



POREX
Filtration Group®

POREX Virtek® PTFE

Robust and durable

Sintered PTFE membranes



Filtration Group[®]

Making the World Safer, Healthier & More Productive

Filtration Group's History of **Transformative Growth**

2012

\$371 Million

1,400 team members
32 locations



2022

~\$2 Billion

9,200+ team members
150+ locations

Our Evolution

AIR FLOW TECHNOLOGY
September 2012

Flow Dry
November 2019

Columbus Industries, Inc.

October 2021

AFPRO
January 2021

MULTISORB
April 2018

PCI
February 2017

purafil
June 2015

ZINGA
March 2015

Air System Products
October 2014

BUFFALO FILTER
July 2013

CLEAR|EDGE™
May 2013

Waco
July 2011

FG
December 2010

FILTRAN
October 2009

April 2020
oxyphen

Facet
April 2018

MAHLE
October 2016

CON-AIR
November 2014

AG INDUSTRIES
May 2013

Universal air filter
February 2012

CHEMCO
October 2010

June 2021
molecular

ESSENTRA
March 2017

POREX
November 2013

KAYDON FILTRATION
June 2015

JONELL™
December 2012

GLOBAL FILTER
March 2011

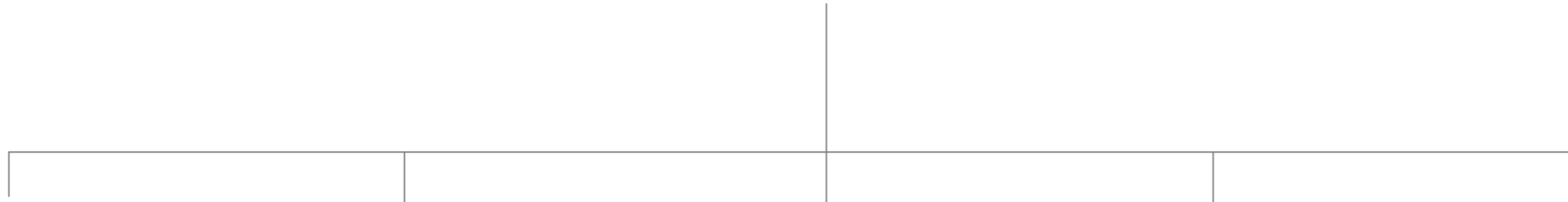
June 2022
WHIRL-PAK®

Enhancing our capabilities through acquisitions while delivering organic growth

The Strength of **Madison Industries**

MADISON[®]

INDUSTRIES



MADISON[®]

IAQ

MADISON[™]

SAFETY & FLOW

MADISON[™]

INDUSTRIAL SOLUTIONS

MADISON[®]

MEDICAL



TOGETHER, WE ARE MAKING
THE WORLD SAFER, HEALTHIER
AND MORE PRODUCTIVE.

Quality manufacturing and local support



quality
manufacturing



All global facilities are ISO certified

Manufacturing facility: Aness, Scotland



Facility

- 2,300m² footprint
- 1,000m² class 100k cleanroom manufacturing
- QC and product development laboratories
- Warehouse and distribution center

Site certifications

- Quality - ISO:9001
- Safety - ISO:45001



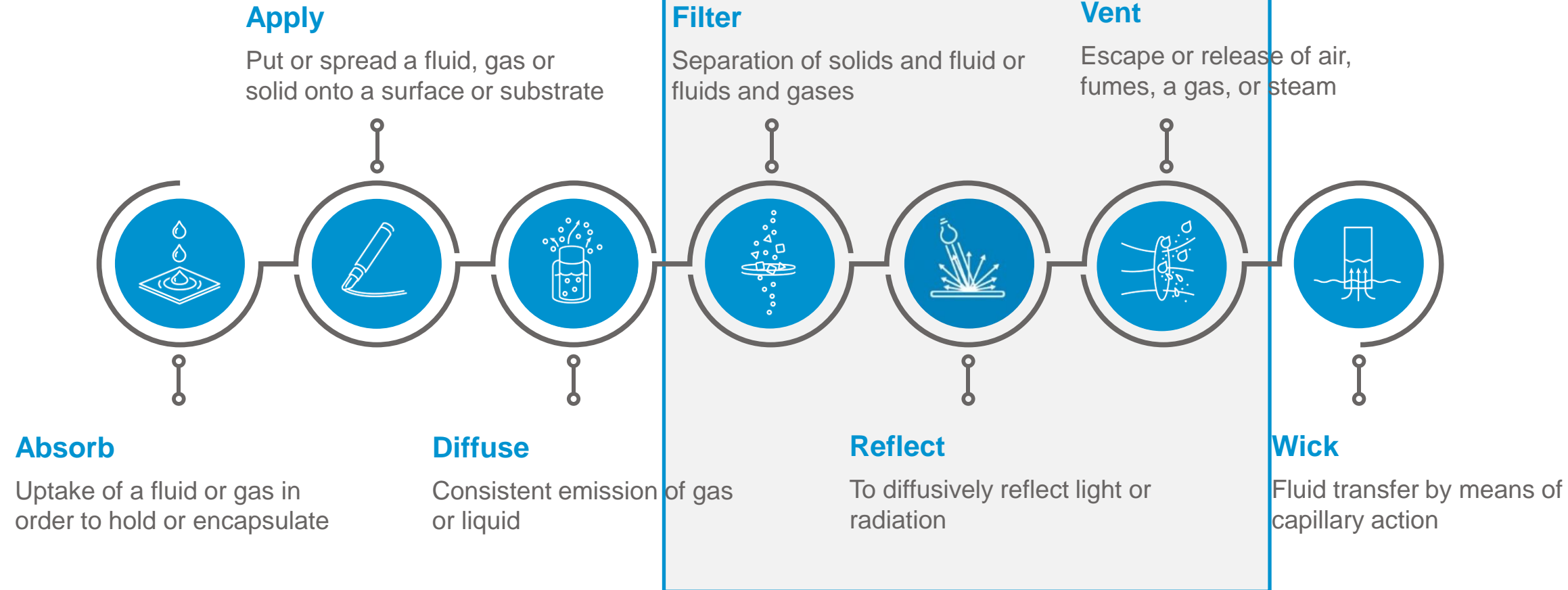
Material Properties: physical properties

| Polymer | Pore Size (microns) | Pore Volume % | Operating Temperature (°F / °C) |
|--------------------------------|---------------------|---------------|---------------------------------|
| Polyethylene (PE) | 5 to 250 | 25 – 60 | 180 / 82 |
| Polypropylene (PP) | 100 to 300 | 30 – 40 | 250 / 121 |
| Polyvinylidene Fluoride (PVDF) | 20 to 30 | 30 - 40 | 300 / 149 |
| Polytetrafluoroethylene (PTFE) | <1 to 60 | 25 - 60 | 500+ / 260+ |

