



Impact of European REACH Regulations on DoD and Military Equipment Manufacturers and Suppliers

VERSION 7

1.00794	2																	4.002602	2																																																
H	Helium																	He	Helium																																																
6.941	3	9.012182	4																	18.9984	8	19.998473	9	20.1797	10																																										
Li	Lithium	Be	Beryllium																	B	Boron	C	Carbon	N	Nitrogen	O	Oxygen	F	Fluorine	Ne	Neon																																				
22.989769	11	24.304	12																	26.981538	13	28.0855	14	30.97376	15	32.005	16	35.453	17	39.948	18																																				
Na	Sodium	Mg	Magnesium																	Al	Aluminum	Si	Silicon	P	Phosphorus	S	Sulfur	Cl	Chlorine	Ar	Argon																																				
39.0983	19	40.078	20	44.95591	21	51.961	22	50.9415	23	51.9962	24	54.938045	25	55.845	26	58.933195	27	58.9332	28	63.546	29	65.38	30	69.723	31	72.64	32	74.9216	33	75.94	34	79.904	35	83.798	36																																
K	Potassium	Ca	Calcium	Sc	Scandium	Ti	Titanium	V	Vanadium	Cr	Chromium	Mn	Manganese	Fe	Iron	Co	Cobalt	Ni	Nickel	Cu	Copper	Zn	Zinc	Ga	Gallium	Ge	Germanium	As	Arsenic	Se	Selenium	Br	Bromine	Kr	Krypton																																
85.4678	37	87.62	38	88.90585	39	91.224	40	92.90638	41	92.906	42	95.94	43	95.94	44	101.07	45	101.07	46	106.3655	47	107.8682	48	112.411	49	114.818	50	118.710	51	127.60	52	126.90447	53	132.905	54																																
Rb	Rubidium	Sr	Strontium	Y	Yttrium	Zr	Zirconium	Nb	Niobium	Mo	Molybdenum	Tc	Technetium	Ru	Ruthenium	Rh	Rhodium	Pd	Palladium	Ag	Silver	Cd	Cadmium	In	Indium	Sn	Tin	Sb	Antimony	Te	Tellurium	I	Iodine	Xe	Xenon																																
132.9054	55	137.327	56	174.964	71	178.49	72	180.94788	73	183.84	74	186.207	75	190.23	76	193.227	77	195.084	78	196.96657	79	200.59	80	204.38	81	207.2	82	208.9804	83	223.0185	84	223.0185	85	223.0185	86																																
Cs	Cesium	Ba	Barium	Lu	Lutetium	Hf	Hafnium	Ta	Tantalum	W	Tungsten	Re	Rhenium	Os	Osmium	Ir	Iridium	Pt	Platinum	Au	Gold	Hg	Mercury	Tl	Thallium	Pb	Lead	Bi	Bismuth	Po	Polonium	At	Astatine	Rn	Radon																																
223.0185	87	226.0254	88	227.03373	89	227.03373	90	227.03373	91	227.03373	92	227.03373	93	227.03373	94	227.03373	95	227.03373	96	227.03373	97	227.03373	98	227.03373	99	227.03373	100	227.03373	101	227.03373	102	227.03373	103	227.03373	104																																
Fr	Francium	Ra	Radium	Lr	Lanthanum	Rf	Rutherfordium	Db	Dubnium	Sg	Seaborgium	Bh	Berkelium	Hs	Hassium	Mt	Moscovium	Ds	Darmstadtium	Rg	Roentgenium	Cn	Copernicium																																												
																												138.90473	57	140.116	58	140.90765	59	144.242	60	144.9128	61	150.36	62	151.964	63	157.25	64	158.92535	65	162.50	66	164.93033	67	167.259	68	168.93402	69	171.034	70												
																												La	Lanthanum	Ce	Cerium	Pr	Praseodymium	Nd	Niobium	Pm	Promethium	Sm	Samarium	Eu	Europium	Gd	Gadolinium	Tb	Terbium	Dy	Dysprosium	Ho	Holmium	Er	Erbium	Tm	Thulium	Yb	Ytterbium												
																												Ac	Actinium	Th	Thorium	Pa	Protactinium	U	Uranium	Np	Neptunium	Pu	Plutonium	Am	Americium	Cm	Curium	Bk	Berkelium	Cf	Californium	Es	Einsteinium	Fm	Fermium	Md	Mendelevium	No	Nobelium												

Client: Robin Nissan

Organization: SERDP/ESTCP

Original issue date: February 21, 2008

Update: September 14, 2015

Authors: Ralph Alexander, Keith Legg

Rowan Technology Group, klegg@rowantechnology.com, (847)-219-9868

DISTRIBUTION STATEMENT

Notes

Opinions expressed in this document are the opinions of the authors, and do not reflect the official positions of SERDP-ESTCP or the US Department of Defense. As of the time of writing, the Pentagon has not issued a legal opinion on the manner or extent to which REACH applies to DoD.

REACH rules and requirements are frequently modified by changing interpretations from EChA and legal opinions of the European Court, as well as differing interpretations and procedures (such as Defense Exemptions) in European countries. As a result, statements that may have been accurate when this document was written may not remain accurate.

In order to make this report easier to understand, we have included only the Introduction and Impacts in the main body of the report, and moved two Sections into Appendices:

Appendix 4 Primary Provisions of REACH

Appendix 5 Examples of REACH Impacts

A note on spelling:

To make the document easier to search, US spelling has been used consistently throughout, even where the original text used UK spelling. However, since REACH is European, all REACH documents and web sites use UK English spelling. In particular:

US	UK
Aluminum	Aluminium
Authorization	Authorisation
Color	Colour
Colorant	Colourant
Defense	Defence
Harmonization	Harmonisation
Organization	Organisation
Sensitizer	Sensitiser

EXECUTIVE SUMMARY

This document summarizes the known and expected impacts of the European REACH regulations on the U.S. Department of Defense (DoD). Information on impacts is provided in Section 2, with details in the sections following. The table below summarizes the main aspects of REACH with links to relevant sections of the document in the right hand column.

Issue	Description and impact	Link
Precautionary Principle	Precautionary philosophy does not require clear proof of harm, and bases regulation primarily on hazard, rather than risk in the way chemicals are used. Impact: Chemicals can be regulated or restricted based on little solid data (e.g. by "read-across" similarity with other chemicals).	3.1
Impact of Registration	No chemical can be imported or used in Europe in quantities >1 tonne/yr unless it is registered <u>for the application in which it will be used</u> . Substances in Articles need not be registered unless they are intended to be released and imported at >1 tonne/yr. Registration is very expensive. Only EU companies, importers, and representatives of non-EU companies can register substances. Impact: Expected loss of low-volume chemicals from market. Cannot import to Europe items containing substances not registered for their application, even if benign. Potential loss of essential constituents for military sales and sustainment	3.2, Appendix 4.3
Authorization, Annex XIV - once placed on Annex XIV a chemical cannot be used in Europe without Authorization, but it can be imported on components	Once a chemical is placed in Annex XIV or its Candidate List, users usually deselect it and forbid its use on their products. Authorization allows the chemical to be used by authorized organizations only, and for authorized uses only, for a limited period of time (a few years). Impact: Essential chemicals may be modified (and therefore no longer qualified), or withdrawn from the market worldwide if they are no longer profitable. They cannot be used to maintain defense products in Europe outside US bases (e.g. chromated primers) except by authorized organizations. On-base use may be restricted to US personnel. Most components are exempt under the "Article Exemption."	3.3, Appendix 4.4
Restriction, Annex XVII	Restriction defines disallowed uses of materials. Impact: Restrictions on the use of chemicals may prevent their use for sustainment in Europe. Most current restrictions are not relevant to DoD , except restrictions on the use of methylene chloride (paint stripping) and Cd plating where there are exemptions for aerospace applications and the impact on military vehicles and vessels is unclear.	3.4, Appendix 4.5

Classified and ITAR materials	All substances used in paints, etc. must be registered, providing information on all constituents. Mixtures containing SVHCs must be reported to ECHA, which may result in release of classified information. This information can be released, e.g. in the case of an accident or spill. Impact: Although information sent to ECHA can be confidential, classified and ITAR materials cannot be properly protected.	2.3
Defense Exemptions	Defense Exemptions are valid only in the issuing country, and are not recognized across the EU. The UK has the most comprehensive approach to DEs, and the purpose of a UK DE is to allow temporary use of a chemical until an alternative is available. Impact: Defense Exemptions are of limited use for FMS and sustainment in multiple EU countries. US acquisitions that require ITAR materials (e.g. specialty coatings) can only be sourced from European countries that permit DEs (issue encountered in F-35 program). Acquisitions requiring Annex XIV materials can only be sourced with EU vendors with Authorizations.	2.3
Sustainment of US equipment in the EU	Many DoD-critical chemicals are already subject to Restriction or Authorization, and many more will be added to those lists. Impact: Many critical sustainment chemicals will become unavailable from local EU sources and will be difficult to import. Some may only be usable on US bases by US personnel, eliminating local sources of chemicals and local contractors. If Authorizations are granted to suppliers this may alleviate the problem for a few years.	2.5.1
Military Sales	European customers are requiring various levels of proof of REACH-compliance on imported systems, and may also require REACH-compliance for chemicals used for sustainment. Impact: This has already been a factor in the loss of one contract and can lead to additional RTD&E and record keeping, which increases cost and risk of European sales for US companies.	2.4.1
Munitions and pyrotechnics	Munitions such as cartridges are generally defined as Articles. Munitions designed to release materials (obscurants, flares, etc.) are expected to be defined as Articles containing Mixtures. Impact: REACH will have little effect on most munitions. It will not affect propellants, but may affect the import to Europe of flares and other munitions that release chemicals.	2.5.1.1

TABLE OF CONTENTS

1. Introduction	- 1 -
2. Impact of REACH on DoD	- 5 -
2.1. Summary of overall impact on DoD	- 6 -
2.2. Materials subject to authorization or restriction	- 7 -
2.2.1. Chromates	- 9 -
2.2.2. Cadmium.....	- 9 -
2.2.3. Organics	- 10 -
2.3. Defense Exemptions, ITAR, EAR.....	- 10 -
2.4. Impact on Military Sales and suppliers	- 12 -
2.4.1. Military Sales	- 12 -
2.4.2. Effect of rules on equipment design.....	- 12 -
2.4.3. Impact on chemical suppliers	- 14 -
2.4.4. Classified and proprietary materials.....	- 15 -
2.5. Impact on DoD units in Europe.....	- 16 -
2.5.1. Sustainment	- 16 -
2.5.2. Munitions.....	- 18 -
2.6. Impact on DoD operations in the US	- 20 -
2.6.1. EU users of US-made military equipment	- 21 -
3. Impact of REACH on the DoD supply chain	- 22 -
3.1. Impact of REACH Precautionary Principle.....	- 22 -
3.2. Impact of Registration	- 22 -
3.3. Impact of Authorization	- 24 -
3.3.1. Authorizations Sought or Granted.....	- 25 -
3.4. Impact of Restriction (Annex XVII).....	- 25 -
3.5. Impact of REACH enforcement	- 25 -
3.6. Impact of Uncertainty	- 26 -
3.7. Migration of MRO and other EU industries	- 26 -
4. Potential political and competitive issues with REACH.....	- 27 -
5. Summary of risks and opportunities	- 28 -
6. Recommendations	- 30 -
Appendix 1. Sources of REACH information.....	- 33 -
Appendix 2. Annex XIV Substances as of April 2015	- 34 -

Appendix 3.	Annex XVII Substances as of April 2015	- 36 -
Appendix 4.	Primary provisions of REACH	- 37 -
Appendix 4.1	Definitions	- 38 -
Appendix 4.2	Schedule	- 40 -
Appendix 4.3	Registration	- 40 -
Appendix 4.4	Authorization.....	- 41 -
Appendix 4.4.1	Annex XIV Authorization List.....	- 41 -
Appendix 4.4.2	Candidate materials	- 41 -
Appendix 4.4.3	Rules for Authorization	- 42 -
Appendix 4.5	Restriction	- 44 -
Appendix 4.5.1	Annex XVII, Restricted Substances.....	- 44 -
Appendix 4.5.2	Restrictions under consideration.....	- 45 -
Appendix 4.6	Summary of issues critical to alloys, fluids, components and sustainment chemicals - 45 -	
Appendix 4.6.1	Rules for Mixtures (aka Preparations)	- 45 -
Appendix 4.6.2	Coatings and paints.....	- 46 -
Appendix 4.6.3	Rules for Articles	- 46 -
Appendix 4.6.4	Concentration threshold.....	- 49 -
Appendix 4.6.5	Compliance costs	- 49 -
Appendix 4.6.6	Interpretations and changes in the regulations	- 51 -
Appendix 4.6.7	Differing interpretations by EU member states	- 51 -
Appendix 4.6.8	Potential changes.....	- 52 -
Appendix 4.6.9	Risk Management Option Analysis	- 52 -
Appendix 4.6.10	REACH Expansion	- 53 -
Appendix 5.	Examples of REACH Impacts	- 55 -
Appendix 5.1	Generic examples	- 55 -
Appendix 5.1.1	REACH Impacts on direct DoD activities	- 55 -
Appendix 5.1.2	REACH impacts on military equipment OEMs and vendors in Europe ..	- 56 -
Appendix 5.1.3	Sale of a US Aircraft into the EU	- 57 -

LIST OF TABLES

Table 1. A brief overview of REACH concepts and terminology.....	- 4 -
Table 2. Summary of impacts on DoD. Links at right go to relevant sections of this report.....	- 6 -
Table 3. REACH Annex XIV substances, as of April 2015. Defense chemicals shown in gold.....	- 8 -
Table 4. EU Countries with Defense Exemptions, showing responsible agency and number of DEs issued as of 2015.	- 11 -
Table 5. ECHA answer to question of whether ammunition cartridges are articles under REACH	- 19 -
Table 6. BDSV answer to question of whether ammunition cartridges are articles under REACH.	- 20 -
Table 7. REACH Annex XIV substances as of April 2015. DoD-relevant chemicals shown in gold. .	- 35 -
Table 8. Key REACH terms of importance to DoD.	- 39 -
Table 9. Substances subject to authorization (Annex XIV).....	- 42 -
Table 10. Comparison between registration and authorization procedures in REACH (adapted from the Nickel Institute).	- 43 -
Table 11. Some DoD-relevant substances already listed as restricted substances in REACH.....	- 45 -
Table 12. Principal REACH compliance costs (source: EU Regulation No. 254/2013). The first set of numbers shown is for an individual large enterprise; the numbers in square parentheses are for an individual small enterprise, assuming no testing or related costs for new substances.....	- 50 -
Table 13. Calculation of weights in weapon system (double-click in table to change numbers). ...	- 58 -

LIST OF FIGURES

Figure 1. REACH registrations by tonnage as of December 2014.	- 23 -
Figure 2. REACH Registration Schedule.	- 40 -

1. Introduction

This report is intended to provide an overview of the potential impact on DoD, its contractors and vendors of the European REACH legislation ([Regulation \(EC\) No 1907/2006 of the European Parliament and of the Council concerning the Registration, Evaluation, Authorization and Restriction of Chemicals \(REACH\)](#)). It is not intended to provide a thorough review of the details of REACH itself. We have attempted to separate out the known facts from those that are likely, and those that are merely possible. Since the legislation is extremely complex and is still in the process of being fully defined even now, this document is intended to provide a rather broad overview without a great depth of detail. In order to keep this document focused, we do not discuss the finer details unless they are directly relevant to DoD.

Very briefly:

1. The purpose of REACH is to gather information on the toxicity and usage of every chemical (substance) sold, used or imported into Europe. This is done through a process of Registration, which involves production of an extensive dossier on the toxicity and usage of every chemical. No chemical can be sold or used in Europe unless both the chemical and its uses are registered. Even a benign chemical cannot be used in Europe unless that use is registered.
2. The Registration Dossiers are intended to show whether the material is Carcinogenic, Mutagenic, or Toxic for Reproduction (CMR). Any CMR chemical, and more recently chemicals with other types of toxicity, is regarded as a Substance of Very High Concern (SVHC).
3. The aim is that all SVHCs will eventually either be restricted, or their use allowed only through authorization, with the intent that they be replaced by benign alternatives. The European Chemical Agency (ECHA) develops lists of substances requiring Authorization (REACH Annex XIV) and Restricted substances (REACH Annex XVII). A chemical in Annex XVII can be used, but its use is controlled or restricted in some way; a chemical in Annex XIV can only be used by authorized organizations for authorized uses until the authorization expires or an alternative is found.

Important issues to keep in mind for DoD:

- There is no military or aerospace exemption (unlike the case for RoHS, [Restriction of Hazardous Substances in Electrical and Electronic Equipment, Directive of the European Parliament 2002/95/EC](#), and its [Recast 2011/65/EU in 2011](#)).**
- Defense Exemptions are only available for some chemicals in some EU countries.**
- For certain militarily important materials there are no limits below which they can be used in Europe without authorization.**
- Some militarily important materials may be completely unaffected by REACH if their annual usage in the EU is <1 tonne.
- Most components and spare parts are exempt under the so-called "Article Exemption".

Impacts on DoD arise from a number of directions. We have attempted to provide an understanding of the most important issues:

1. REACH requirements affect the choice of materials and sustainment technologies for military equipment, not just for military equipment customers in the EU, but for US sustainment of forces in the EU as well:

- a. Registration and authorization requirements are expected to lead to loss of critical chemicals from the market in the EU, and reformulation of products used elsewhere in the world, since producers do not generally want to maintain additional product lines.
 - b. Certain toxic chemicals required for maintenance will not be able to be commercially imported or widely used in the EU – e.g. plating chemicals, aluminum treatments and primers. It is unclear how this will affect sustainment of US weapon systems stationed in Europe.
 - c. Proprietary and classified information cannot be securely protected if supplied to EChA as required by REACH rules – required Registration of chemicals involves the release of all chemical and usage data.
2. REACH affects OEM and commercial sales of military equipment.
- a. Foreign Military Sales to European users. EU acquisition programs now require that weapon systems be REACH-compliant. The definition of compliance, and the requirements for proving compliance are different in different countries because they have different interpretations of the REACH legislation.
 - b. OEM sales of spare parts and supplies for maintenance of European-owned US military equipment (e.g. vehicle and aircraft components, armaments). Many maintenance chemicals will no longer be able to be imported into the EU, but spare parts will be largely unaffected.
 - c. European vendor sales of chemicals for maintenance of European owned US military equipment (chromating and plating chemicals, cleaners, paints) will no longer be possible in many cases.
3. REACH may increasingly hamper DoD operations in Europe by impacting military importation, use and maintenance of weapon systems, by making it difficult to obtain locally or to import commercially the chemicals and treatments required for operation and maintenance. This may affect:
- a. Military bases, ports, off-base training (including ships) and travel between locations (military vehicles and aircraft)
 - b. Importation of military hardware and supplies, which may need to be along the military supply chain direct to bases, rather than through commercial routes
 - c. Ships in ports and territorial waters and ships refitted in European ports
 - d. Maintenance of military equipment (especially where it requires local acquisition or importation of maintenance chemicals and paints), or where it involves the use of materials by EU citizens.
4. REACH will increasingly affect the availability of materials and chemicals in the global economy that are needed to manufacture, operate and sustain military hardware.
- a. Most manufacturing and sustainment chemicals come from global suppliers, who react to the size and needs of the global market, not just the US. Since DoD is a low-volume chemical user, if some chemicals or materials become too difficult or expensive to continue manufacturing profitably for the US market alone, they will become unavailable in the US.

