INTERNATIONAL CODE COUNCIL®

LITHIUM-ION BATTERY SAFETY IN THE BUILT ENVIRONMENT

Early Release of the Chapter 43 Battery Provisions of the Forthcoming 2027 International Fire Code®

With Guidance for Jurisdictional Adoption and Use

INTERNATIONAL CODE COUNCIL
Washington, D.C.

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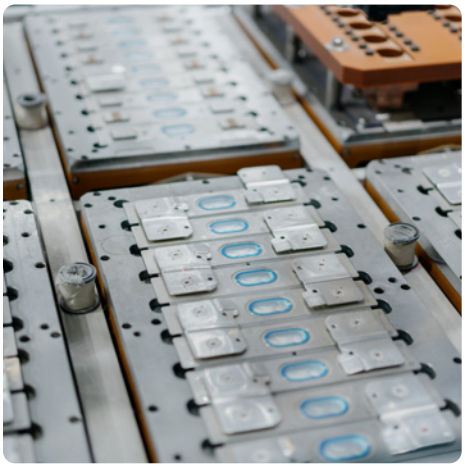
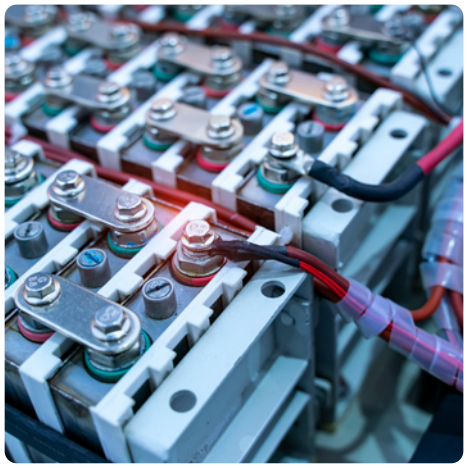


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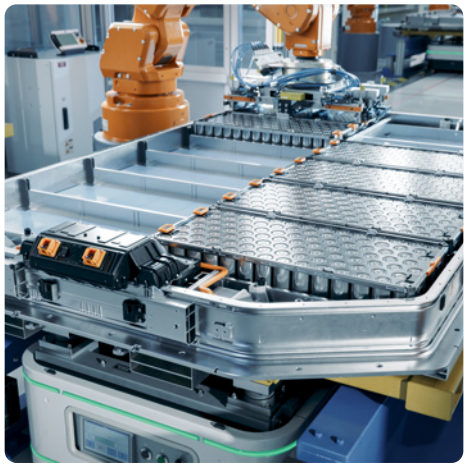

The built environment is undergoing a monumental shift. As our society moves toward a more electrified future, the presence of lithium-ion batteries has transitioned from a specialized technology to a ubiquitous component of daily life. From micromobility devices parked in our hallways and battery-powered equipment operating in our warehouses, to commercial battery installations supporting our hospitals and massive energy storage systems powering our grids, the risks and rewards of this technology are now integrated into the very fabric of our communities.

At the International Code Council, we do not just react to change. We lead it.

We are proud to announce a pivotal initiative to support our members and the safety of their communities in this rapidly changing landscape: the early release of the lithium-ion battery provisions from the forthcoming 2027 International Fire Code® (IFC).

While the full 2027 edition will be published later this year, the safety considerations presented by current and emerging battery technology warrant action now. Through the release of these provisions in advance, we are providing code officials, designers, and first responders with the most current, research-based regulatory framework for the storage, use, charging, and recycling of lithium-ion batteries that may be adopted, referenced, and applied today.

Why ICC Is Leading the Way

The work of the Ad Hoc Batteries and Energy Storage Systems Committee has addressed the full lifecycle of batteries in the built environment. The provisions contained in the forthcoming Chapter 43 of the 2027 IFC are not a narrow update to a previous section, they are a comprehensive, consolidated regulatory framework that addresses five distinct but interrelated categories of battery activity:

Research, testing, manufacturing, and recycling. A requirement that applications to establish these activities include a comprehensive technical opinion and report examining fire and explosion risks, together with the necessary mitigation measures for all identified risks.

Storage and handling. New protocols for high-density battery storage, retail battery storage, outdoor battery storage, and the broader EV supply chain and battery-powered equipment inventory that support today's economy, all calibrated to prevent thermal runaway propagation.

Micromobility and equipment safety. Comprehensive requirements for the safe charging, operation, and repair of e-bikes and e-scooters, industrial trucks, robotics, battery-powered appliances, and automated mobile platforms — a critical need for urban, suburban, institutional, and commercial fire safety.

Enhanced detection and suppression. Data-driven standards for early off-gas detection and for specialized fire suppression strategies tailored to the unique behavior of lithium-ion battery fires.

Protection for first responders. Clearer labeling, permit and fire-safety-plan requirements to ensure that when an incident occurs, the responding fire service professionals have the information they need to remain safe and to act effectively.

Protecting the World through Modern Codes

ICC's mission is to provide the highest-quality model codes, standards, and solutions for the built environment. The International Codes® (I-Codes®) are not merely technical manuals; they are the leading framework that protects lives and property across the globe. By accelerating the availability of the 2027 battery provisions, ICC is ensuring that code officials are not "playing catch-up" with technology but are instead equipped to facilitate innovation safely as soon as possible.

This document provides the Chapter 43 provisions, together with the guidance code officials need to put them into effect in their jurisdictions today through the alternative materials and methods provisions that current editions of the IFC already contain, through local amendment, through ordinance adoption, or through other pathways described in the chapters that follow. ICC is committed to supporting you with the training, technical resources, and companion publications necessary to implement these early provisions successfully.

Together, we are demonstrating that through proactive leadership and rigorous science, we can embrace the benefits of new energy technologies while maintaining our unwavering commitment to public safety.

Thank you for your continued dedication to building a safer world.

How to use this Document

This document contains two parts.

Part 1

Guidance material prepared by ICC and Code Concepts Group. The five chapters of Part 1 provide background information, authority, potential adoption and compliance pathways, and supporting resources that code officials may use if they want to implement the Chapter 43 provisions in advance of the full publication of the 2027 IFC. Part 1 is written for code officials and involved stakeholders — the jurisdictional legislative bodies that adopt codes, the design professionals who will develop projects utilizing these provisions, the industry representatives who will build to the provisions, and the emergency responders who will respond to the unfortunate incidents these provisions are designed to prevent.

The guidance provided within this publication is not legal advice and should be considered advisory only. You should consult your jurisdiction's legal counsel in connection with any code adoption, compliance, and/or enforcement activities.

Part 2

Part 2 includes the code text itself. It reproduces the full Chapter 43 provisions of the forthcoming 2027 IFC as they have been developed through the ICC code development consensus process. The full editorial process for the IFC has not yet been completed. When the 2027 IFC is officially published, editorial differences may appear in the final document. The code text is the substantive content; the guidance in Part 1 explains how to use it.

Disclaimer

This early-release document is a product of ICC and reflects the committee work of the ICC Ad Hoc Batteries and Energy Storage Systems Committee and the ICC Fire Code Action Committee.

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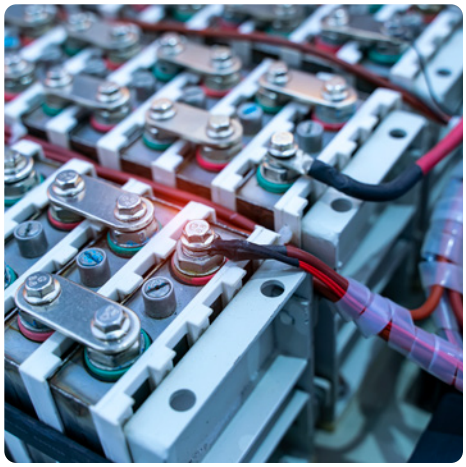


PART 1 – Introduction and Adoption Guidance

CHAPTER 1

Background and Purpose of the Early Release

About this chapter: This chapter explains why the ICC has chosen to release the Chapter 43 provisions in advance of the full 2027 IFC, what the provisions cover, and how this document fits into ICC's broader effort to provide code officials with the tools they need to address battery safety in their communities.

1.1 What This Document Is

This document is the early release of 2027 IFC Chapter 43. Part 1 of this document includes guidance material code officials need to put the Chapter 43 provisions into effect in advance of the edition's full publication. Part 2 of this document reproduces the full Chapter 43 provisions as they are intended to appear in the published 2027 IFC, organized by section and subsection, with the applicable numbering, cross-references and structure. The full editorial process for the IFC has not yet been completed. When the 2027 IFC is officially published, editorial differences may appear in the final document. The code text is the substantive content; the guidance in Part 1 explains how to use it.

The authority under which these provisions can be adopted and used by jurisdictions is addressed in Chapter 2 of this document. Potential practical pathways through which the adoption and use can occur are addressed in Chapter 3. The companion resources ICC has developed to support implementation are identified in Chapter 5.

Additional training, webinars and technical resources will be available through the ICC Learning Center, the ICC Fire and Disaster Mitigation website and the ICC Store website.

1.2 What Chapter 43 Covers

Chapter 43 of the 2027 IFC is a consolidated regulatory framework for the non-Energy Storage System (ESS) lithium-ion and lithium-metal battery activities that occur across the built environment.

The consolidated chapter of provisions previously appeared in multiple locations in the IFC. Section 4303 carries forward and refines the 2024 IFC Section 320. Section 4304 carries forward and expands the 2024 IFC Section 322 micromobility provisions. Sections 4302 and 4305 are newly organized sections that address activities not previously regulated through dedicated provisions. The result is that, for the first time, a code user can find the full set of non-ESS battery provisions in a single chapter. This is an organizational improvement that, beyond its direct usability benefits, signals the regulatory maturity the subject has reached.

Chapter 43 consists of six sections.

1. **Section 4301** establishes the general provisions, scope, and permit framework.
2. **Section 4302** addresses the research, testing, manufacturing, and recycling of lithium-ion and lithium-metal batteries.
3. **Section 4303** addresses the storage of those batteries indoor limited storage, indoor storage areas, and outdoor storage.
4. **Section 4304** addresses the operation, charging, repair, exchange, and listing of battery-powered micromobility devices, industrial trucks, robotic equipment, automated mobile platforms, battery-powered appliances, and battery-powered industrial equipment.
5. **Section 4305** addresses portable power packs
6. **Section 4306** addresses storage of battery types other than lithium-ion and lithium-metal principally lead-acid and nickel-cadmium batteries and related chemistries.

The provisions in Chapter 43 do not replace the stationary energy storage system provisions of IFC Section 1207. Section

1207 continues to govern installed and operational energy storage systems. Chapter 43 governs battery activities that precede or exist outside of ESS installation, batteries in the supply chain, batteries in the manufacturing and recycling stream, batteries in storage pending deployment, batteries in use powering vehicles and equipment, and batteries in the research and testing environments that develop new technology. Both the Section 1207 and Chapter 43 frameworks are needed, and they coordinate through the installation-based boundary that Section 4301.1 establishes.

1.3 The Structure of This Document

Part 1 of this document consists of five chapters.

- **Chapter 1** explains the background and purpose of this early release.
- **Chapter 2** addresses the authority under which jurisdictions and code officials may adopt and use the Chapter 43 provisions in advance of the full 2027 IFC publication.
- **Chapter 3** describes the specific potential pathways — ordinance adoption, amendment to the currently adopted edition, and permit and contractual conditions — through which the provisions may be put into effect at the local level.
- **Chapter 4** identifies various potential compliance pathways based on the code adopted by the jurisdiction.
- **Chapter 5** identifies the companion resources ICC has made available to support implementation.

Part 2 of this document reproduces the full Chapter 43 provisions as they are intended to appear in the published 2027 IFC, organized by section and subsection, with applicable numbering, cross-references, and structure. Users familiar with the I-Codes will find the presentation immediately recognizable.

Together, Parts 1 and 2 provide the user with both the code provisions themselves and the suggested guidance for putting the provisions into effect.

1.4 Why an Early Release

ICC's codes must keep pace with emerging hazards related to lithium-ion battery safety. Over the past five years, battery-related fires in residential, commercial, and institutional occupancies have increased substantially. The New York City Fire Department documented more than 200 battery-related fires in 2022 alone resulting in 17 fatalities, and similar patterns have emerged in other major jurisdictions. The combination of rapid growth in the deployment of battery-powered equipment, the expansion of battery-involved industrial activity, and the persistence of aftermarket and uncertified/unlisted products has produced an environment in which the need for updated code provisions is critical.

The 2024 IFC addressed a significant portion of the battery landscape through new provisions in Sections 320 and 322, and through companion additions in other chapters. The code development work that followed throughout 2024-2026 produced a further body of refinement, consolidation, and expansion, centered on the ICC Ad Hoc Battery and Energy Storage Systems Committee and coordinated through the Fire Code Action Committee and Building Code Action Committee. The result of their efforts is the consolidated Chapter 43 that will appear in the 2027 IFC when published later this year, and that is reflected in this early-release document.

Releasing these 2027 IFC Chapter 43 provisions early alongside the guidance material provided herein allows jurisdictions to begin adoption planning, stakeholders to begin design work complying with the provisions, and code officials to begin applying and enforcing the provisions.

CHAPTER 2

Authority for Jurisdictional Adoption and Use

About this chapter: Once finalized, the Chapter 43 provisions will appear in the 2027 IFC. The full editorial process for the IFC has not yet been completed. When the 2027 IFC is officially published, editorial differences may appear in the final document.

Until that edition is formally adopted in a given jurisdiction, however, the authority under which code officials can apply the provisions depends on specific mechanisms in the currently adopted IFC edition and may differ among jurisdictions. This chapter identifies those mechanisms and explains the scope of authority each provides.

2.1 The General Framework of Code Authority

Code authority in the United States and in most international jurisdictions operates through a layered structure. The I-Codes are model codes, developed and published by the International Code Council. A model code has no direct legal effect. It becomes enforceable only when a governmental authority, such as a state, a county, a municipality, or the equivalent in another country, adopts it, typically by reference, into a statute, ordinance, or regulation.

Once adopted, the code's authority is exercised by the officials the adopting jurisdiction has designated. Most commonly, these designations would include a fire code official for fire-code provisions, a building code official for building-code provisions, and plans examiners and inspectors working under their direction. These officials' authority to act is addressed by the code itself, typically in Chapter 1 of the adopted edition, and by the enabling statutes, ordinances, or regulations that establish their positions and their duties.

This framework has direct implications for the early release of the Chapter 43 provisions. The model provisions themselves are available; what determines whether and how a specific jurisdiction can apply them is the legal authority that jurisdiction has conferred on its code officials through its existing code adoption, together with the additional authority the jurisdiction can confer through amendment, ordinance, or other legislative action.

2.2 Authority Under the Currently Adopted IFC

Every jurisdiction that has adopted any complete edition of the IFC — 2018, 2021, 2024, or any earlier edition — has within that edition a set of provisions that authorize the fire code official to require protective measures beyond the prescriptive minimums where specific conditions warrant. These provisions are the primary authority under which Chapter 43 can be applied in advance of the formal adoption of the 2027 IFC, and each of them merits attention.

2.2.1 Section 102 Applicability

Section 102 of the IFC, in every modern edition, establishes the general applicability of the code. Section 102.7 (or the equivalent numbered provision in earlier editions) provides that, where the code does not specifically cover a hazard, the fire code official has authority to apply nationally recognized standards and to require the application of protective measures consistent with accepted fire safety practice. This provision is the foundation for applying Chapter 43 to battery hazards that the current IFC editions do not specifically address. If a jurisdiction has adopted an edition of the IFC that predates the 2024 edition, utilize Section 102.7 in order to apply the battery-specific requirements found in Sections 320 and 322 of the 2024 IFC. Where the jurisdiction has adopted the 2024 IFC, the Chapter 43 provisions represent the refined, consolidated form of the same regulatory framework and can be applied under Section 102.7 to address aspects that the 2024 sections did not specifically cover.

2.2.2 Section 104 General Authority and Responsibilities

Section 104 of the IFC confers general authority on the fire code official to administer and enforce the code. Section 104.2 establishes the general powers of the fire code official, including the authority to render interpretations, to require permits, to conduct inspections, and to issue orders for compliance. Section 104.8 (in the 2024 edition; correspondingly numbered in earlier editions) establishes the alternative materials and methods authority that is the most-used pathway for applying new code provisions in advance of their formal adoption.

The alternative materials and methods provision within the IFC permits the fire code official to approve materials, equipment, methods of construction, and methods of compliance that differ from those otherwise specifically prescribed by the code, provided the fire code official finds the alternative to be satisfactory and to comply with the intent of the code. A Chapter 43 provision that is more protective than the corresponding provision in the currently adopted edition or that addresses a hazard the currently adopted edition does not address is an alternative that satisfies the intent of the code and, in nearly all cases, exceeds the protection the code prescribes. The fire code official's approval of a project that complies with Chapter 43 is a proper exercise of the Section 104.8 authority.

2.2.3 Section 104.2.2 Technical Opinion and Report

Several Chapter 43 provisions require a technical opinion and report in accordance with IFC Section 104.2.2. The authority to require such a report exists in every modern IFC edition. A fire code official confronted with a battery related project such as a manufacturing facility, a large storage area, or an outdoor storage configuration and who requires the applicant to submit the Chapter 43 style technical opinion and report is exercising authority already present in the currently adopted IFC, not creating a new authority. The substantive content of the report that Chapter 43 requires is the substantive content that reasonable engineering judgment would produce in any case.

2.2.4 Chapter 80 Referenced Standards

Chapter 80 of the IFC identifies the referenced standards that the IFC incorporates. Every jurisdiction that has adopted the entire IFC has adopted, by reference, the referenced standards as listed in the applicable chapter. Those standards are themselves updated on their own cycles. The standards that Chapter 43 references may be updated more frequently than the I-Codes themselves, but the specific referenced edition of the relevant standard within the IFC will continue to apply until the IFC is updated or the jurisdiction takes action to update the reference in its own statute, ordinance, or regulation.

The Chapter 43 references to UL 2272, UL 2849, UL 3100, UL 3300, UL 2595, UL 1487, UL 4900, UL 9540A, and NFPA 70 are references to product certification and testing standards. These standards, through their inclusion in the IFC, apply regardless of edition.

2.3 Authority Under State and Local Law

State and local law provides additional authority for the adoption and application of new code provisions. The specific mechanisms vary by jurisdiction, but several general categories apply broadly. You should consult your jurisdiction's legal counsel with respect to adoption or application of any new code provisions.

