638689

REPORT NO. 121D-LTL- 06-004

SAFETY COMPLIANCE TESTING FOR FMVSS 121D
Air Brakes Systems - Dynamometer

MACK
2006 CXN613 Tractor
Meritor RR20145
NHTSA No.: C60700

LINK TESTING LABORATORIES, INC.
13840 Elmira Avenue
Detroit, MI 48227-3017

January 9, 2007

FINAL REPORT

U.S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Safety Assurance
Office of Vehicle Safety Compliance
400 Seventh Street, SW
Room 6115 (NVS-220)
Washington, DC 20590

Prepared By: _____

Approved By: _____

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16. ABSTRACT

A compliance test was conducted on the 2006 Mack CXN613 Tractor Rear Axle in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No TP-121D-01 for the determination of FMVSS 121D compliance. Test Failures identified were as follows:
None

17. KEY WORDS Compliance Testing FMVSS 121D Mack CXN613	**18. DISTRIBUTION STATEMENT** Copies of this report are available from- NHTSA Technical Reference Division Mail Code: NAD-52, Room 5108 400 Seventh Street, SW Washington, DC 20590 Telephone No.: 202-366-4946

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SECTION I

PURPOSE OF COMPLIANCE TEST

A test was conducted on the braking performance of a 2006 MACK CXN613 TRACTOR REAR VIN# 1M1AK06Y16N011449, to determine compliance with the dynamometer portion of FMVSS 121, "Air Brake Systems."

The compliance test was conducted in accordance with the National Highway Traffic Safety Administration (NHTSA), Office of Vehicle Safety Compliance (OVSC) Laboratory Test Procedure TP-121D-01 Dated May 9, 1990 and the corresponding Link Testing Laboratories, Inc. test procedure Link \ D98071A0 dated October 2, 1998.

There were no test failures.

SECTION II

TEST DATA SUMMARY

DYNAMOMETER TEST SUMMARY

S5.4.1.1 - BRAKE RETARDATION FORCE RATIO

REQUIRED		ACTUAL		PASS / FAIL
AIR PRESSURE	RETARDATION FORCE RATIO (Min)	AVERAGE AIR PRESSURE (psi)	RETARDATION FORCE RATIO	
20 psi	0.05	20	0.11	PASS
30 psi	0.12	30	0.19	PASS
40 psi	0.18	40	0.26	PASS
50 psi	0.25	50	0.33	PASS
60 psi	0.31	60	0.38	PASS
70 psi	0.37	70	0.44	PASS
80 psi	0.41	80	0.50	PASS

S5.4.2.1 - BRAKE POWER PHASE - Requirement: Max Pressure During Stops: 100 psi

SNUB	MAXIMUM AIR PRESSURE (psi)	PASS/FAIL	REMARKS
1	47	PASS	-
2	46	PASS	-
3	48	PASS	-
4	51	PASS	-
5	52	PASS	-
6	53	PASS	-
7	54	PASS	-
8	54	PASS	-
9	59	PASS	-
10	57	PASS	-

S5.4.2.1 - 20 MPH STOP

STOP	MAXIMUM AIR PRESSURE (psi)	PASS/FAIL	REMARKS
11	90	PASS	-

S5.4.3 - BRAKE RECOVERY - Requirement: Air Pressure (psi)

	MIN	MAX
w/o antilock	20	85
w/ antilock	12	85

STOP	AIR PRESSURE (psi)		PASS / FAIL	REMARKS
	MINIMUM	MAXIMUM		
1	55	61	PASS	-
2	55	60	PASS	-
3	54	59	PASS	-
4	53	57	PASS	-
5	52	57	PASS	-
6	51	57	PASS	-
7	50	56	PASS	-
8	49	55	PASS	-
9	48	55	PASS	-
10	48	54	PASS	-
11	47	53	PASS	-
12	47	54	PASS	-
13	47	54	PASS	-
14	46	53	PASS	-
15	46	54	PASS	-
16	46	54	PASS	-
17	46	52	PASS	-
18	46	53	PASS	-
19	46	53	PASS	-
20	45	54	PASS	-

SECTION III

TEST DATA

SPECIFICATIONS

TEST NO.: 121D-LTL-06-004 DATE: 1/9/2007

VEHICLE:

MODEL YEAR/MAKE/MODEL: 2006 Mack CXN613 Tractor

NHTSA NO.: C60700 VIN: 1M1AK06Y16N011449

AXLE: Meritor RR20145

BRAKE ASSEMBLY:

BRAKE TYPE: Meritor Q+

MANUFACTURER: Meritor Assy P/N: A3211P3448

DRUM SIZE: 16.5" X 7"

MANUFACTURER: Gunite P/N: 3600A

FRICTION MATERIAL: Meritor MA312

MANUFACTURER: Meritor Assy P/N: MA312 FF 4707D

SLACK ADJUSTER: Auto 5.5"

MANUFACTURER: Haldex Assy P/N: 25QD410P10

AIR CHAMBER: Anchorlock Type 30/30

MANUFACTURER: Anchorlock P/N: 19QE498P10

TEST PARAMETERS:

TEST START:	11/10/06	DYNAMOMETER:	68
TEST COMPLETE:	11/11/06	FIXTURE:	064355
REQUIRED WHEEL LOAD (lb):	10,000	ROLLING RADIUS (in):	19.4
ACTUAL WHEEL LOAD (lb):	9979	ROTATION:	Left
REQUIRED INERTIA (slug ft²):	812.7	COOLING AIR TEMP:	84°F
ACTUAL INERTIA (slug ft²):	811	COOLING AIR VELOCITY (ft/min):	2,200

REMARKS:

Cooling air velocity was manually adjusted to ensure the flow over the brake was 2,200 feet/min.

BRAKE ADJUSTMENT S6.2.6

VEHICLE MY/MAKE/MODEL: 2006 Mack CXN613 Tractor

VEHICLE NHTSA NO.: C60700 DATE OF TEST: 11/11/06

SCHEDULE: PERFORMANCE REQUIREMENT:

Brakes may be adjusted up to
3 times during the burnish
procedure at intervals specified
by vehicle manufactures, and
may be adjusted at the conclusion
of the burnishing in accordance
with the vehicle manufacturer's recommendation

1st Brake Adjustment = Initial Before Burnish

2nd Brake Adjustment = Before Brake Performance

*Refer to manual for brake adjustment on following pages. Haldex automatic slack adjusters pp.29-30.

RECORDED BY: _____ DATE: _____

APPROVED BY: _____

BRAKE MANUAL FOR INSTRUCTIONS

BRAKE ADJUSTMENT

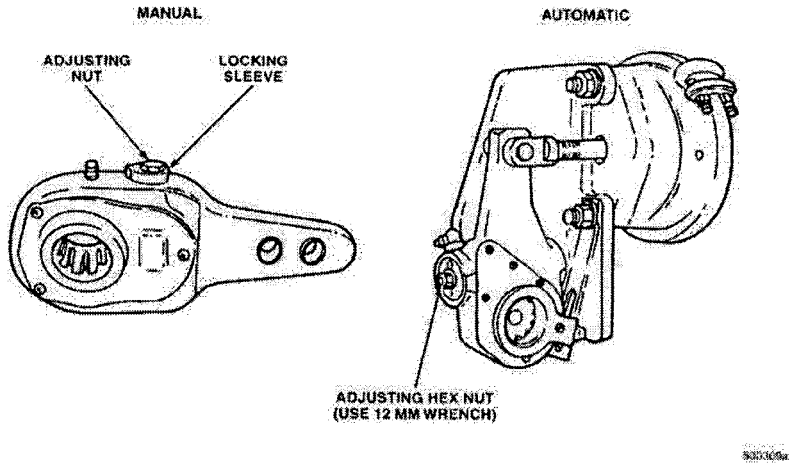
Manual and Automatic Slack Adjusters

DESCRIPTION

Slack adjusters are used on cam or disc brake systems to convert the linear force applied by the air chambers into the rotary force (torque) necessary to bring the brake shoes (or pads) into contact with the brake drums (or rotors). The slack adjuster is installed over the splines of the S-cam (powershaft on disc brakes) and secured to the air chamber push rod with a clevis.

Slack adjusters are either manual or automatic. Manual slack adjusters require periodic adjustment to maintain proper brake shoe-to-drum clearance and air chamber stroke. Automatic slack adjusters adjust automatically during normal service brake applications to compensate for normal brake lining wear and maintain proper stroke and brake shoe-to-drum clearance. All slack adjusters operate on a worm shaft and gear principle.

Figure 1 -- Manual and Automatic Slack Adjusters



NOTE

Automatic slack adjusters, which are designed to maintain proper brake chamber push rod travel and compensate for brake lining wear during normal use, have been required on all air

brake-equipped vehicles since October 1994.

Manual adjustment of an automatic slack adjuster should never be performed except when performing brake or wheel service (such as backing off the brake shoes for wheel removal, brake shoe relining/replacing, brake drum reconditioning, etc.). When push rod travel exceeds specifications (Maximum Allowable Stroke as given in Table 1) on a vehicle equipped with automatic slack adjusters, a mechanical problem with the slack adjuster, brake components or improper installation of the slack adjuster are indicated.

