



THE DRIVELINE EXPERTS

General Information

SUB SECTION

Universal Joints

Driveline Components

Driveline Fabrication

Aluminum Components

PTO Components

Trouble Shooting Guide

Glossary

SECTION **14**



**Manufacturing Driveline Solutions®
in the USA Since 1921.**

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GENERAL INFORMATION

Neapco Driveline Component
Part Numbering System

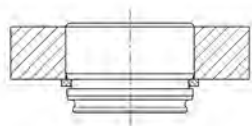
EXAMPLE: N6-3-2651KX

<u>Neapco Series ID</u>		<u>Description</u>		<u>Part Number</u>		<u>Additional Items</u>
Ex: N6	—	3	—	2651	—	KX
1710 Series	—	Slip Yoke	—	Part No.	—	Dust Cap

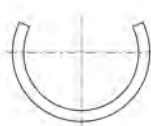
SERIES ID NO	SERIES
N10	1000
N2	1310
	1330
	1350
N3	1410
	1480
N3R	3R or S44
N4	1550
N5	1610
N6	1710
N6.3	1760
N6.5	1810
N729	7290
N170	SPL170*
N250	SPL250*
N350	SPL350*

* SPL - Spicer ® Life Series driveshafts is a registered trademark of Dana Limited.

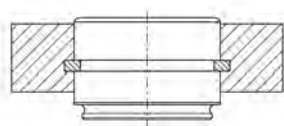
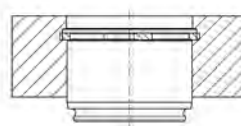
Typical Methods Of Universal Joint Lock-up



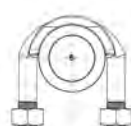
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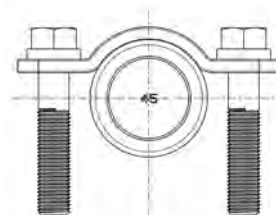
OUTSIDE



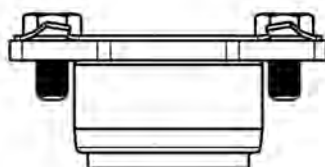
PLASTIC INJECTION



U - BOLT



BEARING STRAP



RETAINER PLATE

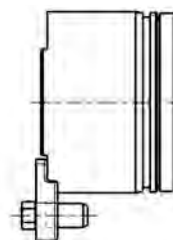
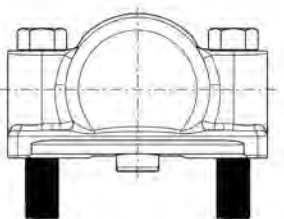
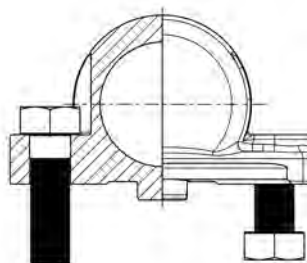


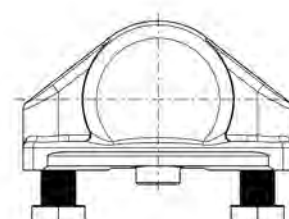
PLATE LOCK



DRILLED BLOCK
BEARING



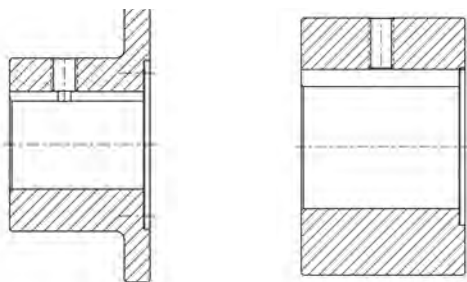
WING BEARING:
1 DRILLED, 1
THREADED



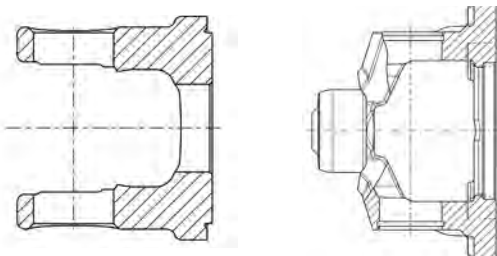
THREADED DELTA
WING BEARING

GENERAL INFORMATION

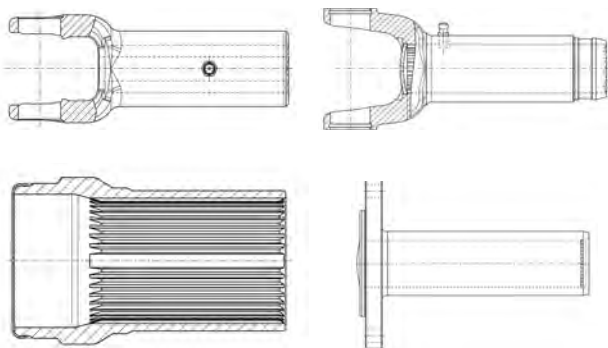
Neapco Driveline Components
SECTION NUMBER (ID NUMBER) AND DESCRIPTION



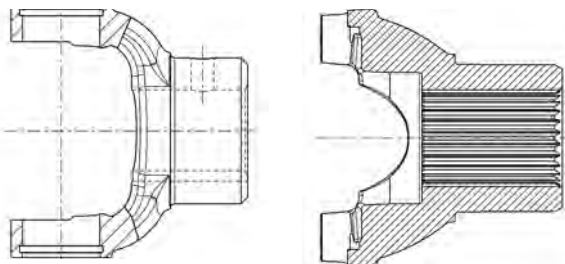
Section 1
(1) Companion Flange



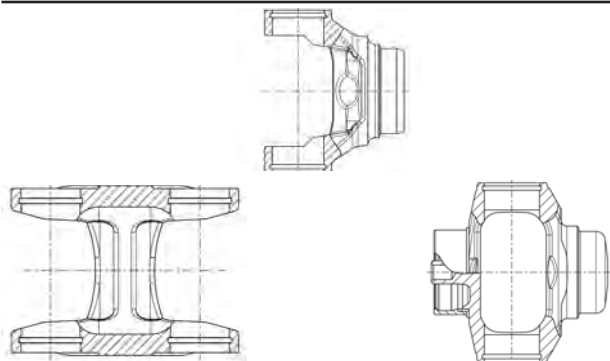
Section 2
(2) Flange Yoke (83) Flange Socket Yoke



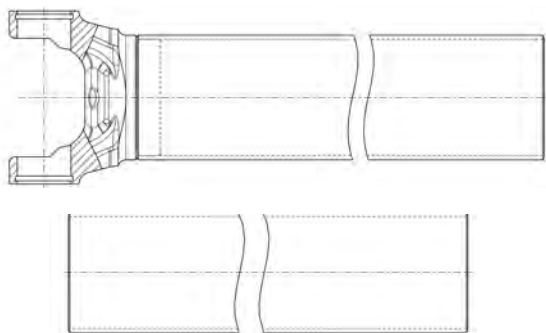
Section 3
(3) Slip Yoke (23) Flange Sleeve (55) Sleeve



Section 4
(4) End Yoke

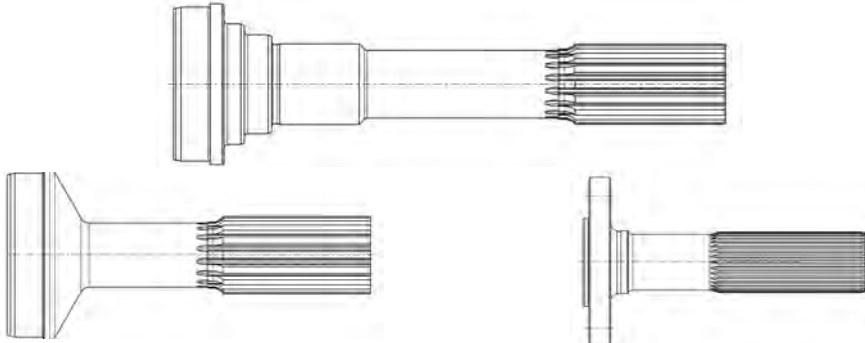
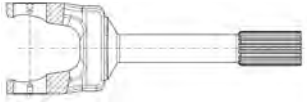
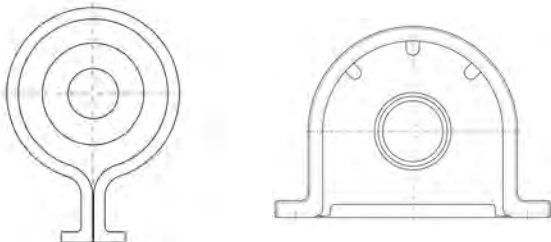


