



Public Input No. 15-NFPA 704-2024 [Section No. 3.3]

3.3 General Definitions.

3.3.1* Boiling Point.

The temperature at which the vapor pressure of a liquid equals the surrounding atmospheric pressure. [30, 2018]

3.3.2 Cryogenic Fluid.

A fluid with a boiling point lower than -130°F (-90°C) at an absolute pressure of 14.7 psi (101.3 kPa). [55, 2020]

3.3.3 Fire Point.

The lowest temperature at which a liquid will ignite and achieve sustained burning when exposed to a test flame in accordance with ASTM D92, *Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester*. [30, 2018]

3.3.4* Flash Point.

The minimum temperature at which a liquid or a solid emits vapor sufficient to form an ignitable mixture with air near the surface of the liquid or the solid.

3.3.5* Frostbite.

Frostbite is a localized condition that occurs when the layers of the skin and deeper tissue freeze.

3.3.6 Materials.

3.3.6.1 Stable Materials.

Those materials that normally have the capacity to resist changes in their chemical composition, despite exposure to air, water, and heat as encountered in fire emergencies.

3.3.6.2 Unstable Materials.

A material that, in the pure state or as commercially produced, will vigorously polymerize, decompose or condense, become self-reactive, or otherwise undergo a violent chemical change under conditions of shock, pressure, or temperature.

3.3.6.3 Radioactive Materials.

Any material which emits, by spontaneous nuclear disintegration, corpuscular or electromagnetic emanations.

3.3.6.4 Corrosive or Caustic Substance.

A chemical that produces destruction of skin tissue, namely, visible necrosis through the epidermis and into the dermis. Corrosive reactions are typified by ulcers, bleeding, bloody scabs, discoloration due to blanching of the skin, complete areas of alopecia, and scars.

3.3.7 Simple Asphyxiant Gas.

A gas that does not provide sufficient oxygen to support life and that has none of the other physical or health hazards. [1, 2018]

3.3.8 (Battery) Energy Storage System [(B)ESS].

One or more devices, assembled together, capable of storing energy to supply electrical energy at a future time. [855 , 2023]

3.3.9 Biological Hazard.

Potential exposure to a biological agent (bacteria, virus, fungus, etc.) or chemical (e.g., many heavy metals) which has yielded positive evidence of an acute or chronic health hazard in testing.

3.3.10 Lithium-based Battery.

A battery made of cells that either use metallic Lithium as an anode or intercalate Li-ions between two of the following: various metal-oxides, phosphate(s), and graphite. Li-based batteries have many desirable properties, but pose a higher fire risk than most other commercial battery technologies.

3.3.11 Toxic and Hazardous Substance Exposure Limits (see Annex B for a more thorough discussion of these values and how they are or are not related to each other).

3.3.11.1 Median Lethal Concentration/Dose (LC 50 or LD 50).

The statistically derived single concentration or dose of a substance that can be expected to cause death within 14 days in 50 percent of young adult albino rats.

3.3.11.2 Immediate Danger to Life and Health (IDLH).

A National Institute for Occupational Safety and Health (NIOSH) defined quantity (regardless of exposure time) that represents an immediate danger to human life or health.

3.3.11.3 Recommended Exposure Level (REL).

A NIOSH defined time-weighted average (TWA) quantity of a hazardous or toxic substance to which a human may be exposed for 8 or 10 hours (depending on the substance) without long term adverse health effects. There are also ST-REL (short term exposure, typically for 15 minutes TWA) and C-REL (ceiling, regardless of exposure time) quantities for some substances.

3.3.11.4 Level of Concern (LOC) for Extremely Hazardous Substances (EHS).

An EPA-defined level for some substances, to which humans should not be exposed for longer than short terms.

3.3.11.5 Acute Exposure Guideline Level (AEGL).

These EPA and U.S. Department of Defense (DOD) values at TWA exposures of 10, 30, 60, 240, and 480 minute can be classified as Level 1, 2, or 3 (in increasing order of danger to humans).

3.3.11.6 Permissible Exposure Limit (PEL).

An OSHA-defined TWA 8-hr exposure limit for a toxic or hazardous substance.

3.3.11.7 Short-Term Exposure Limit (STEL).

An OSHA-defined 15-minute TWA exposure limit published for some toxic or hazardous substances.

3.3.11.8 Emergency Exposure Guideline Limit (EEGL).

A National Research Council and U.S. DOD limit for exposure to certain toxic substances in emergencies for 1-24 hours.

3.3.11.9 Continuous Exposure Guideline Limit (CEGL).

A National Research Council and U.S. DOD limit for exposure to certain toxic substances for up to 90 days.

3.3.11.10 Emergency Response Planning Guideline (ERPG).

Limits to toxic or hazardous substance exposures developed by the American Industrial Hygiene Association (AIHA). They have classifications of 1, 2, or 3, in order of increasing danger to humans.

3.3.11.11 Temporary Emergency Exposure Limit (TEEL).

A guideline limit for emergency exposure to a toxic or hazardous substance, developed by the U.S. Department of Energy (DOE) Subcommittee on Consequence and Protective Actions (SCAPA), in the absence of a published EEGL or ERPG.

3.3.11.12 Threshold Limit Value (TLV).

The American Conference of Government Industrial Hygienists (ACGIH) publishes 3 types of TLVs. TLV-TWA represents time-weighted average 8-hr exposure limit of a toxic substance that could be inhaled. TLV-STEL represents the short-term (15 minutes TWA) exposure limit of a toxic substance that could be inhaled. TLV-C represents a "ceiling" value for an inhaled toxic substance, above which humans should not be exposed for any length of time.

3.3.11.13 Biological Exposure Index (BEI).

For substances that are toxic or hazardous if ingested or are on skin, the ACGIH also publishes biological exposure index values.

3.3.11.14 Workplace Environmental Exposure Limit (WEEL).

The Occupational Alliance for Risk Science (OARS) publishes 8-hr, short-term, and ceiling exposure WEEL values for many hazardous substances.

Statement of Problem and Substantiation for Public Input

These definitions are in relation to PIs 4, 7, 9, and 10 to define the terms introduced to NFPA 704 in those PIs.

Related Public Inputs for This Document

<u>Related Input</u>	<u>Relationship</u>
<u>Public Input No. 4-NFPA 704-2024 [Section No. 8.2]</u>	additional hazardous optional mnemonics in the body of the document
<u>Public Input No. 7-NFPA 704-2024 [Section No. A.8.1.1]</u>	additional hazardous optional mnemonics alternatively in the Annex
<u>Public Input No. 9-NFPA 704-2024 [Section No. A.5.2]</u>	pointer to another Annex for additional guidance on other published toxic/hazardous substance exposure limits
<u>Public Input No. 10-NFPA 704-2024 [Chapter B]</u>	additional guidance on the interrelationship of other published toxic/hazardous substance exposure limits to the NFPA 704 LC and LD50 levels.

Submitter Information Verification

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Submittal Date: Mon May 27 10:06:52 EDT 2024

Committee: CLA-AAA

Committee Statement

Resolution: CI-7-NFPA 704-2024

Statement: The committee created a Task Group on Annex B Exposure Limits to review PI-10, PI-13, PI-14, and PI-15. Task group will work to consolidate those proposals into information in the standard for exposure limits, IDLH values, other relevant categories. Relevant definitions will be considered for addition to Chapter 3 as well as relevant references to assist users with the understanding of acute and long-term exposures.



Public Input No. 16-NFPA 704-2024 [Section No. 6.2]

6.2* Degrees of Hazard.

The degrees of flammability hazard shall be ranked according to the susceptibility of materials to burning detailed in Table 6.2.

Table 6.2 Degrees of Flammability Hazards

<u>Degree of Hazard</u>	<u>Criteria</u>
4 — Materials that rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air and burn readily	Flammable gases <u>other than Category 1B (Low BV) flammable gases with a fundamental burning velocity of less than 3.9 in./s (10 cm/s).</u> Flammable cryogenic materials Any liquid or gaseous material that is liquid while under pressure and has a flash point below 22.8°C (73°F) and a boiling point below 37.8°C (100°F) (i.e., Class IA liquids) Materials that ignite spontaneously when exposed to air Solids containing greater than 0.5 percent by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent.
3 — <u>Liquids and solids (including finely divided suspended solids) that can be ignited under almost all ambient temperature conditions.</u> <u>Materials</u> <u>Liquid and solid materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures or, though unaffected by ambient temperatures, are readily ignited under almost all conditions. See Annex D for more information on ranking of combustible dusts.</u> <u>Materials in this degree also include Category 1B flammable gases that exhibit a low fundamental burning velocity.</u>	<u>Category 1B (Low BV) flammable gases with a fundamental burning velocity of less than 3.9 in./s (10 cm/s).</u> <u>Liquids having a flash point below 22.8°C (73°F) and a boiling point at or above 37.8°C (100°F) and those liquids having a flash point at or above 22.8°C (73°F) and below 37.8°C (100°F) (i.e., Class IB and Class IC liquids).</u> Finely divided solids, typically less than 75 micrometers (µm) (200 mesh), that present an elevated risk of forming an ignitable dust cloud, such as finely divided sulfur; NFPA 70[®], Group E dusts (e.g., aluminum, zirconium, and titanium); and bis-phenol A Materials that burn with extreme rapidity, usually by reason of self-contained oxygen (e.g., dry nitrocellulose and many organic peroxides) Solids containing greater than 0.5 percent by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent.
2 — Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Under normal conditions, these materials would not form hazardous atmospheres with air, but under high ambient temperatures or under moderate heating they could release vapor in sufficient quantities to produce hazardous atmospheres with air. Materials in this degree also include finely divided suspended solids	Liquids having a flash point at or above 37.8°C (100°F) and below 93.4°C (200°F) (i.e., Class II and Class IIIA liquids) Finely divided solids less than 420 µm (40 mesh) that present an ordinary risk of forming an ignitable dust cloud

