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IronHorse™ Worm Gearbox User Manual

WG-USER-M-WO

2nd Edition

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IRONHORSE™ WORM GEARBOX USER MANUAL

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Please include the Manual Number and the Manual Issue, both shown below, when communicating with Technical Support regarding this publication.

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Issue: 2nd Edition

Issue Date: 04/2009

Publication History		
Issue	**Date**	**Description of Changes**
First Edition	06/2008	Original Issue
1st Ed, Rev A	06/2008	Gearbox mounting orientation (Chapter 2)
Second Edition	04/2009	Added hollow-shaft gearboxes

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IRONHORSE™ WORM GEARBOX USER MANUAL TABLE OF CONTENTS

GETTING STARTED

In This Chapter...

Manual Overview

Overview of This Publication

The IronHorse Worm Gearbox User Manual describes the installation, operation, and preventative maintenance of IronHorse Worm Gearboxes.

Who Should Read This Manual

This manual contains important information for people who will install, maintain, and/or operate any of the IronHorse Worm Gearboxes.

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When you see the "notepad" icon in the left-hand margin, the paragraph to its immediate right will be a special note which presents information that may make your work quicker or more efficient. The word "NOTE" will mark the beginning of the text.

When you see the "exclamation point" icon in the left-hand margin, the paragraph to its immediate right will be a warning. This information could prevent injury, loss of property, or even death (in extreme cases). Any warning in this manual should be regarded as critical information that should be read in its entirety. The word "WARNING" in boldface will mark the beginning of the text.

IronHorse™ Worm Gearbox Introduction

Purpose of Worm Gearboxes

Gearboxes, also known as enclosed gear drives or speed reducers, are mechanical drive components that can drive a load at a reduced fixed ratio of the motor speed. The output torque is also increased by the same ratio, while the horsepower remains the same (less efficiency losses). A 10:1 ratio gearbox outputs approximately the same motor output horsepower, but motor speed is divided by 10, and motor torque is multiplied by 10.

Worm gearboxes contain a worm-type gear on the input shaft, and a spur-type mating gear on the output shaft. Worm gearboxes also change the drive direction by 90 degrees. Our worm gearboxes are manufactured in an ISO9001 certified plant by one of the leading and most internationally acclaimed worm gearbox manufacturers in the world today. Only the highest quality materials are tested, certified, and used in the manufacturing process. Strict adherence to and compliance with the toughest international and U.S. testing standards and manufacturing procedures assure you the highest quality products.

We offer right angle worm gearboxes with right-hand and dual (both right and left) output shafts, and with hollow-shaft outputs (all the way through from one side to the other). These outputs are perpendicular to the inputs, and change the drive direction(s) by 90°. Our gearboxes utilize C-face mounting interfaces for C-face motors.

We also offer optional gearbox mounting bases for ease of installation.

Package Contents

After receiving the IronHorse Worm Gearbox, please check for the following:

- Make sure the package includes the speed reducer and the vent plug.
- Inspect the unit to insure it was not damaged during shipment.
- Make sure that the part number on the gearbox nameplate is the same as the part number that you ordered.

Part Number Explanation

WG - 262 - 060 - R

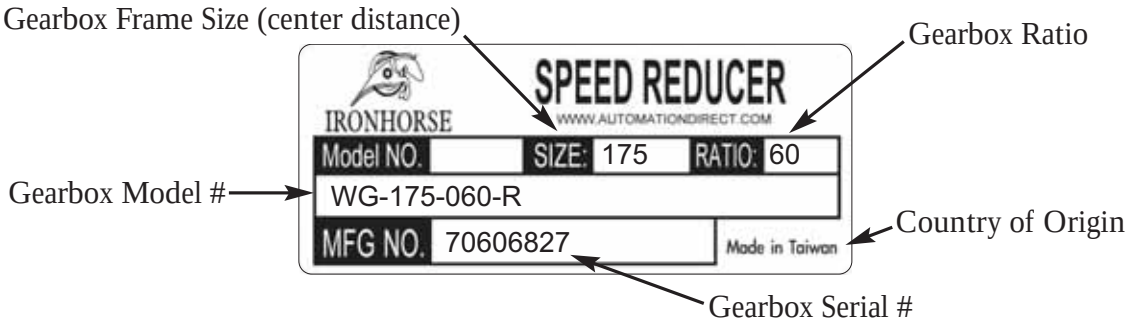
Output Type
D: Dual shaft
H: Hollow shaft
R: Right hand shaft