Section 5
(26) H-Yoke (26) or (28) Tube Yoke (28) Ball Stud Yoke



Section 6
(27) Yoke and Tube Assembly (30) Tubing

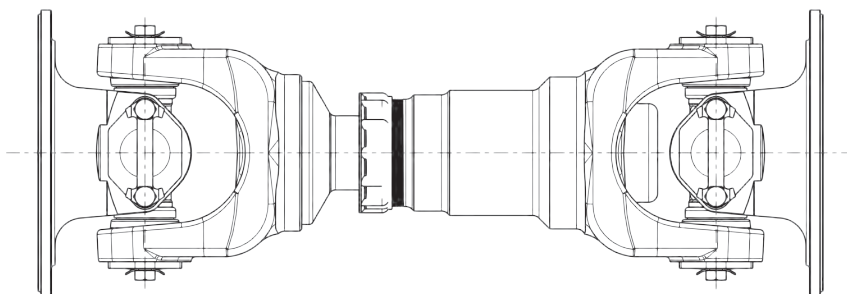
Neapco Driveline Components SECTION NUMBER (ID NUMBER) AND DESCRIPTION

 Section 7 (40 & 42) Stub Shaft (53 & 54) Midship Stub Shaft (81) Flange Stub	 Section 8 (82) Yoke Shaft
· Double Cardan C.V. Repair Kit · Double Cardan C.V. Head Assembly · Double Cardan C.V. Head Components · PTO / AUX Shaft · Driveshaft · Driveshaft Components · Double Cardan Centering Repair Kits · PTO / AUX Shaft Shielding System Section 9 Driveshaft Assemblies	· Driveline Weights · Increasing Bushings · Pilot Reducer · Dust Seal · Welch Plug · Miscellaneous Fasteners · Miscellaneous Hardware · Driveshaft Boots · Centering Tools Section 10 Small Parts
 Section 11 Center Support Bearings (N2xxxxx)	

GENERAL INFORMATION

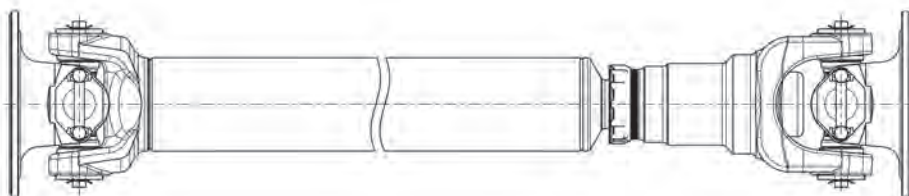
Typical Driveline Assemblies

SHORT COUPLED ASSEMBLY



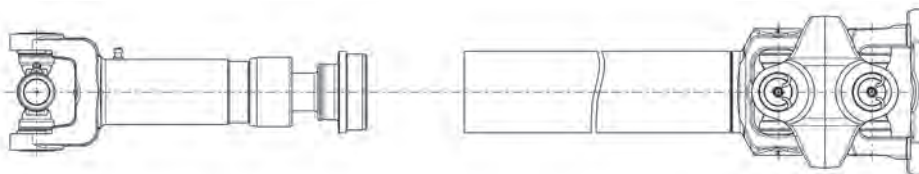
Short coupled assemblies are generally used in applications where space is limited and would not allow tubing to be utilized. A typical application , -would be between the axles of a tandem vehicle.

TWO JOINT ASSEMBLY



Two joint assemblies are used in applications that require the shaft assembly to lengthen and shorten due to movement by either or both of the connecting ends. A short wheel base vehicle is a typical application.

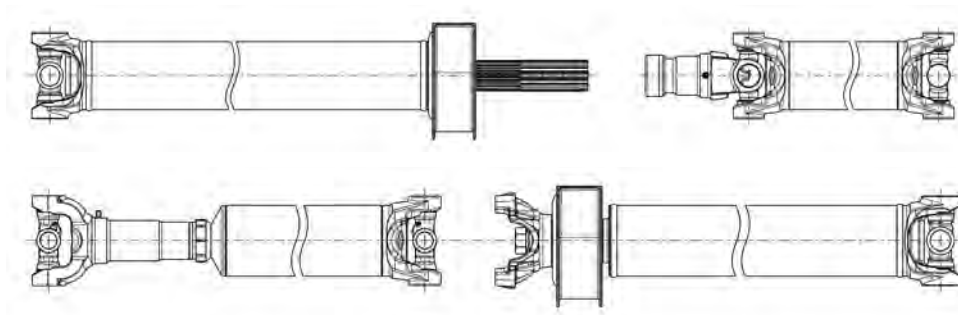
DOUBLE CARDAN CV ASSEMBLY



Double Cardan CV shaft assemblies are used in applications that require operating angles beyond the capability of standard single u-joints. The most common application is the front shaft of a 4 x 4 vehicle.

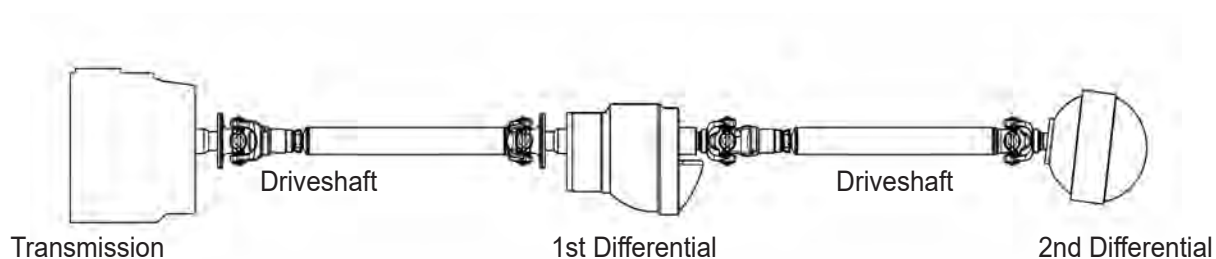
Typical Driveline Assemblies

CENTER BEARING STYLE



Shaft assemblies that use center bearings are typically used to span lengths beyond the capability of a single shaft. A minimum of one shaft assembly will have the ability to provide slip movement. An example is the main driveshaft of most medium duty straight chassis.

TYPICAL DRIVELINE ARRANGEMENT



GENERAL INFORMATION

Basic Driveline Design Procedures & Precautions

In order to get the optimum service life out of any driveline and its components, it is important to start out with a driveline which is right for the application, and an application which allows the use of drivelines in their acceptable working ranges. There are five key elements that must be considered when building a driveline.

- 1 -OPERATING SPEEDS -TABLES I & II**
- 2 -OPERATING LOADS OR TORQUES -TABLE II**
- 3 -OPERATING U-JOINT ANGLES -TABLE III**
- 4 -LENGTH OF DRIVELINE -TABLE 1**
- 5 -DRIVELINE BALANCE**

Each of these elements, separately or in conjunction with each other, can lead to driveline problems and/or failure when not matched with the driveline capabilities.

The maximum operating speed must be held somewhat below the critical speed of the driveline, — 85% for passenger cars and light duty trucks and 75% for medium and heavy-duty trucks. The critical speed is a function of the tubing O.D., the tubing wall thickness, and the centerline to centerline length of the driveshaft. Operating at or near the critical speed of a driveline will cause substantial vibration and possible failure.

The maximum load that a driveline can carry is a function of joint rating, tubing O.D. and wall thickness, and component strength.

It is generally accepted that the major limiting factor in determining allowable U-joint operating angles is speed. Good design practice is to keep operating angles within the 0.5° to 3° range. Higher angles are permissible, depending on shaft speed. Another good design practice is to keep the difference in angles between two U-joints in the same driveshaft to within 1°.

Universal joint operating angles can be determined by measuring the angles of the various components and finding the resultant. A bubble or digital protractor is needed to measure the component angles. Measurements should be taken on machined surfaces, and partial disassembly of the driveline may be required to expose those surfaces. Common surfaces which are used to take angle measurements are: the outside face of yoke ears, flange faces and the outside diameter of the tubing.

Before Starting

When measuring drivelines to determine U-joint angles, it is good practice to start out with a sketch showing the basic driveline and where measurements are to be taken. Before measuring any angles, the vehicle must be parked on level ground with all tires inflated to their normal operating air pressures. Block the front tires to prohibit movement and place the transmission in neutral (Make sure that the parking brake is released). It may be necessary to jack up a rear wheel so that the driveline can be rotated to get the transmission output yoke ear parallel to the ground.

