NFPA STANDARDS DEVELOPMENT SITE

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Closing Date: January 03, 2014

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NFPA 350®, Best Practices Guide for Safe Confined Space Entry and Work, proposed Edition

Edit Chapter Title

Chapter 1 Administration

1.1 Scope.

1.1.1

This guide is intended to protect workers who enter into confined spaces for inspection or testing or to perform associated work from death and from life-threatening and other injuries or illnesses and to protect facilities, equipment, non–confined space personnel, and the public from injuries associated with confined space incidents.

1.1.2

This guide is not intended to replace existing regulations and standards but rather to supplement them by providing additional guidance for safe confined space entry and work. Existing regulations and standards are referenced throughout the guide, and the annexes direct the reader to regulations and standards that might be applicable.

1.1.3

This guide provides both prescriptive and performance-based guidance on how to identify, evaluate, assess, eliminate, and control hazards that occur during entry or work in and around confined spaces.

1.1.4

This guide addresses those fire, explosion, safety, and health hazards that are commonly associated with confined space entry.

1.1.5

This guide addresses training, qualifications, and competencies required for personnel responsible for confined space hazard identification, hazard evaluation, and hazard control as well as for those who are working in and around confined spaces.

1.1.6

This guide provides best practices for confined space rescue.

1.1.7

This guide addresses confined space hazards and safe practices that are common in all industries with confined spaces.

1.1.8

This guide addresses hazards adjacent to confined spaces that might affect the safe conditions necessary for entry and work in the space.

1.1.9

This guide provides criteria for controls that eliminate or minimize confined space hazards in the design phase.

1.2 Purpose.

1.2.1

The purpose of this guide is to provide the best safe work practices for those working in and around confined spaces. The guide goes beyond minimum requirements that have been established by regulations and standards and intends to provide those who strive to achieve a higher level of safety with the best practices for identifying, evaluating, and controlling hazards in order to manage the risk associated with confined space activities. This guide is also intended to address work practices and procedures not fully covered or explained in existing regulations and standards related to confined space entry and work.

1.2.2

This guide also serves to refer the reader to other applicable documents that relate to particular types of industries or type of work being done in a confined space.

1.3* Application.

This guide is intended to provide guidance for entry into confined spaces regardless of location.

1.4 HEADING.

This guide is not intended to supersede or replace any requirements in existing or future codes, standards, and regulations applicable to confined space activities.

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Chapter 2 Referenced Publications (Reserved)

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Chapter 3 Definitions

3.1 General.

The definitions contained in this chapter shall apply to the terms used in this guide. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary,* 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1 Guide.

A document that is advisory or informative in nature and that contains only nonmandatory provisions. A guide may contain mandatory statements such as when a guide can be used, but the document as a whole is not suitable for adoption into law.

3.3 General Definitions.

3.3.1 Accident.

An unplanned occurrence, which results in a loss such as unintended injury, illness, death, property damage, or damage to the environment. [**1521,** 2015]

3.3.2 Accidents.

Unplanned events that result in injuries or damage that interrupts routine operations.

3.3.3* Acceptable Entry Conditions.

Conditions that have met all entry requirements specified in the confined space program and all entry conditions listed on the permit.

3.3.4 Adjacent space.

Those spaces in all directions from subject space, including points of contact, internal and external, such as decks, sumps, floating roofs, secondary containment areas, interstitial spaces, under floors, supports, tank tops, and bulkheads. [**326,** 2015]

3.3.5 Competent Person.

Someone who is designated in writing and who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them. [**1006,** 2013]

3.3.6* Confined Space.

A space that (1) is large enough and so configured that a person can bodily enter and perform assigned work; (2) has limited or restricted means for entry or exit; and (3) is not designed for continuous employee occupancy.

3.3.7 Confined Space Rescue Service.

The confined space Rescue Team designated by the authority having jurisdiction (AHJ) to rescue victims from within confined spaces, including operational and technical levels of industrial, municipal, and private sector organizations.

3.3.8 Confined Space Rescue Team.

A combination of individuals trained, equipped, and available to respond to confined space emergencies.

3.3.9* Explosionproof.

Referring to apparatus enclosed in a case that is capable of withstanding an explosion of a specified gas or vapor that might occur within it and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within and that operates at such an external temperature that a surrounding flammable atmosphere will not be ignited thereby.

3.3.10 Hazard.

Biological, chemical, mechanical, electrical, atmospheric, environmental, or physical agent that has or can have the potential to result in injury, illness, property damage, or interruption of a process or an activity in the absence of a control measure.

3.3.11 Hazard Evaluation.

A two-step process of identifying hazards or potential hazards and then determining the risk of each hazard identified.

3.3.12 Hazard Identification.

The determination of present and potential physical, chemical, atmospheric, mechanical, electrical, and biological hazards in and around a confined space.

3.3.13 Hot Work.

Work involving burning, welding, or a similar operation that is capable of initiating fires or explosions. [**51B,** 2013]

3.3.14 Intrinsically Safe.

Type of protection where any spark or thermal effect is incapable of causing ignition of a mixture of flammable or combustible material in air under prescribed test conditions. [**70,** 2014].

3.3.15* Job Hazard Analysis (JHA).

A safety management risk assessment (RA) technique that is used to define and control the hazards associated with a process, job, or procedure. Any job that has actual or potential hazards is a candidate for a JHA.

3.3.16 Maintenance.

The routine recurring work required to keep a facility (plant, building, structure, ground facility, utility system, or other real property) or equipment in such condition that it can be continuously utilized, at its original or designed capacity and efficiency, for its intended purpose.

3.3.17 Periodic.

Occurring or recurring at regular predetermined or specified intervals.

3.3.18* Permit Required Confined Space (Permit Space).

A confined space that has one or more of the following characteristics: (1) Contains or has the potential to contain a hazardous atmosphere; (2) Contains a material that has the potential for engulfing an entrant; (3) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross-section; (4) Contains any other recognized serious safety or health hazard

3.3.19 Qualified Person.

A person who, by possession of a recognized degree, certificate, professional standing, or skill, and who, by knowledge, training, and experience, has demonstrated the ability to deal with problems relating to a particular subject matter, the work, or the project. [**326,** 2015]

3.3.20 Rescue Attendant.

A person who is qualified to be stationed outside a confined space to monitor rescue entrants, summon assistance, and perform non-entry rescues.

3.3.21 Rescue Entrant.

A person entering a confined space for the specific purpose of rescue.

3.3.22 Retrieval System.

Combinations of rescue equipment used for non-entry (external) rescue of persons from confined spaces.

3.3.23 Risk.

The probability that a substance or situation will produce harm under specified conditions. Risk is a combination of two factors: (1) the probability that an adverse event will occur and (2) the severity of the consequences of the adverse event.

3.3.24 Risk Assessment.

A process for systematically evaluating risk that considers the severity of consequences and the likelihood that the adverse event will occur.

3.3.25 Ventilation.

The changing of air within a compartment by natural or mechanical means. Ventilation can be achieved by introduction of fresh air to dilute contaminated air or by local exhaust of contaminated air. [**302,** 2015]

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Chapter 4 Identification of Confined Spaces Within a Workplace

4.1 HEADING.

The owner/operator or the on-site contractor/subcontractor performing work should evaluate the entire facility, including, but not limited to, detached buildings, structures, sewers and drainage, trenches; tanks, vessels and containers, tunnels, and property grounds to determine if there are confined spaces present that are configured so they could be entered by employees, contractors, the public, or visitors to the facility.

4.2 HEADING.

All construction sites should be evaluated as indicated in the facility or contractor confined space program to determine if confined spaces could be present or created at any time during various construction phases.

4.3 HEADING.

Spaces that should be evaluated to determine if they could be confined spaces include those that a person could enter bodily and that have both of the following characteristics

(1) Have limited or restricted means for entry and exit. Any space that requires a ladder to access or requires a worker to crawl or contort his/her body to enter could be a confined space. Nonstandard staircases such as spiral stairs or ships ladders could also be considered to have limited access or restricted means egress. Often these spaces are located below grade or require descent into a space. There are also confined spaces, such as water tanks, HVAC systems, and wind turbines, that are typically located above ground.

(2) Are not designed for continuous human occupancy. These are spaces where employees would not normally be assigned for work. They are spaces where a desk, computer, or phone would not be placed but that might need to be entered for nonroutine inspection, maintenance, or repair work. Utility vaults, crawl spaces, tanks, and below grade structures are examples of spaces that typically are not designed for continuous human occupancy. There are also structures that might be confined spaces that need to be worked on internally during construction, such as a pipe or a tank that needs to be welded.

4.4 HEADING.

All confined spaces should be posted with signs, tags, or labels denoting them as confined spaces and prohibiting entry to unauthorized entrants. In facilities with multiple, recognizable confined spaces, (such as storage tank facilities with multiple tanks or workplaces with multiple manholes), the owner can identify such spaces with facility signage and identify the spaces in their written confined space program in lieu of individual signs or labels. Signs should have the following (or similar) wording:

DANGER — THIS IS A CONFINED SPACE.

DO NOT ENTER WITHOUT PERMIT FROM CONFINED SPACE ENTRY SUPERVISOR.

4.5 HEADING.

All confined spaces should be locked, guarded, protected, or barricaded to prevent unauthorized entry when entry operations are not in progress.

4.6* HEADING.

All employees who work offsite in a facility or at a location where they could expect to work in or around confined spaces should be informed of the presence, location, and nature of such spaces and should be provided with confined space awareness training (TBD)

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Chapter 5 General

5.1* HEADING.

The terms *confined space*, *non-permit required confined space*, and *permit required confined space* can cause some confusion among employers and workers. To eliminate such confusion, this guide uses only the term *confined space* and makes provisions for evaluating the hazards of and issuing permits for all confined spaces entries regardless of whether the evaluation shows multiple hazards or no hazards at all.

5.1.1

All confined spaces have the potential to become an OSHA-defined *permit required confined space*, depending on the work being performed and the inherent, potential, or introduced hazards in the space at the time of the entry. While procedures required to safely enter a confined space vary widely, the same basic evaluation of the hazards within those spaces should be done prior to and during entry. All confined spaces should be evaluated in accordance with the guidelines in Chapter 6 and Chapter 7, and all hazards should be eliminated or controlled to an acceptable level in accordance with the guidelines in Chapter 8 and Chapter 9.

5.1.2

Table 5.1.2 shows the terminology used in OSHA 29 CFR 1910.146, ANSI Z 117.1, API 2015/2016, and this guide.

Table 5.1.2 Terminology for Confined Space Entry in Various Standards and Documents

Standard or Document	Term Used	Term Used in 350	Comments
29 CFR 1910.146	*Confined space*	*Confined space*	NFPA 350 uses the same definition as OSHA for a confined space.
29 CFR 1910.146	*Permit required confined space*	*Confined space*	NFPA 350 does not distinguish between permit required confined spaces and confined spaces. All confined spaces need permits for entry.
ANSI ASSE Z117	*Non permit confined space*	*Confined space*	All confined spaces need permits for entry. If no hazards are identified and no hazards will be introduced, then no restrictions will be listed on the permit for entry.
29 CFR 1910.146	*Reclassification (downgraded) entry*	*Confined space entry*	Not defined in 350. A confined space with hazards that have been completely eliminated will have no restrictions placed on the authorization/permit for entry.
29 CFR 1910.146	*Alternate procedures entry*	*Confined space entry*	Not defined in 350. A confined space where all hazards have been evaluated and the only hazard is a potentially hazardous atmosphere that is being controlled with effective ventilation. In this case the permit would be issued for entry that contains restrictions requiring ventilation and continuous monitoring.
API 2015/2016	*Non confined space* (a confined space that is no longer a confined space due to reconfiguration)	None	If a space does not meet all the specifications for a confined space, then it is not a confined space and 350 does not apply.
NFPA 326	*Nonconfined space* (for purposes of tank entry, cleaning, or repair, a space that previously was a confined space but no longer meets any of the	None	If a space does not meet all the specifications for a confined space, then it is not a confined space and 350 does not apply.

Standard or Document	Term Used	Term Used in 350	Comments
	requirements for a confined space or a permit required confined space, such as a tank with a large door sheet cut into the side)		

5.2 HEADING.

A written confined space program that meets the guidelines of Chapter 12 should be developed for every facility that has one or more confined spaces.

5.3 HEADING.

A permit should be issued by the designated entry supervisor for all confined spaces in accordance with Chapter 13. The permit can be basic, with limited guidelines and restrictions, or it can be a complex permit with multiple guidelines and restrictions established for entry and work. A "reclassified" (29 CFR 1910.146) confined space, in which all hazards have been eliminated and the work will not create new hazards, would have a permit issued without restrictions. An "alternate procedures" (29 CFR 1910.146) entry would be equivalent to a space in which the only hazard found is a hazardous or potentially hazardous atmosphere. In those cases, the permit would indicate that all other safety hazards have been evaluated or eliminated and that the only restriction is entry with continuous ventilation. *(See Chapter 13.)*

5.4 HEADING.

Entry by employees should take place only after the competent entry supervisor has indicated that acceptable entry conditions as indicated in Section 5.5 and 8.2.1 have been met and after a permit has been issued.

5.5 HEADING.

Prior to entry, the following criteria should be met:

(1) All inherent, potential, introduced, and adjacent hazards of the confined space should be identified and evaluated in accordance with the written confined space entry program and guidance provided in Chapters 6 and 7.

(2) All hazards should be eliminated or controlled in accordance with Chapters 8 and 9.

(3) An authorized entry supervisor who is trained in accordance with Chapter 11 has been assigned to oversee the work.

(4) An authorized entrant who is trained and qualified in accordance with Chapter 11 has been assigned to enter the space

(5) A competent attendant who is trained and qualified in accordance with Chapter 11 has been assigned.

(6) If gas monitoring is necessary according to the permit, a qualified gas monitoring specialist who is trained in accordance with Chapter 11 has been assigned. This person can be the attendant, entry supervisor, or other person, such as a facility or contractor employee provided this individual is qualified in accordance with Chapter 11 guidelines.

(7) If ventilation is required according to the permit, a qualified Ventilation Specialist who is trained in accordance with Chapter 11 should be assigned. This person can be the attendant, the entry supervisor, or other person such as a facility or contractor employee, provided the individual is qualified in accordance with Chapter 11 guidelines.

(8) If energy or other sources exist that must be isolated or controlled according to the permit, a qualified isolation specialist trained in accordance with Chapter 11 should be assigned. This person can be the attendant, the entry supervisor, a standby worker, or entrant if qualified in accordance with Chapter 11 guidelines.

(9) Rescue equipment and/or services should be available in accordance with the permit and the guidelines provided in Chapter 10.

(10) Other required permits, such as hot work, are issued by the permit issuer.

(11) A permit should be issued and signed by the Permit Issuer and entry supervisor in accordance with Chapter 13.

(12) A pre-entry meeting should be held with all personnel who will be entering or working in or adjacent to the space to discuss the work to be performed, job requirements and assignments, actual and potential hazards, and methods of eliminating or controlling the hazards as listed in the conditions on the permit.

(13) Communication between the entrant and the attendant should be established in accordance with Chapter 8.

(14) Entry should not occur until all conditions for entry established on the permit are met.

5.6 Roles and Responsibilities.

Every workplace that has one or more confined spaces as identified in Chapter 4 that will be entered should have personnel assigned to perform the responsibilities of following roles as applicable:

(1) Owner/operator and/or contractor/subcontractor

(2) Entrant

(3) Attendant

(4) Entry Supervisor

(5) Permit Issuer

(6) Gas Tester

(7) Ventilation Specialist

(8) Rescuer (could be attendant for non entry rescue)

(9) Rescue Team

(10) Standby Worker

(11) Isolation Specialist

5.7 Training Guidelines.

5.7.1

Employers (owners/operators) and contractors should ensure that all employees engaged in confined space activities have the necessary understanding, knowledge, and skills and are able to safely perform their assigned duties.

5.7.2

Employers (owners/operators) and contractors should ensure that all employees engaged in confined space activities who are assigned the duties of the roles listed in Section 5.6 have been trained as follows:

(1) Prior to beginning the initial assignment to their work or duties

(2) Before a change in assignment to a different type of work or duties

(3) Whenever there is a change in operations, procedures, or guidelines that has the potential to present a hazard for which the employee has not been previously trained or educated

(4) Whenever an employer (owner/operator) or contractor has reason to believe an employee requires retraining or additional education due to inadequacies in the employee's performance or skill or because the employee deviates from the confined space program or established procedures

5.8 Training Verification.

Employers (owners/operators) and contractors should verify, in writing, that employees have been trained, as required, and the verification should be available for inspection by employees and their designated representatives. The verification should contain the names of the employees trained; the means used to determine that the employees understanding the training; the signature, name, or initials of the trainer(s); the training subjects and content; and the date(s) the training was conducted, in accordance with Chapter 11.

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Chapter 6 Identification of Hazards In and Around Confined Spaces

6.1 General.

6.1.1

Work in and around confined spaces in general is hazardous, and conditions can change significantly with little or no warning. Research and preplanning are necessary to ensure that confined spaces are recognized and that hazards are identified and evaluated. Additionally, the anticipation of potential hazards beyond those currently present should continue throughout the work evolution.

6.1.2

Workers can become quite familiar with the space(s) in which they operate. Likewise, work can be routine and repetitive, and complacency can ensue with continual uneventful entries. While knowledge of the space and equipment can be helpful when preplanning work, it does not lessen the vigilance needed to enter, work in, and exit a confined space safely. The space's history and prior use should be considered in anticipation of hazards, but each entry should be considered an individual and unrelated event.

6.1.3

Identifying hazards in around a confined space is a three-stage process:

(1) The anticipation or preplan stage starts with a sizing up of potential hazards and the identification of resources that might be needed to work in and around confined spaces.

(2) The hazard identification stage confirms anticipated hazards and recognizes additional potential hazards.

(3) The hazard evaluation stage determines the risk of each hazard identified.

6.1.4

After all hazards have been identified and risks have been assessed, controls should be implemented in accordance with Chapter 8.

6.2 Hazard Anticipation/Preplan.

Many hazards can be anticipated before work begins by the preplanning process, which consists of a thorough analysis of the space, its purpose, the systems contained within it, and the scope of work necessitating the entry. Preplanning can identify potential hazards and resources that might be needed to work in and around confined spaces and to prevent adverse consequences related to the work. There are two main components to the preplanning stage: intelligence gathering and resource identification.

6.2.1

Hazard preplanning starts with the collection of information that could be useful prior to starting work. This intelligence gathering includes, but is not limited to, using previously prepared hazard surveys, preplans, schematics, blueprints, work orders, equipment guides, safety data sheets, manuals, control measures, and prior experience from previous entries and knowledge from workers familiar with the space. Likewise, its operations and the process area associated with the entry might be helpful in the anticipation and identification of hazards.

6.2.2

Once intelligence has been gathered, potentially required resources can be identified, including the following:

(1) Instrumentation (e.g., air monitoring equipment, electrical testers)

(2) Controls

    (a) Engineering controls (e.g., ventilation hardware, lighting, line breaking/blanking)

    (b) Administrative controls [e.g., additional permits, hot work, lockout tagout (LOTO), personnel needs]

(3) Personal protective equipment (PPE) (e.g., hardhats, respirators, chemical protective clothing, safety boots)

(4) Outside resources (e.g., technical specialists, rescue services, specialized equipment)

6.3 Hazard Identification.

6.3.1

Hazard identification, which is done at the site of the confined space, verifies anticipated hazards and identifies new ones. It is done by conducting a review of the space's documentation (e.g., safety data sheets for cargo that the space held), a visual inspection, and atmospheric monitoring. The visual inspection should be conducted around the exterior of the space and then in all areas within the space. During the inspection, all posted warning signs and permits should be noted, as should any materials or conditions that could pose a hazard, such as chemical residue or the potential for a change in the atmospheric conditions. Atmospheric monitoring *(see Chapter 7)* should be conducted to determine the atmospheric conditions inside the space and in its adjacent spaces.

6.3.2

There are three sources of hazards that can be directly or indirectly associated with working in and around confined spaces: hazards directly associated with confined spaces and inherently present in or around the space; the result of product(s) stored in or around the space; or the result of processes taking place within or near the space. Indirect hazards are hazards that are not integral to the space but can still affect it.

6.3.3

Hazards can be physical, mechanical, electrical, chemical, biological, or psychological. Equal consideration should be given to potential hazards directly and indirectly associated with the space.

6.3.4 Hazard Sources.

Hazards that directly or indirectly affect the space can be inherent, introduced or adjacent.

6.3.4.1 Inherent Hazards.

6.3.4.1.1

Inherent hazards are those hazards that exist as a permanent, essential characteristic, or attribute of the space. The hazard identification stage should include whether the location and configuration (including restricted access, obstructions, or remoteness) could inhibit or interfere with movement, ventilation, escape, rescue, or fire fighting.

6.3.4.1.2

Inherent hazards to be identified include the following:

(1) *Inaccessible or limited access into the space.* For example, space for which ladders or scaffolding are needed to reach the portal, to enter and exit the space, or to perform work therein. Elevated spaces require different considerations for entry and rescue than those that are at ground level, including fall protection.

(2) *Size and shape of the portal.* For example, the restrictive nature of some portals makes access with certain types of PPE difficult or impossible or requires entrants to contort their bodies while entering or exiting. Likewise, an open, unprotected edge or portal can create a fall hazard.

(3) *Size and shape of the space/vessel.* For example, inwardly converging walls or a funnel shaped discharge can entrap and suffocate an entrant; congested spaces can inhibit mobility or create slip, trip, and fall hazards.

(4) *Products or processes in the space.* For example, chemicals, thermal stress, noise, steam, pressurization, mechanical equipment, and other activities associated with the use of the space can create hazards. Additionally, disturbing product residue during entry or work can release a contaminant that produces a hazard not detected during pre-entry testing.

(5) *Fixed equipment within the space.* For example, piping systems, conduits, ducts, machinery or pressurized lines, and fire suppression systems should be evaluated for potential hazards and locked out/tagged out, tested, gas-freed, and/or inerted if needed to reduce the risk.

6.3.4.2 Introduced Hazards

6.3.4.2.1

Introduced hazards are hazards that are not normally associated with the space's purpose or processes but are brought into the space or adjoining area (s) deliberately or inadvertently. As part of the hazard evaluation and risk assessment, the actions of entrants and the materials, products, and techniques used to gain access, enter, inspect, clean, and/or repair a confined space should be carefully considered to ensure they do not introduce hazards. This also includes an evaluation of work being performed in the area(s) immediately surrounding the space.

6.3.4.2.2

Examples of introduced hazards include the following:

(1) *Atmospheric hazards*. Ventilating a space can introduce contaminants from an ill-placed supply air duct or draw contaminated air from engine exhaust or oxygen-deficient air from another space or source. Product off-gassing can be captured by forced ventilation and contaminate adjacent areas.

(2) *Chemical hazards*. Products used in cleaning, abating, or coating need to be checked for reactivity with other chemicals that might be present. Chemicals can also produce hazardous vapors or gases and/or displace or consume oxygen due to the confined nature of the space.

(3) *Compressed gases*. Compressed gas such as those used for hot work or fire suppression systems pose a hazard due to their contents (e.g., toxic or flammable gases), ability to displace or enrich the atmospheric oxygen content (e.g., carbon dioxide fire extinguishing systems), and their potential to become a projectile if damaged. Compressed gas hoses, valves, and regulators should be thoroughly inspected, evaluated, and leak checked prior to being brought into a confined space. (Note: Due to the inherent risks, compressed gas cylinders should not normally be introduced into confined spaces.)

(4) *Hot work*. Hazardous atmospheres and flammable conditions can be created by hot work such as welding, cutting, grinding, drilling, and burning, which can produce fumes, release gases, deplete or enrich the space's oxygen content, or produce an ignition source, such as sparks from the work or the tool itself.

(5) *Electrical hazards*. Electrical equipment, such as lighting, power tools, and extension cords, can produce electrical shock, trip hazards, and ignition sources; even monitoring instrumentation that is not intrinsically safe can introduce an ignition source.

(6) *Slip, trip and fall hazards*. Ladders or scaffolding used to reach the portal, to gain entry, or for access inside the space can produce slip, trip, fall, and entanglement hazards.

6.3.4.3 Adjacent Hazards.

6.3.4.3.1

Adjacent hazards are hazards or other conditions that might exist in the area(s) surrounding the space. Adjacent hazards can also involve other spaces that are in proximity to the entry site and can pose significant hazards that need to be evaluated separately prior to entry.

6.3.4.3.2

Examples of adjacent hazards include the following:

(1) *Adjacent spaces.* Spaces and vessels that share a common wall, contact each other in any way, or share a surrounding or cover need to be assessed for possible hazards or operation that could influence the subject space or vice versa (e.g., hot work, compressed gases, machinery). This includes evaluating areas in all directions from the subject space — those that share a common point/wall, contact, corners, diagonals, decks/floors, tank tops, and bulkheads/walls.

(2) *Adjacent work activities.* Personnel activities or work that is being performed in nearby spaces should be analyzed for effects or dangers posed to the subject entry.

(3) *External hazards.* Areas surrounding the subject space should be assessed for other possible dangers that can affect the entry. Pedestrian and vehicle traffic, equipment, smoke and exhaust, contaminate-producing activities, sparking, heating or cooling, or transfer of product can all produce hazards.

6.3.5 Types of Hazards.

A pre-entry evaluation should be conducted for all confined spaces to determine if hazards are present. It should be assumed that a confined space is not safe for entry until the hazards (present or potential) are identified, evaluated, and eliminated or controlled. Hazards include, but are not limited, to mechanical hazards, electrical hazards, physical hazards, chemical hazards, biological hazards, and psychological hazards.

6.3.5.1 Mechanical Hazards.

These hazards are created by equipment with stored energy (mechanical, electrical, pneumatic, or hydraulic) or equipment that is/was energized in and around the subject space. Mechanical hazards have the potential to crush, burn, cut, shear, stab, or otherwise strike or wound workers and include rotating or other moving equipment. This equipment can be associated with either mechanical processes that take place in the space or other machinery in the vicinity.

6.3.5.2 Electrical Hazards.

These hazards are created by an electrical current, charge, or field capable of causing injury. All electrical sources should be treated as a potential hazard, including low-voltage sources. Low voltage does not mean low hazard. If electrical hazards are present, they should be evaluated by a qualified electrician as to the potential risk and controls in accordance with *NFPA 70E*. Voltage alone does not determine the severity of and electrical shock. The three factors that determine the severity of electrical shock are as follows:

(1) The actual quantity of current (amperes) flowing through the body

(2) The path of current through the body

(3) The time the current flows through the body

6.3.5.2.1

As electricity travels from its source and returns to that source, either through another wire or through the ground, it makes a complete circuit. If anything, such as a human body, comes in contact with the current-carrying wires and has lower resistance than the wire, electricity will follow the path of least resistance. Note: Arc flash from energized conductors can produce intense blinding light capable of burning entrants and explosive high-pressure shock waves and molten metal projectiles.

6.3.5.3 Physical Hazards.

These hazards include hazards other than mechanical or chemical that would cause harm to the body, including, but not limited to, noise, engulfment, falls, wet/slick surfaces, slip/trip hazards, lighting, radiation, vibration, and extremes of temperature and pressure. Physical hazards include explosion and fire hazards created by various chemical agents such as flammable liquids, paints, solvents, and methane, as well as combustible settled dust in excess of $\frac{1}{32}$ in., and airborne concentrations that impair visibility to less than 5 ft are indicators of potential explosive conditions. Concentration of explosive/flammable vapors should be less than 10 percent of the lower flammable/explosive limit (LFL/LEL) for entry into a work area. Concentrations 10 percent or more of the LFL/LEL pose an explosion hazard. The LFL/LEL can be measured with an instrument configured to measure explosive gases. Note: LFL/LEL is the lowest concentration of gas or vapor in air in which burning will take place.

6.3.5.4 Chemical Hazards.

These hazards can arise from exposure to concentrations of gases, vapors, mists, fumes, liquids, or dusts. Routes of exposure are through inhalation, absorption through skin or mucous membrane (nose, throat, eyes), or ingestion. All three routes of entry should be considered in the evaluation of confined space hazards:

(1) Inhalation is the most common way for a toxic chemical to enter the body. Inhaled materials are in the form of a fume, dust, gas, mist, or vapor.

(2) Skin absorption occurs when a chemical (such as a solvent) passes through the skin and enter the blood stream. Some dusts and mists, like pesticides, can dissolve on moist skin and then be absorbed.

(3) Ingestion occurs when workers do not wash their hands before eating or when they drink beverages or smoke in an area where hazardous chemicals are used.

6.3.5.4.1

Chemical hazards and oxygen levels can be measured using atmospheric monitoring devices, such as multi-gas meters (configured for the compounds of concern), single gas monitors, and colorimetric tubes.

(1) Systemic poisons are materials that damage human organs or systems, such as the kidneys, liver, or central nervous system. Common poisons and toxic chemicals found in or around confined spaces include carbon monoxide from incomplete combustion (e.g., engines) or fires, hydrogen sulfide from decaying biological material (e.g., rotting fish, seaweed, grains), cleaning operations (e.g., toxic volatile organic compounds, solvents), and welding fumes (e.g., heavy metals).

(2) Corrosives are chemicals that cause visible destruction of living tissue at the site of contact. Some examples are muriatic acid, sulfuric acid, and lye.

(3) Irritants are chemicals that are not corrosive but can cause a reversible inflammatory effect on living tissues. Irritants are similar to corrosives, but they are weaker in their effects. Their sites of action are the skin, eyes, and lungs.

(4) Oxygen deficiency and enrichment atmospheres are also hazardous. The normal amount of oxygen is 20.8 percent to 20.9 percent in the air. When oxygen is lower than 20.8 percent, there might be a chemical or process consuming the oxygen; when it is higher, there might be a source of oxygen being introduced to the space. Oxygen deficiency can lead to atmospheres that cannot sustain life and that can become immediately dangerous to life and health. Oxygen-enriched atmospheres greater than 22 percent can create a fire or explosion hazard. Oxygen deficiency (less than 19.5 percent) can be caused by the following:

    (a) Displacement of oxygen by other gases and vapors such as inert gases or by evaporating liquids

    (b) Rusting metals, such as scrap iron or tank wall corrosion

    (c) Organic decay (rotting fruit, molasses, edible oils)

    (d) Curing paints

6.3.5.5 Biological Hazards.

These hazards are created by viruses, bacteria, fungi, parasites, or other living organisms that can cause disease in humans. Common sources of biological hazards include bodily fluids and waste, insect bites or stings, rats, snakes, and microbial pathogens. Some biological materials, such as bacteria and molds, can be sampled and then analyzed at a microbial laboratory. Although the results can take time, the data can assist in determining and documenting potential exposures.

6.3.5.6 Psychological Hazards.

Confined spaces, restricted movement, excessive noise, and PPE restriction can create psychological hazards. Some entrants can easily become claustrophobic or stressed, which can cause them to hyperventilate and alter their ability to reason and make sound decisions.

6.4 Hazard Evaluation.

6.4.1

Once hazards have been identified, their risks to entrants should be assessed. A risk assessment is a process in which the expected severity of illness, injury, or property damage that an identified hazard can cause is coupled with the probability of that level of hazard occurring. If the level of risk is greater than what is acceptable, control measures should be introduced to reduce the risk to an acceptable level. The risk assessment enables prioritization of controls and limited resources or can indicate that a hazard needs to be eliminated in order to establish acceptable entry parameters.

6.4.2

Acceptable entry parameter steps, in general, are as follows:

(1) Identify hazards (through monitoring, visual inspections, documentation, etc.). Using the information in this chapter, conduct a thorough investigation of existing or potential hazards that could pose a danger to an entrant. Document findings and ensure that workers know what the hazards are and where they can be found.

(2) Conduct a hazard evaluation to determine the risks. Develop hazard scenarios that describe the environment, possible exposures, actions or events that could precipitate the hazard, and the outcome that would occur should it happen. In other words, determine what can go wrong, how it could get that way, what the consequences would be, and how likely the event is to happen. Consideration should also be given to the entrants themselves, since their level of training, experience, and PPE can contribute to or create hazards in and around confined spaces (e.g., wearing an encapsulated suit to prevent skin contact can create a heat stress hazard over an extended period of use in a hot environment.)

(3)* Assess and evaluate the –risks. Conduct a risk assessment of the hazards. This assessment can be quantitative, semiquantitative, or qualitative based on the needs of the situation and the identified hazards. There are numerous methods for conducting risk assessments; one such method is outlined in ANSI/AIHA Z10-2012, *Occupational Health and Safety Management Systems*

(4) Prioritize the risks. Note which of the hazards pose the highest risk and focus on controlling or eliminating those first.

(5) Determine control measures. It is always best to eliminate hazards when possible regardless of the probability or severity of the hazard. If that is not feasible, the next best strategy is to use engineering controls to reduce entrants' exposures. Engineering controls include such strategies as local exhaust ventilation to remove contaminants, general dilution ventilation to supply fresh air to the space, and substitution of materials so that chemicals are not introduced or produced during work in the space. Other types of control measures include administrative controls and PPE. Administrative controls include such measures as posting warning signs on confined spaces; ensuring that personnel are trained how to identify, evaluate, and control hazards; and instituting an organization-wide confined space safety program . PPE is used when engineering and administrative controls are not sufficient to reduce or eliminate the hazards — it is the last control measure in the hierarchy of controls because it does not reduce or remove the hazard. See Chapter 8 for hazard elimination and controls.

(6) Verify control measures. Ensure that the control measures chosen do not introduce another hazard that has a higher level of risk. For example, if ventilation ducts block the exit for workers, it could be determined that the risk of not having the ventilation outweighs the risk posed by the blocked exit.

(7) Determine if the level of risk is acceptable. Determine if the risk has been reduced to an acceptable level (as determined by the organization or the supervisor) with the control measures chosen. For example, the risk assessment might conclude that a complicated, redundant ventilation system is required for entry. A facility in-house confined space entry team might conclude they are uncomfortable and unfamiliar with implementing such a system and determine that they will not complete the entry; instead, they conclude the risk is too great and opt to hire a professional contractor.

(8) Implement and train. After the controls are implemented, ensure that personnel involved in the entry operations are informed of the hazards,

risk assessment determinations, and chosen control measures (and if those control measures might pose a hazard).

(9) Institute ongoing assessment. The identification and evaluation of hazards should be an on-going process as conditions often change in a confined space due to inherent, introduced and adjacent hazards. There should be regular visual and atmospheric monitoring of the space to ensure conditions do not change. Changing conditions may indicate the need to evacuate the space and re-evaluate it.

6.5 Communications.

A vital, reiterative part of reducing hazards is communication. It starts after the identification of hazards and communicates them to all persons involved with the entry or working around a confined space.

6.5.1

Communications can be accomplished verbally, through the use of signs and placards, on a Job safety analysis form, or on the permit itself. All verbal notification of hazards should be documented in writing.

6.5.2

The authorization for entry procedures should outline how communication during the entry, work and exit stages will be conducted, ensuring that authorized entrants and attendants can maintain contact during entry and throughout the work shift. Because voice communications can be hampered by noise, PPE, distance, and so forth, two forms of communication should be.

6.5.3

The risks and potential exposures of the entry as well as the signs and symptoms of exposure need to be communicated to the entrant and the attendant. The supervisor should ensure that they are familiar with equipment, such as PPE, atmospheric testing equipment, alarm systems, and the rescue equipment available.