<u>Degree of Hazard</u>	<u>Criteria</u>
that do not require heating before ignition can occur. See Annex D for more information on ranking of combustible dusts.	Solid materials in a flake, fibrous, or shredded form that burn rapidly and create flash fire hazards, such as cotton, sisal, and hemp Solids and semisolids that readily give off flammable vapors Solids containing greater than 0.5 percent by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent.
1 — Materials that must be preheated before ignition can occur. Materials in this degree require considerable preheating, under all ambient temperature conditions, before ignition and combustion can occur. Materials in this degree also include finely divided suspended solids that do not require heating before ignition can occur. See Annex D for more information on ranking of combustible dusts.	Materials that will burn in air when exposed to a temperature of 815.5°C (1500°F) for a period of 5 minutes in accordance with ASTM D6668, <i>Standard Test Method for the Discrimination Between Flammability Ratings of F = 0 and F = 1</i> Liquids, solids, and semisolids having a flash point at or above 93.4°C (200°F) (i.e., Class IIIB liquids) Liquids with a flash point greater than 35°C (95°F) that do not sustain combustion when tested using the "Method of Testing for Sustained Combustibility," per 49 CFR 173, Appendix H, or the UN publications <i>Recommendations on the Transport of Dangerous Goods, Model Regulations and Manual of Tests and Criteria</i> Liquids with a flash point greater than 35°C (95°F) in a water-miscible solution or dispersion with a water noncombustible liquid/solid content of more than 85 percent by weight Liquids that have no fire point when tested by ASTM D92, <i>Standard Test Method for Flash and Fire Points by Cleveland Open Cup</i>, up to the boiling point of the liquid or up to a temperature at which the sample being tested shows an obvious physical change Combustible pellets, powders, or granules greater than 420 µm (40 mesh) Finely divided solids less than 420 µm (40 mesh) that are nonexplosible in air at ambient conditions, such as low volatile carbon black and polyvinylchloride (PVC) Most ordinary combustible materials Solids containing greater than 0.5 percent by weight of a flammable or combustible solvent are rated by the closed cup flash point of the solvent.

<u>Degree of Hazard</u>	<u>Criteria</u>
0 — Materials that will not burn under typical fire conditions, including intrinsically noncombustible materials such as concrete, stone, and sand.	Materials that will not burn in air when exposed to a temperature of 816°C (1500°F) for a period of 5 minutes in accordance with ASTM D6668, <i>Standard Test Method for the Discrimination Between Flammability Ratings of F = 0 and F = 1</i>

Statement of Problem and Substantiation for Public Input

The 2023 edition of NFPA 55 was updated to segment flammable gases into Category 1A and 1B and was subsequently extracted into NFPA 1-2024. By definition, Category 1B flammable gases have a lower flammability than Category 1A flammable gases. This Public Input recognizes the differences between the categories established by NFPA 55 and further aligns the NFPA flammability classification system with the updates to the OSHA Hazard Communication Standard (<https://www.osha.gov/hazcom/rulemaking>) that become effective July 19, 2024.

OSHA has stated that the bifurcation into Category 1A and Category 1B flammable gases will "better articulate the hazards of flammable gases to support appropriate hazard communication, identification, and assessment of alternatives...no distinctions were drawn between gases that exhibit a wide spectrum of flammable properties for hazard identification and communication purposes. The new subcategories of flammable gases provide greater information on the exact conditions under which the gas is flammable...and how flammable the gas is. Therefore, under the proposed divisions downstream users will have the information necessary to determine whether an alternative product would be not only less flammable but also less likely to propagate, and thereby cause less risk to workers."

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Committee: CLA-AAA

Committee Statement

Resolution: CI-5-NFPA 704-2024

Statement: The committee created a Task Group on Flammability Hazards 3 and 4 to review the submitted public input. The Task Group will review the burning velocity and will evaluate the boiling point of mixtures in relation to flash fire hazards.



Public Input No. 1-NFPA 704-2021 [Section No. 7.1.5]

7.1.5

The degree of instability hazard shall indicate to fire-fighting and emergency personnel whether the area shall be evacuated, whether a fire shall be fought from a protected location, whether caution shall be used in approaching a spill or fire to apply extinguishing agents, ~~or~~ and whether a fire can be fought using normal procedures.

Statement of Problem and Substantiation for Public Input

item is an or statement when it is possible it is an and statement

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Submittal Date: Sun Jun 13 20:37:58 EDT 2021

Committee: CLA-AAA

Committee Statement

Resolution: The committee rejects the public input to replace the 'or' with 'and' because the requirement is differentiating the instability hazards with normal firefighting procedures. The requirement does not prescribe all of the items, it requires one of the listed items.

**Public Input No. 4-NFPA 704-2024 [Section No. 8.2]****8.2 Symbols.**

Special hazards shall be represented by a spatial arrangement denoted by symbols always at the six o'clock position.

8.2.1*

Materials that react violently or explosively with water (i.e., water reactivity rating 2 or 3) shall be identified by the letter "W" with a horizontal line through the center (~~W~~).

8.2.2*

Materials that possess oxidizing properties shall be identified by the letters "OX."

8.2.3*

For chemicals requiring both "special hazard" symbols (i.e., ~~W~~ and OX), the ~~W~~ shall be displayed inside the special hazards quadrant, and the OX shall be displayed directly below or adjacent to the special hazards quadrant.

8.2.4*

Materials that are simple asphyxiant gases shall be permitted to be identified with the letters "SA" and shall include the following gases: nitrogen, helium, neon, argon, krypton, and xenon.

8.2.4.1*

The SA symbol shall also be used for liquefied carbon dioxide vapor withdrawal systems and where large quantities of dry ice are used in confined areas.

8.2.5

All forms of energized electrical hazards (shock, arc, etc.) that are above 600 V (ac or dc) that may be energized in an adverse condition shall be permitted to use the special symbol of **ELC** above or below the diamond (not in the whitespace).

8.2.6*

Sites or "spaces" with materials that may present an emitted ionizing radiation exposure to a first responder in an abnormal situation shall be permitted to use the special symbol of **RAD** above or below the diamond (not in the whitespace), in order to warn the first responder(s) of the potential need for special approach precautions and/or special equipment needs.

8.2.7*

Sites or "spaces" with materials that may present a biological hazard to a first responder in an abnormal situation shall be permitted to use the special symbol of **BIO** above or below the diamond (not in the whitespace), in order to warn the first responder(s) of the potential need for special approach precautions and/or special equipment needs.

8.2.8*

Sites with corrosive liquids (such as acids or caustic basic substances) that may present during a normal or abnormal situation in quantities large enough that could require runoff containment and processing post event shall be permitted to use the special symbol of **COR** above or below the diamond (not in the whitespace).

8.2.9

Sites or "spaces" with Li-based battery systems with a rated energy storage capacity between 20-600 kWh shall be permitted to use the special symbol of **LB3** above or below the diamond (not in the whitespace).

8.2.10

Sites or "spaces" with Li-based battery systems with a rated energy storage capacity greater than 600 kWh shall be permitted to use the special symbol of **LB4** above or below the diamond (not in the whitespace).

Statement of Problem and Substantiation for Public Input

Multiple firefighters and their management/administrative layers have been polled by members of the NFPA 855 committee who have told them they would like to see more information available on or around the NFPA 704 diamond, in addition to seeing more than one sign in large areas where the hazards may differ from one area to another (this is covered in another PI). NFPA 704 allows the user to put whatever information they would like outside the diamond, but standardization helps with recognition. Therefore, the NFPA 704 Task Group of the NFPA 855 committee came up with these proposed optional identifiers for the hazards that these firefighting personnel who were polled most identified as needing warning of. The globally harmonized system of hazard symbology (ISO 7010), discussions with firefighting personnel, references in OSHA 29CFR and DOT 49CFR, and quantities in NFPA 855 were used to come up with this list of 6 additional optional standardized terms to warn of potential hazards. Because the NFPA 855 Task Group for NFPA 704 is unsure whether the committee prefers that this material be in the body of the document in chapter 8, or in an Annex, two different (main) PIs (along with a few other PIs for additional annex notes) have been submitted, covering similar material.

