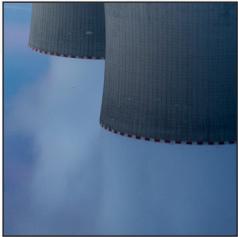
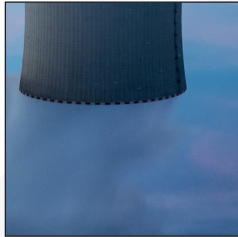
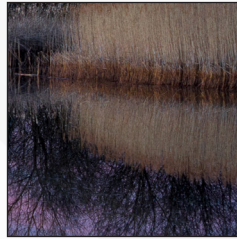
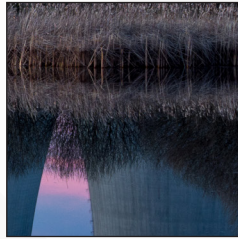
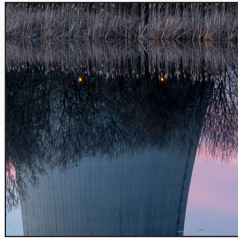
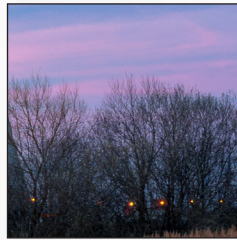
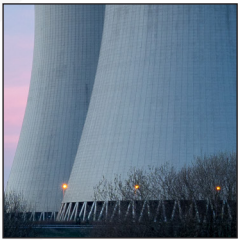
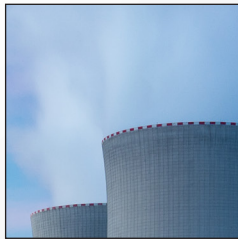


Nuclear Filtration

Power Generation, Fuel Processing,
Decommissioning, Decontamination, Waste
Treatment and Waste Disposal



Porvair Filtration Group in the Nuclear Industry

Porvair Filtration Group is an international leader in the development and supply of materials and products for applications in filtration and separation.

Porvair manufactures in the UK, USA, India and China and has an extensive network of sales offices and distribution channels throughout the world. Our expertise is wide and varied, with products used in markets such as:

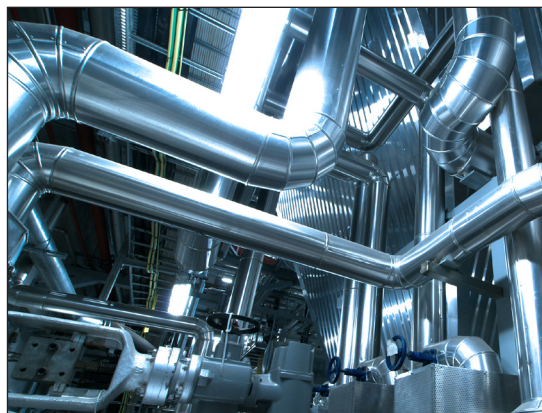
- Aerospace and Defence
- Food and Beverage
- Gasification
- Microelectronics
- Nuclear
- Original Equipment Manufacturers
- Pharmaceutical
- Printing
- Process

Our ongoing success is based on a dedication to technical excellence and superior customer service. Our future will be built on our investment in research and development to provide innovative new products that exceed the expectations of our customers in solving the challenges they face.

Nuclear

Porvair offers both the engineering competence and quality infrastructure to meet the challenges of the nuclear industry. We produce solutions to ensure the efficiency and safety of critical processes, using a range of technologies, products and techniques. Our experience includes:

- both civil and military nuclear applications
- filtered containment venting systems (FCVS)
- high temperature off gas clean-up
- HEPA protection and pre-filtration
- pulsed jet self-cleaning HEPA filtration
- metallic HEPA filtration for extreme conditions
- metallic filter septa and resin traps for filter demineralisers
- powder/product collection vent filtration
- waste package filter vent/breathers
- active effluent treatment packages
- coalescers (liquid/liquid and liquid/gas)
- designed-for-purpose filtration and separation packages for the most demanding of applications.



Porvair Filtration Group has many years' experience in the supply of high quality filtration solutions. Working across the field, designing and supplying filtration and other equipment, we offer solutions to the following sectors:

- power generation
- fuel production
- reprocessing
- decontamination
- decommissioning
- waste packaging sectors.

