AMARILLO COMPOSITE DRIVE SHAFTS

FOR COOLING TOWERS

T.M.

Amarillo® Gear Company

TABLE I

Dimensional Data (All dimensions shown in inches (mm))									
Model No. Excluding M, L, or X Suffix	# Bolts & Size per Flex Disc	Flex Disc Color	Flex Disc OD	Max Bore Standard Hub	Max Bore Large Hub	Minimum Bore	Dim "A"	Dim "B"	Dim "C"
CF 52 275	6 - 8 x 45 mm	red	5.25 (133)	2.375	2.375	0.938 (24)	2.75 (70)	5.75 (145)	2.44 (62)
CF60 275	6 - 12 x 50 mm	green	6.00 (152)	2.375	3.375	0.938 (24)	2.75 (70)	6.38 (162)	2.44 (62)
CF60 425						0.938 (24)	4.25 (108)	6.38 (162)	2.44 (62)
CF67 275	6 - 14 x 60 mm	orange	6.75 (171)	3.000	3.375	1.56 (40)	2.75 (70)	7.13 (181)	2.75 (70)
CF67 425						1.56 (40)	4.25 (108)	7.13 (181)	2.75 (70)
CF67 600						1.56 (40)	6.00 (152)	7.13 (181)	2.75 (70)
CF73 425	8 - 12 x 60 mm	blue	7.30 (185)	3.375	3.625	1.81 (46)	4.25 (108)	7.67 (195)	2.75 (70)
CF73 600						1.81 (46)	6.0 (152)	7.67 (195)	2.75 (70)
CF73 800						1.81 (46)	8.0 (203)	7.67 (195)	2.75 (70)
CF73 950						1.81 (46)	9.5 (241)	7.67 (195)	2.75 (70)
CF83 425	8 - 14 x 70 mm	yellow	8.38 (213)	3.625	CF	2.06 (53)	4.25 (108)	8.75 (222)	3.13 (79)
CF83 600						2.06 (53)	6.0 (152)	8.75 (222)	3.13 (79)
CF83 800						2.06 (53)	8.0 (203)	8.75 (222)	3.13 (79)
CF83 950						2.06 (53)	9.5 (241)	8.75 (222)	3.13 (79)
CF83 1150						2.06 (53)	11.5 (292)	8.75 (222)	3.13 (79)

