



自動車用途における マテリアルおよびケーブル の評価試験

2024年11月14日

TIC Industrial 営業部
土井 真美



Safety. Science. Transformation.™

ウェビナー開催中のお願いとお知らせ

- ご質問は、随時、**質問ボックス**へご入力ください。
後日、担当より回答いたします。
- 本ウェビナーのアーカイブ配信を12月に予定しております。
UL Solutionsセミナースペシャルサイトにて期間限定で公開致します。
- 投票**にご協力ください。
- ご退出の際は、簡単な**アンケート**にご協力ください。

質問ボックス

質問がありません

ここに入力してください

投票ボックス

弊社担当からの詳細説明を希望されますか？

はい

無投票

アンケートにご協力ください

1. アンケートのリンクはこちら

Agenda

1. EV関連の規格
2. OEM規格に基づく材料評価試験
3. UL Solutions イエローカード
4. まとめ

Automotive Material Testing Labs



Northbrook, US



Krefeld, DE



Ise, JP



Carugate, IT



Querétaro, MX



Taipei, TW

1.EV関連の規格



EV コンポーネントに関連する規格

EV charging cables

EN 50620, IEC 62893,
UL2263, CSA C22.2 No.49,
JCS 4522

Charging coupler and connector

IEC 62196, UL 2251, 2734, LV 214, SAE J1772,
JEVS G105(DC), JARI A0101(AC), GB/T 20234,
VW 80303

Exterior

ISO, IEC, ASTM, OEM specific (UV/heat
aging, mechanical, fire,....)

Power control units

ISO, IEC ASTM and UL
(specific UL 2594, UL 2231, UL 2251)

Automotive cables

ISO 19642, 6722, 14572,
SAE J1127, J1128, J1678, J3117
UL 2276, 4127, 2733, 2726

Electric motors

IEC 61857-42, UL 1004, UL 1446

Interior

ISO, IEC, ASTM, OEM specific
(UV/heat aging, mechanical, fire,
emissions...)

Thermal management systems

ISO, IEC, ASTM and UL (94, 746 A&B)

Battery pack

UL 2596, UL2580, USABC, SAE J2464,
SAE J2929, ISO 12405-3

Film capacitors

EN 60384-14, IEC 61071/60252, UL 810, UL 1283,
DIN EN 60674, VDE 0345

Battery

IEC 62660, UL 2580, UL 2054, ISO 12405,
SAE J2929, QC/T 743/UN ECE R-100, GB38031

バッテリーモジュール・パックの構造要求

Battery Pack

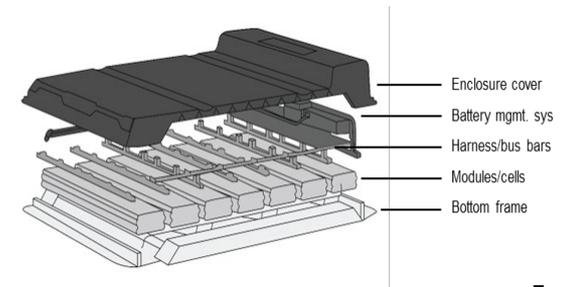
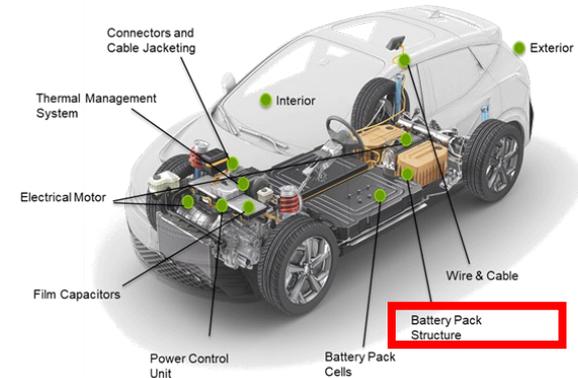
UL 2596, UL 2580, USABC, SAE J2464,
SAE J2929, ISO 12405-3

要求事項:

- 1) Temperature resistance
- 2) Flame and ignition resistance
- 3) Pressure and impact resistance
- 4) Insulation and shielding properties
- 5) Chemical resistance

Polymer material requirements for battery pack structure

- **Battery enclosure screening methods (BEMS) (UL 2596)**
 - **Battery enclosure thermal runaway (BETR)**
 - **Torch and grit (TaG)**
- Fire retardancy (IEC 60695, UL 94, the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances/TL 1010, FMVSS)
- Isolation of high voltages (volume resistivity, CTI > 400V/IEC 60122, electrical strength,...UL 746)
- Crash and intrusion protection (High speed tensile test, puncture impact, ball drop test 1 to 5 m)
- Dimensional stability (ISO 11359)
- High stiffness (ISO 178, ISO 527)
- Electromagnetic interference (EMI)/electromagnetic compatibility (EMC) shielding
- Thermal shock
- Emissions – volatile organic compounds (VOCs)
- Chemical resistance (ISO 175, ISO 11403-3, ISO 4599, ISO 4600, ISO 6252, etc.)



