

TECHNICAL PROCEDURE

TRAILER SUSPENSION SYSTEMS

SUBJECT: Alignment Procedure

LIT NO: L579

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TOOLS AND EQUIPMENT

The following tools and equipment are necessary to complete the procedure within this publication:

- 50-foot (minimum) steel tape measure with $\frac{1}{32}$ in. or millimeter increments
- 12 ft. (minimum) steel tape measure with $\frac{1}{32}$ inch or millimeter increments, or a trammel bar
- Tape tensioning device; consisting of:
 - Fish (or engineering) scale
 - Clamp
 - String - used to fasten the clamp to the fish scale
- Kingpin adapter or kingpin extender (pogo stick)
- Level - used to plumb the kingpin extender
- Wheel-end (or spindle) extenders
- $\frac{1}{2}$ in. breaker bar or ratchet
- E20 or E22 Torx® socket; 1 in. drive recommended (refer to the section titled **TORX® SOCKETS** for more Torx socket details)
- Impact wrench with a minimum torque capability of 600 ft. lbs. (813 N•m)
- $\frac{17}{16}$ in. shallow impact socket
- $\frac{17}{16}$ in. combination wrench
- Tire changing equipment (as needed)

TORX® SOCKETS

Hendrickson offers four Torx sockets (Table 1) that may be used on the shear-type bolt during alignment. E20 and E22 Torx sockets are also available from other vendors.

NOTE: Hendrickson does not recommend the $\frac{3}{4}$ in. drive socket for use in high volume trailer production environments. The $\frac{3}{4}$ in. drive socket can back away from full Torx head engagement during the shearing process and strip the Torx-head splines. When damage occurs to the Torx-head splines, the proper torque and clamp load may not be achieved.

TORX SOCKET SIZE	DRIVE SIZE	PIVOT CONNECTION	COMMENTS
E20 (part # A-24303)	$\frac{3}{4}$ in	QUIK-ALIGN®	For occasional use (not recommended for high-volume trailer production environments)
E20 (part # A-24536)	1 in	QUIK-ALIGN®	For medium-duty use (dealers, repair facilities, etc.)
E20 with sleeve (part # A-25119)	1 in	QUIK-ALIGN®	For high-volume trailer production environments or manufacturing facilities. The sleeve provides greater operator control.
E22 (part # SR1TL100)	1 in	AdVANtage	For AdVANtage style pivot connections in high-volume trailer production environments or manufacturing facilities.

Table 1: Hendrickson E20 Torx socket summary

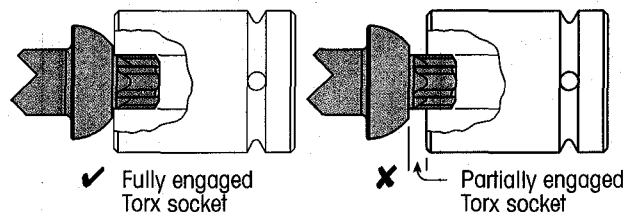


Figure 1: Socket engagement

To avoid damaging the shear bolt's Torx head (regardless of the drive socket being used), the drive socket must fully engage the Torx head (Figure 1).

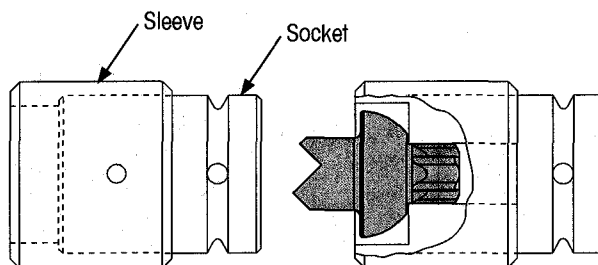
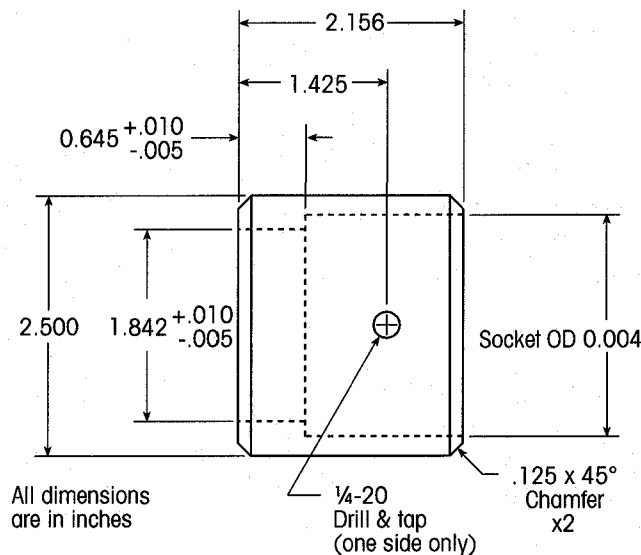


Figure 2: 1 inch drive E20 Torx socket with sleeve



FABRICATION NOTES:

1. Sleeve undersized by .004; shrink fit socket into sleeve OD.
2. Drill and tap assembly for 1/4-20 x .25 (oval point) standard hex socket set screw.
3. Material: Ø2.500 6150 H.R.S.
4. Heat treatment (sleeve):
 - a. oil drenched: 1550° F (538° C)
 - b. tempered: 1000° F (843° C)

Figure 3: Sleeve dimensions

For QUIK-ALIGN® style pivot connections in high volume trailer production and service facilities, Hendrickson recommends the one in. drive E20 Torx socket with sleeve, part number A-25119 (Figure 2). The sleeve helps support the tool by riding over the entire head of the shear bolt. It also provides greater operator control at the moment of shear by preventing the heavy tool from veering. The operator can rest the tool on the bolt during the entire operation resulting in greater control of socket-to-bolt engagement, reduced fatigue and consistently torqued pivot connections. If you already own the one in. drive E20 Torx socket without the sleeve (part number A-24536) and wish to add a sleeve to it, dimensions are included in Figure 3. A local fabricating shop can make and assemble the sleeve for you using this information.

RELATIVE LITERATURE

If you suspect your version of this or any other Hendrickson manual is not "Up-to-Date", the most current version is free online at:

www.hendrickson-intl.com/literature/

Available Hendrickson documentation can be viewed or downloaded from this site.

All Hendrickson online documentation are PDF files that require Adobe Acrobat Reader to open. This is a free application downloadable from Adobe's home page (<http://get.adobe.com/reader/>).

Other relative literature may include:

NAME	DESCRIPTION
L583	Comprehensive Warranty Statement
L785	Pre-aligned VANTRAAX® Warranty Update
L874	Pre-aligned VANTRAAX Alignment Verification Procedure
L926	Factory-torqued Curbside Pivot Connection
L1072	Pivot Connection Fastener Information

PIVOT CONNECTION HARDWARE

Hendrickson suspensions are equipped with either QUIK-ALIGN®, AdVantage, SmartRide or welded-collar style pivot connections.

CAUTION: DO NOT apply an anti-sieze compound to the pivot connection hardware or allow undercoating, paint, or any other commonly used compounds to contact the threads of the pivot connection fasteners. These compounds can act like a lubricant, reducing the friction between the threads of the nut and bolt. This can lead to overtightened fasteners, unpredictable pivot connection clamp loads and unreliable axle alignments.

CAUTION: DO NOT apply undercoating, paint or other surface coating to the suspension and frame brackets until after completing the alignment. Mask as shown in Figure 4.

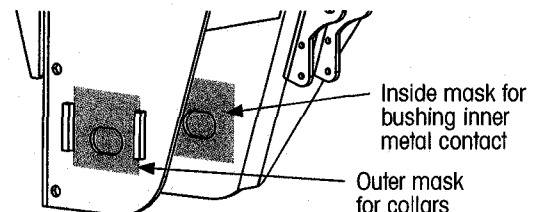


Figure 4: Paint mask areas (example for QUIK-ALIGN)

NOTE: Areas where alignment collars and bushing inner metal contact the frame bracket must be masked if coating prior to assembly.

QUIK-ALIGN® PIVOT CONNECTION

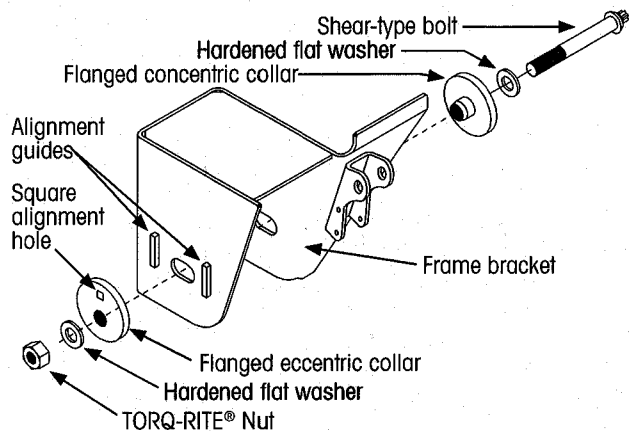


Figure 5: QUIK-ALIGN® pivot connection

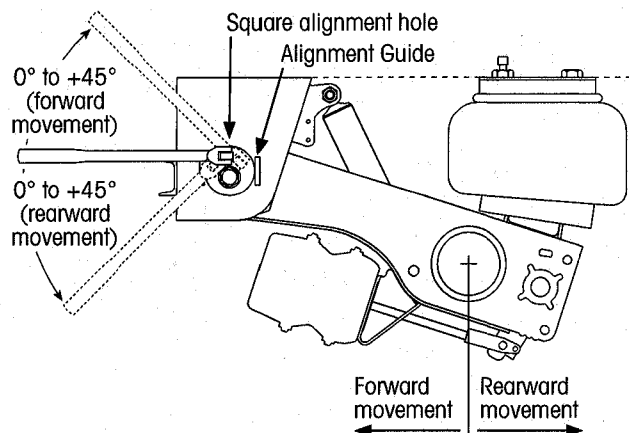


Figure 6: Rotating QUIK-ALIGN® flanged eccentric collar

The QUIK-ALIGN® style pivot connection uses two flanged collars inserted into slots on each side of the frame bracket (Figure 5). The eccentric collar on the outboard side of the frame bracket is used to adjust the position of the axle during an alignment. The alignment guides on the side of the frame bracket limit the eccentric collar to rotational movement in the frame bracket slot. Rotating the eccentric collar clockwise causes the axle to move forward. Rotating the eccentric collar counterclockwise causes the axle to move rearward (Figure 6). The maximum range of adjustment is ± 45 degrees from the 12 o'clock position.

Along with hardened flat washers, a shear-type bolt and a TORQ-RITE® nut are also part of the QUIK-ALIGN style pivot connection. Use of this shear-type bolt and TORQ-RITE nut with an E20 Torx socket ensures proper clamping force without the use of a torque wrench.

