















Applications Guide





	Application	PSC Products	Application Description
	Acid Cooling	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	<p>Combining acids produces heat which needs to be removed, both to protect the system and maintain the process. The function of the acid cooling system is to remove the heat from the acid flow, ensuring that the process is maintained and the process equipment is protected.</p>
	Anodizing	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	<p>Electrochemical passivation process used to increase the thickness of the oxide layer on the surface of metal parts, increasing corrosion and wear resistance. Cooling is needed to keep the acid at the proper temperature.</p>
	Asphalt Sample Tempering	<ul style="list-style-type: none"> Refrigerated Circulators 	<p>Asphalt ductility testing ensures proper characteristics of asphalt mixture. This testing requires temperature control to be better than 1°C.</p>
	Atomic Absorption (AA) Furnace	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	<p>Atomic Absorption Spectroscopy is a technique for determining the concentration of a particular metal element within a sample. Typically, the technique uses a flame or furnace to atomize the sample. The sample is placed inside a tube held in place by clamps and then heated. In order to give reproducible results, the tube heating must be closely controlled. In order to prevent damage to the clamps, they need to be cooled. Any change in clamp temperature will be reflected in the tube temperature. Clamp cooling must be precise and reproducible so it won't distort the test results.</p>

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	Bacterial Incubation	<ul style="list-style-type: none"> • MX Immersion Circulator • 6000 & DuraChill™ Series Chillers 	See "Incubation."
	Bakeries	<ul style="list-style-type: none"> • 6000 & DuraChill™ Series Chillers 	Specific temperatures are sometimes required while mixing raw ingredients before baking. Our Chillers can be used to cool the containers to maintain temperature during the mixing process.
	Beer Forced-Aging Tests	<ul style="list-style-type: none"> • 75L Circulating Bath 	Beer forced-aging is a process where beer is rapidly aged by applying consistent heat. Cooling equipment will provide controlled cool-down after the forced-age process is complete, which will result in a consistent product from batch to batch.
	Bioreactor	<ul style="list-style-type: none"> • Recirculating Coolers • 6000 & DuraChill™ Series Chillers 	Changes in temperature will effect the growth inside the bioreactor. Our equipment can be used to maintain one temperature or to ramp from temperature to temperature.





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	Blood Banks	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	See "Blood Thawing."
	Blood Thawing	<ul style="list-style-type: none"> Refrigerated Circulators 75L Circulating Bath 	When fresh frozen plasma (FFP) is thawed at the proper temperature and rate, precipitate will form which is rich in fibrogen, factor VIII, von Willebrand factor, factor XIII, and fibronectin.
	Blow Molding	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	Manufacturing process where hollow plastic parts are formed, such as soda bottles. Heat removal is critical in ensuring the molding machine performs at optimal levels.
	Calibration	<ul style="list-style-type: none"> Refrigerated Circulators Calibration Baths Heated Circulators MX Immersion Circulators 	<p>Process of determining the accuracy or stability of any of a variety of instrumentation, i.e. speed, torque, or in our case, temperature. Many of our Circulating Baths and Chillers would be appropriate for determining the validity of calibration of an instrument. The thermal load is very small, so choose our product based on temperature stability, good circulation, and uniformity. Other features such as programmability and datalogging may also be helpful.</p> <p>The calibration device is placed directly into the bath and should be immersed at least 5 times the length of the sensor element.</p>





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	CCD Camera Cooling	<ul style="list-style-type: none"> • Refrigerated Circulators • Benchtop Chillers (LS/LM/MM) • Recirculating Coolers 	<p>A CCD camera uses a small, rectangular piece of silicon rather than a piece of film to receive incoming light. This is a special piece of silicon called a charge-coupled device (CCD). Cooling the CCD chip improves image quality and greatly reduces background noise (distortion). Typically, these CCDs are cooled using a Peltier thermoelectric cooler, which in turn is cooled by our small refrigerated system or a small recirculating cooler. Thermal loads are very small, tens of watts. Depending on the configuration, temperature control is needed for direct cooling of the CCD chip or for cooling of a Peltier device thermally coupled to the CCD chip. In the first case, low temperatures are needed; the lower the better. Exact temperature is not important. In the second case, requirements are identical for Peltier devices shown below.</p>
	Cell Culture	<ul style="list-style-type: none"> • Heated Circulators • MX Immersion Circulators 	<p>Changes in temperature will effect cell growth. Our equipment can be used to maintain one temperature or to ramp from temperature to temperature.</p>
	Cell Freezing	<ul style="list-style-type: none"> • Refrigerated Circulators 	<p>A technique to determine at what temperature a given cell will freeze. Refrigerated Circulators will permit a sub-ambient environment for a quick freeze.</p>
	Chemical Processing	<ul style="list-style-type: none"> • 6000 & DuraChill™ Series Chillers 	<p>The process of combining chemicals or chemical compounds always creates heat. Cooling is needed to ensure that the process and follow-up testing are done accurately.</p>




