IronHorse Worm Gearboxes

Gearbox Selection

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 10 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 to be used will have a nominal speed of 1800 rpm (1725 rpm actual speed). The conveyor will require 2700 in·lb of torque.

1) Required **torque** = 2700 in·lb; required **speed** = 20 rpm.
2) Determine the **overall speed ratio** of motor speed to load speed:
   Overall speed ratio = motor speed / load speed = 1725 / 20 = 86.25 [about 86:1]
3) Determine **pulley ratios** at available **gearbox ratios**:
   Gearbox ratio = (overall speed ratio) / (pulley ratio)
   Pulley ratio = (overall speed ratio) / (gearbox ratio)

   For ~~5:1 gearbox~~: pulley ratio = 86.25 / 5 = ~~17.25~~ [17.25" pulley size is prohibitively large]
   For 10:1 gearbox: pulley ratio = 86.25 / 10 = 8.63
   For 15:1 gearbox: pulley ratio = 86.25 / 15 = 5.75
   For 20:1 gearbox: pulley ratio = 86.25 / 20 = 4.31
   For 40:1 gearbox: pulley ratio = 86.25 / 40 = 2.16
   For 60:1 gearbox: pulley ratio = 86.25 / 60 = 1.44

   Pulley ratio = (conveyor 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 **Maximum Thermal Torque rating > required real torque**:
   Gearbox required real torque = (final torque) / (pulley ratio)

   For 10:1 gearbox: (2700 in·lb) / 8.63 = 312.86 in·lb; use WG-175-x or larger
   For 15:1 gearbox: (2700 in·lb) / 5.75 = 469.57 in·lb; use WG-175-x or larger
   For 20:1 gearbox: (2700 in·lb) / 4.31 = 626.45 in·lb; use WG-206-x or larger
   For ~~40:1 gearbox~~: (2700 in·lb) / 2.16 = 1250.0 in·lb; none applicable
   For ~~60:1 gearbox~~: (2700 in·lb) / 1.44 = 1875.0 in·lb; none applicable

(continued on next page)

Gearbox Selection (continued)

Gearbox Selection Example (continued)

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

[Load requirements: Conveyor to run 10 hr/da; moderate shock loading; driven by V-belt @ approx 20 rpm; requires 2700 in·lb of torque. Motor speed 1725 rpm (1800 rpm nominal).]

6) Use specifications table to select gearbox with **Maximum Mechanical Torque rating > required design torque**:
Gearbox required design torque = (real gearbox torque)(service factor)

For 10:1 gearbox: (312.86 in·lb)(1.25) = 391.08 in·lb; use WG-175-x or larger
For 15:1 gearbox: (469.57 in·lb)(1.25) = 586.96 in·lb; use WG-206-x or larger
For 20:1 gearbox: (646.45 in·lb)(1.25) = 808.06 in·lb; use WG-206-x or larger

7) Use the gearbox overhung load ratings from the specifications table to determine the minimum allowable pulley diameters. 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, WG-175-010-x gearbox:
Minimum gearbox pulley diameter = (312.86 in·lb)(1.5)(1.25)(2)/(650 lb) = 1.8" [use 2"]
Conveyor pulley diameter = (2")(8.63) = ~~17.26"~~ [17.26" pulley size is prohibitively large]
Determine pulley sizes and OHL for next larger gearbox ratio.

For 15:1, WG-206-015-x gearbox:
Minimum gearbox pulley diameter = (469.57 in·lb)(1.5)(1.25)(2)/(700 lb) = 2.5" [use 2.5"]
Conveyor pulley diameter = (2.5")(5.75) = 14.38" [use 14.4"]
Select **WG-206-015-x gearbox**, **2.5" gearbox pulley**, and **14.4" conveyor pulley**.

