



Aluminum Pretreatment to Support Structural Adhesive Bonding

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 is intended to cover the requirements and process of a pretreatment system that can be used to condition aluminum substrates to achieve structural adhesive bonds, which will meet the strength and durability requirements for specified automotive applications.

1.2 Applicability. This pretreatment could be used to prepare all types of aluminum substrate that would then be utilized for structural bonding applications.

1.3 Remarks. Generally, pretreatment is indicated when a structural adhesive bond is load bearing or safety critical.

1.4 Approvals. Pretreatment processes shall not be used for GM production vehicles without full approval by GM Materials Engineering. Pretreatments can only be used in production when there is an accompanying "AAA" number, that is, an Approved Adhesive Application (AAA) number for the intended application. The AAA number is unique to each substrate and surface treatment. The AAA number is released after all required testing to this specification has been completed for the specific combination of substrates plus surface treatments. The AAA number can be used as surrogate for multiple bond joint configurations or multiple assembly plant locations as determined by the approving GM Materials Engineer.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW3059

GMW18077

2.3 Additional References.

- GWS-5K Standard Test Procedures, Welding Performance of Weld-Through Sealer and Adhesive, Steel available from GM Supply Power at Uniform Resource Locator (URL):
<https://gmsupplypower.covisint.com/web/portal/home>: Document Library (tab): Manufacturing, Standards Mach and Equip Facilities, Global ME Body (folders).

3 Requirements

3.1 Cohesive Separation Mode. Aluminum substrates pretreated according to this specification, and bonded with approved structural adhesive systems, shall demonstrate cohesive separation within the adhesive layer when stressed to bond failure. In order to achieve this type of adhesive separation mode consistently, it is anticipated that the aluminum substrate surface must be standardized prior to the application of the conversion coat.

3.2 Standardized Surface Condition. A standardized surface is a surface condition characterized by an absence of loose or adhered organic contamination and surface oxide. The level of de-ox and etch required on production representative as received substrate shall be sufficient to produce a surface energy of 840 mJ/m². Production representative as received substrate is critical since the degree of required de-ox and etch is dependent upon the actual thickness of aluminum oxide present on the substrate. Oxide thickness can vary dependent on several factors. The oxide layer on substrate used for production may vary only within a narrow bandwidth so that the identified, and specified, de-ox and etch process validated as satisfactory in the process development, remains legitimate for the purpose of structural bonding.

3.3 Pretreatment Process. The pretreatment process can be chemical or physical in nature. The settings for the key operating characteristics of the pretreatment process shall be documented and submitted to GM as part of the pretreatment process approval.

Note: The expectation is that the pretreatment process will result in the formation of a conversion coating or stable oxide on the surface of the aluminum. Currently, there are several different types of commercially available aluminum pretreatments and processes that may be suitable in providing an acceptable interface between the aluminum substrate and the structural adhesive.

3.4 Pretreatment Measurables. Different types of conversion coatings and pretreatment processes will likely have different recommendations regarding coating weights, surface energy, surface morphology or other key measurables. Engineering limits on the key measurables shall be established and become part of the engineering approval for the specific pretreatment process.

Note: It is the intention of this specification that whatever process is applied to an aluminum part and/or assembly from a prototype or production supplier, that the specific surface modification be identified, whether it be a coating weight, physical, chemical or metallurgical change in the treated surface. In addition, the method of measurement for the surface modification shall be disclosed and demonstrated. It is also expected that the aluminum substrate, which is representative of the intended production part, treated with the production intent pretreatment, demonstrate, by means of laboratory stress durability testing, a bonding system (substrate, conversion coating, and adhesive) which is capable of providing satisfactory bond strength and durability.

4 Validation

4.1 General. Laboratory testing shall be performed on the aluminum substrate, (representative of the production part (s)), to demonstrate the efficacy of the intended coating.

4.2 Test Requirements. Pretreatment processes shall be evaluated by testing specific pretreated substrate alloys, to the requirements listed in GMW18077, Table 2.

4.2.1 Substrates. Use the production intended substrate.

4.2.2 Adhesive. Use an approved GM structural adhesive.

4.3 Test Evaluation and Approval. For production approval, all environmental test results from GMW18077, Table 2, shall be at least 90% of initial room temperature values.

4.4 Weldability. Pretreatments shall not impede the welding process. Test according to GWS-5K for Standard Test Procedures.

5 Provisions for Shipping

All pretreated surfaces shall be protected from contamination when being shipped to the bonding and assembly location.

6 Notes

6.1 Glossary. Not applicable.

6.2 Acronyms, Abbreviations, and Symbols.

AAA	Approved Adhesive Application
IMDS	International Material Data System
mJ	Megajoule
URL	Uniform Resource Locator