Air Techniques INTERNATIONAL

100X Automated Filter Tester Sales Playbook

The **100X Automated Filter Tester** is designed for test and quality control validation of filter media, replaceable particulate filters, and masks used in medical and industrial hygiene applications.

High performance air filters in the workplace

Filter Media

Masks

Replaceable Particulate Filters

Canisters

Air filters are used to protect people and products from airborne contamination such as dust, pollen, mold, bacteria, or viruses. Filters are essential for ensuring the quality production of a wide variety of goods, including hard disk drives, medical devices, semiconductors, nuclear, food and pharmaceutical products, as well as for protection of people who depend on respirators when working in hazardous environments.

Filters for respiratory protective devices are highly specialized as they must protect a person from the ***type*** and ***concentration of contaminants*** they will be exposed to, and for the typical ***duration*** of the exposure required by the work performed. The effectiveness of a filtering facepiece respirator (FFR) is a measure of the ***filter's efficiency*** (the percentage of particles of a given size removed from the air) and ***resistance*** (how freely air moves through the filter for inhalation and exhalation) when presented with a predefined aerosol challenge.

A healthcare worker needs a respirator that provides protection from solid and water-based organisms like bacteria and viruses, whereas the construction worker needs a respirator that can withstand exposure to airborne contaminants including oil from a saw's cutting fluids.

Given the importance of filters in the workplace, government regulatory and industry standards bodies created filter classes and certification tests which call for worst-case test conditions that are considered the most critical factors ***degradation*** to contaminants.

A respiratory protective device is considered adequate if it has the capacity to reduce the wearer's exposure to a hazardous substance to acceptable levels. A worker exposed to oils (e.g., lubricants, cutting fluids, glycerin) will need a filter that is *oil-proof* or *oil-resistant*, whereas a worker exposed to *non-oil* (i.e., solid and water-based) aerosols will require a different filter media.

Filtering facepiece respirators (FFR) are subject to various regulatory standards around the world. These standards specify certain required physical properties and performance characteristics for respirators to claim compliance with a particular standard. Health authorities often reference these standards when making respirator recommendations,

stating, for example, that certain populations should use an “N95, FFP2, or similar” respirator. As you will learn in the next section on standards, these abbreviations tell a lot about the respirator filter!

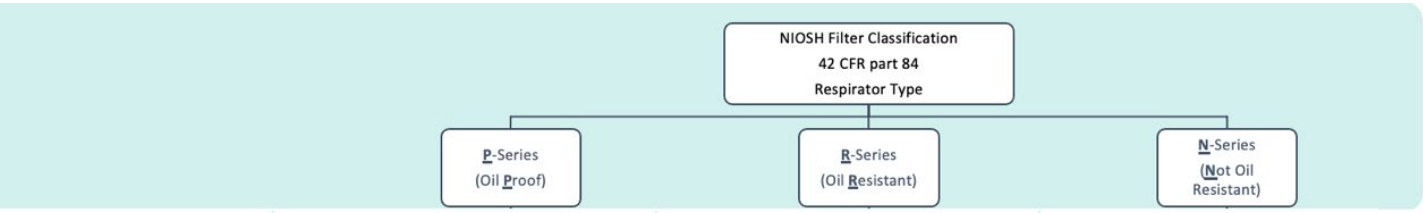
Filter media is selected for an individual application based on its ability to comply with a given regulatory standard.

United States Standards

The U.S. Centers for Disease Control and Prevention (CDC), National Institute for Occupational Safety and Health (NIOSH) created regulation 42 CFR Part 84 which provides for nine classes of filters (three levels of filter efficiency, with three categories of resistance to filter efficiency degradation). The three levels of filter efficiency are 95%, 99%, and 99.97%. The three categories of resistance to filter efficiency degradation are labeled N (***N***ot resistant to oil), R (***R***esistant to oil), and P (oil ***P***roof).

The selection of N-, R-, and P-series filters depends on whether oil particles are present in the work environment:

- If no oil particles are present in the work environment, use a filter of any series (i.e., N-, R-, or P-series).
- If oil particles (e.g., lubricants, cutting fluids, glycerin, etc.) are present, use an R- or P-series filter. ***Note*:** N-series filters cannot be used if oil particles are present.
- If oil particles are present and the filter is to be used for more than one work shift, use only a P-series filter.



Rating/Classification	P100	P99	P95	R100	R99	R95	N100	N99	N95
Efficiency	≥99.97%	≥99%	≥95%	≥99.97%	≥99%	≥95%	≥99.97%	≥99%	≥95%
Type of Contaminant Test Reagent	Oil-Proof Test with Oil (DOP, PAO)			Oil-Resistant Test with Oil (DOP, PAO)			Not Oil Resistant Test with Salt (NaCl)		
Duration / Exposure	Re-usable			8-hour use			8-hour use		
Test Reagent	Oil (DOP, PAO)			Oil (DOP, PAO)			Salt (NaCl)		

European Standards

There are several standards in Europe for respiratory protective devices, EN 134/149 and EN 12941/12942. These standards define the performance parameters. EN 13274 prescribes the test method which dictates the aerosol used, particle size, flow rate in some cases, and aerosol concentration. The protocol tests the masks' ability to filter a given percentage of contaminant and the filter ratings are similar to the U.S. equivalent standard rated P1 (N95), P2 (N97), and P3 (N99).

