

ACADEMY / STUDY BOOK

Brake Inspection & Measurement

Document a repeatable brake inspection, relate measurements to service limits, and explain findings without guessing at cause.



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<https://mechanicroster.com/index.php/academy/brake-inspection-measurement>

How to use this book

Read the lessons, work each example, then complete the practice questions before checking the answer explanations. Write your evidence and next step in the exercises. Training examples are not vehicle service specifications.

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Before you begin

Basic brake-system identification; hands-on work must follow vehicle procedures with appropriate supervision.

Learning objectives

- Separate a reported symptom from a confirmed finding.
- Compare friction and hydraulic observations across an axle.
- Interpret thickness, variation and runout as different measurements.
- Document a defensible service decision and verify the repair.

Course contents

Establish the concern and a safe inspection

Inspect the complete wheel-end and hydraulic system

Measure thickness, variation and runout

Recommend, authorize and verify

Worked shop cases / Practical worksheet / Practice assessment / Answer explanations / Further study

Establish the concern and a safe inspection

A brake inspection begins with the driver's complaint, not a parts order. Ask whether the concern is noise, vibration, pull, pedal travel, effort or a warning indicator. Record speed, temperature, road conditions, when it began, and recent service. A vibration during braking is different evidence from one present at constant road speed; neither description alone proves a failed rotor.

Review vehicle identification and brake-system type. Electronic parking brakes, electro-hydraulic systems and regenerative braking may require special service modes and precautions. Do not assume that switching the ignition off prevents every actuator from operating. Obtain the relevant procedure before touching the system.

Assess safety before any road test. Fluid loss, uncertain pedal response or another serious defect calls for controlled inspection and escalation, not an attempt to reproduce the concern in traffic. Follow approved support points and shop lifting procedures. Control brake dust with an approved method; do not blow exposed dust into the work area. Keep oil, grease and inappropriate cleaners off friction surfaces.

Intake example

"Shakes" is incomplete. "Steering wheel oscillates during moderate braking from approximately 45 mph after ten minutes of driving; no vibration reported at steady speed" provides conditions for a test plan. It is still a complaint statement, not a rotor diagnosis.

Record what you can safely verify and what remains unverified. The customer's expectation, the diagnostic scope and authorization belong on the repair order before the inspection expands into repair.

Understand the system before naming a fault

The service brake converts vehicle motion into heat at the friction surfaces. The pedal input is assisted and transmitted through a hydraulic or electronically controlled system to apply the wheel brakes. A disc brake clamps pads against a rotor; a drum brake presses shoes against a drum. The parking brake may share components, but its controls and service procedure are not necessarily the same as the service brake. Identify which function the complaint concerns.

Keep three symptom categories separate. A vibration is a repeated movement felt in the pedal, steering wheel or body. Noise is a sound whose timing and conditions must be described. A pedal concern relates to travel, firmness, effort or a change while pressure is held. Different causes can produce similar symptoms, so these categories organize inspection rather than identify parts. A warning indicator adds another source of information; retrieve and interpret relevant system information instead of assuming every illuminated lamp means friction wear.

Build an inspection plan

Write the question the next check should answer. For a braking-only vibration, ask what measurements and mounting conditions could explain a repeating brake-force change. For visible fluid loss, first address the hydraulic safety concern. Choose an inspection that can discriminate causes, list the required equipment and information, and establish what would make you stop. A useful plan ends in a decision, not simply "check brakes."

Build a testable complaint, not a parts order

Consider an intake that says only “brakes shake.” That statement does not identify whether the concern is pedal pulsation, steering-wheel movement, a body vibration or a noise. Ask when it begins, the approximate speed, whether braking is light or firm, whether the vehicle is hot or cold, and whether the symptom appears without braking. Record the customer's words separately from the technician's observation. A symptom reproduced during braking narrows the investigation; it does not prove that a rotor needs replacement.

Before planning a road check, review the stationary safety findings and the applicable shop procedure. An active hydraulic leak, unsafe pedal condition or other unresolved safety concern changes the plan. Document why a test cannot proceed and obtain qualified direction. During the inspection, preserve wheel position and inner/outer pad identity. Without those labels, a pile of measurements cannot show which assembly requires attention.

From complaint to defensible recommendation

- Describe Condition, location, speed and temperature
- Inspect Record position-specific observations
- Measure Use the specified method and limits
- Decide Explain evidence, uncertainty and next action

Try it before reading the answer

Rewrite “needs rotors” into a useful initial work order when the customer reports steering-wheel shake only during moderate braking from highway speed. What remains unknown?