Ratio
Three digit input for output of 1
Example: 060 = 60:1 ratio

Frame Size (center distance)
175: 1.75”
206: 2.06”
237: 2.37”
262: 2.62”

Gearbox Type Series Designation
WG: Worm gear

Nameplate Information



IronHorse™ Worm Gearbox Specifications

IronHorse™ Worm Gearbox Specifications – Frame Size 175																	
Part Number	Ratio	Output RPM @ 1750 rpm Input	Nominal Motor HP [1] @ 1800 rpm	NEMA Motor Frame	Output Type [2]	Center Distance [3] (in)	Overhung Load [4] (lb)	Thrust Load [5] (lb)	Efficiency (%)	Approx Weight (lb)	Maximum Ratings @ 1750 rpm Input						Maximum Input Speed (rpm)
											Mechanical [6]			Thermal [7]			
											Input Power (hp)	Output Power (hp)	Output Torque (lb-in)	Input Power (hp)	Output Power (hp)	Output Torque (lb-in)	
WG-175-005-D	5:1	350	1-1/2	56C	D	1.75	650	550	93	23	2.83	2.62	499	2.28	2.11	402	2500
WG-175-005-H					H					27							
WG-175-005-R					R					22							
WG-175-010-D	10:1	175	1	56C	D				88	23	1.57	1.38	515	1.36	1.19	445	
WG-175-010-H					H					27							
WG-175-010-R					R					22							
WG-175-015-D	15:1	117	3/4	56C	D				85	23	1.24	1.06	554	1.13	0.96	506	
WG-175-015-H					H					27							
WG-175-015-R					R					22							
WG-175-020-D	20:1	88	3/4	56C	D				83	23	1.26	1.04	737	0.98	0.81	572	
WG-175-020-H					H					27							
WG-175-020-R					R					22							
WG-175-040-D	40:1	44	1/3	56C	D				62	23	0.79	0.49	714	0.45	0.28	404	
WG-175-040-H					H					27							
WG-175-040-R					R					22							
WG-175-060-D	60:1	29	1/4	56C	D				52	23	0.38	0.20	433	0.35	0.19	404	
WG-175-060-H					H					27							
WG-175-060-R					R					22							

1) Nominal Motor HP is the highest HP 1800 rpm motor to be used with the gearbox under conditions of 1.0 service factor. Gearbox input power capacity decreases as motor speed decreases and as service factor increases.

2) Output Type: D = Dual Shaft; H = Hollow Shaft; R = Right-Hand Shaft

3) The Center Distance is the distance between the centerlines of the input and output shafts; serves as the gearbox frame size.

4) Overhung Load ratings are for forces perpendicular to the output shaft and located at the shaft midpoint, such as from a gear, pulley, or sprocket with a belt or chain. Divide OHL ratings by the applicable OHL K factors shown separately in the Selection Factors tables. OHL ratings should also be divided by applicable service factors.

5) Thrust Load ratings are for forces along the axis of the output shaft, usually encountered in vertical-drive applications from agitators, mixers, fans, blowers, etc.

6) Maximum Mechanical Ratings are limits based on strength and durability of gearbox components; applicable when operating time is short and stopped time is greater than or equal to operating time. These ratings are applicable for 1.0 service factor loads, and may require modification depending upon characteristics of the applicable driven loads. Refer to the "Service Factors" table for more information.

7) Maximum Thermal Ratings are limits for gearbox continuous use without overheating.

IronHorse™ Worm Gearbox Specifications (continued)

IronHorse™ Worm Gearbox Specifications – Frame Size 206																		
Part Number	Ratio	Output RPM @ 1750 rpm Input	Nominal Motor HP [1] @ 1800 rpm	NEMA Motor Frame	Output Type [2]	Center Distance [3] (in)	Overhung Load [4] (lb)	Thrust Load [5] (lb)	Efficiency (%)	Approx Weight (lb)	Maximum Ratings @ 1750 rpm Input						Maximum Input Speed (rpm)
											Mechanical [6]			Thermal [7]			
											Input Power (hp)	Output Power (hp)	Output Torque (lb·in)	Input Power (hp)	Output Power (hp)	Output Torque (lb·in)	
WG-206-005-D	5:1	350	2	56C	D	2.06	700	750	92	27.9	3.62	3.33	925	2.57	2.36	657	2500
WG-206-005-H					H					32							
WG-206-005-R					R					27.3							
WG-206-010-D	10:1	175	1-1/2	56C	D				90	27.9	2.77	2.50	935	2.10	1.89	708	
WG-206-010-H					H					32							
WG-206-010-R					R					27.3							
WG-206-015-D	15:1	117	1	56C	D				85	27.9	2.09	1.78	1002	1.40	1.20	673	
WG-206-015-H					H					32							
WG-206-015-R					R					27.3							
WG-206-020-D	20:1	88	1	56C	D				82	27.9	1.57	1.29	914	1.17	0.96	681	
WG-206-020-H					H					32							
WG-206-020-R					R					27.3							
WG-206-040-D	40:1	44	1/2	56C	D				71	27.9	1.09	0.77	1120	0.71	0.50	726	
WG-206-040-H					H					32							
WG-206-040-R					R					27.3							
WG-206-060-D	60:1	29	1/3	56C	D				58	27.9	0.60	0.35	750	0.48	0.28	606	
WG-206-060-H					H					32							
WG-206-060-R					R					27.3							

