General Information

Driveline Angularity

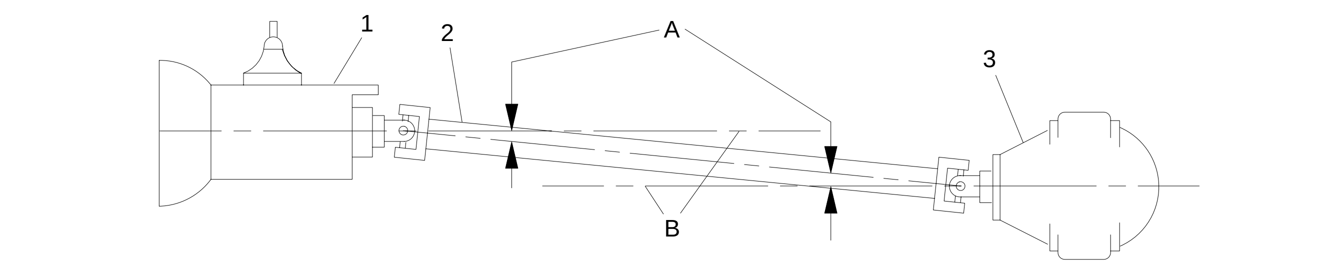
The most important consideration of driveline angularity is the U-joint working angle. The U-joint working angle is the angle formed by the intersection of the driveshaft centerline and the extended centerline of the shaft of any component to which the U-joint connects. See **Fig. 1.** Because the action of a U-joint causes a fluctuating speed difference between the shafts it connects, the effect created by the U-joint at the input yoke must cancel the effect created by the U-joint at the output yoke. This is done by making the U-joint working angles at both ends of the driveshaft approximately equal, with the U-joints in phase.

The U-joint working angles may be made approximately equal by either of two basic arrangements: a parallel arrangement (**Fig. 1**), or an intersecting arrangement (**Fig. 2**).

Driveline angularity may be adversely affected if rear suspension U-bolts are loose or broken; rear springs are broken, shifted, or mismatched; spring seats are broken; frame rails are bent, twisted, or broken; or transmission or engine mounts are loose or deteriorated.

U-Joint Phasing

The fluctuating speed difference caused by the action of a U-joint connecting angled shafts can be cancelled only if the U-joint at the other end of the driveshaft is in phase with that U-joint (and the U-joint working angles are approximately equal). If the yoke lugs at both ends of the driveshaft are lying in the same plane (a plane that bisects the shaft lengthwise) the U-joints will be in phase. See **Fig. 3.**



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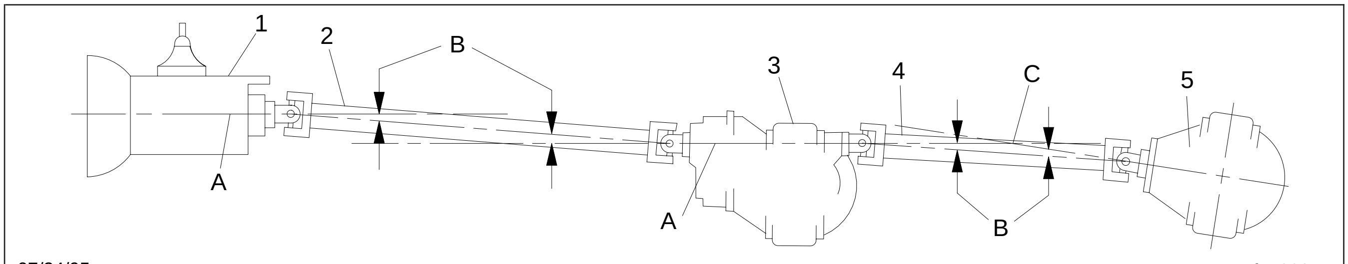
A. Equal U-Joint Working Angles
B. Parallel Centerlines
1. Transmission
2. No. 2 Driveshaft
3. Rear Axle

Fig. 1, Parallel Arrangement for Single-Drive Vehicles



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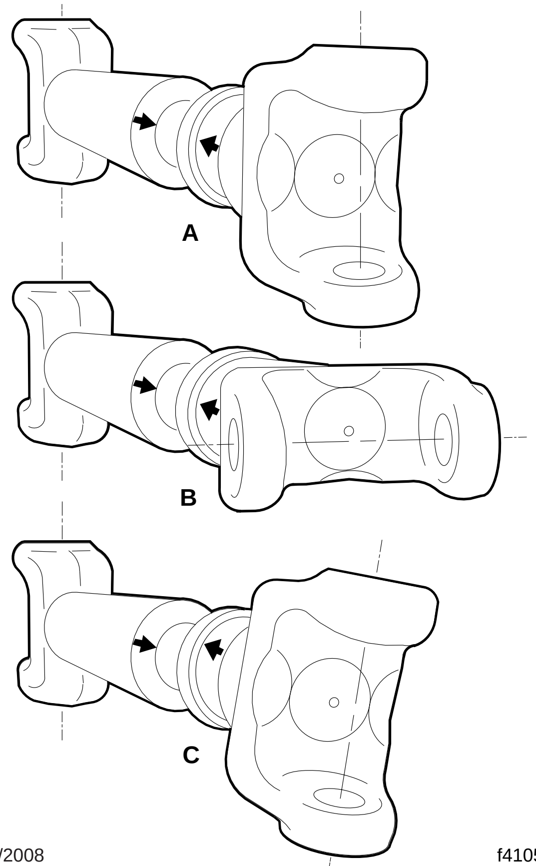
A. Parallel Centerlines
B. Equal U-Joint Working Angles
C. Intersecting Centerlines
1. Transmission
2. No. 2 Driveshaft
3. Forward-Rear Axle
4. No. 3 Driveshaft
5. Rearmost Axle

Fig. 2, Intersecting Planing Arrangements for Dual-Drive Vehicles

NOTE: Some driveshafts are designed and phased with their end yokes clocked 90 degrees from each other. This is referred to as cross phasing.



A. In Phase (parallel phased)
B. In Phase (cross phased)
C. Out of Phase

Fig. 3, Driveline U-Joint Phasing

To ensure that the U-joints turn in phase, the sleeve yoke and splined shaft of driveshaft slip joints, and the tube shaft and midship bearing end yoke or midship bearing shafts, should be marked for assembly reference before disassembly.

Driveline Balance

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

If the driveshaft slip joint is disassembled for any reason, the sleeve yoke and splined shaft should be marked for assembly alignment. Misaligned slip joints will seriously affect the U-joint phasing and balance of the driveline. Even if the 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, or otherwise damaged. Operating a vehicle at speeds that exceed the speed of the driveshaft's design specifications will cause an out-of-balance vibration. Loose end yoke nuts, loose midship bearing or auxiliary transmission mounts, loose bearing retainer capscrews, worn U-joint trunnions or bearings, and worn slip joint splines can lead to excessive movement of the driveshaft and cause driveline imbalance.

Midship Bearings

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, most vehicles having a long wheelbase use a midship bearing, mounted on a crossmember in the frame, for additional driveline support (Fig. 4). This allows the driveshaft to be separated into two shorter shafts, thus improving balance and stability.