- b. Another major concern is whether REACH regulators might effectively ban materials because they conclude that good alternatives are now available (while in reality the alternatives are inadequate, sole source, awaiting validation as an acceptable alternative, or not qualified for DoD use).
- 5. REACH is likely to impact the relative competitiveness of US and EU military OEMs, contractors and vendors.
 - a. There may be impacts on the relative availability and competitiveness of maintenance and repair facilities within and outside the EU. It is rumored that aerospace companies are considering moving manufacturing and MRO operations out of Europe, and some operations may already have moved, although we have found no clear evidence of this.
 - b. The REACH Authorization process effectively shields Authorized companies from competition and ensures that new competitors cannot enter the market. There is also the possibility of EU regulators effectively creating an EU cartel or sole source chemical supplier for a particular product through the use of Authorization.

Table 1. A brief overview of REACH concepts and terminology.

REACH provision	Description	Sec.
Precautionary principle	REACH explicitly uses the Precautionary Principle, which does not require proof of harm. Based on hazard (toxicity of a chemical), not risk (whether it poses a real risk to the general public)	3.1
Substance	Term for a chemical with a defined CAS or EC / List number	Appendix 4.1
SVHC	Substance of Very High Concern, usually, but not necessarily, a CMR	Appendix 4.1
CMR	Carcinogenic, Mutagenic, or toxic for Reproduction	Appendix 4.1
Preparation / Mixture	A mixture of substances such as paint, plating solution, alloy. Originally termed a Preparation, now most commonly called a Mixture.	Appendix 4.6.1
Article	A product, from a screw to an airplane. Also the term for a section of the REACH legislation. In general toxic SVHCs such as chromates and Cd can be used on articles imported to the EU (the "Article Exemption")	Appendix 4.6.3
Registration	Any chemical imported or used in the EU, whether by itself or in a product must be registered (cutoff date May 2018). Registration requires extensive Dossier and is registration is of the chemical for each of its uses. Non-registered products or uses are not allowed in the EU even if the chemical is benign or registered for other uses.	Appendix 4.3
CoRAP	Community Rolling Action Plan – substances to be evaluated for Candidate List for Authorization or Restriction	Appendix 4.1
Authorization, Annex XIV & Candidate list	Substances in Annex XIV cannot be used in Europe without authorization. Authorization permits temporary use while an alternative is found. Continually updated with new chemicals. REACH aim is that all SVHCs should eventually be authorized or restricted	Appendix 4.4
Restriction, Annex XVII	Substances in Annex XVII are restricted in various ways, usually by their usage.	Appendix 4.5
Downstream notification	Inclusion of an SVHC into a product triggers the need for notification to all downstream users	2.1
Defense Exemption	Unlike RoHS, REACH has no general exemption for defense. A Defense Exemption provides temporary permission to continue using a chemical in defense. Only some countries make provision for DEs, and there is no provision for EU-wide acceptance	2.3

2. Impact of REACH on DoD

The information in this section is supplemented by the examples provided in Section 3. Table 1 provides a very brief summary of REACH concepts, with links to the detailed explanations in the document. Table 2 summarizes the primary impacts on DoD.

2.1. Summary of overall impact on DoD

Table 2. Summary of impacts on DoD. Links at right go to relevant sections of this report.

Issue	Impact	Link
Precautionary Principle	Based on hazard, not risk. Chemicals can be regulated or restricted based on minimal data (e.g. "read-across" by similarity with other chemicals).	3.1
Registration	Expected loss of low-volume chemicals from market. Cannot import to Europe mixtures (lubricants, paints, etc.) containing substances not registered for their application, even if benign. Potential loss of essential constituents for military sales and sustainment	3.2, Appendix 4.3
Authorization, Annex XIV	Essential chemicals may be modified (and therefore no longer qualified), or withdrawn from the market worldwide if they are no longer be profitable. They cannot be used to maintain defense products in Europe outside US bases (e.g. chromated primers) except by authorized organizations. On-base use may be restricted to US personnel. Most components are exempt.	3.3, Appendix 4.4
Restriction, Annex XVII	Restrictions on the use of chemicals may prevent their use for sustainment in Europe (e.g. Cd plating). Most current restrictions are not relevant to DoD , except restrictions on the use of methylene chloride and Cd plating.	3.4, Appendix 4.5
Classified and ITAR materials	Although information sent to EChA can be confidential, classified and ITAR materials cannot be properly protected.	2.3
Defense Exemptions	Defense Exemptions from one country are not recognized by other countries, making them of limited use for FMS and sustainment across Europe. Items requiring the use of ITAR materials can typically only be sourced in European countries that permit DEs.	2.3
Sustainment of US equipment in the EU	After September 2017, many critical sustainment chemicals (primarily those containing chromates) will no longer be readily available in the EU from local sources and will be difficult to import. Some may only be usable on US bases by US personnel, eliminating many true local sources of chemicals and local contractors. If authorizations are granted this may alleviate the problem for a few years	2.5.1
Foreign Military Sales	This has already contributed to the loss of one FMS contract, and can lead to very expensive modifications and record keeping, greatly increasing the risk and reducing the profitability of European sales for US companies.	2.4.1
Munitions and pyrotechnics	REACH will have little effect on most munitions. It will not affect propellants, but may affect the import to Europe of some flares	2.5.1.1

A summary of REACH acronyms and definitions can be found at:

<http://www.reach-compliance.eu/english/REACH-ME/engine/sources/definitions.html>

2.2. Materials subject to authorization or restriction

By far the biggest direct effect of REACH on DoD will be the authorization and restriction rules, especially for SVHCs used in articles or for maintenance. The materials that will be of most concern are what are called the Annex XIV Substances. These are the materials that are considered so dangerous to health or the environment that their use must be authorized and may be restricted, with the intent of replacing them as soon as viable alternatives are available. This is summed up very simply in the 2007 version of the ASD Guidelines¹ in the box below:

Principle governing the management of toxic substances and preparations regulation under REACH (Note: Does not apply to substances in Articles):

Any use of a substance of very high concern included in Annex XIV of the REACH regulation that is not authorized is prohibited. (ASD REACH Interpretation Guidelines, 2007).

Note that it is not just the substance that must be authorized, but also the uses of it, whether by itself or in mixtures. It is not yet clear how broad or specific the use data must be since as of the time of writing only one substance has been authorized.

Specific materials in that are used by DoD and meet the above criteria include:

- Cr⁶⁺ compounds (except barium chromate) – used throughout DoD on all Al alloys for aircraft skins, Mg gearboxes, primers, sealants, wash primers, Zn plate, Cd plate, fasteners, electrical connectors, etc.
- Cd – widely used for all steels, fasteners, etc.
- Various Co and Cd compounds – used in various plating baths.
- Hydrazine and its salts – rocket fuels.
- Trichloroethylene – solvent, cleaner (moving into disuse)
- Methyl Ethyl Ketone – paint remover (moving into disuse)
- Methylene chloride – paint remover.

Table 3 shows the substances in Annex XIV as of the time of writing. Those substances used in defense applications are shown in colored cells – 21 out of the 31 materials. The F-35 program, with its European suppliers and customers, has been affected by the loss of a number of these chemicals, requiring reformulations and searches for alternatives. Many of these uses are quite subtle, being minor (but important) additives, or precursors for other chemicals. The chromates are primarily used for corrosion control, especially in aluminum pretreatments and aerospace primers. The prevalence of these corrosion inhibitors reflects the basic principle that **any chemical active enough to inhibit corrosion is also likely to be active enough to pose an environmental or health hazard.**

As additional substances are added to Annex XIV we can expect to find more aerospace and defense materials among them.

Table 3. REACH Annex XIV substances, as of April 2015. Defense chemicals shown in gold.

Name	CAS #	Sunset date	Latest applic.	DoD applications
1,2-Dichloroethane (EDC)	107-06-2	22/11/2017	22/05/2016	
2,2'-dichloro-4,4'-methylenedianiline (MOCA)	101-14-4	22/11/2017	22/05/2016	Polymer insulators, epoxy
2,4 – Dinitrotoluene (2,4-DNT)	121-14-2	21/08/2015	21/02/2014	Precursor
4,4'- Diaminodiphenylmethane (MDA)	101-77-9	21/08/2014	21/02/2013	Polymer insulators
5-tert-butyl-2,4,6-trinitro-m-xylene	81-15-2	21/08/2014	21/02/2013	
Acids generated from chromium trioxide and their oligomers	13530-68-2	21/09/2017	21/03/2016	Passivates
Ammonium dichromate	2151163	21/09/2017	21/03/2016	Phosphate stripper, corrosion inhibitor
Arsenic acid	7778-39-4	22/08/2017	22/02/2016	
Benzyl butyl phthalate (BBP)	85-68-7	21/02/2015	21/08/2013	Polymers
Bis(2-ethylhexyl) phthalate (DEHP)	117-81-7	21/02/2015	21/08/2013	Polymers
Bis(2-methoxyethyl) ether (Diglyme)	111-96-6	22/08/2017	22/02/2016	Rain erosion coatings, adhesives
Chromium trioxide	1333-82-0	21/09/2017	21/03/2016	Chrome plating, Al treatment
Diarsenic pentaoxide	1303-28-2	21/05/2015	21/11/2013	
Diarsenic trioxide	1327-53-3	21/05/2015	21/11/2013	
Dibutyl phthalate (DBP)	84-74-2	21/02/2015	21/08/2013	Flares
Dichromium tris(chromate)	24613-89-6	22/01/2019	22/07/2017	Aerospace
Diisobutyl phthalate (DIBP)	84-69-5	21/02/2015	21/08/2013	Adhesives
Formaldehyde, oligomeric reaction products with aniline (tech MDA)	25214-70-4	22/08/2017	22/02/2016	Ejection seats, flares
Hexabromocyclododecane (HBCDD)	134237-50-6	21/08/2015	21/02/2014	
Lead chromate	7758-97-6	21/05/2015	21/11/2013	
Lead chromate molybdate sulphate	12656-85-8	21/05/2015	21/11/2013	
Lead sulfochromate yellow	1344-37-2	21/05/2015	21/11/2013	
Pentazinc chromate octahydroxide	49663-84-5	22/01/2019	22/07/2017	Aerospace
Potassium chromate	7789-00-6	21/09/2017	21/03/2016	Al treatment
Potassium dichromate	7778-50-9	21/09/2017	21/03/2016	Primer, anodize and phosphate sealer
Potassium hydroxyoctaoxidizincatedichromate	11103-86-9	22/01/2019	22/07/2017	
Sodium chromate	2146108	21/09/2017	21/03/2016	Al treatment
Sodium dichromate	10588-01-9	21/09/2017	21/03/2016	Al treatment
Strontium chromate	2151068	22/01/2019	22/07/2017	Primer, fuel tank coating
Trichloroethylene	79-01-6	21/04/2016	21/10/2014	Cleaner
Tris(2-chloroethyl)phosphate (TCEP)	115-96-8	21/08/2015	21/02/2014	Insulative coating

All substances in Annex XIV are subject to Authorization, regardless of whether they are used alone or in mixtures (such as plating baths or cleaners). However, according to the most recent REACH Guidelines for Articles² “Substances being (an integral) part of imported articles cannot be

*subject to **authorization**. This means that in order to import articles into the EEA an authorization cannot be required.”* This means that an Annex XIV substance can generally be used in an article imported into the EU, even if there is no Authorization (or even a registration) for it, unless it is intended to be released. **Thus, for example, after September 2017 an aluminum aircraft panel, chromate converted and painted with strontium chromate primer, cannot be made in the EU except with Authorization, but that same panel can be imported into the EU.**

Although there are lower limits on their concentrations (wt%) for other actions, such as notifying the ECHA, there are no lower limits for the purposes of authorization, unless spelled out when and if they are included.

2.2.1. Chromates

The class of materials on Annex XIV most widely used by DoD for sustainment is the chromates. Sodium dichromate chromic acid particular are used for passivation of aluminum, sealing of anodized coatings, and hard chrome plating, while strontium chromate is widely used as a corrosion inhibitor for aerospace primers. They are also used for passivation of Cd and Zn plating used for the protection of steels in aircraft and vehicles. For this reason, there are consortia seeking authorization of various chromates, particularly for aerospace use. Given the importance of the aerospace industry to the European economy, it is likely that Authorizations will be granted for the continued use of these various chromates. However, since Authorization is intended as a temporary measure until an alternative is found, it is only a matter of time until these materials will no longer be available for sustainment in Europe. Because they are Articles, chromates can be imported into Europe on spare parts, fasteners, etc.

2.2.2. Cadmium

Cadmium plating is commonly used on high-strength steel components (such as aircraft landing gear), fasteners and electrical connectors. It is also used on stainless steels for galvanic compatibility with aluminum. Its import into Europe on aerospace fasteners, electrical connectors and spare parts is permitted since they are Articles. Cadmium is specifically Restricted in REACH [[Annex XVII \(23\)](#)] as follows:

- It cannot be used in paints and as a colorant or stabilizer in many polymers (electrical wiring, for example)
- There is currently an exemption for aerospace, electrical contacts and safety devices.
- Cd plating cannot be used for components in road vehicles or vessels. Most military vehicles use Cd-plated bolts, electrical connectors and high strength steel components, and it is currently unclear whether they are exempt.

Cd brush electroplating is a common repair technique for Cd-plated components. At the present time the use of cadmium salts in brush plating for repair is not restricted or authorizable in Europe. As Table 3 shows, there are no cadmium salts currently on Annex XIV. However, most of the chemicals used in cadmium plating are on the [Candidate List for Authorization](#) – Cd, Cd, oxide Cd chloride, Cd sulfate, Cd Sulfide, Cd fluoride. Cd sulfate is a constituent of Cd brush plating solutions. Therefore, if these Cd salts are entered into Annex XIV, as we expect, then brush plating solutions will become subject to Authorization in Europe.

2.2.3. Organics

A third major class of materials in Table 3 is phthalates. While phthalates are used for sustainment, they are primarily used as plasticizers in polymeric materials, seals, etc., which are articles, and therefore can be imported into Europe. However, phthalates are also used in adhesives and sealants that may be used for sustainment. Since these materials are mixtures, they are subject to the Authorization use limitations, and therefore may become unavailable through local sources in Europe. A number of companies have applied for authorization to continue the use of phthalates.

Trichloroethylene (TCE) is commonly used in sustainment as a cleaner. It will not be available on the European market after April 21, 2016, except to authorized users for authorized uses. There are a number of applications for TCE authorization currently under consideration.

2.3. Defense Exemptions, ITAR, EAR

Information in this section comes primarily from Chemical Watch³ and from Aerospace and Defense (ASD)⁴, the European aerospace and defense manufacturers' trade group.

REACH regulations require that only registered substances be used in the EU; but registration requires that ECHA be informed of the uses of all substances, with no exemption for classified uses (except for integral substances in articles). There is therefore a basic conflict between REACH and ITAR/EAR. Without a Defense Exemption no classified or ITAR document or component can be provided to, or manufactured by, any European organization. This is a major concern for multinational programs such as F-35 as well as for overseas military sales. The information in the box below is taken from a publication of the Aerospace and Defense Industries Association Europe (ASD)⁴:

Any information sent to the European Chemicals Agency (ECHA) cannot be sent to identified, security cleared, individuals. Although disclosure of information by ECHA is governed by EU Regulation 1049/2001, which does have provision for protecting state security, it would appear impossible to comply with national security requirements and notify ECHA of any use of a substance that is classified. (ASD REACH Interpretation Guidelines, 2014)

If a **substance subject to authorization or restriction** under REACH is used to produce materials or parts for military aircraft or equipment, companies can in principle seek a **“Defense Exemption”** as REACH Article 2 states that *“member states may allow for exemptions from this Regulation in specific cases for certain substances, on their own, in a mixture or in an article, where necessary in the interests of defense.”* It is also possible for a company to seek an **exemption from substance registration** for the same reason. But most European countries make no provision for DEs, and among those that do there is no uniformity in the requirements. Consequently, there exists **no common system for granting defense exemptions** across member states, and member states do not recognize each other's DEs. This causes problems even for European countries trying to ship matériel or engage in multinational projects.

The European Defense Agency (EDA) maintains information on Defense Exemptions at <https://reach.eda.europa.eu/home>. The countries in Table 4 have Defense Exemption procedures. However, the only country that has created a process for Defense Exemptions is the UK, and there is no mechanism for a DE granted by one EU country to be recognized and accepted in other EU countries. This makes them all but useless for US forces moving around Europe or for

US companies selling defense products across the EU, although they can be useful for selling a weapon system to a specific country.

In May 2014 the UK Ministry of Defense (MOD) issued a Guide to REACH and to the DE⁵. DEs are issued by the UK Secretary of State. The document states

“The MOD managed exemption will be extended to:

- *Defense Industry Partners that supply the MOD with items that come under the remit of REACH and are obtained in the interests of defense;*
- *UK based Defense Industry Partners that supply the EU defense community with items that come under the remit of REACH and are supplied in the interests of defense;*
- *Visiting forces in the UK;*
- *Permanent British bases overseas.*

Table 4. EU Countries with Defense Exemptions, showing responsible agency and number of DEs issued as of 2015.

Austria	Federal Ministry of Defense and Sports	0
Belgium	Belgium MOD	0
Cyprus	Department of Labor Inspection	1
Finland	Ministry of Defense	1
France	MOD and the Ministry in charge of Environmental affairs	0
Germany	Federal Ministry of Defense	0
Greece	Ministry of Economics, General Chemical State Laboratory	14
Poland	Ministry of National Defense	0
Romania	Ministry of Defense	0
Slovakia	Ministry of Defense	?
Spain	Ministry of Defense	0
Sweden	Swedish Armed Forces	0
UK	UK MOD	10

...In principle United States (US) military bases in the UK would be covered by the same exemptions and MOD administrative arrangements as UK facilities.”

Since DEs are extended to “permanent British bases overseas”, it would seem that they could apply to British bases elsewhere in Europe, perhaps creating an argument for extending UK DEs to US bases in Europe. The Guidance document does not, however, directly address whether or how one EU country would be permitted to use DE substances when operating elsewhere in the EU, which would be the situation most similar to US forces stationed in Europe.

