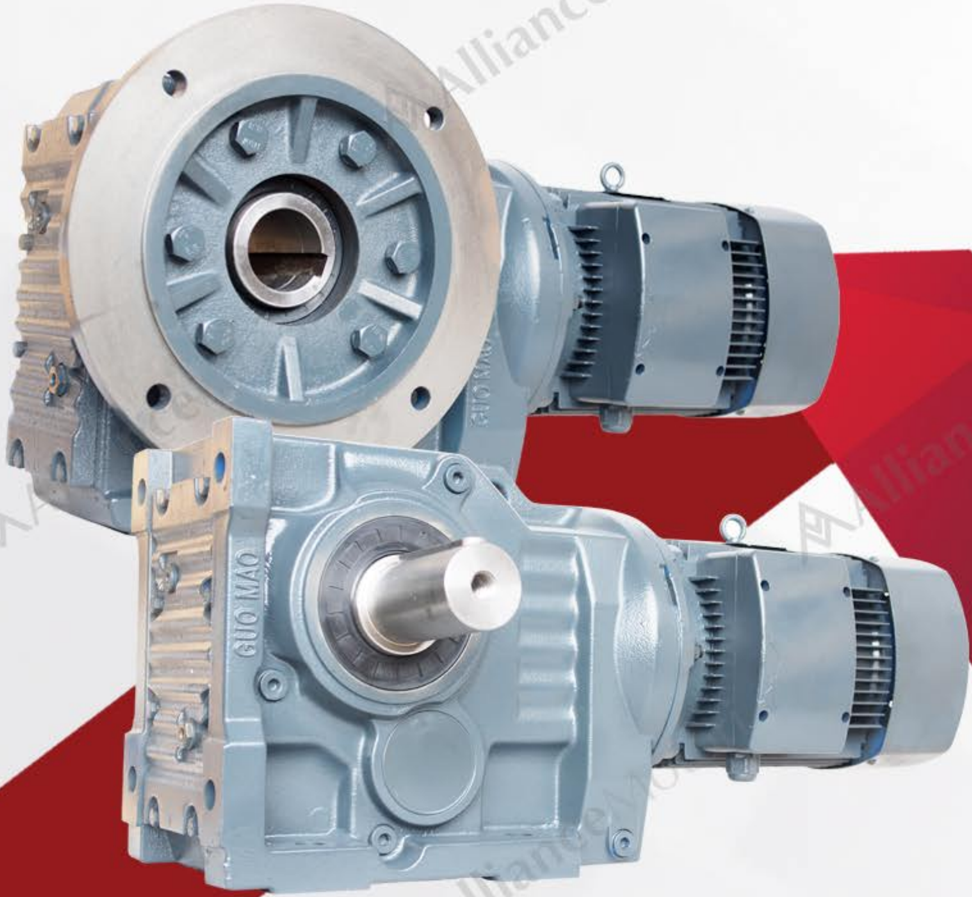
AllianceMotori



AK Series

Bevel Gearbox

www.alliancemotori.com

2 Product Description

2.1 General notes on the product description

Ambient temperature

Gear units and gearmotors from Alliance Motori can be operated in a wide ambient temperature range. The following standard temperature ranges are permitted for filling the gear units according to the lubricant table:

Gear unit	Filled with	Permitted standard temperature range
Helical, parallel-shaft helical and helical-bevel gear units	CLP(CC) VG220	-10 °C ... +40 °C
Helical-worm gear unit	CLP(CC) VG680	0 °C ... +40 °C

The rated data of the gear units and gearmotors specified in the catalog/price catalog refer to an ambient temperature of +25 °C.

Installation altitude

Due to the low air density at high installation altitudes, heat dissipation on the surface of motors and gear units decreases. The rated data listed in the catalog/price catalog applies to an installation altitude of maximum 1000 m asl. Installation altitudes of more than 1000 m asl must be taken into account for project planning of gear units and gearmotors.