Custom Designed Solutions

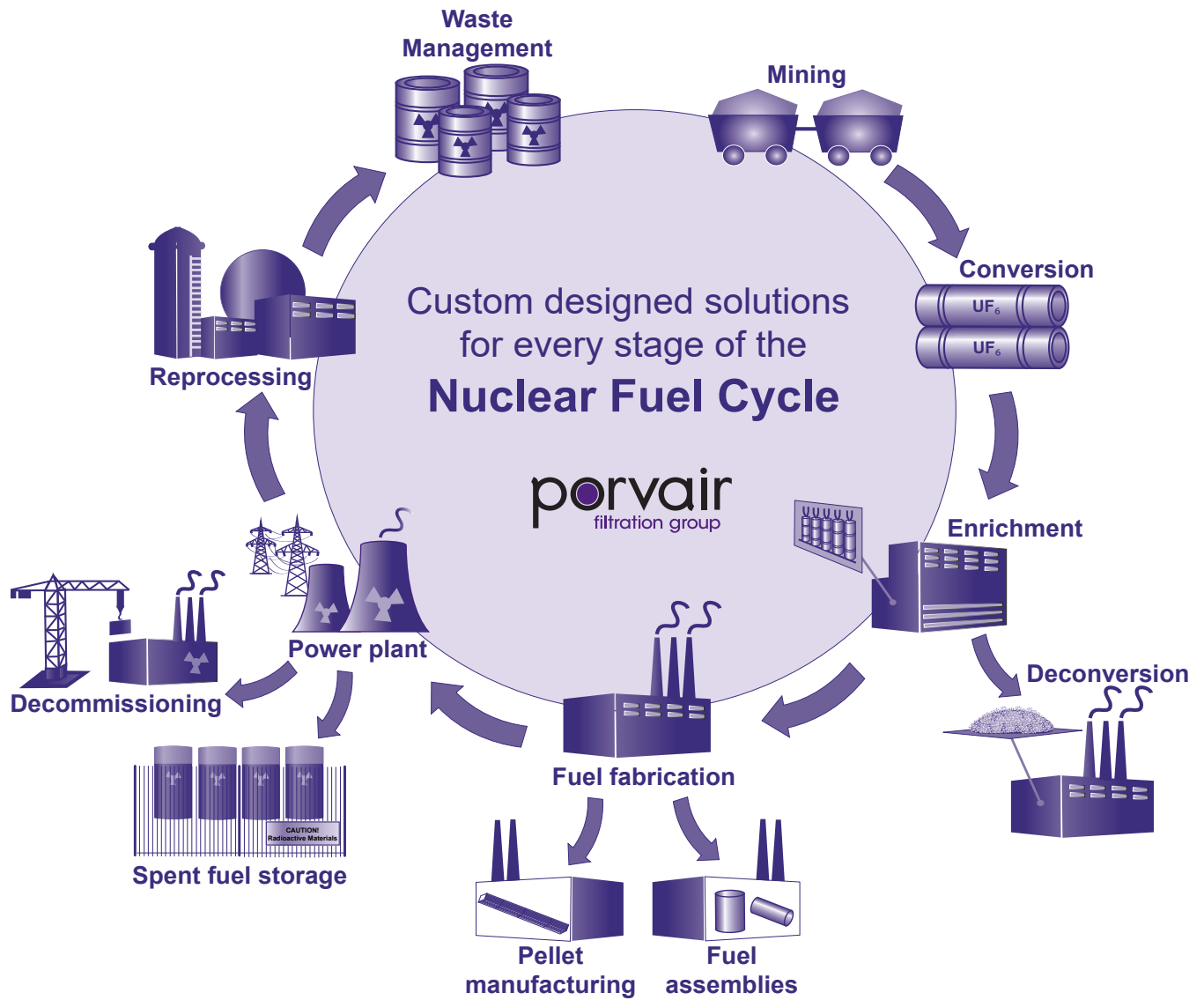
As an engineering company, we are able to take an application from an initial discussion to a fully optimised solution; meeting material, code and technical requirements and providing a complete solution to a specific problem.

