



Wheel Test Sample Crack Inspection

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 standard is to define how to inspect for cracks in wheel test samples using dye penetrant inspection and magnetic particle inspection methods. Both methods may use full immersion in a liquid or an application of it to a limited region of the part. In the case of magnetic particle inspection, a dry powder can be used instead of a liquid (typically an aqueous suspension). In the case of dye penetrant inspection, a developer may be required for reliable indication of cracks. Cracks are indicated by either a dye color visible in normal lighting conditions or fluorescence of the penetrant under ultraviolet light.

1.2 Applicability. This standard applies to aluminum and steel wheel test samples, with or without plastic cladding or inserts. Cladding is typically attached to an aluminum wheel with adhesive foam. Inserts are typically attached to an aluminum wheel with steel screws which may or may not be coated with a thread-locking adhesive.

Note: Cladding, inserts, or adhesive materials may be vulnerable to chemicals used in a crack inspection method. Evaluation of cladding or insert performance or their effect on wheel performance is typically part of the test assessment, so cladding, inserts, or adhesive materials should not be exposed to crack inspection chemicals that would degrade them prior to the test. In addition, inserts should not be removed before crack inspection and reinstalled afterwards in order to avoid this exposure. The reason for this is that removal and reinstallation would prevent their test assessment in their original as-installed state. If it is necessary to crack inspect a wheel under these conditions, crack inspection chemicals should only be used on exposed surfaces of the wheel and should not come into contact with cladding, inserts, or adhesive materials. The reason this procedure requires that crack inspection chemicals not come into contact with cladding, inserts, or adhesive materials is as follows. It will not be determined if dye penetrant chemicals are compatible with cladding, inserts, or adhesive materials, and incompatibility will be assumed. This avoids taking the significant amount of time required to try to determine compatibility.

See Appendix A, Table A1 for a summary of the applicability of crack inspection types to different test and wheel types.

2 References

For all Crack Inspection practices, the manufacturer equipment recommendations and the standards referenced by the manufacturer should be used as the procedure for the testing. The external standards referenced below are general standards for liquid penetrant and magnetic particle testing. Within those standards, more specific standards are referenced for more specific testing types.

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

2.1 External Standards/Specifications.

ASTM E165	ASTM E709	ASTM E1417	ASTM E1444
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2.2 GM Standards/Specifications.

GMW14340	GMW14910	GMW15443	GMW16617
GMW14341	GMW15321	GMW15531	GMW16768
GMW14909	GMW15439	GMW16590	GMW17578 (ID)

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(ID) = This standard is limited to internal distribution within General Motors and shall not be distributed outside this company. Contact the GM Lead Engineer for further instructions.

2.3 Additional References.

2.3.1 Dye Penetrant References:

Zyglo Fluorescent Penetrant Operating Instructions For Bulk Applications; www.magnaflux.com

Zyglo Penetrant Kit Operating Instructions; www.magnaflux.com

Spot check Dye Penetrant Operating Instructions; www.magnaflux.com

2.3.2 Magnetic Particle Inspection Reference:

Magnaglo/Magnavis Magnetic Particle Kits Operating Instructions; www.magnaflux.com

3 Resources

3.1 Facilities. A conditioned indoor environment is recommended.

3.2 Equipment. Equipment specifications recommended by the manufacturer should be used.

3.2.1 Dye Penetrant Equipment.

3.2.1.1 Dip Dye Penetrant Equipment.

3.2.1.1.1 A spray water wash facility for pre-cleaning wheels and removing the penetrant on wheel surfaces.

3.2.1.1.2 A dryer for drying wheels after pre-cleaning and after the removal of the penetrant on wheel surfaces.

3.2.1.1.3 A dip tank containing the penetrant sufficiently large to accommodate wheels.

3.2.1.1.4 A drain rack for wheels to allow excess penetrant to return to the dip tank while time is allowed for the penetrant to penetrate cracks.

3.2.1.1.5 A dark booth and ultraviolet light source for inspection.

3.2.1.2 Spray-On Dye Penetrant Equipment: A spray water wash facility for pre-cleaning wheels. A dark booth and ultraviolet light source for inspection, if the penetrant is fluorescent under ultraviolet light.

3.2.1.3 Wipe-On Dye Penetrant Equipment: A spray water wash facility for pre-cleaning wheels. A dark booth and ultraviolet light source for inspection, if the penetrant is fluorescent under ultraviolet light.