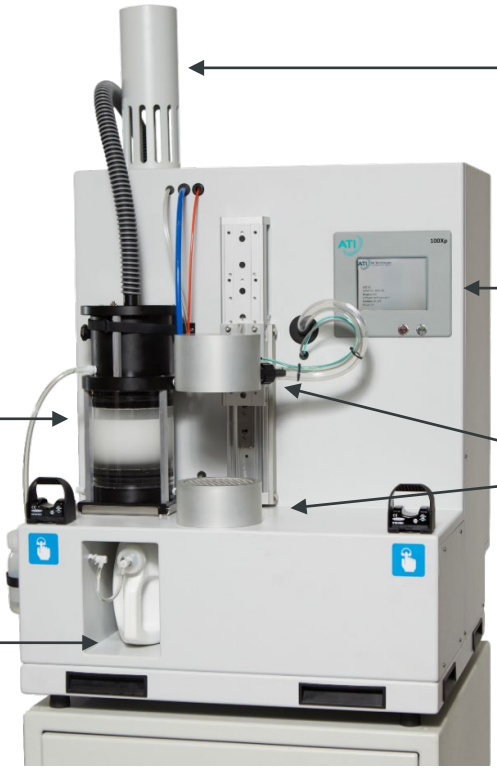
These standards, and others like them, not only specify the environment for where the respirator is to be used, but also how they are to be tested and certified.

	Particle Filter			Filtering half masks - particles			Powered Air for Masks/ Half Masks			Powered Hoods/ Helmets		
Rating / Classification	P1	P2	P3	FFP1	FFP2	FFP3	TM1P or TM1(gas)P	TM2P or TM2(gas)P	TM3P or TM3(gas)P	TH1P or TH1(gas)P	TH2P or TH2(gas)P	TH3P TH3(gas)P
Efficiency	>80%	≥94%	≥99.95%	>80%	≥94%	≥99.95%	≥95%	≥99.5%	≥99.95%	≤10%	≤2%	≥99.98%
Test Reagent	Oil: Paraffin, Salt: NaCl solution			Oil: Paraffin, Salt: NaCl solution			Oil: Paraffin, Salt: NaCl solution			Oil: Paraffin, Salt: NaCl solution		

Introducing the 100X

The 100X Automated Filter Tester is designed for test and quality control validation of filter media, replaceable particulate filters, and masks used primarily for respiratory protective applications. The 100X is a high-capacity automated solution ideally suited to meet the precise and rigorous requirements for quality control (QC) and production environments.

Key features and components:



Canopy exhaust included to use with facility exhaust. Optional local exhaust required if facility exhaust is not available. See below.

User-friendly **LCD touchscreen** for ease of operation

Aerosol generator produces a specific size and concentration of oil or salt aerosol particles

Drip jar (oil only) catches excess oil particles

Aerosol replenishment system automatically refills generator minimizing downtime

Test fixture holds the media in place during testing. Custom inserts and mask test adapters are available for testing replaceable particulate filters and respirator masks.

Accessories (optional)

Local exhaust equipped with a pre-filter and HEPA filter used with the 100X when facility exhaust is not available. It is critical that either facility or local exhaust is used.

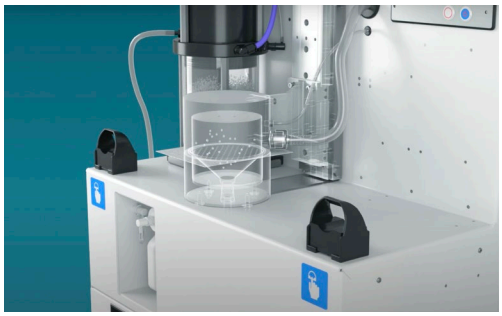
Base cabinet provides a sturdy platform for the 100X, allows the 100X to be easily moved, and provides extra storage space.

Mask test adapter is seated in the test fixture to test N95 and FFP-style masks.

How does the 100X work?

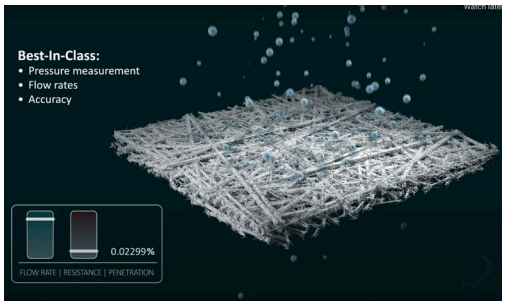
1

The 100X aerosol generator produces a specific size and concentration of oil or salt aerosol particles. The 100X measures and verifies the particle concentration at the flow rate set by the user.



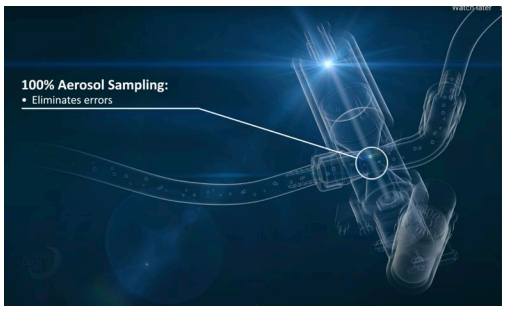
2

A filter is placed in the test fixture to begin the test. Filter performance is determined based on efficiency (% of particles that pass through the filter) and resistance (pressure drop).



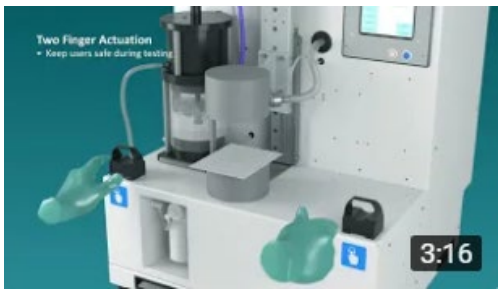
3

The 100X's photometer measures the mass of the particles that pass through the filter to calculate efficiency. Similarly, the mass flow controller measures the air flow to calculate filter resistance.



