

Automotive Testing and Engineering Services



Safety. Science. Transformation.™

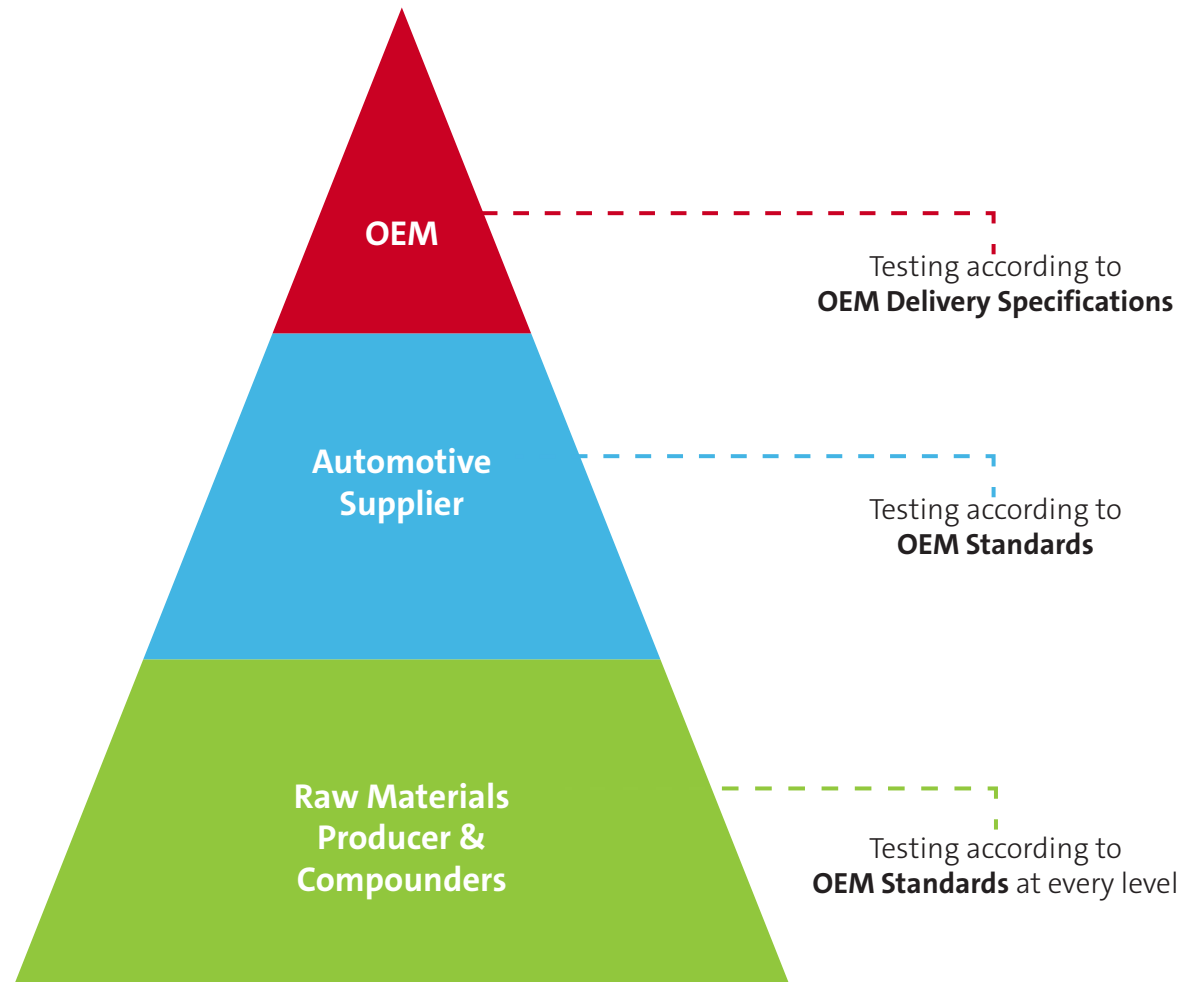
Materials for Automotive Applications

UL Solutions helps car manufacturers and automotive suppliers to reduce costs, improve product reliability and increase efficiency along the entire automotive supply chain by complementing or substituting internal testing capabilities.

