Chapter 6.9 Entering Confined Spaces and Controlled Areas

This could be you . . .

Three technicians died in a confined space that contained nitrogen. The first one passed out and died when he entered the space. The other two passed out and died trying to rescue him.

A technician was working in a chamber that was not a confined space and encountered an oxygen-deficient atmosphere after climbing a ladder to a higher level. The technician lost consciousness and fell from the ladder.

6.9.1. Applicability of this chapter

6.9.1.1 You are required to follow this chapter if you:

a. Are part of a work crew entering confined spaces or controlled areas to do work, to include entry supervisors and attendents.

b. Are a facility manager or manager who has a confined space or controlled area in your work area.

NOTE: WSTF personnel are required to follow WSTF procedures and requirements for entering confined spaces or controlled areas and use WSTF forms that meet the intent of this chapter.

6.9.2. What this chapter covers

This chapter contains JSC requirements for safely entering confined spaces that meet and exceed those in 29 CFR 1910.146, “Permit-Required Confined Spaces,” and 29 CFR 1926, Subpart AA for construction. Paragraphs 6.9.27 - 6.9.30 cover controlled areas.

6.9.3. What is a confined space?

6.9.3.1 A confined space is one that meets all of the following criteria:

a. An employee can completely enter and work in the space.

b. The space has limited or restricted entries or exits.

c. The space isn’t designed for continuous employee occupancy.

6.9.4. What is an OSHA permit-required confined space?

6.9.4.1 An OSHA permit-required confined space, by OSHA definition, is a confined space (see definition in 6.10.3) with one or more of the following characteristics:

a. Contains, or has the potential to contain, a hazardous atmosphere that may expose employees to the risk of death, incapacitation, impaired ability to self rescue, injury, or acute illness from one or more of the following causes:

(1) Flammable gas, vapor, or mist in excess of 10% of its lower explosive limit (LEL).

(2) Airborne combustible dust at a concentration that meets or exceeds its LEL.

(3) Atmospheric oxygen concentrations below 19.5% or above 23.5%.

(4) Atmospheric concentration of any substance for which there is a published Exposure Limit and which could result in employee exposure in excess of its dose or Exposure Limit.

(5) Any other atmospheric condition immediately dangerous to life or health.

b. Contains a material that could engulf an entrant.

c. Has an internal configuration which could trap or asphyxiate an entrant by inwardly converging walls or by a floor that slopes downward or tapers to a smaller cross section.

d. Contains any other recognized serious safety or health hazard.

6.9.5. What is a JSC permit-required confined space?

A JSC permit-required confined space is a confined space (see definition in 6.10.3) that doesn't contain or, with respect to atmospheric hazards, have the potential to contain, any hazard capable of causing death or serious physical harm. The OSHA standards considers these to be a non-permit confined space however, JSC requires an approved procedure and permit to enter all confined spaces.

6.9.6. Classifying a confined space at JSC

6.9.6.1 The Safety and Test Operations Division, Occupational Healthand certain JSC organizations have classified known confined spaces at JSC. Occupational Healthmaintains a list of JSC's confined spaces and their normal classifications at https://nasa.sharepoint.com/sites/jsc-oh/SitePages/confined.aspx . Confined space locations and classification may change as facilities and operations change. The following requirements apply to identifying and classifying confined spaces:

a. JSC and WSTF managers and facility managers shall evaluate their work areas to identify and classify confined spaces with concurrence from the Safety and Test Operations Division and the Occupational Health.

b. Classification of a confined space is based on its normal use. However, the work to be done in a confined space may change its normal classification. Entry supervisors:

(1) Shall reclassify a JSC permit-required confined space as an OSHA permit-required confined space if the work to be done increases the hazard in the space. Examples include welding, chemical use, radiography, and painting.

(2) May temporarilly reclassify an OSHA permit-required confined space as a JSC permit-

required confined space if they can eliminate the hazards without entering the confined space. This reclassification is only valid for as long as the hazards remain eliminated for that entry.

