

Anodizing Standards and Quality Control Tests of America's Automakers

AACOA, Inc.

America's Automakers

DaimlerChrysler Corporation
Ford Motor Company
General Motors



DaimlerChrysler Corporation

Standards - more process-oriented than performance-oriented

Standard

Finish, Application

PS-1576

Dyed, Interior/Exterior

PS-4905

Clear, Exterior

PS-5385

Clear, Interior

PS-7362

Electrolytic color,
Interior/Exterior

Additional standards - special applications (i.e.
PS-6426 - Anodizing of brake components)

DaimlerChrysler Corporation

Each standard - includes an approved source list

Each standard - multiple finishes numbered and referred to as CAF's (Chrysler Aluminum Finish)

CAF's differ by the following:

- 🚗 Mechanical finish, chemical finish, anodizing, coloring, and anodizing supplier

Standards - revised with each new approved supplier and/or CAF (some standards revised over 25 times)

DaimlerChrysler Corporation

Process requirements:

Cleaning - type of chemistry

Bright dip - type of bright dip and rinsing

Anodizing - acid, phosphate, and aluminum concentrations, temperature, voltage, current density, and rinsing

Sealing - type of chemistry; concentrations of seal, phosphates, sulfates, solids, and silicates; pH; temperature; time; filtration; rinsing

DaimlerChrysler Corporation

Performance requirements:

- 🚗 Coating thickness (CT), Acid Dissolution Test (ADT), Light-fastness (LF), Appearance acceptance to a “Master” sample

<u>Standard</u>	<u>CT</u> <u>(μm)</u>	<u>ADT</u> <u>(Rating)</u>	<u>LF</u> <u>(Hours)</u>
PS-1576 (Black)	3.8-15.2	6.0 max.	1000
PS-1576 (Others)	3.8-15.2	6.0 max.	500
PS-4905	8.0	6.0 max.	None
PS-5385	4.0	10.0 max.	None
PS-7362	8.0	6.0 max.	None

Ford Motor Company

Five old standards replaced by four new standards

<u>Old Standard</u>		<u>New Standard</u>
ESB-M4P6-B	superseded by	WSB-M4P9-B2
ESB-M4P9-A1	superseded by	WSB-M4P9-B1
ESB-M4P9-A2	superseded by	WSB-M4P9-B2
ESB-M4P10-A	superseded by	WSB-M4P10-B1
ESB-M4P11-A	superseded by	WSB-M4P11-B1

Ford Motor Company

Performance not process requirements

Finish and application dictate standard

Standard

Finish, Application

WSB-M4P9-B1

Clear, Interior

WSB-M4P9-B2

Clear, Exterior

WSB-M4P10-B1

Dyed, Interior

WSB-M4P11-B1

Electrolytic color, Exterior

Ford Motor Company

Performance requirements:

- 🚗 Coating Thickness (CT) and Weight (CW), Acid Dissolution Test (ADT), and CASS Resistance

<u>Standard</u>	<u>CT</u> <u>(μm)</u>	<u>CW</u> <u>(g/m^2)</u>	<u>ADT</u> <u>(Rating)</u>	<u>CASS</u> <u>(Hours)</u>
WSB-M4P9-B1	2.5	6.2	6.0 max.	16
WSB-M4P9-B2	7.5	18.6	6.0 max.	16
WSB-M4P10-B1	2.5	6.2	6.0 max.	16
WSB-M4P11-B1	7.5	18.6	6.0 max.	16

Ford Motor Company

SUPPLIER performance requirements:

- 🚗 Weatherometer and Florida Exposure
- 🚗 Required for first time source approval
- 🚗 NOT required for production parts

<u>Standard</u>	<u>Weatherometer (Hours)</u>	<u>Florida Exposure (Miami / Facing south)</u>
WSB-M4P9-B1	1000	12 months at 5° angle
WSB-M4P9-B2	1000	12 months at 5° angle
WSB-M4P10-B1	500	6 months at 45° angle
WSB-M4P11-B1	1000	12 months at 5° angle

General Motors

One standard - GM4472M

Performance not process requirements

Performance determined by application type

“Type” depends upon the following:

Finish: Clear or Color

Use: Decorative or Functional

Location: Exterior or Interior























General Motors

Coating application types:

<u>Application</u>	<u>Coating Type</u>
Clear exterior	A
Color exterior	B
Clear interior	C
Color interior	D
Non-decorative/Functional	E
Functional/Unsealed for paint base	F

General Motors

Required testing for each coating type:

<u>Test</u>	<u>Coating Type</u>					
	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F</u>
Thickness						
Mass						
ADT						
CASS						
Weatherometer						
Florida Exposure						