In general, manually adjusting an automatic slack adjuster to bring push rod travel back within specifications is masking a mechanical problem, not repairing it. Additionally, routine adjustment of most automatic slack adjusters will likely result in premature wear of the adjuster. If automatic slack adjusters are found to be out of adjustment, it is recommended that the vehicle be taken to the nearest repair facility as soon as possible to have the problem investigated and corrected.

Slack Adjuster Maintenance

PRELIMINARY SLACK ADJUSTER CHECKS (MANUAL AND AUTOMATIC)

Perform the following service tests:

1. Apply the brakes and check that the slack adjusters rotate freely and without binding.
2. Release the brakes and check that the slack adjusters return to the released position freely and without binding.
3. With the brakes released, check that the angle formed by the slack adjuster arm and the push rod is greater than 90 degrees.
4. With the brakes applied, check that the angle formed by the slack adjuster and the push rod is 90 degrees. The angle formed by the push rod and the flat surface of the brake chamber should also form a 90-degree angle.

Figure 2 -- Incorrect Adjustment

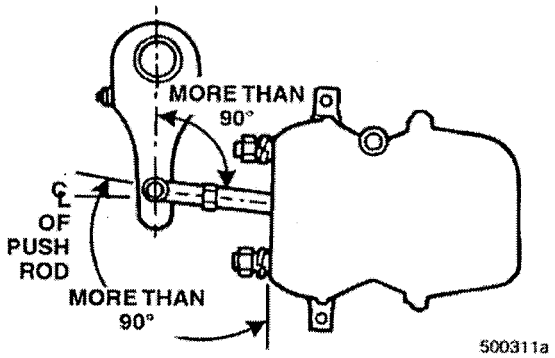
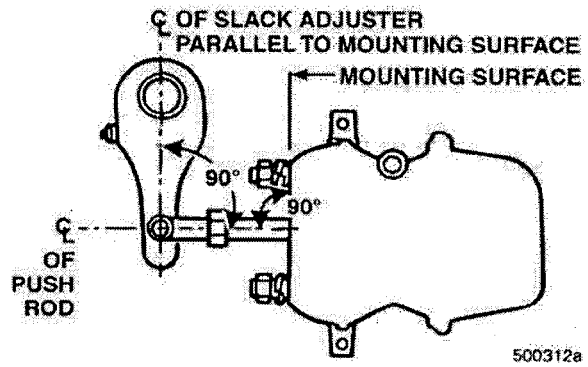


Figure 3 -- Correct Adjustment



5. Measure the push rod stroke. Stroke should be as short as possible without allowing the brakes to drag. Refer to Adjusting Stroke for measurement procedures.

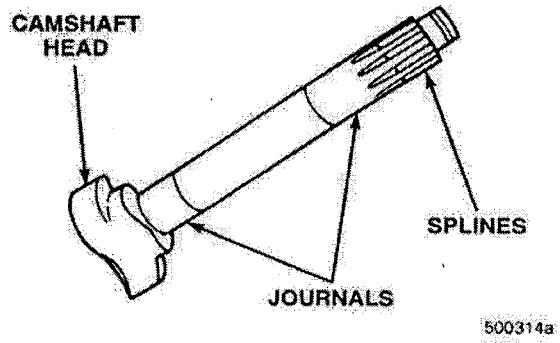
Automatic slack adjusters are designed to compensate for brake lining wear and maintain proper air chamber stroke by automatically adjusting during normal brake applications. Automatic slack adjusters should never require manual adjustments while in service. However, periodic measurements should be made as part of routine brake system maintenance to ensure proper slack adjuster operation.

The only time automatic slack adjusters should be adjusted is during installation or removal, or after backing off the adjusters to provide clearance when removing the brake drums for brake service. If an automatic slack adjuster cannot maintain proper air chamber stroke, it must be removed and repaired, or replaced as necessary.

Maintaining proper brake adjustment cannot be accomplished by the slack adjuster alone. Other brake system components have a direct bearing on the proper operation of the slack adjusters. Therefore, it is necessary to inspect the following components before assuming that an automatic slack adjuster is at fault:

- **Air Chambers**— Check that the air chambers are securely mounted and that proper alignment is maintained to avoid interference between the chamber push rod and the chamber housing.
- **Camshafts**— Check the camshaft bushings for wear. A worn camshaft bushing increases push rod travel.

Figure 4 -- Camshaft

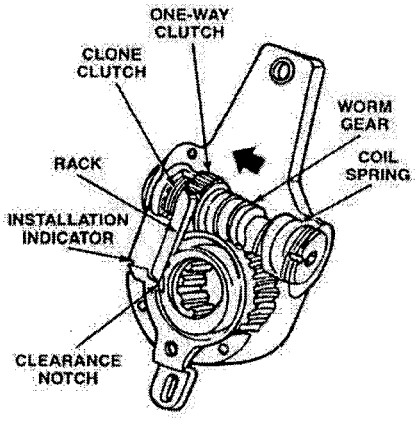


- **Wheel Bearing Adjustment**— Proper wheel bearing adjustment is necessary to maintain proper alignment between the brake drums and the brake shoes. Wheel bearing end play must be maintained between 0.001–0.005 inch (0.025–0.13 mm). Refer to Master Manual section 15-701, Wheel Bearings Service Manual, for wheel bearing adjustment procedures.

AUTOMATIC SLACK ADJUSTERS

Haldex Automatic Slack Adjusters

Figure 5 -- Haldex Slack Adjuster Cutaway



Inspect the slack adjuster for the following:

1. Inspect the slack adjuster mounting bracket for damage and make sure it is tight.
2. Check that the control arm is in the full release position.

3. Check the slack adjuster for damage.

4. Check the de-adjustment torque of the one-way clutch by placing a torque wrench on the manual adjusting nut and turning counterclockwise. If the nut turns at a torque less than 13 lb-ft (18 N•m), the one-way clutch is slipping, making it necessary to replace the slack adjuster. (When backing off the adjusting nut, a ratcheting sound should be heard.)

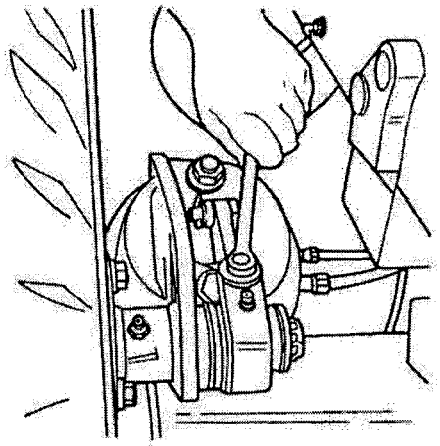
Check slack adjuster operation as follows:

1. Block the wheels to prevent the vehicle from moving.

2. Release the spring brakes.

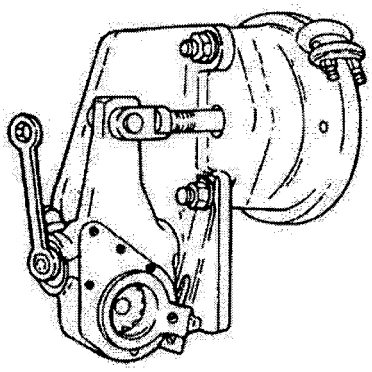
3. Check that the push rods are fully retracted.

Figure 6 -- Backing Off Slack Adjuster



4. Create an excessive clearance between the brake shoes and the brake drum by turning the manual adjusting nut counterclockwise. (When backing off the adjusting nut, a ratcheting sound should be heard.)

Figure 7 -- Checking Slack Adjuster Operation

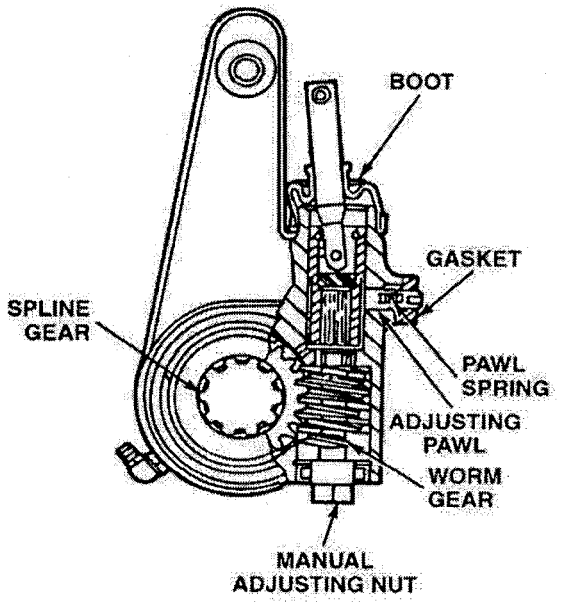


5. Fully apply, then release the service brakes. During release, observe if the manual adjusting nut rotates. (It may be easier to detect rotation by placing a wrench on the adjusting nut.) The rotating adjusting nut indicates that the slack adjuster is automatically adjusting to compensate for the excessive clearance between the brake shoes and brake drum. On each subsequent brake application and release, the amount of adjustment should be reduced until the desired clearance is obtained.

6. With the brakes released, check that the angle formed by the slack adjuster arm and the push rod is greater than 90 degrees.

