

DELL CONTROLLED PRINT



Materials Restricted for Use

Document Number: ENV0424
Revision: A03-00

Author: Frans Loen
Owner: Frans Loen

Approval Authorities	Approval Signatures	Revision	Approval Date
Maureen Martinez	Maureen Martinez	A01-00	09/23/2015
Stephen Greene	Stephen Greene	A02-00	03/17/2017
Markus Stutz	Markus Stutz	A03-00	01/03/2018

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1. Revision History

Rev.	PCO #	Revision Description	Approved	Date
A00	PCO29189	Initial Release converted over from 6T198	Matt Marshall	May 2015
A01	PCO30586	<p>Scope: Communication of compliance uses Agile PG&C instead of N6685.</p> <p>References: Added legal as well as ecolabel references.</p> <p>Definitions: A definition of halogenated plastics has been re-introduced.</p> <p>Table 1:</p> <ol style="list-style-type: none"> 1. Dioctyltin (DOT) compounds: Reduced scope of restriction to align with EU REACH. 2. HBCDD: Lowered threshold to 100ppm (proposed EU POPs regulation) 3. Removed Perchlorate. 4. Added Red Phosphorous. <p>Table 2 and Table 3:</p> <ol style="list-style-type: none"> 1. Merged into a single table, requiring reporting of all substances at the homogeneous material level (following judgment by the European Court of Justice). 2. Packaging restrictions: Removed restriction on expanded polystyrene (EPS foam). Added a restriction on free-rise polyurethane based foam-in-place. 3. Battery restrictions: Deleted Mercury exemption for button cell batteries. 4. Supplier declaration process: Communication of compliance uses Agile PG&C instead of N6685. <p>Appendix A: Deleted exemptions 7(b) and 8(b).</p>	Maureen Martinez	09/27/15
A02	PCO34984	<p>Table 1 - Banned or Restricted Substances</p> <ol style="list-style-type: none"> 1. Chromium VI and its compounds - metallic and non-metallic applications unified under a single threshold of 1000 PPM 2. Lead and its compounds – “frequently handled” added to restriction on cable jacketing material for external cables. 3. BNST - Exemption added for EMC BNST permit for sale of product into Canada in 2016 and 2017 for any legacy EMC parts designed before 2015. 4. Dibutyltin (DBT) compounds – “Threshold relates to the mass of tin” added to explanation. 5. Hexabromocyclododecane (HBCDD) and all major diastereoisomers – “Substances may not 	Stephen Greene	3/14/17

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		<p>be intentionally added to parts/product.” added to explanation for threshold in Japanese Law concerning the Examination and Regulation of Manufacture etc. of Chemical Substances (Class 1 chemical substances).</p> <p>6. Polycyclic Aromatic Hydrocarbons (PAH) – Specification changed from 64MNT to specification ENG0014187 (additional information on PAH and German Safety Mark).</p> <p>7. Red Phosphorous – “Restriction applies to Red Phosphorous flame retardants in molding compounds.” added to clarify specific applications where substance is banned.</p> <p>Table L - Brominated/Chlorinated flame retardants/additives (other than PBBs, PBDEs, HBCD and HBCDD)</p> <p>8. HBCD and HBCDD now excluded from list of BRF because the substances are restricted in Table 1</p> <p>9. Four CFR added:</p> <ol style="list-style-type: none"> 38051-10-4, Tetrakis(2-chloroethyl) dichloroisopentylidiphosphate 13674-84-5, Tris(1-chloro-2-propyl)phosphate 66108-37-0, Tris(2,3-dichloro-1-propyl)phosphate No CAS, Chlorinated Flame Retardants (CFR), Other Chlorinated Retardants Flame 		
A03	PCO37551	<p>Introduction, references: updated legal references</p> <p>Table 1</p> <ol style="list-style-type: none"> Removed exemption for EMC BNST permit for sale of product into Canada in 2016 and 2017 PFOA and its salts added (including references in Table W, new) <p>Table 2</p> <ol style="list-style-type: none"> Added 1,2-benzenedicarboxylic acid, di-C6-10-alkyl esters; 1,2-benzenedicarboxylic acid, mixed decyl and hexyl and octyl diesters with ≥ 0.3% of dihexyl phthalate (EC No. 201-559-5), 68515-51-5 and 68648-93-1 Added , 1,3-propanesultone, 1120-71-4 Added 2-(2H-benzotriazol-2-yl)-4-(tert-butyl)-6-(sec-butyl)phenol (UV-350), 36437-3-37 		01/03/2018

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		4. Added 2-(2H-benzotriazol-2-yl)-4,6-ditertpentylphenol (UV-328), 25973-55-1		
		5. Added 2-ethylhexyl 10-ethyl-4,4-dioctyl-7-oxo-8-oxa-3,5-dithia-4-stannatetradecanoate (DOTE), 15571-58-1		
		6. Added 2,4-di-tert-butyl-6-(5-chlorobenzotriazol-2-yl)phenol (UV-327), 3864-99-1		
		7. Added Cadmium oxide, 1306-23-06		
		8. Added CAS 12267-73-3 to the entry on Disodium tetraborate, anhydrous		
		9. Added Disodium 3,3'-[[1,1'-biphenyl]-4,4'-diylbis(azo)]bis(4-aminonaphthalene-1-sulphonate) (C.I. Direct Red 28), 573-58-0		
		10. Added Disodium 4-amino-3-[[4'-[(2,4-diaminophenyl)azo][1,1'-biphenyl]-4-yl]azo]-5-hydroxy-6-(phenylazo)naphthalene-2,7-disulphonate (C.I. Direct Black 38), 1937-37-7		
		11. Added [Phthalato(2-)]dioxotrilead, 69011-06-9		
		12. Added Dioxobis(stearato)trilead, 12578-12-0		
		13. Added Fatty acids, C16-18, lead salts, 91031-62-8		
		14. Imidazolidine-2-thione; (2-imidazoline-2-thiol), 96-45-7		
		15. Added Lead chromate, 7758-97-6		
		16. Added Lead chromate molybdate sulphate red (C.I. Pigment Red 104), 12656-85-8		
		17. Added Lead cyanamidate, 20837-86-9		
		18. Added Lead dinitrate, 10099-74-8		
		19. Added Lead oxide sulfate, 12036-76-9 Lead sulfochromate yellow (C.I. Pigment Yellow 34), 1344-37-2		
		20. Added Lead titanium zirconium oxide, 12626-81-2		
		21. Added Nonadecafluorodecanoic acid (PFDA) and its sodium and ammonium salts, 335-76-2, 3830-45-3 and 3108-42-7		
		22. Added Pentalead tetraoxide sulphate, 12065-90-6		
		23. Added Perfluorohexane-1-sulphonic acid and its salts, 355-46-4, 68259-08-5, 3871-99-6 and 2923-26-4		

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		<p>24. Added Perfluorononan-1-oic-acid and its sodium and ammonium salts, 375-95-1, 4149-60-4 and 21049-39-8</p> <p>25. Added Pyrochlore, antimony lead yellow, 8012-00-8</p> <p>26. Added reaction mass of 2-ethylhexyl 10-ethyl-4,4-dioctyl-7-oxo-8-oxa-3,5-dithia-4-stannatetradecanoate and 2-ethylhexyl 10-ethyl-4-[[2-[(2-ethylhexyl)oxy]-2-oxoethyl]thio]-4-octyl-7-oxo-8-oxa-3,5-dithia-4-stannatetradecanoate (reaction mass of DOTE and MOTE), no CAS #</p> <p>27. Added Silicic acid (H₂Si₂O₅), barium salt (1:1), lead-doped, 68784-75-8</p> <p>28. Added Strontium chromate, 7789-06-2</p> <p>29. Added Sulfurous acid, lead salt, dibasic, 62229-08-7</p> <p>30. Added Trilead dioxide phosphonate, 12141-20-7</p> <p>31. Added Trixylyl phosphate, 25155-23-1</p> <p>Table 4, packaging restrictions: added Formaldehyde, 50-00-0</p> <p>Appendix A:</p> <ol style="list-style-type: none"> 1. Deleted exemption 5(a) 2. Added time limitation date for exemption 6(a), added exemption 6(a)-I 3. Added time limitation date for exemption 6(b), added exemptions 6(b)-I and 6(b)-II 4. Added time limitation date for exemption 13(b), added exemptions 13(b)-I, 13(b)-II and 13(b)-III <p>Appendix B: added Table W as reference for the new Table 1 entry on PFOA and its salts</p> <p>Appendix C: updated reference to Dell BFR/CFR/PVC-Free Specification</p>		

2. Introduction

Dell Technologies' vision is to avoid the use of substances in its products that could seriously harm the environment or human health and to ensure that we act responsibly and with caution. Dell Technologies material restrictions are based on consideration for legal requirements, international treaties and conventions, and specific market requirements.

This specification lists substances banned or restricted for use in Dell Technologies products and in the manufacture of Dell Technologies products. If restricted substances are introduced and/or detected in products, potential courses of action may include developing corrective actions to requalify parts to meet this specification, delaying the launch of products and/or removing non-compliant suppliers from the Dell Technologies approved vendor lists.

2.1 Purpose

To communicate to Dell Technologies design teams and suppliers materials restrictions required for parts in all Dell Technologies-branded products. The specification should be used when selecting materials for product parts and packaging.

2.2 Scope

All *parts* in Dell Technologies-branded products that are supplied to Dell Technologies and/or designed by Dell Technologies Inc. must meet this specification. Compliance with this specification is communicated to Dell via Supplier Declaration of Conformity (SDoC) which will be uploaded into Dell Technologies compliance systems. The scope includes all of the components, parts, assemblies, batteries and packaging of each product. The restricted substances cannot be contained in the product and its components above the designated thresholds for the controlled applications listed in Section 3. Some restrictions also apply to the manufacturing of components or products.

