Siemens PLM Software

Substance compliance for sustainability: Turning requirements into opportunities

White Paper
A plan to succeed
Co-authored by Siemens PLM Software and thinkstep

Siemens PLM Software’s solution for substance compliance helps manufacturers develop products that comply with government-mandated environmental regulations. Companies that leverage compliance as an integral element in their lifecycle processes (as opposed to treating compliance only as an event) gain competitive advantage by getting their products to market faster and more cost effectively.
Contents

Executive summary .......................................................... 3
Business challenges .......................................................... 4
Compliance in the context of sustainability .................... 5
Substance compliance with Teamcenter and NX .......... 6
Elements of the Teamcenter substance compliance solution ......................................................... 8
Conclusion ........................................................................ 9
Appendix ........................................................................... 10
Executive summary

“We are continually faced by great opportunities brilliantly disguised as insoluble problems.”
Anonymous

Substance compliance is a major challenge for manufacturers operating in today’s global marketplace. Thousands of materials used in product development are tightly regulated by local, state, country and regional directives. In addition, original equipment manufacturer (OEM) requirements, branch-specific industry standards and voluntary company targets need to be managed. To compound this challenge, the list of materials, exemption values and sunset dates, the number of Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) substances of very high concern (SVHCs) and the levels of regulation are constantly changing to meet environmental concerns, improve resource management and avoid supporting geopolitical conflicts and human rights abuses.

OEMs and their suppliers must report the quantities and concentration levels of every substance used in their products – sometimes even those substances used in the process of building these products – to regulatory bodies, supply chain partners, OEMs and the OEM customer. Failure to comply with these regulations can result in severe penalties including costly administrative or criminal fines, closing of factories, rework and scrap write-offs, and even the risk of being banned from a key market. A single incident for one high tech company resulted in $130 million (US) in direct costs for having to rework noncompliant products and missed sales. Such incidents can greatly damage a company’s image and brand for many years.

Corporate social responsibility initiatives like the US Conflict Minerals law must also be taken into consideration. For example, every cell phone, tablet computer or flat screen TV sold today potentially contains mined substances that help fund a civil war in the Democratic Republic of Congo (DRC). Sanctions against the use of conflict minerals in products are increasingly being enacted, and complying with these regulations can be complex, costly and difficult.

The advantages of a sound substance compliance strategy include the ability to:

• Intelligently integrate material and substance information into your design environment, providing a single source of accurate and compliant data to support Design for the Environment (DfE) initiatives
• Minimize errors and rework costs by automating the data exchange of material and substance declarations with suppliers as early as possible
• Reduce risk of significant fines, restricted market access and damage to brands by tracking and reporting substances of concern that are used in a product

Substance compliance can actually be a competitive opportunity, if it is built into your company’s product development process.
Business challenges

Today, most people expect lead-free gas, an asbestos-free workplace and increasingly, smoke-free restaurants. Tomorrow, they will assume that the electrical and electronic equipment they use will be completely free from hazardous substances and will likely be informed about “reportable substances” like SVHCs. Today, most people are accustomed to recycling newsprint, aluminum cans and glass. Tomorrow, they will be used to recycling the materials and components that comprise their electronic products. Changes like this are endemic in today’s fast-moving modern economy and can adversely impact a company’s financial success unless they are fully anticipated and systematically addressed. This will be supported by the new Resource Efficiency and Circular Economy initiatives in several regions.

This is why companies that produce products and the supply chains that support them need to understand the overriding rationale, scope, implications and potential consequences of regulations such as the European Union’s REACH and Restriction of Hazardous Substances (RoHS) directives, the upcoming Conflict Minerals Law in Europe and the U.S. Dodd-Frank law as well as the immediate requirements associated with these specifications.

Noncompliance can damage the competitive position of manufacturers already struggling with the ebb and flow of today’s global economy. Material and component suppliers that fail to comply with new compliance-related reporting requirements can be devastated by the loss of a major customer. At the bottom line, these issues carry with them a monetary risk that needs to be mitigated.

Figure 1: Complexity of global substance information and restriction management.
Compliance in the context of sustainability

“WAGO is keenly aware of its responsibility towards employees, customers, the environment and future generations. We underscore our commitment through the design of products that are reliable, maintenance-free, conserve space and cost, increase productivity, minimize failure, and thus decrease waste. We also accomplish this through minimizing/monitoring use of hazardous substances in our products and processes and through prudent utilization of waste materials and packaging.”