Understanding typical material properties will guide you in selecting the right material for your device's function and operating conditions

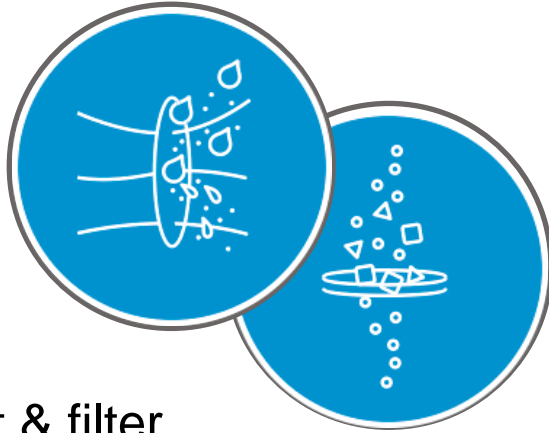
Porex – your partner in innovative porous polymer solutions

Main Functional Areas for Porex Virtek® PTFE



Porex porous polymers create unique functionality within a 2D or 3D shape

Solving your design challenges with porous PTFE membrane



vent & filter

Exchange of air, fumes, a gas, or water vapor while acting as fluid, dust or bacteria barrier



reflectivity

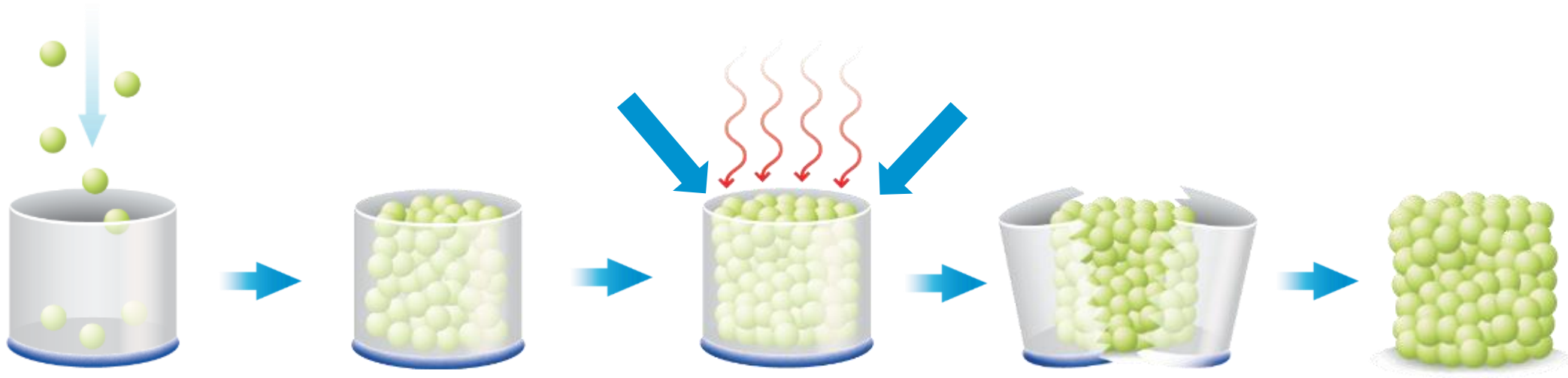
Property of diffusively reflecting light or radiation



support / separation

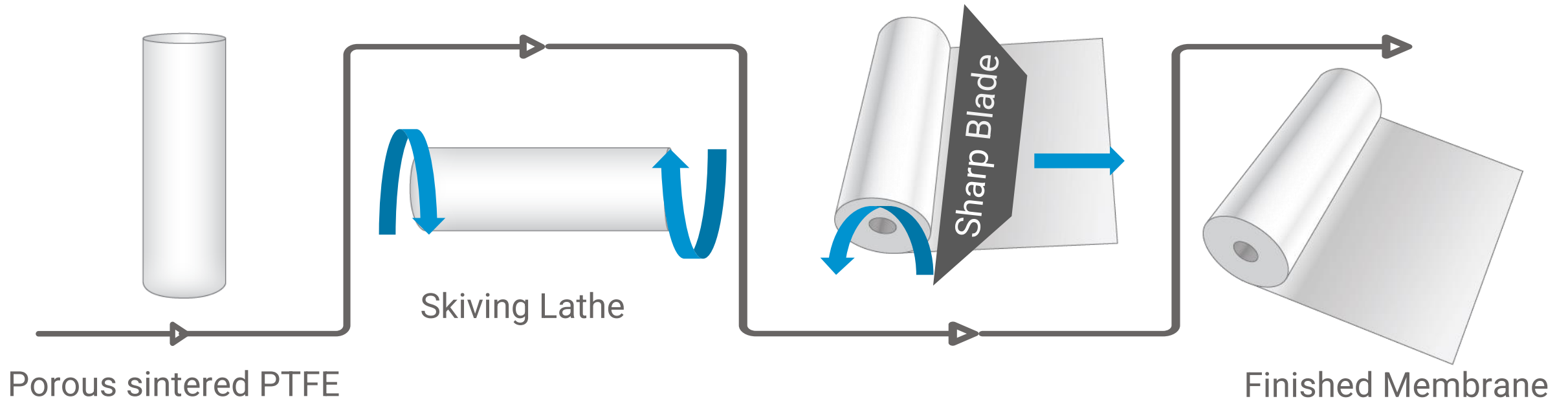
Low di-electric constant substrate for antennae systems or inert porous layer to allow gas or liquid flow

The sintering process - basics



Process of compacting and forming a solid mass of porous material by heat and/or pressure without melting

The skiving process membrane formation



Process of cutting or slicing a larger form with precision tools into thinner films, membranes or sheets