2.3.1 Statutory Authority to Amend Adopted Codes

Most states confer on the adopting authority — whether that is a state building code council, a state fire marshal's office, a county board, or a municipal legislature — the statutory authority to amend adopted codes at the state or local level. Amendments are the mechanism through which jurisdictions tailor the I-Codes to local conditions, and they are generally a direct pathway for adopting Chapter 43 provisions in advance of the full 2027 IFC.

Generally, an amendment may take the form of a substitution (replacing currently adopted text with Chapter 43 text), an addition (adding Chapter 43 provisions to the currently adopted edition), or a reference (requiring compliance with Chapter 43 without formally integrating it into the adopted code). Each form has its own procedural and legal requirements, and the appropriate form will depend on the specific jurisdiction's adoption mechanism.

2.3.2 Ordinance Authority

Municipalities with ordinance authority over fire safety and building safety have the ability to adopt ordinances that would require compliance with specific Chapter 43 provisions. Ordinance adoption is a faster mechanism than formal code amendment in many jurisdictions and has been used historically to address rapidly emerging fire safety concerns. An ordinance requiring compliance with Chapter 43 provisions for battery-related activities — storage above a threshold, research and manufacturing operations, commercial charging activities — is intended to be a recognized mechanism for implementing the Chapter 43 framework in advance of the full 2027 IFC adoption.

2.3.3 Permit and Inspection Authority

The fire code official's permit and inspection authority provides additional leverage for applying the Chapter 43 framework. Where a proposed activity requires a permit, the conditions attached to the permit can require compliance with Chapter 43 provisions as a condition of approval. Where an ongoing activity is subject to inspection, the conditions imposed as a result of the inspection — to address identified hazards — can reference the Chapter 43 provisions as the appropriate protective framework. These authorities are generally routine in code enforcement and are available immediately under any current IFC edition.

2.3.4 Review with Elected Leaders

The potential pathways and authorities discussed above are the legal mechanisms for adoption. The political and relational work which surrounds those mechanisms is its own undertaking, and deserves individual attention. Code adoption is, in most jurisdictions, an action of an elected or appointed authoritative body. Even where the technical work of drafting and review sits with the fire code official and building code official, the vote that puts an amendment or ordinance into effect is usually subject to an action by a city council, county board, state code council, or similar body whose members may have limited prior engagement with battery safety or with code development in general.

Briefing those decision makers in advance of the formal vote is the single most consequential step a code official can take to support a successful adoption. A government official who first encounters these changes the night of the vote, in a packet that arrived three days earlier, is being asked to act on something they have not had time to understand. The conversations that should have happened beforehand have not happened, and the questions that surface during the meeting are the questions that should have been answered weeks earlier through deliberate engagement.

Effective engagement with elected and appointed leaders has several characteristics that distinguish it from the technical work of code review. Appropriate framing of the issue matters. A council member is not asking the fire code official to summarize Section 4302.5 or to walk through the IBC use group framework. Rather, the council member is asking why this matters for the community, what the cost of action is compared to the cost of inaction, how the regulated community may respond during the public hearing, and whether the proposed adoption aligns with what neighboring jurisdictions are adopting. The technical content provides the foundation for the answer, but the answer itself must speak to the council member's perspective.

Speaking in plain language also matters. The code official who briefs governmental leadership should be prepared to explain Chapter 43 without code citations and without acronyms. For example, an opening statement such as "This chapter addresses how lithium-ion batteries are stored, charged, and used in our community, and it is designed to

prevent the kinds of fires we have seen in other jurisdictions" is clear language any audience may comprehend. Then, any technical details can be explained if and when the leader requests it.

Anticipating governmental leadership concerns matters. They want to know about cost, and the cost arguments cut in both directions: there is the cost of compliance for the regulated community, and there is the cost of the incident the code is designed to prevent. The impacts of both arguments should be presented honestly. Leaders will want to know about economic development and the resulting outcomes of using the proposed provisions. The use group framework discussion in 4.2 of this document is directly relevant here, because the same Chapter 43 framework that imposes requirements on existing operators is also what enables a community to attract and approve battery-related manufacturing, storage, and research facilities under appropriate occupancy classifications rather than defaulting to a Group H designation that may be incompatible with the project's siting. Code adoption is, in this respect, both protective and enabling.

The fire code official is rarely the only voice that should be heard by elected leadership when adopting battery provisions. The building code official has the use group and structural perspective, the emergency management coordinator has the response and continuity perspective, the economic development department has a siting and recruitment perspective, and the risk management or insurance professional has the financial exposure perspective. Coordinating who presents which part of the message to the audience is part of the administrative skills work. The fire code official should be the technical anchor but should not always be the sole spokesperson.

Engagement with governmental leadership should begin well in advance of the formal vote. The first conversations are exploratory, briefing leadership on the existence of the early release framework, the reasons for the early release, and the adoption pathways available. Subsequent conversations narrow the scope, address specific concerns, and circulate draft amendment language. By the time the formal vote is on the calendar, the leaders should be voting on an item they have already been engaged with, not something they are reviewing for the first time.

As part of the broader ICC mission, this engagement also serves the forward-looking purpose of preparing communities for the safe expansion of battery-related activities within their jurisdiction. A community whose leadership has been engaged in battery safety is a community that can confidently host a battery storage facility, a manufacturing line, a recycling operation, or a charging-intensive logistics center. The protective framework that Chapter 43 provides is the predicate for that confidence. Code officials who engage their elected leaders in advance of formal adoption are not merely supporting one ordinance; they are positioning their communities to participate in the energy transition that battery technology enables.

2.4 Interaction With the Building Code

Several Chapter 43 provisions interact with the International Building Code. The 2-hour fire-resistance-rated separations required by Sections 4302.9 and 4303.3.2.2 reference IBC Sections 707 (fire barriers) and 711 (horizontal assemblies). The 2024 IBC companion provisions on occupancy classification (Group B, F-1, M, S-1 for battery-related operations) and on automatic sprinkler and detection systems (Sections 903 and 907) provide the IBC-side framework that Chapter 43 coordinates with.

A jurisdiction adopting Chapter 43 in advance of the 2027 IFC may also need to consider the 2024 IBC companion provisions, depending on the edition of the IBC currently in force. Most of the 2024 IBC additions carry forward unchanged into the 2027 IBC, and a jurisdiction currently enforcing an edition of the IBC prior to 2024 may find that the 2024 IBC additions warrant parallel early adoption to support the Chapter 43 framework. The coordination between the building code official and the fire code official on this point is important, and the early adoption of Chapter 43 should ordinarily be accompanied by coordination with whatever IBC edition is in force and by whatever parallel action on the building code side the jurisdiction determines appropriate.

2.5 The Limits of Authority

The authorities described above are substantial, but they have limits. No authority under the currently adopted IFC permits a fire code official to require compliance with a provision that is contrary to a provision of the adopted code. Where Chapter 43 would impose a requirement inconsistent with a requirement of the currently adopted edition, the authority to require the Chapter 43 provision is limited to the extent of that inconsistency. For most Chapter 43 provisions, this limit is not operative as Chapter 43 is generally more protective than or consistent with the currently adopted text. For provisions that represent a departure, the fire code official should confirm that the Chapter 43 application does not conflict with an existing express provision of the adopted code.

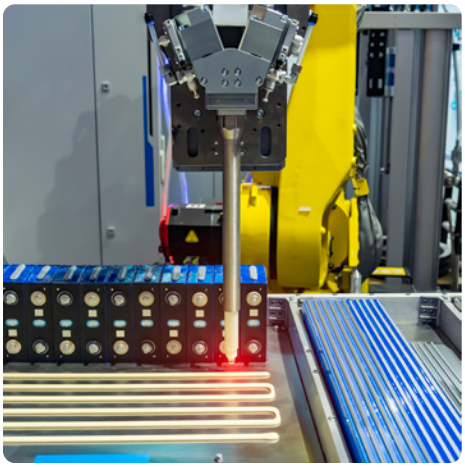
The authorities also do not extend to creating new permit types not provided for in the adopted code. A jurisdiction currently operating under an IFC edition that lacks the specific lithium battery operational permit (Section 105.5.29) or the battery exchange permit (Section 105.5.5) that Chapter 43 references can address the gap by amendment or ordinance, but cannot simply require a permit that the currently adopted code does not authorize.

The practical effect of these limits is to reinforce the importance of the formal amendment or ordinance pathways discussed in Chapter 3. For routine applications of Chapter 43 requiring appropriate detection, suppression, separations, ventilation, and protective measures, the alternative materials and methods pathway and the general authority of the fire code official are generally sufficient. For the establishment of new permit categories, new thresholds, and new specific enforcement mechanisms, the more formal pathways provide the authority the informal pathways do not.

2.6 Summary

The legal authority under which Chapter 43 can be applied in advance of the full 2027 IFC is substantial. The alternative materials and methods provisions of the currently adopted IFC, together with the general authority of the fire code official to address hazards consistent with the intent of the code, provide the primary foundation. State and local amendment and ordinance authority provide additional, more formal pathways. The interaction with the IBC requires coordinated attention, but does not present obstacles that cannot be addressed through ordinary code coordination. The limits of authority are real, but they are narrow and predictable.

The next chapter translates this authority into concrete, jurisdiction-level pathways for putting the Chapter 43 provisions into effect.



CHAPTER 3

Pathways to Putting These Provisions into Effect

About this chapter: This chapter describes the practical pathways through which jurisdictions can put the Chapter 43 provisions into effect in advance of the full 2027 IFC. Three pathways are addressed: direct adoption by amendment to the currently adopted IFC, ordinance adoption, and contractual requirement in permits and approvals. Each pathway has its own procedural characteristics, its own scope, and its own appropriate use. Jurisdictions will typically use more than one.

3.1 Pathway 1 — Direct Adoption by Amendment

The most direct potential pathway is to amend the currently adopted IFC to incorporate the Chapter 43 provisions by reference, by substitution, or by addition. The amendment approach is the mechanism through which jurisdictions have historically adopted proposed or newly published provisions ahead of the next full IFC edition. The procedural path is familiar to code administrators.

A jurisdiction amending its adopted IFC to incorporate Chapter 43 has several structural options. The jurisdiction may add Chapter 43 as a new chapter to the adopted code, carrying the text verbatim from this early-release document.

Alternatively, the jurisdiction may amend Sections 320 and 322 of the currently adopted edition (if applicable) to replace their text with the Chapter 43 text, retaining the numbering of the current edition. A jurisdiction enforcing a pre-2024 edition that has no Sections 320 or 322 would add Chapter 43 as a new chapter, together with whatever coordinating references are needed in other sections (permit types in Section 105, for example).

Direct adoption by amendment has several characteristics that make it a strong and viable option. The Chapter 43 provisions become enforceable on their own terms, not as alternative compliance methods approved case by case. The fire code official has a clear textual basis for requiring compliance. The regulated community has clear notice of what is required. The permit, inspection, and enforcement processes work in the same way they work for any other chapter of the adopted code.

Direct adoption by amendment also has requirements. The amendment must be adopted through whatever legislative process the jurisdiction requires: for a municipality, typically that is action by the city council or equivalent body after a public hearing; for a state, typically that is action by the state code-adoption authority. The process may take some months to complete, depending on the jurisdiction. The jurisdiction's code attorneys should be involved from the outset to ensure that the amendment is drafted in a form that integrates correctly with the existing adopted code.

For jurisdictions considering amendment, ICC makes available sample adoption language support for the adoption process. Chapter 5 of this document provides contact information for these resources.

3.2 Pathway 2 — Ordinance Adoption

Many municipalities have the authority to adopt ordinances that impose specific requirements for regulated activities without amending the underlying code. An ordinance requiring compliance with Chapter 43 provisions in whole or in part for battery-related activities within the municipality would potentially be a faster mechanism than the direct adoption by amendment method. Similar ordinance adoption has been used in a number of jurisdictions for rapidly emerging safety concerns.

Ordinance adoption may be particularly useful where a jurisdiction wishes to address a specific battery activity like commercial charging operations, for example, or large-scale storage without undertaking the full Chapter 43 adoption. An ordinance may be able to reference a specific set of Chapter 43 provisions and require compliance with them for the activities named in the ordinance, leaving other activities to be addressed through the currently adopted code or through subsequent local ordinance action.

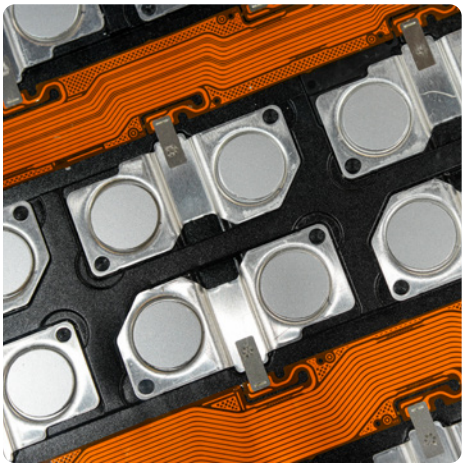
The procedural requirements for ordinance adoption vary by jurisdiction. The municipality's own procedures govern, and jurisdictional legal counsel should be consulted on the specific process. The content of the ordinance can, for most municipalities, be drafted to incorporate the Chapter 43 text directly, either by attachment or by reference to this early-release document. ICC makes available sample ordinance language for this purpose.

3.3 Pathway 3 – Permit and Contractual Conditions

The third potential pathway is the use of permit conditions and contractual requirements to require Chapter 43 compliance as a condition of approval. Where a proposed activity requires a permit under the currently adopted IFC (for example, the general permits established under Section 105.5, for industrial ovens and furnaces, for hot work, or for similar activities), the fire code official has authority to impose conditions on the permit that are reasonably related to the hazards the permit addresses. A condition requiring compliance with specific Chapter 43 provisions is a reasonable condition where the activity presents battery-related hazards that those provisions are designed to address.

Similarly, for contractual arrangements (for example, where a jurisdiction contracts with a private operator for municipal services that involve battery activities, or where a jurisdiction enters into a development agreement for a specific project), the jurisdiction can include Chapter 43 compliance as a contractual obligation. Contract requirements may be enforceable through contractual obligations rather than through code-enforcement mechanisms.

The permit condition and contractual potential pathways are the narrowest of the three pathways, and they are most useful as supplements to one of the others. A jurisdiction using permit conditions without also using either direct adoption by amendment or ordinance adoption methods. may find itself unable to address battery activities that do not require the specific permits to which the conditions can attach.



3.4 Coordination Across Pathways

Most jurisdictions will find that the appropriate response is a combination of pathways rather than a single selection. A typical implementation might include:

- A permit application beginning immediately on individual projects or as they come forward
- Ordinance adoption for specific high-consequence activities within several months (commercial charging in residential buildings, for example, where the urgency of the prohibition is greatest)
- Formal amendment to incorporate the full Chapter 43 into the adopted code when the jurisdiction's regular code update cycle comes around, or when a specific triggering event makes formal action timely (a notable local incident, a legislative priority, a stakeholder request)

While each jurisdiction is different, the pathways are not usually mutually exclusive, and the use of one likely will not preclude the use of another.

3.5 The Role of the Fire Code Official

Across all three pathways, the role of the fire code official is central. The fire code official is most commonly the person who applies the Chapter 43 provisions in the field through permit decisions, plan review, and inspection, regardless of which pathway has been used to put the provisions into effect. The fire code official's familiarity with Chapter 43, comfort with its provisions, and ability to explain them to applicants and stakeholders are the operational foundation for any of the adoption approaches.

ICC has training and educational resources that are oriented toward equipping code and fire safety officials with the substantive knowledge required to apply Chapter 43 including webinars, certifications, and continuing-education offerings through ICC provide the complementary training. Chapter 5 of this document identifies the specific resources available and the means by which they can be accessed.

3.6 Timing Considerations

The timing of any of these pathways depends on the jurisdiction. Some pathways involve legislative or regulatory processes that may take three to twelve months or longer. However, utilizing Sections 102.7 and 102.8 (if adopted) as pathways can take effect immediately, as soon as the fire code official is prepared to apply them. For jurisdictions that delete Sections 102.7 and 102.8 or Chapter 1 entirely, in most cases the enabling act provides broad authority to address identified hazards.

Jurisdictions considering code adoption are encouraged not to defer action on the immediate pathways while the longer pathways proceed. The immediate pathways can assist in working toward protective outcomes on current projects while the jurisdiction completes the longer-term adoption.

3.7 Summary

Three potential pathways are available for putting the Chapter 43 provisions into effect: direct adoption by amendment to the currently adopted IFC, ordinance adoption, and contractual requirement in permits and approvals. Each has its own characteristics and appropriate uses. Most jurisdictions will combine more than one pathway, beginning with the immediate effect pathways and moving to formal amendment over time. The code official's role is central across all pathways, and ICC's companion resources in Chapter 5 support that role.

CHAPTER 4

Compliance Pathways Based on the Currently Adopted IFC Edition

About this chapter: The three general pathways described in Chapter 3 — direct adoption by amendement, ordinance adoption, and permit and contractual conditions — apply across all editions of the IFC. The specific drafting a jurisdiction uses, however, depends on which edition is currently in force. This chapter provides edition-specific guidance for the 2018, 2021, and 2024 editions of the IFC, including recommended amendment language for jurisdictions that choose to adopt Chapter 43 through formal legislative action. The guidance in this chapter is addressed primarily to the adopting code bodies — state building code councils, state fire marshal offices, municipal code-adoption authorities, and the jurisdictional offices that manage code-update ordinances.

4.1 Why Edition Matters

A jurisdiction's choice of amendment or adoption language depends on what its currently adopted code already contains. The 2021 and earlier editions of the IFC contain no lithium-ion or lithium metal battery-specific storage or charging provisions. The 2024 edition contains Sections 320 (lithium-ion and lithium-metal battery storage) and 322 (powered micromobility) that are the direct predecessors of Chapter 43 and whose scope overlaps with it. A jurisdiction adopting Chapter 43 while enforcing the 2021 IFC or earlier would require additional language as well as modifications to certain code sections; a jurisdiction adopting Chapter 43 while enforcing the 2024 IFC would need to make a substitution deleting Sections 320 and 322 and adding Chapter 43 in their place as well as other changes to definitions and miscellaneous sections.

The following sections address each of the three current editions in turn and provide the specific amendment language recommended for each. The language is drafting-ready in the sense that a jurisdiction's code attorney can adapt it to the jurisdiction's legislative format with minimal substantive modification. It is not a substitute for the jurisdictional legal review that any code amendment requires; it is the starting point that reduces drafting time and aligns adopting jurisdictions around consistent language. You should consult your jurisdiction’s legal counsel for all decisions related to code adoption.

