More Than Just Motor Size

Use Application Information to Size Your Gearbox Correctly

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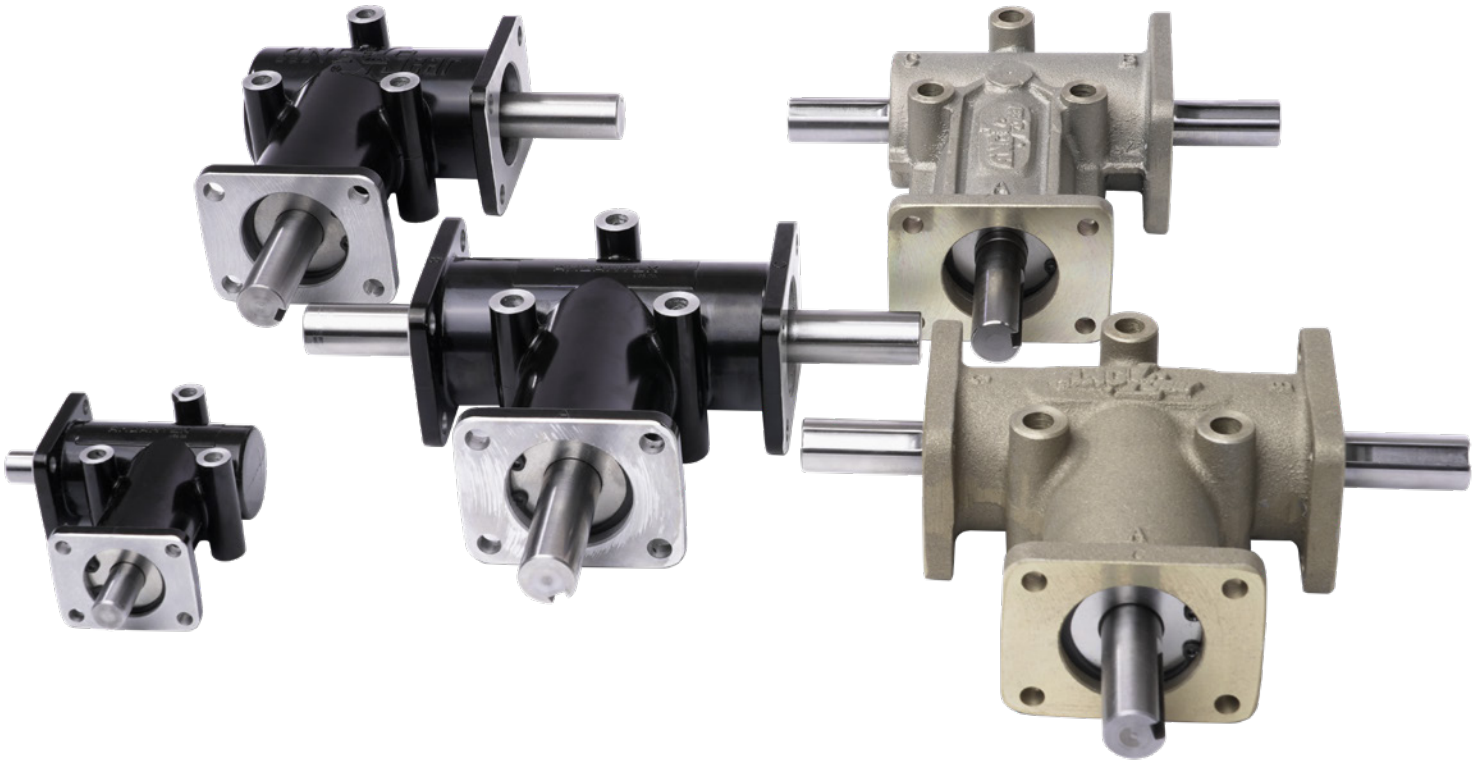


When a right angle gearbox is subjected to a higher torque or horsepower load than its rating, the overload situation will eventually shorten its lifetime. If the overload is mild in severity, the gearbox may operate normally for some period before the increased wear makes replacement necessary.

