Архангельск (8182)63-90-72
Астана (7172)727-132
Астрахань (8512)99-46-04
Барнаул (3852)73-04-60
Белгород (4722)40-23-64
Брянск (4832)59-03-52
Владивосток (423)249-28-31
Волгоград (844)278-03-48
Вологда (8172)26-41-59
Воронеж (473)204-51-73
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Ижевск (3412)26-03-58
Иркутск (395)279-98-46
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Кемерово (3842)65-04-62
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Красноярск (391)204-63-61
Курск (4712)77-13-04
Липецк (4742)52-20-81
Киргизия (996)312-96-26-47
Магнитогорск (3519)55-03-13
Москва (495)268-04-70
Мурманск (8152)59-64-93
Набережные Челны (8552)20-53-41
Нижний Новгород (831)429-08-12
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Новосибирск (383)227-86-73
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Орел (4862)44-53-42
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Ростов-на-Дону (863)308-18-15
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Самара (846)206-03-16
Санкт-Петербург (812)309-46-40
Саратов (845)249-38-78
Севастополь (8692)22-31-93
Симферополь (3652)67-13-56
Смоленск (4812)29-41-54
Сочи (862)225-72-31
Ставрополь (8652)20-65-13
Таджикистан (992)427-82-92-69
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Уфа (347)229-48-12
Хабаровск (4212)92-98-04
Челябинск (351)202-03-61
Череповец (8202)49-02-64
Ярославль (4852)69-52-93

https://tsi.nt-rt.ru || tfs@nt-rt.ru

FILTER TESTING FOR AIR FILTERS AND FILTER MEDIA

TRUSTED BY FILTER MANUFACTURERS AROUND THE GLOBE

The World Health Organization (WHO) stated "In 2016, 91% of the world population was living in places where the WHO air quality guidelines levels were not met.*" At the same time, there is increasing awareness about the health effects of inhaling higher concentrations of particles. This has caused an increased use of respiratory masks for protection in daily life, at workplaces, in healthcare, by firefighters, etc.

In order to ensure the quality of these protective respiratory masks and filters, worldwide standards are in place to ensure reproducible test results, such as US 42 CFR 84, GB 2626, JMOL, ISO 16900-3, EN 143/149, ISO 23328-1 and more.

TSI provides filter testing solutions to manufacturers and certification agencies for performance and compliance testing to many standards and regulations such as:

+ Respiratory Filter Testing: US 42 CFR 84, GB 2626, EN 143/149, ISO 16900-3
+ Air Cleaner Testing: AHAM AC-1-2013, GB/T 18801-2015
+ HEPA and ULPA filter and filter media testing: EN 1822-3/5, MIL STD
+ Ventilation filter testing: ASHRAE 52.2, ISO 16890-2
+ Others (cabin air filter testing, engine intake filter testing)

The Automated Filter Testers (AFTs) that are offered for respiratory filter testing and fractional efficiency testing are designed to increase throughput, to reduce the cost of ownership and to result in more profitable filter testing. These AFTs measure the filter or filter media resistance with highly accurate electronic pressure transducers. Simultaneous upstream and downstream detector readings provide the most accurate penetration or filter efficiency measurement results.

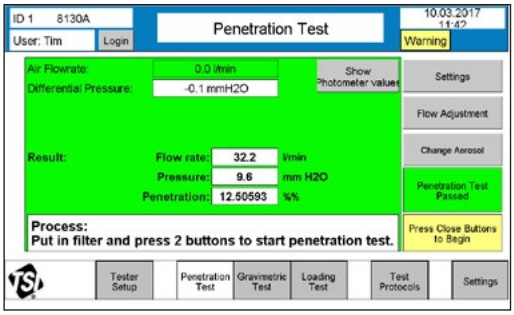
TSI also offers various high end components for cost effective customized systems or specific application requirements (e.g. very high efficiency filters, protective garments) for:

+ Aerosol Generation
  (salt, oil, and powder/dust generators, polydisperse and monodisperse)
+ Isokinetic Sampling
+ Aerosol Particle Counting and Sizing:
  (Model 3330 Optical Particle Sizer, Condensation Particle Counters)

