

PORE FILTRATION

THE COMPLETE GUIDE TO

DEPTH FILTERS

Everything You Need to Know
About Depth Filtration Technology,
Construction, Applications and
Filter Selection



HIGH DIRT HOLDING CAPACITY

Retains more contaminants
for longer service life



LOW PRESSURE DROP

Optimised flow performance
reduces energy costs



COST-EFFECTIVE FILTRATION

Longer life and fewer changes
lower operating costs



VERSATILE APPLICATIONS

Ideal for a wide range of
industrial processes

TYPICAL APPLICATIONS



WATER
TREATMENT



FOOD &
BEVERAGE



PHARMACEUTICAL
MANUFACTURING



CHEMICAL
PROCESSING



PAINTS &
COATINGS



ELECTRONICS
MANUFACTURING



GENERAL
INDUSTRIAL

CLEANER LIQUIDS.
BETTER PERFORMANCE.



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Introduction

Depth filtration is one of the most widely used and cost-effective filtration technologies in modern industry. From pharmaceutical manufacturing and food processing to water treatment and chemical production, depth filter cartridges provide reliable removal of suspended solids, protecting critical equipment and extending the life of downstream filtration systems.

Unlike membrane filters, which capture particles primarily on their surface, depth filters retain contaminants throughout the entire thickness of the filter media. This three-dimensional filtration mechanism enables them to hold significantly greater quantities of dirt and particulate matter before requiring replacement.

Their high dirt-holding capacity, low operating costs and wide range of micron ratings make depth filters an essential component in countless industrial filtration processes.

Whether protecting reverse osmosis systems, preparing pharmaceutical process water, filtering food ingredients or removing sediment from chemical solutions, depth filters deliver dependable performance across a broad range of applications.

This guide explains how depth filters work, how they are manufactured, the different materials available, their technical characteristics and how to select the most suitable filter for your application.

What is a Depth Filter?

A depth filter is a porous filtration medium designed to capture particles throughout its entire structure rather than only on the surface.

Instead of acting as a simple screen, the filter consists of thousands of interconnected microscopic pathways. As liquid flows through the cartridge, particles become trapped at multiple levels within the filter matrix.

Larger contaminants are retained near the outer layers, while progressively finer particles penetrate deeper into the media until they are captured.

This unique filtration mechanism provides several important advantages:

- High dirt holding capacity
- Long service life
- Excellent particle retention
- Reduced cartridge replacement frequency
- Cost-effective filtration
- Protection for downstream membrane filters
- Improved process efficiency

Depth filters are therefore widely used as pre-filters, process filters and clarification filters across almost every industrial sector.

How Depth Filtration Works

Depth filtration relies on a tortuous flow path through a porous filter structure. As contaminated liquid enters the outer surface of the cartridge, it encounters a complex network of microscopic fibres and pores. Particles are removed through several mechanisms simultaneously.

Mechanical Sieving

Particles larger than the pore openings are physically retained.

Direct Interception

Particles following the flow stream collide with filter fibres and become trapped.

Inertial Impaction

Larger particles cannot follow rapid changes in fluid direction and impact directly onto filter fibres.

Adsorption

Very fine particles may adhere to fibre surfaces through electrostatic or molecular forces.

Because contaminants are captured throughout the entire depth of the cartridge, the filter is capable of holding significantly more particulate matter than surface filtration technologies. This is why depth filters often remain in service for much longer than equivalent membrane filters operating under similar conditions.

Surface Filtration vs Depth Filtration

Understanding the difference between surface and depth filtration is essential when designing an efficient filtration system. In many industrial systems, both technologies are used together.

Depth Filters	Membrane Filters
Capture particles throughout the filter	Capture particles on the membrane surface
High dirt holding capacity	Lower dirt holding capacity
Longer service life in dirty applications	Ideal for final filtration
Nominal or absolute ratings available	Typically absolute rated
Lower operating cost	Higher precision filtration
Depth Filters	Membrane Filters
Excellent pre-filtration	Excellent sterile filtration

A depth filter removes larger particulate contamination before a membrane filter performs the final polishing stage. This staged approach reduces membrane fouling, increases process reliability and lowers operating costs.

