

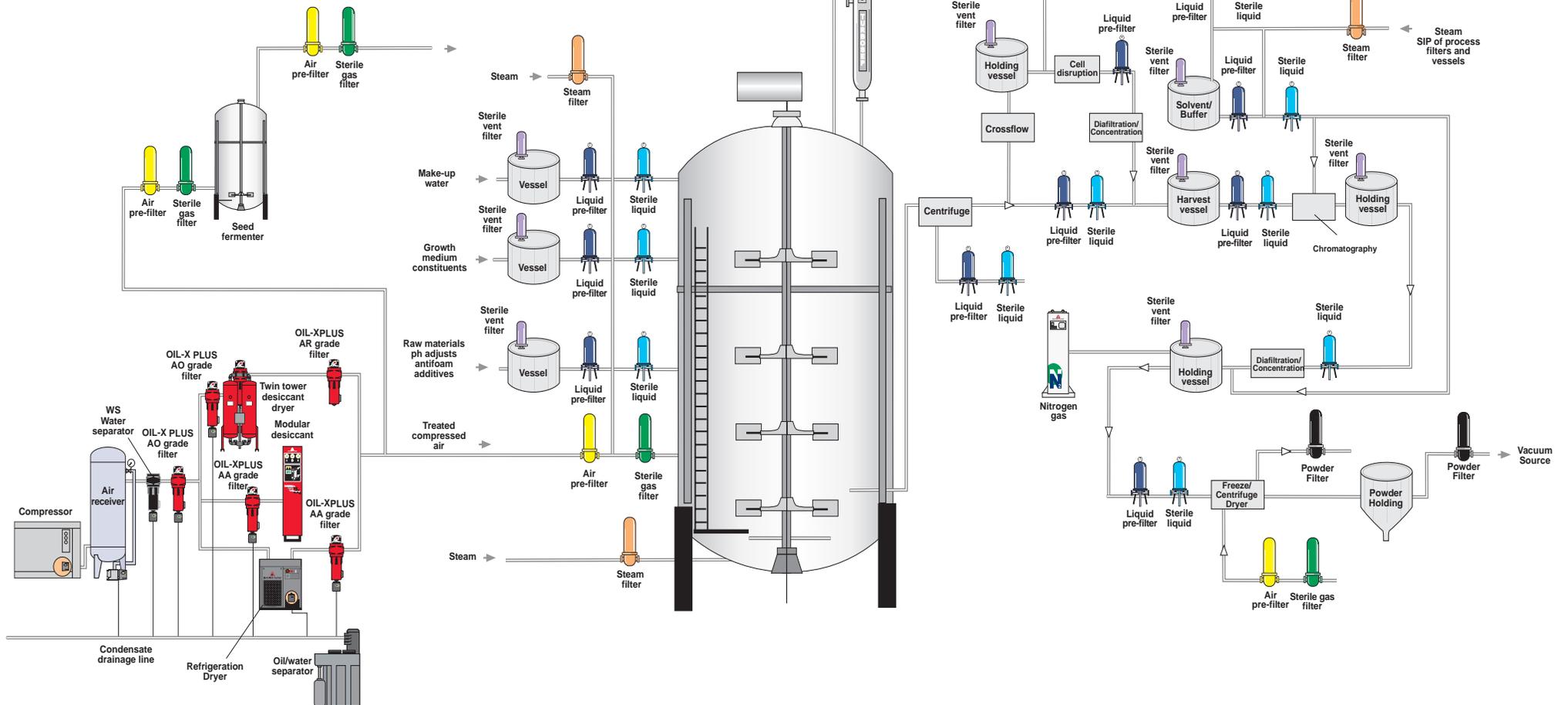
your guide to processes and products used in  
**Industrial Fermentation**



# Industrial Fermentation

## Key to domnick hunter Capabilities

-  Air Pre-filter
-  Liquid Pre-filter
-  Sterile Gas Filter
-  Sterile Vent Filter
-  Steam Filter
-  Coalescing / Activated Carbon
-  TURBOSEP™
-  Sterile Liquid Filter
-  Powder Filter



### Integrity Testing



PORECHECK 4



VALA/RDATA II

# Optimising fermentation performance through advanced filtration solutions

At domnick hunter we understand that in the current demanding economic environment it is not sufficient to simply supply the best performing filter cartridges. We pride ourselves in being able to supply individual cost effective filtration solutions that truly integrate with your process.

From inoculation through to downstream processing domnick hunter has partnered the leading names in bulk fermentation of healthcare products, food additives, enzymes and industrial chemicals. This partnership extends from selection of the most appropriate filtration to commissioning, operator training and continuous product and process support.

The continuous supply of sterile gas is paramount in preventing costly contamination that results in lower yields or potential total loss of product. The type of compressor, pre treatment and plant location, all affect the choice of filter type. domnick hunter have an outstanding portfolio of sterile gas products making the optimum choice both easy and cost effective.

