



F-35: REACH Replacement Projects

2016 ASETSDefense Workshop

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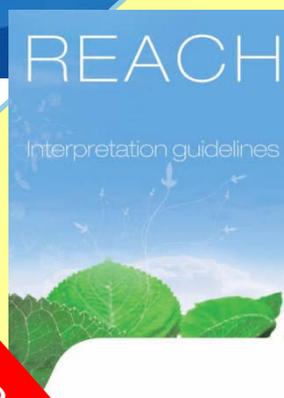
Overview



- REACH
- Remaining/Replacing Chrome
- Remaining/Replacing Cadmium
- Addressing other REACH impacted materials
- Risk of 'Hidden' or 'Unknown' upstream chemicals
- Summary



F-35 REACH Management



REGULATION (EC) No 1907/2006 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 18 December 2006

concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 761/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/762/EEC and Commission Directive 76/162/EEC, 93/67/EEC, 93/105/EC and 2002/31/EC

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION, Having regard to the Treaty establishing the European Community, and in particular Article 95 thereof, Having regard to the proposal from the Commission, Having regard to the opinion of the European Economic and Social Committee, Having regard to the opinion of the Committee of the Regions, Acting in accordance with the procedure laid down in Article 251 of the Treaty,

1. OJ L 370, 18.12.2006, p. 18
2. OJ L 24, 27.01.2007, p. 16



Candidate List of Substances of Very High Concern for Authorisation

EC Number	CAS Number	Chemical Name	EC Number	Decision Number	REACH 5. Substances
371-493-9	80315-10-4	2,3,7,8-TCDF	2010/001/5	001/001/5	001/001/5

Document HAZMATs throughout Life Cycle

Understand Regulation and Monitor Developments



Outputs

External Collaboration



Risk Planning and Communications

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Database Tracking and Predictions



HAZMAT Elimination



Baseline Non-Chrome Primer



AF-1 First Flight



BF-1 First Flight



CF-1 First Flight



* Except fuel tanks

Airframe Interior/Exterior
Over 68,000 Flight Hours
Enables Production Moving Line
Enables 'Shirt Sleeve' Maintenance*



Remaining Chrome



- **Chromium Trioxide/Chromic Acid – Henkel Alodine 1200(S)RTU conversion coating**
 - Continuously testing new products for compatibility with airframe primer
- **Chromium Trioxide Acids – Chromic Acid Anodize in supply chain**
 - JSFPO funding qualification of boric/tartaric-sulfuric acid anodize
 - AFLCMC funding TCP use as anodize seal
- **Calcium Dichromate – PPG PR-1425 Canopy Sealant**
 - PR-2061/PR-1861 adhesion promoter in final qualification/implementation
- **Strontium Chromate – PPG 833K086/930K088 Fuel Tank Coating, 3M EC 3917 adhesive film, Cytec BR-127, MIL-PRF-23377 primer used by supply chain**
 - Neutral/SO₂ salt fog testing completed, starting AFLCMC-funded flight test demonstration of non-chrome fuel tank coating
 - Continuously testing non-chrome -23377 formulations esp. Hentzen 16708TEP
 - Replaced BR-127 for aluminum adhesive bonding, working on titanium
- **Zinc Chromate – PPG 515x408/910x937 Super Koropon Quick Cure Touch-up Primer**

