GM	WORLDWIDE ENGINEERING STANDARDS	General Specification	GMW14095

Steering Wheel Assembly - Requirements

1 Introduction

The steering wheel assembly is a component of the steering and restraint subsystems.

Steering wheel requirements consist of two parts:

- Steering Wheel Assembly – Requirements per GMW14095
- GM Steering Wheel Mounted Accessory Control Switches per 25757496

Steering wheel verification requirements (validation) consists of one part:

- Steering Wheel Assembly – Verification Requirements per GMW14096

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 Scope. This document details the requirements for a Steering Wheel Assembly Component (referred to as the Steering Wheel) to be used on vehicles produced by General Motors Worldwide. As defined by the responsible Vehicle Engineering Center (VEC), the Steering Wheel consists, as applicable, of an armature, steering wheel molding assembly, back cover, leather wrap or synthetic wrap, wiring, floating horn mechanism, trim plates and switches.

Any vehicle level and steering wheel interface requirements contained herein **shall** be addressed by the responsible VEC(s). The Steering Wheel supplier **shall** work cooperatively with the responsible VEC(s) and any other component supplier(s) in resolving any identified interface, design or functional issues. The responsible VEC(s) **shall** be the final arbiter of any vehicle level and interface requirements.

1.2 Mission/Theme. The main purpose of the steering wheel assembly is to allow the driver to maneuver the vehicle. The steering wheel assembly is to function with the Driver Airbag (DAB) Module Inflatable Restraint and the steering column to create a Driver Airbag Module/Steering Wheel Assembly/Steering Column system. The system supplements the restraint offered by the seat belt systems for frontal collisions. The system is intended to, reduce injury potential in those frontal accidents where there is a significant risk that the driver might otherwise be seriously injured, meet applicable regulations, and address GM Worldwide performance goals referenced in Section 2.

1.3 Classification. Not applicable.

2 References

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

2.1 External Standards/Specifications.

49CFR107.105	ASTM E505-01	FMVSS 208	SAE J1128
67/548/EEC	CAA, Sec. 610(d)	FMVSS 302	SAE J1344
70/311/EEC	CMVSS 101	GB 8410-1994	SAE/USCAR-2
74/60/EEC	CMVSS 201	GB 11551-2003	SAE/USCAR-12
74/297/EEC	CMVSS 203	GB 11552-1999	SAE/USCAR-20
78/316/EEC	CMVSS 208	GB 11557-1998	SAE/USCAR-21
78/632/EEC	CMVSS 302	IEC 68-2-14 Na	SAE/USCAR-25
91/662/EEC	CONTRAN 463/73	IEC 68-2-14 Nb	SFS 1991:1289
95/28/EEC	DOT-E 8273	IEC 68-2-27 Ea	TRIAS 10
96/79/EEC	ECE R12	IEC 68-2-38 Z/AD	TRIAS 27

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2000/53/EEC	ECE R21	IEC 68-2-64	TRIAS 34
ADR 12/00	ECE R94	ISO 1431-1	TRIAS 47
ADR 18/02	EN 10204	ISO 11469	TRIAS 48
ADR 21/00	FMVSS 101	ISO 3795-76	TS-INT-001
ADR 69/00	FMVSS 201	KMVSS 95	
ASS 90	FMVSS 203	KMVSS 203	

2.2 GM Standards/Specifications.

GM9538P	GMW3402	GMW14207	GMW14797
GMW3059	GMW3417	GMW14296	GMW14864
GMW3097	GMW3428	GMW14334	GMW14867
GMW3109	GMW3431	GMW14439	GMW15010
GMW3112	GMW6992	GMW14444	GMW15272
GMW3116	GMW7293	GMW14573	GMW15424
GMW3172	GMW7699	GMW14594	GMW15634
GMW3191	GMW8518	GMW14595	GMW15987
GMW3205	GMW8738	GMW14596	GMW16323
GMW3232	GMW14011	GMW14597	GMW16626
GMW3235	GMW14096	GMW14598	GMW16629
GMW3286	GMW14181	GMW14599	

2.3 Additional References.

- 25757496 (Steering Wheel Mounted Control Switch Component Technical Specification)
- Best Practices (The supplier shall work with the GM Design Release Engineer (DRE) to comprehend this requirement)
- Cold Weather Proving Grounds Vehicle Durability Test Schedule
- Component Specification and Requirements of Steering Wheel Accessory Control Switches
- GM Master Standards
- GMLS-001
- GMLS-011
- Guidelines for Harness Coverings
- Kent-Moore Tool J-35616
- Power and Signal Distribution Subsystem Technical Specification for North American Vehicle Platforms
- Statement of Requirements (SOR)/SOR Appendix
- Subsystem Technical Specification (SSTS) 861

Use of the following GM documents is recommended during Steering Wheel/Driver Airbag Module design and development:

- Avoidance Plan – Assessment Work Sheet Blank Template – Squeak and Rattle (S and R)
- Dimensional Technical Specifications (DTS)
- Geometric Dimensioning and Tolerancing (GDT)
- Isolation Material Selection Guide
- Material Compatibility (Subjective) Matrix
- Material Compatibility Smart Matrix
- MATSPC (Material Specifications)
- Preferred Material Catalog (PMC)
- Squeak and Rattle Noise Glossary
- Steering Wheel Best Practices and Knowledge Sets

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3 Requirements

This section, inclusive of all subparts, defines the requirements for the steering wheel assembly. Specific validation procedures for each subsection are listed in Table 4 (see 4.2). The companion verification document(s) contain validation tests, procedures and documentation protocol.

The use of "**shall**" in this document denotes a binding provision that must be met unless a deviation is granted by the responsible VEC(s). Deviations to "**shall**" requirements will only be considered and, if approved, granted by the responsible VEC(s) after evaluating appropriate available technologies and balancing all steering wheel and restraint system performance considerations.

The use of "**should**" denotes a preference or desired conformance, which must be tested and, if not met, must be documented by the supplier and disclosed to the responsible VEC(s). Non-compliance to "**should**" requirements must be approved by the responsible VEC(s).

The term Steering Wheel refers to the Steering Wheel Assembly subsystem and not a specific component (i.e., the molding assembly).

Unless otherwise noted, all requirements apply over the environments (see 3.1.3) and the steering wheel Reliability Evaluation Point (see 3.2.3.1).