CF - Contact Factory

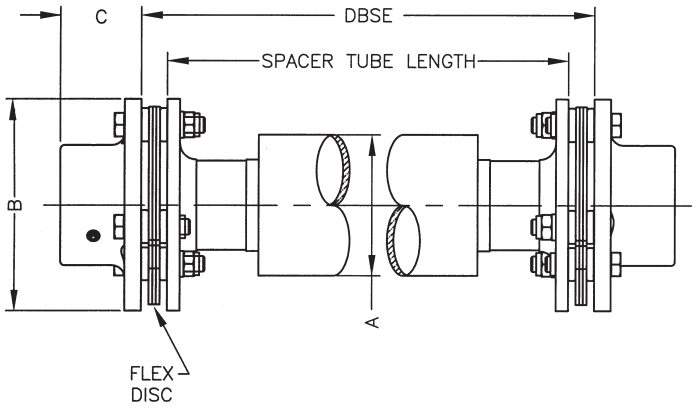


TABLE II

Engineering Data (All dimensions shown in inches (mm))										
Model #	# Bolts per Flex Disc	Flex Disc Color	HP Rating @ 1800 rpm w/ 2.0 SF	Continous Torque, 2.0 SF (in-lb)	Peak Overload Torque (in-lb)	Max DBSE @ 1785 rpm	Max DBSE @ 1485 rpm	Max DBSE @ 1185 rpm	Weight @ Minimum Bore and Max. DBSE @ 1785 (lb)	Assembly WR^2 at Minimum Bore & Max DBSE @ 1785 rpm ($lb\text{-}in^2$)
CF52 275M	6	red	51 (38 kW)	1780 (201 Nm)	7120 (804 Nm)	77 (1955)	84 (2130)	93 (2360)	25	61
CF52 275L						94 (2385)	103 (2610)	115 (2930)	26	63
CF60 275M	6	green	90 (67 kW)	3175 (359 Nm)	12700 (1435 Nm)	77 (1955)	84 (2130)	93 (2360)	31	102
CF60 275L						94 (2385)	103 (2610)	115 (2930)	32	104
CF60 275X						106 (2700)	116 (2960)	130 (3310)	33	105
CF60 425L						122 (3090)	133 (3380)	149 (3790)	43	147
CF60 425X						136 (3450)	149 (3780)	167 (4230)	44	153
CF67 275M	6	orange	106 (79 kW)	3750 (424 Nm)	15000 (1696 Nm)	77 (1955)	84 (2130)	93 (2360)	41	175
CF67 275L						94 (2385)	103 (2610)	115 (2930)	42	177
CF67 275X	6	orange	150 (112 kW)	5250 (593 Nm)	21000 (2374 Nm)	106 (2700)	116 (2960)	130 (3310)	43	178
CF67 425L						122 (3090)	133 (3380)	149 (3790)	53	220
CF67 425X						136 (3450)	149 (3780)	167 (4230)	54	226
CF67 600L						151 (3820)	165 (4190)	185 (4690)	69	365
CF67 600X						162 (4110)	177 (4500)	198 (5040)	71	378
CF73 425L	8	blue	225 (168 kW)	7880 (891 Nm)	31520 (3564 Nm)	122 (3090)	133 (3380)	149 (3790)	54	281
CF73 425X						136 (3450)	149 (3780)	167 (4230)	56	287
CF73 600L						151 (3820)	165 (4190)	185 (4690)	71	426
CF73 600X						162 (4110)	177 (4500)	198 (5040)	72	439
CF73 800L						166 (4205)	181 (4605)	203 (5160)	93	777
CF73 800X						184 (4665)	201 (5110)	225 (5720)	97	826
CF73 950X						200 (5085)	219 (5570)	245 (6240)	119	1350
CF83 425X	8	yellow	357 (266 kW)	12500 (1413 Nm)	50000 (5650 Nm)	136 (3450)	149 (3780)	167 (4230)	75	485
CF83 600L						151 (3820)	165 (4190)	185 (4690)	90	624
CF83 600X						162 (4110)	177 (4500)	198 (5040)	92	637
CF83 800L						166 (4205)	181 (4605)	203 (5160)	113	975
CF83 800X						184 (4665)	201 (5110)	225 (5720)	116	1025
CF83 950X						200 (5085)	219 (5570)	245 (6240)	138	1550
CF83 1150X						220 (5600)	242 (6135)	270 (6870)	172	2685

TABLE III - STANDARD KEYWAYS-INCH BORE HUBS

Bore Size		Keyway	Bore Size		Keyway
Over	To		Over	To	
.875	1.250	1/4 x 1/8	2.25	2.750	5/8 x 5/16
1.250	1.375	5/16 x 5/32	2.75	3.250	3/4 x 3/8
1.375	1.750	3/8 x 3/16	3.25	3.750	7/8 x 7/16
1.750	2.250	1/2 x 1/4	3.75	4.500	1 x 1/2

Listed keyways are for square keys. Contact factory for rectangular keyway dimensions.

TABLE IV - STANDARD KEYWAYS-METRIC BORE HUBS

Bore Size		Keyway	Bore Size		Keyway
Over	To		Over	To	
17	22	6 x 2.8	58	65	18 x 4.4
22	30	8 x 3.3	65	75	20 x 4.9
30	38	10 x 3.3	75	85	22 x 5.4
38	44	12 x 3.3	85	95	25 x 5.4
44	50	14 x 3.8	95	110	28 x 6.4
50	58	16 x 4.3	110	130	32 x 7.4

TABLE V - BORE TOLERANCES-CLASS 2 CLEARANCE FIT

(ref. AGMA 9002-A86)

Bore Size		Clearance Fit		
Over	To	Bore Tolerance		
.437	1.500	-0.000	to	+0.002
1.500	2.000	-0.000	to	+0.002
2.000	3.000	-0.000	to	+0.002
3.000	4.000	-0.000	to	+0.003
4.000	5.000	-0.000	to	+0.004

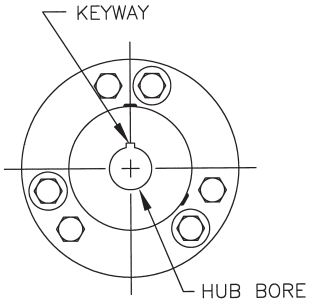


TABLE VI

CONSTANTS FOR CALCULATING ACTUAL WEIGHT AND WR²

Last 3 digits in part number	a	c
275	0.059	0.101
425	0.092	0.393
600	0.132	1.135
800	0.176	2.733
950	0.210	4.611
1150	0.255	8.238

