Driveshaft Products

Application Guidelines

DSAG-0200
November 2013

Driveline Sizing

Critical Speed

Center Bearing Mounting

Driveline Analysis

Appendix

Specifying a Spicer Driveline

Application Definitions

- Domestic applications - restricted to the continental United States, Canada, Australia and New Zealand.
  - On-highway - operation on well-maintained, concrete and asphalt roadways including turnpikes, interstates, and state routes with not more than 10% off-highway operation.
  - Off-highway - operation on unimproved dirt or gravel roads, as well as, poorly maintained paved roads, more than 10% of the time.
  - Line haul - operation on well maintained concrete and asphalt roadways including turnpikes, interstates, and state routes 100% of the time with a maximum 80,000 lb. GCW.
- Export applications - outside of the continental United States, Canada, Australia and New Zealand.

  Driveline sizing for export applications is based on Maximum Driveshaft Torque **only.** (see "Calculating Maximum Driveshaft Torque (Export Applications)" on page 5)

Calculating Maximum Low Gear Torque

Step 1 - Low Gear Torque Calculation
LGT = T x TLGR x TE x SR x TCR x C

LGT = Maximum Driveshaft Low Gear Torque

T = Net Engine Torque or 95% of the Gross Engine Torque

TLGR = Transmission Low Gear Ratio (forward)*

TE = Transmission Efficiency (automatic = 0.8; manual = 0.85)

SR = Torque Converter Stall Ratio (if applicable)

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

C = Transfer Case 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 = (T x TR x AR x TCR x 942.4) / (RR x GCW)

SI = Startability Index

T = Engine Clutch Engagement Torque at 800 RPM

TR = Transmission Second Lowest Forward Gear Ratio

AR = Axle Ratio

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

RR = Tire Rolling Radius (in)

GCW = Maximum Gross Combination Weight (lbs)

Step 2 - Wheel Slip Calculation
WST = (.71 x W x RR) / (11.4 x AR)

WST = Wheel Slip Torque Applied to the Driveshaft

W = Axle Capacity (lbs)

RR = Tire Rolling Radius (in)

AR = Axle Ratio

Step 3 - Gradeability Calculation

Calculate the torque required for 25% gradeability.

Note: For Linehaul applications with 3.10 axle ratio or numerically larger only.

GT = (.265 x RR x GVW) / (11.4 x AR)

GT = Net Driveline Torque at 25% Gradeability
RR = Tire Rolling Radius (in)
GVW = Gross Vehicle Weight (lbs)
AR = Axle Ratio

Step 4 - Overall Low Gear Ratio Calculation
OLGR = TLGR x SR x TCR

OLGR = Overall Low Gear Ratio
TLGR = Transmission Low Gear Ratio
SR = Torque Converter Stall Ratio (if applicable)
TCR = Transfer Case or Auxiliary Transmission Ratio (if applicable)

Step 5 - Driveline Series Selection

To select a driveline series:

1. Plot the torque values determined from Steps 1, 2, and 3 with the overall low gear ratio (OLGR) from Step 4 on the appropriate graph for Ten Series or SPL Series in the Applications Guidelines section on pages 6 & 7.
2. To determine the appropriate driveline series for SPL or 10 Series using the Application Guidelines graphs on pages 6 & 7, use the smallest series for the main driveline as determined from Steps 1, 2, and 3.

Note: The selected driveline series can not be more than one series smaller than the series selected from Step 1 (LGT).

Step 6 - Specifying the Interaxle Driveline (if applicable)

To specify the interaxle driveline, use:

1. 60% of the Driveline Series Selection torque from Step 5 and the OLGR from Step 4.
2. Find the appropriate interaxle driveline series for SPL using the Driveline Sizing graph. under "Application Guidelines" on page 8, and for Ten Series using the Driveline Sizing graph. under "Application Guidelines" on page 6.

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

Calculating Maximum Driveshaft Torque for Export Applications

Step 1 - Low Gear Torque Calculation
LGT = T x TLGR x TE x SR x TCR x C

LGT = Maximum Driveshaft Low Gear Torque

T = Net Engine Torque or 95% of the Gross Engine Torque

TLGR = Transmission Low Gear Ratio (forward)

TE = Transmission Efficiency (automatic = 0.8; manual = 0.85)

SR = Torque Converter Stall Ratio (if applicable)

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

C = Transfer Case Efficiency (if applicable, 0.95)

Step 2 - Overall Low Gear Ratio Calculation
OLGR = TLGR x SR x TCR

OLGR = Overall Low Gear Ratio

TLGR = Transmission Low Gear Ratio

SR = Torque Converter Stall Ratio (if applicable)

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

Step 3 - Driveline Series Selection

To select a driveline series:

1. Plot the torque value determined from Step 1 with the overall low gear ratio (OLGR) from Step 2 on the appropriate graph for 10 Series or SPL Series in the "Applications Guidelines" section on pages 6 & 7.

Step 4 - Specifying the Interaxle Driveline (if applicable)

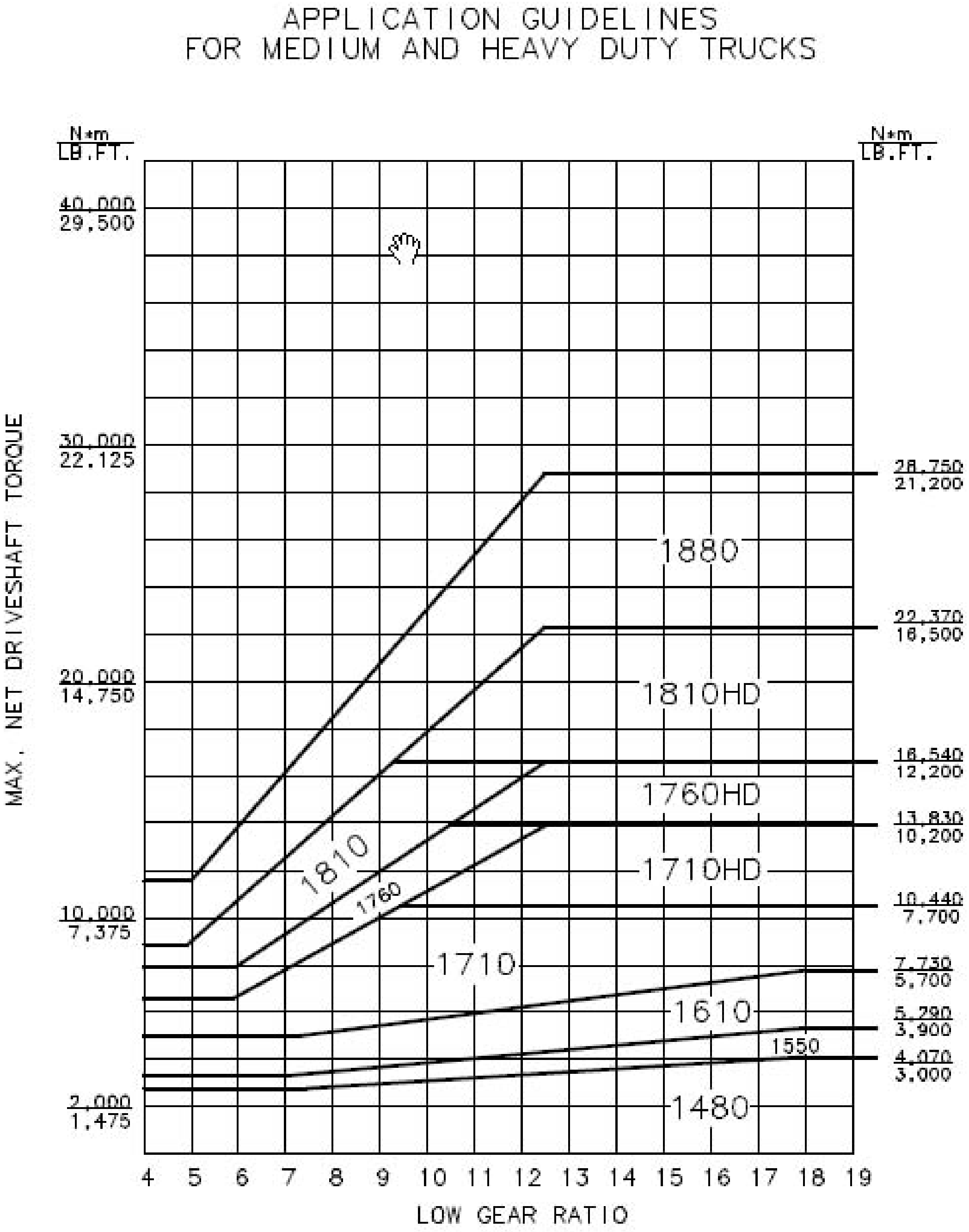
To specify the interaxle driveline, use:

