



Duke University - Facilities Management Department Environmental Safety and Health Program

CONFINED SPACE PROGRAM

Applicable to: All FMD Organizations

Date Effective: 15 May 2011

Issue No.: 1 **Revision:** 4

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A. Purpose

1. The Confined Space Entry (CSE) Program is designed to eliminate hazards while entering or working in confined spaces. This Facilities Management Department (FMD) program should be used in conjunction with the Duke University Confined Space Entry Program and provides specific procedures and responsibilities for FMD personnel.

B. Scope

1. This program applies to all FMD employees and contractors working for FMD.

C. Policy

1. FMD will take all reasonable measures to provide a safe workplace. All FMD operations must be performed in a manner, which will prevent any undesirable effects to FMD and/or Duke employees, assets, the local community, and the environment.
2. The provisions of this program and all applicable standards will be followed to ensure the safety of personnel performing service or maintenance activities to equipment, machines, or systems. **Failure to follow the requirements of the Confined Space Program will be cause for disciplinary action.**

D. Definitions

1. **Acceptable Entry Conditions:** The conditions that must exist in a permit-required confined space (permit space) to allow entry and to ensure that employees involved with a permit-required confined space entry can safely enter into and work within the space.
2. **Alternate Entry Procedure:** Procedure that may be used when the employer can demonstrate with monitoring and inspection data that the only hazard is an actual or potential hazardous atmosphere that can be made safe entry using continuous forced air ventilation. In this case, the employer may be exempted from some requirements, such as tripods and attendants. However, even in these circumstances, the employer must test the internal atmosphere of the space for oxygen content, flammable gases and vapors, and the potential for toxic air contaminants before any employee enters it. The employer must also provide continuous ventilation and verify that the required measurements are performed before entry.
3. **Attendant:** An individual stationed outside one or more permit spaces who monitors the authorized entrants and who performs all attendant's duties assigned in the employer's permit space program.
4. **Authorized Entrant:** An employee who is authorized by the employer to enter a permit space.
5. **Confined Space:** A space that:
 - a. Is large enough and so configured that an employee can bodily enter and perform assigned work; and
 - b. Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry.); and
 - c. Is not designed for continuous employee occupancy.
6. **Contract labor:** Personnel contracted from a company and who work directly with/in an FMD shop/work area.
7. **Entry:** The action by which a person passes through an opening into a permit-required confined space. Entry includes 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.
8. **Entry Permit (permit):** The Duke University Confined Space Entry form (see Attachment A) to allow and control entry into a permit space.
9. **Entry Supervisor:** The person responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required by this section. **Note:** An Entry Supervisor also may serve as an attendant or as an authorized entrant,

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as long as that person is trained and equipped as required by this section for each role he or she fills. Also, the duties of Entry Supervisor may be passed from one individual to another during the course of an entry operation.