6.5.4

Entrants and attendants should have the ability to witness and review any testing results conducted; if that is not done, then the results need to be communicated to them.

6.5.5

The means of rescue or recovery as well as the means of egress should be communicated to all entrants and attendants.

6.5.6

The supervisor needs to ensure that the attendant(s) has the means to notify the designated Rescue Team.

6.5.7

All personnel involved need to be informed of other key information given the circumstances of the particular confined space to ensure employee safety. This information includes, but is not limited to, additional permits (e.g., hot work, electrical work, lockout/tag out); other work being performed in the vicinity of the confined space; forecasted atmospheric conditions; and past concerns or issues with the space.

6.6 Resources.

The resources in 6.6.1 through 6.6.5 might be helpful in identification of hazards associated with confined spaces:

6.6.1 Safety Data Sheets (SDS).

Safety Data Sheets should be available and reviewed for recent materials that previously have been stored or used in a confined space being entered, have been used to purge a confined space being entered, or are being brought into the space being entered.

6.6.1.1

Safety Data Sheets should be reviewed or evaluated to determine, at a minimum, the flammability, combustibility, toxicity, asphyxiation hazard, and reactivity of materials.

6.6.1.2

All hazards identified during the SDS evaluation should be recorded on the confined space permit in accordance with Chapter 13 and evaluated and controlled in accordance with Chapters 7, 8, and 9 (atmospheric monitoring, ventilation, and hazard control sections).

6.6.2 Blueprints and Schematics.

Blueprints and schematics can provide information about the construction of the space, such as dimensions and distances. They can familiarize the entrant with equipment locations, size, power sources, and safety features.

6.6.3 Placards and Markings.

Warning placards and markings can provide entrants with specific hazard warnings, such as "Electrocution Hazard." They also provide warning of toxins and chemical hazards. The NFPA 704 marking system, which provides a warning of significant hazards, should be present at most facilities.

6.6.4 Department of Transportation Emergency Response Guide.

This guide is available online at http://phmsa.dot.gov/staticfiles/PHMSA/DownloadableFiles/Files/Hazmat/ERG2012.pdf

6.6.5 Documentation.

See Chapter 13 Permits.

NFPA 350®, Best Practices Guide for Safe Confined Space Entry and Work, proposed Edition

Edit Chapter Title

Chapter 7 Atmospheric Monitoring.

7.1 Procedures for Atmospheric Testing.

Atmospheric testing should be done using the criteria described in Chapter 7 prior to any confined space entry to determine if the atmosphere is safe for entry. Further atmospheric monitoring might not be necessary after initial entry testing based on the permit requirements of Chapter 13. Atmospheric testing is performed for three distinct purposes:

(1) Evaluation testing (initial hazard evaluation)

(2) Verification testing (pre-entry testing)

(3) Continuous monitoring of the atmosphere within the space *(See Section 7.12.)*

7.1.1 Evaluation Testing.

(Note: Evaluation testing is performed for the purpose of initial hazard evaluation and hazard identification. See Chapter 6.) The atmosphere of a confined space should be tested using equipment of sufficient sensitivity and specificity to identify and evaluate any atmospheric hazards that could exist or arise, so that appropriate permit entry procedures can be developed and acceptable entry conditions can be stipulated for that space. Evaluation and interpretation of the data and development of the atmospheric monitoring procedures necessary for entry, should be done by or reviewed by a technically qualified professional such as but not limited to a Certified Industrial Hygienist, Certified Safety Professional, or Certified Marine Chemist based on evaluation of all hazards.

7.1.2 Verification Testing (Pre-Entry Testing).

The atmosphere of a confined space should be tested for all hazardous contaminants identified by the evaluation testing above or by the permit issuer or entry supervisor using appropriate equipment to determine that the atmospheric concentrations at the time of entry are within the range of acceptable entry conditions as described in 8.2.1. Results of testing (actual gas concentrations, etc.) should be recorded along with the stipulated acceptable entry conditions according to the permit recommendations in Chapter 13. All detection equipment should be designed for the gases and vapors being tested and certified for use in the environment where it is being used. Refer to manufacturers' specifications and hazardous location certifications.

7.1.3

All portable gas monitoring equipment used for confined space atmospheric testing should be turned on and zeroed according to Section 7.9.

7.1.4

All portable gas monitoring equipment used for confined space atmospheric testing should be bump tested and calibrated according to Sections 7.6 and 7.7.

7.1.5

If atmospheric testing is done from outside the space, initial testing should be performed with all ventilation controls turned off to ensure testing of a static atmosphere and to determine the background gas concentration levels in the event that ventilation fails during the entry. However, after the initial testing is completed, it is acceptable to test the atmosphere with the ventilation controls turned on if ventilation is necessary as a means to mitigate the hazard.

7.1.6

Tests for atmospheric hazards should be conducted simultaneously or in the following order:

(1) Oxygen deficiency and/or oxygen enrichment. An oxygen-deficient atmosphere represents the most common atmospheric hazard in confined spaces. Most combustible gas sensors are oxygen dependent and might not provide reliable readings in oxygen-deficient atmospheres. Therefore, oxygen concentrations should be noted during testing first to ensure that sufficient oxygen is present for proper sensor operation according to the equipment manufacturer's recommendations.

(2) Combustible or flammable mixtures. Combustible gases and vapors present an immediate threat for fire and explosion and are a common atmospheric hazard found in confined spaces.

(3) Toxic gases and vapors as necessary and determined by hazard identification *(see Chapter 6)*:

   (a) Carbon monoxide (CO) and hydrogen sulfide (H2S) are the two most common toxic gases found in confined spaces.

   (b) Carbon monoxide is a by-product of combustion and should be a suspected hazard in and around any space where combustion processes occur.

   (c) Hydrogen sulfide is a by-product of decomposition of organic material and debris and should be suspected whenever there is natural decay of any plant or animal material.

7.1.7

The qualified gas tester performing atmospheric testing should be trained and knowledgeable with regard to the potential atmospheric hazards and the specific monitor being used to test the confined space according to Section 7.8 and Chapter 11.

7.1.7.1

The qualified gas tester performing atmospheric testing should verify that the monitor is functioning properly *(see Sections 7.6 and 7.7)*, has the appropriate accessories (filters, tubing, probes, etc.) and is equipped with the proper sensors for the identified atmospheric hazards related to the confined space. In addition, the qualified gas tester should have an understanding of the equipment specifications, including, but not limited to, response time, measurement range, and operating temperature *(see Section 7.2)*.

7.1.8

If the confined space has not been opened or the atmosphere is not immediately accessible for testing, the qualified Gas Tester should open the confined space just enough to allow insertion of the probe for testing. Any potential hazard including but not limited to pressure and electric shock should be eliminated prior to opening the space. *Note: Many manhole covers have a small opening to allow the insertion of a sampling hose.*

7.1.8.1

If the entrance to the confined space could be affected by wind or ambient air flow, the qualified gas tester should remain on the upwind side of the entrance.

7.1.8.2

The purpose of testing before completely opening the confined space is to prevent creation of an immediately hazardous atmosphere either inside or outside the confined space and to protect the personnel outside the space.

7.1.9

As much of the confined space's horizontal or vertical area(s) should be tested by use of a pump and remote probe or sample hose from the outside before the space is entered for further testing.

7.1.10

Testing should include all irregular areas of the confined space where atmospheric hazards could be present or could accumulate. *(See Section 7.11.)*

7.1.11

If entry into the confined space is required to test the entire area, the confined space should be ventilated according to Chapter 9, and a second qualified gas tester, who can be the intended space entrant, equipped with all appropriate PPE (breathing air, harness, lifeline, etc.) can enter the space to complete the test, which would include irregular areas where pockets of gas could become trapped. An entry permit and an attendant are required for this operation. *Note: It is not uncommon for each entrant to be equipped with a multi-gas monitor in this situation.*

7.1.12

When testing for entries involving a vertical descent is performed, the atmosphere should be tested according to the procedures outlined in 7.11.2

7.1.13

If the confined space requires a horizontal entry, the atmospheric testing should be performed according to 7.11.3.

7.1.14

The qualified gas tester performing the atmospheric testing should document the initial results of the atmospheric monitoring, including all gas readings, along with but not limited to the tester's signature and the date and time of the gas test, on the entry permit.

7.1.15

While the pre-entry test determines the initial air quality before the confined space is entered, it is important to monitor for changes in the atmosphere that could occur during work operations inside the space to ensure that a safe atmosphere is maintained. Therefore, continuous atmospheric monitoring according to 7.12 should be performed.

7.1.16

If hazardous atmospheric conditions as described in Section 7.14 are detected during pre-entry testing, entry should be prohibited until corrective actions are taken and retesting verifies acceptable atmospheric conditions.

7.1.17

Any change in atmospheric measurements should be reported to the entrant and the entry supervisor immediately. The test results should be recorded, documenting the change in concentration and time.

7.1.17.1

If any results from atmospheric testing while working within the confined space exceed the acceptable limits for entry described in Section 7.14, all work should cease and the space should be evacuated immediately.

7.2 Selection and Types of Monitors.

7.2.1

A gas monitor should be selected based on the initial hazard evaluation of the confined space. The atmospheric hazards that could be in the confined space prior to entry and during work in or around the space should be defined in accordance with Chapter 6. Once the atmospheric hazards are determined, the proper monitor can be selected.

7.2.2

Confined space monitors should be calibrated, direct reading, continuous monitoring instruments. The monitor should detect for oxygen (O2) content, flammable gasses and vapors (LFL), and for potential toxic gases. These are minimum requirements. The hazard evaluation will determine if it is necessary to monitor for specific gases, including, but not limited to, carbon monoxide (CO), hydrogen sulfide (H2S), ammonia (NH3), or volatile organic compounds (VOCs), like benzene. Each of these hazardous gases can require its own unique sensor technology in order to be detected properly. In addition, monitoring of other potential atmospheric hazards could be necessary according to the hazard identification and hazard evaluation.

7.2.3

Portable gas monitoring instruments should be used for confined space entry atmospheric testing. In confined spaces where fixed gas detectors are installed, portable instruments should be used for pre-entry testing and worn by the entrant in the space.

7.2.4 Monitor Accuracy.

7.2.4.1

Direct reading instruments used for the purpose of evaluating or verifying confined space atmospheres should provide reading accuracy of +/-20 percent of the actual gas concentration or better in all use conditions that are covered within the monitors' operating specifications.

7.2.4.2

Instruments using correlation or response factors to determine the level of a particular gas or vapor concentration present that is different from that for which the sensor or instrument is calibrated should have accuracy of +/-30 percent or better with the correlation factor applied. For example, a monitor equipped with a PID-calibrated to isobutylene can be used to detect the level of trichloroethylene in a confined space. The monitor reading should be multiplied by a correlation or response factor, specified by the manufacturer, to determine the relative concentration of trichloroethylene in the space. The accuracy of the value after the reading has been multiplied by the correlation factor should be better than +/-30 percent.

7.2.4.3

In addition to the accuracy stated in 7.2.4.1 and 7.2.4.2, the user should be aware of the instrument's capabilities in the areas discussed in 7.2.5 through 7.2.10.

7.2.5 Limits of Detection.

The minimum detection limit (MDL) (the smallest level of a gas that can be detected within the specified accuracy or repeatability of the monitor) should be less than 2 percent for oxygen, 2 percent LFL for combustible gases, and at least one order of magnitude lower than the published PEL or TLV, whichever is lower, for toxic gases. The levels can be determined from manufacturers' specifications. For example, the current OSHA PEL for chlorine (Cl2) is a ceiling limit of 1.0 ppm. The MDL for a chlorine monitor should be less than or equal to 10 percent of 1 ppm, or 0.1 ppm. Lower MDLs will provide for greater reading stability and confidence around gas concentration action points and reduce or eliminate false or nuisance alarms due to detector or sensor instability.

7.2.6 Measuring Range.

The instrument measuring range for detection of each of the targeted gas hazards should be known and be verified to be adequate for proper evaluation of all potential hazards. Instrument and sensor measuring ranges should be greater than or equal to 25 percent for oxygen, 100 percent LFL for combustible gases, and greater than or equal to 50 percent of the IDLH level for toxic gas hazards. These levels can be determined from manufacturers' specifications. Note: It is desirable to use instruments with broader measuring ranges in order that atmospheres with contaminants that are outside normal limit values can be properly evaluated, proper mitigation procedures can be established and followed, and proper PPE can be issued and used.

7.2.7 Interferences.

7.2.7.1

Instrument users should be aware of gases other than the targeted sensor gas that can interfere with and cause erroneous sensor readings. For example, typical carbon monoxide sensors will produce an erroneous response when exposed to hydrogen. It is important that all known potential atmospheric contaminants are identified, whether or not they can be considered to present a hazard to the entrant of the space, and the effect on the particular contaminant on the instrument's sensors be verified with the instrument or sensor manufacturer.

7.2.7.2

Certain compounds can produce positive interferences that enhance or make instrument or sensor readings appear greater than actual target gas concentrations. Unless the presence and concentration of a potential positive interfering gas can be positively identified and confirmed, the resulting reading should be accepted as the true representation of the targeted gas concentration and proper action steps taken accordingly.

7.2.7.3

Certain compounds can produce negative interferences that make instrument/sensor readings appear lower than actual target gas concentrations. In the event that a known negative sensor interfering gas is encountered, the resulting reading from the concentration of that interfering gas determined or believed to be present should be added to the instrument reading for the target gas and the sum of the two values accepted as the actual concentration of the target gas present with proper action procedures followed as a result.

7.2.7.4

Commonly known sensor interferences should be listed in the instrument user's manual or otherwise provided by the instrument's manufacturer.

7.2.7.5 RFI/EMI.

Instrument/sensor readings can be affected by radio frequency interference (RFI) or other electromagnetic interference (EMI).

7.2.7.5.1

Instruments used for evaluation/verification of confined space atmospheres should be certified by the manufacturer to tested and verified to perform in accordance with relevant guidelines for RFI/EMI.

7.2.7.5.2

Care should be taken to keep instruments isolated from potential sources of RFI/EMI as much as possible during use. As a rule, portable electronic instruments should not be used within 18-in. of the antenna of a transmitting mobile or hand-held radio.

7.2.8 Environmental Factors (Temperature, Humidity, Pressure/Altitude).

Portable gas monitoring instruments can be affected by environmental factors, including, but not limited to, temperature, relative humidity, and atmospheric pressure.

7.2.8.1

All instruments/sensors used for evaluation/verification should be compensated for the effects of temperature on the readings throughout the full measuring range of the sensor and the full operating temperature range of the instrument.

7.2.8.2

The absolute effects as well as the effects of changes in relative humidity and pressure/altitude on the monitor readings should be identified and understood in accordance with the manufacturer's product recommendations.

7.2.9 Alarm Indications

7.2.9.1

Monitors should have simultaneous, multiple alarm indicators, including audible, visible, and vibrating alarms to indicate the conditions in 7.2.9.2 through 7.2.9.6.

7.2.9.2 Gas Alarm Set Points.

Portable gas monitors should have preset alarm values but also should allow the user to set the alarms at particular levels. It is critical that a qualified health and safety professional be consulted to determine the level at which instrument/sensor alarms should be set for a specific application.

7.2.9.3

Portable gas monitors should have at least two levels of instantaneous alarms for all sensors (oxygen, LEL, and toxics).

7.2.9.4

Portable gas monitors should have alarms to indicate that the Short Term Exposure Limit (STEL) for toxic gases has been exceeded.

7.2.9.5

Portable gas monitors should have time weighted average (TWA) (typically 8 hours average) alarms for toxic gases.

7.2.9.6

Gas monitors should have alarms to alert the user to other conditions, including, but not limited to, the following:

(1) Low battery

(2) Low flow (on instruments that include remote sampling pumps)

(3) Sensor failure

(4) Calibration past due

(5) Bump test past due

7.3 Other Monitor Types.

7.3.1

If the confined space potentially could have atmospheric hazards that current gas monitoring technology cannot detect, other types of detection equipment should be utilized to assess the atmosphere. Such potential air contaminants could include uncommon chemicals, particulates, and, in some cases, unknown air contaminants. Colorimetric detector tubes and industrial hygiene sampling are two methods that can be utilized.

7.3.2

Colorimetric detector tubes that are selected for particular chemicals can sometimes be used for screening purposes. These tubes, which are usually made of glass, change color in accordance with the concentration level of contaminant measured. Air is drawn through the tube with a bellow or manual aspiration pump.

7.3.3

Detector tubes should be used as according to the manufacturers' specifications. Most detector tube manufacturers require that only their brand of pump be used.

7.3.3.1

Prior to use, detector tube pumps should be leak checked. This is typically done by compressing the bellows fully, inserting an unbroken tube and releasing the bellows to see if they expand. The bellows will remain fully compressed if no leaks in the pump exist.

7.3.3.2

If measurements are to be made inside a confined space, the detector tube should be attached to the end of the sampling hose and not near the pump. Otherwise, the air in the tubing will be measured rather than the air in the confined space, resulting in erroneous measurements.

7.3.3.3*

Most colorimetric test methods are best used for screening purposes since they are typically only accurate to within +/-25 percent. To ensure safety, 25 percent should be added to the resulting reading to determine what the level of toxic gas might actually be in the confined space.

7.3.4*

If direct reading instruments or colorimetric tubes are not available to assess the potential hazard, laboratory-based industrial hygiene monitoring with intrinsically safe battery-operated pumps and various air contaminant collection filters, tubes, impingers, or other devices, such as vacuum canisters, should be used. They might be the only means available to measure air contaminants.

7.4 Intrinsic Safety.

All monitors used for the purpose of testing for atmospheric hazards within a confined space should be appropriately certified by a nationally recognized testing laboratory (NRTL) to be intrinsically safe for use in the space according to the classification of hazardous atmospheres under *NFPA 70, National Electrical Code*. *(See Chapter 8.)*

7.5 Personal Monitoring Versus Remote Sampling.

Direct-reading gas monitors can be used in different configurations. Diffusion or passive (personal) monitors work on the basis of the gas sensors being exposed to the ambient environment, unassisted. The sensors sense the immediate ambient environment surrounding the gas monitor. Remote sampling or sample draw mode utilizes either a manual or an automatic pump. The pump could be an attachment or internal to the gas monitor. In either configuration the pump draws air through a probe and tubing into the gas monitor and directly onto the sensors, which allows the gas monitor to sense the environment away from where the gas monitor is located.

7.5.1*

In all cases, remote sampling should be done prior to entering a confined space. The instrument and its display should be in the direct sight of the qualified gas tester at all times during testing. A pump, defined length of tubing, and a probe will be connected to the gas monitor while the qualified gas tester remains outside the confined space with the gas monitor and inserts the probe and tubing into the confined space to the farthest possible point from the entry.

7.5.1.1* Tubing Length and Response Times.

The qualified gas tester should ensure that adequate time is allowed to completely purge the sample tubing and ensure that a full reading is obtained during remote sampling operations. Most automatic pumps will draw at approximately 2 seconds per foot of sample tubing. Therefore, the qualified gas tester should allow 2 seconds for every foot of sample probe and tubing used plus the normal instrument response time for the air from the sampling area to be sensed by the sensors.

7.5.1.2

The instrument manufacturer should be consulted to determine the proper type of sample tubing or probe to be used to detect particular hazards because there are some gases that can be absorbed into specific types of tubing, producing erroneous readings.

7.5.2

Gas monitors for personal monitoring should be used in the diffusion mode.

7.5.2.1

Confined space entrants should wear a gas monitor at all times during the entry. It is critical that the monitor does not get covered by clothing or PPE or it will no longer be measuring the atmosphere.

7.5.2.2

Confined space attendants also should wear a direct-reading, diffusion mode gas monitor, or one should be placed in the area outside the space. This allows the attendant to monitor the environment just around the confined space to make sure the environment around the confined space is not changing. For example, if ventilation is exhausting toxic materials outside the space, it could affect the adjacent space and attendant even if the inside of the confined space is not showing elevated readings. If there is a toxic or combustible gas reading outside the confined space, it could affect the environment in the confined space. The sooner the attendant can be made aware of this, the more effective decision making can be.

7.6 Monitor Calibration

7.6.1

A calibrated, direct-reading instrument is required for entry into a confined space. A calibrated instrument is one that has completed a span calibration function before being put into service. Executing a span calibration is the best way to ensure the unit is reading concentrations as designed. Span calibration is the action of exposing a direct-reading instrument (or sensors) a defined concentration of calibration gas. Prior to completion of a span calibration, the direct-reading instrument should have a zero calibration performed in a clean air environment, preferably outdoors and upwind from any sources of air contaminants.

7.6.1.1

The gas monitor should be programmed to sense a set concentration of specific gases aligned to the configuration of the instrument for the purpose of calibration. For example, the instrument might be programmed to read 20.9 percent oxygen (O2), 32 percent methane (LFL), 25 ppm hydrogen sulfide (H2S), and 50 ppm carbon monoxide (CO) during the calibration process. The instrument will then be exposed to a blend of calibration gases of the identical defined concentrations of the same gases. The instrument will then "calibrate" what it is programmed to see to what it is being exposed to. This is a span calibration. Through this process, the instrument will either pass or fail the span calibration. If it fails, the unit should be removed from service and tagged for maintenance. If the instrument passes, it is acceptable to use for confined space monitoring.

7.6.1.2

The gas monitor instruction manual or the manufacturer should be consulted to determine the proper gases and concentrations to be used for monitor calibration. Calibration gas can vary depending on the manufacturer of the calibration gas. There are different types of combustible gases used in calibration gas blends (pentane, propane, methane, etc.). Each gas monitor manufacturer has a rationale on which type of combustible gas should be used to most accurately calibrate their combustible sensors. The manufacturer's recommendations should always be followed. If the manufacturer of the gas monitor provides calibration gas, the calibration gas from the same manufacture as the gas monitor should be used. This ensures that the calibration gas cylinders have gone through a quality assurance program in alignment with the gas monitors.

7.6.2

Calibration results should be documented. Some direct-reading gas monitors have a data-logging feature that allows the calibration process to be documented and downloaded from the instrument, which allows electronic storage of the activity. Otherwise, the following data related to monitor calibration should be documented manually:

(1) Date of test

(2) Serial number of instrument and sensors tested

(3) Serial number of any docking/calibration station used to perform the test or name of individual conducting a manual test

(4) Type and concentration of each gas used to conduct the test

(5) The result of the test for each sensor in the instrument tested.

7.6.3

The person performing calibration should ensure that the gas monitor is programmed to sense the gas concentrations listed on the cylinder label.

7.6.4

The person performing the calibration should ensure that the calibration gas cylinder has not expired. Gas cylinders typically have a shelf life of 2 years or less, depending on the type of gas in the cylinder. Calibrating with expired gas can result in inaccurate calibration and is not acceptable.

7.6.5

When a manual span calibration is conducted, the person performing the calibration should ensure that the regulator and tubing meet the gas monitor manufacturer's recommendations for the gases that are being calibrated. Regulators can come in a variety of materials and flow rates. If the manufacturer specifies a 0.5 LPM flow rate, a regulator with that flow rate should be used. If the manufacturer of the gas monitor supplies regulators, a regulator from that manufacturer should be used. A manufacturer that owns the quality assurance program for all components will ensure a more accurate calibration process and less questions for troubleshooting if there are questions along the way.

7.6.6

Gas monitor span calibration can be performed utilizing an automated docking or calibration station. A docking station made by one manufacturer should be used to calibrate an instrument manufactured by another. Docking stations are designed specifically by a manufacturer to be used with its gas monitors. Docking stations should ensure that the calibration process is documented. When possible, a docking station should be utilized as part of the calibration process. Docking stations help eliminate potential errors in the manual process and also can be more efficient in the use of calibration gas.

7.7 Zeroing.

Prior to any atmospheric testing, the gas monitor should be zeroed in a known clean air environment according to the manufacturer's recommendations and instructions.

7.8 Bump Testing

7.8.1

Instruments used for the evaluation/verification of confined space atmospheres should be bump tested prior to each day's use. A typical bump test will take 30 to 45 seconds and is a critical step to ensuring that the gas monitor is functioning since it was last used or calibrated.

7.8.1.1

The only way to ensure that a portable gas monitoring instrument will respond to the targeted gas is to test it with a known concentration of that gas or an acceptable surrogate gas.

7.8.1.2

A bump test is defined as a brief exposure of the instrument/sensors to specified target gas(es) for the purpose of verifying sensor and alarm functionality. It is not intended to be a measure of the accuracy of the instrument/sensors.

7.8.1.3

Any instrument that fails to respond properly during a functional bump test should undergo a successful full calibration prior to further use.

7.8.2

An instrument bump test should be performed prior to daily use using an automated docking or bump test/calibration station or by manual application of gas to the sensors.

7.8.3

The test should be performed by applying a known concentration of each of the target gases to the instrument/sensors individually or in combination and verifying that each sensor responds in a positive manner and that all instrument alarms are activated accordingly.

7.8.4

The concentration of gas used for the purposes of conducting a bump test should be greater than the lowest alarm set point for each sensor.

7.8.5

Surrogate gases (a gas different from the explicit target gas for the sensor) can be used for the purpose of conducting a bump test of the sensor provided that the concentration of gas used produces a response equivalent to or greater than the concentration of the target gas required to exceed the lowest alarm set point for each sensor. This should be done in accordance with manufacturer's approval.

7.8.6

Bump test results should be documented and include the following data:

(1) Date of test

(2) Serial number of instrument and sensors tested

(3) Serial number of the docking/bump station used to perform the test or the name of individual conducting a manual test

(4) Type and concentration of each gas used to conduct the test

(5) The result of the test (Pass/Fail) for each sensor in the instrument tested

7.9 Clearing Peak Values.

Prior to any atmospheric testing, the gas monitor's stored peak reading values should be reset according to the manufacturer's recommendations and specifications.

7.10 Training and Competency.

All personnel serving as qualified gas testers should be trained in the proper use of the gas monitor according to the manufacturer's recommendations and in accordance with the requirements given in Chapter 11.

7.11 Continuous Air Monitoring.

7.11.1

It is imperative that the atmosphere in and around a confined space remain safe during ongoing entry operations. Conditions can change quickly or slowly over time; without continuous air monitoring, air contaminants can increase or oxygen percentage can decrease, creating dangerous confined space atmospheric conditions. Entrants, attendants, and other involved personnel especially might be unaware of changing conditions if the air quality was initially monitored and determined to be acceptable.

7.11.2

There are many reasons that air quality can deteriorate in and around confined spaces, including air contaminants being generated by entrant activities, increased temperatures causing additional chemical vaporization, and existing hazards that have not been adequately controlled.

7.11.3

Continuous air monitoring is the best method to ensure that air quality remains acceptable throughout entry operations. The OSHA Permit Required Confined Spaces regulation requires that "entry conditions should be continuously monitored in the areas where authorized entrants are working" [29 CFR 1910.146(d)(5)(i)].

7.11.4

Air quality meters for common confined space air contaminants and oxygen are designed to perform continuous air monitoring. In addition, many meters have features, such as "peak" and "STEL" (short term exposure limit) that allow for data review of the highest air contaminant concentration and lowest oxygen reading. Data typically can be downloaded and stored electronically.

7.11.5

It is advantageous for the confined space attendant to use and view the meter as long as the measurements are taken in the vicinity of the confined space entrants. Having an additional meter(s) worn by one or more entrants provides additional air monitoring evaluation.

7.12 Acceptable Limits for Entry.

The atmosphere in the confined space should be considered within acceptable limits for entry whenever the following conditions are maintained *(see Chapter 5)*:

(1) Oxygen concentration within the range of 19.5 percent to 22.0 percent

(2) Combustible gas concentration less than 10 percent of the LEL

(3) Toxic gas concentrations less than the recognized occupational exposure limits for the respective gases

7.13 Maintenance.

7.13.1

Confined space meters need to be maintained according to the manufacturers' specifications to ensure that they operate properly, to maximize their longevity, and to maintain their warranties. Occasional inspection for damage, cleaning, proper battery charging, and periodic sensor replacement is all that is typically needed to be done by the user. Major repairs should been done by the manufacturer.

7.13.2

Sensors have limited service lives, even when the meters are used infrequently. The oxygen sensor typically has the shortest life, usually 2 to 3 years. The majority of confined space meters have rechargeable batteries that provide years of service as long as they are charged according to the manufacturers' procedures.

7.14 Record Retention.

7.14.1

Records pertaining to gas monitoring instruments and confined space atmospheric testing should be retained according to all applicable regulations.

7.14.2

Records should be maintained with regard to calibration and bump testing, personnel exposure, and gas monitor maintenance.

NFPA 350®, Best Practices Guide for Safe Confined Space Entry and Work, proposed Edition

Edit Chapter Title

Chapter 8 Hazard Elimination and Control

8.1 General.

Inherent, introduced and adjacent hazards identified in and around confined spaces should be completely eliminated or controlled to the extent possible prior to entry. The confined space Entry Supervisor and/or Permit Issuer should ensure that all hazards have been eliminated or controlled and should document the corrective actions taken on the confined space permit. Hazards that are unable to be adequately eliminated or controlled should be clearly noted on the permit and personal protection or other provisions should be made for safe entry.

8.2 Chemical and Atmospheric Hazards.

Atmospheric hazards identified during gas monitoring should be eliminated or controlled prior to entry. Methods to remove hazardous materials include cleaning, displacement or purging using ventilation. Where this cannot be initially accomplished, inerting and purging, or other methods to provide a safe atmosphere for entry and work should be utilized. Suggested methods to remove hazardous atmospheres are given in 8.2.1–8.2.3. Atmospheric monitoring should be performed in accordance with Chapter 7 to confirm the space is safe to enter prior to entry.

8.2.1 Acceptable Entry Conditions.

When levels are outside the following parameters , entry is allowed only after control measures as indicated in Chapter 8 are applied.

(1) < LFL (LEL): 10 percent

(2) O2: 19.5 percent to 22.0 percent

(3) Toxic materials: any level

8.2.2 Removal of Hazardous Materials and Vapor Freeing.

Residual materials in confined spaces should be removed from the space prior to entry. This can be done by cleaning, ventilating and/or purging with inert gas, water or steam.

8.2.2.1*

Whenever possible, the confined space should be cleaned from the outside without the need for entry.

8.2.2.2*

Remaining vapors and toxic gases should be exhausted to eliminate hazards when entry is required using ventilation blowers and controlled exhaust eductors in accordance with Chapter 9. Note that intrinsically safe blowers and eductors should be used for flammable or combustible vapor removal.

8.2.2.3

Methods such as purging with an inert gas, water or steam can be used to remove residual vapors. See 8.2.3 and 9.5.9.

8.2.2.4 Regulations and Standards for Tank Cleaning.

8.2.2.4.1

Confined space entries of petroleum storage tanks should be in accordance with API 2015, *Requirements for Safe Entry and Cleaning of Petroleum Storage Tanks*, and API 2016, *Guidelines and Procedures for Entering and Cleaning Petroleum Storage Tanks*. These standards provide detailed safety requirements for above ground petroleum storage tanks.

8.2.2.4.2

Cleaning and entry of tanks other than petroleum tanks should be in accordance with NFPA 326, *Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair*. This standard provides detailed safety requirements for tanks that are not above ground petroleum tanks.

8.2.2.4.3

Confined space entry in marine vessels should be in accordance with NFPA 306, *Standard for the Control of Gas Hazards on Vessels*. This standard provides advice for entry into confined spaces on marine vessels.

8.2.2.5 Chemical Residues.

Even after cleaning has been completed, chemical residues might be present. A review of the SDS should be done to determine if the chemical residues could be corrosive or absorbed through the skin. Methods such as wipe testing, testing with pH paper should be done prior to entry. This will help determine if additional cleaning and the type of personal protective equipment required.

8.2.3 Combustible Dusts.

Combustible dust residue should be removed using intrinsically safe vacuums or using manual cleaning. Compressed air should not be used to move or clean combustible dust.

8.2.4 Inerting.

Entry into inert atmospheres should not be allowed except in very limited circumstances. If hot work is to be conducted in or adjacent to a confined space that contains flammable or combustible vapors or liquids, one method of controlling the ignition hazard is to displace the oxygen within the space by inerting. Inert gas can also be used to displace oxygen in situations where flammable materials or atmosphere cannot be removed prior to entry. Following the use of inert gas, the space should either be ventilated with air in accordance with Chapter 9 until acceptable entry conditions are met in accordance with 8.2 prior to entry.

8.2.4.1

Containers adjacent to a confined space where and work is to be conducted should also be considered as potential sources of flammable material and should be made safe prior to the start of hot work.

8.2.4.2

Whenever inert gases are used to purge a space, consider the discharge point for the evacuated atmosphere from the space in relation to the workers outside the space and any related processes or work adjacent to the space. It might be necessary to perform atmospheric testing in the adjacent areas and to create barriers with approach distances to insure that levels of exhausted contaminants are within acceptable levels as defined in 8.2. Hot, warm, and cold zones can be used to delineate areas of hazard.

8.2.4.3

Whenever inerting is performed the atmosphere within 35 feet of the opening should be tested as needed, to assure that it is safe for breathing. In outside environments wind direction and speed should be taken into consideration and area of testing extended if necessary.

8.2.4.4

The confined space and the surrounding area should be posted to indicate that the space has been inerted.

?Check National Safety Council?

DANGER INERT GAS ENVIRONMENT

ATMOSPHERE UNSAFE FOR WORKERS

INSUFFICIENT OXYGEN FOR BREATHING

DO NOT ENTER

8.2.4.5

Entry into inert atmospheres should not occur except in well controlled situations where no other option for entry is available. If an inert atmosphere remains, a combination full face-piece pressure demand supplied air respirators (SAR) with auxiliary Self Contained Breathing Apparatus (SCBA) escape mechanism or a full face-piece pressure demand SCBA with a 30 minute tank should be provided to and used by entrants. A full respiratory protection program that includes fit testing and medical screening should be developed before providing an employee with a respirator.

8.2.4.6 Regulations and Standards for Inerting.

8.2.4.6.1

Inerting in the maritime industry should be in accordance with NFPA 306, *Standard for the Control of Gas Hazards on Vessels*. This standard includes a section on inerting procedures for marine vessels.

8.2.4.6.2

Inerting in above ground petroleum storage should be in accordance with API 2217A Guidelines for Safe Work in Inert Confined Spaces in the Petroleum and Petrochemical Industries.

8.2.4.6.3

Inerting in other storage tanks should be in accordance with NFPA 326, *Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair*.

8.3 Hot Work.

8.3.1 General.

Hot work is any work that may produce a source of ignition. Sources of ignition include, but are not limited to open flames, sparks or heat producing activity and is typically associated with cutting, welding, grinding, drilling, abrasive blasting, burning, heating and brazing operations as part of maintenance or construction work. It also includes the use of non-approved electrical equipment in flammable atmospheres, internal combustion powered equipment, and so forth. Hot work in areas containing flammable vapor/air mixtures has been the source of many confined space accidents including injuries and fatalities. Sometimes, these fatal accidents occur in spaces adjacent to the confined spaces when these spaces had not been considered as a part of the confined space evaluation.

8.3.2 Hot Work Permit.

When hot work is required in or adjacent to a confined space, a separate hot work permit should be issued by the qualified hot work Permit Issuer and should be attached to the confined space permit. The facility where hot work is to occur (or the contractor conducting the hot work) should have a hot work program and permit procedures. The hot work permit should contain information, including, but not limited to:

(1) Conditions under which hot work permit authorization is to start and stop or be cancelled.