ArvinMeritor™ Automatic Slack Adjusters

Figure 8 -- ArvinMeritor™ Automatic Slack Adjuster Cutaway



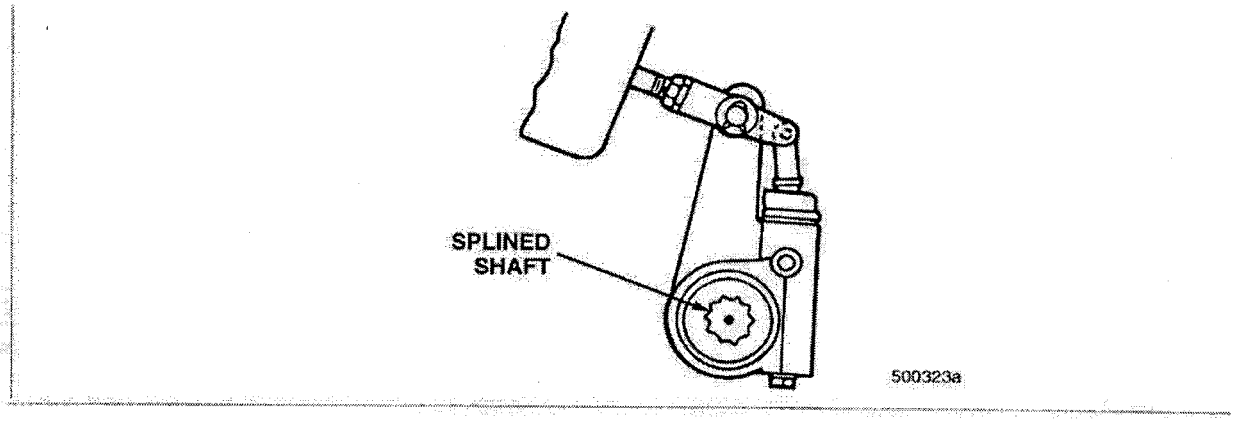
Inspect the slack adjuster for the following:

1. Check the in-service free stroke and the adjusted chamber stroke. Refer to ARVINMERITOR™ AUTOMATIC SLACK ADJUSTERS for measurement procedures.

2. Inspect the slack adjuster boots for damage. If damage is evident, install a **new** boot after first inspecting the condition of the grease inside the slack adjuster. If the grease is dry or contaminated, or if the slack adjuster pawl or actuator is dry or worn, the slack adjuster must be removed, disassembled and repaired.

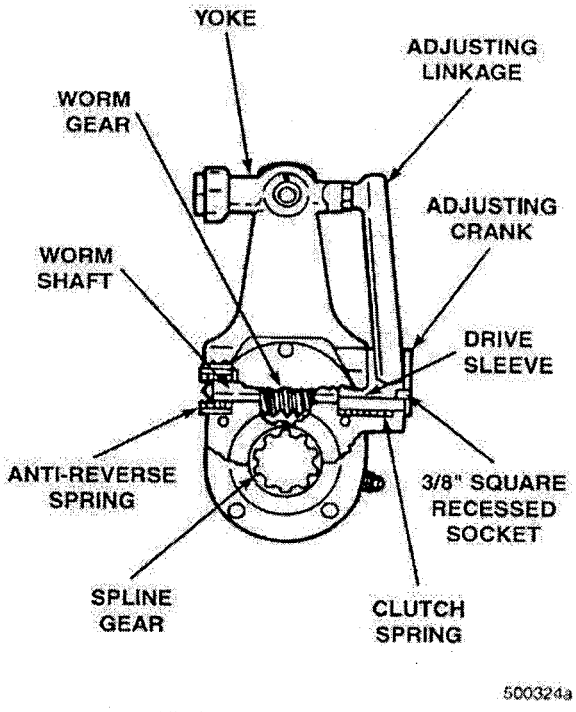
3. Check for heavy corrosion or contamination around the splines and retainer ring. Clean the area as necessary. Also check for excessive movement between the slack adjuster and the S-cam (or powershaft on disc brakes). Repair or replace worn or damaged parts.

Figure 9 -- Splined Shaft



Bendix Automatic Slack Adjusters

Figure 10 -- Bendix Automatic Slack Adjuster Cutaway



Inspect the slack adjuster for the following:

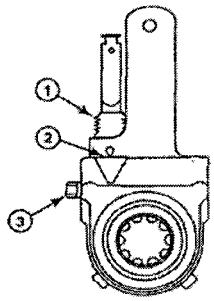
- Test the adjusting mechanism torque by inserting a 3/8-inch square drive torque wrench into the adjusting crank socket and turning in the opposite direction of the arrow stamped on the face of the housing. If the torque required to back off the crank is greater than 50 lb-ft (68 N•m), replace the slack adjuster.

Check slack adjuster operation as follows:

1. Block the wheels to prevent the vehicle from moving. Release the parking brakes.
2. Apply and release the service brakes several times and observe that the slack adjusters and external components move freely and without binding.
3. Check the brake chamber stroke. Refer to Adjusting Stroke for measurement procedures.
    - If the brakes do not fully release when the chamber push rod is fully retracted and the measured stroke for a full service brake application is less than 1-1/4 inches, the slack adjuster may be overadjusting and should be removed and replaced.
    - If the measured push rod stroke is greater than 1-1/4 inches and the brakes do not completely release when the brake chamber air is exhausted, a problem with the service brakes is indicated and must be identified and corrected.
    - If the measured push rod stroke exceeds the recommended maximum operating stroke, the slack adjuster may be underadjusting. Check the linkages for physical damage or excessive wear, and replace as necessary. If no damage to the linkage is evident, check the brake assemblies for excessive camshaft movement, cracked or broken brake chamber brackets, or oversized drums. Repair or replace as necessary. If none of the above conditions exist, replace the slack adjuster.

GUNITE AUTOMATIC SLACK ADJUSTERS

Figure 11 -- Gunite Automatic Slack Adjuster



1. Boot 2. Grease Fitting	3. Adjusting Hex

Inspect the slack adjuster for the following:

- Check the slack adjuster housing for structural damage, and also check for a worn clevis, clevis bushing and a torn or cut boot. Replace as required.

Check slack adjuster operation as follows:

1. Using a 7/16" box wrench on the adjusting hex, turn the hex counterclockwise 3/4 turn.

A ratcheting sound should be heard when the adjusting hex is rotated counterclockwise.

2. Make a chalk mark on the adjusting hex.

3. Apply and release the service brakes several times while watching the adjusting hex. The hex should rotate clockwise during this test.

NOTE

The adjustment is intentionally made in small increments, so it will take several brake applications to bring the slack adjuster back within stroke specifications.

4. Check the adjusting mechanism torque by using a torque wrench and a 7/16" socket to turn the adjusting hex counterclockwise. Note the amount of torque it took to rotate the adjusting hex counterclockwise.

   If the adjusting hex did not rotate clockwise when the brakes were applied and released during step 3, or if less than 15 lb-ft (20 N•m) of torque was required to rotate the adjusting hex counterclockwise, the slack adjuster must be replaced.

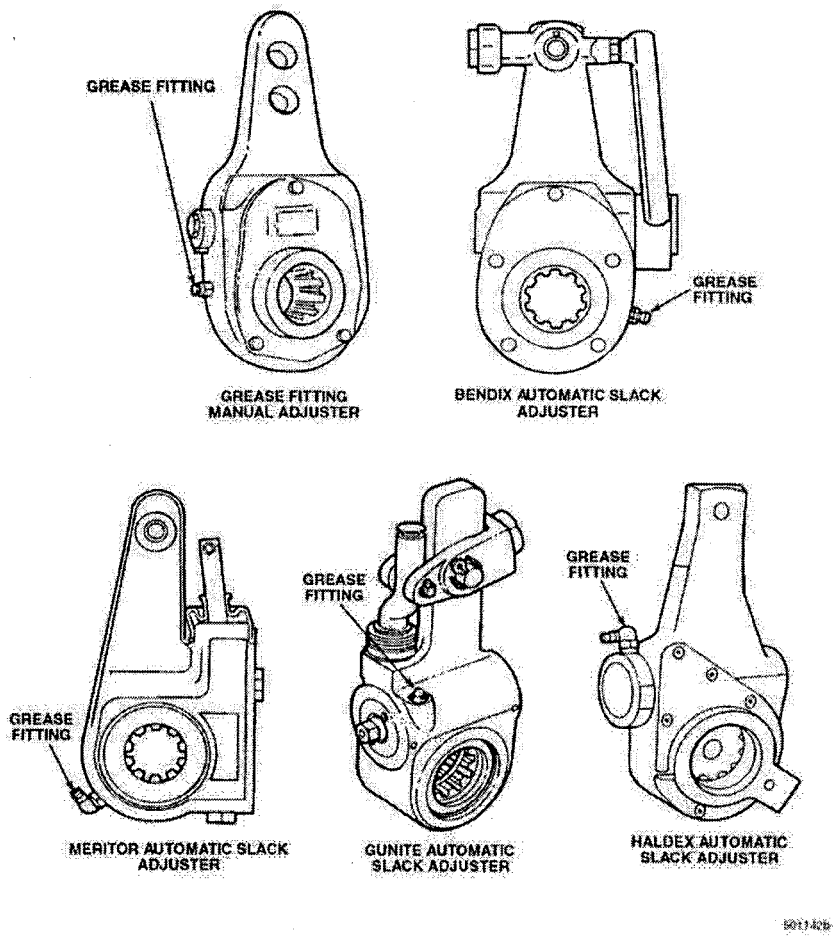
   If the adjusting hex rotated clockwise when the brakes were applied and released, and a torque greater than 15 lb-ft (20 N•m) was required to turn the adjusting hex counterclockwise, the slack adjuster is functioning properly.

