

Indoor Air Quality Issues for Hotels

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DEA 670

Spring, 2000

Hotel Indoor Air Quality

Thermal Control

Relative Humidity	Winter Temperature Temperature	Summer
30%	68.5°F - 76.0°F	74.0°F - 80.0°F
40%	68.5°F - 75.5°F	73.5°F - 79.5°F
50%	68.5°F - 74.5°F	73.0°F - 79.0°F
60%	68.0°F - 74.0°F	72.5°F - 78.0°F

(ASHRAE Standard 55-1992)

Hotel Indoor Air Quality

Fungi-Mold & Mildew

70 million replacing items have been damaged by mold and mildew. *(American Gas, Jul 1999)*



(Mold on the bath curtain)

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Conditions to Thrive

Temperature range above 40°F and below 100°F

Mold spores

Nutrient base (most surfaces contain nutrients)

Moisture $RH > 70\%$

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Health Impact

- Allergies
- Asthmatic reactions
- Skin Disease
- Parasite in lungs

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Controls

- Reduce the moisture content (vapor pressure) of the air
- Increase air movement at the surface
- Increase the air temperature (either the general space temperature or the temperature at building surfaces).
- Wash mold off hard surfaces and dry completely.
- Absorbent materials, such as ceiling tiles and carpet, with mold may need to be replaced.

(EPA, Moisture, Mold and Mildew¹⁴¹ Appendix C)

Hotel Indoor Air Quality

Carpet

Interior products in the home have the potential to impact the indoor air because they emit volatile organic compounds (VOCs) into the air.



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Health Impact

- Eye and respiratory tract irritation
- Headache
- Dizziness
- Memory impairment
- Neurotoxicity
- Cancer

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Controls

- Look for and purchase a carpet, cushion, or floor-covering adhesive that displays the Carpet and Rug Institute (CRI) Indoor Air Quality Testing label.
- Tests indicated that carpet emissions that are released upon installation, with proper ventilation, will dissipate within 48-72 hours.

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(CRI/IAQ Carpet Testing Label)

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The current criteria for the program are based on a maximum emission factor measured in $\text{mg}/\text{m}^{-2} \text{ hr}$ as follows:

Total Volatile Organic Compounds	0.5
4-PC (4-Phenylcyclohexene)	0.05
Formaldehyde (to prove that none is used)	0.05
Styrene	0.4

(CRI/IAQ Carpet Testing Program, 1992)