6.9.7. What to do if you have confined spaces in your work area

a. Facility managers or managers with a -permit required confined space in their work areas shall follow the requirements of the OSHA standards listed above and this chapter.

b. Contact Occupational Health at x36726 for signs and stencils

6.9.8. Requirements for entering any confined space

6.9.8.1 Eliminate the hazards in a confined space before entering it. If you can't eliminate the hazards, control them with other administrative measures or PPE. Entry supervisors, attendants, and entrants shall follow these requirements for entering any confined space:

a. Have the following before entering any confined space:

(1) An approved and posted written entry procedure as described in paragraph 6.9.12.

(2) An approved and posted entry permit as described in paragraph 6.9.13.

(3) Current confined space training (within the last 2 years).

(4) A certification card (JF353) or equivalent from your employer (see Chapter 5.8).

b. Follow the current approved entry procedure and all conditions on the permit. Ensure the entry supervisor has approved the permit.

6.9.9. Controlling atmospheric hazards in a confined space

6.9.9.1 Entrants shall control atmospheric hazards in a confined space before entering it by following these requirements:

a. Ventilate all confined spaces with clean air as required by the entry procedure before testing the atmosphere in the confined space. If the space has permanently-installed continuous ventilation that has been running and continues to run, workers may enter without the 30-minute waiting period if they have met all other safe entry conditions in the entry procedure and permit. (In some cases, atmospheric testing may not be required in continuously ventilated spaces, as approved in the entry procedure.) Entrants shall follow these requirements for forced-air ventilation:

(1) Ventilate the space continuously until the job is done, whether the space is occupied or not.

(2) Don't enter the space until the forced-air ventilation has eliminated any hazardous atmosphere without approval from the Safety and Test Operations Division, Occupational Health, and your safety representative.

(3) Direct the ventilation to the immediate areas where employees are or will be working within the space.

(4) Take air from a clean source and make sure that the source won't increase the hazard in the space.

b. If feasible isolate pipelines containing flammable, toxic, irritating, or oxygen-displacing gases or

vapors to prevent a hazardous atmosphere from forming inside the space while work is being done. Isolate pipelines by:

(1) Completely depressurizing and disconnecting possible contaminant supply lines and placing a blank flange on the pipe leading into the confined space.

(2) Using two blocking valves with a vent valve open between them.

(3) Using other blank, block, and bleed valve configurations previously approved by the Safety and Test Operations Division.

6.9.10. Controlling other hazards in a confined space

6.9.10.1 Entry Supervisors and Entrants shall isolate energy sources to the area where they will be working to prevent mishaps, such as electrical shock, fire, or injury from moving parts as follows:

a. Follow lockout/tagout and isolation requirements in Chapter 8.2, “Lockout/tagout Practices,” to protect entrants from unexpected energy release.

b. Deactivate, shield, or remove all radioactive sources.

c. Safeguard personnel by:

(1) Using only properly insulated or grounded portable electrical equipment. Double-insulated electrical hand tools are acceptable. Inspect all electrical equipment before entry.

(2) Using ground fault circuit interrupter (GFCI) circuit breakers for all case-grounded, portable electrical equipment. GFCIs should be 4 to 6 milliamp. Place them at the power source unless the source is an ungrounded portable generator, an ungrounded battery of less than 28 volts, or an ungrounded isolation transformer of less than 28 volts.

(3) Using pneumatic power tools instead of electrical tools when possible. Pneumatic tools shall have conductive air supply hoses. Never use nitrogen or other inert gases to power the tools. Use breathable air to power pneumatic tools.

(4) Using cordless, rechargeable portable power tools, with an intrinsically safe rating, when possible. If they are used, they shall have an explosion-proof or intrinsically safe rating for spaces that could contain or develop an explosive atmosphere.

(5) Protecting temporary lighting with bulb guards or by recessing the bulbs. Power temporary lighting in locations that are wet or have standing fluids with batteries or low-voltage circuits.

(6) Grounding or double-insulating heavy-duty electric cords and all metal housings.

d. Control ignition sources by:

(1) Using explosion-proof or intrinsically safe (non-sparking) lighting, ventilation equipment, and tools in potentially flammable atmospheres.