EV バッテリー関連規格

Battery

IEC 62660, UL 2580, UL 2054, ISO 12405,
SAE J2929, QC/T 743/UN ECE R-100,
GB38031

要求事項：

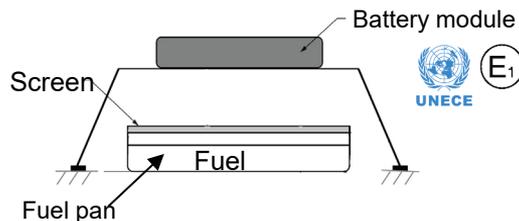
- 1) Temperature resistance >100 °C
- 2) Flame and ignition resistance
- 3) Impact resistance
- 4) Weathering resistive
- 5) Insulation properties



Polymer material requirement for EV Battery

	EV	Light EV (e-bike)	Light electric rail and stationary
Std #	UL 2580 Ed3	UL 2271 Ed2	UL 1973 Ed2
FR	V-1	V-1	5VA
RTI (Impact)	100 °C	80 °C	80 °C
f1 (outdoor)	Required	Required	Required for outdoor
Enclosure	Compliant with UL 746C/50		

EVバッテリーの安全要求と試験方法



GB38031: Electric Vehicle Traction Battery Safety Requirement. This standard replaces GB/T31485-2015 "Safety Requirements and Test Methods for Traction Battery of Electric Vehicle" and GB/T31467.

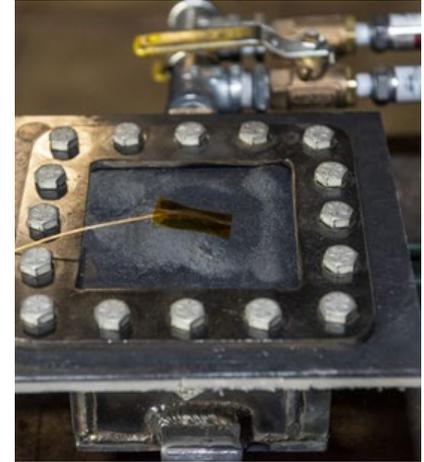
✓ Major Battery testing method follow UL 2054, the Standard for Household and Commercial Batteries

UNECE: the United Nations Economic Commission for Europe

Battery Enclosure Material Screening (BEMS)

UL 2596 - Test Method for Thermal and Mechanical Performance of Battery Enclosure Materials

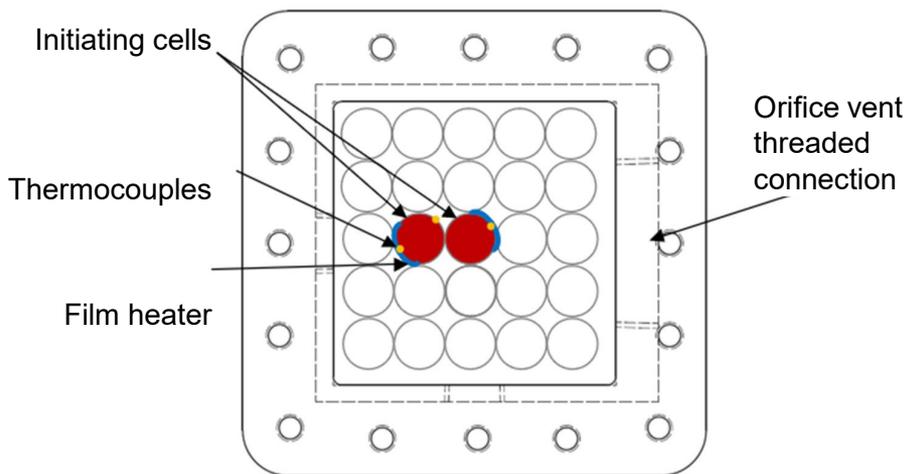
第1版:
Battery Enclosure Thermal Runaway
(BETR, 2022/1/27)
Liイオンバッテリーの熱暴走を想定した材料
の評価試験



