SPICER®
Driveshaft Products

Driveshaft Application Guidelines

DSAG-0200
May 2022

Driveline Sizing

Critical Speed

Center Bearing Mounting

Driveline Analysis

Appendix

Specifying a Spicer Driveline

Application Definitions

- Domestic applications - restricted to North America, Europe, Brazil, Japan, Australia, and New Zealand.
- Export applications - outside of North America, Europe, Brazil, Japan, Australia, and New Zealand.

  *Driveline sizing for export applications is based on Maximum Driveshaft Torque and Bearing Life calculations **only**. The wheel slip torque calculation is not used for Export applications due to overload conditions that can occur in these regions.

Application Description	Application Definition
Linehaul	Vehicles transporting goods in excess of 60,000 mi (100,000 Km) per year over well maintained concrete and asphalt roadways with a maximum grade of 8% and a maximum GCW of 80,000 lbs. (36,300 Kg).
Regional Haul / General Freight	Vehicles transporting goods in excess of 60,000 mi (100,000 Km) per year over well maintained concrete and asphalt roadways with a maximum GCW of 80,000 lbs. (36,300 Kg) with typical trips between 100 and 300 miles (160 and 480 Km).
Refrigerated	Vehicles transporting frozen foods in excess of 60,000 mi (100,000 Km) per year over well maintained concrete and asphalt roadways with a maximum GCW of 80,000 lbs. (36,300 Kg) with typical trips over 100 miles (160 Km).
Liquid Bulk	Vehicles transporting Bulk liquids in excess of 60,000 mi (100,000 Km) per year over well maintained concrete and ashphalt roadways with a maximum GCW of 80,000 lbs. (36,300 Kg) with typical trips over 100 miles (160 Km).
Coach Bus	Vehicles used for transporting passengers in excess of of 60,000 mi (100,000 Km) per year over well maintained concrete and asphalt roadways with a GVW in excess of 33,000 lbs. (15,000 Kg).
Wrecker	Trucks with recovery body used for recovering and towing stranded vehicles and equipment over well maintained concrete and ashphalt roadways.
Heavy Equipment	Tractors used for transport of heavy equipment, machinery, and materials in excess of 80,000 lbs. (36,300 kg) GCW over well maintained concrete and ashphalt roadways.
Refuse	Vehicles used for collecting, transporting and disposing of waste material from residential, commercial or industrial sites. Examples include vacuum tank, rear packer, recycling and rear dump trailers.
Agriculture	Vehicles used primarily to transport agricultural and dairy products from the farm or field to processing or storage facilitities. Examples include feed trucks, bulk tank, dump and hopper bottom trailers.
Oil Field	Vehicles used primarily to support on site activities in the exploration, construction and drilling of oil and natural gas wells. Examples include bulk tanker, facturing, winch and service trucks.
Construction	Vehicles used primarily to transport building materials and support activities at construction sites of residential, commercial, industrial and roadways. Examples include mixer, dump, flat bed, tanker and paving.
Logging	Vehicle used to transport logs or wood chips from logging sites to processing facilities over un-improved roads and steep grades.
Utility	Trucks with specialized bodies used to tranport equipment and materials used to perform repairs and maitenance of public infrastructure at residential, commercial and industrial work sites including some off-road operation.
Mining	Vehicles primarily used to transport rock and minerals within a mining site or to an off-site collection/processing facility. These are typically high horsepower / high capacity vehicles subjected to severe operating conditions.
Military	Vehicles produced for government agencies by the defense industry primarily used to transport personel, equipment and materials operating in severe off-road conditions.
City P&D	Vehicles used to transport goods to and from residential, commercial, industrial and warehousing sites operating on city, suburban, and rural routes with multiple stop/start cycles per day within a 50 mile (80 Km) radius.
Shuttle Bus	Vehicles used to transport passengers between sites making multiple trips per hour. Examples include airport, hotel and parking lot shuttles.
Transit Bus	Vehicles used to transport passengers over city or suburban routes making multiple stops per hour.
Fire/Rescue	Vehicles used to transport people and equipment to the site of an emergency to extinguish fires and evacuate and transport injured victims to a medical facility.
School Bus	Vehicles specifically designed to transport passengers to and from school and extracurricular activities. Includes Prison and church busses.
Recreational Vehicle	Vehicles used for non-commercial transportation travelling less than 30,000 mi. (48,280 Km) per year. May pull a small trailer or automobile.

Main Driveline Series Selection - Metric Units

Step 1 - Low Gear Torque Calculation – Use the following formula to calculate the maximum torque imparted to the driveline from the engine.

$$LGT = T_E \; x \; 0.95 \; x \; TLGR \; x \; E_T \; x \; SR \; x \; TCR \; x \; E_C \quad \textit{(Nm)}$$

LGT = Maximum Driveshaft Low Gear Torque (Nm)

T_E = Gross Engine Torque (advertised torque rating) (Nm)

TLGR = Transmission Low Gear Ratio (forward only) *

E_T = Transmission Efficiency (automatic = 0.90; manual = 0.95)

SR = Torque Converter Stall Ratio (if applicable)

TCR = Transfer Case or Auxiliary Transmission Ratio (if applicable)

E_C = Transfer Case or Auxiliary Transmission Efficiency (if applicable, 0.95)

*** Some applications require deep reduction transmissions for speed-controlled operations such as paving and pouring. In these applications it may be more appropriate to use the second lowest forward transmission ratio to calculate the Maximum Low Gear Torque. To use the second lowest forward gear ratio to calculate LGT, all three of the following conditions must be met:**

1. Lowest forward gear ratio numerically greater than 16:1.
2. Split between the lowest forward gear ratio and the second lowest forward gear ratio is greater than 50%.
3. Startability Index must be greater than 25 (see below calculation).

Startability Index Calculation (SI)

$$SI = ((T_E \; x \; TR_2 \; x \; E_T \; x \; AR \; x \; TCR \; x \; E_C \; x \; 4.6) \; / \; (SLR \; x \; GCW)) - .75$$

T_E = Gross Engine Torque (advertised torque rating) (Nm)

TR_2 = Transmission Second Lowest Forward Gear Ratio

E_T = Transmission Efficiency (automatic = 0.90; manual = 0.95)

AR = Axle Ratio

TCR = Transfer Case or Auxiliary Transmission Ratio (if applicable)

E_C = Transfer Case Efficiency (if applicable, 0.95)

SLR = Drive Tire Static Loaded Radius (m)

GCW = Maximum Gross Combination Weight (kg)

<u>Step 2</u> - Wheel Slip Torque Calculation – Use the following formula to calculate the main driveshaft torque required to slip the wheels.

Note: The wheel slip calculation is used for Domestic applications only. See Application Definitions on Page 2.

$$WST = (6.965\ x\ GAWR\ x\ R_S)\ /\ (AR\ x\ E_A)\ \ (Nm)$$

WST = Wheel Slip Torque Applied to the Driveshaft (Nm)

GAWR = Gross Axle Weight Rating (kg)

SLR = Drive Tire Static Loaded Radius (m)

AR = Axle Ratio

E_A = Axle Efficiency (single axle = .95, tandem axle = .926, tridem axle =.914)

*** Compare the Low Gear Torque (LGT) calculated in step 1 and the Wheel Slip Torque (WST) calculated in step 2 and use the <u>lower</u> of the two values as the "application torque" to select the appropriate driveline Series from table 2 on page 9. The maximum torque rating of the selected Series must be equal to or greater than the application torque value.**

<u>Step 3</u> – Calculate the Universal Joint Bearing Life (B_{10}) for the Series selected in Step 2.

$$B_{10} = 98,000\ x\ (AR/(SLR\ x\ 1.04))^{(7/3)}\ x\ \left(BF/(GCW\ x\ AF)\right)^{(10/3)}\ \ (Km)$$

GCW = Maximum Gross Combination Weight (Kg)
AF = Application Factor (See **Table 1** on Page 9)
SLR = Drive Tire Static Loaded Radius (m)
AR = Axle Ratio
BF = Universal Joint Bearing Factor (Nm) (See **Table 2** on Page 9)

Note: The bearing life formula assumes a universal joint true operating angle ≤ 3°. For main driveline applications with static universal joint true operating angles in excess of 3° the formula can be adjusted by replacing the 98,000 constant value with 294,000 ÷ true operating angle.

<u>Step 4</u> – Compare the B_{10} universal joint bearing life value calculated in step 3 to the Bearing Life Requirement (B_{10}) for your application listed in **table 1** on page 9. The calculated B_{10} bearing life must exceed the requirement of the vehicle application. If the B_{10} bearing life does not meet the application requirement repeat step 3 for the next larger Series until the B_{10} requirement is met.

Interaxle Driveline Series Selection (If Applicable)

Step 1 – Calculate the torque capacity requirement for the interaxle driveshaft using the following formula.

$$T = T_m\ x\ 0.60 \quad \textit{(Nm) (tandem axle and tridem } 1^{st} \textit{ interaxle)}$$

T = Interaxle driveshaft torque requirement (Nm)

T_m = Main driveline application torque requirement from step 2, page 4 (Nm).

