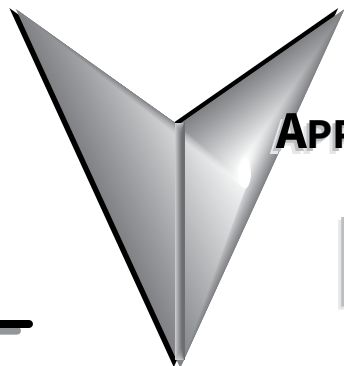


GEARBOX SELECTION



APPENDIX

B

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GEARBOX SELECTION PROCEDURE

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 at approximately 20 rpm. The motor used will have a nominal speed of 1800 rpm (1750 rpm actual speed). The conveyor will require 5500 lb·in of torque.

- 1) Required torque = 5500 lb·in; required speed = 20 rpm
- 2) Determine the overall speed ratio of motor speed to load speed:
 $Overall\ speed\ ratio = motor\ speed / load\ speed = 1750 / 20 = 87.5$ (about 88:1)
- 3) Determine pulley ratios at available gearbox ratios:
 $Pulley\ ratio = (overall\ speed\ ratio) / (gearbox\ ratio)$

For 10:1 gearbox:	pulley ratio = $87.5/10 = 8.75$
For 20:1 gearbox:	pulley ratio = $87.5/20 = 4.38$
For 25:1 gearbox:	pulley ratio = $87.5/25 = 3.50$
For 40:1 gearbox:	pulley ratio = $87.5/40 = 2.19$
For 60:1 gearbox:	pulley ratio = $87.5/60 = 1.46$
For 65:1 gearbox:	pulley ratio = $87.5/65 = 1.35$
For 80:1 gearbox:	pulley ratio = $87.5/80 = 1.09$
For 85:1 gearbox:	pulley ratio = $87.5/85 = 1.03$
For 120:1 gearbox:	pulley ratio = $87.5/120 = 0.73$

 $Pulley\ ratio = (conveyor\ or\ pulley\ diameter) / (gearbox\ pulley\ diameter)$
- 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 specifications table to select gearbox with Max Output Torque Rating > required real torque:

$$\text{Gearbox required real torque} = (\text{final torque})(\text{pulley ratio})$$

For 10:1 gearbox:	$(5500 \text{ lb}\cdot\text{in}) / 8.75 = 628.57 \text{ lb}\cdot\text{in};$	use HBR-37-x or larger
For 20:1 gearbox:	$(5500 \text{ lb}\cdot\text{in}) / 4.38 = 1255.71 \text{ lb}\cdot\text{in};$	use HBR-47-x or larger
For 25:1 gearbox:	$(5500 \text{ lb}\cdot\text{in}) / 3.50 = 1571.43 \text{ lb}\cdot\text{in};$	use HBR-37-x
For 40:1 gearbox:	$(5500 \text{ lb}\cdot\text{in}) / 2.19 = 2511.42 \text{ lb}\cdot\text{in};$	use HBR-47-x or larger
For 60:1 gearbox:	$(5500 \text{ lb}\cdot\text{in}) / 1.46 = 3767.12 \text{ lb}\cdot\text{in};$	use HBR-77-x or larger
For 65:1 gearbox:	$(5500 \text{ lb}\cdot\text{in}) / 1.35 = 4074.07 \text{ lb}\cdot\text{in};$	use HBR-67-x or larger
For 80:1 gearbox:	$(5500 \text{ lb}\cdot\text{in}) / 1.09 = 5045.87 \text{ lb}\cdot\text{in};$	use HBR-77-x or larger
For 85:1 gearbox:	$(5500 \text{ lb}\cdot\text{in}) / 1.03 = 5339.81 \text{ lb}\cdot\text{in};$	use HBR-67-x or larger
For 120:1 gearbox:	$(5500 \text{ lb}\cdot\text{in}) / 0.73 = 7534.25 \text{ lb}\cdot\text{in};$	use HBR-77-x or larger

- 6) Use specifications table to select gearbox with Max Output Torque Rating > required design torque:

$$\text{Gearbox required design torque} = (\text{gearbox required real torque})(\text{service factor})$$

