Axle Alignment Specifications

M-652-001

(March 2009)

Valid for

ALL CXU, CHU, GU, TD, MRU, LEU

Case description

This service bulletin provides the latest Mack axle alignment specifications.

Note: For vehicles equipped with the MACK RSA (Road Stability Advantage) program (Bendix® ABS-6 Advanced with ESP® [Electronic Stability Program]), any adjustments to vehicle alignment require recalibration of the steering angle sensor. For information, refer to the Bendix® Service Data Sheet (SD-13- 4869). This data sheet can be obtained by visiting the Bendix® website at www.bendix.com.

Note: Does not apply to Mack Trucks Australia

Caster

All measurements must be taken with the vehicle in an unloaded condition, and the steering axle and drive axles on a level surface. RH and LH caster readings must not vary more than 0°30′ (.5°).

Caster Specifications	
Single Non-Driving Front Axle — Power Steering	
MRU, LEU, LE, MR, CV, CL, RD, RB, DM, DMM models	4° to 6°
CH models prior to 12/9/96	1° to 3°
CXU, CHU, GU, TD, CXP, CXN, CHN, CTP, CT, CX models and CH models after 12/9/96	3° to 5°
Single Non-Driving Front Axle — Manual Steering	
All model except those equipped with ArvinMeritor™ front axles	1° to 3°
All Models equipped with ArvinMeritor™ Front Axles (Excluding CH Models)	0° to 2°
CH Models equipped with ArvinMeritor™ Front Axles	1° to 3°
AIRTEK® 12, 13.2 and 14.6 Front Axles*	
Left Side	3.75° +1°/ -0.5°
Right Side	3.75° +1°/ -0.5°
Cross Caster	0° to maximum 1.5°
Single Front Driving Axle (Except Marmon Herrington (MT23) after January 1, 1995	3°30′ to 5°30′ (3.5° to 5.5°)
Marmon Herrington Front Driving Axle (MT23) After January 1, 1995	2°30′ to 4°30′ (2.5° to 4.5°)
Two Front Axles	
Front Driving Axle	3°30′ to 5°30′ (3.5° to 5.5°)
Non-Driving Front-Front Axle	4° to 6°

Non-Driving Rear-Front Axle	4°30′ to 6°30′ (4.5° to 6.5°)

* On chassis equipped with AIRTEK® front axles, it is critical that caster be measured with the vehicle at the correct ride height. For information on measuring and adjusting ride height, and for any other information concerning the AIRTEK® front axle, refer to the Hendrickson Technical Procedure Manual, AIRTEK® Service Instructions for MACK Vehicles, manual No. 17730-250.

Specifications for vehicles built prior to 1993 may be different. See previously published information, or alignment equipment manufacturer's charts for specifications on older vehicles.

Camber

All measurements must be taken with the vehicle in the unloaded condition.

Camber Specifications	
Vehicles Built after January 1, 1995 (with MACK Front Axles)	
MACK Non-Driving Front Axles:	
FXL 12, 14.6, 18, 20 and 23	1/4° ± 7/16° (0.25° ± 0.43°
FAW 10.5, 12 and 14.3	0° ± 7/16° (0° ± 0.43°)
FA(W) 18 and 20	1/4° ± 7/16° (.25° ± 0.43°)
FA23	3/4° ± 7/16° (.75° ± 0.43°)
Vehicles Built Prior to January 1, 1995 (with MACK Front Axles)	
MACK Non-Driving Front Axles (Except FA23)	0° to 0°30′ (0° to 0.5°)
MACK FA23 Non-Driving Front Axle	0°30′ to 1° (.5° to 1°)
AIRTEK® 12, 13.2 and 14.6 Front Axles	
Left Side	0° ± 0.5°
Right Side	0° ± 0.5°
Cross Camber	0° to maximum 1°
Eaton/Dana Non-Driving Front Axles:	
EFA-12F4, EFA-13F5 and EFA-20F4 Axles	
Left Side	7/16° ± 7/16° (.43° ± 0.43°)
Right Side	−1/16° ± 7/16° (−.06° ± 0.43°)
E1202I Axles	
Left Side	1/8° ± 7/16° (.13° ± 0.43°)
Right Side	−1/8° ± 7/16° (−.13° ± 0.43°)
Eaton/Dana Non-Driving Front Axles:	
I-120	
Left Side	−1/8° ± 7/16° (−.13° ± 0.43°)
Right Side	−1/8° ± 7/16° (−13° ± 7/16)
ArvinMeritor™ Non-Driving Front Axles	−0°41′ to 0°11' (−.69° to 0.19°)
Driving Front Axles:	
ArvinMeritor™	0° to 0°30′ (0° to 0.5°)
FABCO (SDA23, 20B, 18B and 16)	0°15′ to 0°45′ (.25° to 0.75°)
Marmon-Herrington (MT23)	0°24′ to 0°36′ (.4° to 0.6°)

Toe

Set toe toward zero side of specification on vehicles equipped with steel-belted radial tires or vehicles with lightly loaded front axles.

