Lessons Learn(ing) about Battery Incidents

Brian Engle

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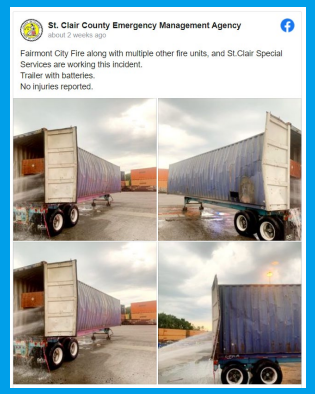
Chair, SAE Battery Standards Steering Committee

Chair, SAE First/Second Responders Task Force

30 July, 2025




(Photo by Birmingham Fire and Rescue Service)

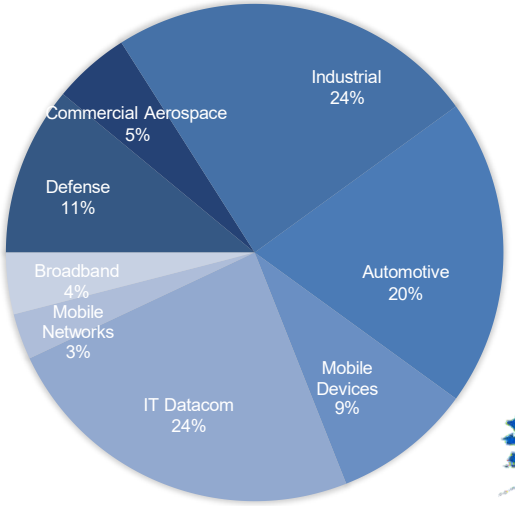
Amphenol: Enabling the Electronics Revolution

Amphenol Sensors

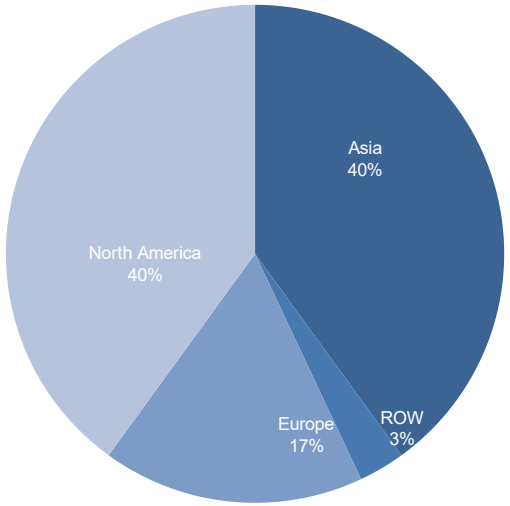
Leading provider of high-technology sensor, interconnect, and antenna solutions

