

MONROE

BRAKES

QUALITY FRICTION PRODUCTS FROM A NAME YOU TRUST



A PROFESSIONAL TECHNICIAN'S GUIDE TO BRAKE SERVICE

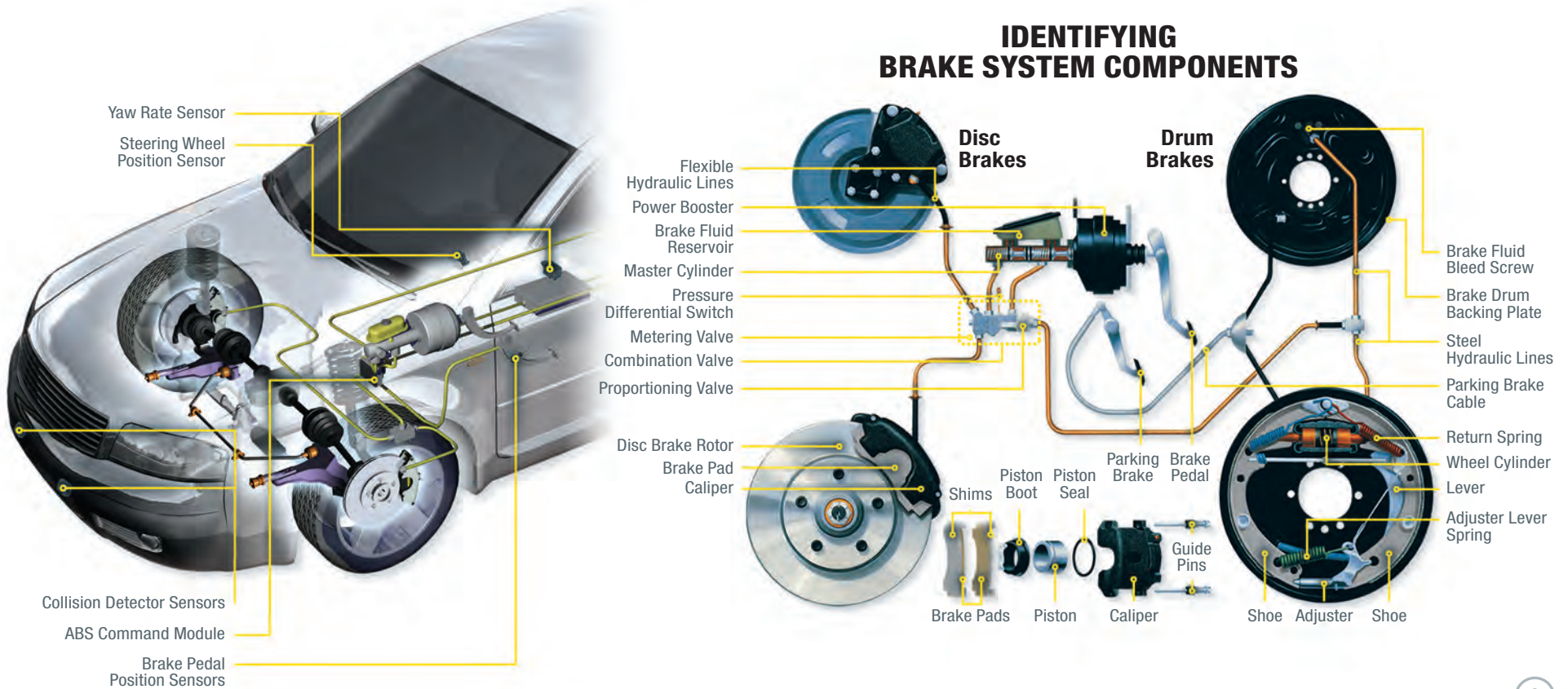
- How is the Brake System Evolving?
- Performing a Proper Diagnosis
- Latest Repair Techniques and Installation Recommendations