Toe Specifications	
MACK Non-Driving Front Axles:	
FAW10.5, 12, 14.3, FA(W)18, 20, FA23, FXL12, 14.6, 18, 20	1/16″ ± 1/32″ (.06″ ± 0.03″) or 0.07° ± 0.035° or 1.5 mm/m ± 0.75 mm/m
AIRTEK® 12, 13.2 and 14.6 Front Axles	1/16″ +0"/ -1/16" (.06″ +0"/ -.06″) or 0.07° +.00°/ -.07° or 1.5 mm/m +0/ -1.5 mm/m
ArvinMeritor™, Eaton/Dana Non-Driving Front Axles	1/16″ ± 1/32″ (.06″ ± 0.03″) or 0°4′ ± 0°2′ (0°2′ to 0°6′) or .07° ± 0.03° (.03° to 0.10°) or 1.5 mm/m ± 0.75 mm/m
ArvinMeritor™ and Marmon Herrington Front Driving Axles	1/16″ ± 1/16″ (.06″ ± 0.06″) or 0°4′ ± 0°4′ (0° to 0°8') or .07° ± 0.07° (0° to 0.14°) or 1.5 mm/m ± 1.5 mm/m
TOE-OUT*	
FABCO Front Driving Axles (SDA23, 20B, 18B and 16)	1/16″ ± 1/16″ (.06″ ± 0.06″) or 0°4′ ± 0°4′ (0° to 0°8') or .07° ± 0.07° (0° to 0.14°) or 1.5 mm/m ± 1.5 mm/m

* HUNTER Alignment equipment measurements indicating toe-out will be a negative number, e.g., −.07°

Thrust

Specifications for Thrust Angles on Rear Drive Axles:

Thrust Specifications	
Adjustable Suspensions	0″ ± 1/8″ (0″ ± 0.125″) 0° ± 0.08° 0 mm/m ± 1.4 mm/m
Non-Adjustable Suspensions	0″ ± 1/4″ (0″ ± 0.25″) 0° ± 0.16° 0 mm/m ± 2.8 mm/m

Scrub (Parallelism)

Specifications for Scrub (Parallelism) on Rear Drive Axles:

Thrust Specifications	
Adjustable Suspensions	0″ ± 1/8″ (0″ ± 0.125″) 0° ± 0.08° 0 mm/m ± 1.4 mm/m
Non-Adjustable Suspensions	0″ ± 1/4″ (0″ ± 0.25″) 0° ± 0.16° 0 mm/m ± 2.8 mm/m