(2) Requirements for ventilation, inerting or other atmospheric precautions

(3) Requirements for continuous monitoring of the atmosphere within and outside of the confined space while hot work is being conducted.

8.3.3 Cold Repair Options.

Whenever possible hot work should not be performed in or around confined spaces. Alternative means such as mechanical cutting, cold cutting, scraping, and hand grinding or filing with equipment that minimizes the potential for sparks and heat should be considered. For instance, cutting can be performed with hand saws, hydraulic shears, pneumatic chisels or pipe cutters. Mechanical joining methods such as nuts and bolts, screwed fittings, or couplings can be used. Hand filing is an option instead of mechanical grinding, and threaded pipe is an alternative to welded or soldered pipe. Note-sparks can still be generated using some of the techniques recommended but the risk is greatly reduced.

8.3.4

Whenever hot work may be performed, the qualified person should evaluate all potential locations where flammable or combustible materials may have accumulated and take measures to remove and clean the materials from these locations and adjacent spaces prior to issuing the hot work permit. Hot work should not be done on or in the adjacent area of “live” tanks or lines containing flammable or combustible materials unless there is no other alternative and a hot work permit covering such activity gas been approved.

8.3.5

Tanks containing flammable or combustible materials should be gas-free, cleaned or inerted prior to hot work being performed in or around confined spaces. Precautions should be taken to insure that there are no ignition sources in the area adjacent to the confined space being cleaned or inerted since the vapors exiting the space will be flammable or combustible as well.

8.3.6

Hot work should never be performed above a tank, container or line containing flammable of combustible materials unless precautions have been taken to shield the area below from falling materials and assure that vapors from the space cannot reach the area of hot work. An example of this would be the use of a welding blanket to cover pipes that contain flammable or combustible liquids.

8.3.7

Atmospheric monitoring should be conducted in adjacent spaces within 7.6 meters (35 feet) horizontally of the hot work being performed. No hot work should be performed unless atmospheric testing indicates that levels of 02 levels are less than 22% by volume and the LFL is less than 10% unless appropriate precautions are taken and the work is specifically authorized by the hot work permit.

8.3.8

Consideration should also be given for adjacent spaces that are above and below the work being conducted. Note that when welding takes place on an elevated surface, all surfaces below the elevated platform in the vicinity of the welding are potentially at risk.

8.3.9

Fire protection indicated in the hot work permit such as appropriate portable fire extinguishers selected in accordance with NFPA 10 should be located within 10 feet of the hot work area. Hoses and foam producing equipment may also be used.

8.3.10

Oxygen, flammable gas and inert gas tanks should remain outside a confined space whenever possible. Leaking oxygen lines can create and oxygen-enriched environment which can lead to increased fire and explosion hazards and leaking acetylene can create a flammable atmosphere.

8.3.11

All hoses and torches associated with oxygen and gas cylinders should be disconnected and the gas and oxygen supply shut off during extended break periods of more than 1 hour.

8.3.12

All electrical welding equipment used in flammable and combustible atmospheres should be intrinsically safe, be inspected and approved by a qualified person and be properly grounded.

8.3.13

Combustible materials should not be located within the 35 feet of where hot work will be performed.

8.3.14 Regulations and Standards for Hot Work.

All welding and hot work should be in accordance with applicable regulations, codes and recommended standards applicable to the particular industry or type of operation being performed. The most current regulations, codes and recommended practices should be followed. A summary of those standards follows:

8.3.14.1 General Industry.

8.3.14.1.1

Those workplaces that are considered general industry according to OSHA should follow requirements given in OSHA 1910 Subpart Q - Welding, Cutting, and Brazing (1910.251-1910.255) as a minimum. These standards provide both general requirements and specific requirements for oxygen-fuel gas welding and cutting, arc welding and cutting and resistance welding. In addition to the minimum OSHA general industry requirements, several additional standards should be considered.

8.3.14.1.2

ANSI Z49.1, Safety in Welding, Cutting, and Allied Processes provides for the safe setup and use of welding equipment and the safe performance of welding and cutting operations. It has specific provisions for oxyfuel gas and arc welding and cutting, resistance welding, electron beam welding, laser beam cutting and welding as well as brazing and soldering. The standard is generally applicable to other welding processes such as submerged arc welding and allied processes

8.3.14.1.3

NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work* provides guidance for persons, including outside contractors and property managers, who manage, supervise, and perform hot work.

8.3.14.1.4

NFPA 326, *Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair* provides minimum procedures that permit repair, hot work, or other operations that have the potential to create a fire, an explosion, or another hazard whenever hot work will be performed on tanks or containers containing flammable, combustible or other hazardous substance vapors, liquids, or solid residues, The American Welding Society also has information regarding hot work operations.

8.3.14.2 Construction Industry.

8.3.14.2.1

In construction settings OSHA 1926 Subpart J-Welding and Cutting (1926.350-1926-354) provides information for gas welding and cutting, arc welding and cutting, fire prevention, ventilation in welding cutting and heating, and welding cutting and heating in way of preservative coatings.

8.3.14.2.2

NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work* provides guidance for persons, including outside contractors and property managers, who manage, supervise, and perform hot work in the construction industry.

8.3.14.2.3

NFPA 326, *Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair* provides minimum procedures that permit repair, hot work, or other operations that have the potential to create a fire, an explosion, or another hazard whenever hot work will be performed on tanks or containers containing flammable, combustible or other hazardous substance vapors, liquids, or solid residues,

8.3.14.3 Shipyard/Maritime.

In shipyard/maritime settings OSHA regulations included in 1915 Subpart B (1915.11-1910.16) and 1915 Subpart D(1915.51-1915.57) and NFPA 306 (4.3.4), provide information covering hot work performed in the maritime industry.

8.3.14.4 Petroleum Industry.

In addition to applicable OSHA, NFPA and ANSI regulations listed above in 8.3.3.1 and 8.3.3.2, appropriate API standards, including but not limited to the following, provide information related to hot work in the petroleum industry

8.3.14.4.1 API 653 Tank Inspection, Repair, Alteration, and Reconstruction.

This document covers the inspection, repair, alteration, and reconstruction of steel aboveground storage tanks used in the petroleum and chemical industries. It provides the minimum requirements for maintaining the integrity of welded or riveted, non-refrigerated, atmospheric pressure, aboveground storage tanks after they have been placed in service.

8.3.14.4.2

API RP 2009 Safe Welding and Cutting Practices in Refineries, Gasoline Plants, and Petrochemicals Plants. This document provides guidelines for safely conducting welding, cutting or other hot work activities in refineries, gas plants, petrochemical plants and other facilities in the petroleum and petrochemical industries. It provides specific guidance for evaluating procedures for certain types of work on equipment in services. It does not include guidance for compliance with regulations or codes: hot tapping; welding techniques, normal, “safe work” practices; or entry or work in inert environments.

8.3.14.4.3

API Std 2015 Safe Entry and Cleaning of Petroleum Storage Tanks, Planning and Managing Tank Entry From Decommissioning Through Recommissioning. This standard provides safety practices for preparing, emptying, isolating, ventilating, atmospheric testing, cleaning, entry, hotwork and recommissioning activities in, on and around atmospheric and low-pressure (up to and including 15 psig) above ground storage tank that have contained flammable, combustible or toxic materials. This standard directs the user from decommissioning (removal from service) through recommissioning (return to service). This standard applies to stationary tanks used in all sectors of the petroleum and petrochemical plants, and terminals.

8.3.14.4.4

API RP 2016 Guidelines and Procedures for Entering and Cleaning Petroleum Storage Tanks. This Recommended Practice supplements the requirements of ANSI/API Standard 2015, Requirements for Safe Entry and Cleaning of Petroleum Storage Tanks, Sixth Edition. This RP provides guidance and information on the specific aspects of tank cleaning, in order to assist employers (owners/operators and contractors) to conduct safe tank cleaning operations in accordance with the requirements of ANSI/API Standard 2015.

8.3.14.4.5

API RP 2027. Ignition Hazards Involved in Abrasive Blasting of Atmospheric Storage Tanks in Hydrocarbon Service. This document identifies the ignition hazards involved in abrasive blasting of the exteriors of hydrocarbon storage tanks containing a mixture that is flammable or that can become flammable when air is added. It provides operational guidelines for procedures that significantly reduce ignition risks during abrasive blasting of hydrocarbon tanks that may contain a flammable vapor space.

8.3.14.4.6

API 2202 Dismantling and Disposing of Steel from Aboveground Leaded Gasoline Storage Tanks. This document outlines precautions to prevent hazardous exposure of personnel to lead antiknock compounds when dismantling tanks that have contained leaded gasoline and when disposing of the steel.

8.3.14.4.7

API RP 2207 (R2012) Preparing Tank Bottoms for Hot Work, This publication addresses only the safety aspects of hot work on petroleum storage tank bottoms. It discusses safety precautions for preventing fires, explosions and associated injuries. The term hot work, is used in this publication, is defined as an operation that can produce a spark or flame hot enough to ignite flammable vapors.

8.4 Energy Sources.

All sources of energy, mechanical, electrical, hydraulic, chemical or stored energy in confined spaces that could impact employee safety should be eliminated using a lockout tagout program. OSHA 1910.147 *The Control of Hazardous Energy (Lockout/Tagout)* applies to preventing the accidental startup of equipment and machinery (such as an agitator) or the release of stored energy. OSHA 1910.333 - *Selection and use of work practices* has specific requirements for de-energizing and locking out electrical equipment. The OSHA electrical safe work practices requirements were derived from *NFPA 70E, Standard for Electrical Safety in the Workplace* This standard provides comprehensive electrical safety information to prevent shock, arc and other electrical safety hazards.

8.4.1

All workplaces with confined spaces that contain energy sources requiring lockout/tagout should have an energy control program.

8.4.2

The qualified Isolation Specialist should verify that the energy sources affecting employees in the confined spaces have been locked/tagged out or otherwise safeguarded prior to work being performed in a confined space. If there is a need to enter the space to verify that sources have de-energized, the entry should be done using the permit process defined in Chapter 13.

8.4.3

Pipes and lines containing materials that could enter into the confined space should be disconnected and/or blanked, bled, flushed, purged or otherwise isolated prior to entry.

8.4.4

Pipes and lines running through confined spaces that will be worked on from inside the space need to be disconnected and/or blanked, bled, flushed, purged, isolated prior to working on the lines.

8.4.5

Pipes and lines containing material that run through the space but do terminate within the space do not necessarily need to be disconnected or isolated as indicated in 8.4.3 so long as Entry Supervisor and/or Permit Issuer has determined that the materials in these lines are not impacted by the work being done in the space nor does the material create a hazard to employees working in the space.

8.4.6*

Where equipment should be operational in order to perform the work in the space then the Entry Supervisor and/or Permit Issuer should insure that the work is performed using alternative measures which provide effective protection of employees in the space.

8.4.7

Hot Tapping in the petroleum industry should be in accordance with API 2201 *Safe Hot Tapping Practices in the Petroleum & Petrochemical Industries.*

8.5 Portable Electrical and Mechanical Equipment Used in and Adjacent to Confined Spaces.

Electrical and mechanical equipment used in confined spaces should be listed (and labeled) for its intended use. All approved equipment should be inspected by a qualified person prior to use. Equipment to be considered includes the following:

(1) Lighting

(2) Communication Equipment including cell phones, pagers and two way radios

(3) Cordless tools that utilize a battery.

(4) Ventilation systems

(5) Portable tools

(6) Welding equipment

(7) Mechanical equipment

(8) Extension cords

8.5.1 Wet and Damp Locations.

All electrical equipment used in wet or damp locations should be equipped with ground fault circuit interrupters and inspected by a qualified person prior to use.

8.5.2 Hazardous Locations.

8.5.2.1

All electrical and mechanical equipment used in flammable or potentially flammable atmospheres should be approved for Class 1 Division 1 locations and inspected by a qualified person prior to use.

8.5.2.2

All electrical equipment used in areas where combustible dusts may be present should be approved for Class 2 Division 1 locations and inspected by a qualified person prior to use.

8.5.2.3

All electrical equipment used in areas where easily ignitable fibers or flyings may be present should be approved for Class 3 Division 1 locations and inspected by a qualified person prior to use.

8.5.2.4

Equipment brought into confined spaces should be guarded with no exposed electrical components or unguarded moving parts that could cause injury, entanglement or amputation.

8.5.3 Regulations and Standards.

8.5.3.1

NFPA 497, *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*

8.5.3.2

NFPA 499, *Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*

8.6 Bonding and Grounding for Flammable and Combustible Materials.

Static electricity may be generated in several ways, most typically whenever two dissimilar materials rub against each other. These materials may be solids, liquids, or gases. The accumulation of a charge creates a potential safety hazard in that the charge may be quickly discharged, creating a spark. If there are flammable or combustible gases, vapors or dusts present, a fire or explosion may occur. The purpose for grounding and bonding objects is to provide a safe path for static electricity that may have accumulated on one or more insulated objects to safely dissipate. The combination of grounding one object to the earth and then bonding other objects to it with a conductive material, such as copper wire, is referred to as grounding and bonding.

8.6.1 Bonding.

Bonding is the joining of metal parts to form an electrically conductive path that ensures electrical continuity and the capacity to safely conduct any current likely to be generated. Entry Supervisors, attendants, entrants and all workers working in and adjacent to confined spaces should be informed that metallic parts of equipment, accessories and appurtenances used in confined space entry, ventilation and cleaning operations, are capable of generating an electrostatic charge unless they are electrically bonded to the space to avoid ignition from sparks.

8.6.1.1 Requirements.

Before use, a qualified person, such as an electrician, should thoroughly inspect all tank cleaning equipment, nozzles, hoses, couplings and accessories to ensure that they are properly bonded, including, but not limited to, the following:

(1) Vapor and gas freeing, degassing and ventilation equipment and appurtenances, such as blowers and eductors; inert gas piping and connections; water, fuel oil and steam piping, hoses, nozzles, and connections; flame and detonation arrestors: and flexible vapor intake and exhaust ducts.

(2) Vacuum trucks used for removing materials, degassing and exhausting vapors from a confined space should be located such that the vapors are discharged downwind of the truck and away for the confined space and potential sources of ignition. (Note: Regulations may require the capture, removal and treatment of liquids, vapors and residue). The vacuum truck suction and discharge hoses should be electrically bonded to both the truck and space and grounded. See 8.6.3.2.

(3) Hoses and nozzles used to inject product, steam, chemicals, solvents or water into the tank to dislodge and flush residue and sludge or wet down pyrophoric deposits.

(4) Abrasive blasting hoses, nozzles, and equipment.

(5) Mechanized portable and robotic cleaning equipment.

(6) Welding, cutting, grinding, and hot tapping equipment should be bonded to the work to avoid stray currents.

8.6.2 Grounding (Earthing).

Grounding is the process of directing electrical current to earth in order to reduce the possibility of an electrical spark (ignition source). Care should be taken to ensure that equipment is properly grounded to the power source. With power from power lines, the electrical ground is tied in at the breaker box. For portable generator sets, the unit should be grounded locally to the frame. Portable generator sets can be staked to form an earth grounding system or grounded to a facility ground system. Grounding should be consistent with the equipment manufacturer's instructions and applicable national and local electrical wiring codes.

8.6.3 Regulations and Standards for Bonding and Grounding.

The following publications are good resources to consult:

(1) NFPA 77, *Recommended Practice on Static Electricity*, which provides detailed information on how to control static electricity

(2) API 2219, *Safe Operations of Vacuum Trucks in Petroleum Service*, which provides requirements for safe use of vacuum trucks in petroleum facilities to remove flammable or combustible liquids and which can be used as a reference for other facilities where vacuum trucks are used

(3) API RP 2003, *Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents*

(4) API RP 2027, *Ignition Hazards Involved in Abrasive Blasting of Atmospheric Storage Tanks in Hydrocarbon Service*

(5) NFPA 326, *Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair*

8.7 Ignition Sources.

Flammable or combustible liquids and vapors may be released both within the space and around the outside area of a confined space during the process of ventilation, inerting, gas freeing or when removing, agitating or cleaning residue. In addition to hot work, which is covered in 8.2 sources of ignition that should be eliminated or controlled include the following:

(1) Internal combustion engines

(2) Non explosion proof and equipment not rated for the location

(3) Non bonded electrostatic generating equipment such as welding machines, fans and eductors, vacuum trucks, portable generators, pumps, etc.

(4) Lighting equipment

(5) Smoking

(6) Blast cleaning

(7) Grinding and cutting

(8) Unprotected pyrophoric iron sulfide deposits

(9) Heating equipment

(10) Vacuum trucks

(11) Communication devices including cell phones, two-way radios, pagers

8.7.1

Ignition sources should be eliminated or removed from inside and adjacent to confined spaces.

8.7.2

Ignition sources should be evaluated regardless of whether or not there are flammable or combustible atmospheres. Ignition sources can also create a fire hazard if combustible materials are present in or adjacent to a confined space.

8.8 Fall Protection.

Fall protection should be used for entries into confined spaces where falls greater than 4 ft could occur. Confined space fall hazards should be managed by the confined space fall protection hierarchy:

(1) *Elimination*: Removal of the hazard by covering all vertical entry points until entry is required

(2) *Protection*: Use of OSHA-approved guardrail systems that will provide a controlled access zone around all vertical entry points

(3) *Restriction*: Use of positioning or restraint devices that will eliminate the possibility of a fall to all personnel located outside of the immediate vertical entry point

(4) *Fall arrest*: Use of OSHA approved fall arrest/belay devices that will limit the maximum arresting forces to below 1800 lbs in the event of a fall from a height greater than 4 feet above the lower level of the vertical entry point for all personnel exposed to a fall hazard during confined space operations.

8.8.1 Guarded Openings.

Falls into confined spaces can occur while preparing to enter a confined space or while working outside the confined space. Floor and wall openings leading into confined spaces should be protected to prevent falls from occurring. There are a number of ways to do this:

8.8.1.1

Controlled access zones can be used during confined space operations to limit exposure to any open spaces or leading edges into which persons can accidentally walk. This can include the attendant warning of the potential fall hazard or providing a barricade around the space.

8.8.1.2

Restraint systems can be used during confined space operations when a worker needs to work near the opening or leading edge. This would be accomplished by wearing a properly fitted full body harness attached a shortened lanyard which is secured to a suitable anchor point able to withstand 1000 pounds.

8.8.1.3

Fall arrest systems can be used during confined space operations when the risk of a fall cannot be eliminated though the use of controlled access or restraint systems. This would be accomplished by wearing a properly fitted full body harness with a self retracting device attached to a suitable anchor point able to withstand 5000 pounds or engineered with a 2:1 safety factor.

8.8.2 Access.

All employees entering into confined spaces regardless of space configuration or size should wear a properly fitted full body harness.

8.8.2.1

When utilizing fixed ladders, three points of contact should be maintained at all times. When the ladder extends beyond 20 feet it should be equipped with ladder climbing system or a secondary form of protection such as self retracting device or a belay line attached to a suitable anchor point able to withstand 5000 pounds or engineered with a 2:1 safety factor.

8.8.2.2

When utilizing potable ladders, three points of contact should be maintained at all times. A secondary form of protection should be used such as self retracting device or a belay line attached to a suitable anchor point able to withstand 5000 pounds or engineered with a 2:1 safety factor.

8.8.2.3

When employee needs to be lowered vertically into the confined space a secondary form of protection should be used such as self retracting device or a belay line attached to a suitable anchor point able to withstand 5000 pounds or engineered with a 2:1 safety factor.

8.8.3

Fall protection for vertical descents for rescue should be in accordance with Chapter 10.

8.9 Slip, Trip, and Entanglement Hazards.

8.9.1

Floors should be dried to eliminate slip hazards. Floors and surfaces should be de-iced if necessary. Where this cannot be initially achieved, entrants should use non-slip footwear.

8.9.2

Cords, lines, and hoses that are brought into the space should be placed and secured in such a manner so as to minimize trip hazards in work areas and pathways of travel. Trip hazards should be clearly identified and/or flagged or marked.

8.9.3

Non-fixed entanglements not required for the entry operation and work may be removed from the space to minimize hazards. Fixed entanglements should be recognized and appropriate precautions

8.9.4

In-space lighting should provide illumination so that all surfaces and obstructions are clearly visible to those working in the space. Note that portable lighting should be approved for the location in which it is used in accordance with 8.5.

8.9.5

Whenever surfaces remain slippery or wet consider the installation of portable floor mats, or duck boards to raise the worker above the level of the liquid.

8.10 Lighting.

Approved, safe lighting should be used for the work being performed. The selection of lighting should include the presence of flammable or combustible hazards in accordance with 8.5. Additional options for lighting may include helmet lights, portable lighting, etc. Calumine lights (glow sticks) are portable and can be utilized for backup lighting should the primary lighting fail. They can also be used to provide markings as a visual trail to a means of egress in poorly lit confined spaces.

8.11 Critters.

Confined spaces can be ideal hideouts for animal, snakes and insects. If the confined space to be entered has been visually inspected and found to contain a critter, measures should be taken to remove them from the space prior to entry. A trap could be lowered into the space for larger animals such as skunks or raccoons or a pest control company or local animal control agency could be consulted. Care should be taken if an extermination chemical is used to reassess the environment and hazards including the hazard of the pesticide that has now been introduced into the space. The space may need to be ventilated and protective clothing and gloves worn to prevent skin contact with the chemicals.

8.12 Personal Protective Equipment.

Personal protective equipment should be worn in accordance with the requirements of the entry permit when engineering or administrative controls cannot fully eliminate the hazard to entrants and workers.

8.12.1

Personal protective equipment including, but not limited to, eye protection, head protection, foot protection, hand protection, protective clothing, respiratory protection and hearing protection should be worn whenever the potential exists for an injury that could be prevented by the use of such equipment as determined in 6.7. Other PPE to be considered may include knee or elbow pads, if crawling into a space, cooling vests for hot environments, etc.

8.12.2

The Entry Supervisor or Permit Issuer should list the required PPE on the permit in accordance with the facility and/or contractor confined space entry programs.

8.12.3

PPE should be selected and used in accordance with applicable regulations and employer requirements.

8.12.3.1

General PPE requirements including hazard assessments, maintenance, and training requirements should follow the requirements given in 29 CFR 1910.132. Although that standard covers general industry in the United States only, it provides a good basis for developing a solid personal protective equipment program.

8.12.3.2

Eye and face protection should be selected and used in accordance with 29 CFR 1919.133.

8.12.3.3

Respiratory protection requirements should be in accordance with 29 CFR 1910.134.

8.12.3.4

Head protection should be selected and used in accordance with 29 CFR 1910.135.

8.12.3.5

Foot protection should be selected and used in accordance with 29 CFR 1910.136.

8.12.3.6

Hand protection should be selected and used in accordance with 29 CFR 1910.138.

8.12.3.7

Electrical protective clothing should be selected and used in accordance with 29 CFR 1910.137 and *NFPA 70E*, *Standard for Electrical Safety in the Workplace*.

8.12.3.8

Whenever skin contact with chemicals is of concern, the appropriate protective clothing should be worn. There is no single source of information for chemical protective clothing. Manufacturers of chemical protective clothing can often provide information on the appropriate clothing for the particular chemical or chemicals of concern. In addition there are several NFPA standards including NFPA 1991, *Standard on Vapor-Protective Ensembles for Hazardous Materials Emergencies* and NFPA 1992, *Standard on Liquid Splash–Protective Ensembles and Clothing for Hazardous Materials Emergencies*.

8.12.3.9

Hearing protection should be selected and used in accordance with 29CFR 1910.95.

8.12.3.10

Other PPE including cooling vests and flotation devices, etc. should be selected and worn as determined by the hazard evaluation.

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Chapter 9 Ventilation

9.1 General.

9.1.1

Ventilation is used for two reasons: first, to remove or control atmospheric contaminants and second, to control temperature for personal comfort. In most confined space applications, the primary concern will be controlling atmospheric contaminants. Ventilation will commonly be used to establish initial safe conditions (prior to initial entry) and may be required to maintain safe conditions during entry where factors exist that encourage changing conditions (e.g., presence of residues or during hot work).

9.1.2

The need for ventilation should be determined initially through the results of a hazard evaluation and risk assessment conducted in accordance with Chapter 6.

9.1.3

When considering use of ventilation, it is important to recognize the differences between ventilation and purging. These common practices are often described interchangeably, but actually apply to different atmospheric hazard control situations. Ventilation generally introduces fresh, uncontaminated air into a space and controls contaminants in that space through mixing and dilution. Purging uses air, steam, or inert gas to displace the air within the space. See 9.3 for guidance on selection of method.

9.2 Ventilation Types.

There are two types of ventilation – natural and mechanical.

9.2.1* Natural Ventilation.

Natural ventilation is achieved when the closure(s) on a space is (are) removed or opened so as to enable the natural air flow present outside the space to enter and circulate within the space.

9.2.1.1

Natural ventilation should only be used when a documented hazard evaluation and risk assessment demonstrates that its use will effectively achieve the removal or control of atmospheric contaminants within the space.

9.2.1.2

When natural ventilation is used, continuous monitoring should be performed to ensure the atmospheric conditions are maintained in accordance with the permit for the space.

9.2.2 Mechanical Ventilation.

Mechanical ventilation uses an air-moving device (fan, blower, eductor) to either push or pull air into or within the space and circulate it to achieve the required mixing and dilution of air within the space. There are two types of mechanical ventilation – general (sometimes referred to as dilution) and local exhaust.

9.2.2.1 General (Dilution) Ventilation.

General ventilation can be oriented as either supply or exhaust. It is referred to as dilution ventilation because it achieves control of contaminants through mixing and dilution of the contaminated air using fresh, uncontaminated supply and make-up air.

9.2.2.1.1

Supply ventilation uses an air-moving device oriented so that air is pushed into the space. Depending on the size of the space and capacity of the air-moving device, ducting can be used to direct the air a greater distance into the space.

9.2.2.1.1.1

The source of supply air to the air-moving device should be taken from a location known to be free of contaminants.

9.2.2.1.1.2

Supply ventilation is generally less effective for controlling highly-toxic contaminants as it tends to spread the contaminants before dilution becomes effective. Local exhaust ventilation should be used in these instances (see 9.2.2.2).

9.2.2.1.2

Exhaust ventilation uses an air-moving device oriented so that air is pulled from the space.

9.2.2.1.2.1

The area or location where exhaust ventilation is discharged from the space should be monitored to ensure contaminants are dissipating upon discharge to the atmosphere.

9.2.2.1.2.2

The area or location where exhaust ventilation is discharged from the space should be located to ensure contaminants do not reenter the confined space through the ventilation supply air source. *(See Section 9.5.)*

9.2.2.1.2.3

The source for the make-up or replacement air should also be free of contaminants.

9.2.2.1.3

Supply and exhaust ventilation can be used together where sufficient openings in the space enable this arrangement.

9.2.2.1.4*

Ventilation serves as a source for the generation and accumulation of static electrical charges and all equipment used in the ventilation system should be properly bonded or grounded.

9.2.2.2 Local Exhaust Ventilation.

9.2.2.2.1*

Local exhaust ventilation should be used to capture and collect point source (localized or locally created) contaminants generated from specific work activities in order to limit the release of the contaminants to the space and the potential for further contamination of the entire space.

9.2.2.2.2*

For local exhaust to be effective, it should be located and maintained as close to the source of the contaminants as possible.

9.2.3 Comfort Ventilation.

Where the hazard evaluation and risk assessment determines that either heat or cold stress conditions exist, ventilation that provides heating or cooling should be considered.

9.3 Selection and Design of Ventilation.

9.3.1 General.

9.3.1.1

The entry supervisor should consider the following as part of the evaluation on the selection of ventilation for controlling a hazardous atmosphere:

(1) Whether to use purging or ventilation

(2) Size and configuration of the confined space including the number and location of openings that can be used for ventilation and entrant access

(3) Capacity of the ventilation equipment

(4) Prior use of the confined space for the storage or containment of a hazardous material

(5) Current use of the confined space that might contribute to the existence of hazards within the space

(6) Whether assigned work processes in or adjacent to the space could introduce atmospheric hazards into a confined space

(7) Type of ventilation equipment available

9.3.1.2*

Based on the size of the confined space (volume) and the capacity of the air-moving device, the entry supervisor should determine the time for a single air change for the confined space. Common practices recommend from 3 to 5 air-changes per hour as typical ventilation rates within spaces once safe conditions have been established. Note that this number assumes that safe conditions were initially achieved at 3-5 ACH and conditions have not changed.

9.3.2 Contaminant characterization.

The physical and chemical properties of gases, vapors, dusts, and any other contaminant form that might be present in a confined space should be considered when selecting and designing a ventilation system. Considerations should include, but not necessarily be limited to:

(1) Characteristics of air, vapor, gas and dust movement

(2) Vapor density (gases and vapors)

(3) Specific gravity (liquids or residues)

(4) Vapor pressure

(5) Effect(s) of space temperature on air contaminants

(6) Flammability characteristics (flammable range for gases and vapors or MEC for dusts)

(7) Flash point

(8) Boiling point

(9) Recommended exposure limits (PEL, TLV, or equivalent)

(10) Stability characteristics of contaminants

9.3.3 Ventilation Design Considerations.

9.3.3.1

Supply ventilation should be used when ventilating to return atmospheric conditions to normal oxygen levels or to maintain safe atmospheric concentrations within the established acceptable range.

9.3.3.1.1

Supply ventilation should not be used when initially controlling highly toxic atmospheric contaminants.

9.3.3.1.2

Supply ventilation should be used only when a clean source of make-up or return air is available.

9.3.3.1.3*

Supply ventilation should be evaluated to ensure that sufficient air flow reaches the most distant point within the space.

9.3.3.2*

Exhaust ventilation should be used when ventilating atmospheric contaminants in locations where it is not permitted to release those contaminants to the atmosphere.

9.3.3.2.1*

Exhaust ventilation should not use axial-flow air-moving devices when controlling flammable atmospheric contaminants.

9.3.3.2.2

Exhaust ventilation should be used only when a clean source of make-up or return air is available.

9.3.3.2.3

Exhaust ventilation should be evaluated to ensure that the air-moving device can be located so that there is effective capture of the contaminants.

9.3.4* Purging Applications and Design.

The purging medium should be determined based on the contaminant in the space and the entry or work condition objective.

9.3.4.1*

Where the purging objective is to gas-free a storage tank that previously contained a flammable liquid while reducing the potential for a fire or an explosion, then purging with an inert gas should be implemented.

9.3.4.1.1

When an inert gas purge is used to displace the flammable vapors from above or within the flammable range, the inert gas should be introduced into the space and maintained until the flammable vapor concentration has been reduced to approximately 1 percent by volume (which represents the LFL for typical petroleum products).

9.3.4.1.2

Once the flammable vapor concentration has been lowered to 1% by volume, then purging can now resume with fresh air to displace the remaining flammable vapors and to increase the oxygen content to ambient fresh air levels.

9.3.4.1.3*

While monitoring for the atmospheric conditions during the inerting process, it should be noted that the flammable vapor concentrations in the inerted atmosphere will not be detectable using a catalytic bead-type sensor without taking special steps.

9.3.4.2

Purging with fresh air should be used to displace toxic contaminants or to displace oxygen deficient air (previously inerted) and return to fresh air levels.

9.3.4.3

Purging with an inert gas should be used whenever hot work is to be performed on or adjacent to a confined space that has not been thoroughly cleaned and gas-freed of flammable gases, vapors, and residues.

9.3.4.4

Precautions should be taken to alert all workers working near spaces that have been inerted as any venting of the inert gas might displace the oxygen in localized areas near the space and create unsafe levels of oxygen.

9.4 Ventilation Equipment.

9.4.1 Air-Moving Devices.

This includes venturi-type devices that exhaust only (eductors) and fan systems.

9.4.1.1 Axial-Flow Fans.

In an axial-flow fan, the air flow through the impeller is parallel to the shaft on which the impeller is mounted. Within this category of equipment there are three types – propeller, tube-axial, and vane-axial.

9.4.1.2 Centrifugal-Flow Fans.

A centrifugal-flow fan includes a wheel or rotor mounted on a shaft that rotates within a scroll-shaped housing. Air enters the center of the rotor and moves with centrifugal force at right angles through the rotor blades and into the housing.

9.4.1.3 Venturi-Type (Eductors).

These devices are also known as air ejectors, air eductors, or air horns. They operate on the venturi principle where air moving through the horn increases in velocity as it passes through the smaller cross-sectional area and exits the horn. They are commonly powered by air or steam. When using air, these devices work as supply or exhaust, but when using steam as the source of power, they should only be used for exhaust ventilation.

9.4.2 Duct Work.

The evaluation conducted as part of the selection and ventilation design in accordance with 9.3.1.1 should include a determination on use of ventilation ductwork.

9.4.2.1

The size, shape, or configuration of some confined spaces might make it necessary to attach flexible ducting to the air-moving device that has been selected in order to deliver the air movement to the designed location within the space.

9.4.2.2

It is recommended that the flexible ducting include means for bonding or grounding of the ducting along with the air-moving device in order to control the generation and accumulation of static charge.

9.4.2.3*

The hazard evaluation should establish conditions where collapsible, rolled, plastic tubing can be used as ventilation ductwork.

9.4.2.4

For entry into spaces with single entry access portals, the hazard evaluation should consider using the ductwork and blower adapter (saddle) to minimize the degree to which the space opening is restricted by the placement of the ductwork.

9.4.3* Thermal Oxidizers.

For ventilation requirements in tanks and other spaces with flammable atmospheres, local environmental regulations often restrict emissions. Within the petroleum, aboveground storage tank industry common practice for gas-freeing or vapor-freeing tanks is to use exhaust ventilation with the discharge connected to a thermal oxidizer unit.

9.4.4* Bonding/Grounding.

Static electricity is created whenever surfaces are separated, which occurs when movement occurs, such as air moving through a fan or blower or ducting. Since applications where ventilation is used involve flammable gas or vapor concentrations, control of ignition sources becomes essential. Regulations and best practices require that all air-moving devices be properly bonded or grounded. This includes the ducting when attached to the air-moving device.

9.4.5 Other Equipment.

In addition to flexible ducting, the ventilation installation can include other equipment such as adapters (saddle) that attach through the opening of the space to the air-moving device and ducting so as not to completely obstruct the opening.

9.5 Installation of Ventilation.

9.5.1

Ventilation should be placed in such a way to reach the farthest point within the space, in order to maximize the turbulence in the space and to minimize the creation of dead air pockets.

9.5.1.1*

When evaluating the space configuration a competent person should consider obstructions within the space that restrict or limit air movement.

9.5.1.2

The location, size and number of portals or openings that can be used for ventilation should be considered when designing and installing a ventilation system.

9.5.1.3

Location of openings can limit the ability to efficiently and effectively move air throughout the entire space.

9.5.1.4*

In placing the ventilation equipment, openings for exhaust and supply air should be separated as much as possible to limit the potential for creating short circuiting conditions.

9.5.2

Ventilation ductwork should be installed so as not to block access into or exit from the space.

9.5.3*

Stratified atmospheres (see Chapter 7) should be considered as part of the selection and design evaluation to ensure that ventilation ductwork is positioned to achieve the removal or displacement of contaminants.

9.5.4

Precautions should be taken to control or remove all ignition sources from the area since gases and vapors might be present in the flammable range both inside the confined space and at the point of ventilation discharge.

9.5.5

All air-moving devices and related equipment should be bonded and grounded.