(2) Never bringing ignition sources into an OSHA permit-required confined space until tests by a confined space monitor have confirmed combustible or flammable gases or vapors aren’t present in the space. Entrants may work in confined space atmospheres with more than 0%, but never more than 10%, of the LEL with previous approval from the Safety and Test

Operations Division or Occupational Health.

(3) Never using polyethylene and other materials that generate static electricity where explosive atmospheres could exist. Tents erected over or around the space shall be of a conductive material and properly grounded.

6.9.11. Testing for Atmospheric Hazards

6.9.11.1 Testing for atmospheric hazards shall follow these requirements:

a. A qualified person does the testing. This person shall be an authorized representative of Occupational Health or an employer-designated person.

b. Make sure all instruments used to test the atmosphere in a confined space are:

(1) Calibrated under the manufacturer's guidelines

(2) Working properly before using them ("bump testing")

(3) Labeled with calibration dates and cycles to show that they are within the calibration period

c. Before entry, test the atmosphere in the confined space with a calibrated direct-reading instrument from outside the space as required by the entry procedure. Test for the following conditions in this order and record the results on the entry permit form:

(1) Oxygen content

(2) Flammable gases and vapors

(3) Potential toxic air contaminants

d. Confirm acceptable atmospheric conditions exist in the confined space as stated on the procedure before entry:

(1) If initial testing shows conditions are unacceptable, you shall continue ventilation and retest the atmosphere unless the entry procedure says otherwise.

(2) If the readings continue to be unacceptable, call the Occupational Health Contractor at x36726 for further air quality testing**.**

e. While working in the confined space, test the atmosphere and record the results on the entry permit form as required by the entry procedure. If continuous monitoring is required, record your results at least every 60 minutes.

f. If entrants have left the space for more than 30 minutes (breaks), retest and document the test results before re-entering the confined space.

6.9.12. Entry procedure required to enter a confined space

6.9.12.1 Entrants shall have a current, approved written entry procedure before entering a confined space that covers the specific job to be done in the space. The entry procedure shall:

a. Use JSC Form 992, "Confined Space Entry Procedure," (Appendix D).

b. Document the following:

(1) The hazards of the confined space or work procedure.

(2) How the hazards will be eliminated or controlled.

(3) Pre-entry notifications.

(4) Ventilation and atmospheric testing requirements.

(5) Detailed work procedures.

(6) Emergency procedures.

c. Be:

(1) Approved and signed by the contract safety representative, the Safety and Test Operations Divisionand Occupational Health.

(2) Valid for up to one year from the date of approval. You may use an entry procedure repeatedly as long as its approval is current..

(3) Rewritten if there are changes in the hazards or work procedure.

(4) Followed as written.

(5) Posted at the entrance(s) to the space so the entrants can confirm that safe entry conditions have been met.

(6) Used only by the organization that has prepared the procedure.

d. Include Safety Data Sheets (SDSs) for any chemicals tobe used in or near the confined space.

6.9.13. Permits for entering a confined space

6.9.13.1 Confined space entry permits document that employees involved with the entry have met the safe entry conditions required by the entry procedure before anyone enters a confined space. Entrants shall have a completed and endorsed entry permit form, JSC Form 1476, “Confined Space Entry Permit,” (Appendix D), to enter any confined space. Entry permits shall:

a. Document all safety measures required in the entry procedure are taken before entry. The entry supervisor does this by completing and signing the entry permit form to authorize personnel to enter.

b. Be posted (when completed and signed) at the entrance to the space so entrants can confirm safe entry conditions have been met.

c. Be valid only for the time required to complete the job identified on the permit and only for one working shift.

d. Include SDSs for any chemical being used in or near the space.

6.9.14. Canceling a permit

6.9.14.1 Entry supervisors shall follow these requirements to cancel a permit:

a. Cancel if one of the following occurs:

(1) The work covered by the entry permit is completed.

(2) The work shift is over.

(3) A condition arises in or near the space that is not allowed under the entry procedure or permit.

b. Ensure all entrants leave the space when the permit is canceled.

c. Follow these steps after cancelling the permit:

(1) Note any problems encountered during the operation on the permit so JSC can improve its confined space program.