1) Nominal Motor HP is the highest HP 1800 rpm motor to be used with the gearbox under conditions of 1.0 service factor. Gearbox input power capacity decreases as motor speed decreases and as service factor increases.

2) Output Type: D = Dual Shaft; H = Hollow Shaft; R = Right-Hand Shaft

3) The Center Distance is the distance between the centerlines of the input and output shafts; serves as the gearbox frame size.

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7) Maximum Thermal Ratings are limits for gearbox continuous use without overheating.

IronHorse™ Worm Gearbox Specifications (continued)

IronHorse™ Worm Gearbox Specifications – Frame Size 237																		
Part Number	Ratio	Output RPM @ 1750 rpm Input	Nominal Motor HP [1] @ 1800 rpm	NEMA Motor Frame	Output Type [2]	Center Distance [3] (in)	Overhung Load [4] (lb)	Thrust Load [5] (lb)	Efficiency (%)	Approx Weight (lb)	Maximum Ratings @ 1750 rpm Input						Maximum Input Speed (rpm)
											Mechanical [6]			Thermal [7]			
											Input Power (hp)	Output Power (hp)	Output Torque (lb·in)	Input Power (hp)	Output Power (hp)	Output Torque (lb·in)	
WG-237-005-D	5:1	350	3	56C	D	2.37	900	900	93	37.6	4.32	4.02	766	3.56	3.31	630	2500
WG-237-005-H					H					38							
WG-237-005-R					R					36.7							
WG-237-010-D	10:1	175	1-1/2		D				89	37.6	3.47	3.09	1158	2.24	1.99	746	
WG-237-010-H					H					38							
WG-237-010-R					R					36.7							
WG-237-015-D	15:1	117	1		D				84	37.6	2.64	2.22	1249	1.55	1.30	732	
WG-237-015-H					H					38							
WG-237-015-R					R					36.7							
WG-237-020-D	20:1	88	1		D				82	37.6	2.06	1.69	1195	1.36	1.12	791	
WG-237-020-H					H					38							
WG-237-020-R					R					36.7							
WG-237-040-D	40:1	44	1/2		D				71	37.6	1.45	1.02	1483	0.83	0.58	845	
WG-237-040-H					H					38							
WG-237-040-R					R					36.7							
WG-237-060-D	60:1	29	1/2		D				61	37.6	0.86	0.53	1149	0.63	0.39	844	
WG-237-060-H					H					38							
WG-237-060-R					R					36.7							

1) Nominal Motor HP is the highest HP 1800 rpm motor to be used with the gearbox under conditions of 1.0 service factor. Gearbox input power capacity decreases as motor speed decreases and as service factor increases.

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6) Maximum Mechanical Ratings are limits based on strength and durability of gearbox components; applicable when operating time is short and stopped time is greater than or equal to operating time. These ratings are applicable for 1.0 service factor loads, and may require modification depending upon characteristics of the applicable driven loads. Refer to the "Service Factors" table for more information.

7) Maximum Thermal Ratings are limits for gearbox continuous use without overheating.