9.5.6

The discharge point from all exhaust ventilation processes, not connected to scrubbing systems or other contaminant control systems, should be located a minimum of 3.7 m (12 ft) above grade. The selection of the discharge point should ensure that exhausted contaminants are directed away from areas that might contain sources of ignition and areas where personnel may be working, and directed to a location that will reduce the likelihood of re-entrainment of exhausted contaminants.

9.5.7

Displacement of the confined space atmosphere with air should be accomplished by one of the following methods:

(1) A negative pressure or vacuum used to pull outside air into the confined space using an educator-type air-moving device or other similar equipment.

(2) A positive pressure or diffused air blower used to push outside air into the confined space.

(3) A combination of options (1) and (2)

9.5.7.1

When the method described in 9.5.7(1) is used, the following should apply:

(1) The connection between the eductor and the confined space should be airtight.

(2) Air should be drawn through the confined space to allow cross ventilation and removal of vapors.

(3) All equipment should be bonded or grounded.

9.5.7.2

When the method described in 9.5.7(2) is used, the following should apply:

(1) If a fill opening that extends into the confined space is used as an air supply point, the portion of the fill pipe that extends into the confined space should be removed.

(2) The air should be supplied from a compressor or blower that has been checked for delivery of clean air that is free of flammable or toxic vapors.

(3) The air-diffusing pipe, if used, should be bonded to the confined space to control the accumulation and discharge of static electricity.

9.5.8 Ventilation for controlling hazards of extreme heat or cold.

9.5.8.1

When entry and work in confined spaces involves potential for exposure to temperature extremes, the hazard evaluation and risk assessment should include a determination of the need for comfort ventilation to be applied.

9.5.8.2*

Based on the outcome from the hazard evaluation and risk assessment, air can be conditioned to be warmed or cooled as appropriate for the environment and work.

9.5.9* Purging.

A hazard evaluation and risk assessment should be completed to determine that purging can be safely implemented.

9.5.10 Atmospheric Monitoring.

9.5.10.1

Atmospheric testing should be conducted by a competent person in accordance with Chapter 7.

9.5.10.2

If the hazard evaluation and risk assessment indicates that atmospheric conditions within the space can change adversely, continuous forced mechanical ventilation should be provided for the space during all entry and work.

9.5.10.3*

If the hazard evaluation and risk assessment indicates that atmospheric conditions will not be maintained within acceptable levels at all times during the entry and work, flow monitoring, alarms, secondary power systems and similar backup systems should be utilized to ensure the safety of entrants and the integrity of the ventilation system and fresh air supply.

9.5.10.4

When ventilation cannot or does not completely eliminate a recognized atmospheric hazard, other protective measures or methods for controlling air contaminants and protecting entrants should be determined by a competent person prior to entry authorization.

9.6 Limitations of Ventilation.

The following limitations should be considered during the hazard evaluation and risk assessment process, during design and selection, and during installation and use of ventilation systems for confined spaces:

(1) Source of supply and make-up air

(2) Use of approved equipment where required (electrical area classification for example)

(3) Bonding and grounding of all air-moving devices

(4) Noise levels associated with air-moving devices

(5) Maintaining access and egress needs while ventilating spaces

(6) Frequent atmospheric monitoring inside space and outside space

(7) Time required to achieve initial safe conditions

(8) Worker protection in addition to ventilation

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Chapter 10 Rescue.

10.1 General.

10.1.1 Application.

Prevention is recognized as the best method to avoid the need for rescue. If a hazard evaluation is properly performed and all hazards are controlled in a way that will eliminate the chance of harm to entrants, the likelihood of a need for rescue is greatly reduced. Even in cases where hazards may exist, training entrants to understand these potential hazards so they may exit the space on their own power when they recognize the threat is far better than waiting until they are incapacitated by it. Other options include the ability to remove ill or injured entrants without entering the space (Non-entry rescue) or entering the space to properly treat, package and remove these ill or injured entrants (Entry -type rescue). This guide applies to all organizations that are responsible for selection or provision of a response capability for rescue emergencies in or associated with confined spaces. The elements associated with rescue program needs should be identified in the hazard evaluation and risk assessment conducted by the AHJ (person, persons or organization having responsibility for acquiring a rescue provision for one or more confined spaces).

10.1.2 Non-entry Rescue — Attendant Capabilities.

In a confined space emergency where hazards exist that may affect others who would enter the space to provide rescue, it is best practice to extract the incapacitated patient without entering the space. In most cases, non-entry rescue provisions (retrieval systems) should be in place to allow this option. However, it should be recognized that conditions may exist or arise that would prohibit the use of non-entry rescue. This section is intended to address non-entry rescue.

10.1.2.1 Attendants Should Be Responsible for Performing Certain Non-Entry Rescue (Retrieval) Operations.

Attendants should be responsible for performing emergency notification and certain non-entry rescue (retrieval) operations. If properly qualified/trained an Attendant may perform in the capacity of a confined space rescuer once relieved of Attendant duties.

10.1.2.2 Concept and Purpose of Retrieval Systems for Non-Entry Rescue

Retrieval lines are intended primarily to provide a means for removal of ill or injured persons from a space in order to limit the exposure to other persons tasked with providing rescue. This provides a means for removal without entering the space to do so. These systems should also be applied for rescue entrants whenever possible, although the configuration of these systems may differ significantly. If properly configured, these systems may also double as fall protection in spaces where fall hazards exist.

10.1.2.2.1 Composition of Retrieval Systems.

Retrieval systems are usually comprised of rope or cable based systems which are attached to the entrant in such a way as to provide a profile, appropriate to the space's configuration, that would allow successful removal from the space. The retrieval system itself should, in most cases, provide a means of lifting or otherwise moving the entrant so that they may be removed without significant stress to the operator and without danger of dropping the ill or injured entrant should the operator release the system during retrieval (progress capture). This is much more important in vertically-oriented spaces where an ill or injured patient could be dropped. In spaces with a vertical depth greater than 4 feet, a mechanical means of retrieval (one employing mechanical advantage to reduce the force required) with a progress capture mechanism (to prevent drop if the system is released) should be used. In horizontally oriented spaces, retrieval equipment may be as simple as a rope, webbing or cable system; attached to the entrant's harness or other appropriate type of body rigging (wristlets, anklets, wheeled or low-friction drag devices, etc.) to allow removal without endangering the entrant. These systems may not have a need for progress capture or a mechanical means of retrieval if the entrant is on a perfectly horizontal, low-friction plane. In all cases, the retrieval system should be appropriately anchored outside of the space to prevent it from being accidentally pulled into the space during operations, rendering it ineffective.

10.1.2.2.2 Retrieval Systems for Entry and Fall Protection.

As previously stated, the equipment utilized to create retrieval systems may sometimes serve other purposes as well. In the case of vertically configured spaces where no other means of self-assisted entry exists (i.e. ladders or stairs), retrieval systems having the capability of both lowering and raising personnel may be helpful as the principal means of lowering entrants into the space. This is a non-emergency application of this equipment and it is highly recommended that a redundantly anchored and operated backup system of some sort be in place during these operations in the event of any failure associated with the primary system. For instance, a tripod and winch being utilized to lower workers into a space in a purely vertical environment should also maintain some sort of backup device which may include; but are not limited to; fall protection blocks, self-retracting lifelines or belay systems. As mentioned, it is highly recommended that backup systems be redundantly anchored to be completely independent of the primary system so that any failure of the primary (including the anchor system) would be sufficiently backed up.

10.1.2.2.2.1

When fall hazards exist within a space, the retrieval system may, in some cases, also provide an adequate means of fall protection to keep the entrants safe from falls while working in the space. In order for this to be effective, entrants must be independently attached to retrieval lines which are anchored outside of the space and incorporate devices that will withstand the forces expected from a fall while providing appropriate energy absorption to make the fall tolerable to the entrant's body. These systems should be capable of not only preventing and/or arresting a fall, but also capable of removal of the entrant in the event of a fall. Fall protection systems and recommended tolerances are addressed in detail within Chapter 8. If possible, these systems should limit the ability of the entrants to approach unprotected edges, in effect, becoming fall restraint rather than fall arrest systems.

10.1.2.2.3 Retrieval System Configurations.

As it applies to the entrant in a typical confined space entry, unless waived, retrieval systems should maintain independent lines on each worker entering the space so as to allow independent retrieval with any worker should an incident occur. These systems should also be immediately ready to provide removal of the ill or injured entrant. It is highly recommended that retrieval systems be capable of actuation within seconds of recognition of the emergency. As it applies to rescue entrants, configurations may vary from the typical in certain circumstances. In any case, retrieval systems, unless waived, should be attached prior to entry and maintained at all times until the entrant(s) have left the space. A retrieval line should NEVER be disconnected inside a space. This would render the system ineffective should an emergency occur requiring retrieval.

10.1.2.2.3.1 Retrieval System Configuration Considerations for Typical Entries.

In entries where portable anchor devices and manufactured systems may be employed with only one entrant, retrieval system configurations may be very simplistic. When the need for multiple entrants occurs or specific structural restrictions in and around the space exist, configuring these systems may become complicated.

(A)

While it is often thought that a simple tripod and winch system will solve most retrieval problems, this may not be the case. A tripod and winch may offer a good alternative to retrieval in most cases but, when overhead or working surfaces restrict the ability to erect a Tripod, other methods must be utilized. A winch device or other manufactured system may be an excellent choice in a single-entrant type of entry where an adequate overhead anchor exists, but when multiple entrants must enter the space or the device cannot be positioned above the portal, it may become slightly more complicated to configure all of the retrieval devices so that they may be easily monitored and effectively utilized in the event of an emergency.

(B)

In some cases, retrieval systems may be required to lift ill or injured entrants up and directly over the edge of the portal. Significant knowledge of managing human bodies over such edges and the equipment and systems necessary to effect retrieval without further injury (to entrants and operators) is of paramount importance.

(C)

Appropriate assessment and training is vital to assure proper configuration of these systems based on the circumstances surrounding the entry. It is important that the retrieval system utilized accomplish the rescue objective effectively and safely within an appropriate time frame.

10.1.2.2.3.2 Retrieval System Configuration Considerations for Rescue Entrants.

As previously stated, entry for rescue still requires the need for retrieval. Unless waived, these systems may offer significant assistance to persons who are entering spaces during an emergency. Consider the following question: If it is important to maintain an immediate means of retrieval during normal entries when no emergency yet exists, how much more so in a situation where an emergency has already occurred. Even when retrieval is possible, it is recommended that rescue entrants have trained back-up rescuers immediately available (one for each rescue entrant inside the space) for entry rescue should a rescue entrant get in trouble. These represent significant differences in rescue entries vs. typical confined space entries.

(A)

Other differences are associated with the need for rescuers to handle emergencies quickly and safely by managing risks and minimizing complication in their systems. While using independent retrieval might be typical for most entries, rescuers must take other issues into consideration. For instance, when no fall hazards exist within the space and breathing air systems are not required for rescue entrants, they may consider placing several rescuers on a single retrieval line, spacing them out so each may be independently retrieved, one at a time. This makes the rigging of the rescue systems necessary to lift and lower these rescuers more efficient on the outside of the space. Of course, while this may be more manageable on the outside of the space, there is additional rope between rescuers that must be managed inside the space.

(B)

In the case of rescuers on breathing air systems, independent retrieval lines are recommended so that the first rescuer in may be the first rescuer out since fatigue or depletion of air supply typically affects the first rescuer earlier than the subsequent rescue entrants.

(C)

In cases where fall hazards exist, rescuers should follow the same guidelines as typical entries by providing independent attachment to appropriate systems to act as fall protection.

(D)

In general, rescuers need more versatility in their retrieval systems while providing the same degree effectiveness and safety associated with typical entry retrieval.

10.1.2.2.4 Ensuring Operational Readiness in Retrieval Systems.

Retrieval systems should be ready at all times. To assure operational readiness, the following three questions may be helpful prior to entry:

(1) Does everyone involved know the plan for retrieval? Without communication of this plan of action, personnel around the scene of the emergency may attempt to try many different options, slowing or rendering retrieval ineffective. Know the plan!

(2) Does everyone involved know their part in the retrieval plan? While typically, these systems are operated by the Attendant, more advanced systems may be utilized which require more than one person's efforts to effect retrieval. Again, it is very important that everyone involved knows "who does what."

(3) Will the retrieval system work the way it is configured? This may seem like an unreasonable question, but retrieval equipment is frequently setup without regard for whether or not it will actually work. For instance, slightly off-setting a winch device from center of a portal in a vertically-oriented space may allow ill or injured workers to be trapped against the underside of the portal during extraction, creating the significant potential for severe injury. A friction reducing device or other edge management methods might have been effectively used at the portal to prevent this from happening. In any case, these systems should be tested prior to use to assure that everything works the way it was intended.

10.1.2.3 Limitations and Exceptions for Retrieval.

It should be recognized that retrieval is not always prudent or even possible. In the case of spaces that contain internal configurations that could entangle or trap a person against structure, a line attached to the entrant might not function at all or, worse yet, may actually cause further harm to the entrant during the retrieval attempt.

10.1.2.3.1

The conditions within a space should be carefully evaluated to assure that such dangers are mitigated or eliminated entirely. In most cases where these types of internal hazards exist, the logical choice may be to forgo retrieval lines entirely to prevent further rescue complications. Consider the following questions when determining whether or not to use a retrieval system:

(1) Would the retrieval equipment increase the overall risk of entry? (If the answer to this question is yes, then the use of retrieval equipment can be waived.)

(2) Would the retrieval equipment contribute to the rescue of the entrant? (If the answer to this question is no, the retrieval equipment can be waived.)

(A)

In these situations, it is important to assure that an entry-type rescue provision should be available to respond in a timely manner.

(B)

It should be recognized that, regardless of the ability to rig and operate retrieval lines effectively, it may not be prudent to utilize them. For example, a worker who is positioned on built-up scaffolding within a space might fall and strike his head on an object. Simply operating the retrieval to extract this person, without regard for a potential spinal injury, could create permanent damage to the patient's spine with significant potential for paralysis. Retrieval operations should take into account the hazard vs. the risk to the patient to ensure safety.

10.1.2.4

Organizations should implement procedures for the following attendant operations:

(1) Recognizing the need for confined space search and rescue

(2) Initiating contact and establishing communications with victims where possible

(3)* Recognizing and identifying the hazards associated with non-entry confined space emergencies

(4) Advising the responding rescuers of the situation and potential hazards

(5) Recognizing confined spaces

(6)* Identifying the need for and performing a non-entry retrieval, based on the conditions present

(7)* Implementing the emergency response system for confined space emergencies

10.1.3 Entry-Type Rescue.

Government or jurisdictional regulations often delineate between those spaces that contain actual or potential threats (hazards) that may necessitate rescue vs. those that do not have that potential. Confined spaces that do not contain a threat (or in some cases where the threats have been mitigated, controlled or eliminated entirely) have no requirement for a rescue provision.

10.1.3.1

Existing NFPA standards relative to confined space rescue (1670 and 1006) consider all spaces to which they respond to possibly contain hazards. Therefore, NFPA technical rescue standards make no delineation between confined spaces and permit-required confined spaces since an emergency has already occurred, evoking a response. It assumes the worst; that a hazard may have caused this emergency; regardless of whether or not that is the case.

10.1.3.2

Many elements of a confined space rescue program, such as the need for a rescue provision and the mode of response should be addressed in the planning phase. The response phase addresses the approach to emergencies when they have occurred. All elements of the rescue operation should be carefully considered in the planning phase.

10.1.3.3

This guide contends that the requirement for a rescue provision should not be based solely on the hazards within and around a space that might create emergencies and make it difficult to self-rescue, but also the characteristics that might make it difficult for an ill or injured worker to be removed when not under his or her own power, even if there are no atmospheric, engulfment, entrapment or other chemical or physical hazards introduced to cause the emergency. Unless a space can be proven to have no potential for hazards and no potential difficulty associated with removal of ill or injured entrants, a rescue provision of some degree is required.

10.1.3.4 Rescue Response Mode.

The degree and rapidity of response should be principally driven by the anticipated hazards. Those spaces that contain known hazards should receive greater scrutiny and perhaps more rapid or complex response based on these hazards. Considerations should also include those spaces where technical rescue may be required to move an ill or injured entrant to a stable environment once extracted from the space. Rescue capabilities should be evaluated to assure they are appropriate to the response. Many emergency response agencies may not have the training or equipment to respond to confined space emergencies. Consideration should be given to three basic modes of rescue response;

(1) Tier 1 – Those that have no recognized hazards but could require technical rescue for extraction should the worker become incapacitated

(2) Tier 2 – Those with non-life-threatening hazards requiring rapid intervention

(3) Tier 3 – Those with life-threatening hazards requiring immediate intervention

10.1.3.4.1* Tier 1 Response Mode.

If a hazard evaluation has been performed (in accordance with Chapter Six of this guide) and the space contains no potential for hazards but, due to its configuration, would prohibit workers from being easily removed if they were to become incapacitated, either due to medical illness or injury, a Tier 1 response mode may be indicated. At the minimum, this should include any vertically-oriented space greater than five feet in vertical height whether or not retrieval equipment is in place. A Tier 1 capability suggests that a fully trained Rescue Team meeting NFPA 1670, Chapter 7, Technician level is available to respond within five minutes to the site and capable of setup and rescue entry within 12–15 minutes of arrival on site.

10.1.3.4.2* Tier 2 Response Mode.

If a space contains no IDLH or other potentially immediate life-threatening hazards, but contains some other actual or potential hazard that could incapacitate a worker or prevent them from exiting the space without assistance (self rescue), a Tier 2 response mode should be indicated. A Tier 2 capability suggests that a fully trained Rescue Team meeting NFPA 1670, Chapter 7, Technician level is on site with appropriate capability to make safe entry for rescue. This team should be equipped and mobile, capable of setup and rescue entry within 12-15 minutes of incident occurrence.

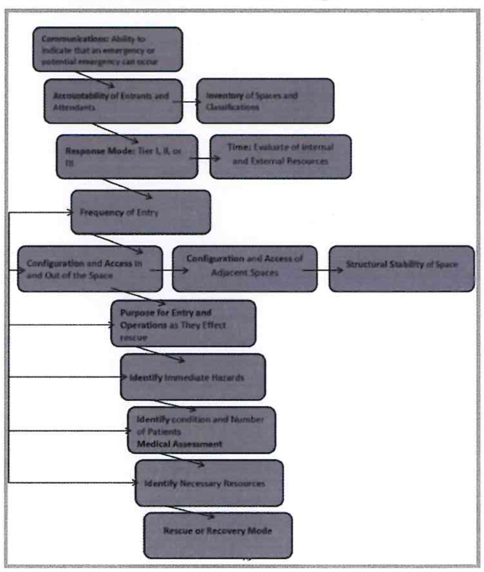
10.1.3.4.3* Tier 3 Response Mode.

If work is occurring inside a space that contains an IDLH or other potentially immediate life-threatening hazard, either actual or potential, a Tier 3 response mode should be indicated. A Tier 3 capability suggests that a fully trained Rescue Team meeting requirements stated in NFPA 1670, Chapter 7, Technician level is standing by in the immediate area with appropriate capability to make safe entry for rescue. This team should be completely set up and capable of rescue entry within two minutes of incident occurrence. The Rescue Team should be dedicated to this singular entry with no other responsibilities.

10.1.3.5* Protection of Personnel During Rescue.

In general; if the cause of the incident cannot be proven to be unrelated to the atmosphere, regardless of the atmospheric monitor readings, appropriate protection in the form of atmosphere supplying respirators should be worn by rescuers and provided to breathing victims. If chemical protective clothing is indicated by conditions, appropriate protection should be provided for rescue entrants as well.

Figure 10.1.3.5 Pre-Incident Action Planning and Assessment Flow Chart.



10.1.3.5.1* Rescue Vs. Recovery.

It is recognized that not all rescues can be performed safely. Certain conditions may exist that would create an unreasonable risk (as opposed to calculated risks) to rescuers. In these cases, the decision should be made to downgrade the rescue effort which may result in a body recovery. The decision to change the approach to this incident is generally the responsibility of the person in charge of the rescue service and may be loosely based on the following guidelines:

(1) Are there enough Rescue Team members to perform the rescue safely,

(2) Do rescuers have the proper equipment to perform the rescue safely, and

(3) Do rescuers have the proper training to perform the rescue safely.

(4) If any one of these questions cannot be answered in the affirmative, the rescue should not be performed.

10.1.3.5.2 Communications.

While communications equipment and methods are thoroughly outlined in Chapter 8. It is important to note that the need for communications in rescue operations should be based on the circumstances and rescue objective, which means the choices made by the Rescue Team are not only about the type of communications equipment, but the methods employed.

10.1.3.5.2.1

The principle operational concerns regarding communications for rescue operations involve not only communication from inside to the outside of the space, but the communication among rescuers inside and outside the space. For example, teams utilizing rope-based or other rescue systems for lowering or raising rescuers/patients must have definitive communications so that the systems may be operated safely. Systems remote from the portal or positioned in high-noise environments may require the use of hand signals in addition to verbal or radio communication methods. On the interior of the space, high noise environments or the use of breathing apparatus may inhibit the ability of rescuers to speak to one another, even in close proximity. It will be important to utilize equipment such as voice amplifiers or even methods such as hand signals to assure adequate communication and efficient operations.

10.1.3.5.2.2

Regarding communications between team efforts outside of the space to those inside the space and vice versa, methods utilized should be as patent as possible with provisions in the event of a communications system failure. For example, a Rescue Team utilizing portable radio systems as the primary means of communications between the inside and outside of the space should have a secondary method of communications readily in place in the event of a radio failure or interference. This may be as simple as the utilization of a pre-designated series of hand signals but, in any case, should provide an appropriate substitute. One of the most patent means of communications between the outside and inside of a space is hard line communications. This type of system utilizes a communications cable that allows transmission of voice between its terminal points. While this may be a very good means of communications, circumstances such as entanglement hazards within the space may render it ineffective. In any case, the pre-incident rescue action plan and practice of that plan represent the best means of determining the effectiveness of the communications methods chosen by the Rescue Team.

10.2 Rescue Team Qualification

10.2.1* Responsibility.

The AHJ (The person, persons, or organization(s) responsible for the spaces or spaces at the site) should assure that the rescue service, regardless of who provides it, is qualified to act in that capacity. On-site, contracted or contractor-supplied rescue services should all meet applicable requirements to assure their level of capability is commensurate with the task at hand. Assessment of the rescue service's qualifications should consider their training, standard operating procedures, equipment, availability and ability to perform rescue. An evaluation of their capabilities should include the overall timeliness of response and a demonstration of their ability to perform safe and effective rescue in those types of spaces to which the team must respond.

10.2.2 Rescue Program Audits.

Confined space rescue programs should be audited periodically. It is suggested that this occur at least once a year. It is also a good practice to review the rescue program following each rescue operation and make adjustments to the program if needed.

10.2.2.1 Content of Audit.

Rescue program audits should be conducted to include a full evaluation of the rescue program, regardless of the source of the rescue services and their capability. The components of the Rescue Program Audit should include, but not be limited to:

(1) Evaluation of the rescue response plan.

(2) Review of the rescue service's equipment including the system utilized for Inspection, Inventory, History of use and documentation.

(3) Review of the rescue service's standard operating procedures to assure they coincide with the needs of the response area.

(4) Evaluation of the rescue service's availability and timeliness of response to assure it is appropriate to the response required.

(5) Evaluation of the rescue service capability by means of a performance evaluation.

(6) Review of rescue service's qualifications and training records relative to both rescue and medical provisions.

(7) Review of rescue service's pre-incident emergency action plans for each space for which they are responsible.

(8) Evaluation of the communications methods used for both rescue service notification and operation at an emergency.

(9) Additions and corrections to the rescue plan based on audit results.

10.2.2.2* Auditor Qualifications.

Confined space rescue program audits should be conducted by a designated person or group of persons trained in or familiar with rescue operations and medical provisions at a level commensurate with the recommendations of this guide for Rescue Team members.

10.2.3 Performance Evaluations.

Performance evaluations are a principal means of deciding who is qualified among a group of perspective rescue service providers. Performance evaluations should be conducted prior to considering a rescue service and then periodically to assure their performance is still satisfactory. Performance should be evaluated by means of simulated rescue operations in which the rescue service removes dummies, mannequins, or persons from actual confined spaces or from representative confined spaces resembling all those to which the rescue service could be required to respond in an emergency within their jurisdiction. Representative confined spaces should; with respect to opening size, configuration, and accessibility; simulate the types of confined spaces from which rescue is to be performed.

10.2.3.1* Team Composition for Evaluations.

Evaluation of rescue service performance should include all combinations of personnel expected to participate as a member of that team. This may require multiple evaluations to assure all team member compositions will provide the appropriate capability for confined space rescue. Ad hoc or one-time Rescue Teams may only need a qualifying pre-operation evaluation.

10.2.3.2 Frequency of Performance Evaluations.

Performance evaluations should be repeated annually.

10.2.3.3 Components of Performance Evaluations.

Performance evaluations should include a means of evaluating the team's ability to address patient care (prior to transfer of the patient to the local EMS provider), rescue operations, and safety and confined space operations and safety.

10.2.3.3.1 Patient Care Components.

Patient care components should include; but are not limited to, the following:

(1) Assessing and addressing critical immediate life-threatening conditions,

(2) Assessing and addressing conditions that are not immediately life threatening

(3) Stabilization and packaging of the patient with regard to injuries so as to prevent further harm if possible,

10.2.3.3.2 Rescue Operations and Safety Components.

These components include the following:

(1) Rescue system safety

(2) Rescue system efficiency

(3) Team operations (command, control and communications)

10.2.3.3.3 Confined Space Operations and Safety Components.

These components include the following:

(1) Hazard identification

(2) Entry assessment – Go or No go?

(3) Hazard mitigation

(4) Regulatory compliance

10.3 Hazard Evaluation and Risk Assessments.

The AHJ should conduct a hazard evaluation and risk assessment of the response area and should determine the feasibility and type of incidents that may require confined space rescue operations.

10.3.1 Components.

These assessments should include, but not be limited to, the following:

(1) Evaluation of the environmental, physical, social, and cultural factors influencing the scope, frequency, and magnitude of a potential incident

(2) The impact these factors may have on the ability of the AHJ to respond to and to operate while minimizing threats to rescuers at an incident site.

(3) Identification and maintenance of a list of the type and availability of internal resources needed for technical search and rescue incidents.

(4) Identification of the type and availability of external resources needed to augment existing capabilities in confined space rescue incidents

(5) A determination of the potential to respond to rescue incidents that might involve nuclear or biological weapons, chemical agents, or weapons of mass destruction, including those with the potential for secondary devices. If the AHJ determines that a hazard evaluation exists for rescue response into a nuclear, biological, explosive and/or chemical environment, appropriate training and equipment for response personnel should be provided.

10.3.2 Acquisition of Resources.

Where an advanced level of search and rescue capability may be needed in a given confined space, organizations should have a system in place to utilize the most appropriate resource(s) available, through the use of local experts, agreements with specialized resources, and mutual aid. The AHJ should establish procedures for the acquisition of those external resources needed for specific emergencies in and associated with confined spaces. A list of these resources should be maintained and updated at least once a year, where necessary. At a minimum, the list should be reviewed and updated prior to a planned entry requiring advanced capability.

10.3.3 Documentation.

The hazard evaluation and risk assessment should be documented.

10.3.4 Review Process.

The hazard identification and risk assessment should be reviewed and updated on a scheduled basis and as operational or organizational changes occur.

10.3.5 Surveys.

At intervals determined by the AHJ; depending on changes in equipment, operations or materials; the AHJ should conduct surveys in the organization's response area for the purpose of identifying the types of rescue incidents that are most likely to occur in and around confined spaces.

10.4 Standard Operating Procedures.

The AHJ should establish written standard operating procedures (SOPs) consistent with a level of capability to respond to confined space rescue incidents.

10.4.1* Rescue Procedures.

Rescue procedures should include; but not be limited to; identification of hazards, use of equipment, and application of techniques necessary to coordinate, perform, and supervise confined space rescue incidents. The person, persons or organization(s) having responsibility for acquiring a rescue provision and for performing rescue for the confined space, should work together to establish operational procedures to ensure that confined space rescue operations are performed in a manner that minimizes threats to rescuers and others.

10.4.2 Evacuation Procedure.

The AHJ should ensure that there is a standard operating procedure to evacuate Rescue Team members and other personnel from an area and to account for their safety when an imminent hazard condition is discovered. This procedure should include a method to notify all personnel in the affected area immediately by any effective means, including audible warning devices, visual signals, and/or radio signals.

10.5 Regulatory Compliance.

The AHJ should comply with all applicable local, state, and federal laws and regulations.

10.6 Incident Response Planning.

The AHJ should train responsible personnel in procedures for developing pre-incident emergency action plans in order to prepare the rescue service for safe practices associated with rescue from specific and generic confined spaces for which they provide rescue. This process should include determining, reviewing, accessing, and using relevant components of applicable national, state, industry and local response plans.

10.6.1 Documentation of Response Plan.

The procedures for a rescue emergency response in and around confined spaces should be documented in the confined space rescue incident response plan.

10.6.1.1

The plan should be a formal, written document.

10.6.1.2

Where external resources are required to achieve a desired level of operational capability, mutual aid agreements should be developed with other organizations.

10.6.2 Response Plan Distribution.

Where required, copies of the confined space rescue incident response plan should be distributed to agencies, departments, owners/contractors and employees having responsibilities designated in the plan. Copies may also be given or shown to the Entry Supervisor, entrants, attendants and others involved in the confined space entry.

10.6.2.1

A record should be kept of all holders of the confined space rescue incident response plan, and a system should be implemented for issuing all changes or revisions.

10.6.2.2

The confined space rescue incident response plan should be approved by the AHJ through a formal, documented approval process and, where required, should be coordinated with participating agencies and organizations.

10.6.3 Type of Response Plan.

Confined space Response Plans are of two types:

10.6.3.1

Organizational response plan to manage confined space rescue incidents within a specific area or jurisdiction. This is the overall plan for managing generic emergencies of this type.

10.6.3.2

Rescue Team pre-incident emergency action plans to address specific or generic approaches to rescue from confined spaces for which they are responsible. This is the confined space-specific rescue plan that should fit into the organizational response plan.

10.6.4 Components of Organizational Response Plan.

The organizational response plan should include, but not be limited to, the following components:

(1) Command Structure

(2) Communications

(3) Internal Resources

(4) External Resources

(5) Safety and Accountability

(6) Regulatory compliance (state, local and Federal)

10.6.5* Components of Pre-incident emergency action plan.

The rescue pre-incident emergency action plan should include, but not be limited to, the following components *(see* Figure 10.6.5*)*:

(1) Space identification and configuration (Adjacent areas)

(2) Notification

(3) Command and control

(4) Communications

(5) Work to be performed

(6) Hazard identification and mitigation (Include adjacent areas)

(7) Environmental concerns

(8) Resource identification (Haz-mat, Fire, EMS, etc.)

(9) Access and egress methods

(10) Retrieval systems

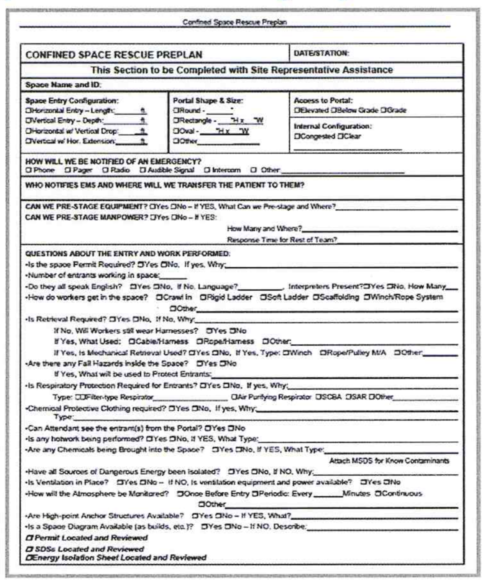
(11) Rescue systems

(12) Personal protective equipment (including atmosphere supplying respirators)

(13) Action planning

(14) Equipment required (medical and rescue)

Figure 10.6.5 Sample Pre-Incident Emergency Action Planning Form



Confined Space Rescue Preplan

CONFINED SPACE RESCUE PREPLAN		DATE/STATION:
This Section to be Completed with Site Representative Assistance		
Space Name and ID:		
Space Entry Configuration: ☐Horizontal Entry – Length:_____ft. ☐Vertical Entry – Depth:_____ft. ☐Horizontal w/ Vertical Drop:_____ft. ☐Vertical w/ Hor. Extension:_____ft.	Portal Shape & Size: ☐Round - _____" ☐Rectangle - ___"H x ___"W ☐Oval - ___"H x ___"W ☐Other_____	Access to Portal: ☐Elevated ☐Below Grade ☐Grade Internal Configuration: ☐Congested ☐Clear

HOW WILL WE BE NOTIFIED OF AN EMERGENCY?
☐ Phone ☐ Pager ☐ Radio ☐ Audible Signal ☐ Intercom ☐ Other_____

WHO NOTIFIES EMS AND WHERE WILL WE TRANSFER THE PATIENT TO THEM?

CAN WE PRE-STAGE EQUIPMENT? ☐Yes ☐No – If YES, What Can we Pre-stage and Where?_____
CAN WE PRE-STAGE MANPOWER? ☐Yes ☐No – If YES:
How Many and Where?_____
Response Time for Rest of Team?_____

QUESTIONS ABOUT THE ENTRY AND WORK PERFORMED:
•Is the space Permit Required? ☐Yes ☐No, If yes, Why:_____
•Number of entrants working in space:_____
•Do they all speak English? ☐Yes ☐No, If No, Language?_____, Interpreters Present?☐Yes ☐No, How Many___
•How do workers get in the space? ☐Crawl In ☐Rigid Ladder ☐Soft Ladder ☐Scaffolding ☐Winch/Rope System ☐Other_____
•Is Retrieval Required? ☐Yes ☐No, If No, Why:_____
If No, Will Workers still wear Harnesses? ☐Yes ☐No
If Yes, What Used: ☐Cable/Harness ☐Rope/Harness ☐Other:_____
If Yes, Is Mechanical Retrieval Used? ☐Yes ☐No, If Yes, Type: ☐Winch ☐Rope/Pulley M/A ☐Other:_____
•Are there any Fall Hazards inside the Space? ☐Yes ☐No
If Yes, What will be used to Protect Entrants:_____
•Is Respiratory Protection Required for Entrants? ☐Yes ☐No, If yes, Why:_____
Type: ☐☐Filter-type Respirator_____ ☐Air Purifying Respirator ☐SCBA ☐SAR ☐Other_____
•Chemical Protective Clothing required? ☐Yes ☐No, If yes, Why:_____
Type:_____
•Can Attendant see the entrant(s) from the Portal? ☐Yes ☐No
•Is any hotwork being performed? ☐Yes ☐No, If YES, What Type:_____
•Are any Chemicals being Brought into the Space? ☐Yes ☐No, If YES, What Type:_____
Attach MSDS for Know Contaminants
•Have all Sources of Dangerous Energy been Isolated? ☐Yes ☐No, If NO, Why:_____
•Is Ventilation in Place? ☐Yes ☐No – If NO, Is ventilation equipment and power available? ☐Yes ☐No
•How will the Atmosphere be Monitored? ☐Once Before Entry ☐Periodic: Every_____Minutes ☐Continuous ☐Other_____
•Are High-point Anchor Structures Available? ☐Yes ☐No – If YES, What?_____
•Is a Space Diagram Available (as builds, etc.)? ☐Yes ☐No – If NO, Describe:_____
☐Permit Located and Reviewed
☐ SDSs Located and Reviewed
☐Energy Isolation Sheet Located and Reviewed

10.7 Confined Space Rescue Equipment and Gear.

10.7.1 Operational Rescue Equipment.

The AHJ should ensure that confined space rescue equipment is procured and utilized commensurate with recognized standards of reference and the respective operational needs for rescue operations. Confined space rescue equipment may include, but is not limited to, the following:

(1) Rescue harnesses (Class II or III)

(2) Rescue rope

(3) Auxiliary equipment and rope hardware

- (a) Carabiners and snap links
- (b) Rope grap and ascending devices
- (c) Descent controlled devices
- (d) Portable anchors
  - i. Beam straps and clamps
  - ii. Anchor plates
- (e) Pulleys
- (f) Load straps (end-to-end and multiple configurations)

(4) Mechanical rescue/retrieval devices (vertical and horizontal)

- (a) Winches
- (b) Pulley systems (i.e., block and tackle, pre-built)
- (c) Tripods and davit arms

(5) Illumination

(6) Ventilation

(7) Energy Control Devices

(8) Communication and technology systems

- (a) Hardwire
- (b) Mobile communication devices
- (c) Laptops and tablets

(9) Patient packaging and care equipment (BLS and ALS)

- (a) Medical first response kits
- (b) Backboards
- (c) Basket and flexible litters
- (d) Stabilization devices

(10) Grain rescue tube

10.7.1.1 Confined Space Rescue Equipment Standards.

The following publications should be consulted as appropriate:

(1) NFPA 1983, *Standard on Life Safety Rope and Equipment for Emergency Services*

(2) NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services*

(3) NFPA 1951, *Standard on Protective Ensembles for Technical Rescue Incidents*

(4) NFPA 1855, *Standard on Selection, Care, and Maintenance of Protective Ensembles for Technical Rescue Incidents*

10.7.1.2 Inspection, Care, and Maintenance of Confined Space Rescue Equipment and Gear.

In accordance with manufacturer's requirements/recommendations and reference standards, confined space rescue equipment should be properly inspected and maintained to ensure it will operate as designed. All equipment should be inspected for damage or defect before and after each use as appropriate and removed from service if found defective. Inspections performed according to manufacturer's requirements should be properly documented.