2.3 References

Dell Specifications:

1. Dell P/N ENV0199, Dell BFR/CFR/PVC-Free Specification (formerly "halogen-free")
2. Dell P/N ENG0014187, Dell Regulatory Critical Components Peripheral Guide Sheets
3. Regulatory Quality Procedure – RQP4.10/004

European Union Regulations / Directives / Decisions:

4. Regulation of the European Parliament and of the Council on the Registration, Evaluation, Authorization and Restriction of Chemicals, 1907/2006/EC, December 2006 (REACH Regulation)
5. Directive of the European Parliament and of the Council on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment, 2011/65/EU, June 2011 (RoHS Directive) and 2015/863/EU, June 2015 (addition of four phthalates)
6. Regulation of the European Parliament and of the Council on persistent organic pollutants (EU No 519/2012)
7. Regulation of the European Parliament and of the Council on certain fluorinated greenhouse gases, 842/2006, May 2006
8. Regulation of the European Parliament and of the Council on substances that deplete the ozone layer (EC) No. 1005/2009
9. Directive of the European Parliament and of the Council on Packaging and Packaging waste, 94/62/EC, December 1994 (Packaging Directive)

10. Directive 2006/66/EC of the European Parliament and of the Council on Batteries and Accumulators and Waste Batteries and Accumulators, September 2006 (Battery Directive)
11. Directive 2012/19/EU of the European Parliament and the Council on Waste Electrical and Electronic Equipment, July 2012 (WEEE directive)
12. Commission Decision 2009/251/EC requiring Member States to ensure that products containing the biocide dimethylfumarate are not placed or made available on the market, March 2009

Other Reduction of Hazardous Substance Regulations outside of European Union:

13. Restriction of Hazardous Substances (RoHS) in Electrical and Electronic Equipment (EEE) in Singapore (Singapore RoHS)
14. Guidance to reduction of the restricted chemical substances in electrical and electronic equipment, CNS15663 (Taiwan RoHS)
15. Regulating the permitted limits for a number of hazardous substances in electric and electronic products, in Circular 30/2011/TT-BCT (Vietnam RoHS)
16. E-Waste (Management & Handling) Rules, Ministry of Environment & Forests, Government of India (India RoHS)
17. Management Methods for Control of Pollution Caused by Electronic and Electrical Products in China (China RoHS)
18. Technical Regulation on restrictions as to the use of some dangerous substances in electric and electronic devices (Ukraine RoHS)
19. The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (Turkey RoHS)

Other Regulations / Standards by Country:

20. Austria - BGB - 1990/194: Formaldehydverordnung, §2, 12/2/1990
21. Canada Prohibition of Certain Toxic Substances Regulations, 2012 (SOR/2012-285)
22. Canadian Environmental Protection Act SOR/SOR/2008-178
23. California Safe Drinking Water and Toxic Enforcement Act of 1986 (Section 25249.5- 25249.13 of the California Health and Safety Code), commonly referred to as “California Proposition 65”
24. California Electronic Waste Recycling Act SB 20, amended by SB 50 and AB 575
25. China CEC technical requirement for environmental labeling products for computers and displays
26. Geprüfte Sicherheit for ProdSG / Safety Mark certification for German Product Safety
27. Japanese Law concerning the Examination and Regulation of Manufacture etc. of Chemical Substances (Class 1 chemical substances)
28. Japan revised Law for Promotion of Effective Utilization of Resources (J-MOSS)
29. Japanese Law Concerning the Protection of the Ozone Layer through the Control of Specified Substances and others
30. Japan Law Concerning Prevention from Radiation Hazards, 1986
31. Japan Mercury Law
32. Norway Product Regulations FOR-2004-06-01-922
33. 1990 revision of Article 611 of the US Clean Air Act
34. American Apparel & Footwear Association (AAFA) Restricted Substance List
35. EPA Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)
36. U.S. Consumer Product Safety Improvement Act

37. U.S. Nuclear Regulatory Commission Title 10 CFR Part 20 (Appendix C)
38. United States: Toxic Substances Control Act (TSCA)
39. IEC62474 Material Declaration for Products of and for the Electrotechnical Industry
40. IEEE 1608.1 Standard for Environmental Assessment of Personal Computer Products, Including Notebook Personal Computers, Desktop Personal Computers, and Personal Computer Displays, March 2010
41. TCO Development: TCO Certified Desktops; TCO Certified Displays; TCO Certified Notebooks; TCO Certified Projectors; TCO Certified Tablets

2.4 Definitions

Agile PG&C: Compliance system used to combine compliance data from suppliers with product bills of materials.

Antimicrobial: An agent that prevents or inhibits microorganisms

Article: Object which during production is given a special shape, surface or design which determines its function to a greater degree than does its chemical composition (e.g. all Dell parts and products are classified as Articles).

Assembly: An integrated set of components. A populated printed circuit board is an assembly and not a component because individually functioning components can be removed.

CAS #: Chemical Abstract System numbers are assigned to chemicals for unique identification. The CAS numbering system is an international convention. For example, the CAS# for lead is 7439-92-1.

Component: a combination of homogenous materials that have been formed into a single manufactured mechanical or electrical part. Examples of components may include microprocessors, plastic enclosures, coin cell batteries, capacitors, etc. Sub-assemblies and semi-finished goods are not considered components. Examples of sub-assemblies/semi-finished goods may include populated motherboards/daughter cards, power supplies and adaptors, hard drives, tape drives, mouse, etc.

External cables: cables and cords that are likely to be accessible to the consumer during ordinary use

Halogenated plastics: Plastics/polymers that contain or are treated with one or more of the following elements: fluorine, chlorine, bromine, iodine, and/or astatine. Examples include, but are not limited to, polyvinyl chloride (PVC) and tetrafluoroethylene (TFE, "Teflon").

Homogenous material: one material of uniform composition throughout or a material, consisting of a combination of materials, that cannot be disjointed or separated into different materials by mechanical actions such as unscrewing, cutting, crushing, grinding and abrasive processes.

Mechanical plastic part: plastic parts that do not internally carry an electrical signal such as housings, brackets, bezels, latches, etc. that form the basic structure of the product and/or have mechanical functions. Plastic parts such as fans, connectors, printer fuser assemblies, etc. are not considered "mechanical plastic parts" in the context of this specification.

Non-compliance: A failure to meet the requirements of the specification. Non-compliance requires corrective action.

Non-electrical/Non-electronic parts and products (Dell Technologies-Branded): Electricity is not required to operate these parts and products. Examples include, but not limited to, apparel products (e.g. shirts, pants, hats...), stationary products (e.g. pens, pencils, erasers, staplers, key chains, paper pads and notebooks ...), office equipment accessories (e.g. computer bags, locks, mouse pads...) and toys. Packaging materials are excluded from this definition.

Not detectable: a substance in a part or homogenous material is not detected at the lowest detectable limit using standard analytical techniques.

Packaging: Materials used to protect products from damage due to storage or transportation (e.g., boxes, shipping supplies, cushioning & foam, bags, shrink wrap, tape/adhesives). Includes inks and dyes used to label packages.

PPM: parts per million, unit of measurement for weight percentage. 1 ppm = 1 mg/kg = 0.0001 % by weight.

Prolonged skin contact: Skin contact for longer than 30 seconds

RoHS substances: Those substances restricted under the European RoHS Directives 2011/65/EU and 2015/863/EU and other RoHS-type legislation (China, India, Turkey, Ukraine, etc.), including cadmium, chromium VI, lead, mercury, polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE).

Solder (in reference to the RoHS exemption for lead in solders for servers, storage and networking products): alloys used to create metallurgical bonds between two or more metal surfaces to achieve an electrical and/or physical connection". In this context, the term 'solder' also includes all materials that become part of the final solder joint, including solder finishes on components or printed circuit boards.

Substance: a chemical element and its compounds in the natural state or obtained by any manufacturing process, including any additive necessary to preserve its stability and any impurity deriving from the process used, but excluding any solvent which may be separated without affecting the stability of the substance or changing its composition

Threshold Limit: the maximum concentration at which a restricted substance can be present or above which a declarable substance needs to be reported.

3. Product Content Restrictions

3.1 Material Restriction Requirements

Table 1 lists substances that Dell Technologies has banned or restricted. For each listed substance, a threshold limit has been established to account for unavoidable impurities consistent with regulatory requirements. Table 1 also lists allowed exemptions and references to specific restricted substances and CAS numbers (Appendix B). Refer to Appendix C for substance testing protocols and requirements. Compliance with this specification is communicated to Dell Technologies via Supplier Declaration of Conformity (SDoC).

TABLE 1 - Banned or Restricted Substances

Substance	Threshold Limit (mg substance / kg homogenous material =ppm)	Explanations / Exemptions / Effective dates	Reference Appendix B / CAS #
Cadmium and its compounds	100	See Appendix A for applicable RoHS exemptions.	Table B
Chromium VI and its compounds	1000		Table D
Mercury and its compounds	1000	See Appendix A for applicable RoHS exemptions.	Table G
Polybrominated Biphenyls (PBB)	1000		Table I
Polybrominated Diphenyl Ethers (PBDE)	1000		Table I
Lead and its compounds	300	Restriction applies only to lead and compounds in cable jacketing material of frequently handled external cables.	Table F
	1000	Restriction applies for all other lead applications. See Appendix A for applicable RoHS exemptions.	Table F
Alkanes C10-C13, chloro, Short Chained Chlorinated Paraffins (SCCP)	1000		Table S
Alkanes C14-C17, chloro, Medium Chain Chlorinated Paraffins (MCCPs)	1000		Table S
Antimony and its compounds	1000	Restriction applies to mechanical plastic parts above 25 grams.	Table V
Asbestos and its compounds	Not detectable		Table A
Azocolorants and Azodyes	30	Restriction only applies to textile and leather articles that may come into direct and prolonged contact with the human skin or oral cavity.	Table K

