DEVELOPMENT OF A COSMETIC CORROSION TEST FOR ALUMINUM AUTOBODY PANELS AMD 309

USAMP

2008 DOE Peer Review Presentation

February 28, 2008

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This presentation does not contain any proprietary or confidential information

USAMP AMD-309 - DEVELOPMENT OF A COSMETIC CORROSION TEST FOR ALUMINUM AUTOBODY PANELS

- This material is based upon work supported by the Department of Energy National Energy Technology Laboratory under Award Number DE-FC05-02OR22910.

Participants and Consultants

- Alcoa
- Novelis
- GM
- Ford
- Daimler/Chrysler
- Atlas Materials Testing Technology
- CorrPro Companies, Inc
- PPG
- Surface Science Western (UWO)
- Auto Technology
- Singleton Corp.
- US Army Research Lab
- National Exposure Testing (NET)
- Quality Statistics
- Henkel

Program Objective and Approach

- **Objective**
  - To develop a cosmetic corrosion test for painted aluminum autobody sheet which provides a good correlation between lab testing and field performance.

- **Approach**
  - Exposures of a series of painted panels to laboratory tests and on-vehicle sites with correlation based on:
    - Relative ranking of extent of corrosion on various substrates
    - Morphology of corrosion
    - Composition of corrosion products

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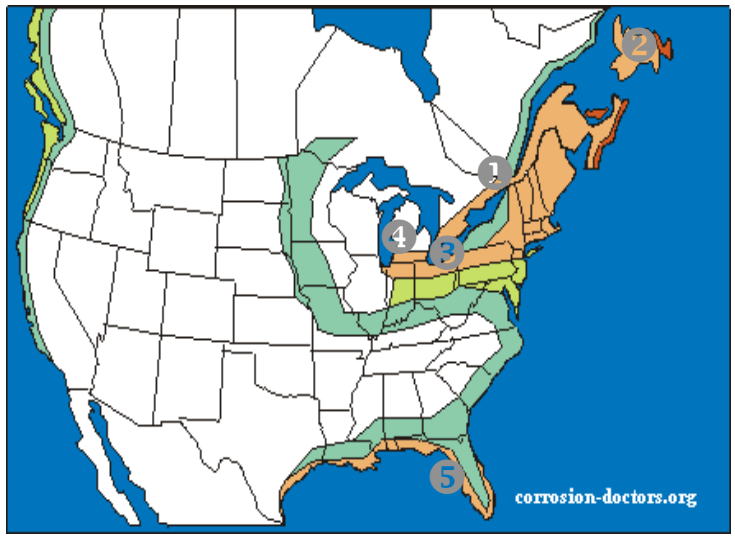
On-Vehicle Test Sites

- **2 or 3 Vehicles per site**
- **Horizontal and Vertical (Cleveland/Buffalo Truck Route Vertical Only)**



❶Montreal, QC; ❷St. Johns, NF;
❸Cleveland, OH/Buffalo,NY;
❹Detroit, MI ❺Orlando, FL

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Program Progress

- Program established mid 2000
- Extensive discussions on program content through mid 2001
- Support through AMD in March, 2002
- Initial Round of Accelerated testing completed September 2003
- OEM Test Track testing completed December 2004
- Outdoor exposure completed June 2005
- 4 years of in-service testing completed in 2007

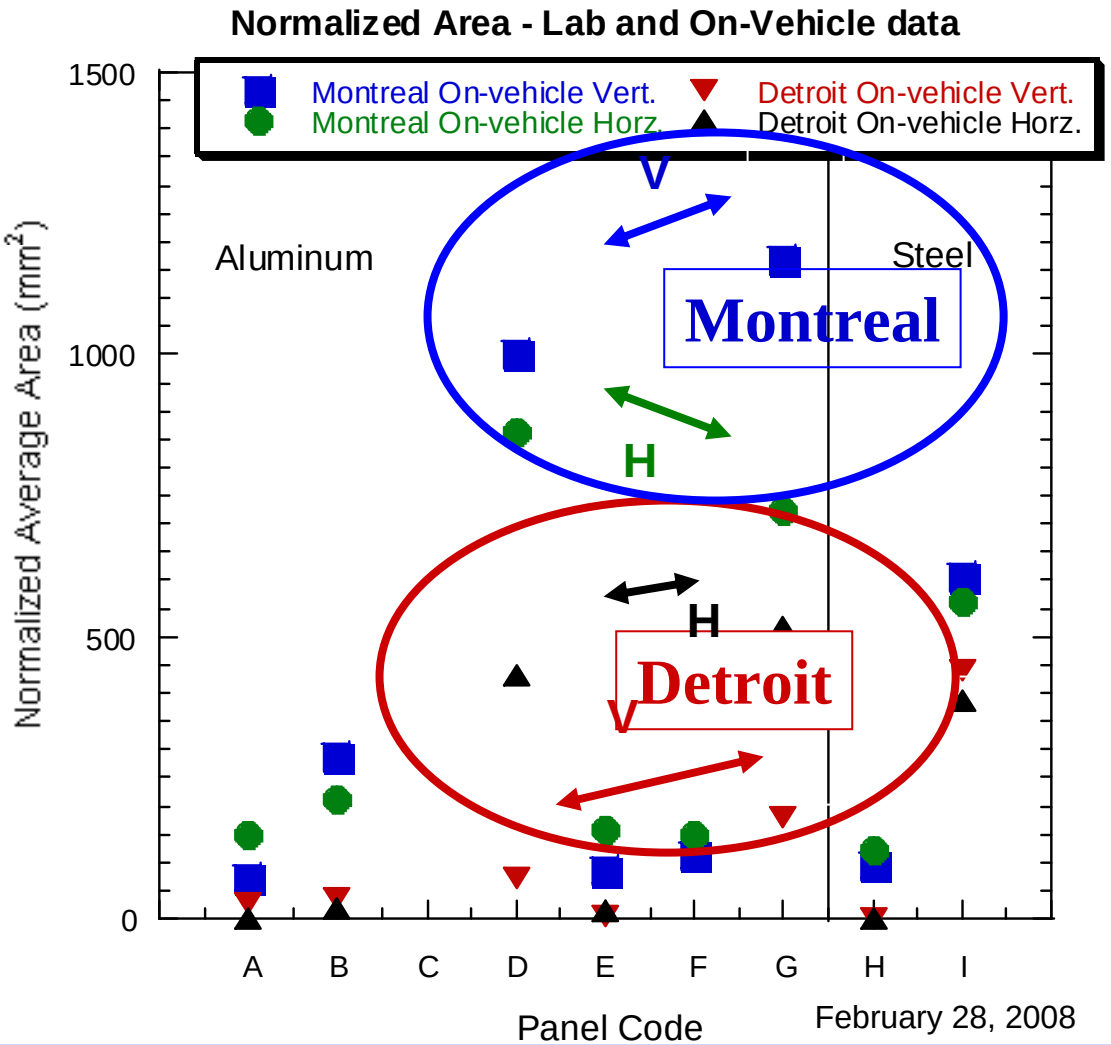
- A series of modifications of identified test methods and round robin testing repeatability/reproducibility to be conducted 2007-2009
- Correlation of 4 yr in-service testing to lab testing in 2008
- Publish Test Recommendations as SAE Test Method in 2009