Worked answer and reasoning

Record the reported condition, check whether it is reproducible when safe, inspect the braking and related wheel-end systems, and measure as directed by the vehicle information. Rotor condition, mounting effects, tire/wheel issues and other causes are not established by the intake statement. Do not authorize a particular component from the symptom alone.

Inspect the complete wheel-end and hydraulic system

Compare inner and outer pads and both sides of an axle. Record the thinnest measured friction material, not just the easiest pad to see through the wheel. Inspect rotors or drums for damage, contamination and abnormal contact. Uneven wear is a clue to investigate caliper movement, hardware, piston operation and other relevant causes; it does not identify one failed component by itself.

Inspect flexible hoses, rigid lines, fittings and accessible hydraulic components for wetness, corrosion, cracking, interference or damage. Note exact location. A low reservoir needs investigation in the context of wear and leaks; topping it up alone does not explain the cause. Use the specified fluid and sealed supplies. Never identify compatibility by color alone.

Check wheel-end play and mounting condition when relevant to vibration or runout. A rotor measurement can be affected by debris on a hub or bearing condition. Drum systems require inspection of shoes, springs, adjusters, wheel cylinders and parking-brake components under the correct procedure. Treat brake dust as a controlled exposure.

Compare evidence

Left pads measure 3 mm inner and 7 mm outer; right pads measure 6 mm and 6 mm. This is an uneven pattern requiring investigation. “Replace left caliper” is not yet supported. Document all four positions, inspect movement and hardware, and follow the procedure to distinguish mechanical binding from hydraulic issues.

A final inspection must state its limits. If a wheel was not removed or a shield prevented inspection, mark the area not inspected rather than normal.

Map observations to positions

Use one row for each wheel and identify inner and outer friction surfaces. State whether the reading includes friction material only. Record the observation before rounding it into a status such as “due.” An axle average hides uneven wear: an inner pad at 2 mm and outer pad at 8 mm do not become two 5 mm pads. Position labels allow another technician to recheck the actual concern.

On a floating-caliper design, the caliper must move as intended for both pads to apply and release. Uneven wear can justify examining movement, hardware and related hydraulic conditions, but the wear pattern alone does not distinguish all possible faults. On other caliper designs, the moving parts and test procedure differ. Identify the architecture before applying a memorized explanation. A pad contaminated by fluid also requires identifying the source rather than treating cleaning as proof of a complete repair.

Use a useful defect description

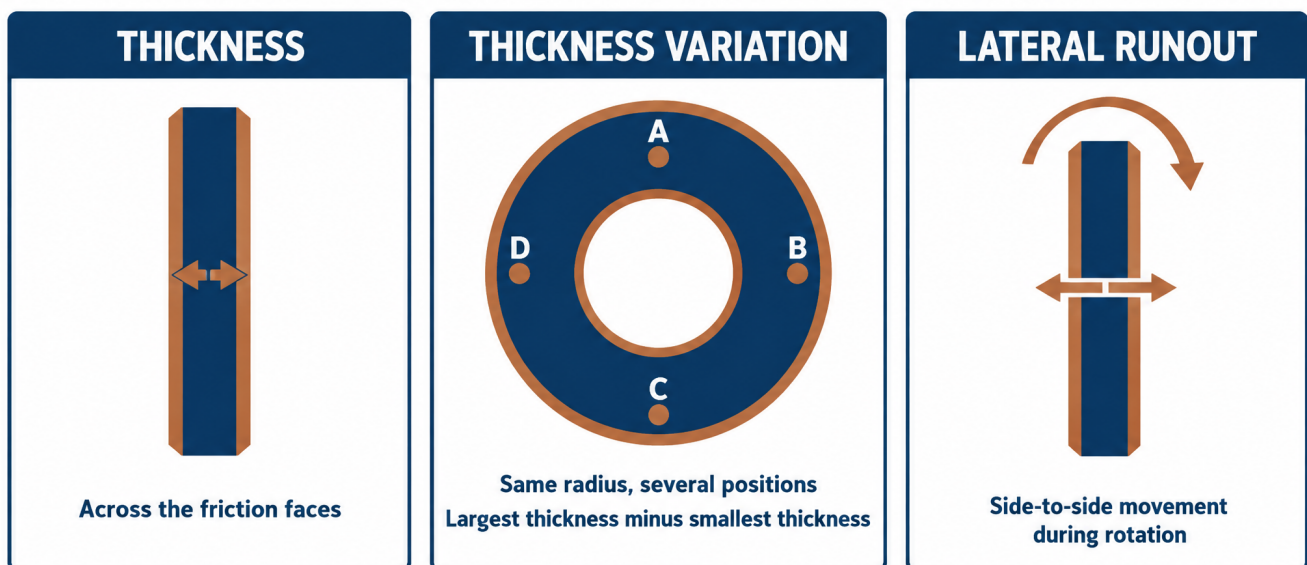
“Left-front flexible hose: wetness observed near the crimp after the authorized inspection; source requires confirmation” identifies a location and evidence. “Bad hose” does not. Distinguish old residue from active leakage using the applicable inspection method. Record conditions you cannot see. If an inaccessible line was not inspected, a green box would falsely communicate a completed check. The inspection record should show both its findings and its coverage limits.