TABLE 1 - Banned or Restricted Substances

Substance	Threshold Limit (mg substance / kg homogenous material =ppm)	Explanations / Exemptions / Effective dates	Reference Appendix B / CAS #
Benzenamine N-phenyl, reaction products with styrene and 2,4,4-trimethylpentene (BNST)	Not detectable		68921-45-9
Brominated/Chlorinated flame retardants (excluding PBB, PBDE)	1000	Restriction applies to mechanical plastic parts; plastic parts greater than 25 grams and products designated as Halogen Free or BFR/CFR-Free. Exemption applies to internal plastic components such as circuit boards, electronic components, fans, cables, printer fuser assembly and electrical assemblies contained in Dell products unless designated as Halogen Free or BFR/CFR-Free products.	Table L
Diarsenic pentaoxide	1000	Semiconductors exempt.	1303-28-2
Diarsenic trioxide	1000	Semiconductors exempt.	1327-53-3
Dibutyltin (DBT) compounds	1000	Threshold relates to the mass of tin.	Table T
Diocetyl tin (DOT) compounds	1000	Restriction applies to (a) textile and leather articles intended to come into contact with the skin, (b) childcare articles, (c) two-component room temperature vulcanization molding kits (RTV-2 molding kits).	Table T
Dimethyl Fumarate (DMF)	0.1		624-49-7
Fluorinated greenhouse gases (GHG) (HFC, PFC, SF6)	Not detectable	Restriction applies to both manufacturing processes and products.	Table Q
Formaldehyde	Not detectable	Restriction only applies to wood products.	50-00-0
Hexabromocyclododecane (HBCDD) and all major diastereoisomers	100	Substances may not be intentionally added to parts/products.	25637-99-4; 3194-55-6
Nickel and its compounds	1000	Metallic nickel or nickel alloy exempt in all applications except external chassis/case parts likely to result in prolonged skin exposure. No exemptions for organo-nickel compounds.	Table H
Ozone depleting substances (Class I & Class II CFCs and HCFCs)	Not detectable	Non-Class I or Class II ozone depleting substances. Restriction applies to both manufacturing processes and products.	Table C, E

TABLE 1 - Banned or Restricted Substances

Substance	Threshold Limit (mg substance / kg homogenous material =ppm)	Explanations / Exemptions / Effective dates	Reference Appendix B / CAS #
Perfluorooctane sulfonates (PFOS), C8F17SO2X (X = OH, metal salt (O-M*), halide, amide, and other derivatives including polymers)	Not detectable	Photoresists or anti-reflective coatings for photolithography processes, photographic coatings applied to films, papers or printing plates exempt.	Table O
Perfluorooctanoic Acid (PFOA) and its salts; Pentadecafluorooctanoic acid	25 ppb	Restriction effective by February 1, 2019 for newly launched Dell parts and by July 1, 2019 for all sustaining products	335-67-1 Table W
Phenol,2-(2H-benzotriazol-2-yl)-4,6-bis(1,1-dimethylethyl)-	Not detectable		3846-71-7
Phthalate: Bis (2-ethylhexyl)phthalate (DEHP)	1000		117-81-7
Phthalate: Benzyl butyl phthalate (BBP)	1000		85-68-7
Phthalate: Dibutyl phthalate (DBP)	1000		84-74-2
Phthalate: Diisobutyl (DIBP)	1000		84-69-5
Phthalate: Di-n-octyl phthalate (DNOP)	1000		117-84-0
Phthalate: Diethyl phthalate (DEP)	1000		84-66-2
Polychlorinated Biphenyls (PCBs) and Terphenyls (PCTs)	Not detectable		Table J
Polychlorinated naphthalene (PCNs)	Not detectable		Table N
Polycyclic Aromatic Hydrocarbons (PAH)	10 PPM (Sum of 18 PAH) and 1 PPM each for: Benzo[a]pyren, Benzo[e]pyrene, Benzo[a]anthracene, Chrysen, Benzo[b]fluoranthene, Benzo[j]fluoranthene, Benzo[k]fluoranthene, Dibenzo[a,h]-anthracene	Restriction applies to external plastics and soft surfaces that can experience frequent skin contact. Refer to Dell specification ENG0014187 for additional details. Concentration limit is the sum of all 18 PAHs.	Table P
Polyvinyl chloride (PVC)	1000	Restriction applies to mechanical plastic parts, plastic parts greater than 25 grams and products. Cables, connectors, electronic components, battery trays, magnetic tape, and similar non-mechanical plastic parts are exempt unless designated as Halogen Free or PVC-Free products.	9002-86-2

TABLE 1 - Banned or Restricted Substances

Substance	Threshold Limit (mg substance / kg homogenous material =ppm)	Explanations / Exemptions / Effective dates	Reference Appendix B / CAS #
Radioactive substances	Not detectable		Table R
Red Phosphorous	1000	Restriction applies to Red Phosphorous flame retardants in molding compounds.	7723-14-0
Tributyl tin (TBT), Triphenyl tin (TPT) and Tributyl Tin Oxide (TBTO) compounds	Not detectable		Table M
Tri-o-cresyl phosphate or Tricresyl phosphate (TCP)	1000	Restriction applies to mechanical plastic parts above 25 grams. Exempted in PCB laminates, electronic components and cable insulations.	78-30-8; 1330-78-5
Tris(2-chloroethyl)phosphate (TCEP)	1000		115-96-8

3.2 Material Declaration Requirements

To encourage industry alignment with IEC 62474 “Material Declaration for Products of and for the Electrotechnical Industry”, Dell Technologies is requesting supplier disclosure of the list of substances (Table 2 below). It is important to note:

1. That these substances are not currently banned or restricted in any application per this specification.
2. That the thresholds listed in Table 2 are at the homogenous material level although the regulation or standard where the substance is listed may be specified at the article or product level.

TABLE 2 – Material Declaration Requirements at Homogeneous Material Level

Substance	Threshold Limit (mg substance / kg homogeneous weight =ppm)	Examples of Use	Reference Appendix B / CAS #
Antimony and its compounds	1000	Pigment, paint, catalyst, lead free solder, stabilizer, n-type dopant, flame retardant catalyst.	Table V
1,2-Benzenedicarboxylic acid, di-C6-8-branched alkyl esters, C7-rich	1000	Plasticizer, dye, pigment, paint, ink, adhesive, lubricant.	71888-89-6
1,2-benzenedicarboxylic acid, di-C6-10-alkyl esters; 1,2-benzenedicarboxylic acid, mixed decyl and hexyl and octyl diesters with ≥ 0.3% of dihexyl phthalate (EC No. 201-559-5)	1000	Plasticisers, lubricants, adhesives, coatings, cable compounding, polymer foils, PVC compound coatings, paints, thinners, paint removers, fillers, putties, plasters, ink and toners, greases, release products, polymer preparations and compounds, and semiconductors	68515-51-5, 68648-93-1
1,2-Benzenedicarboxylic acid, dipentylester, branched and linear	1000	Plasticizer in plastic materials in specialist applications, for example where high solvating plasticizers and stain resistance are required.	84777-06-0
1,2-bis(2-methoxyethoxy)ethane (TEGDME; triglyme)	1000	Solvent may be used in battery electrolytes for lithium batteries. May be in found in printing inks.	112-49-2
1,2-Diethoxyethane	1000	Solvent used in electrolytes for lithium batteries.	629-14-1
1,2-dimethoxyethane; ethylene glycol dimethyl ether (EGDME)	1000	Solvent used in battery electrolytes for lithium batteries. May be in found in printing inks and paint strippers.	110-71-4
1,3-propanesultone	1000	Electrolyte fluid of rechargeable lithium ion batteries	1120-71-4
2-(2H-benzotriazol-2-yl)-4-(tert-butyl)-6-(sec-butyl)phenol (UV-350)	1000	UV stabilizer	36437-37-3
2-(2H-benzotriazol-2-yl)-4,6-ditertpentylphenol (UV-328)	1000	UV stabilizer	25973-55-1

TABLE 2 – Material Declaration Requirements at Homogeneous Material Level

Substance	Threshold Limit (mg substance / kg homogeneous weight =ppm)	Examples of Use	Reference Appendix B / CAS #
2-ethylhexyl 10-ethyl-4,4-dioctyl-7-oxo-8-oxa-3,5-dithia-4-stannatetradecanoate (DOTE)	1000	PVC stabilizer	15571-58-1
2,4-di-tert-butyl-6-(5-chlorobenzotriazol-2-yl)phenol (UV-327)	1000	UV stabilizer	3864-99-1
4-(1,1,3,3-tetramethylbutyl)phenol	1000	Unreacted process chemical.	140-66-9
4-Aminoazobenzene	1000	Used as yellow pigment and in inks, including inks for inkjet printers. It is also used as a dye for lacquer, varnish, wax products, oil stains and styrene resins.	60-09-3
4-Nonylphenol, branched and linear, ethoxylated	1000	Nonylphenol ethoxylates are used in paints, lacquers and varnishes in concentrations up to 10% w/w of the mixture.	-
Aluminosilicate Refractory Ceramic Fibers	1000	Thermal insulation for high temperature test equipment.	-
Ammonium pentadecafluorooctanoate (APFO)	1000	APFO is used as an emulsion stabilizer to manufacture polyvinylidene fluoride (PVDF) and other fluorinated polymers and elastomers and can be found in concentrations up to 1% w/w in these plastics.	3825-26-1
Beryllium and its compounds	1000	Ceramics, metal alloy, copper-beryllium alloy, catalyst, precipitation hardening alloy, copper-beryllium alloy for spring, solder.	Table U
Bis(2-methoxyethyl) ether	1000	Electrolyte in lithium batteries.	111-96-6
Bisphenol-A (4,4'-isopropylidenediphenol)	1000	Manufacture of polycarbonate resins (PC).	80-05-7
Boric acid	1000	In wood veneers/ pressed wooden panels as starch additive, flame retardant and stabilizer in amino-plastic resin, wood preservative, as flame retardant in wood, cotton and other plant derived material.	10043-35-3, 11113-50-1
Brominated Flame Retardant (excl. PBB, PBDE, HBCDD and TBBPA)	1000	Flame retardant use on electrical and mechanical components.	Table L
Cadmium oxide	1000	Relay contact; photodiode voltaic cell, Ni/Cd battery	1306-19-0

