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Specifying a Spicer Driveline

Driveline Specification Criteria

Prime Factors:

- Net torque input
- Baseline duty cycle
  - On-highway tractor - 80,000 lbs. GCW
- Modifiers (+/- factors)
  - Duty cycle (vocation)
  - Gross Vehicle Weight (GVW/GCW)
  - Rear axle ratio
  - Universal joint working angle

Application Definitions

- Domestic applications - restricted to the continental United States and Canada.
  - 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.
- Export applications - outside of the continental United States and Canada.
  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

\[ \text{LGT} = T \times \text{TLGR} \times \text{TE} \times \text{SR} \times \text{TCR} \times \text{C} \]

- \( \text{LGT} \) = Maximum Driveshaft Low Gear Torque
- \( T \) = Net Engine Torque or 95% of the Gross Engine Torque
- \( \text{TLGR} \) = Transmission Low Gear Ratio (forward)
- \( \text{TE} \) = Transmission Efficiency (automatic = 0.8; manual = 0.85)
- \( \text{SR} \) = Torque Converter Stall Ratio (if applicable)
- \( \text{TCR} \) = Transfer Case Ratio (if applicable)
- \( \text{C} \) = 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

\[ \text{SI} = \frac{(T \times TR \times AR \times TCR \times 942.4)}{(RR \times GCW)} \]

- \( \text{SI} \) = Startability Index
- \( T \) = Engine Clutch Engagement Torque at 800 RPM
- \( TR \) = Transmission Second Lowest Forward Gear Ratio
- \( AR \) = Axle Ratio
- \( TCR \) = Transfer Case Ratio (if applicable)
- \( RR \) = Tire Rolling Radius (in)
- \( GCW \) = Maximum Gross Combination Weight (lbs)

Step 2 - Wheel Slip Calculation

\[ \text{WST} = \frac{(.71 \times W \times RR)}{(11.4 \times AR)} \]

- \( \text{WST} \) = 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.

\[
GT = \frac{.265 \times RR \times GVW}{11.4 \times AR}
\]

- \(GT\) = 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**

\[
OLGR = TLGR \times SR \times TCR
\]

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

**Step 5 - Driveline Series Selection**

To select a driveline series:

1. Use the torque determined from Steps 1, 2, and 3 with the overall low gear ratio (OLGR) from Step 4 to find the applicable series for each torque value.
2. Find the appropriate driveline series for SPL or Ten Series using the “Application Guidelines” on page 6 & 7.
3. Use the smallest series for the main driveline series, 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 or Ten Series using the “Application Guidelines” on page 6 & 7.

**Note:** High angle (45°) interaxle driveshafts are available in SPL-170 and 1710 Series only.
Calculating Maximum Driveshaft Torque (Export Applications)

**Step 1 - Low Gear Torque Calculation**

\[ \text{LGT} = T \times \text{TLGR} \times \text{TE} \times \text{SR} \times \text{TCR} \times \text{C} \]

- \( \text{LGT} \): Maximum Driveshaft Low Gear Torque
- \( T \): Net Engine Torque or 95% of the Gross Engine Torque
- \( \text{TLGR} \): Transmission Low Gear Ratio (forward)
- \( \text{TE} \): Transmission Efficiency (automatic = 0.8; manual = 0.85)
- \( \text{SR} \): Torque Converter Stall Ratio (if applicable)
- \( \text{TCR} \): Transfer Case Ratio (if applicable)
- \( \text{C} \): Transfer Case Efficiency (if applicable, 0.95)

**Step 2 - Overall Low Gear Ratio Calculation**

\[ \text{OLGR} = \text{TLGR} \times \text{SR} \times \text{TCR} \]

- \( \text{OLGR} \): Overall Low Gear Ratio
- \( \text{TLGR} \): Transmission Low Gear Ratio
- \( \text{SR} \): Torque Converter Stall Ratio (if applicable)
- \( \text{TCR} \): Transfer Case Ratio (if applicable)

**Step 3 - Driveline Series Selection**

To select a driveline series:

1. Use the torque determined from Step 1 with the overall low gear ratio (OLGR) from Step 2 to find the applicable series from the appropriate Driveline Sizing graph. See “Application Guidelines” for more information.