Manufacturing process

Various stages

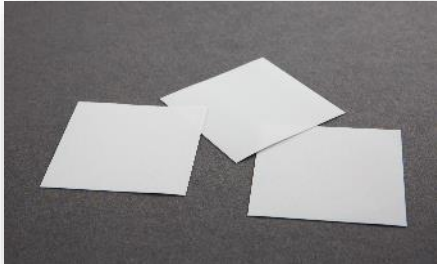
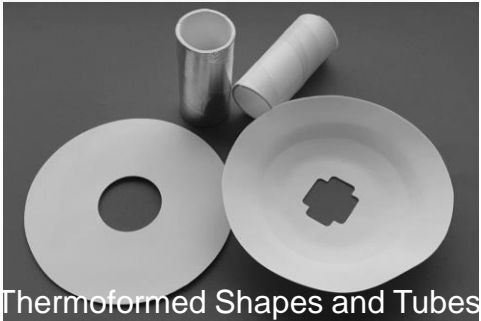
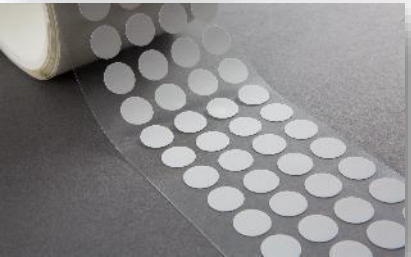
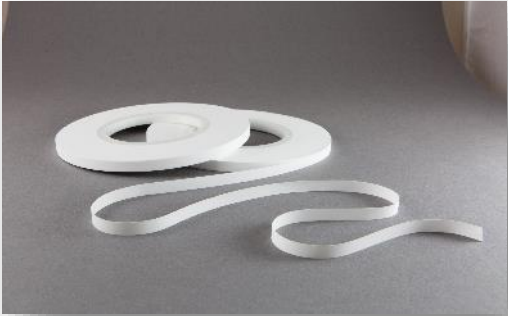
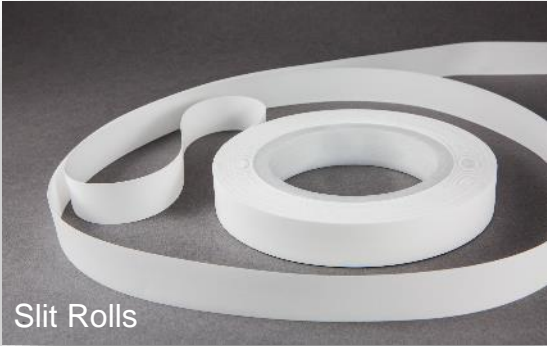
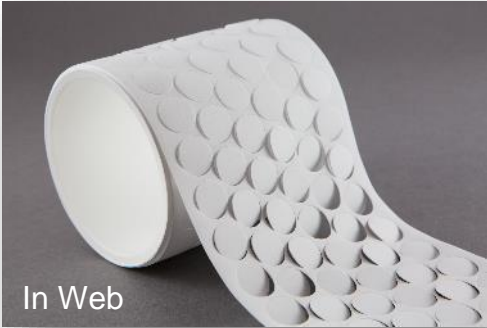


Range of material options

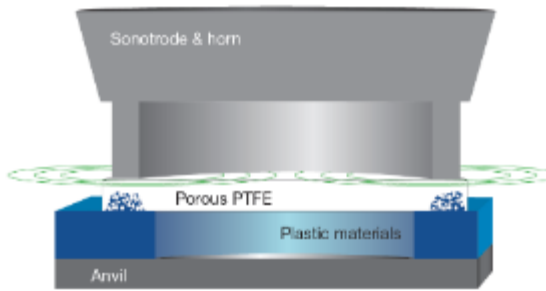


- **Master roll:**
 - 330mm wide
 - Thickness from 0.1mm - 3.0mm
 - Roll length dependent on thickness (3m – 100m)
- **Converting options:**
 - **Slit Rolls**
 - 8mm minimum width (for most materials)
 - Provided on 76mm (3") ID plastic cores
 - **Die-cutting**
 - Minimum 3mm diameter
 - Minimum 5mm diameter if with adhesive
 - Custom Shapes
 - Robotic Frit cutting for thicker membranes
 - **Adhesive Discs**
 - Numerous stock, standard and custom size/shapes available
 - **Lamination**
 - PP / PE scrim options available
 - Adhesive backing

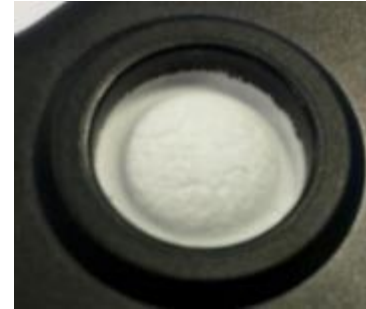
Material format possibilities



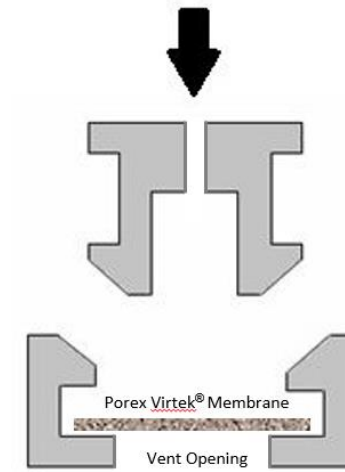
Common **Assembly** options Porex Virtek PTFE



Thermal &
Ultrasonic Welding



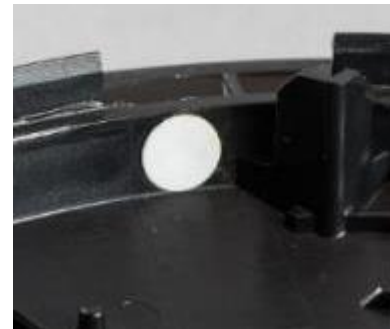
Overmolding



Snap-fit or
Clamping

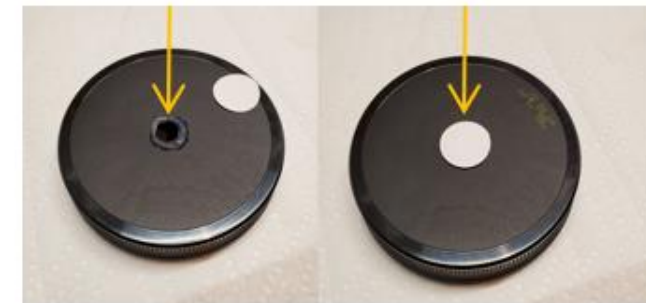


Press Fit



Pressure-sensitive
adhesive (PSA)