A DE does not give the holder carte blanche to continue using a DE substance indefinitely. Its intent (at least in the UK) is to permit its use until such time as an alternative can be implemented. For ITAR preparations (e.g. specialty coatings) it provides a way to meet the REACH requirements without supplying classified information to EChA. EChA can handle proprietary information, but it is not set up to handle classified information.

Modern weapon systems designed and built in the US often have subsystems manufactured in other countries. However, under REACH it will presumably no longer be possible to manufacture components that require classified or ITAR materials such as specialty coatings in European countries that do not provide defense exemptions; nor will it be possible for defense organizations within those countries to maintain these weapon systems by importing ITAR chemicals. This issue has already arisen in the F-35 program, where LO-coated components cannot be sourced as

finished products from EU suppliers whose countries do not have Defense Exemptions for LO coating materials.

2.4. Impact on Military Sales and suppliers

2.4.1. Military Sales

REACH has already had an impact, contributing to the loss of one sale because the US supplier could not demonstrate that the weapon system was REACH-compliant. European countries are requiring that acquisitions meet REACH requirements, including the constantly-changing REACH Authorization, Restriction, and Candidates for Authorization Lists. These lists contain many SVHCs that are required for corrosion control or used in various formulations such as adhesives, sealants, pyrotechnics, etc. However, the requirements vary from one country to another, and may even vary from one contract to another, depending on competitive and political issues.

Under the rules for Foreign Military Sales, the cost of meeting REACH requirements should be shouldered by the foreign customer. However, resulting system specification changes may affect performance and life-cycle cost for DoD as well, either positively or negatively.

REACH presents a very large and undefinable long-term risk to weapon system suppliers since the materials permitted on products and product sustainment in Europe are constantly changing. An increasing number of chemicals are becoming subject to restriction and authorization, and it is very likely that an even larger number of chemicals will simply be lost from the market because it is too complicated and expensive to register them. This means that the materials that can be used on weapon systems are constantly changing, even during their design and production, and that the OEM must keep track of all chemicals used in all products on the weapon system as long as that system continues to be manufactured or maintained. These are, of course, not just those chemicals applied by the OEM but the myriad chemicals bought in as paints, adhesives, sealants, polymers, surface treatments, etc. This means that the OEM must keep track of many thousands of individual supply chain products used on a complex weapon system, and will be under continuing pressure throughout the production of that system to remove chemicals that are entered into REACH Annexes. This pressure to change sustainment chemical formulations will continue throughout the life of that system.

2.4.2. Effect of rules on equipment design

REACH is already strongly affecting the design of military equipment intended for overseas sales (e.g. F-35). Because the F-35 is an international program it must meet the requirements of all of the partner countries, which include the UK, Norway, Italy and the Netherlands. For this reason, the aircraft has eliminated many materials classified as SVHCs, including OML and IML chromated primers and many uses of Cd, chromates and hard chrome plate, while various sealants and adhesives have had to be reformulated.

In addition, since various parts of the aircraft are being built in these countries, components produced in European countries do not benefit from the "Article Exemption". As a result, an article manufactured in Europe cannot contain the materials that could be present on the same article imported into Europe, except under authorization or a DE. This limits the supply chain that can be used to provide components for weapon systems made in the US and intended for international sale.

There have already been a number of impacts on defense equipment sold or maintained in Europe. The legacy F-16 program also has many European customers and is looking for ways to remove chemicals impacted by REACH. The F-35 program has been particularly impacted because it is partially sourced and sold in Europe. Its EU customers therefore require that it meet their REACH requirements and be sustainable in the EU. Its suppliers are constrained by REACH rules on what materials and treatments they can apply. Examples include (courtesy of Scott Fetter, Lockheed-Martin F-35 program):

- Chromic acid and chromium trioxide are on Annex XIV, with a 2017 sunset date. They are used for hard chrome plating and conversion coating of Al, Zn, etc.
- Sodium chromate and dichromate, with a 2017 sunset date, used in conversion coatings for Al alloys
- Chromated primers and sealants used on almost all military aircraft. This includes strontium chromate, used in primers and fuel tank coatings.
- Lead azide and formaldehyde, on the Candidate list, are used in ejection seats, flare cartridges and fire suppression systems
- Diisobutyl phthalate (DIBP) is on Annex XIV, with a 2021 sunset date. It is a component of adhesives that are widely used on composite structures. The adhesive has had to be reformulated.
- Dibutyl phthalate (DBP), with a 2021 sunset date is used in flares
- Tris (2-chloroethyl) phosphate, with a 2021 sunset date, is a component of insulating coatings.
- Bis(2-methoxyethyl) ether, on the Candidate List, is used in rain erosion coatings, adhesives
- Cd and CdO, used for Cd plating, are on the Registry of Intentions for future inclusion as Candidates
- LO coatings – these cannot be applied or maintained by any country that does not have Defense Exemptions, to avoid revealing their chemistry
- Nanophase Co-P coatings – these coatings were developed for DoD by the Canadian company Integran as replacements for hard chrome. As soon as development was completed the Co salts required to produce them were made Annex XIV Candidates. European companies and US aerospace companies immediately deselected them, even though they have not been placed on Annex XIV.

There are numerous other specific examples of impacts, especially from REACH Authorization rules (see Section 3.3 below). The need to reformulate, retest and requalify impacted products is increasing performance risk and creating a very large testing and redesign cost for military equipment and chemical suppliers. It is likely that these reformulations will have to be repeated in the future as the alternatives themselves are added to REACH lists, as has already happened with cobalt chloride and sulfate used for depositing the nCo-P alternative to hard chrome.

2.4.2.1. Loss of materials from the market

A long-term DoD concern with REACH will be the possible withdrawal of raw materials and process chemicals from the market by EU material suppliers, which would affect the design and

manufacturing of DoD equipment both inside and outside the EU. Materials are likely to become less readily available or taken off the market altogether if volumes are small – because of restrictions, the many requirements for authorization, or the high costs of compliance (including registration and testing). And even for raw materials or chemicals supplied in larger quantities, costs are likely to increase for the same reasons. The new rules will be especially burdensome for small suppliers that may not have the money or personnel to comply.

While there appear to be few structural materials for military equipment that will be subject to authorization or restriction, there could be a large number of process chemicals used in either manufacturing or maintenance, the eventual loss of which could present serious problems for DoD.

2.4.2.2. Access to materials information

Another concern is the access to information on substances in articles (as well as substances on their own or in preparations) which is mandated by REACH. For any article containing more than 0.1 wt.% of an SVHC, the supplier of the article is required to communicate to users, and also to consumers on request, sufficient information to allow safe use of that article [REACH Article 33]. The minimum information that must be provided is the name of the SVHC, but additional information that can be requested includes summaries of the physicochemical and toxicological data included in the registration application (for SVHCs intended for release), and information contained in the product safety data sheet.

However, although this requirement could in principle be very onerous and costly for DoD because of the vast number of products and systems used in the EU, in practice the burden should be minimal. This is because the declared intent of the right-to-know rules on communication of information is to give EU citizens “access to information about chemicals to which they may be exposed, in order to allow them to make informed decisions about their use of chemicals” [REACH Recital (117)]. Since consumers do not use DoD equipment and parts, and in general are not even exposed to them, the information issue should only arise for EU civilian employees of DoD and for European finishers of DoD parts. It seems reasonable to assume that these two groups will be no more likely to request materials information about DoD systems under REACH than before the regulation came into effect.

Nevertheless, nowhere in REACH nor any of its supporting documents is it actually stated that information requests will *not* be granted if information is sought about materials the consumer will never come in contact with, such as those in DoD equipment. **It would be wise to confirm with the Chemicals Agency that DoD will not be asked to respond to information requests from non-users of military articles.**

2.4.3. Impact on chemical suppliers

Weapon sales, alloy manufacture, plastics manufacture, the production of cleaning and metal finishing chemicals, and many other industries that impact DoD are global industries. In order to serve their markets cost-effectively, manufacturers must make products that can be sold to all their customers, or increase their prices to reflect market fragmentation. REACH can therefore be expected to have a number of short term and long term effects on the availability of materials and chemicals for the US DoD market:

- The manufacturers of alloys and composites, cleaning chemicals, metal finishing chemicals, primers, sealants and other materials used in sustainment will obviously

evaluate the cost and complexity of registering materials and their uses, and of seeking authorization for materials that contain SVHCs likely to end up on the Annex XIV, as well as the cost of maintaining the databases and staff to supply all the required information upstream and downstream in the manufacturing and use chain.

- ❑ For each product and market segment they will decide whether or not there is sufficient volume and profitability to warrant the added REACH costs.
- ❑ Those materials with sufficient market to justify the costs will continue to be supplied worldwide as before, although prices may rise to maintain margins.
- ❑ Other materials with a small EU market, but a sufficient market outside the EU will be dropped from Europe, but remain available elsewhere. The price may rise because of reduced manufacturing volume.
- ❑ However, products with too small a market or too low a profit margin will no longer be manufactured. Manufacturing in the US may be picked up by other companies, but probably at a higher price. In either case, prices can be expected to rise as the number of vendors falls.
- ❑ Compared with other industries DoD is a relatively small market, and as the commercial world adopts chromate-free, Cd-free, Pb-free and other clean products, the market size for the older products currently in DoD specifications will shrink.
- ❑ This means that over the next 5-10 years it will become more difficult and expensive to obtain the currently-specified materials needed to sustain legacy systems.
- ❑ On the other hand, manufacturers can be expected to develop better products to meet the new rules. This will make improved technologies available to reduce environmental impacts and improve worker health in sustainment operations. But DoD will only be able to take full advantage of this opportunity by improving the speed of qualification and implementation.

The aerospace industry is exempt from the restriction on Cd plating set out in Annex XVII of REACH. However, Cd is certain to be listed in Annex XIV as an SVHC, which would make plating and other uses of Cd subject to authorization, with a view to replacement as soon as practicable. Almost every chromate is already listed in Annex XIV, making it necessary to replace them quickly.

2.4.4. Classified and proprietary materials

An important issue related to the requirements for communication of materials information discussed in the previous section is how REACH treats proprietary formulations. The compositions of many DoD materials such as LO coatings, rocket and missile fuels, propellants for munitions, and explosives are classified or otherwise restricted.

As we have stated above, the EU purpose in meeting materials information requests from the public under REACH is to allow those exposed to chemicals (especially SVHCs) to make decisions on the acceptability of the related risks. Because the public is not exposed to DoD products or systems, we do not expect DoD to receive any such requests. REACH contains a number of safeguards for the protection of confidential commercial information, which apply to any suppliers or finishers of DoD parts in the EU:

- ❑ “...The institutions shall refuse access to a document where disclosure would undermine the protection of commercial interests of a natural or legal person, including intellectual property...” [REACH Article 118(1), EC Regulation 1049/2001 Article 4(2)]

- ❑ “The following information on substances whether on their own, in preparations or in articles, shall be made publicly available...except where a party submitting the information submits a justification...as to why such publication is potentially harmful for the commercial interests of the registrant or any other party concerned...” [REACH Article 119(2)]
- ❑ “Non-confidential information on chemicals...will be made available. This is done in such a way that the interests of the public’s ‘right to know’ is balanced with the need to keep certain information confidential.” [REACH-in-brief Section 2.11].
- ❑ Under REACH Article 118, details of the full composition of a material and its precise use, function or application are not to be released. However, “where urgent action is essential to protect human health, safety or the environment” this information can be released, although the provision is primarily for “emergency situations”. Under Article 120, information can also be released to a third country or international organization “concerning the export and import of dangerous chemicals”. Confidentiality is intended to be maintained by the third party.

Although proprietary and classified materials information can be withheld from the public, there is still the issue of how much information needs to be provided to the Chemicals Agency itself. Any SVHCs in articles which are intended for release must be registered, while those SVHCs that appear on the list in Annex XIV are subject to authorization. All substances in any form must be registered under REACH when the quantity exceeds 1 tonne per year. For both registration and authorization, the basic information required by the Agency is the same and includes details such as the composition, chemical formula, molecular weight, and uses of the substance. Even if the Agency holds such information in its records in confidence, there is clearly a problem with the information requirement for classified DoD materials.

Once information is provided to the ECHA there is no practical way of controlling its further dissemination, including to foreign governments, United Nations agencies, etc.

Once provided to the ECHA the confidentiality of classified or proprietary information cannot be absolutely guaranteed.

2.5. Impact on DoD units in Europe

2.5.1. Sustainment

One of the major direct DoD impacts of REACH will be on the supply and sustainment of DoD operations in Europe. DoD has many bases throughout Europe. These troops must be supplied and weapon systems maintained in Europe, requiring the use of materials such as:

1. Munitions, since there is no overall Defense Exemption
2. Supplies such as oils, greases and other consumables
3. Chromated primers and sealants used for aircraft repainting and touchup
4. Cadmium brush plating solutions for corrosion control
5. Chromate conversion solutions and pens for corrosion control of Al

If Authorization applications are successful, most of these materials will remain available for several years from local authorized sources (usually using authorizations derived from suppliers). However, authorization is not guaranteed, and may not include all defense uses. As more and more critical chemicals become subject to Authorization, they will eventually become unavailable in Europe.

Where sustainment work is carried out on US military bases, REACH may have little direct effect on operations, since these bases are not in the customs territory of the EU. The REACH provisions should not therefore have any legal effect on what materials are used on equipment or in its sustainment.

Supplies shipped through military channels (brought in by sea or air, or even shipped overland) will also be unaffected, since goods in transit are not covered by REACH.

However, REACH does cover any materials, supplies or services purchased in Europe or brought into the customs territory of the EU (commercial ports and airports). This means that certain materials, chemicals and processes may no longer be available, or may be harder to obtain locally. For example, chromate conversion and other chromate materials such as primers and sealers are likely to be more difficult to obtain, as well as Cd-containing brazes and polymers. Cd plated screws for vehicles are not permissible. If any military system or component goes off-base for repair to a commercial facility (or even to another military facility) in the EU, it comes into the EU customs territory and becomes subject to REACH.

In addition, at least in principle, US troops operating in Europe on peacekeeping missions, humanitarian missions, NATO exercises or other missions that put them and their equipment among the general population may be affected by REACH requirements, especially for the use of supplies and sustainment chemicals.

2.5.1.1. EU vs non-EU sustainment suppliers

The legal aspects of REACH have not so far been defined by the Pentagon. The following is therefore speculative.

The definition of the term “import” in REACH appears to allow the problem with classified materials to be circumvented, so long as no EU suppliers or finishers of DoD parts are involved. The “no data, no market” rule includes imports, but importation covers only the *customs territory* of the EU (Table 1).

All DoD bases in the EU are outside this customs territory, so that REACH information requirements presumably do not apply to any materials that enter a US base in Europe without going through customs. This will be the case for many shipments of DoD equipment or supplies from outside the EU to a European base – either from a US DoD base or from a non-EU supplier in the US or elsewhere. Classified materials can presumably be shipped back and forth without regard to REACH rules.

Unfortunately for EU suppliers, it appears that this does not apply to them. Any DoD part sent from a US base in the EU to an EU supplier or finisher enters the customs territory of the EU and is thus “placed on the market”, albeit temporarily, bringing on all the ramifications of REACH. Therefore, EU suppliers will be in the difficult position of having to comply with the registration and authorization requirements of REACH, but being bound by agreements with DoD not to divulge classified information. The confidentiality provisions discussed in the previous section

apply only to information released to the public, not to the information required by the Chemicals Agency. This affects the ability of European suppliers to provide US defense materiel.

EU suppliers may not be able to continue doing business with DoD if it involves confidential or classified information.

Status of Forces Agreements

It may be possible for DoD to negotiate Exemptions with the EU freeing US forces from REACH provisions. That would help with some issues, but not all, requiring forces to be self-sufficient:

- Local sourcing of materials – chromates and other chemicals needed for sustainment will no longer be available from local sources, except from authorized companies.
- Local sourcing of services – services carried out using Restricted or Authorizable materials, or removing them from components will not be available locally (e.g. repair involving touch up painting), except for authorized suppliers.
- Carrying out on-base operations with local manpower could be problematic if it involves their potential exposure to SVHCs, regardless of any use of PPE.
- Electronic repair and parts replacement – RoHS exempts military equipment from non-lead solder requirements, and as far as possible defense equipment uses leaded solder. Lead solder is not exempt from REACH, however, which could make local electronic repair and components unreliable.
- **Interoperability of NATO equipment should be examined for loss of compatibility due to the use of different, incompatible supply chain chemicals.**

2.5.2. Munitions

Even though the very concept of “environmentally benign munitions” is an oxymoron, this does not prevent REACH being applied to munitions. DoD asked ECHA how munitions would be classified, and received the answer in Table 5. The rules for Articles are great deal less intrusive than those for mixtures (see Section Appendix 4.6). It is therefore advantageous for munitions to be treated as articles.

Table 5. ECHA answer to question of whether ammunition cartridges are articles under REACH

[1059] Are ammunition cartridges designed to launch a projectile (e.g. a bullet) considered as 'articles' under REACH?

REACH

Authorisation

Version: 1.0

Latest update: 04/06/2015

Yes, ammunition cartridges that are designed to launch a bullet are considered to be articles with an integral substance/mixture (the propellant) because the shape, surface and design of such ammunition cartridges determine their function to a greater degree than does its chemical composition.

It should be noted that this answer is limited to ammunition cartridges that are designed to launch a projectile (i.e. a bullet). It does not necessarily apply to ammunition where the function of the object is the deliberate release of a mixture (i.e. flares, gas grenades, etc.).

[\[http://echa.europa.eu/qa-display/-/qadisplay/5s1R/view/reach/authorization\]](http://echa.europa.eu/qa-display/-/qadisplay/5s1R/view/reach/authorization)

The question of how to classify munitions under REACH has been considered in some detail by BDSV, Germany, in a report "Classification of Ammunition as Articles with an Integral Substance/Mixture"⁶. This document provides a decision tree for classification of articles. Their conclusion on ammunition is given in Table 6. They also state "Yet, even ammunition that is classified as combination of an article and a substance is never a container to the propellant." Thus the material in the munition is exempt from Authorization, and information on the propellant does not have to be registered or disclosed to ECHA.

Table 6. BDSV answer to question of whether ammunition cartridges are articles under REACH

Conclusion on the classification of ammunition according to the proceeding proposed in the ECHA *Guidance on requirements for substances in articles*:

Page 10:

When applying the steps 1 to 5 provided in the ECHA *Guidance on requirements for substances in articles* (version of April 2011), the assessment comes to the result that most common **ammunition can be classified as article** with the propellant forming an integral part. In contrast, the ECHA Guidance shows that ammunition is not a container to the propellant / not a combination of an article (namely the cartridge casing, functioning as a container) and a substance/mixture (the propellant).