10. **Hazardous Atmosphere:** An atmosphere that may expose employees to the risk of death, incapacitation, and impairment of ability to self-rescue (that is, escape unaided from a permit space), injury, or acute illness from one or more of the following causes:
 - a. Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;
 - b. Flammable gas, vapor, or mist in excess of 10 percent of its Lower Explosive Limit (LEL);
 - c. Airborne combustible dust at a concentration that meets or exceeds its LEL; this should be conducted via a visual inspection; **Note:** This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet (1.52 m) or less.
 - d. Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in 29 CFR Subpart G, Occupational Health and Environmental Control, or in 29 CFR Subpart Z, Toxic and Hazardous Substances, and which could result in employee exposure in excess of its dose or permissible exposure limit;
 - e. Any other atmospheric condition that is immediately dangerous to life or health. **Note:** For air contaminants for which OSHA has not determined a dose or permissible exposure limit, other sources of information, such as Material Safety Data Sheets that comply with the 29 CFR 1910.1200 Hazard Communication Standard, published information, and internal documents can provide guidance in establishing acceptable atmospheric conditions.
11. **Hot Work:** Any work involving burning, welding or similar fire-producing operations. Also, any work that produces a source of ignition, such as grinding, drilling, or heating.
12. **Hot Work Permit:** The employer's written authorization to perform operations (for example; welding, cutting, burning, riveting, and heating) capable of providing a source of ignition.
13. **Lower Explosive Limit (LEL):** The minimum concentration of a combustible gas or vapor in air that will ignite if an ignition source is introduced.
14. **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.
15. **Oxygen Deficient Atmosphere** means an atmosphere containing less than 19.5 percent oxygen by volume.
16. **Oxygen Enriched Atmosphere** means an atmosphere containing more than 23.5 percent oxygen by volume.
17. **Permit-required Confined Space (Permit Space)** means a confined space that has one or more of the following characteristics:
 - a. Contains or has a potential to contain a hazardous atmosphere;
 - b. Contains a material that has the potential for engulfing an entrant;
 - c. Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or
 - d. Contains any other recognized serious safety or health hazard.
18. **Prohibited Condition:** Any condition in a permit space that is not allowed by the permit during the period when entry is authorized.
19. **Rescue Service:** means the personnel designated to rescue employees from permit spaces. For FMD and Duke University, the rescue service is the Durham Fire Department.
20. **Retrieval System:** means the equipment (including a retrieval line, chest of full-body harness, and a lifting device or anchor) used for non-entry rescue of persons from permit spaces.
21. **Testing:** means the process by which the hazards that may confront entrants of a permit space are identified and evaluated. Testing includes specifying the test that are to be performed in the permit space.

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E. Responsibilities

1. Attendant

- a. Know the hazards that may be faced during entry, including information on the mode, signs or symptoms and consequences of the exposure;
- b. Be aware of possible behavioral effects of hazard exposure in authorized entrants;
- c. Maintain a continuous and accurate count of authorized entrants in the permit space and ensures the means to identify authorized entrants accurately identifies who is in the permit space;
- d. Remain outside the permit space during entry operations until relieved by another attendant;
- e. Monitor activities inside and outside the space to determine if it is safe for entrants to remain in the space and order the entrants to immediately evacuate if: the attendant detects a prohibited condition, detects the behavioral effects of hazard exposure in an authorized entrant, detects a situation outside the space that could endanger the entrants; or if the attendant cannot effectively and safely perform all the attendant duties;
- f. Record the atmosphere analyzer readings once every 30 minutes and document the results on the Confined Space Permit form;
- g. Have in their possession a radio and/or cell phone that can reach/dial 911 in an emergency;
- h. Summon rescue and other emergency services as soon as the attendant determines that authorized entrants may need assistance to escape from permit space hazards (see Emergency and Rescue Service Procedures below);
- i. Take the following actions when unauthorized persons approach or enter a permit space while entry is underway:
 - 1) Warn the unauthorized persons that they must stay away from the permit space;
 - 2) Advise the unauthorized persons that they must exit immediately if they have entered the space; and
 - 3) Inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space.
 - 4) Remove unauthorized persons who enter or attempt to enter the space during entry operations;
 - 5) Perform no duties that might interfere with the attendant's primary duty to monitor and protect the authorized entrants.

2. Authorized Entrant

- a. All entrants must be authorized by the Entry Supervisor to enter permit spaces, have received the required training, use the required confined space entry equipment, and observe the entry procedures and permit. The following entrant duties are required:
- b. Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;
- c. Communicate with the attendant to enable the attendant to monitor entrant status and alert entrants of the need to evacuate the space;
- d. Alert the attendant whenever: The entrant recognizes any warning sign or symptom of exposure to a dangerous situation, or the entrant detects a prohibited condition; and
- e. Exit the permit space as quickly as possible whenever: the attendant or Entry Supervisor gives an order to evacuate. The entrant recognizes any warning sign or symptom of exposure to a dangerous situation, the entrant detects a prohibited condition, or an evacuation alarm is activated.