5. Readjust the brakes.

Slack Adjuster Lubrication

Lubricate the slack adjusters at each scheduled chassis lubrication interval. Apply a sufficient amount of grease to the fitting to completely fill the slack adjuster body cavity.

Figure 12 -- Slack Adjuster Lubrication Points

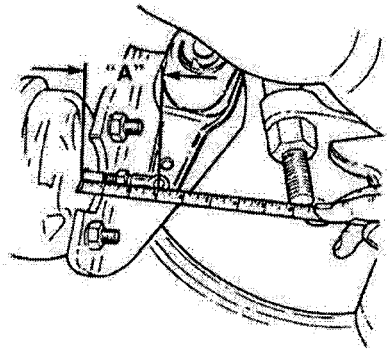


Adjusting Stroke

MEASURING PUSH ROD TRAVEL

1. With the brakes released, measure the distance between the flat surface of the brake chamber to the center of the push rod clevis pin.

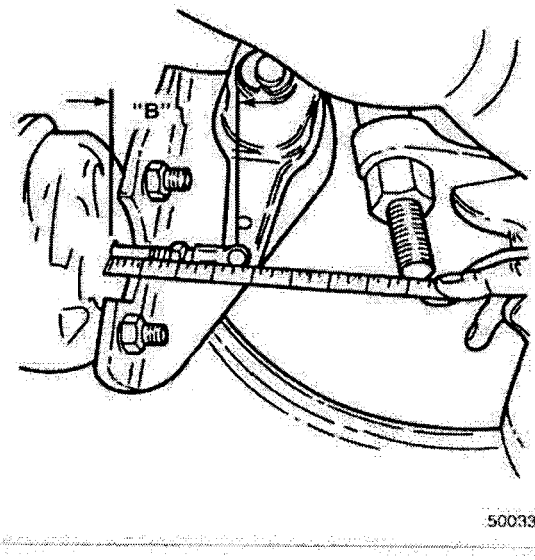
Figure 13 -- Measuring Distance "A"



2. Make and hold a full brake treadle application.

3. With the brakes applied, again measure the distance between the flat surface of the brake chamber to the center of the push rod clevis pin.

Figure 14 -- Measuring Distance "B"



4. Subtract the measurement made with the brakes released from the measurement made with the brakes applied. The difference is the stroke.

5. Compare the stroke measurement with the maximum allowable stroke shown in the last column of the following table.

Table 1

Type		Effective Diaphragm Area (Square Inches)	Overall Diameter (Inches)	Maximum Allowable Stroke (Inches [mm])
Clamp and Stamped Ring Type	9...	9	5-1/4	1-3/8 [35]
	12...	12	5-11/16	1-3/8 [35]
	16...	16	6-3/8	1-3/4 [44]
	20...	20	6-13/16	1-3/4 [44]
	24...	24	7-1/4	1-3/4 [44]
	24L...	24	7-1/4	2 [51]
	30...	30	8-1/8	2 [51]
	36...	36	9	2-1/4 [57]
Rotochambers	24...	24	7-1/32	1-7/8 [48]

Manual slack adjusters must be adjusted whenever the actual push rod applied stroke exceeds the maximum allowable stroke. With automatic slack adjusters, investigate and correct the probable cause if actual push rod applied stroke exceeds the maximum allowable stroke. Do not attempt to operate an automatic slack adjuster as a manual adjuster.

⚠ DANGER

Proper brake adjustment must be maintained for the safe operation of the truck.

⚠ WARNING

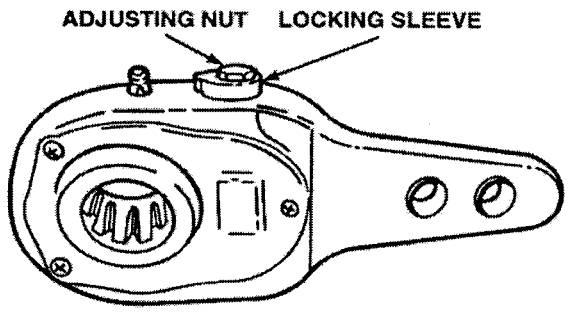
Block the wheels that remain on the ground. Raise the axle to be adjusted and support on safety stands.

- **Support the front axle under the axle housing or the center of the axle.**
- **Support the rear axle under the lower spring trunnion.**

Release the parking brake while adjusting the brakes.

MANUAL SLACK ADJUSTERS

Figure 15 -- Manual Slack Adjuster



Position the wrench over the adjusting screw and depress the adjusting lock sleeve BEFORE attempting to turn the adjusting screw. With the brake chamber push rod in the released position, turn the adjusting screw until the brake linings are against the brake drum. Back off the adjusting screw 1/4 turn or until the wheel rotates freely (a light drag may still be felt when rotating the wheel). When the adjustment is complete, be sure the locking sleeve is returned to its locked position by allowing the sleeve to engage the hex head of the adjusting screw.

NOTE

Because of different applications and slack adjuster mounting, always make sure the adjusting screw is being turned in the proper direction to adjust the brakes.

After proper adjustment, apply the brakes.

NOTE

All wheels must be on the ground before the brakes are applied.

The slack adjuster arm and brake chamber push rod should form a 90-degree angle. The brake chamber push rod should also form a 90-degree angle with the flat mounting surface of the brake chamber. All slack adjusters on the vehicle must be at the same angle.

ARVINMERITOR™ AUTOMATIC SLACK ADJUSTERS

The brakes must be readjusted after any operation involving the removal and reinstallation of the slack adjusters, or if the adjustment has been backed off for any reason. DO NOT rely on automatic slack adjusters to take up excess initial clearance.

Slack Adjuster Free Stroke

⚠ CAUTION

Spring brake chambers must be manually caged, and there must not be any air pressure in the service portion of the chambers before measuring free stroke.

⚠ CAUTION

Make sure the spring brakes are uncaged before returning the vehicle to service.

NOTE

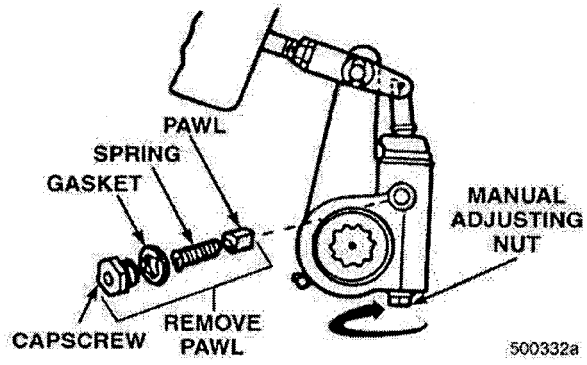
Pawls on old-style ArvinMeritor™ automatic slack adjusters must be removed when manually adjusting the brakes or damage to the pawl teeth may result. New-style pawls are spring-loaded and need only be pried out 1/32 inch to disengage. The pawl automatically re-engages when the pry bar is removed.

Setting Free Stroke

⚠ CAUTION

Before attempting to turn the manual adjusting nut, remove or disengage the pawl.

Figure 16 -- Setting Free Stroke



Set the stroke to its approximate length and set the lining-to-drum (or brake pad-to-rotor) clearance as follows:

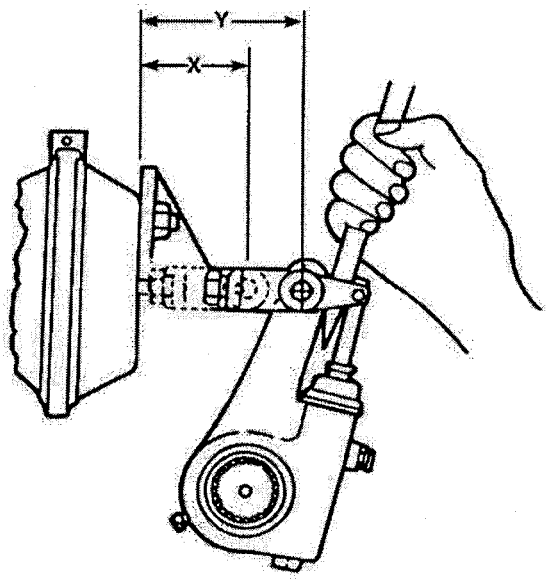
Turn the manual adjusting nut clockwise until the brake linings contact the drum or disc rotor. Then:

- Turn the nut 1/2 turn counterclockwise for drum brakes.
- Turn the nut 3/4 turn counterclockwise for disc brakes.

Measuring Free Stroke

1. Measure the distance from the bottom flat surface of the air chamber to the center of the large clevis pin.
2. Using a pry bar inserted in the clevis between the large and small clevis pins, move the slack adjuster until the brake linings contact the brake drum (or disc rotor).
3. Again measure the distance from the bottom flat surface of the air chamber to the center of the large clevis pin.

Figure 17 -- Measuring Free Stroke



FREE STROKE = Y MINUS X

500333a

The difference between the two measurements is the free stroke.