Furthermore, since the propellant is not intended to be released under normal or reasonably foreseeable conditions of use and since it only comes to an (uncontrolled) release of the reaction products developing during the propellant's combustion, there is no obligation to register the propellant according to REACH.

Page 14:

There are some specialised ammunition types that intentionally release a substance/mixture during use (e.g. exercise ammunition using a colourant to mark a target). For those, the classification as combination of an article (the casing, functioning as container for the colourant) and a substance/mixture can indeed be indicated. However, this classification result is **not linked to the propellant**, but only to the type of charge comprised in the projectile. In other words: it is not the propellant that is decisive for the classification of ammunition; and **even ammunition that is classified as combination of an article and a substance is never a container to the propellant.**

A number of chemicals used to manufacture munitions and pyrotechnics are currently in the CoRAP list for consideration as candidates for Annex XIV. These include

- Ammonium perchlorate
- Sodium perchlorate
- Lead azide
- Lead styphnate

Chemicals that are used only in manufacture and do not remain in the munition (such as lead azide and styphnate) are not affected if the munition is made in the US. If these substances are eventually entered into Annex XIV, REACH rules require that they cannot be used in Europe without authorization. This does not, however affect munitions made outside Europe and brought into the European theater.

2.6. Impact on DoD operations in the US

One might think that DoD operations in the US would be totally unaffected by REACH, since it only operates on European soil. However, as we have noted in Section 2.4.3, it is very likely that suppliers of chemicals used in sustainment, such as Cd plating, chromate conversion, chromate primers and sealants, etc. will reassess their product lines in light of the market size and cost of

registration and authorization. As a result, it is likely that, in the absence of an EU market, some chemicals will cease to be sold, or will become more expensive and difficult to obtain, even in the US.

In addition, REACH, in common with other environmental and health rules, is driving manufacturers to develop and adopt clean alternatives. These alternatives will no longer be sustainable with the older technologies used on legacy systems, and if the older technologies are used those systems will cease to be compliant. We already see this in new weapon systems. For example, all new aircraft are now using HVOF coatings in place of hard chrome on most of their landing gear and actuators. These coatings require different stripping, coating and finishing techniques, requiring installation of thermal spray equipment in depots. Substitution of chromate-free finish systems means, not only that depots must change tank chemicals, but that they institute better quality control procedures, since the new finishes are more sensitive to processing conditions and contaminants.

Sustainment will be particularly difficult over the coming decade or so, as depots must implement new technologies and materials for the new systems, while maintaining the old methods for legacy systems.

2.6.1. EU users of US-made military equipment

We are already seeing that EU purchasers of commercial and military equipment are demanding that it meet European environmental and health rules, including WEEE, RoHS and REACH, and also the use of clean technologies, even where they are not mandated. For example, Airbus required HVOF in place of hard chrome on the new A387. With the advent of REACH these requirements will be insisted on because equipment cannot legally be maintained in Europe unless it meets the requirements. Equipment and chemicals that do not meet REACH requirements will become increasingly difficult to sell in the EU. To avoid needing multiple product lines, global equipment manufacturers are being forced to adopt EU REACH requirements even for sales outside the EU. In fact, we are helping multinational companies to adopt REACH-compatible processes and materials for their commercial product lines, no matter where in the world their products are manufactured.

European users are also demanding increasing disclosure of the details of materials used in chemical solutions and on components. As more chemicals are classified as SVHCs under Annex XIV, European companies will look to manufacturers and suppliers to change materials and formulations to eliminate these materials, driving them to cleaner technologies, even though that may sometimes be at the expense of performance. EU users will be forced to make materials changes themselves on older equipment. This means either that they will develop clean alternatives or that they will license them from elsewhere.

Because the REACH rules affect chemicals that can be used in Europe, we expect this to be a driver that accelerates the trend toward aircraft MRO in Singapore and elsewhere in Asia. It may also make it easier for EU users of US-made military equipment to have MRO work performed in the US rather than in Europe, especially for legacy systems that require the use of cleaning, plating and finishing chemicals that must be authorized in Europe (see also Section 3.7).

3. Impact of REACH on the DoD supply chain

This section examines the impact of the various REACH regulations and approaches on companies in the DoD supply chain.

[Note that active substances in insecticides and biocides are regulated by the EU Biocidal Products Regulation (# 334/2014, March 2014), Article 95⁷.]

3.1. Impact of REACH Precautionary Principle

The Precautionary Principle is based on hazard, not risk. The Precautionary Approach places the burden on the manufacturer to prove that a product is not harmless, and mandates precaution in the face of uncertainty. It therefore places burdens on the use of chemicals even when they pose no risk to the public and can be safely used in manufacturing with the use of PPE. By eliminating chemicals from commerce, the EU permanently forgoes all possible technologies based on those chemicals, no matter how beneficial they may be. For example, had arsenic, boron and phosphorus not been available over the past half century, solid state electronics, and the computers and cell phones based on them, could not have been developed.

Sweden's chemicals agency in 2014 urged its government to seek changes in REACH that would result in a stricter interpretation of the Precautionary Principle, with more substances subject to market restrictions and a faster improvement in our understanding of chemical risk assessment. However, this move is unlikely to affect DoD, at least in the short term, since Sweden does not yet have the support of all the other member states, and the European Commission is at present unwilling to consider any legislative changes to REACH.

3.2. Impact of Registration

As mentioned in Appendix 4.6.5, a survey of mostly EU chemical businesses was conducted in 2012 to assess the early implementation of REACH.¹⁷ Of the 1601 companies surveyed, approximately a third were large companies and the remaining two thirds were Small and Medium Enterprises (SMEs). Around 700 were manufacturers of chemicals or articles, while another 300 were importers; the remainder included formulators and end users.

REACH Annex VII requires only physical chemistry information for substances in the 1-10 tonnes/year range (not all of the toxicological information required for other substances) unless the low-volume substance is an SVHC. Nevertheless, a major concern before the introduction of REACH was the possible loss of tens of thousands of low-volume chemicals from the market due to the cost of registration alone. But although 35% of survey respondents reported the withdrawal of at least one substance by one or more of their suppliers, the vast majority (84%) indicated that no more than five substances had been withdrawn. The most common response of manufacturers or importers producing at levels close to 1,000 tonnes per year has been to reduce production volumes below the threshold, in order to lower registration fees and other costs (Table 12).

The **major caveat** with this survey, however, is that it was taken when the only registration closed was substances sold at > 1,000 tonnes/year. Few, if any substances would be dropped from so large a market because of registration cost. The registration of substances with markets from 1-100 tonnes/year does not end until May 2018 (see Figure 2), and **it is these low-volume chemicals that are at greatest risk of being withdrawn from the market** because the cost and complexity of registration is more likely to exceed their commercial value. Figure 1 illustrates this issue. As

of December 19, 2014 the total number of registrations was only 14,094, 10% of the total number of pre-registered substances. Thus 90% of the substances currently in commerce in Europe have not yet been registered. Some proportion of these may well have market sizes < 1 tonne/ year, and therefore do not have to be registered. But the remainder must either be registered by May

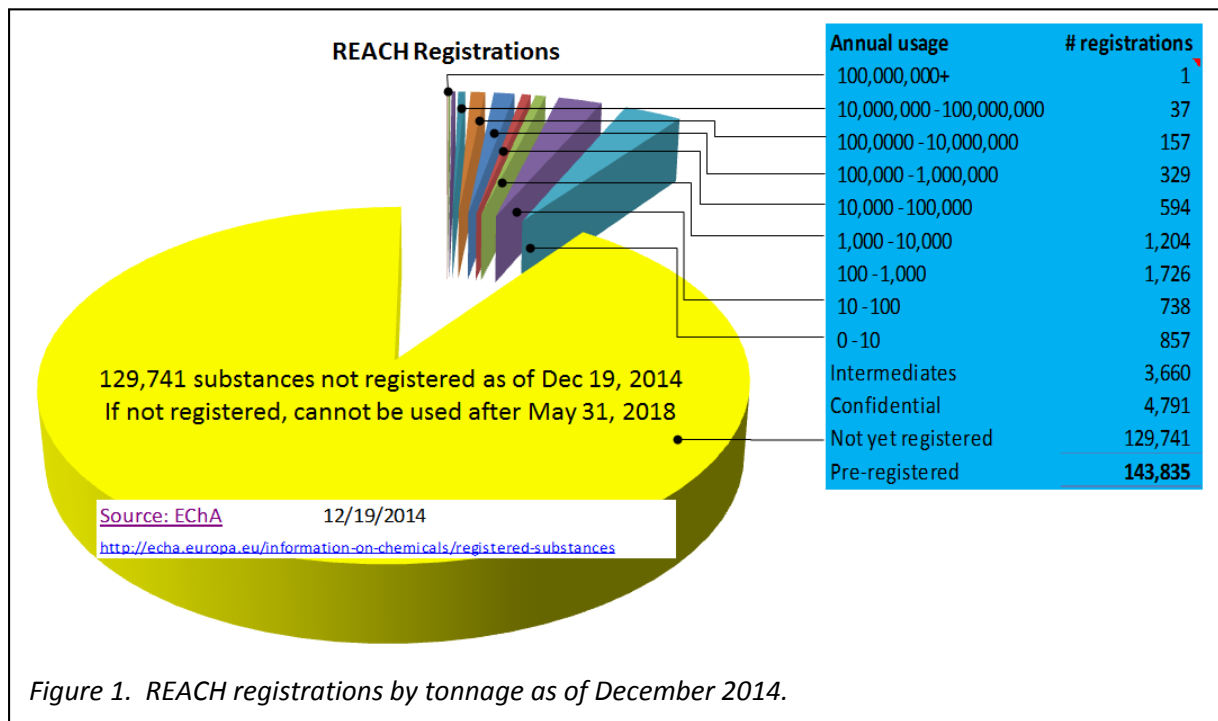


Figure 1. REACH registrations by tonnage as of December 2014.

31, 2018, or be withdrawn from the European market. That means that as of May 2018 any chemical sold in Europe, no matter where it is manufactured, may not contain any of these unregistered substances, **even if they are totally benign**. However, unregistered substances can still be used in articles imported into Europe, provided the substances are not intended to be released. ECHA's 2018 Roadmap expects up to 70,000 registrations by the deadline. Even if this is correct, that still leaves about 60,000 unregistered substances that must be dropped from the market or reduced to <1 tonne/year.

However, relevant to DoD is the finding that there has been a reduction in the number of suppliers of chemicals with low profit margins such as chromium or potassium compounds, which are used in several electroplating processes, leading to reduced choice and competition for these materials. Because of concern over possible withdrawals or materials not being registered at all due to the cost, some aerospace companies have acquired producers of small-volume chemicals in order to ensure security of supply.

In a smaller survey of 179 UK firms conducted in 2013,⁸ only 14% said they had withdrawn a substance from the market solely for REACH-related reasons. In 17 of 25 cases, the reason was the high cost of registration. Downstream users reported significant impacts on their businesses because of chemical withdrawals, including plant closings and loss of profit. Again, the caveat with this survey is that it does not include the low-volume chemicals.

The only industry on which registration costs have had a documented severe impact so far is the textile sector, where the survival of Europe's textile and leather supply chains is threatened by a

likely reduction in the number of available dyes⁹. However, this appears to be an isolated case so far, and does not significantly impact DoD.

In order to assist smaller companies with the registration of low-volume chemicals several REACH regulatory service providers are creating a consortium called the [REACH Orphan Substances Consortium](#) (ROSC).

3.3. Impact of Authorization

Under the original REACH legislation there were only two approaches to SVHCs – Authorization and Restriction – with the bulk of chemicals moving on the Authorization route. Only recently has the EU recognized the damage that the loss of large numbers of chemicals will cause in their economy, and has begun to explore alternative Risk Management Options (see Section Appendix 4.6.9).

EU countries put forward substances for potential inclusion in Annex XIV (e.g. France handles most Ni salts). Once a substance is deemed to be an SVHC it can be entered into the Candidate List for inclusion in Annex XIV, the list of chemicals that cannot be used without Authorization. As soon as a chemical appears on the Candidate List it is deselected by many users, who demand that it be no longer used on products they purchase. Most candidates are ultimately placed on Annex XIV, although some are not prioritized and languish on the Candidate List for years, leaving them largely off the market (Co salts are examples).

For substances that do end up on Annex XIV, from the time a substance is placed on the Candidate List manufacturers have about 6 or 7 years to find an alternative. Since historically it takes about 20 years to develop, qualify and implement a defense material safely, this means that materials development cycles must be compressed. A substance on Annex XIV cannot be used in Europe without Authorization, which is a very expensive process.

When a substance is placed in Annex XIV a Sunset Date is established after which it cannot be used or imported without Authorization. Eighteen months prior to the Sunset date is the Last Application Date, after which no company can even apply for Authorization. Authorization is a temporary license to continue manufacturing or using a chemical for a few years (as of now only one Authorization has been granted, so there are no statistics on how long an Authorization can be).

Authorization effectively bans importing or using a chemical in Europe. Authorization can only be sought by importers, European chemical manufacturers, users, and the “Only Representatives” of overseas companies. DoD cannot obtain Authorization to continue using a chemical outside US bases beyond the Sunset Date. Nor can that chemical be imported into the EU without Authorization, except directly to US bases. However, Annex XIV chemicals can be imported into Europe in Articles, e.g. chromate primer on aircraft components, or chemicals used in munitions.

Although Authorization allows continued use, it is the death knell for the material since it is by definition temporary. It therefore results, as it is intended to do, on the loss of Authorized chemicals from the market, regardless of how important they may be to DoD. The only ways around this are Defense Exemptions (which are also intended to be temporary), or perhaps in the future adoption of alternative Risk Management Options.

3.3.1. Authorizations Sought or Granted

As of the date of writing, 56 applications for Authorization have been made and placed on the list of [Adopted Opinions and Previous Consultations on Applications for Authorization](#). Of these only one Authorization has been granted – to Rolls-Royce for the use of the phthalate DEHP in a stop-off formulation for diffusion bonding in the manufacture of aircraft engine Ti fan blades. Rolls-Royce was given authorization to continue using the material until February 2022 (8 years from the decision date on the basis that risk was adequately controlled, there are no suitable alternatives, and a 5-10 year research program will be carried out to develop an alternative). All of the [information and reports developed for this decision](#) can be found on the ECHA website, providing some insight into the way authorization decisions are made.

Other authorizations sought include:

- Phthalates – 17 authorization requests for DEHP and DBP for aircraft engines, propellants, missile motors, and industrial polymer processing
- Diarsenic trioxide – 5 authorization requests for metal purification and plating
- Chromates – 13 authorization requests for lead sulfochromate yellow and lead chromate molybdate for pigments in paints and plastics, and lead chromate for pyrotechnical delay devices for naval ammunition
- HBCDD – 2 authorization requests for flame retardants
- Trichloroethylene – 19 authorization requests for use as a solvent.

Information on all of these can be found on the [list of Adopted Opinions](#) link noted above.

Additional authorizations are being assembled by various corporations and consortia for other important chemicals such as sodium dichromate and chromic acid for corrosion protection and plating.

3.4. Impact of Restriction (Annex XVII)

Although Restriction sounds as though it is a more stringent way of handling chemicals it is in fact far less of a problem in most cases. Restriction simply means that a chemical cannot be used for certain specific applications. For DoD the most important Restrictions at present appear to be restrictions on the use of methylene chloride (paint stripper), and the restriction that Cd plating cannot be used on vehicles. The Cd Restriction defines the classes of vehicles on which it cannot be used, but military vehicles are neither explicitly excluded nor explicitly included in the restriction. Military vehicles and other equipment use Cd plating extensively for corrosion prevention on steels, as well as on fasteners and electrical connectors. Cd brush plating is often used to repair Cd-plated components. However, most connectors and fasteners are only plated by the manufacturer and can be brought into Europe as Articles. There are alternatives to Cd and brush Cd, suitable for most components. Thus the restriction appears likely to have limited impact on US forces in the EU.

Since other substances will be added to Annex XVII over time, however, it is highly likely that restriction will cause additional problems in the future.

3.5. Impact of REACH enforcement

REACH enforcement activities appear to have been very limited so far. The Chemicals Agency has established an Enforcement Forum, consisting primarily of representatives from the member states, which meets regularly and has initiated a number of enforcement projects. Although the

projects have uncovered various examples of non-compliance, mostly related to registration requirements, the emphasis to date has been on advice and remediation orders rather than sanctioning through fines or the threat of criminal prosecution. The main complaint about compliance in the business survey discussed previously¹⁷ was inconsistent enforcement across the various member states; almost 50% of firms with experience in market surveillance made negative assessments of current REACH enforcement activities.

3.6. Impact of Uncertainty

Even where chemicals have not been entered into Annex XIV or Annex XVII, there is uncertainty over the fate of any chemical that has been or might be classified as an SVHC. This leads to a great deal of uncertainty among chemical suppliers and formulators, as well as to product designers, as to whether or not critical materials could become impacted by REACH. This leads to a great deal of instability in the market and the de-selection of materials that might become affected, leaving fewer reliable solutions available to the manufacturing and sustainment community.

The EU courts are expanding the number of chemicals that can be subjected to Authorization, as outlined in Section Appendix 4.6.9. This means that the rules will constantly change, and it will no longer be possible for producers to have any clear knowledge of what additional chemicals may become highly regulated under REACH in the future. We would expect this lack of certainty to result in fewer materials being developed in the EU in future, since the return on investment is highly uncertain.

3.7. Migration of MRO and other EU industries

While a number of EU industries have threatened to move their manufacturing and distribution activities outside Europe because of the impositions of REACH, it is the aircraft MROs that appear to be closest to moving.

In an AEA (Association of European Airlines) position paper on the proposed addition of chromates to Annex XIV in 2013, a Lufthansa Technik manager who was interviewed revealed that the majority of parts maintained or repaired in Lufthansa's Hamburg MRO facility had already been affected by REACH legislation.¹⁰ He asserted that "Airlines will likely bring their aircraft, engines and components to maintenance shops in non-EU countries, such as Turkey and Egypt, which are not confronted with the burden of REACH". The AEA paper added that forcing the MRO industry to move production to countries outside the EU by making chromates subject to the authorization process would have "a devastating impact on the EU economy and jobs".

Additionally, for DoD, carrying out MRO in non-allied nations peripheral to Europe could present a significant security concern.

4. Potential political and competitive issues with REACH

The REACH rules themselves are essentially even-handed, with manufacturing and imports both being affected in the same way.