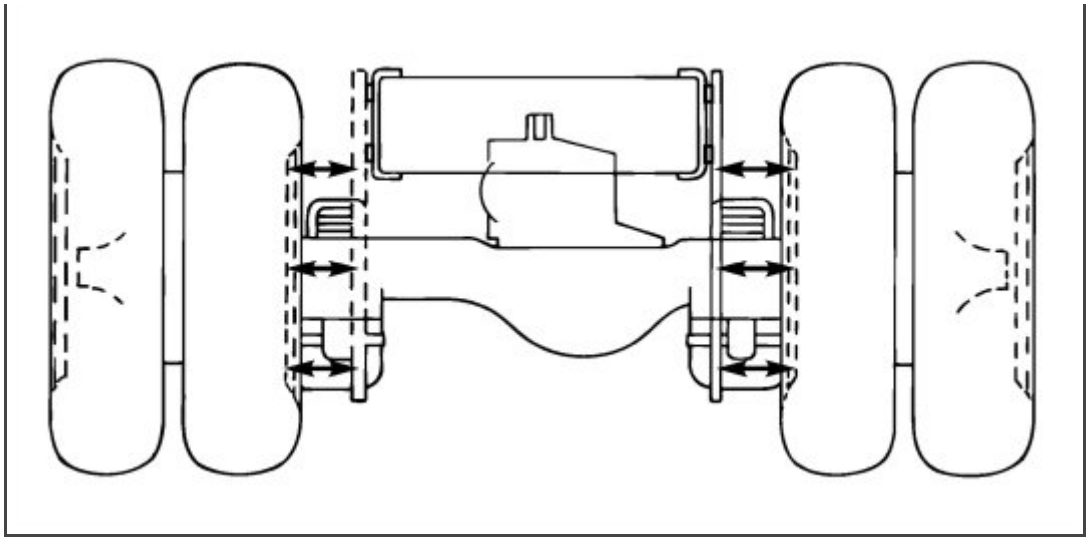
Axle Alignment

The following specifications have been established for axle alignment on a MACK vehicle under chassis only conditions in order to achieve the optimum in tire wear and subsequent customer satisfaction. Before taking measurements, always drive the vehicle back and forth in a straight line four or five times. Where distance is limited, at least the length of the chassis should be travelled. This operation must be performed to ensure that the suspension has not taken a set.

Centring Rear Axles (Chassis Equipped with SS Suspensions)

The first step in axle alignment is the centring of rear axles. To accomplish this, a measurement must be made between the frame and the brake drums on each axle. A convenient extension straightedge can be made from a straight piece of steel bar stock and attached to the frame rail with magnets. With a tape measure, measure from the straightedge to the brake drum at the three designated points shown in the illustration below.

Straightedge to Tire Measuring Points (SS Suspension Shown)



The maximum allowable difference between the measurements taken at the front-rear and rear-rear brake drums to the straightedge must not exceed 6.4 mm (1/4 inch), whether or not the chassis is equipped with a transverse torque rod.

The maximum allowable difference between the left- and right-hand sides on the same axle, front-rear or rear-rear must not exceed 6.4 mm (1/4 inch) if the chassis is equipped with a transverse torque rod, or 12.7 mm (1/2 inch) if the chassis is NOT equipped with a transverse torque rod.

Centring Rear Axles (Chassis Equipped with AL Suspension and Fixed-Length Transverse Torque Rods)

The first step in proper axle alignment is verifying that the rear axles are properly centred on the chassis. Before any alignment measurements are taken, the chassis should be driven back and forth in a straight-line several times to allow the suspension to move into its normal operating position. To verify that the rear axles are centred, perform the following steps:

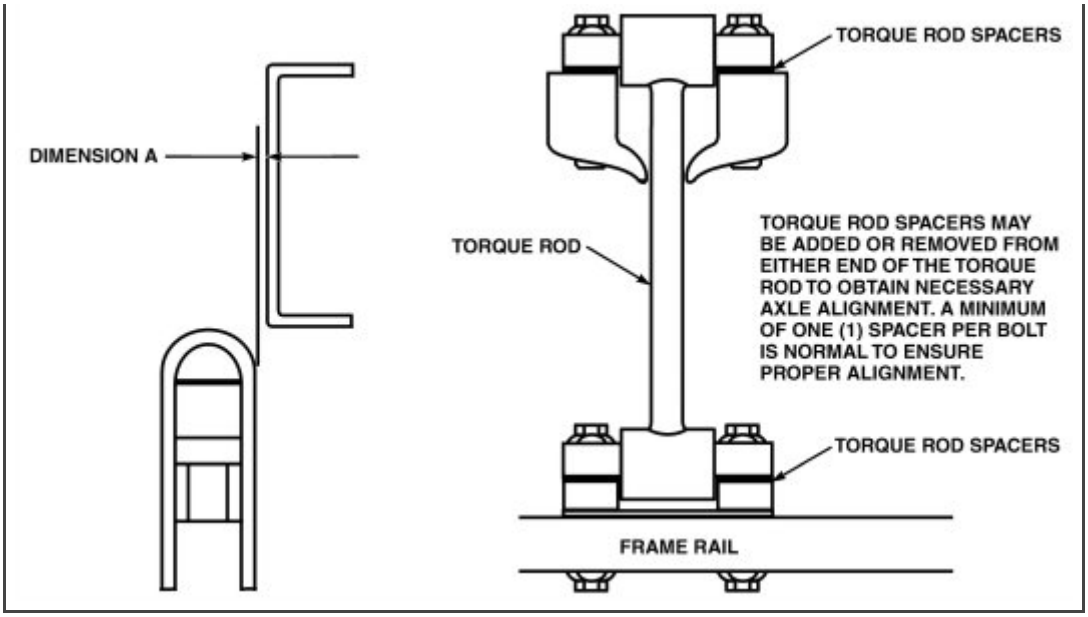
1. With the chassis parked on a level surface, block the front wheels to prevent the vehicle from moving, then release the parking brakes. (Air system pressure should be between 110 psi to 130 psi when performing these procedures.)
2. Measure the ride height. Ride height gauges are available to accurately measure chassis ride height. Refer to service bulletin SB136012 for information on using the gauges, and for a list of gauge part numbers.