For 10:1 gearbox:	$(628.57 \text{ lb}\cdot\text{in}) / (1.25) = 785.72 \text{ lb}\cdot\text{in};$	use HBR-37-x or larger
For 20:1 gearbox:	$(1255.71 \text{ lb}\cdot\text{in}) / (1.25) = 1569.64 \text{ lb}\cdot\text{in};$	use HBR-47-x or larger
For 25:1 gearbox:	$(1571.43 \text{ lb}\cdot\text{in}) / (1.25) = 1964.29 \text{ lb}\cdot\text{in};$	none available
For 40:1 gearbox:	$(2511.42 \text{ lb}\cdot\text{in}) / (1.25) = 3139.28 \text{ lb}\cdot\text{in};$	use HBR-47-x or larger
For 60:1 gearbox:	$(3767.12 \text{ lb}\cdot\text{in}) / (1.25) = 4708.90 \text{ lb}\cdot\text{in};$	use HBR-77-x or larger
For 65:1 gearbox:	$(4074.07 \text{ lb}\cdot\text{in}) / (1.25) = 5092.59 \text{ lb}\cdot\text{in};$	use HBR-67-x or larger
For 80:1 gearbox:	$(5045.87 \text{ lb}\cdot\text{in}) / (1.25) = 6307.34 \text{ lb}\cdot\text{in};$	use HBR-77-x or larger
For 85:1 gearbox:	$(5339.81 \text{ lb}\cdot\text{in}) / (1.25) = 6674.76 \text{ lb}\cdot\text{in};$	use HBR-67-x or larger
For 120:1 gearbox:	$(7534.25 \text{ lb}\cdot\text{in}) / (1.25) = 9417.81 \text{ lb}\cdot\text{in};$	use HBR-77-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 =

$$(\text{gearbox required real torque})(K)(SF) / (\text{gearbox pulley diameter} / 2)$$

$$\text{Minimum gearbox pulley diameter} = (T)(K)(SF)(2) / (\text{OHL rating})$$

$$\text{Conveyor pulley diameter} = (\text{gearbox pulley diameter})(\text{pulley ratio})$$

For 10:1, HBR-37-010-A gearbox:

$$\text{Minimum gearbox pulley diameter} = (628.57 \text{ lb}\cdot\text{in})(1.5)(1.25)(2) / (475 \text{ lb}) = 4.96'' \text{ (use 5.0'')}$$

$$\text{Conveyor pulley diameter} = (5.0'')(8.75) = 43.75''$$

[pulley size is too large; try next higher gearbox ratio]

For 20:1, HBR-47-020-B gearbox:

$$\text{Minimum gearbox pulley diameter} = (1255.71 \text{ lb}\cdot\text{in})(1.5)(1.25)(2) / (690 \text{ lb}) = 6.82'' \text{ (use 6.8'')}$$

$$\text{Conveyor pulley diameter} = (6.8'')(4.38) = 29.78''$$

[pulley size is too large; try next higher gearbox ratio]

For 40:1, HGR-67-040-A gearbox:

$$\text{Minimum gearbox pulley diameter} = (2511.42 \text{ lb}\cdot\text{in})(1.5)(1.25)(2) / (2140 \text{ lb}) = 4.4'' \text{ (use 4.4'')}$$

$$\text{Conveyor pulley diameter} = (4.4'')(2.19) = 9.63'' \text{ (use 9.4'')}$$

Select HGR-67-040-A gearbox, 4.4" gearbox pulley, and 9.4" conveyor pulley.

For 60:1, HBR-67-065-A 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-67-040-A gearbox is preferable over the HBR-67-065-A 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) =
 $(1750 \text{ rpm}) / (37.98)(9.4''/4.4'') = 21.57 \text{ rpm}$
- b) Max real torque available at conveyor =
 (gearbox output torque from specification table)(pulley ratio) =
 $(5730 \text{ lb}\cdot\text{in})(2.19) = 12534.38 \text{ lb}\cdot\text{in}$
- c) Max design torque available at conveyor =
 (gearbox output torque from specification table)(pulley ratio) / SF =
 $(5730 \text{ lb}\cdot\text{in})(9.4''/4.4'') / 1.25 = 9793.09 \text{ lb}\cdot\text{in}$

The speed is very close to required 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 20 rpm.