$15.2B 2024 Sales

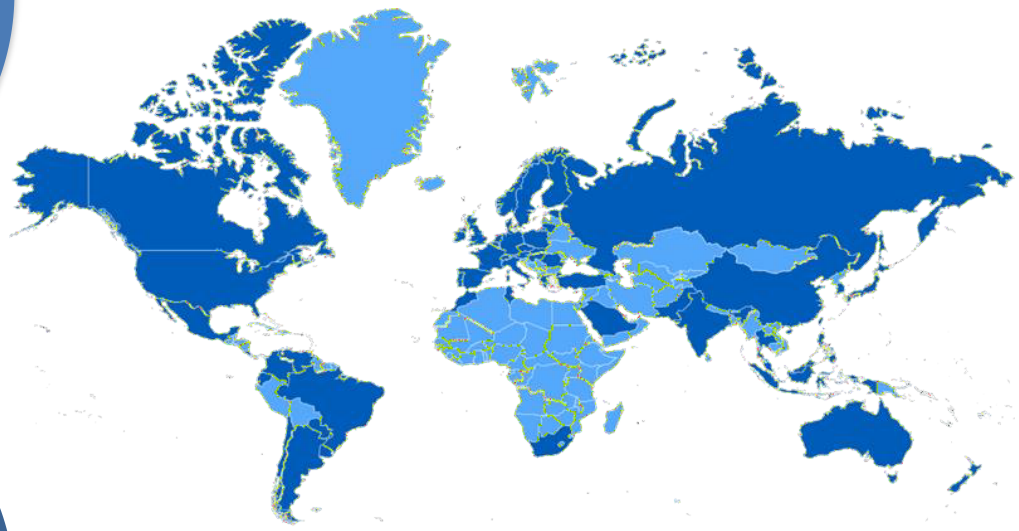
2024 Q3 Sales By Market



By Geography



~130,000 employees worldwide



Broad Global Capabilities

Leading Interconnect Technologies

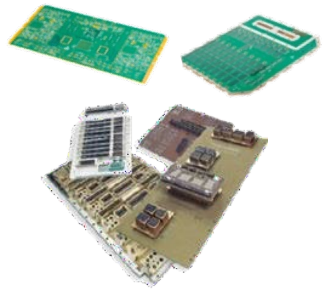
Amphenol Sensors

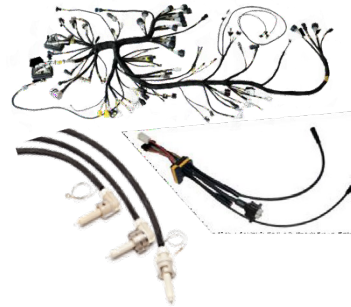
Extending the reach of the interconnect system

Connectors	Antennas	Sensors	Flex	PCB	Cables	Value-add









Core pillars of technology innovation

Harsh Environment	High Speed	Power	Sensors	Radio Frequency	Fiber Optics






Amphenol Sensor Products

Amphenol Sensors

Validation Instruments

Validation systems

KAYE

Monitoring solutions

Pressure

NOVA SENSOR

ALL SENSORS

Pressure

Pressure Temperature

Combined pressure and temperature

i2s

Hydrogen

Pressure

Gas, Humidity, Moisture

Hun

sing

PROTIMETER

TELAIRE

Gas sensing - CO2

APSG

Position, Speed, Current

PIHER sensing systems

Temperature

THERMOMETRICS

A COMMITMENT TO EXCELLENCE

EXATHERMOMETRICS

EXACTING TEMPERATURE SENSING

Air Quality (Gas, PM2.5)

SGX SENSORTECH

TPMS and Telematics

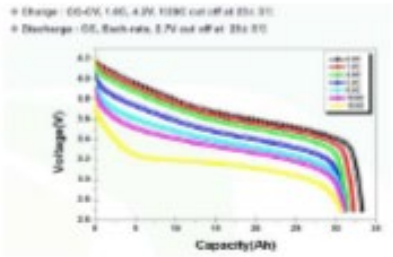
LID TECHNOLOGIES

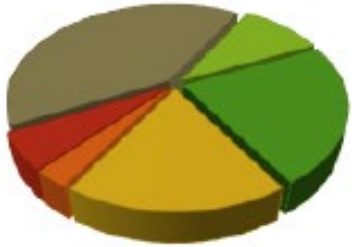
Temperature | Pressure | Gas Detection | Humidity | Validation | Angular Position | Acceleration /Vibration | Speed | Level | Concentration | Linear Position | Acoustic | Weather

Bob's 5 Golden Rules

5 Golden Rules of Electrification: A Philosophy to Live By

- Safety
- Performance
- Life
- Cost
- Environmental





Headlines….

Burton firefighters respond to lithium battery fires at convenience center

Firefighters from the Burton Fire District responded to fires caused by lithium batteries at a convenience center on Monday afternoon.

BATTERY FIRE AT RECYCLING CENTER IN SOUTH CAROLINA

BURTON, S.C. (WCSC) - Firefighters from the Burton Fire District responded to fires caused by lithium batteries at a convenience center on Monday afternoon.

Fire crews responded just before 4 p.m. to a reported dumpster fire at the Beaufort County Convenience Center on Shanklin Road, according to Burton Fire District officials.

Upon arrival, firefighters saw smoke coming from **debris in the metal recycling drop-off area**. Employees at the center told firefighters that there was a possibility of liquid propane gas tanks in the debris.

As firefighters began to put out the fire and move debris, they found a large lithium battery on fire, which was igniting other items in the debris pile.

Los Angeles experiences almost 1 garbage truck fire/week

- Vape pens, consumer electronics often the source
- Many consumers do not relate their electronics to li-ion batteries

Consumer education needed

Battery incidents – July 8

https://www.fox17online.com/news/local-news/holland-manufacturing-business-suffers-2nd-fire-in-less-than-4-months

Holland manufacturing business suffers 2nd fire in less than 4 months

HOLLAND, Mich. — A Holland manufacturing plant suffered its second fire in less than four months Wednesday afternoon.

