Transportation in Transition

PROVIDING SERVICES TO MEET THE NEEDS OF AN AUTOMOTIVE INDUSTRY IN TRANSITION

UL has been involved within the automotive industry for over 100 years. UL serves leading automotive original equipment manufacturers (OEM's) and their key supply chain partners to bring leading automotive technologies to the market. UL's involvement starts with the design of the product, including material selection, through supply chain management and production and finally to helping with marketing of the product. UL works with key international regulatory agencies, local authorities having jurisdiction (AHJ's) and manufacturers on the development of consensus based standards and services that apply to emerging technologies within the automotive industry. You can count on UL for intelligent, proactive and cost-effective services designed to serve the automotive industry. Consider the value that UL brings with its global footprint of laboratories and workforce that can best match and meet your global needs within the automotive industry.

For more information on any of the programs mentioned in this booklet, or for questions about other UL services, please feel free to contact one of the following staff on our Global Automotive Team:

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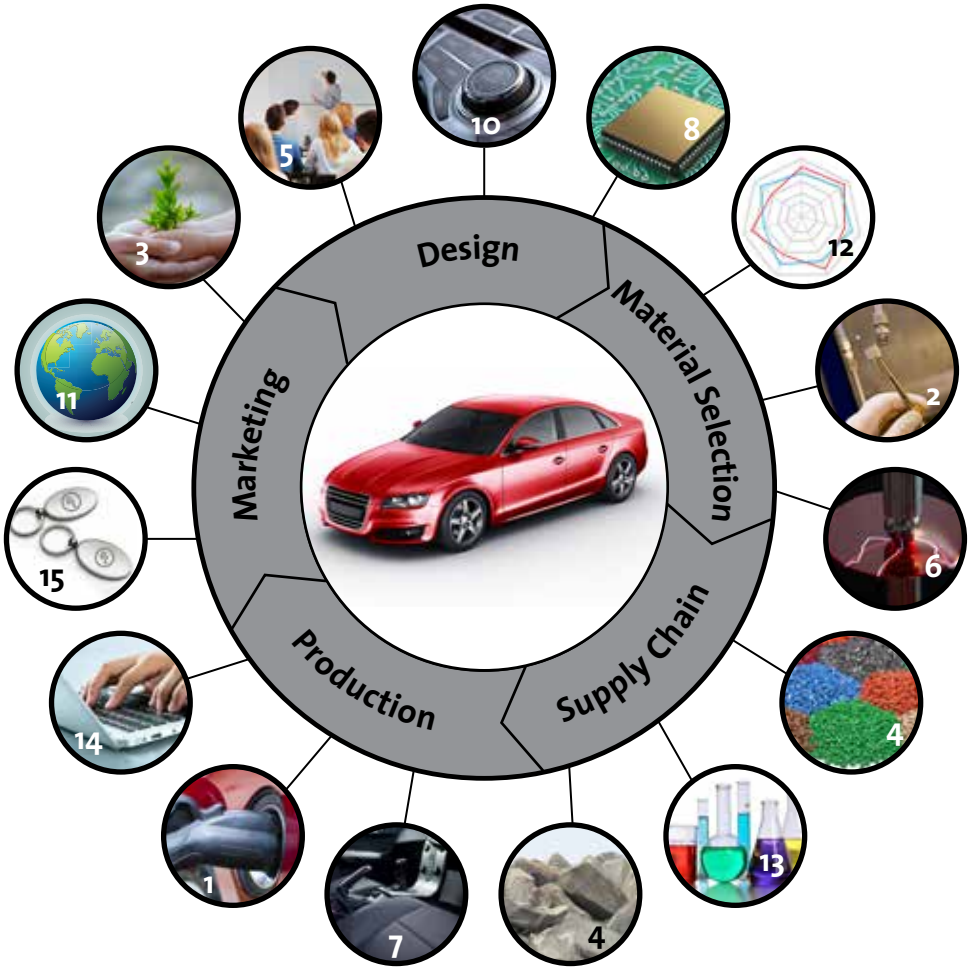

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Touch to start...

Building a New Electric Vehicle Infrastructure

Electric Vehicles will connect consumers to a new energy infrastructure that empowers them to take control of their energy costs – and their environmental footprint. It will also accelerate the use of plug-in electric vehicles and the infrastructure components that support them.