(2) Within one week, send a copy of each canceled permit to Occupational Health for a review.

(3) Keep each canceled entry permit for at least one (1) year.

6.9.15. Duties of entry supervisors

6.9.15.1 *Entry supervisors* shall:

a. Follow the requirements of the applicable OSHA standards.

b. Be an employee of the organization or company providing the entry procedure.

c. Make required pre-entry notifications, and coordinate all entries with the cognizant contract safety representative as stated on the procedure.

d. Complete an entry permit and check each entry to make sure of the following before signing the permit and allowing anyone to enter:

(1) All required blocks are filled in.

(2) All tests specified by the entry procedure have been conducted.

(3) All requirements and equipment specified by the entry procedure are in place.

e. Post the approved entry procedure and permit at the confined space entrance(s).

f. Make sure to have all other required permits, such as hot work and hazardous operations permits, before entry.

g. Make sure oxygen and combustible gas-monitoring devices are available, calibrated, and used for atmospheric testing, if required by the entry procedure.

h. When transfering responsibility for the space to another supervisor, make sure operations remain consistent with terms of the entry permit and acceptable entry conditions are maintained. Evaluate conditions as often as needed by the hazards of operations in the space.

i. Remove all workers from the space and cancel the permit when the job is done, the work shift is over, or when unacceptable conditions arise. Provide Occupational Health a copy of the canceled permit.

6.9.16. Duties of entry attendants

6.9.16.1 At least one attendant shall be in the immediate vicinity outside a permit-required confined space, if the entry procedure requires, while people are working in the space.

6.9.16.2 *Entry attendants* shall:

a. Follow the requirements of the applicable OSHA standard(s)

b. Be properly trained and certified in confined space entry procedures.

c. Know the hazards entrants may face in a confined space, including information on the mode, signs or symptoms, and consequences of the hazard exposures.

d. Be aware of possible behavioral effects on entrants exposed to hazards.

e. Continuously keep an accurate count of authorized entrants in the space on the entry permit form.

f. Remain outside the permit space during entry operations until relieved by another qualified attendant.

g. Keep in visual or voice contact with authorized entrants as necessary to monitor entrant status. If the personnel in the space need to leave visual contact and verbal contact with the attendants, use mechanical or electronic communications.

h. Monitor activities inside and outside the space to determine whether it is safe for entrants to stay in the space. Order those inside to leave the space immediately if you:

   (1) Detect a prohibited condition,

   (2) Notice behavioral effects of hazard exposure in someone in the space,

   (3) See a situation outside the space that could endanger those inside, or

   (4) Can’t effectively and safely perform all required duties

i. Maintain the method of contacting emergency services as required in the approved entry procedure.

j. Call emergency rescue services when they suspect those inside may need help to escape from hazards in the space.

k. Take the following actions when unauthorized persons (not involved in the entry) approach or enter a permit space while entry is under way:

   (1) Warn the unauthorized persons to stay away from the permit space.

   (2) Advise the unauthorized persons to exit immediately if they have entered the permit space.

   (3) Inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space.

   (4) Stop confined space operations until unauthorized personnel are removed.

l. Perform non-entry rescues, when necessary and feasible, after notifying emergency rescue services. Never enter a confined space to rescue someone unless you are part of an emergency rescue team as described in paragraph 6.9.20.

m. Never do anything that might interfere with their primary duty to monitor and protect those inside the space.

6.9.17. Duties of authorized entrants

6.9.17.1 *Authorized entrants* shall:

a. Be properly trained and certified in confined space entry procedures.

b. Know the hazards that they may face in a confined space, including information on the mode, signs or symptoms, and consequences of the hazard exposures.

c. Properly use equipment as required by this chapter.

d. Communicate with the attendant as necessary so the attendant can monitor your status and alert you if you need to evacuate the space.

e. Alert the attendant if they:

(1) Recognize any warning sign or symptom of a dangerous situation

(2) Detect a prohibited condition

f. Exit from the permit space as quickly as possible if they:

(1) Get an order to evacuate from the attendant or the entry supervisor

(2) Recognize any warning sign or symptom of a dangerous situation

(3) Detect a prohibited condition

(4) Hear an evacuation alarm

6.9.18. Equipment for entering a confined space

Before entering a confined space, entrants, attendants, and supervisosrs shall have the proper and necessary equipment required by OSHA standards and the entry procedure.

