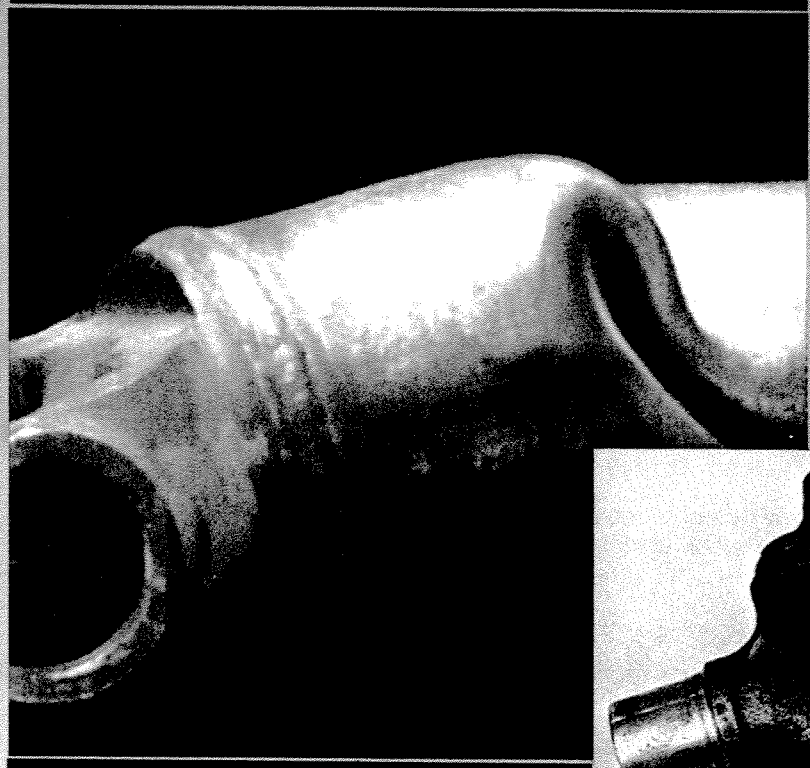
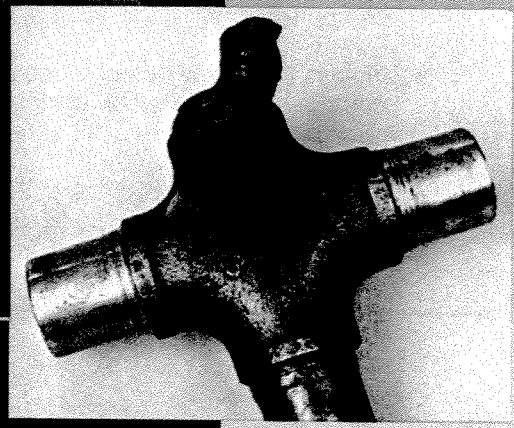
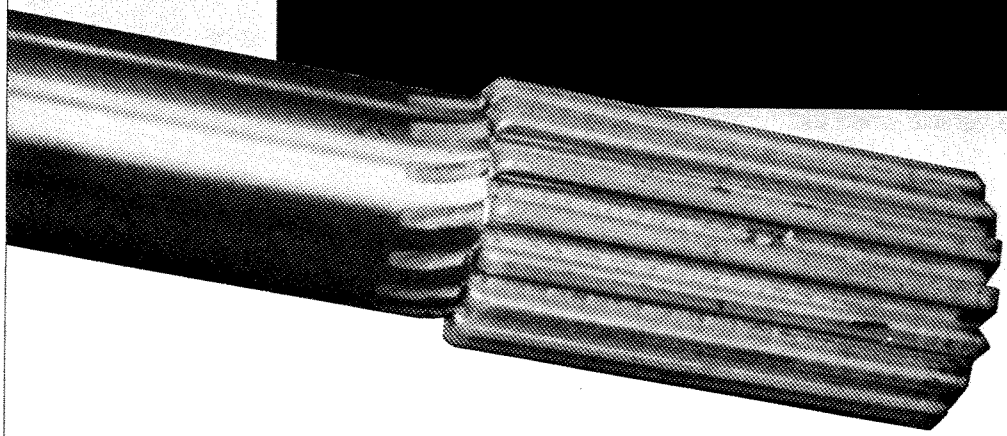
Spicer Driveline Components