Benefits

- Best-in-class accuracy of test measurement allowing for improved production yields
- Best-in-class flow controller maintains constant flow rate during testing and ensures accurate penetration results
- High-flow rates and fast-cycle times results in high production throughput
- Patented continuous aerosol replenishment system, eliminates downtime due to refilling the generator



Video: 100X overview

Opportunity Areas

Top Use Cases

- High-efficiency media (typically HEPA grade)
- Respirator filter masks
- Replaceable particulate filters for Powered Air Purifying Respirators (PAPRs) or Air-Purifying Escape Respirators (APERs)

Standards based on photometer technology, for example:

- NIOSH 42 CFR Part 84
- ISO 23328
- GB 2626
- EN 148/149 and EN 12941/12942
- EN 13274
- JICOSH / JMOL
- ASTM F3502-21

Not Used to Test

- Liquid membrane filters
- ULPA filters (Note: While the 100X has the ability to test a filter's efficiency to 99.9995%, at the lower end of an ULPA filter's range, the 100X is not calibrated to test the ULPA filter's Most Penetrating Particle Size (MPPS) of 0.12um).

Standards based on particle counter technology, for example:

- EN 1822
- EN-ISO 16890
- EN 779:2012
- ASHRAE 52.2

Market Segments

Matregenix R&D lab equipment uses nanofiber material to create custom filter applications

Close up of Matregenix R&D lab equipment creating new filters with electrospun nanofiber filters

Filter media used to manufacture replaceable particulate filters and respirator masks

Filter Media Companies

Overview

Filter media companies produce bulk flat sheet media that is used in various air and liquid filtration applications. The media is sold to filter manufacturers who then convert the bulk media into finished air filtration products, such as HEPA filters used in cleanrooms or N95 masks used for personal protective equipment (PPE). These companies use the 100X for testing penetration and resistance of the media to ensure it meets their quality standards.

These customers batch test the media, meaning the 100X is not integrated into the production line. Because the rolls for flat sheet media are quite large, they test different sections of the roll to ensure that the expected quality of the media is consistent throughout the roll.

Typical Configurations

Usually, these companies have 2 or 3 Manual units in their lab for R&D, as well as batch testing production media. Because filter media companies are producing material for a variety of customers, they may need equipment for both salt and oil-based tests.

Job Titles

- **R&D Engineers** develop new filtration products, redesign existing products, and with **Lab Test Engineers** qualify the new filter media. Because the R&D and Lab Test Engineers may be developing and testing new filter media, they are dependent on highly accurate and consistent measurement of the filter media resistance (pressure drop) and efficiency. These engineers will typically have a Fractional Efficiency tester for pure R&D work as well as a 100X.
- **Quality Engineers or Quality Assurance Managers** are responsible for ensuring the company meets regulatory standards. They establish quality procedures and monitor the work of others to ensure those standards are met. QA Engineers are responsible for identifying technical issues and getting to the root of the problem. The Quality Engineer is interested in measurement consistency of the 100X. They want to know that if at any time they test a known product that they will get consistent results. This gives them confidence that the 100X is able to provide repeatable and accurate measurement results.

Virtual 100X

Selection Criteria

- Depending on the markets served, filter media companies may need a **wide range of air flow capabilities including high flow rates up to 170 lpm**.
- **Highly accurate measurement** of a filter's flow rate, efficiency, and resistance (pressure drop).
- **Repeatable, consistent measurement** of a filter's efficiency and resistance and ability to validate filter performance against historical results.
- **Available local exhaust** that is equipped with a pre-filter and HEPA filter for operating the 100X when facility exhaust is not available. This is typical in a lab environment.
- **Quiet operation** – required because the tests are performed in a lab environment.

Market Leaders

- Hollingsworth & Vose (H&V)
- Donaldson
- Lydall
- Don & Low

Respirator Mask Manufacturers

Video: Testing masks

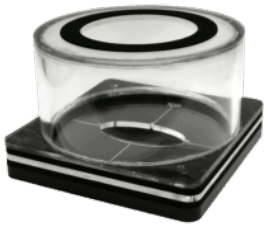
Overview

Respirator mask manufacturers test the filter media received from the media manufacturer upon incoming receipt to ensure that the material meets the standards that they require. As a result, many times they will seek to have similar test equipment between the manufacturer of the media and the mask manufacturer.

Filter mask manufacturers convert filter media into high-efficiency PPE masks (e.g., N95/KN95/FFP) and test each mask individually by placing the mask in an airtight adapter that is challenged by aerosol. The test for penetration and resistance to ensure the respirators meet the quality standards.

The number of masks in the batch test is dependent on the standard. For NIOSH, 20 masks per batch need to be tested. This test is destructive to the mask due to the need to attach the mask to a substrate while testing. This application requires a Manual 100X unit as well as a mask test adapter.

If the mask manufacture is new to making NIOSH-compliant masks, then they may send a sample to a pre-certification lab, such as Nelson Labs, to ensure that their product meets NIOSH testing requirements. Once the mask manufacturer is confident that their product meets NIOSH testing requirements, they will send production quality samples to NIOSH for full qualification. Once the production quality samples are qualified by NIOSH, the manufacturer can place a NIOSH certification stamp on their mask.



Respirator masks come in many shapes and sizes

Video: Preparing masks to test

Typical Configurations

N95 and KN95 mask customers use a 100X Salt unit to perform the tests, whereas FFP-style masks are tested using a 100X EN 13274-7 Paraffin unit according to the test specification. In both cases, the 100X unit almost exclusively operates in Manual mode. The reason for Manual mode is because testing is destructive to the mask, so only batch testing is performed. A mask test adapter (optional accessory from ATI) is used to properly secure and test the masks. The masks are typically tested in a laboratory where a 100X unit is equipped with an optional local exhaust module, containing a pre-filter and HEPA filter, to handle the excess aerosol generated during testing. The local exhaust is required when facility exhaust is not available.

These customers may need 1 or 2 Manual units for incoming inspection testing, lab use, or quality control testing.