Angularity Standards and Driveline Configuration

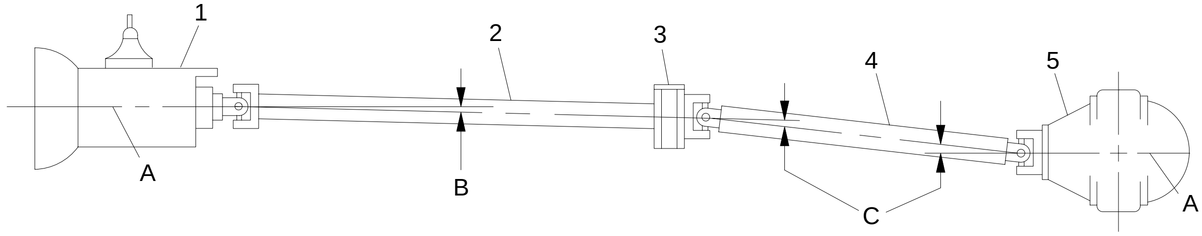
The U-joints require a minimum working angle of 1/2 degree to ensure needle-roller movement in the U-joint bearings. Without this movement, brinelling of the trunnion bearing contact surfaces would occur. Suspension movement causes driveshaft angles to change (and therefore, needle-roller movement) in both U-joints attached to driveshafts that connect to the axles. However, no angle change occurs in the U-joints attached to a driveshaft that connects the main transmission to a midship bearing or auxiliary transmission. Their working angles must be established during installation.

When a midship bearing is included in the drivetrain, it must be installed so that the centerline of the midship bearing shaft is in horizontal alignment within 1/2 degree and within 1/2 to 1 degree of vertical alignment with the centerline of the main transmission output shaft. See **Fig. 4.**

When an auxiliary transmission is included in the drivetrain, it must be installed so that the centerline of the intertransmission (no. 1) driveline is in exact horizontal alignment within 1/2 degree and down 1/2 to 1 degree vertically from the centerline of the main transmission output shaft. Further, the auxiliary transmission thru-shaft centerline must be parallel to the centerline of the main transmission output shaft, in order to achieve equal working angles. See **Fig. 5.**

struction of the U-joint. For smooth operation and long drivetrain component life, the U-joint working angles of each shaft must be kept small and approximately equal.

The U-joint working angles may be made approximately equal by either of two basic arrangements: a parallel arrangement (**Fig. 1**) or an intersecting arrangement (**Fig. 2**). The parallel arrangement consists of installing the drivetrain components so that all of the input, output, and thru-shaft centerlines are approximately parallel. The intersecting arrangement (used only for some interaxle drivelines) consists of installing the drive components so that the rearmost



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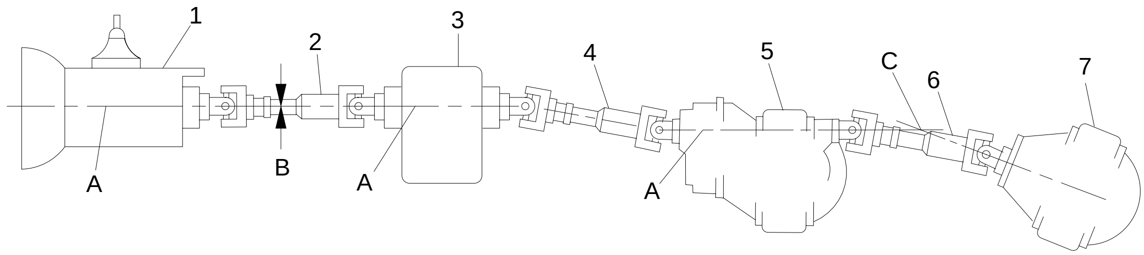
A. Parallel Centerlines
B. 1/2 to 1 Degree
C. Working Angles Unequal by 1/2 to 1 Degree

1. Main Transmission
2. Coupling Shaft
3. Midship Bearing
4. No. 2 Driveshaft
5. Rear Axle

Fig. 4, Midship Bearing in a Single-Drive Vehicle



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A. Parallel Centerlines
B. 1/2 to 1 Degree
C. Intersecting Centerlines

1. Main Transmission
2. No. 1 Driveline
3. Auxiliary Transmission
4. No. 2 Driveshaft
5. Forward-Rear Axle
6. No. 3 Driveshaft
7. Rearmost Axle

Fig. 5, Auxiliary Transmission in a Dual-Drive Vehicle

Every U-joint has a maximum working angle, determined by the design and size of its cross assembly and yokes. Exceeding the maximum working angle can cause rapid U-joint wear, or in severe cases, de-

axle pinion shaft's extended centerline intersects the forward-rear axle thru-shaft's extended centerline approximately midway between the U-joints, when all of

General Information

the other shafts (including the forward-rear axle thru-shaft) are approximately parallel.

All single-drive vehicles, and the forward-rear axles of dual-drive vehicles, use the parallel arrangement. Rearmost axles of dual-drive vehicles may use the parallel arrangement or the intersecting arrangement, depending on the drivetrain configuration.

The specific drivetrain configuration of each Freightliner vehicle consists of its wheelbase, number and type of axles, axle spacing, type of suspension, and number of transmissions. The specific drivetrain configuration determines the driveline arrangement and required installation angles of all the vehicle's drivetrain components.

The simplest drivetrain configuration consists of a single short driveline connecting a main transmission to a single-drive axle, in a parallel arrangement. This driveshaft is always referred to as the no. 2 driveshaft. The parallel arrangement always used on single-drive vehicles is shown in **Fig. 1**.

On dual-drive vehicles that have both axle input shafts of approximately the same height, a parallel arrangement is used. The driveshaft connecting the main (or auxiliary) transmission to the forward-rear axle is always referred to as the no. 2 driveshaft; and the interaxle driveshaft is always referred to as the no. 3 driveshaft. See **Fig. 6**, which shows a parallel arrangement when used on dual-drive vehicles.

Most dual-drive vehicles have a high thru-shaft on the forward-rear axle, and a low pinion on the rearmost axle. When the vehicle is on level ground, the interaxle (no. 3) driveshaft may create very sharp U-joint working angles with the input and output shafts when they are parallel. In normal driving, the U-joints could momentarily exceed their maximum working angle, and driveline or drivetrain damage could result. By using an intersecting arrangement at the no. 3 driveshaft, smaller U-joint working angles are created, promoting longer U-joint life and reduced driveline vibration. An intersecting arrangement used on dual-drive vehicles is shown in **Fig. 2**.