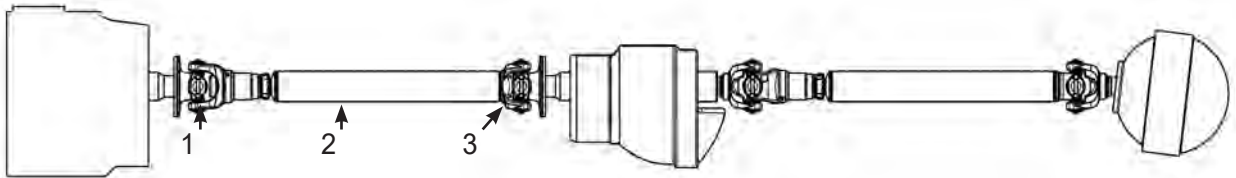
*Measure all angles on flat surfaces, which are clean and free from rust, scale or nicks.

The following is a typical procedure for determining U-joint operating angles:

1. Measure transmission output shaft angle and determine its direction (up or down), record.
2. Measure angle of driveshaft and determine its direction, record.
3. Measure angle of axle input yoke and determine its direction, record.
4. The difference between the transmission output shaft angle and the driveshaft angle is the transmission output U-joint operating angle.
5. The difference between the driveshaft angle and the axle input angle is the axle input U-joint operating angle.
6. Check difference of U-joint operating angle to make sure they are within 1° of each other.

Follow same pattern to determine U-joint angles in other driveshafts.

Below is a typical driveline arrangement and a sample U-joint angle calculation:



1. Transmission output angle = 3° (down)
2. Driveshaft angle = 4.5° (down)
3. Axle input shaft angle = 2.8° (down)
4. Difference between 3° (down) and 4.5° (down) = 1.5° This is the transmission output U-joint operating angle. (#1-#2)
5. Difference between 4.5° (down) and 2.8° (down) = 1.7° This is the axle input U-joint operating angle. (#2 -#3)
6. Difference between 1.5° and 1.7° = $.2^\circ$ This is less than the recommended 1° maximum. (#4-#5)

GENERAL INFORMATION

**Table I - Driveline Centerline To Centerline
MAXIMUM LENGTH AT MAXIMUM RATED RPM BY SERIES**

Series	Tube Size	Part No.	Max. RPM	Max. Length ¹
1000	2" x .083	N16-30-62	2500	54
1310	2"x .065	N16-30-32	6000	35
	2"x .083	N16-30-62	6000	35
	2"x 120	N16-30-102	6000	34
	2.5"x .065	N20-30-12	6000	39
	2.5"x .083	N20-30-22	6000	39
	2.16"x .065	N22-30-12	6000	41
	3"x .065	N24-30-82	6000	43
	3"x .083	N24-30-42	6000	43
	3.5"x .065	N28-30-42	6000	46
	3.5"x .083	N28-30-62	6000	46
1330	2.5"x .083	N20-30-22	5000	43
	3"x .065	N24-30-32	5000	47
	3"x .083	N24-30-42	5000	47
	3.5"x .083	N28-30-62	5000	51
1350	2.5"x .083	N20-30-22	5000	43
	2.75"x .083	N22-30-22	5000	45
	3"x .083	N24-30-42	5000	47
	3.5"x .083	N28-30-62	5000	51
	2.5"x .120	N20-30-62	5000	39
1410	3"x .083	N24-30-42	5000	47
	3.5"x .065	N28-30-42	5000	51
	3.5"x .083	N28-30-62	5000	51
1480	3.5"x .083	N28-30-62	5000	51
	3.5"x .095	N28-30-22	5000	50
	4"x .083	N32-30-22	5000	54
1550	3.5"x .095	N28-30-22	5000	50
	4"x .083	N32-30-22	5000	54
1610	3.5"x .134	N28-30-92	4500	53
1710	3.5"x .156	N28-30-52	4500	53
	4"x .134	N32-30-52	4500	57
	4.095"x .180	N32-30-72	4500	57
1760	4"x .134	N32-30-52	4500	57
	4.095"x .180	N32-30-72	4500	57
1810	4.5"x .134	N36-30-62	4500	60
SPL170*	4.73"x .197	N110-30-5	4000	60
	4.96"x .118	N120-30-3	4000	60
SPL250*	5.06"x .167	N120-30-4	4000	60
	5.12"x .197	N120-30-5	4000	60
	5.20"x .236	N120-30-6	4000	60

* SPL - Spicer ® Life Series driveshafts is a registered trademark of Dana Limited.

¹ Maximum centerline to centerline using a .75 safe speed factor generally accepted for medium and heavy duty trucks.

Table II- Universal Joint Torque Ratings

MAXIMUM OPERATING TORQUE CAPABILITY

SERIES	PART NUMBER	ELECTRIC MOTOR (LBS-FT)	FUEL APPLICATION (LBS-FT)	MAXIMUM RPM
1000	1-0170	75	50	2500
1210	1-0315	95	65	6000
1280	1-0350	140	95	6000
1310	1-0153	195	130	6000
1330	2-4800	220	150	5000
1350	2-0053	310	210	5000
1410	2-0054	375	250	5000
1480	3-0188	500	335	5000
1550	3-0155	640	420	5000
1610	4-0279	975	640	4500
1710	5-0280	1330	895	4500
1760	6-0407	1630	1095	4500
1810	6-0281	1850	1245	4500
3C	3-3152	295	200	5000
4C	3-4138	375	250	5000
5C	4-5122	640	425	5000
6C	4-6143	875	575	5000
7C	5-7205	1150	775	4500
8C	6-8205	1750	1175	4500
9C	6-9016	2700	1800	3000
10C	6-1007	3800	2550	2500
7260	1-6301	195	130	5000
7290	2-1175	260	175	5000
3R	2-3011	260	175	5000
SPL170*	6-1170	1650	1125	4000
SPL250*	6-1250	1940	1306	4000

* SPL - Spicer ® Life Series driveshafts is a registered trademark of Dana Limited.

Table III - Operating Angles

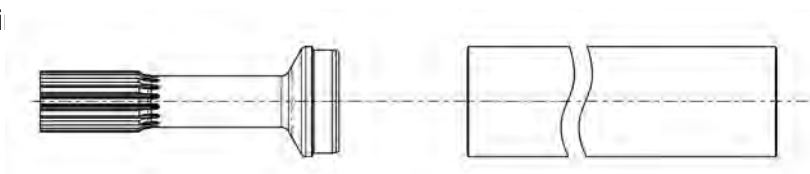
Shaft RPM	Max Operating Angle	Shaft RPM	Max Operating Angle
1000	17°	3000	6°0'
1500	11°30'	3500	5°10'
2000	8°50'	4000	4°20'
2500	7°0'	4500	4°0'
		5000	3°20'

GENERAL INFORMATION

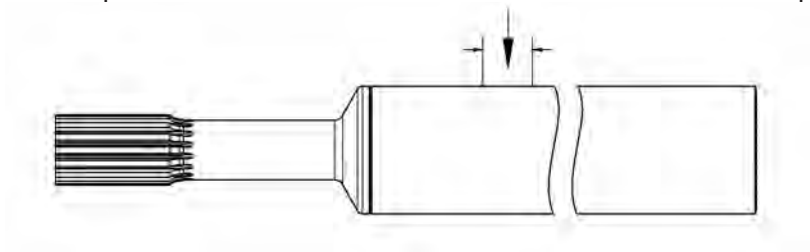
Basic Driveline Fabrication

TYPICAL TWO JOINT ASSEMBLY (1310 Series)

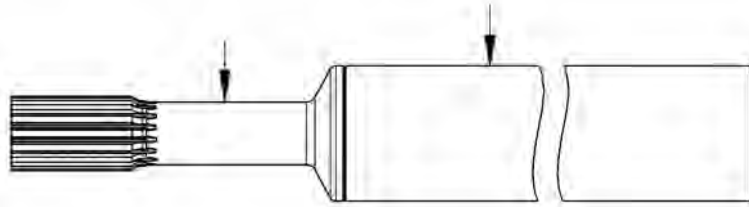
1. Stay within the boundaries of the five key elements in the basic driveline design procedures and precautions section.
2. Select appropriate components for the application. NOTE: We will use a typical hollow spindle lathe for assembly.
3. Cut the tubing to approximately $\frac{3}{8}$ inch longer than the required length in a cutoff saw. Remove all burrs and weld flash from the inside of the tube.
4. Chuck the tubing in the lathe with approximately 2 inches protruding. Face the tubing to square it up, then chamfer I.D. and O.D.
5. Remove the tubing from the lathe and measure from the machined end to the required length. Scribe or mark the required length on the tube at two places (90 degree intervals).
6. Recheck the tubing with the marked end protruding from the chuck jaws approximately 2 inches. Rotate the tubing and mark the full diameter of the tube at the required length with a marker or grease pencil.
7. Face the tube



8. Remove the tubing from the lathe then tamp or press the slip stub into either end of the tubing. (NOTE: if tamping method is preferred, a lead plate should be the surface tamped against.)
9. Place back into lathe with approximately $3 \frac{3}{4}$ inches of tubing protruding from the jaws and slip stub pointing toward the bed of the lathe.
10. Move tail stock into position with center located into the center hole in the slip stub.



