SARS and Air Filtration Application

Severe Acute Respiratory Syndrome (SARS) is thought to be spread through airborne droplets generated from coughing, sneezing or talking. It is also possible to contract the virus from contacting body secretions that would typically emanate from the eyes, nose or mouth. Droplet infection is most likely within 3 feet of infected patients. It is also important to note that unlike most viruses which cannot live outside of a host for long periods, SARS has been noted surviving up to 24 hours on uncleaned surfaces. Presently standard infection control practices are being recommended for the environmental area where suspected SARS patients, or probable infected individuals, are being cared for.

Environmental Controls

The environment should be controlled by using proven methodologies to reduce the probability of exposure. Some items of control include individual respiratory protection, direct source capture using local exhaust ventilation, controlling airflow direction to prevent cross-contamination, dilution and removal of contaminated air via general ventilation, and air cleaning through air filtration and ultraviolet germicidal irradiation.

The information presented includes recommendations from the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) and the United States Department of Health & Human Services (Figure 2). It is important to note that some of these guidelines are also expressed in the Centers for Disease Control document, *Guidelines for the Control of Mycobacterium Tuberculosis* (TB), but that TB is a bacterium whose size is measured in microns.

The coronavirus associated with SARS is viral and measured in nucleotides (magnitudes smaller than a micron).

These recommendations are consistent with World Health Organization (WHO) and CDC recommended precautions for environmental control for SARS at this time.

Critical areas for environmental control include; waiting/admittance areas, treatment areas, patient rooms, satellite treatment areas, and defined infectious isolation rooms. The following chart notes recommendations for specific areas of a medical facility.

The most important factor for infectious disease control is to isolate the patient. The isolation room should be under negative pressure to prevent droplet nuclei from transferring to other areas of the facility (negative pressure is defined as 0.001" W.G., or 100 feet per minute inward velocity). The area should also include a ventilation system that reduces droplet nuclei (virus carrier resultant from coughs or sneezes) generated by the patient within the space. Additionally, we should follow procedures as defined by cognizant authorities (local, state, CDC, ASHRAE), ventilation air should meet guidelines as established by the EPA defining 'clean air' and the absolute minimum air change rate of 6 air changes per hour should be used (12 is preferred).

It is important to note that negative pressure can only be maintained when access is controlled (door closed). Doors should only be opened for entrance and exiting of attending personnel, and closed immediately thereafter.

When exhausting air from an isolation room we should use exhaust criteria as defined by the *ASHRAE Fundamentals Handbook* Chapter 14 or the ACGIH *Industrial Ventilation Manual* (never less than within 30 feet of inhabitant areas). Air should not be exhausted in the

HHS Medical Facility Requirements

Area	Filter Efficiency Bed #1	Bed #2	ACH	Temp F	Relative Humidity Min	Max	Relative Room Pressure
Operating Room	7	14	25	70-76	50	60	Positive
Delivery Room	7	14	12	70-76	50	60	Positive
Nursery	7	14	12	75	30	60	Positive
Recovery	7	14	6	75	50	60	Positive
Intensive Care	7	14	6	75-80	30	60	Positive
Patient	7	14	2	75	---	---	Equal
Isolation	7	14	12	75	---	---	Negative
Treatment	7	---	6	75	---	---	Equal
Food Prep	13	---	10	75	---	---	Equal
Laundry	13	---	10	75	---	---	Equal
Administration	7	---	---	75	---	---	Equal
Bulk Storage	7	---	10	75	---	---	Negative
Soiled Handling Area	7	---	10	75	---	---	Negative
Exhaust Hoods	99.97% DOP Test	---	---	---	---	---	Negative

Efficiencies are MERVs in accordance with ASHRAE 52.2 (except exhaust hoods).
Isolation room criteria is based upon 1994 CDC Guidelines. Changed from 6 ACH to 12 ACH and positive to negative room pressure.
Outdoor intakes should be located as high as possible above ground level (minimum 6' above ground, 3' minimum above roof).
Intakes should be not less than 25 feet from exhausts or any ventilating or combustion equipment.
Room supplies should be located at or near ceiling height.
Autopsy rooms require 12 ACH.

Figure 1

vicinity of walkways or adjacent to windows or openings that may allow reentrance of contaminant.

Air Filtration for Contaminant Control

When infectious isolation rooms can not be 100% exhausted, HEPA filters should be used in duct systems discharging into general ventilation (recirculated air), in ducts for individual room recirculation, in exhaust ducts from booths and enclosures, or in exhaust ducts to remove droplet nuclei from being discharged to other facility areas of habitation.

It is important to note that a HEPA filter is tested and certified to meet HEPA performance criteria (procedure as defined by the Institute of Environmental Sciences & Technology (IEST)). The term HEPA has been misused in the air filtration industry. In critical applications as defined herein you should request a letter of certification with each filter. This is a common practice in the air filtration industry when critical applications are involved. These documents are offered without charge as long as they are requested at the same time the filter is ordered. For your facility's protection these letters should be maintained in a file to note conformance to the latest standards of care or recommended practices.

Air filtration serves an important function in the control of airborne droplet nuclei. A MERV 14 filter, as evaluated by ASHRAE Filter Testing Standard 52.2, will be more than 95% efficient on removing droplet nuclei as long as it is given the opportunity to clean the air by moving air through the filter.

Air Changes are Critical

In critical situations air changes should be increased to the maximum ability of the HVAC system serving the area. Variable air volume systems should be modified to operate at full capacity and the fan on all systems should be in the constant-on position rather than the typical mode of cycling based upon temperature. Please note, if an air filter can remove 90% of all 1 micron size particles within a space in 23 minutes the same filter only requires 9 minutes if the air change rate is increased to 15 (Figure 2).
Exposure and the susceptibility of contracting a disease are tied with the volume of contaminant that the individual is exposed to. Reduce the volume of contaminant; reduce the individual's risk of contraction. Air filters and air changes are the critical factor in this equation.

Camfil Farr can provide a copy of the CDC Guidelines for the Control of Mycobacterium Tuberculosis (the document most often referred to in infectious disease situations) and some of the latest publications specific to SARS. All documents are in PDF format and compressed into one zip file. Send your name, affiliation and email to: literature@camfilfarr.com for your electronic copy. Click here to send request.

Your local Camfil Farr Distributor is well versed in the intricacies of applying air filtration in medical or other critical care facilities. Your local Camfil Farr Representative can assist engineering and contracting firms in new system or room design. Contact camfilfarr@camfilfarr.com for the name of your local Camfil Farr agency.

Air Changes Per Hour

Number of Air Changes per Hour	Minutes Required for a removal efficiency of		
	90%	99%	99.9%
6	23	46	69
10	14	28	41
15	9	18	28
20	7	14	21
30	5	9	14
40	3	7	10
50	3	6	8

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Figure 2

Additional important SARS sites:

Hospital Infection Control Guidance for Severe Acute Respiratory Syndrome (SARS), World Health Organization, http://www.who.int/csr/sars/infectioncontrol/en/

SARS, What Everyone Should Know, United States Centers for Disease Control, http://www.cdc.gov/ncidod/sars/index.htm