



Brake Rotor Splash Shield Technical Specification

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 document provides the program specific technical requirements for the brake rotor splash shield. The brake splash shield performance requirements are focused on a hydraulically actuated service brake mechanism.

Note: The program specific technical specification may include additional program specific requirements that are not referenced in this document and does supercede any requirements included in this document. In the case of any conflicts between this document and the program specific technical specification, the program specific technical specification takes precedence.

Note: The program specific Statement of Requirements (SOR) shall determine if this document is issued as one entity for corner level performance or as part of packet of documents that may additionally include specifications for vehicle level performance, component level performance, or both.

This specification establishes requirements for the brake rotor splash shield. These requirements apply to the bandwidth parameters described in the Brake Corner Assembly Program Specific Technical Specification.

1.2 Applicability. This standard applies to all brake rotor splash shield(s) used with a friction-based, service brake mechanism.

1.3 Remarks. The brake rotor splash shield protects the brake rotor and the rotor-to-friction material interface from road debris and water that may impact the disc brake apparent friction levels, friction material wear rates, and rotor thickness variation development. The splash shield may also provide ancillary protection for other disc brake corner components, such as the brake caliper and wheel bearing assembly; however, this protection is secondary in nature.

2 References

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

2.1 External Standards/Specifications.

ISO/TS 16949

2.2 GM Standards/Specifications.

GMW2	GMW14671	GMW15367	GMW16352
GMW3032	GMW14700	GMW15386	GMW16377
GMW3059	GMW14829	GMW15392	GMW17000
GMW3172	GMW14872	GMW15632	GMW17026
GMW8518	GMW14925	GMW15862	GMW17699
GMW14089	GMW15272	GMW16066	
GMW14165	GMW15344	GMW16316	
GMW14375	GMW15363	GMW16331	

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2.3 Additional References.

- CG1290 (ID)
- CG3856 (ID)
- GM Best Practice: Brakes - 92 (<https://e2ks.gm.com/e2ks/kpac/view/BRAKES-92>)
- GM Best Practice: Brakes - 96 (<https://e2ks.gm.com/e2ks/kpac/view/BRAKES-96>)
- GM Global Fastener Engineering web site (<https://gmweb.gm.com/sites/fastening1/Pages/Home.aspx>) (ID)
- GM Global Legal Database (ID)
- GM Global Preferred Materials Catalog (ID)
- GM Labels and Literature web site (<https://gmweb.gm.com/sites/toolkit/48Inl/Pages/Home-Page.aspx>) (ID)
- GM Materials and Corrosion web site (https://gmweb.gm.com/sites/veh_matls/Pages/default.aspx) (ID)
- Interface Dimension Chart
- Program specific Subsystem Technical Specification (SSTS)
- Program specific Component Technical Specification (CTS)
- Program specific Statement of Requirements (SOR)
- Program specific Vehicle Technical Specification (VTS)
- Squeak and Rattle Noise Glossary

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3 Requirements

3.1 System/Subsystem/Component/Part Definition. The brake rotor splash shield protects the brake rotor and the rotor-to-friction material interface from road debris and water that may impact the disc brake apparent friction levels, friction material wear rates, and rotor thickness variation development.

3.1.1 Appearance. The brake rotor shield shall have a uniform color (black with electrocoat paint on galvanized steel and silver or gray with aluminized steel) and appearance that is reviewed and agreed to by GM Engineering. See section 3.1.2 for appearance and performance specifications related to cosmetic corrosion resistance.

3.1.2 Content. Including content and splash, debris, and corrosion protection.

3.1.2.1 Physical Content. The brake rotor splash shield contains all the hardware necessary to perform the requirements set forth in this document. The brake rotor splash shield includes the shield(s) and any additional hardware associated with the shield itself.

3.1.2.2 Functional Content. The brake rotor splash shield protects the brake rotor and the rotor-to-friction material interface from road debris and water that could impact the disc brake apparent friction levels, friction material wear rates, and rotor thickness variation development. The splash shield may also provide ancillary protection for other disc brake corner components, such as the brake caliper and wheel bearing assembly.

