Market Analysis of Smoke Detection and Applications

An Interactive Qualifying Project Report

Submitted to the Faculty of

WORCESTER POLYTECHNIC INSTITUTE

In partial fulfillment of the requirements for the

Degree of Bachelor of Science
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Abstract

This project researched and evaluated smoke detection and its applications, including air sampling smoke detection (ASD) systems, conventional ionization, photo-electric and spot-type heat detectors. An analysis of the National Fire Incident Reports was used to determine how much more efficient detection systems were at decreasing property damages, injuries and casualties. Questionnaires were created to gather feedback from professionals to determine their preference on the topic. The results of this research assisted in the making of recommendations to further increase the understanding for the need of early warning detection systems.

Keywords: fire protection, fire detection, smoke detection, air sampling smoke detection

Executive Summary

The goal of this project was to research and evaluate air sampling systems compared to other detection systems. In this report the air sampling systems are contrasted to traditional ionization, photo-electric, and heat detector systems. These contrasts, along with other methods, were done to find potential markets within larger commercial buildings for the air sampling smoke detection systems.

To find the best market for these systems various research methods were employed. An analysis of the National Fire Incident Reporting System (NFIRS) determined how efficient detection systems were at decreasing damages and casualties. This was done by looking at the amount of damage with detection versus the amount without detection. Different areas of origin (i.e. kitchens, storage areas, and function areas), along with materials ignited (i.e. wood, gases, and natural products), were also studied in relation to various structure fires from the NFIRS. Numbers regarding fires originating in various areas were extracted from NFIRS along with the materials that were ignited. From these numbers it was discovered that the leading areas of origin were "function areas", "storage areas", and "structural areas." It was also determined that the leading materials causing fires were "wood, paper", "fabrics, textiles, furs", and "natural products." This information was used to give a prediction on a potential market for the air sampling systems.

Another method exercised to obtain results about the air sampling systems was sending out questionnaires via e-mail to receive feedback from engineers, building owners, and fire officials. The answers received from the professionals were compared to determine their qualified preferences on air sampling systems. A perspective based on

their experience was gained from the results of these questionnaires. The engineers yielded their professional opinions on the strengths, weaknesses, and applications of air sampling systems against traditional systems.

Very Early Smoke Detection Apparatus's (VESDA) ability to detect smoke during the incipit stages or a fire allows the system to be implemented in scenarios where heat sensitive chemicals or pharmaceutical storage is involved. VESDA also has the capability to detect small changes in the quantity of smoke particles in the air. This could allow VESDA to be utilized as a friction/over-friction monitoring device in manufacturing facilities. However, a two hindrances of the wide spread installation of VESDA is its price and ability to be integrated into control boxes. There are a few options that should be considered. First would be to further the capability of VESDA to be easily integrated into a large number of control boxes. This ability is highly advantageous to installers and engineers and provides a way to further VESDA's penetration into the high end smoke detection market. The next is to consider producing a scaled-down and less expensive VESDA system for use in smaller spaces. This would allow the system to be implemented strategically and provide incentive to prospective buyers. Another route would be to reduce the price of the total system; however it is beyond the scope of this report to make technical refinements of the system itself.

The goal of this project was to research and evaluate smoke detection and its applications, including air sampling systems, traditional ionization, photo-electric, and heat spot-type detectors. Potential markets within larger commercial buildings where air sampling smoke detection systems could be applied.

To find the potential market for smoke detection systems various research methods were employed. An analysis of National Fire Incident Reports (NFIRS) was used to determine how much more efficient detection systems were at decreasing property damages, injuries and casualties. Different areas of fire origin (i.e. kitchens, storages areas, and function areas), along with materials ignited (i.e. wood, gases, and natural products), were studied in relation to structure fires in large commercial buildings. The number of fires originating in various areas with specific materials was extracted from the NFIRS. From these numbers it was discovered which areas and materials were most commonly associated with fires.

Questionnaires sent via e-mail were used to receive feedback from design engineers, consultants, building owners, and fire officials to determine their professional opinions of the benefit of using smoke detection systems, especially the early warning air sampling smoke detection (ASD) systems. A perspective based on their experience was gained from the results of these questionnaires. The engineers yielded their professional opinions on the strengths, weaknesses, and uses of air sampling systems against traditional systems.

VESDA®, a leading Air Sampling Smoke Detection Systems, is recognised as the market leader in early warning smoke detection, VESDA products are used in industries such as transportation, manufacturing, IT&T, utilities and storage services. VESDA air sampling smoke detectors are renowned for their ability to consistently deliver smoke detection that protects a diverse range of global businesses and their challenging environments providing enhanced life safety and business continuity solutions.

VESDA's ability to detect smoke during the incipit stages as well as big fires due to its very wide sensitivity range, allows the system to be implemented in scenarios where heat sensitive chemicals or pharmaceutical storage is involved. VESDA system product ranges allow the use of such an ASD technology in both large and smaller spaces. This would allow the system to be implemented strategically and provide incentive to prospective buyers.

Authorship

Nichole Carriere wrote some of the Literature Review and NFIRS Results. She organized all of the information gathered and put it together in the Literature Review. Nichole also helped write the Abstract, Executive Summary, Introduction, Results and Conclusions sections.

Ryan Graves organized the effort to contact and interview contacts. The data was analyzed and entered into the report. Ryan also assisted in the writing of the Abstract, Introduction, Literature Review, Results and Conclusions.

Donald Havener contributed to the Literature Review, as well as creating and arranging all of the NFIRS tables and graphics. Donald also was the main contributor to the Recommendations and Conclusions section. He also spread his knowledge and assistance to help with everyone else efforts.

Mark Rizzo was the main contributor for the Methodology section, while also contributing to the Literature Review, and Results sections.

Overall, the group attempted to evenly distribute the required project's work. However, individual specialties and interests did allow for some to contribute to areas where others felt uncomfortable working.

Acknowledgements

The project team would like to thank the following people and their organizations for

their assistance with the project:

Table of Contents

Table of Figures

1 Introduction

Since the beginning of civilization, fire has been a large hazard facing communities. During the year 2005 in the United States there were over 1,602,000 fires causing 10.6 billion dollars in property loss and 3,675 casualties. These numbers seem large, but they have declined from previous years. It is also important to consider that there are over 300 million people in the United States and 3,675 casualties is a small percentage number compared to the population. (Karter, Michale K)

The businesses that supply products and services are vulnerable to fire. Production and dispersion of items require storage and production facilities, all of which are at risk. When fires occur, there is usually one of two outcomes; loss of property and productivity or quick, decisive action resulting in minimal loss. With a small fire, the fire department must be notified, detection and suppression systems must be reset, and insurance companies most likely become involved. When taking downtime into account, a small fire quickly escalates into a costly situation. (Karter, Micheal K)

There are systems that can be used in conjunction with fire suppression, namely heat detection and smoke detection. Some of these products are precise enough to detect microscopic smoke particles in large quantities of air. Systems such as those provided by Vision Systems use optical detectors to sense the presence of smoke particles as low as 0.005 percent obscurity per meter, compared to the average 2 percent obscuration per foot. At present, these high sensitivity detectors are found in commercial and industrial buildings where suppression can be costly. The best option is human intervention before a smoldering or overheat condition can progress to a fire. The rise of market awareness

and concern over fire related safety could cause an increase in the market for these high quality ASD detectors. The intent of this report is to analyze possible markets for high end ASD detectors like VESDA. (Vision Systems document 10947, version 01)

2 Literature Review

2.1 Fire and Building Codes and Standards

In order to identify areas within the general fire market for very early warning smoke detection systems, it was first necessary to identify where smoke detection may already be required by law, building codes, or fire codes. NFPA (National Fire Protection Association) standards, building codes, and fire codes on a state-by-state basis were researched with the goal of uncovering code requirements as well as requirements that could be added to increase fire safety standards.

It is important to understand the difference between fire and building codes and standards. A fire code is a requirement for buildings that already exists and buildings yet to be constructed. Fire codes are in place to provide guidelines for achieving an acceptable level of safety and must be maintained. A building code is a set of requirements, regarding fire safety, for a structure that is being built. A standard sets forth the details of how to do things in the building. For the purposes of this report, the focus of fire and building codes and standards will be on smoke detection requirements.

2.1.1 Fire Codes and Standards

NFPA 72 (National Fire Alarm Code) provides requirements for the installation, performance, testing, inspection, and maintenance of a fire alarm system. These systems range from basic domestic smoke alarms comprised of battery operated smoke detectors, to large scale integrated systems for large scale residential, commercial and public places. Each system is defined in the entire NFPA's codes and standards by its composition,

building size, and fire load capabilities. Although commercial and public buildings are required to have fire alarm systems in place, they may not be required to have smoke detection of any kind. Manual "pull boxes" generally satisfy code requirements.

NFPA 101 (Life Safety Code) was researched for its implementation of fire alarm requirements in various types of commercial buildings. It compliments NFPA 72, by classifying different building types and determining whether a fire alarm system is required in a given occupancy. This "Life Safety" code gives recommended and safe practices which can offer the building and its occupant's protection. (National Fire Protection Association)

State fire codes are mainly comprised of adopted NFPA standards. Most states choose to modify these standards in order to better protect building types and conditions common to their jurisdiction. An example of this would be a rural state such as Maine. Maine has fewer high-rise buildings than states like California and therefore might not need such in-depth codes concerning high-rise buildings. In addition, California may add extra protection to buildings in case of earthquakes, while Maine would not need such protection. Also, there was realization during this research that fire alarm systems are required by law in commercial and public buildings. Most states require that all plans for new construction and renovations be inspected and approved for adherence to fire codes by the fire marshal's office. This system ensures that buildings are equipped for emergency situations and the general safety of its occupants is ensured. (Dean, John C.)

Developed by the NFPA, codes and standards are intended to minimize the possibility and effects of fire and other risks. Virtually every building, process, service, design, and installation in the United States is addressed by NFPA documents. Some of

the various standards include NFPA 13, which deals with sprinkler technology, NFPA 25, dealing with minimum requirements necessary for inspection, testing and maintenance of water extinguishing systems, and NFPA 72, which consists of requirements for the full range of fire alarm systems. All of these standards compliment building codes, but describes how things should be done and what is required by inspectors. (National Fire Protection Association)

2.1.2 Building Codes

Sections of NFPA 5000 (Building Construction and Safety Code) identify the construction requirements of commercial-type building spaces. This code not only dictates how these buildings should be designed, but also what sort of fire alarm system must be installed. According to this code, most commercial buildings are required to have alarm systems, though they are not necessarily required to have smoke detection. The code takes into account factors like building capacity, disbursement of people inside the building, and hazards within the building to recommend specific components of the alarm or detection system. (National Fire Protection Association)

The International Building Codes were also researched to find differences between those and NFPA 5000. The International Building Codes classify buildings by their occupancy type and in some cases by level of contained hazards. These recommendations were created accordingly to develop fire alarm requirements. International Building Codes and NFPA 5000 are quite similar with respect to fire alarm requirements. For most commercial and public buildings, alarm systems can be activated manually and/or by activation of an automatic sprinkler system. Automatic smoke detection is generally not required. (National Fire Protection Association)

State-enforced building codes are developed in the same fashion as fire codes. Some codes are adopted directly from the International Building Codes, and/or NFPA 5000, while others are modifications made to those codes by officials on the state level. (Dean, John C.)

2.1.3   Authority Having Jurisdiction

The Authority Having Jurisdiction or AHJ is the organization, office, or individual responsible for approving equipment, installation, or a procedure. The term AHJ is used in a broad manner by the NFPA due to the large variation of responsibilities by jurisdiction and approval agencies. Where public safety comes first, the authority having jurisdiction may be a federal, state, local, or other regional department. The AHJ may also be an individual such as fire chief or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance representative may be the authority having jurisdiction. Many times, the property owner or a designated agent assumes the role of AHJ. (Baker, Michael)

2.2   *Different Types of Detectors*

Fire detectors are common throughout all commercial and public buildings. These detectors are usually tied together into a larger system which will audibly and visually notify the occupants, in order to allow evacuation of the building in a timely fashion in addition to notifying emergency services.

When looking into the different types of fire detectors, it is important to have an understanding of where these detectors are required, and where they will be placed throughout building spaces. The difference in space usage can mean a great deal,

depending how much dust is in the air, or how often steam or smoke is released into the air in the room. There are three types of automatic detection systems for fire alarms. They include smoke detectors, heat detectors, and infrared detectors. (McEwen, R.H.L)

2.2.1   Smoke Detectors

Smoke detectors are used to look for the presence of smoke within a given area. These detectors are commonly found in commercial buildings, however they are not often found in cooking areas because steam and smoke resulting from normal cooking activities can result in false positives. False positives are when a detector goes off because there is dust, dirt, and/or smoke in the air, which has caused the alarm (instead of smoke from an actual fire). Smoke detectors consist of three general types; ionization detectors, photo-electric detectors, and air sampling detectors. All three detection methods provide reliable detection times after combustion particles spark fire conditions.

2.2.1.1   Ionization Smoke Detectors

Ionization smoke detectors ionize the air making a conductive path in which the current flowing through can be measured. A change in current caused by the presence of smoke particles will trigger the smoke alarm. One downside to these detectors is that they can easily have a false alarm if the detector is placed too close to a high humidity area such as a bathroom. (Apollo Fire)

2.2.1.2   Photo-electric Smoke Detectors

Photo-electric smoke detectors usually contain a light source shining directly or indirectly on a photo-electric cell. When the light is obstructed or reflected by smoke particles, the change in current on the photo-electric cell can be measured and interpreted

and used to trigger the fire alarm. Photo-electric detectors are a better choice for steamy areas or areas where ionization could occur in the air, as this will not create false alarms. However, these detectors are prone to false alarms if located in dusty areas or areas influenced by outdoor conditions because dust particles can have the same effect as smoke on the detector. (Apollo Fire)

2.2.1.3 Air Sampling Smoke Detectors

Air sampling smoke detectors are a newer technology which was developed in order to achieve earlier detection of smoke particles. Air sampling detectors monitor increasing smoke levels in the air and compare these values to preset threshold limits. These detectors can detect smoke while in the incipient stage, allowing time for human intervention which can prevent material flame up and costly damages.

Most air sampling detectors pull air into a pipe network through openings in the ceiling. This air is passed through a filter where smoke particulates can be separated from large dust particles. Then there is either laser based or LED based smoke detection. These air sampling systems are able to continually monitor the smoke content of a given area, as it will keep working after it sets off the alarm. This can provide valuable data to occupants and emergency personnel. (Vision Systems document 10947, version 01)

2.2.2 Heat Detectors

Heat detectors are used to monitor air temperature or to detect the rate of temperature change in a given area. These detectors are used more often found around bathrooms and kitchens. Heat detectors will not sense steam released into the air by

boiling water or by smoking food. The detector will only be triggered if the air by the detector reaches a set threshold or by a rapid heating of the air. (McEwen, R.H.L.)

Sprinkler heads on automatic suppression systems are also heat detectors. As a fire reaches a sprinkler head and heats it to a set threshold, the fire will cause a metal link to melt or a piece of glass in the sprinkler head to break. The melted link or ruptured glass causes the suppression system to release water or other fire suppressants. A flow detector is tied to all automatic fire suppression systems, which when triggered sets off visual and audible alarm systems. (Rohr and Hall)

2.2.3   Near-Infrared Radiation Detectors

Near-infrared radiation detectors are new technologies which operate on the principle of apparent source temperatures obtained from spectral radiation intensity measurements at two near-infrared wavelengths. The system combines smoke sensors and temperature sensors. An advantage of such a system is the system is less prone to false alarms than a conventional smoke detector. There is also an interest in the systems due to fast response time and because most natural fires are easily distinguished by the unsteady nature of the emitted radiation. However, the initial and maintenance costs of near-infrared radiation detectors are more costly. (Sivathanu, Yudaya R.)

2.3   *Detection in Commercial Buildings*

The definition of a commercial building is one where more than fifty percent of its floor space is used for commercial activities. They include, but are not limited to, stores, offices, schools, churches, libraries, museums hospitals, warehouses, and jails.

Government buildings are also included with the exception of military bases or reservations.

2.3.1 What is used due to Requirements

Commercial buildings are required to have a code complying fire detection system. Minimum requirement is a manual pull box that a person could trigger the fire alarm upon seeing a fire. Also, a basic sprinkler head detection system is used in many buildings. For this type of system, a sprinkler head will go off (releasing water) and set off a water-flow sensor. The water-flow sensor is then able to set off the alarm system.

2.3.2 What is used in Addition to Requirements

In more specialized areas such as clean rooms, server rooms, and general computer labs there should be minimal or no smoke in such an area, as it could damage the contents of the room. This leads to a need for more sensitive smoke detection to prevent damages. This gap is what brought about air sampling, which allows for smoke detection at 0.0015 percent obscurity per foot, which can be found in the very early stages of a fire, such as smoldering or pre-flame. Most smoke detectors may only be able to detect about 2.00 percent obscurity per foot. When detecting a fire at a very early stage, it can easily be extinguished with minimal or no water usage to prevent damages not only from flames but from suppression as well. Air sampling detectors are now able to span twenty thousand square feet on one detector, which will save money and allow for easier zone monitoring. (www.vision-fs.com)

An early warning to a potential fire buys time to investigate and intervene which potentially avoids the damage, downtime, and cost of suppression release (Vision

Systems document 10947, version 01). Suppression release can be costly and disruptive. However, an early warning allows the prevention of this exercise saving time and money. The early warning can also provide notification to fire departments or other emergency response organizations before the situation worsens.

A detection system is run by the control panel, which electronically monitors all the sensors that are contained within the system. It is responsible for devices such as manual and automatic detection components as well as triggering alarm devices. The more complex the system, the more specific the control panel is to an area. The panel would be able to pick up an "input" signal from a certain area and alert the people where the signal comes from. Compared to a basic suppression system, such as a sprinkler system in which it is activated by a glass head breaking, this is considered an "intelligent" system. (www.vision-fs.com)

2.3.3   Insurance Benefits of Additional Detection

Insurance is an important factor in a building or company. The insurance agencies go through a questionnaire or checklist that involves the following risk exposures before a policy is written:

- Property losses
- Business interruption losses
- Liability losses
- Key person losses
- Automobile losses
- Injury to employees

Property losses can come from physical damage to the property or losing use of the property for a period of time.

Business interruption losses are not always covered. Only a special kind of insurance covers such indirect losses. Business interruption insurance reimburses the difference between normal income and the income during the interruption.

Liability losses can occur when a court decides the company is responsible for bodily injury. If a person is injured in a fire because the company did not provide adequate detection then the company could be charged and have to pay liability loss.

Key person losses occur when a business owner or important member of the business falls ill or dies. If something happens to the business owner in a fire, often an attorney, accountant, or insurance agent helps in developing a plan for the survival of the company.

Once exposures are identified and analyzed, the business must consider its risk management. Loss control and guaranteeing availability of funds should be kept in mind during risk management analysis. Transferring risk is a method of managing exposure to loss. Most businesses do this by buying insurance. Insurance agents have been trained in risk analysis in addition to being familiar with financial strategies and regulations that govern them in each state. If extra measures have been taking, such as advanced smoke and fire detection, the agent can amend a basic policy by adding special coverage and endorsements. (Anastasio, Susan)

2.3.4 Reasons Certain Smoke Detection is not used

Each type of detector has positive and negative qualities. Smoke detectors are great for a household, and smaller buildings which do not require a large volume of people to move if there is an alarm. However, when evacuating large commercial buildings, such as a mall, there are security and life safety issues to consider. Also, false

alarms are more likely in some areas, which should be taken into consideration before detectors are installed and employed. It is common for smoke detectors to trip when people walk out of a steamy bathroom or where food is cooked, releasing steam or smoke into the air. To solve this problem, heat detectors are used in such places. (Vision Systems document 10947, version 01)

An "intelligent" system is more resourceful than a basic system. Intelligent systems utilize microprocessors which is capable of incorporating and triggering many systems such as alarms, ventilation and suppression systems. These systems have a higher stability, enhanced maintenance, and ease of modification. This means that if a building owner with such a system wants to add a detector to the alarm system the operator would program this into the control panel of the system rather than rewire the entire system. Also the stability of the device prevents false alarms. If the system detects a problem, it attempts a quick reset. If dust or an insect is the problem, the detector would fix itself on the quick reset. If the problem is smoke or fire condition then the detector reenters the alarm mode immediately after the reset and the panel will now regard this as a fire condition (Artim, Nick).

Maintenance of "intelligent" systems is often more simple than that of a basic system. The system monitors the status of each detector. As it becomes dirty, the microprocessor recognizes a decreased capability, and provides a maintenance alert. Also, the system can be modified, adding or deleting a detector, by simply connecting or removing the device from the addressable circuit, and changing the memory section (Artim, Nick). These features suggest that the more basic systems would become less likely to be used in newer and upgraded buildings.

2.4   *What has not been researched*

Through the data collected through research, it is apparent that there has not been sufficient research done into why fire and smoke detection systems are not utilized in commercial buildings. Some factors may include financial obligations, legal reasons, or negligence.   In discovering this information, it could provide potential markets for detection systems which address these features. This project would potentially expand the market for Vision Systems' PROACTIV® fire alarm control panel and VESDA® air sampling smoke detector systems by exposing the holes in the market.

3 Methodology

The goal of this Interactive Qualifying Project was to provide Vision Systems with insight for potential markets for their PROACTIV® integrated fire alarm control panel and VESDA® air sampling smoke detector systems within large commercial buildings. This chapter introduces the procedure that was used to analyze and identify types of commercial buildings, and how effective current detectors are in reducing losses, and increasing safety during fires.

3.1 Identifying ways to find potential markets

3.1.1 National Fire Incident Reporting System

The National Fire Incident Reporting System (NFIRS) was used as a primary research tool. The NFIRS database is a compilation of fire department database reports on every incident to which they responded. This yielded a general overview of the types of incidents across the United States. In working with this data, it was discovered not only what types of incidents occurred, but also how frequently. It was also determined what types of deaths, injuries, detection systems, extinguishing systems, and causes were involved with each fire.

In order to sort through and extract the relevant data contained in NFIRS, the field was narrowed to larger commercial buildings such as public recreational complexes, stadiums, medical complexes, hotels, warehouses, industrial plants, office buildings, as well as shopping complexes. These buildings were known for having a larger building structure classification, which could allow implementation of more preventative detection.

A program was written to allow a database to be created. This database incorporated a few different files that included civilian deaths, firefighter deaths, areas of origin, relative damages, and the ignited materials. The programs were used to incorporate the tables into one large database which can be found in Appendix I. The first program was used to incorporate data from years 1990 through 1998. The second program was used incorporate data from 1999 through 2004.

In order to sort the data, Microsoft Access was used. Access allowed the data to be narrowed down specifically to large commercial (non-residential) buildings. This was accomplished by referencing the NFIRS' Manual for value types. In each column on the table (in the database), values are given which relate to specific building types, casualties, locations, and materials involved in incidents. Once the database was sorted down to large commercial buildings, information began to be extrapolated from the database in the form of statistics. These statistics were broken down by year, in order to get insight into general trends. Areas of the fires' origin, initial material ignited, and casualties' data was then analyzed. Types of detectors and sprinkler systems located inside of buildings with fires will also be analyzed from years 1999 through 2004. This data allowed insight into which types of systems or combination of systems were best at reducing chances of damages and casualties.

3.1.2 Interviews

In order to make use of some of the information received from the NFIRS and to look into the current and future market for detection systems, it was important to talk to current professionals that have created, tested, recommended, implemented and used various detection systems.

16

Insurance companies, building owners, system developers, fire marshals and various consulting firms were contacted to see what types of systems they favor, and why they recommended the systems they did in various situations. Through fire investigators, fire marshals and building owners, it was possible to gain insight into systems that are/are not used and why. Consulting firms and fire investigators provided insight into what are the best and most feasible locations for air sampling detection systems. In many cases, they were also able to discuss the limitations and problems that may arise with the systems.

Some consulting and insurance firms also do testing on various systems. Through these tests, and contacting of individuals that ran these tests, insight was given into how accurate various systems are and how each type goes above and beyond the current markets capabilities with regards to smoke, heat, and water flow/sprinkler detection systems.

All of the individuals interviewed came from a list of professionals provided by Vision Systems and Worcester Polytechnic Institute's staff. These individuals were asked for their qualifications, to determine each person's credibility and allowing insight into their fire protection background. A range of questions were then asked that included:

- In your opinion, where are the top places to use air sampling and very early detection fire detectors?

- How effective do you feel these systems are compared to traditional systems?

- Do you know the difference between Vision System's VESDA[®] and Fenwal's AnaLASER air sampling systems?
  o What some of the limitations of each due to building construction and environment?

- How dependable are smart detection systems that have continual monitoring capabilities, and how useful will they be.

- What are the limitations of each due to building construction and design?

- What are your qualifications and where have you worked in the fire protection industry?

4   Results and Analysis

4.1   NFIRS Data Collection

An analysis of the National Fire Incident Reporting System (NFIRS) revealed many trends. The data was collected by fire departments across the United States. They report on many aspects of fire incidents, some of which include location of the fire, general building type, what material was ignited, what type of detection and sprinkler systems were present (if any), as well as data on casualties.

Often NFIRS reports are incomplete with fields left blank. This is most likely due to lack of knowledge with the reporting system. There is no required training for the NFIRS reporting system and there are no regulations requiring reports to be filled out in any specific manner. Due to this, as data is presented there may be columns with an "unknown" value. This is to show where no data was entered into the report on that subject matter.

As data was sorted and analyzed there were a few issues. In 1998, the NFIRS reporting format changed. One result of this change in format was the addition of detector type in the building. Because of this, detector types were able to be determined for fires from 1999-2004 but not from 1990-1998. Despite this difference, the majority of the NFIRs data remained the same between 1999-2004 and 1990-1998.

In order to find a good location for VESDA air sampling smoke detection, it is a good idea to know what fires are common in larger scale commercial buildings. Statistics were sorted out by year to determine which areas of origin and causes of ignition are most common for structure fires.

All data from the National Fire Incident Reports were inputted into tables which can be found in Appendix II. The graphs found in sections 4.1.1 and 4.1.2 represent average incidents from 1990 through 2004.

