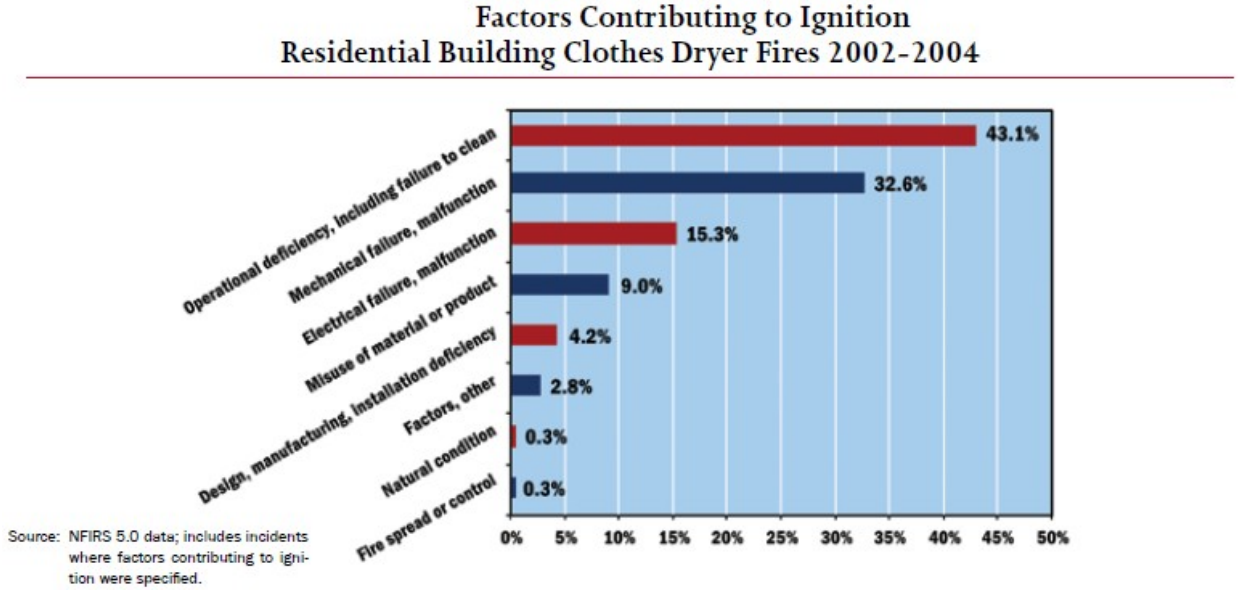
TECHNICAL ARTICLE

Proper Dryer Venting & Maintenance The Key to Reduced Fire Risk

By Skip Walker November 2009

Almost every one of us that inspects properties for a living has some pet peeves; i.e. those things that we pay special attention to - perhaps because of some special knowledge or experience. ***One*** of mine is clothes dryer venting. Dryer venting isn't a very glamorous topic, but if we look at residential clothes dryer related fires as a percentage of the total number of fires per year – it is a very significant safety concern. There are over 15,500 residential dryer related fires per year. Dryer related fires rank as a **Top Ten** cause of residential fires and are responsible for nearly **$100,000,000** per year in property losses. They are responsible for around **400 injuries** per year with an average of **15 fatalities**. Around 83% of all clothes dryer related fires occur in 1 and 2 unit single-family dwellings.



In older dwellings, the laundry is often located in the garage separated from the living areas and away from the bedrooms. In modern construction, there is a tendency to locate laundry facilities inside the living areas and often on the same floor as the sleeping areas. This increases the risk of fatalities should a dryer be left running in the evening when the occupants are sleeping.

Dryer related fires do not just occur in gas dryers, electric dryers contribute as well. Many may believe that keeping the lint trap clean is the key to the safe operation of the appliance. That is only partially true. Most dryer manufacturers recommend that the dryer side panels be removed periodically and that the interior and vent system be cleaned as part of the appliance maintenance. This is because lint does escape the vent system over time and collect around the interior components.

I randomly selected an LG Brand gas dryer and looked at the maintenance requirements. LG recommends *annual cleaning* of the dryer ***interior*** and vent system. What do you suppose the odds of that actually happening are?