3.1.2.3 Wheel Bearing Protection. The rotor splash shield shall provide protection to the wheel bearing in order to help protect the wheel bearing in its installed position. In particular, the design should comprehend the shielding impact that the rotor splash shield may have on the wheel bearings inboard seals. Every effort should be made to protect these seals from road debris and water.

3.1.2.4 Rotor Splash Shield Geometry. The front corner splash shield(s) designs on passenger cars or crossover vehicles should always incorporate a full shield with a wraparound feature that covers half of the inboard rotor cheek thickness during the initial brake sizing studies for a vehicle program. To meet brake thermal requirements due to vehicle program airflow changes, the front corner shield designs on passenger cars or crossover vehicles may allow for features (such as central vents, louvered slots or removal of the wraparound feature) to provide airflow to the rotor braking surfaces without allowing for direct exposure of the rotor friction surface to debris flow. The splash shield(s) on body-on-frame vehicles and vehicles that may see significant off-

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road usage (e.g., elevated stone impingement exposure) and all rear splash shield applications must be a full shield with a wraparound feature that covers half the thickness of the inboard rotor cheek.

The rotor splash shield should include a wraparound feature that covers at least half of the thickness of the inboard rotor cheek. If a wraparound feature is not feasible, the outer diameter of the shield must extend at least 10 mm beyond the outer edge of the rotor (in the radial direction) to provide coverage from under vehicle airborne debris and water flow. The outer edge of the splash shield must incorporate a 180 degree full hem on every outer diameter edge that can be hemmed. The shield should also incorporate features such as, wraparound features or flares near the brake caliper opening or cutout to help prevent spring back or "oil-canning" effects due to manufacturing processes.

Protection from debris and water flow must be validated to GMW16377 on all shield designs and show no visible wetting of the brake rotor friction surfaces. All shield designs must be approved by the GM Brake Rotor Splash Shield Bill of Material (BOM) Family Owner (BFO).

Additional geometry requirements are invoked in Best Practice Brakes-92 and Brakes-96 (for GM internal use, the supplier shall work with the GM Design Responsible Engineer (DRE) to comprehend the requirements in these best practices). See program specific technical specification.

3.1.2.5 Shield Material. For a reference of suitable splash shield materials, refer to the GM Global Preferred Materials Catalog from GM Materials Engineering. All materials and coatings must be approved by GM Brake Engineering and GM Materials Engineering. The splash shield(s) on body-on-frame vehicles and vehicles that may see significant off road usage (elevated stone impingement exposure) or temperatures greater than 200 °C shall utilize an aluminized steel that has a 1.0 mm minimum thickness. For applications requiring less than a 240 MPa yield strength, a material such as GMW2M-ST-S-CR2-AL-T1M-120 shall be used. For those applications requiring a tensile strength greater than 240 MPa, a grade such as GMW3032M-ST-S-CR340LA-AL-T1M120 shall be used. A grade of material should be selected that is a suitable grade for formability and to minimize spring back due to manufacturing processes. Refer to GMW16066 for the aluminized sheet steel specification.

The splash shield(s) on passenger car, crossover vehicles, or applications where shield temperatures are routinely less than 200 °C, with minimal excursions above 200 °C, shall utilize a galvanized steel with electrocoat paint that has a 1.0 mm minimum thickness. For applications requiring less than a 240 MPa yield strength, a material such as GMW2M-ST-S-CR2-HD60G60G-U shall be used. For those applications requiring a tensile strength greater than 240 MPa, a grade such as GMW3032M-ST-S-CR340LA-HD60G60G-U shall be used. A grade of material should be selected that is a suitable grade for formability spring back due to manufacturing processes. The material must be cleaned with zinc phosphate per GMW17699 and have a black electrocoat per GMW14671-B-U/B. The electrocoat adhesion shall be tested to GMW14829 with a rating of 0 or 1 at delivery.

3.1.2.6 Galvanic Corrosion Protection. Materials for adjoining components shall be selected to minimize the potential for galvanic corrosion. This means employing similar materials at interfaces and/or employing a suitable barrier coating as noted in the Material section.

3.1.2.7 Fastener Selection. GMW17000, GM Global Fastener Catalogue, contains the recommended brake system fasteners. See the GM Global Fastener Engineering web site. The design of these interfaces shall accommodate the use of the recommended fasteners. Exceptions can be made for non-standard interfaces or special packaging situations.

