"One in six laundries report fires each year.
One in three laundry managers have experienced facility fires.
Polyethylene carts are a serious contributor to facility fires."

Spontaneous Ignition Fires In Laundries

THE DANGEROUS AND OFTEN MISUNDERSTOOD CONTRIBUTING FACTORS

by Jim Everitt
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Inside This Report

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Although most laundry facility managers are aware of fire dangers, many remain unaware of measures they can take to significantly reduce the odds of fire in their facility. The first step is to understand what can cause the conditions for a fire to erupt. The second step is to minimize those conditions.

Midnight Blaze Strikes Prison
Chino, CA
The laundry at the California Institute for Men sustained heavy damage during an early morning fire. Investigators contribute the fire to spontaneous combustion of items which had been removed from hot dryers and placed in polyethylene plastic transport carts. The loss was estimated at $1.5 million.

Hotel Fire Causes $1.5 Million Loss
Orlando, FL
According to officials, the fire at the Marriott Orlando Hotel, which originated in the hotel laundry, was the result of linens, self-combusting in a laundry cart. The fire, which was reported about midnight, completely destroyed the building which housed the hotel's laundry and maintenance facility.

After Hours Blaze Guts Nursing Home Laundry
Litchfield, IL
The County Care Center Laundry, which served five area nursing homes, was totally destroyed in a $1.5 million fire which started several hours after the plant closed. The fire originated in the linens which had been piled in a cart. The source of ignition was spontaneous combustion caused by residual chemicals in the laundered fabric reacting to the heat of the dryer.

These are only 3 examples of the thousands of reported fires that could have been prevented, saving millions of dollars in facility damage.

"Analysis of the facts leads to the conclusion that it is not dryer heat alone, but spontaneous ignition that causes the vast majority of laundry fires.

Properly functioning dryers do not produce temperatures high enough to cause ignition. Commercial dryers must meet American National Standards Institute requirements for safe operation to obtain design certification from the American Gas Association. Utilities will not supply gas to uncertified appliances. The ANSI standard limits dryer temperature settings to a maximum of 225 degrees F. A temperature limiting mechanism must be incorporated into the drying chamber discharge temperature to less than 250 degrees F, even when the blower has failed, and the lint screen and vent is blocked. One of the required tests measures the highest temperature in the drying load in ten locations. The temperatures record cannot exceed 240 degrees F in more than five. (sic. locations) The range of minimum auto ignition temperatures for textiles is 490 degrees to 1060 degrees F. The lowest ignition temperature for any is nearly twice that allowed by the standard. Laundry fires related to the drying process, that where not malfunction of the drying system, can be demonstrated are almost certainly spontaneous ignition fires."

- John Vassiliades, The Journal, April 2000

"As a 35 year member of the Fire Prevention and Investigation community, I have noted 3 distinct times in the laundry cycle where spontaneous ignition occurs:"

1. **Laundry waiting in carts or trucks for processing**
2. **During the dryer cool-down process**
3. **Laundry removed from the dryer awaiting processing or distributio**n

What Is Spontaneous Ignition (Combustion)?

Webster defines "spontaneous ignition" as:
Self-ignition of combustible material through chemical action as oxidation of its constituents

Dr. Paula Beever, in the SFPE Handbook of Fire Prevention Engineering[5] defines spontaneous combustion as ***"the culmination of a runaway temperature rise in a body of combustible material, which arises as a result of heat generated by some process taking place within the body."***

There are 3 types of spontaneous ignition.

1. That which occurs in piles of organic material such as hay, where heat is generated by bacteria, molds and fungi.

2. Spot heating of trapped gasses and particles in a space, such as in coal mine fires.

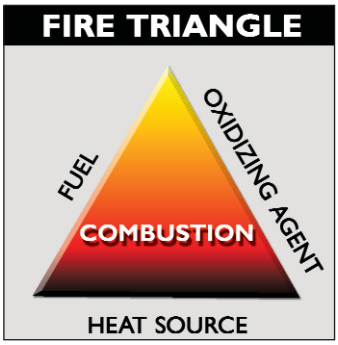
3. Materials that are reactive at normal ambient temperatures, where a heat source is not required as occurs in piles of laundry.

Spontaneous Ignition is a more complex process than short definitions can relate, and requires a series of factors that are unfortunately commonly found in laundry facilities.

