

## Typical UFP Sources

- Laser printers, fax machines and photocopiers
- Cleaning agents and chemical storage
- Kitchen and laundry areas
- Smoking areas
- Boiler and furnace leaks
- HVAC duct and filter leaks
- Grinding, welding, soldering, etc.
- Battery charging
- Vehicle emissions
- Loading docks and parking garages
- Stack emissions
- Outdoor air pollutant sources

## Typical UFP Pathways

- Stairs and hallways
- Attics and crawlspaces
- Elevators
- Ductwork
- Doors and windows
- Cracks
- Electrical conduit
- Vent stacks

## Calculating Expected Filter Effectiveness

ASHRAE filter rating		Expected UFP reduction (%)	Measured conc. of UFPs <sup>3</sup> (particles/cm <sup>2</sup> )
(MERV <sup>1</sup> )	(% efficiency <sup>2</sup> )		
N/A	No filter	0	10,000
N/A	HEPA	100	<1
15	95	90–93	700–1,000
14	90–95	85	1,500
11	60	35–40	6,000–6,500
9	40	20–30	7,000–8,000
8	<30	10–20	8,000–9,000

<sup>1</sup> Estimated minimum efficiency value, as shown in ASHRAE 52.2

<sup>2</sup> Estimated dust spot, as shown in ASHRAE 52.2

<sup>3</sup> Assuming intake air = 10,000

Your indoor air “goal” can be calculated as:

$$\text{Indoor goal} = \text{Before filter UFP reading} \times \left[ 1 - \left( \frac{\text{Expected UFP reduction}}{100} \right) \right]$$

# P

**Prepare** your approach

- Meet with building authorities.
- Understand the area you are investigating.
- Plan your strategy and set goals.
- Interview affected individuals.

# -

# T

**Target** the true source.

- Take and compare readings.
- Pathways are not the source—they lead to the source.

# R

**Remediate** the source of the problem.

- Remove it.
- Repair it.
- Control it.

# A

**Authenticate** the results.

- Test the effectiveness of the remediation.
- Did the corrective action solve the problem?

# K

**Keep** after sources until goal is achieved.

- Remember the highest source may mask others and may not be the source of complaints.
- Conduct follow-up checks to ensure good air quality is maintained.

# P-TRAK™ Quick Guide for Indoor Air Quality Investigations



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# P-TRAK® Ultrafine Particle Counter Quick Guide for IAQ Investigations

This step-by-step guide was designed to assist you in conducting an ultrafine particle (UFP) investigation. The information presented below provides an overview of UFPs and their possible relationships to air quality complaints. Steps 1 through 5 guide you in preparing for an investigation, and steps 6 through 10 tell you how to conduct the actual survey, eliminate sources, and maintain desired air quality. Additional information on P-TRAK® Ultrafine Particle Counter operation is provided in the product manual.

## Background

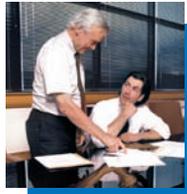
When a complaint is made and air quality is suspected as a reason for the complaint, a number of conventional checks and adjustments should be made. Parameters of concern include temperature, humidity and air velocity, which determine comfort; CO<sub>2</sub> levels, which indicate ventilation or fresh air supplied; and CO levels, which can present immediate danger if high. ASHRAE Standard 51 provides the recommended levels for these parameters. What if all of these parameters are within prescribed guidelines and complaints continue? There must be another cause that was undetected using conventional means. The problem may be related to very small airborne particles known as UFPs.

UFPs are defined as those particles less than 0.1 micrometer in diameter. In a given sample of air, UFPs constitute the greatest number of particles, yet they make up only a small fraction of the mass. Researchers are currently studying UFPs to identify any links to specific health effects. Actual IAQ investigations in thousands of buildings have already shown that UFPs are directly related to complaints.

UFPs are usually products of combustion or chemical reactions occurring at a wide variety of sources (see list of typical potential sources). The particles travel along often-unexpected pathways to areas that may be far from their source. UFPs may be influenced by moving air or simply move from areas of higher pressure to lower. These tiny particles, are not detectable using conventional instruments. With the P-TRAK, you are able to find the source(s) and control, repair or remove them, as necessary.

See [www.tsi.com](http://www.tsi.com) for additional information on UFPs.

## Preparation



1. Meet with building authorities, inquire about the complaint(s) and explain the investigation procedure.
2. Create or obtain a site map showing key building features such as exhaust stacks, intakes, loading docks, parking areas, smoking areas, copiers, boilers, furnaces, kitchens, elevators, cleaning supplies, highways, wind direction, other buildings, etc.
3. Interview the affected individuals. Document key information such as symptoms, time of occurrence, specific locations, etc. Remember that symptoms may be due to an intermittent occurrence that happens at only certain times of the day. Conduct the investigation at the known time and location of the complaints.
4. Take several P-TRAK readings in different outdoor locations. Write the readings on the map. A reading near the fresh air intake will serve as a baseline for comparison when you move indoors.
5. Review the HVAC system with the facilities manager. Using the filter effectiveness chart (see reverse), determine the expected percentage of particles removed by the filter(s). Use the provided equation to compute your indoor UFP goal. **Note:** *If humidification equipment is present, turn it off during the investigation since it may affect readings and mask the true source of UFPs.*



## Implementation



6. Begin your sampling by looking for areas where the UFP count is higher than the indoor goal. Start with readings in the complaint area and compare them with readings from complaint-free areas to establish reference points. Be sure to cover the areas thoroughly by checking diffusers, electrical outlets, windows, doors, ceiling tiles, wall cracks, etc.
7. When you locate higher UFP concentrations, follow them until the actual source is found. Remember, you may have simply located a pathway and may need to continue until the source is discovered.
8. Once a UFP source is located, the problem should be controlled, repaired or removed.
9. There may be multiple sources of UFPs. The first one located may or may not be the cause of complaints. Continue using steps 6 through 8 to find the next highest UFP sources until the UFP levels approach your indoor goal and/or the complaints stop.
10. Encourage routine monitoring to ensure that desired air quality levels are maintained.