Torque, tension, and angle evaluation of fastened joints shall be evaluated per GMW14165 to determine the correct torque specifications.

3.1.3 Ambient Environment. Operating and non-operating environments.

3.1.3.1 Environmental Definition. The shield(s) will be exposed to the environmental conditions in either customer usage or in the manufacturing and assembly process. The shield(s) will be exposed to the corrosive environment, which occurs in the Scandinavian countries, the Northeast United States of America and Southeast Canada. The environment is composed of temperature, humidity, salt, splash, mud, and component usage. The shield(s) should be expected to be exposed to all of these environments and shall maintain full functionality while operating in these environments. Corrosion will be evaluated on durability vehicles completing 15 year corrosion schedules. Test procedures will be listed in the vehicle program specific Vehicle Technical Specification (VTS). The shield shall meet the requirements contained in this document during and after these exposures. Appropriate laboratory tests may be used to demonstrate this performance. The minimum temperature is the minimum temperature at which a component will be expected to operate. Assisted vehicle

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starting shall be permitted. Temporary degradation of the component function shall be permitted, but permanent loss of function shall not result in a walk home situation.

The maximum continuous temperature is the maximum temperature a component will experience on a continuous basis and be expected to maintain design functional life. The vehicle shall be able to experience 1200 h/12 000 cycles per 160 000 km of operation during continuous thermal conditions. Occupant safety shall not be compromised during continuous thermal conditions.

The maximum excursion temperature is the maximum temperature the component will experience on an infrequent basis and be expected to maintain functional life. The vehicle shall be able to experience 60 h/400 cycles per 160 000 km of operation during excursion thermal conditions. Occupant safety shall not be compromised during excursion thermal conditions.

If the vehicle target life is > 160 000 km, the hours and cycles should be adjusted accordingly.

3.1.3.2 Temperature Range. The temperature range for ambient conditions is -40 °C to +85 °C. The temperature range of each component during operation and storage shall range from -40 °C (-48 °C for Siberia) to a Maximum Temperature (TMAX) which is generated by the dynamic requirements specified in this document for the shield, or the temperature reached due to extreme usage of the service brake components surrounding the shield.

Excursion conditions represent elevated temperature exposure not to exceed 30 minutes continuous. Materials and component geometries shall be selected/designed that allow the operating temperature conditions (a, b, and c) to be met.

Extreme service brake temperatures that the shield can be subjected are:

- **Lining:** TMAX = 600 °C; 800 °C excursion. TMAX for the lining backing plate/shoe is determined through static (rotor not spinning and vehicle not moving) physical test, or heat transfer analysis with the rotor set at 600 °C and heat transfer driven through conduction from the rotor, through the shoe assemblies, and to the back of the backing plate/shoe.
- **Cast Iron Rotor:** TMAX = 700 °C; 800 °C excursion for cast iron rotors. See program specific technical specifications for rotors constructed from alternate materials.
- **Bearing:** TMAX = 120 °C, 180 °C excursion with no seal damage.

3.1.3.3 Humidity Range. The relative humidity range for each component during operation and storage shall range from 0% to 100% in the specified ambient temperature range of -40 °C to +85 °C.

3.1.3.4 Atmospheric Pressure. The shield will be exposed to between 330 mm Hg and 860 mm Hg during operation and storage.

3.1.3.5 Potential Contaminants. The shield must either be able to withstand prolonged exposure to contaminants which could be encountered in vehicle use or must be packaged to protect from them. Validation is accomplished through physical testing or through prior knowledge of material and coating compatibility with contaminants.

Coatings or exposed construction material used on the shield must withstand the application of a film (the viscosity of the liquid will define the film thickness) of the following contaminants, applied at ambient temperature, for a duration of 2 h, without penetration of the coating or damage (pitting or erosion) of the base material: engine oil, transmission fluid, power steering fluid, coolant/antifreeze, brake fluid, windshield washer fluid, ammonia glass cleaner, applicable fuels (gasoline, diesel, ethanol, or methanol), transaxle or differential lube, wheel bearing lube, air conditioning refrigerant, water, salt water, snow, ice, acid rain, road tar, rust proofing/undercoating, ozone, acid rim cleaner, and urea (diesel emission fluid).