1. 60% of the Driveline Series Selection torque from Step 1 and the OLGR from Step 2.
2. Find the appropriate interaxle driveline series for SPL using the Driveline Sizing graph. under "Application Guidelines" on page 8, and for 10 Series using the Driveline Sizing graph. under "Application Guidelines" on page 6.

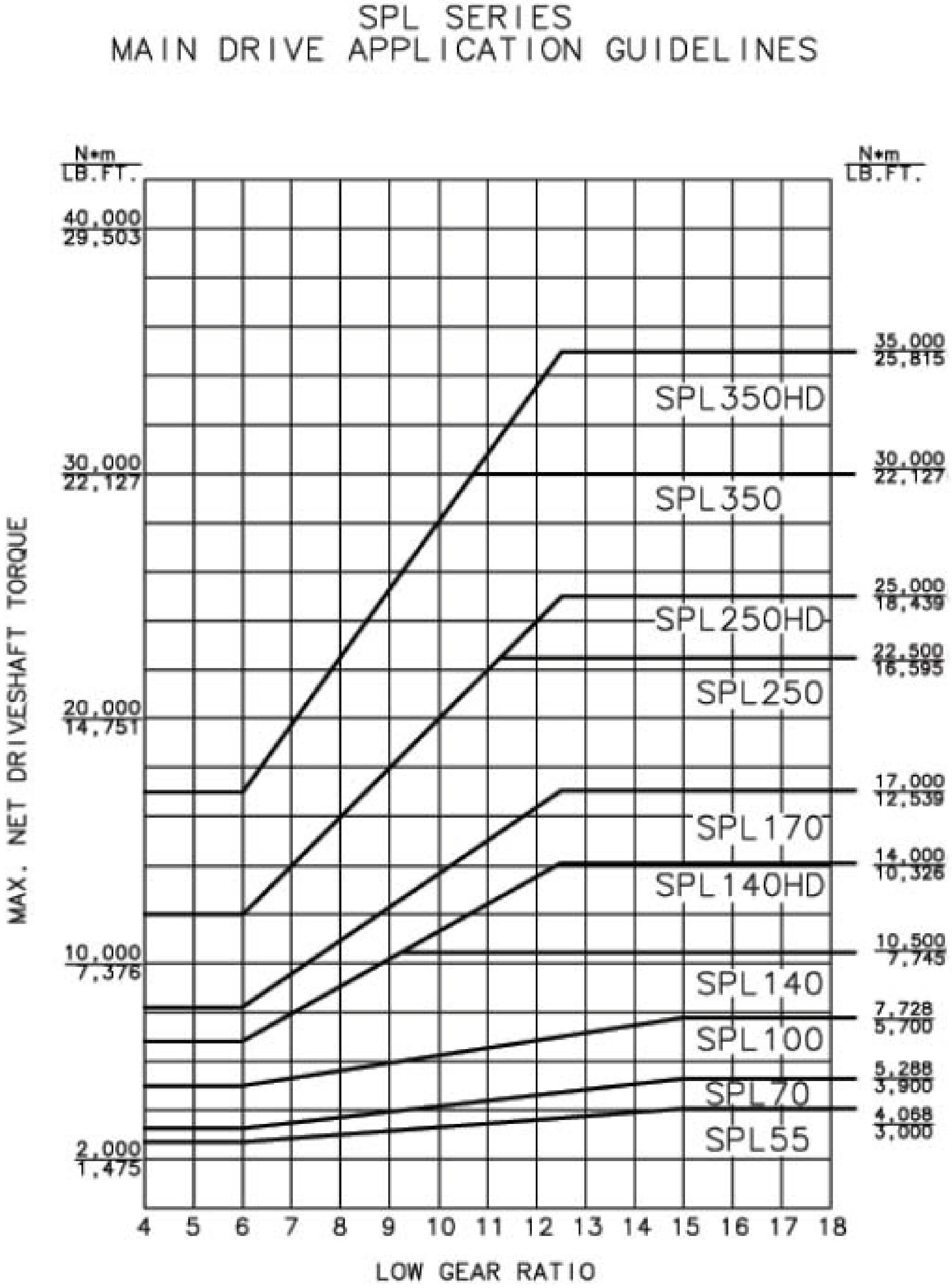
Note: High angle (45°) interaxle driveshafts are available in SPL170, SPL250 and 1710 Series only.