Quality Friction Products from a Name You Trust	Brake System Overview	Understanding the Safety Triangle™	Professional Technician's Recommended Checklist	Inspection of Brake Pads Conditions That May Cause Noise	Inspection of Brake Pads Overheating Conditions	Inspection of Brake Dust	Inspection of Brake Pads Normal vs. Excessive Pad Wear Comparisons
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BRAKE SYSTEM OVERVIEW

A TECHNICIAN'S GUIDE TO ASSIST WITH DIAGNOSIS AND INSPECTION



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UNDERSTANDING THE SAFETY TRIANGLE™

INTERCONNECTED UNDERCAR PARTS THAT AFFECT A DRIVER'S ABILITY TO AVOID ACCIDENTS



WHAT IS THE SAFETY TRIANGLE™ INSPECTION?

The Safety Triangle™ Inspection is a three-part process during which a professional technician (1) interviews the owner of the vehicle, (2) evaluates the brake system balance during operation, and (3) physically evaluates the brake system components.

The Safety Triangle™ Inspection checks critical interconnected system components that control steering, stopping and stability. Going beyond tires and brakes to include shocks, struts, springs, tie rod ends, ball joints and a host of other suspension and chassis parts, the Safety Triangle™ is vital to a driver's ability to avoid accidents.

Just one worn part could diminish vehicle control and compromise safety.



STEERING

Brakes work in conjunction with Anti-Lock Brake Systems providing controlled steering during hazardous stopping situations.



STOPPING

Front and rear brakes work together to help your vehicle consistently stop under various driving conditions. Modern Active Braking Systems can help you stop sooner in emergency situations.



STABILITY

Brakes in conjunction with Stability Control Systems help improve vehicle balance and handling during evasive maneuvers.

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PROFESSIONAL TECHNICIAN'S RECOMMENDED CHECKLIST

CUSTOMERS EXPECT QUIET, CLEAN, DEPENDABLE AND SAFE BRAKES



CUSTOMER INTERVIEW

- Have you experienced any noises while braking?
 - Grinding / Groan / High-pitched squeal
- Have you felt any vibrations in the steering wheel, brake pedal or vehicle body while braking?
- Does the brake pedal feel spongy, or have excessive travel?
- Does the vehicle take longer to stop, or do you have to apply higher pedal pressure than you used to?
- Do any of your rims exhibit excessive brake dust?
- Does vehicle pull to left or right while braking?



TEST DRIVE

- Evaluate the vehicle drive compared with customer's interview responses
- Check each wheel for equal braking temperature using infrared thermometer
- Check for pull, pulsation and pedal feel
- Are any advanced technology warning lights illuminated?



PHYSICAL INSPECTION

- Mechanical Components - Friction material, rotors, brake cables and installation hardware
- Hydraulic System - Master cylinder, calipers, wheel cylinders, hydraulic lines / hoses metering proportioning and pressure differential valves and brake fluid
- Electronics - Wheel speed, yaw rate / rotational rate and collision avoidance sensor(s)
Steering wheel position sensor calibration, electronic brake control module codes, ABS relays and tail light bulb / switches
Brake pedal position and wire wear sensors

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INSPECTION OF BRAKE PADS

CONDITIONS THAT MAY CAUSE NOISE

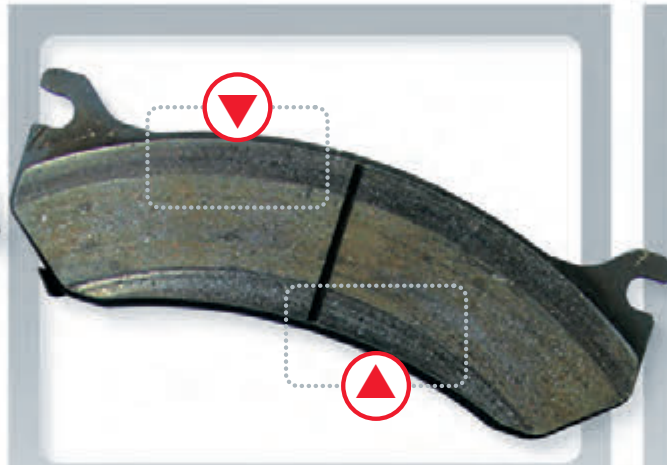


STEEL FRAGMENTS

From Turned Rotor

... that was not cleaned prior to installation.