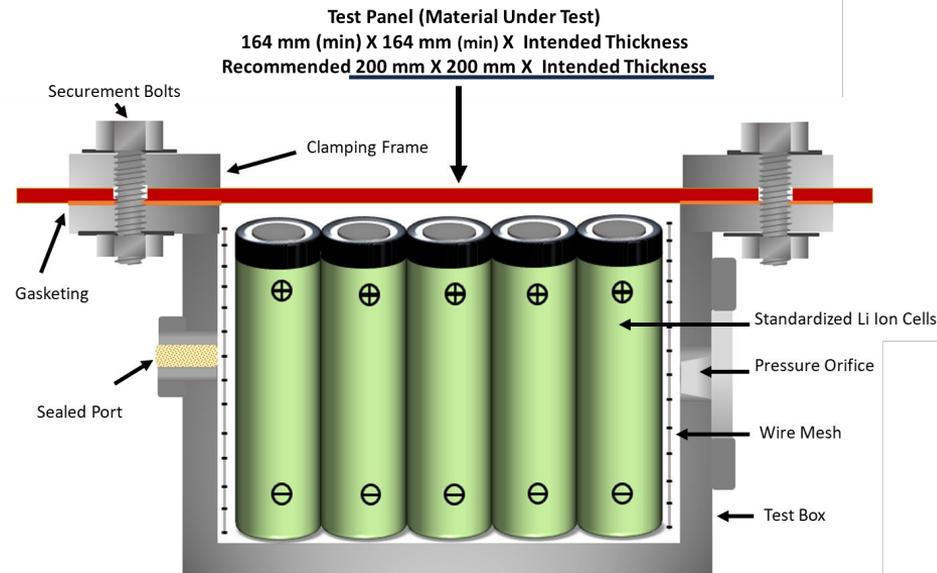
第2版:
Torch and Grit (TaG, 2023/9/8)を追加
材料の耐火性評価



UL 2596 熱暴走時 (BETR) のバッテリーに使用される材料の熱的および機械的特性評価



Li-ion cells 18650, 25本



Torch and Grit (TaG) 試験

EVバッテリーの熱暴走を想定した材料に対する評価試験方法



高温における耐性評価



セルの熱暴走時に発生するGritやアウトガスなどに対する耐性を模擬



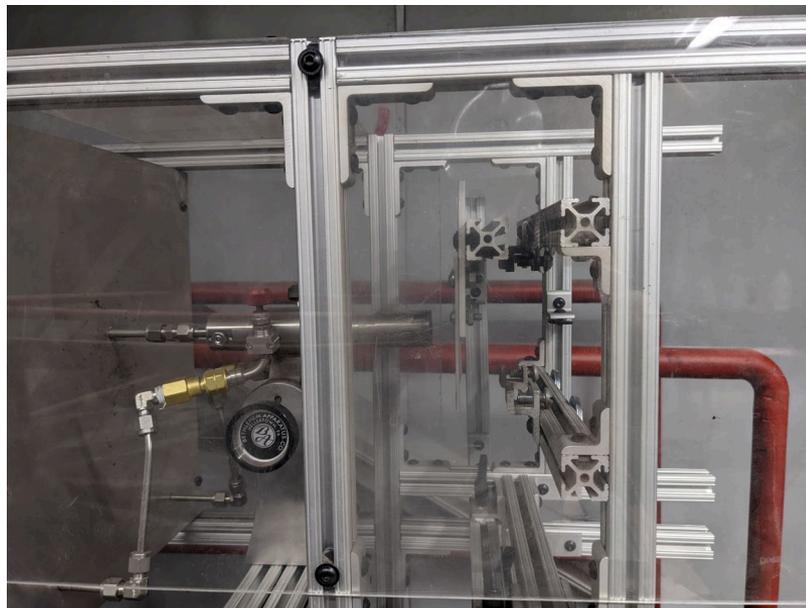
BETR試験よりも簡易的なスクリーニング試験



Torch and Grit (TaG) 試験

Torch + Grit サイクル
開穴が確認されるまで最大10サイクル

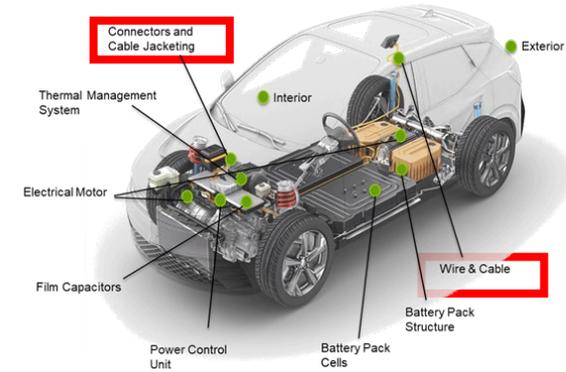
- Torch (15秒)
 - 炎温度: 1200°C (3kW)
 - メタン+酸素 混合ガス
- Grit (5秒)
 - アルミナ粉末の噴射
(メッシュサイズ: 70-200)



