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Clothes Dryer Fires in Residential Buildings

Findings:

- Clothes dryer fires account for about 15,600 structure fires, 15 deaths, and 400 injuries annually.
- Eighty percent of clothes dryer fires in structures occur in residential buildings.
- Annually, 12,700 clothes dryer fires occur in residential buildings resulting in 15 deaths and 300 injuries.
- "Failure to clean" is the leading factor contributing to clothes dryer fires in residential buildings.
- New home construction trends place clothes dryers and washing machines in more hazardous locations away from outside walls such as bedrooms, second-floor hallways, bathrooms, and kitchens.

For many households and other establishments, the clothes dryer is an indispensable convenience and necessity. However, if clothes dryers are not properly installed or maintained, critical fires can occur. Using the latest 3 years of data, from 2002 to 2004, the yearly national fire loss for clothes dryer fires in structures is estimated at $99 million. Each year, these losses result from an estimated 15,600 fires that required a fire department response. These clothes dryer fires cause an annual average of approximately 400 injuries and 15 fatalities.[1,2,3]

Fire Rates Attributed to Clothes Dryers

Dryer fires in nonresidential buildings are far more injurious than those in their residential counterparts. The injury rates resulting from nonresidential building dryer fires is 78% higher than the injury rate for dryer fires in residential buildings. Dollar loss per fire, however, is higher (by 23%) for residential building dryer fires (Table 1). Nonresidential buildings generally can include large occupancy-type buildings such as hospitals, schools, institutions, service areas, or stores, where the incidence of even a small fire could affect more people. The only deaths reported to the National Fire Incident Reporting System (NFIRS), however, occurred in residential buildings.

NFIRS data show that 80% of clothes dryer fires in structures occur in residential buildings and resulted in approximately 12,700 fires, 15 deaths, 300 injuries, and $88 million in property loss each year.[4,5] As the residential portion of these fires predominates, the primary focus of this analysis will involve fires in residential buildings, which include single or multifamily dwellings, mobile homes, hotels and motels, dormitory-type residences, barracks, and other such occupancies.

Table 1. Loss Measures for Clothes Dryer Fires in Buildings [All fires, 3-year average (2002–2004)]

Measure	All Buildings	Non-residential Buildings	Residential Buildings
Loss per fire	$8,891	$7,462	$9,176
Injuries per 1000 fires	37.2	58.9	33.0
Deaths per 1000 fires	1.0	0.0	1.2

Source: NFIRS 5.0 data only; Loss per fire is computed for only those fires where loss information was provided.

The Hows and Whys of a Dryer Fire

A clothes dryer works by forcing hot air through a turning drum. Wet clothes placed in the drum are then dried by the moving hot air. It is possible for a full load of wet clothes to contain as much as one and a half gallons of water.[6] Lint is created from the clothes as the water is removed and the clothes dry. While much of the lint is trapped by the dryer's filter, lint also is carried through the venting system, together with moist air.[7] The accumulation of lint, both in the dryer and in the dryer vent, reduces the airflow and creates a highly flammable fuel source.[8]

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In addition to the accumulation of lint, blockage in dryer exhaust vents also can occur from the nests of small birds and animals or from bends in the venting system itself. A compromised vent will not exhaust properly to the outside. Overheating may result. If enough heat is produced to ignite the lint itself or nearby combustible items, such as the clothes in the dryer or combustibles left nearby, the engineered safety mechanisms are compromised and fire ensues.

Where Residential Clothes Dryer Fires Occur

One- and two-family residences account for 81% of residential building dryer fires. Only 13% of dryer fires occur in multifamily homes, and even fewer dryer fires occur in hotels and motels (4%). The remaining 2% of residential properties include boarding and rooming homes, sororities and fraternities, dormitories, barracks, and other residences.

According to the NFIRS data, 83% of clothes dryer fires occur in a "laundry area." However, a precise location for the laundry area within the residence is not provided. Traditionally, laundry areas were adjacent to utility areas, often in a basement or garage. In current housing, however, laundry areas can be in the bedroom area, kitchen and family room areas, hallways, closets, and other areas of convenience for the homeowner. Based on the standard NFIRS data, further investigation of the actual location in the home of residential building dryer fires, therefore, cannot be pursued.