ADVANTAGE PIVOT CONNECTION

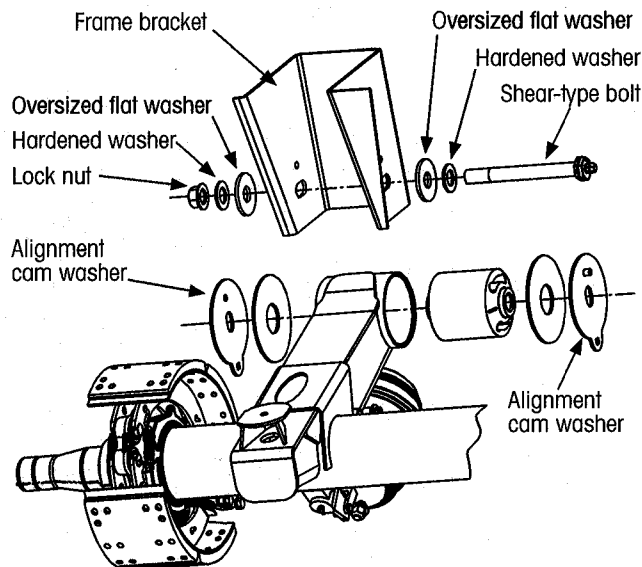


Figure 7: AdvANTage pivot connection (roadside view)

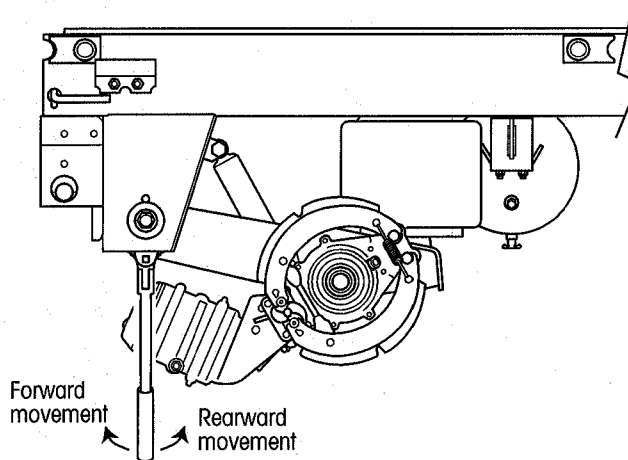


Figure 8: Adjusting cam washers on AdvANTage pivot connection

The AdvANTage style pivot connection uses two alignment cam washers on each side of the suspension beam inside the frame bracket (Figure 7). Both alignment cam washers in the frame bracket must be rotated in unison to adjust the position of the axle during an alignment. The shear-type bolt and the horizontal slot in the sides of the frame bracket limit the rotational movement of the alignment cam washers. Rotating the alignment cam washers toward the front of the trailer causes the axle to move forward. Rotating the alignment cam washers toward the rear of the trailer causes the axle to move rearward (Figure 8).

Along with oversized flat and hardened washers, a shear-type bolt and lock nut are also part of the AdvANTage style pivot connection. Use of this shear-

type bolt and lock nut with an E22 Torx head socket ensures proper clamping force without the use of a torque wrench.

SMARTRIDE STYLE PIVOT CONNECTION

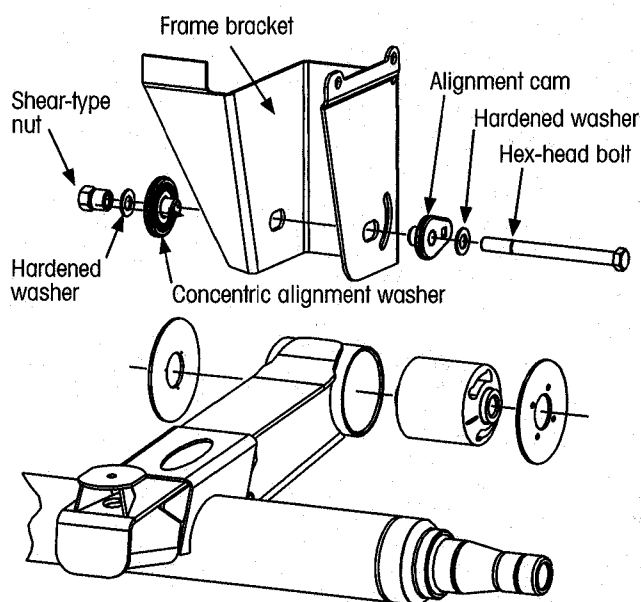


Figure 9: *SmartRide pivot connection (curbside view)*

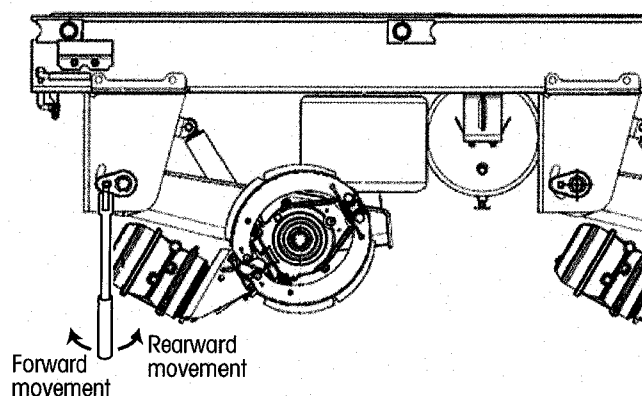


Figure 10: *Adjusting SmartRide pivot connection*

The SmartRide style pivot connection uses a single alignment cam inserted into a slot on the outboard side of the frame bracket (Figure 9). The alignment cam on the outboard side of the frame bracket is used to adjust the position of the axle during an alignment. The slot in the side of the frame bracket limits the rotational movement of the alignment cam. Rotating the alignment cam up causes the axle to move forward. Rotating the alignment cam down causes the axle to move rearward (Figure 10).

Along with hardened washers and a concentric alignment washer, a unique 7/8 in. hex-head bolt

and a shear-type nut are also part of the SmartRide style pivot connection. Use of this hex-head bolt and shear-type nut ensures proper clamping force without the use of a torque wrench.

WELDED COLLAR PIVOT CONNECTION

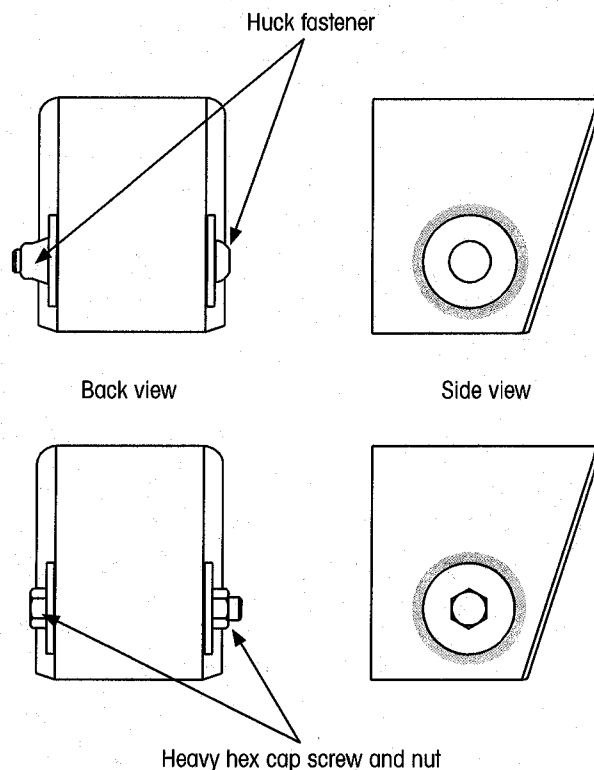


Figure 11: *Welded Collar pivot connection*

The welded collar style pivot connection is clamped together by either a huck fastener or a 1 1/8 in. heavy hex cap screw and nut (Figure 11). After the alignment is completed, the entire circumference of both inboard and outboard collars is welded to the frame bracket. The nut is welded to the 1 1/8 in. heavy hex cap screw (if used instead of the Huck fastener).

To realign this style of pivot connection, the collar welds must be removed so the pivot joint can be repositioned.

ALIGNMENT BACKGROUND

Properly aligned trailer axles optimize fuel economy, driveability and help prevent excessive tire wear.

A perfect alignment scenario has all trailer wheels parallel to one another and perpendicular to the centerline of the trailer. However due to uncontrollable factors, this perfect scenario is often an unreasonable expectation. A more likely alignment scenario has the trailer wheels parallel within a very small tolerance range to one another and perpendicular within a very small tolerance range to the centerline of the trailer.

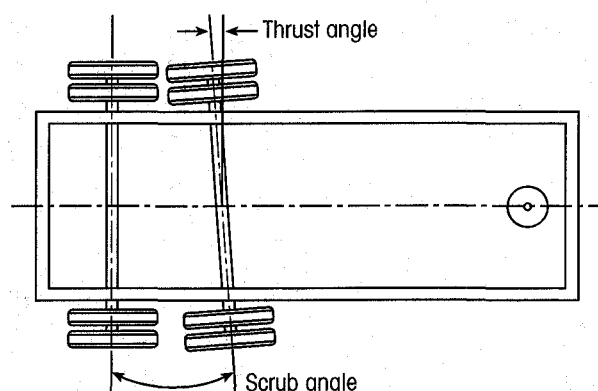


Figure 12: Tandem trailer axle angles

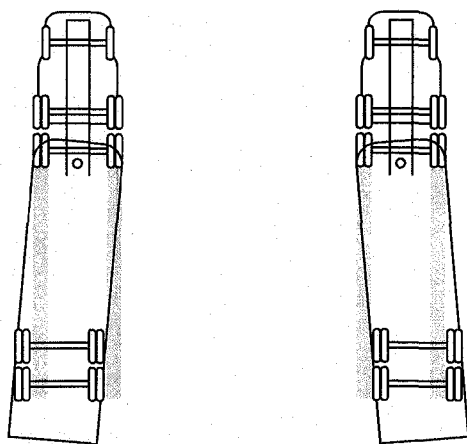


Figure 13: Examples of dog tracking

There are two important trailer axle angles that must be kept within recommended tolerance ranges: **thrust angle** and **scrub angle** (Figure 12). These angles, when out of tolerance, can lead to increased rolling resistance, excessive tire wear and can contribute to trailer "dog tracking". Dog tracking is a condition where the trailer does not follow or track directly behind the truck as the vehicle is being operated in a straight line (Figure 13) and is influenced by body rail alignment, king pin location, axle side-to-

side location, etc. The procedures presented in this publication detail how to check and, if necessary, bring these angles within the recommended tolerance range.

