

Survey of Confined Space Sites and Training at a Midwestern Company

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ABSTRACT

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This report contains the findings, observations, and recommendations of the investigator's confined space program audit at the tractor manufacturing operation of a midwestern company (the "company"). At the request of the company industrial hygienist, the confined space inventory and confined space training class were evaluated and updated between June 2, 2014 and August 28, 2014. The goals of the audit were to update the inventory of the six facilities that are part of the operation and evaluating the employee confined space training class.

As the previous inventory was out of date and hard to follow, a new spreadsheet was created to help organize information to better identify each space. The inventory was done by observing conditions around each facility, and by talking to union safety representatives, safety managers, and maintenance personnel. In total 804 permit spaces were found.

The confined space training program was evaluated to determine whether it was adequate or required modifications. The main training class was attended in July at the local fire department. The content of the class was deemed to be adequate but it seemed clear too many people attended one class, greatly reducing the effectiveness of the hands-on practice, a critical component.

Using the observations made while completing the inventory, recommendations were given to increase the efficiency of the inventory process. Recommendations were made to reduce confusion caused by over-attendance. By increasing the efficiency of the inventory process and reducing the number of people attending the confined spaces training class, the confined space program and the training for it should be greatly improved, thus better protecting employees from the hazards of confined spaces.

Table of Contents

ABSTRACT.....	1
Introduction.....	1
Background Material	1
Tractor Operations Background.....	1
Confined Space Program Background	2
Confined Space Inventory Background.....	2
Confined Space Training Background	3
Literature Review.....	3
Data Collection	9
Confined Space Inventory.....	9
Confined Space Training	10
Results.....	10
Confined Space Inventory.....	10
Confined Space Training	12
Discussion	13
Manhole/Drain/Well.....	14
Tanks	14
Pits.....	15
Equipment.....	15
Out of Service Spaces.....	16
Supervisor Involvement	17
Training	17
Recommendations.....	19
Conclusions.....	22
Caveats.....	22
References.....	22
Appendix 1: Standard Number 29CFR1910.146.....	24

Introduction

At the request of the company, the inventory and training class portions of their confined space program were audited between June 2, 2014 and August 28, 2014 at their tractor manufacturing operation. The goals of this audit were to update their confined space inventory and to evaluate the adequacy of the confined space training class.

The finished product for the confined space inventory was an Excel[®] spreadsheet documenting each of the confined spaces identified at the six locations that make up the tractor manufacturing operation. The spreadsheet contained pertinent information about each space that will enable better identification and location of that space. The inventory was started from the beginning as changes in the facilities made previous inventories obsolete. The finished product for the training portion was a list of recommendations and an agenda for the training class after attending the class. This was done because it had been awhile since the training class was reviewed for adequacy.

Background Material

Tractor Operations Background

The tractor manufacturing operation is one of the largest operations of this company. This operation consists of six facilities that play a specific role in the manufacturing of tractors.

Table 1: The Six Facilities at Tractor Operations

Facility	Description
Tractor Assembly	Assemble tractors and paint
Foundry	Manufacture metal parts from castings and iron
Service Parts	Manufacture parts for older model tractors
Drive Train	Manufacture tractor drive train
Product Engineering	Test and verify new and experimental equipment
Museum	Remodeled old manufacturing facility

All of the facilities are still in operation but are continuously changing, including being renovated to accommodate new equipment or processes.

Confined Space Program Background

The company's written Confined Space Program (see Appendix I) was initiated around 1993 when the Occupational Safety and Health Administration (OSHA) promulgated the Confined Space Standard (29 CFR 1910.146). The program procedures and paperwork since then have been kept and updated by the company's Senior Industrial Hygienist. Many of the procedures, permits, and declassification permits can be found on the company's website and on the company's network.

Confined Space Inventory Background

The company has been doing a confined space inventory every few years since 1993. As the facilities of the tractor operations continue to change and expand, it is important to keep track of the confined spaces that still exist at each location and to document which ones have been decommissioned or removed. Each facility is in charge of how they keep track of their confined spaces. Generally, this is done by a combination of safety managers, union safety

representatives, and maintenance personnel. However, the comprehensive inventory audit is normally done by the Senior Industrial Hygienist or an intern/student worker that he or she has assigned this task. Prior to the inventory audit done in 2014, the confined space inventory was updated in 2013 and placed on the company's website. However, there was no consistency in the way the confined spaces were numbered and parts of the information contained in the inventory were outdated. For example, the old inventory included buildings that were no longer part of the company. The Senior Industrial Hygienist directed that for this project a new spreadsheet be created and that the new inventory be started without assuming that anything in the previous inventory was still true.

Confined Space Training Background

Along with the program starting in 1993, OSHA has required a training class for those who could enter a confined space. The company decided to have the local fire department teach the class for all of the employees that need training. As the training is only needed for new employees and for current employees whose roles during entry are changed, the class is held only on an as-needed basis.

Supervisors can determine whether a specific employee has had the required confined space training by viewing a company database that displays all of the training that employees have gone through, including the confined space training.

Literature Review

Confined Spaces still remain an important safety topic in industry. According to the Board of Labor Statistics (BLS) Census of Fatal Occupational Injuries, between 1997 and 2011 confined spaces caused an average of 92 deaths per year. The National Institute of Occupational Safety and Health (NIOSH) publication No.86-110 states that approximately "60 percent of all fatalities are would-be rescuers" (NIOSH, 1986). NIOSH also investigated confined space fatalities for their Fatality Assessment and Control Evaluation (FACE) Program Investigations from 1983 to 1993. NIOSH then published NIOSH publication No.94-103 to summarize their investigations into 70 confined space related fatalities (NIOSH, 1994). Often the hazards encountered in a confined space are not apparent, in part because many injuries and fatalities are caused by atmospheric hazards that cannot easily be detected without monitoring equipment. These atmospheric hazards can range from oxygen deficiency to combustible or poisonous gases.

Other times the hazards are more apparent, such as moving machinery, electrical hazards, engulfment, or sloping floors/converging walls. In many cases accidents cause an injury or fatality in a split second.

In 1993 the Occupational Safety and Health Administration (OSHA) passed 29 CFR1910.146, which is known as the Confined Space Standard. In it OSHA defines a confined space as having all three of the following conditions:

1. “Is large enough and so configured that an employee can bodily enter and perform assigned work
2. Has limited or restricted means for entry or exit
3. Is not designed for continuous employee occupancy”

The OSHA confined space standard also defines a “permit-required” confined space as being a confined space having at least one of the four following characteristics:

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

OSHA requires employers to first evaluate their locations to determine if permit-required confined spaces are present. If permit spaces are present, these spaces must have a sign that warns employees of the dangers. The employer must determine if the employees have to enter the confined spaces. If the employees have to enter the permit spaces, the employer is required to “develop and implement a written permit space program.” The program requires the following:

1. “Implement the measures necessary to prevent unauthorized entry;
2. Identify and evaluate the hazards of permit spaces before employees enter them;
3. Develop and implement the means, procedures, and practices necessary for safe permit space entry operations, including, but not limited to, the following:
 - a. Specifying acceptable entry conditions;

- b. Providing each authorized entrant or that employee's authorized representative with the opportunity to observe any monitoring or testing of permit spaces;
 - c. Isolating the permit space;
 - d. Purging, inerting, flushing, or ventilating the permit space as necessary to eliminate or control atmospheric hazards;
 - e. Providing pedestrian, vehicle, or other barriers as necessary to protect entrants from external hazards; and
 - f. Verifying that conditions in the permit space are acceptable for entry throughout the duration of an authorized entry
4. Provide the following equipment at no cost to employees, maintain that equipment properly, and ensure that employees use that equipment properly:
- a. Testing and monitoring equipment;
 - b. Ventilating equipment needed to obtain acceptable entry conditions;
 - c. Communications equipment;
 - d. Personal protective equipment insofar as feasible engineering and work practice controls do not adequately protect employees;
 - e. Lighting equipment needed to enable employees to see well enough to work safely and to exit the space quickly in an emergency;
 - f. Barriers and shields.
 - g. Equipment, such as ladders, needed for safe ingress and egress by authorized entrants;
 - h. Rescue and emergency equipment; and
 - i. Any other equipment necessary for safe entry into and rescue from permit spaces.
5. Evaluate permit space conditions as follows when entry operations are conducted:
6. Test conditions in the permit space to determine if acceptable entry conditions exist before entry is authorized to begin, except that, if isolation of the space is infeasible because the space is large or is part of a continuous system (such as a sewer), pre-entry testing shall be performed to the extent feasible before entry is authorized and, if entry is authorized, entry conditions shall be continuously monitored in the areas where authorized entrants are working;