Per the US Fire Administration/National Fire Incident Reporting System, the 2000-2004 statistics show that the leading cause of dryer related fires is "***Failure to Clean***." Improper dryer and vent maintenance causes around 70% of dryer related fires. Lint build-up in the dryer and vent system has a number of effects. The lint itself is highly flammable. The accumulation of lint inside the dryer and vent system restricts exhaust airflow. The restricted airflow across the dryer heat exchanger will result in an increase in air and heat exchanger temperature. Clothes dyers are equipped with over temperature cutout switches – the same as furnaces. However, prolonged exposure to high temperatures may desensitize the switches or cause outright switch failure. In that case, the system continues to operate until it becomes hot enough to ignite the lint. The lint will burn like a fuse along the dryer vent duct. Ducts often run through wall cavities, through crawlspaces and through attics. Tests conducted by a Jupiter Florida based lab measured vent fire wall cavity temperatures of around ***1000° F within 150 seconds*** of the lint ignition. The bottom line - these fires burn hot and they burn fast.

Click to See a YouTube Video Clip of a Plastic Dryer Vent Igniting

If you don't already, I suggest that including some language recommending periodic maintenance of the dryer and vent system as part of your inspection reporting. For example I use this comment:

> *Periodic Cleaning is Critical to Safe Operation of the Clothes Dryer: Lint build-up in the dryer and vent system poses a significant fire and safety risk. Dryer lint related fires are one of the top ten causes of residential appliance related fires in the US. Dryer related fires account for nearly 15,500 residential fires and around 400 injuries in the US each year. To insure the safe operation of the appliance, we recommend periodic inspection and cleaning of the dryer and vent system. Please refer to the manufacturers instructions the specific maintenance requirements for your dryer. Failure to properly maintain the appliance may potentially void any manufacturer and or homes warranty coverage and can also create unsafe operating conditions. Interested parties should consult with a qualified appliance service technician for additional information and or service.*

The CREIA Standards of Practice give us the following guidelines on what must be inspected:

7. Heating and Cooling

A. Items to be *inspected*:

1. Heating equipment
2. Central cooling equipment
3. Energy source and connections
4. Combustion air and **exhaust vent** *systems*
5. Condensate drainage

6. Conditioned air distribution *systems*

Since the clothes dryer vent is an exhaust vent system, it must be included in our inspections. The ***how*** we inspect and ***the extent of the comments*** are left to the individual inspector. I suggest considering a "***Best Practices***" approach to the inspection of all systems. In doing this, we would look at the problems a system causes and work back to the components or issues that caused the problem. Then break the inspection of the system down into its components and the conditions that cause the problems. Each component would then have its own series of installation requirements and defect conditions.

The current California Mechanical Code (CMC 2007) requires the following for dryer installations:

504.3 Clothes Dryers.

Moisture exhaust ducts *shall terminate on the outside of the building and shall be equipped with a backdraft damper. Screens shall not be installed at the duct termination. Ducts for exhausting clothes dryers shall not be connected or installed with sheet metal screws or other fasteners that will obstruct the flow. Clothes dryer moisture exhaust ducts shall not be connected to a gas vent connector, gas vent; or chimney, and shall only serve clothes dryers. Clothes dryer moisture exhaust ducts shall not extend into or through ducts or plenums.*

> ***504.3.2 Domestic Clothes Dryers****. When a compartment or space for a domestic clothes dryer is provided, a minimum four (4) inch diameter moisture exhaust duct of approved material shall be installed in accordance with this section and Section 504.0. When a closet is designed for the installation of a clothes dryer, a minimum opening of 100 square inches for makeup air shall be provided in the door or by other approved means.*
>
> > ***504.3.2.1 Domestic Dryer Vents****. Domestic clothes dryer moisture exhaust ducts shall be of metal and shall have smooth interior surfaces.*
> >
> > > ***Exception****: Listed clothes dryer transition ducts not more than six (6) feet in length may be used in connection with domestic dryer exhausts. Flexible clothes dryer transition ducts shall not be concealed within construction.*
> >
> > ***504.3.2.2 Length Limitation****. Unless otherwise permitted or required by the dryer manufacturer's installation instructions and approved by the Authority Having Jurisdiction, domestic dryer moisture exhaust ducts shall not exceed a total combined horizontal and vertical length of fourteen (14) feet, including two (2) 90-degree elbows. Two (2) feet shall be deducted for each 90-degree elbow in excess of two.*

504.5 Termination of Environmental Air Ducts*. Environmental air duct exhaust: three (3) feet from property line; three (3) feet from openings into the building.*

***701.1.4 Makeup air** requirements for the operation of exhaust fans, kitchen ventilation systems, clothes dryers, and fireplaces shall be considered in determining the adequacy of a space to provide combustion-air requirements.*

[NFPA 54: 9.3.1.5]