Porvair has the capability to provide everything from a single, specialised retrofit element to a complete, packaged system to meet the precise needs of a complex application, together with on-site support and a complete after sales service. In addition to our acknowledged leadership in both engineering and quality, we also have the capability to offer the services of our extensive laboratory, development and testing facilities.

Available in a range of metallic filter media, or from non-metallic media, such as glass fibre and polymer, **Porvair** can meet any requirement at virtually any scale to meet the nuclear filtration application; whether as a retrofit or to meet a challenging footprint, for both liquid and gas environments.

As unrivalled experts of engineering solutions for nuclear filtration, **Porvair** can meet nuclear applications with confidence and quality, relying on decades of experience in the successful provision of solutions to the worldwide nuclear industry.





Nuclear Power Generation

Porvair Filtration Group is working with the global nuclear power generation and with new nuclear technology industries.

We are exploring the best technical and economic solutions to separation issues as varied as:

- spent fuel pond (fuel pool) water clean up
- Caesium removal packages
- AGR CO² coolant line and vent clean up, including safety relief valve protection (SRV), pre and post dryer and bypass blowdown units
- containment venting and relief valve protection
- Magnox and VVVR spent fuel processing for dry storage
- PWR coolant loop filtration
- HTGR He coolant cleanup
- innovative PWR fuel cleaning process
- package venting for spent fuel disposal.

We are committed to serving and supporting the existing and new-build nuclear power generation industries, by designing and supplying filtration systems to the highest technical and quality standards, in order to meet the exacting demands of the global nuclear power generation industry.

Filtered Containment Venting Systems (FCVS)

Porvair Filtration Group is heavily involved in the development of custom designed filtered containment venting solutions for water cooled reactors.

Using high-efficiency particulate air filters (HEPA) composed of 316L stainless steel Sinterflo® F sintered metal fibre elements, we engineer tailored solutions for passive FCVSs, capable of operating in the event of a total loss of power.

Our FCVSs manage the release of over-pressure within the reactor containment whilst capturing solids and removing liquid aerosols.

Coalescing and Demisting

Many processes within the industry require the separation of liquid aerosol from gas streams (typically water droplets from an airflow) or the separation of immiscible liquid combinations (typically oils from water).

Our experience in this field has enabled us to successfully supply systems to achieve both demisting and liquid/liquid coalescing.

Sinterflo® Septa

Porvair manufactures 1" and 2" diameter 316L stainless steel sintered wire mesh laminate filter Septa. These tubular filter elements are typically supplied in tube bundle assemblies for retrofit into existing pressure vessels.

Sinterflo® Septa provides a base structure for pre-coating ion exchange resins and nominal filtration often used in high-energy air surge backwashing systems.

Designed for uniform pre-coat and process flow distribution, typical applications in nuclear Boiling Water Reactors (BWR), and Pressure Water Reactors (PWR) would include:

- condensate polishing
- reactor water clean-up
- fuel pool treatment
- radwaste processing.



Sinterflo® Septa is designed to be a direct replacement for existing top tubesheet, bottom tubesheet and custom design configurations.



Decommissioning and Decontamination

Porvair Filtration Group is active in every aspect of nuclear decommissioning and decontamination.

As processes are developed to deal with legacy wastes, and legislation is introduced to define storage conditions, we are developing novel solutions to meet increasingly complex filtration problems associated with decommissioning and decontamination facilities around the world.

Our engineered solutions include:

- the clean-up of liquid wastes
- the decomposition, reduction and reformation of organic and other wastes
- the drying and storage of spent fuel
- the venting of waste tanks and storage
- effluent treatment packages
- UK and US (AG compliant) radial flow and metal HEPA systems
- dewatering of legacy liquid wastes
- a full range of industry standard disposable filters for power generation and decommissioning applications.

Our capabilities also extend to:

- the collection of mechanically generated demolition debris
- spent fuel transport cask washing
- high temperature and chemical attack resistant HEPA and THE filters.

Fluidised Bed Diffusers

In several areas of the nuclear fuel cycle and waste treatment processes, fluidising beds are used to encourage accelerated chemical conversions.

Porvair has both the materials and the expertise to supply specially designed new build diffusers or to supply retrofit diffusers into existing plants.



Porvair Filtration Group actively supports the nuclear waste treatment and storage industry. As processes are developed to deal with legacy wastes and legislation is introduced to define storage conditions, we are at the forefront of developing novel solutions to meet increasingly complex filtration problems through our extensive research programme.