   Note: For information concerning measuring and adjusting ride height, refer to the MACK AL and AL II Air Suspension Service and Repair Manual, 14–101, for AL, AL II and AL-401LH suspensions, and the MAXAIR™ 40 Air Suspension Service and Repair Manual, 14–102, for the MAXAIR™ 40 (AL-405) suspensions.

   Note: Beginning approximately 3/19/01, a change in the spring seat and spacer resulted in a ride height dimension change from 5-1/ 4" to 4-7/8" on MAXAIR™ 40 air suspensions. Suspensions having a ride height of 4-7/8" are identified by an “X” marking on the spring cap. Always look for the “X” marking before adjusting ride height. (Refer to service bulletin SB136010.)

3. After the ride height has been checked and/or adjusted, determine if the axles are centred by measuring from the outside of the frame rail to the inside edge of the spring clip (U-bolt) (Dimension “A” in the illustration below). The maximum allowable side-to-side difference on any one axle is 6.34 mm (1/4 inch). Washer spacers (part number 37AX271) can be added or removed from either side of the torque rod in order to obtain the correct axle positioning. (Refer to the figures below.)

Rear Axle Alignment — MACK AL Suspension with Fixed-Length Transverse Torque Rods



4. After axle centring is verified or corrected, exhaust the air from the suspension and verify that no interference exists between the frame rail and any spring clip (U-bolt).

Centring Rear Axles (Chassis Equipped with AL Suspension and Adjustable Transverse Torque Rods)

The first step in proper axle alignment is verifying that the rear axles are properly centred on the chassis. Before any alignment measurements are taken, the chassis should be driven back and forth in a straight-line several times to allow the suspension to move into its normal operating position. To verify that the rear axles are centred, perform the following steps:

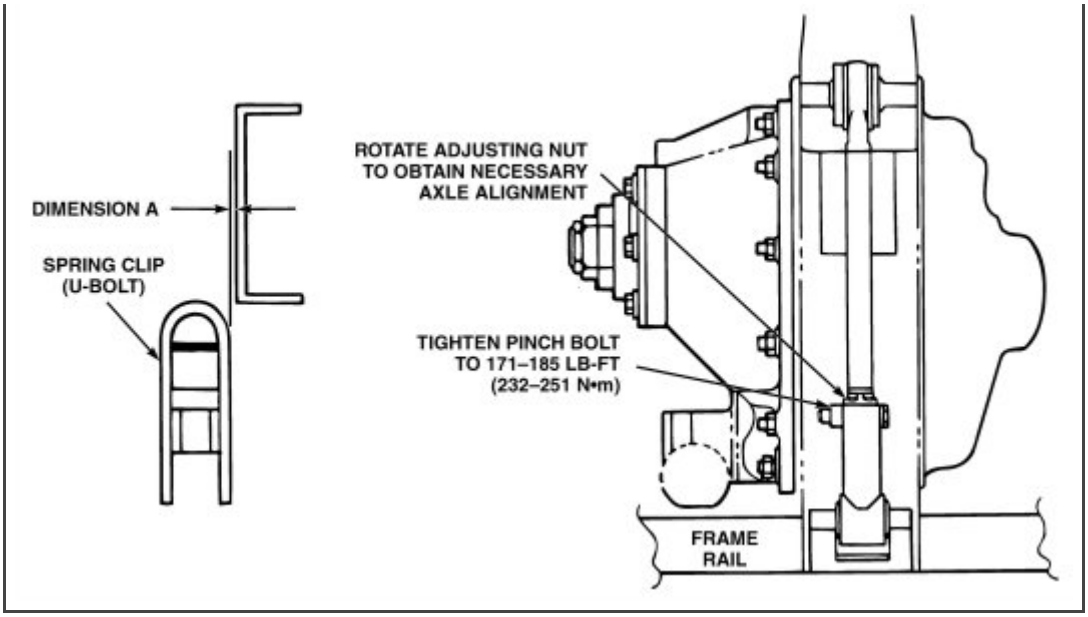
1. With the chassis parked on a level surface, block the wheels to prevent the vehicle from moving, then release the parking brakes. (Air system pressure should be between 110–130 psi when performing these procedures.)
2. Measure the ride height. Ride height gauges are available to accurately measure chassis ride height. Refer to service bulletin SB136012 for information on using the gauges, and for a list of gauge part numbers.

