

Acoustic Absorbing Material for Exhaust Applications

1 Scope

This specification defines fibrous glass materials used as acoustic-absorbing and thermal insulation media primarily used in automotive exhaust applications. The specification includes properties, both chemical and physical, required for moderate-, intermediate-, and high-temperature applications in exhaust systems.

1.1 Material Description. This specification describes three (3) types of fibrous glass materials typically used in silencer components of exhaust systems. The materials are classified as Type 1 for moderate-temperature applications, Type 2 for high-temperature applications and Type 3 for intermediate-temperature applications. These materials are utilized in environments where they will be exposed to hot exhaust gases, but the primary flow of the exhaust gasses is not normally through the mass of glass fibers. The fibers provide a mechanism for the dissipation of acoustic energy as well as providing thermal insulation around the path of the exhaust gases.

1.1.1 Material Identification.

- **Type 1**, or moderate-temperature applications, are those applications where the fibrous material itself will achieve continuous operating temperatures of 730 °C or intermittent temperatures as high as 825 °C for up to 2 h. Thus, this material should be suitable for virtually all applications toward the rear of the exhaust system and many applications near the catalytic converter, either alone or in combination with a high-temperature material adjacent to the perforated tube.
- **Type 2**, or high temperature applications, are those applications where the fibrous material itself will achieve continuous operating temperatures of 825 °C or intermittent temperatures as high as 900 °C for up to 2 h. This material is suitable for virtually all applications toward the rear of the exhaust system and near the catalytic converter.
- **Type 3**, or intermediate-temperature applications, are those applications where the fibrous material itself will achieve continuous operating temperatures of 810 °C or intermittent temperatures as high as 890 °C for up to 2 h. This material is suitable for virtually all applications toward the rear of the exhaust system and most applications near the catalytic converter.

Note: For many silencer applications in continuous operation, the glass temperature adjacent to the perforation tube is $\geq 50\text{ }^{\circ}\text{C}$ below the exhaust gas temperature. For cyclic operations of a few minutes duration, this temperature differential is larger.

1.2 Symbols. Not applicable.

1.3 Typical Applications. These materials are typically used in exhaust systems where thermal insulation and/or acoustic attenuation are required. The choice of materials is primarily determined by the maximum operating temperature that the material will achieve.

1.4 Remarks. Not applicable.

2 References

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

2.1 External Standards/Specifications.

ASTM C336 ASTM E1050

2.2 GM Standards/Specifications.

GMW3059 GMW3205

2.3 Additional References.

TMC003 Material Safety Data Sheet guidance documents (available at www.gmsupplypower.com).

3 Requirements

3.1 Performance Requirements. The Type 1 moderate-temperature fiberglass rovings (containing about 4000 individual filaments), Type 2 high-temperature fiberglass rovings (containing about 1850 individual filaments), and the Type 3 intermediate-temperature fiberglass rovings (containing about 4000 individual filaments) are put through a process (texturizing) which separates them into individual filaments and groups of a few dozen filaments before they are placed into a silencer. The ability to separate the strand into filaments is required for the silencer to achieve the desired acoustic performance.

3.2 Chemical Requirements. The compositions of the three (3) types of glasses are shown in Table 1.

Table 1: Composition of Glass Fibers in Weight Percent (wt%)

Chemical Constituent	Type 1 Moderate Temperature	Type 2 High Temperature	Type 3 Intermediate Temperature
SiO ₂	55 to 65	62 to 69	62 to 69
CaO	18 to 25	< 1	15 to 19
Al ₂ O ₃	10 to 15	22 to 27	16 to 20
MgO	0 to 5	8 to 12	< 2.0
B ₂ O ₃	< 0.1	< 0.1	< 0.1
F ₂	< 0.05	< 0.05	Not applicable
Other Oxides	< 2	< 2	< 1

3.2.1 Chemical Durability Requirements. The glasses must lose < 1.0 wt% of their mass when tested for 24 h according to the simulated exhaust fluid durability test described in Appendix A. For this test, the fibers must have the same average fiber diameter and fiber diameter distribution as the material used in the exhaust system.

3.2.2 Viscosity Requirements. The Type 1 moderate-temperature glass must have an annealing point > 720 °C as determined by ASTM C336. The Type 2 high-temperature glass must have an annealing point > 810 °C as determined by ASTM C336. The Type 3 intermediate-temperature glass must have an annealing point > 790 °C as determined by ASTM C336.