11. Clean the tubing approximately 3 inches from the slip stub around the full diameter of the tube. A $\frac{3}{4}$ to 1 inch wide band will be sufficient. Emery cloth can be used.



12. Check the runout on the ground diameter of the slip stub and 3 inches in on the tubing (cleaned area) with a dial indicator.

Maximum runout 3 inches on tubing = .020

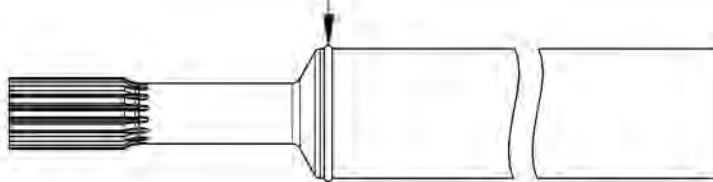
TIR Maximum runout slip stub = .005 TIR

Correct, if necessary, to stay within the runout tolerance.

13. Tack weld in place at 90 degree intervals.

NOTE: Insure that the bed of the lathe is protected from welded spatter whenever welding with component in the lathe.

14. Recheck runout and correct, if necessary. (Refer to step 12)



15. Weld single pass starting at the high point determined by the dial indicator.

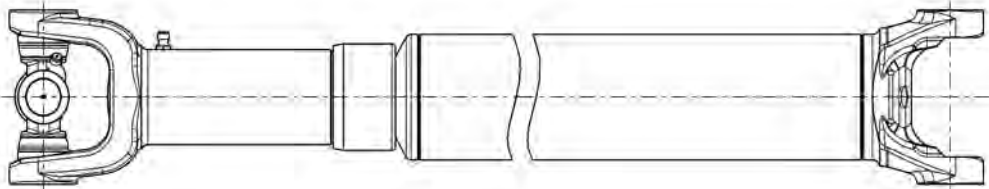
16. Allow driveshaft to cool then recheck runout.

NOTE: Do not use any oil, water or an air jet to cool the driveshaft.

17. Remove shaft from lathe and partially tap new tube yoke into tube.

(a) The components must be properly phased at this time. (NOTE: Alignment arrows unique to Neapco slip yokes will ease the phasing procedure.)

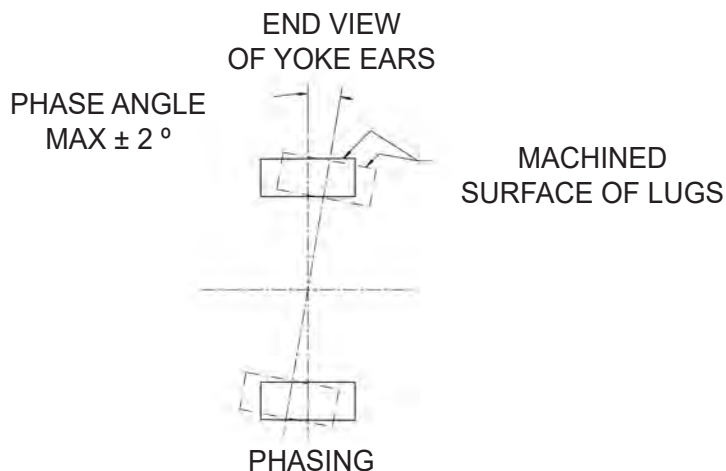
(b) Some driveshafts are manufactured with special phasing. In this case, the equipment manufacturer's service manual or specifications must be consulted to obtain phasing angles and tolerances.



18. Clamp shaft in a pipe vise with slip yoke temporarily assembled on the slip stub with the ear lugs of the slip yoke and tube yoke pointing upwards. Pipe vise should be on the tube yoke end of the shaft.

19. Support the opposite end of the shaft with an open steady rest near the slip stub on the tubing.

GENERAL INFORMATION

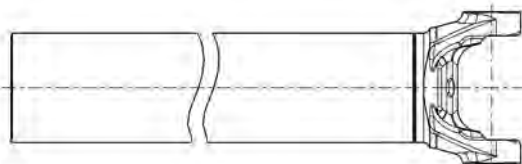


20. Place a straight edge on the machined surface of the lug on the slip yoke and align by eye with a second straight edge on the lug of the tube yoke. Correct if necessary.

21. Use a protractor level for final phasing. The cross holes of the 1310 Series drive line must be in line within plus or minus 2° maximum.

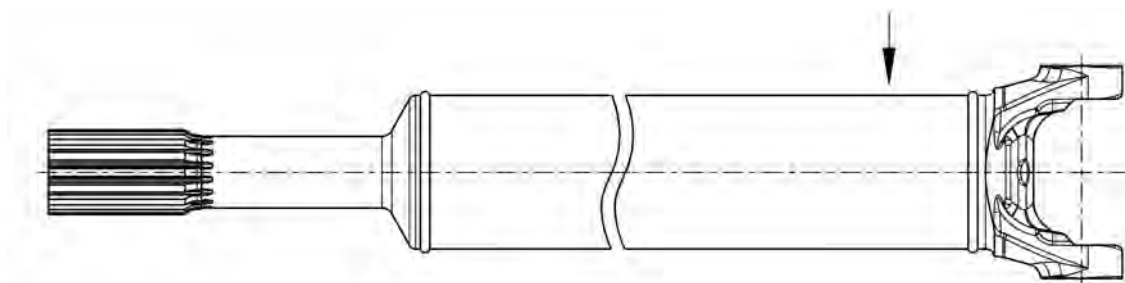
22. With tube yoke tapped into proper phasing, remove slip yoke and shaft from vise. Press or tamp tube yoke into position.

NOTE: Use a lead pad if tamping method is used.

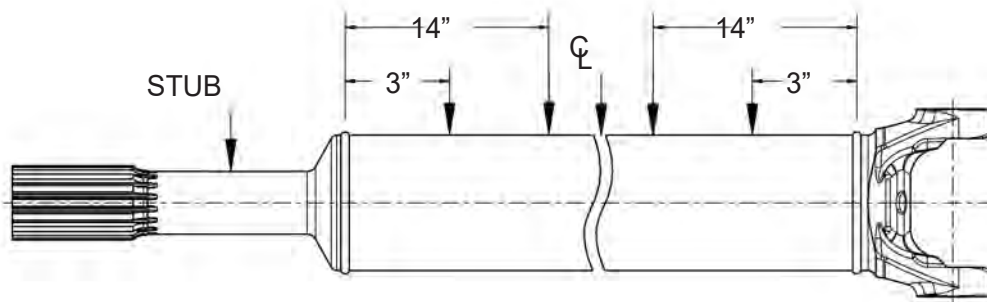


23. Place the shaft back into the lathe with the proper fixturing (adapters), tube yoke towards the tail stock.

24. Clean the tubing approximately three inches from the tube yoke around the full diameter of the tube. A 3/4 to 1 inch wide band will be sufficient. Emery cloth can be used.



25. Check the runout three inches in on the tubing from the tube yoke end with a dial indicator. Maximum runout three inches on tubing = .020 TIR
26. Tack weld tube yoke in place at 90 degree intervals.
NOTE: Insure the bed of the lathe is protected from weld spatter.
27. Recheck runout and correct, if necessary. (Refer to step 25)
28. Weld single pass starting at the high point determined by the dial indicator.
29. Allow driveshaft to cool then recheck runout.
NOTE: Do not use any external cooling methods, i.e. water, oil or air jets.

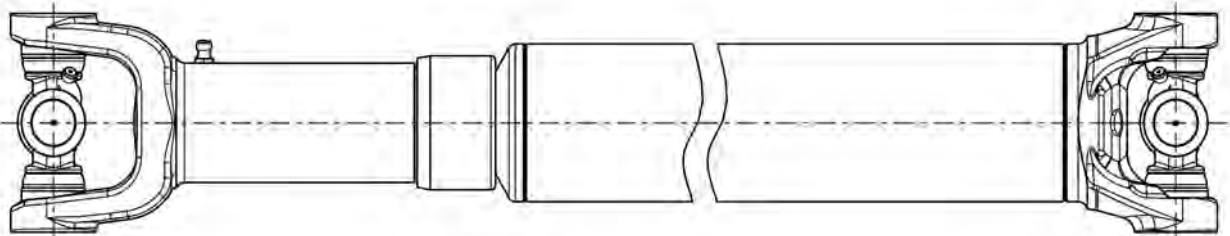


30. Adapt assembly to centers in the lathe and clean 3/4 to one inch wide bands using emery cloth at 14 inches from each weld on the tube and in the center of the tube. Check the runout at the following areas with a dial indicator:

- MAXIMUM RUNOUT THREE INCHES FROM EACH WELD = .020 TIR
- MAXIMUM RUNOUT 14 INCHES FROM EACH WELD = .010 TIR
- MAXIMUM RUNOUT ON GROUND DIAMETER OF SLIP STUB = .005 TIR
- MAXIMUM RUNOUT AT CENTER OF TUBE (OVER 30") = .010 TIR
- MAXIMUM RUNOUT AT CENTER OF TUBE (UNDER 30") = .020 TIR

NOTE: Do not include tubing ovality.

