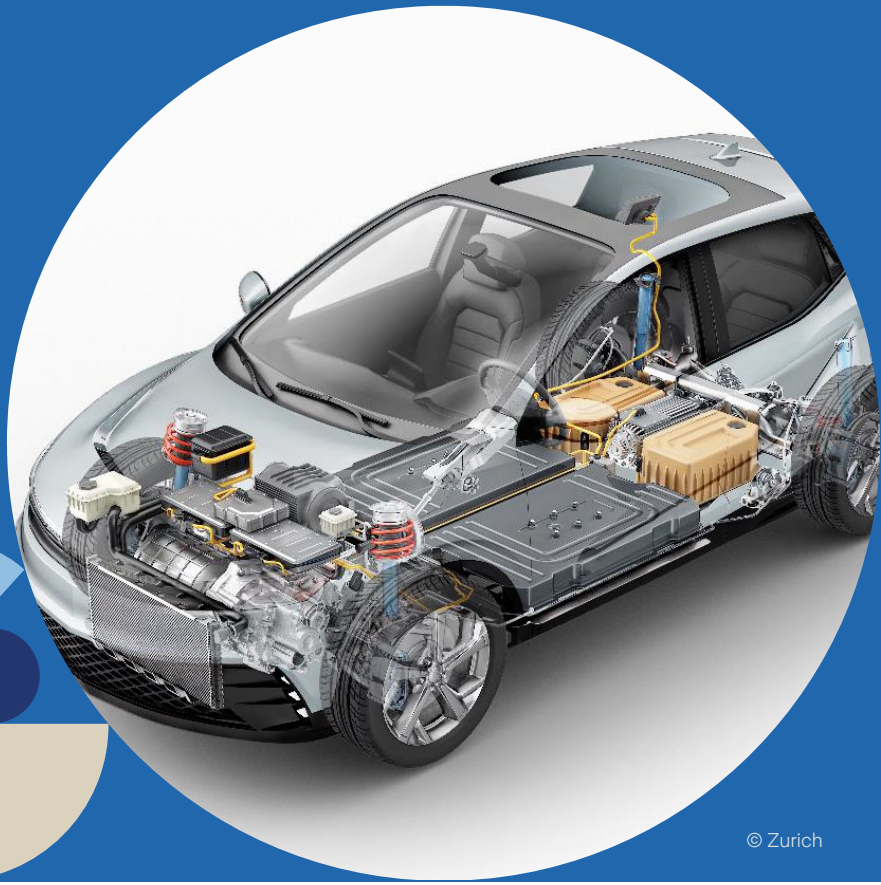
EV Battery Safety at the Dealership

Modern vehicles and emerging risks related to plastics and lithium-ion batteries



December 5, 2023
Presenters: Dan Hornback and Rich Gallagher
Zurich Resilience Solutions I Risk Engineering

Today's presentation

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Approximately 45 minutes of presentation

Phone lines are muted

Event will be recorded and posted on the Zurich Automotive Resource Hub. Email will also be sent with a link directly to the presentation.

Today's presenters

Rich Gallagher

Rich is the VP Property Technical Director for Zurich Resilience Solutions. He has over 45 years of experience in the loss-control industry. His primary responsibilities include developing technical knowledge, policies, and procedures for the property line of business. Dan is a member of several professional organizations, including the National Fire Protection Association (NFPA), NFPA Standards Council, NFPA Research Foundation, Research Advisory Council, NFPA 13, Sprinkler System Discharge Criteria, and others.

Dan Hornback

Dan joined Zurich in 2005 and is the AVP, Technical Director WC & Fleet. He is a member of the Risk Engineering North America (RENA) Technical Operations Team and is responsible for the Worker Compensation and Fleet lines of business. He provides technical expertise to customers, brokers, business partners, and risk engineering. Dan is the leader of the Global Risk Engineering Technical Center (GRETC) committee for Worker Health and Safety and the Fleet GRETC committee.