7. Test or monitor the permit space as necessary to determine if acceptable entry conditions are being maintained during the course of entry operations; and
8. When testing for atmospheric hazards, test first for oxygen, then for combustible gases and vapors, and then for toxic gases and vapors.
9. Provide each authorized entrant or that employee's authorized representative an opportunity to observe the pre-entry and any subsequent testing or monitoring of permit space;
10. Reevaluate the permit space in the presence of any authorized entrant or that employee's authorized representative who requests that the employer conduct such reevaluation because the entrant or representative has reason to believe that the evaluation of that space may not have been adequate;
11. Immediately provide each authorized entrant or that employee's authorized representative with the results of any testing conducted.
12. Provide at least one attendant outside the permit space into which entry is authorized for the duration of entry operations;
13. If multiple spaces are to be monitored by a single attendant, include in the permit program the means and procedures to enable the attendant to respond to an emergency affecting one or more of the permit spaces being monitored without distraction from the attendant's responsibilities;
14. Designate the persons who are to have active roles (as, for example, authorized entrants, attendants, entry supervisors, or persons who test or monitor the atmosphere in a permit space) in entry operations, identify the duties of each such employee, and provide each such employee with the training;
15. Develop and implement procedures for summoning rescue and emergency services, for rescuing entrants from permit spaces, for providing necessary emergency services to rescued employees, and for preventing unauthorized personnel from attempting a rescue;
16. Develop and implement a system for the preparation, issuance, use, and cancellation of entry permits as required by this section;
17. Develop and implement procedures to coordinate entry operations when employees of more than one employer are working simultaneously as authorized entrants in a permit

space, so that employees of one employer do not endanger the employees of any other employer;

18. Develop and implement procedures (such as closing off a permit space and canceling the permit) necessary for concluding the entry after entry operations have been completed;
19. Review entry operations when the employer has reason to believe that the measures taken under the permit space program may not protect employees and revise the program to correct deficiencies found to exist before subsequent entries are authorized; and
20. Review the permit space program.”

Three other organizations within the United States that publish confined space recommendations or standards are American National Standards Institute (ANSI) in cooperation with the American Society of Safety Engineers (ASSE) as the Secretariat (MSA, 2009), the American Society for Testing and Materials (ASTM) and the National Fire Protection Agency (NFPA). Although the only standard required by law in the United States is OSHA, these other organizations and agencies have their own recommendations and standards that can be used as best practices and in most cases go above what is required by OSHA. They are particularly useful because the OSHA standard has not been revised since 1993.

The most updated form of “Safety Requirements for Confined Spaces” (ANSI/ASSE standard Z117.1) became effective in 2009 (MSA, 2009). This standard distinguishes between a “permit required confined space” and a “non-permit required confined space.” The main difference between the two is that a permit required confined space must contain “actual or potential serious hazards” and must have “written authorization for entry” (MSA, 2009) and the non-permit does not. Z117.1 discusses what is needed prior to entry; the atmospheric testing that needs to be done; what the entry team’s jobs are and their responsibilities; proper use of lockout/tagout procedures; ventilation procedures; personal protective equipment needed in the space; emergency response and rescue; and training requirements. Unlike the OSHA confined space standard, ANSI/ ASSE standard Z117.1-2009 was revised in 2012 to include the most relevant safety standard references and more training requirements for personnel entering a permit space (MSA 2009).

The ASTM “Standard Practice for Confined Area Entry” (ASTM D4276-02) was reapproved in 2012 (ASTM, 2012). In this standard a confined space is referred to as a “confined area” and

there is no distinction between a confined space and a permit-required confined space. The standard sets procedures for personnel to follow prior to entering the space. These include having an appropriate signed entry permit for the space; properly locking out equipment and blocking/ capping valves; cleaning the area of hazardous substances; ventilating the space; testing for atmospheric hazards; and selecting the appropriate personal protective equipment. Though ASTM D4276-02 does mention training, it states only that employees “working in confined areas must be properly trained in safe entry and rescue procedures.” It does not go into detail about what the training should encompass nor how often employees should be trained.

The National Fire Protection Agency (NFPA) has begun work on its own confined space entry standard. The standard, NFPA 350: Best Practices Guide for Safe Confined Space Entry and Work, is in its first draft stages and is open to revision (NFPA, 2013). In the NFPA standard, confined spaces are defined similarly to OSHA’s definition, but they do not distinguish between a confined space and a permit-required confined space. The standard covers signage of confined spaces and locking up confined spaces so they cannot accidentally be entered. The standard goes on to cover what the confined space program should contain, what should be done to evaluate the space before entering, what the written confined space permit should contain, and the roles and responsibilities for employees involved in entering a confined space.

Outside of the United States, there are other countries that have a confined space standard. In Canada confined space regulations are present in all of their jurisdictions under their Occupational Safety and Health Administration (CCOHS, 2012). Although the regulations vary between these jurisdictions, most of the basic requirements and definitions remain the same. For instance, a “confined space” is defined as being an “enclosed or partially enclosed space that:

- is not primarily designed or intended for human occupancy
- has a restricted entrance or exit by way of location, size or means
- Can represent a risk for the for the health and safety of anyone who enters, due to one or more of the following factors:
 - its design, construction, location or atmosphere
 - the materials or substances in it
 - work activities being carried out in it, or the

- mechanical, process and safety hazards present” (CCOHS, 2012).

Canadian regulations have requirements for air testing in confined spaces. The regulations require that the atmosphere be tested prior to entering the confined space for oxygen content and atmospheric hazards and the testing might need to continue for the duration the work (CCOHS, 2012). However, there is no distinction between a confined space and a permit-required confined space and there is no requirement for an employer to have a permit required confined space program.

In comparing other countries, the definition of a “confined space” and how they are regulated varies. In June 2011 the Dumortier and Hendel-Blackford conducted a survey of 60 countries’ confined space regulations. According to the survey, some countries have a very broad definition. For example, Germany and the United Kingdom define a “confined space” as an “enclosed space” with “reasonably foreseeable specified risks”. Other countries standards are more narrowly drawn. Japan and Korea focus on defining these spaces in terms of oxygen deficiency (Dumortier and Hendel-Blackford, 2011). China defines a confined space as one where no more than two people can enter the space at a time. Confined spaces are also defined as “closed, narrow, and poorly ventilated” with a limited means of entry and exit and a vertical dimension of 1.2 meters (Dumortier and Hendel-Blackford, 2011). This wide variance in confined space regulations has the potential to pose problems for employers operating in multiple countries.

Data Collection

The data for this project were collected over the summer of 2014 from June 2nd to August 18th. Two separate methods were used in collecting the data for the inventory and the training evaluation.

Confined Space Inventory

Prior to the inventory audit, the company’s industrial hygienist (IH) provided a copy of the Confined Space Program, and Confined Space Evaluation sheet to this investigator to aid in understanding. An older Confined Space Inventory was accessed on the company’s website to determine how it had been set up. As the company industrial hygienist wanted the inventory done without using the previous inventory spreadsheets, a new spreadsheet was created in

Excel[®]. This new inventory spreadsheet was intended to contain information about all of the company's confined spaces.

The spreadsheet was developed to provide input of asset numbers or machine identification numbers, space name, whether the space was inside or outside, column number or bay if the space was inside, GPS coordinates if the space was outside and hard to locate, building name or number, the purpose of the space, and whether it had a sign identifying that it was a permit-required space. The confined spaces were placed in worksheets based on facility.

