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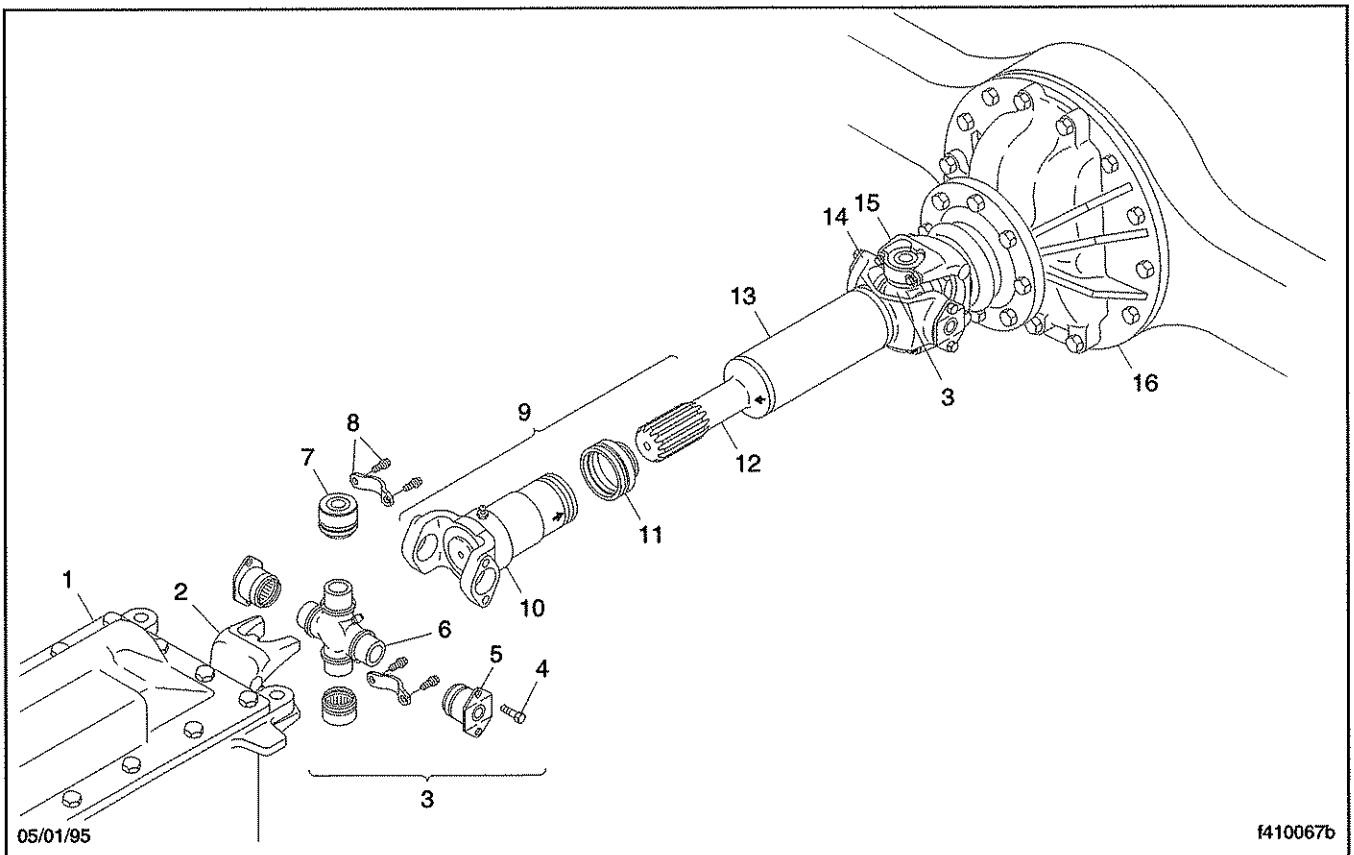
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General Information

The simplest driveline consists of a transmission output-shaft end-yoke, an axle input-shaft end-yoke, and a single slip-jointed driveshaft connecting the two end-yokes. See **Fig.1**. The driveshaft is made up of a universal joint (U-joint), a sleeve-yoke, a splined stub shaft, a driveshaft tube, a tube-yoke, and a second U-joint.

DRIVELINE CONFIGURATIONS

The specific type and number of drivelines used on each vehicle depends on its number of transmissions, its number of drive axles, and its wheelbase. See **Fig. 2**. A driveline is used between each driving and driven component. A driveline connecting a main transmission (or anauxiliary transmission) to a single drive axle or forward-rear axle of a dual-drive vehicle is always referred to as a no. 2 driveline. See **Fig. 2**, examples A, B, C,D, and E. An interaxle driveline of a dual-drive vehicle is always called a no. 3 driveline. See**Fig. 2**, examples *B*and *C*. A driveline connecting



NOTE: Not all fasteners are shown.

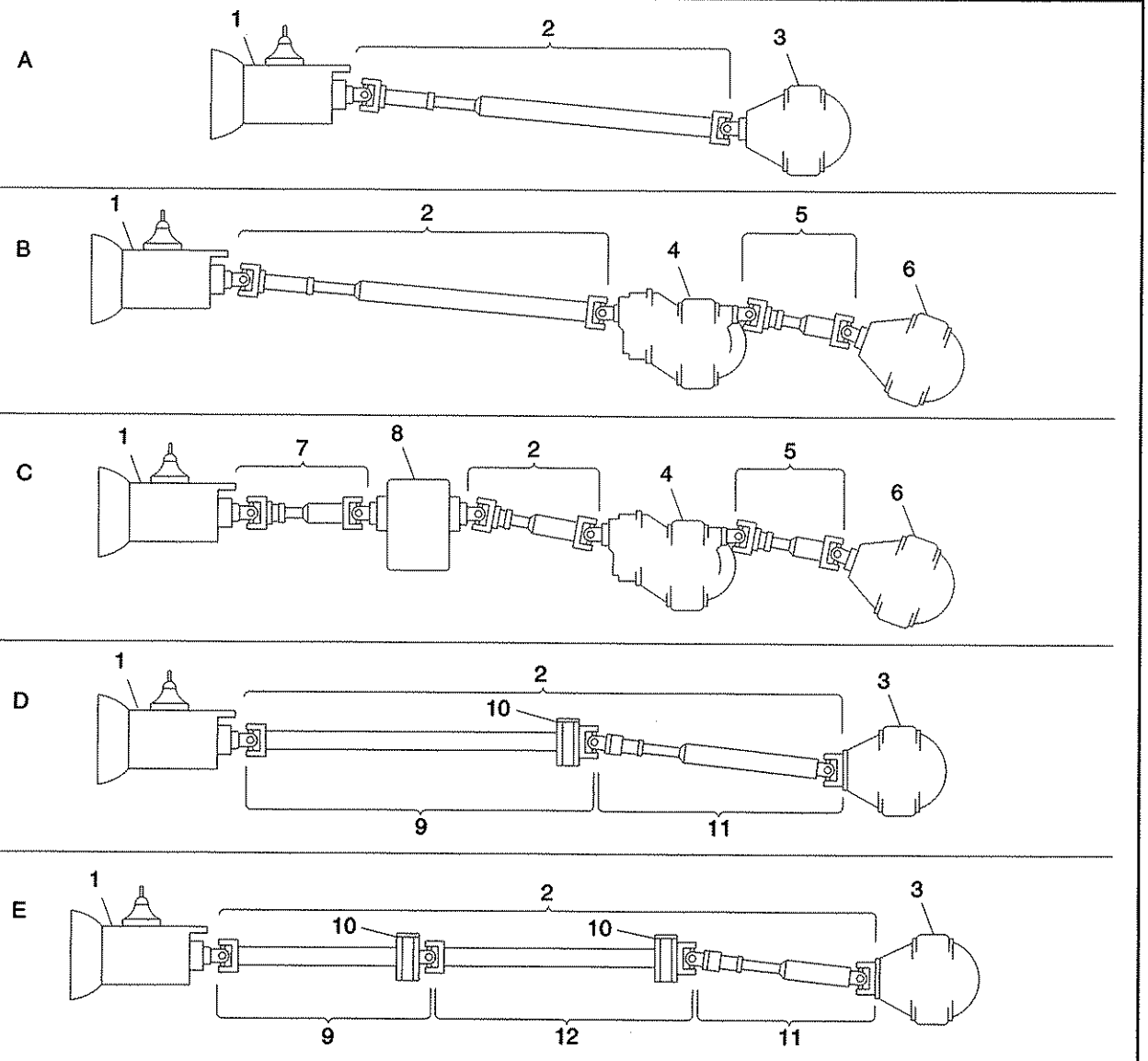
1. Transmission
2. Transmission Output-Shaft End-Yoke (half-round)
3. U-Joint Assembly
4. Bearing Plate Self-Locking Capscrew
5. Bearing Cup (for full-round yoke)
6. U-Joint Cross
7. Bearing Cup (for half-round yoke)
8. Bearing Strap and Bearing-Strap Capscrew
9. Slip-Joint Assembly
10. Sleeve-Yoke (full-round)
11. Dust Cap
12. Splined Stub Shaft
13. Driveshaft Tube
14. Tube-Yoke (full-round)
15. Axle Input-Shaft End-Yoke (half-round)
16. Rear Axle

Fig. 1, Components of a Basic Driveline

General Information

a main transmission to an auxiliary transmission is alwaysreferred to as a no. 1 driveline. See **Fig. 2**, example *C*. Business Class Trucks are not equipped with no. 1 drivelines or auxiliarytransmissions.

A long driveshaft, supported only at its ends, will sag in the middle from its own weight. When turning at high rpm, it will flex, causing an out-of-balance vibration. Therefore, vehicles having a long wheelbase use a midship bearing, mounted on a frame crossmember, for additional support. See **Fig.2**, example *D*. This



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1. Main Transmission
2. No. 2 Driveline
3. Rear Axle
4. Forward-Rear Axle
5. No. 3 Driveline
6. Rearmost Axle
7. No. 1 Driveline
8. Auxiliary Transmission
9. Primary Coupling Shaft
10. Midship Bearing
11. No. 2 Driveshaft
12. Intermediate Coupling Shaft

Fig. 2, Driveline Configurations

allows the no. 2 driveline to be separated into two, shorter shafts (a coupling shaft and a no. 2 driveshaft), thus improving balance and stability.

Vehicles having an even longer wheelbase use two crossmember-mounted midship bearings, allowing the no. 2 driveline to be separated into three short shafts, joined by four U-joints. See **Fig.2,** example *E*. The first shaft is the primary coupling shaft, the second is the intermediate coupling shaft, and the third is the no. 2 driveshaft.

Vehicles manufactured with all-wheel-drive use a transfer case to provide power to the front driveaxle. See **Fig. 3**.

SLIP-JOINTS, U-JOINTS, AND YOKES

The basic function of the driveline is to send torque from the transmission to the axle in a smooth and continuous action. Because the vehicle axles are not attached directly to the frame, but are suspended by springs, theyride in an irregular, floating motion (when going over bumps or depressions), thus changing the distance between the transmission (or coupling shaft) and the rear axle, and the distance between the rear axles. The slip-joints of the no.2 and no. 3 driveshafts, by expanding and contracting, allow for length changes between drivetrain components. Couplingshafts do not require a slip-joint.

Motion of the rear axle(s) also causes changes to the relative angles between drivetrain components. U-jointsallow transfer of torque from an output shaft (or coupling shaft) to the driveshaft, and from the driveshaft to an input shaft, even though the angles between the shafts may be constantly changing.

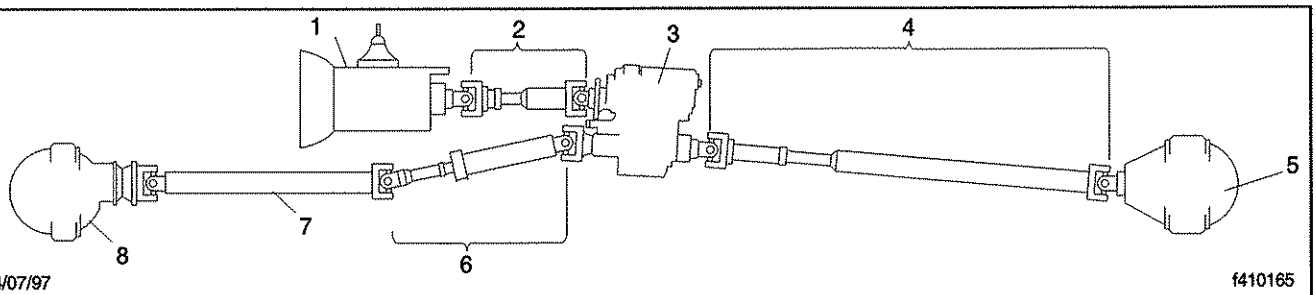
Each U-joint consists of a cross with a close-tolerance ground cylindrical surface (trunnion) at the end of each of the four arms. Installed on each trunnion is a bearing cup lined with bearing needles. All bearing cups are sealed to retain lubricants, and to prevent entry of foreign material. See **Fig.4**. In operation, the four bearing cups are held stationary in a pair ofyokes, while the U-joint cross pivots on its trunnions.

Full-round yokes are installed at the front of coupling shafts and at both ends of the no. 2 and no.3 driveshafts. All tube-yokes (yokes that are welded into driveshaft tubes) and all sleeve-yokes (yokes that are part of the internally splined half of slip-joints) are full-round yokes. See **Fig.5**, Refs. 4 and 9.

An end-yoke is an internally splined yoke, held on an externally splined shaft by a locknut. As standard equipment, all end-yokes used on Business Class Trucks are half-round; full-round end-yokes are optional. End-yokes areinstalled on the transmission output shaft, on each axle input and output shaft, and behind the midship bearing of most coupling shafts. See **Fig. 5**, Refs. 2, 7, 12,and 14. A half-round flange-yoke is used with the driveline parking brake, and fastens with locknuts to the studs of a companion flange that installs on the transmission output shaft or the rear axle input shaft in the same manner as an end-yoke. See **Fig. 6**.

Spicer SPL90 (1590), 1610, 1710, 1760, and 1810 U-joints, and Rockwell 17T, 176T, and 18T U-joints are coupled to half-round end-yokes and flange-yokes by capscrews inserted through semicircular bearing straps that hold the bearing cups in place under tabs in the yoke cross-holes. See **Fig. 7**.

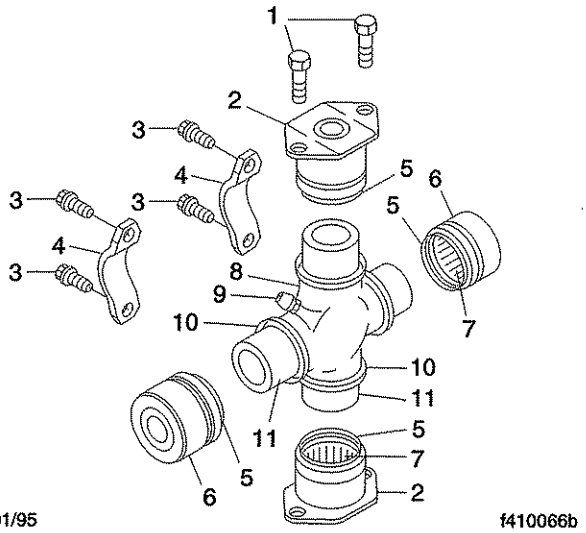
A Spicer SPL90 (1590) U-joint is installed in a full-round tube-yoke or sleeve-yoke by installing the cross



1. Engine
2. No. 1 Driveline
3. Transfer Case
4. No. 2 Driveshaft
5. Rear Axle
6. AWD Driveshaft No. 1
7. AWD Driveshaft No. 2
7. Front Drive Axle

Fig. 3, All-Wheel-Drive Driveline Configuration

General Information



NOTE: Components shown are typical of all U-joints installed in Freightliner vehicles with half-round end-yokes, except Spicer SPL90 (1590) U-joints.

1. Bearing-Plate Capscrews
2. Bearing Cup (for full-round yoke)
3. Bearing-Strap Capscrew
4. Bearing Strap
5. Bearing-Cup Seal
6. Bearing Cup (for half-round yoke)
7. Bearing Needles
8. U-Joint Cross
9. Grease Fitting
10. U-Joint Cross Slinger
11. Trunnion

Fig. 4, Typical U-Joint

and bearing cups into the yoke cross-holes, then installing a snap ring into a groove in each cross-hole. See**Fig. 8**.

Spicer 1610, 1710, 1760, and 1810 U-joints, and Rockwell 17, 176, and 18 series U-joints are installed in full-round tube-yokes, sleeve-yokes, and end-yokes, by inserting the cross through from the inside of both yoke cross-holes, then installing the bearing cups into the outsides of the yoke and over the ends of the trunnions.Capscrews, inserted through a bearing plate at the back of each cup, thread into the yoke to secure the cups. For bothSpicer and Rockwell U-joints installed from April 1, 1994, the capscrews are self-locking; for U-joints installed before April 1, 1994, non-self-locking capscrews are used with lockstraps to secure the capscrews. See**Fig. 9**.

U-JOINT ANGLES, PHASING, AND DRIVELINE BALANCE

Correct U-joint working angles, U-joint phasing, and driveline balance are vital to maintaining a quiet-running drivetrain and long life of drivetrain components (including driveline components).

The U-joint working angle is the angle formed by the intersection of the driveshaft centerline and the extended centerline of the shaft of any component (or other driveshaft) to which the U-joint connects. See**Fig. 10**. Because the double oscillating motionof a U-joint that connects angled shafts causes a fluctuating speed difference between the shafts, the effect created by the U-joint at one end of the shaft must cancel the effect created by the U-joint at the other end. This is done bymaking U-joint working angles at both ends of the driveshaft approximately equal, with the U-joints in phase. If theyoke lugs at both ends of the shaft are lying in the same plane (a plane which bisects the shaft lengthwise) theU-joints will be in phase. See **Fig. 11**.

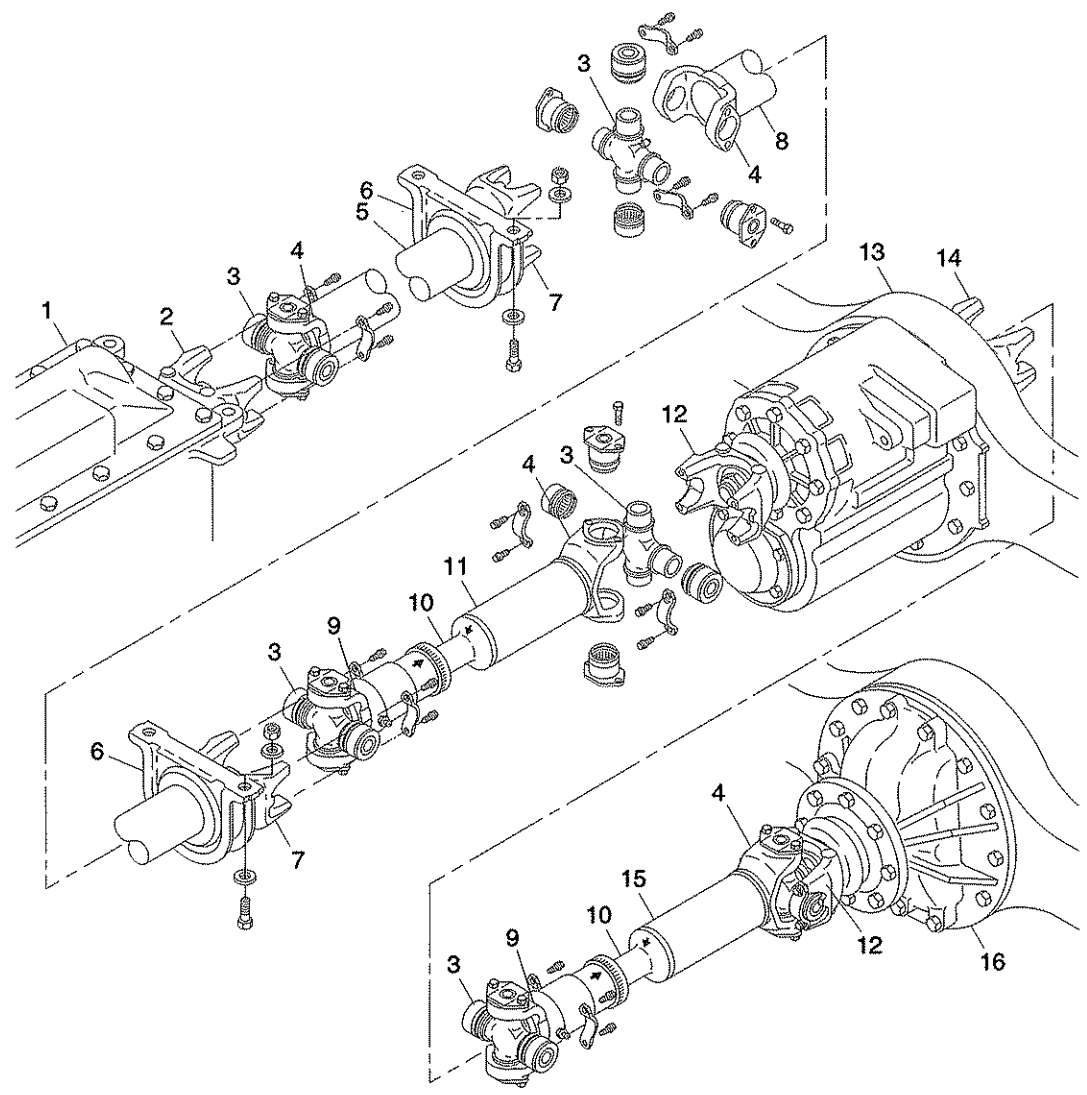
After manufacture, each driveline yoke is statically balanced. After assembly, each driveshaft and coupling shaft is checked for out-of-roundness, straightened as necessary, then dynamically balanced.

AVOIDING DRIVELINE PROBLEMS

To ensure that U-joints turn in phase, sleeve-yokes, splined shafts, coupling shaft end-yokes, and coupling shafts, should be marked for assembly reference before disassembly. A misaligned slip-joint will seriously affect driveline balance (and U-joint phasing). Even if a slip-joint is assembled 180 degrees from its original position (which will keep the U-joints in phase), the dynamic balance of the driveshaft will be negatively affected.

A driveline can become unbalanced or greatly weakened if a driveshaft has been dented, bent, twisted, orotherwise damaged. Operating a vehicle at speeds which exceed the speed of the driveshaft's design specifications willcause an out-of-balance vibration. Any condition which allows excessive movement of a driveshaft will cause drivelineimbalance: loose end-yoke nuts, loose midship bearing mounts, loose U-joint bearing cup retaining capscrews, wornU-joint trunnions and bearings, and worn slip-joint splines.

Among the most common causes of U-joint and slip-joint damage is lack of lubrication.



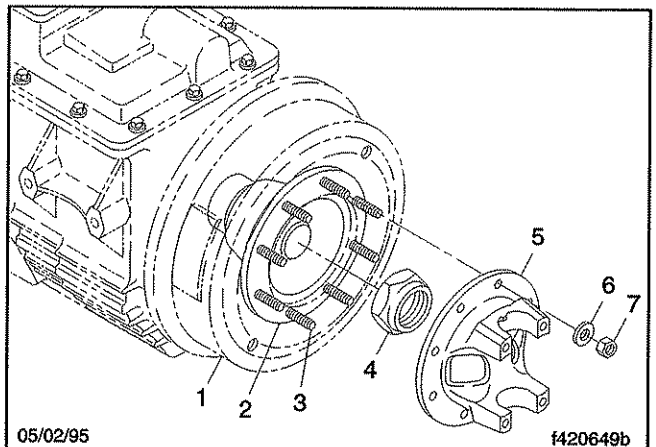
NOTE: Not all fasteners are shown.