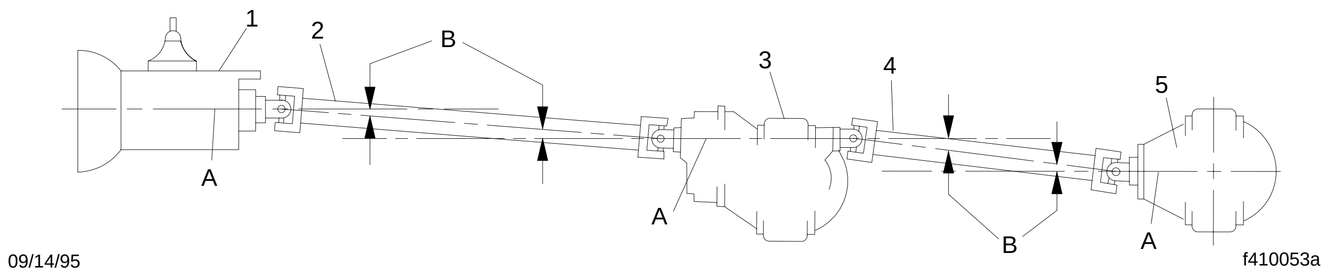
However, some axle spacings, axle models, and suspension designs allow additional axle movement or axle windup, require additional clearances between the driveshaft and the frame or suspension components, or create other conditions that make the intersecting arrangement of the no. 3 driveshaft unsatisfactory. For those drivetrain configurations, it is necessary to use a modified parallel or modified-intersecting arrangement for the no. 3 driveshaft.

On drivetrain configurations that require a modified parallel arrangement, the rearmost axle pinion shaft centerline is placed at an angle that is 2 degrees higher above horizontal than are the other input and output shafts. See **Fig. 7.**

On drivetrain configurations that require a modified-intersecting arrangement, the "proper" intersecting angle is determined, then the rearmost axle pinion shaft centerline is placed at an angle that is 2 degrees closer to horizontal than the "proper" intersecting angle. See **Fig. 8.**

The axle pinion angles for all suspensions are factory-set for correct driveline angularity. On Hendrickson and Neway suspensions, spacers or washers at the torque rods are used to maintain the correct axle pinion angles. On the suspensions listed in **Specifications, 400**, tapered axle planing shims at the springs help maintain the correct axle pinion angle.

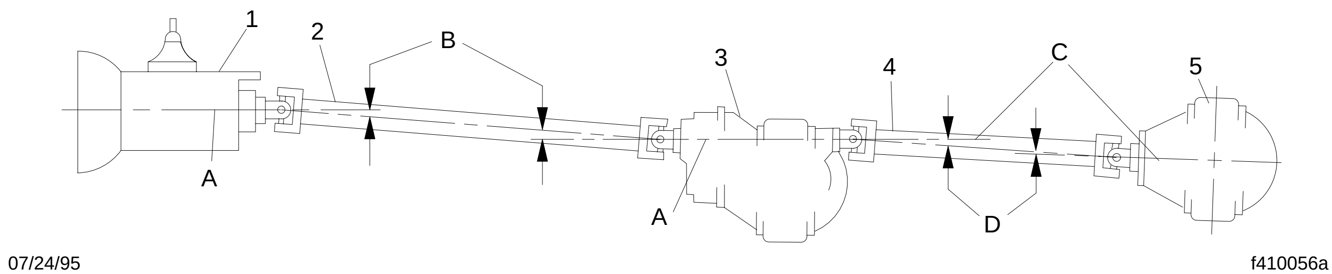
In the field, whenever axle or suspension components are changed, the axle pinion angles may also change. If this occurs, contact your district service manager for the correct axle pinion angle adjustment procedure.



A. Parallel Centerlines
B. Equal U-Joint Working Angles

1. Transmission
2. No. 2 Driveshaft
3. Forward-Rear Axle
4. No. 3 Driveshaft
5. Rearmost Axle

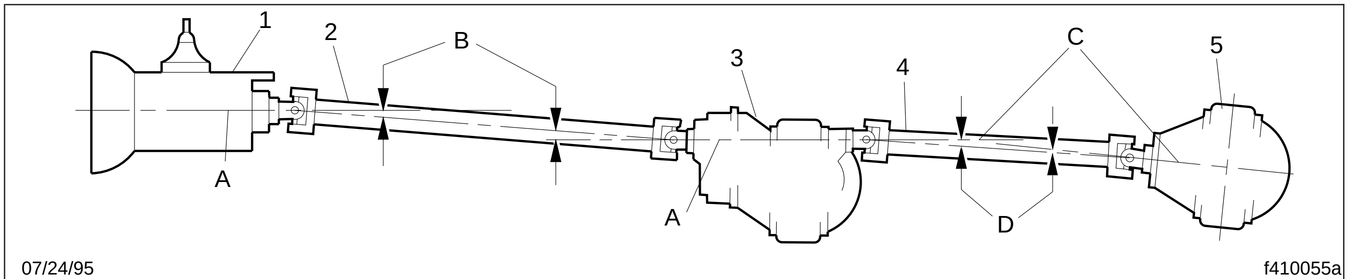
Fig. 6, Parallel Arrangement for Dual-Drive Vehicles



A. Parallel Centerlines
B. Equal U-Joint Working Angles
C. Modified-Parallel Centerlines
D. U-Joint Working Angles Not Equal by 2 Degrees

1. Transmission
2. No. 2 Driveshaft
3. Forward-Rear Axle
4. No. 3 Driveshaft
5. Rearmost Axle

Fig. 7, Modified-Parallel Arrangement for Dual-Drive Vehicles



A. Parallel Centerlines
B. Equal U-Joint Working Angles
C. Modified-Intersecting Centerlines
D. U-Joint Working Angles Not Equal by 2 Degrees

1. Transmission
2. No. 2 Driveshaft
3. Forward-Rear Axle
4. No. 3 Driveshaft
5. Rearmost Axle

Fig. 8, Modified-Intersecting Arrangement for Dual-Drive Vehicles

Measurement

Before checking the pinion angles or engine angle, check that the engine and transmission mounts are tight and in good condition. Loose or deteriorated mounts will cause inaccurate readings.

Using a digital angle meter, spirit level protractor **(see Fig. 1)**, or the head of a machinists's protractor, measure the engine angle, driveshaft angles, and pinion angles. Read all angles within 1/2 degree (30 minutes).

After adjustment of any driveline angle, check the angle again.

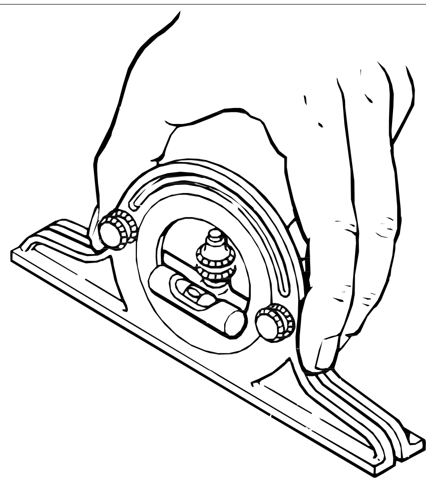


Fig. 1, Spirit Level Protractor

To measure the engine angle (transmission) output shaft angle) or pinion angles, do the following:

1. Inflate the vehicle tires to their normal operating pressure.
2. Park the unloaded vehicle on a level surface. Do not try to level the vehicle frame by jacking the front or rear axles. If the frame cannot be leveled from front to rear, determine and record the off-level inclination of the frame and add or subtract that value from the measured values.
3. Chock the tires and place the transmission in neutral. Release the parking brakes.
4. The transmission, midship bearing, and axle yoke angles can be measured at either the top or bottom lug of the output shaft or axle pinion end yoke being checked. Remove the bearing cap from the yoke lug.
   - 4.1 Bend the lockstrap tabs away from the heads of the bearing cap capscrews. Remove the capscrews and lockstrap
   - 4.2 Loosen the bearing cap by tapping the driveshaft or yoke on the side opposite the bearing cap, using a plastic or rawhide mallet. Remove the bearing cap by hand.
5. Turn the end yoke until the machined surface of the yoke lug is horizontal. **See Fig. 2.**

NOTE: To turn the driveshaft, raise one side of the rear (single-drive) or rearmost (dual-drive) axle until the tires are off the ground. Place a safety stand under the axle. With the interaxle differential unlocked, turn the tire to move the driveshaft.