* Use the calculated application torque value to select the appropriate interaxle driveline Series from **table 2** on page 9. The maximum torque rating of the selected Series must be equal to or greater than the application torque value.

Note: High angle (45°) interaxle driveshafts are available in C2045, C2055, SPL170, SPL250 and 1710 Series only.

Step 2 – Calculate the Universal Joint Bearing Life (B_{10}) for the Series selected in Step 1 using the following formula.

$$B_{10} = 294,000\ x\ (AR/(SLR\ x\ 1.04))^{(7/3)}\ x\ \left(BF/(GCW\ x\ AF)\right)^{(10/3)} \quad (Km)$$

GCW = Maximum Gross Combination Weight (Kg)
AF = Application Factor (See **Table 1** on Page 9)
SLR = Drive Tire Static Loaded Radius (m)
AR = Axle Ratio
BF = Universal Joint Bearing Factor (Nm) (See **Table 3** on Page 10)

Note: For interaxle driveline applications with static universal joint true operating angles in excess of 6 degrees contact Spicer Engineering.

Step 3 – Compare the B_{10} universal joint bearing life value calculated in step 2 to the Bearing Life Requirement (B_{10}) for your application listed in **table 3** on page 10. The calculated B_{10} bearing life must exceed the requirement of the vehicle application. If the B_{10} bearing life does not meet the application requirement repeat step 2 for the next larger Series until the B_{10} requirement is met.

For tridem applications, the 2nd interaxle driveshaft can be the same or one Series smaller than the forward interaxle driveshaft (torque capacity and B_{10} life calculations are not needed).

Main Driveline Series Selection - English Units

Step 1 - Low Gear Torque Calculation – Use the following formula to calculate the maximum torque imparted to the driveline from the engine.

$$LGT = T_E \; x \; 0.95 \; x \; TLGR \; x \; E_T \; x \; SR \; x \; TCR \; x \; E_C \quad \textit{(lb.ft.)}$$

LGT = Maximum Driveshaft Low Gear Torque (lb.ft.)

T_E = Gross Engine Torque (advertised torque rating) (lb.ft.)

TLGR = Transmission Low Gear Ratio (forward only) *

E_T = Transmission Efficiency (automatic = 0.90; manual = 0.95)

SR = Torque Converter Stall Ratio (if applicable)

TCR = Transfer Case or Auxiliary Transmission Ratio (if applicable)

E_C = Transfer Case or Auxiliary Transmission Efficiency (if applicable, 0.95)

*** Some applications require deep reduction transmissions for speed-controlled operations such as paving and pouring. In these applications it may be more appropriate to use the second lowest forward transmission ratio to calculate the Maximum Low Gear Torque. To use the second lowest forward gear ratio to calculate LGT, all three of the following conditions must be met:**

1. Lowest forward gear ratio numerically greater than 16:1.
2. Split between the lowest forward gear ratio and the second lowest forward gear ratio is greater than 50%.
3. Startability Index must be greater than 25 (see below calculation).

Startability Index Calculation (SI)

$$SI = ((T_E \; x \; TR_2 \; x \; E_T \; x \; AR \; x \; TCR \; x \; E_C x \; 541.5) \, / \, (SLR \; x \; GCW)) - .75$$

T_E = Gross Engine Torque (advertised torque rating) (lb.ft.)

TR_2 = Transmission Second Lowest Forward Gear Ratio

E_T = Transmission Efficiency (automatic = 0.90; manual = 0.95)

AR = Axle Ratio

TCR = Transfer Case or Auxiliary Transmission Ratio (if applicable)

E_C = Transfer Case Efficiency (if applicable, 0.95)

SLR = Drive Tire Static Loaded Radius (in.)

GCW = Maximum Gross Combination Weight (lb.)

Step 2 - Wheel Slip Torque Calculation– Use the following formula to calculate the main driveshaft torque required to slip the wheels.

Note: The wheel slip calculation is used for Domestic applications only. See Application Definitions on Page 2.

$$WST = (GAWR \; x \; SLR) \,/\, (16.9 \; x \; AR \; x \; E_A) \quad \textit{(lb.ft.)}$$

WST = Wheel Slip Torque Applied to the Driveshaft (lb.ft.)

GAWR = Gross Axle Weight Rating (lbs.)

SLR = Drive Tire Static Loaded Radius (in.)

AR = Axle Ratio

E_A = Axle Efficiency (single axle = .95, tandem axle = .926, tridem axle =.914)

*** Compare the Low Gear Torque (LGT) calculated in step 1 and the Wheel Slip Torque (WST) calculated in step 2 and use the lower of the two values as the "application torque" to select the appropriate driveline Series from table 2 on page 9. The maximum torque rating of the selected Series must be equal to or greater than the application torque value.**

Step 3 – Calculate the Universal Joint Bearing Life (B_{10}) for the Series selected in Step 2.

$$B_{10} = 60,900 \; x \; (AR \; x \; 37.8559/SLR)^{(7/3)} \; x \; \left(BF \; x \; 2.989/(GCW \; x \; AF)\right)^{(10/3)} \quad \textit{(mi.)}$$

GCW = Maximum Gross Combination Weight (lbs.)
AF = Application Factor (See **Table 1** on Page 9)
SLR = Drive Tire Static Loaded Radius (in.)
AR = Axle Ratio
BF = Universal Joint Bearing Factor (lb.ft., See **Table 2** on Page 9)

Note: The bearing life formula assumes a universal joint true operating angle ≤ 3°. For main driveline applications with static universal joint true operating angles in excess of 3° the formula can be adjusted by replacing the 60,900 constant value with 182,700 ÷ true operating angle.

Step 4 – Compare the B_{10} universal joint bearing life value calculated in step 3 to the Bearing Life Requirement (B_{10}) for your application listed in **table 1** on page 9. The calculated B_{10} bearing life must exceed the requirement of the vehicle application. If the B_{10} bearing life does not meet the application requirement repeat step 3 for the next larger Series until the B_{10} requirement is met.

Interaxle Driveline Series Selection (If Applicable)

<u>Step 1</u> – Calculate the torque capacity requirement for the interaxle driveshaft using the following formula.

$T = T_m \, x \, 0.60$ ***(lb.ft.) (tandem axle and tridem 1st interaxle)***

T = Interaxle driveshaft torque requirement (lb.ft.)

T_m = Main driveline application torque requirement from step 2, page 7 (lb.ft.)

* Use the calculated application torque value to select the appropriate interaxle driveline Series from **table 2** on page 9. The maximum torque rating of the selected Series must be equal to or greater than the application torque value.

Note: High angle (45°) interaxle driveshafts are available in C2045, C2055, SPL170, SPL250 and 1710 Series only.

<u>Step 2</u> – Calculate the Universal Joint Bearing Life (B_{10}) for the Series selected in Step 1 using the following formula.

$B_{10} = 182{,}700 \, x \, (AR \, x \, 37.8559/SLR)^{(7/3)} \, x \, \left(BF \, x \, 2.989/(GCW \, x \, AF)\right)^{(10/3)}$ ***(mi.)***

GCW = Maximum Gross Combination Weight (lbs.)
AF = Application Factor (See **Table 1** on Page 9)
SLR = Drive Tire Static Loaded Radius (in.)
AR = Axle Ratio
BF = Universal Joint Bearing Factor (lb.ft.) (See **Table 3** on Page 10)

Note: For interaxle driveline applications with static universal joint true operating angles in excess of 6 degrees contact Spicer Engineering.

<u>**Step 3**</u> **–** Compare the B_{10} universal joint bearing life value calculated in step 2 to the Bearing Life Requirement (B_{10}) for your application listed in **table 3** on page 10. The calculated B_{10} bearing life must exceed the requirement of the vehicle application. If the B_{10} bearing life does not meet the application requirement repeat step 2 for the next larger Series until the B_{10} requirement is met.

For tridem applications, the 2nd interaxle driveshaft can be the same or one Series smaller than the forward interaxle driveshaft (torque capacity and B_{10} life calculations are not needed).

