



## **Tire, Wheel and Wheel Trim Subsystem Technical Specification (SSTS)**

### **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 standard technical requirements for the Tires, Wheels and Wheel Trim. This document must only be used when invoked by a Program Specific Technical Specification (Requirements). References to the Program Specific Requirements are included in this document where Program Specific Requirements are expected to exist.

**1.1.1** The Program Specific Requirements may include additional Program Specific Requirements that are not referenced in this document and may supercede any requirements included in this document. In the case of any conflicts between this document and the Program Specific Requirements, the Program Specific Requirements take precedence.

**1.1.2** This document serves as the Statement of Requirements (SOR), Appendix C1. This document is also referred to as a Subsystem Technical Specification (SSTS). This document also includes Interface Driven System Requirements (IDSR). Program Specific Requirements are shown in CG1012 and CG1150 which are SOR Component Technical Specification (CTS), (Appendix C2) documents. Requirements shown in SOR, (Appendix C2) take precedence.

**1.1.3** Tires, Wheel Trim and Wheels have Vehicle Partitioning and Product Structure (VPPS) identification number 20.03. The Bill of Material (BOM) row identification numbers are 231 for Tires, 232 for Wheel Trim, and 233 for Wheels.

**1.2 Applicability.** This document applies to GM vehicles. Unless noted otherwise, this document also pertains to special order vehicles (e.g., police, fleet, taxi).

**1.3 Remarks.** The Tire, Wheel and Trim is a functional subsystem that with the suspension subsystem, supports the weight of the vehicle and provides a load path between the road surface and vehicle.

### **2 References**

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

#### **2.1 External Standards/Specifications.**

SAE J1561

#### **2.2 GM Standards/Specifications.**

|         |          |          |          |
|---------|----------|----------|----------|
| GMW3059 | GMW14239 | GMW14469 | GMW15357 |
| GMW8460 | GMW14264 | GMW14502 | GMW15359 |
| GMW8518 |          |          |          |

#### **2.3 Additional References.**

- CG1012 Wheel and Wheel Trim Statement of Requirements (SOR), Appendix C2
- CG1150 Tire Statement of Requirements (SOR), Appendix C2
- Drawings 9590333, 9591026, 9591027, 9591395, 9591441, 9592038 and 9592294
- European Tyre and Rim Technical Organisation (ETRTO), Brussels, Belgium ([www.etrto.org](http://www.etrto.org))

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- GM K-PAC Best Practice TIRE-WHEEL-17 Global Common Standard Wheel Interfaces Drawing
- GM Tire Flop Clearance and Running Clearance Requirements
- Labels, Literature and Vehicle Identification Number (VIN) website (<https://gmweb.gm.com/sites/toolkit/48In/Pages/Home-Page.aspx>).
- Owner's Manual
- Service Manual
- Squeak and Rattle Noise Glossary
- Thatcham Research, Berkshire, United Kingdom ([www.thatcham.org](http://www.thatcham.org))
- The Tire and Rim Association, Incorporated, (TRA) Yearbook, Copley, Ohio ([www.us-tra.org](http://www.us-tra.org))
- Vehicle Technical Specification (VTS)

### 3 Requirements

**3.1 System/Subsystem/Component/Part Definition.** The Tire, Wheel and Trim Subsystem includes:

- Road tires and wheels; spare tire and wheel; wheel trim; tire air valves and extensions; balance weights; wheel nuts and wheel lock nuts; wheel bolts and wheel lock bolts, labels specific to tires; wheels, and wheel nuts and trim.

The function of the Tire, Wheel and Trim Subsystem is to:

- Support the weight of the vehicle, occupants and luggage.
- Provide isolation from road surfaces.
- Provide road holding capability for vehicle stability.
- Provide traction for vehicle during acceleration, driving and braking.
- Provide aesthetic appeal to vehicle appearance.
- Provide uniform low levels of dynamic force characteristics during various road/driving conditions.

**3.1.1 Appearance.** The appearance of Tire, Wheel and Trim shall implement the overall theme developed by GM Design Staff and approved by the Marketing division. GM Design Staff will adhere to the Tire-Wheel Systems engineering design criteria requirements in the design development process.

- For tires, no indentations in sidewall, no bulges in sidewall, and no appearance disturbing vent nipples on side wall of tire are permitted.

**3.1.2 Content.** The required physical and functional content for the Tire, Wheel and Trim are identified in 3.1.2.1 and 3.1.2.2.