If requirements stated herein are not objectively defined, the responsible VEC(s) **shall** be the final arbiter of these requirements.

3.1 System/Subsystem/Component/Part Definition. The Steering Wheel provides support to the Driver Airbag Module supplemental restraint for the vehicle's driver in frontal collisions and may at the responsible VEC(s) option, include, as applicable, accessory control function and other subcomponent(s).

a. The steering wheel molding assembly consists of the structural armature (frame) assembly which may be of a solid ferrous, non-ferrous, molded or composite construction that is used to produce a molded steering wheel that meets program specific Polar Moment of Inertia (PMI) requirements while meeting facial load requirements. The armature assembly may also be attached, after molding, as a subsequent operation.

b. The steering wheel assembly consists of the items defined in 3.1 (a.), with the addition of the following items and components (when specified).

- The Back Cover (when specified)
- Leather or Synthetic Wrap (when specified)
- Wood (when specified)
- Trim Parts (when specified)
- Tuned Absorber (when specified)
- The Horn Parts (when specified)
- Heating Components (when specified)
- The Accessory Controls (when specified)
- **Note:** The accessory controls may include functions for cruise control, radio control, Heating, Ventilation and Air Conditioning (HVAC) driver information center, transmission, cellular phone, heat and other similar controls.

c. The system will be defined as the complete steering wheel assembly and driver airbag assembly. An illustration of entities that have major influence on the functionality, design, and/or implementation of the steering wheel assembly is provided by the functional context diagram of Figure 1 and Figure 2.

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Figure 1: Steering Wheel Assembly Functional Context Diagram Top View

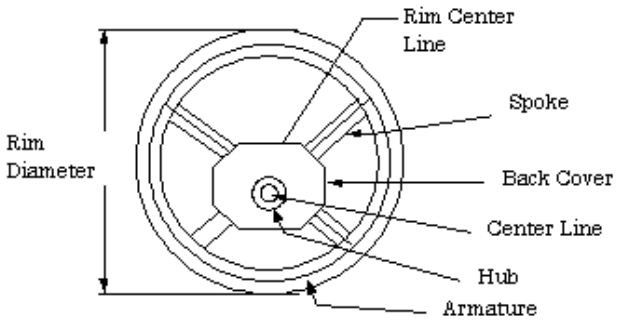
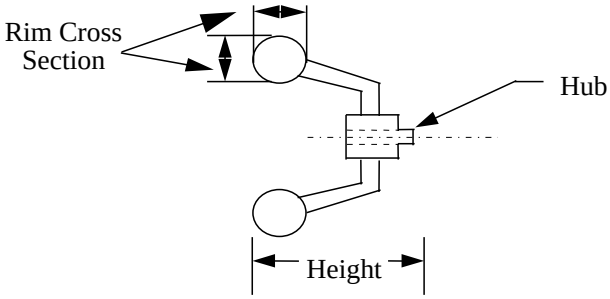


Figure 2: Steering Wheel Assembly Functional Context Diagram Side Sectional View



3.1.1 Appearance. The steering wheel assembly (show surface) **shall** conceal the wheel's structural armature and components, the inside of the Driver Airbag Module and the upper-end of the steering column, and provide a uniform smooth surface without bumps, bubbles, roughness, pits, swelling or peeling or other distortions.

3.1.1.1 Color/Gloss/Grain. The steering wheel assembly **shall** match GM "master" color and grain standards as specified on Visual Evaluation of Automotive Trim (GMW6992). The steering wheel assembly **shall** have a uniform gloss, visually matching the standards specified in the Appearance Requirements Drawing (ARD) maintained by the GM Appearance Engineering Group. Standards are available from Thierry Corporation, Royal Oak, Michigan. All components specified as low gloss must be fabricated using materials and processes, which are capable of consistently matching the specified gloss standard in volume production. In addition the chosen materials for each component must support an overall uniform low gloss appearance within and across assemblies such that the components and assemblies appear to have been uniformly coated with a low gloss interior paint. All appearance surfaces and parting lines are to satisfy visual inspection standards as defined by GMW15424. The responsible release VEC(s) **shall** approve gate location and size (length and width). Additional appearance requirements are given in the following paragraphs.

3.1.1.2 Steering Wheel Assembly Fit and Finish. The steering wheel assembly **shall** meet all vehicle-specific fit and finish criteria that appear on the Best Practices and DTS. The fit and finish guideline criteria has been established to ensure proper fit, function, and appearance of the steering wheel assembly, all attached trim components, switches, and the Driver Airbag Module assembly.

3.1.1.3 Perceptual Quality.

3.1.1.3.1 Integration Appearance.

a. **Shall** be rigid with no perceivable unintentional deflection under normal use, feel and appearance of a rigid mount.

b. Joint interface and perimeters **shall** be net fit and flush with minimized and uniform gaps to the interfacing surface (approved by Design Studio).

   1. **Shall** meet or exceed Dimensional Technical Specifications (DTS) targets for gap and flush.
   2. Should have joint lines that are out of front occupant visual sight line.
   3. **Shall** minimize the number and length of joint lines.
   4. Joint lines should not be on the horizontal surface edge to avoid visual variation of surfaces between components.

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c. It should be easy to reach and actuate all components on steering wheel (e.g., human factor requirements for reach and button size).
d. Rim shape changes (e.g., finger grips) should be purposeful and feel correct and substantial (e.g., human factor requirements).
e. Integration and offsets should appear purposeful.
f. All surfaces and components **shall** be finished, styled and integrated in all operating positions.
g. All decorative materials (e.g., moldings) should be refined, finished, precise, have a consistent appearance and be well integrated and competitively appropriate.
h. There **shall** be no exposed or touchable fasteners, gaskets, welds, sealers, adhesives, mechanical components, or assembled components (underlying mechanisms, fasteners).
i. Seams, stitching and joints should appear precise, uniform and purposeful (e.g., no waviness or misalignment).
j. There **shall** be no rat holes.
k. Wiring **shall** be concealed.

