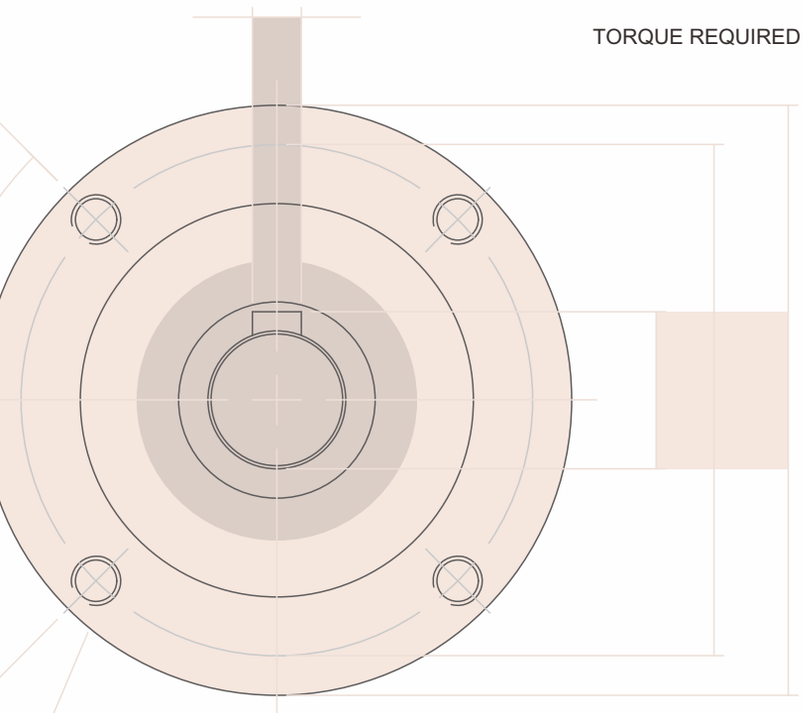
PRECISION PLANETARY GEAR REDUCERS

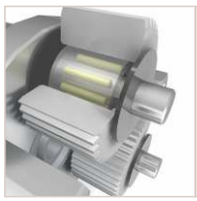


PRECISION RIGHT ANGLE GEAR REDUCERS

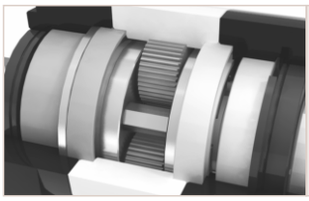


FEATURES

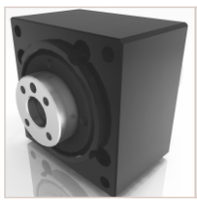
- NEMA mounting standards available for quick installation.
- Integral gear ratio available from 3:1 through 512:1 for wide range selection.
- Two types of GEAR REDUCERS with round and square output flange.
- High performance and high reduction ratio for transferring high torques in limited space.
- Precision gears to raise transmission efficiency above 96%.
- Hardened high strength steel components for reliability under severe environmental conditions.
- All grease-filled, the gear head can be used in any orientation without oil leaks.
- Available for wide range applications of automation and motion control in industries such as aerospace, medical, pharmaceutical, factory automation, printing, robotics, auto control system, automotive, textile equipment, semiconductor, manufacturing equipment, X-Y positioning systems, coordinate measuring, optical positioning equipment, telecommunications, packaging, material handling, assembly line, CCTV system, machine tools and special machinery etc.



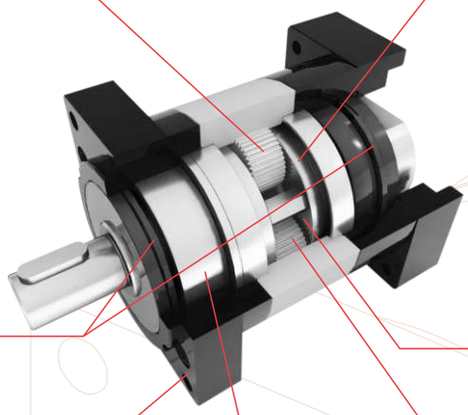
Needle bearings for high output torque.

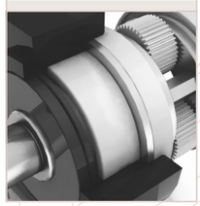


All grease filled and double seal design to eliminate leakage in any orientation.



Versatile output design.



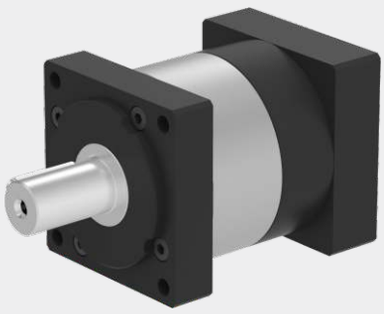


Larger bearings for increased loading.

Closed planet cage provides extremely high rigidity.

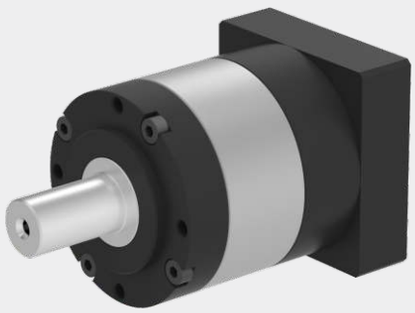
Planet gear train provides compact size yet high transmission efficiency.

Alloy steel made gears with carburized heat treatment for superior wear resistance and strength.



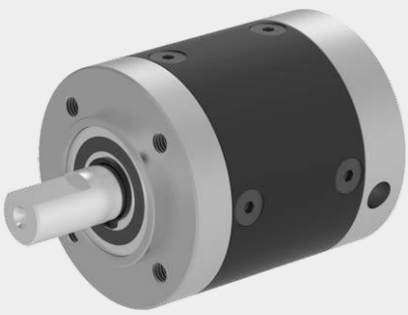
PS FEATURES

Precision performance square flange gearbox with two piece adaptor flange for flexible mounting options and optimized stock management. The semi-closed planet carrier design provides maximum radial load capacity and increase gear train reliability and stiffness. Four frame sizes are available with gear ratios from 1:3 to 1:100.



PN FEATURES

Precision performance round flange gearbox with two piece adaptor flange for flexible mounting options and optimized stock management. The semi-closed planet carrier design provides maximum radial load capacity and increased gear train reliability and stiffness. Four frame sizes are available with gear ratios from 1:3 to 1:100.



EL FEATURES

Why pay the cost for a heavy-duty gearbox for a light-duty application when our highly customizable economy line can give you what you need at the price that meets your target.

The economy line gear reducer with built for purpose engineering ensures that you don't over pay for features that are not required. Frame sizes are available from 30mm, 32mm, 36mm, 42mm, 52mm, 60mm and 90mm in various of ratio combinations.

Other frame sizes and dimensions can be customized according to the actual requirement.

PS/PN

TECHNICAL DATA

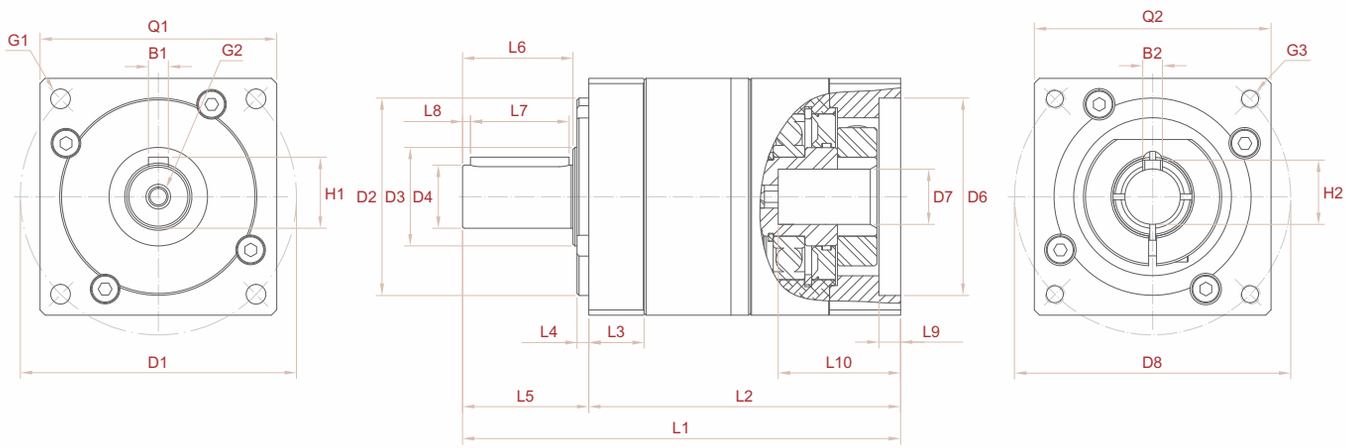
- Low noise
- Compact size and optimized weight
- Economic value with quality
- Optimized inertia moment
- Stable temperature rise
- High efficiency transmission
- Optimized design with special lubricant for long service life
- Flexible mounting dimensions

Model / Size		Stages	42 (NEMA 17)	60 (NEMA 23)	90 (NEMA 34)
Full load efficiency	%	1		96	
		2		92	
Standard Backlash	arcmin	1	<14	<13	<12
		2	<17	<16	<15
Precision Backlash	arcmin	1	<8	<7	<6
		2	<10	<9	<8
Noise	dB(A)		58	62	64
Lifetime	hr			20000	
Max radial load	N		810	1150	2080
Max axial load	N		405	575	1040
Nominal Input Speed	rpm	1,2	4500	4000	3600
Max input speed	rpm		9000	8000	7000
Torsional stiffness	Nm/arcmin		0.9	2.2	8
Weight	kg	1	0.5	1.2	3.2
		2	0.9	1.6	4.5
Operating temp.	℃			-20 ~ 90	
Degree of protection				IP 65	
Lubrication				Life lubrication	
Mounting direction				Any	

Model / Size		Stages	Ratio	42	60	90
Nominal output torque	Nm	1	3	13	34	102
			4	16	48	138
			5	15	46	130
			7	10	30	90
			9	7	22	80
			10	6	17	60
		2	12	13	34	102
			15	13	34	102
			16	16	48	138
			20	16	48	138
			25	15	46	130
			30	13	34	102
			40	16	48	138
			50	15	46	130
			70	10	30	90
			100	6	17	60
MAX Output torque		2.5 times of Nominal output torque				

Model / Size		Stages	Ratio	42	60	90
Mass Moments of Inertia	g-cm^2	1	3	21	140	800
			4,5	18	90	500
			7,9,10	17	60	400
		2	12,15,21,30	23	120	750
			20,28,40	20	80	450
			25,35,50	16	70	400
			49,70,100	20	80	450

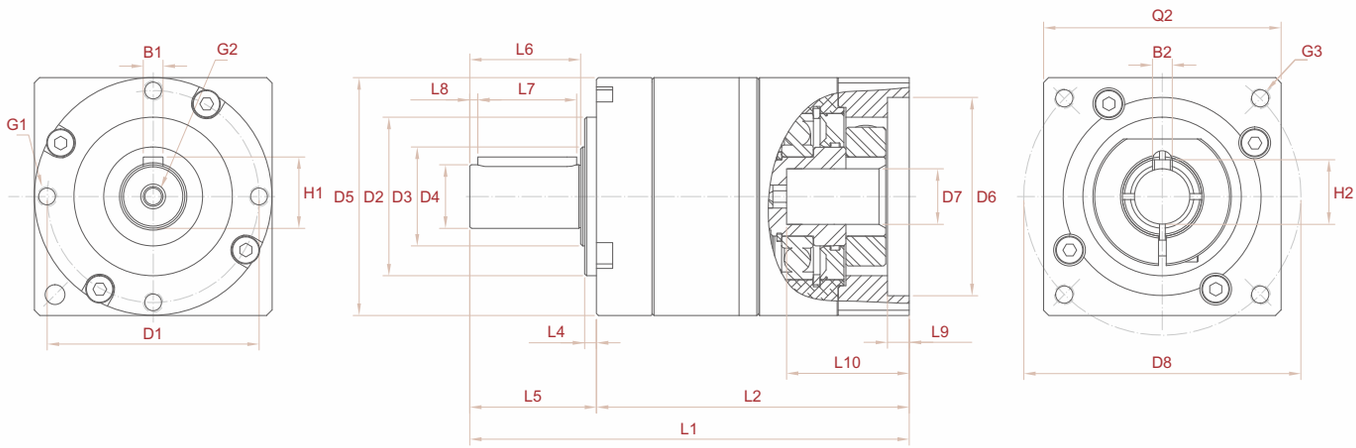
PS PROFILE DIMENSIONS



Model / Size			PS42	PS60	PS90
Overall length	1	L1	90	111	144
	2		113.5	138	178.5
	3		137	165	213
Body length	1	L2	64	79	103
	2		87.5	106	137.5
	3		111	133	172
Output flange		Q1	□42	□60	□90
Input flange		Q2	□42	□60	□90
Output					
Flange thickness		L3	9.5	14	20
Pilot length		L4	2.5	3	3
Output shaft length		L5	26	32	41
Shaft shoulder to the shaft end		L6	22.5	28	37
Key length		L7	18	25	30
Key length to the shaft end		L8	2	2	2.5
Mounting hole circle		D1	Ø50	Ø70	Ø100
Pilot diameter		D2	Ø35 g6	Ø50 g6	Ø80 g6
Shaft shoulder diameter		D3	Ø15	Ø20	Ø35
Output shaft diameter		D4	Ø13 h7	Ø16 h7	Ø22 h7
Key width		B1	5	5	6
Key Height		H1	15	18	24.5
Mounting hole		G1	Ø4.2	Ø5.2	Ø6.8
Center screw hole x depth		G2	M4 x 10	M5 x 12	M6 x 16
Input					
Pilot depth		L9	3	5.5	5.5
Motor shaft length		L10	25	30	40
Pilot diameter		D6	Ø30 G7 / Ø22 G7	Ø50 G7 / Ø38.1 G7	Ø70 G7
Input shaft diameter		D7	Ø8 / Ø5	Ø14 / Ø6.35	Ø19
Mounting hole circle		D8	Ø46 / Ø43.84(□31)	Ø70 / Ø66.67(□47.14)	Ø90
Mounting thread x depth		G3	M4 x 10 / Ø3.3	M5 x 12 / M4 x 10	M6 x 12
Key width		B2	3 / —	5 / —	6
Key Height		H2	9.4 / —	16.3 / —	21.8

