



RoHS, RoHS 2, and RoHS 2 Revision European Union Directives

Abstract

Serious human health issues and other considerations compelled the European Union (EU) to enact laws to reduce environmental toxicity and facilitate reuse, recycling, and recovery of products containing electrical and electronic components. These laws include directives known collectively as the Restrictions of Hazardous Substances (RoHS). The first RoHS directive, 2002/95/EU, was implemented in 2006 and was aimed at reducing waste contamination from six substances, including 4 heavy metals and two toxic flame retardants. The RoHS 2 Directive 2011/65/EU entered into effect on July 21, 2011 and refocused upon restricting toxic product entry into the market, adding CE marking requirements, compliance documentation retention, and introducing additional in-scope Product Categories (8 & 9). The most recent RoHS 2 Revision, Directive 2015/863/EU, entered into effect 22 July 2019 for most impacted product categories, and added 4 phthalates commonly used as plasticizers, and an even broader new Product Category 11 which includes most remaining products containing electrical or electrical components which are not specifically exempted. This whitepaper describes specifics of the RoHS Directives and the implications for companies which make, market or plan to market products in the EU countries.

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Introduction

The European Union (EU) RoHS (Restriction of Hazardous Substances) Directive definition of Electrical and Electronic Equipment (EEE) is much broader than the average person would expect from the name. The European Commission (EC) has defined EEE piecemeal in a wide range of regulations that have evolved over the past 25 years, and so it is not possible to point to one source for an exhaustive and comprehensive definition. RoHS regulations scope EEE as most product types containing electric or electronic parts. The current RoHS regulations apply not only to consumer goods such as computers, home entertainment and mobile phones, but also less obvious categories such as engines with electronic ignition and/or injection, toys, and virtually anything containing wiring or integrated circuitry. Examples of less obvious impacted industries include heavy equipment, recreational vehicles, and some aerospace applications.

Although the products in these and other industries may not be primarily electrical in nature, they include electric and electronic components such as gas, diesel and turbo engines with electronic ignition and/or injection, fans and blowers, batteries, generators, etc. Often, these products are within RoHS scope except where explicitly excluded, usually because comparable environmental regulations are addressed within the scope of other overlapping European Union (EU) and or European Economic Area (EEA) regulations, or less often because a product category is perceived as having lesser impact upon health and the environment.

Over the last few decades, awareness of chemical impact upon the human and human-dependent health concerns has grown significantly. As an example, recognition of the severe long-term health effects resulting from heavy metal lead poisoning in children resulted initially in restrictions on leaded plumbing, then leaded paint, then leaded fuels, then lead in automotive vehicles, and most recently upon leaded solder in electronics. Modern growth in the use of EEE containing Substances of Concern (SoCs) has resulted in an increased focus on environmental protection because of the growing awareness that SoCs are destructive to human and other forms of life. Also, industry has found a growing scarcity of sources for raw minerals necessary for product manufacturing. For example, 50 years ago, raw copper ore was relatively plentiful, but today obtaining and mining copper ore is often more expensive than reproducing from scrap. The recycling of EEE not only reduces detrimental impact upon human health, it also provides both short-term and long-term benefits to most manufacturing industries.

The topic of this paper is specifically the EU version of RoHS. There are dozens of different RoHS regulations in different global jurisdictions, many of which contain RoHS in their name. While these legislations generally have common elements, there are also differences. This paper provides general background on RoHS style regulations, and specifics on the EU RoHS on which many global regulations are based. This paper is not a comprehensive treatise on all global versions of RoHS. Readers should always become familiar with the specific details of any jurisdictional variants in regions where their business conducts operations.

A note on European law. As the EU/EEA member countries (also called member states) are each independent sovereign nations, the European Commission (EC) does not pass laws, but rather issues Directives. EC Directives are then implemented and enforced as individual regulations within each member country. Thus, the EC RoHS Directive provides the framework for the multiple member state RoHS regulations, all having generally the same requirements, yet with enforcement and implementation details defined by each state. The RoHS directives impose requirements, but do not provide direction on how EU member states must fulfill their obligations. U.S. and other non-EU entities exporting EEE into EU countries must accept that national implementation and enforcement rules differ from country to country.

EU RoHS Background

Since the original RoHS inception in 2002, the RoHS directives have evolved considerably, as legislators have used findings and broader knowledge to drive efforts to reduce further the hazards from chemicals in EEE. Some changes have been driven by increased understanding of how to effectively legislate chemical safety, while other changes have been driven by broader understanding of hazards in electrical equipment. Currently there are three EU RoHS directives Original RoHS, RoHS 2, and the most recent 2016 RoHS 2 Amendment, which became effective in 2019 for some product types, and which will have effect in the remaining product types in 2021. Some refer to the RoHS 2 2016 Amendment as RoHS 2 Amendment. You may also occasionally see the RoHS 2 Amendment and Annex 2 Amendment collectively referred to informally as RoHS 3. While this is not technically correct, it does provide some clarity as to what is being referenced, and so may appear occasionally in this document.

Although the basic structure and requirements of RoHS Directive has been developed by EU, RoHS adoption is growing globally and a number of countries have adopted and implemented their own version of RoHS. Appendix in this document provides brief description of RoHS directives as implemented in other countries. Companies need to be proactive and understand how proposed revisions and amendments may affect their regulatory compliance requirements and prepare to meet the requirements.