TABLE 2 – Material Declaration Requirements at Homogeneous Material Level

Substance	Threshold Limit (mg substance / kg homogeneous weight =ppm)	Examples of Use	Reference Appendix B / CAS #
Cadmium sulphide	1000	Used in photo-resistors, solar cells and piezoelectric transducers	1306-23-06
Chlorinated Flame Retardant	1000	Flame retardant use on electrical and mechanical components.	Table L
Cobalt dichloride	1000	Pneumatic panels to indicate water contamination.	7646-79-9
Diboron trioxide	1000	Found in wood veneers, glass/fiber optics and ceramics - for industrial applications.	1303-86-2
Dibutyltin dichloride (DBTC)	1000	Ingredient in some paint thinner and as heat stabilizer for PVC.	683-18-1
Disodium tetraborate, anhydrous	1000	In wood veneers/ pressed wooden panels as starch additive, flame retardant and stabilizer in amino-plastic resin, wood preservative.	1303-96-4, 1330-43-4, 12179-04-3, 12267-73-3
Disodium 3,3'-[[1,1'-biphenyl]-4,4'-diylbis(azo)]bis(4-aminonaphthalene-1-sulphonate) (C.I. Direct Red 28)	1000	Dye for textiles and paper	573-58-0
Disodium 4-amino-3-[[4'-[(2,4-diaminophenyl)azo][1,1'-biphenyl]-4-yl]azo]-5-hydroxy-6-(phenylazo)naphthalene-2,7-disulphonate (C.I. Direct Black 38)	1000	Used in ink for printers	1937-37-7
[Phthalato(2-)]dioxotrilead	1000	Heat stabilizer for plastics, for example for wiring and cabling insulation	69011-06-9
Dioxobis(stearato)trilead	1000	Heat stabilizer for plastics, for example for wiring and cabling insulation	12578-12-0
Hexahydromethylphthalic anhydride, Hexahydro-4-methylphthalic anhydride, Hexahydro-1-methylphthalic anhydride, Hexahydro-3-methylphthalic anhydride	1000	Primary use is as a hardener for epoxy resins.	25550-51-0, 19438-60-9, 48122-14-1, 57110-29-9
Fatty acids, C16-18, lead salts	1000	Heat stabilizer for plastics, for example for wiring and cabling insulation	91031-62-8

TABLE 2 – Material Declaration Requirements at Homogeneous Material Level

Substance	Threshold Limit (mg substance / kg homogeneous weight =ppm)	Examples of Use	Reference Appendix B / CAS #
Imidazolidine-2-thione; (2-imidazoline-2-thiol)	1000	Used as a catalyst in some acrylic adhesive glues which may be used in adhesive tapes (for example, double sided adhesive tapes which may be used to hold the back-light in place in mobile phones)	96-45-7
Lead chromate	1000	Colorant in plastics; Colorant in yellow paint	7758-97-6
Lead chromate molybdate sulphate red (C.I. Pigment Red 104)	1000	Colorant in plastics; Colorant in yellow paint	12656-85-8
Lead cyanamidate	1000	Used in anticorrosion coatings e.g. steel articles	20837-86-9
Lead dinitrate	1000	Heat stabilizer in nylon and polyesters, also used as a coating on paper for photo thermography	10099-74-8
Lead oxide sulfate	1000	Heat stabilizer for PVC used for wiring and cabling insulation	12036-76-9
Lead sulfochromate yellow (C.I. Pigment Yellow 34)	1000	Colorant in plastics; Colorant in yellow paint	1344-37-2
Lead titanium zirconium oxide	1000	In piezoelectric components, ultrasound transducers, gas igniters, ultrasonic motors, ceramic capacitors and other electronic components that use piezoelectric materials	12626-81-2
Nonadecafluorodecanoic acid (PFDA) and its sodium and ammonium salts	1000	Plasticizer, lubricant, corrosion inhibitor	335-76-2 3830-45-3 3108-42-7
N,N-dimethylformamide	1000	Used as electrolyte in electrolytic capacitors rated for low temperature use to -55C.	68-12-2
Pentalead tetraoxide sulphate	1000	Heat stabilizer for plastics; for example, non-transparent PVC	12065-90-6
Pentazinc chromate octahydroxide	1000	Colorant	49663-84-5
Perfluorohexane-1-sulphonic acid and its salts	1000	Impurity in production of PFOS and alternative for PFOS, a surfactant which can be found in protective coatings and adhesives which are resistant to water, dirt, oils etc	355-46-4 68259-08-5 3871-99-6 2923-26-4
Perfluorononan-1-oic-acid and its sodium and ammonium salts	1000	Surfactant in the production of the fluoropolymer polyvinylidene fluoride (PVDF)	375-95-1, 4149-60-4, 21049-39-8

TABLE 2 – Material Declaration Requirements at Homogeneous Material Level

Substance	Threshold Limit (mg substance / kg homogeneous weight =ppm)	Examples of Use	Reference Appendix B / CAS #
Perfluorooctanoic Acid (PFOA); Pentadecafluorooctanoic acid	1000	Applicable until January 31, 2019.	335-67-1
Phthalate: 1,2-Benzenedicarboxylic acid, di-C7-11-branched and linear alkyl esters (DHNUP)	1000	plasticizer, dye, pigment, paint, ink, adhesive, lubricant.	68515-42-4
Phthalate: 1,2-Benzenedicarboxylic acid, dihexyl ester, branched and linear	1000	plasticizer, dye, pigment, paint, ink, adhesive, lubricant.	68515-50-4
Phthalate: Di(methoxyethyl) phthalate (DMEP)	1000	plasticizer, dye, pigment, paint, ink, adhesive, lubricant.	117-82-8
Phthalate: Dihexyl phthalate (DnHP)	1000	plasticizer, dye, pigment, paint, ink, adhesive, lubricant.	84-75-3
Phthalate: Diisodecyl phthalate (DIDP)	1000	plasticizer, dye, pigment, paint, ink, adhesive, lubricant.	26761-40-0
Phthalate: Diisooheptyl phthalate (DIHP)	1000	plasticizer, dye, pigment, paint, ink, adhesive, lubricant.	71888-89-6
Phthalate: Diisononyl phthalate (DINP)	1000	plasticizer, dye, pigment, paint, ink, adhesive, lubricant.	28553-12-0
Phthalate: Diisopentylphthalate (DIPP)	1000	plasticizer, dye, pigment, paint, ink, adhesive, lubricant.	605-50-5
Phthalate: Dipentyl phthalate (DPP)	1000	plasticizer, dye, pigment, paint, ink, adhesive, lubricant.	131-18-0
Phthalate: N-pentyl-isopentylphthalate (nPiPP)	1000	plasticizer, dye, pigment, paint, ink, adhesive, lubricant.	776297-69-9
Polyvinyl Chloride (PVC)	1000	Cables, connectors, electronic components, battery trays, magnetic tape, and similar non- mechanical plastic parts.	9002-86-2
Potassium hydroxyoctaoxidizincatedichromate	1000	Paint, anti-corrosion.	11103-86-9
Pyrochlore, antimony lead yellow	1000	Used as yellow pigment for coloring plastics and paint	8012-00-8
reaction mass of 2-ethylhexyl 10-ethyl-4,4- dioctyl-7-oxo-8-oxa-3,5-dithia-4- stannatetradecanoate and 2-ethylhexyl 10- ethyl-4-[[2-[(2-ethylhexyl)oxy]-2- oxoethyl]thio]-4-octyl-7-oxo-8-oxa-3,5- dithia-4-stannatetradecanoate (reaction mass of DOTE and MOTE)	1000	PVC stabilizer	
Silicic acid (H2Si2O5), barium salt (1:1), lead-doped	1000	Used in UV emitting light bulbs and lamps	68784-75-8
Strontium chromate	1000	Pigment; corrosion resistant coating	7789-06-2

TABLE 2 – Material Declaration Requirements at Homogeneous Material Level

Substance	Threshold Limit (mg substance / kg homogeneous weight =ppm)	Examples of Use	Reference Appendix B / CAS #
Sulfurous acid, lead salt, dibasic	1000	Heat stabilizer for PVC, for example for wiring and cabling insulation	62229-08-7
Tetrabromobisphenol A (TBBPA) additive and reactive	1000	Flame retardant used in PCB Laminates and other electrical components.	30496-13-0
Trilead dioxide phosphonate	1000	Heat stabilizer for PVC, for example for wiring and cabling insulation	12141-20-7
Trixylyl phosphate	1000	Used as a plasticizer for vinyl resin, cellulose resin, natural and synthetic rubber. Also, used as a flame retardant	25155-23-1
Zirconia Aluminosilicate Refractory Ceramic Fiber	1000	Thermal insulation for high temperature test equipment.	-

3.3 BFR/CFR/PVC-Free “Halogen Free” Requirements

All parts and/or products designed to satisfy “halogen-free” requirements must satisfy Dell Technologies’s BFR/CFR/PVC-Free Specification (formerly “Dell Halogen-Free Specification”), p/n ENV0199 (in Agile) in addition to this specification. Parts and/or products without a “halogen-free” requirement are not required to comply with ENV0199 but with this specification.

4. Product Packaging Content Restrictions

Table 4 lists substances that Dell Technologies has banned or restricted in product packaging materials supplied to or designed by Dell Technologies Inc. These substances cannot be used in the manufacturing of or contained in product packaging materials supplied to or designed by Dell Technologies Inc. In some instances, a threshold limit has been established to account for unavoidable impurities. The material is acceptable if the restricted substances are present at a quantity below the threshold limit for a controlled application. For packaging recycle marking requirements (SPI marks and country-specific marks), please see Dell Technologies WW Packaging Recycle Marking Specification (ENV0427, in Agile).

Refer to Appendix B for a detailed list of CAS #'s for each substance below.