Related Public Inputs for This Document

Related Input
Public Input No. 5-NFPA 704-
2024 [Section No. A.8.2.4.1]

Relationship
the body text related to the Annex notes

[Public Input No. 6-NFPA 704-2024 \[Section No. A.8.1.1\]](#)

[Public Input No. 7-NFPA 704-2024 \[Section No. A.8.1.1\]](#)

[Public Input No. 5-NFPA 704-2024 \[Section No. A.8.2.4.1\]](#)

[Public Input No. 6-NFPA 704-2024 \[Section No. A.8.1.1\]](#)

[Public Input No. 7-NFPA 704-2024 \[Section No. A.8.1.1\]](#)

[Public Input No. 13-NFPA 704-2024 \[Section No. I.1.2.2\]](#)

[Public Input No. 15-NFPA 704-2024 \[Section No. 3.3\]](#)

example drawing showing where to put this proposed text in relation to the diamond

alternative of putting similar information as to what is found in this PI in the body of the standard, but in the Annex instead

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Submittal Date: Fri May 24 16:43:48 EDT 2024

Committee: CLA-AAA

Committee Statement

Resolution: Committee does not feel this information is necessary in the Chapter 8 requirements. The committee is considering new annex material in Section A.8.1.1 to assist users with the application of other special symbol possibilities.



Public Input No. 8-NFPA 704-2024 [Section No. A.4.3]

A.4.3

The quantity and location of NFPA 704 placards are based on factors such as fire department response and access; fire department operations; location, configuration, size, and arrangement of storage areas; location, configuration, and construction of the buildings; and other factors. The authority having jurisdiction should be consulted regarding the placement of identification to assist in response to incidents at the location. At a minimum the diamond should be placed at the entrance closest to the address of record on file with the local fire department. It is prudent to consider placing them at more than one building entrance if there is more than one entrance that might be used by first responders.

For indoor Li-ion or flow battery energy storage systems (BESS) where aggregate capacity exceeds 20 kWh, the building is larger than 900 ft², and where the Li-ion or flow battery BESS is installed in an interior room, each separate room containing a Li-ion or flow battery BESS > 20 kWh should have its own placard [see Figure A.4.3(a)].

For dedicated BESS facilities with outdoor containers, each potential fenced entry gate should have its own placard [see Figure A.4.3(b)]. If there are differing size containers within the facility where the hazards differ, then each container should have its own NFPA 704 diamond [see Figure A.4.3(c)].

Figure A.4.3(a) Placarding of Interior Rooms Containing Li-ion or Flow Battery BESS > 20 kWh

Figure A.4.3(b) Placarding of Separate Fenced Gate Entries to Outdoor Container Li-ion or Flow Battery BESS Sites

Figure A.4.3(c) Placarding of Individual Li-ion or Flow Battery Outdoor BESS Containers Only When the Hazards Differ Between Containers

Additional Proposed Changes

<u>File Name</u>	<u>Description</u>	<u>Approved</u>
placard_inside_building.jpg	inside building placard	
multiple_entries_to_BESS_outdoor_facility.jpg	multiple gate placarding	
large_container_field_with_differing_hazards_placarding.jpg	differing hazards BESS field placarding	

Statement of Problem and Substantiation for Public Input

The Hazards that exist at the entry to a facility may not be the same as the hazards that exist at other locations in the facility. Historically the NFPA 704 placard considers the worst case of all the hazards in a facility. However, if an incident (fire, spill, etc.) happens only in one portion of the facility, overreacting to the hazard in a particular portion of the facility can be detrimental. Therefore, in interviews with firefighting personnel by the NFPA 855 Task Group 28, they have indicated a desire to see different placarding within the facility at multiple points for large facilities and wherever there are differing hazards. This submission gives guidance in the Annex for how an AHJ might direct that NFPA 704 placarding be placed.

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Submittal Date: Fri May 24 19:05:59 EDT 2024

Committee: CLA-AAA

Committee Statement

Resolution: [FR-19-NFPA 704-2024](#)

Statement: Revision made to clarify that for larger sites with multiple entrances, an NFPA 704 placard should be placed at each of those entrances. Revision also refers users to NFPA 855 for specific requirements for Battery Energy Storage Systems (BESS) and battery warehousing.



Public Input No. 9-NFPA 704-2024 [Section No. A.5.2]

A.5.2



Certain materials upon release can cause frostbite. Frostbite, as a health hazard, should be related to the skin/eye component of the health hazard rating criteria.

LC 50 and LD 50 values present in Table 5.2 represent exposure levels at which half of subjected albino rats will die within a certain period after exposure for a certain amount of time (see the UN definitions in Annex B). As a general rule, humans would never want to be exposed to anywhere near these levels. Various regulatory or advisory bodies publish lower exposure limits, such as IDLH, AEGL, ERPG, TEEL, LOC, PEL, STEL, WEEL, REL, EEGL/EEL, TLV, BEI, CGL/CEL, etc. Definitions of those values whose abbreviations are given in the preceding sentence can also be found in Annex B.

Statement of Problem and Substantiation for Public Input

Interviews by members of NFPA 855 Task Group 28, with multiple different firefighters from various jurisdictions, revealed a desire to have more information in a single location on the toxic hazards than what is presently in NFPA 704. Presently 704 values of LC50 and LD50 represent truly dangerous levels. There are many other published values available for toxic substances below those levels that represent different exposure times. It was felt that there is value in adding Annex material on those various published levels and their interrelationships to help readers of NFPA 704 better understand the hazards of toxic substances covered by the leftmost diamond. This addition to Annex A is one of two PIs (along with significant additions to Annex B) to attempt to address that desire, since such information is not readily available from other sources in a compiled format.

Related Public Inputs for This Document

<u>Related Input</u>	<u>Relationship</u>
<u>Public Input No. 10-NFPA 704-2024 [Chapter B]</u>	detailed information on the various toxic exposure limits from other sources
<u>Public Input No. 10-NFPA 704-2024 [Chapter B]</u>	
<u>Public Input No. 13-NFPA 704-2024 [Section No. I.1.2.2]</u>	
<u>Public Input No. 14-NFPA 704-2024 [Section No. I.1.2.4]</u>	
<u>Public Input No. 15-NFPA 704-2024 [Section No. 3.3]</u>	

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Submittal Date: Sat May 25 19:14:57 EDT 2024

Committee: CLA-AAA

Committee Statement

Resolution: The submitted public input has information that involves both acute and chronic exposures. The committee feels this information is better covered in Annex B and will consider revisions to incorporate new language in Annex B based on other submitted public inputs.



Public Input No. 6-NFPA 704-2024 [Section No. A.8.1.1]

A.8.1.1

Only two special hazard symbols (OX and ~~W~~) are required by NFPA 704, and SA is an optional symbol inside the NFPA special hazards quadrant. Outside NFPA 704, limited, special situations might exist in which individual circumstances dictate use of a unique hazard symbol. Other user-defined symbols or markings must be placed outside the NFPA “diamond.” Appropriate training and communication addressing these other markings are essential. Other

special hazard symbols (beyond OX and ~~W~~) should not be considered to be part of the NFPA 704 hazard rating system. In many cases, the hazards represented by these symbols are already considered in the health, flammability, or instability rating categories. For example, a polymerization hazard is covered by the numerical instability rating and does not require a separate symbol. Also, corrosive properties are considered in the health rating and, again, do not require a separate symbol. In addition, because these additional symbols are not defined by the standard, emergency responders might not recognize their significance.

Figure A.8.1.1(a) Example of Optional Hazard Identification Symbol Placement on a Typical Outdoor Li-ion Battery Energy Storage System (BESS) ISO Container

Additional Proposed Changes

<u>File Name</u>	<u>Description</u>	<u>Approved</u>
new_proposed_Annex_drawing_for_704_showing_Li-ion_BESS_ISO_container_sign.jpg	example NFPA 704 diamond optional hazard text symbol placement on a Li-ion outdoor BESS ISO Container	

Statement of Problem and Substantiation for Public Input

Multiple interviews with firefighting personnel by members of NFPA 855 Task Group 28 have revealed a desire to have more optional information standardized for easy recognition. PIs 4 and 7 have been submitted as 2 different ways to achieve this goal. This PI gives some guidance to the text already in the Annex around placement of optional information in relation to the diamond, using a real world example of a Li-ion BESS with proposed new text from PI 4.

Related Public Inputs for This Document

<u>Related Input</u>	<u>Relationship</u>
<u>Public Input No. 4-NFPA 704-2024 [Section No. 8.2]</u>	suggested additional language in the body of the document that could be used underneath or over the diamond in this drawing
<u>Public Input No. 7-NFPA 704-2024 [Section No. A.8.1.1]</u>	suggested additional language in the Annex that could be used under or over the diamond as shown in this drawing
<u>Public Input No. 4-NFPA 704-2024 [Section No. 8.2]</u>	
<u>Public Input No. 7-NFPA 704-2024 [Section No. A.8.1.1]</u>	

Public Input No. 12-NFPA
704-2024 [Section No. I.1.1]

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Submittal Date: Fri May 24 18:07:32 EDT 2024
Committee: CLA-AAA

Committee Statement

Resolution: FR-10-NFPA 704-2024

Statement: Revision made to add new example special hazard symbol markings on placards for lithium-based batteries, to assist firefighters before entry. The other proposed special hazard symbols are covered by other standards and also reflected by the hazard criteria definitions for the respective placard quadrants. Revision also adds new example Figure A.8.1.1 to show where the special hazard symbol should be placed.