RoHS, Directive 2002/95/EC

The Initial EU RoHS Directive 2002/95/EC entered into force July 1, 2006, somewhat in complement with Directive 2012/19/EU, the [Waste Electrical and Electronic Equipment](#) (WEEE) Directive. The initial RoHS Directive was modelled after the Directive 2000/53/EC, End-of-Life Vehicle (ELV or EoLV), an automotive-specific directive which uses vehicle dismantling and SoC recycling at the vehicle end of life to reduce environmental impact.

The goals of the initial RoHS regulation were to:

- Facilitate recycling, reuse, and setting recovery targets
- Reduce negative environmental impact
- Minimize the impact on human health from disposal of electrical and electronics products

Although the ELV regulation concerning automotive vehicle content recycling upon which the original RoHS was based has been highly effective, the circumstances involving EEE were found to be very different. It is much more difficult to “throw away” an automobile without following recycling procedures than it is to dispose of a cell phone or other small item of EEE, and so original RoHS did not provide adequate performance towards the desired goals.

An implementation feature of the original RoHS directive and the WEEE directive was to identify EEE that did not contain the regulated substances, and so a green RoHS checkmark label was designed and used to indicate a product either did not contain the restricted SoCs, or contained the substances below what is considered acceptable thresholds, and so could be thrown away without need for WEEE or RoHS recycling procedures.

RoHS 2, Directive 2011/65/EU

Five years after the original RoHS release, the European Union released RoHS 2 Directive 2011/65/EU, or RoHS 2 published on July 21, 2011 with enforcement from January 2, 2013, superseding the earlier original RoHS Directive. The simultaneously enacted WEEE Directive sets collection, recycling, and recovery targets for electrical goods, and remains in effect.

RoHS 2 is essentially a complete re-cast of the RoHS directive. In the original RoHS, the focus was upon actions taken at product disposal time. In RoHS 2, the focus was changed to the time at which the product was manufactured, imported, and/or brought to market. One of the issues with the original RoHS was difficulty of enforcing the legislation, so RoHS 2 provided for enforcement by making RoHS 2 compliance a requirement for a product to receive CE-marking. CE marking is a required certification mark for certain product types, and indicates conformity with health, safety, and environmental protection standards for products sold within the European Economic Area (EEA). The original green RoHS label with the checkmark was replaced with the CE mark. Although RoHS 2 adds no further substances to the original six restricted SoCs, RoHS2 expanded the product scope to include two new product categories: 8 (medical devices) and 9 (control and monitoring instruments).

RoHS 2 Annex 2 Amendment, Directive 2015/863/EU

The European Union (EU) further updated RoHS 2 with Directive 2015/863/EU, or RoHS 2 Annex 2 Amendment, with additional changes to enforcement made effective July 22, 2019. Annex 2 is the portion of the RoHS directive that identifies the scope of the RoHS 2 directive, and so it is unsurprising this directive changes the regulatory substance list of RoHS 2. This directive added four additional substances (four phthalates) and a new product category: 11 (all 'grey area' EEE). The four phthalates are most commonly used in plasticizers, especially in wiring, to provide pliability to prevent wiring insulation from becoming brittle under conditions of vibration or flexing.

RoHS 2 Annex 2 Amendment, Directive 2017/2102

EU periodically examines the need to amend the scope of RoHS Directives in respect of the EEE covered therein and, if appropriate, presents legislative proposal (Amendments) with respect to any additional exclusions related to that EEE. Directive 2011/65/EU was amended, now known as Directive (EU) 2017/2102, by the European Parliament and of the Council of 15 November 2017 with clarifications, exclusions, and some incentives as shown below.

Clarification: Directive 2011/65/EU does not apply to non-road mobile machinery with an on-board power source, which is made available exclusively for professional use. However, for certain types of non-road mobile machinery, two versions are produced in the same production line, with the power source (either on-board or external) being the only difference. Those versions should be treated in the same way under that Directive. Non-road mobile machinery with a traction drive powered by an external power source should therefore also be excluded from the scope of Directive 2011/65/EU.

Exclusion of a few niche products: A few niche products have been recommended for their exclusion from the scope of Directive 2011/65/EU based on the reason that when these products are recycled, the impact on environment and human health is negligible. Besides if these niche products are included it will potentially introduce unresolvable compliance issues. An example of such a niche product is "pipe organ". These products are built using a specific type of lead-based alloy, for which an alternative hasn't been found. Generally a large majority of pipe organs are kept in the same place for centuries and their turnover rate is negligible, therefore, even though they contain lead based alloy, their inclusion in the scope of Directive 2011/65/EU would bring negligible benefit in terms of the substitution of lead.

Recycle, Reuse, Re-Purpose: To facilitate and promote a circular economy within the EU, Directive 2011/65/EU provides incentive to companies for reuse and repurposing an EEE product. This can involve repair, replacement of spare parts, retrofitting, refurbishment and reuse. If a spare part, that may contain hazardous substances, is used to repair electrical and/or electronic equipment placed in the EU market before July 1, 2006, then the RoHS Directive does not apply to the spare part. This allowance permits repair and maintenance of old equipment and promotes reuse. However, it is not permissible to repair any new equipment, put on the market after 1st July 2006, with spare parts containing hazardous substances.

