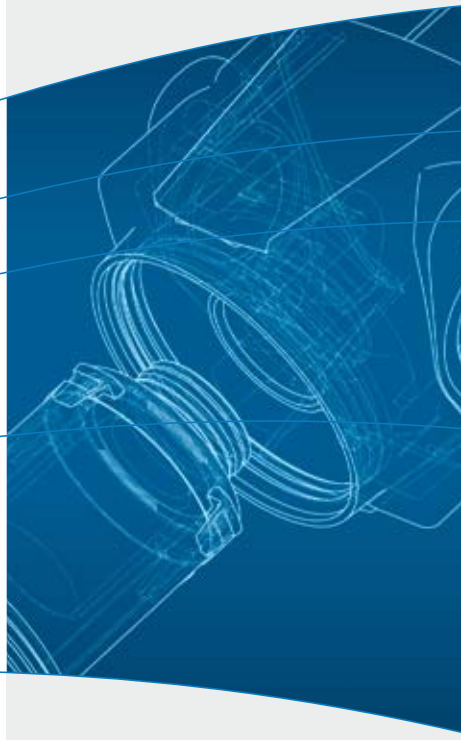
WALKER FILTRATION

The ultimate filtration & drying technology

Filter Performance Validation

Validated to ISO 12500-1:2007
Filters for Compressed Air – Test Methods – Part 1: Oil Aerosols

Independent test report for the Alpha Series
compressed air and gas filters



www.walkerfiltration.com

Introduction

Market leadership

Walker Filtration is a world leader in the manufacture of filtration products for use across a wide range of industries. The Company has a truly enviable and technically advanced product range including compressed air dryers, filter housing and elements, medical air dryers and bespoke filtration products.

Walker Filtration continues to lead this competitive sector through its ability to provide high quality products, exceptional technical expertise, innovation and an excellent standard of customer service.

Walker Filtration is a pioneer within the filtration industry, introducing many new technologies, thanks to its passion for driving research forward.

Walker Filtration has remained true to its goal of delivering a market leading product range that provides the customer with reliable and efficient solutions to their filtration needs.

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Choosing the right filter

Deciding on the correct filter and element combination to use within each application can have huge implications. Quality must be the number one priority. Inferior elements can cause corrosion, contamination and add unnecessary operating costs to your compressed air system.

Ongoing investment into research and development has resulted in the manufacture of elements using only the highest quality engineered components.

Filters from Walker Filtration ensure continuous high filtration efficiency with reduced power loss due to the selection of new and improved filter media. Custom made borosilicate microfibre glass filter media and chemically treated anti re-entrainment layer ensure optimum performance. The elements are engineered to provide continued operation at elevated temperatures with both mineral and synthetic oils.

Flexibility and reliability

A wide range of high performance filtration equipment, elements and spares coupled with reliable technical service makes Walker Filtration the natural choice for many industry leaders. The Walker Filtration brand name, known for providing consistent quality and innovation has become synonymous with providing the highest possible standards.

The Company's products have been adopted by a diverse range of market sectors including electronics, oil and gas, automotive and clean room environments.

Specialist in-house manufacturing capabilities ensure the Company's ability to deliver the right solution including exacting 'LABSfrei' for automotive standards.

The customer is at the forefront, their demands are quickly met, however complex. Pro-active research continues to push the accepted boundaries of filtration technology.

Construction

Filter Element Design and Materials

A dynamic approach to design, material selection and construction means that Walker Filtration is at the forefront of filtration technology. The Company's Research and Development team constantly identify, evaluate and implement enhancements to improve the ease of use and performance of their market leading product range.

Drop-Fit Design for ease of installation, servicing and maintenance. Eliminates the need for troublesome tie rods.

Durable, Chemical Resistant End Caps injection moulded from nylon then bonded to the filter core with a high strength two part polyurethane potting resin for maximum strength.

Colour Coded End Caps provide easy and accurate filtration grade indication.