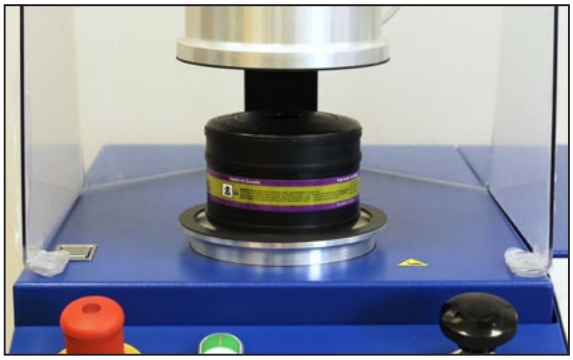
The components can be controlled with the Component Filter Test System (CFTS Model 3150) that consists of software and a hardware module to collect data from the TSI particle instruments. This off-the-shelf modular platform is pre-configured to work with the TSI components, while additionally providing analog and digital inputs and outputs to communicate with a wide variety of flow meters, pressure transducers, valves and sensors (temperature, pressure and relative humidity) to automate data collection.

The software allows you to define a test protocol and to create a report from the measurement data. Whether designing a new test duct or updating an existing system, the CFTS provides an easy to use system with the flexibility to meet your filter testing needs.

Several hundred Automated Filter Testers are being used worldwide. They have a proven track record of durability, reliability, and minimal maintenance. Additionally, all filter testers are backed by TSI's commitment to provide superior customer support and service.



Screen capture of the 8130A graphical user interface. A respiratory filter was tested for penetration and pressure drop and passed the target requirements



Respiratory filter cartridge placed into the 8130A automated filter tester

RESPIRATORY FILTER TESTING

Meet your standards and achieve your goals with the Automated Filter Tester Model 8130A

The 8130A enables the testing of respirator filters, disposable filtering face pieces, and a wide assortment of filter media to meet the requirements of many different standards. It provides salt and oil testing in one unit, ergonomic design improvements for reduced operator fatigue, and further reduced cost of ownership with the new user-serviceable photometers. These improvements not only enable proactive scheduling of maintenance, with minimal impact to production schedules, but also increase uptime. The completely redesigned hardware and electronics coupled with a new intuitive interface, will optimize your testing process.

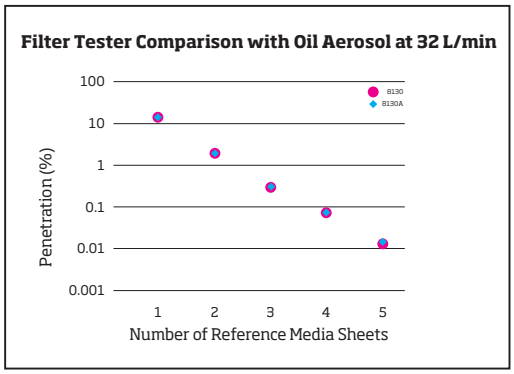
The model 8130A is based on the model 8130, which for more than 20 years has been well known and used worldwide in quality control and manufacturing testing. Improvements made in signal processing led to increase in sensitivity in the 8130A. It is now able to measure up to six 9's of efficiency with oil. Overall, the data gathered with the new system, compares well with the original 8130.

Maintenance and time saving benefits of the 8130A

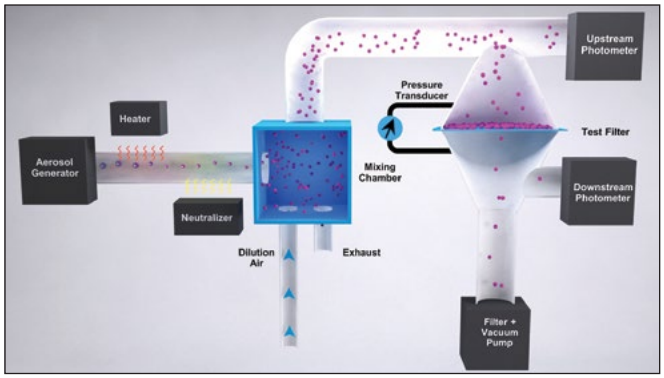
Our customers told us that saving time and costs were their top priorities. They asked us to reduce tester downtime and slowdowns. We listened, and improved the 8130A to make maintenance not only quicker, but also easier. Here are a few examples:

+ The photometers can now be cleaned onsite by the user. No tools are necessary to remove the box containing the photometers and filters
+ The aerosol generator now swivels out to help ease refilling
+ We installed controls and gauges on the door for quick access
+ Operators can now change the main filter in significantly less time
+ Swapping out filter holders is fast and easy. The bottom chuck is held in place by six strong magnets rather than screws (Which require tools for removal)

Your time is important. The 8130A lets you spend less time on routine maintenance and more time on profitable filter testing.