Read a wheel-end record as a system

A complete brake finding relates friction material to hardware and hydraulic operation. In this fictional record, the left-front inner pad is much thinner than the outer pad. That imbalance is a reason to examine the permitted movement, contact surfaces, hardware and hydraulic behavior using the vehicle procedure. It is not a unique diagnosis of a seized slide or caliper. The opposite wheel provides context but cannot replace the specification for the affected wheel.

Separate observations that can be seen from conditions that require another test. "Inner pad 2.0 mm" is a measurement. "Caliper seized" is a diagnosis requiring evidence. "Replace pads and inspect cause of unequal wear" is a proposed scope that must be explained and authorized. Include the actual method, service reference and any item that could not be inspected; a complete-looking checklist with unchecked assumptions is less useful than an honest incomplete record.

THREE DIFFERENT ROTOR CHECKS



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Use the vehicle procedure and limits. Illustration not to scale.

One rotor, three different questions The labeled locations illustrate a thickness survey. Thickness variation and lateral runout require different measurement methods; this concept drawing is not an equipment setup instruction. Concept illustration; use the vehicle-specific procedure for service.

Fictional pad record-not service limits

Position	Inner	Outer
Left front	2.0 mm	6.0 mm
Right front	5.5 mm	5.8 mm

Try it before reading the answer

What conclusion is supported by the pad record, and what should the recommendation avoid?

Worked answer and reasoning

The left-front pads show unequal recorded wear and need investigation against the applicable limits and inspection procedure. The table alone does not prove which component caused it. Avoid promising that replacing pads alone will correct the cause or every reported symptom.

Measure thickness, variation and runout

Rotor thickness is the distance between its friction faces. Thickness variation is the difference between maximum and minimum thickness around specified locations. Lateral runout is side-to-side movement of the installed friction face during rotation. These are separate quantities with different tools, setup and limits. A dial indicator does not replace a thickness micrometer, and a single thickness reading cannot establish variation.

Clean the relevant measuring and mounting surfaces, verify tool zero and resolution, and follow the specified measurement radius and sampling pattern. Avoid a wear lip when the method requires measuring the swept area. Secure the rotor as instructed before runout measurement; record bearing and hub concerns rather than treating every oscillation as rotor-only failure.

Fictional rotor exercise - use actual OEM data on a vehicle

Location	Thickness
A	25.12 mm
B	25.09 mm
C	25.11 mm
D	25.10 mm

Minimum measured = 25.09 mm; maximum = 25.12 mm; variation = 0.03 mm. If the supplied discard limit is 25.00 mm, the readings are above that thickness limit. If the supplied variation limit is 0.02 mm, variation fails. Passing one test does not make the rotor serviceable. A proposed machining operation also needs its own allowed final thickness and other applicable limits.

For drums, compare measured internal diameter and condition with the specified maximum and service instructions. Do not reverse the logic: a rotor has a minimum thickness, while a drum may have a maximum diameter. Include units and specification source in every decision.

Read a measurement as a complete statement

A number needs a quantity, unit, location, method and comparison limit. "25.09" alone cannot establish serviceability. "Left-front rotor minimum measured thickness 25.09 mm at the specified swept locations; applicable minimum 25.00 mm" can be interpreted. Record the source separately so a later reviewer can confirm it applies to the rotor and vehicle. Tool resolution must be fine enough for the criterion being evaluated; a coarse ruler cannot decide a hundredth-of-a-millimeter difference.