Job Titles

- **R&D Engineers** develop new respirator mask designs, redesign existing products, and with **Lab Test Engineers** qualify the new designs. R&D and Lab Test Engineers are dependent on highly accurate and consistent measurement of the respirator's media efficiency and resistance (pressure drop).
- **Quality Engineers or Quality Assurance Managers** are responsible for ensuring the respirators meet regulatory standards. They establish quality procedures and monitor the work of others to ensure those standards are

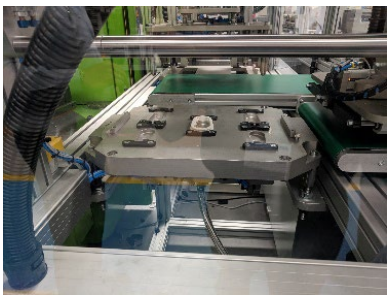
met. QA Engineers are responsible for identifying technical issues and getting to the root of the problem. The Quality Engineer is interested in measurement consistency. They want to know that if at any time they test a known product they will get consistent and expected results.

Selection Criteria

- **Accuracy and repeatability** – accurate and consistent measurement results with the ability to validate filter performance against historical results.
- **Flexibility** to test multiple mask types.
- **Local exhaust** equipped with a pre-filter and HEPA filter for operating the 100X when facility exhaust is not available to handle excess aerosol.
- **Quiet operation** since the tests are performed in a lab environment.

Market Leaders

- 3M
- GVS
- Honeywell Safety Products
- Gerson
- Moldex



Multi-filter remote test fixture

Replaceable Particulate Filter Manufacturers

Overview

Replaceable particulate filter manufacturers convert filter media into high-efficiency replaceable particulate filters, such as P100 replaceable particulate filters, for respirators used in half or full-face masks, Powered Air Purifying Respirators (PAPRs) or Air-Purifying Escape Respirators (APERs).

In this application, the 100X is an integral part of the production process. In some cases, production lines are built around the automated filter tester to optimize production throughput. Completed replaceable particulate filter assemblies are loaded onto the automated test line, lifted by robotic arms, and placed into a test fixture insert which can house a single or multiple replaceable particulate filters.

Aerosol is transported from the 100X via tubing to a remote test fixture, completing the filter load in a non-destructive test, and measures the filter's efficiency in a test cycle that takes ~ 6 seconds. If the replaceable particulate filter passes, it continues to the final assembly and packaging. Replaceable

100X units configured in automatic mode do not need a test fixture. Rather, a tube carries the aerosol to a test fixture integrated on the production line where replaceable particulate filters are tested.

A robotic arm picks up a replaceable particulate filter and places it in a test fixture on the production line. Each filter is challenged with aerosol generated by the 100X in a test that takes ~ 6 seconds.

One of the most common filters is the P100 replaceable particulate filter, which is reusable, oil-proof, and ≥99.97% efficient in removing particles less than and equal to 0.3 micrometers (µm) in diameter.

particulate filters that fail the in-line test are set aside, collected, and retested either on a separate tester in Manual mode or put back into the production line to verify the original test result to determine if the replaceable particulate filters should be accepted or rejected. The timing of the pick, place, test, and accept/reject is managed by a programmable logic controller (PLC).

Typical Configurations

For these customers the 100X operates fully in Auto mode so they would purchase either the Auto or Hybrid variants. The Hybrid variant is desirable if the customer wants to retest a replaceable particulate filter that failed in production, giving them the opportunity to test it again in Manual mode on the same unit as the auto. As a reminder, the Hybrid unit can operate in either Auto or Manual mode, hence the Hybrid name.

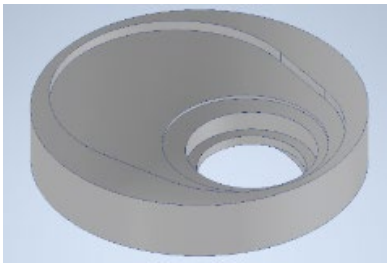
The High Flow 100X model, with flow rates up to 170 L/min, provides higher aerosol challenge flow rate for testing PAPR (Powered Air Purifying Respirator) replaceable particulate filters. The higher flow rate also enables increased production throughput as custom test fixtures can test multiple replaceable particulate filters at once.

Replaceable particulate filter manufacturers may have six or more Automated Filter Testers on a single production line, and some of our customers have more than 30 testers in a single facility. Typically, they have a tester operating in Manual mode for incoming inspection or QC testing, numerous units on the production line, and one or more spare testers that are available for when one or more of the production units is offline due to regularly scheduled preventative maintenance. Production line downtime is to be avoided at all costs.

Job Titles

- **Process or Production Engineers** are responsible for designing or optimizing the production process, increasing throughput of quality replaceable particulate filters, while reducing production cost. These individuals are focused on how the 100X will be integrated into their production line and primary concerns include equipment footprint, interoperability with PLC commands, repeatability, reliability, safety, ergonomics, total cost of ownership, and most importantly – fast test cycle times so they can maximize filter production.

- **Quality Assurance Manager** is responsible for ensuring consistent quality of manufacturing and production processes and ensuring quality of products and processes and compliance with regulatory standards. Customers will be focused on whether the 100X meets industry standards, if test results are consistent with those produced by their legacy equipment (whether ATI's 100P or competitor units), and the methods for controlling,



ATI designs customized inserts to accommodate unique replaceable particulate filter form factors

maintaining, and calibrating test equipment.

- **Operations or Production Managers** are responsible for managing production, supervising, hiring, and training employees. These individuals focus on equipment safety, ergonomics, ease of operations, maintenance, training for production staff, safety, ergonomics, total cost of ownership, and most importantly product reliability and consistency of results.