When Residential Clothes Dryer Fires Occur

People typically do laundry at all times of the day and all year long. Clothes dryer fires increase in frequency beginning in the early morning and occur fairly regularly between the hours of 8 a.m. and midnight. There is a constant peak between noon and 5 p.m. and again after the dinner hour (Figure 1). Interestingly, as shown in Figure 2, the peak month for clothes dryer fires is January. Notably, clothes dryer fires show a slight increase during the winter and spring months from November until the end of April. The quantity and type of clothing worn in cooler months may be the defining factor in the monthly occurrence of dryer fires.

Leading Factors Contributing to Residential Building Dryer Fires

Proper maintenance for clothes dryers involves removing the lint from the traps, vents, and surrounding areas of the dryer. Not unexpectedly, the leading factor contributing to ignition for dryer fires is operation deficiencies (Figure 3)—specifically "failure to clean." Failure to clean accounts for 70% of dryer fire operational deficiency contributing factors.

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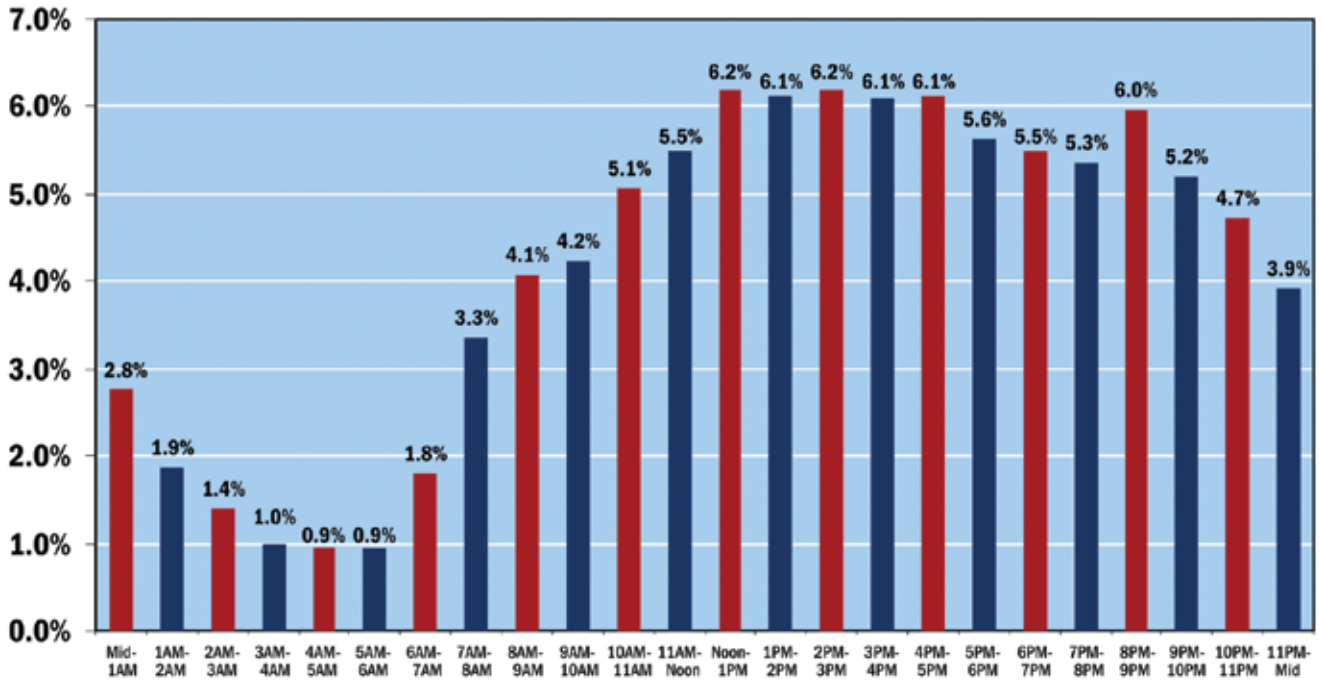
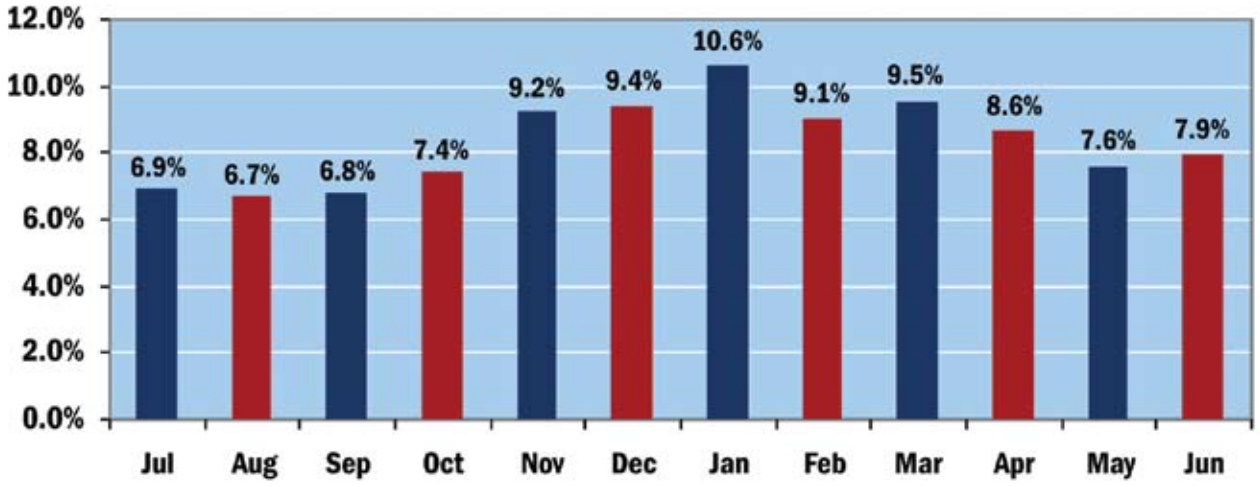
Figure 1. Time of Alarm
Residential Building Clothes Dryer Fires 2002-2004