Public Input No. 7-NFPA 704-2024 [Section No. A.8.1.1]

A.8.1.1

Only two special hazard symbols (OX and ~~W~~) are required by NFPA 704, and SA is an optional symbol inside the NFPA special hazards quadrant. Outside NFPA 704, limited, special situations might exist in which individual circumstances dictate use of a unique hazard symbol. Other user-defined symbols or markings must be placed outside the NFPA "diamond." Appropriate training and communication addressing these other markings are essential. Other

special hazard symbols (beyond OX and ~~W~~) should not be considered to be part of the NFPA 704 hazard rating system. In many cases, the hazards represented by these symbols are already considered in the health, flammability, or instability rating categories. For example, a polymerization hazard is covered by the numerical instability rating and does not require a separate symbol. Also, corrosive properties are considered in the health rating and, again, do not require a separate symbol. In addition, because these additional symbols are not defined by the standard, emergency responders might not recognize their significance.

Some example hazard symbol markings that could go outside the diamond to aid firefighters in knowing appropriate PPE or actions to take before entry include:

- (1) BIO for biological hazards that may exist during adverse conditions and possibly require specialized entry procedures or specialized equipment.
- (2) CORR for Corrosive substances, including strong acids and caustic bases, that are stored there or may be released in adverse conditions
- (3) DISC when energy Disconnect (such as through an emergency power off [EPO]) may be advisable before entry.
- (4) ELEC for all energized Electricity hazards above shock and arc flash minimums (per NFPA 70E) that may be still energized and exposed under adverse conditions
- (5) EXPL for Explosive materials, whether stored there normally, or produced during adverse conditions
- (6) GAS for instances where it may be advisable to use a gas detector because gases above exposure limit levels may be present or created/released during adverse conditions
- (7) LB3 for sites or "spaces/areas" where Li-based batteries are located with an aggregate potential nominal stored capacity of between 20-600 kWh.
- (8) LB4 for sites, rooms, areas, or containers where li-based batteries are located with an aggregate potential nominal stored capacity greater than 600 kWh
- (9) RAD for instances where Radioactive material(s) above alpha sources, or ionizing radiation may be present normally, or could be created/released during an adverse condition
- (10) RESP for instances where it is advisable to Wear respiratory protection, either during normal, or adverse conditions
- (11) TOX for instances where Toxic material or gasses, including Biological hazards may be present during normal or adverse conditions
- (12) VENT for instances where it is advisable to Ventilate before (and during) entry.

As an alternative, or in addition to the wording outside of the diamond (typically above or below), the international standard pictogram (from ISO 7010) for the hazard may be used. This includes the ISO symbols for the special hazards that are permitted inside the diamond: No

Water (W), Oxidizing substance (OX). For the optional simple asphyxiant (SA) symbol permitted inside the whitespace of the diamond, the “Wear respiratory protection” or breathing hazard ISO symbols may be used.

Statement of Problem and Substantiation for Public Input

Multiple interviews with firefighting personnel in multiple jurisdictions by members of the NFPA 855 Task Group 28 revealed a desire to provide some more suggested standardized wording for above or below the diamond besides the 3 symbols permitted in section 8.2. Task Group 28 decided to submit two similar proposals (this PI where suggestions are only in the Annex, and PI 4, where suggestions are in the body of the document in section 8.2) to this end. NFPA 855 already allows the user to place whatever information they'd like outside of the diamond(s), but firefighting personnel felt there were some additional items that would be useful to them as they enter a site to help them treat the hazard(s) appropriately. ISO 7010 (globally harmonized hazard graphical symbology, OSHA 29CFR, DOT 49CFR, and NFPA 855 in regards to quantities were used to come up with the suggestions in these 2 PIs).

Related Public Inputs for This Document

<u>Related Input</u>	<u>Relationship</u>
<u>Public Input No. 4-NFPA 704-2024 [Section No. 8.2]</u>	alternative putting some of this information in the body rather than the Annex
<u>Public Input No. 5-NFPA 704-2024 [Section No. A.8.2.4.1]</u>	annex information for the alternative to this proposal where much of this information is placed in the body of the document
<u>Public Input No. 6-NFPA 704-2024 [Section No. A.8.1.1]</u>	an example drawing for how to place this optional hazard text outside the NFPA 704 diamond
<u>Public Input No. 4-NFPA 704-2024 [Section No. 8.2]</u>	
<u>Public Input No. 6-NFPA 704-2024 [Section No. A.8.1.1]</u>	
<u>Public Input No. 12-NFPA 704-2024 [Section No. I.1.1]</u>	
<u>Public Input No. 13-NFPA 704-2024 [Section No. I.1.2.2]</u>	
<u>Public Input No. 15-NFPA 704-2024 [Section No. 3.3]</u>	

Submitter Information Verification

Submitter Full Name: Curtis Ashton

Organization: American Power Systems LLC

Affiliation: NFPA 855 Task Group 28 (suggested changes to NFPA 704, as well as updates to references to NFPA 704 in 855). Group members: Curtis Ashton (chair), Morris Stoops, Tony Natale, Jose Marrero

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Submittal Date: Fri May 24 18:23:02 EDT 2024

Committee: CLA-AAA

Committee Statement

Resolution: [FR-10-NFPA 704-2024](#)

Statement: Revision made to add new example special hazard symbol markings on placards for lithium-based batteries, to assist firefighters before entry. The other proposed special hazard symbols are covered by other standards and also reflected by the hazard criteria definitions for the respective placard quadrants. Revision also adds new example Figure A.8.1.1 to show where the special hazard symbol should be placed.



Public Input No. 5-NFPA 704-2024 [Section No. A.8.2.4.1]

A.8.2.4.1

Even though carbon dioxide is technically not just a simple asphyxiant, the hazards created by the release of carbon dioxide are similar to those caused by a simple asphyxiant and the response for emergency responders should be similar to that for simple asphyxiants. Carbon dioxide poses additional health risks beyond being an asphyxiant.

A.8.2.6

Reference 29CFR Parts 1910.1096 (all) for further information on ionizing radiation.

A.8.2.7

Reference 29CFR Part 1910.1200 (applicable subsections) for further information on biological hazards.

A.8.2.8

Reference 29CFR Part 1910.1200 (applicable subsections) and 49CFR Part 173.136 (Hazardous Material Class 8 Definitions) for further information on corrosive hazards.

Statement of Problem and Substantiation for Public Input

Interviews with fire personnel in multiple jurisdictions by members of the NFPA 855 Task Group 28 revealed their desire for standardization of additional information surrounding the NFPA 704 hazard diamond [as well as ideas on placement(s) of the diamond(s), which is covered in another main PI (along with sub-PIs for additional annex material)]. Using 29CFR (OSHA), 49CFR (DOT), ISO 7010 (globally harmonized hazard symbology), NFPA 855 quantities, and the ideas of these firefighting personnel, the NFPA 855 Task Group 28 has proposed 6 optional standardized markings (2 separate PIs - one proposing the majority of the material to go in the main body of the document in section 8.2, or an alternative to put the material in the Annex area, depending on where the NFPA 704 committee thinks is best) to potentially go above and/or below the NFPA 704 diamond to help first responders better understand and prepare for hazards they may encounter. This particular PI provides reference material for 3 of these proposed additions.

Related Public Inputs for This Document

<u>Related Input</u>	<u>Relationship</u>
<u>Public Input No. 4-NFPA 704-2024 [Section No. 8.2]</u>	Annex A explanatory material relevant to the additions in section 8.2
<u>Public Input No. 4-NFPA 704-2024 [Section No. 8.2]</u>	
<u>Public Input No. 7-NFPA 704-2024 [Section No. A.8.1.1]</u>	

Submitter Information Verification

Submitter Full Name: Curtis Ashton

Organization: American Power Systems LLC

Affiliation: NFPA 855 Task Group 28 (responsible for suggestions to NFPA 704, and any updates to NFPA 855 referencing 704).

Committee members are: Curtis Ashton (chair), Morris Stoops, Tony Natale, and Jose Marrero.

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Submittal Date: Fri May 24 17:24:38 EDT 2024

Committee: CLA-AAA

Committee Statement

Resolution: The proposed references are not necessary as the related public inputs proposing those referenced topics were not accepted by the committee.



Public Input No. 10-NFPA 704-2024 [Chapter B]

Annex B Health Hazard Rating

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

B.1 Development of Quantitative Guidelines for Health.

In developing this edition of NFPA 704, the Technical Committee on Classification and Properties of Hazardous Chemical Data determined that the standard should provide quantitative guidelines for determining the numerical health hazard rating of a material (see Table B.1).