Apply zone adhesive / epoxy around vent hole Seal with Porex Virtek® Membrane

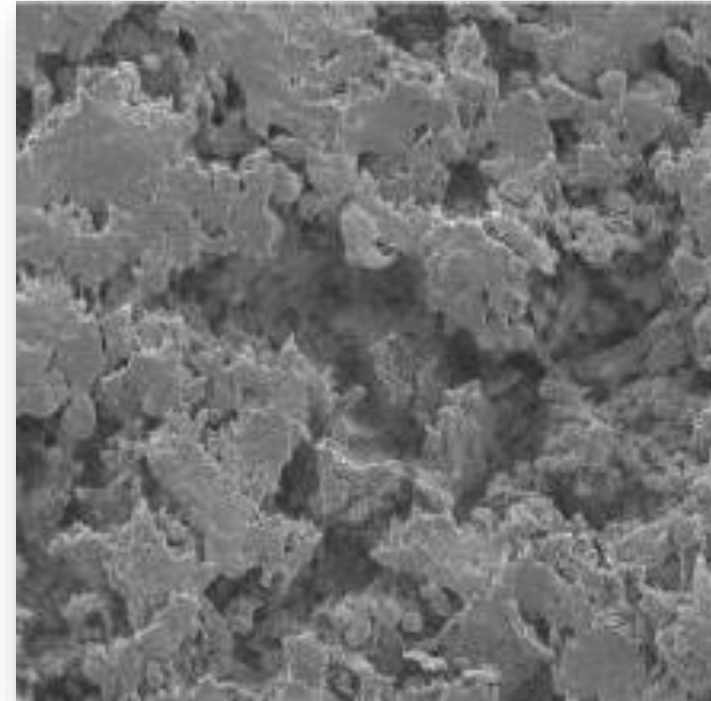


Zone adhesive / Epoxy

Porex Virtek® sintered PTFE

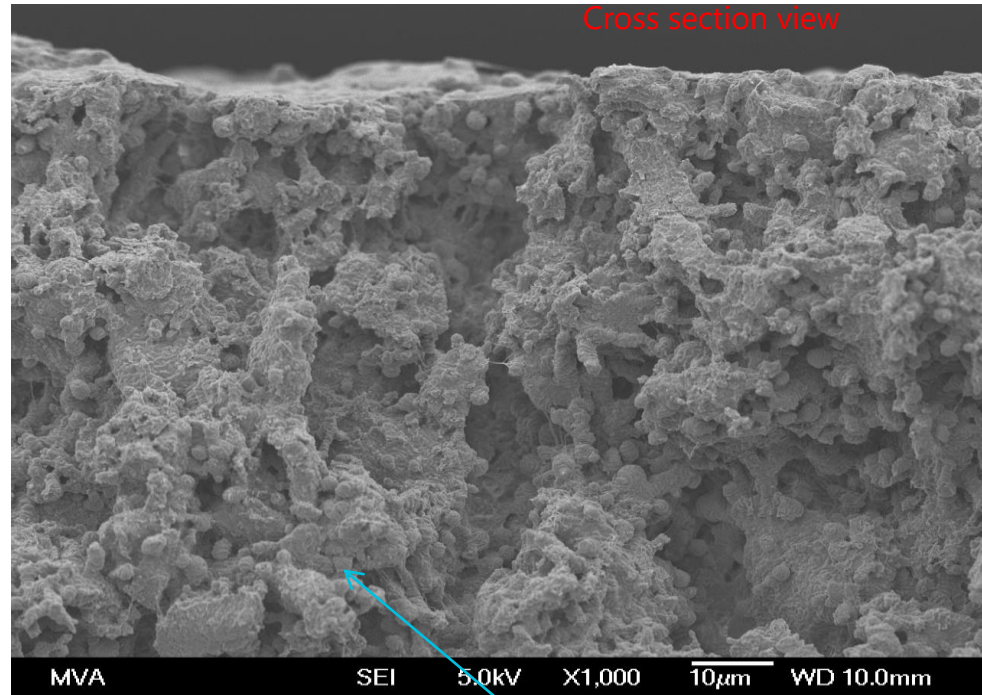
What to expect

- **Robust, pure and durable:**
 - Requires no supporting layers or chemical treatments
 - Safe to handle without damaging
 - Highly heat and chemical resistant
 - No assembly orientation required
 - High purity with virtually no leachable or extractables
- **Customizable membrane options:**
 - 0.1 to 3 mm thickness available
 - Several application specific product ranges
 - Several secondary process options available
- **Manufactured in class 100k cleanroom**
- **UL-94 and UL-746C listed**
- **Raw material certified for:**
 - USP class VI (bio-compatibility)
 - FDA 21 CFR 177:1550 (food contact)
- **PFOA Free**



**SEM image
of Porex Virtek® PTFE**

Hydrophobic membranes

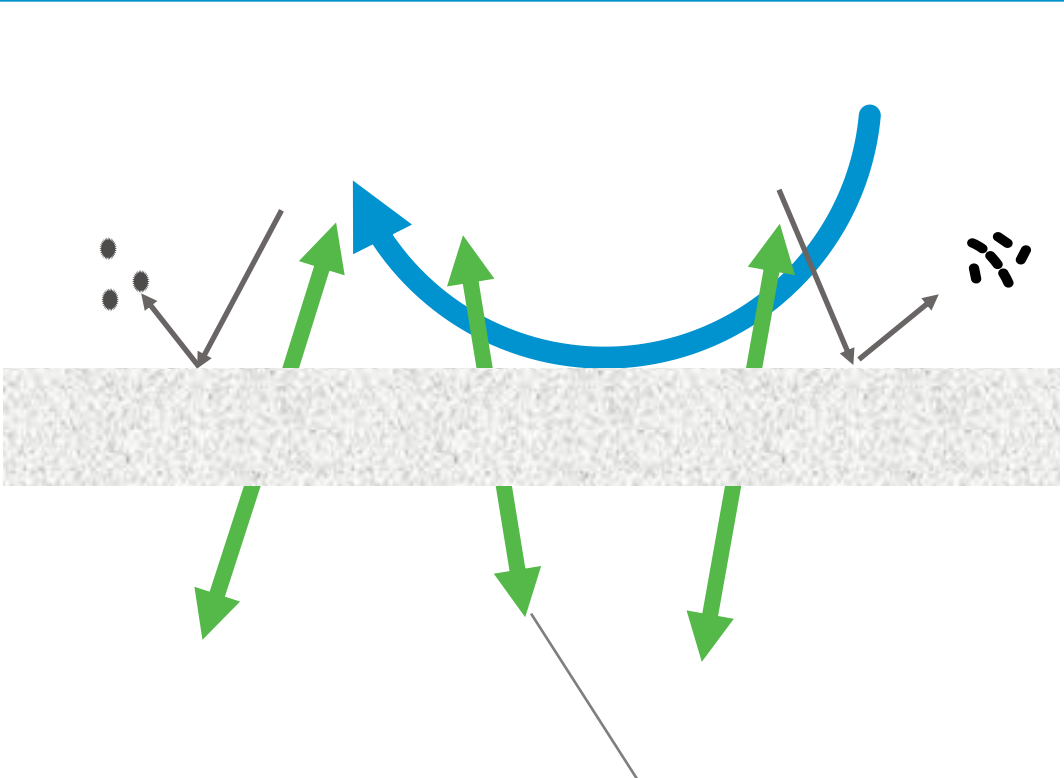


Due to the unique manufacturing process:

- Robust and durable
- Easily welded & assembled
- Naturally super-hydrophobic
- Structure has “memory” when stressed
- Customizable & printable

The base material is super hydrophobic by nature. [Additional oleophobic treatment](#) option for applications where there is contact with low surface energy fluids (such as oils, alcohols and surfactants)


Hydrophobic membrane



The diagram illustrates a cross-section of a hydrophobic membrane. A grey, porous-looking membrane is shown. Above it, a blue curved line represents the water contact angle. Green arrows point upwards from the membrane, indicating the passage of air and gases. Black arrows point downwards from the membrane, indicating the rejection of liquids, dust, microbes, and debris. A blue arrow points to the right, indicating the direction of flow.