**Step 4 - Specifying the Interaxle Driveline (if applicable)**

To specify the interaxle driveline, use:

1. 60% of the Driveline Series Selection torque from Step 3 and the OLGR from Step 2.
2. Find the appropriate interaxle driveline series for SPL or Ten Series using the “Application Guidelines” on page 6 & 7.

**Note:** High angle (45°) interaxle driveshafts are available in SPL-170 and 1710 Series only.
Application Guidelines

10 Series Graph

Application Guidelines for Medium and Heavy-Duty Trucks
SPL Graph

Application Guidelines for Medium and Heavy-Duty Trucks

Maximum Net Driveshaft Torque

Low Gear Ratio
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**

\[
CS = 30 \pi \sqrt{\frac{E \times 386.4 \ (O^2 + I^2)}{P \times L^4 \times 16}}
\]

- **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/in³)
- **L** = Distance Between Journal Cross Centers (in)

* Refer to “Spicer Standard Tube Sizes” on page 19 for tube dimensions.

**Material Properties**

<table>
<thead>
<tr>
<th>Material</th>
<th>Modulus</th>
<th>Density</th>
<th>(\frac{E}{P} \times 386.4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>30.00 x 10⁶</td>
<td>0.2830</td>
<td>41.0 x 10⁹</td>
</tr>
<tr>
<td>Aluminum</td>
<td>10.30 x 10⁶</td>
<td>0.0980</td>
<td>39.4 x 10⁹</td>
</tr>
</tbody>
</table>

**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
- **L** = Distance Between Journal Cross Centers (in)
- **O** = Outside Diameter of Tubing (in)
- **I** = Inside Diameter of Tubing (in)

**Note:** The theoretical values and the simplified equation values are the same for the material constants provided.
Critical Speed

Adjusted Critical Speed

\[ ACS = TC \times CF \times SF \]

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

Maximum Driveshaft Length

Refer to the TMC Recommended Practice RP610A Chart 3 for maximum driveshaft length vs. RPM guidelines.

The general length limitations are as follows:

<table>
<thead>
<tr>
<th>Tube O.D.</th>
<th>Maximum Length *</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0 in.</td>
<td>60 in.</td>
</tr>
<tr>
<td>3.5 in.</td>
<td>65 in.</td>
</tr>
<tr>
<td>4.0 in.</td>
<td>70 in.</td>
</tr>
<tr>
<td>4.2 in.</td>
<td>72 in.</td>
</tr>
<tr>
<td>4.3 in.</td>
<td>73 in.</td>
</tr>
<tr>
<td>4.5 in.</td>
<td>75 in.</td>
</tr>
<tr>
<td>5.0 in.</td>
<td>80 in.</td>
</tr>
</tbody>
</table>

* Installed length u-joint center to u-joint center.
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 OR the center bearing assembly must not operate at a linear offset greater than 1/8" as shown in Figure 2.

**Note:** The Spicer "XC" center bearing may be mounted up to +/- 10° of perpendicular to the coupling shaft centerline as shown in the side view of Figure 1.

**Figure 1**

![Side View](image1.png)

![Top View](image2.png)

**Figure 2**

![Side View](image3.png)
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) - (-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.


### Driveline Analysis

#### Calculate Torsional and Inertia Excitation

Calculate the torsional effect:

\[ \Theta_{\text{torsion}} = \sqrt{(\Theta_A - \phi_A)^2 + (\Theta_B - \phi_B)^2 + (\Theta_C - \phi_C)^2} \]

(1) When \( \delta_1 = 0 \) deg, \( \delta_2 = 0 \) deg.

\[
= \sqrt{(2.78 - 284.1)^2 + (1.26(276.01 - 90))^2 + (2.58(108.29))^2} \\
= \sqrt{(7.7284 - 151.8) + (1.5876 - 12.02) + (6.6564 - 143.42)} \\
= \sqrt{(12.8667 - 145.4)} \\
= 3.5870^\circ - 72.75^\circ \\
3.3405 \times 10^8 (2368 \text{rpm})^2 (3.5870^\circ)^2 = 241.0154 \text{ rad/sec}^2
\]