Table 4 – Packaging Content Restrictions

Substance	Threshold Limit (mg substance / kg homogeneous weight =ppm)	Exemptions	Reference Appendix B
Cadmium, Chromium VI, Lead and Mercury compounds	100 (sum of concentrations)	None	Tables B, D, F, G

Table 4 – Packaging Content Restrictions

Substance	Threshold Limit (mg substance / kg homogeneous weight =ppm)	Exemptions	Reference Appendix B
Ozone depleting substances (Class I & Class II CFCs and HCFCs)	Not detectable	None	Table C, E
Halogenated plastics or polymers (ex: PVC)	Not detectable	None	See Section 2.4 for definition
Formaldehyde	Not detectable	Restriction only applies to wood products.	50-00-0

Use of elemental chlorine as a bleaching agent in packaging is prohibited. Dell Technologies has restricts use of chlorine in processing of packaging material. Printed documentation should be bleached in a chlorine-free process.

Dell Technologies restricts the use of free-rise polyurethane based foam-in-place.

5. Battery Content Restrictions

Table 5 lists substances that Dell Technologies has restricted in batteries supplied to or designed by Dell Technologies Inc. above the indicated threshold limit for unavoidable impurities. Battery technology used in Dell Technologies products cannot be based on lead**, mercury or cadmium.

Refer to Appendix B for a detailed list of CAS #'s for each substance below.

Table 5 – Battery Content Restrictions

Substance	Threshold Limit (mg/kg=ppm)	Exemptions	Reference Appendix B
Cadmium and its compounds	5	None	Table B
Lead and its compounds	40	Lead-acid batteries (UPS)**, solder used in battery packs	Table F
Mercury and its compounds	1	None	Table G
** Uninterruptible Power Supply (UPS) units may utilize lead-acid technology. Batteries for this application are subject to certain fees and material labeling requirements.			

6. Non-Electrical/Non-Electronic Parts and Products Requirements

All Dell Technologies branded non-electrical and non-electronic parts and/or products must satisfy the minimum requirements below (this list may not be comprehensive and suppliers should comply with local laws and regulations where the products are sold):

Table 6 - Non-Electrical/Non-Electronic Parts and Products Content Restrictions

Substance	Threshold Limit (mg/kg=ppm)
Lead and its compounds (Pb)	90 PPM
Cadmium and its compounds (Cd)	100 PPM
Mercury and its compounds (Hg)	Not Detectable
Hexavalent Chromium and its compounds (Cr+6)	Not Detectable
Phthalate DEHP, BBP, DBP, DINP, DIDP, DNOP, DIBP and all other phthalates	1000 PPM for each phthalate
Nickel and its compounds	1000 PPM on all surfaces with expected direct and prolonged skin exposure
Additional requirements for textiles, toys and apparels only (e.g. shirts, pants, coats, hats, gloves, shoes...)	Adhere to the latest requirements from the American Apparel & Footwear Association (AAFA) Restricted Substance List (RSL)

7. Antimicrobial & Biocidal Substance Restrictions

Antimicrobial and/or Biocidal substances not limited to those defined by US EPA FIFRA and EU Biocidal Products Regulation 528/2012 (BPR) are restricted worldwide for use in all Dell Technologies products, even if the antimicrobial/biocidal substance is approved for use by the US EPA or EU BPR.

Appendix A: Applicable RoHS Exemptions

Only the following RoHS exemptions can be used on Dell parts.

Exemption Number	Exemption	Scope and dates of applicability
3(a)	Mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) for special purposes not exceeding (per lamp) short length (< 500mm)	Max 3.5 mg per lamp
3(b)	Mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) for special purposes not exceeding (per lamp) medium length (>500mm and <1,500mm)	Max 5.0 mg per lamp
3(c)	Mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) for special purposes not exceeding (per lamp) long length (>1500mm)	Max 13.0 mg per lamp
4(a)	Mercury in other low pressure discharge lamps (per lamp)	Max 15.0 mg per lamp
4(b)-I	Mercury in High Pressure Sodium (vapour) lamps for general lighting purposes not exceeding (per burner) in lamps with improved colour rendering index $R_a > 60$: $P < 155W$	Max 30.0 mg per lamp
4(b)-II	Mercury in High Pressure Sodium (vapour) lamps for general lighting purposes not exceeding (per burner) in lamps with improved colour rendering index $R_a > 60$: $155W < P < 405W$	Max 40.0 mg per lamp
4(b)-III	Mercury in High Pressure Sodium (vapour) lamps for general lighting purposes not exceeding (per burner) in lamps with improved colour rendering index $R_a > 60$: $P > 405W$	Max 40.0 mg per lamp
4(c)-I	Mercury in other High Pressure Sodium (vapour) lamps for general lighting purposes not exceeding (per burner) $P < 155W$	Max 25.0 mg per lamp
4(c)-II	Mercury in other High Pressure Sodium (vapour) lamps for general lighting purposes not exceeding (per burner) $155W < P < 405W$	Max 30.0 mg per lamp
4(c)-III	Mercury in other High Pressure Sodium (vapour) lamps for general lighting purposes not exceeding (per burner) $P > 405W$	Max 40.0 mg per lamp
4(e)	Mercury in metal halide lamps (MH)	
4(f)	Mercury in other discharge lamps for special purposes not specifically mentioned in this Annex	
5(b)	Lead in glass of fluorescent tubes not exceeding 0,2 % by weight	
6(a)	Lead as an alloying element in steel for machining purposes and in galvanized steel containing up to 0,35 % lead by weight	Applicable until October 31, 2018
6(a)-I	Lead as an alloying element in steel for machining purposes containing up to 0.35% lead by weight and in batch hot dip galvanised steel components containing up to 0.2% lead by weight	Applicable from November 1, 2018
6(b)	Lead as an alloying element in aluminum containing up to 0,4 % lead by weight	Applicable until October 31, 2018
6(b)-I	Lead as an alloying element in aluminium containing up to 0,4 % lead by weight, provided it stems from lead-bearing aluminium scrap recycling	Applicable from November 1, 2018
6(b)-II	Lead as an alloying element in aluminium for machining purposes with a lead content up to 0,4 % by weight	Applicable from November 1, 2018
6(c)	Copper alloy containing up to 4 % lead by weight	

Exemption Number	Exemption	Scope and dates of applicability
7(a)	Lead in high melting temperature type solders (i.e. lead- based alloys containing 85 % by weight or more lead)	
7(c)-I	Electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezoelectronic devices, or in a glass or ceramic matrix compound	
7(c)-II	Lead in dielectric ceramic in capacitors for a rated voltage of 125 V AC or 250 V DC or higher	
13(a)	Lead in white glasses used for optical applications	
13(b)	Cadmium and lead in filter glasses and glasses used for reflectance standards	Applicable until April 30, 2018
13(b)-I	Lead in ion coloured optical filter glass types	Applicable from May 1, 2018
13(b)-II	Cadmium in striking optical filter glass types; excluding applications falling under point 39 of this Annex	Applicable from May 1, 2018
13(b)-III	Cadmium and lead in glazes used for reflectance standards	Applicable from May 1, 2018
15	Lead in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit flip chip packages	
34	Lead in cermet-based trimmer potentiometer elements	

Appendix B: List of CAS Numbers

Table A – Asbestos and its Compounds

Example Compounds	CAS Number
Asbestos	1332-21-4
Actinolite	77536-66-4
Amosite (Grunerite)	12172-73-5
Anthophyllite	77536-67-5
Chrysotile	12001-29-5
Crocidolite	12001-28-4
Tremolite	77536-68-6

Table B - Cadmium and its Compounds

Example Compounds	CAS Number
Cadmium	7440-43-9
Cadmium oxide	1306-19-0
Cadmium sulfide	1306-23-6
Cadmium chloride	10108-64-2
Cadmium sulfate	10124-36-4
Other cadmium compounds	-

Table C – Chlorofluorocarbons (CFC's)

Example Compounds	CAS Number
Trichlorofluoromethane	75-69-4
Dichlorodifluoromethane (CFC12)	75-71-8
Chlorotrifluoromethane (CFC 13)	75-72-9
Pentachlorofluoroethane (CFC 111)	354-56-3
Tetrachlorodifluoroethane (CFC 112)	76-12-0
Trichlorotrifluoroethane (CFC 113)	354-58-5
1,1,2 Trichloro-1,2,2 trifluoroethane	76-13-1
Dichlorotetrafluoroethane (CFC 114)	76-14-2
Monochloropentafluoroethane (CFC 115)	76-15-3
Heptachlorofluoropropane (CFC 211)	422-78-6 135401-87-5
Hexachlorodifluoropropane (CFC 212)	3182-26-1
Pentachlorotrifluoropropane (CFC 213)	2354-06-5 134237-31-3
Tetrachlorotetrafluoropropane (CFC 214)	29255-31-0
1,1,1,3-Tetrachlorotetrafluoropropane	2268-46-4

Table C – Chlorofluorocarbons (CFC’s)

Example Compounds	CAS Number
Trichloropentafluoropropane (CFC 215)	1599-41-3
1,1,1-Trichloropentafluoropropane	4259-43-2
1,2,3-Trichloropentafluoropropane	76-17-5
Dichlorohexafluoropropane (CFC 216)	661-97-2
Monochloroheptafluoropropane (CFC 217)	422-86-6
Bromochlorodifluoromethane (Halon 1211)	353-59-3
Bromotrifluoromethane (Halon 1301)	75-63-8
Dibromotetrafluoroethane (Halon 2402)	124-73-2
Carbon Tetrachloride (Tetrachloromethane)	56-23-5
1,1,1, - Trichloroethane (methyl chloroform) and its isomers except 1,1,2-trichloroethane	71-55-6
Bromomethane (Methyl Bromide)	74-83-9
Bromodifluoromethane and isomers (HBFC’s)	1511-62-2

Table D - Chromium VI and its Compounds

Example Compounds	CAS Number
Chromium (VI) oxide	1333-82-0
Barium chromate	10294-40-3
Calcium chromate	13765-19-0
Chromic acetate	1066-30-4
Chromium trioxide	1333-82-0
Lead (II) chromate	7758-97-6
Sodium chromate	7775-11-3
Sodium dichromate	10588-01-9
Strontium chromate	7789-06-2
Potassium dichromate	7778-50-9
Potassium chromate	7789-00-6
Zinc chromate	13530-65-9
Other hexavalent chromium compounds	-

