ORDER

GL AF 3900.1A

Great Lakes Region, Airway Facilities Division

Occupational Safety and Health Program

JULY 09, 2003

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

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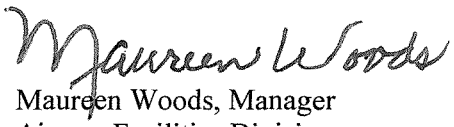
RECORD OF CHANGES

DIRECTIVE NO. **GL AF 3900.1A**

CHANGE TO BASIC	SUPPLEMENTS			OPTIONAL	CHANGE TO BASIC	SUPPLEMENTS			OPTIONAL

FOREWORD

This order establishes the policy framework and assigns responsibility for an effective Great Lakes Region, Airway Facilities Division, employee Occupational Safety and Health program. The goal of the OSH program is to ensure employees are provided with places and conditions of employment free from recognized hazards that cause or are likely to cause death or serious physical harm. Future Chapters will be issued in order of priority to address emerging safety and health issues within the Division.



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CHAPTER 1. GENERAL

1-1. PURPOSE. This order establishes broad roles, responsibilities, accountability, and criteria for implementing a Great Lakes Region (AGL), Airway Facilities (AF) Division, Occupational Safety and Health (OSH) program. It shall be used to assist with the development and implementation of an OSH program within the division. This OSH program should satisfy safety and health requirements outlined within FAA orders and related Occupational Safety and Health Administration (OSHA) standards as referenced in Paragraph 1-10.

1-2. DISTRIBUTION. This order is distributed to the section level and above in the AF Division, and at the minimum to all AF field offices in the AGL.

1-3. CANCELLATION. Order GL AF 3900.1 "Occupational Safety and Health Program" dated January 24, 2002 is canceled by this order.

1-4. POLICY. This order sets the policy for the framework of the overall OSH program. The AF Division is committed to providing for the occupational safety and health of employees, preventing accidental loss of material resources, avoiding facility interruption due to accident or fire, enforcing a system of formal accountability, and integrating program activities at all levels within the Division's day-to-day operations. The program shall have top management commitment and support.

1-5. DEFINITIONS.

a. Consensus Standard. An occupational safety or health standard which has been adopted or promulgated by a nationally recognized standards-producing organization under procedures which interested and affected persons have reached substantial agreement for its adoption.

b. Environmental Protection Specialist (or designated equivalent). Serves as the recognized expert and advisor responsible for planning, administering, evaluating, and controlling a comprehensive System Management Office (SMO) Occupational Safety, Environmental, and Health program.

c. Facility. A single physical location where AF business is conducted, where services or operations are performed, or where unmanned electronic and/or mechanical equipment provide a service.

d. First-Line Supervisor. All divisional personnel who have subordinates under their direct supervision.

e. Hazardous Substance. Any material or compound that has the capability of producing adverse effects on the health and safety of humans.

f. Implementation Plan. A comprehensive course of action designed to achieve a pre-determined set of goals. These plans are subparts to the overall AGL, AF Division, OSH program.

g. Industrial Hygiene. The science devoted to the recognition, evaluation, and control of environmental factors and stresses, arising in or from the workplace.

h. Industrial Hygienist. An individual whose duties include advising, administering, supervising, managing or performing professional and scientific work in the field of Industrial Hygiene, including the identification and evaluation of conditions affecting the health and efficiency of employees, the formulation and

recommendation of measures to eliminate or control occupational health hazards, and the promotion of occupational health programs for instructing and motivating managers and employees in the prevention, as well as the correction, of potential health hazards.

i. Management Representative. A supervisor or management official as defined in a labor management relations program.

j. Medical Surveillance. Procedures used to assess the adequacy of protective measures, which include the development of baseline and periodic evaluations.

k. Personnel. Safety specialists, managers, engineers; industrial hygienists; and equally qualified agency, military, or non-government personnel who meet the basic qualifications of the above classifications as defined within the Office of Human Resources, AHR-1, Standard Position Descriptions.

l. Qualified Personnel. Employees, who by education and/or specialized training, have the expertise to anticipate, recognize, and evaluate employee exposures and knowledge to specify necessary controls and personal protective equipment (PPE) to ensure employee safety.

1-6. FORMS. Forms are provided in Appendix 2. They can be locally reproduced or ordered through normal supply channels.

1-7. AUTHORITY TO ISSUE CHANGES TO THIS ORDER. The AF Division Manager has the authority to issue changes to this order following the procedures outlined in the FAA Order 1320.1D, "FAA Directives System."

1-8. STANDARDS.

a. Occupational Safety and Health Standards. The FAA has adopted the OSHA standards published in the Code of Federal Regulations (CFR), 29 CFR 1910, "Occupational Safety and Health Standards for General Industry," and 29 CFR 1926, "Safety and Health Regulations for Construction." These standards apply to all AF Division workplaces.

b. Existing FAA OSH Orders. The Regional Occupational Safety and Health Manager (ROSHM) shall perform an annual review of related FAA safety and health orders for currency with OSHA standards and FAA organizational structure. Orders not meeting OSHA standards shall be revised or canceled. The most current OSHA standard(s) shall apply when FAA orders are found to be inconsistent due to changes with OSHA standards.

c. Consensus Standards. The OSH program will apply OSHA standards and other non-FAA regulatory or current industry/consensus standards to equipment, operations, or workplaces. Non-FAA regulatory or industry/consensus standards include, but are not limited to, those published by the American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), United States (US) Department of Transportation (DOT), US Environmental Protection Agency (EPA), National Fire Protection Association (NFPA), and the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE).

1-9. RESPONSIBILITIES.

a. Airway Facilities Division, AGL-400, Manager, shall:

(1) Provide top management commitment and support to the OSH program.

(2) Ensure policies and procedures are developed to comply with applicable Federal safety and health regulations and FAA orders.

(3) Assign OSH program management responsibilities to qualified personnel.

(4) Provide an adequate number of technically qualified staff to support the OSH program.

(5) Ensure funding needs that support the OSH program are documented and forwarded to the National Airspace System (NAS), Transition and Integration Office – Environmental, Energy and Safety Division, AFZ-800.

(6) Ensure procedures are in place to respond to employee reports of imminent danger or other immediate hazard concerns.

(7) Ensure that written guidance and procedures are in place to expedite the notification of safety-related accidents, fatalities, and incidents.

b. Airway Facilities Division, Operations Branch, AGL-470, Manager, shall:

(1) Ensure the OSH program is executed in accordance with applicable regulatory and industry requirements.

(2) Manage, track and provide fiscal oversight at the divisional level.

(3) Provide technical assistance to the AF Division and other lines of business to support their responsibilities under existing OSHA standards and FAA orders.

(4) Perform an annual OSH program evaluation to ensure compliance with applicable OSHA standards and FAA orders.

(5) Coordinate with the AF Division, Resource Management Branch, AGL-420, on management and training requirements, resources, and responsibilities necessary to implement the OSH program.

c. Airway Facilities Division, Resource Management Branch, AGL-420, Manager, shall:

(1) Coordinate and implement training requirements outlined within the various chapters of the OSH program per current standards and policies.

(2) Coordinate with the AF Division, Operations Branch, AGL-470, to ensure training providers meet requirements outlined within the OSH program and Public Law 104-50.

d. Airway Facilities Division, System Management Office, Manager, shall:

(1) Direct the administration and compliance of the OSH program within the SMO.

(2) Ensure implementation plans are developed to meet OSH program requirements.

(3) Ensure coordination and compliance of the OSH program in sponsor/lessor owned property (e.g., Airport Authorities).

(4) Ensure funding needs that support the OSH program are documented and forwarded to the

Regional Program Manager, Environment and Safety (RPMES) within AGL- 470.

(5) Ensure the SMO OSH program is evaluated on an annual basis.

(6) Ensure employees receive the appropriate training, equipment, PPE and applicable medical evaluations in accordance with the OSH program.

(7) Ensure appropriate OSH program training and recordkeeping requirements are maintained, updated, and filed in accordance with applicable FAA orders and OSHA standards.

(8) Be responsible for advising all parties, outside the AF Division, of the requirements outlined in 1-9. h. & i. that must be implemented before the start of any construction, remodeling or maintenance project.

(9) Ensure required OSH provisions are contained by reference in all project specifications.

e. Airway Facilities Division, System Support Center Manager / First-Line Supervisor, shall:

(1) Ensure all employees under their supervision are aware and understand the requirements within this Order.

(2) Advise appropriate management and non-management personnel of procedure changes and/or changes in conditions, materials, and work practices that would affect the OSH program and/or working conditions.

(3) Transmit employee comments regarding OSH concerns to the Environmental Protection Specialist (EPS) or designated OSH personnel in a timely manner. Provide assistance on addressing and correcting such issues.

(4) Ensure workplaces are inspected annually. Assist with the abatement of any hazards.

(5) Ensure procedures are developed and implemented that provide employees with equipment, tools, and PPE to perform their jobs in a safe and efficient manner.

(6) Ensure procedures are developed and implemented to properly maintain and inspect PPE according to manufacturer's recommendations.

(7) Enforce safety rules and regulations and require the use of PPE when mandated by assigned tasks.

(8) Ensure all employees receive OSH and PPE training that is appropriate for their assigned tasks. All training should be properly documented within the appropriate FAA system.

(9) Ensure all construction and maintenance contracts contain a written statement mandating full compliance with the requirements set forth in the OSH program.

(10) Ensure all contractors and outside service personnel are notified of their obligation to comply with the requirements of the OSH program.

(11) Ensure all contractors and outside service personnel are familiar with the applicable rules and regulations of the OSH program that pertain to a particular project.

(12) Ensure FAA Order 3900.57, "FAA Pre-Construction and Maintenance Project Safety and Health Checklist," has been completed, discussed and distributed for all construction and maintenance projects.

(13) Ensure all work-related injuries and illnesses are reported and investigated in accordance with prescribed procedures as outlined in FAA Order 3900.19B, Occupational Safety and Health Program, Chapter 7, "Accident Reporting and Investigation."

(14) Ensure all reports of hazardous conditions are investigated and reports are completed in accordance with FAA Order 3900.19B, Chapter 9, "Reports by Employees on Hazardous Conditions."

(15) Announce or provide written documentation of the location of the OSH written program for inspection by employees and/or their representatives.

f. Airway Facilities Division, SMO Environmental Protection Specialists (or designated equivalent), shall:

(1) Provide technical guidance and support to the SMO as required under the OSH program.

(2) Respond to SMO employee concerns regarding OSH issues in a timely manner.

(3) Ensure SMO personnel have acquired the knowledge, understanding, equipment, and skills necessary to safely and effectively perform their duties in accordance with the OSH program.

(4) Assist the SMO with recordkeeping requirements as mandated by the various OSH programs.

(5) Provide an annual report to the SMO Manager regarding the status of the OSH program implementation, effectiveness and training requirements.

g. Airway Facilities Division, Employees, shall:

(1) Observe safe work practices, including the use of PPE, and comply with the safety and health policies outlined within the OSH program.

(2) Ensure all materials and/or equipment, including PPE, required to safely perform their duties is available, in good working order, and properly used.

(3) Advise their System Support Center Manager (SSCM) / first-line supervisor of any changes in conditions, materials, and work practices that would affect their work environment.

(4) Attend applicable OSH-related training sessions and comply with OSH medical surveillance requirements.

(5) Immediately report all injuries or illnesses to their SSCM / first-line supervisor following the procedures outlined in FAA Order 3900.19B, Chapter 7.

(6) Report any unsafe or unhealthy conditions to their SSCM / first-line supervisor either orally or in writing following the procedures provided in FAA Order 3900.19B, Chapter 9.

h. Other FAA Offices, when in areas controlled by the AF Division, shall:

(1) Follow the policies and procedures outline within the OSH program for all construction,

remodeling and maintenance projects.

(2) Ensure contract specifications contain a written statement that mandates all contractors, sub-contractors, or service personnel to follow the requirements outlined in 1-9. i.

(3) Ensure contractors, sub-contractors, and service personnel are familiar with the applicable regulations outlined within the OSH program related to a particular project before it commences.

(4) Audit the performance of all contractors, sub-contractors, and service personnel at various intervals of the project to ensure compliance with the OSH program.

(5) Ensure FAA Order 3900.57, "FAA Pre-Construction and Maintenance Project Safety and Health Checklist," has been completed, discussed and distributed for all construction and maintenance projects.

i. Contractors, Sub-Contractors, and Service Personnel, shall:

(1) Comply with all OSHA safety and health provisions, applicable FAA orders and requirements outlined within the OSH program.

(2) Provide copies of their OSH program and applicable training records, when required.

(3) Alert appropriate FAA employees of their intent to use any hazardous substance(s) and/or equipment that may introduce an unsafe or unhealthy condition during a project.

(4) Provide Material Safety Data Sheets (MSDS) on all hazardous materials used or stored on a FAA owned or leased facility. Immediately remove any hazardous materials from the premises after their use is no longer necessary.

(5) Report any unsafe or unhealthy conditions or hazardous substances to their FAA point of contact.

1-10. REFERENCES. The following references have been identified as resources related to this Chapter.

a. FAA Order 1320. 1D, "FAA Directives System." Office of Cost and Performance Management, Standards and Information Division, APF-100, FAA Headquarters, 800 Independence Avenue, S.W., Washington, D.C. 20591. (202) 267-8160. Web Site:http://www.faa.gov/aba/index.html

b. FAA Order 3900.19B, "Occupational Safety and Health Program." Office of Environment and Energy, Environment, Energy & Employee Safety Division, AEE-200. Contact address listed in 1-10. a. (202) 267-3554. Web Site: http://www.aee.faa.gov/aee-200/safety.htm

c. FAA Order 3900.57, "FAA Pre-Construction and Maintenance Project Safety and Health Checklist." NAS Transition and Integration - Environmental Energy and Safety Division (AFZ-800). Contact address listed in 1-10. a. (202) 267-8679. Web site: http://ats.awa.faa.gov/aaf/afz/800/afz800frame.htm

d. FAA, Position Description Library. Office of Human Resource Management, AHR-1. Contact address listed in 1-10. a. (202) 267-3979. Web Site: http://pdlibrary.faa.gov/

e. Public Law 104-50, "Department of Transportation and Related Agencies Appropriations Act, Title III, General Provisions, Section 337, Employee Training." United States Department of Transportation, 400 Seventh Street, Washington, D.C. 20590. (202) 366-5135. Web Site: http://www.dot.gov/

f. United States Department of Labor, Occupational Safety and Health Administration, Publications Office, Room N-3101, 200 Constitution Avenue, Washington, D.C, 20210. (202) 693-2121. Web Site: http://www.osha.gov

CHAPTER 2. INDOOR AIR QUALITY

2-1. INTRODUCTION. This Indoor Air Quality (IAQ) Program is designed to proactively anticipate and prevent conditions and/or building systems from contributing to poor indoor air. When concerns are filed or noted by building occupants, an IAQ investigation shall be conducted to identify the nature and severity of the observed IAQ conditions. The goal of an IAQ investigation is to identify and abate conditions contributing to reduce indoor air quality, and to prevent similar situations or conditions from occurring. The initial investigation will normally follow a basic protocol. The information collected during the initial investigation may dictate more advanced IAQ investigation methodologies. Initial procedures will follow the parameters of gathering information from the affected building occupants, forming and testing a causation hypothesis, and applying the proper solution to rectify the situation. Further environmental testing may be necessary to ensure a quality indoor air environment. A review of the issues related to indoor air quality can be found in Appendix 3, "Indoor Air Quality Guidance Document (Non-Mandatory)."