4.2 IBC Use Group Classification for Battery Operations

Before turning to the IFC amendment language for each edition, the adopting jurisdiction should consider a parallel question on the building code side. Chapter 43 prescribes the protective measures for battery activities, but it does not classify the occupancies in which those activities may occur. Occupancy classification is a building official's responsibility under IBC Chapter 3. Battery operations have, in many jurisdictions, been incorrectly defaulted to Group H (high hazard) occupancy because the IBC editions adopted do not list the activities anywhere else. The Group H occupancy default is rarely correct for battery operations and it produces construction requirements that do not reflect the actual hazard profile.

The 2024 edition of the IBC clarifies the proper occupancy group classifications for battery activities by adding specific listings under Group B (Business), Group F-1 (Moderate-hazard Factory Industrial), and Group S-1 (Moderate-hazard Storage) occupancies. These additions reflect a settled position of the building code community: battery testing, research and development, manufacturing, storage, and vehicle repair are appropriately classified as B, F-1, and S-1 occupancies when the protective measures of IFC Chapter 43, IFC Section 1207, and IFC Sections 903 and 907 sprinkler and detection requirements are in place. The H Group occupancy classification is reserved for cases that fall outside this protective framework or that exceed the maximum allowable quantities (MAQ) for hazardous materials in a control area.

The occupancy group framework is not edition-specific in the IFC. The same group occupancy classifications apply regardless of which IFC edition the jurisdiction enforces. What changes by edition is whether the IBC, adopted alongside the IFC, already contains the 2024 IBC clarifications. A jurisdiction that has adopted a pre-2024 IBC edition has the same need for these classifications but does not yet have them in its adopted code. One potential pathway for that jurisdiction

is to adopt the 2024 IBC occupancy group additions through a parallel amendment to the IBC, in coordination with the Chapter 43 IFC adoption.

4.2.1 The 2024 IBC Use Group Additions

The 2024 IBC additions appear in IBC Sections 304.1 (Group B), 306.2 (Group F-1), and 311.2 (Group S-1). The relevant sections are reproduced below as they can be incorporated into a jurisdiction's adopted IBC, either directly through 2024 IBC adoption or through a parallel amendment to a pre-2024 IBC adoption.

IBC Section 304.1 Business Group B. The Group B classification list adds the following activity:

- Lithium-ion or lithium metal battery testing, research and development

IBC Section 306.2 Moderate-hazard Factory Industrial, Group F-1. The Group F-1 classification list adds the following activities:

- Energy storage systems (ESS) in dedicated use buildings
- Energy storage systems (ESS) and equipment containing lithium-ion or lithium metal batteries
- Lithium-ion batteries
- Vehicles powered by lithium-ion or lithium metal batteries

IBC Section 311.2 Moderate-hazard Storage, Group S-1. The Group S-1 classification list adds the following activities:

- Lithium-ion or lithium metal batteries
- Motor vehicle repair garages complying with the maximum allowable quantities of hazardous materials specified in Table 307.1(1) (see Section 406.8)
- Vehicle repair garages for vehicles powered by lithium-ion or lithium metal batteries

4.2.2 Are Batteries Hazardous Materials

The occupancy group classifications above operate within a hazardous materials carve-out built into the IBC framework. Battery electrolytes involve raw materials that, in isolation, would meet the definition of hazardous materials (sulfuric acid in lead-acid, the flammable electrolyte in lithium-ion, the alkaline electrolyte in nickel-based chemistries), however, without the carve-out, the presence of completed batteries containing those materials above the maximum allowable quantities in Table 307.1(1) has caused code officials to default the occupancy to Group H by adding up the small amounts in each battery cell to reach the MAQ. The concept of MAQs was never to add up smaller amounts sealed in equipment or articles; it is based upon being confronted with amounts above the MAQ readily available for involvement in an event causing the need for fire department response.

The carve-out recognizes that the protective measures of IFC Chapter 43, IFC Section 1207, and the IFC Sections 903 and 907 sprinkler and detection requirements provide a level of protection that is appropriate for the B, F-1, and S-1 occupancy classifications when those measures are in place. The largest lithium-ion battery, electric-vehicle manufacturing, and ESS manufacturing facilities in operation today are designed with A, B, F-1, and S-1 spaces by employing emergency action plans, suppression, and detection. The H Group designation is reserved for activities that cannot meet the protective framework, that the use of raw materials which exceed the MAQ even with the protective measures in place such as in cell manufacturing, or that involve other hazardous materials operations independent of the battery activity.

A jurisdiction adopting Chapter 43 should ensure that its building official is prepared to apply the group occupancy framework correctly. A plan reviewer encountering a battery facility in a B, F-1, or S-1 occupancy classification should verify that the Chapter 43 protective measures are in place rather than defaulting the classification to H based on the presence of hazardous materials.

4.2.3 Coordination Across IFC Editions

The occupancy group additions described above are recommended for adoption alongside Chapter 43 regardless of which IFC edition the jurisdiction currently enforces. The reasoning is the same in each case — Chapter 43 prescribes the protective measures; the IBC occupancy group classification places the activity in the correct construction-type and occupancy framework. The combined effect is the regulatory environment in which battery operations can be designed, constructed, and operated safely.

A jurisdiction that has adopted the 2018 or 2021 IFC will, in many cases, also have adopted the 2018 or 2021 edition of the IBC. Those editions of the IBC do not contain the 2024 occupancy group additions so it's recommended the jurisdiction adopt the additions through a parallel amendment to its adopted IBC at the same time it adopts 2024 IFC Chapter 43.

A jurisdiction that has adopted the 2024 IFC will, in many cases, also have adopted the 2024 IBC, which contains the additions. Therefore, the parallel amendment is not required. The jurisdiction should verify, however, that any local amendments it has made to its 2024 IBC adoption have not removed the additions.

The following edition-specific pathways address the IFC amendment language for each edition. The IBC parallel amendment, where required, is addressed at the end of this chapter in section 4.9.

4.3 Battery-Related Definitions

Like the occupancy group classification framework discussed in 4.2, the substantive definitions on which Chapter 43 relies on are located outside Chapter 43 itself. IFC Section 202 contains the general definitions used throughout the code, and Chapter 43's regulatory framework draws on a set of battery-specific terms that the code development cycles parallel to Chapter 43 added to Section 202. Without these definitions, Chapter 43's references to terms such as "BATTERY," "LITHIUM-ION BATTERY," "BATTERY-POWERED MICROMOBILITY DEVICES," "BATTERY-POWERED INDUSTRIAL TRUCK," and similar terms have no defined meaning in the adopting jurisdiction's code.

Two principal 2027 code development proposals account for the Section 202 additions. Proposal F11-24 addresses battery chemistry, providing a new umbrella definition for BATTERY along with revised and new sub-definitions for the various chemistries used in modern battery products. Proposal F58-24 addresses battery-powered equipment, providing definitions for the categories of devices regulated by Section 4304. The two code development proposals together establish the vocabulary on which Chapter 43 operates.

It's recommended that a jurisdiction adopting Chapter 43 adopt the underlying Section 202 definitions at the same time. The 2018 and 2021 IFC editions do not contain any of these battery-specific definitions, so a jurisdiction enforcing those editions needs the full set of definitions. The 2024 IFC contains BATTERY-POWERED MICROMOBILITY DEVICES in a format that Proposal F58-24 revises and contains existing battery chemistry definitions that Proposal F11-24 revises and expands. Sample amendment language for each edition addresses the appropriate scope of the definition adoption, starting in section 4.5.2.

4.3.1 Battery Chemistry Definitions

Proposal F11-24 establishes a tiered definition framework for battery chemistry. The umbrella term BATTERY is defined as a class of devices, with sub-definitions provided for specific chemistries. The framework allows code provisions to refer to "batteries" generally where the requirement applies across chemistries, and to specific chemistries where the requirement is chemistry-specific. Chapter 43 uses both forms.

The Proposal F11-24 umbrella definition is reproduced below.

BATTERY. A class of devices that contain materials that convert chemical energy into electrical energy which then can be used as a power source. There are several technologies that utilize a variety of materials and chemistries for the purpose of storing this electrochemical energy for use when required.

Proposal F11-24 revises six existing sub-definitions and adds ten new sub-definitions to the BATTERY TYPES heading in Section 202. F11-24 also deletes the existing "Stationary storage battery" sub-definition because the regulatory scope it served has been transferred to the energy storage system provisions in IFC Section 1207.

Revised Sub-Definitions

Flow battery. A type of storage battery that includes chemical components dissolved in two different liquids. Ion exchange, which provides the flow of electrical current, occurs through the membrane while both liquids circulate in their respective spaces. Examples of flow batteries include vanadium redox, zinc-bromine, polysulfide-bromide, and other flowing electrolyte-type technologies.

Lead-acid battery. An aqueous storage battery that is comprised of lead electrodes immersed in a solution of water and sulfuric acid electrolyte. Lead dioxide is the active material for the positive anode and metallic lead is the active material for the negative cathode. Common major classification distinctions or types of lead acid batteries include vented lead-acid (VLA) and valve-regulated lead-acid (VRLA). The VRLA is further subdivided into two types representing the method in which the electrolyte is immobilized: either gelled (gel cell) or absorbed in finely-woven porous fiberglass mat (AGM) separators inside the battery between the electrodes.

Lithium-sulfur rechargeable battery. A storage battery that is similar to the lithium-ion battery except that it has a lithium metal anode in the place of the traditional carbon or graphite anode. A lithium-sulfur battery is a secondary rechargeable battery that has lithium metal at the anode, sulfur at the cathode, and the electrolyte is nonaqueous.

Lithium-ion battery. A storage battery with lithium ions serving as the charge carriers of the battery. The electrolyte is a polymer mixture of carbonates with flammable organic salt in a liquid form. Lithiated metal or mixed metal oxides typically make up the cathode, and forms of carbon, graphite or lithium titanate oxide (LTO) typically form the anode. Examples of lithiated metal or mixed metal oxides include cobalt (CLO), manganese (LMO), nickel-manganese-cobalt (NMC or NCM), nickel-cobalt-aluminum (NCA) or iron phosphate (LFP). Each of these different types of cathodes and anode combinations produce different energy densities, different lifetimes, differing fast charge abilities and differing safety characteristics, among many other things. The choice of Li-ion chemistry is often driven by whichever of these factors or best mix of factors is/are most important for application.

Nickel-cadmium (Ni-Cd) battery. An alkaline storage battery in which the positive active material is nickel oxide, the negative electrode contains cadmium and the electrolyte is a solution of water and potassium hydroxide. They lose less life at high temperatures and have better capacity at low temperatures than most other battery technologies, and have a long life if not cycled too much.

Nickel-metal hydride (Ni-MH). An alkaline storage battery in which the positive active material is nickel oxide, the negative electrode is an intermetallic compound and the electrolyte is usually potassium hydroxide solution in water.

New Sub-Definitions

Electrochemical double layer capacitors (EDLCs). These devices are usually built up from an electrolyte, a separator, and two carbon-based electrodes. Also referred to as supercapacitors, they store energy using either ion adsorption (electrochemical double layer capacitors) or fast surface redox reactions (pseudo-capacitors). They are commonly also called “supercapacitors” or the trademarked “ultracapacitor” because they store orders of magnitude more power and energy for the same unit mass or volume as a traditional electrolytic capacitor.

They can release power and accept charge much faster than batteries for the same footprint, but store much less energy.

Hybrid supercapacitor Battery (Lithium-ion capacitor (LIC)). The lithium-ion capacitor (LIC or LiC) is a hybrid type of capacitor classified as a type of supercapacitor. It combines lithium-ion technology and electric double layer capacitor (EDLC) construction. It is called a hybrid because the anode is the same as those used in lithium-ion batteries and the cathode is the same as those used in supercapacitors. Activated carbon is typically used as the cathode. The anode of the LIC consists of carbon material which is often pre-doped with lithium ions.

Iron-air aqueous battery. Each of the cells are filled with water-based, non-flammable alkaline electrolyte (which functions partially like the anolytes and catholytes of flow batteries). The battery does not present the risk of thermal runaway. Like the Ni-Fe battery they are relatively coulombically inefficient on float charge, and thus are usually disconnected from the charge bus when at or nearing full charge.

Nickel Iron (Ni-Fe). The battery has nickel (III) oxide-hydroxide positive plates and iron negative plates, with an electrolyte of potassium hydroxide. The active materials are held in nickel-plated steel tubes or perforated pockets. Nickel-iron batteries do not cause spill concerns since there is no acid in the component. They are capable of tens of thousands of cycles and have calendar lifetimes of well over 50 years. However, they are highly coulombically inefficient (with the inefficiency coming from high percentages of water electrolysis from the charging current) when at or near full state-of-charge (SOC). As such, they are usually equipped with catalytic recombiner vents and automatic watering systems.

Nickel-hydrogen (NiH_2). The cells are a hybrid technology, combining elements from both batteries and fuel cells. The battery differs from a nickel-metal hydride (NiMH) battery by the use of hydrogen in gaseous form. The nickel-hydrogen cells utilize the nickel hydroxide electrode from nickel-cadmium cells and a platinum hydrogen electrode from fuel cell technology to create a chemistry without the issues and limitations inherent with the cadmium electrode. The cell is contained within a hermetically sealed pressure vessel that envelopes the electrodes and accommodates the pressurized hydrogen.

Nickel-Zinc (Ni-Zn). A battery that is chemically similar to the nickel-metal hydride battery. Nickel and zinc have low toxicity, the battery is non-flammable, and presents no threat to the environment. The Ni-Zn battery uses an alkaline electrolyte (potassium hydroxide, KOH) and zinc acts as the negative electrode while nickel hydroxide is the positive electrode.

Sodium nickel chloride (NaNiCl). This battery is a member of the 'high temperature' family, which works at typical temperature scope of 270°C–350°C. Its cell contains sodium and nickel chloride electrodes, isolated by a beta-alumina electrolyte, which can conduct sodium particles yet not electrons. This chemistry is much safer than most battery chemistries with far fewer toxic materials involved in its production, but it does not have the cycling ability or energy density of most of the Li-ion chemistries.

Zinc-air aqueous battery. A zinc-air battery contains a zinc electrode and porous air electrode separated by a membrane and an aqueous alkaline electrolyte that is used in a manner similar to the catholytes and anolytes of a flow battery. The cathode is a bi-functional air electrode which features one or more catalysts that can per-form the oxygen reduction reaction (ORR) during discharging and the oxygen evolution reaction (OER) during charging.

Zinc bromide. In zinc bromide batteries, the cathode is made using zinc instead of lithium. The electrolyte is water-based and, therefore, does not pose a fire risk.

Zinc manganese dioxide (Zn-MnO_2). The battery features a Zinc (Zn) anode and a dioxide (MnO_2) cathode with a strongly basic electrolyte (typically potassium hydroxide, KOH). The battery does not present environmental hazards and is EPA-certified for landfill disposal in the United States, and the aqueous electrolyte is nonflammable.

Proposal F11-24 also deletes, without substitution, the existing definition of "Stationary storage battery." The deletion reflects that the scope previously addressed by this term is now addressed by the energy storage system provisions of IFC Section 1207. A jurisdiction adopting the F11-24 chemistry definitions should also delete this superseded sub-definition from its adopted code.

The deleted definition reads: ~~**Stationary storage battery.** A group of electrochemical cells interconnected to supply a nominal voltage of DC power to a suitably connected electrical load, designed for service in a permanent location.~~

4.3.2 Battery-Powered Equipment Definitions

Proposal F58-24 establishes the equipment-side definitions on which Section 4304 relies on. The terms identify the categories of battery-powered devices that the section regulates: micromobility devices, appliances, industrial equipment, industrial trucks, automated mobile platforms, and robotic equipment. Without these definitions, Section 4304's scope provisions reference categories of devices that are not defined in the adopting jurisdiction's code.

Proposal F58-24 revises one existing definition (BATTERY-POWERED MICROMOBILITY DEVICES, which was added in the 2024 IFC and is revised by F58-24) and adds five new definitions. Proposal F176-24 adds the definition of Portable Power Pack. The full set is reproduced below.

Revised Definition

BATTERY-POWERED MICROMOBILITY DEVICES. Products or equipment that include motorized bicycles, motorized scooters and other personal mobility devices intended for one or more riders powered by a lithium-ion or lithium metal battery. The term does not include automobiles and trucks built to DOT requirements.

New Definitions

BATTERY-POWERED APPLIANCE. A device or apparatus with an electric motor powered by battery.

BATTERY-POWERED INDUSTRIAL EQUIPMENT. A motorized hand truck, floor scrubber or buffer or similar device with an electric motor intended to be personally driven or guided, powered by a battery.

BATTERY-POWERED INDUSTRIAL TRUCK. A forklift, tractor, platform lift truck or similar apparatus with an electric motor powered by a battery.

BATTERY-POWERED AUTOMATED MOBILE PLATFORMS (AMPs). A device with an electric motor powered by a battery that provides an automated function involving lifting, carrying, product picking, towing, and similar operations. These devices may also be capable of automatous movement including operating, moving and completing automated functions independently, without direct human guidance or control.

BATTERY-POWERED ROBOTIC EQUIPMENT. A machine or device with an electric motor powered by a battery capable of automatically carrying out a complex series of actions using computer programming. This equipment may be permanently mounted or capable of autonomous movement where they have the means to determine path selection by processing data from sensors, powered by a battery.

4.3.3 Coordination Across IFC Editions

The definition adoption requirements vary by IFC edition.

A jurisdiction that has adopted the 2021 or earlier editions of the IFC has none of the battery-specific definitions reproduced above. The full Proposal F11-24 chemistry set and the full Proposal F58-24 equipment set should be added to Section 202 through the amendment ordinance. The sample amendment language for the 2021 and earlier editions of the IFC pathways includes a Section that adds these definitions.

A jurisdiction that has adopted the 2024 IFC has BATTERY-POWERED MICROMOBILITY DEVICES in its adopted code in a form that Proposal F58-24 revises. The 2024 IFC also has the existing battery chemistry definitions that Proposal F11-24 revises (Lead-acid, Lithium-ion, Nickel-cadmium, Nickel-metal hydride). The 2024 amendment requires both revisions to existing definitions and the addition of new definitions, which the sample amendment language for the 2024 IFC pathway addresses.

The structural pattern is the same as for the use group framework discussed in 4.2. Definitions are located in Section 202 (general definitions), apply across IFC editions, and require parallel amendment to the adopted code concurrently when Chapter 43 is adopted. The next sections turn to the edition-specific IFC amendment language and integrate the definition adoption with the Chapter 43 adoption.

