Dynamic Multivariate Accelerated Corrosion Test Protocol

**Exposure Sites**
- Daytona Beach, FL
- Wright Patterson AFB, OH
- Kirtland AFB, NM
- Tyndall AFB, FL
- Pt. Judith, RI
- Hickam AFB, HI
- University National Oceanographic Laboratory System (UNOLS) Ships
- University of Delaware
- University of Washington

**Issues**
- Multiple lab corrosion tests are used:
  - ASTM B117 for aluminum alloys
  - GM 9540P for steel
- Does not account for UV, O3, temp, %RH.
- Outdoor & laboratory corrosion testing vary:
  - Rank order
  - Failure mode

**Technical Approach**
- Panels of bare Al AA2024-T3, AA6061-T6, AA7075-T6, and 1010 steel, pure silver and pure copper were exposed to eight environments and two test chambers.
- Test chambers:
  - 5% NaCl salt fog (ASTM B117).
  - 5% NaCl salt fog, UV, O3.
- Mass loss determinations, corrosion morphology and elemental analysis were used to investigate correlations between outdoor and laboratory sites.
- Qualitative & quantitative (SEM-EDS, FTIR) rankings were made after 1 and 2 years.
- Weather data was recorded on deployed weather monitoring systems or from EPA.
- A proof of concept model for predicting atmospheric corrosion rates of 1010 steel was developed using a cumulative damage non-linear modeling and simulation approach.

**Results**
- Corrosion of field samples correlates more strongly to Temp and %RH than UV/O3.
- For field exposure time is the dominant factor in corrosion severity.
- Degradation of coatings in B117 with UV/O3 more pronounced than B117 alone.
- Full Cr coating system degradation in B117 more like field than B117 UV/O3.
- Mg-rich coating system degradation in B117 UV/O3 more like field than B117 alone.
- High UV/O3 levels in B117 more corrosive than field sites with high UV/O3.
- Surface chemistry & morphology different for chamber & field at similar mass loss.

**Substrates / Coating Systems Deployed**
- Land site-mounted coated and bare sample exposure rack
- Ship-mounted bare sample exposure rack
- Land site-mounted bare sample exposure rack
- Ship-mounted coated sample exposure rack

**Smart Rack**
- ENVIROMENTAL CHARACTERIZATION EQUIPMENT
  - Multi-Axis Weather Sensor
  - Anemometer & Quality Meter
- CORROSION TEST METHODOLOGY
  - Compact form factor ambient air quality monitoring system. Automatically measures 10x CO and NOx levels (ppm resolution). Equipment secure for compliance with EN reference methods.
- Specimen cards (paper right) or custom “failing test” specimen will be mounted on removable future UV/UVF specifications.
- Smart rack components have been ordered and may be mounted. The system is being assembled.

**Accelerated Combined Effects Simulation (ACES) Chamber**
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