2-2. PURPOSE. Due to the absence of a specific OSHA standard or other applicable federal, state or municipal regulations on IAQ, this chapter has been created to provide direction when IAQ issues arise within AF facilities.

2-3. RESPONSIBILITIES. General responsibilities for the OSH program are found in Chapter 1, Paragraph.1-7. Specific responsibilities related to IAQ are listed below:

a. Airway Facilities Division, System Support Center Manager / First-Line Supervisor, shall:

(1) Provide assistance to the qualified person(s) performing the indoor air quality evaluation.

(2) Ensure heating, ventilation, and air-conditioning (HVAC) systems are maintained on an established routine basis.

b. Airway Facilities Division, SMO Environmental Protection Specialist / (or designated equivalent), shall:

(1) Ensure appropriate investigative methods are conducted.

(2) Verify the qualifications of potential contractors (e.g., Certified Industrial Hygienist, etc.) to ensure they possess the understanding, knowledge, and skills necessary to perform IAQ investigations. Those selected should be ready to provide their services in a reasonable time frame, since IAQ concerns can occur at any time.

(3) Act as the SMO point of contact for upward reporting of IAQ issues.

c. Airway Facilities Division, Employees, shall:

(1) Bring indoor air quality concerns to the attention of their SSCM/First Line Supervisor.

(2) Note any trends associated with the indoor air quality conditions.

(3) Provide complete information when answering questions from the qualified person(s) conducting an indoor air quality survey.

(4) Follow the guidelines and preventive measures outlined within this chapter.

(5) Take care not to hinder the operation of the HVAC system (i.e., blocking vents).

(6) Follow instructions on container labels when using chemicals.

(7) Clean up any standing water or water-damaged surfaces to prevent growth of biological contaminants.

(8) Keep the work environment clean.

2-4. DEFINITIONS.

a. Air Cleaning. An IAQ control strategy to remove various airborne particulates and/or gases from the air. The three types of air cleaning most commonly used are particulate filtration, electrostatic precipitation, and gas sorption.

b. Antimicrobial. Agent that kills microbial growth. See "Disinfectant," "Sanitizer," and "Sterilizer."

c. Biological Contaminants. Agents derived from, or that are, living organisms (e.g., viruses, bacteria, fungi, mammal and bird antigens, etc.) that can be inhaled and can cause many types of health effects including allergic reactions, respiratory disorders, hypersensitivity diseases, and infectious diseases. Also referred to as "microbiologicals" or "microbials."

d. Chemical-Specific Badges. Passive air monitoring devices that are specific to one chemical. These badges are small and lightweight which make them ideal for personal air monitoring. It should be noted their use in investigations is limited.

e. Cubic Feet Per Minute. The amount of air, in cubic feet per minute (CFM), that flows through a given space in one minute. 1 CFM equals approximately 2 liters per second (l/s).

f. Conditioned Air. Air that has been dehumidified, cooled, heated or humidified to maintain an interior space within the "controlled set points." (sometimes referred to as "tempered" air).

g. Constant Flow System. An HVAC system that maintains temperature through heating / cooling modulation.

h. Dampers. Controls that vary airflow through an air outlet, inlet, or duct. A damper position may be immovable, manually adjustable, or part of an automated control system.

i. Disinfectants. One of three groups of antimicrobials registered by the EPA for public health uses. The EPA considers an antimicrobial to be a disinfectant when it destroys or irreversibly inactivates infectious or other undesirable organisms, but not necessarily their spores. The EPA registers three types of disinfectant products based upon submitted efficacy data: limited, general or broad spectrum, and hospital disinfectant.

j. Drain Trap. A dip in the drain pipe of sinks, toilets, floor drains, etc., which is designed to stay filled with water, thereby preventing sewer gases from escaping into the room.

k. Environmental Stressors. Conditions other than indoor air contaminants that may cause stress, discomfort, and/or health problems {e.g., temperature/humidity extremes, drafts, poor air circulation, noise, overcrowding, vibration, lighting, ergonomic stressors (e.g., poor workstation design, seating)}. These may produce the same symptoms as those associated with poor IAQ.

l. **Exhaust Ventilation.** Mechanical removal of air from a portion of a building (e.g., piece of equipment, restroom, or general area).

m. **Hypersensitivity Diseases.** Diseases characterized by allergic responses to pollutants. The hypersensitivity diseases most clearly associated with indoor air quality are asthma, rhinitis (inflammation of the mucous membrane that lines the nose), and hypersensitivity pneumonitis. Hypersensitivity pneumonitis is a rare but serious disease that involves progressive lung damage as long as there is exposure to the causative agent.

n. **Indoor Air Pollutant.** Particles and dust, fibers, mists, bioaerosols, and gases or vapors.

o. **Microbiologicals.** See "Biological Contaminants."

p. **Negative Pressure.** Condition that exists when less air is supplied to a space than is exhausted from the space, so the air pressure within that space is less than that in surrounding areas. Under this condition, if an opening exists, air will flow from surrounding areas into the negatively pressurized space.

q. **Positive Pressure.** Condition that exists when more air is supplied to a space than is exhausted, so the air pressure within that space is greater than that in surrounding areas. Under this condition, if an opening exists, air will flow from the positively pressurized space into surrounding areas.

r. **Psychogenic Illness.** This syndrome has been defined as a group of symptoms that develop in an individual (or a group of individuals in the same indoor environment) who are under some type of physical or emotional stress. This does not mean that individuals have a psychiatric disorder or they are imagining symptoms.

s. **Qualified Person**. A person capable (by education and/or specialized training) of anticipating, recognizing, evaluating, and controlling employee exposure to hazardous atmospheres. This person will be capable of specifying the necessary controls to ensure worker safety. This person can be the Environmental Protection Specialist (EPS) / designated equivalent or a contractor selected by the EPS / designated equivalent or the AGL Regional Office as long as this individual meets the qualifications listed in the 1st and 2nd sentences of this subparagraph.

t. **Radon.** A colorless, odorless gas that occurs naturally in almost all soil and rock. Radon migrates through the soil and groundwater and can enter buildings through cracks or other openings in the foundation. Radon can also enter well water. Exposure to radon can cause lung cancer.

u. **Sanitizer.** One of three groups of antimicrobials registered by the EPA for public health uses. The EPA considers an antimicrobial to be a sanitizer when it reduces but does not necessarily eliminate all microorganisms on a treated surface. To be a registered sanitizer, the test results for a product must show a reduction of at least 99.9% in the number of each test microorganism over the parallel control.

v. **Short-circuiting.** Situation that occurs when the "supply air" flows to return or exhaust grilles before entering the breathing zone (area of a room where people are). To avoid short-circuiting, the HVAC system and furniture layout must be designed to allow the "supply air" to freely circulate throughout the entire room before it exits though an exhaust or return grille.

w. **Soil Gases.** Gases that enter a building from the surrounding ground (e.g., radon, volatile organic compounds, and gases from pesticides in the soil).

x. Sources. Sources of indoor air pollutants. Indoor air pollutants can originate within the building or be drawn in from outdoors. Common sources include people and room furnishings such as carpeting, photocopiers, art supplies, etc.

y. Sterilizer. One of three groups of antimicrobials registered by EPA for public health uses. The EPA considers an antimicrobial to be a sterilizer when it destroys or eliminates all forms of bacteria, fungi, viruses, and their spores. Because spores are considered the most difficult form of a microorganism to destroy, the EPA considers the term "sporicide" to be synonymous with "sterilizer."

z. Variable Air Volume. A HVAC system component that automatically adjusts the airflow delivery to an occupied space based on the temperature setting.

aa. Volatile Organic Compounds. Compounds that vaporize (become a gas) at room temperature. Common sources that may emit volatile organic compounds (VOC) into indoor air include housekeeping and maintenance products, and building and furnishing materials. In sufficient quantities, VOCs may cause eye, nose, and throat irritations; headaches; dizziness; visual disorders; and memory impairment. Some are known to cause cancer in animals while some are suspected of causing, or are known to cause, cancer in humans. At present, not much is known about what health effects occur at the levels of VOCs typically found in public and commercial buildings.

2-5. GENERAL REQUIREMENTS.

a. Preventive Practices. Most indoor air quality problems can be avoided if preventive practices are established. Recommendations have been provided below to assist with implementing such practices. These recommendations are non-mandatory, unless applicable FAA orders or other policy documents (e.g., memorandum of agreements) address these issues.

(1) Heating, Ventilating, and Air-Conditioning System Operation and Maintenance.

(a) Equipment operating schedules should be maintained to ensure timing of occupied and unoccupied cycles is compatible with actual occupied periods, unless operating schedules must be maintained regardless of space occupancy. The ASHRAE Standard 62-Latest Version, "Ventilation of Acceptable Indoor Air Quality" guidelines providing guidance on lead and lag times for HVAC equipment operation should be observed, where feasible. In hot, humid conditions, ventilation may be needed during long unoccupied periods to prevent mold growth.

(b) The HVAC system should be operated to maintain appropriate pressure relationships between building usage areas. Recirculation of air from areas that are strong sources of contaminants (e.g., designated smoking areas, chemical storage, loading docks) should be avoided.

(c) The HVAC system supply and return air grilles should be located to ensure adequate air distribution throughout the work area/space. These components should be properly spaced to ensure thorough mixing of conditioned air within the area.

(d) Outside air should be introduced into the building in accordance with the recommendations of ASHRAE 62-Latest Version, whenever feasible. It is recognized that some existing HVAC systems will not be able to meet this requirement. Care must be taken to avoid increasing outside air volume beyond the capacity of the HVAC equipment to properly condition the air.

(e) The HVAC system should be inspected and serviced as necessary to ensure proper operation. Records of inspection, service, and maintenance should be maintained accordingly. Inspections may include:

1 Outdoor air intake opening.

2 Damper controls.

3 Air filters.

4 Condensate drip pans and drains.

5 Cooling and heating coils.

6 Fan belts.

7 Humidification equipment and controls.

8 Distribution systems.

9 Exhaust fans.

10 Control systems.

(f) The HVAC filters should be serviced and maintained as necessary to ensure proper operation.

1 Filters should be kept in a dry condition to avoid growth of microbial agents.

2 Collapsed filters should be replaced immediately.

3 Filters should be changed, as required, to maintain the intended volume of airflow.

4 Filter efficiency should be selected in accordance with ASHRAE recommendations consistent with HVAC system capabilities.

(g) The HVAC system should be rebalanced whenever the configuration of the system or the area being served is changed.

(2) Moisture Control.

(a) Water leaks (e.g., plumbing, roof) should be repaired, as soon as possible, to prevent conditions that support growth of microbial agents.

(b) Building materials that become soaked with water, as a result of flooding or leaks, should be quickly dried or removed and replaced to prevent conditions that support microbial growth.

(c) Relative humidity shall be maintained for occupant comfort, equipment and system requirements and to limit the formation of conditions favorable to microbial growth.

(d) Controls should be implemented to limit the formation of condensation on building surfaces that could lead to microbial growth (e.g., reduce humidity to prevent condensation from forming on room-side surface of cold exterior wall during winter months).

(3) Housekeeping and Maintenance.

(a) Provide a routine cleaning schedule that includes regular trash pick-up, storage, and cleaning of all surfaces.

(b) Cleaning supplies and chemical products shall be stored in an approved designated room or cabinet.

(c) When smoking is permitted inside the building, designated smoking areas should be provided with separate ventilation that exhausts air directly out of the building.

(d) Housekeeping and maintenance activities which produce strong or objectionable odors should be avoided, whenever feasible. Alternative products or procedures should be used to reduce odor problems. It may be necessary to operate the ventilation system in a different mode (i.e., exhaust only), or use auxiliary exhaust ventilation to control odors and ventilate the building.

(e) Before a housekeeping or maintenance project begins, building occupants should be advised of the following:

1 Activities that may produce unusual odors and/or dust,

2 Methods used to control excessive odors and/or dust, and

3 Anticipated duration of the activity.

(4) Construction and Renovation.

(a) Construction and renovation activities should be assessed for impact on indoor air quality prior to implementation.

(b) Building occupants should be advised of the following related to construction and renovation projects:

1 Methods to control excessive odors and/or dust, and

2 Anticipated duration of the project.

(c) When siting new facilities, a number of factors should be considered:

1 Location and type of nearby structures.

2 Proximity to potential off-site sources of air contaminants.

3 Prevailing wind direction.

4 Future use of adjacent space.

5 Presence of sub-surface contaminants that may migrate into the building.

(d) New building design should consider:

1 Location of HVAC intakes.

2 Exhaust locations to prevent cross contamination of intakes.

3 Air filtration and treatment requirements.

4 Humidity control.

5 Chemical usage and storage requirements.

6 Air pressure differentials to isolate areas with emissions from other occupied areas.

7 The need for drain trap primers in areas having the potential to dry out, allowing sewer gas to enter the building.

(e) Building products and finishes should be specified and selected which eliminate or reduces the release of contaminants into building air. Product Material Safety Data Sheets (MSDS) should be reviewed prior to their selection.

(f) Construction activities which produce strong or objectionable odors should be avoided, whenever feasible. Alternative products or procedures should be used to reduce odor problems. It may be necessary to operate the HVAC system in a different mode, i.e. exhaust only, or use auxiliary exhaust ventilation to control odors and ventilate the building.

(g) Physical barriers should be installed, when appropriate, to prevent the spread of objectionable dusts and/or odors (e.g., floor to ceiling plastic sheeting across hallways or openings leading to construction area).

(h) The impact of temporarily shutting down HVAC systems to accommodate construction activities should be determined in advance with alternative ventilation provided, where necessary.

(i) Time should be built into the construction work schedule to allow for volatile compounds in new finishes or products, i.e. paint, adhesives and carpeting, to escape or exhaust from the building. Operating HVAC systems in the exhaust only mode during this time may increase the odor removal process.

(j) Air monitoring may be considered to verify that work practices are being performed as designed.

b. Baseline IAQ Investigation. When concerns of poor indoor air quality are initially voiced, actions shall be taken by responsible parties described below to begin the process of investigation and resolution. This section describes the primary components of a baseline, or initial IAQ investigation. The initial investigation will assess the risk factors frequently associated with poor indoor air quality and identify possible corrective actions.

(1) Initial Contact.

(a) Occupant concerns shall be collected by the System Support Center Manager (SSCM)/First Line Supervisor or Facility Manager. This individual shall notify the EPS / designated equivalent that a potential indoor air quality problem exists in the building.

(b) The EPS / designated equivalent should immediately notify the Regional Office and/or AGL-471C, Operations Branch, Program Management Section, Environmental Safety Group. If the EPS / designated equivalent or facility manager needs additional resources to conduct the investigation, a person proficient in IAQ surveys shall be contacted to respond and address the concern(s). This person will be referred to as the qualified person.