By 2050, widespread adoption of plug-in hybrid electric vehicles can reduce greenhouse gas emissions from vehicles by more than 45 metric tons—the equivalent of removing 82.5 million vehicles from the road.

UL's EV Charging Systems & Infrastructure Program

You can help fuel this growth by developing EV infrastructure components that meet emerging standards for safety, accuracy and interoperability with other Smart Grid technologies. UL works directly with EV original equipment manufacturers and companies throughout the EV supply chain to test grid connection equipment. UL currently offers certification and validation for EV infrastructure components which include:

- Electric vehicle on/off board chargers (charging systems)
- Electric vehicle power inlets (plugs, receptacles and couplers)
- Electric vehicle power outlets (charging stations)
- Electric vehicle portable indoor/outdoor cord sets
- Electric vehicle charging system personal protection equipment
- Electric vehicle cable
- Electric vehicle wireless charging

Surpassing EV Safety Standards

EV charging systems require safe installations and safe integration with household systems to protect consumers and their household data and to prevent electrical fires, short-outs, power surges and power leakages. UL has the knowledge and experience to help you differentiate your products by testing and certifying next-generation components for compliance with the National Electrical Code® (NEC).

Because Electric Vehicles are still developing, manufacturers must monitor the landscape carefully and stay abreast of both the technical features required for new products and the changing regulatory and compliance environment. UL has tested and certified plug-in hybrid electric vehicle technologies for more than 10 years and continues to update and develop new Standards as the market evolves. That makes UL an experienced resource to support you throughout the product development process.

UL Environment

UL Environment helps manufacturers capture value for their sustainability efforts, advances the recognition of healthier, more sustainable products, and helps bring trust and transparency to the marketplace. The market is demanding healthier, safer, more sustainable products — and the automotive industry is no exception.

Sixty-five percent of consumers globally agree that they would purchase more environmentally responsible products if companies' health and environmental claims were more believable. UL Environment offers solutions to help auto manufacturers to meet and exceed those expectations.

Chemical Emissions Testing

Chemical emissions testing uses advanced technology to detect and measure emissions of volatile organic compounds (VOCs) from products and components. These emissions can pose a health threat, which is why it is critical to understand product emissions during research and development.

UL evaluates materials to determine their impacts on human health. Whether an automotive manufacturer needs to meet requirements of environmental certifications or regulations, or simply wishes to have a better understanding of a product for legal, odor evaluation, or risk assessment purposes, UL is your partner for developing healthier vehicle interiors.

Environmental Claim Validations

Environmental claim validations help manufacturers communicate their products' environmental achievements though the use of the UL validation badge equipping them with a powerful tool for differentiation. UL Environment works closely with automotive manufacturers to tailor the validation process to meet their specific needs and goals.

- **Bio-Based:** Bio-based content encompasses materials derived from renewable biological resources. UL Environment can validate, through an audit process, the use of content that improves manufacturing responsibility by substituting bio-based materials for fossil energy-based materials.

- **Recycled Content:** UL Environment validates the post-consumer, pre-consumer (post-industrial) or total recycled content of a product to help manufacturers communicate their product's unique environmentally-preferable attributes clearly and credibly.

- **Zero-Waste:** There are three types of landfill waste diversion claims eligible for validation: Zero Waste to Landfill (landfill waste diversion rate of 100%), Virtually Zero Waste to Landfill – (98% or greater), Landfill Diversion Rate (greater than or equal to 80%).

Environmental Product Declarations

Transparency into the environmental impacts of a product at each stage of its lifecycle has become a critical driver of purchases and specifications.

Environmental Product Declarations (EPDs) certified by UL Environment enable manufacturers to disclose product impacts in a credible, streamlined and universally understood manner.

Advisory Services

To make sustainable choices, decision makers need the right information, in the right format, at the right time. Whether your company is just getting started with sustainability or looking to take your existing sustainability initiatives to the next level, UL Environment can provide advisory services to empower you with customized information and expertise.

