

# Black Streaks (Ghosting) on Walls (AEN-174)

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## BLACK STREAKS (GHOSTING) ON WALLS

Black streaks on walls and ceilings are a perplexing and difficult problem to diagnose and solve. Only limited research studies are available.

### What causes black streaks on walls and ceilings?

The main causes are:

- Soot (small carbon particles)
- Mold
- Dirt

### How can the cause be determined?

Laboratory testing can determine whether the streaks are soot, mold, or dirt (U of I Hygienic Laboratory). Field tests, not always conclusive, include wiping one location with bleach to determine if the material is mold and a strong commercial cleaner to determine soot or dirt.

### Where does the soot come from?

Soot comes from incomplete combustion of a carbon-based material. Any material that can burn can produce soot, including natural gas, LP, wood, oil, candle wax, gasoline, diesel fuel, tobacco smoke, dust, dirt, cooking oils, and carpet fibers. Sources include:

- Unvented fossil-fired heating appliances, such as space heaters, kitchen ranges, and clothes dryers.
- Vented fossil-fired heating appliances that experience vent failure (often intermittent and sporadic).
- Candles (scented candles might be worse).

- Fireplaces
- Tobacco smoking
- Environmental contaminants (dust, dirt, and cooking oils)
- Carbon from vehicle exhaust in attached garages.
- Outside sources (factories).

### **Why is soot produced?**

Incomplete combustion produces soot. Keeping burners and pilots cleaned and properly adjusted can reduce the amount of soot produced. Uncontrolled combustion, such as wood burning in an open fireplace, candles, and cigarettes, produce higher amounts of soot.

What causes incomplete combustion?

Incomplete combustion occurs when all of the fuel does not burn. Common causes are:

- Dirt on burners
- Incorrect gas orifice sizes (either too large or too small, especially critical to check as natural gas/LP conversions are made).
- Flame impinging on a cold surface (incorrectly placed artificial logs in a gas fireplace, cold cooking utensils on gas range, incorrectly designed burner and heat exchanger).
- Incorrect gas pressure (either too high or low). Can be intermittent, if gas regulator is malfunctioning, or continuous if pressure adjustments were made incorrectly.
- Air flow disturbing flame (fan blowing on burner or cracked heat exchanger in furnace).
- Insufficient oxygen in small room.
- Downdrafting of vent disturbing air flow through heating appliance (often intermittent and sporadic).

### **Why does soot collect on walls and ceilings, not at the source?**

About 99 percent of particles in indoor air are too small to be seen individually, and many are so small they can only be seen with an electron microscope. (North Central Regional Publication 393). The human eye can detect particles larger than 30 microns. Suspended household dust ranges from 0.001 to 20 microns in size and the major smudging sizes range from 0.001 to 1.0 micron in size. (One inch is approximately 25,000 microns).

The particles are so small they settle extremely slowly and are disrupted as air molecules “bump” into each other. The particles vary in size, density and electrostatic charge. Deposition of the particles is most affected by surface electric charge, temperature, and moisture content. Soot can move a long distance from the source before being deposited. Heating appliances that do not have soot around them can be the source of soot in other rooms.

### **What causes intermittent sooting?**

Gas pressure fluctuations and downdrafting are the main causes. Gas pressure regulators can stick or be misadjusted. In cold weather the regulator pressure relief vent can freeze, causing incorrect gas pressures. Liquefied petroleum pressure varies with the temperature. Pressure from nearly empty LP tanks fluctuates, and can lead to appliance sooting. Gas piping that is too small reduces gas pressure.

Downdrafting is caused by pressure differences between the house and outdoors. For natural draft appliances to vent properly ALL the following are necessary:

- Properly designed and maintained vent (chimney) system (proper sizing, rise, height, material, and not blocked).
- Vent system located so it will work in ALL weather conditions ALL the time (i.e, works in all wind, temperature, humidity, and icing conditions).
- Sufficient combustion air openings to the structure that work in ALL weather conditions ALL the time (see above).
- Adequate make-up air openings for all exhaust appliances. All air that exits the structure must be replaced.
- Heating appliance room NEVER depressurized more than vent (chimney) can overcome. Some sources of depressurization include exhaust fans, attic bypasses, leaky return ductwork, inadequate returns or supplies, recessed lights, fireplaces, wind, and temperature.

Recent studies indicate downdrafting to be a prevalent and serious problem. Minnegasco Gas Company found downdrafting can disrupt a flame that burned normally during venting conditions, causing soot and carbon monoxide production during downdrafting.

### **Do blue flames indicate proper combustion?**

Not always. Under some conditions (i.e., oversized orifices or excess gas pressure) the flame can remain blue but be producing large amounts of carbon monoxide. The following can be checked to assure proper combustion: orifice size, gas pressure, gas flow, and combustion gas composition (using a combustion gas analyzer).

### **Where does streaking and discoloration occur?**

Typically streaking occurs at studs on outside walls and at rafter. These locations are cooler (and therefore wetter) than the insulated cavities. Carbon and dirt are more likely to collect there, and mold is more likely to grow there. Other locations include polished light fixtures, t.v. screens, refrigerators, inside cabinets, around pictures, carpet under doorways, on plastics (such as storage containers in the kitchen), and on walls above heat sources.

### **What causes streaking above wall mounted heat sources?**

Battelle concluded the streaking above electric heaters is caused by air contaminants charring and depositing on the cooler wall surfaces. Ontario Hydro-Electric concluded that discoloration above heating systems (such as convective wall units, lighting fixtures, and refrigerators) is caused by air-borne material in the room flowing past the heater and depositing. The deposits were yellow-brown when from cooking vapors; dust and lint; smoke from tobacco, candles, or open fireplace. Jet black deposits were caused by carbon soot from heating appliances (often caused by problem with the inlet air supply system.)

### **Can vehicles in attached garages contribute to soot?**

In the winter, many homes pull large amounts of air (and carbon monoxide) from the garage, even though the door between the house and garage is weatherstripped and the wall sealed.

How is the soot problem solved?

Find and eliminate the source. Adjust and vent combustion appliances. Provide combustion and make-up air. Use a range hood while cooking to remove cooking vapors and combustion products from gas stoves (Caution, range hoods depressurize houses, and can cause downdrafting of vented appliances). Vent gas clothes dryers outdoors. Do not use unvented gas heating appliances except for emergency heating. Replace natural draft heating appliances with sealed combustion or electric units. Clean or replace carpets, drapes, and furniture as needed. Clean and repaint walls and ceilings.

### **How is mold removed?**

Mold needs high moisture levels to grow. Reduce interior moisture, warm exterior walls with insulation, remove mold with bleach solutions, and then repaint. Severe mold growth in wall cavities will require removal of the wall surfaces.

### **What about dirt streaks?**

As with mold, dirt streaks often are caused by excess moisture. Reduce the moisture in the dwelling and warm the walls. Reduce outdoor dirt entry by sealing the house (ie, caulking, weatherstripping, new windows). Filter the air through a ventilation systems, like an air-to-air heat exchanger. (Caution – sealing the house can cause downdrafting problems unless new heating appliances are installed).

### **Why is it so hard to find and correct soot problems?**

The diagnostic equipment needed is expensive and not readily available, and includes: particulate samplers, differential pressure transducers, electron microscopes, combustion analyzers, and blower doors. Many of the causes of soot are intermittent and sporadic. To fully investigate the cause of blackening, continuous monitoring of all suspected appliances might be needed for several weeks, at the cost of several thousand dollars.