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	Chromatography Column	<ul style="list-style-type: none"> Refrigerated Circulators 6000 & DuraChill™ Series Chillers 	<p>Column chromatography is generally used as a purification technique. It isolates desired compounds from a mixture. In the stationary phase, a solid absorbent is placed in a vertical glass column. In the mobile phase, a liquid is added to the top and flows down through the column by either gravity or external pressure. Control and maintenance of column temperature throughout a series of analyses are an important, yet frequently overlooked, parameter that can affect retention time reproducibility.</p>
	Cloud Point Testing	<ul style="list-style-type: none"> Refrigerated Circulators 	<p>Cloud point and pour point are indicators of the lowest temperature of utility for petroleum products. The sample is periodically examined while it is being cooled in the cloud and pour point apparatus. The highest temperature at which haziness is observed (cloud point), or the lowest temperature at which movement of the oil is observed (pour point), is reported as the test result. A refrigerated circulator is necessary to maintain the sample at -1°C, -18°C, and -35°C for test measurement according to ASTM requirements. Precise temperature control is paramount as is traceability to temperature standards. The thermocouple, or RTD, is placed directly into the bath. Good circulation and uniformity of the bath are critical. Temperatures depend on the sample 100 to -50°C.</p>
	Computed Tomography (CT) Scanning	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	<p>CT Scan equipment adds large heat loads to the total at a medical site; adequate cooling is needed to prevent the equipment from overheating and malfunctioning, which would render it useless for medical use.</p>
	Concentrator/Extractor	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	<p>Separates an item into its unique components. There are two applications here. First, the sample has to be heated to evaporate the solvent. Second, the solvent vapor is usually condensed to recycle or to dispose of it. Size depends on the solvent and evaporation rate. See "Condenser Cooling."</p>

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	Condenser Cooling	<ul style="list-style-type: none"> • Refrigerated Circulators • Benchtop Chillers (LS/LM/MM) • Recirculating Coolers • 6000 & DuraChill™ Series Chillers 	<p>A device that transfers heat out of a refrigeration system to a medium (either air, water, or a combination of air and water), that absorbs the heat and transfers it to a disposal point.</p> <p>There are three types of condensers: air-cooled condensers, water-cooled condensers, and evaporative condensers. The evaporative condenser uses a combination of air and water as its condensing medium. Temperature depends on the vapor being condensed.</p>
	Culture Media Warming	<ul style="list-style-type: none"> • Heated Circulators • MX Immersion Circulators 	<p>A Heated Circulator is extremely convenient for dissolving culture media and warming.</p>
	Defined Substrate Technology Testing	<ul style="list-style-type: none"> • Coliform Bath 	<p>See "E. coli Determination."</p>
	Densitometer	<ul style="list-style-type: none"> • Refrigerated Circulators • Recirculating Coolers • 6000 & DuraChill™ Series Chillers 	<p>An apparatus for measuring the optical density of a material such as a photographic negative. Optimized readout temperature is between 18°C and 27°C. A refrigerated system is required to maintain the optimum temperature as the incorporated electronics heat the unit up significantly.</p> <p>An instrument used to determine the ratio of the density of a substance to the density of a given substance (as water or hydrogen) taken as a standard, when both densities are obtained by weighing in air. Precise temperature control is important as is traceability to standards. The thermal load is very small. The densitometer is placed directly into the bath. Good circulation and uniformity of the bath are critical.</p>