Selection Criteria

- **Reliability**
- **Repeatability** – consistency of measurement and ability to validate filter performance against historical results
- **Integration with production line** – with custom test inserts, and ability to handle PLC commands
- **Test cycle time** ~6 seconds in Auto mode
- **Total cost of ownership** – fewer, more robust parts, supported by a solid preventative maintenance program
- **Minimum downtime** – aerosol replenishment system

Market Leaders

- 3M
- GVS
- Honeywell Safety Products
- Draeger Safety
- Gentex
- MSA Safety
- Avon Protection
- Moldex

To find a list of NIOSH-Approved Particulate Filtering Facepiece Respirators

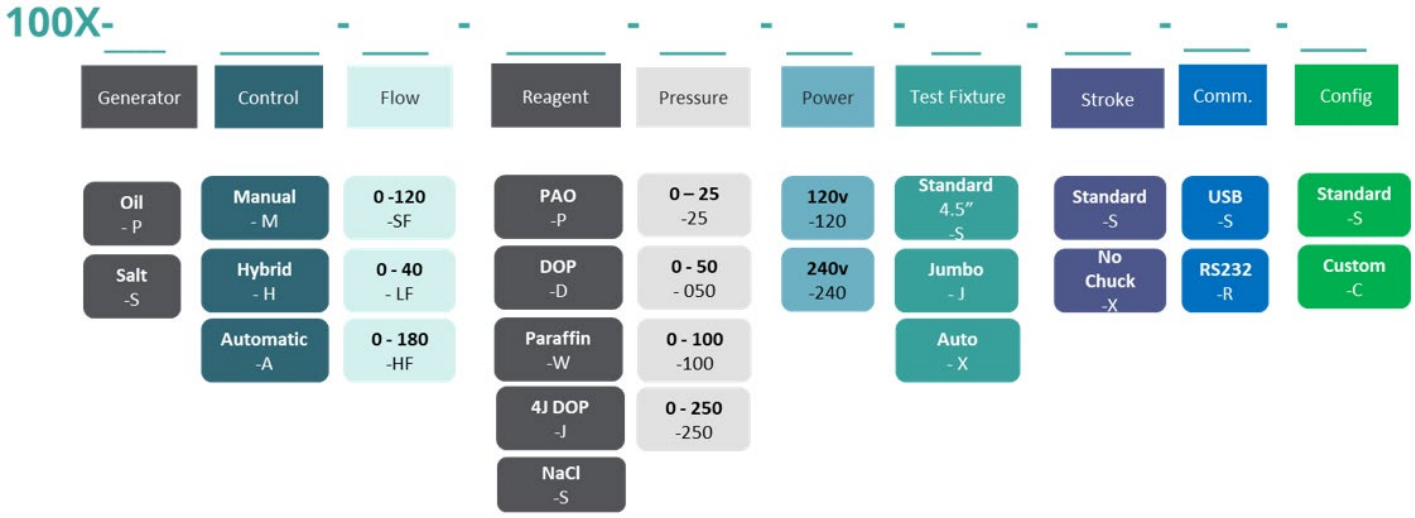
https://www.cdc.gov/niosh/npptl/topics/respirators/disp_part/default.html

To find a list of Certified Equipment Manufacturers, click here

https://www2a.cdc.gov/drds/cel/cel_form_code.asp

Sales Qualification Questions

The 100X uses a "smart" part numbering system that enables easy identification and configuration.



Click here to access the 100X quote tool and guide a customer through a configuration with step-by-step questions

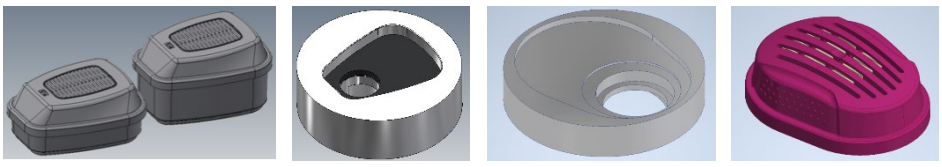
What is the filter media grade that you are trying to test? HEPA/ASHRAE?	If the answer is HEPA grade then the 100X is suitable, if it's ASHRAE or ULPA, then probably not. HEPA grade media is tested with particles that are of the size generated by the 100X and require particle efficiency of 99.97% or better. While the 100X can test 99.9995% efficiency, as required of some ULPA grade materials, it is not optimized for the ULPA filter's MPPS of 0.12um. The reason is that ASHRAE filter media is tested with particles much larger than what the 100X generates and have low efficiency requirements.
What industry testing standards, if any, are you trying to meet?	The reason for this question is that testing standards specify the reagent to be used, the test aerosol flow rate, and the particle size and aerosol concentration. With this information we can determine whether the 100X meets the customer testing requirements. Please check the ATI website for the most current standards that we meet. Industry test standards typically specify a technology to measure a filter's efficiency. The 100X uses photometers. The 100X is not suitable for standards that require only particle counter-based technology.

What type of filter are you testing? Gas, liquid, or air?	The 100X can only test air filtration products for penetration and efficiency. However, there are instances when the 100X can be used for integrity testing.
Are you testing flat sheet media, respiratory mask, replaceable particulate filters, or filter canisters?	This question helps to determine whether the customer will need an Auto/Manual/Hybrid unit and whether a salt or oil generator is needed.
What is the desired particle size distribution, aerosol concentration and flow rate?	The customer should know this information and the answers will help us determine if the 100X is the right product for them.
What aerosol type are your testing with? Oil (PAO, DOP, Paraffin, DEHS, other) or Salt (NaCl)?	This is to further define the type of 100X unit to be used. The 100X configuration is dependent on the reagent.
Do you have access to exhaust in your building?	If you do not, we offer an optional local exhaust module that safely filters out all aerosol exhaust using a HEPA filter. The accessory is required if facility exhaust is not available.
Is this your first time using an automated filter tester? What other tester(s) have you used?	It's important to understand the customer's familiarity with automated filter testers to appreciate how technical the conversation should be. It's also a way to gain insight into the competitive environment.
How much have you budgeted for this project?	This is an important question. Someone who has only $20-25k to invest in a tester is not the target customer. A budget of $75k or greater is needed.