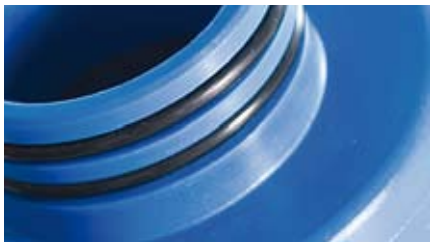
Stainless Steel perforated support cylinders are corrosion resistant, twice as strong as expanded and galvanised steel, with the ability to withstand pressure in either direction.

Extra Stainless Steel inner support on the larger flow elements is provided by an additional coil spring spot welded to the inner cylinder. This ensures the element meets the particular demands of 'outside to in' flow and does not rupture causing downstream contamination.

Element End Cap label on base indicates product part number for easy model identification and re-ordering.

Air Distribution Duct for uniform airflow distribution through the media providing improved element utilisation and low operating differential pressure.

Double O-ring Seal provides additional security against contaminant bypass. The double O-ring ensures perfect sealing within the filter housing whilst withstanding temperatures of 120°C.



This feature is a standard requirement for filter products installed within pharmaceutical environments where O-ring bypass has been identified as a significant risk for contamination for many years.

Annular Location Ring on lower end cap prevents element vibration and improves stability in reverse flow dust removal applications. In addition, its design also improves oil drainage.

Support Media offers protection with air flow in either direction. This non-woven glass fibre also enhances the strength of the filter pack and increases filter life.

Anti Re-Entrainment Layer is chemically treated and custom engineered. It collects coalesced oil from the media pack allowing swift drainage to the quiet zone of the filter bowl, preventing oil carry-over.

Unlike reticulated foams which degrade causing downstream contamination, this polyester material has a high tensile strength and withstands temperatures up to 120°C. All elements are suitable for use with mineral and synthetic oils.

New improved ultrasonic weld process which, combined with the improvement in tensile strength offered by the anti re-entrainment layer, gives a truly robust and homogenous bonded seam.

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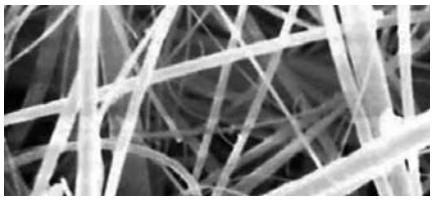
Deep Bed Spiral Wrapped technology is used to form the media pack. This offers low differential pressure, extremely high oil removal efficiencies and proven continuous performance with long service life.

Borosilicate Microfibre Glass Media has been specifically developed for Walker Filtration. This high quality, custom engineered material is able to



withstand high temperatures due to its immobilised structure. It is also completely inert and is immune to degradation. With high gamma factor capabilities this filter media is specially treated to be oleophobic and hydrophobic with sub-micron fibre diameters and an extremely high voids volume.

Quality Control. Full traceability is provided by ink jet marking specific manufacturing codes on every filter element. This complies with the Company's ISO 9001-2008 manufacturing procedures. All elements are supplied with a Certificate of Conformity.

