

Miniature Spiral Bevel Gearboxes Right-Angle Power Transmission

*Excellent for semi-conductor,
pharmaceutical, medical, or any other
miniature mechatronics applications.*



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GAM CAN. JUST ASK!

Company Overview

If you need high precision gear reducers at a reasonable cost and you value innovation and excellent service, take a close look at our product line. You will find a wide range of products all created to minimize your design and installation time, minimize space requirements and maximize your machine's performance.

As you look through the pages that follow, you will find in-line and right-angle gearboxes that offer varying degrees of precision.

GAM also offers one of the widest ranges of servo couplings and safety couplings. Please see the GAM coupling catalog for details on those products.

- 1** *We are flexible! We will modify our products or tailor our services to meet your needs. GAM Can, Just Ask!*
- 2** *Quick delivery on the standard products marked in our literature.*
- 3** *24-Hour a day emergency service and same day delivery available.*
- 4** *Excellent technical assistance from our inside application engineers and trained network of outside sales engineers.*
- 5** *Immediate 2-D drawings or 3-D models configured on-line.*
- 6** *100% inspection and quality control on every gearbox shipped from GAM.*
- 7** *Lean manufacturing procedures used to ensure our products are produced cost effectively.*
- 8** *Largest product range of precision gearboxes for motion control applications.*
- 9** *U.S. owned. Our roots date back to the early 1950s.*
- 10** *We have a great team at GAM. We will listen to you and we promise to do our very best to respond to your needs.*

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Type L Gearboxes



- **Small compact bevel gearboxes**
- **35 mm to 45 mm frame sizes**
(65mm to 350mm frame sizes in our V-Series range found in our standard Spiral Bevel Gearbox Catalog)
- **Lightweight aluminum housing**
- **Numerous standard options available including:**
 1. Hard coat anodize
 2. Viton, FPM seals
 3. Non-toxic/food grade lubrication
 4. Numerous shaft configuration and features
- **Excellent for pharmaceutical, medical and semi-conductor applications**

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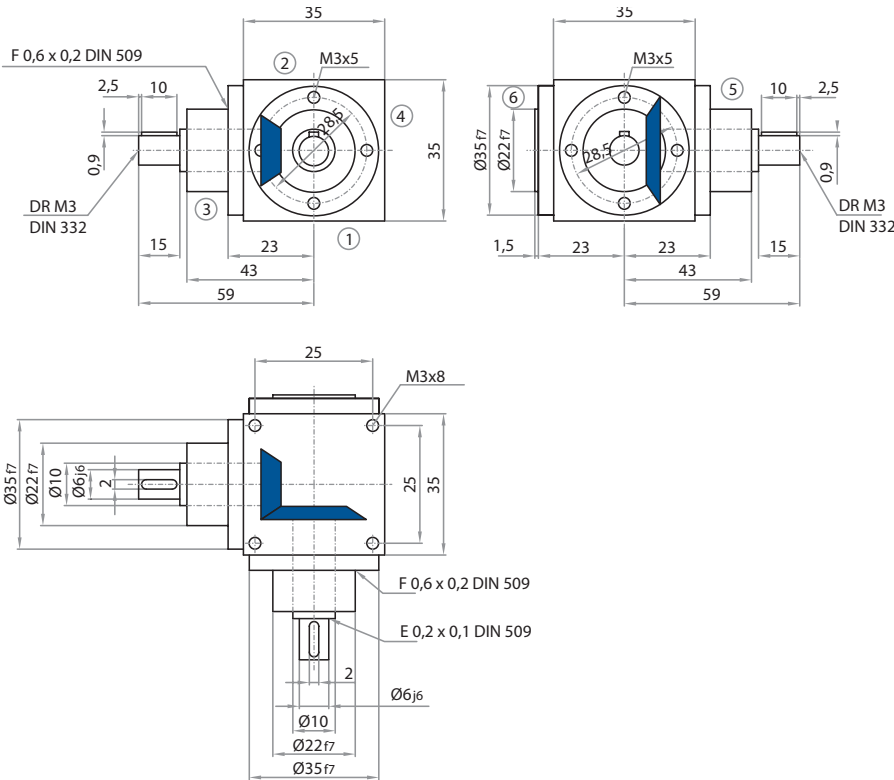
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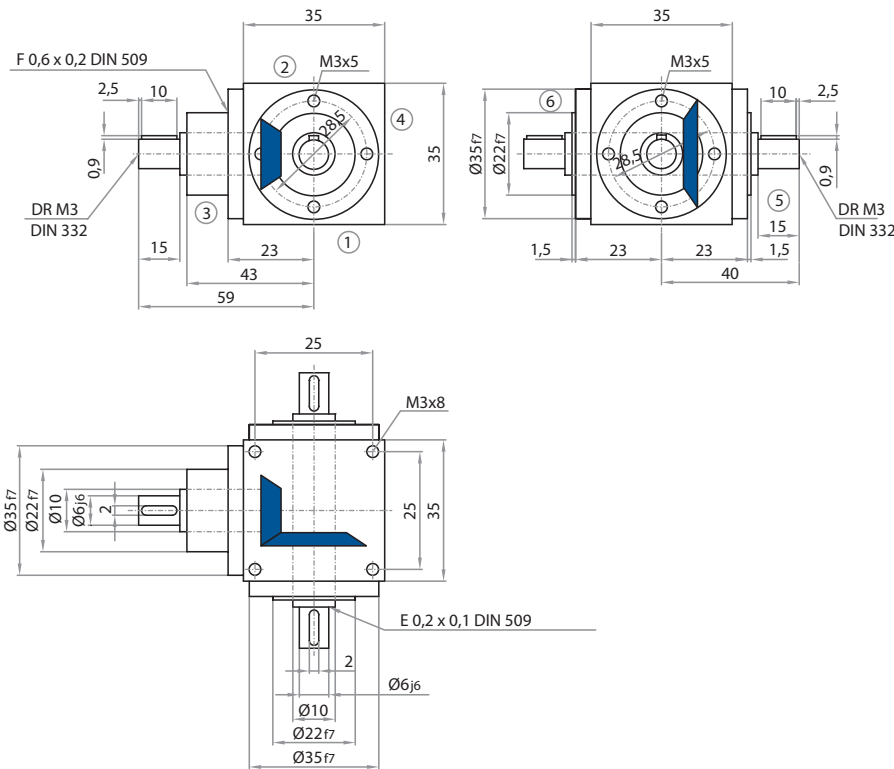
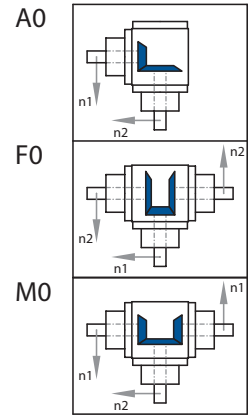
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Type L 035