Refer to driveshaft straightness tolerances section for other series



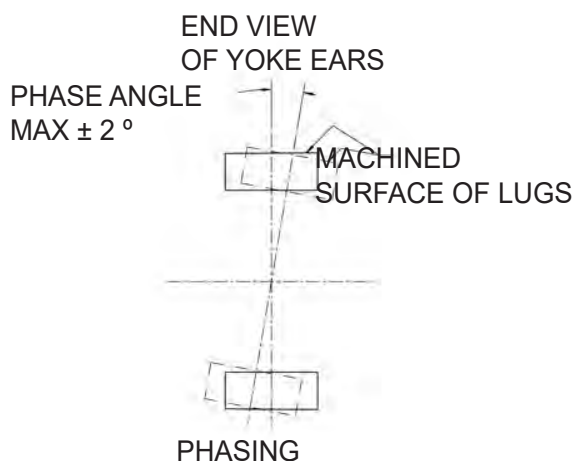
GENERAL INFORMATION

31. Assemble U-Joints and slip yoke into the newly fabricated driveshaft making sure that alignment arrows match up. Balance to specification. Balancing will vary depending on the type of balancer being used. Refer to the manufacturer's procedure for the type of equipment being utilized.
32. Paint the completed driveline and place a decal or sticker on it with your shop logo.

This procedure describes a typical 1310 two-joint assembly fabrication. Methods may vary due to type of equipment utilized. The method may also be followed when repairing a driveline: Simply follow the appropriate steps pertaining to the components in need of replacement. —To fabricate other than 1310 Series refer to the appropriate series data where noted in each procedure.

ALWAYS REPLACE DAMAGED COMPONENTS
ADHERE TO ALL SHOP SAFETY PROCEDURES
ALWAYS STAY WITHIN SPECIFIED TOLERANCES
ALWAYS BALANCE YOUR DRIVELINE

Phasing Specifications



The cross holes of all two joint driveshafts must be in line within $\pm 2^\circ$ Maximum.

Driveshaft Straightness Tolerances

1000 THRU 1480 — ALSO 7260, 7290, 3R, AND 3C

After welding, runout (not to include tubing ovality) should never exceed the TIR (total indicator reading) as detailed below.

FOR TUBE LENGTH OVER 30"

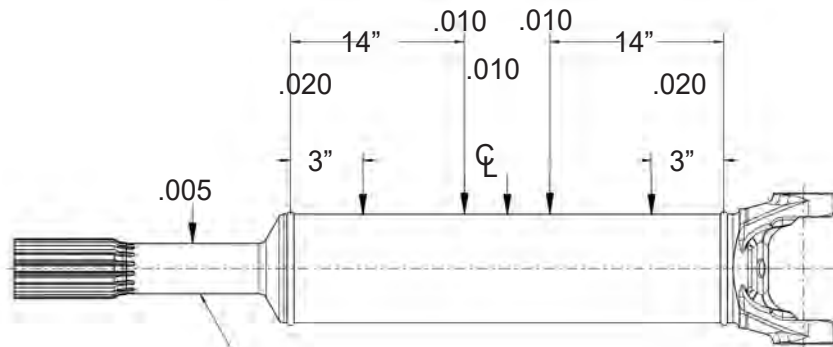
MAXIMUM RUNOUT 3 INCHES FROM EACH WELD = .020 TIR

MAXIMUM RUNOUT 14 INCHES FROM EACH WELD = .010 TIR

MAXIMUM RUNOUT ON GROUND DIAMETER OF SLIP STUB = .005 TIR

MAXIMUM RUNOUT ON BEARING DIAMETER IF CENTER BEARING STUB IS USED = .003 TIR

MAXIMUM RUNOUT AT CENTER OF TUBE = .010 TIR



NOTE: If center bearing stub is used hold .003 on bearing diameter

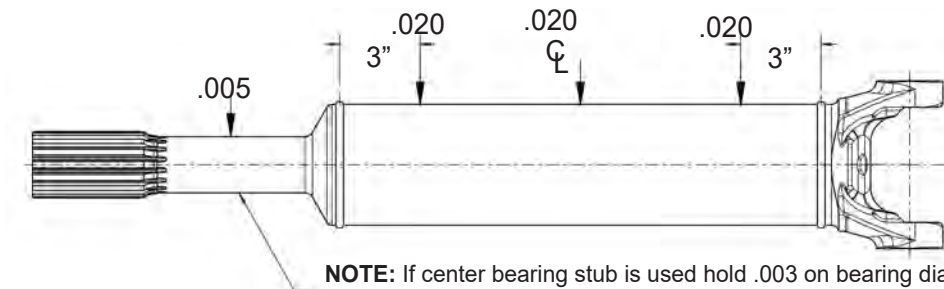
FOR TUBE LENGTH UNDER 30"

MAXIMUM RUNOUT 3 INCHES FROM EACH WELD = .020 TIR

MAXIMUM RUNOUT AT CENTER OF TUBE = .020 TIR

MAXIMUM RUNOUT ON GROUND DIAMETER OF SLIP STUB = .005 TIR

MAXIMUM RUNOUT ON BEARING DIAMETER IF CENTER BEARING STUB IS USED = .003 TIR



NOTE: If center bearing stub is used hold .003 on bearing diameter

GENERAL INFORMATION

Driveshaft Straightness Tolerances

1550 THRU 1810 — ALSO 4C THRU 10C

After welding, runout (not to include tubing ovality) should never exceed the total indicator reading as detailed below.

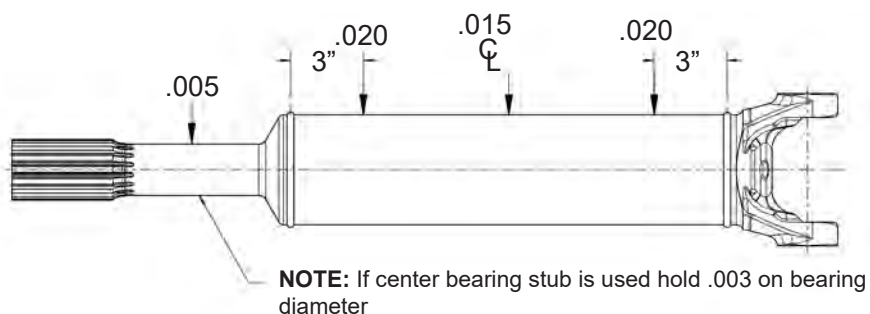
FOR ALL TUBE LENGTHS

MAXIMUM RUNOUT 3 INCHES FROM EACH WELD = .010 TIR

MAXIMUM RUNOUT ON GROUND DIAMETER OF SLIP STUB = .005 TIR

MAXIMUM RUNOUT ON BEARING DIAMETER IF CENTER BEARING STUB IS USED = .003 TIR

MAXIMUM RUNOUT AT CENTER OF TUBE = .015 TIR



Lubrications

WHY LUBRICATE?

Proper lubrication of any moving parts in a driveline is essential to keep the driveline in proper working order and to obtain an acceptable service life.

WHAT SHALL I LUBRICATE?

All universal joints, slip yoke and stub shaft assemblies, as well as centering kits in CV heads should be greased regularly.

HOW?

Universal Joints

Secure grease gun on grease fitting and pump in grease until all four bearings are lubricated. To check for this, make sure that all four seals have purged out air and old grease. Grease until fresh grease appears at the base of all four seals. If a seal does not purge properly, move the driveline to free up the end to end clearance of the bearing cup. On bearing plate style U-joints, it may be necessary to loosen the bolts two or three turns to allow grease to flow. If the joint still does not grease properly, disassemble the kit to determine the source of the problem.

Slip Yoke and Stub Shaft Assemblies

Before putting the slip yoke onto the stub shaft, coat both parts uniformly with a layer of grease. After assembly, but before installation into vehicle, fully collapse the driveline and apply grease to the grease fitting until it comes out of the vent hole in the welch plug. Cover the hole and continue greasing until grease appears at the seal.

At relubrication it may be impossible to fully collapse the driveline. Follow the same general greasing procedure but be careful not to overfill. Overfilling may cause the welch plug to pop out during operation.

Centering Kits

A special needle nose grease gun adapter is needed to grease the flush type fitting on centering kits. Apply grease until fresh grease appears at purge hole or at ball seal.

