



Brake Corner Lateral Runout Measurement During Corner Assembly

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. This procedure describes the recommended practice for measuring brake rotor Assembled Lateral Runout (ALRO) in a brake corner assembly manufacturing environment. For on-vehicle ALRO measurement, refer to GMW14933.

1.2 Applicability. This procedure applies to any disc brake corner assembly, front and rear. Separate instruction is provided for Gen-3 wheel bearing designs versus Gen-1 wheel bearing designs, due to the significant difference in brake corner construction with the different bearing types.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW14933

3 Resources

3.1 Facilities.

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. Equipment may be of varying design and construction to best integrate into the surrounding manufacturing processes. This section notes features of this equipment expected to be common in most installations.

3.2.1 Sensor. The ALRO measurement sensor is recommended to be a contacting-type (to remove a thin line of surface coating if applicable), with a carbide tip (or material of similar hardness and dimensional stability) to avoid premature wear. The sensor must be capable of a resolution of 1 μm or less.

3.2.2 Table Surface. The surface of the measurement station shall have sufficient structure and material specification to avoid beaming or other distortion that can affect the measurement due to the brake corner mass and simulated clamp loads involved.

3.2.3 Data Acquisition. The measurement equipment shall be capable of recording in 1 degree of revolution increments.

3.3 Test Vehicle/Test Piece.

3.3.1 Gen-3 Wheel Bearing Brake Corner. ALRO is typically measured on a wheel bearing and brake rotor assembly. Other brake corner components (such as the knuckle) are not required (see Figure A1, Appendix A).

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3.3.2 Gen-1 Wheel Bearing Brake Corner. The wheel bearing must be installed into the knuckle, and the wheel hub must be installed into the bearing to establish the correct datum for the ALRO measurement. The ALRO measurement involves the knuckle/bearing/hub assembly, and the brake rotor.

3.4 Test Time. Cycle time will depend on the equipment selection and overall process design. With GM design and manufacturing responsible engineer approval, reasonable modifications to procedure may be enacted to ensure that the measurement process meets assembly line cycle time requirements.

3.5 Test Required Information. The ALRO monitoring station will need to know what brake corner variant is being assembled, and what the applicable ALRO requirement limit is.

3.6 Personnel/Skills. An operator trained to operate the ALRO monitoring equipment and procedure, and who understands the importance to the customer of achieving the ALRO specifications. The ALRO monitoring station may be automated.

4 Procedure

4.1 Preparation. Parts entering the ALRO monitoring station shall be free of shipping/packing debris. Compressed air may be used to clean the parts if necessary.

4.2 Conditions.

4.2.1 Environmental Conditions. Not applicable.

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.

4.2.3 Cleanliness. The brake corner assembly area shall be free of excessive dust, airborne debris, and other potential contamination of the brake rotor to wheel bearing mating surfaces. While it is not necessary to have an enclosed clean room, the process should be located in as clean of an environment as possible. Cleanliness will significantly reduce rework.

4.3 Instructions.

4.3.1 Instructions for Brake Corners with Gen-3 (self-retained) Wheel Bearings. See Figure A2 in Appendix A for graphical details.

4.3.1.1 Visually ensure that the wheel bearing and rotor mating surfaces are clean and free of debris. Compressed air may be used to blow the surfaces clean if needed.

4.3.1.2 Set the rotor in place over the wheel bearing.

4.3.1.3 Apply a load of 890 N (200 lb) to lightly seat the rotor hub against the wheel bearing. Do not use the set screw to apply load (do not install the set screw at any point prior to measurement) as this will likely distort the measurement.

4.3.1.4 Apply the sensor (contacting stylus) to the rotor at a distance of approximately 10 mm from the rotor outer edge. The stylus tip should be carbide (or material of similar wear resistance and dimensional accuracy) to resist wear over numerous measurements.

4.3.1.5 Rotate the rotor three (3) revolutions in total, recording the Lateral Runout (LRO) during the third revolution (the first two (2) revolutions are to clean a line through the rotor surface coating, if applicable). Typical rotation speed is 30 rpm but may be adjusted to suit the process.

4.3.1.6 If LRO meets specifications ($< 40 \mu\text{m}$ unless otherwise specified by product engineering), release the assembly to the next station. See Appendix B for instructions on scaling the requirement for different measurement locations.

4.3.1.7 If LRO does not meet specification, then remove the rotor from the bearing, clean the mating surfaces (with compressed air), and repeat 4.3.1.2 thru 4.3.1.6.

4.3.1.8 If LRO still does not meet specifications, then add paint mark to both the bearing and rotor and return to start of process queue.