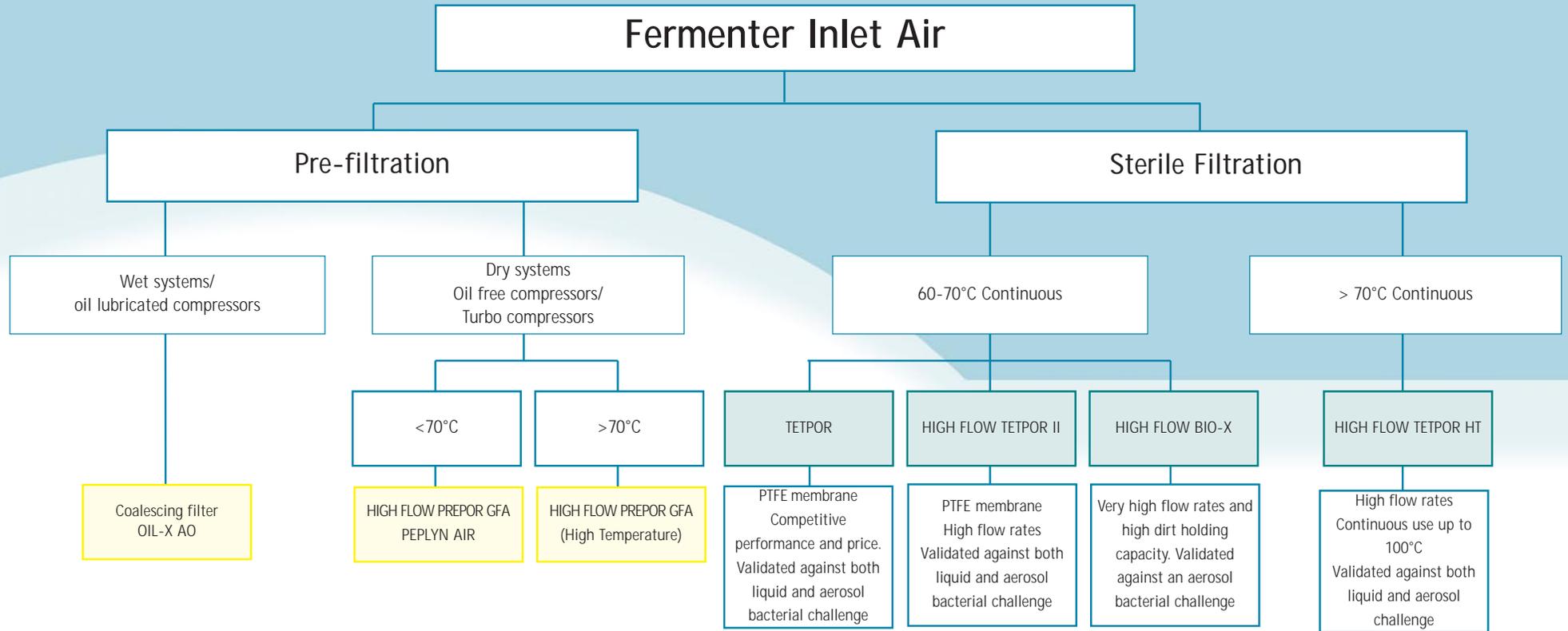
Our unique off gas filtration concept has consistently allowed improvement in yields and reduction in contamination levels on a wide range of fermentation products such as lysine, antibiotics, insulin and growth hormones.

This, coupled with expertise in the filtration of heat labile liquid feeds and specifically designed filter integrity test systems mean that domnick hunter are the first choice when it comes to filtration within the fermentation process.