Construction of Depth Filter Cartridges

Modern depth filter cartridges are designed to maximise contaminant retention while maintaining low pressure loss and high flow rates. Although several manufacturing methods exist, most industrial depth filters share the same basic construction.

A typical cartridge consists of:

- Outer filtration layer
- Progressive depth filtration media
- Central support core (where required)
- Thermally bonded end caps
- Polypropylene support cage (optional)

Unlike pleated filters, which rely on increased surface area, depth filters use the thickness of the media itself to provide filtration. This construction enables contaminants to be distributed throughout the cartridge rather than accumulating on the surface.

How Melt Blown Depth Filters Are Manufactured

The majority of industrial depth filter cartridges are manufactured using a process known as melt blowing. Melt blowing is an advanced manufacturing technique that produces an exceptionally uniform network of ultra-fine fibres without the need for adhesives or chemical binders.

Step 1 – Polymer Preparation

The process begins with high-purity polypropylene resin. The resin is dried and fed into an extruder where it is heated until it becomes molten. Using virgin polypropylene ensures excellent chemical resistance, low extractables and suitability for demanding industrial applications.

Step 2 – Fibre Formation

The molten polymer is forced through hundreds of microscopic nozzles. High-velocity heated air stretches the molten material into extremely fine fibres, often measuring only a few microns in diameter. These fibres cool almost instantly while remaining suspended in the air stream.

Step 3 – Layer Formation

The fibres are collected around a rotating central mandrel. As more fibres are deposited, they naturally bond together without adhesives. By carefully controlling:

- Air pressure
- Polymer flow rate
- Fibre diameter
- Collection speed

manufacturers create highly consistent filtration structures.

Step 4 – Graded Density Construction

One of the biggest advantages of melt blown technology is the ability to produce a graded density structure. The outer layers contain larger pores, while the inner layers contain progressively finer pores. This creates a filtration gradient that captures larger particles first while allowing finer particles to penetrate deeper into the cartridge. The result is:

- Greater dirt holding capacity
- Longer cartridge life
- Lower pressure increase
- Better contaminant distribution

Step 5 – Thermal Bonding

Because polypropylene fibres naturally fuse during manufacture, the completed cartridge requires no glues or resin binders. This provides several important benefits:

- Reduced extractables
- Improved chemical resistance
- Better pharmaceutical compatibility
- Lower risk of media migration

High-quality melt blown cartridges are therefore suitable for demanding food, beverage and pharmaceutical applications.

Graded Density Explained

Graded density is one of the defining features of premium depth filter cartridges. Instead of having the same pore size throughout the cartridge, the pore structure gradually becomes finer from the outside towards the centre. Imagine the cartridge as a series of filtration zones.

Outer Layer

REMOVES

- Rust
- Sand
- Scale
- Large suspended solids

Middle Layer

CAPTURES

- Fine sediment
- Corrosion products
- Organic particles
- Process debris

Inner Core

RETAINS

- Fine particulate
- Small suspended solids
- Residual contaminants

This progressive filtration prevents premature surface blockage and ensures the entire cartridge volume is utilised. Compared with single-density filters, graded density cartridges typically offer:

- Longer service life
- Lower replacement frequency
- Higher contaminant capacity
- Lower total filtration costs
- Improved flow stability

Dirt Holding Capacity

One of the biggest advantages of depth filtration is its exceptional dirt holding capacity. Unlike surface filters, which accumulate contaminants only on the outer layer, depth filters utilise their full internal structure. This allows contaminants to be distributed throughout the cartridge rather than concentrating in one location.

