



Assessment of Disc Brake Rotor Assembled Lateral Runout and Thickness Variation

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. The purpose of this test is to accurately quantify the lateral runout of a disc brake rotor with the brake corner fully assembled.

1.2 Applicability. This test applies to all vehicles equipped with disc brakes.

1.3 Remarks. This procedure defines the method that is used to measure the Assembled Lateral Runout (ALRO) and Thickness Variation (TV) of a disc brake rotor. The procedure can be used to measure ALRO in a laboratory environment with the brake corner module removed from the vehicle or in the on-vehicle state such as during an assembly line audit.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

None

2.3 Additional References.

- Capacitec Incorporated, Ayer, Massachusetts (www.capacitec.com)
- Digital Metrology Solutions, Incorporated, Columbus, Indiana (www.digitalmetrology.com)
- Evaluation Report template (available in Global Document Management (GDM) System) (ID)
- Global Document Management (GDM) System (<https://documents.gm.com/gdm3>) (ID)
- Verified Technologies Incorporated, Michigan (www.brakeview.com)

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3 Resources

3.1 Facilities. A test facility with suitable environment for precision measurement is required.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment.

3.2.1 Electronic equipment capable of measuring ALRO in 1 degree increments with a resolution $\leq 1 \mu\text{m}$ is recommended. The equipment includes Capacitec, Linear Variable Differential Transformer (LVDT) (available from Capacitec Incorporated), or other electronic probes, a wheel rotation indicator, and a data acquisition system such as BrakeView (Verified Technologies Incorporated) or MOVE (available from Digital Metrology

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Solutions, Incorporated). Reference Figure A4 (Appendix A) for LVDT Graphical Representation of the Rotor Runout vs. Position example. Reference Figure A5 (Appendix A) for LVDT example.

3.2.2 Fixture capable of rigidly holding the probe(s) or dial indicator. Reference Figures A6, A7, A8 and A9 (Appendix A) for examples of methods to fixture the LVDT probes.

3.2.3 Equipment to drive the assembly the required number of revolutions for data recording. String or twine to wrap around wheel/tire unit may be needed.

3.2.4 Optional. A dial indicator with a resolution $\leq 1 \mu\text{m}$.

3.3 Test Vehicle/Test Piece. If the intent of the testing is to assess the ALRO of a particular vehicle line or corner module after final assembly, then a minimum of 15 vehicles or 30 corner modules is suggested. The preferred method of measuring the ALRO is with the wheel installed using the production process or service procedure to capture the effect the wheel clamping has on rotor Lateral Runout (LRO) and TV readings.

3.4 Test Time.

3.4.1 Vehicle Final Assembly Line Study.

Calendar time: 2 days to 5 days
Test hours: 15 hours to 30 hours
Coordination hours: 2 hours to 4 hours

3.4.2 Single Vehicle Study.

Calendar time: 1 day
Test hours: 1 hour to 2 hours
Coordination hours: 1 hour to 2 hours

3.5 Test Required Information. Part drawing of the test rotor is required.

3.6 Personnel/Skills. One (1) technician trained in the operation of the electronic equipment or dial indicator. Additional person may be required to observe readings from dial indicator.

4 Procedure

4.1 Preparation.

4.1.1 If requested, clean the Inboard (IB) and Outboard (OB) rotor surfaces to remove any debris that might interfere with the measurements. Remove the corrosion protection coating from the rotor surface using five to twenty (5 to 20) light brake applications or a hand cleaning method such as chemical stripping. An example of chemical stripping is using glass cleaner and a mild abrasive pad. Cleaning method should effect surface only and not include any sanding of rotor.

4.1.2 Wheel nuts should be tightened using the production process or service procedure to the torque specification. If the testing is an end-of-line audit at a vehicle assembly plant, wheel nut torque may be measured only after the testing is completed.

4.1.3 If the test is conducted on a corner module, the knuckle shall be rigidly clamped to the work surface using a vise or fixture. The probe or dial indicator shall be attached to the knuckle with a rigid fixture. Additionally, a wheel or wheel center shall be mounted to the corner assembly with the wheel nuts tightened to the torque specification using the applicable service procedure.