**3.1.2.1 Physical Content.** See Part SOR Appendix C2 for Program Specific Requirements. See GM K-PAC Best Practice TIRE-WHEEL-17 Global Common Standard Wheel Interfaces Drawing. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.

**3.1.2.2 Functional Content.** The Tire, Wheel and Trim provide the following functions, as depicted in Figure 1, Tire, Wheel and Trim Functional Flow Diagram:

- Support the weight of the vehicle, occupants and luggage.
- Provide isolation and driving performance under all projected customer use conditions short of significant impacts or road hazards.
- Provide fundamental spring and dampening for the vehicle.
- Provide traction for vehicle acceleration, driving, braking and cornering.
- Minimize road noise transmitted to the passenger compartment.
- Allow for an adequate amount of airflow to cool the brakes.
- Provide for retention of wheel to spindle and all trim components to wheel.
- Allow for wheel and tire service.

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- Provide a spare tire/wheel assembly for emergency use. Depending on product program the car might be equipped with Run Flat Tires (RFT), Tire Sealant and Compressor Kit (TSCK), or Sealant Tires.
- Complement the overall styling theme of the vehicle.
- Provide for tire chain use.

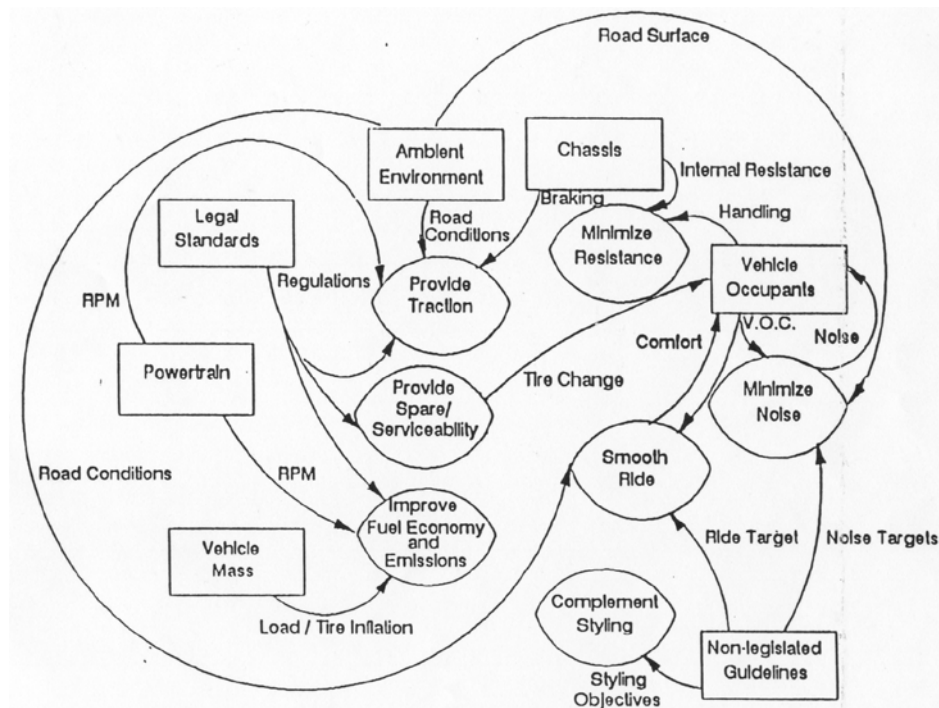


Figure 1: Tire, Wheel, and Trim Functional Flow Diagram

**3.1.3 Ambient Environment.** The Tire, Wheel and Trim Subsystem shall withstand the conditions listed in 3.1.3.1 through 3.1.3.7.

#### 3.1.3.1 Corrosion.

**3.1.3.1.1 Functional Performance.** The Tire, Wheel and Trim Subsystem shall not degrade after being exposed to road and atmospheric corrosion, equivalent to 15 years as determined by GM durability schedules (in the case of tires, it pertains to the usable life of the tire tread).

**3.1.3.1.2 Cosmetic Performance.** The Tire, Wheel and Trim Subsystem shall not have a degraded appearance after being exposed to sun loading, hot and cold temperatures, water, various chemicals, or other environmental elements for a period of up to 4 years.

**3.1.3.2 Chemical Exposure.** The Tire, Wheel, and Trim shall be resistant to reasonable exposure to or be protected from the contaminants in Table 1.