Table B.1 Health Hazard Rating Chart

<u>Degree of Hazard</u>		<u>Gas/Vapor</u>					<u>Skin/Eye Contact</u>
		<u>Inhalation LC₅₀ (ppm-v)</u>	<u>Saturated Vapor Concentration</u> (× LC ₅₀ in ppm-v)	<u>Dust/Mist Inhalation LC₅₀ (mg/L)</u>	<u>Oral LD₅₀ (mg/kg)</u>	<u>Dermal LD₅₀ (mg/kg)</u>	
4	0 to 1,000	10 to >10	0.00 to 0.5	0.00 to 5	0 to 40	—	
3	1,001 to 3,000	1 to <10	0.51 to 2	5.01 to 50	40.1 to 200	Corrosive, irreversible eye injury; corrosive if pH ≤2 or ≥11.5	
2	3,001 to 5,000	0.2 to <1	2.01 to 10	50.1 to 500	201 to 1,000	Severe irritation, reversible injury; sensitizers, lacrimators; frostbite from compressed liquefied gases	
1	5,001 to 10,000	0 to <0.2	10.1 to 200	501 to 2,000	1,001 to 2,000	Slight to moderate eye irritation; mild irritation is borderline 0/1	
0	>10,000	0 to <0.2	>200	>2,000	>2,000	Essentially nonirritating	

Notes:

(1)

$$\text{ppm} = \frac{\text{mg/m}^3 \times 24.45}{\text{molecular weight}} \quad [\text{B.1a}]$$

(2) Saturated vapor concentration (ppm) at 20°C and standard atmospheric pressure:

$$\text{SVC} = \frac{\text{Vapor pressure (mmHg)} \times 106}{760} \quad [\text{B.1b}]$$

(3) See Section B.3 for definitions of LC₅₀ and LD₅₀.

B.1.1 Inhalation Hazard Considerations Using DOT Criteria.

In addition, the Committee agreed that a health hazard rating of 4 or 3 should be assigned to any material classified as a "Poison-Inhalation Hazard" by the US Department of Transportation (DOT). The poison-inhalation hazard classification was adopted by DOT from the United Nations (UN) criteria detailed in the UN publication *Recommendations on the Transport of Dangerous Goods — Model Regulations*.

B.1.2 Inhalation Hazard Considerations Using UN Criteria.

The UN criteria for inhalation toxicity are based on the LC₅₀ and saturated vapor concentration of the material.

B.1.3 Oral and Dermal Hazard Considerations Using UN Criteria.

Furthermore, in addition to inhalation toxicity, the UN has established criteria for oral and dermal toxicity, as well as corrosivity. Based on those criteria, the UN assigns materials to categories called Packing Groups. Packing Group I materials represent a severe hazard in transport, Group II materials represent a serious hazard, and Group III materials represent a low hazard.

The Committee decided to adopt the UN criteria for toxicity and corrosivity, and to correlate Packing Groups I, II, and III with the health hazard ratings 4, 3, and 2, respectively.

B.1.4 Adoption of UN Criteria.

Adoption of the UN system has several advantages.

B.1.4.1

First, it addresses hazards in transportation that are similar to the type of emergencies likely to be encountered by fire-fighting personnel and emergency responders. Most other hazard ranking systems have been developed for occupational exposures.

B.1.4.2

Second, the UN system is well established, and it is presumed that a large number of chemical manufacturers have already classified (or can easily classify) materials into the appropriate packing groups.

B.1.4.3

Finally, users of chemicals can assign a 4, 3, or 2 health hazard rating by establishing whether a chemical has been assigned to a UN packing group due to toxicity or to corrosivity.

B.1.5 Hazard Considerations Using HMIS Criteria.

To establish 1 and 0 health hazard rankings, the Committee utilized criteria for the 1 and 0 ratings contained in the Hazardous Materials Identification System (HMIS) developed by the American Coatings Association (ACA), formerly the National Paint & Coatings Association (NPCA) (*see Hazardous Materials Identification System Revised, Implementation Manual*). Although the ACA criteria were developed for occupational exposure, the 1 and 0 criteria are on the low end of the hazard spectrum and are fairly consistent with, and complementary to, the 4, 3, and 2 ratings based on the UN criteria. No UN criteria were established for eye irritation, and the Committee adopted ACA 3, 2, 1, and 0 criteria as health hazard ratings for eye irritation.

B.2 Additional Revisions to Health Hazard Rating.

The Committee made a number of revisions to the proposed hazard rating system to provide conformity with existing industrial practice and to recognize the limitations and availability of corrosivity and eye irritation in a single "skin/eye contact" category and to utilize descriptive terms for the health hazard ratings. Minor changes were made to the 2, 1, and 0 criteria for oral toxicity and to the 1 and 0 criteria for dermal toxicity. Specifically, the distinction between solids and liquids in the oral toxicity criteria was eliminated, and the cutoff between 1 and 0 rankings for oral and dermal toxicity was lowered from 5000 to 2000 mg/kg.

In summary, the 4, 3, and 2 health hazard rankings for oral, dermal, and inhalation toxicity are based primarily on UN criteria. The 1 and 0 health hazard rankings for oral, dermal, inhalation toxicity, and all the "skin/eye contact" rankings are based primarily on ACA criteria.

B.3 UN Definitions.

For the user's assistance in utilizing this standard, the following definitions are extracted from Section 6.5 of the UN publication *Recommendations on the Transport of Dangerous Goods — Model Regulations*. In the absence of data for the species defined as follows, the committee currently considers other mammalian species, including human data and professional judgment to assign health ratings. In addition, Table B.1 can be used for guidance.

B.3.1

LD₅₀ (median lethal dose) for acute oral toxicity is the statistically derived single dose of a substance that can be expected to cause death within 14 days in 50 percent of young adult albino rats when administered by the oral route. The LD₅₀ value is expressed in terms of mass of test substance per mass of test animal (mg/kg).

B.3.2

LD₅₀ for acute dermal toxicity is that dose of the substance which, administered by continuous contact for 24 hours with the bare skin of albino rabbits, is most likely to cause death within 14 days in one half of the animals tested. The number of animals tested shall be sufficient to give a statistically significant result and be in conformity with good pharmacological practice. The result is expressed in milligrams per kg body mass.

B.3.3

LC₅₀ for acute toxicity on inhalation is that concentration of vapor, mist, or dust which, administered by continuous inhalation to both male and female young adult albino rats for one hour, is most likely to cause death within 14 days in one half of the animals tested. A solid substance shall be tested if at least 10 percent (by mass) of its total mass is likely to be dust in the respirable range (e.g., the aerodynamic diameter of that particle-fraction is 10 microns or less). A liquid substance shall be tested if a mist is likely to be generated in a leakage of the transport containment. Both for solid and liquid substances more than 90 percent (by mass) of a specimen prepared for inhalation toxicity shall be in the respirable range as defined above. The result is expressed in milligrams per liter of air for dusts and mist, or in milliliters per cubic meter of air (part per million) for vapors.

B.4

The following information extracted from the UN publication, *Recommendations on the Transport of Dangerous Goods — Model Regulations*, also applies:

The criteria for inhalation toxicity of dusts and mists are based on LC₅₀ data relating to 1 hour exposures and where such information is available it should be used. However, where only LC₅₀ data relating to 4 hour exposures to dusts and mists are available, such figures can be multiplied by four and the product substituted in the above criteria, i.e., LC₅₀ (4 hour) × 4 is considered equivalent of LC₅₀ (1 hour).

The criteria for inhalation toxicity of vapors are based on LC₅₀ data relating to 1 hour exposures, and where such information is available it should be used. However, where only LC₅₀ data relating to 4 hour exposures to dusts and mists are available, such figures can be multiplied by two and the product substituted in the above criteria, i.e., LC₅₀ (4 hour) × 2 is considered equivalent of LC₅₀ (1 hour).

B.5 Lower Exposure Limits than the LC 50 or LD 50 Published by Other Standards, Regulatory, or Advisory Bodies

B.5.1 NIOSH Limits

NIOSH (the National Institute for Occupational Safety and Health) is a research institute under the auspices of the CDC (Centers for Disease Control), which is a public health organization that is a part of the U.S. Department of Health and Human Services (HHS). Unlike the OSHA PELs and STELs, the NIOSH IDLH and REL values are not legally enforceable.

B.5.1.1 IDLH

Among other things that NIOSH does, they publish (via a National Institute of Health [NIH] document) a set of exposure limits to toxic substances defined as immediate danger to life and health (IDLH). Unlike most LC 50 and LD 50 values, they do not depend on exposure time. LC 50 and LD 50 values, along with other research were used (and continues to be used since NIOSH periodically updates the values based on new research) to set the IDLH values, but they are more conservative than the LC 50 and LD 50 values since those values represent death for some animals and humans. NIOSH wants the IDLH to be lower than the LC 50 and LD 50 values so that immediate action is taken to attempt to prevent even one exposure death. IDLH values are typically 3-40 times less than LC 50 or LD 50 values.

B.5.1.2 REL

NIOSH also publishes Recommended Exposure Levels (RELs) for toxic substances. These are usually based on a 10-hr time-weighted average (TWA), although some are based on 8 hours. There are sometimes published REL values for short-term exposure (similar to the OSHA STEL). In those cases, the REL value will be preceded by "ST-". And in some cases, NIOSH will publish a ceiling (C) value, very similar to the definition for the TLV ceiling. This "C" value will typically be between a REL ST- and an IDLH level. The main purpose of the RELs is to provide guidance to OSHA for their next revision of PELs and STELs. In many cases, the existing published OSHA PEL or STEL matches the NIOSH REL, and where it doesn't the NIOSH REL is typically more conservative (a lower number).

