Virtual Battery Seminar

December 17-19, 2024

- 6 hours training

Shmuel De-Leon Energy invites you to join 7 hours battery virtual seminar taking place as 3 parts on December 17-19, 2024.

Registration to seminar 3 parts (Parts 1-3) - $599 per person

Registration to Battery Safety Training (Part 3 only) - $299 per person

- **Discount registration rate for group registration - Contact us for more details.**

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17 December 2024 - Part 1 - (3 hours) - starting at 16:00 PM Central Europe Time, 10:00 AM EST USA Time

Part 1 includes 3 sections - Battery Essentials, Li-Ion Cells Data Sheet Design, Primary Batteries

18 December 2024 - Part 2 - (2 hours) - starting at 16:00 PM Central Europe Time, 10:00 AM EST USA Time

Part 2 includes 2 sections - Rechargeable batteries and battery Packs Design

19 December 2024 - Part 3 - (2 hours) - starting at 16:00 PM Central Europe Time, 10:00 AM EST USA Time

Part 3 includes 1 session - Battery Safety Training

* Registered attendants will receive the training presentation (Presentations are confidential for internal use only)

Training Syllabus:

Battery Essentials

- Battery History
- The strong need for batteries
- Cells & Battery Packs
- Cells classifications
- Internal cell components
- Anode and cathode structure
- Cell components affecting energy density
- Charge - Discharge operation
- Cells - Button & Coin Cells Shape
- Cells - Hard Case Cylindrical Shape
- Cells - Hard Case Prismatic Shape
- Cells - Prismatic Pouch Shape
- Cells Internal Construction - Bobbin and Spiral Types
- Li-Ion Pouch Cells Internal Construction Formats

- Cells – Thin Film Type
- Cells - Case Polarity, Seals
- Cell Voltage Definitions
- Internal Resistance/Impedance
- Operating Temperature – What Does it Mean?
- Storage Temperature
- Shelf Life, Prolonging Cycle Life, Life, Service/Calendar Life
- Parameters Affecting Aging and State of Health
- State of Charge – State of Health
- Cells Grading
- What is a C-Rate (Apply to Charge and/or Discharge)
- Energy & Power Density

Design of Li-Ion Rechargeable cell data sheet

- Lithium rechargeable cells data sheets
- No One Way to Define Cell Data sheet
- Cell Data Sheet Validation
- Typical Data Sheets
- Cell Voltage Range - [V]
- Maximum Charging Voltage - [V]
- Maximum Open Circuit Voltage - [V]
- Standard Charge Current Rate (Slow Charging) – [A]
- Maximum Constant Current Charge Rate (Fast Charging) – [A]
- Maximum Pulse Current Charge Rate – [A]
- Standard Discharge Current Rate (Slow Discharging) – [A]
- Maximum Continues Discharge Current rate (Fast Discharging) – [A]
- Maximum Pulse Discharge Current rate (Fast Discharging) – [A]
- Safety Certifications and Status
- Cell Capacity – [Ah]
- Nominal Voltage – [V]

- Energy – [Wh]
- Weight Energy Density - [Wh/kg]
- Volumetric Energy Density –[Wh/l]
- Charge Capacity @ Temperature – [%]
- Discharge Capacity @ Temperature – [%]
- Discharge Capacity @ C-Rates – [Ah]
- Standard Cycle Life
- Fast Charge Cycle Life
- Cycle Life @ Discharge C-Rates
- Cycle Life @ Temperature
- AC Resistance (0%SOC, 25oC) – [mOhm]
- DC Resistance (50%SOC, 25oC) – [mOhm]
- Self-Discharge – [%]
- Thickness variation (0 to 100% SOC) – [%]
- Thickness variation as function of cycle life [%]
- Performance limits for BMS/PCM
- OCV vs SOC @Temperature for BMS
- Some Extra Information
- Identification and marking – Murata Example

Primary Batteries

- Primary Batteries Characteristics
- Why Still Talk About Primary Battery?
- Commercial Primary Cells Energy Density Comparison
- Zinc Chloride and Zinc Carbon- (Heavy Duty)
- Alkaline Manganese Dioxide – Zn/MnO2
- Alkaline Manganese Dioxide Cells – Bobbin Construction
- Silver Oxide (Zinc) – Zn/Ag2O
- Discharge Profile: Silver Oxide & Alkaline Button Cells
- Lithium Primary Cells

- Lithium Primary Cells Electrolyte Classification
- Lithium Passivation
- High Temperature (> 100 Deg C) Lithium Battery Applications
- Lithium Iron Disulphide Li/FeS2
- Lithium Manganese Dioxide Li/MnO2
- Lithium Carbon Mono Fluoride Li/CFx
- Ultralife – Li/CFx-MnO2, CETE Li-Cfx Cells
- Lithium Thionyl Chloride LI/SOCl2
- Lithium Sulfuryl Chloride Li/so2cl2
- High Power Lithium Organic Cell (TLM series)
- Tadiran Low TMV Lithium Thionyl Chloride Cells (TRR)
- Li-Mox New High Energy and Power cells

Rechargeable Batteries

- Why Rechargeable Batteries?
- Rechargeable Battery System Performance
- Lead Acid Batteries, Advantages, Limitations
- Nickel-Cadmium Batteries, Advantages, Limitations
- Nickel-Metal Hydride Batteries, Advantages, Limitations
- Sodium Ion Batteries
- Rechargeable Lithium Batteries & Systems
- Raw Materials Used in Li-Ion Batteries Cathodes
- Best Performance Li-Ion Cells
- Li-Ion Cylindrical Hard Case Cells Advantages, Limitations,
- Hard Case Cylindrical Cells Construction
- The Need for Larger Lithium-Ion Cylindrical Cell Sizes
- 18650 Cells Till 2015