Troubleshooting Guidelines





Causes and Solutions To Field Problems



SPICER®

DANA

SAFETY PRECAUTIONS

GENERAL SAFETY INFORMATION

To prevent injury to yourself and/or damage to the equipment:

- ➤ Read carefully all owners manuals, service manuals, and/or other instructions.
- ➤ Always follow proper procedures and use proper tools and safety equipment.
- ➤ Be sure to receive proper training.
- ➤ Never work alone while under a vehicle or while repairing or maintaining equipment.
- ➤ Always use proper components in applications for which they are approved.
- ➤ Be sure to assemble components properly.
- ➤ Never use worn-out or damaged components.
- ➤ Always block any raised or moving device that may injure a person working on or under a vehicle.
- ➤ Never operate the controls of the power take-off or other driven equipment from any position that could result in getting caught in the moving machinery.

WARNING: ROTATING DRIVESHAFTS

- ➤ Rotating auxiliary driveshafts are dangerous. You can snag clothes, skin, hair, hands, etc. This can cause serious injury or death.
- ➤ Do not go under the vehicle when the engine is running.
- ➤ Do not work on or near an exposed shaft when engine is running.
- ➤ Shut off engine before working on power take-off or driven equipment.
- ➤ Exposed rotating driveshafts must be guarded.

WARNING: GUARDING AUXILIARY DRIVESHAFTS

We strongly recommend that a power take-off and a directly mounted pump be used to eliminate the auxiliary driveshaft whenever possible. If an auxiliary driveshaft is used and remains exposed after installation, it is the responsibility of the vehicle designer and PTO installer to install a guard.

WARNING: USING SET SCREWS

Auxiliary driveshafts may be installed with either recessed or protruding set screws. If you choose a square head set screw, you should be aware that it will protrude above the hub of the yoke and may be a point where clothes, skin, hair, hands, etc. could be snagged. A socket head set screw, which may not protrude above the hub of the yoke, does not permit the same amount of torquing as does a square head set screw. Also, a square head set screw, if used with a lock wire, will prevent loosening of the screw caused by vibration. Regardless of the choice made with respect to a set screw, an exposed rotating auxiliary driveshaft must be guarded.

THIS SYMBOL WARNS OF POSSIBLE PERSONAL INJURY.

Introduction

Universal joint failures, as a rule, are of a progressive nature, which, when they occur, generally accelerate rapidly resulting in a mass of melted trunnions and bearings.

Some recognizable signs of universal joint deterioration are:

1) Vibrations - Driver should report to maintenance.
2) U-joint Looseness - End play across bearings.
3) U-joint discoloration due to excessive heat build-up.
4) Inability to purge all four trunnion seals when relubing U-joint.

Items 2) thru 4) should be checked at re-lube cycle and if detected, reported to the maintenance supervisor for investigation.

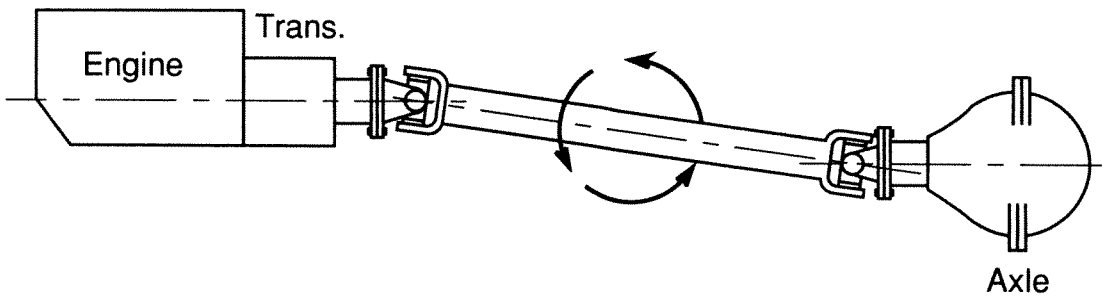
Experience with universal joint failures has shown that a significant majority are related to lubricating film breakdown. This may be caused by a lack of lubricant, inadequate lube quality for the application, inadequate initial lubrication or failure to lubricate properly and often enough.

Failures which are not the result of lubrication film breakdown are associated with the installation, angles and speeds and manufacturing discrepancies.

Driveshaft failures through torque, fatigue and bending are associated with overload, excessively high U-joint angles and drive shaft lengths excessive for operating speeds.