After the spreadsheet was created, the new inventory was initiated. Facility maps were obtained at each location to aid in locating confined spaces. Maintenance personnel, union safety representatives, and safety managers were also consulted to find more spaces as they were more familiar with the layout and where potential confined spaces might be located. Once the preliminary information was gathered, the inventory consisted of observing, finding, and evaluating each space, and recording the information about the space on the "Confined Space Evaluation" paper sheet. Finally the information from the evaluation sheet was recorded in the Excel[®] spreadsheet.

Confined Space Training

The investigator attended a training class and evaluated by comparing the training agenda to OSHA requirements and observer's recommendations. Recommendations were made as to what should be done to enhance the effectiveness of the class. These results and recommendations were later reviewed with the company IH.

Results

The results for this project include tables representing the confined space inventory spreadsheet data and the confined space training itinerary based on observations made for the confined space training course.

Confined Space Inventory

The resulting confined space inventory identified 807 spaces found in the six locations at the company's tractor operation. Table 2 displays the number of spaces by location and the total number of spaces identified during the inventory. The categories for the confined spaces were chosen to be "Manhole/Drain/ Well," "Pit," "Tank," and "Equipment."

Table 2: Confined Spaces by Location and Category

Facility	Category	Number found	Number of Confined Spaces with Signs
Tractor Assembly	Manhole/Drain/Well	82	5
	Pit	9	6
	Tank	19	15
	Equipment	3	3
	Total	113	29
Foundry	Manhole/Drain/Well	77	1
	Pit	1	0
	Tank	12	5
	Equipment	181	98
	Total	271	104
Service Parts	Manhole/Drain/Well	41	0
	Pit	5	2
	Tank	17	15
	Equipment	13	6
	Total	76	23
Drive Train	Manhole/Drain/Well	40	1
	Pit	4	2
	Tank	71	56
	Equipment	98	91
	Total	213	150
Product Engineering	Manhole/Drain/Well	99	88
	Pit	13	13
	Tanks	13	12
	Equipment	7	7
	Total	132	120
Museum	Manhole/Drain/Well	1	1
	Pit	1	1
	Total	2	2
Total		807	428

Table 3 displays the number of spaces in different locations that are no longer in use and are known to be out of service.

Table 3: Out of Service Spaces by Facility

Facility	No. of Spaces
Tractor Assembly	3
Foundry	2
Service Parts	0
Drive Train	2
Product Engineering	0
Tractor Museum*	0
Total	7

Confined Space Training

The content of the eight hour confined space training class that was attended in July of 2014 was found to be adequate based on OSHA requirements and investigator expectations. It contained a presentation with pertinent information about confined space hazards, class participation, information on equipment, hands-on training, and a survey at the end of the class for feedback on the effectiveness of the class. Table 4 displays the training agenda for the class attended.

Table 4: Observed Confined Space Training Agenda

Section	Time	Information
Introduction and general information about confined spaces	2 hours	Discuss what a confined space and permit required confined space are Discuss potential hazards Discuss important points in the standard (i.e. gas monitoring, permits, jobs during confined space entry and associated duties, emergency procedures for non-entry rescue, and procedures if non-entry rescue is not possible)
Training videos	1.5 hour	Videos on confined space general information and rescue
Knot tying demonstrations	2 hour	Hands on instruction of important knots used during confined space entry and rescue
Hands on Entry Practice	2 hours	Practice entering at least two different confined space types Employees should rotate and become familiar with at least two different positions

Discussion

The total number of spaces identified as permit-required confined spaces was 804. The spaces were broken down into three generic categories: manhole/drain/well, pit, tank, and equipment (i.e., all other spaces that cannot be placed in the three previous categories). The number of spaces varied by location (see Table 3) and the different types of production processes taking place at each location contributed to variance differences in numbers of confined spaces.

Manhole/Drain/Well

One of the most populated categories of permits spaces was Manhole/Drain/Well. 96 of 340 were properly labeled as confined spaces. This poses a problem to both the employer and employees as it could lead to someone entering the space without a required permit, increasing the risk of injury or death.

Facility maps displaying sewer systems at the Foundry and Tractor Assembly were not updated to reflect changes in the facility layout. Facility maps displaying sewer systems at Service Parts, Drive Train, and Museum were not able to be reviewed. Since there are multiple manholes, drains, and wells that are both inside and outside of the facility, it is important to know where each one is located and how it will be identified (i.e., an asset number). If maps are not updated and the spaces are not numbered, this creates an issue with locating and identifying the space. This could become a serious problem if there is an emergency and time is wasted trying to find and identify the space. Product Engineering was the only site that had both a numbering system and an updated map of the locations for each manhole, well, and drain.

Finally, the type of each manhole was also not clear at some locations. The manholes at each location should be identified as sanitary, storm, electrical, and process waste. At the Foundry, Tractor Assembly, and Drive Train there is no distinction between the sewer manholes. However, all locations had electrical manhole covers that correctly denoted them as electrical. Only Service Parts and Product Engineering had systems in place to identify the sewage systems associated with the manholes at each facility. Service Parts had placed medallions identifying which manholes were connected to the storm sewer system, allowing quick identification of the storm sewer manholes and drains. At Product Engineering the manholes were color coded to differentiate between the different types, a practice that should be instituted at all other locations. Otherwise, it can be difficult to discern by looking at the manhole which sewage system it belongs to. It is important to differentiate between the different types since the hazards associated with each type can vary and employees need to be aware of what they may encounter.

Tanks

Another type of permit required confined space encountered was tanks. Tractor Assembly, Foundry, Service Parts, Drive Train, and Product Engineering had an assortment of tanks that held chemicals for different processes. Many of the tanks had at least one identifying sign on

them but other entrances to some tanks did not have a sign designating it a confined space. It is important that all entrances be clearly marked to ensure that employees know they are entering a confined space.

It was observed that all tanks had labels to identify them and their contents. Tanks had an asset number associated with them and in most cases that asset number was placed on the tank and was easy to read. This is important for quick identification. However, Tractor Cab, Foundry, Drive Train, and Product Engineering facilities all had tanks that did not have an asset number that could not be easily identified. This could pose a problem when attempting to quickly identify the space if there is an accident and rescue is needed.

The tanks also had a large label for the contents and a NFPA hazard label that corresponded with the substance that it contained. This is also important when looking to enter the space as different chemicals will have different hazards associated with them. Employees that are entering the space will need to know what these hazards are and by having tanks directly labeled, it will allow employees a quick reference to this information. It is important to have a system to check tanks periodically to ensure that their contents match the label and that other tanks that are labeled “empty,” do not contain a substance that is unknown.

Pits

Over time the company has been reducing the number of pits that are confined spaces in each facility. Through redesign, many of the pits that were considered to be permit spaces no longer exist. At the Product Engineering and Museum sites, all of the identified pits were marked. At Tractor Assembly, the Foundry, Service Parts, and Drive Train there were pits that did not have signs or the sign needed to be replaced. Again it is important to ensure that all permit spaces are marked and to have signs checked and replaced as needed. Pits also need to be properly labeled with an identification number. Many of the pits identified did not have a visible identifying number. Clear identification not only helps with inventory but it could save lives if someone became trapped in one of these areas.

Equipment

The equipment used in the different processes around the tractor operations varied from location to location. The majority of the locations had the equipment containing a permit space properly marked. The Foundry and Service Parts were the only locations that had a significant difference between the number of spaces marked and the number of spaces in the facility (See Table 3).

At the Foundry there was a lot of equipment in each department that is used frequently. Signage needs to be checked regularly to see if it is still present and clearly legible. If the signage has worn away or otherwise become difficult to read it should be replaced promptly. It also can take a perhaps unacceptable period before signage is placed on a new confined space or equipment. For example, in the Foundry some of the unlabeled spaces were newer equipment.

There should be a system in place to identify confined spaces prior to placing the equipment in operation. This will ensure that the equipment can be investigated thoroughly to identify that all confined spaces are located.