According to the Holland Department of Public Safety, the fire division responded to a reported commercial structure fire at ATC Drivetrain on Waverly Road around 1pm.

A release says that due to the size and complexity of the structure, along with the nature of the fire, a full commercial fire response was initiated.

Roughly a ***dozen different departments from the area assisted*** to help..
Crews removed multiple lithium-ion batteries that were on fire, and according to the release, heavy smoke inside the building and water from the sprinklers made it more challenging to remove the batteries.

There were no reports of injuries, but one firefighter was treated for heat exhaustion.

ATC Drivetrain faced a previous fire in late March, which involved crate and packaging material that contained a lithium-ion battery pack for a vehicle. Several other crates in the fire area were damaged but did not ignite.

Remanufacturing facilities on steep learning curve for battery safety - insufficient local code /expert guidance

Battery incidents – July 11

https://gmauthority.com/blog/2025/07/chevy-equinox-ev-fire-causes-boston-highway-shutdown-video/

Westbound traffic on the Mass Pike in Boston was shut down last week because a Chevy Equinox EV was on fire on the highway. Local CBS affiliate WBZ spoke with the unfortunate driver to find out what happened. The driver, identified only as Brian, was driving his 90-year-old grandfather to an operation when he ***believed he had hit something in the road*** that caused his EV to burst into flames. “I didn’t have enough time to react or swerve safely,” Brian said.

No injuries or fatalities were reported in connection with the fire. Brian was able to safely exit the vehicle and help his grandfather out, as well, with no injuries
As the fire department did what it could to manage the inferno of the burning Chevy Equinox EV, **traffic was blocked for approximately two hours,** given how long an EV can burn once it catches fire. Research has consistently shown that EV fires are not more common than fires in ICE vehicles. The problem is that when an EV is on fire, it’s much harder to extinguish and burns longer.

“Once a lithium-ion battery is in thermal runaway, we cannot stop it.” Brockton, MA Deputy Fire Chief Kevin Galligan told WBZ. “The only thing we can do is try to cool the adjoining batteries.”

Sometimes critical damage unavoidable
First Responder guidance – foam was used, but not helpful
First Responder tools/training needed

Battery incidents – July 14

https://focustaiwan.tw/society/202507140007
Kaoshiung, July 14 (CNA) At ***least 15 people, including three firefighters, were injured*** after a fire broke out at a lithium-ion battery cell plant in Kaohsiung early Monday morning.

The blaze at Molie Quantum Energy Corp.'s plant in Siaogang District was reported around 5 a.m., prompting the dispatch of 46 fire engines and 91 firefighters, according to the Kaohsiung Fire Bureau.

The fire is currently under control, the bureau said, adding that 12 of the company's employees suffered abrasions and three firefighters sustained minor burns. All have been taken to the hospital for treatment.

The cause of the incident is yet to be investigated.
TCC Group Holdings Co., the parent company of Molie Quantum Energy, said the fire originated in a warehouse storing semi-finished battery products.

The **plant's automatic sprinkler system was activated immediately to help contain the blaze**, TCC Group said in a statement.

The fire was quickly brought under control, the company said, adding that all employees were evacuated and that those injured have since been released from the hospital and returned home.

The city's Environmental Protection Bureau later issued a separate statement warning of poor air quality, after fine particulate matter (PM2.5) was detected across an area of approximately six kilometers surrounding the plant.

Battery formation rooms and storage are vulnerable to incident; detailed hazard analysis and mitigation plans can improve outcomes

Headlines….

Spanish battery factory explodes, toxic cloud floats in the air VIDEO

60,000 residents of Azuqueca de Henares, Cabanillas del Campo and Aloevera warned not to leave their homes

Jul 5, 2025 05:43 1 749

Several explosions at a battery factory northeast of Madrid caused a toxic cloud to form, local authorities reported, quoted by DPA and BTA.

Around 60,000 residents of the towns of Azuqueca de Henares, Cabanillas del Campo and Aloevera received a warning on their mobile phones not to leave their homes, to close windows and doors and to turn off their air conditioning.

Regional authorities in the Castilla-La Mancha region in central Spain said the alert was issued due to a fire at a battery recycling plant in Azuqueca de Henares, about 50 km from Madrid.

According to Spanish television, the plant ***recycles lithium batteries.***

Video footage shared on social media shows a dark cloud of smoke rising from a plant in an industrial area in Azuqueca de Henares.