Our independent testing centers will verify material and product performance according to customer-specific requirements, international test standards as well as local and global regulations. UL Solutions supports customers from the product concept stage and early product development, to the final Part Production Approval Process (PPAP). Our DVPR (Design, Verification, Plan and Report) approach to providing product validation helps OEMs achieve optimized time-to-market.

The UL Solutions service portfolio gives customers access to a single source for compounding trials, test specimen production via injection molding, as well as testing and certification of thermoplastics, rubbers, thermosets and textiles. Beyond testing raw materials, we also evaluate parts and components designed for automotive applications. Moreover, we address safety considerations for the future of automotive, such as our solutions for testing EV battery enclosure materials.

The global testing facilities at UL Solutions offer large-scale testing capacities and reduced lead times. Our global presence ensures easy and clear communication lines to local subject matter experts. Each service is available individually or as part of a customized package.



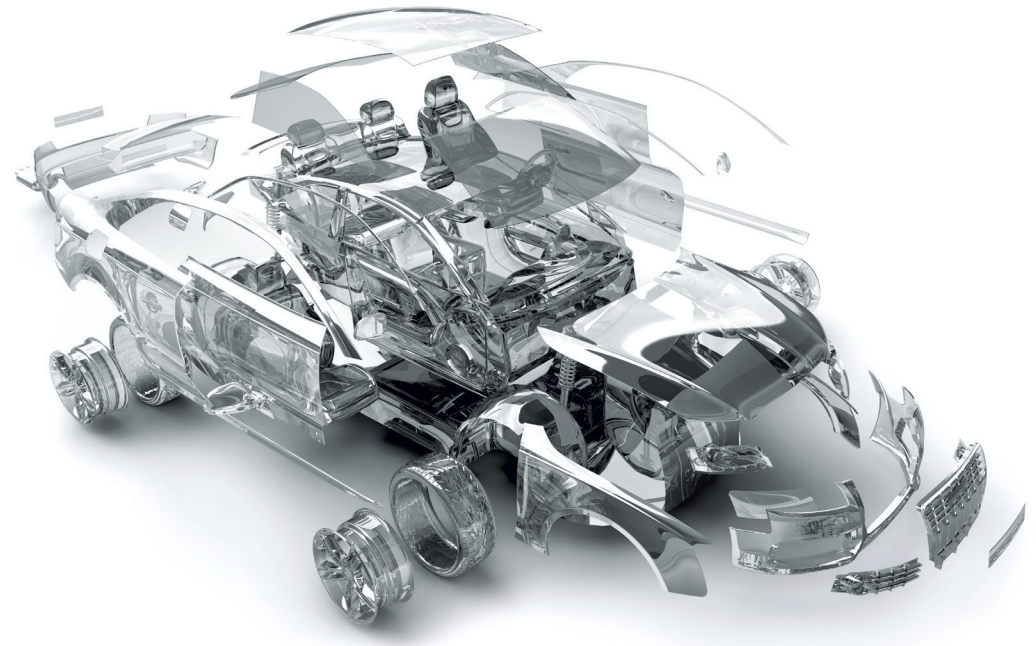
Automotive Testing and Engineering Services

Our Services for the Automotive Industry Include:

- Automotive testing in all areas of material characterization, emissions, optical changes, mechanics, fire, media resistance, surface performance and Battery Enclosure Material Screening (BEMS).
- Prediction of environmental performance via weather, temperature, climate change and ozone stress testing.
- Development, execution and management of test programs according to OEM requirements, standards and regulations.
- Preparation of test specimens from injection molding to cutting of finished parts.

Additional UL Solutions Automotive Services:

- Battery Testing
- Textile Testing
- Wireless/EMC Testing
- On-board Functional Safety
- UL Prospector® Supplier Database
- Global Market Access



Environmental Testing



Surface Testing



Optical Evaluations



Vehicle Interior Air Quality Testing



Mechanical Testing



Burning Behavior



Electrical Testing



EV Component Testing and Applications



Media Resistance and Analytical Testing



Textile Testing



Environmental Testing

UL Solutions offers a comprehensive range of tests determining the effects of the environment on internal and external automotive components. The experts in our labs can provide accelerated processes to help you meet the demands of car manufacturers and end-user expectations.



Ozone Resistance

Testing for ozone resistance helps you avoid exposure related damage that considerably reduces product longevity.