Agenda

- Modern vehicles including EVs
- Electric vehicle battery safety
- Charging stations

Modern vehicles including EVs

Modern vehicles including EVs

- What is a modern vehicle?
- What are the challenges of modern vehicles with lithium-ion batteries?
- What about EVs with damaged lithium-ion batteries?
- What to consider for lithium-ion batteries in bulk storage.
- What can trigger a lithium-ion battery emergency?

Modern vehicles including EVs

What is a modern vehicle?

Historically, car exteriors were metal

- The metal external surfaces helped to resist car-to-car fire spread
- Parking garages often were not equipped with fire sprinklers

Modern vehicles including EVs

What is a modern vehicle?

Historically, car exteriors were metal

- The metal external surfaces helped to resist car-to-car fire spread
- Parking garages often were not equipped with fire sprinklers

Today, cars have more plastics, especially on the vehicle exterior surfaces

- External plastics influence how fires now spread among parked cars
- Automatic sprinklers are recommended for showrooms, service departments, and any indoor parking

Modern vehicles including EVs

What is a modern vehicle?

Examples of exterior plastics

- Door handles, door trim, rearview mirrors

Modern vehicles including EVs

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Examples of exterior plastics

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- Window gaskets/seals, fuel fill cover

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Modern vehicles including EVs

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- Door handles, door trim, rearview mirrors
- Window gaskets/seals, fuel fill cover
- Headlight and taillight assemblies
- Bumper covers, grills
- Body trim, mud flaps, and tires

Modern vehicles including EVs

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Examples of exterior plastics

- Door handles, door trim, rearview mirrors
- Window gaskets/seals, fuel fill cover
- Headlight and taillight assemblies
- Bumper covers, grills
- Body trim, mud flaps, and tires

These plastics are why modern vehicle fires spread rapidly from car to car

Modern vehicles including EVs

As an added note, modern vehicles also have plastic fuel tanks.

Modern vehicles including EVs

What is a modern vehicle?

Recommended sprinkler protection guidance

- The National Fire Protection Association is pursuing modern vehicle fire research
- Until that research is complete, the recommended guidance is as follows:
  - Existing sprinkler systems - Ordinary hazard systems may remain in use
  - New sprinkler systems - Provide an extra hazard system

Modern vehicles including EVs

What are the challenges of modern vehicles with lithium-ion batteries?

- Compared to other modern vehicles:
  - They do not appear to increase the fire severity or heat release rate
- But there are other challenges:
  - Expect them to prolong a car fire event due to a longer firefighting effort
  - Expect the battery to reignite at any time after it is extinguished

Image Source: Google Earth

Modern vehicles including EVs

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Extinguishing EV fires

"The recommendation to firefighters to deal with EVs is to apply very large amounts of water directly to the outside of the battery pack, potentially for several hours."

Source: Modern Vehicle Hazards in Parking Structures and Vehicle Carriers, Quincy, MA: NFPA Research Foundation, 2020. https://www.nfpa.org/News-and-Research/Data-research-and-tools/Building-and-Life-Safety/Modern-Vehicle-Hazards-in-Parking-Garages-Vehicle-Carriers

Modern vehicles including EVs

What about EVs with damaged lithium-ion batteries?