Application Factors, Ratings and Bearing Life Requirements

<table>
<tr><th>Application Vocation</th><th>Application Factor (AF)</th><th>Bearing Life Requirement</th></tr>
<tr><td>Linehaul</td><td>0.265</td><td rowspan="7">GVW>14,968 Kg (33,000 lbs.) / GCW>22,680 Kg (50,000 lbs.) 1,609,000 Km (1,000,000 mi.)</td></tr>
<tr><td>Coach Bus</td><td rowspan="6">0.290</td></tr>
<tr><td>General Freight</td></tr>
<tr><td>Refrigerated</td></tr>
<tr><td>Liquid Bulk</td></tr>
<tr><td>Wrecker</td></tr>
<tr><td>Heavy Equipment</td></tr>
<tr><td>Refuse</td><td rowspan="6">0.400</td><td rowspan="8">GVW≤14,968 Kg (33,000 lbs.) / GCW≤22,680 Kg (50,000 lbs.) 804,672 Km (500,000 mi.)</td></tr>
<tr><td>Agriculture</td></tr>
<tr><td>Oil Field</td></tr>
<tr><td>Construction</td></tr>
<tr><td>Logging</td></tr>
<tr><td>Utility</td></tr>
<tr><td>Mining</td><td rowspan="2">0.520</td></tr>
<tr><td>Military</td></tr>
<tr><td>City P&D</td><td rowspan="4">0.400</td><td rowspan="6">804,672 Km (500,000 mi.)</td></tr>
<tr><td>Shuttle Bus</td></tr>
<tr><td>Transit Bus</td></tr>
<tr><td>Fire/Rescue</td></tr>
<tr><td>School Bus</td><td>0.375</td></tr>
<tr><td>Rec. Vehicle</td><td>0.310</td></tr>
</table>

Table 1

Main Driveline Series	Maximum Torque Capacity		Bearing Factor (BF)	
	Nm	lb.ft.	Nm	lb.ft.
1610	7,728	5,700	4,446	3,279
1710	10,440	7,700	5,840	4,307
1710HD	13,829	10,200	5,840	4,307
1760	13,829	10,200	6,975	5,144
1760HD	16,541	12,200	6,975	5,144
1810	16,541	12,200	7,646	5,639
1810HD	22,371	16,500	7,646	5,639
SPL055	4,068	3,000	2,345	1,730
SPL070	5,288	3,900	2,974	2,194
SPL100	7,728	5,700	4,136	3,051
SPL140	14,000	10,326	5,711	4,212
SPL140HD	15,000	11,063	5,711	4,212
SPL170	17,000	12,538	9,509	7,013
SPL170HD	20,000	14,751	9,509	7,013
SPL250	22,500	16,595	10,893	8,034
SPL250HD	25,000	18,439	10,893	8,034
SPL250 Lite HT	25,000	18,439	10,893	8,034
SPL350	30,000	22,127	13,296	9,807
SPL350 Lite HT	30,000	22,127	13,296	9,807
SPL350HD	35,000	25,815	13,296	9,807
C2035	10,000	7,375	3,790	2,795
C2040	14,000	10,326	5,848	4,313
C2045	17,000	12,538	7,633	5,630
C2047	19,000	14,013	7,633	5,630
C2055	25,000	18,439	9,788	7,219
C2060	30,000	22,127	11,388	8,399
C2065	35,000	25,815	13,296	9,807

Table 2

Application Factors, Ratings and Bearing Life Requirements (Cont'd.)

Interaxle Driveline Series	Maximum Torque Capacity		Bearing Factor (BF)	
	Nm	lb.ft.	Nm	lb.ft.
1710 I/A	10440	7700	5840	4307
1710	10440	7700	5840	4307
1710HD	13829	10200	5840	4307
1810	16541	12200	7646	5639
1810HD	22371	16500	7646	5639
SPL170 I/A	15000	11063	9509	7013
SPL170	17000	12538	9509	7013
SPL170HD	20000	14751	9509	7013
SPL250 I/A	21000	15489	10893	8034
SPL250	22500	16595	10893	8034
SPL250HD	25000	18439	10893	8034
C2035	10000	7375	3790	2795
C2040	14000	10326	5848	4313
C2045	17000	12538	7633	5630
C2047	19000	14013	7633	5630
C2055	25000	18439	9788	7219

Table 3

Critical Speed

Critical speed is defined as: The speed at which the rotational speed of the driveshaft coincides with the natural frequency of the shaft.

Standard Equation:

$$CS = 30\pi \sqrt{\frac{E\ x\ 386.4\ x\ (O^2\ +\ I^2)}{\rho\ x\ L^4\ x\ 16}}$$

CS = Critical Speed (rpm)
E = Modulus of tubing material (psi)
O = Outside Diameter of Tubing (in)
I = Inside Diameter of Tubing (in)
ρ = Density of Tubing Material (lbs/in^3)
L = Distance Between Universal Joint Centers (in)

* Refer to "Spicer Standard Tube Sizes" on page 14 for tube dimensions.

<u>Material Properties</u>

Material	**Modulus (lbs./in^2)**	**Density (lbs./in^3)**	**E/P x 386.4**
Steel	30.00×10^6	0.2830	41.0×10^9
Aluminum	10.30×10^6	0.0980	39.4×10^9

Simplified Equations

Steel:

$$CS = \frac{4.769 \times 10^{6}}{L^{2}} \sqrt{O^{2} + I^{2}}$$

Aluminum:

$$CS = \frac{4.748 \times 10^{6}}{L^{2}} \sqrt{O^{2} + I^{2}}$$

CS = Critical Speed (rpm)
L = Distance Between Journal Cross Centers (in)
O = Outside Diameter of Tubing (in)
I = Inside Diameter of Tubing (in)

Adjusted Critical Speed (Maximum Safe Operating Speed)

$$ACS = TC \times CF \times SF$$

ACS = Adjusted Critical Speed (rpm)
TC = Theoretical Critical
CF = Correction Factor
SF = Safety Factor

Suggested factors for Adjusted Critical Speed:

Safety Factor = 0.75
Correction Factor
  Outboard Slip = 0.92
  Inboard Slip = 0.75

Note: The value for ACS (Maximum Safe Operating Speed) must be greater than the maximum driveshaft speed of the vehicle.

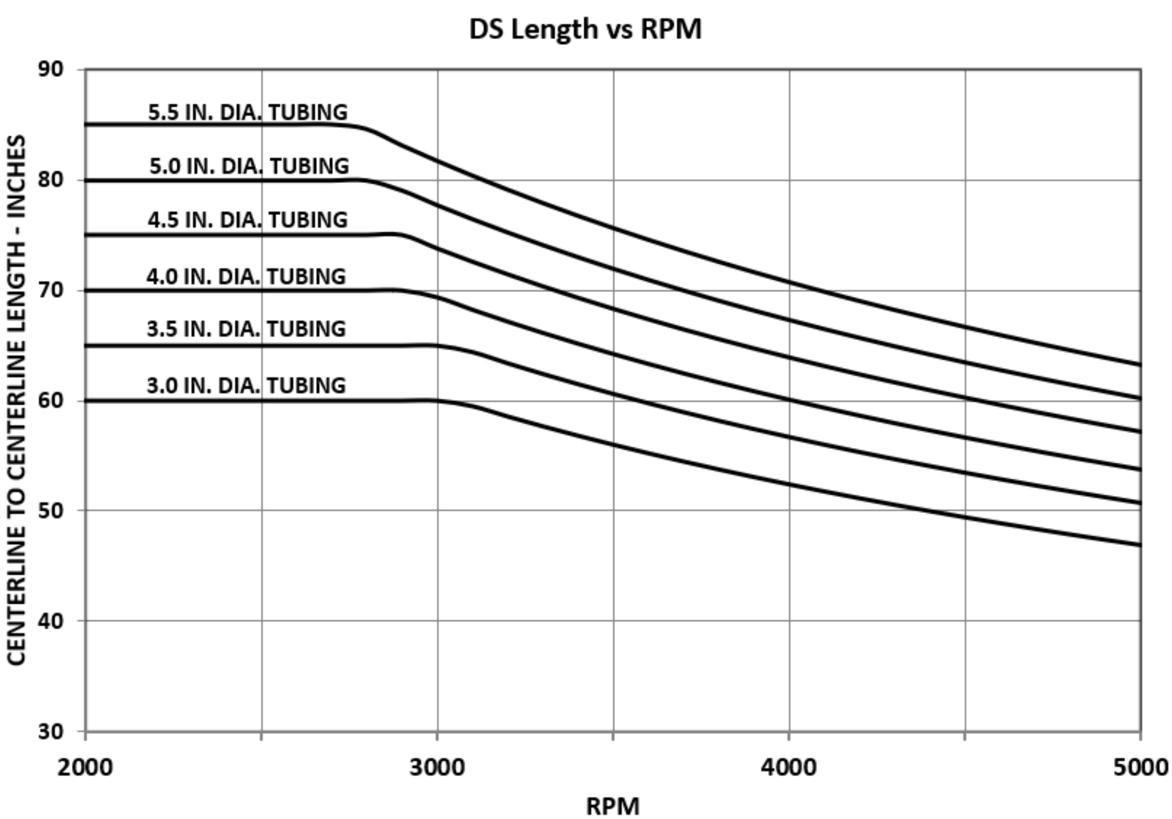
Maximum Driveshaft Length

Refer to the chart at the bottom of this page for maximum driveshaft length vs. RPM guidelines.

The general length limitations are as follows:

Tube O.D.	Maximum Length *	Driveline Series
3.5 in. (88.9 mm)	65 in. (1651 mm)	SPL55, SPL70
4.0 in. (101.6 mm)	70 in. (1778 mm)	1710, 1760, SPL100
4.21 in. (107.0 mm)	72 in. (1829 mm)	SPL140
4.33 in. (110.0 mm)	73 in. (1854 mm)	SPL140HD
4.5 in. (114.3 mm)	75 in. (1905 mm)	1710, 1810
4.66 in. (118.4 mm)	80 in. (2032 mm)	SPL250 Lite HT
4.72 in. (120.0 mm)	80 in. (2032 mm)	SPL350 Lite HT
5.0 in. (127.0 mm)	80 in. (2032 mm)	SPL170, SPL250
5.5 in. (140 mm)	83 in. (2108 mm)	SPL350, SPL350HD

*Installed length universal joint centerline to universal joint centerline.



