CONFINED SPACE ENTRY AND RESCUE GUIDELINE

APPROVAL:

Signature on file
Institution Safety Committee Chair
Signature on file
Environmental Health & Safety Director

5/18/09
Date
5/14/09
Date
1.0 INTRODUCTION

1.1 The purpose of this guideline is to establish requirements for protecting Woods Hole Oceanographic Institution (WHOI) personnel from hazards associated with entering and working in confined spaces.

1.2 This guideline applies to all WHOI personnel. This Guideline does not apply to marine operations that are addressed by applicable U.S. Coast Guard regulations.

2.0 ROLES AND RESPONSIBILITIES

2.1 Environmental Health and Safety (EH&S) Office

- Maintains this guideline
- Ensures that confined space monitoring instruments are maintained and calibrated
- Provides training and assists with program implementation (x3347)

2.2 Supervisors and Personnel

- Attends required training
- Implement and follow all applicable requirements of this guideline

3.0 DEFINITIONS

3.1 Attendant -- The individual assigned to remain immediately outside the entrance to a confined space whose responsibility it is to render assistance as needed to the personnel inside the space. The Attendant and Entry Supervisor can be the same individual.

3.2 Authorized Entrant -- The individual who is authorized by WHOI to enter a permit-required confined space.

3.3 Blanking or Blinding -- The absolute closure of a pipe, line, or duct by the fastening of a solid plate that completely covers the bore and that is capable of withstanding the maximum pressure of the pipe, line, or duct with no leakage beyond the plate.

3.4 Confined Space – A space that has ALL of the following features:
- Is large enough and so configured that personnel can bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit (for example, tanks, vessels, storage bins, hoppers, vaults and pits are spaces that may have limited means of entry).
- Is not designed for continuous personnel occupancy.

A list of known, shore-side confined spaces is provided on the WHOI EH&S website.

3.5 Double block and bleed -- The closure of a line, duct, or pipe by closing and locking or tagging two in-line valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves.

3.6 Engulfment -- The surrounding or capture of an entrant by a liquid or a flowable fine solid substance (i.e. silica, powders) that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the entrant to cause death by strangulation, constriction, or crushing.
3.7 **Entry** -- The action of a person passing through an opening into a confined or enclosed space. The entry starts as soon as any part of the entrant’s body breaks the plane of the opening into the space.

3.8 **Emergency** -- Any occurrence (including any failure of hazard control or monitoring equipment) or event internal or external to the permit space that could endanger entrants.

3.9 **Entry Supervisor** -- The person (such as the lead worker, foreman, or crew chief) 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. The Entry Supervisor and Attendant can be the same individual.

3.10 **Hazardous Atmosphere** -- An atmosphere that may expose personnel to the risk of death, incapacitation, impairment of ability to self-rescue, injury, or acute illness from one or more of the following causes:

- Flammable gas, vapor or mist in excess of 10% of its lower flammable limit.
- Airborne combustible dust at a concentration that meets or exceeds its lower flammable limit.
- Atmospheric oxygen concentration below 19.5% or above 23.5%.
- Atmospheric concentration of any substance that could exceed an OSHA-established permissible exposure limit (PEL).
- Any other atmospheric condition that is immediately dangerous to life or health.

3.11 **Isolation** -- The process by which a permit space is removed from service and completely protected against the release of energy and material into the space by such means as: blanking or blinding; misaligning or removing sections of lines, pipes, or ducts; a double block and bleed system; lockout or tagout of all sources of energy; or blocking or disconnecting all mechanical linkages.

3.12 **Line breaking** -- The intentional opening of a pipe, line, or duct that is or has been carrying flammable, corrosive, or toxic material, an inert gas, or any fluid at a volume, pressure, or temperature capable of causing injury.

3.13 **Non-permit confined space** -- A confined space that does not contain atmospheric hazards or have the potential to contain any hazard capable of causing death or serious physical harm.