The use of spare parts containing banned substances for the repair of new equipment would prolong the existence of hazardous substances in the waste stream and hamper efforts to increase recycling.

RoHS Directives – a few key points to note

Any company (manufacturer, importer, or distributor) placing a product on the European Union market needs to be aware of the following items of significance and that currently, RoHS Directive 2011/65/EU, RoHS 2 Directive 2015/863/EU and RoHS 2 Annex 2 Amendment Directive 2017/2102 are enforced.

- RoHS and WEEE directives impose requirements but neither provide direction on how the EU member states must fulfill their obligations. Therefore, non-EU and US companies exporting EEE products to EU countries need to understand that national rules for implementing each directive will differ from country to country within EU.
- RoHS and REACH (Registration, Evaluation, Authorization, Restriction of Chemicals) overlap with respect to the 10 RoHS-identified hazardous substances since these substances are also on the REACH's Candidate List of Substances of Very High Concern (SVHC).
- Any company placing the product on the EU market must maintain compliance with record keeping from everyone in the supply chain to ensure EEE has been designed and manufactured to meet RoHS 2 and RoHS 2 Amendment requirements. Records must be kept for 10 years. The records can include a conformity assessment, CE marking, maintenance of compliance throughout production, and self-reporting of non-compliance.
- The CE mark, a legal requirement for supplying products and gain market access within the EU, is the manufacturer's declaration that their product meets the requirements of applicable RoHS directives and failure to comply could lead to product recalls, prohibition notices, fines and imprisonment. However, before the CE mark can be applied on products, the products need to have a unique traceable declaration of conformity (DoC) as required by RoHS 2.
- Companies can be fined by European Union for RoHS Directives non-compliance. Penalties and fines for non-compliance vary considerably between European Countries. Some EU state also have imprisonment as penalty for non-compliance.

The regulatory compliance requirements of RoHS Directives and REACH regulations make it necessary for companies to implement a compliance management solution by establishing procedures to monitor their legal requirements, and tailor the compliance management solution by the relevant products, tracking within the supply chain, and by the region / countries the products are planned to be marketed.

Companies can begin to manage their compliance data requirements by employing business and data management processes and requirements by employing fully outsourced service to obtain and maintain regulatory compliance. **Compliance Data Exchange (CDX) from DXC Technology** is a compliance and data management solution that simplifies the complexities of product compliance data management for RoHS Directives. More information on CDX Solutions has been described in the Compliance Management Solutions section.

List of 10 RoHS Restricted Substances

The list below shows the 10 restricted substances by RoHS Directives with their permissible ranges. Any product in scope, that is, imported or made in the European Union, may contain only trace amounts below

0.1%, with the exception of cadmium, which must remain under 0.01% weight by weight (w/w) in its homogeneous materials rather than the product or a part itself. A homogeneous material means any material of uniform composition throughout that cannot be mechanically separated into different materials.

1. **Lead (Pb): 1000ppm (0.1%):** Lead is commonly used in the electrical and electronics industry in solder, lead-acid batteries, electronic components, and cable sheathing. Based on the classification provided by companies to the European Chemicals Agency (ECHA) in REACH registrations, lead (Pb) may affect fertility or damage an unborn child, causing damage to organs through prolonged or repeated exposure. Lead may cause cancer, is very toxic to aquatic life, and may cause harm to breast-fed children.
2. **Mercury (Hg): 1000ppm (0.1%):** Mercury is widely used in the production of electrical and electronic products because its high density requires less space. Mercury is a good conductor of electricity and has fluid properties over a large temperature range. Use of mercury is concentrated in batteries, fluorescent lamps, switches, and thermostats. Mercury is toxic: inhalation of mercury vapor can produce harmful effects on the nervous, digestive and immune systems, lungs and kidneys, and may be fatal.
3. **Cadmium (Cd): 100ppm (0.01%):** Cadmium is used in electronic equipment, car batteries, and pigments. It is a toxic metal and can enter human bodies through various pathways, for example, through dermal contact with contaminated water, inhalation of dust, and consumption of food grown in contaminated fields.
4. **Polybrominated Biphenyl (PBB): 1000ppm (0.1%):** PBB is used in flame retardants and commonly found in molded thermoplastics in electrical appliances, since this substance only decomposes above 300°C. PBB is most commonly used in textiles, plastic foams, laptop cabinets, etc. to make them difficult to burn. PBB has been found in indoor dust and air through evaporation from plastics. PBB can also enter the environment as a result of the incineration of materials containing PBB, as well as during accidental fires.
5. **Polybrominated Diphenyl Ether (PBDE): 1000ppm (0.1%):** An industrial toxic flame retardant, PBDE is commonly used in many consumer products, including mobile phones, remote controls, personal computers and monitors, electronics (wires, circuit boards), cabinet enclosures for electronics, foam cushioning, upholstery, carpet padding, foam-based packaging materials, paint products and adhesives. Because PBDE sheds from these products, PBDE concentrations build up in household dust and indoor air. These chemicals can enter human body by breathing them in or accidentally ingesting dust. PBDE contamination has also become so widespread in our environment that it has moved up the food chain and is now a common contaminant in meat, fish, and dairy products. Human health effects of PBDE occurs during the development of the brain and reproductive organs.
6. **Hexavalent Chromium (CrVI): 1000ppm (0.1%):** Hexavalent Chromium plating is the traditional method to electroplate chromium onto metal parts to provide a decorative or protective coating. Chromium metal is also added to alloy steel to increase hardenability and corrosion resistance. Because of its anticorrosive properties, CrVI is added to paints, primers, and other surface coatings. Chrome plating, however, produces several byproducts which are considered hazardous waste, including lead chromates and barium sulfate. Hexavalent chromium itself is a hazardous substance and carcinogen. CrVI is known to cause cancer and affects the respiratory system and kidneys; therefore, it is heavily regulated. Most automotive OEMs have made efforts to replace hexavalent chromium finishes with more eco-friendly ones. Trivalent chromium plating is another method for chrome plating as an alternative to hexavalent chromium, with many of the same characteristics. This process uses chromium sulfate or chromium chloride as its main ingredient instead of chromium trioxide, making trivalent chromium less toxic than hexavalent chromium. Trivalent chromium has lower toxicity, thus reducing hazardous waste and other compliance costs.

