Enhancing Your Safety Program with Safety Signs

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Introduction

Whether your workplace has been in operation for decades or it's a brand new facility, the likelihood is that a wide variety of safety signs are installed on the walls and doors of your facility. The purpose of safety signs is to guide human behavior and reinforce training so that hazards are avoided, people are not injured and/or equipment and the facility are not damaged. As such, safety signs play a critical role in your overall safety program. Given their important function, the irony of the situation is that many safety engineers are unaware of the latest standards regarding safety sign design and therefore their facilities lack a coherent well-defined strategy for visually communicating safety information in compliance with current standards. The standards in this area exist for a reason – they provide a definition for the "best practice," the "state-of-the-art," for industry to follow with regards to conveying safety messages in the form of signs, labels, tags and markings. Attendees at this presentation will learn what is involved in the development of a well designed facility signage program. The presentation will cover the history of safety sign standardization, describe the current relevant standards and give concrete, practical steps towards implementing a company-wide strategy that uses the latest technology for the visual communication of safety in the workplace.

A Brief History of Safety Sign Standardization

Safety signs are recognized as one of the oldest types of safety equipment. The earliest guidance on their use dates back to a pamphlet titled, "Signs and Slogans" published in 1914. This document was referenced in the first American National Standards Institute (ANSI) standard on signage, Z35.1 *Accident Prevention Signs* (1941). The 1967 version of ANSI Z35.1 served as the basis document for OSHA's safety sign regulation 29 CFR 1910.145, *Specifications for Accident Prevention Signs and Tags* issued in 1971. The current OSHA regulation for safety sign design has not changed; it is still based on the vintage 1940's-1960's ANSI standard. This would be fine except for the fact that the ANSI Z35.1 standard was replaced by the ANSI *Z535.2 Environmental and Facility Safety Sign Standard* in 1991, a standard which has been revised every 5-6 years according to ANSI's revision policy. Over the years new and improved methods for visually communicating safety information have been developed by the ANSI Z535 committee, the committee in charge of the development of national standards for safety signs, colors, symbols, labels, tags and the communication of safety information in manuals. The fact is that in an effort to nationally standardize on improved formatting methodologies, the outdated

Z35.1/OSHA formats were relegated to a non-preferred status in the 1998 version of the ANSI Z535 standards and then were made completely obsolete in the 2002 ANSI Z535 standards (see Exhibit 1).

Exhibit 1: Examples of the ANSI Z35.1-1967/OSHA formats made obsolete by ANSI Z535.2-2002.

Much has changed in the world since 1941 in the areas of legal liability and the science of human factors engineering. Both of these bodies of knowledge have contributed greatly to the modern concept of a safety sign as has been developed by the ANSI Z535 committee over the past two decades. In short, what the Z535 committee determined was that the old Z35.1/OSHA formats were not adaptable to the modern world of facility safety. Safety sign formats must be adaptable in a variety of ways – they must be able to convey simple messages on certain occasions and complex messages in others. The old Z35.1 formats did not easily accommodate the addition of text beyond a simple statement that typically either described the hazard (e.g. "High Voltage") or described a specific avoidance procedure (e.g. "Wear Hard Hat"). From both a safety communication and liability perspective, today's safety signs often need to convey:

- A more complete word message that communicates type of hazard and hazard avoidance information
- Word messages in more than one language
- One or more graphical symbols to better communicate all or a portion of the message

The old Z35.1/OSHA formats did not easily accommodate symbols, multiple languages, or more detailed messages, all of which are now fundamental building block choices for a facility safety program's purpose of reducing risk in the today's workplace.

It should be noted here that OSHA fully accepts compliance with the current version of the *ANSI Z535.2 Standard for Environmental and Facility Safety Signs* as a legitimate substitute for compliance with the sign regulations as outlined in OSHA CFR 1910.145. Such compliance is called a "de minimus situation" because compliance is with the latest version of the basis document for the regulation. Since OSHA has yet to revise its regulation in the area of safety signage, this is an important aspect to understand: Compliance with ANSI Z535.2 is accepted by OSHA.