Naturally hydrophobic, 100% pure PTFE membrane:

- Naturally repels water
- Resistant to steam, ETO and other sterilization techniques (no Gamma)
- Resistant to virtually all chemicals
- Continuous-use temperature up to 260 °C
- Many assembly techniques including heat and ultrasonic welding, clamping, press-fit, overmolding and adhesive or epoxy bonding

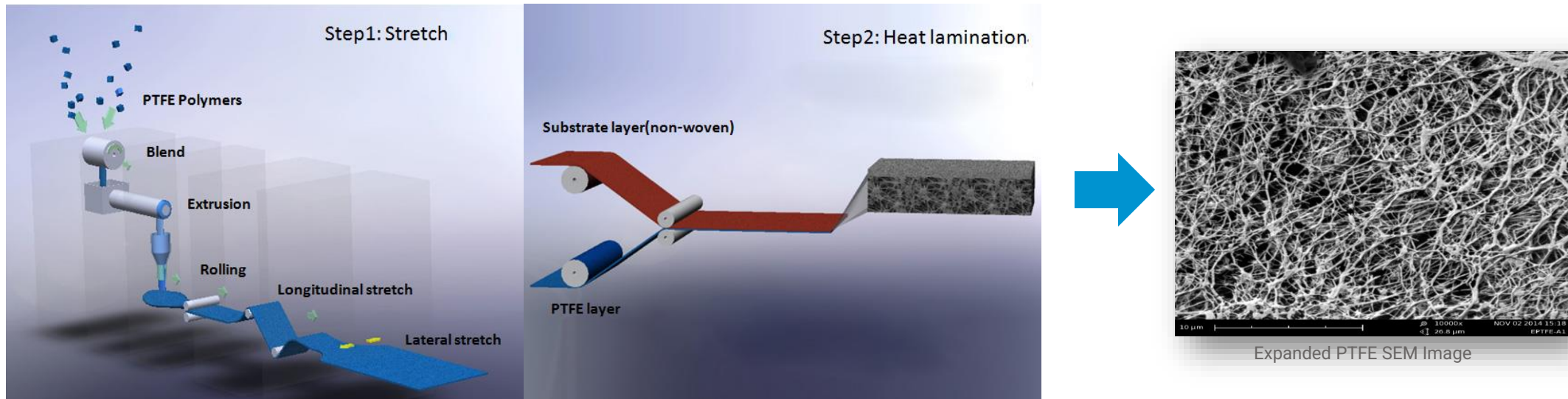


Naturally superhydrophobic

Air and gases freely pass through membrane while liquids, dust, microbes and debris are blocked

02. Comparison to other material technologies

Stretched membranes



Source: Cobetter Filtration <https://www.cobetterfiltration.com/Industries/Medical/OEM-Membranes-and-Devices/Hydrophobic-ePTFE-Membrane/>

Manufacturing process:

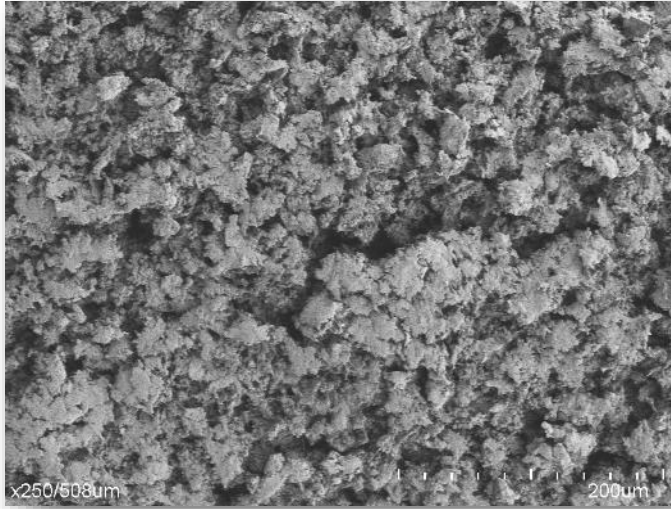
- Involves extrusion, rolling and stretching
- After forming the porous membrane, a supporting layer is usually added for strength and stability

Offered by many manufacturers with many material configurations

Common drawbacks:

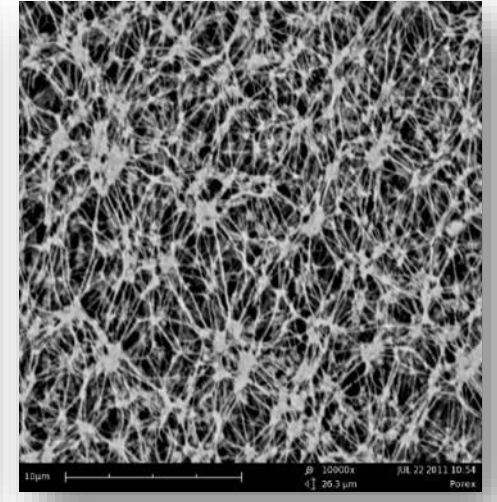
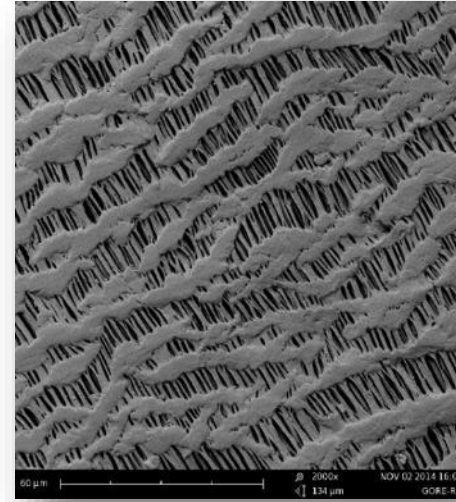
- Very thin and can be fragile
- Membrane orientation is critical
- Supporting layer often a limiting inferior material
- Physical properties limited to substrate layer so secondary treatments & additives may be needed to maintain or boost properties