6.9.19. Protective clothing and equipment for entering a confined space

6.9.19.1 When entering a confined space, wear PPE as required in the entry procedure to protect you from hazards in the space. Entrants shall:

a. Follow Chapter 5.6, “Personal Protective Equipment.”

b. Follow Chapter 7.2, “Respiratory Protection,” for respirator use.

c. Use a self-contained breathing apparatus (SCBA) only when they can fit through the entry openings with an SCBA strapped on. If not, or if the space opening is less than or equal to 18 inches in diameter, use a supplied-air respirator.

6.9.20. Rescue and emergency equipment

Work crews shall have rescue and emergency equipment in place before anyone enters the confined space as required by the OSHA standards and the approved entry procedure.

6.9.21. What to do in an emergency

Remember, your emergency numbers are: x33333 or (281) 483-3333 at JSC, Sonny Carter Training Facility, and Ellington Field.

6.9.21.1 In an emergency, the *attendant* or *entry supervisor* shall:

a. Follow emergency procedures. Never attempt to rescue a worker from a confined space until they call your emergency number for a rescue team.

b. Never enter a confined space to rescue someone. Only approved rescue teams meeting the requirements of 29 CFR 1910.146(k) and approved by the Safety and Test Operations Division and Occupational Healthmay enter a confined space for rescue.

c. Make sure an SDS or similar written information is provided to the medical facility treating an entrant who is exposed to a hazardous substance.

d. Coordinate with local fire and ambulance services if relying on them for confined space rescues and medical transport by:

(1) Telling them about the hazards they may face during confined space rescues.

(2) Having them visit all confined spaces to which they may be called so they can develop rescue plans for each space and practice rescue operations.

6.9.22. Medical surveillance examination

Entrants shall have a medical surveillance examination as required in Chapter 3.6 before becoming qualified to enter a Confined Space.

6.9.23. Training for confined spaces

6.9.23.1 Training provides supervisors, attendants, and entrants with the understanding, knowledge, and skills needed to work safely in and around confined spaces. Training shall:

a. Fulfill the requirements of the applicable OSHA standards and JSC requirements:

b. Include JSC's Confined Space Entry course. This course meets the requirements of 29 CFR 1910.146 and 29 CFR 1926.1207 for entry supervisors, attendants, and entrants. Employees may also take JSC site-specific confined space entry training through the Houston Area Safety Council.

NOTE: WSTF personnel take WSTF's confined space entry course.

c. Be documented with a training completion card stating the employee has been trained in JSC's confined space requirements. The card is good for 2 years. Then retraining is required.

6.9.24. Certification

The employer shall certify that the training required by the OSHA standard has been accomplished. See Chapter 5.8.

6.9.25. Off-site contractors entering confined spaces

a. JSC team members who arrange to have off-site contractor employees perform work in a confined space shall:

(1) Inform the contractor the workplace has confined spaces and the contractor needs to follow JSC's confined space entry program when working in confined spaces.

(2) Tell the contractor why a space in question is a confined space, including the hazards identified and JSC's experience with the space.

(3) Tell the contractor of any precautions or procedures JSC has implemented under its program to protect employees in or near the spaces contractor personnel will be working in.

(4) Ensure the contractor is working under an approved entry procedure.

(5) Make sure contractor employees who will enter confined spaces receive the training in paragraph 6.9.23 and have been certified by their employer.

(6) Coordinate entry operations with the contractor.

(7) Debrief the contractor when the job is done to get feedback about JSC's permit space program and the hazards found or created in the spaces during operations.

b. Off-site contractors whose employees work in confined spaces at JSCshall follow JSC's confined space requirements in this chapter and:

(1) Obtain any available information on permit space hazards and entry operations from the contracting organization.