Harmonization With International Standards

Before evaluating the latest revisions to current U.S. safety sign standards, and because harmonization with international standards has been a driving factor behind the latest U.S. standards revisions, it is necessary to understand the key ISO standards developed since 2002. There is a new language of safety signage evolving in the international standards arena and in the

past several years it has had an impact on U.S. standards. The aim of most of much of the revision work being accomplished in the U.S. standards has been done in an effort to harmonize the graphical symbols, colors and, to a lesser degree, the formats, used for safety signs found in public areas and workplaces. The resulting markings are used to communicate critical safety-related information on signs that are strategically placed in the environment, both internal and external to buildings. For the past decade, the international committee in charge of graphical symbols and safety signs, ISO/TC 145, has standardized symbols used on public information signs, safety signs, and symbols used on equipment to indicate function and control.

The purpose of ISO/TC 145's standards is to bring about a degree of global uniformity to markings which utilize graphical symbols. The goal overall is to limit the proliferation of safety symbols intended to convey the same meaning. Use of the internationally standardized symbols should create consistency which, in turn, should lead to increased user comprehension on a cross-cultural basis. This will benefit both companies that have a single facility with workers of varied backgrounds as well companies with multiple facilities located throughout the world. The end result should be that anyone anywhere should understand the meaning of all or a significant portion of the safety sign through the use of the internationally standardized symbols.

The following are the four primary ISO standards that are the key to understanding the new safety sign technology, a technology that is now appearing in the U.S. facility safety environment.

ISO 3864-1. *ISO 3864-1 Graphical symbols – Safety colours and safety signs* (2002) defines the rules for the color and shape of safety signage, rules for incorporating text and formulas for viewing distance/sign size. The "vocabulary" of color and shape defined in this standard is both elegant and simple:
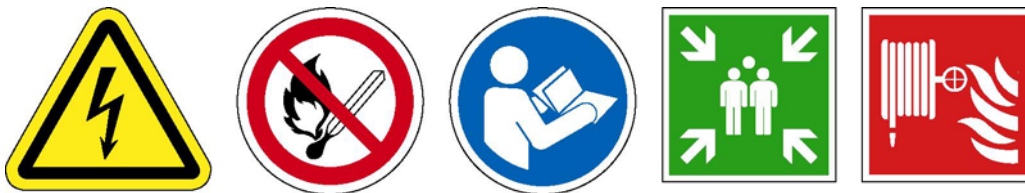

Exhibit 2. Examples of ISO formatted graphical symbol signs (left to right): electrical hazard warning sign, no open flame prohibition sign, read instructions mandatory action sign, assembly point safe condition sign, fire hose fire safety sign

- **Warning signs** consist of a yellow triangle with a black outer band, containing a black graphical symbol. These sign are intended to warn people of hazards.
- **Mandatory action signs** consist of a blue circle with a white graphical symbol. These signs are intended to instruct people about actions they must take in order to avoid a hazard.
- **Prohibition signs** consist of a prohibition surround shape (red circular band with a red slash going from the upper left to the lower right) over top of a black graphical symbol.
- **Safe Condition / Emergency Equipment signs** consist of a green rectangle with a white graphical symbol.
- **Fire safety signs** consist of a red rectangle with a white graphical symbol which includes the standardized flames "determinative" element.

ISO 7010. *ISO 7010 Graphical symbols — Safety colours and safety signs — Safety signs used in workplaces and public areas* is the primary ISO document that standardizes safety signs consistent with the principles set forth in ISO 3864-1. First published in 2003, it is a document that is in a state of continual revision as new symbols are added in subsequent addendums.

