

Fire Extinguishers in Academic Settings

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Introduction

When accessible and fully charged, fire extinguishers are an effective and proven means of fighting a fire during its early stages; however, fire extinguishers located in academic institutions are subjected to costly vandalism and tampering that threatens their usefulness in time of need. *NFPA 10 Standard for Portable Fire Extinguishers* outlines all required materials, identification, and maintenance of portable fire extinguishers. Such specifications include which type of fire extinguisher that are applicable for specific hazards as well as the selection for specific locations. Also included in this standard is the use of Electronic Monitoring Systems which allow the fire extinguisher to be maintained and monitored remotely. The cost of installation and maintenance of these devices along with the associated with vandalisms is creating uncertainty about the overall value of fire extinguishers in academic settings. This study will take a look at the role fire extinguishers play in academic settings and the exposure institutions face due to tamperings and vandalism.

Historical incident data, collected and analyzed in this study, demonstrates that when used appropriately, fire extinguishers are an effective tool to stop fires at the earliest stages. A description of three historical incidents presented below conveys the varied experience with fire extinguishers in academic settings. A fire at Yale University in 2003 illustrates the life saving effectiveness of proper fire extinguisher use.

On May 22, 2003 at Yale University an explosion ripped through an empty classroom. A nearby student grabbed a fire extinguisher and doused the flames, completely extinguishing the fire and saving the lives of fellow students. The presence of an accessible and fully charged fire extinguisher allowed the students to extinguish a fire which could have been much more devastating than it was. ^[1]

As shown in this instance, properly used fire extinguishers can provide life safety. On the contrary, when fire extinguishers are missing disaster can occur.

On April 3, 2010 a fire was set to a couch in front of a residence occupied by five college students who attended Eastern Michigan University No one who saw the fire could stop it because the fire extinguishers were missing from the residence. Because of this fire one woman lost her life, while two other individuals were hospitalized. ^[2]

Tragic events such as this occur when fire extinguishers are missing, empty, or obstructed. These situations are often the result of tampering or vandalism. Acts of vandalism such as the incident at Estero High School located in Estero, Florida, compromise fire extinguishers' ability to provide life safety and drive-up the cost of maintenance:

On May 27, 2008 four students from Estero High School decided to have a night of fun in their high school halls. The vandals spray painted walls, damaged vending machines, discharged fire extinguishers, dumped buckets of paint on school-owned golf carts and painted over surveillance cameras. The fire extinguishers that they tampered with, if needed to combat a fire, would be completely useless due to their abuse. ^[3]

If the extinguishers were more accountable, in each instance someone would have been notified and the students would have been stopped earlier in their destructive behavior. While

quite demonstrative of the experience with fire extinguishers in academic settings, these stories are each independent and singular events. Therefore, in order to understand the frequency of these event and the trends associated with them, a project to collect historical data was conducted.

Research Methods

The research plan for this study was developed to meet the three established project goals:

- 1) To create one or more databases of news stories/fire reports related to fire extinguisher usage in academic institutions over a ten year period including public and private, K-12 and post-graduate institutions. These stories and reports include incidents related to proper usage of fire extinguishers and those related to improper usage such as vandalism, tampering and pranks.
- 2) To conduct an analysis of this collected data to determine lessons learned and identify important trends.
- 3) To provide a solid perspective on the scope of the issue of fire extinguishers in academic settings by estimating the total usage of fire extinguishers in academic settings in a year.

The research methods for accomplishing the first of these three project goals involved searches of archived news stories and fire reports. These searches were conducted using major internet search engines such as Google Archives for past events, and Google Alerts for up to date daily email notification. All searches were done using targeted search parameters consisting of the words “Fire Extinguisher” followed by any of the following: Campus, College, Dorm, Hall, School, Student or University. From this historical incident data two databases were created in

Microsoft Excel. The creation and population of these databases was an iterative process which included the following elements:

- a) Determining appropriate, effective and efficient search parameters;
- b) Selecting criteria to determine if a hit should become an entry;
- c) Developing a structure and framework for each of the two databases that both captures pertinent factors pertaining to each incident and allowed for comparison between incidents
- d) Reading through each of the hits, selecting those that meet the criteria, and entering the pertinent information into the database.