(2) When \( \delta_1 = 0 \) deg, \( \delta_2 = 90 \) deg.

\[
= \sqrt{(2.78 - 284.1)^2 + (1.26(276.01 - 90))^2 + (2.58(108.29 - 90))^2} \\
= \sqrt{(7.7284 - 151.8) + (1.5876 - 167.98) + (6.6564 - 143.42)} \\
= \sqrt{(0.65124 - 82.32)} \\
= 0.80699^\circ - 41.162^\circ \\
3.3405 \times 10^8 (2368 \text{rpm})^2 (0.80699^\circ)^2 = 12.1988 \text{ rad/sec}^2
\]

(3) When \( \delta_1 = 90 \) deg, \( \delta_2 = 90 \) deg.

\[
= \sqrt{(2.78 - 284.1)^2 + (1.26(276.01 - 90 - 90))^2 + (2.58(108.29 - 90 - 90))^2} \\
= \sqrt{(7.7284 - 151.8) + (1.5876 - 167.98) + (6.6564 - 143.42)} \\
= \sqrt{(15.847236 - 149.89)} \\
= 3.98085^\circ - 74.94^\circ \\
3.3405 \times 10^8 (2368 \text{rpm})^2 (3.98085^\circ)^2 = 296.84 \text{ rad/sec}^2
\]
(4) When $\delta_1 = 90\,\text{deg}$, $\delta_2 = 0\,\text{deg}$.

$$\begin{align*}
&= \sqrt{(2.78 - 284.1^2) + (1.26 - (276.01 - 90)^2) + (2.58 - (108.29 - 90)^2)} \\
&= \sqrt{(7.7284 - 151.8^2) + (1.5876 - 167.98^2) + (6.6564 - 36.58^2)} \\
&= \sqrt{(3.018639 - 179.699^2)} \\
&= 1.737423 \, \text{rad} \\
&= 3.3405 \times 10^4 \, \text{rad} \, \text{sec}^{-2} \\
&= (2368 \, \text{rpm}) \, (1.737423^2) = 56.54 \, \text{rad} \, \text{sec}^{-2}
\end{align*}$$

Calculate the inertia drive effects:

$$\begin{align*}
\Theta_d &= \sqrt{2(\Theta_1 - \phi_1)^2 + (\Theta_2 - (90\,\text{deg} - \delta_0))^2} \\
(1) \text{ When } &\delta_1 = 0 \, \text{deg}, \delta_2 = 0 \, \text{deg} \text{ or } \delta_1 = 0 \, \text{deg}, \delta_2 = 90 \, \text{deg}.
\end{align*}$$

$$\begin{align*}
&= \sqrt{2(2.78 - 284.1^2) + (1.26 - (276.01 - 90)^2)} \\
&= \sqrt{(15.4568 - 151.8^2) + (1.5876 - 12.02^2)} \\
&= \sqrt{(16.987278 - 153.29^2)} \\
&= 4.12156 \, \text{rad} \\
&= 3.3405 \times 10^4 \, \text{rad} \, \text{sec}^{-2} \\
&= (2368 \, \text{rpm}) \, (4.12156^2) = 261.10 \, \text{rad} \, \text{sec}^{-2}
\end{align*}$$

$$\begin{align*}
(2) \text{ When } &\delta_1 = 90 \, \text{deg}, \delta_2 = 90 \, \text{deg} \text{ or } \delta_1 = 90 \, \text{deg}, \delta_2 = 0 \, \text{deg}.
\end{align*}$$

$$\begin{align*}
&= \sqrt{2(2.58 - 108.29^2) + (1.26 - (276.01 + 90)^2)} \\
&= \sqrt{(13.3128 - 143.42^2) + (1.5876 - 12.02^2)} \\
&= \sqrt{(11.887165 - 140.24^2)} \\
&= 3.44777 \, \text{rad} \\
&= 3.3405 \times 10^4 \, \text{rad} \, \text{sec}^{-2} \\
&= (2368 \, \text{rpm}) \, (3.44777^2) = 222.66 \, \text{rad} \, \text{sec}^{-2}
\end{align*}$$