Calculate variation from the maximum and minimum of all required readings, not just the first two. For values 25.12, 25.09, 25.11 and 25.10 mm, subtract 25.09 from 25.12. The result is 0.03 mm. The average, 25.105 mm, answers a different question and cannot conceal the lowest reading or the spread. Keep adequate precision through the calculation before reporting to the required precision.

For a dial-indicator exercise, suppose the highest indication is +0.03 mm and the lowest is -0.02 mm. The total indicated movement is 0.05 mm, not 0.01 mm. The sign describes the pointer's direction relative

to its zero; the full excursion is the difference between extremes. This does not supply a universal runout limit. Recheck mounting, bearing condition, tool stability and the applicable procedure before assigning that movement to a particular component.

Work thickness, variation and runout separately

A minimum-thickness comparison uses the lowest valid reading, not the mean. A thickness-variation calculation uses the greatest reading minus the least reading at the specified measuring radius. A runout calculation uses the full indicator excursion while the mounted assembly rotates under the prescribed setup. All three quantities may be expressed in millimeters, but they answer different questions. Writing one number under the wrong label can reverse a repair decision.

Use the fictional limits below only for this exercise. The four thickness readings produce a minimum of 25.10 mm and a variation of 0.04 mm. Thus the minimum-thickness comparison passes its stated 25.00 mm floor, while variation fails its 0.03 mm maximum. An assembly can pass one comparison and fail another. Do not average away the failure. If an indicator moves from -0.02 to +0.04 mm, total travel is 0.06 mm, not 0.02 mm.

Training rotor worksheet-fictional values

Item	Reading or supplied limit	Interpretation
A / B / C / D	25.14 / 25.12 / 25.10 / 25.13 mm	Lowest = 25.10 mm
Minimum allowed	25.00 mm	Thickness passes
Maximum variation	0.03 mm	Observed 0.04 mm fails
Indicator extremes	-0.02 to +0.04 mm	Total travel = 0.06 mm

Try it before reading the answer

A second rotor reads 24.98, 25.00, 25.01 and 24.99 mm using the same fictional minimum. Calculate minimum and variation. Would an average of 24.995 mm be an acceptable substitute?

Worked answer and reasoning

Minimum is 24.98 mm and variation is 0.03 mm. The minimum is below 25.00 mm even though variation meets its stated inclusive maximum. The average is not the required comparison. Record each measurement and follow the applicable repair procedure; this worksheet does not determine whether machining or replacement is permitted.

Recommend, authorize and verify

Convert findings into a clear recommendation by separating observed condition, measured value, applicable limit, interpretation and proposed work. Explain what is established and what needs further testing. Pair or axle service decisions must follow the vehicle and component requirements, not an unsupported blanket rule. Obtain authorization for the actual scope, parts and price.

Use the correct service mode, hardware, fastener procedure, fluid and cleanliness controls. Hydraulic work may require a specific bleed sequence or scan-tool routine. Do not substitute a universal sequence for the vehicle instructions. A warning lamp reset does not prove that a hydraulic or mechanical problem was repaired.

Before movement, perform the required static checks for pedal response, fluid level, leaks, assembly security and warning status. Confirm any electronic parking-brake or other initialization requirement. A soft or otherwise abnormal pedal is a reason to stop and investigate, not to hope a road test will correct it. Only conduct an appropriate controlled road check after the vehicle is safe to move.

Close the record

“Rotor variation measured 0.03 mm; exercise limit 0.02 mm. Authorized correction completed, final readings recorded, pedal and leak checks completed, original symptom no longer observed under the documented safe test conditions.” This is stronger than “brakes good.” If the symptom persists, say so and define the next diagnostic step.

Give the customer applicable bedding or break-in instructions from the component manufacturer, warranty terms and follow-up guidance. Keep all measurements, approvals and verification results traceable to the job.

Write a repair recommendation someone can approve

Use five connected statements: the finding, the reference, its interpretation, the proposed scope and the verification plan. If a measurement fails, say which criterion failed. If the cause remains unknown, offer the diagnostic step rather than a guaranteed component replacement. Explain associated work, hardware and applicable axle requirements in the estimate. Do not present a partly diagnosed fault as a fixed-price promise to eliminate every symptom.

The finished record should preserve before-and-after evidence. A replacement invoice proves that a part was billed, not that the initial complaint was resolved. A pedal check, leak check, assembly inspection, applicable electronic procedure and safe functional verification answer different questions. Record who performed each required check and any limitations. If verification reveals a new concern, reopen the diagnostic process and obtain the necessary decision before adding work.