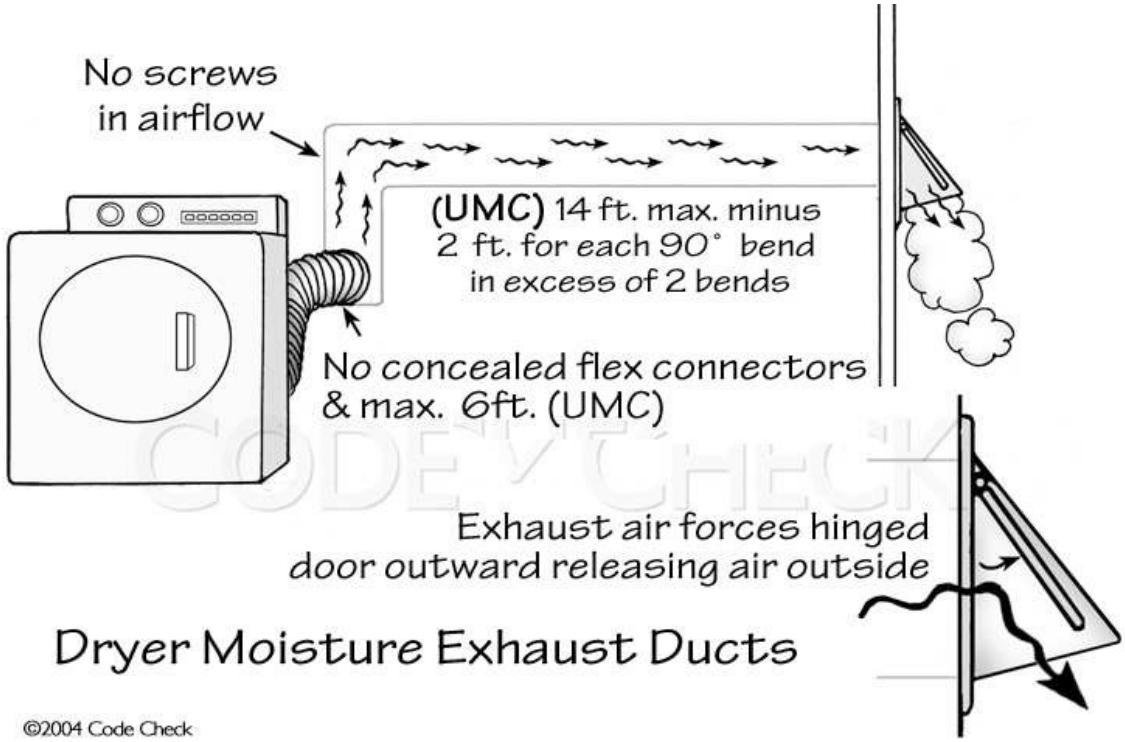


Illustration Courtesy of CREIA's Friends at CodeCheck

The CMC dryer venting requirements appear somewhat different from the IRC 2009. The current IRC allows dryer vents up to 25 feet. However, the IRC's 25-foot maximum does not include **any** allowance for 90° Ell's. If we adjust the IRC requirements for 2-90° Ell's, they are actually fairly close – 14 feet versus 15 feet.

Now, let's talk about the inspection of the dryer venting by the looking at the vent system components and issues.

Is a dryer vent required? There is no requirement that a clothes dryer be installed. However, ***if provisions to install a dryer exist***, per the CMC, a dryer vent system ***must*** be installed. The only exception to this would be if a condensing/ventless dryer were installed. That would require a jurisdictional exception. Condensing dryers remove water from the dryer air by condensing the air on a chilled coil. Condensing dryers are expensive and will always be electric – never gas. Condensing dryers do require a means to drain condensate from the system. The condensate drain often uses the washer drain.

Maximum Dryer Vent Length: The longer the vent run, the harder the dryer fan has to work, the slower the airflow is across the dryer heat exchanger, the more interior duct surface area to collect lint. Lint on the vent interior creates friction, further restricting airflow. Lower airflow across the heat exchanger means higher air temperatures. All this translates into more rigorous

maintenance requirements and higher fire risk. In general, dryer vents that run vertically will require more maintenance than horizontal runs. It is harder to push wet lint straight up than it is to move it horizontally.

The maximum vent length allowed under the CMC is 14 feet. This includes an allowance for 2-90° Ell's. For each additional 90° Ell, we would deduct 2 feet from the maximum length allowed. The AHJ may allow longer runs. Exceptions should be based on engineered solutions and may include the requirement that the specific dryer installed be rated for longer runs by the manufacturer. In general, the shorter and the straighter the dryer vent – the better. In some installations, we may see signs posted at the laundry area that the dryer installed must be rated for some stated minimum dryer vent length. There are some new Ell's specifically engineered for dryer venting. These have long sweeps and do not require a reduction in vent length when installed.