3.1.1.3.2 Component Appearance.

a. All Materials **shall** have a pleasing tactile feel/surface quality.
b. All components (e.g., levers, switches, etc.,) finish should be competitively appropriate as mandated by Design Center.
c. All components finish levels should be coordinated (e.g., gloss, grain, materials) with surrounding components (steering wheel, lever, shroud, cluster) and minimize glare.
d. Components **shall** be finished, styled, and integrated in all operating positions (buttons, levers).
e. Flushness should be consistent between components and overall styling theme (e.g., buttons on wheel, buttons under wheel) and be approved by the Design Manager.
f. Components **shall** have no sharp/exposed corners.
g. Button/components should minimize bezels and match contour at interfaces: utilize simple shapes, straight lines, and simple curves.
h. Button/components should be lighted or back lighted.
i. Components **shall** not interfere with operation, feel, or induce unwanted sound.
j. Components should fit precisely with no apparent surface disruptions or distortions and appear integrated.
k. Components **shall** have consistent appearance with surrounding components.
l. Components **shall** have no visible, unfinished or raw edges.
m. Surfaces **shall** be free of surface irregularities (e.g., distortion, sink marks, parting lines, wrinkles, knit lines, material flow gates, injector pin marks, etc.,) that are visible to the customer during normal use.
n. Parting lines and/or flash **shall** not be visible or touchable.

3.1.1.3.3 Graphic Appearance.

a. Graphics shall be centered and clearly mark location and function.
b. Any graphics on the primary/show surface shall have studio approval.
c. Avoid coverings that create reflection or glare over graphics.

3.1.2 Content. The physical and functional content of the steering wheel assembly are identified in the following paragraphs.

3.1.2.1 Physical Content. Program and VEC specific Steering Wheel content and interface requirements **shall** be defined in a Program Specific SOR and SOR Appendix. All Steering Wheel baseline and optional content **shall** be subject to the requirements stated within this document.

The following paragraphs define the typical physical content of the assembly in terms of baseline and optional content items.

3.1.2.1.1 Baseline Content. The following elements constitute a baseline steering wheel assembly.

a. Steering wheel molded assembly.
b. Styled material covering to meet Design Center criteria.

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c. The styled material **shall** utilize an in-mold paint type process and the Ultraviolet (UV) stabilized *substrate* foam **shall** be 80% to 100% color match, if applicable. The number of colors will be provided in the SOR and SOR Appendix.

d. A solid armature (structural insert) which **shall** perform the following functions.

   1. Support the material in 3.1.2.1.1 b.
   2. Provide a means of attachment to the steering column.
   3. Provide a means of attachment for the Driver Airbag Module. The module attachment **shall** consist of snap-in fasteners, description to be provided in the SOR and SOR Appendix. All wire routing attachment features to be utilized by GM personnel at a GM assembly plant or staging plant **shall** be of a snap-in nature.
   4. Provide a means of attachment and wire routing for the additional items and components listed above in 3.1 b. The assumed attachment method including fasteners **shall** be included with the quote.
   5. Provide means of disassembly from the steering column without a special tool.
   6. Provide support for the airbag cushion during any type of Driver Airbag Module deployment conditions, including but not limited to documents listed in Section 2.
   7. Provide a means of support to the occupant during crash performance.

e. Back Cover as specified in the SOR and SOR Appendix.

f. Horn mechanism - Full-frontal floating mechanical-type horn. (When specified).

g. Horn Wiring – The electrical power and ground for the horn mechanism **shall** be capable of being provided through the clock coil coupling device.

3.1.2.1.2 Option Content. The following elements are optional items that may be added to the baseline assembly depending on specific vehicle requirements, as specified in the SOR and SOR Appendix:

a. Top-grain leather covering (e.g., leather call outs; WGWADA, WGWBDA or WGWBBX), up to four rim seams.

b. Split Grain Leather

c. Synthetic Leather

d. Wood

e. Heater mechanism under the leather or synthetic wrap covering.

f. Post-mold painted components

g. Molded-in color components

h. Multiple color components

i. Accessory controls and wiring as specified (Examples include radio, HVAC, cruise control, transmission and driver information center).

j. Cellular Phone

k. Horn Circuit/Wiring

l. Steering Wheel Emblems

3.1.2.2 Functional Content. The Steering Wheel Assembly **shall** provide the following functions.

a. Provide vehicle maneuvering to the driver.

b. Interact with the Driver Airbag Module/Horn Pad and steering column to enhance vehicle safety.

c. Incorporate controls for the vehicle's horn and in some applications, for the radio, HVAC, cruise control, driver information center, transmission and/or cellular phone.

d. Harmonize with the vehicle's interior-appearance theme.

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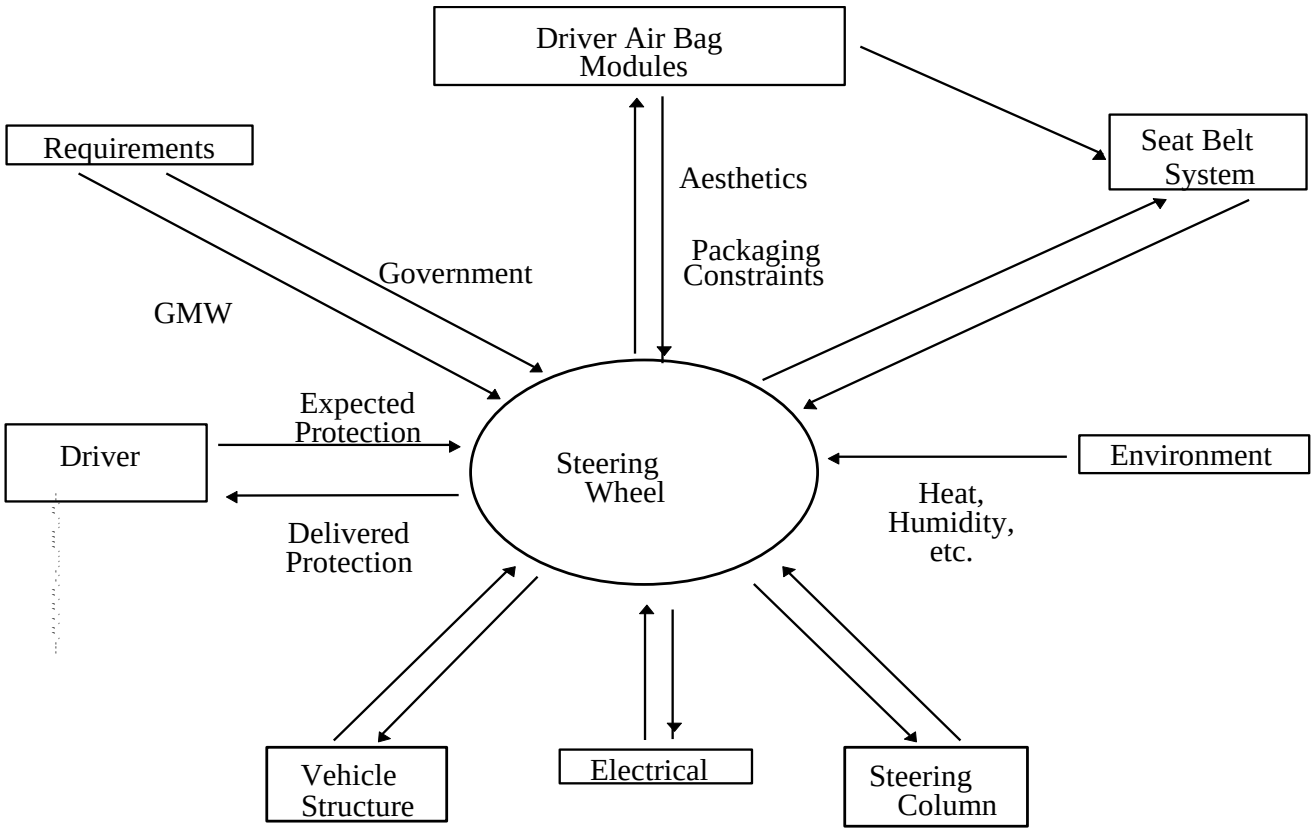
Figure 3: Steering Wheel Functional Context Diagram