(c) A standardized IAQ questionnaire, as provided in Appendix 2, Figure 1, "Indoor Air Quality Questionnaire (Non Mandatory)," may be distributed to the building occupants who filed the initial complaint. The questionnaire may also be administered to employees who work in the same area where the complaint originated, or anyone outside the affected area to determine the extent of the problem. The SSCM / First Line Supervisor and/or bargaining unit representative should be provided a copy of the questionnaire, if utilized, before it is distributed to the employee(s) for review. It may be useful to have this information gathered prior to a site visit by the qualified person(s).

(d) The Facility Manager shall ensure bargaining unit representatives are notified.

(2) Investigation. The EPS / designated equivalent or qualified person, in coordination with AF management, will determine the investigation protocol appropriate for the situation at hand. The investigation will normally progress in logical steps that include the review of background information, a building evaluation, and a review of the HVAC system. These steps may be followed by initial testing of certain air quality parameters.

(a) Background Information.

1 Background information should include floor plans, MSDSs, building specifications, construction documents, a description of activities occurring in the building, hours of operation, ongoing maintenance/construction activities, and a description of any changes to the building or occupant activities.

2 If IAQ questionnaires are completed by the building occupants, they should be provided to those conducting the investigation who may use the information to identify potential sources of the problem. The questionnaire may be used to:

(aa) Evaluate the severity and frequency of symptoms, and any common symptoms between different building occupants.

(bb) Determine if the affected employee(s) had/has a history of smoking, medical problems, and identify hobbies and/or craft activities they perform.

(b) Building Evaluation. The EPS / designated equivalent and/or qualified person(s) will perform a walk-through survey of the workspace to evaluate the different building systems, workspace conditions, and potential sources of contaminants. Basements, crawl spaces, attics, and areas outside of the building may also be examined. The investigator(s) will usually rely on their senses rather than make environmental measurements during this part of the effort. Questions may be asked of occupants and persons knowledgeable in the history and operation of the building. The proper chain of communication with bargaining

unit members will be followed before interviews are conducted. A walk-through will often include an evaluation of:

1 Changes in facility from its original design and function.

2 Building materials.

3 Signs of moisture in work area(s) or mechanical equipment.

4 Damage to building material or equipment.

5 Insulation material.

6 Mold build-up.

7 Ongoing or recent construction.

8 Number of employees working in the area.

9 Office equipment compared to work station.

10 Ability of employees to control thermostats.

11 Sources of chemical contaminants.

12 Sources of biological contaminants.

(c) HVAC System Evaluation. The EPS / designated equivalent and/or qualified person(s) should seek to understand the design and function of the building HVAC system because of its importance in maintaining desirable indoor air quality. The investigator(s) may wish to:

1 Determine the type of HVAC system {e.g., variable air volume (VAV), constant flow}.

2 Check the maintenance and calibration logs.

3 Note any changes to the system (additions to, removal of, or replacement of any equipment).

4 Determine if the system's performance is adequate for the current building use.

5 Determine if the location of the building air intake(s) and exhaust(s) on the outside of the building are appropriate.

6 Determine if the supply and return air grilles serving the work area provide adequate air mixing.

7 Determine condition of filters, cooling coils, condensate pans, and humidification equipment.

8 Determine proper function of supply and exhaust fans, control dampers.

9 Identify control zones.

10 Examine cooling towers.

(3) Initial Air Quality Testing.

(a) Following an evaluation of background information, building layout, and the HVAC system, the qualified person(s) may elect to make a variety of air measurements. Measurements may aid in the evaluation of potential sources of contaminants and the performance of the HVAC system.

(b) Air quality parameters tested usually include:

1 Temperature.

2 Humidity.

3 Air flow and mixing.

4 Carbon monoxide (CO).

5 Carbon dioxide (CO_2).

6 In some cases VOCs, compounds of specific concern, or microbial agents may also be included based on initial observations.

7 Hydrogen Sulfide (from floor drains).

c. Advanced IAQ Investigation.

(1) Based on initial findings, it may be necessary to conduct further investigation in order to determine an IAQ problem source, severity, or solution. There are several reasons why further investigation may be appropriate, including:

(a) Initially proposed solutions did not resolve the problems.

(b) Additional detail about contaminants is required.

(c) An evaluation over an extended period of time is necessary to observe all potential problems.

(2) A decision to conduct an additional investigation will normally be based on a recommendation by the qualified person(s), or on a desire to improve confidence in the initial findings. The advanced IAQ investigation shall also be performed by a qualified person(s); if additional medical-related information is needed, involvement from the Regional Flight Surgeon, Aerospace Medicine Division, AGL-300, may be required. Further investigation requirements are dependent on the facts at hand, and may include:

(a) Measurement of specific air contaminants or other stressors.

(b) Detailed evaluations of HVAC systems.

(c) Recommendation for medical evaluations.

(3) Examples of situations where further investigation is appropriate include:

(a) High concentrations of VOCs were found, but the specific source is unknown.

(b) Exhaust air is suspected of entering the supply openings.

d. Data Reliability. Standard procedures for analysis of indoor air contaminants often do not exist. Many analytical methods are by necessity adaptations of methods established for other purposes. Wherever possible, standardized procedures should be followed by the qualified person(s) to improve data reliability, as follows:

(1) Air samples shall be collected in accordance with approved National Institute for Occupational Safety and Health analytical methods, when appropriate.

(2) Air sampling equipment shall be pre-and post-calibrated.

(3) The analytical testing laboratory shall be accredited according to the contaminant(s) that require testing.

(4) Collection of air samples by other methods shall be performed in accordance with professional guidelines or accepted practice.

e. Environmental Stressors. It should be recognized that a variety of environmental stressorscould cause many of the generalized symptoms and discomforts often associated with poor IAQ. The presence of environmental stressors should be considered in the initial IAQ investigation and noted where appropriate.

f. Evaluation, Reporting and Control Methods.

(1) Evaluation of collected data. The data collected during the investigation shall be evaluated by the qualified person(s), and appropriate facility management.

(a) Factors that must be considered in the interpretation of any data include:

1 The variability in human response from exposure to contaminants (e.g. hypersensitivity).

2 Symptoms described by occupants may be similar to those of other health problems.

3 Effects of exposure to low concentrations.

4 Effects of exposures and environmental stresses from activities that are not work related.

5 The effectiveness of the HVAC system to operate as design.

6 The reliability of data collected during background evaluations.

(b) If air monitoring is performed in the course of the investigation, results should be compared to available published occupational exposure standards and guidelines, and public health guidelines

for the specific pollutants. Reports by the qualified person(s) shall clearly state the source and applicability of referenced values. A summary of some common standards and guidelines is provided in Appendix 3.

(2) Control Methods. Control methods are means of resolving employees' comfort or health effects due to exposure to chemicals or environmental stresses in the workplace. There are various control methods available, and it is the responsibility of the qualified person(s) to recommend the most appropriate method. Some controls require engineering evaluation and design to ensure effective, practical and affordable solutions. Common control approaches include source control, ventilation, air cleaning, and exposure control.

(a) Source control is generally the most cost-effective approach to mitigating IAQ problems in which point sources of contaminants can be identified. Examples of source control include:

1 Removal or reduction of the source from the building or work area.

2 Isolation of the source.

3 Modification of the environment (e.g., creating conditions which preclude growth of mold).

(b) Ventilation is commonly used and is effective where buildings are under ventilated or where a specific contaminant source cannot be identified. Ventilation can be used to control indoor air by:

1 Dilution with outdoor air.

2 Controlling air pressure relationships.

(c) Air cleaning is usually most effective when used in conjunction with either source control or ventilation; however, it may be the only approach when the source of concern is located outside of the building. Once installed, the equipment requires regular maintenance in order to ensure good performance. Three technologies are commonly employed:

1 Particulate filtration is readily available in a range of efficiencies. The performance of filters is determined according to standard techniques. Most ventilation systems include particulate filters of some type and design.

2 Electrostatic precipitation uses the attraction of charged particles to oppositely charged surfaces to collect airborne particulates. Particles are charged by ionizing the air with an electric field. Charged particles are then collected on oppositely charged surfaces that can be removed for cleaning. Electrostatic precipitators produce some ozone and care must be exercised to avoid creating problems.

3 Gas sorption is used to control compounds that behave as gases rather than as particles. Building air is passed through special sorption materials (e.g., charcoal) to remove the contaminant of concern. Each type of sorption material performs differently with different gases. Some substances cannot be removed by sorption. Unlike particulate air filters, no standard methods for rating performance or useful life exist. Design requirements are difficult to determine. Operating costs can be high.

(d) Exposure control is an administrative means of adjusting working conditions. Methods include:

1 Scheduling contaminant-producing activities to avoid exposure. This is an effective, common sense approach that is not always available to facilities that are operated around the clock.

2 Relocating susceptible individuals permanently or during periods of potential exposure. This option is undesirable and should be used only when all other strategies are ineffective. People vary significantly in their response to air pollutants. It is not always possible to reduce pollutant levels to the point where all people will be protected or feel comfort completely all of the time.

g. Emergencies.

(1) Most IAQ concerns can be safely resolved on a non-emergency basis. On rare occasions, emergency response to indoor air quality conditions is necessary. In these situations, a number of variables need to be carefully evaluated to adequately assess the IAQ concern. The Facility Manager shall ensure that adequate resources are available to evaluate IAQ emergencies. Resources available to facility managers in evaluating possible emergencies include:

(a) Safety and health professionals within local and regional offices.

(b) Local emergency service providers.

(c) Contracted safety and health service providers.

(2) Local emergency service providers, such as fire and police departments, are usually very skilled at managing situations where lives and property are in immediate danger. These same agencies, however, have limitations with IAQ matters; therefore become familiar with their response capabilities and procedures before emergencies occur.

h. Recordkeeping. Information that documents the IAQ investigation procedures and results shall be maintained by the facility manager. All documents shall be kept on file at a designated facility. Copies may be kept at the facility where the initial investigation was conducted.

(1) The Facility Manager shall develop a policy to permit employees to report concerns on an anonymous basis without any fear of reprisal and a means to maintain and conceal confidential and sensitive health information.

(2) Copies of IAQ reports shall be provided to bargaining unit representatives.

(3) Records shall be kept to document the following:

(a) The IAQ investigation location,

(b) Employees involved, i.e., filed complaints,

(c) Building supervisors,

(d) Personnel performing the investigation,

(e) The problems identified,

(f) Air monitoring measurement methods and calibration records, if applicable.

(g) Air monitoring results and field notes, if applicable.

(h) Follow up procedures.

2-6. REFERENCES. The following references have been identified as resources related to this Chapter.

a. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. ASHRAE 62-Latest Edition, "Ventilation or Acceptable Indoor Air Quality." ASHRAE Headquarters, 1791 Tullie Circle, NE, Atlanta, GA 30329. (404) 636-8400. Web Site: www.ashrae.org

b. United States Environmental Protection Agency, Indoor Air Division. 1200 Pennsylvania Ave. NW. Mail Code 6609J, Washington, D.C. 202-564-9370. Web site: www.epa.gov/iaq

CHAPTER 3. PERMIT-REQUIRED CONFINED SPACE ENTRY

3-1. INTRODUCTION.

a. Purpose. The purpose of this Chapter is to specify the requirements for FAA employees and contractors who may:

(1) Be a member of a permit-required confined space (PRCS) entry team, or

(2) Work in permit-required confined spaces, or

(3) Otherwise have assigned responsibilities under the provisions of this Chapter.

b. Background. Confined spaces such as tanks, vessels, silos, storage bins, hoppers, vaults, cooling towers, manholes, and pits may contain serious safety and health hazards that are capable of causing bodily injury, illness, and even death to employees who enter the space. The hazards that may be encountered in confined spaces include, but are not limited to, atmospheric hazards such as flammable, oxygen deficient, or toxic atmospheres, and/or non-atmospheric hazards such as engulfment, mechanical, or electrical hazards.

c. Standard. The OSHA standard, 29 CFR 1910.146, "Permit-Required Confined Spaces," governs entry into such spaces. In this standard, OSHA has defined a confined space as a space which is large enough and so configured that an employee can bodily enter and perform assigned work; has limited means for entry and/or exit; and is not designed for continuous employee occupancy. A confined space is designated a PRCS if it exhibits one or more of the following:

(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 that might cause an entrant to be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section, or

(4) Contains any other recognized serious safety or health hazard.

d. Scope. This Chapter applies primarily to PRCSs. Those areas classified as confined spaces should follow the guidelines outlined in the FAA, AF, "Implementation Guidance for the Confined Space Program." For a definition of terms in this Chapter, refer to Section 3-3. "DEFINITIONS."

e. Objective. It is the objective of Great Lakes Region, AF Division, that any operation requiring entry of AF employees or contractors into a PRCS will be performed safely and in accordance with the requirements of this Chapter. Furthermore, whenever possible, AF Division employees should be prevented from entering a PRCS. Entry should be avoided by eliminating the need to enter the space to perform the work (e.g., by performing interior tank cleaning outside, rather than inside the tank). However, when entry cannot be avoided and when it is not feasible or practical to utilize trained contractors, AF Division employees may enter a PRCS in accordance with the provisions of this Chapter.

3-2. RESPONSIBILITIES. General responsibilities for the OSH Program are found in Chapter 1, Paragraph 1-9. Specific responsibilities related to PRCS Entry are listed below:

a. Airway Facilities Division, System Management Office (SMO) Manager shall:

(1) Serve as the confined space program manager.

(2) Ensure that confined space requirements are identified and incorporated as early as possible into all design specifications, projects and programs.

b. Airway Facilities Division, System Support Center Manager (SSCM) / First Line Supervisor shall:

(1) Assist with the identification of confined spaces and ensure applicable employees are informed of the location and policies of such spaces in their work area.

(2) Ensure the entry supervisor(s), entrant(s) and attendant(s) have received the required training, equipment, and reviewed specific guidelines for safe entry/exit and emergency procedures prior to entering a PRCS.

(3) Ensure non-permit spaces are reevaluated when there are changes in their use or configuration that may present a hazard to entrants.

c. Airway Facilities Division, SMO Environmental Protection Specialist (EPS) / (or designated equivalent) shall:

(1) Ensure all confined spaces are identified using the criteria listed in 3-1. c. to determine if the spaces are PRCSs.

(2) Ensure an accurate inventory is maintained for all confined spaces.

(3) Ensure all confined spaces are reviewed on an annual basis or if conditions change to determine whether they require reclassification.

(4) Ensure applicable employees are informed of all confined spaces through appropriate signage or by other equally effective means.

(5) Authorize/issue a PRCS entry permit or designate a representative who is authorized to issue an entry permit when the EPS or designated equivalent is unavailable.

(6) Develop and implement safe entry practices and procedures that are used to maintain the PRCS safe for occupancy (e.g., supply continuous forced air ventilation to control any hazardous atmosphere, appropriate PPE, and other equipment necessary for safe entry, such as communications, lighting, ladders, lifting rigging, etc.).

(7) Ensure appropriate records are maintained relevant to the PRCS Entry operation(s).

(8) Develop and implement atmospheric testing procedures that are used to confirm acceptable entry conditions.

(9) Assist the Entry Supervisor with the selection of PPE.

d. Entry Supervisor shall:

(1) Obtain and complete the PRCS Entry Permit, as provided in Appendix 2, Figure 2, "Permit Required Confined Space Entry Permit," or equivalent and submit the permit to the EPS or designated equivalent for authorization. After the Entry Permit has been approved and signed, post the permit at the entrance to the PRCS prior to entry.