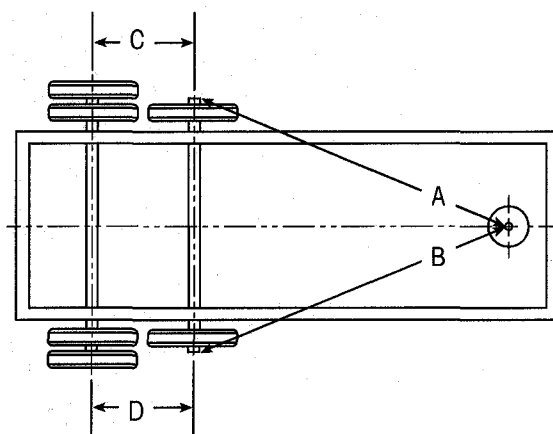


Figure 14: Measurements to check axle alignment

The front axle is used as a starting point to measure thrust angle. First, the measurement target value (or tolerance range) is determined. Then, the distance from the kingpin (used as the trailer centerline) to matching points on each end of the front axle is measured (distances "A" and "B" in Figure 14). The difference between these two measurements is then compared to the measurement target value to determine the axle thrust angle. If the difference between the "A" and "B" measurements is larger than the target value, the axle must be adjusted to achieve an acceptable axle thrust angle. If the difference between the "A" and "B" measurements is smaller than or equal to the target value, axle thrust angle is within the tolerance range and no adjustment is necessary. The remaining axles are then measured with respect to the front axle and adjusted, if necessary, to an acceptable scrub angle.

Even though distances are being measured using measurement points on the ends of the axle, it is the axle thrust angle that is important. As shown in Figure 14, the acceptable axle thrust angle remains constant over the length of the axle. However, the measurement target value that coincides with the acceptable axle thrust angle varies over the length of the axle. Because of a simple geometrical relationship, the measurement target value gets larger as you move farther away from the center of the axle.

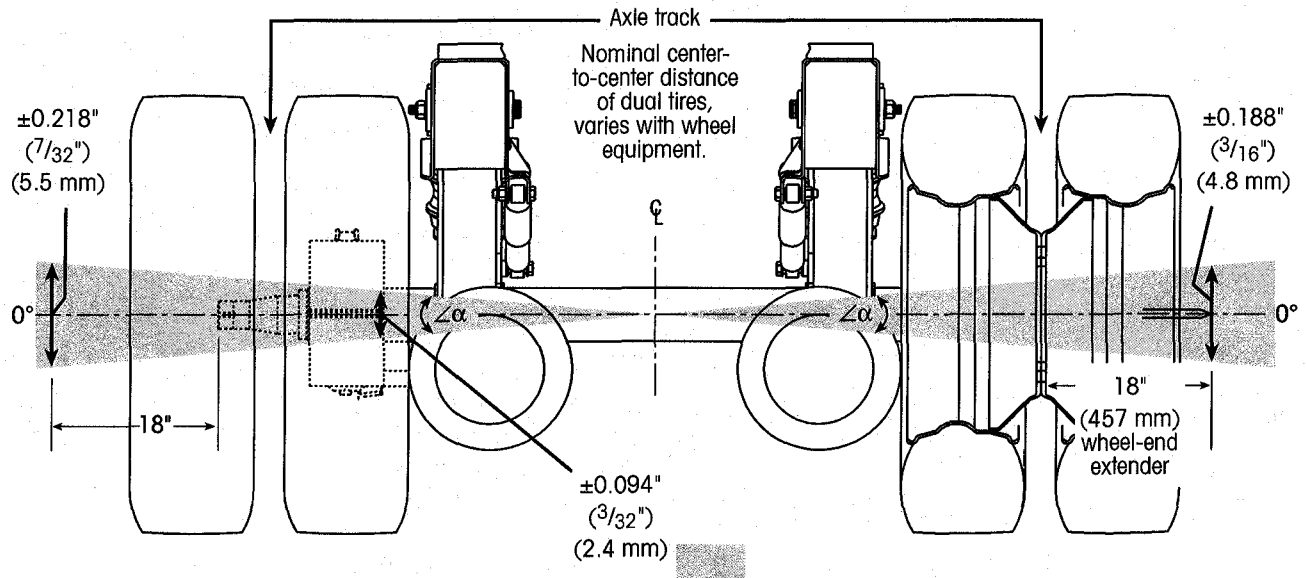


Figure 15: Thrust angle geometry example

For example:

Measuring from the king pin to a point 18 inches beyond the end of the spindle might produce a measurement target value of ± 0.218 ($7/32$) inches (Figure 15). But a measurement from the king pin to the brake drum might only produce a measurement target value of ± 0.094 ($3/32$) inches. Both of these measurements are within the acceptable axle thrust angle, but one is more than two times larger than the other. This is because one measurement is taken at a point much farther away from the center of the axle than the other measurement.

The typical trailer industry alignment specification for thrust angle is ± 0.1 degrees, which equals $\pm 1/8$ inch when measured from the king pin to the axle track of a 77.5 in. track axle (distances "A" and "B" in Figure 14). Hendrickson suspensions are no different. However, there are two additional clarifications to this specification that must be addressed. The first one deals with axle track (Figure 14). Using the value for axle track simplifies the axle thrust angle calculation, but it is impractical to use axle track for a measurement. Not only does the outer tire/wheel assembly have to come off to even attempt the measurement, but where specifically on the spindle do you measure to? What point on the spindle defines axle track? A more practical approach is to use wheel-end extenders to provide a more accurate and consistent measurement point (more wheel-end extender information is presented later in this document).

The second clarification deals with measurement limitation. The ± 0.1 degrees of thrust angle is difficult to achieve because of measurement limitations. No currently existing alignment measurement method can consistently provide an alignment within this ± 0.1 degree tolerance. The reason for this is measurement error.

MEASUREMENT METHOD	PRECISION/ TOLERANCE RATIO ($\pm 0.1^\circ$)	PRECISION/ TOLERANCE RATIO ($\pm 0.2^\circ$)
Tape measure to rim	330%	165%
Laser devices ¹	309%	155%
$1/16$ " graduated tape measure to wheel-end extenders	207%	104%
$1/32$ " graduated tape measure to wheel-end extenders	148%	74%
Extensometer	64%	32%

¹ per SAE technical paper 933046

Table 2: Measurement method and associated accuracy

All measurement devices and procedures (Table 2) have variations that affect their accuracy. A study typically performed to identify measurement device or procedure accuracy is a gauge repeatability and reproducibility study. It evaluates how well the measurement device or procedure can perform with respect to specifications. The result of such a study is a factor called "**precision to tolerance ratio**". This ratio expresses the percent of the tolerance used up by measurement error.

For example:

Say you have a measurement with a tolerance of ± 0.125 ($1/8$) inches. Say also that the result of a gauge repeatability and reproducibility study revealed a precision to tolerance ratio of 75 percent. This means that ± 0.0938 ($3/32$) inches (or 75 percent) of the $\pm 1/8$ in. tolerance could be attributed to measurement error.

As summarized by [Table 2](#), the measurement error introduced by current alignment measurement methods (except extensometer devices) is greater than the ± 0.1 degree industry specification.

With the two previously described clarifications in mind, Hendrickson continues to recommend using the ± 0.1 degree thrust angle alignment specification for initial alignments, realizing that, due to measurement error, the actual thrust angle may be in the ± 0.2 degree range. The ± 0.2 degree range complies with most tire manufacturers' recommendations for an allowable trailer axle thrust angle. Hendrickson also recommends using a steel tape measure with $1/32$ in. or millimeter graduations, a tape tensioning device and wheel-end extenders to allow for greater measurement accuracy. Subsequent alignment verification measurements should use the ± 0.2 degree thrust angle range recommended by most tire manufacturers.

ALIGNMENT PREPARATIONS**SELECT THE ALIGNMENT AREA**

The alignment should be performed on a flat, level, debris-free surface.

PERFORM TIRE INSPECTION

The tires in each dual wheel set must be matched to within $1/4$ inch in diameter and $3/4$ inch in circumference.

The tires must also be at the manufacturer's recommended pressure when checking or performing an axle alignment. Inflate or deflate the tires to match this recommended pressure.

Also make sure that the same tires and rims are mounted on each side of the trailer.

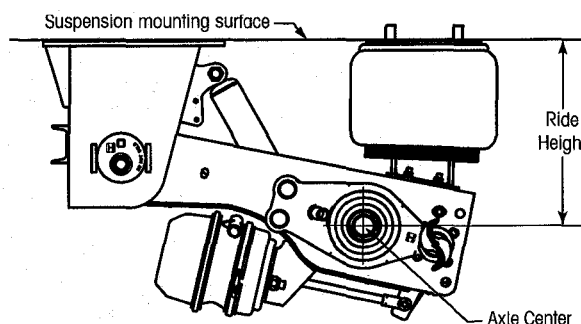
SET SUSPENSION RIDE HEIGHT

Figure 16: *Ride height defined*

The suspension must be at its designed ride height when checking or performing an axle alignment. A suspension's designed ride height ([Figure 16](#)) is defined as the distance from the suspension mounting surface (the bottom of the trailer or slider box) to the center of the axle. For complete instructions on determining and setting ride height, refer to Hendrickson publication [L459 Checking Trailer Ride Height](#), available online at www.hendrickson-intl.com/literature.

PROPERLY POSITION THE TRAILER

Trailer positioning is important during an axle alignment. The trailer suspension must be in a "relaxed" state without any pre-load applied to the TRI-FUNCTIONAL® Bushings.

IMPORTANT: A pre-loaded bushing will complicate the axle alignment process by providing inaccurate measurement data. Also, a seemingly-aligned axle that contains an unknowingly-compressed bushing may cause tracking problems and/or premature tire wear. To avoid these conditions, perform the proper trailer positioning procedure as follows.

1. Position trailer for alignment:

A. Sliders -

- i. **Move** slider to rear-most position of the trailer.
- ii. Make sure the slider locking **pins are fully extended** through the body rail holes.
- iii. With trailer still coupled to the tractor, **adjust** trailer landing legs so there is adequate ground clearance.
- iv. **Pull** trailer forward in a straight line for a minimum of 10 feet and gently apply trailer brakes. This forces slider locking pins to rear of the body rail holes, removing locking pin slack and relieving bushing pre-load.

B. Non-sliders -

- i. With the trailer still coupled to the tractor, **adjust** the trailer landing legs so there is adequate ground clearance.
- ii. **Pull** the trailer forward in a straight line for a minimum of 10 feet and ease the trailer to a stop using only the service brakes, thus relieving bushing pre-load.

2. **Lower** trailer landing legs so they contact the ground. Uncouple trailer from the tractor and apply shop air to trailer emergency glad hand to release parking brakes.

IMPORTANT: Keep trailer parking brakes disengaged to allow wheel rotation while positioning suspension fore and aft.

SET DESIGNED KINGPIN HEIGHT

Set the front of the trailer to its designed kingpin height:

1. Determine what the designed kingpin height should be. Check the trailer ID tag on the trailer front bulkhead or contact the trailer manufacturer for the designed kingpin height.