4.2 Conditions.

4.2.1 Environmental Conditions. The ambient conditions throughout the test shall be maintained within 5 °C of the temperature at the start of the test. The environment shall be free from excessive vibration or airflow that could alter the test results.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.2.2.1 Place vehicle in Neutral prior to measurements.

4.2.2.2 For floating rear axle, axle shaft must be held in place.

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4.3 Instructions. Refer to 4.3.1 if the test is conducted using the electronic equipment method, or 4.3.2 if using the optional dial indicator method.

4.3.1 Electronic Equipment Method.

4.3.1.1 Attach the measurement fixture to the knuckle, caliper bracket, or other rigid object that is fixed to the knuckle.

4.3.1.2 Position the probe tip on the IB rotor surface and another probe at the OB rotor surface at a radius that is 10 mm less than the outer radius of the rotor. Probes should be perpendicular to the rotor surface and inline to each other. These positions are defined as the Inboard Outer Diameter (IBOD) and the Outboard Outer Diameter (OBOD) positions. If the rotor surface has any damage at this diameter that may affect the measurements, adjust the measurement radius and record the radius in the test results.

Note: Some assemblies will not have enough room for probes at both IBOD and OBOD locations. In those cases measure one location only.

4.3.1.3 Mark a portion of the tire/wheel assembly (or rotor if a corner module is being measured) to indicate the starting point for the measurement. Mark the rotor in relation to the wheel, in relation to the hub, in relation to the starting point, to provide indexing if performing diagnostic work.

4.3.1.4 If the corner is not on a driven axle and a driving device, such as motorized roller at tire tread, is not available, the use of string or twine wrapped around the center portion of the tire tread should be used. Slowly pull the string to rotate the tire in the forward vehicle direction maintaining smooth, fluid rotation. Minimum of five (5) revolutions are needed for the BrakeView equipment to record properly.

Note: A motorized driving device is only acceptable as long as side-to-side (axial) forces are eliminated.

4.3.1.5 If the corner is on a driven axle, rotate the opposite wheel in the forward vehicle direction by hand.

4.3.1.6 Measurements will be recorded over the entire 360 degrees of wheel rotation. See Figure A1 (Appendix A) for example of results table.

Note: Measurement software should have a speed compensation algorithm when rotating the wheel by hand or string.

4.3.1.6.1 When using electronic probes, record three (3) measurements per corner.

4.3.2 Optional Dial Indicator Method.

Note: For final assembly plant measurements where diagnostic work will not be performed, use Figure A2 (Appendix A). For lab measurements where corner module diagnostic work will be performed, use Figure A3 (Appendix A).

4.3.2.1 Attach the measurement fixture to the knuckle, caliper bracket, or other rigid object that is fixed to the knuckle.

4.3.2.2 Position the dial indicator tip on the IB rotor surface at a radius that is 10 mm less than the outer radius of the rotor. This is the IBOD position. If the rotor surface has any damage at this diameter that may affect the measurements, adjust the measurement radius and record the radius in the test results.

4.3.2.3 Orient the dial indicator tip such that the stem is perpendicular to the rotor surface. If required to reduce vibration of the indicator tip, first change the size of the tip. If vibration still occurs change the stem angle by 5 degrees or less.

4.3.2.4 Mark a portion of the tire/wheel assembly (or rotor if a corner module is being measured) to indicate the starting point for the measurement. Observe the initial reading of the indicator and record. Index the rotor, the wheel, and the hub and indicate the starting point when performing diagnostic work.

4.3.2.5 If the corner is not on a driven axle and a driving device, such as motorized roller at tire tread, is not available, the use of string or twine wrapped around the center portion of the tire tread should be used. Slowly pull the string to rotate the tire in the forward vehicle direction maintaining smooth, fluid rotation.

Note: A motorized driving device is only acceptable as long as side-to-side (axial) forces are eliminated.

4.3.2.6 If the corner is on a driven axle, rotate the opposite wheel in the forward vehicle direction by hand.

4.3.2.7 Dial Indicator Measurements.

4.3.2.7.1 For final assembly plant measurements, record the maximum and minimum thickness as in Figure A2 (Appendix A).

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