Table E – Hydrochlorofluorocarbons (HCFC’s)

Example Compounds	CAS Number
Dichlorofluoromethane (HCFC 21)	75-43-4
Chlorodifluoromethane (HCFC 22)	75-45-6
Chlorofluoromethane (HCFC 31)	593-70-4
Tetrachlorofluoroethane (HCFC 121)	134237-32-4
1,1,1,2-tetrachloro-2-fluoroethane (HCFC 121a)	354-11-0
1,1,2,2-tetracloro-1-fluoroethane	354-14-3

Table E – Hydrochlorofluorocarbons (HCFC's)

Example Compounds	CAS Number
Trichlorodifluoroethane (HCFC 122) 1,2,2-trichloro-1,1-difluoroethane	41834-16-6 354-21-2
Dichlorotrifluoroethane(HCFC 123) Dichloro-1,1,2-trifluoroethane 2,2-dichloro-1,1,1-trifluoroethane 1,2-dichloro-1,1,2-trifluoroethane (HCFC-123a) 1,1-dichloro-1,2,2-trifluoroethane (HCFC-123b) 2,2-dichloro-1,1,2-trifluoroethane (HCFC-123b)	34077-87-7 90454-18-5 306-83-2 354-23-4 812-04-4 812-04-4
Chlorotetrafluoroethane (HCFC 124) 2-chloro-1,1,1,2-tetrafluoroethane 1-chloro-1,1,2,2-tetrafluoroethane (HCFC 124a)	63938-10-3 2837-89-0 354-25-6
Trichlorofluoroethane (HCFC 131) 1-Fluoro-1,2,2-trichloroethane 1,1,1-trichloro-2-fluoroethane (HCFC131b)	27154-33-2;(134237-34-6) 359-28-4 811-95-0
Dichlorodifluoroethane (HCFC 132) 1,2-dichloro-1,1-difluoroethane (HCFC 132b) 1,1-dichloro-1,2-difluoroethane (HFCF 132c) 1,1-dichloro-2,2-difluoroethane 1,2-dichloro-1,2-difluoroethane	25915-78-0 1649-08-7 1842-05-3 471-43-2 431-06-1
Chlorotrifluoroethane (HCFC 133) 1-chloro-1,2,2-trifluoroethane 2-chloro-1,1,1-trifluoroethane (HCFC-133a)	1330-45-6 1330-45-6 75-88-7
Dichlorofluoroethane(HCFC 141) 1,1-dichloro-1-fluoroethane (HCFC-141b) 1,2-dichloro-1-fluoroethane	1717-00-6; (25167-88-8) 1717-00-6 430-57-9
Chlorodifluoroethane (HCFC 142) 1-chloro-1,1-difluoroethane (HCFC142b) 1-chloro-1,2-difluoroethane (HCFC142a)	25497-29-4 75-68-3 25497-29-4
Hexachlorofluoropropane (HCFC 221)	134237-35-7
Pentachlorodifluoropropane (HCFC 222)	134237-36-8
Tetrachlorotrifluoropropane (HCFC 223)	134237-37-9
Trichlorotetrafluoropropane (HCFC 224)	134237-38-0
Dichloropentafluoropropane, (Ethyne, fluoro-) (HCFC 225) 2,2-Dichloro-1,1,1,3,3-pentafluoropropane(HCFC 225aa) 2,3-Dichloro-1,1,1,2,3-pentafluoropropane (HCFC 225ba) 1,2-Dichloro-1,1,2,3,3-pentafluoropropane (HCFC 225bb) 3,3-Dichloro-1,1,1,2,2-pentafluoropropane (HCFC 225ca) 1,3-Dichloro-1,1,2,2,3-pentafluoropropane (HCFC 225cb) 1,1-Dichloro-1,2,2,3,3-pentafluoropropane(HCFC 225cc) 1,2-Dichloro-1,1,3,3,3-pentafluoropropane (HCFC 225da) 1,3-Dichloro-1,1,2,3,3-pentafluoropropane (HCFC 225ea) 1,1-Dichloro-1,2,3,3,3-pentafluoropropane(HCFC 225eb)	127564-92-5; (2713-09-9) 128903-21-9 422-48-0 422-44-6 422-56-0 507-55-1 13474-88-9 431-86-7 136013-79-1 111512-56-2
Chlorohexafluoropropane (HCFC 226)	134308-72-8
Pentachlorofluoropropane (HCFC 231)	134190-48-0
Tetrachlorodifluoropropane (HCFC 232)	134237-39-1

Table E – Hydrochlorofluorocarbons (HCFC's)

Example Compounds	CAS Number
Trichlorotrifluoropropane (HCFC 233) 1,1,1-Trichloro-3,3,3-trifluoropropane	134237-40-4 7125-83-9
Dichlorotetrafluoropropane (HCFC 234)	127564-83-4
Chloropentafluoropropane (HCFC 235) 1-Chloro-1,1,3,3,3-pentafluoropropane	134237-41-5 460-92-4
Tetrachlorofluoropropane (HCFC 241)	134190-49-1
Trichlorodifluoropropane (HCFC 242)	134237-42-6
Dichlorotrifluoropropane (HCFC 243) 1,1-dichloro-1,2,2-trifluoropropane 2,3-dichloro-1,1,1-trifluoropropane 3,3-Dichloro-1,1,1-trifluoropropane	134237-43-7 7125-99-7 338-75-0 460-69-5
Chlorotetrafluoropropane (HCFC 244) 3-chloro-1,1,2,2-tetrafluoropropane	134190-50-4 679-85-6
Trichlorofluoropropane (HCFC 251) 1,1,3-trichloro-1-fluoropropane	134190-51-5 818-99-5
Dichlorodifluoropropane (HCFC 252)	134190-52-6
Chlorotrifluoropropane (HCFC 253) 3-chloro-1,1,1-trifluoropropane (HCFC 253fb)	134237-44-8 460-35-5
Dichlorofluoropropane (HCFC 261) 1,1-dichloro-1-fluoropropane	134237-45-9 7799-56-6
Chlorodifluoropropane (HCFC 262) 2-chloro-1,3-difluoropropane	134190-53-7 102738-79-4
Chlorofluoropropane (HCFC 271) 2-chloro-2-fluoropropane	134190-54-8 420-44-0

Table F - Lead and its Compounds

Example Compounds	CAS Number
Lead	7439-92-1
Lead (II) sulfate	7446-14-2
Lead (II) carbonate	598-63-0
Lead hydrocarbonate	1319-46-6
Lead acetate	301-04-2
Lead (II) acetate, trihydrate	6080-56-4
Lead phosphate	7446-27-7
Lead selenide	12069-00-0
Lead (IV) oxide	1309-60-0
Lead (II,IV) oxide	1314-41-6
Lead (II) sulfide	1314-87-0
Lead (II) oxide	1317-36-8
Lead (II) carbonate basic	1319-46-6

Table F - Lead and its Compounds

Example Compounds	CAS Number
Lead hydroxidcarbonate	1344-36-1
Lead (II) phosphate	7446-27-7
Lead (II) chromate	7758-97-6
Lead (II) titanate	12060-00-3
Lead sulfate, sulphuric acid, lead salt	15739-80-7
Lead sulphate, tribasic	12202-17-4
Lead stearate	1072-35-1
Other lead compounds	-

Table G - Mercury and its Compounds

Example Compounds	CAS Number
Mercury	7439-97-6
Mercuric chloride	33631-63-9
Mercury (II) chloride	7487-94-7
Mercuric sulfate	7783-35-9
Mercuric nitrate	10045-94-0
Mercuric (II) oxide	21908-53-2
Mercuric sulfide	1344-48-5
Other mercury compounds	-

Table H - Nickel and its Compounds

Example Compounds	CAS Number
Nickel	7440-02-0
Nickel acetate	373-02-4
Nickel carbonate	3333-67-3
Nickel carbonyl	13463-39-3
Nickel hydroxide	12054-48-7 or 11113-74-9
Nickelocene	1271-28-9
Nickel oxide	1313-99-1
Nickel subsulfide	12035-72-2
Other nickel compounds	-

Table I – Polybrominated Biphenyls (PBBs) and their Ethers / Oxides (PBDEs)

Example Compounds	CAS Number
Bromobiphenyl and its ethers	2052-07-5 (2-Bromobiphenyl) 2113-57-7 (3-Bromobiphenyl) 92-66-0 (4-Bromobiphenyl) 101-55-3 (ether)
Decabromobiphenyl and its ethers	13654-09-6 1163-19-5 (ether)
Dibromobiphenyl and its ethers	92-86-4 2050-47-7 (ether)
Heptabromobiphenylether	68928-80-3
Hexabromobiphenyl and its ethers	59080-40-9 36355-01-8 (hexabromo-1,1'-biphenyl) 67774-32-7 (Firemaster FF-1) 36483-60-0 (ether)
Nonabromobiphenylether	63936-56-1
Octabromobiphenyl and its ethers	61288-13-9 32536-52-0 (ether)
Pentabromobiphenyl ether (note: Commercially available PeBDPO is a complex reaction mixture containing a variety of brominated diphenyloxides.	32534-81-9 (CAS number used for commercial grades of PeBDPO)
Polybrominated Biphenyls	59536-65-1
Tetrabromobiphenyl and its ethers	40088-45-7 40088-47-9 (ether)
Tribromobiphenyl ether	49690-94-0

Table J - Polychlorinated Biphenyls (PCBs) and Terphenyls (PCTs)

Example Compounds	CAS Number
Polychlorinated Biphenyls	1336-36-3
Aroclor	12767-79-2
Chlorodiphenyl (Aroclor 1260)	11096-82-5
Kanechlor 500	27323-18-8
Aroclor 1254	11097-69-1
Terphenyls	26140-60-3

Table K – Azo colorants (aromatic amines that may be formed by azo dyes)

Example Compounds	CAS Number
biphenyl-4-ylamine	92-67-1
benzidine	92-87-5
4-chloro-o-toluidine	95-69-2