6. Adjust the protractor scale to read 0 degrees. Position the protractor alongside the U-joint trunnion, on the machined surface of the end yoke, and at a 90-degree angle to the frame centerline. **See Fig. 3.** Then turn the end yoke until the bubble in the level vial is exactly between the two marks on the vial. Remove the jack stand and lower the rear axle to the ground.
7. Without changing the position of the end yoke, turn the protractor until it is parallel to the frame centerline. **See Fig. 3.** Adjust the calibrated scale so the bubble is exactly between the two marks on the level vial. Record the calibrated scale reading opposite the "0" mark. Correct this value for any previously recorded off-level inclination.
8. Install the bearing cup.
   - 8.1 Move the driveshaft until the U-joint trunnion projects through the end-yoke bearing bore, beyond the machined surface of the yoke lug.
   - 8.2 Apply antiseize compound or chassis lube to the outside of the bearing cap. Position the bearing cap over the U-joint trunnion and align the bearing-cap capscrew holes. Press the bearing cap on by hand, until the bearing cap is tight against the machined surface of the yoke lug.

Engine and Pinion Angle Measurement

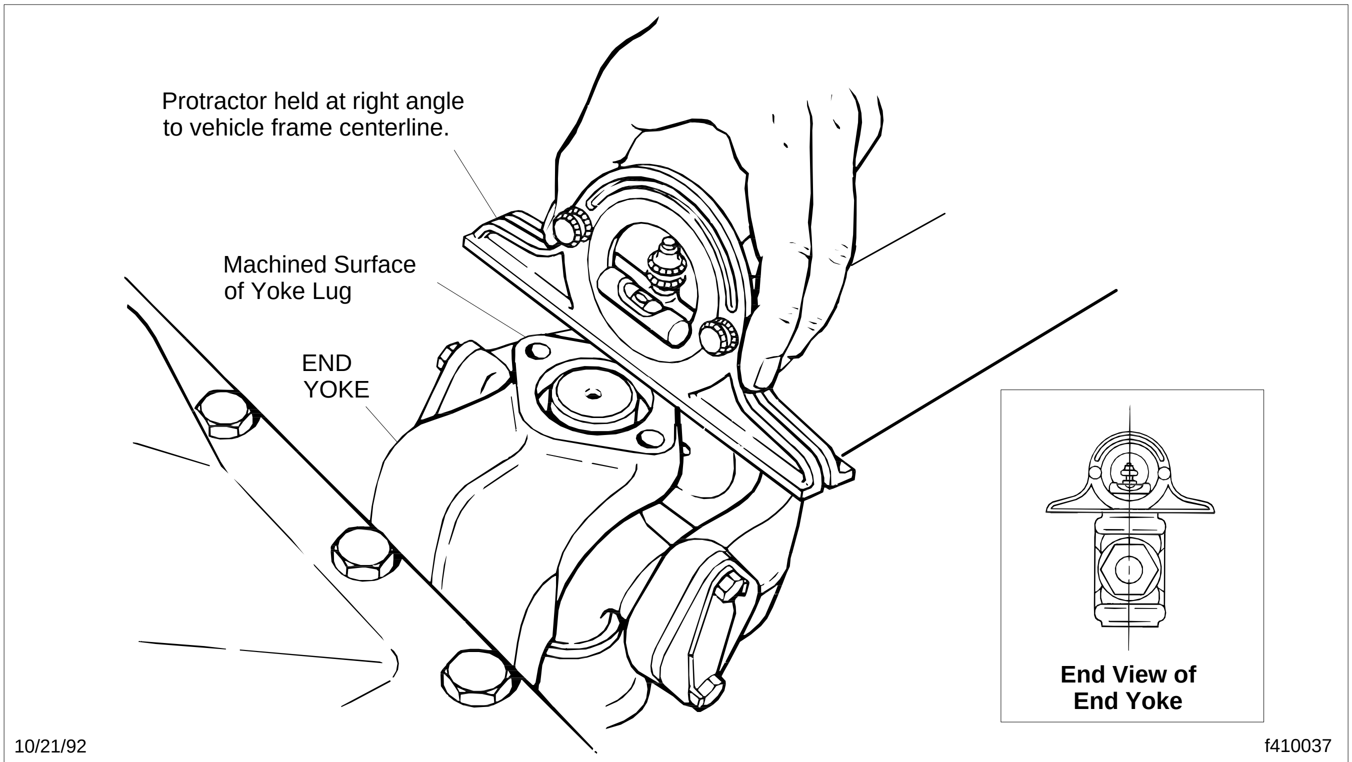


Fig. 2, Horizontal Positioning of Yoke Lug Machined Surface

NOTE: If necessary, tap the bearing cap in the center with a ball-peen hammer. Don't tap on the outer edges of the bearing cap.

8.3 Position the lockplate, then insert the bearing cap capscrews and tighten them until the capscrews, lockplate, and bearing cap are drawn down tight.

8.4 Back off the bearing-cap capscrews slightly, then tighten them to the torque values in **Table 1.**

Capscrew Size	Torque lbf·ft (N·m)
5/16–24	20 (27)
3/8–24	37 (50)
7/16–20	60 (81)

Table 1

CAUTION

CAUTION: Don't overtighten the bearing-cap capscrews. A broken fastener at any point in the driveline weakens the driveline connection, which could result in serious damage to the vehicle.

