OSHA Confined Space Entry

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Abstract
The right to life is one of the most important privileges and it must be guaranteed during labour activities. Supported guidelines issued by the International Labour Organization (ILO), legal and regulatory systems issued by the Occupational, Safety and Health Administration (OSHA), the National Institute for Occupational Safety and Health (NIOSH), Mine Safety and Health Administration (MSHA) and many others official bodies expect that all workers must be able to perform any task safely and that their well-being can never be under valuated. This article proposes an OSHA confined space entry regulation understanding, focusing only on two variables: atmospheric hazards and emergency rescue and their misconceptions, since they are considered the most responsible for accidents and injuries in confined spaces. The exact number of workers fatalities or injuries in these places annually is unknown. As a result of this study we realize that if an accurate confined space program is followed and mainly understood, accidents can be prevented in these workplaces.

Keywords: confined space, emergency rescue, work related accidents, atmospheric hazards.

1. INTRODUCTION
By identifying all hazardous activities, it is possible to recognize and evaluate the workplaces where they occur (Peake, 2006). In 1999, the "North West Occupational Health and Safety" undertook a study about confined spaces work related accidents, between 1982-1990, based on research conducted by OSHA, NIOSH and MSHA (Carron, 2006). It was found that the recommendations proposed by NIOSH, some years before, in 1979, that could have prevented these fatalities, were not taken into account. Even in those cases, where a written program for confined space entry was made, the preventive measures were not implemented, or were inadequate. Furthermore, both situations occurred. The need and importance of establishing written procedures, defining responsibilities, educating and training all workers involved in confined space activities as a way of reducing the number of fatalities in these workplaces was evident (Manwaring & Conroy, 1990). Resulting from these studies conducted by official bodies about work related accidents, their causes and locations, the United States of America (USA) became pioneers in the elaboration and application of rules regarding confined spaces entries (Ibbetson, 2007). As it is not achievable to explain in this article all the steps of a confined space program, only atmospheric hazards and emergency rescues will be focussed.

2. MATERIALS AND METHOD
To accomplish this study, a literature review about OSHA confined space program was undertaken. This review was performed using the search engine Exlibris MetaLib, Academics Google, official bodies in the U.S., doctoral thesis repositories and international expertise magazines. Several scientific opinions on some misconception about OSHA regulation were taken into account and confronted.

3. SHORT REVIEW OF USA PERSPECTIVE
In 1970, the USA created the Occupational Safety and Health Act emphasizing the need for implementation of standards to protect the health and safety of the workers exposed to an increasing variety of potential hazards in their workplaces. Promptly they identified confined spaces as dangerous workplaces and worthy of having their own regulations. They started by investigating accidents and near misses happening in these spaces, as a way to learn and implement proper measures for protection and prevention. In December 1979, NIOSH published a criteria document for Working in Confined Spaces, which recommended procedures for workers protection against the hazards of entering, working in, or exiting confined spaces (OSHA, 1993). In July 1987, NIOSH published A Guide to Safety in Confined Spaces, focusing on the identification of confined spaces, measures to take when a confined space presents atmospheric hazards, and incidents in which the lack of hazard awareness and unplanned rescue attempts led into deaths. This guide also describes other potential hazards as physical and non-atmospheric, due mainly to the deaths that keep on happening, even after the 1979 criteria document was published. In addition, NIOSH's FACE Project (Fatal Accident Circumstances and Epidemiology) concentrated much of its effort analysing, assembling and reporting all confined space-related fatalities from years 1984 to 1988. Those reports contributed significantly to OSHA's understanding of the wide range of hazards arising from confined spaces works (OSHA, 1993). On January 14, 1993, OSHA issued a standard for general industry (29 CFR 1910.146) to request protection to all workers who needed to remain inside permit- spaces. The standard is based on years of collecting information on confined space fatalities and on testimonies about the hazards of confined spaces from all sectors of industry and labour (OSHA, 1993)