7. **Bis(2-ethylhexyl) phthalate (DEHP, added in 2015): 1000ppm (0.1 %):** DEHP accounts for more than half of the plasticizer industry and almost 60% of that in the Asian markets. It is used in the production of polyvinyl chloride (PVC) and vinyl chloride resins, where it is added to plastics to make them flexible. It is not a toxic substance at the low levels that are usually present in the environment. Increased exposures may come from intravenous fluids delivered through plastic tubing, and from ingesting contaminated foods or water. DEHP is included in the Proposition 65 list because exposure may increase the risk of cancer and birth defects, or other reproductive harm.
8. **Butyl benzyl phthalate (BBP, added in 2015): 1000ppm (0.1 %):** It is a clear oily liquid that is used as a plasticizer mainly in polyvinyl chloride for vinyl floor tiles, vinyl foams, traffic cones, artificial leather, carpet backing, and in cellulose plastics and polyurethane. Workers in the PVC processing industry are exposed to higher levels of BBP than the general public, thus are more at risk of experiencing negative health effects. Although no effects of the respiratory or peripheral nerve system have been observed in workers, long-term occupational exposure to BBP does, however, significantly increase the risk of multiple myeloma.
9. **Dibutyl phthalate (DBP, added in 2015): 1000ppm (0.1 %):** DBP, an organic compound, is commonly used as a plasticizer and is often used in adhesives and inks. It is a colorless oil, although commercial samples are often yellow. It has low acute toxicity through all routes of exposure, and low eye, skin, and respiratory irritation. It is absorbed rapidly if ingested, thus becoming bioavailable in humans. Bioavailability through skin absorption is at a lower rate (5%). Very limited data exists on the absorption of DBP by breathing. DBP has been reported to be non-genotoxic (i.e., it does not cause genetic mutations) in most *in vitro* and all *in vivo* animal tests performed to standard testing guidelines. No adequate long-term carcinogenicity (cancer-causing) studies with DBP in laboratory animals are available. However, based on the information available for genotoxicity, DBP is not likely to be a genotoxic carcinogen.
10. **Di-isobutyl phthalate (DIBP, added in 2015): 1000ppm (0.1 %):** DIBP is an odorless plasticizer and has excellent heat and light stability. It is the lowest cost plasticizer for cellulose nitrate. According to European Union plasticizers, DIBP is considered as a specialist plasticizer often used in combination with other high molecular weight phthalates as a gelling agent. DIBP has a lower density and freezing point than DBP. Since it has very similar application properties to DBP, it is used as a substitute for DBP in most, if not all, of its applications. A common use of DIBP is in making Poly Methyl MethAcrylate (PMMA), or plexiglass. PMMA, a clear plastic acrylic material, is used as a replacement for glass and is commonly used in places where shatter-proof glass or windows are required, such as the puck barriers found in hockey rinks. PMMA is used in signs, lenses, paints, and is also the core material used in plastic optical fiber. Medical devices, however, have special rules. DIBP has shown endocrine disrupting properties based on scientific evidence of probable serious effects to human health and the environment.

Product Categories Requiring RoHS Compliance

The following list shows recognizable categories of products in which their electrical and electronic components comprise substances that would require RoHS compliance:

- **Category 1:** Large household appliances: refrigerators, washer, stoves, air conditioners.
- **Category 2:** Small household appliances: vacuum cleaners, hair dryers, coffee makers, irons.
- **Category 3:** Computing, IT and telecommunications equipment: computers, printers, copiers, phones.
- **Category 4:** Consumer electronics: TVs, DVD players, stereos, video cameras.
- **Category 5:** Lighting equipment: lamps, lighting fixtures, light bulbs.

- **Category 6:** Electrical and electronic power tools (with the exception of large-scale stationary industrial tools) drills, saws, nail guns, sprayers, lathers, trimmers, blowers, and gas / diesel powered equipment with electronics in them.
- **Category 7:** Toys, leisure and sports equipment: video games, electric trains, and treadmills.
- **Category 8:** Medical devices and equipment (these are also affected by the Good Manufacturing Practice (GMP), or Regulation-21 CFR 820.
- **Category 9:** Monitoring and control instruments (including industrial monitoring and control instruments).
- **Category 10:** Automatic dispensers: vending machines, ATMs.
- **Category 11:** All other Electronics, Electrical Equipment (EEE) not covered by any of the categories above.