3. Entry Supervisor

- a. Responsible for the overall permit space entry and must coordinate all entry procedures, tests, permits, and other relevant activities.
- b. Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

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- c. Verify that the permit has been filled out properly, all tests specified by the permit have been conducted and that all procedures and equipment specified by the permit are in place before signing the permit and allowing entry to begin;
- d. Verify that rescue services are available and that the means for summoning them are operable;
- e. Determine, whenever responsibility for a permit space entry operation is transferred and at intervals dictated by the hazards and operations performed within the space, that entry operations remain consistent with the permit terms and that acceptable entry conditions are maintained; and
- f. Terminate the entry and cancel the permit when the entry is complete or there is a need for terminating the permit.

4. Shop Supervisor

- a. Ensure that the employee(s) entering confined spaces have the necessary PPE, and are familiar with the use and operation of this equipment and all other equipment needed for safe entry.
- b. Responsible for confined space equipment maintenance and calibration.
- c. When contracted laborers enter a confined space while working with/for FMD personnel, the Shop Supervisor will be responsible for ensuring these contract personnel have the necessary protective equipment and they are familiar with its use.
- d. Coordinate with the FMD Training Coordinator and OESO annual confined space entry training.
- e. Maintain all permits on file for a minimum of one calendar year.

5. FMD Training Coordinator

- a. Work with OESO to ensure that all Authorized Entrants, Attendants, and Entry supervisors are properly identified within the Safety Management System database to allow for compliance tracking for the department
- b. Compile timely rosters of training required for Confined Space Entry Supervisors, Authorized Entrants.
- c. Supply those rosters to Shop/Area Supervisors as required and at least annually.
- d. Ensure Confined Space training is documented within the FMD and OESO training databases and training documentation (rosters, quizzes, etc.) is retained
- e. Coordinate with OESO to provide a copy of FMD's Confined Space Inventory to the Durham Fire Department for use in emergency situations.

6. Contracted Labor

- a. Whenever outside servicing personnel are to be engaged in activities covered by the scope and application of this Program, FMD and the outside employer shall inform each other of their respective confined space procedures. It is the responsibility of the contractor to ensure their employees are not only compliant with the current OSHA regulations, but also with any additional requirements set forth by Duke and/or FMD in this program.
- b. Utilize the FMD Confined Space Entry Form (Attachment A) if they do not have one.
- c. When requested, contractors will provide documentation of their OSHA-compliant program and employee training records.

F. Entry Procedures

- 1. **Pre-entry.** Complete sections 2, 3, 4 of Attachment A: Confined Space Entry Form to determine the type of entry to be used at that particular job site. One of two types of entry will be utilized, Permit Entry or Alternate Entry.
 - a. If any work involving burning, welding or similar fire-producing operations is to occur, a hot work permit will be obtained before work begins.
- 2. **Permit Entry**
 - a. **BEFORE Work Begins:** Call either the Work Control Center at 684-2122 (Maintenance Services personnel) or the Steam Plant Control Room at 660-4243 (Utilities and High Voltage personnel) to let them know work is

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commencing in a Confined Space and who is involved. They will utilize Attachment C – Confined Space Entry Log to document who is entering a confined space, where, and when.

- b. A tripod will always be set up at the work site for manhole entry.
- c. A harness and lanyard system is always required to be worn before entering a confined space regardless of whether the space is permit or non-permit required.
- d. Anklets or wristlets will be worn when conducting horizontal confined space entry.
- e. If open flames are to be used in a confined space, a hot-work permit will be obtained before work begins.
- f. Identify hazard sources affecting the confined space (such as electric, steam, gas, etc.).
- g. Drain and/or purge the space as appropriate.
- h. Lockout and tagout any other hazard sources, if possible.
- i. Post temporary warning signs or temporary barriers to control access to the confined space and to guard the opening for falls.
- j. Prior to entry, test the atmosphere of the space every 4 feet in elevation and in the vicinity of where the work will be performed in the following order:
 - 1) Oxygen level. Acceptable limit is 19.5% to 23.5%.
 - 2) Combustible gas. Acceptable level is less than 10% of Lower Explosive Limit (LEL).
 - 3) Toxic gases.
 - a) Acceptable level for hydrogen sulfide (H₂S) is less than 10 ppm.
 - b) Acceptable level for carbon monoxide (CO) is less than 35 ppm.
 - c) When other toxic gases may be present, contact OESO at 684-5996 for assistance.
 - 4) Heat. Test for air temperature. Ensure compliance with standards for heat stress as determined by OESO.
- k. If a potential hazardous atmosphere exists, use continuous mechanical ventilation sufficient to purge the confined space atmosphere while entrants are inside the space.
- l. If the atmospheric hazards are eliminated, then the Entry Supervisor shall complete the Confined Space Entry Form, sign and certify the confined space is safe to enter and post it adjacent to the entry location.
- m. Use continuous air monitoring equipment in the confined space while personnel are inside a PRCS.
- n. Before any re-entry, for example after break or lunch, retest atmosphere.
- o. If the atmosphere analyzer (gas tester) alarm signal activates:
 - 1) The confined space must be evacuated immediately.
 - 2) Call Entry Supervisor and Shop Supervisor,
 - 3) Confined space must be reassessed for hazardous atmosphere, and
 - 4) The atmosphere shall be tested before entry and the Entry Supervisor will re-certify the confined space on the confined space entry form.
- p. When the task is completed, ensure all entrants have exited the space and all tools and equipment have been removed.
- q. Close and/or secure the access to the space and remove temporary protective barriers and signs.
- r. Record the completion time on the Confined Space Entry Form and return the form to the Supervisor.