**domnick hunter**

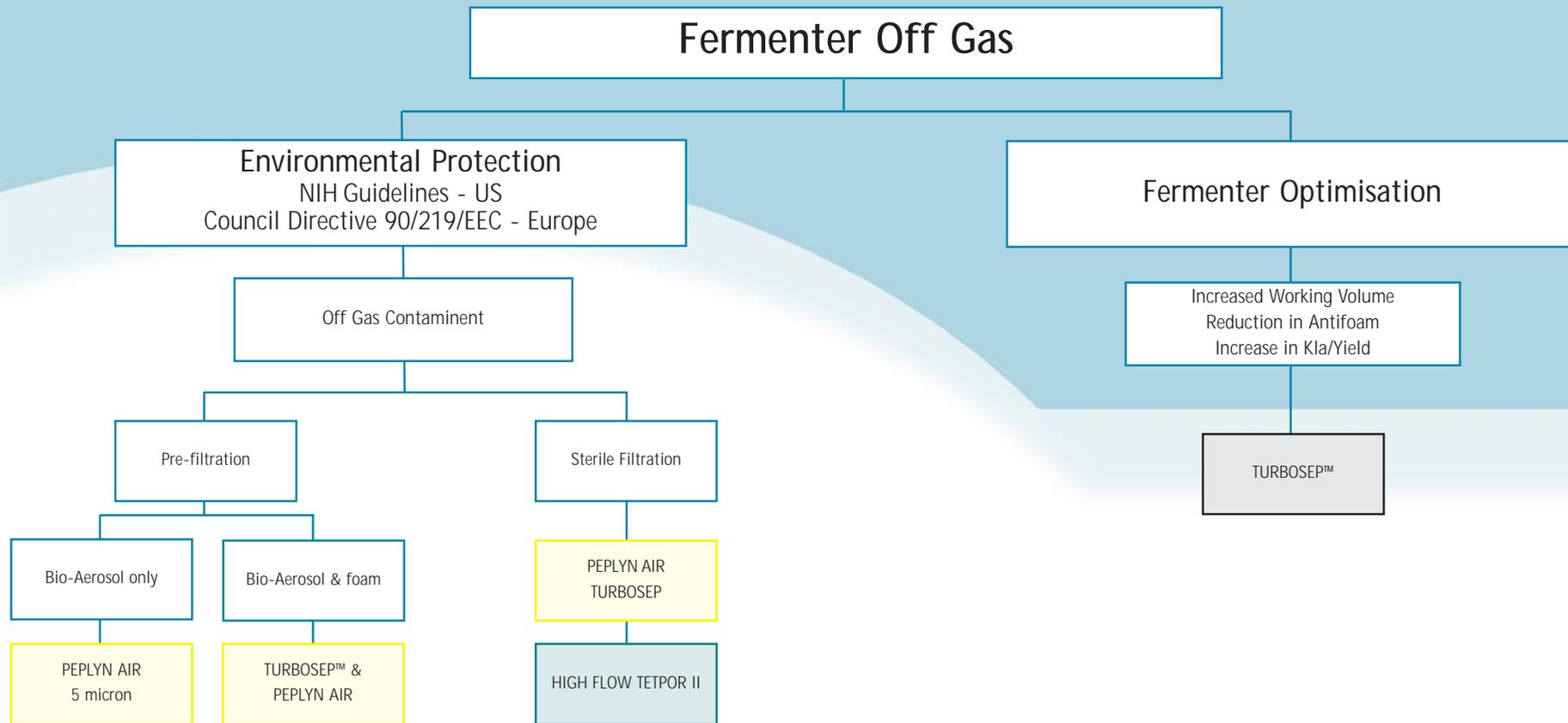
PROCESS FILTRATION



## Features and Benefits of Fermenter Inlet Air Filtration from domnick hunter

- Most comprehensive range of products on the market
  - Ensures optimum operational design configuration
  - Guarantees the most cost effective solution
- High flow rates
  - Minimise system design and reduce purchase and installation costs
- Choice of both membrane and glass microfibre depth filtration media
  - For example the inherently hydrophobic microfibre media used in HIGH FLOW BIO-X results in higher dirt holding, longer lifetime and potentially simpler systems.
- Full range of retrofits
  - Easily transfer domnick hunter technology into existing systems





### Features and Benefits of Fermenter Off Gas Filtration from domnick hunter

- The only filter manufacturer to offer the unique combination of filtration and mechanical separation
  - Off gas system tailored precisely to customer requirement
  - Availability to increase the yield from the fermentation
- Fully steam sterilisable off gas pre-filters



TURBOSEP™

# TURBOSEP™ Complete fermenter and off gas control

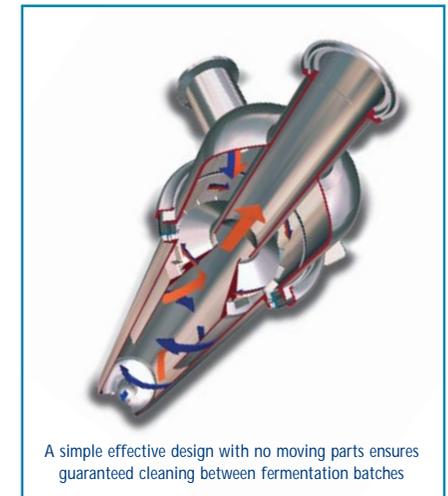
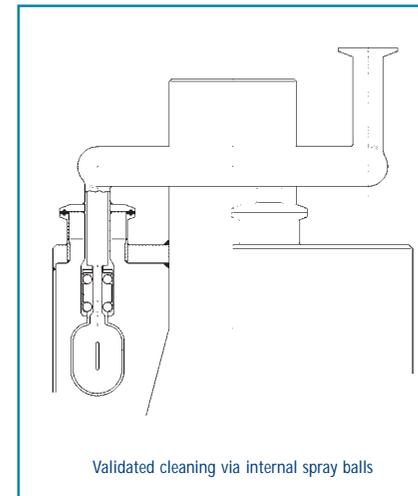
TURBOSEP™ is a unique device for separating entrained aerosols, liquids and foams from the off gas of fermentations. It is fully scaleable and has been successfully installed on fermenters from 0.05 to 500m<sup>3</sup> allowing it to be used from pilot scale through to bulk production.