4.3.1.9 Any paint marked component that fails to meet LRO requirements after its next attempt should be treated as defective and enter the appropriate defect parts handling process (likely returned to its supplier).

4.3.1.10 Upon successful assembly (meeting LRO requirements) the brake rotor set screw is installed and torqued to specification.

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4.3.2 Instructions for Brake Corners with Gen-1 (Press Fit) Wheel Bearings. See Figures A3 thru A6 in Appendix A for graphical details. This procedure assumes that a complete corner assembly with knuckle, bearing, bearing retainers, rotor, and hub enters the ALRO measurement station.

4.3.2.1 Locate the corner assembly to the LRO tooling using the inboard side of the inner race of the bearing as the primary datum. The knuckle shall not be directly supported for the LRO measurement operation other than for anti-rotation. No force shall be applied to the hub at the spline surface at any time during this LRO measurement process. Tool design shall help to avoid damage to the encoder or snap ring that may be incurred by part load/unload or running of this LRO measurement process (see Figure A3, Appendix A). At no time during the LRO operation shall the backup or locating support on the lower (inboard) side contact the hub from that side. This would result in the bearing load being fully or partly absorbed by a solid body (the hub) rather than going into loading the bearing.

4.3.2.2 Use any concentric hub features shown (see Figure A4, Appendix A) as the secondary Datum (B) to provide centering for the assembly to the hub axis and to align that axis with the LRO machine's motor rotation axis. At no time during the LRO operation shall the centering feature of the tool contact the hub on the lower (inboard) side. This would result in the bearing load being fully or partly absorbed by a solid body (the hub) rather than going into loading the bearing. The centering can be done using the bearing inner race on the inboard side or using the hub on the outboard side.

4.3.2.3 Apply force F1 to hub (Figure A5, Appendix A) aligned with Datum (B) (Figure A4, Appendix A). The allowable force range will be specified by product engineering and is intended to simulate the clamp force generated by the production axle shaft and hub nut when torqued to specification. It is assumed, based on lessons learned, that the ideal bearing loading will need to be determined empirically. Start with production load on the bearing (or as close as is reasonable). The load application will typically need to be repeated at least once to ensure proper seating and assembly of components.

4.3.2.4. Apply force F2 to the rotor, parallel to the center line of the bearing inner race (see Figure A6, Appendix A). The force may be applied anywhere along the area where the hub and rotor overlap. The force shall have the ability to be adjusted across the range shown in Figure A6, Appendix A, and the overall force supplied shall be accurate repeatable to ± 5 kg-f or less. The total force F2 shall be applied at even spacing around the circumference of the rotor and at even distances from the center line of the bearing inner race. The number of contact points is not critical, but compliance is required in order to ensure **even loading** (e.g., evenly spaced spring loaded fingers used to apply the force). Spring constant/compression variation is assumed to be insignificant relative to **even loading**. The contact pads at the rotor surface shall have a curved shape in order to minimize off center loading when the rotor is tilted.

4.3.2.5 Align the LRO sensor to the caliper mounting surfaces on the knuckle (indicated with green lines in Figure A7, Appendix A) such that it moves with these surfaces during the LRO measurement machine cycle. The sensor must stay in the exact same location/orientation relative to these surfaces regardless of the shape of the motion path the knuckle takes during the LRO cycle (it may rotate and or translate a small amount in any direction). The alignment process/placement of the sensor must not influence the movement of the knuckle at all. The machine's sensor will read LRO continuously, and always perpendicular to these surfaces, relative to a location on the revolving rotor as described in 4.3.2.6.

4.3.2.6 Begin rotation of the rotor/hub. Rotational force can be applied via lug studs, friction contact with hub (except spline surface), friction contact with the rotor or friction contact with bearing inner race. Typical rotation speed is 30 rpm but may be adjusted to suit the process.

4.3.2.7 Rotate the rotor three (3) revolutions in total, recording the LRO during the third revolution (the first two (2) revolutions are to clean a line through the rotor surface coating, if applicable).

4.3.2.8 After the rotating motion is stopped, remove the rotor force F2.

4.3.2.9 Remove the hub/bearing force F1.

4.3.2.10 If LRO meets specifications ($< 40 \mu\text{m}$ unless otherwise specified by product engineering), release the assembly to the next station. See Appendix B for instructions on scaling the requirement for different measurement locations.

4.3.2.11 If LRO does not meet specification, then remove the rotor from the knuckle/bearing assembly, clean the mating surfaces (with compressed air), and repeat 4.3.2.1 thru 4.3.2.9.

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