ISO 16069. *ISO 16069 Graphical symbols — Safety way guidance systems* (2003) is a standard for directional egress path marking systems for buildings. The need for universal exit path marking systems to lead people to safety was deemed by ISO/TC 145 in 1997 as one of the most critical applications for standardized signage. For six years a multi-disciplinary committee of the world's experts in evacuation systems and graphical symbols met several times a year to develop ISO 16069. The result, published in 2003, is a standard that sets forth the basic principles for designing egress path marking systems for buildings. It's well defined components and concepts include:

- Directional way guidance signs
- Continuous guidance lines
- Step markings
- Handrail markings
- Door signs and perimeter markings
- High, intermediate and low location placement
- Luminance performance criteria for photoluminescent materials

The signs defined in ISO 16069 use the symbols found in ISO 7010 and the sign design criteria presented in ISO 3864. A series of informational illustrations are contained in the standard to show how the standard's concepts are used.

ISO 17398. *ISO 17398 Graphical symbols — Test methods* (2003)
The development of a materials test method standard took place simultaneously with the writing of ISO 3864 and ISO 16069. The standard which was created, ISO 17398, is used both by those responsible for specifying a sign's performance characteristics relative to the environment and performance requirements dictated by the application. ISO 17398 is also used by manufacturers of safety signs to specify their products' performance characteristics. As such, this standard is playing a critical role in the updating of the world's safety signage because it gives a common ground of material categorization that can be used by subsequent standards-writing bodies to specify minimum safety sign performance characteristics. The standard's material classification system also then lends confidence to the subsequent purchase of sign products which use the ISO 17398 system to specify their physical characteristics.

Incorporating ISO Principles Into U.S. Standards

- As chairman of the U.S. delegation to the ISO/TC 145 since 1996 and as a member of the ANSI Z535 committee since 1992, my role has been to ensure as much as possible that the most critical principles embodied in the ANSI Z535 safety sign standards were incorporated by ISO. This was accomplished between 2002 and 2004. Next the effort was made to have the relevant NFPA and ANSI Z535 standards incorporate ISO concepts where appropriate.

This too was accomplished. What follows is a list of the standards most relevant to this discussion:

NFPA 170. *NFPA 170 Fire Safety and Emergency Symbols* (2006)
With the major ISO standards completed, the adoption of the ISO principles and graphical symbols into U.S. standards began with the National Fire Protection Association's *NFPA 170 Standard for Fire Safety Symbols*. This standard's 2002 edition included some poorly drawn renditions of the ISO egress symbol and directional arrow and it did not give guidance on how the symbols should be used for directional way guidance. Proposals for international harmonization in accordance with ISO 3864 and ISO 7010 were accepted in 2004 for the next revision, published in 2006. The 2006 edition included the following important changes:

- Replacing the existing egress and arrow symbols with the exact ISO 7010 versions of these symbols (see Exhibit 3).
- The addition of figures showing the use of the ISO arrow with the ISO egress symbol for all eight directional signs.
- The adoption of the ISO fire safety signs as the U.S. safety symbols for fire alarm, fire hose, fire phone, and fire extinguisher. These signs are intended to be posted in facilities to indicate the location of this equipment, replacing existing signage.
- The adoption of a national sign for AED devices so they can be quickly located.
- The adoption of the Department of Homeland Security's symbols for use on disaster planning/occurrence maps.
- The title of the standard was changed to, "*NFPA 170 Fire Safety and Emergency Symbols*," a title that better reflects its new and broader scope.

Exhibit 3. NFPA 170-2006 Fire safety, AED and emergency exit symbols/signs

NFPA 170 is the reference sited by the *NFPA 101 Life Safety Code* (2006) as the source for the proper depictions for safety signs used for fire safety and evacuation purposes.[1] NFPA 101, in turn, is sited by many state and national building codes that are enforceable by local and state laws by the building inspectors, fire departments and other "authorities having jurisdiction." It is within this chain of standards-based codes that the ISO safety signs for fire safety and emergency egress are in the process of becoming the official U.S. safety signs for conveying the location of fire-related equipment and directional emergency exit route marking. Thus, though it may have

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[1] NFPA Life Safety Code 2006, section A.7.10.3

been a relatively obscure standard prior to 2006, NFPA 170 has risen to a level of prominence in the post 9/11 era.