3.14 **Permit-Required Confined Space** - A confined space that has one or more of the following characteristics:

- Contains or has a potential to contain a hazardous atmosphere;
- Contains a material that has the potential for engulfing an entrant;
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward/tapers to a smaller cross-section; or
- Contains any other recognized serious safety and health hazard.

4.0 **HAZARD IDENTIFICATION AND CONTROL**

4.1 The potential hazards that entrants could be exposed to in confined spaces may include:

- Oxygen deficiency or enrichment. A concentration of oxygen in the atmosphere less than 19.5% by volume or concentrations higher than 23.5% by volume.
- The presence of explosive/flammable gases, equal to or greater than 10% of the lower flammable limit (LFL).
- The presence of toxic hydrogen sulfide (H₂S) gas, equal to or more than 10-ppm.
- The presence of carbon monoxide (CO) equal to or more than 35-ppm.
- Engulfment.
• Other hazards such as electrical shock, burns, heat stress, slips and falls.
• If the presence of other toxic contaminants is suspected, specific monitoring programs will be required to be developed.

4.2 Procedures for controlling hazards associated with entering confined spaces are included in Appendices A and B.

5.0 TRAINING

5.1 Initial and 2-year refresher training will be provided to affected personnel (Authorized Entrant, Attendant, and Entry Supervisor) by the EH&S Office. All requirements of the confined space entry and rescue program will be covered during this training. Additionally, training shall be provided:

• Prior to personnel being assigned to serve as an Authorized Entrant, Attendant, or Entry Supervisor.
• When there is a change in permit space operations that presents a new or different hazard about which personnel have not previously been trained.
• When there are significant deviations from requirements established in this guideline.
• When supervisors determine that there are inadequacies in personnel knowledge or use of these procedures. As necessary, the EH&S Office can assist with this training.

6.0 SPACE CLASSIFICATION

6.1 A list of known shore-side confined spaces is provided on the EH&S website.

6.2 Any confined space not identified on the EH&S website will be considered permit-required until verified that it is a non-permit space. A permit-required confined space may be reclassified as a non-permit confined space if all of the following conditions are met: 1) the space poses no actual or potential atmospheric hazards, and 2) all other hazards within the space are eliminated without entry into the space.

6.3 If entry into the space is required to eliminate hazards the space must be treated as permit-required until the hazards are abated.

6.4 Reclassification of a permit-required confined space must be approved by the EH&S Office.

7.0 ACCESS CONTROL

7.1 Wherever feasible, all permit-required confined spaces will be marked by posting danger signs indicating entry is by permit only and/or by authorized personnel only.

7.2 Wherever feasible, permit-required confined spaces will be secured with locks to prevent unauthorized access.

8.0 OUTSIDE CONTRACTORS

8.1 If outside contractors perform work at WHOI that involves entry into confined spaces, the coordinating or supervising WHOI department must inform the contractor(s) that confined spaces exist and that OSHA-compliant entry procedures are required.
8.2 The coordinating or supervising WHOI department will apprise the contractor(s) of hazards and potential hazards within the space(s) and procedures (including this guideline) that are required for entry.

8.3 The contractor(s) must perform confined space entry in accordance with this guideline or use an equivalent program.

8.4 As necessary, a trained representative of the coordinating or supervising WHOI department may be present during entry into the space(s) by the contractor(s).

8.5 The coordinating or supervising WHOI department will debrief the contractor(s) at the conclusion of entry operations regarding entry procedures used, hazards confronted or created in the space(s), and any lessons learned. Any lessons learned or safety issues should be communicated to the EH&S Office.

9.0 PROCEDURES

9.1 Procedures for entering confined spaces are provided in Appendices A and B.

9.2 A Confined Space Entry Permit is provided in Appendix C.

9.3 A list of confined space entry equipment is provided in Appendix D.

10.0 RECORDKEEPING AND DOCUMENTATION

10.1 The department performing entry into permit-required confined spaces will maintain canceled permits for a minimum of one year.