The trouble shooting chart in this bulletin is intended to provide service people with an aid to enable them to associate complaints with some of the **probable causes** and **probable corrections**. Through normal vehicle maintenance and recognition of discrepancies, this may enable them to make necessary corrections to ward off a serious breakdown.

Driveshaft Torque



Twisted driveshaft tube?
Broken yoke shaft?
Broken journal cross?

Usually a result of torque overload– How much torque can be generated in your application?

Here is how to figure torque:

L.G.T. = N.E.T. x Trans L.G.R. x .85 (efficiency factor)

$$\text{D.L.T. (to Slip Wheels)} = \frac{W_R \times \text{C.O.F.} \times \text{R.R.}}{12 \times \text{A.R.}}$$

A.R. = Axle ratio
C.O.F. = Coefficient of friction (.7)
D.L.T. = Drive line torque
L.G.R. = Low gear ratio
L.G.T. = Low gear torque
N.E.T. = Net engine torque
R.R. = Tire loaded rolling radius
W_R = Weight on drive axle

Relate the lesser of above to Spicer U-joint ratings. If your torque exceeds the Spicer rating for the U-joint used in your application, switch to a size with a rating compatible to your calculation.

U-Joint Operating Angles

U-joint operating angles are a primary source of problems contributing to:

- Vibrations
- Reduced U-joint life
- Problems with other drivetrain components that may include:
  - Transmission gear failures
  - Synchronizer failures
  - Differential problems
  - Premature seal failures in axles, transmissions, pumps or blowers
  - Premature failure of gears, seals and shafts in Power Take-Offs

Every U-joint that operates at an angle will vibrate.

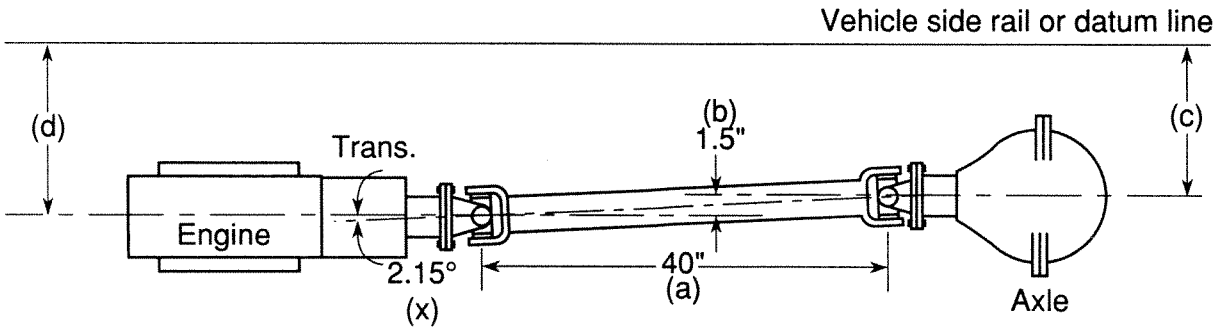
U-joint operating angles are probably the most common causes of driveline vibrations in vehicles that have been re-worked or in vehicles that have had auxiliary equipment installed.

To correct or eliminate these causes of driveline vibrations from your vehicle or new installation, you must determine the TRUE OPERATING ANGLE of each U-joint in your system.

The TRUE OPERATING ANGLE of a U-joint is a combination of the angle that occurs in the top view and the angle that occurs in the side view.

To determine the TRUE OPERATING ANGLE of a U-joint you must follow the instructions outlined in the following sections, numbered I and II, and calculate the TRUE OPERATING ANGLE using the information detailed in Section III.