Comparison of penetration test results between model 8130A and model 8130



Operational schematic of the 8130A

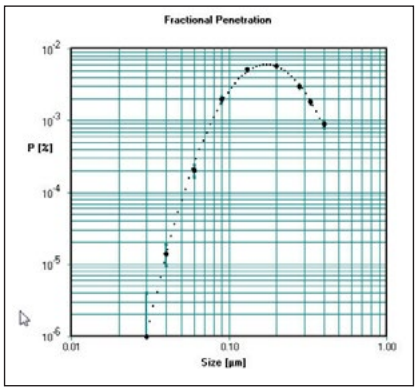
HEPA AND ULPA FILTER TESTING

HEPA and ULPA filters are used in hospitals, operating rooms, laboratories, clean rooms and other places that require low concentrations of particles and bacteria. Filter quality is measured by determining the fractional filter efficiency (or penetration) and the most penetrating particle size (MPPS).

Measure filter performance at individual particle sizes with highest sensitivity

The model 3160 determines the pressure drop and fractional filter efficiency at different particle sizes in order to obtain the MPPS of HEPA and ULPA filters and filter media. The system is designed to comply with the test requirements of EN 1822 parts 3 and 5 as well as ISO 29463. Filter tests are performed automatically following user-specific test parameters and up to 99.999999% (eight 9s) fractional filter efficiencies.

The 3160 uses a bank of atomizers and the research grade TSI classifier to challenge a filter or filter media with known-size, monodisperse particles. Two new generation Condensation Particle Counters (CPCs) simultaneously count the upstream and downstream particles while the software calculates the penetration value. Filters can be sequentially challenged with up to 20 different monodisperse particle sizes in the range from 15 to 800 nm. The penetration value for each particle size is obtained. At the end of a test, the model 3160 generates a curve of penetration vs. particle size and produces a summary of test results, including the MPPS.



MPPS and fractional penetration results measured with Model 3160

AUTOMATED FILTER TESTER SPECIFICATIONS

Model	8130A	3160
Measurement Application	Loading and Quality Control Tests	MPPS
Maximum Efficiency	99.9999%	99.999999%
Aerosol Type[d]	DOP, PAO, DEHS, Paraffin, and other Oils or NaCl	DOP, PAO, and other Oils or NaCl
Aerosol Generation	Atomizer	Atomizer with Classifier
Count Median Diameter[b]	0.2 µm (Oil) or 0.075 µm (NaCl)	N/A
Geometric Standard Deviation[b]	<1.6 (Oil) or < 1.86 (NaCl)	<1.3
Flow Rate	10 to 110 L/min	5 to 100 L/min
Resistance	0-150 mm H_2O (0-1470 Pa)	
Particle Detection	Light Scattering Photometer	Condensation Particle Counter
Typical Test Length	10 sec	30 sec to 20 min[c]
Data Reporting	Touch screen and RS-232	PC with Integrated Software
Operation	Stand Alone Tester/ Automated Production Lines	Stand Alone Tester
Compliance	US 42 CFR part 84, EN 143, JMOL, ISO 23328-1	EN 1822 parts 3 and 5

[a] EN versions (for equivalent results to EN 143 standard) available (8130A-EN)
[b] EN version CMD and GSD are different. See 8130A spec sheet for more information
[c] Efficiencies higher than 99.9999% require longer than typical testing times
[d] Aerosol abbreviations: DOP (dioctyl phthalate), PAO (polyalpha olefin), DEHS (di-ethylhexyl sebacate)

New!

