

UL 2595 General Requirements for Battery-Powered Appliances

2020-07-02



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Introduction



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Advancing Battery Safety Science for Over 35 Years

- UL developed the world's first Lithium Battery safety standard in 1985 (UL1642)
- UL currently has 30+ battery safety standards for a wide variety of cells, products, and systems

Information available on www.ul.com



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Why Does Battery Safety Certification Matter to user?

High level of incidence

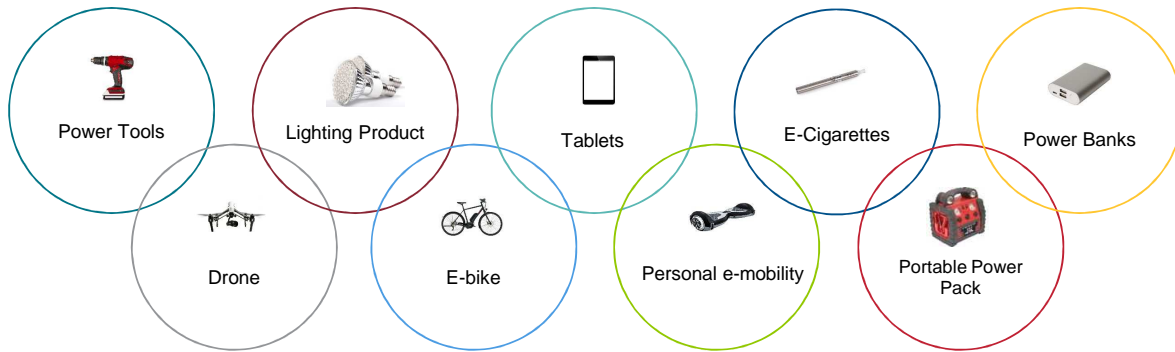
- 21,687 incident reports from Lithium Batteries (Jan 2012 – Jan 2017)

Source: CPSC.org



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Battery and Electrical Products



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Why is It More Risk?



Thermal Runaway:
The incident when an electrochemical cell increases its temperature through self-heating in an uncontrollable fashion. The thermal runaway progresses when the cell's generation of heat is at a higher rate than the heat it can dissipate. This may lead to fire, explosion, and gassing.

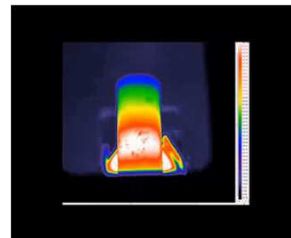
Causes

Internal Defects

- Internal short circuit
- Misplaced or deficient insulation
- Problems with separator
- Misalignment of internal parts
- Contaminants

External Abuse

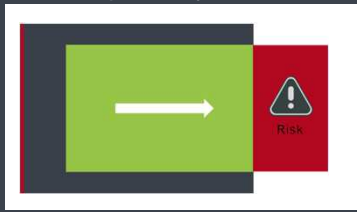
- Overcharge
- Overheating
- High-rate discharge/short circuit
- Mechanical abuse



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Pushing the Limits for Higher Capacity Increases Risk

- Li-ion energy density increasing 8-10% annually
- Applications rapidly proliferating
- Assemblies are getting bigger and more tightly packed
- Product defects due to fragmented supply chain and/or accelerated development cycles



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Storage, Transport, and Disposal