Application Graphs

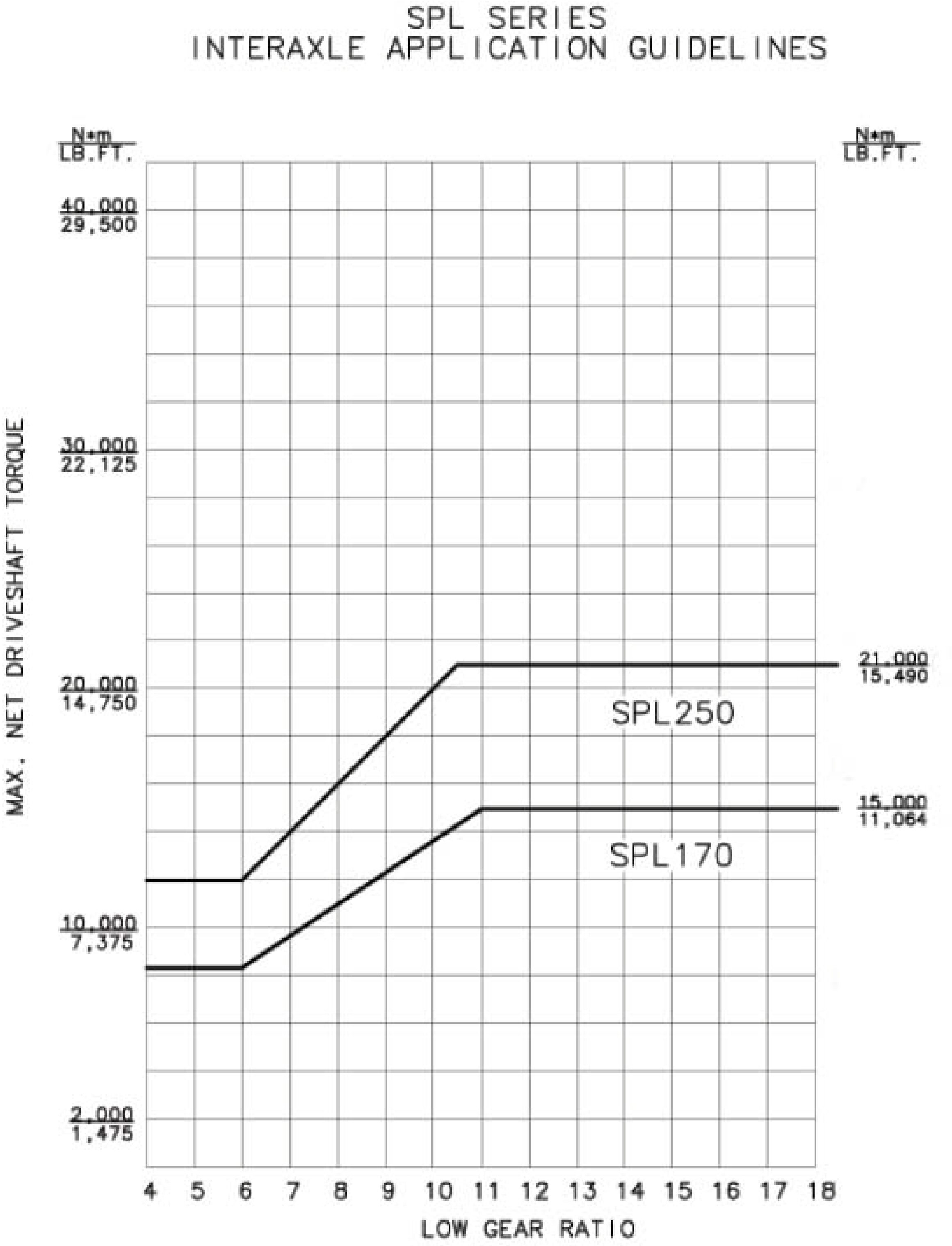
10 Series Graph



SPL Series Graph



SPL Interaxle Series Graph



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

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

CS = Critical Speed

E = Modulus of tubing material (psi)

O* = Outside Diameter of Tubing (in)

I* = Inside Diameter of Tubing (in)

P = Density of Tubing Material (lbs/in^3)

L = Distance Between Journal Cross Centers (in)

* Refer to "Spicer Standard Tube Sizes" on page 11 for tube dimensions.

Material Properties

Material	Modulus	Density	E/P x 386.4
Steel	30.00 x 10^6	0.2830	41.0 x 10^9
Aluminum	10.30 x 10^6	0.0980	39.4 x 10^9

Simplified Equations

Steel:

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

Aluminum:

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

CS = Critical Speed

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 x CF x SF

ACS = Adjusted Critical Speed
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 that the maximum driveshaft speed of the vehicle.

Spicer Diamond Series™ Adjusted Critical Speed

The Spicer Diamond Series driveshaft combines a light weight aluminum tube with traditional steel end components. The Spicer Diamond Series is available in two tube sizes for driveline installed lengths of 80 in. to 130 in. The following formulas can be used to calculate the Maximum Safe Operating Speed (ACS) for each tube design.

Spicer Diamond Series 7 inch straight tube:

$$ACS = \left(\frac{L}{7816}\right)^{-1.8457}$$

Note: The maximum installed length for the 7 inch straight design is 106 in.

Spicer Diamond Series 8.5 inch hydroformed tube:

$$ACS = \left(\frac{L}{6440}\right)^{-1.967}$$

Note: The maximum installed length for the 8.5 inch hydroformed design is 130 in.

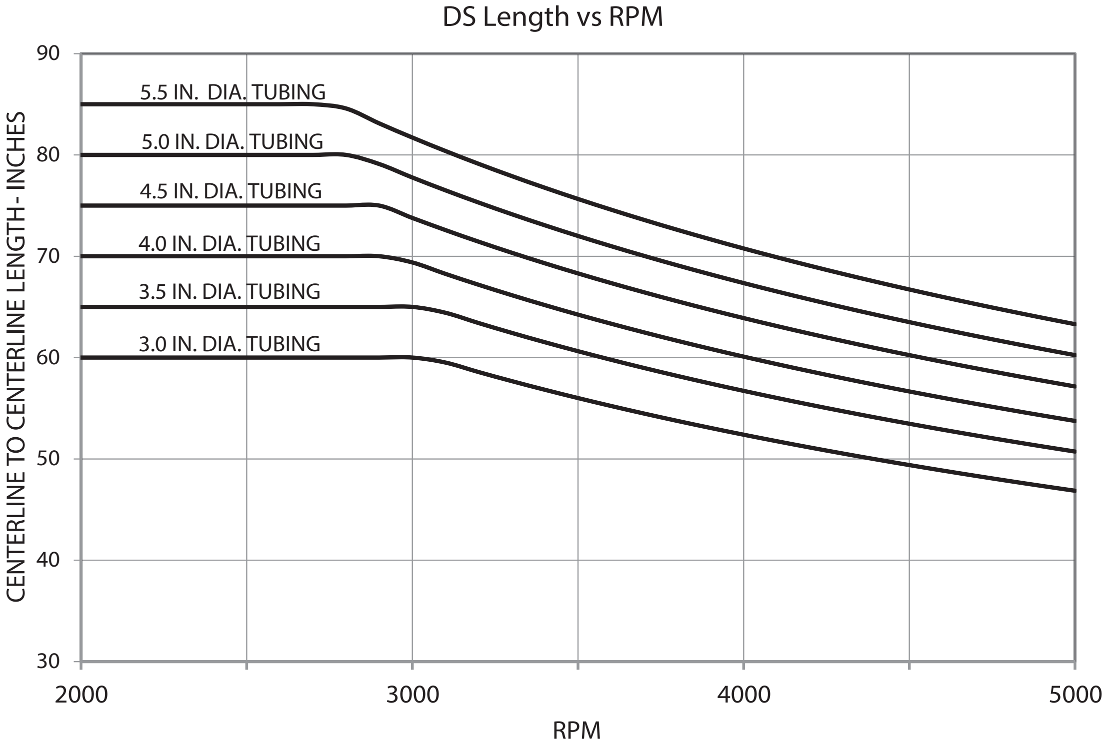
Maximum Driveshaft Length

Refer to the chart at the bottom of this page for maximum driveshaft length vs. RPM guidelines. This information can also be found in TMC Recommended Practice RP610A Chart 3.

The general length limitations are as follows:

Tube O.D.	Maximum Length *	Driveline Series
3.0 in.	60 in.	SPL32, SPL36
3.5 in.	65 in.	SPL55, SPL70
4.0 in.	70 in.	1710, 1760, SPL100
4.2 in.	72 in.	SPL140
4.3 in.	73 in.	SPL140HD
4.5 in.	75 in.	1710, 1810
5.0 in.	80 in.	SPL170, SPL250
5.5 in.	83 in.	SPL350

* Installed length u-joint center to u-joint center.