Source: NFIRS 5.0 data

Figure 2. Month of Occurrence
Residential Building Clothes Dryer Fires 2002-2004



Source: NFIRS 5.0 data

Other leading factors contributing to dryer fires include "mechanical failure," "electrical failure," and "misuse of material or product." A clothes dryer that has to work harder to evacuate lint and moisture can trigger enough heat to cause some dryer components to malfunction and can sometimes produce sparks or even flames. The overheating can sometimes produce enough heat to ignite lint or other nearby combustibles.[9,10,11]

As a good fire safety practice, combustibles such as clothing, boxes, and other items should not be placed near or around the clothes dryer.[12] In addition, synthetic materials are more combustible than natural materials—they ignite at lower temperatures and burn at much higher temperatures. For example, anything made of plastic, rubber or foam should not be placed in the drum for drying.

Items First Ignited and Fire Spread in Clothes Dryers

Not unexpectedly, the two leading items first ignited are "wearing apparel not on a person" (the clothes in the dryer) and "dust, fiber, lint etc.," which combined account for slightly over half (56%) of the fires as shown in Figure 4 on page 4.

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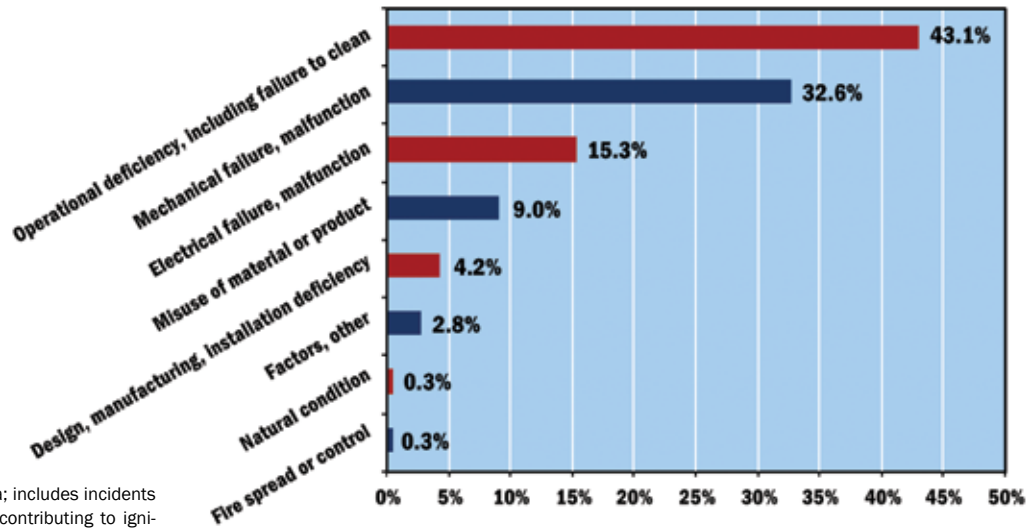
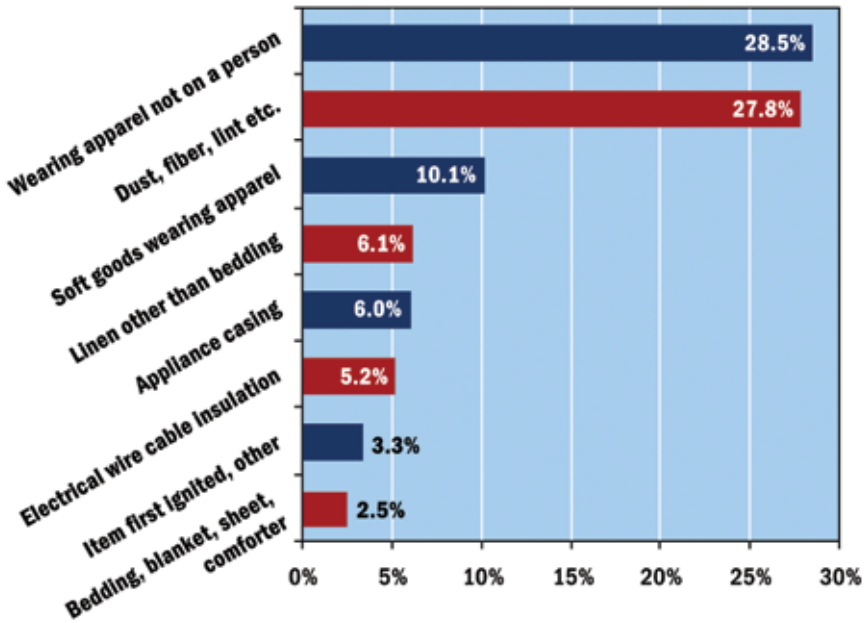
Figure 3. Factors Contributing to Ignition
Residential Building Clothes Dryer Fires 2002-2004



Source: NFIRS 5.0 data; includes incidents where factors contributing to ignition were specified.

Figure 4. Leading Items First Ignited
Residential Building Clothes Dryer Fires, 2002–2004



Source: NFIRS 5.0 data; includes incidents where the item first ignited was specified.

Generally, 62% of clothes dryer fires remain confined to the object of origin and 27% are confined to the room of origin. Less than 4% of fires remain confined to the floor of origin. However, the percentage of fires confined to the building of origin increases slightly to 7%. The likelihood of dryer fires spreading beyond the building is very small—less than 1% of these fires extend beyond the building of origin. The average dollar loss per fire confined to the object and the room of origin is less than $5,000 as show in Table 2.