4.4 Fuel-Powered Industrial Equipment

Chapter 4 of this document has addressed two structural topics that operate alongside Chapter 43: the IBC occupancy group classification framework and the Section 202 definitions. A third structural topic merits parallel treatment. The 2024 IFC Section 309 has historically addressed both fuel-powered industrial trucks (forklifts, tractors, lift trucks powered by hydrogen, flammable liquid, or flammable gas) and battery charging operations associated with battery-powered industrial equipment. The resulting effect is an overlap between Section 309 and the emerging battery framework, with battery charging provisions in Section 309 that duplicate or conflict with the more comprehensive Chapter 43 (and predecessor Section 322) provisions.

Code development Proposal F42-24 resolves the overlap. The proposal renames Section 309 from "Powered Industrial Trucks and Equipment" to "Fuel-Powered Industrial Trucks and Equipment", deletes battery-charging provisions from Section 309 since those activities are now exclusively addressed in Chapter 43, and adds new definitions and operational requirements specific to fuel-powered equipment. The result is a clean scope split: Section 309 governs fuel-powered industrial equipment, and Chapter 43 (specifically Section 4304) governs battery-powered industrial equipment, so the two frameworks no longer overlap.

Proposal F42-24 is a recommended companion amendment to any Chapter 43 adoption. A jurisdiction that adopts Chapter 43 without addressing Proposal F42-24 will leave the pre-2024 Section 309 battery charging provisions in force alongside the new Chapter 43 framework, producing exactly the overlap that Proposal F42-24 was designed to eliminate. The recommended approach is to adopt the Proposal F42-24 code changes through the same amendment ordinance that adopts Chapter 43.

4.4.1 What Proposal F42-24 Changes

Proposal F42-24 makes the following changes to the 2024 IFC. The same changes are recommended for adoption in any IFC edition adopting Chapter 43.

Section 309 Title and Scope.

Section 309 is renamed from "Powered Industrial Trucks and Equipment" to "Fuel-Powered Industrial Trucks and Equipment." Section 309.1 is revised to clarify the section addresses fuel-powered industrial trucks and fuel-powered industrial equipment. The renaming is the structural change that signals the carve-out: Section 309 is now specific code language for fuel-powered industrial equipment, Chapter 43 is for battery-powered industrial equipment.

Deletions from Section 309.

Proposal F42-24 deletes the following provisions from Section 309 without substitution. The substantive content of these provisions is now addressed in Chapter 43 (Section 4304) in a more complete and battery-specific format.

- Section 309.3 (Battery chargers) addressed conventional approval requirements, combustible separation distance, and prohibition of battery charging in public-access areas.
- Section 309.4 (Ventilation) addressed flammable gas accumulation in battery charging areas.
- Section 309.5 (Fire extinguishers) addressed the 4-A:20-B:C extinguisher within 20 feet of the battery charger.

All three of these provisions were premised on the conventional understanding of battery charging hazards that predated the lithium-ion era. They remained unchanged through several IFC cycles even as battery chemistries evolved, and by 2024 they were inadequate to the actual hazard profile of lithium-ion industrial truck charging. Chapter 43 Section 4304 provides the modern framework, calibrated to the chemistries and configurations actually in use.

Additions to Section 309.

Proposal F42-24 adds the following provisions to Section 309. These provisions complete the fuel-powered framework that the deletions left open.

- Section 309.2.1 (Fuel-powered industrial equipment) requires fuel-powered industrial equipment to be listed for its intended use and operated in accordance with its listing and the manufacturer's instructions. This is a new general listing-and-operation requirement that parallels Chapter 43 Section 4304.6 listing requirements for battery-powered equipment.
- Sections 309.3.1 through 309.3.3 (restructured refueling provisions) reorganizes the refueling provisions previously in Section 309.6 into three subsections covering fuel-dispensing equipment, fuel-dispensing operations, and indoor refueling fire extinguishers.
- Section 309.4 (Hydrogen-fueled industrial trucks) requires hydrogen fuel-powered industrial trucks to comply with Chapter 23 of the IFC, the International Mechanical Code, and NFPA 2. This is a new provision recognizing the emergence of hydrogen as a fuel for industrial trucks.
- Section 309.5 (Autonomous fuel-powered industrial trucks) requires autonomous fuel-powered industrial trucks to return to a predetermined location upon activation of the manual fire alarm system or automatic fire detection system, and to remain stationary until manually reactivated following the reset of the fire alarm system. This addresses the safety question raised by autonomous operation: if a fire event triggers the alarm, the autonomous truck should not continue its programmed work in the affected area.

New and Revised Section 202 Definitions.

Proposal F42-24 adds a new definition for FUEL-POWERED INDUSTRIAL EQUIPMENT and revises the existing definition of FUEL-POWERED INDUSTRIAL TRUCK. The revisions establish that the terms cover hydrogen fuel cell, flammable or combustible liquid, and flammable gas-powered devices but not electric-motor or battery-powered devices. The clean exclusion of battery-powered equipment from these definitions is the linguistic complement to the structural carve-out from Section 309.

FUEL-POWERED INDUSTRIAL EQUIPMENT (new). A motorized hand truck, floor scrubber or buffer or similar device with an internal combustion engine intended to be personally driven or guided, powered by a hydrogen fuel cell, flammable or combustible liquid or flammable gas.

FUEL-POWERED INDUSTRIAL TRUCK (revised). A forklift, tractor, platform lift truck or similar apparatus powered by an internal combustion engine fueled by a hydrogen fuel cell, flammable or combustible liquid or flammable gas.

4.4.2 Why the Carve-Out Matters for Chapter 43 Adoption

A jurisdiction adopting Chapter 43 without also adopting the Proposal F42-24 carve-out will operate two parallel frameworks for battery charging in industrial environments. The pre-2024 Section 309 framework will continue to require approved battery chargers, ventilation, and a 4-A:20-B:C extinguisher within 20 feet of the charger.

The new Chapter 43 framework requires listed equipment, more comprehensive ventilation calibrated to specific chemistry hazards, and fire safety plan and emergency response provisions which are outlined in Section 4304. If these two frameworks are combined, it will result in conflicting interpretations on routine matters: the distance between batteries during charging, whether a particular charger meets the appropriate approval standard, what constitutes adequate ventilation design, and so on.

The conflicts are resolvable in principle but resolving them on a case-by-case basis is the burden the regulatory framework should not impose onto the fire code official or the regulated community. The Proposal F42-24 carve-out resolves them at the structural level: Section 309 is fuel-powered; Chapter 43 is battery-powered. The determination of which framework applies to a given activity is made by examining the energy source rather than by interpreting two overlapping provisions. Beyond the interpretive cleanup, the Proposal F42-24 changes introduce two substantive provisions that meaningfully advance fuel-powered safety: the new hydrogen industrial truck requirements (Section 309.4) and the autonomous truck fire alarm response requirements (Section 309.5). Both address emerging operational realities that earlier Section 309 versions did not anticipate. A jurisdiction adopting Proposal F42-24 provisions alongside Chapter 43 receives the benefit of these provisions as well as the carve-out.

4.4.3 Portable Power Packs

The proposal F176-24 added needed language in chapter 1209 relative to portable power packs. These battery powered devices are referenced in section 4305 in a new section 1209. The added definition of portable power pack is needed to indicate it's a moveable device that contains an integral or removable battery, or batteries, that when charged are intended to provide temporary power to various outputs of the device. This includes hand portable or wheeled devices. Portable power packs are not intended to include devices regulated as mobile or portable *Energy Storage Systems* (ESS). This distinction is to indicate the difference between a mobile or stationary ESS, yet provided needed guidance.

Mobile devices over 1kwh, and under 20kwh are regulated by the section. These devices shall be *Portable power packs* shall be *listed* and *labeled* in accordance with UL 2743.

Portable power packs shall be used and maintained in accordance with the listing and the manufacturer's instructions. Units marked for "indoor use only" shall not be used outdoors.

4.4.4 Coordination Across IFC Editions

The pre-Proposal F42-24 version of Section 309 has been carried forward through the 2018, 2021, and 2024 editions of the IFC with only minor editorial changes. All three editions therefore present the same overlap problem, and all three benefit from the same Proposal F42-24 companion amendment. The structural carve-out is needed in any of the three pathways.

The sample amendment language for each edition, starting in section 4.5.2, includes a Section addressing the Proposal F42-24 changes. The amendment language is the same in substance across the three editions because Section 309 is the same in substance across the three editions. Jurisdictional adoption of Proposal F42-24 provisions alongside Chapter 43 is recommended regardless of the edition currently adopted.

The next sections turn to the edition-specific IFC amendment language, which now incorporates the Proposal F42-24 carve-out alongside the Chapter 43 adoption, the Section 105.5 permits, the Chapter 80 standards, and the Section 202 definitions discussed in 4.3.

4.5 Pathway for the 2018 IFC

The 2018 IFC addresses energy storage systems at a general level in Section 1206 as it existed in that edition. The lithium-ion or lithium metal-specific provisions that address micromobility charging, high-density lithium-ion and lithium metal storage, and lithium-ion and lithium metal battery research and manufacturing do not exist in the 2018 edition.

The recommended pathway for a jurisdiction that has adopted the 2018 IFC is therefore a direct addition of Chapter 43 to the adopted code. The amendment consists of inserting the Chapter 43 text as a new chapter, together with minor coordinating references discussed below.

4.5.1 Recommended Amendment Structure for the 2018 IFC

It's recommended that a jurisdiction adopting Chapter 43 as an amendment to the 2018 IFC should adopt an amendment containing the following components, subject to your jurisdiction's legal counsel review and recommendation:

1. The addition of a new Chapter 43 to the 2018 IFC, containing the text of Chapter 43 as it appears in Part 2 of this document including section 1209 on portable power packs.
2. The addition of new permit categories in Section 105.5 — specifically Section 105.5.5 (battery exchange operations) and Section 105.5.28 (lithium-ion and lithium-metal battery storage), and Section 105.5.29 (research, testing, manufacturing, or recycling of lithium-ion and lithium-metal batteries) — each cross-referenced from the Chapter 43 provisions.
3. The addition of a new referenced standard in Chapter 80 for each of the UL standards named in Chapter 43 (UL 2272, UL 2743, UL 2849, UL 3100, UL 3300, UL 2595, UL 1487, UL 4900, UL 9540A) and confirmation that NFPA 70, already referenced in the 2018 IFC, continues as the applicable electrical code.
4. A general applicability clause confirming that Chapter 43 applies to the activities it names, notwithstanding any conflict with earlier chapters, and that the provisions of Chapter 43 prevail where they are more stringent than or specifically address matters that earlier chapters address generally.
5. The addition of the Proposal F11-24 battery chemistry definitions and the Proposal F58-24 battery-powered equipment definitions to Section 202, and the definition of Portable Power Pack from Proposal F176-24 as discussed in 4.3 of this document.
6. The adoption of the Proposal F42-24 fuel-powered industrial equipment carve-out, as discussed in 4.4 of this document, including the renaming of Section 309, the deletion of the battery charging provisions from Section 309, and the addition of the new fuel-powered equipment definitions and operational requirements.
7. The adoption of the changes in Proposal F233-24, providing a Chapter 50 carve out for completed batteries.

4.5.2 Sample Amendment Language — 2018 IFC

The following sample amendment text is recommended language for a 2018 IFC amendment. The language uses the placeholder [JURISDICTION] for the adopting body's name; a jurisdiction adapting the text should substitute its own name consistently throughout.

SAMPLE AMENDMENT — 2018 IFC

AN ORDINANCE OF [JURISDICTION] AMENDING THE [JURISDICTION] FIRE CODE, BASED ON THE 2018 EDITION OF THE INTERNATIONAL FIRE CODE, TO ADOPT THE BATTERY PROVISIONS OF THE FORTHCOMING 2027 EDITION OF THE INTERNATIONAL FIRE CODE AS CHAPTER 43; TO ADD

COORDINATING PERMIT AND STANDARD REFERENCES; AND TO PROVIDE FOR AN EFFECTIVE DATE.

WHEREAS, the International Code Council has released, in advance of the publication of the 2027 International Fire Code, the battery provisions that will appear as Chapter 43 of that edition; and

WHEREAS, the safety considerations presented by current and emerging battery technology warrant

action in advance of the full publication of the 2027 International Fire Code; and

WHEREAS, the 2018 International Fire Code, as adopted by this jurisdiction, does not contain lithium-specific storage, charging, or operational provisions addressed by the forthcoming Chapter 43; now therefore,

BE IT ORDAINED BY [JURISDICTION]:

Section 1. The [JURISDICTION] Fire Code is amended by adding a new Chapter 43, entitled "Batteries," to read as set forth in Attachment A to this ordinance. Attachment A reproduces the text of Chapter 43 of the forthcoming 2027 International Fire Code in its entirety.

Section 2. Section 105.5 of the [JURISDICTION] Fire Code is amended by adding the following operational permit categories:

105.5.5 Battery exchange. An operational permit is required for facilities providing battery exchange programs or equipment provided for the exchange of lithium-ion batteries.

105.5.28 Lithium-ion and lithium metal battery storage. An operational permit is required for accumulation of more than 15 cubic feet of lithium-ion or lithium metal batteries, other than batteries listed in the exceptions to Section 4303.1.

105.5.29 Lithium-ion and lithium metal battery research, testing, manufacturing, or recycling. An operational permit is required for occupancies conducting research, testing, manufacturing, or recycling of lithium-ion or lithium metal batteries as regulated by Chapter 43.

Section 3. Chapter 80 of the [JURISDICTION] Fire Code is amended by adding the following referenced standards: UL 1487, UL 2272, UL 2595, UL 2743, UL 2849, UL 3100, UL 3300, UL 4900, and UL 9540A, each in its current edition.

Section 4. Section 202 of the [JURISDICTION] Fire Code is amended as follows:

(a) The following definitions are added under the heading "BATTERY TYPES," and the standalone definitions identified below are added as Section 202 terms:

BATTERY. A class of devices which contain materials that convert chemical energy into electrical energy which then can be used as a power source. There are several technologies that utilize a variety of materials and chemistries for the purpose of storing this electrochemical energy for use when required.

Flow battery. A type of storage battery that includes chemical components dissolved in two different liquids. Ion exchange, which provides the flow of electrical current, occurs through the membrane while both liquids circulate in their respective spaces. (Includes vanadium redox, zinc-bromine, polysulfide-bromide, and other flowing electrolyte-type technologies).

Lead-acid battery. An aqueous storage battery that is comprised of lead electrodes (lead dioxide is the active material for the positive anode and metallic lead is the active material for the negative cathode), immersed in a solution of water and sulfuric acid electrolyte. Common major classification distinctions (i.e., types) include vented lead-acid (VLA) and valve-regulated lead-acid (VRLA). The VRLA is further subdivided into two types representing the method in which the electrolyte is immobilized: either gelled (gel cell) or absorbed in finely-woven porous fiberglass mat (AGM) separators inside the battery between the electrodes.

Lithium-ion battery. A storage battery with lithium ions serving as the charge carriers of the battery. The electrolyte is a polymer mixture of carbonates with an inorganic flammable organic salt and can be in a liquid or a gelled polymer form. Lithiated metal or mixed metal oxides (e.g. cobalt [LCO], manganese [LMO], nickel-manganese-cobalt [NMC or NCM], nickel-cobalt-aluminum [NCA] or iron phosphate [LFP]) typically make up the cathode and forms of carbon or graphite (or lithium titanate oxide [LTO]) typically form the anode.

Lithium-sulfur rechargeable battery. A storage battery that is similar to the lithium-ion battery except that it has a lithium metal anode in the place of the traditional carbon or graphite anode. A lithium-sulfur battery is a secondary (rechargeable) battery that has lithium metal at the anode, sulfur at the cathode, and the electrolyte is nonaqueous.

Nickel-cadmium (Ni-Cd) battery. An alkaline storage battery in which the positive active material is nickel oxide, the negative electrode contains cadmium and the electrolyte is a solution of water and potassium hydroxide.

Nickel-metal hydride (Ni-MH). An alkaline storage battery in which the positive active material is nickel oxide, the negative electrode is an intermetallic compound and the electrolyte is usually potassium hydroxide solution in water.

Electrochemical double layer capacitors (EDLCs). Devices, also referred to as supercapacitors, that store energy using either ion adsorption (electrochemical double layer capacitors) or fast surface redox reactions (pseudo-capacitors).

Hybrid supercapacitor Battery (Lithium-ion capacitor (LIC)). The lithium-ion capacitor (LIC or LiC) is a hybrid type of capacitor classified as a type of supercapacitor. It combines lithium-ion technology and electric double layer capacitor (EDLC) construction.

Iron-air aqueous battery. The battery includes iron and air electrodes. Each of the cells are filled with water-based, non-flammable alkaline electrolyte. The battery does not present the risk of thermal runaway.

Nickel Iron (Ni-Fe). The battery has nickel (III) oxide-hydroxide positive plates and iron negative plates, with an electrolyte of potassium hydroxide.

Nickel-hydrogen (NiH_2). The cells are a hybrid technology, combining elements from both batteries and fuel cells. The battery differs from a nickel-metal hydride (NiMH) battery by the use of hydrogen in gaseous form.

Nickel-Zinc (Ni-Zn). A battery that is chemically similar to the nickel-metal hydride battery. The Ni-Zn battery uses an alkaline electrolyte (potassium hydroxide, KOH) and zinc acts as the negative electrode while nickel hydroxide is the positive electrode.

Sodium nickel chloride (NaNiCl). A battery that is a member of the 'high temperature' family. Its cell contains sodium and nickel chloride electrodes, isolated by a beta-alumina electrolyte.

Zinc-air aqueous battery. A battery that contains a zinc electrode and porous air electrode separated by a membrane and an aqueous alkaline electrolyte.

Zinc bromide. A battery in which the cathode is made using zinc instead of lithium. The electrolyte is water-based and does not pose a fire risk.

Zinc manganese dioxide (Zn-MnO_2). A battery that features a Zinc (Zn) anode and a dioxide (MnO_2) cathode with a strongly basic electrolyte.

BATTERY-POWERED MICROMOBILITY DEVICES. Products or equipment that include motorized bicycles, motorized scooters and other personal mobility devices intended for one or more riders powered by a lithium-ion or lithium metal battery. The term does not include automobiles and trucks built to DOT requirements.

BATTERY-POWERED APPLIANCE. A device or apparatus with an electric motor powered by a battery.

BATTERY-POWERED INDUSTRIAL EQUIPMENT. A motorized hand truck, floor scrubber or buffer or similar device with an electric motor intended to be personally driven or guided, powered by a battery.

BATTERY-POWERED INDUSTRIAL TRUCK. A forklift, tractor, platform lift truck or similar apparatus with an electric motor powered by a battery.

BATTERY-POWERED AUTOMATED MOBILE PLATFORMS (AMPs). A device with an electric motor powered by a battery that provides an automated function involving lifting, carrying, product picking, towing, and similar operations.