Calculate the inertia coast effects:

$$\begin{align*}
\Theta_c &= \sqrt{2(\Theta_1 - \phi_1)^2 + (\Theta_2 - (90\,\text{deg} + \delta_0))^2} \\
(1) \text{ When } &\delta_1 = 0 \, \text{deg}, \delta_2 = 0 \, \text{deg} \text{ or } \delta_1 = 90 \, \text{deg}, \delta_2 = 0 \, \text{deg}.
\end{align*}$$

$$\begin{align*}
&= \sqrt{2(2.78 - 284.1^2) + (1.26 - (276.01 - 90)^2)} \\
&= \sqrt{(15.4568 - 151.8^2) + (1.5876 - 12.02^2)} \\
&= \sqrt{(16.987278 - 153.29^2)} \\
&= 4.12156 \, \text{rad} \\
&= 3.3405 \times 10^4 \, \text{rad} \, \text{sec}^{-2} \\
&= (2368 \, \text{rpm}) \, (4.12156^2) = 318.19 \, \text{rad} \, \text{sec}^{-2}
\end{align*}$$
(2) When \( \delta_1 = 0 \) deg, \( \delta_2 = 90 \) deg or \( \delta_1 = 90 \) deg, \( \delta_2 = 90 \) deg.

\[
\begin{align*}
&= \sqrt{2(2.58-08.89^2) + (1.26(276.01 + 90 + 90)^2)} \\
&= \sqrt{(13.3128 - 143.42) + (1.5876 - 167.98^2)} \\
&= \sqrt{(14.7715 - 145.98)} \\
&= 3.84337 - 72.99^2 \\
&= 3.3405 \times 10^6 (2368 \text{rpm})^2 (3.84337^2) = 276.69 \frac{\text{rad}}{\text{sec}^2}
\end{align*}
\]

**Note:** The recommended torsional excitation level is 300 rad/sec\(^2\) or less. The recommended inertia excitation level is 1000 rad/sec\(^2\) or less.

Calculate the torque fluctuations:

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

<table>
<thead>
<tr>
<th></th>
<th>lbf-in-sec(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission</td>
<td>2.33</td>
</tr>
<tr>
<td>Axle</td>
<td>2.53</td>
</tr>
<tr>
<td>1760 Driveshaft</td>
<td>1.3</td>
</tr>
</tbody>
</table>

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

\[
T_{\text{axle}} = T_{\text{torsional, axle}} + T_{\text{inertia, drive}} = J_{\text{axle torsional}} + J_{\text{driveshaft drive}} = (2.53)(241.01) + (1.3)(261.10) = 949.18 \text{ in-lb} = 79.1 \text{ ft-lb}
\]

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

\[
T_{\text{transmission}} = T_{\text{torsional, transmission}} + T_{\text{inertia, coast}} = J_{\text{transmission torsional}} + J_{\text{driveshaft coast}} = (2.33)(241.01) + (1.3)(222.66) = 851.01 \text{ in-lb} = 70.92 \text{ ft-lb}
\]
Center Bearing Loading

Calculate Static / Dynamic Center Bearing Load

Static

\[
\frac{1}{2} \frac{T}{AB - DB} \left\{ \sin \alpha \left( \Phi_x + 90 \right)^\circ + \left( \tan \beta \cdot \frac{AB}{BC} \sin \beta \right) \left( \Phi_x + 90 \right)^\circ \\
+ \frac{AB}{BC} \tan \phi \left( \Phi_x - 90 \right)^\circ \right\}
\]

\[
= \frac{1}{2} \frac{12214 \times 12}{(40 - 6.2)} \left\{ \sin 2.78^\circ \left( 284.1 + 90 \right)^\circ \\
+ \left( \tan 1.26^\circ \cdot \frac{40}{44.34} \sin 1.26^\circ \right) \left( 276.01 + 90 \right)^\circ \\
+ \frac{40}{44.34} \tan 2.58^\circ \left( 108.29 - 90 \right)^\circ \right\}
\]