IronHorse™ Worm Gearbox Specifications (continued)

IronHorse™ Worm Gearbox Specifications – Frame Size 262

Part Number	Ratio	Output RPM @ 1750 rpm Input	Nominal Motor HP [1] @ 1800 rpm	NEMA Motor Frame	Output Type [2]	Center Distance [3] (in)	Overhung Load [4] (lb)	Thrust Load [5] (lb)	Efficiency (%)	Approx Weight (lb)	Maximum Ratings @ 1750 rpm Input						Maximum Input Speed (rpm)
											Mechanical [6]			Thermal [7]			
											Input Power (hp)	Output Power (hp)	Output Torque (lb·in)	Input Power (hp)	Output Power (hp)	Output Torque (lb·in)	
WG-262-005-D	5:1	350	3	182TC	D	2.62	1000	1000	93	57.0	5.24	4.86	924	4.32	4.00	761	2500
WG-262-005-H					H					50							
WG-262-005-R					R					55.7							
WG-262-010-D	10:1	175	2		D				90	57.0	4.17	3.74	1445	3.06	2.75	1061	
WG-262-010-H					H					50							
WG-262-010-R					R					55.7							
WG-262-015-D	15:1	117	2	56C	D				87	49.9	3.22	2.81	1577	2.47	2.16	1212	
WG-262-015-H					H					50							
WG-262-015-R					R					48.6							
WG-262-020-D	20:1	88	1-1/2		D				83	49.9	2.67	2.21	1563	1.84	1.53	1078	
WG-262-020-H					H					50							
WG-262-020-R					R					48.6							
WG-262-040-D	40:1	44	3/4		D				72	49.9	1.85	1.32	1919	1.11	0.80	1153	
WG-262-040-H					H					50							
WG-262-040-R					R					48.6							
WG-262-060-D	60:1	29	3/4		D				66	49.9	1.16	0.77	1670	0.94	0.62	1346	
WG-262-060-H					H					50							
WG-262-060-R					R					48.6							

1) Nominal Motor HP is the highest HP 1800 rpm motor to be used with the gearbox under conditions of 1.0 service factor. Gearbox input power capacity decreases as motor speed decreases and as service factor increases.

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6) Maximum Mechanical Ratings are limits based on strength and durability of gearbox components; applicable when operating time is short and stopped time is greater than or equal to operating time. These ratings are applicable for 1.0 service factor loads, and may require modification depending upon characteristics of the applicable driven loads. Refer to the "Service Factors" table for more information.

7) Maximum Thermal Ratings are limits for gearbox continuous use without overheating.

Gearbox Selection Factors

Service Factors and 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*
Occasional 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.				

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.	

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INSTALLATION AND LUBRICATION

In This Chapter...

IronHorse™ Worm Gearbox Installation

Read these instructions thoroughly before installing or operating the gearbox.

Installation Instructions

- Leave the protective shaft sleeves in place for safe handling of the gearbox during installation.
- Add or partially drain oil as needed depending upon the mounting orientation. (Refer to the lubrication section of this chapter for more information.)
- Install the vent plug! (Refer to the next subsection for more information.)
- Align all shafts accurately, since improper alignment can result in premature failure. Use flexible couplings to compensate for slight misalignment.
- For hollow-shaft output gearboxes – Use anti-seize compound when inserting the load shaft into the hollow output shaft. It is preferrable to size the load shaft with sufficient length to allow complete insertion through the hollow output shaft of the gearbox. This allows equal support of the load shaft by both of the output shaft bearings, and permits the use of the output shaft setscrews to lock the two shafts together on both sides of the gearbox. At minimum, the load shaft should be inserted at least half way into the hollow output shaft, and secured with the setscrews on the insertion end of the gearbox.
- Mount the gearbox to a rigid foundation, and use the maximum possible bolt size. Periodically inspect the mounting bolts. (Do NOT mount gearbox vertically with input shaft pointing downward. Refer to the lubrication section of this chapter for allowable mounting orientations.)
- Optional gearbox and motor mounting bases are available for ease of mounting and alignment.
- Mount auxiliary drive components such as sprockets, gears and pulleys on the gearbox shaft as close to the housing as possible in order to minimize the effects of overhung loads. Avoid force fits that might damage bearings or gears.
- Check and record gear backlash at installation and again at regular intervals. This should be done by measuring the rotary movement of the output shaft, rotating the shaft alternately clockwise and counterclockwise at a suitable radius while holding the input shaft stationary. The gearbox should be replaced when the backlash exceeds four times the measurement taken at installation.
- Gear drives are rated for 1750 input rpm and Class I Service (Service Factor 1.0), using Mobil SHC634 synthetic lubricant.
- Initial operating temperatures may be higher than normal during the break-in period of the gear set. For maximum life, DO NOT ALLOW THE GEARBOX TO OPERATE CONTINUOUSLY ABOVE 225°F at the gear case. In the event of overheating, check for overloads or high ambient temperatures. Keep shafts and vent plugs clean to prevent foreign particles from entering seals or gear housing.

