



WHITE PAPER

HAND-HELD TOOLS, TRANSPORTABLE TOOLS, LAWN & GARDEN MACHINERY: WHAT YOU NEED TO KNOW!



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A transition is underway for UL's hand-held, motor-operated electric tool Standards. The legacy UL 60745 series Standards are giving way to a new UL 62841 series and the transition involves more than a new Standard number. In addition to updated guidance and clarification regarding the introduction of new battery and battery charger technologies (lithium-ion batteries, in particular), increased reliance on electronic circuits for functional safety, new marking requirements, and numerous other advancements in tool technology, one of the most noticeable changes is the difference in scope between UL 60745-1 and UL 62841-1. Primarily, the new UL 62841-1 Standard adds needed guidance for transportable tools and lawn and garden machinery and is intended to harmonize certification.

UL works diligently to remain aware of innovations and changes in the market and strives to update and / or create new standards to address these changes and offer guidance. This article will cover the significant new changes and requirements resulting from the adoption and publication of UL 62841-1. Higher voltage battery requirements will be covered in a future article.

UL 60745 OVERVIEW, STATUS AND IMPACT

The legacy *Standard for Hand-Held Motor-Operated Electric Tools*, UL 60745-1 is the 4th edition published on July 31, 2007. It is the US national adoption of the eponymous IEC tool standard. This Standard is maintained by a voluntary, consensus process accredited by the American National Standards Institute (ANSI). The consensus process is administered by a UL Standards Technical Panel (STP) that currently consists of 20 individuals representing various interest categories. The STP is responsible for providing proposals to amend and maintain the standard, and for reviewing and balloting proposals (including those generated by others) for adoption as part of the ANSI/UL tool Standard. As part of the STP process, anybody can make a proposal to revise the Standard in addition to reviewing and/or commenting on proposals. UL customers have free access to all UL Standards (not including UL IEC based Standards), end product and component, regardless of which products they currently have Certified with UL.

UL 60745-1 is the Part 1 Standard which includes general requirements for all hand-held, motor-operated electric tools. The Part 1 standard includes normative references, terms, definitions, markings, instruction manual requirements, mechanical construction requirements and specific test requirements. The Part 1 standard also covers battery tools and battery packs under Annex K of the standard. Annex L covers battery tools and battery packs with mains connections or connections to non-isolated sources. There are associated Part 2s that cover 20 different types of hand-held tools that include specific ("particular") requirements for those tools. The structure of the Part 2s is to accept or amend the Part 1 requirements in both the main section and applicable annexes. Because UL 60745 is based on an IEC standard, it identifies US national differences from IEC requirements within Part 1 and associated Part 2s.



UL 62841 OVERVIEW, STATUS AND IMPACT

The UL 62841-1 Standard covers Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery with the 1st edition published February 20, 2015. Similar to UL 60745-1, this is an ANSI Standard adopted from an IEC standard and amended for the US market through the Standards development process. UL 62841-1 represents significant changes and new requirements compared to UL 60745-1. In UL 60745-1, the scope only covers Hand-Held Tools in association with all the applicable Part 2s. In UL 62841-1, the scope includes the Part 2s for hand held tools, but now also includes Part 3s for transportable tools, and Part 4s for lawn and garden machinery. The expanded scope will also impact other legacy UL standards beyond those discussed in this article.

This transition from UL 60745 to UL 62841, with respect to the development and publication of the Part 2s, 3s and 4s, will phase in at different times over the coming years as each applicable part is adopted. The Standard changes may initially



have a significant impact on manufacturers regarding the design of their products, but they will enable a single design for a global market (within the limitations of infrastructure, including supply voltage / frequency). This will eliminate situations where a compliant European design needs to comply with different requirements in North America that could drive design changes.