First 2 digits in part number	b	d	e	L
52	0.88	0.069	0.77	2.44
60	0.88	0.069	0.77	2.44
67	2.43	0.076	5.92	2.69
73	3.28	0.077	10.73	2.69
83	4.24	0.087	18.00	3.06

Calculate Actual Drive Shaft Weight

start with → **Weight from Table 2**
minus → correction for Bore 1 → 0.22 x L x [(bore 1)² - b]
minus → correction for Bore 2 → 0.22 x L x [(bore 2)² - b]
minus → correction for DBSE → a x (DBSE @ 1785 rpm from Table 2 - Actual DBSE)
equals → **Actual Weight**

Calculate Actual Drive Shaft WR²

start with → **WR² from Table 2**
minus → correction for Bore 1 → d x [(bore 1)⁴ - e]
minus → correction for Bore 2 → d x [(bore 2)⁴ - e]
minus → correction for DBSE → c x (DBSE @ 1785 rpm from Table2 - Actual DBSE)
equals → **Actual WR²**

Limited Warranty

The Amarillo Gear Composite Drive Shaft is guaranteed against defects in workmanship and material for a period of one year after installation when operated under normal service at rated capacity. Within the above stated period, the manufacturer will replace the defective parts returned transportation prepaid. The buyer shall not be entitled to incidental or consequential damages, losses or expenses. The guarantee will not apply to repairs made outside the factory without the consent of the manufacturer or to drive shafts that have been subject to abuse, accident, neglect or improper installation. No warranty is made in regard to trade accessories, machinery, or other articles of merchandise not manufactured by us. This warranty is expressly made in lieu of any warranties otherwise expressed or implied by law.

Amarillo Composite Drive Shafts

Selection Procedures

1. Fax or e-mail a completed Application Data Request Form to Amarillo Gear at F: 806-622-3258, or info@amarillogear.com

– or –

2. Use Amarillo Gear Company's automated selection program at www.amarillogear.com. Just enter your application data and let the program do the rest.

– or –

3. Use the manual selection method as shown below.
   a. Determine the motor torque in in-lb using the following equation:
      Motor torque = Motor HP x 63,000 / Motor RPM
   b. Select the model that provides equal or more continuous torque rating from the Engineering Data Table II. Note that the values in Table II include a 2.0 service factor. Make sure the motor peak overload torque is less than the allowable peak overload torque shown in the Engineering Data Table II.
   c. Select the tube size/type (last 4 digits of the model number) with a maximum DBSE that meets or exceeds the application's DBSE at the motor speed.
      Example: Motor Torque (1785 rpm, 75 hp motor) = 2647 in-lb
      Application DBSE = 120"
      Selection: Model CF60 425L (torque rating = 3175 in-lb, Max. DBSE at 1785 rpm is 122")
   d. Calculate the critical speed (ω_c) of the shaft using the following equation:

$$\omega_c = \frac{A \bullet 7.8 \times 10^6}{*DBSE^2}$$

*(DBSE is in inches)

Last 4 Digits of Model Number	275M or L	275X	425L	425X	600L	600X	800L	800X	950X	1150X
Value for "A"	2.317	2.967	3.881	4.855	5.955	6.881	7.199	8.861	10.532	12.778

   e. Make sure that the calculated critical speed is at least 15% greater than the intended operating speed, or 2050 for this example, and that the first three harmonics of blade pass frequency (fan speed x number of fan blades) are at least 10%, 7.5% & 5% respectively, away from the critical speed. If either condition is not met, choose the next model down (Table II) and recalculate the critical speed.
      Example: Tube Size/Type = 425L DBSE = 120"
      Fan speed: 120 rpm Number of Blades: 8
      Blade pass frequencies: 1x = 960 cpm, 2x = 1920 cpm, 3x = 2880 cpm
      Calculated critical speed = 2102 cpm
      The initial selection is OK.
   f. Check both shaft sizes against the maximum hub bore for the selected model. Specify a "large" hub, or select the next larger model if necessary.