Spicer Standard Tube Sizes

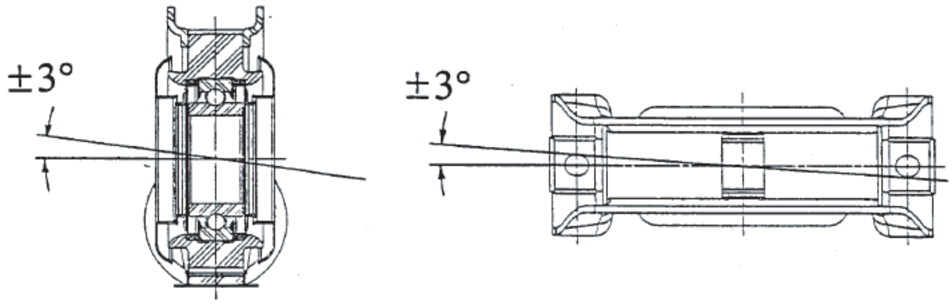
Series	Tube Size (in)	Dana Part Number	Torque Rating (lbs. ft.)	Tube JAEL (lbs. ft.)
1610	4.00 x .134	32-30-52	5,700	8,600
1710	4.00 x .134	32-30-52	7,700	8,600
1710 HD	4.09 x .180	32-30-72	10,200	13,925
1760	4.00 x .134	32-30-92	10,200	10,435
1760 HD	4.09 x .180	32-30-72	12,200	13,925
1810	4.50 x .134	36-30-62	12,200	13,065
1810 HD	4.59 x .180	36-30-102	16,500	17,935
SPL 90	4.00 x .095	32-30-12	4,900	6,300
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	10,325	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	12,539	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
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	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 "XC" 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.

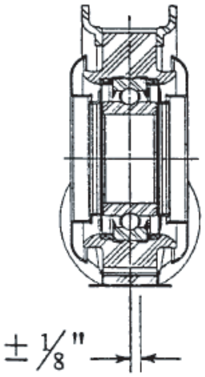
Figure 1



Side View

Top View

Figure 2



Side View

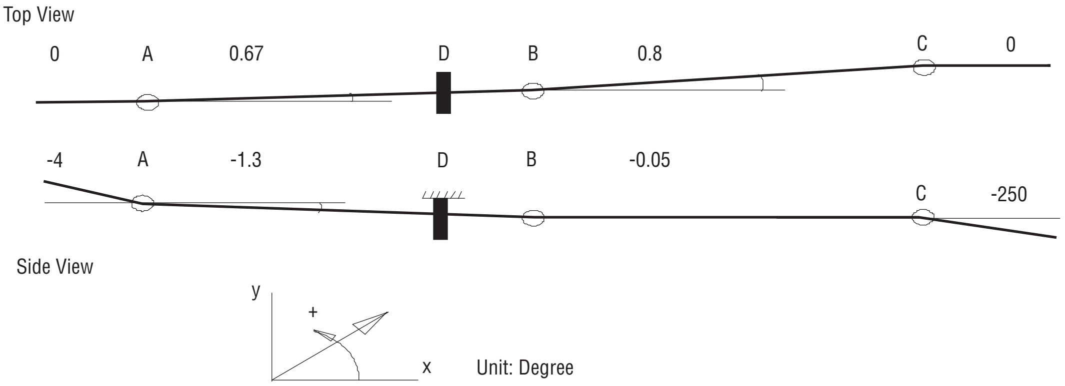
Driveline Analysis

Design Criteria

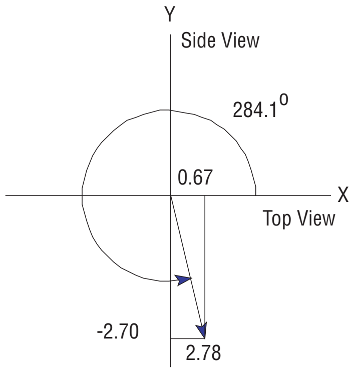
- Torsional Vibration
- Inertial Vibration
- Center Bearing Loading

Torsional and Inertial Excitation

Driveline Layout



Calculate Joint Angles



View from Rear of Driveline

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 @ 284.1 degrees.

Note: The true joint angle is a vector: the 2.78 degrees is the magnitude and the 284.1 degree 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	0.67	0.13	-0.80
Joint Angle - Side View	-2.70	-1.25	2.45
True Joint Angle Θ	2.78	1.26	2.58
Plane of True Joint Angle ϕ	284.10	276.01	108.29

Calculate Torsional and Inertia Excitation

Calculate the torsional effect:

$$\Theta_{res} = \sqrt{(|\Theta_1|\angle\phi_1)^2 + (|\Theta_2|\angle(\phi_2 - 90° - \delta_1))^2 + (|\Theta_3|\angle(\phi_3 - \delta_2 - \delta_1))^2}$$

(1) When d_1= 0 deg, d_2= 0 deg.

$$\begin{aligned}
&= \sqrt{(2.78\angle 284.1°)^2 + (1.26\angle(276.01 - 90)°)^2 + (2.58\angle 108.29°)^2} \\
&= \sqrt{(7.7284\angle -151.8°) + (1.5876\angle 12.02°) + (6.6564\angle -143.42)} \\
&= \sqrt{(12.8667\angle -145.4°)} \\
&= 3.5870°\angle -72.75°
\end{aligned}$$

$$3.3405x\ 10^{-6}(2368rpm)^2(3.5870°)^2 = 241.0154\frac{rad}{\sec^2}$$

(2) When d_1= 0 deg, d_2= 90 deg.

$$\begin{aligned}
&= \sqrt{(2.78\angle 284.1°)^2 + (1.26\angle(276.01 - 90)°)^2 + (2.58\angle(108.29 - 90)°)^2} \\
&= \sqrt{(7.7284\angle -151.8°) + (1.5876\angle 12.02°) + (6.6564\angle 36.58)} \\
&= \sqrt{(0.65124\angle 82.32°)} \\
&= 0.80699°\angle 41.162°
\end{aligned}$$

$$3.3405x\ 10^{-6}(2368rpm)^2(0.80699°)^2 = 12.1988\frac{rad}{\sec^2}$$

(3) When d_1= 90 deg, d_2= 90 deg.

$$\begin{aligned}
&= \sqrt{(2.78\angle 284.1°)^2 + (1.26\angle(276.01 - 90 - 90)°)^2 + (2.58\angle(108.29 - 90 - 90)°)^2} \\
&= \sqrt{(7.7284\angle -151.8°) + (1.5876\angle -167.98°) + (6.6564\angle -143.42)} \\
&= \sqrt{(15.847236\angle 149.89°)} \\
&= 3.98085°\angle -74.94°
\end{aligned}$$

$$3.3405x\ 10^{-6}(2368rpm)^2(3.98085°)^2 = 296.84\frac{rad}{\sec^2}$$

(4) When d_1= 90 deg, d_2= 0 deg.

$$= \sqrt{(2.78\_284.1^{\circ})^2 + \ (1.26\_(276.01 - 90 - 90)^{\circ})^2 + \ (2.58\_(108.29 - 90)^{\circ})^2}$$

$$= \sqrt{(7.7284\_-151.8^{\circ}) + (1.5876\_-167.98^{\circ}) + (6.6564\_36.58)}$$

$$= \sqrt{(3.018639\_-179.699^{\circ})}$$

$$= 1.737423^{\circ}\ \_-89.84^{\circ}$$

$$3.3405x\ 10^{-6}(2368rpm)^2(1.737423^{\circ})^2 \ = \ 56.54\frac{rad}{\sec^2}$$

Calculate the inertia drive effects:

$$\Theta_D = \sqrt{2(|\Theta_1|\_\phi_1)^2 + (|\Theta_2|\_(\phi_2 - 90^{\circ} - \delta_1))^2}$$

(1) When d_1= 0 deg, d_2= 0 deg or d_1= 0 deg, d_2= 90 deg.