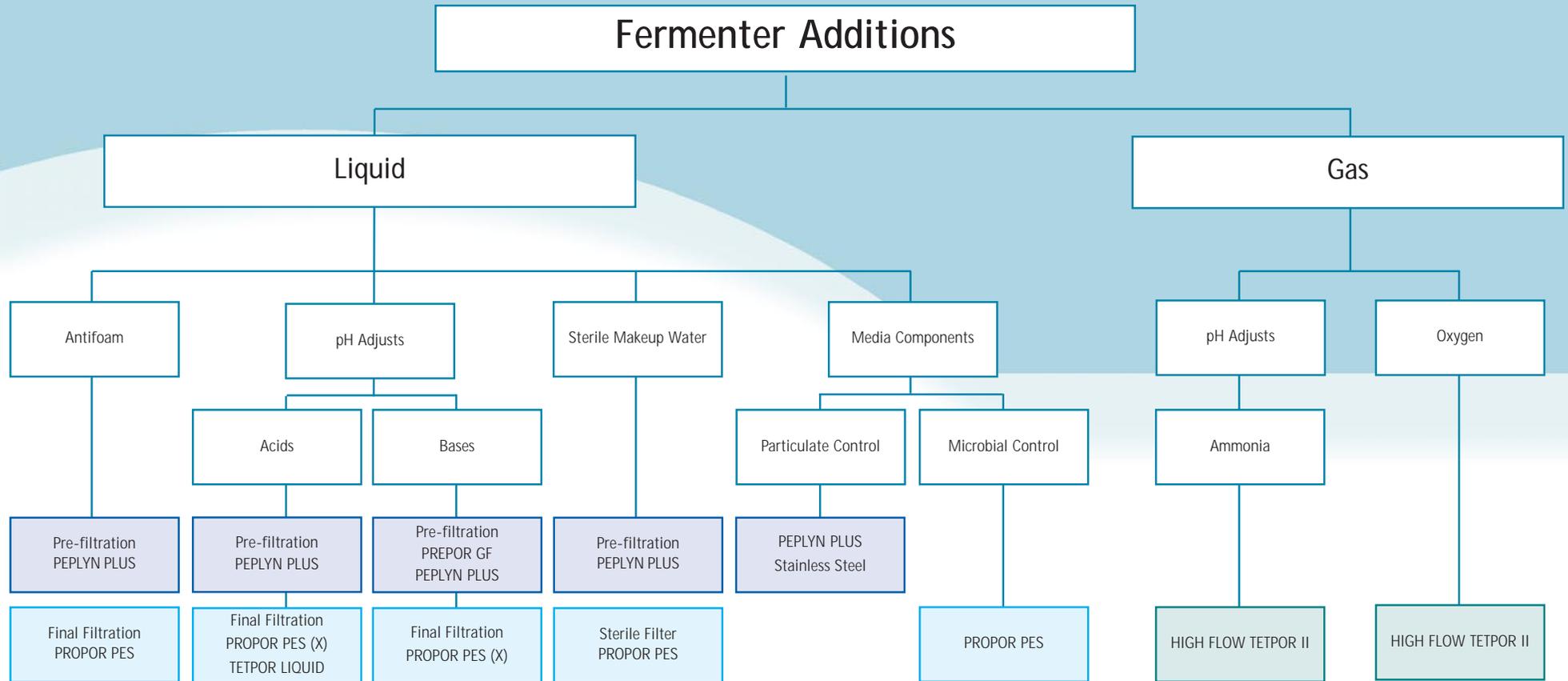
TURBOSEP™ is designed to work with the fermentation, helping to increase capacities, reduce antifoam consumption and protect off gas filters when installed.

The removal efficiency of TURBOSEP™ has been optimised using computational fluid dynamics.

When used as the primary sensing method for the addition of antifoam, usage is reduced by 60%, independent of the fermented product. As less antifoam is added, K<sub>la</sub>'s increase to create larger yields.

TURBOSEP™ contains no moving parts and is supplied with integral spray balls that ensure complete cleaning of the system between batches. The effectiveness of the cleaning has been validated in accordance with industry accepted procedures using riboflavin, as well as in-process on fermentations involving broths highly susceptible to contamination.