In Oregon, there have been 3 large-loss exterior fires in large, a nationally prominent commercial laundry within the last 4 years. Each of these fires had components in common. In each of the fires linen and uniforms were placed in large linen carts to sit outside the building for several hours on a warm day. Two of the fires ignited in polyethylene carts; one fire ignited in a steel cage cart. These fires had the three components that lead to spontaneous ignition: fuel, contaminants, and ambient temperature in sufficient mass to insulate the heat reaction, not allowing for internal generated heat dissipation.

Further contributing to 2 of the fires, was the use of polyethylene carts. Polyethylene ignites, burns and melts at fairly low temperatures and becomes fully engaged in fire within 3 minutes, thereby further fueling the already existing fire. It should be noted that the fire loss associated with the polyethylene carts more than doubled the losses to the structures and neighboring buildings than did the fire that began in the steel cage cart.

Spontaneous ignition fires in laundries are common enough to warrant understanding how they start, so measures can be taken to minimize this threat to property and business.



In order for any fire to start, 3 conditions must be present. These conditions are fuel, an oxidizing agent and a heat source as represented by the Fire Triangle.

The following is a short discussion of each of the components that contribute to a fire ignition.

What Is Oxidation?

Oxidation is the combination of materials with oxygen that produces a breakdown of the material. In the case of fire, it is the reaction of combustible material (fuel, or "contaminates") with oxygen that produces heat release. When heat release increases, so does the temperature. As the temperature increases so does oxidation. When heat cannot be dissipated, but instead builds upon itself, fire can result depending upon how combustible the material is. The more flammable the material is, and the more dense the pile of the material is, the greater is the opportunity for fire proportionately.

Fuels Existing In Laundries

Fuel Source #1

By the very nature of the laundry industry, linens, especially those with a high cotton content, are combustible either as cloths, uniforms, rags or lint. The ignition point for these materials is referred to as the critical surface temperature. Cotton begins to oxidize at a surface temperature of 95 degrees centigrade. Oxidization (the decaying process) creates its own heat. **If materials are not allowed to cool down after the drying process, are placed in carts or folded and stored tightly, because they are hot and moist, oxidation continues. Oxidation continues to build on itself until the material reaches critical surface temperature and self-ignites.**

Fuel Source #2

Another source of fuel in laundries is contaminates held in fabric either before laundering, or traces left in the fabric after laundering such as **cleaning products, oils and fats. If the laundering process is not enough to remove these contaminates from fabric, the opportunity for fire from spontaneous ignition increases.**

Early Morning Fire Destroys Laundry

Findlay, OH

Fire officials blame spontaneous combustion of processed linens piled in a laundry cart for the 3:30 am blaze that caused an estimated $5 million damage to City Laundry. Test results indicate the clean, warm garments piled in a cart waiting to be folded during the next shift, contained traces of linseed oil.

Spontaneous ignition fires in janitorial areas, laundry processing facilities, temporary laundry storage areas, coin-op laundries and restaurants are all too common. Why? Because even small amounts of cleaning products, oils and fats in cleaning rags, mop heads and linens piled or stored tightly together cause increased spontaneous fire risk. Even if the linens, rags or mop heads have been laundered, they can still hold enough contaminate traces to add fuel to the oxidation process that causes spontaneous ignition.

The conditions for spontaneous ignition within laundries are always present. They are:

1. Heat
2. Combustible fabric
3. Substances subject to spontaneous heating

The Consumer Product Safety Commission conducted tests on cotton towels containing unsaturated cooking oils including canola, corn, sunflower and soybean. In the laundering process these oils had the potential to ignite especially when dried, folded, stacked or piled. Test results demonstrated that towels with 20% of their weight in oil after being laundered combusted in the dryer or after the towels were removed from the dryer.

The National Fire Protection Handbook lists over 70 common materials which are subject to spontaneous heating.[2] Below is a partial list of common oils that could be in commercial laundries at any time, but probably are present in varying amounts and mixtures at any given time.