Product Categories Exempt from RoHS Compliance

The following product categories are currently exempted under RoHS compliance. It is important to note that these exemptions are primarily application or industry dependent:

1. **Military:** Equipment used for defense or national security.
2. **Space:** Equipment sent into space, such as satellites, space probes, telescopes, spacecraft.
3. **Transportation:** Vehicles used for transport (except 2-wheeled electric vehicles).
4. **Research & Development (R&D):** Equipment specifically designed for the purpose of research and development and made available solely on a business-to-business basis. This is to avoid any burden on research, scientific advancement, development, and innovation in the EU.
5. **Non-Road Mobile Machinery (NRMM):** Agricultural products like harvesters, railway, waterway, construction machinery, hydraulic excavators, fork lifts, road maintenance equipment.
6. **Large-Scale Fixed Installations (LSFI):** Elevators (lifts), electrical distribution, HVAC, robotic equipment and lines, conveyor transport systems.
7. **Large-Scale Stationary Industrial Tools (LSSIT):** Computer Numerical Control (CNC) automated milling machines, metal-forming, testing machines, cranes.
8. **Means of Transport:** Cars, commercial vehicles, boats.
9. **Fixed-location Photovoltaic (PV):** Panel installations, panels such as solar panels/arrays.
10. **Active Implantable Medical Devices (AIMDs):** Pacemakers, implanted defibrillators, insulin pumps.
11. **Compact fluorescent bulbs**
12. **Spare parts for equipment in the market before RoHS took effect:** Applies to all **except** for Category 11 products.
13. **Batteries and package materials:** Out of the scope for RoHS since they are subject to different directives EU Battery Directive (2006/66/EC) and Amendment 2013/56/EU. The Battery Directive restricts the use of lead to 0.004%, mercury to 0.0005%, and cadmium to 0.002% (medical devices/equipment and alarm/emergency systems are excluded for cadmium).
14. **Niche Products:** Selected 'niche' products whose inclusion would bring negligible environmental and health benefits when recycled. For example, pipes in organs which are made of lead-based alloys stays in one place for centuries with a very low turnover.
15. **Spare Parts:** Involving repair, replacement of spare parts, retrofitting, refurbishments and reuse – this is primarily to support the circular economy.
16. **Equipment for professional use only:** For example, a non-road mobile machinery with an on-board power source for professional use only, including non-road mobile machinery with a traction drive powered by an external power source.

In addition to the fore-mentioned product categories, Annexes III and IV of RoHS 2 contain certain applications that are exempt from RoHS restrictions, such as cadmium in helium-cadmium lasers. Some RoHS 2 exemptions are time-limited.

RoHS and REACH

RoHS Directive and REACH (Registration, Evaluation, Authorization, Restriction of Chemicals) both developed, released and enforced by the European Chemicals Agency (ECHA) work together. REACH is a horizontal legislation controlling the risks associated with chemical substances throughout their whole life cycle, while RoHS is a product-specific vertical legislation that focuses on hazardous substances in all products containing electrical and electronics equipment (wiring, components, circuit boards, displays, sub-assemblies, cabling). REACH applies to all substances including those used to make the equipment (alloys, paint, solvents, etc) and to chemicals present in finished products (an Article in REACH terminology) of all types.

There is some overlap between RoHS and REACH with respect to restricted substances, namely the four phthalates (plasticizers): DEHP, BBP, DBP, and DIBP, which are now also included in the list of substances subject to REACH authorization in Annex XIV. REACH Annex XIV is also known as the REACH Authorization list and contains a list of substances subject to authorization under EU REACH regulation. The most recent update was on January 15, 2019 and included a total of 197 SVHC (Substance of Very High Concern). A substance of very high concern (SVHC) is a chemical substance (or part of a group of chemical substances) for which it has been proposed that the use within the European Union be subject to authorization under the REACH Regulation.

RoHS allows exemptions, whereas, REACH does not.

RoHS and WEEE

The RoHS directives goal is really to reduce the amount of toxic waste produced by electronics post-use. Collection of waste electrical and electronic equipment (WEEE) and its subsequent recovery and treatment in an environmentally sound manner has been an objective for the European Commission to develop and enforce WEEE Directive 2002/96/EC, in addition to promoting reuse and recycling. The Waste Electrical and Electronic Equipment Directive (WEEE Directive) which, together with the RoHS Directive, became European Law in February 2003. The Directive introduced producer responsibility for WEEE and set a target for collection of WEEE as well as targets for recovery and for reuse and recycling.

The revised version of Waste electrical and electronic equipment (WEEE) Directive 2012/19/EU, published in July 2012 sets more ambitious targets for collection based on the weight of electric and electronic equipment (EEE) put on the market, with a minimum rate of 4 kilograms per head of population per annum recovered for recycling by 2009, and defines staged recovery and recycling targets and extends the scope of EEE covered by the regulation.

RoHS and End of Life Vehicle (ELV) Directives

End of Life Vehicle (ELV), the European Union directive to address the issues related with the disposal of cars at the end of their useful life, relates to passenger cars and light commercial vehicles. ELV covers aspects along the lifecycle of a vehicle, as well as aspects related to treatment operations. The RoHS directive places restrictions on the use of hazardous substances in electrical and electronic equipment (wiring, components, circuit boards, displays, sub-assemblies, cabling). Both directives are essentially

very similar since the automobile must also be free of the hazardous substances on the RoHS list: lead, mercury, cadmium, hexavalent chromium, and the flame retardants polybrominated biphenyls (PBBs), and polybrominated diphenyl ethers (PBDEs) used in plastics.