Power and torque

The power and torque ratings listed in the catalogs refer to mounting position M1 and similar mounting positions in which the input stage is not completely submerged in oil. In addition, the gearmotors are assumed to be standard versions with standard lubrication and under normal ambient conditions.

Please note that the motor power shown in the selection tables for gearmotors is subject to selection. However, the output torque and the desired output speed are essential for the application and need to be checked.

Speeds

The quoted output speeds of the gearmotors are recommended values. You can calculate the rated output speed based on the rated motor speed and the gear unit ratio. Please note that the actual output speed depends on the motor load and the supply system conditions.

Weights

Please note that all weights shown in the catalogs exclude the oil fill for the gear units and gearmotors. The weights vary according to gear unit type and gear unit size. The lubricant fill depends on the mounting position which means no universally applicable information can be given. Please refer to "Lubricants" in the "Design and Operating Notes" section for recommended lubricant fill quantities depending on the mounting position. For the exact weight, refer to the order confirmation.

Multi-stage gear units

You can achieve particularly low output speeds by using multi-stage gear units or multi-stage gearmotors. Such a setup requires a helical gear unit or gearmotor on the input end as a second gear unit.

It may be necessary to limit the motor power to match the maximum permitted output torque of the gear unit.

6.1 Service factor

Determining the service factor

The effect of the driven machine on the gear unit is taken into account to a sufficient level of accuracy using the service factor f_B. The service factor is determined according to the daily operating time and the starting frequency Z. Three load classifications are taken into account depending on the mass acceleration factor. You can read off the service factor applicable to your application in Figure 3 . The service factor determined from this diagram must be smaller than or equal to the service factor according to the selection tables.

$$M_a \cdot f_b \leq M_{a\,max}$$

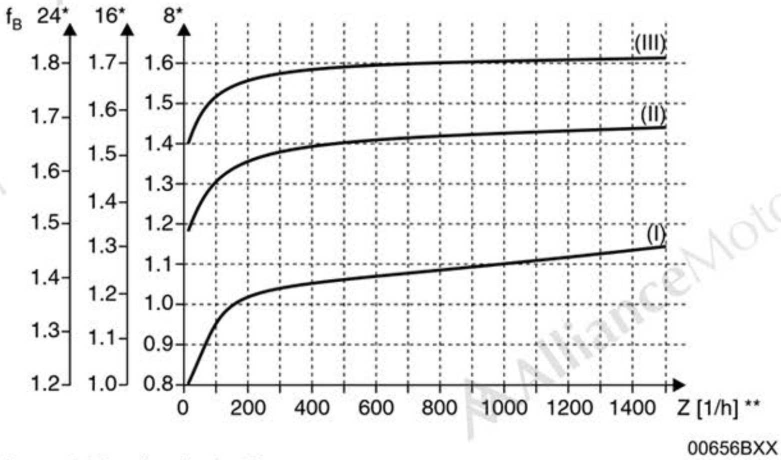


Figure 3: Service factor f_B

* Daily operating time in hours/day
** Starting frequency Z: The cycles include all starting and braking procedures as well as changeovers from low to high speed and vice versa.

Load classification

There are three load classifications:

(I) Uniform, permitted mass acceleration factor ≤ 0.2

(II) Non-uniform, permitted mass acceleration factor ≤ 3

(III) Non-uniform, permitted mass acceleration factor ≤ 10

Mass acceleration factor

The mass acceleration factor is calculated as follows:

$$\textbf{Mass acceleration factor} = \frac{\textbf{All external mass moments of inertia}}{\textbf{Mass moment of inertia on the motor end}}$$

"All external mass moments of inertia" are the mass moments of inertia of the driven machine and the gear unit, scaled down to the motor speed. The calculation for scaling down to motor speed is performed using the following formula:

$$J_X = J \cdot \left(\frac{n}{n_M}\right)^2$$

J_X = Mass moment of inertia scaled down to the motor shaft
J = Mass moment of inertia with reference to the output speed of the gear unit
n = Output speed of the gear unit
n_M = Motor speed

"Mass moment of inertia at the motor end" is the mass moment of inertia of the motor and, if installed, the brake and the flywheel fan (Z fan).