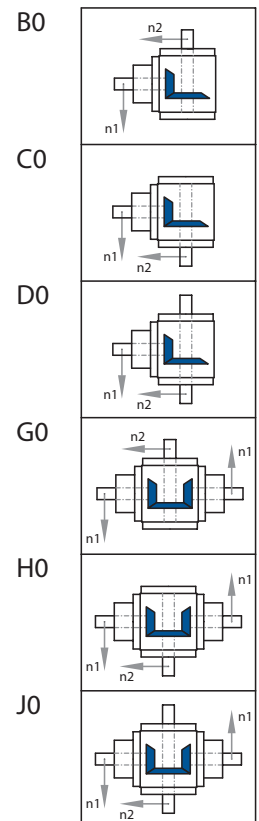


Note: Standard fastening thread in the housing only on sides 1, 2 & 4.
Alternatively, also possible in grid dimension 28 on sides 3, 5 & 6

Model



Model



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Note: Standard fastening thread in the housing only on sides 1, 2 & 4.
Alternatively, also possible in grid dimension 28 on sides 3, 5 & 6

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IV Power Ratings, Torque Ratings

[n = min-1, P = kW, T = Nm]

i = n1	1:1 n2	P1N T2N	2:1 n2	P1N T2N	3:1 n2	P1N T2N	4:1 n2	P1N T2N
3000	3000	0,661 2,000						
2400	2400	0,635 2,400						
1500	1500	0,496 3,000						
1000	1000	0,386 3,500						
750	750	0,298 3,600						
500	500	0,220 4,000						
250	250	0,124 4,500						
50	50	0,025 4,500						
P1Nt		0,350						
T2max		8,000						

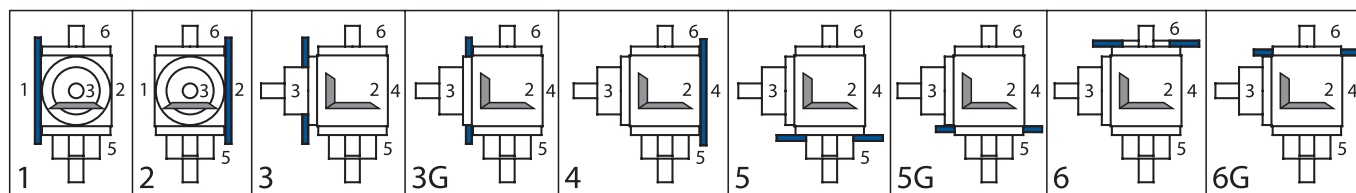
Moments of Inertia

Gearbox Weights (kg)

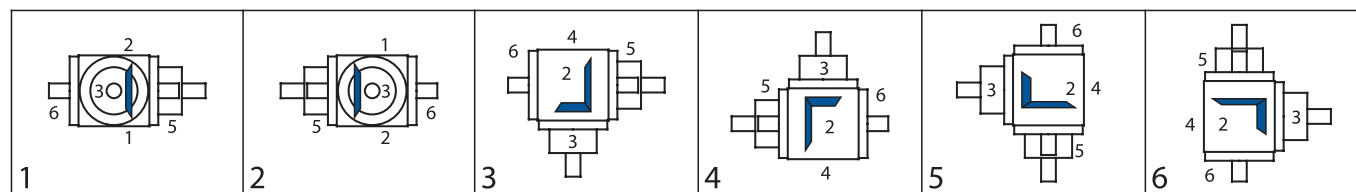
Model	Transmission Ratios	1:1
	upon request	

Model	app. Weight
A0	ca. 230g
F0	ca. 290g
M0	ca. 290g
B0, C0	ca. 225g
D0	ca. 230g
G0, H0	ca. 285g
J0	ca. 290g

V Mounting Side



VI Mounting Configuration (downward-facing side)