When your equipment calls for a right angle gearbox, proper sizing makes a difference. A wide range of application factors must be considered, or you will face problems down the road. Possible problems can include increased maintenance, worn teeth and reduced mean time between failure (MTBF). Additionally, an oversized gearbox will cost more money than necessary. This article will provide an overview of how to apply application information to accurately size an Andantex Anglgear right angle gearbox for your installation.

Determine Your Target Speed and Output Torque

To begin sizing, determine the horsepower or torque that must be transmitted in the application. Next, you must consider how fast the output shaft will turn to meet your requirements. Additionally, we must consider both the axial and radial loads applied to the gearbox shafts.

As power and torque requirements increase, the gear set diameter will also increase to transmit the larger forces. As the gearset grows in diameter, the gearbox housing must grow to accommodate the larger gears. Knowing the power and speed, you can always calculate the torque. Or, by knowing the torque and speed, you can calculate the power. The formulae for determining torque and horsepower are shown in Table 1. The axial and radial load ratings can be found in Table 2.

When a right angle gearbox is subjected to a higher torque or horsepower load than its rating, the overload situation will eventually shorten its lifetime. If the overload is mild in severity, the gearbox may operate normally for

some period before the increased wear makes replacement necessary. Severe overloading can result in damaged bearings, broken gear teeth or both. When the axial or radial load ratings are exceeded, it will shorten the life of the bearing thus reducing the between-gearbox replacement. Therefore, some gearbox specifiers may be tempted to size the gearbox to the drive motor, resulting in an oversized gearbox.

For example, if the application requires ¾ hp, a motor manufacturer may recommend a 1 hp motor. When it's time to select the gearbox, the customer may in turn be inclined to select the appropriate gearbox for 1 hp, which may be a unit rated for 1½ hp. The gearbox will be capable of transmitting much greater torque than required, but it will come with a higher price tag, size and weight. That's why it's important to determine your gearbox's service factor requirements.

Understand Service Factor

Gearbox manufacturers typically publish charts that account for the working conditions the gearbox is expected to withstand such as hours of service per day and the type of load—uniform and moderate shock. Service factors for Anglgear right angle gearboxes are shown in Table 1. Note that high-shock or impact loads can prematurely damage gear teeth and bearings. If you expect the application to impose non-uniform loads on a gearbox, be sure to consult the manufacturer to determine the appropriate service factor that will account for those loads.

SERVICE FACTORS

OPERATION CONDITIONS		UNIFORM LOAD	MODERATE SHOCK
SERVICE (hours/day)	3	0.7	0.9
	8	0.9	1
	12	1	1.3
	24	1.3	1.8

$$T\ (in.lb) = 63{,}000 \times HP / RPM$$

$$HP = T \times RPM / 63{,}000$$

Table1—Service factors for Anglgear right angle gearboxes.

Step by Step: How to Size an Anglgear Right Angle Gearbox

1. Determine the output speed and torque required for your application. The maximum recommended output speed for Anglgear right angle gearboxes is 3,000 rpm for 1:1 units and 1,500 rpm for 2:1 units. Note: 2:1 units are *not* recommended for use as speed increasers.
2. Select an application service factor from Table 1. Multiply your torque by the selected service factor.
3. Using Table 2, find your output speed in the left column. If you do not see your output speed, use the next highest speed. Depending on the ratio you require—1:1 or 2:1—follow the chart across until you find a torque value that is larger than your corrected torque value.
4. The unit size for your application will be at the top of that column. Anglgear comes in five sizes, and the bottom of the column lists the various models available for the selected size. Select the model number based on the gear ratio and the number of shafts you need—two or three. When ordering, use the model number you selected along with the desired ratio.