Common testing methods

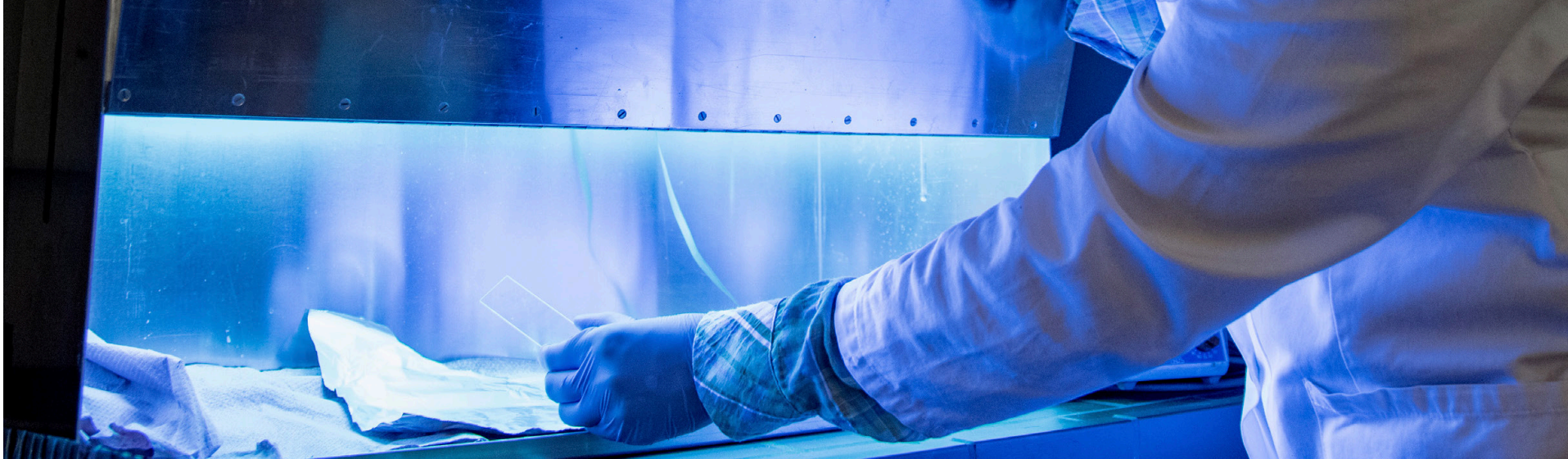
- DIN 53509
- ASTM 1149
- ISO 1431
- PV 3305
- PV 3316
- VDA 675-311
- GM 4486P
- D47 1100

Artificial Weathering

Our experts can help you determine whether your components are likely to reveal any optical and mechanical changes following long-term exposure to artificial weathering. Our tests will include exposure to solar simulation and measuring resistance to light. We use only the best equipment designed for testing accelerated weathering.

Common testing methods

- ASTM G26
- ASTM G151
- ASTM G155
- DIN EN ISO 4892
- SAE J2412
- SAE J2527
- VDA 75202
- PV 1303
- PV 3929
- PV 3930
- DIN EN ISO 105-B06
- ISO 75220



Humidity and Climate Change Test

Fluctuating weather and temperature conditions can weaken automotive components. Our testing capabilities can simulate a broad range of climate conditions and help to create a reliable performance forecast.

Common testing methods

- ASTM G26 PV 1200
- DIN 40046
- IEC 60721-4
- IEC 60068-2
- GMW 14729
- PR 303.5
- PV 2005
- D47 1309
- GMW 14124
- PR 308.2

Salt Spray Test and Cyclic Corrosion

The salt spray test is a corrosion test in artificial atmospheres. A standing fog creates a saline climate with 100% humidity which uniformly affects the sample surface. Depending on the test, different anions and cations can play a role and aggravate the test.

Common testing methods

- ASTM B 117
- ASTM D1654
- IEC 60068-2-52
- ISO 6270-2
- DIN EN ISO 11997-1
- DIN EN ISO 9227

Functional Durability

We can assess durability of parts from external factors, such as vibration and heat, by conducting thermal aging testing. Our temperature test chambers can simulate aging in an accelerated process and reveal the effects of long-term heat exposure.

Common testing methods

- IEC 60216-1
- UL 746 B
- D45 1139 PSA
- D45 1234 PSA
- PV 3355
- ISO 188
- EN ISO 2578
- VDA 675-310

Thermal Shock

During thermal shock testing, products are exposed to alternating low and high temperatures to accelerate failures caused by temperature cycling or thermal shock during normal use. The transition between temperature extremes is very rapid, at more than 15°C per minute.