Table K – Azo colorants (aromatic amines that may be formed by azo dyes)

Example Compounds	CAS Number
2-naphthylamine	91-59-8
o-aminoazotoluene	97-56-3
5-nitro-o-toluidine	99-55-8
4-chloroaniline	106-47-8
4-methoxy-m-phenylenediamine	615-05-4
4,4'-methylenedianiline	101-77-9
3,3'-dichlorobenzidine	91-94-1
3,3'-dimethoxybenzidine	119-90-4
3,3'-dimethylbenzidine	119-93-7
4,4'-methylenedi-o-toluidine	838-88-0
6-methoxy-m-toluidine	120-71-8
4,4'-methylene-bis(2-chloroaniline)	101-14-4
4,4'-oxydianiline	101-80-4
4,4'-thiodianiline	139-65-1
o-toluidine	95-53-4
4-methyl-m-phenylenediamine	95-80-7
2,4,5-trimethylaniline	137-17-7
o-anisidine	90-04-0
4-amino azobenzene	-

Table L – Brominated/Chlorinated flame retardants/additives (other than PBBs, PBDEs, HBCD and HBCDD)

Example Compounds	CAS Number
Brominated flame retardant which comes under notation of ISO 1043-4 code number FR(14) [Aliphatic/alicyclic brominated compounds]	-
Brominated flame retardant which comes under notation of ISO 1043-4 code number FR(15) [Aliphatic/alicyclic brominated compounds in combination with antimony compounds]	-
Brominated flame retardant which comes under notation of ISO 1043-4 code number FR(16) [Aromatic brominated compounds excluding brominated diphenyl ether and biphenyls]	-
Brominated flame retardant which comes under notation of ISO 1043-4 code number FR(17) [Aromatic brominated compounds excluding brominated diphenyl ether and biphenyls] in combination with antimony compounds]	-
Brominated flame retardant which comes under notation of ISO 1043-4 code number FR(22) [Aliphatic/alicyclic chlorinated and brominated compounds]	-

Table L – Brominated/Chlorinated flame retardants/additives (other than PBBs, PBDEs, HBCD and HBCDD)

Example Compounds	CAS Number
Brominated flame retardant which comes under notation of ISO 1043-4 code number FR(42) [Brominated organic phosphorus compounds]	-
Poly(2,6-dibromo-phenylene oxide)	69882-11-7
Tetra-decabromo-diphenoxy-benzene	58965-66-5
1,2-Bis(2,4,6-tribromo-phenoxy) ethane	37853-59-1
3,5,3',5'-Tetrabromo-bisphenol A (TBBA)	79-94-7
TBBA, unspecified	30496-13-0
TBBA-epichlorhydrin oligomer	40039-93-8
TBBA-TBBA-diglycidyl-ether oligomer	70682-74-5
TBBA carbonate oligomer	28906-13-0
TBBA carbonate oligomer, phenoxy end capped	94334-64-2
TBBA carbonate oligomer, 2,4,6-tribromo-phenol terminated	71342-77-3
TBBA-bisphenol A-phosgene polymer	32844-27-2
Brominated epoxy resin end-capped with tribromophenol	139638-58-7
Brominated epoxy resin end-capped with tribromophenol	135229-48-0
TBBA-(2,3-dibromo-propyl-ether)	21850-44-2
TBBA bis-(2-hydroxy-ethyl-ether)	4162-45-2
TBBA-bis-(allyl-ether)	25327-89-3
TBBA-dimethyl-ether	37853-61-5
Tetrabromo-bisphenol S	39635-79-5
TBBS-bis-(2,3-dibromo-propyl-ether)	42757-55-1
2,4-Dibromo-phenol	615-58-7
2,4,6-tribromo-phenol	118-79-6
Pentabromo-phenol	608-71-9
2,4,6-Tribromo-phenyl-alltl-ether	3278-89-5
Tribromo-phenyl-allyl-ether, unspecified	26762-91-4
Bis(methyl)tetrabromo-phtalate	55481-60-2
Bis(2-ethylhexyl)tetrabromo-phtalate	26040-51-7
2-Hydroxy-propyl-2-(2-hydroxy-ethoxy)-ethyl-TBP	20566-35-2
TBPA, glycol-and propylene-oxide esters	75790-69-1
N,N'-Ethylene -bis-(tetrabromo-phthalimide)	32588-76-4
Ethylene-bis(8,5,6-dibromo-norbornane-2,3-dicarboximide)	52907-07-0
2,3-Dibromo-2-butene-1,4-diol	3234-02-4
Dibromo-neopentyl-glycol	3296-90-0
Dibromo-propanol	96-13-9
Tribromo-neopentyl-alcohol	36483-57-5
Poly tribromo-styrene	57137-10-7
Tribromo-styrene	61368-34-1

Table L – Brominated/Chlorinated flame retardants/additives (other than PBBs, PBDEs, HBCD and HBCDD)

Example Compounds	CAS Number
Dibromo-styrene grafted PP	171091-06-8
Poly-dibromo-styrene	31780-26-4
Bromo-/Chloro-paraffins	68955-41-9
Bromo-/Chloro-alpha-olefin	82600-56-4
Vinylbromide	593-60-2
Tris-(2,3-dibromo-propyl)-isocyanurate	52434-90-9
Tris(2,4-Dibromo-phenyl) phosphate	49690-63-3
Tris(tribromo-neopentyl) phosphate	19186-97-1
Chlorinated and brominated phosphate ester	125997-20-8
Pentabromo-toluene	87-83-2
Pentabromo-benzyl bromide	38521-51-6
1,3-Butadiene homopolymer, brominated	68441-46-3
Pentabromo-benzyl-acrylate, monomer	59447-55-1
Pentabromo-benzyl-acrylate, polymer	59447-57-3
Decabromo-diphenyl-ethane	84852-53-9
Tribromo-bisphenyl-maleinimide	59789-51-4
Brominated trimethylphenyl-lindane	59789-51-4
Tetrabromo-chyclo-octane	31454-48-5
1,2-Dibromo-4-(1,2 dibromo-methyl)-cyclo-hexane	3322-93-8
TBPA Na salt	25357-79-3
Tetrabromo phthalic anhydride	632-79-1
Other Brominated Flame Retardants	-
Tetrakis(2-chloroethyl) dichloroisopentylidiphosphate	38051-10-4
Tris(1-chloro-2-propyl)phosphate	13674-84-5
Tris(2,3-dichloro-1-propyl)phosphate	66108-37-0
Other Chlorinated Flame Retardants	-

Table M – Tributyl tin (TBT), Triphenyl tin (TPT) and Triphenyl tin oxide (TPTO)

Example Compounds	CAS Number
Tributyl tin bromide	1461-23-0
Tributyl tin oxide	56-35-9
Tributyl tin acetate	56-36-0
Tributyl tin laurate	3090-36-6
Tributyl tin fluoride	1983-10-4
Triphenyl tin	668-34-8

Table M – Tributyl tin (TBT), Triphenyl tin (TPT) and Triphenyl tin oxide (TPTO)

Example Compounds	CAS Number
Triphenyl tin chloride	639-58-7
Triphenyl tin hydroxide	76-87-9
Triphenyl tin acetate	900-95-8
Triphenyl tin fluoride	1983-10-4

Table N – Polychlorinated Naphthalene (PCN)

Example Compounds	CAS Number
Trichloronaphthalene	1321-65-9
Tetrachloronaphthalene	1335-88-2
Pentachloronaphthalene	1321-64-8
Octachloronaphthalene	2234-13-1

Table O – Perfluorooctane sulfonates (PFOS)

Example Compounds	CAS Number
Perfluorooctanesulfonyl fluoride	307-35-7
2-Propenoic acid, 2-methyl-, 2-[ethyl[(heptadecafluorooctyl)sulfonyl]amino] ethyl ester	376-14-7
2-Propenoic acid, 2-[butyl[(heptadecafluorooctyl)sulfonyl]amino]ethyl ester	383-07-3
2-Propenoic acid, 2-[ethyl[(heptadecafluorooctyl)sulfonyl]amino]ethyl ester	423-82-5
N-allylheptadecafluorooctanesulphonamide	423-86-9
heptadecafluorooctanesulphonamide	754-91-6
1-Propanaminium, 3-[[[(heptadecafluorooctyl)sulfonyl]amino]-N,N,N-trimethyl-,iodide	1652-63-7

Table P – Polycyclic Aromatic Hydrocarbons (PAHs)

Example Compounds	CAS Number
Acenaphthen	83-32-9
Acenaphthylen	208-96-8
Anthracen	120-12-7
Benzo[a]anthracen	56-55-3
Benzo[b]fluoranthen	205-99-2
Benzo[j]fluoranthen	205-82-3
Benzo[k]fluoranthen	207-08-9
Benzo[ghi]perylen	191-24-2
Benzo[a]pyren	50-32-8

Table P – Polycyclic Aromatic Hydrocarbons (PAHs)

Example Compounds	CAS Number
Benzo[e]pyren	192-97-2
Chrysen	218-01-9
Dibenzo[a,h]anthracen	53-70-3
Fluoranthen	206-44-0
Fluoren	86-73-7
Indeno[1,2,3-cd]pyren	193-39-5
Naphthalin	91-20-3
Phenanthren	85-01-8
Pyren	129-00-0

Table Q – Fluorinated Greenhouse Gases

Example Compounds	CAS Number
Carbon tetrafluoride (Perfluoromethane)	75-73-0
Perfluoroethane (Hexafluoroethane)	76-16-4
Perfluoropropane (Octafluoroproane)	76-19-7
Perfluorobutane (Decafluorobutane)	355-25-9
Perfluoropentane (Dodecafluoropentane)	678-26-2
Perfluorohexane (Tetradecafluorohexane)	355-42-0
Perfluorocyclobutane	115-25-3
Sulfur Hexafluoride (SF6)	2551-62-4
HFC-23 CHF3	75-46-7
HFC-32 CH2F2	75-10-5
HFC-41 CH3F	593-53-3
HFC-43-10mee C5H2F10	138495-42-8
HFC-125 C2HF5	354-33-6
HFC-134 C2H2F4	359-35-3
HFC-134a CH2FCF3	811-97-2
HFC-152a C2H4F2	75-37-6
HFC-143 C2H3F3	430-66-0
HFC-143a C2H3F3	420-46-2
HFC-227ea C3HF7	431-89-0
HFC-236cb CH2FCF2CF3	677-56-5
HFC-236ea CHF2CHF2CF3	431-63-0
HFC-236fa C3H2F6	690-39-1
HFC-245ca C3H3F5	679-86-7
HFC-245fa CHF2CH2CF3	460-73-1
HFC-365mfc CF3CH2CF2CH3	406-58-6