Application Data Request Form

Company Name: _____ Date: _____
Contact: _____ Telephone: _____ Fax: _____
Location: _____ Reference: _____
E-Mail: _____

Number of Drive Shafts Required: _____ Distance Between Shaft Ends (DBSE): _____

Motor Details

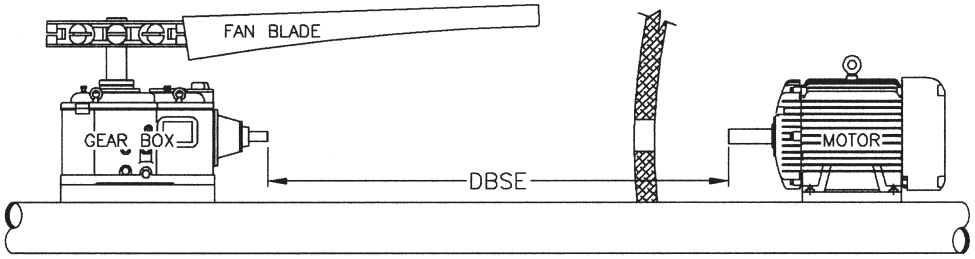
Nameplate Power Rating: _____
Full Speed RPM: _____
Motor Shaft Diameter: _____
Shaft Keyway Dimensions: _____
Starts per Day: _____
Single Speed Motor: Yes No
2-Speed Motor: Yes No
VFD Motor: Yes No
Speed Range if 2-Speed or VFD: _____
Reversing: Yes No

Gearbox Details

Manufacturer: _____
Model: _____
Ratio: _____
Input Shaft Dimensions: _____
Shaft Keyway Dimensions: _____

Fan Details

Fan Manufacturer: _____
Model: _____
Fan Diameter: _____
Fan Speed: _____
# of Fan Blades: _____



Amarillo Composite Drive Shafts

Amarillo Gear Company, a leader in the design and manufacturing of gear drives for mechanical draft cooling towers and air cooled condensers, now offers the Amarillo Composite Drive Shaft product line for cooling tower service. Our many years of experience in cooling tower power transmission systems provided this natural extension into designing and manufacturing composite drive shafts. Each drive shaft connects the electric motor to the gearbox input shaft, thereby transmitting torque to rotate the cooling tower fan. These drive shafts will accommodate spans ranging from 2 feet in small HVAC towers, to over 20 feet in large field erected towers.

Amarillo Gear has always been a leader in new and innovative products for the cooling tower and heat exchanger industries. We listen to what the problems are, and then design our products to provide superior performance. Based upon customer surveys and input from cooling tower industry professionals, Amarillo Gear has designed, manufactured and tested its composite drive shafts to incorporate the following features and benefits:

Comparison with Steel Drive Shafts

Features	Benefits
High Strength to Weight Ratio	Composite center spacer member weight is a mere fraction of the weight of a steel drive shaft center member.
Inherent Corrosion Resistance	Composite materials have corrosion resistance exceeding that of 316 stainless steel.
Long Spans	Eliminates requirement for high maintenance and costly intermediate pillow block bearings.
Patented Composite Flex Disc	Low maintenance; no fretting corrosion of steel “shim” packs, plus much easier installation and maintenance.
Dimensionally Stable	Very low Coefficient of Thermal Expansion (CTE).
Vibration & Shock Control	The natural dampening of composite materials reduces the transmission of vibration throughout the power train, resulting in less wear and tear on mechanical equipment.