- 9) Select a motor and check torque transmitted to the load:

From the gearbox spec tables, HBR-67-040-A:

Max mechanical input power @ 1.0 SF = 4.62 hp

Max mechanical input power @ 1.25 SF = (max input power) / (SF) =
 $4.62 \text{ hp} / 1.25 = 3.70 \text{ hp}$ (use 3 hp)

- a) Select 3 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)(motor hp) / (motor rpm/(gearbox ratio)(pulley ratio)) =
 $(63025)(3) / (1750 / ((40)(9.4/4.4))) = 9232.75 \text{ lb}\cdot\text{in}$

Although a 3 hp motor can be used, the torque value far exceeds the required 5500 lb·in.

- b) Try 2 hp motor to reduce motor size:

Torque load = (63025 lb·in·rpm)(motor hp) / (motor rpm/(gearbox ratio)(pulley ratio)) =
 $(63025)(2) / (1750 / ((40)(9.4/4.4))) = 6155.17 \text{ lb}\cdot\text{in}$

This torque value is greater than the required 5500 lb·in required by the load.

Final Selection: HBR-67-040-A gearbox 2hp motor

AGMA SERVICE FACTORS

A.G.M.A. Service Factors for Spur, Helical & Bevel Gear Drives & Reducers with Uniform Power Source			
Application	Total Operation [hr/day]		
	Up to 3	3 to 10	Over 10
Agitators (mixers)			
Pure liquids	1.00	1.00	1.25
Liquids and solids	1.00	1.25	1.50
Liquids - variable density	1.00	1.25	1.50
Blowers			
Centrifugal	1.00	1.00	1.25
Lobe	1.00	1.25	1.50
Vane	1.00	1.25	1.50
Brewing and distilling			
Bottling machinery	1.00	1.00	1.25
Brew kettles - continuous duty	1.25	1.25	1.25
Cookers - continuous duty	1.25	1.25	1.25
Mash tubs - continuous duty	1.25	1.25	1.25
Scale hopper - frequent starts	1.25	1.25	1.50
Can filling machines	1.00	1.00	1.25
Car dumpers	1.50	1.75	2.00
Car pullers	1.00	1.25	1.50
Clarifiers	1.00	1.00	1.25
Classifiers	1.00	1.25	1.50
Clay working machinery			
Brick press	1.50	1.75	2.00
Briquette machine	1.50	1.75	2.00
Pug mill	1.00	1.25	1.50
Compactors	2.00	2.00	2.00
Compressors			
Centrifugal	1.00	1.00	1.25
Lobe	1.00	1.25	1.50
Reciprocating, multi-cylinder	1.50	1.50	1.75
Reciprocating, single-cylinder	1.75	1.75	2.00
1) Crane drives are to be selected based on gear tooth bending strength. Contact gear manufacturer for strength ratings. Service factor in durability shall be a minimum of 1.0. 2) Service factors for paper mill applications are applied to the nameplate rating of the electric drive motor at the motor rated base speed. 3) Anti-friction bearings only. Use 1.5 for sleeve bearings. 4) A service factor of 1.00 may be applied at base speed of a super calender operating over-speed range of part range constant horsepower, part range constant torque where the constant horsepower speed range is greater than 1.5 to 1. A service factor of 1.25 is applicable to super calenders operating over the entire speed range at constant torque or where the constant horsepower speed range is less than 1.5 to 1.			
(table continued next page)			

A.G.M.A. Service Factors for Spur, Helical & Bevel Gear Drives & Reducers with Uniform Power Source (continued)			
Application	Total Operation [hr/day]		
	Up to 3	3 to 10	Over 10
Cranes 1)			
Dry dock			
Main hoist	2.50	2.50	2.50
Auxiliary hoist	2.50	2.50	3.00
Boom hoist	2.50	2.50	3.00
Slewing drive	2.50	2.50	3.00
Traction drive	3.00	3.00	3.00
Container			
Main hoist	3.00	3.00	3.00
Boom hoist	2.00	2.00	2.00
Trolley drive			
Gantry drive	3.00	3.00	3.00
Traction drive	2.00	2.00	2.00
Mill duty			
Main hoist	3.50	3.50	3.50
Auxiliary	3.50	3.50	3.50
Bridge	2.50	3.00	3.00
Trolley travel	2.50	3.00	3.00
Industrial duty			
Main	2.50	2.50	3.00
Auxiliary	2.50	2.50	3.00
Bridge	2.50	3.00	3.00
Trolley travel	2.50	3.00	3.00
Crusher			
Stone or ore	1.75	1.75	2.00
Dredges			
Cable reels	1.25	1.25	1.50
Conveyors	1.25	1.25	1.50
Cutter head drives	2.00	2.00	2.00
Pumps	2.00	2.00	2.00
Screen drives	1.75	1.75	2.00
Stackers	1.25	1.25	1.50
Winches	1.25	1.25	1.50
Elevators			
Bucket	1.00	1.25	1.50
Centrifugal discharge	1.00	1.00	1.25
Escalators	1.00	1.00	1.25
Freight	1.00	1.25	1.50
Gravity discharge	1.00	1.00	1.25
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(table continued next page)			