3. Alternate Entry

- b. **BEFORE Work Begins:** Call either the Work Control Center at 684-2122 (Maintenance Services personnel) or the Steam Plant Control Room at 660-4243 (Utilities and High Voltage personnel) to let them know work is commencing in a Confined Space and who is involved. They will utilize Attachment C – Confined Space Entry Log to document who is entering a confined space, where, and when.
- c. A harness and lanyard system is always required to be worn before entering a confined space regardless of whether the space is permit or non-permit required.
- d. Anklets or wristlets will be worn when conducting horizontal confined space entry
- e. Identify hazard sources affecting the confined space (such as electric, steam, gas, etc.).

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- f. Drain and/or purge the space as appropriate.
- g. Lockout and tagout any other hazard sources, if possible
- h. Post temporary warning signs or temporary barriers to control access to the confined space and to guard the opening for falls.
- i. Prior to entry, test the atmosphere of the space every 4 feet in elevation and in the vicinity of where the work will be performed in the following order:
 - 1) Oxygen level. Acceptable limit is 19.5% to 23.5%.
 - 2) Combustible gas. Acceptable level is less than 10% of Lower Explosive Limit (LEL).
 - 3) Toxic gases.
 - a) Acceptable level for hydrogen sulfide (H₂S) is less than 10 ppm.
 - b) Acceptable level for carbon monoxide (CO) is less than 35 ppm.
 - c) When other toxic gases may be present, contact OESO at 684-5996 for assistance.
 - 4) Heat. Test for air temperature. Ensure compliance with standards for heat stress as determined by OESO.
- j. Use continuous mechanical ventilation sufficient to purge the confined space atmosphere while entrants are inside the space.
- k. If the atmospheric hazards are eliminated, then the Entry Supervisor shall complete the Confined Space Entry Form, sign and certify the confined space is safe to enter and post it adjacent to the entry location.
- l. Use continuous air monitoring equipment in the confined space while personnel are inside a PRCS.
- m. Before any re-entry, for example after break or lunch, retest atmosphere.
- n. If the atmosphere analyzer (gas tester) alarm signal activates:
 - 1) The confined space must be evacuated immediately.
 - 2) Call Entry Supervisor and Shop Supervisor.
 - 3) Confined space must be reassessed for hazardous atmosphere, and
 - 4) The atmosphere shall be tested before entry and the Entry Supervisor will re-certify the confined space on the confined space entry form.
- o. When the task is completed, ensure all entrants have exited the space and all tools and equipment have been removed.
- p. Close and/or secure the access to the space and remove temporary protective barriers and signs.
- q. Record the completion time on the Confined Space Entry Form and return the form to the Supervisor