4.1.1 Areas of Fires

The areas of fire origin of structure fires were evaluated. *Figure 1* illustrates that "function areas", "storage areas", and "structural areas" are three major areas in which detection systems would be beneficial. Before a recommendation can be made, a further analysis of each area type must be done.

Area of Origin
(Average percentages in fires from 1990-2004)
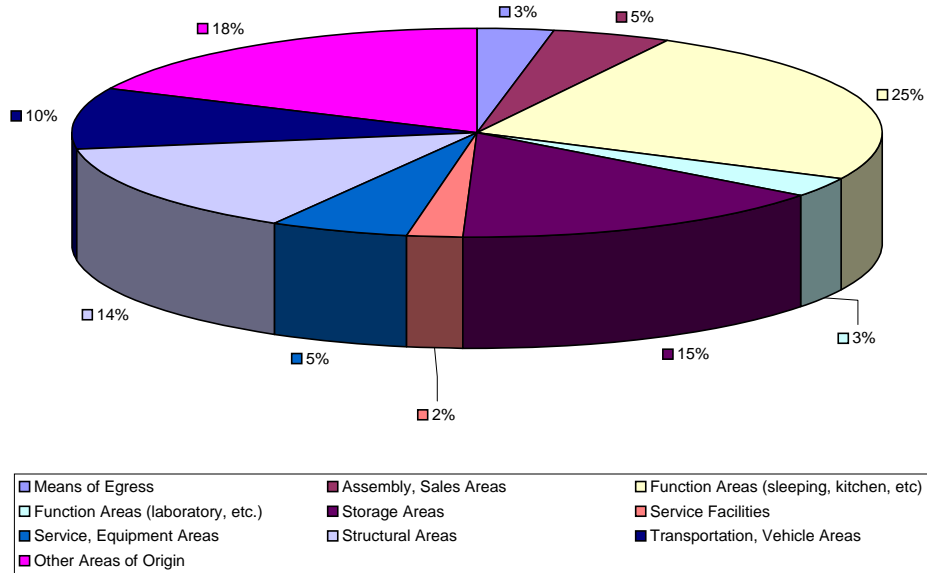
Figure 1-Area of Origin

Figure 2 breaks down the most common places of origin. It is seen that the three most common areas were "kitchen and cooking areas", "sleeping areas", along with "lavatories, locker rooms, and cloakrooms."

Area of Origin
Function Areas

20%

4%

7%

34%

16%

12%

6%

1%

Legend:
- Sleeping room for under 5 persons.
- Sleeping area for 5 or more persons.
- Dining area, lunchroom, cafeteria.
- Kitchen, cooking area.
- Lavatory, locker room, cloakroom.
- Laundry room, area.
- Office.
- Personal service area.
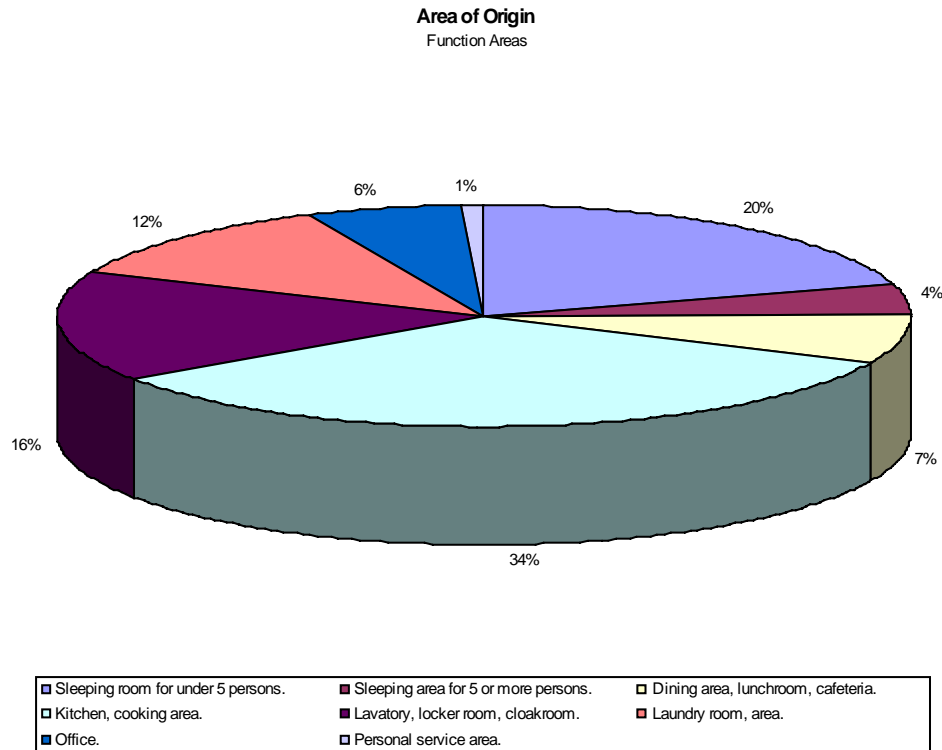
Figure 2-Area of Origin's Function Areas

Throughout storage areas, "trash and rubbish containers" were found to be the most common area of origin for fires. "Vehicle storage" and "product storage" areas were also found to be frequent areas of origin. This is seen in *Figure 3*.

Area of Origin
Storage Areas

Product storage room or area, storage tank, storage bin.
Supply storage room or area.
Shipping, receiving, loading area.
Garage, carport, vehicle storage area.
Closet.
Records storage room, vault.
Trash or rubbish area, container.
Storage Areas not classified above.
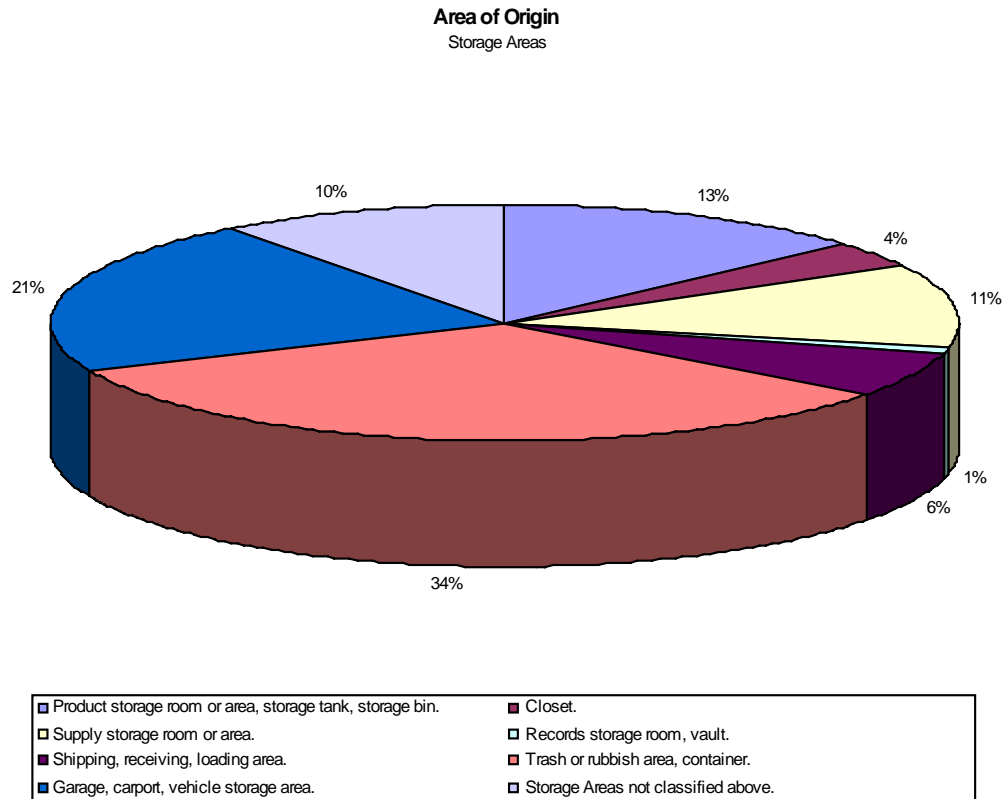
Figure 3-Area of Origins, Storage Areas

Figure 4 shows structural areas of origin were most commonly "exterior wall surfaces", "ceiling and roof assembly, concealed roof/ceiling space", and "wall assembly, concealed wall space."   This can be determined by the location of the initial alarm that goes off, or by the intensity and location of damage.

Area of Origin
Structural Areas

Legend:
- Crawl space, substructure space.
- Ceiling and floor assembly, concealed floor/ceiling space.
- Wall assembly, concealed wall space.
- Exterior roof surface.
- Structural Areas not classified above.
- Exterior balcony, open porch.
- Ceiling and roof assembly, concealed roof/ceiling space.
- Exterior wall surface.
- Awning.
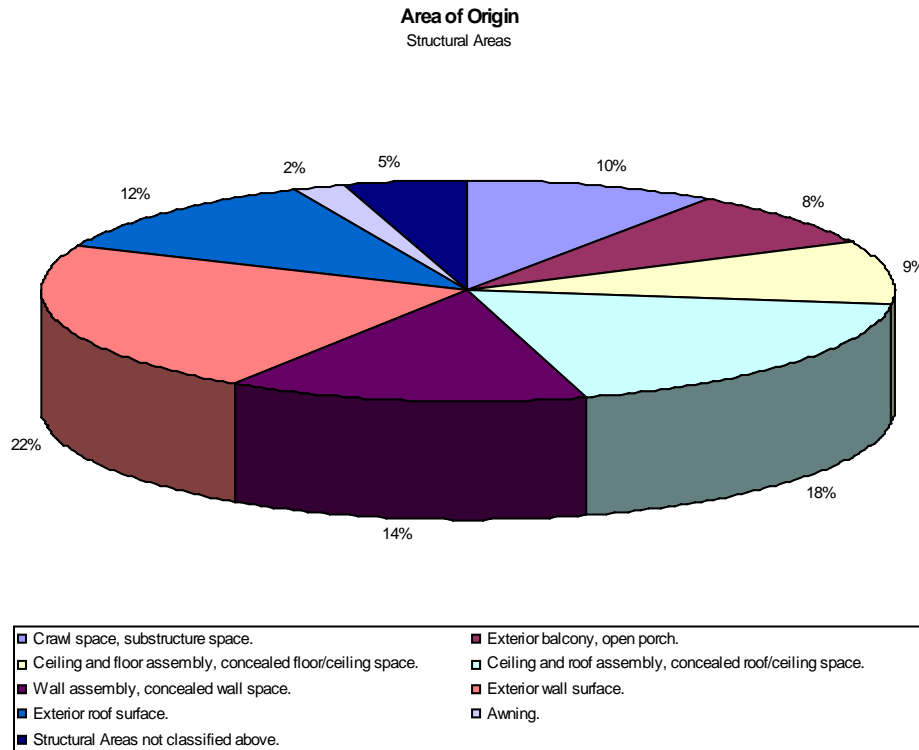
Figure 4- Area of Origins, Structural Areas

When reviewing this data, it is readily apparent as to which spaces would benefit from smoke detection. Two types of area that standout amongst others are function areas, and kitchen/cooking areas. These represent two of the most common areas for a structure fire to originate. Less significant, though still worth note are storage areas (mainly trash/rubbish areas) and structural areas (such as ceiling and roof assemblies). Kitchens and trash storage areas are to be expected as common areas of origin due to the large amount of open flames in kitchens, buildups of methane in trash areas (due to decomposition), and a general lack of smoke detection in both areas. Benefits of aspirated detection systems could be seen in these areas due to earlier warning of fire and general resiliency to harsh environments.

4.1.2   Materials ignited

The leading materials ignited during incidents were primarily "wood, paper", "fabrics, textiles, furs", and "natural products." Similar to areas of origin, the materials ignited must be analyzed further to draw any conclusions.

Type of Material Ignited
(Average percentages in fires from 1990-2004)
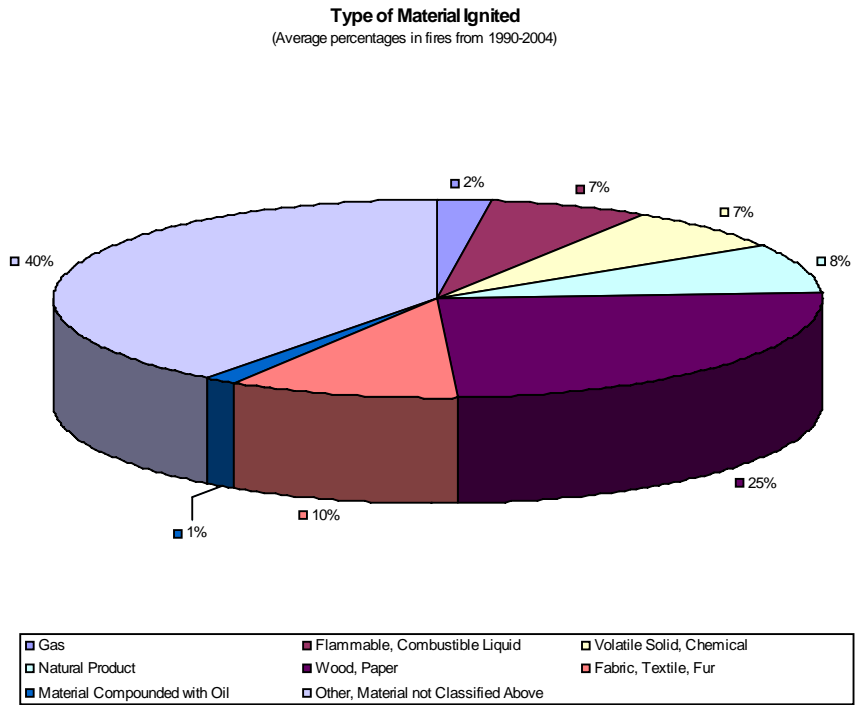
Figure 5-Type of Material Ignited

As shown by *Figure 5*, wood and paper products are reported as the cause of 25% of structure fires from 1990-2005. While already a large percentage, it appears even more significant when considering that forty percent of the materials were listed as "unclassified". Out of all the fires caused by wood and paper products, thirty percent were cause by sawn wood and twelve percent were caused by wood shavings (see *Figure 6*, below). These findings are significant as they point to saw mills and wood-working shops as potential areas for aspirated smoke detection systems. Buildings like saw mills

and wood-working shops are at high risk for two specific reasons. First, the equipment used creates very high levels of friction which, when combined with the present materials (sawdust, dried lumber, etc.) creates a fire hazard. Secondly, this type of facility often does not employ smoke detection because of its limitations in a high-dust atmosphere. Thus, aspirated smoke detection systems would be vital to control and prevent fire in these areas mainly for the very early warning properties but also for their filtering capability in the dusty environments.

Type of Material Ignited
Wood, Paper

☐ Growing wood.	■ Felled but unsawn wood.
☐ Sawn wood.	☐ Wood shavings.
■ Hardboard, plywood.	■ Fiberboard (low density material), wood pulp.
■ Paper, untreated, uncoated.	☐ Cardboard.
■ Wood, Paper; insufficient information available to classify further.	
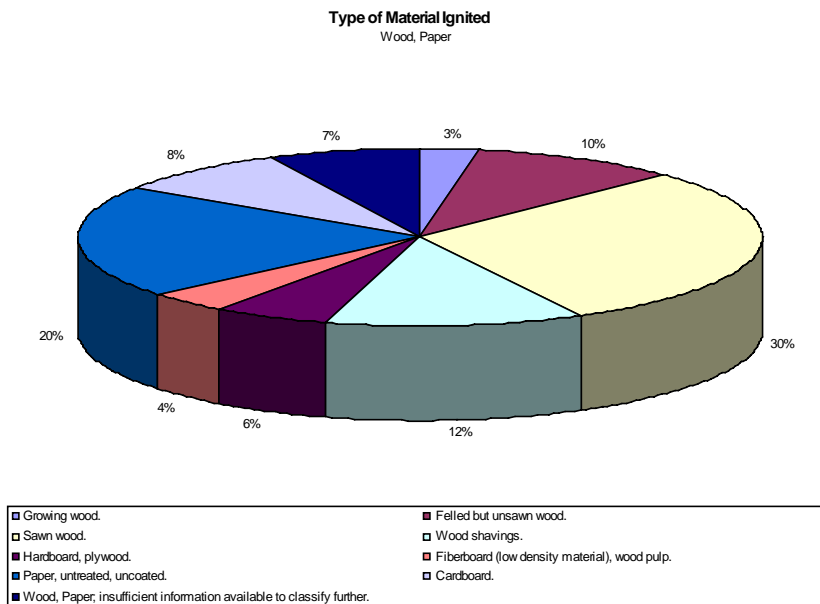
Figure 6-Type of Material Ignited, Wood and Paper

"Man-made fabric, fiber, finished goods" were ignited the most often throughout the fabrics, textiles and fur category. "Furs, silk, other fabric, finished goods" followed behind at almost one fifth the number of confirmed fires started by man-made fabrics. This is shown in *Figure 7*.

25

Material Ignited
Fabric, Textile, Fur
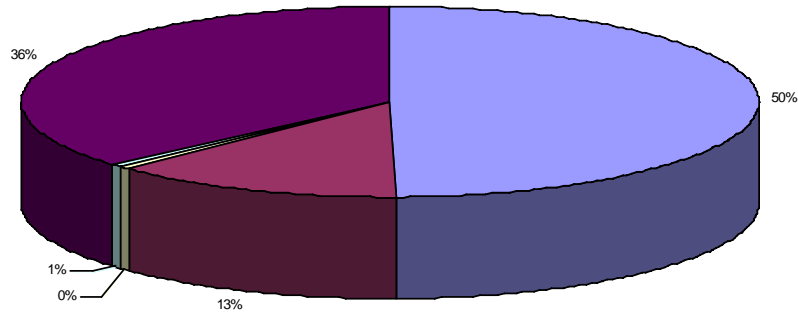
▫ Man-made fabric, fiber, finished goods.	■ Fur, silk, other fabric, finished goods.
▫ Wig.	▫ Human hair.
■ Fabric, Textile, Fur; insufficient information available to classify further.	

Figure 7-Type of Material Ignited , Fabric, Textiles and Fur

From a breakdown of natural products ignited, shown in *Figure 8*, "grass, leaves, hay, straw" were the most commonly ignited material. "Tobacco" and "food, starch" ranked second and third, in this category.

□ Cork.	■ Leather.
□ Grass, leaves, hay, straw.	□ Grain, natural fiber (pre-process).
■ Coal, coke, briquettes, peat.	□ Food, starch.
■ Tobacco.	□ Natural Product; insufficient information available to classify further.
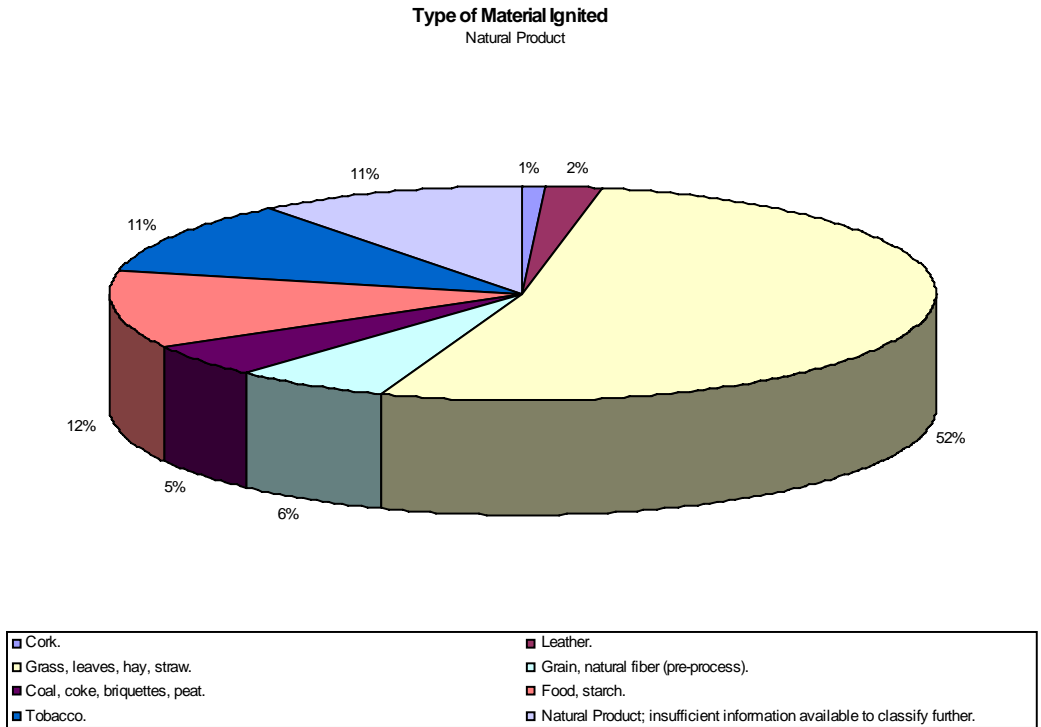
Figure 8-Type of Material Ignited, Natural Products

It can be seen that one-fourth of the reported fires were started by wood and paper. This is a high number considering forty percent of the materials were listed as unknown or not reported. The other two types of material in the top three did not combine to make up the number wood and paper did. However, fabrics and man-made textiles were also a significant source of the fires along with grass, leaves, hay, and straw. This can be expected due to the fact that when heated grass and hay could ignite easily compared to something such as rubber.

4.1.3 Deaths in relation to Sprinkler and Detection systems

Overall when looking into deaths during fires, the use of sprinklers and general detection systems decreased the amount of deaths in a structure. Combination systems were more effective than sprinkler systems alone. Having only detection systems would result in a slightly higher death rate than both of the above. When looking into areas which did not have any detection or sprinklers present, a drastic rise in death rate occurred. This rise was usually about ten times higher than the amount of deaths that resulted from a combination sprinkler and detection system, or sprinklers alone. These results are seen in *Figure 9*.

Casualty Data With and Without Sprinklers and Detectors
From 1990 through 2004
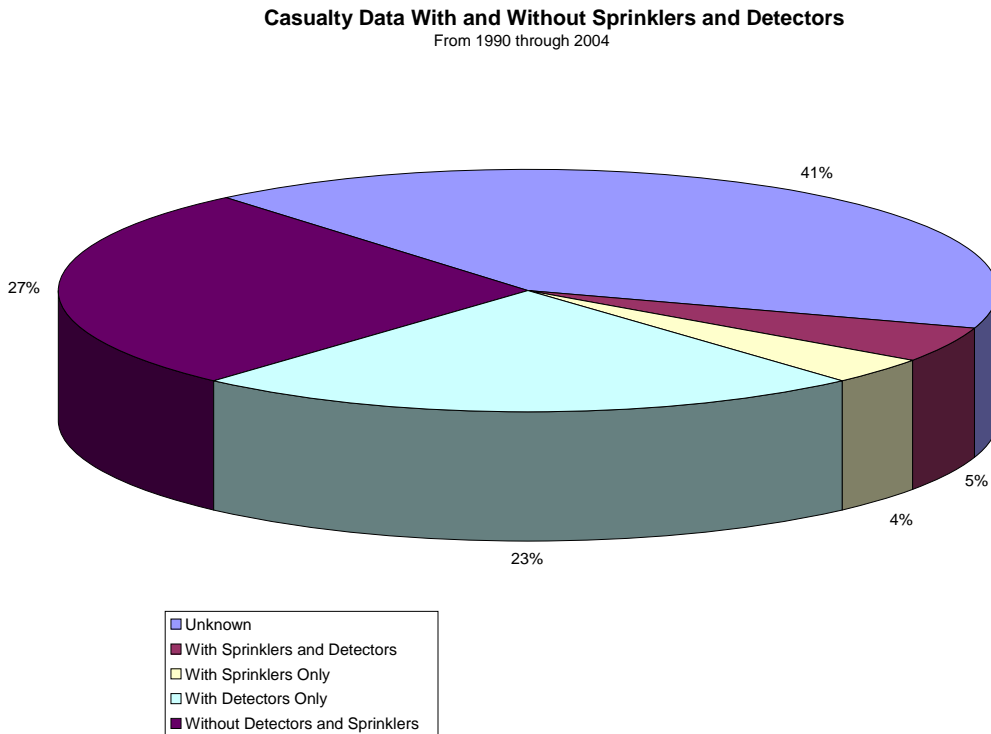
Figure 9-Casualty Data with/without Sprinklers and Detectors

From the years 1999-2004 it was possible to determine what detection types were present for fires with casualties. In order to get accurate numbers, all fires that had detection systems present (it could also have sprinklers present) were sorted from the database for analysis. The results are shown in *Figure 10.* The most common system present while there were casualties reported were "smoke detection" systems. The next common type of detection system was a "combination of heat and smoke detection", followed closely by "heat detection", "sprinkler/water flow detection" and "other" detection systems.