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

\[
= 2168.1657 (0.0912 - 15.77^\circ )
\]

\[
= 197.738 \text{ lbs } 15.77^\circ
\]

Dynamic

\[
\frac{1}{2} \frac{T}{AB - DB} \left\{ \sin \alpha \left( 90 - \Phi_x \right)^\circ + \left( \tan \beta + \frac{AB}{BC} \sin \beta \right) \left( 90 - \Phi_x + 2\delta \right)^\circ \\
+ \frac{AB}{BC} \tan \phi \left( 90 - \Phi_x + 2\delta \right)^\circ \right\}
\]

(1) When \( \delta_1 = 0 \) deg, \( \delta_2 = 0 \) deg.

\[
= \frac{1}{2} \frac{12214 \times 12}{(40 - 6.2)} \left\{ \sin 2.78^\circ \left( 90 - 284.1 \right)^\circ \\
+ \left( \tan 1.26^\circ + \frac{40}{44.34} \sin 1.26^\circ \right) \left( 90 - 276.01 \right)^\circ \\
+ \frac{40}{44.34} \tan 2.58^\circ \left( 90 - 108.29 \right)^\circ \right\}
\]

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

\[
= 2168.1657 (0.0502 - 176^\circ )
\]

\[
= 108.7635 \text{ lbs } 176^\circ
\]
(2) When $\delta_1 = 0$ deg, $\delta_2 = 90$ deg.

$$\frac{1}{2} \frac{12214 \times 12}{(40-6.2)} \left( \sin 2.78^\circ (90 - 284.1)^\circ \right)$$

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

$$+ \frac{40.}{44.34} \tan 2.58^\circ (90 - 108.29 + 2x90)^\circ \right)$$

$$= 2168.1657 \{ (0.0485 - 194.1^\circ) + (0.0418 - 186.01^\circ) + (0.0406 - 161.71^\circ) \}$$

$$= 2168.1657 (0.1305 - 167.18^\circ)$$

$$= 282.9240 \text{ lbs}$$

(3) When $\delta_1 = 90$ deg, $\delta_2 = 90$ deg.

$$\frac{1}{2} \frac{12214 \times 12}{(40-6.2)} \left( \sin 2.78^\circ (90 - 284.1)^\circ \right)$$

$$+ (\tan 1.26^\circ + \frac{40.}{44.34} \sin 1.26^\circ (90 - 276.01 + 2x90)^\circ$$

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

$$= 2168.1657 \{ (0.0485 - 194.1^\circ) + (0.0418 - 6.01^\circ) + (0.0406 - 18.29^\circ) \}$$

$$= 2168.1657 (0.0336 - 9.11^\circ)$$

$$= 72.8115 \text{ lbs}$$

(4) When $\delta_1 = 90$ deg, $\delta_2 = 0$ deg.

$$\frac{1}{2} \frac{12214 \times 12}{(40-6.2)} \left( \sin 2.78^\circ (90 - 284.1)^\circ \right)$$

$$+ (\tan 1.26^\circ + \frac{40.}{44.34} \sin 1.26^\circ (90 - 276.01 + 2x90)^\circ$$

$$+ \frac{40.}{44.34} \tan 2.58^\circ (90 - 108.29 + 2x90)^\circ \right)$$

$$= 2168.1657 \{ (0.0485 - 194.1^\circ) + (0.0418 - 6.01^\circ) + (0.0406 - 161.71^\circ) \}$$

$$= 2168.1657 (0.0484 - 155.36^\circ)$$

$$= 105.0332 \text{ lbs}$$

**Center Bearing Loads**

<table>
<thead>
<tr>
<th>Design</th>
<th>Static Load</th>
<th>Dynamic Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid Rubber</td>
<td>500 lbs.</td>
<td>500 lbs.</td>
</tr>
<tr>
<td>Semi-Slotted Rubber</td>
<td>250 lbs.</td>
<td>250 lbs.</td>
</tr>
<tr>
<td>Slotted Rubber</td>
<td>100 lbs.</td>
<td>100 lbs.</td>
</tr>
</tbody>
</table>
Application Form