Example of Order

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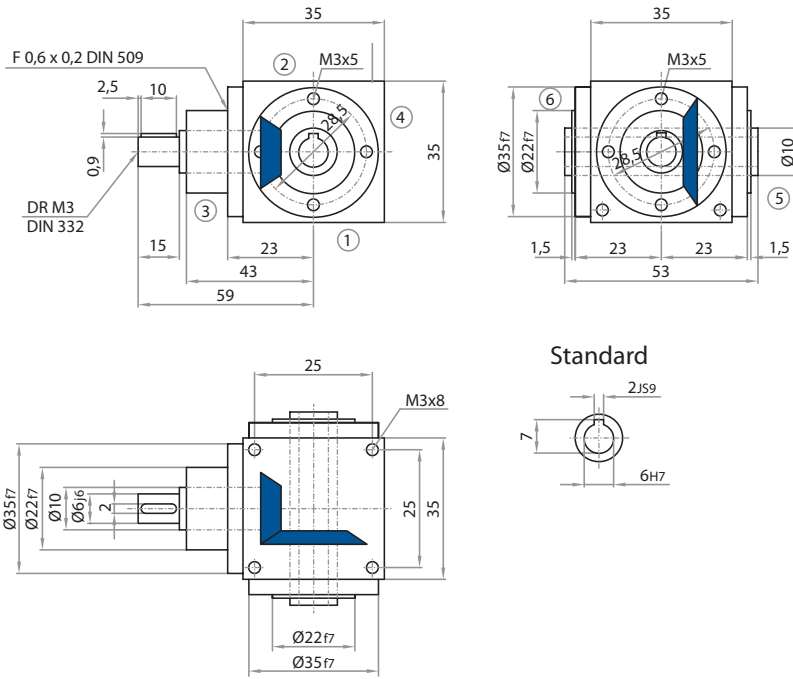
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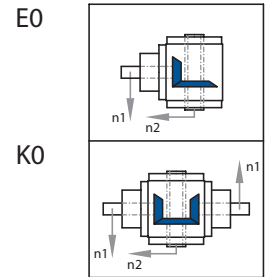
Ratio	Model	Mounting Side	Mounting Config.	Speed	n2max	Design
1:1	A0	-	1	-	500 / 0000=Standard	

Type L 035



Note: Standard fastening thread in the housing only on sides 1, 2 & 4.
Alternatively, also possible in grid dimension 28 on sides 3, 5 & 6

III Model



IV Power Ratings, Torque Ratings

[n = min-1, P = kW, T = Nm]

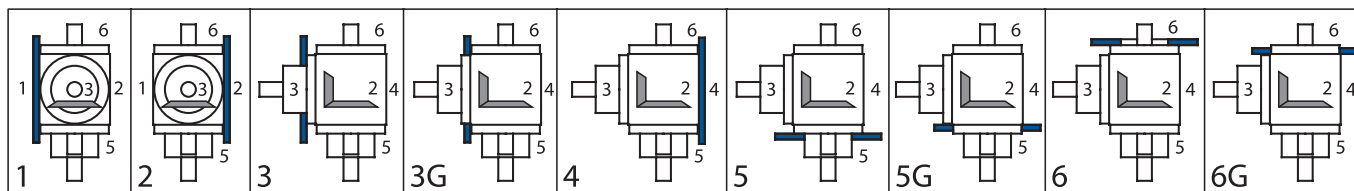
i = n1	1:1 n2	P1N T2N	2:1 n2	P1N T2N	3:1 n2	P1N T2N	4:1 n2	P1N T2N
3000	3000	0,661 2,000						
2400	2400	0,635 2,400						
1500	1500	0,496 3,000						
1000	1000	0,386 3,500						
750	750	0,298 3,600						
500	500	0,220 4,000						
250	250	0,124 4,500						
50	50	0,025 4,500						
P1Nt		0,350						
T2max		8,000						

Moments of Inertia

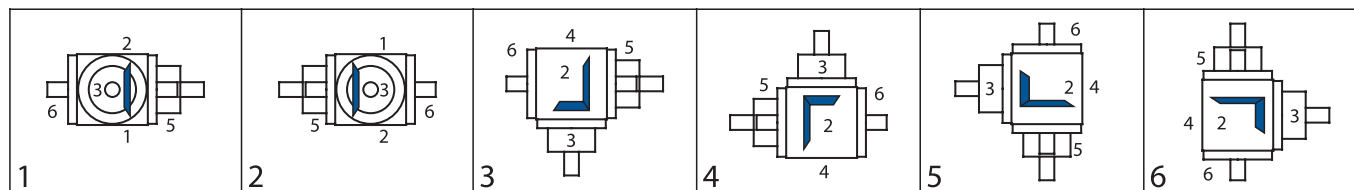
Gearbox Weights (kg)

Model	Transmission Ratios	1:1	Model	app. Weight
	upon request		E0	ca. 210g
			K0	ca. 270g

V Mounting Side



VI Mounting Configuration (downward-facing side)



Example of Order

I	Type	Size	IV	Ratio	III	Model	V	Mounting Side	VI	Mounting Config.	IV	Speed	n2max	Design
L		035		1:1	E0			1	.	1	-		500 / 0000=Standard	

