

DuraBloc™: High Performance Fuel Tank Compliance for the Long Haul.

Client: **BMW** Industry: **Automotive**
 Application: **Plastic fuel tank**

Inhance Technologies' DuraBloc™ fuel systems barrier technology, chosen by BMW for its Z3 roadster, remains in compliance after 20 years of service life - across a wide variety of operating conditions.

Background and challenge

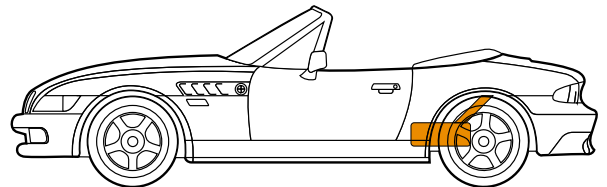
From 1995 to 2002, nearly 300,000 BMW Z3 vehicles were built in South Carolina, USA. The BMW Z3 was a major success, even driven by James Bond in GoldenEye. Sales of the Z3 spiked as the film reached number one at the box office. In the initial production run, more than 15,000 roadsters were sold by the time the car was officially introduced.

For the Z3 fuel tank, Inhance Technologies' DuraBloc™ fuel systems barrier technology was used. Inhance Technologies built a dedicated plant to help produce these blow molded HDPE fuel tanks.

Over 20 years has passed since those fuel tanks were made and installed. With so many miles driven, and fuel consumed all over the world, Inhance Technologies investigated how those tanks were performing in terms of gasoline permeation.

Details

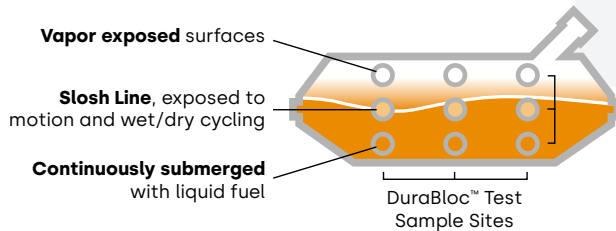
Inhance Technologies' fuel systems engineers sought Z3's that would represent a variety of conditions of use, to fully challenge the durability of the DuraBloc™ technology. The U.S. sourced vehicles represented exposure to different weather conditions, including the hot and dry southwest, the humid northwest, and multi-season mid-Atlantic regions. The three selected vehicles had been driven an average of 120,000 miles over 20 years, which is equal to five trips around the earth each. This distance required roughly 5,000 gallons of fuel passing through each fuel tank over the course of its use.



BMW Z3 Models sourced for the study:

Model	VIN Number	Model Year	Fuel Tank Age	Mileage	Total Fuel Used	Weather History
1.9 L Convertible	AUSHCH7327VLE01558	1997	21	107,903	4,316	Mid-Atlantic ☀️ ☁️ ☔️ ☁️
2.8 L Convertible	4USCJ3329VLC08678	1997	21	184,284	7,371	Pacific Northwest ☁️ ☔️
M 3.2 L Convertible	WBSC9343YLC92081	2000	18	69,997	2,800	Southwest ☀️

The fuel tanks were removed from the vehicles and multiple places on the fuel tank were carefully chosen to represent three modes of fuel exposure to the plastic fuel tank barrier surface:



The main goals of Inhance Technologies' investigation was to review the present condition of the barrier after the car had been driven a large amount of miles and been refueled many times, as well as to discover how the fuel tanks would perform compared to the compliance requirements.

Samples were tested in triplicate to determine the state of the barrier layer using spectrophotometric analysis. Inhance Technologies' Quality Control standards and procedures, used to analyze the production of up to 7MM fuel tanks annually, were used to check US Environmental Protection Agency ("EPA") Executive Order and California Air Resources Board ("CARB") compliance.

Results

Using Fourier-transform infrared spectroscopy (FTIR) on the fuel tank samples allowed for the precise determination of the composition of the HDPE fuel tank surfaces. The chemical structure and integrity of the surface of the tank are critical measures to ensure the continued functioning of the barrier. If the surface was altered over time - due to prolonged exposure to gasoline (liquid or vapors), physical or temperature shock or cycling, vibrations or physical damage - the barrier performance of the fuel tank would be impacted. If the composition of the surface was maintained, compliance can be assured.

DuraBloc™ Barrier Composition (% of Original):

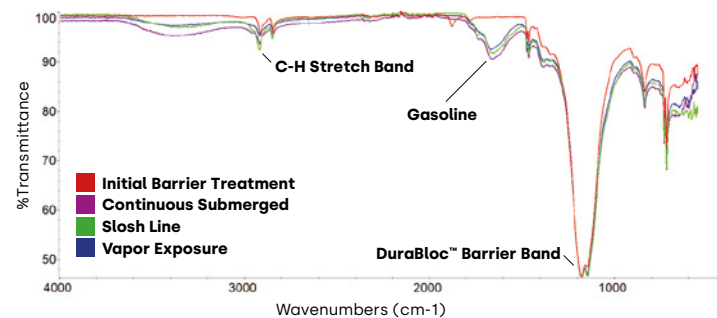
VIN#	Age of Fuel Tank	Mileage	Vapor Exposed	Slosh Line	Continuous Submerged
1558	21	107,903	100%	100%	100%
8678	21	184,284	100%	100%	99%
2081	18	69,997	100%	100%	100%

Standard error in test method is +/- 2%

Analysis of each sample revealed essentially 100% retention of the DuraBloc™ barrier despite over 20 years of service life, an average of 120,000 miles driven and approximately 5,000 gallons of gasoline passing through the fuel tank during its use.

In addition, Inhance Technologies engaged a leading third-party testing lab to perform permeation tests using the US EPA 40 CFR Part 1060.520 procedure. The results (0.036 g/m²/day) demonstrated the permeation rate of the tanks remained an order of magnitude below today's compliance rates, once again demonstrating the durability and robustness of the DuraBloc™ technology.

FTIR Analysis of VIN #1558:



Conclusions

Outstanding barrier, compliance and long-term durability of barrier performance are the key requirements to ensure not only regulatory compliance, but in keeping vehicle emissions low and protecting the environment. DuraBloc™ fuel systems barrier technology, through years of innovation, continues to provide optimum performance and compliance for the most challenging fuel tanks. DuraBloc™ can be used on HDPE, or XLPE fuel tanks of any size shape or design.

DuraBloc™ is now offered for all types of fuel systems, from Automotive to Outdoor Power Equipment, from Marine to Power Sports. Whether your system is blow molded, injection molded or rotomolded, DuraBloc™ will help you meet the most stringent compliance challenges and maintain compliance for the long-term.

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