B.5.2 EPA Limits

The U.S. Environmental Protection Agency (EPA) publishes some guidance on exposure limits for some toxic substances as well.

B.5.2.1 LOC

EPA defines a level of concern (LOC) for extremely hazardous substances (EHS), where even a relatively short time exposure may cause serious irreversible health effects, or possibly even death. This value is defined as 10% of the IDLH.

B.5.2.2 AEGL

Acute exposure guideline levels (AEGLs) were recently developed by the EPA and the U.S. Army. They consist of a classification of the toxic substance into 3 levels, according to the severity of the effects. AEGLs are calculated for 5 different exposure periods: 10 minutes, 30 minutes, 60 minutes (1 hour), 4 hours, and 8 hours. Level 1 exposure causes noticeable discomfort and/or irritation. The effects are not disabling, are transient, and are reversible upon cessation of exposure. Level 2 exposure causes irreversible or other serious, long-lasting adverse health effects, or affects the ability of a person to escape. Level 3 exposure causes life-threatening health effects or death. The 10-minute Level 3 AEGL is usually between the IDLH and the LC 50 or LD 50. The 10 and 30 minute Level 2 AEGLs usually bound the OSHA STEL, and the 8-hr Level 2 AEGL is usually similar to the OSHA PEL or NIOSH REL.

B.5.3 OSHA Limits

The U.S. Department of Labor's (DOL) Occupational Safety and Health Administration (OSHA) publishes toxic exposure limits based on exposure time. OSHA's limits are typically legally enforceable.

B.5.3.1 PEL

Most of the OSHA permissible exposure limits (PELs) are based on an 8-hr time-weighted average (TWA). These values are obviously less than the IDLH since no "immediate" action must be taken, which obviously makes them far lower than the LC 50 or LD 50 level. In fact, typical PEL levels are usually around 10-2,000 times lower than the IDLH.

B.5.3.2 STEL

In addition to the PEL values, OSHA publishes short-term exposure limits (STEL) based on a TWA of 15 minutes for some toxic substances. Most of these STEL thresholds were actually established by Cal/OSHA (California's state occupational and health safety administration). When available, these STEL values are higher than the PEL because the exposure is short-term, but they are still less than the IDLH.

B.5.4 NRC and DOD EEGL and CEGL Limits

The U.S. National Research Council (NRC, not to be confused with the Nuclear Regulatory Commission) publishes guideline limits for exposure to toxic substances in emergency situations. The emergency exposure guideline limits (EEGLs) are intended for 1-24 hour exposures only in emergency conditions, while the continuous exposure guideline limits (CEGLs) are intended for up to 90 day longer-term exposures. Originally, these values were called emergency exposure limits (EELs), and continuous exposure limits (CELs), respectively. The "G" (standing for "guideline" in the abbreviations) was added in the 1980s to highlight that these limits are not enforceable by law, and should not be used in normal situations (only emergencies). These "guideline" limits would be below the IDLH, but above the PEL and REL values because they are meant to be applied only in emergencies, and only with relatively young and relatively healthy "responders", such as military personnel (which is why the U.S. Department of Defense [DOD] is involved in their creation and use). Due to the longer exposures, CEGL limits are typically lower than EEGL limits.

B.5.5 TEEL Levels

Temporary Emergency Exposure Limits (TEELs) are derived by the U.S. Department of Energy (DOE) Subcommittee on Consequence Assessment and Protective Actions (SCAPA). They are supposed to be used only when AEGL or ERPG limits are not available. AEGL and ERPG values are derived from actual studies on humans and animals and should be used instead of a TEEL when available. The hierarchy of usage is: 1) 60-minute AEGL, 2) ERPG, and 3) TEEL. A substance may have up to 3 TEEL values. TEEL-3 is the airborne concentration above which the general population (including susceptible individuals) could experience life-threatening

health effects or death if exposed for more than one hour. TEEL-2 is the airborne concentration above which the general population (including susceptible individuals) could experience irreversible or other serious long-lasting adverse health effects or have their ability to escape impaired, if exposed for more than one hour. TEEL-1 is the airborne concentration above which the general population (including susceptible individuals) could experience notable discomfort or irritation, if exposed for more than one hour. However, TEEL-1 effects are not disabling, are transient, and are reversible upon cessation of exposure.

B.5.6 Exposure Limits Guidance from Associations of Industrial Hygienists

B.5.6.1 AIHA ERPG Levels

The American Industrial Hygiene Association (AIHA), among other things that they do, develops Emergency Response Planning Guidelines™ (ERPGs). Similar to AEGL and TEEL Levels, there are 3 classifications: ERPG-1 (mild effects), ERPG-2 (serious effects), and ERPG-3 (life-threatening effects).

B.5.6.2 ACGIH Limits

The American Conference of Government Industrial Hygienists (ACGIH) publishes both TLV® and BEI® values.

B.5.6.2.1 TLV® Limits

Threshold Limit Values (TLVs) from ACGIH are divided into 3 categories: TWA, STEL, and Ceiling (C).

B.5.6.2.1.1 TLV-TWA

TLV® time-weighted average (TLV-TWA) values represent the 8-hour exposure limit to which a worker can be subjected for up to 8 hours a day, 5 days a week, week after week. These values are similar to the OSHA PEL and NIOSH REL values.

B.5.6.2.1.2 TLV-STEL

TLV® short-term exposure limits (TLV-STELs) represent the exposure limit for up to 15 minutes. These values generally correspond to the OSHA STEL values and the NIOSH REL ST- values.

B.5.6.2.1.3 TLV-C

TLV® ceiling (TLV-C) limits represent exposure levels to which humans should not be exposed. These values most closely correspond to NIOSH IDLH levels, but are often less than the IDLH.

B.5.6.2.2 BEIs

In addition to various TLV values, the ACGIH also publishes Biological Exposure Indices. While TLV values typically correspond to toxic inhalation, BEI® values are more typically used for dermal exposures in combination with potential ingestion and/or inhalation.

B.5.7 OARS WEEL Limits

The Occupational Alliance for Risk Science (OARS) publishes workplace environmental exposure levels (WEELs) for 182 chemicals presently. Similar to OSHA PEL/STEL, NIOSH REL, EPA AEGL, and ACGIH TLV levels, there are usually separate limits for 8-hr exposure, short-term exposure, and ceilings.

Statement of Problem and Substantiation for Public Input

Interviews by members of NFPA 855 Task Group 28 with firefighting personnel in various jurisdictions revealed a desire to know more about how various other published toxic exposure hazard levels relate to the LC50 and LD50 toxic hazard values referenced by the leftmost diamond in the NFPA 704 hazard diamond. The Task Group felt the best place for this information was in the Annex sections. This is the most extensive of the 2 PIs submitted to add information that will enable the reader to go to one place to find how various toxic exposure levels are related.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 9-NFPA 704-2024 [Section No. A.5.2]	details of the various published toxic exposure limits referenced by the new PI addition to A.5.2
Public Input No. 9-NFPA 704-2024 [Section No. A.5.2]	
Public Input No. 13-NFPA 704-2024 [Section No. I.1.2.2]	
Public Input No. 14-NFPA 704-2024 [Section No. I.1.2.4]	
Public Input No. 15-NFPA 704-2024 [Section No. 3.3]	

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Submittal Date: Sat May 25 19:23:13 EDT 2024

Committee: CLA-AAA

Committee Statement

Resolution: [CI-7-NFPA 704-2024](#)

Statement: The committee created a Task Group on Annex B Exposure Limits to review PI-10, PI-13, PI-14, and PI-15. Task group will work to consolidate those proposals into information in the standard for exposure limits, IDLH values, other relevant categories. Relevant definitions will be considered for addition to Chapter 3 as well as relevant references to assist users with the understanding of acute and long-term exposures.



Public Input No. 2-NFPA 704-2022 [Section No. B.4]

B.4

The following information extracted from the UN publication, *Recommendations on the Transport of Dangerous Goods — Model Regulations*, also applies:

The criteria for inhalation toxicity of dusts and mists are based on LC₅₀ data relating to 1 hour exposures and where such information is available it should be used. However, where only LC₅₀ data relating to 4 hour exposures to dusts and mists are available, such figures can be multiplied by four and the product substituted in the above criteria, i.e., LC₅₀ (4 hour) × 4 is considered equivalent of LC₅₀ (1 hour).

The criteria for inhalation toxicity of vapors are based on LC₅₀ data relating to 1 hour exposures, and where such information is available it should be used. However, where only LC₅₀ data relating to 4 hour exposures to ~~dusts and mists are~~ vapors are available, such figures can be multiplied by two and the product substituted in the above criteria, i.e., LC₅₀ (4 hour) × 2 is considered equivalent of LC₅₀ (1 hour).

Statement of Problem and Substantiation for Public Input

Annex B, paragraph B.4 of the current edition of the standard has an error in the guidance provided for calculating the LC₅₀ for vapors (second main paragraph of B.4) when 1 hour exposure data from the lab testing are not available and must be substituted for by using 4 hour exposure data. The first paragraph of B.4 guides the user when calculating the adjusted 4 hour LC₅₀ for dusts and mists and the second paragraph does the same for calculating adjusted 4 hour LC₅₀ for vapors. However, the current text shows the words "dusts and mists" in what is the vapor calculation guidance and it should correctly be "vapors" in the second sentence of this 2nd paragraph as the recommended change shows. The basis for this guidance is the reference cited in the beginning of this annex, "Recommendations on the Transportation of Dangerous Goods - Model Regulations", which I reviewed to verify this error in the calculation adjustment for vapors, which can be found correctly stated in paragraph 2.6.2.2.4.5 of the UN model regulations.