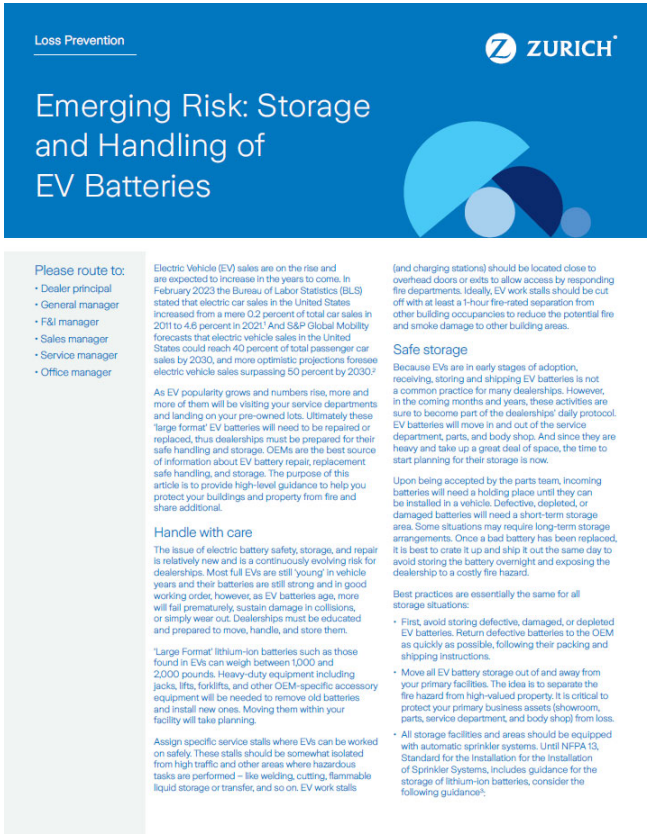
- It is not desirable to have such vehicles in the service department or body shop for any length of time.
- Consider the following measures:
  - Store the vehicle outside, away from important buildings, structures, or inventory
  - If the vehicle is to be repaired, remove the battery from the car and building as soon as possible
  - Arrange for the damaged battery to be removed from the property as soon as possible

Modern vehicles including EVs

What to consider for lithium-ion batteries in bulk storage

- Fire test data for the bulk storage is extremely limited
  - So, the available sprinkler guidance is conservative
- For bulk storage (e.g., in a parts department), provide sprinklers
  - For guidance, see our paper, Emerging Risk: Storage and Handling of EV Batteries

Available on Zurich's Automotive Resource Hub



Loss Prevention

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Emerging Risk: Storage and Handling of EV Batteries

Please route to:
- Dealer principal
- General manager
- F&I manager
- Sales manager
- Service manager
- Office manager

Electric Vehicle (EV) sales are on the rise and are expected to increase in the years to come. In February 2023 the Bureau of Labor Statistics (BLS) stated that electric car sales in the United States increased from a mere 0.2 percent of total car sales in 2011 to 4.6 percent in 2021.[1] And S&P Global Mobility forecasts that electric vehicle sales in the United States could reach 40 percent of total passenger car sales by 2030, and more optimistic projections foresee electric vehicle sales surpassing 50 percent by 2030.[2]

As EV popularity grows and numbers rise, more and more of them will be visiting your service departments and landing on your pre-owned lots. Ultimately these 'large format' EV batteries will need to be repaired or replaced, thus dealerships must be prepared for their safe handling and storage. OEMs are the best source of information about EV battery repair, replacement safe handling, and storage. The purpose of this article is to provide high-level guidance to help you protect your buildings and property from fire and share additional.

Handle with care

The issue of electric battery safety, storage, and repair is relatively new and is a continuously evolving risk for dealerships. Most full EVs are still 'young' in vehicle years and their batteries are still strong and in good working order, however, as EV batteries age, more will fail prematurely, sustain damage in collisions, or simply wear out. Dealerships must be educated and prepared to move, handle, and store them.

'Large Format' lithium-ion batteries such as those found in EVs can weigh between 1,000 and 2,000 pounds. Heavy-duty equipment including jacks, lifts, forklifts, and other OEM-specific accessory equipment will be needed to remove old batteries and install new ones. Moving them within your facility will take planning.

Assign specific service stalls where EVs can be worked on safely. These stalls should be somewhat isolated from high traffic and other areas where hazardous tasks are performed – like welding, cutting, flammable liquid storage or transfer, and so on. EV work stalls (and charging stations) should be located close to overhead doors or exits to allow access by responding fire departments. Ideally, EV work stalls should be cut off with at least a 1-hour fire-rated separation from other building occupancies to reduce the potential fire and smoke damage to other building areas.

