

Using the TSI[®] P-TRAK[™] Ultrafine Particle Counter for Testing HEPA Filters

Application Note ITI-063

The TSI P-TRAK[™] Ultrafine Particle Counter is a very precise means of checking leaks in negative air machines as well as any other high efficiency particle arresting (HEPA) filtration system.

The test that is traditionally done on negative air machines is an industry standard efficiency test that requires upstream and downstream measurement of a generated aerosol (usually DOP) having an average particle size of 0.3 microns. The efficiency usually must meet or exceed 99.97% to pass this test. There are instruments on the market that are specifically designed to perform that test that consist of an aerosol generator and a photometer to measure concentration in milligrams per cubic meter.

The P-TRAK[®] particle counter is a particle counter, rather than a photometer. The difference is that a particle counter counts single particles and a photometer measures the density of a cloud of particle. Photometers cannot "see" single particles. The P-TRAK[®] particle counter cannot effectively perform the same efficiency test as above, however, it can be used to perform a leak test that is far more stringent. A negative air machine that passes the DOP efficiency test will often exhibit leaks that can be precisely located and eliminated using the P-TRAK[®] particle counter. Often, these leaks are found around the filter gaskets, not the filter itself. The leaks may involve thousands of ultrafine particles per cubic centimeter and yet be invisible to a photometer since they are too small to be detected.

HEPA filters are typically certified at 99.97% efficient when manufactured. After that, there are only two things that can happen to the filter.

1. It can load up with particulates and eventually clog.
2. It can develop leaks due to age or physical damage.

In the case of loading, the filter will become more and more efficient over time, but incur higher pressure drop. This can be tested with a differential pressure gauge such as a Magnehelic. Since filters naturally become more and more efficient during use, that leaves leaks as the primary concern. In other words, the only thing that can cause exposure to particle contaminants when using a previously certified HEPA filter is that it can develop leaks (of course, the gaskets around the filter can also leak).

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When leak testing with a P-TRAK[®] particle counter, there is no need to generate an aerosol. This is because ambient air always contains huge numbers of ultrafine particles under 0.1 micron in size that the P-TRAK can see. Leaks allow any size particle to pass through so there is no need to insist on particles 0.3 microns in size. If there are leaks, ultrafine particles will pass through easily. Research has shown that the vast majority of the number of ambient air particles are below 0.1 micron in size, which explains why they cannot be used in the industry standard DOP test.

When leak testing with the P-TRAK[®] particle counter you should use the wand and scan the filter itself and the surrounding gaskets. An increase in the particle count or concentration means you found a leak. One precaution that should be taken is to determine if the motor, bearing, belts or other components of the HVAC system may be generating particles. One way to overcome this possibility is to pull air through the equipment being tested (while it's off) using a second machine. A quick check can be made by using the P-TRAK[®] particle counter to sample the air in the duct between the two machines. If the particle count is acceptable, you're done. If it's higher than expected, you need to further investigate and find the leak(s).

Unfortunately, there are no industry standards to reference regarding leak testing filters with a particle counter. The question of how much of a leak is acceptable is a tough one to answer. You will have to make that determination yourself. Technically, the downstream particle count should be "zero" if the filter is OK and there are no gasket leaks. This is probably not realistic, however. Suffice to say that you should expect a very low particle count near zero. As a leak is approached, the particle concentration will increase allowing you to find the exact point of leakage.

Specifications for the P-TRAK Ultrafine Particle Counter can be viewed on the TSI website at <http://www.tsi.com/iaq/products/ptrak/ptrak.shtml>.

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