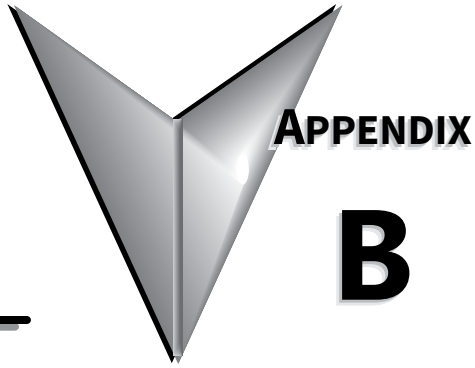
GEARBOX SELECTION



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Gearbox Selection Steps

1) Determine the torque and speed required for the load.
2) Determine the overall speed ratio of motor speed to load speed.
3) Determine the gearbox ratio as well as any reduction outside the gearbox (pulleys, gears, etc.).
4) Determine the applicable service factor and overhung load K factor.
5) Determine the gearbox real output torque required, and select a gearbox with a higher Maximum Thermal output Torque rating.
6) Determine the gearbox design output torque required (torque with service factor applied), and select a gearbox with a higher Maximum Mechanical Output Torque rating. (Gearbox must also meet requirement #5.)
7) Determine the required sizes of pulleys, gears, etc., and determine the overhung load force. Select a gearbox with a higher Overhung Load rating. (Gearbox must also meet requirements #5 & #6.)
8) Confirm that the selected gearbox meets the applicable system requirements.
9) Select a compatible motor.

Gearbox Selection Example

(Refer to the specifications tables for gearbox specifications, service factors, and K factors.)

A conveyor will run 8 hours/day with moderate shock loading. The conveyor will be driven by a v-belt and needs to be driven approximately 30 rpm. The motor used will have a nominal speed of 1800 rpm (1750 rpm actual speed). The conveyor will require 5500 in·lb of torque.

1) Required torque = 5500 in·lb; required speed = 30 rpm.
2) Determine the overall speed ratio of motor speed to load speed:
   Overall speed ratio = (motor speed) / (load speed) = 1750 / 30 = 58.33 (about 58:1)
3) Determine pulley ratios at available gearbox ratios:
   Gearbox ratio = (overall speed ratio) / (pulley ratio)
   Pulley ratio = (overall speed ratio) / (gearbox ratio)
   = (conveyor pulley diameter) / (gearbox pulley diameter)
   For ~~5:1 gearbox:~~ pulley ratio = 58.33 / 5 = ~~11.67~~ [11.67 pulley ratio too large]
   For 10:1 gearbox: pulley ratio = 58.33 / 10 = 5.83
   For 15:1 gearbox: pulley ratio = 58.33 / 15 = 3.89
   For 20:1 gearbox: pulley ratio = 58.33 / 20 = 2.92
   For 30:1 gearbox: pulley ratio = 58.33 / 30 = 1.94
   For 40:1 gearbox: pulley ratio = 58.33 / 40 = 1.46
   For ~~60:1 gearbox:~~ pulley ratio = 58.33 / 60 = ~~0.97~~ [0.97 pulley ratio too small]
4) Determine service factor (SF) and overhung load factor (K) from applicable tables:
   SF = 1.25 due to moderate shock loading and 3-10 hours/day operation
   K = 1.5 due to V-belt

5) Use specification table to select gearbox with Max Output Torque Rating > required real torque:
Gearbox required real torque = (final torque) / (pulley ratio)

For 10:1 gearbox:	(5500 lb·in) / 5.83 = 943.40 lb·in;	use HGR-37-x or larger
For 15:1 gearbox:	(5500 lb·in) / 3.89 = 1413.88 lb·in;	use HGR-37-x or larger
For 20:1 gearbox:	(5500 lb·in) / 2.92 = 1883.56 lb·in;	use HGR-47-x or larger
For 30:1 gearbox:	(5500 lb·in) / 1.94 = 2835.05 lb·in;	use HGR-67-x or larger
For 40:1 gearbox:	(5500 lb·in) / 1.46 = 3767.12 lb·in;	use HGR-67-x or larger

6) Use specifications table to select gearbox with Max Output Torque Rating > required design torque:
Gearbox required design torque = (real gearbox torque)(service factor)

For 10:1 gearbox:	(943.40 lb·in)(1.25) = 1179.25 lb·in;	use HGR-37-x or larger
For 15:1 gearbox:	(1413.88 lb·in)(1.25) = 1767.35 lb·in;	use HGR-47-x or larger
For 20:1 gearbox:	(1883.56 lb·in)(1.25) = 2354.45 lb·in;	use HGR-47-x or larger
For 30:1 gearbox:	(2835.05 lb·in)(1.25) = 3543.81 lb·in;	use HGR-67-x or larger
For 40:1 gearbox:	(3767.12 lb·in)(1.25) = 4708.90 lb·in;	use HGR-67-x or larger

