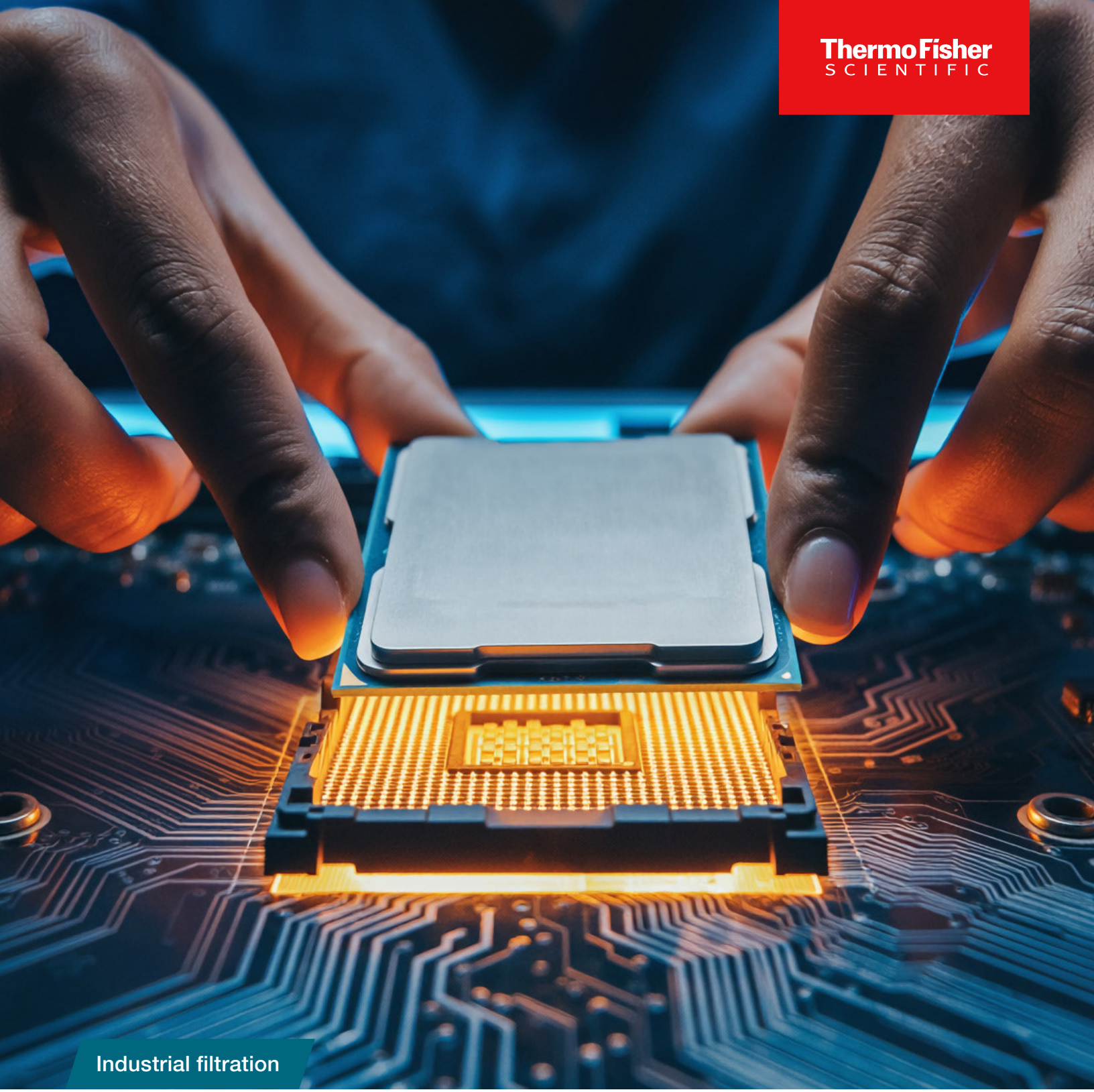


Industrial filtration

Let’s move microelectronics manufacturing forward

Filtration and dissolved gas control for microelectronics

thermo scientific

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Precision and purification you can count on

When you manufacture microelectronics, you know that precision is critical in Ultrapure Water (UPW) and that the smallest defect can lead to big challenges. Whether it's reducing contaminants in electronics manufacturing, helping to ensure uniform particle distribution or optimizing your process with reliable and scalable filtration, we have solutions to help you meet strict requirements at every step of your process — and keep you moving in the right direction.

Filtration and separation solutions from Thermo Fisher Scientific are:

Comprehensive

The Thermo Fisher filtration and separation product portfolio is made up of high-quality solutions that can be tailored to support your manufacturing processes — from source water to process fluids to wastewater.

Dependable

High-quality and long filter life help ensure process and product consistency at every step of your manufacturing process.

Efficient

Easy to change out filters help you save time and avoid manufacturing disruptions while maintaining or improving quality — making them a smart, cost-effective solution. Thermo Fisher technical expertise can help support your unique filtration needs.

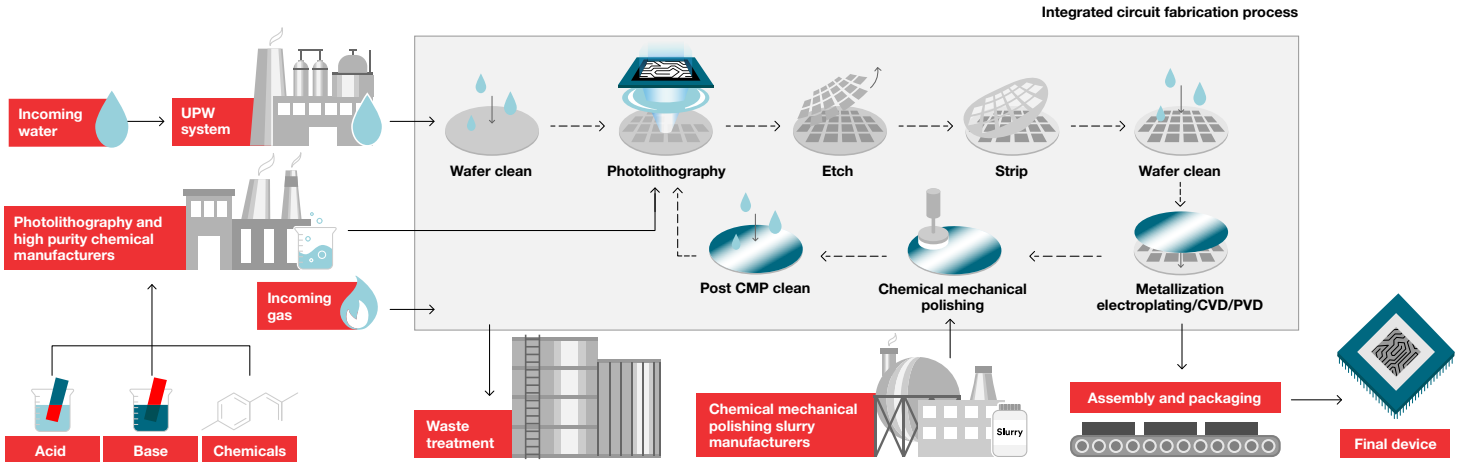
Responsible

Filtration and separation products from Thermo Fisher provide high-quality, cost-effective solutions for particle filtration, gas control and sustainable water management from start to finish.



Reducing contaminants is crucial in your semiconductor manufacturing operation. Any particles, metals or dissolved gases not removed during production can lead to defects, or even product recalls, later. That's why you need the proven performance of Thermo Fisher filtration and separation products for every step in your manufacturing process.

Semiconductor process map



Applications for semiconductors

Ultrapure water

Ultrapure water (UPW) is mainly used to remove defect-causing contaminants from the wafer surface and to rinse or clean wafers after they have been exposed to chemicals during various processes.

Thermo Fisher purification filtration and gas transfer membrane products help provide the required particle reduction and dissolved gas (O_2 and CO_2) control to meet the strict requirements of the semiconductor and electronics industry.

Filtration and dissolved gas control solutions:

Thermo Scientific™ High Flow Filter Cartridge

- High flow and high contaminant loading capacity with 99%+ Particle Removal Efficiency (PRE) for long filtration life

Thermo Scientific™ LifeASSURE™ EPF Filter Cartridge

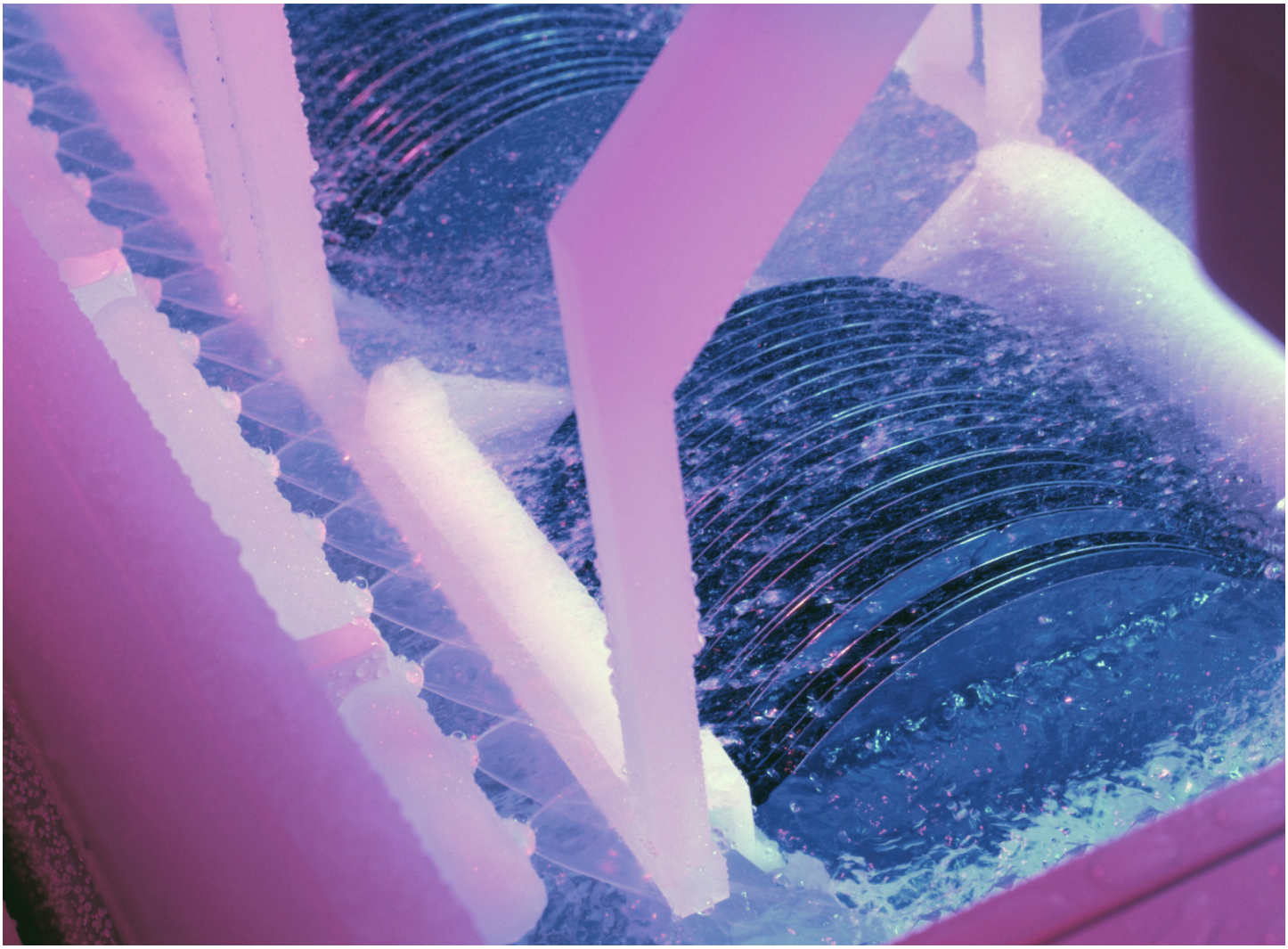
- Compatible with a wide range of chemicals and the high flow rate helps increase the rate of recirculation

Thermo Scientific™ LifeASSURE™ EMZ Filter Cartridge

- Charge modified nylon membrane helps provide mechanical and electrokinetic contaminant reduction

Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance



Chemical mechanical polishing

Chemical mechanical polishing (CMP) is a process to level uneven areas by combining a chemical (acidic or basic) slurry of microabrasives with mechanical force provided by polishing. In multilevel metallization processes, as each new metal layer gets added it magnifies the imperfections in the layer just below it.

Thermo Fisher has filtration solutions to control particle size in the slurries used in the CMP process to allow chipmakers to continue shrinking circuity needed in next generation devices.

A post-CMP cleaning process typically involves a buff-cleaning step to eliminate residual slurry from wafer surfaces. For this step, cleaning solutions with minimal chemical content or ultrapure water (UPW) are preferred to reduce chemical exposure. To enhance particle removal efficiency while maintaining low chemical usage, gas-functionalized UPW offers a promising approach enabling effective cleaning with reduced or no chemical additives in the rinse stream.