Material	Danger	Conditions For Fire
Castor Oil	Slight	Fabrics in poorly ventilated piles
Coconut Oil	Slight	Dangerous in fabrics
Corn Oil	Moderate	Dangerous in heated piles
Cotton Seed Oil	Moderate	Fabrics in poorly ventilated piles
Fish Oil	High	Saturated fabrics
Lard Oil	Slight	Dangerous in fabrics
Linseed Oil	High	Extremely dangerous in saturated fabrics
Oleo Oil	Slight	May heat in saturated fabrics
Olive Oil	Moderate	Fabrics in poorly ventilated piles
Palm Oil	Low	Fabrics in poorly ventilated piles
Peanut Oil	Low	Fabrics in poorly ventilated piles
Pine Oil	Moderate	Fabrics in poorly ventilated piles
Soybean Oil	Moderate	May heat in saturated fabrics
Tung Oil	Moderate	Fabrics in poorly ventilated piles

Source: NFPA Handbook Nineteenth Edition

Fuel Source #3

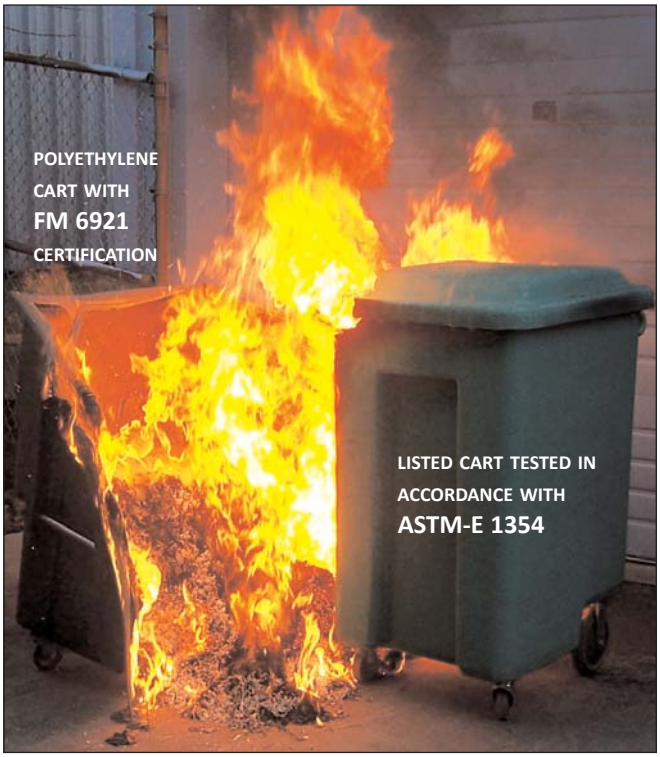
Polyethylene carts, trucks and containers are a huge contributor to fires both in numbers and severity. As mentioned earlier in this report, fires in which polyethylene carts are involved can more than double the fire loss to facilities and neighboring structures.

Numerous tests have been performed to determine how fast polyethylene containers catch fire, and how soon that fire spreads to neighboring combustible materials. Time after time, test after test, independent laboratory after independent laboratory, the results remain the same.

Carts made from polyethylene burn, release toxic gasses, melt and flow burning polyethylene liquid, adding fuel to any fire. Period. Why? They are made of petroleum based materials. They have nearly the same heat release rate as premium gasoline.

"If This Were True, It Would Be Illegal To Use Them", you might think.

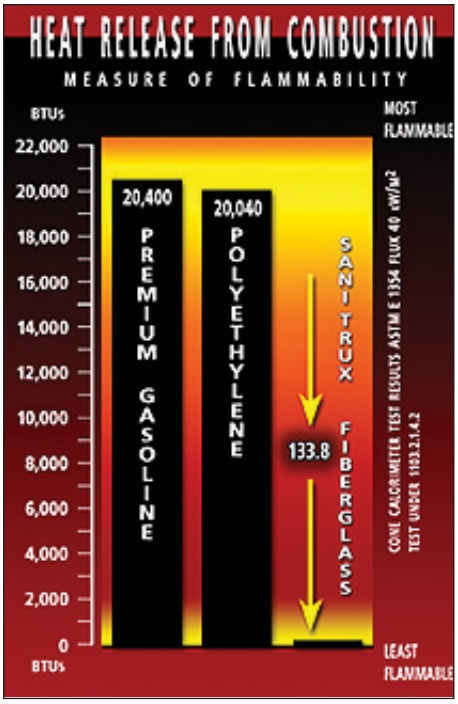
Fire Codes Have Recently Changed Because Data Supports The Proven Dangers Of Polyethylene Containers, Trucks And Carts.