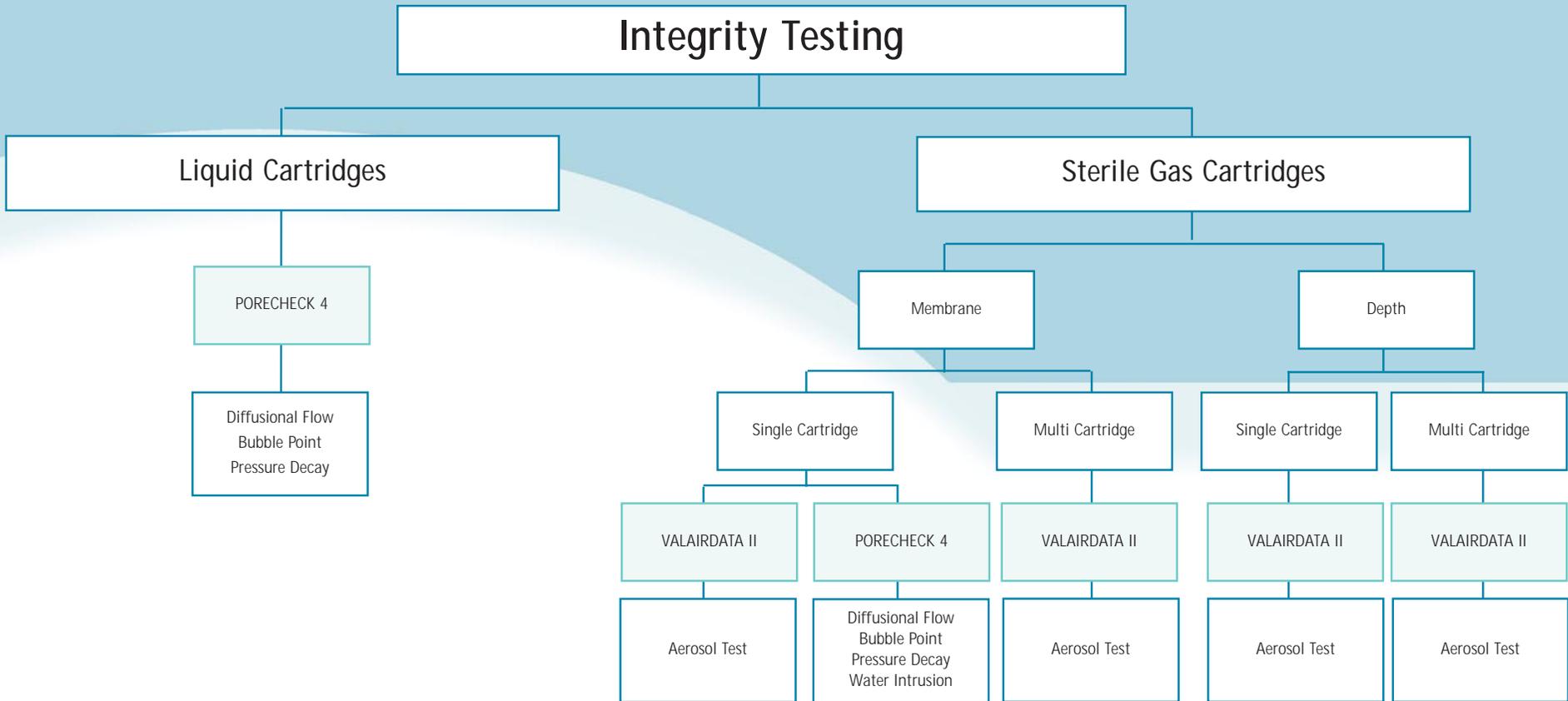




### Features and Benefits of Fermenter Additive Filtration from domnick hunter

- The filtration of fermenter additions especially antifoams can be challenging. The application knowledge and experience available from domnick hunter ensures that solutions are capable and cost effective.
- Optimised filtration / support layer combinations have been developed to solve specific application problems, whether it be for throughput or compatibility issues.





### Features and Benefits of Fermenter Off Gas Filtration from domnick hunter

- domnick hunter is the only company to provide integrity test solutions specifically designed for both liquid and gas filters. This allows the most cost effective and practical solution to be offered.
- PORECHECK 4 is an adaptable unit capable of testing all types of filters by a variety of methods and can be incorporated into process automation
- The VALAIRDATA II can provide significantly reduced test times, typically a 10<sup>th</sup> of those required for liquid based tests.
- The unique VALAIRDATA II aerosol challenge test offers a fast and efficient method of integrity testing multi-cartridge systems common in industrial fermentation. The use of liquid based methods can be both impractical and, where solvents are required, hazardous.



## Fermenter Inlet Air

The specification of product for inlet air filtration is dependant on the type of compressor/pre-treatment used and the climatic conditions. Specifying incorrect prefiltration can result in significant expense, or worse, the efficiency and the effectiveness of the system can be compromised. For example, OIL-X coalescing filters should always be used where there is a risk of bulk water and/or residual oil in the gas. Conversely significant savings on capital and running costs can be gained on dry systems by using pleated pre-filtration rather than traditional coalescing filters. **domnick hunter** has over 40 years of experience in this application and can provide a wide portfolio of products to satisfy the most demanding of applications.