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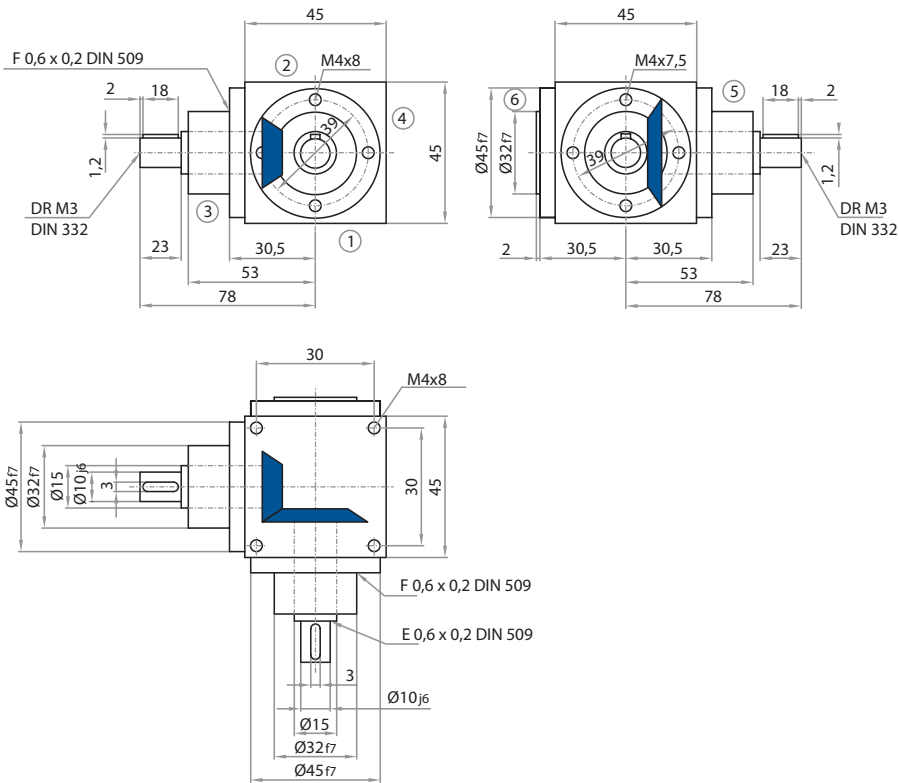
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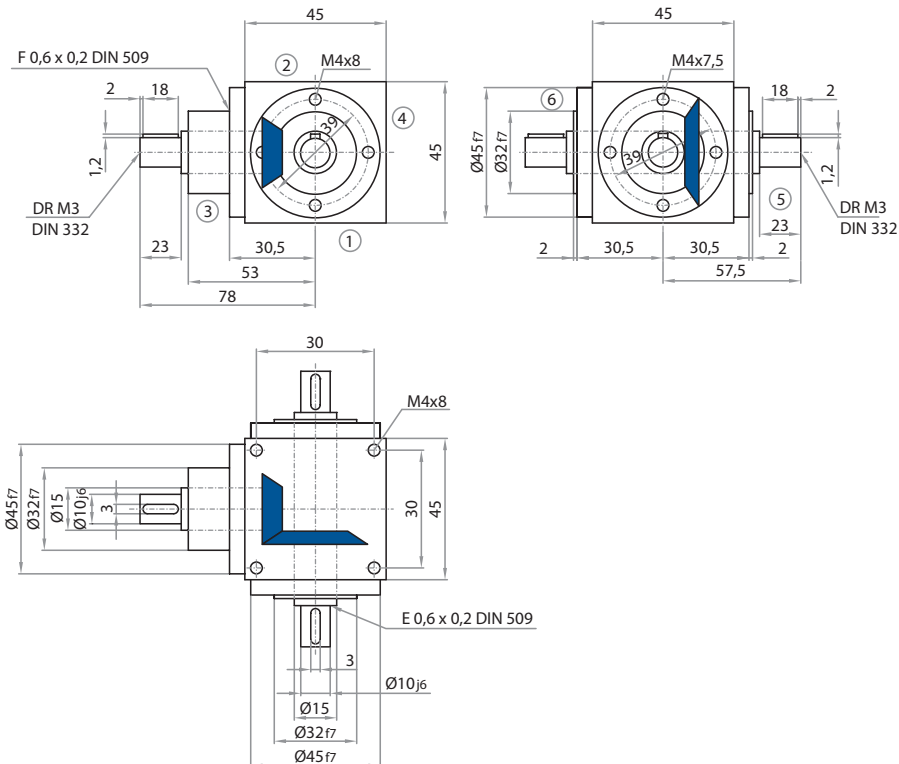
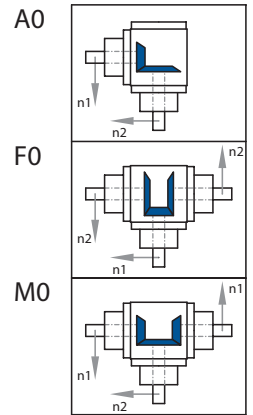
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Type L 045

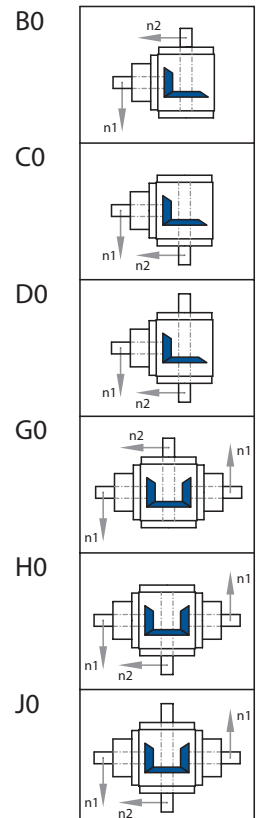


Note: Standard fastening thread in the housing only on sides 1, 2 & 4. Alternatively, also possible in grid dimension 38 on sides 3, 5 & 6

Model



Model



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Note: Standard fastening thread in the housing only on sides 1, 2 & 4. Alternatively, also possible in grid dimension 38 on sides 3, 5 & 6

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IV Power Ratings, Torque Ratings

[n=min-1, P=kW, T=Nm]

i = n1	1:1 n2	P1N T2N	2:1 n2	P1N T2N	3:1 n2	P1N T2N	4:1 n2	P1N T2N
3000	3000	1,323 4,000	1500	0,744 4,500	1000	0,331 3,000	750	0,289 3,500
2400	2400	1,190 4,500	1200	0,628 4,750	800	0,300 3,400	600	0,238 3,600
1500	1500	0,992 6,000	750	0,413 5,000	500	0,193 3,500	375	0,155 3,750
1000	1000	0,772 7,000	500	0,303 5,500	333	0,147 4,000	250	0,110 4,000
750	750	0,603 7,300	375	0,236 5,700	250	0,116 4,200	188	0,087 4,200
500	500	0,441 8,000	250	0,165 6,000	167	0,083 4,500	125	0,059 4,250
250	250	0,248 9,000	125	0,090 6,500	83	0,046 5,000	62,5	0,031 4,500
50	50	0,050 9,000	25	0,019 7,000	17	0,010 5,500	12,5	0,006 4,500
P1Nt		0,600		0,600		0,600		0,600
T2max		16,000		12,500		10,000		8,000