PN

PROFILE DIMENSIONS



Model / Size			PN42	PN60	PN90
Overall length	1	L1	90	111	144
	2		113.5	138	178.5
	3		137	165	213
Body length	1	L2	64	79	103
	2		87.5	106	137.5
	3		111	133	172
Output flange		D5	Ø42	Ø60	Ø90
Input flange		Q2	□42	□60	□90
Output					
Pilot length		L4	2.5	3	3
Output shaft length		L5	26	32	41
Shaft shoulder to the shaft end		L6	22.5	28	37
Key length		L7	18	25	30
Key length to the shaft end		L8	2	2	2.5
Mounting hole circle		D1	Ø37	Ø53.5	Ø80
Pilot diameter		D2	Ø26 g6	Ø40 g6	Ø60 g6
Shaft shoulder diameter		D3	Ø15	Ø20	Ø35
Output shaft diameter		D4	Ø13 h7	Ø16 h7	Ø22 h7
Key width		B1	5	5	6
Key Height		H1	15	18	24.5
Mounting hole		G1	M4 x 10	M5 x 11	M6 x 15
Center screw hole x depth		G2	M4 x 10	M5 x 12	M6 x 16
Input					
Pilot depth		L9	3	5.5	5.5
Motor shaft length		L10	25	30	40
Pilot diameter		D6	Ø30 G7 / Ø22 G7	Ø50 G7 / Ø38.1 G7	Ø70 G7
Input shaft diameter		D7	Ø8 / Ø5	Ø14 / Ø6.35	Ø19
Mounting hole circle		D8	Ø46 / Ø43.84(□31)	Ø70 / Ø66.67(□47.14)	Ø90
Mounting thread x depth		G3	M4 x 10 / Ø3.3	M5 x 12 / M4 x 10	M6 x 12
Key width		B2	3 / —	5 / —	6
Key Height		H2	9.4 / —	16.3 / —	21.8

EL TECHNICAL DATA

- Low cost
- Compact size
- Customizable
- Stable temperature rise
- Efficient transmission
- Optimized design with special lubricant for long service life
- Flexible mounting dimensions

Model / Size		Stages	32	42	52	60	90
Full load efficiency	%	1	80	95			
		2	70	90			
Noise	dB(A)		54	58	60	60	65
Lifetime	hr		N/A	20000			
Max radial load	N		100	150	300	400	700
Max axial load	N		50	75	150	200	350
Max input speed	rpm		8000	8000	7000	7000	6000
Weight	kg	1	0.153	0.42	0.652	1.115	2.164
		2	0.18	0.47	0.75	1.22	3.2
Operating temp.	℃		-20 ~ 90				
Degree of protection			IP 54				
Lubrication			Life lubrication				
Mounting direction			Any				

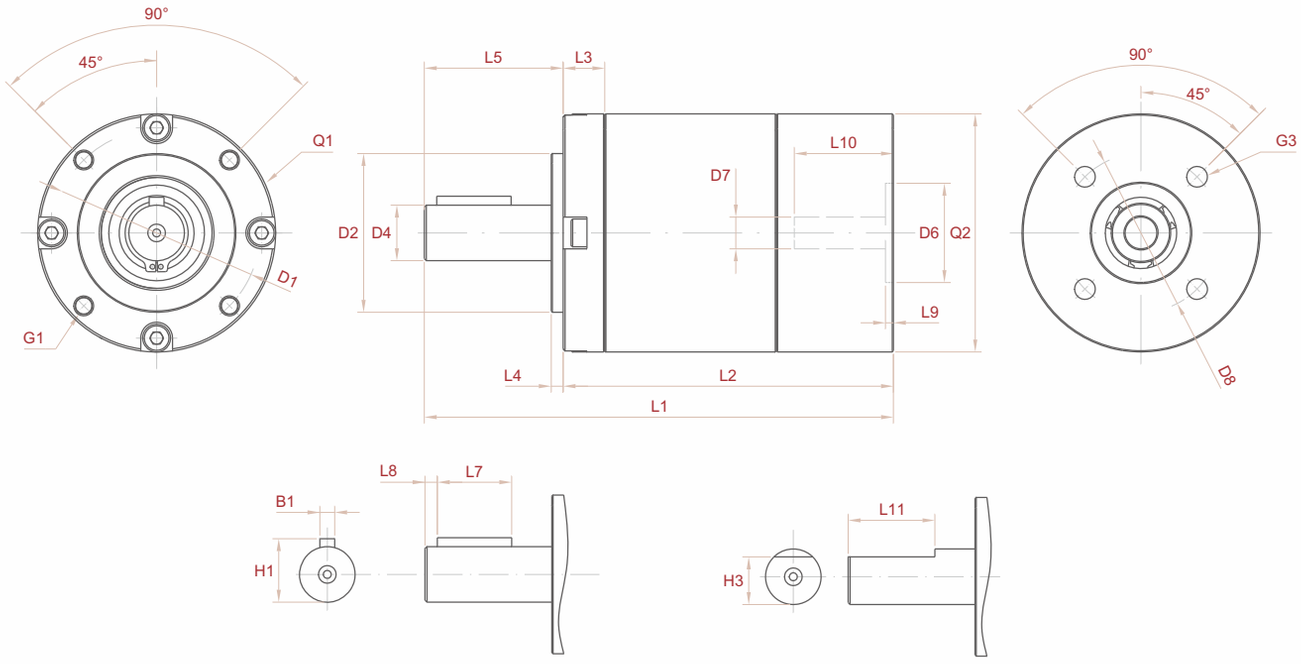
Model / Size		Stages	Ratio	32	Ratio	42	52	60	90
Nominal output torque	Nm	1	3.6	1.3	3	8	17	19	52
			4.5		4	9	18	21	60
			6.25		5	9	18	21	60
			8		7	5.5	13	13	45
					9	5	10	10	40
					10	5	10	10	40
		2	16.2	1.3	12	8	17	19	52
			22.5		15	8	17	19	52
			28.8		16	9	18	21	60
			28.125		20	9	18	21	60
			36		25	9	18	21	60
			50		30	8	17	19	52
					40	9	18	21	60
					50	9	18	21	60
					70	5.5	13	13	45
					100	5	10	10	40
MAX Output torque		2 times of Nominal output torque							

- 32: All available single stage ratios

Model / Size		Stages	Ratio	42	60	90
Mass Moments of Inertia	$g\text{-}cm^2$	1	3	21	140	800
			4,5	18	90	500
			7,9,10	17	60	400
		2	12,15,21,30	23	120	750
			20,28,40	20	80	450
			25,35,50	16	70	400
			49,70,100	20	80	450

EL

PROFILE DIMENSIONS



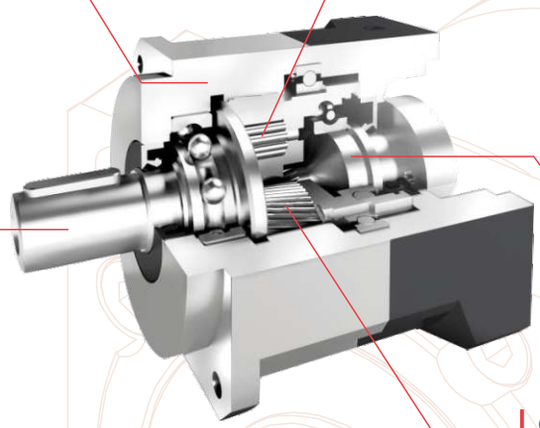
Model / Size			EL32	EL42	EL52	EL60	EL90
Overall length	1	L1	54.9	84	89	106.6	122.5
	2		65.4	99.3	103.5	123.4	144
	3		75.9	114.6	118	140.2	165.5
Body length	1	L2	35.6	62	64	71.6	77.5
	2		46.1	77.3	78.5	88.4	99
	3		56.6	92.6	93	105.2	120.5
Output flange		Q1	Ø32	Ø42	Ø52	Ø60	Ø90
Input flange		Q2	Ø32	Ø42	Ø52	Ø60	Ø90
Output							
flange thickness		L3	5.5	5	9.7	10.5	13.3
Pilot length		L4	3	2	3	3	5
Output shaft length		L5	19.3	22	25	35	45
Key length		L7	—	18	25	30	40
Key length to the shaft end		L8	—	2	2	2	2.5
Flat end length		L11	12	—	—	—	—
Mounting hole circle		D1	26	34	40	52	72
Pilot diameter		D2	20	26	32	40	55
Output shaft diameter		D4	6	8	12	14	19
Key width		B1	—	3	4	5	6
Key Height		H1	—	11.2	13.5	16	22.5
Flat end height		H3	5.5	—	—	—	—
mounting thread		G1	M3	M4	M5	M5	M6
Input							
Pilot depth		L9	2	3	3	3.6	3.5
Motor shaft length		L10	15.6	24	24	31.5	41
Pilot diameter		D6	12.7	22	25	50	50
Input shaft diameter		D7	4	5	8	9	12.7
Mounting hole circle		D8	25.4	32	38.89	50	65
Mounting thread		G3	3.2	3.2	4.2	5.2	6.2

FEATURES

- Low noise
- Compact size and optimized weight
- Precision gearing
- Optimized inertia moment
- Stable temperature rise
- High efficiency transmission
- Optimized design with special lubricant for long service life
- Flexible mounting dimensions

One piece and heat treated unibody designed housing for high output torque capability, longer lifespan and maintain stable precision performance.

Planet gears with full complement needle bearing provide highest structural rigidity and lifespan of the gear reducer.



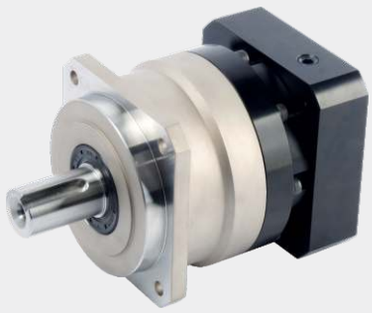
One piece pinion coupler design for maximum transmission efficiency and torsional stiffness

Output shaft with oversized and large-span bearing design that ensures the highest precision and torsional stiffness.

Gears made from high strength alloy steel and vacuum carburized to 58 - 62 HRC, then are skived to ensure high precision gear profile and impact resistance.

ZS FEATURES

High output torque solid one piece square housing that provides performance and efficiency with torque and sturdiness. The helical toothed and one piece carrier design provides maximum radial load capacity as well as system reliability and stiffness. Four frame sizes are available with gear ratios from 1:3 to 1:100.



ZN FEATURES

High output torque solid one piece round housing that provides performance and efficiency with torque and sturdiness. The helical toothed and one piece carrier design provides maximum radial load capacity as well as system reliability and stiffness. Four frame sizes are available with gear ratios from 1:3 to 1:100.

ZE FEATURES

Offers low-cost precision one piece housing gear reducer combined many of the features and benefits that's upgraded from our PS / PN series with the ability to serve as an easy drop-in replacement from spur to helical toothed gear reducers. The ZE Series provides a cost-effective solution for many applications. Four frame sizes are available with gear ratios from 1:3 to 1:100.

ZF FEATURES

Flexible mounting diameter and high output torque solid round housing that provides performance and efficiency with torque and sturdiness. The helical toothed and one piece carrier design provides maximum radial load capacity as well as system reliability and stiffness. The flange type output shaft is targeted for application in Robotics, Automation and Offshore. Four frame sizes are available with gear ratios from 1:4 to 1:100.

ZS/ZN

TECHNICAL DATA

Model / Size		Stages	60	90	120	140
Full load efficiency	%	1	≥95			
		2	≥92			
Standard Backlash	arcmin	1	≤5	≤5	≤5	≤5
		2	≤8	≤8	≤8	≤8
Precision Backlash	arcmin	1	≤3	≤3	≤3	≤3
		2	≤5	≤5	≤5	≤5
Noise ②	dB(A)		≤60	≤60	≤65	≤67
Lifetime ①	hr		20000			
Max radial load	N		1530	3250	6700	9400
Max axial load	N		630	1300	3000	4700
Nominal Input Speed	rpm		5000	4000	4000	3000
Max input speed	rpm		10000	8000	8000	6000
Torsional stiffness	Nm/arcmin		7	14	25	50
Weight	kg	1	1.35	4.25	9.15	14.6
		2	1.7	7	13	19.2
Operating temp.	℃		-20 ~ 90			
Degree of protection			IP 65			
Lubrication			Synthetic lubrication			
Mounting direction			Any			

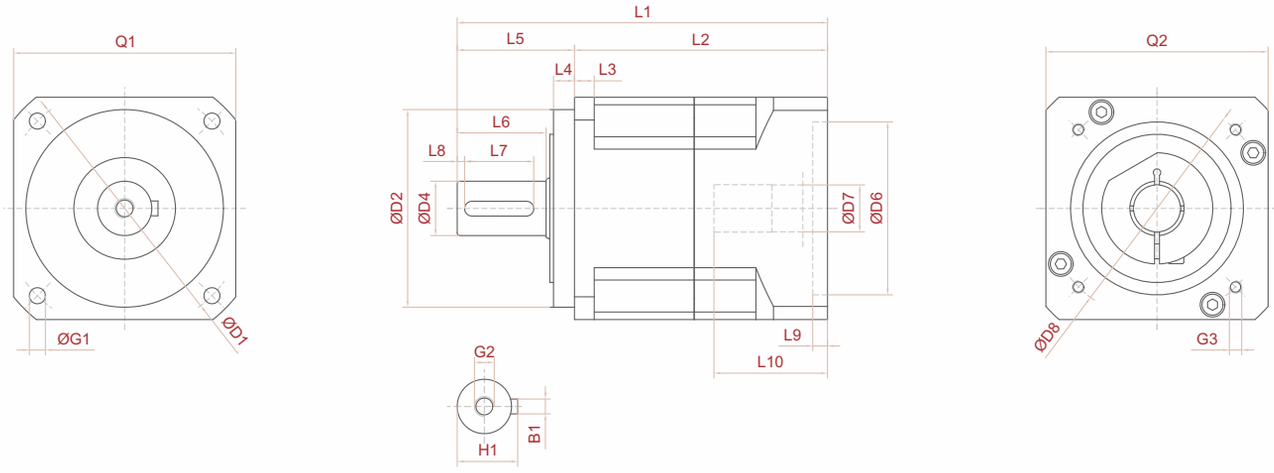
① Life reduced by half under continuous operation.
② Noise level measured on input running at 3000 rpm with no load (i = 5)

Model / Size		Stages	Ratio	60	90	120	140
Nominal output torque	Nm	1	3	55	130	208	342
			4	50	140	290	542
			5	60	160	330	650
			7	50	140	300	550
			10	40	100	230	450
		2	15	55	130	208	342
			20	50	140	290	542
			25	60	160	330	650
			30	55	150	310	600
			35	50	140	300	550
			40	50	140	290	542
			50	60	160	330	650
			70	50	140	300	550
			100	40	100	230	450
MAX Output torque		2.5 times of Nominal Output Torque					