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	Diffusion Pump	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	<p>A diffusion pump is basically a stainless steel chamber containing vertically stacked cone-shaped jet assemblies. Typically there are three jet assemblies of diminishing sizes, with the largest at the bottom. At the base of the chamber is a pool of a specialized type of oil having a low vapor pressure. The oil is heated to boiling by an electric heater beneath the floor of the chamber. The vaporized oil moves upward and is expelled through the jets in the various assemblies. Water circulates through coils on the outside of the chamber to cool the chamber, thereby preventing thermal runaway and permitting operation over long periods of time. Due to its simplicity, high performance, and low initial cost, the diffusion pump remains as the primary industrial high vacuum pumping mechanism. Applications for this type of pump are found in such diverse areas as: Analytical instructions, Coating, Metallurgy, Optics, Petrochemicals, Pharmaceuticals, R&D laboratories, and Semiconductor manufacture. 20°C medium to high heat loads, 1 KW to 10 KW for lab systems.</p>
	Distillation Apparatus	<ul style="list-style-type: none"> Refrigerated Circulators 6000 & DuraChill™ Series Chillers 	<p>The process of purifying a liquid by boiling it and condensing its vapors. Depending on the size of the apparatus, a Refrigerated Circulator or Chiller can be used to condense the vapors back into a purified liquid.</p> <p>Distillation is a technique for separating components of a mixture on the basis of differing boiling points. The mixture is heated, vaporizing some of the components. The vapor is collected and condensed to isolate the components with the lowest boiling points.</p>
	DNA Melting Curves	<ul style="list-style-type: none"> Heated Circulators 	<p>DNA melting curve analysis can identify single-copy gene fragments amplified from genomic DNA.</p>
	Dry Ice Replacement	<ul style="list-style-type: none"> Immersion Probe and Flow-Through Coolers 	<p>Dry ice is -77°C. In many cases, the customer does not really need such a low temperature. It is used because of the easy, inexpensive availability of dry ice. The convenience of a cooler can be an advantage over having to keep dry ice on hand and is more economical than continually purchasing dry ice.</p>

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	E. coli Determination	<ul style="list-style-type: none"> Coliform Bath 	Testing drinking water for the presence/absence of coliforms and E. coli in compliance with the Safe Drinking Water Regulations.
	Electrical Discharge Machining (EDM)	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	<p>Electric Discharge Machining: The electrolyte fluid needs cooling because the sparks that do the machining generate heat. Power levels are probably around 1 KW. Precise temperature is not important.</p> <p>A popular option is "Ambient Temperature Control." By keeping the fluid the same as the ambient air, the parts being machined will be dimensionally stable when taken in and out of the bath.</p>
	Electron Microscope	<ul style="list-style-type: none"> Recirculating Coolers 6000 & DuraChill™ Series Chillers 	An electron microscope is a large microscope that is capable of looking at the electron level of elements. A laser is used to control the temperature of the exciter lamp. See "Lasers."
	Electrophoresis	<ul style="list-style-type: none"> Refrigerated Circulators 	A system used for separating substances, especially proteins, and analyzing molecular size based on the rate of movement of each component in a colloid suspension (gel) while under the influence of an electrical field. Occasionally, a Refrigerated Circulator will be used to ensure that the gel chamber is maintained at the proper operating temperature by cooling the buffer within the chamber. If a constant temperature is not maintained, the heat energy from the electric current passing through the gel will damage the gel.





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	Enzyme Assays	<ul style="list-style-type: none"> • Heated Circulators • MX Immersion Circulators 	<p>An assay used as a relative measure of the amount of a particular enzyme in a solution. Most enzymes have an optimum temperature, which may be related to the type of organism from which the enzyme was isolated. Some organisms, like plants, grow well near room temperature and so their enzymes are most active at a temperature around 30 to 40°C. A Circulator is used to maintain the optimum temperature of a given enzyme sample.</p>
	Exothermic Reaction Cooling	<ul style="list-style-type: none"> • Immersion Probe and Flow-Through Coolers 	<p>Exothermic describes processes that release heat energy.</p>
	Fecal Coliform Testing	<ul style="list-style-type: none"> • Coliform Bath 	<p>Fecal coliform, found in the lower intestines of humans and other warm-blooded animals, is one type of coliform bacteria. The presence of fecal coliform in a water supply is a good indication that sewage has polluted the water. Testing can be done for fecal coliform specifically or for total coliform bacteria, which includes all coliform strains and may indicate fecal contamination.</p>
 <p style="font-size: small; text-align: center;">© 2000 Home Staff Works</p>	Fermentation	<ul style="list-style-type: none"> • 6000 & DuraChill™ Series Chillers 	<p>Controlling the temperature during fermentation processes is critical in arriving at the desired outcome; i.e. beer, where variability in the fermentation process can lead to different tastes and composition.</p>