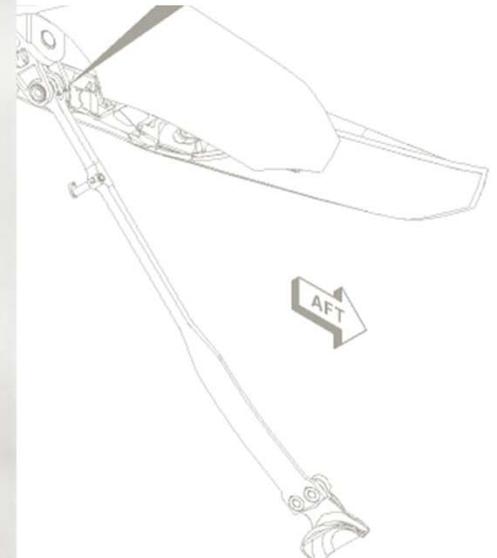
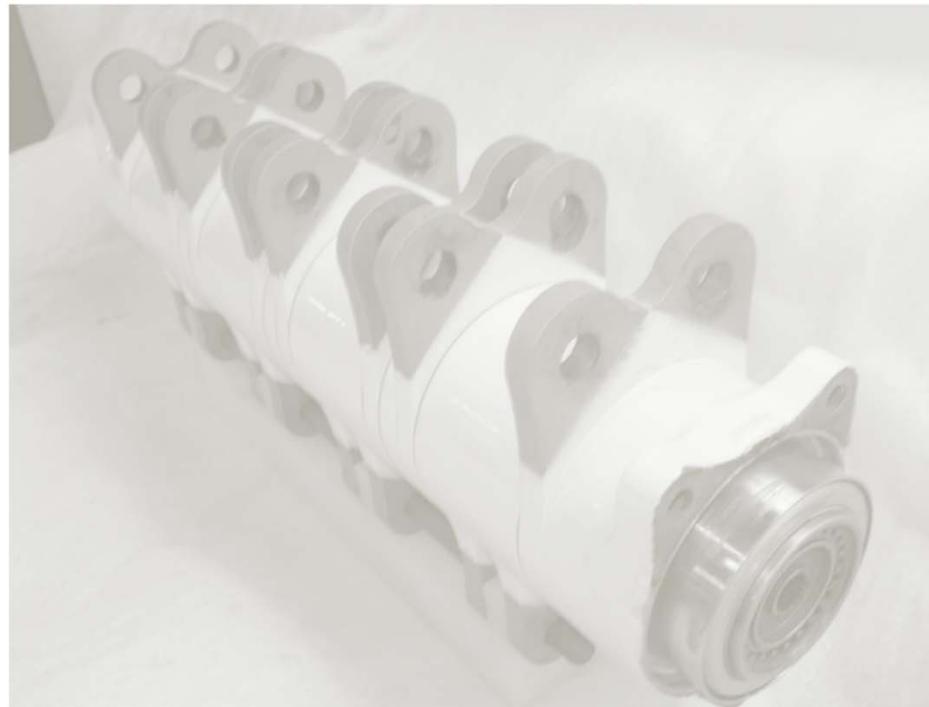
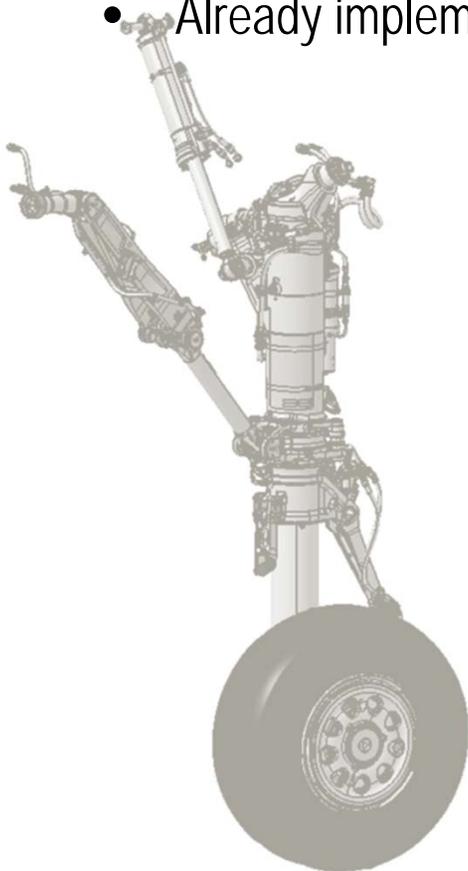
Still Working Critical Materials



Remaining Cadmium



- **Landing Gear, Leading Edge Flap, Arresting Gear, CV Wing-fold**
 - Starting AFLCMC funded demonstration/validation projects for Dipsol IZ-C17+ LHE zinc-nickel to meet F-35 neutral/SO₂ salt fog corrosion resistance requirements
 - Already implemented at OO-ALC landing gear depot



Promising Replacement in Work



TCEP and DMF



- Tris(2-chloroethyl)phosphate (TCEP) Sunset Aug 2015
- Dimethyl Formamide (DMF) on Candidate list
- Both contained in 3M EC-5817 Moisture Barrier Coating
 - Used on heating/cooling duct foam insulation
 - TCEP and DMF currently sourced from US
- Coating very specialized and low usage
- 3M re-formulated, lowered VOC, eliminated TCEP, but not DMF
 - Re-formulated version implemented in 2015
- Alternative product under AFLCMC-funding in final qualification

Partial Reformulation – Still Risk



Dibutyl tin Diacetate



- CLP re-classified dibutyl tin compounds as Reproductive 2 – August 2009
- Dow Corning announced re-formulation of high temperature sealant DC 93-006-1 March 2011
 - Reformulated product DC 93-006-1 RF contained Cristobalite, Titanium Dioxide, and Chromic Acid
 - F-35 decided to qualify completely new material
 - Qualification testing for DC 3145 RTV with PR-1200 Primer completed/implemented

Required Adopting Existing Material



DBDE



- Decabromodiphenyl ether(DBDE)
- Initial F-35 survey did not find any DBDE
- July 2012 – Min-K thermal ceramic insulation identified DBDE in Article coating, coating reformulated/implemented 2015
- April 2013 - Hi-Temp announced re-formulation of aluminized glass cloth HT-1542 for insulation Articles
 - F-35 had six months to evaluate re-formulated product and accept in time to meet December 2012 production halt (due to EPA negotiated agreement)
 - Reformulated product contain decabromodiphenyl ethane (CAS 84852-53-9) which is on CoRAP list
 - Hi-Temp aware potential to re-formulate again to replace –ethane version