10.7.2* Personal Protective Equipment (PPE).

Rescue teams should assess the need for, provide and train personnel in the utilization of appropriate PPE based on guidelines listed in Chapter 8. Since some PPE requirements may be satisfied in different ways, it is important that Rescue Teams not only choose PPE appropriate to the hazards, but choose equipment that will most efficiently allow them to meet the rescue objectives.

10.8 Incident Management System.

10.8.1

The AHJ should provide for and utilize training on the implementation of an incident management system that meets the requirements of NFPA 1561, *Standard on Emergency Services Incident Management System*, with written SOPs applying to all members involved in emergency operations. All members involved in emergency operations should be familiar with the system.

10.8.2

The AHJ should provide for training on the implementation of an incident accountability system that meets the requirements of NFPA 1561, *Standard on Emergency Services Incident Management System.*

10.8.3

The incident commander should ensure rotation of personnel to reduce stress and fatigue.

10.8.4

The incident commander should ensure that all personnel are aware of the potential impact of their operations on the safety and welfare of rescuers and others, as well as on other activities at the incident site.

10.8.5

At all rescue incidents, the organization should provide supervisors who possess skills and knowledge commensurate with the organizations rescue capability.

10.9 Rescue Team Composition

10.9.1*

The size and composition of a confined space Rescue Team should be based on pre-incident planning and practice of those plans to assure effective operations. The role of a Confined Space Rescue Team is intended to include entry into the space to perform a rescue and, as a minimum, should be staffed to provide sufficient members with the following exclusive functions:

(1)* Entrant / Entry team of sufficient size and capability to perform the rescue

(2)* Back up team of sufficient size to provide immediate assistance to, or rescue of, entry team members who become ill or injured and are unable to perform self-rescue.

(3) Attendant whose function is deny unauthorized persons access, monitor the conditions in the space and the status of all entrants

(4) Supervisor who should maintain control of the entire operation and be knowledgeable in all team functions"

10.10 Entry Rescue – Rescue Service Capabilities.

10.10.1

The organization should be responsible for the development and training of a confined space Rescue Team who are trained, equipped, and available to respond to emergencies in and around confined spaces of a type and complexity that require anything other than non-entry type rescues from confined spaces.

10.10.2

The Rescue Service may perform both non-entry and entry type rescues from confined spaces.

10.10.3

Organizations should develop and implement procedures for the following:

(1) Determining and recognizing existing and potential conditions at rescue emergencies

(2) Protecting personnel from hazards in and around the confined space

(3) Ensuring that personnel are capable of managing the physical and psychological challenges that affect rescuers performing these rescues.

(4) Identifying the duties of the rescue entrant(s) and backup rescue entrant (s), rescue attendant, and Rescue Team leader as defined herein

(5) Monitoring continuously, or at frequent intervals, the atmosphere in all parts of the space to be entered for oxygen content, flammability [lower explosive limit/lower flammable limit (LFL/LFL)], and toxicity, in that order

(6) Performing entry-type rescues into confined spaces

(7) Using victim packaging devices that could be employed in confined space rescue

(8) Selecting, constructing, and using rope or cable based lowering and raising systems in the high-angle environment commensurate with the needs of the organization.

(9) Developing hazard isolation and control requirements

(10) Ensuring that Rescue Team members take part in a medical surveillance program

(11) Planning response for entry-type confined space rescues in hazardous environments

(12) Implementing the planned response

10.10.4

Where applicable, organizations should have a working understanding of the machinery-related hazards in and around the space as it relates to the rescue.

NFPA 350®, Best Practices Guide for Safe Confined Space Entry and Work, proposed Edition

Edit Chapter Title

Chapter 11 Confined Space Personnel Duties, Responsibilities and Competencies

11.1 General.

All persons engaged in confined space activities and operations should be competent and/or qualified. There are numerous entities that may be involved, individually or working together, in confined space entry and related activities. These include, but are not limited to owners, facility personnel, contractors, visitors, subcontractor personnel and as well as other persons and operations both within and outside of the confined space. This chapter covers the duties, responsibilities, qualifications and competencies of these individuals as related to confined space activities.

11.2 Entrants.

11.2.1 General.

11.2.1.1

Entrants should be competent, qualified and authorized to enter and work within confined spaces.

11.2.1.2*

Entry occurs when *any* part of the entrant's body breaks the plane of a confined space opening that provides for entry.

11.2.1.3

Entrants may also perform other activities and assigned duties if qualified in accordance with the applicable Confined Space Program including, but not limited to, self rescue, monitoring and performing non-entry tasks.

11.2.2 Entrant Duties and Responsibilities.

11.2.2.1

Entrants should enter the confined space only after issuance of the entry permit

11.2.2.1.1

Entrants should verify that their name is listed on the entry permit.

11.2.2.1.2

Entrants should be able to verbally identify all confined space hazards and controls noted on the permit to the Entry Supervisor.

11.2.2.2

Entrants should conduct assigned work following approved procedures that minimize hazards.

11.2.2.3

Entrants should demonstrate the proper use of approved equipment, materials, tools, and personal protective equipment identified in the permit to the Entry Supervisor.

11.2.2.4

Entrants should remain aware of potential atmospheric and non-atmospheric hazards that might be encountered during confined space entry.

11.2.2.4.1

Entrants should exit the confined space when changing conditions result in hazards that cause unacceptable risks.

11.2.2.4.2

Entrants should immediately exit the space if the entry permit expires or is cancelled.

11.2.2.4.3

Entrants should immediately exit the space when directed by the attendant or Entry Supervisor, or during an emergency else when in the vicinity that requires evacuation.

11.2.2.5

Entrants should verbally identify the hazards inside and outside the confined space that may be faced during entry, including information on the mode, signs or symptoms and consequences of exposure and acts accordingly

11.2.2.5.1

Entrants should notify the attendant of any symptoms of exposure, emergency or unacceptable condition.

11.2.2.5.2

Entrants should exit the confined space immediately if symptoms, warning signs, or unacceptable conditions occur.

11.2.2.6

Entrants should respond to emergencies as trained and directed including, but not limited to, self-rescue or evacuation of the confined space.

11.2.3 Entrant Qualifications.

11.2.3.1

An entrant should verbally identify the governmental regulations that pertain to the planned confined space work to the Permit Issuer.

11.2.3.2

An entrant should verbally identify the use, limitations and hazards of materials, substances, and equipment approved for use within the specific confined space (i.e., tools, personal protective equipment, energy isolation devices, Gas Testers and chemicals) to the Permit Issuer before entry.

11.2.3.3

An entrant should verbally identify the primary and secondary means of communication to be used during emergencies to the Permit Issuer before entry.

11.2.3.4

An entrant should verbally explain how to interpret air monitor displays and alarms to the Permit Issuer before entry.

11.2.3.5

An entrant should verbally explain all sections of the confined space entry permit that are applicable to the entrants' duties to the Permit Issuer before entry.

11.2.3.6

An entrant should verbally explain personal warning signs and overexposure symptoms to the Permit Issuer before entry.

11.2.3.7

An entrant should verbally explain applicable emergency procedures within or around the confined space to the Permit Issuer before entry.

11.2.4 Entrant Demonstrated Competencies.

11.2.4.1

An entrant should be able to read and understand permit requirements.

11.2.4.2

An entrant should be able to properly demonstrate the proper use required assigned equipment including, but not limited to, PPE, respiratory protection (if needed), non-entry rescue devices; etc.

11.2.4.3

An entrant should be able to communicate when evacuation is desired.

11.2.4.4

An entrant should be able to complete assigned tasks in an approved manner.

11.3 Attendant.

11.3.1 General.

11.3.1.1

Attendants should be competent, qualified and authorized to oversee the entrants working inside the confined space and activities outside the confined space that might impact confined space operations.

11.3.1.2

Attendants should be stationed outside of confined spaces.

11.3.1.3

Attendants may also perform other assigned duties, if competent, in accordance with the applicable Confined Space Program including, but not limited to, summoning rescuers and performing non-entry rescue.

11.3.2 Attendant Duties and Responsibilities.

11.3.2.1

Attendants should verbally indentify the hazards inside and outside the specific confined space that might occur during entry, including information on the modes, signs or symptoms and consequences of exposure to entrants.

11.3.2.1.1

Attendants should verify name is listed on the entry permit.

11.3.2.1.2

Attendants should be constantly monitoring the conditions in and around the confined space to assure that requirements on the permit

11.3.2.1.3

Attendants should monitor adjacent areas outside the confined space for changing conditions that might impact safe entry work or activities.

11.3.2.2

Attendants should remain outside the confined space during entry operations until relieved by another assigned attendant.

11.3.2.2.1

Attendants should inform the new (replacement) attendant of current confined space and entrant status.

11.3.2.2.2

The replacement attendant's name should be listed on the entry permit.

11.3.2.3

Attendants should monitor entrant's status and direct entrant evacuation as needed.

11.3.2.4

Attendants should continuously maintain an accurate count of entrants in the permit space.

11.3.2.5

Attendants should take the following actions when unauthorized person(s) approach or enter a permit space while entry is underway:

11.3.2.5.1

Attendants should prevent entry of non-authorized personnel into the confined space.

11.3.2.5.2

Attendants should inform entrants and supervisors when non-authorized personnel enter or attempt to enter the confined space.

11.3.2.5.3

Attendants should prevent non-authorized personnel from interfering with attendant duties.

11.3.2.6

Attendants should summon rescue and other emergency services immediately upon recognizing an entrant's distress inside the confined space.

11.3.2.7*

Attendants should perform non-entry rescue as trained and equipped.

11.3.2.8*

Attendants may perform other approved assigned duties that do not interfere with the primary duty to monitor and protect the entrants.

11.3.3 Attendant Qualifications.

11.3.3.1

An attendant should competent, qualified and authorized the confined space program and governmental regulations that pertain to the planned confined space work.

11.3.3.2

An attendant should verbally indentify the use, limitations and hazards of materials, substances, and equipment approved for use outside the specific confined space (i.e., tools, personal protective equipment, energy isolation devices, Gas Testers and chemicals).

11.3.3.3

An attendant should verbally explain the hazards inside and outside the specific confined space that might be faced during entry operations, including information on the modes, signs or symptoms and consequences of exposure to entrants.

11.3.4 Attendant Demonstrated Competencies.

11.3.4.1

An attendant should be able to read and verbally explain permit requirements.

11.3.4.2

An attendant should be able to properly use required assigned equipment including, but not limited to, PPE, respiratory protection, non-entry rescue devices

11.3.4.3

An attendant should be able to communicate with the entrant to evacuate when conditions arise that might endanger the entrant.

11.3.4.4

An attendant should be able to perform assigned tasks safely

11.3.4.5

An attendant should be able to recognize entrant signs and symptoms related to hazardous or toxic chemical exposures and oxygen deficiency.

11.4 Entry Supervisor.

11.4.1 General.

11.4.1.1

Entry Supervisors should be competent to oversee and direct confined space entry and associated operations in accordance with applicable regulations and this document

11.4.1.2*

Entry Supervisors may also be designated as attendants, Permit Issuers, Gas Testers, Ventilation Specialists, Isolation Specialists and entrants in accordance with the applicable confined space program if properly trained and/or qualified in accordance with the respective requirements provided in Chapter 11.

11.4.2* Entry Supervisor Duties and Responsibilities.

11.4.2.1

Entry Supervisors should verify that the appropriate information has been recorded on the confined space entry permit or other specified permit and all tests specified by the permit have been completed and that all requirements, procedures and equipment specified by the permit are in place before issuing the permit to authorize entry.

11.4.2.1.1

Entry Supervisor be able to indentify, eliminate, control or mitigate hazards

11.4.2.1.2

Entry Supervisors should be identified and documented on all permits.

11.4.2.1.3

Assigned Entry Supervisors should remain at the confined space work site to control operations unless relieved by another competent, qualified and authorized Entry Supervisor.

11.4.2.1.4

Entry Supervisors should ensure that personnel involved with the confined space operations are informed when a different person assumes the Entry Supervisor role.

11.4.2.1.5

The Entry Supervisor should be trained as an entrant if duties require entry into confined spaces.

11.4.2.1.6

The Entry Supervisor should be trained and qualified as a Gas Tester if duties require maintaining, testing and operating Gas Testers.

11.4.2.1.7

The Entry Supervisor should be trained and qualified as a Ventilation Specialist if duties require ventilation of the space.

11.4.2.2

Entry Supervisors should conduct a pre-entry safety meeting with all persons involved prior to the start of confined space operations in accordance with the applicable Confined Space program. (see Section 5.5)

11.4.2.3

Entry Supervisors should coordinate activities where multiple employers (owner/operator, contractor and subcontractor) are working on the same job or on nearby jobs that might impact the confined space operations.

11.4.2.4*

Entry Supervisors should terminate the entry and cancel the permit when permit requirements are no longer met.

11.4.2.4.1

Entry Supervisors should cancel the permit whenever unauthorized individuals or equipment enter the confined space.

11.4.2.4.2

Entry Supervisors should cancel the permit when conditions arise within or outside of the confined space that were not anticipated on the permit and have the potential to adversely affect operations.

11.4.2.4.3

Entry Supervisors should cancel and reissue the permit with the new entry and control requirements when the confined space is reclassified.

11.4.2.5

Entry Supervisors should identify methods of alerting rescuers and assure rescuers are available for a timely response as required by the confined space program.

11.4.2.6

Entry Supervisors should determine acceptable entry conditions are met and that they remain consistent with requirements of the entry permit including whenever changes occur within or outside the confined space.

11.4.2.7

Entry Supervisors should assure that all energy sources (including, but not limited to, electrical, steam, hydraulic and mechanical) and all tank equipment and appurtenances (including, but not limited to, tank mixers, heaters, sensors, and other instrumentation) have been controlled, disconnected or isolated before the permit is issued.

11.4.2.8

Entry Supervisors should assure that the Gas Tester, entrants, attendants and other confined space personnel properly wear and use approved personal protective equipment and appropriate respiratory protection as identified on the permit.

11.4.2.9

Entry Supervisors should verify that prohibition of access to confined spaces is secure when work is not in process or when appropriate timely emergency response is not available.

11.4.2.10

Entry Supervisors should assure that areas are barricaded/cordoned off to prevent exposure where toxic and flammable gases, vapors, or inert gas are vented, or where ignition sources exist.

11.4.2.11*

Entry Supervisors should assure that all ignition sources in the area are eliminated or controlled before permitting work to be conducted that might involve the actual or potential release of flammable vapors into the atmosphere around or inside the confined space.

11.4.3 Entry Supervisor Qualifications.

11.4.3.1*

A supervisor should be certified as a Confined Space Entry (Safety) Supervisor where certification is available and required or applicable.

11.4.3.1.1

A supervisor should verbally explain the hazards that might be faced during entry, including information on the modes, signs or symptoms, and consequences of exposure.

11.4.3.2

A supervisor should verbally explain and should be able to apply the regulatory and applicable confined space program requirements.

11.4.3.3

A supervisor should verbally explain the proper use of monitors and should be able to interpret monitor readings.

11.4.4 Demonstrated Competencies.

11.4.4.1

A supervisor should be able to identify, recognize and assess hazards associated with the specific confined space and operations and the methods to be used for elimination, mitigation or control of such hazards in accordance with Chapters 6, 7, 8.

11.4.4.2

A supervisor should be able identify and evaluate need for required equipment.

11.4.4.3

A supervisor should be able to prepare and understand permits.

11.4.4.4

A supervisor should be able to communicate with all personnel.

11.4.4.5

A supervisor should be able to perform assigned tasks in an approved manner.

11.5 Permit Issuer.

11.5.1 General.

11.5.1.1*

Permit Issuers should determine and delineate the specific permit requirements applicable to the hot work, cold/safe work and/or confined space entry operations to be performed and issue the appropriate permits upon assuring that the requirements have been met and that all persons involved are aware of these requirements in accordance with Chapter 13. The Permit Issuer can be a facility employee, Entry Supervisor or other designated person.

11.5.2 Permit Issuer Duties and Responsibilities.

Prior to the start of work, the Permit Issuer should perform a hazard analysis and assessment to establish the conditions and requirements for entry into confined spaces and for conducting hot and/or cold/safe work in and around confined spaces in accordance with Chapter 6.

11.5.2.1

The Permit Issuer should assure the implementation of these requirements and document them on the permit prior to issuing a completed permit allowing entry or work within and around the confined space.

11.5.2.2

The Permit Issuer should determine the requirements and designate appropriate protective personal protective equipment and respiratory protection required for entry into confined spaces.

11.5.2.3

The Permit Issuer should determine that the risk assessment level (see Chapter 6) is within the parameters of the applicable confined space program.

11.5.2.4

The Permit Issuer should issue a written entry permit for every entry into a confined space attesting that all required testing and safeguarding has been completed and that the entry requirements on the permit have been satisfied.

11.5.2.4.1

The Permit Issuer should assure that the duration of the permit does not exceed the time required to complete the assigned operations or tasks identified on the permit.

11.5.2.4.2

The Permit Issuer should determine prohibited entry and work limitations and document these on the entry and work permits.

11.5.2.4.3

The Permit Issuer should determine if continuous ventilation is required to assure atmospheric levels inside the space remain within permit limits. If ventilation is required the Permit Issuer should ensure that a Ventilation Specialist has determined what ventilation is required and list those requirements on the work permit.

11.5.2.4.4

The Permit Issuer should determine if periodic or continuous toxic exposure monitoring is required during entry. If monitoring is required the Permit Issuer should ensure that a Gas Tester has determined what ventilation is required and list those requirements on the permit.

11.5.2.4.5

The Permit Issuer should enter the names of all persons and their duties on every entry, safe (cold) work and hot work permit issued.

11.5.2.5

The Permit Issuer should assure that Entry Supervisors, entrants, attendants and other workers (or their authorized representatives) are capable to confirm that the pre-entry requirements have been met by posting the permit at the entry portal or by other effective means.

11.5.2.6

Where there are any physical conditions that might result in entrapment or engulfment, or affect the rapid evacuation of the space by entrants, the Permit Issuer should determine if supplementary rescue equipment and measures are required. The rescue equipment should be identified on the permit.

11.5.2.7*

The Permit Issuer should be aware that there might be a need to cancel and reissue the permit if unforeseen conditions arise.

11.5.2.8

The Permit Issuer should ensure that all appropriate information has been recorded on the permit, that all tests specified by the permit have been completed and are acceptable, and that all procedures and equipment specified by the permit are in place before endorsing and posting the permit to allow entry and/or hot work or safe work to operations commence.

11.5.2.9

The Permit Issuer should verify that required rescue services are available, that the means for summoning them for timely response are operable, and that potential rescue procedures are planned to assure proper equipment needed for the specific job has been identified, inspected and staged so as to be available to or near the entry location prior to issuing the permit.

11.5.3 Permit Issuer Qualifications.

11.5.3.1

A Permit Issuer should be able to recognize hazards associated with the specific space and operations.

11.5.3.2

A Permit Issuer may be certified as a Confined Space Entry (Safety) Supervisor where certification is available and applicable.

11.5.3.3

A Permit Issuer should verbally indentify the hazards that are applicable to entry, hot work and cold work operations and the equipment, procedures and controls required to protect against such hazards.

11.5.3.4

A Permit Issuer should verbally explain and be able to apply the applicable regulatory and confined space program requirements.

11.5.3.5

A Permit Issuer should know and understand the proper use of monitors and be able to interpret monitor readings.

11.5.4 Permit Issuer Demonstrated Competencies.

11.5.4.1

A Permit Issuer is capable to prepare and issue permits

11.5.4.2

A Permit Issuer is able to identify and evaluate the hazards and the need for required equipment and controls.

11.5.4.3

A Permit Issuer is able to communicate with all personnel.

11.5.4.4

A Permit Issuer is able to perform assigned tasks in an approved manner.

11.6 Rescuer.

11.6.1 General.

Rescuers should be competent, trained, equipped, designated and able to respond to emergencies requiring the rescue of entrants from outside of or from within confined spaces and should be familiar with all provisions of Chapter 10.

11.6.2 Rescuer Duties and Responsibilities.

11.6.2.1

Rescuers should evaluate the internal and external physical, atmospheric and other hazards (specific to the confined space) that might be encountered during a rescue situation.

11.6.2.2

Rescuers should assure all required rescue and personal protective equipment is inspected and in good working order prior to start of confined space operations.

11.6.2.3

Rescuers should determine if a non-entry rescue or an entry required rescue is needed.

11.6.2.3.1

The rescue may be conducted totally from outside the confined space and without the need for entry.

11.6.2.3.2

Should the rescue require entry into the space, the rescuers should be trained similar to entrants and should meet the same entry requirements applicable to entrants.

11.6.2.4

Rescuers should develop a pre-emergency action plan with the ability to respond in an organized manner that includes, but is not limited to, the following:

(1) Alarm or notification method specific to the facility or operation

(2) Assessing the incident and identifying potential related hazards

(3) Determining if rescue is to be external or internal

(4) Determining the appropriate PPE and respiratory protection required for entry

(5) Organizing equipment and personnel prior to start of rescue operations

(6) Determining signals or communication to be used during rescue

(7) Planning the specific step-by-step operations of the rescue

(8) Responding to the incident and performing rescue

(9) Conducting a post-incident evaluation and taking necessary action to correct pre-emergency rescue plans where needed.

11.6.2.5

Rescuers should consider the rescue requirements with respect to entrant's self-rescue capability or physical and mental condition, hazards, equipment, communications, confined space configuration and other rescue related conditions prior to starting rescue operations.

11.6.3 Rescuer Qualifications.

11.6.3.1

A rescuer should be familiar with the confined space program and governmental regulations that pertain to the planned rescue work.

11.6.3.2

An rescuer should be familiar with the use, limitations and hazards of materials, substances, and equipment approved for use outside the specific confined space (i.e., tools, personal protective equipment, energy isolation devices, Gas Testers and chemicals).

11.6.3.3

A rescuer should verbally explain the hazards inside and outside the specific confined space that might be faced during rescue operations, including information on the modes, signs or symptoms and consequences of exposure to rescuers and entrants

11.6.3.4

A rescuer should be able to identify hazards and eliminate, control or mitigate exposures during rescue operations (in accordance with Chapters 6, 7, 8)

11.6.4 Rescuer Demonstrated Competencies.

11.6.4.1

A rescuer should be able to pre-plan rescues specific to the confined space.

11.6.4.2

A rescuer should be able to properly use required assigned equipment including, but not limited to, rescue equipment, PPE and respiratory protection.

11.6.4.3

A rescuer should be able to communicate with the entrants, attendants, and supervisors.

11.6.4.4

A rescuer should be able to perform assigned tasks in an approved manner.

11.7 Gas Tester.

11.7.1 General.

Gas Testers should be qualified in the appropriate selection, inspection, calibration, testing, adjustment and use of monitoring equipment and applicable monitoring and testing procedures associated with the assessment and evaluation of atmospheres in and around confined spaces in accordance with Chapter 7

11.7.2 Gas Tester Duties and Responsibilities.

11.7.2.1

Gas Tester should determine proper selection of monitoring equipment based on the hazards that are present or to be encountered during confined space operations.

11.7.2.2

Gas Tester should calibrate, test and adjust equipment prior to use.

11.7.2.3

Prior to entry, Gas Tester should first test, sample and monitor the atmosphere around the confined space

11.7.2.3.1

Gas Tester should verify their name is listed on the entry permit as tester

11.7.2.3.2

Gas Tester should be aware of all confined space hazards, entry requirements and controls noted on the permit prior to entry for testing.

11.7.2.4

Gas Tester should sample and monitor the atmosphere inside the confined space in the following order:

(1) Oxygen levels

(2) Flammable gases and vapors

(3) Toxic/hazardous atmospheric contaminants

11.7.2.5

Gas Tester should record test results on the permit and verify by signing the permit indicating the time(s) and the result(s) of the testing.

11.7.2.6

Gas Tester should allow Permit Issuers, Entry Supervisors, attendants, entrants, and workers (or their authorized representatives) to observe the monitoring process and results.

11.7.2.7

Gas Tester should re-evaluate conditions by testing, sampling and monitoring the atmosphere both around and inside the confined space as often as necessary as determined by the Permit Issuer and/or Entry Supervisor.

11.7.3 Gas Tester Qualifications.

11.7.3.1

A Gas Tester should be familiar with the confined space program and governmental regulations that pertain to the planned confined space work.

11.7.3.2

A Gas Tester should be trained and qualified in the appropriate selection, inspection, calibration, adjustment and use of monitoring equipment.

11.7.3.3

A Gas Tester should be able to verbally explain, assess, interpret and apply material safety data information and limitations pertinent to the hazards associated with the confined space and surrounding area and operations.

11.7.3.4

A Gas Tester should be able to verbally explain and apply the appropriate testing procedures associated with the monitoring of atmospheres in and around confined spaces.

11.7.3.5

A Gas Tester should meet the qualifications for an entrant

11.7.3.6

The Gas Tester should know how to determine, select and use required personal protective equipment and respiratory protection based on hazards associated with the confined space operations.

11.7.3.7

The Gas Tester should be able to verbally explain how to monitor and interpret atmospheric hazards.

11.7.4 Gas Tester Demonstrated Competencies.

11.7.4.1

A Gas Tester should be able to demonstrate the competencies required for an entrant and understand permit requirements for recording monitoring results.

11.7.4.2

A Gas Tester should be able to select, adjust, calibrate, bump test and properly use required equipment.

11.7.4.3

A Gas Tester should be able to conduct monitoring and testing in approved manner.

11.7.4.4

A Gas Tester should be able to compare results with recognized OSHA, NIOSH ACGIH and other applicable recommended exposure limits to determine if hazard exists.

11.8 Owner/Operator.

11.8.1 General.

Owners/Operators should have control, ownership or authority over the confined space and should assure that confined space operations are conducted in accordance with regulatory and industry practices and the owner/operator's and/or contractor's confined space program and Chapter 12

11.8.2 Owner/Operator Duties and Responsibilities.

11.8.2.1

The owner/operator should evaluate and re-evaluate confined spaces and identify and designate those that should be classified as permit required confined spaces in accordance with Chapter 4. This responsibility can be delegated by the owner when the space is under the control of a third party (such as when a building or portion thereof (a space) is leased or contracted to a third party) and owner/operator has no obligation to the building, space or operations therein.

11.8.2.2

The owner/operator should obtain required jurisdictional permits and authorizations.

11.8.2.3

The owner/operator should identify and designate those individuals (either facility personnel or contractors) who are educated, trained, competent and/or qualified to perform specific confined space related duties, including, but not limited to, supervising operations, issuing permits, entering into confined spaces, conducting gas testing, providing for rescue, performing attendant duties, overseeing ventilation, and conducting hot or cold work operations. The owner/operator should designate and identify the individuals and their duties in the written confined space program in accordance with Chapter 12

11.8.2.4

The owner/operator should develop and implement a confined space program in accordance with Chapter 12 which should be available for inspection by the employees and their authorized representatives. The confined space program applicable to the operations may be that of the owner/operator or a contractor or both

11.8.2.5

Owner/operators should conduct a pre-entry safety meeting in accordance with Chapter 5 to assure that all Permit Issuers, Entry Supervisors, Gas Testers, entrants, attendants, etc. and contractors/subcontractors are apprised of the hazards associated with the confined space.

11.8.2.6

When an owner/operator arranges for a contractor to perform work that involves confined space entry, the owner/operator should assure that the contractor is aware that entry into a confined space requires compliance with an applicable confined space program.

11.8.2.7

Owners/operators should assure that contractors/subcontractors are aware of any precautions or procedures that the host employer has implemented for the protection of employees in or near the confined space where the contractor/subcontractor personnel will be working.

11.8.2.7.1

Owners/operators should coordinate entry operations with the contractor when both host employer personnel and contractor personnel will be working in or near permit spaces.

11.8.2.7.2

Owners/operators should debrief contractors at the conclusion of entry operations regarding the permit space program followed and regarding any hazards confronted or created in permit spaces during entry operations.

11.8.2.7.3

Owner/operators should coordinate activities where multiple employers (owner/operator, contractor and subcontractor) are working on the same job or other nearby jobs that may impact upon the confined space operations.

11.8.2.8

Owner/operators should implement effective measures to prevent unauthorized personnel from entering confined spaces

11.8.2.9

If there are changes in the use or configuration of a confined space that affect the hazards, owner/operators should assure that the entry is cancelled and the confined space is reevaluated and, as necessary, reclassified, issuing new permits and establishing revised entry criteria.

11.8.2.10*

Owners/operators should provide the required equipment and assure that it is properly inspected, tested, maintained, and used in accordance with the confined space program.

11.8.2.11

The owner/operator should evaluate, qualify and identify rescuer services and develop and implement procedures for summoning rescue and emergency services.

11.8.2.12

The owner/operator should develop and implement procedures to review entry operations when there is reason to believe that the measures taken under the confined space program might not protect employees. The owner/operator should revise the program to correct identified deficiencies before subsequent entries are authorized.

11.8.2.13*

The owner/operator should review the confined space program annually utilizing cancelled permits and other information to ensure protection from hazards during entry operations.

11.8.2.14

The owner/operator should consult with employees and their authorized representatives on the development and implementation of all aspects of the confined space program and make information available to all affected employees and their authorized representatives.

11.8.2.15

The owner/operator should provide training regarding existing, new, and revised procedures and work practices so that all employees involved in confined space operations and activities acquire the understanding, knowledge and proficiency necessary for the safe performance of assigned duties. Training should be provided ;

(1) Before the employee is first assigned confined space related duties

(2) Whenever there is a change in assigned duties

(3) Whenever there is a change in confined space related operations that presents a hazard

(4) Whenever the employer has reason to believe that there are deviations from the confined space entry procedures, operations or program requirements or that there are inadequacies in the employee's knowledge of these procedures and requirements.

11.8.2.16

The owner/operator should certify that the training has been accomplished. The certification should contain the training provided, employee's name, the signatures or initials of the trainers and the dates of training and should be available for inspection by employees or their authorized representatives.

11.8.3 Owner/Operator Qualifications.

11.8.3.1

The owner/operator should be able to identify and classify confined spaces within their facility

11.8.3.2

Where the owner/operator is an absent party this may be delegated to another responsible entity such as;

(1) Spaces within a Leased facility controlled by another entity

(2) Entire facility is controlled by another entity

11.8.3.3

The owner/operator should verbally indentify and apply the regulatory requirements.

11.8.3.4

The owner/operator should be able to develop and implement an appropriate confined space program.

11.8.3.5

The owner/operator should be able to train, qualify and designate personnel for confined space operations.

11.8.3.6

The owner/operator should be able to evaluate and select contractors, subcontractors and rescuers.

11.8.4 Demonstrated Competencies

11.8.4.1

The owner/operator should be able to verbally explain and apply requirements and evaluate permits.

11.8.4.2

The owner/operator should be able to identify, evaluate need for and provide for required equipment.

11.8.4.3

The owner/operator should be able to communicate and coordinate activities associated with confined space operations.

11.8.4.4

The owner/operator should be able to assign tasks in accordance with the confined space program and operational requirements.

11.8.4.5

The owner/operator should be able to recognize, evaluate and classify confined spaces

11.9 Contractor/Subcontractor.

11.9.1 General.

A contractor is an employer who performs work under contract to the owner/operator at the owner/operator's confined space work site. Contractors may employ sub-contractors who perform work under contract to the primary contractor.

11.9.2 Contractors and Sub-Contractors Duties and Responsibilities.

11.9.2.1

The contractor should identify and designate those individuals (either contractor personnel or sub-contractors) who are educated, trained, competent and/or qualified to perform specific confined space related duties, including, but not limited to, supervising operations, issuing permits, entering into confined spaces, conducting gas testing, providing for rescue, performing attendant duties, overseeing ventilation, and conducting hot or cold work operations. The contractor should designate and identify the individuals and their duties in the written confined space program in accordance with Chapter 12

11.9.2.2

The contractor should attend a pre-job safety meeting with the owner/operator to establish assignments and responsibilities associated with the confined space entry. Subcontractors may attend this meeting or the contractor may conduct separate meetings for subcontractors.

11.9.2.3

The contractor should review the owner/operator's confined space programs and determine and establish the requirements needed to conduct operations. The confined space program applicable to the operations may be that of the owner/operator or the contractor or both.

11.9.2.4

If the contractor does not agree to use the owner/operators confined space program, the contractor should develop and implement its own confined space program in accordance with regulatory requirements, Chapter 12 and contractor's procedures. This program should not conflict with the facility program and may be used in lieu of or to supplement the owner/operators program.

11.9.2.5

The confined space program to be used should be available for inspection by the employees and their authorized representatives.

11.9.2.6*

The contractor should review and evaluate the confined space to be entered to pre-plan operations, identify hazards and determine necessary controls and measures to be taken.

11.9.2.7*

When contractors/subcontractors perform work that involves confined space entry, they should be aware that entry into a confined space requires compliance with an applicable confined space program. *(Note: The same requirements apply between a contractor and a subcontractor)*

11.9.2.8

Contractors should assure that they are apprised of the hazards associated with the confined space and that they apprise subcontractors as necessary.

11.9.2.9

Contractors/subcontractors should be aware of any precautions or procedures that the host employer has implemented for the protection of employees in or near the confined space where the contractor/subcontractor personnel will be working.