- HIGH FLOW TETPOR II has unmatched resistance to steam sterilisation that can be a major benefit in the aggressive environments often seen within industrial fermentation processes.
- HIGH FLOW TETPOR HT combines resistance to dry heat up to 100°C with unrivalled flow performance making it the filter of choice for high temperature fermentation processes.
- HIGH FLOW BIO-X combines the extremely high flow and dirt holding capacity of glass microfibre depth media with PTFE. This results in a hydrophobic material and system sizes half that of conventional PTFE membranes.

## Fermenter Off Gas

Increased environmental attention and the introduction of international standards such as ISO14001 have resulted in the re-assessment of the conditioning of off gas before it is discharged to atmosphere. **domnick hunter** manufacture the unique TURBOSEP™ separation device that can not only significantly reduce off gas contaminants but can also be used to increase fermentation capacity and increase product yields. This is achieved with a combination of separation design technology and more refined methods of introducing antifoam into the fermentation. Standard solutions to off gas filtration such as polypropylene prefilters have their place in some systems but they cannot address the issue of foam carry-over. TURBOSEP™ can protect downstream filters in conjunction with improving the efficiency of the fermentation.



## Antifoam Filtration

Antifoam within industrial fermentation has historically been sterilised using direct heat exchangers or steam injection. This has a number of disadvantages;

- It can change the characteristics of antifoam reducing the effectiveness of the foam suppression qualities.
- It can render the antifoam difficult to handle. They can become very viscous emulsions leading to blockages in delivery pipework and control valves.
- Typical antifoams have reasonably high molecular weights that result in lower solubility in water. This inhibits the effectiveness of steam as a sterilant as it is difficult for the moist heat to get direct contact with the micro-organism. It is extremely difficult, if not impossible, to validate that sterilisation is complete.

Filtration has often been seen as non-viable due to the inherent difficulties in processing the fluid with respect to flowrate and lifetime to blockage. However, advances in membrane materials and pore morphology means that sterile filtration of antifoam is now an extremely attractive alternative that can guarantee sterility prior to the antifoam being dosed into the fermenter.

## pH Adjusts (Acids and Bases)

Although it is not expected that microbial growth will occur in these solutions, the presence of bacterial spores has been identified - these can be activated once introduced into the fermentation media. To eliminate this possibility a number of multi-national companies are now sterilising these solutions. **domnick hunter** have extensive experience, and can provide filtration options for a wide range of applications, including Phosphoric and Propionic acids, Sodium Hydroxide, Ammonium Hydroxide and Ammonium Sulphate. A choice of PES and PTFE membranes ensures the most effective filtration method is always available.



## Media Component Filtration

Media is made up of a complex mix of nutrients dependant on the micro-organism being grown. The majority of these are currently sterilised using direct heat exchangers and steam but some can cause major problems with process equipment if high temperatures are used. Salt solutions such as calcium and sodium chloride can severely corrode stainless steel pipe work resulting in pin holing and the subsequent ingress of contamination. Heat treatment may also damage certain media components reducing their efficiency. Sterile filtration using a combination of polypropylene pre-filters and PES membrane final filters can provide a practical solution that eliminates the requirement for heat treatment.

## Sterile Water

Sterile filtration of make-up water becomes a cost effective solution when using the high capacity PES membrane of **domnick hunters** PROPOR PES filter. The alternative method is steam injection to replace liquid vent losses - this can lead to damage of the microorganism at the injection point.

## Steam

Steam for sterilisation is essential within the fermentation industry and its quality can be guaranteed through filtration. Fine particulate removal is essential if process equipment is to run efficiently. **domnick hunter** can provide solutions for both central stream filtration in new facilities or point of use filtration on existing ones where steam supply may contain corrosive elements which need to be removed before they transfer into the process. Both traditional sintered and new high capacity / efficiency filters utilising metal fibre technology in a pleated construction are available.

## Downstream Processing

Downstream purification processes vary considerably depending on the particular product being manufactured. Microfiltration can provide the solution to both clarification and purification stages. These include sterile water used for dilution in primary centrifugation, protection between chromatography stages, or the filtration of solvents used during extraction processes. A wide range of filtration media and formats ensures **domnick hunter** can provide solutions to both standard and specialised applications.



# Technical support group

## Support Where It Counts

domnick hunter provide support through a trained team of scientists and engineers available to answer questions regarding the technical capabilities of our products, to assist in the selection and design of appropriate filtration systems and to provide user training programs.

The Technical Support Group (TSG) is familiar with all aspects of the filter validation process offering both in-house and on-site support to meet current regulatory validation requirements.

## Meeting Your Needs

- development of validation plans and protocols
- filterability testing
- advice on the development of integrity testing, steam-in-place and clean-in-place protocols
- facility audits to ensure continued optimisation of filters
- operator training, including filtration theory, filter system design and management, sterilising grade filter validation, etc.