11.0 PROGRAM REVIEW AND UPDATE

11.1 The EH&S Office will review the Confined Space Entry and Rescue Program annually to ensure its adequacy and effectiveness. The results of the annual review will be kept on file in the EH&S Office. The EH&S Office will revise the program as necessary.

11.2 Entry Supervisors will immediately inform the EH&S Office of new confined spaces and significant changes in the conditions and/or hazards of existing confined spaces.
APPENDIX A: PROCEDURES FOR NON-PERMIT CONFINED SPACES

1.0 ATMOSPHERIC TESTING

1.1 Before a confined space is classified as non-permit, it must be evaluated by the EH&S Office and listed on the EH&S website.

1.2 The minimum parameters to be monitored are, in order:
   - Oxygen deficiency (19.5-23.5%)
   - Flammable and Combustible Gases (Less than 10% LFL)
   - Hydrogen Sulfide Concentration (Less than 10 ppm)
   - Carbon Monoxide (Less than 35 ppm)
   - Other Toxic Gases as applicable (less than occupational exposure limit)

1.3 A written record of the initial test results will be retained by the EH&S Office.

1.4 The atmosphere of a non-permit confined space shall be re-tested by the Entry Supervisor if conditions or operations change in a manner that could create a hazardous atmosphere (e.g., welding, cutting, carbon monoxide from internal combustion engines, use of hazardous chemicals, buildup of standing water, etc.) within the space. It is the Entry Supervisor’s responsibility to identify if re-testing of the confined space is necessary.

1.5 Only calibrated and properly functioning instruments shall be used for atmospheric testing. Multi-gas monitors are located at the EH&S Office (L’Hirondelle), Quissett Central Heating Plant, and Switchboard (Smith Building).

2.0 HAZARD CONTROL

2.1 When entrance covers are removed, guard the opening(s) with a railing, temporary cover, or other temporary barrier that will prevent an accidental fall through the opening and that will protect personnel working in the space from foreign objects entering the space.

2.2 Survey the surrounding area to identify and avoid hazards such as drifting vapors from tanks, piping, or sewers.

2.3 Isolate all pumps and lines that may allow contaminants to flow into the space by disconnecting, blinding and locking out.

2.4 If the implementation of hazard controls (e.g., blocking, bleeding, line breaking, isolation, lockout/tagout, etc) requires entry into the space, STOP, the provisions for entry into a permit-required confined space must be followed.

3.0 ENTRY PROCEDURES

3.1 Entry into the space may proceed if ALL of the following conditions exist:
- There are no physical hazards present or they have been adequately controlled.

- No atmospheric hazards are present based on re-testing and there is no reason to believe that any are likely to develop. NOTE: If a portable blower is required to keep the atmosphere safe, the space cannot be classified as a non-permit-required confined space. This space can only be entered as a permit-required confined space.

3.2 For vertical entries into non-permit confined spaces, follow the WHOI Fall Protection Guideline posted on the EH&S website. Note: A fall arrest device (harness) is generally used in combination with a retrieval device and a lifeline. The fall arrest/retrieval device should be used in conjunction with a tripod designed for that particular device and purpose.

3.3 If a hazard (including a hazardous atmosphere) arises within the non-permit confined space, personnel in the space will immediately exit the space and contact the Entry Supervisor and the EH&S Office. The supervisor, with assistance from the EH&S Office, will re-evaluate the space to determine whether it must be re-classified as a permit-required confined space.

3.4 If an emergency occurs within the space call ext. 2911 or 508-289-2911 (cell phone).
APPENDIX B: PROCEDURES FOR PERMIT-REQUIRED CONFINED SPACES

1.0 GENERAL

1.1 Personnel required to enter a permit-required confined space will have successfully completed a Confined Space Entry Training Program that complies with these procedures.

1.2 A written copy of approved entry permit will be at the work site for the duration of the job.

1.3 The ENTRY SUPERVISOR must complete the Confined Space Entry Permit (Appendix C) before approval can be given to enter a permit-required confined space.