4. CONFINED SPACE CONCEPTION
In industrial environments confined space entry is one of the activities that workers may face, and often occurs during activities of inspections, repairs or maintenance (NIOSH, 1979), but this situation can also take place during the construction phase and, in these cases, it is easier to identify associated risks, since these spaces were never used. Needless to say that many of the confined spaces will need maintenance or repair works and that is why "the USA construction industry should implement the concept of designing for construction safety as a standard practice to reduce

overall project risks" (Behm, 2005). In the view of OSHA and NIOSH, confined spaces entries are primarily limited by size or location, but it is a wrong idea to identify them as being exclusively confined. This may lead to erroneous classifications, which may be one of the reasons why the identification remains difficult, and fatalities still happen (Taylor, 2011).
Confined spaces cannot be identified by size, configuration or nature of the work to perform. Some may be larger, others smaller. In some cases, these spaces are partially open, others fully closed. The identification and classification can range from immediately obvious to quite complex, depending on the processes and activities taking place (Manus, 2010).

4.1. Hazardous Atmosphere Classification

Monitoring the atmosphere in a confined space is an OSHA requirement, as a way to assess the air quality inside, before and during activities (Roth, 2013). Confined spaces may contain hazardous substances, deficiency of oxygen or enriched atmospheres; hydrogen sulphide (H_2S), carbon monoxide (CO) and methane (CH_4) are the most common gases in enclosed spaces that can only be detected through atmospheric tests with the use of gas detectors (Ursulan, 2009). However, control methods should be adjusted to the type of confined space, surroundings and works performed inside (Ursulan, 2009), or these could lead to erroneous checks. Another very important element is guaranteeing certified and calibrated equipment to perform gas measurements, as well as trained persons to perform these checks (Taylor, 2011). NIOSH created a methodology to classify hazardous atmospheres within confined spaces, which is based on the percentage of oxygen in the air, characteristics of inflammable gas or vapour and the concentration of toxic substances that may be present inside - see Table 1 (NC, 2012). Classifying a confined space as class A, B or C is determined by the most dangerous condition in this space. The usefulness of this classification is to produce a scheme with recommendations of work practices, and rescue procedures that must be applied.

Table 1 - Confined Space Classification

	Class A	**Class B**	**Class C**
Characteristics	Immediately dangerous to life	Dangerous, but not immediately life threatening	Potential hazard
Oxygen	16% or less or greater than 25%	16.1% to 19.4%, or 21.5% to 25%t	19.5% to 21.4%
Flammability Characteristics	20% or greater of lower flammability limit	10% to19% of lower flammability limit	10% of lower flammability limit or less
Toxicity	IDLH*	Greater than contamination level, referenced in 29 CFR Part 1910, Subpart Z (IDLH*)	Less than contamination level referenced in 29 CFR Part 1910, Subpart Z

Adapted from NC, 2012; **Immediately Dangerous to Life or Health*

4.2. Rescue and Emergency

As a requirement by OSHA "an emergency response plan for industrial permit-required confined space entry is essential (Wilson & Wang, 2013). Due to confined space configuration, misdeeds rescues can be a challenge that could lead to increase risks beyond the existing ones. "The inability to respond effectively in the event of a rescue situation is often the cause of confined space entry fatal incidents" (Wilkinson, Burns, Simpson, Walker & Hunter, 2012). "Rescuing a worker from a confined space is a low frequency, high-risk operation that is both time sensitive and technically challenging. Experience shows that a hastily executed rescue increases the likelihood that would-be rescuers will become victims" (Wilson, Madison & Healy, 2012). Although OSHA regulation does not require exclusively internal rescue teams, companies should create and train their own emergency teams and prepare them with appropriate equipment for the existing risks, so they can be able to perform the primary rescue not relaying exclusively on public fire departments (Wilson, Madison & Healy, 2012). "When a confined space emergency occurs", time is crucial. "Many employers have failed to adequately evaluate rescue capability or have failed to make corrections when evaluations reveal serious problems. In most cases, rescue plans have several problems" (Taylor, 2011). Furthermore, confined space occupancy can cause another problem during rescue operations. Determining a suitable occupant load of a hazardous confined space, guaranteeing a proper emergency readiness to evacuate safely is another variable that must be thought (Wilson & Wang, 2013).

5. CONCLUSIONS

As a result of this study, the simple implementation of OSHA regulation in confined space entries is not enough; understanding OSHA regulation, evaluating in situ the real conditions and training all workers about specific hazards in that area, are the most important keys to avoid accidents and injuries from happening. Through the correct understanding of OSHA confined space program and an appropriate evaluation, it is possible to prevent accidents or injuries from happening in such places.