   Note: For information concerning measuring and adjusting ride height, refer to the MACK AL and AL II Air Suspension Service and Repair Manual, 14–101, for AL, AL II and AL-401LH suspensions, and the MAXAIR™ 40 Air Suspension Service and Repair Manual, 14–102, for the MAXAIR™ 40 (AL-405) suspensions.

   Note: Beginning approximately 3/19/01, a change in the spring seat and spacer resulted in a ride height dimension change from 5-1/4" to 4-7/8" on MAXAIR™ 40 air suspensions. Suspensions having a ride height of 4-7/8" are identified by an "X" marking on the spring cap. Always look for the "X" marking before adjusting ride height. (Refer to service bulletin SB136010.)

3. After ride height has been checked and/or adjusted, determine if the axles are centred by measuring from the outside of the frame rail to the inside edge of the spring clip (U-bolt) (dimension "A" in the illustration below). The maximum allowable side-to-side difference on any one axle is 6.34 mm (1/4 inch).

Rear Axle Alignment — All MACK AL Suspensions with Adjustable Transverse Torque Rods

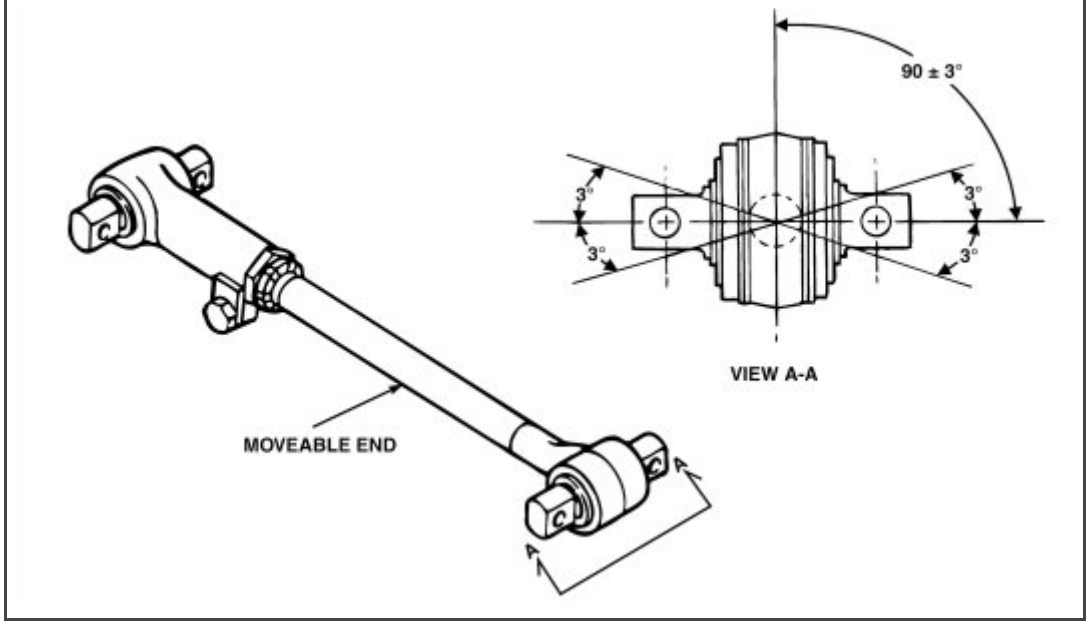


To obtain proper axle positioning, adjust the adjustable transverse torque rod as follows:

a. Loosen the pinch bolt and rotate the adjusting nut to adjust torque rod length in order to obtain proper axle centring as described in step 3 above. When facing the frame rail to which the torque rod is attached, rotating the adjusting nut counterclockwise lengthens the torque rod. Rotating the adjusting nut clockwise shortens the torque rod.

b. After the axle has been properly centred, ensure that the moveable end of the torque rod is perpendicular to the bar pin within ±3 degrees (refer to figure 5 below). If not, rotate the moveable end of the rod to obtain 90 ± 3 degrees perpendicularity between the torque rod end and the bar pin. Tighten the pinch bolt to 171–185 lb-ft (232–251 N·m).