Casualties with Detectors Type Present
From 1999-2004

- Smoke Detection
- Heat detection
- Combo Smoke/Heat
- Sprinkler/waterflow
- Undetermined
- Other
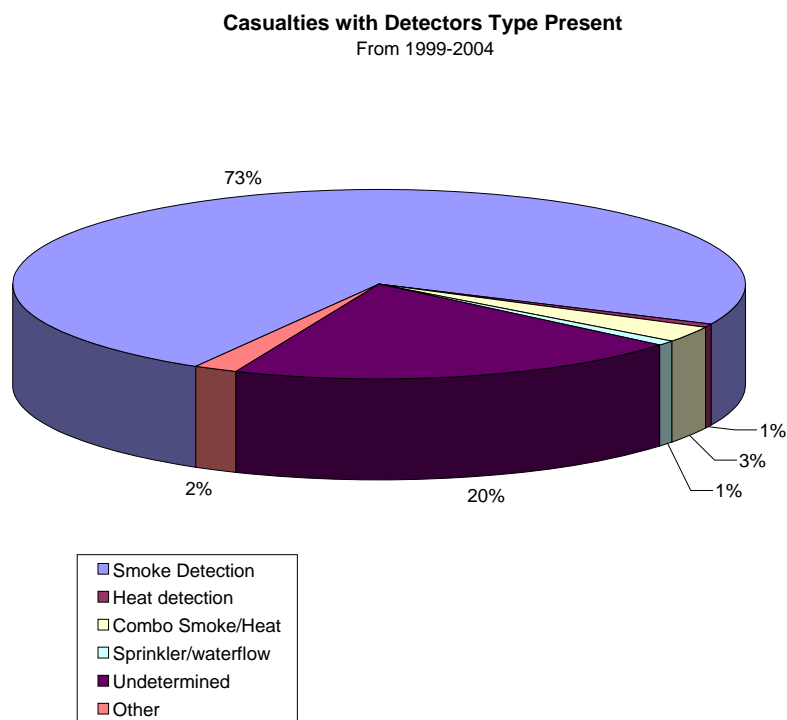
Figure 10-Casualties by Detector Type

While analyzing NFIRS data concerning casualties it was noted that smoke detection was present in a large number of casualty-producing incidents. This fact seemed contrary to popular belief and research showing that smoke detection saves lives. Further analysis of the data was performed to find a reason for this odd result. Sorting the general database of incidents by the detection type present revealed the answer. It could be seen that thirty three percent of buildings had a combination of smoke and heat detection while twenty two percent had only smoke detection. This means that fifty five percent of buildings had smoke detection in place while the remaining forty five percent had an array of different systems (heat detection only, water flow/sprinkler detection, etc.). Since a majority of the buildings had smoke detection in place, it makes sense (statistically) that casualties would appear more often with smoke detection. Because NFIRS doesn't note the number of lives saved in any given incident it is impossible to comment with certainty on the comparative effectiveness of smoke detection.

4.2   Interview results

People were contacted and asked questions regarding their professional view on the air sampling smoke detection systems. In total, 925 individuals were contacted via e-mail with a response rate of 3.25%. Fire Protection and industry engineers accounted for 64.3% of those contacted. According to the answers received, Fire Protection Engineers view the VESDA system very favorably. Respondents listed numerous features that they felt made the VESDA system advantageous, however one feature seemed particularly popular. The ability for the VESDA system to be easily integrated into a large number of fire alarm control panels appears to make the system stand out against its competitors in the eyes of fire protection engineers. Another feature that sticks out to engineers is

VESDA's ability to deal with smoke detection in buildings with atriums. The precision smoke detection offered by VESDA allows for smoke detection in high roofed areas and places with very large temperature gradients. However, there were complaints on VESDA's inability to deal with smoke detection in inert environments. This is a cause for concern in chemical storage rooms and other places where the system may be used when air circulation is a factor.

When asked about the limitations of the air sampling systems compared to the limitations of spot detections, the answers revealed some weaknesses in both systems. Of the engineers contacted, 64 percent cited a problem with spot detectors as having difficulties with high ceilings and large temperature gradients, problems that the VESDA system is well suited in handling. However, according to the answers received, VESDA also had some difficulties with certain environments. As previously mentioned, inert air systems can cause problems for the VESDA system. In addition, fire protection systems in facilities such as nuclear power plants and even biomedical facilities must be able to provide adequate protection and also prevent radiation or biological contamination of outside zones. VESDA does have the ability to maintain itself in individual quarantine zones; however it might be cost prohibitive to install a separate VESDA system in each quarantined room. Other difficulties noted in the responses were the problems involved with troubleshooting pipe flow. According to one respondent, problems have occurred where scanning the entire length of an air pipe was required to find a problem. This means removing wall, ceiling and floor panels and scanning individual pipes to find the problem. Vision Systems has acknowledged this problem and has introduced measures to

alert the control panel of precisely where blockages have occurred, see the literature review for more information.

Of the respondents who were familiar with the VESDA system, everyone had good things to say about VESDA. The ability for the system to integrate into many panels, to detect combustion at different levels, and the ability to provide protection virtually anywhere make the system almost the perfect system for any location. However, contamination risks, inert environments and, most importantly, prohibitive costs are the main problems areas reported back by fire protection engineers that have worked with the systems. According to the respondents of the questionnaire the most popularly viewed areas that would make use of VESDA's system include historical buildings, lobbies with large atriums, explosives storage, high cost storage rooms, service dependent areas, server rooms, and live broadcast television studios.

4.3   Compiled Analysis

As shown by a review of building/fire codes and standards, detection systems are not explicitly required in large commercial buildings. The codes reviewed focus mainly upon safety of occupants inside the building rather than the structure itself. Generally, these buildings require sprinkler systems along with a manual "pull box" and a public address system. While such a system is not exactly proactive in its detection of fire, it will give occupants more time to evacuate though not necessarily save the building.

The interviews of AHJs have shown, that they favored a detection system that constantly monitors a building for fire, opposed to detects that respond once a fire has already begun, such as spot detectors A common theme was that an earlier notification of fire is always better, preferably one that can detect combustion in the incipient stage.

Notification of a fire during this stage would give the building occupants enough time to respond to the situation before the combustion has advanced. Another example given by AHJ's was that early detection (in their experience) is best used in buildings containing irreplaceable items, expensive items, or buildings of historical value.

Although smoke detection, including air sampling smoke detection, systems are not required by code, it may be in the best interest of building owners to take a proactive approach to fire detection. According to the interviews conducted, the chance of preventing bodily harm and reduced losses due to fires are significantly decreased with early detection systems. It was learned that the type of materials stored in the buildings affects what type of detection system building owners prefer to use. VESDA has been recommended for use in chemical storage facilities with heat sensitive materials and also pharmaceutical storage facilities. Correlations between type of material stored and their risks are represented in the NFIRS data.

NFIRS reiterated that specific materials housed within a building pose higher risk of fire than others. Leading materials were "wood and paper", "fabrics, textiles, and fur", and "other natural products". Areas housing materials such as these could make use of an early detection system, as their fire load is extremely high with potential for a rapidly spreading fire. Scaled down air sampling systems that are made only to cover high-risk areas may be beneficial to building owners. These building owners could protect valuable products while keeping protection costs down. The areas housing these "high risk" materials were also analyzed with the NFIRS reports. These high risk areas of origin were found to be larger scale "storage areas" and "production and manufacturing" areas. Adopting an air sampling systems in these likely fire origin areas would have been

very beneficial in keeping fires small throughout the NFIRS reports that were analyzed. From these results, conclusions and recommendations can be drawn for viable marketing niche for Vision Systems' VESDA air sampling system.

5   Conclusions

Through the data collected, it was observed that to successfully market the VESDA product it is important to exemplify the strengths of the system and to modify the system to overcome the problems that have come up. The following suggestions are recommended to increase the marketability of Vision Systems' VESDA system.

VESDA's ability to detect smoke during the incipit stages allows the system to be implemented in scenarios where heat sensitive chemicals or pharmaceutical storage is involved. By gaining understanding of the needs of such an industry, VESDA could break into a large market which it could potentially dominate. A main hindrance of VESDA's widespread use is the perception of higher cost. There are two options that should be considered. First would be to consider actively promoting the full product range such as a scaled-down and less expensive VESDA system LaserFOCUS for use in smaller spaces. This would allow the system to be implemented strategically and provide incentive to prospective buyers. Another route would be to develop a clear picture of total cost of system ownership, including on-going system maintenance needs and high system reliability to change people's perception of higher first installation cost.

The ability for VESDA to be able to detect small changes in the quantity of smoke particles in the air provides another market for the system. VESDA could possibly be used as a friction/over-friction monitoring device in manufacturing facilities. This would allow Vision Systems to enter an entirely new market that could potentially be a very easy transition.

Another recommendation is to further the ability of the VESDA system to easily integrate into a large number of control boxes. This ability is highly advantageous to

installers and engineers and provides a way to further VESDA's penetration into the high end smoke detection market.

The system's technology allows its use in nearly every building condition. If the first install price of the systems could be lowered while still maintaining a modest profit margin for the manufacturer, the AHJ's expressed a notion that the system would be a valid fire safety option for many United States buildings.

The objective of this project was to find a profitable marketing solution for Vision Systems' VESDA air sampling system. In the future, Vision Systems may find it profitable to decrease their prices while marketing to more business owners who wish to proactively protect their building and its contents. In addition, using VESDA's technology in other applicable situations may allow Vision Systems to expand into more specialized and less populated markets.

6 Glossary of abbreviations

Abbreviation	Actual Name
USFA	United States Fire Administration
NFIRS	National Fire Incident Reporting System
NFPA	National Fire Protection Association
IBC	International Building Codes
AHJ	Authority Having Jurisdiction
VESDA ®	Vision System©'s Very Early Smoke Detection Apparatus

7 Works Cited

Anastasio, Susan. "Small Business Insurance & Risk Management Guide." U.S. Small

    Business Administration. The Travelers, Hartford, CT.

Artim, Nick. "An Introduction to Fire Detection, Alarm, and Automatic, Fire

    Sprinklers." Northeast Document Conservation Center. 1999.

Baker, Michael. "Fire Protection Glossary." ETnews.org Michael Baker & Associates

    Inc. Gladstone, OR. 2006.

Dean, John C. "State of Maine Fire Marshall's Office." <u>Maine State Fire Marshall</u>.

    <http://www.maine.gov/dps/fmo>.

Fekete, Chen-Fang Chang. "Air-fuel ratio control in spark-ignition engines using

    estimationtheory." Control Systems Technology. March 1995.

Karter, Michale K. "Fire Loss in the United States During 2005: Full Report"

    National Fire Protection Association, 2006

McEwen, R.H.L. "Fire Alarm and Detection Systems"

    Canadian Building Digest, August 1984

National Fire Protection Association. <u>National Fire Codes</u>. Vol. 2005 Fall Revision

    Cycle., 2005

Robin, Mark and Forsell, Eric. "Comparison Testing in a Simulated Data

    Processing/Telecommunications Facility: FM-200® and Automatic Sprinkler

    Systems." Hughes Associates, Inc., West Lafayette, IN.

Sivathanu, Yudaya R. "Fire Detection Using Near-IR Radiation and Source Temperature

    Discrimination." Perdue University, West Lafayette, IN.

Tabor, Caterina. "Modern Fire Protection System safeguards Venues."

International Association of Assembly Managers, 2006

Vision Systems. "VESDA Buys Time. Air Sampling Smoke Detection." Part no:

30101, document: 10947, version: 01. July 2006.

Rohr, Kimberly D. and Hall, John R. Jr. "U.S. Experience with Sprinklers and Other Fire

Extinguishing Equipment", National Fire Protection Association, August 2005

8 Appendix I -NFIRS sorting programming codes

8.1 Program 1 (1999-2004)

Program one was run for the combining of NFIRS from the years 1999 through

2004. Program located below.

```c
#include <stdio.h>
#include <stdlib.h>                /* for malloc() */
#define INPUTLINELENGTH 150       /* max length of input file line. */

/* structure for holding relevant data from inputfile */ typedef struct FireRecP {
 int FDID,IncidentNumber,ExposureNumber;
 char textRecord[INPUTLINELENGTH];
 struct FireRecP *Next,*End;
} fireRec;

/* function prototypes */
fireRec *addToList(fireRec*,int,int,int,int,char*);
int findMatchesInLists(fireRec*,fireRec*);

int main()
{
 fireRec
  *t20List,                       /* list of type20 records */
  *t55List;                       /* list of type55 records */
 int FDID,IncNum,ExpNum,RecType, /* NFIRS record vars */
  numType20,numType55,           /* record type counters */
  matchesFound;                  /* No. 55/20 matches found */
 char inputLine[INPUTLINELENGTH]; /* char array for holding lines
                                       from inputfile */
 t20List=t55List=NULL;           /* initialize list pointers to NULL */
 numType20=numType55=0;       /* initialize counters */
 /* Part 1: we read in the input file... taking t20 and t55
   records....... */
 while (fgets(inputLine,INPUTLINELENGTH,stdin)!=NULL)
  { /* while we still have inputlines, read 'em in. */
   sscanf(inputLine,"%d,%d,%d,%d", /* use nasty slow scanf library routine */
          &FDID,&IncNum,&ExpNum,&RecType);
   /* If the rec is a type20 or type55 add it to a list of those
         records: */
   switch (RecType)
       {
       case 20:
        t20List=addToList(t20List,FDID,IncNum,ExpNum,RecType,inputLine);
        numType20++;
        if (numType20%50000==0)
          fprintf(stderr,"read %9d t20, %7d t55 records...\n",
                                  numType20,numType55);
```

40

```c
                 break;
            case 55:
              t55List=addToList(t55List,FDID,IncNum,ExpNum,RecType,inputLine);
              numType55++;
              if (numType55%5000==0)
                fprintf(stderr,"read %9d t20, %7d t55 records...\n",
                                           numType20,numType55);
              break;
            default: break;
            }
      /* OK, done reading the inputfile, now do our search for Russo:
            for each t20 record, find any corresponding t55.  If you find
            a corresponding record, tack the inputlines for the t20 and
            t55 together, and output them to stdout. */
    }
  fprintf(stderr,"TOTAL: Read %d t20 records and %d t55 records.\n",
          numType20,numType55);
/*
  Now that we have our t20 and t55 record lists, go through the 20's
  looking for matches in the 55's.  Which way would be faster?
  Probably "foreach 55, look for 20's." as opposed to "foreach 20,
  look for 55's" since there are fewer 55's than 20's by a long
  margin.
*/
  matchesFound=findMatchesInLists(t20List,t55List);
  fprintf(stderr,"Found %d t20/t55 matches in the input.\n",
          matchesFound);
  return(0);
}

int findMatchesInLists(fireRec *t20List, fireRec *t55List) {
  int matches,
    num55sSearched;
  fireRec *t20Place,*t55Place;
  t55Place=t55List;
  matches=num55sSearched=0;
  while(t55Place!=NULL)
    {
      t20Place=t20List;
      while (t20Place!=NULL)
          {
            if (t20Place->FDID==t55Place->FDID)
              {
                if (t20Place->IncidentNumber==t55Place->IncidentNumber)
                    {
                      if (t20Place->ExposureNumber==t55Place->ExposureNumber)
                        {
                          printf("%s,%s\n",t20Place->textRecord,
                                 t55Place->textRecord);
                          matches++;
                        }
                    }
              }
```

```
                t20Place=t20Place->Next;
             }
      t55Place=t55Place->Next;
      num55sSearched++;
      if (num55sSearched%1000==0)
          fprintf(stderr,"Searched %d t55 records...\n",num55sSearched);
    }
  return(matches);
}

fireRec *addToList(fireRec *list, int FDID, int IncNum, int ExpNum, int RecType,
                   char *inputLine)
{
 fireRec *place;
 int i=0;
 if (list==NULL)
   {
     list=(fireRec *)malloc(sizeof(fireRec));
     if (list==NULL)
          {
           perror("\nAdd To List (1):");
           exit(1);          /* exit 1 is bad malloc making initial list node */
          }
     place=list;
   }
  else
   {
     place=list->End;
     place->Next=(fireRec *)malloc(sizeof(fireRec));
     if (place->Next==NULL)
          {
           perror("\nAdd To List (2):");
           exit(2);          /* exit 2 is bad malloc making initial list node */
          }
     place=place->Next;
   }
 place->Next=NULL;
 list->End=place;
 place->FDID=FDID; place->IncidentNumber=IncNum; place->ExposureNumber=ExpNum;
 while (inputLine[i]!=0 && inputLine[i]!='\r')
   { /* while loop above should also check "&& i<INPUTLINELENGTH" but
     I removed it to speed up processing --mvoorhis */
    place->textRecord[i]=inputLine[i];
    i++;
   }
 place->textRecord[i]=0;          /* remember to null-terminate the string */
 return(list);
}
```

8.2   Program 2 (1990-1998)

Program one was run for the combing of NFIRS from the years 1990 through
1998. Program is located below.

```c
#include <stdio.h>
#include <stdlib.h>                 /* for malloc() */
#define INPUTLINELENGTH 150         /* max length of input file line. */

/* structure for holding relevant data from inputfile */ typedef struct FireRecP {
  int FDID,IncidentNumber,ExposureNumber;
  char textRecord[INPUTLINELENGTH];
  struct FireRecP *Next,*End;
} fireRec;

/* function prototypes */
fireRec *addToList(fireRec*,int,int,int,int,char*);
int findMatchesInLists(fireRec*,fireRec*);

int main()
{
  fireRec
    *t20List,                       /* list of type20 records */
    *t55List;                       /* list of type55 records */
  int FDID,IncNum,ExpNum,RecType,   /* NFIRS record vars */
    numType20,numType55,            /* record type counters */
    matchesFound;                   /* No. 55/20 matches found */
  char inputLine[INPUTLINELENGTH];  /* char array for holding lines
                                        from inputfile */
  t20List=t55List=NULL;             /* initialize list pointers to NULL */
  numType20=numType55=0;            /* initialize counters */
  /* Part 1: we read in the input file... taking t20 and t55
     records....... */
  while (fgets(inputLine,INPUTLINELENGTH,stdin)!=NULL)
    { /* while we still have inputlines, read 'em in. */
     sscanf(inputLine,"%d,%d,%d,%d", /* use nasty slow scanf library routine */
            &FDID,&IncNum,&ExpNum,&RecType);
     /* If the rec is a type20 or type55 add it to a list of those
          records: */
     switch (RecType)
         {
         case 20:
          t20List=addToList(t20List,FDID,IncNum,ExpNum,RecType,inputLine);
          numType20++;
          if (numType20%50000==0)
            fprintf(stderr,"read %9d t20, %7d t55 records...\n",
                                        numType20,numType55);
          break;
         case 55:
```

43

```c
           t55List=addToList(t55List,FDID,IncNum,ExpNum,RecType,inputLine);
           numType55++;
           if (numType55%5000==0)
             fprintf(stderr,"read %9d t20, %7d t55 records...\n",
                                        numType20,numType55);
           break;
         default: break;
         }
    /* OK, done reading the inputfile, now do our search for Russo:
          for each t20 record, find any corresponding t55.  If you find
          a corresponding record, tack the inputlines for the t20 and
          t55 together, and output them to stdout. */
  }
 fprintf(stderr,"TOTAL: Read %d t20 records and %d t55 records.\n",
          numType20,numType55);
/*
  Now that we have our t20 and t55 record lists, go through the 20's
  looking for matches in the 55's.  Which way would be faster?
  Probably "foreach 55, look for 20's." as opposed to "foreach 20,
  look for 55's" since there are fewer 55's than 20's by a long
  margin.
*/
 matchesFound=findMatchesInLists(t20List,t55List);
 fprintf(stderr,"Found %d t20/t55 matches in the input.\n",
          matchesFound);
 return(0);
}

int findMatchesInLists(fireRec *t20List, fireRec *t55List) {
 int matches,
   num55sSearched;
 fireRec *t20Place,*t55Place;
 t55Place=t55List;
 matches=num55sSearched=0;
 while(t55Place!=NULL)
  {
    t20Place=t20List;
    while (t20Place!=NULL)
        {
         if (t20Place->FDID==t55Place->FDID)
           {
            if (t20Place->IncidentNumber==t55Place->IncidentNumber)
                {
                 if (t20Place->ExposureNumber==t55Place->ExposureNumber)
                  {
                   printf("%s,%s\n",t20Place->textRecord,
                          t55Place->textRecord);
                   matches++;
                  }
                }
           }
         t20Place=t20Place->Next;
        }
```

```c
      t55Place=t55Place->Next;
      num55sSearched++;
      if (num55sSearched%1000==0)
            fprintf(stderr,"Searched %d t55 records...\n",num55sSearched);
   }
 return(matches);
}


fireRec *addToList(fireRec *list, int FDID, int IncNum, int ExpNum, int RecType,
                   char *inputLine)
{
 fireRec *place;
 int i=0;
 if (list==NULL)
   {
    list=(fireRec *)malloc(sizeof(fireRec));
    if (list==NULL)
         {
          perror("\nAdd To List (1):");
          exit(1);          /* exit 1 is bad malloc making initial list node */
         }
    place=list;
   }
 else
   {
    place=list->End;
    place->Next=(fireRec *)malloc(sizeof(fireRec));
    if (place->Next==NULL)
         {
          perror("\nAdd To List (2):");
          exit(2);          /* exit 2 is bad malloc making initial list node */
         }
    place=place->Next;
   }
 place->Next=NULL;
 list->End=place;
 place->FDID=FDID; place->IncidentNumber=IncNum; place->ExposureNumber=ExpNum;
 while (inputLine[i]!=0 && inputLine[i]!='\r')
   { /* while loop above should also check "&& i<INPUTLINELENGTH" but
     I removed it to speed up processing --mvoorhis */
    place->textRecord[i]=inputLine[i];
    i++;
   }
 place->textRecord[i]=0;          /* remember to null-terminate the string */
 return(list);
}
```

9 Appendix II -Data Tables

Data Table from first run of NFIRs (1999-2004)

Fires in Commercial buildings

Had detectors	39.96%
Did not have any type of detector present	60.04%

Detector Type(out of the 39.96 percent with detectors)

smoke	78.72%
heat	1.25%
both	4.83%
sprinkler/water flow detection	1.44%
had multiple types	3.13%
confirmed other type	0.66%
unknown type	9.97%

Detector operation

Detector(s) in the room or space of fire origin, and they operated.	13.66%
Detector(s) not in the room or space of fire origin, and they operated.	54.01%
Detector(s) in the room or space of fire origin, and they did not operate.	14.18%
Detector(s) in the room or space of fire origin, but fire too small to require to set off detectors	2.13%
undetermined/unknown	16.02%

Number of buildings involved

One Buildings	99.27%
Two Buildings	0.53%
Three Buildings	0.10%
Four Buildings or more	0.10%

Cause of ignition

Unknown/undetermined	10.74%
Incendiary	7.29%
Suspicious	43.66%
Misuse of heat ignited	15.84%
Misuse of material ignited	2.08%
Mechanical failure/malfunction	14.62%
Other	5.77%

Fire Spread

Confined to object of origin	18.52%
Confined to room of origin	33.47%
Confined to floor of origin	8.42%
Confined to building of origin	33.02%
Beyond building of origin	6.57%

Structural Damage (as described in the FEMA NFIR's Manual)

None/not reported	11.71%
Minimal	54.46%
Heavy	21.34%
Extreme	12.49%

Area of origin

MEANS OF EGRESS	8108	1.98%
Hallway, corridor, mall.	1963	0.48%
Exterior stairway.	1870	0.46%
Interior stairway.	2034	0.50%
Escalator.	63	0.02%
Lobby, entrance way.	3301	0.81%
Means of Egress not classified above.	2549	0.62%
ASSEMBLY, SALES AREAS (groups of people)	581	0.14%
Large assembly area with fixed seats (100 or more persons).	272	0.07%
Large open room without fixed seats (100 or more persons).	305	0.07%
Small assembly area with or without fixed seats (less than 100 persons).	915	0.22%
Lounge area.	19607	4.79%
Sales, showroom area.	1156	0.28%
Library.	57	0.01%
Swimming pool.	53	0.01%
FUNCTION AREAS	14234	3.48%
Sleeping room for under 5 persons.	39074	9.54%
Sleeping area for 5 or more persons.	1470	0.36%
Dining area, lunchroom, cafeteria.	778	0.19%
Kitchen, cooking area.	65731	16.05%
Lavatory, locker room, cloakroom.	12554	3.07%
Laundry room, area.	16398	4.00%
Office.	2786	0.68%
Personal service area.	343	0.08%
FUNCTION AREAS	397	0.10%
Laboratory.	298	0.07%
Printing or photographic room, area.	66	0.02%
First aid, treatment room.	43	0.01%
Operating room.	17	0.00%
Electronic equipment room, area.	275	0.07%
Performance, stage area.	69	0.02%
Projection room, area.	11	0.00%
Process, manufacturing area.	2938	0.72%
STORAGE AREAS	9134	2.23%
Product storage room or area, storage tank, storage bin.	4353	1.06%
Closet.	4175	1.02%
Supply storage room or area.	4930	1.20%
Records storage room, vault.	203	0.05%
Shipping, receiving, loading area.	751	0.18%
Trash or rubbish area, container.	1157	0.28%
Garage, carport, vehicle storage area.	17613	4.30%
Storage Areas not classified above.	1	0.00%

SERVICE FACILITIES	1499	0.37%
Elevator, dumb-waiter.	181	0.04%
Utility shaft.	1393	0.34%
Light shaft.	70	0.02%
Chute.	345	0.08%
Duct.	2881	0.70%
Display window.	113	0.03%
Chimney.	848	0.21%
Conveyor.	231	0.06%
SERVICE, EQUIPMENT AREAS	3853	0.94%
Machinery room, area.	2021	0.49%
Heating equipment room or area, water heater area.	7963	1.94%
Switchgear area, transformer vault.	800	0.20%
Incinerator room, area.	184	0.04%
Maintenance shop, area.	2055	0.50%
Test cell.	39	0.01%
Enclosure with pressurized air.	63	0.02%
Enclosure with enriched oxygen atmosphere.	1	0.00%
STRUCTURAL AREAS	8821	2.15%
Crawl space, substructure space.	8136	1.99%
Exterior balcony, open porch.	6359	1.55%
Ceiling and floor assembly, concealed floor/ceiling space.	6619	1.62%
Ceiling and roof assembly, concealed roof/ceiling space.	14156	3.46%
Wall assembly, concealed wall space.	13067	3.19%
Exterior wall surface.	16323	3.99%
Exterior roof surface.	6442	1.57%
Awning.	503	0.12%
TRANSPORTATION, VEHICLE AREAS	838	0.20%
Passenger area of transportation equipment.	346	0.08%
Trunk, load carrying area of transportation equipment.	104	0.03%
Engine area, running gear, wheel area of transportation equipment.	1014	0.25%
Fuel tank, fuel line area of transportation equipment.	179	0.04%
Operating, control area of transportation equipment.	15	0.00%
Exterior exposed surface of transportation equipment.	1083	0.26%
OTHER AREA OF ORIGIN	6233	1.52%
On or near railroad right of way, embankment.	72	0.02%
On or near highway, public way, street.	378	0.09%
Court, terrace, patio.	2744	0.67%
Lawn, field, open area.	2169	0.53%
Wildland area, woods.	207	0.05%
Multiple location, use area.	456	0.11%
Area of Origin not applicable.	2454	0.60%
Other Area of Origin not classified above.	2224	0.54%
Other/Unknown	41385	10.11%