We can provide you with:

- **Sustainable Sourcing Research** – A comprehensive analysis of environmental risks related to raw material sourcing.
- **Green Market Intelligence** – A detailed and customized report that provides expert insights on a manufacturer's specific "green" market.
- **Innovative Claims Development** – This specialized service provides a solution for environmental claim substantiation by providing validation of unique environmental claims.

Responsible Sourcing Solutions

UL is a leading global provider of responsible sourcing auditing and advisory services, which include supply chain monitoring, research and program development, and training. UL's Responsible Sourcing team has the global footprint to provide services in over 140 countries. UL provides the intelligence and tools that businesses need to develop and implement sustainable business practices within their supply chains.

Monitoring

Annually, UL conducts nearly 20,000 audits of factories, processing plants and warehouses. We are accredited monitors for WRAP, ICTI and SA8000, and are active in a broad range of monitoring initiatives like BSCI, EICC, SEDEX, ICS, FFC, and a number of other industry and client-specific monitoring programs. UL completed the GSCP Equivalence Process for Auditing Competence.

Monitoring services include:

- Conflict mineral and raw material traceability assessments
- Social responsibility workplace assessments
- Due diligence assessments
- Brand protection assessments, chain of custody audits and anti-counterfeit audits
- Customs-Trade Partnership Against Terrorism (C-TPAT) audits

Research and Advisory Services

UL advances sustainable business practices within supply chains through six areas of expertise:

- Social Responsibility and Accountability
- Supply Chain Risk Identification and Management
- Environmental Responsibility
- Capacity Building and Continuous Improvement
- Supply Chain Security and Brand Protection
- Extractives and Raw Materials Sourcing

Program Development, Training, Education, and Management

Drawing from extensive industry knowledge and best practices, UL delivers innovative solutions through customized services that establish, assess, track and measure supply chain sustainability programs. UL also offers a wide array of classroom and E-learning opportunities in over 15 languages.

Automotive Knowledge Services

UL Knowledge Services: Researching existing global automotive regulations, developing tomorrow's automotive emerging technology standards and training today's global workforce.

The Automobile industry is witnessing an evolution not seen since the advent of cars over 100 years ago. Whether they are powered by gas, electricity or hydrogen, self-driven or driver assisted, the car of today and the car of tomorrow will continue to evolve.

Keeping up with all of the technology changes is only half the battle. Understanding the various new regulations, standards and protocols promises to be a full time effort and something that you may need assistance with in order to keep abreast of the latest changes. You can stay on top of these emerging regulations, standards and protocols by teaming with UL in the following areas:

- Electric Vehicles
- Functional Safety
- Plastics & Environmental
- CTECH (Wireless, Interoperability, Security, EMC)

Advisory – Accessing UL's knowledge early in the process can help you avoid costly project delays and meet your aggressive timetables for bringing new products to market. UL's Advisory Services can review new products at the conceptual/prototype stage and identify potential design issues that may present compliance challenges as well as assist with process and management gap analysis.

UL can assist you in obtaining global approval

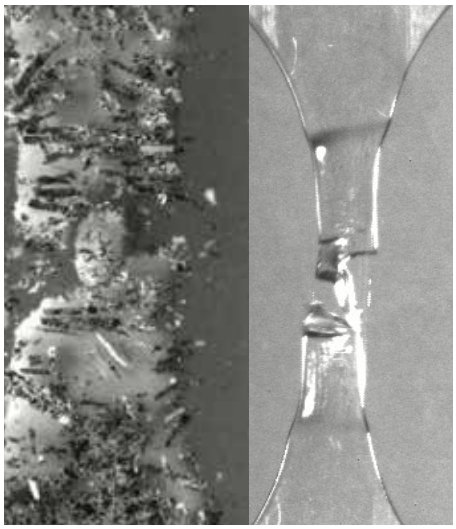
in wireless devices of all types, in particular cellular (GSM, GPRS, EDGE, 3G, LTE), microwave, Bluetooth, Wi-Fi, WirelessHD and other short range devices. UL has extensive expertise in Automotive EMC, Radio Performance, SAR, Bluetooth, and more. UL can advise you on global market access requirements for your automotive components and systems. In addition, UL can work with you on hazard identification & risk assessment, safety analysis and the qualification of software tools.