In some respects, REACH will make Europe less competitive industrially:

- ❑ The regulations will raise the cost and complexity of manufacturing in Europe, making the EU less competitive with the rest of the world for chemicals and products sold outside the EU.
- ❑ By requiring the use of many chemical formulations to be authorized, REACH will make it harder to perform maintenance on military equipment in Europe.
- ❑ If the REACH rules lead to the adoption of lower performance materials or finishes for EU products, this will reduce their attractiveness elsewhere.
- ❑ On the other hand, since REACH largely guarantees clean products in the long run, users for whom that is an important consideration will be more likely to purchase European products.

There are ways in which REACH could be used as an anti-competitive weapon. For example

- ❑ Authorization could be withheld or removed for certain non-European processes and materials in order to favor local producers.
- ❑ Potential EU purchasers of military systems could exclude overseas competition by insistence on proof of strict adherence to REACH requirements. This may already have been the case in one instance.
- ❑ If a European company develops a clean alternative to an SVHC-containing material, the original material could be banned whether or not the performance of the alternative is adequate. This could leave the European producer in a monopoly position. (Of course, this same scenario could work for a non-European producer, but in that case complaints regarding a monopoly would be more likely to carry weight.)

Are there ways in which REACH could be used to hinder or harass DoD operations in Europe? It appears unlikely that anti-US and anti-military groups could use the legislation with much effect under normal circumstances since civilians are not users and so cannot demand extensive information, for example. However, in the event of an aircraft accident or similar problem, it is possible that civilians could demand all the available information on the materials in use, including LO materials, propellants, etc., on the grounds that the information is critical to protecting the health of responders and nearby populations. Governments could release such information on similar grounds, with or without pressure, making it critical that classified materials information not be supplied to the ECHA.

5. Summary of risks and opportunities

In general, the direct risks to DoD operations from REACH are quite small

- ❑ There will be an indirect effect in terms of reducing the availability and increasing the cost of chemicals and processes that DoD uses for sustainment.
- ❑ By forcing US military suppliers selling into Europe to replace some materials (especially corrosion protection methods) with clean alternatives, those alternatives will often also be used on equipment sold in the US. This means that DoD depots will need to adopt new repair technologies and new quality control methods to sustain the new systems effectively.
- ❑ On-base operations in Europe will in general not be governed by the REACH legislation since it acts only within the customs territory of the EU. It may, however, make it more difficult to carry out operations off-base.
- ❑ There is a very high risk associated with divulging information on classified materials, including LO materials, to meet the REACH requirements. REACH requires that information be provided on materials and on their uses. If any information is provided on classified systems, it would need to be done in such a manner that material chemistry and structure could not be deduced from all the various pieces of documentation.

The risks and costs for the supply chain, however, are significantly higher

- ❑ REACH will raise the costs for US military equipment manufacturers of supplying European customers, through the cost and complexity of registration and the requirement to maintain databases and infrastructure to supply information to downstream users. Since similar costs will be borne by European manufacturers that does not put either in a better competitive position for EU sales. However, as we have seen, US suppliers and primes must understand REACH to compete effectively in Europe.
- ❑ Because Europe is such a large market, REACH raises the costs for all manufacturers, which, in a worldwide market raises the cost of products in the US as well. At the same time, any technology or material that can no longer be sold in Europe could become unavailable or more costly elsewhere because of the reduced market size.
- ❑ A particularly serious issue for manufacturers is that REACH imposes a set of costs and a set of rules, both of which are undefined. Uncertainty will remain for many years over what rules will govern what material. The requirement for information places a large and undefined burden on companies that requires a deep knowledge of all the materials in complex systems, and continues throughout the lifecycle of the system.
- ❑ The rules are particularly strict with respect to SVHCs. Use of many of our standard military materials and coatings will not be permitted in the EU unless authorized, and they will only be authorized with a view to their eventual replacement. This may force suppliers to abandon certain materials, such as chromated corrosion protection systems, and implement alternative technologies in their place. This type of change carries both technical and cost risks if carried out too quickly.
- ❑ Of particular concern is the possibility of Europe removing the authorization for an SVHC on the basis that a clean alternative is now available, while the alternative is inadequate for defense use. Of course, under those circumstances there would be the option of mandating the continued use of the existing technology for DoD products. However, as we are already finding with lead-free solder, such a requirement does not mean that the original technology will remain available.

However, we should also recognize that REACH presents us with an opportunity to adopt cleaner technologies that will better protect the health of US depot workers and military personnel:

- ❑ REACH will force the development of compliant technologies, including better alternatives to many of the materials we use in legacy systems, as we have already seen. This means that these technologies will be available for adoption by DoD programs.
- ❑ Reducing the availability and increasing the cost of some current sustainment technologies, will amplify the driver for adopting clean alternatives in depots and operations.
- ❑ We have already seen after the adoption of the ELV and RoHS rules that, while the rules were developed for Europe, it is primarily US companies that have developed the compliant technologies, putting them in a stronger competitive position worldwide. With the stronger market drive and flexibility of US companies, REACH may well have a similar effect.

6. Recommendations

For US manufacturers, including military equipment manufacturers, the main problem with REACH is that it raises the cost of all materials, components and systems, with clear environmental or health benefits for only a few of them. This will increase the cost of materials available in the US because either all products must meet the REACH standards or the market will be subdivided into EU and non-EU segments, each of which will be smaller than today's global market.

However, in the area of materials that are known to be hazardous, REACH will have a positive impact and presents us with a good opportunity for improving DoD operations by eliminating toxic materials that pose particular problems for DoD maintainers, including:

- ❑ Cd, used on most steels and fasteners
- ❑ Chromates, used in conversion coatings, primers and many thousands of chromated materials.

These materials are found in all weapon systems and are a constant personnel hazard in service and in depot sustainment. REACH (together with RoHS) are already forcing the elimination of these materials in Europe. This will in turn force the development of cost-effective, better performing alternatives. Although alternatives are already in place in other industries, DoD and the aerospace industry have been slow to adopt them because of performance, reliability and qualification issues. However, REACH will provide additional impetus to their removal, and will probably lead to the development of better alternatives with improved performance that will be more viable for DoD use, and, if the past is any guide, many of these improvements will be made by US companies.

DoD can take advantage of this opportunity, which organizations such as SERDP/ESTCP, the Emerging Contaminants Office and the DoD Corrosion Office are strongly positioned to do:

- ❑ In 2009 Under Secretary of Defense John Young issued a Memo on "[Minimizing the Use of Hexavalent Chromium](#)", which primarily affected the use of chromated primers and sealants in depots, as well as their use in new weapon systems. In order to put the policy into effect the [DFARS was changed](#) to include hexavalent chromium minimization requirements.
- ❑ [A SERDP-ESTCP Advanced Coatings 5-Year Strategy project](#) is under way to develop implementation plans to replace most of the Cd and Cr⁶⁺ in depots over the next 5 years.
 - In order to meet OSHA requirements for Cd and hexavalent chromium control, a number of depots are attempting to implement technologies that will eliminate Cd and Cr⁶⁺ contamination.
 - Depots have a serious problem with making these types of changes because (a) they often do not have sufficient funding for the major capital and qualification costs involved, (b) they do not have shop floor space for two sets of equipment, one for the new process and one for the old, and (c) qualification and implementation of alternative technologies is always very difficult because of the risk and expense involved.
 - This program aims to demonstrate that it is possible to put clean technologies into place without compromising weapon system performance.
 - Ultimately major changes will require a Pentagon-level decision that requires change on most systems, since it is only a requirement that creates a strong enough driver.

- The qualification and implementation time is very long for new materials and finishes (traditionally 20 years). Yet REACH and other environmental and health regulations work on far shorter timetables (typically 5 years). Depots and vendors therefore need assistance in adopting better and cleaner technologies more certainly and more rapidly. By its nature some testing (especially service testing) cannot be safely accelerated. Other parts of the qualification/implementation chain can be shortened:
 - Improve collaboration between DoD and commercial suppliers to develop alternatives without loss of performance. This is already being done through various programs and websites such as [CorrDefense](#), through workshops and data-sharing programs such as [SERDP/ESTCP ASETSDefense](#) and the [ASETSDefense database](#). This type of leverage allows lessons learned to be transferred effectively to reduce time to market.
 - Engineers need solid data on which to base the engineering decisions that implement clean technologies. This has been done successfully with in the implementation of HVOF chrome replacements, and other technologies such as corrosion resistant coatings and new alloys.
 - Better and more reliable test methods are needed to speed up development and laboratory testing cycles. [SERDP-ESTCP](#) has funded projects to develop better corrosion and embrittlement tests. But improved tests are also needed for performance issues such as wear, and will be important for measuring and curing long-term material deterioration such as whisker growth in Pb-free electronics.
 - Computational methods are being adopted for faster and more reliable [materials development](#) and implementation of new materials and coatings into [durable aircraft designs](#).
- Specifications are a critical aspect of implementing new technologies. Since most specifications are written around the technologies that existed at the time the spec was issued, they are often a hindrance to adopting newer and better technologies because those technologies, by definition, are never exactly the same as those they replace. A more modern method of creating and updating specifications is needed that uses modern methods of linking data and incorporating media to provide far more useful documents that can be more easily, quickly and safely adjusted to changes in technology.

REFERENCES

- ¹ "REACH Interpretation Guidelines", Aerospace and Defense Industries Association of Europe (June 2007)
- ² "Guidance on Requirements for Substances in Articles", ECHA (April 2011). http://echa.europa.eu/documents/10162/13632/articles_en.pdf
- ³ Chemical Watch Global Business Briefing, September 2014, "The aerospace sector: managing substance restrictions"
- ⁴ "REACH Interpretation Guidelines", Version 3 (May 2014), <http://www.asd-europe.org/commissions/environment/reach/>
- ⁵ "The REACH Regulation – A Guide to REACH Process and Exemption in the Ministry Of Defense", UK Ministry of Defense, Defense Equipment & Support, (May 2014)
- ⁶ "Classification of Ammunition In Articles with an Integral Substance/Mixture", Federation of German Security and Defense Industries (2014), <http://www.bdsv.eu/data/8aae7b7ac2cebbc67ea7d086bed47bceb9a494cdb9dca0cdc7b798bac7b774d8c3a7b3b88aae777cc3a9c7847da7ae93.pdf>
- ⁷ Biocidal Products Regulation, (# 334/2014, March 2014), <http://echa.europa.eu/information-on-chemicals/active-substance-suppliers>
- ⁸ DEFRA survey on REACH business impacts (January 28, 2014), <https://chemicalwatch.com/18199/uk-survey-finds-reach-triggers-substance-withdrawals>
- ⁹ R. Knauf Chemical Watch Briefing, October 2014.
- ¹⁰ "EU Chemical Ban Effects European MROs", Aviation Week (February 11, 2013), <http://aviationweek.com/awin/eu-chemical-ban-effects-european-mros>

Appendix 1. Sources of REACH information

A frequently updated list of REACH and other environmental regulatory information can be found at:

<http://www.rowantechology.com/technical-resources/additional-regulatory-information/>

Pre-registered Substances List: <http://echa.europa.eu/web/guest/information-on-chemicals/pre-registered-substances>

Registration List: <http://echa.europa.eu/web/guest/information-on-chemicals/registered-substances>

Proposals for Candidate List for Authorization: <http://www.echa.europa.eu/web/guest/proposals-to-identify-substances-of-very-high-concern-previous-consultations>

Candidate List for Authorization: <http://echa.europa.eu/web/guest/candidate-list-table>

Annex XIV Authorization List: <http://echa.europa.eu/web/guest/addressing-chemicals-of-concern/authorisation/recommendation-for-inclusion-in-the-authorisation-list/authorisation-list>

Annex XVII Restriction List: – <http://echa.europa.eu/web/guest/addressing-chemicals-of-concern/restrictions/list-of-restrictions>

Registry of Intentions (GHS, SVHCs, Restrictions): <http://echa.europa.eu/addressing-chemicals-of-concern/registry-of-intentions>

Risk Management Option Analysis (RMOA) – <http://echa.europa.eu/addressing-chemicals-of-concern/substances-of-potential-concern/svhc-roadmap-implementation-plan/pact>

European Defense Agency REACH Portal (defense exemptions) – <https://reach.eda.europa.eu/home>

AIA REACH Interpretation guidelines, June 2007, http://www.aia-aerospace.org/pdf/reach_interpret_guide.pdf

EC Directive No 67/548/EEC on the classification, packaging and labeling of dangerous substances, <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31967L0548:EN:HTML>

EC Draft regulation on the fees and charges payable to the European Chemicals Agency pursuant to REACH, October 2007, http://www.euractiv.com/29/images/Commission%20draft%20REACH%20fees_tcm29-168130.pdf

European Inventory of Existing Commercial chemical Substances (EINECS), <http://ecb.jrc.it/existing-chemicals/>

Navigator Tool for determining obligations under REACH, <http://reach.jrc.it/>

Q and A on the new Chemicals policy, REACH, December 2006, <http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/06/488&format=HTML&aged=0&language=EN&guiLanguage=fr>

REACH Implementation Projects (RIPs), <http://ecb.jrc.it/reach/rip/>

REACH in brief – updated February 2007, http://ecb.jrc.it/documents/REACH/REACH_in_brief_0207.pdf

Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), EC Regulation No 1907/2006, <http://ecb.jrc.it/legislation/2006R1907EC.pdf>

Appendix 2. Annex XIV Substances as of April 2015

The current version of Annex XIV (Authorization List) is at

<http://echa.europa.eu/web/guest/addressing-chemicals-of-concern/authorisation/recommendation-for-inclusion-in-the-authorisation-list/authorisation-list>

Candidate List for Authorization:

<http://echa.europa.eu/web/guest/candidate-list-table>

Previous Proposals for Candidate List for Authorization

<http://www.echa.europa.eu/web/guest/proposals-to-identify-substances-of-very-high-concern-previous-consultations>

Table 7. REACH Annex XIV substances as of April 2015. DoD-relevant chemicals shown in gold.

Name	CAS #	Sunset date	Latest applic.	DoD applications
1,2-Dichloroethane (EDC)	107-06-2	22/11/2017	22/05/2016	
2,2'-dichloro-4,4'-methylenedianiline (MOCA)	101-14-4	22/11/2017	22/05/2016	Polymer insulators, epoxy
2,4 – Dinitrotoluene (2,4-DNT)	121-14-2	21/08/2015	21/02/2014	Precursor
4,4'- Diaminodiphenylmethane (MDA)	101-77-9	21/08/2014	21/02/2013	Polymer insulators
5-tert-butyl-2,4,6-trinitro-m-xylene	81-15-2	21/08/2014	21/02/2013	
Acids generated from chromium trioxide and their oligomers	13530-68-2	21/09/2017	21/03/2016	Passivates
Ammonium dichromate	2151163	21/09/2017	21/03/2016	Phosphate stripper, corrosion inhibitor
Arsenic acid	7778-39-4	22/08/2017	22/02/2016	
Benzyl butyl phthalate (BBP)	85-68-7	21/02/2015	21/08/2013	Polymers
Bis(2-ethylhexyl) phthalate (DEHP)	117-81-7	21/02/2015	21/08/2013	Polymers
Bis(2-methoxyethyl) ether (Diglyme)	111-96-6	22/08/2017	22/02/2016	Rain erosion coatings, adhesives
Chromium trioxide	1333-82-0	21/09/2017	21/03/2016	Chrome plating, Al treatment
Diarsenic pentaoxide	1303-28-2	21/05/2015	21/11/2013	
Diarsenic trioxide	1327-53-3	21/05/2015	21/11/2013	
Dibutyl phthalate (DBP)	84-74-2	21/02/2015	21/08/2013	Flares
Dichromium tris(chromate)	24613-89-6	22/01/2019	22/07/2017	Aerospace
Diisobutyl phthalate (DIBP)	84-69-5	21/02/2015	21/08/2013	Adhesives
Formaldehyde, oligomeric reaction products with aniline (tech MDA)	25214-70-4	22/08/2017	22/02/2016	Ejection seats, flares
Hexabromocyclododecane (HBCDD)	134237-50-6	21/08/2015	21/02/2014	
Lead chromate	7758-97-6	21/05/2015	21/11/2013	
Lead chromate molybdate sulphate	12656-85-8	21/05/2015	21/11/2013	
Lead sulfochromate yellow	1344-37-2	21/05/2015	21/11/2013	
Pentazinc chromate octahydroxide	49663-84-5	22/01/2019	22/07/2017	Aerospace
Potassium chromate	7789-00-6	21/09/2017	21/03/2016	Al treatment
Potassium dichromate	7778-50-9	21/09/2017	21/03/2016	Primer, anodize and phosphate sealer
Potassium hydroxyoctaoxidizincatedichromate	11103-86-9	22/01/2019	22/07/2017	
Sodium chromate	2146108	21/09/2017	21/03/2016	Al treatment
Sodium dichromate	10588-01-9	21/09/2017	21/03/2016	Al treatment
Strontium chromate	2151068	22/01/2019	22/07/2017	Primer, fuel tank coating
Trichloroethylene	79-01-6	21/04/2016	21/10/2014	Cleaner
Tris(2-chloroethyl)phosphate (TCEP)	115-96-8	21/08/2015	21/02/2014	Insulative coating

Appendix 3. Annex XVII Substances as of April 2015

The current version of Annex XVII (Restricted Substances List) is found at

<http://echa.europa.eu/web/guest/addressing-chemicals-of-concern/restrictions/list-of-restrictions>

As mentioned in Section Appendix 4.5, most of the current restrictions are not relevant to DoD usage, with the exception of the cadmium plating. However, this does not preclude the existence or addition of other chemicals that may be relevant to DoD, or the addition of DoD-relevant restrictions to existing chemicals.

Registry of Intentions (identifying SVHCs, proposing restrictions, proposing globally harmonized system (GHS) classifications):

<http://echa.europa.eu/addressing-chemicals-of-concern/registry-of-intentions>

Appendix 4. Primary provisions of REACH

This Appendix covers many of the details of REACH, and is included primarily for reference. **Note that this appendix was originally written in 2008, primarily a reference for the original REACH legislation, and has been updated in 2015. Note also that links may have changed – refer to**

<http://www.rowantechology.com/technical-resources/additional-regulatory-information/>

for updated links.

REACH is an extremely complicated piece of legislation, comprising 230 pages of legislative language and 620 pages of annexes. It is broken down into Titles, Chapters, Articles, Paragraphs (and subparagraphs) and Annexes, and is not bookmarked. When referring to the legislation we use the Article or Annex number, paragraph and subparagraph in square brackets, as in [Article 3(5a)] or just [3(5a)] or [Annex XVII, 23 (5a)].

Despite the fact that the legislation is written in fairly plain English it is by no means easy to understand:

- It is inconsistent, with completely different regulations for the same items in different parts of the document.
- It is ill-defined, with no clear definition of what its terms actually mean, so that many of the details of the legislation are still being worked out. As a result, the European Chemicals Agency has funded REACH Implementation Projects, in which teams have developing additional guidance documents.
- Only a few of the chemicals that will ultimately require authorization are yet defined, so we can only make informed guesses as to how the legislation will affect other specific defense materials and processes.
- And all of this has to mean the same thing in all of the more than 20 European languages.