NIST WTC Report. In October 2005 the 9/11 Commission, chaired by the National Institute for Standards and Technology (NIST), published its final report.[2] Thirty-two recommendations geared to improving safety in buildings appeared at the end of this report. Number 28 reads:

"Recommendation 18. NIST recommends that egress systems be designed…with consistent layouts, standard signage, and guidance so that systems become intuitive and obvious to building occupants during evacuations….Egress systems should have consistent layouts and standard signage and guidance so that the systems become intuitive and obvious to all building occupants, including visitors, during evacuations."[3]

In short, what NIST calls for is standardized evacuation signage systems that clearly and consistently demark the layout of egress paths in high rise buildings. Yet these same principles can and should be considered for all facilities; from warehouses to manufacturing plants to office buildings.

NYC Building Code Reference Standard 6-1. In 2003 the New York City World Trade Center Taskforce (a panel of experts appointed by the Major of New York City) issued their report aimed at making high rise commercial buildings safer.[4] The report contained recommendations to the City Council to amend the city's building code to achieve this goal. In June 2004, the City Council unanimously voted to adopt 21 recommendations and issued a set of regulations for all five boroughs of New York City that is called Local Law 26. The first of these new requirements to be met by building owners was the mandatory installation of photoluminescent directional way guidance systems in the stairwells of all Class E commercial buildings over 75 feet tall. The Buildings Department could have invented their own version of what markings should be used but they did not. Instead they turned to ISO 7010 for the egress symbols and directional arrows and utilized the configurations as described in the then soon-to-be-published NFPA 170 standard for how these symbols should be used to present directional information to the occupants of buildings. The Buildings Department's standard, Reference Standard 6-1, closely resembles the concepts presented in ISO 16069 for safety signs, handrail markings and demarcation lines and it uses the luminance test method found in ISO 17398 for establishing the minimum luminance performance criteria acceptable for photoluminescent products to meet the code (though using a two foot candle charging source to mimic the minimum lighting found in stairwells as mandated by the City's building code). It should be noted that the Buildings Department actually developed two standards, one for the retrofit of existing buildings and one for new buildings whose plans were submitted after July 1, 2006. As of the writing of this paper, the vast majority of photoluminescent egress marking systems have been installed in the applicable NYC high rise commercial buildings. The mandatory deadline for installation was July 1, 2006.[5]

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[2] This report can be downloaded from the following URL: wtc.nist.gov/reports_octobero5.htm
[3] NIST NCSTAR 1 WTC Investigation, Final Report on the Collapse of the World Trade Center Towers, p. 216-217
[4] This report is available from the following URL:http://www.nyc.gov/html/dob/downloads/pdf/wtcbctf.pdf
[5] See 2007 ASSE PDC presentation 503 "Egress Exit Technology Opens in New York City" by this same author for more information on the successful implementation of Reference Standard 6-1.
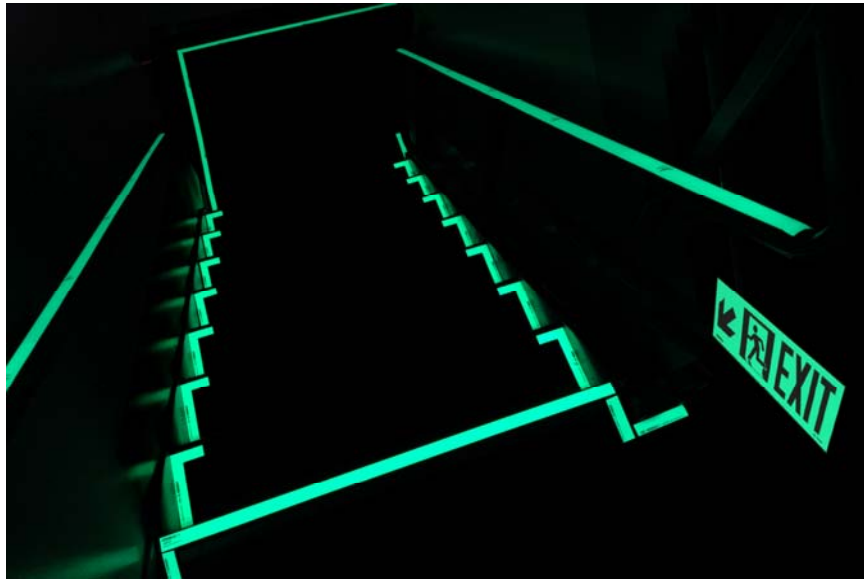
Exhibit 4. A typical NYC RS 6-1 photoluminescent stairwell egress system installation