3.1.3 Ambient Environment. The Steering Wheel **shall** be exposed to varying environmental conditions. Environmental elements which may impact the appearance, function and/or performance of the Steering Wheel include, but are not necessarily limited to, altitude differentials, humidity, temperature, solar exposure, dust, ozone, salt spray, sulfur dioxide, perspiration, manufacturing contaminants, cleaning contaminants, vibrations, dynamic shock, electromagnetic interference, coffee, tea, cola, ketchup, milk chocolate, isopropyl alcohol, Sunscreen, Bug Repellant, vehicle fuels and paint thinner.

3.1.4 Interfaces. Figure 4 shows the block diagram for the Steering Wheel and interfaces prior to deployment.

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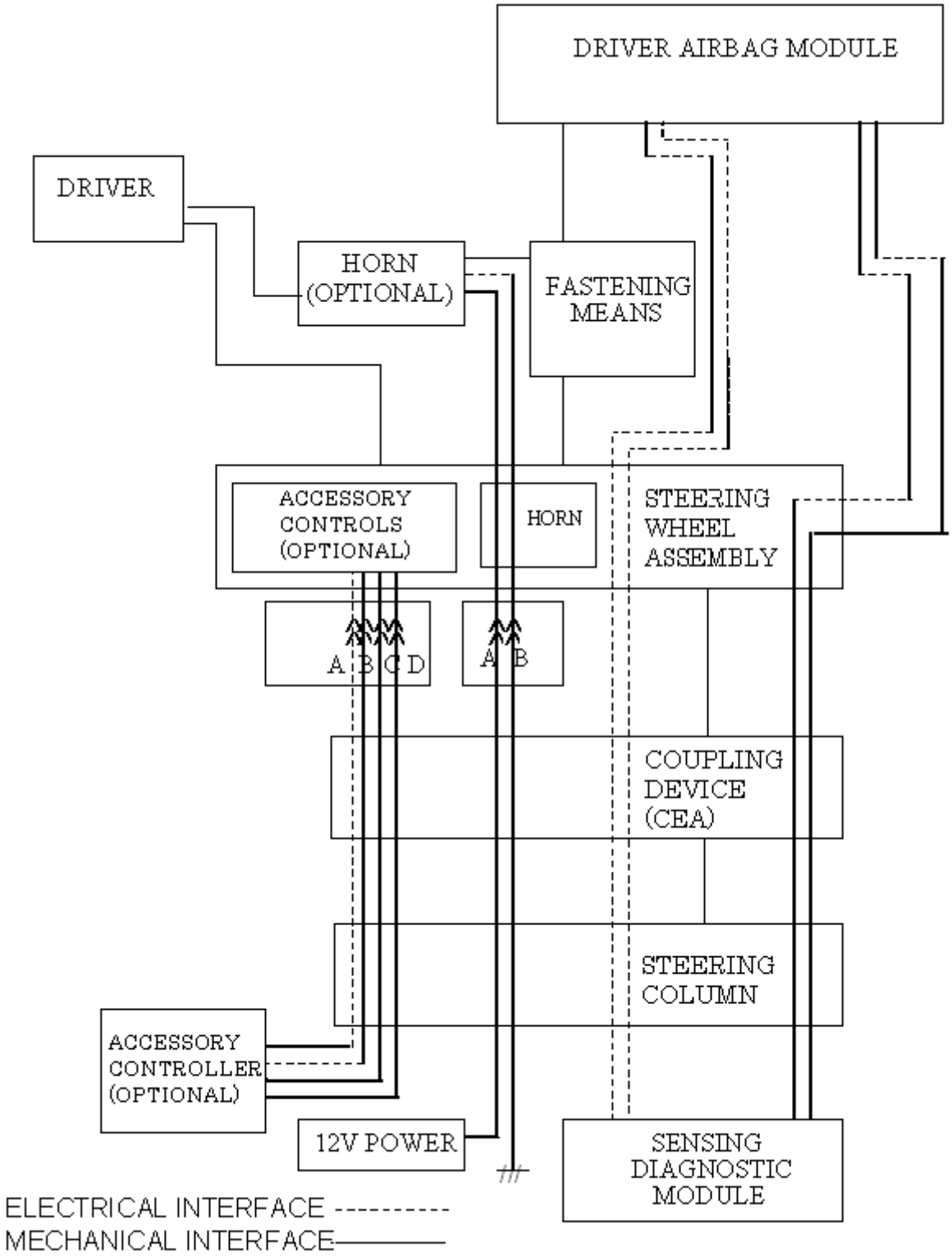
Figure 4: Steering Wheel and Interfaces, Pre-deployment



3.1.4.1 Mechanical Interface. Steering Wheel interface development to meet the following requirements **shall** be jointly done on a systems basis by the Responsible VEC(s) and the Steering Wheel Supplier(s). The Responsible VEC(s) and Steering Wheel Supplier(s) **shall** cooperate to resolve all design and functional interface issues.