OUTPUT SPEED (RPM)	SIZE 1				SIZE 2				SIZE 3				SIZE 4				SIZE 5	
Ratio	1:1		2:1		1:1		2:1		1:1		2:1		1:1		2:1		1:1	
RATINGS*	in.lb	HP	in.lb	HP	in.lb	HP	in.lb	HP	in.lb	HP	in.lb	HP	in.lb	HP	in.lb	HP	in.lb	HP
50	17	0.01	10	0.01	51	0.04	32	0.03	229	0.18	125	0.01	400	0.32	193	0.15	800	0.63
100	16	0.03	10	0.02	49	0.08	30	0.05	215	0.34	117	0.02	370	0.59	182	0.29	740	1.17
200	15	0.05	9	0.03	48	0.15	28	0.09	207	0.66	110	0.03	345	1.10	172	0.55	700	2.22
300	15	0.07	9	0.04	47	0.23	27	0.13	205	0.98	105	0.04	325	1.55	162	0.77	660	3.14
400	14	0.09	8	0.05	47	0.30	26	0.17	203	1.29	100	0.05	310	1.97	154	0.98	625	3.97
500	14	0.11	8	0.06	46	0.37	25	0.20	200	1.59	96	0.06	300	2.38	148	1.17	600	4.76
750	13	0.15	8	0.09	46	0.54	24	0.29	196	2.34	91	0.09	278	3.31	137	1.63	565	6.73
1000	13	0.20	8	0.12	45	0.71	23	0.37	193	3.06	87	0.12	265	4.21	130	2.06	540	8.57
1250	13	0.25	7	0.14	44	0.88	23	0.45	190	3.77	84	0.14	260	5.16	128	2.53	520	10.32
1500	13	0.30	7	0.17	44	1.05	23	0.54	187	4.45	81	0.17	257	6.11	125	2.98	500	11.90
1750	12	0.34			43	1.21			185	5.14			254	7.04			485	13.47
2000	12	0.39			43	1.37			183	5.80			250	7.95			470	14.92
2500	12	0.48			42	1.68			179	7.11			245	9.73			448	17.76
3000	12	0.57			42	1.99			176	8.39			241	11.5			435	20.24
2-WAY	R3000		R3000-2		R3200		R3200-2		R3330		R3330-2		R3400		R3400-2		R3570	
3-WAY	R3100		R3100-2		R3300		R3300-2		R3350		R3350-2		R3500		R3500-2		R3590	
2-WAY	R3003		R3003-2		R3203		R3203-2											
3-WAY	R3103		R3103-2		R3303		R3303-2											

MODEL DATA (lbs)	R3000		R3100		R3200		R3300		R3330		R3350		R3400		R3500		R3570	R3590
	1:1	2:1	1:1	2:1	1:1	2:1	1:1	2:1	1:1	2:1	1:1	2:1	1:1	2:1	1:1	2:1	1:1	1:1
RADIAL LOAD	25	25	25	25	50	50	50	50	100	100	100	100	100	100	100	100	100	100
THRUST LOAD	50	50	50	50	100	100	100	100	200	200	200	200	200	200	200	200	200	200
WEIGHT	0.5	0.5	0.5	0.5	2.2	2.2	2.4	2.4	8.7	8.7	9.0	9.0	14.5	14.5	15	15	17.5	18

* Unit ratings are: Output Torque in in.lb and Output Power in HP.

Table2—Andantex Anglgear selection chart: Note the unit ratings output torque (in.lb) and outpower power (hp).

5. Check the applied radial and thrust loads on the unit compared with the loads in Table 2. If the applied loads are larger than the chart values, select a larger unit.

Andantex Anglgear right angle gearboxes are available in both imperial and metric versions, and each appear in separate sections of our catalog. When ordering, keep in mind that the versions are not interchangeable. Shaft diameters are available in either imperial or metric measurements, and the housings are also measured to each system.

When to Size Up

Although it's important to avoid oversizing a gearbox, there are times that specifiers may have to go up in size.

Overhung loads

Failure to address an overhung load could result in reduced bearing life and possibly misaligned gears that may cause the gear teeth to deteriorate. If you anticipate an overhung

load, manufacturers publish an acceptable overhung load value for a specific gearbox size. If your overhung load exceeds that value, the manufacturer typically recommends the next size up.

Shafts

Anglgear gearboxes are available with output shafts. If the size is smaller than the application's size requirements, consider a larger size or work with your manufacturer to create a custom gearbox. Andantex specializes in creating custom gearboxes, and we can design or modify units with special shaft lengths and configurations.

Applied loads

As mentioned previously, if applied load values are larger than those in the manufacturer's chart, move up to a size that can accommodate them. Be sure to consider how the gearbox will be coupled to the application. Whether coupled directly or via a belt or chain drive, your coupling method is critical to calculate the radial loads your gearbox will handle.