All articles describing incidents involving actual fires were entered into the “Fire” database, while all incidents involving misuse of fire extinguishers were logged into the “Vandalism” database.

The research method for accomplishing the second goal consisted of running statistical analyses on each of the databases to determine the lessons learned and to identify major trends.

Finally, multiple methods were used to attempt to get a real perspective on the scope of the issues. These methods included speaking with facilities engineers at several academic institutions, investigation of how fire extinguisher use is reported in NFIRS, and analysis of both an NFPA study of unreported fires and a New Zealand study of unreported fire extinguisher use.

Summary of Databases

The search methods employed resulted in over forty-thousand hits and resulted in 450 useful articles. This large disparity in numbers is due to the difference between hits and entries. Anytime the searched keywords are found on any webpage they are returned as hits. These hits include relevant WebPages as well as completely irrelevant ones. As an example, using the search parameters “Fire Extinguisher School” resulted in a page produced by Google which included the word School, but had an advertisement for fire extinguishers which was completely irrelevant to the search. The most common hits are from advertisements, blogs, and other irrelevant topics. For queries through Google Archives, on average, each one hit that resulted in an entry into the database was the result of reviewing approximately 100 hits, i.e, the ratio of relevant to irrelevant hits is approximately 1:100 (or 1 percent). A typical alert email may contain up to fifteen hits, and often not a single link will be useful. With Google Alerts the ratio is on average 5:100 (or five percent).

Each email notification from Google Alerts had to be opened and read for any possible successful hits. For an article to be selected as a hit and thus entered into the database, it must describe an incident where a fire extinguisher was used either to combat a real fire or in an act of vandalism in an academic setting. In addition, for a hit to become an entry, all factors pertinent to the description and categorization of an incident had to be available. Often times, collecting enough information for a full database entry involved reviewing the original hit and additional internet searches pertaining to the incident. In all cases, the internet news article was extracted from the web and saved as a Word document for preservation and ease of referencing later.

As stated previously, the successful hits which pertained to actual fires were logged into the “Fire” database, and all hits related to pranks or vandalisms were entered into the

“Vandalism” database. All articles entered into the databases have the following information: location in the United States, date of occurrence, type of location, a brief summary of the article for later reference, and a hyperlink of the captured Word document. From here the two databases differ in the information collected and documented.

Summary of Real Fire Database

The real fire database consists of 209 incidents which occurred in the United States between 2001 and 2010. These incidents represent actual fires in a range of academic settings from elementary schools to universities. Figure 1 shows a capture of the header of the database along with examples of how the database is populated.

Date	Location-Geographical	Location-Type	Initiating Event	FE-present	FE-used	Result	Damages	Injuries	Deaths	Description
3/13/2003	Atlantic City, PA	High School Gym	cigarette burning	Y	Y	Effective - Extinguishment	none none	none	none	put out with FE,
5/21/2003	New Haven, CT	University Classroom	explosion in classroom	Y	Y	Effective - Extinguishment	none none	none	none	Students used F
12/18/2001	Washington D.C.	High School	high school fire	Y	Y	Non-Effective	none none	none	none	FE malfunctione
6/25/2006	Tampa, FL	University Chem Lab	chemical explosion	Y	Y	Effective - Extinguishment	minor 1	minor	none	explosion in chei