Filtration solutions:

Thermo Scientific™ Betapure™ AUL Filter Capsule

- Bi-component fiber technology enables Large Particle Count (LPC) reduction

Thermo Scientific™ Betapure™ NTT Filter Cartridge

- Superior particle retention with ratings from 0.5 to 70 micron to suit a range of applications

Thermo Scientific™ Betapure™ SKYL Filter Cartridge

- Polypropylene, non-woven depth filter providing a high filtration efficiency as well as high flow rates, suitable for pre-filtration of CMP slurries and upstream raw materials

Thermo Scientific™ Betapure™ PPK Filter Cartridge

- Polypropylene, non-woven depth filter cartridges are composed of all polypropylene components and feature a multi-zone design for the optimum level of particle classification

Thermo Scientific™ LifeASSURE™ EPF Filter Cartridge

- Hydrophilic PES membrane in a robust polypropylene construction ensures superior chemical and thermal compatibility — designed for advanced slurry applications demanding high particle retention and high flow rates

Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance and is used in post-CMP processes for introducing select gases to UPW, creating functional water and enhancing particle removal

Lithography/high purity chem

Photolithography is a process used to pattern circuitry on a wafer. Removing unwanted organic contaminants, particles and ionic metal species from high purity chemicals supports the advancement of miniaturization of devices.

Filtration and purification products from Thermo Fisher allow you to reduce contaminants to help meet the needs of high performance semiconductor manufacturing.

Filtration solutions:

Thermo Scientific™ NanoSHIELD™ Hollow Fiber Filter Cartridge and Capsule

- Provides low operating and differential pressure across the filter to help remove gels and particles down to 5 nm with polypropylene, polyethylene and nylon hollow fiber membranes

Thermo Scientific™ Metal Ion Purifier

- Effective reduction of metal ions to <50ppt with higher capacity compared to membrane purifiers

Thermo Scientific™ LifeASSURE™ MFE/BFS Filter Cartridge

- PTFE microporous membrane filters designed for contaminant control in aggressive chemical environments

Thermo Scientific™ LifeASSURE™ PSN Filter Cartridge and Capsule

- Nylon filter cartridge and capsule designed for photoresist and ancillary chemical applications

Thermo Scientific™ Betafine™ PEG Filter Cartridge

- Multi-layer polypropylene non-woven graded-porosity filter cartridge featuring APT (Advanced Pleat Technology) construction provides high surface area and higher product throughputs for prolonged service life



Wet cleaning chemicals

During wet processing, semiconductor devices are repeatedly dipped, immersed or sprayed with solutions. Even when cleaning steps are performed, the primary reason for device failure is contamination of the wafer surface. As device features continue to shrink, ensuring the purity of acids, bases and solvents used in the manufacturing process will remain critical.

From most acids and bases to alcohols and etchants, Thermo Fisher has the filter for your chemical application.

Filtration solutions:

Thermo Scientific™ NanoSHIELD™ Hollow Fiber Filter Cartridge

- Helps provide low operating and differential pressure across the filter to reduce outgassing and micro-bubble formation

Thermo Scientific™ LifeASSURE™ EMC Filter Cartridge

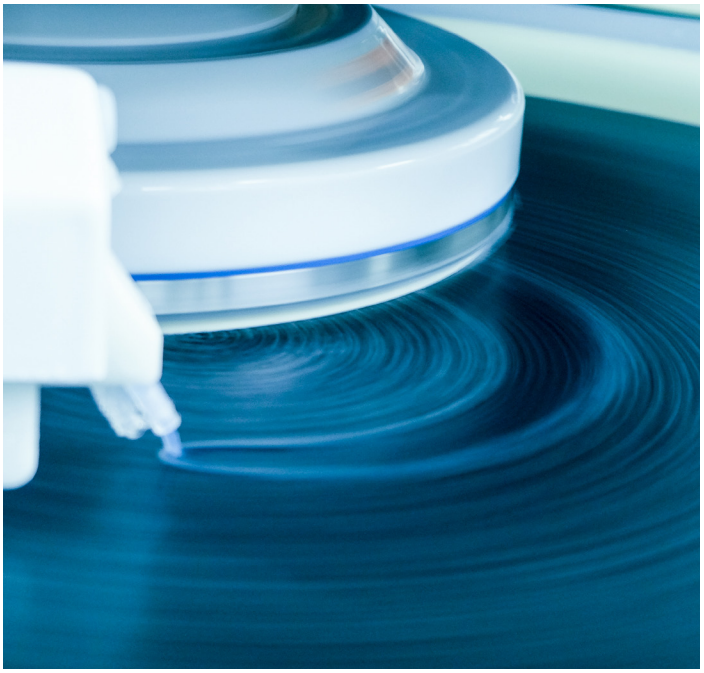
- Excellent downstream cleanliness and no IPA pre-wetting and system flushing required

Thermo Scientific™ Betafine™ PEG Filter Cartridge

- Advanced Pleat Technology construction provides high surface area and higher product throughputs for prolonged service life

Thermo Scientific™ LifeASSURE™ MFE Filter Cartridge

- Robust PTFE and polypropylene materials provide excellent resistance in aggressive chemicals





Thermo Scientific™ LifeASSURE™ EPF Filter Cartridge

Electrolyte plating

Electroplating solutions require both stringent particle and dissolved gas control to prevent defects and impurities in the deposited metal layer.

Thermo Fisher has both particle and dissolved gas solutions to meet the needs for your electroplating process.

Filtration and dissolved gas control solutions:

Thermo Scientific™ LifeASSURE™ EPF Filter Cartridge

- Compatible with a wide range of chemicals and the high flow rate helps increase the rate of recirculation

Thermo Scientific™ LifeASSURE™ EMC Filter Cartridge

- Downstream cleanliness and no IPA pre-wetting and system flushing required

Thermo Scientific™ Betafine™ PEG Filter Cartridge

- Advanced pleat technology construction provides high surface area and higher product throughputs for prolonged service life

Thermo Scientific™ Liqui-Cel™ SP Membrane Contactor

- In-line degassing that utilizes hollow fiber membrane that is impermeable to chemically compatible low surface tension liquids

Wastewater

Manufacturing semiconductors requires large amounts of chemicals, which invariably generates substantial volumes of wastewater. The many different fabrication processes create a variety of wastewater contaminants.

Thermo Fisher has filtration solutions designed to help you filter your wastewater to protect the environment and meet increasingly stringent discharge requirements.

Filtration and dissolved gas control solutions:

Thermo Scientific™ High Flow Filter Cartridge

- High flow and high contaminant loading capacity with 99%+ Particle Removal Efficiency (PRE) for long filtration life

Thermo Scientific™ Micro-Klean™ RT Filter Cartridge

- Enhanced contaminant holding capacity for fewer filter change-outs versus other traditional cartridge filters

Thermo Scientific™ Betafine™ XL Filter Cartridge

- Features 100% polypropylene construction that provides chemical and thermal compatibility in many demanding applications

Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance for ammonia removal and recovery



Dissolved gas control

Thermo-Scientific™ Liqui-Cel™ Membrane Contactors provide efficient dissolved gas control in a compact design. Capable of adding gases to or removing dissolved gases and bubbles from compatible liquid streams, these gas transfer devices utilize hollow fiber membrane technology that helps facilities around the world improve operating efficiency and performance while protecting product quality.

Dissolved gas control solutions:

Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance

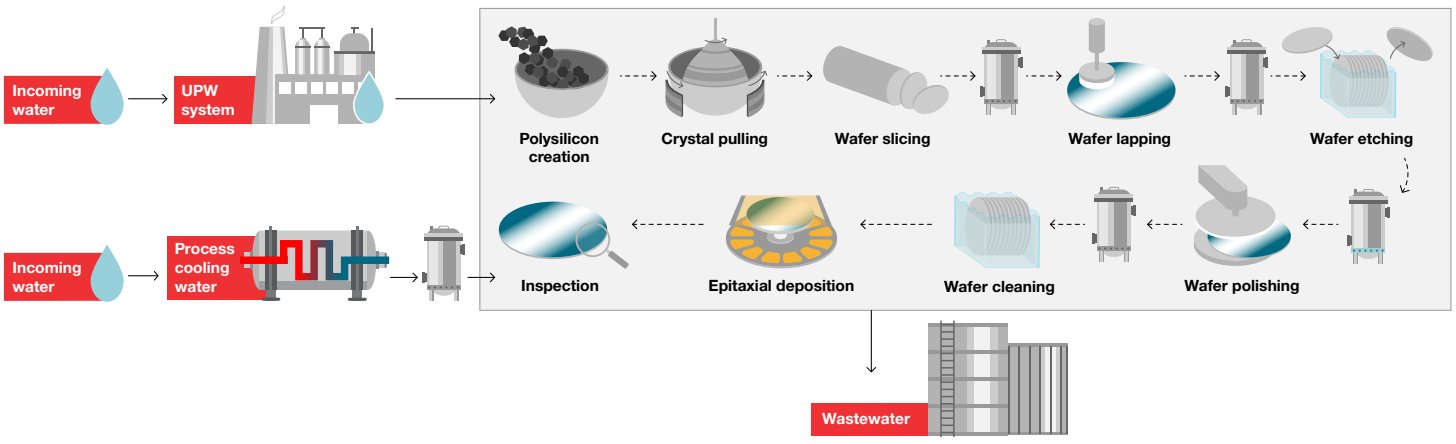
Thermo Scientific™ Liqui-Cel™ SP Membrane Contactor

- In-line degassing that utilizes hollow fiber membrane that is impermeable to chemically compatible low surface tension liquids



Silicon wafers are the substrate where electronic circuits are formed to create the integrated circuit which is one of the most essential components of most electronic devices. Increasing levels of filtration performance are needed to meet the strict requirements of today's electronics and semiconductor manufacturing processes.

Silicon wafer process map



Applications for silicon wafer manufacturing

Ultrapure water

Ultrapure water (UPW) is mainly used to remove defect-causing contaminants from the wafer surface and to rinse or clean wafers after they have been exposed to chemicals during various processes.

Thermo Fisher purification filtration and gas transfer membrane products help provide the required particle reduction and dissolved gas control to meet the strict requirements of the semiconductor and electronics industry.

Filtration and dissolved gas control solutions:

Thermo Scientific™ High Flow Filter Cartridge

- High flow and high contaminant loading capacity with 99%+ Particle Removal Efficiency (PRE) for long filtration life

Thermo Scientific™ LifeASSURE™ EPF Filter Cartridge

- Compatible with a wide range of chemicals and the high flow rate helps increase the rate of recirculation

Thermo Scientific™ LifeASSURE™ EMZ Filter Cartridge

- Charge modified nylon membrane helps provide mechanical and electrokinetic contaminant reduction

Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance



Lapping and polishing

Lapping and polishing are processes to level uneven areas by combining a chemical (acidic or basic) slurry of micro-abrasives with mechanical force provided by polishing. Critical slurry particle size control allows for the proper surface finish.

Thermo Fisher has the filtration solutions to control particle size in the slurries used in the polishing process to allow wafer manufacturers to supply the industry.

Filtration solutions:

Thermo Scientific™ Betapure™ NTT Filter Cartridge

- Superior particle retention with ratings from 0.5 to 70 micron to suit a range of applications

Thermo Scientific™ Betapure™ SKYL Filter Cartridge

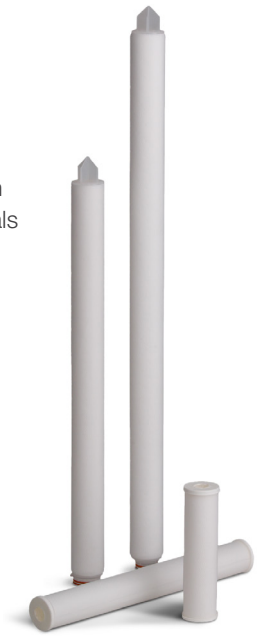
- Polypropylene, non-woven depth filter providing a high filtration efficiency as well as high flow rates, suitable for pre-filtration of CMP slurries and upstream raw materials

Thermo Scientific™ Betapure™ AU Filter Capsule

- Bi-component fiber technology enables Large Particle Count (LPC) reduction

Thermo Scientific™ Betapure™ PPK Filter Cartridge

- Polypropylene, non-woven depth filter cartridges are composed of all polypropylene components and feature a multi-zone design for the optimum level of particle classification



Wet cleaning chemicals

During wet processing, semiconductor devices are repeatedly dipped, immersed or sprayed with solutions. Even when cleaning steps are performed, the primary reason for device failure is contamination of the wafer surface. As device features continue to shrink, ensuring the purity of acids, bases and solvents used in the manufacturing process will remain critical.

From most acids and bases to alcohols and etchants, Thermo Fisher has the filter and gas control for your chemical application.