Confined spaces with multiple entry points sometimes did not have labels on all entry points, especially dog houses/plow boxes, and hoppers. In some cases there was a label noting that a particular entry point was considered a permit space but another entry point for the same space was not labeled. Employees who are entering the space might not see the one label and assume that they do not need a permit for that space if they enter through another entrance. Labeling all entry points would reduce confusion and potential for accidents. At Service Parts, the only spaces without signs were the furnaces. They should have signs placed on them when they are down for operation or on a surface that does not get hot.

At the Foundry and Drive Train sites, it was noted that the equipment had Lock Out Zero Energy State information placed on the equipment. The label made it easier to see what hazards could be encountered in the space and it made the inventory process less difficult. This labeling also allows employees a reference for what they can expect to encounter while working in the space and also shows them the steps to properly lock out a piece of equipment.

Out of Service Spaces

At some of the locations it was observed that there were confined spaces that were no longer in operation. These out of service spaces consisted of empty tanks, dust collectors, and old bag houses that were no longer in use. These spaces should be marked as “out of service.” If these spaces should no longer be entered, these spaces should be padlocked for security purposes. Once a space is determined to be out of service, the inventory should be updated to reflect this. Out of service spaces that are placed back into operation should show an “in-use” status in the confined space inventory before that space is used. If an out of service space is removed, then that space should be deleted from inventory.

Supervisor Involvement

Facilities are constantly changing and there needs to be a specific inventory process. Important information such as building renovations, changes in layout, new construction, and repairing or replacing manholes should be communicated to the IH. These communications will allow the industrial hygienist to know that inventory's status will change and that an audit should be done. Supervisors need to be aware of the confined spaces in their area and should inspect and replace signs on these spaces as needed.

Training

The training course held by the local fire department gave adequate information on confined spaces and how to enter and exit them safely. The adequacy was determined by comparing what was experienced in class to requirements in the OSHA standard and expectations of the investigator. The OSHA confined space standard requirements on training are that training must establish that the employee is proficient in his or her duties and that there will be a certificate given to the employee after the class has been completed. Since these requirements are vague, the investigator also included expectations of a presentation with pertinent information about confined space hazards, class participation, information on equipment, hands-on training, and a survey at the end for feedback on the effectiveness of the class. The class attended included a presentation, class participation, hands-on training, and a survey to evaluate the class. One observation for improvement was that there was not enough time allocated for the hands-on training portion. The hands-on training was rushed. Table 5 displays a recommended course outline for future classes so that there is more time for hands-on training.

Table 5: Recommended Confined Space Training Course Outline

Section	Time	Information
Introduction and general information about confined spaces	1-2 hours	Discuss what a confined space and permit required confined space are Discuss potential hazards Discuss important points in the standard (i.e. gas monitoring, permits, jobs during confined space entry and associated duties, emergency procedures for non-entry rescue, and procedures if non-entry rescue is not possible)
Training videos	1 hour	Videos on confined space general information and rescue
Knot tying demonstrations	1 hour	Hands on instruction of important knots used during confined space entry and rescue
Hands on Entry Practice	4-5 hours	Practice entering at least two different confined space types Employees should rotate and become familiar with at least two different positions

The issues associated with the training were due to communication. The day of the class, there were only ten employees signed up to attend. When it was time for the class to start, there were around 20 employees in attendance. Instead of signing employees up for the class via email, supervisors simply sent employees to get trained. Thus it was a surprise when the number of attendees was twice capacity. As a result some of the training took longer. This especially impacted the hands-on portion of the class where employees practiced entering and exiting a confined space. A system should be in place to determine who needs training and when they

should be trained. No one else should be allowed to attend once the maximum capacity is reached.

Recommendations

The following recommendations have been made to address the findings discussed above:

1. New signs:

The spaces identified in the inventory as needing signs should have new signs on them. These would include spaces that were identified as needing the current sign replaced. Once the sign is in place, the inventory should then reflect that the space now has a new sign. By doing this the company is communicating whether the space is safe to enter or not. If compliance with the procedures outlined in the permit have not been documented no entry should be allowed until compliance is demonstrated.

2. Permit numbers on signs:

Some of the signs that are currently being used at the six facilities do not have the permit numbers of the space on the sign. To aid employees who are working in the space, the permit number should be on the sign.

3. Continue inventory and supervisor/ management involvement:

As the tractor operations of the company are dynamic, new equipment and buildings will be added over time. For that reason it is important to update the confined space inventory at least once a year. It is also important to ask supervisors and managers to communicate changes as they occur. Since there is only one industrial hygienist, having other employees aiding in the confined space inventory would be beneficial.

4. Facility layout maps:

Many of the facility layout maps for the six facilities were shown to be out of date. The only facility with an updated map was Product Engineering. The other five facilities should have their maps updated to show all locations of the manholes and sewage systems. This will allow employees to locate manholes instead of guessing where they might be. These maps should be kept in a location that is accessible to the employees who need them and protected so the only authorized users can manipulate them. The

maps should be updated whenever construction is completed or when manholes are repaired or replaced.

5. Confined space map:

Product Engineering also included their confined spaces on their facilities layout map. This made it easier to find confined spaces that were already in existence. It is recommended that the other sites create a map that shows the locations of confined spaces around their site. It will help employees locate confined spaces. The maps should be updated whenever new equipment is added or construction is completed.

6. Alternative Signage:

As there are spaces in different locations around all six of the facilities, certain spaces might need a different type of sign from the general sticker. Manholes are the most prominent example where sticker permit signs will not work. In most cases, manholes are located in either heavy trafficked areas where stickers will wear off in a short amount of time. In some cases even the metal placards are not able to be welded to the covers due to the metal weld being weak. Using signs that either sit over the top of manholes or are visible once the manhole cover is removed are viable solutions to the problem.

7. Manhole numbering system:

As there are 340 manholes, storm drains, and wells that have been identified at the company's tractor operations, a numbering system that identifies these confined spaces should be created. It was observed that most facilities did not have a numbering system for these spaces. Product Engineering did have a numbering system for all of their confined spaces, making it easier to locate confined spaces and to account for them. The number of the space was listed in the placard on the cover. This number was also present on their inventory list and map. If other sites follow this practice, it would aid in the location and identification of the spaces.

8. Manhole differentiation:

The differentiation between sewage systems was not always clear. The different manholes should be marked so they can be identified by looking at them. It is recommended to use a similar system to what is in place at Product Engineering. If other sites follow this practice, it would aid in manhole differentiation.

9. Tank audit:

An audit of the tanks should be done to ensure that tanks contain what the placard on the outside says. For example, a tank that says “Empty” should be, in fact, empty. It is recommended that this information is updated at least once a year.

10. Out of service spaces:

There are pieces of equipment that are no longer in use and have been taken out of service. For these confined spaces it is recommended that all entry points are barred and a sign is affixed to the space saying it is out of service. The inventory should also reflect that the space has now out of service. This process can also be implemented with empty tanks. Once the piece of equipment is either placed back into operation or removed completely from the facility, this should also be reflected in the inventory.

11. Lockout placards:

As mentioned above, the use of lockout zero energy state placards helped identify hazards associated with equipment that had confined spaces. It is recommended that this be continued.

12. Confined space inventory database:

It is recommended that the spreadsheet created for this inventory be used as the precursor for a database. This will make updating, editing, and keeping track of these spaces easier. Software is now available that will help organize inventory and also generate permits based on what information is available. This would allow for easier record keeping.

13. Confined space training refresher class:

A confined space training refresher class is recommended to keep employees trained. With all of the other duties that employees are responsible for, a review class for entering a confined space will allow them the opportunity to brush up on entry procedures and other information that they have forgotten. This class should be completed once every two years.

14. Confined space training tags:

In order to keep track as to who has received training for confined space entry, it is recommended that employees be given a tag by their supervisor or safety manager that shows they have been trained to enter a confined space. This tag should be checked prior

to entering a confined space to ensure those who are entering the space are qualified to do so. The tag can also have an expiration date on it to let employees know when they need to go to refresher training. After refresher training, the tag can be exchanged for a new tag or the date on the tag can be changed to a new expiration date.