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Battery standard

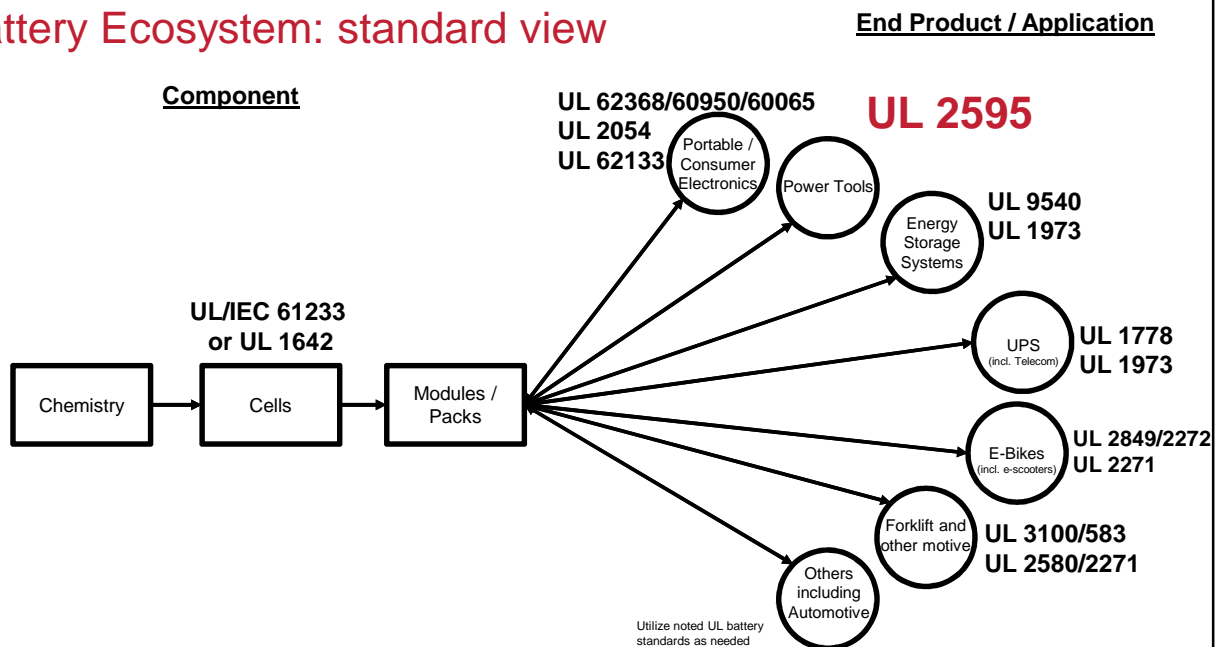
US*	CB scheme*	Japan*	Others*
<ul style="list-style-type: none"> • Portable <ul style="list-style-type: none"> • UL 1642 • UL 2054 • UL 2056 • UL 8139 • UL 62133 • UL 60086-4 • UL 62368-1 • Motive/Transportation <ul style="list-style-type: none"> • UL 2271 • UL 2272 • UL 2580 • UL 2849 • UL 3030 • Stationary <ul style="list-style-type: none"> • UL 1989 • UL 1973 • UL 9540 • Multi-use <ul style="list-style-type: none"> • UL 810A • UL 2743 • Appliance, Lighting, Tool <ul style="list-style-type: none"> • UL 924 • UL 2595 • UL 60745-1 • UL 62841-1 • ... 	<ul style="list-style-type: none"> • Portable <ul style="list-style-type: none"> • IEC 62133-1,-2 • IEC 60086-1,2,4,5 • IEC 61960 • IEC 61951-1,2 • IEC 62188 • IEC 62368-1 • Motive/Stationary <ul style="list-style-type: none"> • IEC 60896 series • IEC 62040-1 • IEC 62485 series • IEC 62619 • IEC 62933 series • IEC 62660-1,2,3 • IEC 62620 • IEC 60335-2-11s4 • Multi-Use <ul style="list-style-type: none"> • IEC 62281 • Appliance, Lighting, Tool <ul style="list-style-type: none"> • IEC 60745-1 • IEC 62841-1 	<ul style="list-style-type: none"> • JIS C 8712 • JIS C 8714 • JIS C 8715 • PSE DENAN • SBA S 1101 	<ul style="list-style-type: none"> • UN 38.3 – Transportation • International Civil Aviation Organization (ICAO); • International Air Transport Association (IATA) • CTIA – USA Cellular Industry <ul style="list-style-type: none"> • IEEE 1625 • IEEE 1725 • BSMI - Taiwan <ul style="list-style-type: none"> • CNS 15364 • CNS 15387 • CNS 15424-1,2 • BIS - India <ul style="list-style-type: none"> • Ed 16046-2015 • GB - China <ul style="list-style-type: none"> • GB/T 31241 • GB/T 18287 • KC 62133 – Korea



* More standards could be listed, for brevity, ones commonly tested are listed.

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Battery Ecosystem: standard view



Many other industry, regional, or country specific battery standards can also be done by UL, for simplicity only sharing UL standards.

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Relevant Battery and Battery related Standards

Portable Applications:

1. UL 2054 or UL 62133 - Portable/Consumer Electronic Batteries (BBFS, BBFS2, BBTG, BBTG2)
 - battery packs used in laptops, Bluetooth speakers, and other portable applications
2. UL 1642 or UL 62133 – Lithium Battery Cells (BBCV2, BBTM2)
 - electro-chemical unit, i.e. cell, for portable use, but not for motive or stationary use
3. UL 2056 – Power Banks (BBSZ)
 - portable rechargeable battery back-up for mobile devices
4. UL 8139 – Electrical Systems for e-Cigarettes (FKIF)
 - portable rechargeable or non-rechargeable e-cigarette devices



Search the category code on www.ul.com/database for further detail.