Figure 1 - Real Fire Database Header and examples

For the “Fire” database an initiating event is logged. This captures the location of the fire within the location/occupancy type (colleges, high schools, etc.), as well as the cause of the fire (cigarette, chemical burn, etc.). It is also noted whether or not a fire extinguisher is present, and whether the fire extinguisher is used. The effectiveness of the use of the fire extinguisher is also noted. In this report, fire extinguisher performance is defined by two categories: Effective and Non-Effective. The effective category is further sub-divided into- Effective – Life safety, which is where the fire extinguisher has been used to protect human life, Effective – Containment, which is where the fire extinguisher has contained and limited the spread of the fire, and Effective – Extinguishment, which is where the fire extinguisher has successfully extinguished

all traces of fire. The category of Non-effective is used if the fire extinguisher has absolutely no influence on the outcome of the fire. The number and extent of injuries and the number of deaths which occur from the fire are also logged. A short description of the fire is provided along with a link to the full story.

As an example, it is shown below how an article becomes an entry in the database. The following article was found through Google Alerts on May 11, 2010.

Fondren Science evacuated after small lab fire

By Daily Campus Staff

Published: Tuesday, May 11, 2010

Updated: Tuesday, May 11, 2010

*The Fondren Science building was evacuated Tuesday afternoon due to a small **lab fire**. Emergency vehicles were on the site and Daniel Avenue was closed between Airline Road and Hillcrest Avenue due to the incident. The initial call regarding the fire came to SMU police at 3:18, and University Park Fire Department responded and were on the scene shortly thereafter. The fire was contained by 3:35. "Within 15 minutes upon fire personal arriving the fire was contained. They were able to put the fire out with sand," said Kent Best of SMU Public Affairs. Best said that the fire was "about the size of a wastebasket," David Son, an associate professor of chemistry, a visiting professor and two students were in the lab when the fire occurred. **One student suffered minor burns on her leg and was treated at the University Health Center**. No other injuries were reported. The fire started as a result of the disposal of the chemical sodium hydride, said Best. In order to dispose of the chemical it is poured over ice water, if poured too fast, it will ignite. "She poured it a little too quickly and it did ignite," said Best. After initially **attempting to put out the fire with a fire extinguisher**, Son called 911. The Dallas HAZMAT team arrived to check air quality and quality of clean up, as is protocol after any chemical spill, said Best. The building was given the all-clear at 4:45 p.m.^[4]*

The highlighted text in the article is where the data for the database is found within the original hit. As seen the fire took place in a lab, where one student is injured, and a fire extinguisher is used. All other data required by the structure and framework of the database had to be found from outside sources, such as what type of institution this lab is associated with, along with where the geographical location of the event occurred. In this example "Fondren

Science” was searched in Google. This resulted in another news station’s coverage of the same incident which noted that the lab was part of Southern Methodist University located in Dallas, Texas. The final database entry is shown in Figure 2.

Date	Location-Geographical	Location-Type	Initiating Event	FE-present	FE-used	Result	Damages	Injuries	Deaths	Description
5/12/2010	Dallas, TX	University	Lab Fire	Y	Y	Effective - Containment	Unknown	1	0	sodium hydride i

Figure 2 - Fondren Example Database Entry

Summary of Vandalism Database

The vandalism database consists of 241 incidents which occurred in the United States between 2001 and 2010. These incidents represent pranks and acts of vandalism involving fire extinguishers in academic settings. As with the real fire database, incidents occurred from elementary schools, to universities. Figure 3 shows a capture of the header of the database along with examples of how the database is populated.

Date	Location-Geographical	Location-Type	Description	Concequences
5/26/2008	Estero, FL	High School	Highschool Prank	\$10,000 in damage
6/14/2007	North Mason, Wash.	High School	Highschool Prank	\$38,000 in damage
1/18/2004	Albilene, TX	Dorm(ACU)	Pranks	perceved fire-dorm

Figure 3 - Vandalism Database Header with Examples

For the vandalism database it was documented whether or not the fire extinguisher was discharged. Most vandalism occurs when a fire extinguisher is discharged, but often the fire extinguisher is used as a weapon or ram. It is also noted in the data base if any monetary damages are assessed, or if any arrests or punishments are generated against perpetrators. The following article was captured through Google Archives.