Technical Support Group

## INLET AIR PRE-FILTRATION

OIL-X PLUS	Filter Medium	Features / Applications
	Glass Microfibre 1 micron	<ul style="list-style-type: none"> <li>Specifically designed to coalesce and remove the high levels of oil and water droplets found in oil lubricated compressors</li> <li>AO grade guarantees oil removal down to 0.6mg/m<sup>3</sup></li> </ul>

PREPOR GFA (ZCHP)	Filter Medium	Features / Applications
	Glass Microfibre 1 micron	<ul style="list-style-type: none"> <li>Exceptional flow rates resulting in smaller installations</li> <li>High temperature version available (100°C)</li> <li>Designed for dry/oil free systems</li> </ul>

PEPLYN AIR (ZCPH)	Filter Media	Features / Applications
	Polypropylene 1 - 25 micron	<ul style="list-style-type: none"> <li>Excellent dirt holding capacity</li> <li>Comprehensive micron range to match contamination profile</li> <li>Graded density meltblown polypropylene media maximises service lifetime</li> </ul>

## INLET AIR STERILE FILTRATION

TETPOR AIR (ZCMT)	Filter Medium	Features / Applications
	PTFE Membrane 0.01 micron	<ul style="list-style-type: none"> <li>Robust cost effective filtration</li> <li>Validated against liquid challenge (ASTM F838-38)</li> <li>Validated against aerosol bacterial and viral challenge</li> </ul>

HIGH FLOW TETPOR II (ZHFT)	Filter Medium	Features / Applications
	PTFE Membrane 0.01 micron	<ul style="list-style-type: none"> <li>Excellent flow rates resulting in smaller systems</li> <li>New generation PTFE membrane guaranteeing exceptional strength. (225 steam cycles @ 142°C)</li> <li>Fully validated against liquid bacterial (ASTM F838-38) and aerosol bacterial and viral challenge</li> </ul>

HIGH FLOW BIO-X (ZCHB)	Filter Medium	Features / Applications
	PTFE Impregnated Glass Microfibre 0.01 micron	<ul style="list-style-type: none"> <li>Very high flowrates resulting in significantly reduced system size</li> <li>Fully validated against both bacteria and viral aerosol challenge</li> <li>Improved lifetime to blockage</li> <li>Unique combination of hydrophobic PTFE and high flow capacity glass microfibre</li> </ul>

HIGH FLOW TETPOR H.T. (ZCHT-N)	Filter Medium	Features / Applications
	PTFE Membrane	<ul style="list-style-type: none"> <li>Specifically designed for high temperature inlet air filtration up to 100°C</li> <li>Fully validated against both liquid bacterial challenge (ASTM F838-38) and aerosol bacterial and viral challenge</li> <li>Excellent flowrates</li> </ul>

## OFF GAS FILTRATION

PEPLYN AIR (ZCPH)	Filter Medium	Features / Applications
	Polypropylene pleated depth media 5 micron	<ul style="list-style-type: none"> <li>Absolute cut off at stated micron size (the majority of aerosols generated in off gas from fermentations are in the range of 5-10 microns)</li> <li>Good flow rates resulting in the low pressure drops that are required to maintain adequate head pressure control.</li> <li>Fully steam sterilisable to 142°C</li> </ul>

TURBOSEP (ZVT)	Filter Medium	Features / Applications
	Mechanical separator	<ul style="list-style-type: none"> <li>Complete protection of the off gas pre or final filter from bulk foam or broth</li> <li>Prevention of product loss through foam-outs</li> <li>Increased fermenter capacities possible</li> <li>Reduction of antifoam consumption</li> </ul>

HIGH FLOW TETPOR II (ZHFT)	Filter Medium	Features / Applications
	PTFE membrane 0.01 micron	<ul style="list-style-type: none"> <li>Excellent flowrates providing low pressure drops for good head pressure control</li> <li>Fully validated against liquid bacterial (ASTM F838-38) and aerosol bacterial and viral challenge</li> <li>Use in conjunction with pre filter and/ or TURBOSEP for long term filtration duties</li> </ul>

## LIQUID FERMENTER ADDITIONS - PRE-FILTRATION

PEPLYN PLUS (ZCPP)	Filter Medium	Typical Applications	Features
	Polypropylene 0.6 - 10 micron	<ul style="list-style-type: none"> <li>Excellent chemical compatibility: required for acids and bases used for pH adjusts</li> <li>Combined meltblown and spun-bonded filtration layers provides a graded density construction to maximise throughputs on the pre-filtration of culture media components</li> <li>Robust construction makes it ideal for applications requiring the filters to be repeatedly steam sterilised</li> </ul>	