The benefits include:

- Longer operating life
- Reduced maintenance
- Fewer cartridge changes
- Improved process uptime
- Lower operating costs

The actual dirt holding capacity depends on several factors, including:

- Micron rating
- Cartridge diameter
- Cartridge length
- Filter media
- Particle size distribution
- Flow rate
- Differential pressure

As a general rule, a properly selected depth filter will continue removing contaminants long after a comparable surface filter has become blocked.

Polypropylene vs Glass Fibre Depth Filters

One of the most important decisions when specifying a depth filter cartridge is selecting the appropriate filter media. While several materials are available, polypropylene and glass fibre are by far the most common in industrial liquid filtration. Each material offers distinct advantages depending on the process fluid, operating conditions and filtration objectives.

Polypropylene Depth Filters

Polypropylene is the most widely used material for melt blown depth filter cartridges due to its excellent chemical resistance, low extractables and broad compatibility with a wide range of industrial liquids. Manufactured from 100% virgin polypropylene fibres, these cartridges provide consistent filtration performance without the use of adhesives or binders.

TYPICAL APPLICATIONS

- Process water
- Purified water
- Food and beverage production
- Pharmaceutical manufacturing
- Chemical processing
- Reverse osmosis pre-filtration
- General industrial filtration

ADVANTAGES

- Excellent chemical resistance
- Broad pH compatibility
- Low extractables
- Binder-free construction
- High dirt holding capacity
- Cost-effective replacement
- Suitable for food contact applications
- Resistant to bacterial growth

Polypropylene cartridges are particularly suited to aqueous solutions and are compatible with many acids, alkalis and salt solutions. Their excellent chemical stability makes them one of the most versatile filtration media available.

Glass Fibre Depth Filters

Glass fibre depth filters are manufactured from extremely fine borosilicate glass microfibres arranged in a graded density structure. Unlike polypropylene, glass fibre media offers exceptionally high particle retention and is particularly effective where fine particulate removal is required.

TYPICAL APPLICATIONS

- Fine chemical filtration
- High-purity water
- Pharmaceutical pre-filtration
- Electronics manufacturing
- Solvent filtration
- Coatings and inks

ADVANTAGES

- Excellent fine particle retention
- High filtration efficiency
- High temperature capability
- Excellent clarification performance
- Low pressure drop
- Suitable for demanding process conditions

Glass fibre cartridges are often selected as high-performance pre-filters upstream of membrane cartridges, helping to maximise membrane service life.

Polypropylene vs Glass Fibre Comparison

Both materials perform exceptionally well when correctly selected. Polypropylene is generally the preferred choice for most industrial applications due to its versatility and cost-effectiveness, while glass fibre is often chosen where finer clarification or higher temperature resistance is required.

Feature	Polypropylene	Glass Fibre
Chemical Resistance	Excellent	Good
Dirt Holding Capacity	Excellent	Very Good
Temperature Resistance	Good	Excellent
Extractables	Very Low	Low
Cost	Lower	Higher
Pharmaceutical Use	Excellent	Excellent (pre-filtration)
Water Treatment	Excellent	Excellent
Solvent Compatibility	Good	Excellent

Understanding Micron Ratings

The micron rating of a depth filter indicates the approximate size of particles it is designed to retain. Selecting the correct micron rating is essential to achieve the desired balance between filtration efficiency, flow rate and service life.

Typical depth filter micron ratings include:

Micron Rating	Typical Application
100 µm	Coarse sediment removal
75 µm	Large particulate
50 µm	Sand and rust
25 µm	General process filtration
10 µm	Equipment protection
5 µm	Fine clarification
1 µm	Membrane pre-filtration
0.5 µm	High-purity applications

Smaller micron ratings provide finer filtration but generally result in higher pressure drop and reduced dirt holding capacity.

Choosing the smallest available filter is not always the most efficient solution. Correct sizing should always reflect the process requirements.

Nominal vs Absolute Depth Filters

Depth filters are available in both nominal and absolute retention ratings. Understanding the difference is critical when specifying a filtration system.

