

Erosion Management

High Durability XPE® Mats and Edge Treatments

Market Trends

Future emission regulations are forcing catalytic converter design engineers to address the increasingly stringent emission targets. Design engineers are placing the catalytic converter closer to the exhaust manifold for faster light-off to provide systems with lower emissions. However, placement of the converter at or near the manifold also increases the operating temperature of the entire system. In some applications, the temperature increase will challenge the design limits of the converter and its ability to manage gap expansion between the substrate and shell. Additionally, the proximity of the converter to the engine causes the mat to be subjected to stronger exhaust gas pulsations.

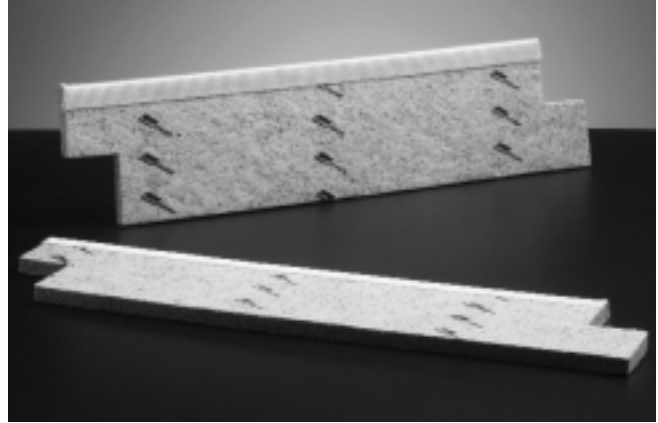
Durability

Durability of the catalytic converter support material is of major importance to long-term converter efficiency and integrity. Mat erosion is most often the result of low mat pressure caused by the inability of a design to maintain targeted gap bulk density (GBD). A design is unable to maintain GBD due to shell spring deformation or if temperatures inside the converter cause shell expansion beyond the mat performance design limits. Pulsating exhaust gases then attack and erode the unsupported mat resulting in bypass and a decrease in converter efficiency.

GBD vs. Erosion

Laboratory testing confirms a direct relation between mat erosion and GBD. Figure 1 presents the relationship between gap bulk density and durability for traditional intumescent mat systems. Data provided in Figure 1 was generated at Unifrax in a test apparatus designed to simulate a 4-cylinder engine running at 6000 rpm. Samples are mounted in adjustable fixtures. The test fixtures are then closed to a specified GBD and aged twice to 600°C. The samples are subsequently cooled to room temperature. The edges of the mat, while under compression in the fixture, are subjected to the pulsing air-stream for 50 minutes at room temperature.

Refer to the product Material Safety Data Sheet (MSDS) for recommended work practices and other product safety information.



XPE Support Mat With Silica Cloth Edge Treatment.

The nominal GBD targeted in an application for traditional intumescent mat is approximately 1.0. However, as GBD decreases, the mat loses pressure and erosion increases. A properly designed converter will manage gap expansion, creating a robust design. Unifrax does not recommend designs in which minimum GBD of traditional intumescent mat systems falls below 0.69.

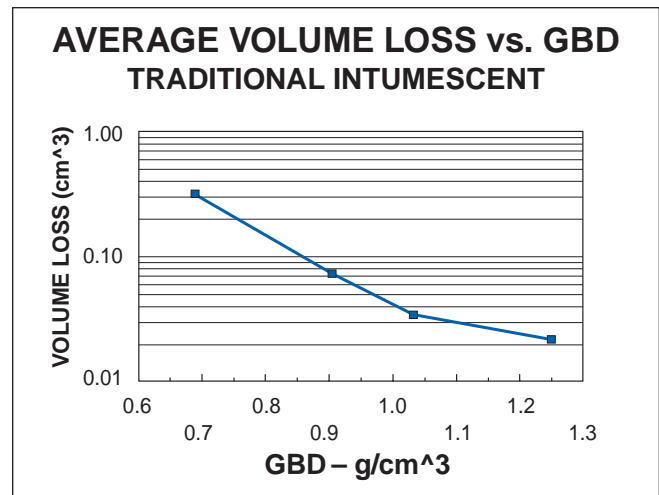


Figure 1: Average Volume Loss versus GBD for XPE-NV.

The test data shown are average results of tests conducted under standard procedures and are subject to variation. Results should not be used for specification purposes.

Unifrax Solutions

Unifrax has developed a variety of catalytic converter mat products with high durability and erosion resistance. As a manufacturer of fibers used in a variety of catalytic converter mounting systems, Unifrax has successfully combined fiber-making expertise with a state-of-the-art paper manufacturing process to maximize the performance of our catalytic converter support mats.