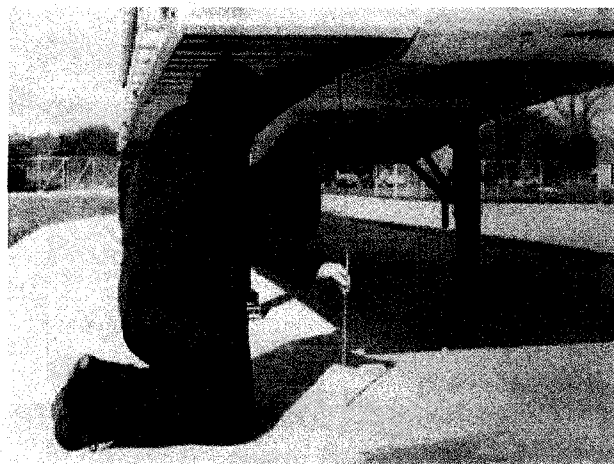


Figure 17: Measuring actual kingpin height

2. Using a tape measure, determine the current trailer kingpin height by measuring from the ground to the kingpin mounting plate (Figure 17).
3. Adjust the landing legs to place the trailer at the designed kingpin height.
4. Verify the kingpin height by measuring from the ground to the kingpin mounting plate on both sides of the kingpin.

CHECK INITIAL AXLE ALIGNMENT

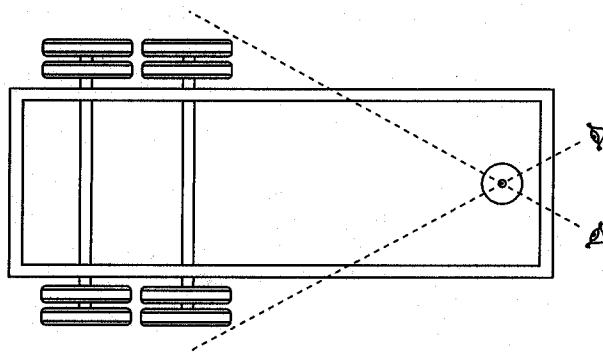


Figure 18: Checking for measurement obstructions

1. From a position at the front of the trailer, sight along a line under the trailer from the kingpin to each end of the front axle (Figure 18).

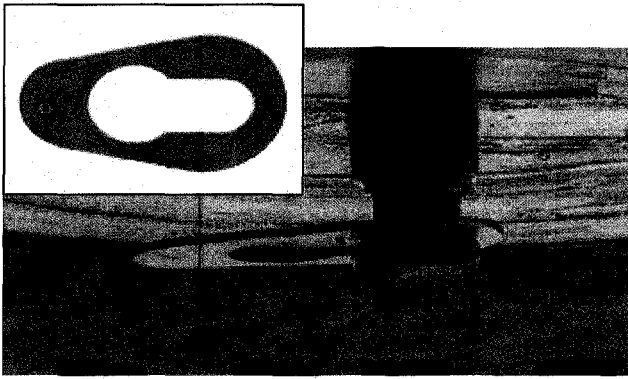


Figure 19: Kingpin adapter

- A. If this sightline is free from under-trailer obstructions that would interfere with a measurement (i.e., landing legs, trailer frame, tool boxes, etc.), then the kingpin adapter (Figure 19) can be used to make the measurement in Step 5.

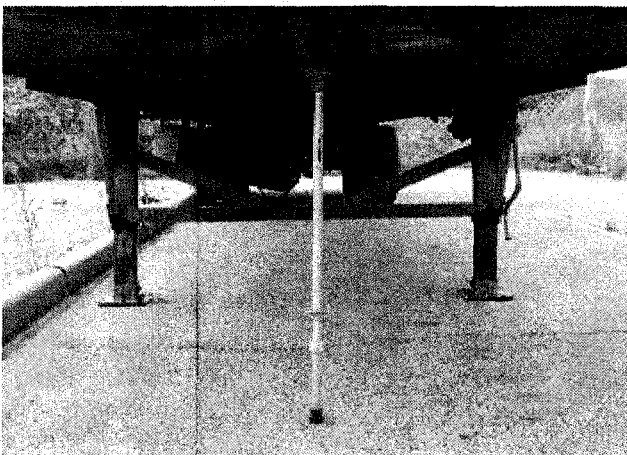


Figure 20: Kingpin extender

- B. If this sightline is obstructed, then the kingpin extender or pogo stick (Figure 20) must be used to make the measurement in Step 5.

NOTE: Follow manufacturer's instructions to install and align the kingpin extender. The extender typically includes a leveling bubble to ensure vertical alignment.

2. **Place** kingpin adapter (Figure 19) or kingpin extender (Figure 20) onto the kingpin.

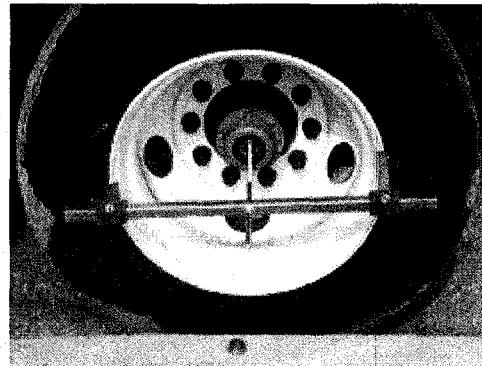


Figure 21: Installed wheel-end extender

3. Following the manufacturer's recommended instructions, install wheel-end extenders on each end of the front axle (Figure 21).

NOTE: A wide range of wheel-end extenders are available from various companies, ranging from simple fixtures to complex devices. Wheel-end extenders are designed to ease alignment by eliminating the need to remove the outer wheel when checking or aligning axles. Once in place, wheel-end extenders position axle reference points far enough outside the trailer to allow the measuring tape to clear tires when measuring "A" and "B" dimensions from the kingpin. Some wheel-end extenders require contact with the spindle plug through the hub cap oil fill hole. Others offer a more universal mount, fitting over the entire hub. Select wheel-end extenders that work best with your style of hubs.

IMPORTANT: Make sure the wheel-end extenders are a matched pair and are properly installed. Failure to properly install a matched pair of wheel-end extenders will significantly reduce the accuracy of the alignment measurement.

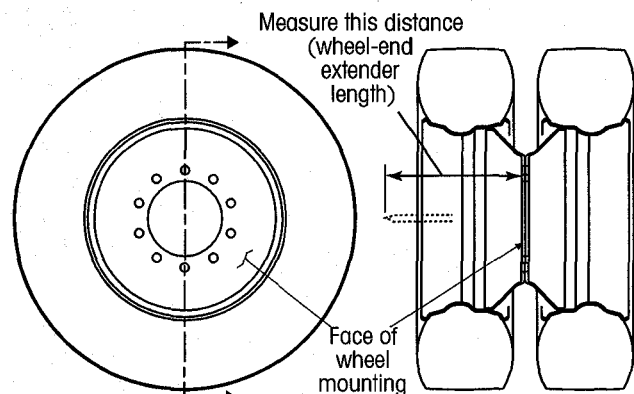


Figure 22: Measuring wheel-end extender length

4. Determine front axle target value as follows:
 - A. Measure the length of one wheel-end extender. Measure from the face of the wheel mounting to the tip of the wheel-end extender (Figure 22).
 - B. Read the front axle target value from Table 3.

FRONT AXLE TARGET VALUES ^{1,2}											
Track Length		71.5									
Axle to King Pin ²		48	44	40	36	32	28	24	20	16	12
Wheel Extender Length	12										
	13										
	14										
	15										
	16										
	17										
	18										
	19										
	20										
	21										
	22										
	23										
	24										
Track Length		77.5									
Axle to King Pin ²		48	44	40	36	32	28	24	20	16	12
Wheel Extender Length	12										
	13										
	14										
	15										
	16										
	17										
	18										
	19										
	20										
	21										
	22										
	23										
	24										
Track Length		83.5									
Axle to King Pin ²		48	44	40	36	32	28	24	20	16	12
Wheel Extender Length	12										
	13										
	14										
	15										
	16										
	17										
	18										
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	20										
	21										
	22										
	23										
	24										

¹ The front axle (or thrust angle) target values presented in this table have been pre-calculated for your convenience. To see the steps involved in this process and an example of front axle target value calculation, refer to APPENDIX B: FRONT AND REAR AXLE TARGET VALUE SAMPLE CALCULATION on page 23.

² Axle to king pin values are in feet, all others in inches.

Table 3: Thrust angle target values

For example:

Suppose the measured length of your wheel-end extender is 18 inches and your trailer has a 77.5 in. axle track. **First**, find the 18 in. row in the 77.5 in. section of the table. **Then**, find the column for a 40 ft. axle to king pin distance and **read** down the column. The **value shown** where 18 in. wheel-end extender length and 40 ft. axle to king pin meet is $\pm 3/16$ inch, which is the front axle target value. This front axle target value will be required for a comparison in Step 6.

NOTE: Axle track can be read from the suspension model identification tag, found on the inside surface of the curbside beam (INTRAAX® suspensions) or on the roadside slider box side rail above the front frame bracket (VANTRAAX® suspensions). For complete details on reading the Hendrickson suspension identification tag, refer to Hendrickson publication *L760 New Product Identification System*, available at www.hendrickson-intl.com/literature.

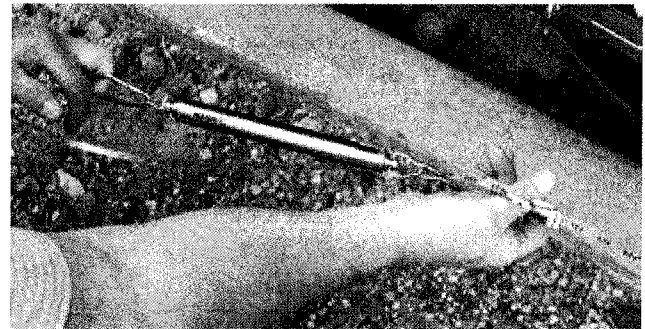


Figure 23: Using tape tension device (fish scale)

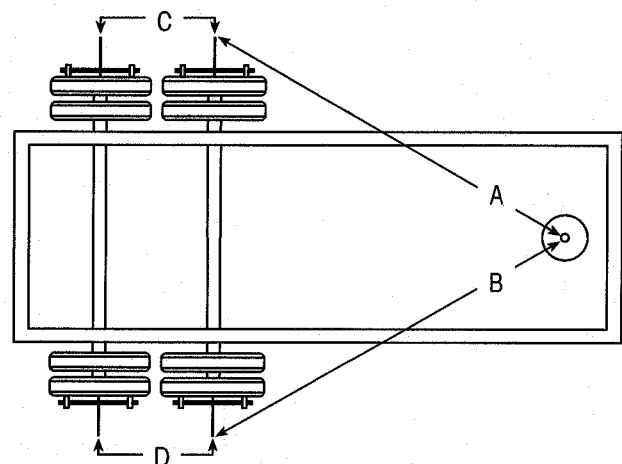


Figure 24: Axle alignment measurements

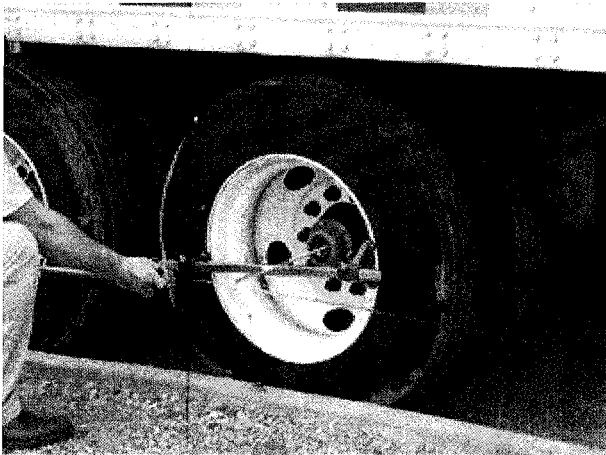


Figure 25: Measuring the "A" and "B" distances

5. Hook a steel measuring tape (50 ft. min.) to the kingpin adapter (or kingpin extender). Holding the measuring tape with the tape tensioning device (Figure 23), measure the distances "A" and "B" from the kingpin to the wheel-end extender pointer on each end of the front axle (Figure 24 and Figure 25).