PREPOR GF (ZGPF)	Filter Medium	Features / Applications
	Graded density glass microfibre	<ul style="list-style-type: none"> <li>Ideal for applications where high bioburden reduction is required</li> <li>Glass microfibre provides unrivalled combination of retention and throughput</li> </ul>

STAINLESS STEEL (ZCMF)	Filter Medium	Features / Applications
	Pleated mesh and metal fibre	<ul style="list-style-type: none"> <li>Ultimate chemical compatibility</li> <li>Ideal for particulate control in highly viscous solutions</li> <li>The filters can be back flushed for cleaning and extending lifetimes</li> </ul>

## LIQUID FERMENTER ADDITIONS - STERILE FILTRATION

PROPOR PES (ZCMS)	Filter Medium	Features / Applications
	Polyethersulphone 0.1 - 0.45 micron membrane	<ul style="list-style-type: none"> <li>Graded membrane pore structure ensures large throughput and flowrates for additives such as antifoam</li> <li>PES-X option with polypropylene membrane supports is available for sterile filtration of acids and bases</li> </ul>

TETPOR LIQUID (ZCMT)	Filter Medium	Features / Applications
	PTFE Membrane 0.2 - 0.45 micron	<ul style="list-style-type: none"> <li>PTFE membrane gives excellent chemical compatibility</li> <li>Ideal for higher concentration acids</li> </ul>

## DOWNSTREAM PROCESSING - LIQUID PRE-FILTRATION

PEPLYN PLUS (ZCPP)	Filter Medium	Typical Applications	Features
	Polypropylene 1 - 25 micron	<ul style="list-style-type: none"> <li>Excellent chemical compatibility: required for acids and bases used for pH adjusts</li> <li>Combined meltblown and spun-bonded filtration layers provides a graded density construction to maximise throughputs on the pre-filtration of culture media components</li> <li>Robust construction makes it ideal for applications requiring the filters to be repeatedly steam sterilised</li> </ul>	

## DOWNSTREAM PROCESSING - STERILE LIQUID FILTRATION

PROPOR PES (ZCMS)	Filter Medium	Features / Applications
	Polyethersulphone 0.1 - 0.45 micron	<ul style="list-style-type: none"> <li>Fully validated against liquid bacterial challenge</li> <li>Extensive range of filter formats for small and large batches</li> <li>Graded membrane pore structure ensures large throughput and flowrates for additives</li> </ul>

## DOWNSTREAM PROCESSING - POWDER PROCESSING

PEPLYN PT (ZCDV)	Filter Medium	Features / Applications
	Polypropylene Sintered 5 micron	<ul style="list-style-type: none"> <li>Ideal for vacuum transfer systems</li> <li>Disposable format eliminates costly validation of filter cleaning</li> <li>Excellent powder release properties</li> </ul>

STAINLESS STEEL (ZCMF)	Filter Medium	Features / Applications
	Mesh 5 - 25 micron Metal fibre 3 - 10 micron	<ul style="list-style-type: none"> <li>Re cleanable for multiple batch operation</li> <li>Metal fibre construction offers absolute ratings</li> </ul>

## STEAM FILTRATION

PLEATED STAINLESS STEEL (ZCHS)	Filter Medium	Features / Applications
	1 - 5 micron	<ul style="list-style-type: none"> <li>A combination of metal fibre filtration media and the high surface area of the pleated construction provides exceptional flowrates ideal for optimising central steam filtration solutions.</li> <li>The filtration media is re-cleanable allowing the life time of the cartridge to be extended considerably</li> </ul>

SINTERED STAINLESS STEEL (ZCSS)	Filter Medium	Features / Applications
	1 - 25 micron	<ul style="list-style-type: none"> <li>The most cost effective solution for low capacity systems</li> <li>Sintered filtration media is extremely robust</li> </ul>

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 BIO-X, PEPLYN, PORECHECK, PREPOR, PROPOR, TETPOR

## INTEGRITY TESTING

VALAIRDATA II	Features / Applications	PORECHECK 4	Features / Applications
	<ul style="list-style-type: none"> <li>Specifically designed for the testing of sterile gas filters</li> <li>Fully correlated to aerosol bacterial and phage challenges</li> <li>21CFR part 11 compliant environment</li> <li>Ideal for the testing of multi-round fermenter inlet air systems</li> </ul>		<ul style="list-style-type: none"> <li>Portable instrument</li> <li>Designed for 21CFR part 11 compliant environment</li> <li>Can be integrated into automated processes</li> <li>Features testing by diffusional flow bubble point and water intrusion</li> </ul>

For the latest product information from domnick hunter please visit us at  
[www.domnickhunter.com](http://www.domnickhunter.com)



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domnick hunter limited has a continuous policy of product development and although the Company reserves the right to change specification, it attempts to keep customers informed of any alterations. This publication is for general information only and customers are requested to contact our Process Filtration Sales Department for detailed information and advice on a products suitability for specific applications. All products are sold subject to the company's Standard conditions of sale.

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