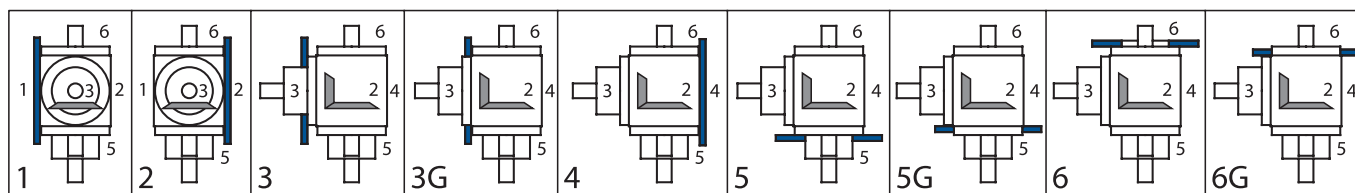
Moments of Inertia

Gearbox Weights (kg)

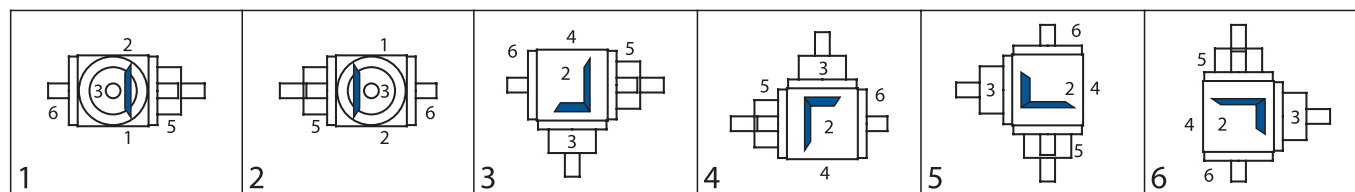
Model	Transmission Ratios			
	1:1	2:1	3:1	4:1
	upon request			

Model	app. Weight
A0	ca. 510g
F0	ca. 700g
M0	ca. 700g
B0, C0	ca. 500g
D0	ca. 530g
G0, H0	ca. 660g
J0	ca. 690g

V Mounting Side



VI Mounting Configuration (downward-facing side)



Example of Order

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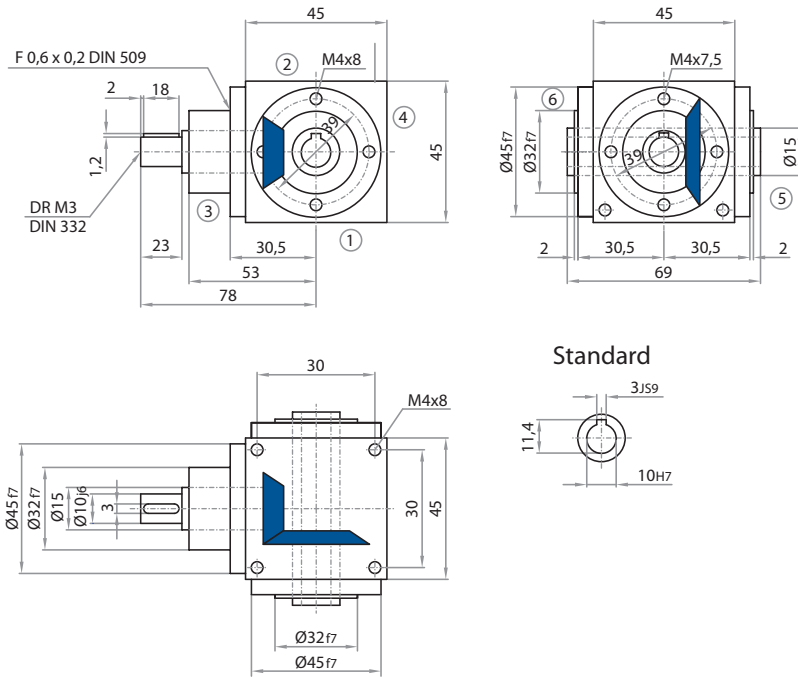
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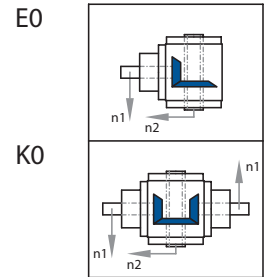
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Ratio 1:1 Model A0 Mounting Side 1 Mounting Config. 1 Speed n2max Design 500 / 0000=Standard

Type L 045



Model



Note: Standard fastening thread in the housing only on sides 1, 2 & 4.
Alternatively, also possible in grid dimension 38 on sides 3, 5 & 6

IV Power Ratings, Torque Ratings

[n = min-1, P = kW, T = Nm]