1. Transmission
2. Transmission Output-Shaft End-Yoke (half-round)
3. U-Joint Assembly
4. Full-Round Tube-Yoke
5. Primary Coupling Shaft Tube
6. Midship Bearing Assembly
7. Coupling Shaft End-Yoke (half-round)
8. Intermediate Coupling Shaft Tube
9. Sleeve-Yoke (full-round)
10. Slip-Joint Assembly
11. No. 2 Driveshaft Tube
12. Axle Input-Shaft End-Yoke (half-round)
13. Forward-Rear Axle
14. Axle Output-Shaft End-Yoke (half-round)
15. No. 3 Driveshaft Tube
16. Rearmost Axle

Fig. 5, Dual-Drive Installation With Primary and Intermediate Coupling Shafts

To keep a vehicle operating smoothly and economically, the driveline must be carefully checked and lubricated at regular intervals. For inspection and lubri-

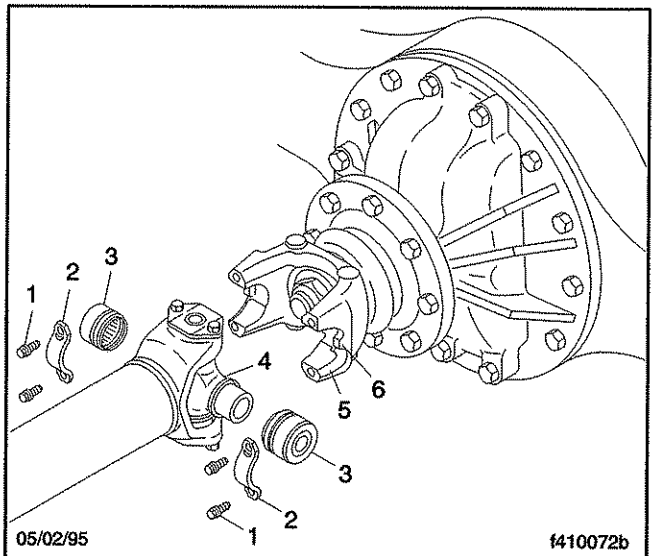
General Information



NOTE: Not all fasteners are shown.

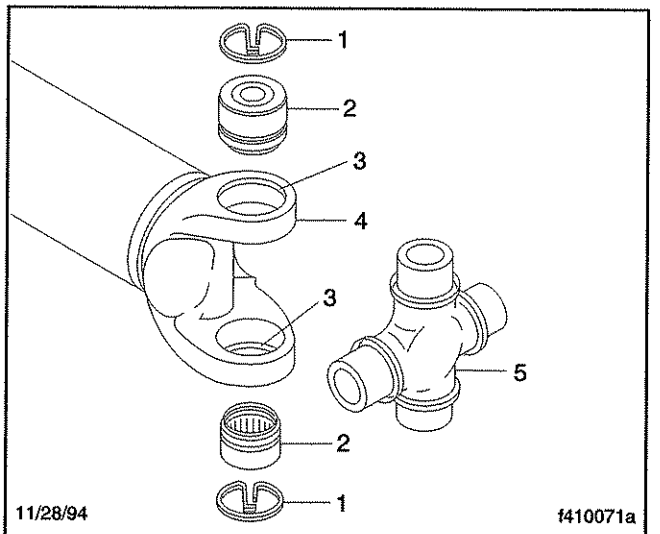
1. Parking Brake Drum
2. Companion Flange
3. 3/8–24 Threaded Stud
4. Companion-Flange Locknut
5. Half-Round Flange-Yoke
6. Bearing Washer
7. Flange-Yoke Locknut

Fig. 6, Companion Flange and Flange-Yoke Installation



1. Bearing-Strap Capscrew
2. Bearing Strap
3. Bearing Cup
4. U-Joint Cross
5. Half-Round Yoke
6. Yoke Cross-Hole Tab

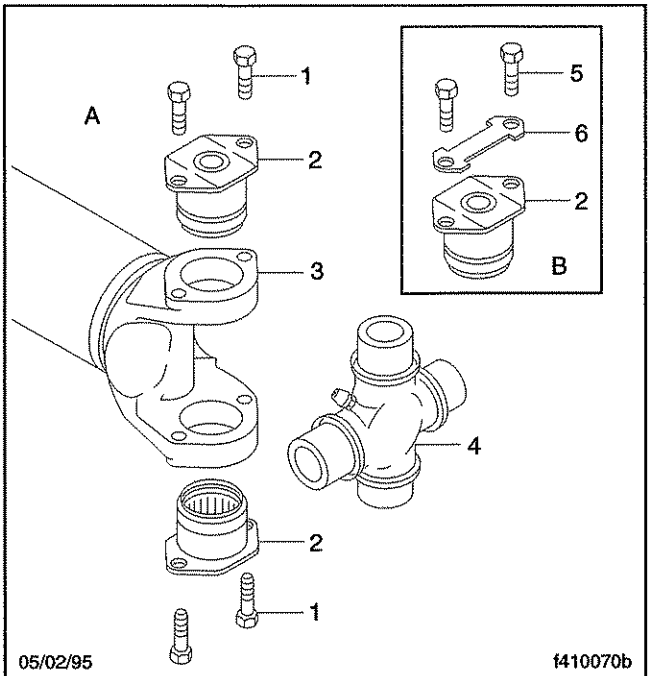
Fig. 7, Coupling of a Spicer or Rockwell U-Joint With a Half-Round End-Yoke



1. Snap Ring
2. Bearing Cup
3. Snap-Ring Groove
4. Full-Round Yoke
5. U-Joint Cross

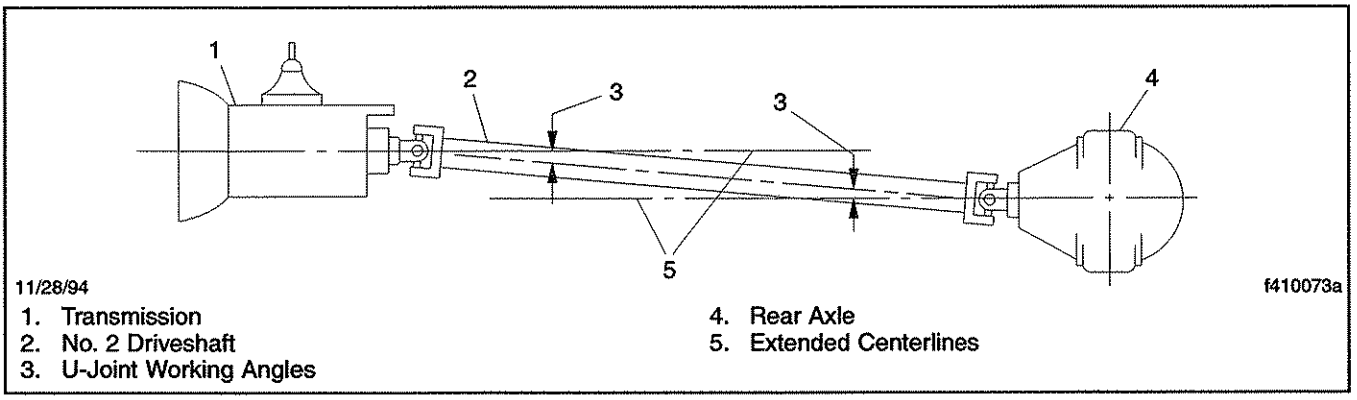
Fig. 8, Installation of a Spicer SPL90 (1590) U-Joint in a Full-Round Yoke

cation intervals and procedures, see **Group 41** of the *Business Class Trucks Maintenance Manual.*



A. U-joint installed from April 1, 1994.
B. U-joint installed before April 1, 1994.
1. Bearing-Plate Self-Locking Capscrew
2. Bearing Cup (bearing-plate-type)
3. Full-Round Yoke
4. U-Joint Cross
5. Bearing-Plate Capscrew
6. Lockstrap

Fig. 9, Installation of a Spicer 1610/1710/1760/ 1810 U-Joint or Rockwell 17/176/18-Series U-Joint in a Full-Round Yoke



1. Transmission
2. No. 2 Driveshaft
3. U-Joint Working Angles
4. Rear Axle
5. Extended Centerlines

Fig. 10, U-Joint Working Angles

General Information

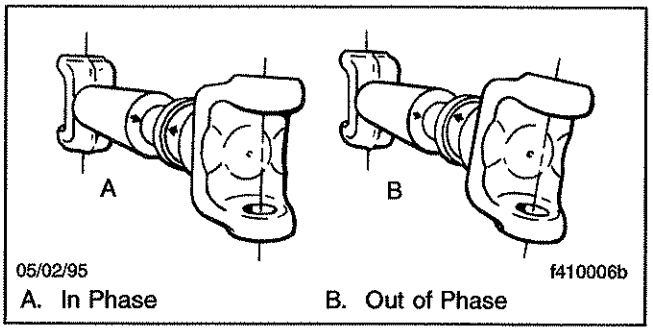


Fig. 11, U-Joint Phasing

U-Joint Uncoupling and Coupling With a Half-Round End-Yoke

NOTE: It is easier to check driveline parts, and to replace a U-joint or midship bearing assembly if the driveshaft is removed from the vehicle. If a driveshaft requires straightening or balancing, it must be removed, and installed on a lathe or a balance machine. Removal is required for replacement of slip-joint parts, a driveshaft tube, or a tube-yoke. To remove the driveshaft, see **Subject 120.**

Many service operations do not require driveshaft removal from the vehicle: end-yoke or companion-flange nut tightening; drive component shaft seal, end-yoke, or flange-yoke replacement; changing U-joint phasing at the slip-yoke; and transmission or axle removal (for overhaul, repair, or replacement). To perform these operations, uncouple the U-joint at the applicable end of the appropriate driveshaft.

U-Joint Uncoupling (See Fig. 1)

1. Apply the parking brakes, and chock the tires.
2. Turn the appropriate end-yoke (or flange-yoke) until the centerline through its cross-holes is horizontal. See **Fig. 1**, details *A* and *B*. If the half-round bearing cups do not already have a retaining wire installed, install a bearing-cup retaining wire. See **Fig. 1**, detail *C*. Or, install safety wire from the retaining-wire groove of one half-round bearing cup to the other.
3. Support the driveshaft with a nylon support strap.

   When uncoupling a coupling shaft, install two or three support straps, as needed. Remove the fasteners that attach the midship bearing(s) to its bracket(s). See **Fig. 1**.
4. Remove the capscrews that secure the bearing straps to the half-round yoke. Remove the bearing straps.
5. Compress the slip-joint to remove the U-joint from the yoke.

⚠ CAUTION

Do not expose the U-joint trunnions or bearing-cup needles to dirt or grit. The smallest bits of dirt or grit can cause rapid wear and serious damage to the U-joint.

U-Joint Coupling (See Fig. 1)

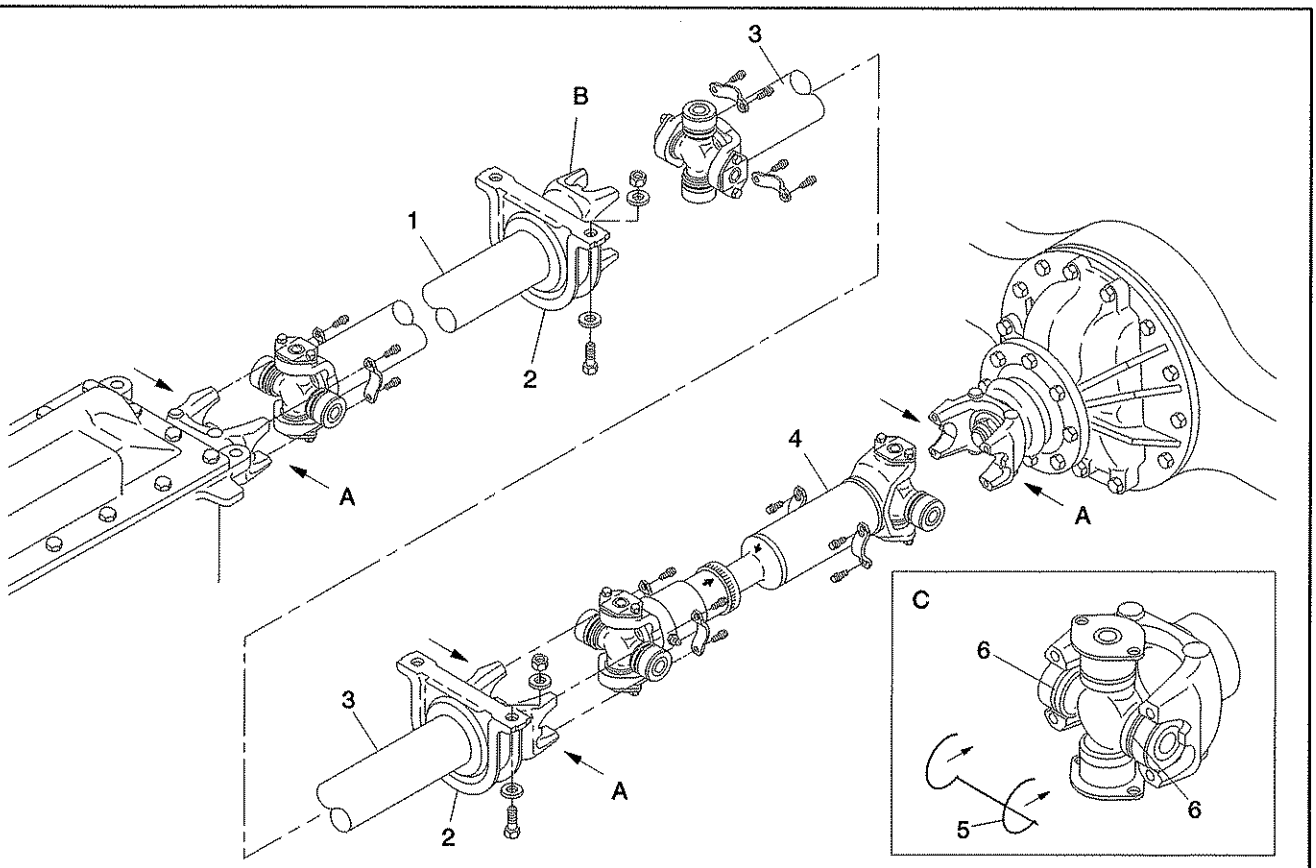
1. Check and clean the end-yoke.
   - 1.1 Check the torque on the end-yoke nut; see the applicable table in **Specifications 400.**
   - 1.2 Check the end-yoke (or flange-yoke) cross-holes for burrs or raised metal. Using a half-round file, remove burrs or raised metal. See **Fig. 2.**
   - 1.3 Using fine emery cloth, smooth and clean the entire surface of the yoke cross-holes and bearing straps. See **Fig. 3.**
   - 1.4 Turn the end-yoke (or flange-yoke) until its cross-holes are horizontal. See **Fig. 1.**
2. Check, clean, and lubricate the U-joint.
   - 2.1 Remove the bearing-cup retaining wire or safety wire. See **Fig. 1**, detail *C*.

⚠ CAUTION

Do not expose the U-joint trunnions or bearing-cup needles to dirt or grit. The smallest bits of dirt or grit can cause rapid wear and serious damage to the U-joint.

   - 2.2 Using fine emery cloth, smooth and clean the outside surfaces of both bearing cups. See **Fig. 4.**
   - 2.3 Check the U-joint trunnions and bearing cups for minute particles of dirt or grit. Clean if necessary; see **Subject 130.**
   - 2.4 Using NLGI grade 2 grease with EP additives, wipe a small amount of grease on the needles in the bearing cups.
   - 2.5 Using a light-weight oil, lubricate the lips of the bearing-cup seals. See **Fig. 5.**
   - 2.6 Install the bearing cups on the cross.
   - 2.7 Install a bearing-cup retaining wire. See **Fig. 1**, detail *C*. Or, install safety wire from the retaining-wire groove of one half-round bearing cup to the other.
3. Extend the slip-joint, while pressing the cross and bearing cups into place in the yoke cross-holes.

U-Joint Uncoupling and Coupling With a Half-Round End-Yoke



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NOTE: Not all fasteners are shown.

A. End-yoke cross-hole centerline is horizontal.
B. Before uncoupling/coupling the U-joint, turn the end-yoke until its cross-hole centerline is horizontal.
C. Install a half-round bearing-cup retaining wire (or safety wire) before removing the bearing straps.

1. Primary Coupling Shaft
2. Midship Bearing
3. Intermediate Coupling Shaft
4. No. 2 Driveshaft
5. Half-Round Bearing-Cup Retaining Wire
6. Retaining-Wire Groove

Fig. 1, U-Joint Uncoupling/Coupling for Drivelines With Half-Round End-Yokes

Using a rubber or plastic mallet, gently tap the bearing cups to seat them in the yoke. See **Fig. 6.**

⚠ CAUTION

Do not use the capscrews and bearing straps to seat the bearing cups in the yoke. Seating the cross by tightening the bearing straps can deform the bearing straps, allowing the bearing cups to spin, which will cause rapid wear and serious damage to the U-joint.

4. Place the bearing straps over the cups, and install the new strap capscrews, finger-tight.

⚠ WARNING

The self-locking bearing-strap capscrews must not be reused. Replace the capscrews with new ones. Also, do not undertighten or overtighten the capscrews; use proper torque values. A loose or broken fastener at any point in the driveline weakens the driveline connection and can result in a driveshaft separating from the vehicle. Driveline sepa-

U-Joint Uncoupling and Coupling With a Half-Round End-Yoke

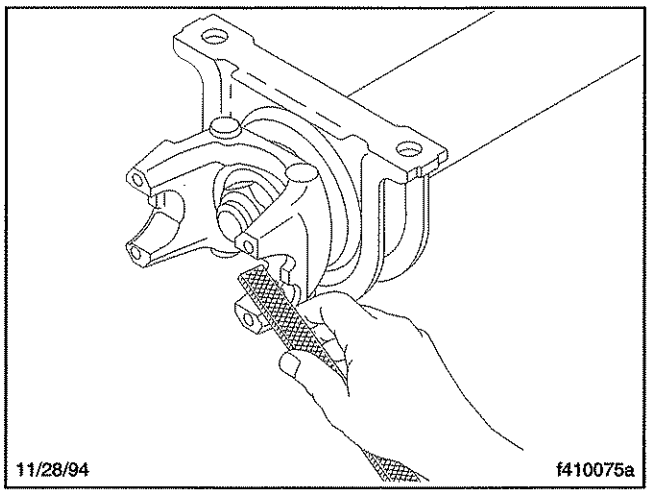
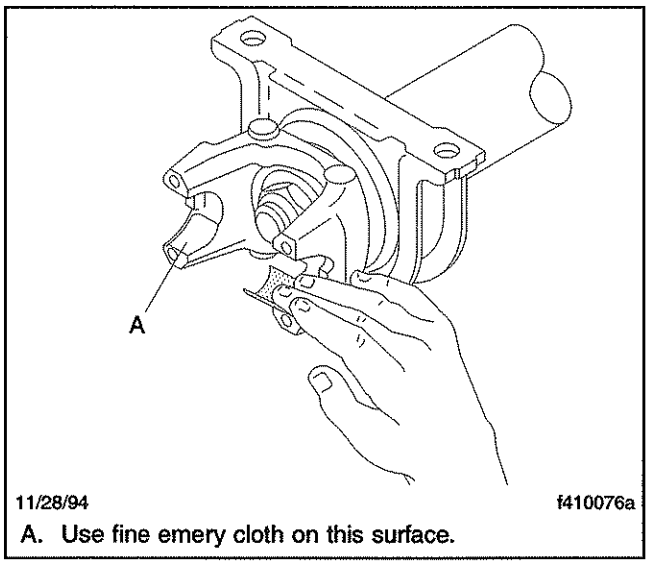


Fig. 2, Removing Burrs From a Half-Round End-Yoke Cross-Hole



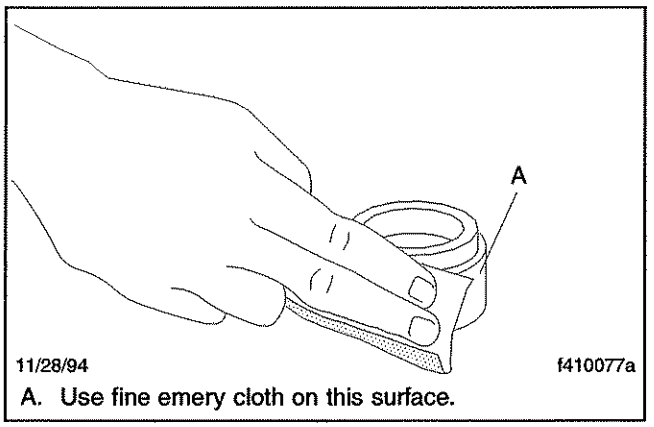
A. Use fine emery cloth on this surface.

Fig. 3, Smoothing a Half-Round End-Yoke Cross-Hole

ration can cause loss of vehicle control that could result in serious personal injury or death.

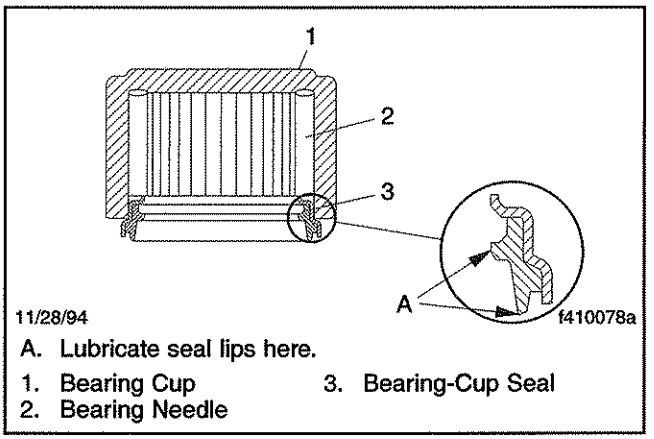
Separation of the driveline can also cause damage to the driveline, driveline components, or other areas of the vehicle.

5. Alternately tighten the bearing-strap capscrews in increments of 20 lbf·ft (27 N·m) to the applicable torque value in **Specifications, 400.**



A. Use fine emery cloth on this surface.

Fig. 4, Smoothing a Half-Round End-Yoke U-Joint Bearing Cup



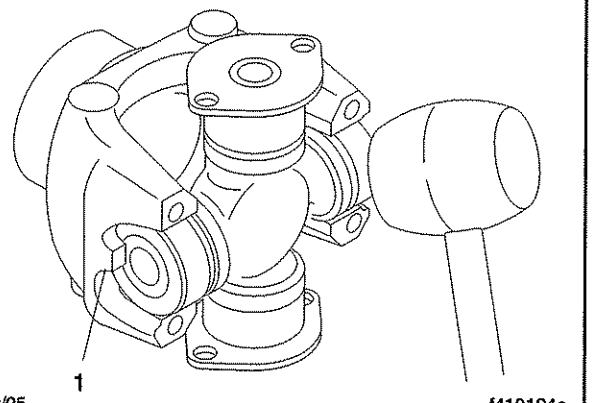
A. Lubricate seal lips here.

1. Bearing Cup
2. Bearing Needle
3. Bearing-Cup Seal

Fig. 5, Sectional View of a Half-Round End-Yoke U-Joint Bearing Cup

6. If they were removed, install the fasteners that attach each midship bearing to its bracket; tighten the flanged locknuts 91 lbf·ft (123 N·m).
7. Lubricate the U-joint, following the procedure in **Group 41** of the *Business Class Trucks Maintenance Manual.*
8. Remove the nylon support straps, then remove the chocks.