$$= \sqrt{2(2.78\_284.1^{\circ})^2 + (1.26\_(276.01 - 90)^{\circ})^2}$$

$$= \sqrt{(15.4568\_-151.8^{\circ}) + (1.5876\_12.02^{\circ})}$$

$$= \sqrt{(13.939105\_-149.98^{\circ})}$$

$$= 3.733511^{\circ}\ \_-74.99^{\circ}$$

$$3.3405x\ 10^{-6}(2368rpm)^2(3.733511^{\circ})^2 \ = \ 261.10\frac{rad}{\sec^2}$$

(2) When d_1= 90 deg, d_2= 90 deg or d_1= 90 deg, d_2= 0 deg.

$$= \sqrt{2(2.78\_284.1^{\circ})^2 + (1.26\_(276.01 - 90 - 90)^{\circ})^2}$$

$$= \sqrt{(15.4568\_-151.8^{\circ}) + (1.5876\_-167.98^{\circ})}$$

$$= \sqrt{(16.987278\_-153.29^{\circ})}$$

$$= \ 4.12156^{\circ}\ \_-76.64^{\circ}$$

$$3.3405x\ 10^{-6}(2368rpm)^2(4.12156^{\circ})^2 \ = \ 318.19\frac{rad}{\sec^2}$$

Calculate the inertia coast effects:

$$\Theta_C = \sqrt{2(|\Theta_3|\_\ \phi_3)^2 + (|\Theta_2|\_(\phi_2 + 90^{\circ} + \delta_2))^2}$$

(1) When d_1= 0 deg, d_2= 0 deg or d_1= 90 deg, d_2= 0 deg.

$$= \sqrt{2(2.58\_108.29^{\circ})^2 + (1.26\_(276.01 + 90)^{\circ})^2}$$

$$= \sqrt{(13.3128\_-143.42^{\circ}) + (1.5876\_12.02^{\circ})}$$

$$= \sqrt{(11.887165\_-140.24^{\circ})}$$

$$= \ 3.44777\_-70.11^{\circ}$$

$$3.3405x\ 10^{-6}(2368rpm)^2(3.44777^{\circ})^2 \ = \ 222.66\frac{rad}{\sec^2}$$

(2) When d_1= 0 deg, d_2= 90 deg or d_1= 90 deg, d_2= 90 deg.

$$= \sqrt{2(2.58\_108.29°)^2 + (1.26\_(276.01 + 90 + 90)°)^2}$$

$$= \sqrt{(13.3128\_{-143.42°}) + (1.5876\_{-167.98°})}$$

$$= \sqrt{(14.77151\_{-145.98°})}$$

$$= 3.84337\_{-72.99°}$$

$$3.3405x\ 10^{-6}\,(2368 rpm)^2\,(3.84337°)^2 = 276.69\,\frac{rad}{\sec^2}$$

Note: The maximum torsional excitation level is 300 rad/sec^2. The maximum inertia excitation level is 1000 rad/sec^2.

Calculate the torque fluctuations:

The mass moment of inertia of the following items are approximately equal to:

	lbf-in-sec^2
Transmission	2.33
Axle	2.53
1760 Driveshaft	1.3

(1) The torque fluctuation at the axle end is:

$$\begin{aligned} T_{axle} &= T_{torsional,axle} + T_{inertia,drive} \\ &= J_{axle\ torsional} + J_{driveshaft\ drive} \\ &= (2.53)(241.01) + (1.3)(261.10) \\ &= 949.18 in\text{-}lb \\ &= 79.1 ft\text{-}lb \end{aligned}$$

(2) The torque fluctuation at the transmission end is:

$$\begin{aligned} T_{transmission} &= T_{torsional,transmission} + T_{inertia,coast} \\ &= J_{transmission\ torsional} + J_{driveshaft\ coast} \\ &= (2.33)(241.01) + (1.3)(222.66) \\ &= 851.01 in\text{-}lb \\ &= 70.92 ft\text{-}lb \end{aligned}$$

Center Bearing Loading

Calculate Static / Dynamic Center Bearing Load

Static

$$= \frac{1}{2}\frac{T}{AB-DB}\{\sin a^\circ \angle(\phi_a+90)^\circ+(\tan b^\circ-\frac{AB}{BC}\sin b^\circ)\angle(\phi_b+90)^\circ$$

$$+\frac{AB}{BC}\tan c^\circ \angle(\phi_c-90)^\circ\}$$

$$= \frac{1}{2}\frac{12214x12}{(40.-6.2)}\{\sin 2.78^\circ \angle(284.1+90)^\circ$$

$$+(\tan 1.26^\circ-\frac{40.}{44.34}\sin 1.26^\circ)\angle(276.01+90)^\circ$$

$$+\frac{40.}{44.34}\tan 2.58^\circ \angle(108.29-90)^\circ\}$$

$$= 2168.1657\{(0.0485\angle 374.1^\circ)+(0.0022\angle 366.01^\circ)+(0.0406\angle 18.29^\circ)\}$$

$$= 2168.1657(0.0912\angle 15.77^\circ)$$

$$= 197.7738lbs \ \angle 15.77^\circ$$

Dynamic

$$= \frac{1}{2}\frac{T}{AB-DB}\{\sin a^\circ \angle(90-\phi_a)^\circ+(\tan b^\circ+\frac{AB}{BC}\sin b)\angle(90-\phi_b+2\delta_1)^\circ$$

$$+\frac{AB}{BC}\tan c^\circ \angle(90-\phi_c+2\delta_1+2\delta_2)^\circ\}$$

(1) When d_1= 0 deg, d_2= 0 deg.

$$= \frac{1}{2}\frac{12214x12}{(40.-6.2)}\{\sin 2.78^\circ \angle(90-284.1)^\circ$$

$$+(\tan 1.26^\circ+\frac{40.}{44.34}\sin 1.26^\circ)\angle(90-276.01)^\circ$$

$$+\frac{40.}{44.34}\tan 2.58^\circ \angle(90-108.29)^\circ\}$$

$$= 2168.1657\{(0.0485\angle -194.1^\circ)+(0.0418\angle -186.01^\circ)+(0.0406\angle -18.29^\circ)\}$$

$$= 2168.1657(0.0502\angle 176.^\circ)$$

$$= 108.7635lbs \ \angle 176.^\circ$$

(2) When d_1= 0 deg, d_2= 90 deg.

$$\begin{aligned}
&= \frac{1}{2}\frac{12214x12}{(40.-6.2)}\{\sin 2.78^\circ \angle (90-284.1)^\circ \\
&+ (\tan 1.26^\circ + \frac{40.}{44.34}\sin 1.26^\circ)\angle (90-276.01)^\circ \\
&+ \frac{40.}{44.34}\tan 2.58^\circ \angle (90-108.29+2x90)^\circ\} \\
&= 2168.1657\{(0.0485\angle -194.1^\circ)+(0.0418\angle -186.01^\circ)+(0.0406\angle 161.71^\circ)\} \\
&= 2168.1657(0.1305\angle 167.18^\circ) \\
&= 282.9240 lbs \ \angle 167.18^\circ
\end{aligned}$$

(3) When d_1= 90 deg, d_2= 90 deg.

$$\begin{aligned}
&= \frac{1}{2}\frac{12214x12}{(40.-6.2)}\{\sin 2.78^\circ \angle (90-284.1)^\circ \\
&+ (\tan 1.26^\circ + \frac{40.}{44.34}\sin 1.26^\circ)\angle (90-276.01+2x90)^\circ \\
&+ \frac{40.}{44.34}\tan 2.58^\circ \angle (90-108.29)^\circ\} \\
&= 2168.1657\{(0.0485\angle -194.1^\circ)+(0.0418\angle -6.01^\circ)+(0.0406\angle -18.29^\circ)\} \\
&= 2168.1657(0.0336\angle -9.11^\circ) \\
&= 72.8115 lbs \ \angle -9.11^\circ
\end{aligned}$$