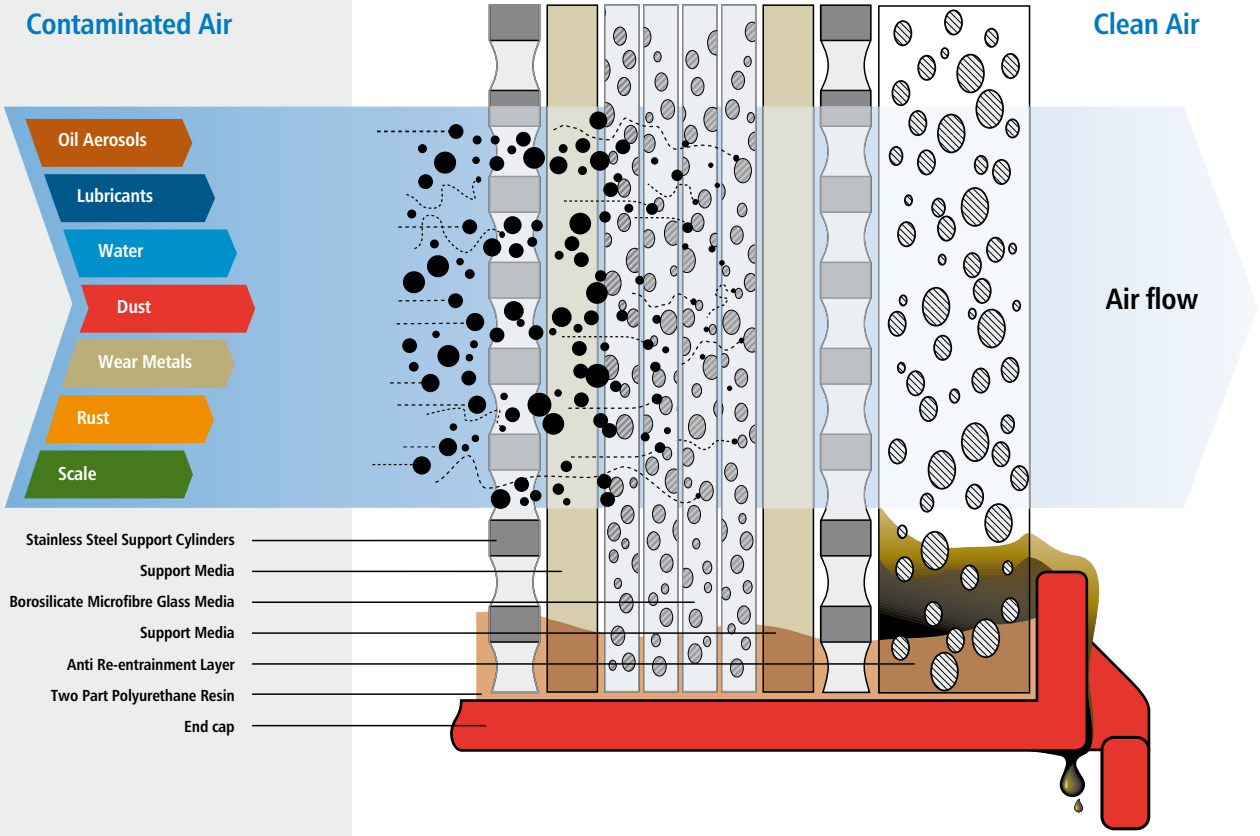
Performance

Filter Collection Mechanisms

Effective filtration takes place in five main stages facilitated by the single fibre collection mechanisms illustrated below and explained on the page opposite.

Each mechanism is effective in eliminating certain contaminants at varying particle sizes collected on individual fibres in the filter media.

These particles are captured and coalesce into larger droplets, migrating through the media to be drained away.



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Five Physical Methods of Filtration

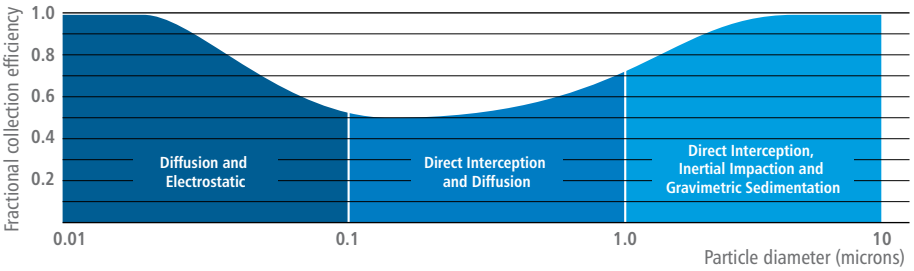
1. Gravimetric Sedimentation
Gravimetric sedimentation generally affects only larger particles of approximately 2 microns or larger, and is usually a contributor to capture efficiency only at low flow rates. Particles in this scenario are of a significant magnitude as to be affected by gravity and therefore cross the flow streamlines to be captured by the fibres.

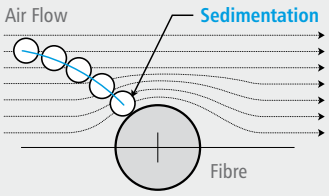
2. Inertial Impaction
Inertial impaction occurs when small particles (usually less than 2 microns) penetrate through the surface of the filter media but cannot negotiate the tortuous path within the media and are eventually captured by the fibres.