Vent Breathers

Using a range of metallic filter media in a variety of metal types, **Porvair** is able to supply waste package breathers that are precisely tailored to the individual needs of any application.

Available with defined separation efficiencies, gas diffusion and flow/ ΔP characteristics.

Specially designed vent breathers supplied to nuclear storage users include:

- HEPA (THE) grade shielded vent breathers for spent fuel drying and storage
- WIPP compliant TrU waste package vent breathers
- 500 litre drum breathers
- 3m³ box breathers.

In addition, we are working with the nuclear industry to improve the efficiency, safety and cleanliness of cementation, vitrification and disposal technologies including:

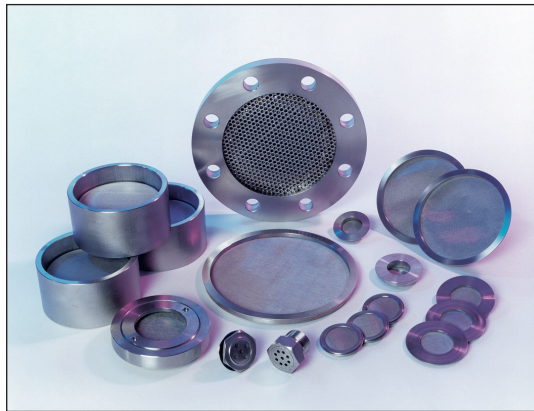
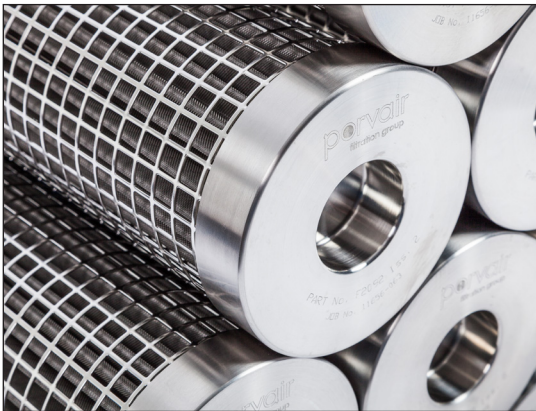
- drum filling, cement dust collection pulsed jet system
- vitrification plant, high temperature, pour and drain vent filters
- bulk vitrification pre-treatment evaporator filter systems.

HEPA High Strength Radial Filter Elements

Porvair's unique 2,000 cfm radial flow, low ΔP HEPA filter with extreme dirt holding capacity was developed at our Ashland, VA facility for a US DOE waste treatment plant.

Tested on our own test rig as well as at MSU, this filter is now ASME AG-1, Section FK compliant, DOE approved, installed and awaiting plant start-up.

Made from high purity borosilicate glass fiber, this design provides for heat stable potting compound, flame resistant media and high humidity tolerance. The extreme dirt holding capacity is to be credited to Porvair's patented pleat separation technology. Available in both safe and remote change format.



Pulsed Jet Self Cleaning Air and Gas Filters

Pulsed jet cleaning is a process developed by **Porvair Filtration Group** for the effective removal of collected solids from the surface of a filter element.

The process is typically undertaken whilst the filter is in operation on-line and, apart from a very small pressure spike (or 'overpressure'), it does not interrupt or interfere with the process flow.

This technique is widely used across a range of processes in areas as diverse as:

- **fuel production**
including fuel pellet grinding, furnace off-gas venting, powder transport and conversion oven/fluidised bed venting at temperature
- **power generation**
including spent fuel and debris vault venting, and protection and spent fuel drying processes
- **decommissioning**
including mechanically generated dust collection, smoke removal, ceramic membrane crushing and cementation drum fill operations
- **waste deposition**
including vitrification and waste solidification processes, drum filling and drum venting

Pulse jet filtration allows a properly designed system to reach a stable operating pressure differential in the long term, returning to the user all the solids collected for effective, minimum volume disposal or re-use.

The technique and its associated equipment can be designed to be used in high temperature, high solids, high pressure, chemically aggressive and highly active environments to provide filtration down to very fine levels, with continuous operation and consistent pressure loss, allowing the accurate specification of complementary equipment around the filter.