3.2.3 Phase Stability Requirements. The Type 1 moderate-temperature material must remain amorphous when heat-treated for 24 h at a temperature of 860 °C. The Type 2 high-temperature material must remain amorphous when heat-treated for 24 h at a temperature of 925 °C. The Type 3 intermediate-temperature material must remain amorphous when heat-treated for 24 h at 920 °C.

3.2.4 Requirements for Preforms and Bag Materials. For initial material qualification approval only, the bag or preform shall achieve a rating of six (6) minimum when tested to GMW3205 Code C modified at a minimum temperature of 400 °C.

3.2.4.1 Requirements for Low Emission Preforms. The Low Emission Preforms (also known as Preform LE) must present a mean Loss on Ignition (LOI) of ≤ 0.6% when tested according to the Loss on Ignition Test described in Appendix B.

3.3 Transmission Loss. The minimum transmission loss of a 100 mm thick sample of this material at various packing densities after texturizing is shown in Table 2. The absorption coefficient is measured according ASTM E1050.

Table 2: Minimum Linear Absorption Coefficient of Absorptive Materials

Frequency (Hz)	100 g/L	150 g/L	200 g/L
200	> 0.3	> 0.4	> 0.5
400	> 0.8	> 0.8	> 0.8
600	> 0.9	> 0.8	> 0.75
> 800	> 0.9	> 0.85	> 0.8

4 Manufacturing Process

Not applicable.

5 Rules and Regulations

5.1 Legal Regulations. All materials must satisfy applicable laws, rules, regulations and recommendations valid in the country of usage.

5.2 Language. In the event of conflict between the English and domestic language, the English language shall take precedence.

5.3 Inspection and Rejection. Samples of components or materials released to a GM material specification shall be tested for conformity with the requirements of this material specification and approved by the responsible Engineering department prior to commencement of delivery of bulk supplies.

A new approval must be received for any changes, e.g., properties, manufacturing process, location of manufacture, etc. If not otherwise agreed, all testing and documentation normally required for initial release must be completed.

It is the responsibility of the supplier to inform the customer in a timely manner, without solicitation, and to include documentation of all modifications of materials and/or processes and to apply for a new release.

If not otherwise agreed, all release tests shall be repeated and documented by the supplier prior to commencement of delivery of non-conforming bulk supplies. In individual cases, a shorter test can be agreed to between the responsible Engineering department and the supplier.

5.4 Material Safety Data Sheets/Safety Data Sheets (MSDS/SDS). 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 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.

5.5 All materials supplied to this standard must comply with the requirements of GMW3059, Restricted and Reportable Substances for Parts.

6 Approved Sources

Materials supplied to this specification must be approved by General Motors.

A list of approved materials can be found in MATSPC. This GM Material File is provided to third parties to reduce redundant testing of materials. If approved material already listed is used, the part supplier can use GM Material File reference for Production Part Approval Process (PPAP) material approval. If the decision is made to use a not yet approved material, contact the appropriate GM Materials Engineer for details on the approval process. The material approval process must be completed prior to PPAP start date of the part supplied to General Motors.

7 Notes

7.1 Glossary.

MATSPC: Global repository of GM approved materials for corresponding GM Engineering Standards.

7.2 Acronyms, Abbreviations, and Symbols.

ASTM	ASTM International
FWL	Fiber Weight Loss
GHS	Globally Harmonized System of Classification and Labeling of Chemicals
GSSLT	Global Subsystem Leadership Team
H₂SO₄	Sulfuric Acid
HCl	Hydrochloric Acid
KCl	Potassium Chloride
LE	Low Emission
LOI	Loss On Ignition
MSDS	Material Safety Data Sheet
((NH₄)₂SO₄)	Ammonium Sulfate
(NH₄)(NO₃)	Ammonium Nitrate
PPAP	Production Part Approval Process
SDS	Safety Data Sheet
W_B	Balance Weight
W_C	Crucible Weight
W_S	Stabilized Weight
Wt%	Weight Percent

8 Coding System

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

Material per GMW16977

9 Release and Revisions

This standard was originated in May 2013. It was first approved by the Textiles/Trim Materials Global Subsystem Leadership Team (GSSLT) in June 2013. It was first published in June 2013.

Issue	Publication Date	Description (Organization)
1	JUN 2013	Initial publication.

Cross Reference of Replaced Material Coding

GMW16977 Material Codes	Formerly Identified As
Type 1	GMN10027 Type 1 (GMNA)
Type 2	GMN10027 Type 2 (GMNA)