U-Joint Uncoupling and Coupling With a Half-Round End-Yoke



1. Retaining Tab

Fig. 6, Seating a U-Joint in a Half-Round End-Yoke

U-Joint Uncoupling and Coupling With a Full-Round End-Yoke

NOTE: It is easier to check driveline parts, and to replace a U-joint or midship bearing assembly if the driveshaft is removed from the vehicle. If a driveshaft requires straightening or balancing, it must be removed, and installed on a lathe or a balance machine. Removal is required for replacement of slip-joint parts, a driveshaft tube, or a tube-yoke. To remove the driveshaft, see **Subject 120.**

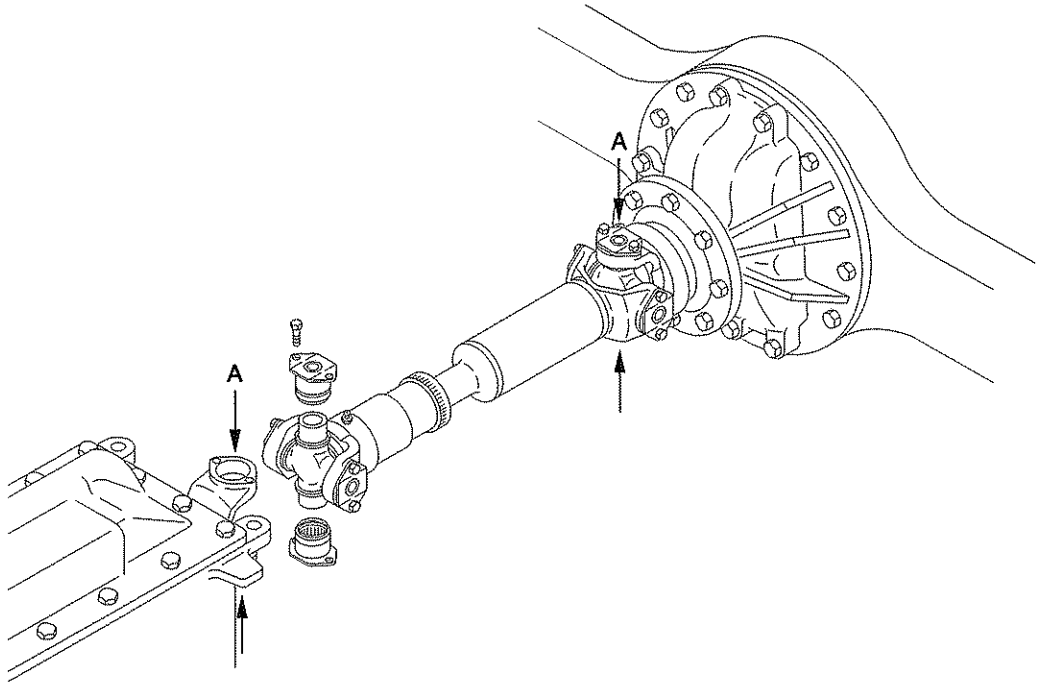
Many service operations do not require driveshaft removal from the vehicle: end-yoke or companion-flange nut tightening; drive component shaft seal, end-yoke, or flange-yoke replacement; changing U-joint phasing at the slip-yoke; and transmission or axle removal (for overhaul, repair, or replacement). To perform these operations, uncouple the U-joint at the applicable end of the appropriate driveshaft.

U-Joint Uncoupling (See Fig. 1)

1. Apply the parking brakes, and chock the tires.
2. Turn the appropriate end-yoke until the centerline through its cross-holes is vertical. See **Fig. 1.**
3. Support the driveshaft with a nylon support strap.

   When uncoupling a coupling shaft, install two or three support straps, as needed. Remove the fasteners that attach the midship bearing(s) to its bracket(s).
4. For a vehicle built from April 1, 1994, remove and discard all four bearing-cup-plate self-locking capscrews.

   For a vehicle built before April 1, 1994, use a pin punch to bend the tabs of the lockplates away from all four of the bearing-cup-plate capscrews. See **Fig. 2.** Remove the capscrews and lockplates.
5. Using one of the U-joint pullers listed in **Specifications 400**, remove both bearing assemblies from the end-yoke cross-holes. See **Fig. 3.**
6. Compress the slip-joint and pivot the end of the U-joint cross to remove it from the yoke. Install the



NOTE: Not all fasteners are shown.

A. End-yoke cross-hole centerline is vertical.

Fig. 1, U-Joint Uncoupling/Coupling of a Driveline With Full-Round End-Yokes

U-Joint Uncoupling and Coupling With a Full-Round End-Yoke

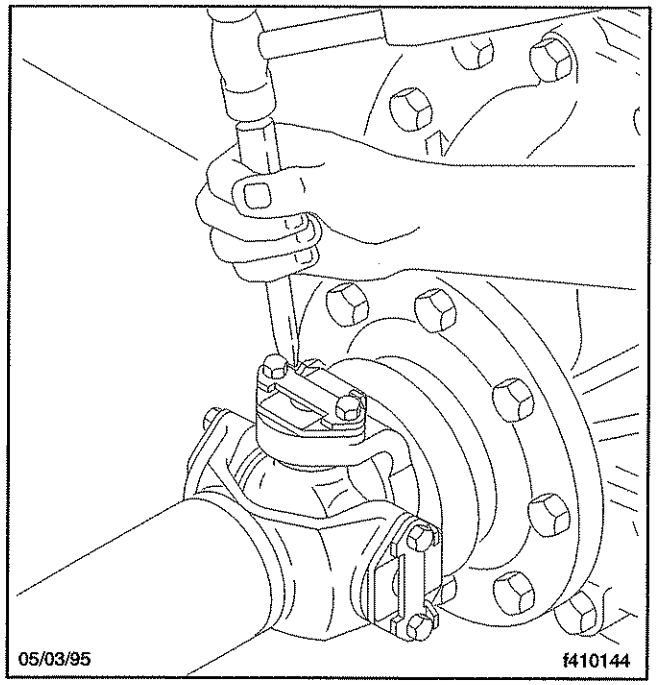


Fig. 2, Bending a Lockplate Tab Away From a U-Joint Capscrew

bearing cups, then use tape to secure them to the U-joint cross.

⚠ CAUTION

Do not expose the U-joint trunnions or bearing-cup needles to dirt or grit. The smallest bits of dirt or grit can cause rapid wear and serious damage to the U-joint.

U-Joint Coupling (See Fig. 1)

1. Check and clean the end-yoke.
   - 1.1 Check the torque on the end-yoke nut; see the applicable table in **Specifications 400.**
   - 1.2 Check the end-yoke cross-holes for burrs or raised metal. Using a rat-tail or half-round file, remove burrs or raised metal. See **Fig. 4.**
   - 1.3 Using a mill file, and holding it flat against the machined surface of the yoke lug,

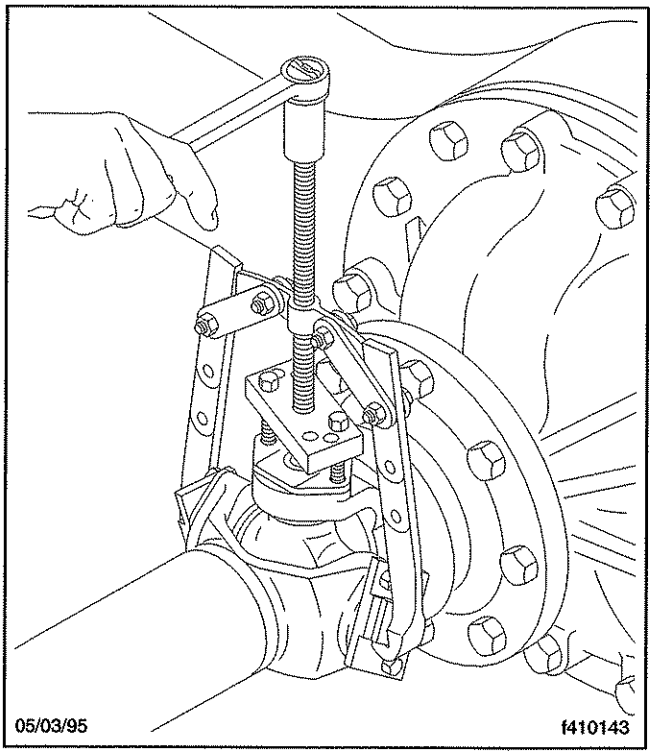
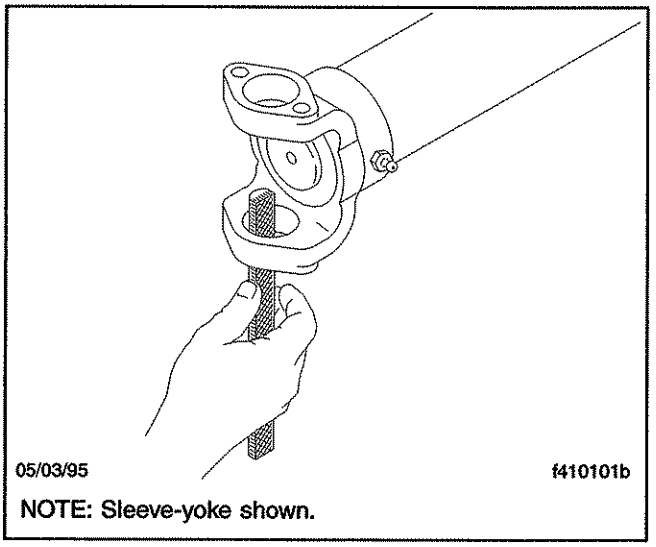


Fig. 3, Removing a Bearing Cup From a Full-Round End-Yoke

remove any burrs or raised metal. See **Fig. 5.**



NOTE: Sleeve-yoke shown.

Fig. 4, Removing Burrs From a Full-Round Yoke Cross-Hole

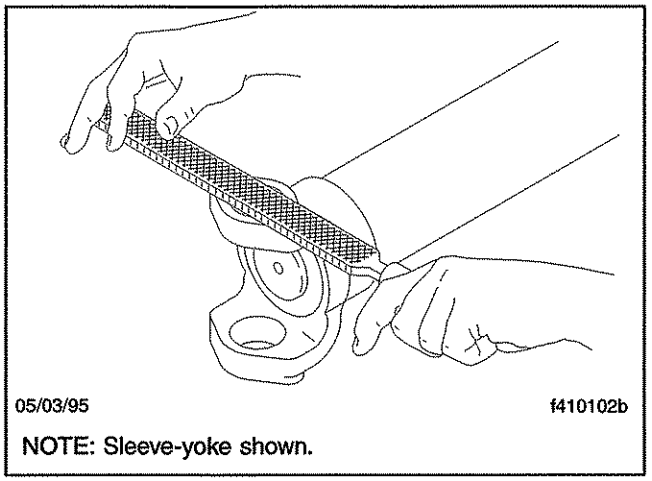
U-Joint Uncoupling and Coupling With a Full-Round End-Yoke

1.4 Using fine emery cloth, smooth and clean the entire surface of the yoke cross-holes. See **Fig. 6**.

1.5 Turn the end-yoke until the centerline through its cross-holes are vertical. See **Fig. 1**.

2. Check, clean, and lubricate the U-joint.

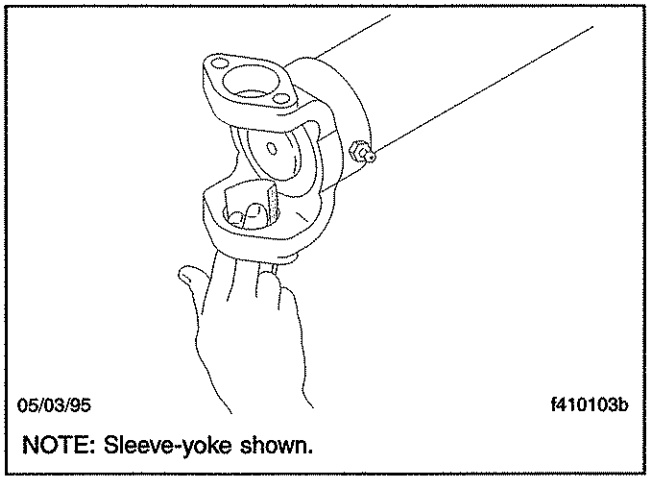
2.1 Using fine emery cloth, smooth and clean the outside surfaces of both bearing cups. See **Fig. 7**.



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NOTE: Sleeve-yoke shown.

Fig. 5, Removing Burrs From the Machined Surface of a Full-Round Yoke Lug



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NOTE: Sleeve-yoke shown.

Fig. 6, Smoothing a Full-Round Yoke Cross-Hole

2.2 Check the U-joint trunnions and bearing cups for minute particles of dirt or grit. Clean if necessary; see **Subject 130**.

⚠ CAUTION

Do not expose the U-joint trunnions or bearing-cup needles to dirt or grit. The smallest bits of dirt or grit can cause rapid wear and serious damage to the U-joint.

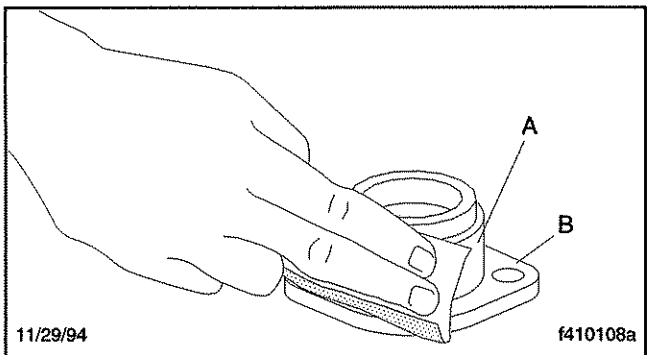
2.3 Using NLGI grade 2 grease with EP additives, wipe a small amount of grease on the needles in the bearing cups.

2.4 Using a light-weight oil, lubricate the lips of the bearing-cup seals. See **Fig. 8**.

3. Couple the U-joint cross to the end-yoke.

3.1 Extend the slip-joint, while pivoting the U-joint cross into place in the yoke cross-holes.

3.2 Move one end of the cross until a trunnion projects through the cross-hole, beyond the outer machined face of the yoke lug. Using a Spicer trunnion (journal) locator (see **Specifications 400**), hold the trunnions in alignment with the cross-holes, while placing a bearing assembly over the projected trunnion, and aligning it with the cross-hole. See **Fig. 9**.



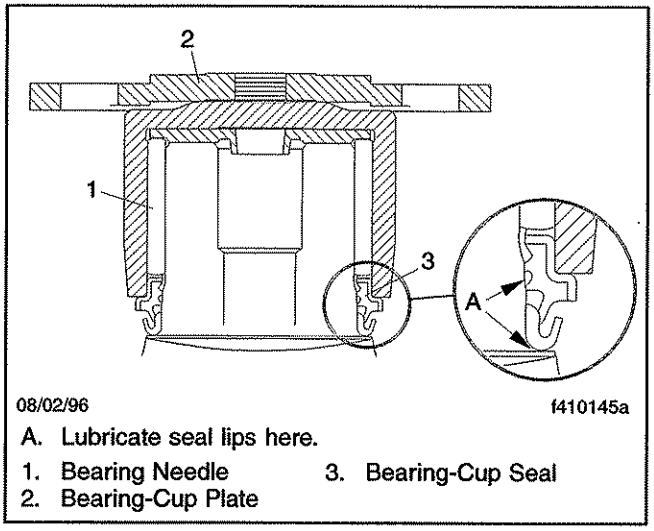
11/29/94 f410108a

A. Use fine emery cloth on this surface.

B. Use a mill file on this surface.

Fig. 7, Smoothing a Full-Round Yoke U-Joint Bearing Cup

U-Joint Uncoupling and Coupling With a Full-Round End-Yoke

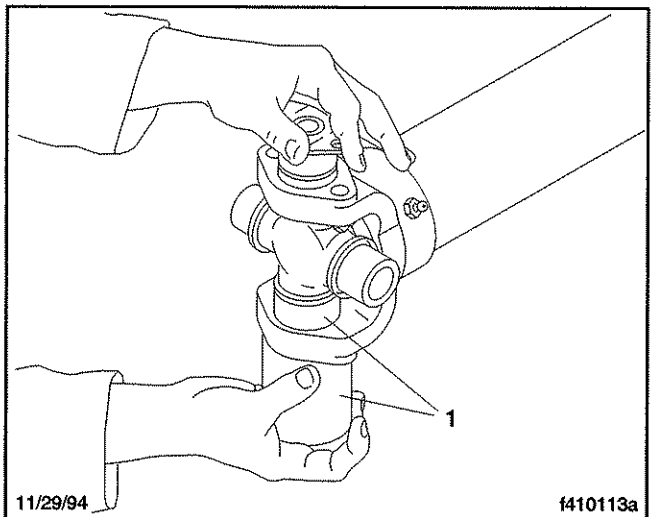


A. Lubricate seal lips here.
1. Bearing Needle
2. Bearing-Cup Plate
3. Bearing-Cup Seal

Fig. 8, Sectional View of a Full-Round Yoke U-Joint Bearing Cup

IMPORTANT: A Spicer trunnion (journal) locator should be used, to prevent damage to the U-joint trunnions and slingers.

3.3 By hand, press the bearing assembly flush with the face of the yoke. If the bearing assembly binds in the cross-hole, tap the *center* of the bearing plate with a rubber or rawhide mallet; do not tap the outer edges of the bearing plate. See **Fig. 10.**



NOTE: Sleeve-yoke shown.
1. Trunnion Locator

Fig. 9, Using a U-Joint Trunnion Locator

3.4 As equipped, install *new* bearing-cup-plate self-locking capscrews (**Fig. 11** for a Spicer U-joint; **Fig. 12** for a Rockwell U-joint), or the lockstrap and bearing-cup-plate (not self-locking) capscrews. Tighten the capscrews until all the parts are drawn down tight, with no gaps; do not tighten the capscrews to their final torque value.

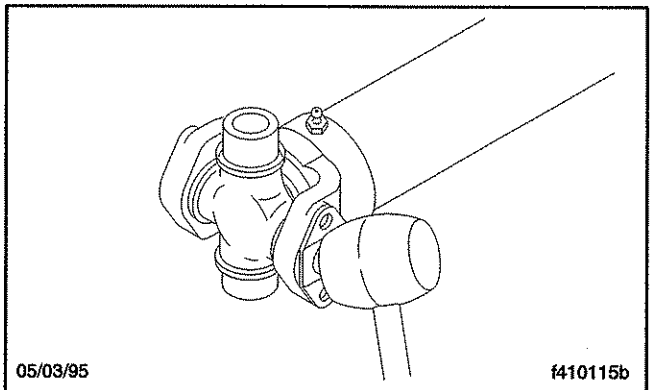
⚠ WARNING

Self-locking bearing-cup-plate capscrews must not be reused; replace the capscrews with new ones. Also, do not undertighten or overtighten any bearing-cup-plate capscrews. A loose or broken fastener at any point in the driveline weakens the driveline connection, which could cause serious vehicle damage, or could result in a driveshaft separating from the vehicle, possibly causing loss of vehicle control that could result in serious personal injury or death.

3.5 Move the cross until it projects beyond the machined surface of the opposite yoke lug. Repeat applicable substeps to install the opposite bearing.

3.6 Alternately tighten the bearing-cup-plate capscrews in increments of 5 lbf·ft (7 N·m), to the torque value in **Specifications 400.**

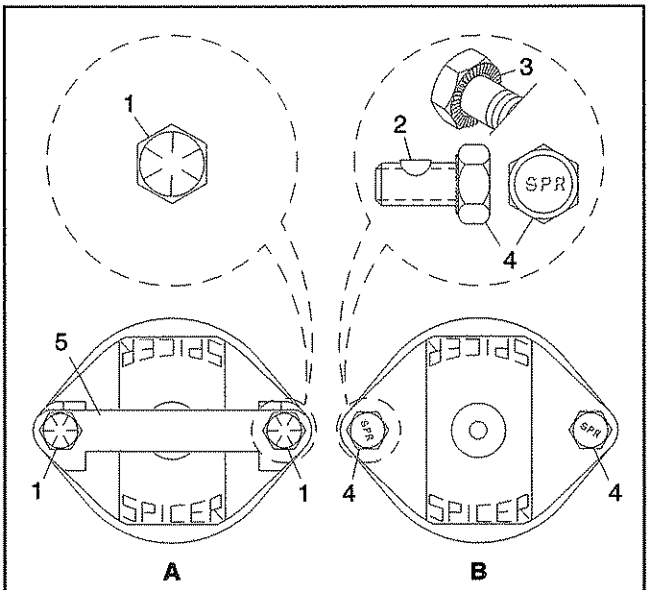
If equipped with lockplates, use a hammer and a pin punch to bend all four tabs of both lockplates upward until the tabs are firmly



NOTE: Sleeve-yoke shown.

Fig. 10, Seating a U-Joint Bearing Cup in a Full-Round Yoke

U-Joint Uncoupling and Coupling With a Full-Round End-Yoke

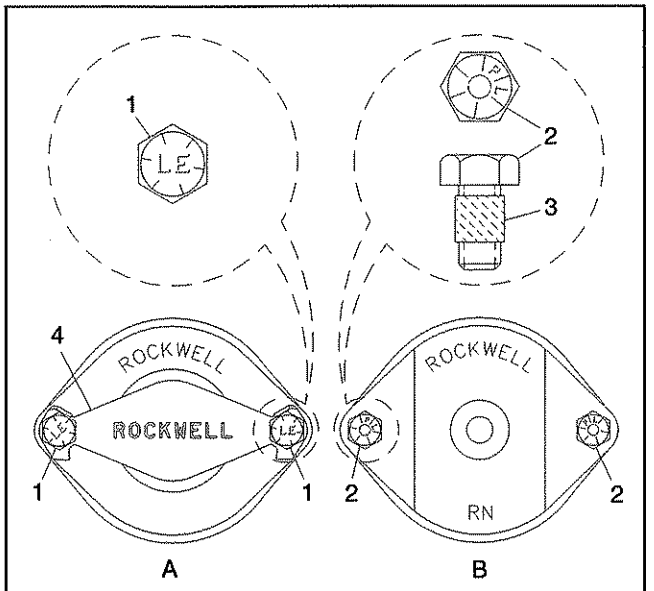


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A. U-Joint With a Lockplate (for a vehicle built before April 1, 1994).
B. U-Joint With Self-Locking Capscrews (for a vehicle built from April 1, 1994).

1. Capscrew (not self-locking)
2. Lock Patch
3. Serrations
4. Self-Locking Capscrew
5. Lockplate

Fig. 11, Spicer U-Joint Fasteners for Full-Round Yokes



08/13/96 f410033b

A. U-Joint With a Lockplate (for a vehicle built before April 1, 1994).
B. U-Joint With Self-Locking Capscrews (for a vehicle built from April 1, 1994).

1. Capscrew (not self-locking)
2. Self-Locking Capscrew
3. Adhesive Band
4. Lockplate

Fig. 12, Rockwell U-Joint Fasteners for Full-Round Yokes

against a flat side of each capscrew. See **Fig. 13.**

4. If they were removed, install the fasteners that attach each midship bearing to its bracket; tighten the flanged locknuts 91 lbf·ft (123 N·m).
5. Lubricate the U-joint, following the procedure in **Group 41** of the *Business Class Trucks Maintenance Manual.*
6. Remove the nylon support straps, then remove the chocks.