A.G.M.A. Service Factors for Spur, Helical & Bevel Gear Drives & Reducers with Uniform Power Source (continued)			
Application	Total Operation [hr/day]		
	Up to 3	3 to 10	Over 10
Extruders			
General	1.50	1.50	1.50
Plastics			
Variable speed drive	1.50	1.50	1.50
Fixed speed drive	1.75	1.75	1.75
Rubber			
Continuous screw operation	1.75	1.75	1.75
Intermittent screw operation	1.75	1.75	1.75
Fans			
Centrifugal	1.00	1.00	1.25
Cooling towers	2.00	2.00	2.00
Forced draft	1.25	1.25	1.25
Induced draft	1.50	1.50	1.50
Industrial & mine	1.50	1.50	1.50
Feeders			
Apron	1.00	1.25	1.50
Belt	1.00	1.25	1.50
Disc	1.00	1.00	1.25
Reciprocating	1.50	1.75	2.00
Screw	1.00	1.25	1.50
Food industry			
Cereal cooker	1.00	1.00	1.25
Dough mixer	1.25	1.25	1.50
Meat grinders	1.25	1.25	1.50
Slicers	1.25	1.25	1.50
Generators and excitors	1.00	1.00	1.25
Hammer mills	1.75	1.75	2.00
Hoists			
Heavy duty	1.75	1.75	2.00
Medium duty	1.25	1.25	1.50
Skip hoist	1.25	1.25	1.50
Laundry			
Tumblers	1.25	1.25	1.50
Washers	1.50	1.50	2.00
1) Crane drives are to be selected based on gear tooth bending strength. Contact gear manufacturer for strength ratings. Service factor in durability shall be a minimum of 1.0. 2) Service factors for paper mill applications are applied to the nameplate rating of the electric drive motor at the motor rated base speed. 3) Anti-friction bearings only. Use 1.5 for sleeve bearings. 4) A service factor of 1.00 may be applied at base speed of a super calender operating over-speed range of part range constant horsepower, part range constant torque where the constant horsepower speed range is greater than 1.5 to 1. A service factor of 1.25 is applicable to super calenders operating over the entire speed range at constant torque or where the constant horsepower speed range is less than 1.5 to 1.			
(table continued next page)			