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The Steering Wheel **shall** be compatible with the Driver Airbag Module and/or the steering column attachment structure. The Steering Wheel **shall** also be compatible with VEC specified horn designs and/or accessory control designs. Driver Airbag Module interface development to meet the following requirements **shall** be jointly done on a systems basis by the Responsible VEC(s) and the component supplier(s). The Responsible VEC(s) and component supplier(s) **shall** work cooperatively in resolving potential design and function interface issues. The steering wheel assembly **shall** provide a means of attachment to the steering column, Driver Airbag Module and any electrical switches. Provisions will be necessary to allow electrical wires to pass through the hub area into the steering column at the 12 o'clock and 6 o'clock positions. Typical wires may include but are not limited to functions for:

- Horn and Switches
- Driver Airbag Module
- Radio, HVAC Controls
- Cruise Control
- Cellular Phone
- Transmission Shift Controls
- Driver Information Center
- Heated Steering Wheel

3.1.4.1.1 Material Interface/Compatibility. This requirement applies to material interface/compatibility for the Steering Wheel and its subcomponents as well as for the Steering Wheel and mating subsystem/component interfaces. The physical properties of all subcomponents of the Steering Wheel **shall** be compatible so as not to adversely affect the requirements stated herein.

Note: All production Steering Wheel colors shall be evaluated.

3.1.4.1.1.1 Steering Wheel Subcomponents and Interface Subsystems/Components.

a. **Shall not** adhere to other Steering Wheel subcomponents or interface subsystems/components (e.g., DAB Module and Steering Column).

b. **Shall not** chemically react with other Steering Wheel subcomponents.

c. **Shall not** be adversely affected by other Steering Wheel subcomponents in any way.

d. The material expansion/contraction characteristics of the Steering Wheel and the mating subsystem(s)/component(s) **shall** be compatible throughout the conditioning temperature ranges defined in 3.2.1.2.4.

e. The Steering Wheel supplier **shall** cooperate with the Responsible VEC(s) to optimize Steering Wheel-to-mating subsystem fit and compatibility over all conditioning temperatures. The Responsible VEC(s) **shall** judge and be the final arbiter of Steering Wheel level fit and compatibility over all conditioning temperature(s).

3.1.4.1.1.2 Material Transfer to Interior Components. The Steering Wheel should not transfer materials by off-gassing or other means to vehicle windows and other interior components. The window glass sample reflectivity **shall** be 90% or greater of baseline following Fog Resistance test per GMW14444.

3.1.4.1.2 Attachment. The Steering Wheel **shall** be secured to the steering column as specified in the SOR and SOR Appendix.

a. The DAB Module **shall** be secured to the floating horn assembly (when specified)/Steering Wheel by snap-in attachments as specified in the SOR and SOR Appendix (A snap-in attachment is a fastener that mechanically latches into position when inserted into its receptacle). The attachment **shall** meet or exceed all fit, vibration and deployment and life cycle requirements of this specification. All fasteners **shall** be qualified per the SOR and SOR Appendix and/or "as approved by GM Fastener Engineer" prior to usage. The Steering Wheel **shall** be compatible with a "design for assembly" philosophy allowing installation and in-vehicle removal of the DAB Module and Steering Wheel with the steering column and instrument panel in place.

b. A special tool **shall** not be required to disconnect a snap-in DAB Module attachment.

c. The attachment criteria that **shall** be used for the snap-in Driver Airbag Module are shown in the SOR and SOR Appendix.

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Note: The hole shape, dimensions and tolerances may be design/process dependent. Horn mechanism may be part of DAB module as specified in SOR.

3.1.4.1.2.1 Push-in/Snap-in Attachment Insertion/Removal Cycles. The Steering Wheel/Driver Airbag Module designs **shall** accommodate a total of 10 insertion/removal cycles. No damage that affects the fit or function or deployment of the Module, Steering Wheel and/or fastening elements **shall** occur during installation and removal.

3.1.4.1.2.2 Module Movement. No discernible movement, except that which is required for horn function, of the Driver Airbag Module or cover relative to the steering wheel assembly **shall** occur after the Driver Airbag Module is installed in the steering wheel assembly and while the vehicle is being used in its intended function.

3.1.4.1.2.3 Steering Wheel Attachment Installation/Removal Cycles. The steering wheel assembly design **shall** accommodate a total of six (6) installation/removal cycles. No damage that affects the fit or function or structural integrity of the Steering Wheel and/or Column **shall** occur during installation and removal. Removal **shall** be easily accomplished without using special servicing techniques.

3.1.4.1.3 Interface with Mating Subsystems/Components. The Steering Wheel **shall not** pinch cut or abrade any electrical wires when installed in mating subsystem(s)/component(s), including the DAB Module and steering column. The Steering Wheel Supplier(s) **shall** assess Steering Wheel fit and **shall** verify compatibility between the Steering Wheel and the mating subsystem(s)/component(s).

3.1.4.2 Deployment Interface. In this section, the term “deployment system” encompasses the Steering Wheel, the Steering Wheel subcomponents and all interfacing Driver Airbag Module components including the cover.

a. During deployment, with or without occupant loading, the deployment system(s) **shall not** provide any sharp or rough surfaces for the cushion and/or the occupant to contact.

b. During deployment, with or without occupant loading, the Driver Airbag Module **shall not** separate or partially separate from the Steering Wheel during cushion deployment.

c. During deployment, with or without occupant loading, the deployment system(s) **shall not** fragment in any manner, which would result in impaired occupant restraint or injury.

d. During or after deployment (with or without occupant loading), distortion or loosening of the fasteners is acceptable provided the system meets the other requirements as stated in 3.2. The minimum total deployment load (defined as the Driver Airbag Module being pulled from the steering wheel assembly) that the attachment feature **should** withstand is 5 kN Also, the Steering Wheel and Driver Airbag (DAB) Module attachment **shall** withstand the maximum inflator output without cushion vents, per the DAB SOR and SOR Appendix, at a temperature range of -30 to +85 °C.

e. During deployment, the Steering Wheel/steering wheel controls **shall not** inhibit the Module cover from opening properly.

f. The deployment system(s) **should** be designed so that interface subsystem/component replacement after deployment is minimized. Following static DAB Module deployment(s), the steering wheel/subcomponents and DAB Module attachments **should not** be permanently deformed at the hot and cold inflator and cover/door surface exposure temperatures specified in 3.2.1.2.4 Temperature. The Responsible VEC(s), the Steering Wheel Supplier(s) and the interfacing subsystem/component supplier(s) **shall** cooperate to resolve any deformation, replacement and/or serviceability issues.

g. All tolerance and performance issues resulting from deployment system(s) and their interface/reaction with other vehicle interior components **shall** be reviewed with the Responsible VEC(s).