U-Joint Uncoupling and Coupling With a Full-Round End-Yoke

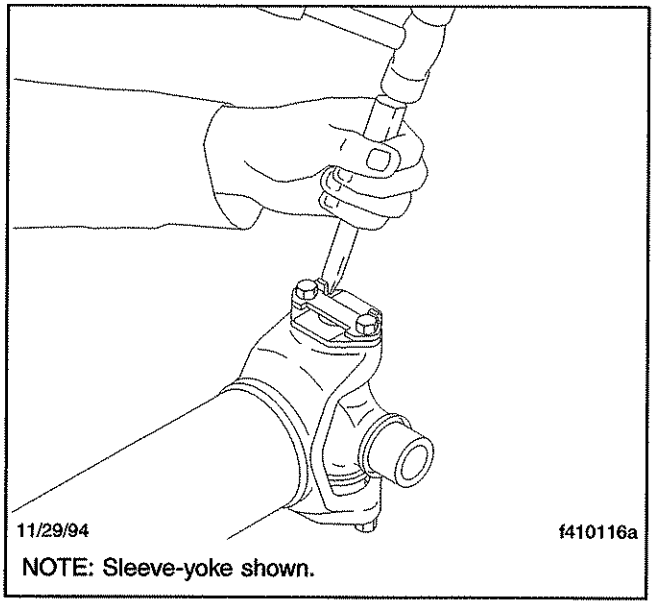


Fig. 13, Bending a Lockplate Tab Against a U-Joint Capscrew

Driveshaft Removal and Installation

NOTE: Many service operations do not require driveshaft removal from the vehicle: end-yoke or companion-flange nut tightening; drive component shaft seal, end-yoke, or flange-yoke replacement; changing U-joint phasing at the slip-yoke; and transmission or axle removal (for overhaul, repair, or replacement). To perform these operations, uncouple the U-joint at the applicable end of the appropriate driveshaft; see **Subject 100**, for uncoupling from a *half-round* end-yoke, or see **Subject 110**, for uncoupling from a *full-round* end-yoke.

It is easier to check driveline parts, and to replace a U-joint or midship bearing assembly if the driveshaft is removed from the vehicle. If a driveshaft requires straightening or balancing, it must be removed, and installed on a lathe or balance machine. Removal is required for replacement of slip-joint parts, a driveshaft tube, or a tube-yoke.

No. 3 Driveshaft Removal (See Fig. 1)

1. Uncouple the no. 3 driveshaft from the rearmost axle. If the no. 3 driveshaft is coupled to *half-round* end-yokes, follow the uncoupling procedure in **Subject 100**. If the no. 3 driveshaft is coupled to *full-round* end-yokes, follow the uncoupling procedure in **Subject 110**.
2. Uncouple the no. 3 driveshaft from the forward-rear axle. If the no. 3 driveshaft is coupled to half-round end-yokes, follow the uncoupling procedure in **Subject 100**. If the no. 3 driveshaft is coupled to full-round end-yokes, follow the uncoupling procedure in **Subject 110**.
3. Lift the no. 3 driveshaft out of the chassis.

No. 2 Driveshaft Removal (See Fig. 2)

1. Uncouple the no. 2 driveshaft from the single or forward-rear axle. If the no. 2 driveshaft is coupled to *half-round* end-yokes, follow the uncoupling procedure in **Subject 100**. If the no. 2 driveshaft is coupled to *full-round* end-yokes, follow the uncoupling procedure in **Subject 110**.
2. For a vehicle with a Spicer SPL90 (1590) *coupling shaft*, use a marking stick or paint to mark the sleeve-yoke and coupling shaft with alignment marks, as shown in **Fig. 3**. Then, pull the driveshaft sleeve-yoke off of the midship bearing splined shaft.

   For all other installations, uncouple the no. 2 driveshaft from the transmission or coupling shaft. If the no. 2 driveshaft is coupled to half-round end-yokes, follow the uncoupling procedure in **Subject 100**. If the no. 2 driveshaft is coupled to full-round end-yokes, follow the uncoupling procedure in **Subject 110**.
3. Lift the no. 2 driveshaft out of the chassis.

Intermediate Coupling Shaft Removal (See Fig. 4)

1. If the no. 2 driveshaft is also being removed, remove it first.

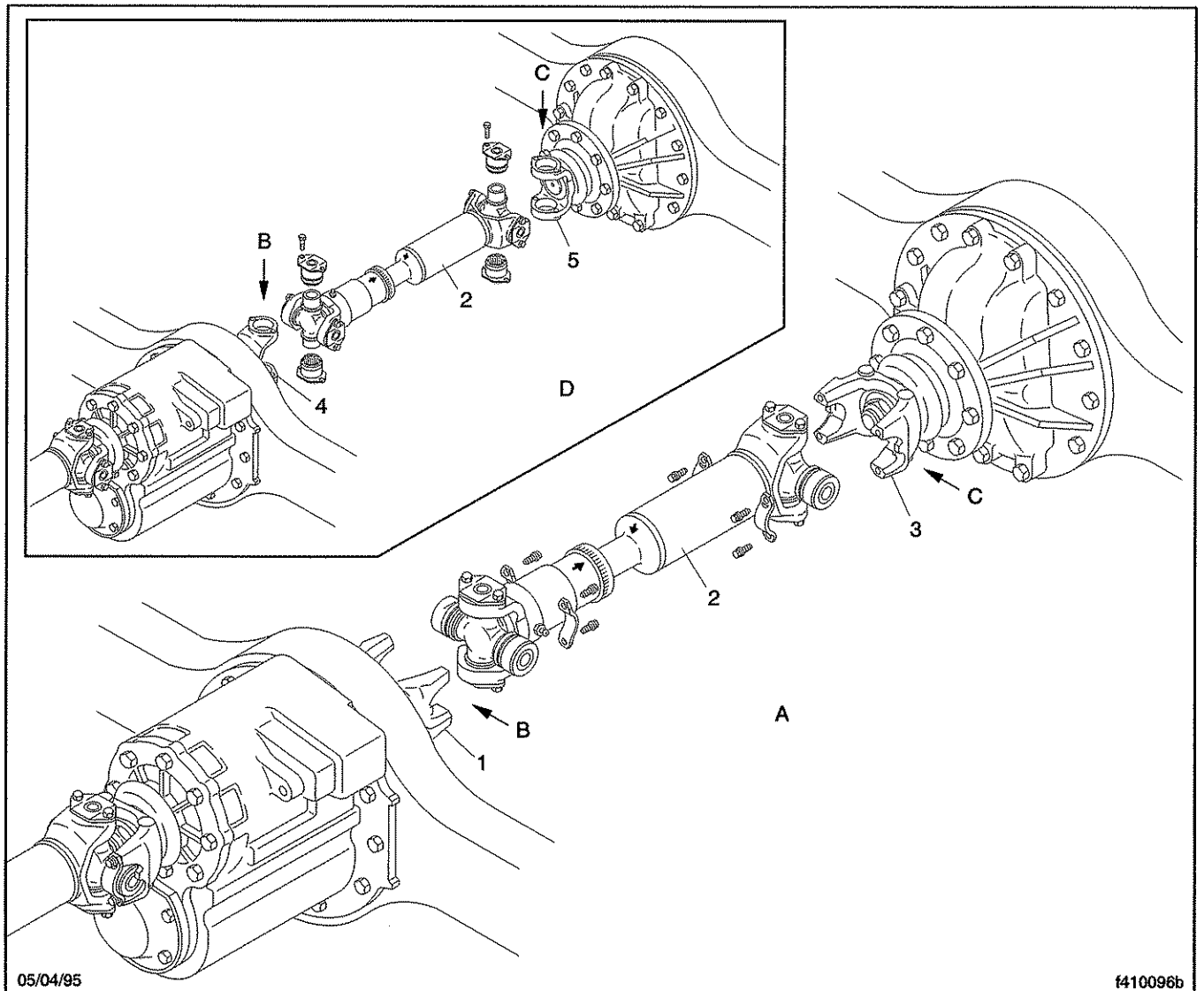
   If the no. 2 driveshaft is not being removed, use a nylon support strap to support its forward end.
2. For a vehicle with a Spicer SPL90 (1590) coupling shaft, use a marking stick or paint to mark the sleeve-yoke and coupling shaft with alignment marks, as shown in **Fig. 3**.

   For all other installations, uncouple the intermediate coupling shaft from the no. 2 driveshaft. If the intermediate coupling shaft has a *half-round* end-yoke, follow the uncoupling procedure in **Subject 100**. If the intermediate coupling shaft has a *full-round* end-yoke, follow the uncoupling procedure in **Subject 110**.
3. Uncouple the intermediate coupling shaft from the primary coupling shaft. See **Fig. 5**. If the primary coupling shaft has a half-round end-yoke, follow the uncoupling procedure in **Subject 100**. If the primary coupling shaft has a full-round end-yoke, follow the uncoupling procedure in **Subject 110**.

NOTE: If the no. 2 driveshaft was not removed from a vehicle with a Spicer SPL90 (1590) driveline, pull the midship bearing splined shaft out of the no. 2 driveshaft sleeve-yoke. See **Fig. 3**.

4. Lift the intermediate coupling shaft out of the chassis.

Driveshaft Removal and Installation



NOTE: Not all fasteners are shown.

A. No. 3 Driveshaft Coupled to Half-Round End-Yokes
B. Uncouple this end last; couple this end first.
C. Uncouple this end first; couple this end last.
D. No. 3 Driveshaft Coupled to Full-Round End-Yokes
1. Forward-Rear Axle Output-Shaft Half-Round End-Yoke
2. No. 3 Driveshaft
3. Rearmost Axle Input-Shaft Half-Round End-yoke
4. Forward-Rear Axle Output-Shaft Full-Round End-Yoke
5. Rearmost Axle Input-Shaft Full-Round End-yoke

Fig. 1, Removal/Installation of a No. 3 Driveshaft

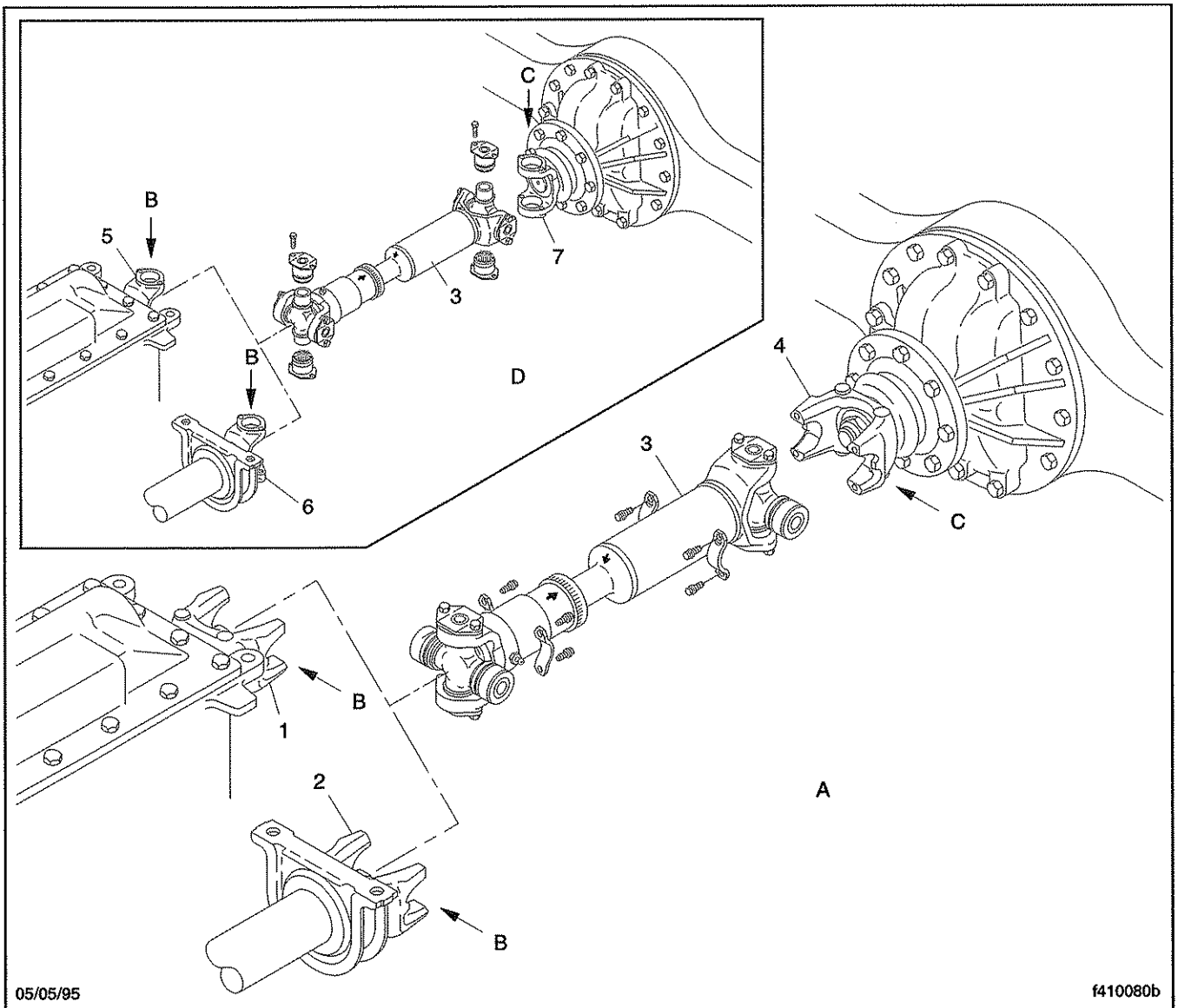
Primary Coupling Shaft Removal

(See Fig. 5)

1. *For a vehicle with one coupling shaft:*

If the no. 2 driveshaft is also being removed, remove it first.

If the no. 2 driveshaft is not being removed, use a nylon support strap to support its forward end. For a vehicle with a Spicer SPL90 (1590) coupling



NOTE: Not all fasteners are shown.

A. No. 2 Driveshaft Coupled to Half-Round End-Yokes
B. Uncouple this end last; couple this end first.
C. Uncouple this end first; couple this end last.
D. No. 2 Driveshaft Coupled to Full-Round End-Yokes

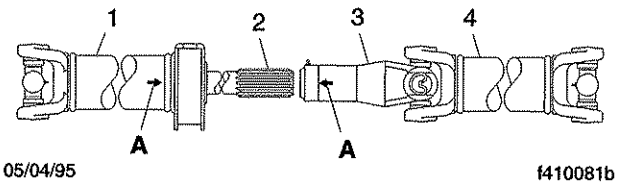
1. Transmission Output-Shaft Half-Round End-Yoke
2. Coupling Shaft Half-Round End-Yoke
3. No. 2 Driveshaft
4. Single Axle or Forward-Rear Axle Input-Shaft Half-Round End-Yoke
5. Transmission Output-Shaft Full-Round End-Yoke
6. Coupling Shaft Full-Round End-Yoke
7. Single Axle or Forward-Rear Axle Input-Shaft Full-Round End-Yoke

Fig. 2, Removal/Installation of a No. 2 Driveshaft

shaft, use a marking stick or paint to mark the sleeve-yoke and coupling shaft with alignment marks, as shown in **Fig. 3**.

For a vehicle with two coupling shafts:

Driveshaft Removal and Installation



A. Add alignment marks at these locations before separating the parts of the slip-joint.
1. Spicer SPL90 (1590) Coupling Shaft
2. Splined Shaft
3. Sleeve-Yoke
4. No. 2 Driveshaft

Fig. 3, Spicer SPL90 (1590) Coupling Shaft Slip-Joint

If the no. 2 driveshaft is also being removed, remove it first; then, remove the intermediate coupling shaft.

If the intermediate coupling shaft is also being removed (but not the no. 2 driveshaft), remove the intermediate coupling shaft first.

If only the primary coupling shaft is being removed, use nylon support straps to support the forward end of the no. 2 driveshaft and both ends of the intermediate coupling shaft. Then, remove the fasteners that attach the intermediate coupling shaft midship bearing to its bracket. See **Fig. 5**.

2. If not already done, uncouple the primary coupling shaft from the no. 2 driveshaft or intermediate coupling shaft. If the primary coupling shaft has a *half-round* end-yoke, follow the uncoupling procedure in **Subject 100**. If the primary coupling shaft has a *full-round* end-yoke, follow the uncoupling procedure in **Subject 110**.

3. Using two nylon support straps, support the primary coupling shaft. Then remove the fasteners that attach the primary coupling shaft midship bearing to its bracket. See **Fig. 5**.

4. Uncouple the primary coupling shaft from the transmission. If the primary coupling shaft is coupled to a half-round end-yoke, follow the uncoupling procedure in **Subject 100**. If the primary coupling shaft is coupled to a full-round end-yoke, follow the uncoupling procedure in **Subject 110**.

NOTE: If the no. 2 driveshaft was not removed from a vehicle with a Spicer SPL90 (1590) single-coupling-shaft driveline, pull the midship bearing splined shaft out of the no. 2 driveshaft sleeve-yoke. See **Fig. 3**.

5. Lift the primary coupling shaft out of the chassis.

Primary Coupling Shaft Installation

(See Fig. 5)

IMPORTANT: Before installing a coupling shaft that has a fixed end-yoke (not a splined reverse-slip shaft), make sure the yokes are aligned to keep the U-joints in phase; see **Fig. 6**.

1. Place the primary coupling shaft under the vehicle and support it with nylon support straps so it can be coupled to the transmission end-yoke.

   If the no. 2 driveshaft was not removed from a vehicle with a Spicer SPL90 (1590) single-coupling-shaft driveline, align the alignment marks **(Fig. 3)** of the coupling shaft and the driveshaft sleeve-yoke, slide the sleeve-yoke over the splined reverse-slip shaft.

2. Couple the shaft to the transmission end-yoke (or flange-yoke). If the primary coupling shaft was coupled to a *half-round* end-yoke, follow the coupling procedure in **Subject 100**. If the primary coupling shaft was coupled to a *full-round* end-yoke, follow the coupling procedure in **Subject 110**.

3. *For a vehicle with one coupling shaft:*

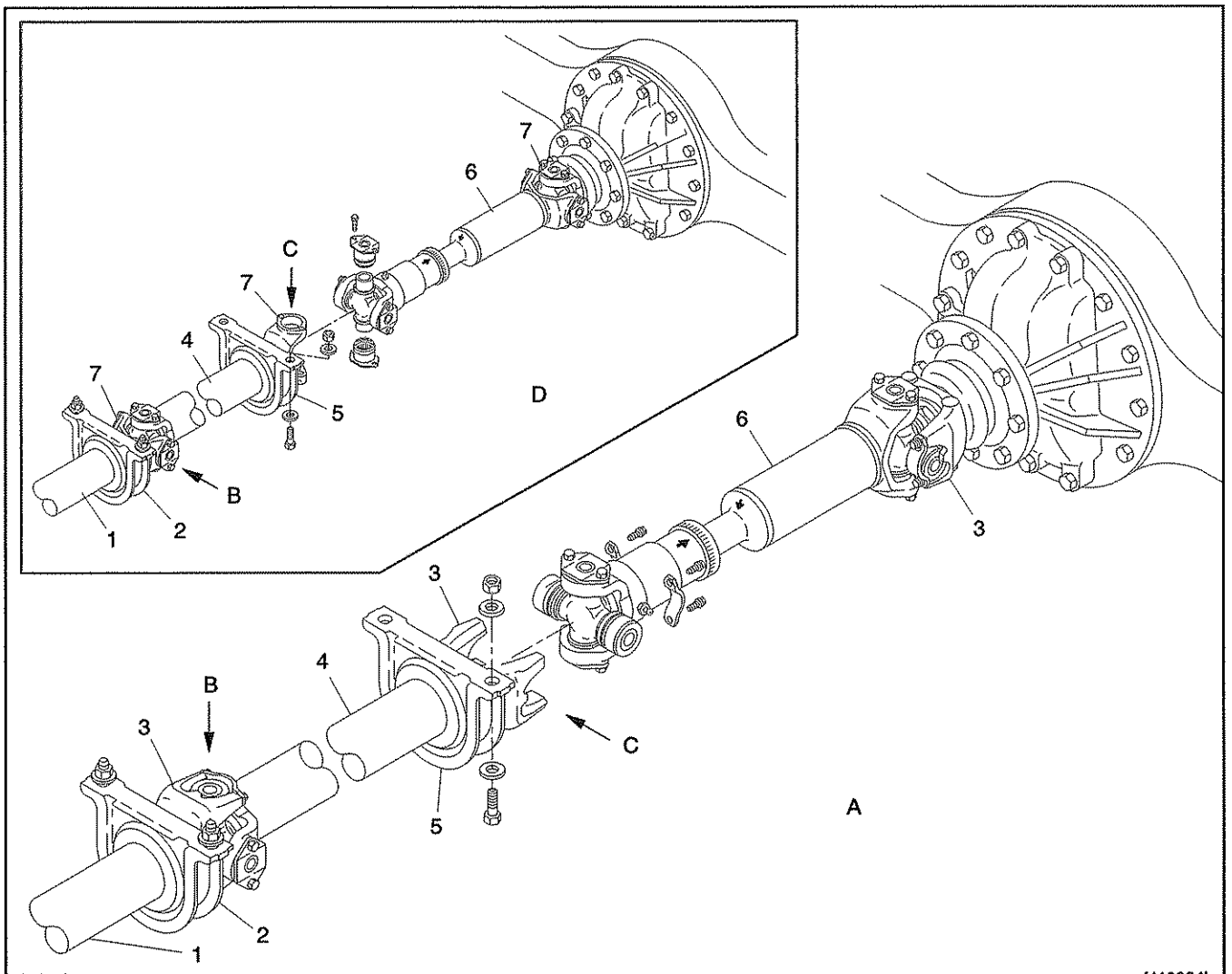
   If the no. 2 driveshaft was also removed, install it, as instructed in this subject.

   If the no. 2 driveshaft was not removed from a vehicle equipped with other than a Spicer SPL90 (1590) driveline, couple it to the primary coupling shaft end-yoke. If the primary coupling shaft has a half-round end-yoke, follow the coupling procedure in **Subject 100**. If the primary coupling shaft has a full-round end-yoke, follow the coupling procedure in **Subject 110**.

   For a vehicle with two coupling shafts:

   If the intermediate coupling shaft was also removed, install it, as instructed in this subject.

   If only the primary coupling shaft was removed, couple the intermediate coupling shaft to the primary coupling shaft end-yoke. If the primary cou-



NOTE: Not all fasteners are shown.