- Drum brake free stroke = 1/2–5/8 inch (12.7–15.9 mm)
- Disc brake free stroke = 3/4–7/8 inch (19.1–22.2 mm)

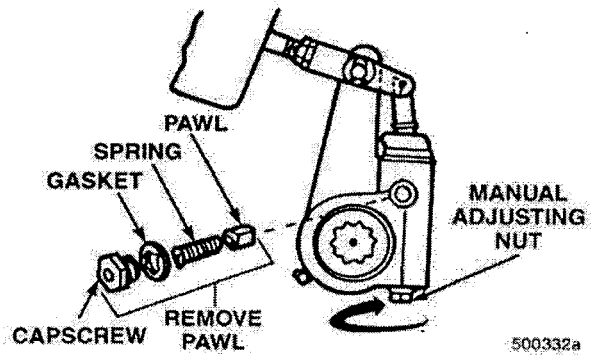
Adjusting Free Stroke

Adjust the free stroke by turning the adjusting nut in 1/8-turn increments.

⚠ CAUTION

Before attempting to turn the manual adjusting nut, remove or disengage the pawl.

Adjusting Free Stroke



- Turning the nut clockwise lengthens stroke length.
- Turning the nut counterclockwise shortens stroke length.

After properly setting the free stroke, verify the correct installation of the slack adjuster or proper operation of the brakes by checking the adjusted stroke.

Refer to Adjusting Stroke for measurement procedures.

NOTE

When measuring adjusted stroke, the applied pressure must be between 80 and 90 psi. If the vehicle is not equipped with an application gauge, pressurize the reservoirs to 100 psi. A full brake application with a reservoir pressure of 100 psi gives an application pressure of 80 to 90 psi at the air chambers.

After properly setting the chamber stroke, reinstall the pawl assembly, and torque the capscrew to 15–20 lb-ft (20–27 N•m).

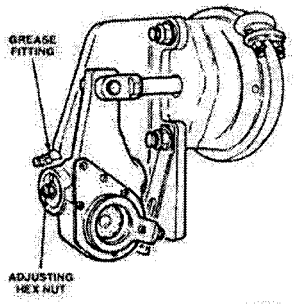
HALDEX AUTOMATIC SLACK ADJUSTERS

The brakes must be readjusted after any operation involving the removal and reinstallation of the slack adjusters, or if the adjustment has been backed off for any reason. DO NOT rely on automatic slack adjusters to take up excess initial clearance.

1. Block the wheels to prevent the vehicle from moving. Then release the parking brakes.

2. Turn the manual adjusting nut until the brake linings contact the brake drum.

Figure 18 -- Haldex Slack Adjuster



3. Back off the adjusting nut 1/2 turn.

NOTE

A minimum torque of 13 lb-ft (17.6 N•m) is required to overcome the one-way clutch. A ratcheting sound should occur while the adjusting nut is being turned counterclockwise.

4. After properly setting the slack adjuster, measure the adjusted stroke. Refer to Adjusting Stroke for measurement procedures.

BENDIX AUTOMATIC SLACK ADJUSTERS

The brakes must be readjusted after any operation involving the removal and reinstallation of the slack adjusters, or if the adjustment has been backed off for any reason. DO NOT rely on automatic slack adjusters to take up excess initial clearance.

1. Block the wheels to prevent the vehicle from rolling. Release the parking brakes and raise the wheel to be adjusted off the ground so it spins freely.

2. Insert a 3/8-inch square drive ratchet into the adjusting crank socket.

3. While spinning the wheel, turn the adjusting crank in the direction indicated by the arrow stamped on the face of the housing until wheel rotation stops.

4. Back off the adjustment 3/4 turn in the opposite direction, or until the wheel spins freely.

NOTE

Considerable torque, as much as 50 lb-ft (67.8 N•m), is required to back off the manual adjustment.

5. After properly setting the slack adjuster, measure the adjusted stroke. Refer to Adjusting Stroke for measurement procedures.

GUNITE AUTOMATIC SLACK ADJUSTERS

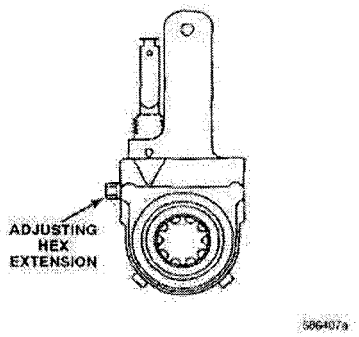
The brakes must be readjusted after any operation involving the removal and reinstallation of the slack adjuster, or if the adjustment has been backed off for any reason. DO NOT rely on automatic slack adjusters to take up excess initial clearances.

1. Block the wheels to prevent the vehicle from rolling, and then release the parking brakes.
2. Turn the adjusting hex extension clockwise until the brake linings contact the brake drum.
3. Back off the slack adjuster by turning the adjusting hex counterclockwise approximately 1/2 turn.

NOTE

Approximately 25–30 lb-ft (34–41 N•m) of torque will be required to back off the slack adjuster. When rotating the adjusting hex counterclockwise, a ratcheting should be heard. This is normal.

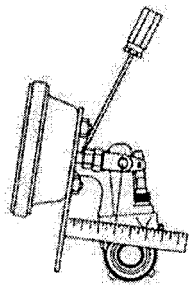
Figure 19 -- Slack Adjuster Adjusting Hex



4. After backing off the slack adjuster, measure the stroke by measuring the distance between the face of the air chamber and the center of the large clevis pin with the brakes released and applied (refer to Adjusting Stroke).
5. Measure free stroke. Free stroke is the amount of movement of the slack adjuster required to move the brake shoes against the brake drum. Free stroke is measured as follows:
   a. With the brakes released, measure the distance from the face of the brake chamber and the center of the large clevis pin.

b. Using a large screwdriver or pry bar as a lever, move the slack adjuster until the brake shoes contact the brake drum. With the brake shoes in contact with the brake drum, again measure the distance between the face of the brake chamber and the center of the large clevis pin.

Figure 20 -- Measuring Free Stroke



Free stroke should be 3/8"–5/8" (9.53–15.88 mm). If free stroke is within specifications, but the applied stroke is too long, check the brakes for problems such as missing or worn components, cracked brake drums or improper lining to drum contact.

If free stroke is greater than specifications, perform the tests outlined in the section Slack Adjuster Maintenance.

If free stroke is less than 3/8" (9.53 mm), dragging brakes can occur. Recheck the brake adjustment procedure.

BURNISH TEST DATA S6.2.6

VEHICLE NHTSA NO.: C60700 DATE OF TEST: 11/11/06

SCHEDULE:

200 stops from 40 MPH (347 rpm) @ 10 ft/s/s, IBT 315-385°F each stop

200 stops from 40 mph (347 rpm) @ 10 ft/s/s, IBT 450-550°F each stop

Stop time: 5.78-5.96 seconds

PERFORMANCE REQUIREMENT:

None

STOP	RPM	F/M TEMP. (315-385°F)	TORQUE (lb-ft)	STOP TIME (5.78 - 5.96 sec)	AVERAGE AIR PRESSURE	REMARKS
1	347	350	4934	5.83	79	-
20	347	349	5031	5.79	80	-
40	348	348	5039	5.79	61	-
60	348	349	4987	5.84	59	-
80	347	348	4984	5.83	54	-
100	347	349	4997	5.81	52	-
101	347	349	4998	5.81	51	-
120	346	349	4981	5.82	51	-
140	347	348	5029	5.79	50	-
160	347	349	5009	5.80	50	-
180	347	348	5045	5.76	49	-
200	346	349	5024	5.77	49	-
		(450-550°F)				
201	346	373	5007	5.78	53	-
220	347	500	4999	5.81	53	-
240	347	500	4991	5.83	51	-
260	347	500	4996	5.78	50	-
280	346	500	4990	5.81	49	-
300	346	500	4985	5.81	49	-
301	346	500	4979	5.82	49	-
320	347	500	4993	5.82	49	-
340	347	500	4980	5.85	50	-
360	348	500	5015	5.81	50	-
380	347	500	4998	5.82	50	-
400	346	500	4988	5.80	50	-

Percent Shoe Contact	LEADING SHOE	85%
	TRAILING SHOE	75%

BRAKE RETARDATION FORCE S5.4.1, S5.4.1.1

VEHICLE NHTSA NO.: C60700 DATE OF TEST: 11/11/06

SCHEDUILE:

Decelerate from 50 MPH at pressures of 20,30,40,50,60,70,80 psi

IBT 125-200 °F each stop

Measure torque starting coincident with required pressure

PERFORMANCE REQUIREMENT:

Retardation ratio as in table below

AIR PRESSURE APPLIED (psi)	RPM	F/M TEMPERATURE (°F)	TORQUE (lb-ft)	STOP TIME (seconds)
20	433	169	1752	20.8
30	434	169	2918	12.5
40	433	169	4005	9.1
50	433	169	4954	7.3
60	434	169	5776	6.3
70	434	170	6611	5.5
80	433	171	7414	4.9

AIR PRESSURE APPLIED (psi)	TORQUE DIVIDED BY STATIC RAD 1.62 feet	FORCE DIVIDED BY LOAD 9978.7 lbs	REQUIRED RETARDATION FORCE QUOTIENT	Pass/ Fail	Remarks
20	1084	0.11	0.05	PASS	-
30	1805	0.18	0.12	PASS	-
40	2477	0.25	0.18	PASS	-
50	3065	0.31	0.25	PASS	-
60	3573	0.36	0.31	PASS	-
70	4089	0.41	0.37	PASS	-
80	4586	0.46	0.41	PASS	-

