Fire & Air: The Damper Series

By Kent Maune

Smoke in Fires: Smoke Then and Now

The fire protection industry has made tremendous strides in saving lives in commercial buildings, hospitals, apartments, and other structures. Yet smoke remains a major – and often overlooked – threat. Modern building materials and furnishings burn faster and produce far more toxic smoke than the natural materials commonly used in the 1960s and 1970s. As a result, escape times have decreased significantly, while risks to occupants and first responders have increased.

What Is Burning?

Material Comparison

CATEGORY	1960s BUILDINGS	MODERN BUILDINGS (TODAY)
Structural materials	Solid wood framing, plaster, brick, concrete	Engineered lumber, drywall, foam insulation, composites
Interior finishes	Natural wood, plaster, wool, cotton, linoleum	PVC flooring, vinyl wall-coverings, acrylic paint, laminates
Furniture/fabrics	Cotton, wool, horsehair, natural latex	Polyurethane foam, polyester, nylon, synthetic leather
Adhesives and coatings	Animal glues, casein, shellac	Urea-formaldehyde resins, epoxies, polyurethanes

Key Point: Buildings in the 1960s were constructed primarily with natural materials, while modern structures contain a high percentage of synthetic and chemically treated products that burn faster and produce more hazardous smoke.

Material Smoke Characteristics

PROPERTY	1960s BUILDINGS	MODERN BUILDINGS (TODAY)
Smoke density	Light to medium gray	Dense, black, heavy
Smoke composition	Mostly organic particulates and tars	Complex mix of toxic gases and fine synthetic particulates
Burn rate	Slower – wood chars and slows fire spread	Faster – plastics melt, drip, and ignite easily
Smoke visibility	More transparent, less obscuration	Highly opaque, reducing visibility rapidly

Observation: Modern smoke can fill a room two to three times faster than smoke from older materials, reducing visibility to near zero within minutes and dramatically shortening available escape time.

Toxic Gases and Health Effects

Smoke in the 1960s

- Dominated by carbon monoxide (CO), carbon dioxide (CO_2), water vapor, and wood tars.
- Still harmful and capable of causing asphyxiation or CO poisoning, but overall chemical toxicity was comparatively lower.

Modern Smoke

Modern smoke contains CO, CO_2, and water vapor, along with a dangerous mix of additional toxic compounds, including:

- **Hydrogen cyanide (HCN)** – Produced by burning synthetic foams, nylon, and laminates. HCN interferes with the body's ability to use oxygen and can be fatal within minutes.
- **Hydrogen chloride (HCl)** – Released from PVC pipes, vinyl products, and insulation. When inhaled, it forms hydrochloric acid, causing severe damage to the lungs and eyes.
- **Isocyanates and formaldehyde** – Generated by polyurethane products and resins. These are severe respiratory irritants and known carcinogens.
- **Benzene, toluene, and styrene** – Emitted from plastics and coatings. These compounds are both neurotoxic and carcinogenic.

Firefighters often refer to this combination as the "toxic cocktail." Modern fires are faster, hotter, and far more chemically dangerous than fires decades ago.

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Survivability and Fire Behavior

ASPECT	1960s HOME	MODERN HOME
Time to flashover	Approximately 15 - 20 minutes	3 - 5 minutes or less
Available escape time	15+ minutes	Often under 3 minutes
Smoke toxicity	Primarily CO	CO + HCN + acids + irritants
Firefighter risk	Heat and CO exposure	Severe chemical exposure, even with PPE

Health Impact

Smoke in the 1960s

- Primarily organic in origin
- Harmful mainly through asphyxiation and particulate inhalation.
- Long-term health risks were lower, although chronic exposure still posed hazards.

Modern Smoke

- Primarily synthetic in origin.
- Produces toxic, corrosive, and carcinogenic gases.
- **Short-term effects:** acute poisoning, respiratory distress, and chemical burns.
- **Long-term effects:** cancer, neurological damage, and chronic respiratory disease.

Key Insight: The transition from natural to synthetic materials means that modern smoke can be five to ten times more toxic by volume than smoke produced by older building materials.

Key Takeaways

- Buildings in the 1960s burned “dirty but organic.”
- Modern structures burn faster, hotter, and with significantly greater chemical toxicity.
- For occupants and firefighters, this means:
    - Less time to escape
    - Greater exposure to carcinogens and toxic gases
    - Increased need for ventilation, smoke detection, and smoke control systems

For the life safety damper industry, these trends underscore the critical importance of combination fire/smoke dampers in modern construction. Properly rated dampers, maintained fire-resistance systems, and effective smoke control strategies can significantly improve occupant safety while reducing long-term health risks associated with toxic smoke exposure.

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