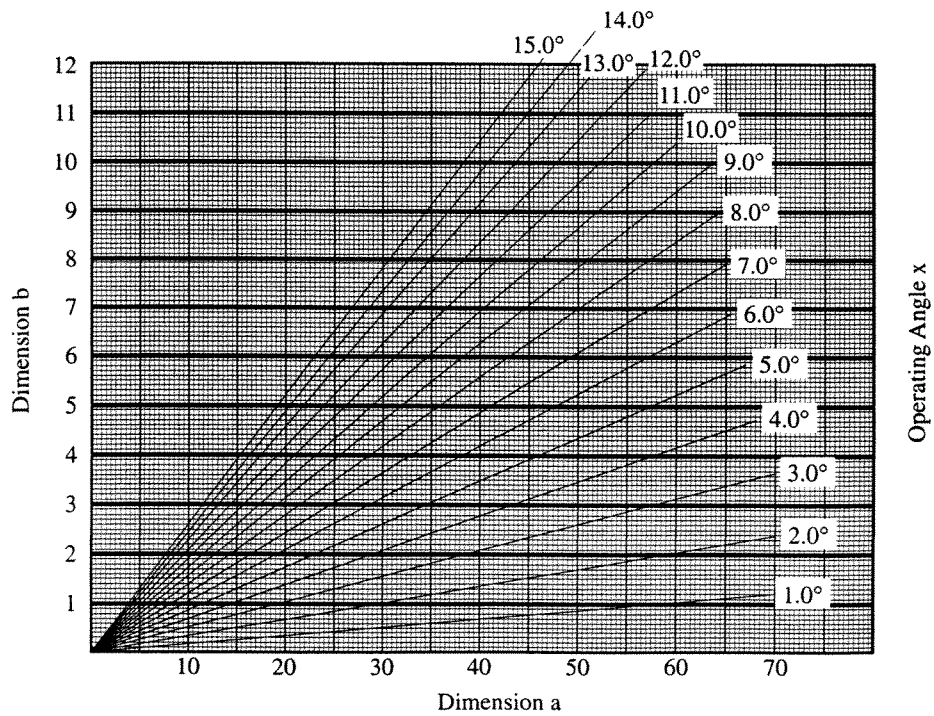
I. To Determine Operating Angles in Top View



1. From side rail or convenient datum, measure offset dimensions c & d.
2. Calculate dimension b = d - c
3. Measure dimension a
4. Using dimensions a & b, determined through measurement, calculate U-joint angle x by using the chart provided.

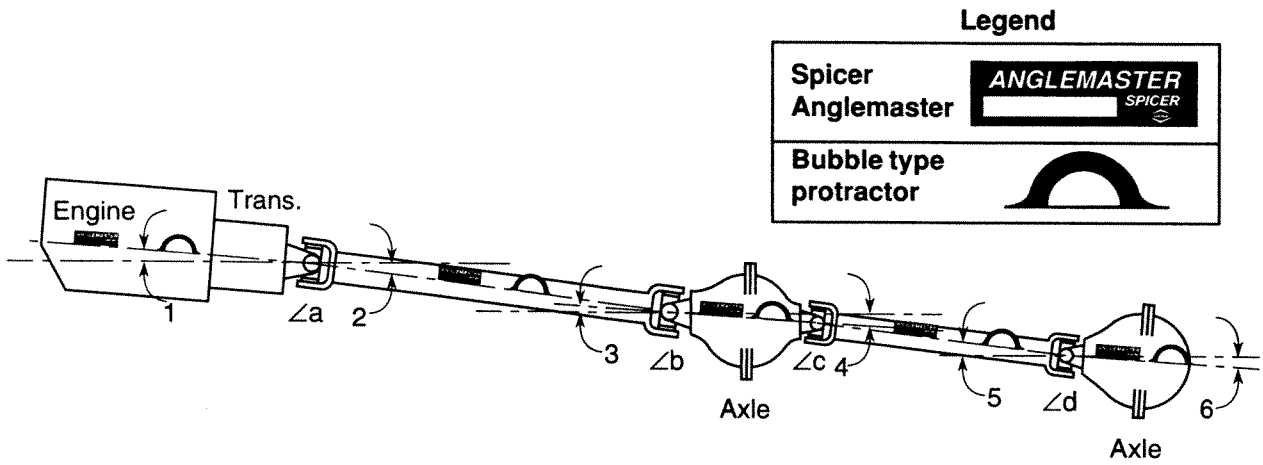
Example:

Where a = 40.0"
b = 1.5"
X = 2.15° operating angle



U-Joint Operating Angles

II. To Determine Operating Angles in Side View



The most convenient way to determine U-joint angles in the side view is through use of a Spicer Anglemaster™ or a bubble type protractor. Procedure is as follows:

Step I. Using an Anglemaster or a bubble protractor, record inclination angles of drivetrain components. Set Anglemaster or protractor on machined surfaces of engine, transmission, axle or on machined lugs of transmission output and axle input yokes.