Cart selection is a contributing factor in laundry fires. As previously discussed, heat, fuel and oxygen play integral roles in the combustion process. The selection of carts play a significant role on the fuel side of the fire triangle.

Consider that polyethylene is derived from petroleum and becomes a combustible liquid at relatively low temperatures, 120-130 degrees Centigrade, or 240-266 degrees Fahrenheit.

Further, comparison is necessary when you consider the fuel content of Polyethylene is 20,040 BTU per pound(4) to that of cotton at 6,894 BTU per pound. You now have added 3 times the fuel, not to mention that polyethylene burns and runs across the floor, setting other combustibles on fire at an exponential rate.



The National Fire Protection Agency (NFPA), the International Fire Code (IFC) and California Title 19 have provisions which require materials including those susceptible to spontaneous ignition to be in listed containers, which are designed to contain or suppress a fire, and not contribute additional fuels. **Codes require that listed containers obtain a certification by an independent testing laboratory according to ASTM-E 1354, a cone calorimeter test. <u>No other test is recognized as a valid fire test by fire professionals and code enforcement officers. Period.</u>**

No other certification including the often mentioned Factory Mutual 6921 certifies fire retardant materials, as many professionals erroneously believe. To not KNOW the differences between ASTM-E 1354 and FM 6921 is a fatal mistake.

Polyethylene laundry carts do NOT meet NFPA or IFC requirements because they cannot pass the cone calorimeter test specified in ASTM-E 1354.

CONE CALORIMETER TEST RESULTS
Warnock Hersey/;Intertek Testing Laboratories

POLYETHYLENE

POLYETHYLENE CART PANELS - flame spread 255.82
"Test specimen ignited shortly after flame impingement and traveled the standard 15 inches and beyond in 2 minutes, 50 seconds. Thick streams of flaming, dripping (melted polyethylene) produced a pool of flaming sample residue in the collecting tray positioned beneath the test unit. Flame heights from the flaming residue reached 2-3 feet. Test was terminated (approx 3.30) to prevent damage to test apparatus and danger to personnel. Excessive smoke generation was observed." Peak heat release and heat flux could not be determined due to test termination.

LISTED CART

SANITRUX CART PANELS - flame spread 13.60
Three tests were conducted with exposure for 15 minutes each. "Slight charring and cracking to 12" scribed line. Heat checking noted. Slight flashing was observed."
Peak heat release: 133.8kW/m2 Heat flux: 35 kW/m2
Note: better than code mandates for fire retardant classification

"It makes little sense that non-sprinklered laundries continue to operate without listed containers!"

Hospital Laundry Fire Destroys
Victoria, BC
Spontaneous combustion was blamed for the fire which gutted the Glendale Laundry. Despite the laundry's automatic alarm system, which was activated at 10:12 pm. The fire caused an estimated $2.3 million damage. Fire officials found evidence that the fire had started in three or four of a group of 25 plastic laundry carts that were filled with linen waiting to be ironed.

Heat Sources In Laundries That Contribute To Spontaneous Ignition

1. Heat from oxidation before the laundering process **when piled in carts**
2. Heat from the dryer
3. Ambient heat of the linens after drying and piled in carts **without sufficient cool-down**
4. Heat generated by **linens stored in a constantly warm place as in a sunny area thereby adding to heat contained by them from the drying process**
5. Stacks or piles of **linen still warm and moist from folding**

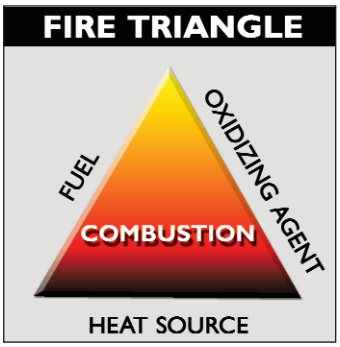
Fires associated with dryers present a more complex situation in that the dryer is a listed appliance with high temperature limitation switches. Some have moisture sensors; some have heat detectors, sprinkler systems, preprogrammed cool-down cycles and temperature settings for each type of fabric. But what is common to all dryer fires is that the wash process is insufficient to remove all the contaminants, and the human factor of rushing the cool-down process to meet deadlines or leaving laundry in the dryer is always a problem that can lead to spontaneous ignition.