11.9.2.10

Contractors and subcontractors should coordinate entry operations with each other and with the owner/operator when both host employer personnel and contractor personnel are working in or near permit spaces.

11.9.2.11

Contractors/subcontractors should implement effective measures to prevent personnel from entering confined spaces unless designated as entrants.

11.9.2.12

If there are changes in the use or configuration of a confined space that affect the hazards, contractors/subcontractors should assure that the entry is cancelled and the confined space is reevaluated and, as necessary, reclassified, issuing new permits and establishing revised entry criteria,

11.9.2.13*

Contractors/subcontractors should provide the required equipment and assure that it is properly inspected, tested, and maintained and used in accordance with the confined space program.

11.9.2.14

If provided by the contractor/subcontractor, the contractor should evaluate, qualify and identify rescuer services and develop and implement procedures for summoning rescue and emergency services.

11.9.2.15

The contractor/subcontractor should develop and implement procedures to review entry operations when there is reason to believe that the measures taken under the confined space program might not protect employees. and revise the program to correct deficiencies found to exist before subsequent entries are authorized. The contractor/subcontractor should revise the program to correct identified deficiencies before subsequent entries are authorized.

11.9.2.16*

The contractor should review the confined space program annually utilizing cancelled permits and other information to ensure protection form hazards during entry operations. Copies of permits should be provided to the owner/operator for their review and evaluation.

11.9.2.17*

The contractor should consult with subcontractors, employees and their authorized representatives on the development and implementation of all aspects of the confined space program and make information available to all affected employees and their authorized representatives.

11.9.2.18

The contractor/subcontractor should providing training covering existing, new and revised procedures and work practices so that all employees involved in confined space operations and activities acquire the understanding, knowledge and proficiency necessary for the safe performance of assigned duties.

11.9.2.18.1

Training should be provided to each affected employee:

(1) Before the employee is first assigned duties under this section.

(2) Whenever there is a change in assigned duties

(3) Whenever there is a change in permit space operations that presents a hazard

(4) Whenever the employer has reason to believe that there are deviations from the confined space entry procedures, operations or program requirements or that there are inadequacies in the employee's knowledge of these procedures and requirements

11.9.2.18.2

The contractor/subcontractor should certify that the training has been accomplished. The certification should contain the training provided, employee's name, the signatures or initials of the trainers and the dates of training and should be available for inspection by owner/operators, contractor/subcontractor employees or their authorized representatives.

11.9.2.19

After completion of the work, the contractor should meet with the subcontractors and with the Owner/operator to review safety issues that were involved on the job.

11.9.2.19.1

Contractors should debrief owners/operators at the conclusion of the entry operations regarding the permit space program followed and any hazards confronted or created in permit spaces during entry operations.

11.9.3 Contractor/Subcontractor Qualifications.

11.9.3.1

The contractor/subcontractor should be able to identify and understand confined space.

11.9.3.2

The contractor/subcontractor should know and understand the hazards that may be faced during entry into confined spaces and necessary controls and protective measures.

11.9.3.3

The contractor/subcontractor should know, understand and apply the regulatory requirements.

11.9.3.4

The contractor/subcontractor should be able to develop and implement an appropriate confined space program to comply with the owner/operator program.

11.9.3.5

The contractor/subcontractor should be able to train, qualify and designate personnel for confined space operations.

11.9.3.6

The contractor/subcontractor should be able to evaluate and select subcontractors and rescuers.

11.9.4 Contractor/Subcontractor Demonstrated Competencies.

11.9.4.1

The contractor/subcontractor should be able to understand requirements and evaluate permits.

11.9.4.2

The contractor/subcontractor should be able to identify, evaluate need for and provide for required equipment.

11.9.4.3

The contractor/subcontractor should be able to communicate and coordinate activities associated with confined space operations.

11.9.4.4

The contractor/subcontractor should be able to assign tasks in accordance with the confined space program and operational requirements.

11.9.4.5

The contractor/subcontractor should be able to recognize hazards associated with the specific space and operations.

11.9.4.6

The contractor/subcontractor should be able to qualify and select personnel and subcontractors.

11.10 Ventilation Specialist.

11.10.1* General.

Ventilation Specialists should be familiar with, educated, trained and/or qualified in the various methods and requirements for removing hazardous and/or contaminated atmospheres from confined spaces. Ventilation Specialists may also perform other activities if competent or qualified and assigned in accordance with the applicable Confined Space Program and Chapter 9.

11.10.2 Ventilation Specialist Duties and Responsibilities.

11.10.2.1

Ventilation Specialists should be familiar with acceptable ventilation methods and procedures and ensure that the specific procedures or methods to be used have been reviewed and approved in accordance with Chapter 9.

11.10.2.2

Ventilation Specialists should review the potential hazards associated with the use of ventilation, purging, etc. during the planned confined space work prior to permit issuance and entry.

11.10.2.3*

Ventilation Specialists should be aware of the hazards associated with infrequently used procedures and the risks of using inert gas, chemicals or steam and that such use should be approved.

11.10.2.4

Ventilation Specialists should ensure that if exhausted vapors, etc. are or may be flammable, ignition sources in and around confined spaces have been eliminated or controlled prior to ventilation.

11.10.2.5

Ventilation Specialists should ensure that adequately sized openings are provided for both clean air replacement and air exhaust and that the air supply and exhaust points are separated as far apart as possible.

11.10.2.6

Ventilation Specialists should never use pure oxygen (or oxygen above normal atmospheric levels) to ventilate a confined space.

11.10.2.7

Ventilation Specialists should assure that air introduced into an area is from a "clean" (uncontaminated) source.

11.10.2.8*

Ventilation Specialists should assure that hazardous atmosphere is properly exhausted in accordance with the confined space program and regulatory requirements and does not accumulate in unapproved areas.

11.10.2.9

Ventilation Specialists should modify ventilation procedures or use appropriate alternatives as necessary to maintain acceptable exposures during entry, hot work or cold work.

11.10.2.10

Ventilation Specialists should direct ventilation flows toward occupied areas, as well as areas that may compromise air quality in occupied spaces.

11.10.2.11

Ventilation Specialists should be familiar with potential contaminant (liquid, sludge, or vapor) collection points within confined spaces, including less visible or accessible areas where contaminants are at risk of *remaining* following routine cleaning or other activities.

11.10.2.12*

Ventilation Specialists should ensure that ventilation air streams do not compromise the accuracy of continuous or periodic air test results.

11.10.2.13

Ventilation Specialists should provide ventilation in accordance with the entry permit and for as long as deemed necessary by the Entry Supervisor, tester, or entrants.

11.10.2.14

Ventilation Specialist should be able to coordinate and communicate ventilation activities if the Gas Tester is a separate person when required

11.10.3 Ventilation Specialist Qualifications.

11.10.3.1

The Ventilation Specialist should be familiar with the confined space program and industry and governmental regulations that pertain to ventilations including, but not limited to oxygen levels, flammable and toxic atmospheric levels and required air changes per hour.

11.10.3.2

The Ventilation Specialist should be familiar with the use, limitations and hazards of materials, substances, and equipment approved for use outside the specific confined space — including fans, eductors, hoses, personal protective equipment, Gas Testers and chemicals.

11.10.3.3

The Ventilation Specialist should know and understand the hazards inside and outside the specific confined space associated with ventilation operations.

11.10.3.4

he Ventilation Specialist should know ventilation techniques appropriate to the specific hazards and confined space, including accepted industry standards, regulatory requirements, etc.

11.10.4 Ventilation Specialist Demonstrated Competencies.

11.10.4.1

The Ventilation Specialist should be able to read and verbally explain permits.

11.10.4.2

The Ventilation Specialist should be able to appropriately inspect, maintain, test and use required equipment.

11.10.4.3

The Ventilation Specialist should be able to verbally indentify, assess, interpret and apply monitor readings.

11.10.4.4

The Ventilation Specialist should be able to communicate when evacuation is desired.

11.10.4.5

The Ventilation Specialist should be able to complete assigned tasks in an approved manner.

11.10.4.6

The Ventilation Specialist should be able to determine required ventilation flow rates.

11.11 Isolation Specialist.

11.11.1* General.

Isolation is the process of removing a confined space from service and completely protecting the space from the unwanted release of energy, hazardous atmosphere and materials into the spaces. These operations are performed by the Isolation Specialist who should be qualified, competent and authorized. Isolation may be permanent or temporary.

11.11.2* Isolation Specialist Duties and Responsibilities.

11.11.2.1

Isolation Specialists should comply with applicable lockout tagout program and be authorized to work with the applicable energy control devices or other isolation equipment, materials and procedures.

11.11.2.2

Isolation Specialists should inspect and determine that equipment or devices to be used for isolation are approved, in acceptable condition and appropriate for the task prior to their use.

11.11.2.3

Isolation Specialists should notify authorized personnel when the energy control measures are either applied or removed.

11.11.2.4

Isolation Specialists should determine if stored energy is a potential issue, and if so, eliminate or control the hazard.

11.11.2.5

Isolation Specialists should properly sequence isolation and energy control procedures.

11.11.2.6

Isolation Specialists should verify that relevant energy sources have been isolated prior to the issuance of permits for work in or around areas impacted by equipment or spaces that need to be isolated and notify the Permit Issuer and/or Entry Supervisor

11.11.2.7

Isolation Specialists should develop and make available to the owner/operator or contractor and Entry Supervisor, an isolation checklist relevant to the confined space.

11.11.2.8

Isolation Specialists, as well as other authorized individuals, should use methods and procedures approved by the applicable confined space or isolation program when *temporarily* removing lockout or tagout devices.

11.11.2.9

At the conclusion of the work, Isolation Specialists should take appropriate safeguards prior to releasing the space from lockout or tagout using the isolation checklist for verification purposes

11.11.3 Isolation Specialist Qualifications.

11.11.3.1

An Isolation Specialist should comply with the confined space program and industry and governmental regulations that pertain to isolation.

11.11.3.2

An Isolation Specialist should verbally explain the use, limitations and hazards of materials, substances, and equipment approved for use for isolating the specific confined space.

11.11.3.3

An Isolation Specialist should verbally identify the hazards inside and outside the specific confined space associated with isolation operations.

11.11.3.4

An Isolation Specialist should verbally explain isolation techniques appropriate to the specific hazards and confined space including accepted industry standards, regulatory requirements, etc.

11.11.3.5

An Isolation Specialist should be able to comply with and be authorized to work with the applicable energy control devices or other isolation procedures.

11.11.4 Isolation Specialist Demonstrated Competencies.

11.11.4.1

An Isolation Specialist should understand all sections of the confined space entry permit.

11.11.4.2

An Isolation Specialist should be able to identify and evaluate need for required equipment.

11.11.4.3

An Isolation Specialist should be able to communicate with all personnel.

11.11.4.4

A An Isolation Specialist should be able to perform assigned tasks in an approved manner.

11.11.4.5

An Isolation Specialist should be able to determine isolation devices, methods and requirements.

11.12 Standby Worker.

11.12.1* General.

Standby Workers are individuals assigned to stay outside the confined space and conduct confined space related operations as assigned by the Entry Supervisor which do not involve duties assigned specifically to entrants, Gas Tester, rescuers, supervisors, Permit Issuers, attendants and isolation and ventilation persons.

11.12.2 Standby Workers Duties and Responsibilities.

11.12.2.1

Standby Workers should have an understanding of the work required and the knowledge and skills to perform the work in a safe manner around the permit area.

11.12.2.2

Standby Workers should be familiar with the hazards in and around the confined space and use appropriate protective clothing and equipment as appropriate for assigned duties and exposures or as required by a work permit.

11.12.2.3

Standby Workers should receive direction from the confined space Entry Supervisor regarding tasks to be performed.

11.12.2.4

Standby Workers assigned to monitor supplied air systems should adhere to the following:

11.12.2.4.1

This should be the only task assigned to one person.

11.12.2.4.2

The Standby Workers should maintain air supply cylinders in a secured, upright position, properly switch cylinders as required to provide a constant air supply and ensure that the cylinders are protected against damage.

11.12.2.4.3

The Standby Workers should ensure that breathing air supply lines, hoses and couplings are maintained and are not used for supplying anything other than breathing air.

11.12.2.4.4

The Standby Workers person should assure that the intake air supply provided to compressors and/or air pumps (used in lieu of cylinders) is suitable for breathing and is free of contaminants.

11.12.2.4.5

The Standby Workers should immediately notify entrants to switch to emergency bottled air and leave the tank in the event of air supply failure, contamination or disruption.

11.12.2.5

Standby Workers should have an understanding of the emergency response plans established by the owner/operator or contractor and know what to do during an emergency.

11.12.2.6

Standby Workers conducting cleaning, disposal, hot work and/or cold work operations in and around the confined space should be able to perform these activities in accordance with the confined space program and issued permit requirements.

11.12.3 Standby Workers Qualifications (should they have the awareness level training too).

11.12.3.1

Standby Workers should comply with confined space program and industry and governmental regulations that pertain to work assignments.

11.12.3.2

Standby Workers should verbally explain the use, limitations and hazards of materials, substances, and equipment approved for use in assigned duties.

11.12.3.3

Standby Workers should verbally identify the hazards inside and outside the specific confined space associated with assigned operations.

11.12.3.4

Standby Workers should verbally explain the safe work practices appropriate to the specific hazards and confined space.

11.12.4 Standby Workers Demonstrated Competencies.

11.12.4.1

Standby Worker should be able to read required permits if assigned to conduct hot or cold work.

11.12.4.2

Standby Worker should be able to properly use required equipment.

11.12.4.3

Standby Worker should be able to verbally communicate with all personnel.

11.12.4.4

Standby Worker should be able to perform assigned tasks.

11.13 Training.

11.13.1 General.

All confined space personnel should be trained, educated and/or qualified as required by the applicable written confined space program and regulatory requirements to include, but not limited to, the following;

(1) General and specific duties and responsibilities for assigned work.

(2) Equipment, tools, PPE, respiratory protection and monitoring instruments to be used.

(3) Type of confined space to be entered, configuration and structure and materials or substances within, around or introduced into the space.

(4) Atmospheric, physical and chemical (toxic) hazard awareness including, but not limited to, the identification, elimination, protection and control measures applicable to the proposed entry and work.

(5) Certification, registration or licensing when required

11.13.1.1

Sources of Training/Education include, but are not limited to, the following:

11.13.1.1.1

On the Job (apprentice) training or experience

11.13.1.1.2

Company sponsored training/education – internal or external

11.13.1.1.3

Job required regulatory training/education, including, but not limited to, respiratory protection, hot work, lock-out tag-out, etc. as applicable to duties and assignment.

11.13.1.1.4

Government, regulatory, private and labor organization training/education programs such as NFPA Entry Supervisor Training Program, OSHA on-line courses or similar programs

11.13.1.2 Re-training.

11.13.1.2.1

All confined space personnel should be re-trained, educated and/or qualified as required by the confined space program or regulations.

11.13.1.2.2

All confined space personnel should be re-trained, educated and/or qualified when new duties and responsibilities are assigned.

11.13.1.2.3

All confined space personnel should be re-trained, educated and/or qualified when new equipment, types of space, or materials are introduced.

11.13.1.2.4

All confined space personnel should be re-trained, educated and/or qualified when work deficiencies are observed.

11.13.1.2.5

All confined space personnel should be re- trained, educated and/or qualified when certification requires renewal

11.13.1.2.6

All confined space personnel should be re- trained, educated and/or qualified when regulatory requirements change

11.13.1.2.7

All confined space personnel should be re-trained, educated and/or qualified in the proper use of tools and equipment, PPE, respiratory protection and monitoring instruments etc. according to the manufacturer's recommendations for changes in existing or new tools or equipment

11.13.2 Rescue Training.

The AHJ should provide for training in the responsibilities that are commensurate with the needs of the organization.

11.13.3 Roles and Responsibilities.

The AHJ should determine distribution of roles and responsibilities in order to focus rescue training and resources to maintain proficiency.

11.13.4 Continuing Education.

The AHJ should provide for the continuing education necessary to maintain all requirements of the organization's identified rescue needs.

11.13.5 Documentation of Training.

The AHJ should be responsible for the documentation of all required rescue related training. This documentation should be maintained and available for inspection by individual team members or their authorized representatives and by the owner/contractor who has arranged for the rescue service.

11.13.6 Fitness.

The AHJ should ensure that Rescue Team members are psychologically, physically, and medically capable to perform assigned duties and functions at technical search and rescue incidents and to perform training exercises in accordance with Chapter 10 of NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program.*

11.13.7 Individual Team Member Requirements.

Each member of the rescue service should meet the requirements defined in NFPA 1006, Chapter 7 Confined Space Rescue, Level 2.

11.13.7.1

Each member of the rescue service should be provided with, and trained to use properly, the PPE and rescue equipment necessary for making rescues from in and around confined spaces according to his or her designated level of competency.

11.13.7.2

Each member of the rescue service should be trained to perform the assigned rescue duties.

11.13.7.3

Each member of the rescue service should be equipped, trained, and capable of functioning to perform confined space rescues within the area for which they are responsible.

11.13.7.4

Each member of the rescue service should also receive the training required of authorized rescue entrants.

11.13.7.5

Each member of the rescue service should practice making confined space rescues once every 12 months.

11.13.7.6

Each member of the rescue service should be certified to the level of first responder or equivalent according to U.S. Department of Transportation (DOT) *First Responder Guidelines*.

11.13.7.7

Each member of the rescue service should successfully complete a course in cardiopulmonary resuscitation (CPR) taught through the American Heart Association (AHA) to the level of a "Health Care Provider," through the American Red Cross (ARC) to the "CPR for the Professional Rescuer" level, or through the National Safety Council's equivalent course of study.

11.13.7.8

Each member of the rescue service should be aware of the hazards he or she could confront when called on to perform rescue in areas and within confined spaces for which the service is responsible.

11.13.8 Rescue Team Requirements.

11.13.8.1

All confined space rescue services should meet the requirements defined in NFPA 1670, Chapter 7 Confined Space Rescue to the Technician level.

11.13.8.2

The rescue service should be capable of responding in a timely manner to rescue summons. This should take into account possible barriers, traffic, logistics or other factors that may create delays in response.

11.13.8.3

The AHJ should provide the rescue service with appropriate information on the hazards to which they may be exposed while performing rescue from specific or generic spaces for which they are responsible.

11.13.8.4

The AHJ should provide the rescue service with access to all confined spaces for which they are responsible so that they can develop rescue plans and practice rescue operations.

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Edit Chapter Title

Chapter 12 Written Confined Space Program

12.1 General.

Before confined space operations begin and before workers enter confined spaces for any reason, employers whose employees will be entering confined spaces should develop and implement written confined space programs that include, but are not limited to, the following elements:

(1) Program Responsibilities

(2) Identification of Confined Spaces

(3) Identification of Personnel who will be involved in confined space entry

(4) Standard Operating Procedures such as atmospheric monitoring and ventilation

(5) Entry Permits

(6) Other Facility Safety Permits and Procedures

(7) Rescue Procedures

(8) Training

(9) Resources

(10) Program Auditing

(11) Medical Qualifications

(12) Regulatory and Best Practices

(13) Employers that will only have qualified contractors enter their confined spaces need to have a written confined space policy that explains the following:

(14) How the employer determines if contractors are qualified

(15) How Confined Space Hazards are communicated to contractors

(16) How relevant facility safety information is communicated to contractors

(17) How the contractor is debriefed after entry is completed

12.2 Responsible Person and Responsibilities.

There should be one person assigned to be the “Responsible Person” for the company or facility’s confined space entry program. This person can be the owner/operator or another competent individual assigned by the company owner/operator. This individual should be clearly identified in the written program. The confined space program should clearly establish the roles and responsibilities of all individuals involved in confined space entries. As a minimum, the name of the responsible person should be listed along with the list of “authorized” entrants, attendants and Entry Supervisors. Other roles such as the Gas Tester, Ventilation Specialist, Isolation Specialist, standby person, Hot/Cold work Permit Issuer, etc. should be assigned to other individuals if needed or can be assigned to the attendant or Entry Supervisor if appropriate. Chapter 11 of this guide provides a list of roles and required training.

12.2.1

A written confined space entry program should be developed by the responsible person for every workplace in which confined pace entries will be performed by employees. The program should meet, at a minimum, applicable regulatory requirements, and ideally, best practices as well.

12.2.2 Employee Involvement.

Employees who will be involved in confined space entry operations should be involved in the development and institution of the written program.

12.2.3

All employees and contractors should receive a copy of, or know how to have easy access to, the facility’s written confined space entry program.

12.2.4 Roles and Responsibilities.

The confined space program should clearly establish the roles and responsibilities of all individuals involved in confined space entries. As a minimum, the name of the responsible person should be listed along with the list of “authorized” entrants, attendants and Entry Supervisors. Other roles such as the Gas Tester, Ventilation Specialist, Isolation Specialist, standby person, Hot/Cold work Permit Issuer, etc. should be assigned to other individuals if needed or can be assigned to the attendant or Entry Supervisor if appropriate. Chapter 11 of this guide provides a list of roles and required training.

12.3

The written program should state that all employees and management are required to follow all confined space program elements and related safety procedures. The program and policy should also require that if anyone involved in confined space entry operations feels an unsafe condition exists they must immediately report that condition to the attendant or Entry Supervisor and entrants should not enter the space, or if entry has already been performed, leave the space until the concern is addressed by the responsible person or Entry Supervisor.

12.4 Periodic Review.

The written program and other program elements should be reviewed by the employer and employees involved in confined space operations at least annually to determine if the program is effective in providing safe operations for confined space entries.

12.4.1

If a confined space related near miss, accident or equipment failure occurs the confined space program should be audited and modified as necessary to address any deficiencies before any additional entries are made.

12.4.2

The confined space written program should be dated and signed by the owner/operator, and approved by senior management.

12.5* Identification of Confined Spaces.

An audit of the facility should be done and all confined spaces should be identified in accordance with Chapter 4 of this document. The recognized inherent and adjacent hazards that exist should be documented. In addition, the most probable introduced hazards based on the work likely to be performed in the spaces should be documented. NOTE- This does not eliminate the need for a full hazard evaluation risk assessment of the space at the time of the entry. Rather, it is to provide a general understanding of the hazards likely to be encountered so that proper equipment can be purchased and maintained, personnel trained on them, and roles can be assigned as needed. *(See Figure A.12.5.)*

12.6 HEADING.

The written program should describe the procedures used to evaluate confined space hazards . Entry Supervisors should use the criteria listed in Chapters 6 and 7 to identify and evaluate the hazards, and the procedures listed in Chapters 7 and 8 to control or eliminate the hazards.

12.7 HEADING.

Gas monitoring. The program should specify the gas monitor(s) and other atmospheric testing instrumentation and procedures to be used for confined space entry, including information about maintenance and repair, calibration, calibration frequency, bump testing and limitations.

12.7.1*

The program should also specify the atmospheric conditions that prohibit entry. The program should indicate that if acceptable atmospheric quality criteria are not met, or if a hazardous atmosphere develops during occupancy, all entrants must exit immediately. For example, no entry should be allowed if any of the following conditions exists:

(1) Oxygen is lower than 19.5 percent or higher than 22.0 percent.

(2) Hydrogen sulfide is greater than 10 ppm.

(3) LEL is greater than 10 percent.

(4) Carbon monoxide greater than 35 ppm.

12.7.2

The program should specify when and how gas monitoring is conducted. For example, the program should specify if workers are to wear monitoring devices during the entire entry, or if the attendant will be performing gas monitoring, or both.

12.7.3

The program should specify who is responsible for maintaining and calibrating monitoring equipment.

12.7.4

The program should specify where gas monitor instructions and manuals are maintained and where calibration records are maintained.

12.8 HEADING.

The written program should provide information about the types of mechanical ventilation systems available for confined space entry including where they are located and who is responsible for maintaining these systems.

12.8.1

The program should specify when and how mechanical ventilation will be used in confined spaces. For example, some confined spaces may require continuous ventilation during confined space entry operations.

12.8.2

The program should specify if additional or special types of mechanical ventilation may be required for particular tasks such as welding or using flammable solvents.

12.9 Rescue.

The program should explain how rescue will be performed. It should state that whenever possible all permit required confined space entries will be done with entrants wearing full body harnesses that are either attached to a mechanical retrieval device or to a fixed object outside the space. Personal fall arrest may be necessary depending on the configuration of the confined space relative to entry operations. If attached non-entry rescue is not possible due to the configuration of the space, then a comprehensive emergency rescue contingency plan should be developed.

12.9.1

The program should designate who is responsible for maintaining and inspecting all mechanical retrieval, personal fall arrest, and rescue equipment. The program should state that all equipment will be inspected prior to use regardless of how frequently it is otherwise inspected.

12.9.2

The program should indicate the type of personal fall arrest equipment that will be used for entries.

12.10 Personal Protective Equipment (PPE).

The program should indicate who is responsible for obtaining and maintaining personal protective equipment and should cross reference other PPE programs such as the respiratory protection program and the facility's PPE written policies or procedures.

12.11 Energy Control Program (Lockout/Tagout).

If there is any energy source(s) that can create a hazard in or around the confined space during entry operations then the program should cross reference lockout/tagout or other energy control programs in the facility.

12.12 Hot/Cold Work.

The program should cross reference facility hot/cold work written policies and procedures. If hot/cold work is performed in or around confined spaces a hot/cold work Permit Issuer should be assigned in accordance with Chapter 11.

12.13 Permits.

The written program should include the facility's confined space entry permit. See Chapter 13 for permits.

12.14 Training.

The written program should include information about the types of training required and who will be responsible for ensuring that all employees are trained to the level of competency required by their job assignment.

12.14.1

The program may indicate that generic training materials may be used for initial training, however the program should also indicate that all employees MUST BE TRAINED on the facility's specific confined space hazards, procedures and equipment before being authorized to perform any confined space program function.

12.14.2

The program should indicate who is responsible for maintaining records of training.

12.14.3*

The program should indicate how often retraining will occur.

12.15 Recordkeeping.

The program should indicate who will maintain confined space program records, including cancelled permits. All permits should be maintained for a period of at least one year.

12.16 Contractors.

The program should indicate that contractors will be expected to follow the procedures established by the written program. It should indicate that all contractors will be informed of the hazards and potential hazards in the confined spaces they will be entering. If joint entries are performed, the program should explain how these entries are managed. For example, will there be one or two attendants, whose permit(s) will be used, and how air monitoring is conducted. At the conclusion of a contractor entry, the program should explain how the contractor is debriefed concerning the entry, and how the debriefing is documented. The program should also indicate that if procedures are not being followed, the contractor may be disciplined, including removal from the facility.

12.17 Reporting of Accidents or Near Misses.

The program should indicate that all accidents or near misses, including failures of retrieval systems, ventilation systems, gas monitor alarms sounding, etc. are to be reported to the responsible person. The facility's incident investigation procedure should be cross referenced and followed.

12.18* General Fitness for Duty Evaluation.

The written program should include procedures to be used to evaluate the physical and mental capabilities of personnel working in or adjacent to confined spaces. The program should consider the hazards and the work assignment and may cross reference other program medical evaluation procedures, such as for respiratory protection and hazardous material response. Additional medical evaluations may be necessary to address physiological and psychological stresses that may be present during confined space entries, such as climbing ladders, heat stress and claustrophobia.*

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Chapter 13 Permits

13.1 General.

13.1.1 Permit Use.

Permit should be used for all entries into Confined Spaces, reclassification, or alternate procedure. Permit shall be conspicuously visible at the Confined Space location. Permits should be marked as cancelled when work has been completed or conditions have changed requiring a new permit. Canceled Permits shall be maintained for duration not less than 2 years and shall be made available to Entry Supervisors or Permit Issuer for review prior to entering Confined Space. Permit are to be limited to 1 shift, if work activity exceeds 1 shift the permit should be reissued. Additionally, permit should be considered cancelled if personnel change.

13.2 Permit Elements.

A Permit should be developed or adopted that meets the needs of the work activities of the owner/operator. The elements below describe in detail the expectation of the elements, how they should be used and why they are important. Each element may be expanded or minimized on the permit to meet the job task requirement and/or the responsible parties' program management requirements. Each element of the permit identified has an in-depth section within this standard that the Program Manager, Entrant Supervisor, Attendant, and Entrant should be familiar with and addressed as mandatory requirements under the training program. At a minimum, 12 of the 14 elements listed below should be addressed on any owner/operator's permit. Two of the elements are discretionary; " 4. Alternate Procedure" and " 5. Reclassification" should only be used if owner/operator's written program allows them. It should be noted that these 2 discretionary sections have a history of misuse in industry. This guideline cautions the use of these sections, programs that have clear written procedures including management of change these sections may utilize these sections. Figure 13.2 is an example of a typical permit.

Figure 13.2 Example of a Typical Confined Space Entry Permit.

	CONFINED SPACE ENTRY PERMIT	** COMPLETE BOTH SIDES OF PERMIT AND POST AT JOB SITE **
1	LOCATION OF CONFINED SPACE	ADDITIONAL DESCRIPTOR (Ex. LOCATION # Risk Assessment # etc.)
	DESCRIPTION OF CONFINED SPACE (TANK # MANHOLE, ETC.)	
2	DATE ISSUED / TIME OF ENTRY ISSUED	TIME PERMIT EXPIRES (MAX DURATION = 10 HRS.)
	DESCRIPTION OF WORK TO BE DONE	

3 **Initial Confined Space Safe Work evaluation. If "YES", is indicted for any of the questions. ENTRY NOT PERMITTED UNTIL hazards are indentified and mitigated by use of the permit and authorized Entry Supervisor.**

If "NO" is indicated for every question work may proceed. Entry Supervisor Signature________________

If any conditions change work shall stop and supervisor contacted

HAZARD IDENTIFICATION	HAZARDS PRESENT OR POTENTIALLY PRESENT		
	INHERENT HAZARDS	INTRODUCED HAZARDS	ADJACENT HAZARDS
MECHANICAL / ELECTRICAL (springs, elevated parts, electric over 50volts)			
Physical Engulfment by material			
PNEUMATIC / HYDRAULIC/ FLUIDS/GASES (lifts, agitators, etc.)			
CHEMICAL/ BIOLOGICAL/ ATMOSHERIC			

4 **Alternate Procedure:**

Are Alternate Procedures allowed ☐ yes ☐ no If alternate procedure is allowed there shall be a formal hazard assessment by qualified person including written formal procedure.

If YES and being used. Entry Supervisor must sign and date ________________

5 **Reclassification Procedure:**

Are Reclassification Procedures allowed ☐ yes ☐ no If reclassification procedures is allowed there shall be a formal hazard assessment by qualified person including written formal procedure.

If YES and being used. Entry Supervisor must sign and date ________________

6

ENERGY SOURCES (examples)	HAZARDS PRESENT OR POTENTIALLY			7 HAZARD CONTROLLED BY If additional permits are used indicate here in addition to other controls.
	INHERENT HAZARDS	INTRODUCED HAZARDS	ADJACENT HAZARDS	
MECHANICAL (springs, elevated parts, etc.)				
ELECTRICAL (motors, agitators, etc.)				
PNEUMATIC / HYDRAULIC (lifts, agitators, etc.)				

Figure 13.2 ***Continued***

If YES and being used. Entry Supervisor must sign and date ________________

6

ENERGY SOURCES (examples)	HAZARDS PRESENT OR POTENTIALLY (CHECK ALL THAT APPLY)			7 HAZARD CONTROLLED BY If additional permits are used indicate here in addition to other controls.
	INHERENT HAZARDS	INTRODUCED HAZARDS	ADJACENT HAZARDS	
MECHANICAL (springs, elevated parts, etc.)				
ELECTRICAL (motors, agitators, etc.)				
PNEUMATIC / HYDRAULIC (lifts, agitators, etc.)				
FLUID / GASES (CIP lines, nitrogen, steam, etc.)				
OTHER HAZARDS				
UNAUTHORIZED ENTRY OF PERSONNEL				
NOISE >85 dB				
EXCESSIVE HEAT OR COLD				
FALLING OBJECTS				
Other Permits: Hot Work, Line Break, LOTO, Live Elect Work				

ATMOSPHERIC HAZARDS: *(record pre-entry and document continuous at least every two hours until exit)* *Bump Test required and completed ye s ☐* Gas Tester: Type Model ________ Serial # ________				PRE-ENTRY REQUIRED AM / PM:	Time AM / PM:	Time AM / PM:	Time AM / PM:	Time AM / PM:
CONTINUOUS MONITORING REQUIRED YES ☐ NO ☐								
PERCENT OF OXYGEN								

Figure 13.2 ***Continued***

FLUID / GASES (CIP lines, nitrogen, steam, etc.)									
OTHER HAZARDS									
UNAUTHORIZED ENTRY OF PERSONNEL									
NOISE >85 dB									
EXCESSIVE HEAT OR COLD									
FALLING OBJECTS									
Other Permits: Hot Work, Line Break, LOTO, Live Elect Work									
ATMOSPHERIC HAZARDS: *(record pre-entry and document continuous at least every two hours until exit)* *Bump Test required and completed yes* ☐ Gas Tester: Type Model Serial #				[illegible] AM / PM	Time AM / PM	Time AM / PM	Time AM / PM	Time AM / PM	
CONTINUOUS MONITORING REQUIRED YES ☐ NO ☐									
PERCENT OF OXYGEN 19.5% to 22.5%									
LOWER EXPLOSIVE LIMIT <10% of LFL									
CARBON MONOXIDE <35 ppm									
HYDROGEN SULFIDE <10 ppm									
OTHER									
			TESTER INITIALS:						

PERSONAL PROTECTIVE EQUIPMENT REQUIRED: *(FOR ALL, EITHER CHECK THE BOX OR CIRCLE "N/A")*

N/A ☐ Respirator — Type: ______ Model: ______ Cartridge/Filter: ______
N/A ☐ Safety Glasses w/ Side Shields
N/A ☐ Goggles
N/A ☐ Ear Plugs/Muffs
N/A ☐ Gloves (Type: ______)
N/A ☐ Hard Hat
N/A ☐ Face Shield
N/A ☐ Boots
N/A ☐ Disposal Coveralls
☐ Other (specify ______)

8	**COMMUNICATIONS:** **ENTRANT** ☐ VERBAL (ONLY ALLOWED FOR LINE OF SIGHT) ☐ RADIO **EMERGENCY RESCUE WILL BE REQUESTED BY:**
9	**RESCUE:** *(FOR ALL, EITHER CHECK THE BOX OR CIRCLE "N/A")* N/A ☐ Full Body Harness w/ "D" Ring; N/A ☐ Tripod/Retrieval System; N/A ☐ Fall Arresting Equipment; N/A ☐ Lifelines and Safety or Wrist Harness; N/A ☐ Emergency Escape Retrieval Equipment; ☐ Emergency Response Team has been notified of entry, hazards, and duration; ☐ Incident Action Plan has been completed and available
10	**ENTRANT(S):** I am aware of the hazards and their effects, and will take the precautions required. *Print Name* *Initial* *Print Name* *Initial* *Print Name* *Initial*

Figure 13.2 ***Continued***

11	**ATTENDANT(S):** I am aware of the hazards and their effects. I will arrange for rescue from outside the space, if required. *Print Name* *Initial* *Print Name* *Initial* *Print Name* *Initial*
12	**ENTRY SUPERVISOR:** I authorize entry into this confined space and verify that the hazards have been evaluated, control measures have been instituted and the conditions are as indicated on this permit. *Printed Name(s)* *Department* *Phone* *Signature(s)*
13	CANCEL PERMIT This permit shall be cancelled at the completion of the entry or if hazards change by placing a large "X" across both sides of the permit.
14	**RESCUE & EMERGENCY CONTACT** ______: (555)555-5555

13.2.1 Confined Space Identification.

The confined space should be clearly identified on the permit. This may be done by using its name, location and description.