Note: U-joint angles can change significantly in a loaded situation. Therefore, check vehicle loaded and unloaded to achieve the accepted angle cancellation. (See Step IV.)

Example:

Eng-Trans Output	4°30' Down (1)
Main Drive Shaft	7°00' Down (2)
Input 1st Rear Axle	4°00' Up (Input Shaft Nose Up) (3)
Output 1st Rear Axle	4°00' Down (4)
Inter-axle Shaft	7°00' Down (5)
Input 2nd Rear Axle	4°15' Up (Pinion Shaft Nose Up) (6)

Note: If inclination of driveshaft is opposite connecting component, add angles to obtain the U-joint operating angle.

∠ a = (2) - (1) = 7°00' - 4°30' = 2°30' (2.50°)
∠ b = (2) - (3) = 7°00' - 4°00' = 3°00' (3.00°)
∠ c = (5) - (4) = 7°00' - 4°00' = 3°00' (3.00°)
∠ d = (5) - (6) = 7°00' - 4°15' = 2°45' (2.75°)

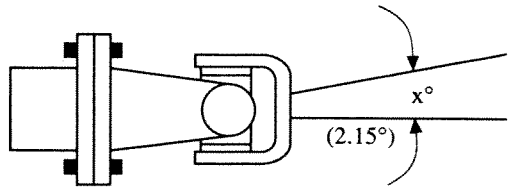
III. Calculating the True U-Joint Operating Angle

The true U-joint operating angle is the sum of the U-joint angles in both the top view and the side view. The true U-joint operating angle is calculated in the following manner:

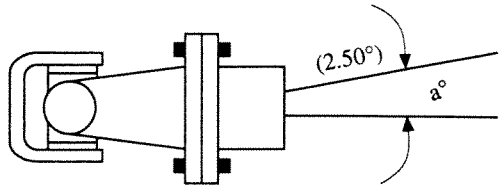
True operating angle = $\sqrt{x^{o2} + a^{o2}}$
Where x = 2.15° as determined by use of chart in Section I.

a = 2.5° as determined in Section II.

True operating angle = $\sqrt{2.15^2 + 2.5^2}$
= 3.297° or 3°18'



ANGLE IN TOP VIEW (FROM CHART)



ANGLE IN SIDE VIEW (MEASURED)

IV. U-Joint Angle Cancellation

After calculating the TRUE OPERATING ANGLE of each U-joint in your driveline:

- Make sure the inboard yoke ears of each driveshaft are in line within each other.
- Compare the TRUE OPERATING ANGLE of each U-joint on each end of each shaft. They must be within one degree of each other or they will be a potential source of vibration.

If adjustments must be made to the system:

- Install shims between the axle housing and springs to rotate the axle input yoke to change operating angles.
- Change operating angle on torque arm type suspensions by lengthening or shortening torque arms.
- Raise, lower, or shift side to side a pump, blower or other piece of auxiliary equipment to change operating angles.

IMPORTANT TO REMEMBER: Keep the centerlines of two components that are connected by a driveshaft parallel in both the top and side views, so the operating angles will ALWAYS be equal.