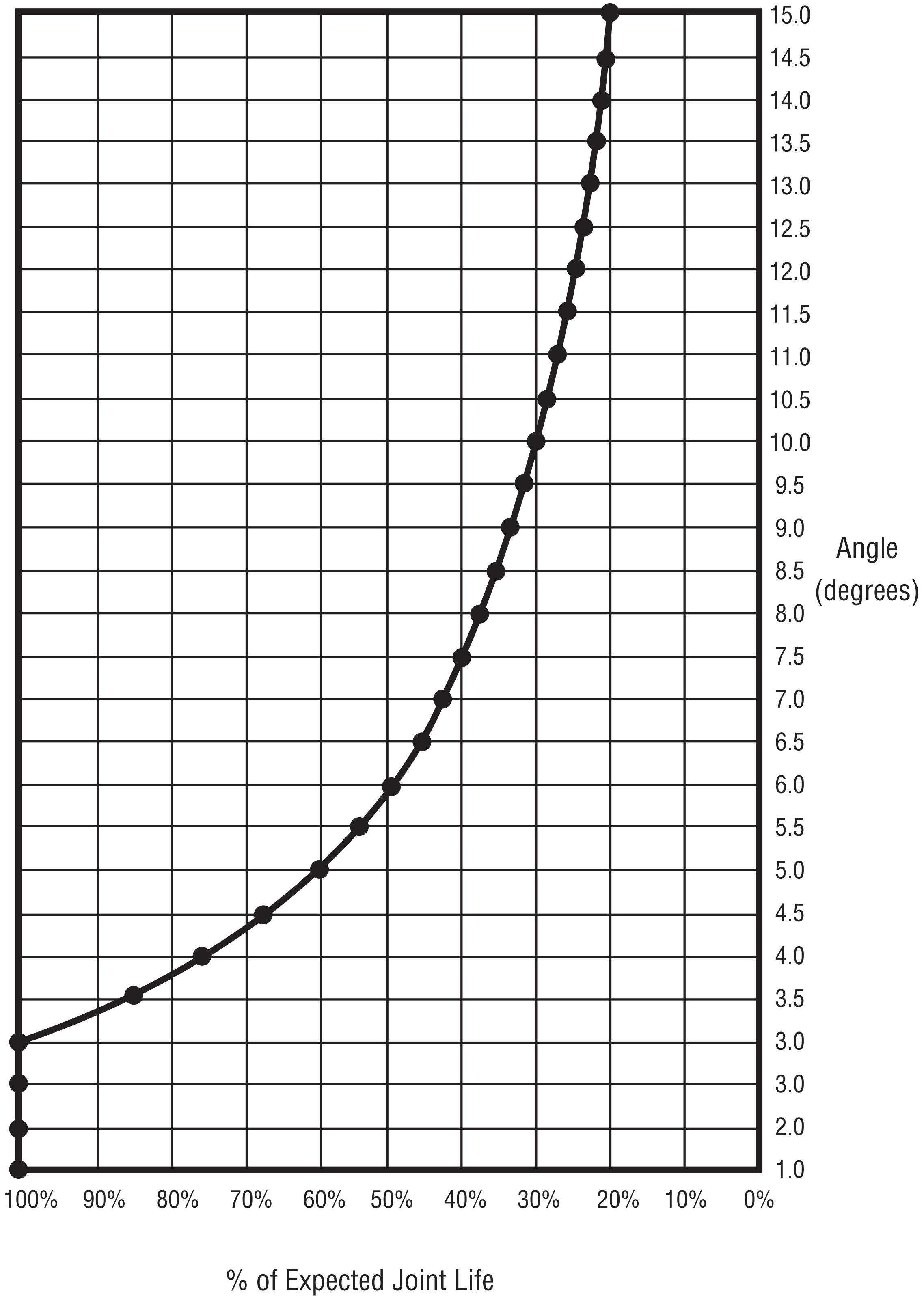
(4) When d_1= 90 deg, d_2= 0 deg.

$$\begin{aligned}
&= \frac{1}{2}\frac{12214x12}{(40.-6.2)}\{\sin 2.78^\circ \angle (90-284.1)^\circ \\
&+ (\tan 1.26^\circ + \frac{40.}{44.34}\sin 1.26^\circ)\angle (90-276.01+2x90)^\circ \\
&+ \frac{40.}{44.34}\tan 2.58^\circ \angle (90-108.29+2x90)^\circ\} \\
&= 2168.1657\{(0.0485\angle -194.1^\circ)+(0.0418\angle -6.01^\circ)+(0.0406\angle -161.71^\circ)\} \\
&= 2168.1657(0.0484\angle 155.36^\circ) \\
&= 105.03326 lbs \ \angle 155.36^\circ
\end{aligned}$$

Maximum Center Bearing Loads

Design	Static Load	Dynamic Load
Solid Rubber	500 lbs.	500 lbs.
Semi-Slotted Rubber	250 lbs.	250 lbs.
Slotted Rubber	100 lbs.	100 lbs.

Joint Life vs. Joint Angle



Application Form

SPICER® DRIVETRAIN COMPONENTS

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: ______________________

DANA

Application Form

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

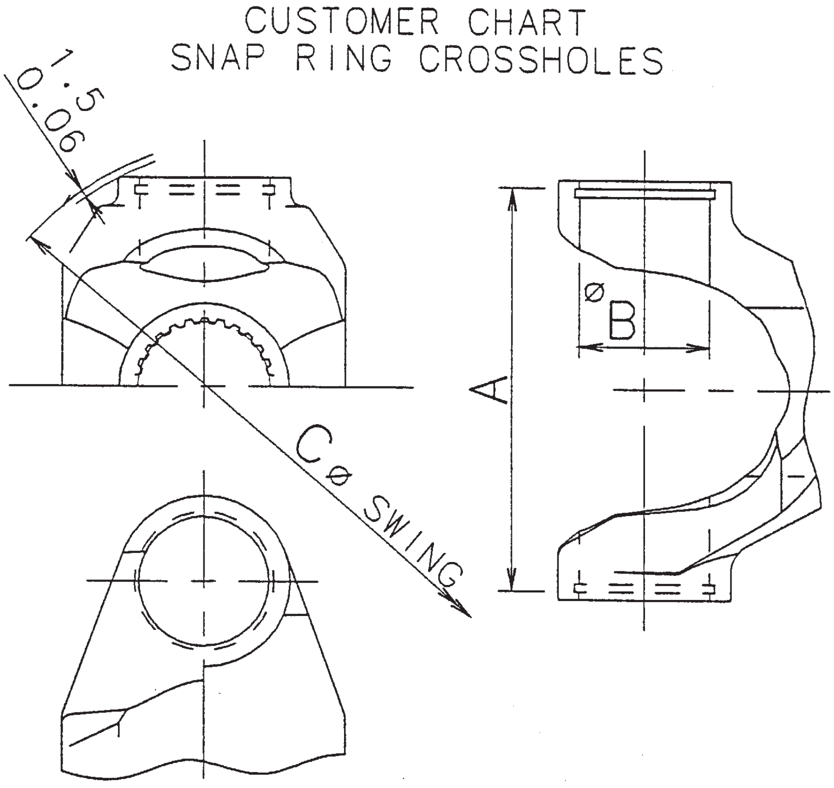
Proposed By: ______________________________