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Relevant Battery and Battery related Standards

Motive/Transportation Applications:

1. ANSI/UL 2271 – Light EV Batteries (BBCA, BBGA2 & for cell BBGA2)
 - battery cell, module, and packs used in light EV application such as forklifts and drones
2. ANSI/UL 2580 – EV Batteries (BBAS, BBAS2 and for cell level BBGA2)
 - Battery cell, module, and packs used on ride-on applications
3. ANSI/UL 2272 – Electrical Systems for Personal e-Mobility Devices (FKIS)
 - www.ul.com/hoverboards
4. UL 2849 – e-Bikes, e-Scooters, e-Motorcycle (QGNS, FEBR, FEBL)
 - www.ul.com/offerings/personal-e-mobility-testing-and-certification
5. UL 3030 – UAS / Drones (YEFY)
 - Unmanned Aerial Systems



Search the category code on www.ul.com/database for further detail.

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Relevant Battery and Battery related Standards

Stationary Applications:

1. ANSI/UL 1973 – Stationary Batteries (BBCA, BBGA2 & for cell BBGA2)
 - battery cell, module, and packs used in residential, commercial, and utility energy storage
2. ANSI/UL 9540 – Energy Storage Systems (FTBW)
 - battery or other storage technology used in conjunction with inverters
3. ANSI/UL 1989 – Standby Batteries (BAZR2 and full UPS YEDU, YEDU2)
 - Lead-acid batteries used in standby or UPS applications

Multi-use (including AC output) Applications:

1. ANSI/UL 2743 – Portable Power Packs (QPNA)
 - Portable automotive jump starter and back-up power that have AC output



Search the category code on www.ul.com/database for further detail.

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Relevant Battery and Battery related Standards

Appliance & Tools Applications:

1. UL 2595 – General Requirements for Battery-Powered Appliances (BBOI, BBON)
 - Note: Horizontal standard that is referenced in end product appliance standards
2. UL 60745-1 – Hand-held Motor-operated Electric Tools – Safety – Part 1: General Requirements, annex K
 - end product categories: XJYW, XJYW2, XJZV, XJZV2, JHKT, JHKT2)
3. UL 62841 – Electric Motor-operated Hand-held Tools, Transportable Tools and Lawn and Garden Machinery – Safety – Part 2 : General Requirements, annex K
 - end product categories: XJYW, XJYW2, XJZV, XJZV2, JHKT, JHKT2)



Search the category code on www.ul.com/database for further detail.

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Relevant UL Standards, end product

Gardening Appliance Applications :

1. UL 82 – Electric Gardening Appliances (JHKT)
 - Lawn trimmer, Edger-trimmer, Edger, Grass Shear, Cultivators, Shredders, Pruner
2. UL 1447 – Electric Lawn Mowers (JHKT)
3. UL 1017 – Vacuum Cleaners, Blower Cleaners, and Household Floor Finishing Machines (JHKT, DMLW, DMLW2, DMGK, DMME, IMSR)



Search the category code on www.ul.com/database for further detail.

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Relevant UL Standards, end product

Other Appliance Applications :

1. UL 1576 - Flashlights and Lanterns (IKIQ)
2. UL 1776 - High-pressure Cleaning Machines, Electrically Operated (DMKK)
3. UL 1450 – Motor-Operated Air Compressors, Vacuum Pumps, and Painting Equipment (QDGS, QDIQ)
4. UL 778 - Motor-Operated Water Pumps
5. UL 325 - Door, Drapery, Gate, Louver, and Window Operators and Systems (FDDR)
6. More end-product standards will add and reference to UL 2595.



Search the category code on www.ul.com/database for further detail.

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UL 2595 – General Requirements for Battery-Powered Appliances

- BBOI - Lithium-ion Battery Packs
- BBON - Battery-charger Units

UL 62133 – Secondary Cells and Batteries Containing Alkaline or Other Non-acid Electrolytes - Safety Requirements for Portable Sealed Secondary Cells, and for Batteries Made from Them, for Use in Portable Applications

- BBET - Nickel Batteries, Sealed – Component BBTG - Secondary Nickel and Lithium Battery Packs for Use in Portable Applications
- BBTM – Secondary Lithium Cells, for Use in Portable Applications
- BBTP – Secondary Nickel Cells, for Use in Portable Applications

UL 1642 – Lithium Batteries

- BBCV -Lithium Batteries – Component

UL 2054 – Household and Commercial Batteries

- BBET - Nickel Batteries, Sealed – Component
- BBFS - Batteries, Household and Commercial