Sintered PTFE vs. ePTFE



Sintered PTFE

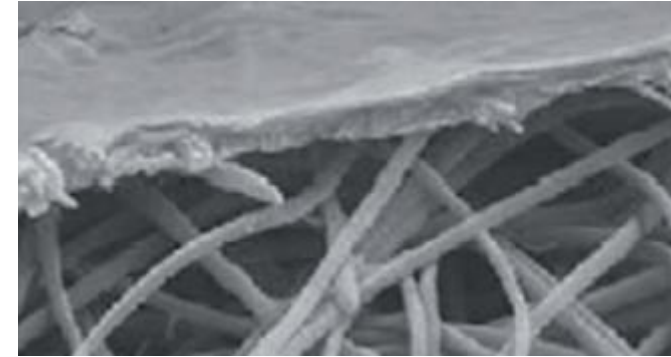
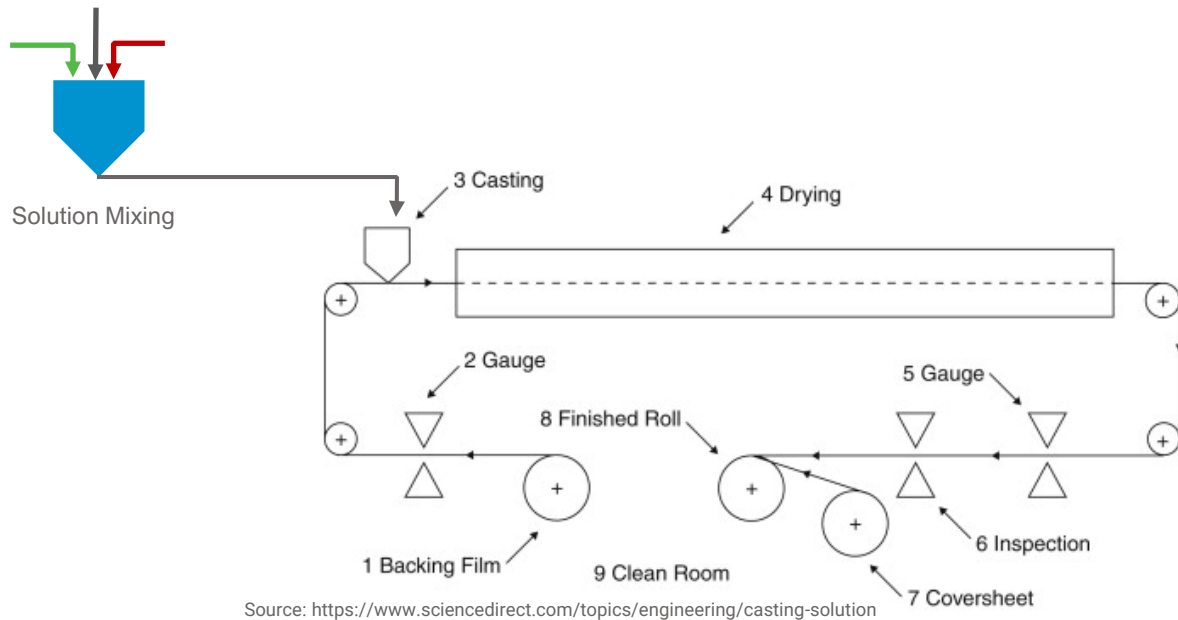
- **Robust** pore structure due to sintered **3D matrix** construction
- **Self-supporting** membrane that is easy to handle and is **omni-directional**



Expanded PTFE (ePTFE)

- Extruded film that is stretched to create a **micro-fractured pore structure**
- Structure tends to be **delicate** and often **requires a supporting layer**

Cast membranes



Cast membrane on non-woven substrate SEM Image

Manufacturing process:

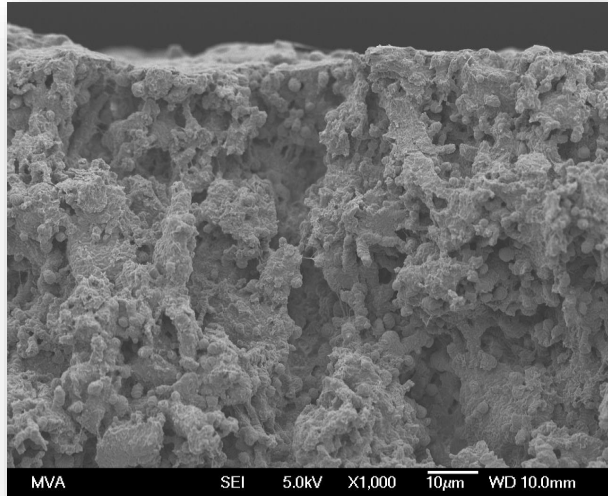
- Involves casting a thin layer on top of a substrate
- Developing a pore structure can be complex and can involve various processes to either remove sacrificial material or developing a uniform coating on a coarser porous layer

Common drawbacks:

- Physical properties limited by the substrate
- Can be fragile and may separate from backing
- Membrane orientation is critical
- Often uses solvents or chemicals to develop pores that can lead to residuals and contamination issues
- Lack of consistency and uniformity

Microscopic comparison

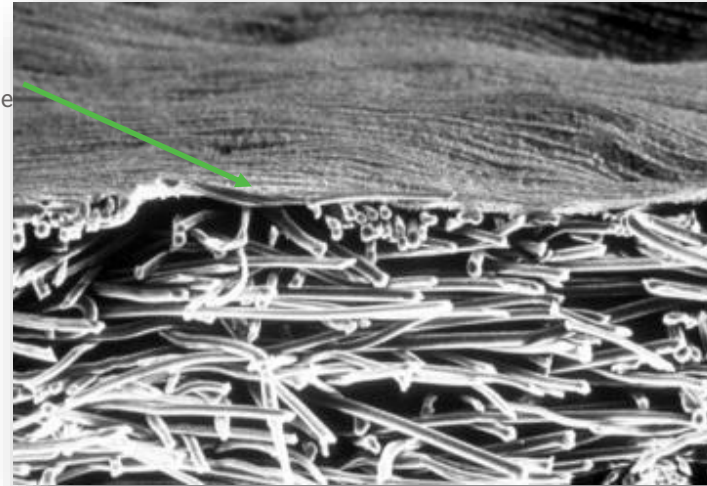
Sintered PTFE Membrane



Active Membrane
Active Membrane

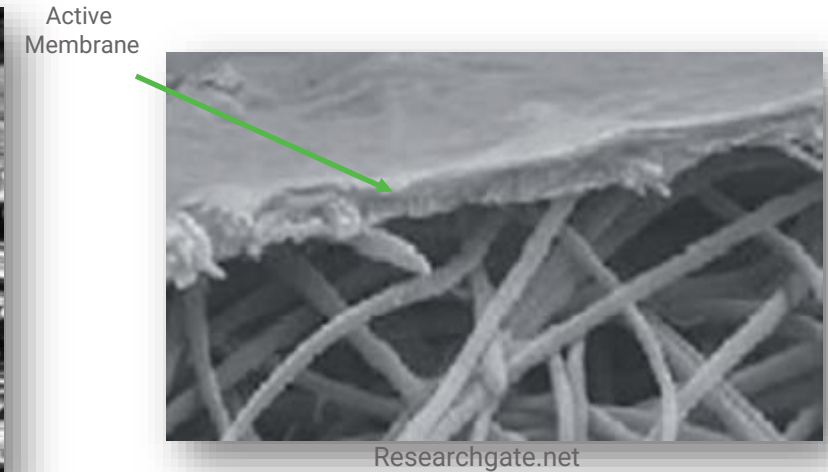
- Material has depth, is self supporting and will rebound under pressure
- Individual particles bonded to its neighbor providing superior strength
- No additives or binders necessary
- Membrane is a depth filter and follows a torturous path
- Both sides identical and omnidirectional