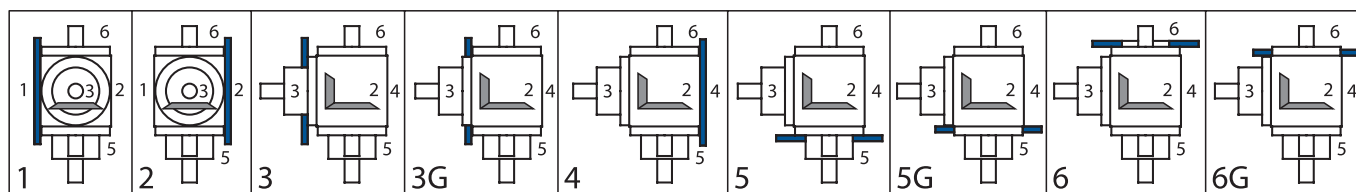
i = n1	1:1 n2	P1N T2N	2:1 n2	P1N T2N	3:1 n2	P1N T2N	4:1 n2	P1N T2N
3000	3000	1,323 4,000	1500	0,744 4,500	1000	0,331 3,000	750	0,289 3,500
2400	2400	1,190 4,500	1200	0,628 4,750	800	0,300 3,400	600	0,238 3,600
1500	1500	0,992 6,000	750	0,413 5,000	500	0,193 3,500	375	0,155 3,750
1000	1000	0,772 7,000	500	0,303 5,500	333	0,147 4,000	250	0,110 4,000
750	750	0,603 7,300	375	0,236 5,700	250	0,116 4,200	188	0,087 4,200
500	500	0,441 8,000	250	0,165 6,000	167	0,083 4,500	125	0,059 4,250
250	250	0,248 9,000	125	0,090 6,500	83	0,046 5,000	62,5	0,031 4,500
50	50	0,050 9,000	25	0,019 7,000	17	0,010 5,500	12,5	0,006 4,500
P1Nt		0,600		0,600		0,600		0,600
T2max		16,000		12,500		10,000		8,000

Moments of Inertia

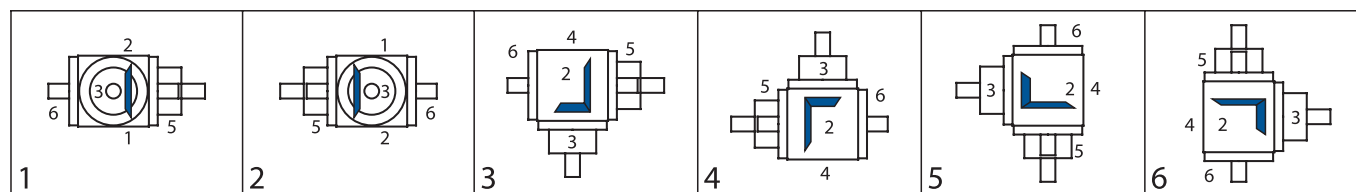
Gearbox Weights (kg)

Model	Transmission Ratios				Model	app. Weight
	1:1	2:1	3:1	4:1		
	on request				E0	ca. 460g
					K0	ca. 620g

V Mounting Side



VI Mounting Configuration (downward-facing side)



Example of Order

I	Type	Size	IV	Ratio	III	Model	V	Mounting Side	VI	Mounting Config.	IV	Speed	n2max	Design
		045		1:1		E0		1		1		-	500 / 0000=Standard	

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Selection Criteria

Bevel Gearbox with Aluminium Housing

The consistent use of the very latest FEM analysis methods allowed the achievement of a harmonious distribution of material and tension curves. The result: L-Series gearboxes operate without the need for maintenance are compactly built and easy to fit.

The smallest gearbox in the series has a cube dimension of 35 mm and a rated torque of 4,5 Nm.

The L-Series gearboxes have housings made of high-strength aluminium. That means not only low weight, but also and above all corrosion resistance, thermal resistance of the surfaces even at the highest temperature ranges, and excellent thermal conductivity of the housing.

By dispensing with paintwork, the L-Series offers many attachment and mating surfaces. In conjunction with tapped holes at all fixing points and with its installation-favouring cube dimension, it can be integrated cost-effectively into existing designs.

Surface

For a more attractive appearance, it is possible to anodize the gearboxes in black, silver and gold.

Transmission Ratios

The following standard transmission ratios are available: for L 035 1:1, for L 045 1 - 2 - 3 - and 4:1. All transmission ratios are mathematically precise. The gearboxes can be used for gearing down and gearing up. Special transmission ratios are available.

Efficiency

The efficiency of the GAM bevel gearbox is 94 - 98%, depending on the speed, installation configuration, sealing rings and lubricant type used. The efficiencies given relate to the power transmission ratings of the gearboxes.

It should be noted that starting efficiency is always lower than operating efficiency. The resultant increased breakaway torque must be taken into consideration when determining the driving power.

Low-Backlash Version

Standard bevel gearboxes have – depending on their size and transmission ratio – a circumferential backlash of 10 to 30 arc minutes. Nevertheless, all GAM bevel gearboxes can be supplied in a low-backlash version. When the drive shaft is locked, circumferential backlash on the slow-running shaft is measured on a 100 mm lever arm with a measuring force of 3% of the rated torque and then is quoted as a torsion angle.

The following values can be set with standard gear sets:

Version S2: $i = 1:1$ to $4:1 < 10$ arc minutes

Tighter values can be obtained from specially selected or ground gear sets – please ask (Version S1).

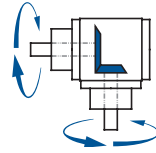
Mounting Side

All 6 sides of the gearbox are machined and can be used as mounting surfaces. The flange surfaces always have mounting holes as a standard feature. The housing surfaces are provided with holes once the mounting side has been determined depending on the order. The lower tightening torques for female threads made of aluminium must be borne in mind.

The following ordering options are available:

Code	for mounting holes
0	only in the flange surfaces
1,2 ...	on one gearbox side without flange
9	on all gearbox sides without flange
9G	on all gearbox sides with flange

Preferential Direction of Rotation



GAM bevel gearboxes can normally be run in either rotational direction. The spiral direction of the gear set and the rotational direction used are key factors determining the forces evolved within the unit. In most instances permissible torque transmission can be maximized by using the gear pairing such that the driving gear rotates in the same direction as the spiralling. This arrangement creates a more favourable contact point which reduces gear distortion. This also reduces noise from the gear pairing by 1-2 dBA due to the fact that the axial forces caused by the spiral meshing push the gears apart. In GAM bevel gear transmissions the pinion gear always has a left-handed spiral; accordingly, the large gear has a right-handed spiral.