Common testing methods

- IEC 60068-2-38
- ISO 16750



Surface Testing

In order to engineer and produce automotive parts with consistent and market leading quality, it is vital to use appropriate testing technologies to analyze surface characteristics. The test results can help predict real-world product characteristics and lifetime behavior. At UL Solutions, we conduct a wide range of destructive and non-destructive surface tests on standardized specimens and finished component.



Surface Scratch Test

With equipment like the Scratch Hardness Tester, multiple cut, scratch and tear tests can be carried out on all types of coatings and materials.

Common testing methods

- DIN EN ISO 2409
- ASTM D 3359
- VDA 621-411
- GME 60 280
- GMW 14829
- PV 3952
- PV 3964

Metallic Coating Thickness

Our experts can provide coulometric coating thickness measurements for nearly all metallic coating types. These coatings can be single or multi-layer structures on polymers, that are then analyzed by the STEP test.

Common testing methods

- DIN EN ISO 2177
- ASTM B764-94
- DIN 50022
- PV 1065



Car Wash Simulation

With the car wash simulation apparatus, our experts at UL Solutions help determine how surfaces with or without coatings can resist the influence of specifically defined brushes of a common car wash system.

Common testing methods

- ISO 20566
- PV 3.3.3
- DIN 55668
- TM-5017
- AA00545
- STD 423-0019
- MBN 10494

Impact Resistance

The Stone Hammer Blow Test is used to determine a coating's ability to withstand impacts of small objects, such as stones.

Common testing methods

- ISO 20566
- PV 3.3.3
- DIN 55668
- TM-5017
- AA00545
- STD 423-0019
- MBN 10494

DuPont Impact

DuPont Impact is used to test the endurance of a coated material during impact tests involving a falling weight, such as stones, dropped at specified points. The aim is to ascertain how specimens can withstand the impact of rapid impact testing, thus checking for damage or deformation.

Common testing methods

- DIN EN ISO 2177
- ASTM B764-94
- DIN 50022
- PV 1065



Optical Evaluation

UL Solutions offers a full range of standard and specialized optical and color measurement services.



Color Measurement

Color measurements are used to assess color changes induced by various stresses. The following characteristics of a specimen are measured or calculated in a spectral photometer with the help of the CIELAB table system.

- Transmittance
- Reflectance
- Yellowness index
- L*a*b* values
- Standard color values XYZ
- Delta E

Common testing methods

- DIN 5033
- ASTM E179
- ASTM E313
- ISO 13468-2

Gloss Index

Gloss is an optical property of a surface to reflect light fully or partially, specularly measured at 20°, 60° and 85° using a reflectometer.

Common testing methods

- ISO 2813
- ASTM D523



Haze Measurement

This test method for transparent products is used to determine the translucency of a material. Following various load tests such as processing, after-treatment, light aging, weathering and temperature aging, an optical measuring system evaluates all important criteria that determine the transparency of the test specimen.

Common testing methods

- STM D1003

Gray Scale Determination

By means of the gray scale determination, the optical surface change is identified after different loads. The difference in color of a specimen is compared with the gray scale sections. The tested specimen is given the number closest to the color fastness level on the gray scale.

Common testing methods

- ISO 105-A02

UV/VIS/NIR Measurement

In material research, it is sometimes necessary to assess test specimens with a high absorption capacity such as laser protection lenses, optical filters and polarization materials. Most specimens of this kind have to be investigated across the visible electromagnetic spectrum – from UV through VIS to NIR.

Common testing methods

- IN-HOUSE STANDARD



Vehicle Interior Air Quality Testing

The use of polymers and other performance materials may result in the release of unwanted or irritating substances. In small spaces, concentrated emissions can affect comfort or user health. The nature and quantity of these emissions are strictly regulated and quantified in specifications that include qualitative smell tests, quantitative fogging measurements and extensive emission tests.



Fogging

Condensing of organic substances can cause window fogging and thus limit visibility. Fogging is a method to simulate desorption of substances out of interior car parts in a measurable, representative and reproducible way.