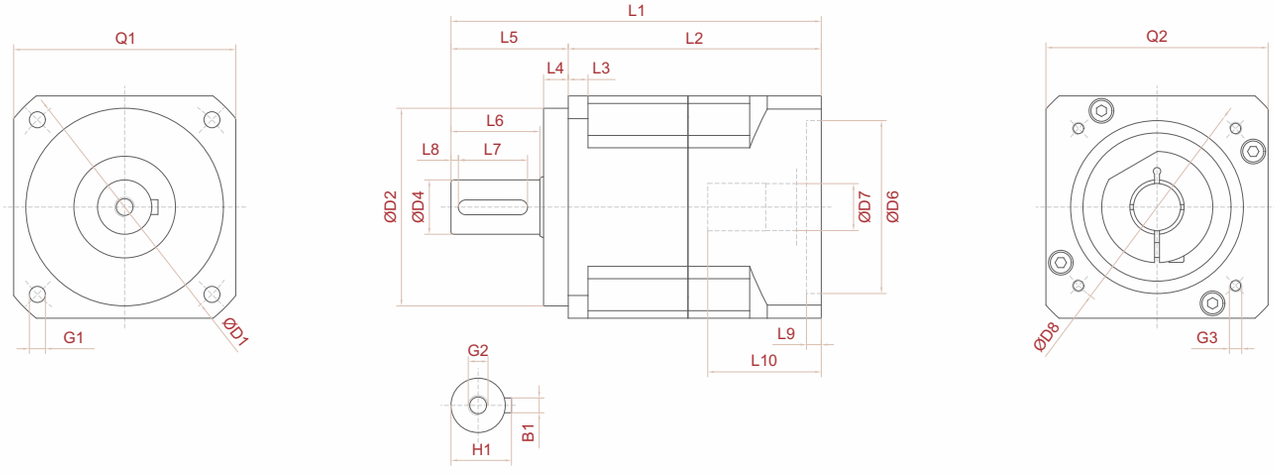
Model / Size		Stages	Ratio	60	90	120	140
Mass Moments of Inertia	Kg-cm^2	1	3	0.16	0.61	3.25	9.21
			4	0.14	0.48	2.74	7.54
			5	0.13	0.47	2.71	7.42
			7	0.13	0.45	2.62	7.14
			10	0.13	0.44	2.57	7.03
		2	15,20,25	0.13	0.47	2.71	7.42
			35	0.13	0.45	2.57	7.14
			30,40,50	0.13	0.44	2.62	7.03
			70,100	0.13	0.13	0.44	2.57

ZS PROFILE DIMENSIONS

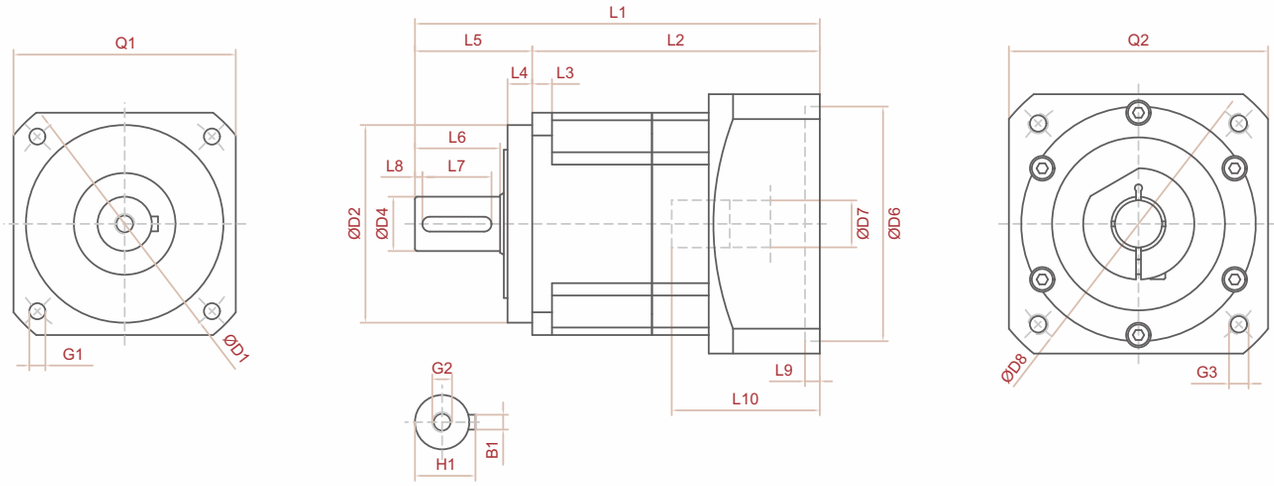
ZS60



ZS90

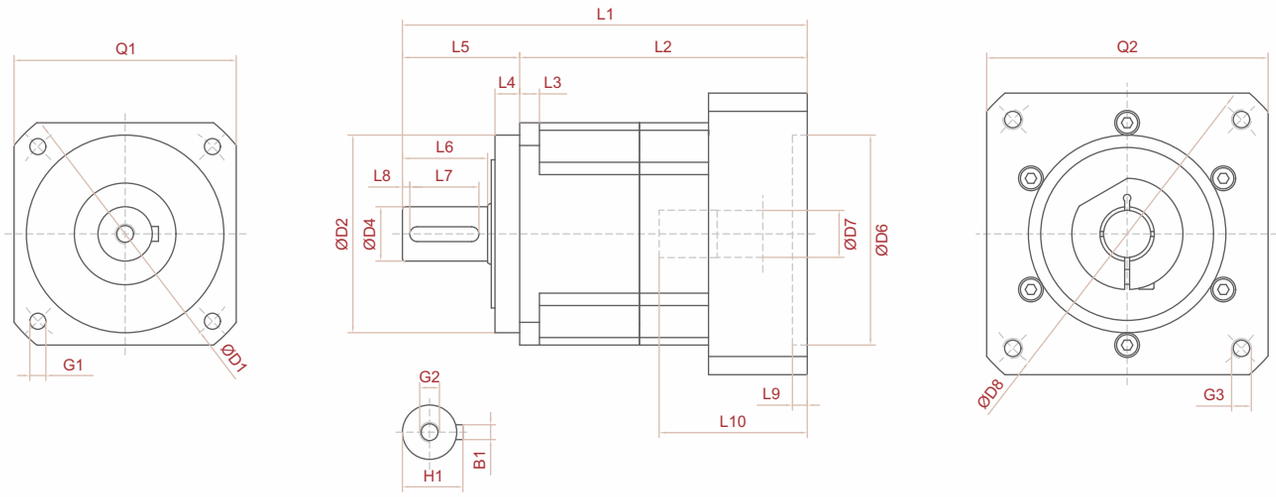


ZS120



ZS PROFILE DIMENSIONS

ZS140

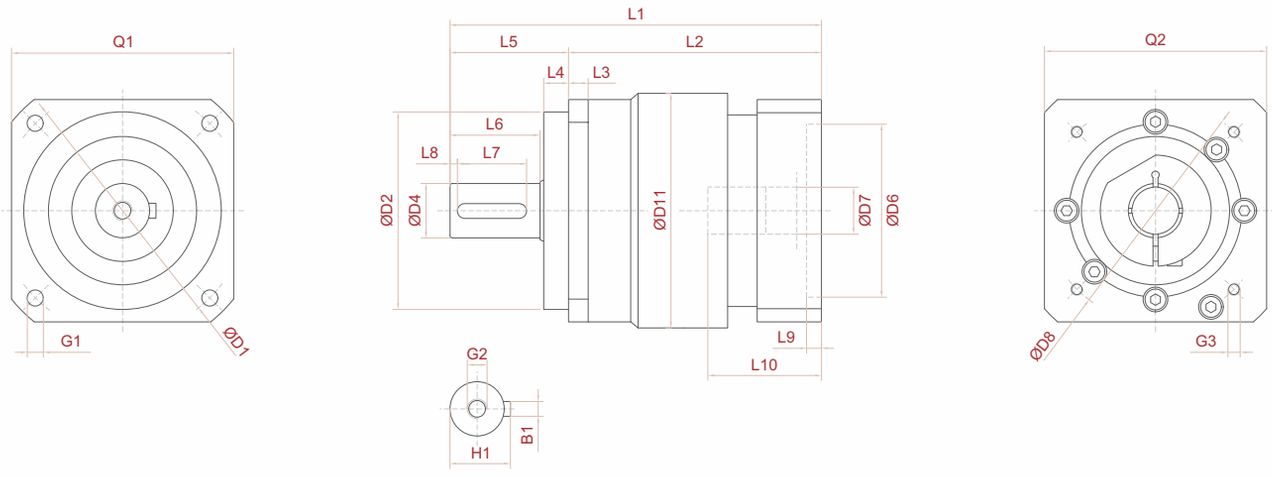


Model / Size	Stages		ZS60	ZS90	ZS120	ZS140
Overall length	1	L1	123	150.5	201.5	263.5
	2		151	187	231	330
Body length	1	L2	86	102.5	136.5	166.5
	2		114	139	166	233
Output flange		Q1	□60	□90	□115	□140
Input flange		Q2	□60	□90	□130	□180
Output						
Length from flange		L3	8.5	8	10	12
Pilot length		L4	7	10	12	12
Output shaft length		L5	37	48	65	97
shaft shoulder to the shaft end		L6	28.5	36.5	51	82
Flat end length / Key length		L7	20	30	40	65
Key length to the shaft end		L8	3	3	5	5
Mounting hole circle		D1	Ø70	Ø100	Ø130	Ø165
Pilot diameter		D2	Ø50 g6	Ø80 g6	Ø110 g6	Ø130 g6
Output shaft diameter		D4	Ø16 g6	Ø22 g6	Ø32 g6	Ø40 g6
Key width		B1	5	6	10	12
Flat end height / Key Height		H1	18	24.5	35	43
mounting thread x depth		G1	4-Ø5.5	4-Ø6.5	4-Ø9	4-Ø11
center screw hole x depth		G2	M5x12	M8	M12	M16
Input						
Pilot depth		L9	6	6	8	8
motor shaft length		L10	32	44	68	81
Pilot diameter		D6	Ø50 G6	Ø70 G6	Ø110 G6	Ø114.3 G6
Input shaft diameter		D7	Ø14 G6	Ø19 G6	Ø24 G6	Ø35 G6
Mounting hole circle		D8	Ø70	Ø90	Ø145	Ø200
mounting thread x depth		G3	4-M4	4-M5	4-M8	4-M12