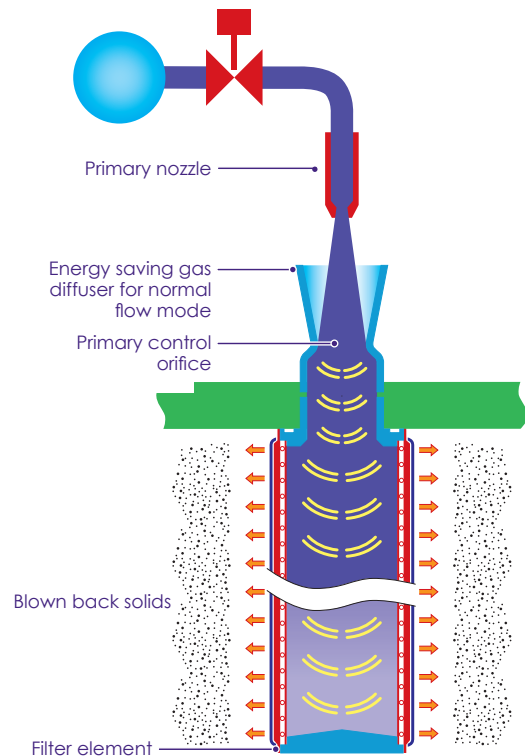
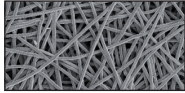


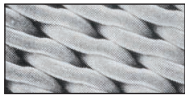
Figure 1 Moving across the photograph from left to right: the metal fibre element loaded with dust; the dust is removed from the surface by the pulsed jet action; the dust is carried away; the dust begins to settle; and quickly falls to the bottom of the vessel leaving a clean element. The sequence time is less than half a second. The cleaning pulse is made whilst process flow continues.

Our custom designed filtration solutions are manufactured from a range of metallic filtration media, including:



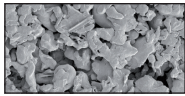
Sinterflo® F Sintered Metal Fibre

- High permeability
- Low clean and operating pressure drops
- Excellent cleanability, particularly in pulsed jet operation
- Pleatable, offering higher filtration area per element
- Available in 316L stainless and a range of alloys
- True HEPA air and gas filtration possible (with pulsed jet cleaning if necessary)



Sinterflo® M Sintered Metal Mesh

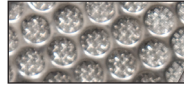
- Available in a wide range of mesh sizes and separation ratings
- Available in various metal types
- Sintered, layered mesh that can be designed to meet specific needs in a range of plate sizes and other shapes
- Widely used in fluidised bed and packed bed laterals, distributors and bed plates



Sinterflo® P Sintered Metal Powder

- Low permeability, but extremely robust
- Pressure drops typically higher than sintered metal fibre
- Primarily a depth filter, so cleanability is not as effective as Sinterflo® F Sintered Metal Fibre
- Robust structure permitting successful use in properly designed liquid filtration backwashable systems
- Available in a wide range of stainless steels and other alloys

Also available are a range of media surface treatments to further enhance the chemical, temperature and solids abrasion resistance of the media within a particular application.



Sinterflo® MC Mesh Composite

Sinterflo® MC multi layered, diffusion-bonded stainless steel mesh is available in 316L and other alloys. This precision filter mesh is available in a range of different pore sizes ranging from 2 to 100 micron in diameter. This material is easily custom engineered for non-standard applications and can be formed into tubes and small discs or large scale circular plates.

Sinterflo® MC is particularly well-suited to demanding applications where high operating temperatures up to 540°C (1000°F), increased chemical resistance and/or high abrasion resistance is essential.

Polymeric Disposable Filters

We provide a comprehensive range of filters for use as prefilters, filters and sub-micron membrane filters. They are suitable for use in new installations or as replacement cartridges in existing systems. With a broad range of quality filtration products, tested and guaranteed to international standards,

Our filters are in service in applications as diverse as the pharmaceutical, electronics, nuclear, chemical and food and beverage industries. This supports our proven capability in the field of high efficiency filtration by satisfying the particular requirements of each customer, whilst meeting the most exacting industry standards.



Porvair Filtration Group has a policy of continuous improvement in all areas of its business. Listening to the customers' present and future requirements is a vital part of our operations and a key part of driving change.