Automation interface for model 8130A

The automation interface enables remote controlled operation of the 8130A via the communication port. It provides a straightforward integration of the 8130A into a PLC-driven automated production line for fully automated testing of your filtration products.

Contact your TSI representative for more information.

AIR CLEANER TESTING

People in industrialized countries spend most of the day indoors. Airborne particulates (solid particles or liquid droplets) are either transported indoors from outdoor environments, or the particles directly result from indoor sources like smoking, cooking, housework and many more. Indoor measured particle concentrations can be very high in cities or from the sources listed above. Inhalation of particulates has been linked to increased risk for a number of adverse health effects. Awareness is continuing to increase in workplaces as well as private homes; more and more are being outfitted with air cleaners.

In order to ensure the quality of air cleaners/purifiers and give a quantitative performance verification the Association of Home Appliance Manufacturers (AHAM) has created a certification program. This is offered by independent laboratories. This program provides a uniform and commercially practical verification of manufacturers' Clean Air Delivery Rates (CADR) for tobacco smoke, dust and pollen. The method and requirements are specified in the most recent edition of the ANSI/AHAM AC - 1 Standard "Method for Measuring Performance of Portable Household Electric Room Air Cleaners". In addition, some countries developed additional standards that must be met when selling air cleaners in that country, for example, China with GB/T 18801-215.

TSI provides components for air cleaner test systems, most of which are listed in Annex A of the AHAM standard. Some component examples include:

+ Model 3400A Fluidized Bed Aerosol Generator
+ Model 3012 Aerosol Neutralizer
+ Model 3074B Filtered Air Supply
+ Model 3321 Aerodynamic Particle Sizer (optional with model 3302A Aerosol Diluter) for dust/pollen counting
+ Model 3340A Laser Aerosol Spectrometer for cigarette smoke detection
+ Model 3330 Optical Particle Sizer

VENTILATION FILTER TESTING

Air filters used for general ventilation are widely used in heating, ventilation and air-conditioning (HVAC) applications in buildings. Similar filters are also used in cabin air filtration and engine air intake filtration. Here these filters lower the concentration of particles and improve the (indoor) air quality. When design engineers and maintenance personnel choose which filter type to use, they depend on specifications that are based on standardized tests. Currently two main standards are used: ASHRAE 52.2 in the United States and ISO 16890 which replaced EN 779.

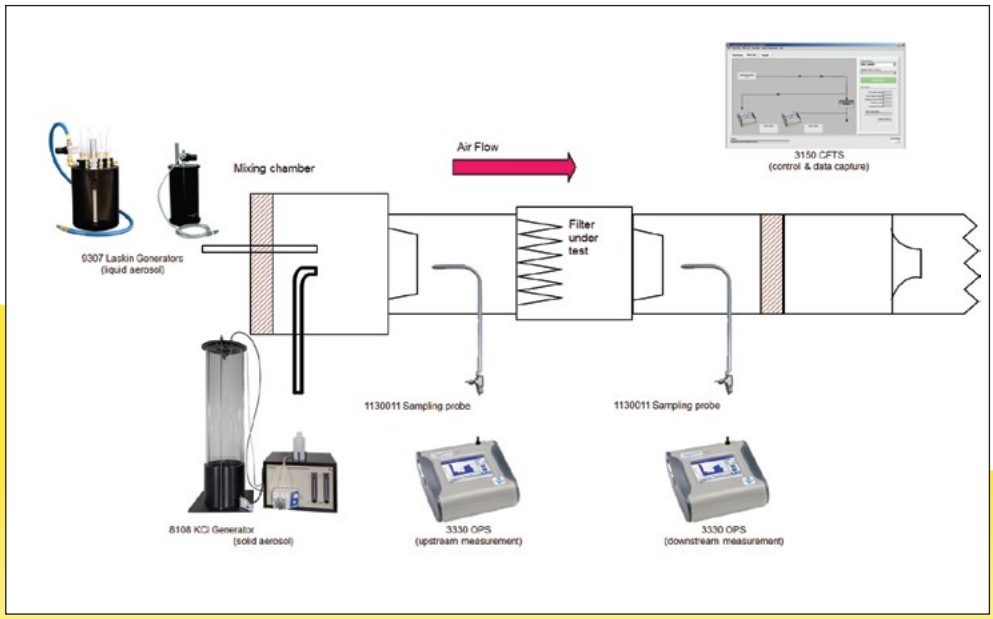
The World Health Organization (WHO) and other environmental authorities have called attention to the negative impact of particulate matter (PM) on human health (World Health Organization 2002; Dockery et al., 1993). In order to work towards testing ventilation filters in a manner that reflects the nature (and terminology) of PM pollution, ISO 16890 specifies that filter efficiencies will be calculated regarding how successfully they remove PM_1, $PM_{2.5}$, and PM_{10} particle sizes. KCl salt particles are now generated and measured in the size range from 0.3 to 10 µm using 8 to 12 size bins. For more information on how the ISO 16890 compares to EN 779 and ASHRAE 52.2 please refer to the application note on ISO 16890-2 Air Filters for General Ventilation: Determining Fractional Efficiency" (AFT-005).