V. Maximum True Operating Angles*

For Two Joint Shafts with Equal or Intersecting Angles

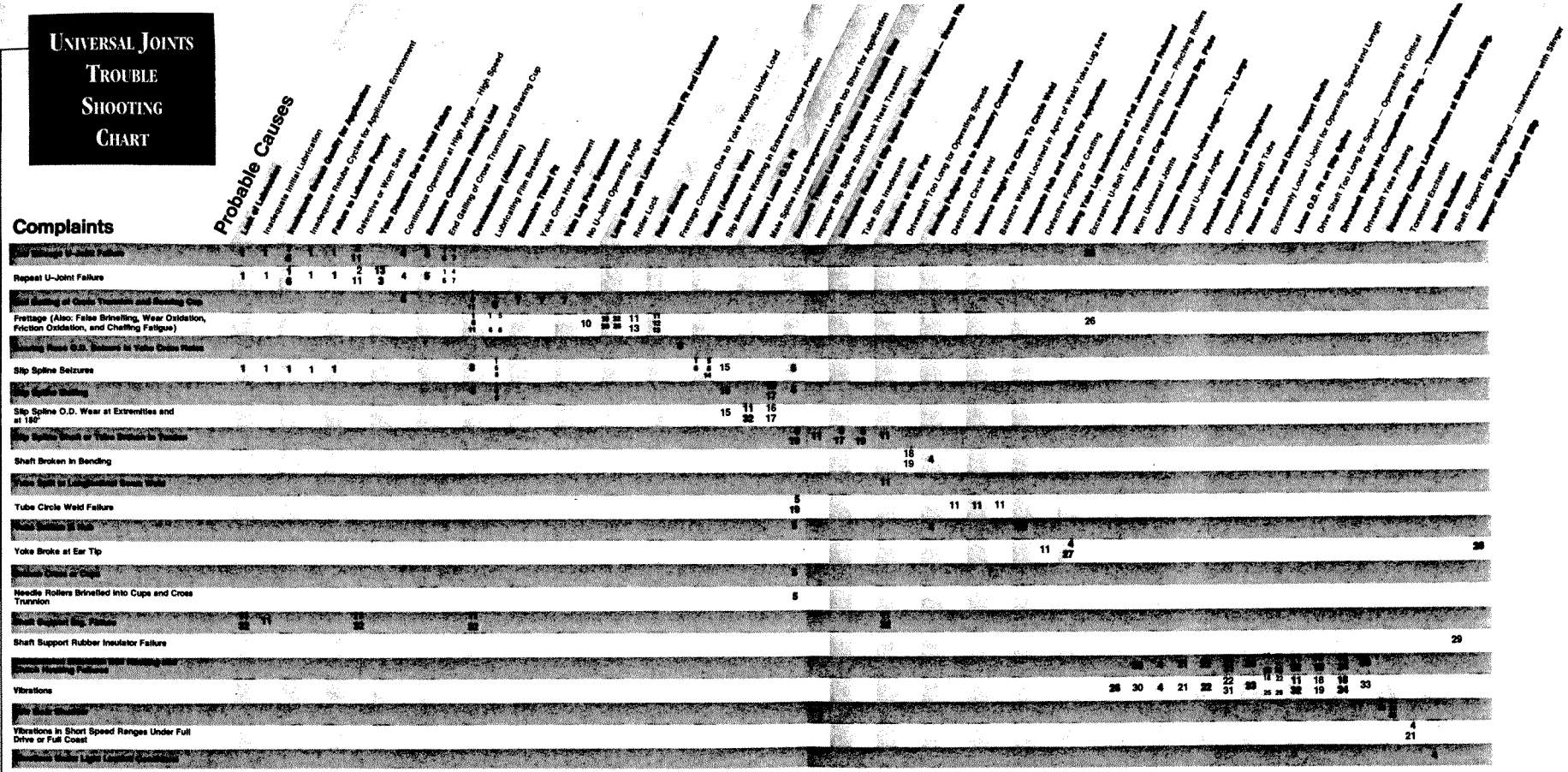
When you settle on a true operating angle that is correct, make sure it doesn't exceed the angles shown in this chart for the driveshaft RPM.

R.P.M. is the main factor in determining maximum allowable operating angles. As a guide to maximum normal operating angles, refer to the chart below.

Driveshaft RPM	Max. Normal Operating Angles	Driveshaft RPM	Max. Normal Operating Angles
5000	3.2°	3000	5.8°
4500	3.7°	2500	7.0°
4000	4.2°	2000	8.7°
3500	5.0°	1500	11.5°

*Based on application experience (1000 rad/sec acceleration).