Each rotor must be washed with clear detergent liquid cleanser, in warm water.



GROOVES ON PAD EDGES

Grooves on Pad Edge Indicate Lack of Proper Rotor Preparation

Lack of proper rotor preparation leaves hard oxidation (rust) areas that wear away the edges of the pad. The resulting grooves can lead to noise events.

Decreased pad-to-rotor surface contact area may increase stopping distance.



GROOVED PAD SURFACE

Caused by Failing to Apply a Fine, Non-Directional Finish After Turning the Rotors

Resulting grooves can lead to noise events and / or increase stopping distance

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INSPECTION OF BRAKE PADS

OVERHEATING CONDITIONS

GLAZED AND HEAT-CRACKED FRICTION MATERIAL



Excessively shiny and hard friction material surface can result in glazing and pedal feel issues, likely resulting in increased stopping distances

Causes of glazing and uneven, “wavy” rotor surface:

- Excessive brake temperatures
- “Riding” the brake pedal
- High speed stops
- Unbalanced braking effort from front-to-rear or side-to-side
- Friction material contaminated with solvents or grease
- Hydraulic binding
- Mechanically binding
- Lack of down shifting / engine braking on steep grades
- Improper friction material selection for braking conditions

OVERHEATED / DRAGGING BRAKES



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INSPECTION OF BRAKE DUST

COMMON BRAKE DUST CONDITIONS



BLACK
BRAKE PAD DUST
Excessive wear of semi-metallic pads and rotors



TAN
BRAKE PAD DUST
Excessive wear of ceramic pads



RUST
BRAKE ROTOR OR PAD DUST
Ferrous metal in brake dust from rotors and / or pads oxidizes on wheels, causing wheel finish to be rust-colored



SOLUTION 2)
DUST CAN BE REDUCED BY ENSURING THE PADS FIT PROPERLY

Visual symptoms include shiny edges, no lubricant, cracks in the pad surface from heat, and glazed friction material from brake drag

- Indicates the brake pads were forced into place, without lubricant
- Proper preparation includes cleaning rust from tab contact surface and areas underneath noise elimination clips
- Pads should slide in by hand, with slight drag
- Do not force pads into place with tools such as a hammer, or a rubber mallet

SOLUTION 1)

HEAT = WEAR = DUST

CHECK FOR EQUAL BRAKING EFFORT ON ALL FOUR CORNERS VIA INFRARED THERMOMETER

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INSPECTION OF BRAKE PADS

NORMAL vs. EXCESSIVE PAD WEAR COMPARISONS



NORMAL Pad Wear

- Even wear on both the inner and outer pad
- If both wheel sets are in this condition, then brake system is functioning normally
- Technician should continue with M.A.P. preventative maintenance schedule



NORMAL Full Life Pad Wear

- Even wear on both the inner and outer pad
- If both wheel sets are in this condition, then brake system is functioning normally and pads have run their useful life



EXCESSIVE Inner Pad Wear

Causes:

- Seized piston, pin or bushings
- Limited movement of caliper; seized or not lubricated
- Installation hardware and / or bushings not lubricated



EXCESSIVE Outer Pad Wear

Causes:

- Rust near installation hardware binds pad
- Limited movement of caliper; seized or not lubricated
- Installation hardware and / or bushings not lubricated



EXCESSIVE Tapered Pad Wear

Causes:

- Binding of caliper usually from contamination or lack of lubrication on caliper slides / pins