Conclusions

The company can to reduce the hazards associated with confined spaces by keeping an updated confined space inventory, reviewing current methods for record retention, and evaluating training for effectiveness every few years. By reviewing and updating current practices, the company can continue to protect employees from hazards associated with confined spaces.

Caveats

A limitation of this project was that much of the information came from employees or by the investigator walking around sites and observing conditions. Although many spaces were found, there might be other spaces that have been forgotten or spaces that have been overlooked.

Another limitation is that the tractor operations are dynamic. Many of the sites are being renovated or updated. Therefore it is important to maintain the inventory and update it as new confined spaces are identified.

The other portion of this report centered on the company's 8-hr confined space training class. The limitations associated with evaluating the training classes are that only one training class was evaluated. There might be some variation with instructors and how classes are structured and how certain criterion is prioritized.

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Appendix 1: Standard Number 29CFR1910.146

1910.146(a)

Scope and application. This section contains requirements for practices and procedures to protect employees in general industry from the hazards of entry into permit-required confined spaces. This section does not apply to agriculture, to construction, or to shipyard employment (Parts 1928, 1926, and 1915 of this chapter, respectively).

1910.146(b)

Definitions.

"Acceptable entry conditions" means the conditions that must exist in a 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.

"Attendant" means 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.

"Authorized entrant" means an employee who is authorized by the employer to enter a permit space.

"Blanking or blinding" means the absolute closure of a pipe, line, or duct by the fastening of a solid plate (such as a spectacle blind or a skillet blind) 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.

"Confined space" means a space that:

- (1) Is large enough and so configured that an employee can bodily enter and perform assigned work; and
- (2) 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
- (3) Is not designed for continuous employee occupancy.

"Double block and bleed" means 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.

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

"Engulfment" means the surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.

"Entry" means 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.

"Entry permit (permit)" means the written or printed document that is provided by the employer to allow and control entry into a permit space and that contains the information specified in paragraph (f) of this section.

"Entry supervisor" means the person (such as the employer, 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.

NOTE: An entry supervisor also may serve as an attendant or as an authorized entrant, 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.

"Hazardous atmosphere" means an atmosphere that may expose employees to the risk of death, incapacitation, 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:

- (1) Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL);
- (2) Airborne combustible dust at a concentration that meets or exceeds its LFL;

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.

- (3) Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;
- (4) Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in Subpart G, Occupational Health and Environmental Control, or in Subpart Z, Toxic and Hazardous Substances, of this Part and which could result in employee exposure in excess of its dose or permissible exposure limit;

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

- (5) 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 Hazard Communication Standard, section 1910.1200 of this Part, published information, and internal documents can provide guidance in establishing acceptable atmospheric conditions.

"Hot work permit" means the employer's written authorization to perform operations (for example, riveting, welding, cutting, burning, and heating) capable of providing a source of ignition.

"Immediately dangerous to life or health (IDLH)" means any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from a permit space.

NOTE: Some materials -- hydrogen fluoride gas and cadmium vapor, for example -- may produce immediate transient effects that, even if severe, may pass without medical attention, but are followed by sudden, possibly fatal collapse 12-72 hours after exposure. The victim "feels normal" from recovery from transient effects until collapse. Such materials in hazardous quantities are considered to be "immediately" dangerous to life or health.

"Inerting" means the displacement of the atmosphere in a permit space by a noncombustible gas (such as nitrogen) to such an extent that the resulting atmosphere is noncombustible.

NOTE: This procedure produces an IDLH oxygen-deficient atmosphere.

"Isolation" means 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.

"Line breaking" means 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.

"Non-permit confined space" means 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.

"Oxygen deficient atmosphere" means an atmosphere containing less than 19.5 percent oxygen by volume.

"Oxygen enriched atmosphere" means an atmosphere containing more than 23.5 percent oxygen by volume.

"Permit-required confined space (permit space)" means a confined space that has one or more of the following characteristics:

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

"Permit-required confined space program (permit space program)" means the employer's overall program for controlling, and, where appropriate, for protecting employees from, permit space hazards and for regulating employee entry into permit spaces.

"Permit system" means the employer's written procedure for preparing and issuing permits for entry and for returning the permit space to service following termination of entry.

"Prohibited condition" means any condition in a permit space that is not allowed by the permit during the period when entry is authorized.

"Rescue service" means the personnel designated to rescue employees from permit spaces.

"Retrieval system" means the equipment (including 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 permit spaces.

"Testing" means the process by which the hazards that may confront entrants of a permit space are identified and evaluated. Testing includes specifying the tests that are to be performed in the permit space.

NOTE: Testing enables employers both to devise and implement adequate control measures for the protection of authorized entrants and to determine if acceptable entry conditions are present immediately prior to, and during, entry.

1910.146(c)

General requirements.

1910.146(c)(1)

The employer shall evaluate the workplace to determine if any spaces are permit-required confined spaces.

NOTE: Proper application of the decision flow chart in Appendix A to section 1910.146 would facilitate compliance with this requirement.

1910.146(c)(2)

If the workplace contains permit spaces, the employer shall inform exposed employees, by posting danger signs or by any other equally effective means, of the existence and location of and the danger posed by the permit spaces.

NOTE: A sign reading DANGER -- PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER or using other similar language would satisfy the requirement for a sign.

1910.146(c)(3)

If the employer decides that its employees will not enter permit spaces, the employer shall take effective measures to prevent its employees from entering the permit spaces and shall comply with paragraphs (c)(1), (c)(2), (c)(6), and (c)(8) of this section.

1910.146(c)(4)

If the employer decides that its employees will enter permit spaces, the employer shall develop and implement a written permit space program that complies with this section. The written program shall be available for inspection by employees and their authorized representatives.

1910.146(c)(5)

An employer may use the alternate procedures specified in paragraph (c)(5)(ii) of this section for entering a permit space under the conditions set forth in paragraph (c)(5)(i) of this section.

1910.146(c)(5)(i)

An employer whose employees enter a permit space need not comply with paragraphs (d) through (f) and (h) through (k) of this section, provided that:

1910.146(c)(5)(i)(A)

The employer can demonstrate that the only hazard posed by the permit space is an actual or potential hazardous atmosphere;

1910.146(c)(5)(i)(B)

The employer can demonstrate that continuous forced air ventilation alone is sufficient to maintain that permit space safe for entry;

1910.146(c)(5)(i)(C)

The employer develops monitoring and inspection data that supports the demonstrations required by paragraphs (c)(5)(i)(A) and (c)(5)(i)(B) of this section;

1910.146(c)(5)(i)(D)

If an initial entry of the permit space is necessary to obtain the data required by paragraph (c)(5)(i)(C) of this section, the entry is performed in compliance with paragraphs (d) through (k) of this section;

1910.146(c)(5)(i)(E)

The determinations and supporting data required by paragraphs (c)(5)(i)(A), (c)(5)(i)(B), and (c)(5)(i)(C) of this section are documented by the employer and are made available to each employee who enters the permit space under the terms of paragraph (c)(5) of this section or to that employee's authorized representative; and

1910.146(c)(5)(i)(F)

Entry into the permit space under the terms of paragraph (c)(5)(i) of this section is performed in accordance with the requirements of paragraph (c)(5)(ii) of this section.

NOTE: See paragraph (c)(7) of this section for reclassification of a permit space after all hazards within the space have been eliminated.

1910.146(c)(5)(ii)

The following requirements apply to entry into permit spaces that meet the conditions set forth in paragraph (c)(5)(i) of this section.

1910.146(c)(5)(ii)(A)

Any conditions making it unsafe to remove an entrance cover shall be eliminated before the cover is removed.

..1910.146(c)(5)(ii)(B)

1910.146(c)(5)(ii)(B)

When entrance covers are removed, the opening shall be promptly guarded by a railing, temporary cover, or other temporary barrier that will prevent an accidental fall through the opening and that will protect each employee working in the space from foreign objects entering the space.

