



Ergonomics Engineering/Vendor Guidelines for New Products

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 specification provides ergonomics guidelines for part and component design for new products supplied to GM.

1.2 Applicability. This specification will apply to all Statements of Requirements (SOR) used in General Motors product designs, including Global Propulsion Systems (formerly GM Powertrain) designs. Where possible the use of these SORs will be included in specific components, i.e., spark plug wires, hoses, caps, etc.

1.3 Remarks. For information concerning electrical connector designs, see SAE International (SAE) United States Council for Automotive Research (USCAR) 25 document: Electrical Connector Assembly Ergonomics Design Criteria.

For information on shipping caps and body plug design and acceptable force criteria, see SAE USCAR43 Shipping Caps, Torque Caps, and Body Plugs.

Note: To access SAE/USCAR standards go to the SAE website listed in 2.3.1.

Note: For GM Employees to access similar material, refer to the Ergonomic Requirements and examples found on the GM websites listed in 2.3.2.

2 References

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

2.1 External Standards/Specifications.

SAE USCAR25 SAE USCAR43

2.2 GM Standards/Specifications.

GMW3059

2.3 Additional References.

- Statement of Requirements (SOR)

2.3.1 External References.

- SAE USCAR Standards available through: <http://standards.sae.org/uscar-standards/>
- TMC003 Material Safety Data Sheet/Safety Data Sheet Guidance Documents available through <https://gmsupplypower.covisint.com>

2.3.2 Internal References. These references are limited to access within General Motors and cannot be accessed outside this company. Contact the GM Lead Engineer for further instructions or refer to 2.3.1.

- General Motors Acceptable Body Plugs:
https://gmweb.gm.com/manufacturing/me_ergonomics/gmergo/MFG007_Guidelines_Specs_Standards/Product_Design_Guidelines/Ergo%20Plug%20Catalog.xlsx?web=1
- General Motors Acceptable Shipping Caps:
https://gmweb.gm.com/manufacturing/me_ergonomics/gmergo/MFG007_Guidelines_Specs_Standards/Product_Design_Guidelines/GM%20Acceptable%20Shipping%20Caps.xlsx?web=1

- General Motors Ergonomics Requirements (includes requirements for Quick Connects):
https://gmweb.gm.com/manufacturing/me_ergonomics/gmergo/MFG007_Guidelines_Specs_Standards/GM%20Ergonomics%20Requirements_2_10_17.xlsx?web=1

3 Requirements

3.1 Within GM Manufacturing Centers, contact the Program Ergonomics Representative for product and program specific ergonomic requirements.

3.2 For a given exertion type (i.e., push, pull, finger turns), the number of repetitions per job cycle should not exceed 10/minute. For Global Propulsion Systems applications, sub-cycles of similar repeated tasks should be < 50% of the total cycle time.

3.3 If a part is installed using a finger pad or thumb, the recommended surface area provided on the part for installation should be $\geq 100 \text{ mm}^2$ (0.16 in²) or $\geq 10 \text{ mm}$ (0.39 in) diameter.

3.4 If a part is to be installed using the palm of the hand, the recommended surface area provided on the part for that installation should be $\geq 500 \text{ mm}^2$ (0.8 in²) or $\geq 25.2 \text{ mm}$ (1.0 in) diameter.

3.5 For components located within the primary work envelope (see Appendix A, Figure A1) and requiring a linear force applied by one hand during assembly, forces should not exceed the values given for the six (6) force directions listed:

1. Push Forward $\leq 75 \text{ N}$ (17 lb).
2. Push Down $\leq 71 \text{ N}$ (16 lb).
3. Pull Back $\leq 98 \text{ N}$ (22 lb).
4. Pull Up/Lift Up $\leq 53 \text{ N}$ (12 lb).
5. Sideways Push Away $\leq 53 \text{ N}$ (12 lb).
6. Sideways Push Toward $\leq 62 \text{ N}$ (14 lb).

3.5.1 If components are located outside the primary work zone, reference the force matrices in Appendix B, Tables B1 and B2.

3.5.2 Consult the Program Ergonomics Representative to confirm the specific force value to be used if the work zone and/or the exertion direction are not known.

3.6 Hand applied torque using a key grip should be $\leq 1.5 \text{ N}\cdot\text{m}$ (13 in·lb). Torque applied by the full hand should be $\leq 2.5 \text{ N}\cdot\text{m}$ (22 in·lb).

3.7 The recommended clearances for finger/thumb and hand access are provided in Appendix C, Sections C1 through C5.

3.8 For design of Shipping Caps/Plugs refer to 2.3.2 for additional requirements.

3.9 Linear force applied by the finger/thumb to a component with a surface area $\geq 100 \text{ mm}^2$ (0.16 in²) or $\geq 10 \text{ mm}$ (0.39 in) diameter should be $\leq 45 \text{ N}$ (10 lbf). The linear force applied by the finger/thumb to a component with a surface area $\leq 100 \text{ mm}^2$ (0.16 in²) or $\leq 10 \text{ mm}$ (0.39 in) diameter should be $\leq 25 \text{ N}$ (5 lb).