Common reporting error

“New brakes; no warranty on noise” does not explain whether a noise was checked. A stronger note states the reported conditions, observations during verification, completed work and any remaining concern. Customer instructions should be the relevant manufacturer guidance, not an invented number of emergency stops or a universal bedding routine. The learner's role is to explain evidence and follow the applicable process, not to invent service procedures from this course.

Close the loop with a before-and-after record

An effective completion record links the original concern, authorized work, corrected findings and final verification. Preserve the initial measurements; do not replace them with the final values. Identify any required assembly, fluid, initialization or bedding procedure from the actual product and vehicle information. There is no universal bedding sequence or torque value in this course.

For a fictional job, the original pulsation is not present during the permitted post-repair check, but a separate low-speed noise remains. The correct record is not “all brake concerns fixed.” State which condition was checked, under what conditions, what improved and what remains unresolved. If the original operating conditions could not safely be reproduced, say so. That limitation informs the next decision and prevents an invoice from becoming a guarantee unsupported by testing.

Delivery evidence

- Approved scope Match the work to the customer's decision
- Final checks Record the required checks and measurements
- Concern check Compare like operating conditions
- Handoff Explain completed work and open concerns

Try it before reading the answer

Write a two-sentence delivery note for the pulsation/noise case without overstating success.

Worked answer and reasoning

“The authorized work and required checks were completed; the reported pulsation was not reproduced during the documented post-repair check. A separate low-speed noise remains and requires the next agreed diagnostic step.” Add the actual conditions, readings, source and authorization details to the repair record.

Work the shop cases

A passing thickness reading is not a passing rotor

A fictional inspection supplies these values: minimum allowed thickness 24.00 mm; maximum allowed variation 0.02 mm; maximum allowed installed runout 0.05 mm. Measurements at the required locations are 24.18, 24.15, 24.17 and 24.16 mm. Installed runout is 0.04 mm. Both inner and outer pads were measured and no hydraulic leak was found in the inspected areas.

Write three separate measurement decisions. Explain why the phrase “rotor passes because it is above minimum” is incomplete. Identify the additional information needed before promising that machining is appropriate. Then write a two-sentence recommendation that keeps the diagnosis separate from a service quotation.

Your evidence, decision and next step:

Compare with the model answer

Minimum thickness is 24.15 mm, above the supplied 24.00 mm limit. Variation is $24.18 - 24.15 = 0.03$ mm, above the supplied 0.02 mm maximum. Runout of 0.04 mm is below the supplied 0.05 mm maximum. The variation criterion fails even though the other two comparisons pass.

Before offering machining, obtain the applicable procedure, permitted final thickness, condition criteria and amount of material that would need removal. The discard limit is not automatically a machining target. A defensible recommendation is: “The measured thickness variation exceeds the supplied limit; minimum thickness and installed runout are within their supplied limits. We recommend the appropriate authorized correction after confirming the permitted service method and final dimensions.” It does not claim that one measurement explains every possible complaint.

Uneven wear and an incomplete explanation

A customer authorizes a brake inspection for a scraping noise. Left-front pad readings are 2 mm inner and 7 mm outer; right-front readings are 6 mm and 6 mm. The technician writes “caliper seized, replace it” without documenting movement checks. The advisor promises the customer this will eliminate all noises. No rotor measurements or final scope approval are recorded.

Identify what is established, what is only a hypothesis, which documentation is missing, and how you would correct the customer update. Draft the next authorized step without promising a specific part or unsafe road test.

Your evidence, decision and next step:

Compare with the model answer

The position-specific readings establish uneven left-front friction wear. They do not uniquely establish the failed component or prove the cause of every sound. The next step is the applicable inspection of caliper operation, hardware and related conditions, plus the remaining required wheel-end measurements. Preserve the original readings and identify the inspection boundaries.

Explain that the initial component statement was premature: “We found uneven wear at the left front. We are checking the mechanism and related conditions before finalizing the repair recommendation.” Obtain approval for any additional diagnostic scope and then for the actual repair. Verification must return to the original complaint conditions when safe, with static checks completed first. Do not mark the vehicle complete solely because new parts have been installed.

Apply it to a job

From the rotor table, calculate minimum thickness and variation. Write separate pass/fail statements using the supplied limits. Create an axle worksheet with inner/outer pad readings, rotor measurements, hose condition, limits and source. Write a recommendation that does not claim an unproven cause. Complete a static-verification checklist before describing a safe road-check plan.