Education and training – UL can develop and deliver custom training programs that address specific products and different stages of the product development cycle. We can also educate your staff on emerging international regulations, standards and protocols.

UL Thermoplastics Testing Center (UL TTC)

SERVICES FOR OEMS AND SUPPLIERS OF THE AUTOMOTIVE INDUSTRY





With highly capable testing laboratories and comprehensive materials databases, UL can provide automotive industry OEMs and Tier 1 suppliers with services to help lower costs, improve product reliability and facilitate efficient supply chain management.

As a DIN EN ISO/IEC 17025 accredited, independent testing center, the UL TTC ensures all requirements associated with materials testing are met. With a facility covering over 5,000 square meters, the UL TTC offers one-stop services:

- Compounding of standard polymers and engineering thermoplastics in quantities of 1.3 to 200kg.
- Fully automated production of test specimens, with over 100 different molds for all ISO and ASTM test specimens
- More than 200 different standard tests
- Testing of specimens from finished components
- Test engineering consultation
- Certification
- Follow-Up Service / Certification Maintenance

Unique to UL TTC, is our ability to perform **High Speed Tensile Tests.**

During crash events, plastic parts are heavily exposed to high rates of stressing and deformation. Extensive knowledge is available about the mechanical behavior of plastics at low rates. Due to the complicated experimental procedure, not enough reliable material data has so far been determined at typical crash speeds (up to 45 mph).

In order to increase safety, reliable material properties at typical crash speeds are essential for precise simulations of crash processes involving plastic parts. In a high speed tensile test, the required high stressing rates of up to 65 feet/s (45 mph) are achieved with the help of servo-hydraulic test equipment. At the same time, any local deformations which occur are determined using an ultra-high speed camera with a maximum frequency of 1 MHz. This corresponds to one million pictures per second.

The results of the high speed tensile test are "force-displacement curves". From these, technical as well as true stress-strain curves can be developed, which are essential data input for precise crash simulations.

Our automotive plastics testing services include weathering, mechanical and physical tests, chemical and resistance tests, as well as flammability.

Alternatively, the UL TTC can also test for compliance with existing standards. Some examples of existing customer specifications include:

Exterior applications	**Interior applications**	**Heat aging**
Ford SAE J 2527	Citroën PSA D 471431	Ford WSS-M4D550-A10
Honda factory standard	FORD SAE J 2412	VW TL 52388
Nissan M8020	Nissan JASO M 346	VW 44045
Rover RES.30.CF.005	Opel GME 60292-2-X	
VW PV 3902	Peugeot PSA D 47 1431	**Tackiness**
VW PV 3930	Renault PSA D 47 1431	Ford M4D550-A10/FLTM-BO 116-01
Yamaha JIS D 0205	Rover RES.30.A.A.101	VW PV 1306
VW PV 3929	Saab Sts 3159	
Renault PSA D27 1911	VW PV 1303	
Peugeot PSA D27 1389	Opel GME 14162-B	
Ford SAE J 1960	Ford FLTM-BO 116-01	
(SAE J2412)		
NISSAN NES MO135-2008	NISSAN NES MO135-2008	
DBL 5555	DBL 5555	
GMW 14650 (ISO and SAE Procedure)		

ON-BOARD AUTOMOTIVE FUNCTIONAL SAFETY

UL has a long history in advising, evaluating, and certifying the functional safety aspects of products and systems. UL's functional safety services staff have the required understanding and expertise in all the relevant disciplines and methods, making cooperation with UL on functional safety a real benefit.

UL serves the Automotive Functional Safety community by actively participating in automotive standards writing for EV and EVSE. We are a member of ISO/TC 22/SC 3/WG 16 and contribute to the development of ISO 26262.

Our deep understanding of functional safety issues as they apply to different application domains allows UL to know the nuances between different functional safety standards, but at the same time – and more importantly – gives UL a firm grasp of the fundamental principles and concepts of functional safety as they apply across all industries and domains.