Below is a list of changes to UL 62841-1 from UL 60745-1. More significant changes are detailed later:

- General Markings and Instructions
- Marking or Test for Light Sources
- Voltage recovery requirements. For example: For a table saw, if power is lost, the saw will not turn on inadvertently upon restoration of power if the power switch is left on.
- Durability of lock-off devices
- Correlation Marking changes

LITHIUM-ION REQUIREMENTS FOR UL 62841-1

A significant change from UL 60745-1 to UL 62841-1 involves the inclusion of new requirements for lithium-ion (Li-ion) cells and battery systems. Li-ion cells must now comply with UL 62133, Standard for Safety for 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* or IEC, which is essentially an identical standard. This also includes the normal charging of Li-ion systems where cells must be within the Specified Operating Region of the cell during the normal charging of the system. Though tools will still be evaluated as complete systems which include the tool,

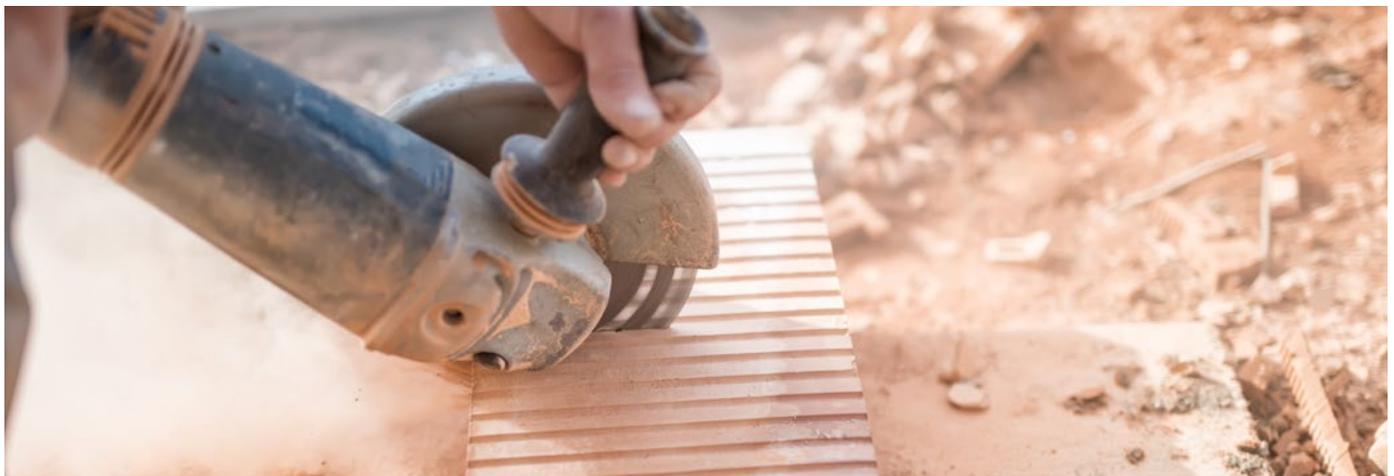
battery pack and battery charger, this is a critical new aspect within UL 62841-1. It means that charger manufacturers and tool manufacturers who make their own chargers have to comply with the same new Li-ion system requirements.

The *Specified Operating Region* for charging is identified by the cell manufacturer as the conditions for voltage and current during charging required to comply with UL 62133 or IEC. When testing and evaluating tools with Li-ion cells, the specified operating region must be known for both the voltage and charging currents and must not be exceeded, even under fault conditions in the tool (including battery pack) or charger. Some of the additional requirements include a Li-ion enclosure pressure test to help ensure that the cell doesn't explode should it start to vent and a mechanical strength test, conducted on the tool and battery pack, to help ensure that, after dropping, the battery pack:

- a) open circuit voltage is not less than 90 percent prior to the test,
- b) complies with a normal discharging and recharging test, and
- c) exhibits no damage to the cell vent.

The Li-ion charging systems must also undergo abnormal component fault conditions. When the components in the charging system are faulty, the cells shall not exceed the upper limit charging voltage by more than 150 mV. If exceeded, the charging system must be permanently disabled from recharging the battery. Li-ion charging systems may need to be redesigned in order to comply with the new requirements.

The components and the electronic circuits that comprise the battery system are considered to be critical with respect





to safety performance. For example, if there is a change from one manufacturer's cell to another cell within the battery pack, the alternate cell may have a different *Specified Operating Region* characteristic, as determined by the performance and test criteria specified in UL 62133. As such, if the cell parameters are different, the combination of the cells with the battery pack and the battery-charger need to be investigated again to help ensure they are still in compliance with the safety requirements for the battery system. This is a system approach for the overall tool evaluation; investigation of the charger alone is not sufficient.