BATTERY-POWERED ROBOTIC EQUIPMENT. A machine or device with an electric motor powered by a battery capable of automatically carrying out a complex series of actions using computer programming.

PORTABLE POWER PACK. A moveable device that contains an integral or removable battery, or batteries,

that when charged are intended to provide temporary power to various outputs of the device. This includes hand portable or wheeled devices. Portable power packs are not intended to include devices regulated as mobile or portable Energy Storage Systems (ESS).

Section 5. Section 309 of the [JURISDICTION] Fire Code is amended as follows:

(a) The title of Section 309 is amended to read "Fuel-Powered Industrial Trucks and Equipment."

(b) Section 309.1 is amended to read: "Fuel-powered industrial trucks and fuel-powered industrial equipment, including but not limited to floor scrubbers and floor buffers, shall be operated and maintained in accordance with Sections 309.2 through 309.7."

(c) Sections 309.3 (Battery chargers), 309.4 (Ventilation), and 309.5 (Fire extinguishers) are deleted in their entirety. The deleted text reads:

~~**309.3 Battery chargers.** Battery chargers shall be of an approved type. Combustible storage shall be kept not less than 3 feet (915 mm) from battery chargers. Battery charging shall not be conducted in areas open to the public.~~

~~**309.4 Ventilation.** Ventilation shall be provided in an approved manner in battery-charging areas to prevent a dangerous accumulation of flammable gases.~~

~~**309.5 Fire extinguishers.** Battery-charging areas shall be provided with a fire extinguisher complying with Section 906 having a minimum 4-A:20-B:C rating within 20 feet (6096 mm) of the battery charger.~~

(d) Section 309 is amended by adding the following new subsections:

309.2.1 Fuel-powered industrial equipment. Fuel-powered industrial equipment shall be listed for their intended use and shall be operated in accordance with their listing and the manufacturer's instructions.

309.4 Hydrogen-fueled industrial trucks. Fuel-powered industrial trucks utilizing hydrogen as a fuel shall be operated and maintained in accordance with applicable requirements in Chapter 23 of this code, the International Mechanical Code, and NFPA 2.

309.5 Autonomous fuel-powered industrial trucks. Autonomous fuel-powered industrial trucks shall immediately return to an approved predetermined location upon activation of the manual fire alarm system or automatic fire detection system and shall remain stationary until manually reactivated following the reset of the fire alarm system.

(e) Section 202 of the [JURISDICTION] Fire Code is amended by adding the following definition and revising the definition of FUEL-POWERED INDUSTRIAL TRUCK:

FUEL-POWERED INDUSTRIAL EQUIPMENT. A motorized hand truck, floor scrubber or buffer or similar device with an internal combustion engine intended to be personally driven or guided, powered by a hydrogen fuel cell, flammable or combustible liquid or flammable gas.

FUEL-POWERED INDUSTRIAL TRUCK (revised). A forklift, tractor, platform lift truck or similar apparatus powered by a hydrogen fuel cell, flammable or combustible liquid or flammable gas. Powered industrial trucks do not include farm vehicles or automotive vehicles for highway use.

Section 6. Where the provisions of Chapter 43 address specific activities, materials, or equipment that are also addressed in general terms by other chapters of this Code, Chapter 43 shall prevail as to the specific activities, materials, and equipment named. This ordinance shall not be construed to modify or limit the provisions of Section 1206 as it applies to installed energy storage systems.

Section 5. This ordinance shall take effect [EFFECTIVE DATE].

The sample language above is intended for use by a jurisdiction with the authority to adopt a code amendment by ordinance. Jurisdictions with different legislative formats such as state building code council resolutions, state fire marshal regulations, or other formal actions may adapt the language to their required format while preserving the substantive content of each section.

4.6 Pathway for the 2021 IFC

The 2021 IFC presents a profile substantially similar to the 2018 edition for purposes of this adoption. The 2021 IFC does not contain a Section 320 or a Section 322; the lithium-specific provisions that became Sections 320 and 322 in the 2024 edition were not yet in the code in the 2021 cycle. The 2021 IFC does contain Chapter 12 (Energy Systems) addressing energy storage systems in Section 1207.

The recommended pathway for a jurisdiction enforcing the 2021 IFC is identical in structure to the 2018 pathway: addition of Chapter 43 as a new chapter, with coordinating permit and referenced standard additions. The amendment is a pure addition; no existing text is deleted or substituted.

4.6.1 Recommended Amendment Structure for the 2021 IFC

The recommended amendment structure for the 2021 IFC is the same four-component structure recommended for the 2018 IFC:

1. Addition of a new Chapter 43 containing the text of Chapter 43 as it appears in Part 2 of this document including section 1209.
2. Addition of new permit categories in Section 105.5 (Sections 105.5.5, 105.5.28, and 105.5.29) cross-referenced from Chapter 43.
3. Addition of new referenced standards in Chapter 80 (UL 1487, UL 2272, UL 2595, UL 2743, UL 2849, UL 3100, UL 3300, UL 4900, and UL 9540A).
4. A general applicability clause confirming Chapter 43's scope relative to the existing 2021 IFC provisions.
5. The addition of proposal F11-24 battery chemistry definitions and proposal F58-24 battery-powered equipment definitions and F176-24 Definition to Section 202, as discussed in 4.3 of this document.
6. Adoption of the F42-24 fuel-powered industrial equipment carve-out, as discussed in 4.4 of this document.
7. The adoption of the changes in proposal F233-24 providing a Chapter 50 carve out for completed batteries.

4.6.2 Sample Amendment Language 2021 IFC

The sample amendment language for the 2021 IFC follows the same structure as the 2018 sample. A jurisdiction enforcing the 2021 IFC can use the 2018 sample language above with the single substitution of "2021" for "2018" in the enacting recitals and the relevant operative clauses. No substantive changes to the sample language are required for a 2021-jurisdiction adoption, because the absence of Sections 320 and 322 in the 2021 edition as in the 2018 edition means the amendment is a pure addition.

SAMPLE AMENDMENT — 2021 IFC

AN ORDINANCE OF [JURISDICTION] AMENDING THE [JURISDICTION] FIRE CODE, BASED ON THE 2021 EDITION OF THE INTERNATIONAL FIRE CODE, TO ADOPT THE BATTERY PROVISIONS OF THE FORTHCOMING 2027 EDITION OF THE INTERNATIONAL FIRE CODE AS CHAPTER 43; TO ADD COORDINATING PERMIT AND STANDARD REFERENCES; AND TO PROVIDE FOR AN EFFECTIVE DATE.

WHEREAS, the 2021 International Fire Code, as adopted by this jurisdiction, does not contain lithium-specific storage, charging, or operational provisions addressed by the forthcoming Chapter 43; now therefore,

BE IT ORDAINED BY [JURISDICTION]:

Section 1. The [JURISDICTION] Fire Code is amended by adding a new Chapter 43, entitled "Batteries," to read as set forth in Attachment A to this ordinance. Attachment A reproduces the text of Chapter 43 of the forthcoming 2027 International Fire Code in its entirety.

Section 2. Section 105.5 of the [JURISDICTION] Fire Code is amended by adding the following operational

permit categories:

105.5.5 Battery exchange. An operational permit is required for facilities providing battery exchange programs or equipment provided for the exchange of lithium-ion batteries.

105.5.28 Lithium-ion and lithium metal battery storage. An operational permit is required for accumulation of more than 15 cubic feet of lithium-ion or lithium metal batteries, other than batteries listed in the exceptions to Section 4303.1.

105.5.29 Lithium-ion and lithium metal battery research, testing, manufacturing, or recycling. An operational permit is required for occupancies conducting research, testing, manufacturing, or recycling of lithium-ion or lithium metal batteries as regulated by Chapter 43.

Section 3. Chapter 80 of the [JURISDICTION] Fire Code is amended by adding the following referenced standards: UL 1487, UL 2272, UL 2595, UL 2743, UL 2849, UL 3100, UL 3300, and UL 4900, each in its current edition.

Section 4. Section 202 of the [JURISDICTION] Fire Code is amended as follows:

(a) The following definitions are added under the heading "BATTERY TYPES," and the standalone definitions identified below are added as Section 202 terms:

BATTERY. A class of devices which contain materials that convert chemical energy into electrical energy which then can be used as a power source. There are several technologies that utilize a variety of materials and chemistries for the purpose of storing this electrochemical energy for use when required.

Flow battery. A type of storage battery that includes chemical components dissolved in two different liquids. Ion exchange, which provides the flow of electrical current, occurs through the membrane while both liquids circulate in their respective spaces. (Includes vanadium redox, zinc-bromine, polysulfide-bromide, and other flowing electrolyte-type technologies).

Lead-acid battery. An aqueous storage battery that is comprised of lead electrodes (lead dioxide is the active material for the positive anode and metallic lead is the active material for the negative cathode), immersed in a solution of water and sulfuric acid electrolyte. Common major classification distinctions (i.e., types) include vented lead-acid (VLA) and valve-regulated lead-acid (VRLA). The VRLA is further subdivided into two types representing the method in which the electrolyte is immobilized: either gelled (gel cell) or absorbed in finely-woven porous fiberglass mat (AGM) separators inside the battery between the electrodes.

Lithium-ion battery. A storage battery with no deletions or substitutions lithium ions serving as the charge carriers of the battery. The electrolyte is a polymer mixture of carbonates with an inorganic flammable organic salt and can be in a liquid or a gelled polymer form. Lithiated metal or mixed metal oxides (e.g. cobalt [LCO], manganese [LMO], nickel-manganese-cobalt [NMC or NCM], nickel-cobalt-aluminum [NCA] or iron phosphate [LFP]) typically make up the cathode and forms of carbon or graphite (or lithium titanate oxide [LTO]) typically form the anode.

Lithium-sulfur rechargeable battery. A storage battery that is similar to the lithium-ion battery except that it has a lithium metal anode in the place of the traditional carbon or graphite anode. A lithium-sulfur battery is a secondary (rechargeable) battery that has lithium metal at the anode, sulfur at the cathode, and the electrolyte is nonaqueous.

Nickel-cadmium (Ni-Cd) battery. An alkaline storage battery in which the positive active material is nickel oxide, the negative electrode contains cadmium and the electrolyte is a solution of water and potassium hydroxide.

Nickel-metal hydride (Ni-MH). An alkaline storage battery in which the positive active material is nickel oxide, the negative electrode is an intermetallic compound and the electrolyte is usually potassium hydroxide solution in water.

Electrochemical double layer capacitors (EDLCs). Devices, also referred to as supercapacitors, that store energy using either ion adsorption (electrochemical double layer capacitors) or fast surface redox reactions (pseudo-capacitors).

Hybrid supercapacitor Battery (Lithium-ion capacitor (LIC)). The lithium-ion capacitor (LIC or LiC) is a hybrid type of capacitor classified as a type of supercapacitor. It combines lithium-ion technology and electric double layer capacitor (EDLC) construction.

Iron-air aqueous battery. The battery includes iron and air electrodes. Each of the cells are filled with water-based, non-flammable alkaline electrolyte. The battery does not present the risk of thermal runaway.

Nickel Iron (Ni-Fe). The battery has nickel (III) oxide-hydroxide positive plates and iron negative plates, with an electrolyte of potassium hydroxide.

Nickel-hydrogen (NiH_2). The cells are a hybrid technology, combining elements from both batteries and fuel cells. The battery differs from a nickel-metal hydride (NiMH) battery by the use of hydrogen in and fuel cells. The battery differs from a nickel-metal hydride (NiMH) battery by the use of hydrogen in gaseous form.

Nickel-Zinc (Ni-Zn). A battery that is chemically similar to the nickel-metal hydride battery. The Ni-Zn battery uses an alkaline electrolyte (potassium hydroxide, KOH) and zinc acts as the negative electrode while nickel hydroxide is the positive electrode.

Sodium nickel chloride (NaNiCl). A battery that is a member of the 'high temperature' family. Its cell contains sodium and nickel chloride electrodes, isolated by a beta-alumina electrolyte.

Zinc-air aqueous battery. A battery that contains a zinc electrode and porous air electrode separated by a membrane and an aqueous alkaline electrolyte.

Zinc bromide. A battery in which the cathode is made using zinc instead of lithium. The electrolyte is water-based and does not pose a fire risk.

Zinc manganese dioxide (Zn-MnO_2). A battery that features a Zinc (Zn) anode and a dioxide (MnO_2) cathode with a strongly basic electrolyte.

BATTERY-POWERED MICROMOBILITY DEVICES. Products or equipment that include motorized bicycles, motorized scooters and other personal mobility devices intended for one or more riders powered by a lithium-ion or lithium metal battery. The term does not include automobiles and trucks built to DOT requirements.

BATTERY-POWERED APPLIANCE. A device or apparatus with an electric motor powered by a battery.

BATTERY-POWERED INDUSTRIAL EQUIPMENT. A motorized hand truck, floor scrubber or buffer or similar device with an electric motor intended to be personally driven or guided, powered by a battery.

BATTERY-POWERED INDUSTRIAL TRUCK. A forklift, tractor, platform lift truck or similar apparatus with an electric motor powered by a battery.

BATTERY-POWERED AUTOMATED MOBILE PLATFORMS (AMPs). A device with an electric motor powered by a battery that provides an automated function involving lifting, carrying, product picking, towing, and similar operations.

BATTERY-POWERED ROBOTIC EQUIPMENT. A machine or device with an electric motor powered by a battery capable of automatically carrying out a complex series of actions using computer programming.

PORTABLE POWER PACK. A moveable device that contains an integral or removable battery, or batteries, that when charged are intended to provide temporary power to various outputs of the device. This includes hand portable or wheeled devices. Portable power packs are not intended to include devices regulated as mobile or portable Energy Storage Systems (ESS).

(b) The existing definition of "Stationary storage battery" is deleted without substitution. The deleted text reads:

~~**Stationary storage battery.** A group of electrochemical cells interconnected to supply a nominal voltage of DC power to a suitably connected electrical load, designed for service in a permanent location.~~

~~Section 5. Section 309 of the [JURISDICTION] Fire Code is amended as follows:~~

(a) The title of Section 309 is amended to read "Fuel-Powered Industrial Trucks and Equipment."

(b) Section 309.1 is amended to read: "Fuel-powered industrial trucks and fuel-powered industrial equipment, including but not limited to floor scrubbers and floor buffers, shall be operated and maintained in accordance with Sections 309.2 through 309.7."

(c) Sections 309.3 (Battery chargers), 309.4 (Ventilation), and 309.5 (Fire extinguishers) are deleted in their entirety. The deleted text reads:

~~**309.3 Battery chargers.** Battery chargers shall be of an approved type. Combustible storage shall be kept not less than 3 feet (915 mm) from battery chargers. Battery charging shall not be conducted in areas open to the public.~~

~~**309.4 Ventilation.** Ventilation shall be provided in an approved manner in battery-charging areas to prevent a dangerous accumulation of flammable gases.~~

~~**309.5 Fire extinguishers.** Battery-charging areas shall be provided with a fire extinguisher complying with Section 906 having a minimum 4-A:20-B:C rating within 20 feet (6096 mm) of the battery charger.~~

(d) Section 309 is amended by adding the following new subsections:

309.2.1 Fuel-powered industrial equipment. Fuel-powered industrial equipment shall be listed for their intended use and shall be operated in accordance with their listing and the manufacturer's instructions.

309.4 Hydrogen-fueled industrial trucks. Fuel-powered industrial trucks utilizing hydrogen as a fuel shall be operated and maintained in accordance with applicable requirements in Chapter 23 of this code, the International Mechanical Code, and NFPA 2.

309.5 Autonomous fuel-powered industrial trucks. Autonomous fuel-powered industrial trucks shall immediately return to an approved predetermined location upon activation of the manual fire alarm system or automatic fire detection system and shall remain stationary until manually reactivated following the reset of the fire alarm system.

(e) Section 202 of the [JURISDICTION] Fire Code is amended by adding the following definition and revising the definition of FUEL-POWERED INDUSTRIAL TRUCK:

FUEL-POWERED INDUSTRIAL EQUIPMENT. A motorized hand truck, floor scrubber or buffer or similar device with an internal combustion engine intended to be personally driven or guided, powered by a hydrogen fuel cell, flammable or combustible liquid or flammable gas.

FUEL-POWERED INDUSTRIAL TRUCK (revised). A forklift, tractor, platform lift truck or similar apparatus powered by a hydrogen fuel cell, flammable or combustible liquid or flammable gas. Powered industrial trucks do not include farm vehicles or automotive vehicles for highway use.

Section 6. Where the provisions of Chapter 43 address specific activities, materials, or equipment that are also addressed in general terms by other chapters of this Code, Chapter 43 shall prevail as to the specific activities, materials, and equipment named. This ordinance shall not be construed to modify or limit the provisions of Section 1207 as it applies to installed energy storage systems.

Section 7. This ordinance shall take effect [EFFECTIVE DATE].

Jurisdictions that have adopted the 2021 IFC should verify, as part of their adoption process, that their existing Section 1207 energy storage system provisions remain consistent with the Chapter 43 scope boundary. Chapter 43 does not modify the Section 1207 ESS framework, and the Section 4301.1 exception for installed energy storage systems regulated by Section 1207 preserves the existing 2021 ESS framework unchanged.

4.7 Pathway for the 2024 IFC

The 2024 IFC presents a more complex adoption picture than the 2018 and 2021 editions. The 2024 IFC contains Section 320 (Storage of Lithium-Ion and Lithium Metal Batteries) and Section 322 (Powered Micromobility Devices), both of which were added in the 2024 cycle and both of which are the direct predecessors of Chapter 43. The 2024 IFC also contains companion provisions in Sections 903 and 907 that add sprinkler and detection requirements keyed to Group F-1 battery manufacturing, Group B battery research and testing, Group M battery retail storage, and Group S-1 battery warehouse storage.

A jurisdiction enforcing the 2024 IFC that adopts Chapter 43 must therefore address the overlap between Sections 320 and 322 and the forthcoming Chapter 43. The recommended approach is to delete Sections 320 and 322 in full and to replace them with Chapter 43, rather than to retain the 2024 sections and add Chapter 43 as an additional chapter. Retention of the 2024 sections alongside Chapter 43 would produce two parallel regula-tory frameworks addressing the same activities and would generate interpretive conflicts that the jurisdiction would then have to resolve case by case. Deletion and replacement produce a single, coherent regulatory framework.