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Vacuum cleaner



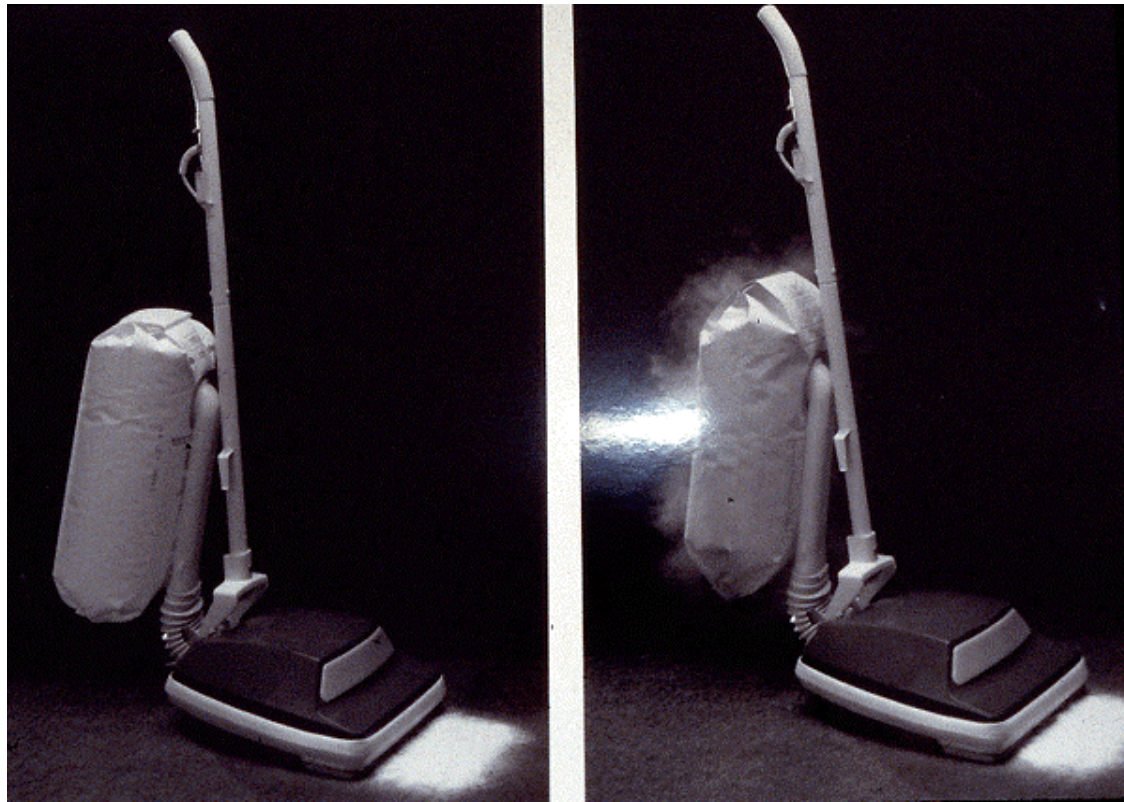
Hotel Indoor Air Quality

- Use portable HEPA (high efficiency particulate arrestance) vacuums instead of low-efficiency paper-bag collectors.
- True HEPA exhaust filter captures 99.99% of all particles down to 0.3 microns.

(Plant Engineering; Feb 1998)

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HEPA Vacuum Cleaner V.S. Non-HEPA Vacuum Cleaner



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Dishwasher



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Waterborne pollutants from tap water enter the air when water is heated. Within a minute or 2, the first cycle in the dishwasher stripped the water of 96 to 100 percent of **toluene**, **ethylbenzene**, and **cyclohexane**. It continuously vent some 5 to 7 liters of air per minute into the kitchen, the volatilized pollutants almost immediately begin circulating within the house.

Solution

Use exhaust fans or open windows in kitchens and bathrooms when showering, cooking, or using the dishwasher.

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Bacteria



Legionnaire's Disease can be infected via
the mist of cooling towers

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Conditions

- Ubiquitous
- Many bacteria are $\sim 1\mu\text{m}$
- Ventilation duct dust can contain up to 50,000 bacteria per gram of dust.
- Dirty HVAC filters can contain up to 6,700 bacteria per gram of dust.
- Bacteria need 95% RH to survive.

Hotel Indoor Air Quality

Health Impact

Legionnaire's Disease

- *Legionella pneumophila* can thrive in cooling towers and the cooling tower mist can be re-entrained into the HVAC system.
- Symptoms - malaise, headache, high fever, gastro-intestinal symptoms, respiratory failure, death.
- Legionnaire's disease mainly fatal for elderly and immune-suppressed (e.g. AIDS patients).
- > 600 deaths per year.

Hotel Indoor Air Quality

Controls

- Lower water temperature by installing cooling towers. Optimal growth temperature ~35°C in water (~95°F).

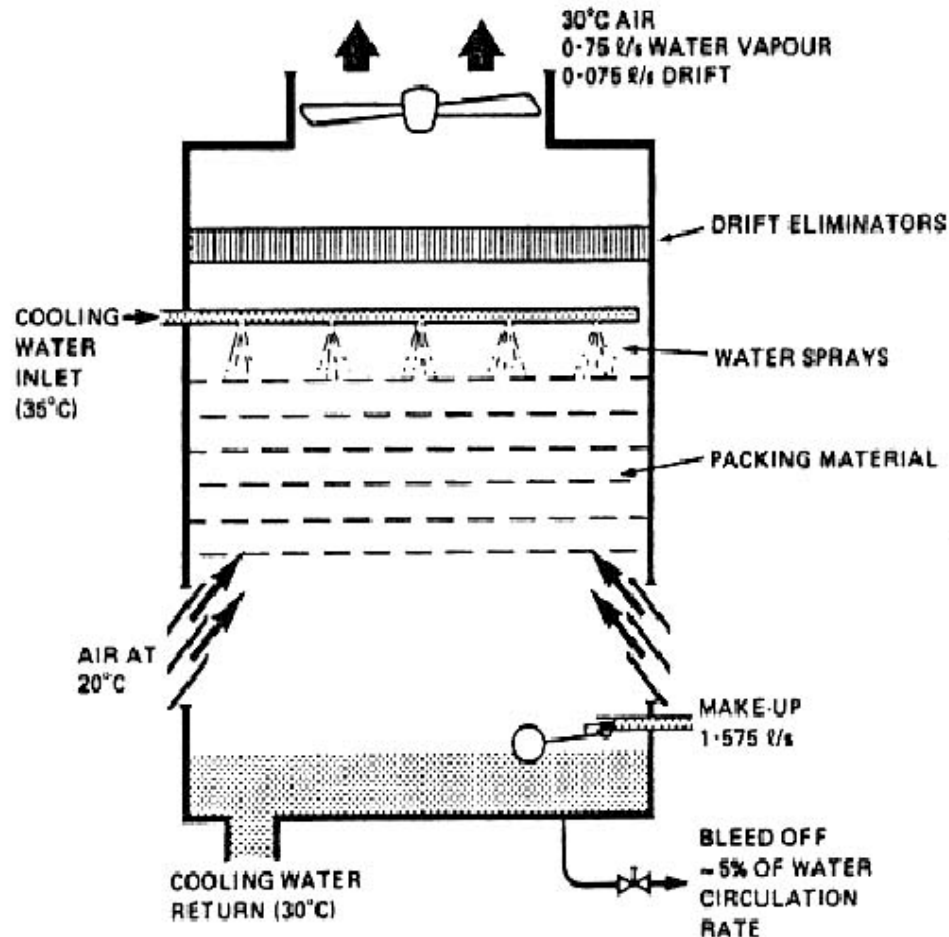
(Issues on Prevention of Nosocomial Pneumonia, 1994)