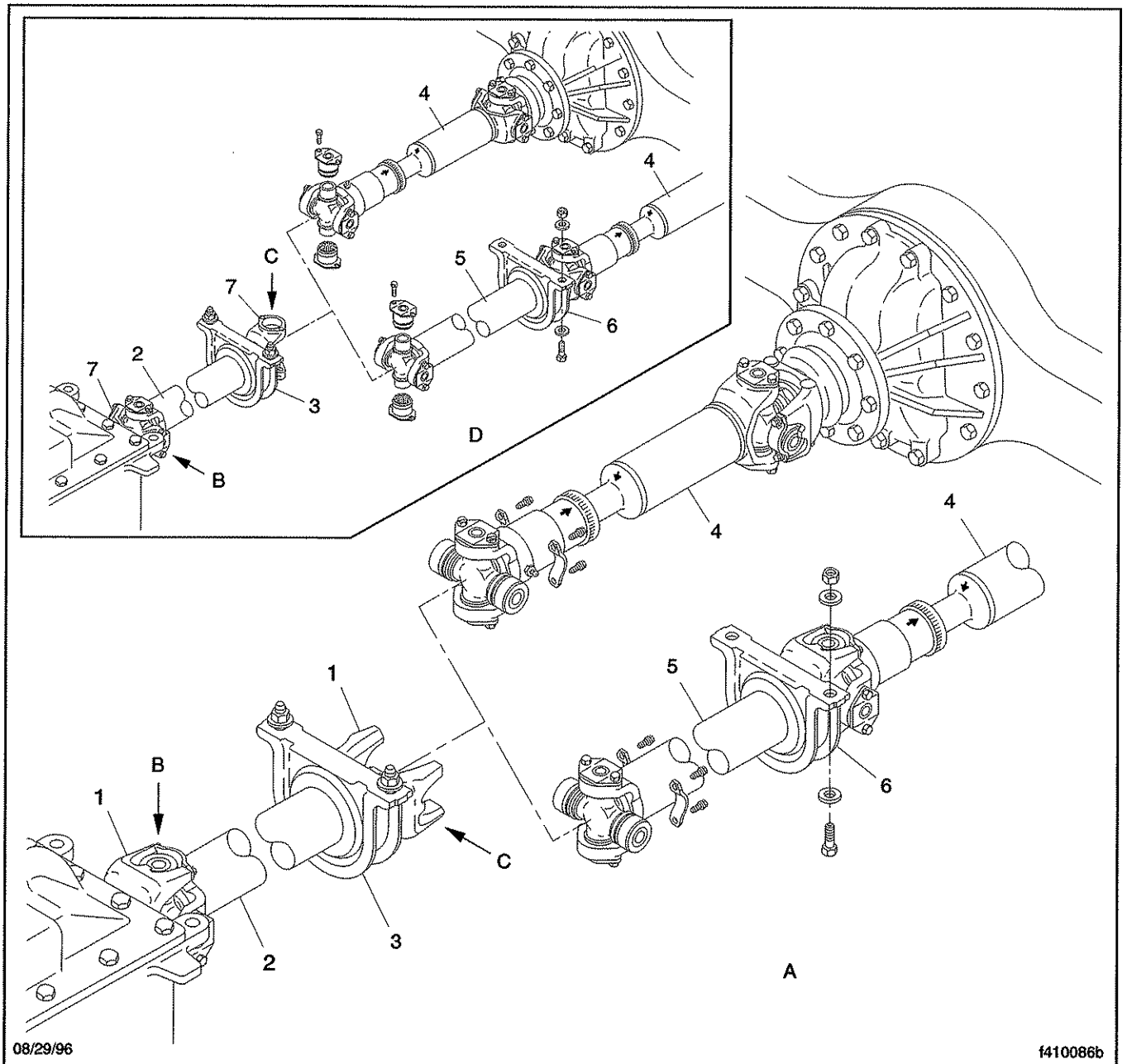
A. No. 2 Driveline With Half-Round End-Yokes
B. Uncouple this end last; couple this end first.
C. Uncouple this end first; couple this end last.
D. No. 2 Driveline With Full-Round End-Yokes

1. Primary Coupling Shaft
2. Primary Coupling Shaft Midship Bearing
3. Half-Round End-Yoke
4. Intermediate Coupling Shaft
5. Intermediate Coupling Shaft Midship Bearing
6. No. 2 Driveshaft
7. Full-Round End-Yoke

Fig. 4, Removal/Installation of an Intermediate Coupling Shaft

pling shaft has a half-round end-yoke, follow the coupling procedure in **Subject 100**. If the primary coupling shaft has a full-round end-yoke, follow the coupling procedure in **Subject 110**.

Driveshaft Removal and Installation

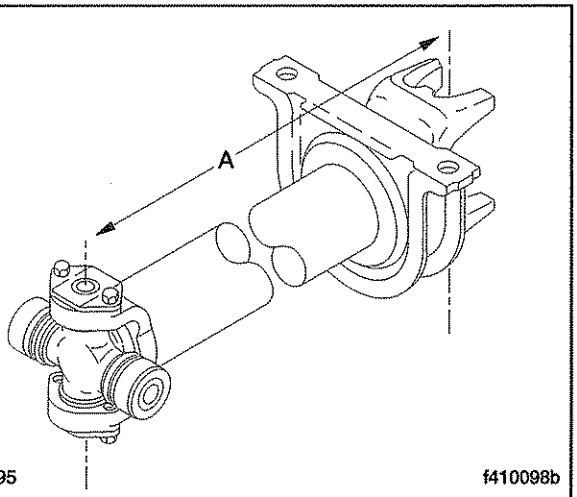


NOTE: Not all fasteners are shown.

A. No. 2 Driveline With Half-Round End-Yokes
B. Uncouple this end last; couple this end first.
C. Uncouple this end first; couple this end last.
D. No. 2 Driveline With Full-Round End-Yokes

1. Half-Round End-Yoke
2. Primary Coupling Shaft
3. Primary Coupling Shaft Midship Bearing
4. No. 2 Driveshaft
5. Intermediate Coupling Shaft
6. Intermediate Coupling Shaft Midship Bearing
7. Full-Round End-Yoke

Fig. 5, Removal/Installation of a Primary Coupling Shaft



A. Cross-hole centerlines of both yokes must be in alignment.

Fig. 6, U-Joint Phasing of a Coupling Shaft Equipped With an End-Yoke

Intermediate Coupling Shaft Installation (See Fig. 4)

IMPORTANT: Before installing a coupling shaft that has a fixed end-yoke (not a splined reverse-slip shaft), make sure the yokes are aligned to keep the U-joints in phase; see **Fig. 6**.

1. If the primary coupling shaft was also removed, install it first, as instructed in this subject.
2. Place the intermediate coupling shaft under the vehicle and support it with nylon support straps so it can be coupled to the primary coupling shaft end-yoke.

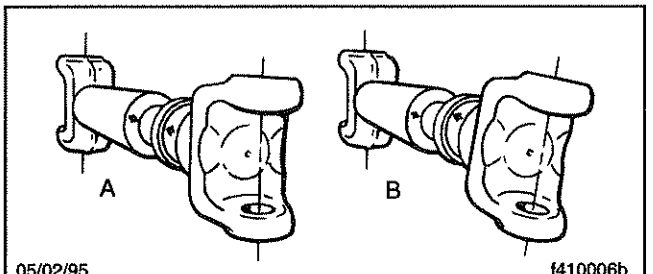
   If the no. 2 driveshaft was not removed from a vehicle with a Spicer SPL90 (1590) driveline, align the alignment marks (**Fig. 3**) of the coupling shaft and the driveshaft sleeve-yoke, slide the sleeve-yoke over the splined reverse-slip shaft.
3. Couple the intermediate coupling shaft to the primary coupling shaft end-yoke. If the intermediate coupling shaft was coupled to a *half-round* end-yoke, follow the coupling procedure in **Subject 100**. If the intermediate coupling shaft was coupled to a *full-round* end-yoke, follow the coupling procedure in **Subject 110**.
4. If the no. 2 driveshaft was also removed, install it, as instructed in this subject.

   If the no. 2 driveshaft was not removed from a vehicle equipped with other than a Spicer SPL90 (1590) driveline, couple it to the intermediate coupling shaft end-yoke. If the intermediate coupling shaft has a half-round end-yoke, follow the coupling procedure in **Subject 100**. If the intermediate coupling shaft has a full-round end-yoke, follow the coupling procedure in **Subject 110**.

No. 2 Driveshaft Installation (See Fig. 2)

IMPORTANT: Before installing a no. 2 driveshaft that has a sleeve-yoke (not a splined reverse-slip shaft) at its forward end, make sure the alignment marks on the slip-joint assembly are aligned, to keep the U-joints in phase; see **Fig. 7**.

1. If a primary coupling shaft was also removed, install it first, as instructed in this subject.
2. If an intermediate coupling shaft was also removed, install it before installing the no. 2 driveshaft.
3. Place the no. 2 driveshaft under the vehicle with its sleeve-yoke at the forward end, and support its rear end with a nylon support strap.
4. For a vehicle with a Spicer SPL90 (1590) coupling shaft, align the alignment marks (**Fig. 3**) of the coupling shaft and the no. 2 driveshaft sleeve-yoke, then slide the sleeve-yoke over the splined reverse-slip shaft.



A. In Phase B. Out of Phase

Fig. 7, U-Joint Phasing

Driveshaft Removal and Installation

For all other vehicles, couple the sleeve-yoke to the coupling shaft end-yoke or transmission output-shaft end-yoke, as applicable. If the no. 2 driveshaft was coupled to *half-round* end-yokes, follow the coupling procedure in **Subject 100**. If the no. 2 driveshaft was coupled to *full-round* end-yokes, follow the coupling procedure in **Subject 110**.

5. Couple the no. 2 driveshaft to the axle input-shaft end-yoke. If the no. 2 driveshaft was coupled to half-round end-yokes, follow the coupling procedure in **Subject 100**. If the no. 2 driveshaft was coupled to full-round end-yokes, follow the coupling procedure in **Subject 110**.

No. 3 Driveshaft Installation (See Fig. 1)

IMPORTANT: Before installing a no. 3 driveshaft, make sure the alignment marks on the slip-joint assembly are aligned, to keep the U-joints in phase; see **Fig. 7**.

1. Place the no. 3 driveshaft under the vehicle with its sleeve-yoke at the forward end, and support its rear end with a nylon support strap.
2. Couple the sleeve-yoke to the forward-rear axle output-shaft end-yoke. If the no. 3 driveshaft was coupled to *half-round* end-yokes, follow the coupling procedure in **Subject 100**. If the no. 3 driveshaft was coupled to *full-round* end-yokes, follow the coupling procedure in **Subject 110**.
3. Couple the no. 3 driveshaft to the axle input-shaft end-yoke. If the no. 3 driveshaft was coupled to half-round end-yokes, follow the coupling procedure in **Subject 100**. If the no. 3 driveshaft was coupled to full-round end-yokes, follow the coupling procedure in **Subject 110**.

Driveline Component Removal/Disassembly, Cleaning and Inspection, and Replacement or Installation/Assembly

Driveline Parking Brake Flange-Yoke or Companion Flange Removal

For removal of a driveline parking brake flange-yoke or companion flange, see **Group 42.**

Spicer 1610/1710/1760/1810 U-Joint or Rockwell 17/176/18-Series U-Joint Removal

1. Remove the driveshaft from the vehicle; see **Subject 120.**
2. Place the driveshaft in V-blocks or a soft-jawed vise; do not distort the tube with excessive grip.
3. For a vehicle built from April 1, 1994, remove and discard all four bearing-plate self-locking capscrews. See **Fig. 1**, for Spicer U-joints or **Fig. 2** for Rockwell U-joints.

   For a vehicle built before April 1, 1994, use a pin punch to bend the tabs of the lockplates away from all four bearing-cup-plate capscrews. See **Fig. 3.** Remove all four capscrews and both lockplates.

IMPORTANT: If the U-joint will be reinstalled, use care not to nick the cross trunnions or damage the slingers. See **Fig. 4.**

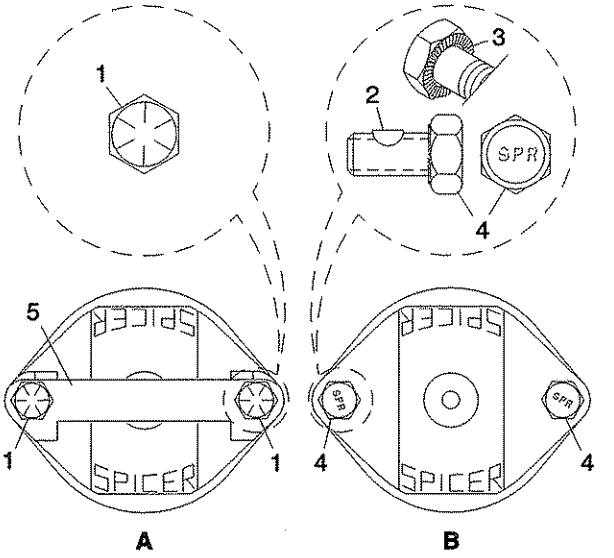
4. Using one of the U-joint pullers listed in **Subject 400**, remove both bearing cups from the yoke cross-holes. See **Fig. 5.** Remove the cross from the yoke.

Spicer SPL90 (1590) U-Joint Removal

1. Remove the driveshaft from the vehicle; see **Subject 110.**
2. Clamp the driveshaft in a soft-jawed vise; do not distort the tube with excessive grip.

NOTE: When removing a U-joint that connects the sleeve-yoke to the forward tube-yoke of the no. 2 driveshaft, mark the sleeve-yoke and driveshaft tube with alignment marks, clamp the driveshaft tube in the vise, and disconnect the U-joint from the tube-yoke, first. Then, clamp the sleeve-yoke in the vise, and remove the U-joint from the sleeve-yoke. See **Fig. 6.**

3. Remove the U-joint snap rings from the yoke.
   - 3.1 Using a hammer and a soft drift, tap the outside of the bearing cup to loosen the snap ring. See **Fig. 7.** Tap the bearing only hard enough to break the assembly away from the snap ring.
   - 3.2 Using pliers, remove the snap ring. See **Fig. 8.**
   - 3.3 Turn the shaft (or sleeve-yoke) over, then repeat this step for the opposite snap ring.
4. Press the U-joint bearing assemblies and cross out of the yoke. See **Fig. 9.**
   - 4.1 Set the yoke in an arbor press, on a piece of tube stock with an inside diameter larger

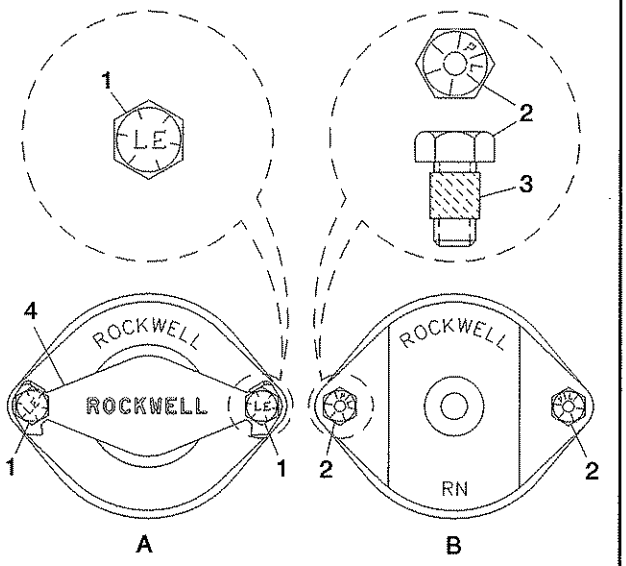


05/03/95 f410140a

A. U-Joint With a Lockplate (for a vehicle built before April 1, 1994).
B. U-Joint With Self-Locking Capscrews (for a vehicle built from April 1, 1994).
1. Capscrew (not self-locking)
2. Lock Patch
3. Serrations
4. Self-Locking Capscrew
5. Lockplate

Fig. 1, Spicer U-Joint Fasteners for Full-Round Yokes

Driveline Component Removal/Disassembly, Cleaning and Inspection, and Replacement or Installation/Assembly



08/13/96 f410033b

A. U-Joint With a Lockplate (for a vehicle built before April 1, 1994).
B. U-Joint With Self-Locking Capscrews (for a vehicle built from April 1, 1994).

1. Capscrew (not self-locking)
2. Self-Locking Capscrew
3. Adhesive Band
4. Lockplate

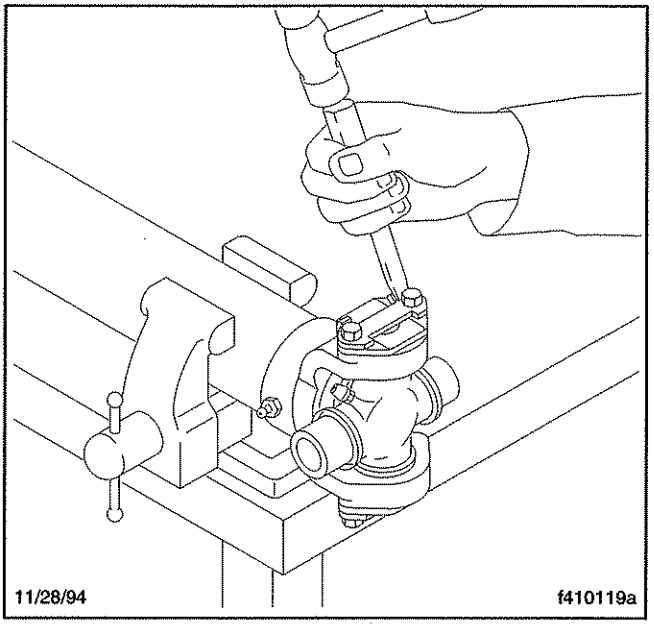
Fig. 2, Rockwell U-Joint Fasteners for Full-Round Yokes

than the outside diameter of the bearing cup. See **Fig. 9.**

4.2 Place a solid plug with an outside diameter slightly smaller than the inside diameter of the yoke cross-holes, on the upper bearing assembly. Press it through the upper cross-hole to release the lower bearing assembly.

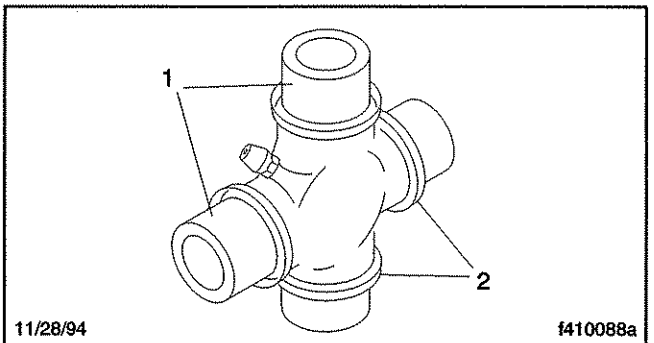
If the bearing assembly will not pull out by hand after pressing, tap the base of the yoke lug near the bearing assembly to dislodge it.

4.3 Remove the opposite bearing assembly by turning the yoke over, and straightening the cross in the open cross-hole. Then carefully press on the end of the cross so the remaining bearing assembly moves straight out of the cross-hole.



11/28/94 f410119a

Fig. 3, Bending a Lockplate Tab Away From a U-Joint Capscrew



11/28/94 f410088a

1. Trunnions 2. Slingers

Fig. 4, U-Joint Cross

IMPORTANT: If the cross or bearing assembly is cocked, the bearing assembly will score the walls of the cross-hole and ruin the yoke.

Slip-Joint Disassembly

1. Check that the driveshaft yokes are aligned to hold the U-joints at either end in phase, as shown in **Fig. 10.** Using a marking stick or paint, mark the sleeve-yoke and splined shaft with alignment marks, as shown in **Fig. 11.** This will ensure proper

Driveline Component Removal/Disassembly, Cleaning and Inspection, and Replacement or Installation/Assembly

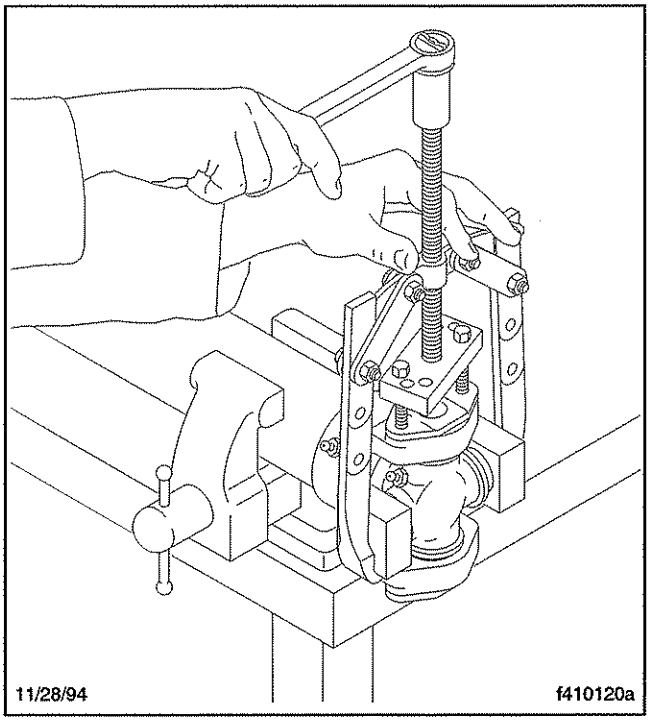


Fig. 5, Removing a Bearing Cup From a Full-Round Yoke

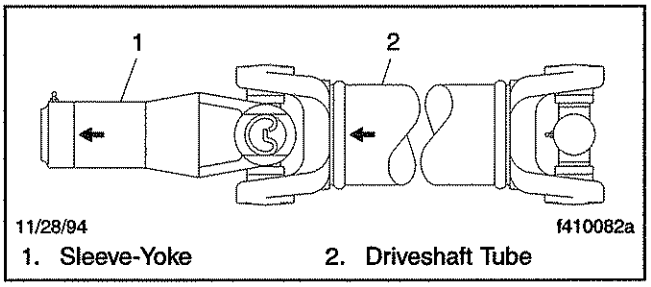


Fig. 6, Spicer SPL90 (1590) No. 2 Driveshaft (as used with a coupling shaft)

alignment of the slip-joint components when the driveshaft is assembled.

IMPORTANT: Misaligned driveshaft yokes will cause the U-joints to be out of phase, which will cause vibration in the driveline.

2. With the driveshaft uncoupled at one end, *or* removed from the vehicle, use a strap wrench to unscrew the slip-joint dust cap from the sleeve-yoke, then pull the sleeve-yoke off of the splined shaft. Remove the dust cap, and (if so equipped) the steel washer and cork seal. See **Fig. 12.**

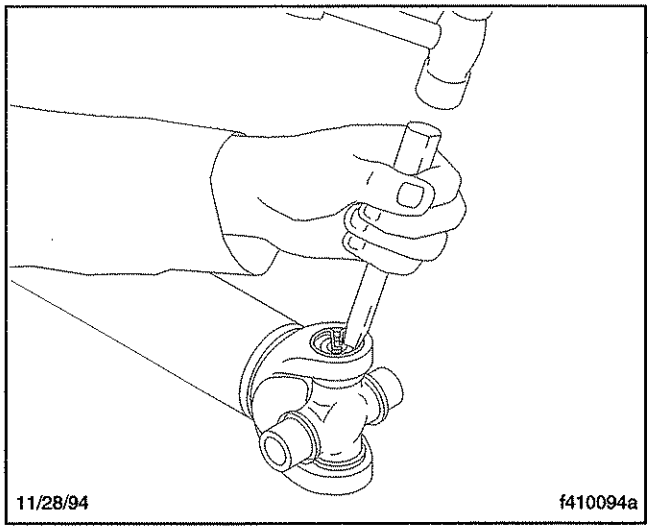


Fig. 7, Loosening a Spicer SPL90 (1590) U-Joint Snap Ring

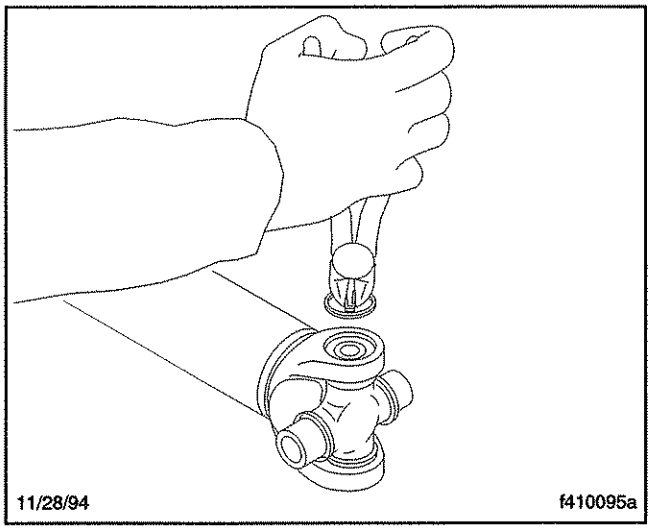


Fig. 8, Removing/Installing a Spicer SPL90 (1590) U-Joint Snap Ring

Transmission/Axle End-Yoke Removal

IMPORTANT: Before removing a transmission output-shaft end-yoke or an axle shaft end-yoke, do the steps under "End-Yoke Cleaning and Inspection."