Clothes Dryer Venting Systems

For optimal venting the exhaust should vent directly outside the house.[13] New construction trends now situate washers and dryers in nontraditional areas of the house, such as upstairs bedrooms, hallways, bathrooms, kitchens, and closets. These new sites generally require longer dryer vents in order to reach an outside wall. These routes contain sharp turns and bends that navigate through the structure of the home. Dryer vents cannot be longer than the equivalent of 25 feet (5 feet is added to the actual vent length for each 90-degree bend in the vent).[14] When lint has to pass through an exhaust that is under a floor or through walls and is more than 6-feet long, it is almost impossible to propel all the lint out of the vent.[15] As a result, lint can accumulate in pockets along the vent where they are harder to reach and clean. Thus, it is crucial for homeowners to also regularly inspect and clean out the dryer vent.

All manufacturers now state in their manuals not to use plastic flexible dryer ducts between the vent and the clothes dryer. However, many homes, as well as some new construction homes, continue to use plastic flexible ducts.[16] The plastic itself can provide additional fuel for a fire. Even flexible foil

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Table 2. Dollar Loss per Clothes Dryer Fire by Fire Spread
[Residential Buildings, 3-year average (2002–2004)]

Measure	Flame Spread Confined to:				
	Confined to object of origin	Confined to room of origin	Confined to floor of origin	Confined to building of origin	Beyond building of origin
Clothes dryer loss per fire	$2,420	$4,742	$28,971	$63,822	$65,665
Percent of fires	61.8%	26.5%	3.8%	7.4%	.5%

Source: NFIRS 5.0 data only; Loss per fire is computed for only those fires where loss information was provided.