Check Both Ends of Torque Rod to Verify Alignment of Eyelets



4. Exhaust the air from the suspension and verify that there is no interference between the frame rail and any of the spring clips (U-bolts).

Perpendicular Datum

Next, a perpendicular datum must be established at some location along the frame rails. For MACK bogies, the trunnion spindle may be used, providing adequate controls are employed to ensure that the trunnion spindle is perpendicular to the chassis centreline.

At no time is it permissible to use the bogie axles as a reference datum.

Measuring Points

Measuring points are located at the extreme ends of each axle along the axle center line.

On drive axles, the centre of the axle shaft flange or centre of the drive hub can be used.

Bogie Wheelbase

Bogie wheelbase side-to-side variation of 3.3 mm (1/8") is to be held on MACK taper leaf suspensions — ST34 and ST38, all four spring suspensions, Neway and MACK air suspensions, and Chalmers suspensions.

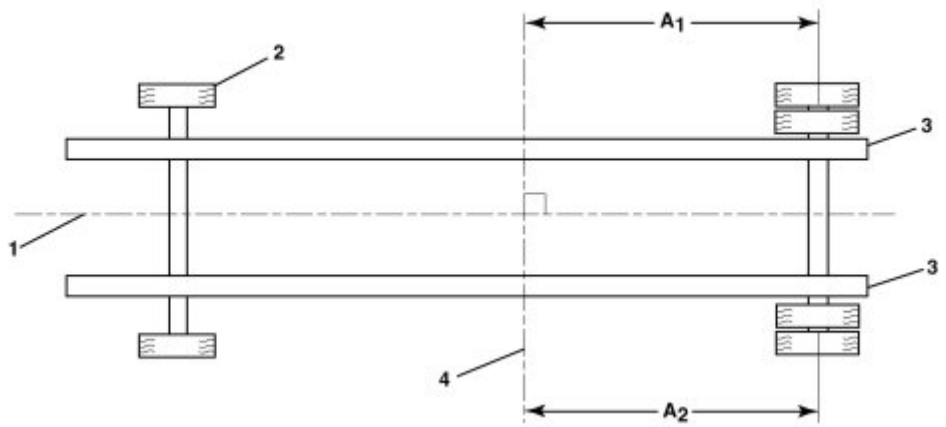
A tolerance of 6.4 mm (1/4") bogie wheelbase side-to-side variation is to be held on all MACK SS/SW suspensions with camel back springs or walking beams equipped with rubber shock insulators. This tolerance also includes Hendrickson beam and Ridewell suspensions.

Caution

Bogie wheelbase variation may be caused by a broken spring leaf. Prior to proceeding, VERY CAREFULLY inspects all spring leaves to ensure that NONE are cracked or broken. Be especially careful to inspect behind the spring clips (U-bolts). Rust streaks originating from this area are an indicator of broken spring leaves. Also, wear at the shock insulator caps in the T-slot area would be a sign of broken leaves. If a cracked or broken leaf is found, replace the spring assembly before making any additional measurements.