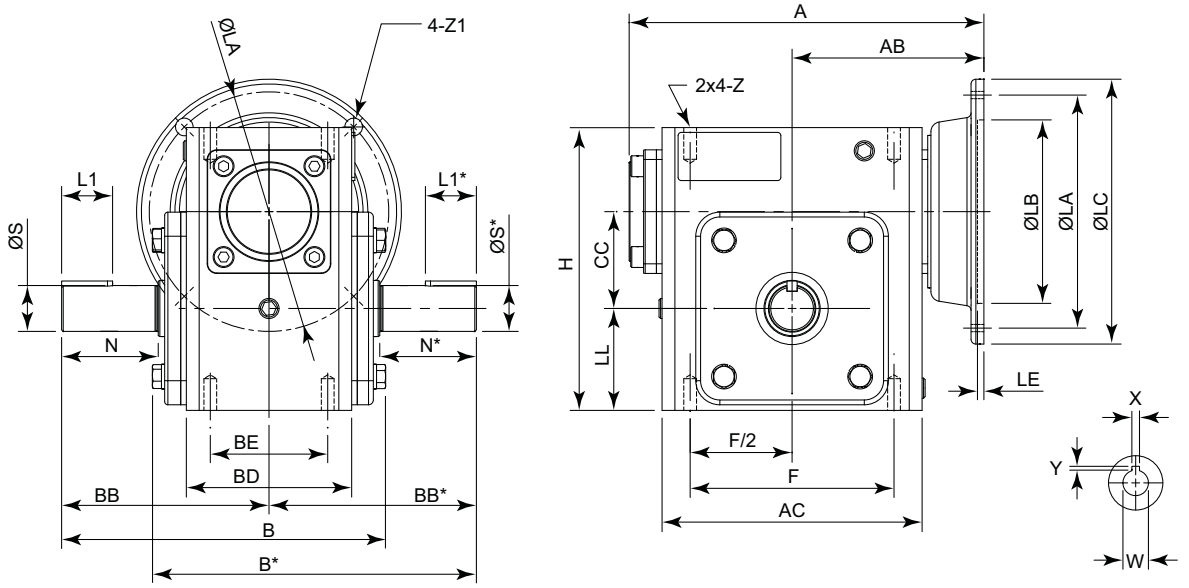
Vent Plug Installation

All IronHorse Worm Gearboxes are tested and filled with Mobil SHC634 synthetic lubricant prior to shipment. All vent openings are plugged by the manufacturer to prevent the loss of lubricant in shipment. The vent plug is shipped loose in the package with the gearbox, and should be installed prior to placing the gearbox in operation.

- The ventplug must be installed in the uppermost position.
- For all mounting positions where the vented plug is located in a horizontal plane, the vent hole must point upward.
- For all mounting positions where the vented plug is located in a vertical plane, the vent hole must point toward the center of the gearbox housing.
- Failure to properly install the vent plug can lead to pressurization of the gearbox housing as operating temperature rises, resulting in leakage at the shaft seals.

Gearbox Dimensions

Solid-Shaft Output Gearboxes WG-xxx-xxx-D/R



Rear View | Left View | Input Shaft View

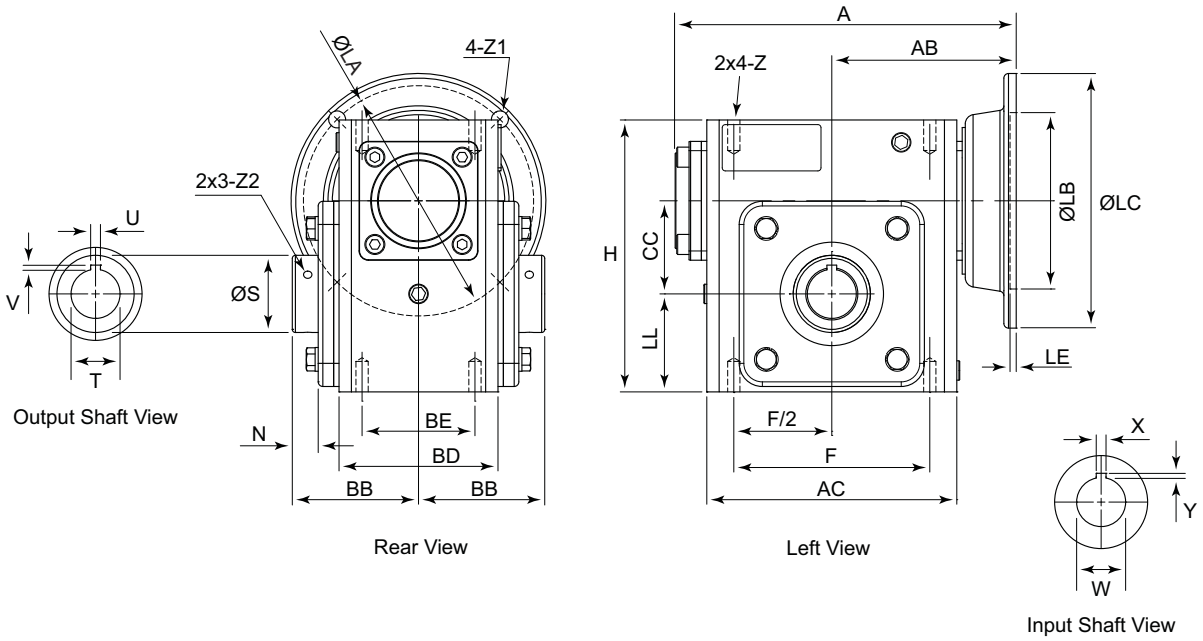
* Left side output shafts are present only on dual-shaft models (WG-xxx-xxx-D)