vents are not the best choice for venting clothes dryers. Flexible vents can sag, allowing lint to build up and catch on fire if it comes in contact with a sufficient amount of heat. If a fire starts beneath the dryer when the motor overheats, then the drafts from the dryer can pull that fire up into the duct and venting allowing a house fire to develop.[17]

Other extremely serious dryer hazards occur when dryer vents do not terminate exhaust at all to the outside. Faulty installations can vent dryer exhaust to the attic, crawl space, chimney or interior walls, which can cause indoor air deterioration and mold buildup.[18] Small birds and animals that nest in dryer vents also can obstruct air flow and prevent the lint from properly venting to the outside.[19]

Proper Dryer Maintenance

By observing a few simple indications of poor system performance, one can examine the dryer components for any blockage or excessive heat. If you notice heavy clothes such as blue jeans or towels taking a long time to dry, or clothes feel hotter than usual at the end of the cycle, then a clogged dryer vent exhaust is likely the problem.

Disconnect, clean, and inspect the dryer duct and venting every couple of years, or hire a professional company to clean the dryer components. Some dryer vents may need more frequent inspection, such as in homes with complex construction where the dryer vents exceed 6 feet from the outside, or with smaller stack dryers and dryers that are older and do not have moisture sensors or high temperature safety limit controls. This will reduce the fire risk and increase the dryer's efficiency.

Outside wall dampers should have a covering that will keep out rain, snow, and dirt. However, do not use wire screen or cloth of any kind to protect the exhaust opening. It can collect lint and clog areas of the dryer vent. In order to deter birds and small animals from nesting in vents, make sure the dryer vent system and damper are working suitably.[20] Several recommendations for clothes dryer safety include the following:

- Never put synthetic materials such as rubber, plastic, foam, or pieces of cloth that have been used to sponge up flammable liquids in the dryer, even if previously washed.
- Clean the lint out of the exhaust pipe and the rear of the dryer regularly.
- Inspect your lint filter for rips each time you use it. If you see any rips, replace immediately.
- The exhaust pipe should be as short as possible and have limited bends to allow for adequate airflow.
- The American Household Appliance Manufacturers Association (AHAM) recommends the use of UL-approved rigid aluminum or steel duct or spiral-wound aluminum flex hose, NOT white vinyl hose.
- Never let your clothes dryer run while you are out of the house or asleep.
- Have gas-powered dryers inspected by a professional annually to ensure that the gas line and connection are intact.

Examples

Clothes dryer fires, small and large, can have devastating consequences. Below are four examples of such fires:

- On December 12, 2005, a woman suffered severe burns after the clothes dryer in her Deerfield Beach, Florida, home exploded.[21]
- On November 16, 2006, a clothes dryer caught fire and caused $3,000 in damage to a China Grove, North Carolina, laundromat.[22]
- On December 13, 2005, a Tuesday morning clothes dryer fire in Hialeah, Florida, left a family homeless. The family said the fire was caused by lint in the ventilation duct.[23]
- On January 26, 2006, according to a Suffolk, Virginia, fire report, a blaze was caused by an obstructed dryer-vent hose. The fire was contained to the dryer, destroying the appliance and the clothes inside.[24]

Conclusion

In most cases, clothes dryer fires can be prevented. "Failure to clean" is the number one factor contributing to clothes dryer fires, followed by mechanical and electrical failure. Clogged dryer vents occurring from lint buildup may make the dryer operate incorrectly and raise the temperature of the dryer machinery high enough to ignite lint or nearby combustibles. The exhaust vent should be as short as possible and have limited bends to allow sufficient airflow. Improper items placed in the dryer, such as plastic, foam, or other synthetic materials also can increase the risk of fire. Make sure to follow the recommended safety tips for operating clothes dryers safely.

In particular, by following installation guidelines and performing regular inspections on dryer vents, consumers can protect themselves further from clothes dryer fires. Depending on the frequency of use, how long the vent is,

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or the age and type of dryer used, dryer vents need inspection on average every 2 to 3 years. [25]

If you do not feel comfortable cleaning or inspecting the dryer vent yourself, you can call a duct cleaning service. The Chimney Safety Institute of America (CSIA), a nonprofit educational organization, also provides information on clothes dryer fires and can provide a list of CSIA-certified dryer exhaust duct technicians.