For 20:1, WG-206-020-x gearbox:
N/A – larger ratio of same frame size GB is same price, yet provides lower efficiency and power characteristics

8) **Check results** against original speed and torque requirements:
a) Conveyor speed = (motor speed) / (gearbox ratio)(pulley ratio) = (1725 rpm) / (15)(14.4"/2.5") = 20 rpm
b) Maximum real torque available at conveyor = (gearbox thermal torque)(pulley ratio) = (673 in·lb)(14.4"/2.5") = 3876 in·lb
c) Maximum design torque available at conveyor = (gearbox mechanical torque)(pulley ratio) / (service factor)
= (1002 in·lb)(14.4"/2.5") / 1.25 = 4617 in·lb
The speed is correct as required, and both maximum torque values are greater than the 2700 in·lb required by the load.

9) **Select** a **motor** and check torque transmitted to the load:
From the gearbox spec tables, WG-206-015-x efficiency = 85%.
maximum thermal input power = 1.40 hp
maximum mechanical input power @ 1.0 SF = 2.09 hp
maximum mechanical input power @ 1.25 SF = (rated max mechanical input power) / (SF) = 2.09 hp / 1.25 = 1.67 hp
maximum allowable motor power = 1.40 hp; select nominal 1hp motor
Select **1hp motor**, and check for adequate torque at the load:
Torque = Power / Speed [**conversion factor: (1hp) = (63,025 in·lb·rpm)**]
$Torque_{load}$ = (63,025 in·lb·rpm / hp)(gearbox input hp)(gearbox efficiency) / (motor rpm / (gearbox ratio)(pulley ratio))
= (63,025)(1)(0.85) / (1725 / (15/1)(14.4/2.5)) = ~~2683 in·lb~~ **[insufficient torque at load]**
This torque value is less than the 2700 in·lb required by the load.
So, select and check the next larger nominal motor size, which is 1-1/2 hp.
Since the 206 frame size 15 ratio gearboxes do not meet the 1-1/2 hp thermal rating, choose the WG-237-015-x gearbox.
Select **1-1/2 hp motor** and **WG-237-015-x gearbox**, and check for adequate torque:
WG-237-015-x gearbox efficiency = 84%
maximum thermal input power = 1.55 hp
maximum mechanical input power @ 1.25 SF = 2.64 hp / 1.25 = 2.11 hp
maximum allowable motor power = 1.55 hp; select nominal 1-1/2 hp motor
gearbox ratio is still 15:1, and OHL rating is increased to 900 lb, so the previous pulley calculations [step 7] remain sufficient
[smaller pulleys can be calculated and selected for this gearbox, if desired]
T_{load} = (63,025 in·lb·rpm/hp) (1.5hp) (84%) / (1725 rpm / (15/1)(14.4/2.5)) = 3977 in·lb > 2700 in·lb; sufficient torque at load