WAGO

There are five domains in the realm of corporate sustainability: environmental health and safety (EH&S), design for the environment (DfE), corporate energy and carbon, plants and building optimization and overall supply chain integration. DfE is about developing products in a way that reduces their environmental impact. The aim is to design products that are functional, attractive and cost-effective and have no harmful side effects for human health or the environment. One of the foundation elements of DfE is the ability to monitor the “substances of concern” during and after the product development process. Traditionally this activity is done after the design has reached maturity. The new paradigm is to track the substances of concern starting with early design.

Global OEMs and their supply chains not only need to choose materials that are compliant with substance regulations, but they also need to move beyond basic compliance with a sustainability strategy that phases out or replaces current components and materials with new “green” ones. In addition to substances of concern, DfE elements also include multi-domain optimization, materials and process management, requirements management and lifecycle assessment (LCA). LCA initiatives, which help companies measure and understand the environmental impact of their products throughout their entire lifecycle, can be coupled with materials and requirements management to deliver a comprehensive understanding of how to build sustainable products. Overall supplier integration into the product development process is also an important factor in helping companies achieve sustainability goals.

Addressing environmental objectives at the start of the design process is the most cost-effective way to reduce potential legal and reputational risk. By embedding DfE in the new product design process as part of good design practice, companies can achieve significant cost savings.

Companies can trace requirements from product design to the manufacturing process, and then on to the product in-service. Requirements management ensures that program and product targets are set correctly upfront. You can look ahead in the product lifecycle and include environmental considerations for each phase, establishing the sustainability objectives of the product and process from the start. With requirements traceability, you can track requirements and the responsible parties (including supply chain) for each requirement throughout the process to ensure that critical deliverables are met.

Incorporating new processes and technologies to support environmental compliance and sustainability initiatives can initially seem cumbersome and costly to companies. However, studies have indicated that the effort is well worth the initial expenditures. According to the Harvard Business Review in their article “Why Sustainability Is Now the Key Driver of Innovation,” companies that foster sustainability as a business objective (versus just a corporate social responsibility) can lower their costs by reducing the inputs that they use and yield top-line returns by producing better, more innovative products.
Substance compliance with Teamcenter and NX

“The foundation to any sustainability program is compliance. Without being compliant to regulatory laws companies are putting their business and all of their customers at risk. Compliance not only ensures competitiveness through sustainability excellence but also enables reliable product development across the whole supply chain.”

Michael Betz, Co-founder of thinkstep

According to the Americas Society of Mechanical Engineers (ASME), nearly 75 percent of the manufacturing cost of a typical product is committed by the end of the conceptual phase, meaning that only 25 percent of a product’s cost can be influenced by decisions made after this time. Likewise, environmental decisions made early in the design process reduce the costs of changing these later, and are critical to ensuring environmental requirements are captured early, not as an afterthought.

The Teamcenter® software substance compliance solution from Siemens PLM Software helps companies address environmental decisions early in the product development process. Substance compliance is a fully integrated solution and natural extension of the Teamcenter PLM platform. The data model has been extended to manage specific product materials and the substances used in the development of products. All material and substance definitions and their relationships to parts and products are managed using Teamcenter.

Management of material and substance information combined with core Teamcenter capabilities such as program and process management, configuration and change management, requirements management and document management provide companies with an intelligently integrated PLM system to address current and future sustainability goals. Support of supplier integration throughout the product development process is also a key element to addressing efficient, green design. Suppliers are able to participate in the material and substance compliance process via Teamcenter workflow and the Microsoft® Office integration to Teamcenter. In addition, users of NX™ software can now search for approved materials and create material assignments to the NX parts as they design products. This supports “where used” reporting on materials using Teamcenter to find out exactly which products use a given material.

Key features and benefits of this solution include:

Managing materials and substances to trace them across a product bill of materials (BOM) to identify their impact to the value chain

Teamcenter allows you to manage a BOM down to its constituent materials and substances and drill down to a constituent substance in a BOM tree and roll up material and substance amounts across a whole product or manufacturing process. Material information can be leveraged across Siemens PLM Software applications to support DfE and other product sustainability initiatives.