4.7.1 What Is Retained From the 2024 IFC

Not all of the 2024 IFC's battery-related provisions are subsumed by Chapter 43, and the amendment should be careful to retain the 2024 provisions that Chapter 43 does not replicate. In particular:

- Sections 903 and 907 companion provisions. The 2024 IFC added sprinkler and detection requirements in Sections 903.2.4 (Group F-1 battery manufacturing), 903.2.7 (Group M battery storage), 903.2.9 (Group S-1 battery storage and repair garages servicing battery-powered vehicles), 907.2.2 (Group B battery laboratories), 907.2.4 (Group F-1 battery manufacturing), 907.2.7 (Group M battery storage), and 907.2.10 (Group S-1 battery storage). These provisions are the IFC-side companions to the IBC Chapter 9 additions and provide the sprinkler and detection thresholds that Chapter 43 relies on through its references to Sections 903 and 907. They should be retained in the adopted 2024 IFC without modification.
- Section 105.5 permit categories. Section 105.5.28 (lithium-ion and lithium-metal battery storage) was added to the 2024 IFC and is cross-referenced from Chapter 43 Section 4303.2. Section 105.5.5 (battery exchange) existed in earlier editions and is cross-referenced from Chapter 43 Section 4304.8.1. Section 105.5.29 (lithium-ion and lithium-metal battery research, testing, manufacturing, or recycling) is added by the forthcoming 2027 edition and must be added through the amendment; the 2024 IFC does not contain this permit category.
- Section 608. Section 608 addresses stationary storage battery systems — primarily lead-acid, nickel-cadmium, and VRLA batteries in facility emergency power and uninterrupted power supply applications. Section 608 is not replaced by Chapter 43 and should be retained. Section 4305 of Chapter 43 coordinates with Section 608 but does not duplicate it.
- Section 1207. Section 1207 addresses installed energy storage systems. Chapter 43 expressly excepts installed ESS from its scope (Section 4301.1 exception), and Section 1207 should be retained in its current 2024 form.
- Chapter 80 standards additions. The 2024 IFC added several of the UL standards that Chapter 43 references (UL 2272, UL 2849, UL 9540A). These should be retained. The remaining UL standards named in Chapter 43 (UL 3100, UL 3300, UL 2595, UL 1487, UL 4900) should be added as part of the amendment if they are not already referenced.

4.7.2 Recommended Amendment Structure for the 2024 IFC

The recommended amendment structure for the 2024 IFC has five components:

1. Deletion of Section 320 in full. The 2024 IFC Section 320, including all subsections (320.1 through 320.4.3.3), is deleted and has no further effect in the adopted code.
2. Deletion of Section 322 in full. The 2024 IFC Section 322, including all subsections (322.1 through 322.11), is deleted and has no further effect in the adopted code.
3. Addition of a new Chapter 43 containing the text of Chapter 43 as it appears in Part 2 of this document including section 1209 on portable power packs. The new Chapter 43 is inserted into the code in the position the chapter numbering indicates.

4. Addition of Section 105.5.29 (lithium-ion and lithium-metal battery research, testing, manufacturing, or recycling) to Section 105.5. Sections 105.5.5 and 105.5.28 already exist in the 2024 IFC and do not require amendment.
5. Addition of any UL standards not already referenced in Chapter 80 (UL 2743, UL 3100, UL 3300, UL 2595, UL 1487, UL 4900).
6. Adoption of the F11-24 battery chemistry definitions (with revisions to existing terms and additions of new terms) and the F58-24 battery-powered equipment definitions (with revision to BATTERY-POWERED MICROMOBILITY DEVICES and addition of five new equipment terms) to Section 202, as discussed in 4.3 of this document. The deletion of the existing "Stationary storage battery" definition should also be affected through this amendment.
7. Adoption of the F42-24 fuel-powered industrial equipment carve-out, as discussed in 4.4 of this document. This requires the renaming of Section 309, the deletion of the existing Sections 309.3 (Battery chargers), 309.4 (Ventilation), and 309.5 (Fire extinguishers), the addition of the new Sections 309.2.1 (Fuel-powered industrial equipment), 309.3.1 through 309.3.3 (refueling provisions), 309.4 (Hydrogen-fueled industrial trucks), and 309.5 (Autonomous fuel-powered industrial trucks), and the addition of the new FUEL-POWERED INDUSTRIAL EQUIPMENT and revised FUEL-POWERED INDUSTRIAL TRUCK definitions to Section 202.
8. The adoption of the changes in proposal F233-24 providing a Chapter 50 carve out for completed batteries

The amendment should not modify Sections 903, 907, 608, or 1207. These sections continue in their 2024 form and provide the IFC-side framework that Chapter 43 coordinates with.

4.7.3 Sample Amendment Language — 2024 IFC

The following sample amendment text is recommended language for a 2024 IFC amendment, subject to your jurisdiction's legal counsel review. It includes the deletions of Sections 320 and 322 that distinguish the 2024 amendment from the 2018 and 2021 amendments

SAMPLE AMENDMENT — 2024 IFC

AN ORDINANCE OF [JURISDICTION] AMENDING THE [JURISDICTION] FIRE CODE, BASED ON THE 2024 EDITION OF THE INTERNATIONAL FIRE CODE, TO DELETE SECTIONS 320 AND 322 OF THE 2024 INTERNATIONAL FIRE CODE; TO ADOPT THE BATTERY PROVISIONS OF THE FORTHCOMING 2027 EDITION OF THE INTERNATIONAL FIRE CODE AS CHAPTER 43; TO ADD COORDINATING PERMIT AND STANDARD REFERENCES; AND TO PROVIDE FOR AN EFFECTIVE DATE..

WHEREAS, the International Code Council has released, in advance of the publication of the 2027 International Fire Code, the battery provisions that will appear as Chapter 43 of that edition; and

WHEREAS, the forthcoming Chapter 43 consolidates, refines, and extends the provisions that currently appear as Sections 320 and 322 of the 2024 International Fire Code; and

WHEREAS, the safety considerations presented by current and emerging battery technology warrant action in advance of the full publication of the 2027 International Fire Code; and

WHEREAS, simultaneous operation of Sections 320 and 322 of the 2024 International Fire Code and the forthcoming Chapter 43 would produce parallel regulatory frameworks and create interpretive conflicts; now therefore,

BE IT ORDAINED BY [JURISDICTION]:

Section 1. Section 320 of the [JURISDICTION] Fire Code, titled "Storage of Lithium-Ion and Lithium Metal Batteries," and all subsections thereof, are hereby deleted in their entirety and shall have no further force or effect in this jurisdiction.

Section 3. The [JURISDICTION] Fire Code is amended by adding a new Chapter 43, entitled "Batteries,"

to read as set forth in Attachment A to this ordinance. Attachment A reproduces the text of Chapter 43 of the forthcoming 2027 International Fire Code in its entirety including section 1209 on portable power packs.

Section 4. Cross-references in other sections of the [JURISDICTION] Fire Code to Section 320 or Section 322 shall be deemed to refer to the corresponding provisions of Chapter 43. Specifically, references to Section 320 shall refer to Section 4303 of Chapter 43, and references to Section 322 shall refer to Section 4304 of Chapter 43.

Section 5. Section 105.5 of the [JURISDICTION] Fire Code is amended by adding the following operational permit category:

105.5.31 Lithium-ion and lithium metal battery research, testing, manufacturing, or recycling. An operational permit is required for occupancies conducting research, testing, manufacturing, or recycling of lithium-ion or lithium metal batteries as regulated by Chapter 43.

Sections 105.5.5 and 105.5.28, as they exist in the 2024 International Fire Code, are retained without modification.

Section 6. Chapter 80 of the [JURISDICTION] Fire Code is amended by adding the following referenced standards: UL 1487, UL 2595, UL 2743, UL 3100, UL 3300, and UL 4900, each in its current edition. UL 2272, UL 2849, and UL 9540A, as already referenced in Chapter 80 of the 2024 International Fire Code, are retained.

Section 7. Section 202 of the [JURISDICTION] Fire Code is amended as follows:

(a) The existing definitions of "Lead-acid battery," "Lithium-ion battery," "Nickel-cadmium (Ni-Cd) battery," "Nickel-metal hydride (Ni-MH)," and "BATTERY-POWERED MICROMOBILITY DEVICES" are deleted in their existing form and replaced with the revised text set forth in subsection (c).

(b) The existing definition of "Stationary storage battery" is deleted without substitution. The deleted text reads:

~~**Stationary storage battery.** A group of electrochemical cells interconnected to supply a nominal voltage of DC power to a suitably connected electrical load, designed for service in a permanent location.~~

(c) he following definitions are added under the heading "BATTERY TYPES," and the standalone definitions identified below are added as Section 202 terms:

BATTERY. A class of devices which contain materials that convert chemical energy into electrical energy which then can be used as a power source.

Flow battery. A type of storage battery that includes chemical components dissolved in two different liquids. Ion exchange, which provides the flow of electrical current, occurs through the membrane while both liquids circulate in their respective spaces.

Lead-acid battery. An aqueous storage battery that is comprised of lead electrodes immersed in a solution of water and sulfuric acid electrolyte. Common major classification distinctions include vented lead-acid (VLA) and valve-regulated lead-acid (VRLA), with VRLA further subdivided into gelled (gel cell) or absorbed glass mat (AGM).

Lithium-ion battery. A storage battery with lithium ions serving as the charge carriers of the battery. The electrolyte is a polymer mixture of carbonates with an inorganic flammable organic salt and can be in a liquid or a gelled polymer form.

Lithium-sulfur rechargeable battery. A storage battery that is similar to the lithium-ion battery except that it has a lithium metal anode in the place of the traditional carbon or graphite anode. A lithium-sulfur battery is a secondary (rechargeable) battery that has lithium metal at the anode, sulfur at the cathode, and the electrolyte is nonaqueous.

Nickel-cadmium (Ni-Cd) battery. An alkaline storage battery in which the positive active material is nickel oxide, the negative electrode contains cadmium and the electrolyte is a solution of water and potassium hydroxide.

Nickel-metal hydride (Ni-MH). An alkaline storage battery in which the positive active material is nickel oxide, the negative electrode is an intermetallic compound and the electrolyte is usually potassium hydroxide solution in water.

Electrochemical double layer capacitors (EDLCs). Devices, also referred to as supercapacitors, that store energy using either ion adsorption or fast surface redox reactions.

Hybrid supercapacitor Battery (Lithium-ion capacitor (LIC)). A hybrid type of capacitor classified as a type of supercapacitor that combines lithium-ion technology and electric double layer capacitor construction.

Iron-air aqueous battery. A battery that includes iron and air electrodes, with cells filled with water-based, non-flammable alkaline electrolyte. The battery does not present the risk of thermal runaway.

Nickel Iron (Ni-Fe). A battery with nickel (III) oxide-hydroxide positive plates and iron negative plates, with an electrolyte of potassium hydroxide.

Nickel-hydrogen (NiH_2). Cells that are a hybrid technology, combining elements from both batteries and fuel cells, using hydrogen in gaseous form.

Nickel-Zinc (Ni-Zn). A battery using an alkaline electrolyte (potassium hydroxide, KOH) with zinc as the negative electrode and nickel hydroxide as the positive electrode.

Sodium nickel chloride (NaNiCl). A high-temperature battery whose cell contains sodium and nickel chloride electrodes, isolated by a beta-alumina electrolyte.

Zinc-air aqueous battery. A battery containing a zinc electrode and porous air electrode separated by a membrane and an aqueous alkaline electrolyte.

Zinc bromide. A battery in which the cathode is made using zinc instead of lithium, with a water-based electrolyte that does not pose a fire risk.

Zinc manganese dioxide (Zn-MnO_2). A battery featuring a zinc anode and a manganese dioxide cathode with a strongly basic electrolyte.

BATTERY-POWERED MICROMOBILITY DEVICES. Products or equipment that include motorized bicycles, motorized scooters and other personal mobility devices intended for one or more riders powered by a lithium-ion or lithium metal battery. The term does not include automobiles and trucks built to DOT requirements.

BATTERY-POWERED APPLIANCE. A device or apparatus with an electric motor powered by a battery.

BATTERY-POWERED INDUSTRIAL EQUIPMENT. A motorized hand truck, floor scrubber or buffer or similar device with an electric motor intended to be personally driven or guided, powered by a battery.

BATTERY-POWERED INDUSTRIAL TRUCK. A forklift, tractor, platform lift truck or similar apparatus with an electric motor powered by a battery.

BATTERY-POWERED AUTOMATED MOBILE PLATFORMS (AMPs). A device with an electric motor powered by a battery that provides an automated function involving lifting, carrying, product picking, towing, and similar operations.

BATTERY-POWERED ROBOTIC EQUIPMENT. A machine or device with an electric motor powered by a battery capable of automatically carrying out a complex series of actions using computer programming.

PORTABLE POWER PACK. A moveable device that contains an integral or removable battery, or batteries, that when charged are intended to provide temporary power to various outputs of the device. This includes hand portable or wheeled devices. Portable power packs are not intended to include devices regulated as mobile or portable *Energy Storage Systems (ESS)*.

Section 8. Section 309 of the [JURISDICTION] Fire Code is amended as follows:

(a) The title of Section 309 is amended to read "Fuel-Powered Industrial Trucks and Equipment."

(b) Section 309.1 is amended to read: "Fuel-powered industrial trucks and fuel-powered industrial

equipment, including but not limited to floor scrubbers and floor buffers, shall be operated and maintained in accordance with Sections 309.2 through 309.7."

(c) Sections 309.3 (Battery chargers), 309.4 (Ventilation), and 309.5 (Fire extinguishers) are deleted in their entirety. The deleted text reads:

~~**309.3 Battery chargers.** Battery chargers shall be of an approved type. Combustible storage shall be kept not less than 3 feet (915 mm) from battery chargers. Battery charging shall not be conducted in areas open to the public.~~

~~**309.4 Ventilation.** Ventilation shall be provided in an approved manner in battery-charging areas to prevent a dangerous accumulation of flammable gases.~~

~~**309.5 Fire extinguishers.** Battery-charging areas shall be provided with a fire extinguisher complying with Section 906 having a minimum 4-A:20-B:C rating within 20 feet (6096 mm) of the battery charger.~~

(d) Section 309 is amended by adding the following new subsections:

309.2.1 Fuel-powered industrial equipment. Fuel-powered industrial equipment shall be listed for their intended use and shall be operated in accordance with their listing and the manufacturer's instructions

The 2024 sample language is more complex than the 2018 and 2021 samples because of the deletions required. A jurisdiction adapting this language should confirm that its existing 2024 IFC adoption matches the standard 2024 IFC structure — that is, that the jurisdiction has not already adopted local amendments to Sections 320, 322, or the permit categories in Section 105.5. Where local amendments to those sections exist, the repeal language may need additional specificity to address the local amendments as well as the model-code text.

4.8 Cross-Edition Comparison

The following table summarizes the differences among the three edition-specific pathways.

Amendment Action	2018 IFC	2021 IFC	2024 IFC
Delete existing sections	No deletions required	No deletions required	Delete Sections 320 and 322 in full
Add new chapter	Add Chapter 43 including section 1209	Add Chapter 43 including section 1209	Add Chapter 43 including section 1209
New permit categories	Add 105.5.5, 105.5.28, 105.5.29	Add 105.5.5, 105.5.28, 105.5.29	Add 105.5.29 only (others already exist)
UL standards to add	All nine UL standards (UL 2272, 2743, 2849, 3100, 3300, 2595, 1487, 4900, 9540A)	All nine UL standards (UL 2272, 2743, 2849, 3100, 3300, 2595, 1487, 4900, 9540A)	Five UL standards UL 3100, 3300, 2595, 1487, 4900 (UL 2272, 2743, 2849, 9540 already referenced)
Sections 903/907 companion provisions	Not present in 2018; Chapter 43 cross-references rely on general 903/907	Not present in 2021; Chapter 43 cross-references rely on general 903/907	Present and retained without modification
F42-24 Section 309 carve-out	Adopt — rename Section 309, delete battery charger provisions (309.3, 309.4, 309.5), add hydrogen and autonomous truck requirements	Adopt — rename Section 309, delete battery charger provisions (309.3, 309.4, 309.5), add hydrogen and autonomous truck requirements	Adopt — rename Section 309, delete battery charger provisions (309.3, 309.4, 309.5), add hydrogen and autonomous truck requirements
F233-24 Chapter 50 carve out	Add battery exception to Section 5001.1.	Add battery exception to Section 5001.1.	Add battery exception to Table 5003.1.1(5)
Complexity of amendment	Low — pure addition	Low — pure addition	Moderate — deletions and additions

4.9 Coordination with the Adopted Building Code

Chapter 43 references several provisions of the International Building Code, including Section 707 (fire barriers), Section 711 (horizontal assemblies), Section 903 (automatic sprinkler systems), and Section 907 (fire alarm and detection systems). These references are in the IBC as the jurisdiction has adopted it, not to any particular edition. A jurisdiction's Chapter 43 adoption will therefore work with whatever IBC edition the jurisdiction enforces.

However, the 2024 IBC added companion provisions that parallel the 2024 IFC Sections 903 and 907 additions specifically, the Group B laboratory, Group F-1 manufacturing, Group M storage, and Group S-1 storage sprinkler and detection provisions. A jurisdiction that has adopted a pre-2024 edition of the IBC will find that the companion IBC provisions are not present and that the Chapter 43 sprinkler and detection requirements operate under the jurisdiction's general IBC framework. The 2024 edition of the IBC also included critical clarification of use group classifications related to battery based occupancies. This is functional Chapter 43's cross-references to Sections 903 and 907 invoke whichever framework the jurisdiction has adopted but produces a less complete framework than the coordinated 2024 IFC / 2024 IBC combination.

Jurisdictions that wish to achieve the coordinated framework may consider parallel adoption of the 2024 IBC Chapter 3 Use Group Classifications and Chapter 9 additions alongside the Chapter 43 adoption. This is a separate amendment to the adopted IBC and should be addressed through the building code adoption process of the jurisdiction. Parallel adoption is recommended but is not required for Chapter 43 to function.

4.10 Effective Date Considerations

The effective date of the Chapter 43 amendment is a practical question that each jurisdiction should address on the basis of local conditions. Several considerations inform the timing:

- Stakeholder notification. The regulated community operators of battery-related facilities, designers of battery installations, and retailers of battery-powered equipment should have adequate notice of the new provisions. A 60- to 120-day delay between adoption and effective date is typical for code amendments of this scope.
- Staff training. The fire code official's office and the coordinated building code official's office should have time to train staff on the new provisions before they take effect. ICC training resources (discussed in Chapter 5 of this document) should be scheduled and completed before the effective date where possible.
- Pending projects. Projects that were submitted under the current code before the effective date should be handled under the current code unless the amendment specifically provides otherwise. The amendment language should address transitional cases explicitly.
- Coordination with IBC adoption. Where the jurisdiction is also adopting 2024 IBC Chapter 9 companion provisions, the effective dates should align so that the combined framework takes effect as a single regulatory change.