As a result, there are significant differences in the interpretation of the legislation, and it will doubtless take many regulatory and court decisions over a decade or more for it to become settled law. Therefore, this report provides our understanding of how its requirements will affect engineering and materials decisions, based on the language of the legislation and the interpretations of various government and commercial organizations in the US, Europe and elsewhere. A continuous watch will be required to keep track of the effects of the legislation as it evolves.

REACH is based on the Precautionary Principle, as is all European Union (EU) environmental and health legislation. Even though many EU laws are based on this principle, it has no official or legal definition.

The Rio Declaration¹¹ of 1992 (Principle 15) adopted it with the following language:

“In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”

Another commonly used definition is the Wingspread Statement¹², which summarized the principle as:

“When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically.”

And further that

“the applicant or proponent of an activity or process or chemical needs to demonstrate that the environment and public health will be safe. The proof must shift to the party or entity that will benefit from the activity and that is most likely to have the information.”

Note that the primary focus of the Precautionary Principle is the threat of any technology, not its positive impact. All chemicals and technologies are assumed to be a threat unless proved otherwise; and in practice there is little consideration of cost-benefit, which is the hallmark of US environmental and health regulations. These basic philosophical differences should be remembered in interpreting the REACH statute, since they will color the way in which the statute is enforced.

Since the Precautionary Principle is intended always to err on the side of caution, where the REACH legislation is inconsistent the most stringent interpretation should normally be assumed.

It is also critical to note that, unlike other European regulations such as RoHS, ***there is no general exemption for defense or aerospace***, although governments can make narrow exceptions:

“Member States may allow for exemptions from this Regulation in specific cases for certain substances, on their own, in a preparation or in an article, where necessary in the interests of defense.” [Article 2(3)]

At this time the UK has the best-defined process for Defense Exemptions, but those exemptions are intended to exist only until alternatives are developed (see Section 2.3). Note also that throughout the legislation, as with all EU legislation, British spelling is used, as in the above extract (this is important to remember when searching the EU documents).

Appendix 4.1 Definitions

Terms in the REACH legislation that are of particular relevance to DoD, as well as acronyms used in this report, are given in Table 8.

The provisions of REACH most likely to affect DoD and military equipment manufacturers and suppliers are the requirements and procedures for registration, authorization and restriction, and the record-keeping that will be required.

Table 8. Key REACH terms of importance to DoD.

Term	Definition	REACH Article
Annex XIV	List of substances subject to authorization	
Annex XVII and appendices	List of restricted substances, with conditions on use (includes likely candidates for Annex XIV, such as Cd & Cr ⁶⁺ compounds)	
Article	An object with a shape, surface or design which determines its function to a greater degree than its chemical composition; includes individual components and entire systems (e.g. aircraft)	3(3)
Authorization	Procedure that allows placing of SVHCs on the market or using them; authorization is granted on a case by case basis for a limited period only	56-60
CMR	Carcinogenic, Mutagenic, or toxic for Reproduction	57(a), (b),(c)
CoRAP	Community Rolling Action Plan – plans to evaluate substances for Annex XIV	
ECB	European Chemicals Bureau http://ecb.jrc.it/ ; responsible for managing RIPs and REACH guidance documents	
ECHA	European Chemicals Agency, Helsinki; responsible for overall management of REACH	Recital (15)
EU	European Union	
Import	Introduce into the <i>customs</i> territory of the EU	3(10)
Non phase-in substance	New substance, or substance manufactured in the EU prior to 1992 but not placed on the market	26, 27
PBT	Persistent, Bioaccumulative and Toxic	57(d)
Phase-in substance	Already on market; listed in EINECS ¹³ or previously manufactured in the EU	3(20)
Place on the market	Sell to, or make available for use by, a third party; includes import.	3(12)
PP	Precautionary Principle	
Preparation	Chemical mixture or solution (includes alloys, composites, paints and coatings)	3(2)
Registration	Procedure for submission of data on a manufactured or imported substance; required for all substances placed on the market	5-7
Restriction	Procedure that imposes partial or total bans on the manufacturing, placing on the market, or use of dangerous substances, preparations and articles	69-73
RIP	REACH Implementation Project, which develops guidelines and tools for interpretation of REACH	Recital (24)
RMO	Risk Management Option (including alternatives to authorization and restriction)	
RoHS	Restriction of Hazardous Substances (another EU regulation)	
SDS	Safety Data Sheet	
Substance	Chemical element or compound (including any stabilizers and process impurities, but excluding separable solvents)	3(1)
SVHC	Substance of Very High Concern (CMR, PBT, vPvB)	57
vPvB	Very Persistent and Very Bioaccumulative	57(e)

Appendix 4.2 Schedule

Figure 2 shows the overall timetable for REACH.

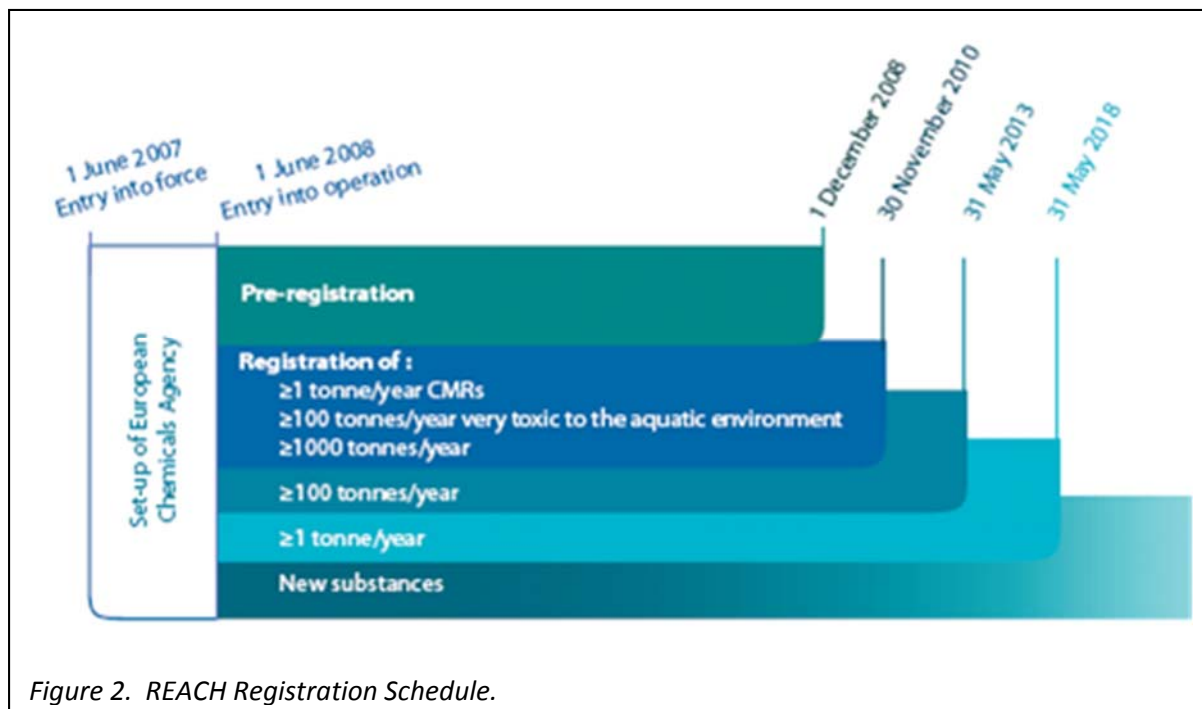


Figure 2. REACH Registration Schedule.

Note that REACH is firmly established in European law, and in 2015 we are currently in the final registration period. Pre-registration was the period when existing chemicals (those in the European EINECS database) could be registered free of charge. Pre-registration allowed these materials to be sold and used prior to their full registration, by the dates shown in Figure 2, dependent on the annual amount of each chemical manufactured or imported. Every chemical must be registered, and a dossier must be developed of its health and environmental effects, including a Safety Data Sheet (SDS, a more detailed version of an MSDS).

Any new chemicals (chemicals not in EINECS) must be registered, and if necessary authorized, prior to being manufactured, imported or used in the EU. Substances of very high concern (SVHCs, which include a number of important DoD materials and finishes) have much stricter requirements.

Appendix 4.3 Registration

Materials (chemicals) are broadly divided into three major categories

- Substances – individual chemicals and compounds
- Mixtures (formally known as Preparations) – formulations such as paints, plating chemicals and alloys
- Articles – components and systems, from individual bolts to whole aircraft

All substances on their own or in preparations, and certain substances in articles, must be registered under REACH if the substance is manufactured or imported in quantities in excess of one tonne per year. The often cited statement “No data, no market” means that if a substance on its own, in a preparation, or in an article is not registered by the relevant deadline, then it cannot be placed on the market – i.e. manufactured, imported or sold, which effectively precludes its use in the EU; “no data” refers to the data required for registration.

Registration is not only registration of the material, but also of its uses. Registration only covers the uses specified in the registration application, and before a substance can be used for a new application, that application must also be registered. While it is up to the supplier – manufacturer, importer or distributor – to register the substance, the end user needs to check that the substance is registered for the intended uses. In general, it will be the commercial supply chain that registers materials, but it is important to ensure that military uses of materials, alloys, etc. are registered for the applications in which they will be used. **Note that DoD cannot register materials. If a DoD use is not registered, then that use is not permitted.**

To take advantage of an extended timetable for registration, to be completed in 2018 for the lowest volume substances as indicated in Figure 2, phase-in substances (those already on the market) could be pre-registered free of charge from June 1 to November 30, 2008. A pre-registered substance could then continue to be used, with a full registration to be submitted before the appropriate deadline. **Any phase-in substances not pre-registered during the initial 6-month period was not be able to benefit from the phased registration timetable, and could only be placed on the market or used if registered immediately [REACH Article 28(3)].** No extended timetable exists for registration of non phase-in (new) substances.

The typical total cost of registration is \$52,500-105,000 (see Section Appendix 4.6.5). However, the cost can easily exceed \$1 million for a large company registering a substance with a volume of 100-1000 tonnes/yr (Table 12).

Appendix 4.4 Authorization

REACH establishes the principle that most toxic materials cannot be manufactured, imported, sold or used in the EU without authorization for both the material and its use. Authorization is not intended to be automatic. It is intended to be used only for those materials for which there are no current alternatives, and it is intended that those materials should ultimately be banned as alternatives are developed.

Appendix 4.4.1 [Annex XIV Authorization List](#)

Annex XIV Authorization List can be found at:

<http://echa.europa.eu/web/guest/addressing-chemicals-of-concern/authorisation/recommendation-for-inclusion-in-the-authorisation-list/authorisation-list>

The Annex XIV List as of April 2015 is shown in Table 3 (Section 2.2). ***Two thirds of the chemicals on this list are used by DoD and the supply chain.***

Appendix 4.4.2 Candidate materials

Substances that are proposed for Annex XIV are first placed on the list of Proposals to Identify Substances of Very High Concern

<http://www.echa.europa.eu/web/guest/proposals-to-identify-substances-of-very-high-concern-previous-consultations>

After a period of public comment, the substances may be moved to the Candidate List for Authorization

<http://echa.europa.eu/web/guest/candidate-list-table>

The intent of REACH is that ultimately every substance that is classified as carcinogenic, mutagenic or toxic for reproduction (CMR) will be subject to Authorization or Restriction (although the European authorities are beginning to consider other Risk Management Options (RMOs, see Section Appendix 4.6.6), while also including as SVHCs materials other than CMRs. REACH specifies several classes of SVHCs, as outlined in Table 9.

Table 9. Substances subject to authorization (Annex XIV).

Health or environmental effect	Risk phrase	Classification #
CMR substances		
Carcinogenic, category 1, 2	May cause cancer	R45
Carcinogenic, category 1, 2	May cause cancer by inhalation	R49
Mutagenic, category 1, 2	May cause heritable genetic damage	R46
Toxic for reproduction, category 1, 2	May impair fertility	R60
Toxic for reproduction, category 1, 2	May impair fertility	R61
PBT (persistent, bioaccumulative and toxic)		
vPvB (very persistent and very bioaccumulative)		

CMR substances cover several critical materials used in DoD finishing processes such as Cd, Cr⁶⁺, and compounds of Ni and Pb, as well as numerous organics used in polymers, adhesives, paints, and sealants, all of which are likely candidates for the future list of substances subject to authorization in **Annex XIV**. Some of these materials have already been placed on Annex XIV (most Cr⁶⁺ compounds) and others are virtually certain to appear on the authorization list at some point. This expectation is reinforced by the fact that they are already included in REACH as Restricted Substances listed in the Annex XVII Appendices. **Note that many of these are materials commonly used for sustainment of legacy weapon systems.**

Appendix 4.4.3 Rules for Authorization

At the beginning of the section on Authorization, REACH states [Article 55]:

“The aim of this Title is to ensure the good functioning of the internal market while assuring that the risks from substances of very high concern are properly controlled and that these substances are progressively replaced by suitable alternative substances or technologies where these are economically and technically viable. To this end all manufacturers, importers and downstream users applying for authorizations shall analyse the availability of alternatives and consider their risks, and the technical and economic feasibility of substitution.”

The same basic rules apply for materials by themselves, incorporated in or on components, processing solutions, paints and alloys. Article 56 states:

“A manufacturer, importer or downstream user shall not place a substance on the market for a use or use it himself if that substance is included in Annex XIV, unless:

(a) the use(s) of that substance on its own or in a preparation or the incorporation of the substance into an article for which the substance is placed on the market or for which he uses the substance himself has been authorized”

As the EChA “Guidance on the Preparation of an Application for Authorization”¹⁴ states:

“After the sunset date, substances that are included in Annex XIV cannot be used by a manufacturer, importer or a downstream user, or be placed on the market by a manufacturer, importer or a downstream user for a use unless an authorization has been granted for that use ... or the use is exempt from authorization.”

The list of materials that must be authorized is to be found in Annex XIV (see Sections Appendix 4.4.1 and Appendix 4.4.2). For DoD, the REACH procedure that will undoubtedly have the greatest impact is authorization, which is required for the use of any SVHCs including those in articles. Authorization is a much more restrictive procedure than registration: the differences between the two are set out in Table 10.

Unlike registration, there is no lower limit (either volume = tonnes/yr or concentration = wt.%) **for authorization except in the case of preparations**, in which SVHCs below a concentration of 0.1 wt.% do not need to be authorized. An authorized substance may only be employed for the particular use(s) specified by the Chemicals Agency; new uses of authorized chemicals require re-authorization.

Another difference between authorization and registration is that **all**

SVHCs in Annex XIV are subject to authorization, whether they are intended for release or not [REACH Article 56, AIA REACH guidelines page 19]. Furthermore, notification of use (though not registration) is required for SVHCs in articles, if the substance has not already been registered for that use, when the quantity exceeds 1 tonne per year and the concentration is above a threshold of 0.1 wt.%. Although notification is a very simple process, the definition of an article is subject to interpretation (see Section Appendix 4.6.3, a. What is an article?, and Section Appendix 4.6.7). The current Chemicals Agency interpretation is that the SVHC concentration threshold of 0.1% for notification is relative to the weight of the **whole** article, not to the weight of any component or homogeneous material (such as a coating) of which the SVHC forms a part.

There are two alternative paths to authorization of an Annex XIV SVHC:

1. Showing that the risk from using the substance can be adequately controlled throughout its life cycle
2. Showing that (a) the socioeconomic benefits of using the substance outweigh the risk, and (b) there are no suitable alternative substances or processes that are economically and technically viable.

Table 10. Comparison between registration and authorization procedures in REACH (adapted from the Nickel Institute).

Registration	Authorization
Volume based	Risk/hazard based, no volume threshold
One registration covers all uses of a substance	Each authorization covers limited uses of a substance
Market access for a substance	Market access for a use of a substance

The problem is that the first of these options only applies to CMR substances for which a threshold or safe level is defined. A safe level is defined to mean that scientists agree on a threshold, below which the substance does not have adverse effects on the human body or the environment. However, all PBTs and vPvBs, plus those **CMR substances for which a safe level is not defined cannot be authorized based on adequate control of risk alone** [REACH Article 60(3), REACH-in-brief Section 2.7].

This has serious implications, because there is no generally agreed safe threshold for CMR materials of importance to DoD and its suppliers, such as Cd, Cr⁶⁺, Ni and Pb compounds. Authorization of these substances will only be granted if no suitable alternatives exist, and if a case is made for their socioeconomic benefits, which can be very difficult. In any case, authorization is subject to a time-limited review, which can even be triggered earlier if new alternatives become available. Therefore, authorization provides only a limited window for the continued use of a substance until an alternative can be found. **DoD will most likely need to find alternatives to Cd, Cr⁶⁺, and some other materials in order to sell or maintain military equipment long-term in the EU.**

Appendix 4.5 Restriction

Appendix 4.5.1 [Annex XVII, Restricted Substances](#)

Annex XVII Restriction List:

<http://echa.europa.eu/web/guest/addressing-chemicals-of-concern/restrictions/list-of-restrictions>

The list of restricted materials is based on an earlier EU list that formed part of legislation on the packaging and labeling of dangerous substances (Annex I of Directive 67/548/EEC), a list which was incorporated into REACH. The term dangerous includes toxic substances and mixtures, as well as other categories such as explosives or flammables, although it is not at all clear whether any currently used energetics or propellants will be included. Restricted substances can only be used under very specific conditions, e.g. Cd plating is only allowed in certain industries such as aerospace, nuclear and mining [REACH Annex XVII, #23 paragraph 7]. It is not permitted on many classes of vehicles, although **it is not clear whether or not military vehicles are exempt.**

Unlike the Authorization List, which covers any and all uses of specific materials, the restriction list must be read very carefully, because restrictions are very specific and tend to be related to consumer items. By way of illustration only two of the restrictions shown in Table 11 are relevant to defense. However, there may be other materials on the list whose restrictions are relevant.

Table 11. Some DoD-relevant substances already listed as restricted substances in REACH.