Expanded / Stretched PTFE Membrane



- Active membrane has minimal depth and is only a surface filter
- Bonding to substrate requires adhesives or lamination to tie layers together
- Service temperatures limited to substrate
- Both sides have different properties
- Membrane properties can be altered if pressure is applied

Cast Membrane



- Casting process often requires chemicals or other additives to create structure
- Layers can delaminate
- Service temperatures and chemical resistance limited to substrate
- Membrane orientation is critical (different sides have different properties)
- Treatment often needed for hydrophobicity

Comparison with other membrane technologies

| Characteristic | Expanded / Stretched Membranes | Cast Membranes | Sintered Porex Virtek® PTFE Membranes |
|--------------------------------------|--|--|---|
| Manufacturing process | Stretching can cause non-uniform and varying densities and can shrink when heated | Casting process can be uneven and difficult to control and can involve many steps | Precise particle size and repeatable process leads to membrane robustness and consistency |
| Porosity | Pores can have high variability | Many factors can affect pore formation, size and distribution | Depth filtration creates many paths for fine particle capture |
| Air flow and water repellency | Large tolerances in gas permeability and water entry pressures | Often requires secondary treatments to reach high hydrophobicity levels | Naturally super-hydrophobic with well-defined air flow range and water entry pressures |
| Chemical resistance | PTFE membrane excellent – however supporting structure or other membrane types will vary | Highly dependent on cast material and support structure | Resistant to virtually all chemicals |
| Heat resistance | Limited by supporting material | Limited by supporting material | 260 °C continuous use |
| Toughness / robustness | Membrane can be altered by physical exposure or temperature extremes | Highly variable depending on membrane type and support | Highly durable and minimal change due to physical contact or temperature exposure |
| Durability | Delamination possible, stretched membranes very delicate and can be altered with contact | Separation of layers possible, as are traces of solvent or secondary process aids / coatings | Pure and durable single layer membrane free of processing aids or supporting structures |

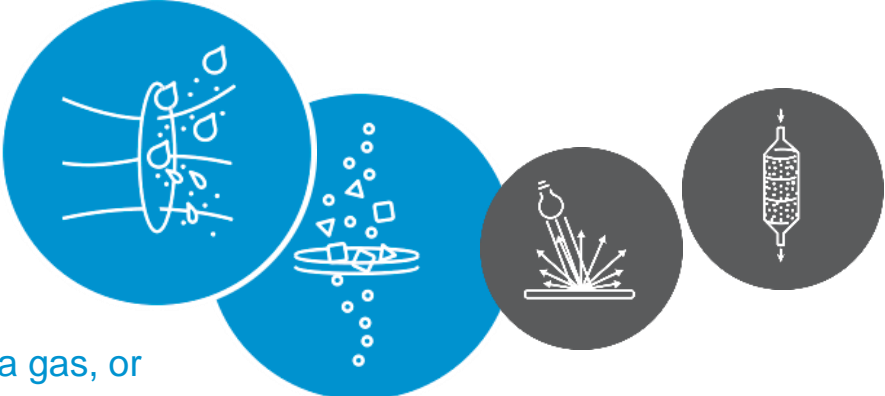
Video Comparison

<https://www.youtube.com/watch?v=HVY4NQjPGC4&t=96s>

Your partner in PTFE filtered venting solutions for automotive applications

vent & filter:

exchange of air, fumes, a gas, or water vapor while acting as water, fluid, and particulate barrier



Automotive lighting vents



Battery system vents

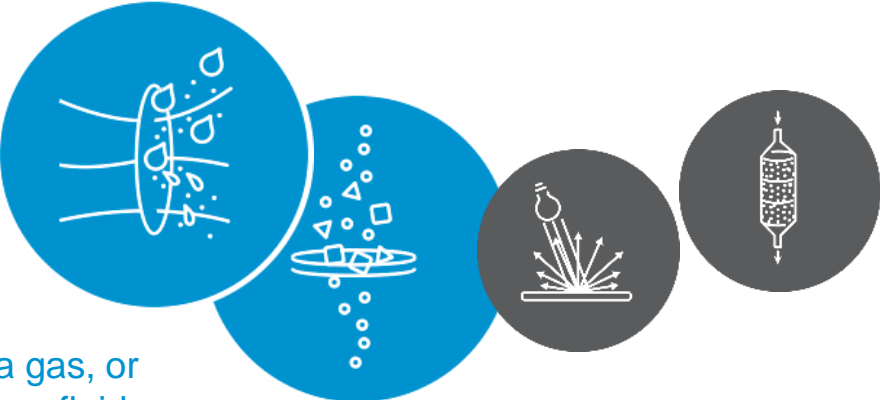


Fluid system vents



Electrical system vents

Your partner in **PTFE** filtered venting solutions for **electronics** applications



vent & filter:

exchange of air, fumes, a gas, or water vapor while acting as fluid, particulate and bacteria barrier



Protection vents

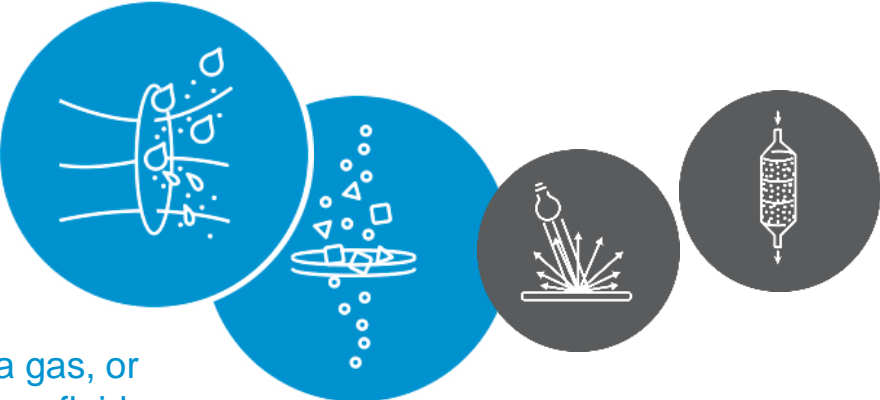


Sensor components



Refillable printer cartridge vents

Your partner in PTFE filtered venting solutions for medical applications



vent & filter:

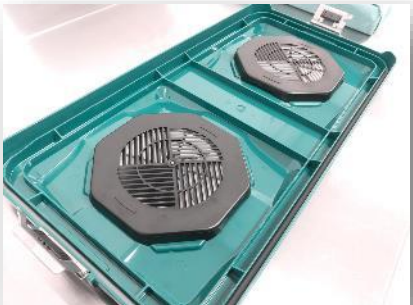
exchange of air, fumes, a gas, or water vapor while acting as fluid, particulate and bacteria barrier



Spike & infusion set vents



Safety IV catheter vents



Sterilization container filters

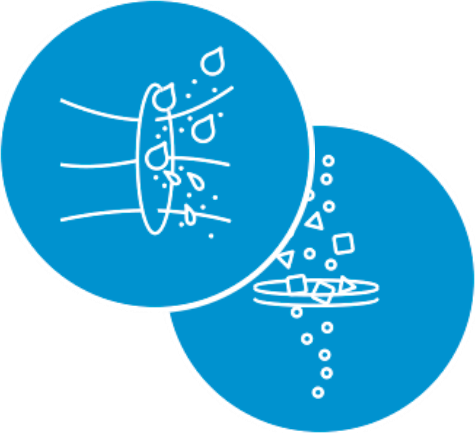


Ostomy bag vents



Drug delivery vents

Applications in the **life sciences**



vent & filter:

exchange of air, fumes, a gas, or water vapor while acting as fluid, particulate and bacteria barrier

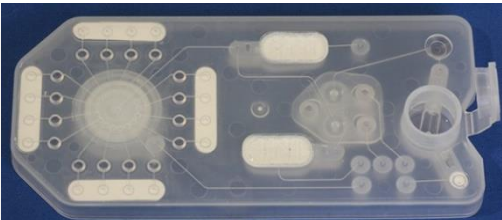
Fluid Management is among the many Life Science application areas



Spike set vents



Drug delivery vents



Microfluidic Cartridge Vents



Fluid bag vents

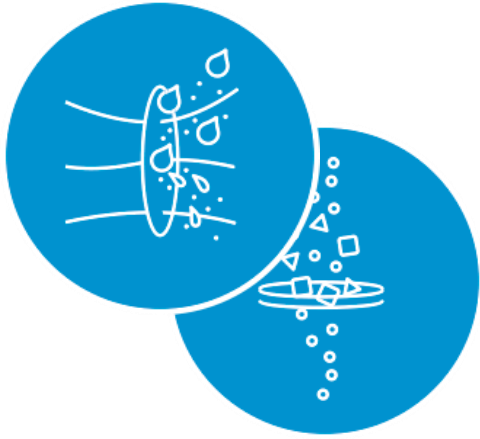


Infusion set vents



Safety IV catheter vents

Applications in Sterile Processing



vent & filter:

exchange of air, fumes, a gas, or water vapor while acting as fluid, particulate and bacteria barrier

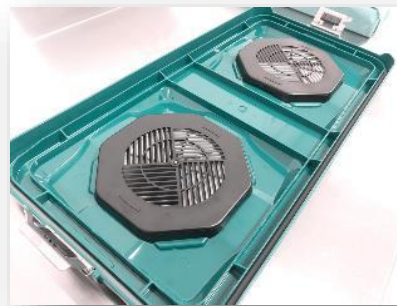
Infection Control is among the many Life Science application areas



Cell growth container vents



Fluid container vents



Sterilization container filters

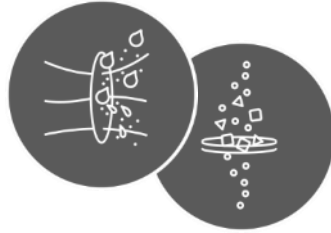


Diagnostic PCR & rapid testing



General sterile packaging

Your partner in **PTFE reflectivity** solutions for **UV** applications



reflectivity:

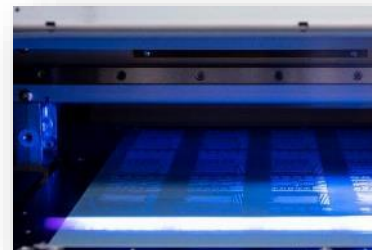
property of reflecting light or radiation



Medical phototherapy



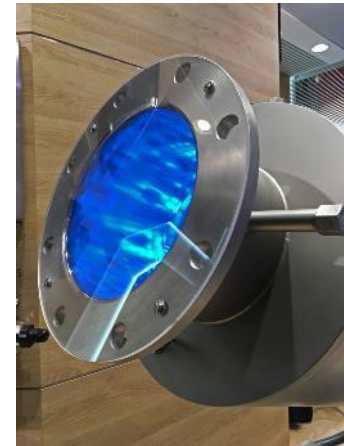
Surface disinfection



UV curing

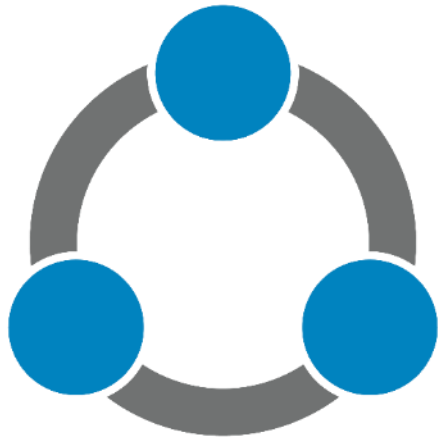


Air disinfection



Water disinfection

How we do it – our unique capabilities



collaborative innovation



material science
expertise



quality manufacturing

Getting started with Porex



What is the **function of the part** you are looking for within the application or assembly?

What **formulas / solutions / environment** will the part interact with?



What are the **performance requirements** for functionality?

What are the **size requirements?**



Are there **manufacturing constraints?**



Examples of our engaged partners in innovation



healthcare

- Abbott
- B. Braun
- Bayer
- BD
- Cardinal Health
- Danaher
- Fresenius Medical Care
- GE Healthcare
- Haemonetics
- Hamilton Company
- Hill-Rom
- Johnson & Johnson
- Medtronic
- Medline
- Siemens Healthineers
- Smiths Medical
- Stryker
- Tecan
- Teva
- Thermo Fisher Scientific
- Zimmer Biomet

automotive

- BMW
- East Penn
- Ford
- GM
- Continental
- Valeo
- Schreiner
- Hella
- Clarios
- Hyundai

electronics & industrial

- Entegris
- Fitbit
- Google
- HP
- Honeywell
- Intel
- Samsung
- Logitech
- Parker Hannifin
- Phillips
- Polaris
- Church & Dwight
- Flextronics

Contact us



PTFE support

[Contact Us](#)

Dan Furey 773.771.1955

Dan.furey@filtrationgroup.com

phone +44 (0) 1349 884060

email PorexVirtek@filtrationgroup.com

Online

porex.com

LinkedIn/[Porex](#)

twitter/[PorexCorp](#)

YouTube/[PorexCorporation](#)