Safe storage

Because EVs are in early stages of adoption, receiving, storing and shipping EV batteries is not a common practice for many dealerships. However, in the coming months and years, these activities are sure to become part of the dealerships' daily protocol. EV batteries will move in and out of the service department, parts, and body shop. And since they are heavy and take up a great deal of space, the time to start planning for their storage is now.

Upon being accepted by the parts team, incoming batteries will need a holding place until they can be installed in a vehicle. Defective, depleted, or damaged batteries will need a short-term storage area. Some situations may require long-term storage arrangements. Once a bad battery has been replaced, it is best to crate it up and ship it out the same day to avoid storing the battery overnight and exposing the dealership to a costly fire hazard.

Best practices are essentially the same for all storage situations:

- First, avoid storing defective, damaged, or depleted EV batteries. Return defective batteries to the OEM as quickly as possible, following their packing and shipping instructions.
- Move all EV battery storage out of and away from your primary facilities. The idea is to separate the fire hazard from high-valued property. It is critical to protect your primary business assets (showroom, parts, service department, and body shop) from loss.
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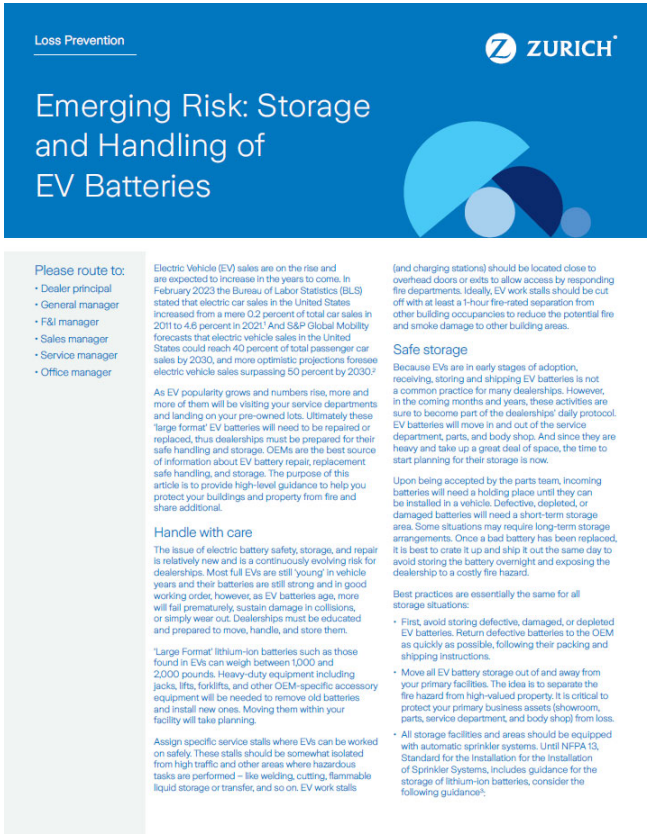
Options to avoid upgrading sprinklers

- Storing batteries offsite at a leased location
- Delivering batteries just-in-time from an outside vendor
- Storing batteries in a detached, low-value, secure building
  - We understand the National Highway Transportation Safety Administration recommends storing batteries at least 50 ft. from buildings or inventory