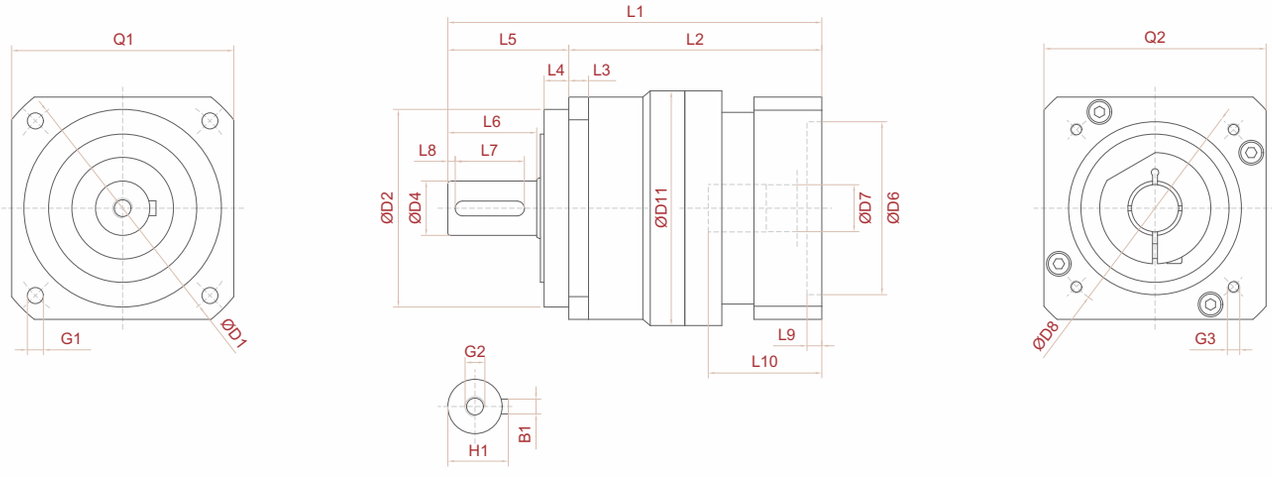
ZN

PROFILE DIMENSIONS

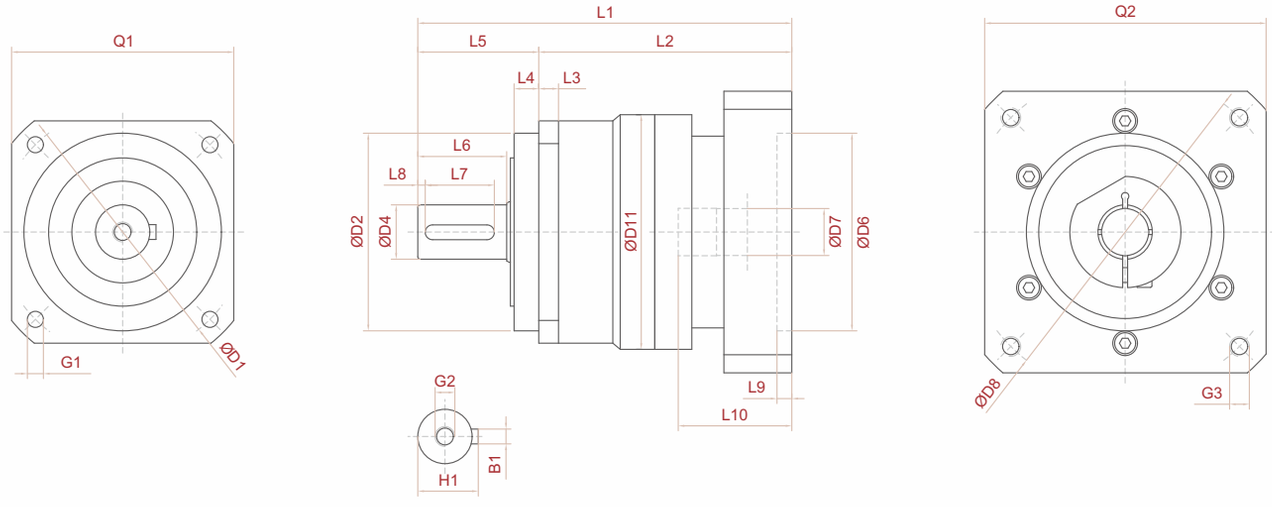
ZN60



ZN90



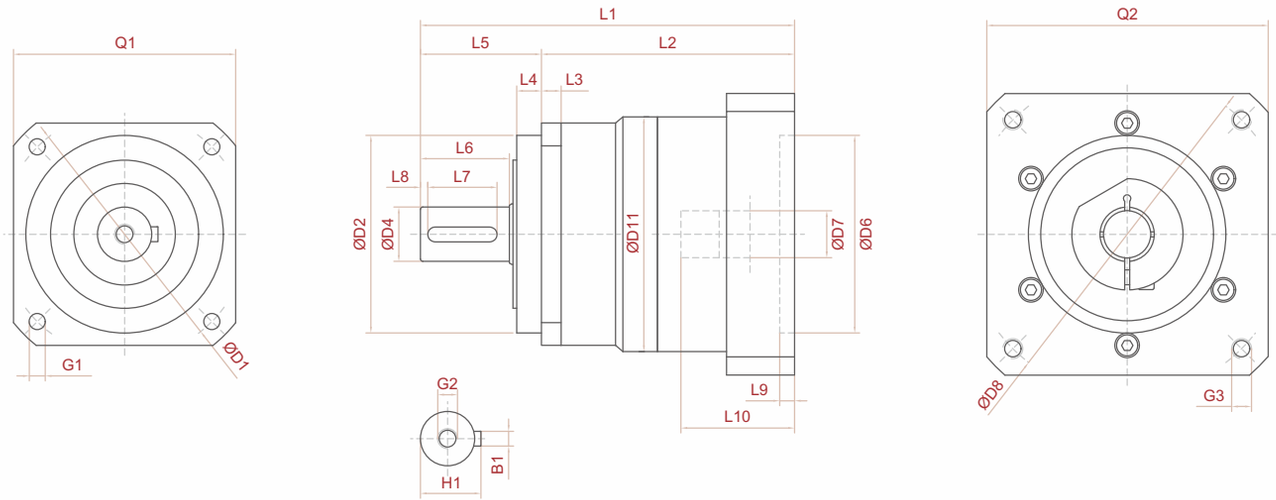
ZN120



ZN

PROFILE DIMENSIONS

ZN140



Model / Size	Stages		ZN60	ZN90	ZN120	ZN140
Overall length	1	L1	123	160	201.5	263
	2		151	195	231	330
Body length	1	L2	85.5	112	136.5	166.5
	2		113.5	147	166	233
Output flange		Q1	□60	□90	□115	□140
Input flange		Q2	□60	□90	□130	□180
Output						
Length from flange		L3	8	10	10	12
Pilot length		L4	7.5	10	12	12
Output shaft length		L5	37.5	48	65	97
shaft shoulder to the shaft end		L6	28.5	36.5	51	82
Flat end length / Key length		L7	20	30	40	65
Key length to the shaft end		L8	3	3	5	5
Mounting hole circle		D1	Ø70	Ø100	Ø130	Ø165
Pilot diameter		D2	Ø50 g6	Ø80 g6	Ø110 g6	Ø130 g6
Output shaft diameter		D4	Ø16 g6	Ø22 g6	Ø32 g6	Ø40 g6
Housing diameter		D11	Ø65	Ø95	Ø125	Ø150
Key width		B1	5	6	10	12
Flat end height / Key Height		H1	18	24.5	35	43
mounting thread x depth		G1	4-Ø5.5	4-Ø6.5	4-Ø9	4-Ø11
center screw hole x depth		G2	M5x12	M8	M12	M16
Input						
Pilot depth		L9	5.5	6	8	8
motor shaft length		L10	32.5	47.5	62.5	81.5
Pilot diameter		D6	Ø50 G6	Ø70 G6	Ø110 G6	Ø114.3 G6
Input shaft diameter		D7	Ø14 G6	Ø19 G6	Ø22 G6	Ø35 G6
Mounting hole circle		D8	Ø70	Ø90	Ø145	Ø200
mounting thread x depth		G3	4-M4	4-M5	4-M8	4-M12

ZE TECHNICAL DATA

Model / Size		Stages	60	90	120	140
Full load efficiency	%	1	≥95			
		2	≥92			
Standard Backlash	arcmin	1	≤5	≤5	≤5	≤5
		2	≤8	≤8	≤8	≤8
Precision Backlash	arcmin	1	≤3	≤3	≤3	≤3
		2	≤5	≤5	≤5	≤5
Noise ②	dB(A)		≤60	≤60	≤65	≤67
Lifetime ①	hr		20000			
Max radial load	N		1300	2800	5200	9400
Max axial load	N		550	1000	2300	4700
Nominal Input Speed	rpm		5000	4000	4000	3000
Max input speed	rpm		10000	8000	8000	6000
Torsional stiffness	Nm/arcmin		5	11	18	50
Weight	kg	1	1.35	4.25	9.15	14.6
		2	1.7	7	13	19.2
Operating temp.	℃		-20 ~ 90			
Degree of protection			IP 65			
Lubrication			Synthetic lubrication			
Mounting direction			Any			

① Life reduced by half under continuous operation.
② Noise level measured on input running at 3000 rpm with no load (i = 5)

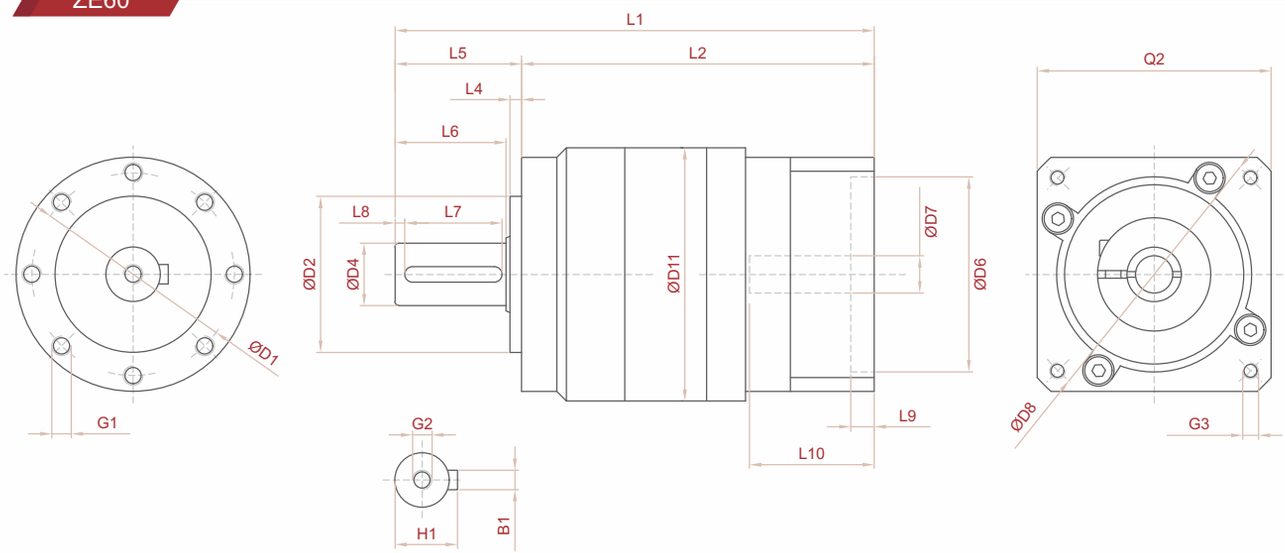
Model / Size		Stages	Ratio	60	90	120	140
Nominal output torque	Nm	1	3	35	100	170	342
			4	40	110	220	542
			5	45	125	250	650
			7	40	110	200	550
			10	30	80	180	450
		2	15	35	100	170	342
			20	45	110	220	542
			25	45	125	250	650
			30	40	110	220	600
			35	40	125	200	550
			40	40	110	220	542
			50	45	125	250	650
			70	40	110	200	550
			100	30	80	180	450
MAX Output torque		2.5 times of Nominal Output Torque					

Model / Size		Stages	Ratio	60	90	120	140
Mass Moments of Inertia	Kg-cm^2	1	3	0.16	0.61	3.25	9.21
			4	0.14	0.48	2.74	7.54
			5	0.13	0.47	2.71	7.42
			7	0.13	0.45	2.62	7.14
			10	0.13	0.44	2.57	7.03
		2	15,20,25	0.13	0.47	2.71	7.42
			35	0.13	0.45	2.57	7.14
			30,40,50	0.13	0.44	2.62	7.03
			70,100	0.13	0.13	0.44	2.57

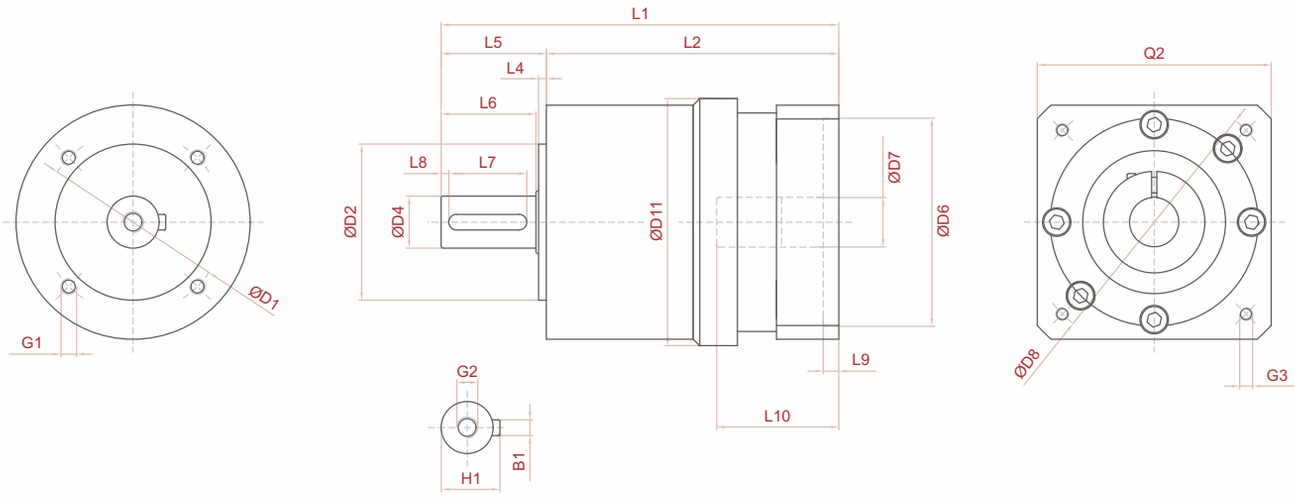
ZE

PROFILE DIMENSIONS

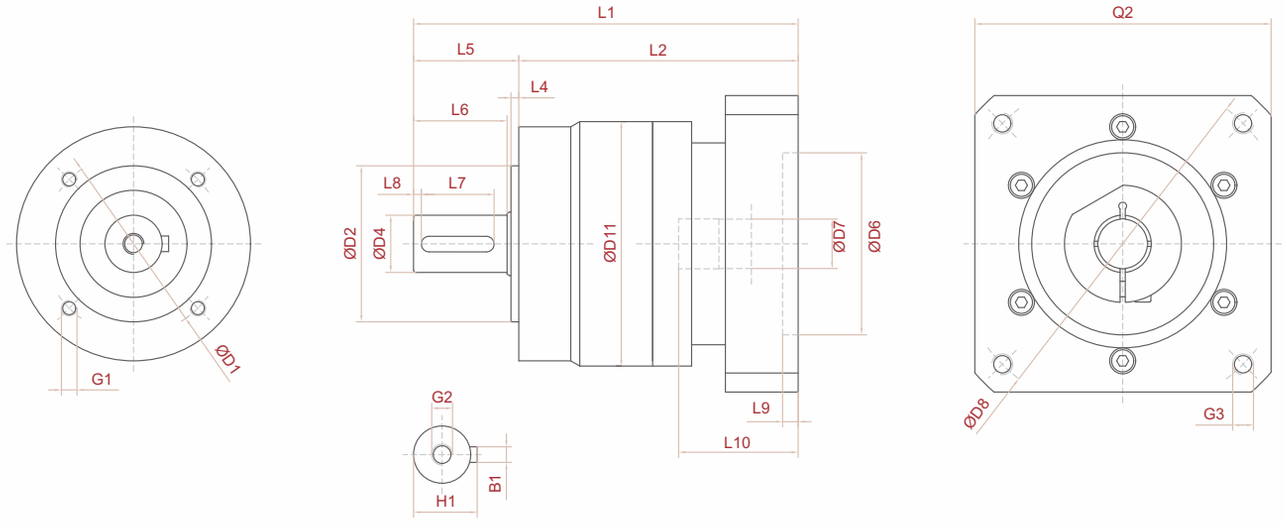
ZE60



ZE90



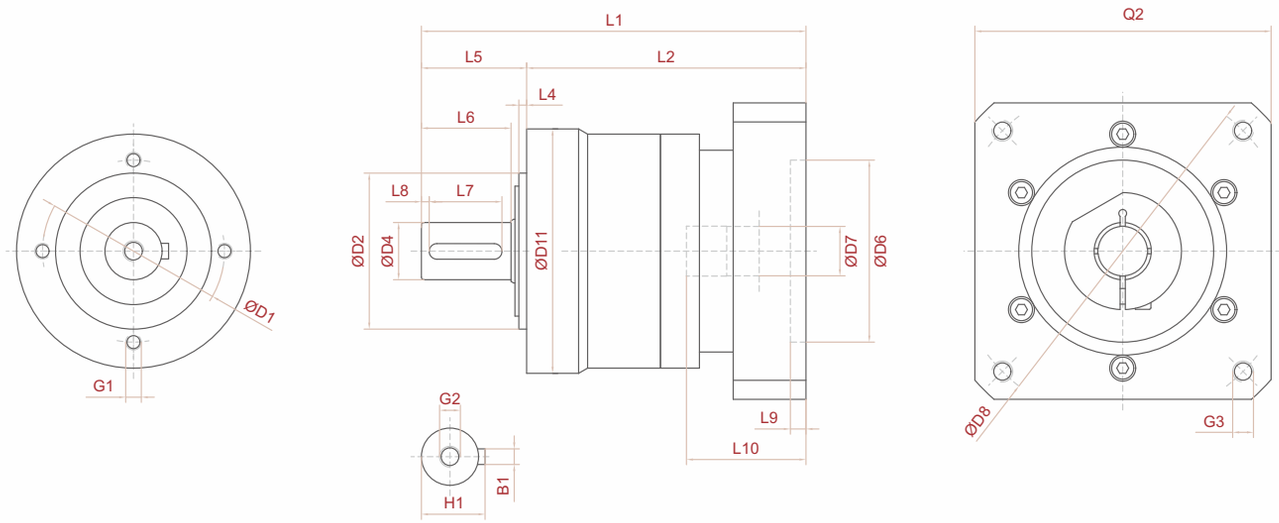
ZE120



ZE

PROFILE DIMENSIONS

ZE140



Model / Size	Stages		ZE60	ZE90	ZE120	ZE140
Overall length	1	L1	123	146.5	191.5	262
	2		151	183	234	330
Body length	1	L2	90.5	105.5	136.5	166.5
	2		118.5	142	179	233
Input flange		Q2	□60	□90	□130	□180
Output						
Pilot length		L4	3	3	4	12
Output shaft length		L5	32.5	40.5	55	97
shaft shoulder to the shaft end		L6	28.5	36.5	49	82
Flat end length / Key length		L7	20	30	40	65
Key length to the shaft end		L8	3	3	5	5
Mounting hole circle		D1	Ø52	Ø70	Ø100	Ø140
Pilot diameter		D2	Ø40 g6	Ø60 g6	Ø80 g6	Ø120 g6
Output shaft diameter		D4	Ø16 g6	Ø20 g6	Ø25 g6	Ø40 g6
Housing diameter		D11	Ø65	Ø95	Ø125	Ø155
Key width		B1	5	6	8	12
Flat end height / Key Height		H1	18	22.5	28	43
mounting thread x depth		G1	8-M5	4-M6	4-M10	4-M10
center screw hole x depth		G2	M5x12	M8	M8	M16
Input						
Pilot depth		L9	6	6	8	8
motor shaft length		L10	32	47	62.5	81.5
Pilot diameter		D6	Ø50 G6	Ø80 G6	Ø110 G6	Ø114.3 G6
Input shaft diameter		D7	Ø14 G6	Ø19 G6	Ø22 G6	Ø35 G6
Mounting hole circle		D8	Ø70	Ø100	Ø145	Ø200
mounting thread x depth		G3	4-M4	4-M6	4-M8	4-M12