Spicer Standard Tube Sizes

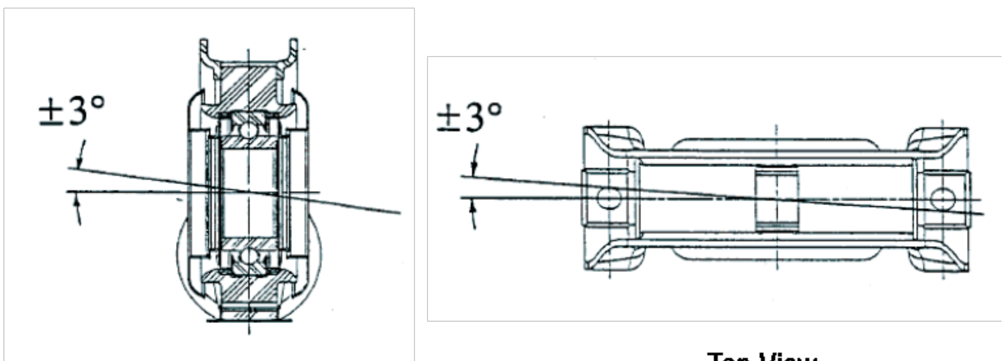
Series	Tube Size (in) OD x wall thickness	Dana Part Number	Torque Rating (lbs. ft.)	Tube JAEL (lbs. ft.)
1610	4.00 x .134	32-30-52	5,700	8,600
1710	4.00 x .134	32-30-52	7,700	8,600
1710 HD	4.09 x .180	32-30-72	10,200	13,925
1760	4.00 x .134	32-30-92	10,200	10,435
1760 HD	4.09 x .180	32-30-72	12,200	13,925
1810	4.50 x .134	36-30-62	12,200	13,065
1810 HD	4.59 x .180	36-30-102	16,500	17,935
SPL55	3.50 x .083	28-30-62	3,000	4,017
SPL 70	3.50 x .095	28-30-22	3,900	4,600
SPL 100	4.00 x .095	32-30-12	5,700	6,300
SPL 140	4.21 x .138	100-30-3	7,744	11,010
SPL 140 HD	4.33 x .197	100-30-5	11,063	16,519
SPL 170	4.96 x .118	120-30-3	12,539	13,185
SPL 170 HD	5.06 x .167	120-30-4	14,751	19,617
SPL 170 I/A	4.59 x .180	36-30-102	11,063	17,935
SPL 250 I/A	5.06 x .167	120-30-4	15,489	19,617
SPL250 Lite HT	4.66 x .205	108-30-5	18,439	20,652
SPL 250	5.06 x .167	120-30-4	16,595	19,617
SPL250 HD	5.12 x .197	120-30-5	18,439	23,555
SPL350 Lite HT	4.72 x .236	108-30-6	22,127	24,041
SPL350	5.45 x .167	130-30-21720	22,127	24,180
SPL350 HD	5.51 x .197	130-30-21718	25,815	28,731

Center Bearing Mounting

Spicer heavy duty center bearings must be mounted within 3° of perpendicular to the coupling shaft centerline as shown in Figure 1 below and the center bearing assembly must not operate with a linear offset greater than 1/8 inch as shown in Figure 2.

Note: The Spicer "Dura-Tune®" self-aligning center bearing may be mounted up to +/- 10° of perpendicular to the coupling shaft centerline as shown in the side view of Figure 1. The rubber isolator must remain perpendicular to the coupling shaft centerline within 3° as shown in Figure 1.

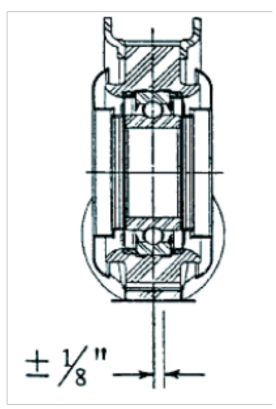
Figure 1



Side View

Top View

Figure 2



Side View

Driveline Analysis

Design Criteria

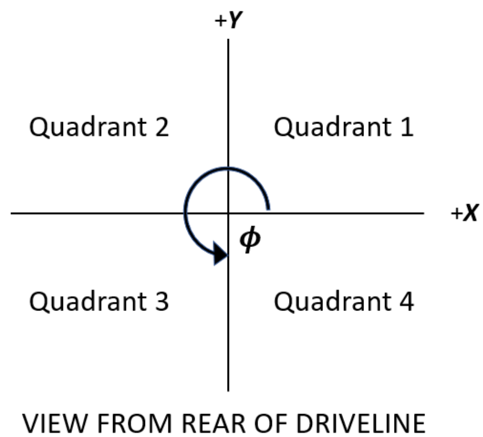
- Torsional Vibration
- Inertial Vibration
- Center Bearing Loading

Torsional and Inertial Excitation

Calculate the true universal joint operating angles for each universal joint location in Polar format ($\theta \angle \phi$)

$$\theta = \sqrt{\theta_x{}^2 + \theta_y{}^2} \qquad \phi = tan^{-1}\left\{\frac{\theta_y}{\theta_x}\right\}$$

It is critical that the correct polar angle value of ϕ be determined for use in the torsional acceleration, inertial acceleration, and center bearing load calculations. This value must be expressed by a positive angle value originating at the positive x axis in the counterclockwise direction. The proper values for ϕ can be obtained using the formulas below for the various values of θ_x and θ_y.



For positive values of θ_x and θ_y (quadrant 1): $\phi = tan^{-1}\left\{\frac{\theta_y}{\theta_x}\right\}$

For negative θ_x and positive θ_y (quadrant 2): $\phi = tan^{-1}\left\{\frac{\theta_y}{\theta_x}\right\} + 180°$

For negative values of θ_x and θ_y (quadrant 3): $\phi = tan^{-1}\left\{\frac{\theta_y}{\theta_x}\right\} + 180°$

For positive θ_x and negative θ_y (quadrant 4): $\phi = tan^{-1}\left\{\frac{\theta_y}{\theta_x}\right\} + 360°$

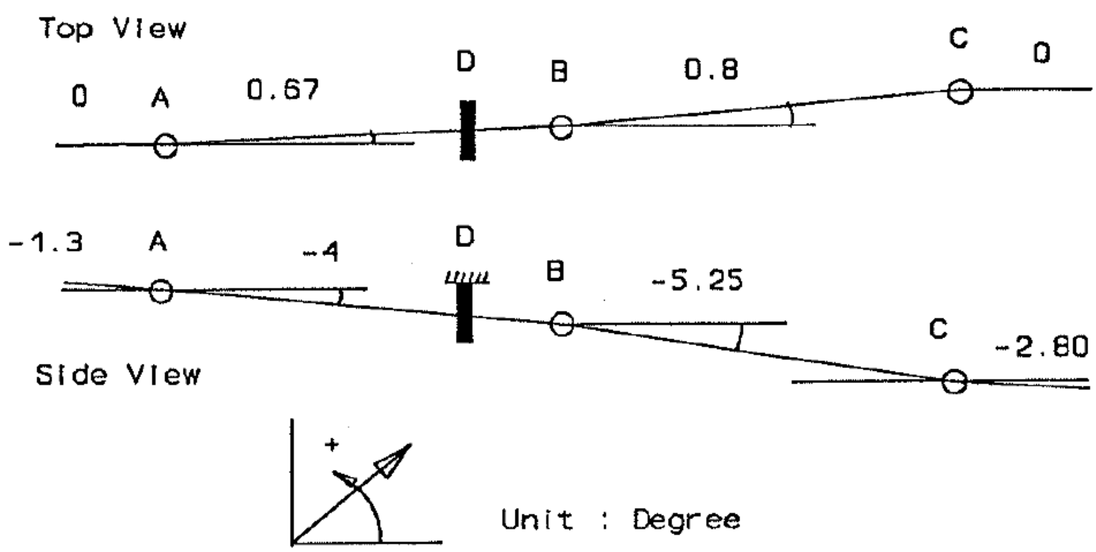
For positive values of θ_x and $\theta_y = 0$ $\phi = 360°$

For negative values of θ_x and $\theta_y = 0$ $\phi = 180°$

For positive values of θ_y and $\theta_x = 0$ $\phi = 90°$

For negative values of θ_y and $\theta_x = 0$ $\phi = 270°$

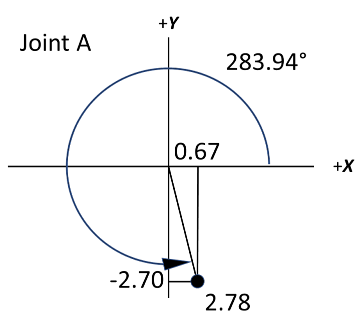
Driveline Layout Example:



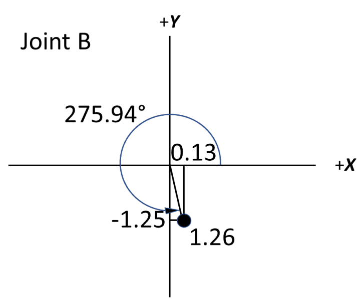
To find the true joint angle of each joint, first find the top-view and side-view angles of each joint. The top-view angle of Joint A is equal to 0.67 - 0.00 = 0.67 and the side-view joint angle of Joint A is equal to (-4.0) - (-1.3) = -2.70. By putting the top-view angle (0.67) to the X-axis and the side-view angle (-2.70) to the Y-axis, the true joint angle of Joint A is equal to 2.78°∠283.94°.