Comparison with Other Composite Drive Shafts

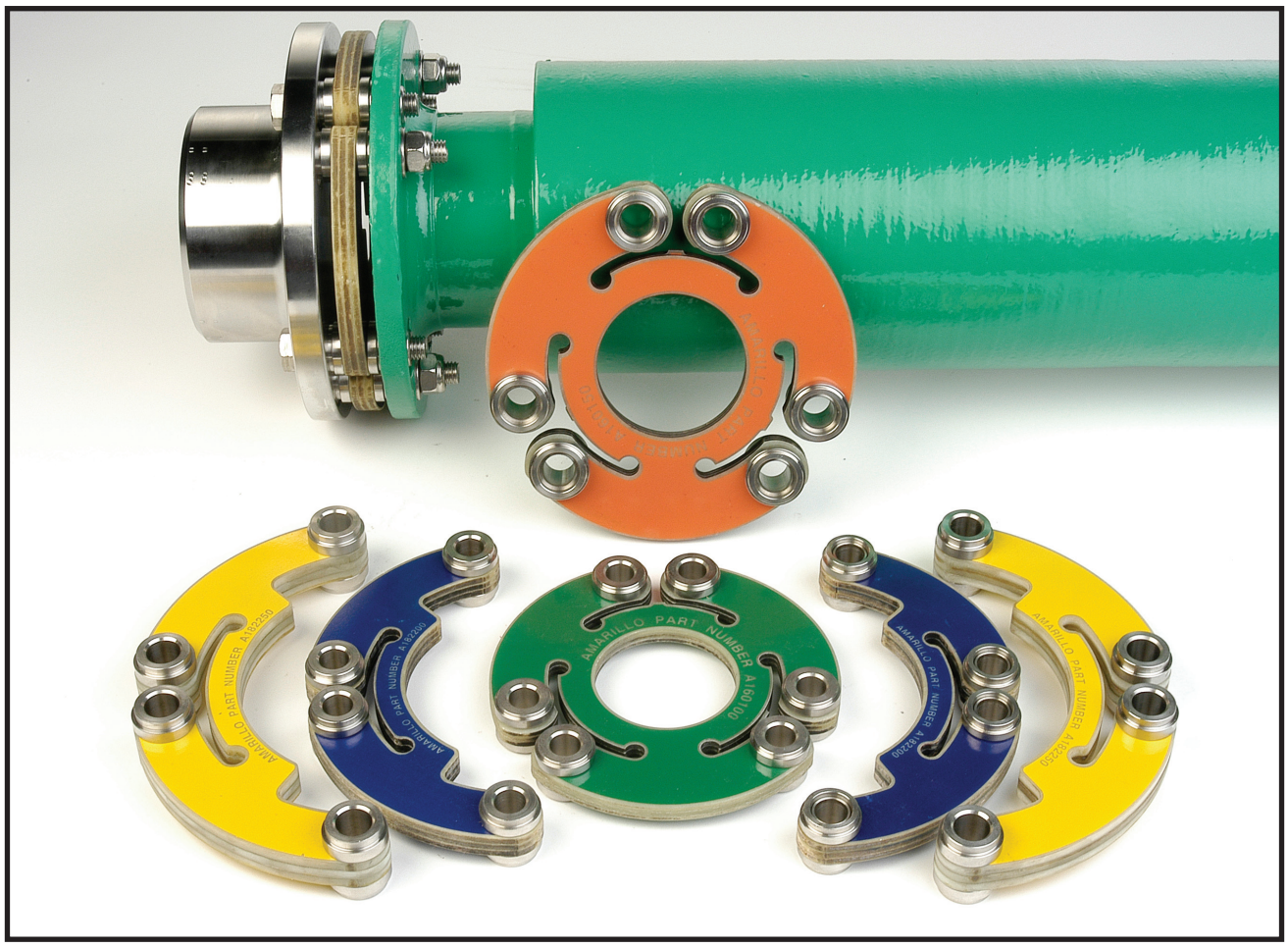
Features	Benefits
Greater Misalignment Tolerance	When misalignment occurs due to mechanical equipment shifting, greater than one degree of angular misalignment per flex disc allowed.
Composite Flex Discs	Color coded by size for easy identification. Includes integral 316 SS bushings.
Registered Bushings & Flanges	Lower stress concentrations and better assurance of alignment.
High Strength Composite Flange Hubs	Spacer tube flange hubs are strong and corrosion resistant, while at the same time lightweight, reducing overhung loads.
316 SS Flange Hubs	Corrosion resistance of stainless steel for motor & gearbox hubs.
Standard 316 SS Hardware	Since precision hardware is not required, fasteners are easily replaced, and at lower costs. Optional monel hardware available.
High Service Factor Rating	Capable of withstanding repetitive high start-up torques.
Durable UV Resistant Coating	Longer lasting protection from UV degradation.
Balancing	All drive shafts are dynamically balanced to AGMA 9000-C90, Class 9 specifications.
Process Verification	Each Amarillo composite drive shaft is tested to 4 times continuous operating torque prior to shipment.
Easier Installation	Fewer parts required at each flex disc connection.
Special Shipping Tubes	Designed to give ultimate drive shaft protection for both international and domestic shipments.

Amarillo Composite Drive Shafts

For Cooling Towers

The composite drive shafts produced by Amarillo Gear Company for cooling towers reflect a long history of quality workmanship and reliability. Amarillo Gear has been designing and manufacturing power transmission products since 1934, and the commitment to excellence continues today. Amarillo Gear is proud to be a certified ISO 9001:2000 company.

Design features and ratings of the Amarillo Gear Composite Drive Shafts are in accordance with, or exceed, the minimum requirements of AGMA (American Gear Manufacturers Association) standards.



Catalog DS 4/05

T.M.

Amarillo® Gear Company

P. O. Box 1789 • Amarillo, Texas 79105 • 2401 Sundown Lane (79118) • 806-622-1273 • Fax 806-622-3258
www.amarillogear.com e-mail: info@amarillogear.com