1.4 The Confined Space Entry Permit verifies the completion of items listed below.

1.5 If circumstances cause an interruption in the work, a new Confined Space Entry Permit must be completed.

1.6 The Entry Supervisor shall implement reasonable measures necessary to prevent unauthorized entry into permit-required spaces.

2.0 ATMOSPHERIC TESTING

2.1 The atmosphere within the space will be tested to determine whether a hazardous atmosphere exists.

2.2 The ENTRY SUPERVISOR, AUTHORIZED ATTENDENT, or other authorized person will perform testing to identify atmospheric hazards, including:

- Oxygen deficiency (19.5-23.5%)
- Flammable and Combustible Gases (Less than 10% LFL)
- Hydrogen Sulfide Concentration (Less than 10 ppm)
- Carbon Monoxide (Less than 35 ppm)
- Other Toxic Gases, as applicable, known or suspected to be present in the space (Contact the EH&S Office for assistance at X3347)
- Concentrations of the last known product present in the space if not included above (Contact the EH&S Office for assistance at X3347)

2.3 The pre-entry test results will be recorded on the Confined Space Entry Permit.

3.0 VENTILATION

3.1 Mechanical ventilation systems, where applicable, will be set at 100% outside air to ensure that an adequate supply of non-hazardous (i.e., fresh and clean) makeup air is provided to the space.

3.2 Use portable blowers to augment natural circulation if needed.

3.3 After sufficient ventilation of the confined space, repeat the atmospheric testing.
3.4 Entry may not begin until testing has demonstrated that the hazardous atmosphere has been eliminated. If a portable blower is required to keep the atmosphere safe, the space cannot be reclassified as a non-permit-required confined space. The space will only be entered as a permit-required confined space.

4.0 PHYSICAL HAZARD CONTROL

4.1 When entrance covers are removed, guard the opening(s) with a railing, temporary cover, or other temporary barrier that will prevent an accidental fall through the opening and that will protect personnel working in the space from foreign objects entering the space.

4.2 Survey the surrounding area to identify and avoid hazards such as drifting vapors from tanks, piping, or sewers.

4.3 Isolate all pumps and lines that may allow contaminants to flow into the space by disconnecting, blinding and locking out.

4.4 When entering sewers or storm drains, laterals will be blocked, where experience or knowledge indicates there is a reasonable potential for contamination of air or engulfment of an occupied sewer.

5.0 ENTRY PROCEDURES

5.1 If any of the identified hazards cannot be adequately controlled, the space will not be entered. Contact the Entry Supervisor and the EH&S Office. The Entry Supervisor, with assistance from the EH&S Office, will evaluate the situation and determine the appropriate course of action.

5.2 At least one worker will be posted as an attendant outside of the space at all times to monitor activity within the space and be ready to provide assistance in case of emergency.

5.3 Methods for continuous communications will be verified and maintained between the Authorized Entrant and Attendant. The Attendant will be equipped with a cell phone, two-way radio or similar device to communicate with the switchboard in an emergency.

5.4 When making vertical entries (e.g., manholes) into permit-required confined spaces, Authorized Entrants will be connected to a fall arrest device. Note: A fall arrest device (e.g., full body harness) is usually in combination with a retrieval device and a lifeline. The fall arrest/retrieval device should be used in conjunction with a tripod designed for that particular device and purpose.

5.5 Continuous atmospheric monitoring will be performed during all confined space operations.

5.6 If at any time the atmospheric monitor goes into alarm, entry personnel will immediately exit the confined space and evaluate the conditions.