ANSI Z535.3. The *ANSI Z535.3 Criteria for Safety Symbols* (2007) is the American National Standards Institute's standard for safety symbols. For this revision the ANSI Z535 committee agreed that the standard should contain the ISO fire safety and emergency symbols, the same symbols contained in the NFPA 170 standard. The ANSI Z535.3 standard is slated for publication in summer 2007 it will serve to reinforce the country's move towards international harmonization in the field of safety symbols.

ANSI Z535.2. The new version of the *ANSI Z535.2 Standard for Environmental and Facility Safety Signs* (2007) also incorporates the new ISO fire extinguisher sign and incorporated the ISO signal word panel color scheme that includes a yellow/black general warning sign as the safety alert symbol next to the signal word DANGER, WARNING or CAUTION. This formatting option is now presented in all of the Z535 standards and serves as means to harmonize the formats for safety signs in the U.S. with the safety labels found on products as defined by the standard *ISO 3864-2 Graphical Symbols, Design Principles, Product Safety Labels*.

Exhibit 5. The signal word panel for ANSI Z535.2 safety signs using the ISO safety alert symbol

Exhibit 6. Example of an ANSI Z535.2 facility safety sign with ISO formatted symbol

Standardization—Leading the Way to Safety

The net effect of all of the above standards is that the United States is moving towards an approach to safety signage that integrates international symbols. This development helps to fulfill the need described in NIST's 9/11 WTC report for "standardized signs" to assist people in intuitively recognizing the direction along egress routes as well as the location of critical fire safety equipment. With New York City having taken the necessary steps to implement the international egress marking system in the stairwells of all of its high rise commercial structures, predictions are that this technology will make its way into other state and local metropolitan building codes within the next decade. And the range of application of this technology is not limited to commercial high rise buildings - residential high rise buildings, hotels, hospitals, sports arenas, areas of public assembly - these systems can be utilized in practically any location where safety and emergency egress are of concern.

Knowledge Put Into Action

Thus far we have examined the standards related to safety signage, past and present. The next step is to determine how best to use this knowledge and implement a strategy for bringing your facility's safety signage up-to-date.

Signage problems in the workplace are typically the result of a situation where no one "owns" the program. When the situation is such that anybody can post a sign, visual clutter and inconsistency take place. With a carefully considered signage program, a uniform system of visual communication and identification can exist at your workplace. Start by forming a signage committee with representatives from key business groups and departments.   Your safety committee is the logical choice. The safety committee should raise awareness of workplace signage and assume responsibility for signage related policies. A good signage program should consider policies for standards compliance, formats, postings, procurement, inspection (e.g., wear, visibility), training, employee feedback and observation, and accident investigation.

There are many good reasons for initiating a workplace signage program:

- Eradicate visual clutter and outdated signage

- Enhance regulatory compliance and employee awareness
- Facility upgrade and expansion
- Consistency among multiple locations
- Simplify procurement and reduce costs