(2) Make sure all employees who will work in confined spaces are trained as described in paragraph 6.9.23 and certified as described in paragraph 6.9.24. They shall also provide documentation of prior class work in confined space entry, receive the JSC confined space overview, and demonstrate an understanding of JSC's program.

(3) Coordinate entry operations with the contracting organization.

(4) Inform the contracting organization of any hazards found or created in any confined space, either at a debriefing or while working.

6.9.26. For more information on entering confined spaces

a. 29 CFR 1910.146, "Permit-Required Confined Spaces"

b. 29 CFR 1926 Subpart AA, "Confined Spaces in Construction"

c. NIOSH Criteria Document on Working in Confined Spaces

d. NIOSH Publication IF 87-113, "A Guide to Safety in Confined Spaces"

e. NHS/IH 1845.2, Publication No. 80-106, "Entry Into and Work in Confined Spaces"

6.9.27. Definition of a controlled area

6.9.27.1 A controlled area is one that

a. An employee can completely enter and work in, but is not, by definition, a confined space.

b. Periodically contains, or can, after a single point failure, contain a hazardous atmosphere when employees are present that may expose them to the risk of death, or acute illness, injury, incapacitation, and impaired ability to self rescue from any of the following conditions:

(1) Flammable gas, vapor, or mist in excess of 10% of its lower explosive limit (LEL).

(2) Airborne combustible dust at a concentration that meets or exceeds its LEL.

(3) Atmospheric oxygen concentrations below 19.5% or above 23.5%. Note: Atmospheric oxygen concentrations may vary significantly due to stratification or inadequate mixing (e.g., be acceptable at one location but not another).

(4) Atmospheric concentration of any substance for which there is a published exposure limit and which could result in employee exposure in excess of that limit.

c. Contains any other condition immediately dangerous to life or health. Examples of controlled areas include:

(1) Vacuum chambers (during non-test conditions).

(2) Hyperbaric and hypobaric chambers.

(3) WSTF altitude test stands.

(4) Enclosed outdoor areas for loading liquid nitrogen.

(5) Laboratories with compressed or plumbed gas lines or LN2 dewars.

(6) Temporary work areas where construction, welding, or other work processes can create the conditions described above.

6.9.28. Identifying controlled areas at JSC

6.9.28.1 To identify controlled areas, JSC managers shall:

a. Evaluate work areas to identify controlled areas. Consult safety or health representatives to help in the determination. Consider the area based on its use when personnel are present. For example, evaluate the interior of a vacuum test chamber during periods for maintenance, test article mounting, instrumentation set-ups, etc. Do not evaluate a vacuum chamber while it is at vacuum under test conditions.

b. Designate an area as “controlled” if occupational safety or health representatives determine it should be a controlled area after close calls, mishaps, hazard analysis, or other inspection indicate the hazards require additional mitigation or monitoring.

NOTE: Depending on the configuration of the area, a controlled area may be upgraded to a JSC- or OSHA-permitted confined space.

6.9.29. What to do if you have controlled areas in your work area

6.9.29.1 Facility managers or JSC managers with controlled areas in their facilities shall:

a. Ensure the controlled area is covered by a Hazard Analysis per chapter 2.3. The Hazard Analysis shall include:

(1) Control of both hardware configuration and procedures that may generate the hazardous condition. Consider an entry checklist, entry procedure, warning signs, or training.

(2) Any critical timing associated with the controls. Note there are trades to be made. For example, if the valve were closed and locked, the critical time may be extended to a shift or longer.

b. Notify Occupational Healthof the controlled area.

c. Include the hazard analysis in the facility baseline documentation if required by Chapter 10.4.

d. Periodically assess the effectiveness of controls by field inspection.

6.9.30. Responsibilities for controlled areas

a. Occupational Healthshall:

(1) Maintain a list of controlled areas under these requirements at **https://nasa.sharepoint.com/sites/jsc-oh/SitePages/Controlled.aspx#controlled-area-library**.

(2) Assess the effectiveness of controlled area controls yearly.

b. The Safety and Test Operations Division shall:

(1) Assess the hazard analyses and controls during audits of the facility.

(2) Assess workplace conditions for compliance with these requirements during periodic facility inspections.