Table 1: Chemical Exposures

| Chemical Exposure and Contaminants Chassis Components |          |                                |           |
|-------------------------------------------------------|----------|--------------------------------|-----------|
| Element                                               | Exposure |                                |           |
|                                                       | None     | Short time, removed within 1 h | Prolonged |
| Water, Snow, Ice                                      |          |                                | X         |
| Acid Rain                                             |          |                                | X         |

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| Chemical Exposure and Contaminants Chassis Components                                                                      |          |   |   |
|----------------------------------------------------------------------------------------------------------------------------|----------|---|---|
| Element                                                                                                                    | Exposure |   |   |
| Road Salt                                                                                                                  |          |   | X |
| Sand, Gravel                                                                                                               |          |   | X |
| Dirt/Grit (Mud/Dust)                                                                                                       |          |   | X |
| Road Oil, Tar                                                                                                              |          |   | X |
| Leaves, Mold, Fungus                                                                                                       |          |   | X |
| Sap, Insects, Animal, Animal Waste                                                                                         |          |   | X |
| Ozone                                                                                                                      |          |   | X |
| Ultraviolet Light                                                                                                          |          |   | X |
| Fuels                                                                                                                      |          |   |   |
| Gasoline                                                                                                                   |          | X |   |
| Diesel Fuel                                                                                                                |          | X |   |
| Fuel Additives                                                                                                             |          | X |   |
| Ethanol                                                                                                                    |          | X |   |
| Lubricants and Auxiliary Fluids                                                                                            |          |   |   |
| Engine Oil                                                                                                                 |          |   | X |
| Transmission Fluid                                                                                                         |          |   | X |
| Differential Fluid                                                                                                         |          |   | X |
| Wheel Bearing Lube                                                                                                         |          |   | X |
| Constant Velocity Joint Lube                                                                                               |          |   | X |
| Power Steering Fluid                                                                                                       |          |   | X |
| Brake Fluid                                                                                                                |          |   | X |
| Engine Coolant                                                                                                             |          |   | X |
| Air Conditioning Refrigerant                                                                                               |          |   | X |
| Battery Fluid                                                                                                              |          | X |   |
| Rust Proofing or Undercoating                                                                                              |          |   | X |
| Diesel Emission Fluid                                                                                                      |          | X |   |
| Detergents and Cleaners                                                                                                    |          |   |   |
| Windshield Washer Fluid                                                                                                    |          |   | X |
| Ammonia Glass Cleaner                                                                                                      |          |   | X |
| Tar Remover                                                                                                                |          | X |   |
| Detergent, Wheel, Tire, and Engine Cleaners                                                                                |          | X |   |
| Deicing and Dust Control Chemicals (NaCl <sup>Note</sup> , CMA <sup>Note</sup> , CaCl <sub>2</sub> <sup>Note</sup> , etc.) |          | X |   |

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| Chemical Exposure and Contaminants Chassis Components |          |   |  |
|-------------------------------------------------------|----------|---|--|
| Element                                               | Exposure |   |  |
| Steam Cleaning                                        |          | X |  |

**Note:** NaCl = Sodium Chloride, CMA = Calcium Magnesium Acetate, CaCl<sub>2</sub> = Calcium Chloride.

**3.1.3.3 Ozone Exposure.** The Tire, Wheel, and Trim shall be resistant to ozone concentration (instantaneous) seen by the subsystem, is 0.40 ppm with an average of 0.029 ppm.

**3.1.3.4 Road Conditions.** The following are conditions that the vehicle can be expected to see during 240 000 km (150 000 mi) for cars and light duty trucks during 15 years of customer usage.

- a. Road Surface.
- b. Material and Surface.
  1. Grass, wood, dirt, metal grating, sand, brick and cobblestone, gravel, concrete, and asphalt.
  2. Condition; smooth and rough.
  3. Road ruts (groove wander), wash boards, potholes, and bumps.
- c. Road Cover.
  1. Dry, dew and water depth (area of coverage, pH and salt concentration, and NaCl and CaCl<sub>2</sub>).
- d. Oil and Grease.
  1. Mud, slush, snow, ice, dust, sand, miscellaneous particles, and miscellaneous debris.
- e. Roadside Characteristics.
  1. Shoulders, material, and softness.
- f. Parking Provisions.
  1. Curb parking, parking lots, and parking structures.
- g. Roadway Obstacles.
  1. Barricades, accidents and other emergencies, small rocks, debris, and animals.
- h. Special Features.
  1. Railroad crossings, bridges/overpasses, tunnels/underpasses, and streetcar/trolley tracks.
- i. Moving Vehicles.
  1. Weaving/wandering, skidding, swerving, crossing lanes, leaving road, and crossing median.