1. Uncouple the driveshaft from the end-yoke (**Subject 100** for a half-round yoke or **Subject 110** for

Driveline Component Removal/Disassembly, Cleaning and Inspection, and Replacement or Installation/Assembly

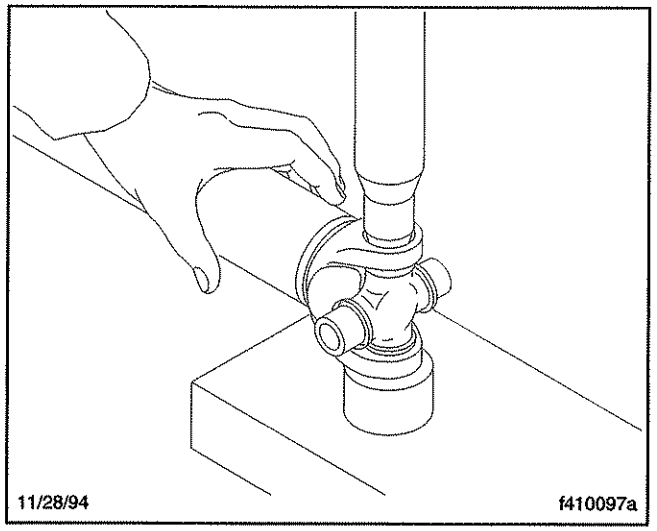


Fig. 9, Pressing a Spicer SPL90 (1590) U-Joint Out-of/Into a Yoke

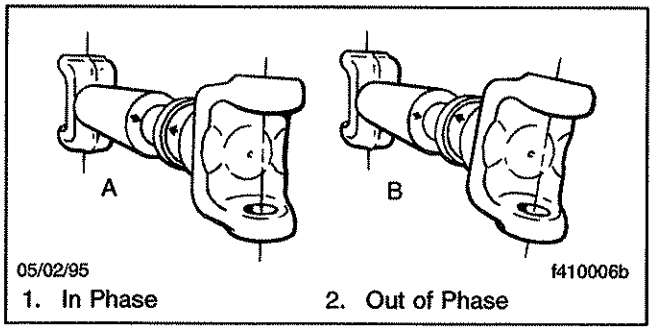


Fig. 10, U-Joint Phasing

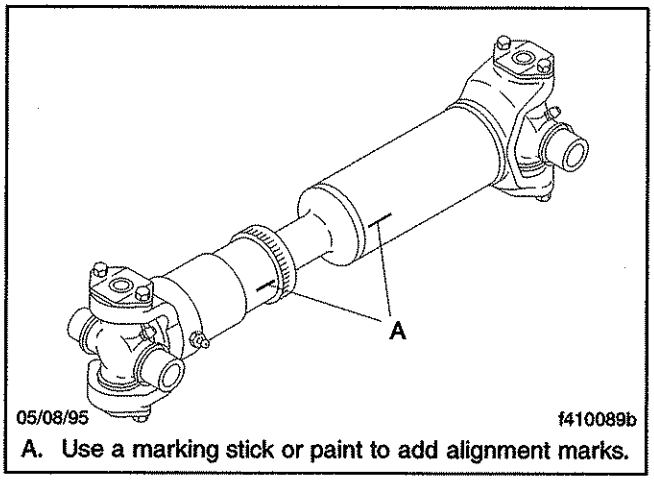


Fig. 11, Slip-Joint Alignment Marks

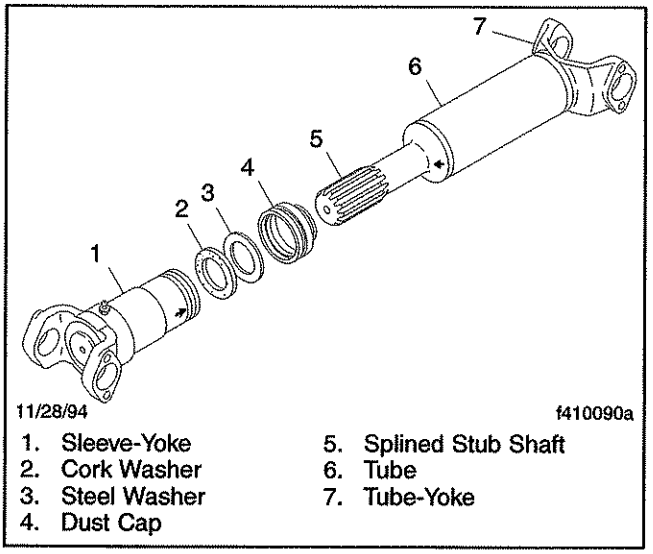


Fig. 12, Slip-Joint Components

a full-round yoke), or remove the driveshaft from the vehicle (**Subject 120**).

2. Remove the end-yoke locknut. See **Fig. 13**.
3. Using a yoke puller, remove the end-yoke. See **Fig. 14** for a half-round end-yoke, or **Fig. 15** for a full-round end-yoke.

Coupling Shaft End-Yoke and Midship Bearing Removal

1. Remove the coupling shaft from the vehicle; see **Subject 120**.

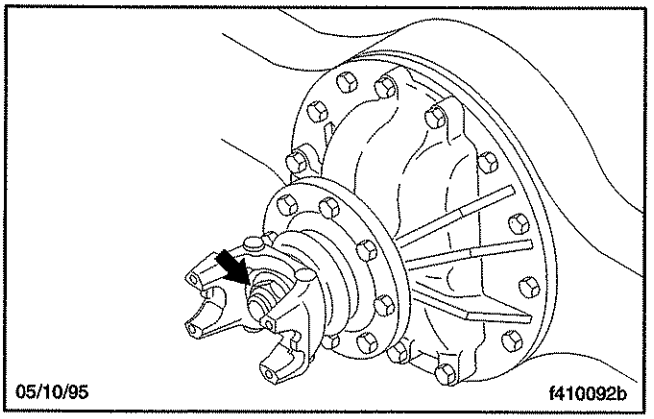
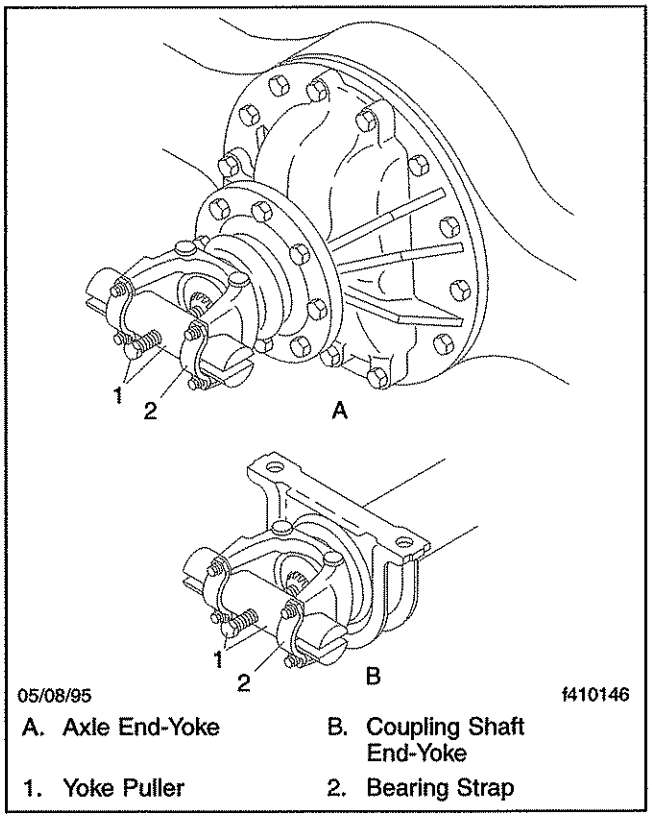


Fig. 13, Axle End-Yoke Locknut

Driveline Component Removal/Disassembly, Cleaning and Inspection, and Replacement or Installation/Assembly



A. Axle End-Yoke
B. Coupling Shaft End-Yoke
1. Yoke Puller
2. Bearing Strap

Fig. 14, Removing a Half-Round End-Yoke

2. Clamp the coupling shaft in a soft-jawed vise; do not distort the tube with excessive grip.

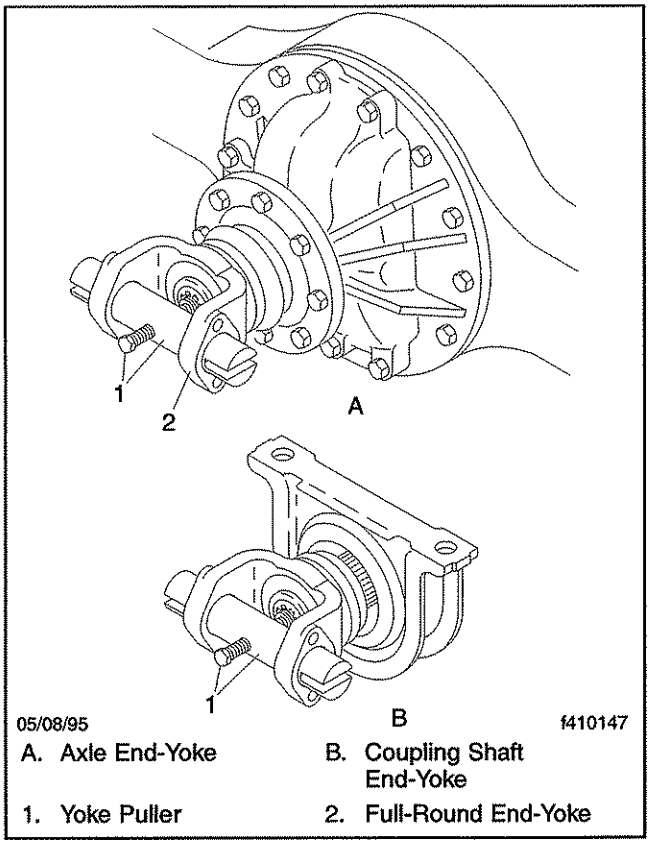
3. If the coupling shaft has an end-yoke (**Fig. 16**), not a splined reverse-slip shaft, go to the next step.

   If the coupling shaft has a splined reverse-slip shaft, not an end-yoke (**Fig. 17**), use a hammer and a brass drift to remove the midship bearing and slingers. See **Fig. 18**.

4. If the coupling shaft has an end-yoke, remove the end-yoke; see **Fig. 14** for a half-round end-yoke, or **Fig. 15** for a full-round end-yoke. Then, remove the midship bearing and slingers; see **Fig. 18**.

   4.1 Use a marking stick or paint to mark the end-yoke and coupling shaft with alignment marks. See **Fig. 16**.

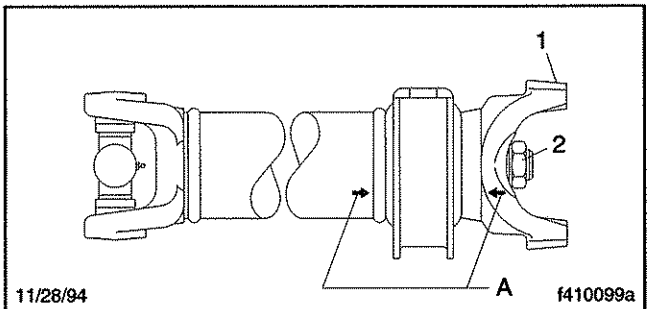
   4.2 Remove the coupling shaft end-yoke locknut.



A. Axle End-Yoke
B. Coupling Shaft End-Yoke
1. Yoke Puller
2. Full-Round End-Yoke

Fig. 15, Removing a Full-Round End-Yoke

   4.3 Using a yoke puller, remove the end-yoke. See **Fig. 14** for a half-round end-yoke, or **Fig. 15** for a full-round end-yoke.



A. Use a marking stick or paint to mark the end-yoke and coupling shaft with alignment marks.
1. Half-Round End-Yoke 2. End-Yoke Locknut

Fig. 16, Alignment Marks on a Coupling Shaft With an End-Yoke

Driveline Component Removal/Disassembly, Cleaning and Inspection, and Replacement or Installation/Assembly

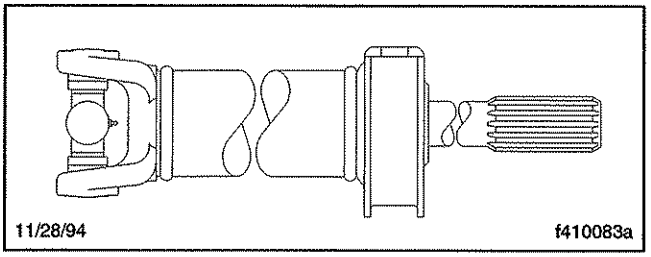


Fig. 17, Spicer SPL90 (1590) Coupling Shaft With a Splined Reverse-Slip Shaft

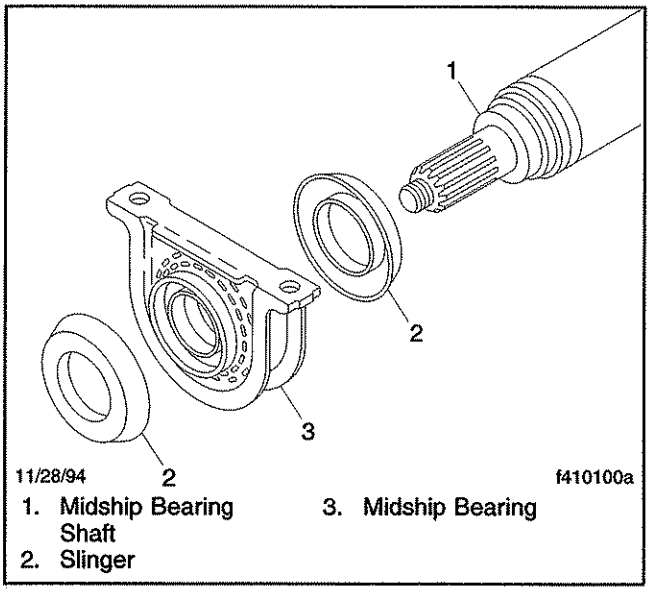


Fig. 18, Midship Bearing and Slingers

4.4 Use a hammer and a brass drift to remove the midship bearing and slingers. See **Fig. 18.**

Driveshaft Tube, Slip-Joint, Sleeve-Yoke, and Tube-Yoke Cleaning and Inspection

1. With the driveshaft removed, scrape or soak away any foreign material.
2. Examine the driveshaft tube for dents, bends, twists, splitting weld-seams, and signs of missing balance weights.

   Replace the driveshaft tube if damaged; see "Driveshaft Tube, Stub Shaft (Slip-Joint), or Tube-Yoke Replacement." If balance weights appear to be missing, have the driveshaft balanced to a maximum tolerance of one inch-ounce per ten pounds weight per end, at 3000 rpm.
3. Clean the slip-joint (male and female) splines, then check them for twisting and galling. See **Fig. 19.** Replace both the sleeve-yoke and the splined shaft if the slip-joint is damaged; see "Slip-Joint Replacement or Assembly" and "Driveshaft Tube, Stub Shaft (Slip-Joint), or Tube-Yoke Replacement." Remove any burrs or rough spots using fine emery cloth.
4. Check for a loose or missing sleeve-yoke plug. See **Fig. 20.** Repair or replace the plug as needed.
5. With the U-joint assemblies removed, check all driveshaft yoke cross-holes for raised metal. Using a rat-tail or half-round file, remove burrs or raised metal. See **Fig. 21.**

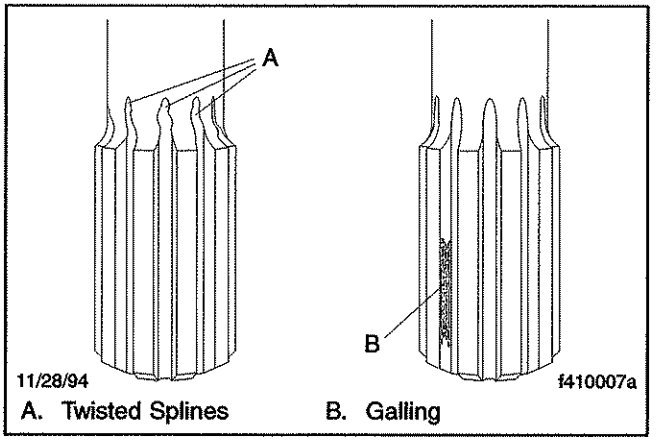


Fig. 19, Damaged Slip-Joint Splines

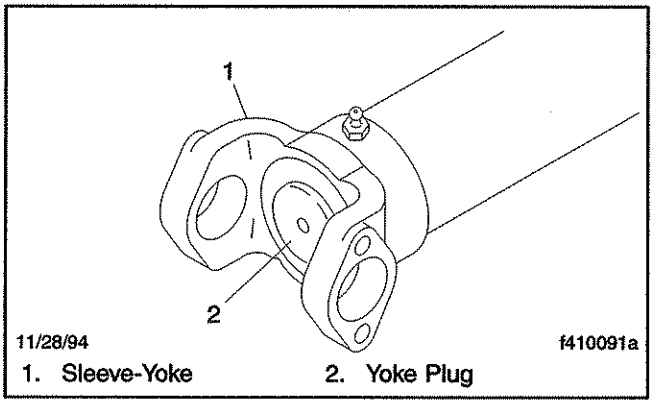
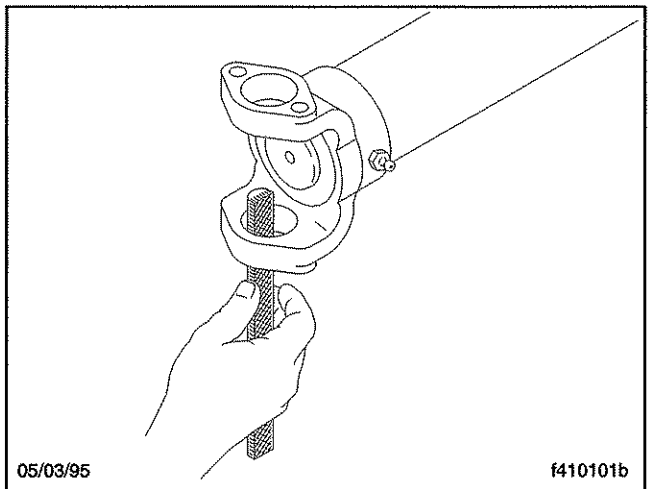


Fig. 20, Sleeve-Yoke Plug

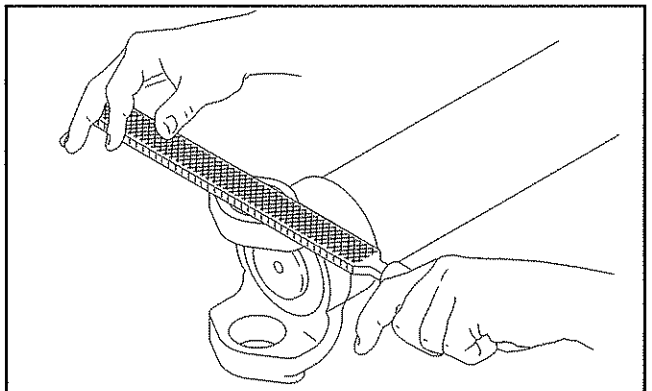
Driveline Component Removal/Disassembly, Cleaning and Inspection, and Replacement or Installation/Assembly

6. Using a mill file, and holding it flat against the machined surface of the driveshaft yoke lug, file each yoke lug, to remove any burrs or raised metal. See **Fig. 22**.
7. Using fine emery cloth, smooth and clean the entire surface of all driveshaft yoke cross-holes. See **Fig. 23**.



NOTE: Sleeve-yoke shown.

Fig. 21, Removing Burrs From a Full-Round Yoke Cross-Hole



NOTE: Sleeve-yoke shown.

Fig. 22, Removing Burrs From the Machined Surface of a Full-Round Yoke Lug

Midship Bearing Cleaning and Inspection

1. With the midship bearing removed from the coupling shaft, use clean rags or paper towels to wipe off the outside of the midship bearing, rubber cushion, and slingers.

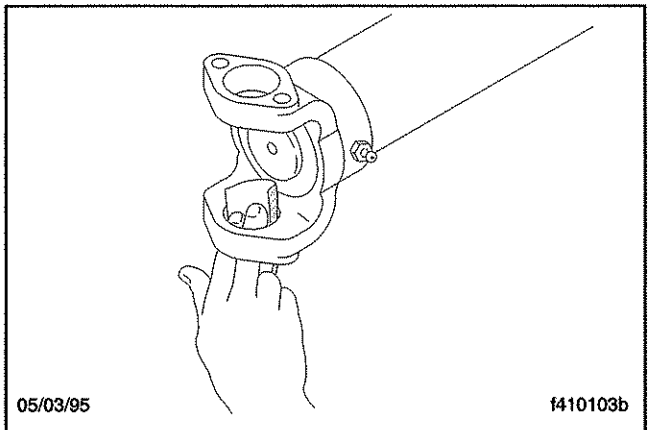
IMPORTANT: Do not immerse the midship bearing in cleaning solvent. The solvent will wash out the lubricant, requiring bearing-assembly replacement.

2. Check the midship bearing for roughness or rattles by holding the outside of the bearing while manually turning the inner bearing race. Replace the bearing assembly if there are any rough spots or rattles.
3. Check the rubber cushion for deterioration or oil-soaking, and replace the midship bearing assembly if needed.

End-Yoke Cleaning and Inspection

1. With the transmission output-shaft and axle shaft end-yokes installed, check them for cracks and looseness.

   Replace cracked yokes. If the end-yoke can be moved in or out on its shaft, or can be rocked on its shaft, uncouple the driveshaft from the end-yoke. Check the drive component's shaft seal for leakage or other visible damage that may have been caused by the loose yoke. Replace the shaft seal



NOTE: Sleeve-yoke shown.

Fig. 23, Smoothing a Full-Round Yoke Cross-Hole

Driveline Component Removal/Disassembly, Cleaning and Inspection, and Replacement or Installation/Assembly

if needed. Tighten the end-yoke nut to the torque value given in **Subject 400**. If the end-yoke is still loose after tightening the yoke nut, install a new yoke and yoke nut.

NOTE: If the end-yoke locknut is removed for any reason, install a new one.

2. With the U-joints uncoupled from the end-yokes, check all driveshaft and input/output shaft end-yoke cross-holes for raised metal. Using a rat-tail or half-round file, remove burrs or raised metal. See **Fig. 21** for full-round yokes, or **Fig. 24** for half-round yokes.
3. Using a mill file, and holding it flat against the machined surface of the *full-round* end-yoke lug, file each yoke lug, to remove any burrs or raised metal. See **Fig. 22**.
4. Smooth and clean the entire surface of all end-yoke cross-holes, using fine emery cloth. See **Fig. 23** for full-round yokes, or **Fig. 25** for half-round yokes.