Filtration solutions:

Thermo Scientific™ NanoSHIELD™ Hollow Fiber Filter Cartridge

- Helps provide low operating and differential pressure across the filter to reduce outgassing and micro-bubble formation

Thermo Scientific™ LifeASSURE™ EMC Filter Cartridge

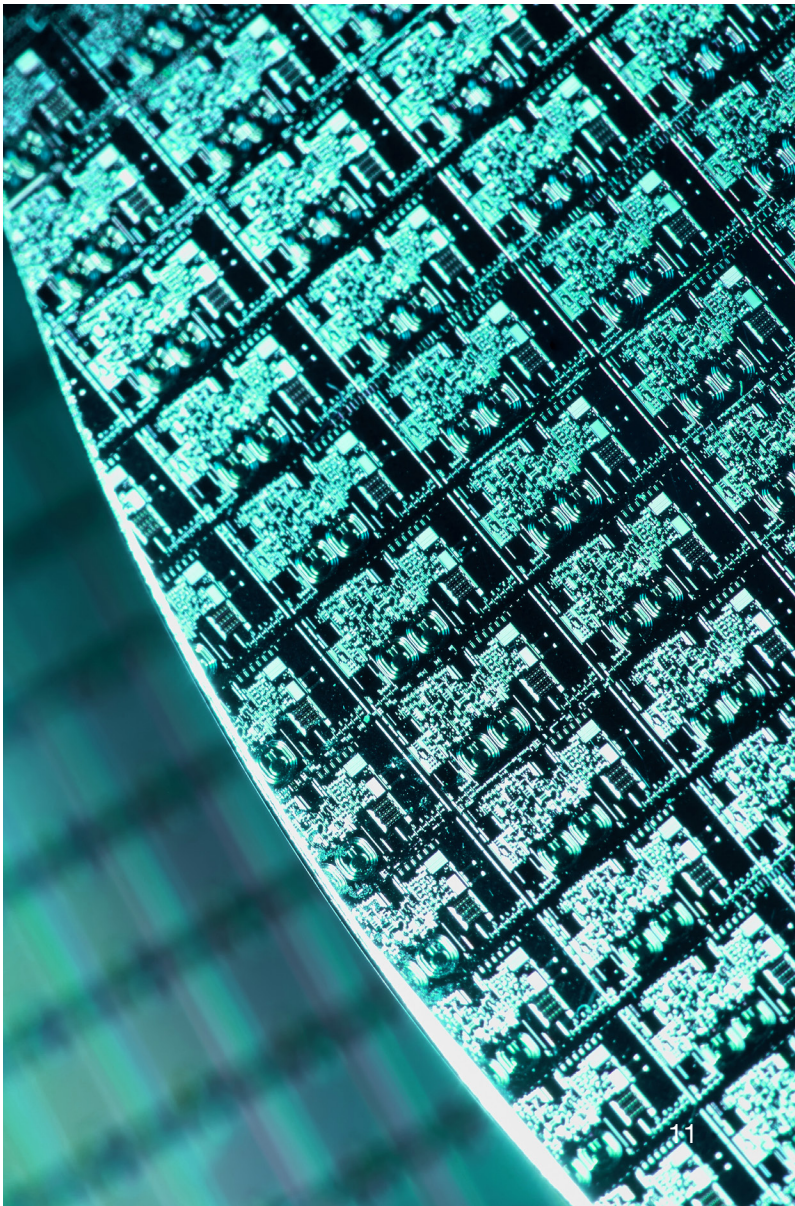
- Excellent downstream cleanliness and no IPA pre-wetting and system flushing required

Thermo Scientific™ Betafine™ PEG Filter Cartridge

- Advanced Pleat Technology construction provides high surface area and higher product throughputs for prolonged service life

Thermo Scientific™ LifeASSURE™ MFE Filter Cartridge

- Robust PTFE and polypropylene materials provide excellent resistance in aggressive chemicals



Electrochemical Deposition (ECD)

Electroplating solutions require both stringent particle and dissolved gas control to prevent defects and impurities in the deposited metal layer.

Thermo Fisher has both particle and dissolved gas solutions to meet the needs for your electroplating process.

Filtration and dissolved gas control solutions:

Thermo Scientific™ LifeASSURE™ EPF Filter Cartridge

- Compatible with a wide range of chemicals and the high flow rate helps increase the rate of recirculation

Thermo Scientific™ LifeASSURE™ EMC Filter Cartridge

- Downstream cleanliness and no IPA pre-wetting and system flushing required

Thermo Scientific™ Betafine™ PEG Filter Cartridge

- Advanced Pleat Technology construction provides high surface area and higher product throughputs for prolonged service life

Thermo Scientific™ Liqui-Cel™ SP Membrane Contactor

- In-line degassing that utilizes hollow fiber membrane that is impermeable to chemically compatible low surface tension liquids



Process cooling water

Process cooling water is circulated to water cooled equipment. Temperature cycling, entrained air, contaminants and poor water quality can lead to corrosion, scaling and other issues that may inhibit proper cooling and/or decrease service of water-cooled equipment. Proper water treatment allows water-cooled equipment to function optimally during use.

Thermo Fisher has the filtration and dissolved gas control solutions to control contaminant and entrained gas in your process cooling water loops to enable a more efficient and stable operation.

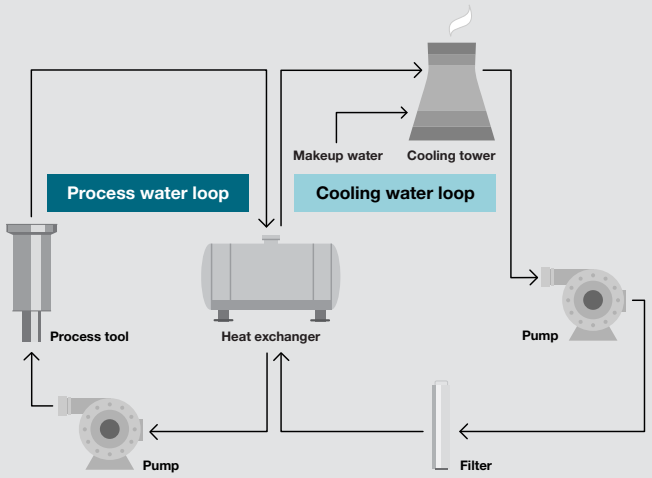
Filtration and dissolved gas control solutions:

Thermo Scientific™ High Flow Filter Cartridge

- High flow and high contaminant loading capacity with 99%+ Particle Removal Efficiency (PRE) for long filtration life

Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance



Wastewater

Manufacturing semiconductors requires large amounts of chemicals, which invariably generates substantial volumes of wastewater. The many different fabrication processes create a variety of wastewater contaminants.

Thermo Fisher has filtration solutions designed to help you filter your wastewater to protect the environment and meet increasingly stringent discharge requirements.

Filtration and dissolved gas control solutions:

Thermo Scientific™ High Flow Filter Cartridge

- High flow and high contaminant loading capacity with 99%+ Particle Removal Efficiency (PRE)

Thermo Scientific™ Micro-Klean™ RT Filter Cartridge

- Enhanced contaminant holding capacity for fewer filter change-outs versus other traditional cartridge filters

Thermo Scientific™ Betafine™ XL Filter Cartridge

- Features 100% polypropylene construction that provides chemical and thermal compatibility in many demanding applications

Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance for ammonia removal and recovery

Dissolved gas control

Thermo Scientific™ Liqui-Cel™ Membrane Contactors provide efficient dissolved gas control in a compact design. Capable of adding gases to or removing dissolved gases and bubbles from compatible liquid streams, these gas transfer devices utilize hollow fiber membrane technology that help facilities around the world improve operating efficiency and performance and protect product quality.

Dissolved gas control solutions

Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance

Thermo Scientific™ Liqui-Cel™ SP Membrane Contactor

- In-line degassing that utilizes hollow fiber membrane that is impermeable to chemically compatible low surface tension liquids





Display manufacturing leaves little room for error at every step of the process. Take your display manufacturing process to the next level with the help of reliable and scalable filtration solutions from Thermo Fisher.

Applications for display manufacturing

Ultrapure water

In display manufacturing, any particles in your process water can reduce the quality of your finished product. Ultrapure water (UPW) is needed for rinsing and cleaning glass plates, as well as an ingredient in other processes.

Thermo Fisher has filtration solutions to help ensure the water you use is converted to UPW, so you can have confidence in your process.

Filtration and dissolved gas control solutions:

Thermo Scientific™ High Flow Filter Cartridge

- High flow and high contaminant loading capacity with 99%+ Particle Removal Efficiency (PRE) for long filtration life

Thermo Scientific™ LifeASSURE™ EPF Filter Cartridge

- Compatible with a wide range of chemicals and the high flow rate helps increase the rate of recirculation

Thermo Scientific™ LifeASSURE™ EMZ Filter Cartridge

- Charge modified nylon membrane helps provide mechanical and electrokinetic contaminant reduction

Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance

Edge bevel

Edge beveling is an important step in your display manufacturing process. Glass edges left untreated after a cut make the glass vulnerable to damage and also leaves sharp edges. Smoothing the edges with abrasives creates particles that need to be removed from the process.

Thermo Fisher has the filtration solutions you need to help remove harmful particles created during the edge beveling process.

Filtration solutions:

Thermo Scientific™ Betapure™ NTT Filter Cartridge

- Superior particle retention with ratings from 0.5 to 70 micron to suit a range of applications

Thermo Scientific™ Betapure™ SKYL Filter Cartridge

- Polypropylene, non-woven depth filter providing a high filtration efficiency as well as high flow rates

Thermo Scientific™ Betapure™ PPK Filter Cartridge

- Polypropylene, non-woven depth filter cartridges are composed of all polypropylene components and feature a multi-zone design for the optimum level of particle classification



Lithography/color resist chem

Filtering the chemicals used in your lithography process is crucial for removing contaminants which can cause defects in the finished product.

Meet the needs of high-performance display manufacturing with the help of filtration products from Thermo Fisher.

Filtration solutions:

Thermo Scientific™ NanoSHIELD™ Hollow Fiber Filter Cartridge

Helps provide low operating and differential pressure across the filter to reduce outgassing and micro-bubble formation

Thermo Scientific™ LifeASSURE™ EMC Filter Cartridge

Excellent downstream cleanliness and no IPA pre-wetting and system flushing required

Thermo Scientific™ Betafine™ PEG Filter Cartridge

Advanced Pleat Technology construction provides high surface area and higher product throughputs for prolonged service life

Thermo Scientific™ Metal Ion Purifier

Effective reduction of metal ions to <50ppt with higher capacity compared to membrane purifiers

Wet cleaning chemicals

The filtration you choose for your wet cleaning chemical applications matters. You need to help ensure you're cleaning the layers of your display without adding any new contaminants in the process.

Thermo Fisher has wet cleaning chemical application solutions to meet the level of filtration you need for your display manufacturing process.



Filtration solutions:

Thermo Scientific™ LifeASSURE™ IMC Filter Cartridge

- Enhanced contaminant reduction capacity with no IPA pre-wetting and system flushing required

Thermo Scientific™ LifeASSURE™ EMC Filter Cartridge

- Excellent downstream cleanliness and no IPA pre-wetting and system flushing required

Thermo Scientific™ Betafine™ PEG Filter Cartridge

- Advanced Pleat Technology construction provides high surface area and higher product throughputs for prolonged service life

Thermo Scientific™ LifeASSURE™ MFE Filter Cartridge

- Robust PTFE and polypropylene materials provide excellent resistance in aggressive chemicals

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Wastewater

Manufacturing flat panel displays requires large amounts of chemicals, which invariably generates substantial volumes of wastewater. The many different fabrication processes create a variety of wastewater contaminants.

Thermo Fisher has filtration solutions designed to help you filter your wastewater to protect the environment and meet increasingly stringent discharge requirements.

Filtration and dissolved gas control solutions:

Thermo Scientific™ High Flow Filter Cartridge

- High flow and high contaminant loading capacity with 99%+ Particle Removal Efficiency (PRE) for long filtration life

Thermo Scientific™ Micro-Klean™ RT Filter Cartridge

- Enhanced contaminant holding capacity for fewer filter change-outs versus other traditional cartridge filters

Thermo Scientific™ Betafine™ XL Filter Cartridge

- Features 100% polypropylene construction that provides chemical and thermal compatibility in many demanding applications

Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance for ammonia removal and recovery

Dissolved gas control

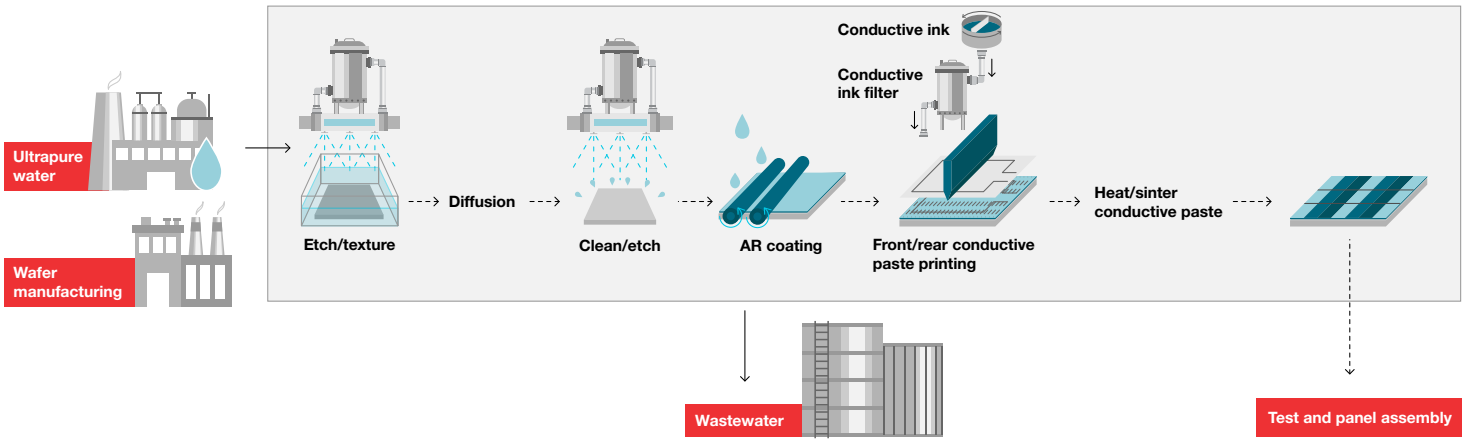
Thermo Scientific™ Liqui-Cel™ Membrane Contactors provide efficient dissolved gas control in a compact design. Capable of adding gases to or removing dissolved gases and bubbles from compatible liquid streams, these gas transfer devices utilize hollow fiber membrane technology that may help facilities around the world improve operating efficiency and performance and protect product quality.

Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance

As the demand for renewable energy like solar continues to grow, so will your need to produce high-quality PV cells to support that growth. Any particles in the water used in your conversion process can reduce the effectiveness and yield of your PV cells. Thermo Fisher filtration products can help ensure you're using high-quality water in your process to get high quality results.

Photovoltaics process map



Applications for photovoltaics

Ultrapure water

Ultrapure water (UPW) is needed to remove contaminants when cutting PV cells. Any particles in your process water can reduce the quality of your finished product.

Thermo Fisher has filtration and dissolved gas solutions to help ensure the water you use is converted to UPW, so you can have confidence in your process.

Filtration and dissolved gas control solutions:

Thermo Scientific™ High Flow Filter Cartridge

- High flow and high contaminant loading capacity with 99%+ Particle Removal Efficiency (PRE) for long filtration life

Thermo Scientific™ LifeASSURE™ EPF Filter Cartridge

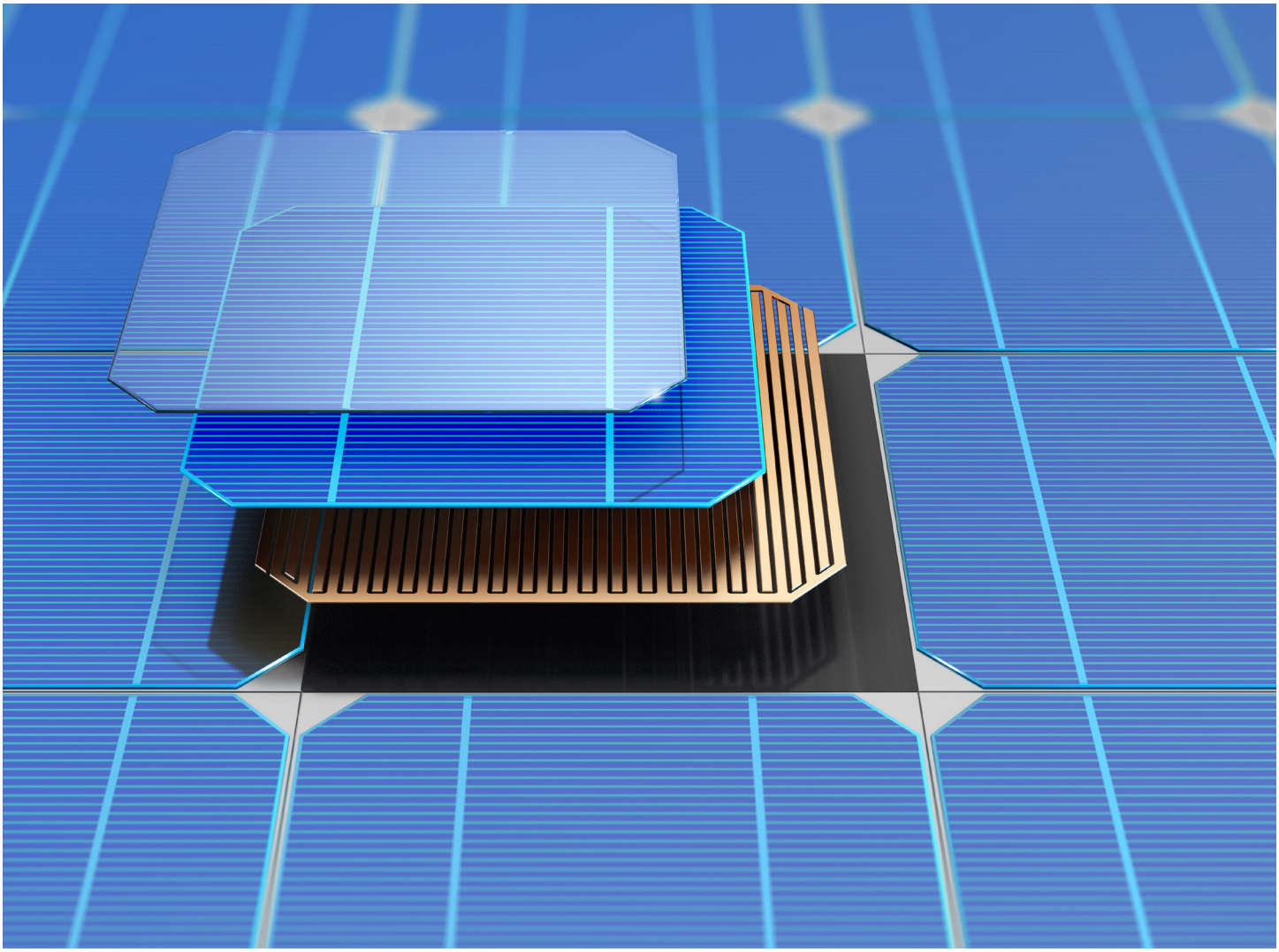
- Compatible with a wide range of chemicals and the high flow rate helps increase the rate of recirculation

Thermo Scientific™ LifeASSURE™ EMZ Filter Cartridge

- Charge modified nylon membrane helps provide mechanical and electrokinetic contaminant reduction

Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance



Edge bevel

After the cutting process all sharp edges need to be rounded and polished. That's why you need high-quality filtered water to continuously rinse away the generated particles to avoid scratches during the edge bevel process.

Thermo Fisher has solutions to help keep your PV cells free of contaminants that could hinder performance during the edge bevel process.

Filtration solutions:

Thermo Scientific™ Betapure™ NTT Filter Cartridge

- Superior particle retention with ratings from 0.5 to 70 micron to suit a range of applications

Thermo Scientific™ Betapure™ SKYL Filter Cartridge

- Polypropylene, non-woven depth filter providing a high filtration efficiency as well as high flow rates

Thermo Scientific™ Betapure™ PPK Filter Cartridge

- Polypropylene, non-woven depth filter cartridges are composed of all polypropylene components and feature a multi-zone design for the optimum level of particle classification



Process cooling water

Certain manufacturing processes require equipment to maintain optimized thermal profiles. Temperature cycling, entrained air, contaminants and poor water quality can lead to corrosion, scaling and other issues that may inhibit proper cooling and/or decrease service of water-cooled equipment. Proper water treatment allows water-cooled equipment to function optimally during use.

Thermo Fisher has the filtration and dissolved gas control solutions to help control contaminants and entrained gas in your process cooling water loops to enable a more efficient and stable operation.

Filtration and dissolved gas control solutions:

Thermo Scientific™ High Flow Filter Cartridge

- High flow and high contaminant loading capacity with 99%+ Particle Removal Efficiency (PRE)

Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance

Conductive ink

It's crucial that the conductive ink you use in your process isn't contaminated with oversize particles that can compromise the integrity of the printed circuit of your PV cells.

Thermo Fisher has conductive ink filtration solutions to help meet the needs of your process.

Filtration solutions:

Thermo Scientific™ Betafine™ XL Filter Cartridge

- Features 100% polypropylene construction that provides chemical and thermal compatibility in many demanding applications

Thermo Scientific™ Betapure™ AU Filter Capsule

- Bi-component fiber technology enables Large Particle Count (LPC) reduction

Thermo Scientific™ Betapure™ NTT Filter Cartridge

- Superior particle retention with ratings from 0.5 to 70 micron to suit a range of applications

Wastewater

Manufacturing PV cells generates large amounts of wastewater that needs to be treated before being recycled or discharged.

Thermo Fisher has filtration solutions designed to address your filtration wastewater needs to either re-use in your process or to meet increasingly stringent discharge requirements.

Filtration and dissolved gas control solutions:

Thermo Scientific™ High Flow Filter Cartridge

- High flow and high contaminant loading capacity with 99%+ Particle Removal Efficiency (PRE) for long filtration life

Thermo Scientific™ Micro-Klean™ RT Filter Cartridge

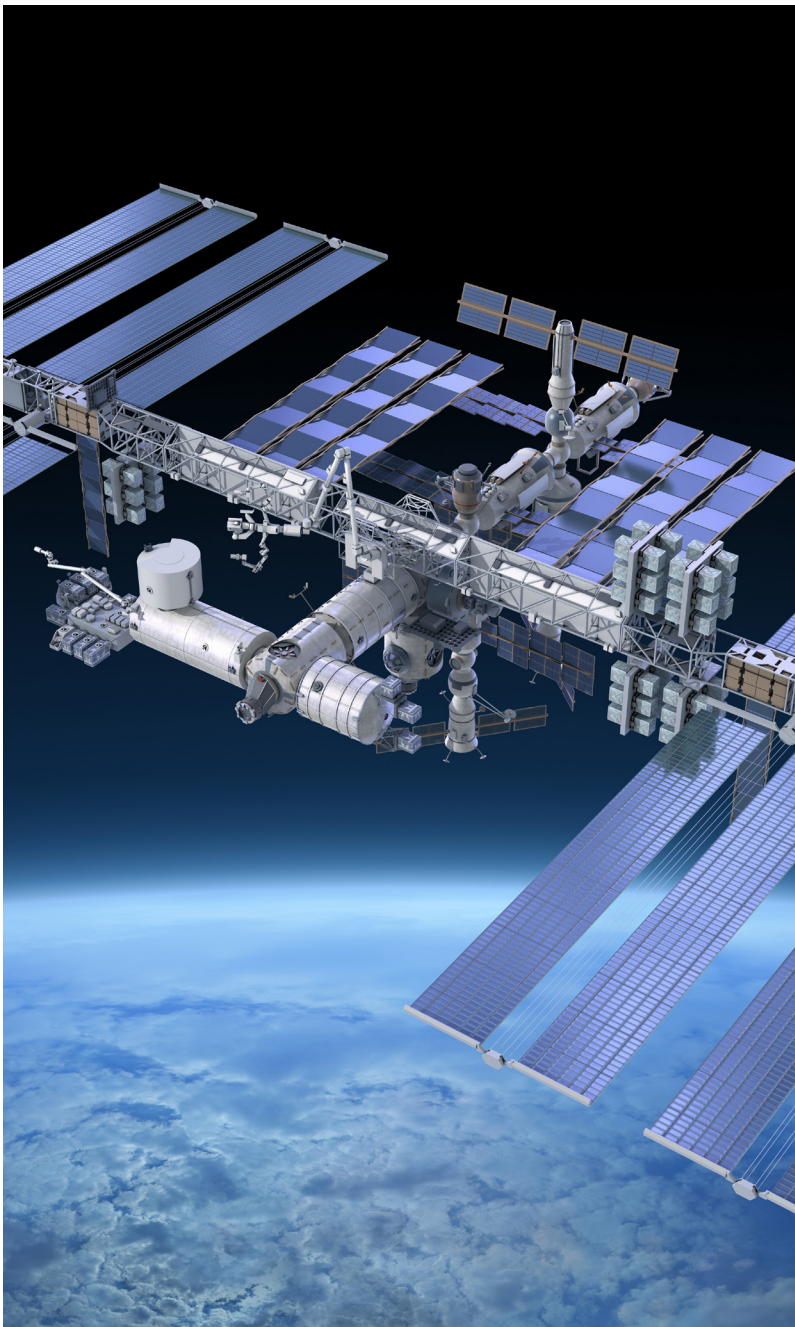
- Enhanced contaminant holding capacity for fewer filter change-outs versus other traditional cartridge filters

Thermo Scientific™ Betafine™ XL Filter Cartridge

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Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance for ammonia removal and recovery





Hard disk drives

For manufacturers of hard disk drives, eliminating damaging contaminants is an essential part of the quality process. Thermo Fisher filtration products help achieve high levels of process integrity for their critical applications for computer hard disk drives, server farms, data centers and cloud storage.

Applications for hard disk drives

Ultrapure water

Ultrapure water (UPW) is mainly used to remove defect-causing contaminants from the wafer surface and to rinse or clean wafers after they have been exposed to chemicals during various processes.

Thermo Fisher filtration and gas transfer membrane products provide the required particle reduction and dissolved gas reduction to help meet the strict requirements of the semiconductor and electronics industry.

