LG Energy Solution

LG Energy Solution
Lithium-ion Battery Safety Guide
For Industrial Users

For LG Energy Solution, the safety of our customers and partners, as well as the quality of our products, is of utmost importance. To prevent any accident caused by misuse or mishandling of the product, please read carefully and comply with this 'Lithium-ion Battery Safety Guide for Industrial Users'.

(Note: This guide applies to LG Energy Solution's lithium-ion battery products excluding ESS batteries. For safe use of ESS batteries, please refer to the Energy Storage System (ESS) Product Safety Guide.)

This guide outlines the minimum safety requirements. The manufacturer of the final product is responsible for implementing additional safety measures.

LG Energy Solution will not assume legal liability for any product damage, fire, explosion, or related personal or property damage caused by failure to follow the items and precautions specified in this guide.

The content of this guide may be periodically updated or revised as the scope of product environmental regulations expands.

※1) Battery Unit : Battery Cell/Module/Pack, 2) System: Final product equipped with a battery pack

1 Lithium-ion Battery Unit contains intensive energy, and it can cause fire or explosion when misused or mishandled, leading to severe injury or property damage.

2 As internal energy of Lithium-ion Battery Cell/Module may not be controlled by itself, it must be used in Battery Pack with protective circuitry to safeguard against fire, explosion, or abnormal conditions.

3 Lithium-ion Battery Unit must not be sold or distributed directly or indirectly to individual consumers (or end users), nor used in products not approved by LG Energy Solution. LG Energy Solution does not permit, approve, or recommend such act.

4 LG Energy Solution's industrial users must comply with this 'Lithium-ion Battery Safety Guide for Industrial Users'.

Section 1. Caution for using and handling

※ Battery Unit : Battery Cell/Module/Pack

(1) Use

① Use lithium-ion battery units only in applications pre-approved by LG Energy Solution.

② Before using or handling Lithium-ion Battery Cell or Pack, please read carefully and comply with the latest version of the Product Specification.

③ Do not handle Lithium-ion Battery Pack in electrostatic environment.
Static electricity may damage the protection circuit of Lithium-ion Battery Pack.

④ Wear proper protective equipment to prevent electric shock and burns when handling lithium-ion battery units.

⑤ Handle lithium-ion battery units with care to avoid physical damage on them.

⑥ Verify and correctly use the (+) and (-) terminals when operating lithium-ion battery units.

(2) Charging

① When charging lithium-ion battery units, strictly follow the detailed charging conditions (voltage, current, time, etc.) specified in the product specifications and adhere to the charging manual.

② Use only the designated charger for lithium-ion battery units.
*Designated charger: Genuine charger specifically designed for the system, Globally certified charger under standards such as UL, IEC, CE, KC, PSE, CCC, etc.

③ If any of the following abnormal signs are observed, stop charging the lithium-ion battery unit immediately and report the issue to LG Energy Solution:

A. Smoke is emitted during charging the battery unit

B. Liquid leakage or unusual odor from the battery

C. Swelling, deformation, or discoloration of the battery unit

D. Unusually high temperature of the battery unit

E. Any other abnormal behavior

④ Do not leave the lithium-ion battery unit connected to the charger or store it while charging for a long time. Disconnect the charger after full charge.

(3) Storage

① Store lithium-ion battery units according to the detailed storage conditions specified by LG Energy Solution (temperature/humidity, stacking layers, etc.).

② Do not stack lithium-ion battery units beyond the designated number of layers during storage or transport to prevent internal damage caused by pressure.

③ Insulate the terminals of unused lithium-ion battery units during storage to prevent short circuits.

④ Do not store lithium-ion battery packs while connected to a charger, fully charged, or fully discharged.

⑤ It is recommended to keep lithium-ion battery units in their original packaging until use.

Remove the packaging only when you use the product.

⑥ If the system will not be used for several months, disconnect the lithium-ion battery unit from the system and store it according to the product specifications.

Section 2. Prohibitions

※ Battery Unit : Battery Cell/Module/Pack

① Do not disassemble lithium-ion battery units supplied by LG Energy Solution without prior authorization from LG Energy Solution.

② Failure to comply with the following may result in overheating, fire, or explosion. Strictly adhere to these guidelines:

- Do not drop or strike the lithium-ion battery unit.
- Do not step on the battery unit or apply excessive pressure to the battery unit.
- Do not puncture, hammer, or otherwise damage the internal or external structure of the battery unit.
- Do not expose any part of the lithium-ion battery unit to heat, direct sunlight, fire, or heat sources.
- Do not place or store lithium-ion battery units in high-temperature environments or near heat sources.
- Do not immerse the battery unit in water or seawater, and do not use or charge wet battery units.
- Do not forcibly discharge the battery by connecting its (+) and (-) terminals to a conductor (e.g., metal).
- Do not store the battery unit with metal objects.