TECHNICAL DATA

- Low noise
- Compact size and optimized weight
- Precision gearing
- Optimized inertia moment
- Stable temperature rise
- Higher performance & torsional stiffness
- High efficiency transmission
- Optimized design with special lubricant for long service life
- Flexible mounting dimension

Model / Size		Stages	60	90	120	140
Full load efficiency	%	1	≥95			
		2	≥92			
Standard Backlash	arcmin	1	≤5	≤5	≤5	≤5
		2	≤8	≤8	≤8	≤8
Precision Backlash	arcmin	1	≤3	≤3	≤3	≤3
		2	≤5	≤5	≤5	≤5
Noise ②	dB(A)		≤60	≤60	≤65	≤67
Lifetime ①	hr		20000			
Max. Bending moment M_{2KB}	Nm		125	235	430	1300
Max axial load	N		2110	2310	4800	6200
Nominal Input Speed	rpm		5000	4000	4000	3000
Max input speed	rpm		10000	8000	8000	6000
Torsional stiffness	Nm/arcmin		13	31	82	151
Weight	kg	1	1.35	4.25	9.15	14.6
		2	1.7	7	13	19.2
Operating temp.	℃		-20 ~ 90			
Degree of protection			IP 65			
Lubrication			Synthetic lubrication			
Mounting direction			Any			

① Life reduced by half under continuous operation.
② Noise level measured on input running at 3000 rpm with no load (i = 5)

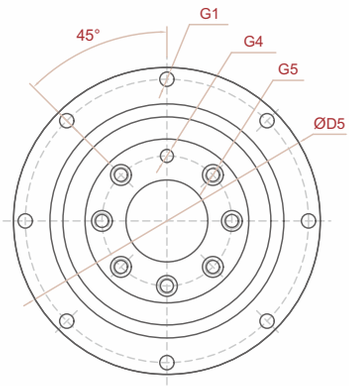
Model / Size		Stages	Ratio	60	90	120	140
Nominal output torque	Nm	1	4	48	130	270	560
			5	60	160	330	650
			7	50	140	300	550
			10	40	100	230	450
		2	20	48	130	270	560
			25	60	160	330	650
			35	50	140	300	550
			40	48	130	270	560
			50	60	160	330	650
			70	50	140	300	550
			100	40	100	230	450
MAX Output torque		2.5 times of Nominal Output Torque					

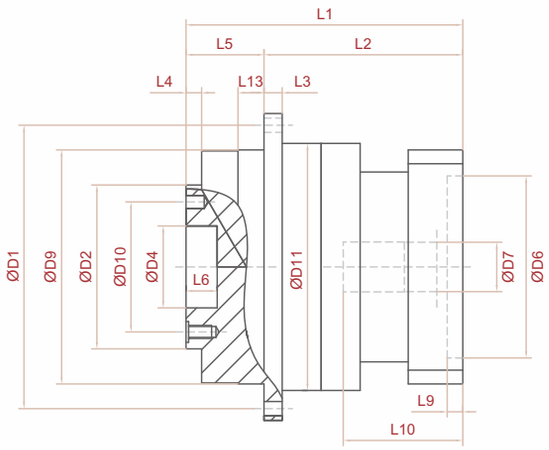
Model / Size		Stages	Ratio	60	90	120	140
Mass Moments of Inertia	$Kg\text{-}cm^2$	1	4	0.14	0.48	2.74	7.54
			5	0.13	0.47	2.71	7.42
			7	0.13	0.45	2.62	7.14
			10	0.13	0.44	2.57	7.03
		2	20	0.13	0.47	2.71	7.42
			25	0.13	0.47	2.71	7.42
			35	0.13	0.47	2.62	7.14
			40,50	0.13	0.44	2.57	7.03
			70,100	0.13	0.13	0.44	2.57

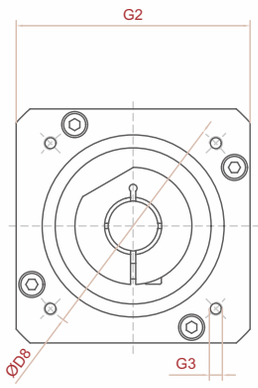
ZF

PROFILE DIMENSIONS

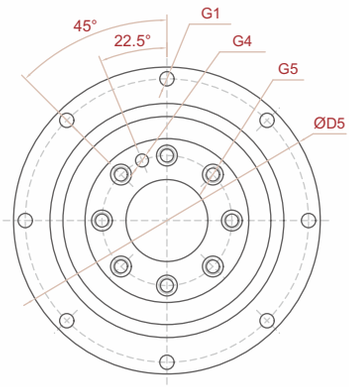
ZF60

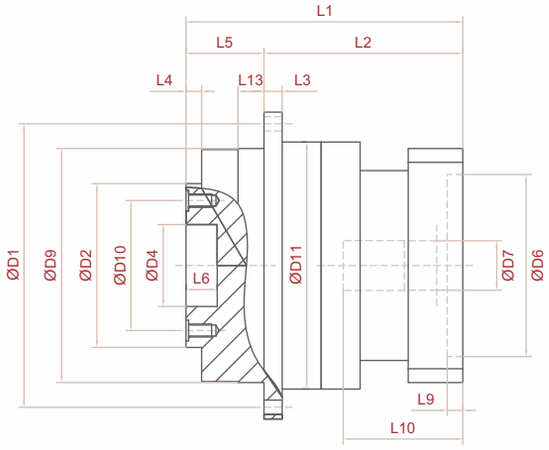


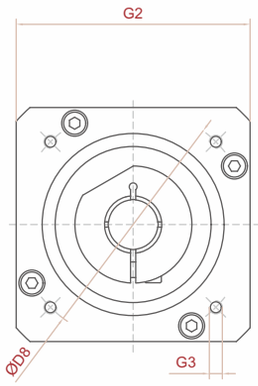




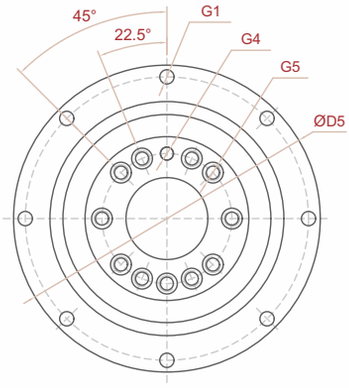
ZF90

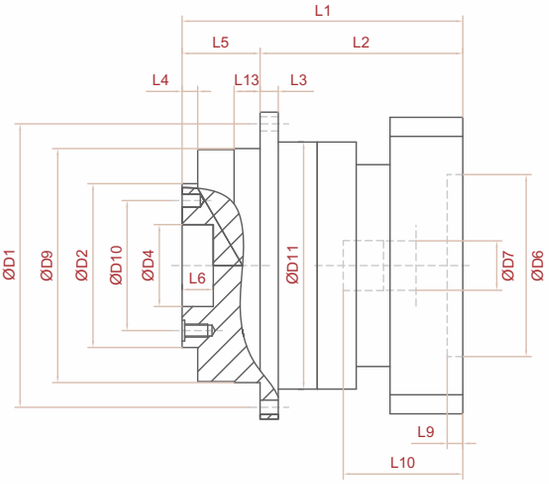


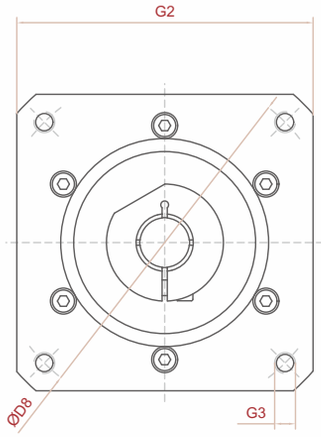




ZF120

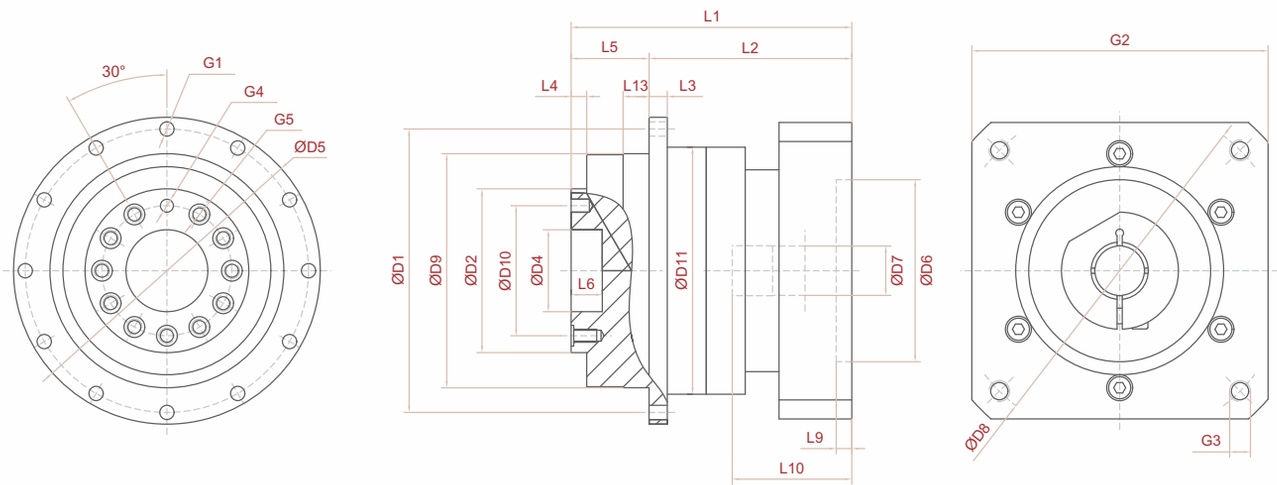






ZF PROFILE DIMENSIONS

ZF140

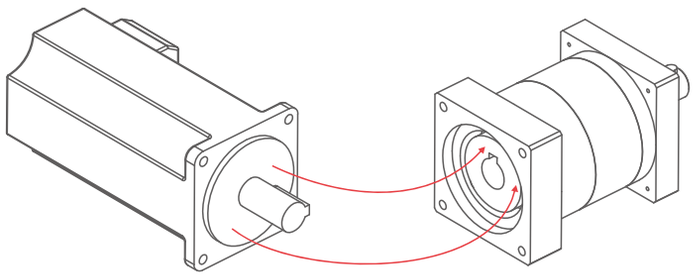


Model / Size	Stages		ZF60	ZF90	ZF120	ZF140
Overall length	1	L1	82.5	109.5	131	179
	2		110.5	146	161	245.5
Body length	1	L2	63	79.5	102	141
	2		91	116	132	207.5
Input flange		Q2	□60	□90	□130	□180
Output						
Length from flange		L3	4	8	7	10
Pilot length		L4	3	6	6	7.5
Output shaft length		L5	19.5	30	29	38
shaft shoulder to the shaft end		L6	8	12	12	12
Spigot depth		L13	6.8	10	10	14.5
Hole circle diameter		D1	Ø79	Ø109	Ø135	Ø168
Mounting hole circle		D2	Ø40 h6	Ø63 h6	Ø80 h6	Ø100 h6
Centering		D4	Ø20 H7	Ø31.5 H7	Ø40 H7	Ø50 H7
Output shaft diameter		D5	Ø86	Ø118	Ø145	Ø179
Centering		D9	Ø64 g6	Ø90 g6	Ø110 g6	Ø140 g6
Hole circle diameter		D10	Ø31.5	Ø50	Ø63	Ø80
Housing diameter		D11	Ø65	Ø95	Ø115	Ø150
Pinion bore		G1	8-Ø4.5	8-Ø5.5	8-Ø5.5	8-Ø6.6
mounting thread x depth		G4	Ø5x6 DP.	Ø6x7 DP.	Ø6x7 DP.	Ø8x7 DP.
		G5	7-M5	8-M6	11-M6	11-M8
Input						
Pilot depth		L9	5.5	6	8	10
motor shaft length		L10	31	45.5	67	83
Pilot diameter		D6	Ø50 G6	Ø70 G6	Ø110 G6	Ø114.3 G6
Input shaft diameter		D7	Ø14 G6	Ø19 G6	Ø22 G6	Ø35 G6
Mounting hole circle		D8	Ø70	Ø90	Ø145	Ø200
mounting thread x depth		G3	4-M4	4-M5	4-M8	4-M12

GEAR REDUCER MOUNTING INSTRUCTION / TORQUE REQUIRED TO SECURE BOLT

GEAR REDUCER MOUNTING INSTRUCTION

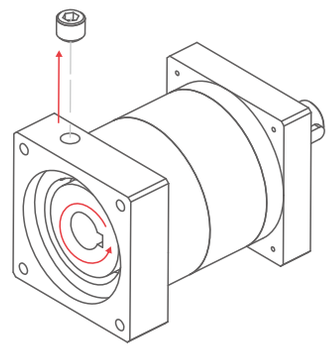
STEP 1



A. Verify fit before assembly
B. Clean both surfaces thoroughly

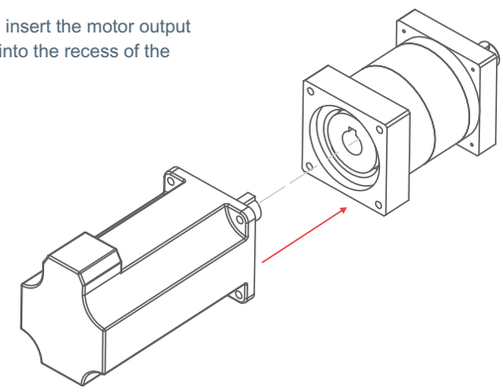
STEP 2

A. Loosen the plug screw on the side of gearbox input flange.
B. Rotate the gearbox inlet bushing until the head of the lock bolt is aligned with access hole.
C. Loosen the lock bolt on the gearbox inlet bushing.

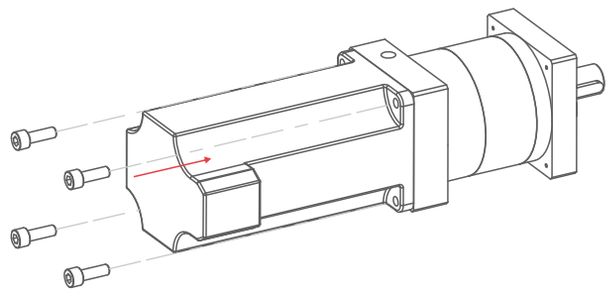


STEP 3

Postion and then insert the motor output shaft and flange into the recess of the gearbox.