Common testing methods

- PV 3015
- D45 1727 PSA
- SAE J1756
- DBL 5306_18.2
- ISO 6452
- ISO 17071
- DIN EN 14288
- DIN 75201

Semi-volatile and Volatile Organic Compounds (SVOC and VOC)

Our experts can provide a detailed breakdown of emissions, including the assessment of critical substances.

Common testing methods

- VDA 276
- VDA 278
- ISO 12219-3
- ISO 12219-4
- PV 3942
- GS 97014-3
- VCS 1027,2769



Headspace

Headspace and thermal desorption analysis can be used to determine odor-related issues with polymers, compare material recipes and analyze polymer softening agents.

Common testing methods

- VDA 277
- VDA 278
- PV 3341

Formaldehyde

Formaldehyde emissions may adversely affect user comfort. Mass-related testing, such as the flask method, helps further ensure interior air quality.

Common testing methods

- VDA 275
- PV 3925

Odor

New car odors should not be unpleasant to users. Testing and qualitative ratings are applied per various OEM requirements for user comfort.

Common testing methods

- VDA 270
- PV 3900
- ISO 12219-7
- DBL 5306 17
- D10 5495 PSA



Mechanical Testing

UL Solutions is an industry leader in polymer testing, with a global network of laboratories offering a diversified range of destructive testing in a fully automated start-to-finish sequence.



Tensile Test

This test method is used to assess the behavior of plastics when subjected to uniaxial tensile stress.

Common testing methods

- DIN EN ISO 527
- DIN EN 20527
- DIN 53455/53457
- DIN EN 61
- ASTM D638

Tensile Impact Test

The tensile impact test is a test with a very high deformation speed.

Common testing methods

- DIN EN ISO 8256
- DIN EN 28256
- DIN 53448

High Speed Tensile Test

This complex test method simulates crash conditions and is used to determine the data of plastic materials at very high strain rates. This test can be run at hot and cold.

Common testing methods

- IN-HOUSE STANDARD

Izod & Charpy Impact Tests

These are quick and simple tests to facilitate a comparative assessment.

Common testing methods

- DIN EN ISO 180
- EN ISO 20180
- ASTM D256
- DIN EN ISO 179
- DIN EN 20179
- DIN 53453



Penetration Test

The instrumented test in accordance with this standard describes a test method that is used to determine the penetration behavior of solid plastics.

Common testing methods

- DIN EN ISO 6603-2

Ball Drop Test

This test method is to determine the penetration resistance and flexibility of coatings and the adhesion at low temperatures of acoustic damping systems.

Common testing methods

- DIN 53509
- ASTM 1149
- ISO 1431
- PV 3305

Ball Indentation

The ball indentation hardness is the quotient of the applied load and the surface area of the indentation that is present underneath a ball.

Common testing methods

- DIN EN ISO 2039-1
- DIN EN 53456

Steering Wheel Hardness

The steering wheel hardness measurement is used for the comparative evaluation of the material hardness on steering wheels.

Common testing methods

- PV 3931

Rockwell Hardness

This test method is used to determine the hardness of a test specimen as a function of the depth of indentation, taking the elastic recovery into consideration.

Common testing methods

- DIN EN ISO 2093-2
- STM D785

Bending Test

This test method determines the strength and dimensional change properties of plastics when subjected to three-point loading.

Common testing methods

- DIN EN ISO 178
- DIN EN 20178
- DIN 53452/53457
- DIN EN 63
- ASTM D790



Burning Behavior

Combustion and ignition tests are used to determine the quality and safety of materials in critical applications. Many requirements of the automotive industry can be met using standard test methods.