MONROE MIDDLE OPEN AFTER VANDALISM

St. Petersburg Times (Florida)

April 17, 2009 Friday

Monroe **Middle School** resumed classes on schedule Monday after three teenagers reportedly caused more than **\$60,000 in damage** during spring break. Two former Monroe students were **arrested** and another is being sought in connection with the

vandalism, which occurred April 7. Jonathan Dow, 19, faces charges of burglary, criminal mischief and preventing extinguishment of fire, while a 15-year-old boy is facing juvenile charges. They were arrested at the school. Tampa police say the trio broke into the media center through a glass door, shattered windows, **opened seven fire extinguishers** and stole food. ^[5]

Figure 4 shows the resulting entry in the database.

Date	Location-Geographical	Location-Type	Description	Concequences	Link
7/4/2009	Monroe, FL	Middle School	set off FE's	60,000 in damage	MONROE MIDDLE OPEN

Figure 4 - Monroe Example Database Entry

Statistical Analysis of Databases

Statistical analysis was conducted on the two completed databases including 450 data points, where 241 are from the vandalism database, and 209 are from the fire database.

- Of the incident logged, there were 39 documented injuries ranging from minor to severe including smoke inhalation.
- In total there were 3 deaths as a result of the fire incident
- Fire extinguishers are used as tools in crimes that can cost academic institutions thousands in damage and repair costs.
- Of the vandalisms logged: 17% occurred in Elementary schools, 24% occurred in High Schools, 13% occurred in middle schools, 5% on school buses, and 40% in colleges.

Estimation of Total Fire Incidents

The two databases created during this study provide a record of multiple incidents related to proper usage of fire extinguishers as well as those related to improper usage of fire extinguishers. The databases do not and simply cannot provide is real perspective on the scope of the issue. That is to say, we don't know from looking at the database of 209 incidents where fire extinguishers were used successfully or from the database of 241 incidents involving

vandalism or tampering, how many times over the ten year period of this study that these types of incidents occurred.

The simple fact is that often times when fire extinguishers are used successfully to extinguish an incipient fire, there is no need and even as we found out in this study, no mechanism for reporting these success stories. Thus, the study authors have made an attempt to weigh data collected in this study against estimates others have made of reported to non-reported fires in an attempt to get a real perspective on the scope of the issue.

The National Fire Incident Reporting System, or NFIRS, was reviewed to determine how it captured the use of fire extinguishers at fire scenes. After speaking with the Massachusetts Department of Fire Service it was discovered that the MFIRS did not capture fire extinguisher use data, therefore as the NFIRS is generated from the MFIRS, the NFIRS based on Massachusetts would also lack this information. However, as the NFIRS system does include the use of hand extinguisher in the “Fire Fighter Activity” section, other states may indicate their fire extinguisher usage.

In addition after interviewing local fire departments in Massachusetts it was discovered that the use of fire extinguishers is very rarely documented in the fire department incident reports. The only time that the fire extinguisher is documented is if it is a crucial part of the attack by the department or if the department is called for cleanup of a dry chemical fire extinguisher that was operated. In cases where the fire extinguisher is used by a civilian prior to the involvement of the Fire Department, the fire extinguisher will only be noted if the Fire Department did not have to take any further fire fighting actions. According to the Massachusetts Department of Fire Service if a fire investigation is being conducted at a fire scene, even if there

was a fire extinguisher present at the fire, whether or not it was used during fire suppression activities it is very rarely noted. Because of the lack of a reporting system to find this data NFPA studies and reports had to be analyzed to scale known incidents to find total number of fire extinguisher uses in academic settings.