1910.146(c)(5)(ii)(C)

Before an employee enters the space, the internal atmosphere shall be tested, with a calibrated direct-reading instrument, for oxygen content, for flammable gases and vapors, and for potential toxic air contaminants, in that order. Any employee who enters the space, or that employee's authorized representative, shall be provided an opportunity to observe the pre-entry testing required by this paragraph.

1910.146(c)(5)(ii)(C)(1)

Oxygen content,

1910.146(c)(5)(ii)(C)(2)

Flammable gases and vapors, and

1910.146(c)(5)(ii)(C)(3)

Potential toxic air contaminants.

1910.146(c)(5)(ii)(D)

There may be no hazardous atmosphere within the space whenever any employee is inside the space.

1910.146(c)(5)(ii)(E)

Continuous forced air ventilation shall be used, as follows:

1910.146(c)(5)(ii)(E)(1)

An employee may not enter the space until the forced air ventilation has eliminated any hazardous atmosphere;

1910.146(c)(5)(ii)(E)(2)

The forced air ventilation shall be so directed as to ventilate the immediate areas where an employee is or will be present within the space and shall continue until all employees have left the space;

1910.146(c)(5)(ii)(E)(3)

The air supply for the forced air ventilation shall be from a clean source and may not increase the hazards in the space.

1910.146(c)(5)(ii)(F)

The atmosphere within the space shall be periodically tested as necessary to ensure that the continuous forced air ventilation is preventing the accumulation of a hazardous atmosphere. Any employee who enters the space, or that employee's authorized representative, shall be provided with an opportunity to observe the periodic testing required by this paragraph.

1910.146(c)(5)(ii)(G)

If a hazardous atmosphere is detected during entry:

1910.146(c)(5)(ii)(G)(1)

Each employee shall leave the space immediately;

1910.146(c)(5)(ii)(G)(2)

The space shall be evaluated to determine how the hazardous atmosphere developed; and

1910.146(c)(5)(ii)(G)(3)

Measures shall be implemented to protect employees from the hazardous atmosphere before any subsequent entry takes place.

1910.146(c)(5)(ii)(H)

The employer shall verify that the space is safe for entry and that the pre-entry measures required by paragraph (c)(5)(ii) of this section have been taken, through a written certification that contains the date, the location of the space, and the signature of the person providing the certification. The certification shall be made before entry and shall be made available to each employee entering the space or to that employee's authorized representative.

1910.146(c)(6)

When there are changes in the use or configuration of a non-permit confined space that might increase the hazards to entrants, the employer shall reevaluate that space and, if necessary, reclassify it as a permit-required confined space.

1910.146(c)(7)

A space classified by the employer as a permit-required confined space may be reclassified as a non-permit confined space under the following procedures:

1910.146(c)(7)(i)

If the permit space poses no actual or potential atmospheric hazards and if all hazards within the space are eliminated without entry into the space, the permit space may be reclassified as a non-permit confined space for as long as the non-atmospheric hazards remain eliminated.

1910.146(c)(7)(ii)

If it is necessary to enter the permit space to eliminate hazards, such entry shall be performed under paragraphs (d) through (k) of this section. If testing and inspection during that entry demonstrate that the hazards within the permit space have been eliminated, the permit space may be reclassified as a non-permit confined space for as long as the hazards remain eliminated.

NOTE: Control of atmospheric hazards through forced air ventilation does not constitute elimination of the hazards. Paragraph (c)(5) covers permit space entry where the employer can demonstrate that forced air ventilation alone will control all hazards in the space.

1910.146(c)(7)(iii)

The employer shall document the basis for determining that all hazards in a permit space have been eliminated, through a certification that contains the date, the location of the space, and the signature of the person making the determination. The certification shall be made available to each employee entering the space or to that employee's authorized representative.

1910.146(c)(7)(iv)

If hazards arise within a permit space that has been declassified to a non-permit space under paragraph (c)(7) of this section, each employee in the space shall exit the space. The employer shall then reevaluate the space and determine whether it must be reclassified as a permit space, in accordance with other applicable provisions of this section.

1910.146(c)(8)

When an employer (host employer) arranges to have employees of another employer (contractor) perform work that involves permit space entry, the host employer shall:

1910.146(c)(8)(i)

Inform the contractor that the workplace contains permit spaces and that permit space entry is allowed only through compliance with a permit space program meeting the requirements of this section;

1910.146(c)(8)(ii)

Apprise the contractor of the elements, including the hazards identified and the host employer's experience with the space, that make the space in question a permit space;

1910.146(c)(8)(iii)

Apprise the contractor of any precautions or procedures that the host employer has implemented for the protection of employees in or near permit spaces where contractor personnel will be working;

1910.146(c)(8)(iv)

Coordinate entry operations with the contractor, when both host employer personnel and contractor personnel will be working in or near permit spaces, as required by paragraph (d)(11) of this section; and

1910.146(c)(8)(v)

Debrief the contractor at the conclusion of the entry operations regarding the permit space program followed and regarding any hazards confronted or created in permit spaces during entry operations.

1910.146(c)(9)

In addition to complying with the permit space requirements that apply to all employers, each contractor who is retained to perform permit space entry operations shall:

1910.146(c)(9)(i)

Obtain any available information regarding permit space hazards and entry operations from the host employer;

1910.146(c)(9)(ii)

Coordinate entry operations with the host employer, when both host employer personnel and contractor personnel will be working in or near permit spaces, as required by paragraph (d)(11) of this section; and

1910.146(c)(9)(iii)

Inform the host employer of the permit space program that the contractor will follow and of any hazards confronted or created in permit spaces, either through a debriefing or during the entry operation.

1910.146(d)

Permit-required confined space program (permit space program). Under the permit space program required by paragraph (c)(4) of this section, the employer shall:

1910.146(d)(1)

Implement the measures necessary to prevent unauthorized entry;

1910.146(d)(2)

Identify and evaluate the hazards of permit spaces before employees enter them;

1910.146(d)(3)

Develop and implement the means, procedures, and practices necessary for safe permit space entry operations, including, but not limited to, the following:

1910.146(d)(3)(i)

Specifying acceptable entry conditions;

1910.146(d)(3)(ii)

Providing each authorized entrant or that employee's authorized representative with the opportunity to observe any monitoring or testing of permit spaces;

1910.146(d)(3)(iii)

Isolating the permit space;

1910.146(d)(3)(iv)

Purging, inerting, flushing, or ventilating the permit space as necessary to eliminate or control atmospheric hazards;

1910.146(d)(3)(v)

Providing pedestrian, vehicle, or other barriers as necessary to protect entrants from external hazards; and

1910.146(d)(3)(vi)

Verifying that conditions in the permit space are acceptable for entry throughout the duration of an authorized entry.

1910.146(d)(4)

Provide the following equipment (specified in paragraphs (d)(4)(i) through (d)(4)(ix) of this section) at no cost to employees, maintain that equipment properly, and ensure that employees use that equipment properly:

1910.146(d)(4)(i)

Testing and monitoring equipment needed to comply with paragraph (d)(5) of this section;

1910.146(d)(4)(ii)

Ventilating equipment needed to obtain acceptable entry conditions;

1910.146(d)(4)(iii)

Communications equipment necessary for compliance with paragraphs (h)(3) and (i)(5) of this section;

1910.146(d)(4)(iv)

Personal protective equipment insofar as feasible engineering and work practice controls do not adequately protect employees;

1910.146(d)(4)(v)

Lighting equipment needed to enable employees to see well enough to work safely and to exit the space quickly in an emergency;

1910.146(d)(4)(vi)

Barriers and shields as required by paragraph (d)(3)(v) of this section.

1910.146(d)(4)(vii)

Equipment, such as ladders, needed for safe ingress and egress by authorized entrants;

1910.146(d)(4)(viii)

Rescue and emergency equipment needed to comply with paragraph (d)(9) of this section, except to the extent that the equipment is provided by rescue services; and

1910.146(d)(4)(ix)

Any other equipment necessary for safe entry into and rescue from permit spaces.