Nominal Rated Filters

A nominal filter removes a percentage of particles at its stated micron rating.

For example: a nominal 5 µm cartridge may retain between 85% and 95% of particles measuring 5 microns, depending on its construction and test method.

Nominal filters are commonly used for:

- General process filtration
- Water treatment
- Equipment protection
- Bulk particulate removal

Absolute Rated Filters

Absolute-rated depth filters are manufactured to much tighter tolerances and provide a significantly higher level of particle retention. These filters are often used where consistent filtration performance is essential, particularly as pre-filters before membrane cartridges.

Typical applications include:

- Pharmaceutical production
- Electronics manufacturing
- High-purity chemicals
- Fine beverage filtration

Pressure Drop and Flow Characteristics

Every filter creates resistance to fluid flow. This resistance is measured as **differential pressure (ΔP)**. When a new cartridge is installed, pressure loss is typically very low. As contaminants accumulate within the filter structure, resistance gradually increases.

Several factors influence pressure drop:

- Cartridge length
- Cartridge diameter
- Micron rating
- Flow rate
- Fluid viscosity
- Contamination loading
- Temperature

A properly sized filter should operate well within its recommended differential pressure limits. Monitoring pressure drop is one of the simplest and most effective methods of determining when a cartridge requires replacement.

Pharmaceutical Applications

Depth filters play a vital role throughout pharmaceutical manufacturing. Although membrane filters perform the final sterile filtration stage, depth filters protect these expensive membranes by removing larger particulate contamination beforehand.

Typical pharmaceutical applications include:

- Water for Injection (WFI) pre-filtration
- Purified Water (PW)
- API production
- Buffer preparation
- Bulk drug manufacture
- Fermentation
- Cell culture
- Vaccine production
- Final polishing before membrane filtration

Using a staged filtration system significantly reduces membrane fouling and improves overall process efficiency.

Food & Beverage Applications

Depth filtration is extensively used throughout the food and beverage industry to improve product quality while protecting downstream equipment. Applications include:

Brewing

- Yeast reduction
- Haze removal
- Process water

Wine Production

- Clarification
- Sediment removal
- Pre-filtration before sterile membranes

Bottled Water

- Sediment removal
- Final polishing pre-filtration
- Reverse osmosis protection

Dairy

- Ingredient preparation
- Process water
- Cleaning solution filtration

Soft Drinks

- Syrup preparation
- Ingredient filtration
- Water treatment

Because polypropylene cartridges are free from binders and offer low extractables, they are widely used in food-grade applications.

Chemical Processing

Chemical manufacturing often presents demanding operating conditions involving aggressive fluids and fine particulate contamination. Depth filters are commonly used for:

- Process chemicals
- Solvents
- Resins
- Acids
- Alkalies
- Paint manufacture
- Coatings
- Industrial cleaners

Correct material compatibility should always be confirmed before installation.

Water Treatment Applications

Water treatment remains one of the largest applications for polypropylene depth filter cartridges. Typical installations include:

- Reverse osmosis pre-filtration
- Municipal water treatment
- Borehole water
- Cooling water
- Boiler feedwater
- Process water
- Wastewater treatment
- Drinking water production

Depth filters remove suspended solids before they reach expensive downstream equipment. Protecting reverse osmosis membranes alone can result in significant savings through reduced maintenance and longer membrane life.

How to Select the Right Depth Filter

Choosing the correct depth filter involves more than simply selecting a micron rating. To achieve reliable performance, long service life and cost-effective operation, several process variables should be considered before specifying a filter cartridge.

Selecting the wrong filter can lead to premature blockage, increased maintenance, unnecessary operating costs and reduced product quality. The following steps provide a practical framework for selecting the most suitable depth filter for your application.