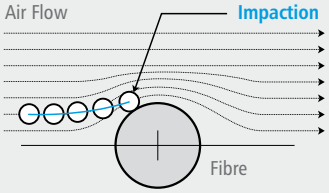
3. Direct Interception
Particles larger than the mean pore size of the filter media (approximately 0.1 microns) will simply impact directly onto the surface of the fibre matrix. Walker Filtration utilises glass micro-fibre filter media with a mean fibre diameter of 0.5 micron.

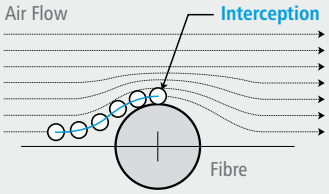
4. Diffusion (Brownian Motion)
It has been established that very small particles (less than 0.1 to 0.2 microns) move in a very random and erratic manner within the airstream. When particles are so small their motion is often violent and collisions with the fibre matrix are therefore increased.

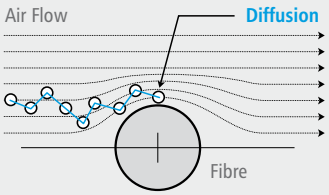
5. Electrostatic
Particles can be deposited (captured) via electrostatic deposition if electrical charges on either the particle or the filter, or both, create attractive electrostatic forces of sufficient magnitude to attract the particle to the filter surface. The electrostatic capture mechanism can aid the other capture mechanisms, especially interception and diffusion.

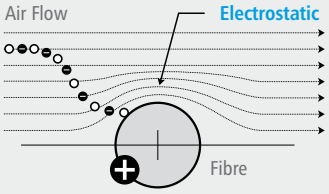












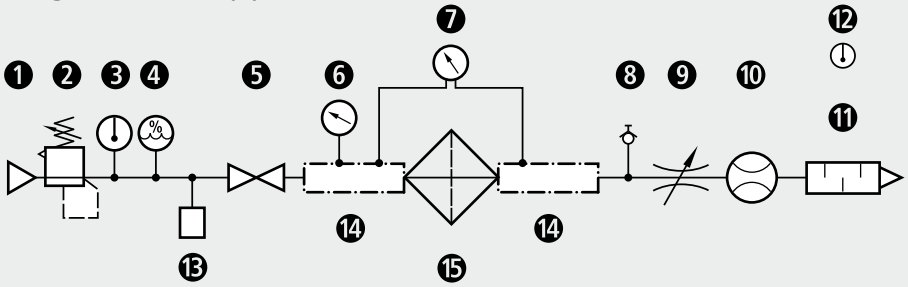
INTERBASIC RESOURCES INC.

Test Report

Introduction

This document details the testing methodology and performance characteristics for a series of oil aerosol removal experiments performed on Walker Filtration Grade XA and X1 Alpha Series coalescing filter elements. Target downstream oil aerosol concentrations are 0.01 mg/m³ and 0.1 mg/m³ respectively in order to meet class 1 and 2 of ISO 8573-1:2007 (Compressed Air - Contaminants and Purity Classes).

Figure 1.
Arrangement of the test equipment



1. Compressor air supply
2. Pressure regulator
3. Temperature sensing/measuring
4. Dew point sensing/measuring
5. Full-flow ball valve
6. Pressure sensing/measuring
7. Differential pressure gauge
8. Sample test point
9. Multi-turn flow control valve
10. Flow sensing/measuring
11. Silencer
12. Ambient temperature sensing/measuring
13. Aerosol generator
14. Pressure measuring tube
15. Filter under test

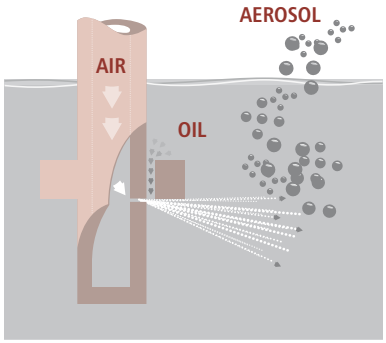
Method

Filter testing was carried out in accordance with the protocols of ISO 12500-1:2007 (Filters for Compressed Air – Test Methods – Part 1 : Oil Aerosols). The general principle is to generate a known challenge concentration of oil aerosol which is introduced to the filter. The aerosol content is measured downstream thereby quantifying the efficiency and removal performance. The test layout, equipment and measurement points are shown in figure 1 above. In order to characterise worse case, all filter elements selected for testing were determined on the basis of having the highest gas flow velocities (media face velocity) within the range.