8.5 Bend the tabs of both lockstraps firmly against the flat side of each capscrew head.

Engine and Pinion Angle Measurement

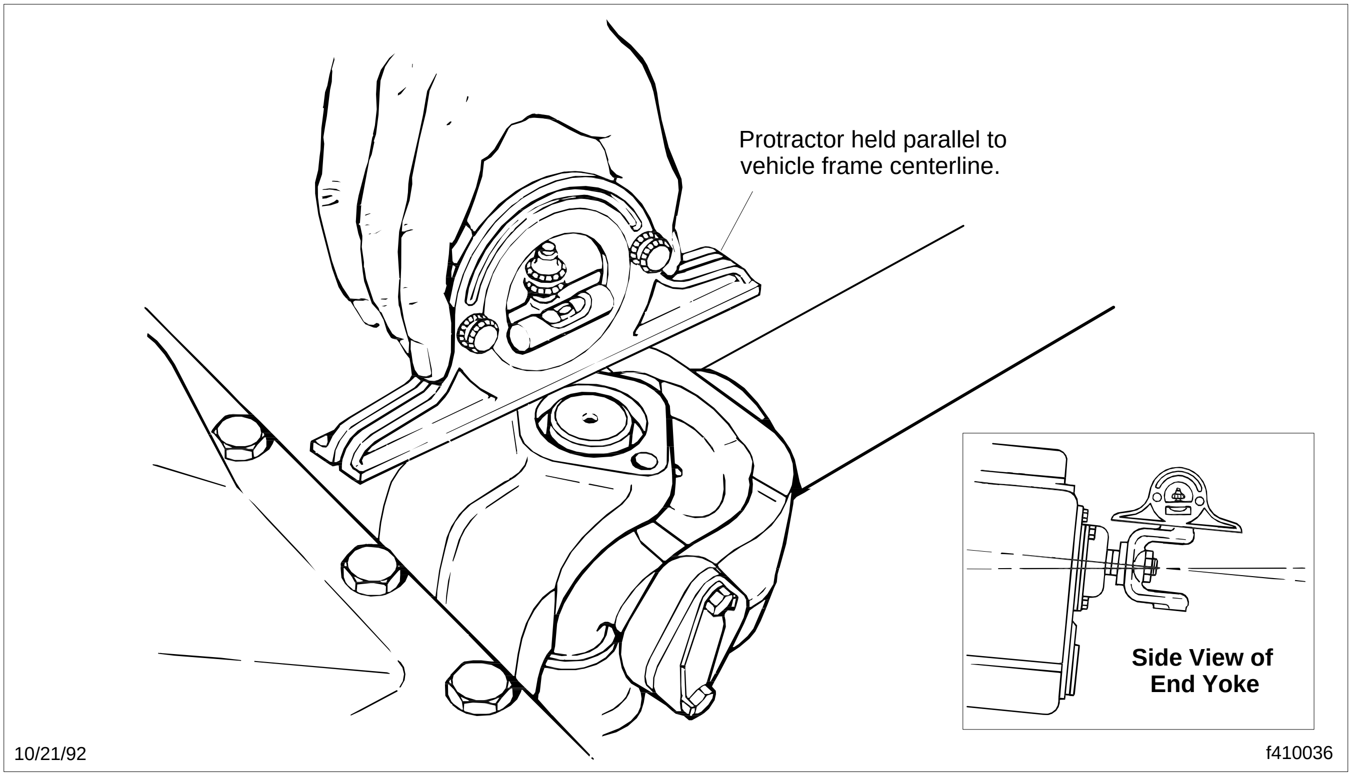


Fig. 3, Measuring Pinion Angles

Checking

If the vehicle is equipped with a Freightliner four-spring suspension, Freightliner Air Suspension (FAS), or Reyco 102AR suspension, the axle pinion angles are factory-set using alignment shims at the rear springs. Starting in September 1990, these shims have notches on the thick end of the shim. Count the number of notches in the thick end of each shim to make sure that the correct shim is used. Also, make sure the thick end of the shim is positioned correctly. Refer to the applicable table in **Specifications, 400** for shim identification and use. The pinion angles listed for these suspensions are for vehicles built before September 1990. If the axle pinion angles on these suspensions are incorrect, contact your district service manager for the adjustment procedure.

On Hendrickson and Neway 244-6 suspensions, spacers or washers at the torque rods are used to maintain the correct axle pinion angles. If the measured axle pinion angles on these suspensions are not the same as the angles listed in the applicable table in **Specifications, 400**, contact your district service manager for the adjustment procedure.

NOTE: In any of the following steps, if an off-level inclination was added to or subtracted from the engine angle, the same figure must be added to or subtracted from the midship shaft or axle pinion reading before comparing the angles.

1. Check the engine angle at the transmission output yoke. The engine angle must be 3 degrees ± 1/2 degree. For instructions, refer to **Subject 100**.

2. If the driveline includes a midship bearing, place a protractor on top of the midship shaft. Align the protractor with the driveshaft centerline. **See Fig. 1.** Read the scale. The centerline of the midship shaft must be 1/2 degree out of vertical alignment with the transmission output shaft. **See Fig. 2.** Compare this reading with the measured engine angle.

   If needed, adjust the midship bearing mounting to meet the above specification. Contact your district service manager for midship bearing mount adjusting procedures.

3. On single-drive installations, measure the rear axle pinion angle at the back of the no. 2 driveline. For instructions, refer to **Subject 100**.

   The measured rear axle pinion angle must be equal ±1 degree to the measured engine angle. If the rear axle pinion angle doesn't meet the above specification, contact your district service manager.

4. On dual-drive installations, measure the forward rear-axle pinion angle (at the rear of the no. 2 driveline). For instructions, refer to **Subject 100**.

   The measured forward-rear axle pinion angle must be equal ±1 degree to the measured engine angle. If the forward rear-axle pinion angle doesn't meet the above specification, contact your district service manager.

   Measure the rearmost axle pinion angle (at the rear of the no. 3 driveline). For instructions, refer to **Subject 100**.

   Compare the measured angle with that shown in the applicable table in **Specifications, 400**. The measured rearmost axle pinion angle must be equal ±1 degree to the angle shown in the table. If the measured angle is incorrect, contact your district service manager.