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: _____________

Max 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:  ________________

B₁₀ Life Expectancy:____________________________________________________________________

Vehicle Duty Cycle: ______________________________________________________________________

Description of Vehicle Function: _____________________________________________________________

_______________________________________________________________________________________

_______________________________________________________________________________________

Signed:  ___________________________________  Title:  _____________________________________

Spicer Engineer: ______________________________  Phone: ____________________________________

Email: ______________________________________  Fax:  ______________________________________
**APPLICATION PROPOSAL**

<table>
<thead>
<tr>
<th>Vehicle Position</th>
<th>Series</th>
<th>Dana Part Number</th>
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<tbody>
<tr>
<td>Transmission to Rear Axle</td>
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<tr>
<td>Transmission to Auxiliary</td>
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<td>Transmission to Mid Bearing</td>
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<td>Interaxle</td>
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<td>Wheel Drive</td>
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**Vehicle Application Sketch**

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<tr>
<th>Plan View</th>
<th>Side View</th>
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Proposed By: ____________________________

Signed: ____________________________

Title: ____________________________
## Spicer Standard Tube Sizes

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<th>Series</th>
<th>Tube Size (in)</th>
<th>Dana Part Number</th>
<th>Torque Rating (lbs. ft.)</th>
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Joint Life vs. Joint Angle

% of Expected Joint Life

Angle (degrees)
# Charts

## Snap Ring Cross Holes

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<th>Type</th>
<th>Series</th>
<th>A (mm / in)</th>
<th>B (mm / in)</th>
<th>C* (mm / in)</th>
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<td>1410</td>
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<td>109.2 / 4.30</td>
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* Swing diameter clears yoke by 1.5 mm / 0.06 in.
## Half Round Cross Holes

* Swing diameter clears yoke by 1.5 mm / 0.06 in.

<table>
<thead>
<tr>
<th>Type</th>
<th>Series</th>
<th>A (mm / in)</th>
<th>B (mm / in)</th>
<th>C (mm / in)</th>
<th>D (mm / in)</th>
<th>E (mm / in)</th>
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<td>35.1 / 1.38</td>
<td>93.7 / 3.69</td>
<td>53.8 / 2.12</td>
<td>0.8 / 0.03</td>
<td>134.9 / 5.31</td>
<td>-</td>
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<td>35.1 / 1.38</td>
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<td>53.8 / 2.12</td>
<td>0.8 / 0.03</td>
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<td>0.375 - 24</td>
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* Swing diameter clears yoke by 1.5 mm / 0.06 in.
SPL Full Round Cross Holes

**CUSTOMER CHART**
SPL FULL ROUND CROSSHOLES

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<tr>
<th>Type</th>
<th>Series</th>
<th>A (mm)</th>
<th>B (mm)</th>
<th>C (mm)</th>
<th>D * (mm)</th>
<th>E (mm)</th>
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<td>184</td>
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* Swing diameter clears yoke by 1.5 mm.
# SPL Half Round Cross Holes

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<th>B (mm)</th>
<th>C (mm)</th>
<th>D (mm)</th>
<th>E (mm)</th>
<th>F (mm)</th>
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BP Cross Holes

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<th>C (mm)</th>
<th>D* (mm)</th>
<th>E (mm)</th>
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*Swing Diameter Clears Yoke by 1.5/0.06 mm/in.
Joint Kit Attaching Hardware and Torque Specifications