3.10 If the part is to be lifted with one hand, the weight should be $\leq 4.5 \text{ kg}$ (10 lb). If the part must be flipped/rotated or held with a static grasp for > 5 s, then the weight should be $\leq 3.2 \text{ kg}$ (7 lb).

Note: If the part is held in one hand > 380 mm (15 in) from the body, then these weight limits could be lower. Contact the Program Ergonomics Representative in such situations.

3.11 If the part is to be lifted with two hands, the lift moment should be $\leq 46 \text{ N}\cdot\text{m}$ (410 in·lb) as calculated by:

$$(\text{Part weight}) \times (\text{Horizontal distance from barrier or edge of job to part location} + 0.2 \text{ m (8 in)})$$

Note: $\text{N} = \text{kg}/9.8$.

3.12 The operator should not have to enter the vehicle or have to lie down, kneel or squat to assemble the product.

3.13 The operator should perform assembly activities within the Ergonomic Work Envelope (see Appendix A, Figure A1 for illustration).

3.14 The approved torque rating for:

- Clutch/electric right angle tool is $\leq 60 \text{ N}\cdot\text{m}$.

- Pistol grip tool is $\leq 6 \text{ N}\cdot\text{m}$ ($\leq 10 \text{ N}\cdot\text{m}$ when programmable speed/ramp down capability is present).
- In-line tool is $\leq 3 \text{ N}\cdot\text{m}$.

If feasible, assign pulse tools (torque rating $< 600 \text{ N}\cdot\text{m}$).

3.15 Back up wrenches (hand held) and self-drilling screws are not acceptable.

3.16 If the assembly path/orientation of the part is under/behind the vehicle/tool structure, then tactile feedback and guiding/self-locating features are recommended. No assembly, regardless of access, should require critical operator judgment.

4 Validation

4.1 General. Not applicable.

4.2 Validation Cross Reference Index. Not applicable.

4.3 Supporting Paragraphs. Not applicable.

5 Provisions for Shipping

Not applicable.

6 Notes

6.1 Glossary. Not applicable.

6.2 Acronyms, Abbreviations, and Symbols.

GHS	Globally Harmonized System of Classification and Labeling of Chemicals
H	Horizontal Reach
MSDS	Material Safety Data Sheet
SAE	SAE International
SDS	Safety Data Sheet
SOR	Statements of Requirements
USCAR	United States Council for Automotive Research
USCS	United States Customary System
V	Vertical Height

7 Additional Paragraphs

7.1 All parts or systems supplied to this standard must comply with the requirements of GMW3059, **Restricted and Reportable Substances**.

7.2 For new product submissions, or when a change in chemical composition of an existing product has occurred, a complete copy of the Material Safety Data Sheet/Safety Data Sheet (MSDS/SDS) must be submitted in compliance with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS) requirements or other country-specific MSDS/SDS requirements. In addition, product MSDS/SDS submissions must be in compliance with specific country General Motors **TMC003 Material Safety Data Sheet/Safety Data Sheet** guidance documents where available.

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

GMW14234

9 Release and Revisions

This standard was originated in July 2005. It was first approved by the Ergonomics Department in December 2005. It was first published in March 2006.

Issue	Publication Date	Description (Organization)
1	MAR 2006	Initial publication.
2	MAY 2007	Updated Tables in Appendix, Asia Pacific work envelope, editorial (Ergonomics Department)
3	OCT 2008	Website link; value changes in 3.5, 3.7, 3.11 3.13, 3.14, 3.15; Editorial. (Ergonomics Department)
4	JUL 2009	Updated 3.1, 3.4, 3.5, 3.9.2, 3.12, 3.19, Appendix A, and Appendix C to reflect changes made to the Design Ergonomics Worksheet (Ergonomics Department)
5	MAY 2013	Updated Appendix C, Added 3.8 and Appendix D. (Manufacturing Engineering - Ergonomics)
6	JUL 2015	Updated information on external standards, updated links, additional notes on Figure A1, redundant figure removed from C1, removed Appendix D, security classification of "GM Confidential" removed. (Manufacturing Engineering – Ergonomics)
7	APR 2016	Replaced "Powertrain" with "Global Propulsion Systems". Updated 3.2 to include Global Propulsion Systems repetition guideline. Replaced fingertip with finger pad in 3.3. Updated 3.6 hand torque requirement. Added and updated links to internal and external references. (Global Manufacturing - Manufacturing Engineering Integration – Ergonomics)
8	OCT 2016	Updated Global Ergonomics Work Envelope in Appendix A. (Global Manufacturing - Manufacturing Engineering Integration – Ergonomics)