Type of material ignited

Combustible metal.	1	0.00%
Anesthetic gas.	9	0.00%
Growing wood.	9	0.00%

Volatile Solid, Chemical; insufficient information available to classify further	26	0.01%
Specialty gas other than anesthetic.	30	0.01%
Felled but unsawn wood.	37	0.01%
Class IA flammable liquid.	51	0.01%
Flammable, Combustible Liquid; insufficient information available to classify further.	57	0.01%
Polyurethane.	80	0.02%
Applied paint, varnish.	90	0.02%
Fiberboard (low density material), wood pulp.	109	0.03%
Class II combustible liquid.	166	0.04%
Gas; insufficient information available to classify further.	167	0.04%
Natural Product; insufficient information available to classify further.	188	0.05%
Acetylene.	191	0.05%
Hardboard, plywood.	205	0.05%
Adhesive, resin, tar.	263	0.06%
Polyacrylic.	269	0.07%
Grain, natural fiber (pre-process).	297	0.07%
Polyolefin.	307	0.07%
Class IIIB combustible liquid.	333	0.08%
Gasoline.	362	0.09%
Polyvinyl.	381	0.09%
Polish.	696	0.17%
Sawn wood.	712	0.17%
Grease (nonfood).	779	0.19%
Wood shavings.	829	0.20%
Fat, grease (food).	911	0.22%
Rubber.	1051	0.26%
Class IC flammable liquid.	1090	0.27%
Paper, untreated, uncoated.	1165	0.28%
Volatile Solid, Chemical not classified above.	1257	0.31%
LP-gas.	1407	0.34%
LP-City Gas (LP and air mix).	1638	0.40%
Plastic; insufficient information available to classify further.	1890	0.46%
Manufactured gas.	2500	0.61%
Polystyrene.	2623	0.64%
Gas not classified above.	3399	0.83%
Food, starch.	3595	0.88%
Class IB flammable liquid.	4208	1.03%
Polyester.	4443	1.08%
Radioactive material.	4807	1.17%
Tobacco.	6673	1.63%
Flammable, Combustible Liquid not classified above.	7383	1.80%
Leather.	8004	1.95%
Class IIIA combustible liquid.	9377	2.29%
Grass, leaves, hay, straw.	9808	2.40%
Coal, coke, briquettes, peat.	10045	2.45%
Type of Material not classified above.	11535	2.82%
Plastic not classified above.	11937	2.91%
Natural gas.	14105	3.44%
Solid chemical (specify type).	26570	6.49%
Natural Product not classified above.	42025	10.26%

Cork.	47568	11.62%
Type of Material undetermined or not reported	61957	39.52%

Heat source

HEAT FROM FUEL-FIRED, FUEL-POWERED OBJECT	21241	5.19%
Spark, ember, flame escaping from gas fueled equipment.	40299	9.84%
Heat from gas fueled equipment.	21498	5.25%
Spark, ember, flame escaping from liquid fueled equipment.	46081	11.25%
HEAT FROM OPEN FLAME, SPARK	34858	8.51%
Cutting torch operation (separating metals).	19384	4.73%
Welding torch operation (joining metals).	2662	0.65%
Torch operation, other than cutting and welding.	3193	0.78%
HEAT FROM HOT OBJECT	18188	4.44%
Heat, spark from friction.	312	0.08%
Hot ember, ash.	25	0.01%
Electric lamp.	21	0.01%
Rekindle, reignition.	1402	0.34%
Heat from properly operating electrical equipment.	34	0.01%
HEAT FROM EXPLOSIVE, FIREWORKS	1524	0.37%
Explosive.	13037	3.18%
Blasting agent.	12155	2.97%
Fireworks.	218	0.05%
Paper cap, party popper.	1896	0.46%
Model rocket, not amateur rocketry.	6900	1.68%
Incendiary device.	8346	2.04%
Heat from Explosive, Fireworks not classified above.	13622	3.33%
Heat from Explosive, Fireworks; insufficient information available to classify further.	82	0.02%
HEAT FROM NATURAL SOURCE	212	0.05%
Sun's heat.	2955	0.72%
Spontaneous ignition, chemical reaction.	1005	0.25%
Lightning discharge.	192	0.05%
Static discharge.	1919	0.47%
HEAT SPREADING FROM ANOTHER HOSTILE FIRE (Exposure)	6217	1.52%
Heat from direct flame, convection currents.	270	0.07%
Radiated heat.	1704	0.42%
Heat from flying brand, ember, spark.	3332	0.81%
Conducted heat.	4345	1.06%
Multiple forms of heat of ignition.	254	0.06%
Other Form of Heat of Ignition not classified above.	421	0.10%
Form of Heat of Ignition undetermined or not reported	2192	29.23%

Structure Type

Fire resistive.	396572	96.84%
Protected noncombustible or limited combustible.	8797	2.15%
Protected ordinary structure	216	0.05%
Unprotected ordinary structure	1265	0.31%
Protected Wood Frame	313	0.08%
Unprotected wood frame	2343	0.57%

Fire Fighter Deaths With/without detectors

Detectors were present in the building		27.21%
Detectors were not present in the building		72.79%
Total number of deaths		***136***

Detector type present in fires with firefighter deaths

Smoke detector		86.49%
Combination of smoke and heat detector		5.41%
More than one type of detector present		2.70%
Unknown or unconfirmed detector type		5.41%

Power supply for detectors present in fires with firefighter deaths

Battery only	26	70.27%
Hardwired only	4	10.81%
hardwired with battery back-up	3	8.11%
Multiple detectors and power supplies	1	2.70%
Unknown/Unconfirmed	3	8.11%

Power Supply in detectors

Battery only	868	0.53%
Hardwired only	77792	47.54%
Plug-in detector	26558	16.23%
hardwired with battery back-up	445	0.27%
Plug-in detector with battery back-up	24045	14.69%
Mechanical. (Includes spring-wound, stored pressure source, etc.)	1158	0.71%
Multiple detectors and power supplies	692	0.42%
Confirmed other type of power supply	5104	3.12%
Unknown/Unconfirmed	26977	16.49%

Damages incured during fires where smoke detectors were present

Minimal	120368	80.24%
Heavy	22577	15.05%
Extreme	7071	4.71%

NFIRs Data 1990

Fires in Commercial buildings

Had detectors	27486	49.07%
Did not have any type of detector present	28529	37.94%

Structural Damage (as described in the FEMA NFIR's Manual)

None/not reported	3184	5.68%
Minimal	26353	47.05%
Heavy	4533	8.09%
Extreme	14251	25.44%

Area of origin

MEANS OF EGRESS

Hallway, corridor, mall.	606	1.08%
Exterior stairway.	103	0.18%

Interior stairway.	101	0.18%
Escalator.	10	0.02%
Lobby, entrance way.	296	0.53%
Means of Egress not classified above.	87	0.16%
ASSEMBLY, SALES AREAS (groups of people)		
Large assembly area with fixed seats (100 or more persons).	66	0.12%
Large open room without fixed seats (100 or more persons).	121	0.22%
Small assembly area with or without fixed seats (less than 100 persons).	184	0.33%
Lounge area.	534	0.95%
Sales, showroom area.	724	1.29%
Library.	9	0.02%
Swimming pool.	22	0.04%
Assembly, Sales Areas not classified above.	50	0.09%
FUNCTION AREAS		
Sleeping room for under 5 persons.	1389	2.48%
Sleeping area for 5 or more persons.	65	0.12%
Dining area, lunchroom, cafeteria.	292	0.52%
Kitchen, cooking area.	2298	4.10%
Lavatory, locker room, cloakroom.	1051	1.88%
Laundry room, area.	1176	2.10%
Office.	906	1.62%
Personal service area.	59	0.11%
FUNCTION AREAS		
Laboratory.	150	0.27%
Printing or photographic room, area.	97	0.17%
First aid, treatment room.	50	0.09%
Operating room.	21	0.04%
Electronic equipment room, area.	274	0.49%
Performance, stage area.	25	0.04%
Projection room, area.	8	0.01%
Process, manufacturing area.	1900	3.39%
Function Areas not classified above.	160	0.29%
STORAGE AREAS		
Product storage room or area, storage tank, storage bin.	1878	3.35%
Closet.	184	0.33%
Supply storage room or area.	1515	2.70%
Records storage room, vault.	85	0.15%
Shipping, receiving, loading area.	507	0.91%
Trash or rubbish area, container.	5980	10.68%
Garage, carport, vehicle storage area.	1438	2.57%
Storage Areas not classified above.	776	1.39%
SERVICE FACILITIES		
Elevator, dumb-waiter.	146	0.26%
Utility shaft.	113	0.20%
Light shaft.	24	0.04%
Chute.	37	0.07%
Duct.	536	0.96%
Display window.	47	0.08%
Chimney.	162	0.29%
Conveyor.	126	0.22%

Service Facilities not classified above.	147	0.26%
SERVICE, EQUIPMENT AREAS		
Machinery room, area.	1269	2.27%
Heating equipment room or area, water heater area.	892	1.59%
Switchgear area, transformer vault.	301	0.54%
Incinerator room, area.	100	0.18%
Maintenance shop, area.	782	1.40%
Test cell.	13	0.02%
Enclosure with pressurized air.	14	0.02%
Enclosure with enriched oxygen atmosphere.	7	0.01%
Service, Equipment Areas not classified above.	322	0.57%
STRUCTURAL AREAS		
Crawl space, substructure space.	208	0.37%
Exterior balcony, open porch.	125	0.22%
Ceiling and floor assembly, concealed floor/ceiling space.	409	0.73%
Ceiling and roof assembly, concealed roof/ceiling space.	965	1.72%
Wall assembly, concealed wall space.	452	0.81%
Exterior wall surface.	1345	2.40%
Exterior roof surface.	816	1.46%
Awning.	111	0.20%
Structural Areas not classified above.	380	0.68%
TRANSPORTATION, VEHICLE AREAS		
Passenger area of transportation equipment.	1770	3.16%
Trunk, load carrying area of transportation equipment.	467	0.83%
Engine area, running gear, wheel area of transportation equipment.	6734	12.02%
Fuel tank, fuel line area of transportation equipment.	224	0.40%
Operating, control area of transportation equipment.	185	0.33%
Exterior exposed surface of transportation equipment.	428	0.76%
Transportation, Vehicle Areas not classified above.	276	0.49%
OTHER AREA OF ORIGIN		
On or near railroad right of way, embankment.	86	0.15%
On or near highway, public way, street.	969	1.73%
Court, terrace, patio.	247	0.44%
Lawn, field, open area.	4698	8.39%
Wildland area, woods.	297	0.53%
Multiple location, use area.	262	0.47%
Area of Origin not applicable.	506	0.90%
Other Area of Origin not classified above.	877	1.57%
Other/Unknown	2179	3.89%

Type of material ignited

GAS		
Natural gas.	290	0.52%
LP-City Gas (LP and air mix).	48	0.09%
Manufactured gas.	124	0.22%
LP-gas.	180	0.32%
Anesthetic gas.	10	0.02%
Acetylene.	87	0.16%
Specialty gas other than anesthetic.	27	0.05%

Gas not classified above.	42	0.07%
Gas; insufficient information available to classify further.	75	0.13%
FLAMMABLE, COMBUSTIBLE LIQUID		
Class IA flammable liquid.	166	0.30%
Class IB flammable liquid.	149	0.27%
Gasoline.	3425	6.11%
Class IC flammable liquid.	122	0.22%
Class II combustible liquid.	553	0.99%
Class IIIA combustible liquid.	90	0.16%
Class IIIB combustible liquid.	785	1.40%
Flammable, Combustible Liquid not classified above.	166	0.30%
Flammable, Combustible Liquid; insufficient information available to classify further.	448	0.80%
VOLATILE SOLID, CHEMICAL		
Fat, grease (food).	1186	2.12%
Grease (nonfood).	215	0.38%
Polish.	27	0.05%
Adhesive, resin, tar.	570	1.02%
Applied paint, varnish.	333	0.59%
Combustible metal.	162	0.29%
Solid chemical (specify type).	81	0.14%
Radioactive material.	2	0.00%
Volatile Solid, Chemical not classified above.	39	0.07%
Volatile Solid, Chemical; insufficient information available to classify further	30	0.05%
PLASTIC		
Polyurethane.	401	0.72%
Polystyrene.	173	0.31%
Polyvinyl.	1454	2.60%
Polyacrylic.	92	0.16%
Polyester.	184	0.33%
Polyolefin.	56	0.10%
Plastic not classified above.	1232	2.20%
Plastic; insufficient information available to classify further.	2194	3.92%
NATURAL PRODUCT		
Rubber.	1899	3.39%
Cork.	30	0.05%
Leather.	28	0.05%
Grass, leaves, hay, straw.	3233	5.77%
Grain, natural fiber (pre-process).	294	0.52%
Coal, coke, briquettes, peat.	107	0.19%
Food, starch.	353	0.63%
Tobacco.	64	0.11%
Natural Product not classified above.	272	0.49%
Natural Product; insufficient information available to classify further.	54	0.10%
WOOD, PAPER		
Growing wood.	289	0.52%
Felled but unsawn wood.	330	0.59%
Sawn wood.	4816	8.60%
Wood shavings.	1053	1.88%
Hardboard, plywood.	656	1.17%
Fiberboard (low density material), wood pulp.	413	0.74%

Paper, untreated, uncoated.	5965	10.65%
Cardboard.	1497	2.67%
Wood, Paper not classified above.	1014	1.81%
Wood, Paper; insufficient information available to classify further.	795	1.42%
FABRIC, TEXTILE, FUR		
Man-made fabric, fiber, finished goods.	1582	2.82%
Cotton, rayon, cotton fabric, finished goods.	2244	4.01%
Wool, wool mixture fabric, finished goods.	71	0.13%
Fur, silk, other fabric, finished goods.	22	0.04%
Wig.	33	0.06%
Human hair.	9	0.02%
Fabric, Textile, Fur not classified above.	196	0.35%
Fabric, Textile, Fur; insufficient information available to classify further.	319	0.57%
MATERIAL COMPOUNDED WITH OIL		
Linoleum.	18	0.03%
Oil cloth.	17	0.03%
Treated and/or coated paper.	81	0.14%
Waterproof canvas.	31	0.06%
Oily rags.	192	0.34%
Asphalt treated material.	241	0.43%
Material Compounded with Oil not classified above.	149	0.27%
Material Compounded with Oil; insufficient information available to classify further.	81	0.14%
OTHER TYPE OF MATERIAL		
Multiple types of material first ignited.	1941	3.47%
Type of Material not classified above.	2442	4.36%
Type of Material undetermined or not reported	7362	13.14%

Construction Type

Fire resistive.	3900	6.96%
Heavy timber.	670	1.20%
Protected noncombustible or limited combustible.	2296	4.10%
Unprotected noncombustible or limited combustible not qualifying for 3.	3072	5.48%
Protected ordinary.	3416	6.10%
Unprotected ordinary, not qualifying 5.	4059	7.25%
Protected Wood Frame	2084	3.72%
Unprotected wood frame not qualifying for 7.	3924	7.01%
Not classified above	452	0.81%
Undetermined or not reported	3531	6.30%

Structural Damage with Sprinklers Only   total 28328

None/not reported	301	0.54%
Minimal	13999	24.99%
Heavy	3388	6.05%
Extreme	6567	11.72%

Structural Damage with Sprinklers and Smoke Detection   total 27289

None/not reported	301	0.54%
Minimal	13701	24.46%
Heavy	3279	5.85%
Extreme	6036	10.78%

Fires in Commercial buildings

Had detectors	27951	48.10%
Did not have any type of detector present	30165	36.56%

Structural Damage (as described in the FEMA NFIR's Manual)

None/not reported	3089	5.32%
Minimal	27187	46.78%
Heavy	4527	7.79%
Extreme	16142	27.78%

Area of origin

MEANS OF EGRESS

Hallway, corridor, mall.	609	1.05%
Exterior stairway.	97	0.17%
Interior stairway.	99	0.17%
Escalator.	6	0.01%
Lobby, entrance way.	356	0.61%
Means of Egress not classified above.	93	0.16%

ASSEMBLY, SALES AREAS (groups of people)

Large assembly area with fixed seats (100 or more persons).	48	0.08%
Large open room without fixed seats (100 or more persons).	126	0.22%
Small assembly area with or without fixed seats (less than 100 persons).	191	0.33%
Lounge area.	462	0.79%
Sales, showroom area.	680	1.17%
Library.	11	0.02%
Swimming pool.	14	0.02%
Assembly, Sales Areas not classified above.	41	0.07%

FUNCTION AREAS

Sleeping room for under 5 persons.	1248	2.15%
Sleeping area for 5 or more persons.	59	0.10%
Dining area, lunchroom, cafeteria.	255	0.44%
Kitchen, cooking area.	2340	4.03%
Lavatory, locker room, cloakroom.	1113	1.92%
Laundry room, area.	1146	1.97%
Office.	968	1.67%
Personal service area.	51	0.09%

FUNCTION AREAS

Laboratory.	165	0.28%
Printing or photographic room, area.	95	0.16%
First aid, treatment room.	50	0.09%
Operating room.	19	0.03%
Electronic equipment room, area.	237	0.41%
Performance, stage area.	22	0.04%
Projection room, area.	12	0.02%
Process, manufacturing area.	1798	3.09%
Function Areas not classified above.	194	0.33%

STORAGE AREAS

Product storage room or area, storage tank, storage bin.	1826	3.14%
Closet.	183	0.31%
Supply storage room or area.	1531	2.63%
Records storage room, vault.	81	0.14%
Shipping, receiving, loading area.	495	0.85%
Trash or rubbish area, container.	6316	10.87%
Garage, carport, vehicle storage area.	1657	2.85%
Storage Areas not classified above.	835	1.44%
SERVICE FACILITIES		
Elevator, dumb-waiter.	139	0.24%
Utility shaft.	119	0.20%
Light shaft.	25	0.04%
Chute.	44	0.08%
Duct.	484	0.83%
Display window.	42	0.07%
Chimney.	174	0.30%
Conveyor.	120	0.21%
Service Facilities not classified above.	159	0.27%
SERVICE, EQUIPMENT AREAS		
Machinery room, area.	1222	2.10%
Heating equipment room or area, water heater area.	866	1.49%
Switchgear area, transformer vault.	261	0.45%
Incinerator room, area.	116	0.20%
Maintenance shop, area.	748	1.29%
Test cell.	17	0.03%
Enclosure with pressurized air.	19	0.03%
Enclosure with enriched oxygen atmosphere.	1	0.00%
Service, Equipment Areas not classified above.	352	0.61%
STRUCTURAL AREAS		
Crawl space, substructure space.	247	0.43%
Exterior balcony, open porch.	133	0.23%
Ceiling and floor assembly, concealed floor/ceiling space.	344	0.59%
Ceiling and roof assembly, concealed roof/ceiling space.	947	1.63%
Wall assembly, concealed wall space.	415	0.71%
Exterior wall surface.	1510	2.60%
Exterior roof surface.	828	1.42%
Awning.	104	0.18%
Structural Areas not classified above.	363	0.62%
TRANSPORTATION, VEHICLE AREAS		
Passenger area of transportation equipment.	1741	3.00%
Trunk, load carrying area of transportation equipment.	447	0.77%
Engine area, running gear, wheel area of transportation equipment.	7177	12.35%
Fuel tank, fuel line area of transportation equipment.	225	0.39%
Operating, control area of transportation equipment.	223	0.38%
Exterior exposed surface of transportation equipment.	392	0.67%
Transportation, Vehicle Areas not classified above.	279	0.48%
Man-made fabric, fiber, finished goods.	1586	2.73%
Cotton, rayon, cotton fabric, finished goods.	2188	3.76%
Wool, wool mixture fabric, finished goods.	69	0.12%
Fur, silk, other fabric, finished goods.	29	0.05%

Wig.	25	0.04%
Human hair.	7	0.01%
Fabric, Textile, Fur not classified above.	206	0.35%
Fabric, Textile, Fur; insufficient information available to classify further.	323	0.56%
MATERIAL COMPOUNDED WITH OIL		
Linoleum.	19	0.03%
Oil cloth.	16	0.03%
Treated and/or coated paper.	220	0.38%
Waterproof canvas.	33	0.06%
Oily rags.	217	0.37%
Asphalt treated material.	215	0.37%
Material Compounded with Oil not classified above.	160	0.28%
Material Compounded with Oil; insufficient information available to classify further.	85	0.15%
OTHER TYPE OF MATERIAL		
Multiple types of material first ignited.	2127	3.66%
Type of Material not classified above.	2556	4.40%
Type of Material undetermined or not reported	8060	13.87%

Construction Type

Fire resistive.	3841	6.61%
Heavy timber.	687	1.18%
Protected noncombustible or limited combustible.	2402	4.13%
Unprotected noncombustible or limited combustible not qualifying for 3.	3115	5.36%
Protected ordinary.	3481	5.99%
Unprotected ordinary, not qualifying 5.	3906	6.72%
Protected Wood Frame	2205	3.79%
Unprotected wood frame not qualifying for 7.	4086	7.03%
Not classified above	509	0.88%
Undetermined or not reported	3775	6.50%

Structural Damage with Sprinklers Only   total 28815

None/not reported	274	0.47%
Minimal	14522	24.99%
Heavy	3456	5.95%
Extreme	6878	11.83%

Structural Damage with Sprinklers and Smoke Detection   total 27743

None/not reported	274	0.47%
Minimal	14222	24.47%
Heavy	3378	5.81%
Extreme	6299	10.84%

NFIRs Data 1992

Fires in Commercial buildings

Had detectors	27493	48.94%
Did not have any type of detector present	28680	37.83%

Structural Damage (as described in the FEMA NFIR's Manual)

None/not reported	2506	4.46%
Minimal	27374	48.73%
Heavy	4440	7.90%
Extreme	14520	25.85%

Area of origin

MEANS OF EGRESS

Hallway, corridor, mall.	529	0.94%
Exterior stairway.	96	0.17%
Interior stairway.	76	0.14%
Escalator.	8	0.01%
Lobby, entrance way.	349	0.62%
Means of Egress not classified above.	97	0.17%

ASSEMBLY, SALES AREAS (groups of people)

Large assembly area with fixed seats (100 or more persons).	56	0.10%
Large open room without fixed seats (100 or more persons).	128	0.23%
Small assembly area with or without fixed seats (less than 100 persons).	157	0.28%
Lounge area.	428	0.76%
Sales, showroom area.	662	1.18%
Library.	6	0.01%
Swimming pool.	28	0.05%
Assembly, Sales Areas not classified above.	48	0.09%

FUNCTION AREAS

Sleeping room for under 5 persons.	1186	2.11%
Sleeping area for 5 or more persons.	56	0.10%
Dining area, lunchroom, cafeteria.	265	0.47%
Kitchen, cooking area.	2424	4.32%
Lavatory, locker room, cloakroom.	1081	1.92%
Laundry room, area.	1120	1.99%
Office.	982	1.75%
Personal service area.	64	0.11%

FUNCTION AREAS

Laboratory.	150	0.27%
Printing or photographic room, area.	68	0.12%
First aid, treatment room.	52	0.09%
Operating room.	22	0.04%
Electronic equipment room, area.	263	0.47%
Performance, stage area.	18	0.03%
Projection room, area.	9	0.02%
Process, manufacturing area.	1681	2.99%
Function Areas not classified above.	176	0.31%

STORAGE AREAS

Product storage room or area, storage tank, storage bin.	1735	3.09%
Closet.	165	0.29%
Supply storage room or area.	1372	2.44%
Records storage room, vault.	83	0.15%
Shipping, receiving, loading area.	472	0.84%
Trash or rubbish area, container.	5501	9.79%
Garage, carport, vehicle storage area.	1449	2.58%
Storage Areas not classified above.	822	1.46%

SERVICE FACILITIES

Elevator, dumb-waiter.	133	0.24%
Utility shaft.	112	0.20%
Light shaft.	19	0.03%
Chute.	48	0.09%
Duct.	516	0.92%
Display window.	46	0.08%
Chimney.	155	0.28%
Conveyor.	119	0.21%
Service Facilities not classified above.	162	0.29%

SERVICE, EQUIPMENT AREAS

Machinery room, area.	1209	2.15%
Heating equipment room or area, water heater area.	882	1.57%
Switchgear area, transformer vault.	267	0.48%
Incinerator room, area.	100	0.18%
Maintenance shop, area.	715	1.27%
Test cell.	7	0.01%
Enclosure with pressurized air.	17	0.03%
Enclosure with enriched oxygen atmosphere.	3	0.01%
Service, Equipment Areas not classified above.	297	0.53%

STRUCTURAL AREAS

Crawl space, substructure space.	264	0.47%
Exterior balcony, open porch.	123	0.22%
Ceiling and floor assembly, concealed floor/ceiling space.	369	0.66%
Ceiling and roof assembly, concealed roof/ceiling space.	941	1.68%
Wall assembly, concealed wall space.	462	0.82%
Exterior wall surface.	1412	2.51%
Exterior roof surface.	810	1.44%
Awning.	86	0.15%
Structural Areas not classified above.	353	0.63%

TRANSPORTATION, VEHICLE AREAS

Passenger area of transportation equipment.	1522	2.71%
Trunk, load carrying area of transportation equipment.	421	0.75%
Engine area, running gear, wheel area of transportation equipment.	7171	12.77%
Fuel tank, fuel line area of transportation equipment.	175	0.31%
Operating, control area of transportation equipment.	176	0.31%
Exterior exposed surface of transportation equipment.	409	0.73%
Transportation, Vehicle Areas not classified above.	295	0.53%

OTHER AREA OF ORIGIN

On or near railroad right of way, embankment.	79	0.14%
On or near highway, public way, street.	1083	1.93%
Court, terrace, patio.	310	0.55%
Lawn, field, open area.	4664	8.30%
Wildland area, woods.	517	0.92%
Multiple location, use area.	268	0.48%
Area of Origin not applicable.	914	1.63%
Other Area of Origin not classified above.	1038	1.85%
Other/Unknown	2893	5.15%

Type of material ignited

GAS

Natural gas.	312	0.56%
LP-City Gas (LP and air mix).	47	0.08%
Manufactured gas.	114	0.20%
LP-gas.	178	0.32%
Anesthetic gas.	13	0.02%
Acetylene.	78	0.14%
Specialty gas other than anesthetic.	30	0.05%
Gas not classified above.	68	0.12%
Gas; insufficient information available to classify further.	118	0.21%