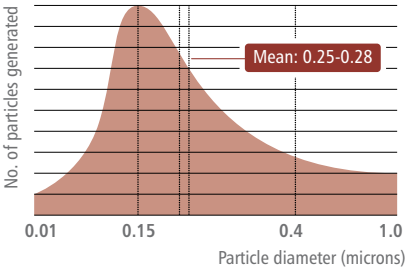
Filter testing was carried out using compressed air at the rated inlet flow and pressure (7 barg) of the unit(s) under test. Hydrosafe Grade VG46 (ISO 3448) oil was aerosolised to challenge concentrations of 10 mg/m³ in the case of Grade XA filters and 40 mg/m³ for grade X1 filters.

Aerosol generation was by means of a Laskin nozzle which produced a polydispersed aerosol distribution with an average particle size of between 0.15 microns and 0.4 microns by particle count. Care was taken to ensure that all of the oil challenge concentration was delivered to the filter in aerosol form and within the range detailed above, and not as wall flow.

Aerosol generation by Laskin nozzle



Polydispersed aerosol distribution



Test Report

Pressure and Flow Measurements

The following measurements were taken and recorded for each filter under test:

- Flow rate, Pressure, Temperature and Humidity
- Differential Pressure – Empty Housing
- Differential Pressure – Complete Housing (Dry Conditions)
- Differential Pressure – Complete Housing (Saturated Conditions)
- Oil Aerosol Challenge
- Downstream Oil Aerosol (Filter Performance)

Before taking measurements in the saturated condition, the filter element was allowed to reach a state of equilibrium by conditioning the filter under test using the challenge aerosol concentration. Equilibrium was considered to have been achieved when liquid oil is observed in the bottom of the filter housing in which the filter under test is contained and the rate of change in pressure drop was less than 1% per hour of the measured pressure drop.

At this point the pressure drop across the test filter was recorded and the oil aerosol carry-over measured.

Determination of Oil Aerosol Concentration

The determination of oil aerosol concentration both upstream (challenge) and downstream was carried out using a calibrated light-scattering aerosol photometer as specified in ISO 12500-1 using compressed-air sampling methods detailed by ISO 8573-2, i.e. iso-kinetic sampling.

Results

Oil Removal Performance

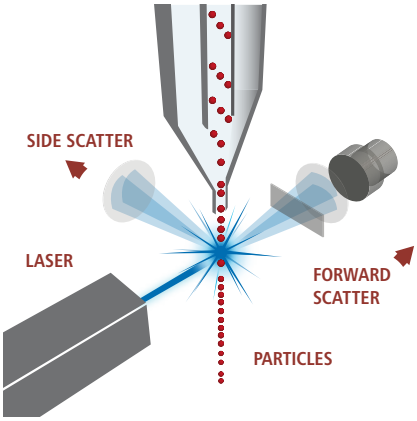
Filter Grade	ISO 8573-1:2001 Quality Class	Specification	Test Results
Grade XA	1	0.01 mg/m³	0.007 mg/m³
Grade X1	2	0.10 mg/m³	0.050 mg/m³

Conclusion

In terms of oil aerosol removal performance, Alpha Series grade XA and X1 filter elements, when tested in accordance with ISO 12500-1 challenge conditions at their rated flow, exceed target performance and allow users to meet the relevent compressed air quality classes stated in ISO 8573-1:2001.

March 2009
IBR are an A2LA accredited laboratory to ISO/IEC 17025:2005

Principles of particle detection

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Quality

Compressed Air Purity Standards

The ISO 8573 group of International Standards is used for the classification of compressed air. It also provides the test methods and analytical techniques for each type of contaminant.