Material	Restriction – only gold cells are relevant to DoD
Cd	Cannot be used in plastics. Cd plating cannot be used in many vessels and vehicles (not clear whether military vehicles are included)
Cr6+	Cannot be used in cement
Ni	Ni metal cannot be used in jewelry
Pb and compounds	Cannot be used in jewelry
Phthalates	DEHP, DBP, BBP, DINP, DIDP, DNOP cannot be used in toys and childcare items
Ammonium nitrate	Primarily restricted to use in fertilizers
Methylene dichloride	Paint stripper - may be permitted in some EU countries

Appendix 4.5.2 Restrictions under consideration

The only materials currently under consideration for restriction, in addition to those already in Annex XVII, are the flame retardant decaBDE; PFOA, which is related to the already banned PFOS (a surfactant formerly used in applications such as hard chrome plating); methanol; and bisphenol A, used in coatings for thermal paper. Slated for future consideration are combinations of perfluorinated silanes and organic solvents in spray products; certain grill lighter fluids and fuels for decorative lamps; and certain chemicals used in wash-off personal care products. PFOS is also the basis for Aqueous Film Forming Foam (AFFF), a very effective fire-fighting agent. DoD has approximately 0.5M gal of AFFF in its remaining inventories. It is estimated that the US Army will probably expend their AFFF by 2019, the Navy by 2023, and USAF by 2030.

On the policy side, a recent Chemical Watch briefing has questioned whether authorization is necessarily the best way to tackle chemicals that meet the criteria for classification as SVHCs. EU member state authorities now routinely conduct a risk management option analysis (see Section Appendix 4.6.9), to see if a restriction, mandatory classification, or evaluation might be more suitable. Authorization puts the burden of proving safety on users, while restriction requires the Chemicals Agency to prove a restriction is necessary.

Appendix 4.6 Summary of issues critical to alloys, fluids, components and sustainment chemicals

The only defense-relevant exemption is for PBTs and vPvBs in preparations, which are limited to 0.1 wt%. **The legislation dictates authorization (and eventual replacement) as the default requirement for all uses of SVHCs.**

Appendix 4.6.1 Rules for Mixtures (aka Preparations)

Mixtures (previously called Preparations in REACH) are defined as mixtures or solutions consisting of two or more substances – which covers cleaning chemicals, oils and hydraulic fluids, paints and sealants. Also included in this category are alloys, which are defined as “special preparations” [Recital (31)].

The mixture itself does **not** have to be registered under REACH, so that both fluid mixtures and aerospace alloys are exempt from registration requirements. However, the constituent substances in a mixture do need to be registered, including the component elements in an alloy, with the single exception of carbon that is exempt from all REACH requirements. The following rules apply to mixtures:

1. All substances in mixed-use (including alloys) imported or produced in quantities > 1 tonne per year per importer or manufacturer must be registered, with the exception of carbon. Note that this is the tonnage of each substance, not of the mixture, and that the tonnage is summed over all the importer's or manufacturer's mixtures (or alloys) that include that substance.
2. Any SVHCs in a mixture are subject to authorization
 - a. For PBTs, vPvBs and endocrine disruptors, if the concentration in the mixture is >0.1 wt.%
 - b. For CMR substances, if the concentration in the mixture is above the lowest concentration limit specified in Annex I of Directive 67/548/EEC which results in the classification of the mixture as dangerous. This limit is 0.1 wt.% for most CMR substances listed.
 - c. If any such SVHC that is subject to authorization (Annex XIV) is used in a mixture or alloy, the mixture or alloy cannot be placed on the market until the SVHC has been authorized or exempted from authorization [56(1)].

Appendix 4.6.2 Coatings and paints

Some ambiguity arises in the case of coatings and paints, which can be classified in two different ways under REACH: as mixtures when in the form of a liquid in a container or a plating solution, but as part of an article when applied to that article and allowed to dry or cure. Dried coatings can be regarded as alloys, which are classified as "special preparations" under REACH. In either case Cr⁶⁺ will have to be authorized.

As mentioned in Section 2.4, there is a lower limit of 0.1 wt.% for authorization of an SVHC as a use in a mixture. All chromate conversion baths and washes are well above this level. If this limit were applied to the whole article – as in the rule for notification of SVHCs in articles – the Cr⁶⁺ level in a chromate conversion coating could easily fall below the 0.1% limit, even though the concentration in the coating itself is 25 wt.% or more, and the Cr⁶⁺ would not require the additional step of notification to ECHA.

Appendix 4.6.3 Rules for Articles

An Article is defined as a product whose utility is defined by its structure and shape rather than primarily by its chemistry – that is, any item from a rivet to an aircraft carrier. ECHA has provided guidance how REACH treats articles².

REACH treats articles far less stringently than substances or mixtures – the is informally known as the "Article Exemption", a term that does not appear in the legislation. Articles can contain substances that are not Registered, if the substances are not intended to be released. If they are intended to be released, registration is still not needed unless the weight of the substance (not of the articles) exceeds 1 tonne per year. Even SVHCs can be freely used in articles imported into the EU, provided they do not constitute > 0.1wt% of the article, and no more than 1 tonne of the material is imported

per year, which exempts most products. For example, after the sunset date of September 2017 only authorized organizations in the EU will be able apply chromates to articles, but articles containing chromates can be freely imported to the EU, provided the chromate does not exceed 0.1wt% of the product and <1 tonne of chromate on articles is imported per year. If these limits are exceeded, the articles can still be imported, but their use triggers certain registration, notification, and communication requirements.

A non-SVHC substance in an article must be registered if **all** the following requirements are met [7(1)]:

1. The substance is imported or produced in quantities > 1 tonne per year per importer or manufacturer. Note that this is the tonnage of each substance, not of the total article weight.
2. **AND** the substance is **intended to be released** under normal or reasonably foreseeable conditions of use
3. **AND** the substance has not already been registered for that use.

Note that this registration is in addition to any general registration of the material, and covers its use in or on the component.

If an SVHC substance is used in or on an article (i.e., a substance that is on the “candidate list” of materials subject to authorization published on the ECHA website), the article cannot be placed on the market until that SVHC has been authorized or exempted from authorization [56(1)]. Furthermore, the ECHA must be **notified** if **all** the following requirements are met [7(2)]:

1. The substance is imported or produced in the article in quantities > 1 tonne of SVHC per year per importer or manufacturer. Note that this is the tonnage of each SVHC, not of the total article weight.
2. **AND** its concentration in the article is > 0.1 wt.%
3. **AND** human exposure cannot be precluded under normal or reasonably foreseeable operating conditions throughout its life cycle, **including disposal**.
4. **AND** the substance has not already been registered for that use

Most substances on or in articles are unlikely to trigger reporting:

- Chromate finishes on articles are generally too thin to reach 0.1% of any article mass
- Chromate primers, sealers and sealants would generally not be 0.1% of an article mass and > 1 tonne/yr on defense components
- Cd plate on aircraft is currently exempt from restriction
- Cd-containing brazes for defense use is are currently exempt from restriction

Note that Cd may not be used in ships and vehicles (including fasteners), but may be used (for the time being) in aircraft [Annex XVII, 23(6,7)]. However, this is a Restriction (Annex XVII, see Section 3.4), not an Authorization (Annex XIV).

Beryllium is a substance that could well exceed the 0.1% and > 1 tonne/yr limits, and is frequently identified as toxic and carcinogenic. However its situation under REACH is presently unresolved. Beryllium is currently classified as Carc. 1B, but the REACH [Registration dossier hazard assessment](#) for beryllium metal (and therefore Be alloys) shows no clear hazards. On the other hand the [CoRAP Substance Evaluation for Be](#) issued by the German Federal Institute for Occupational Safety and Health (March 2014) recommends that Be should be entered into Annex XV for consideration for Annex XIV (Authorization). Be is widely used in

- BeCu bushings on aircraft and vehicle actuators
- Electronic contacts for circuit boards

- ❑ Pins for electrical connectors
- ❑ BeAl alloy optical components.

Of these applications, the one most likely to trigger registration or notification requirements is BeCu bushings because of their size and extensive use.

These rules raise several major issues commonly encountered in military equipment that are not yet well-defined, and are still undergoing debate and definition:

a. What is an article?

The REACH Guidance Document on requirements for substances in articles¹⁵ states “Most of the commonly used products in private households and industries are articles, e.g. furniture, clothes, vehicles, books, toys, kitchen equipment, and electronic equipment.” Under this definition a whole vehicle or aircraft is an article when sold. If so, the 0.1 wt.% rule for SVHCs is unlikely ever to be met, if it refers to 0.1 wt.% of the total weight; but the 1 tonne rule would almost always be met. However, the REACH Guidance also states that producing an article can be understood to include the assembly of the components (which can themselves be articles) of a complete article (e.g. a laptop).

Although the Chemicals Agency interpreted an assembled article as a single article, several member states (Austria, Belgium, Denmark, France, Germany and Sweden, plus non-member Norway) held the opinion that an assembled article consists of two or more other articles, since the individual components of the assembled article also meet the definition of an article under REACH. In their view, the guiding principle should be “once an article, always an article.” This view was adjudicated and in September 2015 the European Court of Justice ruled in favor of this interpretation. **Thus, SVHCs in articles cannot be “diluted” by incorporating individual articles into assemblies.**

b. What is intended release?

Clearly, ink from a pen is intended release. Engine effluents are excluded. Is wear debris from a BeCu bushing an intended release, on the basis that the bushing wears to protect the bushed component? Are tire marks an intended release, on the basis that adhesion of rubber to road is a requirement for braking?

Cd and chromates are released during scuff sanding for paint touch-up. Since military equipment is designed for overhaul and corrosion control in this manner, one might ask whether this would be considered an intended release under a reasonably foreseeable life cycle operating condition. The entire paint system (including LO materials) might perhaps be classified as “intended to be released” since they are not a permanent part of the product. In that case, under rules for non-SVHCs they would not need to exceed 0.1 wt.% of the article.

However, the article Guidance Document states that release is intended only if it fulfils an **accessory function** (differentiated from the main function) which is deliberately planned and would not be achieved if the substance were not released. A release is not intended when “a release occurs during use or maintenance of the article, but the released substances do not contribute to any function of the article”. On this basis release of Cd and Cr⁶⁺ during aircraft overhaul or touch-up would not be an intended release, even though the system is designed to be maintained in this manner.

c. What are normal or reasonably foreseeable operating conditions throughout the life cycle?

Military equipment will always be used by a professional user, not a consumer. In this context

an accident, such as a plane crash, is not considered “reasonably foreseeable”. For a consumer, an accident, such as dropping and breaking a glass jar, is considered “reasonably foreseeable”.

Uses are not foreseeable if they are clearly excluded by the manufacturer or covered by wording on warning labels. Thus releases resulting from failure to follow the maintenance manual would not be considered deliberate.

Disposal is included in the life cycle, and must be arranged so that SVHCs do not leach out into groundwater or volatilize into the air.

Notification and supply of information to consumers concerning substances in articles:

- ❑ The **ECHA** must be notified as of June 1, 2011, of substances in articles that are on the SVHC candidate list and meet the above requirements, for any article supplied after that date. Whenever a substance is added to the candidate list, manufacturers and importers have 6 months to notify the ECHA of the presence of those materials in their products. In fact, they must notify the ECHA, not just for new items sold, but for any item sold from June 1, 2011 onwards.
- ❑ **End users** must be supplied with sufficient information to use the product safely, with, at a minimum, the names of any SVHCs on the candidate list.
- ❑ **Consumers** may ask for sufficient information to “allow safe use of the article”. Given that normal consumers are not users of military equipment, this should not permit any EU citizen to demand information on materials in military products (see also Section 2.4.2.2). However, the word “use” is broadly defined elsewhere in the statute, and can even include storage. Thus it is not clear how European courts may rule in the future.

All this means that manufacturers and importers must keep track of all potential SVHCs in their products and any substances that are likely to become classified as “intended to be released”.

Appendix 4.6.4 Concentration threshold

As we have noted in Section Appendix 4.4, any SVHC listed in Annex XIV will require authorization. In addition, above a concentration threshold of 0.1 wt.% the SVHC must be authorized for use in a mixture. The principal rules for use of SVHCs are:

- All SVHCs listed in Annex XIV must be authorized before they can be sold, imported or used.
- In mixtures, SVHCs are subject to *authorization* for that particular use if they are above a concentration of 0.1 wt.%
- In articles, *notification* is required for SVHCs present at levels above 0.1 wt.% and in annual quantities over 1 tonne
- The *restriction* rules for Cd specify a maximum concentration of 0.1 wt.% Cd when used as a pigment in paints – but only 0.01 wt.% Cd when used as a colorant or stabilizer in plastic
- The *restriction* rules limit the concentration of CMR substances (categories 1 and 2) to 0.1 wt.% when sold to the general public in substances or mixtures. However, this limit does not apply to “professional users”, except for a limit of only 0.0002 wt.% of soluble Cr⁶⁺ in cement.

Appendix 4.6.5 Compliance costs

Estimates of the main compliance costs associated with REACH are summarized in Table 12.^{16, 18} The costs vary considerably both with tonnage and with the size of the enterprise; the numbers given here

are for the three lowest tonnage bands (up to 1000 tonnes/yr).

For large enterprises, defined as those with >250 employees, the total estimated cost is considerable at EUR 144,000 (approximately \$150,000 at today's exchange rate) for a single use of an SVHC in the lowest tonnage band of 1-10 tonnes/yr, ranging up to EUR 930,000 (approximately \$980,000) for the 100-1000 tonnes/yr band. However, in recognition of the financial burden that REACH places on SMEs (small and medium-sized enterprises), the EU fees for smaller companies and research organizations are much lower. Table 12 shows that small enterprises typically pay only 4-21% of the costs incurred by their larger counterparts, while micro enterprises (<10 employees) pay even less at 1-4%. In the case of joint submissions by multiple registrants, there is a 25% reduction in the fees for registration and confidentiality requests. It is seen that the costs for registration, the chemical safety report (which is an extended safety data sheet), and testing escalate rapidly as the volume increases.

As stated in the table, the total estimated cost includes authorization for a single use of one SVHC by one applicant. An additional fee of EUR 10,660 applies for each additional SVHC authorized in a preparation or article, or for each extra use of the same substance, and a fee of up to EUR 40,000 is levied for any additional applicant.

Table 12. Principal REACH compliance costs (source: EU Regulation No. 254/2013). The first set of numbers shown is for an individual large enterprise; the numbers in square parentheses are for an individual small enterprise, assuming no testing or related costs for new substances.

Cost	Fee (EUR)			Comments
	1-10 t/yr	10-100 t/yr	100-1000 t/yr	
Registration fee	1,714 [600]	4,605 [1,612]	12,317 [4,311]	One substance
Chemical safety report		25,000	50,000	Only required for volumes >10 t/yr
Testing	75,000	300,000	800,000	Physicochemical, toxicological
Authorization fee	53,300 [23,985]	53,300 [23,985]	53,300 [23,985]	One SVHC, one use, one applicant
	10,660 [4,797]	10,660 [4,797]	10,660 [4,797]	Each additional SVHC or use

Because some of the required physicochemical testing information will likely form part of the existing safety data sheet for any particular substance, and testing costs may be shared between members of the Substance Information Exchange Forum (SIEF) which includes all registrants of that substance, the testing costs in Table 12 may be overestimates. However, these overestimates will be balanced by further costs that have not been included, such as:

- Administrative costs including preregistration costs, the acquisition of background data for registration and chemical safety reports (including purchase of access to studies), and updated data processing systems. The cost of acquiring data from larger companies, which often abuse their dominant position and demand fees up to EUR 100,000 or more, can be particularly burdensome for SMEs.

- ❑ Fees to update registrations for new uses.
- ❑ The cost of any delays in the supply of materials, caused by the registration or evaluation procedures.
- ❑ Legal and other fees for appeals of EU decisions.
- ❑ Acquisition and maintenance of detailed information on all materials, especially SVHCs, for use by downstream users, and that might become the subject of an information request.

According to a recent report which evaluated the implementation and acceptance of REACH in its first few years,¹⁷ the average cost of registration for the 1601 businesses surveyed fell in the range of EUR 50,000-100,000 (\$52,500-105,000). The cost range was lower than this for chemical importers, but higher for chemical manufacturers. For 70% of firms in the survey, registration costs were less than 1% of annual sales.

Another finding of the report was that the cost of registration is the most common reason for the withdrawal of a substance from the market, or the decision to reduce production below the 1000 tonnes per year level when previously producing just above that level. Because of all the additional costs listed above, approximately 50% of all firms have established dedicated REACH units.¹⁸

Appendix 4.6.6 Interpretations and changes in the regulations

Detailed interpretation of the rules is constantly under discussion. Originally, the EU introduced REACH Implementation Projects (RIPs) to guide interpretation of the legislation. As the legislation came into force, the RIPs began to draft and discuss Guidance Documents on specific topics, which were then handed over to the Chemicals Agency for publication and maintenance. The objective of the Guidance Documents¹⁹ is to facilitate implementation of REACH by describing good practice on fulfilling the obligations of the legislation. Any updates to the guidance are drafted by the Chemicals Agency and then subjected to a review procedure, involving stakeholders from EU member states, industry and NGOs.

The various EU member states do not always agree. Their disputes will eventually be resolved by European legislators (the European Commission), regulators and judges, but the process is expected to take many years.

For DoD the most important additions to REACH are likely to be the Annex XIV substances. These are the materials that have particularly harmful health or environmental effects, some of which have already been added to Annex XIV since 2009 as seen in Section Appendix 4.4.1, and which will continue to be added for some years. The use of these Annex XIV materials is already restricted, with the intention of ultimately banning them.

Appendix 4.6.7 Differing interpretations by EU member states

As mentioned in Appendix 4.6.3, the 0.1 wt.% rule for notification of SVHCs in articles was in dispute, until the EU Court rendered the opinion in 2015 that the rules should be interpreted as “once an article always an article”, as opposed to the original ECHA interpretation that the percentage of SVHC should be taken as its percentage in the final assembled product. This more stringent interpretation adopted by the Court is more in line with other EU rules, such as RoHS, which have similar wt.% rules that apply to homogeneous substances, meaning that, for example, the Cr⁶⁺ in a primer cannot be > 0.1wt.% of the coating weight, rather than the weight of the painted part.

Another current issue on which EU member states disagree is the inclusion in REACH of rules for nanomaterials, although the disagreement involves possible future rules rather than interpretation of existing rules. France, Belgium and Denmark, who have each introduced their own national register for nanomaterials, are urging the EU to do the same. However, at a meeting in December 2014 the European Commission, supported by several individual member states, expressed its opposition to the idea.

Appendix 4.6.8 Potential changes

Legal steps have already been taken to modify the 0.1 wt.% rule for notification of SVHCs in articles, although it appears that any rule change will affect only importers but not EU manufacturers. In February 2015, the Advocate General at the EU Court of Justice delivered an opinion (Case C-106/14) on SVHCs in articles.²⁰ In this opinion, the Advocate General proposed that the Court answer the request made by Austria, Belgium, Denmark, France, Germany and Sweden for a preliminary ruling, with the following addition to the REACH Guidance Document on articles:

Producers of assembled articles that consist of component articles need to notify ECHA only in case the entire article contains an SVHC above 0.1wt.%. In contrast to this, an importer of assembled articles needs to notify ECHA if in one of the component articles an SVHC is present above the threshold concentration.