Table R – Radioactive Substances

Example Compounds	CAS Number
Uranium-238	7440-61-1
Radon	10043-92-2
Americium-241	14596-10-2
Thorium-232	7440-29-1
Cesium (Radioactive Isotopes only)	7440-46-2 (Cs-137 010045-97-3)
Strontium (Radioactive Isotopes only)	(elemental 7440-24-6) (Sr-90 10098-97-2)
Other radioactive substances	-

Table S – Alkanes, Short Chain Chlorinated Paraffins C₁₀₋₁₃ (SCCPs) and Medium Chain Chlorinated Paraffins C₁₄₋₁₇ (MCCPs)

Example Compounds	CAS Number
Alkanes, C10-13, chloro	85535-84-8
Alkanes, C10-12, chloro	108171-26-2
Alkanes, C12-13, chloro	71011-12-6
Alkanes, chloro	61788-76-9
Other Short Chain Chlorinated Paraffins	-
Alkanes, C14-17, chloro	85535-85-9
Chlorinated polyethylene	64754-90-1

Table T – Dibutyltin (DBT) and Dioctyltin (DOT) Compounds

Example Compounds	CAS Number
Dibutyltin oxide	818-08-6
Dibutyltin diacetate	1067-33-0
Dibutyltin dilaurate	77-58-7
Dibutyltin maleate	78-04-6
Other dibutyltin compounds	-
Dioctyl Tin Oxide	870-08-6
Dioctyltin dilaurate	3648-18-8
Other Dioctyltin compounds	-

Table U – Beryllium and compounds

Example Compounds	CAS Number
Beryllium metal	7440-41-7
Beryllium-aluminium alloy	12770-50-2
Beryllium-copper alloy	11133-98-5
Beryl	1302-52-9

Table U – Beryllium and compounds

Example Compounds	CAS Number
Beryllium chloride	7787-47-5
Beryllium fluoride	7787-49-7
Beryllium hydroxide	13327-32-7
Beryllium sulfate	13510-49-1
Beryllium sulfate tetrahydrate	7787-56-6
Beryllium oxide	1304-56-9
Beryllium carbonate basic	1319-43-3
Beryllium nitrate	13597-99-4
Beryllium nitrate trihydrate	7787-55-5
Beryllium nitrate tetrahydrate	13510-48-0
Beryllium phosphate	13598-15-7
Beryllium silicate	13598-00-0
Zinc beryllium silicate	39413-47-3

Table V – Antimony and its compounds

Example Compounds	CAS Number
Antimony	7440-36-0
Antimony Trioxide	1309-64-4
Antimony Pentoxide	1314-60-9

Table W – Perfluorooctanoic acid (PFOA) and its salts

Example Compounds	CAS Number
Perfluorooctanoic acid (PFOA)	335-67-1
Any related substance (including its salts and polymers) having a linear or branched perfluoroheptyl group with the formula C ₇ F ₁₅ - directly attached to another carbon atom, as one of the structural elements.	
Any related substance (including its salts and polymers) having a linear or branched perfluorooctyl group with the formula C ₈ F ₁₇ - as one of the structural elements.	
The following substances are excluded from this designation: — C ₈ F ₁₇ -X, where X = F, Cl, Br. — C ₈ F ₁₇ -C(=O)OH, C ₈ F ₁₇ -C(=O)O-X' or C ₈ F ₁₇ -CF ₂ -X' (where X' = any group, including salts).	

Appendix C : Materials Compliance Testing

To ensure adequate due diligence is performed to satisfy regulatory material compliance, in addition to supplier declarations of conformity (SDoCs, Dell p/n N6685), Dell Technologies will now require suppliers to maintain supporting analytical laboratory data on file for parts/products supplied to Dell. Suppliers are required to provide this information to Dell within 10 business days upon request by Dell.

Purpose: This section provides instructions on sample preparation, test methods and recommended 3rd party laboratories for analytical laboratory testing. Dell expects all suppliers to conform to these requirements as part of their material due diligence activities.

Scope: All parts in Dell-branded products that are supplied to Dell and/or designed by Dell must satisfy this specification. Compliance with this specification is communicated to Dell via Supplier Declaration of Conformity (SDoC, Dell part number N6685). The scope includes all of the components, parts, assemblies and packaging of each product.

References:

- Dell P/N ENV0199, Dell **BFR/CFR/PVC-Free** Specification
- Directive of the European Parliament and of the Council on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment, 2011/65/EU, June 2011 (RoHS Directive) and 2015/863/EU, June 2015 (addition of four phthalates)
- Directive of the European Parliament and of the Council on Packaging and Packaging waste, 94/62/EC. December 1994
- IEC 62321 Electrotechnical Products–Determination of Levels of Six Regulated Substances (Lead, Mercury, Cadmium, Hexavalent Chromium, Polybrominated Biphenyls, Polybrominated Diphenyl Ethers)

Definitions:

- AAS: Atomic Absorption Spectroscopy
- AFS: Atomic Fluorescence Spectrometry
- Brominated/chlorinated flame retardants (BFRs and CFRs): flame retardants that contain or are treated with bromine and/or chlorine. These elements are typically added to reduce the flammability of components such as epoxy resins and thermoplastics. Example include, but are not limited to, tetrabromobisphenol-A, brominated epoxy oligomer (BEO) and polybrominated diphenyl ethers (PBDEs).
- CV-AAS: Cold Vapor Atomic Absorption Spectrometry
- CV-AFS: Cold Vapor Atomic Fluorescence Spectrometry
- Electronic Component: a combination of homogeneous materials that have been formed into a single manufactured mechanical or electrical part. Examples of electronic components may include microprocessors, plastic enclosures, capacitors...
- GC/MS: Gas Chromatography/Mass Spectrometry
- ICP-OES: Inductively Coupled Plasma Optical Emission Spectrometry
- ICP-MS: Inductively Coupled Plasma-Mass Spectrometry
- IEC: International Electro technical Commission <http://www.iec.ch/>
- Polymer Material: An organic substance made of many repeating chemical units or molecules. Materials in this category include plastics, rubber, elastomers...
- XRF: X-Ray Fluorescence material screening equipment

Sample Preparation for RoHS Compliance Testing:

Disassembly

RoHS compliance thresholds, as provided in ENV0424 apply to each homogenous material within the product/component, NOT to the entire product/component. “Homogenous material” is defined as a material that cannot be mechanically disjointed into different materials. The term is understood as "of uniform composition throughout". As it is impractical to test each homogenous material in a given sample, products may need to be disassembled to the sub-component level to approximate the homogenous material level of compliance. For example, a hard disk drive would need to be disassembled into multiple parts – metal casing, plastic casing, PCB, electrical components, drive disks themselves, and etc. Each of these parts should be tested individually. For a cable - the cable jacket and connector would each similarly need to be tested.

Laboratory facilities

All industry and regulatory certified laboratories (e.g. ISO17025 certified laboratories) are acceptable to Dell. Laboratories without accreditation will not comply to this specification. Examples of acceptable laboratories are listed below

- SGS Laboratories
- Intertek Testing Services
- TUV
- Bureau Veritas
- UL

Each laboratory has individual requirements for the amounts of material needed for testing. Most laboratories request between 10 and 20 grams of a homogenous material to yield accurate results.

Analytical Testing Methods for RoHS Substances

Dell will only accept RoHS testing to specification IEC 62321, latest edition: “Electrotechnical Products– Determination Of Levels Of Six Regulated Substances (Lead, Mercury, Cadmium, Hexavalent Chromium, Polybrominated Biphenyls, Polybrominated Diphenyl Ethers)” as the RoHS testing methodology. Below summarizes the test equipment/procedure used for RoHS testing.

Substances	Polymer and Non-Metals	Metals
Cadmium (Cd) and compounds	ICP-OES, ICP-MS, AAS	ICP-OES, ICP-MS, AAS
Hexavalent Chromium (Cr+6) compounds	Alkaline Digestion / Colorimetric Method	Spot test procedure / Boiling water extraction procedure (EPA 3060A is not an acceptable test method)
Lead (Pb) and compounds	ICP-OES, ICP-MS, AAS	ICP-OES, ICP-MS, AAS
Mercury (Hg) and compounds	ICP-OES, ICP-MS, CV-AAS, CVAFS	ICP-OES, ICP-MS, CV-AAS, CV-AFS
PolyBrominated Biphenyls (PBB)	GC/MS	Not Applicable
PolyBrominated Diphenyl Ethers (PBDE)	GC/MS	Not Applicable

Detailed test parameters and methodologies are found in the IEC 62321 specification.

Recommended Analytical Testing Methods for Halogens - Bromine and Chlorine (“Halogen-Free”)

A number of test methods have been established for determining the concentration of total bromine and chlorine in electronic products. Dell will accept the following tests.

Articles to be Tested	Analytical Testing Method
Printed circuit board (PCB) laminates	IPC-TM-650 2.3.41; IEC 61189-2:2006; EN 14582 (Method A & B)
Other materials	IEC 61189-2:2006; EN 14582 (Method A & B)

Tests beyond this list will require approval from Dell.

X-Ray Fluorescence

Bench top/handheld X-ray fluorescence (XRF) can be used as a SCREENING tool only for ENV0424 and/or ENV0199 as part of the supplier’s active verification programs. Due to accuracy limitations of XRF, Dell will not

accept XRF results as a substitute to the tests above for official compliance documentation provided to Dell upon request.