UL CATEGORY: LITHIUM-ION CERTIFICATION FOR LITHIUM-ION BATTERY PACKS

The UL category, *Lithium-ion Certification for Lithium-ion Battery Packs* (BBOI), covers detachable or separable lithium-ion battery packs intended for use in battery-powered appliances. This category provides supply chain control over the battery pack construction, providing a link back to the end-product (tools and other appliances) that use these battery packs. The battery packs covered under this category are intended for use with an end-product system whereby the complete system consists of a battery-powered appliance, Li-ion battery pack and a battery-charger unit. The battery packs are required to be marked with the manufacturer's name / trade name / trademark and model number / catalog number / series identification (or equivalent) and are also required to be marked with the following (or equivalent): "For use only with ____ charger."

These markings identify the specific charger, thereby linking the battery charging systems. Alternatively, the statement, "See Instruction Manual for Additional Chargers" (or the equivalent) may be employed in addition to at least one charger referenced by catalog number. Li-ion battery packs can be covered as either a Listed product (bearing a UL Mark) or as a Component of the tool (no separate UL Mark for the battery pack).



UL CATEGORY: LITHIUM-ION CERTIFICATION FOR LITHIUM-ION BATTERY-CHARGER UNITS

The UL category, *Lithium-ion Certification for Lithium-ion Battery-Charger Units* (BBON), covers battery-charger units intended for use with an end-product system whereby the complete system consists of a battery-powered appliance, Li-ion battery pack, and a battery-charger unit. The battery-charger unit is covered in the category to provide supply chain control over the battery-charger construction, providing a link back to the end-product (tools and other appliances) that use these battery chargers. To obtain Certification for Listing under this category, the battery charger must comply with the requirements of one of the relevant charger standards (UL 1012, UL 1310, or UL 60950-1) AND the end product Standard (UL 62841-1 (Annex K) or UL 2595 plus the relevant appliance standard).

FUNCTIONAL SAFETY OVERVIEW, STATUS AND IMPACT

Under UL 60745, the only option that is available is a single fault tolerant design. The new requirements under UL 62841-1 allow for a safety evaluation alternative for electric circuits that provide a safety critical function (SCF), defined as follows: Function(s) required by this standard, the loss of which would cause the tool to function in such a manner as to expose the user to a risk that is in excess of the risk permitted by this standard under abnormal conditions. Electric circuits that provide a SCF are required to be reliable and not susceptible to loss of a SCF due to exposure to electromagnetic environmental stresses encountered in anticipated environments. Immunity tests are carried out for all SCF electric circuits, including dual (two) channel designs (i.e. single fault tolerant).

The rationale for subjecting dual channel designs to immunity tests is that both channels in the circuit could be simultaneously affected by the immunity tests and could result in the failure of the electronic circuit to perform its intended function. The SCF, fault conditions and safety level of performance of electronic circuits are specified by the end product standard. The typical SCFs and the minimum performance levels (PLs) are defined in the applicable Part 2s, 3s, and 4s that have already been published or are going to be published under the UL 62841-1 series Standards.

In general, the more reliance a product places on an electronic system for safety, the higher the reliability of the system must be for that product. For instance, when the associated risk of injury for that failure is very high, then the electronic circuit



reliability for the product needs to be high. Conversely, if the associated risk is very low, the product's level of the reliability can be lower. For discrete electronics, the reliability analysis is conducted by using a statistical approach (e.g. ISO 13849-1), which includes everything except programmable logic, as indicated in UL 62841-1. For the evaluation of programmable logic/devices and microcontrollers, IEC 60730 (Annex H) is applied. This is to ensure that the microelectronics and software, in addition to the discrete components, are appropriately evaluated.

NEW HIGHER BATTERY VOLTAGE

The maximum rated voltage for a battery operated tool and battery packs is currently 75 V d.c. There is a proposal under review that is being finalized to increase the voltage to 250 V d.c. A UL Certification Requirement Decision (CRD) dated July 1, 2016 was published for UL 2595 to address higher voltages. Some associated changes along with this voltage rating proposal are the following:

- a) Insulation fault current measurement
- b) Safety symbol marking
- c) Humidity test
- d) Environmental (IPX) testing, with and without battery, and
- e) Creepage and clearance revisions

It is expected that a proposal will be sent to the STP to revise UL 62841-1 (Annex K) in addition to making revisions to UL 2595. This proposal is subject to change and should not be applied for certification to UL 62841-1.