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INSPECTION OF BRAKE PADS

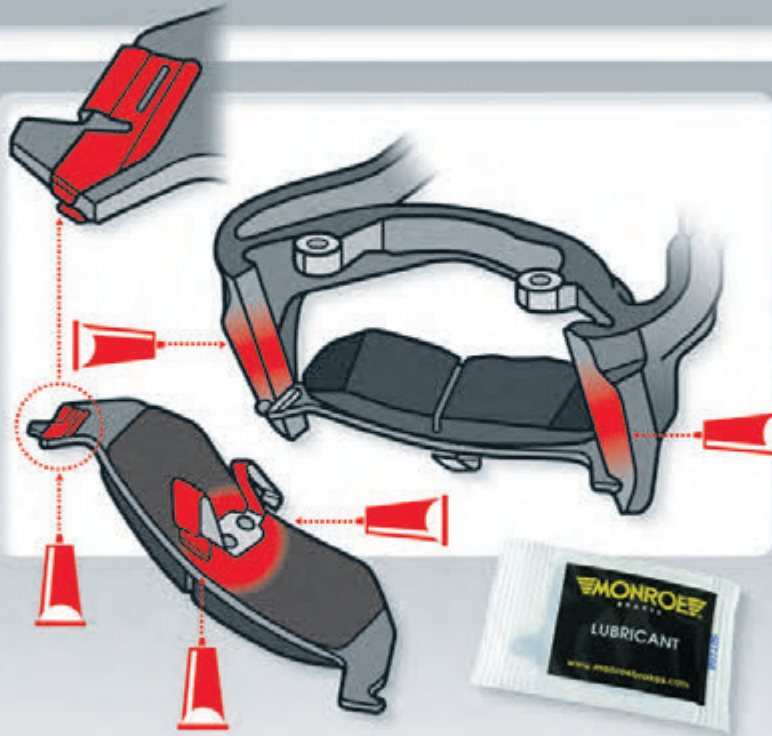
LACK OF PROPER LUBRICATION - MAIN CAUSE OF BRAKE NOISE



LACK OF LUBRICANT

Backing Plate / Shim Shows Circular Wear from Piston Contact

Lubricate all pad-to-caliper contact areas, including: Backing plate / shim, piston, tabs, spring clips and abutment area.



WHERE TO APPLY LUBRICANT

To avoid rotor contamination, do not apply an excessive amount of lubricant.

Apply an even amount of lubricant to areas of the backing plate that will touch metal - including the shim and both sides of installation hardware.

Clean and lubricate slide pins on pin-type floating calipers.



OVER-LUBRICATED / CONTAMINATION

Pad Surface Looks Greasy or Shiny

Caused by friction material contaminated with grease.

To resolve, use warm water and clear detergent to clean friction material. Make sure to handle new pads only with clean material during installation.

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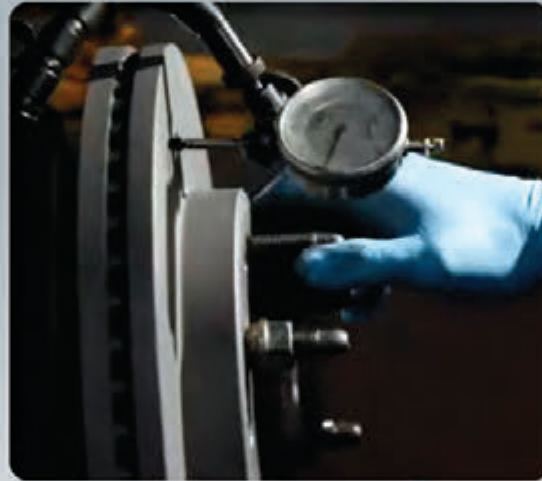
INSPECTION OF ROTOR AND HYDRAULIC SYSTEM