Kinematic environment

The rotation direction and the spiral direction result in a different loading of the bearings. Assuming that both operating states (left-hand and right-hand running) are approximately the same, a service life of more than 10,000 hours can be expected. The gearboxes can be operated from both the drive side and the output side. The housings and flanges are made from high-strength aluminium. When further machine elements are attached, no forces may act on the bearings.

Lubrication

The L-Series gearboxes are provided with a lifetime oil fill. The filling level is designed to ensure an optimum temperature dissipation in any installation configuration. For extreme applications, the lubrication can be adapted accordingly. The gearboxes of the lightweight series are designed as standard without bleed feature. For critical applications inevitably leading to high internal temperatures due to their operating mode, bleeding may however be necessary. This must be clarified for each individual case.

Limit capacity

The limit capacities of the gearboxes were ascertained on the assumptions of an ambient temperature of 20 °C and a gearbox oil temperature of max. 90 °C. The maximum limit capacity that can be input by the drive unit is independent of the speed and must be taken into account without fail. This assessment applies for S1 continuous operation, where a temperature dissipation exclusively via free radiation is assumed. The limit capacity must be individually adjusted for a poorer or better heat dissipation and for changed temperature conditions. Practical trials in a real-life environment will provide the most reliable findings.

Shaft Seals

The gearboxes are sealed with single-lip shaft seals made of NBR. If necessary, it is also possible to seal with a dust lip or also with more temperature-stable material (Viton, FPM). This does however involve a greater power loss, which might have to be taken into consideration during design.

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Guidelines for the Selection of a Gearbox

The intended application, the driving motor and the available space determine the type of gearbox to be used, the model and the transmission ratio. All external effects that will act on the gearbox in subsequent operation should be taken into consideration in selecting the optimum gearbox size.

The points listed below are thus key factors for operational reliability and a long service life:

A. Gearbox Application

- Type of driving motor, drive power, drive speed
- Transmission ratio required
- Type of machine driven, operating power, operating speed, operating torque, maximum output torque, output speed
- Relationship of directions of rotation for drive shaft and power take-off shaft
- Ambient conditions
- Other requirements

B. Gearbox Loading Conditions

- Operational mode of driving unit
- Operational mode of machine
- Average operating time in hours per day
- Average operating time per hour in percent
- Start-ups per hour
- Ambient temperature
- Additional loads on drive and driven shafts

Terms, Equations and Factors

n_1 (1/min)	RPM speed of the faster-running shaft
n_2 (1/min)	RPM speed of the slower-running shaft ($n_1:i$)
iN	Nominal transmission ratio
i ist	Actual transmission ratio
J (kgm ²)	Mass moment of inertia
P_1 (kW)	Effective input power ($P_1 = T_2 \times n_2 : 9550 \times \eta$)
P_{1m} (kW)	Input power, corrected by factors, mechanical
P_{1t} (kW)	Input power, corrected by factors, thermal
P_{1N} (kW)	Permissible rated input power for the gearbox, mechanical
P_{1Nt} (kW)	Permissible rated input power for the gearbox, thermal
T_2 (Nm)	Effective output torque ($T_2 = 9550 \times P_1 : n_2 \times \eta$)
T_{2m} (kW)	Mechanical output torque, corrected by factors
T_{2t} (kW)	Thermal output torque, corrected by factors
T_{2N} (kW)	Permissible rated output torque for the gearbox, mechanical
T_{2Nt} (kW)	Permissible rated output torque for the gearbox, thermal
T_{2max} (Nm)	Maximum permissible output torque for the gearbox
η	Efficiency
f_1	Operating factor
f_2	Start-up factor
f_3	Lubrication factor (only for mineral oil lubrication)
f_4	Ambient temperature
f_5	Operating time per hour
f_{MB}	Mass acceleration factor ($f_{MB} = J$ external: J driving motor)

Size Determination

The permissible nominal input power ratings P_{1N} and the nominal output torques T_{2N} given in the tables are valid only for shock-free operation, ten hours operation per day and ten start-ups per hour, with an input power of 2.5 times the rated power being permitted during start-up. The thermal nominal power ratings P_{1Nt} and output torque ratings T_{2Nt} apply for an ambient temperature of 20°C and 100% operating time. The maximum output torques T_{2max} may be reached frequently for brief loading peaks, but may not be exceeded.

The required input power or output torque must be calculated on the basis of the operating factors for the determination of the gearbox size.

Mechanical:	Thermal:
$P_{1m} = P_1 \times f_1 \times f_2 \times f_3$	$P_{1t} = P_1 \times f_3 \times f_4 \times f_5$
$T_{2m} = T_2 \times f_1 \times f_2 \times f_3$	$T_{2t} = T_2 \times f_3 \times f_4 \times f_5$

The formulae take account of the mechanical and thermal effects. The following conditions apply for selection of gearbox size:

$$P_{1m} < P_{1N} \quad P_{1t} < P_{1Nt} \quad T_{2m} < T_{2N} \quad T_{2t} < T_{2Nt}$$

The values given in the specification tables apply for lubrication by synthetic oils, based on an oil temperature of 95 °C. Determination of the thermal limit is not necessary if special measures are used (eg. an oil cooler) to ensure that the permissible oil temperature is never exceeded. The permissible torques may be exceeded in special cases, eg. very short running times or static loading only. Please consult us for detailed information.

Exploitation of the maximum output torques T_{2max} may make a press fit on the output shaft necessary, as the normal feather key connection is not always adequate.

The efficiency data given in the specification tables relate to the permissible rated loading of the transmissions and are guide values for fully run-in gearboxes running at operational temperature with standard seals.