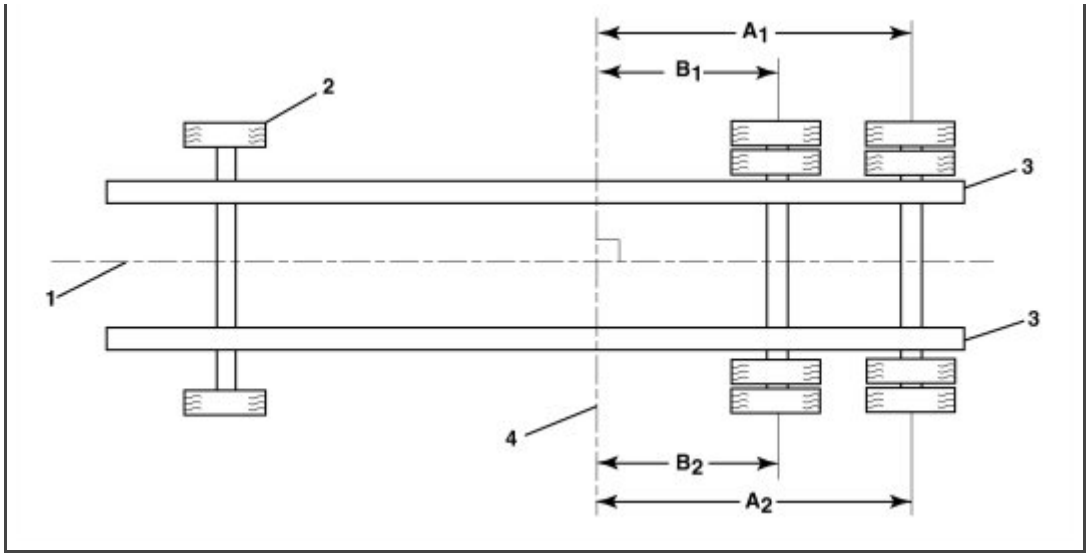
Chassis Wheelbase

4 x 2 Chassis — A1 = A2 with a Tolerance of No More Than 1/8 Inch (3.3 MM)



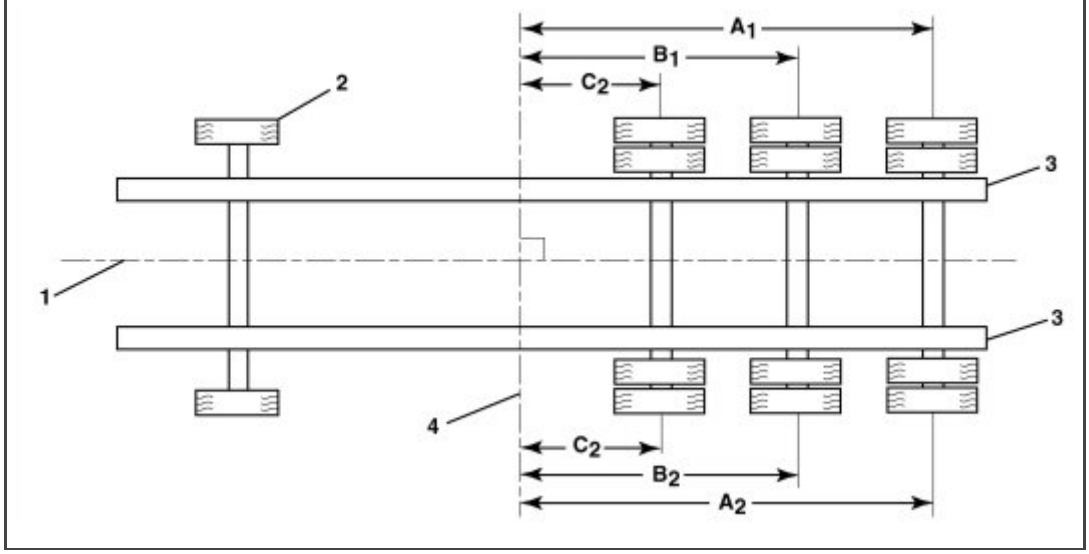
1. Chassis Centerline	3. Frame Rail
2. Front Axle	4. Perpendicular Datum

6 x 4 Chassis — A1 = A2, B1 = B2 with a Tolerance of No More Than 1/8 Inch (3.3 MM)



1. Chassis Centerline	3. Frame Rail
2. Front Axle	4. Perpendicular Datum

6 x 4 Chassis — A1 = A2, B1 = B2 with a Tolerance of No More Than 1/8 Inch (3.3 MM)8 x 6 Chassis — A1 = A2, B1 = B2, C1 = C2 with a Tolerance of No More Than 1/8 inch (3.3 MM)



1. Chassis Centerline	3. Frame Rail
2. Front Axle	4. Perpendicular Datum

Hunter Alignment Equipment

If HUNTER Alignment Equipment is used to check axle alignment, the following information applies:

When measuring thrust and scrub angles on HUNTER alignment equipment, the symbol (−) denotes left and (+) means right.

Older HUNTER Equipment measures Set Back, Rear Axle Thrust Angle, and Rear-Rear Axle Thrust Angle. The technician must then compare the two thrust angles of the rear axles to determine the Bogie Scrub Angle.

Thrust Angle(MACK taper leaf suspensions — ST34 and ST38, all four spring suspensions, Neway and MACK air suspensions, and Chalmers suspensions): 0° ± 0.08°

Thrust Angle (MACK SS/SW suspensions with camel back springs or walking beams equipped with rubber shock insulators. Also Hendrickson beam and Ridewell suspensions): 0° ± 0.16°

Bogie Scrub Angle is determined by comparing the two rear axle Thrust Angles.

To maintain side-to-side bogie wheelbase**(Bogie Scrub Angle)** within 1/8″ (MACK taper leaf suspensions, all four spring suspensions, Neway and MACK air suspensions, and Chalmers suspensions), the thrust angles of both rear axles must be within .08° of each other.