Signed: ______________________________

Title: ______________________________

Yoke Dimensions

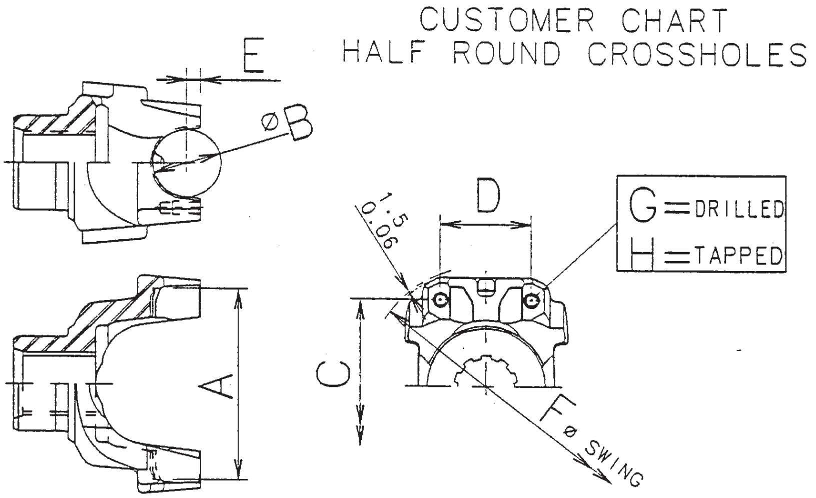
Snap Ring Cross Holes



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.

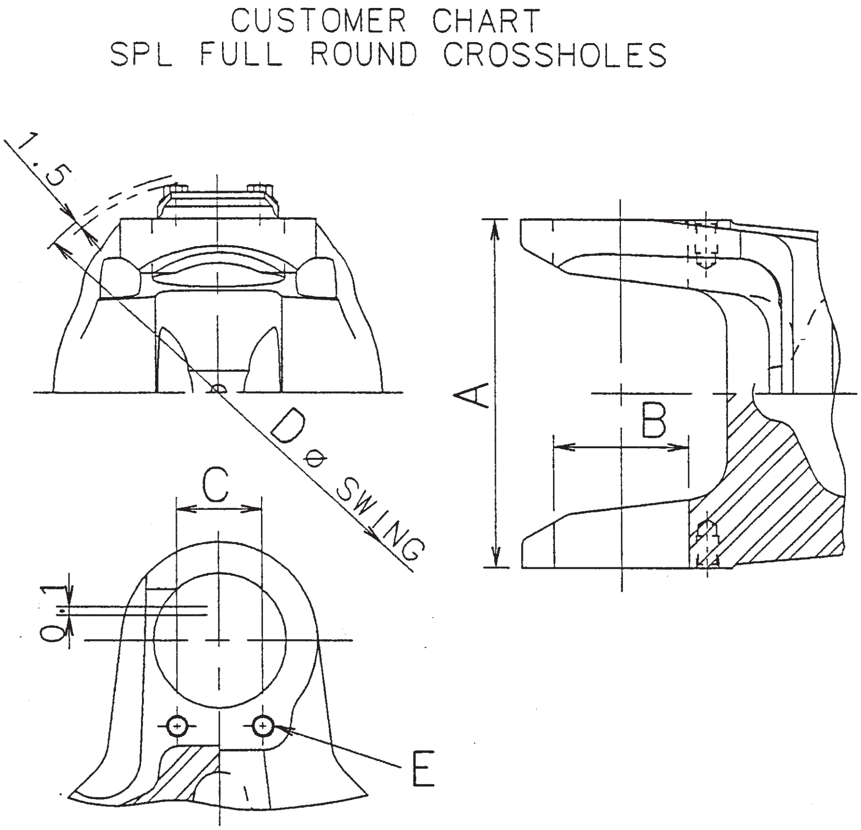
10 Series Half Round Cross Holes



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.

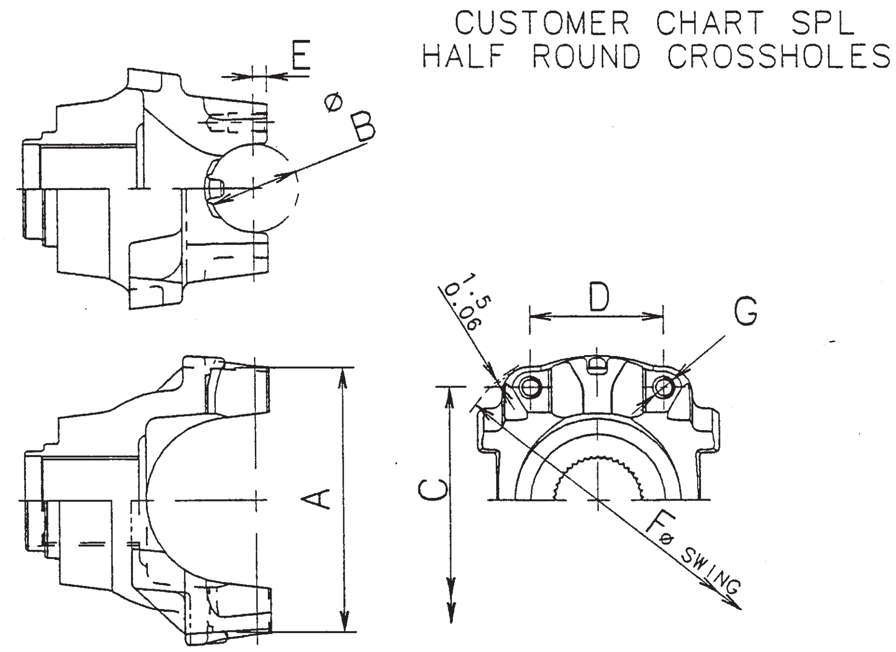
SPL Full Round Cross Holes



Type	Series	A (mm)	B (mm)	C (mm)	D * (mm)	E (mm)
SPL	SPL 140	128	49	32	160	M8 x 1.00
Full	SPL 170	153	55	32	185	M8 x 1.00
Round	SPL 250	152	60	32	184	M8 x 1.00

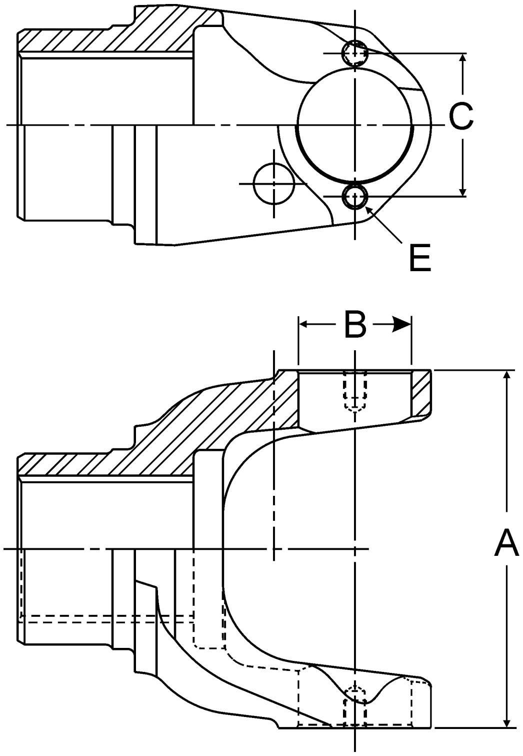
* Swing diameter clears yoke by 1.5 mm.