Service factors f_B 1.8 may occur with large mass acceleration factors (> 10), high levels of backlash in the transmission elements or large overhung loads.

helical-worm gear unit

For helical-worm gear units, two additional service factors will have to be taken into consideration besides service factor f_B derived from Figure 3 . These are:

- f_{B1} = Service factor from ambient temperature
- f_{B2} = Service factor from cyclic duration factor

The additional service factors f_{B1} and f_{B2} can be determined by referring to the diagrams in Figure 4 . For f_{B1}, the load classification is taken into account in the same way as for f_B.

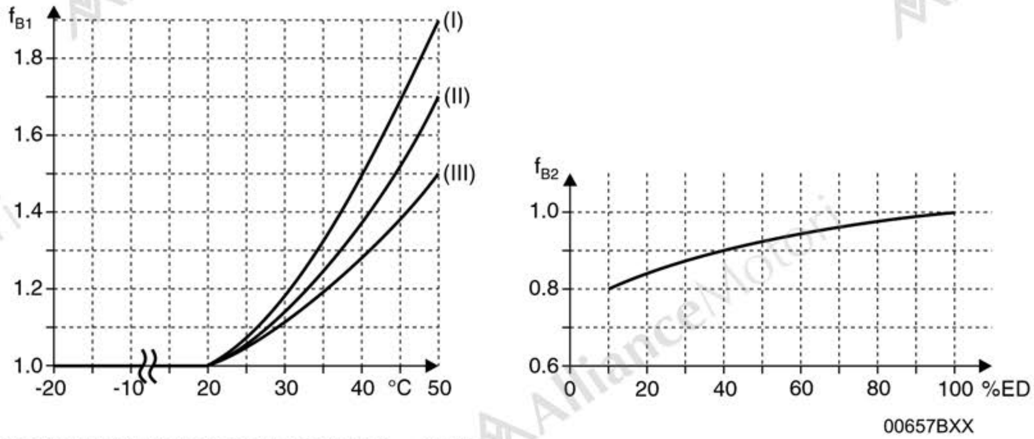


Figure 4: Additional service factors f_{B1} and f_{B2}

$$\text{cdf (\%)} = \frac{\text{Time under load in min/h}}{60} \bullet 1$$

Contact **Alliance Motori** in case of temperatures below -20 °C (→ f_{B1}).

The total service factor for helical-worm gear units is calculated as follows:

$$f_{Bges} = f_B \bullet f_{B1} \bullet f_{B2}$$

Example

The gearmotor with the service factor f_B = 1.51 in the previous example is to be a helical-worm gearmotor.

Ambient temperature ϑ = 40 °C → f_{B1} = 1.38 (read off at load classification II)

Time under load = 40 min/h →cdf = 66.67% → f_{B2} = 0.95

The total service factor is f_{Bges} = 1.51 • 1.38 • 0.95 = 1.98

According to the selection tables, the selected helical-worm gearmotor must have an service factor of 1.98 or greater.

7.1 Overhung and axial loads

Determining the overhung load

An important factor for determining the resulting overhung load is the type of transmission element mounted to the shaft end. The following transmission element factors f_Z have to be considered for various transmission elements.

Transmission element	Transmission element factor f_Z	Comments
Gears	1.15	< 17 teeth
Chain sprockets	1.40	< 13 teeth
Chain sprockets	1.25	< 20 teeth
Narrow V-belt pulleys	1.75	Influence of the pre-tensioning
Flat-belt pulleys	2.50	Influence of the pre-tensioning
Toothed belt pulleys	1.50	Influence of the pre-tensioning

The overhung load exerted on the motor or gear shaft is calculated as follows:

$$F_R = \frac{M_d \cdot 2000}{d_0} \cdot f_Z$$

F_R = Overhung load in N

M_d = Torque in Nm

d_0 = Mean diameter of the installed transmission element in mm

f_Z = Transmission element factor

Permitted overhung load

The basis for determining the permitted overhung loads is the computation of the rated bearing service life L_{10h} of the anti-friction bearings (according to ISO 281).