A.G.M.A. Service Factors for Spur, Helical & Bevel Gear Drives & Reducers with Uniform Power Source (continued)			
Application	Total Operation [hr/day]		
	Up to 3	3 to 10	Over 10
Lumber industry			
Barkers - spindle feed	1.25	1.25	1.50
Main drive	1.75	1.75	1.75
Conveyors - burner	1.25	1.25	1.50
Main or heavy duty	1.50	1.50	1.50
Main log	1.75	1.75	2.00
Re-saw, merry-go-round	1.25	1.25	1.50
Conveyors			
Slab	1.75	1.75	2.00
Transfer	1.25	1.25	1.50
Chains			
Floor	1.50	1.50	1.50
Green	1.50	1.50	1.75
Cut-off saws			
Chain	1.50	1.50	1.75
Drag	1.50	1.50	1.75
Debarking drums	1.75	1.75	2.00
Feeds			
Edger	1.25	1.25	1.50
Gang	1.75	1.75	1.75
Trimmer	1.25	1.25	1.50
Log deck	1.75	1.75	1.75
Log hauls - incline - well type	1.75	1.75	1.75
Log turning devices	1.75	1.75	1.75
Planer feed	1.25	1.25	1.50
Planer tilting hoists	1.50	1.50	1.50
Rolls - live-off bearing - roll cases	1.75	1.75	1.75
Sorting table	1.25	1.25	1.50
Tipple hoist	1.25	1.25	1.50
Transfers			
Chain	1.50	1.50	1.75
Craneway	1.50	1.50	1.75
Tray drives	1.25	1.25	1.50
Veneer lathe drives	1.25	1.25	1.50
1) Crane drives are to be selected based on gear tooth bending strength. Contact gear manufacturer for strength ratings. Service factor in durability shall be a minimum of 1.0. 2) Service factors for paper mill applications are applied to the nameplate rating of the electric drive motor at the motor rated base speed. 3) Anti-friction bearings only. Use 1.5 for sleeve bearings. 4) A service factor of 1.00 may be applied at base speed of a super calender operating over-speed range of part range constant horsepower, part range constant torque where the constant horsepower speed range is greater than 1.5 to 1. A service factor of 1.25 is applicable to super calenders operating over the entire speed range at constant torque or where the constant horsepower speed range is less than 1.5 to 1.			
(table continued next page)			

A.G.M.A. Service Factors for Spur, Helical & Bevel Gear Drives & Reducers with Uniform Power Source (continued)			
Application	Total Operation [hr/day]		
	Up to 3	3 to 10	Over 10
Metal mills			
Draw bench carriage and main drive	1.25	1.25	1.50
Runout table			
Non-reversing			
Group drives	1.50	1.50	1.50
Individual drives	2.00	2.00	2.00
Reversing	2.00	2.00	2.00
Slab pushers	1.50	1.50	1.50
Shears	2.00	2.00	2.00
Wire drawing	1.25	1.25	1.50
Wire winding machine	1.25	1.50	1.50
Metal strip processing machinery			
Bridles	1.25	1.25	1.50
Coilers & uncoilers	1.00	1.00	1.25
Edge trimmers	1.00	1.25	1.50
Flatteners	1.25	1.25	1.50
Loopers (accumulators)	1.00	1.00	1.25
Pinch rolls	1.25	1.25	1.50
Scrap choppers	1.25	1.25	1.50
Shears	2.00	2.00	2.00
Slitters	1.00	1.25	1.50
Mills, rotary type			
Spur ring gear	2.00	2.00	2.00
Helical ring gear	1.50	1.50	1.50
Direct connected	2.00	2.00	2.00
Cement kilns	1.50	1.50	1.50
Dryers & coolers	1.50	1.50	1.50
Mixers			
Concrete	1.25	1.25	1.50
<p>1) Crane drives are to be selected based on gear tooth bending strength. Contact gear manufacturer for strength ratings. Service factor in durability shall be a minimum of 1.0.</p> <p>2) Service factors for paper mill applications are applied to the nameplate rating of the electric drive motor at the motor rated base speed.</p> <p>3) Anti-friction bearings only. Use 1.5 for sleeve bearings.</p> <p>4) A service factor of 1.00 may be applied at base speed of a super calender operating over-speed range of part range constant horsepower, part range constant torque where the constant horsepower speed range is greater than 1.5 to 1. A service factor of 1.25 is applicable to super calenders operating over the entire speed range at constant torque or where the constant horsepower speed range is less than 1.5 to 1.</p>			
(table continued next page)			