- Bacterium killed in 8 minutes at 58°C (136°F).
- Bacterium killed in 4 minutes at 60°C (140°F).
- Killed by chlorination.
- Killed by UV light.

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Schematic of a Typical Cooling Tower

(after MILLER, 1979)



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<i>Suggested Legionella Risk Assessment Levels</i>			
Legionella Per ml.	Cooling Towers	Hot Water Systems	Humidifiers fogger
<1	Low	Low	Low but increasing
1 to 9	Low	Low but increasing	Moderate
10 to 99	Low but increasing	Moderate	High
100 to 999	Moderate	High	High
>1000	High	High	High

(Occupational Hazard, 1999)

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HVAC



Room HEPA filter unit (*Isolate, INC.*)

Hotel Indoor Air Quality

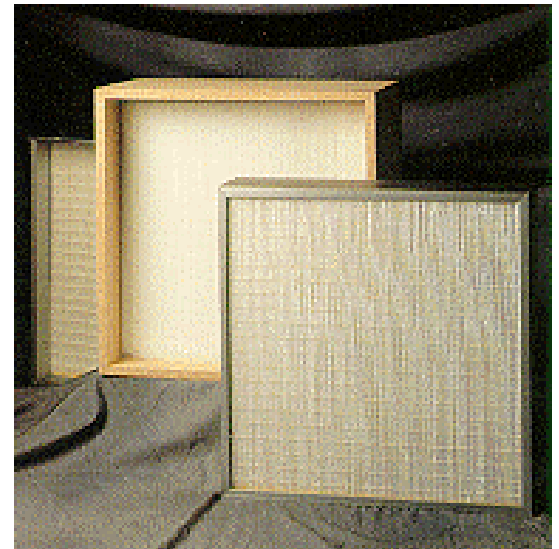
Contaminant

- Dust or dirt in ductwork or other components
- Microbiological growth in drip pans, humidifiers, ductwork, and coil
- Improper use of biocides, sealants, and cleaning compounds
- Improper venting of combustible products
- Refrigerant leakage

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Filter efficiency suggested by ASHRAE:

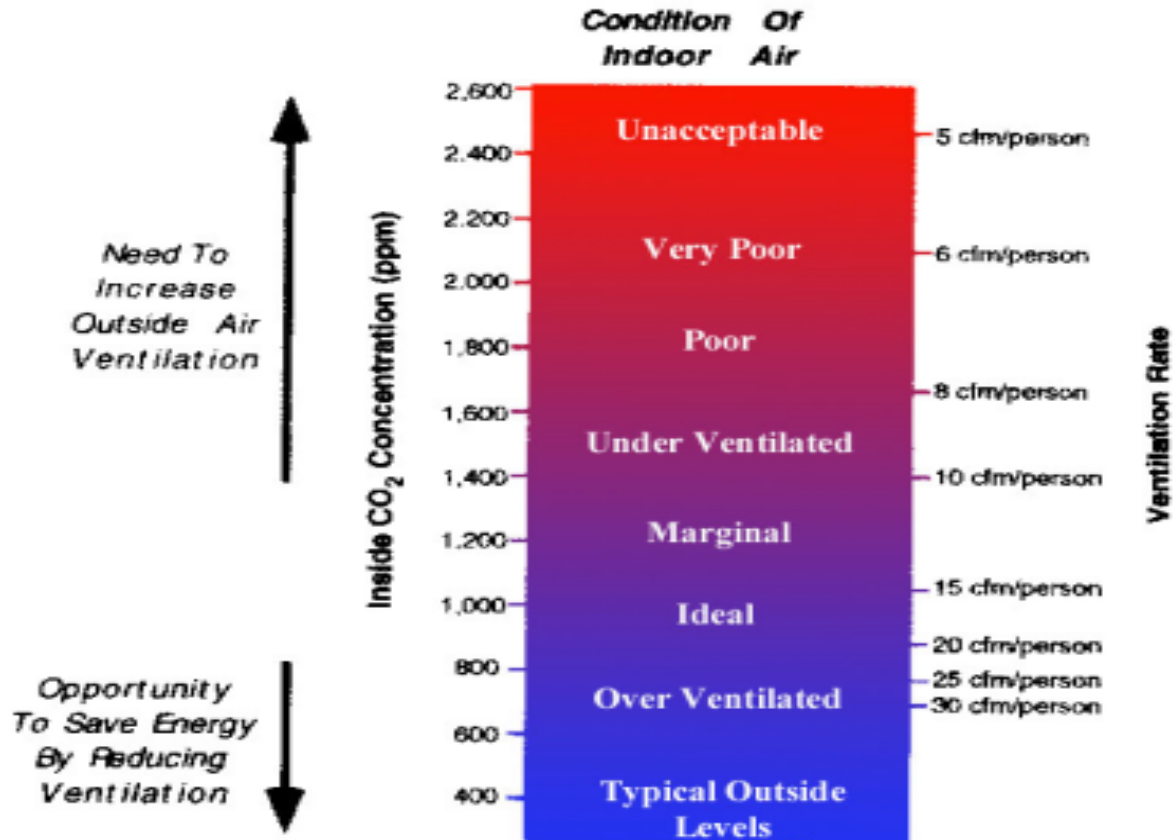
Hotel/Motel	
Bedrooms	20%-30%
Suites	20%-30%
Lobbies	20%-30%
Conference	20%-30%
Assembly Hall	20%-30%
Restaurant/Nite-club	35%-40%
Smoking Room	80%



HEPA filters

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Relationship between CO₂ levels in a space and ventilation

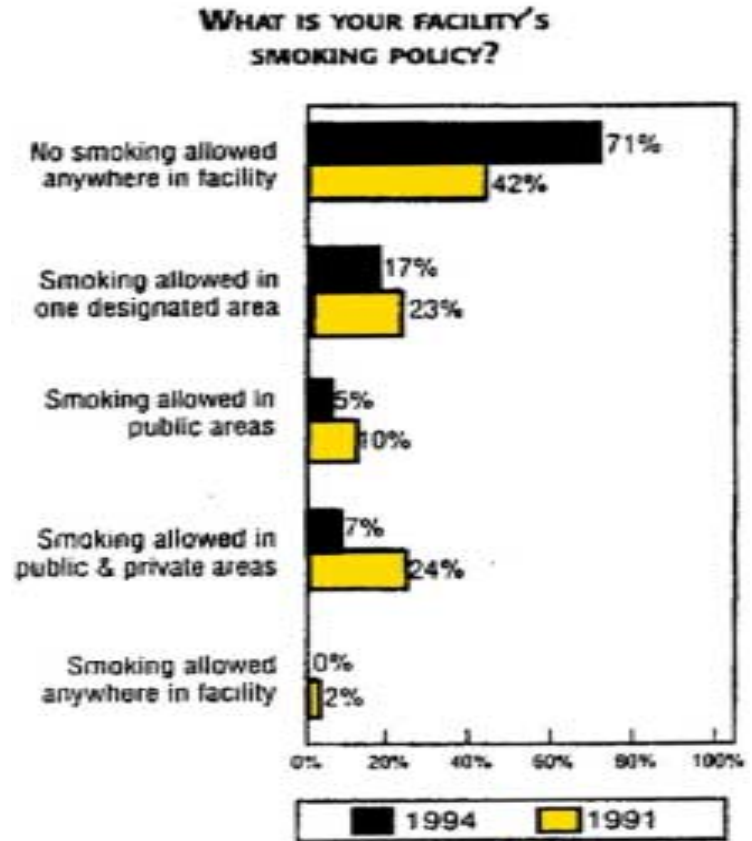


(Telaire Systems, Inc)

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Smoking

EPA concluded that ETS(Environmental Tobacco Smoke) is a human lung carcinogen, responsible for approximately 3,000 lung cancer deaths annually in U.S. nonsmokers.



(IFMA, 1994)

Hotel Indoor Air Quality

Health Impact

- Eye, nose and throat irritation
- Headaches
- Lung cancer
- Heart disease.

Control

- Do not smoke in your home or permit others to do so.
- Do not smoke if children are present, particularly infants and toddlers.
- Increase ventilation in the area where smoking takes place. Open windows or use exhaust fans.