General Motors

Performance requirements:

- 🚗 ADT testing - 6.0 maximum rating
- 🚗 CASS testing - 6 hours minimum
- 🚗 Coating thickness and mass requirements:

<u>Color</u>	<u>Thickness</u> (min μm)		<u>Mass</u> (min g/m^2)	
	<u>Exterior</u>	<u>Interior</u>	<u>Exterior</u>	<u>Interior</u>
Clear, ND, Fun.	7.5	2.5	20	6
Elec. Black (Sn/Ni)	15.0	7.5	40	20
Elec. Black (Co)	7.5	7.5	20	20
Gold (FAO)	7.5	2.5	20	6

General Motors

Weather Resistance Testing

- 🚗 Weatherometer and Florida Exposure
- 🚗 Developmental tests - new colors
Electrolytic Black (Sn, Ni, Co), Gold FAO,
Clear, ND, and Funct. - “Grandfathered”
- 🚗 NOT required for production parts

<u>Type</u>	<u>Weatherometer</u>	<u>Florida Exposure</u>
B	2500 kJ/m ²	31380 MJ/m ²
D	1241 kJ/m ²	12550 MJ/m ²

Quality Control Tests



Coating Thickness

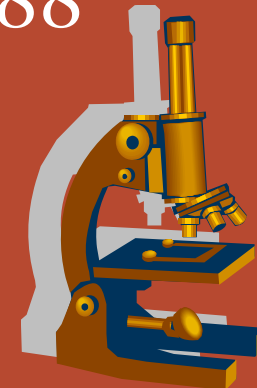
Four ASTM methods:

- 🚗 ASTM B244 Eddy Current Meter
- 🚗 ASTM B487 Cross Section Measurement
- 🚗 ASTM B588 Interference Microscope
- 🚗 ASTM B681 Light-Section Microscope

DaimlerChrysler - ASTM B487 / ASTM B588

Ford - ASTM B659 (Includes all four above)

GM4260P - ASTM B487 / ASTM B588



Coating Mass (Weight)

ASTM B137

1. Measure sample surface area (SA)
2. Mass sample (M_1)
3. Immerse sample in a phosphoric acid bath inhibited by the presence of chromium (Strips off coating without dissolving the aluminum substrate)
4. Mass sample again (M_2)
5. Coating Mass = $(M_1 - M_2) / SA$

DaimlerChrysler - No requirement

Ford and GM - ASTM B137



ADT Seal Quality

ASTM B680

Acid Dissolution Test (ADT)

DaimlerChrysler Standard - LP-461A-241

Ford Standard - BQ 007-02

GM utilizes ASTM B680 and ASTM B137

ASTM B680 generates a mass loss / unit area

Results from ASTM B680 and ASTM B137
entered into an Automaker's formula
generates an "ADT Rating"

ADT Seal Quality

$$(W_1 - W_2) \times K \times CT / (W_1 - W_3) = \text{Rating (6.0 Max)}$$

W_1 = Weight of coupon (prior to testing)

W_2 = Weight after ASTM B680 (prior to ASTM B137)

W_3 = Weight after ASTM B137

CT = Coating thickness (mils or microns)

K = Constant

<u>Standard</u>	<u>K</u>	<u>CT</u>	<u>K x CT = ?</u>
General Motors	7.8	μm	$7.8 \times 25.4 = 198.12$
Ford and Chrysler	200	mils	$200 \times 1.00 = 200.00$

CASS Corrosion Resistance

ASTM B368

Copper-Accelerated Acetic Acid-Salt
Spray (CASS)

DaimlerChrysler - No requirement

Ford - No base metal (white corrosion)
present after 16 hours

GM - No pitting, corrosion, or other
appearance change present after 6 hours

Weatherometer

Fade Resistance - Exposure to energy in the form of UV light determines the light-fastness of colored anodic finishes

DaimlerChrysler - LP-461H-90 - Black dyed finishes 1000 hours and all other dyed finishes 500 hours

Ford - ASTM D3361 - Dyed finishes 500 hours and all other finishes 1000 hours

GM - SAE J1960 (2500 kJ/m² - Type 'B') and SAE J1885 (1241 kJ/m² - Type 'D')

Florida Exposure

Weather Resistance - Exposure to a natural or created environment to test resistance to weather bloom, color fade, and atmospheric corrosion

DaimlerChrysler - No requirement

Ford

- 🚗 Dyed - Facing south at a 45° angle for 6 months under glass in Miami, Florida
- 🚗 Other finishes - Facing south at a 5° angle off horizontal for 12 months in Miami, Florida