3.1.4.3 Electrical Interface. The Steering Wheel **shall** electrically interface with a VEC specified coupling device through which deployment command and other electrical signals are transmitted as shown in Figure 4. The electrical power, signals and grounds, for the horn mechanism **shall** be capable of being provided through the clock coil coupling device.

The design of the steering wheel **shall** include provisions for the electrical bonding of the Driver Airbag Module inflator to the vehicle ground through the steering wheel wire harness. This can be accomplished by conductive elements from the Driver Airbag Module inflator to the steering wheel harness ground wire. If the Driver Airbag Module inflator is not grounded through the module to the steering wheel attachment points, a separate dedicated element(s) from the steering wheel harness ground wire to the Driver Airbag Module inflator **shall** be provided.

All signal leads **shall** be isolated from vehicle chassis ground.

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3.1.4.3.1 Horn Switch.

3.1.4.3.1.1 Horn Switch Interface. Electrical power and ground **shall** be provided to the horn mechanism through the clock coil/Column Electrical Assembly (CEA) or as specified in the SOR and SOR Appendix. Electrical grounding **shall** also be achieved through the clock coil/CEA (isolated from the armature) or as specified in the SOR and SOR Appendix. Exception would be for emerging market where the horn ground could be through the steering wheel armature.

3.1.4.3.2 Accessory Control Switches.

3.1.4.3.2.1 Interface. The interface for the accessory controls is shown in Figure 4.

Note: Accessory controls may include radio, HVAC, cruise control, transmission shift, driver information center and cellular phone

3.1.4.3.2.2 Function. The Steering Wheel Supplier is responsible for all interfacing requirements to insure that the steering wheel accessory control switches function in a steering wheel, per the "Component Specification and Requirements of Steering Wheel Accessory Control Switches" (e.g., requirement for not sticking) and proper mounting as called out in GMW15987.

3.1.4.3.2.3 Appearance. Accessory control switches covers **shall** match GM "Master" standards for color as specified on the appearance requirement drawing. As specified in the SOR and SOR Appendix, the button and bezel **shall** be compatible with the surrounding steering wheel assembly and Driver Airbag Module. Colors are vehicle-dependent. The Button/Bezel **shall** contain word descriptions and/or symbols of switch function. Wording and/or symbols and size are vehicle-dependent.

3.1.4.3.2.4 Fit and Finish. The supplier **shall** provide a means to meet GM vehicle-specific fit and finish guidelines for the compatibility of the steering wheel assembly and switches as an assembly.

3.1.4.3.2.5 Deployment Requirements. The switch design and switch attachment system **shall** be strong enough so that deployment of the Driver Airbag Module, at the specified temperature extremes (hot and cold), **shall not** separate switch components or cause fragmentation of switch components from the steering wheel assembly system in a way that would result in impaired restraint system or injury.

3.1.4.3.2.6 Inadvertent Actuation. Accessory control switches **shall not** inadvertently actuate their respective control function during vehicle operation.

3.1.4.3.2.7 Serviceability. The switch attachment system **shall** allow it to be removed and/or replaced for service. The requirements contained herein **shall** be met after servicing.

3.1.4.3.2.8 Switch Movement. No discernible movement, except that which is required for switch function, of the switch housing relative to the steering wheel assembly **shall** occur after the switch is installed in the steering wheel assembly and while the vehicle is being used in its intended function (<0.8 mm of movement under a 40 N load).

3.1.4.4 Vehicle to Subsystem. Vehicle-level requirements associated with interfaces between the Steering Wheel and DAB Module Assembly and other elements of the vehicle are defined in the following paragraphs. Steering Wheel and DAB Module Assembly performance requirements which result from these vehicle-level requirements are given in 3.2.1 of this specification.

3.1.4.4.1 Squeak, Rattle and Other Audible Noise Avoidance: Vehicle Level. The requirement for this program **shall** have no customer annoyance due to squeaks and rattles. This also includes, Vehicle Durability Testing and Audio Excitation (GMW7699) and GMW7293. The final authority for the determination of whether a noise is objectionable lies with the responsible VEC engineer and/or the Squeak and Rattle (S and R) Engineer. Squeaks and rattles include, but are not limited to all the noises described in the "Squeak and Rattle Noise Glossary" (see S and R Engineer).

The supplier **shall** accept full responsibility to produce squeak and rattle free, subsystems and/or components. The supplier **shall** cooperate with the buyer and/or other suppliers to assure that no squeak and rattle annoyance occur at the interface of their subsystem/component to other subsystem/component. If an objectionable noise is found during any phase of the program, it **shall** 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 **shall** 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 **shall** be responsible for the Squeak and Rattle performance of their subsystem. Use the available Avoidance Plan – Assessment Work Sheet Blank Template - S and R.

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3.1.5 Usage Definition. Not applicable.

3.2 Product Characteristics.

3.2.1 Performance Requirements. GM Worldwide vehicle design and execution tunes Steering Wheel performance to meet Airbag Subsystem, Steering Column and total restraint system performance expectations.

The Steering Wheel **shall** support the Driver Airbag Module's cushion and mitigate interior contacts in case of a frontal collision. The Steering Wheel, in conjunction with the Driver Airbag Module and steering column, is intended to reduce injury potential in those frontal accidents where there is a significant risk that drivers might otherwise be seriously injured, meet applicable regulations, and address GM performance goals referenced in Section 2.

The Steering Wheel Supplier **shall** work cooperatively with the responsible VEC(s) and all mating subsystem/subcomponent supplier(s) to optimize Steering Wheel performance. The responsible VEC(s) **shall** be the final arbiter of Steering Wheel component level performance and corresponding total restraint system performance.