Automating the processing of supplier material and substance declarations

Teamcenter helps improve accuracy and reduces labor and data transmission costs, with capabilities including routing declaration forms to suppliers to request material and substance disclosure, automatic processing of material substance declarations received from suppliers, and the ability to leverage Microsoft Office integrations to import, update and bulk edit material and substance data.

Standard as well as company-specific rule sets for compliance grading

Your company can now choose the best option to maintain compliance with regulations. Preconfigured rule sets created by thinkstep® are available to address standard industry regulations such as REACH, RoHS and conflict minerals. The system enables conditional and flexible processing of compliance status based on your business process. You can even write and update your own list of regulated substances and rule sets for specific regulatory bodies or internal business specifications.

Compliance reporting

Users can quickly produce reports to demonstrate product compliance or noncompliance. You can build and run queries to report on the compliance status of products and structures, easily tailor output to match various standard formats (for example, IPC-1752) and view material and substance information in a dashboard format to clearly understand product contents and compliance status. In addition, you can leverage NX high definition 3D and lifecycle visualization reporting to quickly generate color-coded 3D models.
Rules Editor
The Rules Editor helps subject matter experts to develop rules used for compliance grading against BOMs in Teamcenter.

Companies rely on the proactively delivered regulatory interpretations from thinkstep, as well as additionally focused substances going beyond the compliance needs.

Rules Editor is provided as an application dedicated for compliance officers and consultants to edit their specific compliance regulatory rules. This enables the creation of client-specific rules, often put in place to track internal guidelines as well as specifically requested and enforced rules coming from the demand chain and OEMs. After successful creation and approval steps, these rules are published into Teamcenter, which grades the bills of materials according to the selected standard regulations plus the custom rules created by the Rules Editor. Tracking those regulations can be set up by substance or groups thereof, to which the rules are mapped accordingly.

As an added value, with the Rules Editor users are able to manage their own internal guidance and rules on specific handling of critical substances and materials without programming skills and completely independent from any service provider.

DfE framework
A sustainability framework that supports the effective management of product requirements is critical to enabling sustainable product design. Teamcenter traces requirements from product design to the manufacturing process and on to the product in-service. Requirements management ensures that your program and product targets are set correctly up-front. Users can look ahead in the product lifecycle and include environmental considerations for each phase to establish the sustainability of the product and process from the start. With requirements traceability, users can track those requirements throughout the process to ensure that critical deliverables are met. Also important is the ability to see where impacts occur when considering changes to requirements.

Integration with third-party applications
In addition to Teamcenter integrated material management of your materials library, you can leverage best-in-class resources to ensure complete data and accurate results, including material providers such as Granta, thinkstep and WIAM. You can also integrate to International Material Data System (IMDS), import MatML files for content and exchange information with supplier data warehouses such as BOMcheck.
Elements of the Teamcenter substance compliance solution

Developing environmentally compliant products is a must for any company that competes in today’s global marketplace. In practical terms, this means product makers must capture and report on the material content of their product offerings. In essence, this requirement arises from the need for product makers to verify that their products are free of hazardous substances and are comprised of components and materials that are able to be widely recycled.

The core of Teamcenter substance compliance is a rich set of functionality that enables OEMs and suppliers to declare the substance composition of parts and identify substances that are controlled by various regulatory agencies. Substance compliance leverages the compliance process manager (CPM) tool from thinkstep® to check a product BOM for specific substances in accordance with environmental compliance regulations. Product developers can easily capture detailed material and substance data that pertains to each of the components provided by the product’s various suppliers. Once the material and substance data is captured, product developers can relate this data to a hierarchical model that fully defines a part in terms of its underlying substances, material composition, technical materials, part composition and environmental part data.

The Teamcenter solution is equally adept at handling newly manufactured parts, as well as previously qualified parts. Rapid data capture is facilitated through the use of standard Teamcenter import/export facilities including its support for common exchange standards. After the part model is in place, product developers are able to analyze compliance at multiple levels, including at the manufactured material level (for example, to determine RoHS compliance) and at higher levels (for example, to facilitate multi-source worst case analyses or multi-level aggregations for entire BOMs).