DXC Technology introduced the International Material Data System (IMDS, <https://www.MDSystem.com>) in 2000 as the result of collaboration between German Automotive OEMs, the chemicals and materials industries, and EDS (now DXC Technology). All materials present in an automobile as sold to a customer are collected, maintained, analyzed, and archived throughout the entire supply chain.

The Data Compliance Management Solution section of this document provides further details.

Who is Responsible for RoHS Directives Compliance?

Business entities that sell products containing electrical and electronics, sub-assemblies, or components directly to European Union countries, or sell to resellers, distributors, or integrators that in turn sell products to European Union countries, are required to have RoHS compliance. They are required to ensure that their products do not contain above the allowable threshold of any of the 10 restricted substances and that the company placing the product on the EU market maintains records to document compliance. Manufacturers need to ensure that any materials and parts suppliers they use are well aware of the RoHS Directive and are capable of assisting the manufacturers in assuring compliance doesn't become an issue. For example, a materials supplier should also have a clear understanding of which materials they supply or use in parts are RoHS compliant. Thus, a close relationship between a manufacturer and their suppliers is essential for RoHS compliances.

Business entities are:

- Manufacturers
- Authorized Representatives
- Suppliers
- Importers
- Distributors

RoHS Certification Process

The RoHS Directive holds electrical and electronic equipment manufacturers and companies directly responsible for the chemical compliance of their products. A typical RoHS certification process includes the following elements:

- **Documentation Review:** Review Bill of Materials, assembly drawings, Materials Declarations for each component and product, test reports and Conformance Certificates.
- **Audit:** Inspect all manufacturing processes needed to meet RoHS compliance for the ten restricted substances.
- **Testing:** Perform on-site portable XRF testing to determine values of the ten restricted RoHS substances.
- **Certification:** After successful audit, issue a RoHS Certificate.

RoHS Testing

RoHS Compliance testing using laboratory methods is chosen by manufacturers, sellers, distributors, and recyclers of electrical and electronic components or equipment sold or used in the European Union. Many

independent laboratories and testing services are now available to companies requiring RoHS testing for product compliance. Testing services from many of the labs can include, not only the EU RoHS Directive, but also testing services for China RoHS, Korea RoHS, and California RoHS requirements. These are usually more expensive solutions.

In addition to materials and substances testing for ensuring RoHS compliance, companies are also required to manage compliance data that involves recording, storing, retrieving, and distributing the compliance data when needed. DXC Technology has been providing a Software-as-a-Service solution for Data Compliance Management (CDX) to enable companies, including suppliers, manage RoHS, REACH and other regulatory compliant requirements. CDX offers a broad RoHS compliance solution, including attachments of necessary records, but does not require companies to attach all the necessary documentation.

Compliance Management Solutions: CDX and IMDS

Compliance Data Exchange (CDX)

Manufacturers, importers, and distributors who place products in European Union marketplace are required to be RoHS compliant. To comply with RoHS, RoHS 2, and RoHS 2 Amendment, they need to obtain information on identification of RoHS compliant substances across the entire supply chain and must maintain compliance with record keeping (records must be kept for 10 years) from everyone in the supply chain.

With the Compliance Data Exchange (CDX) solution from DXC Technology as a material data management solution, this task becomes easier since users can create, search, extract, evaluate, exchange, and retain the information required for RoHS compliance. CDX also maintains data validation rules to simplify the effort of data collection and reduce the possibilities for errors. Lists of regulatory relevant substances and materials, curated by legal and material engineering consultants to ensure high-quality chemical reporting are integral part of CDX. Once your supply chain has helped document your product at the chemical level, CDX compares the collected full or partial chemical product declaration to multiple regulations, including the RoHS directive.

CDX is a cloud-based, highly secured, centrally operated Software-as-a-Service (SaaS) solution optimized for manufacturers and suppliers in virtually any industry and requires almost no IT infrastructure to implement. CDX is accessible through the internet via a web browser.

CDX employs legal advisors, who monitor regulation-defining organizations, such as the European Chemical Agency (ECHA) for new revised regulations and directives, and who update CDX with necessary information.

The CDX [Regulation Wizard](#) walks you and your supply chain step by step through the process of building your product Material Data Sheet (MDS) with a focus on regulatory material product compliance. The Regulation Wizard guides CDX users through reporting against supported legal regulations, corporate responsibility concerns, and product sustainability topics. The Regulation Wizard supports both user-defined and pre-defined substance lists provided by our contracted regulatory and material engineering staff and regulations to simplify provisioning of the required substances to satisfy your reporting needs.

The Web Services Interface (WSI) allows CDX users to leverage data in your current systems and automatically exchange product and supplier data with CDX. The WSI integrates CDX data with in-

house Product Lifecycle Management (PLM), Enterprise Resource Planning (ERP), Environment Health and Safety (EHS), and Product Data Management (PDM) processes and systems in your environment. This includes internal workflows to support product development and reporting.

CDX automatically matches the assigned substances in a Material Data Sheet (MDS) with the regulations that are considered in scope for the company, RoHS and REACH being a few regulations amongst many. A CDX user can use CDX to search and display any potential violations of regulations regarding limits, exceptions, and expiration dates. Reports generation and analysis tools in CDX makes management of REACH compliance for a company much easier.