3.2.2 Magnetic Particle Inspection Equipment.

3.2.2.1 Magnetic Particle Inspection Equipment (Liquid Suspension).

3.2.2.1.1 A spray water wash facility for pre-cleaning wheels.

3.2.2.1.2 A dip tank containing the liquid suspension sufficiently large to accommodate wheels, or a facility to spray on the suspension.

3.2.2.1.3 A drain rack for wheels to allow excess liquid suspension to return to the dip tank or reservoir.

3.2.2.1.4 An appropriate electromagnetic yoke or other equipment to generate a magnetic field around the wheel.

3.2.2.1.5 A dark booth and ultraviolet light source for inspection, if the magnetic particles are fluorescent under ultraviolet light.

3.3 Test Vehicle/Test Piece. As-received wheel. This may be a steel wheel with electro-coated paint, an aluminum wheel with clear-coat, paint, chrome plating, or plastic cladding (typically fastened with an adhesive foam), or a wheel with inserts. For wheels with inserts, the inserts are typically plastic and fastened to the wheel with screws. Wheels may also be received without their design-intent coating, although for the most accurate lab or road performance tests, they should still have gone through all of the processes associated with their intended coating, such as shot-peening or heating in a paint-bake oven.

Note: Uncoated wheels provide the most accurate crack inspection results, since there is no coating to interfere with the penetrant penetrating into cracks or with visual inspection.

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3.4 Test Time.

Calendar time: 1 hour
Test time: 0.5 hour
Coordination time: 0.5 hour

3.5 Test Required Information.

 Not applicable.

3.6 Personnel/Skills.

 Ability to set up and calibrate testing equipment, conduct the inspection according to codes and standards.

4 Procedure

For all Crack Inspection practices, the standard referenced by the manufacturer should be used as the procedure for the testing. The external standards referenced above are general standards for liquid penetrant and magnetic particle testing. Within those standards, more specific standards are referenced for more specific testing types.

4.1 Preparation.

 Not applicable.

4.2 Conditions.

4.2.1 Environmental Conditions.

 A conditioned indoor environment is recommended.

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 Crack Inspection Sensitivity.

 Sensitivity of the crack inspection chemicals used is dependent upon the size of the fluorescent particles used. The sensitivity scale is applicable to only Type 1 (fluorescent dye). Not type 2 (visible dye). The smaller the particle, the smaller the width of the crack that can be detected.

There are typically four (4) levels of sensitivity:

- 1 is low.
- 2 is normal.
- 3 is high.
- 4 is ultra-high.

Note: There is also a level 1/2 that stands for very low sensitivity.

It is recommended to use chemicals having a sensitivity of 2. This reduces the chance of false positive results. It also reduces the tendency for the crack inspection chemicals to be absorbed evenly by the residual porosity of a cast surface, which makes actual crack indications more difficult to detect. If further review is desired regarding the presence of a crack, inspection using chemicals having a sensitivity of 3, respectively, may be performed.

4.2.2.2 Crack Inspection Chemical Purity.

 Penetrant or liquid suspension should be reasonably free of contaminants such as dirt, rust, oil, etc., and should not be excessively diluted with water, solvent, etc. Regular inspections of the penetrant should be performed to ensure this.

4.3 Instructions.

 Use Appendix A, Table A1 to select the appropriate crack inspection type based on test, wheel type, and whether the inspection is a pretest or posttest inspection.

Follow the instructions provided by the supplier of the crack inspection chemicals. Generic instructions for different types of inspections are provided in 4.3.1 through 4.3.2 for reference.

4.3.1 Liquid Dye Penetrant Instructions.

Note: For more detailed instructions, refer to ASTM E1417 standard liquid penetrant practices or ASTM E165 standard liquid penetrant examination.

4.3.1.1 Dip Dye Penetrant Instructions.

 For an example of dip dye penetrant instructions, refer to Zyglo Fluorescent Penetrant Operating Instructions for Bulk Applications.

4.3.1.1.1 Clean and dry the wheel completely.

4.3.1.1.2 Dip the wheel into the penetrant to completely immerse it and lift it out, and allow the excess to drain off.

4.3.1.1.3 Place on drip rack and allow 5 minutes to 10 minutes of dwell time for penetrant.

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