FLAMMABLE, COMBUSTIBLE LIQUID

Class IA flammable liquid.	225	0.40%
Class IB flammable liquid.	133	0.24%
Gasoline.	3063	5.45%
Class IC flammable liquid.	104	0.19%
Class II combustible liquid.	345	0.61%
Class IIIA combustible liquid.	66	0.12%
Class IIIB combustible liquid.	742	1.32%
Flammable, Combustible Liquid not classified above.	203	0.36%
Flammable, Combustible Liquid; insufficient information available to classify further.	469	0.83%

VOLATILE SOLID, CHEMICAL

Fat, grease (food).	1192	2.12%
Grease (nonfood).	266	0.47%
Polish.	21	0.04%
Adhesive, resin, tar.	531	0.95%
Applied paint, varnish.	283	0.50%
Combustible metal.	153	0.27%
Solid chemical (specify type).	76	0.14%
Radioactive material.	1	0.00%
Volatile Solid, Chemical not classified above.	46	0.08%
Volatile Solid, Chemical; insufficient information available to classify further	36	0.06%

PLASTIC

Polyurethane.	400	0.71%
Polystyrene.	186	0.33%
Polyvinyl.	1686	3.00%
Polyacrylic.	78	0.14%
Polyester.	156	0.28%
Polyolefin.	74	0.13%
Plastic not classified above.	1293	2.30%
Plastic; insufficient information available to classify further.	2504	4.46%

NATURAL PRODUCT

Rubber.	1884	3.35%
Cork.	21	0.04%
Leather.	34	0.06%
Grass, leaves, hay, straw.	3515	6.26%
Grain, natural fiber (pre-process).	377	0.67%
Coal, coke, briquettes, peat.	109	0.19%
Food, starch.	474	0.84%

Tobacco.	56	0.10%
Natural Product not classified above.	351	0.62%
Natural Product; insufficient information available to classify further.	97	0.17%
WOOD, PAPER		
Growing wood.	275	0.49%
Felled but unsawn wood.	301	0.54%
Sawn wood.	4316	7.68%
Wood shavings.	1063	1.89%
Hardboard, plywood.	672	1.20%
Fiberboard (low density material), wood pulp.	307	0.55%
Paper, untreated, uncoated.	4961	8.83%
Cardboard.	1497	2.66%
Wood, Paper not classified above.	932	1.66%
Wood, Paper; insufficient information available to classify further.	1167	2.08%
FABRIC, TEXTILE, FUR		
Man-made fabric, fiber, finished goods.	1434	2.55%
Cotton, rayon, cotton fabric, finished goods.	2051	3.65%
Wool, wool mixture fabric, finished goods.	58	0.10%
Fur, silk, other fabric, finished goods.	25	0.04%
Wig.	41	0.07%
Human hair.	11	0.02%
Fabric, Textile, Fur not classified above.	201	0.36%
Fabric, Textile, Fur; insufficient information available to classify further.	325	0.58%
MATERIAL COMPOUNDED WITH OIL		
Linoleum.	11	0.02%
Oil cloth.	16	0.03%
Treated and/or coated paper.	411	0.73%
Waterproof canvas.	32	0.06%
Oily rags.	170	0.30%
Asphalt treated material.	214	0.38%
Material Compounded with Oil not classified above.	146	0.26%
Material Compounded with Oil; insufficient information available to classify further.	72	0.13%
OTHER TYPE OF MATERIAL		
Multiple types of material first ignited.	1945	3.46%
Type of Material not classified above.	2713	4.83%
Type of Material undetermined or not reported	7887	14.04%

Construction Type

Fire resistive.	3528	6.28%
Heavy timber.	694	1.24%
Protected noncombustible or limited combustible.	2568	4.57%
Unprotected noncombustible or limited combustible not qualifying for 3.	3244	5.78%
Protected ordinary.	3446	6.13%
Unprotected ordinary, not qualifying 5.	3881	6.91%
Protected Wood Frame	1876	3.34%
Unprotected wood frame not qualifying for 7.	3912	6.96%
Not classified above	531	0.95%
Undetermined or not reported	3393	6.04%

Structural Damage with Sprinklers Only   total 27748

None/not reported	3	0.01%
Minimal	15336	27.30%
Heavy	3381	6.02%
Extreme	5630	10.02%

Structural Damage with Sprinklers and Smoke Detection	total 27336	
None/not reported	3	0.01%
Minimal	15101	26.88%
Heavy	3313	5.90%
Extreme	5584	9.94%

NFIRs Data 1993

Fires in Commercial buildings		
Had detectors	27493	48.94%
Did not have any type of detector present	28680	37.83%

Structural Damage (as described in the FEMA NFIR's Manual)		
None/not reported	2506	4.46%
Minimal	27374	48.73%
Heavy	4440	7.90%
Extreme	14520	25.85%

Area of origin

MEANS OF EGRESS		
Hallway, corridor, mall.	529	0.94%
Exterior stairway.	96	0.17%
Interior stairway.	76	0.14%
Escalator.	8	0.01%
Lobby, entrance way.	349	0.62%
Means of Egress not classified above.	97	0.17%
ASSEMBLY, SALES AREAS (groups of people)		
Large assembly area with fixed seats (100 or more persons).	56	0.10%
Large open room without fixed seats (100 or more persons).	128	0.23%
Small assembly area with or without fixed seats (less than 100 persons).	157	0.28%
Lounge area.	428	0.76%
Sales, showroom area.	662	1.18%
Library.	6	0.01%
Swimming pool.	28	0.05%
Assembly, Sales Areas not classified above.	48	0.09%
FUNCTION AREAS		
Sleeping room for under 5 persons.	1186	2.11%
Sleeping area for 5 or more persons.	56	0.10%
Dining area, lunchroom, cafeteria.	265	0.47%
Kitchen, cooking area.	2424	4.32%
Lavatory, locker room, cloakroom.	1081	1.92%
Laundry room, area.	1120	1.99%
Office.	982	1.75%
Personal service area.	64	0.11%
FUNCTION AREAS		

Laboratory.	150	0.27%
Printing or photographic room, area.	68	0.12%
First aid, treatment room.	52	0.09%
Operating room.	22	0.04%
Electronic equipment room, area.	263	0.47%
Performance, stage area.	18	0.03%
Projection room, area.	9	0.02%
Process, manufacturing area.	1681	2.99%
Function Areas not classified above.	176	0.31%
STORAGE AREAS		
Product storage room or area, storage tank, storage bin.	1735	3.09%
Closet.	165	0.29%
Supply storage room or area.	1372	2.44%
Records storage room, vault.	83	0.15%
Shipping, receiving, loading area.	472	0.84%
Trash or rubbish area, container.	5501	9.79%
Garage, carport, vehicle storage area.	1449	2.58%
Storage Areas not classified above.	822	1.46%
SERVICE FACILITIES		
Elevator, dumb-waiter.	133	0.24%
Utility shaft.	112	0.20%
Light shaft.	19	0.03%
Chute.	48	0.09%
Duct.	516	0.92%
Display window.	46	0.08%
Chimney.	155	0.28%
Conveyor.	119	0.21%
Service Facilities not classified above.	162	0.29%
SERVICE, EQUIPMENT AREAS		
Machinery room, area.	1209	2.15%
Heating equipment room or area, water heater area.	882	1.57%
Switchgear area, transformer vault.	267	0.48%
Incinerator room, area.	100	0.18%
Maintenance shop, area.	715	1.27%
Test cell.	7	0.01%
Enclosure with pressurized air.	17	0.03%
Enclosure with enriched oxygen atmosphere.	3	0.01%
Service, Equipment Areas not classified above.	297	0.53%
STRUCTURAL AREAS		
Crawl space, substructure space.	264	0.47%
Exterior balcony, open porch.	123	0.22%
Ceiling and floor assembly, concealed floor/ceiling space.	369	0.66%
Ceiling and roof assembly, concealed roof/ceiling space.	941	1.68%
Wall assembly, concealed wall space.	462	0.82%
Exterior wall surface.	1412	2.51%
Exterior roof surface.	810	1.44%
Awning.	86	0.15%
Structural Areas not classified above.	353	0.63%
TRANSPORTATION, VEHICLE AREAS		
Passenger area of transportation equipment.	1522	2.71%

Trunk, load carrying area of transportation equipment.	421	0.75%
Engine area, running gear, wheel area of transportation equipment.	7171	12.77%
Fuel tank, fuel line area of transportation equipment.	175	0.31%
Operating, control area of transportation equipment.	176	0.31%
Exterior exposed surface of transportation equipment.	409	0.73%
Transportation, Vehicle Areas not classified above.	295	0.53%
OTHER AREA OF ORIGIN		
On or near railroad right of way, embankment.	79	0.14%
On or near highway, public way, street.	1083	1.93%
Court, terrace, patio.	310	0.55%
Lawn, field, open area.	4664	8.30%
Wildland area, woods.	517	0.92%
Multiple location, use area.	268	0.48%
Area of Origin not applicable.	914	1.63%
Other Area of Origin not classified above.	1038	1.85%
Other/Unknown	2893	5.15%

Type of material ignited

GAS		
Natural gas.	312	0.56%
LP-City Gas (LP and air mix).	47	0.08%
Manufactured gas.	114	0.20%
LP-gas.	178	0.32%
Anesthetic gas.	13	0.02%
Acetylene.	78	0.14%
Specialty gas other than anesthetic.	30	0.05%
Gas not classified above.	68	0.12%
Gas; insufficient information available to classify further.	118	0.21%
FLAMMABLE, COMBUSTIBLE LIQUID		
Class IA flammable liquid.	225	0.40%
Class IB flammable liquid.	133	0.24%
Gasoline.	3063	5.45%
Class IC flammable liquid.	104	0.19%
Class II combustible liquid.	345	0.61%
Class IIIA combustible liquid.	66	0.12%
Class IIIB combustible liquid.	742	1.32%
Flammable, Combustible Liquid not classified above.	203	0.36%
Flammable, Combustible Liquid; insufficient information available to classify further.	469	0.83%
VOLATILE SOLID, CHEMICAL		
Fat, grease (food).	1192	2.12%
Grease (nonfood).	266	0.47%
Polish.	21	0.04%
Adhesive, resin, tar.	531	0.95%
Applied paint, varnish.	283	0.50%
Combustible metal.	153	0.27%
Solid chemical (specify type).	76	0.14%
Radioactive material.	1	0.00%
Volatile Solid, Chemical not classified above.	46	0.08%
Volatile Solid, Chemical; insufficient information available to classify	36	0.06%

further

PLASTIC

Polyurethane.	400	0.71%
Polystyrene.	186	0.33%
Polyvinyl.	1686	3.00%
Polyacrylic.	78	0.14%
Polyester.	156	0.28%
Polyolefin.	74	0.13%
Plastic not classified above.	1293	2.30%
Plastic; insufficient information available to classify further.	2504	4.46%

NATURAL PRODUCT

Rubber.	1884	3.35%
Cork.	21	0.04%
Leather.	34	0.06%
Grass, leaves, hay, straw.	3515	6.26%
Grain, natural fiber (pre-process).	377	0.67%
Coal, coke, briquettes, peat.	109	0.19%
Food, starch.	474	0.84%
Tobacco.	56	0.10%
Natural Product not classified above.	351	0.62%
Natural Product; insufficient information available to classify further.	97	0.17%

WOOD, PAPER

Growing wood.	275	0.49%
Felled but unsawn wood.	301	0.54%
Sawn wood.	4316	7.68%
Wood shavings.	1063	1.89%
Hardboard, plywood.	672	1.20%
Fiberboard (low density material), wood pulp.	307	0.55%
Paper, untreated, uncoated.	4961	8.83%
Cardboard.	1497	2.66%
Wood, Paper not classified above.	932	1.66%
Wood, Paper; insufficient information available to classify further.	1167	2.08%

FABRIC, TEXTILE, FUR

Man-made fabric, fiber, finished goods.	1434	2.55%
Cotton, rayon, cotton fabric, finished goods.	2051	3.65%
Wool, wool mixture fabric, finished goods.	58	0.10%
Fur, silk, other fabric, finished goods.	25	0.04%
Wig.	41	0.07%
Human hair.	11	0.02%
Fabric, Textile, Fur not classified above.	201	0.36%
Fabric, Textile, Fur; insufficient information available to classify further.	325	0.58%

MATERIAL COMPOUNDED WITH OIL

Linoleum.	11	0.02%
Oil cloth.	16	0.03%
Treated and/or coated paper.	411	0.73%
Waterproof canvas.	32	0.06%
Oily rags.	170	0.30%
Asphalt treated material.	214	0.38%
Material Compounded with Oil not classified above.	146	0.26%
Material Compounded with Oil; insufficient information available to classify further.	72	0.13%

OTHER TYPE OF MATERIAL

Multiple types of material first ignited.	1945	3.46%
Type of Material not classified above.	2713	4.83%
Type of Material undetermined or not reported	7887	14.04%

Construction Type

Fire resistive.	3528	6.28%
Heavy timber.	694	1.24%
Protected noncombustible or limited combustible.	2568	4.57%
Unprotected noncombustible or limited combustible not qualifying for 3.	3244	5.78%
Protected ordinary.	3446	6.13%
Unprotected ordinary, not qualifying 5.	3881	6.91%
Protected Wood Frame	1876	3.34%
Unprotected wood frame not qualifying for 7.	3912	6.96%
Not classified above	531	0.95%
Undetermined or not reported	3393	6.04%

Structural Damage with Sprinklers Only   total 27748

None/not reported	3	0.01%
Minimal	15336	27.30%
Heavy	3381	6.02%
Extreme	5630	10.02%

Structural Damage with Sprinklers and Smoke Detection   total 27336

None/not reported	3	0.01%
Minimal	15101	26.88%
Heavy	3313	5.90%
Extreme	5584	9.94%

NFIRs Data 1994

Fires in Commercial buildings

Had detectors	27111	48.07%
Did not have any type of detector present	29286	37.68%

Structural Damage (as described in the FEMA NFIR's Manual)

None/not reported	2403	4.26%
Minimal	29712	52.68%
Heavy	4784	8.48%
Extreme	16897	29.96%

Area of origin

MEANS OF EGRESS

Hallway, corridor, mall.	595	1.06%
Exterior stairway.	81	0.14%
Interior stairway.	78	0.14%
Escalator.	7	0.01%
Lobby, entrance way.	313	0.55%
Means of Egress not classified above.	74	0.13%

ASSEMBLY, SALES AREAS (groups of people)

Large assembly area with fixed seats (100 or more persons).	50	0.09%
Large open room without fixed seats (100 or more persons).	136	0.24%
Small assembly area with or without fixed seats (less than 100 persons).	180	0.32%
Lounge area.	335	0.59%
Sales, showroom area.	628	1.11%
Library.	7	0.01%
Swimming pool.	14	0.02%
Assembly, Sales Areas not classified above.	63	0.11%
FUNCTION AREAS		
Sleeping room for under 5 persons.	1119	1.98%
Sleeping area for 5 or more persons.	37	0.07%
Dining area, lunchroom, cafeteria.	254	0.45%
Kitchen, cooking area.	2491	4.42%
Lavatory, locker room, cloakroom.	998	1.77%
Laundry room, area.	1170	2.07%
Office.	895	1.59%
Personal service area.	66	0.12%
FUNCTION AREAS		
Laboratory.	116	0.21%
Printing or photographic room, area.	83	0.15%
First aid, treatment room.	56	0.10%
Operating room.	21	0.04%
Electronic equipment room, area.	266	0.47%
Performance, stage area.	24	0.04%
Projection room, area.	4	0.01%
Process, manufacturing area.	1665	2.95%
Function Areas not classified above.	208	0.37%
STORAGE AREAS		
Product storage room or area, storage tank, storage bin.	1553	2.75%
Closet.	138	0.24%
Supply storage room or area.	1320	2.34%
Records storage room, vault.	59	0.10%
Shipping, receiving, loading area.	492	0.87%
Trash or rubbish area, container.	5332	9.45%
Garage, carport, vehicle storage area.	1422	2.52%
Storage Areas not classified above.	833	1.48%
SERVICE FACILITIES		
Elevator, dumb-waiter.	111	0.20%
Utility shaft.	103	0.18%
Light shaft.	18	0.03%
Chute.	46	0.08%
Duct.	524	0.93%
Display window.	37	0.07%
Chimney.	155	0.27%
Conveyor.	131	0.23%
Service Facilities not classified above.	124	0.22%
SERVICE, EQUIPMENT AREAS		
Machinery room, area.	1233	2.19%
Heating equipment room or area, water heater area.	857	1.52%
Switchgear area, transformer vault.	314	0.56%

Incinerator room, area.	82	0.15%
Maintenance shop, area.	637	1.13%
Test cell.	18	0.03%
Enclosure with pressurized air.	19	0.03%
Enclosure with enriched oxygen atmosphere.	3	0.01%
Service, Equipment Areas not classified above.	305	0.54%
STRUCTURAL AREAS		
Crawl space, substructure space.	248	0.44%
Exterior balcony, open porch.	129	0.23%
Ceiling and floor assembly, concealed floor/ceiling space.	324	0.57%
Ceiling and roof assembly, concealed roof/ceiling space.	896	1.59%
Wall assembly, concealed wall space.	434	0.77%
Exterior wall surface.	1429	2.53%
Exterior roof surface.	793	1.41%
Awning.	99	0.18%
Structural Areas not classified above.	389	0.69%
TRANSPORTATION, VEHICLE AREAS		
Passenger area of transportation equipment.	1565	2.77%
Trunk, load carrying area of transportation equipment.	460	0.82%
Engine area, running gear, wheel area of transportation equipment.	7523	13.34%
Fuel tank, fuel line area of transportation equipment.	187	0.33%
Operating, control area of transportation equipment.	201	0.36%
Exterior exposed surface of transportation equipment.	498	0.88%
Transportation, Vehicle Areas not classified above.	249	0.44%
OTHER AREA OF ORIGIN		
On or near railroad right of way, embankment.	95	0.17%
On or near highway, public way, street.	1120	1.99%
Court, terrace, patio.	351	0.62%
Lawn, field, open area.	5283	9.37%
Wildland area, woods.	510	0.90%
Multiple location, use area.	250	0.44%
Area of Origin not applicable.	623	1.10%
Other Area of Origin not classified above.	1127	2.00%
Other/Unknown	3017	5.35%

Type of material ignited

GAS		
Natural gas.	310	0.55%
LP-City Gas (LP and air mix).	35	0.06%
Manufactured gas.	84	0.15%
LP-gas.	203	0.36%
Anesthetic gas.	7	0.01%
Acetylene.	83	0.15%
Specialty gas other than anesthetic.	40	0.07%
Gas not classified above.	54	0.10%
Gas; insufficient information available to classify further.	119	0.21%
FLAMMABLE, COMBUSTIBLE LIQUID		
Class IA flammable liquid.	210	0.37%
Class IB flammable liquid.	122	0.22%

Gasoline.	2917	5.17%
Class IC flammable liquid.	75	0.13%
Class II combustible liquid.	345	0.61%
Class IIIA combustible liquid.	82	0.15%
Class IIIB combustible liquid.	770	1.37%
Flammable, Combustible Liquid not classified above.	213	0.38%
Flammable, Combustible Liquid; insufficient information available to classify further.	373	0.66%
VOLATILE SOLID, CHEMICAL		
Fat, grease (food).	1168	2.07%
Grease (nonfood).	247	0.44%
Polish.	25	0.04%
Adhesive, resin, tar.	419	0.74%
Applied paint, varnish.	278	0.49%
Combustible metal.	145	0.26%
Solid chemical (specify type).	69	0.12%
Radioactive material.	3	0.01%
Volatile Solid, Chemical not classified above.	48	0.09%
Volatile Solid, Chemical; insufficient information available to classify further	28	0.05%
PLASTIC		
Polyurethane.	394	0.70%
Polystyrene.	170	0.30%
Polyvinyl.	1752	3.11%
Polyacrylic.	71	0.13%
Polyester.	156	0.28%
Polyolefin.	77	0.14%
Plastic not classified above.	1393	2.47%
Plastic; insufficient information available to classify further.	2593	4.60%
NATURAL PRODUCT		
Rubber.	1802	3.20%
Cork.	17	0.03%
Leather.	28	0.05%
Grass, leaves, hay, straw.	3559	6.31%
Grain, natural fiber (pre-process).	263	0.47%
Coal, coke, briquettes, peat.	124	0.22%
Food, starch.	589	1.04%
Tobacco.	65	0.12%
Natural Product not classified above.	421	0.75%
Natural Product; insufficient information available to classify further.	100	0.18%
WOOD, PAPER		
Growing wood.	302	0.54%
Felled but unsawn wood.	314	0.56%
Sawn wood.	4224	7.49%
Wood shavings.	1246	2.21%
Hardboard, plywood.	775	1.37%
Fiberboard (low density material), wood pulp.	339	0.60%
Paper, untreated, uncoated.	4155	7.37%
Cardboard.	1381	2.45%
Wood, Paper not classified above.	895	1.59%
Wood, Paper; insufficient information available to classify further.	1161	2.06%
FABRIC, TEXTILE, FUR		

Man-made fabric, fiber, finished goods.	1336	2.37%
Cotton, rayon, cotton fabric, finished goods.	2090	3.71%
Wool, wool mixture fabric, finished goods.	60	0.11%
Fur, silk, other fabric, finished goods.	31	0.05%
Wig.	29	0.05%
Human hair.	12	0.02%
Fabric, Textile, Fur not classified above.	220	0.39%
Fabric, Textile, Fur; insufficient information available to classify further.	355	0.63%
MATERIAL COMPOUNDED WITH OIL		
Linoleum.	7	0.01%
Oil cloth.	17	0.03%
Treated and/or coated paper.	731	1.30%
Waterproof canvas.	460	0.82%
Oily rags.	152	0.27%
Asphalt treated material.	191	0.34%
Material Compounded with Oil not classified above.	159	0.28%
Material Compounded with Oil; insufficient information available to classify further.	90	0.16%
OTHER TYPE OF MATERIAL		
Multiple types of material first ignited.	2097	3.72%
Type of Material not classified above.	2477	4.39%
Type of Material undetermined or not reported	8487	15.05%

Construction Type

Fire resistive.	3333	5.91%
Heavy timber.	663	1.18%
Protected noncombustible or limited combustible.	2497	4.43%
Unprotected noncombustible or limited combustible not qualifying for 3.	3374	5.98%
Protected ordinary.	3312	5.87%
Unprotected ordinary, not qualifying 5.	3759	6.67%
Protected Wood Frame	1864	3.31%
Unprotected wood frame not qualifying for 7.	3880	6.88%
Not classified above	511	0.91%
Undetermined or not reported	3599	6.38%

Structural Damage with Sprinklers Only — total 27338

None/not reported	3	0.01%
Minimal	16425	29.12%
Heavy	3739	6.63%
Extreme	6170	10.94%

Structural Damage with Sprinklers and Smoke Detection — total 26955

None/not reported	3	0.01%
Minimal	16216	28.75%
Heavy	3665	6.50%
Extreme	6130	10.87%

NFIRs Data 1995

Fires in Commercial buildings

Had detectors	25455	47.98%
Did not have any type of detector present	27598	40.05%

Structural Damage (as described in the FEMA NFIR's Manual)

None/not reported	2075	3.91%
Minimal	26225	49.43%
Heavy	4446	8.38%
Extreme	14608	27.53%

Area of origin

MEANS OF EGRESS

Hallway, corridor, mall.	526	0.99%
Exterior stairway.	89	0.17%
Interior stairway.	56	0.11%
Escalator.	15	0.03%
Lobby, entrance way.	312	0.59%
Means of Egress not classified above.	75	0.14%
ASSEMBLY, SALES AREAS (groups of people)		
Large assembly area with fixed seats (100 or more persons).	46	0.09%
Large open room without fixed seats (100 or more persons).	131	0.25%
Small assembly area with or without fixed seats (less than 100 persons).	131	0.25%
Lounge area.	330	0.62%
Sales, showroom area.	557	1.05%
Library.	10	0.02%
Swimming pool.	13	0.02%
Assembly, Sales Areas not classified above.	70	0.13%
FUNCTION AREAS		
Sleeping room for under 5 persons.	969	1.83%
Sleeping area for 5 or more persons.	54	0.10%
Dining area, lunchroom, cafeteria.	221	0.42%
Kitchen, cooking area.	2299	4.33%
Lavatory, locker room, cloakroom.	916	1.73%
Laundry room, area.	1114	2.10%
Office.	800	1.51%
Personal service area.	68	0.13%
FUNCTION AREAS		
Laboratory.	143	0.27%
Printing or photographic room, area.	76	0.14%
First aid, treatment room.	48	0.09%
Operating room.	20	0.04%
Electronic equipment room, area.	256	0.48%
Performance, stage area.	9	0.02%
Projection room, area.	10	0.02%
Process, manufacturing area.	1574	2.97%
Function Areas not classified above.	210	0.40%
STORAGE AREAS		
Product storage room or area, storage tank, storage bin.	1434	2.70%
Closet.	174	0.33%
Supply storage room or area.	1233	2.32%