(2) Know the hazards that may be encountered during entry into a PRCS, including information on the routes, signs or symptoms, and consequences of exposure to hazardous materials.

(3) Ensure PPE is available, appropriate for the PRCS and ready for use.

(4) Ensure all PRCS permit requirements are satisfied.

(5) Ensure atmospheric testing is conducted to confirm acceptable entry conditions. Continuous monitoring requirements will be at the discretion of a qualified person when issuing the PRCS permit.

(6) Prevent unauthorized personnel from entering the PRCS during entry operations.

(7) Coordinate entry operations when employees from more than one employer will be working in or around the PRCS.

(8) Determine entry operations remain consistent and within the terms of the permit, especially whenever responsibilities are transferred at the PRCS.

(9) Summon the rescue service in the event they are not already on site and ensure the means for contacting such service is available and operating.

(10) Cancel the permit once the entry operations have been completed, or prohibited conditions develop.

(11) Advise the EPS or designated equivalent and SSCM/first line supervisor of conditions that developed which terminated a project.

e. Attendant shall:

(1) Verify the permit has been signed to authorize entry and posted at the entrance to the PRCS.

(2) Know the potential hazards that may be encountered in a PRCS, including information on the route, signs or symptoms, and consequences of exposure to hazardous materials.

(3) Maintain a count of all authorized entrants who have entered the PRCS. Verify the entrants listed on the permit are the same personnel who have entered the PRCS.

(4) Remain outside the PRCS entrance during entry operations until relieved by another authorized attendant.

(5) Maintain constant communication with entrants to monitor their condition.

(6) Continually monitor activities and conditions inside and outside the PRCS to determine if conditions remain safe for entrants to continue working in the PRCS.

(7) Prevent unauthorized entry into the PRCS by keeping unauthorized personnel away from the PRCS entrance, advising unauthorized personnel to exit the PRCS, and informing the entrants and entry supervisor if an unauthorized entry was observed.

(8) If multiple PRCSs are to be monitored simultaneously by a single attendant, identify the means and procedures required to respond to an emergency effecting one or more of the PRCSs being monitored without detracting from the assigned responsibilities for the unaffected PRCS(s).

(9) Order an evacuation of the PRCS, if prohibited conditions develop, entrant behavioral effects are recognized, communications fail, dangerous conditions develop outside the PRCS which can endanger the entrants, the attendant can not perform his/her duties or rescue services are unable to respond in the event of an emergency.

(10) Summon rescue and other emergency services, if necessary.

(11) Perform non-entry rescue in the event of an emergency.

(12) Perform no work that will interfere with their responsibilities.

(13) Remain outside the PRCS during an emergency unless properly trained and equipped to perform emergency rescue and the appropriate authorities have been notified before entering the PRCS.

f. Authorized Entrants shall:

(1) Verify that the permit has been signed to authorize entry and posted at the entrance to the PRCS.

(2) Enter the PRCS only when the attendant is present.

(3) Know the hazards that may be encountered in the PRCS, including information on the route, signs or symptoms, and consequences of exposure to hazardous materials.

(4) Receive training on the equipment used to perform PRCS tasks.

(5) Ensure appropriate safety and PPE is properly worn and in good working order.

(6) Remain in constant communication with the attendant.

(7) Inform the attendant when signs of exposure are recognized or prohibited conditions develop.

(8) Exit the PRCS whenever ordered to by the attendant or entry supervisor; the entrant recognizes a hazardous condition or signs of exposure; communications fail; or an alarm to warn of a hazardous condition is activated.

g. Employees shall:

(1) Contact their SSCM/first line supervisor if entry into a PRCS is required or they notice

unsafe conditions within or around a PRCS.

(2) Refrain from entering any PRCS unless they have received proper training, appropriate equipment, specific guidelines for safe entry/exit and emergency procedures and notified the appropriate authorities of their intent to perform a PRCS rescue.

(3) Perform their assigned duties as attendants, authorized entrants, or entry supervisors in accordance with the guidelines outlined within this Chapter.

(4) Work safely around a PRCS to ensure their activities outside the PRCS do not jeopardize entry operations.

(5) Follow FAA PRCS entry procedures before entering a non-FAA PRCS.

3-3. DEFINITIONS.

a. Attendant. An individual stationed outside one or more PRCSs who monitors authorized entrants and performs all assigned attendant duties.

b. Authorized Entrant. An employee who is authorized by the employer to enter a PRCS.

c. Confined Space. A space which:

(1) Is large enough and so configured that an employee can bodily enter and perform assigned work,

(2) Has limited means for entry and/or exit; and

(3) Is not designed for continuous employee occupancy.

d. Engulfment. The surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance.

e. Entrant. A trained individual; who is authorized to enter the space and perform duties and assigned tasks as outlined by this PRCS Entry program.

f. Entry. The action by which a person passes through an opening into a PRCS. Entry includes the ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.

g. Entry Supervisor. Person responsible for authorizing and overseeing the PRCS entry operation, determining if acceptable entry conditions are present prior to entering a PRCS, and terminating the entry at the conclusion of the operation or if unacceptable conditions occur. This may or may not be a management level position.

h. Hazardous Atmosphere. An atmosphere that may expose employees to risk of death, incapacitation, impairment of ability to self-rescue (that is, escape unaided from a permit space), injury, or acute illness due to one or more of the following conditions:

(1) Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL).

(2) Airborne combustible dust concentrations that meet or exceed its LFL.

(3) Oxygen concentrations below 19.5 percent or above 23.5 percent.

(4) Concentrations of any substance for which an exposure limit is published in the OSHA General Industry Standard, 29 CFR 1910, Subpart G, "Occupational Health and Environmental Control," or Subpart Z, "Toxic and Hazardous Substances," and which could result in employee exposure in excess of an exposure limit.

NOTE: An atmospheric concentration of any substance that is not capable of causing death, incapacitation, impairment, ability to self-rescue, injury, or acute illness due to its health effect is not covered by this provision.

(5) Any other condition that is Immediately Dangerous to Life or Health (IDLH).

i. Hotwork. Any work that may generate a spark or other source of ignition including but not limited to burning, welding, riveting, drilling, abrasive blasting, and space heating.

j. Immediately Dangerous to Life or Health. A condition that poses an immediate or delayed threat to life, may cause irreversible adverse health effects, or would interfere with the exposed individuals ability to escape unaided.

k. Inerting. Displacement of an atmosphere with a non-reactive gas such as nitrogen, argon, helium, etc., so that the resulting atmosphere is non-combustible. "Inerting" usually results in oxygen deficient atmospheres.

l. Isolation. The separation of a confined space by protecting against the release of energy and materials that could pose a threat to occupants of the confined space. Isolation may be accomplished by such means as blanking or blinding; blocking or disconnection of all mechanical linkages; misaligning or removing lines, pipes, or ducts; double block and bleed system; or lockout/tagout of all sources of energy.

m. Lower Flammable Limit. The Lower Flammable Limit is the lowest concentration of a substance in air that will produce a flash or fire when an ignition source is present. It is expressed as a percent of vapor or gas in the air by volume.

n. Non-Permit Confined Space. A confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.

o. Oxygen Deficient Atmosphere. An atmosphere containing less than 19.5 percent oxygen by volume.

p. Oxygen Enriched Atmosphere. An atmosphere containing more than 23.5 percent oxygen by volume.

q. Permissible Exposure Limit. The Permissible Exposure Limit is the allowable air contaminant level established by the United States Department of Labor, Occupational Safety and Health Administration.

r. Permit-Required Confined Space. A confined space that has one or more of the following conditions:

(1) Contains or has a potential to contain a hazardous atmosphere, or

(2) Contains a material that has the potential for engulfment of an entrant, or

(3) Has an internal configuration such that an entrant could be trapped or asphyxiated due to inwardly converging walls or a floor that slopes downward and tapers to a smaller cross section, or

(4) Contains any other recognized serious safety or health hazard.

s. Permit System. A written procedure for preparing and issuing permits for entry and for returning the PRCS to service following termination of entry.

t. Prohibited Condition. Any condition in a PRCS that is not allowed by the permit during the period when entry is authorized.

u. Purging. The process by which gases, vapors, and/or particulates are removed from a PRCS by ventilating the space.

v. Qualified Person. An individual (by education and/or specialized training) who is capable of anticipating, recognizing, and evaluating employee's exposure to a hazardous atmosphere in a PRCS. This person will be capable of specifying the necessary controls and PPE to ensure worker safety. The EPS or designated equivalent, entry supervisor or attendant may be considered a qualified person if they meet the qualifications listed in the 1st sentence.

w. Retrieval System. Equipment such as a retrieval line, chest or full body harness, wristlets (if appropriate) and a lifting device or anchor used for non-entry rescue of persons from PRCSs.

3-4. GENERAL REQUIREMENTS.

a. Confined Space Inventory. A qualified person should evaluate all FAA workplaces to identify all confined spaces. Identified confined spaces shall then be reviewed to determine if they meet the requirements for a PRCS. The OSHA "Permit-Required Confined Space Decision Flow Chart," located in Appendix 4, can be used as an evaluation tool. The EPS or designated equivalent shall maintain an inventory of all confined spaces including non-FAA confined spaces where AF employees need entry. This inventory should be reviewed and updated on an annually basis. Copies of the inventory shall be distributed by the EPS or designated equivalent to each facility containing a confined space.

b. Comprehensive Hazard Evaluation and Control. Existing and potential hazards of each PRCS shall be identified and evaluated. Procedures and practices shall be established in order for each PRCS to be safely entered.

c. PRCS Labeling and Posting. PRCSs shall be identified with appropriate signage or other equally effective methods stating their existence, hazards, entry permit requirements, and prohibition of unauthorized entry.

(1) All warning signage shall be printed in English, and in the predominant language of non-English reading workers as determined by local needs.

(2) Signage shall include, but is not be limited to that which is listed Figure 3-1.

(3) Emergency procedures shall be attached to each PRCS Entry permit. Phone numbers of fire departments and emergency medical services shall be indicated on the PRCS permit and near the telephone from which help would be summoned.

(4) Labeling and subsequent entrance into PRCSs under the control of the representative SMO shall be coordinated through the SMO in advance.

Figure 3-1.

DANGER **PERMIT-REQUIRED** **CONFINED SPACE** **ENTRY BY PERMIT ONLY** **(Optional – Phone number for point of contact, hazards of the Permit Required Confined Space)**

d. Isolation and Lockout/Tagout. All energy sources that are potentially hazardous to PRCS space entrants shall be secured, relieved, disconnected and/or restrained before personnel are permitted to enter the PRCS.

e. Permit System. Entry into a PRCS shall only be permitted after a PRCS Entry Permit has been completed and approved. The Entry Supervisor or their designated equivalent shall secure and complete this permit. An example of a PRCS Entry Permit is located in Appendix 2, Figure 2. When completing the permit, a qualified person's assistance may be necessary to identify and evaluate the PRCS hazard(s). The permit shall be submitted to the EPS or designated equivalent for review and signature authorization. Entry into a PRCS is authorized only after the EPS or designated equivalent has reviewed and signed the permit. The permit shall identify, by name, the entry supervisor(s), authorized entrant(s), and attendant(s) associated with the project, as well as any necessary PPE. If necessary, the entry supervisor may consult the EPS or designated equivalent for assistance with required PPE. All testing, monitoring, ventilating, communicating, PPE, lighting, barriers, ladders, and rescue equipment shall be properly maintained, utilized, and provided at no cost to AF employees. The permit shall be:

(1) Dated and shall carry an expiration time that is valid for a period not to exceed which is necessary to complete the task or job for which the permit was obtained,

(2) Updated for each additional shift with the same requirements,

(3) Posted in a conspicuous place at the entrance to the PRCS,

(4) Returned to the EPS or designated equivalent at termination of the project, and

(5) Kept on file for a period of at least 2 years. Canceled permits should be analyzed during the annual program evaluation.

f. Permit Space Entry Alternatives.

(1) To the extent feasible, AF employees should avoid entering PRCSs by developing alternatives that eliminate the need to enter the space. For example, entry into a PRCS tank for cleaning purposes may not be necessary if the tank can be cleaned without entering the space. If employees are prohibited from entering a PRCS, measures must be taken to prevent employees from entering such spaces. Such measures could

include permanently closing the opening, bolting or locking the opening to the space such that special tools are required to gain access to the PRCS, providing additional training, and posting warning signs.

(2) With the approval of the EPS or designated equivalent, the permit and personnel requirements (i.e., duties of entrants, attendants, and supervisors) of a PRCS can be deferred (but not training requirements) if the only hazard of the PRCS is an actual or potential atmospheric hazard and the atmospheric hazard can be maintained at a safe concentration using continuous forced air ventilation. These requirements can be deferred if:

(a) Air monitoring data is generated that demonstrates that ventilation will control the atmospheric hazard,

(b) Documentation that the atmospheric hazard can be maintained at safe levels using ventilation if provided in a written certification. The OSHA considers a guideline of less than 50 percent of the level of flammable or toxic substances that would constitute a "hazardous atmosphere" to be a safe level for the purposes of this determination. An example of a certification form is located in Appendix 2, Figure 5, "Certification of Safe Entry." Copies of the certification shall be provided to AF employees, if requested, and posted at the entrance to the PRCS,

(c) Air monitoring is performed prior to any entry to measure the oxygen, LFL, and atmospheric contaminant concentrations,

(d) Air monitoring is performed periodically during the entry operation to verify the ventilation control of atmospheric hazards, and

(e) The determinations and supporting data shall be made available to each PRCS entrant or their authorized representative, prior to entry into a PRCS.

g. Non-Permit Confined Spaces.

(1) A PRCS may be re-classified as a non-permit confined space if:

(a) The PRCS contains no actual or potential atmospheric hazards,

(b) All hazards can be eliminated (Note: If it is necessary to enter a confined space to eliminate the hazards, entry should be performed as if the space was indeed a PRCS, i.e., all controls and permits would need to be in place and followed), and

(c) The basis for determining that all hazards have been eliminated is documented in a certification that is completed by the EPS or designated equivalent. The certification must be posted or provided to employees who enter the space. An example of a certification form is located in Appendix 2, Figure 4, "Certification of Permit Space Reclassification." If a hazard in a re-classified, non-permit confined space develops, the confined space must be re-evaluated to determine the proper classification. A non-permit confined space can remain as such, as long as the hazards are eliminated. Data used to determine non-permit required confined spaces should be maintained and updated by the EPS or designated equivalent.

(2) A non-permit confined space must be re-evaluated, if the use or configuration of the space changes and may present a hazard to entrants. If a hazardous condition develops, the non-permit confined space must be re-classified as a PRCS.

h. Testing and Monitoring.