U-Joint Cleaning and Inspection

1. With the U-joints removed from the yokes, and the bearing cups removed from the crosses, inspect the U-joint cross slingers for damage, then inspect the U-joint trunnions for spalling (flaking metal), end galling (displacement of metal), brinelling (grooves caused by bearing needles), and pitting (small craters caused by corrosion). See **Fig. 26**. If damaged, replace the U-joint assembly.
2. Using a hand-type grease gun, apply multipurpose chassis grease to the fitting on each U-joint cross until all old lubricant is forced out. See **Fig. 27**. Examine the old lubricant. If it appears rusty, gritty, or burnt, replace the U-joint assembly.
3. Soak the bearing cups in a non-flammable cleaner until particles of grease and foreign matter are loosened or dissolved. Do not disassemble the bearing cups; clean the bearing needles with a short, stiff brush, then blow them dry with compressed air. Check for minute particles of dirt or grit, and clean again if necessary.
4. Check each bearing cup for missing bearing needles. Check the bearing-cup seals for nicks. See **Fig. 28** for a half-round-yoke U-joint bearing cup, or **Fig. 29** for a full-round-yoke U-joint bearing cup. Replace the U-joint assembly if any bearing needles are missing or any seals are damaged.
5. Apply a small quantity of multipurpose chassis grease to the bearing needles in each cup, then apply a small amount of light-weight oil to the lips of the bearing-cup seals. Rotate each bearing cup on the cross to check for wear. Replace the U-joint assembly if any bearing surfaces are worn.

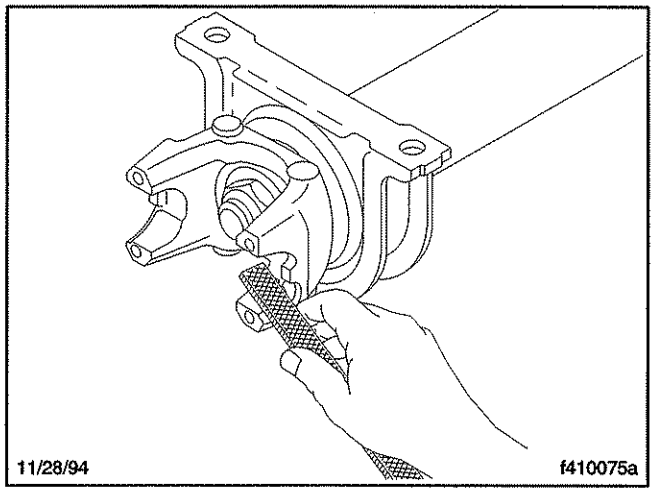
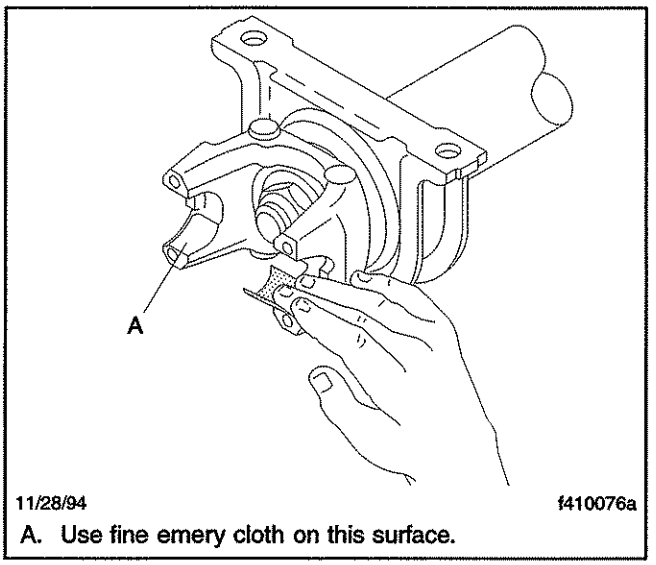


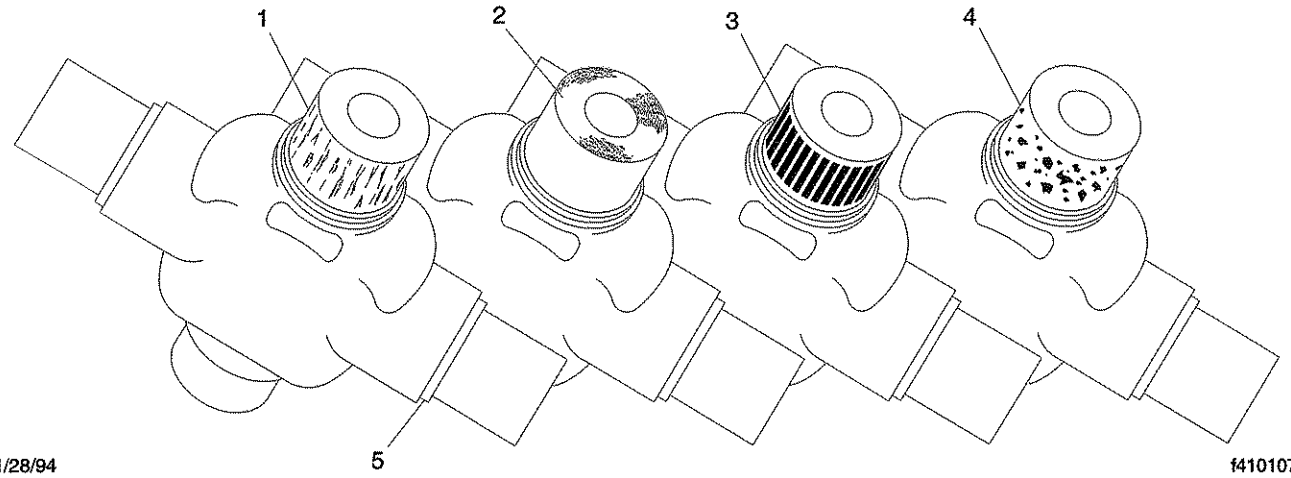
Fig. 24, Removing Burrs From a Half-Round End-Yoke Cross-Hole



A. Use fine emery cloth on this surface.

Fig. 25, Smoothing a Half-Round End-Yoke Cross-Hole

Driveline Component Removal/Disassembly, Cleaning and Inspection, and Replacement or Installation/Assembly



1. Spalling
2. End Galling
3. Brinelling
4. Pitting
5. Slinger

Fig. 26, Damaged U-Joint Crosses

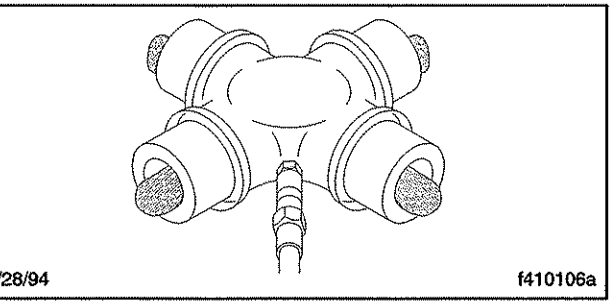
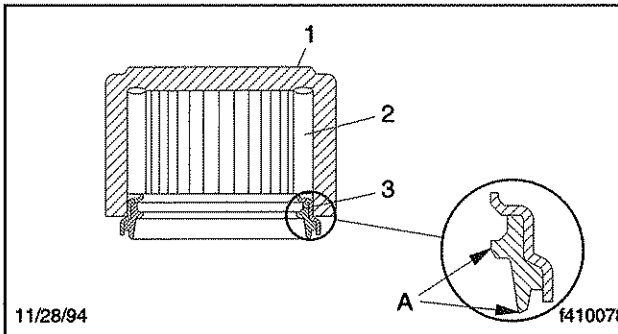


Fig. 27, Forcing Out Old Lubricant From a U-Joint Cross



A. Lubricate seal lips here.

1. Bearing Cup
2. Bearing Needle
3. Bearing-Cup Seal

Fig. 28, Sectional View of a Half-Round End-Yoke U-Joint Bearing Cup

6. Check the underside of each bearing-cup plate for burrs or raised metal. Use a mill file to remove any burrs or raised metal. See **Fig. 30.**
7. Using fine emery cloth, smooth and clean the outside surfaces of all bearing cups. See **Fig. 30** and **Fig. 31.**

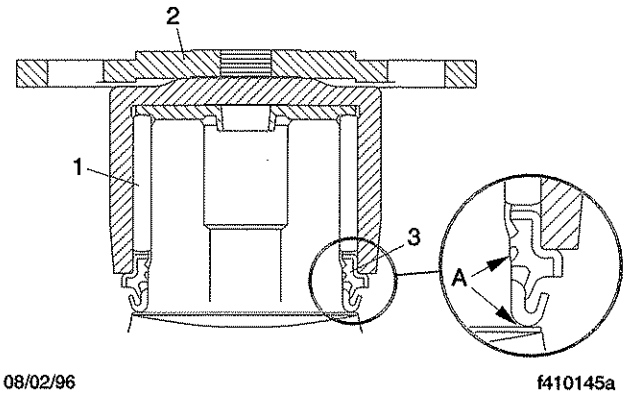
Driveshaft Tube, Stub Shaft (Slip-Joint), and Tube-Yoke Replacement

IMPORTANT: Parts for different series drivelines must not be intermixed. Incorrectly assembled or worn components can affect the entire driveline, resulting in too much vibration or driveline damage.

To replace a driveshaft tube, a tube-yoke, or a stub shaft (**Fig. 32**), the driveshaft must be chucked in a lathe, so the welds can be removed. Driveshaft rebuilding should be done by a machine shop that specializes in driveline repair.

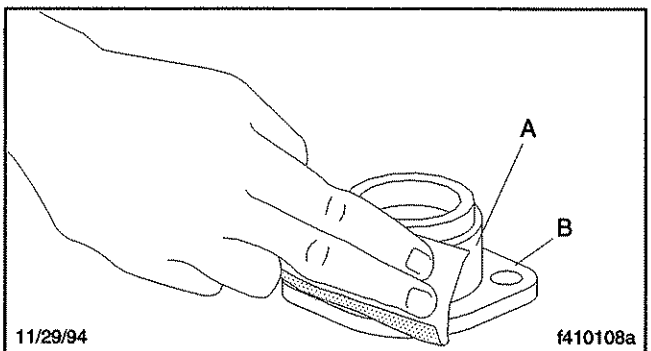
Runout limits for a new (rebuilt) driveshaft (**Fig. 33**) are:

Driveline Component Removal/Disassembly, Cleaning and Inspection, and Replacement or Installation/Assembly



A. Lubricate seal lips here.
1. Bearing Needle
2. Bearing-Cup Plate
3. Bearing-Cup Seal

Fig. 29, Sectional View of a Full-Round Yoke U-Joint Bearing Cup



A. Use fine emery cloth on this surface.
B. Use a mill file on this surface.

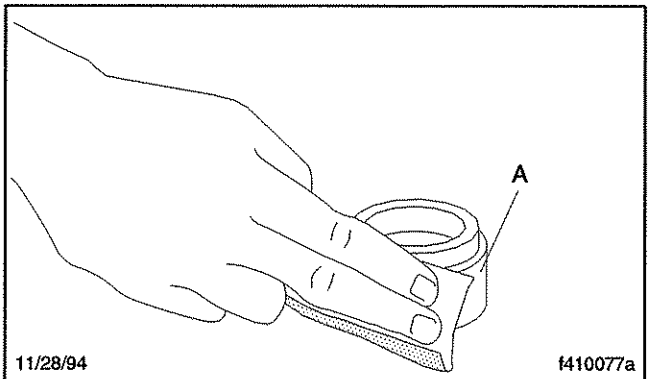
Fig. 30, Smoothing a Full-Round Yoke U-Joint Bearing Cup

0.005 in (0.127 mm) T.I.R. (Total Indicator Reading) on the smooth portion of the stub shaft neck;

0.010 in (0.254 mm) T.I.R. on the tube 3 in (76 mm) from the front and rear welds;

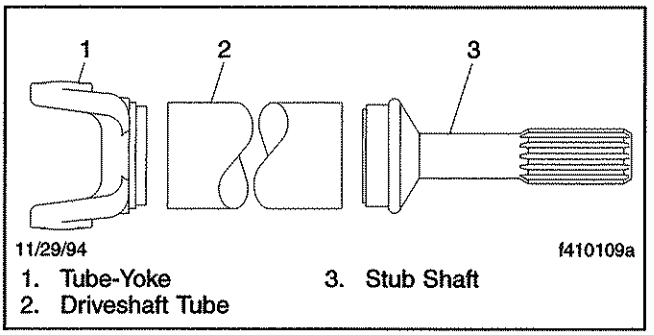
0.015 in (0.381 mm) T.I.R. at the center of the tube.

Balance the rebuilt driveshaft to a maximum tolerance of one inch-ounce per ten pounds weight per end, at 3000 rpm.



A. Use fine emery cloth on this surface.

Fig. 31, Smoothing a Half-Round Yoke U-Joint Bearing Cup



1. Tube-Yoke
2. Driveshaft Tube
3. Stub Shaft

Fig. 32, Driveshaft Tube, Stub Shaft, and Tube-Yoke

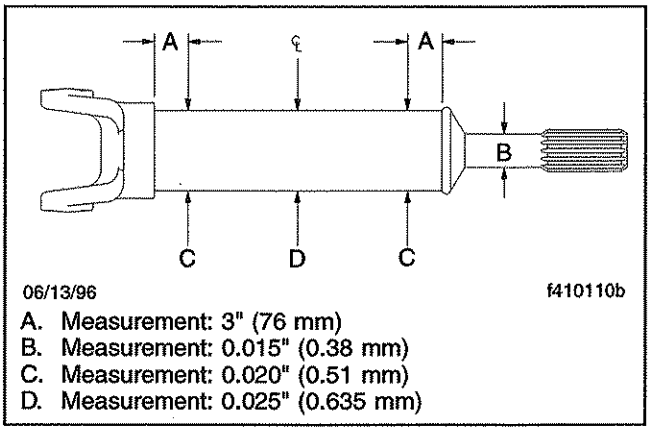
Slip-Joint Replacement or Assembly

IMPORTANT: Parts for different series drivelines must not be intermixed. Incorrectly assembled or worn components can affect the entire driveline, resulting in too much vibration or driveline damage.

1. Place the slip-joint dust cap, and (if so equipped) steel washer and cork seal, over the splined shaft. See **Fig. 12.**
2. Coat the splines of the shaft with multipurpose chassis grease.
3. Insert the splined shaft in the sleeve-yoke, so that the alignment marks are aligned, and the U-joints at each end of the driveshaft will be in phase. See **Fig. 10** and **Fig. 11.**

IMPORTANT: If no alignment marks are visible, or new slip-joint components have been installed, align the

Driveline Component Removal/Disassembly, Cleaning and Inspection, and Replacement or Installation/Assembly



A. Measurement: 3" (76 mm)
B. Measurement: 0.015" (0.38 mm)
C. Measurement: 0.020" (0.51 mm)
D. Measurement: 0.025" (0.635 mm)

Fig. 33, Driveshaft Runout Specifications

yokes, assemble the slip-joint, then have the driveline balanced to a maximum tolerance of one inch-ounce per ten pounds weight per end, at 3000 rpm.

4. Using a strap wrench, tighten the slip-joint dust cap. Use only enough torque to seat the steel washer and cork seal (if so equipped) snug against the end of the sleeve-yoke; do not overtighten.

NOTE: The splines should slide freely, with only a slight drag from the slip-joint dust cap.

Midship Bearing and Coupling Shaft End-Yoke Replacement or Assembly

IMPORTANT: Parts for different series drivelines must not be intermixed. Incorrectly assembled or worn components can affect the entire driveline, resulting in too much vibration or driveline damage.

1. Place the coupling shaft in a soft-jawed vise; do not distort the tube with excessive grip.
2. Fill the entire cavity around the midship bearing with a waterproof grease, to shield the bearing from water and contaminants. Use enough grease to fill the cavities to the extreme edge of the slingers that surround the front and rear of the bearing. See **Fig. 34**.

NOTE: Both Spicer and Rockwell midship bearings are permanently lubricated when manufactured; it is not necessary to pack the bearing with grease.

3. Install one of the slingers, the midship bearing, then the other slinger on the coupling shaft. Press the bearing and slingers on by hand, as far as they will go.
4. If the coupling shaft has a splined reverse-slip shaft (not an end-yoke), coat the shaft splines with multipurpose chassis grease. See **Fig. 17**.

   If the coupling shaft has an end-yoke, install the end-yoke. See **Fig. 16**.

   4.1 Apply Loctite® 242 to the shaft threads where the end-yoke locknut will be installed.

   4.2 Align the marks added to the coupling shaft and end-yoke during removal, then place the end-yoke on the shaft so the yoke bores are aligned at both ends of the shaft. See **Fig. 16**.

   4.3 Install the end-yoke nut, and tighten it 475 to 525 lbf·ft (645 to 710 N·m). Then back the nut off slightly, and tighten it to the same torque.

Spicer 1610/1710/1760/1810 U-Joint or Rockwell 17/176/18-Series U-Joint Replacement or Installation

IMPORTANT: Parts for different series drivelines must not be intermixed. Also, components of the various

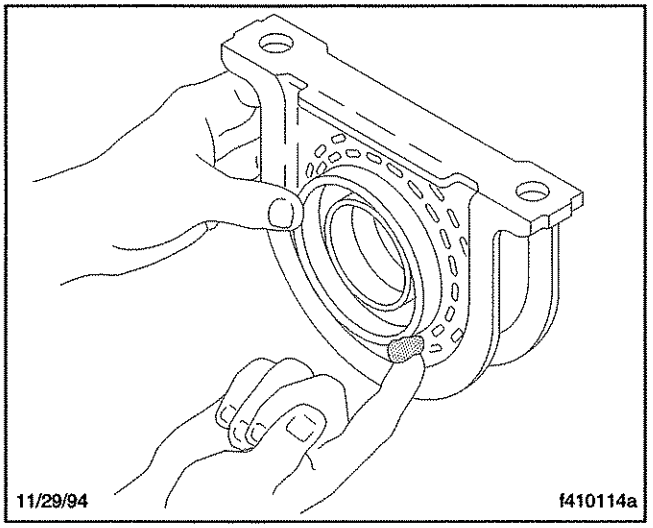


Fig. 34, Greasing a Midship Bearing

Driveline Component Removal/Disassembly, Cleaning and Inspection, and Replacement or Installation/Assembly

makes of U-joints may not be interchangeable, and must be assembled only with compatible products. Incorrectly assembled or worn components can affect the entire driveline, resulting in too much vibration or driveline damage.

Worn bearing assemblies used with a new cross, or new bearing assemblies used with a worn cross will wear rapidly, making another replacement necessary in a short time. Always replace the cross and all four bearing assemblies at the same time.

If the slip-joint of a no. 2 or no. 3 driveshaft has been disassembled, assemble the slip-joint before installing the U-joints.

1. Place the assembled driveshaft in V-blocks or a soft-jawed vise; do not distort the tube with excessive grip.
2. For a no. 2 or no. 3 driveshaft, check that the slip-joint alignment marks are aligned, so that the U-joints at each end of the driveshaft will be in phase. See **Fig. 10** and **Fig. 11**.

   For a coupling shaft, check that the end-yoke and tube-yoke are aligned, so that the U-joints at each end of the coupling shaft will be in phase. See **Fig. 16**.

IMPORTANT: Misaligned driveshaft yokes will cause the U-joints to be out of phase, which will cause vibration in the driveline.

3. Inspect and lubricate the U-joint.

   3.1 Remove the bearing cups from the cross. Inspect the bearing-cup seals for nicks or other damage. See **Fig. 28** for a half-round-yoke U-joint bearing cup, or **Fig. 29** for a full-round-yoke U-joint bearing cup.

⚠ CAUTION

CAUTION: Do not expose the U-joint trunnions or bearing-cup needles to dirt or grit. The smallest bits of dirt or grit can cause rapid wear and serious damage to the U-joint.

   3.2 Using a hand-type grease gun, or a high-pressure gun equipped with a low-pressure adapter, fill the lube passages in the cross with multipurpose chassis grease (lithium 12-hydroxy stearate, NLGI grade 2 with EP additives). See **Fig. 27**.

   3.3 Wipe a heavy coating of the same grease on the needles and the inside end of each bearing cup; then, using a light-weight oil, lubricate the lips of the bearing-cup seals. See **Fig. 28** for a half-round-yoke U-joint bearing cup, or **Fig. 29** for a full-round-yoke U-joint bearing cup.

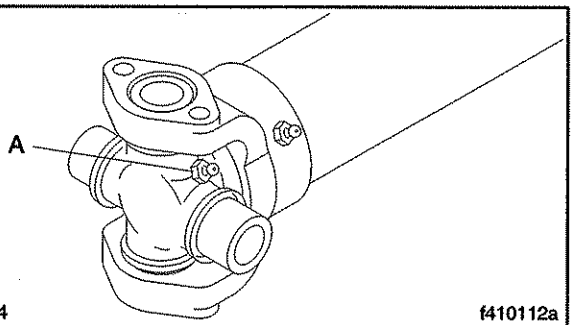
4. Install the U-joint cross and bearing assemblies in the yoke.

   4.1 Position the U-joint cross in the driveshaft yoke so one grease fitting points toward the driveshaft, and aligns with the grease fitting on the sleeve-yoke (if so equipped). See **Fig. 35**.

   4.2 Move one end of the cross until a trunnion projects through the cross-hole, beyond the outer machined face of the yoke lug. Using a Spicer trunnion (journal) locator (see **Subject 400**), hold the trunnions in alignment with the cross-holes, while placing a bearing cup (plate-type) over the projected trunnion, and aligning it with the cross-hole. See **Fig. 36**.

   IMPORTANT: A Spicer trunnion (journal) locator should be used, to prevent damage to the U-joint trunnions and slingers.

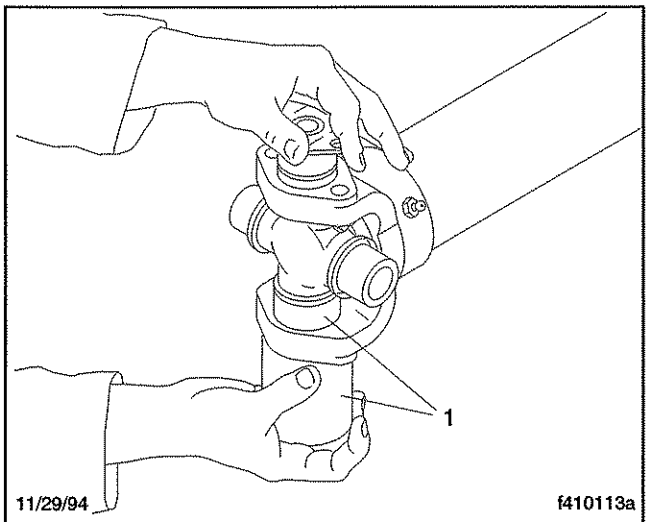
   4.3 By hand, press the bearing-cup-plate flush with the face of the yoke. If the bearing cup binds in the cross-hole, tap the *center* of the bearing-cup plate with a leather or rubber mallet; do not tap the outer edges of the plate. See **Fig. 37**.



A. Install cross with grease fitting pointing toward driveshaft, and aligned with sleeve-yoke grease fitting.

Fig. 35, U-Joint Grease Fitting Positioning

Driveline Component Removal/Disassembly, Cleaning and Inspection, and Replacement or Installation/Assembly



NOTE: Sleeve-yoke shown.

1. Trunnion Locator

Fig. 36, Using a U-Joint Trunnion Locator

4.4 As equipped, install *new* bearing-cup-plate self-locking capscrews, or the lockplate and bearing-cup-plate (not self-locking) capscrews. See **Fig. 1** for Spicer U-joints, or **Fig. 2** for Rockwell U-joints. Tighten the capscrews until all the parts are drawn down tight, with no gaps; do not tighten the capscrews to their final torque value.

⚠ WARNING

WARNING: Self-locking bearing-cup-plate capscrews must not be reused; replace the capscrews with new ones. Also, do not undertighten or overtighten any bearing-cup-plate capscrews. A loose or broken fastener at any point in the driveline weakens the driveline connection, which could cause serious vehicle damage, or could result in a driveshaft separating from the vehicle, possibly causing loss of vehicle control that could result in serious personal injury or death.