SCOPE OF UL'S FUNCTIONAL SAFETY ADVISORY SERVICES

UL excels in disciplines, practices, methods and techniques that are both crucial and challenging when embedded control systems need to be developed for safety-related applications. Our programs address:

- Assessment and implementation guidance for functional safety management systems. Integration in existing systems, possibly in compliance with ISO/TS 16949, Automotive SPICE, ISO 15504, CMM.
- Work item templates, documentation structures, and activity planning in view of safety case construction
- Establishing and performing thorough traceability
- Tool qualification
- Confirmation measures and verification reviews
- Safety analysis throughout the product or system lifecycle, at all levels (system, hardware, and in particular software), applying methods such as HazOp, FMEA, FTA, Markov, RBD, static code analysis.

- Development of concepts and architectures on system/hardware level, and on software level, to satisfy requirements for ASIL decomposition, redundancy, independence, non-interference, and diagnostic coverage.
- Hardware quantification (reliability prediction, reliability modeling, determination of diagnostic coverage, calculation of metrics PMHF, SPFM, LFM)
- Designing and testing for increased environmental immunity
- Performing functional safety assessment

UL'S FUNCTIONAL SAFETY CERTIFICATION

In addition to our advisory services, UL offers certificates for the following:

- Products, components (in ISO 26262 terminology: items, systems, SEooC (safety elements out of context))
- Organizations and their functional safety management system
- Aspects of functional safety management, such as
  - Management systems
  - Life-cycle specifications
  - Processes, workflows, methods
  - Tools for use in the creation of safety-related products (in accordance with software tool qualification per IEC 61508 or ISO 26262)
  - Combinations of the above.

GENERAL OBJECTIVES OF UL'S FUNCTIONAL SAFETY ADVISORY SERVICES

Our mission in Functional Safety is to help our clients gain sufficient confidence in the appropriate functional safety of products and systems, by constructing a complete, understandable and comprehensive safety case. We want to help you create appropriate balance between product-related and process-related requirements by assuring that a functional safety case addresses both sides. For UL, compliance is not only a matter of satisfying a standard, but of providing a real benefit both with respect to safety, and also with respect to general quality and development efficiency.

EMC / Wireless Products

Global Market Access

When it comes to Global Market Access, manufacturers need to be aware that each country has its own rules and regulations that dictate which regulatory requirements may apply to products in terms of market access. The key to successful global market access is to have a clear understanding of the various regulatory compliance rules and how those rules are implemented and applied to your products.

It's important to be aware that these rules and regulations are subject to change, and can differ on a country-by-country basis. It is in your interest to remain up-to-date so you can understand how these changes may impact your product designs. Manufacturers need to develop their export strategies for different worldwide regions. This process can quickly become time consuming and complex to manage if you wish to ensure that all national standards are adhered to.

UL will work with manufacturers to mitigate those risks and assist them in reaching their intended global markets as seamlessly as possible. UL's global presence and global reach allows us to offer local services in local languages while also providing access to UL expertise in all of your targeted markets.