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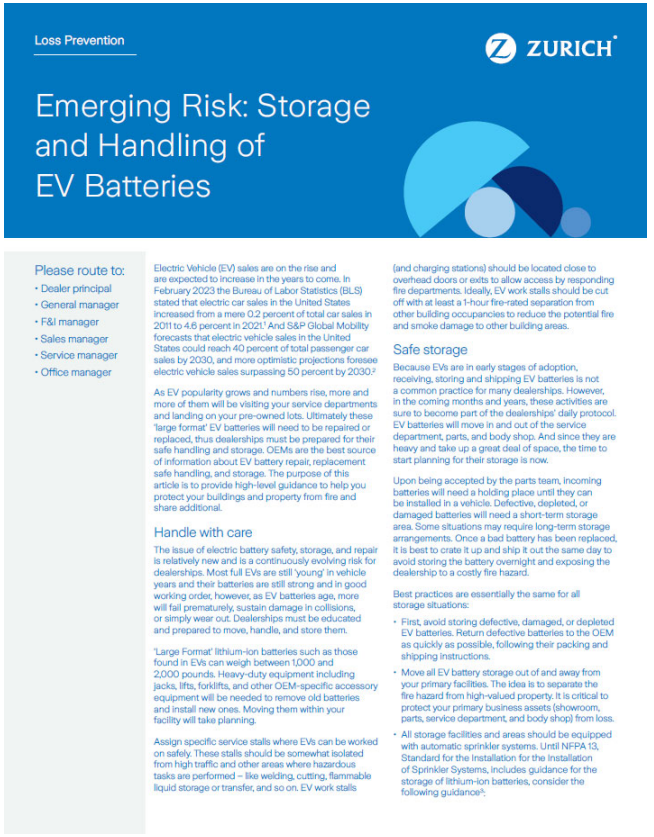
Lithium-ion batteries and explosion hazards

When a lithium-ion battery experiences thermal runaway, it may vent flammable electrolyte vapors into the building. If these vapors accumulate into the explosive range, an explosion may occur.

Consult with the battery manufacturer and fire protection experts for guidance on recommended explosion controls such as flammable vapor detection and emergency ventilation systems.



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Modern vehicles including EVs

What can trigger a lithium-ion battery emergency?

- Battery experiencing physical abuse, such as dropping
- Battery experiencing thermal heating
- Battery experiencing a fire

Modern vehicles including EVs

What may trigger a lithium-ion battery emergency?

- Battery experiencing physical abuse, such as dropping
- Battery experiencing thermal heating
- Battery experiencing a fire

Responding to battery emergencies

- The goal ~ isolating these batteries from important buildings, structures, or inventory
- The challenge is how to recognize and respond to each type of emergency
- For guidance, consult with the vehicle and battery manufacturers

Electric vehicle battery safety

Electric vehicle battery safety

- Best practices to protect employees and facilities
- EV battery definitions
- What should an electric vehicle repair services safety program include?
- Leading EV battery hazards
- Common EV battery weights
- EV battery-safe handling and storage practices
- Safety requirements for working on EVs
- Tools used for working on EV batteries
- Arc flash safety practices

Electric vehicle battery safety

Best practices to protect employees and facilities

- Update the company safety program to ensure it addresses workplace hazards
- Conduct a hazard identification assessment to ensure your program is current
- Address the EV maintenance operations
- Manage the intake of a vehicle for service

Intake of a vehicle for service

Learn as much as possible about the vehicle's history when it arrives.

- Accident history
- Flood exposure history
- Battery abuse and battery concussion history

Electric vehicle battery safety

EV battery definitions

- **Lithium-Ion (Li-ion) battery**
- **Nickel-metal hydride (NiMH) battery**
- **Solid-state battery**
- **Thermal Management System (TMS)**
- **Balancing**
- Battery pack
- Battery cell
- Capacity
- Voltage
- State of Charge (SOC)
- State of Health (SOH)
- Charge rate (C-rate)
- Fast charging
- Cycle life Lithium-ion

Electric vehicle battery safety

What should an electric vehicle repair services safety program include?

- **Hazard assessment**
- **Safe work practices**
- **Training**
- **Personal Protective Equipment (PPE)**
- **Emergency procedures**
- **Lockout/Tagout**
- **Tools and equipment**
- Labeling and signage
- Fire safety
- Ventilation
- Hazardous materials
- Equipment maintenance
- Incident reporting
- Regulatory compliance
- Communication
- Documentation
- Compliance
- Continuous improvement

Electric vehicle battery safety

Leading EV hazards

- **Battery weight**
- **Crushing and impact risks**
- **High voltage**
- **Chemical hazards**
- **Thermal runaway**
- Fire risk
- Overheating and overcharging
- Short circuits
- Chemical exposure
- Gas venting
- Environmental impact
- Electric shock from wiring