Records storage room, vault.	54	0.10%
Shipping, receiving, loading area.	484	0.91%
Trash or rubbish area, container.	4831	9.11%
Garage, carport, vehicle storage area.	1429	2.69%
Storage Areas not classified above.	864	1.63%
SERVICE FACILITIES		
Elevator, dumb-waiter.	103	0.19%
Utility shaft.	92	0.17%
Light shaft.	21	0.04%
Chute.	52	0.10%
Duct.	453	0.85%
Display window.	33	0.06%
Chimney.	139	0.26%
Conveyor.	139	0.26%
Service Facilities not classified above.	140	0.26%
SERVICE, EQUIPMENT AREAS		
Machinery room, area.	1073	2.02%
Heating equipment room or area, water heater area.	783	1.48%
Switchgear area, transformer vault.	260	0.49%
Incinerator room, area.	83	0.16%
Maintenance shop, area.	568	1.07%
Test cell.	18	0.03%
Enclosure with pressurized air.	20	0.04%
Enclosure with enriched oxygen atmosphere.	5	0.01%
Service, Equipment Areas not classified above.	329	0.62%
STRUCTURAL AREAS		
Crawl space, substructure space.	219	0.41%
Exterior balcony, open porch.	136	0.26%
Ceiling and floor assembly, concealed floor/ceiling space.	295	0.56%
Ceiling and roof assembly, concealed roof/ceiling space.	877	1.65%
Wall assembly, concealed wall space.	454	0.86%
Exterior wall surface.	1382	2.60%
Exterior roof surface.	747	1.41%
Awning.	96	0.18%
Structural Areas not classified above.	313	0.59%
TRANSPORTATION, VEHICLE AREAS		
Passenger area of transportation equipment.	1501	2.83%
Trunk, load carrying area of transportation equipment.	448	0.84%
Engine area, running gear, wheel area of transportation equipment.	7058	13.30%
Fuel tank, fuel line area of transportation equipment.	205	0.39%
Operating, control area of transportation equipment.	202	0.38%
Exterior exposed surface of transportation equipment.	510	0.96%
Transportation, Vehicle Areas not classified above.	239	0.45%
OTHER AREA OF ORIGIN		
On or near railroad right of way, embankment.	116	0.22%
On or near highway, public way, street.	1124	2.12%
Court, terrace, patio.	358	0.67%
Lawn, field, open area.	4871	9.18%
Wildland area, woods.	461	0.87%
Multiple location, use area.	286	0.54%

Area of Origin not applicable.	555	1.05%
Other Area of Origin not classified above.	1059	2.00%
Other/Unknown	2788	5.26%

Type of material ignited

GAS

Natural gas.	274	0.52%
LP-City Gas (LP and air mix).	39	0.07%
Manufactured gas.	94	0.18%
LP-gas.	159	0.30%
Anesthetic gas.	5	0.01%
Acetylene.	70	0.13%
Specialty gas other than anesthetic.	36	0.07%
Gas not classified above.	70	0.13%
Gas; insufficient information available to classify further.	131	0.25%

FLAMMABLE, COMBUSTIBLE LIQUID

Class IA flammable liquid.	216	0.41%
Class IB flammable liquid.	113	0.21%
Gasoline.	2594	4.89%
Class IC flammable liquid.	84	0.16%
Class II combustible liquid.	342	0.64%
Class IIIA combustible liquid.	82	0.15%
Class IIIB combustible liquid.	627	1.18%
Flammable, Combustible Liquid not classified above.	201	0.38%
Flammable, Combustible Liquid; insufficient information available to classify further.	397	0.75%

VOLATILE SOLID, CHEMICAL

Fat, grease (food).	1172	2.21%
Grease (nonfood).	193	0.36%
Polish.	16	0.03%
Adhesive, resin, tar.	416	0.78%
Applied paint, varnish.	317	0.60%
Combustible metal.	142	0.27%
Solid chemical (specify type).	82	0.15%
Radioactive material.		0.00%
Volatile Solid, Chemical not classified above.	52	0.10%
Volatile Solid, Chemical; insufficient information available to classify further	36	0.07%

PLASTIC

Polyurethane.	366	0.69%
Polystyrene.	156	0.29%
Polyvinyl.	1647	3.10%
Polyacrylic.	70	0.13%
Polyester.	149	0.28%
Polyolefin.	65	0.12%
Plastic not classified above.	1404	2.65%
Plastic; insufficient information available to classify further.	2497	4.71%

NATURAL PRODUCT

Rubber.	1789	3.37%
Cork.	12	0.02%
Leather.	36	0.07%

Grass, leaves, hay, straw.	3427	6.46%
Grain, natural fiber (pre-process).	269	0.51%
Coal, coke, briquettes, peat.	83	0.16%
Food, starch.	520	0.98%
Tobacco.	70	0.13%
Natural Product not classified above.	410	0.77%
Natural Product; insufficient information available to classify further.	114	0.21%
WOOD, PAPER		
Growing wood.	262	0.49%
Felled but unsawn wood.	297	0.56%
Sawn wood.	4056	7.65%
Wood shavings.	1174	2.21%
Hardboard, plywood.	746	1.41%
Fiberboard (low density material), wood pulp.	318	0.60%
Paper, untreated, uncoated.	3711	6.99%
Cardboard.	1262	2.38%
Wood, Paper not classified above.	890	1.68%
Wood, Paper; insufficient information available to classify further.	1055	1.99%
FABRIC, TEXTILE, FUR		
Man-made fabric, fiber, finished goods.	1279	2.41%
Cotton, rayon, cotton fabric, finished goods.	1914	3.61%
Wool, wool mixture fabric, finished goods.	38	0.07%
Fur, silk, other fabric, finished goods.	15	0.03%
Wig.	20	0.04%
Human hair.	9	0.02%
Fabric, Textile, Fur not classified above.	199	0.38%
Fabric, Textile, Fur; insufficient information available to classify further.	322	0.61%
MATERIAL COMPOUNDED WITH OIL		
Linoleum.	12	0.02%
Oil cloth.	12	0.02%
Treated and/or coated paper.	628	1.18%
Waterproof canvas.	409	0.77%
Oily rags.	159	0.30%
Asphalt treated material.	172	0.32%
Material Compounded with Oil not classified above.	138	0.26%
Material Compounded with Oil; insufficient information available to classify further.	84	0.16%
OTHER TYPE OF MATERIAL		
Multiple types of material first ignited.	1938	3.65%
Type of Material not classified above.	2452	4.62%
Type of Material undetermined or not reported	7942	14.97%
Construction Type		
Fire resistive.	2927	5.52%
Heavy timber.	612	1.15%
Protected noncombustible or limited combustible.	2407	4.54%
Unprotected noncombustible or limited combustible not qualifying for 3.	3109	5.86%
Protected ordinary.	3212	6.05%
Unprotected ordinary, not qualifying 5.	3517	6.63%
Protected Wood Frame	1714	3.23%
Unprotected wood frame not qualifying for 7.	3737	7.04%

Not classified above	492	0.93%
Undetermined or not reported	3384	6.38%

Structural Damage with Sprinklers Only   total 25662

None/not reported	2	3.76982E-05
Minimal	14475	0.272840367
Heavy	3400	0.064086857
Extreme	4736	0.089269221

Structural Damage with Sprinklers and Smoke Detection   total 25360

None/not reported	2	3.76982E-05
Minimal	14313	0.269786817
Heavy	3335	0.062861667
Extreme	4692	0.088439862

NFIRs Data 1996

Fires in Commercial buildings

Had detectors	25164	47.26%
Did not have any type of detector present	28081	39.91%

Structural Damage (as described in the FEMA NFIR's Manual)

None/not reported	2331	4.38%
Minimal	25747	48.36%
Heavy	4528	8.50%
Extreme	14636	27.49%

Area of origin

MEANS OF EGRESS

Hallway, corridor, mall.	450	0.85%
Exterior stairway.	65	0.12%
Interior stairway.	80	0.15%
Escalator.	10	0.02%
Lobby, entrance way.	347	0.65%
Means of Egress not classified above.	90	0.17%

ASSEMBLY, SALES AREAS (groups of people)

Large assembly area with fixed seats (100 or more persons).	57	0.11%
Large open room without fixed seats (100 or more persons).	169	0.32%
Small assembly area with or without fixed seats (less than 100 persons).	141	0.26%
Lounge area.	329	0.62%
Sales, showroom area.	517	0.97%
Library.	8	0.02%
Swimming pool.	24	0.05%
Assembly, Sales Areas not classified above.	69	0.13%

FUNCTION AREAS

Sleeping room for under 5 persons.	1042	1.96%
Sleeping area for 5 or more persons.	43	0.08%
Dining area, lunchroom, cafeteria.	237	0.45%
Kitchen, cooking area.	2342	4.40%
Lavatory, locker room, cloakroom.	988	1.86%

Laundry room, area.	1029	1.93%
Office.	901	1.69%
Personal service area.	83	0.16%
FUNCTION AREAS		
Laboratory.	115	0.22%
Printing or photographic room, area.	80	0.15%
First aid, treatment room.	33	0.06%
Operating room.	24	0.05%
Electronic equipment room, area.	255	0.48%
Performance, stage area.	21	0.04%
Projection room, area.	13	0.02%
Process, manufacturing area.	1605	3.01%
Function Areas not classified above.	192	0.36%
STORAGE AREAS		
Product storage room or area, storage tank, storage bin.	1336	2.51%
Closet.	125	0.23%
Supply storage room or area.	1188	2.23%
Records storage room, vault.	49	0.09%
Shipping, receiving, loading area.	465	0.87%
Trash or rubbish area, container.	4568	8.58%
Garage, carport, vehicle storage area.	1398	2.63%
Storage Areas not classified above.	902	1.69%
SERVICE FACILITIES		
Elevator, dumb-waiter.	106	0.20%
Utility shaft.	101	0.19%
Light shaft.	23	0.04%
Chute.	54	0.10%
Duct.	497	0.93%
Display window.	36	0.07%
Chimney.	149	0.28%
Conveyor.	137	0.26%
Service Facilities not classified above.	129	0.24%
SERVICE, EQUIPMENT AREAS		
Machinery room, area.	1057	1.99%
Heating equipment room or area, water heater area.	861	1.62%
Switchgear area, transformer vault.	213	0.40%
Incinerator room, area.	60	0.11%
Maintenance shop, area.	552	1.04%
Test cell.	8	0.02%
Enclosure with pressurized air.	17	0.03%
Enclosure with enriched oxygen atmosphere.	7	0.01%
Service, Equipment Areas not classified above.	373	0.70%
STRUCTURAL AREAS		
Crawl space, substructure space.	247	0.46%
Exterior balcony, open porch.	144	0.27%
Ceiling and floor assembly, concealed floor/ceiling space.	267	0.50%
Ceiling and roof assembly, concealed roof/ceiling space.	967	1.82%
Wall assembly, concealed wall space.	432	0.81%
Exterior wall surface.	1426	2.68%
Exterior roof surface.	714	1.34%

Awning.	91	0.17%
Structural Areas not classified above.	300	0.56%
TRANSPORTATION, VEHICLE AREAS		
Passenger area of transportation equipment.	1485	2.79%
Trunk, load carrying area of transportation equipment.	412	0.77%
Engine area, running gear, wheel area of transportation equipment.	7005	13.16%
Fuel tank, fuel line area of transportation equipment.	190	0.36%
Operating, control area of transportation equipment.	176	0.33%
Exterior exposed surface of transportation equipment.	433	0.81%
Transportation, Vehicle Areas not classified above.	260	0.49%
OTHER AREA OF ORIGIN		
On or near railroad right of way, embankment.	96	0.18%
On or near highway, public way, street.	1088	2.04%
Court, terrace, patio.	364	0.68%
Lawn, field, open area.	4842	9.09%
Wildland area, woods.	477	0.90%
Multiple location, use area.	217	0.41%
Area of Origin not applicable.	585	1.10%
Other Area of Origin not classified above.	1109	2.08%
Other/Unknown	3307	6.21%

Type of material ignited

GAS	1	
Natural gas.	268	0.50%
LP-City Gas (LP and air mix).	41	0.08%
Manufactured gas.	93	0.17%
LP-gas.	196	0.37%
Anesthetic gas.	2	0.00%
Acetylene.	90	0.17%
Specialty gas other than anesthetic.	36	0.07%
Gas not classified above.	67	0.13%
Gas; insufficient information available to classify further.	142	0.27%
FLAMMABLE, COMBUSTIBLE LIQUID		
Class IA flammable liquid.	209	0.39%
Class IB flammable liquid.	94	0.18%
Gasoline.	2375	4.46%
Class IC flammable liquid.	85	0.16%
Class II combustible liquid.	291	0.55%
Class IIIA combustible liquid.	92	0.17%
Class IIIB combustible liquid.	591	1.11%
Flammable, Combustible Liquid not classified above.	203	0.38%
Flammable, Combustible Liquid; insufficient information available to classify further.	411	0.77%
VOLATILE SOLID, CHEMICAL		
Fat, grease (food).	1168	2.19%
Grease (nonfood).	246	0.46%
Polish.	27	0.05%
Adhesive, resin, tar.	380	0.71%
Applied paint, varnish.	261	0.49%
Combustible metal.	101	0.19%

Solid chemical (specify type).	41	0.08%
Radioactive material.	3	0.01%
Volatile Solid, Chemical not classified above.	50	0.09%
Volatile Solid, Chemical; insufficient information available to classify further	26	0.05%
PLASTIC		
Polyurethane.	329	0.62%
Polystyrene.	150	0.28%
Polyvinyl.	1703	3.20%
Polyacrylic.	80	0.15%
Polyester.	120	0.23%
Polyolefin.	85	0.16%
Plastic not classified above.	1555	2.92%
Plastic; insufficient information available to classify further.	2424	4.55%
NATURAL PRODUCT		
Rubber.	1631	3.06%
Cork.	11	0.02%
Leather.	23	0.04%
Grass, leaves, hay, straw.	3595	6.75%
Grain, natural fiber (pre-process).	295	0.55%
Coal, coke, briquettes, peat.	84	0.16%
Food, starch.	496	0.93%
Tobacco.	163	0.31%
Natural Product not classified above.	381	0.72%
Natural Product; insufficient information available to classify further.	140	0.26%
WOOD, PAPER		
Growing wood.	293	0.55%
Felled but unsawn wood.	304	0.57%
Sawn wood.	4125	7.75%
Wood shavings.	977	1.83%
Hardboard, plywood.	743	1.40%
Fiberboard (low density material), wood pulp.	303	0.57%
Paper, untreated, uncoated.	3455	6.49%
Cardboard.	1345	2.53%
Wood, Paper not classified above.	873	1.64%
Wood, Paper; insufficient information available to classify further.	1159	2.18%
FABRIC, TEXTILE, FUR		
Man-made fabric, fiber, finished goods.	1335	2.51%
Cotton, rayon, cotton fabric, finished goods.	1794	3.37%
Wool, wool mixture fabric, finished goods.	61	0.11%
Fur, silk, other fabric, finished goods.	20	0.04%
Wig.	39	0.07%
Human hair.	11	0.02%
Fabric, Textile, Fur not classified above.	219	0.41%
Fabric, Textile, Fur; insufficient information available to classify further.	368	0.69%
MATERIAL COMPOUNDED WITH OIL		
Linoleum.	21	0.04%
Oil cloth.	4	0.01%
Treated and/or coated paper.	701	1.32%
Waterproof canvas.	364	0.68%
Oily rags.	104	0.20%

Asphalt treated material.	187	0.35%
Material Compounded with Oil not classified above.	160	0.30%
Material Compounded with Oil; insufficient information available to classify further.	92	0.17%
OTHER TYPE OF MATERIAL		
Multiple types of material first ignited.	1866	3.50%
Type of Material not classified above.	2433	4.57%
Type of Material undetermined or not reported	8468	15.90%

Construction Type

Fire resistive.	2877	5.40%
Heavy timber.	606	1.14%
Protected noncombustible or limited combustible.	2509	4.71%
Unprotected noncombustible or limited combustible not qualifying for 3.	3224	6.06%
Protected ordinary.	3202	6.01%
Unprotected ordinary, not qualifying 5.	3482	6.54%
Protected Wood Frame	1756	3.30%
Unprotected wood frame not qualifying for 7.	3512	6.60%
Not classified above	452	0.85%
Undetermined or not reported	3214	6.04%

Structural Damage with Sprinklers Only total 25329

None/not reported	3	0.01%
Minimal	13724	25.78%
Heavy	3340	6.27%
Extreme	4997	9.38%

Structural Damage with Sprinklers and Smoke Detection total 25060

None/not reported	3	0.01%
Minimal	13577	25.50%
Heavy	3300	6.20%
Extreme	4960	9.32%

NFIRs Data 1997

Fires in Commercial buildings

Had detectors	22026	50.90%
Did not have any type of detector present	21250	49.10%

Structural Damage (as described in the FEMA NFIR's Manual)

None/not reported	5	0.01%
Minimal	20806	48.08%
Heavy	3752	8.67%
Extreme	13188	30.47%

Area of origin

MEANS OF EGRESS

Hallway, corridor, mall.	418	0.97%

Exterior stairway.	67	0.15%
Interior stairway.	64	0.15%
Escalator.	7	0.02%
Lobby, entrance way.	270	0.62%
Means of Egress not classified above.	97	0.22%
ASSEMBLY, SALES AREAS (groups of people)		
Large assembly area with fixed seats (100 or more persons).	41	0.09%
Large open room without fixed seats (100 or more persons).	101	0.23%
Small assembly area with or without fixed seats (less than 100 persons).	158	0.37%
Lounge area.	263	0.61%
Sales, showroom area.	491	1.13%
Library.	5	0.01%
Swimming pool.	17	0.04%
Assembly, Sales Areas not classified above.	42	0.10%
FUNCTION AREAS		
Sleeping room for under 5 persons.	794	1.83%
Sleeping area for 5 or more persons.	22	0.05%
Dining area, lunchroom, cafeteria.	191	0.44%
Kitchen, cooking area.	2065	4.77%
Lavatory, locker room, cloakroom.	735	1.70%
Laundry room, area.	915	2.11%
Office.	700	1.62%
Personal service area.	77	0.18%
FUNCTION AREAS		
Laboratory.	115	0.27%
Printing or photographic room, area.	54	0.12%
First aid, treatment room.	38	0.09%
Operating room.	14	0.03%
Electronic equipment room, area.	216	0.50%
Performance, stage area.	19	0.04%
Projection room, area.	5	0.01%
Process, manufacturing area.	1404	3.24%
Function Areas not classified above.	181	0.42%
STORAGE AREAS		
Product storage room or area, storage tank, storage bin.	1063	2.46%
Closet.	98	0.23%
Supply storage room or area.	903	2.09%
Records storage room, vault.	46	0.11%
Shipping, receiving, loading area.	395	0.91%
Trash or rubbish area, container.	3527	8.15%
Garage, carport, vehicle storage area.	1059	2.45%
Storage Areas not classified above.	703	1.62%
SERVICE FACILITIES		
Elevator, dumb-waiter.	104	0.24%
Utility shaft.	104	0.24%
Light shaft.	14	0.03%
Chute.	40	0.09%
Duct.	438	1.01%
Display window.	28	0.06%
Chimney.	143	0.33%

Conveyor.	137	0.32%
Service Facilities not classified above.	126	0.29%
SERVICE, EQUIPMENT AREAS		
Machinery room, area.	1019	2.35%
Heating equipment room or area, water heater area.	677	1.56%
Switchgear area, transformer vault.	204	0.47%
Incinerator room, area.	61	0.14%
Maintenance shop, area.	449	1.04%
Test cell.	15	0.03%
Enclosure with pressurized air.	20	0.05%
Enclosure with enriched oxygen atmosphere.	2	0.00%
Service, Equipment Areas not classified above.	317	0.73%
STRUCTURAL AREAS		
Crawl space, substructure space.	185	0.43%
Exterior balcony, open porch.	106	0.24%
Ceiling and floor assembly, concealed floor/ceiling space.	255	0.59%
Ceiling and roof assembly, concealed roof/ceiling space.	772	1.78%
Wall assembly, concealed wall space.	364	0.84%
Exterior wall surface.	1121	2.59%
Exterior roof surface.	569	1.31%
Awning.	97	0.22%
Structural Areas not classified above.	290	0.67%
TRANSPORTATION, VEHICLE AREAS		
Passenger area of transportation equipment.	1264	2.92%
Trunk, load carrying area of transportation equipment.	353	0.82%
Engine area, running gear, wheel area of transportation equipment.	5914	13.67%
Fuel tank, fuel line area of transportation equipment.	162	0.37%
Operating, control area of transportation equipment.	183	0.42%
Exterior exposed surface of transportation equipment.	398	0.92%
Transportation, Vehicle Areas not classified above.	229	0.53%
OTHER AREA OF ORIGIN		
On or near railroad right of way, embankment.	81	0.19%
On or near highway, public way, street.	866	2.00%
Court, terrace, patio.	326	0.75%
Lawn, field, open area.	3348	7.74%
Wildland area, woods.	294	0.68%
Multiple location, use area.	147	0.34%
Area of Origin not applicable.	442	1.02%
Other Area of Origin not classified above.	1140	2.63%
Other/Unknown	2347	5.42%

Type of material ignited

GAS		
Natural gas.	238	0.55%
LP-City Gas (LP and air mix).	28	0.06%
Manufactured gas.	110	0.25%
LP-gas.	140	0.32%
Anesthetic gas.	5	0.01%
Acetylene.	60	0.14%

Specialty gas other than anesthetic.	18	0.04%
Gas not classified above.	64	0.15%
Gas; insufficient information available to classify further.	144	0.33%
FLAMMABLE, COMBUSTIBLE LIQUID		
Class IA flammable liquid.	149	0.34%
Class IB flammable liquid.	97	0.22%
Gasoline.	1854	4.28%
Class IC flammable liquid.	62	0.14%
Class II combustible liquid.	246	0.57%
Class IIIA combustible liquid.	56	0.13%
Class IIIB combustible liquid.	471	1.09%
Flammable, Combustible Liquid not classified above.	214	0.49%
Flammable, Combustible Liquid; insufficient information available to classify further.	379	0.88%
VOLATILE SOLID, CHEMICAL		
Fat, grease (food).	1076	2.49%
Grease (nonfood).	201	0.46%
Polish.	23	0.05%
Adhesive, resin, tar.	322	0.74%
Applied paint, varnish.	220	0.51%
Combustible metal.	159	0.37%
Solid chemical (specify type).	47	0.11%
Radioactive material.	1	0.00%
Volatile Solid, Chemical not classified above.	44	0.10%
Volatile Solid, Chemical; insufficient information available to classify further	33	0.08%
PLASTIC		
Polyurethane.	340	0.79%
Polystyrene.	168	0.39%
Polyvinyl.	1518	3.51%
Polyacrylic.	69	0.16%
Polyester.	102	0.24%
Polyolefin.	68	0.16%
Plastic not classified above.	1182	2.73%
Plastic; insufficient information available to classify further.	2299	5.31%
NATURAL PRODUCT		
Rubber.	1328	3.07%
Cork.	7	0.02%
Leather.	20	0.05%
Grass, leaves, hay, straw.	2336	5.40%
Grain, natural fiber (pre-process).	269	0.62%
Coal, coke, briquettes, peat.	63	0.15%
Food, starch.	449	1.04%
Tobacco.	146	0.34%
Natural Product not classified above.	218	0.50%
Natural Product; insufficient information available to classify further.	105	0.24%
WOOD, PAPER		
Growing wood.	250	0.58%
Felled but unsawn wood.	181	0.42%
Sawn wood.	3200	7.39%
Wood shavings.	964	2.23%
Hardboard, plywood.	614	1.42%

Fiberboard (low density material), wood pulp.	264	0.61%
Paper, untreated, uncoated.	3049	7.05%
Cardboard.	1177	2.72%
Wood, Paper not classified above.	781	1.80%
Wood, Paper; insufficient information available to classify further.	977	2.26%
FABRIC, TEXTILE, FUR		
Man-made fabric, fiber, finished goods.	1116	2.58%
Cotton, rayon, cotton fabric, finished goods.	1493	3.45%
Wool, wool mixture fabric, finished goods.	33	0.08%
Fur, silk, other fabric, finished goods.	15	0.03%
Wig.	13	0.03%
Human hair.	7	0.02%
Fabric, Textile, Fur not classified above.	170	0.39%
Fabric, Textile, Fur; insufficient information available to classify further.	306	0.71%
MATERIAL COMPOUNDED WITH OIL		
Linoleum.	8	0.02%
Oil cloth.	10	0.02%
Treated and/or coated paper.	31	0.07%
Waterproof canvas.	16	0.04%
Oily rags.	113	0.26%
Asphalt treated material.	162	0.37%
Material Compounded with Oil not classified above.	138	0.32%
Material Compounded with Oil; insufficient information available to classify further.	97	0.22%
OTHER TYPE OF MATERIAL		
Multiple types of material first ignited.	1689	3.90%
Type of Material not classified above.	1968	4.55%
Type of Material undetermined or not reported	6769	15.64%

Construction Type		
Fire resistive.	2661	6.15%
Heavy timber.	512	1.18%
Protected noncombustible or limited combustible.	2414	5.58%
Unprotected noncombustible or limited combustible not qualifying for 3.	2876	6.65%
Protected ordinary.	2776	6.41%
Unprotected ordinary, not qualifying 5.	3016	6.97%
Protected Wood Frame	1680	3.88%
Unprotected wood frame not qualifying for 7.	2932	6.78%
Not classified above	424	0.98%
Undetermined or not reported	2502	5.78%

	total	
Structural Damage with Sprinklers only	22181	
None/not reported	5	0.01%
Minimal	11555	26.70%
Heavy	2956	6.83%
Extreme	4644	10.73%

	total	
Structural Damage with Sprinklers and Smoke Detection	21917	
None/not reported	5	0.01%

Minimal		11419	26.39%
Heavy		2896	6.69%
Extreme		4607	10.65%

NFIRs Data 1998

Structure Damage	number	percentage
Minimal	25613	57.74416
Signifigant	4348	9.802507
Heavy	12353	27.84967
unknown	2042	4.603661

Area of origin

origin	number	percentage
MEANS OF EGRESS	2889	6.513211
Hallway, corridor, mall.	336	0.757507
Exterior stairway.	67	0.151051
Interior stairway.	42	0.094688
Escalator.	10	0.022545
Lobby, entrance way.	264	0.595184
Means of Egress not classified above.	96	0.216431
Large assembly area with fixed seats (100 or more persons).	75	0.169086
Large open room without fixed seats (100 or more persons).	168	0.378754
Small assembly area with or without fixed seats (less than 100 persons).	126	0.284065
Lounge area.	266	0.599693
Sales, showroom area.	469	1.057354
Library.	10	0.022545
Swimming pool.	15	0.033817
Assembly, Sales Areas not classified above.	61	0.137524
Sleeping room for under 5 persons.	758	1.708901
Sleeping area for 5 or more persons.	28	0.063126
Dining area, lunchroom, cafeteria.	149	0.335918
Kitchen, cooking area.	2174	4.901253
Lavatory, locker room, cloakroom.	698	1.573632
Laundry room, area.	826	1.862206
Office.	679	1.530796
Personal service area.	74	0.166832
Laboratory.	103	0.232212
Printing or photographic room, area.	67	0.151051
First aid, treatment room.	43	0.096943
Operating room.	15	0.033817
Electronic equipment room, area.	228	0.514023
Performance, stage area.	10	0.022545
Projection room, area.	7	0.015781
Process, manufacturing area.	1418	3.196862
Function Areas not classified above.	206	0.464424
Product storage room or area, storage tank, storage bin.	1002	2.258995
Closet.	114	0.257011
Supply storage room or area.	864	1.947876