Filtration and dissolved gas control solutions:

Thermo Scientific™ High Flow Filter Cartridge

- High flow and high contaminant loading capacity with 99%+ Particle Removal Efficiency (PRE)

Thermo Scientific™ LifeASSURE™ EPF Filter Cartridge

- Compatible with a wide range of chemicals and the high flow rate helps increase the rate of recirculation

Thermo Scientific™ LifeASSURE™ EMZ Filter Cartridge

- Charge modified nylon membrane helps provide mechanical and electrokinetic contaminant reduction

Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance

Chemical mechanical polishing

Chemical mechanical polishing (CMP) is a process to level uneven areas by combining a chemical slurry of micro-abrasives with mechanical force provided by polishing.

Thermo Fisher has the CMP filtration solutions to allow hard disk drive manufacturers to help reduce micro scratches and defects and provide more process stability and reliability.

A post-CMP cleaning process typically involves a buff-cleaning step to eliminate residual slurry from wafer surfaces. For this step, cleaning solutions with minimal chemical content or ultrapure water (UPW) are preferred to reduce chemical exposure. To enhance particle removal efficiency while maintaining low chemical usage, gas-functionalized UPW offers a promising approach enabling effective cleaning with reduced or no chemical additives in the rinse stream.

Filtration solutions:

Thermo Scientific™ Betapure™ AUL Filter Capsule

- Bi-component fiber technology enables Large Particle Count (LPC) reduction

Thermo Scientific™ Betapure™ NTT Filter Cartridge

- Superior particle retention with ratings from 0.5 to 70 micron to suit a range of applications

Thermo Scientific™ Betapure™ PPK Filter Cartridge

- Polypropylene, non-woven depth filter cartridges are composed of all polypropylene components and feature a multi-zone design for the optimum level of particle classification

Thermo Scientific™ LifeASSURE™ EPF Filter Cartridge

- Compatible with a wide range of chemicals and the high flow rate helps increase the rate of recirculation

Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance enabling inline gas-functionalized UPW production

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Plating chemicals

Your plating solutions require stringent particle control and dissolved gas control to prevent defects and impurities in the deposited metal surface.

Thermo Fisher has particle degassing devices control solutions to help remove particulate or contaminants and extend bath life to meet the needs for your electroplating process for process reliability and stability.

Filtration solutions:

Thermo Scientific™ LifeASSURE™ EPF Filter Cartridge

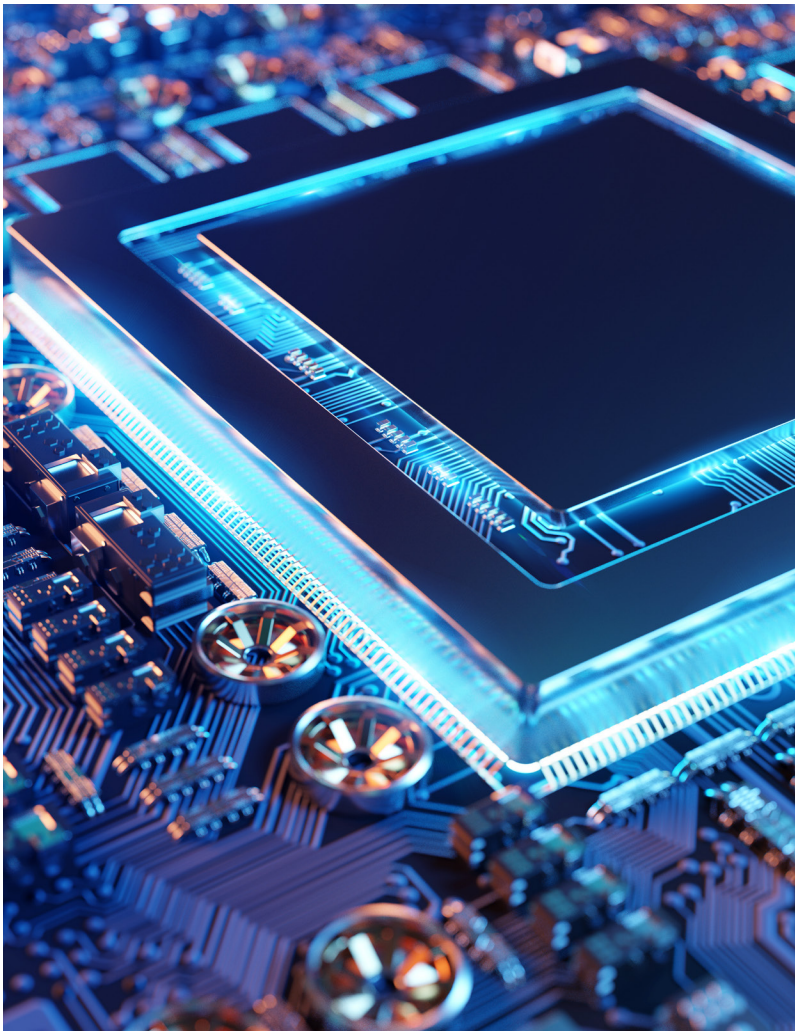
- Compatible with a wide range of chemicals and the high flow rate helps increase the rate of recirculation

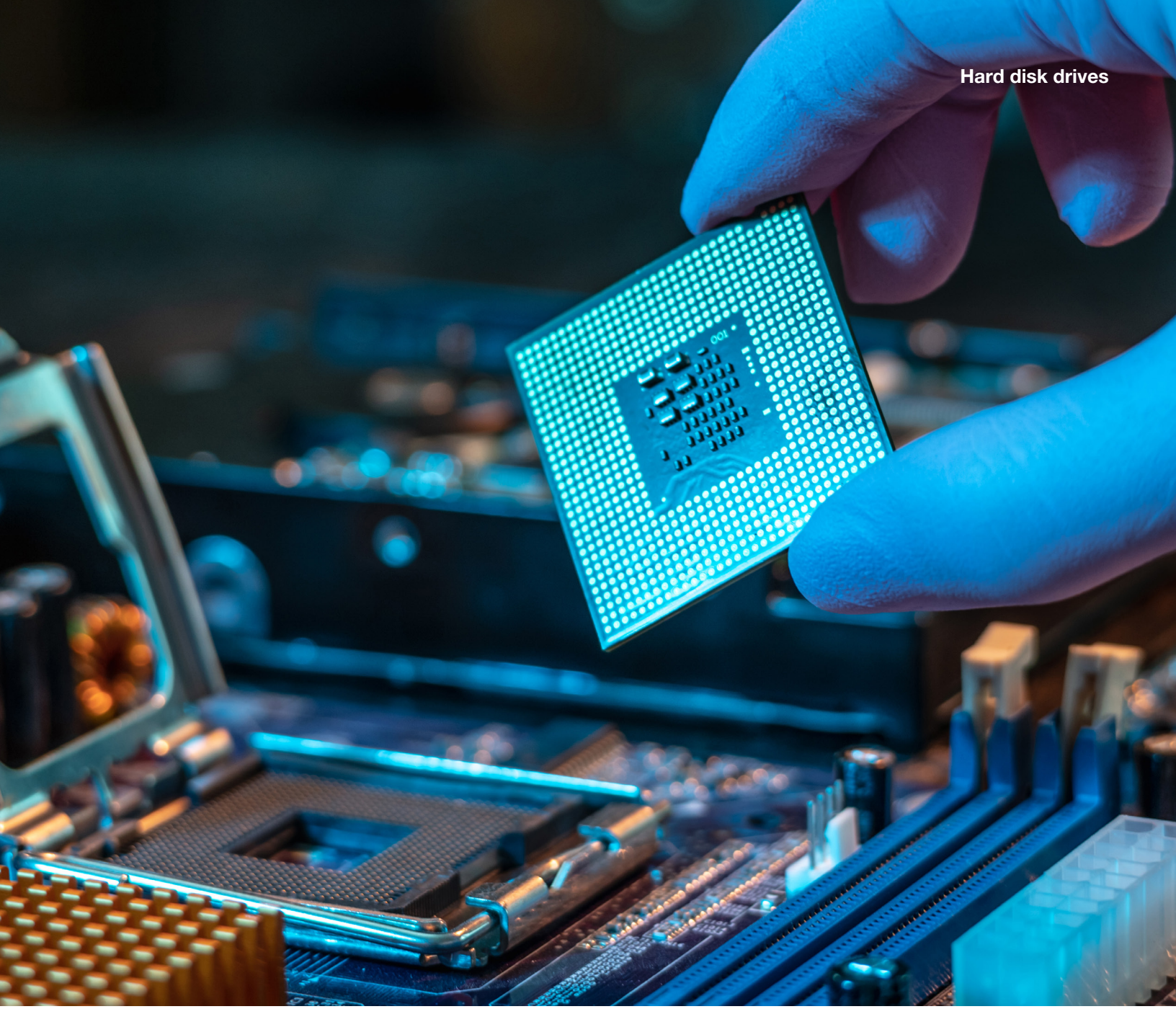
Thermo Scientific™ LifeASSURE™ EMC Filter Cartridge

- Excellent downstream cleanliness and no IPA pre-wetting and system flushing required

Thermo Scientific™ Betafine™ PEG Filter Cartridge

- Advanced Pleat Technology construction provides high surface area and higher product throughputs for prolonged service life





Wastewater

Manufacturing of hard disk drives requires large amounts of chemicals, which invariably generates large volumes of wastewater.

Thermo Fisher has particle control solutions to help remove or help reduce particulate/contaminants to extend bath life meeting your desired specifications.

Filtration and dissolved gas control solutions:

Thermo Scientific™ High Flow Filter Cartridge

- High flow and high contaminant loading capacity with 99%+ Particle Removal Efficiency (PRE) for long filtration life

Thermo Scientific™ Micro-Klean™ RT Filter Cartridge

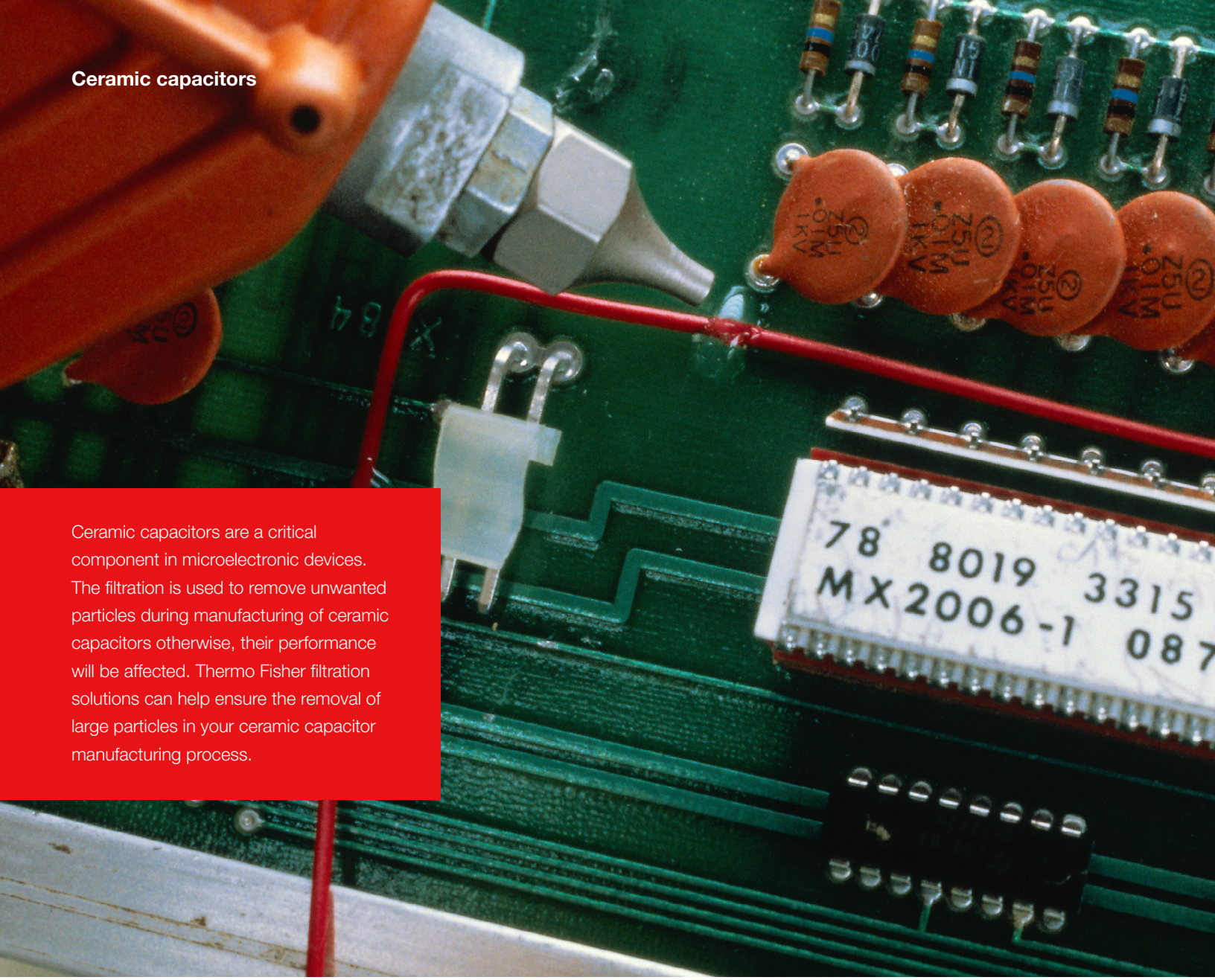
- Enhanced contaminant holding capacity for fewer filter change-outs versus other traditional cartridge filters