In addition to RoHS, CDX also addresses other compliance topics, including China RoHS, and other jurisdictional variations, California Proposition 65, Batteries, Packaging, ELV/GADSL, HKC, Conflict Minerals reporting, and many others. CDX supports data collection and reporting using its own optimized user interface, or via data import and export using IMDS-AI, IPC-1752A, IPC-1754, IPC-1755, IEC-62474, CMRT, and .XLS formats.

CDX contains standardized material declarations for thousands of materials produced to an industry standard and aids in the collection of product declarations from your supply chain to assist your company in building complete, accurate, and secure product declarations.

As a Software-as-a-Service (SaaS) Digital computing Cloud analytics service, CDX is available now, and ready to use with no complex IT requirements or in-house implementation tasks required. Companies and their supply chain can begin using CDX immediately after registering at the CDX website (www.CDXSystem.com).

International Material Data Systems (IMDS)

The International Material Data System (IMDS, <https://www.MDSsystem.com>) was introduced in 2000 in response to ELV with collaboration between German Automotive OEMs, the chemicals and materials industries, and EDS (now DXC Technology). Originally a way for the auto makers to meet their obligations under ELV, the IMDS community has since broadened to include virtually all global automotive manufacturers and their supply chains, addressing a much broader range of product material compliance regulations and concerns.

IMDS is a cloud-based, highly secure, materials data management system, and it is accessed through the internet via a web browser. All materials present in an automobile as sold to a customer are collected, maintained, analyzed, and archived throughout the entire supply chain. The automobile manufacturer using IMDS can easily obtain all the necessary data for meeting REACH compliance, including declaration and management of substances. IMDS supports recyclability and recoverability of materials in an automobile and addresses the disposal of substances of concern.

The automotive industry guidelines on REACH have recommended that IMDS be used for collecting information on SVHCs in articles. Thus, the entire automotive industry is in an advantageous position, when compared with other industries, since it can comply with several REACH obligations easily and communicate (REACH Article 33) the data without developing new tools or processes.

Appendix: RoHS Worldwide

<p>U.S. California RoHS (SB20/SB50) Compliance</p> <p>Effective January 1, 2007</p> <p>California Senate Bills SB 20 and SB 50 contain both RoHS and WEEE-like provisions.</p>	<p>California RoHS is narrower in scope than EU RoHS.</p> <ul style="list-style-type: none"> • Restricts only lead, mercury, cadmium and hexavalent chromium and not the other six substances covered under EU RoHS 2 Amendment. • Only applies to "covered electronic devices" that are defined as standalone LCD, plasma, and CRT video displays with a screen greater than four inches diagonally. • Displays integrated into other equipment do not apply.
<p>China RoHS</p> <p>Effective 1 March 2007.</p> <p>Known as the Administrative Measure on the Control of Pollution Caused by Electronic Information Products (ACPEIP).</p> <p>Note: China RoHS also used to be referred to as RPCEP (Regulation for Pollution Control of Electronic Products).</p>	<p>China RoHS has product marking requirements for the six EU RoHS restricted substances for all applicable products, whether it is compliant or non-compliant.</p> <ul style="list-style-type: none"> • Disclosure can be at the component or at the sub-assembly level. • It has to be in a prescribed format in Chinese as detailed in "Marking for the control of Pollution Caused by Electronic Information Products". • A sticker with the Environment Friendly Use Period (EFUP) is applied. • List the period-of-time in years before any of the RoHS substances are likely to cause possible harm to health or the environment.
<p>Japan RoHS (J-MOSS)</p> <p>Effective April 2001</p> <p>Also used to be referred to as Japan Green Procurement Survey Standardization Initiative (JGPSSI).</p> <p>It amended the Resource Recycling Promotion Law of 1991 which relied upon voluntary initiatives.</p>	<ul style="list-style-type: none"> • EU RoHS has a defined focus on restricting certain hazardous substances for one specific industry (electrical and electronic equipment) but the Japan RoHS is more comprehensive. • The "Law for the Promotion of Effective Utilization of Resources" seeks to establish a sustainable society based on: <ul style="list-style-type: none"> ○ reduction, reuse, and recycling • Construction companies and electric utilities are targeted as well as a wide range of manufacturers.