WHEN SHALL I LUBRICATE?

Frequency of lubrication is determined by the type of service which the driveline is subject to. A list of recommended relube cycles for various service conditions is shown below:

Service Conditions	Re-lube Period	Approximate Miles
City	Every 3 Months	6,500
Highway	Every 3 Months	15,000
Off Highway	Every 1 Months	6,500
Line Haul	Every 3 Months	20,000-30,000
Off Highway 4x4	Every 1 Month	2,500
<i>(Relube on period or miles, which ever comes first)</i>		

WHAT TYPE OF GREASE SHOULD I USE?

A good quality Lithium Complex soap type EP (extreme pressure) grease, with an NLGI grade2, is recommended.

GENERAL INFORMATION

General Procedures For Assembling Aluminum Driveshafts

Tools Required:

Push-Up Press or Enerpac Hydraulic Press
Centering Tools (Available from Neapco)
“Weld Aid” Cleaning Agent

Assembly procedures for aluminum driveshafts are similar to the procedures Driveline Specialists are familiar with. The most significant difference is the set-up of the welding equipment to allow successful welding of aluminum. Neapco recommends that the Driveline Specialist contact the manufacturer of their welding equipment for set-up specifications and training for welding aluminum.

Preparing the Components:

The tubing and tube weld yokes should be clean and free of burrs. Aluminum is fragile compared to steel, so be careful when handling these components during and after assembly.

1. Chamfer the I.D. of the aluminum tubing to remove any burrs or sharp edges.
2. Clean the inside and outside of the aluminum propeller shaft tubing – a minimum of 2” in from each end using “Weld Aid” cleaning agent or similar cleaning product available from your local welding supply source. Repeat this cleaning procedure for the entire surface of both turned diameters on the aluminum tube weld yoke.
3. Wash both ends of the tubing and tube weld yoke in clean water. Wipe the I.D. and O.D. end of the tubing and the entire tube yoke with a clean, dry towel or cloth until completely dry. Note: Successful welding of aluminum is directly related to cleanliness. Towels or cleaning clothes should be used for aluminum work only and changed frequently. Rinsing water should be placed in a clean container and changed when any signs of contamination are evident. Oil, grease or any foreign material will cause a potential blow hole in the weld.
4. Using a push-up machine or Enerpac and fixtures specifically designed for driveshaft fabrication, assemble the aluminum tube weld yokes into the tubing. Correct phasing (alignment of the yoke ears) is critical to the satisfactory performance of the driveshaft. Adjust phasing so that the yoke ears are in line with each other. (This can be checked with a precision level.) Adjust, if necessary, before proceeding to press.
5. A .090” gap (approximately twice the thickness of the weld wire) should be left between the turned shoulder of the tube weld yoke and the end of the tubing. Spacers should be made for both ends and inserted into the gap between the two components to avoid over pressing. Press until shim stock is snug at both ends, but avoid over pressing. After removing shim stock there should be a minimum of .090” gap.
6. The assembled driveshaft is now ready to be set up for welding. The rotation rate should be set for the tube size you are welding.

Approximate Tube Rotation Rate

Tube Dia.	RPM	Seconds Per Rev.
3.0”	3.18	19
3.5”	2.73	22
4.0”	2.39	25
5.0”	1.60	32

General Procedures For Assembling Aluminum Driveshafts

The rotation rate is a guideline. Neapco recommends that you contact the supplier of your welding equipment or your local welding supply service for set up of your specific equipment.

A dial indicator should be used to check the runout at each end of the tubing. Using a dead blow hammer tap over the joint between the tube weld yoke and the tubing until the runout is close to 0.000" as possible, but not to exceed .005". This will help to keep the finish welded assembly within .010" TIR at the welds. The middle of the tube should have no more than .015" runout.

Tube Straightening Hint – An arbor press with a 2 ft. piece of wood mounted on the ram with a "V" cut in it to fit over the O.D. of the tube can be used to over press the tubing in the opposite direction of the measured runout. This extra step will not only ease the balancing operation; it is sound driveshaft fabrication practice.

7. The weld gun tip should be aligned with the center of the gap between the tube weld yoke and the tubing. The wire should be perpendicular to the tube/tube yoke surface and at a 12o-15o angle from the centerline of the tubing. The weld should start and end (with ½" overlap) in line with one of the yoke ears. The driveshaft is now ready to weld. Neapco recommends formal training in aluminum welding from your equipment supplier. There is no substitute for practice and hands-on experience.

After the shaft has cooled, the welds should be visually inspected. Any visible porosity is a sign that some contamination was present. Visible porosity in an aluminum weld is a sign of a potential failure point. Any sign of an inferior weld other than an occasional small pin hole should be cause for replacement of the product.

Balancing the Aluminum Driveshaft

1. Assemble end connections to the driveshaft (slip yoke and pinion yoke, if available). Balance the assembly to .250 oz./in. maximum at each end of the shaft.
2. Position the appropriate balance weight on the barrel / shoulder area of the yoke or yokes. Balance weights may be taped in place, using fiber reinforced duct tape, full length around the yoke barrel / shoulder area.
The driveshaft should be rechecked for proper specifications (within .250 oz./in. total at each end).
3. After verifying correct balance performance, the balance weights should be attached. While aluminum balance weights may be attached by spot welding, or epoxy. If using epoxy, Neapco recommends using a two-part chemical Epoxy bond for attaching balance weights. The exact position of the weights should be marked for reinstallation while removing the duct tape. Using Epoxy Quik-Bond from J-B Weld or similar product, coat each surface with a thin layer of the epoxy. The balance weight should carefully be pressed into position. The weight must not be disturbed after installation. The shaft should be set aside until initial curing occurs. The weight should then be taped in place until the epoxy has ample time to dry before the driveshaft is installed in the vehicle. Note: There are many fast dry epoxies on the market today. Choose the proper product for your needs.

GENERAL INFORMATION

Auxiliary Power Take-Off Technical Information

POWER-TAKE-OFF (PTO) BASICS

An auxiliary power-take-off shaft transmits power from the source to the driven accessory. The shaft must be capable of transmitting the peak torque and maximum R.P.M. required by the accessory, while withstanding any shock loads. The information in this publication is focused on 1000 and 1310 series auxiliary power-take-off products.

An auxiliary power shaft operates through constantly changing angles between the power source and the driven accessory. Chassis twisting and power train deflections due to torque contribute to these changes in operating angles. This deflection also will cause changes in the length of the auxiliary power shaft. Including a slip member (slip yoke and spline stub shaft) in the driveline system accommodates this.

Joint operating angles are very important considerations in the configuration of an auxiliary power-take-off application. The service life of the universal joint is directly affected by the operating angles experienced in the completed system. Guidelines for permissible operating angles are identified in the accompanying chart.

<u>UNIVERSAL JOINT OPERATING ANGLES</u>			
SHAFT RPM	MAXIMUM NORMAL OPERATING ANGLE	SHAFT RPM	MAXIMUM NORMAL OPERATING ANGLE
500	17°	2500	7°
1000	17°	3000	6°
1500	11°	3500	5°
2000	8°		

SPECIFYING SHAFT TYPE

Applications in auxiliary PTO use either solid shafting or tubular driveshaft assemblies.

Neapco tubular auxiliary PTO shaft kits are manufactured using 2" diameter by .083" wall (2" x .083) tubing. These unwelded assemblies are convenient for fabricating different length driveshaft requirements as needed. Neapco recommends using tubular auxiliary PTO shafts whenever possible. Neapco tubular shafts are designed to reduce vibration as a dynamically balanced assembly. Minimizing vibration increases the service life of the driveshaft, universal joints, bearings in the driving and driven units and helps keep end connections secure.

Solid shafting should only be used in auxiliary power-take-off applications designed for 1,000 R.P.M. or less intermittent service.

INSTALLING A PTO DRIVELINE

When installing a remote-mount PTO, one requiring a propeller shaft (driveline), please observe that there is a slight angle of inclination to the engine, and that you must install the driven shaft of the pump parallel to the PTO output shaft. In addition, the yokes of the PTO driveshaft should be in line, in phase, and in the same plane.

Auxiliary Power Take-Off Technical Information

Some light-duty under body hoist applications use a pump and tank combination, and there are many large tank trucks which have pneumatic blowers. Both require a level horizontal installation, making parallel input and output shafts difficult to configure. The correct remedy for this common driveline problem is to use a two-piece driveshaft. In close-coupled applications a center yoke assembly may be necessary to provide correct phasing and angularity.

To properly measure the driveline angle, use a bubble or digital protractor to determine TRUE JOINT ANGLE, which is a composite of vertical and horizontal components. This can also be calculated by measuring and using trigonometry. We recommend that you install with at least a two-degree angle, to insure that oscillations will properly rotate the needle bearings in the u-joints.