1

Understand Your Process Fluid

The first consideration is the liquid being filtered. Key questions include:

- Is the fluid water-based or solvent-based?
- Does it contain suspended solids?
- Is it food grade or pharmaceutical?
- Does it contain oils or fats?
- What is the operating temperature?
- What is the fluid viscosity?
- Is the fluid chemically aggressive?

Understanding the characteristics of the process fluid helps determine the most appropriate filter media and cartridge construction.

2

Determine the Required Micron Rating

The micron rating should be selected according to the level of contaminant removal required. General guidance includes:

- Coarse sediment removal — 50–100 μm
- General industrial filtration — 20–50 μm
- Equipment protection — 10–25 μm
- Fine clarification — 5–10 μm
- Membrane pre-filtration — 0.5–5 μm

Using an unnecessarily fine filter may increase pressure drop and shorten cartridge life without providing any additional process benefit.

3

Calculate Flow Rate

Every cartridge has a recommended operating flow range. Oversizing the filter generally provides:

- Lower pressure drop
- Longer service life
- Greater dirt holding capacity
- Reduced replacement frequency

Where high flow rates are required, multiple cartridges or larger filter housings may be more economical than operating a single cartridge beyond its recommended limits.

4

Consider Dirt Loading

The amount of suspended solids within the process fluid has a significant impact on filter life. Applications with heavy particulate contamination often benefit from:

- Larger cartridge diameters
- Longer cartridges
- Multi-stage filtration
- Coarser pre-filtration

Reducing contaminant loading before fine filtration significantly lowers operating costs.

5

Check Chemical Compatibility

Although polypropylene depth filters offer excellent resistance to many chemicals, compatibility should always be verified. Consider exposure to:

- Acids
- Alkalis
- Solvents
- Oxidising agents
- Cleaning chemicals
- Sanitising solutions

Where compatibility is uncertain, chemical resistance data should always be reviewed before installation.

6

Select the Correct Cartridge Size

Common industrial cartridge lengths include:

- 5"
- 10"
- 20"
- 30"
- 40"

Longer cartridges provide greater filtration area and contaminant capacity, making them suitable for higher flow rates and extended service intervals.

Common Causes of Depth Filter Failure

Depth filters are designed to provide long, reliable service. However, incorrect specification or operating conditions can reduce their effectiveness. Understanding the most common causes of failure helps maximise cartridge performance and minimise downtime.

Premature Blockage

The most common reason for cartridge replacement is excessive particulate loading. Possible causes include:

- Undersized cartridge
- Incorrect micron rating
- Excessive contamination
- No coarse pre-filtration

Solution: Increase filter surface area, install a staged filtration system or use a coarser upstream filter to remove larger particles before fine filtration.

Incorrect Micron Rating

Using an excessively fine filter often results in:

- Reduced flow rates
- Higher pressure drop
- Frequent cartridge replacement
- Increased operating costs

Solution: The filter should always be selected according to the actual process requirements rather than assuming finer is always better.

Chemical Attack

Although polypropylene is resistant to many chemicals, exposure to incompatible fluids can damage the filter media. Potential effects include:

- Swelling
- Softening
- Fibre degradation
- Reduced filtration performance

Solution: Always verify compatibility before use.

Excessive Temperature

Every filter cartridge has a maximum operating temperature. Exceeding this limit may result in:

- Distortion
- Reduced mechanical strength
- Cartridge deformation
- Seal failure

Solution: Temperature limits should always be checked against the manufacturer's specifications.

Excessive Differential Pressure

Operating beyond the recommended pressure differential can compress the filter structure and reduce filtration efficiency.

Solution: Monitoring differential pressure helps determine the optimum replacement interval.

Inadequate Cleaning

Where reusable filter systems are employed, poor cleaning procedures can cause:

- Permanent fouling
- Reduced permeability
- Microbial growth
- Shortened service life

Solution: Cleaning procedures should follow validated process instructions.