Dimensions (inches) – IronHorse™ Worm Gearboxes – Solid-Shaft Outputs													
Part Number	**Frame**	**A**	**AB**	**AC**	**B**	**BB**	**BD**	**BE**	**CC**	**F**	**H**	**LL**	**Z (UNC)**
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
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
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	
WG-262-005-D/R	182TC	10.57	6.24	7.165	8.872	5.63	4.685	3.375	2.625	6.375	8	2.938	
WG-262-010-D/R													
WG-262-015-D/R	56C	9.41	5.059										
WG-262-020-D/R													
WG-262-040-D/R													
WG-262-060-D/R													
Part # (repeated)	**Frame**	**Flange**					**Input Shaft**			**Output Shaft**			
		LA	**LB**	**LC**	**LE**	**Z1**	**W**	**X**	**Y**	**L1**	**N**	**S**	
WG-175-xxx-D/R	56C	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										1.25	2.09	1	
WG-237-xxx-D/R										1.25	2.37	1.125	
WG-262-005-D/R	182TC	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	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													

Dual-shaft output gearboxes have B, BB, L1, S, & N dimensions on both sides.
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).

Gearbox Dimensions (continued)

Hollow-Shaft Output Gearboxes WG-xxx-xxx-H

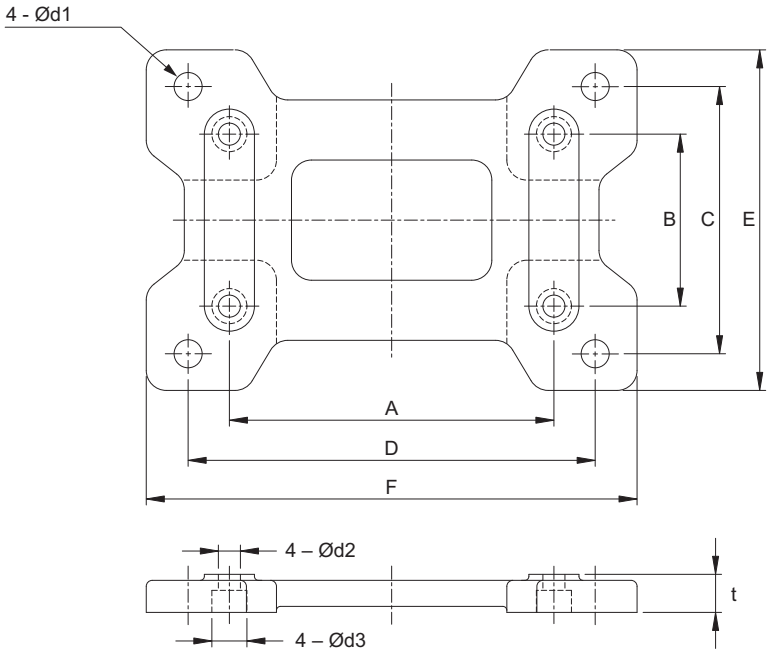


Dimensions (inches) – IronHorse™ Worm Gearboxes – Hollow-Shaft Outputs																
Part Number	**Frame**	**A**	**AB**	**AC**	**BB**	**BD**	**BE**	**CC**	**F**	**H**	**LL**	**Z (UNC)**				
WG-175-xxx-H	56C	7.28	4.035	5.059	3.091	3.563	2.750	1.75	4.188	5.75	2.062	5/16-18				
WG-206-xxx-H		7.95	4.370	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 Gearbox Mounting Bases

Mounting Base Selection and Dimensions

IronHorse™ Worm Gearbox Mounting Bases											
Part Number	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



IronHorse™ Worm Gearbox Lubrication & Mounting Orientations

Lubricant selection is important to all gearboxes, and it is particularly critical for the worm gear type. An oil with special characteristics and a relatively high viscosity is required due to sliding action between the gear teeth where they mesh. Aside from improper gearbox selection, inadequate lubrication is the greatest factor contributing to premature worm gearbox failures. Improper lubrication also causes reduced gearbox performance.