5.7 When the existence of flammable and/or combustible substances (such as gas lines) is possible, entrants will take the following precautions:
   - Use intrinsically safe lighting and electrical equipment (National Electrical Code - Class 1, Division 1),
   - Do not introduce ignition sources such as open flames or electrical currents unless specifically authorized on the permit, and
   - Use only non-sparking tools.
6.0 EMERGENCY PROCEDURES AND RESCUE

6.1 If a hazard arises within the confined space personnel in the space will immediately exit and contact the Entry Supervisor and the EH&S Office. The Entry Supervisor, with assistance from the EH&S Office, will re-evaluate the space to determine the appropriate course of action.

6.2 Personnel will immediately leave the space when any of the gas monitor alarm points are activated.

6.3 If at any time there is any questionable action or non-movement by the Authorized Entrant, the Attendant will make a verbal check. If there is no response or a questionable response, the worker in the space will be ordered to evacuate the space immediately.

6.4 If possible, Authorized Entrants will initiate self-rescue by climbing out of the space.

6.5 If self-rescue is not possible, the attendant will retrieve the entrant via the connected retrieval line. If the attendant is unable to retrieve the entrant via the lifeline, the attendant will call for emergency rescue services.

6.6 If the entrant is disabled due to falling or impact, he/she will not be removed from the confined space unless there is immediate danger to his/her life.

6.7 The attendant will not enter the space to perform rescue operations.

To Report an Emergency Dial

2911

or

508-289-2911 (Cell Phone)
Appendix C: WHOI Confined Space Entry Permit

1. GENERAL INFORMATION – Permit valid only for job duration and must be kept at jobsite during job

<table>
<thead>
<tr>
<th>Date:</th>
<th>Time Started:</th>
<th>Time Ended:</th>
<th>Space Description/ID:</th>
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<table>
<thead>
<tr>
<th>Entry Supervisor:</th>
<th>Job Description (permit valid only for this job):</th>
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</table>

<table>
<thead>
<tr>
<th>Attendant:</th>
<th>Estimated Job Duration:</th>
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<tr>
<th>Entrant(s):</th>
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<table>
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<tr>
<th>Hazard controls implemented:</th>
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2. PRE-ENTRY ATMOSPHERIC TESTING

<table>
<thead>
<tr>
<th>Substance (acceptable entry conditions)</th>
<th>Measurement results</th>
<th>Time</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen (19.5-23.5%)</td>
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<tr>
<td>Flammable Gases (Less than 10% LFL)</td>
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<td>Hydrogen Sulfide (Less than 10 ppm)</td>
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<tr>
<td>Carbon Monoxide (Less than 35 ppm)</td>
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<tr>
<td>Other Gases --</td>
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<tr>
<th>Name of Tester:</th>
<th>Signature:</th>
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3. VENTILATION

<table>
<thead>
<tr>
<th>Installed System Activated</th>
<th>Natural Ventilation Only</th>
<th>Portable System Activated</th>
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</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No</td>
<td>N/A</td>
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</table>

4. ATMOSPHERIC TESTING AFTER VENTILATION

<table>
<thead>
<tr>
<th>Substance (acceptable entry conditions)</th>
<th>Measurement results</th>
<th>Time</th>
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<td>Flammable Gases (Less than 10% LEL)</td>
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<td>Other Gases --</td>
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<tr>
<th>Name of Tester:</th>
<th>Signature:</th>
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NOTE: If atmospheric test results do not fall within acceptable entry conditions, DO NOT ENTER THE CONFINED SPACE. Notify the EH&S Office at X3347 or 508-289-3347 (Cell Phone).
### 5. HAZARD IDENTIFICATION AND CONTROL