(1) A qualified person shall perform all air monitoring. All employees or their authorized representative(s) should be provided the opportunity to observe any monitoring or testing of PRCSs . Entry into a PRCS is prohibited until initial testing of the atmosphere has been completed and acceptable entry conditions are present. The tests to be performed include measuring, 1) the percent oxygen, 2) the LFL, and 3) toxic material concentrations (in this order). PRCS air monitoring shall be performed using pre-calibrated direct reading instruments. Instruments should be maintained and calibrated in accordance with the manufacturer's recommendations. The qualified person will determine the duration of air monitoring during the entry operation. When determining the duration of monitoring, the qualified person will take into consideration the following:

(a) Size and configuration of the space,

(b) Nature of the entry operations,

(c) Atmospheric contaminant dynamics,

(d) Airborne concentrations,

(e) Hazards,

(f) Prior monitoring history, and

(g) Parameters specified in the permit by the entry supervisor.

(2) For a vertical space where stratification of heavier or lighter than air gases may occur, the qualified person must monitor throughout the space to be certain contaminant concentrations are fully characterized. Air monitoring results will be recorded on the PRCS Entry Permit. Where space on the permit is insufficient to record multiple readings, additional air monitoring results shall be recorded on a separate document. An example of such a document is located in Appendix 2, Figure 3, "Additional Air Monitoring Log." Air monitoring results should be posted at the entrance to the PRCS and provided to each entrant, if requested. During the entry operation, the PRCS will be continuously ventilated whenever there is the possibility of an explosive, toxic, or oxygen deficient/enriched atmosphere.

(3) The entrants or their authorized representatives may request that the space be re-evaluated if they believe the evaluation was not adequate.

i. Acceptable Entry Conditions.

(1) Acceptable oxygen content requirements for entry into permit spaces is between 19.5 percent and 23.5 percent. If the oxygen content in the air is less than 19.5 percent (oxygen deficient) or more than 23.5 percent (oxygen enriched), the area must be ventilated to maintain the oxygen concentration within the acceptable range. When employees must enter an oxygen deficient PRCS, a NIOSH approved respirator must be worn as determined by the qualified person(s), based on conditions, test results, and the type of work performed. Acceptable respiratory protection includes self-contained breathing apparatus (SCBA) or combination airline respirator with SCBA. Respirators will be used in accordance with 29 CFR 1910.134, "Respiratory Protection."

(2) Entry into a PRCS shall be prohibited when tests indicate the concentration of flammable gases in the atmosphere are greater than 10 percent of the LFL. It is necessary to test the oxygen level before testing for the LFL, because the accuracy of the instrument for the LFL measurement is dependent on the correct

oxygen percentage. Monitoring shall be conducted using explosion-proof (intrinsically safe) equipment having an audible alarm or danger-signaling device that will alert employees when a hazardous condition develops.

(3) Entry is prohibited in a PRCS when the atmospheric concentration of carbon monoxide (CO) exceeds 35 parts per million (ppm) or the atmospheric concentration of hydrogen sulfide (H_2S) exceeds 10 ppm. When the concentration of other contaminants in the atmosphere cannot be kept within permissible exposure limits (PELs) established in 29 CFR 1910, Subpart G, "Occupational Health and Environmental Control," and Subpart Z, "Toxic and Hazardous Substances," the employee must wear NIOSH-approved respiratory protection, as determined by the qualified person(s), based upon the conditions, test results, and type of work to be performed.

j. Hazardous Operations.

(1) A fire watch must be established as part of the entry procedure into PRCSs classified as hazardous locations by the National Electric Code, "Article 500," (e.g., spaces that contain flammable or combustible gases, vapors, liquids, or combustible dusts). Surface dust must be removed and no hot work is to be initiated until the airborne particulate concentration is below the lower explosion level for the material. A "hot work permit" or equivalent shall be obtained from the EPS or designated equivalent if operations may ignite flammable or combustible materials in the work area or cause burning odors that may drift into occupied spaces. A hot work permit means a written authorization to perform operations; for example, riveting, welding, cutting, burning, and heating capable of providing a source of ignition. When flammable gases, vapors, liquids or combustible dusts are present, all electrical wiring and equipment shall be explosion proof or dust ignition proof, as applicable, and approved as intrinsically safe for use in the hazardous location for which it is approved. Electrical equipment used in hazardous locations shall meet the appropriate requirements of Article 500.

(2) Welding, cutting or brazing operations in confined spaces require specific controls to assure acceptable entry conditions. These operations should be performed in accordance with 29 CFR 1910.252, "Welding, Cutting, and Brazing Operations." Gas cylinders and welding machines must be kept outside the confined space. To avoid accidental sparks, all welding arc electrodes must be removed from holders if welding is suspended for a substantial period of time (such as during lunch or overnight) and holders carefully located so that accidental contact cannot occur. The welding machine must also be disconnected from the power source. In addition, when gas welding or torch cutting is suspended for a substantial period of time, valves must be closed and the gas supply closed to eliminate the possibility of gas escaping into the confined space through leaks or improperly closed valves. Where practicable, torches and hoses should also be removed from the confined space. After welding/cutting operations are completed, the operator or designated equivalent shall mark the hot metal or provide some other means of warning other workers and begin a 30-minute fire watch. In addition, Material Safety Data Sheets (MSDS) shall be reviewed before welding, cutting or brazing using toxic filler rods or fluxes, substrates such as stainless steel, or coatings containing fluorides, cadmium, zinc, lead, beryllium, or mercury that may pose additional hazards.

(3) The use of flammable or toxic cleaning or degreasing compounds in a confined space may also create special hazards. In these cases, local exhaust ventilation is usually required. Ensure MSDSs pertaining to the compounds are evaluated before use.

(4) Oxygen must never be used to ventilate a confined space.

k. Training.

(1) PRCS Entry Training. Employees designated as PRCS team members (entry supervisor, attendant, or entrant) will receive, as a minimum, the following training before they are allowed to participated in a PRCS entry operation:

(a) Introduction to 29 CFR 1910.146.

(b) OSH PRCS Entry Permit.

(c) Location and identification of confined spaces and PRCSs.

(d) Hazards that may be encountered in PRCSs including, but not limited to, atmospheric hazards and non-atmospheric hazards such as engulfment, mechanical, electrical or fire hazards, etc.

(e) Methods of controlling the hazards (lockout/tagout, ventilation, purging, etc.).

(f) Familiarization with the facility PRCS permit system.

(g) Safety equipment to be used (mechanical, retrieval/fall protection systems, PPE, etc.).

(h) "Hot Work Permit" system, if applicable.

(i) Familiarization with air monitoring equipment.

(j) Roles and responsibilities of the PRCS team members.

(k) Communication procedures and proper use of communication equipment.

(l) Emergency exit and rescue procedures.

(2) Pre-entry Briefing. Members of the PRCS entry team will receive a briefing about the requirements and hazards specific to the PRCS prior to entry. The entry supervisor or designated equivalent shall conduct the briefing. The briefing should cover all the information documented on the PRCS Entry Permit including, but not limited, to the following:

(a) Specific hazards that classify the space as a PRCS.

(b) Initial air-monitoring data for flammable and atmospheric hazards and acceptable entry conditions.

(c) Methods for controlling the hazards.

(d) Equipment that will be used inside and outside the PRCS, including PPE.

(e) Roles and responsibilities of the PRCS team members.

(f) Emergency rescue procedures that will be implemented in the event of an emergency specific to this permitted operation.

(3) Awareness Training. Training will be provided for personnel who work within or around a confined space(s). This training will include, but is not limited to:

(a) Overview of OSHA's 29 CFR 1910.146.

(b) OSH PRCS Entry Permit.

(c) Location and identification of confined spaces and PRCSs.

(d) Labeling and posting.

(e) PRCS permit system.

(f) Personnel in charge of authorizing entry.

(g) Identification and roles of PRCS team members.

(h) Emergency procedures.

(4) Retraining. Retraining will be provided whenever there is a change in permit operations that presents a hazard about which an employee has not been previously trained. Retraining will also be provided whenever there is reason to believe there have been deviations from the required procedures or inadequacies in the employee's knowledge or use of the required procedures.

(5) Refresher Training. Refresher training will be provided on an annual basis to members of the PRCS entry team.

l. Rescue and Emergency Services

(1) The SMO should identify and characterize the types of emergencies that may occur within and/or around a PRCS. Examples of emergency situations that may arise include fires, injuries to personnel (lacerations, sprains, broken bones, etc), and sudden changes in physical and atmospheric conditions. AF personnel should not perform any rescue requiring emergency entry, unless they are properly trained, equipped, and have notified the proper authorities. The nature and degree of emergencies along with the availability of rescue services shall determine whether rescue personnel are stationed immediately outside the PRCS or called to respond. For entry into PRCSs containing an IDLH atmosphere, emergency rescue personnel must be present at the PRCS ready to enter immediately in the event an emergency arises. Training and availability of rescue team personnel should be determined by an initial and on-going performance evaluations as outlined in 29 CFR 1910.146, Appendix F, "Rescue Team or Rescue Service Evaluation." Data within this appendix also provides the necessary information to determine whether to train an on-site rescue team or hire an off-site emergency rescue service.

(2) In remote locations where non-entry rescue would be ineffective and off-site rescue services are not available or are available but would not provide an acceptable response time, an on-site rescue team should be trained and readily available. However, this location must:

(a) Demonstrate that off-site rescue services are not available or cannot respond in a timely manner,

(b) The confined space is classified as a PRCS, and

(c) Non-entry rescue (requires the use of equipment to retrieve a victim without anyone entering the PRCS) equipment cannot be used.

(3) Before entry operations are conducted, rescue personnel shall be notified and available at all times during entry operations. Only properly trained emergency rescue personnel shall enter the PRCS.

(4) Non-entry rescue retrieval systems shall be set up and ready for use for all PRCS entries, unless the retrieval equipment would increase the overall risk of entry and would not contribute to the rescue of the entrant. All members of the PRCS entry team and all emergency rescue personnel shall be properly trained in non-entry rescue, which includes training on the non-entry rescue retrieval equipment in use.

(a) Each authorized entrant shall use a chest or full body harness with a retrieval line attached at the center of the entrant's back near shoulder level, or above the entrant's head. Wristlets may be used in lieu of a chest or full body harness if it can be demonstrated that the use of a chest or full body harness is infeasible or creates a greater hazard and that the use of wristlets is the safest and most effective alternative.

(b) The other end of the retrieval line shall be attached to a mechanical device or fixed point outside the PRCS in such a manner that rescue can begin as soon as the rescuer becomes aware that rescue is necessary. A mechanical device shall be available to retrieve personnel from vertical type PRCSs of more than 5 feet deep.

(c) If an injured entrant is exposed to a substance for which a MSDS or other similar written information is required to be kept at the worksite, that document shall be made available to the medical personnel treating the exposed entrant.

(5) If an on-site rescue team is utilized, each member shall:

(a) Be trained to perform assigned rescue duties and receive training required of authorized entrants as outlined in 29 CFR 1910.146 (g), "Training" and (h), "Duties of Authorized Entrants."

(b) Practice making PRCS rescues at least once every 12 months by means of simulated rescues in which they remove dummies, mannequins or actual persons from on-site PRCSs or from representative PRCSs.

(c) Be trained in first aid and cardio-pulmonary resuscitation (CPR) and at least one member of the responding team must hold current first aid and CPR certification.

(d) Be provided with the necessary training, equipment, and PPE to safely conduct PRCS rescues.

(6) If an off-site rescue service will be utilized, their qualifications and availability shall be evaluated by an initial and performance evaluation following the criteria described within 29 CFR 1910.146, Appendix F. If such a service is utilized, records such as a contract or agreement letter that documents the working agreement between the FAA and the service should be maintained. This document should verify their capability of performing rescue operations as outlined in Appendix F. At a minimum, this document should include a checklist signed by a high-ranking rescue company official documenting their ability to meet all the items listed on the checklist.

m. Contractors and Subcontractors. Contractors and/or subcontractors who may perform any work in or around a FAA PRCS shall present their PRCS entry program to the FAA for review and approval **PRIOR** to initiation of PRCS entry projects. They must abide with the procedures outlined within the FAA PRCS work permit.

(1) When a contractor or subcontractor performs work that involves entry into any FAA PRCS(s), the FAA will:

(a) Advise the contractor of the hazards and AFs determination of the reason(s) the space has been classified as a PRCS.

(b) Advise contractors of any procedures or precautions they should take to protect employees in or near PRCSs where the contractor will be working.

(c) Coordinate entry operations and emergency procedures with the contractor if both FAA and contractor employees will be working in the PRCSs. Methods to facilitate coordination efforts might include communication systems, signage, assignments of liaison personnel, or contractual agreements.

(d) Require the contractor to submit the following information:

1 Overall safety program.

2 PRCS procedures.

3 List of references from their last 3 PRCS projects.

4 List of trained entrants, attendants, and entry supervisors.

5 Confined Space Entry training records.

6 Hot work procedures, if necessary.

7 Confined Space Entry safety equipment, which includes monitoring and rescue equipment.

8 Calibration records for atmospheric monitoring equipment.

9 A statement indicating they have never been cited by municipal, state or federal agencies for any confined space safety infractions.

10 Inspection and maintenance records for all equipment that requires inspection.

11 Emergency procedures that will be implemented in the event an emergency rescue is required.

(e) Debrief the contractor at the conclusion of the entry operations in a post-entry meeting regarding the PRCS procedures and any hazards in the space confronted or created during entry.

(2) When a contractor and/or subcontractor performs work around a PRCS, the FAA will:

(a) Advise the contractor(s) that the work place contains PRCSs in the area where they will be working and that PRCS entry is allowed only with approval of the FAA.

(b) Advise the contractor(s) that work in a PRCS will be occurring near their work site and provide any procedures by the PRCS contractor that my effect their working conditions.

(c) Coordinate emergency procedures with the contractor in the event an emergency occurs within the PRCS.

3-5. REFERENCES. The following references have been identified as resources related to this Chapter.

a. 29 CFR 1910.146, "Permit-Required Confined Spaces." Contact source listed in Chapter 1-10.f.

b. 29 CFR 1910.146, Appendix F, "Permit-Required Confined Spaces, Rescue Team or Rescue Service Evaluation Criteria." Contact source listed in Chapter 1-10.f.

c. 29 CFR 1910.252, "Welding, Cutting, and Brazing." Contact source listed in Chapter 1-10.f.

d. 29 CFR 1910.134, "Respiratory Protection." Contact source listed in Chapter 1-10.f.

e. 29 CFR 1910, Subpart G, "Occupational Health and Environment Control," and Subpart Z, "Toxic and Hazardous Substances." Contact source listed in Chapter 1-10. f.

f. Airway Facilities, "Confine Space Entry Implementation Guidance Program," Resources Management Program, Environmental, Energy and Safety Division (AFZ-800). Contact address listed in 1-10.a. (202) 267-8679. Web site listed in 1-10.c.

g. National Electric Code, "Article 500 - 503." National Fire Protection Association, Customer Service. 1 Batterymarch Park, P.O. Box 9101, Qunicy, MA 02269-9101. (800) 344-3555. Web Site: www.nfpa.org

h. OSHA Compliance Directive, CPL 2.100, "Application of the Permit-Required Confined Spaces." May 5, 1995. Contact source listed in Chapter 1-10.f.

