



Electrical Build to Print Brackets Component Technical Specification (CTS)

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1 Introduction

Note: Nothing in this standard supersedes 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 standard establishes the requirements for electrical build to print brackets.

1.2 Applicability. All passenger cars, light duty trucks, heavy duty trucks and sport utility vehicles.

1.3 Remarks. This standard defines build to print bracket specifications only.

2 References

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

2.1 External Standards/Specifications.

32008-1	GB 11566-1995
24.449 Articles 29/6 and 48/y	IEC 60068-2-27
AAIG PPAP-4	ISO 16750-4
ADR 42	KMVSS 19
AIS-012:2004	Law 5616/2014/Decree 3427/2014
AIS-120:2014	RTE 38, 41, 43 and Resolution 2205-2
Article 18 Attachment 20, 21 and 22	S346/74
Chapter H-3.01 Regulation 8	SAE 980689
CONTRAN Resolution 197/06	TR CU 018/2011
CONTRAN Resolution 215/06	Traffic Law 118/84 Article 10.14
Decree 43/95	UN R 26.03 Supplement 2
DS 58/03 Article 27	UN R78/2009

2.2 GM Standards/Specifications.

GMW3044	GMW14058	GMW14650	GMW15540
GMW3059	GMW14085	GMW14872	GMW15725
GMW3172	GMW14234	GMW15272	GMW16215
GMW8518	GMW14270	GMW15425	
GMW14056	GMW14444	GMW15443	
GMW14057	GMW14529 (ID)	GMW15531	

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2.3 Additional References.

- Analysis Development Validation Process Tasks and Deliverables, Appendix G2, of the electronic Statement of Requirements (eSOR)
- Automotive Industry Action Group (AIAG) Production Parts Approval Process (PPAP) available at Uniform Resource Locator (URL) <https://www.aiag.org/>
- Automotive Regulation Information Database (ARID) available at URL <https://businessconnect.gm.com/sites/ARID> (ID)
- CAE 50-00-106 available from the Computer Aided Engineering (CAE) Analysis Procedures home page at URL https://gmweb.gm.com/sites/global_cae/pages/procedures.aspx (ID)
- GM1829
- GP12 Early Production Containment (GM 1927-33 GP-12 Audit) available from GM SupplyPower at URL: <https://gmsupplypower.covisint.com/web/portal/home>
- Material Engineering Requirements from Appendix F10 of the eSOR
- nCode GlyphWorks Data Processing System for Durability available at URL <http://www.ncode.com/>

- Operation Environmental Conditions (as defined by the module being retained by the bracket, if applicable)
- Released Bracket Math File and electronic Geometric Dimensioning and Tolerance (eGD&T) file from the eSOR
- Vehicle Technical Specifications (VTS) (ID)

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3 Requirements

Note: Conformance to the requirements contained in this section will be verified throughout regularly scheduled full vehicle, subsystem, and component durability testing.

3.1 System/Subsystem/Component/Part Definition. The bracket may be used for a variety of purposes that may include adding strength or stiffness to a subsystem or providing an interface to attach another component.

3.1.1 Appearance. Visible manufacturing features (not represented in the math model) shall be minimized. Boundary samples with dimensional checks are required and must be provided prior to first part delivery for first required build event. Agreed upon dimensions will be included in the released math file and the released electronic Geometric Dimensioning and Tolerance (eGD&T) file.

3.1.2 Content.

3.1.2.1 Physical Content. The part/assembly content is defined in the accompanying math data file. It may contain any/all the following:

- Stamped panels/brackets/plates/battery trays
- Molded plastic brackets
- Fasteners
- Weldments

Note: All various names of bracketry shall be referred to as brackets for the remainder of this standard.

3.1.2.2 Functional Content.

3.1.2.2.1 Attachment Interfaces. The integral nut/studs (if present) provide the ability to attach electrical components to the bracket or the bracket to any interfacing vehicle component or structure as follows:

- Bracket interface to vehicle
- Module interface to bracket

3.1.2.2.2 Location. The bracket/assembly may provide the ability to locate sub-components, reinforcements, panels, etc. via locating holes, weld nut centers, shoulder features on weld studs or formed surfaces.

3.1.3 Ambient Environment. For brackets retaining modules, the operation environmental conditions as defined by the module or per Table 1 if module operation environmental conditions are not specified.