Records storage room, vault.	47	0.105961
Shipping, receiving, loading area.	396	0.892777
Trash or rubbish area, container.	3904	8.801515
Garage, carport, vehicle storage area.	1051	2.369465
Storage Areas not classified above.	779	1.756245
Elevator, dumb-waiter.	81	0.182613
Utility shaft.	90	0.202904
Light shaft.	12	0.027054
Chute.	57	0.128506
Duct.	433	0.976193
Display window.	37	0.083416
Chimney.	116	0.26152
Conveyor.	140	0.315628
Service Facilities not classified above.	138	0.311119
Machinery room, area.	1021	2.301831
Heating equipment room or area, water heater area.	673	1.517269
Switchgear area, transformer vault.	241	0.543331
Incinerator room, area.	62	0.139778
Maintenance shop, area.	465	1.048336
Test cell.	14	0.031563
Enclosure with pressurized air.	23	0.051853
Enclosure with enriched oxygen atmosphere.	4	0.009018
Service, Equipment Areas not classified above.	337	0.759762
Crawl space, substructure space.	173	0.390026
Exterior balcony, open porch.	116	0.26152
Ceiling and floor assembly, concealed floor/ceiling space.	212	0.477951
Ceiling and roof assembly, concealed roof/ceiling space.	739	1.666065
Wall assembly, concealed wall space.	368	0.829651
Exterior wall surface.	1115	2.513752
Exterior roof surface.	633	1.42709
Awning.	74	0.166832
Structural Areas not classified above.	276	0.622238
Passenger area of transportation equipment.	1255	2.82938
Trunk, load carrying area of transportation equipment.	384	0.865723
Engine area, running gear, wheel area of transportation equipment.	5887	13.27216
Fuel tank, fuel line area of transportation equipment.	146	0.329155
Operating, control area of transportation equipment.	166	0.374245
Exterior exposed surface of transportation equipment.	362	0.816124
Transportation, Vehicle Areas not classified above.	268	0.604202
On or near railroad right of way, embankment.	70	0.157814
On or near highway, public way, street.	989	2.229687
Court, terrace, patio.	384	0.865723
Lawn, field, open area.	3615	8.149968
Wildland area, woods.	406	0.915321
Multiple location, use area.	166	0.374245
Area of Origin not applicable.	535	1.20615
Other Area of Origin not classified above.	1104	2.488953
Area of Origin undetermined or not reported.	435	0.980702

Material Ignited	number	percentage
Type of Material undetermined or not reported	7389	16.6584
Gas; insufficient information available to classify further.	143	0.322392
Natural gas.	252	0.568131
LP-City Gas (LP and air mix).	29	0.06538
Manufactured gas.	82	0.184868
LP-gas.	137	0.308865
Anesthetic gas.	4	0.009018
Acetylene.	67	0.151051
Specialty gas other than anesthetic.	24	0.054108
Gas not classified above.	61	0.137524
Flammable, Combustible Liquid; insufficient information available to classify further.	392	0.883759
Class IA flammable liquid.	197	0.444134
Class IB flammable liquid.	77	0.173595
Gasoline.	1799	4.055821
Class IC flammable liquid.	61	0.137524
Class II combustible liquid.	228	0.514023
Class IIIA combustible liquid.	59	0.133015
Class IIIB combustible liquid.	480	1.082153
Flammable, Combustible Liquid not classified above.	185	0.41708
Volatile Solid, Chemical; insufficient information available to classify further	27	0.060871
Fat, grease (food).	1050	2.367211
Grease (nonfood).	206	0.464424
Polish.	16	0.036072
Adhesive, resin, tar.	325	0.732708
Applied paint, varnish.	216	0.486969
Combustible metal.	139	0.313374
Solid chemical (specify type).	41	0.092434
Radioactive material.	2	0.004509
Volatile Solid, Chemical not classified above.	39	0.087925
Plastic; insufficient information available to classify further.	2387	5.381459
Polyurethane.	292	0.65831
Polystyrene.	145	0.326901
Polyvinyl.	1267	2.856434
Polyacrylic.	52	0.117233
Polyester.	102	0.229958
Polyolefin.	61	0.137524
Plastic not classified above.	1259	2.838398
Natural Product; insufficient information available to classify further.	113	0.254757
Rubber.	1294	2.917305
Cork.	13	0.029308
Leather.	15	0.033817
Grass, leaves, hay, straw.	2449	5.521237
Grain, natural fiber (pre-process).	240	0.541077
Coal, coke, briquettes, peat.	94	0.211922
Food, starch.	499	1.124989
Tobacco.	125	0.281811
Natural Product not classified above.	306	0.689873

Wood, Paper; insufficient information available to classify further.	1163	2.621968
Growing wood.	259	0.583912
Felled but unsawn wood.	214	0.48246
Sawn wood.	2967	6.689061
Wood shavings.	1129	2.545315
Hardboard, plywood.	654	1.474434
Fiberboard (low density material), wood pulp.	305	0.687618
Paper, untreated, uncoated.	2911	6.56281
Cardboard.	1156	2.606186
Wood, Paper not classified above.	764	1.722428
Fabric, Textile, Fur; insufficient information available to classify further.	306	0.689873
Man-made fabric, fiber, finished goods.	1035	2.333393
Cotton, rayon, cotton fabric, finished goods.	1414	3.187844
Wool, wool mixture fabric, finished goods.	24	0.054108
Fur, silk, other fabric, finished goods.	18	0.040581
Wig.	13	0.029308
Human hair.	9	0.02029
Fabric, Textile, Fur not classified above.	155	0.349445
Material Compounded with Oil; insufficient information available to classify further.	116	0.26152
Linoleum.	10	0.022545
Oil cloth.	11	0.024799
Treated and/or coated paper.	262	0.590675
Waterproof canvas.	10	0.022545
Oily rags.	91	0.205158
Asphalt treated material.	181	0.408062
Material Compounded with Oil not classified above.	139	0.313374
Multiple types of material first ignited.	1601	3.609433
Type of Material not classified above.	267	0.601948
Unknown	2732	6.159257

Structure Type

Type	number	percentage
other structure type	2848	6.420777
Enclosed building	2628	5.92479
fixed portable or mobile structure	483	1.088917
open structure	2322	5.234917
air supported structure	2685	6.053296
tent	2857	6.441068
open platform	2841	6.404996
underground structure work areas	1500	3.38173
connective structure	2753	6.206601
Unknown/ Undetermined	23439	52.84291

NFIRs Data 1999

Structure Damage

Type of damage	number	percentage
Minimal	3058	31.66%

Significant	818	8.47%
Heavy	2080	21.53%
Unknown	3704	38.34%
Total	9660	

Area of origin

	number	percentage
MEANS OF EGRESS	182	1.88%
Hallway, corridor, mall.	57	0.59%
Exterior stairway.	59	0.61%
Interior stairway.	39	0.40%
Escalator.	3	0.03%
Lobby, entrance way.	88	0.91%
Means of Egress not classified above.	33	0.34%
ASSEMBLY, SALES AREAS (groups of people)	9	0.09%
Large assembly area with fixed seats (100 or more persons).	13	0.13%
Large open room without fixed seats (100 or more persons).	4	0.04%
Small assembly area with or without fixed seats (less than 100 persons).	15	0.16%
Lounge area.	604	6.25%
Sales, showroom area.	20	0.21%
Library.	1	0.01%
Swimming pool.	1	0.01%
FUNCTION AREAS	183	1.89%
Sleeping room for under 5 persons.	973	10.07%
Sleeping area for 5 or more persons.	51	0.53%
Dining area, lunchroom, cafeteria.	60	0.62%
Kitchen, cooking area.	1306	13.52%
Lavatory, locker room, cloakroom.	277	2.87%
Laundry room, area.	406	4.20%
Office.	44	0.46%
Personal service area.	12	0.12%
FUNCTION AREAS	8	0.08%
Laboratory.	13	0.13%
Printing or photographic room, area.	2	0.02%
First aid, treatment room.	1	0.01%
Operating room.	1	0.01%
Electronic equipment room, area.	16	0.17%
Performance, stage area.	2	0.02%
Process, manufacturing area.	118	1.22%
STORAGE AREAS	187	1.94%
Product storage room or area, storage tank, storage bin.	139	1.44%
Closet.	64	0.66%
Supply storage room or area.	94	0.97%
Records storage room, vault.	4	0.04%
Shipping, receiving, loading area.	13	0.13%
Trash or rubbish area, container.	52	0.54%
Garage, carport, vehicle storage area.	550	5.69%
SERVICE FACILITIES	143	1.48%
Elevator, dumb-waiter.	4	0.04%
Utility shaft.	20	0.21%

Light shaft.	2	0.02%
Chute.	7	0.07%
Duct.	55	0.57%
Display window.	1	0.01%
Chimney.	31	0.32%
Conveyor.	6	0.06%
SERVICE, EQUIPMENT AREAS	47	0.49%
Machinery room, area.	97	1.00%
Heating equipment room or area, water heater area.	201	2.08%
Switchgear area, transformer vault.	14	0.14%
Incinerator room, area.	3	0.03%
Maintenance shop, area.	64	0.66%
Test cell.	1	0.01%
Enclosure with pressurized air.	1	0.01%
STRUCTURAL AREAS	172	1.78%
Crawl space, substructure space.	297	3.07%
Exterior balcony, open porch.	159	1.65%
Ceiling and floor assembly, concealed floor/ceiling space.	168	1.74%
Ceiling and roof assembly, concealed roof/ceiling space.	324	3.35%
Wall assembly, concealed wall space.	286	2.96%
Exterior wall surface.	521	5.39%
Exterior roof surface.	159	1.65%
Awning.	9	0.09%
TRANSPORTATION, VEHICLE AREAS	14	0.14%
Passenger area of transportation equipment.	21	0.22%
Engine area, running gear, wheel area of transportation equipment.	30	0.31%
Fuel tank, fuel line area of transportation equipment.	7	0.07%
Exterior exposed surface of transportation equipment.	11	0.11%
OTHER AREA OF ORIGIN	68	0.70%
On or near highway, public way, street.	10	0.10%
Court, terrace, patio.	63	0.65%
Lawn, field, open area.	67	0.69%
Wildland area, woods.	3	0.03%
Multiple location, use area.	72	0.75%
Area of Origin not applicable.	33	0.34%
Unknown area of orgin	755	7.82%

Material ignited

	number	percentage
Type of Material undetermined or not reported	258	2.67%
Gas; insufficient information available to classify further.	36	0.37%
Natural gas.	93	0.96%
LP-City Gas (LP and air mix).	44	0.46%
Manufactured gas.	1	0.01%
LP-gas.	4	0.04%
Anesthetic gas.	2	0.02%
Flammable, Combustible Liquid; insufficient information available to classify further.	60	0.62%
Class IA flammable liquid.	9	0.09%
Class IB flammable liquid.	14	0.14%
Gasoline.	118	1.22%

Class IC flammable liquid.	9	0.09%
Class II combustible liquid.	28	0.29%
Class IIIA combustible liquid.	12	0.12%
Class IIIB combustible liquid.	112	1.16%
Volatile Solid, Chemical; insufficient information available to classify further	11	0.11%
Fat, grease (food).	143	1.48%
Grease (nonfood).	8	0.08%
Polish.	21	0.22%
Adhesive, resin, tar.	21	0.22%
Applied paint, varnish.	29	0.30%
Combustible metal.	12	0.12%
Solid chemical (specify type).	4	0.04%
Polyurethane.	569	5.89%
Natural Product; insufficient information available to classify further.	209	2.16%
Rubber.	27	0.28%
Cork.	1	0.01%
Leather.	2	0.02%
Grass, leaves, hay, straw.	61	0.63%
Grain, natural fiber (pre-process).	7	0.07%
Coal, coke, briquettes, peat.	7	0.07%
Food, starch.	78	0.81%
Tobacco.	20	0.21%
Wood, Paper; insufficient information available to classify further.	226	2.34%
Growing wood.	43	0.45%
Felled but unsawn wood.	19	0.20%
Sawn wood.	1146	11.86%
Wood shavings.	165	1.71%
Hardboard, plywood.	164	1.70%
Fiberboard (low density material), wood pulp.	5	0.05%
Paper, untreated, uncoated.	316	3.27%
Cardboard.	101	1.05%
Fabric, Textile, Fur; insufficient information available to classify further.	272	2.82%
Man-made fabric, fiber, finished goods.	892	9.23%
Fur, silk, other fabric, finished goods.	6	0.06%
Human hair.	2	0.02%
Material Compounded with Oil; insufficient information available to classify further.	26	0.27%
Oil cloth.	3	0.03%
Asphalt treated material.	27	0.28%
Type of Material not classified above.	1378	14.27%

Structure Type

enclosed building	9404	97.35%
open structures	169	1.75%
tent	36	0.37%
open platforms/wharves	29	0.30%
Underground structure work areas	7	0.07%
connective structures	15	0.16%

NFIRs Data 2000

Structure Damage

Type of damage	number	percentage
Minimal	6955	32.03%
Significant	1974	9.09%
Heavy	4765	21.94%
Unknown	8021	36.94%

Area of origin

	number	percentage
MEANS OF EGRESS	376	1.73%
Hallway, corridor, mall.	113	0.52%
Exterior stairway.	97	0.45%
Interior stairway.	77	0.35%
Escalator.	1	0.00%
Lobby, entrance way.	206	0.95%
Means of Egress not classified above.	100	0.46%
ASSEMBLY, SALES AREAS (groups of people)	16	0.07%
Large assembly area with fixed seats (100 or more persons).	14	0.06%
Large open room without fixed seats (100 or more persons).	19	0.09%
Small assembly area with or without fixed seats (less than 100 persons).	42	0.19%
Lounge area.	1295	5.96%
Sales, showroom area.	58	0.27%
Library.	4	0.02%
Swimming pool.	6	0.03%
FUNCTION AREAS	690	3.18%
Sleeping room for under 5 persons.	2104	9.69%
Sleeping area for 5 or more persons.	104	0.48%
Dining area, lunchroom, cafeteria.	69	0.32%
Kitchen, cooking area.	3161	14.56%
Lavatory, locker room, cloakroom.	707	3.26%
Laundry room, area.	904	4.16%
Office.	132	0.61%
Personal service area.	17	0.08%
FUNCTION AREAS	17	0.08%
Laboratory.	23	0.11%
Printing or photographic room, area.	2	0.01%
First aid, treatment room.	2	0.01%
Operating room.	2	0.01%
Electronic equipment room, area.	22	0.10%
Performance, stage area.	3	0.01%
Projection room, area.	1	0.00%
Process, manufacturing area.	172	0.79%
STORAGE AREAS	513	2.36%
Product storage room or area, storage tank, storage bin.	299	1.38%
Closet.	215	0.99%
Supply storage room or area.	326	1.50%
Records storage room, vault.	9	0.04%
Shipping, receiving, loading area.	49	0.23%

Trash or rubbish area, container.	69	0.32%
Garage, carport, vehicle storage area.	1054	4.85%
SERVICE FACILITIES	87	0.40%
Elevator, dumb-waiter.	8	0.04%
Utility shaft.	64	0.29%
Light shaft.	4	0.02%
Chute.	11	0.05%
Duct.	126	0.58%
Display window.	4	0.02%
Chimney.	113	0.52%
Conveyor.	7	0.03%
SERVICE, EQUIPMENT AREAS	136	0.63%
Machinery room, area.	132	0.61%
Heating equipment room or area, water heater area.	470	2.16%
Switchgear area, transformer vault.	32	0.15%
Incinerator room, area.	4	0.02%
Maintenance shop, area.	113	0.52%
Test cell.	2	0.01%
Enclosure with pressurized air.	1	0.00%
STRUCTURAL AREAS	456	2.10%
Crawl space, substructure space.	504	2.32%
Exterior balcony, open porch.	294	1.35%
Ceiling and floor assembly, concealed floor/ceiling space.	379	1.75%
Ceiling and roof assembly, concealed roof/ceiling space.	744	3.43%
Wall assembly, concealed wall space.	645	2.97%
Exterior wall surface.	986	4.54%
Exterior roof surface.	342	1.57%
Awning.	22	0.10%
TRANSPORTATION, VEHICLE AREAS	33	0.15%
Passenger area of transportation equipment.	21	0.10%
Trunk, load carrying area of transportation equipment.	3	0.01%
Engine area, running gear, wheel area of transportation equipment.	56	0.26%
Fuel tank, fuel line area of transportation equipment.	13	0.06%
Exterior exposed surface of transportation equipment.	40	0.18%
OTHER AREA OF ORIGIN	269	1.24%
On or near railroad right of way, embankment.	5	0.02%
On or near highway, public way, street.	11	0.05%
Court, terrace, patio.	147	0.68%
Lawn, field, open area.	145	0.67%
Wildland area, woods.	19	0.09%
Multiple location, use area.	21	0.10%
Area of Origin not applicable.	166	0.76%
Unknown area of origin	1860	8.57%

Material Ignited

	number	percent
Unknown	21131	97.31%
Gas; insufficient information available to classify further.	94	0.43%
Natural gas.	158	0.73%
LP-City Gas (LP and air mix).	93	0.43%

Manufactured gas.	1	0.00%
LP-gas.	12	0.06%
Anesthetic gas.	3	0.01%
Flammable, Combustible Liquid; insufficient information available to classify further.	154	0.71%
Class IA flammable liquid.	21	0.10%
Class IB flammable liquid.	5	0.02%
Gasoline.	273	1.26%
Class IC flammable liquid.	24	0.11%
Class II combustible liquid.	66	0.30%
Class IIIA combustible liquid.	8	0.04%
Class IIIB combustible liquid.	353	1.63%
Volatile Solid, Chemical; insufficient information available to classify further	20	0.09%
Fat, grease (food).	414	1.91%
Grease (nonfood).	5	0.02%
Polish.	50	0.23%
Adhesive, resin, tar.	57	0.26%
Applied paint, varnish.	34	0.16%
Combustible metal.	22	0.10%
Solid chemical (specify type).	10	0.05%
Polyurethane.	1353	6.23%
Natural Product; insufficient information available to classify further.	369	1.70%
Rubber.	78	0.36%
Cork.	2	0.01%
Leather.	6	0.03%
Grass, leaves, hay, straw.	170	0.78%
Grain, natural fiber (pre-process).	24	0.11%
Coal, coke, briquettes, peat.	5	0.02%
Food, starch.	208	0.96%
Tobacco.	19	0.09%
Wood, Paper; insufficient information available to classify further.	609	2.80%
Growing wood.	101	0.47%
Felled but unsawn wood.	48	0.22%
Sawn wood.	2846	13.11%
Wood shavings.	387	1.78%
Hardboard, plywood.	529	2.44%
Fiberboard (low density material), wood pulp.	17	0.08%
Paper, untreated, uncoated.	600	2.76%
Cardboard.	217	1.00%
Fabric, Textile, Fur; insufficient information available to classify further.	389	1.79%
Man-made fabric, fiber, finished goods.	2332	10.74%
Fur, silk, other fabric, finished goods.	10	0.05%
Wig.	2	0.01%
Human hair.	7	0.03%
Material Compounded with Oil; insufficient information available to classify further.	57	0.26%
Linoleum.	19	0.09%
Oil cloth.	4	0.02%
Asphalt treated material.	62	0.29%
Type of Material not classified above.	490	2.26%

Structure type

Enclosed building	21035	96.87%
open structure	504	2.32%
tent	24	0.11%
open platform	44	0.20%
underground structure work areas	10	0.05%
connective structure	98	0.45%

NFIRs Data 2001

Structure Damage

damage type	number	percentage
Minimum	17252	30.34
Significant	5441	9.57
Heavy	14712	25.87
Unknown/not reported	19464	34.23

Area of origin

	number	percentage
Unknown	5495	9.66
Hallway, corridor, mall.	226	0.40
Exterior stairway.	258	0.45
Interior stairway.	255	0.45
Escalator.	7	0.01
Lobby, entrance way.	460	0.81
Means of Egress not classified above.	296	0.52
ASSEMBLY, SALES AREAS (groups of people)	79	0.14
Large assembly area with fixed seats (100 or more persons).	41	0.07
Large open room without fixed seats (100 or more persons).	47	0.08
Small assembly area with or without fixed seats (less than 100 persons).	126	0.22
Lounge area.	3001	5.28
Sales, showroom area.	193	0.34
Library.	7	0.01
Swimming pool.	11	0.02
Assembly, Sales Areas not classified above.	1922	3.38
FUNCTION AREAS	5442	9.57
Sleeping room for under 5 persons.	149	0.26
Sleeping area for 5 or more persons.	162	0.28
Dining area, lunchroom, cafeteria.	8870	15.60
Kitchen, cooking area.	1709	3.01
Lavatory, locker room, cloakroom.	2349	4.13
Laundry room, area.	373	0.66
Office.	39	0.07
Personal service area.	41	0.07
FUNCTION AREAS	29	0.05
Laboratory.	11	0.02
Printing or photographic room, area.	3	0.01
First aid, treatment room.	32	0.06
Electronic equipment room, area.	8	0.01

Performance, stage area.	2	0.00
Projection room, area.	386	0.68
Process, manufacturing area.	1273	2.24
STORAGE AREAS	666	1.17
Product storage room or area, storage tank, storage bin.	574	1.01
Closet.	782	1.38
Supply storage room or area.	34	0.06
Records storage room, vault.	79	0.14
Shipping, receiving, loading area.	246	0.43
Trash or rubbish area, container.	2701	4.75
Garage, carport, vehicle storage area.	198	0.35
SERVICE FACILITIES	23	0.04
Elevator, dumb-waiter.	163	0.29
Utility shaft.	6	0.01
Light shaft.	44	0.08
Chute.	362	0.64
Duct.	7	0.01
Display window.	401	0.71
Chimney.	37	0.07
Conveyor.	465	0.82
SERVICE, EQUIPMENT AREAS	271	0.48
Machinery room, area.	1090	1.92
Heating equipment room or area, water heater area.	130	0.23
Switchgear area, transformer vault.	16	0.03
Incinerator room, area.	327	0.58
Maintenance shop, area.	5	0.01
Test cell.	10	0.02
Enclosure with pressurized air.	1099	1.93
STRUCTURAL AREAS	1326	2.33
Crawl space, substructure space.	880	1.55
Exterior balcony, open porch.	798	1.40
Ceiling and floor assembly, concealed floor/ceiling space.	2034	3.58
Ceiling and roof assembly, concealed roof/ceiling space.	1814	3.19
Wall assembly, concealed wall space.	2513	4.42
Exterior wall surface.	964	1.70
Exterior roof surface.	63	0.11
Awning.	118	0.21
TRANSPORTATION, VEHICLE AREAS	77	0.14
Passenger area of transportation equipment.	26	0.05
Trunk, load carrying area of transportation equipment.	242	0.43
Engine area, running gear, wheel area of transportation equipment.	22	0.04
Fuel tank, fuel line area of transportation equipment.	4	0.01
Operating, control area of transportation equipment.	152	0.27
Exterior exposed surface of transportation equipment.	811	1.43
OTHER AREA OF ORIGIN	19	0.03
On or near railroad right of way, embankment.	147	0.26
On or near highway, public way, street.	412	0.72
Court, terrace, patio.	517	0.91
Lawn, field, open area.	38	0.07
Wildland area, woods.	68	0.12

	number	percentage
Multiple location, use area.	496	0.87
Area of Origin not applicable.	289	0.51

Type of Materials ignited

	number	percentage
Gas; insufficient information available to classify further.	220	0.39
Natural gas.	366	0.64
LP-City Gas (LP and air mix).	238	0.42
Manufactured gas.	3	0.01
LP-gas.	38	0.07
Anesthetic gas.	5	0.01
Flammable, Combustible Liquid; insufficient information available to classify further.	461	0.81
Class IA flammable liquid.	31	0.05
Class IB flammable liquid.	7	0.01
Gasoline.	666	1.17
Class IC flammable liquid.	51	0.09
Class II combustible liquid.	148	0.26
Class IIIA combustible liquid.	26	0.05
Class IIIB combustible liquid.	1258	2.21
Volatile Solid, Chemical; insufficient information available to classify further	42	0.07
Fat, grease (food).	1063	1.87
Grease (nonfood).	8	0.01
Polish.	131	0.23
Adhesive, resin, tar.	129	0.23
Applied paint, varnish.	102	0.18
Combustible metal.	47	0.08
Solid chemical (specify type).	15	0.03
Polyurethane.	3839	6.75
Natural Product; insufficient information available to classify further.	734	1.29
Rubber.	168	0.30
Cork.	3	0.01
Leather.	12	0.02
Grass, leaves, hay, straw.	408	0.72
Grain, natural fiber (pre-process).	64	0.11
Coal, coke, briquettes, peat.	32	0.06
Food, starch.	640	1.13
Tobacco.	52	0.09
Wood, Paper; insufficient information available to classify further.	1578	2.77
Growing wood.	280	0.49
Felled but unsawn wood.	135	0.24
Sawn wood.	7076	12.44
Wood shavings.	1061	1.87
Hardboard, plywood.	1347	2.37
Fiberboard (low density material), wood pulp.	40	0.07
Paper, untreated, uncoated.	1554	2.73
Cardboard.	517	0.91
Fabric, Textile, Fur; insufficient information available to classify further.	1005	1.77
Man-made fabric, fiber, finished goods.	6147	10.81
Fur, silk, other fabric, finished goods.	28	0.05