Handling Objections

Can the 100X run both Salt and Oil in the same unit as the TSI 8130A or Palas?	While it is true that the 8130A is able test with both salt and oil aerosol there are some challenges. 1) Because salt is corrosive, extensive cleaning and changing of filters are required when changing from salt to/from oil. 2) It's not applicable for production applications where only one reagent type would be used and there wouldn't be a need to switch from oil to/from salt. In other words, you're paying for a capability you don't need.
Who else uses the 100X?	ATI has been producing automated filter testers for over 30 years and has delivered over 500 automated filter testers around the world. Major filter media and mask/replaceable particulate filter companies such as 3M, H&V, GVS, Scott Safety, and Pall have been using the 100p/100X to ensure their products meet their strict quality standards.
I don't know if my product can be tested on the 100X, will you test samples for me?	Yes, ATI is happy to test flat sheet media and respirator masks for you to ensure that your product can be tested. You can also visit one of our facilities for a hands-on demo. The only product type where we cannot test a sample is a replaceable particulate filter, as it requires a custom test insert.
I've never heard of ATI, how will they support me if I need help?	ATI is well-established and has a global presence for over 50 yrs. ATI is best known for producing best-in-class aerosol photometers and generators used in certifying cleanrooms. The same technology is used in the 100X. With our global network of over 40 ATI certified service centers, we can support you no matter where you need it. We also offer remote installation services where an ATI applications engineer will help you install the unit in real time using ZOOM.
I see that NIOSH uses the TSI unit in their testing procedures, can I still use the 100X?	Absolutely, in fact NIOSH has a 100X in their facility. The 100X meets all the NIOSH salt and oil testing requirements. Most of the customers that have bought the 100X have done so to test to NIOSH standards. Many customers use the 100X for their production QC testing and may have a TSI unit in the lab for final verification.
Does ATI offer a service plan?	Yes, ATI has a service plan that provides full coverage of your 100X.

Frequently Asked Questions

What standards does the 100X meet?	The 100X meets NIOSH 42 CFR Part 84, EN 13274 (Paraffin), EN 143/149/12941/12942, GB 2626, JMOL, ISO 23328, and ASTM F3502. Please refer to the ATI website for full list of standards.
How long does it take to run a test?	Around 6 seconds in Automatic mode and 8 seconds in Manual mode. The time it takes to test really depends on the setting that the customer uses. The load and sampling time are critical to determining the amount of time it takes to perform a test.
Can I control the 100X remotely?	Yes, the 100X can be controlled via the PLC port.
Can I output the results?	Yes, results can be outputted through the serial port, either USB or RS232.
What does 100% aerosol sampling mean?	It means that the 100X tests 100% of the aerosol that passes through the filter, ensuring maximum accuracy of the product under test. With 100% aerosol sampling the light scattering chamber is in the aerosol path whereas for the TSI 8130A, the light scattering chamber samples the aerosol.
I need a custom test fixture, can ATI help?	Yes, ATI has extensive experience in designing custom test fixtures. To design and deliver a custom test fixture, ATI needs 3D CAD models and samples of the product to be tested. Because these are custom parts the lead time is a minimum of 12 weeks. 
Can I test a respirator mask on my 100X?	Yes, but to do so you will need an ATI mask test adapter to test N95/KN95/FFP masks. Before purchasing the adapter, ATI needs five samples of each mask you want to test to ensure that the mask can properly be sealed to the substrate and that the mask fits properly into the mask test adapter.

How can get my 100X serviced?

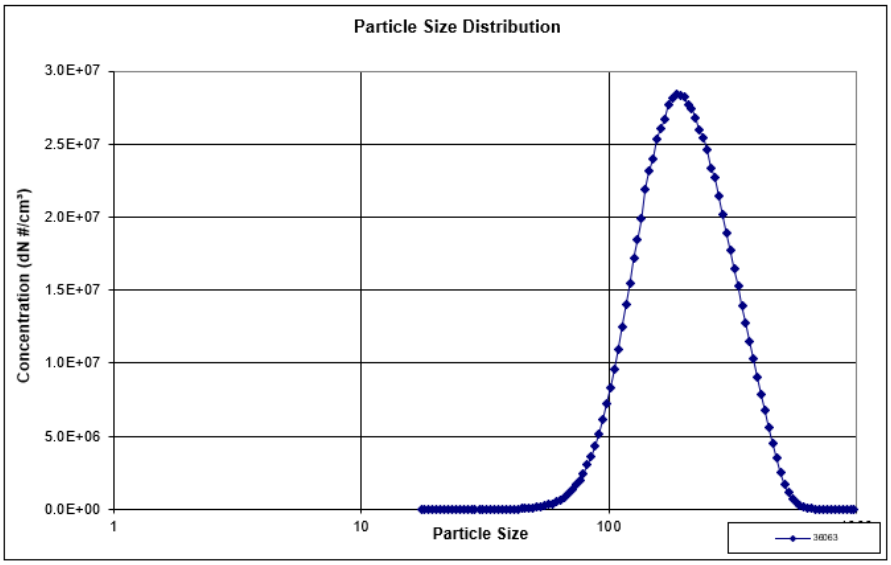
ATI offers multiple service plan options to help protect your investment. Please ask your ATI sales representative for more information.

How do I know that my 100X meets the required particle size?

Every 100X ships with a full calibration report which includes SMPS data showing the particle size information for each unique 100X. This is exclusive to ATI. TSI does not provide particle size information for each unit sold.