We understand that product development involves building multidisciplinary teams, not only within the company, but often in partnership with our customers, improving project efficiency and ensuring complete customer satisfaction. This continuous development of products and materials is vital to enable us to offer new and better solutions to applications. **Porvair** has implemented various methodologies to drive out waste and process variance across the company to achieve the ultimate goal of zero defects.

We have a dedicated team of scientists, engineers, production and quality professionals working towards the best possible filtration solutions for our customers. We have a fully equipped test house and laboratory, and our experienced design engineers use the latest AutoCAD® technology, with 3D solid modelling, integrated with a finite element analysis system, to give full structural assurance capability.

Quality is at the heart of every stage of our operation and a fundamental part of our culture. We are ISO9001 approved at a number of our manufacturing facilities and hold many other accreditations for the various industries we serve.

Research and Development

Continuous development of products and materials are vital to enable **Porvair** to offer new and better solutions to applications. Development plays a fundamental part in our operations and, as a result, we have developed a number of new bespoke products based on our established porous polymeric materials (Vyon®) and sintered metal media (Sinterflo®).

Although we operate across many filtration and separation markets there is significant interaction between each division in terms of product research and development. The new product development team is drawn from scientists and engineers from across all divisions encouraging new ideas and new solutions. The success of this approach has been in the interaction of chemists and engineers working together to find practical solutions to some extremely complex scientific challenges identified in the chosen market areas.

Engineering

From initial concept design through manufacture and validation to in service support, our highly experienced team of dedicated engineers work to develop the optimal filtration solution. Our team utilises the latest engineering tools of 3D AutoCAD®, Finite Element Stress Analysis, Computational Fluid Dynamics (CFD) and bespoke pressure vessel design software (PD5500, ASME VIII, EN13445). This is combined with over 30 years of proven experience and a knowledge and strong ethos of working closely with our customers, ensuring filtration solutions that meet customers' requirements.



Manufacturing

Porvair Filtration Group produce filters and filtration systems, as well as a range of porous materials based on sintered polymers and metals, at production sites within the UK and the USA. We manufacture for a wide variety of industrial, pharmaceutical and biomedical applications, as well as supplying filtration solutions for extreme conditions of temperature, pressure and corrosion for the aerospace and nuclear markets.

Our production capabilities include the complete element or cartridge construction, along with the build of entire tubeplate and vessel assemblies. We boast specialist fabrication skills and techniques in all of our manufacturing sites around the world as well as extensive ISO Class 5 cleanroom facilities.

Testing and Laboratory

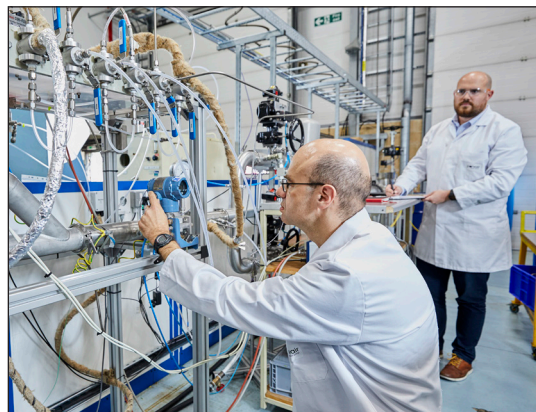
Our dedicated test, development and laboratory services underpin our design and development activity, from filtration media and material characterisation, product verification testing to customer systems simulation trials and in service performance evaluation. Our capabilities include filtration characterisation, environmental testing and analysis.

Quality

Our policy is to provide products and services that consistently satisfy the commitments made to our customers by complying with their requirements, working together as a team and by achieving continual improvement in our skills, systems, processes and performance.

We have a dedicated team of quality professionals with many years' experience in definition, implementation and maintenance of quality management systems meeting multiple industry requirements. This extends across the workforce through a strong quality culture and a philosophy of 'getting it right first time' driven from the top of the organisation.

Our quality management systems are regularly audited internally and by customers and regulatory bodies. We hold ISO9001 at a selection of our manufacturing sites along with, AS9100D at our Ashland facility and EN9100 and EASA Part 21 Subpart G at our Segensworth facility. We are NQA1 capable subject to specific project requirements.





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