Driveline Angle Checking

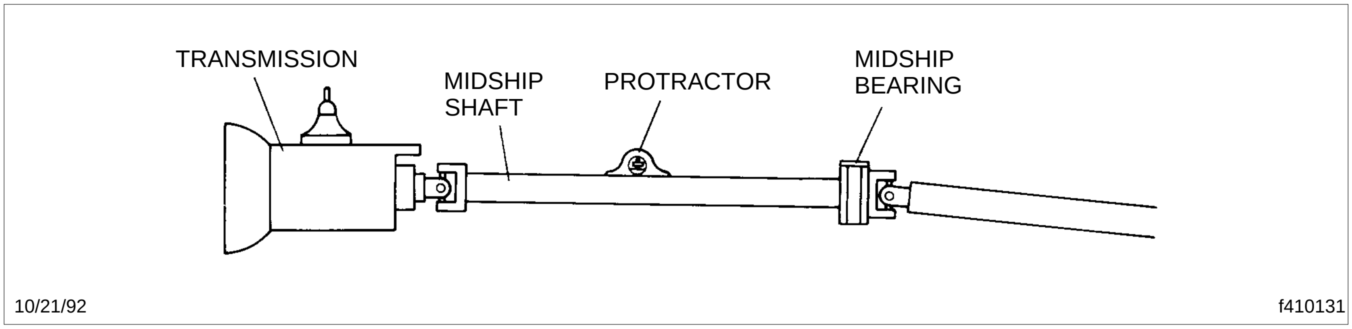


Fig. 1, Midship Shaft Angularity

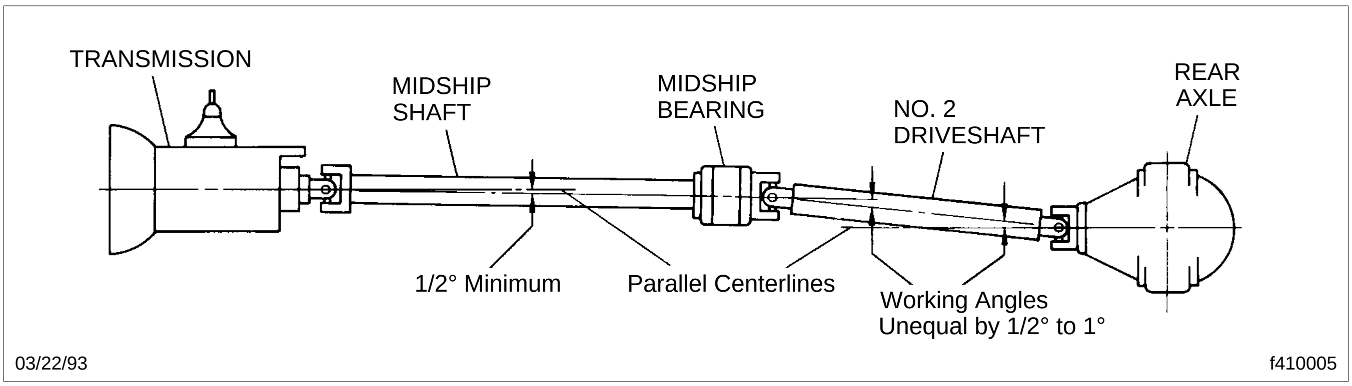


Fig. 2, Midship Bearing in a Single-Drive Vehicle

Troubleshooting

Not all noise or vibration is caused by driveline components. Never change the angularity or balance of the driveline until a thorough check has been completed.

Road test the vehicle to determine the cause of noise or vibration. Drive the vehicle in all gears and all speed ranges for which the vehicle was designed.

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

The following is a troubleshooting elimination process; the checks should be made in the order listed. At each step where a possible cause is found and corrective action is taken, road test the vehicle to see if other problems still exist, before going to the next step. If no more problems exist, stop the process at that step.

1. Check tires for uneven wear and out-of-roundness. Check for mismatched tires. Look for wheels and rims that are out of alignment or are missing balance weights.
2. Check the rear suspension for loose or broken U-bolts; broken, shifted, or mismatched rear springs; or broken spring seats. Look for anything that could cause angular misalignment of the rear axle pinion(s).
3. Check the frame rails for bends, twists, or breaks.
4. Check the engine and main transmission mounts (and auxiliary transmission mounts and midship bearing, if equipped). Tighten any loose mounting bolts and replace any mounts that are deteriorated or oil-soaked. Loose mounting bolts, or oil-soaked or deteriorated mounts, can cause angular misalignment of through-shafts and pinion shafts.
5. Check the U-joint bearing caps for loose capscrews. Tighten any loose bearing-cap capscrews to the torque values in **Table 1**, then bend the tabs of the lockstrap firmly against a flat side of each capscrew.

CAUTION

Don't overtighten the bearing-cap capscrews. A broken fastener at any point in the driveline will weaken the driveline connection, which could result in serious damage to the vehicle.

6. Check all of the U-joint assemblies, slip joint splines, and midship bearings (if so equipped) for wear, as follows:

   6.1 Try to move the driveshaft up and down, and from side to side. If there is movement of the U-joint trunnion in the bearings, replace the complete U-joint cross assembly. If the midship bearing is loose on its shaft, or rattles, replace it.

   6.2 Try to bend the sleeve yoke and splined shaft back and forth. If radial looseness can be seen or felt, replace both the sleeve yoke and the splined shaft.

7. Check the driveshaft for missing balance weights. If any weights are missing, have the driveshaft balanced to a tolerance of one inch-ounce per ten pounds weight per end (maximum) at 3000 rpm.
8. Check the driveshaft tubes for dents, bends, twists, or other damage. If damaged, remove the driveshaft and check the runout. If the tube is not straight (and cannot be straightened) to within 0.001 inch (0.03 mm) on the slip-joint-seal surface of the spline shaft, 0.005 inch (0.13 mm) on the tube, 2 inches (51 mm) from the rear weld, and 0.010 inch (0.25 mm) at the center of the tube, replace the tube. See **Fig. 1**.

   If the driveshaft tube needs to be straightened or replaced, balance the repaired driveshaft before installing it.

9. Check each driveline for proper U-joint phasing as follows. See **Fig. 2**.

   On slip-jointed driveshafts, if the U-joints are out of phase, check the slip joint for alignment marks, 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. Refer to

Troubleshooting

Section 41.00 for instructions covering U-joint uncoupling and coupling.

If no alignment marks are present, disassemble the slip joint, and reassemble 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.

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

On midship shafts, if the U-joints are out of phase remove, align, and install the midship shaft end-yoke.

NOTE: To remove the midship shaft end-yoke, uncouple the U-joint cross assembly from the midship shaft end-yoke, leaving the U-joint attached to the no. 2 driveshaft sleeve yoke. Remove the midship-shaft cotter pin and end-yoke nut. Remove the end yoke, using a yoke puller. See **Fig. 3**. Align the end yoke, then install it by hand. Install the end-yoke nut and tighten it 700 to 750 lbf·ft (949 to 1017 N·m). Back off the nut slightly, and again tighten it to the same torque. Install and lock a new cotter pin. If necessary, turn the nut in a direction that is closest to aligning a nut slot with the shaft hole. Couple the midship shaft to the no. 2 driveshaft. Refer to **Section 41.00** for instructions covering U-joint uncoupling and coupling.

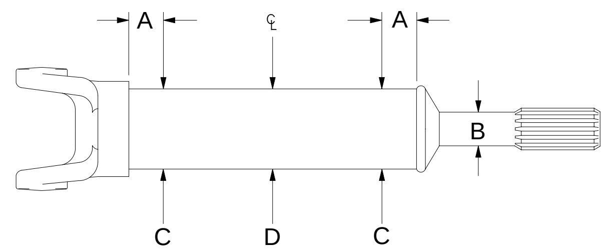
Bearing-Cap Capscrew Torque Values	
Capscrew Size	**Torque lbf·ft (N·m)**
5/16–24	20 (27)
3/8–24	37 (50)
7/16–20	60 (81)

Table 1, Bearing-Cap Capscrew Torque Values

10. On dual-drive vehicles, do the following:

    10.1 With the interaxle differential locked, remove the no. 3 (interaxle) driveshaft, then test drive the vehicle. Refer to **Section 41.00** for instructions covering driveshaft removal and installation.

    If vibration still exists, continue with the next substep.



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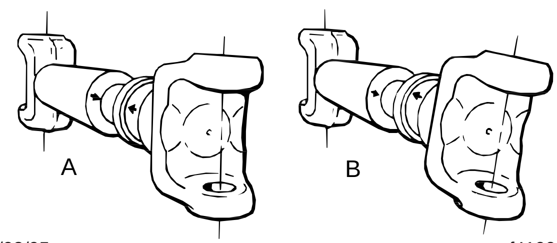
A. Measurement: 3" (76 mm)
B. Measurement: 0.005" (0.127 mm)
C. Measurement: 0.010" (0.254 mm)
D. Measurement: 0.015" (0.381 mm)

Fig. 1, New (rebuilt) Driveshaft Runout Specifications



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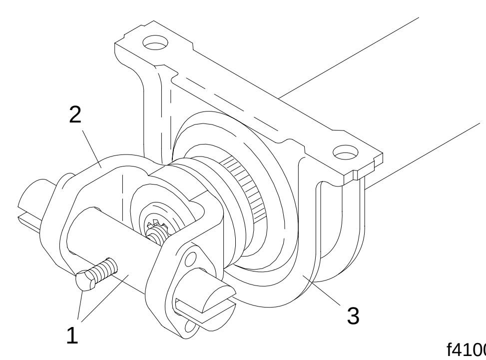
1. In Phase
2. Out of Phase

Fig. 2, U-Joint Phasing



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1. Yoke Puller
2. Midship Bearing Shaft End-Yoke
1. Midship Bearing Assembly

Fig. 3, Midship Shaft End-Yoke Removal

If no vibration exists, install the no. 3 driveshaft, then go to the next step.