DATA INDICATES: XXXXX PASS _____ FAIL

BRAKE POWER S5.4.2, S5.4.2.1, S5.4.2.2

VEHICLE MY/MAKE/MODEL: 2006 Mack CXN613 Tractor

VEHICLE NHTSA NO.: C60700 DATE OF TEST: 11/11/06

SCHEDULE:

Initial Brake Temperature 150 - 200°F
Speed 50-15 MPH (433 RPM) - (130RPM)
Deceleration 9 ft/s/s for 72 sec intervals
Speed from 20 MPH (173 RPM) Stop No. 11
Deceleration at 14 ft/s/s
Snub times stops 1-10, 5.70 - 6.42 seconds
Snub times stop 11, 2.09-2.26 seconds

PERFORMANCE REQUIREMENT:

Maximum pressure during Snubs
100 psi

SNUB OR STOP	RPM	F/M TEMP. (°F)	TORQUE (lb-ft)	MAXIMUM AIR PRESSURE (psi)	STOP TIME (sec)	PASS/ FAIL
1	434	148	4542	47	5.67	PASS
2	433	198	4515	46	5.70	PASS
3	434	249	4525	48	5.71	PASS
4	433	283	4488	51	5.96	PASS
5	433	312	4473	52	5.86	PASS
6	435	342	4495	53	6.13	PASS
7	434	366	4484	54	6.32	PASS
8	433	390	4456	54	5.77	PASS
9	433	413	4645	59	5.80	PASS
10	433	433	4464	57	5.75	PASS
	RPM (1 Minute After Snub 10)					
11	173	454	6745	90	2.12	PASS

DATA INDICATES: XXXXXXXX PASS _____ FAIL

BRAKE RECOVERY S5.4.3

VEHICLE NHTSA NO.: C60700 DATE OF TEST: 11/11/06

SCHEDULE:

Speed 30 mph (270 RPM)
Deceleration at 12 ft/s/s
@ 1 minute intervals
Stop time = 3.52 - 3.83 seconds

PERFORMANCE REQUIREMENT:

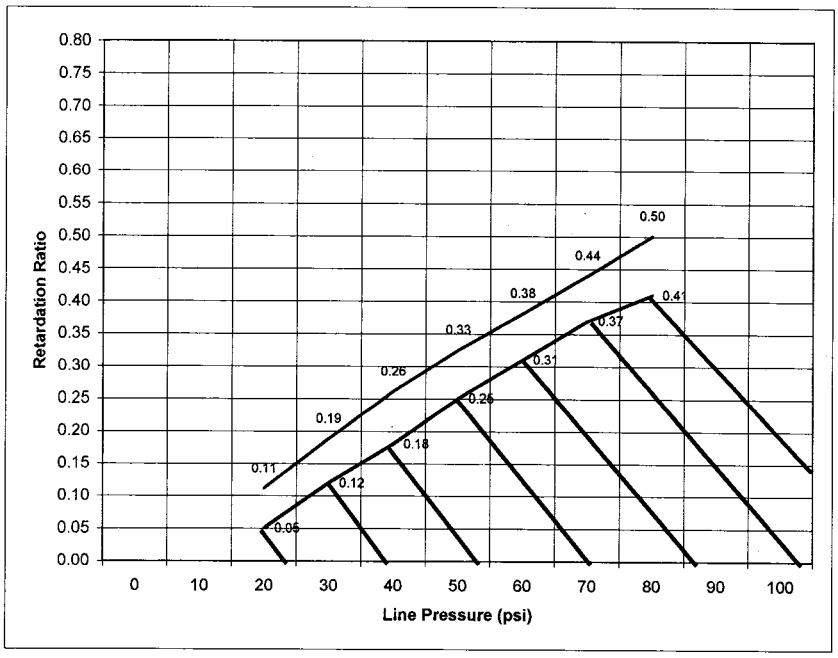
	Min.	Max.
w/o Antilock	20 psi	85 psi
w/ Antilock	12 psi	85 psi

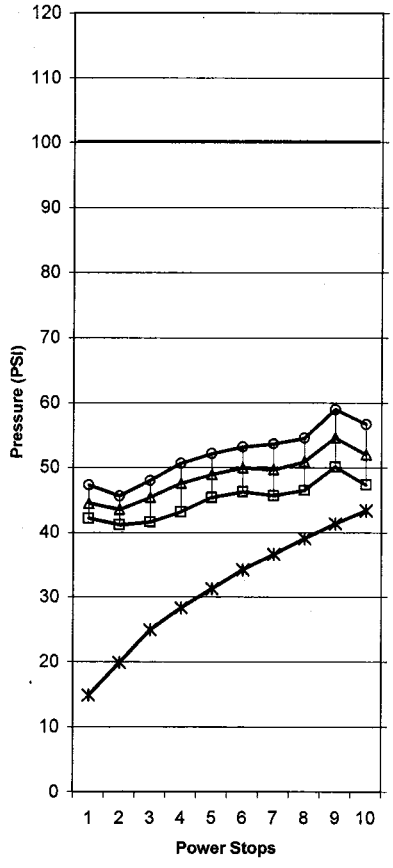
STOP No.	RPM	F/M TEMP. (°F)	TORQUE (lb-ft)	AIR PRESSURE (psi)		STOP TIME (sec)	PASS/ FAIL
				MINIMUM	MAXIMUM		
1	260	419	6036	55	61	3.61	PASS
2	260	421	6021	55	60	3.60	PASS
3	261	424	6044	54	59	3.59	PASS
4	261	423	6061	53	57	3.60	PASS
5	259	426	6001	52	57	3.60	PASS
6	260	426	6029	51	57	3.60	PASS
7	261	426	6066	50	56	3.58	PASS
8	261	425	6075	49	55	3.59	PASS
9	260	426	5963	48	55	3.64	PASS
10	261	426	6009	48	54	3.61	PASS
11	261	426	6031	47	53	3.60	PASS
12	259	426	5994	47	54	3.61	PASS
13	261	423	6033	47	54	3.60	PASS
14	262	423	6045	46	53	3.61	PASS
15	260	423	6018	46	54	3.59	PASS
16	261	422	6036	46	54	3.60	PASS
17	260	421	5973	46	52	3.62	PASS
18	261	421	6046	46	53	3.61	PASS
19	261	420	6056	46	53	3.59	PASS
20	261	420	6051	45	54	3.60	PASS

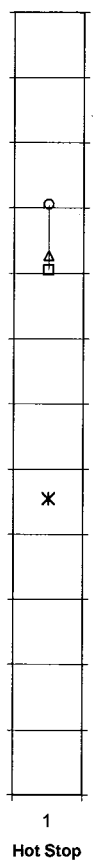
DATA INDICATES: XXXXXXX PASS _____ FAIL

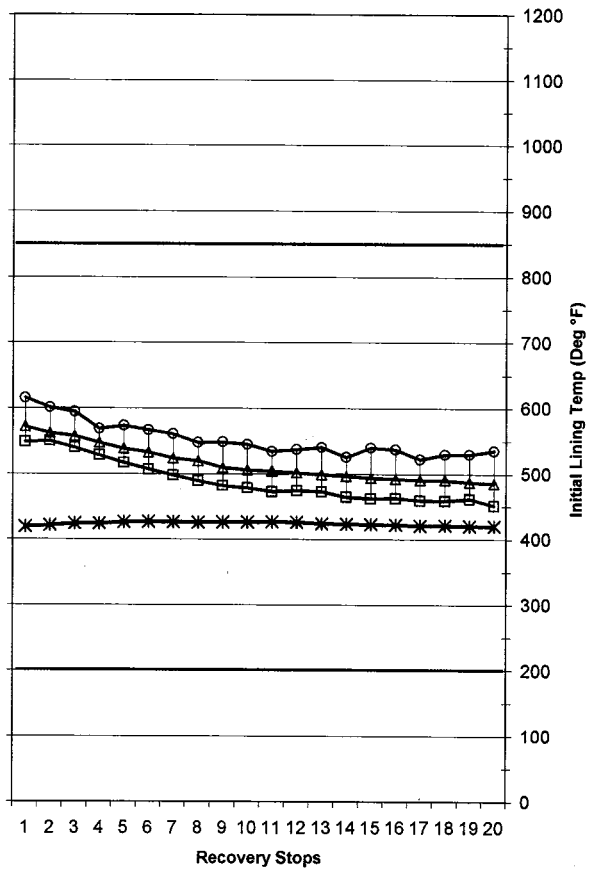
TEST DATA PLOTS: S5.4.1, S5.4.2 AND S5.4.3

REPORT NUMBER:
LTL-DOT-066975-001
MODEL YEAR/MAKE/MODEL:
2006 Mack CXN613 Tractor
AXLE:
Meritor RR20145
BRAKE TYPE:
Meritor Q+
DRUM SIZE AND TYPE:
16.5" X 7" Gunite 3600A
FRICTION MATERIAL:
Meritor MA312
AIR CHAMBER:
Anchorlock Type 30/30
SLACK ADJUSTER:
Haldex 5.5" Automatic
GAWR (lbs):
20000
ROLLING RADIUS (in):
19.4









SECTION IV

TEST EQUIPMENT AND CALIBRATION RECORDS

Section IV - INSTRUMENTATION

Testing Equipment

Link Dynamometer No. 68

Description	Serial Number	*Calibration Date	Next Calibration Date
Torque	3852	6/16/2006	6/16/2007
Brake Temperature	T-135385	6/16/2006	6/16/2007
Air Pressure	76898	6/16/2006	6/16/2007
Stroke	29030148	6/16/2006	6/16/2007
Shaft Speed	96200686	6/16/2006	6/16/2007
Air Velocity	0068AS	6/16/2006	6/16/2007