Universal Joints Trouble Shooting Chart

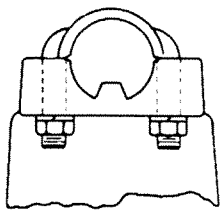


PROBABLE CORRECTIONS

1. See Spicer Universal Joint Lube specs #3306.
2. If new kit...Replace seals. If used...Replace complete kit.
3. Replace yoke if distorted.
4. Reduce U-Joint's continuous running angles.
5. Replace with higher capacity U-joint and driveshaft.
6. Use Hi-Temp grease.
7. Check U-joint flex effort. If sticks, binds or grabs...Replace U-Joint kit. If still sticks, binds or grabs...Check yokes for span, lug squareness, cross hole alignment, etc. Replace as needed.
8. Check components. If serviceable...Clean and relubricate per lube specs. If not serviceable...Replace.
9. No immediate fix. Anti-seize lubricant on bearing O.D. will initially help.
10. Re-align for a minimum 1° running angle.
11. Replace.
12. Replace roller lock assembly.
13. Yoke deflections under load...Use larger joint.
14. Use Spicer "Glidecote" on slip spline.
15. Increase driveshaft assembly length. Position slip spline head towards U-joint.
16. Check for male slip member with longer spline.
17. Design is inadequate for application.
18. Install two piece driveshaft with shaft support bearing.
19. Use larger diameter tube.
20. Design limitation due to axle's or transmission shaft's requirement.
21. Shim drivetrain components to equalize U-joint angles.
22. Straighten and balance.
23. Check with transmission or axle manufacturer ...Replace shaft bearing.
24. Revise power plant mounting scheme.
25. Check U-joint flex effort for looseness.
26. Torque bearing retention to spec.
27. Use wide angle yokes.
28. Check installed length. Adjust driveshaft length to provide proper slip conditions.
29. Re-align mounting bracket to frame cross member and eliminate interference.
30. Replace U-joint kits.
31. Replace tube.
32. If normal wear...Replace.
33. Check O.E.M. maintenance manual or alignment arrows on slip yoke and male slip shaft for correct yoke phasing.
34. If 2 piece-3JT driveshafts...Adjust shaft lengths to 50-50 or 40-60 split.
35. Re-position shaft support bearing.

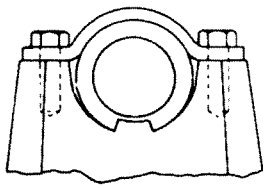
SPICER UNIVERSAL JOINT KIT ATTACHING HARDWARE & TORQUE SPECIFICATIONS CHART

U-BOLT



Series	Spicer Kit No.	U-Bolt Ass'ys.	Recommended Nut Torque
1280	5-200X	2-94-28X	14-17 Lb. Ft.
1310	5-153X	2-94-28X	14-17 Lb. Ft.
1330	5-213X	2-94-28X	14-17 Lb. Ft.
1350	5-178X	3-94-18X	20-24 Lb. Ft.
1410	5-160X	3-94-18X	20-24 Lb. Ft.
1480	5-188X	3-94-28X	32-37 Lb. Ft.
1550	5-155X	3-94-28X	32-37 Lb. Ft.

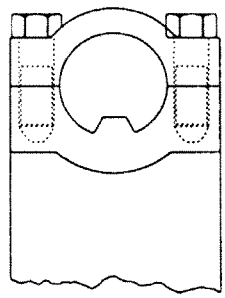
BEARING STRAP



WARNING: Bearing Strap Retaining Bolts Should **NOT** Be Reused.

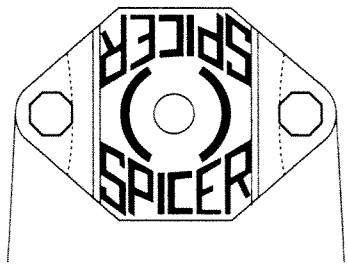
Series	Spicer Kit No.	Strap Kit Ass'ys.	Recommended Bolt Torque
SPL90	SPL90X	90-70-28X	45-60 Lb. Ft.
1210	5-443X	2-70-18X	13-18 Lb. Ft.
1280	5-200X	2-70-18X	13-18 Lb. Ft.
1310	5-153X	2-70-18X	13-18 Lb. Ft.
1330	5-213X	2-70-18X	13-18 Lb. Ft.
1350	5-178X	3-70-28X	30-35 Lb. Ft.
1410	5-160X	3-70-28X	30-35 Lb. Ft.
1480	5-188X	3-70-38X	55-60 Lb. Ft.
1550	5-155X	3-70-38X	55-60 Lb. Ft.
1610	5-438X	5-70-28X	55-60 Lb. Ft.
1710	5-515X	6.5-70-18X	130-135 Lb. Ft.
1760	5-469X	6.5-70-18X	130-135 Lb. Ft.
1810	5-510X	6.5-70-18X	130-135 Lb. Ft.