According to initial reports, there were no casualties in the plant or the surrounding area.

The cause of the fire is still being investigated.

Outcomes can effect many people – be prepared for the worst, learn from others have a well-developed Emergency Response Plan and train!

Headlines….

Massive ship carrying 3,000 cars sinks in international waters

Taylor Ardrey USA TODAY
Updated June 25, 2025, 2:59 p.m. ET

The Morning Midas, operated by the London-based company Zodiac Maritime, sank on Monday, June 23, around 5:30 p.m., officials said. The incident occurred about 450 miles southwest of Adak, Alaska.

Ship caught on fire in early June

The Liberian-flagged Morning Midas, which was headed to Lázaro Cárdenas, Mexico, from China, experienced a fire on June 3. As USA TODAY previously reported, 22 crew members abandoned the ship after they failed to put out the fire.

According to the Coast Guard, the ship carried 1,530 metric tons of very low-sulfur fuel oil, along with 350 tons of marine gas oil. Additionally, it was transporting 3,048 vehicles, including 70 electric and 681 hybrid.

Smoke rises from a fire aboard the cargo vessel Morning Midas, carrying around 3,000 vehicles, including 800 electric vehicles, as seen in an aerial photograph taken from a U.S. Coast Guard C-130J Super Hercules, approximately 300 miles south of Adak, Alaska, U.S. June 3, 2025. *U.S. Coast Guard, Handout Via REUTERS*

Another RORO sinking - no investigation; Suspicion stays with the EV's….

Headlines….

Large US shipping company refuses to carry electric cars after cargo ship carrying 3,000 new cars sinks

Published on Jul 29, 2025 at 5:02 PM (UTC+4)
by Keelin McNamara

Last updated on Jul 29, 2025 at 9:00 PM (UTC+4)
Edited by Keelin McNamara

Hawaii-based shipping company bans electric cars
According to the US Coast Guard, electric cars were partly, if not fully, responsible for the fire that led to the ***Morning Midas cargo ship sinking off the coast of Alaska in June.***

And it has led one American shipping company to officially refuse to transport electric cars on its ships.

Matson, Inc. is a transportation company based in Honolulu, Hawaii, USA.

Due to its location in the middle of the Pacific Ocean, Matson serves a vast swathe of areas in the Pacific.
In a statement to news.com.au, Matson outlined its reasons for the ban on electric cars.

Citing safety concerns, Matson said that it is 'suspending acceptance of used or new EVs…aboard its vessels'.

Matson decision follows fire incidents onboard ships
The Morning Midas cargo ship eventually sunk off the coast of Alaska after a fire started while transporting 3,000 electric cars.

It was in the process of transporting the electric cars to a port somewhere in Mexico.

Having left port from Yantai, China in May, it was on its way to Mexico on June 3 when the crew sent out a distress call from the ship.

Industry must demonstrate improved outcomes and "get out of the headlines"

Reputation crisis adds cost

Why are lithium ion battery fires so pernicious?

Lithium ion cells undergoing thermal runaway can provide their own oxygen as a reactant

SEI Decomposition: $(CH_2OCO_2Li)_2 \xrightarrow{\Delta H} Li_2CO_3 + C_2H_4 + CO_2 + \frac{1}{2}O_2$

Carbonate combustion & Lithium rx with binder and electrolyte :