Note: The true joint angle is a vector: the 2.78° is the magnitude and the 283.94° is the argument. The true joint angles of joints A, B, and C are shown in the following chart.

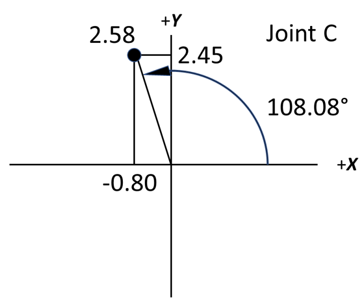
	Trans U-joint (A) degrees	**U-joint (B) degrees**	**Axle U-joint (C) degrees**
Joint Angle - Top View θ_x	0.67	0.13	-0.80
Joint Angle - Side View θ_y	-2.70	-1.25	2.45
True Joint Angle θ	2.78	1.26	2.58
Plane of True Joint Angle ϕ	283.94	275.94	108.08



VIEW FROM REAR OF DRIVELINE



VIEW FROM REAR OF DRIVELINE



VIEW FROM REAR OF DRIVELINE

Calculate Torsional and Inertia Excitation

Step 1 - Calculate the torsional excitation, T_{max} $\left\{\frac{rad}{sec^2}\right\}$:

$$\Theta_{tor} = \sqrt{(|\theta_1|\angle\phi_1)^2 + (|\theta_2|(\angle\phi_2 - 90 - \delta_1))^2 + (|\theta_3|(\angle\phi_3 - \delta_2 - \delta_1))^2 + (|\theta_4|(\angle\phi_4 - 90 - \delta_3 - \delta_2 - \delta_1))^2}$$

*Where $|\theta_1|\angle\phi_1$ represents the true joint angle of the universal joint at the transmission output and δ represents the shaft phase angle for each shaft (typically 0° or 90°). The formula shown is for a 3-piece driveline (4 universal joints). For two-piece drivelines enter zero for universal joint 4 and for single piece drivelines enter zero for universal joints 3 & 4. Contact Spicer Engineering for help with formulas for 4-piece (5 joint) drivelines.

$$T_{max} = (3.3405x10^{-6})\ x\ (\theta)^2\ x\ (rpm)^2\ \left\{\frac{rad}{sec^2}\right\}$$

Note: The Dana design limit for torsional excitation is 300 $\frac{rad}{sec^2}$ in all suspension conditions.

Step 2 - Calculate the drive inertia excitation, I_D $\left\{\frac{rad}{sec^2}\right\}$:

3 pc. Driveline: $\Theta_{drive\ inertial} = \sqrt{3(|\theta_1|\angle\phi_1)^2 + 2(|\theta_2|\angle(\phi_2 - 90° - \delta_1))^2 + (|\theta_3|\angle(\phi_3 - \delta_2 - \delta_1))^2}$

2 pc. Driveline: $\Theta_{drive\ inertial} = \sqrt{2(|\theta_1|\angle\phi_1)^2 + (|\theta_2|\angle(\phi_2 - 90° - \delta_1))^2}$

Single Driveline: $\Theta_{drive\ inertial} = \sqrt{(|\theta_1|\angle\phi_1)^2}$

*Where δ represents the shaft phase angle for each shaft (typically 0° or 90°).

$$I_D = (3.3405x10^{-6})\ x\ (\theta)^2\ x\ (rpm)^2\ \left\{\frac{rad}{sec^2}\right\}$$

Step 3 - Calculate the coast inertia excitation, I_C $\left\{\frac{rad}{sec^2}\right\}$:

3 Piece Drivelines: $\Theta_{coast\ inertial} = \sqrt{3(|\theta_4|\angle\phi_4)^2 + 2(|\theta_3|\angle(\phi_3 + 90° + \delta_3))^2 + (|\theta_2|\angle(\phi_2 + \delta_3 + \delta_2))^2}$

2 Piece Drivelines: $\Theta_{coast\ inertial} = \sqrt{2(|\theta_3|\angle\phi_3)^2 + (|\theta_2|\angle(\phi_2 + 90° + \delta_2))^2}$

Single Drivelines: $\Theta_{coast\ inertial} = \sqrt{(|\theta_2|\angle\phi_2)^2}$

*Where δ represents the shaft phase angle for each shaft (typically 0° or 90°).

$$I_C = (3.3405x10^{-6})\ x\ (\theta)^2\ x\ (rpm)^2\ \left\{\frac{rad}{sec^2}\right\}$$

Note: The Dana design limit for inertial excitation is 1000 $\frac{rad}{sec^2}$ in all suspension conditions.

Center Bearing Loading

Calculate Static and Dynamic Center Bearing Load – English Units

Static Loading, L_S (lbs.):

$$L_S = \frac{6\ x\ LGT}{AB - DB}\left\{\left(sin\ \theta_A \angle(\phi_A + 90)\right) + \left(tan\ \theta_B - \frac{AB}{BC}\sin\theta_B\right)\angle(\phi_B + 90) + \frac{AB}{BC}\tan\theta_C \angle(\phi_C - 90)\right\}$$

Dynamic Loading, L_D (lbs.):

$$L_D = \frac{6\ x\ LGT}{AB - DB}\left\{\left(sin\ \theta_A \angle(90 - \phi_A)\right) + \left(tan\ \theta_B + \frac{AB}{BC}\sin\theta_B\right)\angle(90 - \phi_B + 2\delta_1) + \frac{AB}{BC}\tan\theta_C \angle(90 - \phi_C + 2\delta_1 + 2\delta_2)\right\}$$

LGT = Maximum Driveshaft Low Gear Torque (lb.ft.)

AB = coupling shaft length from universal joint center to universal joint center (in)

DB = coupling shaft length from center bearing center to universal joint center (in)

BC = driveshaft length from universal joint center to universal joint center (in)

Note: Refer to the driveline layout diagram on page 17 to define lengths AB, DB and BC.

<u>Maximum Center Bearing Loads</u>

Design	Static Load	Dynamic Load	Applicable Series
HD Solid Rubber	500 lbs.	500 lbs.	1710HD, 1760, 1810, SPL170, SPL250
HD Slotted Rubber	250 lbs	250 lbs	1710HD, 1760, 1810, SPL140, SPL170, SPL250, SPL350, C2045, C2047, C2055, C2060, C2065
MD Slotted Rubber	100 lbs	100 lbs	SPL100, SPL140, 1610, 1710 C2030, C2035, C2040

Calculate Static and Dynamic Center Bearing Load – Metric Units

Static Loading, L_S (Kg)

$$L_S = \frac{1}{19.62}\frac{LGT}{AB - DB}\left\{\left(\sin\theta_A \angle(\phi_A + 90)\right) + \left(\tan\theta_B - \frac{AB}{BC}\sin\theta_B\right)\angle(\phi_B + 90) + \frac{AB}{BC}\tan\theta_C \angle(\phi_C - 90)\right\}$$

Dynamic Loading, L_D (Kg)

$$L_D = \frac{1}{19.62}\frac{LGT}{AB - DB}\left\{\left(\sin\theta_A \angle(90 - \phi_A)\right) + \left(\tan\theta_B + \frac{AB}{BC}\sin\theta_B\right)\angle(90 - \phi_B + 2\delta_1) + \frac{AB}{BC}\tan\theta_C \angle(90 - \phi_C + 2\delta_1 + 2\delta_2)\right\}$$

LGT = Maximum Driveshaft Low Gear Torque (Nm)

AB = coupling shaft length from universal joint center to universal joint center (m)

DB = coupling shaft length from center bearing center to universal joint center (m)

BC = driveshaft length from universal joint center to universal joint center (m)

Note: Refer to the driveline layout diagram on page 17 to define lengths AB, DB and BC.