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UL 2595 Charging System (Pack & Charger)	IEC/UL 62133-2	UL 2054	UL 1642
This standard applies to battery operated appliances.	For cells and pack	These requirements cover portable primary (non-rechargeable) and secondary (rechargeable) batteries for use as power sources in products. These batteries consist of either a single electrochemical cell or two or more cells connected in series, parallel, or both, that convert chemical energy into electrical energy by chemical reaction.	These requirements cover battery systems as defined by this standard for use as energy storage for stationary applications such as for PV, wind turbine storage or for UPS, etc. applications
Cells evaluated by (IEC)/UL 62133	N/A	Cells evaluated by UL 1642	N/A
For pack; For Appliance (injunction with end-product standard)	Cell and pack	Pack	Cell
End product standards (etc.): UL 82, UL 1447, UL 1017, UL 1576, UL 1776, UL 325, UL 1450, UL 778...	UL 62368-1	UL 62368-1, UL 2056 ...	UL 2054, UL 3030 ...



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UL 2595 Charging System (Pack + Charger)	IEC/UL 62133-2	UL 2054	UL 1642
1) Normal charging of lithium-ion systems: 2) Lithium-ion charging systems – abnormal conditions: 3) Abnormal operation – battery terminal short: 4) Abnormal operation - charging cord: 5) Abnormal operation – parts of opposite polarity shorts due to reduced spacings: 6) Lithium ion battery short circuit 7) Lithium-ion enclosure pressure test: 8) Mechanical strength: 9) Glow-wire test: (enclosure) 10) Glow-wire flammability test: (connections) 11) Mold stress/ball pressure	1) Continuous Low Rate Charging: 2) Vibration: 3) Moulded case stress at high ambient temperature 4) Temperature cycling 5) Incorrect Installation of a cell 6) External short circuit 7) Free fall 8) Mechanical shock (crash hazard) 9) Thermal abuse 10) Crushing of cells 11) Low pressure 12) Overcharge for nickel systems 13) Overcharge for lithium systems	1) Electrolyte 2) Short-Circuit 3) Abnormal Charging 4) Forced-Discharge 5) Crush 6) Impact 7) Shock 8) Vibration 9) Projectile 10) Heating 11) Temperature Cycling	1) Short-Circuit 2) Abnormal Charge 3) Discharge 4) Crush 5) Impact 6) Shock 7) Vibration 8) Heating 9) Temperature Cycling 10) Altitude Simulation 11) Projectile UN T1 – T8 tests: Test 1: Altitude Simulation Test 2: Thermal Test 3: Vibration Test 4: Shock Test 5: External Short Circuit Test 6: Impact Test 7: Overcharge Test 8: Forced Discharge
			

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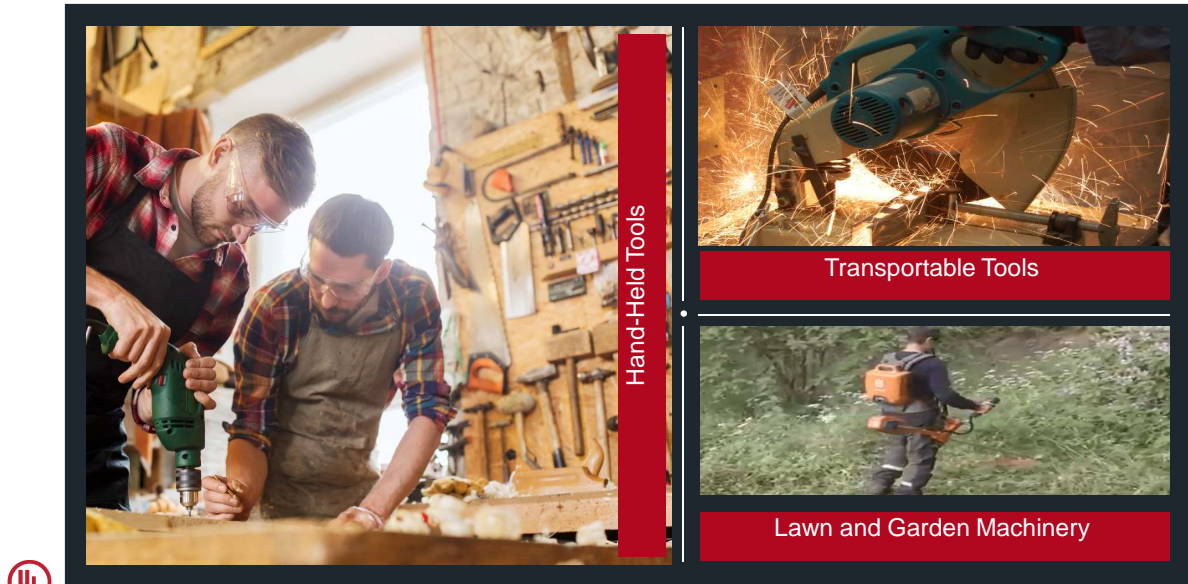
Example