- 2023 First progress after 8 years – Shanghai Far East 18650 3.8-4Ah
- 21700, 46mm, 60mm Cells
- LG 21700 Cells
- Jiangxi Far East 21700, 6Ah
- Tesla 4680 new cells
- Panasonic, LG, Samsung, CATL, Eve 46mm Cells
- 46mm NMC Cells Map
- 46mm LFP cells map
- 46mm Cells main applications
- Cylindrical Li-Ion 21700 Tabless Cells
- Hard Case Prismatic Cells Advantages/Limitations
- Hard Case Button Li-Ion Cells
- Li-Ion Pouch Cells Soft Packaging, Advantages, Limitations
- Thickness Variation (0-100% SOC)
- Li-Ion Liquid Electrolyte Pouch Cells
- Ballooned Li-Ion Pouch Cells (Swelling - Gassing)
- Li-Ion Cylindrical Pouch cells
- LI-Ion Button Pouch Cells
- Lithium Iron Phosphate Batteries, Advantages, Limitations
- Why LFP is Highly Safe?
- LFP as a Replacement to Lead-Acid Batteries
- Cylindrical 32140 LFP Tabless Cells
- LMFP Cathode/Silicon Anode Cells
- LTO Cells, Advantages, Limitations
- Lithium Dendrite During Low Temperature Charging
- Toshiba LTO Battery – SciB
- Li-Ion cells with Silicon Anode
- Enovix 100% Silicon Anode cells in Mass Production
- Amprius 100% Silicon Anode Cells
- Li-Ion High Voltage LCO Cells, Advantages, Limitations

- High charging voltage effect on Weight Energy Density
- LIB in IT Applications – Moving to the 4.5-4.6V & Silicon Anode to Enhance Energy Density
- Quasi Solid, Semi Solid- & Solid-State Cells
- Solid State Batteries, Advantages, Limitations
- Prologium, Ganfeng Lithium, WeLion New Energy, Gotion Guxin Cells
- Li-Metal - Sulfur/NMC – Liquid Electrolyte Rechargeable Cells
- CETC – Lan Tan Technology
- Anhui Tongneng New Energy
- Lyten Li-S Cells
- What Prevents the Implementation of Li-Sulfur?
- Sion “Licerion” Li- Metal Cells With NMC Cathode

Battery Pack Design

- Battery Packs – The Need
- Battery Pack Components
- Cells Used in a Battery Pack
- Resistance & Laser Spot Welding
- Connect: Aluminium Wire 0.4mm
- Wire Bonding Process for Larger Batteries
- High Power Cells Connection
- Pouch Cells Connection
- Battery Packs Internal Construction
- Battery Pack Insulation
- Shrink Wrap Packaging Materials
- Potting for Safety/Strength
- Geometry And Topology
- Battery Pack Enclosures- Plastic Consideration
- Battery Pack of the Shelf
- Guide for Battery Pack Design Requirements

- Battery Pack Design Process
- Cells Selection – Requirements & Process
- Designed Capacity
- Cell Validation Tests
- Design for Safety
- Cells Internal Safety Vent, CID, PTC
- Cell Internal Shut Down Separator (Fuse Like)
- Cell Composite Current Collectors (Fuse Like)
- Battery Pack Safety Components, One Use Fuse, PTC, NTC
- LI-Ion Protection Circuit Module – PCM
- Battery Management System - BMS
- Li-Ion Battery Packs Unbalancing
- Cells Balancing
- Safety Component Validation Tests
- Battery Packs Mechanical Design
- Mechanical Validation Tests
- Battery Pack Performance Tests
- Battery Pack Certifications
- Cell to Pack Concept
- Cell to Chassis/Body

Battery Safety

Batteries have become daily use components for many applications. New growing segments like EV and Grid storage batteries extend the traditional ordinary battery applications. In the race for energy density, we shouldn't forget the safety – as an example the Samsung Galaxy Note 7 battery safety case. Unfortunately, we face daily safety events with injuries and severe damage. This tutorial focuses on portable, stationary, and automotive battery safety along the battery cycle life (acceptance, testing, assembly, use, transportation, and disposal). The training incorporates Shmuel De-Leon's and other experiences on battery safety representing over 30 years of work

in the field. The motivation behind the training is to provide attendees with the knowledge needed to safely handle the batteries in their organization and to support reduction in safety events.

Topics to be covered:

- Battery Safety Hazards – Movies and examples
- Battery Safety Guidelines – recommendations on proper work with batteries (Acceptance, testing, battery pack design, use, transportation, disposal)
- What to do in case of a battery safety event - Recommendations
- Battery Safety Equipment – Check list for labs and warehouses

About Shmuel De-Leon:

Shmuel De-Leon is Founder and CEO of Shmuel De-Leon Energy, Ltd.

Shmuel is a leading international expert in the business of batteries.

Prior to founding the company, Shmuel held for over 20 years various positions as a battery, engineering and

quality control team manager. Shmuel holds BSc. in mechanical engineering from Tel-Aviv University and MBA in quality control and reliability

engineering from the Technion Institute in Haifa as well as an Electronic Technician's diploma.

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