APPENDIX 1. ACRONYMS

A	ACH	Air Changes per Hour
	AF	Airway Facilities
	AGL	Federal Aviation Administration - Great Lakes Region
	AFZ-800	National Airspace System, Transition and Integration Office - Environmental, Energy and Safety Division
	AHR	FAA Office of Human Resources
	ANSI	American National Standards Institute
	ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
	ASTM	American Society of Testing Materials
B		
C	CFR	Code of Federal Regulations
	CFM	Cubic Feet per Minute
	CPR	Cardio Pulmonary Resuscitation
	CO	Carbon Monoxide
	CO_2	Carbon Dioxide
D	DOT	Department of Transportation
E	EPA	Environmental Protection Agency
	EPS	Environmental Protection Specialist
F		
G		
H	HVAC	Heating, Ventilation, and Air Conditioning
	H_2S	Hydrogen Sulfide
I	IAQ	Indoor Air Quality
	IDLH	Immediately Dangerous to Life or Health
J		
K		
L	L/S	Liters per Second
	LFL	Lower Flammable Limit
	LFM	Linear feet per minute
M	MSDS	Material Safety Data Sheet
N	NIOSH	National Institute of Occupational Safety & Health
	NEC	National Electrical Code
	NFPA	National Fire Protection Association
	NAS	National Airspace System
	NO	Nitric Oxide
	NO_2	Nitrogen Dioxide

APPENDIX 1. ACRONYMS (Continued)

O	OSH	Occupational Safety and Health
	OSHA	Occupational Safety and Health Administration
	O_3	Ozone
P	PEL	Permissible Exposure Limit
	PPE	Personal Protective Equipment
	PPM	Parts Per Million
	PRCS	Permit-Required Confined Space
	(pCi/L)	Picocurries per liter of air
Q		
R	ROSHM	Regional Occupational Safety and Health Manager
	RPMES	Regional Program Manager for Environment and Safety
S	SCBA	Self Contained Breathing Apparatus
	SMO	System Management Office
	SSCM	System Support Center Manager
T	TWA	Time Weighted Average
	TVOC	Total Volatile Organic Compound
U	US	United States
	(ug/m^3)	Micrograms per cubic meter of air
V	VAV	Variable Air Volume
	VOC	Volatile Organic Compounds
W		
X		
Y		
Z		

APPENDIX 2. FORMS

FIGURE 1. INDOOR AIR QUALITY QUESTIONNAIRE, GL FORM 3900-8 (Non-Mandatory)

Please fill out the following questionnaire. Upon completion, please return the Questionnaire to your System Support Center Manager/First-Line Supervisor. Thank you for your cooperation.

GENERAL INFORMATION

Name (optional): _____ Date: _____

Facility Name: _____

Work Location: _____

How long at this work location: _____

Job Description: _____

1. Do you have any of the following complaints related with the facility?

☐ Aching Joints	☐ Dizziness	☐ Nausea
☐ Sinus Congestion	☐ Sneezing	☐ Problems wearing contact lens
☐ Fatigue/drowsiness	☐ Temperature too hot	☐ Temperature too cold
☐ Skin irritation/itching	☐ Dust or smoke	☐ Noticeable odors (see below)
☐ Eye Irritation	☐ Other: _____	

2. Noticeable odors? If yes, how would you describe their smell?

☐ Alcohol	☐ Propane	☐ Dusty	☐ Greasy
☐ Ammonia	☐ Gasoline	☐ Smoky	☐ Oily
☐ Glue	☐ Rotten eggs	☐ Musty	☐ Fruity
☐ Vinegar	☐ Stale	☐ Fragrant	☐ Rancid
☐ Fishy	☐ Other: _____		

3. In your opinion, where is/are the odor(s) coming from? How long do this odor(s) last?

4. Are these complaints limited to a specific area or task? ☐ Yes ☐ No

   If yes, please describe: _____

FIGURE 1. INDOOR AIR QUALITY QUESTIONNAIRE (Non-Mandatory)

GL FORM 3900-8 (Continued)

5. When do these complaints occur?
   - ☐ Morning ☐ Afternoon ☐ All day
   - ☐ Before work ☐ After work ☐ No noticeable trend
   - ☐ Specific day(s) of the week: _____
   - ☐ Specific months(s) or year(s): _____
6. How long have you had these complaints? _____
7. Have you seen a physician due to these complaints? ☐ Yes ☐ No

   Comments: _____
8. When do you experience relief from these complaints?
   - ☐ Immediately after leaving the area or completing the task
   - ☐ Immediately after leaving the building
   - ☐ Later that evening
   - ☐ Only after a day off or over the weekend
   - ☐ No noticeable trend
9. Do you feel that your complaints have been properly addressed? ☐ Yes ☐ No

   Comments: _____

   _____
10. Do you have any of the following?
    - ☐ Hay fever or pollen allergies ☐ Skin allergies or dermatitis ☐ Sinus problems
    - ☐ Other allergies ☐ Cold/flu ☐ Contact Lens
    - ☐ Other chronic health problems: _____

    How long have you had these conditions? _____

BACKGROUND INFORMATION

1. What is your primary job task? _____
2. Describe your workstation:
   - ☐ Open area shared by others ☐ Closed office ☐ Own cubical
   - ☐ Other (specify): _____

   _____
3. What is the geographic location of your work area within the building?
   - ☐ East Side ☐ Northeast corner
   - ☐ West Side ☐ Northwest corner

FIGURE 1. INDOOR AIR QUALITY QUESTIONNAIRE (Non-Mandatory)

GL FORM 3900-8 (Continued)

☐ North Side ☐ Southeast corner

☐ South Side ☐ Southwest corner

4. Is there adequate space at your workstation? ☐ Yes ☐ No
5. Is there adequate privacy at your workstation? ☐ Yes ☐ No
6. Is/are there window(s) at your workstation? ☐ Yes ☐ No

   Can the window(s) be opened? ☐ Yes ☐ No
7. Can you or others in the area control the temperature of your work area? ☐ Yes ☐ No
8. Are there photocopiers or printers within or adjacent to your work area? ☐ Yes ☐ No
9. Do you smoke tobacco? ☐ Yes ☐ No
10. Do you work at a Video Display Terminal? ☐ Yes ☐ No

    If yes, estimate how many hours per shift: Hours: _____

GENERAL COMMENTS

_____

_____

_____

_____

_____

_____

_____

APPENDIX 2. FORMS

FIGURE 2. PERMIT-REQUIRED CONFINED SPACE (PRCS) ENTRY PERMIT, GL FORM 3900-9
(POST IN PROMINENT LOCATION NEAR PRCS)

This permit is valid only for the stated purpose, time, and personnel identified. This permit will expire after completion of the task requiring entry into the PRCS.

Today's Date: _____
Location of Entry: _____ **Purpose of Entry:** _____
Entry Date: _____ **Entry Time:** _____ **Entry Supervisor:** _____

Description of Work: _____
_____

Permit Expiration: Date: ____ Time: ____ **Re-Authorization to Entry:** Time: ____ Date: ____
Permit Termination: Date: ____ Time: ____ **Attendant:** _____

Authorized Entrants
Name: _____ ☐ Name: _____ ☐
Name: _____ ☐ Name: _____ ☐
NOTE: Authorized Entrants should initial the box next to their name that certifies they have read this permit, fully understand it, and personally have checked the rescue and personal protective equipment and lockout/tagout devices required for entry into this PRCS.

Have all personnel gone through pre-entry briefing? ☐ Yes ☐ No
If no, explain: _____
Have all personnel received appropriate training? ☐ Yes ☐ No
If no, explain: _____
Is training up-to-date? ☐ Yes ☐ No
If no, explain: _____

HAZARDS (Check each hazard applicable to the PRCS entry)

Corrosives		Toxic Atmosphere		Mechanical	
Hot Equipment		Oxygen Deficiency/Oxygen Enrichment		Falls (slip/trips)	
Combustible Gases		Combustible Vapors		Chemical Contact	
Flammable		Electrical		Pressurized Systems	
Water		Biological		Engulfment Material	
Entrapment		Other:		Other:	
Other:		Other:		Other:	

ATMOSPHERIC MONITORING **
Note: Attendant must order entrants to exit the space if any limit is likely to be exceeded

Date: __/__/__ Tested by:	Time	Oxygen 19.5 % to 23.5%			Carbon Monoxide < 35 ppm			Hydrogen Sulfide < 10 ppm			Lower Flammable Limit <10%			Other		
		Top	Mid	Bot.	Top	Mid	Bot.	Top	Mid	Bot.	Top	Mid	Bot.	Top	Mid	Bot.
Before Entry																
After ventilating																
After entry																
Other:																
Other:																
Other:																

**If additional space is required, GL Form 3900-10 "Permit-Required Confined Space Entry Program, Additional Air Monitoring Log" is available.

FIGURE 2. PERMIT-REQUIRED CONFINED SPACE ENTRY PERMIT, GL FORM 3900-9 (continued)

Other Conditions: _____

Monitoring instrument(s) manufacturer, model, serial number: _____

Date of instrument(s) Calibration: _____

Pre/Post Calibration: _____

ISOLATION/CONTROL METHOD [check method(s)]

Double Block and Bleed	☐	Blanking/Disconnecting	☐	
Electrical Lockout/Tagout	☐	Mechanical Lockout	☐	
Ventilation	☐	Purge	☐	
External Barriers	☐	Confined Space ID's	☐	Other: _____

SAFETY EQUIPMENT (check equipment that will be used)

Ventilation	☐	Lighting	☐	Respirators	☐
Communication	☐	Hot Work Permit	☐	Fire Extinguishers	☐
Harness/Lifeline	☐	Protective Clothing	☐	Ladders	☐
Mechanical Retrieval	☐	Head/Hand/Foot	☐	Intrinsically Safe Tools	☐

Describe Communication Method: _____

EMERGENCY RESCUE

Entry and/or Non-Entry rescue procedures attached to this permit: ☐ Yes ☐ No

If utilized, is emergency rescue service on site or available: ☐ Yes ☐ No

Emergency Service Name: _____ Contact Person(s): _____

Phone Number(s): _____

Comments: _____

AUTHORIZATION OF ENTRY

SMO Environmental Protection

Entry Supervisor (Print): _____ Signature: _____ Date: _____

I have been trained and certified as an individual who can authorize PRCS entry. I have personally inspected the PRCS and I am satisfied that all necessary precautions have been taken and pre-entry testing has been completed.

Entry Supervisor (Print): _____ Signature: _____ Date: _____

TERMINATION OF ENTRY PERMIT

I have ensured that all entrants have left the PRCS and authorization to enter the PRCS under this permit has been terminated.

Entry Supervisor (Print): _____ Signature: _____ Date: _____ Time: _____

REAUTHORIZATION TO ENTER

I have personally reinspected the PRCS and I am satisfied that all necessary precautions have been taken and pre-entry testing has been completed. I have a revised the time that the permit expires.

Entry Supervisor (Print): _____ Signature: _____ Date: _____ Time: _____

This permit is issued with the understanding that those workers involved have received the appropriate training and all certification, medical and respiratory documents have been reviewed and are current. The completed permit shall be posted in a conspicuous place close to the entry point. At the conclusion of the permit space operation, this permit should be returned to the EPS/designated equivalent.

Comments (lessons learned): _____

APPENDIX 2. FORMS

FIGURE 3. ADDITIONAL AIR MONITORING LOG, GL FORM 3900-10

Today's Date: _____ Calibration: _____

Location of Permit: _____

Samples collected by: _____

Date: __/__/__ Tested by:	Time	Oxygen 19.5% to 23.5%			Carbon Monoxide <35 Parts Per Million			Hydrogen Sulfide <10 Parts Per Million			Lower Flammable Limit <10%			Other		
		Top	Mid	Bot.	Top	Mid	Bot.	Top	Mid	Bot.	Top	Mid	Bot.	Top	Mid	Bot.
After Entry																
After Ventilating																
After Entry																
Other:																
Other:																
Other:																
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APPENDIX 2. FORMS

FIGURE 4. CERTIFICATION OF PERMIT REQUIRED CONFINED SPACE RE-CLASSIFICATION, GL FORM 3900-11

I hereby certify that the hazards in the following PRCS have been eliminated and that the space has been reclassified as a non-permit confined space.

Space: _____

Location: _____

Basis for re-classification: _____

_____

_____

Name (SMO-EPS/Designated Equivalent: _____

Printed Name (SMO-EPS/Designated Equivalent: _____ **Phone #:** _____

NOTE: ***Attach all supporting documentation to this form that supports the reclassification listed above.***

APPENDIX 2. FORMS

FIGURE 5. CERTIFICATION OF SAFE ENTRY, GL FORM 3900-12

I hereby certify that the only hazard posed by the following permit space is an actual or potential hazardous atmosphere that is controlled by continuous forced air ventilation alone in accordance with the alternate procedures in 29 CFR 1910.146 (c) (5) (ii).

Name (SMO-EPS/Designated Equivalent): _____

Printed Name (SMO-EPS/Designated Equivalent): _____

Phone Number: _____

Date: _____

Location of Permit Space: _____

_____

_____

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NOTE: Attach all supporting documentation to this form that supports the certification listed above.

APPENDIX 3. INDOOR AIR QUALITY GUIDANCE DOCUMENT (Non-Mandatory)

1. UNDERSTANDING INDOOR AIR QUALITY PROBLEMS. Over the past several decades, exposure to indoor air pollutants has increased due to a variety of factors, including the construction of more tightly sealed buildings, reduced ventilation rates to save energy, the use of synthetic building materials and furnishings, and the use of personal care products, pesticides, and housekeeping supplies. In addition, activities and decisions, such as deferring maintenance to "save" money, can lead to problems from sources and ventilation. The indoor environment in any building is a result of the interactions among the site, climate, building structure and mechanical systems, construction techniques, contaminant sources, and building occupants. To simplify discussion throughout this guide, the issues related to these elements are grouped into four categories:

a. Sources of Indoor Air Pollutants. Pollution or discomfort may originate indoors, outdoors, or within the mechanical system of the building.

b. Heating, Ventilation, and Air-Conditioning System. The heating, ventilation, and air-conditioning (HVAC) system itself may contribute to the problem when it is not able to control air pollutant levels and/or ensure thermal comfort.

c. Pathways. One or more pathways may exist to connect the pollutant source to the occupants. A driving force must exist to move pollutants along the pathway(s).

d. Occupants. Occupant activities have direct impacts on sources, the HVAC system, pathways, and driving forces. Occupants can also be carriers of communicable diseases and allergens, such as pet dander.

2. SOURCES OF INDOOR AIR POLLUTANTS. Indoor air pollutants can originate within the building or be drawn in from outdoors. If pollutant sources are not controlled, indoor air quality (IAQ) problems can arise, even if the HVAC system is properly designed, operated, and maintained. Air contaminants consist of particles, dust, fibers, bio-aerosols, and gases or vapor. It may be helpful to think of air pollutant sources as fitting into one of the categories below. The examples given for each category are not intended to be a complete list.

a. Contaminated outdoor air.

(1) Industrial pollutants from neighboring facilities

(2) Vehicle exhaust from loading docks and nearby roads or alleys

(3) Pollen, fungal spores and dust, occurring naturally or resulting from disruptive activity such as construction

b. Emissions from nearby sources.

(1) Odors from dumpsters or rubbish storage areas

(2) Air from building exhausts or vent pipes drawn back into the building

(3) Debris near building air intakes

c. Soil gases.

(1) Radon

(2) Leakage from underground fuel tanks

(3) Site contaminants (from previous uses of the property, such as landfill.