10.2 Check the torque on the yoke nuts in the drivetrain. Refer to the applicable table in **Specifications, 400** for yoke-nut torque values. If any of the yoke nuts are not tightened correctly, check the yoke for worn splines by trying to move it up and down, and back and forth. If there is any movement of the yoke, replace the yoke and yoke nut. If it doesn't move, tighten the yoke nut to the correct torque value.

10.3 If the vehicle is equipped with alignment shims at the rear springs, count the number of notches in the thick end of each shim to make sure that the correct shim is used. Also, make sure the thick end of the shim is orientated correctly. Refer to the applicable table in **Specifications, 400** for shim identification and use.

10.4 Balance the no. 2 driveshaft to a tolerance of one inch-ounce per ten pounds weight per end (maximum) at 3000 rpm. Also, balance the midship shaft (if equipped). Or, if an auxiliary transmission is included in the drivetrain, the no. 1 driveshaft should also be balanced.

10.5 If vibration still exists after installing the no. 3 (interaxle) driveshaft, balance the driveshaft.

11. Check the torque on the yoke nuts at the forward rear-axle output shaft and the rearmost axle input shaft. Refer to the applicable table in **Specifications, 400** for yoke-nut torque values. If any of the yoke nuts are not tightened to their torque value, check the yoke for worn splines by trying to move it up and down, and back and forth. If there is any movement of the yoke, replace the yoke and yoke nut. If it doesn't move, tighten the yoke nut to the correct torque value.

    Check that both rear axle gear ratios are matched. If necessary, replace one of the gear sets with a gear set of the proper ratio.

    Balance the no. 3 (interaxle) driveshaft to a tolerance of one inch-ounce per ten pounds weight per end (maximum) at 3000 rpm.

12. On single-drive vehicles, do the following:

12.1 Check the torque on all of the yoke nuts in the drivetrain. Refer to the applicable table in **Specifications, 400** for yoke-nut torque values. If any of the yoke nuts are not tightened to their torque value, check the yoke for worn splines by trying to move it up and down, and back and forth. If it moves, replace the yoke and yoke nut. If it doesn't move, tighten the yoke nut to its torque value.

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

12.3 If the no. 2 driveline is equipped with a midship bearing, balance the midship shaft to a tolerance of one inch-ounce per ten pounds weight per end (maximum) at 3000 rpm. Or, if an auxiliary transmission is included in the drivetrain, the no. 1 driveshaft should also be balanced.

Specifications

Application	Size	Torque lbf·ft (N·m)
Transmissions		
Fuller	—	450-500 (610-678)
Spicer	—	550-600 (746-813)
Eaton Axles		
Single-Drive Rear Axle and Dual-Drive Rearmost Axle Drive Pinions	1–20	360-440 (488-597)
	1-1/8–18	360-440 (488-597)
	1-1/4–12	480-600 (651-813)
	1-1/2–18	560-700 (759-949)
	1-3/4–12	840-1020 (1139-1383)
	1-7/8–12	840-1020 (1139-1383)
Dual-Drive Forward Rear-Axle Input Shafts	1-1/2–18	560-700 (759-949)
	1-5/8–18	780-960 (1058-1302)
	1-7/8–12	840-1020 (1139-1383)
Dual-Drive Forward Rear-Axle Output Shafts	1-1/4–12	480-600 (651-813)
	1-3/4–12	840-1020 (1139-1383)
Rockwell Axles		
Single-Drive Rear Axle and Dual-Drive Rearmost Axle Drive Pinions	7/8–20	200-275 (271-373)
	1–20	300-400 (407-542)
	1-1/4–12	700-900 (949-1220)
	1-1/4–18	700-900 (949-1220)
	1-1/2–12	800-1100 (1085-1491)
	1-1/2–18	800-1100 (1085-1491)
	1-3/4–12	900-1200 (1220-1627)
	2–12	1200-1500 (1627-2034)
Dual-Drive Forward Rear-Axle Input Shafts	1-1/4–18	450-600 (610-813)
	1-1/2–12	450-600 (610-813)
	1-1/2–18	450-600 (610-813)
	1-3/4–12	450-600 (610-813)
Dual-Drive Forward Rear-Axle Output Shafts	1–20	450-600 (610-813)
	1-1/4–12	450-600 (610-813)
	1-1/4–18	450-600 (610-813)
	1-1/2–12	450-600 (610-813)
Rockwell Midship Bearings		
Midship Bearing End Yoke	1-1/4–18	700-750 (949-1017)

Table 1, End-Yoke-Nut Torque

Specifications

1. Engine Angle—All Suspensions: Adjust to 3 degrees ±1/2 degree.
2. Single-Drive—All Suspensions: Adjust rear axle pinion angle to 3 degrees ±1 degree.
3. Dual-Drive—Adjust axle pinion angles to the values in **Table 2**, ±1 degree.

Suspension Model	Axle Model	Axle Spacing	Forward Rear-Axle Pinion Angle/ Planing Shims			Rearmost Axle Pinion Angles/ Planing Shims		
			Pinion Angle	Orientation of the Shim's Thick End	Number of Shim Notches	Pinion Angle	Orientation of the Shim's Thick End	Number of Shim Notches
Reyco Suspensions With Eaton Axles (Vehicle Unloaded)								
102AR	401, 402	52"	2° 0'	Forward	2	8° 00'	Forward	4
Reyco Suspensions With Rockwell Axles (Vehicle Unloaded)								
102AR	SQ-100	52"	2° 00'	Forward	2	8° 00'	Forward	4
	RT 40 145 RT 44 145	52"	2° 00'	Forward	2	9° 45'	Forward	1
Reyco Suspensions With Eaton Axles (Vehicle Loaded)								
102AR	401, 402	52"	3° 00'	Forward	2	10° 00'	Forward	4
Reyco Suspensions With Rockwell Axles (Vehicle Loaded)								
102AR	SQ-100	52"	3° 00'	Forward	2	10° 00'	Forward	4
	RT 40 145 RT 44 145	52"	3° 00'	Forward	2	11° 45'	Forward	1
Neway Suspensions With Eaton Axles (Vehicle Loaded or Unloaded)								
244-6	401, 402	52"	3° 00'	—	—	9° 30'	—	—
		54"	3° 00'	—	—	3° 00'	—	—
		60"	3° 00'	—	—	3° 00'	—	—
	461	52"	3° 00'	—	—	10° 45'	—	—
		54"	3° 00'	—	—	10° 30'	—	—
		60"	3° 00'	—	—	3° 00'	—	—
Neway Suspensions With Rockwell Axles (Vehicle Loaded or Unloaded)								