G. Emergency Procedures

- 1. **FMD personnel are not trained to conduct rescue operations. In an emergency the following procedures will be followed:**
 - a. Attempt to regain communication with the entrant.
 - b. Notify campus police dispatcher that you need a confined space rescue. (Use a radio or by cell phone call 684-2444 or 911.) Provide the location of the confined space and any other relevant information about the condition of the entrant and hazards of the space.
 - c. Notify the Entry Supervisor, Shop Supervisor, and Work Control Center.
 - d. Re-attempt to regain communication with the entrant.
 - e. Survey the scene and determine if electrical or other hazards are present at the site and need to be isolated for the protection of Emergency Responders (EMS, Fire Dept., Police).
 - f. Upon arrival of rescue equipment (or before as time allows) provide additional traffic control and working space for equipment and personnel, if appropriate.
 - g. When other rescue personnel arrive, assist in coordination with other departments and the development of a plan of action. Consider atmosphere quality, hazardous energy in the space, fall hazards, other hazards.

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H. Annual Permit Required Confined Space Review

1. Conduct an annual audit on the Confined Space Program to ensure program effectiveness and compliance with applicable standards.

I. Training

1. Training shall be provided so that all employees whose work is regulated by this section acquire the understanding, knowledge, and skills necessary for the safe performance of the duties assigned as contained in this program.
2. Training shall be provided to each attendant and entrant:
 - a. Before the employee is first assigned duties under this section;
 - b. Before there is a change in assigned duties;
 - c. Whenever there is a change in permit space operations that presents a hazard about which an employee has not previously been trained;
 - d. Whenever the employer has reason to believe either that there are deviations from the permit space entry procedures or that there are inadequacies in the employee's knowledge or use of these procedures.
3. The training shall establish employee proficiency in the duties required by this section and shall introduce new or revised procedures, as necessary, for compliance with this program.
4. The training coordinator shall certify that the training required by paragraphs (I)(1) through (I)(3) of this section has been accomplished. The certification shall contain each employee's name, the signatures or initials of the trainers, and the dates of training. The certification shall be maintained on file and available for inspection.

J. References

1. Duke University Safety Manual.
2. OSHA Standard 29 CFR 1910.146, *Permit-Required Confined Spaces*.
3. ANSI/ASSE Z117.1-2003, *Safety Requirements for Confined Spaces*.

K. Attachments

1. Attachment A: Confined Space Entry Form
2. Attachment B: Multi-log Entry Form
3. Attachment C: Confined Space Entry Log

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SECTION II – Physical Hazard(s) Assessment

Check all Real or Potential **PHYSICAL** hazards.

- | | |
|--|---|
| <input type="checkbox"/> Engulfment (loose material) | <input type="checkbox"/> Exposed electrical devices |
| <input type="checkbox"/> Moving machinery | <input type="checkbox"/> Slips / Falls |
| <input type="checkbox"/> Hazardous material | <input type="checkbox"/> Heat stress (i.e. steam) |
| <input type="checkbox"/> Converging walls | <input type="checkbox"/> Other: |
|
 | |
| <input type="checkbox"/> No Physical Hazards | |

SECTION III – Atmospheric Hazard(s) Assessment

Check all Real or Potential **ATMOSPHERIC** hazards.
(Complete Initial Evaluation in Atmospheric Testing Table)

- | | |
|---|--|
| <input type="checkbox"/> Low Oxygen (<19.5%) | <input type="checkbox"/> Hydrogen sulfide (>10ppm) |
| <input type="checkbox"/> High Oxygen (>23.5%) | <input type="checkbox"/> Other: |
| <input type="checkbox"/> Flammable (>10% LEL) | |
| <input type="checkbox"/> Carbon Monoxide (>35ppm) | |

SECTION IV – Hazard Controls

Will any **PHYSICAL** hazards be *eliminated OR controlled* by the following?

- Lockout /Tagout
- Blanking & Bleeding (hydraulic & pneumatic)
- Disconnecting (i.e. mechanical or electrical linkages)
- Securing (moving parts)
- Heat (ventilation)
- Other:

NOTE: If ALL real or potential Physical hazards are eliminated, Alternate Procedure is authorized. If NO to any of these, Permit is required.

Will any identified **ATMOSPHERIC** Hazards be *controlled* by continuous ventilation?