IMPORTANT: The same lateral tension (pulling force) applied to the measuring tape when measuring distance "A" must also be applied when measuring distance "B". When making the measurements, closely monitor the tensioning device scale to make sure that the same pulling force is used in both measurements.

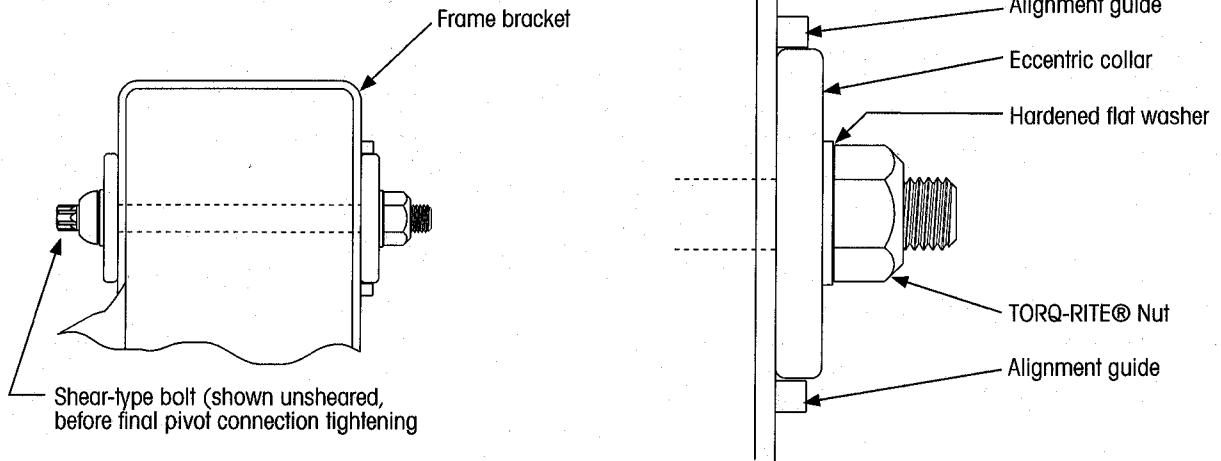
6. Subtract the smaller of the "A" and "B" measurements from the larger of the two, then compare this difference with the target value obtained in Step 4.
 - A. If the difference between the "A" and "B" measurements is smaller than or equal to the target value, the axle is within specification and no alignment is necessary.
 - B. If the difference between the "A" and "B" measurements is larger than the target value, the axle must be adjusted to bring this difference within the target value.

For example:

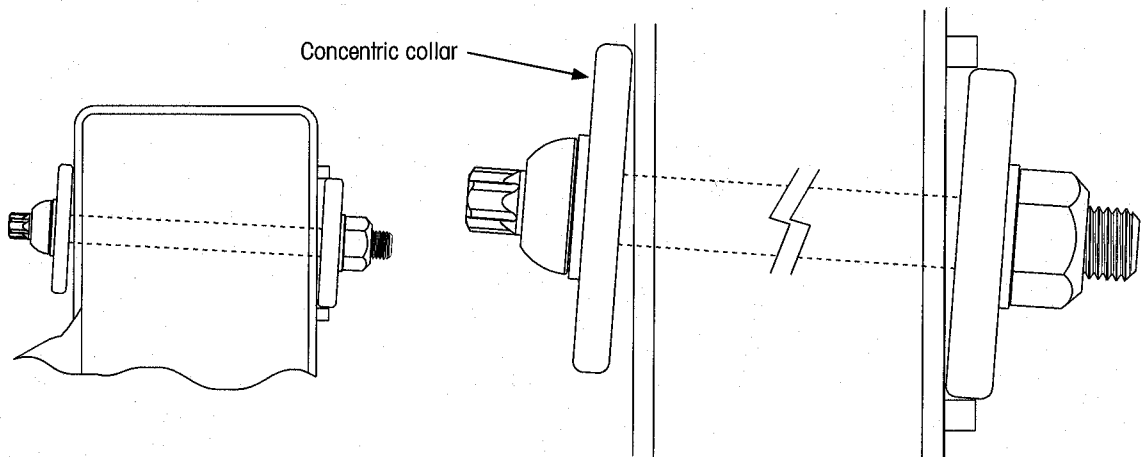
Suppose distance "A" was measured to be $420\frac{1}{8}$ inches and distance "B" was measured to be $420\frac{11}{16}$ inches. Subtracting yields this difference:

$$420\frac{11}{16} - 420\frac{1}{8} = \frac{9}{16}$$

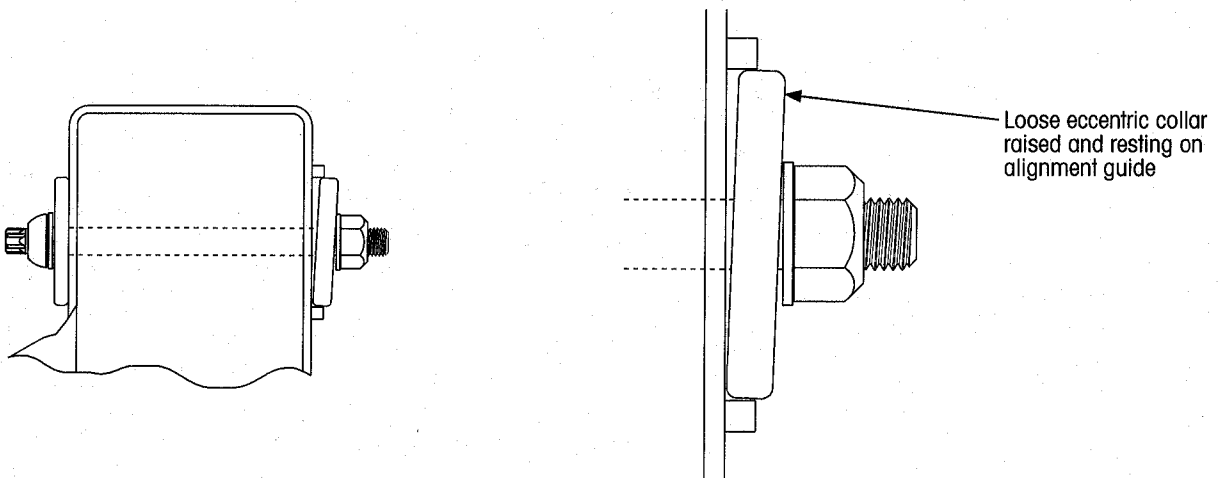
When compared to the target value ($\pm\frac{3}{16}$ inches, read from the Table 3 in Step 4), $\frac{9}{16}$ inches is larger. Therefore the axle must be adjusted to bring the "A" and "B" difference within the target value.



A. Properly positioned eccentric collar



B. "Wedged" pivot connection hardware



C. "Raised" eccentric collar

Figure 26: QUIK-ALIGN® Pivot connection hardware positioning

AXLE ALIGNMENT

QUIK-ALIGN® PIVOT CONNECTION

In June 2006, Hendrickson began factory torquing the curbside QUIK-ALIGN pivot connections on all VANTRAAX® slider suspension systems. "Factory torquing" simply means the curbside pivot connection is aligned in the center of its adjustment range and tightened to the proper torque before the suspension leaves the Hendrickson facility. Therefore the curbside pivot connection on all VANTRAAX slider axles will not require any attention. Alignment will be performed using the roadside pivot connection only. For more information, refer to Hendrickson L926 Factory-torqued Curbside Pivot Connection, available online at www.hendrickson-intl.com/literature.

If your suspension is a VANTRAAX factory-torqued model, perform the alignment using only the roadside pivot connections in the following procedures.

For all other models, perform the alignment using both roadside and curbside pivot connections in the following procedures.

THRUST ANGLE

If the front axle is found to be out of the acceptable thrust angle range, it must be realigned as follows:

1. Remove and discard the existing shear-type bolt, TORQ-RITE® nut and hardened flat washers from the front axle pivot connection. If necessary, clean the surface rust from the alignment collars and frame bracket surface and inspect for excess wear. Replace if worn.
2. Install a new shear-type bolt, TORQ-RITE nut and hardened flat washers into the front axle pivot connection, but **do not fully tighten at this time**. The pivot connection fasteners should be tight enough to hold the flanged eccentric collar in place against the alignment guides and flat against the frame bracket, but loose enough to permit the hardened flat washers to rotate freely.

NOTICE: DO NOT apply anti-sieze compound to pivot connection hardware or allow undercoating, paint, or any other commonly used compounds to contact the threads of the pivot connection fasteners. These compounds can act like a lubricant, reducing the friction between the threads of the nut and bolt. This can lead to overtightened fasteners, unpredictable pivot connection clamp loads and unreliable axle alignments.

IMPORTANT: The eccentric collar must remain flat against the frame bracket throughout the alignment procedure (Figure 26-A, page 13). If the pivot connection fasteners are too loose, the eccentric collar may raise up on the alignment guide, resulting in an improper alignment (Figure 26-C). If this condition occurs during alignment, refer to the raised eccentric collar information in the troubleshooting section.

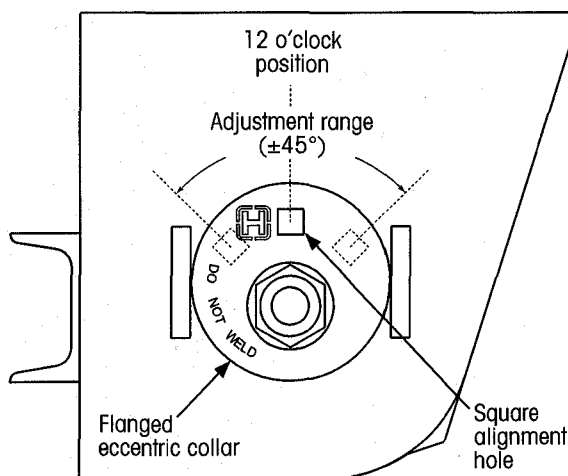


Figure 27: Eccentric collar orientation details

3. On the front axle pivot connection, inspect the orientation of the square alignment hole in the flanged eccentric collar (Figure 27). The square alignment hole must be at the 12 o'clock position, which is the middle of the alignment adjustment range.