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	Food Processing	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	<p>The method of transforming raw ingredients into consumable food relies heavily on temperature control technology. Specific temperatures are critical for handling food. All are sensitive to certain temperature and humidity levels.</p>
	Food Stability Testing	<ul style="list-style-type: none"> 75L Circulating Bath 	<p>Depending on the mode of failure and the food scientist's approach to inhibiting microbial growth and chemical reactions leading to deterioration, scale-up may increase or decrease shelf life. Because of the difficulty in predicting the precise effect of scale-up on food stability, a confirmatory shelf life study is often needed, simulating real distribution conditions using fluctuating temperatures of freeze/thaw cycles.</p>
	Freeze Point Determination	<ul style="list-style-type: none"> Refrigerated Circulators 	<p>A method to determine at what temperature a specific solution will freeze within a chilling chamber. A Refrigerated Circulator is used to reduce the temperature of the heated solution while the solution is observed for initial crystalline formation and subsequent freezing. These systems require good temperature control with temperature traceability and low heat loads.</p>
	Fourier Transform Infrared Spectroscopy (FTIR)	<ul style="list-style-type: none"> Refrigerated Circulators 	<p>FTIR testing identifies chemical compounds in consumer products, paints, polymers, coatings, pharmaceuticals, foods, and petroleum products. FTIR is capable of capturing roughly 60 compounds within the IR scale. A Heated Circulator is required to maintain the vaporized compound sample in its normal state (185°C). Without maintaining this temperature, the sample would return to its liquid state.</p> <p>Fourier transform spectroscopy is a measurement technique whereby spectra are collected based on the response from a pulse of electromagnetic radiation. It can be applied to a variety of types of spectroscopy, including infrared spectroscopy (FTIR), nuclear magnetic resonance, and electron spin resonance spectroscopy. Fourier transform spectroscopy is more sensitive and has a much shorter sampling time than conventional spectroscopic techniques.</p>



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	Fresh Frozen Plasma Thawing	<ul style="list-style-type: none"> • Cryoprecipitate Bath 	See "Blood Thawing."
	Gas Chromatography-Mass Spectrometry (GC-MS)	<ul style="list-style-type: none"> • Recirculating Coolers • 6000 & DuraChill™ Series Chillers 	<p>Gas chromatography ("GC") and mass spectrometry ("MS") make an effective combination for chemical analysis. A high vacuum pump is used to observe light spectrum in a material. Smaller, table-top do not require sub-ambient cooling; however, larger, more expensive units that utilize turbo-molecular pumps or diffusion pumps can require sub-ambient cooling.</p> <p>Mass Spectrometer: The instrument used in an analytical technique that uses a magnetic field to separate ions according to the ratio of mass/charge, and so identify a material by its "mass spectrum."</p>
	General Lab Cooling	<ul style="list-style-type: none"> • Refrigerated Circulators 	This covers a variety of disciplines wherein samples must be maintained at a sub-ambient temperature. Normally, a Refrigerated Circulator will provide the necessary temperature level required to cool the sample.
	Hydraulics Cooling	<ul style="list-style-type: none"> • 6000 & DuraChill™ Series Chillers 	Heating of the hydraulic fluid in operation is caused by inefficiencies. Inefficiencies result in losses of input power, which are converted to heat. It is important to not allow the fluid temperature to exceed the point at which viscosity falls below the optimum level for the system's components.

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	Hydrocooling	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	<p>Process of chilling food, such as fruits and vegetables, in order to stop the process of ripening without freezing, which destroys the composition of the food.</p>
	Impact Testing	<ul style="list-style-type: none"> Refrigerated Circulators Immersion Probe and Flow-Through Coolers 6000 & DuraChill™ Series Chillers 	<p>Impact testing is testing an object's ability to resist high-rate loading. An impact test is a test for determining the energy absorbed in fracturing a test piece at high velocity. Pieces are tested at various temperatures to replicate seasonal or ambient changes. For example, freezing/thawing changes or operation of a specific piece in a cold environment compared to a warm one. Temperature can usually be controlled by the use of a Refrigerated Circulator.</p>
	Incubation	<ul style="list-style-type: none"> Refrigerated Circulators Heated Circulators 	<p>An incubator provides the ideal environment (temperature, humidity, CO₂, etc) for growing a cell culture, or other living organisms. For most cell cultures, 37°C is optimal temperature and a Heated Recirculator or Circulating Bath will provide this. Incubation can be done at lower temperatures where refrigeration may be helpful. Accurate temperature control and temperature traceability may also be required.</p>
	Incubation Water Jacket	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	<p>A water jacket is the space between the inner and outer walls of the incubator. Samples to be incubated are placed inside the inner wall, and temperature controlled fluid is circulated in the jacket. The inner wall of the jacket conducts the fluid temperature to allow air temperature control inside the incubator without affecting the humidity.</p>