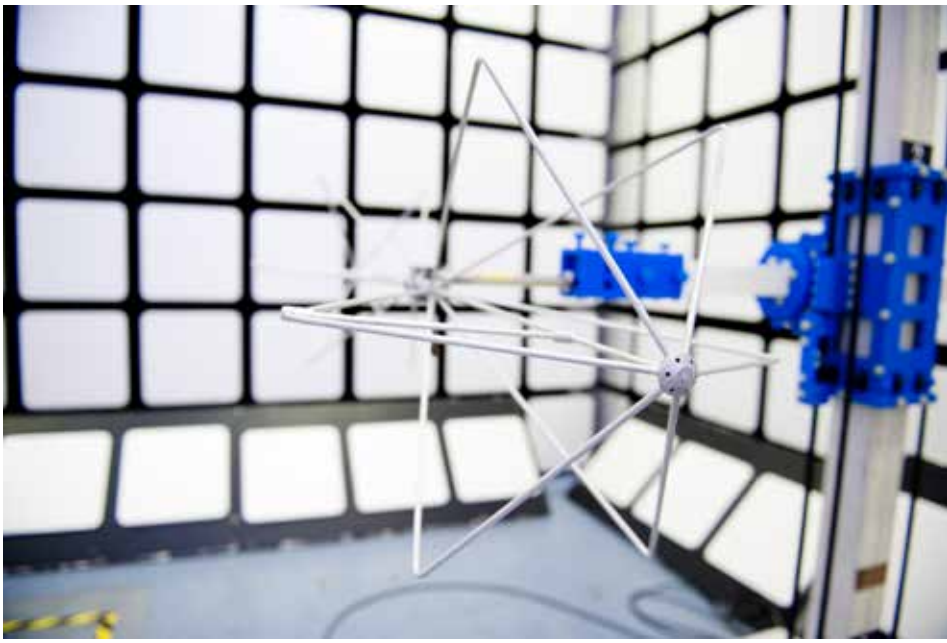
RF Testing

Where there are specific country and industry regulations that must be met, UL will cover all of the key wireless/wired competency which could include technologies such as cellular (GSM, GPRS, LTE etc.), microwave, short range devices, Bluetooth® NFC, Wi-Fi and many others. These regulations are designed to make sure that your products are safe and will not interfere with radio devices, or cause public health issues.

FCC/CE/ Global Certification for infotainment systems

Through its accredited laboratories across the world, UL can help manufacturers obtain FCC, IC, Japan MIC and CE certification in a short period of time and can assist manufacturers to gain worldwide Global Market Access (Type Approvals) through UL's extensive global partners network. With facilities and staff in over 100 countries, UL is able to provide a global service for whichever electronic products you are considering for export.

EMC/Wireless Services



Consumers expect and demand that purchased products perform seamlessly with other devices whether in the home, office or automobile. UL offers a variety of services to help manufacturers provide the best possible user experience for consumers. Our performance testing services, such as wireless regulatory testing and OTA (over the air); can help ensure that devices will meet both consumers' immediate needs and worldwide regulatory market/industry compliance issues.

UL will identify all of the current applicable safety and regulatory requirements for a product, and provide pre-compliance testing during the design and development phase to determine potential compliance issues, and develop a testing plan to ensure products are safe for global markets.

Furthermore, UL's recognition of the unique requirements of electrical automotive products is demonstrated by our dedicated automotive EMC/Wireless services. UL is able to assess all electrical components, from electric motors to ABS brake modules to track and trace modules as well as testing in-car infotainment systems.

Vehicle Certification Agency And More

As a vehicle certification agency (VCA), UL is authorized to test for and approve compliance with the market Vehicle Directive to help customers gain automotive electronic/electric device and components E/e Mark certification, required by their target markets. Using approved VCA quality systems, UL also provides certification to ISO 9001, ISO TS 16949, ISO 14001, OHSAS 18001, Acorn (a phased approach to environmental certification), EMAS and ISO 50001 (Energy Management Certification).

UL is accredited as a Telecommunications Certification Body (TCB), Foreign Certification Body (FCB) and a Notified Body, so we can help you gain access to markets in North America, Europe, and Japan in the fastest period of time.

Information and Insights

Prospector®

UL's Prospector is a searchable online database for solid materials including plastics, plastic additives and metals. View over 86,000 data sheets from 900 manufacturers and 46,000 UL yellow cards. Find all the information you need in one place, including property, processing and supplier contact information. Select plastics using 500 key properties and design parameters, find alternate resins and easily locate automotive approved plastics. You'll save time with material selection by quickly and easily referencing technical information critical to the success of your products. Learn more at ULProspector.com

Data Sheet Services

Our data management software lets you manage your product information from anywhere. An intuitive interface makes it easy to keep your data as accurate and current as possible. With your product information in our database, your documents are automatically updated on your website, your distributor's website and on your Prospector listing. The UL Yellow Card Plug-in for Plastics is the simplest way to let your customers know your Plastics are UL rated. Integrated seamlessly with your site, the Yellow Card Plug-in is automatically kept current, and its information is validated by UL.

Lead Generation

When your company's technical data sheets are accessible via UL's Prospector, you have automatic visibility with the world's largest audience of professionals looking for plastics. As a UL customer you'll find out just who those people are. With Bi-weekly Reports, Analytics, and even CRM Integration, you'll have real-time visibility to who is accessing your technical information on Prospector. We also provide webinar sponsorship, featured listings, custom landing pages, newsletter sponsorship, and brand advertising to help you reach your desired audience.