CAP & BOLT



Series	Spicer Kit No.	Cap & Bolt Ass'ys.	Recommended Bolt Torque
1650	5-165X	5-70-18X	77-103 Lb. Ft.
1850	5-185X	8-70-18X	110-147 Lb. Ft.
1850	5-227X	8-70-18X	110-147 Lb. Ft.
1910	5-316X	N.S.S.	110-147 Lb. Ft.
1950	5-339X	9-70-18X	271-362 Lb. Ft.
2010	5-371X	N.S.S.	102-118 Lb. Ft.
2050	5-340X	9-70-28X	744-844 Lb. Ft.
2110	5-372X	N.S.S.	171-197 Lb. Ft.
2150	5-298X	9-70-38X	744-844 Lb. Ft.
2210	5-373X	N.S.S.	260-298 Lb. Ft.

BEARING PLATE



WARNING: Self Locking Bolts Should **NOT** Be Reused

Series	Spicer Kit No.	Bolt Part No.	Lockstrap Part No.	Recommended Bolt Torque
1610	*5-279X	5-73-709	N.A.	26-35 Lb. Ft.
1710	*5-280X	6-73-209	N.A.	38-48 Lb. Ft.
1760	*5-407X	6-73-209	N.A.	38-48 Lb. Ft.
1810	*5-281X	6-73-209	N.A.	38-48 Lb. Ft.
1880	*5-308X	7-73-315	N.A.	60-70 Lb. Ft.
New part nos. for kits with lockstraps available after Spring, 1994				
1610	5-654X	5-73-109	98-1741	17-24 Lb. Ft.
1710	5-656X	6-73-109	230323	32-42 Lb. Ft.
1760	5-658X	6-73-109	230323	32-42 Lb. Ft.
1810	5-660X	6-73-109	230323	32-42 Lb. Ft.
1880	5-668X	7-73-115	231009	50-66 Lb. Ft.

* THESE U-JOINT KITS WILL USE SELF-LOCKING BOLTS WITH LOCK PATCH™ AFTER SPRING, 1994. A LOCKSTRAP WILL NO LONGER BE NEEDED.

SPICER FLANGE BOLT INFORMATION

Series	Part Numbers			Diameter, Thread, & Length Under Head	Recommended Torque
	Bolt	Washer	Nut		
1000/1100	5-73-414	500357-10	231421-2	.312" - 24 x 0.875"	22-26 Lb. Ft.
1350/1410/1550	5-73-2216	"	"	- 24 x 1.000"	"
1550 *	5-73-1125	"	"	- 24 x 1.562"	"
1280/1310	6-73-316	500357-11	231421-3	.375" - 24 x 1.000"	40-48 Lb. Ft.
SPL90/1610	6-73-1219	"	"	- 24 x 1.188"	"
1710	6-73-220	"	"	- 24 x 1.250"	"
SPL90/1610 *	6-73-325	"	"	- 24 x 1.562"	"
1710 *	6-73-1227	"	"	- 24 x 1.688"	"
1350/1410	7-73-219	500357-12	231421-4	.438" - 20 x 1.188"	63-75 Lb. Ft.
1810	7-73-122	"	"	- 20 x 1.375"	"
1350/1410 *	7-73-126	"	"	- 20 x 1.625"	"
1760/1810 *	7-73-228	"	"	- 20 x 1.750"	"
1480/1550	8-73-122	500357-13	231421-5	.500" - 20 x 1.375"	97-116 Lb. Ft.
1650	8-73-123	(Bearing Race Cap)		- 20 x 1.438"	"
1480/1550 *	8-73-228	500357-13	231421-5	- 20 x 1.750"	"
1880/1910	10-73-131	500358-15	231421-7	.625" - 18 x 1.938"	194-232 Lb. Ft.
1950	12-73-140	500358-17	231421-8	.750" - 16 x 2.500"	341-409 Lb. Ft.
2010	9.55-73-11	——	231483	18mm x 75mm	277-319 Lb. Ft.
2050	14-73-264	500358-19	231421-9	.875" - 9 x 3.500"	543-652 Lb. Ft.
2110	9.60-73-11	——	231482	20mm x 80mm	397-457 Lb. Ft.
2150	16-73-164	500358-21	231421-10	1.000" - 12 x 4.000"	810-976 Lb. Ft.
2210	9.65-73-11	——	231481	22mm x 90mm	534-575 Lb. Ft.

* - Tru Stop Brake Applications

Spicer Flange Bolts are **Special, Heat Treated, Grade 8 Bolts.**
Do not substitute inferior grade bolts.

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3119-5 DSD 4/94