EV給電システムにおけるケーブル関連規格

Includes testing facilities addressing different types of charging used around the world:

- AC cable assembly
- AC portable EV supply equipment
- AC chargers
- DC charging
- And commonly used Levels in the US:
- Level 1/2 for AC charging (up to 12 kW)
- DC Level 1/2 (up to 350 kW)



EV Charging Standards

Plugs, receptacles and couplers:
UL 2251
Plugs, socket-outlets, vehicle connectors and vehicle inlets:
IEC 62196

Wireless charger:
UL 2750*
IEC 61980-1
IEC TS 61980-2
IEC TS 61980-3

Offboard cable:
UL 2263*
Charging cable:
IEC 62893-1: General requirements
IEC 62893-2: Test methods
IEC 62893-3: AC charging
IEC 62893-4-1: DC charging without use of thermal management system
IEC 62893-4-2: DC charging with use of thermal management system
DIN EN 50620

Cord sets:
UL 2594
IEC 62752
IEC 61851-1
Cord sets/pluggable charging systems (IC-CPD)

AC charging station:
UL 2594
EV conductive charging system:
IEC 61851-1: General requirements
IEC 61851-21-2: Offboard EMC
IEC 61439-7: Switchgear and controlgear assemblies

Personnel protection equipment:
UL 2231-1
UL 2231-2
Residual current devices:
IEC 61008-1
IEC 61009-1
IEC 62955
IEC 62423

Bidirectional charging station:
UL 9741*

DC charging station:
UL 2202
EV conductive charging systems:
IEC 61851-1: General requirements
IEC 61851-23: DC charging stations
IEC 61851-21-2: Offboard EMC
IEC 61851-24: Digital communication
IEC 61439-7: Switchgear and controlgear assemblies

*Outline of investigation

給電ケーブル関連規格 (EV充電カプラー)



要求事項:

- 1) Thermal resistance
- 2) Flame and ignition resistance
- 3) Electrical Insulation properties (CTI, Dielectric Strength)/reduces insulation space
- 4) Weathering and aging resistive
 - a) Color stability
- 5) Chemical resistance

Polymer material requirement for plugs and connectors

IEC 62196-1 and 2: Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles
Product safety testing method is according to UL 2251, the Standard for Plugs, Receptacles, and Couplers for Electric Vehicles

BPT:

125 C (rewireable support part)

80 C (other part)

Thermal resistance

After heat aging (80 C/168h)

→ No crack observed

PTI: 175V (CTI PLC 3 level)

Glow Wire: 850 C

Ball impact and mechanical impact test conduct at **-30 C**

Connector design

following **SAE J1772** Safety testing method and requirements follow **UL 2251**

ANSI/UL 2251/

CSA C22.2 No 282-13

Electric performance:

HAI/HWI depend on FR

CTI 3 or better

RTI: 100 C

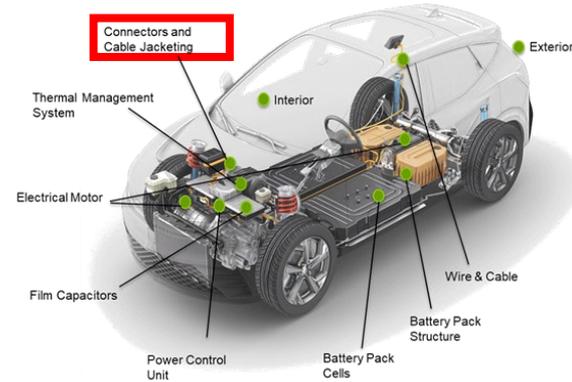
Dielectric withstand

>500V for 1 minute

f1 (UV+water)

HWI and HAI ratings of insulating materials				
Flammability classification (UL 94)	HWI*		HAI*	
	Mean ignition time/sec	PLC	mean no of arcs	PLC
V-0, VTM-0	7~15	4	15~30	3
V-1, VTM-1	15~30	3	30~60	2
V-2, VTM-2	30~60	2		
HB	30~60	2	60~120	1

HWI: Plug or connector thickness < 0.071mm



Charging coupler and connector
IEC 62196, UL 2251, 2734, LV 214, SAE J1772, JEVS G105(DC), JARI A0101(AC), GB/T 20234, VW 80303

ワイヤーとケーブル関連規格



要求事項:

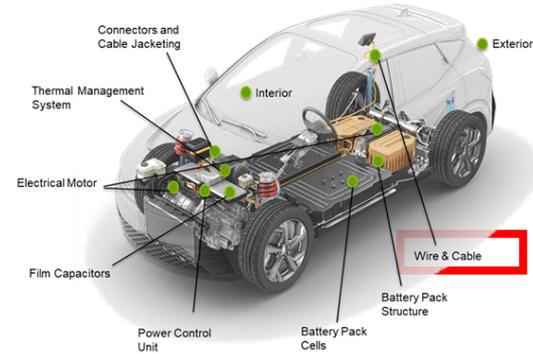
- 1) Dimensional stability
- 2) Electrical insulation and screening effectiveness
- 3) Mechanical resistance
- 4) Environmental properties: thermal rating from class A (T1: -40 °C to 85 °C) up to class H (T8: -40 °C to 250 °C)
- 5) Color resistance (UV weathering and aging)

EV Charging cables

EN 50620, IEC 62893,
UL 2263, CSA C22.2 No.49,
JCS 4522

Automotive cables

ISO 19642, 6722, 14572,
SAE J1127, J1128, J1678, J3117
UL 2276, 4127, 2733, 2726



Material requirements for cables and wires

- Dimensional and constructional requirements
- Electrical resistance, withstand voltage tests, insulation resistance and volume resistivity
- Mechanical resistance (abrasion, strip force, cyclic bending, flexibility, breaking force, crush resistance, tear resistance)
- Environmental properties
 - Thermal stability at high temp. – long-term (3000h), Short-term (240h), thermal overload (6h), shrinkage heat aging (15min)
 - Thermal stability at low temp. – cold impact and winding
 - Chemical fluid compatibility, durability of marking
 - Artificial weathering, resistance to ozone, hot water (hydrolysis), stress cracking, temperature and humidity cycling
 - Flammability – resistance to flame propagation
- Analytical testing (assessment of halogens) for non-metallic materials
- Marking and labeling

Automotive Ethernet Performance Testing Service

試験プログラム

Org./Standard	Scope
 TC9	1000 BaseT Twisted Pair Wire, UTP/STP
 ISO 19642-11	Coaxial Cable
 ISO 19642-12	100/1000 BaseT Twisted Pair Wire, UTP
 SAE J3117	100/1000 BaseT Twisted Pair Wire, UTP/STP
 SAE USCAR2	Connector and Cable Assembly

UL Taiwanにて試験可能

In-vehicle network	CAN	LIN	Automotive Ethernet
Speed	125K~1M	10~125K	100M~Multi G



ADAS (including Radar, LiDAR, CAM, V2X, GPS, navigation)などのAutomotive Ethernetケーブルの大容量・高速通信性を評価

Automotive High Speed Cable Connectivity Test Services

In-vehicle High Speed Cable & Connector



SAE J3117/1, SAE J3117/2
ISO 19642-11, ISO 19642-12
Open Alliance TC9 spec
USCAR30
USCAR2

Car Head Unit with USB ports



CarPlay USB Signal Integrity spec
USB Embedded Host spec
USB Cable spec
ANSI/UL 9990 (charging cable safety)