If the square alignment hole is not at the 12 o'clock position, insert a 1/2 in. breaker bar into the square alignment hole in the flanged eccentric collar and rotate the collar until the square hole is at the 12 o'clock position.

4. With the square alignment hole in the 12 o'clock position on the front axle pivot connection, recheck measurements "A" and "B" from the kingpin to each wheel-end extender pointer.

If necessary, insert a 1/2 in. breaker bar into the square alignment hole in one of the flanged eccentric collars and adjust the axle forward by rotating the collar clockwise or rearward by rotating the collar counterclockwise.

5. While rotating the flanged eccentric collar (on the outboard side of the frame bracket), tap on the flanged concentric collar (on the inboard side of the frame bracket) with a rubber mallet.

IMPORTANT: The tapping allows the concentric and eccentric collars to move and adjust in unison. If the collars do not move and adjust in unison, the concentric collar may wedge against the frame bracket (Figure 26-B, page 13), causing an inaccurate alignment and an improper pivot connection that could potentially loosen. If this condition occurs during the alignment procedure, refer to the "wedged collar" information in the troubleshooting section.

IMPORTANT: There is no change in axle adjustment when the flanged eccentric collar is rotated beyond 45 degrees from the 12 o'clock position in either the fore or aft direction.

6. Recheck measurements "A" and "B" from the kingpin to each wheel-end extender pointer.
If necessary, continue this adjust-and-measure procedure until the difference between the "A" and "B" measurements is within the target value.
7. With the front axle aligned, visually inspect the eccentric and concentric collars on the pivot connection to ensure that they are in place between the alignment guides and flat against the frame bracket.

If a collar is "wedged" or "raised", tap on the concentric collar (on the inboard side of the frame bracket) with a rubber mallet until it lays flat.

8. Hand tighten pivot connection fasteners until hardened flat washers do not rotate freely and recheck measurements "A" and "B" from the kingpin to each wheel-end extender pointer.
 - A. If the difference between the "A" and "B" measurements is still within the target value, proceed with Step 10.
 - B. If the difference between "A" and "B" measurements is not within target value, repeat Step 3 through Step 8.
9. Using an E20 Torx socket, tighten the shear-type bolt on the front axle pivot connection until the Torx head shears off. This ensures the proper torque of 550 ft. lbs. (± 45 ft. lbs.).

⚠CAUTION: An improperly torqued pivot connection can result in injury and/or property damage.

Anyone who assembles or reassembles pivot connection (OEMs, dealers, repair facilities, etc.) is responsible for proper installation of the shear-type bolt.

Failure to reach required torque can result in an insufficient clamp load and unreliable axle alignment.

Do not attempt to reuse a shear-type bolt.

Always wear eye protection when operating pneumatic tooling.

Make sure socket is securely fastened to pneumatic tooling.



SCRUB ANGLE

To be within the acceptable scrub angle range, the rear axle must be aligned to the forward axle:

WHEEL-END EXTENDER LENGTH	AXLE TRACK	
	71.5"	77.5"
12"	$\pm 3/32"$	$\pm 3/32"$
13"	$\pm 3/32"$	$\pm 3/32"$
14"	$\pm 3/32"$	$\pm 3/32"$
15"	$\pm 3/32"$	$\pm 3/32"$
16"	$\pm 3/32"$	$\pm 3/32"$
17"	$\pm 3/32"$	$\pm 3/32"$
18"	$\pm 3/32"$	$\pm 3/32"$
19"	$\pm 3/32"$	$\pm 3/32"$
20"	$\pm 3/32"$	$\pm 3/32"$
21"	$\pm 3/32"$	$\pm 3/32"$
22"	$\pm 3/32"$	$\pm 3/32"$
23"	$\pm 3/32"$	$\pm 1/8"$
24"	$\pm 3/32"$	$\pm 1/8"$

¹ The front axle (or thrust angle) target values presented in this table have been pre-calculated for your convenience. To see the steps involved in this process and an example of front axle target value calculation, refer to APPENDIX B: FRONT AND REAR AXLE TARGET VALUE SAMPLE CALCULATION on page 23

Table 4: Scrub angle target values

10. Following the manufacturer's recommended instructions, install wheel-end extenders on each end of the rear axle.
11. Determine rear axle target value as follows:
 - A. Measure wheel-end extender length. Measure from the face of the wheel mounting to the tip of the wheel-end extender (Figure 21 on page 10).
 - B. Read the rear axle target value from Table 4.

For example:

Suppose the measured length of your wheel-end extender is 18 inches and your trailer has a 77.5 in. axle track.

- A. Find the 18 in. row in Table 4.
- B. Find the column for 77.5 in. axle track and read down the column.

The value shown where 18 in. wheel-end extender length and 77.5 in. axle track meet is $\pm 3/32$ in., which is the rear axle target value.

12. Using a trammel bar or a 12-foot tape measure with $1/32$ in. or millimeter increments, measure the distances "C" and "D" from the front axle center to the rear axle center (Figure 24 on page 11).

IMPORTANT: If the tape measure is used, the tensioning device must also be used. The same lateral tension (pulling force) applied to the tape measure when measuring distance "C" must also be applied when measuring distance "D". When making the measurements, closely monitor the tensioning device scale to make sure that the same pulling force is used in both measurements.

13. Subtract the smaller of the "C" and "D" measurements from the larger of the two, then compare this difference with the rear axle target value obtained in Step 12.
 - A. If the difference between the "C" and "D" measurements is smaller than or equal to the target value, the axle is within specification and no alignment is necessary.
 - B. If the difference between the "C" and "D" measurements is larger than the target value, the axle must be adjusted to bring this difference within the target value.

Repeat Step 1 through Step 9 of this procedure to realign the rear axle. On trailers equipped with more than two axles, measure and if necessary adjust each axle. Measure from the front axle to each remaining axle to prevent inaccuracies.

ADVANTAGE PIVOT CONNECTION

THRUST ANGLE

If the front axle is found to be out of the acceptable thrust angle range, it must be realigned as follows:

1. Remove and discard the existing bolt, hardened washers, oversized flat washers and lock nut from the front axle pivot connections. If necessary, clean the surface rust from the washers and frame bracket surface and inspect for excess wear. Replace worn components.
2. Slide a new hardened washer and oversized flat washer onto the new shear-type bolt and install the bolt on the inboard side of each frame bracket as shown in Figure 8 on page 4. Tighten the new lock nut only until snug. **Do not fully tighten at this time.** The pivot connection should be tight enough to hold the washers flat against the frame bracket, but loose enough to allow the washers to rotate freely.

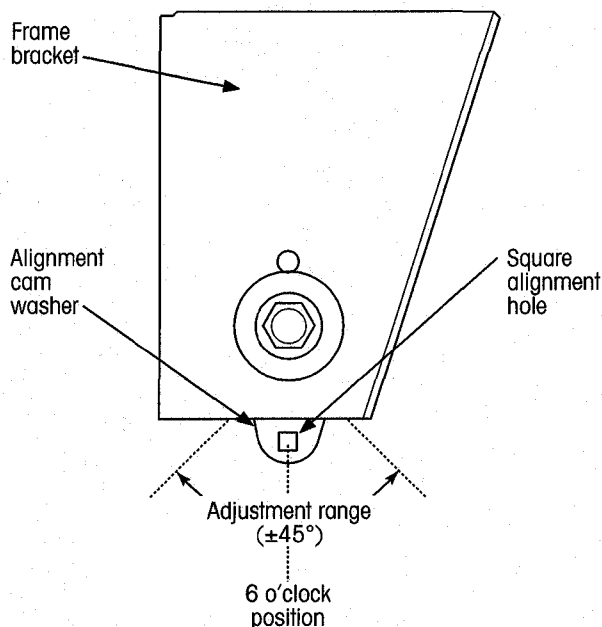


Figure 28: AdvANTage style alignment cam washer orientation details

⚠CAUTION: DO NOT apply an anti-sieze compound to the pivot connection hardware or allow undercoating, paint, or any other commonly used compounds to contact the threads of the pivot connection fasteners. These compounds can act like a lubricant, reducing the friction between the threads of the nut and bolt. This can lead to overtightened fasteners, unpredictable pivot connection clamp loads and unreliable axle alignments.

3. Inspect the orientation of both alignment cam washers (Figure 28). The tab with the square alignment hole must be at the 6 o'clock position (below the frame bracket), which is the middle of the adjustment range.

If the square alignment hole is not at the 6 o'clock position, insert a 1/2 in. breaker bar into the square alignment hole in the alignment cam washer and rotate until the square hole on both alignment cam washers is at the 6 o'clock position.

4. With both square alignment holes in the 6 o'clock position, recheck measurements "A" and "B" from the kingpin to each wheel-end extender pointer.

If necessary, insert a 1/2 in. breaker bar into the square alignment hole and adjust axle forward by rotating both alignment cam washers toward the front of the trailer or rearward by rotating both alignment cam washers toward the rear of the trailer.

IMPORTANT: The square alignment holes in both cam washers must be in the same orientation (e.g. the 5 o'clock position) and both oversized flat washers must be flat against the side of the frame brackets.

5. Recheck measurements "A" and "B" from the kingpin to each wheel-end extender pointer.
If necessary, continue this adjust-and-measure procedure until the difference between the "A" and "B" measurements is within the target value.
6. Using an E22 Torx socket, tighten the shear-type bolt until the Torx head shears off. This ensures the proper torque of 750 ft. lbs. (±50 ft. lbs.).



⚠CAUTION An improperly torqued pivot connection can result in injury and/or property damage.

Anyone who assembles or reassembles the pivot connection (OEMs, dealers, repair facilities, etc.) is responsible for the proper installation of the shear-type bolt.

Failure to reach the required torque can result in an insufficient clamp load and unreliable axle alignment.

Do not attempt to reuse a shear-type bolt.

⚠CAUTION: Always wear eye protection when operating pneumatic tooling.

⚠CAUTION: Make sure the socket is securely fastened to the pneumatic tooling.

SCRUB ANGLE

To be within the acceptable scrub angle range, the rear axle must be aligned to the forward axle:

7. Following the manufacturer's recommended instructions, install wheel-end extenders on each end of the rear axle.
8. Determine rear axle target value as follows:
 - A. Measure wheel-end extender length. Measure from the face of the wheel mounting to the tip of the wheel-end extender (Figure 22 on page 10).
 - B. Read the rear axle target value from Table 4 on page 16.

For example:

Suppose the measured length of your wheel-end extender is 18 inches and your trailer has a 77.5 in. axle track.

- A. Find the 18 in. row in Table 4 on page 16.
- B. Find the column for 77.5 in. axle track and read down the column.

The value shown where 18 in. wheel-end extender length and 77.5 in. axle track meet is $\pm 3/32$ inch, which is the rear axle target value.