Any shield components that move relative to other components must be sealed against dirt, dust, grit, sand, and mud exposure, or feature a design that can withstand this exposure over the life of the vehicle while remaining functional.

3.1.3.6 Cooling Coefficient. Shall be specified for the selected shield geometry to support meeting system level thermal performance requirements. See program specific technical specification.

3.1.3.7 Air Flow Requirements. When applicable, the shield(s) shall provide features or openings to route air flow to the brake rotor or any other appropriate brake corner component specified by GM Engineering. Any openings or airflow features must be designed so that the shield provides coverage for the rotor from under vehicle airborne debris and water flow. The protection from debris and water flow must be validated to

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GMW16377 with no visible wetting of the brake rotor friction surfaces. Air flow requirements related to brake rotor splash shield(s) are invoked in Best Practice Brakes-92 and Brakes-96 (for GM internal use, the supplier shall work with the GM DRE to comprehend the requirements in these best practices). See program specific technical specification.

3.1.3.8 Chassis Electronics and Controls. The chassis electronics and controls subsystem may provide electrical power or signals to the brake corner for items such as wheel speed sensors, electrical park brake actuators, and lining wear sensors. No wiring or electrical components should be attached to the brake shield due to environmental/temperature exposure and the potential for corrosion of the shield wiring attachment feature. See program specific technical specification.

3.1.3.9 Non-Operating Environmental Exposure. The splash shield(s) shall meet all operating performance requirements, without loss of function or degradation of service life, as defined in this document. This requirement must be met with the park brake being applied during the listed vehicle transportation techniques:

- Component transport by airplane at altitudes up to 13 700 m, with air temperature of -50 °C and pressure of 125 mm Hg.
- Free air temperature up to 93 °C.
- Vehicle transport by ground via haul away carrier and train.
- Vehicle transport via ocean transport cargo ship (vibration and corrosion).

Any loads imparted to the shield(s) during vehicle shipping must be considered in the design, with no part failure or service life degradation allowed.

3.1.4 Interfaces. Vehicle Interfaces, Driver Interfaces, and Loads.

3.1.4.1 Structure Interface. The shield(s) shall interface with the brake, suspension and chassis structure as shown in the appropriate drawing file. See program specific technical specification.

3.1.4.2 Interfaces. The program specific technical specification must reference the necessary Interface Dimension Chart (provided by GM Engineering) and appropriate drawing files. See program specific technical specifications.

3.1.5 Usage Definition. The customer usage data given in this section are for high levels of usage in 195 000 km of retail customer driving for car applications. Trucks require 320 000 km.

Note: low levels of usage may be more appropriate for certain failure mechanisms, such as corrosion.

Components may be exposed to water based fluid spray due to vehicle usage. Components may be exposed to water submersion during special vehicle usage (e.g., boat launches from towed trailers and/or fording). Components may be exposed to gravel roads and subjected to stone impingement. The vehicle may be subjected to home or hand washing, drive through washing or wand washing throughout its life.

3.2 Product Characteristics.

3.2.1 Performance Requirements. The performance characteristics apply to the brake rotor splash shield(s). These requirements are in addition to requirements contained in other applicable technical specifications such as GMW15392, CG3856, and CG1290. The brake rotor splash shield and its associated components shall meet the performance requirements for all applicable regions defined in the program specific technical specifications, using GM approved lining/friction material(s).

Supplier shall provide the GM engineer with test data that verifies that performance will meet the stated requirements. For all procedures for which an applicable Test Improvement Process (TIP) Certification program exists, data must be generated using TIP certified equipment. Inertia dynamometer procedures that do not have a TIP certification program established must be TIP certified to run GMW14925. Consult the GM engineer responsible for administering the TIP program for the most current list of procedures with TIP certification programs.

3.2.1.1 Cosmetic Corrosion Resistance. The brake rotor splash shield(s) must meet the corrosion performance and validation requirements specified in GMW15272 for both functional and cosmetic corrosion performance. When invoked by GMW15272 for brake rotor splash shield cosmetic corrosion testing, GMW14872 must include the following additional stresses during the ambient phase of the test:

- Parts shall be sprayed every cycle with a 3.5% chloride content solution.
- Every fifth cycle, parts shall be heated in a 150 °C environment for 1 h.

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