GM

- 🚗 Type 'B' - SAE J1976 (Procedure A) for 31380 MJ/m² total solar radiation
- 🚗 Type 'D' - GM9538P for 12550 MJ/m² total solar radiation

Standards Websites

www.astm.org

www.autoweb.net

www.document-center.com

www.dscc.dla.mil

www.global.ihs.com

www.lib.washington.edu/engineering/standards

www.sae.org

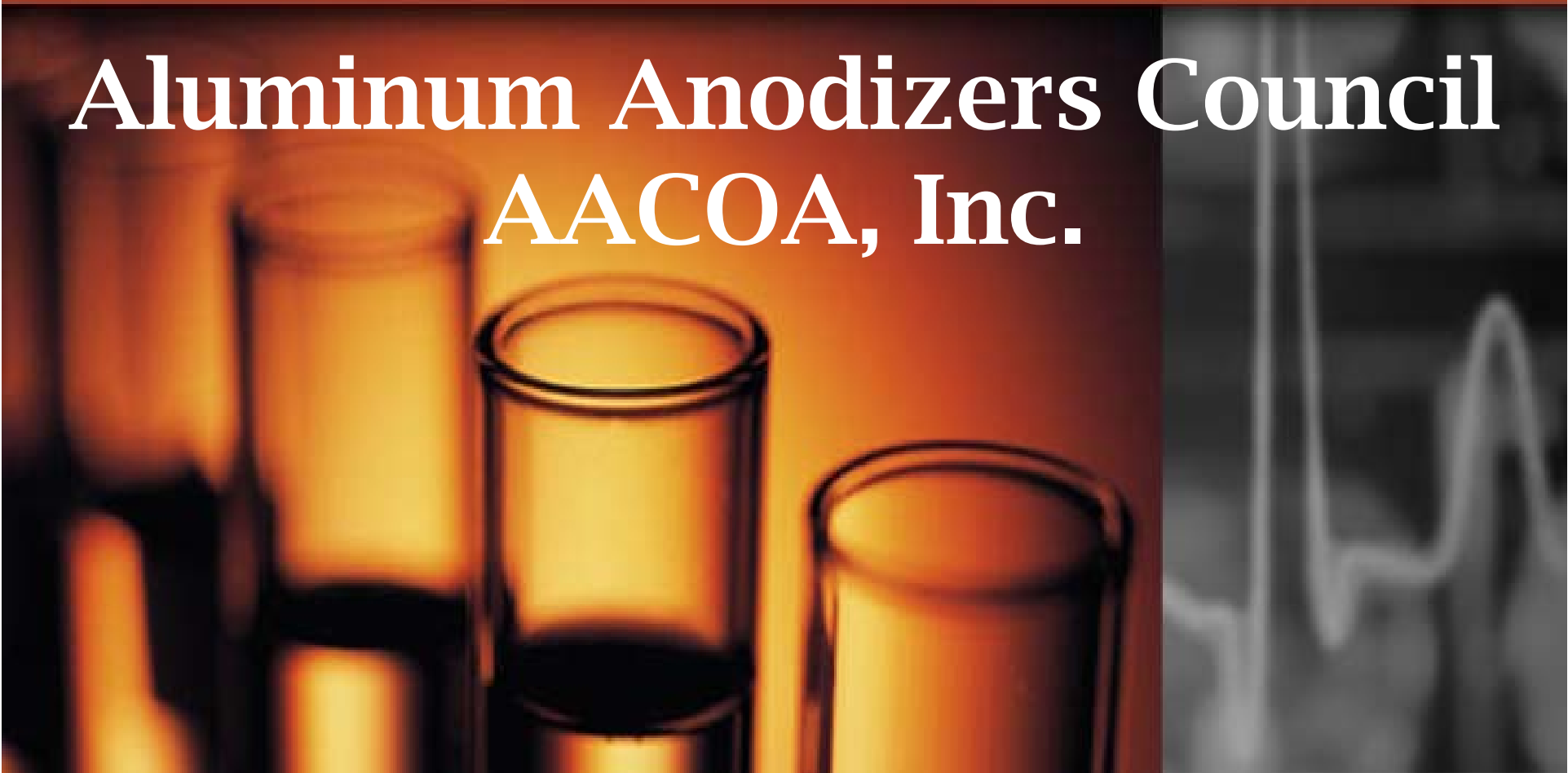
www.techsavvy.com

www.techstreet.com

www.wssn.net

Thank You
to the Following

Aluminum Anodizers Council
AACOA, Inc.

The background of the slide is a composite image. On the left side, there are several glass test tubes containing a dark liquid, set against a warm, orange-gold gradient. On the right side, there is a dark background with a white line graph or waveform, possibly representing an electrochemical process or data analysis.