Concern / scenario

Observation, measurement and reference

Interpretation and next action

Unknowns and who needs to review

Verification and handoff

Check your understanding

- Explain thickness, variation and runout without using them interchangeably.
- Calculate a signed dial-indicator excursion and a thickness spread correctly.
- Write position-specific friction and hydraulic findings.
- State what evidence would justify the next diagnostic or repair decision.
- Create a verification record that distinguishes completed checks from unverified conditions.

Practice assessment

Ungraded practice, separate from the final assessment. Answers and reasoning follow in the next section.

1. A vehicle has a fluid leak and uncertain pedal response. Should a learner road-test it to confirm a pull?

- A. No; control the hazard and inspect under the approved procedure.
- B. Yes at low speed.
- C. Yes if the customer is present.
- D. Only after topping up fluid.

2. One outer pad looks thick through the wheel. What remains unknown?

- A. The specified minimum thickness of that visible pad only.
- B. The condition of the other friction surfaces and complete system.
- C. The remaining pad life, which must match the visible pad.
- D. The axle condition, which can be inferred from that one pad.

3. Measurements are 24.44, 24.47 and 24.45 mm. What is thickness variation?

- A. 24.44 mm
- B. 0.01 mm
- C. 0.03 mm
- D. 73.36 mm

4. After repair the pedal remains abnormal. What is appropriate?

- A. Use the road test to seat the pedal.
- B. Clear the warning lamp only.
- C. Return the car with a verbal caution.
- D. Stop and investigate before vehicle movement.

5. A training rotor reads 24.98, 25.00, 25.01 and 24.99 mm. Which pair is minimum / variation?

- A. 24.98 mm / 0.03 mm
- B. 24.995 mm / 0.03 mm
- C. 25.01 mm / 0.02 mm
- D. 24.98 mm / 0.01 mm

6. Which note clearly separates measurement from diagnosis?

- A. LF caliper failed because the pads differ
- B. LF inner pad 2 mm, outer 6 mm; cause under investigation
- C. LF pads average 4 mm; no further checks needed
- D. LF hose failed because one pad is thin

7. Before a road check, an active hydraulic leak is found. What should control the plan?

- A. Reproduce the complaint first to preserve the customer's conditions
- B. Use a shorter test route as the only change
- C. Resolve the safety concern through the applicable procedure before road testing
- D. Ask the customer to select a lower test speed

8. Final measurements were taken under different conditions from the baseline. What should the record do?

- A. Present the lower values as proof of improvement
- B. Average before and after results
- C. Discard the baseline to simplify the report
- D. Identify the difference and avoid an unsupported direct comparison

Answer explanations

1. No; control the hazard and inspect under the approved procedure.

None of the alternatives resolves the leak or uncertain braking. Test planning starts with a safe vehicle.

Review: Establish the concern and a safe inspection

2. The condition of the other friction surfaces and complete system.

One visible pad does not represent inner pads, the other wheel or hydraulic and wheel-end conditions.

Review: Inspect the complete wheel-end and hydraulic system

3. 0.03 mm

Variation is maximum minus minimum: $24.47 - 24.44$. Minimum, adjacent difference and sum answer different questions.

Review: Measure thickness, variation and runout

4. Stop and investigate before vehicle movement.

A warning reset or caution does not establish braking function. Static safety checks precede movement.

Review: Recommend, authorize and verify

5. 24.98 mm / 0.03 mm

Minimum is the lowest sample. Variation is $25.01 - 24.98 = 0.03$.

Review: Measure thickness, variation and runout

6. LF inner pad 2 mm, outer 6 mm; cause under investigation

The measurements are known; the causal component has not yet been established.

Review: Inspect the complete wheel-end and hydraulic system

7. Resolve the safety concern through the applicable procedure before road testing

A test plan must respond to safety findings; a shorter or slower route does not establish safe operation.

Review: Establish the concern and a safe inspection

8. Identify the difference and avoid an unsupported direct comparison

Comparable setup supports a meaningful before/after conclusion.

Review: Recommend, authorize and verify

Further study

Use current vehicle and equipment information for actual service. These resources support further learning; lessons and questions in this book are original.

ASE automobile task lists and public sample formats

https://www.ase.com/wp-content/uploads/ASE_Automobile_Study_Guide.pdf

OSHA brake and clutch dust guidance

<https://www.osha.gov/sites/default/files/publications/SHIB072606.pdf>

Brake shudder and measurement context - Bendix

<https://www.bendix.com.au/news-events/diagnosing-and-rectifying-brake-shudder>