Maximum Center Bearing Loads

Design	Static Load	Dynamic Load	Applicable Series
HD Solid Rubber	226 Kg	226 Kg	1710HD, 1760, 1810, SPL170, SPL250
HD Slotted Rubber	113 Kg	113 Kg	1710HD, 1760, 1810, SPL140, SPL170, SPL250, SPL350, C2045, C2047, C2055, C2060, C2065
MD Slotted Rubber	45 Kg	45 Kg	SPL100, SPL140, 1610, 1710 C2030, C2035, C2040

Application Form

Heavy / Medium-Duty Applications

Company: ______________________ Contact: ______________________

Email: ______________________ Date: ______________________

Phone: ______________________ Fax: ______________________

Vocation: ____________ Vehicle Make: ____________ Vehicle Model: ____________

Weight - Empty: ______________________ GVW Total: ______________________

GVW (Front): ________ GVW (Rear): ____________ GCW: ____________

Tires - Size: __________ Make: ______________ Rolling Radius: ____________

Engine - Make: ________ Model: ______________ Displacement: ____________

Net Torque: ________ At Speed: ________ Net H.P.: ________ At Speed: ________

Gross Torque: ________ At Speed: ________ Gross H.P.: ________ At Speed: ________

Maximum Operating Speed (including engine over speed): ______________________

Trans - Make: ______________________ Model: ______________________

Ratios - Forward (including overdrive): ____________ Reverse: ____________

Torque Converter - Make: __________ Model: ____________ Stall Ratio: ____________

Auxiliary - Make: __________ Model: ____________ Ratios: ____________

Transfer Case - Make: __________ Model: ____________ Ratios: ____________

Torque Split Ratio - Front: ______________ Rear: ______________

Axle Make - Front: __________ Model: ____________ Ratios: ____________

Make - Front: __________ Model: ____________ Ratios: ____________

B_{10} Life Expectancy: ______________________________________

Vehicle Duty Cycle: ______________________________________

Description of Vehicle Function: ______________________________________

____

____

Signed: ______________________

Title: ______________________

Spicer Engineer: ______________________ Phone: ______________________

Email: ______________________ Fax: ______________________

Heavy / Medium-Duty Applications

APPLICATION PROPOSAL

Vehicle Position	Series	Dana Part Number
Transmission to Rear Axle		
Transmission to Auxiliary		
Auxiliary to Rear Axle		
Transmission to Mid Bearing		
Mid Bearing to Rear Axle		
Interaxle		
Wheel Drive		

Vehicle Application Sketch
Plan View
Side View

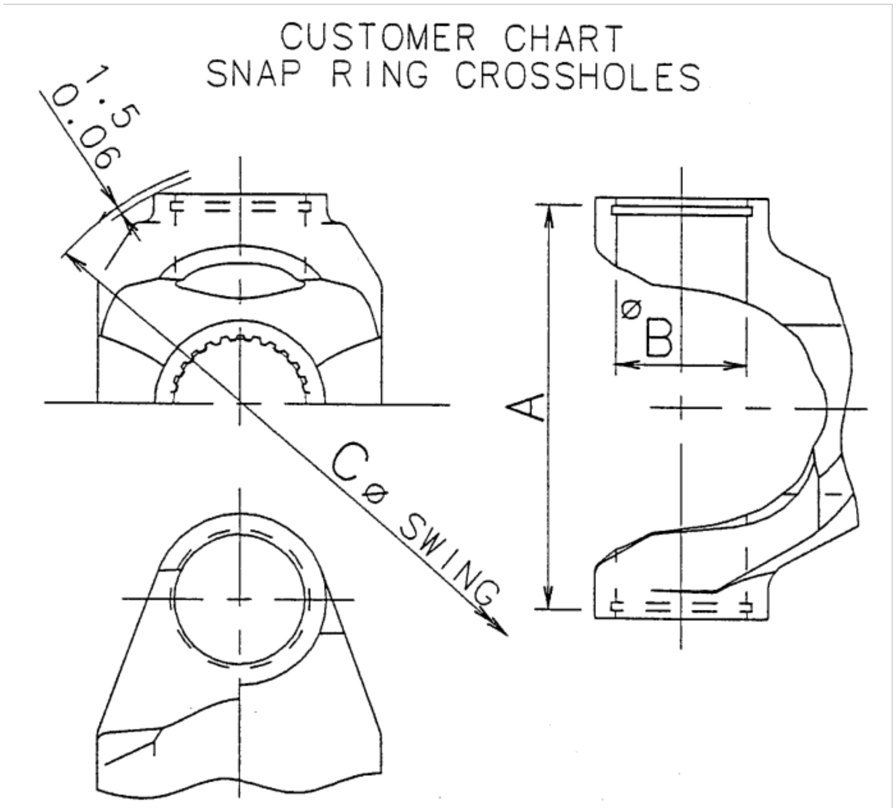
Proposed By: ______________________________

Signed: ______________________________

Title: ______________________________

Yoke Dimensions

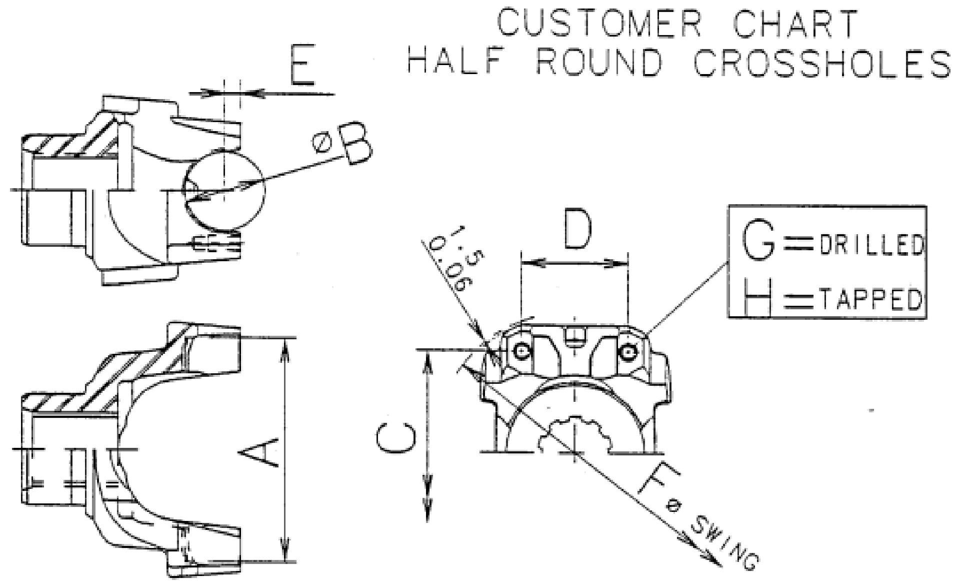
Snap Ring Cross Holes



Type	Series	A (mm / in)	B (mm / in)	C* (mm / in)
Snap Ring Construction	1210	65.0 / 2.56	26.9 / 1.06	79.2 / 3.12
	1280 / 1310	84.8 / 3.34	26.9 / 1.06	96.8 / 3.81
	1330	95.0 / 3.74	26.9 / 1.06	106.4 / 4.19
	1350	95.0 / 3.74	30.2 / 1.19	108.0 / 4.25
	1410	109.2 / 4.30	30.2 / 1.19	124.0 / 4.88
	1480 / SPL 55	109.2 / 4.30	34.8 / 1.37	124.0 / 4.88
	1550 / SPL 70	129.0 / 5.08	34.8 / 1.37	144.5 / 5.69
	SPL 90 / SPL 100	130.6 / 5.14	41.1 / 1.62	149.4 / 5.88
	1650	146.8 / 5.78	41.1 / 1.62	165.1 / 6.50
	SPL350	177.0 / 6.97	65.0 / 2.56	206.0 / 8.11

* Swing diameter clears yoke by 1.5 mm (0.06 in)