A substantial proportion of clothes dryer fires are small and confined to the object and room of origin. The dollar loss generally relates to the damage to the clothes dryer itself and the clothes inside. However, the rate of injury indicates that these fires require attention, highlighting the need for residences to keep fire extinguishers and working smoke alarms near the clothes dryer. More information about how you can help prevent clothes dryer fires can be obtained from your local fire department or the USFA.

To request additional information or comment on this report, visit http://www.usfa.dhs.gov/applications/feedback/

Notes:

[1] NFIRS 5.0 contains both converted NFIRS 4.1 data and native NFIRS 5.0 data. This topical report includes only native 5.0 data. Incident type 110 (structure fire, other) is not included in this analysis as it is a "conversion only" code. That is, incident type 110 is technically a version 4.1 incident and, as such, is not included in this analysis.

[2] National structure fire and residential building fire estimates are based on 2002-2004 native version 5.0 data from the National Fire Incident Reporting System (NFIRS) and national structure and residential structure fire loss estimates from the National Fire Protection Association's (NFPA) annual survey of fire loss. Only fires where the equipment involved was specified are used as the basis for the NFIRS dryer fire sample. Fires are rounded to the nearest 100, deaths to the nearest 5, injuries to the nearest 25, and loss to nearest $million.

[3] NFIRS has two equipment codes that are applicable to dryers: code 811 (clothes dryer) and 814 (washer/dryer combination in one frame). This analysis is based on equipment that is exclusively clothes dryers, equipment code 811.

[4] In NFIRS 5.0, a structure is a constructed item of which a building is one type. The term "residential structure" commonly refers to buildings where people live. The definition of a residential structure fire has therefore changed to include only those fires where the NFIRS 5.0 structure type is 1 or 2 (enclosed building and fixed portable or mobile structure) with a residential property use. Such fires are referred to as "residential buildings" to distinguish these buildings from other structures on residential properties that may include fences, sheds, and other nonhabitable structures. In addition, incidents that have a residential property use, but do not have a structure type specified are presumed to be buildings.

[5] Incident type 110 (structure fire, other) is not included in this analysis as it is a "conversion only" code. That is, incident type 110 is technically a version 4.1 incident and, as such, is not included in this analysis.

[6] Al's Home Improvement Center, "Venting Clothes Dryers," http://www.alsnetbiz.com/homeimprovement/dryervent.html

[7] ibid.

[8] The Laundry Alternative, "Clothes Dryer Fire Prevention," www.laundry-alternative.com/clothes_dryer_fire.htm

[9] NBC6.net, "Woman Severely Burned When Clothes Dryer Explodes," December 12, 2005, http://www.nbc6.net/news/5520232/detail.html

[10] Al's Home Improvement Center, op. cit.

[11] Wiranews.com, "Are Your Clothes Slow to Dry? Safety Tips for Clothes Dryers," http://www.wiranews.com/content/view/260/27/

[12] City of Reno, "Leaving Residence With Appliances Operating is Like Playing Russian Roulette with Fire," http://www.cityofreno.com/gov/news/?newsid=17277

[13] Builder's Best, "Do I Have to Vent My Dryer to the Outside?" www.buildersbest.com/indoor.htm

[14] Colonial Plumbing & Heating, "Dryer Fire Fact Sheet," http://www.colonialplumbing.com/webapp/GetPage?pid=113

[15] WHNT-TV, Huntsville, AL, "Could Your Dryer Catch on Fire?" February 28, 2005, http://www.whnt.com/Global/story.asp?S=3014579&nav=1VPtWxLv

[16] Al's Home Improvement Center, op. cit.

[17] Colonial Plumbing & Heating, op. cit.

[18] Builder's Best, op. cit.

[19] Wiranews.com, op. cit.

[20] Al's Home Improvement Center, op. cit.

[21] NBC6.net, op. cit.

[22] Salisbury Post, "Clothes Dryer Catches on Fire in China Grove Laundromat," November 16, 2006 http://www.salisburypost.com/area/300138938970475.php

[23] NBC6.net, "Family Left Homeless After Clothes Dryer Fire," December 13, 2005, http://www.nbc6.net/news/5528137/detail.html

[24] Suffolk News, "Firefighter at the Right Place at the Right Time," January 26, 2006, http://www.suffolknewsherald.com/articles/2006/01/27/news/news1.txt

[25] Colonial Plumbing & Heating, op. cit.