SDS Authoring Software

Around the globe, The WERCS is considered the most comprehensive, automated SDS authoring software (also known as MSDS authoring software). Based on more than 27 years of experience, we are able to offer a scalable solution regardless of how many SDSs you author. And, because central to each one of our offerings is the industry standard in SDS software, you can rest assured that all your data, time and energy is preserved for your next expansion.

WERCSmart Supply-chain Management And Reporting Technology

Get true regulatory insight into your chemical supply chain with WERCSmart. Each year, new regulations relating to safe handling, global transportation, storage, disposal, selling restrictions, as well as point of origin (i.e., conflict minerals) are appearing at a staggering rate. WERCSmart aggregates independent, validated regulatory data in one reliable place, allowing users to check regulatory compliance automatically.

REACH Compliance

Be ready for the next phase of reporting Exposure Scenarios with Extended Safety Data Sheets and Exposure Scenario Communication XML's. Capture, analyze and comply with REACH 1 2 3, a suite of software tools that can enable your organization to become REACH-compliant based on quantity triggers and defined time lines. This intuitive software module and process helps organizations to easily capture physical, chemical, toxicological and eco-toxicological properties of all chemicals that are being manufactured and imported into Europe

GreenWERCS

Easily assess the health and environmental characteristics of the chemicals in your formulations. GreenWERCS software quickly evaluates ingredients either by reference to your own or industry-accepted criteria.

Workplace Health & Safety

UL Workplace Health & Safety offers leading health and safety management, education and software solutions that companies need to better protect the people who work for them every day. Our solutions include:

Online Safety Training

Delivering comprehensive, interactive learning experiences; centralizing training management; ensuring accountability; and heightening performance. UL has more than 700 environmental, health, safety and human resources courses to choose from, or we'll work with you to design your own.

Safety Management

Managing early detection, incident prevention, corrective actions, injuries and workers' compensation cases, and return to work, our systems provide robust tracking capabilities and detailed reporting.

Occupational Health

Facilitating efficient customer- and patient-focused operations, effectively managing cases and protecting workers' well-being, our software provides medical surveillance automation, health and wellness promotion, and detailed tracking and reporting for regulatory compliance.

Our programs offer a comprehensive approach to safety management and foster a move from simple compliance to a culture of health and safety. More than training, it's learning - which is what drives results.

Brand Protection for Merchandising

PROMOTIONAL AND LICENSED PRODUCTS

Promotional products and merchandising can help add value to a brand, and also enhance consumers' experience with that brand. Promotional items are commonly distributed freely, whereas merchandising items are more commonly sold as a retail line through the brand owners' premises or websites. Many companies outsource to third party suppliers or agencies to manufacture these goods and have to rely on them to provide safe and quality product in order to maintain brand reputation.

When brand licensing for products, a license is granted by the brand owner (licensor) to another company (licensee) with an agreement between these two parties. The licensor is typically giving the right for the licensee to make products with a specific branding or logo and will have an approval process for the look and feel of the designs. Licensee requirements in terms of safety and compliance will vary from company to company and, as with merchandising, compliance is often in the hands of the licensee.

It is important that all products demonstrate satisfactory levels of safety, quality, and performance in line with mandatory regulations and customer expectations; otherwise issues can lead to complaints and negatively impact the brand. With the increased use of internet and social media platforms, consumers can easily and very publicly voice their dissatisfaction, harming brand reputation. Additionally, if products have to be recalled, the cost of the actual recall far exceeds the cost of the product. The risk to your brand often lies in the hands of your supply chain; therefore quality assurance for merchandising and licensed goods should not be overlooked.

UL Consumer Products division can assist by developing customized merchandising and licensing compliance programmes to help you achieve compliance of goods produced on your behalf. A programme can include laboratory testing as well as audits or inspections within the manufacturing facility. UL can also work with your supply chain to provide guidance, best practice and training as needed to all parties with the goal of reducing risk as well as saving time and money.

UL Consumer Products provides services that can be integrated into many aspects of your business model:

Product Concept
- Concept/Design Review
- Quality & Capability Audits

Vendor Selection
- Gap Analysis & Risk Assessments
- Social Audits

Pre-Production
- Raw Materials Testing

Production
- Production Sample Testing

Distribution
- Pre-Shipment Inspection
- Loading Inspection

Store Merchandising
- Return to Vendor Analysis

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