(4) Pesticides from sub-surface applications

d. Moisture or standing water promoting excess microbial growth.

(1) On rooftops from rain or air-conditioning systems

(2) Crawl spaces

e. HVAC equipment.

(1) Dust or dirt in ductwork or other HVAC components

(2) Microbiological growth in condenser drip pans, humidifiers, ductwork and cooling towers

(3) Biocides, sealants and cleaning compounds

(4) Improper venting of combustion products

(5) Refrigerant leakage

f. Non-HVAC equipment.

(1) Emissions from office equipment

(2) Chemical supplies

(3) Emissions from work shops, labs and cleaning processes

(4) Elevator motors and hydraulic equipment

(5) Water treatment systems and other mechanical equipment

g. Personal human activities.

(1) Smoking

(2) Cooking

(3) Body odor

(4) Cosmetics

h. Housekeeping activities.

(1) Cleaning materials and procedures

(2) Room deodorizers and fragrances

(3) Airborne dust circulated by sweeping and vacuuming

(4) Emissions from stored trash

i. Maintenance activities.

(1) Airborne dust and dirt

(2) Volatile organic compounds from paint, caulk, and adhesives

(3) Pesticides

j. Locations that produce or collect dust.

(1) Curtains, carpeting and furniture textiles

(2) Open shelving

(3) Old or deteriorated furnishings

k. Unsanitary conditions and water damage.

(1) Microbiological growth on water damaged furnishings

(2) Microbiological growth in areas of surface condensation

(3) Standing water from clogged or poorly designed drains

(4) Dry traps permitting passage of sewer gas

l. Chemicals released from building components or furnishings.

(1) Volatile organic compounds

(2) Inorganic compounds

m. Accidental events.

(1) Spills of water or other liquids

(2) Microbiological growth due to flooding or leaks from roofs or piping

(3) Fire damage

n. Special use areas of buildings.

(1) Smoking rooms

(2) Laboratories

(3) Print shops

(4) Exercise rooms

(5) Beauty salons

(6) Food preparation areas

o. Renovation and repair activities.

(1) Emissions from new furnishings

(2) Dust and fibers from demolition

(3) Odors and volatile organic and inorganic compounds from paint, caulk, adhesives, carpeting, wall covering, and finishes

(4) Microbiologicals released from demolition or remodeling activities

3. HVAC SYSTEM DESIGN AND OPERATION.

a. All buildings need ventilation, which is the process of supplying outdoor air to the occupied areas in the building. As outdoor air is drawn into the building, indoor air is exhausted by fans or allowed to escape through openings, thus removing indoor air pollutants. The HVAC system includes all heating, cooling, and ventilating equipment serving a building; boilers or furnaces, chillers, cooling towers, air handling units, exhaust fans, ductwork, and filters. A properly designed and functioning HVAC system:

(1) Controls temperature and relative humidity to provide thermal comfort,

(2) Distributes adequate amounts of outdoor air to meet ventilation needs of building occupants, and

(3) Isolates and removes odors and other contaminants through pressure control, filtration, and exhaust fans.

b. Not all HVAC systems are designed to accomplish all of these functions. Some buildings rely only on natural ventilation. Others lack mechanical cooling equipment, and many function with little or no humidity control. The features of the HVAC system in a given building will depend on:

(1) Age of the design,

(2) Climate,

(3) Building codes in effect at the time of the design,

(4) Budget for the project,

(5) Designers' individual preferences, and

(6) Subsequent modifications,

c. Two of the most common HVAC designs used in buildings are central air handling systems and unit ventilators. Both can perform the same HVAC functions of heating, ventilating, and air-conditioning, but the central air-handling unit serves multiple rooms while the unit ventilator serves a single room. With central air handling units it is important that all rooms served by the central unit have similar thermal and ventilation requirements. If these requirements differ significantly, some rooms may be too hot, too cold, or under ventilated, while others are comfortable and adequately ventilated.

d. Most air-handling units distribute a mixture of outdoor air and recirculated indoor air. HVAC designs may also include units that introduce 100% outdoor air or that simply recirculate indoor air within

the building. Uncontrolled quantities of outdoor air enter buildings by leakage through windows, doors, and gaps in the building exterior. Thermal comfort and ventilation needs are met by supplying "conditioned" air, which is a mixture of outdoor and recirculated air that has been filtered, heated or cooled, and sometimes humidified or dehumidified.

e. **Designs that specify HVAC system operation** at reduced or interrupted flow during certain portions of the day in response to thermal conditioning needs (as in many variable air volume installations) may cause elevated indoor contaminant levels and impair contaminant removal.

f. **Failure to maintain proper temperature, humidity, and air movement** in a building can lead occupants to block supply grilles if they emit air that is uncomfortably hot or cold. Placement of partitions or other barriers within a space can also disrupt air movement. In addition, locating air supply and return grilles too close together can result in an uneven distribution of fresh air and insufficient removal of airborne contaminants. Precautions must be taken to maintain comfortable thermal conditions, and proper placement of supply and return grilles, and furnishings.

g. **Air supply vents that are installed too close to building exhaust vents** re-entrain contaminated exhaust air into the building, increasing indoor pollution. Placement of supply vents near outdoor sources of pollution, such as loading docks, parking and heavy traffic areas, chimneys, and trash depots, provides a pathway for contaminants into the building's ventilation system. The location of all air supply vents must be carefully considered.

h. **An HVAC system that begins to operate** after building occupants have arrived, or shuts off before the end of the work day can cause an increase in building-and occupant-generated pollutant levels. Similarly, if the system is off during periods of non-occupancy (e.g., at night and on weekends) building-generated pollutants may accumulate. Therefore, the ventilation system should be activated prior to occupancy, and shut down only after occupants have left.

i. **HVAC systems must be properly maintained to promote indoor air quality.** If this is not done, ventilation systems can become a source of contamination or become clogged and reduce or eliminate airflow. Humidification and dehumidification systems must be kept clean to prevent the growth of bacteria and fungi. Failure to properly treat the water in cooling towers to prevent growth of organisms, such as Legionella, may introduce such organisms into the HVAC supply ducts and cause health problems. Accumulations of water anywhere in the system may foster biological growth that can be distributed throughout the building.

j. **Air cleaners may be an important part of an HVAC system,** but cannot adequately remove all of the pollutants typically found in indoor air. Air cleaners should only be considered as an adjunct to source control and ventilation.

(1) Mechanical filters are the most common and are effective at removing a range of particles.

(2) Electronic air cleaners and ion generators use an electronic charge to remove airborne particles. These devices may also produce ozone, which is a lung irritant.

(3) Special types of air cleaners, containing activated charcoal, are available for removing some odors and gaseous pollutants. Information is limited on the useful lifetime of these systems; they can be expensive and require frequent replacement of the filter media.

4. VENTILATION STANDARDS AND BUILDING CODES.

a. **The amount of outdoor air considered adequate for proper ventilation** has varied substantially over time. Because updating building codes often takes several years, the building code, if any, that was in force

when the building HVAC system was designed may well have required a lower amount of ventilation than what is currently considered adequate. The American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) ventilation standards are used as the basis for most building ventilation codes.

b. ASHRAE Standard 62-Latest Version, "Ventilation for Acceptable Indoor Air Quality" states the "minimum ventilation rates and indoor air quality that will be acceptable to human occupants and are intended to avoid adverse health effects." This standard applies to all types of facilities, including dry cleaners, laundries, hotels, dormitories, retail stores, sports and amusement facilities, and teaching, convalescent and correctional facilities. The specified rates at which outdoor air must be supplied to each room within the facility range from 15 to 60 cubic feet per minute (cfm)/person, depending on the activities that normally occur in that room.

c. The ASHRAE Standard 62-Latest Version is a voluntary standard, which means that it becomes enforceable only after a state or locality adopts the standard in its building code. Furthermore, most current building codes pertaining to ventilation are standards only for the way buildings in a particular jurisdiction must be designed; they are not enforceable standards for the way the buildings are operated. A few states, through recently promulgated regulations, pending legislation, labor agreements and other mechanisms, are working to apply existing design codes and standards to building operations.

5. THERMAL COMFORT.

a. A number of variables interact to determine whether people are comfortable with the temperature and relative humidity of the indoor air. The amount of clothing, activity level, age, and physiology of people in buildings varies widely, so the thermal comfort requirements vary for each individual.

b. Uniformity of temperature is important to comfort. Rooms that share a common heating and cooling system controlled by a single thermostat may be at different temperatures. Temperature stratification is a common problem caused by convection, the tendency of light, warm air to rise, and heavier, cooler air to sink. If air is not properly mixed by the ventilation system, the temperature near the ceiling can be several degrees warmer or cooler than near the floor, where young children spend much of their time. Even if air is properly mixed, uninsulated floors over unheated spaces can create discomfort in some climate zones. Large fluctuations of indoor temperature can also occur when thermostats have a wide "dead band" (a temperature range in which neither heating or cooling takes place).

c. All buildings need ventilation, which is the process of supplying outdoor air to the occupied areas within the building. Radiant heat transfer may cause people located near very hot or very cold surfaces to be uncomfortable even though the thermostat setting and the measured air temperature are within the comfort range. Buildings with large window areas sometimes have acute problems of discomfort due to radiant heat gains and losses, with the locations of complaints shifting during the day as the sun angle changes. Poorly insulated walls can also produce a flow of naturally-convecting air, leading to complaints of draftiness. Closing curtains reduces heating from direct sunlight and reduces occupant exposure to hot or cold window surfaces.

d. Large buildings may have interior "core" spaces in which year round cooling is required to compensate for heat generated by occupants, office equipment, and lighting, while perimeter rooms may require heating or cooling depending on outdoor conditions.

e. Humidity is a factor in thermal comfort. Raising relative humidity reduces a person's ability to lose heat through perspiration and evaporation, so that the effect is similar to raising the temperature. Humidity extremes can also create other IAQ problems. Excessively high or low relative humidity can produce discomfort, high relative humidity can promote the growth of mold and mildew, and low relative humidity can accelerate the release of spores into the air.

6. POLLUTANT PATHWAYS AND DRIVING FORCES.

a. Airflow patterns in buildings result from the combined action of mechanical ventilation systems, human activity, and natural forces. Differences in air pressure created by these forces move airborne pollutants from areas of higher pressure to areas of lower pressure through any available opening. Even if the opening is small, air will move until the pressures inside and outside are equal.

b. If present, the HVAC ducts are generally the predominant pathway and driving force for air movement in buildings. However, all of a building's components (e.g., walls, ceilings, floors, doors, windows, HVAC equipment, and occupants) interact to affect how air movement distributes pollutants within a building. Moving air always follows the path of least resistance. Some of the pathways change as doors and windows open and close. It is useful to think of the entire building - the rooms with connecting corridors and utility passageways between them - as part of the air distribution system. The interaction between pollutant pathways and intermittent or variable driving forces can lead to a single source causing IAQ complaints in an area of the building that is distant from the pollutant source. Identifying and understanding contaminant pathways can often be very difficult.

7. BUILDING OCCUPANTS.

a. Because of varying sensitivity to airborne chemicals and irritants, individuals with heightened sensitivities may react to a particular IAQ problem while surrounding occupants do not display ill effects. Symptoms that are limited to only one or a few persons can also occur when only their area contains the airborne pollutant. In other cases, complaints may be widespread. In addition to different degrees of reaction, an indoor air pollutant or problem can trigger different reactions in different people. Some may not be affected at all.

b. The effects of IAQ problems are often non-specific symptoms rather than clearly defined illnesses. Symptoms (which can occur singly or in groups) commonly attributed to IAQ problems include:

(1) Headache, fatigue, and shortness of breath.

(2) Sinus congestion, coughing, and sneezing.

(3) Eye, nose, throat, and skin irritation.

(4) Dizziness and nausea.

c. These symptoms, however, may also be caused by other factors, and are not necessarily due to air pollutants. For example, when the air in a room is slightly too warm for a person's activity, that person may experience mild discomfort. If the temperature rises, discomfort increases and the symptom of fatigue can appear. The person may attribute this fatigue to an unknown air pollutant, rather than to being too warm.

d. A common IAQ complaint is that "there's a funny smell in here." If occupants think there is an indoor air problem, the slightest odor can trigger concerns over health, even though the cause of that particular odor may not have any effects on health. Environmental stressors such as improper lighting, noise, vibration, poor ergonomics, and psychosocial problems (such as job stress) also can produce symptoms that are similar to those associated with poor air quality.

e. Individuals with heightened sensitivities may react to a particular IAQ problem while surrounding occupants do not display ill effects. Particularly susceptible to the effects of indoor air contaminants are:

(1) Allergic or asthmatic individuals.

(2) People who may be unusually sensitive to chemicals.

(3) People with respiratory disease.

(4) People whose immune systems are suppressed due to chemotherapy, radiation therapy, disease, or other causes.

(5) Contact lens wearers.

f. The term Sick Building Syndrome (SBS) is generally used to describe cases in which building occupants experience acute health or comfort effects that are apparently linked to the time they spend in the building, but in which no specific illness or cause can be identified. Many different symptoms have been associated with SBS, including respiratory complaints, irritation and fatigue. Air testing often fails to identify unusual concentrations of air contaminants.

g. Building Related Illness (BRI) is a term referring to illness brought on by exposure to the building air, where symptoms of a diagnosable illness are identified and can be directly attributed to environmental agents in the air. Legionnaire's disease and hypersensitivity pneumonitis are examples of BRI. Unlike SBS, the cause of a BRI can usually be identified.

8. RESOLVING IAQ PROBLEMS.

a. Solutions to IAQ problems range from simple to complex. Mitigation efforts should be evaluated at the planning stage by considering the following criteria:

(1) Permanence

(2) Durability

(3) Operating principle

(4) Installation and operating cost

(5) Control capacity

(6) Ability to institutionalize the solution

(7) Conformity with codes

b. Common control approaches include:

(1) Source control

(2) Ventilation

(3) Air cleaning

(4) Exposure control

9. EVALUATING THE EFFECTIVENESS OF THE SOLUTION. One shouldn't just assume that implementation of recommended corrective action will make the problem go away. It is generally advisable to validate the solution. Two kinds of indicators can be used:

a. Reduction or elimination of complaints is often a clear indication of success, but you should be aware of certain limitations. Occupants who realize that their concerns are being heard may temporarily stop reporting discomfort or health symptoms, even if the actual cause of their complaints has not been corrected. On the other hand, lingering complaints may continue after successful mitigation if people have become upset over the handling of the problem. A smaller number of ongoing complaints may indicate that there were multiple IAQ problems and that one or more problems are still unresolved.

b. Measurements, by a qualified person, of airflows, ventilation rates, and air distribution patterns can be used to assess the results of control efforts. Airflow measurements taken during the building investigation can identify areas with poor ventilation; later they can be used to evaluate attempts to improve the ventilation rate, distribution, or direction of flow. Studying air distribution patterns will show whether a mitigation strategy has successfully prevented a pollutant from being transported by airflow. While in some cases the measurement of pollutant levels can be used as a means of determining whether indoor air quality has improved, in many cases this may be difficult and/or prohibitively expensive. Concentrations of indoor air pollutants typically vary greatly over time; further, the specific contaminant measured may not be causing the problem. It is important that air measurements be taken by a qualified person to ensure reliable results.