Fires associated with laundry removed from the dryer are offshoots of insufficient cool down time, not being fully cleaned and contain residual moisture. When the laundry is piled or stacked together, it is not able to dissipate its heat. Because it is hot, moist and contains residual contaminates, the oxidizing process continues. If the mass of laundry is large enough to insulate the oxidizing reaction, it will ignite a fire.[3]

Neil Dennis, a CLA member in Australia, wrote to the Association last spring about a spontaneous combustion situation he viewed first-hand. He had laundered 120 oil "tea towels." When the towels finished in the dryer, he spread the hot toweling around his storage area, not wanting to leave them in a bundle, for fear of spontaneous combustion. "Thinking that I had taken all the precaution needed, I gave it no more thought, until the phone rang at 5:00 the next morning," Dennis wrote. ***"No matter how careful you are, or how many precautions you take, you can still be caught with a spontaneous combustion fire."***

Take Measures To Prevent Spontaneous Ignition Fires In Your Laundry Facility

No matter how obvious it may seem, the following steps should be taken to reduce the incident of spontaneous ignition fires. Remember the fire triangle and eliminate contributing factors.



Eliminate fuel (contaminants):

1. Evaluate wash temperatures and detergent formulations for optimum removal of contaminants.
2. Do not dry mop heads in dryer; line dry only.

Eliminate heat:

1. Train managers and workers about spontaneous ignition and contaminates susceptible to oxidizing or self-heating. [2]
2. If dryers do not have high temperature limitation switches or moisture, meters installation is recommended to monitor and regulate load temperatures.
3. Develop dryer maintenance schedules to include regular lint removal; keep a log.
4. Fire suppression systems in dryers is recommended.

Eliminate oxidation:

1. Train dryer operators regarding operating temperatures and cool-down times for each type of fabric.
2. When hot laundry is removed from the cart, process it immediately so heat does not build up in the cart. **Do not leave overnight.**
3. Process soiled laundry immediately or store away from non-sprinklered buildings in listed (fire retardant) containers to contain possible fires.

Prepare for a fire occurance:

1. Laundry buildings should have sprinkler systems and monitored early warning detection systems. [2]
2. Purchase only non-combustible or fire retardant containers that are listed and certified according to ASTM-E 1354.
3. Maintain fire extinguishers and train in their use annually.
4. Have a plan to react to fire and train regularly in its implementation. Keep records.

Conclusion: What You Should Know

Although much has been instituted by laundries of all types, fires in facilities still cause millions of dollars in physical damage, loss in down-time and physical hazards to employees. More can be done to eliminate fire occurances. Education, adherence to safety precautions and attention to conditions that contribute to spontaneous ignition will go a long way in preventing unnecessary fires.

All facility owners and managers need to be aware of recent changes to the NFPA and IFC fire codes that mandate listed (fire retardant) containers and carts be used in public facilities and in certain industries where fire hazards normally exist, such as laundries.

New IFC 2009 Code

316 Laundry Carts

316.1 Laundry carts with a capacity exceeding 1 cubic yard. Laundry carts with an individual capacity of 1 cubic yard [200 gallons (0.76 m^3)] or more, used in laundries within group B, F-1, I, and group R-1 occupancies shall be constructed of noncombustible materials or materials having a peak rate of heat release not exceeding 300 kW/m2 at a flux of 50 kW/m2 when tested in a horizontal orientation in accordance with ASTM E 1354.

Exception:

1. Laundry carts in areas protected by an approved automatic sprinkler system installed throughout in accordance with Section 903.3.1.1.

2. Laundry carts in coin-operated laundries.

For Further Information Please See The Following Reports

Cone Calorimeter:

1. Test According To ASTM-E 1354 - A brief Overview
2. "Ten Years of Heat Release Research with the Cone Calorimeter" by Dr. Vytenis Babrauskas, Fire Science and Technology Inc.

Exact Fire & Public Safety Code Language:

1. IFC Code Change For 2009 - NEW
2. NFPA-1 section 19.2.1.2, section 19.2.1.2.1 and section 19.2.1.2.2
3. California Title 19

Valid & Invalid Cart And Container Certifications:

1. Factory Mutual 6921
2. ASTM-E 1354

References:

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5. SFPE Handbook of Fire Prevention Engineering
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7. The Journal, John Vassiliades, April 2000
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