1910.146(d)(5)

Evaluate permit space conditions as follows when entry operations are conducted:

1910.146(d)(5)(i)

Test conditions in the permit space to determine if acceptable entry conditions exist before entry is authorized to begin, except that, if isolation of the space is infeasible because the space is large or is part of a continuous system (such as a sewer), pre-entry testing shall be performed to the extent feasible before entry is authorized and, if entry is authorized, entry conditions shall be continuously monitored in the areas where authorized entrants are working;

1910.146(d)(5)(ii)

Test or monitor the permit space as necessary to determine if acceptable entry conditions are being maintained during the course of entry operations; and

1910.146(d)(5)(iii)

When testing for atmospheric hazards, test first for oxygen, then for combustible gases and vapors, and then for toxic gases and vapors.

1910.146(d)(5)(iv)

Provide each authorized entrant or that employee's authorized representative an opportunity to observe the pre-entry and any subsequent testing or monitoring of permit spaces;

1910.146(d)(5)(v)

Reevaluate the permit space in the presence of any authorized entrant or that employee's authorized representative who requests that the employer conduct such reevaluation because the entrant or representative has reason to believe that the evaluation of that space may not have been adequate;

1910.146(d)(5)(vi)

Immediately provide each authorized entrant or that employee's authorized representative with the results of any testing conducted in accord with paragraph (d) of this section.

NOTE: Atmospheric testing conducted in accordance with Appendix B to section 1910.146 would be considered as satisfying the requirements of this paragraph. For permit space operations in sewers, atmospheric testing conducted in accordance with Appendix B, as supplemented by Appendix E to section 1910.146, would be considered as satisfying the requirements of this paragraph.

1910.146(d)(6)

Provide at least one attendant outside the permit space into which entry is authorized for the duration of entry operations;

NOTE: Attendants may be assigned to monitor more than one permit space provided the duties described in paragraph (i) of this section can be effectively performed for each permit space that is monitored. Likewise, attendants may be stationed at any location outside the permit space to be monitored as long as the duties described in paragraph (i) of this section can be effectively performed for each permit space that is monitored.

1910.146(d)(7)

If multiple spaces are to be monitored by a single attendant, include in the permit program the means and procedures to enable the attendant to respond to an emergency affecting one or more of the permit spaces being monitored without distraction from the attendant's responsibilities under paragraph (i) of this section;

1910.146(d)(8)

Designate the persons who are to have active roles (as, for example, authorized entrants, attendants, entry supervisors, or persons who test or monitor the atmosphere in a permit space) in entry operations, identify the duties of each such employee, and provide each such employee with the training required by paragraph (g) of this section;

1910.146(d)(9)

Develop and implement procedures for summoning rescue and emergency services, for rescuing entrants from permit spaces, for providing necessary emergency services to rescued employees, and for preventing unauthorized personnel from attempting a rescue;

1910.146(d)(10)

Develop and implement a system for the preparation, issuance, use, and cancellation of entry permits as required by this section;

1910.146(d)(11)

Develop and implement procedures to coordinate entry operations when employees of more than one employer are working simultaneously as authorized entrants in a permit space, so that employees of one employer do not endanger the employees of any other employer;

1910.146(d)(12)

Develop and implement procedures (such as closing off a permit space and canceling the permit) necessary for concluding the entry after entry operations have been completed;

1910.146(d)(13)

Review entry operations when the employer has reason to believe that the measures taken under the permit space program may not protect employees and revise the program to correct deficiencies found to exist before subsequent entries are authorized; and

NOTE: Examples of circumstances requiring the review of the permit space program are: any unauthorized entry of a permit space, the detection of a permit space hazard not covered by the permit, the detection of a condition prohibited by the permit, the occurrence of an injury or near-miss during entry, a change in the use or configuration of a permit space, and employee complaints about the effectiveness of the program.

1910.146(d)(14)

Review the permit space program, using the canceled permits retained under paragraph (e)(6) of this section within 1 year after each entry and revise the program as necessary, to ensure that employees participating in entry operations are protected from permit space hazards.

NOTE: Employers may perform a single annual review covering all entries performed during a 12-month period. If no entry is performed during a 12-month period, no review is necessary.

Appendix C to section 1910.146 presents examples of permit space programs that are considered to comply with the requirements of paragraph (d) of this section.

1910.146(e)

Permit system.

1910.146(e)(1)

Before entry is authorized, the employer shall document the completion of measures required by paragraph (d)(3) of this section by preparing an entry permit.

NOTE: Appendix D to section 1910.146 presents examples of permits whose elements are considered to comply with the requirements of this section.

1910.146(e)(2)

Before entry begins, the entry supervisor identified on the permit shall sign the entry permit to authorize entry.

1910.146(e)(3)

The completed permit shall be made available at the time of entry to all authorized entrants or their authorized representatives, by posting it at the entry portal or by any other equally effective means, so that the entrants can confirm that pre-entry preparations have been completed.

1910.146(e)(4)

The duration of the permit may not exceed the time required to complete the assigned task or job identified on the permit in accordance with paragraph (f)(2) of this section.

1910.146(e)(5)

The entry supervisor shall terminate entry and cancel the entry permit when:

1910.146(e)(5)(i)

The entry operations covered by the entry permit have been completed; or

1910.146(e)(5)(ii)

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

1910.146(e)(6)

The employer shall retain each canceled entry permit for at least 1 year to facilitate the review of the permit-required confined space program required by paragraph (d)(14) of this section. Any problems encountered during an entry operation shall be noted on the pertinent permit so that appropriate revisions to the permit space program can be made.

1910.146(f)

Entry permit. The entry permit that documents compliance with this section and authorizes entry to a permit space shall identify:

1910.146(f)(1)

The permit space to be entered;

1910.146(f)(2)

The purpose of the entry;

1910.146(f)(3)

The date and the authorized duration of the entry permit;

1910.146(f)(4)

The authorized entrants within the permit space, by name or by such other means (for example, through the use of rosters or tracking systems) as will enable the attendant to determine quickly and accurately, for the duration of the permit, which authorized entrants are inside the permit space;

NOTE: This requirement may be met by inserting a reference on the entry permit as to the means used, such as a roster or tracking system, to keep track of the authorized entrants within the permit space.

1910.146(f)(5)

The personnel, by name, currently serving as attendants;

1910.146(f)(6)

The individual, by name, currently serving as entry supervisor, with a space for the signature or initials of the entry supervisor who originally authorized entry;

1910.146(f)(7)

The hazards of the permit space to be entered;

1910.146(f)(8)

The measures used to isolate the permit space and to eliminate or control permit space hazards before entry;

NOTE: Those measures can include the lockout or tagging of equipment and procedures for purging, inerting, ventilating, and flushing permit spaces.

1910.146(f)(9)

The acceptable entry conditions;

1910.146(f)(10)

The results of initial and periodic tests performed under paragraph (d)(5) of this section, accompanied by the names or initials of the testers and by an indication of when the tests were performed;

1910.146(f)(11)

The rescue and emergency services that can be summoned and the means (such as the equipment to use and the numbers to call) for summoning those services;

1910.146(f)(12)

The communication procedures used by authorized entrants and attendants to maintain contact during the entry;

1910.146(f)(13)

Equipment, such as personal protective equipment, testing equipment, communications equipment, alarm systems, and rescue equipment, to be provided for compliance with this section;

1910.146(f)(14)

Any other information whose inclusion is necessary, given the circumstances of the particular confined space, in order to ensure employee safety; and (15) Any additional permits, such as for hot work, that have been issued to authorize work in the permit space.

1910.146(g)

Training.

1910.146(g)(1)

The employer shall provide training 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 under this section.

1910.146(g)(2)

Training shall be provided to each affected employee:

1910.146(g)(2)(i)

Before the employee is first assigned duties under this section;

1910.146(g)(2)(ii)

Before there is a change in assigned duties;

1910.146(g)(2)(iii)

Whenever there is a change in permit space operations that presents a hazard about which an employee has not previously been trained;

1910.146(g)(2)(iv)

Whenever the employer has reason to believe either that there are deviations from the permit space entry procedures required by paragraph (d)(3) of this section or that there are inadequacies in the employee's knowledge or use of these procedures.