Final gearbox and motor selection: 1-1/2 hp motor WG-237-015-x gearbox

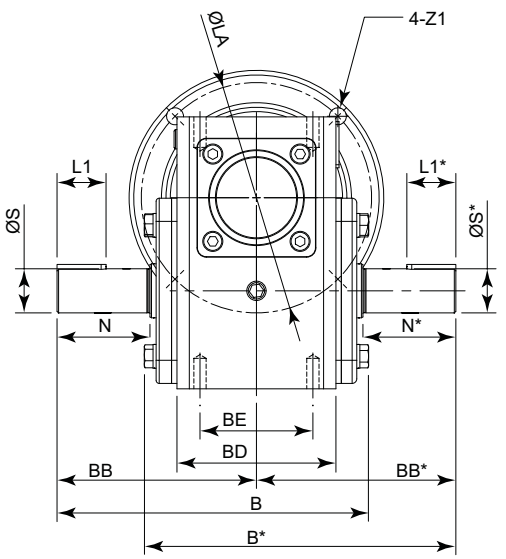
IronHorse Worm Gearboxes

Gearbox Selection Factors

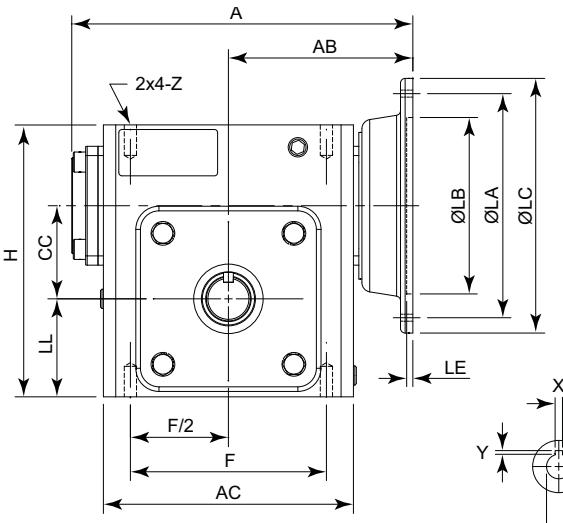
Overhung Load K Factors for Various Drive Types	
Chain & Sprocket	1.00
Gear	1.25
V-belt	1.50
Flat Belt	2.50
Variable Pitch Belt	3.50
Divide gearbox OHL ratings by the applicable OHL K factors.	

Service Factors for Selecting Gearboxes (when used with electric motors)				
Service Continuity (per day)	Load Characteristics			
	Uniform	Moderate Shock*	Heavy Shock*	Extreme Shock*
Occassional 1/2 hour	1.00	1.00	1.00	1.25
Less than 3 hours	1.00	1.00	1.25	1.50
3-10 hours	1.00	1.25	1.50	1.75
More than 10 hours	1.25	1.50	1.75	2.00
** Shock results from sudden increases in the torque demand of the load, such as: sudden stopping, restarting, and/or reversing; significantly heavy loads dropped onto a moving conveyor; impact loads such as punch press operations.*				
Depending upon the load characteristics, divide the gearbox HP, Overhung Load, and Maximum Mechanical Capacity ratings by the applicable service factor.				

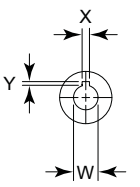
Gearbox Dimensions – Solid-Shaft Output Gearboxes



Rear View



Left View



Input Shaft View

* Left side output shafts are present only on dual-shaft models (WG-xxx-xxx-D)

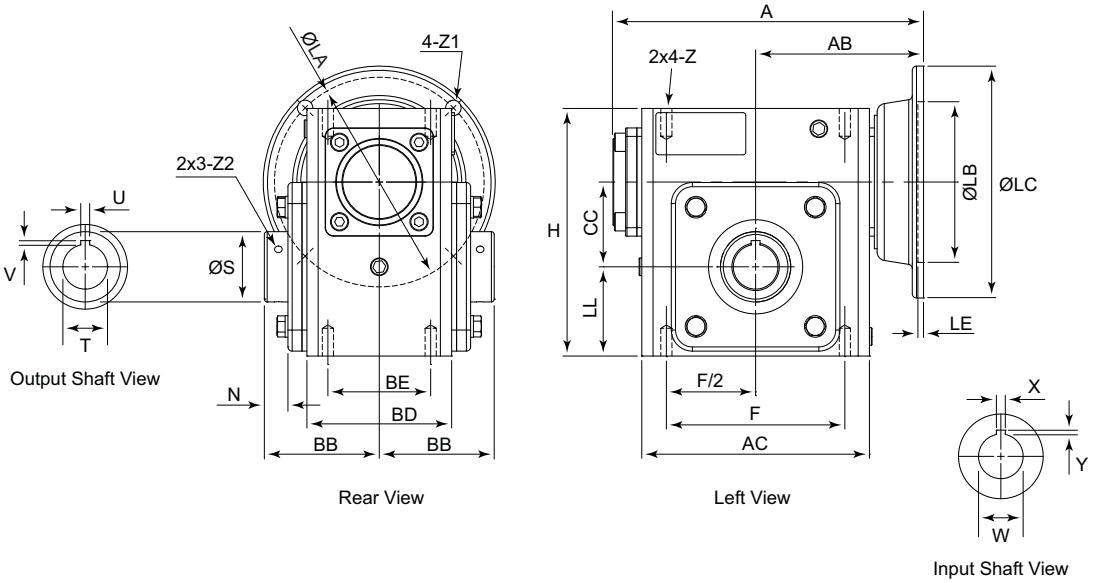
Dimensions (inches) – IronHorse™ Worm Gearboxes – Solid-Shaft Outputs