Thermo Scientific™ Betafine™ XL Filter Cartridge

- Features 100% polypropylene construction that provides chemical and thermal compatibility in many demanding applications

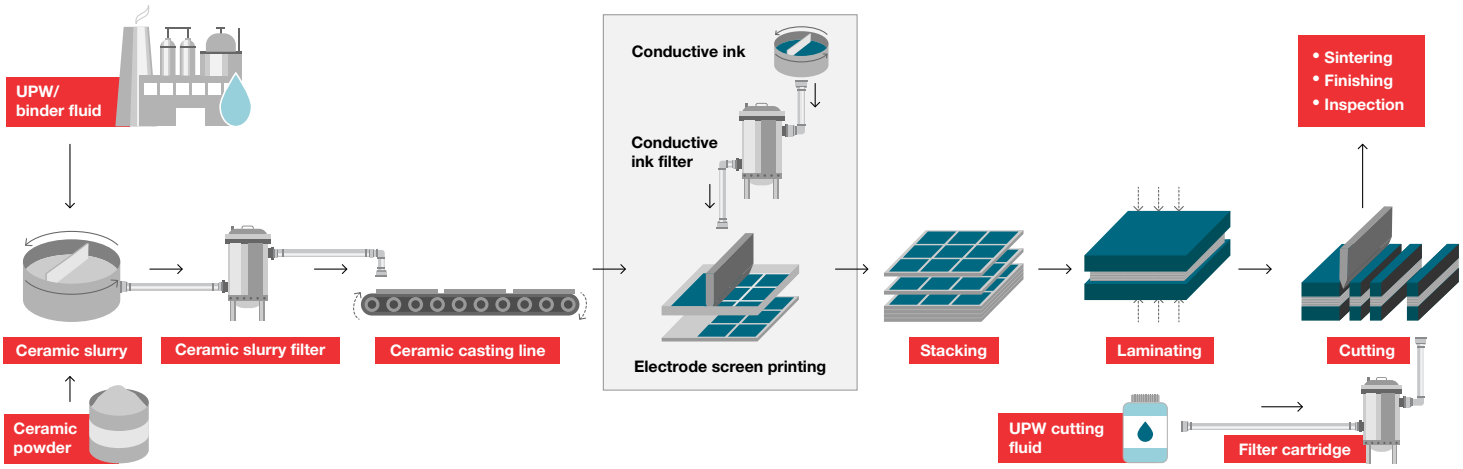
Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance for ammonia removal and recovery



Ceramic capacitors are a critical component in microelectronic devices. The filtration is used to remove unwanted particles during manufacturing of ceramic capacitors otherwise, their performance will be affected. Thermo Fisher filtration solutions can help ensure the removal of large particles in your ceramic capacitor manufacturing process.

Ceramic capacitors process map



Applications for ceramic capacitors

Ultrapure water

Removing contaminants from your source water can help ensure quality finished products. Unwanted contaminants can lead to poor performance and reliability.

Thermo Fisher's filtration solutions for ceramic capacitor applications are designed to help ensure long-lasting high-performance components.

Filtration and dissolved gas control solutions:

Thermo Scientific™ High Flow Filter Cartridge

- High flow and high contaminant loading capacity with 99%+ Particle Removal Efficiency (PRE) for long filtration life

Thermo Scientific™ LifeASSURE™ EPF Filter Cartridge

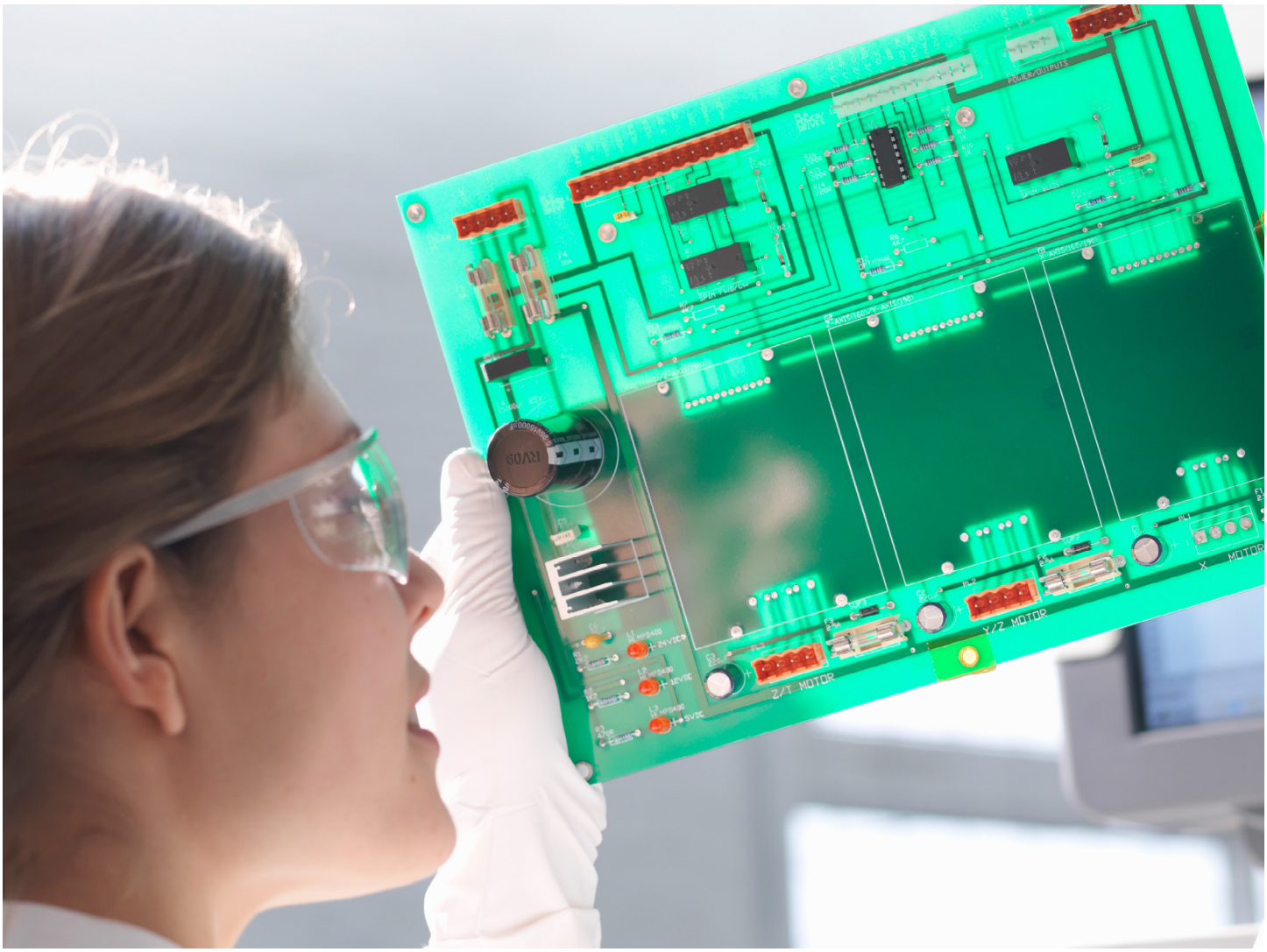
- Compatible with a wide range of chemicals and the high flow rate helps increase the rate of recirculation

Thermo Scientific™ LifeASSURE™ EMZ Filter Cartridge

- Charge modified nylon membrane helps provide mechanical and electrokinetic contaminant reduction

Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance



Conductive ink

Conductive ink applications require filtration to help ensure uniformity of the conductive metal particles used in the process, allowing the desired particle size through the filter while filtering out the larger ones.

Thermo Fisher has conductive ink filtration solutions to help improve the performance of your finished components.

Filtration solutions:

Thermo Scientific™ Betafine™ XL Filter Cartridge

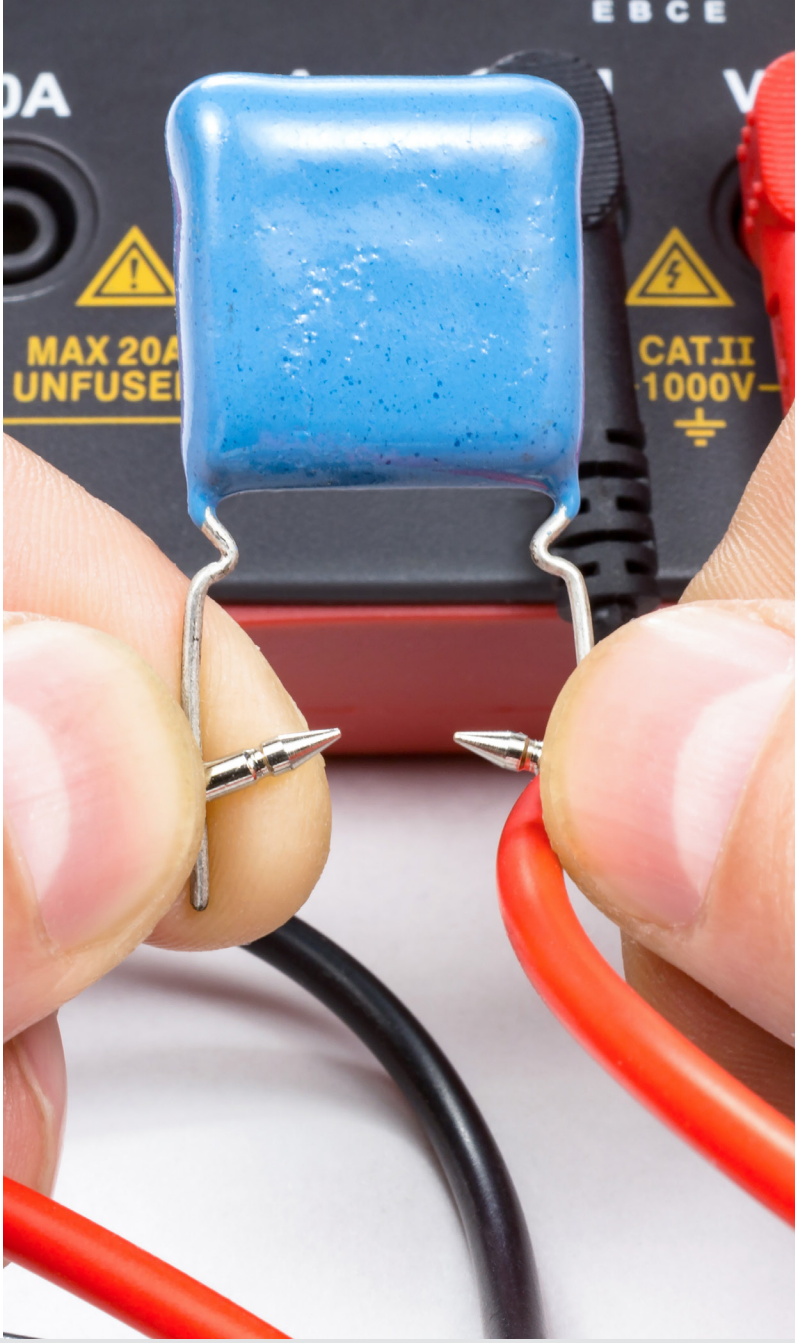
- Features 100% polypropylene construction that provides chemical and thermal compatibility in many demanding applications

Thermo Scientific™ Betapure™ AU Filter Capsule

- Bi-component fiber technology enables Large Particle Count (LPC) reduction

Thermo Scientific™ Betapure™ NTT Filter Cartridge

- Superior particle retention with ratings from 0.5 to 70 micron to suit a range of applications



Wastewater

Almost all manufacturing generates some amount of wastewater that needs to be filtered to remove or neutralize chemicals and metals before it leaves the facility.

Thermo Fisher has filtration solutions designed to help you filter your wastewater to protect the environment and meet increasingly stringent discharge requirements.