For special operating conditions, the permitted overhung loads can be determined with regard to the modified service life L_{na} on request.

The permitted overhung loads F_{Ra} for the output shafts of foot-mounted gear units with a solid shaft are listed in the selection tables for gearmotors.

The values refer to force applied to the center of the shaft end (in right-angle gear units as viewed onto drive end). The values for the force application angle α and direction of rotation are based on the most unfavorable conditions.

- Only 50% of the F_{Ra} value specified in the selection tables is permitted in mounting position M1 with wall attachment on the front face for AK and AS gear units.
- Helical-bevel gearmotors AK167 and AK187 in mounting positions M1 to M4: A maximum of 50% of the overhung load F_{Ra} specified in the selection tables in the case of gear unit mounting other than as shown in the mounting position sheets.
- Foot and flange-mounted helical gearmotors (AR..F): A maximum of 50% of the overhung load F_{Ra} specified in the selection tables for torque transmission via flange mounting are permitted.

Higher permitted overhung loads

Exactly considering the force application angle α and the direction of rotation makes it possible to achieve a higher overhung load. Higher output shaft loads are permitted if heavy duty bearings are installed, especially with AR,AF and AK gear units.

Definition of the force application

The force application is defined according to the following figure:

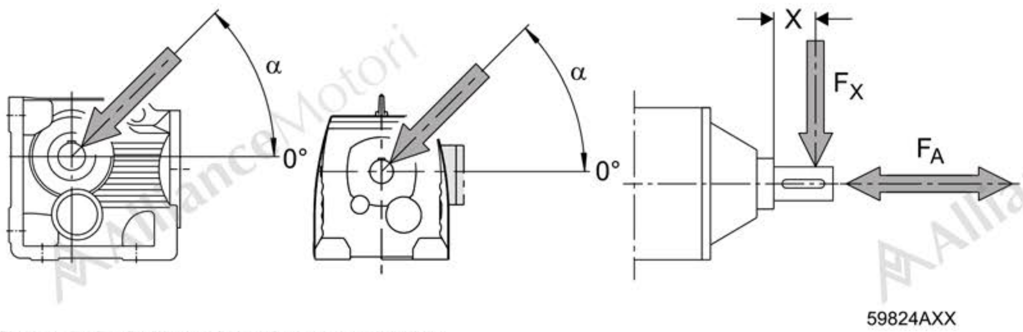


Figure 5: Definition of the force application

F_X = Permitted overhung load at point x [N]

F_A = Permitted axial load [N]

Permitted axial load

If there is no overhung load, then an axial force F_A (tension or compression) amounting to 50% of the overhung load given in the selection tables is permitted. This condition applies to the following gearmotors:

- Helical gearmotors except for AR..137... to AR..167...
- Parallel-shaft and helical-bevel gearmotors with solid shaft except for AF97...
- Helical-worm gearmotors with solid shaft

Contact AllianceMotori for all other types of gear units and in the event of significantly greater axial forces or combinations of overhung load and axial force.

On the output side: Overhung load conversion for off-center force application

The permitted overhung loads must be calculated according the selection tables using the following formulae in the event that force is not applied at the center of the shaft end. The smaller of the two values F_{xL} (according to bearing life) and F_{xW} (according to shaft strength) is the permitted value for the overhung load at point x. Note that the calculations apply to $M_{a\,max}$.

