TECH TIP # 31

HEATING, AIRCONDITIONING & REFRIGERATION DISTRIBUTORS INTERNATIONAL

One of a series of dealer contractor technical advisories prepared by HARDI wholesalers as a customer service.

Filter Selection --- Not a Standard Procedure

With today's complex IAQ challenges, how do you select the best air filtration for a residence or commercial building? ANSI/ASHRAE 52.2 (Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size) should help to eliminate some of the confusion. The standard allows HVAC contractors, building operators, and others to evaluate filters based on controlled and repeatable laboratory testing, providing much more reliable comparisons. It establishes ***minimum*** efficiencies for filters, a more stringent and conservative measure than the previously used ***average*** efficiency. And, for the first time, it allows filter selection based on the offending contaminants and their particle sizes – making the selection process much more specific and targeted than ever before.

ASHRAE Standard 52-2 uses a highly controlled method of laboratory testing. The older standard measures "dust spot" efficiency using atmospheric air – an uncontrolled test aerosol that does not yield accurate, repeatable comparisons among different laboratories and different filter manufacturers. Outside weather conditions can also affect test results. The new standard uses a dry solid-phase aerosol --- potassium chloride (KCl), for more consistent results that atmospheric dust. Using this aerosol, several test cycles are performed, and efficiency and pressure drop across the filter are measured after each dust loading.

ASHRAE 52-2 measures the minimum efficiency instead of the average efficiency. The new standard measures the average efficiency of an air filter over its entire service life. For most media filters, efficiency is lowest just after the filter is installed, and it increases as the filter loads up with dust. Average efficiency is therefore not an accurate measure of the filter performance, because it exaggerates that performance for part of the filter's actual service life. The new standard shows a filter's minimum performance through to life, allowing the contractor or building owner to select filters knowing their "worst case" efficiency.

It measures a filter's ability to remove particles of a specific size. The old standard does not tell you a filter's efficiency in removing specific particle sizes (such as lung-damaging particles). By comparison, with the ASHRAE new standard, particle counters measure the number of airborne particles with diameters of 0.3 to 10 microns, both upstream and downstream of the air filter. Using this information, it becomes possible to take a highly targeted approach to filter selection.

MERV, or Minimum Efficiency Reporting Value, is a number from 1 to 16 that is relative to an air filter's efficiency. The higher the MERV, the more efficient the air filter is at removing particles. At the lower end of the efficiency spectrum a fiberglass panel filter may have a MERV of 4 or 5. At the higher end, a MERV 14 filter is typically the filter choice for critical areas of a hospital (to prevent transfer of bacteria and infectious diseases). Higher MERV filters are also

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capable of removing higher quantities of extremely small contaminant (particles as small as 1/300 the diameter of a human hair.) A higher MERV creates more resistance to airflow because the filter media becomes denser as efficiency increases. For the cleanest air, a user should select the highest filter that their unit is capable of forcing air through based on the limit of the unit's fan power.

This establishes a useful Minimum Efficiency Reporting Value (MERV) system. After the test is completed, the filter's minimum efficiency values at various particle sizes are recorded. These efficiency values are then used to assign a MERV to the filter. Designations range from MERV 1 (typically a low efficiency, throwaway filter) up to MERV 16 (a 95% plus filter. The new MERV system is much more comprehensive than previous systems, and it enables a person to compare efficiencies of filters at a glance.

Most filters become more efficient as the filter is used in the system. Care should be taken when considering filters that incorporate an electrostatic charge. Although offering a reasonable MERV value these filters will actually drop in efficiency as the filter loads with contaminant. A number of electrostatic filters are presently being offered for residential as well as the commercial/industrial applications. Refer to the filter packaging or literature to determine if the filter you are purchasing relies on an electrostatic charge to boost its MERV. If it does, request that the manufacturer provide you with the "discharged MERV" for the filter to determine its actual performance.