4.11 Interim Application Before Formal Adoption

The formal amendment pathway described in this chapter takes time — typically three to twelve months for a municipal ordinance, potentially longer for a state adoption through a building code council. During the period between the availability of this early-release document, the jurisdiction has the ability to apply Chapter 43 provisions on a project-specific basis through the authority given to the code official as part of Chapter 1 of the IFC. Specifically, when the code official provides notice in accordance with **IFC 102.8 Subjects not regulated by this code**.

> Where applicable standards or requirements are not set forth in this code, or are contained within other laws, codes, regulations, ordinances or bylaws adopted by the jurisdiction, compliance with applicable standards of the National Fire Protection Association or other nationally recognized fire safety standards, as approved, shall be deemed as prima facie evidence of compliance with the intent of this code. Nothing herein shall derogate from the authority of the fire code official to determine compliance with codes or standards for those activities or installations within the fire code official's jurisdiction or responsibility.

The bridge-period approach has been used successfully by jurisdictions addressing other emerging code subjects, and it's recommended as a default approach during the period between this early release and full 2027 IFC publication for jurisdictions that will be formally adopting Chapter 43

4.12 When Chapter 43 Is Superseded by the 2027 IFC

When the jurisdiction subsequently adopts the 2027 IFC in its regular code update cycle, the amendment described in this chapter will be superseded by the direct adoption of Chapter 43 as part of the 2027 edition. The transition is seamless: the Chapter 43 text adopted through the amendment is the same Chapter 43 text that appears in the 2027 IFC and no reenactment is required. The jurisdiction's adoption ordinance for the 2027 IFC should, however, expressly repeal the interim amendment to avoid ambiguity about which adoption is operative.

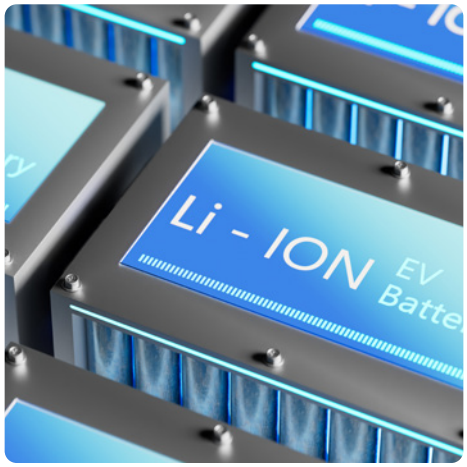
Jurisdictions that adopted Chapter 43 through the early-release amendment will find that the transition to the 2027 IFC requires no change in how Chapter 43 is applied; only the administrative change of updating the code citation from the interim amendment to the adopted 2027 edition. This continuity is by design; the early release is intended to function as a bridge to the formal adoption, not as an independent regulatory framework that will later be displaced.

4.13 Summary

The compliance pathway for adopting Chapter 43 depends on the edition of the IFC currently in force in the jurisdiction. The 2018 and 2021 editions permit straightforward addition of Chapter 43 as a new chapter, with coordinating permit and referenced-standard additions. The 2024 edition requires deletion of Sections 320 and 322 in addition to the Chapter 43 addition, because those sections are the direct predecessors of Chapter 43 and would conflict with it if retained.

Sample amendment language has been provided for each edition. The language is intended for a jurisdiction's code attorney, who can adapt it to the jurisdiction's legislative format with minimal substantive modification.

When the 2027 IFC is subsequently adopted in the jurisdiction's regular code-update cycle, the interim amendment will be superseded without any change in how Chapter 43 is applied. The transition is designed to be seamless, and the early-release amendment described in this chapter is intended to function as a bridge to the formal 2027 adoption.



CHAPTER 5

Companion Resources and Support

About this chapter: The ICC has developed a set of companion resources to support the application of the Chapter 43 provisions. This chapter identifies the principal resources and explains how they relate to one another and to this early-release document.

5.1 Training and Continuing Education

The ICC offers training and continuing education programs on the Chapter 43 provisions through its established training channels. Live and recorded webinars, in person training sessions at ICC chapter meetings and educational events, and continuing-education credit toward code official certifications are all available. The specific offerings and the schedule of availability change over time; code officials and stakeholders should consult the ICC's training and education pages for the current catalog.

For jurisdictions that have formally adopted or are formally adopting Chapter 43 provisions, the ICC can arrange jurisdiction-specific training sessions tailored to the adopting jurisdiction's needs. These sessions can address the specific provisions the jurisdiction has adopted, the specific pathways the jurisdiction has used, and the specific integration questions that arise in the jurisdiction's context.

5.2 Technical Support

The ICC maintains technical support services for code officials applying the I-Codes and for stakeholders working with them. The technical support services can address specific interpretation questions on Chapter 43, can provide guidance on the coordination of Chapter 43 with other chapters and with the IBC, and can identify the specific referenced standards and their current editions that apply to specific scenarios.

For jurisdictions, the technical support services can assist with the drafting of amendments, the review of ordinance language, and the coordination of the Chapter 43 adoption with the broader code-administration framework. Jurisdictional legal counsel should be the primary drafter of amendment and ordinance text, but the ICC's technical support services are available to provide the substantive technical review that complements the legal drafting.

5.3 Referenced Standards

Chapter 43 references a number of UL product certification standards and the NFPA 70 National Electrical Code. The current editions of these standards are the enforceable standards under Chapter 43, and code officials and stakeholders should confirm that they have access to the current editions as part of their implementation preparation. The relevant UL standards UL 2272, UL 2849, UL 3100, UL 3300, UL 2595, UL 1487, UL 4900, and UL 9540A are available through UL Standards & Engagement. NFPA 70 is available through the National Fire Protection Association.

Beyond the referenced standards explicitly cited in Chapter 43, several other standards are relevant to the application of the Chapter 43 framework in practice: IEEE 1635 for battery-room ventilation calculations, NFPA 68 and NFPA 69 for explosion protection, and the IBC, IMC, and IRC for the building-, mechanical-, and residential-code coordination that Chapter 43 requires. Code officials should have these standards available as reference, either in their offices or through online access via the ICC's Digital Codes platform.

5.4 Coordination With Other ICC Work

The Chapter 43 provisions are one component of the ICC's broader battery safety work. The Fire Code Action Committee continues its work on related topics, including the ongoing refinement of the IFC Section 1207 stationary energy storage system provisions and the coordination with the International Residential Code on residential-scale battery installations. Code officials should expect that additional ICC work on battery topics will be released on a continuing basis and should maintain channels of communication with the ICC to stay current on developments.

5.5 Contact Information

For questions about this early-release document, the Chapter 43 provisions, or the ICC's broader battery-safety work, contact the International Code Council at:

International Code Council
200 Massachusetts Ave NW, Suite 250
Washington, DC 20001
www.iccsafe.org

For training and continuing education inquiries, visit the ICC Learning Center at www.iccsafe.org/education.

For technical support inquiries, the ICC maintains a technical services request process accessible through www.iccsafe.org.

For inquiries regarding jurisdictional adoption, amendment drafting, and ordinance development, jurisdictional officials may request assistance through the ICC's Government Relations office.

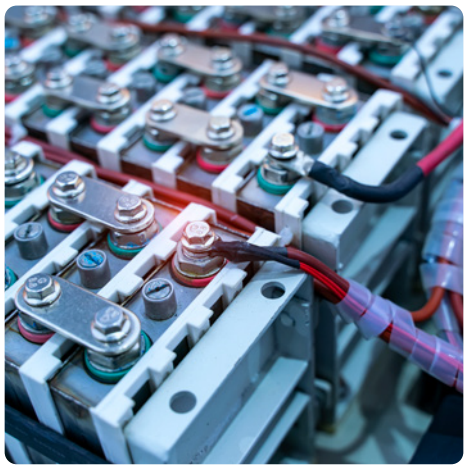
5.6 Conclusion to Part 1

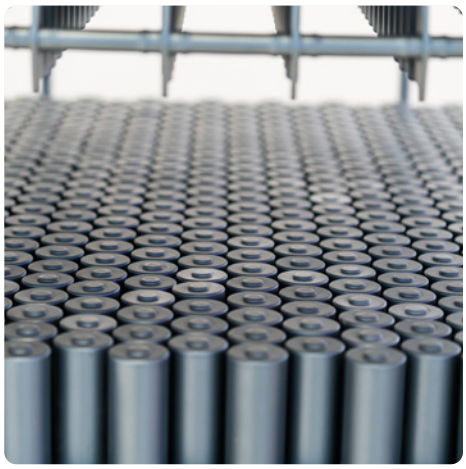
Part 1 of this guide has provided the background, the authority, the pathways, the edition-specific adoption guidance, and the resources that code officials need to put the Chapter 43 provisions into effect in their jurisdictions. The provisions themselves follow in Part 2. Readers are encouraged to read Part 2 in full before determining how to proceed in their own jurisdictions.

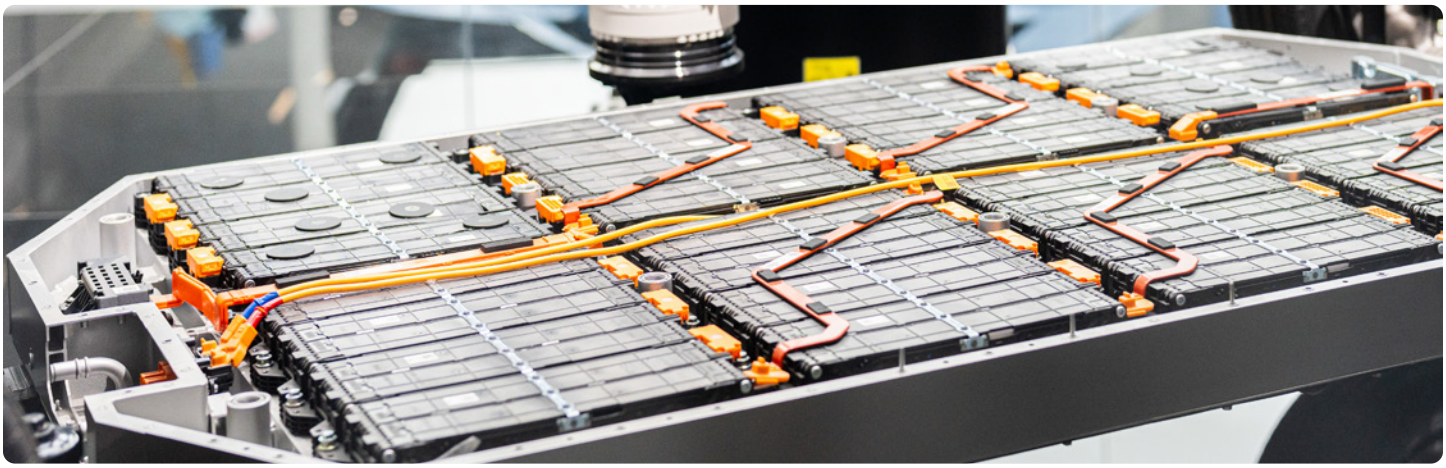
The ICC's expectation is that the early release of Chapter 43 will produce measurably improved battery safety across adopting jurisdictions in the period leading up to the full 2027 IFC publication, and that the transition from early release to formal adoption will be smooth when the 2027 edition is available. Jurisdictions that use the tools this document provides will be positioned to lead that transition.

PART 2 – Chapter 43 Battery Provisions

Disclaimer — The full editorial and publication process for the 2027 IFC has not yet been completed. The final published 2027 IFC may contain editorial differences from this publication.







CHAPTER

43

BATTERIES AND BATTERY POWERED EQUIPMENT AND DEVICES

User notes:

Chapter 43 provides specific requirements for the research, testing, manufacturing, recycling, use, and storage of batteries, including those within equipment and devices that do not meet the definition of an energy storage system. Requirements for energy storage systems are provided in Section 1207. This chapter specifically addresses lithium-ion batteries, lithium metal batteries and powered micromobility devices.

SECTION 4301—GENERAL

4301.1 Scope. Batteries and battery-powered equipment and devices shall comply with this chapter.

4301.1.1 Nonapplicability. This chapter shall not apply to stationary, mobile or portable energy storage systems regulated by Section 1207.

4301.1.2 Hazardous materials applicability. Battery types other than those types defined in Chapter 2 shall also be in compliance with Chapters 50 through 67 as applicable.

4301.2 Electrical wiring and equipment. Electrical wiring and equipment used in connection with batteries shall be installed and maintained in accordance with this chapter, Section 603 and NFPA 70, as applicable.

SECTION 4302—LITHIUM-ION AND LITHIUM METAL BATTERY RESEARCH, TESTING, MANUFACTURING OR RECYCLING

4302.1 General. The research, testing, manufacturing or recycling of lithium-ion and lithium metal batteries shall comply with this section.

4302.2 Scope. Any occupancy where one or more of the following operations involving lithium-ion or lithium metal battery components are conducted shall comply with Sections 4302.3 through 4302.10.

1. Where batteries or cells are tested, modified or subjected to load testing, cycling, thermal tests, short circuit, impact, penetration, crushing, overcharge, shock, vibration or similar conditions.
2. Where battery components are researched, tested or developed.
3. Where batteries are manufactured.
4. Where batteries are recycled, dismantled, repaired or refurbished.

4302.2.1 Collection and collating facilities. Facilities where batteries are only collected and collated for off-site recycling processing or disposal are not regulated by this section. Such facilities shall comply with Section 4303.

4302.3 Fire safety plan. A fire safety plan shall be provided in accordance with Section 403.10.6.

4302.4 Technical opinion and report. A technical opinion and report complying with Section 104.2.2 shall be prepared to evaluate the fire and explosion risks associated with research, testing, manufacturing and recycling, and to make recommendations including the necessary mitigation measures for all identified risks and for the fire and explosion protection design basis. The report shall be submitted to the *fire code official* for approval. The technical opinion and report shall specifically evaluate the following:

1. Compliance with Section 4303.
2. Hazardous materials storage, use and handling, including Group H occupancy requirements, where applicable.
3. *Combustible dust* hazards including cathode and anode powders, notching and cutting equipment, and other processes that involve or generate *combustible dusts* or powders, as applicable.
4. Storage, distribution and dispensing of *flammable liquids* or gases, including electrolytes as applicable.
5. Protection of areas and equipment where formation, aging and testing of batteries or cells occurs, including fire suppression, fire or gas detection, thermal runaway prevention, ventilation and emergency response to runaway cells.
6. Storage of batteries or cells, including high-piled storage requirements where storage exceeds 6 feet (1829 mm) in height.
7. Firefighting access and water supply.
8. Hazards involving flying debris during fire incidents igniting adjacent storage areas, buildings or other exposure hazards.
9. The basis of design for an *automatic sprinkler system* or other *approved* fire suppression system. Such design basis shall reference relevant full-scale fire testing or another *approved* method of demonstrating sufficiency of the recommended design.
10. An evaluation of the suitability of the equipment used.
11. Handling, storage and monitoring of damaged, defective, recalled and out-of-specification batteries and cells.

12. Other items as required by the *fire code official*.

4302.5 Storage. Lithium metal and lithium-ion batteries shall be stored in accordance with Section 4303.

4302.6 Equipment. Equipment used in research, testing, recycling and manufacturing of lithium-ion and lithium metal batteries shall be designed for the intended use and evaluated in the technical report.

4302.7 Fire protection. An *approved automatic sprinkler system* complying with Section 903 shall be provided in buildings where lithium-ion or lithium metal batteries are researched, tested, manufactured or recycled.

4302.8 Fire detection. An *approved* automatic fire detection and alarm system complying with Section 907 shall be provided in buildings where lithium-ion or lithium metal batteries are researched, tested, manufactured or recycled.

4302.9 Fire resistant separation. Indoor rooms or areas where any of the following operations are conducted shall be separated from other portions of the building by 2-hour fire-resistance-rated *fire barriers* and *horizontal assemblies*.

1. Research or manufacturing areas where more than 2 kWh of lithium-ion or lithium metal batteries are charged or tested, or undergo processes such as formation and aging.
2. Where any quantity of batteries or cells undergo destructive testing such as thermal, short circuit, impact, nail penetration, crushing, overcharge or similar testing that can reasonably be expected to result in failure of the battery or cell.
3. Where any quantity of lithium-ion or lithium metal batteries undergo recycling processes including dismantling, repair, refurbishing, incineration or similar processes.

4302.10 Hazardous materials. Hazardous materials stored, used, handled and generated in lithium-ion and lithium metal battery manufacturing, research, testing or recycling shall be in accordance with Chapters 50 through 67, and the *International Building Code*.

SECTION 4303—BATTERY STORAGE

4303.1 General. The storage of batteries shall comply with Section 4303.

Exceptions:

1. New or refurbished batteries installed in the equipment, devices or vehicles they are designed to power.
2. New or refurbished batteries packed for use with the equipment, devices or vehicles they are designed to power.
3. Batteries in original retail packaging that are rated at not more than 300 watt-hours for lithium-ion batteries or contain not more than 25 grams of lithium metal for lithium metal batteries.
4. Temporary storage of batteries or battery components during the battery manufacturing process prior to completion of final quality control checks.
5. Temporary storage of batteries during the vehicle manufacturing or repair process.
6. Batteries in use, staged for use after charging, or charging for use with equipment that are rated at 300 watt-hours or less for lithium-ion batteries or contain 25 grams or less of lithium metal for lithium metal batteries.

4303.1.1 Lithium-ion and lithium metal batteries. The storage of lithium-ion and lithium metal batteries shall comply with Sections 4303.2 through 4303.3.3.3.

4303.1.2 Other battery types. *Batteries in storage, other than lithium-ion or lithium metal batteries, shall comply with Section 4306.*

4303.2 Fire safety plan. A fire safety plan shall be provided in accordance with Section 404. In addition, the fire safety plan shall include emergency response actions to be taken upon detection of a fire or possible fire involving lithium-ion or lithium metal battery storage.

4303.3 Storage requirements. Lithium-ion and lithium metal batteries shall be stored in accordance with Section 4303.3.1.1, 4303.3.2 or 4303.3.3, as applicable.

4303.3.1 Limited indoor storage in containers. A maximum volume of 15 cubic feet (0.42 m^3) of lithium-ion or lithium metal batteries per fire area shall be permitted where stored in accordance with any of the methods provided in Sections 4303.3.1.1 through 4303.3.1.3, lithium-ion or lithium metal batteries shall not exceed a volume of 15 cubic feet (0.42 m^3).