(1) Location: The location of the confined space should be as precise as possible. Ways to do this include: address of location, street or crossroads near site, building location and/or number, room or space number, and Global Positioning System (GPS) coordinates. If there is a space similar to the one on the permit, there should be additional information added to the permit to ensure the correct space is identified by all personnel.

(2) Description: In addition to the location, a detailed description of the space may assist personnel in correctly identifying the confined space. For example, a description may include what type of space it is (e.g., tank, silo, vault), what its function is (e.g., fuel oil waste, grain hopper), and/or its physical attributes (type of material, color, size, shape, etc.).

13.2.2 Work Activities.

(1) Time: The permit should outline the period of time the permit is valid and, if possible, the times when workers are expected to be present in the space. Permits become void once the time/date of the permit has expired.

(2) Work: The permit should outline what work is scheduled to be done in the space. Permits are issued for specific work and if there is a change in the scope of work or its location, a new permit may need to be issued. Work that is not identified on the permit may not be done without the approval of the Entry Supervisor.

13.2.3 Initial Confined Space SAFE WORK Evaluation.

All Confined Spaces shall have an Initial SAFE WORK evaluation. The intent of this evaluation is to ensure the review of confined spaces before any work activity begins, to ensure hazardous conditions do not exist inherently, are introduced, or are adjacent to confined space. Evaluation needs to be signed off by Entry Supervisor or issuer. If no hazardous conditions exist work may proceed. If any hazards exist the Entry Supervisor or Permit Issuer needs to complete the permit appropriately to ensure safe entry.

13.2.4 Alternate procedure. (DISCRETIONARY SECTION)

CAUTION:*Alternate procedure needs to be managed under extreme control. History of confined space entry incidents indicate misuse of this procedure and has resulted in death. Many owner/operators have chosen not to allow the use of this procedure.*

13.2.4.1

When alternate procedure is used, it may only be used if there is no potential for any other hazard besides atmosphere. A written procedure is needed for the confined space, including hazard evaluation, hazard identification, and risk assessment. The use of this procedure only provides relief from the requirement of a confined space attendant, and stand-by rescue.

13.2.4.2

All hazards must be eliminated before entry, except hazardous atmosphere potential. The Entry Supervisor needs to sign off on permit if alternate procedure is to be used and review with entrant what conditions would cancel said permit approval.

13.2.4.3

When this procedure is being used positive pressure ventilation and continuous air monitoring are required. Hazardous atmosphere may not exist prior to ventilation.

13.2.4.4

Note: Emergency Services Rescue notification should still be arranged, and incident action plan documented.

13.2.5 Reclassification. (DISCRETIONARY SECTION).

13.2.5.1

CAUTION: Reclassification procedures need to be managed under extreme control. History of confined space entry incidents indicate misuse of this procedure has resulted in death. Many owner/operators have chosen not to allow the use of this procedure.

13.2.5.2

When Reclassification procedure is used it may only be used if there is no potential for hazard before entry. A written procedure is needed for the confined space including hazard evaluation, hazard identification and risk assessment. Including written detailed description on how each hazard has been eliminated. The use of this procedure only provides relief from the requirement of a confined space attendant, and stand-by rescue.

13.2.5.3

The Entry Supervisor needs to sign off on permit if reclassification procedure confirming reclassification was conducted properly, and review with entrant what conditions would cancel said permit approval.

13.2.5.4

Reclassification is only allowed by formal risk assessment and identification of proper hazard elimination procedures by independent competent person.

13.2.5.5

Emergency Services Rescue notification should still be arranged, and incident action plan documented.

13.2.6 Hazard Identification.

All recognized and potential hazards should be outlined on the permit or on the permit's documentation. These hazards should then be eliminated or controlled to reduce the risk to the workers to an acceptable level. Giving workers information about the hazards will assist them in their own hazard recognition and will help to alert them to changes in the space's condition. Types of hazards include inherent hazards, introduced hazards, and adjacent hazards.

13.2.6.1 Inherent Hazards.

As described in Chapter 6, there may be hazards inherent to the confined space. These hazards exist as a permanent or characteristic attribute such as the space's design, configuration, size, or fixed equipment within the space. These hazards may not be able to be eliminated or controlled, but measures can be taken to assess their risks and take precautions. An example of this is a steep ladder into a fuel tank. The ladder's configuration is not changeable, but the way in which supplies are brought into the space can be altered. The worker does not have to carry them down; instead, they can be lowered to him/her.

13.2.6.2 Introduced Hazards.

These types of hazards are typically brought into the space by workers or work processes. The introduction of materials, personnel and work processes should be evaluated carefully to ensure that they do not create a hazardous condition for personnel. These are hazards that can be controlled or eliminated, making them a key element in a risk assessment. An example of introduced hazards includes the materials brought into a space to clean it. If the materials, such as solvents used to clean a fuel tank, create hazardous levels of vapors, the condition of the space may be altered by the process. Another example of introduced hazards is when workers disturb settled materials, such as fish processing or other biological waste. The disruption of the materials may allow trapped levels of hydrogen sulfide gas to be released creating a hazardous atmosphere.

13.2.6.3 Adjacent Hazards.

Adjacent hazards are those hazards that are not in the space but are in close proximity. These hazards may impact a confined space through an opening or hatch (e.g., smoke from a nearby fire or hot work), common wall or conduit (e.g., leak from an adjacent tank), or through physical changes (e.g., heating of an adjacent wall during hot work). When conducting an inspection to develop a confined space permit, adjacent hazards that exist or can potentially exist should be considered and taken into account.

13.2.7 Hazard Control.

(See also Chapter 8.) Identified hazards should be eliminated or controlled. When the hazards are inherent, they should be recognized and measures should be developed to reduce the risk to the workers. Controls should be clearly outlined on the permit, and include such measures as:

13.2.7.1 Air Monitoring.

Air monitoring is often required to monitor the conditions intermittently or continuously. The frequency of monitoring depends on the work being performed and other potential introduced or adjacent hazards that could alter the atmospheric conditions of the space. These can include Oxygen Deficient, Oxygen Enriched, Flammable or Explosive, Toxics, Irritant/Corrosives or Asphyxiating atmospheres. The permit should detail what air monitoring should be done, by whom, and at what levels personnel are required to exit the space.

13.2.7.2 Ventilation.

If possible, ventilating a space with fresh air before and during confined space work may reduce or remove atmospheric contaminants. Ventilation, especially during the warmer months, may also provide relief for thermal stress. The permit should outline what ventilation is required prior to entry and during entry. If the ventilation will block access in or out of the space, the permit should outline what the procedures will be needed to ensure worker safety during operations.

13.2.7.3 Personal Protective Equipment.

The permit should address entrant and attendant PPE requirements. Likewise, if personnel need to carry escape devices or additional PPE for specific work, such as cleaning or painting, that should also be included.

13.2.7.4 Other Permits.

All other permits that are needed for the space should be delineated on the permit (e.g., Hot Work, Line break, Electrical work, etc.).

13.2.7.5 Grounding and Bonding.

If the space or the ventilation/equipment brought into the space need to be grounded or bonded, that information should be on the permit.

13.2.8 Communications.

Communications should be documented as to how they will be maintained, as follows:

(1) Verbal: Acceptable if line of sight is maintained

(2) Radio: Permit to indicate test intervals

(3) Rescue request: Permits indicate how Rescue Team will be notified

13.2.9 Rescue.

When preparing for entry into a Confined Space Rescue needs to be understood. There are 2 types of rescue both need to be understood as to when they are used and the limitations of each. Regardless of whether a confined space has hazards or not, the owner/operator shall ensure rescue is available and appropriate. All Confined Spaces should have a rescue incident action plan, which describes how rescue will be achieved. This incident action plan needs to be available to Entry Supervisors, Attendants, and Entrants. The incident action plan should be attached to the permit being issued. Emergency Response Team should be notified when all confined spaces are entered.

(1) Self Rescue, permit shall indicate what equipment will be used and who will assist. Individuals should be trained on when and how to use the equipment and the limitations of said equipment.

(2) Emergency Response Rescue- should be notified of the location of entry, hazards, and duration.

13.2.10 Entrants.

[Introductory text]:

(1) Name shall be printed

(2) Entrant shall sign permit, indicating that they have been trained in Confined Space entry and have fully reviewed all the hazards associated with the specific entry they are about to make including which condition changes require their immediate evacuation.

13.2.11 Attendant.

[Introductory text]:

(1) Name shall be printed on the permit

(2) Attendant shall sign permit, indicating that they have been trained in Confined Space entry and have fully reviewed all the hazards associated with the specific entry. The Attendant must be aware of the potential hazards in the confined space. This would include possible behavioral effects related to exposure to these hazards. An Attendant must remain in constant contact with the entrant, unless relieved by another attendant. Maintains communication with entrant, monitors activities and orders evacuations, when needed. Performs NON- ENTRY RESCUE or summons Rescue Team if needed. May not perform any other duty that may interfere with the primary duties of attending to the safety of the entrant.

13.2.12 Entry Supervisor.

The Entry Supervisor has total responsibility for the entry. The Entry Supervisor shall sign permit, indicating that they have been trained in Confined Space entry and have fully reviewed all the hazards associated with the specific entry. They must be aware of the potential hazards in each space and standard operating procedures and equipment required for each entry. Ensures that the work remains consistent with the permit if the work or hazards change, the space is re-evaluated, and a new permit is issued.

13.2.13 Cancel Permit.

Each permit shall have a location on the permit to be identified as canceled. A permit can be canceled at the end of the work activity by attendant or entrant or at anytime by attendant, entrant, supervisor, or safety professional because of hazards.

13.2.14 Rescue and Emergency Contact.

Permit should conspicuously indicate who and how emergency rescue and contact are contacted.

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Chapter 14 Recordkeeping

14.1 General.

All records for a confined space program should be maintained by the owner/operator for a minimum of one calendar year to allow for an annual review of the program

14.2 Employer Site Records.

14.2.1

Documented evaluation and classification for each confined space present should be maintained for the duration of occupancy or until permanently eliminated

14.2.2

Records of all reclassification and permits, including all supporting air monitoring results, should be maintained for a period of two year from the date of entry.

14.2.3

Documentation of annual reviews to determine continued program effectiveness should be maintained for a period of two years from the date of the review.

14.2.4

Documentation of confined space monitoring, personal protection equipment, rescue equipment monthly inspections and maintenance should be maintained for a minimum of two years.

14.2.5

Documentation of confined space monitoring, personal protection equipment, and rescue equipment inspections for and during entry should be maintained for a minimum of two years

14.3 Employee Records.

14.3.1

Employee training records, certifications, competencies, should be maintained for the duration of employment if required for entry.

14.3.2

A roster of employees trained, educated, qualified and authorized to participate in confined space entries

14.3.3

Any medical evaluation program documents should be maintained for thirty years past the last employment date of any employee

14.4 Contractor.

Contractor permits, supporting air monitoring results and qualifications should be retained for a minimum of one year.

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Chapter 15 Management of Change (MOC)

15.1 Purpose.

To establish the procedures to manage changes to equipment, **work Scope** and Application – Owners of confined spaces should complete a MOC review for any temporary or permanent change affecting confined space design, equipment, or work practices. Change is defined as all modifications to confined space configuration, equipment, work processes, materials, procedures, and contents/chemicals.

15.2 Responsibilities and Communication.

For a MOC system to function effectively, confined space owners, entrants, attendants, supervisors, and rescuers should know how to recognize which deviations and changes are significant enough to trigger a MOC review. Once a deviation or change affecting a confined space is identified that triggers the MOC system, facility owners assign qualified personnel and provide the resources to conduct an MOC process to determine what changes, if any, are needed in the confined space program and hazard control measures.

15.3 MOC Process and Activation.

A MOC process should be formally developed, implemented, communicated, and documented to ensure the changes and deviations affecting confined spaces have been reviewed and authorized. The steps for executing a MOC process include, but are not limited to processes, procedures, or the facility for designated confined spaces. The purpose of the Management of Change (MOC) procedure is to ensure that workplace changes to equipment, processes, personnel, procedures, or materials affecting confined spaces are properly reviewed against original confined space hazard assessment data. MOC is a concept that if well implemented could likely prevent confined space accidents associated with changes or modifications with confined spaces.

15.3.1

An MOC form should be originated, submitted, and authorized prior to implementing a change affecting a confined space. The person originating the change or deviation should complete *Part I of the MOC form.*

15.3.2

The MOC Form should then be submitted for review and approval by qualified personnel familiar with the process who should thoroughly identify potential issues, develop protective measures, and propose a course of action for proceeding safely with the confined space program changes or deviations.

15.3.3

After the confined space program changes have been implemented but prior to entry into confined spaces, the MOC form should be reviewed and authorized to ensure all confined space program requirements and documentation have been fully addressed or updated and that the change was implemented and consistent with original or updated confined space classification and hazard assessment documentation prior to providing authorization for confined space entry.

15.4 MOC Warranted Confined Space Changes:

15.4.1 Equipment Changes Affecting Confined Space.

The addition, modification, or removal of equipment such that new processes, procedures, documentation or training for confined space work is required. Examples of changes in confined spaces include, but are not limited to the following:

(1) Physical configuration (e.g.; external or internal dimensions of space, materials of construction, physical condition) of the space

(2) Entry or internal access portals and paths (e.g., number, size, configuration that will modify or affect egress routes, etc.)

(3) Internal equipment (e.g., agitators, dampers, piping, obstructions, safety critical equipment, system parts, etc.)

(4) Instrumentation and monitoring (e.g., monitors, electrical controls, program/control logic or set/alarm points, etc.)

(5) Electrical, hydraulic, pneumatic or mechanical equipment, or change of electrical classification

(6) Reclassification of the space so as to no longer be a confined space

15.4.2 Confined Space Process Changes.

Any changes to confined space or adjacent processes, work practices, or procedures which could impact previously established confined space programs, classification and hazard assessment data including:

(1) Planned confined space or adjacent work activities (welding, cleaning, maintenance, repairs, testing, monitoring, etc.)

(2) Hazardous atmospheric conditions (oxygen, combustible gases, toxic gases, etc.) inside or outside the space

(3) Physical factors (temperature, humidity, noise, radiation, etc.)

(4) Safe upper and lower operating limits (temperature, pressure, flow, composition, etc.)

(5) Changes in ventilation that could affect displacement, dilution, or removal of air contaminants within the space

(6) Preventative Maintenance, isolation or Lockout Tagout Procedures (additions or changes in these procedures or processes)

15.4.3 Confined Space Content/Chemical Changes.

Any changes in contents and/or chemicals used in confined spaces which could impact previously established confined space classification and hazard assessment data including:

(1) The type, amount, or composition of contents/chemicals stored in confined spaces that may affect electrical hazardous area classifications, hazardous atmosphere considerations, air monitoring provisions, ventilation requirements, PPE requirements for entrants, rescue preparedness, etc.)

(2) Introduction or use of new or changed hazardous chemicals or other materials inside confined spaces that may present or produce potential chemical or physical hazard exposure concerns to entrants.

(3) The use of new or different materials or chemicals outside of the confined space whose release could affect the confined space.

15.5 MOC Completion and Verification.

A MOC verification process should be followed to affirm that the potential safety impacts and consequences from the proposed changes or deviation have been properly addressed. The MOC Form should verify all required MOC action items are complete, the confined space classification/hazard assessment have been updated, the confined space program, entry procedure and rescue plan have been revised accordingly, and the confined space is safe to enter. A MOC completion and verification process should confirm, but not be limited to the following items:

(1) Construction and equipment in accordance with design specifications

(2) Confined space safety, operating, maintenance, and emergency procedures are in place and are appropriate for the planned activity.

(3) An updated confined space classification and hazard assessment has been performed and recommendations have been implemented before startup

(4) Requirements and authorizations in MOC have been met

(5) Training of each affected employee on changes has been completed

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Chapter 16 Prevention through Design (PtD)

16.1* Purpose.

A Prevention through Design (PtD) concept seeks to initiate a design process to reduce or eliminate inherent risks and hazards associated with the design of facilities, equipment, and products. PtD can minimize the cost of retrofitting and use of labor intensive administrative hazard control measures. The goal of PtD is to eliminate hazards and reduce risks by studying the safety impacts during the initial stages of design rather than relying on reactive hazard isolation and control approaches.

16.2 Scope and Application.

The root PtD concepts and approach have a very strong and direct relationship and benefit to hazard and risk reduction efforts associated with confined space entry and rescue operations. Specifically, the application of PtD concepts to confined spaces targets two types of interactions; construction and/or installation of new confined spaces, and redesigning and renovation of confined spaces to eliminate or minimize hazards.

16.3 Responsibilities.

PtD is facilitated when HSE professionals and engineers effectively collaborate during the early stages of a capital project process. For a PtD process to function effectively, confined space owners must understand the hierarchy of hazard controls and recognize which confined space hazards and risks can be reduced through improved design or redesign. Once an opportunity for reduced risks through an employment of a PtD process is identified, facility owners should gather the appropriate qualified people and resources to perform a PtD review.

16.4 PtD Process and Activation.

PtD is widely recognized and even formalized by OSHA, NIOSH, other consensus safety organizations and several non-mandatory PtD standards and guidelines have been developed, published, and disseminated to the public. There is not a current regulatory standard, consensus standard, or guideline that specifically addresses a formal process for activating a PtD concept specifically for confined spaces. Confined space owners should consider the following tools and processes to move a PtD concept forward towards reduction and elimination of confined space risks and hazards:

(1) Integrate PtD concepts into your Management of Change (MOC) process when evaluating potential hazards, risks, and control measures for new confined spaces or when making changes or renovations with existing confined spaces;

(2) Use risk assessment and coinciding hierarchy of controls to achieve a tolerable level of risk when performing confined space risk assessments, and during development of confined space entry procedures/permits, and rescue plans;

(3) Investigate confined space incidents and near misses that evaluate the benefit of PtD concepts into the root cause analysis and corrective action process; and

(4) Train and communicate PtD concepts, practices, and benefits to facility managers, supervisors, engineers, and EHS professionals.

16.5 PtD Warranted Confined Space Changes.

The following provides examples of how PtD concepts can be utilized to reduce or eliminate the hazards and risks associated with confined space entry and rescue operations.

16.5.1 PtD to Eliminate Confined Space by Definition.

[Introductory text]:

(1) Eliminate the ability or need to enter and perform work (e.g., remotely operated tools, fixed monitoring devices, viewing windows or cameras, remote grease joints, redesign of work or maintenance tasks, relocate critical valves/equipment outside space, etc.);

(2) Eliminate restricted means of entry and exit (e.g., replace ladders with steps/stairs, enlarge openings/access paths, use standard doorway openings, add access points, etc.);

(3) Design space for continuous employee occupancy (e.g., improves ventilation, illuminate space, alter space configuration, etc.);

16.5.2 PtD to Eliminate PRCS Definition Classification.

[Introductory text]:

(1) Substitute or eliminate hazardous chemicals that present potential hazardous atmospheres (e.g., use combustible liquids with reduced flash points, use corrosives and toxics which present a lessened worker exposure concern, etc.)

(2) Protect from exposure to serious safety hazards (e.g., install fixed guards/covers on mechanical and electrical equipment hazards, install railings and/or fall protection points into space, install energy isolation lockout points outside of space, eliminate or guard exposure to sharp/heated/slippery surfaces)

(3) Prevent from exposure to engulfment or entrapment hazards (e.g., design pipes, valves, and line breaks to allow blocking and bleeding of lines outside of space, design space opening to allow for easy emptying of contents, alter configuration of space to prevent entrapment, etc.)

16.5.3 PtD to Facilitate Rescue of Entrants.

[Introductory text]:

(1) Design or redesign space to allow for two openings for rescue

(2) Design or redesign openings to allow unobstructed access of rescue/retrieval equipment

(3) Permanently mount davit arm, receiver, or other fixed anchor points at space access opening

(4) Work towards the goal the being able to perform external rescue of entrants when designing spaces.

16.5.4* PtD Reference Standards and Guidelines.

Several agencies have developed standards and guidelines in reference to discussion and implementation of a PtD process. The following is a summarized list of PtD references, sites, and standards for further reference:

(1) ANSI/ASSE Z590.3, *Prevention Through Design: Guidelines for Addressing Occupation Hazards & Risks in the Design & Redesign Processes*

(2) NIOSH "Prevention through Design: Plan for the National Initiative"

(3) ANSI/AIHA/ASSE Z10-2012, *Occupational Health and Safety Management System* (provides specific reference to use of PtD process)

(4) ASSE Tech Brief on PtD Standard

NFPA 350®, Best Practices Guide for Safe Confined Space Entry and Work, proposed Edition

Edit Chapter Title

Annex A Explanatory Material

Annex A is not a part of the recommendations of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.1.3

For confined space activities within the United States, this guide is intended to incorporate the requirements included in OSHA standards for general industry, construction, agriculture, and maritime.

A.3.3.3 Acceptable Entry Conditions.

See Section 8.2.

A.3.3.6 Confined Space.

For example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that often have limited means of entry.)

A.3.3.9 Explosionproof.

See *NFPA 70*.

A.3.3.15 Job Hazard Analysis (JHA).

For a JHA, the job first is broken into a sequence of steps. Each step should accompany some major task, which will consist of a series of movements. The analyst then looks at each series of movements within that basic task.

Next, all the hazards or potential hazards associated with each step are identified. It is important that the entire environment be considered in order to determine every conceivable hazard that might exist.

Finally, based on the basic job steps and the potential hazards, it can be determined what actions are necessary to eliminate, control, or minimize hazards that could lead to accidents, injuries, damage to the environment, or possible occupational illness. Each safe job procedure or action must correspond to the job steps and identified hazards.

A.3.3.18 Permit Required Confined Space (Permit Space).

The definition in 3.3.18 is based on 29 CFR 1910.146.

A.4.6

An example of this type of job would be a contractor who is sent to various sites to do contract repair work in confined spaces or a pest control applicator who might enter crawl spaces to apply pesticides.

A.5.1

Although a permit should be issued for all confined space entries according to this guide, this is not to imply that all confined spaces are permit-required confined spaces (PRCSs) as defined by OSHA. There is a difference between a PRCS under OSHA and a confined space that has been issued a permit.

This guide uses the terms *confined space* and *confined space entry* for all spaces that meet the definition of *confined space,* regardless of hazard. The purpose is not to supplant other definitions or regulatory requirements but to clarify and simplify the terminology so that the recommendations contained within this guide can be more easily applied to all industries and situations it is intended to reach.

A.6.4.2(3)

Training, competencies, and PPE are addressed in Chapters 11 and 12; the guidance given there should be used to analyze the hazards and assess the risk.

A.7.3.3.3

Colorimetric detector tubes visibly change color when chemical reactions occur between the air contaminant and the substance in the detector tube. Because the amount of color change is proportional to the concentration of the air contaminant, a quantitative measurement can be obtained. There are approximately 500 different air contaminants that can be measured with detector tubes. Although gas monitors have replaced detector tubes for common air contaminants, detector tubes fill a void for specific chemicals in which alternative direct reading monitoring do not exist. Examples are chemicals such as hydrogen chloride, ozone, and phosgene.

A.7.3.4

The obvious shortcoming to this method is that laboratory analysis of the collected sample needs to be done, which even under the most ideal conditions (i.e., having a qualified laboratory onsite or nearby) can take several hours before the results are known. This type of Industrial hygiene monitoring is of value for determining air contaminant concentrations for entries that do not need to take place immediately or to assist in determining the exposure levels that would be expected for a particular type of task.

For example, stainless steel welding in a confined space creates various safety and health hazards, one of which is generating hexavalent chromium, a known carcinogen and a chemical with an OSHA expanded health standard. Industrial hygiene air monitoring can determine if the controls utilized, such as local exhaust ventilation, are effective in reducing hexavalent chromium concentrations to below the OSHA Action Level and Permissible Exposure Limit, or if the appropriate respiratory protection continues to be needed for future entries.

A.7.5.1

For example if the confined space is 12 ft deep and is 4 ft by 4 ft square and the entry is in the center of the space, the probe should be lowered to within 3-6 in. from the bottom of the space to monitor the air at that location for 2 to 3 minutes, and the readings documented. Then the space at approximately 10 ft deep should be monitored for approximately 2 to 3 minutes. This routine in continued until all levels of the space have been monitored before the confined space is entered.

A.7.5.1.1

For example, if a 12 ft probe and tube configuration is used, a minimum of 24 seconds should be allowed plus the normal response time of the instrument, typically 2-minutes, before the reading from the sensors is accepted. A best practice would be to monitor that environment at 12 ft for 2 minutes and 30 seconds before moving to the next sampling point.

Most remote sampling pumps will have a limit from how far they can sample. Diaphragm or rotary vane pumps used in portable gas detection typically have a limit of up to 100 ft probe and tube length before they are no longer effective.

A.8.2.2.1

Depending on the material to be removed, cleaning devices that utilize water or steam may be preferred. Caution may be needed when using steam to avoid overheating. Approved cleaning chemicals or combustible (non-flammable) liquids may also be used.

A.8.2.2.2

Where flammable vapors may be present, fans, blowers and eductors are usually air or steam powered. If electrically driven equipment is used it should be inspected and certified safe for use by a qualified person.

A.8.4.6

An example of this is a sweep auger in a grain bin that must be energized to move residual material from the bin. Alternative measures to provide employee protection should be to limit the speed of the auger and provide administrative and engineering controls such as a portable guardrail or kill switch to stop the auger in an emergency.

A.9.2.1

Caution is recommended when relying on natural ventilation as the sole means for implementing ventilation of a confined space. Two primary reasons support a cautious approach when considering use of natural ventilation. First, if the space is constructed with internal structure, that structure or other elements of internal configuration can interfere, impede, or divert the air circulation within the space; and, second, depending on the physical properties of the air contaminants, such as vapor density, the air circulation from natural ventilation might not effectively reach the all points in the space and effective contaminant control would not be accomplished. Incident data illustrate reliance on natural ventilation because it is readily available and requires no additional equipment; however, those data also illustrate that a false sense of security exists because the space has been "ventilated." As a best practice, the only certain means for achieving effective ventilation is with mechanical ventilation using well-maintained equipment, approved for the applications, installed according to best practices, and supported by frequent atmospheric monitoring to confirm the conditions.

A.9.2.2.1.4

Ventilation system bonding and grounding is of particular importance when a contaminant is a flammable vapor, gas, solid or a combustible dust. See Section 9.4 for additional information on bonding and grounding of ventilation equipment.

A.9.2.2.2.1

Examples of point source contaminants can include, but not be limited to, fumes from welding or other hot work activities; vapors from solvent cleaning or degreasing; or vapors from painting or coating activities.

A.9.2.2.2.2

Section 9.3 describes the relationship between supply and exhaust for effectively moving air and indicates that the ratio of supplying or blowing air as compared to exhausting or capturing the air is approximately 30 to 1. For local exhaust ventilation to be effective, this performance factor means it is important that the local exhaust ventilation application be located as close to the source as possible – typically within one duct diameter. This might require an assistant within the space to be assigned to move the exhaust air-moving device or its attached flexible ducting as the worker moves (for example, as the welder moves within the space during welding operation the distance from the ventilation device could increase to greater than the capture distance recommended).

A.9.3.1.2

The time required for a single air change can be calculated by knowing the volume of the space and the capacity of the air-moving device, as shown by the equation below:

$$T = \frac{V}{Q}$$

where:

T = time (minutes)

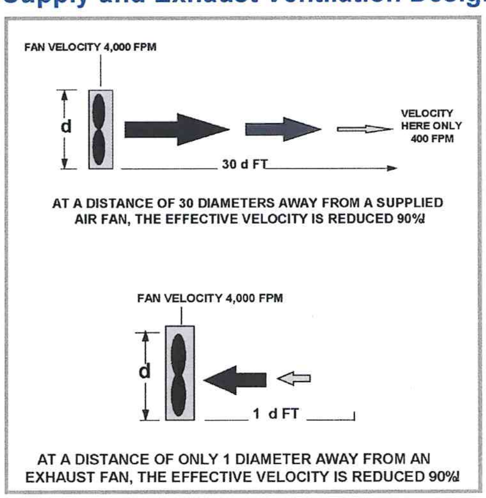
V = volume (ft^3)

Q = volumetric flow rate (ft^3/min)

A.9.3.3.1.3

When selecting and designing ventilation, it is important to recognize that the orientation (supply or exhaust) for the mechanical ventilation makes a difference. The effectiveness of both orientations is limited by the ability of the air-moving device to either push the air into the space or to pull the air from within the space. The ratio for supplying versus exhausting is approximately 30:1. Figure A.9.3.3.1.3 illustrates the impact of such limitations for both supply and exhaust ventilation. Where the air-moving device capacity is inadequate to supply air uniformly throughout the space, a condition known as short-circuiting is likely. Short-circuiting is also possible with exhaust ventilation. See A.9.5 for examples.

Figure A.9.3.3.1.3 Supply and Exhaust Ventilation Design Considerations.



A.9.3.3.2

An example of this condition would be for an aboveground petroleum or chemical storage tank previously containing flammable and/or toxic liquids where local environmental regulations control emissions. In this example, exhaust ventilation would be preferred to supply, and the contaminants captured by the exhaust ventilation would need to be controlled during discharge, so that the contaminants were not freely released to the outside air. For the petroleum application, it is common that the discharge would be connected to a thermal oxidizer or similar device to render the flammable vapors non-hazardous.

A.9.3.3.2.1

Axial-flow fan design includes an impeller or propeller that can act as source for ignition if the impeller gets out of alignment and contacts the fan housing. So, it is advisable when ventilating flammable vapors to either use supply ventilation or to not use an axial-flow fan design.

A.9.3.4

As noted in 9.1.3, purging uses air, steam, or an inert gas in the purging process. The most commonly used inert gases are non-flammable gases such as nitrogen, carbon dioxide, or argon.

A.9.3.4.1

For additional guidance on use of inert gases to gas-free spaces previously containing flammable liquids, see NFPA 306, *Standard for the Control of Gas Hazards on Vessels*, or NFPA 326, *Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair.*

A.9.3.4.1.3

A minimum oxygen concentration is required due to the operation of the catalytic bead-type sensor which requires oxygen to be at least approximately 16% by volume in air so that the sensor can burn the sample. Low oxygen in the sample, such as would be experienced during inerting, will yield inaccurate results for the flammable vapor concentrations. There are other suitable sensor types that do not require oxygen in the sample when detecting flammable gases or vapors or other methods for detecting flammable vapor concentrations in low oxygen atmospheres. See A.9.5.9 regarding examples of specific inerting conditions for flammable gases or vapors.

A.9.4.2.3

Rolled, plastic tubing cannot be properly bonded or grounded due to the non-conductive construction and is considered less safe than typical rigid, flexible ducting if involved in a fire due to the tendency for the plastic tubing style ducting to melt. This material is also not effective when used as ducting for exhaust ventilation as it will collapse on itself due to lack of structural integrity. Because of ease of installation and cost, it is quite common in many applications. It can also be flattened during entry so that the entry path is not completely blocked by the ductwork. In spite of these advantages, the hazard evaluation is important when determining whether the plastic tubing can be used for ductwork.

A.9.4.3

For examples of such installations, refer to ANSI/API Standard 2015, *Requirements for Safe Entry and Cleaning of Petroleum Storage Tanks* and ANSI/API Recommended Practice 2016, *Guidelines and Procedures for Entering and Cleaning Petroleum Storage Tanks.*

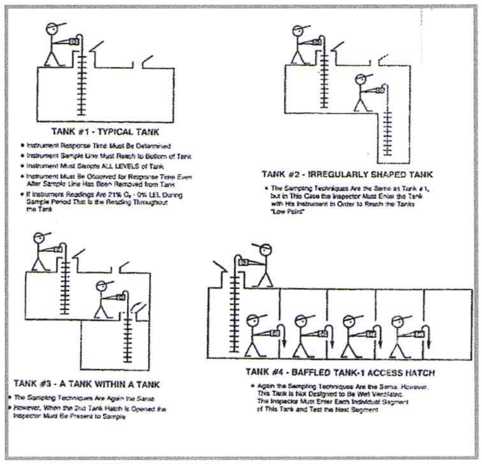
A.9.4.4

For additional guidance on safe practices to control static electricity generation, accumulation, and discharge refer to NFPA 77, *Recommended Practice on Static Electricity*, and API 2003, *Recommended Practice on Protection Against Ignitions Arising Out of Static, Lightning and Stray Currents*.

A.9.5.1.1

Obstruction concerns include, but are not necessarily limited to baffles, piping and equipment, grates and screens, internal configuration (like internal structural members), sumps, sloping or uneven surfaces, and similar space characteristics. Examples of typical space configurations are shown in Figure A.9.5.1.1.

Figure A.9.5.1.1 Typical Space Configurations.



A.9.5.1.4

Short circuiting occurs when inadequate “throw” or projection of the supply air occurs, and the supply air is exhausted before it reaches the desired location within the tank to generate the most turbulence which promotes the mixing and dilution of the contaminated air. Short circuiting is also possible when using exhaust ventilation. Both conditions are impacted by the limitations illustrated in A.9.3.3.1.3. Examples of this condition are shown in Figure A.9.5.1.4(a).

Figure A.9.5.1.4(a) [these diagrams are a start; should show supply, exhaust, local exhaust examples; should also show ventilation from top as well as from at grade (side entry) configuration]

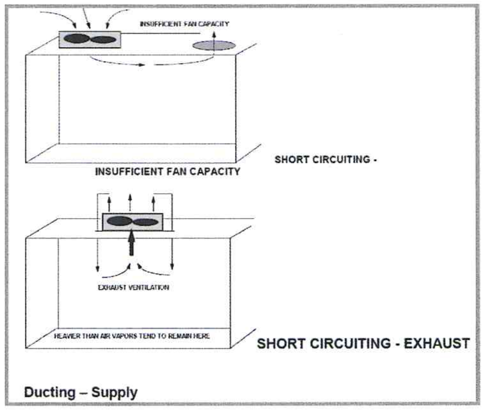


Figure A.9.5.1.4(b)

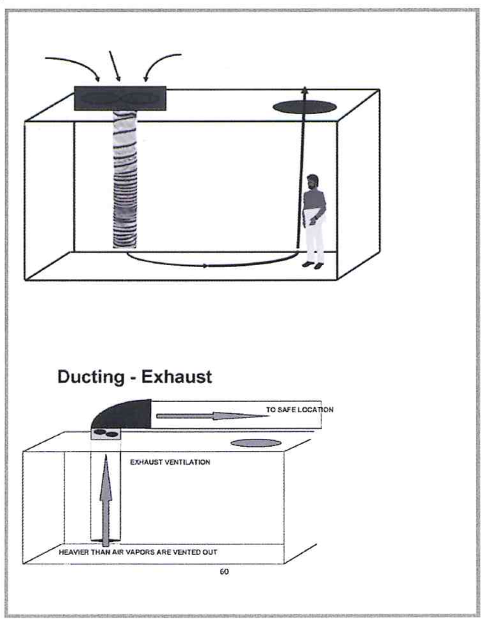
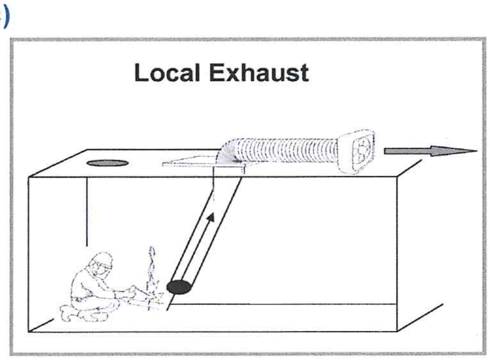


Figure A.9.5.1.4(c)



A.9.5.3

Add case study (illustrative) example of how stratified atmospheres can impact ventilation effectiveness

A.9.5.8.2

Guidance on when ventilation for thermal protection of workers might be necessary can be obtained from the ACGIH, *Threshold Limit Values for Chemical Substances and Physical Agents*.