U-bolts

<table>
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<th>Series</th>
<th>Spicer Kit No</th>
<th>Assemblies</th>
<th>Recommended Nut Torque</th>
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<td>5-443X</td>
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<tr>
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<td>5-153X, 5-785X, SPL22-1X</td>
<td>2-94-28X</td>
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<td>1330, SPL25</td>
<td>5-213X, 5-790X, SPL25-1X</td>
<td>2-94-28X</td>
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<td>3-94-18X</td>
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<td>5-188X, 5-803X, SPL55X</td>
<td>3-94-28X</td>
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<td>5-155X, 5-808X, SPL70X</td>
<td>3-94-28X</td>
<td>32-37 lbs. ft.</td>
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Bearing Strap

**WARNING:** Bearing strap retaining bolts should not be reused.

<table>
<thead>
<tr>
<th>Series</th>
<th>Spicer Kit No</th>
<th>Assemblies</th>
<th>Recommended Bolt Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPL90</td>
<td>SPL90X</td>
<td>90-70-28X</td>
<td>45-60 lbs. ft.</td>
</tr>
<tr>
<td>SPL100</td>
<td>SPL100-1X</td>
<td>90-70-28X</td>
<td>45-60 lbs. ft.</td>
</tr>
<tr>
<td>1210</td>
<td>5-443X</td>
<td>2-70-18X</td>
<td>13-18 lbs. ft.</td>
</tr>
<tr>
<td>1310, SPL22</td>
<td>5-153X, 5-785X, SPL22-1X</td>
<td>2-70-18X</td>
<td>13-18 lbs. ft.</td>
</tr>
<tr>
<td>1350, SPL30</td>
<td>5-178X, 5-799X, SPL30-1X</td>
<td>3-70-28X</td>
<td>30-35 lbs. ft.</td>
</tr>
<tr>
<td>1410, SPL36</td>
<td>5-160X, 5-801X, SPL36-1X</td>
<td>3-70-28X</td>
<td>30-35 lbs. ft.</td>
</tr>
<tr>
<td>1480, SPL55</td>
<td>5-188X, 5-803X, SPL55X</td>
<td>3-70-28X</td>
<td>30-35 lbs. ft.</td>
</tr>
<tr>
<td>1550, SPL70</td>
<td>5-155X, 5-808X, SPL70X</td>
<td>3-70-28X</td>
<td>30-35 lbs. ft.</td>
</tr>
<tr>
<td>1610</td>
<td>5-674X</td>
<td>5-70-28X</td>
<td>45-60 lbs. ft.</td>
</tr>
<tr>
<td>1710</td>
<td>5-675X</td>
<td>6.5-70-18X</td>
<td>115-135 lbs. ft.</td>
</tr>
<tr>
<td>1760</td>
<td>5-677X</td>
<td>6.5-70-18X</td>
<td>115-135 lbs. ft.</td>
</tr>
<tr>
<td>1810</td>
<td>5-676X</td>
<td>6.5-70-18X</td>
<td>115-135 lbs. ft.</td>
</tr>
<tr>
<td>3R</td>
<td>5-3147X, 5-795X, SPL25-6X</td>
<td>2-70-48X</td>
<td>30-35 lbs. ft.</td>
</tr>
<tr>
<td>7260</td>
<td>5-1306X, 5-789X, SPL22-8X</td>
<td>2-70-38X</td>
<td>13-18 lbs. ft.</td>
</tr>
</tbody>
</table>
Cap and Bolts

(*) Discontinued

<table>
<thead>
<tr>
<th>Series</th>
<th>Spicer Kit No</th>
<th>Assemblies</th>
<th>Recommended Bolt Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>1650</td>
<td>5-165X</td>
<td>5-70-18X</td>
<td>77-103 lbs. ft.</td>
</tr>
<tr>
<td>1850</td>
<td>5-185X</td>
<td>8-70-18X (*)</td>
<td>110-147 lbs. ft.</td>
</tr>
<tr>
<td>2050</td>
<td>5-340X</td>
<td>9-70-28X (*)</td>
<td>744-844 lbs. ft.</td>
</tr>
</tbody>
</table>