*Calibration By Matthew J. Curtis

LINK

Certificate of Calibration

Calibration Performed By
Link Testing Laboratories
13840 Elmira Ave
Detroit, Mi 48227
(313) 933-4900

Calibration Performed For
Link Testing Laboratories
13840 Elmira Ave
Detroit,Michigan 48227

Machine Description:	Dynamometer 68
Report Number:	D0068-6-2006
Certificate Number:	3852(F)2006
Calibration Date:	6/16/2006
Next Calibration Date:	6/16/2007
Procedure Used:	1 Torque Calibration
Procedure Date:	6/16/2006
Technician:	M.Curtis
Signature:	M Curtis

Description:	Torque Fwd
Manufacturer:	Lebow
Condition:	Good
Serial Number:	3852(F)
Model Number:	312A
Instrument Range:	15000 lb
Rated Full-Scale:	200 Klb-in
Temperature:	72 F
Relative Humidity:	40 %

Calibration Standard Value (lb-ft)	Initial "As Found" Value (lb-ft)	Calibration Standard Value (lb-ft)	Final Calibrated Value (lb-ft)	Initial Percent (%) of Full Scale Range (FSR) Error	Final Percent (%) of Full Scale Range (FSR) Error
0.2	0.8	0.2	0.8	.004%	.004%
2483.9	2491.3	2483.9	2491.3	.044%	.044%
4906.1	4911.4	4906.1	4911.4	.032%	.032%
9990.1	9994.6	9990.1	9994.6	.027%	.027%
14305.9	14315.2	14305.9	14315.2	.056%	.056%

	PRE-CAL	POST-CAL
Maximum % of full-scale error observed:	0.0560%	0.0560%
Maximum % of FSR error allowable (+/-):	1.0000%	1.0000%

Pre-Calibration Status: Instrument met required accuracy
Post-Calibration Status: Instrument meets required accuracy

The reported expanded uncertainty of measurement is stated as the standard uncertainty multiplied by the coverage factor (k=2), which for a normal distribution corresponds to a coverage probability of 95%. The data contained in this document is applicable only to the above listed equipment and is not valid unless signed by the technician. Measurement standards used for this test are traceable to the National Institute of Standards and Technology. This document shall not be reproduced without the written approval of Link Testing Laboratories.

Ref #	Description	Serial Number	Range	Accuracy	Uncertainty	Last Cal	Cal Due
REF:3	DISPLAY MODULE	13344-1	9999 COUNTS	+/- .05%	% +/- .05	11/7/2005	12 MO.
REF:10	LOAD CELL 3000 LB	97781	3000 LB	+/- .05%FS	%FS +/- .05	11/7/2005	12 MO.

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(313) 933-4900

Calibration Performed For
Link Testing Laboratories
13840 Elmira Ave
Detroit,Michigan 48227

Machine Description:	Dynamometer 68
Report Number:	D0068-6-2006
Certificate Number:	0068TEMP12006
Calibration Date:	6/16/2006
Next Calibration Date:	6/16/2007
Procedure Used:	4 Temperature Calibration (thermocouple cond.)
Procedure Date:	6/16/2006
Technician:	M.Curtis
Signature:	M Curtis

Description:	Temperature1
Manufacturer:	Link Engineering
Condition:	Good
Serial Number:	0068TEMP1
Model Number:	1484-CAO-CAV
Instrument Range:	1400 °F
Rated Full-Scale:	1400 °F
Temperature:	72 F
Relative Humidity:	40 %

Calibration Standard Value (°F)	Initial "As Found" Value (°F)	Calibration Standard Value (°F)	Final Calibrated Value (°F)	Initial Percent (%) of Full Scale Range (FSR) Error	Final Percent (%) of Full Scale Range (FSR) Error
0.0	-0.8	0.0	0.0	-.057%	.000%
350.0	350.8	350.0	350.7	.057%	.050%
700.0	700.9	700.0	699.9	.064%	-.007%
1050.0	1051.5	1050.0	1050.1	.107%	.007%
1390.0	1392.0	1390.0	1389.7	.143%	-.021%

	PRE-CAL	POST-CAL
Maximum % of full-scale error observed:	0.1430%	0.0500%
Maximum % of FSR error allowable (+/-):	1.0000%	1.0000%

Pre-Calibration Status: Instrument met required accuracy
Post-Calibration Status: Instrument meets required accuracy

The reported expanded uncertainty of measurement is stated as the standard uncertainty multiplied by the coverage factor (k=2), which for a normal distribution corresponds to a coverage probability of 95%. The data contained in this document is applicable only to the above listed equipment and is not valid unless signed by the technician. Measurement standards used for this test are traceable to the National Institute of Standards and Technology. This document shall not be reproduced without the written approval of Link Testing Laboratories.

Ref #	Description	Serial Number	Range	Accuracy	Uncertainty	Last Cal	Cal Due
REF.4	TEMP	T-135385	-210-760 C	+/- 1 F	F +/- 1	11/7/2005	12 MO.

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(313) 933-4900

Calibration Performed For
Link Testing Laboratories
13840 Elmira Ave
Detroit,Michigan 48227

Machine Description:	Dynamometer 68
Report Number:	D0068-6-2006
Certificate Number:	768982006
Calibration Date:	6/16/2006
Next Calibration Date:	6/16/2007
Procedure Used:	2 Pressure Calibration
Procedure Date:	6/16/2006
Technician:	M.Curtis
Signature:	M Curtis

Description:	Air Pressure
Manufacturer:	BLH
Condition:	Good
Serial Number:	76898
Model Number:	D-HF
Instrument Range:	200 PSI
Rated Full-Scale:	200 PSI
Temperature:	72 F
Relative Humidity:	40 %

Calibration Standard Value (PSI)	Initial "As Found" Value (PSI)	Calibration Standard Value (PSI)	Final Calibrated Value (PSI)	Initial Percent (%) of Full Scale Range (FSR) Error	Final Percent (%) of Full Scale Range (FSR) Error
0.0	0.0	0.0	0.0	.000%	.000%
24.2	24.1	24.8	24.9	-.050%	.050%
50.0	49.9	49.7	49.7	-.050%	.000%
75.1	74.8	74.8	74.8	-.150%	.000%
117.5	116.7	117.5	117.2	-.400%	-.150%

	PRE-CAL	POST-CAL
Maximum % of full-scale error observed:	-0.4000%	-0.1500%
Maximum % of FSR error allowable (+/-):	1.0000%	1.0000%

Pre-Calibration Status: Instrument met required accuracy
Post-Calibration Status: Instrument meets required accuracy

The reported expanded uncertainty of measurement is stated as the standard uncertainty multiplied by the coverage factor (k=2), which for a normal distribution corresponds to a coverage probability of 95%. The data contained in this document is applicable only to the above listed equipment and is not valid unless signed by the technician. Measurement standards used for this test are traceable to the National Institute of Standards and Technology. This document shall not be reproduced without the written approval of Link Testing Laboratories.

Ref #	Description	Serial Number	Range	Accuracy	Uncertainty	Last Cal	Cal Due
REF:3	DISPLAY MODULE	13344-1	9999 COUNTS	+/- .05%	% +/- .05	11/7/2005	12 MO.
REF:6	PRESSURE CELL 200 PSI	852283	200 PSI	+/- .25%FSR	% FSR +/- .25	11/7/2005	12 MO.

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Detroit, Mi 48227
(313) 933-4900

Calibration Performed For
Link Testing Laboratories
13840 Elmira Ave
Detroit,Michigan 48227

Machine Description:	Dynamometer 68
Report Number:	D0068-6-2006
Certificate Number:	290301482006
Calibration Date:	6/16/2006
Next Calibration Date:	6/16/2007
Procedure Used:	6 Distance Calibration
Procedure Date:	6/16/2006
Technician:	M.Curtis
Signature:	M Curtis

Description:	Drum Brake Stroke
Manufacturer:	Unimeasure
Condition:	Good
Serial Number:	29030148
Model Number:	P5A-004-NJC
Instrument Range:	10 in
Rated Full-Scale:	10 in
Temperature:	72 F
Relative Humidity:	40 %

Calibration Standard Value (in)	Initial "As Found" Value (in)	Calibration Standard Value (in)	Final Calibrated Value (in)	Initial Percent (%) of Full Scale Range (FSR) Error	Final Percent (%) of Full Scale Range (FSR) Error
0.000	0.000	0.000	0.000	.000%	.000%
1.000	0.997	1.000	0.995	-.030%	-.050%
2.000	2.005	2.000	2.000	.050%	.000%
3.000	3.017	3.000	3.008	.170%	.080%

	PRE-CAL	POST-CAL
Maximum % of full-scale error observed:	0.1700%	0.0800%
Maximum % of FSR error allowable (+/-):	1.0000%	1.0000%

Pre-Calibration Status: Instrument met required accuracy
Post-Calibration Status: Instrument meets required accuracy

The reported expanded uncertainty of measurement is stated as the standard uncertainty multiplied by the coverage factor (k=2), which for a normal distribution corresponds to a coverage probability of 95%. The data contained in this document is applicable only to the above listed equipment and is not valid unless signed by the technician. Measurement standards used for this test are traceable to the National Institute of Standards and Technology. This document shall not be reproduced without the written approval of Link Testing Laboratories.