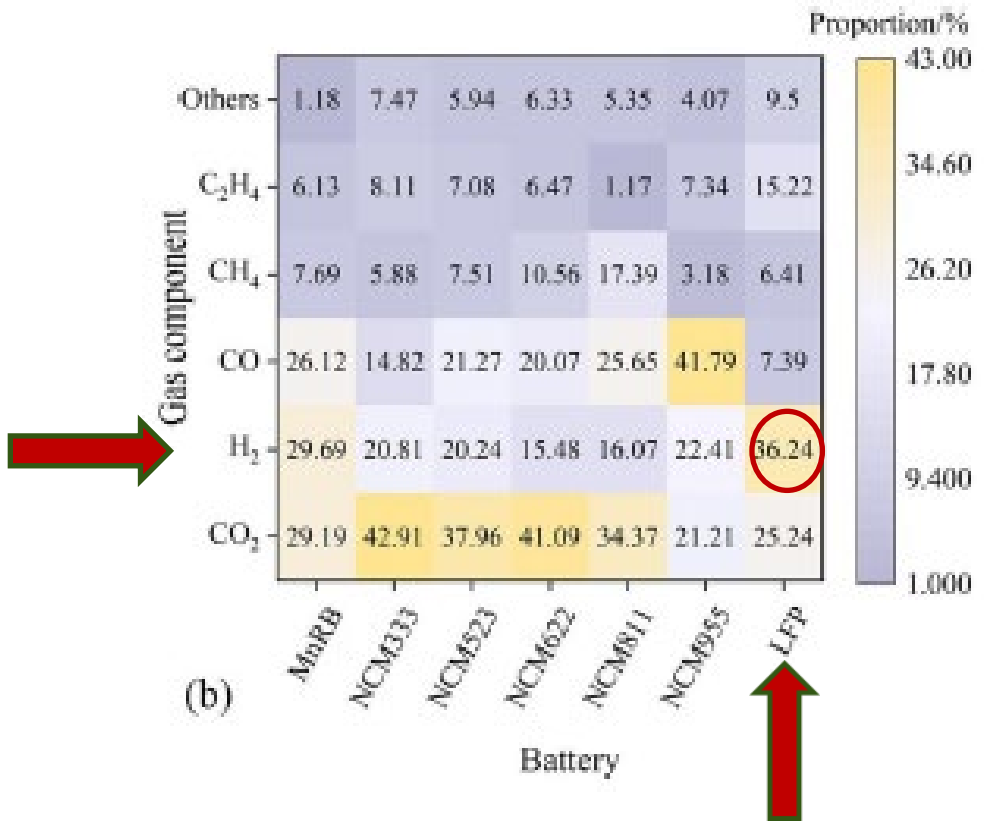
$$\frac{5}{2}O_2 + C_3H_4O_3(EC) \xrightarrow{\Delta H} 3CO_2 + 2H_2O$$

$$\text{-}CH_2\text{-}CF_2\text{-} + Li \xrightarrow{\Delta H} LiF + \text{-}CH{=}CF\text{-} + \frac{1}{2}H_2 \qquad CMC\text{-}OH + Li \xrightarrow{\Delta H} CMC\text{-}OLi + \frac{1}{2}H_2$$

(Photo by Birmingham Fire and Rescue Service)

Hazards from cell venting:

- High Temperatures
- High voltage conductors
- Isolation faults
- ***Arc flash***
- **Flammable Gas Release:**
  - Hydrogen has fast flame propagation, broad flammability limit
  - Explosive, especially within enclosed areas
- **Hazardous Gas Release:**
  - Hydrogen Fluoride, HCN – can be lethal in enclosed spaces
- **Particulates**
  - Carcinogens, ultrafine particles



Battery systems can be difficult to access and assess

- Difficult to cool/extinguish – much water, long duration event, extensive resources required
- No clear path to identify “End of Event”
- Latency: Stranded energy /damaged cells can generate reignition events

CATARC study - Propagation latency

Number	Chemical System	Cell Capacity	Type	Initiation method	Time between TR to TP
1	LFP	130-250Ah	Prismatic	Nail penetration in GB 38031	56min
2					61min
3					63min
4					75min
5					86min
6					47min
7					77min

- Total samples: 120
- 1h observation time in no TP judgement may not be enough
- Tentative idea for observation time in no TP judgement: larger than 1 hour and the temperature of adjacent cells are less than XX ℃ (need more supporting information)

Latency and re-ignition is from damaged packs significant risk to first/second responders!

When is a battery "safe"?

Battery Hazards & First Responders

UL FSRI, NFPA Issue Explosion Hazard Notice for EV Fire Blankets

Experiments by FPRF and FSRI reveal potential explosion risks when using fire blankets in EV fire suppression with battery involvement. Ongoing research aims to improve firefighter safety and tactics.