LAWN AND GARDENING MACHINERY (GARDENING APPLIANCES)

As noted previously, UL 62841 Part 4s will cover Gardening Appliances as Lawn and Garden Machinery and will require a transition from the legacy standards. Current coverage is detailed below:

UL 82: Products such as grass shears, lawn trimmers, edgers, edger-trimmers, cultivators, shredders, chippers, shrub clippers, pruners, pole pruners, and pole hedge trimmers.

UL 1447: Lawn mowers.

UL 60745-2-13 and UL 1662 (UL 1662 will be withdrawn May 15, 2018): Various chain saws.

UL 60745-2-15: Hedge trimmers and extended reach hedge trimmers.

With the adoption and publication of UL 62841, Part 4-1 will cover cordless top handle chain saws (U.S. only) and cordless pruning saws as national deviations. Part 4-2 will cover hedge trimmers and extended reach hedge trimmers as coverage transitions away from UL 60745-2-15. New requirements under UL 62841-4-2 will require the distance between the blade control and the cutter edge of the cutter blade to be at least 1,000 mm to be considered an extended reach hedge trimmer. Additional cutting device categories have also been added. These are defined by a combination of cutting device configurations, the number of handles, the number of handles with blade controls, and the blade stopping time. For each higher category, there is an incremental increase in the level of safety criteria that will be required.



UL 2595 OVERVIEW

UL 2595, *General Requirements for Battery-Powered Appliances*, is a Bi-National Standard with Canada. UL 2595 is considered a “Horizontal Standard,” which means many UL Standards, such as UL 82, *Electric Garden Appliances* and UL 1017, *Vacuum Cleaners, Blower Cleaners, and Household Floor Finishing Machines* reference UL 2595 for their battery-powered requirements. A single standard containing all of the relevant requirements for battery operated products provides consistency in the application of these requirements for battery-powered appliances.

UL 2595 covers various rechargeable battery chemistries, including nickel cadmium and nickel metal-hydrate. Additionally, this Standard covers Li-ion battery system requirements. The requirements in UL 2595 are generally the same as UL 62841-1 Annex K; however, UL 2595 is used for other appliance type products. UL 2595 includes functional safety requirements with SCFs, software reliability, and EMC immunity tests similar to UL 62841-1 Annex K. Moving forward, other appliance standards will reference UL 2595. For example, UL 1090, *Standard for Electric Snow Movers*, recently adopted the reference to UL 2595 for evaluation of battery operated snow movers.



ACHIEVING UL CERTIFICATION TO UL 62841-1

With all the changes to these tool standards, UL is working to help ensure that all clients keep safe and compliant products in the marketplace during and after Standard revisions. UL has two paths to enable uninterrupted UL Certification during the transition: 1) the traditional UL Industry File Review (IFR) and 2) UL’s Continuing Certification Process which most tool products will follow. Under the Continuing Certification Process, the STP responsible for the UL 62841 series Standards will vote on whether a Standards revision will require an Industry File Review (IFR) based on the impact of the revisions. If no IFR is deemed necessary, the Continuing Certification Process will be used.

Currently, only transportable table saws and transportable miter saws will use the IFR path as the new requirements for these product areas are substantially different from the existing safety requirements in the legacy Standard, UL 987. Additionally, as the requirements for Li-ion based systems are new, all battery operated Li-ion based systems are or will be required to be covered under an IFR. IFRs are currently underway for various product areas for tools and gardening appliances and notifications were or will be sent out separately to those affected.

For the remaining tool products, the Continuing Certification Process will be used as the new requirements were substantially driven by harmonization rather than safety. Under the Continuing Certification Process, all currently certified models will remain certified provided that no significant changes are made to the product. If a significant change is made to the product, it will be necessary for the product to comply with the requirements in the new Standard. A significant change is considered to be a change such that the heating, impact and abnormal test(s) must all be performed.

If you have questions about obtaining the UL Mark, an IEC Test Report with or without National Deviations, or other specific country marks for new or existing products, please contact your local UL tool representative or email us at ApplianceInfo@ul.com. Visit our website for additional information at ul.com/tools



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