To maintain side-to-side bogie wheelbase**(Bogie Scrub Angle)** within 1/4″, (MACK SS/SW suspensions with camel back spring or walking beams equipped with rubber shock insulators. Also Hendrickson beam and Ridewell suspensions), the thrust angle of both rear axles must be within.

For Example:

Front-rear axle thrust angle of 0.02° and rear-rear axle thrust angle of 0.05° = difference of 0.03 (Bogie Scrub Angle of 0.03°).

Front-rear axle thrust angle of 0.02° and rear-rear axle thrust angle of −.04° = difference of 0.06 (Bogie Scrub Angle of 0.06°).

Front-rear axle thrust angle of −.02° and rear-rear axle thrust angle of −.04° = difference of 0.02 (Bogie Scrub Angle of 0.02°).

Newer HUNTER Equipment measures Set Back, Thrust Angle, and Bogie Scrub Angle. Scrub Angle is calculated for the technician, and is the measurement of bogie wheelbase.

Thrust Angle(Mack taper leaf suspensions — ST34 and ST38, all four spring suspensions, Neway and MACK air suspensions, and Chalmers Suspensions): 0° ± 0.08°

Thrust Angle (MACK SS/SW suspensions with camel back springs or walking beams equipped with rubber shock insulators. Also Hendrickson beam and Ridewell suspensions): 0° ± 0.16°

Scrub Angle (MACK taper leaf suspensions — ST34 and ST38, all four spring suspensions, Neway and Mack air suspensions, and Chalmers suspensions): 0° ± 0.08°

Scrub Angle (MACK SS/SW suspensions with camel back springs or walking beams equipped with rubber shock insulators. Also Hendrickson beam and Ridewell suspensions): 0° ± 0.16°

JOSAM Alignment Equipment

If JOSAM alignment equipment is used to check axle alignment, the following information applies:

The measurement for parallelism (scrub), toe and out of square (thrust) are expressed in millimetres per metre (mm/M) units based on target spacing.

JOSAM frame gauges are installed on the chassis to locate the chassis center line, which is then used as the reference point to determine the rolling direction of the wheels. If the front-rear and rear-rear square readings are opposite mathematical signs (+ and -), the readings are ADDED together, whereas if the front-rear and rear-rear square readings are the same mathematical signs (+ and + or - and -), the readings are subtracted.

For Example:

Front-rear square reading is -1.1 mm/M and rear-rear scrub reading is + 0.4 mm/M = 1.5 mm/M parallelism (opposite signs [- and +] are added).

Front-rear square reading is + 0.6 mm/M and rear-rear scrub reading is + 1.9 mm/M = 1.3 mm/M parallelism (like signs [+ and +] are subtracted).

Front-rear square reading is -1.6 mm/M and rear-rear scrub reading is -0.7 mm/M = 0.9 mm/M parallelism (like signs [- and -] are subtracted.

Square and parallelism specifications when measured with JOSAM alignment equipment are as follows:

- Non-adjustable rear suspensions — **± 2.9 mm/M**
- Adjustable rear suspension —**± 1.4 mm/M**

Note: Because different types of alignment equipment measure from different reference points, different readings will result. Direct comparisons between measurements taken with different types of alignment equipment are not meaningful.

JOSAM alignment equipment expresses measurements in mm/M. Conversion charts should be used if alignment equipment other than JOSAM is used.

Alignment Parameter Conversion Chart

The following chart provides conversions between millimetres per meter, inches per metre, decimal inches per metre, degrees and minutes.

mm/M	Inches/M	Decimal Inches/mm	Degrees	Minutes
1	3/64	0.039	0.06	3
2	5/64	0.079	0.11	7
3	1/8	0.118	0.17	10
4	5/32	0.157	0.23	14
5	13/64	0.197	0.29	17
6	15/64	0.236	0.34	21
7	9/32	0.276	0.40	24
8	5/16	0.315	0.46	27
9	23/64	0.354	0.51	31
10	25/64	0.394	0.57	34
11	7/16	0.433	0.63	38
12	15/32	0.472	0.69	41
13	33/64	0.512	0.74	45
14	35/64	0.551	0.80	48
15	19/32	0.591	0.86	52
16	5/8	0.630	0.91	55
17	43/64	0.669	0.97	58
18	45/64	0.708	1.03	1°2’

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