1910.146(g)(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 section.

1910.146(g)(4)

The employer shall certify that the training required by paragraphs (g)(1) through (g)(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 available for inspection by employees and their authorized representatives.

1910.146(h)

Duties of authorized entrants. The employer shall ensure that all authorized entrants:

1910.146(h)(1)

Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

1910.146(h)(2)

Properly use equipment as required by paragraph (d)(4) of this section;

1910.146(h)(3)

Communicate with the attendant as necessary to enable the attendant to monitor entrant status and to enable the attendant to alert entrants of the need to evacuate the space as required by paragraph (i)(6) of this section;

1910.146(h)(4)

Alert the attendant whenever:

1910.146(h)(4)(i)

The entrant recognizes any warning sign or symptom of exposure to a dangerous situation, or

1910.146(h)(4)(ii)

The entrant detects a prohibited condition; and

1910.146(h)(5)

Exit from the permit space as quickly as possible whenever:

1910.146(h)(5)(i)

An order to evacuate is given by the attendant or the entry supervisor,

1910.146(h)(5)(ii)

The entrant recognizes any warning sign or symptom of exposure to a dangerous situation,

1910.146(h)(5)(iii)

The entrant detects a prohibited condition, or

1910.146(h)(5)(iv)

An evacuation alarm is activated.

1910.146(i)

Duties of attendants. The employer shall ensure that each attendant:

1910.146(i)(1)

Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

1910.146(i)(2)

Is aware of possible behavioral effects of hazard exposure in authorized entrants;

1910.146(i)(3)

Continuously maintains an accurate count of authorized entrants in the permit space and ensures that the means used to identify authorized entrants under paragraph (f)(4) of this section accurately identifies who is in the permit space;

1910.146(i)(4)

Remains outside the permit space during entry operations until relieved by another attendant;

NOTE: When the employer's permit entry program allows attendant entry for rescue, attendants may enter a permit space to attempt a rescue if they have been trained and equipped for rescue operations as required by paragraph (k)(1) of this section and if they have been relieved as required by paragraph (i)(4) of this section.

1910.146(i)(5)

Communicates with authorized entrants as necessary to monitor entrant status and to alert entrants of the need to evacuate the space under paragraph (i)(6) of this section;

1910.146(i)(6)

Monitors activities inside and outside the space to determine if it is safe for entrants to remain in the space and orders the authorized entrants to evacuate the permit space immediately under any of the following conditions;

1910.146(i)(6)(i)

If the attendant detects a prohibited condition;

1910.146(i)(6)(ii)

If the attendant detects the behavioral effects of hazard exposure in an authorized entrant;

1910.146(i)(6)(iii)

If the attendant detects a situation outside the space that could endanger the authorized entrants; or

1910.146(i)(6)(iv)

If the attendant cannot effectively and safely perform all the duties required under paragraph (i) of this section;

1910.146(i)(7)

Summon rescue and other emergency services as soon as the attendant determines that authorized entrants may need assistance to escape from permit space hazards;

1910.146(i)(8)

Takes the following actions when unauthorized persons approach or enter a permit space while entry is underway:

1910.146(i)(8)(i)

Warn the unauthorized persons that they must stay away from the permit space;

1910.146(i)(8)(ii)

Advise the unauthorized persons that they must exit immediately if they have entered the permit space; and

1910.146(i)(8)(iii)

Inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space;

1910.146(i)(9)

Performs non-entry rescues as specified by the employer's rescue procedure; and

1910.146(i)(10)

Performs no duties that might interfere with the attendant's primary duty to monitor and protect the authorized entrants.

1910.146(j)

Duties of entry supervisors. The employer shall ensure that each entry supervisor:

1910.146(j)(1)

Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

1910.146(j)(2)

Verifies, by checking that the appropriate entries have been made on the permit, that all tests specified by the permit have been conducted and that all procedures and equipment specified by the permit are in place before endorsing the permit and allowing entry to begin;

1910.146(j)(3)

Terminates the entry and cancels the permit as required by paragraph (e)(5) of this section;

1910.146(j)(4)

Verifies that rescue services are available and that the means for summoning them are operable;

1910.146(j)(5)

Removes unauthorized individuals who enter or who attempt to enter the permit space during entry operations; and

1910.146(j)(6)

Determines, 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 terms of the entry permit and that acceptable entry conditions are maintained.

1910.146(k)

Rescue and emergency services.

1910.146(k)(1)

An employer who designates rescue and emergency services, pursuant to paragraph (d)(9) of this section, shall:

1910.146(k)(1)(i)

Evaluate a prospective rescuer's ability to respond to a rescue summons in a timely manner, considering the hazard(s) identified;

Note to paragraph (k)(1)(i): What will be considered timely will vary according to the specific hazards involved in each entry. For example, §1910.134, Respiratory Protection, requires that employers provide a standby person or persons capable of immediate action to rescue employee(s) wearing respiratory protection while in work areas defined as IDLH atmospheres.

1910.146(k)(1)(ii)

Evaluate a prospective rescue service's ability, in terms of proficiency with rescue-related tasks and equipment, to function appropriately while rescuing entrants from the particular permit space or types of permit spaces identified;

1910.146(k)(1)(iii)

Select a rescue team or service from those evaluated that:

1910.146(k)(1)(iii)(A)

Has the capability to reach the victim(s) within a time frame that is appropriate for the permit space hazard(s) identified;

1910.146(k)(1)(iii)(B)

Is equipped for and proficient in performing the needed rescue services;

1910.146(k)(1)(iv)

Inform each rescue team or service of the hazards they may confront when called on to perform rescue at the site; and

1910.146(k)(1)(v)

Provide the rescue team or service selected with access to all permit spaces from which rescue may be necessary so that the rescue service can develop appropriate rescue plans and practice rescue operations.

Note to paragraph (k)(1): Non-mandatory Appendix F contains examples of criteria which employers can use in evaluating prospective rescuers as required by paragraph (k)(1) of this section.

1910.146(k)(2)

An employer whose employees have been designated to provide permit space rescue and emergency services shall take the following measures:

1910.146(k)(2)(i)

Provide affected employees with the personal protective equipment (PPE) needed to conduct permit space rescues safely and train affected employees so they are proficient in the use of that PPE, at no cost to those employees;

1910.146(k)(2)(ii)

Train affected employees to perform assigned rescue duties. The employer must ensure that such employees successfully complete the training required to establish proficiency as an authorized entrant, as provided by paragraphs (g) and (h) of this section;

1910.146(k)(2)(iii)

Train affected employees in basic first-aid and cardiopulmonary resuscitation (CPR). The employer shall ensure that at least one member of the rescue team or service holding a current certification in first aid and CPR is available; and

1910.146(k)(2)(iv)

Ensure that affected employees practice making permit space rescues at least once every 12 months, by means of simulated rescue operations in which they remove dummies, manikins, or actual persons from the actual permit spaces or from representative permit spaces. Representative permit spaces shall, with respect to opening size, configuration, and accessibility, simulate the types of permit spaces from which rescue is to be performed.

1910.146(k)(3)

To facilitate non-entry rescue, retrieval systems or methods shall be used whenever an authorized entrant enters a permit space, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant. Retrieval systems shall meet the following requirements.

1910.146(k)(3)(i)

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, above the entrant's head, or at another point which the employer can establish presents a profile small enough for the successful removal of the entrant. Wristlets may be used in lieu of the chest or full body harness if the employer can demonstrate 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.

1910.146(k)(3)(ii)

The other end of the retrieval line shall be attached to a mechanical device or fixed point outside the permit space 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 permit spaces more than 5 feet (1.52 m) deep

1910.146(k)(4)

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

1910.146(l)

Employee participation.

1910.146(l)(1)

Employers shall consult with affected employees and their authorized representatives on the development and implementation of all aspects of the permit space program required by paragraph (c) of this section.

1910.146(l)(2)

Employers shall make available to affected employees and their authorized representatives all information required to be developed by this section.

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