Car Monitor with various wired ports

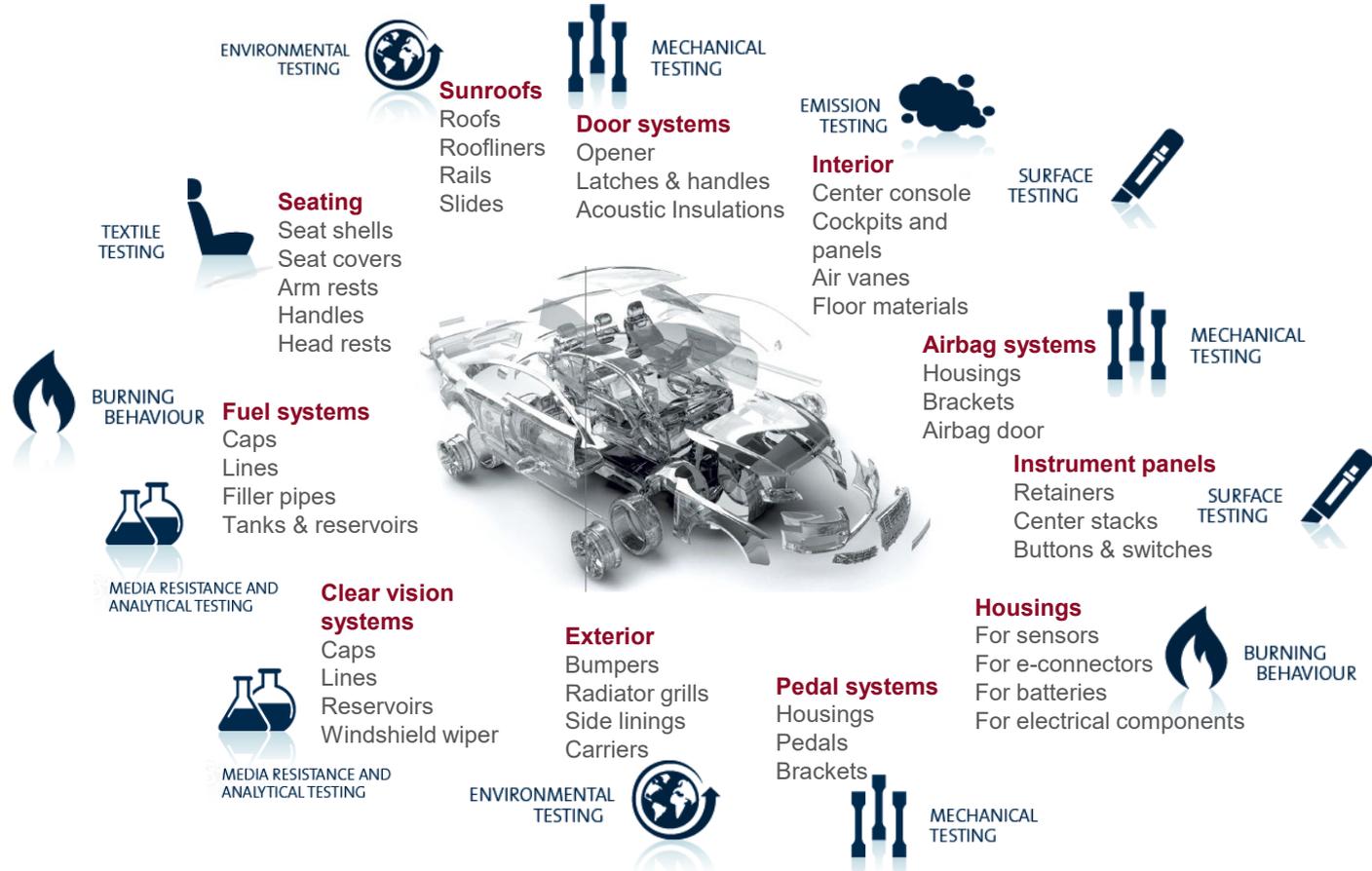


HDMI spec
DisplayPort spec
USB spec

2. OEM規格に基づく 材料評価試験



自動車関連材料に求められる要求特性



内装材関連規格



要求事項:

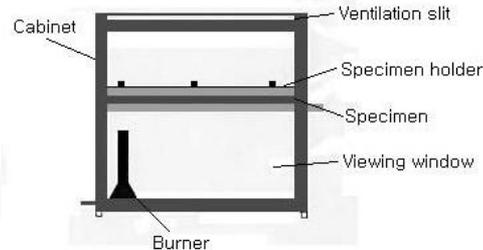
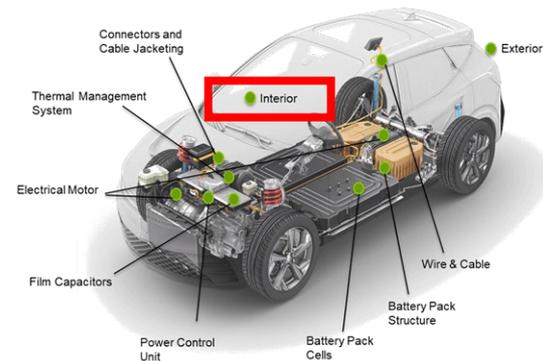
- 1) Flammability and ignition
- 2) Thermal stability
- 3) Mechanical impact
- 4) Dimensional stability
- 5) Emissions
- 6) Electrical insulation