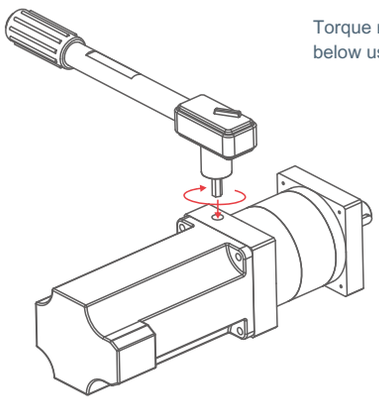


STEP 4



Secure motor to gearbox using specified hardware.

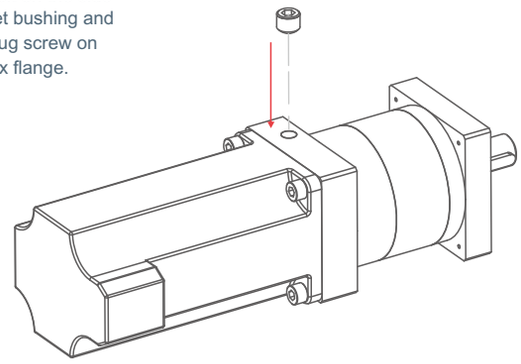
STEP 5



Torque motor coupling according to table below using calibrated torque wrench.

STEP 6

Tighten the lock bolt on the side of the gearbox inlet bushing and then tighteh the plug screw on the side of gearbox flange.



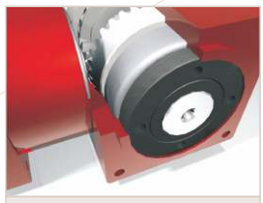
Tightening Torque Recommended For Motor Mounting Bolt & Motor Lock Sleeve Bolt

Bolt Size		M3	M4	M5	M6	M8	M10	M12	M14
Width Across Flats	mm	2.5	3	4	5	6	8	10	14
Strength 12.9 Tightening Torque	Nm	2.1	4.9	9.8	17	41	80	139	343
	In-lbs	19	44	87	151	364	709	1232	3038

Note:
Torques shown above are minimum tightening values. Bolts can be safely tightened up to 25% higher for increasing holding torques.
Optionally, Loctite can be applied to the threads of the Lock Bolt. (Use Loctite 242 for screw sizes above M5 and Loctite 222MS for screws sizes M5 and below)

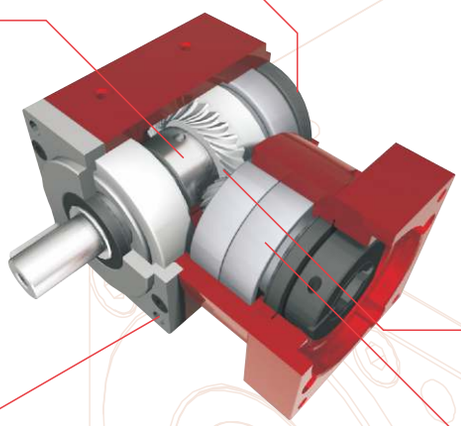
FEATURES

- Precision spiral bevel gears raise efficiency above 96%.
- Reduction ratios for transferring high torques in limited space.
- Hardened high strength steel components for reliability under severe conditions.
- All grease-filled, the gear head can be used in any orientation without oil leaks.
- Backlash under 5 arc-minas low backlash design and 7 arc-min as standard backlash.
- Various of output options available in applications of automation and motion control in industries such as aerospace, medical, pharmaceutical, factory automation, printing, robotics, auto control system, automotive, textile equipment, semiconductor, manufacturing equipment, X-Y positioning systems, coordinate measuring, optical positioning equipment, telecommunications, packaging, material handling, assembly line, CCTV system, machine tools and special machinery, etc.



Axail compression mechanism to increase concentricity and ebgagement between shaft and bearing.

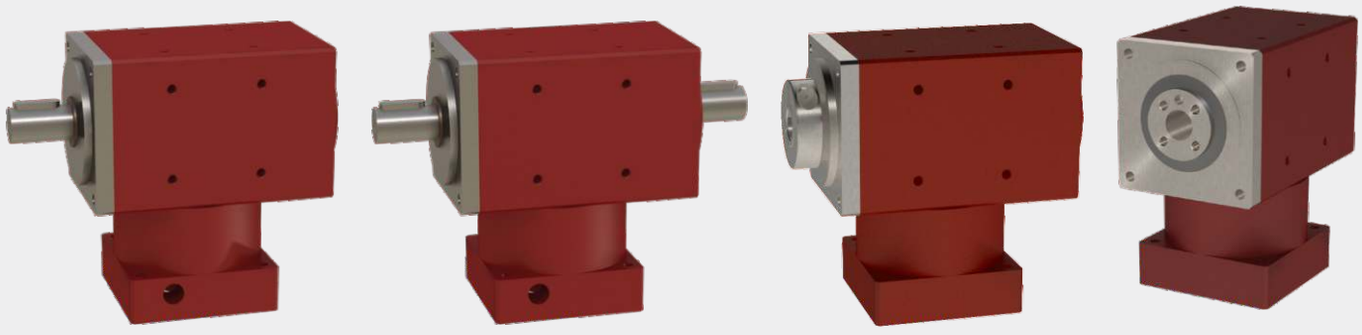
Patented design provides unique backlash adjustment.



Unique wear resistant treatment for spiral bevel reliability.

Patented output mount design for versatility.

Double ball bearing for stable operation at high speed.



RB/RL FEATURES

The compact and rigid right angle design ensures the highest performance while being space and weight efficient. Ground spiral bevel gear set provides the highest efficiency and lower meshing noise with long service life. Available with solid or hollow shafts on the output end. For output with a hollow shaft, the shaft is extended so a shrink disc can be fitted.

Lubricated for life, the gear reducers are virtually maintenance-free (When used under normal conditions).

Three frame sizes are available with gear ratios 1:1, 1:2, 1:3, 1:4 and 1:5

ZSR FEATURES

Quiet spiral teeth right angle gearbox

The rigid right angle design ensures the highest performance while ground spiral bevel gear set provides the highest efficiency and lower meshing noise with long service life.

Lubricated for life, the gear reducers are virtually maintenance-free (When used under normal conditions).

Two frame sizes are available with gear ratios from 1:3 to 1:100

RB/RL

TECHNICAL DATA

- Low noise
- Compact size and optimized weight
- Precision spiral gearing
- Optimized inertia moment
- Stable temperature rise
- High efficiency transmission
- Optimized design with special lubricant for long service life
- Flexible mounting dimensions

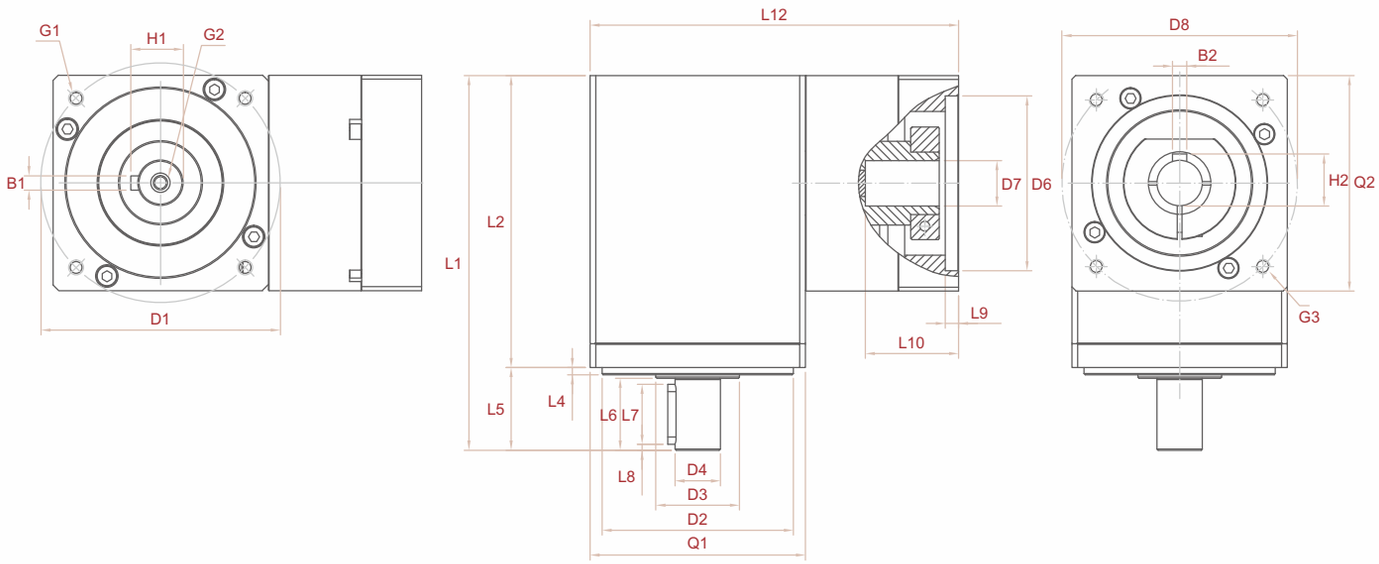
Model / Size		42	60	90
Full load efficiency	%		96	
Backlash	arcmin	<6	<6	<6
Noise	dB(A)	70	72	75
Lifetime	hr		20000	
Max radial load	N	600	800	1700
Max axial load	N	700	900	1500
Nominal Input Speed	rpm	4000	4000	3000
Max input speed	rpm	12000	8000	7000
Torsional stiffness	Nm/arcmin	1.5	2.4	6.6
Weight	kg	0.6	1.7	5.4
Operating temp.	℃	-20 ~ 90		
Degree of protection		IP 65		
Lubrication		Life lubrication		
Mounting direction		Any		

Model / Size		Ratio	42	60	90
Nominal output torque	Nm	1	10	26	73
		2	8	23	69
		3	5	21	54
		4	3	15	44
		5	3	14	43
MAX Output torque		2 times of Nominal Output Torque			

Model / Size		Ratio	42	60	90
Mass Moments of Inertia	$g\text{-}cm^2$	1	70	360	1910
		2	60	230	1050
		3	60	210	940
		4	60	210	900
		5	60	200	900

RB

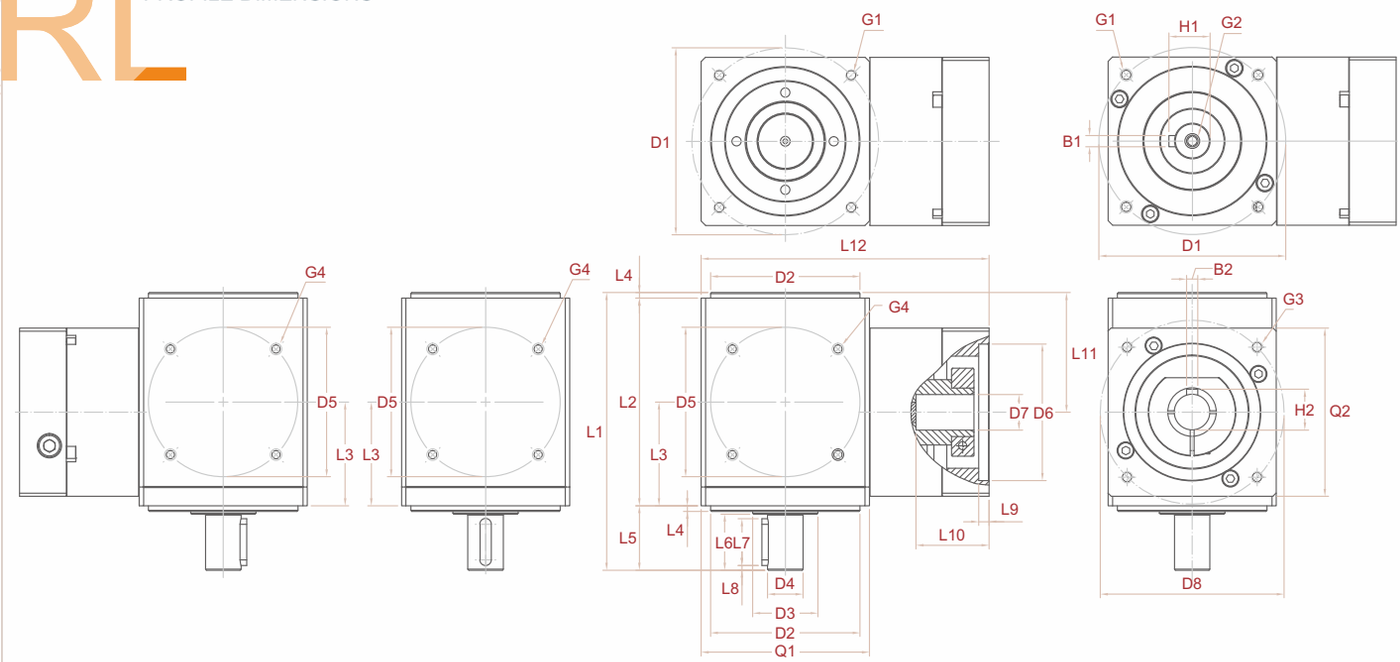
PROFILE DIMENSIONS



Model / Size		RB32	RB42		RB60		RB90
Output flange	Q1	□32	□42		□60		□90
Input flange	Q2	□32	□42		□60		□90
Output							
Overall length	L1	56.5	85		122		165
Body length	L2	41	65		94		130
Pilot length	L4	2.5	2.5		3		3
Output shaft length	L5	15.5	20		28		35
shaft shoulder to the shaft end	L6	12.5	17		24		31
Flat end length / Key length	L7	12.5	12		18		25
Key length to the shaft end	L8	—	2		2		2.5
Mounting hole circle	D1	Ø38	Ø50		Ø70		Ø100
Pilot diameter	D2	Ø28 g6	Ø35 g6		Ø50 g6		Ø80 g6
shaft shoulder diameter	D3	Ø12	Ø15		Ø20		Ø35
Output shaft diameter	D4	Ø6 h7	Ø10 h7		Ø14 h7		Ø19 h7
Key width	B1	—	3		5		6
Flat end height / Key Height	H1	5.5	11.2		16		21.5
mounting thread x depth	G1	M3x8	M4x8		M5x12		M6x15
center screw hole x depth	G2	—	M4x8		M5x12		M6x15
Input							
Pilot depth	L9	3	3		5.5		5.5
motor shaft length	L10	20	25		30		40
Overall length	L12	59	75		105.3		154
Pilot diameter	D6	22	Ø30 G7	Ø22 G7	Ø50 G7	Ø38.1 G7	Ø70 G7
Input shaft diameter	D7	5	Ø8	Ø5	Ø14	Ø6.35	Ø19
Mounting hole circle	D8	Ø32.53(□23)	Ø46	Ø43.84(□31)	Ø70	Ø66.67(□47.14)	Ø90
mounting thread x depth	G3	Ø2.7	M4 x 10	Ø3.3	M5 x 12	M4 x 10	M6 x 12
Key width	B2	—	3	—	5	—	6
Key Height	H2	—	9.4	—	9.4	—	21.8