**3.1.3.5 Operating Conditions.** The Tire, Wheel and Trim will satisfy the operating performance requirements within the following ambient conditions:

- Ambient Temperature: -40 °C to 49 °C.
- Relative Humidity: 1% to 100%.
- Altitude: -152 m to 4572 m (-500 ft to 15 000 ft).

Ambient air temperature is the temperature of the air surrounding a vehicle under standard conditions of ventilation and solar radiation shielding as found in a meteorological shelter. This may be different from the temperature that the vehicle is required to operate in. The anticipated maximum and minimum ambient air temperatures are specified in Table 2.

**Table 2: Ambient Air Temperature, Maximums and Minimums**

| Region                      | Minimum Temperature | Maximum Temperature |
|-----------------------------|---------------------|---------------------|
| Worldwide Default           | -48 °C (-55 °F)     | 52 °C (125 °F)      |
| Russia (Siberia)            | -51 °C (-60 °F)     | Not applicable      |
| Middle East <sup>Note</sup> | Not applicable      | 55 °C (130 °F)      |

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**Note:** Middle East = Iran, Saudi Arabia, Iraq, Oman, Yemen, and United Arab Emirates.

**3.1.3.5.1 Induced Vibration.** During and after use on varied road surfaces, the Tire, Wheel and Trim shall:

- Remain intact and undamaged during normal driver usage.
- Maintain inflation integrity such that pressure loss is not perceived by customer as a leak.
- Retain wheel and trim throughout the life of the vehicle.
- Be free of rattles, squeaks, buzzes, etc.
- Shall meet all requirements with vehicles equipped with anti-lock brakes and/or traction control.

**3.1.3.5.2 Squeak and Rattle Avoidance.** The following requirements apply to all configurations when installed in a vehicle when subjected to the static and dynamic test conditions specified in GMW8518.

**3.1.3.5.2.1** The requirement for this program is to have absolutely no customer annoyance due to squeaks and rattles. The final authority for the determination of whether a noise is objectionable lies with the Buyer Lead Engineer and/or the Squeak and Rattle (S&R) Engineer. Squeaks and rattles include, but are not limited to all the noises described in the Squeak and Rattle Noise Glossary.

**3.1.3.5.2.2** The Supplier is to accept full responsibility to produce squeak and rattle free subsystems and/or components. The Supplier shall cooperate with Buyer and/or other Suppliers to assure that no squeak and rattle annoyance occurs at the interface of their subsystem/component to the body, chassis or other subsystem/component. If an objectionable noise is found during any phase of the program, it will be the Supplier's responsibility, with Buyer cooperation, to eliminate the noise and demonstrate resolution in a vehicle prior to exiting the program phase. If the noise is found in pilot or production, the supplier will be responsible to develop a containment plan (and fix), as well as short and long term solutions, as appropriate. Any issue raised during these processes, which is demonstrated to be the responsibility of the Supplier, shall be corrected with urgency at no additional cost to GM. The Supplier will be responsible for the S&R performance of their subsystem.

**3.1.3.5.3 Shock.** The Tire, Wheel and Trim may experience shock from, but not limited to, the following conditions: potholes, curb impacts, brake spikes and vehicle acceleration.

**3.1.3.6 Non-Operational Conditions.** The non-operating temperature range for the Tire, Wheel and Trim is -51 °C to 70 °C at an altitude range of -152 m to 13 716 m (-500 ft to 45 000 ft).

**3.1.3.7 Wheel/Trim Environmental Requirements.** See Component Technical Specification and detail drawings.

**3.1.4 Interfaces.** The Tire, Wheel and Trim interface with several physical entities that will affect or constrain its functionality and design. These interfaces are described in 3.1.4.1 through 3.1.4.3.6.

**3.1.4.1 External-to-Vehicle to Subsystem.** The major interfaces with items outside of the vehicle pertain to those in the service environment.

**3.1.4.1.1 Service Tools.** The wheel and wheelhouse design shall allow the use of common service tools, such as air and manual wrenches for wheel nut removal and tightening.

**3.1.4.1.2 Balancing Equipment.** The wheel/tire shall allow the use of common static and dynamic balancing equipment. Also, the inner and/or outer wheel flanges shall accept clip-on style balance weights when clip-on style balance weights are used. When stick-on style balance weights are used, the inner and/or outer plane shall be used to accept stick-on style balance weights.

**3.1.4.1.3 Service Tire Mounting Equipment.** The wheel/tire shall allow the use of common service tire mounting equipment without cosmetic or functional damage to the tire/wheel or damage to the tire bead or wheel bead seat when used per manufacturer's instruction.