Figure 2 details the relative erosion resistance of the various catalytic converter support mats at their minimum recommended GBD. Please contact the Unifrax Automotive Application Engineering group at (716) 278-3983 for specific design recommendations.

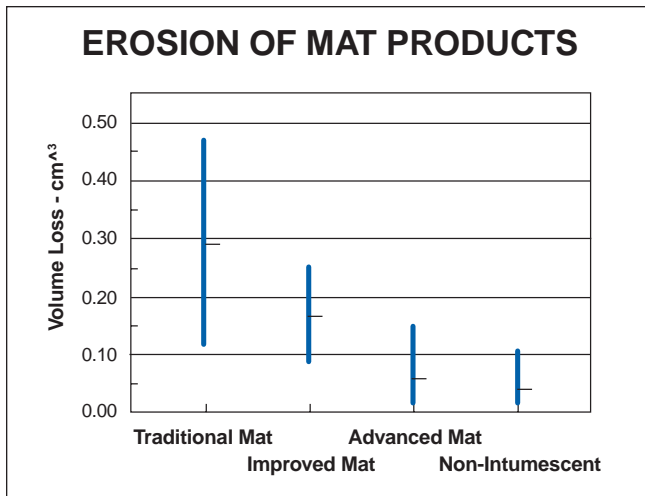


Figure 2: Relative mat durability of catalytic converter products at minimum recommended GBD.

Edge Treatments

Edge treatments can improve a mat's resistance to gas erosion. Such treatments include wire mesh, presoaking with Fiberfrax® Rigidizer-W or silica cloth edge protection.

It is important that an edge protection system functions as an integral part of the mat in order to realize the full benefit of the system. As an integral part of the mat, the protection system is able to respond to dynamic system changes which result in low GBD. When an edge treatment cannot respond to such GBD changes, full protection of the mat edge cannot be maintained, and erosion is inevitable.

Rigidizer-W Edge Treatment

Presoaking mat with Fiberfrax Rigidizer-W increases the mat's durability providing superior erosion resistance. Fiberfrax Rigidizer-W is a high-temperature, inorganic liquid binder capable of withstanding continuous use temperatures

to 1260°C. Rigidizer-W is applied to the mat leading edge just prior to assembly during the canning process. The liquid penetrates uniformly into the mat densifying and binding the fiber-vermiculite matrix. Rigidizer-W does not restrict vermiculite expansion and allows the mat to remain active to respond to changes in GBD while providing superior erosion resistance.

Silica Cloth – Edge Treatment

The Silica cloth edge seal is a high-temperature flexible woven cloth capable of withstanding continuous use temperatures to 1260°C. The cloth fully wraps the leading edge of the mat protecting it from hot gas impingement and erosion. The cloth is preconditioned to a temperature of 980°C to remove shrinkage and retain flexibility. The cloth acts as an integral part of the intumescent system and is able to adapt to the changing GBD conditions associated with thermal cycling.

Figure 3 presents a relative comparison of system durability for the various edge treatments discussed.

Silica cloth or Rigidizer-W edge protection act as an integral part of the mat system and provide virtually “zero” erosion even as GBD may decrease due to converter dynamics. Wire mesh systems act independent of the mat and therefore are unable to absorb gap expansions resulting in increased erosion.

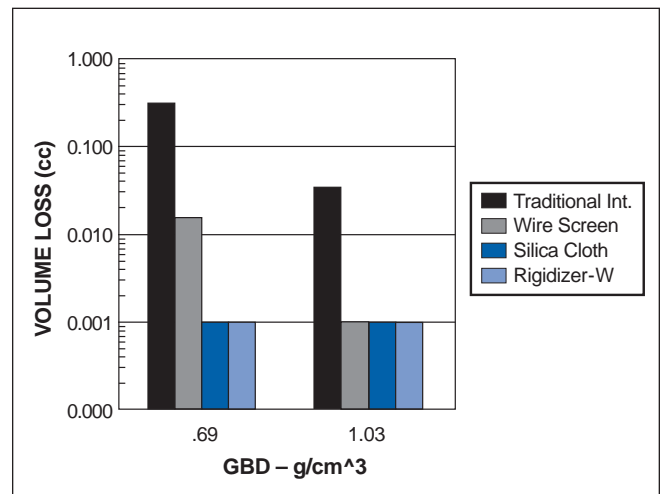


Figure 3: Relative durability of various edge treatments.

The Unifrax Corporation provides full engineering services to review your catalytic converter design. The service features thermal and mechanical analysis as well as a final design recommendation. Contact the Unifrax Automotive Application Engineering Department at (716) 278-3983 for more information regarding any of our catalytic converter support mats or edge treatment systems, or email aecoordinator@unifrax.com.