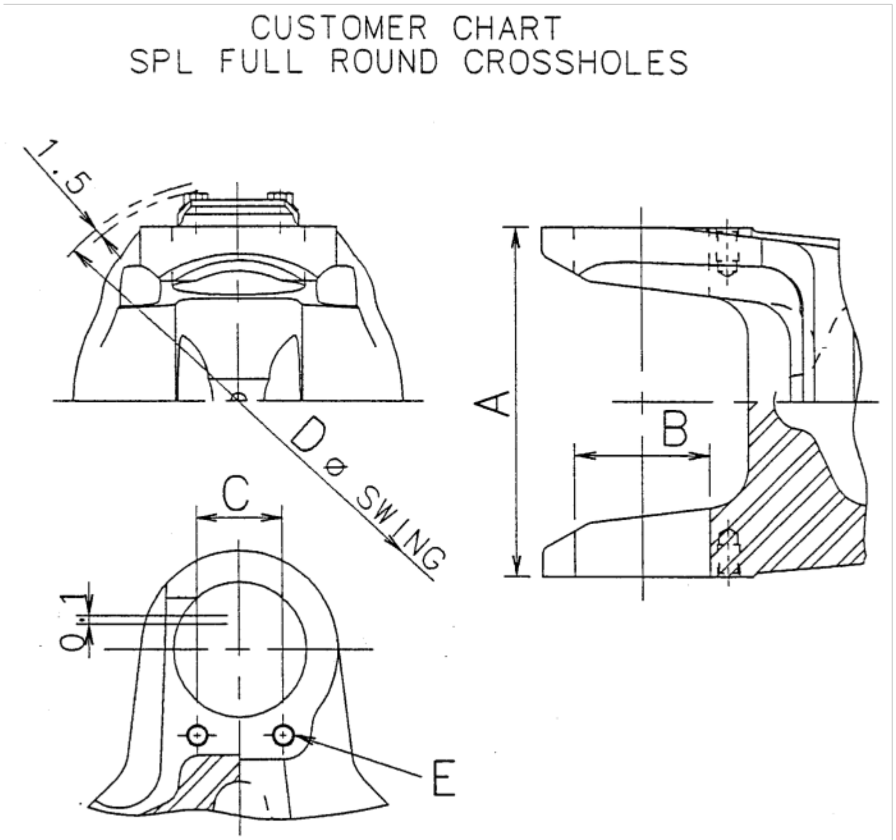
10 Series Half Round Cross Holes



Type	Series	A (mm / in)	B (mm / in)	C (mm / in)	D (mm / in)	E (mm / in)	F* (mm / in)	G (mm / in)	H
U-bolt Design	1210	62.0 / 2.44	26.9 / 1.06	56.4 / 2.22	35.8 / 1.41	0.8 / 0.03	87.4 / 3.44	8.4 / 0.33	-
	1280/1310	81.8 / 3.22	26.9 / 1.06	73.9 / 2.91	35.8 / 1.41	0.8 / 0.03	101.6 / 4.00	8.4 / 0.33	-
	1330	91.9 / 3.62	26.9 / 1.06	84.1 / 3.31	35.8 / 1.41	0.8 / 0.03	115.8 / 4.56	8.4 / 0.33	-
	1350	91.9 / 3.62	30.2 / 1.19	81.0 / 3.19	42.2 / 1.66	0.8 / 0.03	115.8 / 4.56	9.9 / 0.39	-
	1410	106.4 / 4.19	30.2 / 1.19	95.2 / 3.75	42.2 / 1.66	0.8 / 0.03	125.5 / 4.94	9.9 / 0.39	-
	1480	106.4 / 4.19	35.1 / 1.38	93.7 / 3.69	48.5 / 1.91	0.8 / 0.03	134.9 / 5.31	11.7 / 0.46	-
	1550	126.2 / 4.97	35.1 / 1.38	113.5 / 4.47	48.5 / 1.91	0.8 / 0.03	152.4 / 6.00	11.7 / 0.46	-
Bearing Strap Tapped Hole	1210	62.0 / 2.44	26.9 / 1.06	53.8 / 2.12	40.1 / 1.58	0.8 / 0.03	87.4 / 3.44	-	0.25 - 28
	1280/1310	81.8 / 3.22	26.9 / 1.06	73.9 / 2.91	40.1 / 1.58	0.8 / 0.03	101.6 / 4.00	-	0.25 - 28
	1330	91.9 / 3.62	26.9 / 1.06	84.1 / 3.31	40.1 / 1.58	0.8 / 0.03	115.8 / 4.56	-	0.25 - 28
	1350	91.9 / 3.62	30.2 / 1.19	81.0 / 3.19	45.7 / 1.80	0.8 / 0.03	115.8 / 4.56	-	0.312 - 24
	1410	106.4 / 4.19	30.2 / 1.19	95.2 / 3.75	45.7 / 1.80	0.8 / 0.03	125.5 / 4.94	-	0.312 - 24
	1480	106.4 / 4.19	35.1 / 1.38	93.7 / 3.69	53.8 / 2.12	0.8 / 0.03	134.9 / 5.31	-	0.375 - 24
	1550	126.2 / 4.97	35.1 / 1.38	113.5 / 4.47	53.8 / 2.12	0.8 / 0.03	152.4 / 6.00	-	0.375 - 24
	1610	134.9 / 5.31	47.8 / 1.88	122.2 / 4.81	63.5 / 2.50	9.7 / 0.38	171.4 / 6.75	-	0.375 - 24
	1710	157.2 / 6.19	49.3 / 1.94	142.0 / 5.59	71.4 / 2.81	7.9 / 0.31	190.5 / 7.50	-	0.50 - 20
	1760	180.1 / 7.09	49.3 / 1.94	165.1 / 6.50	71.4 / 2.81	7.9 / 0.31	212.9 / 8.38	-	0.50 - 20
	1810	194.1 / 7.64	49.3 / 1.94	179.1 / 7.05	71.4 / 2.81	7.9 / 0.31	228.6 / 9.00	-	0.50 - 20
Bearing Strap Thru-Hole	1410	106.4 / 4.19	30.2 / 1.19	95.2 / 3.75	45.7 / 1.80	0.8 / 0.03	125.5 / 4.94	8.4 / 0.33	-
	1480	106.4 / 4.19	35.1 / 1.38	93.7 / 3.69	53.8 / 2.12	0.8 / 0.03	134.9 / 5.31	9.9 / 0.39	-
	1550	126.2 / 4.97	35.1 / 1.38	113.5 / 4.47	53.8 / 2.12	0.8 / 0.03	152.4 / 6.00	9.9 / 0.39	-

* Swing diameter clears yoke by 1.5 mm (0.06 in)

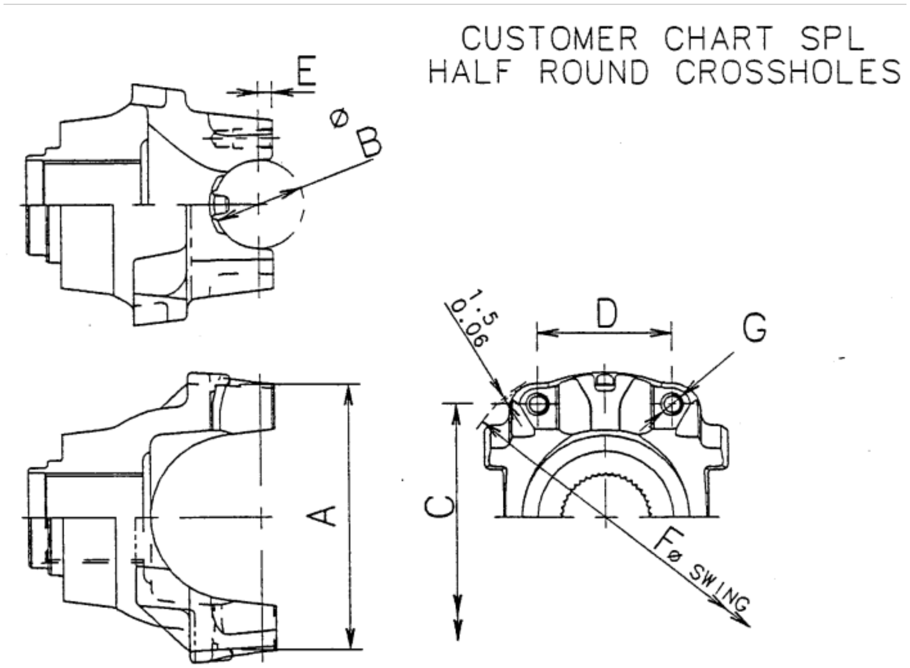
SPL Full Round Cross Holes



Type	Series	A (mm/in)	B (mm/in)	C (mm/in)	D * (mm/in)	E (mm)
SPL	SPL 140	128 / 5.04	49 / 1.93	32 / 1.26	160 / 6.30	M8 x 1.00
Full	SPL 170	153 / 6.02	55 / 2.17	32 / 1.26	185 / 7.28	M8 x 1.00
Round	SPL 250	152 / 5.98	60 / 2.36	32 / 1.26	184 / 7.24	M8 x 1.00

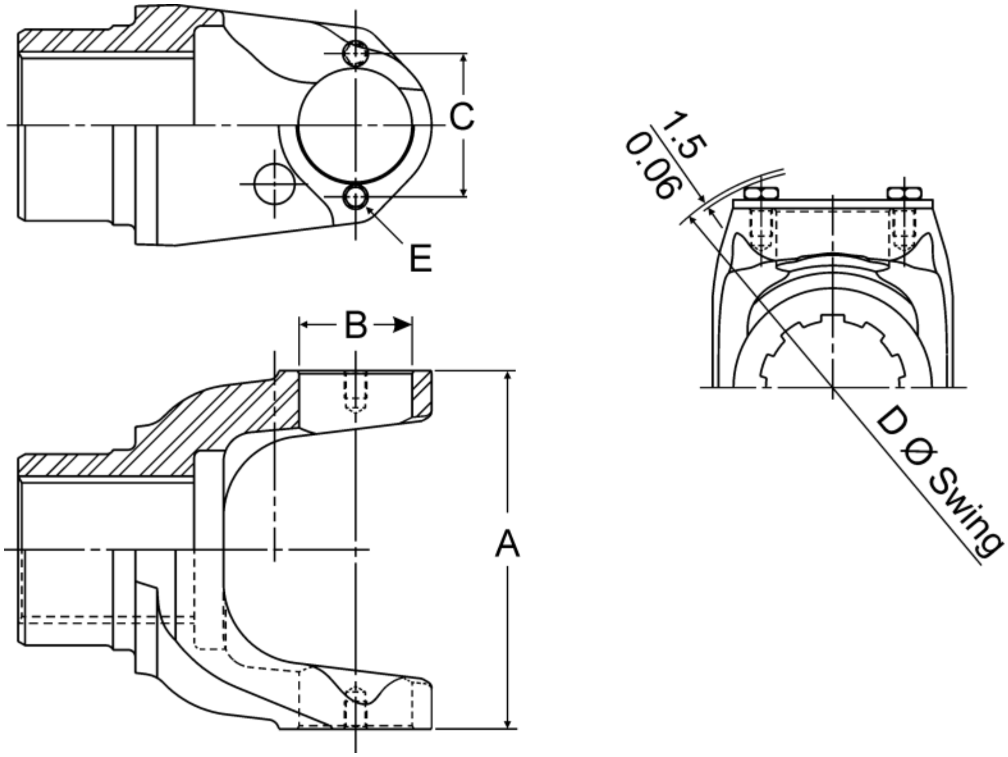
* Swing diameter clears yoke by 1.5 mm (0.06 in)