Painted Panel Identifications

Code	Alloy	Metal finish	Paint System
A or 1	AA6111-T4PD	No	Standard
B or 2	AA6111-T4PD	No	Low F^-
C or 3	AA6111-T4PD	No	Ecoat Only
D or 4	AA6111-T4PD	Yes	Standard
E or 5	AA6016	No	Standard
F or 6	AA6022-T4E29	No	Standard
G or 7	AA2036	Yes	Standard
H or 8	EG 60 Steel	No	Standard
I or 9	Cold Rolled Steel	No	Standard

Comparison of Vehicles with Most Corrosion 2-yr On-Vehicle Exposures from Two Sites

- **Panels D, G, and I generally have more cosmetic corrosion than other panels**
  - Montreal > Detroit
- **Horizontal (Hood) vs. Vertical (Door)?**
  - Montreal: V>H
  - Detroit: H>V



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Summary of 2 year Outdoor Results

- **Relative Ranking of Extent of Corrosion on Al Substrates**
  - D,G>>B>A,E,F
- **Presence of Sulfur in Corrosion Products**
  - Lab test must include sulfur species to replicate corrosion products
- **Morphology of Corrosion**
  - Blisters with filiform on leading edge
  - Sporadic sites along scribe line unlike the relatively uniform creepback observed on CRS

Lab Tests Completed in 2007

- **ASTM G85-A4**
  - Constant salt spray test acidified by periodic introduction of SO_2
- **GM9511P**
  - GM Scab Test 60C/85%RH exposure with daily cycles of neutral NaCl immersion and weekly cycles of thermal shock to -25C
- **GM9682P**
  - GM wheel filiform test w/ 6hr CASS + 4 weeks @60C and 85%RH
  - CASS = 5%NaCl + 0.25g $CuCl_2 \cdot H_2O$ acidified with acetic acid
- **Modified ASTM G85-A2**
  - Cyclic spray/RH test with acidified (acetic acid) NaCl
  - Modifications:
    - substitute H_2SO_4 for acetic acid
    - Add $CaCl_2$
- **Modified ASTM G85-A4**
  - Constant salt spray test acidified by periodic introduction of SO_2
  - Modifications:
    - substitute H_2SO_4 for SO_2
    - Add $CaCl_2$

Summary of Results

	Relative ranking similar to on-vehicle ?	Sulfur in Corrosion Products?	Morphology similar to on-vehicle ?	Lab-to lab reproducible and/or repeatable?
ASTM G85-A4	yes	yes	yes	**Ranking slightly different in 2 runs at same lab**
Mod. ASTM G85-A4	**no**	**no**	**no**	**Good lab-to-lab reproducibility**
Mod. ASTM G85-A2	yes (1/2)	**no**	yes	**Poor lab-to-lab reproducibility**
GM9511P	**no**	**No source in test**	**no**	**Good lab-to-lab reproducibility**
GM9682P	yes (1/2)	**No Source in Test**	**no**	**Poor lab-to-lab reproducibility**

Future Plans

- **Additional Lab Tests to be conducted in 2008**
  - Variants of ASTM G85-A4
  - Variants of ASTM G85-A2 for testing without SO_2
  - Round Robin Testing to demonstrate reproducibility and repeatability

- **On Vehicle Tests will complete 4 years in-service exposures March 2008**
  - Final evaluation of panels from on-vehicle exposures to be evaluated and correlated with lab tests