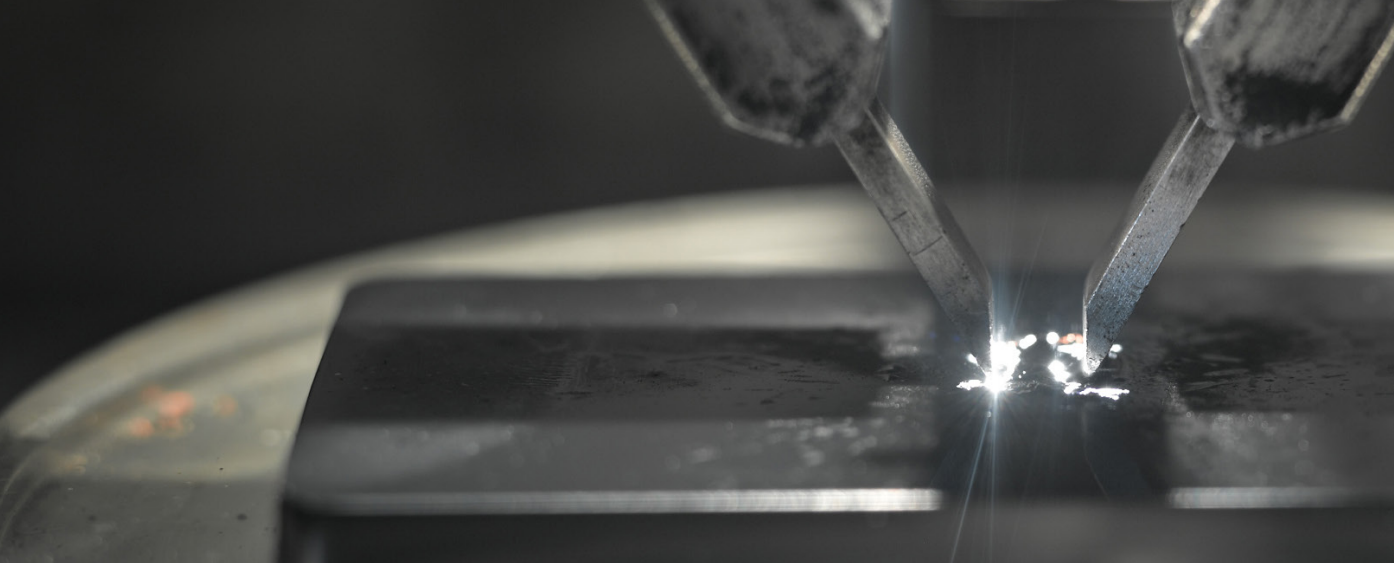


Burning Behavior

UL Solutions offers a wide range of testing capabilities to determine the burning characteristics of raw materials, components and finished products.

Common testing methods

- US FMVSS 302
- TL1010
- TL1011
- ISO 3795
- UL 94
- IEC 60695-2-13
- IEC 60695-2-12
- PV 3343
- PV 3357
- DIN 75200



Electrical Testing

UL Solutions has a long history of testing for electrical safety and performance with regard to many materials and multiple industries. The following tests are most common for automotive applications.

Volume Resistivity Test

This method is used to determine the volume resistivity of an insulating material. The surface flows of the test specimen are eliminated using an electrode.

Common testing methods

- UL 746A
- ASTM D257
- IEC 62631

Surface Resistivity Testing

This method is used to determine the surface resistivity of a test specimen. The volume flows of the insulating material are eliminated using an electrode.

Common testing methods

- UL 746A
- ASTM D257
- IEC 62631

Dielectric Strength Test

This method is used to assess the dielectric strength of an insulating material. It calculates the voltage at which a harmonic alternating voltage collapses upon destruction of the insulating material.

Common testing methods

- VDA 277
- VDA 278
- PV 3341

Comparative Tracking Index (CTI)

This method is used to assess the relative resistance of insulating materials to tracking.

Common testing methods

- VDA 275
- PV 3925

High Voltage Tracking Resistance (IPT)

This method can be used to assess the susceptibility to tracking of insulating materials that are exposed to high voltages outdoors.