A.G.M.A. Service Factors for Spur, Helical & Bevel Gear Drives & Reducers with Uniform Power Source (continued)			
Application	Total Operation [hr/day]		
	Up to 3	3 to 10	Over 10
Paper mills 2)			
Agitator (mixer)	1.50	1.50	1.50
Agitator for pure liquors	1.25	1.25	1.25
Barking drums	2.00	2.00	2.00
Barkers - mechanical	2.00	2.00	2.00
Beater	1.50	1.50	1.50
Breaker stack	1.25	1.25	1.25
Calender 3)	1.25	1.25	1.25
Chipper	2.00	2.00	2.00
Chip feeder	1.50	1.50	1.50
Coating rolls	1.25	1.25	1.25
Conveyors			
Chip, bark, chemical	1.25	1.25	1.25
Log (including slab)	2.00	2.00	2.00
Couch rolls	1.25	1.25	1.25
Cutter	2.00	2.00	2.00
Cylinder molds	1.25	1.25	1.25
Dryers 3)			
Paper machine	1.25	1.25	1.25
Conveyor type	1.25	1.25	1.25
Embosser	1.25	1.25	1.25
Extruder	1.50	1.50	1.50
Fourdrinier rolls (includes lump breaker, dandy roll, wire turning, and return rolls)	1.25	1.25	1.25
Jordan	1.50	1.50	1.50
Kiln drive	1.50	1.50	1.50
Mt. Hope roll	1.25	1.25	1.25
Paper rolls	1.25	1.25	1.25
Platter	1.50	1.50	1.50
Presses - felt & suction	1.25	1.25	1.25
Pulper	2.00	2.00	2.00
Pumps - vacuum	1.50	1.50	1.50
Reel (surface type)	1.25	1.25	1.25
Screens			
Chip	1.50	1.50	1.50
Rotary	1.50	1.50	1.50
Vibrating	2.00	2.00	2.00
Size press	1.25	1.25	1.25
Super calender 4)	1.25	1.25	1.25
Thickener (AC motor)	1.50	1.50	1.50
Thickener (DC motor)	1.25	1.25	1.25
1) Crane drives are to be selected based on gear tooth bending strength. Contact gear manufacturer for strength ratings. Service factor in durability shall be a minimum of 1.0. 2) Service factors for paper mill applications are applied to the nameplate rating of the electric drive motor at the motor rated base speed. 3) Anti-friction bearings only. Use 1.5 for sleeve bearings. 4) A service factor of 1.00 may be applied at base speed of a super calender operating over-speed range of part range constant horsepower, part range constant torque where the constant horsepower speed range is greater than 1.5 to 1. A service factor of 1.25 is applicable to super calenders operating over the entire speed range at constant torque or where the constant horsepower speed range is less than 1.5 to 1.			
(table continued next page)			

A.G.M.A. Service Factors for Spur, Helical & Bevel Gear Drives & Reducers with Uniform Power Source (continued)			
Application	Total Operation [hr/day]		
	Up to 3	3 to 10	Over 10
Washer (AC motor)	1.50	1.50	1.50
Washer (DC motor)	1.25	1.25	1.25
Wind and unwind stand	1.00	1.00	1.00
Winders (surface type)	1.25	1.25	1.25
Yankee dryers ³⁾	1.25	1.25	1.25
Plastics industry			
Primary processing			
Batch mixers	1.75	1.75	1.75
Continuous mixers	1.50	1.50	1.50
Batch drop mill - 2 smooth rolls	1.25	1.25	1.25
Continuous feed, holding & blend mill	1.25	1.25	1.25
Compounding mill	1.25	1.25	1.25
Calenders	1.50	1.50	1.50
Secondary processing			
Blow molders	1.50	1.50	1.50
Coating	1.25	1.25	1.25
Film	1.25	1.25	1.25
Pipe	1.25	1.25	1.25
Pre-plasticizers	1.50	1.50	1.50
Rods	1.25	1.25	1.25
Sheet	1.25	1.25	1.25
Tubing	1.25	1.25	1.50
Pullers - barge haul	1.25	1.25	1.50
Pumps			
Centrifugal	1.00	1.00	1.25
Proportioning	1.25	1.25	1.50
Reciprocating			
Single acting, 3 or more cylinders	1.25	1.25	1.50
Double acting, 2 or more cylinders	1.25	1.25	1.50
Rotary			
Gear type	1.00	1.00	1.25
Lobe	1.00	1.00	1.25
Vane	1.00	1.00	1.25
<p>1) Crane drives are to be selected based on gear tooth bending strength. Contact gear manufacturer for strength ratings. Service factor in durability shall be a minimum of 1.0.</p> <p>2) Service factors for paper mill applications are applied to the nameplate rating of the electric drive motor at the motor rated base speed.</p> <p>3) Anti-friction bearings only. Use 1.5 for sleeve bearings.</p> <p>4) A service factor of 1.00 may be applied at base speed of a super calender operating over-speed range of part range constant horsepower, part range constant torque where the constant horsepower speed range is greater than 1.5 to 1. A service factor of 1.25 is applicable to super calenders operating over the entire speed range at constant torque or where the constant horsepower speed range is less than 1.5 to 1.</p>			
(table continued next page)			