③ Do not use lithium-ion battery units that have been dropped or damaged, as they may pose a risk of internal short circuits.

④ Do not disassemble, open, cut, or modify the lithium-ion battery unit in any way.

⑤ Do not use battery units of different types (e.g., primary vs. secondary, lithium-ion vs. nickel-metal hydride, pouch vs. cylindrical), sizes, or specifications (e.g., voltage, capacity) together.

Section 3. Lithium-ion Battery Pack/System Precautions

※ Battery Unit : Battery Cell/Module/Pack

(1) Battery Pack Assembly Precautions

① Before use for pack or system assembly, inspect the lithium-ion battery unit for external damage. If damage, leakage, odor, or corrosion is found, do not use the product. Report the issue to LG Energy Solution and dispose of it according to local regulations and LG Energy Solution's disposal guide.

② Do not use lithium-ion battery units that have been dropped, subjected to impact, or damaged for pack manufacturing or any other purposes.

③ Ensure battery terminals are not short-circuited by contact with conductors. Handle the product in a clean, organized environment to avoid damage or contamination.

④ Always check the condition of the (+) and (-) terminals of the lithium-ion battery unit and connect them in the correct orientation.

⑤ During the welding process, ensure that excessive heat or pressure is not applied to the lithium-ion battery unit except at the welding points.

⑥ Do not mix battery units from different manufacturers, or lithium-ion battery units with different models or specifications (such as voltage and capacity) in a battery pack or system.

(2) Battery Pack/System Requirements

① Lithium-ion battery packs and chargers must meet the applicable national laws, regulations, and safety standards (e.g., UL, IEC).

② Battery pack and system manufacturers must guide individual consumers(or end-users) to use only genuine chargers designed for the product and follow the charging manual.

③ Battery pack and system manufacturers must restrict individual consumers(or end-users) from using lithium-ion battery units with significantly reduced usage time or those that have reached their end of life (EOL).

④ If the voltage of a lithium-ion battery unit falls below the product's minimum discharge voltage, manufacturers must ensure consumers do not recharge or reuse the unit.

⑤ Lithium-ion battery packs must include a voltage measurement/management system to maintain normal operation and prevent voltage imbalance between units (cells, banks, modules) during charging or discharging.

⑥ Lithium-ion battery chargers must include protection or warning systems for over-temperature, over-voltage, and over-current conditions.

⑦ Lithium-ion battery packs must include the following essential diagnostic functions. Battery packs used in electric vehicles (EVs) must also include additional diagnostic functions. The specific levels,

values, and conditions of these functions must strictly comply with the documents (e.g., check sheets, product specifications) agreed upon with LG Energy Solution. If any function is omitted or modified, the pack manufacturer (system integrator) must notify LG Energy Solution. LG Energy Solution is not legally responsible for any external quality issues caused by the exclusion or omission of functions agreed upon for inclusion.

Cylindrical Battery	
Common Diagnostic Functions	Enhanced Diagnostic Functions for Electric Vehicles
• 1st Over Voltage Protection circuit • 2nd Over Voltage Protection circuit • Safety Over Voltage Protection(Permanent Failure) • Under Voltage Protection circuit • Safety Under Voltage Protection (Permanent Failure) • Over Charge Current Protection circuit • Over Discharge Current Protection circuit • Short Circuit Protection circuit • Over Temperature Protection circuit • FET failure protection(in case of FET is unavailable) • Cell imbalance protection circuit (when more than two cells are assembled in series in one pack.) • Cell voltage balancing function (when more than two cells are assembled in series in one pack.) • State of Health Protection (Permanent Failure, when one cell in series and more than two cells in parallel are assembled in one pack. (1SnP))	• Insulation diagnosis • Overcurrent diagnosis • Detection for abnormal conditions in major components including sensor, contactor and HVIL • De-rating function when over/under voltage is detected • DTC (Diagnostic Trouble Code) record and safety functions for prevention of continuous use when the system alerts • Overpower protection
Pouch Battery	
Common Diagnostic Functions	Enhanced Diagnostic Functions for Electric Vehicles
• Over Voltage Warning Protection • Over Voltage Fault protection • Under Voltage Warning detection • Under Voltage Fault protection • Over Current Warning protection • Over Current Fault protection • Short Circuit Protection Device • Over Temperature Warning protection • Over Temperature Fault Protection • Cell Balancing Function • Low SOH Protection	• Voltage sensor faulty detection • Temperature sensor faulty detection • Current sensor faulty detection • HVIL(High Voltage Inter Lock) detection • De-rating function when over/under voltage is detected • DTC (Diagnostic Trouble Code) record and safety functions for prevention of continuous use when the system alerts

• SOH Deviation Protection • SOC Deviation Protection • Pack Isolation Warning Protection • Pack Isolation Fault Protection • Shutdown or Sleep Mode Function on BMS • Relay/Contactor Faulty Protection • Communication (Internal/External) Faulty Protection • Over Power Protection	