Interior requirements

OEM specific, ISO, IEC ASTM and UL standards

Polymer material requirements for Interior

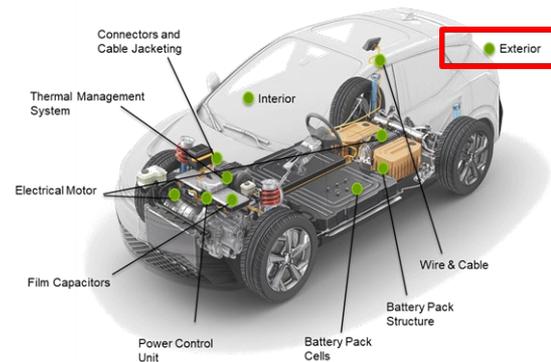
- Flame retardancy (TL 1010, TL 1011, FMVSS302, GS 97038, DBL 5307, etc.)
- Weathering and aging:
 - Lightfastness (PV 1303, ISO 105B-06)
 - Sun simulation (ISO 75220)
 - Surface properties (scratch resistance, color measurement, coating thicknesses)
- Mechanical properties (ISO/ASTM)
- Dimensional stability
- Emission behavior (VOC, odor, VDA 278, VDA 270, ISO 12219-4 etc.)
- Chemical resistance, e.g., sun crème, etc.



外装材関連規格

要求事項:

- 1) Flammability and ignition
- 2) Thermal stability
- 3) Thermal insulation
- 4) Mechanical impact
- 5) Dimensional stability
- 6) Electrical insulation

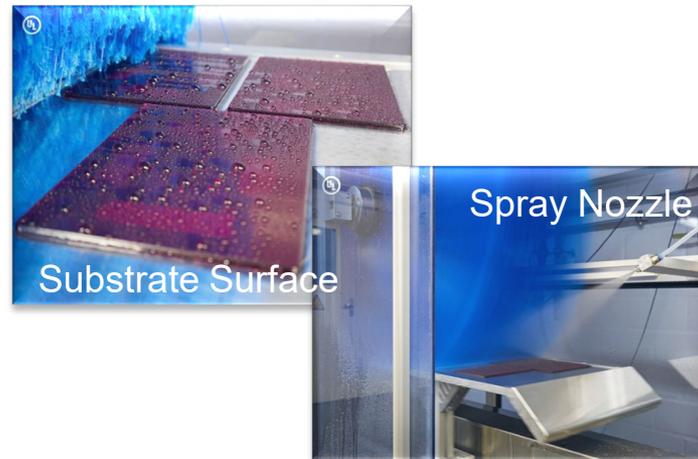


Exterior requirements

OEM specific, ISO, IEC ASTM and UL standards

Polymer material requirements for exterior

- Weathering:
 - Kalahari and/or Florida (ISO 4892-2, PV 3929/3930; AA-0235, etc.)
 - Sun Simulation (ISO 75220)
- Surface properties (scratch resistance, stone chip, Car wash, color measurement, coating thicknesses)
- Mechanical properties:
 - Tensile, creep, high-speed tensile test
 - Impact, Izod, Charpy, puncture impact, etc. (ISO/ASTM)
- Chemical resistance
- Dimensional stability
- Thermal insulation



3. UL Solutions イエローカード



UL Solutions Yellow Card

- イエローカード: E&E向けプラスチック認証データベース
- 安全性と性能に関する特性が掲載
- 5万件以上の登録材料が掲載されている
- 継続的な要求事項への適合確認のためサーベイランス実施
- ホワイトカード: IEC/ISOに基づく特性も掲載



Component - Plastics

1 ABC PLASTIC COMPANY
1000 PLASTICS ROAD, MELVILLE NY 11747-3081

2 Grade ABC (f1)(f3)
Polycarbonate (PC) "TRADENAME", Recycled, furnished as pellets

4 Color ALL

5 Min Thk (mm) 0.75, 1.0, 3.0

6 Flame Class V-1, V-0, V-0

7 HWI 4, 3, 2

8 HAI 2, 1, 0

9

RTI Elec	RTI Imp	RTI Str
80	80	80
120	120	120
140	140	140

10 Comparative Tracking Index (CTI): 0
Dielectric Strength (kV/mm): 32
High-Voltage Arc Tracking Rate (HVTR): 0
Dimensional Stability (%): 0.0

11 Inclined Plane Tracking (IPT): 60 min at 1kV
Volume Resistivity (10x ohm-cm): 14
Surface Resistivity (10x ohms/square): -
High Volt, Low Current Arc Resis (D495): 5

12 (f1) - Suitable for outdoor use with respect to exposure to Ultraviolet Light, Water Exposure and Immersion in accordance with UL 746C

13 (f3) - Suitable for use with respect to exposure to detergents, bleach and solutions typically used in fluid containing parts of laundry equipment, in accordance with UL 2157

14 RoHS 2011/65/EU & 2015/863 Compliant Material (color: NC,BK) [view certificate](#)
UL 746H Non-Halogenated Material (color: ALL)

15 "Grade ABC" contains an average of 30% post-consumer recycled content [view SPOT@certificate](#)

ANSI/UL 94 small-scale test data does not pertain to building materials, furnishings and related contents. ANSI/UL 94 small-scale test data is intended solely for determining the flammability of plastic materials used in the components and parts of end-product devices and appliances, where the acceptability of the combination is determined by UL.