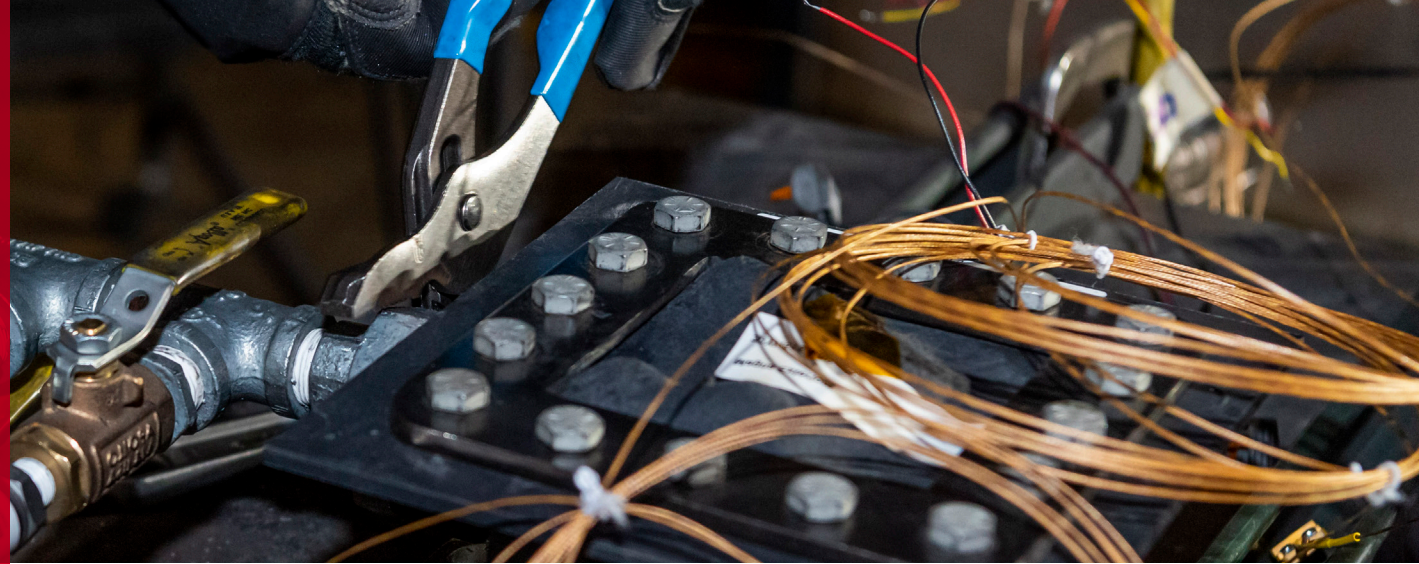
Common testing methods

- ASTM D2303
- IEC 60587



Electric Vehicle (EV) Component Testing and Applications

Lithium-ion batteries are the energy accumulator of choice for portable electronics and cordless machines and tools. In addition, they are also the driving force behind the electric vehicle (EV) industry. Most EVs use powerful lithium-ion batteries, but these kinds of batteries come with safety concerns, making a battery's enclosure in the vehicle incredibly important.



Battery Enclosure Material Screening (BEMS)

At UL Solutions, we developed a unique set of test methods, known as Battery Enclosure Material Screening (BEMS), to evaluate the performance of different battery enclosure materials in response to a thermal runaway event, outlined under UL 2596, Test Method for Thermal and Mechanical Performance of Battery Enclosure Materials. Our Torch and Grit (TaG) test method screens for the dynamic stresses found in a thermal runaway event, focusing on the evaluation of temperature and mechanical abrasion. We have also developed the Battery Enclosure Thermal Runaway (BETR) evaluation to rigorously test material performance in a simulated thermal runaway scenario, which includes evaluating temperature, mechanical abrasion and pressure elements. Our solutions are designed to help material manufacturers, suppliers and automotive OEMs select EV battery enclosure materials with greater confidence.

Common testing methods

- UL 2596



Media Resistance and Analytical Testing

Automotive applications have to be aligned with global regulations, international standards as well as legal requirements. In addition, automotive products need to comply with dedicated OEM and supplier delivery specifications. With the help of chemical and analytical testing, vehicle and part manufacturers can help ensure that consumers are protected from potential risks through early development reviews combined with a root cause analysis.

Chemical and Media Resistance

Chemical and media resistance testing examines the mechanical property retention for the interior and exterior as well as EV cooling applications. At UL Solutions, we measure the interior property resistance to various liquids, such as sweat, coke, sunblock and insect repellent, as well as the exterior property resistance to oils, lubricants, acid rain, car wash soap and washer fluid.

Common testing methods

- DIN EN ISO 22088-3
- ISO 175
- DIN 53521
- PV 3004
- DIN 53449-3

Analytical Testing

Very common test methods, such as TGA, DSC, IR, TMA or MCC also form the basis for material analyses relevant for the automotive industry.