If a long driveshaft is necessary then critical speed problems must be taken into consideration. The solution is to use more than one driveshaft, installed with center support bearing assemblies, and design the driveshaft lengths to avoid critical and half-critical speeds. Usually the best solution is to install 60% of the driveline closest to the source of power, or the driving end, with the remaining 40% toward the driven end. Pillow blocks, flange bearings or hanger bearings used in two-piece driveshafts must be mounted solidly to the chassis.

WHERE TO INSTALL THE SLIP JOINTS

The purpose of the slip joint (slip yoke and spline stub shaft) is to allow proper flexing of the universal joints as they rotate through the entire circle of operation. If a slip joint is not installed, or if it is corroded from lack of lubricant, then severe stresses are imposed upon the bearings and seals in the PTO and pump. An additional purpose of the slip joint is to allow flexing of the chassis without putting lateral loads on the bearings and seals. Bearing and seal damage in PTOs and pumps, and overheating is nearly always attributable to driveline problems.

Our recommendation is that if you have enough space, ***the slip joint should be installed on the end closest to the PTO.*** If the PTO is inadvertently left in gear, the slip joint may leave the shaft during overspeeding, or operating above critical speed.

CAUSES OF DRIVELINE FAILURES

To review u-joint and driveline problems, most failures will be a result of one or more of the following:

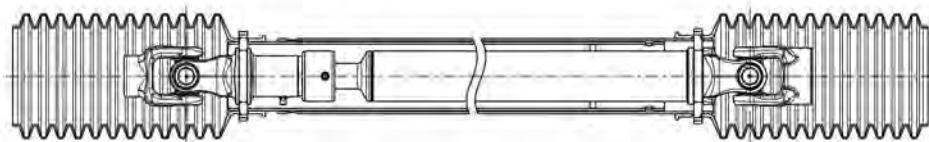
- EXCEEDING TORQUE OR LOAD RATING
- LACK OF LUBRICANT OR DIRTY LUBRICANT
- HIGH DEGREE OF ANGULARITY
- U-JOINTS NOT IN PHASE
- U JOINT ANGLE NOT EQUAL
- DRIVELINE NOT ALLOWED TO SLIP
- DRIVELINE OUT OF BALANCE

If you must use a driveline, it is our recommendation that you use tubular assemblies, and that you purchase from a certified driveline specialist.

GENERAL INFORMATION

Neapco Auxiliary PTO Driveshaft Shielding System

Neapco®, has developed an Auxiliary PTO Driveshaft shield System that is compatible with many 1000 and 1310 Series power-take-off applications. The system consists of four (4) basic components that combine to form a total driveline enclosure system.



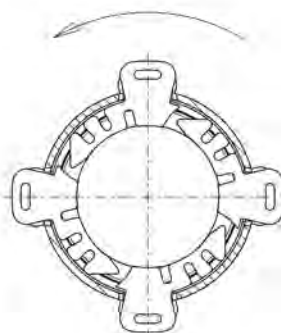
N10270-SF and N10271-SF are equipped with grooves for shield bearings. For all other part numbers choose the appropriate mounting collars.

- 1) A series of Bearing Races (collars) for installation on the driveshaft assembly by tack welding.
- 2) Flex Bell™ Yoke Enclosures with over 8" of coverage featuring fluted construction for easy length adjustment by cutting, providing custom installations.
- 3) Inner (2.75" O.D.) and Outer (3.00" O.D.) Telescoping Plastic Shield Tubes complete with bearing slots (4) and Danger Label. Designed for easy length adjustment by cutting to desired length with bearing slots aligned with bearing races (collars) mounted on the driveshaft. These shields must overlap (telescope) at least 5" or more, if design allows. To accomplish this the shield tube should be cut at least 2 1/2" past the center of the driveshaft with the bearing slots aligned with the bearing race (collars) on the driveshaft.
- 4) Inner (4) and Outer (4) Shield Bearing Sets. These bearing sets lock the Flex Bell™ Yoke Enclosure to the mating shield tube through the aligned slots and ride in the bearing races on the driveshaft collars.

Assembly is easily accomplished after a short orientation to the system. Disassembly (for service work or lubrication) takes only a few minutes with a blade screwdriver.

Shield Bearings must be installed properly in regards to the rotation of the driveline. This prevents the Shield Bearings from loosening or popping out of the Bearing slots.

DIRECTION OF ROTATION



Troubleshooting Guide

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
1. Fractured cross or trunnion or bearing cup.	A. Excessive running load. B. Shock load. C. Insufficient joint capacity. D. Excessive running angle.	A, B & C, Replace with higher capacity driveshaft and U-joint. D. Reduce U-joint angle.
2. Early life U-joint failure	A. Inadequate lubrication. B. Seal failure. C. Excessive running angle and excessive speed. D. Excessive running load.	A Lubricate at minimum recommended intervals with recommended lubricant. B. Replace U-joint. C. Reduce running angle. D. Replace with higher capacity driveshaft and U-joint.
3. Galling of U-joint trunnion end and bearing cup pad.	A. Excessive running angle and excessive speed. B. End to end fit too tight. C. Inadequate lubrication.	A. Reduce U-joint angle. B. Replace U-joint. If replacement kit is tight, check yoke alignment and lockup size: replace yoke. C. Lubricate at minimum recommended intervals with recommended lubricant.
4. Brinnelling of bearing surfaces.	A. Normal fatigue wear. B. Excessive running angle and excessive speed. C. Excessive running load. D. Needle skewing. E. Improper running angle. F. Inadequate lubrication.	A. Replace U-joint. B. Replace U-joint angle. C. Replace with higher capacity driveshaft and U-joint. D. Replace U-joint; check for yoke distortion. E. Maintain minimum recommended running angle (typically 1°). F. Lubricate at minimum recommended intervals with recommended lubricant.
5. Slip assembly seizes up.	A. Inadequate lubrication. B. Seal failure.	A, B. Replace components. Lubricate at minimum recommended intervals with recommended lubricant.

GENERAL INFORMATION

Troubleshooting Guide

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
6. Slip assembly galling.	A. Seal failure leading to contamination. B. Excessive running load. C. Inadequate driveline design; length of spline engagement too short, normal running condition with spline at pulley extended position.	A. Replace assembly. B. Replace with higher capacity driveshaft and U-joint. C. Increase length of spline engagement with longer splined stub. Review driveshaft length requirements and rebuild with stub spline centered in yoke at normal running condition.
7. Stub shaft or tubing failure in torsion.	A. Excessive running load. B. Shock load. C. Inadequate driveline design: tube size too small.	A, B, C. Replace with higher capacity driveshaft.
8. Failure at tube weld.	A. Improper weld. B. Excessive running load. C. Balance weight welded too close to tube weld.	A, C. Replace tube. B. Replace with higher capacity driveshaft.
9. Yoke ear failure.	A. Ear, contacted yoke ear of other yoke in assembly while running.	A. Reduce running angles; use yoke with higher angle rating.
10. Yoke hub failure.	A. Excessive running load. B. Excessive secondary couple loads.	A. Replace with higher capacity driveshaft. B. Reduce running angles.
11. Center support bearing failure.	A. Seal failure. B. Mated with an oversized stub shaft	A, B. Replace with new components.
12. Center support rubber cushion failure.	A. Misalignment. B. Located too close to heat source.	A. Replace and align. B. Shield from heat or move away from heat source.
13. Driveline vibration.	A. Improper assembly. B. Excessive or unequal running angles. C. Defective U-joint. D. Driveshaft out of straightness and balance specifications. E. Worn slip assembly components. F. Driveline length exceeds maximum for speed range.	A. Make sure all snap rings or bolts are fully seated or torqued properly. B. Reduce and equalize running angles. C, E. Replace with new components. D. Straighten and balance. F. Redesign using larger diameter tubing or two piece driveline.