A.9.5.9

Purging can be used to displace high concentrations of flammable vapors from a space during the cleaning and gas-freeing stage of the process. The objective is to introduce the inert gas so that it displaces the flammable vapors to approximately the LFL for the material before introducing fresh air into the space to bring the oxygen level up to fresh air levels. Typically, the inert gas is used to displace the flammable vapor concentration to about 1% by volume in air. At this point, when air is introduced to remove the remaining vapor concentration and raise the oxygen concentration level, the flammable vapor and air mixture will not be within the flammable range (it will be at a concentration below the LFL) so there will be no danger of a fire or explosion. Typical inert gases used are carbon dioxide, nitrogen, and argon. Proper application for this process requires knowledge of the space configuration and openings and the gas selection. Carbon dioxide and argon are both heavier-than-air gases, while nitrogen is slightly lighter-than-air. Selection of the inert gas might depend on what openings are used for introducing the inert gas and how the flammable vapors are vented from the space (or captured and treated if environmental requirements prohibit emissions). The source of the inert gas can also impact the implementation of the purging process. As also noted in 9.3.4.3, purging can be used to prepare an area within a confined space (like piping or other hollow structure) or a confined space for hot work where cleaning cannot be effectively accomplished. In this application, the inert gas is used to displace the oxygen concentration to a level below that which will support combustion. It is necessary to reduce the oxygen level to below the limiting oxidant concentration (LOC), which for many petroleum-based materials is approximately 14 – 16% by volume. NFPA 306, *Standard for the Control of Gas Hazards on Vessels*, or NFPA 326, *Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair* establish a factor of safety below the LOC by requiring that the oxygen concentration be below 8% by volume or 50% of the LOC, whichever is least.

A.9.5.10.3

Examples of this condition could be: a decision to conduct entry into an inerted atmosphere; entry into a space during emergency/rescue conditions where ventilation supply air or power source may be compromised and/or unreliable.

A.10.1.2.4(3)

This should include fall protection where applicable when operating around unprotected edges such as a portal. It may be very easy for the attendant to fall into a vertically-oriented space while attempting to make contact with an entrant or even more likely in the event of an emergency while trying to affect retrieval efforts. The attendant should take whatever measures necessary to avoid the hazards associated with and/or created by the emergency.

A.10.1.2.4(6)

The importance of training attendants to recognize whether or not retrieval should be implemented cannot be overstated. There is a great need to assure attendants understand the implications of retrieval in certain situations. For example, if a significant fall takes place due to a interior collapse of scaffolding not related to the atmospheric hazard and the patient is complaining of numbness of the lower extremities, it may not be prudent to extract this person with the retrieval system as this could create permanent spinal injury and paralysis. The attendant should be taught to assess each emergency quickly to assure the hazards and/or patient condition necessitates rapid removal or not. Some of the considerations may include; but are not limited to; the following parameters:

(1) What is the mechanism of injury (atmospheric, mechanical, etc.)?

(2) What is the patient's chief complaint (what is the injury/illness)?

(3) What is the patient's level of consciousness (talking coherently, disoriented or non-responsive)?

(4) What are the current hazards (Immediate life-threatening, low-hazard or no hazards related to the emergency)?

Questions such as these can be used to rapidly perform a risk vs. benefit matrix to make the proper decisions on whether or not to retrieve in a confined space emergency where retrieval equipment is an option. If the conditions are immediately life threatening and the only choice is to actuate the retrieval system or the patient is likely to die, the retrieval is the correct response. If the patient's condition and the hazards are not immediately life threatening, yet the patient's condition could be worsened by retrieval, then the rescue service should be notified to respond and entry rescue may be the appropriate option.

A.10.1.2.4(7)

Implementing the emergency response system refers to making the appropriate contacts to assure rescue summons as well as those other agencies which may be appropriate. This may be as simple as utilizing an assigned radio to directly notify the rescue service and other appropriate emergency response agencies or as complex as having two attendants so that one can physically leave the scene during an emergency to initiate contact with the appropriate agencies. Regardless of the method, it should be well planned in advance so it can be orchestrated as quickly, safely, and efficiently as possible in the event of an emergency. Simply calling 9-1-1 does not assure an appropriate response to confined space emergencies in a timely manner. The attendant should be ready to summon help in the event of an emergency regardless of whether or not non-entry rescue (retrieval) is appropriate.

A.10.1.3.4.1

Tier 1 responses usually involve those spaces not commonly addressed by Federal standards. While these entries may not require rescue capability of any sort, it is recognized that medical emergencies occurring within these spaces may create a difficult rescue. It is important that organizations recognize this potential through an assessment of each planned work activity to determine the need for a rescue capability. If the need exists, the organization should further assess resources for a qualified rescue capability appropriate to the anticipated emergency. All rescue response should be available and capable of responding in a timely manner. This should be assured prior to making entry into spaces requiring Tier 1 response.

A.10.1.3.4.2

Tier 2 response generally allows a singular Rescue Team to address multiple entries, assuming response times are appropriate to the anticipated emergencies. Pre-incident planning should dictate whether or not a Rescue Team can provide service for multiple spaces. In any case, adequate communications should exist between entry/egress points and the rescue service to assure that an emergency in one space will facilitate immediate suspension of all other entries and exit of all workers from those spaces.

A.10.1.3.4.3

With immediately life-threatening hazards, the goal for patient access should be commensurate with the need for life saving measures associated with cardio-respiratory arrest. It is generally considered that, without intervention, cessation of heart function in normal conditions will yield at least some irreversible brain death within four to six minutes. This is the reasoning behind the recommendations associated with Tier 3 response, especially where non-entry rescue (retrieval) is not possible.

Pre-incident emergency action planning should always serve as the basis for response mode logistics. While Tier 3 response generally suggests a singular dedicated Rescue Team for a singular space, entries may exist that would allow a singular Rescue Team to address multiple entries in the same immediate area. The following criteria should exist before decisions of this type are made:

(1) A walking transition time between the most remote two entry/egress points is within one-minute,

(2) The team is able to divide its forces so that at least one rescuer is located at each entry/egress point with patent communications to allow immediate notification of other team members in the event of an emergency, or where there are multiple entry sites in close proximity, the rescuer is able to monitor a number of sites.

(3) All rescue equipment needed to perform entry rescue is setup within a suitable distance at each entry/egress point or multiple points and every team member possesses the appropriate Personal Protective Equipment to make immediate entry,

(4) In the event of an emergency at one entry/egress point, operations at the remaining entry/egress points may be terminated immediately so that the entrants exit the space and the Rescue Team member attending that entry/egress point can respond to the emergency at another point within one minute to begin or assist in rescue operations.

This is not usually possible with multiple simultaneous entries monitored by only one team since Tier 3 entries are associated with immediate life-threatening emergencies that would require extremely rapid intervention.

A.10.1.3.5

Not all contaminants are readily measured on all atmospheric monitor configurations. Gas monitors used for confined space entry typically monitor only two or three toxic gases. If an atmosphere is unknown it should be assumed to be IDLH and appropriate precautions taken prior to entry.

If rescue response is required, rescuers should assume the worst and provide maximum protection for rescuers based on suspected hazards. Appearances may be deceptive. For example; Scale (this may be rust, a hard mineral coating that forms on the inside of boilers, kettles and other containers in which water is heated, or other encapsulating build-up) may entrap residual products that are in a tank. A worker is cleaning the tank interior and, in the process, scrapes a scale bubble containing a contaminant that creates a temporary IDLH environment. The worker is incapacitated as a result. Rescue personnel respond and monitor the space to find the atmosphere clear. The decision is made to enter the space without atmosphere supplying respirators. The first rescue entrant steps on a scale bubble and releases the same contaminant that incapacitated the first victim. This is a mistake that rescuers cannot afford to make. *(See Figure A.10.1.3.5(a).)*

Figure A.10.1.3.5(a) [FIGURE CAPTION]

Figure A.10.1.3.5(b)

A.10.1.3.5.1

A disregard for rescuer safety can not only inhibit rescue of the ill or injured persons to which they originally responded, but may place fellow rescuers at risk by compelling them to go after their incapacitated fellow rescuer. Rescuers should observe this cardinal rule: Don't become a victim!

A.10.2.1

The term Authority Having Jurisdiction, in this case, is meant to apply to whomever may be responsible for the spaces to which the rescue service responds. It generally implies the person, persons, or organization who acquired the rescue service to act as response for the entry or entries taking place. This is independent of where the rescue service is from since there may be many options including in-plant teams, outside municipal response services and privately-owned contracted services.

A.10.2.2.2

The review team may include the confined space Entry Supervisor.

A.10.2.3.1

The performance evaluations should serve as a basis for determining whether the current training has prepared the rescue service to function at the established level of capability under abnormal weather conditions, extremely hazardous operational conditions, and other difficult situations.

A.10.4.1

It should be recognized that each rescue response should be based on the circumstances surrounding the incident. Standard Operating Procedures should provide a typical approach while allowing latitude for independent judgment. While the incident manager should be held accountable to justify any divergence, this ability to vary allows adjustment to plans to meet changing needs.

A.10.6.5

Analyzing critical areas related to the incident may be the single most important part of any emergency. Emergency response agencies generally refer to this process as "Size-Up". Having a solid, well thought out action plan can positively aid in determining if an incident can have a pre-forecasted result, minimize harm to life and damages to property, or to expedite the process of rescuing trapped victims. Determining, evaluating and assessing of all of the circumstances helps assure the success of the rescue mission.

Information Acquisition and Management. Analysis of the potential emergency begins with managing information from the facility or space location prior to any incident. The basics of defining what takes place in the confined space is a logical place to begin this analysis.

Record all findings on a pre-plan survey or document that can be made readily available on a moment's notice. Today's technological equipment makes information readily available and portable to the incident location. The use of tablets, smart phones and lap top computers aid to facilitate and implement an action plan. Diagrams, plans, blueprints and other means of drawings can be created on paper or computer programs and software may be utilized to aid in managing and inputting ever changing information. Once the information is tabulated, it should be reviewed for accuracy and put on a schedule to be appropriately reviewed so it may be kept current and precise. Technological equipment that is not approved for use in classified areas may present sources of ignition in situations where flammable vapors may be present.

A solid base of written or text type information can be obtained from the facility or owner of the space such as chemical and manufacturing data, Material Safety Data Sheets, the type of processes the space may be used for, dates and times the space may be occupied, size and location of vessels and confined spaces, facility floor plans or site surveys, prior incidents, previous permit entries, and the number of workers in and around the space, or type of work being performed routinely in and around the space.

Hazard and Risk Analysis. Many factors should be taken into consideration when performing an analysis on a confined space. An in depth hazard and risk analysis may include; but not limited to; what type of process takes place in the space and or, what type of work will be done within the space that is not customary to its original process? How does the surrounding environment have an effect on the space and or, are there constant changes in the external environment over periods of time that add layers of complexity that require special attention? What type of work is normally, and potentially performed that may require the entrant/s to evaluate the internal environment of the space on a timed basis including temperature exposure and temperature changes, existing or changing atmospheric conditions, or length of work being performed? Will atmospheric monitoring devices be required or will chemical specific monitoring devices be required? Will the requirement of specialized breathing apparatus be needed to work within the space? Are there biological concerns or radioactive concerns while working inside the space?

Will the work being performed in the space change the internal environment and or will it have an effect on the space's immediate external surrounding areas or adjacent processes? Are there concerns with equipment, tools, and machines working in the space either repairing or cleaning? Will equipment being used in the space effect the current atmosphere? What type of ventilation is needed to sustain a non-hazardous atmospheric condition? Will the physical dimensions of the space have an effect on the entrants, and will the physical and mental health condition of the entrant/s pose a potential hazard to work safely inside the space? These and other considerations are covered more thoroughly in Chapter Six of this guide.

Environmental Considerations. Are low floor level liquids a concern, are there overhead obstructions or utility piping or cables a concern? Will Personal Protective Equipment (PPE) be required to work within the space? Does the space span over many levels or floors? Is there a potential for weather to effect the outcome of an incident within the space? Is uncontrollable ambient noise a factor? Is there a potential for vibrations within and adjacent to the space? Does vehicle traffic or heavy equipment, or other processes effect the space? Does the potential for animal and insect interaction pose a concern to the entrant/s within the space?

Energy Isolation Considerations. Where are the control devices located for power and potential sources of energy for the internal and external areas of the space? How long will it take to verify that these sources can be locked and tagged? Can all sources be mechanically controlled, blocked or blanked or does the space require personnel to be committed to a location to physically control a device?

Will it take a specialty person or special group of individuals or maintenance workers to secure energy sources? How long will it take to assemble a group to secure energy sources within the facility or location of the space? Do these individuals work on premises or off site of the space location? Is there a considerable time factor associated with this specific task of securing energy sources? What is the means of delivering a message that an incident has occurred in a confined space to personnel that will be required to respond?

Communications Considerations. Can entrants, attendants or rescuers communicate effectively throughout the space or is there a need for a more complex system requiring radios or communication systems? Will these communication devices work below grade and span the working length and levels of the space?

Work History and Physical Attributes of the Space. How often has the space been entered into, and is there prior documentation to previous entries? Where are previous entry documents or permit entries located and are they relevant to potential emergencies? Does the configuration, length, or design of the space put limitations on the use of rescue equipment or require specific type of equipment? Does the size, location, or height of the entry point pose challenges for entrants/rescue personnel and rescue type equipment?

Capability of Non-rescuers (Entrants, Attendants, Entry Supervisors). What is the level of training of the individuals working within the space? How often is an emergency plan reviewed and when was the last time a training session was performed? Is there a safety plan in place for the space?

Rescue Capabilities – On-site and Outside Resources. Are there emergency trained professionals on location of the space or is an outside agency or local fire/rescue department tasked as a resource? What is the time frame for a Rescue Team of on-site employees to assemble? What is the time frame for an outside resource to arrive on location of the space? What is the level of training of the outside resource? Is the outside resource trained to the ALS medical level? Where is the closest Medical Facility that can facilitate a patient that has suffered a potential confined space emergency or hazardous materials exposure?

Does the owner of the space have an emergency plan or require notification or contact with specialized agencies such as the FBI, CIA, ATF, Military, local and state police, or local security due to restricted areas, processes or access restrictions?

Does the space require different levels of emergency response depending on the type of process or work being performed in the space? Does the time of day or day of week require different levels of emergency response?

A.10.7.2

As an example, rescuers may choose either Class C Airline respirators (Supplied Air Respirators or SAR) or Self-contain Breathing Apparatus (SCBA) to satisfy the requirements of rescuers to utilize Atmosphere Supplying Respirators for respiratory protection in potentially hazardous atmospheres. However, they should also consider the advantages and disadvantages of each relative to the rescue objective.

In this case, the limited duration of air supply in extended rescue operations requiring spinal immobilization or difficult extraction might preclude the use of SCBA . However, significant entanglement hazards within a space might make the use of SAR impossible. The portal shape and size might be restrictive to the use of SAR so that entry may be made while wearing the apparatus in the manner intended by the manufacturer vs. attempting to remove bulkier SCBA that won't otherwise fit through the portal and exposing the rescuer to the potential of dropping the apparatus, potential pulling the facepiece off and exposing the rescuer to contaminants.

The most effective means of making these and other decisions is through the use of pre-incident rescue action planning and practice of those plans on representative or actual spaces. Only through careful consideration of the circumstances and testing of the plan may PPE choices made by the Rescue Team be validated.

A.10.9.1

In general confined space Rescue Teams are composed of no less than six members in order to perform all the required functions listed. However, the size and capability of a team required to perform a specific rescue will depend on many factors including; the condition of the patient, the size and shape of the space, size of the access opening and the hazards present. The positions described in (1)-(4) of this paragraph describe the minimum number of exclusive roles that should be filled to perform an entry type rescue. Many rescues will require additional functions such as ventilation, rope rescue support or communication that will require additional trained resources. Pre-incident planning of representative spaces is a key element to determining the size and capabilities of the team. Table A.10.9.1 can be of assistance in understanding the correlation of team size relative to the conditions of the space and anticipated rescue methods;

Table A.10.9.1 Confined Space Rescue Team Staffing Decision Table

IF	THEN
The permitted confined space has NO obstructions OR entanglement hazards AND the entrant IS properly attached to a retrieval system.	One rescuer is needed to perform a non entry assisted rescue from the outside
The permitted confined space has obstructions OR entanglement hazards, the entrant IS NOT attached to a retrieval system, NO potential atmospheric hazards exist AND vertical rope rescue IS NOT required.	Three rescuers are needed to perform an emergency entry to perform rescue 1 edge manager 2 person entry team
The permitted confined space has obstructions OR entanglement hazards, the entrant IS NOT attached to a retrieval system, NO potential atmospheric hazards exist AND vertical rope rescue IS required.	Five rescuers are needed to perform an emergency entry to perform rescue 1 Edge Manager 2 Rescue System Operators (with assistance from plant personnel) 2 Person Entry Team
The permitted confined space has obstructions OR entanglement hazards, the entrant IS NOT attached to a retrieval system, potential atmospheric hazards exist, SAR CANNOT be used (requiring **SCBA**) AND vertical rope rescue IS NOT required.	Five rescuers are needed to perform an emergency entry to perform rescue 1 Edge Manager 2 Person Entry Team 2 Person Back Up Team
The permitted confined space has obstructions OR entanglement hazards, the entrant IS NOT attached to a retrieval system, potential atmospheric hazards exist (requiring **SAR**) AND vertical rope rescue IS NOT required.	Six rescuers are needed to perform an emergency entry to perform rescue 1 Edge Manager 2 Person Entry Team 2 Person Back Up Team 1 Air Supply Operator

IF	THEN
The permitted confined space has obstructions OR entanglement hazards, the entrant IS NOT attached to a retrieval system, potential atmospheric hazards exist, SAR CANNOT be used (requiring **SCBA**) AND vertical rope rescue IS required.	Seven rescuers are needed to perform and emergency entry to perform rescue 1 Edge Manager 2 Rescue System Operators (with assistance from plant personnel) 2 Person Entry Team 2 Person Back Up Team
The permitted confined space has obstructions OR entanglement hazards, the entrant IS NOT attached to a retrieval system, potential atmospheric hazards exist (requiring SAR) AND vertical rope rescue IS required.	Eight rescuers are needed to perform and emergency entry to perform rescue 1 Edge Manager 2 Rescue System Operators (with assistance from plant personnel) 2 Person Entry Team 2 Person Back Up Team 1 Air Supply Operator
An employee activates a fall protection system and is suspended in a harness requiring rope rescue.	Four rescuers are needed to perform a pick off rescue 1 Edge Manager 2 Rescue System Operators (with assistance from plant personnel) 1 Rescuer on rope

A.10.9.1(1)

Entry team size will be driven by the size of the space and degree of difficulty of the rescue operation. While at the operations level the entry team size should be no less than two members, some spaces requiring technician level resources may be only large enough to accommodate a single rescuer. Some incidents may involve large spaces or complex rescue operations that will require several rescuers to enter the space.

A.10.9.1(2)

The intent of the backup team is to quickly and effectively remove an incapacitated rescuer who is unable to perform self-rescue. In general this requires no less than two members immediately available to enter the space equipped with the same or greater level of PPE as the entry team. The size and capability of the team should be driven by the specific conditions encountered and the scope of the rescue operation."

A.11.2.1.2

It should be understood that reaching into a confined space with a monitor probe to measure the atmosphere (or other similar activity such as taking a sample of residue through a small opening) should not be considered as "entry" into the space.

A.11.3.2.7

When the employer's confined space program allows attendant entry for rescue, attendants who have been trained and properly equipped for entry rescue operations may do so, only after being relieved by another qualified attendant. Rescue by the primary attendant should be the last solution, as information they have will be critically valuable in assisting the designated Rescue Team when assessing what might be the condition in the space that contributed to the emergency.

A.11.3.2.8

Approved assigned duties may include, but are not limited to, checking gas testing instruments to assure they are positioned and working as intended; watching for outside activity that might affect entry operations, assisting in replacing blowers and ductwork for ventilation if moved during entrant entry/exit, monitoring air supply, etc.

Duties that are not allowed include, but are not limited to, any task where direct contact with entrants could be lost, like going to get a tool from truck, performing unauthorized activities, taking a smoking break, etc. as well as any task for which the attendant is not assigned or qualified. Under some circumstances two attendants may be placed outside the space instead of a single attendant to ensure that if there is a need for one attendant to take a break, that there is at least one attendant still dedicated to the space. This would allow some of the above listed duties to be accomplished.

A.11.4.1.2

Confined space related work practices and activities are typically conducted in compliance with legal regulations and/or industry and facility requirements. For example, in the United States, OSHA requires the employer to designate an Entry Supervisor to supervise work that involves entering Permit Required Confined Spaces, including those with inert atmospheres. Industry practices and facility programs are generally consistent with these legal requirements.

A.11.4.2

It is common practice in industry that the Permit Issuer and the Entry Supervisor are often different persons especially when contractors are doing the entry work in a manned facility. In such cases, the Permit Issuer may be a facility employee who initiates the permit according to facility confined space program requirements. Once the permit requirements are met, the issuer and the Entry Supervisor (and tester) then sign off on the permit. The Entry Supervisor controls the entry and operations in accordance with the permit requirements and can cancel the permit if the conditions change so that the permit requirements are no longer met Where a single entity has total responsibility for the entry and work, the Permit Issuer and Entry Supervisor may be the same person.

A.11.4.2.4

If unacceptable risks develop within or outside the space exceeding those authorized by the permit, the Entry Supervisor should cancel the permit and have entrants vacate the space. The Entry Supervisor should not allow entrants to reenter the space until the hazards are abated and risk is reduced to an acceptable level. Atmospheric testing within the space should be completed before an entry permit may be reissued.

A.11.4.2.11

Before implementing entry or work permits, Entry Supervisors should require that internal combustion and non-approved electrical powered equipment (including, but not limited to, automobiles, trucks, vacuum trucks, forklifts, fans, educators, pumps, welding machines, and compressors) are restricted to designated safe areas (such as outside the tank dike area) away from sources of flammable vapors, by notation on the permits and, if necessary, by posting signs and/or barricading access to the area.

Entry Supervisors should be aware that approved diesel powered internal combustion equipment is preferred to using gasoline or gas powered equipment.

Entry Supervisors should be aware that the use of steam or air operated equipment is preferred to using electric or internal combustion powered equipment.

Entry Supervisors should assure that all electrical equipment and appurtenances have been inspected and approved by a qualified person to determine that they are "explosion proof" or protected so as to not create and/or release sufficient energy to be a source of ignition.

Electrical equipment attached to and around the confined space, should be disconnected and locked or tagged out before issuing an entry permit. Such equipment and appurtenances include, but are not limited to, metering and signaling devices, alarms, sensors, overflow protection systems, cathodic protection systems, and electrical heating coils.

Depending on the potential exposures, Entry Supervisors should assure that all electrically powered cleaning and related equipment, including but not limited to, electrical powered tools, communication devices, lights and motors, used throughout cleaning operations, meets the minimum requirements of *NFPA 70* for Class I, Division 1, Group D (or higher) (or Class 1, Zone 0 or Zone 1) locations. The use of any type of non-explosion proof electrical equipment shall be prohibited unless specifically permitted under an authorized job site procedure or by issuance of an entry, hot work or safe (cold) work permit permitting such use.

Entry Supervisors should assure that bonding and grounding cables and clamps are inspected by a qualified person to assure good condition, adequacy and integrity prior to the start of work and periodically, as necessary, during the work.

Entry Supervisors and qualified persons should ensure that equipment capable of creating an ignitable spark upon disconnection is properly bonded and grounded (earthed) before issuing permits (see API 2003, API 2219 and NFPA 77 for additional information).

A.11.4.3.1

NFPA and other training entities offer training to prepare for the American Petroleum Institute Entry Supervisor certification exam. The Marine Chemist program run through NFPA also certifies individuals who are working on marine vessels.

A.11.5.1.1

It is common practice in industry that the Permit Issuer and the Entry Supervisor are usually different persons (especially when contractors are doing the entry work in a location with facility personnel). In such cases, the Permit Issuer may be a facility employee who initiates the permit according to facility confined space program requirements. Once the permit requirements are met, the issuer and the Entry Supervisor (and tester) then sign off on the permit. The Entry Supervisor controls the entry and operations in accordance with the permit requirements and can cancel the permit if the conditions change so that the permit requirements are no longer met. Where a single entity has total responsibility for the entry and work, the Permit Issuer and Entry Supervisor may be the same person.

A.11.5.2.7

Such changes might include the owner/operator's reclassification of the confined space, other non confined space related activities affecting the confined space operations, emergencies within and outside the space, changes in weather affecting the work, unauthorized persons or equipment entering the work area or confined space, etc.

A.11.8.2.10

Equipment may include, but is not limited to the following:

(1) Testing and monitoring equipment and calibration materials.

(2) Ventilating equipment.

(3) Communications equipment.

(4) Personal protective equipment and respiratory protection.

(5) Lighting equipment.

(6) Barriers, guards, warning signs and shields.

(7) Equipment, such as ladders, needed for ingress and egress.

(8) Rescue and emergency equipment needed to comply with the confined space program requirements (except to the extent that the equipment is provided by rescue services).

(9) Any other equipment necessary for authorized work in and around the confined space.

A.11.8.2.13

The owner/operator should develop should retain each cancelled entry permit for at least one year to facilitate the review of the confined space program. Any problems encountered during an entry operation shall be noted on the pertinent permit so that appropriate revisions to the program can be made.

A.11.9.2.6

The contractor should obtain copies of the owner/operators evaluation of the confined space(s) involved including, but not limited to the MSDS's covering hazardous materials and chemicals in the confined space and in the area of the job, the isolation (Lockout/Tagout) procedures, required and available fire protection equipment, etc.

A.11.9.2.7

The contractor should provide the following documentation to the Owner/operator (and the subcontractor should provide the same to the contractor):

(1) General safety policies and procedures

(2) Confined Space Entry Program

(3) Permit requirements for entry, hot and cold work

(4) Qualifications or training certification for all involved personnel.

(5) Hot Work and cold work procedures where flammables may be present

(6) Past work involving confined spaces

(7) PPE and other equipment, materials and chemical to be provided for use on the job

(8) Emergency procedures or rescue services to be available

(9) A statement indicating that they have never been cited by state or federal safety compliance agencies for any confined space safety infraction. If they have been cited previously, a copy of the citation and a statement from them describing the corrective action they have instituted shall be provided. (Reference 29 CFR 1910.146(C)(9):

(10) In addition to complying with the permit space requirements that apply to all employers, each contractor who is retained to perform permit space entry operations should

- (a) Obtain any available information regarding permit space hazards and entry operations from the owner/operator;
- (b) Inform the owner/operator of the permit space program that the contractor will follow and of any hazards confronted or created in or around the confined space.

A.11.9.2.13

Equipment may include, but is not limited to the following:

(1) Testing and monitoring equipment and calibration materials.

(2) Ventilating equipment.

(3) Communications equipment.

(4) Personal protective equipment and respiratory protection.

(5) Lighting equipment.

(6) Barriers, guards, warning signs and shields.

(7) Equipment, such as ladders, needed for ingress and egress.

(8) Rescue and emergency equipment needed to comply with the confined space program requirements (except to the extent that the equipment is provided by rescue services).

(9) Any other equipment necessary for authorized work in and around the confined space.

A.11.9.2.16

Contractors should retain cancelled entry permits for at least one year to facilitate the review of the confined space program. Any problems encountered during an entry operation should be noted on the pertinent permit so that appropriate revisions to the program can be made.

A.11.9.2.17

When a contractor arranges to have a sub-contractor perform work that involves confined space entry, the contractor should

(1) Inform the subcontractor that the workplace contains confined spaces and that entry is allowed only through compliance with an approved confined space program

(2) Appraise the subcontractor of the hazards and the owner/operators experience with the space.

(3) Apprise the subcontractor of any precautions or procedures that have been implemented for the protection of employees in or near permit spaces where contractor personnel will be working;

(4) Coordinate entry operations with the contractor and owner/operator when owner/operator and contractor personnel will be working in or near the confined space.

(5) The subcontractor should debrief the contractor at the conclusion of the entry operations regarding the permit space program followed and regarding any hazards confronted or created in permit spaces during entry operations.

A.11.10.1

Ventilation methods may include, but are not limited to, displacement. dilution, flushing; inerting, purging or other appropriate methods of removing or controlling a hazard atmosphere. Note: It is not advisable to use steam to remove a flammable atmosphere due to the potential for a static discharge.

A.11.10.2.3

Permit Issuers should assure that appropriate requirements for safe ventilation operations and personal protective equipment are documented on the entry permit and implemented.

Permit Issuers should ensure that acceptable atmospheric levels are documented before ventilated spaces are entered

Permit Issuers should provide for and Entry Supervisors should assure that continuous forced air ventilation is provided while confined spaces are occupied (even if initial and subsequent atmospheric test results are acceptable) where required by the confined space program.

Entry Supervisors should assure that air quality is monitored as often as feasible, and if necessary use appropriate additional measures to maintain exposures within acceptable levels

A.11.10.2.8

Where required, exhausted atmosphere should be captured, disbursed and treated, as appropriate.

A.11.10.2.12

For example, Gas Tester should take readings away from the incoming air flow and in areas where the sample is representative of the air where personnel are located.

A.11.11.1

Isolation should be achieved by approved methods, including but not limited to, blanking, blinding, double block and bleeding, misaligning or removing sections of lines, pipes, or ducts, lockout or tagout of all sources of energy; or blocking or disconnecting all mechanical, hydraulic, electrical, vapor, gas, engulfment, chemical or steam linkages and connections that could create hazards.

A.11.11.2

Authorized personnel to be notified may include, but are not limited to owner/operators, contractors/subcontractors, Permit Issuers and Entry Supervisors.

A.11.12.1

Worker operations and duties may include, but are not limited to, moving and staging equipment and materials for use within or outside the space; conducting non-entry required hot and/or cold work; assisting Gas Tester, attendants, ventilation and isolation personnel with activities outside of the confined space; manning barriers to prevent unauthorized entry into the surrounding area; acting as a fire watch during hot work operations or when ignition sources are present in the area.

A.12.5

Table A.12.5 is an example of a identification template.

Table A.12.5 Identification of Confined Spaces at (Facility/Company)

Name and Location	Size/ Configuration	Normal Contents or Process	Typical Reasons for entry	Safety Hazards	Health Hazard/ Potentially Hazardous Atmosphere	Adjacent Hazards	Notes

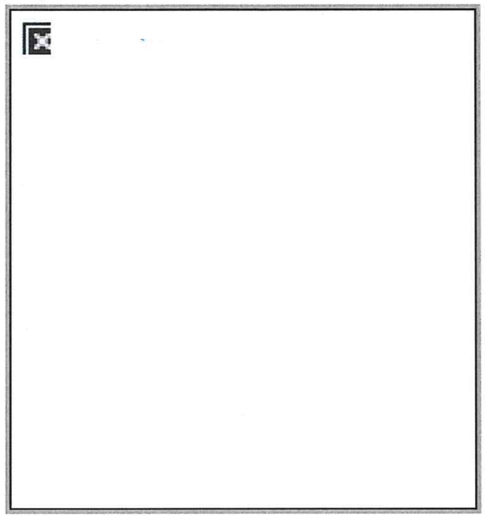
A.12.7.1

There is no hard and fast rule about what levels should be allowed for entry into confined spaces where toxic contaminants may be present. OSHA Permissible Exposure Limits exist for several hundred air contaminants and these levels must not be exceeded. The National Institute for Occupational Safety and Health (NIOSH) and the American Conference of Governmental Industrial Hygienists (ACGIH) also have established occupational exposure limits for many contaminants. When working in confined spaces, it is often standard practice to set meter alarm levels at one half or less of the allowable or recommended exposure limits (called the “action level”). Gas meter manufacturers may also recommend alarm limits based on the contaminant properties and based on the accuracy of the measurement.

A.12.14.3

A sample training certification form and alternate tracking are provided in Figure A.12.14.3.

Figure A.12.14.3 Confined Space Entry Training Certification and Alternate Tracking Option



A.12.18

Items to be considered as part of the fitness for duty may include:

(1) Hot and cold temperature changes

(2) Unstable surfaces

(3) Areas which require climbing up or down

(4) Audible alerts and communication

(5) Tight work spaces

(6) Capable of wearing required PPE

A.16.1

The optimal method of preventing occupation illnesses, injuries and fatalities is to “design out” the hazards and risk; thereby, eliminating the need to control them during work operations. This approach involves the design of tools, equipment, systems, work processes and facilities in order to reduce or eliminate, hazards associated with work. (Young-Corbett, 2011)

A.16.5.4

Review each identified hazard and determine what the probability of an incident occurring and the severity of the incident if it does occur. The assessment may be qualitative or quantitative (numerical). Explanations of each level of within the probability and severity scales are given in Table A.16.5.4(a), Table A.16.5.4(b), and Table A.16.5.4(c).

Table A.16.5.4(a) Risk Assessment Matrix

	Probability						
Severity			**1**	**2**	**3**	**4**	**5**
			Unlikely	Seldom	Occasional	Likely	Frequent
	1	Negligible	2	3	4	5	6
	2	Minor	3	4	5	6	7
	3	Moderate	4	5	6	7	8
	4	Critical	5	6	7	8	9
	5	Catastrophic	6	7	8	9	10

Table A.16.5.4(b) Severity

Severity		
Negligible	1	First aid or minor medical treatment
Minor	2	Minor injury, lost work day
Moderate	3	Moderate injury resulting in lost work days
Critical	4	Permanent or partial disability
Catastrophic	5	Death or permanent total disability

Table A.16.5.4(c) Probability of Occurrence

Probability		**Description**
Frequent	5	Expected to occur in most circumstances.
Likely	4	Will probably occur in most circumstances.
Occasional	3	Occurs sporadically, not regularly.
Seldom	2	Unlikely but could occur at some time.
Unlikely	1	May occur only in exceptional circumstances.

Once the probability and severity are determined, use the matrix to find the level of risk. The above matrix is an example where the different colors indicate the levels of risk. Below is an explanation of each color for this matrix.

Red: Activities in this area are considered unacceptable levels of risk, including catastrophic and critical injuries that are highly likely to occur. Supervisors should consider whether they should eliminate or modify activities that still have this rating after applying all reasonable risk management strategies.

Yellow: Activities in this area are considered critical and may cause severe injury, major property damage, significant, financial loss, and/or result in negative publicity for the organization and/or institution.

Green: Activities in this area are considered minor or negligible hazards that present a minimal threat to the safety, health and well-being of participants. They contain minimal risk and are unlikely to occur. Organizations can proceed with these activities as planned and handle through routine procedures.