May 31, 2025

Lithium ion Battery Fire Hazards:

- Isolation faults
- Flammable gas release – deflagration/detonation
- Hazardous gas release
- High temperatures
- Self sustaining reaction, cell supplies O2 to support combustion
- Stranded energy can cause reignition
- Increased potential for arcflash

First Responder Needs & Considerations:

- Easy, clear Emergency Rescue/Response Guides
- Consistent training across electrified applications
- Consistent SOP
- Consistent and inexpensive tools
- “Let it burn” philosophy can help with stranded energy issues
- Water works, but use requires understanding of cell designs
- Workable procedure needed for de-energizing / preventing reignition

PPE, Defensive positioning, lots of water, and patience required

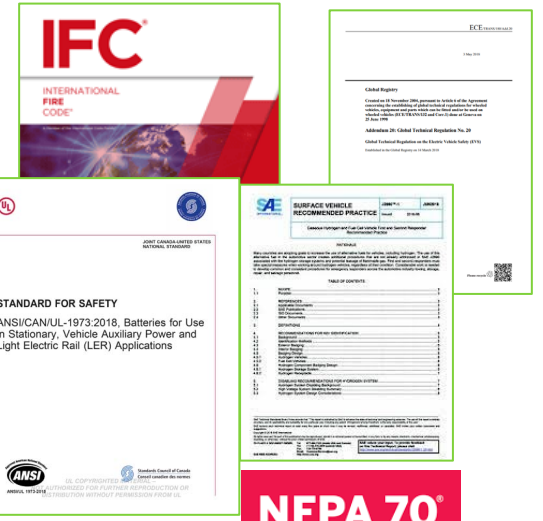
Transport Regulations and practice

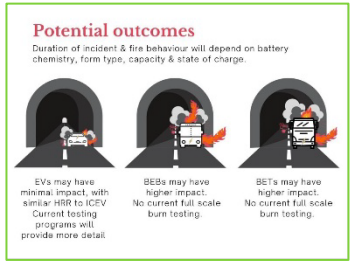
Evolving EV & Battery Safety Regulations & Standards:

- CFR-49 Part 173: Lithium cells & Batteries: https://www.ecfr.gov/current/title-49/section-173.185
- UN 3090, Lithium metal batteries (shipped by themselves)
- UN 3480, Lithium ion batteries (shipped by themselves)
- UN 3091, Lithium metal batteries contained in equipment or packed with equipment
- UN 3481, Lithium ion batteries contained in equipment or packed with equipment Code of Federal Regulations 40: Protection of the Environment Part 273
- UN38.3: Certification for Lithium-ion batteries
- IFC: 2024; Chapter 3: Section 321 Rechargeable Battery Storage
- UL 1973: Batteries for use in Stationary, Vehicle Aux Power and light rail apps
- UL9540: Safety for Energy Storage Systems
- NFPA 70: Electrical Safety
- ISO-17840: Road vehicles — Information for first and second responders
- SAE J2990: Hybrid and EV First and Second Responder Recommended Practice
- SAE J3235: BEST- PRACTICES FOR THE STORAGE OF LITHIUM-ION BATTERIES
- UL TC 1487: Battery Containment Enclosures

Code of Federal Regulations
A point in time eCFR system

Standards & Engagement





ISO

NFPA 70
nec
NFPA
National Electrical Code®

Regs & Standards challenged to keep up with technology changes in the field

Local AHJ's have varying levels of knowledge/experience/adoption

NAATBatt Battery Safety Committee

Committees:

- Recycling Committee
- Manufacturing in NA Committee
- Education Committee
- Energy Materials Committee
- Zinc Battery Committee
- Tracking and Tracing Committee
- Policy and Regulatory Committee
- **Lithium Battery Safety Committee**
- Markets Committee
- Military Batteries Committee
- Onshoring Battery Technology Committee
- 2nd Life Use Committee
- Electrode Materials Committee
- Battery Finance Committee
- Equipment Makers Committee
- Sodium Battery Committee

Topic/Idea	Presenter/Organization
Deep Dive into Surprise AZ ESS Fire	Kevin White/Exponent
Recent battery safety legislation updates	Joe LoGrasso
Safety Committee Year in Review & Topic Solicitation	Brian E & Joe
Perspectives on the Challenges and Opportunities of EV Battery Safety	Galen Ressler/GM
Overview/Status of NFPA EV Tactics Study	Brian Engle
China GB38103-2025 Overview	B. Engle
Field incidents Review	B. Engle
Battery Safety Technology Talk- Pyrophobic Systems	Clarke O'Reilly Sales and Marketing Manager Pyrophobic Systems Ltd
Battery Education Task Force	Amy Brinson and Karen Long
Moss Landing Battery Fire Information Update	Brian Engle
Enclosed Tralier Response Safety Guidelines Video	Brian Engle
Trends in Battery Safety Challenges	Pat Durham, StacheD Training
Li-Ion Tamer	Randy Stacy Nexteris
Second Responders- Response Guidance for dealing with damaged systems + Fire Blanket Considerations	Dalan Zartman- Energy Security Agency
passive propagation resistant materials in battery packs	Ricardo Carter, Saint Gobain