Bearing Plate

**WARNING:** Self locking bolts should not be reused.

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

<table>
<thead>
<tr>
<th>Series</th>
<th>Bolt Part No</th>
<th>Thread Size</th>
<th>Recommended Bolt Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>1610</td>
<td>5-73-709</td>
<td>.312-24</td>
<td>26-35 lbs. ft.</td>
</tr>
<tr>
<td>1710</td>
<td>6-73-209</td>
<td>.375-24</td>
<td>38-48 lbs. ft.</td>
</tr>
<tr>
<td>1760</td>
<td>6-73-209</td>
<td>.375-24</td>
<td>38-48 lbs. ft.</td>
</tr>
<tr>
<td>1810</td>
<td>6-73-209</td>
<td>.375-24</td>
<td>38-48 lbs. ft.</td>
</tr>
<tr>
<td>1880</td>
<td>7-73-315</td>
<td>.438-20</td>
<td>60-70 lbs. ft.</td>
</tr>
</tbody>
</table>

Bolt with Lock Strap (Pre-Spring 1994 Models)

<table>
<thead>
<tr>
<th>Series</th>
<th>Bolt Part No</th>
<th>Thread Size</th>
<th>Recommended Bolt Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>1610</td>
<td>5-73-109</td>
<td>.312-24</td>
<td>26-35 lbs. ft.</td>
</tr>
<tr>
<td>1880</td>
<td>7-73-115 (*)</td>
<td>.438-20</td>
<td>60-70 lbs. ft.</td>
</tr>
</tbody>
</table>

Quick Disconnect (Half Round)

<table>
<thead>
<tr>
<th>Series</th>
<th>Bolt Part No</th>
<th>Thread Size</th>
<th>Recommended Bolt Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPL90</td>
<td>6-73-412</td>
<td>.375-24</td>
<td>45-60 lbs. ft.</td>
</tr>
<tr>
<td>1610</td>
<td>6-73-412</td>
<td>.375-24</td>
<td>45-60 lbs. ft.</td>
</tr>
<tr>
<td>1710</td>
<td>8-73-316</td>
<td>.500-20</td>
<td>115-135 lbs. ft.</td>
</tr>
<tr>
<td>1760</td>
<td>8-73-316</td>
<td>.500-20</td>
<td>115-135 lbs. ft.</td>
</tr>
<tr>
<td>1810</td>
<td>8-73-316</td>
<td>.500-20</td>
<td>115-135 lbs. ft.</td>
</tr>
</tbody>
</table>
### Bearing Retainer

<table>
<thead>
<tr>
<th>Series</th>
<th>Spicer Kit No</th>
<th>Retainer Kit No</th>
<th>Bolt Part No</th>
<th>Recommended Bolt Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPL140</td>
<td>SPL140X</td>
<td>140-70-18X</td>
<td>5007417</td>
<td>115-135 lbs. ft.</td>
</tr>
<tr>
<td>SPL170</td>
<td>SPL170X</td>
<td>170-70-18X</td>
<td>5007417</td>
<td>115-135 lbs. ft.</td>
</tr>
<tr>
<td>SPL250</td>
<td>SPL250X</td>
<td>250-70-18X</td>
<td>5007417</td>
<td>115-135 lbs. ft.</td>
</tr>
</tbody>
</table>

### Spring Tab

<table>
<thead>
<tr>
<th>Series</th>
<th>Spicer Kit No</th>
<th>Spring Tab Kit No</th>
<th>Bolt Part No</th>
<th>Recommended Bolt Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPL140</td>
<td>SPL140X</td>
<td>211941X</td>
<td>8-73-114M</td>
<td>25-30 lbs. ft.</td>
</tr>
<tr>
<td>SPL170</td>
<td>SPL170X</td>
<td>211941X</td>
<td>8-73-114M</td>
<td>25-30 lbs. ft.</td>
</tr>
<tr>
<td>SPL250</td>
<td>SPL250X</td>
<td>211941X</td>
<td>8-73-114M</td>
<td>25-30 lbs. ft.</td>
</tr>
</tbody>
</table>
For spec’ing or service assistance, call 1-800-826-HELP (4357) 24 hours a day, 7 days a week (Mexico: 001-800-826-4357), for more time on the road. Or visit our web site at www.roadranger.com.