Ref #	Description	Serial Number	Range	Accuracy	Uncertainty	Last Cal	Cal Due
REF 5	6 IN CALIPER	33333	0-6 IN	+/- .001 IN	IN +/- .001	11/7/2005	12 MO.

Certificate of Calibration

Calibration Performed By
Link Testing Laboratories
13840 Elmira Ave
Detroit, Mi 48227
(313) 933-4900

Calibration Performed For
Link Testing Laboratories
13840 Elmira Ave
Detroit,Michigan 48227

Machine Description:	Dynamometer 68
Report Number:	D0068-6-2006
Certificate Number:	962006862006
Calibration Date:	6/16/2006
Next Calibration Date:	6/16/2007
Procedure Used:	3 Rotational Speed Calibration
Procedure Date:	6/16/2006
Technician:	M.Curtis
Signature:	M Curtis

Description:	Shaft Speed
Manufacturer:	Lucas Ledex
Condition:	Good
Serial Number:	96200686
Model Number:	HD-20-DN-600-5LD-7LBS
Instrument Range:	2000 RPM
Rated Full-Scale:	1200 RPM
Temperature:	72 F
Relative Humidity:	40 %

Calibration Standard Value (RPM)	Initial "As Found" Value (RPM)	Calibration Standard Value (RPM)	Final Calibrated Value (RPM)	Initial Percent (%) of Full Scale Range (FSR) Error	Final Percent (%) of Full Scale Range (FSR) Error
0.0	0.0	0.0	0.0	.000%	.000%
50.0	50.0	50.0	50.0	.000%	.000%
250.0	250.5	250.0	250.5	.042%	.042%
500.0	500.0	500.0	500.0	.000%	.000%
750.0	749.0	750.0	749.0	-.083%	-.083%

	PRE-CAL	POST-CAL
Maximum % of full-scale error observed:	-0.0830%	-0.0830%
Maximum % of FSR error allowable (+/-):	1.0000%	1.0000%

Pre-Calibration Status: Instrument met required accuracy
Post-Calibration Status: Instrument meets required accuracy

The reported expanded uncertainty of measurement is stated as the standard uncertainty multiplied by the coverage factor (k=2), which for a normal distribution corresponds to a coverage probability of 95%. The data contained in this document is applicable only to the above listed equipment and is not valid unless signed by the technician. Measurement standards used for this test are traceable to the National Institute of Standards and Technology. This document shall not be reproduced without the written approval of Link Testing Laboratories.

Ref #	Description	Serial Number	Range	Accuracy	Uncertainty	Last Cal	Cal Due
REF:24	NON-CONTACT DIGITAL TACHOMETER	TACHOMETER 139044	100000 RPM	+/- .01%	% +/- .01	4/22/2006	12 MO.

LINK

Certificate of Calibration

Calibration Performed By
Link Testing Laboratories
13840 Elmira Ave.
Detroit, MI 48227
(313) 933-4900

Calibration Performed For
Link Testing Laboratories
13840 Elmira Ave
Detroit,Michigan 48227

Machine Description:	Dynamometer 68
Report Number:	D0068-6-2006
Certificate Number:	0068AS2006
Calibration Date:	6/16/2006
Next Calibration Date:	6/16/2007
Procedure Used:	9 Air Velocity Calibration
Procedure Date:	6/16/2006
Technician:	M.Curtis
Signature:	M Curtis

Description:	Air Velocity
Manufacturer:	R M Young
Condition:	Good
Serial Number:	0068AS
Model Number:	27105R
Instrument Range:	50 MPH
Rated Full-Scale:	185 MPH
Temperature:	72 F
Relative Humidity:	40 %

Calibration Standard Value (MPH)	Initial "As Found" Value (MPH)	Calibration Standard Value (MPH)	Final Calibrated Value (MPH)	Initial Percent (%) of Full Scale Range (FSR) Error	Final Percent (%) of Full Scale Range (FSR) Error
0.0	0.0	0.0	0.0	.000%	.000%
5.0	4.5	5.0	5.2	-.270%	.108%
10.0	9.4	10.0	10.0	-.324%	.000%
20.0	19.0	20.0	19.9	-.541%	-.054%
25.0	24.1	25.0	25.0	-.486%	.000%

	PRE-CAL	POST-CAL
Maximum % of full-scale error observed:	-0.5410%	0.1080%
Maximum % of FSR error allowable (+/-):	5.0000%	5.0000%

Pre-Calibration Status: Instrument met required accuracy
Post-Calibration Status: Instrument meets required accuracy

The reported expanded uncertainty of measurement is stated as the standard uncertainty multiplied by the coverage factor (k=2), which for a normal distribution corresponds to a coverage probability of 95%. The data contained in this document is applicable only to the above listed equipment and is not valid unless signed by the technician. Measurement standards used for this test are traceable to the National Institute of Standards and Technology. This document shall not be reproduced without the written approval of Link Testing Laboratories.

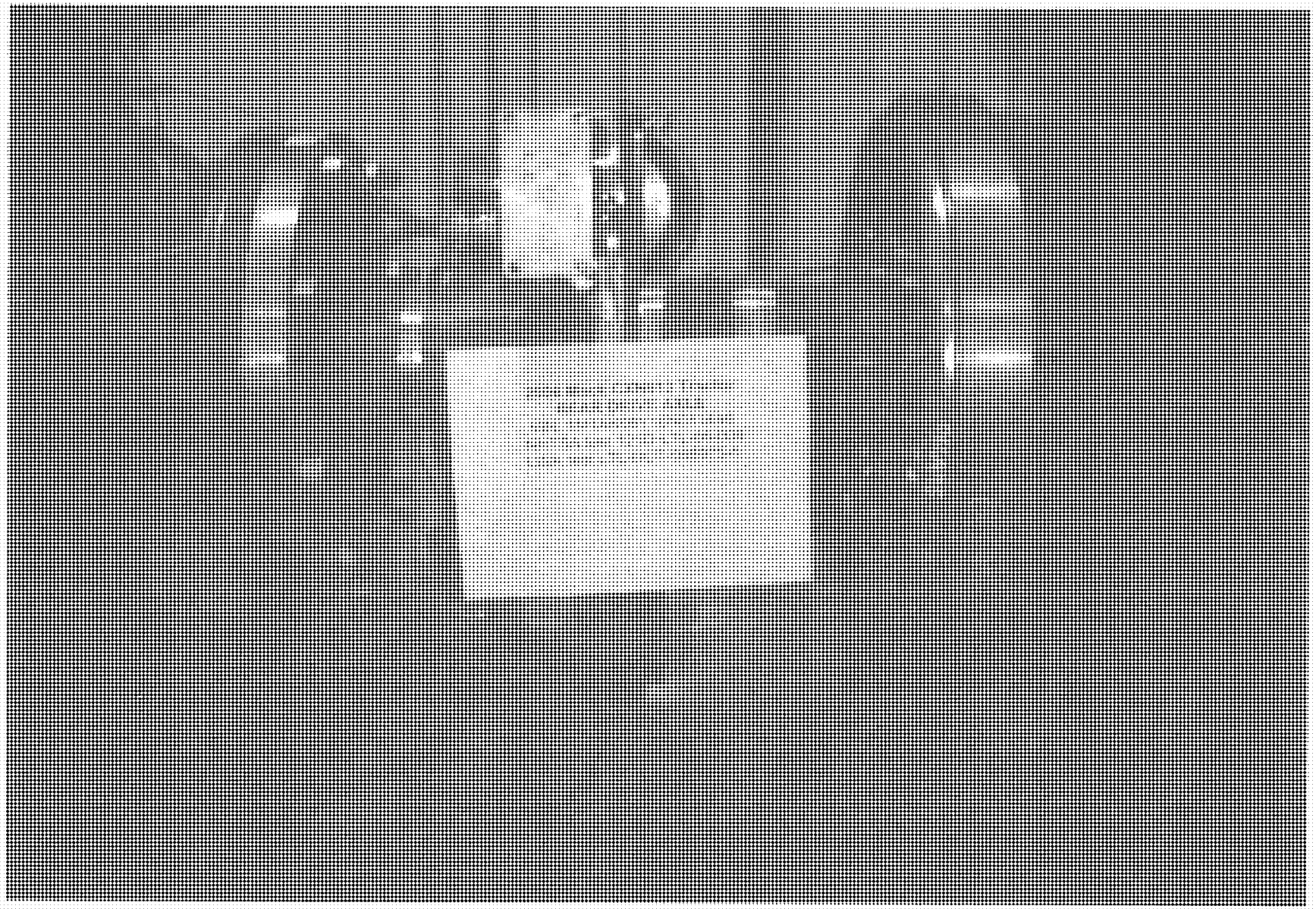
Ref #	Description	Serial Number	Range	Accuracy	Uncertainty	Last Cal	Cal Due
REF 11	AIR VELOCITY	40-96-05425	40-7800 FPM	+/- .25%FSR	% FSR +/- .25	6/30/2005	12 MO.

SECTION V

DYNAMOMETER
BRAKE ASSEMBLY
SET UP
PHOTOGRAPHS

Thermocouple Installation

Dynamometer Setup



Dynamometer Setup