Suspension Model	Axle Model	Axle Spacing	Forward Rear-Axle Pinion Angle/ Planing Shims	Rearmost Axle Pinion Angles/ Planing Shims				
			Pinion Angle	Orientation of the Shim's Thick End	Number of Shim Notches	Pinion Angle	Orientation of the Shim's Thick End	Number of Shim Notches
244-6	SQ-100	52"	3° 00'	—	—	9° 45'	—	—
		54"	3° 00'	—	—	9° 30'	—	—
		60"	3° 00'	—	—	3° 00'	—	—
	SSHD	52"	3° 00'	—	—	9° 30'	—	—
		54"	3° 00'	—	—	9° 00'	—	—
		60"	3° 00'	—	—	3° 00'	—	—
	RT 40 145 RT 44 145	52"	3° 00'	—	—	11° 30'	—	—
		54"	3° 00'	—	—	11° 15'	—	—
		60"	3° 00'	—	—	3° 00'	—	—
	RT 46 160	52"	3° 00'	—	—	11° 30'	—	—
		54"	3° 00'	—	—	11° 00'	—	—
		60"	3° 00'	—	—	3° 00'	—	—
Hendrickson Suspension With Eaton Axles (Vehicle Loaded or Unloaded)								
RS/RT/RTE	401, 402	52"	3° 00'	—	—	9° 30'	—	—
		54"	3° 00'	—	—	9° 00'	—	—
		60"	3° 00'	—	—	8° 00'	—	—
	461	52"	3° 00'	—	—	10° 45'	—	—
		54"	3° 00'	—	—	10° 30'	—	—
		60"	3° 00'	—	—	9° 00'	—	—
Hendrickson Suspensions With Rockwell Axles (Vehicle Loaded or Unloaded)								

Specifications

Suspension Model	Axle Model	Axle Spacing	Forward Rear-Axle Pinion Angle/ Planing Shims	Rearmost Axle Pinion Angles/ Planing Shims				
			Pinion Angle	Orientation of the Shim's Thick End	Number of Shim Notches	Pinion Angle	Orientation of the Shim's Thick End	Number of Shim Notches
RS/RT/RTE	SQ-100	52"	3° 00'	—	—	9° 45'	—	—
		54"	3° 00'	—	—	9° 30'	—	—
		60"	3° 00'	—	—	8° 30'	—	—
	SSHD	52"	3° 00'	—	—	9° 30'	—	—
		54"	3° 00'	—	—	9° 00'	—	—
		60"	3° 00'	—	—	7° 45'	—	—
	STHD	52"	3° 00'	—	—	9° 30'	—	—
		54"	3° 00'	—	—	9° 00'	—	—
		60"	3° 00'	—	—	8° 00'	—	—
	RT 40 145	52"	3° 00'	—	—	11° 35'	—	—
	RT 46 160	54"	3° 00'	—	—	11° 10'	—	—
		60"	3° 00'	—	—	10° 00'	—	—
	RT 48 180	52"	3° 00'	—	—	12° 00'	—	—
		54"	3° 00'	—	—	11° 30'	—	—
		60"	3° 00'	—	—	10° 00'	—	—
	RT 52 180	52"	3° 00'	—	—	12° 00'		—
		54"	3° 00'	—	—	11° 30'	—	—
		60"	3° 00'	—	—	10° 00'	—	—
Freightliner Air Suspensions (FAS) With Eaton Axles (Vehicle Unloaded)								
FAS I	401, 402	52"	2° 00'	—	—	0° 30'	Forward	1
		54"	2° 15'	Rearward	1	1° 30'	—	—
		60"	2° 15'	Rearward	1	0° 30'	Forward	2
	461	52"	2° 00'	—	—	2° 15'	Rearward	2
		54"	2° 15'	Rearward	1	2° 00'	Rearward	2
		60"	2° 15'	Rearward	1	0° 30'	Forward	2
Freightliner Air Suspensions (FAS) With Rockwell Axles (Vehicle Unloaded)								

Suspension Model	Axle Model	Axle Spacing	Forward Rear-Axle Pinion Angle/ Planing Shims	Rearmost Axle Pinion Angles/ Planing Shims				
			Pinion Angle	**Orientation of the Shim's Thick End**	**Number of Shim Notches**	**Pinion Angle**	**Orientation of the Shim's Thick End**	**Number of Shim Notches**
FAS I	SQ-100	52"	2° 00'	—	—	1° 45'	—	—
		54"	2° 15'	Rearward	1	1° 40'	—	—
		60"	2° 15'	Rearward	1	0° 00'	Forward	2
	SSHD	52"	2° 00'	—	—	2° 15'	Rearward	2
		54"	2° 15'	Rearward	1	0° 30'	Forward	1
		60"	2° 15'	Rearward	1	0° 00'	Forward	2
	RT 40 145	52"	2° 00'	—	—	9° 15'	—	—
	RT 44 145	54"	2° 15'	Rearward	1	8° 30'	Forward	1
		60"	2° 15'	Rearward	1	7° 15'	Forward	3
	RT 46 160	52"	2° 00'	—	—	9° 15'	—	—
		54"	2° 15'	Rearward	1	8° 00'	Forward	1
		60"	2° 15'	Rearward	1	7° 15'	Forward	3
Freightliner Spring Suspensions With Eaton Axles (Vehicle Loaded)								
4-Spring	401, 402	52"	1° 15'	Forward	1	8° 45'	—	—
		54"	1° 30'	Rearward	1	8° 15'	Forward	3
		60"	1° 45'	—	—	1° 45'	—	—
	461	52"	1° 30'	Forward	1	10° 00'	Rearward	2
		54"	1° 15'	Rearward	1	9° 30'	—	—
		60"	1° 45'	—	—	1° 45'	—	—
Freightliner Spring Suspensions With Rockwell Axles (Vehicle Loaded)								

Specifications

Suspension Model	Axle Model	Axle Spacing	Forward Rear-Axle Pinion Angle/ Planing Shims	Rearmost Axle Pinion Angles/ Planing Shims				
			Pinion Angle	Orientation of the Shim's Thick End	Number of Shim Notches	Pinion Angle	Orientation of the Shim's Thick End	Number of Shim Notches
4-Spring	SQ-100	52"	1° 30'	Forward	1	8° 45'	—	—
		54"	1° 45'	Rearward	1	8° 15'	Forward	3
		60"	1° 45'	—	—	1° 45'	—	—
	SSHD	52"	1° 15'	Forward	1	8° 45'	—	—
		54"	1° 30'	Rearward	1	7° 45'	Forward	4
		60"	1° 45'	—	—	1° 45'	—	—
	RT 40 145 RT 44 145	52"	1° 30'	Forward	1	10° 30'	Rearward	3
		54"	1° 30'	Rearward	1	10° 15'	Rearward	1
		60"	1° 45'	—	—	1° 45'	—	—
	RT 46 160	52"	1° 30'	Forward	1	10° 00'	Rearward	2
		54"	1° 30'	Rearward	1	10° 00'	Rearward	1
		60"	1° 45'	—	—	1° 45'	—	—

Table 2, Axle Pinion Angle Data