The integration between the Teamcenter requirements management solution and the PLM infrastructure allows product developers to extend compliance analysis through downstream lifecycle processes. As a result, products can be designed upfront for re-use and recycling. This enables enterprises to incorporate compliance validation into standard processes driven by Teamcenter change management, and to work with virtually any CAD system, part qualification and strategic sourcing solution.

Users can also leverage standard interfaces and formats including IMDS, BOMCheck and IPC-1752, to distribute a wide variety of reports and configurable applications to the design and quality assurance teams.
Conclusion

The Teamcenter substance compliance solution enables product manufacturers to link compliance-related requirements and material data to all of the processes that support the product lifecycle. As a result, OEMs and suppliers in all industries can gain full end-to-end visibility to all of the product-related regulatory compliance issues that impact their own organizations, as well as their supply chains. This enables companies to drive hazardous substances out of their product offerings and avoid serious compliance-related problems including product recalls, regulatory fines, product bans, customer dissatisfaction and brand value/image damage.

The Teamcenter sustainability solution enables you to analyze and track compliance at the substance, material, part and product levels. As your single-source of all product and process knowledge, Teamcenter enables you to centrally manage compliance.

Teamcenter-enabled PLM enables companies to strengthen their compliance initiatives by facilitating an overall compliance framework. Companies are able to meet the requirements of regulatory compliance in the same PLM environment they use to accelerate product development and increase their product introduction capacity. By applying a comprehensive PLM strategy to your product development process you not only reduce the costs associated with becoming compliant and maintaining compliance, but also ensure that products are designed right the first time, thereby maximizing your return on investment.
Appendix

RoHS

Substance compliance directly impacts a manufacturer’s ability to meet the eurozone directives on the Restriction of Hazardous Substances (RoHS) that limit the use of hazardous substances in electrical and electronic products. Manufacturers are required to respond by implementing a first round of compliance-related activities.

Affected substances

Manufacturers are required to comply with RoHS by demonstrating that their products do not contain more than the maximum permitted levels of:

- Lead (Pb)
- Mercury (Hg)
- Cadmium (Cd)
- Hexavalent chromium (Cr VI)
- Polybrominated biphenyls (PBB)
- Polybrominated diphenyl ethers (PBDE)
- Bis (2-ethylhexyl) phthalate (DEHP) (0,1 %)
- Butyl benzyl phthalate (BBP) (0,1 %)
- Dibutyl phthalate (DBP) (0,1 %)
- Diisobutyl phthalate (DIBP) (0,1 %)

The maximum permitted levels are 0.01 percent by weight for cadmium in any individual homogeneous material and 0.1 percent for the other substances. Initially, there was some debate as to the definition of a “homogeneous material” and whether this reference applies to a component or assembly. This has been clarified and a “homogeneous material” is now known to be a single substance such as a plastic (e.g., the plastic used in the insulation of a wire is considered to be a single substance). The assembly of “wire + insulations” is not considered to be a single substance, but rather a component. A component may contain several different materials, each of which must be considered separately.

Exemptions

The RoHS directive lists several significant exemptions, but these mainly relate to the use of materials in nonplastic applications. A full list of current exemptions appears in the annex to the RoHS Directive. Additional product and application exemptions have been requested.

Where the affected substances are likely to be used in plastics

In most cases, the affected materials have already been phased out for plastics processing because of rising environmental concerns. Examples of previous uses include:

- **Lead.** Lead-based stabilizers have been used in PVC in the past for a variety of uses but have largely been superseded by other stabilizer systems such as Ba/Ca/Sn systems.

- **Cadmium.** Cadmium has been used as a red colorant in many places in the past, but has been replaced by alternative colorant systems.

- **Hexavalent chromium.** This material has been used in metalizing of plastics and is being rapidly phased out by alternative processes that are less environmentally damaging.

- **PBB and PBDE.** These substances have been used as flame retardants in a range of plastics but the substitution of other flame retardants has already taken place in many instances.

The restriction of DEHP, BBP, DBP and DIBP shall apply to medical devices, including in vitro medical devices, and monitoring and control instruments, including industrial monitoring and control instruments placed on the market before 22 July 2021.

The restriction of DEHP, BBP and DBP shall not apply to toys which are already subject to the restriction of DEHP, BBP and DBP through entry 51 of Annex XVII to Regulation (EC) No 1907/2006.