Part Number	Frame	A	AB	AC	B	BB	BD	BE	CC	F	H	LL	Z (UNC)	Flange					Input Shaft			Output Shaft		
														LA	LB	LC	LE	Z1	W	X	Y	L1	N	S
WG-175-xxx-D/R	56C	7.29	4.035	5.059	6.831	4.311	3.563	2.75	1.75	4.188	5.75	2.062	5/16-18	5.875	4.5	6.496	0.157	0.433	0.625	3/16	3/32	1	1.781	0.875
WG-206-xxx-D/R		7.95	4.37	5.748	7.249	4.69	3.819	2.88	2.062	5	6.375	2.281	3/8-16									1.25	2.09	1
WG-237-xxx-D/R		8.71	4.705	6.378	7.948	5.087	4.055	2.88	2.375	5	6.937	2.5										1.25	2.37	1.125
WG-262-005-D/R	182 TC	10.57	6.24	7.165	8.872	5.63	4.685	3.375	2.625	6.375	8	2.938		7.25	8.5	9	0.197	0.551	1.125	1/4	1/8	2	2.626	
WG-262-010-D/R																								
WG-262-015-D/R	56C	9.41	5.059											5.875	4.5	6.496	0.157	0.433	0.625	3/16	3/32			
WG-262-020-D/R																								
WG-262-040-D/R																								
WG-262-060-D/R																								

Right-hand shaft gearboxes have output shafts only on the right side, as viewed looking into the input shaft (dimensions B, BB, L1, S, & N).
Dual-shaft output gearboxes have B, BB, L1, S, & N dimensions on both sides.