According to incident data published by NFPA, “Structure Fires in Educational Properties,”^[7] fire departments respond to an average of 6,650 fires in academic buildings annually from 2003 to 2006. A separate NFPA study of unreported fires, “National Sample Survey of Unreported Residential Fires” concludes that residential fires where the fire department is called to respond represent a mere 3.4 percent of the total number of residential fires.^[8] The “2004 – 2005 National Sample Survey of Unreported Residential Fires” also reports that fire extinguishers are used in 5 percent of total fire incidents. Knowing these factors it is estimated that there are approximately 10,000 fire extinguisher uses in academic settings for fires. This estimation is achieved by the following mathematical computations:

$$\frac{6650 \text{ Fires in academic settings}}{3.4\% \text{ fires responded to}} * 5\% \text{ fire extinguishers used} = 9780$$

When including dormitories, fraternities, sororities and barracks as academic settings the number of reported fires increases by 3,690 according to NFPA “Structure Fires by Occupancy 2003-2007 Annual Averages.”^[9] Using a value of 10,310 as total number of fires in academic buildings the projected total use is 15,000 fire extinguisher usages used to combat real fires in academic setting per year.

Another method to approximate the total number of fire extinguisher uses in the United States in academic settings was to isolate one month and find as many articles as possible to

represent all uses in that month. For this method the month of May 2010 was isolated using Google Alerts to find all reported fire extinguisher uses. 354 Google Alert Notification emails were received resulting in 2015 potential hits. With a calculated hit to entry rate of 1.84% the total events logged was 37. Of these 37 entries, 18 were vandalisms and 19 were real fires. All 19 fire incidents reported the usage of fire extinguishers. Using the 19 reported and the scaling factor of 3.4 percent was previously used in the last scaling method the total number of uses in the month of May 2010 was estimated to be 559. Multiplying this number by 12 to represent the total usage in one year resulted in 6,705 incidents. Knowing that Google Alerts cannot possible capture all incidents reported, the estimate of 6,705 acts as a lower bound of the total number of uses. All methods show similar results, giving a conservative estimate of 7,000 to 15,000 uses of fire extinguishers in the United State in academic settings.

Conclusion

The “Fire” database shows that when used properly in a situation where fire is present, fire extinguishers provide life safety and property loss prevention. This benefit of having fire extinguishers in academic settings cannot be overlooked. However analysis of the “Vandalism” database shows a clear trend of vandalisms in K-12 through collegiate levels of educations institutions. While the basic replacement or recharge of fire extinguishers may not be a large cost, the damage that can be done when they are used by destructive persons can cost an institution thousands of dollars. In addition, when these fire extinguishers are tampered with and placed back in service without proper maintenance and re-inspection can lead to disaster as the fire extinguisher can no longer provide first aide fighter fighting. Most institutions follow a prescriptive once a month servicing of fire extinguisher, leaving time for an unfit fire

extinguisher to be placed in service. A monitored fire extinguisher system which can provide alarms when fire extinguishers are pulled from stations, and provide up-to-date status conditions of the fire extinguishers vitals would act as a deterrent against improper use, notify authorities of a potential problem, and keep damaged or unfit fire extinguishers back into service. This monitored system would be able to provide additional information on the usage of fire extinguishers in these institutions as well as help to fill in the missing data on total fire extinguisher usage in the United States. This in turn will help to better understand the fire problem in academic settings. With an estimated 7,000 to 15,000 uses of fire extinguishers in settings that include children and young adults, there is a clear need for a better understanding of costs and benefits of installing traditional and/or monitored fire extinguisher systems.

Future Work

Monitored fire extinguishers have a higher installation cost than non-monitored fire extinguishers. However, the benefits of monitored fire extinguishers include lower maintenance costs, higher reliability, a much lower incidence of vandalism, and the potential to prevent other crimes. A study should be conducted to quantify the costs and benefits of monitored fire extinguishers from two important perspectives; that of the building owner and that of society/national codes and standards. Similar studies as this one should be conducted for other occupancies, such as hotels and jails that are also subject to a high vandalism rate. A study that focused on both quantifying the amount of unreported incidents in the United States and also motivated the collection of this data should be conducted by an organization such as the National Fire Protection Research Foundation.

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