Minimum Vent Diameter: The smaller the vent diameter, the harder the fan has to work to move air. Because the surface area is reduced, a given amount of lint creates a more significant impact on airflow. The minimum vent diameter allowed under the CMC is 4 inches. The dryer vent should be no less than 4 inches but never reduced to a size smaller than the appliance vent collar.

Vent Material: Any vent run over 6 feet should be metal. As we saw in the YouTube video, the lint burns quickly and hot. It is critical that the vent material be metal. The CMC requires that all dryer vents be an approved material that has a smooth interior surface. This is generally single-wall vent material such as used for gas appliance vents.

Transition Ducts: The transition duct should be no more than 6 feet long. Shorter is better. The "*transition duct"* term is new to the CMC 2007 and is used to describe the flexible appliance connector. The CMC now requires that the transition ducts be *LISTED*. Meaning they must be tested for use in a dryer venting system by an independent lab such as UL. The old white plastic and many of the thin-foil flexible ducts will no longer comply. The manufacturers installation instructions generally exclude those materials as well. After seeing the YouTube video, it is hopefully ***very*** clear why running the flexible ducts through a concealed space is not allowed.

Per the CMC, the maximum length of the dryer transition duct is 6 feet. Any portion of the dryer vent over 6 feet or that passes through concealed spaces, etc. should be metal. Many states use the I-Codes (IMC/IRC), which have a maximum transition duct length of 8 feet. Consequently, the dryer transition ducts sold are almost always packaged in 8-foot long sections. These should be shortened to a maximum of 6 feet when they are installed. In practice, this seldom seems to occur. The transition duct should be as short as possible while still allowing the appliance to be moved for cleaning and service. Any unnecessary material, bends, kinks, etc should be removed as they can significantly restrict airflow.

Transition ducts should not be joined together to make longer sections and should not pass through concealed spaces, bulkheads, walls, etc.

Dryer Vent Termination: The dryer vent should terminate at the exterior using an appropriate back-draft damper. The vent should terminate at least 3 feet from any building opening, air intake or the property line. The dryer should terminate well away from AC condensing coils to avoid lint build-up in the coil. Dryer vent terminations should not be screened.

The air discharging from the dryer vent is warm. On a cold evening, an improperly terminated dryer opening can make an inviting resting spot for all sorts of critters. When critters take up residence, they can build nests that obstruct airflow that again can result in overheating of the dryer.

General Dryer Vent Installation: The dryer vent and transition duct should be free from mechanical damage. Any areas that are impinged, kinked, mechanically damaged will obstruct airflow and collect lint. Mechanical connections should be made using tape or approved fastening methods. We never want to see screws or fasteners that project into the dryer exhaust flow since they will collect lint. The male ends of the vent should be installed "pointing" in the direction of airflow.

The dryer vent should not pass through a plenum or ductwork. It is not uncommon in older dwellings to find the dryer vent routed through the wood enclosure under the garage furnace. That enclosure often serves as the return air plenum. In that installation, the air pressure inside the plenum is negative when the furnace is operating. When the dryer is operating the pressure inside the duct is positive. The dryer vent in a gas dryer also serves to vent combustion by products to the exterior. Routing the dryer duct through the return creates a situation where the dryer by products can be sucked into the air circulating in the living areas. If a fire starts in the dryer duct, both the smoke and fire will be drawn directly into the living space.

Other Clothes Dryer Vent Considerations: A standard 12 lbs load of laundry comes out of a newer clothes washer weighing around 20 lbs, even more in older washers. That is at least 8 lbs or roughly 1 gallon of water that must be removed from the clothes to dry them. That means that a gallon or more of water is being exhausted from the dryer during a typical cycle. Any improperly sealed dryer ducts introduce a significant amount of moisture into the surrounding area. That much moisture can cause a host of issues - not only damage to wood members but environmental issues as well.

A typical residential clothes dryer exhausts approximately 200 CFM of air to the exterior. If the dryer is installed in a confined space, such as a closet, there should be a provision to provide make-up air to the area. In confined areas, the CMC requires a minimum make-up air opening of 100 square inches. The make-up air can be taken from the living space or under certain circumstances from the exterior.