**3.1.4.1.4 Alignment.** The tire/wheel design shall accommodate the use of common wheel alignment equipment.

**3.1.4.1.5 Tire Inflation.** The tire air valve shall have a design and placement so that tire pressure can be easily checked and the tire can be inflated if necessary.

**3.1.4.1.6 Curbs.** The wheel and trim shall be designed to clear a 160.0 mm (6.3 in) and 203.2 mm (8 in) curb per the requirements of wheel criteria drawing.

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**3.1.4.1.7 Tire Chains.** The Tire/Wheel/Trim Subsystem shall be capable of using tire chains for government mandated countries and for program team designated non-government mandated countries.

**3.1.4.1.8 Car Wash.** The Tire/Wheel/Trim design shall be such that when taken through common car wash facilities, there is no cosmetic or functional damage to the Tire/Wheel/Trim.

**3.1.4.2 Subsystem to Subsystem.** The Tire, Wheel and Trim have interfaces with other subsystems as defined in 3.1.4.2.1 through 3.1.4.2.11.

**3.1.4.2.1 Speedometer Subsystem.** Tire Revolutions Per Kilometer (RPK) are required for determining nominal speedometer calibration. Tire variations and tire pressure impact RPK, which in turn has an impact on the vehicle speed registered on the speedometer.

- The vehicle maximum speed should be compatible with the tire speed rating.

**3.1.4.2.2 Applied Exterior Panels.** The sheet metal blocks road spray and stones thrown from the tire. Also, as the suspension moves in its full range of motion, contact should not occur between the tire/wheel and sheet metal or other cosmetic body materials per GM Tire Flop Clearance and Running Clearance Requirements. The clearance requirements apply for tire chains when used on the drive axle with the tire sizes as described in the Owner's Manual.

- The body sheet metal and trim should not interfere with the removal and installation of a tire/wheel assembly when using the vehicle jack and tools.

**3.1.4.2.3 Bumpers and Fascia.** The bumpers and fascia should not contact the tire/wheel during full suspension motion. Also, the spring rate and loaded radius of the tire affects bumper height of the vehicle.

**3.1.4.2.4 Body Structure.** In addition to interface requirements identical to 3.1.4.2.2, the structure shall accommodate loads transmitted and minimize the transmission of noise and vibration from the tire/wheel.

**3.1.4.2.5 Stowage/Spare Tire Packaging.** Accessible stowage of the spare tire/wheel assembly shall be provided on the vehicle.

Secure stowage of a flat road tire/wheel shall also be provided for safety reasons. It is recommended that spare tire will be stored with the tire air valve accessible.

**3.1.4.2.6 Vehicle Tools.** The vehicle tools provided shall be compatible with the wheel, wheel trim and wheel nuts or wheel bolts on the vehicle. The tools shall allow the removal of wheel trim without cosmetic or functional damage. The tools shall be capable of installing and removing wheel nuts in excess of the nut torque indicated for service. In addition, the Owner's Manual shall list the required wheel nut torque and describe or show the proper removal of wheel trim necessary to change a tire/wheel. The tools shall be able to remove wheel trim with a flat tire before jacking if necessary.

**3.1.4.2.7 Brakes and Brake Controls.** The wheel/tire shall have necessary clearance to the brake calipers, cables and hoses. In addition, the airflow and cooling requirements for the brakes impact the wheel design. The tires have a significant effect on braking performance, including stopping distance and tire noise under braking (howl and squeal). Brake rotor out-of-flatness affects smooth ride.

- The wheel shall have clearance to the brakes and tinnerman clips (when tinnerman clips are used) per wheel criteria requirement drawing.
- The wheel/trim vent area and overlap impacts brake cooling and brake temperatures affect wheel trim operational environment.
- Brake rotor/drum wheel mounting face Total Indicated Run-out (TIR), rotor thickness/drum roundness variation, and rotor/drum balance impacts vehicle ride smoothness.
- Tire rolling resistance and braking coefficients impact stopping distance.
- Difference in tire RPK between road tires and between compact spare and road tires may impact the function of the Anti-lock Brake System (ABS) and Traction Control System (TCS).
- Spare tire/wheel size and offset affects brake pull and vehicle handling.
- Spare tire size and spare wheel offset must be compatible with on-vehicle performance.
- Wheel mounting face and configuration has an effect on brake rotor load and fatigue life.
- The maximum wheel mounting surface diameter is to be as shown on wheel criteria requirements drawing.

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