Table 1: Operation Environmental Conditions

Classification	Temperature (°C)	Relative Humidity (%)
Nominal	Room Ambient (approximately 20 °C)	Room Ambient
Humid	38 °C ± 3 °C	95% ± 5%
Hot	80 °C ± 3 °C	5% ± 5%
Cold	-30 °C ± 3 °C	Room Ambient
Maximum Cold	-40 °C +0 °C/-3 °C	Room Ambient

3.1.4 Interfaces. Not applicable.

3.1.5 Usage Definition. The part is expected to last for the entire life of the vehicle.

3.2 Product Characteristics.

3.2.1 Performance Requirements.

3.2.1.1 Pass/Fail Requirements. Unless stated otherwise, pass/fail criteria is defined as:

- No deformation
- No cracking including weld cracking
- No fastener loosening, i.e., bolt rotation

Note: The electrical component attached to the bracket shall function and be serviceable and no customer objectionable squeaks or rattles shall be permitted during durability testing.

3.2.1.2 Vibration Requirements. 3.2.1.2 and 3.2.1.3 are provided for general reference information for build to print brackets. General Motors is responsible for Computer Aided Engineering (CAE) and other vibration validation testing as specified in 4.2.

3.2.1.2.1 Modal Performance: Frequency and Transmissibility.

3.2.1.2.1.1 Requirements. For assemblies over 1 Kg, The first modal frequency must be > 30 Hz, specified in CAE 50-00-106. The bracket cannot resonate nor have transmissibility at the module mounting location greater than one (1) at any frequency at or below 35 Hz.

3.2.1.2.1.2 Test Procedure. Subject the bracket to a swept sine wave vibration test from 0 Hz to 150 Hz input at the bracket attachment points in each of the three vehicle axis at the operation environmental conditions as defined by the module or per Table 1 if module operation environmental conditions are not specified.

Note: The module mass and attachment points shall be representative of the in vehicle installation, including wire harness routing and attachments (if applicable). Document resonate frequencies and amplification between 36 Hz and 150 Hz.

3.2.1.2.2 Random Vibration Durability and Fatigue.

3.2.1.2.2.1 Requirements.

3.2.1.2.2.1.1 Reliability. 98% Reliability at 50% Confidence (R98C50). The test reliability requirement may be met by either success-run or failure based methodology. GM prefers testing to failure at the development and Design Validation (DV) stages of the product development cycle. Success-run based tests are acceptable for Product Validation (PV) tests and for proven, previously validated designs. The entire reliability program plan must be approved by the General Motors Designing Engineer (DE) and/or, the General Motors Component Validation Engineer (CVE) prior to the start of testing. The Success-Run formula is as follows:

$$R_C = (1 - C)^{1/n+1}$$

Where:

R_C = Reliability at Confidence level

C = Confidence level

n = Sample size, i.e., 34 samples for R98C50, or fewer if running multiple lives.

At least six (6) samples must be tested for success-run or failure testing. For success-run testing, the following equation should be used by the validation engineer and/or supplier to determine the samples and lives that must be tested to show the R98C50 requirement has been met:

$$\left(\frac{n_2}{n_1}\right) = \left(\frac{x_1}{x_2}\right)^\beta$$

Where:

n_1 = original samples tested

n_2 = fewer samples tested

x_1 = original test time

x_2 = longer test time, e.g., 16 h if reducing the sample size from 34 to 6 with an original test time of 8 h

β = Weibull slope **Note:** If the Weibull slope for the bracket material is unknown or if the bracket is a composite of several materials, assume 2.5.

3.2.1.2.2.1.2 Function. GMW3172 Function Status Classification (FSC) Class A after vibration testing, i.e., all functions of the bracket perform as designed during and after the test. See 3.2.1.1.

3.2.1.2.2.2 Test Procedure. Subject the bracket to a random vibration test input at the bracket attachment points in each of the three vehicle axis at the operation environmental conditions as defined by the module or per Table 1 if module operation environmental conditions are not specified. GM prefers all three axis excitation at one time with a vibration system using kurtosis control. If testing one axis at a time, record vibration in the other two directions (the off axis vibration). The DE/CVE must refer to the Vehicle Technical Specification (VTS) to understand the mileage requirements of a vehicle program implementing a bracket and convert vehicle miles to equivalent test hours using SAE 980689, and the associated nCode GlyphWorks tool. If vehicle data is not available, use the appropriate equivalence in Table 2 and generic vibration profiles shown in Figure 1, Figure 2, Figure 3, and Figure 4 based on the bracket location in vehicle. **Note:** Plastic brackets must also superimpose the "Thermal Cycle Profile Used During All Vibration Tests" from GMW3172, (9.3.1.4) on the vibration profiles, adjusting the thermal cycle time to match the vibration test time. See Figure 5 and Table 3.