Standards specify requirements that the test equipment must meet to determine filter efficiency as a function of particle size. TSI focuses on providing high-end components necessary to comply with these requirements. Filtration professionals can use the following components that are compliant with each of these key steps: particle generation, particle sampling, and particle measurement:

+ Model 9307-6 or Model 9307 Laskin Generator
+ Model 8108 Large Particle Aerosol Generator (KCl)
+ PN 113011 Isokinetic Sampling Probe and Coupler
+ Model 3330 Optical Particle Sizer

Depending on further requirements in development or quality assurance, the following additional instruments are used by manufacturers:

+ Model 3321 Aerodynamic Particle Sizer
+ Series 375x Condensation Particle Counters (CPCs)
+ Series 3938 Scanning Mobility Particle Sizers (SMPS systems)



ISO 16890-2 setup with TSI component recommendations

BRINGING IT ALL TOGETHER

COMPONENT FILTER TEST SYSTEM

TSI offers a CFTS (Model 3150) for those applications that are not possible with TSI's automated testers.

For the wide range of flow rates and particle sizes needed to meet the requirements of the many filter testing standards and research needs, an automated tester is not always practical. Building a filter test system from components is often the best way to satisfy your measurement needs. TSI has developed the CFTS as an easy-to-use system that integrates all the necessary parts of this type of system. The CFTS Model 3150 is an instrument platform that connects to the components for air filter testing applications.

Flexibility

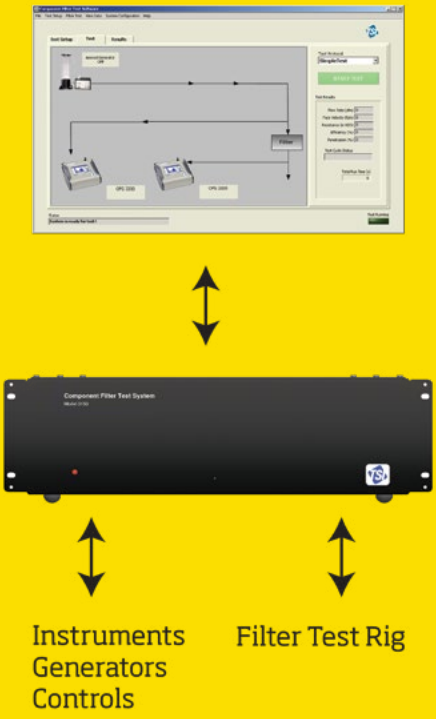
Filters are used for a wide variety of application and are therefore tested to a variety of filter test standards. To satisfy these many requirements you need a filter testing system that is flexible enough to change to meet those requirements. The CFTS system is designed for flexibility.

CFTS is structured as a core platform which controls the filter test. Its graphical user interface defines the test layout and procedures, as well as being your user guide. The CFTS has drivers to communicate with the particle instruments and is the interface for reading sensors and controlling flow. During testing it collects, saves and exports the data needed for test reports.

Complete Solution

As an instrument manufacturer, TSI builds many of the instruments that can be used in these types of systems. Some components of these systems are best obtained locally (such as sheet metal work and welding needed to build duct segments) or from suppliers that specialize in those products (such as blowers, blower controls, pressure transducers and other sensors). While many components can be controlled or read manually, it is desirable to integrate as much of a system as possible to provide an easier to use, automated platform for filter testing. The CFTS system provides the connections and software to make configuration of these systems easier. No longer is custom software required for every component change.