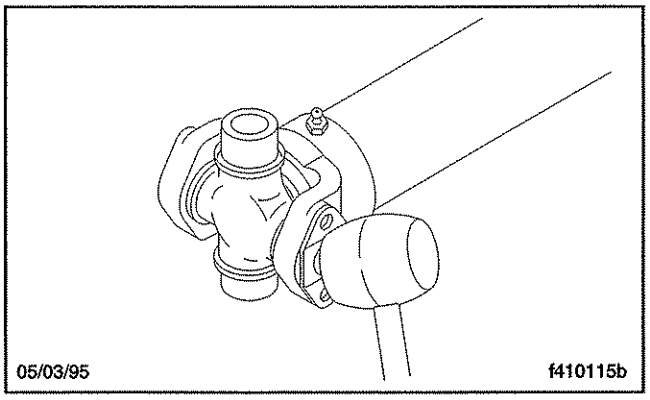


Fig. 37, Seating a U-Joint Bearing Cup In a Full-Round Yoke

4.5 Move the cross until it projects beyond the machined surface of the opposite yoke lug. Using the above procedure, install the opposite bearing assembly and its fasteners.

4.6 Slightly back off all four capscrews, then alternately tighten them in increments of 5 lbf·ft (7 N·m), to the applicable torque value in **Subject 400.**

4.7 If so equipped, bend the tabs of both lockplates upward (using a hammer and a pin punch) until they are firmly against a flat side of each capscrew. See **Fig. 38.**

NOTE: The U-joint should flex, and be free of excessive bind. A slight drag is the most desirable condition for new U-joints. Excessive looseness is not desirable, and may result in an unbalanced driveshaft.

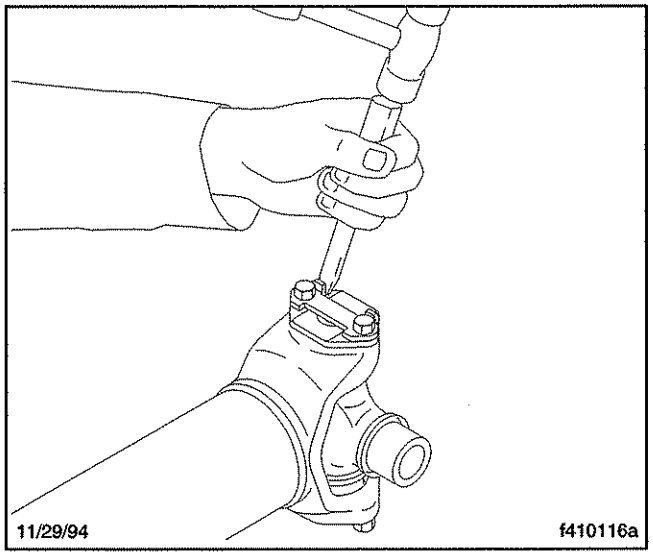


Fig. 38, Bending a Lockplate Tab Against a U-Joint Capscrew

Driveline Component Removal/Disassembly, Cleaning and Inspection, and Replacement or Installation/Assembly

Spicer SPL90 (1590) U-Joint Replacement or Installation

IMPORTANT: Worn bearing assemblies used with a new cross, or new bearing assemblies used with a worn cross will wear rapidly, making another replacement necessary in a short time. Always replace the cross and all four bearing assemblies at the same time.

1. Place the driveshaft in V-blocks or a soft-jawed vise; do not distort the tube with excessive grip.
2. For a no. 2 driveshaft that has a sleeve-yoke (not a splined reverse-slip shaft) at its forward end, make sure the alignment marks on the slip-joint assembly are aligned, to keep the U-joints in phase. See **Fig. 10** and **Fig. 11**.

IMPORTANT: Misaligned driveshaft yokes will cause the U-joints to be out of phase, which will cause vibration in the driveline.

NOTE: For a no. 2 driveshaft that has a splined reverse-slip shaft, install the U-joint in the sleeve-yoke first. Next, align the alignment marks that were added to the sleeve-yoke and driveshaft tube, then connect the U-joint to the forward tube-yoke of the driveshaft. See **Fig. 6**.

For a coupling shaft that has an end-yoke and a tube-yoke, check that the yokes are aligned, so that the U-joints at each end of the coupling shaft will be in phase. See **Fig. 16**.

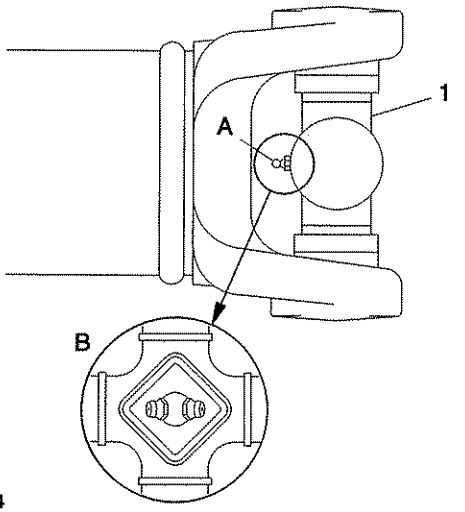
3. Lubricate the U-joint.
   - 3.1 Using a hand-type grease gun, or a high-pressure gun equipped with a low-pressure adapter, fill the lube passages in the cross with multipurpose chassis grease (lithium 12-hydroxy stearate, NLGI grade 1 or 2 with EP additives). See **Fig. 27**.
   - 3.2 Wipe a heavy coating of the same grease on the needles of each bearing cup, and pack each bearing cup about one-quarter full of grease. See **Fig. 28**.

⚠ CAUTION

CAUTION: Do not expose the U-joint trunnions or bearing-cup needles to dirt or grit. The smallest bits of dirt or grit can cause rapid wear and serious damage to the U-joint.

4. Install the U-joint cross and bearing assemblies in the yoke.
   - 4.1 Position the U-joint cross in the yoke with its lube fitting on the inboard side (toward the driveshaft) and pointing 90 degrees away from the driveshaft yoke lugs. See **Fig. 39**.
   - 4.2 Move one end of the cross until a trunnion projects through the cross-hole, beyond the outer machined face of the yoke lug. Hold the trunnions in alignment with the cross-holes, while placing a bearing cup over the projected trunnion, and aligning it with the cross-hole. See **Fig. 40**.
   - 4.3 Using an arbor press, and holding the trunnion in alignment with the cross-hole, place a solid plug (with an outside diameter slightly smaller than the inside diameter of the cross-holes) on the upper bearing cup. See **Fig. 9**. Press the bearing cup into the cross-hole enough to install a snap ring.
   - 4.4 Install the snap ring. See **Fig. 8**.

   IMPORTANT: Be sure the snap ring is properly seated in its groove.



A. Install U-joint cross with grease fitting toward the driveshaft, and pointing 90 degrees away from the yoke lugs.
B. Detail of Grease Fitting
1. Spicer SPL90 (1590) U-Joint Cross

Fig. 39, Spicer SPL90 (1590) U-Joint Grease Fitting Positioning

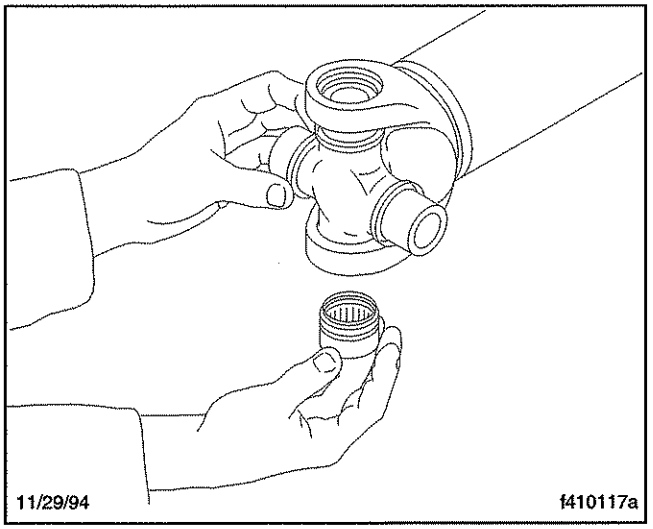


Fig. 40, Installing a Spicer SPL90 (1590) U-Joint Bearing Cup In a Full-Round Yoke

4.5 Turn the yoke over, and install the opposite bearing cup and snap ring.

If movement of the U-joint is stiff, strike the yoke ears with a soft hammer to seat the bearing needles.

Transmission/Axle End-Yoke Replacement or Installation

IMPORTANT: Parts for different series drivelines must not be intermixed. Incorrectly assembled or worn components can affect the entire driveline, resulting in too much vibration or driveline damage.

1. Apply Loctite 242 to the input- or output-shaft threads where the end-yoke locknut will be installed. See **Fig. 13**.
2. By hand, install the end-yoke on the input or output shaft as far as it will go.
3. Install a new end-yoke locknut, and tighten it to the applicable torque value in **Subject 400**.

Driveline Parking Brake Flange-Yoke or Companion Flange Replacement or Installation

For replacement or installation of a driveline parking brake flange-yoke or companion flange, see **Group 42**.

Troubleshooting Procedure

Noise or vibration associated with the driveline can be caused by non-driveline parts. To find the cause of noise or vibration, first road test the loaded vehicle. Drive in all gears and at all speed ranges for which the vehicle was designed, including those at which problems are reported.

NOTE: Operating a vehicle at speeds that exceed its drivetrain design specifications may cause an out-of-balance vibration.

The following is a troubleshooting elimination process; checks should be made in the order listed. At each step where a problem is found, correct the problem before proceeding to the next step, then test drive the vehicle to see if other problems still exist. If no other problems exist, the elimination process may be ended at that step.

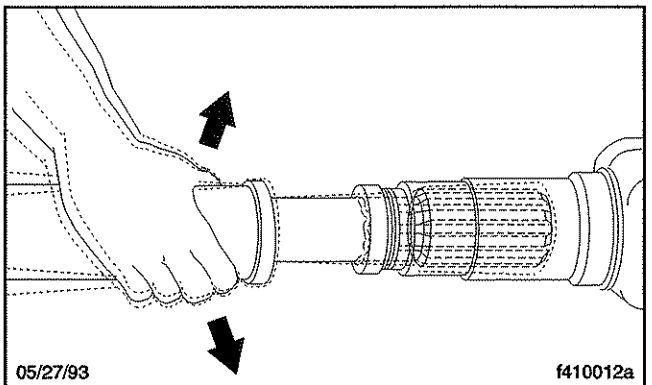
1. Check all tires for uneven wear and for out-of-roundness. Check for mismatched tires. Look for wheels and rims that are out of alignment. For instructions, see **Group 40**.
2. Check the rear suspension for loose or broken U-bolts; broken, shifted, or mismatched rear springs; or broken spring seats. If so equipped, check the air suspension for incorrect air spring height. Look for anything that could cause angular misalignment of the rear axle pinion(s). For instructions, see **Group 32**.
3. Check the frame rails and crossmembers for bends, twists, or breaks; for frame-alignment-checking and crossmember-replacement instructions, see **Group 31**.
4. Check the engine and transmission mounts; see **Group 01** (Engine) and **Group 26** (transmission). Check the coupling shaft's midship bearing mounts. Replace mountings that are deteriorated or oil-soaked; tighten loose mounting bolts. Oil-soaked or deteriorated mountings, or loose mounting bolts, can cause driveline angular misalignment.
5. Check for loose U-joint bearing-cup-plate and bearing-strap capscrews, and for loose flange-yoke locknuts. Tighten any loose fastener to the applicable torque value in **Subject 400**. Then, on U-joint bearing-cup-plates equipped with lockplates, bend a lockplate tab upward until it is firmly against a flat side of the tightened capscrew head.

⚠ CAUTION

CAUTION: Do not overtighten the bearing-cup-plate or bearing-strap capscrews, or the flange-yoke locknuts. A loose or broken fastener at any point in the driveline weakens the driveline connection, which could result in serious vehicle damage.

6. Check all U-joint assemblies, slip-joint splines, and midship bearings for wear.
   - 6.1 Try to move each driveshaft up and down, and from side to side. If movement is greater than 0.006 in (0.15 mm) of a U-joint cross in its bearings, replace the U-joint assembly.
   - 6.2 If the midship bearing rattles or is loose on its shaft, replace it.
   - 6.3 Try to bend the sleeve-yoke and splined shaft up and down, and from side to side. See **Fig. 1**. If looseness is greater than 0.007 in (0.18 mm), replace the sleeve-yoke and splined shaft.

     If driveline components must be replaced, see **Subject 130**.
7. Check each driveshaft for an indication of missing balance weights. If any weights appear to be missing, have the driveshaft balanced to a maxi-



Try to bend the sleeve-yoke and splined shaft up and down, and from side to side.

Fig. 1, Checking for Slip-Joint Spline Wear

Troubleshooting

mum tolerance of one inch-ounce per ten pounds weight per end, at 3000 rpm.

8. Check each driveshaft for dents, bends, twists, or other damage.

   If damaged, jack up the rear axle, support it on jackstands, place the transmission in neutral, and turn the driveshaft by hand to check runout.

   The driveshaft must be straight within 0.015 in (0.38 mm) on the slip-joint seal surface of the splined shaft, 0.020 in (0.51 mm) on the tube 3 in (76 mm) from the front and the rear welds, and 0.025 in (0.635 mm) at the center of the tube. See **Fig. 2.**

   If the driveshaft is not straight within specifications, replace the tube. See **Subject 130** for runout specifications for a *new* (or rebuilt) driveshaft.

9. Check each driveline for proper U-joint phasing. See **Fig. 3.**

   9.1 On no. 2 and no. 3 driveshafts, if the U-joints are out of phase, check the slip-joint for alignment marks. If necessary, disassemble the slip-joint, and align the marks.

   NOTE: To disassemble the slip-joint, uncouple the U-joint at one end of the driveshaft, unscrew the slip-joint seal from the sleeve-yoke, then pull the sleeve-yoke and splined shaft apart. Reverse the procedure to assemble the slip-joint.

   9.2 If no alignment marks are present, disassemble the slip-joint, and reassemble it with the U-joints in one of the two in-phase positions (180 degrees apart).

   Test drive the vehicle, then assemble the slip-joint in the other in-phase position. Test drive the vehicle again.

   Determine which in-phase position provides vibration-free operation; then, assemble the slip-joint in the correct in-phase position, and mark the slip-joint with alignment marks.

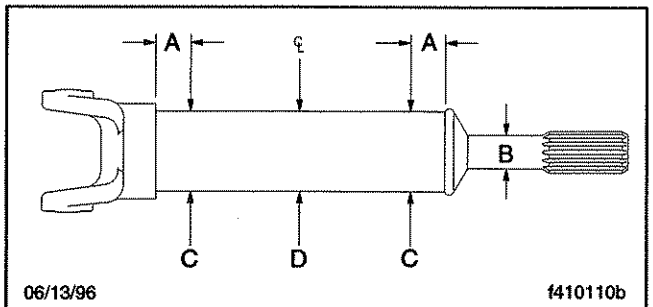
   9.3 If the U-joints are out of phase on a coupling shaft, uncouple the U-joint from the coupling shaft end-yoke, then remove the end-yoke nut. Remove the end-yoke, using a yoke puller. See **Fig. 4** for a half-round end-yoke, or see **Fig. 5** for a full-round end-yoke. Align the end-yoke, then install it by hand. Install the end-yoke nut, and tighten it 475 to 525 lbf·ft (645 to 710 N·m). Slightly back off the nut, and again tighten it to the same torque. Couple the coupling shaft to the driveshaft U-joint.

10. Check the torque on all of the end-yoke nuts in the drivetrain; see the applicable torque values in **Subject 400.**

    If any yoke nut was not at its specified torque, check the yoke for wear by trying to move it up and down, and back and forth. If the yoke can be rocked on its shaft, or moved in or out on its shaft, replace the yoke and yoke nut; see **Subject 130.**

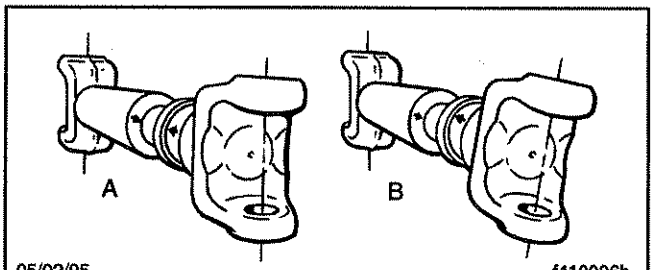
    If the yoke is not worn, tighten the yoke nut to its torque value.

11. *On single-drive vehicles:*



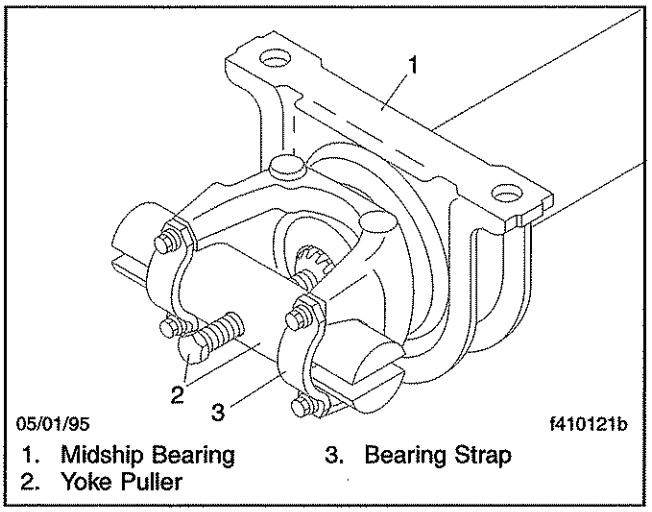
A. Measurement: 3" (76 mm)
B. Measurement: 0.015" (0.38 mm)
C. Measurement: 0.020" (0.51 mm)
D. Measurement: 0.025" (0.635 mm)

Fig. 2, Used Driveshaft Runout Specifications



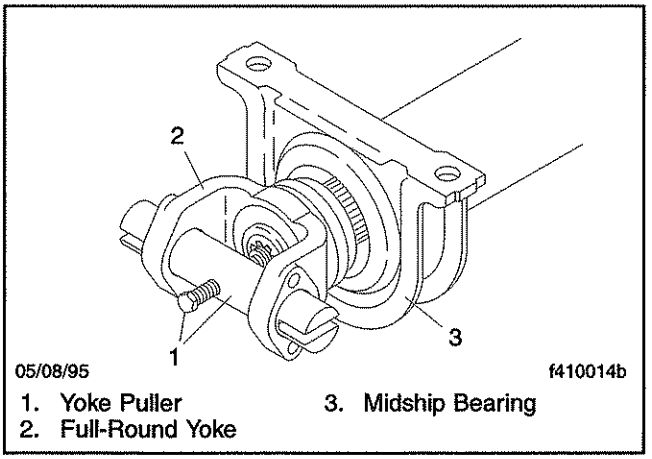
A. In Phase B. Out of Phase

Fig. 3, U-Joint Phasing



1. Midship Bearing
2. Yoke Puller
3. Bearing Strap

Fig. 4, Removing a Half-Round End-Yoke From a Coupling Shaft



1. Yoke Puller
2. Full-Round Yoke
3. Midship Bearing

Fig. 5, Removing a Full-Round End-Yoke From a Coupling Shaft

Have the no. 2 driveshaft balanced to a maximum tolerance of one inch-ounce per ten pounds weight per end, at 3000 rpm.

On dual-drive vehicles:

11.1 Remove the no. 3 driveline; then, with the interaxle differential locked, test drive the vehicle.

11.2 If vibration still exists, install the no. 3 driveline, then have the no. 2 driveshaft balanced to a maximum tolerance of one inch-ounce per ten pounds weight per end, at 3000 rpm.

If *no* vibration exists, check that both rear axle gear ratios are matched. If the gear ratios do not match, replace one of the gear sets with a gear set having the correct ratio, then install the no. 3 driveline.

11.3 Have the no. 3 driveshaft balanced to a maximum tolerance of one inch-ounce per ten pounds weight per end, at 3000 rpm.

11.4 Have the no. 2 driveshaft balanced to a maximum tolerance of one inch-ounce per ten pounds weight per end, at 3000 rpm.

12. If so equipped, balance the coupling shaft(s) to a maximum tolerance of one inch-ounce per ten pounds weight per end, at 3000 rpm.

Specifications

Description			Size	Torque: lbf·ft (N·m)
End-Yoke Nut				
Transmission Output Shaft	Fuller	FS 4005, 5005, 5106, 6105, and 6206	1-1/4–18	300–350 (405–475)
		RT 6609	1-1/2–18	400–450 (540–610)
	Allison	MD Series	2–16	600–800 (815–1085)
Single Axle Input Shaft	Rockwell	RS-15-120, RS-15-210, RS-17-140, RS-17-220	M32 x 1.5	740–920 (1000–1250)
		RS-23-160	M45 x 1.5	1000–1230 (1355–1670)
		RS-23-240	M39 x 1.5	920–1130 (1250–1530)
Forward-Rear Axle Input Shaft	Rockwell	RD-17-145 (of RT-34-145), RD-20-145 (of RT-40-145)	M39 x 1.5	600–800 (815–1085)
Forward-Rear Axle Output Shaft	Rockwell	RD-17-145 (of RT-34-145), RD-20-145 (of RT-40-145)	M39 x 1.5	450–600 (610–815)
Rearmost Axle Input Shaft	Rockwell	RR-17-145 (of RT-34-145), RR-20-145 (of RT-40-145)	M39 x 1.5	920–1130 (1250–1530)
Midship Bearing (coupling shaft)	Spicer	1590, 1610, and 1710	1-1/4–18	475–525 (645–710)
Companion-Flange Nut				
Transmission Output Shaft	Fuller	FS 4005, 5005, 5106, 6105, and 6206	1-1/4–18	300–350 (405–475)
U-Joint Capscrew				
Bearing Plate (for full-round end-yoke)	Spicer	1610	5/16–24	20 (27)
		1710	3/8–24	36 (49)
Bearing Strap (for half-round end-yoke)	Spicer	1590 and 1610	3/8–24	53 (72)
		1710	1/2–20	125 (169)
Flange-Yoke Locknut				
Flange-Yoke to Companion Flange	Spicer	1590, 1610, and 1710	3/8–24	40–48 (54–65)
Midship Bearing Flanged Locknut				
Bracket to Crossmember	Spicer	1590, 1610, and 1710	1/2–13	91 (123)
Bearing Mount to Bracket	Spicer	1590, 1610, and 1710	1/2–13	91 (123)

Table 1, Fastener Torques

Specifications

Special Tools

JOURNAL LOCATOR

(For installing Spicer 1610, 1710, 1760, and 1810 U-joints in full-round yokes)

To order, Contact your Dana Corporation Spicer Service Representative.

U-JOINT REMOVAL TOOL KIT

(For removing Spicer 1610, 1710, 1760 and 1810 U-joints and Rockwell 17N, 17T, 176T and 18T U-joints from full-round yokes)

To order Owatonna Tool Kit No. 7057, Contact:

Owatonna Tool Company
Owatonna, Minnesota 55060

END-YOKE/FLANGE-YOKE PULLER

(For removing end-yokes from transmission output shafts, coupling shafts, and rear-axle input and output shafts)

To order End-Yoke Puller J 7804–01, contact:

Kent-Moore Tool Division
29784 Little Mack
Roseville, MI 48066-2298
Telephone: 1–800–328–6657 Telex: 244040 KMTR
UR FAX: (313) 774–9870

To order Yoke and Flange Remover SP–450, contact:

G & W Tool Company
907 South Dewey
Wagoner, OK 74467