7) Use the gearbox overhung load ratings from the specifications table to determine the minimum allowable pulley diameter.
Select gearbox with Overhung Load Rating > overhung load force:
Gearbox required OHL rating = (gearbox real torque)(K)(SF)/(gearbox pulley diameter / 2)
Minimum gearbox pulley diameter = (T)(K)(SF)(2) / (OHL rating)
Conveyor pulley diameter = (gearbox pulley diameter)(pulley ratio)

For 10:1, HGR-37-010-x gearbox:
Minimum gearbox pulley diameter = (943.40 lb·in)(1.5)(1.25)(2)/(388 lb) = 9.12” (use 9.25”)
Conveyor pulley diameter = (9.25”)(5.83) = ~~53.93”~~
[pulley size is too large; try next higher gearbox ratio]

For 15:1, HGR-37-015-x gearbox:
Minimum gearbox pulley diameter = (1413.88 lb·in)(1.5)(1.25)(2)/(451 lb) = 11.76” (use 11.8”)
Conveyor pulley diameter = (11.8”)(3.89) = ~~45.9”~~
[pulley size is too large; try next higher gearbox ratio]

For 20:1, HGR-47-020-x gearbox:
Minimum gearbox pulley diameter = (1883.56 lb·in)(1.5)(1.25)(2)/(690 lb) = 10.24” (use 10.3”)
Conveyor pulley diameter = (10.3”)(2.92) = ~~30.08”~~
[pulley size is too large; try next higher gearbox ratio]

For 30:1, HGR-67-030-x gearbox:
Minimum gearbox pulley diameter = (2835.05 lb·in)(1.5)(1.25)(2)/(1305 lb) = 8.15” (use 8.5”)
Conveyor pulley diameter = (8.5”)(1.94) = 16.5” (use 16.0”)
Select HGR-67-030-x gearbox, 8.5” gearbox pulley and 16” conveyor pulley.

For 40:1, HGR-67-040-x gearbox:
N/A – All gearboxes of the same frame size are the same price, yet the smaller ratio gearboxes offer higher efficiency and power characteristics than higher ratio gearboxes. Therefore, the HGR-67-030-x gearbox is preferable over the HGR-67-040-x gearbox for this application.

8) Check results against original speed and torque requirements:
NOTE: Actual gearbox ratio is used from the specifications table.
   a) Conveyor speed = (motor speed) / ((gearbox ratio)(pulley ratio))
      = (1750 rpm) / (32.02)(16.0”/8.5”) = 29.03 rpm
   b) Max real torque available at conveyor = (gearbox output torque)(pulley ratio)
      = (5045 lb·in)(1.94) = 9787.3 lb·in
   c) Max design torque available at conveyor = (gearbox output torque)(pulley ratio)/SF
      = (5045 lb·in)(16.0”/8.5”) / 1.25 = 7829.8 lb·in

The speed is very close to the required speed, and both maximum torque values are greater than the 5500 lb·in required by the load. Minor changes to pulley sizes can be tried to get conveyor speed closer to the required 30 rpm.

9) Select a motor and check torque transmitted to the load:
From the gearbox spec tables, HGR-67-030-B efficiency = 94%
   Max mechanical input power @ 1.0 SF = 4.83 hp
   Max mechanical input power @ 1.25 SF
      = (max input power) / (SF) = 4.83 hp / 1.25 = 3.86 hp
   Max allowable motor power = 3.86 hp

The largest motor that HGR-67-030-B can accept is 2 hp.

Select 2 hp motor, and check for adequate torque at the load:
Torque = Power / Speed *[conversion factor: 1 hp = 63,025 lb·in·rpm]*
$Torque_{load}$
= (63025 lb·in·rpm/hp)(motor hp)(gearbox efficiency)/(motor rpm/(gearbox ratio)(pulley ratio))
= (63025)(2)(0.906) / (1750 / ((30)(16/8.5))) = ~~3685.15 lb·in~~ [insufficient torque at load]

This torque value is less than the required 5500 lb·in required by the load.
Since a larger motor will not fit on the HGR-67-030-B, select HGR-77-030-C gearbox with a 3 hp motor.

From the gearbox spec tables, HGR-77-030-C efficiency = 90.7%
   Max mechanical input power @ 1.0 SF = 6.36 hp
   Max mechanical input power @ 1.25 SF = (max input power) / (SF)
      = 6.36 hp / 1.25 = 5.09 hp
   Max allowable motor power = 5.09 hp

The largest motor that HGR-77-030-C can accept is 5 hp.

Select 3 hp motor, and check for adequate torque at the load:
$Torque_{load}$ = (63025)(3)(0.907) / (1750 / ((30)(16/8.5))
= 5533.8 lb·in > 5500 lb·in

Final Selection: HGR-77-030-C gearbox 3 hp motor