CFTS: HOW IT WORKS



COMPONENTS AVAILABLE FROM TSI

TSI has a wide range of particle generators, conditioners, detectors and sizers. The following is a list of some models that are currently available and supported with the CFTS system.

Particle Generators:

3076	Constant Output Generator
8108	Large Particle Aerosol Generator
9306	Six-jet atomizer
9307	Oil Droplet Generator (Laskin Nozzle)
8118A	Salt Generator
1081414R	Oil Generator
8118A-EN	Salt Generator
1081414R-EN	Oil Generator

Particle Conditioners:

3077(A)	Aerosol Neutralizer (Radioactive)
3054(A)	Aerosol Neutralizer (Radioactive)
3087	Advanced Aerosol Neutralizer (Non-Radioactive)
308003	Electrostatic Classifier (w/o neutralizer or DMA)
3081	Long DMA (use with Electrostatic Classifier)
3332	Diluter (-10 and -100 versions)
3302A	Diluter (-20 and -100 versions)

Particle Detectors and Sizers:

3330	Optical Particle Sizer
3750	Condensation Particle Counter
8587A	Laser Photometer
7110-5	AeroTrak Remote Particle Counter

Instrument	Size Range	Concentration	Flow Rate	Count/Size
3330 OPS	0.3 - 10 µm	0 - 3000 /cm³	1 L/min	Up to 16 size bins
3750 CPC	0.007 - 2 µm	0 - 100,000 /cm³	1 L/min	Total Count
8587A	>0.1 µm	1 µg/m³ - >200 mg/m³	2.0 L/min	Not Applicable
7110 Particle Counter	0.1 - 10 µm	0 - 40,000/ft³ (0 -1.4/cm3)	1 CFM (28.3 L/ min)	6 Size Bins

Model 3750

Model 8587A

Model 8108

Model 7110-5

Model 3330

STANDARDS AND REGULATIONS

Air and gas filter testing methods are largely determined by standards and regulations. A large number of standards exist, each one appropriate for the application that category of filters is designed to be used for. Test standards, to a large extend, define the users filter testing needs. The table below gives examples of standards and which combinations of components are needed to test to the standards.

Filter Type	Standard Number	CFTS	OPS	APC	Photometer	CPC	Electrostatic Classifier	Neutralizer	Generator
Ventilation	ASHRAE 52.2	x	x	x				x	KCl/Dust
Ventilation	ISO 16890	x	x	x					KCl/Oil/Dust
Automotive Cabin Air	DIN 71460-1	x	x					x	Dust
Automotive Cabin Air	ISO TR 11155-1	x	x					x	KCl/Dust
Automotive Engine Intake	ISO 17913	x	x						KCl
Crankcase Ventilation	ISO 20654	x	x						KCl
Compressed Air	VDI 3926-2	x	x						Dust
Vacuum Cleaner	ASTM F1977-04	x	x					x	KCl
Vacuum Cleaners	EN 60312 / IEC 60312	x	x						Dust
Cleanable Filters	ISO 11057 / VDI 3926-1	x	x						Dust
Air Cleaner	AHAM AC-1-2013	x	x	x					Dust
HEPA-ULPA Media	ISO 29463-3	x		x*		x	x		Oil
HEPA-ULPA Panels	ISO 29463-5	x	x	x		x	x		Oil
HEPA-ULPA Panels	IEST RP-CC001/CC007	x	x	x		x	x	x	Oil
HEPA-ULPA Cannisters	MIL-STD-282	x		x		x	x	x	Oil
HEPA-ULPA Media	IEST RP-CC022	x		x		x	x		Oil
Medical Face Mask	ASTM F2299-03	x		x					PSL
Respirator	42 CFR part 84	x			x			x	Oil & NaCl
Respirator	EN 143 and 149	x			x				Oil/NaCl/Dust
Respirator	ISO 16900	x			x				Oil & NaCl
Medical Ventilator	ISO 23328-1	x			x				NaCl
Military Respirator	MIL-STD-282	x			x	x			Oil