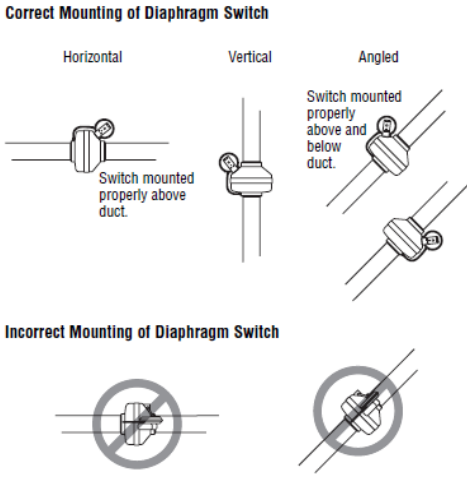
Just as a gas water heater or furnace, a gas clothes dryer also has combustion air requirements. Both gas and electric dryers exhaust air to the exterior as part of their normal operation. When a clothes dryer is running, it competes with other appliances for interior air. This is especially true in confined spaces with gas burning appliances and a dryer installed. How many times do we see a furnace and water heater installed in an interior laundry area where there is an exhaust fan and little to no combustion air? Turn them all on, close the interior laundry door and just imagine what happens next. At least in my business area, very few local jurisdictions seem to understand or choose to enforce the requirement for make-up air in confined laundry areas.

The clothes dryer discharge should not be vented with any other exhaust systems, i.e. kitchen, bath or tied into such things as plumbing vents or gas appliance vents.

It is important that the dryer terminate at the exterior. This can be difficult to verify sometimes, especially in large homes and condos. While testing laundry equipment is not required, turning

on the dryer can be helpful to help verify that the dryer vent actually terminates at the exterior. With the dryer running, walk the exterior and look for the termination with airflow.

The CMC does not specifically deal with the installation of dryer booster fans. Booster fans are engineered specifically to extend the maximum dryer vent length. The 2003 IRC had a general provision for dryer booster fans. This was removed in the 2006 IRC. The provision was deleted because a dryer booster fan must be matched to the specific dryer model installed and not to the dwelling. In general, the booster fan CFM output must be matched to the CFM output of the dryer installed. The booster fan installation instructions will usually require the fan to be installed at least 10 to 15 feet from the clothes dryer. Installing the booster fan as close as possible to the termination is usually preferred. This allows the air and lint in the exhaust airflow a chance to dry somewhat. Installation of the fan too close to the dryer may result in clogging of the fan blades with wet lint. The booster fan manufacturer may allow lesser distances if a secondary lint trap is installed between the dryer and the booster fan. The fan pressure switch orientation is important as well. In general, the switch should be located in the upper portion of the duct. See the illustration from Fantech.



Fantech Dryer Booster Fan and Pressure Switch Orientation

New or old, dryer vent systems are almost always problematic. In older construction, we often see homeowner installations that are often improperly installed. In my business areas, there is a new high-end condo complex where the units have gas dryer hook-ups but most – not all – of the units have no provision to vent a dryer. There is another newer complex with the gas dryer and gas water heater located in a confined area with no provision for combustion or make-up air.

Recently, a local building official caught a dryer venting issue in a new apartment complex that was under construction. The clothes dryers, kitchen and bath exhaust systems were all vented using the same duct system. This installation was designed by a mechanical engineer, had passed plan check and was being installed by a well-respected mechanical contractor. Fortunately, the building inspector prevailed even though the developer brought significant pressure on the city to allow the installation.

Finally, one last example of how a seemingly small mistake can cause a huge problem. This involves litigation on a newer condo project. A mechanical engineer designed the dryer vent system, which again passed plan check. A well-respected mechanical contractor installed the system per the approved plans. The complex was signed off by the city. The engineer designed

custom dryer terminations ***with screens***. In the plans, they were actually referred to as "Lint Traps" and lint traps they were. All the clothes dryers vented vertically to the roof. The problem was discovered shortly after property was fully occupied. The dryer vents were all clogged, many had blown apart and were venting into the attic. Just imagine how much moisture was pumped into the attic area from the dryers. The entire roof framing assembly was moisture damaged. The excessive moisture caused mold issues that required remediation. Of course, the occupants had to be relocated during repairs. The final cost to deal with the mess was around $10,000,000. All over dryer vent terminations that were screened and wet dryer lint.

The next time someone tells you "Its just a dryer vent." Remember, there are 15,500 dryer related fires per year and 83% of those are in single-family homes. Sometimes little things have serious consequences.

About the author:

Skip Walker lives in the SF Bay Area and has performed over 2,300 paid inspections since becoming a CREIA member in 2003. Skip is both a CREIA Master Inspector and an ASHI Certified Inspector. Skip is an ICC Certified Residential Combination Building Inspector and a F.I.R.E. Certified Inspector. Skip is the education chair for the Silicon Valley ASHI/CREIA Chapter and the CREIA Region Three Director. He also holds a California Real Estate Appraisal Trainee License. Skip may be reached at *HomeInspection@sanbrunocable.com*.