PEDAL FEEL CONCERNS: PULSATION, SPONGY, LOW / HIGH AND HARD PEDAL



ROTOR THICKNESS VARIATION

- Thickness variation is also called “parallelism”
- Both sides of the rotor must be parallel to prevent pedal pulsations
- Use a caliper to measure rotor thickness in four to twelve locations around the rotor’s circumference
- Usually indicates scalloping of the rotor



CHECK FOR ROTOR RUN-OUT

- Make sure hub surface is clean before mounting the rotor
- Solution:**
- Apply vehicle manufacturer’s torque specs to lug nuts following recommended star pattern
 - Use a dial indicator to measure rotor run-out
 - Resolve excessive run-out by indexing rotor (Rotate 180° and re-check)



CHECK HYDRAULIC SYSTEM

Hydraulic issues can lead to uneven brake pad wear, pedal feel, noise and dust issues

- Inspect:**
- For leaks
 - For torn dust boots
 - Condition of rubber hoses
 - Condition of steel brake lines
 - For binding calipers and wheel cylinders (Open bleeder to determine if binding is due to internal hose damage)

Bleed air from hydraulic system

- Electronic bleeding is recommended on most modern systems
- High points may require bleeding through line connections to completely eliminate air from the system

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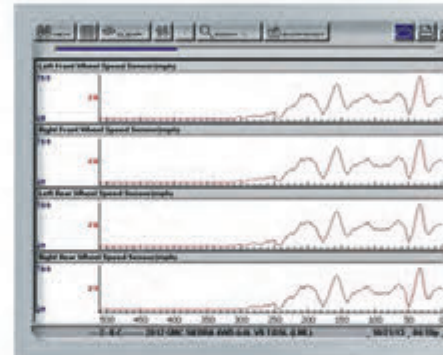
INSPECTION OF BRAKE SYSTEM ELECTRONICS

ADVANCED ELECTRONICS

WHAT TO INSPECT?

Advanced electronics including active braking / collision avoidance are becoming more integrated into the operation of the brake system, making it critical to inspect and repair any electrical issues.

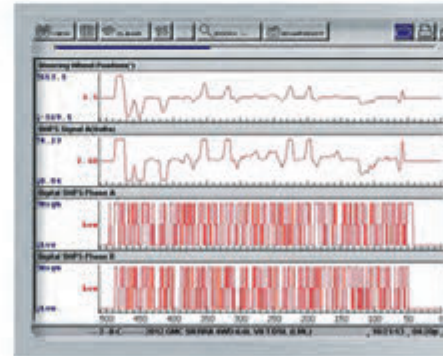
- Inspect brake / tail light operation
- Inspect brake switch, parking brake switch, low fluid level warning switch and pressure differential switch
- Replace worn wire wear sensors
- Graph operation of: wheel speed sensor, brake pedal position sensor, yaw rate sensor, collision detection sensor(s)
- To resolve brake system diagnostic trouble codes:
 - 1) Inspect ABS fuses and relays
 - 2) Perform voltage drop tests on grounds and power
 - 3) Follow recommended diagnostic flow chart procedure
- Ensure steering angle position sensor is calibrated



GRAPHING OF WHEEL SPEED SENSOR

The Wheel Speed Sensor readings should be almost identical to each other with no “drop-outs.”

- Look for Wheel Speed Sensors that lose their signal at a relatively higher speed than the others when coming to a complete stop.



CALIBRATION OF STEERING WHEEL POSITION SENSOR

Steering Wheel Position Sensors often need to be recalibrated after steering components have been replaced or alignment work has been performed.

- If the Steering Wheel Position Sensor is out of calibration it can affect the stability control operation.