SPL Half Round Cross Holes



Type	Series	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F * (mm)	G
Bearing Strap Tapped Hole	SPL 55	106.4	35.1	93.7	53.8	0.8	134.9	0.375 x 24 UNF
	SPL 70	126.2	35.1	113.5	53.8	0.8	152.4	0.375 x 24 UNF
	SPL 100	126	41	115	59	6	154	0.375 x 24 UNF
	SPL 140	139	49	113	76	8	174	12 x 1.25 mm
	SPL 170	164	55	140	82	8	193	12 x 1.25 mm
	SPL 250	163	60	135	88	10	193	12 x 1.25 mm
	SPL 350	171.8	65	142	100	0	219	14 x 1.25 mm

Bearing Plate Cross Holes

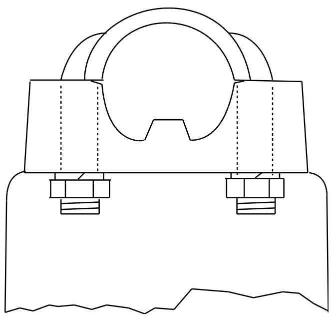


Type	Series	A (mm / in)	B (mm / in)	C (mm / in)	D* (mm/in)	E
Bearing Plate Full Round	1610	134.9/5.31	47.8/1.88	58.7/2.31	180.8/7.12	0.312-24
	1710	154.7/6.09	49.3/1.94	62.0/2.44	200.2/7.88	0.375-24
	1760	177.8/7.00	49.3/1.94	62.0/2.44	220.5/8.68	0.375-24
	1810	191.8/7.55	49.3/1.94	62.0/2.44	235.0/9.25	0.375-24
	1880	205.5/8.09	55.6/2.19	71.4/2.81	250.9/9.88	0.438-20

*Swing Diameter Clears Yoke by 1.5/0.06 mm/in.

Universal Joint Kit Attaching Hardware and Torque Specifications

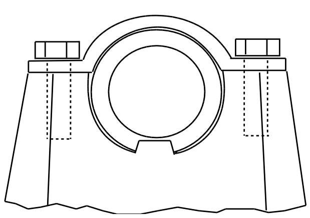
U-bolts



Series	Spicer U-Joint Kit No	U-Bolt Kit	Recommended Nut Torque
1310, SPL22	5-1310X, 5-1310-1X	2-94-28X	14-17 lbs. ft. (19-23 Nm)
1330, SPL25	5-1330X, 5-1330-1X	2-94-28X	14-17 lbs. ft. (19-23 Nm)
1350, SPL30	5-1350X, 1350-1X	3-94-18X	20-24 lbs. ft. (27-32 Nm)
1410, SPL36	5-1410X, 5-1410-1X	3-94-18X	20-24 lbs. ft. (27-32 Nm)
1480, SPL55	SPL55X, SPL55-1X	3-94-28X	32-37 lbs. ft. (43-50 Nm)
1550, SPL70	SPL70X, SPl70-1X	3-94-28X	32-37 lbs. ft. (43-50 Nm)

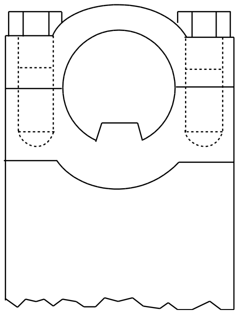
Bearing Strap

WARNING: Bearing strap retaining bolts should not be reused.



Series	Spicer U-Joint Kit No	Strap and Bolt Kit	Recommended Bolt Torque
SPL90	SPL90X	90-70-28X	45-60 lb.ft. (61-81 Nm)
SPL100	SPL100X	90-70-28X	45-60 lb.ft. (61-81 Nm)
1210	5-443X	2-70-18X	13-18 lb.ft. (18-24 Nm)
1310,	5-1310X, 5-1310-1X	2-70-18X	13-18 lb.ft. (18-24 Nm)
1330,	5-1330X, 5-1330-1X	2-70-18X	13-18 lb.ft. (18-24 Nm)
1350,	5-1350X, 5-1350-1X	3-70-28X	30-35 lb.ft. (41-47 Nm)
1410,	5-1410X, 5-1410-1X	3-70-28X	30-35 lb.ft. (41-47 Nm)
1480,	SPL55X, SPL55-1X	3-70-38X	45-60 lb.ft. (61-81 Nm)
1550,	SPL70X, SPL70-1X	3-70-38X	45-60 lb.ft. (61-81 Nm)
1610	5-674X	5-70-28X	45-60 lb.ft. (61-81 Nm)
1710	5-675X	6.5-70-18X	115-135 lb.ft. (156-183 Nm)
1760	5-677X	6.5-70-18X	115-135 lb.ft. (156-183 Nm)
1810	5-676X	6.5-70-18X	115-135 lb.ft. (156-183 Nm)

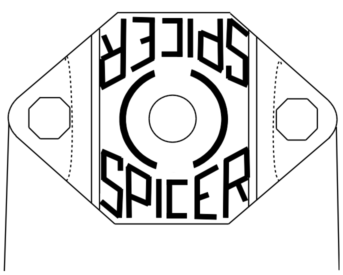
Cap and Bolts



Series	Spicer Kit No	Cap and Bolt Kit	Recommended Bolt Torque
1650	5-165X	5-70-18X	77-103 lb. ft.
1850	5-185X	8-70-18X	110-147 lb. ft.
2050	5-340X	9-70-28X	744-844 lb. ft.

Bearing Plate

WARNING: Self-locking bolts should not be reused.



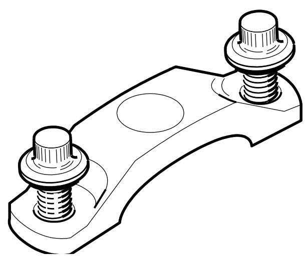
Serrated Bolts with Lock Patch / No Lock Strap (Models after Spring 1994)

Series	Bolt Part No	Thread Size	Recommended Bolt Torque
1610	5-73-709	.312-24	26-35 lb.ft. (36-47 Nm)
1710	6-73-209	.375-24	38-48 lb.ft. (52-65 Nm)
1760	6-73-209	.375-24	38-48 lb.ft. (52-65 Nm)
1810	6-73-209	.375-24	38-48 lb.ft. (52-65 Nm)
1880	7-73-315	.438-20	60-70 lb.ft. (82-95 Nm)

Bolt with Lock Strap (Pre-Spring 1994 Models)

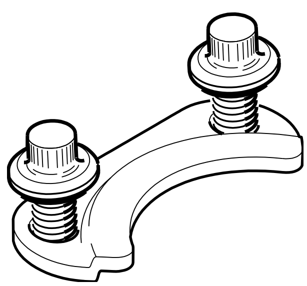
Series	Bolt Part No	Thread Size	Recommended Bolt Torque
1610	5-73-109	.312-24	26-35 lb.ft. (36-47 Nm)
1710	6-73-109	.375-24	38-48 lb.ft. (52-65 Nm)
1760	6-73-109	.375-24	38-48 lb.ft. (52-65 Nm)
1810	6-73-109	.375-24	38-48 lb.ft. (52-65 Nm)
1880	7-73-115	.438-20	60-70 lb.ft. (82-95 Nm)

Bearing Retainer



Series	U-Joint Kit No	Retainer Kit No	Bolt Part No	Recommended Bolt Torque
SPL140	SPL140X	140-70-18X	5007417	100-125 lb.ft. (136-169 Nm)
SPL170	SPL170-4X	170-70-18X	5007417	100-125 lb.ft. (136-169 Nm)
SPL250	SPL250-3X	250-70-18X	5007417	100-125 lb.ft. (136-169 Nm)
SPL350	SPL350X	350-70-18X	5019836	177-199 lb.ft. (240-270 Nm)

Spring Tab



Series	U-Joint Kit No	Spring Tab Kit No	Bolt Part No	Recommended Bolt Torque
SPL140	SPL140X	211941X	8-73-114M	25-30 lb.ft. (34-40 Nm)
SPL170	SPL170X	211941X	8-73-114M	25-30 lb.ft. (34-40 Nm)
SPL250	SPL250X	211941X	8-73-114M	25-30 lb.ft. (34-40 Nm)