Maintenance and Replacement

Routine monitoring is the key to achieving maximum cartridge life. Operators should regularly inspect:

- Differential pressure
- Flow rate
- Product quality
- Visual appearance
- Operating temperature

Most depth filters are replaced when:

1. Pressure drop reaches the recommended limit.
2. Flow becomes insufficient for the process.
3. Product quality begins to decline.
4. Scheduled maintenance intervals are reached.

Implementing a preventative maintenance programme reduces unplanned downtime and improves process consistency.

Maximising Service Life

Several simple practices can significantly extend the operational life of depth filter cartridges.

Install Staged Filtration

Using a coarse filter upstream removes larger particles before they reach the finer depth filter.

Avoid Excessive Flow Rates

Operating within the recommended flow range reduces stress on the filter media and promotes even contaminant loading.

Monitor Differential Pressure

Replacing filters at the correct pressure differential avoids unnecessary cartridge changes while preventing excessive restriction.

Select the Correct Micron Rating

A correctly sized cartridge provides the best balance between filtration efficiency and service life.

Maintain Clean Filter Housings

Routine cleaning of filter housings helps prevent contamination and ensures reliable sealing.

Frequently Asked Questions

What is a depth filter?

A depth filter is a filter cartridge that captures contaminants throughout the entire thickness of its media rather than only on the surface, providing high dirt holding capacity and long service life.

What is the difference between a depth filter and a membrane filter?

Depth filters retain particles within a porous matrix and are ideal for pre-filtration and clarification. Membrane filters capture particles on the surface using controlled pore sizes and are commonly used for final or sterile filtration.

What is a melt blown filter?

A melt blown filter is a polypropylene depth filter manufactured by extruding molten polymer into ultra-fine fibres that form a graded density filtration structure without adhesives or binders.

Why are graded density filters better?

Graded density filters capture larger particles in the outer layers and progressively finer particles towards the centre of the cartridge, improving dirt holding capacity and extending filter life.

What micron rating should I choose?

The correct micron rating depends on the contaminants present and the level of filtration required. Coarser filters are used for sediment removal, while finer filters are typically selected for clarification or membrane pre-filtration.

How long do depth filters last?

Service life varies depending on contamination levels, flow rate and operating conditions. Regular monitoring of differential pressure provides the best indication of when replacement is required.

Can depth filters be cleaned and reused?

Most polypropylene melt blown depth filters are designed for single-use operation. Attempting to clean them may reduce filtration performance and compromise the integrity of the filter media.

What industries use depth filters?

Depth filters are widely used in pharmaceutical manufacturing, food and beverage production, water treatment, chemical processing, electronics manufacturing, cosmetics and general industrial applications.

Are depth filters food safe?

Many polypropylene depth filters are manufactured using materials suitable for food contact applications and are commonly used in beverage production, food processing and drinking water systems. Always confirm compliance with the relevant regulations for your application.

Why does the pressure drop increase over time?

As contaminants accumulate within the filter media, resistance to flow increases. A gradual rise in differential pressure is a normal indication that the filter is approaching the end of its service life.

Conclusion

Depth filter cartridges remain one of the most versatile and cost-effective filtration solutions available for industrial liquid processing. Their unique ability to capture contaminants throughout the full thickness of the filter media provides exceptional dirt holding capacity, extended service life and reliable protection for downstream equipment.

Whether used as a standalone clarification filter or as a pre-filtration stage ahead of membrane cartridges, depth filters play a critical role in maintaining product quality, protecting process equipment and improving operational efficiency across industries including pharmaceuticals, food and beverage, chemicals and water treatment.

By understanding key factors such as filter construction, graded density, micron ratings, pressure drop and chemical compatibility, engineers and procurement professionals can select the most appropriate depth filter for their process, reducing operating costs while achieving consistent filtration performance.

For businesses seeking dependable filtration solutions, PoreFiltration offers a comprehensive range of depth filter cartridges in multiple micron ratings, cartridge lengths and materials, suitable for a wide variety of industrial and high-purity applications.

Cleaner Liquids. Better Performance.

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