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BRAKE PADS INSTALLATION QUICK TIPS

HELP DELIVER THE BEST RESULTS AND MINIMIZE COMEBACKS



1
Rotors should be replaced or resurfaced with a fine, nondirectional finish.

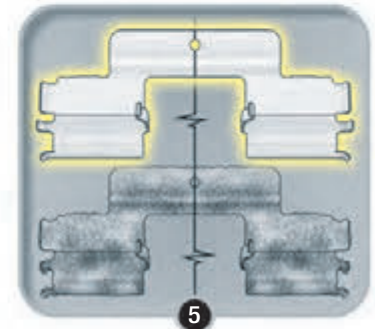
2
Wash rotor with clear detergent liquid cleanser and warm water.



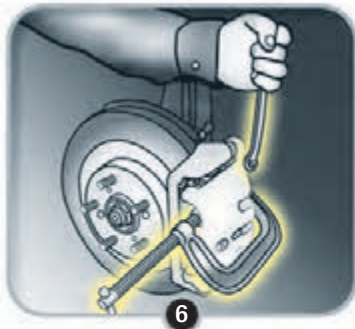
3
Do not touch or contaminate friction material.



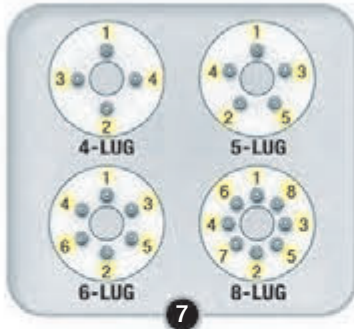
4
Lubricate sliding surfaces, back of pad and both sides of clips.



5
Inspect all components. Replace worn hardware, including pad installation clips.



6
Open bleeder and then compress piston. Do not hammer to set pads in place.



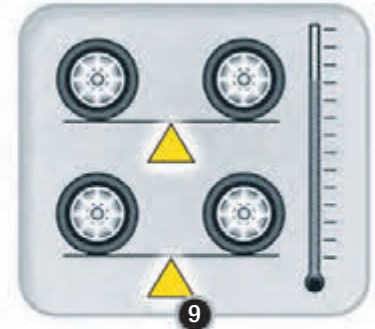
7
Torque lug nuts to manufacturer specifications using star pattern.



8
High-speed break-in is NOT recommended! 20 - 30 stops, 20 - 30 mph (32 - 48 kph) leaving 30 seconds between stops.



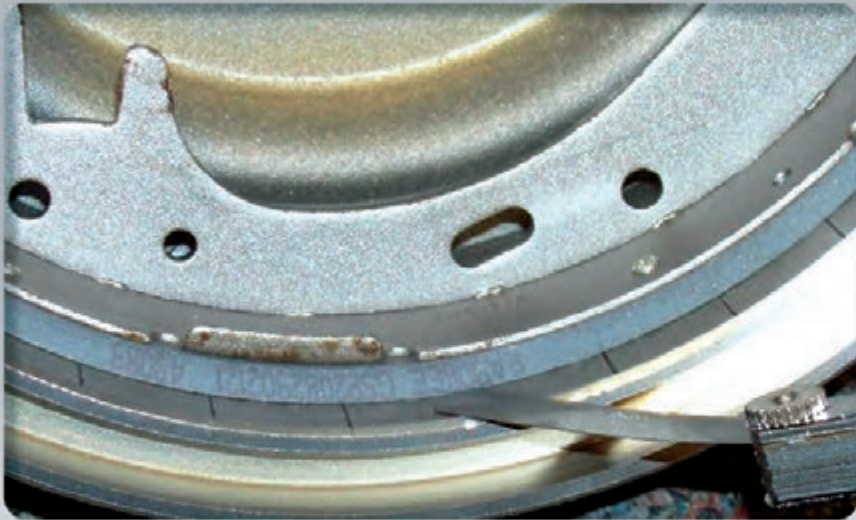
9
Check temperature of all four brakes to ensure balanced braking effort.