Table 2: Vehicle Miles to Equivalent Random Vibration Test Hours

Vehicle Miles	Test Hours (h) per Axis ^{Note 1}
160 000 km (100 000 mi)	8
240 000 km (150 000 mi)	12
320 000 km (200 000 mi)	16

Note 1: GM prefers all three axis excitation at one time with a vibration system using kurtosis control. If testing one axis at a time, record vibration in the other two directions (the off axis vibration).

Figure 1: Car Front Mounted Bracket Random Vibration Profiles, e.g., Front Fascia, Condenser Radiator Fan Module (CRFM), and Front Cradle

Fore-Aft, Grms = 2.64			Lateral, Grms = 3.00			Vertical, Grms = 3.63		
FREQ(Hz)	PSD(m/s ²) ² /Hz	PSD(G ² /Hz)	FREQ(Hz)	PSD(m/s ²) ² /Hz	PSD(G ² /Hz)	FREQ(Hz)	PSD(m/s ²) ² /Hz	PSD(G ² /Hz)
7	1.92865	0.02000	7	0.96432	0.01000	7	1.92865	0.02000
10	5.78594	0.06000	10	2.89297	0.03000	10	9.64324	0.10000
12	9.64324	0.10000	50	5.78594	0.06000	90	9.64324	0.10000
60	3.85730	0.04000	160	2.50724	0.02600	160	0.96432	0.01000
140	0.67503	0.00700	1000	0.03857	0.00040	320	0.96432	0.01000
320	0.67503	0.00700				400	0.14465	0.00150
1000	0.04822	0.00050				1000	0.06750	0.00070

Figure 2: Car Middle and Rear Mounted Bracket Random Vibration Profiles, e.g., Inner Fenders, Dash, Floor Pan, Roof, Rear Cradle, and Rear Fascia

Fore-Aft, Grms = 1.19			Lateral, Grms = 1.36			Vertical, Grms = 1.91		
FREQ(Hz)	PSD(m/s ²) ² /Hz	PSD(G ² /Hz)	FREQ(Hz)	PSD(m/s ²) ² /Hz	PSD(G ² /Hz)	FREQ(Hz)	PSD(m/s ²) ² /Hz	PSD(G ² /Hz)
7	0.19286	0.00200	7	1.15719	0.01200	7	1.92865	0.02000
10	0.57859	0.00600	10	2.41081	0.02500	10	4.82162	0.05000
19	1.92865	0.02000	20	2.41081	0.02500	13	7.71459	0.08000
50	1.92865	0.02000	400	0.09643	0.00100	50	3.08584	0.03200
80	0.19286	0.00200	1000	0.00964	0.00010	1000	0.00964	0.00010
1000	0.01929	0.00020						

Figure 3: Truck/SUV Bracket Random Vibration Profiles, except Front Fascia e.g., Inner Fenders, Dash, Doors, Floor Pan, Roof, Frame, CRFM, Rear Fascia, and Tailgate

Fore-Aft & Lateral, Grms = 2.60			Vertical, Grms = 2.90		
FREQ(Hz)	PSD(m/s ²) ² /Hz	PSD(G ² /Hz)	FREQ(Hz)	PSD(m/s ²) ² /Hz	PSD(G ² /Hz)
10	11.57189	0.12000	10	19.28648	0.20000
30	11.57189	0.12000	100	3.85730	0.04000
150	0.38573	0.00400	130	0.48216	0.00500
360	0.38573	0.00400	400	0.19286	0.00200
1000	0.03857	0.00040	1000	0.02893	0.00030

* Tailgate vibration generally falls within these profiles. Exceptions may be for tailgates open or on Heavy Duty Pickups. If required, data might need to be collected for the specific conditions.

Figure 4: Truck/Sport Utility Vehicle (SUV) Front Fascia Mounted Bracket Random Vibration Profiles

Fore-Aft, Grms = 3.67			Lateral, Grms = 3.15			Vertical, Grms = 3.28		
FREQ(Hz)	PSD(m/s ²) ² /Hz	PSD(G ² /Hz)	FREQ(Hz)	PSD(m/s ²) ² /Hz	PSD(G ² /Hz)	FREQ(Hz)	PSD(m/s ²) ² /Hz	PSD(G ² /Hz)
10	8.67892	0.09000	10	9.64324	0.10000	10	9.64324	0.10000
25	8.67892	0.09000	80	9.64324	0.10000	12	19.28648	0.20000
35	48.21620	0.50000	100	0.86789	0.00900	21	19.28648	0.20000
45	8.67892	0.09000	300	0.86789	0.00900	24	7.71459	0.08000
80	8.67892	0.09000	400	0.02893	0.00030	80	7.71459	0.08000
1000	0.00964	0.00010	1000	0.02893	0.00030	1000	0.00964	0.00010

Figure 5: Thermal Cycle Profile Used During Vibration Tests