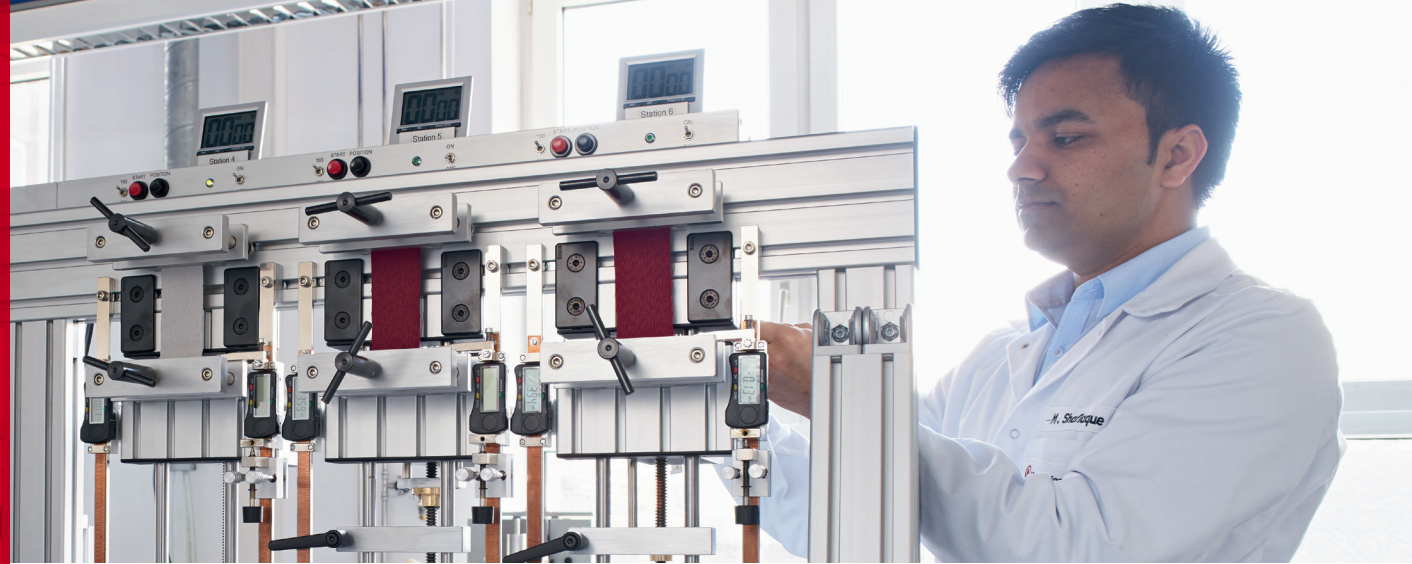
Common testing methods

- DIN 51005
- DIN 53752
- DIN 53765
- DIN 51006
- ASTM D7309



Textile Testing

Many physical testing methods can be used for automotive textiles. UL Solutions provides textile tests in accordance with car manufacturers and industry standards for samples and quality assurance.



Wet and Dry Abrasion

Electric Crockmeter equipment is commonly used for wet and dry abrasion testing. This testing can include the determination of color or structural alternations occurring in textiles, leather and carpeting e.g. as a result of long-term wear.

Common testing methods

- PV 3906
- DIN EN 105-X12
- ISO 105-D02
- DBL 7384_8.9
- PV 3987

Martindale Abrasion and Pilling

OEMs frequently require Martindale abrasion and pilling tests to determine the abrasive wear and pilling properties of textiles and upholstery. In addition, meaningful results for plain thermoplastic surfaces can be generated.

Common testing methods

- DIN EN ISO 12945
- DIN EN ISO 12947
- ASTM D4966
- PV 3356
- PV 3968
- PV 3961
- PV 3975



Abrasion Tester (Schopper Type)

Test equipment like the Schopper abrasion tester forms the basis for the determination of a textile's resistance to soiling, cleaning and abrasion related wear or discoloring. A subsequent surface analysis complements the textile performance evaluation.

Common testing methods

- DIN 53863
- PV 3908
- PV 3353

Flock Testing

UL Solutions offers a demonstrative test to determine the wear resistance of flocked surfaces. Typically, the APG 1000 abrasion tester is used to evaluate the quality of flocked surfaces.

Common testing methods

- DBL 5578
- PV 3366
- PV 3949

Tumble Pilling

To determine the product resistance to form pills and other wear on textile fabrics, UL Solutions uses the Random Tumble Pilling Tester. Similar to abrasion test technologies, this particular test relates to microscopic and macroscopic changes at the substrate surface.

Common testing methods

- PV 3360
- ASTM D3512
- DIN 53867
- ISO 12945 - 3



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