Electric vehicle battery safety

Common EV battery weights

- Lithium-Ion (Li-ion) batteries: Approximately 660 to 1,300 pounds
- Nickel-metal hydride (NiMH) batteries: Approximately 660 to 1,100 pounds
- Solid-state batteries: Weight may vary and likely heavier

Electric vehicle battery safety

EV battery safe handling and storage practices

- **Hazard assessment**
- **Isolation and de-energizing**
- **Training**
- **Storage period**
- **Proper lifting techniques**
- **Transport**
- **Secure the load**
- **Clear pathways**
- **Battery abuse or battery concussion**
- **Personal Protective Equipment (PPE)**
- Pinching hazards
- Ergonomics
- Set weight limits
- Spill containment
- Ventilation
- Hazardous materials
- Schedule breaks
- Emergency response
- Inspection and testing
- Incident reporting
- Regulatory compliance
- Communication
- Documentation
- Recycling and disposal
- Continuous Improvement

Electric vehicle battery safety

Safety requirements for working on EVs

- **Training and certification**
- **Personal Protective Equipment (PPE)**
- **High voltage safety**
- **Lockout/Tagout**
- **Inspection and testing**
- Battery handling
- Tools and equipment
- Ventilation and hazardous materials
- Emergency response
- Fire safety
- Incident reporting
- Regulatory compliance
- Communication
- Documentation

Electric vehicle battery safety

Tools used for working on EV batteries

- **High voltage safety gear**
- **Insulated hand tools**
- **Multimeter**
- **Battery voltage tester**
- **Cell balancer**
- **Charger/discharger**
- Voltage logger
- Battery handling equipment
- Cooling system tools
- BMS diagnostic tools
- Torque wrench
- Isolation tools
- Diagnostic scanner/software
- First aid kit
- Fire extinguisher

Electric vehicle battery safety

Arc flash safety practices

- **High-voltage EV systems pose arc flash risks**
- **Labeling and signage**
- **Safe work practices**
- **Training and certification**
- Tools and equipment
- Safety measures
- Emergency response
- Maintenance and inspections
- Documentation
- Compliance

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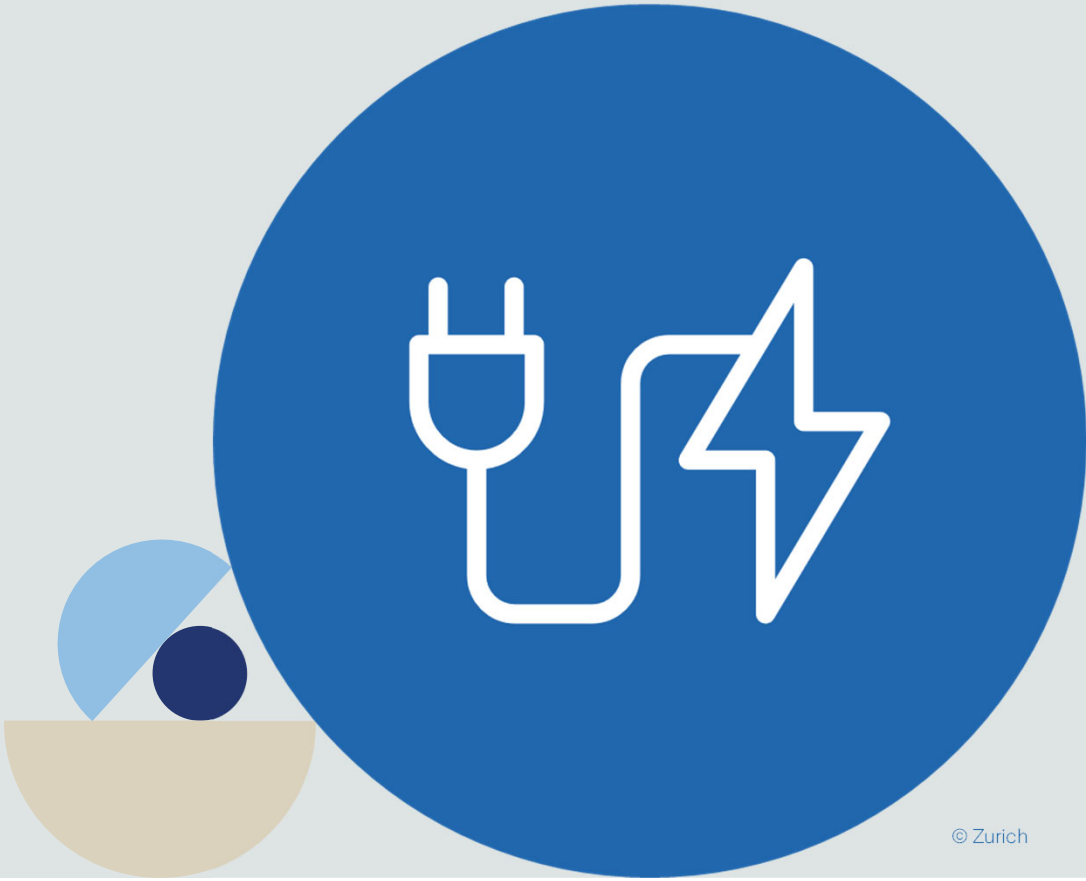
Charging stations