Typical Air Filter Type	Disposable Panel, Fiberglass & Synthetic, Permanent Self Cleaning, Electrostatic and Washable Metal Foam Filters	Pleated, Extended Surface and Media Panel Filters	Non-Supported Bag, Rigid Box and Rigid Cell/Cartridge Filters	Non-Supported Bag, Rigid Box and Rigid Cell/Cartridge Filters	HEPA, ULPA, SULPA Filters
MERV Std. 52.2	1-4	5-8	9-12	13-16	17-20
Average Dust Spot Efficiency	<20%	<20 to 35%	40 to 75%	80-95+	99.97% 99.99% 99.999%
Average Arrestance ASHRAE Std. 52.1	60 to 80%	80 to 95%	>95 to 98%	98 to 99%	N/A
Particle Size Ranges (microns)	>10.0	3.0-10.0	1.0-3.0	0.30-1.0	<0.30
Typical Air Filter Applications	Residential, Light Commercial, Equipment Protection	Industrial Workplace, Commercial, Paint Booths	Industrial Workplace, High End Commercial Buildings	Smoke Removal, General Surgery, Hospitals and Health Care	Clean Rooms, High Risk Surgery, Hazardous Materials

MERV	ASHRAE 52.1 Dust Spot Efficiency	Particle Size Efficiency (PSE) %			Min. Final Resistance (in. wc)	Typical Controlled Contaminants	Filter Type
		Range 1 0.3–1 µm (E_1)	Range 2 1–3 µm (E_2)	Range 3 3–10 µm (E_3)			
1	N/A	N/A	N/A	$E_3 < 20$	0.3	Pollen, moss	Throwaway
2	N/A	N/A	N/A	$E_3 < 20$	0.3	Dust mites, sanding dust	Washable
3	N/A	N/A	N/A	$E_3 < 20$	0.3	Paint dust, textile fibers	Electrostatic
4	N/A	N/A	N/A	$E_3 < 20$	0.3	Carpet fibers	1-3” Electronic air cleaners
5	N/A	N/A	N/A	$20 < E_2 < 35$	0.6	Snuff, powdered milk	Electronic air cleaner
6	N/A	N/A	N/A	$20 < E_2 < 50$	0.6	Dusting, cement dust	Electronic panel
7	N/A	N/A	N/A	$20 < E_2 < 70$	0.6	Hair spray, fabric protector	Electrostatic cartridge
8	N/A	N/A	N/A	$70 < E_3$	0.6	Mold spores	Pleated
9	40-45%	N/A	E2 <50	$85 < E_3$	1.0	Nebulizer drops, welding fumes	Box filters
10	50-55%	N/A	$50 < E_2 < 65$	$85 < E_3$	1.0	Coal dust, auto emissions	Residential EAC’s
11	60-65%	N/A	$65 < E_2 < 80$	$85 < E_3$	1.0	Lead dust, milled flour	Box filters
12	70-75%	N/A	$80 < E_2$	$90 < E_3$	1.0	Legionella, humidifier dust	Bag filters
13	80-85%	$E_1 < 75$	$90 < E_2$	$90 < E_3$	1.4	Copier toner, face powder	Industrial EAC’s
14	90-95%	$75 < E_1 < 85$	$90 < E_2$	$90 < E_3$	1.4	Insecticide dust, most dust	Box filters
15	> 95%	$85 < E_1 < 95$	$90 < E_2$	$90 < E_3$	1.4	Droplet nuclei (sneezing), cooking oil	Box filters
16	N/A	$95 < E_1$	$95 < E_2$	$95 < E_3$	1.4	All bacteria, most tobacco smoke	Box filters

NOTE: The use of a MERV 14 filter in a filter rack or housing with wide gaps or leaks defeats the purpose of having a high efficiency filter in place. A MERV 14 filter in a leaky housing could give you an equivalent MERV value of 5 or 6, since these gaps will allow dirty unfiltered air to bypass the filter. Ensure that the filter rack or housing is leak free to achieve the highest possible efficiency.

E_1 = target is 0.3 to 1.0 microns in size

E_2 = target is 1.0 to 3.0 microns in size

E_3 = target is 3.0 to 10.0 microns in size