4303.3.1.1 Used or unwanted battery collection. Areas where used or unwanted lithium-ion or lithium metal batteries are collected from the public or employees shall comply with all of the following:

1. Containers shall be open top and constructed of noncombustible materials or shall be *approved* for battery collection.
2. Individual containers and groups of containers shall not exceed a capacity of 7.5 cubic feet (0.21 m^3).
3. A second container or group of containers shall be separated by not less than 3 feet (914 mm) of open space or 10 feet (3048 mm) of space that contains combustible materials.
4. Containers shall be located not less than 5 feet (1524 mm) from *exits* or exit access doors.

4303.3.1.2 Waste storage. Where stored, waste batteries shall be packaged in accordance with DOTn shipping requirements.

4303.3.1.3 Miscellaneous storage. Limited storage of lithium-ion or lithium metal batteries, other than collection of used or unwanted batteries or waste storage, shall comply with any of the following:

1. Stored in containers complying with Section 4303.3.1.1.

2. Stored in original wholesale packaging or containers complying with DOTn regulations.
3. *Approved* battery storage cabinets.
4. Other *approved* storage methods.

4303.3.2 Indoor storage areas. Indoor storage areas for lithium-ion and lithium metal batteries, other than those complying with Section 4303.3.1.1, shall comply with Sections 4303.3.2.1 through 4303.3.2.6.

4303.3.2.1 Technical opinion and report. A technical opinion and report complying with Section 104.2.2 shall be prepared to evaluate the fire and explosion risks associated with the indoor storage area and to make recommendations for fire and explosion protection. The report shall be submitted to the *fire code official* and shall require the *fire code official's* approval prior to issuance of a permit. In addition to the requirements of Section 104.2.2, the technical opinion and report shall specifically evaluate the following:

1. The potential for *deflagration* of *flammable gases* released during a thermal runaway event.
2. The basis of design for an *automatic sprinkler system* or other *approved* fire suppression system. Such design basis shall reference relevant full-scale fire testing or another *approved* method of demonstrating sufficiency of the recommended design.

4303.3.2.2 Construction requirements. Where indoor storage areas for lithium-ion and lithium metal batteries are located in a building with other uses, battery storage areas shall be separated from the remainder of the building by 2-hour rated *fire barriers* or *horizontal assemblies*.

Exceptions:

1. Where battery storage is contained in one or more *approved* prefabricated portable structures providing a complete 2-hour fire-resistance-rated enclosure, *fire barriers* and *horizontal assemblies* are not required.
2. Where battery storage is limited to new batteries in packaging that has been demonstrated to and approved by the *fire code official* as sufficient to isolate a fire in packaging to the package interior, *fire barriers* and *horizontal assemblies* are not required.

4303.3.2.3 Fire protection systems. Indoor storage areas for lithium-ion and lithium metal batteries shall be protected by an *automatic sprinkler system* complying with Section 903.3.1.1 or an *approved* alternative fire suppression system.

4303.3.2.4 Fire alarm systems. Indoor storage areas for lithium-ion and lithium metal batteries shall be provided with an *approved* automatic fire detection and alarm system complying with Section 907. The fire detection system shall use air-aspirating smoke detection, radiant energy-sensing fire detection or both.

4303.3.2.5 Explosion control. Where the *approved* technical opinion and report required by Section 4303.3.2.1 recommends explosion control, explosion control complying with Section 911 shall be provided.

4303.3.2.6 Reduced requirements for storage of partially charged batteries. Indoor storage areas for lithium-ion and lithium metal batteries with a demonstrated state of charge not exceeding 30 percent shall not be required to comply with Sections 4303.3.2.1, 4303.3.2.2 and 4303.3.2.5, provided that procedures for limiting and verifying that the state of charge will not exceed 30 percent have been *approved*.

4303.3.3 Outdoor storage. Outdoor storage of lithium-ion or lithium metal batteries shall comply with Sections 4303.3.3.2 through 4303.3.3.6.

4303.3.3.1 Technical opinion and report. A technical opinion and report complying with Section 104.2.2 shall be prepared to evaluate the fire and explosion risks associated with outdoor storage of lithium-ion and lithium metal batteries and to make recommendations for fire and explosion protection. The report shall be submitted to the *fire code official* and shall require the *fire code official*'s approval. In addition to the requirements of Section 104.2.2, the technical opinion and report shall evaluate all of the following:

1. Compliance with this section.
2. Firefighting access and water supply for emergencies involving outdoor battery storage.
3. Outdoor battery fire and explosion hazards.
4. Hazards involving flying debris during fire incidents igniting adjacent storage areas, buildings or other exposure hazards.
5. Handling, storage and monitoring of damaged batteries and post-fire monitoring.

4303.3.3.2 Distance from storage to exposures. Outdoor storage of lithium-ion or lithium metal batteries shall comply with one of the following:

1. Battery storage shall be located not less than 20 feet (6096 mm) from any building, *lot line*, public street, public alley, *public way* or *means of egress*.
2. Battery storage shall be located not less than 3 feet (914 mm) from any building, *lot line*, public street, public alley, *public way* or *means of egress*, where the battery storage is separated by a 2-hour fire-resistance-rated assembly without openings or penetrations and extending 5 feet (1524 mm) above and to the sides of the battery storage area.
3. Battery storage shall be located not less than 3 feet (914 mm) from any building, *lot line*, public street, public alley, *public way* or *means of egress*, where batteries are contained in *approved*, prefabricated portable structures providing a complete 2-hour fire-resistance-rated enclosure.

4. A maximum of 15 cubic feet (0.425 m^3) of lithium-ion or lithium metal batteries or cells packaged in accordance with DOTn shipping requirements where not less than 3 feet (914 mm) from any building with noncombustible exterior walls, lot line, public street, public alley, *public way* or *means of egress*.

4303.3.3.3 Storage area size limits and separation. Outdoor storage areas for lithium-ion or lithium metal batteries shall not exceed 900 square feet (83.6 m^2). The height of battery storage in such areas shall not exceed 10 feet (3048 mm). Multiple battery storage areas shall be separated from each other by not less than 10 feet (3048 mm) of open space.

Exception: Where *approved* by the *fire code official*, smaller separation distances shall be permitted based on findings in the technical opinion report in compliance with Section 4303.3.3.1.

4303.3.3.4 Fire detection. Outdoor storage areas for lithium-ion or lithium metal batteries exceeding 900 square feet (83.6 m^2), regardless of whether such areas are open, under weather protection or in a prefabricated portable structure, shall be provided with an *approved* automatic fire detection and alarm system complying with Section 907. The fire detection system shall use radiant energy-sensing fire detection.

Exception: Where *approved* by the *fire code official*, fire detection and alarm systems are permitted to be omitted based on the findings in the technical opinion report in compliance with Section 4303.3.3.1.

4303.3.3.5 Containers. Containers for outdoor storage of used or waste batteries shall be open-top and constructed of noncombustible materials; containers complying with DOTn regulations for lithium-ion and lithium metal transportation or shall be *approved* for battery collection and storage.

4303.3.3.6 Weather protection. Where weather protection is provided for sheltering outdoor lithium-ion or lithium metal battery storage or use areas, such areas shall be considered outdoor storage or use where the weather protection structure complies with all of the following:

1. Walls shall not obstruct more than one side or more than 25 percent of the perimeter of the storage area.
2. The overhead structure shall be of *approved* noncombustible construction with a maximum area of 3,600 square feet (334.5 m^2).
3. The distance from the structure to buildings, *lot lines*, *public ways* or *means of egress* to a *public way* shall be not less than the distance required for an outside storage in Section 4303.3.3.2.
4. Weather protection structures used for sheltering lithium-ion or lithium metal battery storage shall be separated from lithium-ion or lithium metal battery piles or additional weather protection structures used to shelter lithium-ion or lithium metal battery storage by not less than 20 feet (4572 mm).
5. The height of battery storage in such areas shall not exceed 10 feet (3048 mm).

SECTION 4304—BATTERY-POWERED EQUIPMENT AND DEVICES

4304.1 General. The following battery-powered devices and equipment shall be operated, maintained, charged and repaired in accordance with this section:

1. *Battery-powered appliances.*
2. *Battery-powered automated mobile platforms.*
3. *Battery-powered industrial equipment.*
4. *Battery-powered industrial trucks.*
5. *Battery-powered micromobility devices.*
6. *Battery-powered robotic equipment.*

Exceptions:

1. Equipment and devices with batteries with a capacity less than 200 Whs.
2. Storage, and use of powered micromobility devices, in Group R-2 dwelling units or detached one- and two-family *dwellings* and *townhouses*, other than Group R-4, Condition 2 occupancies, provided that such devices are for personal use by its owner. The charging location shall not obstruct the *means of egress*.

4304.1.1 Battery charging operations. Battery charging operations shall be in accordance with their device listing and the manufacturer's instructions using only the original equipment manufacturer-supplied charging equipment or charging equipment in accordance with the listing and manufacturer's instructions.

4304.1.2 Ventilation. Mechanical exhaust ventilation to the exterior shall be provided at the source in the charging location in accordance with Chapter 5 of the *International Mechanical Code* to prevent the dangerous accumulation of any flammable or other hazardous gases that are produced or discharged by the battery during normal charging operation.

4304.1.3 Spill control and neutralization. *Approved* methods and materials shall be provided for the control and neutralization of spills of electrolyte or other hazardous materials in areas containing batteries as follows:

1. For batteries with free-flowing electrolyte, the method and materials shall be capable of neutralizing a spill of the total capacity from the largest cell or block to a pH between 5.0 and 9.0.2.
2. For batteries with immobilized electrolyte, the method and material shall be capable of neutralizing a spill of 3.0 percent of the capacity of the largest cell or block in the room to a pH between 5.0 and 9.0.

4304.1.4 Battery charging locations. Charging of any *battery-powered industrial equipment*, *battery-powered industrial truck*, *battery-powered robotic equipment* or *battery-powered appliance* in any occupancy shall be in an *approved* outdoor location or in an indoor area that complies with Section 4304.2.

4304.1.4.1 Prohibited locations. Repair or charging operations for business purposes shall not be permitted in the following locations:

1. In a detached one- or two-family *dwelling* or *townhouse* occupied under the *International Residential Code* or R-2, R-3 or R-4 occupancies.
2. In sleeping rooms or *means of egress* paths of R-1 occupancies.

4304.2 Requirements for indoor charging locations. Indoor charging operations shall be provided with fire detection, fire suppression and other hazard mitigation measures as required by this section.

4304.2.1 Charging requirements for lead-acid batteries. Indoor charging areas for lead-acid batteries shall comply with Sections 4304.1 and 4304.2.2.8.

4304.2.2 Charging requirements for lithium-ion and lithium metal batteries. Indoor charging areas for lithium-ion and lithium metal batteries shall comply with Sections 4304.1 and 4304.2.2.1 through 4304.2.2.8.

4304.2.2.1 Fire suppression. The *fire area* containing the indoor charging location shall be protected by an *automatic sprinkler system* installed in accordance with Section 903.3.

4304.2.2.2 Fire detection. The indoor charging location shall be protected by a *fire alarm system* utilizing a smoke detection system, thermal imaging system or radiant energy-sensing fire detection system.

4304.2.2.3 Electrical receptacles. The indoor charging location shall be provided with sufficient electrical receptacles to allow the charging equipment for each device to be directly connected to a receptacle installed in accordance with NFPA 70. Extension cords or relocatable power taps shall not be used.

4304.2.2.4 Prohibited storage. Combustible materials, combustible waste or hazardous materials shall not be stored in the indoor charging location.

4304.2.2.5 Means of egress. The charging operation shall not be conducted in or obstruct any required *means of egress*.

4304.2.2.6 Storage enclosure. Removable batteries shall not be stacked or stored in an enclosed cabinet unless the cabinet is *listed* or is a specially designed battery containment enclosure *approved* for such purpose.

4304.2.2.7 Battery charging separation. A distance not less than 18 inches (457 mm) shall be maintained between each removable storage battery during charging operations unless each battery is isolated from neighboring batteries by an *approved* fire-resistant material or is within a specially designed rack or cabinet designed and *approved* for such purpose.

4304.2.2.8 Device charging separation. Not less than 18 inches (457 mm) shall be maintained between the locations of the batteries on each powered micromobility device, industrial truck, equipment, robot or appliance during charging operations.

4304.3 Repairs. Repairs of *battery-powered micromobility devices*, battery-powered industrial trucks, *battery-powered industrial equipment*, *battery-powered appliances* and *battery-powered robotic equipment* shall be performed in *approved* locations outside of buildings or within buildings in areas specifically *approved* for that purpose.

4304.4 Replacement batteries and chargers. Replacement batteries and chargers shall be supplied by the equipment manufacturer, or the replacement battery or charger shall be in compliance with the manufacturer's instructions for the certified equipment or device.

4304.5 Fire safety plan. A fire safety plan shall be provided in accordance with Section 403.10.6. In addition, the fire safety plan shall include emergency response actions to be taken upon detection of a fire or possible fire involving lithium-ion or lithium metal battery storage.

4304.6 Listing. Battery-powered equipment shall be *listed* and *labeled* in accordance with this section where applicable and shall be operated and charged in accordance with its listing and the manufacturer's instructions.

4304.6.1 Battery-powered micromobility devices. *Battery-powered micromobility devices* shall be *listed* and *labeled* in accordance with UL 2272 or UL 2849, as applicable.

4304.6.2 Battery-powered automated mobile platforms (AMPs). *Battery-powered automated mobile platforms* (*AMPs*) shall be *listed* and *labeled* in accordance with UL 3100.

4304.6.3 Battery-powered robotic equipment. *Battery-powered robotic equipment* shall be *listed* and *labeled* in accordance with UL 3300 or the applicable standard for its use.

4304.6.4 Portable battery-powered equipment and appliances. Where installed or used, portable battery-powered equipment and appliances shall be *listed* and *labeled* in accordance with UL 2595 or the applicable standard for its use.

4304.7 Hazardous (classified) locations. *Battery-powered micromobility devices*, trucks, equipment, appliances and battery-powered tools operated in areas designated as hazardous (classified) locations in accordance with NFPA 70 shall be *listed* and *labeled* or *approved* for use in the environment intended.

4304.8 Battery exchange. Equipment or facilities providing battery exchange operations shall comply with Section 4304.8.1 and be *approved* by the *fire code official*.

4304.8.1 Listed and labeled. Charging equipment utilized for battery exchange facilities or equipment shall be *listed* and *labeled* in accordance with UL 4900.

4304.9 Damaged equipment. The charging of damaged devices or batteries shall be prohibited.

4304.10 Battery containment enclosures. Where provided, containment enclosures for storage or charging of lithium-ion batteries or lithium-ion *battery-powered appliances* shall be in accordance with one of the following:

1. *Listed* and *labeled* in accordance with UL 1487.
2. Specially designed and *approved* for such purpose.

4304.11 Battery-powered micromobility device batteries and chargers. The batteries and chargers used with *battery-powered micromobility devices* shall comply with this section.

4304.11.1 Batteries and battery chargers. Batteries and battery chargers shall be in accordance with Sections 4304.11.1.1 through 4304.11.1.4 as applicable.

4304.11.1.1 Original equipment manufacturer's devices. Batteries and battery chargers shall be provided as part of the *listed* battery-powered micromobility device. This includes both nonremovable and removable batteries.

4304.11.1.2 Replacement batteries. Batteries not provided as part of the *listed* battery-powered micromobility device shall be compatible with the *listed* battery-powered micromobility device in accordance with the battery-powered micromobility device manufacturer's instructions.

4304.11.1.3 Replacement battery chargers. Single-unit battery chargers not provided as part of the *listed* battery-powered micromobility device shall be compatible with the *listed* battery-powered micromobility device in accordance with the battery-powered micromobility device manufacturer's instructions.

4304.11.1.4 Aftermarket devices. The use of batteries and battery chargers that do not comply with Sections 4304.11.1.2 and 4304.11.1.3 shall be prohibited.

4304.12 Micromobility charging equipment. Battery-powered micromobility device charging equipment that are multiple-unit and do not comply with Section 4304.11.1 shall be *listed* and *labeled* in accordance with UL 4900 and installed and operated in accordance with its listing and the manufacturer's instructions. *Micromobility charging equipment* shall only be used to charge the *battery-powered micromobility devices* identified in the instructions. The installation location shall be *approved* by the *fire code official*.

SECTION 4305—PORTABLE POWER PACKS

4305.1 General. The use, operation and maintenance of portable power packs with an energy capacity of 1 kWh or greater shall comply with Section 1209

REFRESHER from Chapter 12:

SECTION 1209—PORTABLE POWER PACKS

1209.1 General. The use, operation and maintenance of *portable power packs* with an energy capacity of 1 kWh or greater shall comply with this section.

1209.1.1 Capacity limit. *Portable power packs* with an energy capacity exceeding 20 kWh shall comply with Section 1207 .

1209.2 Listing. *Portable power packs* shall be *listed* and *labeled* in accordance with *UL 2743.*

1209.3 Operation and maintenance. *Portable power packs* shall be used and maintained in accordance with the listing and the manufacturer's instructions. Units marked for "indoor use only" shall not be used outdoors.

SECTION 4306—OTHER BATTERY TYPES

4306.1 Other battery types general. Batteries in storage, other than lithium-ion or lithium metal batteries, with a volume more than 15 cubic feet (0.42 m^3) within a *fire area* shall be in compliance with Sections 4306.1.1through 4306.1.6.

4306.1.1 Structural and seismic design. Storage shall be protected against accidental dislodgement. Racks and shelving used for storage shall be designed in accordance with the *International Building Code* as applicable.

4306.1.2 Impact protection. Where battery storage is subject to vehicle traffic, the storage shall be protected against impact in accordance with Section 311 or other *approved* method.

4306.1.3 Battery charging. Battery charging shall be performed in accordance with manufacturer instructions utilizing listed or *approved* charging devices.

4306.1.4 Mechanical exhaust system. Where battery charging can produce *flammable gases*, a mechanical exhaust system shall be provided in accordance with the *International Mechanical Code*. The mechanical exhaust system shall be designed to limit the maximum concentration of *flammable gas* to 25 percent of the lower flammable limit (LFL) of the total volume of the room or area during the worst-case event of simultaneous charging of batteries at the maximum charge rate, in accordance with nationally recognized standards.

4306.1.5 Spill control. Spill control supplies shall be provided to control liquid electrolyte spills. The method shall be capable of controlling a spill from the single largest battery stored or handled.

4306.1.6 Hazard warning signage. The entrances to battery storage areas shall be provided with warning signage that states, "BATTERY STORAGE AREA," "ENERGIZED ELECTRICAL DEVICES" and lists the types of batteries present. The size, color and lettering shall be *approved*.