Filtration and dissolved gas control solutions:

Thermo Scientific™ High Flow Filter Cartridge

- High flow and high contaminant loading capacity with 99%+ Particle Removal Efficiency (PRE) for long filtration life

Thermo Scientific™ Micro-Klean™ RT Filter Cartridge

- Enhanced contaminant holding capacity for fewer filter change-outs versus other traditional cartridge filters

Thermo Scientific™ Betafine™ XL Filter Cartridge

- Features 100% polypropylene construction that provides chemical and thermal compatibility in many demanding applications

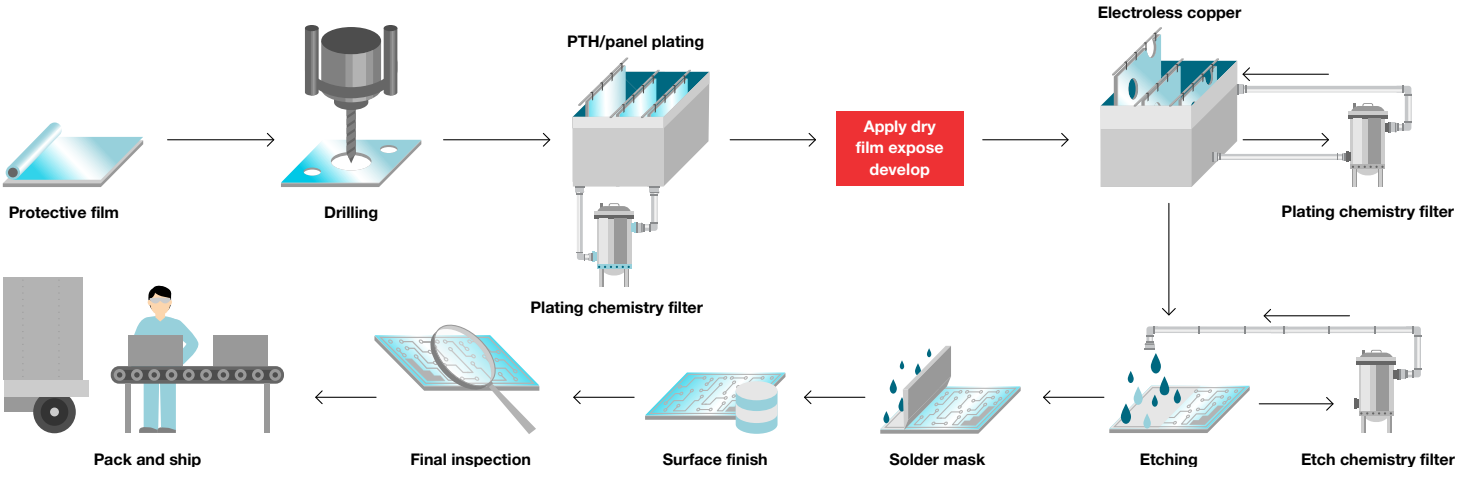
Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance for ammonia removal and recovery

Wire board manufacturing involves a lot of pieces, steps and processes that all have to come together with precision to create a reliable finished product. Any contaminant created in the manufacturing process that aren't filtered out can affect the short- and long-term performance of circuit boards.

From film generation to electroless copper plating and screen printing to applying solder masks, solutions from Thermo Fisher can help ensure your wire boards will meet your performance needs.

Printed wire boards process map



Applications for printed wire boards

Ultrapure water

Ultrapure water (UPW) is mainly used to remove defect causing contaminants from the surface and to rinse or clean wire boards after they have been exposed to chemicals during various processes.

Thermo Fisher filtration products provide the particle reduction needed to meet the strict requirements of the electronics industry.

Filtration and dissolved gas control solutions:

Thermo Scientific™ High Flow Filter Cartridge

- High flow and high contaminant loading capacity with 99%+ Particle Removal Efficiency (PRE) for long filtration life

Thermo Scientific™ LifeASSURE™ EPF Filter Cartridge

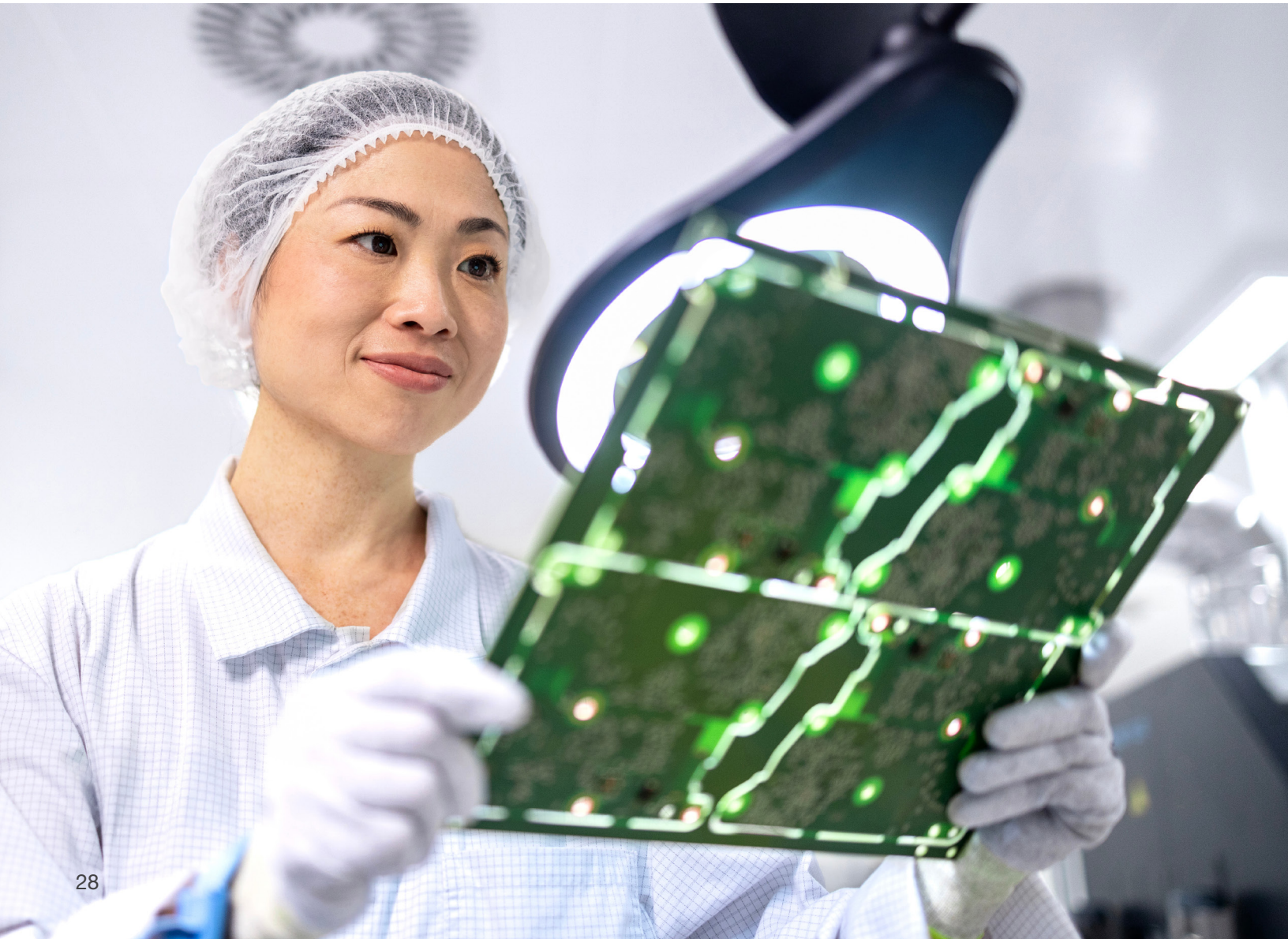
- Compatible with a wide range of chemicals and the high flow rate helps increase the rate of recirculation

Thermo Scientific™ LifeASSURE™ EMZ Filter Cartridge

- Charge modified nylon membrane helps provide mechanical and electrokinetic contaminant reduction

Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance



Plating chemicals

Your plating solutions require stringent particle control and dissolved gas control to prevent defects and impurities in the deposited metal surface.

Thermo Fisher has particle degassing devices control solutions to help remove particulate or contaminants and extend bath life to meet the needs for your electroplating process for process reliability and stability.

Filtration solutions:

Thermo Scientific™ LifeASSURE™ EPF Filter Cartridge

- Compatible with a wide range of chemicals and the high flow rate helps increase the rate of recirculation

Thermo Scientific™ LifeASSURE™ EMC Filter Cartridge

- Excellent downstream cleanliness and no IPA pre-wetting and system flushing required

Thermo Scientific™ Betafine™ PEG Filter Cartridge

- Advanced Pleat Technology construction provides high surface area and higher product throughputs for prolonged service life

Thermo Scientific™ Liqui-Cel™ SP Membrane Contactor

- In-line degassing that utilizes hollow fiber membrane that is impermeable to chemically compatible low surface tension liquids

Wastewater

Your wire board manufacturing process requires large amounts of chemicals, which invariably generates substantial volumes of wastewater. The different fabrication processes create a variety of wastewater contaminants that need to be reduced to meet required levels.

Thermo Fisher has filtration solutions designed to help you filter your wastewater to meet increasingly stringent discharge requirements.

Filtration and dissolved gas control solutions:

Thermo Scientific™ High Flow Filter Cartridge

- High flow and high contaminant loading capacity with 99%+ Particle Removal Efficiency (PRE)

Thermo Scientific™ Micro-Klean™ RT Filter Cartridge

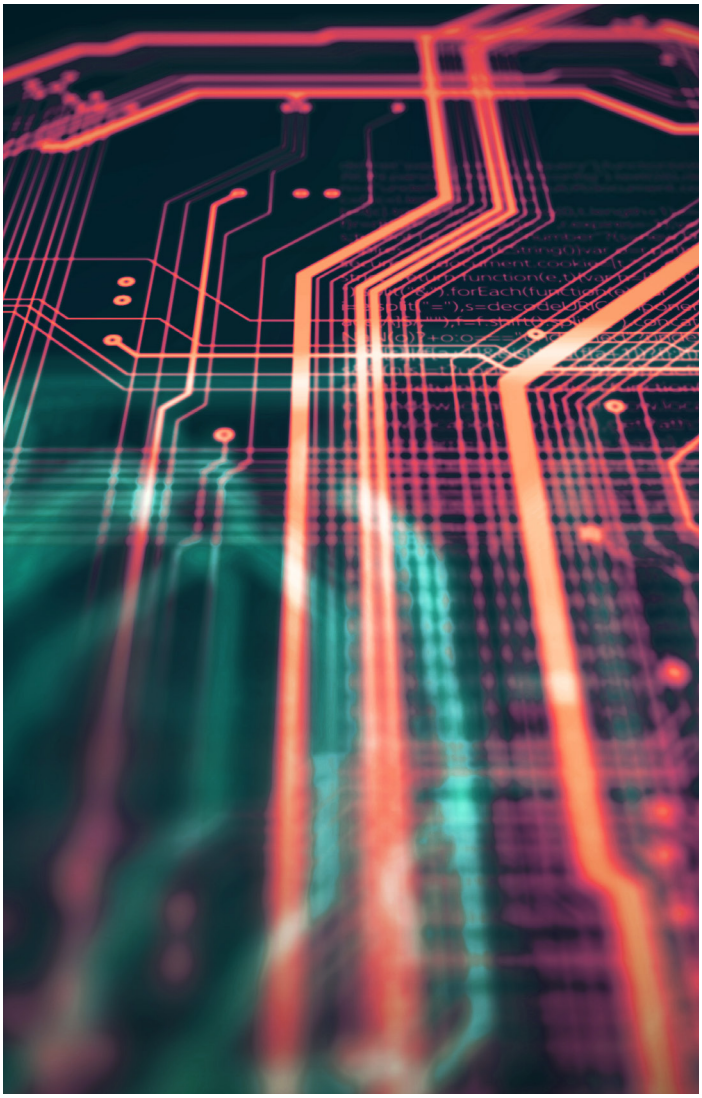
- Enhanced contaminant holding capacity for fewer filter change-outs versus other traditional cartridge filters

Thermo Scientific™ DF Filter Cartridge

- Provides longer filter life than most conventional bag filters

Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance for ammonia removal and recovery

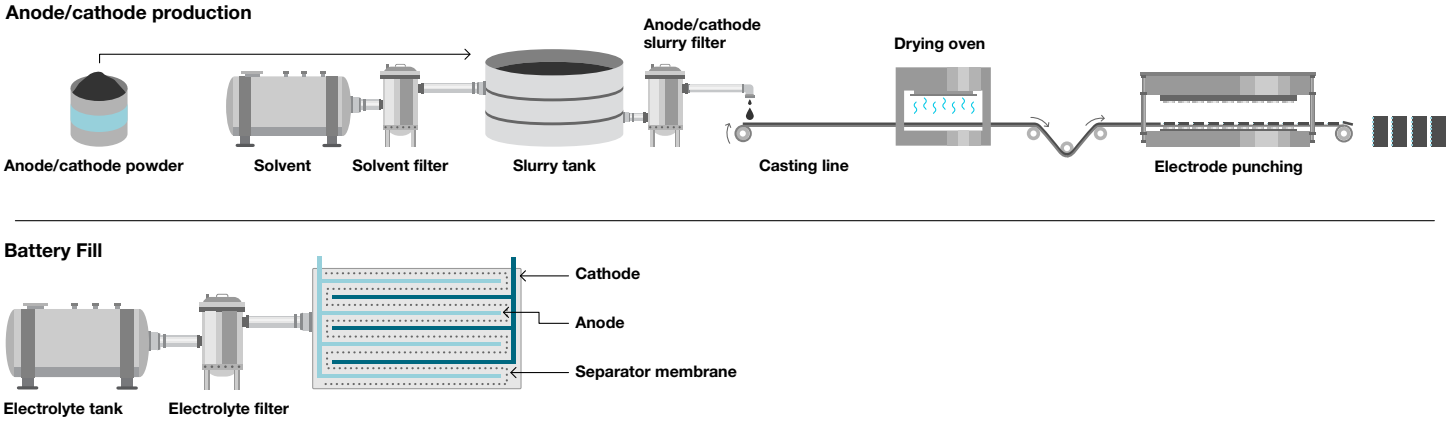




The demand for lithium-ion batteries is high and only expected to keep growing, with electronic devices, hybrid and electric vehicles driving demand. Manufacturers with the capabilities to create lighter, longer lasting and more reliable batteries will need better, more efficient contamination control.