Lubrication Instructions

IronHorse Worm Gearboxes are shipped to you filled with Mobil SHC634 synthetic oil. Oil must be added or partially drained depending upon your mounting orientation, as shown in the Lubricant Capacities table.

Since many oils are not suitable for worm gears, it is very important to use the proper lubricant type. It is also very important to keep the oil free from oxidation and contamination by water or debris. For longer service life, the gearbox should be periodically drained (preferably while warm) and refilled to the proper level with a recommended gear oil. Non-synthetic oils should be changed every 6 months or 250 hours of operation under normal operating conditions. However, synthetic lubricants have increased resistance to thermal and oxidation degradation, and do not need to be changed as frequently.

Synthetic lubricant should be changed every 6,000 hours of operation or every two years, which ever comes first.

Lubricant Selection

The IronHorse Worm Gearbox Lubricant Selection table indicates lubricants that are suitable for IronHorse gearboxes operating at various temperatures.

IronHorse™ Worm Gearbox Lubricant Selection					
Recommended Lubricant	**-30° to 225° F**	**40° to 90° F**		**80° to 125° F**	
	-34° to 107° C	**4.4° to 32.2° C**		**26.7° to 51.7° C**	
AGA Rating	Synthetic	7	7 EP	8	8 EP
ISO Grade	320 / 460	460	460	680	680
Mobil	***SHC634 (supplied with GB)***	600W cylinder oil	–	Extra Heela Super Cylinder Oil	Mobilgear 634
Getty Refining Co	synthetic recommendation is exclusively for Mobil SHC 634	–	Veedol Asreslube 95	–	Veedol Asreslube 98
Lubrication Engr Inc		Almasol 608	–	Almasol 609	–
Lubriplate		–	–	SPO-288	–
Shell Oil Co		Valvala J460	Omala 460	Valvala J680	Omala 680
Texaco Inc		–	Meropa 460	–	Meropa 680

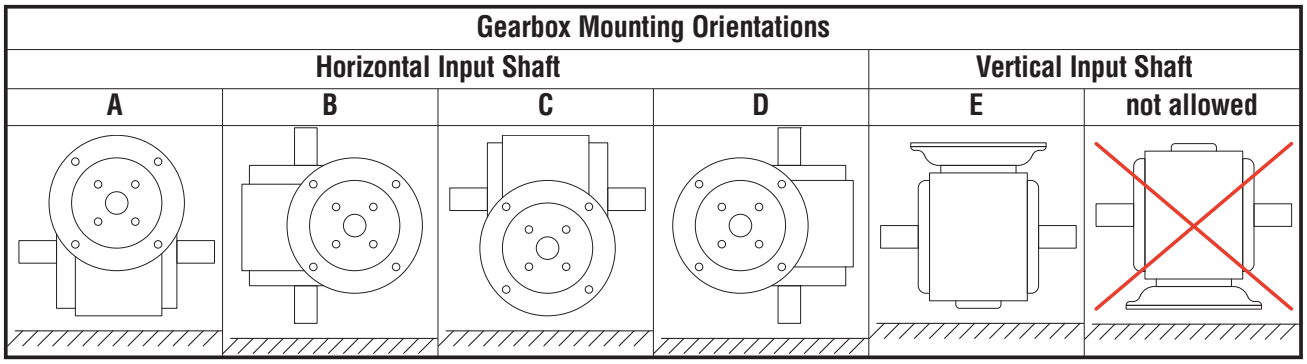
WARNING: Some lubricants contain non-corrosive extreme pressure additives. DO NOT USE lubricants that contain sulphur and/or chlorine, which are corrosive to bronze gears. Also, some extreme pressure lubricants contain materials that are toxic. Avoid the use of these lubricants where harmful effects can occur.

Lubricant Capacities & Mounting Orientations

WARNING: Too much oil will cause overheating, and too little oil will result in gear failure. Check oil level regularly. More frequent oil changes are recommended when operating continuously, at high temperatures, or under conditions of extreme dirt or dust.