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Committee: CLA-AAA

Committee Statement

Resolution: FR-6-NFPA 704-2024

Statement: Revision made to correct the language in Section B.4 replacing the words "dusts and mists" with "vapors" for calculating the LC₅₀ for vapors (second main paragraph of B.4) when 1 hour exposure data from the lab testing are not available and must be substituted

for by using 4 hour exposure data. The first paragraph of B.4 guides the user when calculating the adjusted 4 hour LC50 for dusts and mists and the second paragraph does the same for calculating adjusted 4 hour LC50 for vapors.



Public Input No. 11-NFPA 704-2024 [Section No. F.4]

F.4 Water Reactivity Hazard Degree 1.

The heat of reaction is too small to preclude the use of water during emergency response. Because water is an acceptable agent for dilution of spills and for fire control, chemicals with

this rating are not assigned the ~~W~~ symbol. Using the Two Drop Mixing Calorimeter (Hofelich et al.) or equivalent technique, the heat of reaction is greater than or equal to 30 calories per gram of total mixture (cal/g) but less than 100 cal/g, using a 1:1 wt/wt ratio of chemical to water. The heat of reaction might be capable of causing the water to boil at atmospheric pressure.

The following is an example of a chemical whose heat of reaction falls between 30 and 100 cal/g when water is added using the two-drop mixing calorimeter technique.

- (1) Lead-acid battery electrolyte. The NFPA Fire Protection Guide to Hazardous Materials identifies pure sulfuric acid (oil of vitriol, with a specific gravity of 1.835) as having a water reactivity rating of 2 for the NFPA 704 hazard diamond. This is correct for pure sulfuric acid, as the heat of reaction using the two drop mixing calorimeter technique for pure sulfuric acid is 220 cal/g. This means that any location that stores pure sulfuric acid would need a 2 for water reactivity and a ~~W~~ in the white portion of the NFPA 704 hazard diamond. However, lead-acid battery electrolyte is not pure sulfuric acid. It is a mixture of sulfuric acid and water. Commercially available lead-acid batteries use an electrolyte that has a fully-charged specific gravity ranging from 1.210 (28½ % acid by weight) to 1.330 (42½ % acid by weight) depending on the manufacturer and model. Using the two drop mixing calorimeter technique for electrolytes with this specific gravity range yields maximum heat of reactions ranging from 52 to 68 cal/g, which falls squarely within the 30-100 cal/g range for a water reactivity hazard of 1 on the NFPA 704 hazard diamond. This means that no ~~W~~ is needed in the white space, which makes sense since water has been used as a firefighting agent on this technology for the more than 160 years of its existence. Lead-acid battery manufacturing facilities typically do not have onsite sulfuric acid electrolyte concentrations above a specific gravity of 1.400 (50% sulfuric acid by weight). This corresponds to a heat of reaction of no more than 78 cal/g, meaning these facilities also should have a 1 for the water reactivity of electrolyte stored on site, and not ban the use of water as a firefighting agent.

A chemical that on the basis of heat of reaction results alone would normally be assigned a water reactivity rating of 0 should be increased to a water reactivity rating of 1 if any gas is generated via reaction with water, even if the heat of reaction is below 30 cal/g.

The following are examples of chemicals whose release of gas raise them from a water reactivity rating of 0 to a water reactivity rating of 1.

- (1) *50 percent sodium hydroxide.* The exothermic heat of solution measured using the Two Drop Mixing Calorimeter is -35.3 cal/g with no gas release; therefore, a water reactivity rating of 1 is assigned. It should be noted that the heat of solution of a solid material such as sodium hydroxide is not constant but decreases as the solid goes into solution. The first water that is added to sodium hydroxide could in fact boil, even though the Two Drop Mixing Calorimeter indicates a heat release of much less than 100 cal/g. Where large quantities of such solids are wetted by small quantities of water, the instability hazard might be better represented by a water reactivity rating of ~~W~~ 2.
- (2) *Sodium hydrosulfite.* The exothermic reaction with water releases heat, which can lead to spontaneous combustion of a solid. The rating assigned to this chemical is a water reactivity rating of 1.
- (3) *Acetic anhydride.* The exothermic 1:1 molar reaction with water produces 2 moles of acetic acid and no gas release. Because the reactants are not completely miscible at ambient temperature, the reaction tends to be slow unless a solubilizing agent is present. The water reactivity rating assigned to this chemical is 1.

Statement of Problem and Substantiation for Public Input

A survey of lead-acid battery manufacturer older MSDS and modern SDS sheets performed by the IEEE PES ESSB (Institute of Electrical and Electronics Engineers Power and Energy Society Energy Storage and Stationary Battery) Committee's Codes Working Group revealed a wide variety of recommended numbers for the rightmost diamond in the NFPA 704 placard, including 0, 1, and 2, with 2 being the most common. Per NFPA 704, usage of 2 in that space necessitates putting the slash W (no water) symbol in the lower whitespace diamond. This contradicts common knowledge and practice. For 165 years, fire departments have been putting out fires that involve lead-acid batteries (typically not caused by the batteries) with water (oftentimes disregarding an NFPA 704 placard with a 2 in the rightmost diamond and a slash W in the whitespace because of their experience) without significant heat of reaction. In researching the issue, the IEEE PES ESSB Codes Working Group found that the reason that 2 is often recommended on the (M)SDS is because the reference used for chemicals lists sulfuric acid, but not sulfuric acid electrolyte. Pure sulfuric acid does have a water reactivity that would necessitate a 2; however no lead-acid battery electrolyte (and even the higher concentration electrolytes found in lead-acid battery manufacturer factories) consists of more than 50% sulfuric acid by weight. The mostly water electrolyte used in lead-acid batteries does not have a heat of reaction that exceeds the 100 cal/g threshold to necessitate a 2 in the rightmost diamond and a slash W in the whitespace. It is past time to provide more accurate guidance to environmental professionals who write SDS so that we are no longer prohibiting the use of water on fires that involve lead-acid batteries (a prohibition that is widely ignored by firefighters based on their experience).

Related Public Inputs for This Document

<u>Related Input</u>	<u>Relationship</u>
Public Input No. 14-NFPA 704-2024 [Section No. I.1.2.4]	

Submitter Information Verification

Submitter Full Name: Curtis Ashton

Organization: APS LLC (division of East Penn / Deka Battery Manufacturing)
This is a joint submission of the IEEE PES ESSB Codes Working Group (more than 40 members, co-chairs Bill Cantor and Chris Searles, with primary research on the issue by Steve McCluer, Gary Balash, and Randy Schubert) and the NFPA 855 Task Group 28 (Curtis Ashton, chair)

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Submittal Date: Sat May 25 19:36:46 EDT 2024

Committee: CLA-AAA

Committee Statement

Resolution: [FR-20-NFPA 704-2024](#)

Statement: Revision made to add new annex information to provide an example of how to address mixtures in a more general and succinct manner.



Public Input No. 12-NFPA 704-2024 [Section No. I.1.1]

I.1.1 NFPA Publications.

National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 30, *Flammable and Combustible Liquids Code*, 2021 edition.

NFPA 68, *Standard on Explosion Protection by Deflagration Venting*, 2018 edition.

NFPA 70E, *Electrical Safety in the Workplace*, 2024 edition.

NFPA 400, *Hazardous Materials Code*, 2019 edition.

NFPA 652, *Standard on the Fundamentals of Combustible Dust*, 2019 edition.

NFPA 654, *Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids*, 2020 edition.

NFPA 664, *Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities*, 2020 edition.

Fire Protection Guide to Hazardous Materials, 14th edition, 2010.

NFPA 855, *Standard for the Installation of Stationary Energy Storage Systems*, 2023 edition.

Statement of Problem and Substantiation for Public Input

These added publications are referenced in a newly submitted PI 7 (that added additional mnemonics for other hazards besides simple asphyxiant, no water, and oxidizers, including a reference to NFPA 70E), and PIs 5 and 15 (reference to ESS and its definition, taken from NFPA 855) .

Related Public Inputs for This Document

<u>Related Input</u>	<u>Relationship</u>
<u>Public Input No. 7-NFPA 704-2024 [Section No. A.8.1.1]</u>	introduction of a reference to NFPA 70E in the list of proposed new mnemonics.
<u>Public Input No. 6-NFPA 704-2024 [Section No. A.8.1.1]</u>	example (BESS) of diamond placard with alternative mnemonics for hazards outside the diamond
<u>Public Input No. 15-NFPA 704-2024 [Section No. 3.3]</u>	definitions, including one derived from NFPA 855

Submitter Information Verification

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Committee:

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Committee Statement

Resolution: [FR-13-NFPA 704-2024](#)**Statement:** Revision to add NFPA 855 to the list of Annex I NFPA Publications.