Report Date: 2014-07-15
Last Revised: 2017-02-08

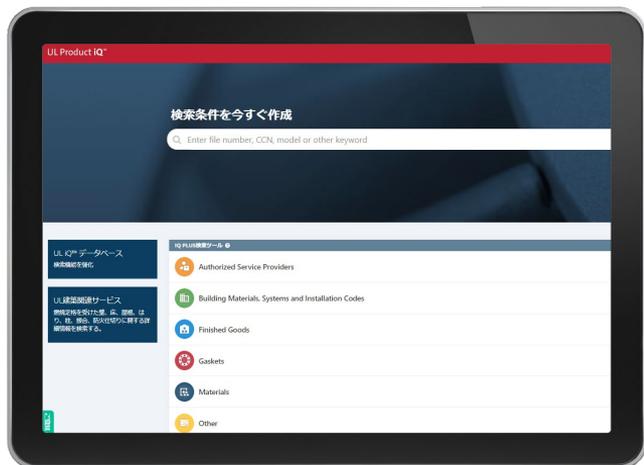
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IEC and ISO Test Methods

Test Name	Test Method	Units	Thk (mm)	Value
Flammability	IEC 60695-11-10	Class (color)	0.4	V-0 (BK)
			0.75	V-0 (BK)
			1.5	V-0 (BK)
			3.0	V-0 (BK)
Glow-Wire Flammability (GWFI)	IEC 60695-2-12	°C	0.4	960
			0.75	960
			1.5	960
			3.0	960
			3.0	960
Glow-Wire Ignition (GWIT)	IEC 60695-2-13	°C	0.4	960
			0.75	960
			1.5	700
			3.0	700
			3.0	700
IEC Comparative Tracking Index	IEC 60112	Volts (Max)	3.0	CTI600
		Material Group		I
IEC Ball Pressure	IEC 60695-10-2	°C	3.0	130
ISO Heat Deflection (1.80 MPa)	ISO 75-2	°C	3.0	124
ISO Tensile Strength	ISO 527-2	MPa	3.0	60
ISO Flexural Strength	ISO 178	MPa	3.0	55
ISO Tensile Impact	ISO 8256	kJ/m ²	3.0	40
ISO Izod Impact	ISO 180	kJ/m ²	3.0	70
ISO Charpy Impact	ISO 179-2	kJ/m ²	3.0	90

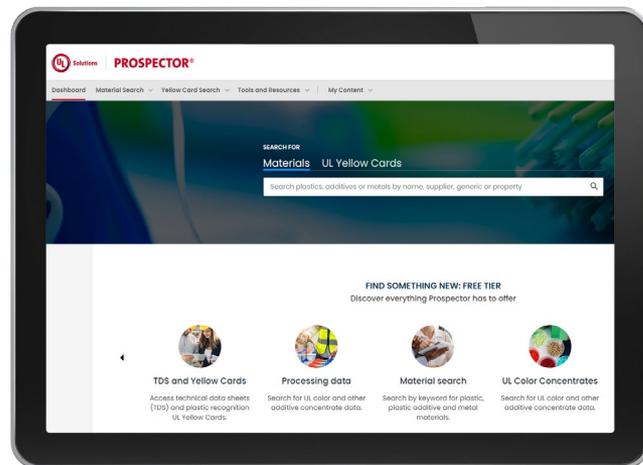


UL Product iQ™ / UL Prospector®



UL Product iQ™

<https://iq.ulprospector.com/info>



UL Prospector®

<https://materials.ulprospector.com/ja>

- UL認証製品・部品・材料、登録企業の検索、材料物性データの検索、Yellow Cardの閲覧 etc.
- アカウントの登録(無料)が必要 – Product iQとProspectorは1つのIDとPW

まとめ

- UL Solutionsでは、自動車用途の材料評価をはじめ、EV給電用ケーブル、EVバッテリー、急速充電気などの評価も実施可能
- UL Solutionsラボは一部自動車OEMの認定試験所であり、各社試験規格に基づく試験を実施可能（Volkswagen, BMW, Toyota Europeなど）
- UL Product iQ/ UL Prospectorより、UL認証材料や特定の性能をもつ材料を検索可能



EVを含む自動車関連の評価試験をワンストップで提供

お問合せ

材料技術部

JP.Materials@ul.com

ウェビナー退出前に、
「投票」と「アンケート記入」
にご協力をお願いいたします