9. Using a trammel bar or a 12-foot tape measure with 1/32 in. or millimeter increments, measure the distances "C" and "D" from the front axle center to the rear axle center (Figure 24 on page 11).

IMPORTANT: If the tape measure is used, the tensioning device must also be used. The same lateral tension (pulling force) applied to the tape measure when measuring distance "C" must also be applied when measuring distance "D". When making the measurements, closely monitor the tensioning device scale to make sure that the same pulling force is used in both measurements.

10. Subtract the smaller of the "C" and "D" measurements from the larger of the two, then compare this difference with the rear axle target value obtained in Step 9.
 - A. If the difference between the "C" and "D" measurements is smaller than or equal to the target value, the axle is within specification and no alignment is necessary.
 - B. If the difference between the "C" and "D" measurements is larger than the target value, the axle must be adjusted to bring this difference within the target value.

Repeat Step 1 through Step 6 of this procedure to realign the rear axle. On trailers equipped with more than two axles, measure and if necessary adjust each axle. Measure from the front axle to each remaining axle to prevent inaccuracies.

SMARTRIDE PIVOT CONNECTION

THRUST ANGLE

If the front axle is found to be out of the acceptable thrust angle range, it must be realigned as follows:

1. Remove and discard the existing bolt, hardened washers and shear-type nut from the front axle pivot connections. If necessary, clean the surface rust from the washers and frame bracket surface and inspect for excess wear. Replace worn components.

- Slide a new hardened washer onto the new hex head bolt and install the bolt on the outboard side of each frame bracket as shown in [Figure 8](#) on [page 4](#). Tighten the new shear-type nut only until snug. Do not shear or fully tighten at this time. The pivot connection should be tight enough to hold the washers flat against the frame bracket, but loose enough to allow the washers to rotate freely.

⚠CAUTION: DO NOT apply an anti-sieze compound to the pivot connection hardware or allow undercoating, paint, or any other commonly used compounds to contact the threads of the pivot connection fasteners. These compounds can act like a lubricant, reducing the friction between the threads of the nut and bolt. This can lead to overtightened fasteners, unpredictable pivot connection clamp loads and unreliable axle alignments.

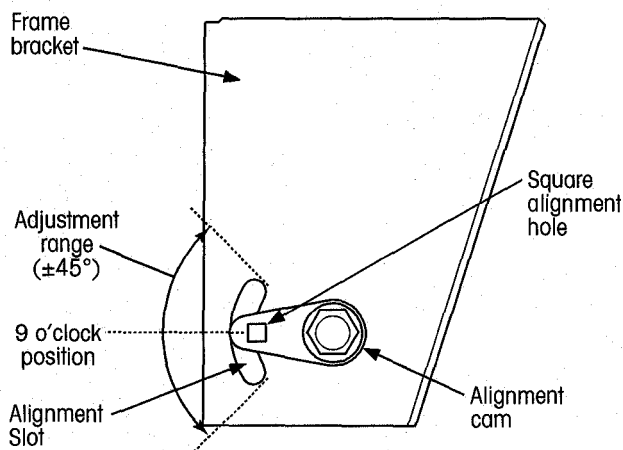


Figure 29: SmartRide alignment cam orientation details

- Inspect the orientation of the alignment cam ([Figure 29](#)). The square alignment hole must be in the middle of the alignment slot in the frame bracket.

If the square alignment hole in the alignment cam is not in the middle of the alignment slot, insert a ½ inch breaker bar into the square alignment hole in the alignment cam and rotate until the square hole in the alignment cam is in the middle of the alignment slot.

- With the square alignment hole in the middle of the alignment slot, recheck measurements "A" and "B" from the kingpin to each wheel-end extender pointer.

If necessary, insert a ½ inch breaker bar into the square alignment hole and adjust the axle forward by rotating the alignment cam up or rearward by rotating the alignment cam down.

IMPORTANT: The inboard concentric alignment washer ([Figure 9](#) on [page 5](#)) must be flat against the side of the frame bracket. If the concentric washer wedges against the side of the frame bracket (similarly to [Figure 27-B](#) on [page 14](#)), tap on the flanged concentric collar (on the inboard side of the frame bracket) with a rubber mallet to properly seat the alignment collar.

- Recheck measurements "A" and "B" from the kingpin to each wheel-end extender pointer. If necessary, continue this adjust-and-measure procedure until the difference between the "A" and "B" measurements is within the target value.
- Tighten the shear-type nut until the head shears off. This ensures the proper torque of 550 ft. lbs. (±50 ft. lbs.).

⚠CAUTION: An improperly torqued pivot connection can result in injury and/or property damage.

Anyone who assembles or reassembles the pivot connection (OEMs, dealers, repair facilities, etc.) is responsible for the proper installation of the shear-type bolt.

Failure to reach the required torque can result in an insufficient clamp load and unreliable axle alignment.

Do not attempt to reuse a shear-type nut.

⚠CAUTION: Always wear eye protection when operating pneumatic tooling.

⚠CAUTION: Make sure the socket is securely fastened to the pneumatic tooling.

SCRUB ANGLE

To be within the acceptable scrub angle range, the rear axle must be aligned to the forward axle:

7. Following the manufacturer's recommended instructions, install wheel-end extenders on each end of the rear axle.
8. Determine rear axle target value as follows:
 - A. Measure wheel-end extender length. Measure from the face of the wheel mounting to the tip of the wheel-end extender (Figure 22 on page 10).
 - B. Read the rear axle target value from Table 4 on page 16.

For example:

Suppose the measured length of your wheel-end extender is 18 inches and your trailer has a 77.5 inch axle track.

- A. Find the 18 inch row in the table.
- B. Find the column for 77.5 inch axle track and read down the column.

The value shown where 18 inch wheel-end extender length and 77.5 inch axle track meet is $\pm 3/32$ inch, which is the rear axle target value.

9. Using a trammel bar or tape measure (12 ft.) with $1/32$ inch or millimeter increments, measure the distances "C" and "D" from the front axle center to the rear axle center (Figure 25 on page 12).

IMPORTANT: If the tape measure is used, the tensioning device must also be used. The same lateral tension (pulling force) applied to the tape measure when measuring distance "C" must also be applied when measuring distance "D". When making the measurements, closely monitor the tensioning device scale to make sure that the same pulling force is used in both measurements.

10. Subtract the smaller of the "C" and "D" measurements from the larger of the two, then compare this difference with the rear axle target value obtained in Step 8.
 - A. If the difference between the "C" and "D" measurements is smaller than or equal to the target value, the axle is within specification and no alignment is necessary.

- B. If the difference between the "C" and "D" measurements is larger than the target value, the axle must be adjusted to bring this difference within the target value.

Repeat Step 1 through Step 6 of this procedure to realign the rear axle. On trailers equipped with more than two axles, measure and if necessary adjust each axle. Measure from the front axle to each remaining axle to prevent inaccuracies.

WELDED COLLAR PIVOT CONNECTION**THRUST ANGLE**

If the front axle is found to be out of the acceptable thrust angle range, it must be realigned as follows:

1. Select one side of the axle and carefully grind or cut the welds securing the inboard and outboard alignment collars to the frame bracket.

IMPORTANT: Do not remove the 1 1/8 inch heavy hex cap screw and nut or huck fastener. Axle alignment with the welded collar style pivot connection does not require pivot joint disassembly.

IMPORTANT: On model HT250U "Y" beam underslung suspensions, the alignment slots are on the beam assembly. The inboard and outboard alignment collars are welded to the beam assembly itself.

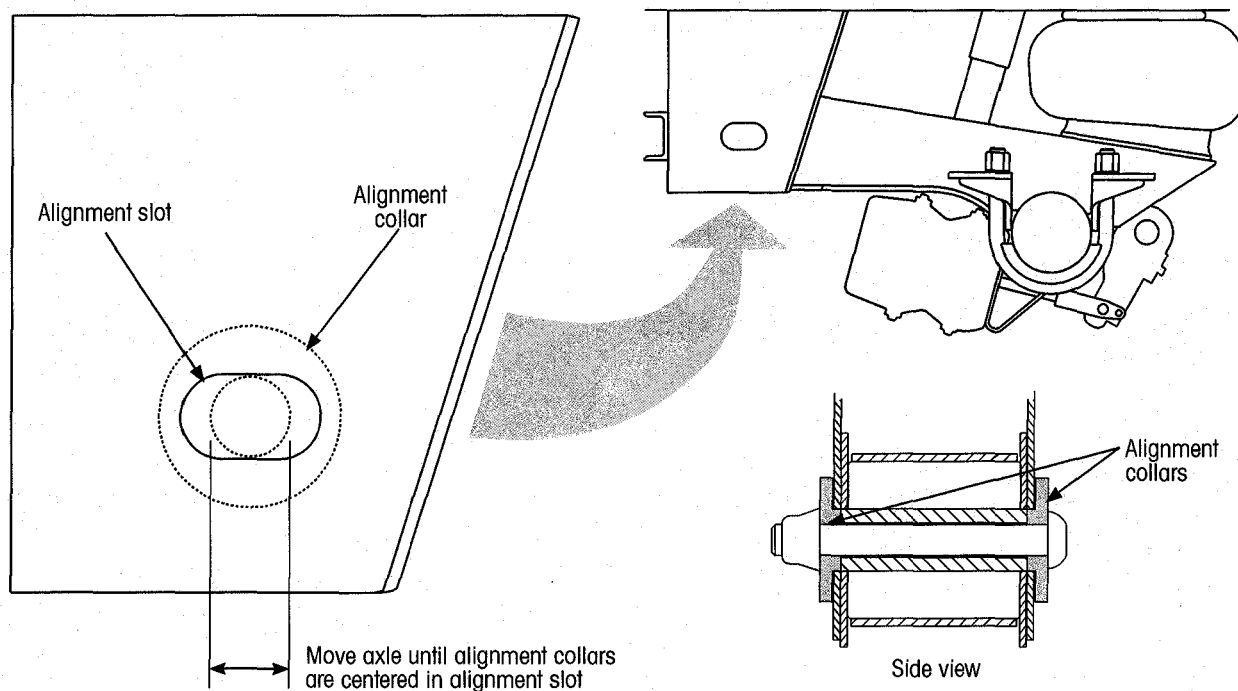


Figure 30: Axle positioning on the welded-collar type frame bracket when major adjustment (both axle ends) is necessary