An assessment of your current signage and a risk assessment of your facility should be prerequisites for launching a signage program. The rule for signage should be *less is more.* Too many signs in one place lends itself to the "cry wolf" syndrome where a question exists in the viewer's mind concerning which sign, if any, should be paid attention to. If several safety messages need to appear in one location, it is often best to consolidate them onto a single sign. Such a choice presents a person with a cleaner visual field of view and lends itself to being noticed. Depending upon the size of your facility, a simple walk through is performed to get an idea of what's presently installed (a digital camera is a great asset for recording the current state of your facility's safety signs). Subsequent study of the areas noted in your risk assessment and current signage report will give you the documentation you need to enlist management support and reveal priorities of signage concerns for updating. The symptoms of ineffective signage are easy to recognize. Look for signs that exhibit lack of clarity, poor visibility, illegibility, outdated format, degradation, inappropriate or incomplete content, and irrelevance. Compare what you currently have with the current standards and make determinations as to how best to communicate your safety messages. Your decisions should include consideration of:

- National and international formats
- Symbols
- Hazard nature content information
- Hazard avoidance content information
- Choice of signal word
- Material choice
- Photoluminescent capability for viewing in the dark
- Size and legibility concerns

For purposes of illustration, take the example of signs indicating the need to wear safety glasses. If you have a large facility where this type of sign is used, you will most likely discover that your signs use varying formats and different symbols of heads wearing glasses and varying text (e.g., "Wear safety glasses" versus "Wear eye protection"). Typically further confused is caused by the inconsistent use of the signal word headers DANGER, WARNING, CAUTION, NOTICE or none. With an understanding of the current standards in mind, the safety committee might choose a single sign for communicating the "Wear safety glasses" message. On the other hand, the committee might choose to have a set of uniformly designed signs to communicate this message with differences only in the specific description of the hazard that necessitates the need for wearing safety glasses (e.g. "Flying debris. Wear safety glasses in this area."). In either case, the specification for the sign or signs should be made available corporate-wide for all areas that require such a message. In this way, standardization takes place, people learn the meaning of the signs and symbols, and workplace safety is improved.

As important as the sign itself, the location of each sign should be evaluated. Location may impact visibility, materials of construction, and installation method. You will want to note signs no longer needed for immediate removal. Often a sign remains posted long after the hazard or

condition to which it relates has been retired. Pay attention to doorway entrances because these are often hot spots for signs needing replacement. As mentioned before, the new method is to consolidate room identification, entry requirements and warnings into a single doorway entrance sign posted on or next to a door.

The content of each safety sign is, at root, the most critical information that needs to be determined by your safety committee. The *ANSI Z535.2 Standard for Environmental and Facility Safety Signs* states that the sign's message panel contains words related to identification of the hazard, how to avoid the hazard, and/or the probably consequences of not avoiding the hazard.[6] Though some of this information may be omitted if it can be readily inferred, most well designed safety signs today incorporate the full safety message. Human behavior studies have shown that people are more motivated to comply with hazard avoidance procedures (e.g. "wear safety gloves") if they understand the nature of the hazard that is trying to be avoided (e.g. "Hazardous chemicals. Wear approved protective gloves."). Expanded content is the reason many companies are replacing their old single-statement safety signs with signs formatted to the new Z535.2 standard that contain a more comprehensive safety message through the use of additional words and one or more symbols. And not just any symbols but the symbols that have credentials established by current standards.

It is in this way that an understanding of the standards (and the format and symbol options they contain) will lead to an intelligent approach to developing the right content for each sign. Typically the content on some signs will be unique for a single location and other signs' content will be standardized for multiple locations within a facility. Standardized or customized, the same degree of attention should be made for every sign in the facility in order to achieve the optimum in visual safety communication.

Conclusion

The purpose of a safety sign is to guide human behavior and reinforce training. Safety signs are a critical part of your facility's safety program and as such, it is essential that people see and understand their meaning. When your signs go unnoticed or are not understood, the consequences could be the difference between life and death. Most facilities have an ad hoc approach to their safety sign policy; those responsible for making the decisions related to the posting of a safety sign are often not aware of the revised and new safety sign standards that are now established. Compared to the old Z35.1/OSHA signs, today's standards utilize new visual communication techniques that more effectively conveys safety information to a wider audience. Make it your priority to update your facility and implement the new safety sign technology.

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[6] ANSI Z535.2-2002, section 4.7.2

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