



STAR4D[®] Research on Sherwin Williams CARC Comparison of MIL-D-53039 Silica vs. Mil-D-53039 Polymeric Bead

For over a year, STAR4D, in conjunction with the National Guard Bureau has been conducting a research project to compare two chemical agent resistant coatings (CARC) produced by Sherwin Williams. This particular research is part of the STAR4D continuing research efforts with the intent to determine the visual effectiveness of the mar resistance over a one-year time period under real world conditions when applied to actual vehicles.

Application Process

Beginning on December 5, 2006, STAR4D and Sherwin Williams staff, along with the assistance and cooperation of the CSMS Paint Shop located at Camp Dodge in Johnston, IA, coated two HMMWV'S M998A1 in good condition. The vehicles were coated at Camp Dodge by one of their CSMS Paint Shop painters. One vehicle was coated with MIL-D-53039 Silica F93G106 and the other with MIL-D-53039 Polymeric Bead (Beaded) F93G107. The current MIL-D-53039 Silica F93G106 is regarded as highly susceptible to marring.



Application equipment consisted of a pressure feed DeVilbiss Plus spray gun attached to a 2.8 gallon pressure pot. Fluid hoses were routed through a Micro Motion fluid meter and a LaserPaint[®] was attached to the spray gun to assist the painter in applying a consistent coating thickness to the subject vehicles to ensure equal finish quality.

In order to accurately produce results, numerous measurements were recorded throughout the painting processes. Multiple wet mil thickness readings were taken on both HMMWV'S during the application process and recorded as well as statistical measurements to assist with the determination of final results. One valuable piece of measuring equipment used was a Micro Motion fluid meter which allowed STAR4D to accurately track the amount of coating applied to each vehicle as noted in the following charts.

Results

Nearly a year after the coating had been applied; STAR4D staff alongside Camp Dodge CSMS Paint Shop personnel revisited these test vehicles and made the following observations on November 29, 2007:

- Mar Resistance
 - A visual mar resistance test was performed by simply rubbing the surface of each vehicles coating with a finger. The MIL-D-53039 Silica F93G106 showed significant marring on the coating surface when compared to the slight marring on the MIL-D-53039 Beaded F93G107.
- Scratch Resistance
 - The MIL-D-53039 Beaded F93G107 also demonstrated reduced scratch resistance on the coating surface when compared to the MIL-D-53039 Silica F93G106.
- Gloss Reading
 - The average gloss reading of the MIL-D-53039 Silica F93G106 was 0.43 units at 60 degrees gloss reading, compared to the average gloss reading of the MIL-D-53039 Beaded F93G107 at 0.87 units at 60 degrees. The gloss requirement for MIL-D-53039 is less than 1.0 unit at 60 degrees. The higher gloss reading of the F93G107 would require additional follow-up measurements to determine if the gloss readings would remain the same over a period of time.
- Water Rubs
 - An interesting observation surfaced when water was applied to the vehicles coatings and the coating was rubbed with a finger. A small amount of color would appear after five finger double rubs from the Silica F93G106 while no color would appear even after 20 double rubs were applied to the Beaded F93G107.
- Delamination
 - A higher degree of delamination on the vehicle coated with the Silica F93G106 was apparent compared to the vehicle coated with the Beaded F93G107. Varying factors may have contributed to this anomaly.

The following table lists the basic information regarding the vehicles and this research process:

Test Vehicles	HMMWV M998A1	HMMWV M998A1
Coating	Mil-D-53039B Beaded F93G107	Mil-D-53039B Silica F93G106
Color	383 Green	383 Green
Viscosity	29 seconds - Zahn #3	25 seconds - Zahn #3
Coating Temperature	66 Degrees Fahrenheit	67 Degrees Fahrenheit
Reduction	None	None
Amount of Coatings Used	0.4239 gallons	0.4362 gallons
Application Time	13:53	15:14
Average Wet Mil Thickness	4	4
Average Dry Coating Thickness	2.7	2.25
Gloss at 60 Degrees	0.4 units	0.4 units

The following table contains information regarding the application equipment used on December 5, 2006 when the test vehicles were coated:

Coating	Mil-D-53039B Beaded F93G107	Mil-D-53039B Silica F93G106
Pressure Pot	2.8 gallon	2.8 gallon
Pressure Feed Spray Gun	Devilbiss Plus	Devilbiss Plus
Nozzle Diameter	1.8 mm	1.8 mm
Air Cap	#410 G4	#410 G4
Atomizing Air Pressure	58 psi	56 psi
Fluid Pressure	20 psi	22 psi
LaserPaint Distance	6"	6"
Metering Equipment	Micro Motion	Micro Motion

The following table contains the conditions present December 5, 2006 when the test vehicles were coated:

Coating	Mil-D-53039B Beaded F93G107	Mil-D-53039B Silica F93G106
Booth Temperature	69 Degrees Fahrenheit	69 Degrees Fahrenheit
Humidity	21%	21%
Air Flow	125-150 fpm	125-150 fpm

On November 29, 2007, STAR4D staff traveled to Camp Dodge to conduct an analysis on the two vehicles. Below are the results of various factors noticed through observation of the two vehicles:

	Mil-D-53039B Beaded F93G107	Mil-D-53039B Silica F93G106
Gloss	0.87	0.43
Delamination	Slight	Significant
Scratch Resistance	Slight	Significant
Mar Resistance	Slight	Significant

Conclusion

Based on the initial intent of the research of determining the visual effectiveness of mar resistance over a one-year time period under real world conditions when applied to actual vehicles, it was expected that the MIL-D-53039 Silica F93G106 would be more susceptible to marring. Based on the test vehicles after the one-year mark, the marring on the MIL-D-53039 Silica F93 was significantly higher when compared to the MIL-D-53039 Beaded F93G107.