IronHorse Worm Gearboxes

Gearbox Dimensions – Hollow-Shaft Output Gearboxes



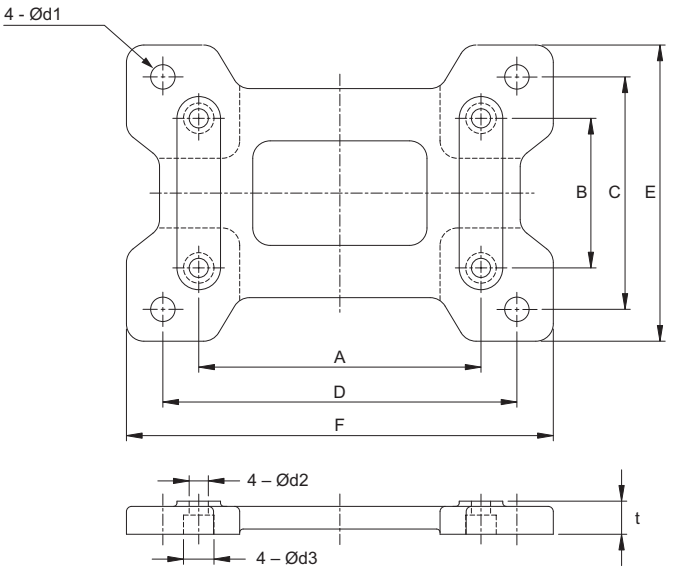
Dimensions (inches) – IronHorse™ Worm Gearboxes – Hollow-Shaft Outputs																				
Part Number	**Frame**	**A**	**AB**	**AC**	**BB**	**BD**	**BE**	**CC**	**F**	**H**	**LL**	**Z (UNC)**								
WG-175-xxx-H	56C	7.28	4.035	5.059	3.091	3.563	2.750	1.75	4.188	5.75	2.062	5/16-18								
WG-206-xxx-H		7.95	4.370	5.748	3.219	3.819	2.880	2.062	5.000	6.375	2.281	3/8-16								
WG-237-xxx-H		8.68	4.705	6.378	3.220	4.055	2.880	2.375	5.000	6.937	2.500									
WG-262-005-H	182 TC	10.59	6.240	7.165	3.500	4.685	3.375	2.625	6.375	8.000	2.938									
WG-262-010-H																				
WG-262-015-H	56C	9.41	5.059																	
WG-262-020-H																				
WG-262-040-H																				
WG-262-060-H																				
Part Number (repeated)	**Frame**	**Flange**					**Input Shaft**			**Output Shaft**										
		LA	**LB**	**LC**	**LE**	**Z1**	**W**	**X**	**Y**	**N**	**S**	**T**	**U**	**V**	**Z2 (UNF)**					
WG-175-xxx-H	56C	5.875	4.5	6.496	0.157	0.433	0.625	3/16	3/32	0.787	1.575	1.0	1/4	7/64	#10-32					
WG-206-xxx-H										0.797	1.772	1.125		1/8	1/4-28					
WG-237-xxx-H										0.661	1.969	1.250		7/64						
WG-262-005-H	182 TC	7.25	8.5	9.000	0.197	0.551	1.125	1/4	1/8	0.626	2.362	1.437	3/8	5/32						
WG-262-010-H																				
WG-262-015-H	56C	5.875	4.5	6.496	0.157	0.433	0.625	3/16	3/32											
WG-262-020-H																				
WG-262-040-H																				
WG-262-060-H																				

IronHorse Worm Gearboxes

Accessories – Mounting Base

IronHorse Worm Gearbox Mounting Base

Mounting Base Dimensions



IronHorse™ Worm Gearbox Mounting Bases												
Part Number	*Price*	*Fits Gearbox Numbers*	*Approx Weight (lb)*	*Dimensions (in)*								
				A	*B*	*C*	*D*	*E*	*F*	*t*	*d1*	*d2*	*d3*
WG-175-BASE	<--->	WG-175-xxx-x	4.0	4.19	2.76	4.50	5.75	5.69	7.00	0.69	0.43	0.35	0.55
WG-206-BASE	<--->	WG-206-xxx-x	4.8	5.00	2.88	4.69	6.38	5.91	7.76	0.72	0.47	0.43	0.69
WG-237-BASE	<--->	WG-237-xxx-x	6.2	5.00	2.88	4.88	7.06	6.22	8.50	0.75	0.47	0.43	0.69
WG-262-BASE	<--->	WG-262-xxx-x	7.5	6.38	3.38	5.25	8.00	6.69	9.65	0.75	0.55	0.43	0.69

Worm Gearbox Cross Reference

IronHorse™ Worm Cross Reference				
AutomationDirect IronHorse™	*WG-175-xxx-x*	*WG-206-xxx-x*	*WG-237-xxx-x*	*WG-262-xxx-x*
Alling Lander	17UF	20UF	23UF	26UF
Baldor	F918	F921	F924	F926
Boston	F718	F721	F724	F726
Browning-Raider	Q175	Q206	Q237	Q262
Dodge-Tigear	Q175	Q200	-	Q262
Falk-Omnibox	1175WBM	1206WBM	1238WBM	1262WBM
Grove (new)	BMQ218	BMQ220	BMQ224	BMQ226
Grove (old)	BMQ1175	BMQ1206	BWQ1238	BMQ1262
Leeson	BMQ618	BMQ621	BMQ624	BMQ626
Morse Invader	718F	721F	724F	726F
Ohio Gear	BMQ2175	BMQ2206	BMQ2238	BMQ2262