Please refer to the relevant sections for further details such as additional loads, start-up and operating efficiencies, low backlash or increased friction from special seals.

GAM gearboxes are designed for a service life of 12,000 operating hours when using the appropriate factors in selection. The prerequisite for this service life is correct installation and commissioning and proper servicing in accordance with the operating instructions for GAM gearboxes.

Operational factor f_1

Driving motor	Load group	Operating hours/day			
		0.5	3	10	24
Electric Motor	G	0.8	0.9	1.0	1.25

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Loading Parameters

Group G: Low loading/shock-free

Mass acceleration factor $m_{af} < 0.25$: Filling machines, elevators, light screw conveyors, light conveyor belts, blowers, small agitators, control machines, assembly lines, auxiliary drives for machine tools, centrifuges, packaging machinery

Group M: Medium loading/light shocks

Mass acceleration factor $m_{af} < 3.00$: Reel winders, agitators, plate conveyors, calenders, lifts, mixers, balancing machines, heavy-duty conveyor belts, sheet metal bending machines, road-building machinery, planing machines, shears, extruders, main drives for machine tools, kneading machines, weaving looms, light table rollers.

Group S: Heavy load/heavy shocks

Mass acceleration factor $m_{af} < 10.00$: Excavators, heavy-duty mixers, presses, muller mixers, rolling mills, heavy-duty table rollers, cold reduction mills, stone crushers, eccentric presses, cutter heads, folding machines, rubber belt conveyors (batch loads), bark peeling drums, running gears, punching presses, piston pumps, rotary furnaces, mills, plate filters.

The mass acceleration factor m_{af} is calculated as follows:

$$m_{af} = \frac{J_{ex.red.}}{J_{mot.}}$$

m_{af} mass acceleration factor
 $J_{ex.red.}$ all external inertia moments corrected to motor input
 $J_{mot.}$ moment of inertia of the motor

Start-up Factor f2

A prerequisite for application of the start-up factor is that the start-up torque (or braking torque) of the driving machine does not exceed 2.5 times the rated torque of the transmission.

$$T1A < 2,5 \times T1N = 9550 \times P1N / n1$$

Start-ups per hour	up to 10	10-60	60-500	500-1500
f2	1.0	1.1	1.2	1.3

Lubrication Factor f3

The lubrication factor must be taken into consideration when mineral oil is used since the efficiency, service life and permissible oil temperature depend to a great extent on the quality of the oil used, particularly in the case of worm gearboxes.

f3	Synthetic oil	Mineral oil	
	Bevel Gearbox. Worm Gearbox	Bevel Gearbox	Worm Gearbox size 040 - 080 100 - 200
	1.0	1.1	1.2 1.25

Temperature factor f4

tu °C	10	20	30	40	50
f4	0.9	1.0	1.15	1.4	1.7

Factor f5 – operating time per hour

ED in %	100	80	60	40	20
f5	1.0	0.95	0.86	0.75	0.56

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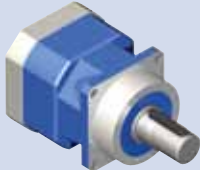


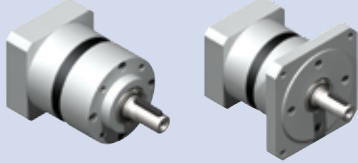
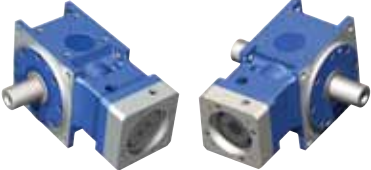



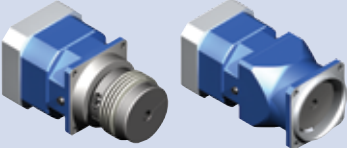







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Output Face	Highest Precision 1-4 arcmin 5-8 arcmin 1 stage 2 stage		High Precision 5-8 arcmin 7-10 arcmin 1 stage 2 stage		Precision <12-15 arcmin <15-20 arcmin 1 stage 2 stage	
	Shaft	SPL Series 	EPL Series  SSP Series 		PE Series 	
Dyna Series 		Dyna-Lite Series 		VC Series  V-Series 		
Hollow	SPL Series 		EPL Series 	FP Series 		
	Dyna Series 	Dyna-Lite Series 		VC Series 		
Flange			FP Series 			
	Dyna Series 					

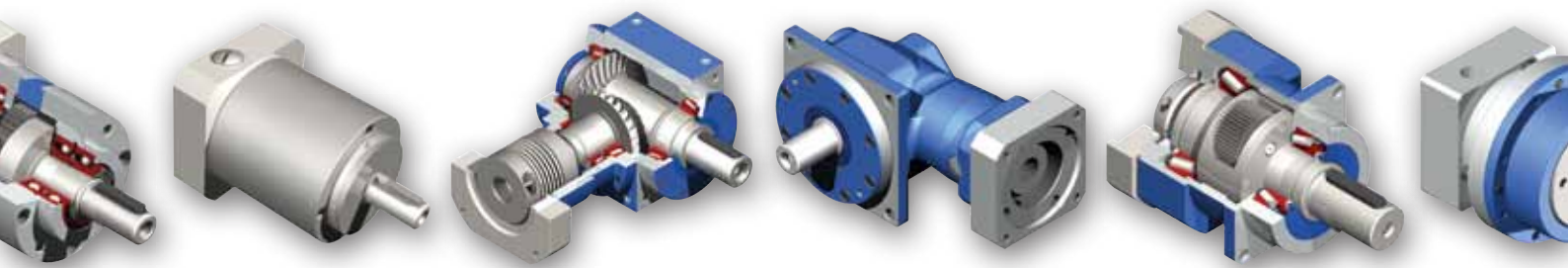
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