Public Input No. 13-NFPA 704-2024 [Section No. I.1.2.2]

I.1.2.2 US Government Publications.

US Department of Energy, Office of Environment, Health, Safety & Security, Subcommittee on Consequence Assessment and Protective Actions, 1000 Independence Ave SW, Washington, DC 20585.

DOE-HDBK-1046-2016, Temporary Emergency Exposure Limits: Methods and Practice, <https://www.standards.doe.gov/standards-documents/1000/1046-Bhdbk-2016-reaff-2022> .

DOE/NSA Protective Action Criteria (PAC): Chemicals with AEGLs, ERPGs, & TEELs, <https://edms3.energy.gov/pac/Search> .

US Environmental Protection Agency, 1200 Pennsylvania Ave NW, Washington, DC 20460.

“Acute Exposure Guideline Levels for Airborne Chemicals”, <https://www.epa.gov/aegl/access-acute-exposure-guideline-levels-aegls-values#chemicals> .

“Technical Guidance for Hazard Analysis, Emergency Planning for Extremely Hazardous Substances”, 1987. <https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=10003LM7.txt> .

US Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute of Safety and Health, 1600 Clifton Road NE, Atlanta, GA 30329.

NIOSH 2014-100, Current Intelligence Bulletin (CIB) 66: Derivation of Immediately Dangerous to Life or Health (IDLH). <https://www.cdc.gov/niosh/docs/2014-100> .

NIOSH Pocket Guide (NPG) to Chemical Hazards. <https://www.cdc.gov/niosh/npg> .

US Department of Labor, Occupational Safety & Health Administration, 200 Constitution Ave., NW, Washington, DC 20210.

“Combustible Dust.” <https://www.osha.gov/Publications/combustibledustposter.pdf>.

“OSHA Fact Sheet: Hazard Alert: Combustive Dust Explosions.” https://www.osha.gov/OshDoc/data_General_Facts/OSHAcombustibledust.html.

OSHA 3644, *Combustible Dust: Firefighting Precautions at Facilities with Combustible Dust*, 2013. https://www.osha.gov/Publications/OSHA_3644.pdf.

OSHA 3674, *Combustible Dust: Precautions for Firefighters to Prevent Dust Explosions QuickCard*, 2013. https://www.osha.gov/Publications/OSHA_3674.pdf.

OSHA, *Hazard Communication Standard*, 2012.

OSHA, “Comparison of NFPA 704 and HazCom 2012 Labels,” 2013. www.osha.gov/Publications/OSHA3678.pdf.

29CFR Part 1910, Subpart Z, “Toxic and Hazardous Substances”, <https://www.ecfr.gov/current/title-29/subtitle-B/chapter-XVII/part-1910/subpart-Z>.

“Permissible Exposure Limits – Annotated Table Z-1”, <https://www.osha.gov/annotated-pels/table-z-1> .

“Permissible Exposure Limits – Annotated Table Z-2”, <https://www.osha.gov/annotated-pels/table-z-2> .

National Academies of Science, Engineering, and Medicine, National Research Council, 500 5th St NW, Washington, DC 20001.

NRC RA 1224.5 C7 1986 c.1, Criteria and Methods for Preparing Emergency Exposure Guidance Level (EEGL), Short-Term Public Emergency Guidance Level (SPEGL), and Continuous Exposure Guidance Level (CEGL) Documents. <https://nap.nationalacademies.org/read/19239/chapter/1#> .

US Department of Transportation, 1200 New Jersey Ave SE, Washington, DC 20590.

49CFR 173.136, “Class 8 - Definitions”, <https://www.ecfr.gov/current/title-49/subtitle-B/chapter-I/subchapter-C/part-173>.

Statement of Problem and Substantiation for Public Input

Several IUS government documents are referenced in PIs 4, 7, 9, and 10 that need to be included here in Annex I if those PIs are accepted

Related Public Inputs for This Document

<u>Related Input</u>	<u>Relationship</u>
<u>Public Input No. 4-NFPA 704-2024 [Section No. 8.2]</u>	suggested additional mnemonics for hazard communication in the body of the document
<u>Public Input No. 7-NFPA 704-2024 [Section No. A.8.1.1]</u>	suggested additional mnemonics for hazard communication in the Annex
<u>Public Input No. 9-NFPA 704-2024 [Section No. A.5.2]</u>	reference in chapter 5 to additional published hazardous exposure levels than the LC50 and LD50
<u>Public Input No. 10-NFPA 704-2024 [Chapter B]</u>	further information on published hazardous exposure ratings other than the LC50 and LD50 levels

Submitter Information Verification

Submitter Full Name: Curtis Ashton

Organization: American Power Systems LLC

Affiliation: NFPA 855 Task Group 28 (suggested revisions to NFPA 704 and references to NFPA 704 in 855). Task Group members: Curtis Ashton (chair), Tony Natale, Morris Stoops, Jose Marrero

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Submittal Date: Sun May 26 21:43:24 EDT 2024

Committee: CLA-AAA

Committee Statement

Resolution: CI-7-NFPA 704-2024

Statement: The committee created a Task Group on Annex B Exposure Limits to review PI-10, PI-13, PI-14, and PI-15. Task group will work to consolidate those proposals into information in the standard for exposure limits, IDLH values, other relevant categories. Relevant definitions will be considered for addition to Chapter 3 as well as relevant references to assist users with the understanding of acute and long-term exposures.



Public Input No. 14-NFPA 704-2024 [Section No. I.1.2.4]

I.1.2.4 Other Publications.

ACGIH 2024 TLVs[®] and BEIs[®], Based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices.

American Coatings Association, *Hazardous Materials Identification System Revised, Implementation Manual*, 1981.

American Industrial Hygienist Association, ERPGs (Emergency Response Planning Guidelines[™]).

Bretherick, L., *Handbook of Reactive Chemicals*, 7th edition, Boston: Butterworths, 2006.

Britton, L. G., "Survey of Fire Hazard Classification Systems for Liquids," *Process Safety Progress*, Vol. 18, No. 4, Winter, 1999.

Britton, L. G., Frurip, D. J. "Further Uses of the Heat of Oxidation in Chemical Hazard Assessment," *Process Safety Progress*, 22(1), 1–19, 2003.

Frurip, D., et al., "The Role of ASTM E27 Methods in Hazard Assessment: Part I. Thermal Stability, Compatibility, and Energy Release Estimation Methods," *Process Safety Progress*, 23(4), 266–278, 2004.

Hanley, B., "A Model for the Calculation and the Verification of Closed Cup Flash Points for Multicomponent Mixtures," *Process Safety Progress*, Summer 1998, pp. 86–97.

Hofelich, T. C., "A Quantitative Approach to Determination of NFPA Reactivity Hazard Rating Parameters," *Process Safety Progress*, Vol. 16, No. 3, p. 121, 1997.

Hofelich, T. C., D. J. Frurip, and J. B. Powers, "The Determination of Compatibility via Thermal Analysis and Mathematical Modeling," *Process Safety Progress*, Vol. 13, No 4. pp. 227–233, 1994.

Hofelich, T. C. and LaBarge, M. S., "On the Use and Misuse of Detected Onset Temperature of Calorimetric Experiments for Hazardous Chemicals," *Journal of Loss Prevention in the Process Industries*, Vol. 15, pp. 163–8, 2002.

ISO 7010:2019, Graphical symbols – Safety Colours and Safety Signs – Registered Safety Signs.

Laidler, K. L., *Chemical Kinetics*, Chapter 3, New York: McGraw-Hill, 1965.

OARS WEEL Table.

Pasturenzi, C., et al., "Thermochemical stability: A comparison between experimental and predicted data," *Journal of Loss Prevention in the Process Industries*, 28, 79–91, 2014.

Stull, D. R., "Fundamentals of Fire and Explosion," *AIChE Monograph Series*, No. 10, Vol. 73, 1977.

Wagman, D.; et al, The NBS tables of chemical thermodynamic properties, *Journal of Physical Chemistry Reference Data*, 1982, 11, 2-58.

Zeleznik, F., Thermodynamic Properties of the Aqueous Sulfuric Acid Systems to 350K, *Journal of Physical Chemistry Reference Data*, 1991, 20, 120.

Statement of Problem and Substantiation for Public Input

PIs 9, 10, and 11 propose additions that use the documents referenced here. So, if those PIs are accepted, these documents need to be added to Annex I.

Related Public Inputs for This Document

<u>Related Input</u>	<u>Relationship</u>
Public Input No. 9-NFPA 704-2024 [Section No. A.5.2]	body text for alternative published hazardous substance exposure limits
Public Input No. 10-NFPA 704-2024 [Chapter B]	alternative Annex text for alternative published hazard exposure levels
Public Input No. 11-NFPA 704-2024 [Section No. F.4]	addition of example water reactivity rating for lead-acid battery electrolyte

Submitter Information Verification

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Statement: The committee created a Task Group on Annex B Exposure Limits to review PI-10, PI-13, PI-14, and PI-15. Task group will work to consolidate those proposals into information in the standard for exposure limits, IDLH values, other relevant categories. Relevant definitions will be considered for addition to Chapter 3 as well as relevant references to assist users with the understanding of acute and long-term exposures.