10. Resolving Non-IAQ Problems. As noted before, symptoms commonly associated with poor indoor air quality are often caused by other things. Specific lighting deficiencies or localized sources of noise or vibration can sometimes be readily identified, and remedial action may be fairly straightforward, such as having more or fewer lights, making adjustments for glare, and relocating, replacing, or acoustically insulating a noise or vibration source. Similarly, some causes of ergonomic or psychosocial stress may be apparent even to an untrained observer. In the course of investigating IAQ concerns, these problems should be noted and may require corrective action as well.

11. IAQ MONITORING TOOLS.

a. Indoor air quality testing can require the use of several different types of instruments. With the exception of only the most simple of instruments, considerable skill and understanding by the operator and analyst are required in order to obtain reliable results. Sample duration, flow rates, media, detector limitations and the presence of interference's must always be considered by the user.

b. Common IAQ Monitoring Tools. Figure 1, "Common IAQ Monitoring Tools," provides a summary of instruments commonly used to assess indoor air quality.

FIGURE 1.

Common IAQ Monitoring Tools		
Parameter	**Instrument Commonly Used**	**Comments**
Carbon Monoxide (CO)	• Indicator tubes • Direct reading instrument	• Results are reported as parts per million (PPM). Indicator tubes contain chemical agents that change color when exposed to carbon monoxide gas. • Direct reading instruments may test carbon monoxide exclusively, or may be capable of testing other gases.

Common IAQ Monitoring Tools		
Parameter	**Instrument Commonly Used**	**Comments**
Carbon Dioxide (CO_2)	• Indicator tubes • Direct reading instrument	• Results reported as PPM. Indicator tubes contain chemical agents that change color when exposed to carbon dioxide. • Direct reading instruments may test carbon dioxide exclusively, or may be capable of testing other gases. • Care must be taken to avoid erroneous readings caused by holding the instrument too close to the operator's exhaled breath.
Volatile Organic Compounds (VOC)	• Sorbent tubes • Passive absorbers • Direct reading instruments • Evacuated containers	• Sorbent tubes are attached to air sampling pumps that draw air through compounds contained within the tube. Tubes are sent to a laboratory for analysis. With the correct selection of sorbent tube and sample duration, fairly good sensitivity to low levels of contaminants can be achieved. • Passive absorbers do not require an air-sampling pump and are easier to use, but may not provide as much sensitivity. They are sent to a laboratory for analysis. • Direct reading instruments can be selected that "see" contaminants collectively or individually. Direct reading instruments can provide real-time results and are especially useful in locating contaminant sources. Sensitivity and interference's are sometimes a limitation. • Evacuated containers are usually made of glass or stainless steel. A valve is opened and sample air enters the container. The container is then sent to a laboratory for contaminant analysis. Evacuated containers can be bulky to handle, but certain types allow for very high sensitivity to low levels of pollutants.
Formaldehyde	• Sorbent tubes • Passive absorbers • Detector tubes	• Operation is the same as noted above for each of these devices. • Media is usually specialized for formaldehyde.

Common IAQ Monitoring Tools		
Parameter	**Instrument Commonly Used**	**Comments**
Radon	• Charcoal canisters • Alpha track detectors • Electret ion detectors	• Charcoal canisters are most commonly used for short term testing. • Alpha track and electret ion detectors are most commonly used for longer term testing. • Sampling is usually conducted in the lowest occupied portion of the structure.
Air flow	• Smoke tubes • Air flow hoods • Velometers	• Smoke tubes release a dense white smoke that allows airflow patterns to be visualized. Care must be taken to avoid triggering smoke detectors. The smoke is sometimes irritating if inhaled. • Airflow hoods are fitted over HVAC duct openings and allow airflow volumes to be determined. Results are reported as CFM. • Velometers are used to calculate airflow across an opening or duct. Results are usually reported as linear feet per minute (LFM) or in terms of pressure as inches of water column. When the area of the opening or duct is known, the data can be converted into CFM.
Temperature & Humidity	• Thermometer • Psychromoter • Hygrometer	• Thermometers range from common glass bulb types to electronic. • Psychrometers are used to determine relative humidity and are equipped with wet and dry bulb thermometers. • Hygrometers electronically determine relative humidity and usually contain an integrated electronic thermometer. • In all temperature and humidity measurements time must be allowed for the instrument to stabilize before readings are recorded.

12. COMMON GUIDELINES FOR EVALUATING EXPOSURES.

a. Standards which define acceptable concentrations of indoor air contaminants are practically non-existent. Investigators must evaluate findings according to good judgment and professional practice.

b. A summary of commonly used guidelines for evaluating indoor air exposures is provided in Figure 2. "Commonly Used Guidelines for Evaluating Indoor Air Exposures."

FIGURE 2.

Commonly Used Guidelines for Evaluating Indoor Air Exposures

Contaminant	Description & Problem	Guideline
Carbon monoxide (CO)	• Carbon monoxide is a colorless, odorless and tasteless gas. • Results from incomplete combustion. • Sources include: ⇨ Boilers and furnaces ⇨ Car and truck engines, ⇨ Exhaust from garages. • Carbon monoxide in high concentrations is very toxic and can be fatal.	• No firm standards for indoor air. Some guidelines include: • United States National Ambient Air Quality Standards for Outdoor air: ⇨ 9 PPM for 8 hours ⇨ 35 PPM for 1 hour ⇨ OSHA Permissible Exposure Limits (PEL): 50 PPM as 8 hour Time Weighted Average (TWA) ⇨ National Institute of Occupational Safety and Health (NIOSH): 35 PPM as 8 hour TWA.
Carbon dioxide (CO_2)	• Carbon dioxide is odorless, colorless and tasteless. • Sources include all combustion and human respiration. • Carbon dioxide is always found in buildings and is frequently tested to determine the adequacy of outdoor air supply.	• ASHRAE Standard 62-1989 recommends: ⇨ 1,000 PPM as an indicator for the upper limit for comfort. ⇨ If >1,000 PPM is present, additional outside air may be needed to control odors and reduce the sense of "stuffy air."

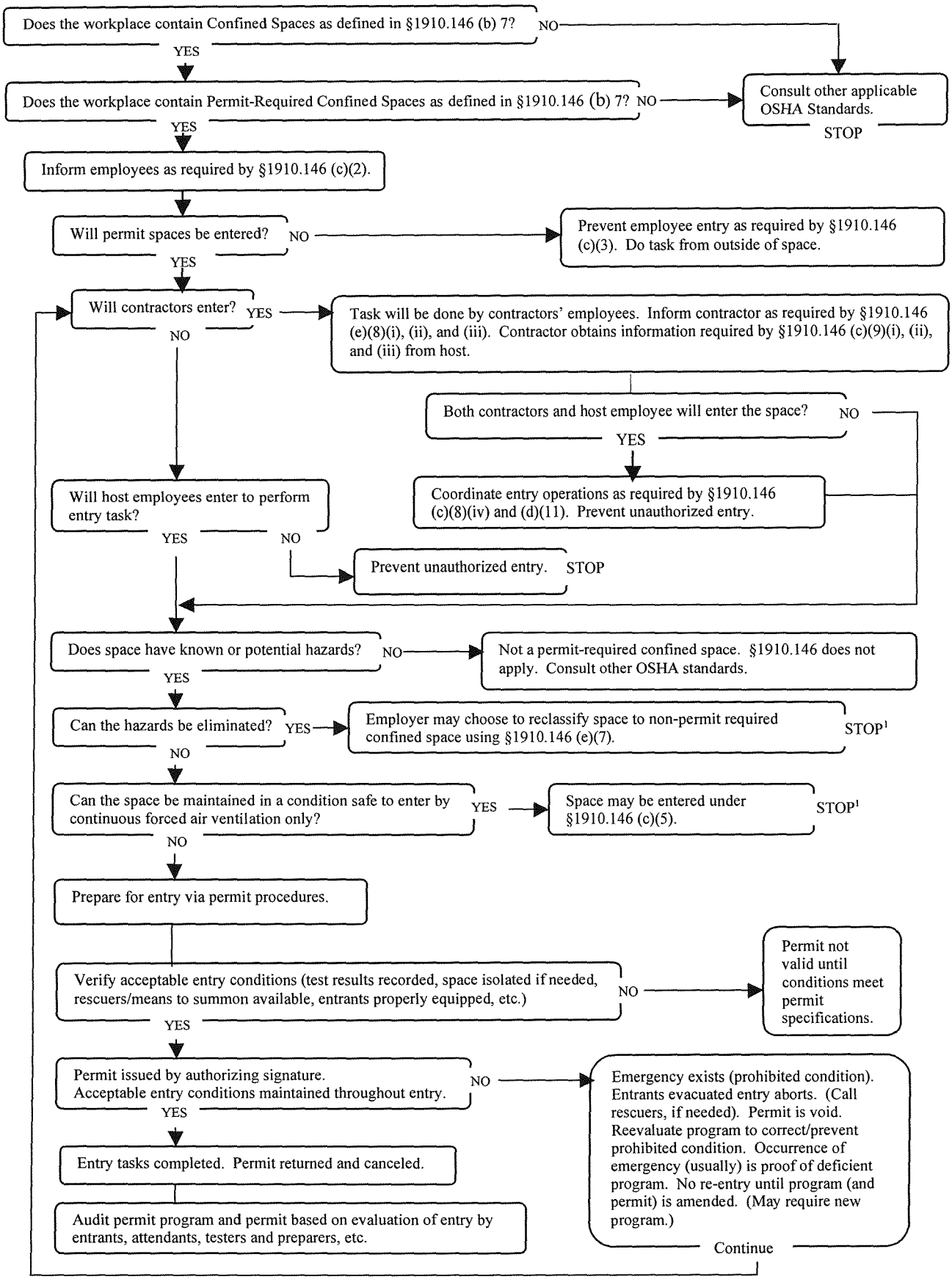
Commonly Used Guidelines for Evaluating Indoor Air Exposures		
Contaminant	**Description & Problem**	**Guideline**
Volatile Organic Compounds (VOC) **Total Volatile Organic Compounds (TVOC)**	• Hundreds of different volatile organic compounds can be found in indoor air. • Originate from cleaners, finishes, solvents, adhesives, equipment and combustion processes. • Frequently tested in total (not as individual substances) and reported as VOCs or TVOCs.	• No standards exist: ⇨ 1 PPM is often used as a guideline by investigators. ⇨ Elevated concentrations may indicate inadequate outside air or a specific source that needs to be further assessed and controlled.
Formaldehyde	• Formaldehyde is a colorless gas. • It is usually looked at separately from other VOCs. • Sources include furnishings, plywood, particleboard, textiles and adhesives. • Formaldehyde has a pungent odor and is detected by many people at levels of about 0.1 PPM. • It may cause eye, respiratory tract, and mucus membrane irritation. • The EPA has determined formaldehyde to be a probable human carcinogen, but the agency believes the risk of cancer is minimal at exposure levels typically encountered in indoor settings.	• No firm indoor air quality standards exist. • OSHA regulates this substance as a carcinogen • Permissible Exposure Limit (PEL) is 0.75 PPM • Action Level is 0.5 PPM. • Concentrations this high will normally not be present within non-industrial settings. • Concentrations above 0.1 PPM should be assessed further and can probably be reduced.

Commonly Used Guidelines for Evaluating Indoor Air Exposures		
Contaminant	**Description & Problem**	**Guideline**
Airborne mold spores and bacteria	• Biological agents, including mold spores and bacteria are commonly found in the indoor environment. • Potential sources include people, animals, plants, cooling towers, and HVAC systems. • Problems include allergic reactions and infection. Some molds produce toxins. • ***Legionella*** can cause the respiratory illness known as Legionosis.	• No specific standards exist. Care must be exercised when interpreting results: ⇨ It is normal to find airborne mold and bacteria in buildings. ⇨ Sampling is usually performed to allow comparison of indoors (or area of concern) with the outdoors or some other control area. ⇨ Higher concentrations indoors, or different species indoors, may mean that conditions in the building exist which promote growth.
Radon	• Radon is a colorless, odorless and tasteless radioactive gas. • Radon exists in the earth's crust in varying concentrations. • Radon is a known lung carcinogen. • Cracks or openings in the building foundation and basement walls are common routes for radon to enter a building. • Control is usually easily achieved through building ventilation.	• The EPA recommends taking action to reduce radon levels when concentrations exceed 4 picocurries per liter of air (pCi/L). • ASHRAE Standard 62-1989 recommends levels not exceed 2 pCi/L. • It is common for radon concentrations to vary over time. • Short-term sampling is okay for screening, but remediation decisions should usually be made only after longer term monitoring has been conducted.

Commonly Used Guidelines for Evaluating Indoor Air Exposures		
Contaminant	**Description & Problem**	**Guideline**
Dust	• Dust is comprised of particles in the air that settle on surfaces. • Dust is commonly found in buildings and can come from soil, fibers, people (shed skin) and combustion.	• Firm indoor air standards do not exist. • Building HVAC systems are normally filtered to reduce dust in the air. • The EPA Ambient Air Quality standard of particles less than 10 microns in diameter is: ⇨ 50 micrograms per cubic meter of air (ug/m^3) for an annual average, ⇨ 150 ug/m^3 for a 24-hour average. • Comparison of the area of concern with other control areas of the building is sometimes useful.
Nitrogen Oxides (NO_x)	• The two most common oxides of nitrogen are: ⇨ Nitrogen dioxide (NO_2) ⇨ Nitric oxide (NO). • Both are toxic. • NO gradually reacts with oxygen in the air to form NO_2. • The primary sources of NO_x are: ⇨ Combustion processes ⇨ Improperly vented boilers and engines. ⇨ Investigators of diesel exhaust odor frequently test for NO_x, though it is seldom found in significant concentrations.	• No standards have been agreed upon for indoor air. • ASHRAE and the US National Ambient Air Quality Standards list 100 ug/m^3 (0.053 PPM) as the average long-term (1 year) limit for NO_2 in outdoor air. • OSHA's PEL: ⇨ NO is 25 PPM, ⇨ NO_2 is 5 PPM.

Commonly Used Guidelines for Evaluating Indoor Air Exposures		
Contaminant	**Description & Problem**	**Guideline**
Ozone (O_3)	• Ozone can cause lung irritation, shortness of breath, coughing, throat irritation and chest pain. • It is often, though not by design, produced by a variety of electrical equipment. • It is deliberately produced by so called air cleaners. • The proliferation of copying machines and laser printers has caused some IAQ investigators to test for ozone, though it is seldom found in significant concentrations. • Ozone "air cleaners" advertised for use in offices and homes are ineffective at controlling odors and dusts, but may be capable of producing harmful concentrations of ozone. • Ozone generators are not a solution for other indoor air quality problems.	• No standards have been agreed upon for indoor air. • The EPA's National Ambient Air Quality Standard for ozone is a maximum 8-hour average outdoor concentration of 0.08 PPM. • OSHA's PEL is 0.1 PPM as 8 hour TWA

APPENDIX 4. APPENDIX A TO §1910.146 "PERMIT-REQUIRED CONFINED SPACE DECISION FLOW CHART"



[1] Spaces may have to be evacuated and re-evaluated if hazards arise during entry.