The Steering Wheel **shall** meet the following functional requirements.

a. Have sufficient abrasion resistance and be protected by packaging so as not to be damaged by normal handling required in assembly, packing, shipping, unpacking, and vehicle installation. The leather and wood on the steering wheel assembly **shall** be protected with shrink wrap or other appropriate covering that **shall** not slip or unravel during handling and assembly. Shrink wrap or other covering **shall** be able to be removed easily, without a sharp object. If a label is used to secure the shrink wrap or covering, it **shall** have a “No Sharp Object” International Organization for Standardization (ISO) Symbol on the label.

b. Recover completely from any reasonable indentation, i.e., edge of coin or fingernail. In addition, no crazing or marring of painted surface is permitted as a result of flexing adjacent areas of the assembly including the Driver Airbag Module.

c. Delamination **shall not** occur to any part of the steering wheel assembly during any conditioning/testing prescribed in 3.2 of this document and in GMW14096 (Steering Wheel Hydrographic Film Impact Performance).

d. **Shall not** show clouding, streaking, color change, tackiness or loss of contour surface when cleaned with approved General Motors cleaner for interior parts.

e. **Shall** support the DAB Module cushion when deployed and retain module attachment before, during, and after deployment.

f. **Shall not** show any signs of burning, cutting of the cushion, weld separation or unwanted mechanical damage which affects Steering Wheel performance before, during or after deployment.

g. **Shall not** show any signs of fragmentation, scuffs, abrasions, stud hole elongation or loosening of mechanical components/fasteners before, during, or after deployment which would result in impaired occupant restraint.

h. **Shall** allow the cover to open in a predetermined manner and time when the DAB Module is commanded. The Steering Wheel and attached piece(s) **shall** remain connected to the steering column as designed.

i. **Shall not** contain exposed edges, tangs, burrs, corners or other mechanical features that may interfere with cushion deployment, cut or abrade any electrical wiring or cause injury to assembly plant or service personnel. All assembly plant or service personnel or wiring contactable stamped or trimmed metal edges **shall** be coined, de-burred or coated. Other contactable material edges **shall** have appropriate treatments, if edges could possibly cause injury or damage to wiring. Edges that can only contact wiring during the initial assembly or service process may not require a secondary operation, as long as they **shall not** cut or abrade any electrical wiring during that process.

Deviations to Steering Wheel function will only be considered and, if approved, granted by the responsible VEC(s) after evaluating appropriate available technologies and balancing all Steering Wheel and restraint system performance considerations.

Note: Loss of attachment integrity **shall** include the Driver Airbag Module attachment and/or the steering column attachment features/mechanisms.

3.2.1.1 Comply with Government Regulations. The Steering Wheel **shall** comply with all applicable government regulations.

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The Steering Wheel **shall** comply with all applicable government shipping regulations in countries where the Steering Wheel is manufactured and transported, as well as, where the vehicle is manufactured and sold.

The Steering Wheel **shall** comply with all applicable Economic Commission for Europe (ECE) regulations, regardless of where the vehicle is manufactured or sold.

The development of the steering wheel assembly to meet the performance requirements in this section **shall** be jointly done on a systems basis by GM and the Supplier.

3.2.1.1.1 Asia. The steering wheel assembly **shall** meet the following requirements:

- TRIAS 27: Steering System (Impact) – Article 11
- TRIAS 34: Interior Impact/Instrument Panel Impact Absorption
- TRIAS 47: Occupant Protection in Frontal Collisions
- TRIAS 48: Flammability. The Steering Wheel and any other applicable Steering Wheel subcomponents **shall** meet the 100 mm/minimum flame propagation requirement. See GMW14444 and GMW3232.
- TRIAS 10: Steering System (Impact) – Article 11

3.2.1.1.1.1 China. The steering wheel assembly **shall** meet the following requirements:

- GB 11552-1999: Motor Vehicles - Interior Fittings (74/60/EEC, 78/632/EEC, ECE R12)
- GB 11557-1998: Motor Vehicles - Protection of Driver against the Steering Mechanism in the event of collision (ECE R12)
- GB 11551-2003: Motor Vehicles - Protection of the occupants in the event of collision (ECE R94)
- GB 8410-1994: Flammability of automotive interior materials (FMVSS 302 (89) ISO 3795-76). See GMW14444 and GMW3232.
- TS-INT-001: The test specification to determine the emission characteristics of interior automotive materials.

3.2.1.1.1.2 Korea.

- KMVSS 95 Flammability Test
- KMVSS 203 (89-1) Impact Test
- KMVSS 203 (89-2) Column Displacement

3.2.1.1.2 Australia. The steering wheel assembly **shall** meet the following requirements:

- ADR 21/00: Impact Against Instrument Panel
- ADR 69/00: Frontal Impact, Full Occupant Protection
- ADR 12/00: Glare Reduction in Field of View
- ADR 18/02: Instrumentation

3.2.1.1.3 Europe. The steering wheel assembly **shall** meet the following requirements:

- ASS 90:13: Asbestos
- ECE R12: Steering Mechanism Impact -- (See GMW16629)
- ECE R21: Interior Fittings
- ECE R94: Occupant Protection in Frontal Impacts
- EN 10204: Inspection Documents for the Delivery of Metallic Products
- SFS 1991:1289: Methylenechloride, Trichloromethane, 1.1.1.-Trichloroethane

3.2.1.1.3.1 European Economic Community (EEC). The steering wheel assembly **shall** meet the following requirements:

- 67/548/EEC: Marking of Environmental Pollutants
- 70/311/EEC: Steering Equipment
- 78/316/EEC: Identification of Controls
- 74/60/EEC: Interior Fittings
- 78/632/EEC: Interior Fittings
- 74/297/EEC: Steering Mechanism Impact Protection Impact -- (See GMW16629

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- 91/662/EEC: Steering Impact Protection
- 96/79/EEC: Protection of Occupants of Motor Vehicles in the Event of a Frontal Impact
- 95/28/EEC: Burning Behavior of Vehicles (interior materials) See GMW14444 and GMW3232.
- 2000/53/EEC: End of Life Vehicles (ELV)

3.2.1.1.4 North America.

3.2.1.1.4.1 United States. The steering wheel assembly **shall** meet the following requirements:

- 49CFR107.105: Department of Transportation Hazardous Materials Regulation DOT-E 8273
- FMVSS 101: Controls and Displays - Passenger Cars, Multipurpose Passenger Vehicles, Trucks and Buses

Note: Compliance to be certified by vehicle VEC(s).