7. ACKNOWLEDGMENTS

The authors would like to thank Master in Occupational Safety and Hygiene Engineering (MESHO), from Faculty of Engineering of the University of Porto (FEUP), all the support in the development and international dissemination of this work

6. REFERENCES

Behm, Michael (2005), Linking construction fatalities to the design for construction safety concept, *Safety Science*, Volume 43, Issue 8, October 2005, Pages 589-611, Retrieved September 13, 2013, from http://www.sciencedirect.com/science/article/pii/S0925753505000731.

Ibbetson, Terry (2007), When Does a Confined Space Rescue Start?, *HSE Today*, Retrieved September 16, 2013, from, http://ehstoday.com/safety/confined-spaces/ehs_imp_39454.

MacCarron, Ciaran, "Confined space fatalities" (2006). *Theses: Doctorates and Masters*. Paper 81. Retrieved September 13, 2013, from, http://ro.ecu.edu.au/theses/81.

Manwearing, J. C., & Conroy, C. (1990). Occupational confined space-related fatalities: Surveillance and prevention. *Journal of Safety Research*, 21, 157-164. Retrieved September 16, 2013, from, http://www.sciencedirect.com/science/article/pii/0022437590900235.

Mc Manus, Neill (2010), Advancing The Paradigm: Confined Spaces and The Uncharacterized Workspace, *NorthWest Occupational Health & Safety. Retrieved September 16, 2013, from http://www.nwohs.com/uncharacterized workspace.pdf.*

N.C. (2012), A Guide to safety in Confined Space, *Occupational Safety and Health Division N.C*. Department of Labor, Retrived September 10, 2013, from http://www.nclabor.com/osha/etta/indguide /ig1.pdf.

NIOSH (1979). Criteria for a recommended standard: working in confined spaces. Cincinnati, OH: U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 80-106.

Peake, Simon (2006), Confined Space Entry, *Health and Safety International*, Retrieved September 14, 2013, from, http://www.hsimagazine.com/article.php?article_id=507.

Roth, Cynthia L, (2013) Safeguarding Confined Space, *Health and Safety International*, Retrieved September 15, 2013, from, http://www.hsimagazine.com/article.php?article_id=767

Taylor, Bill (2011), Confined Spaces: Common Misconceptions & Errors in Complying With OSHA's Standard, *Professional Safety*, The American Society of Safety Engineers. *Retrieved September 12, 2013, from http://www.asse.org/professionalsafety/docs/Taylor_0913.pdf.*

OSHA. (1993). *1910.146 - Permit-required confined spaces*, de United States Department of Labor: Accessed on April 14, 2013, from, https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=PREAMBLES&p_id=838.

Ursulan, Sarah (2009), Confined Space Entry Compliance, Occupational Health & Safety Magazine, Retrieved September 11, 2013, from, http://ohsonline.com/articles/2009/11/01/confined-space-entry-compliance.aspx.

Wilkinson, Tony, Burns, Kenny, Simpson, Alan, Walker, Kirsty & Hunter, Martin, M-I SWACO, a Schlumberger Company (2012), Improving the control of confined-space entry through the implementation of an operational standard and competence based training, Society of Petroleum Engineers, Conference Paper, International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, 11-13 September 2012, Perth, Australia. Retrieved September 10, 2013, from, http://www.onepetro.org/mslib/servlet/onepetropreview?id=SPE-157551-MS&soc=SPE.

Wilson Michael P., Madison Heather N. & Healy Stephen B. (2012), Confined Space Emergency Response: Assessing Employer and Fire Department Practices, Journal of Occupational and Environmental Hygiene, 9: 120–128. Retrieved September 10, 2013, from, http://www.tandfonline.com/doi/abs/10.1080/15459624.2011.646644 - .UmRdmBb98W4.

Wilson, P. and Wang, Q. (2013), Development of a protocol for determining confined space occupant load. Proc. Safety Prog.. doi: 10.1002/prs.11619, Retrieved September 10, 2013, from, http://onlinelibrary.wiley.com/doi/10.1002/prs.11619/abstract.