RL

PROFILE DIMENSIONS



Model / Size		RL32	RL42		RL60	RL90
Output flange	Q1	□32	□42		□60	□90
Input flange	Q2	□32	□42		□60	□90
Output						
Overall length	L1	60	73.5		107	149
Body length	L2	42	51		76	111
Length from flange	L3	21	25.5		38	55.5
Pilot length	L4	2.5	2.5		3	3
Output shaft length	L5	15.5	20		28	35
shaft shoulder to the shaft end	L6	12.5	16.5		24	31
Flat end length / Key length	L7	12.5	12		18	25
Key length to the shaft end	L8	—	2		2	2.5
Mounting hole circle	D1	38	Ø50		Ø70	Ø100
Pilot diameter	D2	Ø28 g6	Ø35 g6		Ø50 g6	Ø80 g6
shaft shoulder diameter	D3	Ø12	Ø15		Ø20	Ø35
Output shaft diameter	D4	Ø6 h7	Ø10 h7		Ø14 h7	Ø19 h7
Key width	B1	—	3		5	6
Flat end height / Key Height	H1	5.5	11.2		16	21.5
mounting thread x depth	G1	M3x8	M4x10		M5x12	M6x15
center screw hole x depth	G2	—	M4x10		M5x12	M6x15
mounting thread x depth	G4	M2x4	M3x6		M4x8	M5x10
Input						
Pilot depth	L9	3	3		5.5	5.5
motor shaft length	L10	20	25		30	40
Offset length	L11	23.5	29		44.5	64
Overall length	L12	59	73		105.3	154
Pilot diameter	D6	22	Ø30 G7	Ø22 G7	Ø50 G7	Ø38.1 G7	Ø70 G7
Input shaft diameter	D7	5	Ø8	Ø5	Ø14	Ø6.35	Ø19
Mounting hole circle	D8	Ø32.53(□23)	Ø46	Ø43.84(□31)	Ø70	Ø66.67(□47.14)	Ø90
mounting thread x depth	G3	Ø2.7	M4 x 10	Ø3.3	M5 x 12	M4 x 10	M6 x 12
Key width	B2	—	3	—	5	—	6
Key Height	H2	—	9.4	—	9.4	—	21.8

ZSR

TECHNICAL DATA

Model / Size		Stages	60	90
Full load efficiency	%	1	≥93	
		2	≥90	
Standard Backlash	arcmin	1	≤8	≤8
		2	≤10	≤10
Noise ②	dB(A)		≤70	≤70
Lifetime ①	hr		20000	
Max radial load	N		1530	3250
Max axial load	N		630	1300
Nominal Input Speed	rpm		5000	4000
Max input speed	rpm		10000	8000
Torsional stiffness	Nm/arcmin		7	14
Weight	kg	1	1.35	4.25
		2	1.7	7
Operating temp.	℃		-10 ~ 90	
Degree of protection			IP 65	
Lubrication			Synthetic lubrication	
Mounting direction			Any	

① Life reduced by half under continuous operation.
② Noise level measured on input running at 3000 rpm with no load (i = 5)

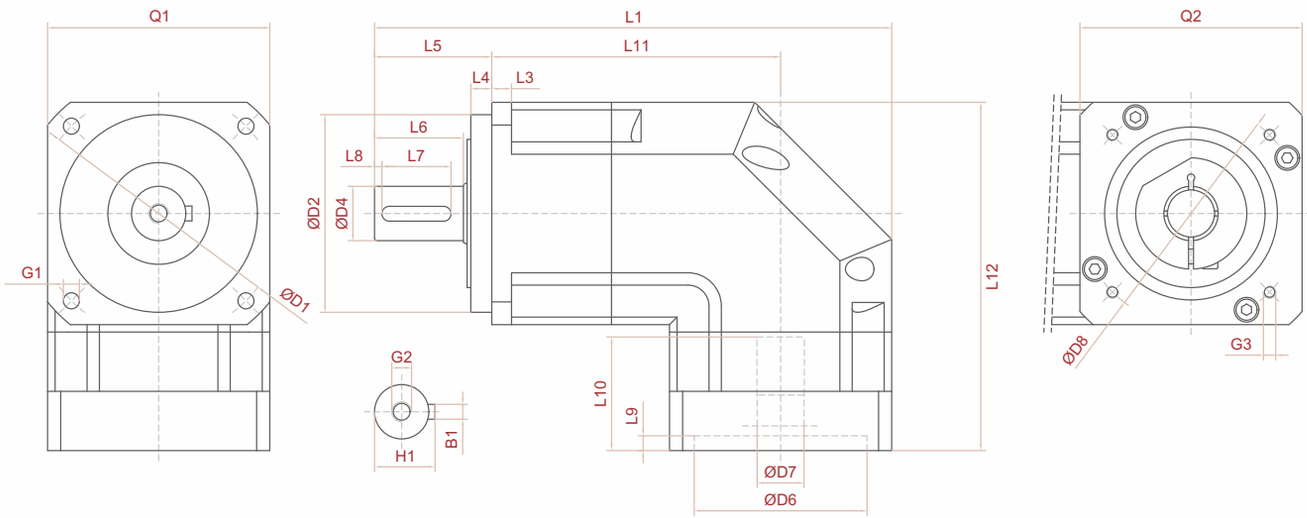
Model / Size		Stages	Ratio	60	90
Nominal output torque	Nm	1	3	55	130
			4	50	140
			5	60	160
			7	50	140
			10	40	100
		2	15	55	130
			20	50	140
			25	60	160
			30	55	150
			35	50	140
			40	50	140
			50	60	160
			70	50	140
			100	40	100
MAX Output torque		2.5 times of Nominal output torque			

Model / Size		Stages	Ratio	60	90
Mass Moments of Inertia	Kg-cm^2	1	3	0.16	0.61
			4	0.14	0.48
			5	0.13	0.47
			7	0.13	0.45
			10	0.13	0.44
		2	15,20,25	0.13	0.47
			35	0.13	0.45
			30,40,50	0.13	0.44
			70,100	0.13	0.13

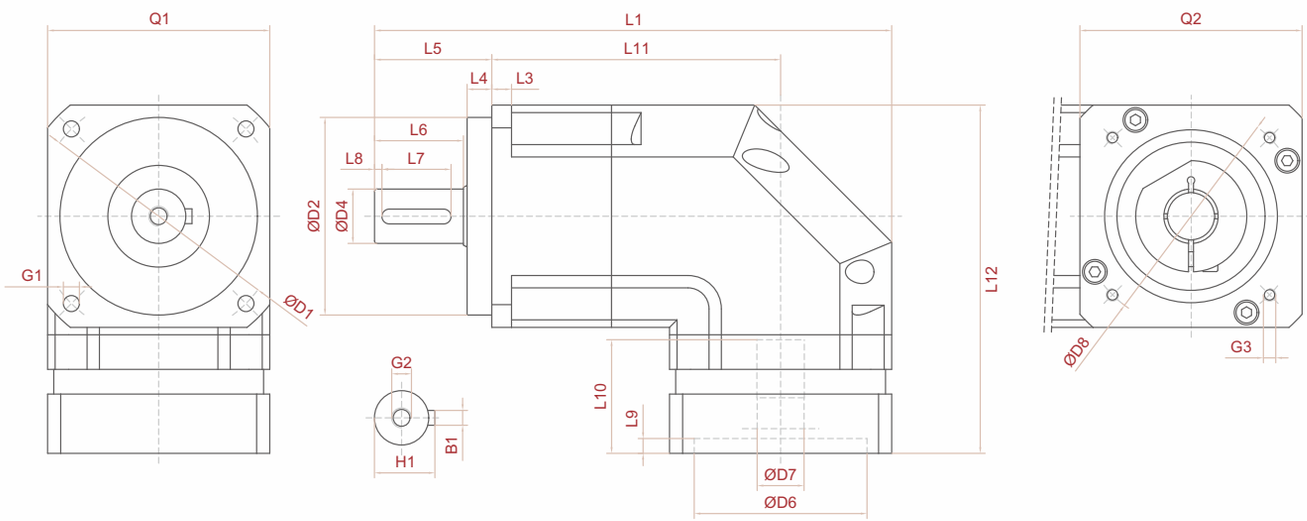
ZSR

PROFILE DIMENSIONS

ZSR60



ZF90



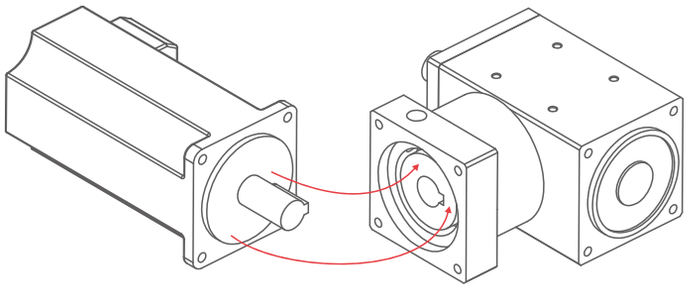
ZSR

PROFILE DIMENSIONS

Model / Size	Stages		ZSR60	ZSR90
Overall length	1	L1	158	209.5
	2		178	242.5
Offset length	1	L11	91	117
	2		111	150
Output flange		Q1	□60	□90
Input flange		Q2	□60	□90
Output				
Length from flange		L3	8	8
Pilot length		L4	7	10
Output shaft length		L5	37	47.5
shaft shoulder to the shaft end		L6	28.5	36
Flat end length / Key length		L7	20	30
Key length to the shaft end		L8	3	3
Mounting hole circle		D1	Ø70	Ø100
Pilot diameter		D2	Ø50 g6	Ø80 g6
Output shaft diameter		D4	Ø16 g6	Ø22 g6
Key width		B1	5	6
Flat end height / Key Height		H1	18	24.5
mounting thread x depth		G1	Ø5.5	Ø6.5
center screw hole x depth		G2	M5	M8
Input				
Pilot depth		L9	6	6
motor shaft length		L10	32	46
Overall length		L12	105	141
Pilot diameter		D6	Ø50 G6	Ø70 G6
Input shaft diameter		D7	Ø14 G6	Ø19 G6
Mounting hole circle		D8	Ø70	Ø90
mounting thread x depth		G3	M4	M5

RIGHT ANGLE GEARBOX MOUNTING INSTRUCTION

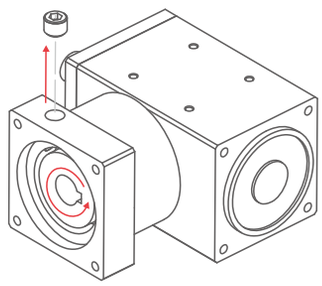
STEP 1



A. Verify fit before assembly
B. Clean both surfaces thoroughly

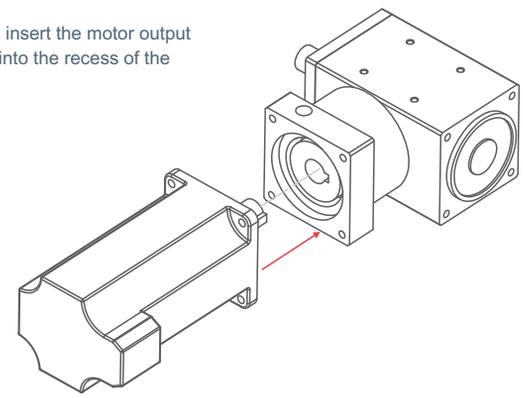
STEP 2

A. Loosen the plug screw on the side of gearbox input flange.
B. Rotate the gearbox inlet bushing until the head of the lock bolt is aligned with the access hole.
C. Loosen the lock bolt on the gearbox inlet bushing.

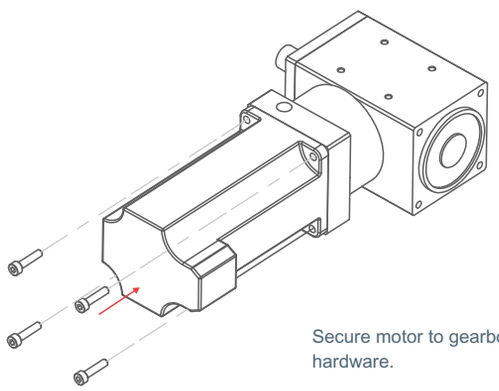


STEP 3

Postion and then insert the motor output shaft and flange into the recess of the gearbox.

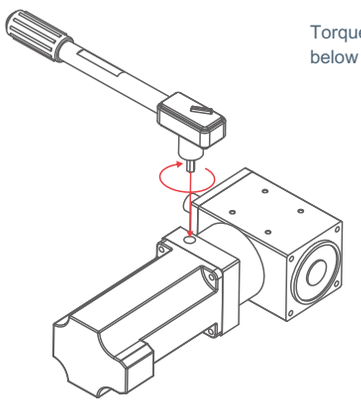


STEP 4



Secure motor to gearbox using specified hardware.

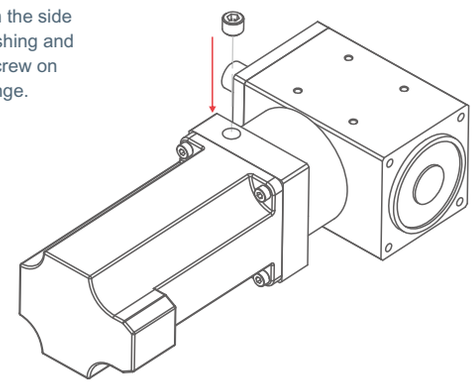
STEP 5



Torque motor coupling according to table below using a calibrated torque wrench.

STEP 6

Tighten the lock bolt on the side of the gearbox inlet bushing and then tighten the plug screw on the side of gearbox flange.