F_{xL} according to bearing service life

$$F_{xL} = F_{Ramax} \cdot \frac{a}{b + x} \text{ [N]}$$

F_{xW} from the Shaft strength:

$$F_{xW} = \frac{c}{f + x} \text{ [N]}$$

F_{Ra} = Permitted overhung load (x = l/2) for foot-mounted gear units according to the selection tables in [N]

x = Distance from the shaft shoulder to the force application point in [mm]

a, b, f = Gear unit constant for overhung load conversion [mm]

c = Gear unit constant for overhung load conversion [Nmm]

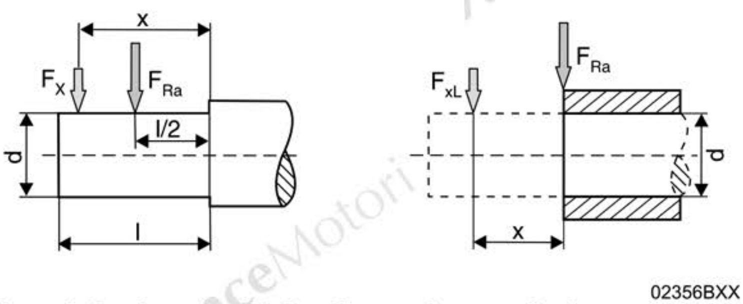


Figure 6: Overhung load F_x for off-center force application

Gear unit constants for overhung load conversion

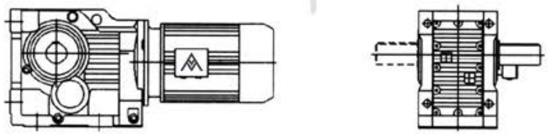
Gear unit type	a [mm]	b [mm]	c [Nmm]	f [mm]	d [mm]	l [mm]
ARX57	43.5	23.5	$1.51 \bullet 10^5$	34.2	20	40
ARX67	52.5	27.5	$2.42 \bullet 10^5$	39.7	25	50
ARX77	60.5	30.5	$1.95 \bullet 10^5$	0	30	60
ARX87	73.5	33.5	$7.69 \bullet 10^5$	48.9	40	80
ARX97	86.5	36.5	$1.43 \bullet 10^6$	53.9	50	100
ARX107	102.5	42.5	$2.47 \bullet 10^6$	62.3	60	120
AR07	72.0	52.0	$4.67 \bullet 10^4$	11	20	40
AR17	88.5	68.5	$6.527 \bullet 10^4$	17	20	40
AR27	106.5	81.5	$1.56 \bullet 10^5$	11.8	25	50
AR37	118	93	$1.24 \bullet 10^5$	0	25	50
AR47	137	107	$2.44 \bullet 10^5$	15	30	60
AR57	147.5	112.5	$3.77 \bullet 10^5$	18	35	70
AR67	168.5	133.5	$2.65 \bullet 10^5$	0	35	70
AR77	173.7	133.7	$3.97 \bullet 10^5$	0	40	80
AR87	216.7	166.7	$8.47 \bullet 10^5$	0	50	100
AR97	255.5	195.5	$1.06 \bullet 10^6$	0	60	120
AR107	285.5	215.5	$2.06 \bullet 10^6$	0	70	140
AR137	343.5	258.5	$4.58 \bullet 10^6$	0	90	170
AR147	402	297	$8.65 \bullet 10^6$	33	110	210
AR167	450	345	$1.26 \bullet 10^7$	0	120	210
AF27	109.5	84.5	$1.13 \bullet 10^5$	0	25	50
AF37	123.5	98.5	$1.07 \bullet 10^5$	0	25	50
AF47	153.5	123.5	$1.40 \bullet 10^5$	0	30	60
AF57	170.7	135.7	$2.70 \bullet 10^5$	0	35	70
AF67	181.3	141.3	$4.12 \bullet 10^5$	0	40	80
AF77	215.8	165.8	$7.87 \bullet 10^5$	0	50	100
AF87	263	203	$1.06 \bullet 10^6$	0	60	120
AF97	350	280	$2.09 \bullet 10^6$	0	70	140
AF107	373.5	288.5	$4.23 \bullet 10^6$	0	90	170
AF127	442.5	337.5	$9.45 \bullet 10^6$	0	110	210
AF157	512	407	$1.05 \bullet 10^7$	0	120	210
AK37	123.5	98.5	$1.30 \bullet 10^5$	0	25	50
AK47	153.5	123.5	$1.40 \bullet 10^5$	0	30	60
AK57	169.7	134.7	$2.70 \bullet 10^5$	0	35	70
AK67	181.3	141.3	$4.12 \bullet 10^5$	0	40	80
AK77	215.8	165.8	$7.69 \bullet 10^5$	0	50	100
AK87	252	192	$1.64 \bullet 10^6$	0	60	120
AK97	319	249	$2.8 \bullet 10^6$	0	70	140
AK107	373.5	288.5	$5.53 \bullet 10^6$	0	90	170
AK127	443.5	338.5	$8.31 \bullet 10^6$	0	110	210
AK157	509	404	$1.18 \bullet 10^7$	0	120	210
AK167	621.5	496.5	$1.88 \bullet 10^7$	0	160	250
AK187	720.5	560.5	$3.04 \bullet 10^7$	0	190	320
AS37	118.5	98.5	$6.0 \bullet 10^4$	0	20	40
AS47	130	105	$1.33 \bullet 10^5$	0	25	50
AS57	150	120	$2.14 \bullet 10^5$	0	30	60
AS67	184	149	$3.04 \bullet 10^5$	0	35	70
AS77	224	179	$5.26 \bullet 10^5$	0	45	90
AS87	281.5	221.5	$1.68 \bullet 10^6$	0	60	120
AS97	326.3	256.3	$2.54 \bullet 10^6$	0	70	140