IronHorse™ Worm Gearbox Lubricant Capacities					
Gearbox Mounting Orientation	**A***	**B**	**C**	**D**	**E**
Gearbox Part Number	**Approx Capacity* (fl oz)**				
WG-175-xxx-x	11.64	18.74	18.74	17.24	15.14
WG-206-xxx-x	19.41	28.41	28.41	26.71	21.81
WG-237-xxx-x	24.07	35.17	35.17	33.77	29.67
WG-262-xxx-x	34.55	48.25	48.25	45.85	41.05

Gearboxes are shipped filled with oil sufficient for mounting orientation "A". Oil must be added to gearboxes installed in other mounting orientations.



GLOSSARY OF TERMS

In This Appendix...

Glossary of Gearbox Terms

Axial Movement

Often called “endplay.” The endwise movement of motor or gear shafts. Usually expressed in thousandths of an inch.

Back Driving

Driving the output shaft of a gearbox to increase speed rather than reduce speed. Worm gearboxes are not suitable for service to increase speed.

Backlash

Rotational movement of the output shaft clockwise and counter clockwise, while holding the input shaft stationary. Usually expressed in thousandths of an inch and measured at a specific radius at the output shaft.

Center Distance

A basic measurement or size reference for worm gearboxes. The distance between the centerlines of the input and output shafts.

Efficiency

A ratio of the input power compared to the output power, usually expressed as a percentage.

Flanged Reducer

Usually used to refer to a gearbox having provisions for close coupling of a motor either via a hollow (quill) shaft or flexible coupling. Most often a NEMA C-face motor is used.

Gearbox

Also called a Speed Reducer. An enclosed set of gears used in mechanical power transmission to reduce speed and increase torque.

Input Power

The power applied to the input shaft of a gearbox. There are separate ratings for Mechanical Input Power, Thermal Input Power, and Nominal Motor Horsepower.

K Factor

Also called an Overhung Load Factor. A constant used to modify the overhung load rating of a gearbox based on the type of load applied on the shaft. Use the K factor either to increase the calculated overhung load, or to reduce the gearbox overhung load rating.

Mechanical Ratings

The maximum power or torque a gearbox can transmit based on the strength and durability of its components. Some applications require the gearbox Mechanical Ratings to be reduced by a Service Factor.

Mounting Position

The relationship of the input and output shafts of a gearbox relative to horizontal.

Nominal Motor Horsepower

The highest horsepower 1800 rpm motor that can be used with the gearbox under 1.0 service factor conditions. This rating decreases as the motor speed decreases, and as the service factor increases.

Output Horsepower

The amount of horsepower available at the output shaft of a gearbox. Output horsepower is always less than the input horsepower due to the efficiency of the gearbox.

Overhung Load

A force applied at right angles to a shaft beyond its outermost bearing. This shaft-bending load must be supported by the bearing. Overhung load ratings are listed for each gearbox size, and should not be exceeded. Some applications require the gearbox Overhung Load rating to be reduced by a K Factor and/or a Service Factor.

Overhung Load Factor

K Factor.

Prime Mover

In industry, the prime mover is most often an electric motor. Occasionally engines, hydraulic or air motors are used. Special considerations are called for when other than an electric motor is the prime mover.

Self-Locking

The inability of a reducer to be driven backwards by its load. No IronHorse worm gearbox should be considered self-locking.

Service Factor (for gearbox)

A constant used to modify the Mechanical Rating of a gearbox based on the duration of service and characteristics of the driven load. Use the Service Factor either as a multiplier to increase the calculated loads, or as a divisor to reduce the gearbox Mechanical and Overhung Load ratings.

Service Factor (for motors)

Refers to a motor's ability to handle a load greater than the motor's rated horsepower on a continuous basis.

Speed Reducer

Gearbox.

Thermal Ratings

The power or torque a gearbox can transmit continuously. These ratings are based upon the gearbox's ability to dissipate the heat caused by friction.

Thrust Load

Forces along the axis of the output shaft, usually encountered in vertical-drive applications.

Worm Gear

A set of threads, similar to a thread screw, that advance as they rotate around their axis. The advancing threads cause the mating gear to turn, and also slide against the gear teeth.

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GEARBOX SELECTION

In This Appendix...

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 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 Max 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

6) Use specs table to select gearbox with Max 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:
   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 WG-206-015-x gearbox is preferable over the WG-206-020-x gearbox for this application.

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 gearbox does not meet the required 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; 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]
   Torque = Power / Speed [conversion factor: (1hp) = (63,025 in·lb·rpm)]
   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

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