<p>Korea RoHS Compliance</p> <p>Effective January 1, 2008</p> <p>Act for Resource Recycling of Electrical and Electronic Equipment and Vehicles went into effect as Korea RoHS.</p>	<p>Korea RoHS restricts the six substances with the same limits as EU RoHS 2 for electrical and electronic equipment.</p> <ul style="list-style-type: none"> • Vehicles under 3.5 tons are also impacted under the first 4 substances (cadmium, mercury, lead, and chromium (Cr6+). The definition of vehicles is adopted from Article 2(1) of the Automobile Management Act. No mark or certification is required. • Korea's equivalent of the EU RoHS, WEEE, and ELV directives adopts an Eastern approach by including "design for the environment" in its requirements. • Implementation is geared toward improvement in product design and recycling technology as they become technically and economically feasible.
<p>Norway RoHS Compliance (PoHS)</p> <p>Effective December 20, 2011</p>	<ul style="list-style-type: none"> • Restriction on lead (at 0.01% vs. 0.1% for EU RoHS), PCP, PFOA and MCCP, of which lead is the only common substance with EU RoHS. • Also known as PoHS (Prohibition on Certain Hazardous Substances in Consumer Products), it is more of a general consumer product legislation rather than for EEE equipment.
<p>India RoHS Compliance</p> <p>Effective May 2014</p>	<ul style="list-style-type: none"> • Restricts the same six substances at the same thresholds as EU RoHS, but with a differing scope of products.
<p>Ukraine RoHS Compliance</p> <p>Effective March 10, 2017</p> <p>Also known as Technical Regulation Decree No. 139, was approved by the Cabinet of Ministers of Ukraine.</p>	<ul style="list-style-type: none"> • This decree supersedes the original Decree No. 1057 from 2008 • Ukraine RoHS follows EU RoHS 2 Amendment (2015/863) in the restriction of 10 substances (6+4) in 11 EEE product categories and with the same exemptions.
<p>UAE RoHS Compliance</p> <p>Effective January 1, 2018</p> <p>UAE Cabinet Decision No. 10/2017 RoHS will be enforced.</p>	<ul style="list-style-type: none"> • ROHS will be enforced in Abu Dhabi, Ajman, Dubai, Fujairah, Ras al-Khaimah, Sharjah, and Umm al-Quwain. • Requires companies to provide a national UAE RoHS Declaration of Compliance (DoC), associated documentation, and obtain a certificate to put products on the UAE market. • Unlike EU RoHS, this information would only be required by regulatory agencies if there was a suspected compliance issue.
<p>Singapore RoHS</p> <p>Effective June 1, 2017</p>	<ul style="list-style-type: none"> • Prohibits the use of the six RoHS substances used in the following products: mobile phones, laptops, flat-panel TVs, refrigerators, air conditioners, and washing machines. • Details are available at: Singapore RoHS vs EU RoHS.

<p>Adopted by Singapore Ministry of the Environment and Water Resources (MEWR)</p>	
<p>Turkey RoHS Compliance</p> <p>Effective June 2019</p> <p>Created by the Turkish Ministry of Environment and Forestry and includes manufacturers and sellers of electronic goods and includes products which are supplied by others under their own brand names.</p>	<ul style="list-style-type: none"> • Manufacturers must keep documentation showing that products they introduce to the market meet the criteria for legislation for 5 years starting from the date the product is released to the market. • Manufacturers must also submit a Conformity Declaration Form to the Turkish government every year.
<p>Brazil RoHS Compliance</p> <p>Draft proposal submitted in Summer 2018.</p>	<ul style="list-style-type: none"> • A working group presented a draft proposal that aligns closely with EU RoHS before the National Environment Council (Conama) in summer, 2018.
<p>Eurasian/Russian RoHS Compliance</p> <p>Passed on March 1, 2018</p> <p>Must comply by March 1, 2020</p>	<ul style="list-style-type: none"> • The Eurasian Economic Union (EEU) member states of Armenia, Belarus, Kazakhstan, Kyrgyzstan and Russia passed RoHS legislation on March 1, 2018. • It has aligned its regulations with the EU RoHS. • This is known as CU TR 037/2016 or EAC RoHS. • EEU member states will have until March 1, 2020 to comply.

Definitions

Certificate of Conformity

A document given to exporters or importers to show that the products bought or supplied meet the required standards. The document is usually required during customs clearance of goods to some countries. In legal circles, a Certificate of Conformity is a document given by an officer of court to certify that an affidavit conforms to the law.

Declaration of Conformity

A document in which the manufacturer declares their product is in **compliance** with the provisions of the European Commission.

EEE

Electrical and Electronic Equipment means an equipment which is dependent on electrical currents or electromagnetic fields in order to work properly and equipment for the generation, transfer and measurement of such currents and fields and designed for use with a voltage not exceeding 1000 Volts for Alternating Current and 1500 Volts for Direct Current.

ECHA

The European Chemicals Agency (ECHA) is an agency of the European Union which manages the technical and administrative aspects of the implementation of the European Union regulation called Registration, Evaluation, Authorization and Restriction of Chemicals.

RoHS and REACH

Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH) is a general regulation that addresses the production and use of chemical substances and their potential impact on human health and the environment. REACH is monitored by the ECHA. While RoHS bans substances present in electrical and electronic equipment, REACH controls all chemicals that might be used to make a product, including solvents, paints, and chemicals.

RoHS and WEEE

WEEE compliance aims to encourage the design of electronic products with environmentally-safe recycling and recovery in mind. RoHS compliance dovetails into WEEE by reducing the amount of hazardous chemicals used in electronics manufacture. RoHS regulates the hazardous substances used in electrical and electronic equipment, while WEEE regulates the disposal of this same equipment.

SVHC

A substance of very high concern (**SVHC**) is a chemical substance (or part of a group of chemical substances) for which it has been proposed that the use within the European Union be subject to authorization under the REACH Regulation.

WEEE

WEEE is the acronym for Waste from Electrical and Electronic Equipment. WEEE, also known as Directive 2002/96/EC, mandates the treatment, recovery and recycling of electric and electronic equipment. A revised version of Waste electrical and electronic equipment (WEEE) Directive 2012/19/EU,

was published in July 2012 and it sets more ambitious targets for collection based on the weight of electric and electronic equipment (EEE) put on the market.

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