To Join a Committee: www.naatbatt.org/join-a-committee/

Link to upcoming topics:

https://docs.google.com/spreadsheets/d/1PiUIdE36KRjtW_1hxUtLFaaY9VdlnF1WwWiexKp5K0k/edit?usp=sharing

Battery Safety Committee meets monthly; works to identify and address industry challenges and provide solutions and share knowledge on battery safety

SAE Vehicle Battery Standards Steering Committee

NAATBatt INTERNATIONAL

BSSC COMMITTEES: 2025

BC1 Battery Safety Standards Committee
BC2 Battery Standards Testing Committee
BC3 Battery Standards Label & Tape Committee
BC4 Battery Transportation Committee
BC5 Battery Size Standardization Committee
BC6 Starter Battery Committee
BC7 Truck Battery Systems Committee
BC8 Battery Standards Fuel Economy & Range Committee
BC9 Battery Standards Advanced Battery Concepts Committee
BC10 Battery Standards Recycling Committee-
BC11 Battery Global Traceability Committee
BC12 Battery Test Equipment Committee
BC13 Battery Terminology Committee
BC14 Battery Materials Testing Committee
BC15 Secondary Battery Use Committee
BC16 Start-Stop Battery Committee
BC17 Battery Diagnostics
BC18 Battery Field Discharge and Disconnect Committee
BC19 Battery Systems Connection Committee
BC20 Battery Management Systems
BC 21 Battery Thermal Management Committee
BC22 Bus Battery System Committee
BC23 Battery Systems Adhesives-Sealants-Heat Transfer Materials
BC24 Battery Sensors Committee
BC25 Construction Agricultural and Off Road Rechargeable ESS Committee
BC26 Micro mobility Battery Standards Committee
BC27 Truck Battery Systems
BC29 Battery Swapping Committee
BC30 Battery Pack Venting Committee
BC31 Insurance
BC32 Vehicle Platform Power Management Committee

First Responders Task Force

>800 Engineers & Scientists; >175 companies and agencies represented

>45 published documents and growing

Free to join committees – we need your expertise!

SAE Battery Recent Activities

- **SAE J3341 Global Traceability**
- **SAE J2997 Second Use** (in ballot)
- **J2929 Battery Safety** – undergoing updates
  - Reflects latest GB38103, UN ECE R100 Rev 5, FMVSS305a
  - Task Force to Publish Technical Information Report on Low-conductivity coolants pursuant to China GB29743.2 as well as use of immersion cooled batteries
- **SAE J3325 Pack Venting** – Published; re-opened to reflect latest regs, offgassing management outside pack and firefighter access
- **Battery Transportation and Storage**: SAE J3235 Storage (Published) SAE J3303 Packaging Performance
  - SAE J2950 Shipping transport & handling – Alyssia Bostrom
- **SAE J2990 – First / Second Responders Guidance** re-opened for updates
  - J3108 Identification of energy sources published
  - Task Force to provide guidance for Heavy Duty vehicles
- ***Field Discharge/Decommissioning Committee*** under Dr. Vivian Tran
  - Decommissioning guide format; discharge of EOL and DDR systems
- Micromobility Committee new chair – John Orlando
- **Battery Management System Committee** formed
  - Diagnostics & Cybersecurity
- SAE J2936 Tape and Label – Published, to be re-opened for bar codes / rf tags
- SAE J3073 Battery Thermal Management

Highly accelerated development of industry standards to support electrification growth

Summary

Battery incidents in production, use, transport, remanufacturing and recycling create headlines that inhibit adoption and increase costs to the industry. While rare, outcomes can be severe, including loss of life, injury, infrastructure damage, environmental harm

- ✓ **Design to prevent / detect failure / prevent propagation / mitigate worst outcome**
- ✓ **Learn "best practices" from previous events and industry peers**
- ✓ **Share and participate in development of standards**
- ✓ **Work with peers on critical safety issues through industry organizations**
- ✓ **Work with local AHJ's and First Responders as a responsible business operator**
- ✓ **Use Risk Assessment Tools and Plan/Prepare for the "worst", train until safety procedure is "muscle memory"**
- ✓ **As you learn, teach others and codify safe practices**

"Every day is a school day – learn AND teach"