Environment, Construction and Other Considerations

In addition to applying power, torque, and load factors to determine the size of your gearbox during selection, you must also consider aspects pertaining to the unit's operating environment and construction. For example, aluminum housings are standard for Anglgear gearboxes. However, aluminum is not always optimal under certain conditions, such as when corrosive chemicals are present.

Food and beverage environments can also be tough on gearbox housings. They will be subjected to frequent washdowns and harsh chemicals. For these environments, Andantex offers Anglgear "specials"—units customized with hard anodized coatings, nickel-plated aluminum housings and epoxy-painted housings with the appropriate shaft seals. Larger versions of Anglgear come with carbon steel shafts, so be sure to consult with us for units subject to wet or corrosive conditions.

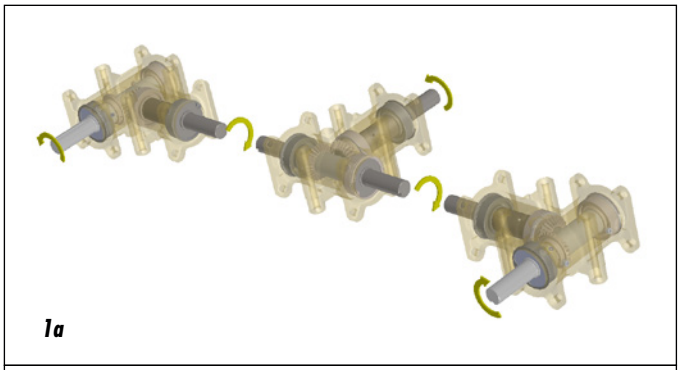
Other considerations include:

- High temperature: Be sure to bring high-temperature environments to the manufacturer's attention.
- Backlash: For reversing and positioning applications, consider a modified gearbox or one that is configured to ensure zero backlash.
- Special greases and coatings for applications in vacuum, high heat, and food environments: Your gearbox manufacturer can provide sizing assistance for these applications.
- Hand operation: Sometimes engineers specify a smaller gearbox for hand-operated systems, without considering that a human can apply more force than the gearbox can tolerate without protection.

Consider A Special Design

Although sizing a right angle gearbox is a straightforward process when applying your power and torque requirements, there may be times when you will need help from your gearbox manufacturer. Andantex works closely with customers, and if a standard unit doesn't fit the requirements, we have the technical means to modify a gearbox or create "special" designs. Examples include:

- Non-standard sizes including various shaft lengths and configurations.
- Changing the relative rotation of input-to-output shafts (BO).
- Three-way units with counter-rotating output shafts.
- Shafts with flats, splines, holes and hexagonal outputs.
- Modifications to the mounting flanges and housing.
- Special materials, bearings, seals, greases and coatings.



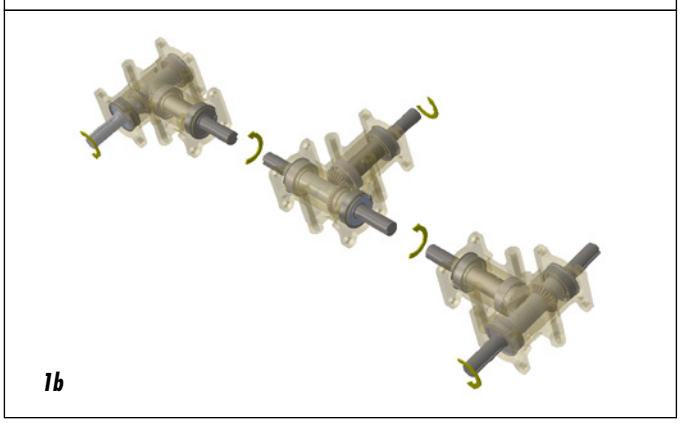


Figure 1a and 1b—Anglgear gearboxes can be outfitted with opposite-rotation input-to-output shafts (a) or the same rotation of input-to-output shafts (b).

Remember All Your Application Factors

When sizing a right angle gearbox, it can be tempting to specify a size according to the drive motor size. However, many factors must be considered to deliver optimal performance and reliability without costly oversizing. Be sure to bring as much application information into the selection process as possible and carefully consider all the factors presented above. By doing so, you'll correctly size a gearbox to match your needs.

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