Values for types not listed are available on request.

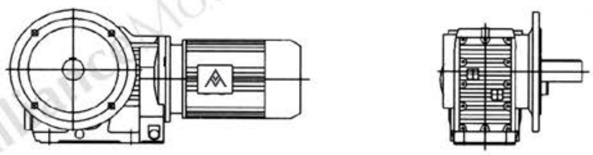
Dimensional Description

Output shafts of GK series geared motors are vertical to input shafts. Each units consist of two stages helical gears and one stage bevel gears.

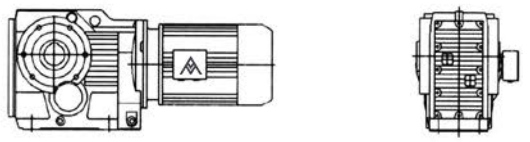
Type AK: Foot mounted Solid output shaft.



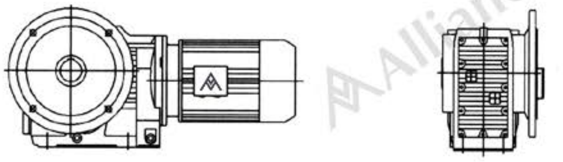
Type AKF: B5 flange mounted Solid output shaft.



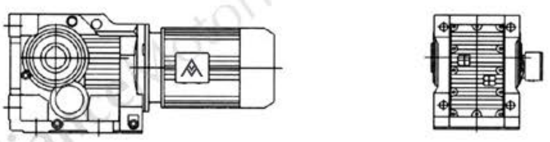
Type AKA: Shaft mounted. Hollow output shaft.



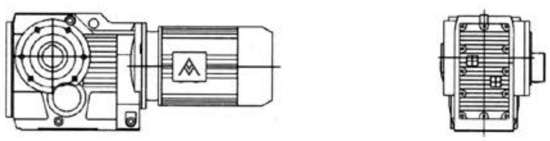
Type AKAF: B5 flange mounted. Hollow output shaft.



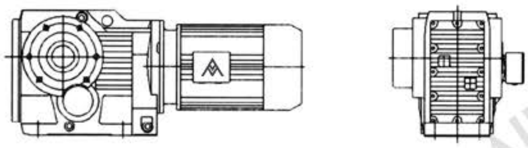
Type AKAB/AKHB: Housings of type GK are used. Hol–low output shaft.