Charging stations

Zurich offers guidance to consider for EV charging stations:

- It can be found in our Risktopic, ***Modern vehicle parking and electric vehicle charging***

Available on Zurich's Automotive Resource Hub

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RiskTopics

Modern vehicle parking and electric vehicle charging
Zurich Resilience Solutions - Risk Engineering

Modern vehicles are changing. Demands for comfort have led to larger vehicles. Climate and sustainability goals have led to alternative energy sources and lighter components. These changes have increased the vehicle fire load. Electric vehicle use has also created demands for vehicle charging and dedicated parking areas. This document provides an overview of modern vehicles hazards and controls from a property risk assessment perspective.

Introduction

This document offers guidance to help control potential fire hazards associated with modern vehicle parking and electric vehicle parking and charging.

Research on the protection of car parks in general and electric vehicles parking and charging in particular is ongoing. As such, be aware the guidance on this topic may be subject to change.

Discussion

Modern cars in general

Cars have changed over the past 50 years. Customer demands for more comfort and space, the demand for more efficient driving performance, and the need for more cost-effective production methods has boosted the use of plastic materials in all aspects of the automotive manufacturing process – body work, chassis, plastic fuel tanks, interior – with the result that the overall fire load has increased. Experience indicates fires involving plastics in modern vehicles may be more challenging and spread more readily from car-to-car. Recent cases of fires involving modern vehicles have led to significant property damage and even structural collapse.

Electric vehicles

The awareness of climate change has led to an accelerating move away from internal combustion engines towards electric vehicles. These vehicles, including hybrid cars, typically store energy in lithium-ion batteries of different chemistries and capacities to supply vehicle power demand. Recent fire experience indicates fires involving lithium-ion batteries may present a challenge to both automatic and manual fire protection.

Charging stations

The charging station is part of the premise's electrical system

- This includes all the onsite charging infrastructure up to the vehicle connector plug

Charging stations

Charging station guidance

- We recommend following local electrical codes
- Local codes are typically based on NFPA 70, the National Electrical Code (NEC)
- Article 625 of the NEC addresses electric vehicle power transfer systems

Charging stations

Do you want to install a charging station and need help?

- Zurich has a vendor, **Bureau Veritas**
  - They provide a turnkey service from planning to installation

For inquiries, contact …

Dave White - dave.white@zurichna.com

Questions & Answers

We welcome your questions and comments.

Please feel free to contact today's presenters at the email addresses below:

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richard.gallagher@zurichna.com

Dan Hornback
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Thank you

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