Thermo Fisher filtration solutions can help ensure your lithium-ion battery manufacturing process meets the growing demands of the industry and the high expectations of your customers.

Lithium-ion batteries process map



Applications for lithium-ion batteries

Cathode/anode coating

The filtration you choose for your cathode and anode coating processes is important because lithium-ion batteries are very sensitive to impurities. Contamination can cause reliability issues and poor battery performance over time.

Thermo Fisher filtration solutions for cathode/anode coating applications are easy to use and remove, helping to improve productivity and reducing the likelihood of shorts between electrodes.

Filtration solutions:

Thermo Scientific™ Betapure™ AU Filter Capsule

- Bi-component fiber technology enables Large Particle Count (LPC) reduction

Thermo Scientific™ CTG-Klean™ System Filter Pack 1GPJ

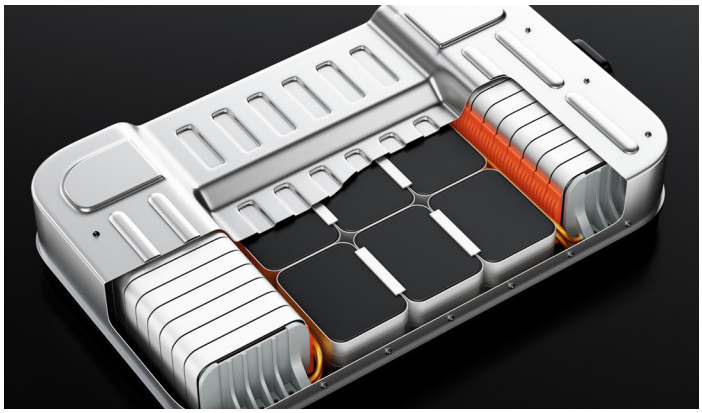
- 1GPJ system features an enclosed, one-round capsule format designed for convenience, sustainability, and reduced waste. By enabling reuse of unused slurry, it helps LiB manufacturers lower total cost of ownership

Thermo Scientific™ Betafine™ XL Filter Cartridge

- Betafine™ XL filter cartridges combine absolute-rated polypropylene media with Advanced Pleat Technology (APT) to deliver high performance and long service life. The optimized pleat design maximizes filtration surface area, enabling excellent dirt-holding capacity, lower pressure drop, and reduced total cost of ownership

Thermo Scientific™ CUNO™ CTG-Klean System

- CTG-Klean System is a totally enclosed filtration system that uses a separate pressure vessel and disposable filter pack to isolate the product to be filtered from the housing. The clean, totally enclosed, cost-effective, operator-friendly alternative to conventional filter change-out



Electrolyte filtration

As with all steps in the manufacturing of lithium-ion batteries, it's crucial to remove particles and impurities that can cause reliability issues and shorten life of batteries.

Thermo Fisher has the electrolyte filtration solutions you need to help remove contaminants and particles to help ensure long-lasting lithium-ion batteries.

Filtration solutions:

Thermo Scientific™ CUNO™ CTG-Klean System

- Reduces the amount of labor and operator exposure to impurities and cleaning solvents involved with filter change-outs and cleaning of conventional housings

Thermo Scientific™ LifeASSURE™ EMC Filter Cartridge

- Provides excellent chemical compatibility with solvents such as NMP and is well-suited for raw-material pre-filtration and electrolyte preparation in LiB manufacturing processes

Thermo Scientific™ CTG-Klean™ System Filter Pack 1GPJ Series

- Cartridge pack system design reduces the time and labor involved with filter change-outs and cleaning of conventional housings



Thermo Scientific™ Betapure™ NTT Filter Cartridge

- Superior particle retention with ratings from 0.5 to 70 micron to suit a range of applications

Dissolved gas control

As semiconductor processing, flat panel display manufacturing and other high-tech industries move to smaller nodes, larger wafer sizes and advancing display technology, dissolved gas control is a critical consideration in ultra-pure water quality.

Because of their efficiency, simplicity and high gas removal performance, Thermo Scientific™ Liqui-Cel™ Membrane Contactors are a widely used degassing technology in semiconductor and flat panel display water treatment systems.

Unlike conventional vacuum towers these membrane degasser systems can be expanded. As water volume requirements grow or dissolved gas specifications get lower additional contactors can be added to a system to meet the changing needs.

Liqui-Cel membrane contactors also enable low concentrations and precision control of the dissolved gases in ultra-pure water and other compatible wet bench processes fluids.



Applications for dissolved gas control

O_2 and CO_2 removal

Thermo Scientific™ Liqui-Cel™ Membrane Contactors remove O_2 from water down to less than 1 ppb and dissolved CO_2 to 0.5 ppm. Low dissolved oxygen levels help protect product yields, while low CO_2 levels may help improve the efficiency of electrodionization (EDI) and other ion exchange processes. Membrane contactors are compact, operate in-line and do not require chemicals in operation.

Liqui-Cel membrane contactors have displaced vacuum towers, forced draft deaerators and oxygen scavengers around the world for over 20 years. Thermo Fisher supports your projects with deep technical support and service by working collaboratively to ensure solutions meet requirements and expectations.

Dissolved gas control solutions:

Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance for ammonia removal and recovery

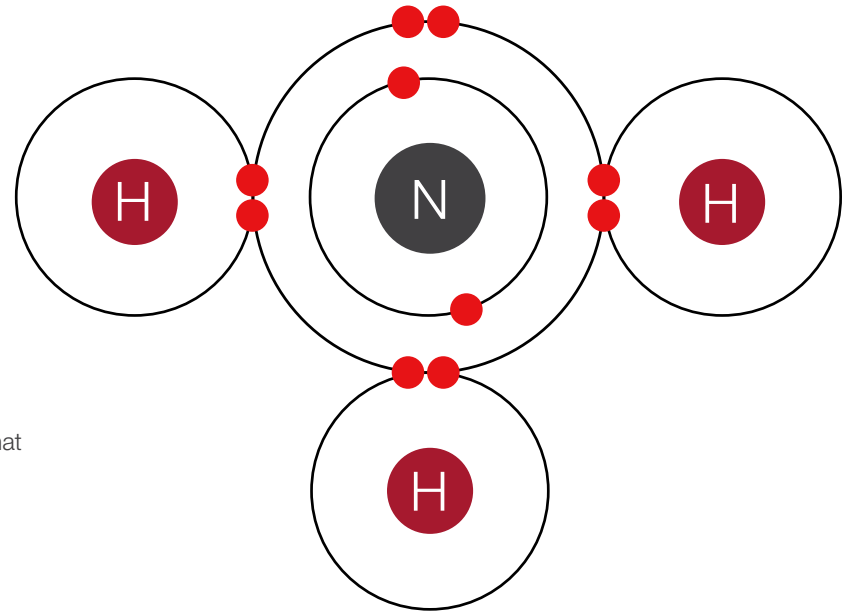
Electrochemical Deposition (ECD)

Electroplating solutions require both stringent particle and dissolved gas control to prevent defects and impurities in the deposited metal layer. Thermo Fisher has both particle and dissolved gas solutions to help meet the needs for your electroplating process.

Dissolved gas control solutions:

Thermo Scientific™ Liqui-Cel™ SP Membrane Contactor

- In-line degassing that utilizes hollow fiber membrane that is impermeable to chemically compatible low surface tension liquids



Ammonia removal and recovery from wastewater

In a process called Transmembrane Chemisorption (TMCS), Liqui-Cel membrane contactors can strip ammonia gas from wastewater streams with a high concentration of ammonia.

The ammonia gas diffuses across the wall of a hollow fiber membrane and is directly absorbed into a reactive acid solution. This makes simultaneous removal and recovery of ammonia possible in a single device.

Dissolved gas control solutions:

Thermo Scientific™ Liqui-Cel™ EXF Membrane Contactor

- Microporous hollow fiber membrane enables rapid and efficient gas transfer performance for ammonia removal and recovery

Help ensure quality at every step of your microelectronics manufacturing process with high-quality Thermo Fisher filtration and separation solutions



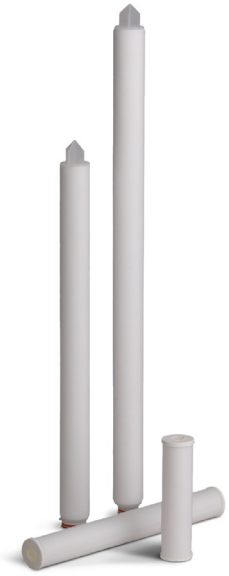
Thermo Scientific™ Betafine™
PEG Filters



Thermo Scientific™ Betafine™
XL Pleated Filters



Thermo Scientific™ CTG-Klean™
Encapsulated Filter System GPJ



Thermo Scientific™ Betapure™
NT Series Depth Filters



Thermo Scientific™
High Flow Filter Cartridges



Thermo Scientific™ Betapure™
AU/AUL Filters



Thermo Scientific™
Metal Ion Purifier



Thermo Scientific™ LifeASSURE™
EMZ, EMC, EPF Filters



Thermo Scientific™ LifeASSURE™
PSN, BFS, IMC Filters



Thermo Scientific™ Liqui-Cel™
Membrane Contactors



Thermo Scientific™ NanoSHIELD™ Filter Cartridge
and Capsules

Application engineering

The cornerstone for Thermo Fisher's philosophy is service to customers, not only in product quality and prompt delivery, but also in validation, application support, and the sharing of scientific information.

By using Thermo Scientific products, customers have access to Thermo Fisher Application Engineering support, a global team of market-focused scientists and engineers who excel in supporting collaborative efforts between customers and Thermo Fisher.

Our Application Engineers can work with you from start to finish to suggest the most effective and economical filters to achieve the clearest results.

Intended Use: LifeASSURE MFE, EPF, EMZ, EMC, PSN, Betapure AU, AUL, NanoSHIELD, Betafine PEG, CUNO CTG Klean products are intended for use in industrial, chemical, and electronics filtration applications of aqueous and non-aqueous fluids in accordance with the product instructions, specifications and where materials of construction are compatible.

High Flow, Betapure NTT, SKYL, PPK, Micro-Klean RT, Betafine XL products are intended for use in industrial, chemical, electronics and food and beverage filtration applications of aqueous and non-aqueous fluids in accordance with the product instructions, specifications and where materials of construction are compatible.

LifeASSURE BFS cartridges are intended for use in industrial, chemical, food and beverage and electronics filtration applications of gases, aqueous and non-aqueous fluids in accordance with the product instructions, specifications and where materials of construction are compatible.

Metal Ion Purifiers are intended for use in industrial purification applications of aqueous and non-aqueous fluids in accordance with the applicable product instructions and specifications and where materials of construction are compatible.

Liqui-Cel membrane contactors are intended to remove dissolved gases and bubbles from liquids or to add gases to a liquid stream. Liqui-Cel products are for use in industrial separation applications of industrial fluids only, in accordance with the applicable product instructions, specifications, and where materials of construction are compatible. Liqui-Cel membrane contactors may further be used in the production of water for various pharmaceutical products upstream of the final water sterilization step.

Certain Liqui-Cel, High Flow, Betapure NTT, SKYL, PPK, Micro-Klean RT, Betafine XL, LifeASSURE BFS products are compliant for use in Food and Beverage applications. For specific details regarding use or limitations for food contact applications please contact your Thermo Fisher Scientific Inc. representative for more information.

Since there are many factors that can affect a product's use, the customer and user remain responsible for determining whether the Thermo Scientific product is suitable and appropriate for the user's specific application, including user risk assessments and evaluation of the Thermo Scientific product in the user's application.

Restrictions on Use: Thermo Fisher Scientific Inc. advises against the use of these Thermo Scientific products in any application other than the stated intended use(s) since other applications have not been evaluated by Thermo Fisher and may result in an unsafe or unintended condition. Refer to the applicable filter product instructions and specifications for product specific restrictions on use.

Betapure AU, AUL, LifeASSURE MFE, EPF, EMC, EMZ, PSN, NanoSHIELD, Betafine PEG, CUNO CTG Klean, and Metal Ion Purifier products are not for use in food contact applications.

Product Selection and Use: Many factors beyond Thermo Fisher's control and uniquely within user's knowledge and control can affect the use and performance of a Thermo Scientific product in a particular application. As a result, customer is solely responsible for evaluating the product and determining whether it is appropriate and suitable for customer's application. Failure to properly evaluate, select, and use a Thermo Scientific product and appropriate safety products, or to meet all applicable safety regulations, may result in injury, sickness, death, and/or harm to property.

Learn more at **thermofisher.com/industrialfiltration**

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