Companies need to start now in the design process to assess if material alternatives are necessary.
REACH

Designed to replace more than 40 existing directives with one overarching regulation, the Registration Evaluation and Authorization of Chemicals (REACH) policy consists of 1,000 pages of legal text and technical annexes. It has been described as one of the most complex texts in the history of the EU.

From a manufacturer’s perspective, REACH can be viewed as part of an escalating regulatory trend – one that places increasing responsibility on manufacturers regarding the environmental and health impacts of their products.

REACH is much larger in scope compared to other EU regulations, impacting more industries, more products and concerning many more substances than RoHS.

It’s been estimated that REACH will eventually affect 1,500 to 3,000 substances of very high concern (SVHC), which will be either authorized or prohibited under the regulation.

These regulatory ideas originated in the EU, but similar regulations are being developed throughout the world. As a result, manufacturers will find it increasingly complex and costly to develop and market globally compliant products.

Examining REACH in detail

REACH entered into force on June 1, 2007 and is intended to ensure that all chemicals are tested and used in safe ways. It requires all chemicals of one ton or more in volume that are produced or imported into the European Union each year to be tested and registered with a new central European authority – the European Chemicals Agency (ECHA) located in Helsinki, Finland. And although REACH certainly affects chemical manufacturers, it also has a profound impact on the makers of all products – even those not sold in Europe.

REACH also regulates chemicals that are considered to be of very high concern to human health or the environment – regardless of volume.

Producers and importers of these substances of very high concern may be required to investigate their effects on human health and the environment and may require specific authorization from the ECHA for use. So, whether your company makes computers, automobiles, toys or textiles – or the components that go into these products – you need to understand REACH and take action now to get your products ready for REACH.

The new REACH agency – the ECHA – oversees the four key procedures of the law:

1. Registration: Registration is an information gathering and risk management exercise. Manufacturers of substances that are imported into the EU in quantities over 1 metric ton per year must register these substances by submitting a dossier which includes data on the chemical’s properties, uses and safe management. The goal is to have one registration per substance so companies may have to register jointly.

2. Evaluation: The agency evaluates the registration information to determine the chemical’s hazards and risks.

3. Authorization: Authorization applies to SVHCs and will be company-specific, use-specific and time-limited. Lists of candidate and official SVHCs will be issued on a rolling basis. The 1 metric ton threshold doesn’t apply to authorization.

4. Restriction: The goal of authorization is to find safe alternatives for the SVHCs and eventually restrict, or ban, these substances for specific uses.

The Regulation also calls for the progressive substitution of the most dangerous chemicals when suitable alternatives have been identified.

Conflict Minerals

Consumers in the United States have begun to realize that minerals used in many products are often mined in conditions associated with human rights abuses. The Dodd-Frank Wall Street Reform and Consumer Protection Act, signed into law in July, 2010 requires companies registered with the US Securities and Exchange Commission (SEC) to disclose whether or not their products contain minerals originating in the DRC.

The minerals in question include tin, tungsten, gold and tantalum, among others. Tantalum is refined from a metallic ore known as coltan, and is used to manufacture capacitors used in electronic products.

There is a new EU Conflict Minerals Law underway which will require similar initiatives throughout the EU.

* thinkstep is the global market leader in strategic consultancy, software solutions and extensive services in the field of sustainability.
About Siemens PLM Software
Siemens PLM Software, a business unit of the Siemens Digital Factory Division, is a leading global provider of product lifecycle management (PLM) and manufacturing operations management (MOM) software, systems and services with over nine million licensed seats and more than 77,000 customers worldwide. Headquartered in Plano, Texas, Siemens PLM Software works collaboratively with its customers to provide industry software solutions that help companies everywhere achieve a sustainable competitive advantage by making real the innovations that matter. For more information on Siemens PLM Software products and services, visit www.siemens.com/plm.

About thinkstep
thinkstep enables organizations worldwide to succeed sustainably. Our industry-leading software, data and consulting services, built on our integrated enterprise software platform thinkstep.one, help businesses drive operational excellence, product innovation, brand value and regulatory compliance. With a global presence in 19 countries we serve more than 2,000 companies, including 40 percent of the Fortune 500, such as BASF, Hewlett-Packard, Interface, Renault, Siemens and Unilever. For more information visit, www.thinkstep.com.