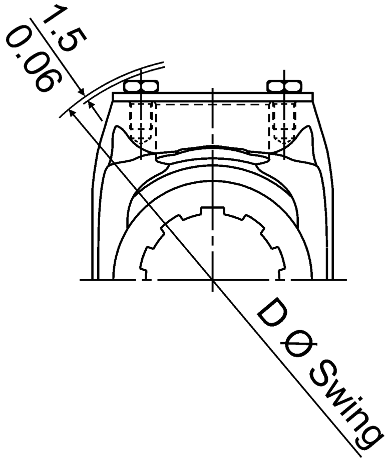
SPL Half Round Cross Holes



Type	Series	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F * (mm)	G (mm)
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
	SPL 170	164	55	140	82	8	193	12 x 1.25
	SPL 250	163	60	135	88	10	193	12 x 1.25
	SPL 350	171.8	65	142	100	0	219	14 x 1.25

BP Cross Holes



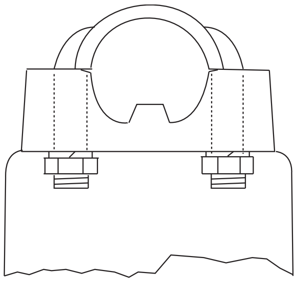


Type	Series	A (mm)	B (mm)	C (mm)	D* (mm)	E (mm)
Bearing Plate Full Round	1610	134.9/5.31	47.8/1.88	58.7/2.31	180.8/7.12	0.312-24
	1710	1.54.7/6.09	49.3/1.94	62.0/2.44	200.2/7.88	0.375-24
	1760	177.8/7.00	49.3/1.94	62.0/2.44	220.5/8.68	0.375-24
	1810	191.8/7.55	49.3/1.94	62.0/2.44	235.0/9.25	0.375-24
	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.

Joint Kit Attaching Hardware and Torque Specifications

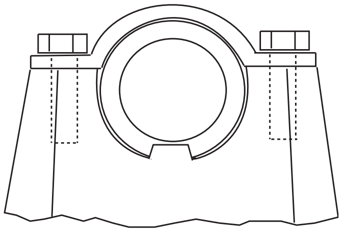
U-bolts



Series	Spicer U-Joint Kit No	U-Bolt Kit	Recommended Nut Torque
1210	5-443X	-	-
1310, SPL22	5-1310X, 5-1310-1X	2-94-28X	14-17 lbs. ft.
1330, SPL25	5-1330X, 5-1330-1X	2-94-28X	14-17 lbs. ft.
1350, SPL30	5-1350X, 1350-1X	3-94-18X	20-24 lbs. ft.
1410, SPL36	5-1410X, 5-1410-1X	3-94-18X	20-24 lbs. ft.
1480, SPL55	SPL55X, SPL55-1X	3-94-28X	32-37 lbs. ft.
1550, SPL70	SPL70X, SPl70-1X	3-94-28X	32-37 lbs. ft.
3R	5-3147X, 5-795X	2-94-58X	17-24 lbs. ft.

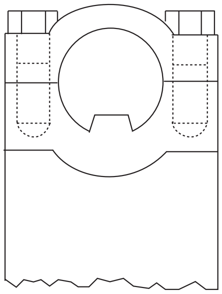
Bearing Strap

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.
SPL100	SPL100X	90-70-28X	45-60 lb. ft.
1210	5-443X	2-70-18X	13-18 lb. ft.
1310, SPL22	5-1310X, 5-1310-1X	2-70-18X	13-18 lb. ft.
1330, SPL25	5-1330X, 5-1330-1X	2-70-18X	13-18 lb. ft.
1350, SPL30	5-1350X, 5-1350-1X	3-70-28X	30-35 lb. ft.
1410, SPL36	5-1410X, 5-1410-1X	3-70-28X	30-35 lb. ft.
1480, SPL55	SPL55X, SPL55-1X	3-70-38X	45-60 lb. ft.
1550, SPL70	SPL70X, SPL70-1X	3-70-38X	45-60 lb. ft.
1610	5-674X	5-70-28X	45-60 lb. ft.
1710	5-675X	6.5-70-18X	115-135 lb. ft.
1760	5-677X	6.5-70-18X	115-135 lb. ft.
1810	5-676X	6.5-70-18X	115-135 lb. ft.
3R	5-3147X, 5-795X	2-70-48X	30-35 lb. ft.
7260	5-1306X, 5-789X	2-70-38X	13-18 lb. ft.

Cap and Bolts



(*) Discontinued

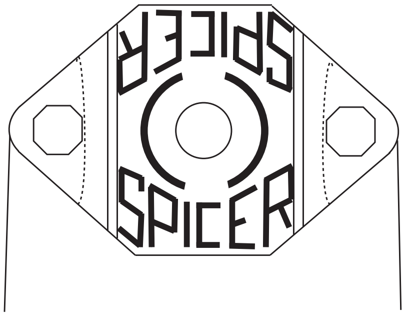
Series	Spicer Kit No	Cap and Bolt Kit	Recommended Bolt Torque
1650	5-165X	5-70-18X	77-103 lb. ft.
1850	5-185X	8-70-18X	110-147 lb. ft.
2050	5-340X	9-70-28X	744-844 lb. ft.

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.
1710	6-73-209	.375-24	38-48 lb. ft.
1760	6-73-209	.375-24	38-48 lb. ft.
1810	6-73-209	.375-24	38-48 lb. ft.
1880	7-73-315	.438-20	60-70 lb. ft.



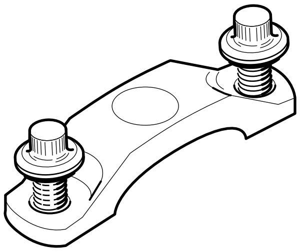
Bolt with Lock Strap (Pre-Spring 1994 Models)

Series	Bolt Part No	Thread Size	Recommended Bolt Torque
1610	5-73-109	.312-24	26-35 lb. ft.
1710	6-73-109	.375-24	38-48 lb. ft.
1760	6-73-109	.375-24	38-48 lb. ft.
1810	6-73-109	.375-24	38-48 lb. ft.
1880	7-73-115	.438-20	60-70 lb. ft.

Quick Disconnect (Half Round)

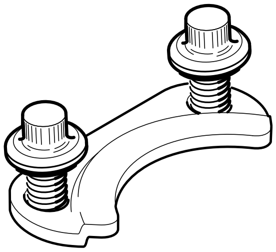
Series	Bolt Part No	Thread Size	Recommended Bolt Torque
SPL90	6-73-412	.375-24	45-60 lb. ft.
1610	6-73-412	.375-24	45-60 lb. ft.
1710	8-73-316	.500-20	115-135 lb. ft.
1760	8-73-316	.500-20	115-135 lb. ft.
1810	8-73-316	.500-20	115-135 lb. ft.

Bearing Retainer



Series	U-Joint Kit No	Retainer Kit No	Bolt Part No	Recommended Bolt Torque
SPL140	SPL140X	140-70-18X	5007417	115-125 lb. ft.
SPL170	SPL170-4X	170-70-18X	5007417	115-125 lb. ft.
SPL250	SPL250-3X	250-70-18X	5007417	115-125 lb. ft.
SPL350	SPL350X	350-70-18X	5019836	177-199 lb. ft.

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.
SPL170	SPL170X	211941X	8-73-114M	25-30 lb. ft.
SPL250	SPL250X	211941X	8-73-114M	25-30 lb. ft.