- Space will be ventilated continuously during entry. (Required for manholes)**
Fan's flow rate = _____ cfm

Copy of **FMD Confined Space Program** on hand.

NOTE: If ALL real or potential Atmospheric hazards are eliminated and/or controlled, Alternate Procedure is authorized. If NO to any of these, Permit is required.

Type of entry to be accomplished:

Alternate Entry Procedure Permit Required

NOTE: If Hot Work is to be performed, Permit Required Entry must be used.

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SECTION V – Equipment Requirements

Entry requirement	Required	Checked	Personal Protective Equipment	Required	Checked
Radio/Cellphone	X		Boots (Type)		
Ventilation Equipment	X		Hard Hat (Type I, Class E)		
GFCI Protected Power	X		Eye Protection (Type)	X	
Full-Body Harness	X		Gloves (Type)		
Tripod On-site (manholes)	X		Hearing Protection (Type)		
Manhole Barricades	X		Respiratory Protection (Type)		
Continuous Air Monitoring	X		Special Clothing (Type)		
Explosion Proof Lighting			Other		
Non-Sparking Tools			Other		
Ladders			Other		
Hot Work Permit					

Comments:

SECTION VI – Atmospheric Testing

Testing Equipment Used	Model	I.D. Number

I certify equipment is in calibration. _____
 Phone: _____ *(Signature of Shop Supervisor or Contractor Rep)*

Atmospheric Testing	Pre-Ventilation	Pre-Entry	Periodic re-check (Reading at least every 30 minutes.)		
	Time: _____ Results/Initials	Time: _____ Results/Initials	Time: _____ Results/Initials	Time: _____ Results/Initials	Time: _____ Results/Initials
Oxygen (19.5%-23.5%)					
Combustibles (<10% LEL)					

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Carbon Monoxide (< 35 ppm)					
Hydrogen Sulfide (<10 ppm)					
Temperature (Steam MH's)					
Other (list)					

SECTION IV – Emergency Action

NEVER enter a confined space to attempt a rescue. Rescue attempts will only be performed by the Durham Fire Department's trained personnel. In the event of a confined space emergency call 911 or 684-2444. Provide detailed information to the emergency operator letting them know it is a confined space emergency, the specifics of the emergency, and location of the emergency. Note any additional requirements/ information:

Non-entry Retrieval Equipment:

Alternate Procedure:

--Body harness & lanyard on entrants

Permit Required:

-- Body harness & lanyard on entrants
-- Tripod and hoist (spaces greater than

SECTION VIII – Permit Cancellation

Permit Cancelled by: _____
Date _____ Time: _____

Permit was canceled because (check one) Work has been completed The permit has expired
 Emergency (specify) _____

AFTER Work is Completed: Call either the Work Control Center at 684-2122 (Maintenance Services personnel) or the Steam Plant Control Room at 660-4243 (Utilities and High Voltage personnel) to let them know the work in the Confined Space is complete and all personnel are accounted for.

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Attachment B – Multi-log Entry Form

ATMOSPHERIC TESTING (Monitor Continuously - Record test results every 30 minutes)

Location (MH#)						
GASES	Acceptable Conditions	Pre-Ventilation	Pre-Entry	Time:	Time:	Time:
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Flammable	<10% LEL					
Carbon Monoxide (CO)	< 35ppm					
Hydrogen Sulfide	<10ppm					
Temperature (Mh's)						
Other:						

ATMOSPHERIC TESTING (Monitor Continuously - Record test results every 30 minutes)

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Revision History

Revision	Description	Effective Date
1	Add Attachments A and B	4/6/10
2	Update Attachment A and other information in Program	4/12/10
3	Update Contractor responsibility language; rename Attachment A; add Attachment C	6/15/10
4	Update language and Attachments	5/15/11



**Duke University - Facilities Management Department
Environmental Safety and Health Program**

CONFINED SPACE PROGRAM

Applicable to: All FMD Organizations

Date Effective: 15 May 2011

Issue No.: 1 Revision: 4

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ATMOSPHERIC TESTING (Monitor Continuously - Record test results every 30 minutes)

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