Tightening Torque Recommended For Motor Mounting Bolt & Motor Lock Sleeve Bolt

Bolt Size		M3	M4	M5	M6	M8	M10	M12	M14
Width Across Flats	mm	2.5	3	4	5	6	8	10	14
Strength 12.9 Tightening Torque	Nm	2.1	4.9	9.8	17	41	80	139	343
	In-lbs	19	44	87	151	364	709	1232	3038

Note:
Torques shown above are minimum tightening values. Bolts can be safely tightened up to 25% higher for increasing holding torques.
Optionally, Loctite can be applied to the threads of the Lock Bolt. (Use Loctite 242 for screw sizes above M5 and Loctite 222MS for screws sizes M5 and below)

ORDERING INSTRUCTION

STEP ONE

Determine the Gear Reducer Ordering

Precision Planetary Gear Reducer Type

PS = Precision Planetary Gearbox With Square Output Flange
PN = Precision Planetary Gearbox With Round Output Flange
ZS = Ultra Precision Planetary Gearbox With Square Housing
ZN = Ultra Precision Planetary Gearbox With Round Housing
ZE = Ultra Precision Planetary Gearbox With Flange Output
ZF = Ultra Precision Planetary Gearbox With Round Flange Output

Backlash Type

S = Standard Backlash
L = Low Backlash
(Not Applicable For Ultra Precision Series)

PS — 060 — 050 — S

Frame Size

042 = 42mm
060 = 60mm
080 = 80mm
090 = 90mm
120 = 120mm
140 = 140mm

Gear Ratio

Single Stage		Two Stages	
3	7	12	35
4	9	15	40
5	10	20	50
		25	70
		30	100

Economy Gear Reducer Type

EL = Economy Gearbox

Output Flange Style

S = Square Flange
R = Round Flange

EL — 060 — 050 — S — S

Frame Size

022 = 22mm
032 = 32mm
042 = 42mm
060 = 60mm
080 = 80mm
090 = 90mm

Gear Ratio

Single Stage		Two Stages	
3	7	12	35
4	9	15	40
5	10	20	50
		25	70
		30	100

Input Flange Style

S = Square Flange
R = Round Flange

Precision Right Angle Gear Reducer Type

RB = Precision Right Angle Gearbox (Ratio 1:1)
RL = Precision Right Angle Gearbox (Ratio 1:2, 1:3, 1:4, 1:5)
ZSR = Only available in Single output shaft

RB & RL Frame Size	ZSR Frame Size
042 = 42mm 060 = 60mm 090 = 90mm	060 = 60mm 090 = 90mm

RB — AS — 060 — 001

AS = Single output shaft
BS = Double output shaft (Not applicable for RB series)
HS = Single hollow shaft
PS = Double hollow shaft (Not applicable for RB series)
FS = Single flange output
DS = Double flange output (Not applicable for RB series)
*ZSR = Only available in Single output shaft

RB & RL Gear Ratio	ZSR Gear Ratio			
Single Stage	Single Stage		Two Stages	
RB: 1 RL: 2,3,4,5	3	7	12	35
	4	9	15	40
	5	10	20	50
			25	70
			30	100

STEP TWO

Please fill in the blanks with the Gearbox ordering No. and the motor or Gearbox type No. to be collocated.

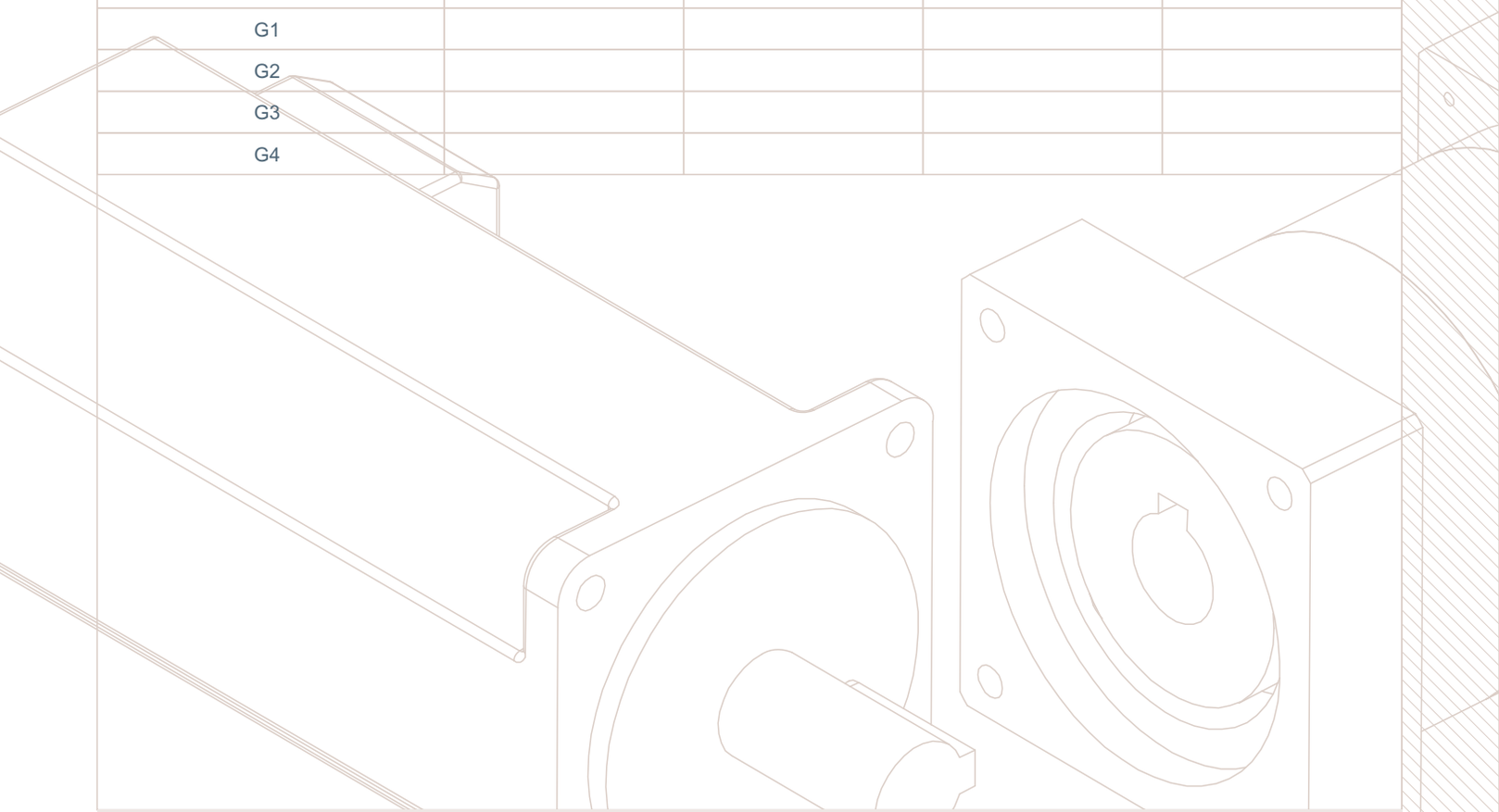
Gearbox Ordering Number	— — —
Motor or Gearbox Model Number	

STEP THREE

1. Please fill all relevant dimensions of the motor or Gearbox output end in the chart below for collocating with the Gearbox you selected.
2. Dimension F7 in the chart below to be specified clearly with relevant depth and quantity.

Motor or Gear Reducer Output Dimension (See following page) ☐ mm ☐ in

Type of output / Dimension	AA	AB	AC	AD
F1				
F2				
F3				
F4				
F5				
F6				
F7				
F8				
F9				
F10				
G1				
G2				
G3				
G4				

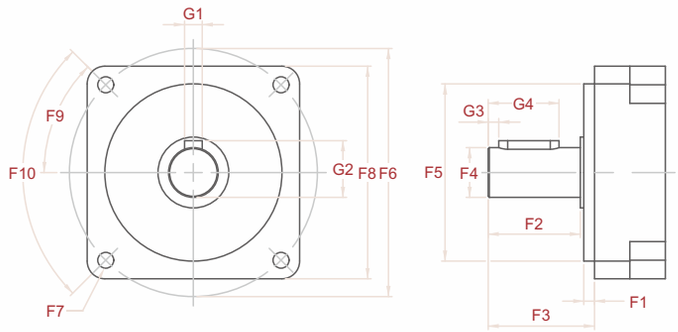


MOTOR OR GEAR REDUCER OUTPUT TYPE / UNIT CONVERSION TABLE

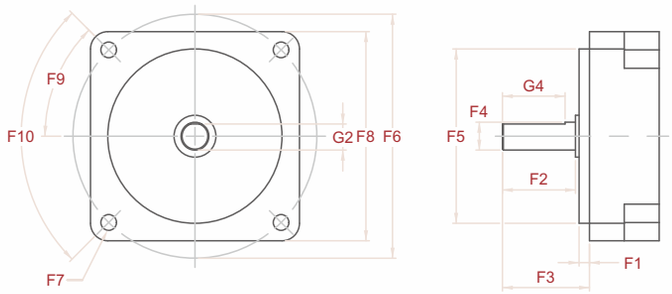
MOTOR OR GEAR REDUCER OUTPUT TYPE

Please fill in the blanks on the previous page with the motor or Gearbox output dimension according to the type or output provided in the chart below.

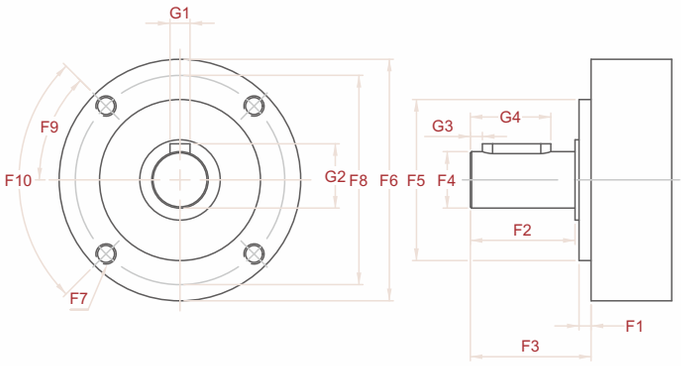
AA (Square flange , keyed shaft)



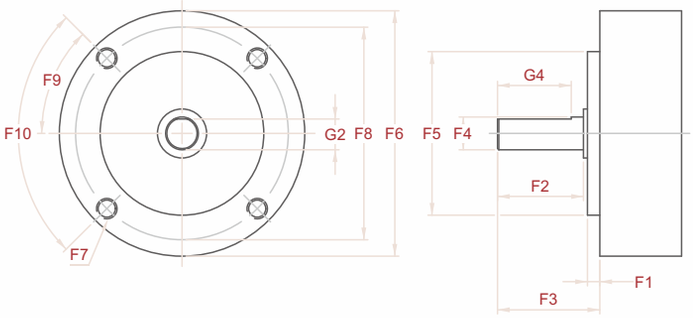
AB (Square flange , round shaft)



AC (Round flange , keyed shaft)



AD (Round flange , round shaft)



UNIT CONVERSION TABLE

TORQUE

N.m	kg.m	kg.cm	ft-lb	in-lb	oz-in
1	0.102	10.2	0.738	8.851	141.6
9.807	1	100	7.233	86.77	1389
0.098	0.01	1	0.072	0.868	13.89
1.356	0.138	13.83	1	12	192
0.113	0.0115	1.152	0.083	1	16
0.007	0.0007	0.072	0.005	0.0625	1

MOMENT INERTIA

lb-in²	g-cm²	oz-in²
0.00034	1	0.00547
0.0625	182.9	1
1	2926.4	16

LENGTH

mm	cm	m	in	ft
1	0.1	0.001	0.0394	0.0033
10	1	0.01	0.3937	.0.0328
1000	100	1	39.37	3.28
25.4	2.54	0.0254	1	0.0833
304.8	30.48	0.3048	12	1

WEIGHT

g	kg	lb	oz
1	0.001	0.002	0.035
1000	1	2.2	35.27
454	0.454	1	16
28.35	0.028	0.06	1

STEP 1

Select the required precision class and gearbox configuration (in-line or right angle).

STEP 2

Select the proper gearbox using exact or general method.

Exact Method

- Calculate the Mean input Speed, n_m , for the Duty Cycle (Eq. 2)
- Calculate the Equivalent Torque T_{EQ} (Eq. 3)
- Calculate the Modified Equivalent Torque T_{EQm} (Eq. 4)
- Compare T_{EQ} to T_r of Gearhead Torque Ratings at Speed n_m

General Method

- Obtain Continuous Torque Rating of Motor, T_m for Specified Speed
- Calculate the Required Gearhead Torque, T_r , for your Application (Eq. 1)
- Let the Mean Input Speed, n_m = Motor Speed at Rated Torque
- Compare T_r to Gearbox Torque Ratings at Speed n_m

Is T_r of Gearbox sufficient?

- NO → Select next larger Gearbox
- YES →

Is Tpeak exceeded during your application?

- YES → Select next larger Gearbox
- NO →

Calculate Mean Gearbox Output Speed $n_{mout} = n_m / i$ where i = ratio

Compare Radial and Axial Loads to Gearbox Values

Are Radial and Axial loads of Gearbox Sufficient?

- NO → Select next larger Gearbox
- YES →

Order your optimized ZIPP gearbox

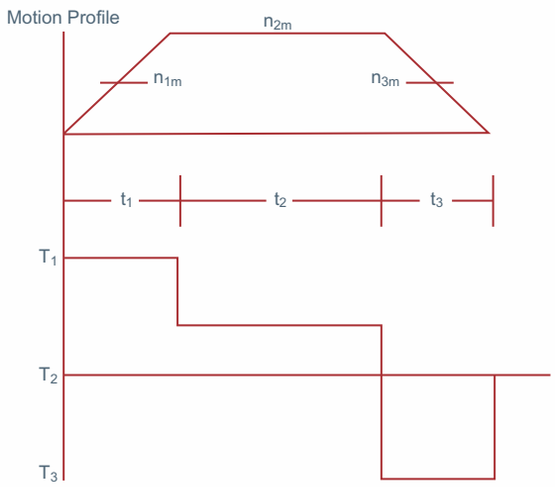
General Method:
Required Gearbox Torque(T_r)

(1) $T_r = T_{M^*} \times i \times e$

Where:
- T_{M^*} = Continuous torque of motor
- i = Gearbox ratio
- e = Efficiency of Gearbox

*Since many motors are capable of exceeding their continuous torque rating for extended lengths of time, the value for TM will only provide a starting point for Gearbox selection. Only use the general method if the continuous motor rating is not exceeded in the application.

Exact Method:



- t_n = time period n
- n_{nm} = mean speed during time period
- t_n T_n = torque during time period t_n

Mean input speed (n_m)

(2) $$n_m = \frac{n_{1m}t_1 + n_{2m}t_2 + n_{3m}t_3 + \ldots\ldots + n_{nm}t_n}{t_t}$$

where $t_t = t_1 + t_2 + t_3 + \ldots\ldots + t_n$

Equivalent torque (T_{EC})

(3) $$T_{EC} = {}_{8,7}T_1^{8,7}\frac{n_{1m}t_1}{n_m t_t} + T_2^{8,7}\frac{n_{2m}t_2}{n_m t_t} + T_3^{8,7}\frac{n_{3m}t_3}{n_m t_t} + \ldots + T_n^{8,7}\frac{n_{nm}t_n}{n_m t_t}$$

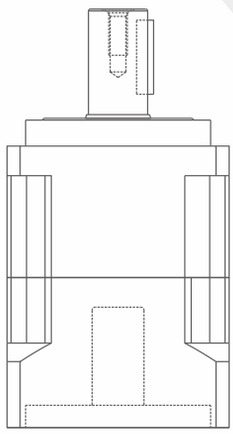
Modified equivalent torque (T_{ECm})

(4) $T_{ECm} = (T_{EC})/C$

where C is:

C	Numer of cycles/hr
1.0	>0
0.9	>1000
0.7	>2500
0.5	>5000

For applications > 10,000 cycles/hour or for continuous duty operation, please contact our engineer consultant.



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