This clarification would resolve the question raised in Section Appendix 4.6.3 (a. What is an article?) about how small a portion of the whole an article might be, but would only benefit manufacturers. Importers would still be burdened with the notification requirement for SVHCs in any component of an assembled article. However, the Advocate General's opinion is not binding, and the issue awaits a final decision by the Court.

Appendix 4.6.9 Risk Management Option Analysis

To identify chemicals of potential concern, the Chemicals Agency has developed a screening procedure to systematically examine the information available in REACH registration dossiers and other databases. The screening is aimed at identifying substances for REACH procedures such as substance evaluation by member states under the community rolling action plan (CoRAP), and risk management measures such as mandatory classification, authorization and restriction.

The purpose of risk management option analysis (RMOA) is to help decide whether further risk management is required for a material and to identify the best regulatory option to manage the risk.²¹ RMOAs are conducted by either member states or the Agency. An RMOA can conclude that regulatory risk management is required for a substance or that no regulatory action is needed at all. As of March 2015, 351 substances had been listed for screening, 213 were being evaluated and 24 RMOAs had been completed (the evaluations and RMOAs being a subset of the screening list); 52 substances were provisionally identified as SVHCs. Of the 24 RMOAs, 11 proposed restriction, 5 declared the substance to be an SVHC that should be added to the Candidate List, and 5 found no further action was necessary.

While RMOA is an important procedure, it is entirely voluntary and not mandated under REACH, and usually not public. The level of detail needed to reach a conclusion in an RMOA depends on the complexity of the case and the available information.

The main objective is to have all relevant currently known SVHCs included in the Candidate List by 2020. However, the Chemicals Agency considers that no numerical goal should be set for the total number of substances to be identified. Apart from satisfying legislative requirements, RMOAs are also expected to give registrants the opportunity to update their registration data, adopt the best

business strategy to address substances of potential concern, and prepare for public consultation during any subsequent regulatory processes.

Appendix 4.6.10 REACH Expansion

REACH Article 57 defines substances that can be placed on the Candidate List as Category 1 CMR, PBTs and vPvBs. However, it also says that other substances can be added if they have “an equivalent level of concern”, such as evidence of serious health or environmental effects. Several EU countries have proposed for the Candidate List substances that are outside these categories, such as respiratory sensitizers and endocrine disruptors. In April 2015 the EU General Court allowed the addition of other substances that are not in the original groups defined in Article 57^{22, 23}. As a result, it is very likely that a great many additional chemicals will be added, essentially expanding the application of REACH Authorization essentially to any chemical that is considered a health or environmental hazard for any reason.

APPENDIX 4 REFERENCES

- ¹¹ United Nations Conference on Environment and Development, Rio de Janeiro (1992), <http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=78&ArticleID=1163>
- ¹² “Protecting Public Health and the Environment: Implementing the Precautionary Principle”, ed by C. Raffenberger and J. Tickner J, Island Press, Washington, DC (1999).
- ¹³ European INventory of Existing Commercial chemical Substances (EINECS), <https://eur-lex.europa.eu/laboratories-research/predictive-toxicology/information-sources/ec-inventory>
- ¹⁴ Guidance on the Preparation of an Application for Authorization – EchA (January 2011) https://www.echa.europa.eu/documents/10162/13637/authorisation-application_en.pdf
- ¹⁵ Guidance on requirements for substances in articles – ECHA (2011), http://echa.europa.eu/documents/10162/13632/articles_en.pdf
- ¹⁶ European Commission Implementing Regulation (EU) No 254/2013, <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:079:0007:0018:EN:PDF>
- ¹⁷ Interim Evaluation: Functioning of the European chemical market after the introduction of REACH, (March 30, 2012), http://ec.europa.eu/enterprise/sectors/chemicals/files/reach/review2012/market-final-report_en.pdf
- ¹⁸ Interim Evaluation: Functioning of the European chemical market after the introduction of REACH, (March 30, 2012), Appendix - Case studies, http://ec.europa.eu/enterprise/sectors/chemicals/files/reach/review2012/market-annex_en.pdf
- ¹⁹ Guidance on REACH – ECHA (April 2011), <http://echa.europa.eu/web/guest/guidance-documents/guidance-on-reach>
- ²⁰ Opinion of Advocate General Kokott, EU Court of Justice Case C-106/14 (2014), <http://curia.europa.eu/juris/document/document.jsf?text=svhc&docid=162239&pageIndex=0&doclang=EN>
- ²¹ Risk Management Option Analysis (RMOA) – ECHA, <http://echa.europa.eu/addressing-chemicals-of-concern/substances-of-potential-concern/rmoa>
- ²² [REACH — Identification of certain respiratory sensitisers as substances of very high concern](#) Doc1
- ²³ [REACH — Identification of certain respiratory sensitisers as substances of very high concern](#) Doc2

Appendix 5. Examples of REACH Impacts

Appendix 5.1 Generic examples

Appendix 5.1.1 REACH Impacts on direct DoD activities

1. Import and use of any chemical or component to a base in Europe, when brought in by military transport or ship (including bringing into a port and shipping overland by military or common carrier to the base)
 - a. Not covered by REACH as it is not placed onto the market in Europe or used within the customs territory of the EU. No impact provided it does not go through customs.
2. Metal finishing chemicals (chromate conversion and chromated primers) are purchased from a European vendor for O-level maintenance of equipment stationed in the EU.
 - a. Covered under REACH. This means that
 - i. The chemical must be registered by the importer if he brings in >1 tonne of the chemical per year. If the imported quantity is < 1 tonne, then it does not need to be registered.
 - ii. If registered, it can only be used for applications for which it is registered.
 - iii. Since it contains Annex XIV substances it is subject to the REACH restrictions (see item a and c. above). It is not subject to authorization
 - b. Since it contains a substance (Cr^{6+}) that will almost certainly be a restricted Annex XIV chemical, it is subject to REACH authorization and restrictions.
 - c. If a non-toxic alternative is developed the chromated primer could be highly restricted or banned, making it unavailable from any European supplier.
3. Purchase in Europe of Cd-plated fasteners for an Army vehicle
 - a. Not permitted. Since REACH controls substances by use as well as by material, a Cd plated fastener cannot be bought for use in a vehicle. [REACH Annex XVII, #23 paragraph 6b].
 - b. Note that there is no lower limit, such as wt% that applies to Cd plating.
4. Purchase in Europe of Cd-plated fasteners for an Army helicopter
 - a. Permitted. Cd plating is allowed for aerospace use. [REACH Annex XVII, #23 paragraph 7].
 - b. However, this rule is to be revised periodically with the expectation that an alternative will be found, in which case aircraft will no longer be exempt.
5. Aluminum aircraft panels that are chromate converted and chromate primed are shipped to a US military base through commercial channels
 - a. Since the item has entered the market it is subject to REACH
 - b. in addition to the general authorization requirements for SVHCs (chromates will almost certainly be included in Annex XIV), the use of SVHCs in surface treatments on articles must be authorized (for that use) if the restricted materials (in this case Cr^{6+}) exceed 0.1wt% of the item and are imported or manufactured at a rate > 1 tonne/yr of SVHC.
 - c. If the primer contains 20wt% strontium chromate and has a thickness of 0.001" on a panel 0.060" thick = approx 0.2 wt% chromate. If the total annual imported weight of chromate is > 1 tonne then the ECHA must be notified. However, 1 tonne of chromate would mean 1.4 million square feet of panel – hardly a likely occurrence.
 - d. Thus the material would have to be authorized in general, but ECHA would not have to be notified.
6. European vendor-performed maintenance or machining tasks off-base in Europe.
 - a. Covered under REACH. Once the item leaves the base it is considered "placed on the market", even though it is not for sale. Thus
 - i. If registered, it can only be used for applications for which it is registered.

- ii. If it contains Annex XIV substances, it is subject to the REACH restrictions (see item 2.a and 2.c. above).
 - iii. If maintenance procedures require the use of chromating, chromate priming, chromate conversion, Cd plating, etc., then these uses must be authorized
 - iv. If maintenance requires any use of Cd-plated bolts, and the component is not for aerospace use, then work on it would be illegal.
7. Use of military equipment on public roads, ports or airfields in the EU. Transfer of chemicals or components by road across Europe.
 - a. No impact. Chemicals in transit are excluded from REACH.
 8. Emissions from vehicle or aircraft engines in Europe.
 - a. No likely impact. Emissions from vehicle engines are explicitly excluded from REACH. GTE emissions are not explicitly excluded, but would be hard to justify given that internal combustion engines are excluded.

Appendix 5.1.2 REACH impacts on military equipment OEMs and vendors in Europe

1. US military equipment sales to EU defense departments (see Section Appendix 5.1.1)
 - a. All equipment is covered by REACH, except in countries whose defense departments have obtained exemptions. Exemptions must, in any case, be limited and specific. (Note: Not all EU countries have provisions for defense organizations.)
 - b. The primary issues are REACH rules on articles, fluids used in the system, and maintenance chemicals
 - c. The total article tonnage will exceed 1 tonne/yr, since each aircraft exceeds this, but the weight of specific chemicals may be very small
 - d. Chromate primer will almost always be < 0.1 wt% of any complete system, but may be a larger percentage of some articles
 - e. Thus use of SVHCs on articles will seldom require ECHA notification
 - f. Cd can be used, for the time being, on aircraft components and fasteners, but not on road vehicles, although military vehicles may be exempt. This may pose a problem for support equipment. It could well be successfully argued that any piece of support equipment is not a road vehicle, and is in any case, an “article used in the aerospace industry” (the rule does not specify that it must actually be an aircraft)
 - g. Some of the fluids in the aircraft may be subject to authorization, such as hydraulic fluids, greases and oils.
 - h. The manufacturer must keep track of all potential SVHCs on the aircraft, and any substances that are likely to become classified as substances intended to be released. They must know the location and weight of each material and component. Note that the rules and interpretations could very well change, so SVHCs should be tracked even if they are well below the 0.1 wt% threshold.
2. Military equipment components manufactured for the F-35 fighter in the EU countries
 - a. A significant percentage of F-35 components are manufactured in EU countries
 - b. Exported items are specifically included under the REACH statutes **[Article I (7)]**
 - c. All of the rules pertaining to articles are therefore in force (Section Appendix 4.6.3)
 - d. In addition, the use of SVHCs in production must be authorized where required, even if the SVHCs do not end up on the product (chrome plating chemicals, for example).
3. US military equipment sales to EU non-defense market segments (such as for police use)
 - a. The same rules are in force as for sales to EU defense departments except

- i. There are no military exemptions. This means that any item sold for both defense and non-defense work must in reality ignore any defense exemptions
 - ii. Because non-defense items are more broadly distributed among the population, non-defense use could in some circumstances trigger demands from citizens for details on SVHC substances used on components.
- 4. Sales of spares and parts for military equipment sold to EU entities
 - a. Since these items are “placed on the market” in the EU, of the rules for articles are in force, which frees them from most of the REACH provisions
 - b. Because these components are smaller than complete systems, the 0.1% rule is more likely to be met, but annual tonnages less likely.
- 5. Export of maintenance cleaners and chemicals to EU entities
 - a. These materials are generally classified as Preparations and must meet all the requirements for preparations.
 - b. This includes paint touch-up kits, chromate pens and other low volume SVHC-containing items.
- 6. Availability of Cd plating and chromating chemicals in the US
 - a. Given the cost and complexity of registering and authorizing chemicals containing such SVHCs as Cd and Cr⁶⁺, we should expect that only those with a sufficient market will continue to be offered in Europe.
 - b. Since DoD is a relatively low-volume user of finishing chemicals, the remaining worldwide market size for some of these formulations may well be too small to be worth supplying. This could well mean that some of these formulations will cease to be produced, or the number of suppliers will drop, or the price will increase significantly in order to make them sufficiently profitable to be worth manufacturing.
- 7. Use of leaded solder worldwide
 - a. No impact. Metallic Pb is not covered under REACH. If it becomes covered in the future, it is unlikely that restrictions will be any less onerous than those already in the RoHS rules.

Appendix 5.1.3 Sale of a US Aircraft into the EU

An idea of the potential impact of REACH and its requirements can be gained by considering what it will take to comply with REACH when selling a major export weapon system, such as the F-35, into the European market.

For the purpose of carrying evaluating the impact, let us assume that a manufacturer sells an aircraft into the EU that has the following statistics (these numbers are intended purely for illustration):

- Empty weight 20,000 lb airframe (9 tonnes)
- Engine weight 10,000 lb (4.5 tonnes)
- At peak production 50 aircraft will be sold annually into the EU (675 tonnes total)
- Aluminum alloys 25 wt% or airframe (175 tonnes/yr)
- Composites 15 wt % (105 tonnes/yr)
- Steels 25 wt% (175 tonnes/yr)
- Ti alloys 10 wt% (70 tonnes/yr)
- Ni superalloys (engine)
- BeCu bushings 100lb/aircraft (2 tonnes/yr)
- Coatings and surface treatments: Cr-free interior primer and paint, chromate conversion coatings on Al, Cd on landing gear (chromated), HVOF WC-Co, low observable (LO) coating on outer mold line.
- Supplied with all required fluids (hydraulics, oils and greases, fuel)

- ☐ Includes maintenance chemicals – cleaners, touch-up kits, etc.

These numbers are summarized in Table 13. With the recent EU court decision affirming “once an article always an article”, each component of the aircraft would need to be evaluated separately

Table 13. Calculation of weights in weapon system (double-click in table to change numbers).

Item	Weight (lb)	wt %	Weight (tonne)	Max annual weight (tonne)	Max annual EU sales	Notes
Airframe	20000		9.1	454	50	
Engine	10000		4.5	227		
Airframe alloys:						
Al alloys		25%	2.3	114		
Composites		15%	1.4	68		
Steels		25%	2.3	114		
Ti alloys		10%	0.9	45		
Ni alloys		80%	3.6	182		
BeCu bushings	100	0.33%	0.045	2.3		2% Be
Primer	15	0.05%	0.007	0.3		25% Chromate
Topcoat	15	0.05%	0.007	0.3		

The manufacturer has the following obligations under REACH:

- Evaluate the chemistry of all materials exceeding an annual sale of >1 tonne to ensure that all substances with an annual import weight >1 tonne have been properly registered for use in those materials. This will usually have been done by the manufacturers. (Note that, while the alloying elements must be registered for use in alloys, the alloys themselves do not need to be registered since they are not intended for release.) On an aircraft there are many uses of substances that are very different from uses that would have been registered in normal consumer items. For example, zirconia would be registered for use in jewelry, but the manufacturer must ensure that it is also registered for use as a thermal barrier coating if the annual weight of zirconia exceeds 1 tonne. **Note that registration of materials >1 tonne per year, and their uses, is required even when those materials are benign.**
- For any materials or uses have not been registered, the manufacturer must hire an EU agent to carry out the registration. This requires the development of toxicological data and an SDS (usually with other manufacturers). The cost of this to the manufacturer is highly variable depending on how many other companies would share the cost.
- The location of all potential SVHCs throughout the aircraft must be known, including the chemistry and weight of all components that contain them, so as to be able to provide the annual imported weight of all potential SVHCs and their proportion of the total weight of the aircraft as well as of any component on which they are used. SVHCs will include, not just materials likely to be placed in Annex XIV in the next 5 years, but any materials that are at all likely to be included in Annex XIV over the life of the aircraft, such as

- Cd, Cd plate, Be, Cr⁶⁺ compounds, Pb, Ni, Co, Zn, PTFE, nanophase materials, explosive materials, propellants, Hg, crystalline silica
- Once any SVHC is placed in Annex XIV, it must be authorized for use in the applications where it is present in the aircraft, if the system is to continue to be sold or used. While the aircraft is still being produced and sold the manufacturer and the EU users will together be responsible for obtaining authorization. **Note that for SVHCs there is no lower limit on either the percentage in the system or the annual weight imported or sold.** Any EU government may create a defense exemption, but that exemption must be specific, not general, and since there is no EU-wide exemption, country-by-country exemptions are of little use to the manufacturer.
- On any SVHC being placed into Annex XIV the manufacturer must inform all downstream users, and advise them on how to handle the material. This is especially important for materials that might be encountered in sustainment.
- If any SVHC exceeds 1 tonne per year and 0.1% of the aircraft weight the ECHA must be notified. We see that from Table 13 that, even though BeCu bushings would meet both of these criteria, the actual SVHC (Be) does not. The use of chromates in conversion coatings or primers would also have to be authorized if chromates are placed in Annex XIV, but again ECHA would not need to be notified of their use in this specific aircraft.
- If the LO coating contains material that becomes designated as an SVHC, this use would also be required to be authorized. Since this information is classified it would be intended to be held confidential. However, the EU reserves the right to release confidential information to another government or a third party, in the case of an emergency or to protect health and the environment. A crash of the aircraft could well be deemed to constitute such an emergency. **This is a major issue for LO materials.**
- The same rules apply to spare parts. In this case, since the items are imported individually, the relevant weights and percentages are calculated based on spare part weight and volume.
- Any maintenance chemicals, paints, fluids, lubricants, etc. follow the rules for preparations. Since they are on the original aircraft they will already have been registered or authorized as necessary.
- REACH rules may not permit the same maintenance procedures and chemicals as are permitted in the US. There could be an issue, for example, with using hard chrome plating for maintenance since the use in Europe of chrome plating solution, which contains chromic acid, will have to be authorized.
- REACH rules also, of course, cover the manufacture of aircraft components by EU companies, as is the case with the F-35. For EU-manufactured components the same rules apply as for imports, with the exception that any manufacturing processes that use SVHCs will require authorization under REACH. This may make it impossible for some components to be manufactured in Europe.
- Authorization is intended to be a prelude to restriction and banning of SVHCs. The manufacturer must assume that any authorized material will be banned as soon as a viable alternative is developed. This means that the manufacturer must pre-emptively seek clean alternatives and test and qualify them as replacements so as to be able to replace SVHCs without jeopardizing flight safety. The alternative must be registered if its weight will exceed 1 tonne per year.
- The manufacturer must maintain the databases and infrastructure to respond to requests for information on all substances in the aircraft. Since such a weapon system is not a consumer item, these requests should only be from European defense agencies and companies involved in maintenance. However, a far larger number of requests could be generated if any of the

aircraft were to be stationed on public airports, as military aircraft often are in the US. The cost of maintaining this infrastructure is unknown, and will not become clear for some years.

From the above we see that there is a great deal of uncertainty over what materials will require authorization, how long existing materials can be used, and the costs of compliance. For a manufacturer this makes it very difficult to predict the potential risks and costs, since the manufacturer is left with open-ended potential costs of unknown magnitude. All the while the aircraft are in service the manufacturer has an ongoing responsibility to provide information to users on any material that becomes classified as an SVHC, even though his responsibility for SVHC replacement presumably ends when the last aircraft is sold.