SMPS Data Summary

	Number Particle Size	Diameter Particle Size	Surface Particle Size	Volume Particle Size	Mass Particle Size
median (nm)	199.1	239.5	283.7	326.9	326.9
mean (nm)	216.9	254.8	293.8	331.0	331.0
geo. mean (nm)	199.3	235.7	274.6	313.0	313.0
mode (nm)	187.7	250.3	310.6	371.8	371.8
geo. st. dev.	1.51	1.49	1.46	1.41	1.41
total conc.	1.35e+07(#/cmÂ³)	2.92e+03(mm/cmÂ³)	2.34e+12(nmÂ²/cmÂ³)	1.15e+14(nmÂ³/cmÂ³)	9.38e+04(Âµg/mÂ³)



Features & Benefits

Feature/Benefit	ATI	Competitor or Alternative
Auto aerosol replenishment No need to shut down the unit during production to replenish the aerosol, saving time and increasing productivity.	The patented aerosol replenishment system is ideal for automated production lines. The 100X automatically draws aerosol from the reservoir when needed ensuring that the unit has enough aerosol to continuously operate. This eliminates the need to stop the machine for aerosol replenishment thereby dramatically increasing production throughput.	The TSI 8130A requires the user to stop testing product to refill the generator with aerosol, which is a disruption to the production line. The new TSI 8150 incorporates an auto aerosol replenishment feature.
100% aerosol sampling with a single photometer • Improves accuracy leading to higher yields • Only one photometer to be maintained reducing mean time before failure (MTBF)	The 100X incorporates a photometer that is placed in the aerosol path. This ensures that 100% of the aerosol is tested which ensures that the resulting penetration value truly represents the actual value. This improves yields as it reduces false negative results and potentially allows for a wider pass criterion. There is only one photometer to maintain, minimizing maintenance time and costs, as well as reducing mean time between failure (MTBF).	The TSI 8130A incorporates a dual photometer architecture, upstream and downstream of the test fixture. In both cases the photometer partially samples the aerosol thereby not capturing 100% of the aerosol, possibly leading to inaccuracies. TSI incorporates two photometers thereby requiring increased maintenance.
Integrated flow controller Improves testing accuracy	The 100X incorporates a flow controller that ensures that the aerosol flow rate is constant as the filter gets loaded with aerosol. This is important as penetration accuracy depends on the flow controller. It also maintains the flow rate as the temperature and humidity changes throughout the day.	We're not sure if the TSI 8130A has this feature or not. Either way it's good to show that ATI addresses flow rate changes as the filter is being loaded. Also, the customer can be confident that the results won't change throughout the day.

Multiple flow rate and pressure measurement range options Increases test accuracy	The flow rate accuracy is determined by the flow rate that the user defines and the max flow rate possible. Pressure measurement accuracy is determined by the max range. So, if the user needs only half the flow rate or pressure range the accuracy will still be based on the max. The 100X offers the user the flexibility to choose different flow rate and pressure measurement options to minimize testing inaccuracies. The flow rate and pressure range are selected at time of order.	TSI 8130A does not allow for different flow rate or pressure measurement options. This could lead to pressure accuracy of up to 10% (TSI) vs. 0.25% (ATI) if your pressure range is between 0-25mmH_20.

Competitive Comparison

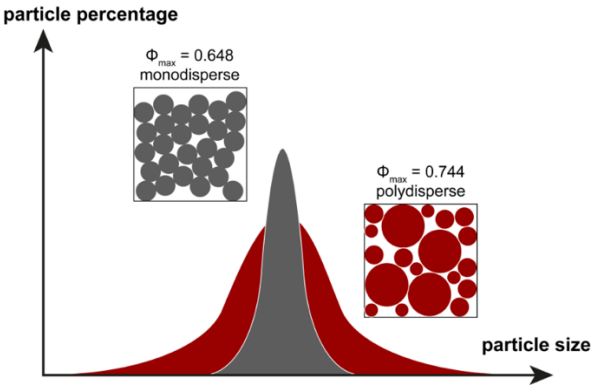
Feature	ATI 100X	TSI 8130A
		
Oil and Salt in One Machine	No	Yes
Available Local Exhaust for Lab/QC	Yes	No
Flow Rate Options	Three options available: 10-40 L/min 10-120 L/min 10-170 L/min (oil only)	One option: 10-110 L/min
Flow Rate Accuracy	+/- 0.4% of reading (measured value) plus +/- 0.2% full scale	+/- 2% of reading
Pressure Measurement Options	Four options available: 0 – 25 mm H_2O 0 – 50 mm H_2O 0 – 100 mm H_2O 0 – 250 mm H_2O	One option: 0 – 250 mm H_2O

Pressure Measurement Accuracy	+/- 0.25% full scale	+/- 1% full scale
Compressed Air Requirements	90 psig @ 14 SCFM	80 psig @ 7 SCFM
Initial Cost (varies by region)	$75-82K (direct)	$85-110K
High Flow Option (oil only)	Yes, up to 170 L/min	No

Glossary

Aerosol	Liquid and solid particles suspended in ambient air.
Airflow	Airflow is the movement of air. The primary cause of airflow is the existence of air. Air behaves in a fluid manner, meaning particles naturally flow from areas of higher pressure to those where the pressure is lower. Atmospheric air pressure is directly related to altitude, temperature, and composition.
Air-Purifying Escape Respirators (APERs)	Worn for protection from breathing harmful gases during an emergency evacuation to fresh air. Chemical, biological, radiological, and nuclear (CBRN) APERs are a special class of APER designed to block chemical and biological agents and radioactive dust particles.
Concentration	The amount of aerosol in a unit of volume by weight. If the concentration is 100ug/L, then for every liter of air there is 100ug of aerosol.
Di-Ethyl-Hexyl-Sebacat (DEHS)	No soluble, colorless, and odorless liquid which is suitable for producing steady aerosols.
Differential Pressure	Differential pressure measurement is the difference in pressure between two points in a system. For filtration applications, the upstream side [A] is positioned before the filter [B], whereas the downstream side [C] is after the filter. Changes in the differential pressure are an indication of physical changes in the filter. A sudden drop in differential pressure may alert us that a filter leak or rupture has occurred.
Dioctyl Phthalate (DOP) Oil	Historically used as a challenge aerosol when testing to NIOSH 42 CFR Part 84 standards.
Efficiency	A measure of the percentage of particles of a given size that are captured by the filter.