The table below summarises the maximum contaminant levels specified in ISO 8573 Part 1 (2001) for the various compressed air quality classes.

Each compressed air classification can be achieved by installing a specific filter grade or a combination of filter grades, depending upon required performance (ISO 8573-1 is currently under review and values are expected to be redefined in 2010).

	Solid Particles					Water		Oil
Purity Class	maximum number of particles per m³			particle size	concentration	vapour	liquid	total oil (aerosol, liquid and vapour)
	0.1-0.5 micron	0.5-1 micron	1-5 micron	micron	mg/m³	pressure dewpoint	g/m³	mg/m³
0	As specified by the equipment user or supplier							
1	100	1	0	-	-	≤-70°C	-	≤ 0.01
2	100000	1000	10	-	-	≤-40°C	-	≤ 0.1
3	-	10000	500	-	-	≤-20°C	-	≤ 1
4	-	-	1000	-	-	≤ +3°C	-	≤ 5
5	-	-	20000	-	-	≤ +7°C	-	-
6	-	-	-	≤ 5	≤ 5	≤ +10°C	-	-
7	-	-	-	≤ 40	≤ 10		≤ 0.5	-
8	-	-	-	-	-	-	0.5 < Cw ≤ 5	-
9	-	-	-	-	-	-	5 < Cw ≤ 10	-

The ISO 8573 standard

ISO 8573-1	Contaminants and Purity classes
ISO 8573-2	Test Methods for Oil Aerosol Content
ISO 8573-3	Test Methods for the Measurement of Humidity
ISO 8573-4	Test Methods for the Solid Particle Content
ISO 8573-5	Test Methods for Oil Vapour and Organic Solvent Content
ISO 8573-6	Test Methods for Gaseous Contaminant Content
ISO 8573-7	Test Methods for Viable Microbiological Contaminant Content
ISO 8573-8	Test Methods for Solid Particle Content by Mass Concentration
ISO 8573-9	Test Methods for Liquid Water Content

The ISO 8573 standard is being re-drafted by the working group of the ISO Technical Committee (ISO TC118/SC4/WG1) of which Walker Filtration are active members.

The ISO 12500 standard

ISO 12500 is a new series of standards for compressed air filter testing and has been introduced to complement the existing ISO 8573 series, and consists of four parts:

ISO 12500-1	Oil Aerosols	ISO 12500-2	Oil Vapours
ISO 12500-3	Particles	ISO 12500-4	Water

Parts 3 and 4 are currently being formulated by the working group of the ISO Technical Committee (ISO TC118/SC4/WG1) of which Walker Filtration are active members.

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Accreditation

Walker Filtration's continued commitment to improvement and business excellence is reflected by their commitment to work with notified bodies and to industry standards to ensure the highest levels of quality in all that they do.

Filter Element Validation

Filter element performance has been tested to international standard ISO 12500, to provide filtered compressed air to ISO 8573-1 (the international standard for compressed air quality). The result has been verified by IBR, an accredited independent laboratory.

- **ISO 8573-1**
  Compressed air purity standard

- **ISO 12500 Series**
  International standard for compressed air filter testing

Filter Housing Validation

Walker Filtration's filter housings are manufactured and tested to meet the requirements of the Pressure Equipment Directive (97/23/EC). This has been independently verified and validated for performance by Lloyds Register.

- **Notified Body (97/23/EC)**
  Lloyd's Register EMEA – Notified Body No 0038.
  71 Fenchurch Street, London, EC3M 4BS. England

ISO 9001 Quality Management Systems

Walker Filtration is accredited to ISO 9001-2008. This certification is focused on providing a framework for consistent manufacturing quality with performance objectives set at executive level and arrived at through adherence to predefined business procedures.

Walker Filtration measure and review quality on a daily basis from goods inwards, through a vendor rating system evaluating core suppliers, to detailed inspection of all manufactured products produced for despatch to customers.

- **Notified Body (Quality Systems): ISO 9001 – LRQ0930553**
  Lloyd's Register EMEA – Notified Body No 0038.
  Hiramford, Middlemarch Office Village, Siskin Drive, Coventry, CV3 4FJ. England

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