<table>
<thead>
<tr>
<th>Question</th>
<th>YES</th>
<th>NO</th>
<th>N/A</th>
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<tbody>
<tr>
<td>Have measures to eliminate or control confined space hazards been implemented?</td>
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<tr>
<td>Has lockout/tagout been performed on all energy sources?</td>
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<td>Have entrance openings been properly guarded?</td>
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<tr>
<td>Did your survey of the surrounding area show it to be free of hazards such as drifting vapors from tanks or piping?</td>
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<td>Is the ENTRY SUPERVISOR trained in the use of the gas monitor provided?</td>
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<td>Is the gas monitor properly calibrated?</td>
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<td>Was a functional test of the gas monitor performed prior to testing the atmosphere in the space?</td>
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<td>Were all atmospheric tests within prescribed limits?</td>
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<td>Have all pumps and lines that may allow contaminants to flow into the space been isolated?</td>
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<tr>
<td>Have all entrants and attendants successfully completed confined space entry training?</td>
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<tr>
<td>Have all entrants and attendants reviewed/completed this permit?</td>
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<tr>
<td>Are full-body harnesses and fall arrest systems available for all entrants?</td>
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<td>Is a retrieval system and tripod available?</td>
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<tr>
<td>Are appropriate ladders available to safely enter and exit the space?</td>
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<tr>
<td>Is lighting within the space adequate to enter and exit safely?</td>
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<tr>
<td>Are entrants equipped with appropriate personal protective equipment (e.g. safety glasses, hard hats, etc.)?</td>
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<tr>
<td>Are communication methods and equipment for Attendant and Authorized Entrant verified to be adequate and effective?</td>
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</tbody>
</table>

If the answer to any of the above questions is no or if you need more information/assistance DO NOT ENTER THE CONFINED SPACE. Notify the EH&S Office at X3347 or 508-289-3347 (Cell Phone).

Checklist prepared by:

<table>
<thead>
<tr>
<th>Entry Supervisor:</th>
<th>Signature:</th>
</tr>
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</table>

We have reviewed the information contained in this Confined Space Pre-Entry Checklist:

<table>
<thead>
<tr>
<th>Entrant/Attendant Name:</th>
<th>Signature:</th>
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</thead>
<tbody>
<tr>
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<td>Signature:</td>
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<td>Signature:</td>
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</tbody>
</table>

FOR EMERGENCY -- Dial 2911 or 508-289-2911 (Cell Phone)

Return terminated permit to Entry Supervisor and note any problems here:
Appendix D: Confined Space Entry Equipment

1.0 INVENTORY

1.1 The following equipment is available for use during confined space entry operations:

<table>
<thead>
<tr>
<th>Description</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>BW Technologies Multi-gas Monitor</td>
<td>Quissett – Central Heating Plant</td>
</tr>
<tr>
<td>BW Technologies Multi-gas Monitor</td>
<td>Village – EH&amp;S Trailer</td>
</tr>
<tr>
<td>BW Technologies Multi-gas Monitor</td>
<td>Village – Switchboard</td>
</tr>
<tr>
<td>Tripod, Fall Arrest Devices, Harnesses</td>
<td>Quissett – Central Heating Plant</td>
</tr>
<tr>
<td>Tripod, Fall Arrest Devices, Harnesses</td>
<td>Village – EH&amp;S Office</td>
</tr>
<tr>
<td>Portable Ventilation Unit</td>
<td>Quissett – Central Heating Plant</td>
</tr>
<tr>
<td>Portable Ventilation Unit</td>
<td>Village – EH&amp;S Office</td>
</tr>
</tbody>
</table>

2.0 CALIBRATION AND FUNCTIONAL TEST

2.1 The BW Technologies Multi-gas Monitor requires calibration every 180 days.

2.2 The BW Technologies Multi-gas Monitor should also be calibrated if users suspect that readings are not accurate. A calibration kit is located with each monitor.

2.3 Calibration should be performed in accordance with the procedure contained in the Instruction Manual provided with each monitor.

2.4 Functional testing (Bump Test) should be performed prior to each use. The functional test should be performed in accordance with the instrument’s Instruction Manual.

3.0 CHARGING

3.1 Each BW Technologies Multi-gas Monitor is equipped with a charger to provide continuous charging to the battery pack.

4.0 EQUIPMENT USE

4.1 ALL equipment should be used in accordance with manufacturer’s instructions and guidelines.

4.2 Equipment should not be modified without prior written permission from the manufacturer.