Glossary of Common Terms

Bearing Plate	A retainer plate fixed to the back of a round bearing used to position the bearing in the yoke.
Balancing	A procedure in which the distribution of mass in a rotating body is checked and altered where necessary to ensure that vibration does not occur during operation.
Ball Seat	A full or segmented angular contact bearing located in a socket that supports and centers the ball stud.
Ball Stud	A yoke generally used in CV applications which incorporates a stud onto which a ball is mounted.
Brinnelling	Failure that occurs when the static forces between two curved surfaces in contact result in local yielding of one or both mating members to produce permanent surface discontinuity. Example: Needle roller indents on a u-joint trunnion or trunnions.
Cardan Universal Joint	A non-constant velocity universal joint consisting of two yokes connected by a cross through four bearings and driveable by external sources.
Center Support	A rolling bearing element surrounded by rubber, mounted in a bracket configuration used to mount the support to an outside structure.
Centering Socket Yoke	A yoke assembly that functions as a self-aligning bearing and provides support and a means of centering in double cardan universal joints.
Companion Flange	A flanged member that attaches a driveline to drivetrain components, typically affixed by some bolt-together method.
Critical Speed	The speed at which the rotational speed of a shaft coincides with the natural vibration frequency of the shaft, causing a dynamically unstable condition.
Cross and Bearing Kit	Drive member with four equally spaced trunnions in the same plane and four bearing cups with attaching parts. Also referred to as a universal joint kit or u-joint kit.
Cross Hole	A through hole located in each ear of a yoke used to locate a round bearing.
Double Cardan Universal Joint	A near constant velocity universal joint consisting of two trunnion type Cardan universal joints whose trunnion yokes are connected by a coupling yoke or H-yoke with internal supporting and centering means.

GENERAL INFORMATION

Glossary of Common Terms

Driveline	An assembly of one or more driveshafts with provisions for axial movement, which transmits torque and/or rotary motion.
Driveshaft	An assembly of one or two universal joints connected to a solid or tubular shaft member.
Driveshaft Length Center to Center	The distance between the outermost universal joint centers on a driveshaft.
Drive Train	Term used for the unit of all components from the Transmission to Rear differential. Also referred to as Power Train.
Ear	One of two projecting parts of a yoke symmetrically located with respect to the rotational axis.
End Yoke	A yoke which attaches a driveshaft to another drive train component such as the transmission.
Flange Yoke	The yoke which attaches the driveshaft assembly to a companion flange.
Flinger	A protective shield used in front of and behind the bearing and rubber on many center supports and end yokes.
Galling	Failure that occurs when two sliding surfaces are subjected to such a combination of loads, sliding velocities, temperatures, environments, and lubricants, that massive surface destruction is caused by welding and tearing, plowing, and gouging. Example: Bearing cup/trunnion end galling on a cross and bearing kit.
H-Yoke	A double yoke which connects the two halves of a double cardan universal joint.
Half Round Yoke Cross Hole	A semicircular hole located on the end of each ear of some end yokes and used to locate a round bearing.
Hub	The central part of a yoke used for attachment to another member.
Inside Lock-up	Term referring to either a cross and bearing kit or a yoke that utilizes a snap ring seated in a groove in the bearing cups and located inside the yoke ears to retain the kit in the yoke.
Joint Angle	The angle described by the intersection of rotational axis of the input and output members of a universal joint and measured on the same plane described by these areas.
Liner	A sound and vibrational deadening material added to the inside surfaces of a tube.

Glossary of Common Terms

Lock-Up	The dimensional distance between the two retaining surfaces in a driveline component used to locate the bearing surfaces.
Midship Stub Shaft.	A short shaft, generally splined, used in applications requiring more than one driveshaft. It mounts through the center of a support bearing and allows an additional driveshaft component to be fixed.
Outside Lock-Up	Term referring to either a cross and bearing kit or a yoke that utilizes a retaining ring in a groove near the outside edge of the yoke ear, rested against the outside face of the bearing cup.
Phase/Phase Angle	The relative positioning of the universal joint yokes on a driveshaft or driveline.
Retaining Ring	A removable ring used as a shoulder to retain and position a round bearing in a hole.
Ring Groove Round Bearing	The surface used for positioning a round bearing with a retaining ring. Consists of a round bearing cup with needle rollers designed to ride on a trunnion.
Seal	A flexible member which prevents the escape of lubricant and the entrance of foreign matter.
Slip Movement	A permissible length of axial movement.
Slip Stub Shaft	A short, machined shaft, generally splined, which, when used with a slip yoke allows axial movement.
Slip Yoke	A yoke which allows axial movement.
Snap Ring	Same as retaining ring.
Strap Bearing Clamp	A semi circular device that conforms to the bearing profile holding them in place in half round and some DC yokes.
Swaged Tubing	A tube with one or both ends having a smaller diameter than the middle section.
Swing Diameter	The maximum diameter of the circular path described by a rotating universal joint.
Thrust End	The end of a cross trunnion used as a thrust surface.
T.I.R.	Total Indicator Reading on a specific point thru 1 revolution of a shaft.
Torsional Damper	A mechanical device, generally an inertia ring, attached to a drivetrain component by means of a rubber inner ring to minimize driveline vibration in addition to balancing.

GENERAL INFORMATION

Glossary of Common Terms

Trunnion	One of four projecting journals of a cross.
Tubing	The tubular connecting member of a driveshaft.
Tube Diameter	The outside diameter of a tube.
Tube Yoke	A yoke with a piloting hub for attachment of a tube.
U-Bolt	A clamping bolt with two parallel threaded legs used to retain a round bearing in certain end yoke designs.
Universal Joint	A device which can transmit torque and/or rotary motion from one shaft to another at fixed or varying angles of intersection of the shaft areas.
Wall Thickness	The measurement between the inside and outside diameter of a tube.
Weld Yoke	Same as tube yoke.
Wing Bearing	A member with a key and projecting wings used as the bearing base and positioning the thrust end of a cross trunnion.
Yoke Shaft	A one piece member designed to incorporate a tube yoke, tubing and stub shaft. It is used in close-couple applications and eliminates the need to use tubing.
Zerk	A lubrication fitting, usually threaded into a driveline component that will allow grease to be injected into the component, but does not allow grease to escape.



THE DRIVELINE EXPERTS

THESE OE PLATFORMS TRUST NEAPCO. YOU CAN TOO!

I	Q	Z	M	S	F	I	E	S	T	A	F	O	C	U	S	A	T
N	J	L	O	I	X	X	E	X	P	E	D	I	T	I	O	N	J
S	X	W	N	E	C	O	S	P	O	R	T	Y	U	K	O	N	V
I	T	S	D	R	R	A	V	I	A	T	O	R	A	N	F	T	G
G	D	L	E	R	J	Y	Y	F	F	G	D	B	C	M	V	R	A
N	X	D	O	A	N	A	V	I	G	A	T	O	R	E	T	A	L
I	S	I	L	V	E	R	A	D	O	T	D	T	V	G	S	N	A
A	P	B	M	U	S	T	A	N	G	J	U	Q	K	A	K	S	X
S	H	E	X	P	L	O	R	E	R	H	C	B	G	N	O	I	Y
X	G	M	N	E	C	O	N	O	L	I	N	E	H	E	D	T	B
N	X	N	J	C	O	L	O	R	A	D	O	Q	P	N	A	A	Y
A	M	U	S	T	A	N	G	S	V	T	Y	T	N	O	N	U	Q

Find the following words in the puzzle.
Words are hidden → ↓ and ↘.

AVIATOR
COLORADO
ECONOLINE
ECOSPORT
EXPEDITION
EXPLORER
F-150
FIESTA

FOCUS
GALAXY
INSIGNIA
MEGANE
MONDEO
MUSTANG
MUSTANG SVT
NAVIGATOR

SIERRA
SILVERADO
SKODA
TRANSIT
YUKON



THE DRIVELINE EXPERTS

THESE OE PLATFORMS TRUST NEAPCO. YOU CAN TOO!

V	E	N	K	A	W	A	S	A	K	I	I	H	H	H	G	C	S
P	X	G	R	A	N	D	W	A	G	O	N	E	E	R	K	K	M
O	G	F	O	R	A	M	M	O	P	E	L	X	T	M	Q	Q	I
L	A	N	F	F	M	E	R	C	E	D	E	S	B	E	N	Z	N
A	T	R	U	S	T	E	D	A	U	D	I	S	P	A	F	H	I
R	Y	T	E	S	T	E	D	J	V	X	V	V	M	K	D	J	E
I	P	C	N	H	Y	S	J	O	H	N	D	E	E	R	E	E	N
S	C	Y	G	R	A	N	D	C	H	E	R	O	K	E	E	E	T
V	O	L	K	S	W	A	G	O	N	Y	L	U	C	I	D	P	O
F	O	G	N	I	S	E	R	I	E	S	Y	K	O	P	L	H	G
O	N	I	G	H	O	N	D	A	K	A	R	M	A	J	J	J	G
O	T	U	S	A	V	F	Y	O	K	E	L	W	F	C	A	Y	B

Find the following words in the puzzle.

Words are hidden → ↓ and ↘.

AUDI

CNH

FCA

GRAND CHEROKEE

GRAND WAGONEER

HONDA

I20

JEEP

JOHN DEERE

KARMA

KAWASAKI

LUCID

MERCEDES BENZ

MINI

OPEL

POLARIS

RAM

3 SERIES

TESTED

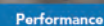
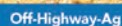
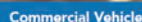
TOGG

TRUSTED

USA

VOLKSWAGON

YOKE

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

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