Electret Filter Media	Particle capture in synthetic media can be enhanced by adding an electrostatic charge, creating an electro-mechanical structure that attracts particles with a natural charge (and those that pick up a natural charge as they pass through the air), similar to magnetic attraction.
Filter Element	A structure made from a filtering material used to remove solid particles from the air. The filter element is contained in a filter housing.
Filter Media	Filter media are the portion of a filtering system that separates unwanted particles from the substance being filtered. The type of air filter material used depends on the application. There are many different kinds of air filter materials that can be selected; each designed to capture different types of recirculated particulate matter.
Filter Performance	The filter is evaluated to measure the reduction in concentration of specific aerosols in air that pass through the filter.
Flow Rate	The volume of aerosol generated over a unit of time. If a mask is being tested at 85 lpm (liters per minute), that means that a mask is being challenged by 85 liters of aerosol every minute.
Full Scale	Full scale refers to the maximum range of a component. If the differential pressure accuracy is "+/- 0.25% Full Scale" that means that no matter what differential pressure is measured, the accuracy will be +/-0.25% of the max possible measurement value. If the max differential pressure range is 0-100mm H_20 with accuracy of +/- 0.25% Full Scale, then the accuracy is +/-0.25mm H_20.
HEPA (High-Efficiency Particulate Air)	Remove at least 99.95% (European Standard) or 99.97% particles, with the filtration efficiency increasing for particle diameters both less than and equal to 0.3 micrometers (μm) in diameter.
MMAD (Mass Median Aerodynamic Diameter)	Is the diameter at which 50% of the particles of an aerosol by mass are larger and 50% are smaller.

Monodisperse / Polydisperse	Monodisperse means that the particles that are generated are primarily of the same size. In a Polydisperse the particles are of varying sizes. The geometric standard deviation for a monodisperse aerosol will be between 1.1-1.3 where in a Polydisperse aerosol it will be greater than 1.5. 
MTBF (Mean Time Between Failure)	The estimated time it takes for a component to fail.
NIOSH (National Institute for Occupational Safety and Health)	In the United States, NIOSH sets the standards for testing and certifying nonpowered, air-purifying, particulate-filter respirators in 42 CFR Part 84 Respiratory Protective Devices. Title 42 Code of Federal Regulations, Part 84 requires that respirators submitted for evaluation against the terms of the Standard must be accompanied by data that demonstrate the respirator under evaluation meets or exceeds the performance requirements set forth therein. Once approved, the quality assurance requirements specified in Subpart E of the standard require an ongoing effort by the approval holder for the purpose of assuring not only the material aspects, but the performance level of the approved product.
OSHA (Occupational Safety and Health Administration)	With the Occupational Safety and Health Act of 1970, U.S. Congress created the Occupational Safety and Health Administration (OSHA) to ensure safe and healthful working conditions for workers by setting and enforcing standards and by providing training, outreach, education and assistance.
Paraffin Oil	Paraffin oil is a mineral oil which is transparent, colorless, odorless, and tasteless. It's used as a challenge aerosol for EN 13274-7:2019 standards.
Particle Size	Particle sizes are measured in microns (μ). A micron is 1/1000 mm. Usually

	particle size is designated as the average diameter in microns.
Penetration	Aerosol penetration and pressure drop are combined to express the performance of a filter in terms of "quality factor."
Poly-alpha-olefins (PAO)	PAOs are specially designed chemicals made from alpha olefins. They are used in many synthetic products such as lubricants, greases and fluids, and have emerged as essential components in many industries and applications. They have good lubrication properties and greater viscosity than mineral oils and are used as a challenge aerosol when testing to NIOSH 42 CFR Part 84 standards.
Powered Air-Purifying Respirator (PAPR)	An air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.
PPE (Personal Protective Equipment)	Equipment worn to minimize exposure to hazards that cause serious workplace injuries and illnesses. Personal protective equipment may include items such as gloves, safety glasses and shoes, earplugs or muffs, hard hats, respirators, coveralls, vests, and full body suits.
Pressure Drop	The resistance air is subjected to as it moves through a medium, such as a respirator filter, typically measured in Pascals (Pa) or mm H_20.
Reagent	The test agent (typically salt or oil) used in the aerosol that is generated during the filter performance test.
Resistance	A measure of how freely air flows through a filter, used interchangeably with pressure drop.
Scanning Mobility Particle Sizer (SMPS)	Used to measure the particle size that is being generated by the 100X. This is critical data as the particle size must meet the standards that are being tested to.

Test Standards	To enable design engineers and maintenance personnel to choose the correct filter types, there is an interest from international trade and manufacturing for a well-defined, common method of testing and classifying air filters according to their particle efficiencies, especially with respect to the removal of particulate matter.
Ultra-Low Particulate Air (ULPA)	ULPA filters are 99.9995% effective at removing submicron particulate matter of 0.12-micron diameter or larger.
Volume Flow	By multiplying air velocity by the cross-section area of a duct, you can determine the air volume flowing past a point in the duct per unit of time. Volume flow is usually measured in Cubic Feet per Minute (CFM).