Wig.	1	0.00
Human hair.	8	0.01
Fabric, Textile, Fur not classified above.	89	0.16
Material Compounded with Oil; insufficient information available to classify further.	130	0.23
Linoleum.	37	0.07
Oil cloth.	12	0.02
Asphalt treated material.	202	0.36
Type of Material not classified above.	1437	2.53

Structure Type

Enclosed building	55183	97.04
open structure	1202	2.11
tent	29	0.05
open platform	172	0.30
underground structure work areas	32	0.06
connective structure	251	0.44

NFIRs Data 2002

Structure Damage

damages	number	percentage
Minimum	25033	31.89283
significant	7501	9.55651
heavy	15834	20.17301
unknown	30123	38.37765

Area of origin

	number	percentage
Hallway, corridor, mall.	334	0.425526
Exterior stairway.	383	0.487954
Interior stairway.	313	0.398772
Escalator.	5	0.00637
Lobby, entrance way.	623	0.793722
Means of Egress not classified above.	495	0.630646
ASSEMBLY, SALES AREAS (groups of people)	108	0.137595
Large assembly area with fixed seats (100 or more persons).	40	0.050961
Large open room without fixed seats (100 or more persons).	47	0.059879
Small assembly area with or without fixed seats (less than 100 persons).	185	0.235696
Lounge area.	3794	4.833675
Sales, showroom area.	222	0.282835
Library.	16	0.020385
Swimming pool.	10	0.01274
FUNCTION AREAS	2760	3.516327
Sleeping room for under 5 persons.	7577	9.653336

Sleeping area for 5 or more persons.	273	0.347811
Dining area, lunchroom, cafeteria.	136	0.173268
Kitchen, cooking area.	12627	16.08719
Lavatory, locker room, cloakroom.	2484	3.164694
Laundry room, area.	3238	4.125314
Office.	534	0.680333
Personal service area.	69	0.087908
FUNCTION AREAS	80	0.101923
Laboratory.	55	0.070072
Printing or photographic room, area.	16	0.020385
First aid, treatment room.	10	0.01274
Operating room.	7	0.008918
Electronic equipment room, area.	60	0.076442
Performance, stage area.	6	0.007644
Projection room, area.	4	0.005096
Process, manufacturing area.	611	0.778433
STORAGE AREAS	1849	2.355684
Product storage room or area, storage tank, storage bin.	837	1.066364
Closet.	830	1.057446
Supply storage room or area.	958	1.220522
Records storage room, vault.	46	0.058605
Shipping, receiving, loading area.	162	0.206393
Trash or rubbish area, container.	203	0.258628
Garage, carport, vehicle storage area.	3570	4.548292
SERVICE FACILITIES	263	0.33507
Elevator, dumb-waiter.	19	0.024207
Utility shaft.	253	0.32233
Light shaft.	11	0.014014
Chute.	68	0.086634
Duct.	569	0.724924
Display window.	19	0.024207
Chimney.	141	0.179638
Conveyor.	35	0.044591
SERVICE, EQUIPMENT AREAS	757	0.964442
Machinery room, area.	413	0.526175
Heating equipment room or area, water heater area.	1676	2.135277
Switchgear area, transformer vault.	149	0.189831
Incinerator room, area.	32	0.040769
Maintenance shop, area.	411	0.523627
Test cell.	10	0.01274
Enclosure with pressurized air.	11	0.014014
STRUCTURAL AREAS	1751	2.230829
Crawl space, substructure space.	1584	2.018066
Exterior balcony, open porch.	1325	1.688092
Ceiling and floor assembly, concealed floor/ceiling space.	1242	1.582347
Ceiling and roof assembly, concealed roof/ceiling space.	2914	3.712528
Wall assembly, concealed wall space.	2746	3.49849
Exterior wall surface.	3330	4.242525
Exterior roof surface.	1352	1.72249
Awning.	93	0.118485

	number	percentage
TRANSPORTATION, VEHICLE AREAS	179	0.228052
Passenger area of transportation equipment.	63	0.080264
Trunk, load carrying area of transportation equipment.	23	0.029303
Engine area, running gear, wheel area of transportation equipment.	192	0.244614
Fuel tank, fuel line area of transportation equipment.	38	0.048413
Operating, control area of transportation equipment.	3	0.003822
Exterior exposed surface of transportation equipment.	247	0.314686
OTHER AREA OF ORIGIN	1268	1.615472
On or near railroad right of way, embankment.	14	0.017836
On or near highway, public way, street.	57	0.07262
Court, terrace, patio.	572	0.728746
Lawn, field, open area.	397	0.50579
Wildland area, woods.	32	0.040769
Multiple location, use area.	77	0.0981
Area of Origin not applicable.	493	0.628097
Area of origin unknown	8085	10.30054

Material Ignited

	number	percentage
Natural gas.	347	0.442089
LP-City Gas (LP and air mix).	476	0.606439
Manufactured gas.	265	0.337618
LP-gas.	1	0.001274
Anesthetic gas.	26	0.033125
Flammable, Combustible Liquid; insufficient information available to classify further.	5	0.00637
Class IA flammable liquid.	696	0.886726
Class IB flammable liquid.	28	0.035673
Gasoline.	5	0.00637
Class IC flammable liquid.	846	1.077831
Class II combustible liquid.	88	0.112115
Class IIIA combustible liquid.	213	0.271369
Class IIIB combustible liquid.	31	0.039495
Volatile Solid, Chemical; insufficient information available to classify further	1894	2.413016
Fat, grease (food).	57	0.07262
Grease (nonfood).	1526	1.944172
Polish.	13	0.016562
Adhesive, resin, tar.	212	0.270095
Applied paint, varnish.	182	0.231874
Combustible metal.	140	0.178364
Solid chemical (specify type).	42	0.053509
Polyurethane.	21	0.026755
Rubber.	5416	6.900154
Cork.	966	1.230714
Leather.	262	0.333796
Grass, leaves, hay, straw.	5	0.00637
Grain, natural fiber (pre-process).	12	0.015288
Coal, coke, briquettes, peat.	589	0.750405
Food, starch.	93	0.118485
Tobacco.	65	0.082812

	number	percentage
Wood, Paper; insufficient information available to classify further.	865	1.102037
Growing wood.	59	0.075168
Felled but unsawn wood.	2413	3.074238
Sawn wood.	385	0.490502
Wood shavings.	196	0.24971
Hardboard, plywood.	9733	12.40015
Fiberboard (low density material), wood pulp.	1535	1.955638
Paper, untreated, uncoated.	2008	2.558255
Cardboard.	65	0.082812
Fabric, Textile, Fur; insufficient information available to classify further.	2022	2.576092
Man-made fabric, fiber, finished goods.	700	0.891822
Fur, silk, other fabric, finished goods.	1294	1.648597
Wig.	8461	10.77958
Human hair.	47	0.059879
Fabric, Textile, Fur not classified above.	2	0.002548
Material Compounded with Oil; insufficient information available to classify further.	1	0.001274
Linoleum.	143	0.182186
Asphalt treated material.	152	0.193653
Type of Material not classified above.	2252	2.869119
Unknown	31636	40.30526

structure type

type	number	percentage
Enclosed building	75964	96.78052
open structure	1671	2.128906
tent	30	0.038221
open platform	253	0.32233
underground structure work areas	57	0.07262
connective structure	516	0.6574

NFIRs Data 2003

Structure Damage

damages	number	percentage
Minimum	34774	30.96996
Significant	10344	9.212436
Heavy	22455	19.99858
Uknown	44710	39.81903

Areas of origin

	number	percent
MEANS OF EGRESS	2266	2.018115
Hallway, corridor, mall.	522	0.464897
Exterior stairway.	496	0.441741
Interior stairway.	636	0.566426
Escalator.	20	0.017812
Lobby, entrance way.	911	0.811343
Means of Egress not classified above.	799	0.711595

ASSEMBLY, SALES AREAS (groups of people)	161	0.143388
Large assembly area with fixed seats (100 or more persons).	79	0.070358
Large open room without fixed seats (100 or more persons).	88	0.078373
Small assembly area with or without fixed seats (less than 100 persons).	260	0.231558
Lounge area.	5020	4.470846
Sales, showroom area.	294	0.261838
Library.	18	0.016031
Swimming pool.	15	0.013359
Sleeping room for under 5 persons.	4069	3.623879
Sleeping area for 5 or more persons.	10666	9.499212
Dining area, lunchroom, cafeteria.	394	0.350899
Kitchen, cooking area.	165	0.14695
Lavatory, locker room, cloakroom.	18200	16.20904
Laundry room, area.	3324	2.960377
Office.	4344	3.868796
Personal service area.	771	0.686658
FUNCTION AREAS	95	0.084608
Laboratory.	112	0.099748
Printing or photographic room, area.	84	0.074811
First aid, treatment room.	20	0.017812
Operating room.	10	0.008906
Electronic equipment room, area.	2	0.001781
Performance, stage area.	75	0.066796
Process, manufacturing area.	27	0.024046
STORAGE AREAS	752	0.669736
Product storage room or area, storage tank, storage bin.	2523	2.247001
Closet.	1150	1.024198
Supply storage room or area.	1122	0.999261
Records storage room, vault.	1317	1.172929
Shipping, receiving, loading area.	55	0.048983
Trash or rubbish area, container.	206	0.183465
Garage, carport, vehicle storage area.	257	0.228886
Storage Areas not classified above.	4473	3.983684
SERVICE FACILITIES	1	0.000891
Elevator, dumb-waiter.	393	0.350008
Utility shaft.	54	0.048093
Light shaft.	411	0.366039
Chute.	22	0.019593
Duct.	110	0.097967
Display window.	842	0.749891
Chimney.	38	0.033843
Conveyor.	98	0.087279
SERVICE, EQUIPMENT AREAS	53	0.047202
Machinery room, area.	1165	1.037557
Heating equipment room or area, water heater area.	495	0.44085
Switchgear area, transformer vault.	2096	1.866712
Incinerator room, area.	218	0.194152
Maintenance shop, area.	58	0.051655
Test cell.	573	0.510318
Enclosure with pressurized air.	7	0.006234

Enclosure with enriched oxygen atmosphere.	20	0.017812
STRUCTURAL AREAS	1	0.000891
Crawl space, substructure space.	2506	2.231861
Exterior balcony, open porch.	2129	1.896102
Ceiling and floor assembly, concealed floor/ceiling space.	1700	1.514032
Ceiling and roof assembly, concealed roof/ceiling space.	1875	1.669888
Wall assembly, concealed wall space.	3719	3.312167
Exterior wall surface.	3539	3.151857
Exterior roof surface.	4219	3.75747
Awning.	1674	1.490876
TRANSPORTATION, VEHICLE AREAS	156	0.138935
Passenger area of transportation equipment.	238	0.211964
Trunk, load carrying area of transportation equipment.	72	0.064124
Engine area, running gear, wheel area of transportation equipment.	30	0.026718
Fuel tank, fuel line area of transportation equipment.	215	0.19148
Operating, control area of transportation equipment.	59	0.052546
Exterior exposed surface of transportation equipment.	3	0.002672
OTHER AREA OF ORIGIN	302	0.268963
On or near railroad right of way, embankment.	1763	1.57014
On or near highway, public way, street.	9	0.008015
Court, terrace, patio.	71	0.063233
Lawn, field, open area.	680	0.605613
Wildland area, woods.	466	0.415023
Multiple location, use area.	53	0.047202
Area of Origin not applicable.	13059	11.63043
Unknown	1293	1.151555

Material Ignited

	number	percentage
Type of Material undetermined or not reported	3884	3.459117
Gas; insufficient information available to classify further.	467	0.415913
Natural gas.	646	0.575332
LP-City Gas (LP and air mix).	383	0.341102
Manufactured gas.	1	0.000891
LP-gas.	60	0.053436
Anesthetic gas.	9	0.008015
Flammable, Combustible Liquid; insufficient information available to classify further.	912	0.812233
Class IA flammable liquid.	39	0.034734
Class IB flammable liquid.	13	0.011578
Gasoline.	1084	0.965418
Class IC flammable liquid.	104	0.092623
Class II combustible liquid.	291	0.259167
Class IIIA combustible liquid.	40	0.035624
Class IIIB combustible liquid.	2614	2.328046
Volatile Solid, Chemical; insufficient information available to classify further	89	0.079264
Fat, grease (food).	1967	1.751824
Grease (nonfood).	12	0.010687
Polish.	233	0.207511
Adhesive, resin, tar.	192	0.170996

Applied paint, varnish.	201	0.179012
Combustible metal.	63	0.056108
Solid chemical (specify type).	24	0.021375
Polyurethane.	7130	6.350026
Natural Product; insufficient information available to classify further.	1212	1.079415
Rubber.	334	0.297463
Cork.	7	0.006234
Leather.	18	0.016031
Grass, leaves, hay, straw.	678	0.603831
Grain, natural fiber (pre-process).	79	0.070358
Coal, coke, briquettes, peat.	63	0.056108
Food, starch.	1249	1.112368
Tobacco.	77	0.068577
Wood, Paper; insufficient information available to classify further.	3241	2.886457
Growing wood.	484	0.431054
Felled but unsawn wood.	284	0.252932
Sawn wood.	12594	11.2163
Wood shavings.	2285	2.035036
Hardboard, plywood.	2655	2.364561
Fiberboard (low density material), wood pulp.	68	0.060561
Paper, untreated, uncoated.	2546	2.267485
Cardboard.	954	0.849639
Fabric, Textile, Fur; insufficient information available to classify further.	1702	1.515813
Man-made fabric, fiber, finished goods.	11221	9.993499
Fur, silk, other fabric, finished goods.	48	0.042749
Wig.	2	0.001781
Human hair.	10	0.008906
Fabric, Textile, Fur not classified above.	206	0.183465
Material Compounded with Oil; insufficient information available to classify further.	231	0.20573
Linoleum.	43	0.038296
Oil cloth.	28	0.024937
Asphalt treated material.	288	0.256495
Type of Material not classified above.	3194	2.844598

Structure Type

	number	percentage
Enclosed building	108679	96.79025
open structure	2441	2.173971
tent	40	0.035624
open platform	361	0.321509
underground structure work areas	101	0.089951
connective structure	661	0.588691

NFIRs Data 2004

Structure Damage

damages	number	percentage
Minimum	40261	30.85418
significant	12215	9.361014

	number	percentage
heavy	26292	20.14898
Unknown	51720	39.63583

Area of origin

	number	percentage
MEANS OF EGRESS	2926	2.242352
Hallway, corridor, mall.	711	0.544878
Exterior stairway.	577	0.442186
Interior stairway.	714	0.547177
Escalator.	27	0.020692
Lobby, entrance way.	1013	0.776317
Means of Egress not classified above.	826	0.633008
ASSEMBLY, SALES AREAS (groups of people)	208	0.159402
Large assembly area with fixed seats (100 or more persons).	85	0.06514
Large open room without fixed seats (100 or more persons).	100	0.076635
Small assembly area with or without fixed seats (less than 100 persons).	287	0.219944
Lounge area.	5893	4.516124
Sales, showroom area.	369	0.282785
Library.	11	0.00843
Swimming pool.	10	0.007664
FUNCTION AREAS	4610	3.532892
Sleeping room for under 5 persons.	12312	9.43535
Sleeping area for 5 or more persons.	499	0.382411
Dining area, lunchroom, cafeteria.	186	0.142542
Kitchen, cooking area.	21567	16.52796
Lavatory, locker room, cloakroom.	4053	3.106033
Laundry room, area.	5157	3.952088
Office.	932	0.714242
Personal service area.	111	0.085065
FUNCTION AREAS	139	0.106523
Laboratory.	94	0.072037
Printing or photographic room, area.	15	0.011495
First aid, treatment room.	17	0.013028
Operating room.	5	0.003832
Electronic equipment room, area.	70	0.053645
Performance, stage area.	23	0.017626
Projection room, area.	4	0.003065
Process, manufacturing area.	899	0.688952
STORAGE AREAS	2789	2.137361
Product storage room or area, storage tank, storage bin.	1262	0.967139
Closet.	1370	1.049905
Supply storage room or area.	1453	1.113512
Records storage room, vault.	55	0.042149
Shipping, receiving, loading area.	242	0.185458
Trash or rubbish area, container.	330	0.252897
Garage, carport, vehicle storage area.	5265	4.034854
SERVICE FACILITIES	415	0.318037
Elevator, dumb-waiter.	73	0.055944
Utility shaft.	482	0.369383

	number	percentage
Light shaft.	25	0.019159
Chute.	105	0.080467
Duct.	927	0.71041
Display window.	44	0.03372
Chimney.	64	0.049047
Conveyor.	93	0.071271
SERVICE, EQUIPMENT AREAS	1283	0.983232
Machinery room, area.	613	0.469775
Heating equipment room or area, water heater area.	2430	1.86224
Switchgear area, transformer vault.	257	0.196953
Incinerator room, area.	71	0.054411
Maintenance shop, area.	567	0.434523
Test cell.	14	0.010729
Enclosure with pressurized air.	20	0.015327
STRUCTURAL AREAS	2837	2.174146
Crawl space, substructure space.	2296	1.759549
Exterior balcony, open porch.	2001	1.533474
Ceiling and floor assembly, concealed floor/ceiling space.	2157	1.653026
Ceiling and roof assembly, concealed roof/ceiling space.	4421	3.388051
Wall assembly, concealed wall space.	4037	3.093771
Exterior wall surface.	4754	3.643247
Exterior roof surface.	1951	1.495157
Awning.	160	0.122617
TRANSPORTATION, VEHICLE AREAS	256	0.196187
Passenger area of transportation equipment.	92	0.070505
Trunk, load carrying area of transportation equipment.	22	0.01686
Engine area, running gear, wheel area of transportation equipment.	279	0.213813
Fuel tank, fuel line area of transportation equipment.	40	0.030654
Operating, control area of transportation equipment.	5	0.003832
Exterior exposed surface of transportation equipment.	331	0.253663
OTHER AREA OF ORIGIN	2054	1.574091
On or near railroad right of way, embankment.	25	0.019159
On or near highway, public way, street.	82	0.062841
Court, terrace, patio.	870	0.666728
Lawn, field, open area.	577	0.442186
Wildland area, woods.	62	0.047514
Multiple location, use area.	159	0.12185
Area of Origin not applicable.	665	0.509625
Uknown	14961	11.46542

Materials ignited

	number	percentage
Type of Material undetermined or not reported	4638	3.55435
Gas; insufficient information available to classify further.	474	0.363252
Natural gas.	761	0.583195
LP-City Gas (LP and air mix).	384	0.29428
Manufactured gas.	2	0.001533
LP-gas.	51	0.039084
Anesthetic gas.	6	0.004598
Flammable, Combustible Liquid; insufficient information available to classify further.	1116	0.855251

Class IA flammable liquid.	39	0.029888
Class IB flammable liquid.	7	0.005364
Gasoline.	1221	0.935718
Class IC flammable liquid.	86	0.065906
Class II combustible liquid.	344	0.263626
Class IIIA combustible liquid.	49	0.037551
Class IIIB combustible liquid.	3146	2.41095
Volatile Solid, Chemical; insufficient information available to classify further	114	0.087364
Fat, grease (food).	2270	1.739624
Grease (nonfood).	11	0.00843
Polish.	264	0.202317
Adhesive, resin, tar.	198	0.151738
Applied paint, varnish.	190	0.145607
Combustible metal.	77	0.059009
Solid chemical (specify type).	16	0.012262
Radioactive material.	1	0.000766
Polyurethane.	8263	6.332383
Rubber.	1317	1.009288
Cork.	388	0.297345
Leather.	8	0.006131
Grass, leaves, hay, straw.	30	0.022991
Grain, natural fiber (pre-process).	717	0.549476
Coal, coke, briquettes, peat.	114	0.087364
Food, starch.	97	0.074336
Tobacco.	1403	1.075195
Wood, Paper; insufficient information available to classify further.	80	0.061308
Growing wood.	3870	2.96579
Felled but unsawn wood.	597	0.457513
Sawn wood.	369	0.282785
Wood shavings.	14173	10.86154
Hardboard, plywood.	2571	1.970296
Fiberboard (low density material), wood pulp.	3105	2.379529
Paper, untreated, uncoated.	102	0.078168
Cardboard.	3007	2.304426
Fabric, Textile, Fur; insufficient information available to classify further.	1106	0.847588
Man-made fabric, fiber, finished goods.	2011	1.541138
Fur, silk, other fabric, finished goods.	12972	9.941144
Wig.	49	0.037551
Human hair.	2	0.001533
Fabric, Textile, Fur not classified above.	9	0.006897
Material Compounded with Oil; insufficient information available to classify further.	224	0.171663
Linoleum.	233	0.17856
Oil cloth.	51	0.039084
Asphalt treated material.	43	0.032953
Type of Material not classified above.	3854	2.953528
Unknown	19717	15.1102

Structure type

	number	percentage
Enclosed building	126307	96.79587
open structure	2810	2.153455
tent	57	0.043682
open platform	406	0.31114
underground structure work areas	106	0.081234
connective structure	802	0.614616

NFIRs Data (averages 1990-2004)

Area of Origin	Average 1990-2004
Means of Egress	3.12975
Assembly, Sales Areas	4.607125
Function Areas (sleeping, kitchen, etc)	24.40539
Function Areas (laboratory, etc.)	3.093394
Storage Areas	15.30354
Service Facilities	2.246183
Service, Equipment Areas	5.436019
Structural Areas	13.98335
Transportation, Vehicle Areas	9.667235
Other Areas of Origin	17.89068
Type of Material Ignited	
Gas	2.218369
Flammable, Combustible Liquid	6.792603
Volatile Solid, Chemical	6.990576
Natural Product	8.137504
Wood, Paper	25.0864
Fabric, Textile, Fur	9.64206
Material Compounded with Oil	1.378411
Other, Material not Classified Above	39.754
Area of Origin- Structural Areas	
Crawl space, substructure space.	1.28%
Exterior balcony, open porch.	1.10%
Ceiling and floor assembly, concealed floor/ceiling space.	1.24%
Ceiling and roof assembly, concealed roof/ceiling space.	2.50%
Wall assembly, concealed wall space.	1.86%
Exterior wall surface.	3.03%
Exterior roof surface.	1.57%
Awning.	0.26%
Structural Areas not classified above.	0.63%
Function Areas	
Sleeping room for under 5 persons.	4.57%
Sleeping area for 5 or more persons.	1.00%
Dining area, lunchroom, cafeteria.	1.66%
Kitchen, cooking area.	7.52%
Lavatory, locker room, cloakroom.	3.63%

Laundry room, area.	**2.68%**
Office.	**1.35%**
Personal service area.	**0.16%**
Storage Areas	
Product storage room or area, storage tank, storage bin.	**2.01%**
Closet.	**0.54%**
Supply storage room or area.	**1.70%**
Records storage room, vault.	**0.12%**
Shipping, receiving, loading area.	**0.91%**
Trash or rubbish area, container.	**4.93%**
Garage, carport, vehicle storage area.	**3.21%**
Storage Areas not classified above.	**1.54%**
Transportation, Vehicle Areas	
Passenger area of transportation equipment.	**1.53%**
Trunk, load carrying area of transportation equipment.	**0.42%**
Engine area, running gear, wheel area of transportation equipment.	**6.54%**
Fuel tank, fuel line area of transportation equipment.	**0.24%**
Operating, control area of transportation equipment.	**0.19%**
Exterior exposed surface of transportation equipment.	**0.60%**
Transportation, Vehicle Areas not classified above.	**0.50%**

Type of Material Ignited

Growing wood.	0.68%
Felled but unsawn wood.	2.35%
Sawn wood.	7.18%
Wood shavings.	2.93%
Hardboard, plywood.	1.37%
Fiberboard (low density material), wood pulp.	0.95%
Paper, untreated, uncoated.	4.93%
Cardboard.	2.01%
Wood, Paper; insufficient information available to classify further.	1.76%

Natural Product

Rubber.	1.79%
Cork.	0.05%
Leather.	0.14%
Grass, leaves, hay, straw.	3.20%
Grain, natural fiber (pre-process).	0.37%
Coal, coke, briquettes, peat.	0.30%
Food, starch.	0.70%
Tobacco.	0.68%
Natural Product; insufficient information available to classify further.	0.64%

Fabric, Textile, Fur

Man-made fabric, fiber, finished goods.	3.60%
Fur, silk, other fabric, finished goods.	0.93%
Wig.	0.03%
Human hair.	0.04%
Fabric, Textile, Fur; insufficient information available to classify further.	2.64%

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Safety Precautions Table 1									
Unknown	61.84%	59.42%	77.14%	58.73%	58.49%	50.00%	25.58%	51.02%	33.33%
With Sprinklers and Detectors	3.95%	8.70%	2.86%	4.76%	3.77%	8.70%	9.30%	6.12%	7.84%
With Sprinklers Only	5.26%	1.45%	1.43%	3.17%	3.77%	2.17%	6.98%	2.04%	11.76%
With Detectors Only	9.21%	5.80%	7.14%	11.11%	9.43%	17.39%	9.30%	8.16%	25.49%
Without Detectors and Sprinklers	19.74%	24.64%	11.43%	22.22%	24.53%	21.74%	48.84%	32.65%	21.57%

Safety Precautions Table 2	1999	2000	2001	2002	2003	2004	**Average across across total years tracked**
Unknown	21.30%	21.20%	22.81%	22.18%	26.27%	26.12%	41.03%
With Sprinklers and Detectors	2.78%	2.30%	1.89%	2.82%	2.15%	2.42%	4.69%
With Sprinklers Only	3.70%	3.23%	2.40%	3.21%	2.93%	2.88%	3.76%
With Detectors Only	39.81%	37.33%	42.37%	41.54%	41.00%	43.00%	23.21%
Without Detectors and Sprinklers	32.41%	35.94%	30.53%	30.26%	27.65%	25.59%	27.32%

Detectors (by type)	1999	2000	2001	2002	2003	2004	**Average across total years tracked**
Smoke Detection	37	61	200	262	392	473	73.56%
Heat detection	0	1	1	2	3	3	0.57%
Combo Smoke/Heat	2	1	7	11	11	13	2.79%
Sprinkler/waterflow	0	2	1	1	9	2	0.90%
Undetermined	3	14	35	40	53	66	20.17%
Other	1	2	3	8	8	11	2.02%
Total	43	81	247	324	476	568	100.00%