	UL/cUL	CB scheme/ IEC report	CE
Pack (used in Lawnmower)	UL 2595, CSA C22.2 No. 0.23, or UL/CSA 62841-1, Annex K	IEC 62133-2 (Li-ion)	EN 62133-2 (Li-ion)
Charger	UL 1012, CAS C22.2 No. 0.23, or UL 1310, CAS C22.2 No. 223	IEC 60335-1 IEC 60335-2-29	EN 60335-1 EN 60335-2-29
Battery operated Lawnmower	UL 1447, CSA C22.2 No. 147	IEC 60335-1 IEC 60335-2-77	EN 60335-1 EN 50636-2-77
Battery operated Screwdriver + Pack	UL/CSA 62841-1, UL/CSA 62841-2-2	IEC 62841-1, IEC 62841-2-2	EN 62841-1, EN 62841-2-2
	UL/CSA 62841-1, Annex K	IEC 62841-1, Annex K	EN 62841-1, Annex K



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UL 62841 scope



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Portable Tools, UL 62841 part 2



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Transportable Tools, UL 62841 part 3



UL 62841-1, annex K; UL 2595

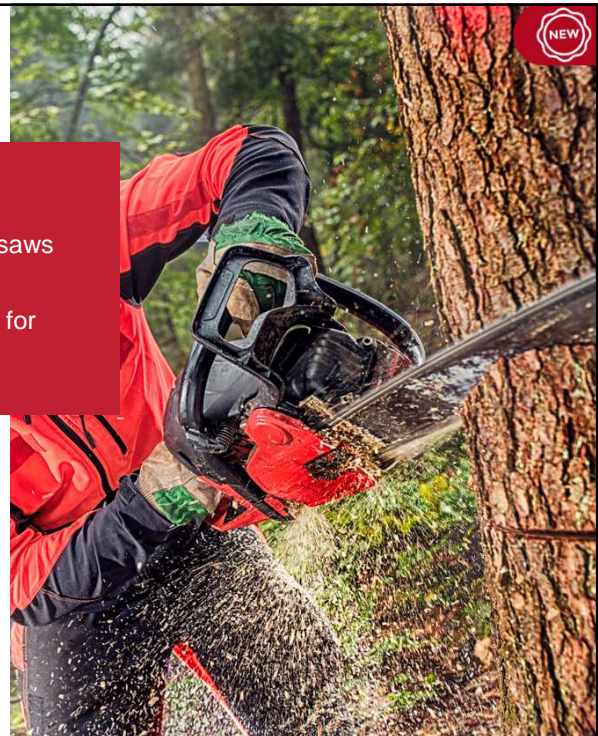
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Chain Saws

UL 62841-4-1, Chain saws

UL (USA) only! Include requirements for “top handle” chain saws under Annex 101.DVA

Pruning saws (U.S. and Canada). Will include requirements for “pruning saws” under Annex 101.DVB



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Hedge Trimmer

UL 62841-4-2, Hedge trimmers.

Extended-reach hedge trimmers are also covered by this standard.

Standard also covers Category 4 blades (wider blade configuration)



Extended reach hedge trimmer

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Lawn Mower

Presently Requires compliance with UL 1447

The new IEC 62841-4-3 for walk behind lawnmowers is expected to be published towards the end of 2020. UL will begin the adoption process when IEC publishes the standard.

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Utility Machines

NEW

UL 62841-4-1000 Particular Requirements for Utility Machines cover battery-operated power-assisted utility carts, wagons and wheelbarrows.



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Laser Engravers

NEW

UL 62841-3-1000: Particular Requirements for Transportable Laser Engravers

Covers transportable CO2 laser engravers with a laser power not exceeding 60 watts intended to engrave, ablate, burn, color, cut and perform similar processes on material samples inserted into the equipment.



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Useful Resource

1. UL standards: <https://ulstandards.ul.com/>
2. Certification Requirement Change (Standard effective date): <https://ifs.ul.com/ifr/ifr.nsf>
3. Certification Database - UL Product iQ: <https://iq.ulprospector.com/>
Access UL certification data on products, components and systems, identify alternatives and view UL guide information with Product iQ.
4. UL Marks and Labels : <https://marks.ul.com/>
5. myUL™ Client Portal : <https://my.ul.com/>
6. Follow-Up Services Additional Resources : <https://www.ul.com/resources/follow-up-services-additional-resources>



Search the category code on www.ul.com/database for further detail.

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