- FMVSS 201: Occupant Protection in Interior Impact
- FMVSS 203: Impact Protection for the Driver from the Steering Control System and Jewelry (S5.2) (See GMW16626).
- FMVSS 208: Occupant Crash Protection
- (The steering wheel assembly and Driver Airbag Module assembly)
- FMVSS 302: Flammability of Interior Materials. The Steering Wheel and any other applicable Steering Wheel subcomponents **shall** meet the 100 mm/minute minimum flame propagation requirement. (See GMW14444 and GMW3232).
- CAA, Sec. 610(d): Stratospheric Ozone Protection – Chlorofluorocarbon (CFC) Nonessential Products (See GMW3059).

3.2.1.1.4.2 Canada. The steering wheel assembly **shall** have no visible English (ISO symbols only).

The steering wheel assembly **shall** meet the following requirements:

- CMVSS 101: Controls and Displays - Passenger Cars, Multipurpose Passenger Vehicles, Trucks and Busses

Note: Compliance to be certified by vehicle VEC(s).

- CMVSS 201 Occupant Protection in Interior Impact
- CMVSS 203 Impact Protection for the Driver from the Steering Control System and Jewelry (Subsection (3)) (See GMW16626).
- CMVSS 208 Occupant Crash Protection. (The steering wheel assembly and Driver Airbag Module assembly)
- CMVSS 302 Flammability of Interior Materials. The Steering Wheel and any other applicable Steering Wheel subcomponents **shall** meet the 100 mm/minute flame propagation requirement. (See GMW14444 and GMW3232).

3.2.1.1.5 South America.

3.2.1.1.5.1 Brazil. The steering wheel assembly **shall** meet the following requirements:

- CONTRAN 463/73: Resolution

3.2.1.2 Resistance to Use and the Environment. The Steering Wheel **shall** function as intended, per the performance requirements of 3.2.1, and **shall** meet the minimum requirements stated in the following subsections. All production Steering Wheel colors **shall** be tested.

3.2.1.2.1 Odor. The Steering Wheel Assembly **shall not** cause or contribute to any unpleasant odors.

3.2.1.2.2 Squeak, Rattle and Other Audible Noise Avoidance: Subsystem Level. All configurations and operating positions of the Steering Wheel and DAB Module Assembly (when used in its intended function with or without hands on any location or part of the steering wheel) or when subjected to moderate hand flexure forces and moderate hand impacts at locations where vehicle occupants are likely to contact the subsystem, prior to deployment, **shall** have an Instationary Zwicker Loudness of less than or equal to 3.0 sones N10 (90th Percentile) in any direction. The requirement is to have 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 and R) Engineer. Squeaks and rattles include, but are not limited to all the noises described in the “Squeak and Rattle Noise Glossary”.

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The supplier is to accept full responsibility to produce squeak and rattle free subsystems and/or components. They **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 Squeak and Rattle performance of their subsystem.

3.2.1.2.3 Steering Wheel Feel. The durometer of the steering wheel polyurethane foam **shall** be 55 ± 10 shore A hardness unless otherwise specified in the SOR and SOR Appendix. Leather or synthetic wrap surfaces are to comply, prior to the application of leather or synthetic wrap. Foam sections less than 5.0 mm thick may be harder.

3.2.1.2.4 Temperature. The Steering Wheel may be exposed to in-vehicle operating temperatures of -30 to + 85 °C.

In hot environments the top surface of the steering wheel assembly (approximately parallel with the steering column) may reach a temperature of 102 °C.

Steering Wheels, when stored outside the vehicle, may be exposed to temperatures of -40 to +90 °C.

Room temperature **shall** be defined as +23 ± 5 °C.

3.2.1.2.4.1 Steering Wheel Assembly - Heat Distortion. There **shall** be no objectionable distortion at temperatures up to 96 °C or as specified in the SOR and SOR Appendix that will detract from the overall appearance of the steering wheel assembly. There **shall** be no functional interference with the column, levers, protrusions or DAB Module. There **shall** be no rattling of the steering wheel assembly due to loosening parts. The horn **shall not** blow during this test.

After each environmental exposure within the test cycle, the Steering Wheel **shall not** exhibit distortion, color change, odor, warping, sag, staining, delamination or any other effects found to be objectionable by the responsible VEC(s).

3.2.1.2.5 Ozone Resistance. The Steering Wheel Assembly **shall not** degrade when exposed to Ozone. The Steering Wheel shall meet all performance requirements of 3.2.1 as well as 3.7.3.1 Steering Wheel visible appearance after exposure to a simulated ozone environment.

3.2.1.2.6 Corrosion Resistance. The Steering Wheel and/or subcomponents **shall not** corrode and **shall** meet all requirements found in GMW3286 and those performance requirements of 3.2.1 and complete vehicle test GMW8738.

The Steering Wheel **shall** have no rust when received at the final GM Vehicle Assembly Plant.

3.2.1.2.7 Dust. The steering wheel assembly may be exposed to a vehicle's interior dust environment.

All electrical switches and horn mechanism **shall** function after dust exposure. This test **shall** be conducted with the complete steering wheel assembly and Driver Airbag Module assembly.

3.2.1.2.8 Perspiration Resistance. The steering wheel assembly **shall** exhibit no objectionable changes (including softening of surface coating, blistering, discoloration, material separation, or swelling) after exposure to perspiration.

3.2.1.2.9 Cleaning Material Resistance. The Steering Wheel **shall** meet all requirements for visible appearance in 3.7.3.1 after exposure to the cleaning materials.

3.2.1.2.10 Wear Resistance. Steering Wheel **shall not** experience loss of grain pattern, color transfer, or other adverse effects.

3.2.1.3 Steering Wheel Performance During DAB Module Deployment. The module **shall** remain completely fastened to all mating subsystems/components (e.g., steering wheel) during and after deployment as well as with and without loading by the occupant.

The Steering Wheel **shall not** inhibit deployment so as to adversely affect occupant restraint and **shall not** cause damage to the cushion(s). The Module cover/door **shall** be allowed to open in a predetermined manner when deployed. During Driver Airbag Module deployment, the horn actuation subcomponent(s) and attachment(s) **shall not** separate, fragment or produce cushion cuts/tears in any manner which would result in impaired restraint system or injury.

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