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COMMON BRAKE SHOE NOISE CONDITIONS

VISIBLE SIGNS OF INSTALLATION ISSUES



NO GAP • NO NOISE Normal Operation

Inspect the drum-to-shoe contact area prior to installation. The arc of the brake shoe should match the arc of the drum surface. A slight clearance at the leading and trailing edges of the friction material is acceptable, but the center contact should be snug.



CENTER GAP • NOISE ISSUES Drum Brake Groan

When the leading edge of the friction material contacts the drum surface before the full friction contacts the drum, noise issues occur. Drum brake groan is a loud, low moan produced at low vehicle speed, with moderate brake pressure.

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BRAKE SHOES INSTALLATION QUICK TIPS

HELP DELIVER THE BEST RESULTS AND MINIMIZE COMEBACKS



1

Inspect the drum for out-of-round and “bell-mouth” conditions. Drum may be replaced or remove lip wear by refinishing.



2

Wash rotor with non-detergent (clear) liquid cleanser and warm water.



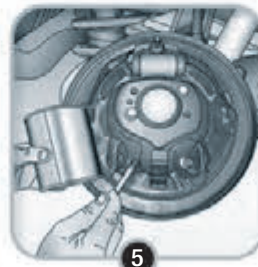
3

Do not touch or contaminate friction material.



4

Press pivot pins in with vise. Do NOT use hammer to install pins!



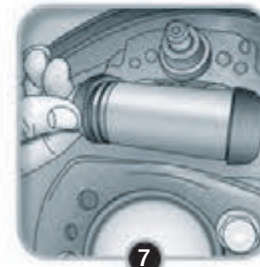
5

Clean, inspect and lubricate backing plate.



6

Inspect and clean or replace hardware, springs and adjuster.



7

Inspect for frozen or leaking wheel cylinders. Inspect for leaking axle seals.



8

Adjust shoes to drum.



8



9

Inspect parking brake operation.



10

Torque lug nuts using star pattern.



11

High-speed break-in is NOT required or recommended! Follow manufacturer's recommendation.



12

Check temperature of all four brakes to ensure balanced braking effort.



12

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A COMPLETE LINE OF STOPPING SOLUTIONS

QUALITY BRAKES FROM A NAME YOU TRUST



**CERAMIC
AND SEMI-METALLIC
FRICTION FORMULATIONS**

**ENGINEERED FOR
HARD-WORKING TRUCKS,
EMERGENCY, SEVERE USE
AND FLEET VEHICLES**

**PERFORMANCE-VERIFIED
FRICTION FORMULATIONS**

**BRAKE SHOES
ENGINEERED TO MATCH
OE SPECIFICATIONS**

ULTRA - PREMIUM

PREMIUM

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THE RIGHT PRODUCT SUPPORT

IN-DEPTH EDUCATIONAL PROGRAMS HELP SERVICE PROVIDERS RESOLVE FRICTION PROBLEMS



Training DVDs



Tech Talk / Website Support



E-Catalog



Master Catalog

TRAINING CLINICS

- Monroe Brakes provides ongoing professional training for technicians nationwide, helping service providers educate consumers about friction products.

TECHNICAL SUPPORT MATERIAL

- Informative reference material identifying symptoms of brakes failure and corrective diagnostics.

INFORMATIVE PRODUCT CATALOGS

- Maximize sales with accurate, industry-leading publications and convenient e-catalog.

FIND ANSWERS TO THE MOST FREQUENTLY ASKED PRODUCT AND INSTALLATION QUESTIONS

Monroe Brakes® Technical Support provides invaluable brake pad technical training information, as well as drum and disc brakes training information.

If you are looking for answers to technical questions, the Monroe Brakes® Customer Service Department is just a phone call away.



Learn more about your coverage solution for today's vehicles

Monroe Brakes' ASE-certified Technical Support Team will help you with answers to the most frequently-asked application, installation and friction questions.

For more information visit: www.monroebrakes.com



For technical assistance (for trade use only):

1 (800) 201-6506 M - F, 8:30 am - 5:30 pm EST

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