A.G.M.A. Service Factors for Spur, Helical & Bevel Gear Drives & Reducers with Uniform Power Source (continued)			
Application	Total Operation [hr/day]		
	Up to 3	3 to 10	Over 10
Rubber industry			
Intensive internal mixers			
Batch mixers	1.75	1.75	1.75
Continuous mixers	1.50	1.50	1.50
Mixing mill - 2 smooth rolls (if corrugated rolls are used, then use the same service factors that are used for a cracker warmer)	1.50	1.50	1.50
Batch drop mill - 2 smooth rolls	1.50	1.50	1.50
Cracker warmer - 2 rolls; 1 corrugated roll	1.75	1.75	1.75
Cracker - 2 corrugated rolls	2.00	2.00	2.00
Holding, feed & blend mill - 2 rolls	1.25	1.25	1.25
Refiner - 2 rolls	1.50	1.50	1.50
Calenders	1.50	1.50	1.50
Sand muller	1.25	1.25	1.50
Sewage disposal equipment			
Bar screens	1.25	1.25	1.25
Chemical feeders	1.25	1.25	1.25
Dewatering screens	1.50	1.50	1.50
Scum breakers	1.50	1.50	1.50
Slow or rapid mixers	1.50	1.50	1.50
Sludge collectors	1.25	1.25	1.25
Thickeners	1.50	1.50	1.50
Vacuum filters	1.50	1.50	1.50
Screens			
Air washing	1.00	1.00	1.25
Rotary - stone or gravel	1.25	1.25	1.50
Traveling water intake	1.00	1.00	1.25
Sugar industry			
Beet slicer	2.00	2.00	2.00
Cane knives	1.50	1.50	1.50
Crushers	1.50	1.50	1.50
Mills (low speed end)	1.75	1.75	1.75
1) Crane drives are to be selected based on gear tooth bending strength. Contact gear manufacturer for strength ratings. Service factor in durability shall be a minimum of 1.0. 2) Service factors for paper mill applications are applied to the nameplate rating of the electric drive motor at the motor rated base speed. 3) Anti-friction bearings only. Use 1.5 for sleeve bearings. 4) A service factor of 1.00 may be applied at base speed of a super calender operating over-speed range of part range constant horsepower, part range constant torque where the constant horsepower speed range is greater than 1.5 to 1. A service factor of 1.25 is applicable to super calenders operating over the entire speed range at constant torque or where the constant horsepower speed range is less than 1.5 to 1.			
(table continued next page)			

A.G.M.A. Service Factors for Spur, Helical & Bevel Gear Drives & Reducers with Uniform Power Source (continued)			
Application	Total Operation [hr/day]		
	Up to 3	3 to 10	Over 10
Textile industry			
Batchers	1.25	1.25	1.50
Calenders	1.25	1.25	1.50
Cards	1.25	1.25	1.50
Dry cans	1.25	1.25	1.50
Dryers	1.25	1.25	1.50
Dyeing machinery	1.25	1.25	1.50
Looms	1.25	1.25	1.50
Mangles	1.25	1.25	1.50
Nappers	1.25	1.25	1.50
Pads	1.25	1.25	1.50
Slashers	1.25	1.25	1.50
Soapers	1.25	1.25	1.50
Spinners	1.25	1.25	1.50
Tenter frames	1.25	1.25	1.50
Washers	1.25	1.25	1.50
Winders	1.25	1.25	1.50
<p>1) Crane drives are to be selected based on gear tooth bending strength. Contact gear manufacturer for strength ratings. Service factor in durability shall be a minimum of 1.0.</p> <p>2) Service factors for paper mill applications are applied to the nameplate rating of the electric drive motor at the motor rated based speed.</p> <p>3) Anti-friction bearings only. Use 1.5 for sleeve bearings.</p> <p>4) A service factor of 1.00 may be applied at base speed of a super calender operating over-speed range of part range constant horsepower, part range constant torque where the constant horsepower speed range is greater than 1.5 to 1. A service factor of 1.25 is applicable to super calenders operating over the entire speed range at constant torque or where the constant horsepower speed range is less than 1.5 to 1.</p>			

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