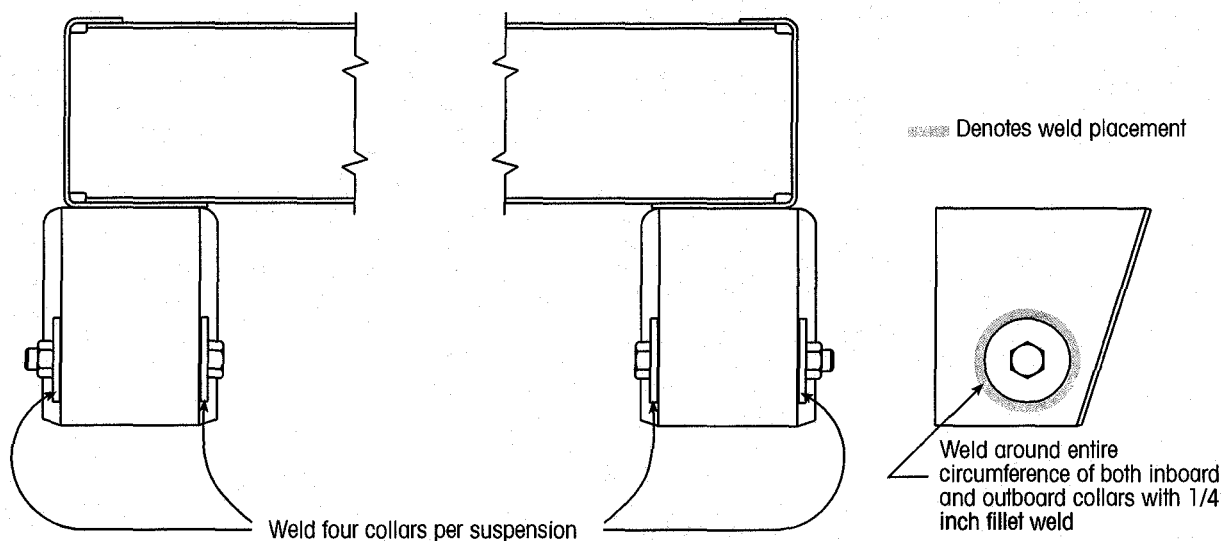


Figure 31: Welding locations on welded collars

2. Recheck measurements "A" and "B" from the trailer kingpin to each wheel-end extender pointer. Move the loose axle end fore or aft until the difference between the "A" and "B" measurements is within the target value.

If the alignment collars can no longer be moved within the alignment slots in the frame bracket and the axle is still not within the target value, the welds on the inboard and outboard alignment collars on the other side of the axle must also be carefully ground or cut loose. With both axle ends loose, move the axle until the alignment collars are centered in the frame bracket alignment slots (Figure 30). The axle can now be repositioned until the difference between the "A" and "B" measurements is within the target value.



3. Remove all equipment used to reposition the axle.
4. Tack weld the alignment collars in place.
5. Verify correct alignment.
6. Weld around the inboard and outboard collars on each end of the axle with a 1/4 inch fillet weld (Figure 31).
7. Verify that the weld goes around the entire circumference of all four collars.

SCRUB ANGLE

To be within the acceptable scrub angle range, the rear axle must be aligned to the forward axle as follows:

8. Following the manufacturer's recommended instructions, install wheel-end extenders on each end of the rear axle.
9. Determine rear axle target value as follows:
 - A. Measure wheel-end extender length. Measure from the face of the wheel mounting to the tip of the wheel-end extender (Figure 21 on page 10).
 - B. Read the rear axle target value from Table 4 on page 16.

For example:

Suppose the measured length of your wheel-end extender is 18 inches and your trailer has a 77.5 inch axle track.

- A. Find the 18 inch row in the table.
- B. Find the column for 77.5 inch axle track and read down the column.

The value shown where 18 inch wheel-end extender length and 77.5 inch axle track meet is $\pm 3/32$ inch, which is the rear axle target value.

10. Using a trammel bar or a tape measure (12 ft.) with $1/32$ inch or millimeter increments, measure the distances "C" and "D" from the front axle center to the rear axle center (Figure 24 on page 11).

IMPORTANT: If the tape measure is used, the tensioning device must also be used. The same lateral tension (pulling force) applied to the tape measure when measuring distance "C" must also be applied when measuring distance "D". When making the measurements, closely monitor the tensioning device scale to make sure that the same pulling force is used in both measurements.

11. Subtract the smaller of the "C" and "D" measurements from the larger of the two, then compare this difference with the rear axle target value obtained in Step 9.
 - A. If the difference between the "C" and "D" measurements is smaller than or equal to the target value, the axle is within specification and no alignment is necessary.
 - B. If the difference between the "C" and "D" measurements is larger than the target value, the axle must be adjusted to bring this difference within the target value.

Repeat Step 1 through Step 8 of this procedure using the "C" and "D" measurements to realign the rear axle. On trailers equipped with more than two axles, measure and if necessary adjust each additional axle. Measure from the front axle to each remaining axle to prevent inaccuracies.

APPENDIX A: PIVOT CONNECTION HARDWARE TROUBLESHOOTING

WEDGED PIVOT-CONNECTION HARDWARE

APPEARANCE

The pivot-connection hardware (collars, washers, etc.) is not flat against the frame bracket. The pivot bolt and collars are "cockeyed" and not in their proper positions.

CAUSES

While being adjusted, the inboard collar did not move in unison with the outboard collar.

RESULTS

An inaccurate alignment and an improper pivot connection that could potentially loosen.

SOLUTIONS

Tap on the inboard collar with a rubber mallet while rotating the outboard collar.

Visually inspect the pivot connection after alignment. If the collars are "wedged" against the frame bracket and the pivot connection shear fastener has been sheared, remove and discard the pivot connection hardware and redo the alignment using new pivot connection hardware. If the collars are "wedged" against the frame bracket but the pivot connection shear fastener has not yet been sheared, carefully loosen the pivot connection and redo the alignment.

RAISED ECCENTRIC COLLAR — QUIK-ALIGN® ONLY

APPEARANCE

The eccentric collar is not flat against the frame bracket; it is resting on an alignment guide. However, the shear-type bolt is properly positioned and the concentric collar is flat against the frame bracket (Figure 27-C on page 14).

CAUSES

When installing the TORQ-RITE nut on the shear-type bolt, the nut was not tightened sufficiently. Initially, the pivot connection fasteners must be tight enough to hold the eccentric collar in place against the alignment guides and flat against the frame bracket, but loose enough to permit the hardened flat washers to rotate freely. The loose nut allowed the eccentric collar to

move freely and work its way onto an alignment guide.

RESULTS

Initially, the alignment appears to be accurate. However, when the eccentric collar eventually slips off the alignment guide, the pivot connection will become loose and alignment accuracy will be lost.

SOLUTIONS

During assembly, tighten the TORQ-RITE nut so the eccentric collar is in place against the alignment guides and flat against the frame bracket, but loose enough to permit the hardened flat washers to rotate freely.

Visually inspect the eccentric collar after alignment. If the eccentric collar is resting on an alignment guide in the "raised" position and the Torx head on the shear-type bolt has been sheared, remove and discard the pivot connection hardware and redo the alignment using new pivot connection hardware. If the eccentric collar is resting on an alignment guide in the "raised" position but the Torx head on the shear-type bolt has not yet been sheared, carefully loosen the pivot connection and redo the alignment.

APPENDIX B: FRONT AND REAR AXLE TARGET VALUE SAMPLE CALCULATION

Determine both axle target values as follows:

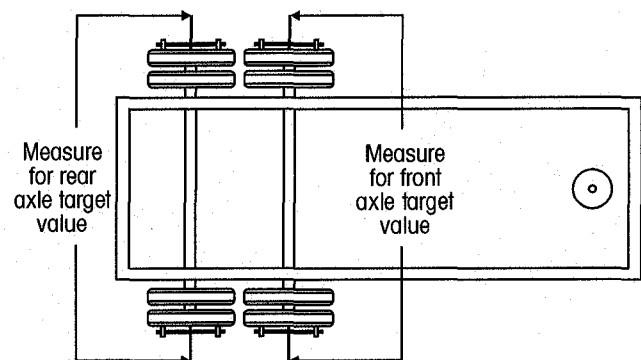


Figure 32: Point-to-point measurement for target values

1. Measure the point-to-point width of the installed wheel-end extenders (Figure 32).

As an alternative to measuring the point-to-point width of the wheel-end extenders, the following method can be used to approximate the distance (Figure 32):

$$\frac{\text{wheel face-to-face distance} + 2(\text{wheel-end extender length})}{\text{point-to-point width of the installed wheel-end extenders}}$$

While the wheel face-to-face distance will vary with different wheel equipment, the following method can be used to approximate the distance without significantly impacting the alignment tolerance:

79.2" for a 77.5" axle track
73.2" for a 71.5" axle track

2. For the front axle, multiply this width by 0.00175¹. The resulting product is the front axle target value.

For example:

Suppose the point-to-point width of the wheel-end extenders is 122.625 inches. Multiplying this by the 0.00175 constant produces:

¹ For axle to kingpin distances of 10 feet or more, the 0.00175 constant can be approximated by using the sine of 0.1°.

$$122.625" \times 0.00175 = \pm 0.215"$$

This provides the front axle (thrust angle) target value.

3. For the rear axle, multiply this width by 0.00087². The resulting product is the rear axle target value.

For example:

Suppose the point-to-point width of the wheel-end extenders is 122.625 inches. Multiplying this by the 0.00087 constant produces:

$$122.625" \times 0.00087 = \pm 0.107"$$

This provides the rear axle (scrub angle) target value.

NOTE: If more than two axles, repeat Step 1 and Step 3 for each axle. Reference all measurements to front axle.

² For axle to kingpin distances of 10 feet or more, the 0.00087 constant can be approximated by using the sine of 0.05°.

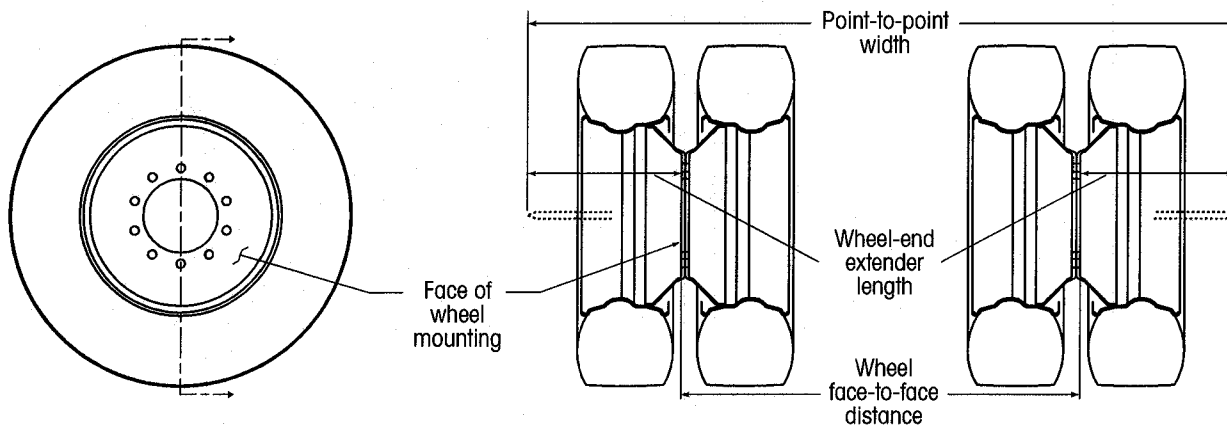


Figure 33: An alternative to measuring the point-to-point width of the wheel-end extenders

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