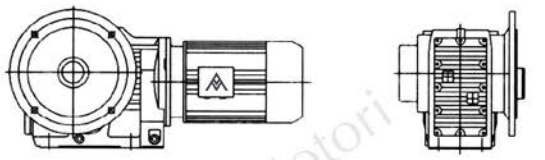
Type AKAZ: B14 flange mounted version with hollow shaft.



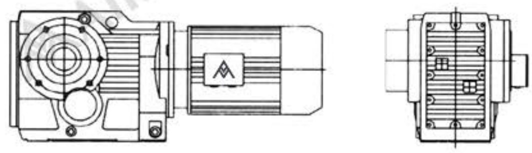
Type AKH: Hollow shaft and shrink disk.



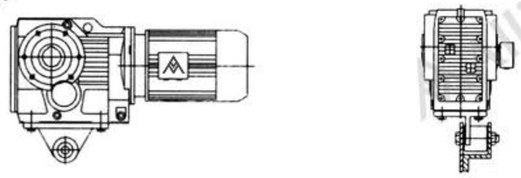
Type AKHF: B5 flange-mounted version with hollow shaft and shrink disk.



Type AKHZ: B14 flange-mounted version with hollow shaft and shrink disk.

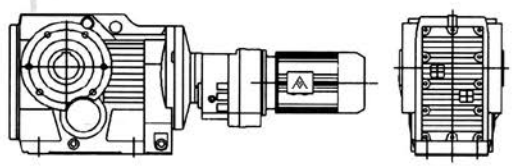


Type AKAT/AKHT: As altered type from type GKA/GKH, this type is added torque arm and other accessories. Basically, accessories except spring washer do not belong to our standard supply.



Type AK..SZ..AD..: Input shaft types.

Type AK...R: Combined types of type GK and type GR.



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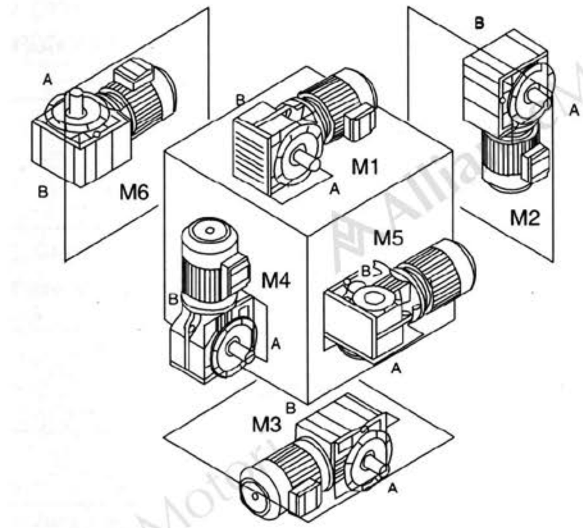
Mounting Arrangements Description



Different kinds of mounting arrangements are defined as following:

M1—horizontally mounted motor, unit base is at bottom.
M2—motor is vertically mounted downwards.
M3—horizontally mounted motor, unit base is top.
M4—motor is vertically mounted upwards.
M5—horizontally mounted motor, if placed on M1 position, left side of unit turns to bottom (view point: towards from motor side).
M6—horizontally mounted motor, if placed on M1 position, left side of unit turns to top (view point: towards from mo–tor side).

(Gear unit weight)

Size	AK37	AK47	AK57	AK67	AK77	AK87	AK97	AK107	AK127	AK157	AK167	AK187
Weight (kg)	14	21	28	32	54	93	153	270	403	630	1122	1630

(Note: The weights mean values, without the motor，only for reference.)

(Description of selection table)

Constant power

n_a [r/min]	M_a [Nm]	i	F_{ra} [kN]	f_B	Type size	Pole
Output speed	Output torque	Gear unit ratio	Permissible radial load	Service factor		

Constant torque

Mamax [Nm]	n_a [r/min]	i	F_{ra} [kN]	Type size	P [kW]/4P
Max. output torque	Output speed	Gear unit ratio	Permissible radial load		Motor power

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