Articles and Unknown Chemicals



REACH Impacts



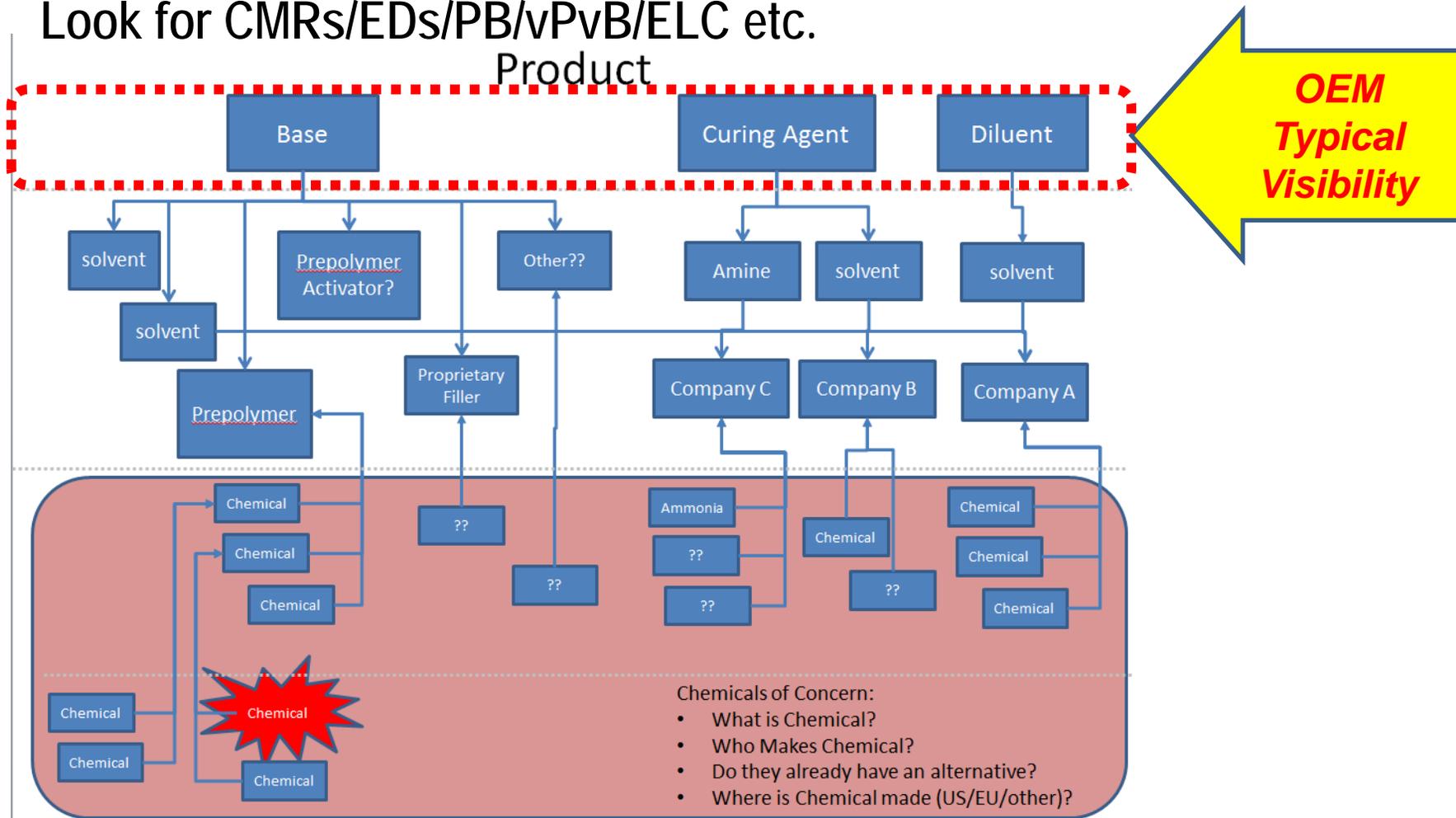
- In addition to hex chrome sunset dates, impacts other chemicals
 - Phthalates – F-35 reformulated ClickBond 200 nutplate adhesive
 - Lead compounds – explosives, flares, dry film lubes, high temperature fabrics, and of course solder
 - Nonylphenols – surfactants, emulsifiers, solubilizers, precursors
 - Bisphenol-A – adhesive films, epoxies, coatings
 - Heptylphenols – lubricant precursors
 - Borates – surfactants, stabilizers
 - Hydrophthalic anhydride MHHPA/HHPA - epoxy resin hardener
 - Refractory Ceramic Fibers (RFC) – high temperature coatings/insulations
 - Titanium Dioxide – colorant for everything
 - E-Glass – fiberglass

Continuous Risk



True REACH Risk of Unknown Chemicals

- Asking Critical Suppliers to Dive Deep into Their Supply Chains and Look for CMRs/EDs/PB/vPvB/ELC etc.



Requires Upstream Knowledge



Summary



- So far so good on replacements
- Still working chromate products but manufacturer's Authorizations have bought more time
- Have cadmium path forward
- Worried about UNKNOWNS due to U.S. SDS difference