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	Inductively Coupled Plasma (ICP)	<ul style="list-style-type: none"> • Recirculating Coolers • 6000 & DuraChill™ Series Chillers <p>*Turbine pump configurations are recommended.</p>	Inductively Coupled Plasma (ICP) is an analytical technique used for the detection of trace metals in environmental samples. Cooling is needed to keep components from overheating. Precise temperature control is not important. Cooling capacities are a few KW.
	Injection Molding	<ul style="list-style-type: none"> • 6000 & DuraChill™ Series Chillers <p>*High flow pumps are typically required.</p>	Process by which plastics granules are compressed in a mold through heat and pressure to form an end piece. A Chiller is used to cool the molds in order to have the plastic release. Rapidly cooling the mold solidifies melted plastic allowing it to be released.
	Isoelectric Focusing	<ul style="list-style-type: none"> • Refrigerated Circulators 	An electrophoretic technique for separating proteins by causing them to migrate under the influence of an electric field through a medium (as a gel) having a pH gradient to locations with pH values corresponding to their isoelectric points. Heat loads are small, a few hundred watts. Good temperature control is a plus to reduce variation in the results.
	Kinetic Research	<ul style="list-style-type: none"> • Heated Circulators • MX Immersion Circulators 	Kinetic energy is the energy of motion. This motion changes based on the temperature of the atom or substance being measured.





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	Laboratories, General-use Cooling	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	See "General Lab Cooling."
	Laminating	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	The process of lamination involves uniting two or more layers of material together, using a combination of heat, pressure, and some sort of adhesive. Generally, setting time would be dependent on these three items, but by efficiently applying cooling, we can reduce downtime and speed up the lamination process.
	Laser Cooling	<ul style="list-style-type: none"> Benchtop Chillers (LS/LM/MM) 	See "Lasers."
	Lasers	<ul style="list-style-type: none"> Recirculating Coolers 6000 & DuraChill™ Series Chillers 	Light Amplification by Stimulated Emission of Radiation - Device that emits highly amplified and coherent radiation of one or more discrete frequencies used for precision cutting, etching, and printing. Chillers are used to reduce and control the internal temperature of the solid state components, including the pump head (diode beam cluster), Q switch ("quality" switch, which generates about 60 Watts of heat), as well as the ceramic focusing ring or aperture. Failure to remove heat from the laser can lead to the laser not meeting performance standards, or even worse, premature failure of the laser. Gas lasers are large power consumers (kilowatts to tens of kilowatts). Precise temperature is not important. Temperature for cooling an argon laser is 20°C or so. Carbon dioxide lasers work better at low temperatures, below 0°C. Good flow is important. Loss of coolant will result in immediate shut down due to the result of overheating and damage to equipment. Diode lasers have similar requirements, but have smaller heat loads, a hundred to a kilowatt for lab systems.





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	Liquid Nitrogen Replacement	<ul style="list-style-type: none"> Immersion Probe and Flow-Through Coolers 	<p>The temperature of liquid nitrogen is 196°C (77K). In many cases, the customer does not really need such a low temperature. It is used because of the easy, inexpensive availability of liquid nitrogen. This is the case for cooling samples in analytical NMR. The convenience of a cooler can be an advantage over having LN2 on hand.</p>
	Lithographic Equipment	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	<p>The process of printing that utilizes flat inked surfaces to create the printed image. Fountain solutions require temperature control to yield consistent results. There are also pre-press applications in plate burning for printing. These are typically small laser systems that require about 100 watts of heat removal and good pumping (6306T or 6106T).</p>
	Low Temperature Calibration	<ul style="list-style-type: none"> Refrigerated Circulators Calibration Baths 	See "Calibration."
	Lyophilization	<ul style="list-style-type: none"> Immersion Probe and Flow-Through Coolers 	See "Dry Ice Replacement."

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	Machine Tool	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	<p>When metals are cut, the friction causes heat to build up in the recirculated cutting oil. By controlling fluid temperature, greater accuracy can be achieved because thermal expansions and contractions of the material are eliminated. Always use a liquid-to-liquid heat exchanger with one path for the cutting oil and the other path for the Chiller.</p>
	Magnetic Resonance Imaging (MRI)	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	<p>Magnetic Resonance Imaging (MRI) scans - MRI uses large coils to generate magnetic fields. The electrical current through the coils generates heat that must be removed. Precise temperature control is not important.</p>
	Medical Diagnostic Equipment	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	<p>See "CT," "MRI," and "PET Scanners." These are examples of the medical diagnostic equipment that can need temperature control.</p>
	Milling Machines	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	<p>See "Machine Tool."</p>





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	<p>Nuclear Magnetic Resonance (NMR)</p>	<ul style="list-style-type: none"> • 6000 & DuraChill™ Series Chillers <p>NMR Magnet: Analytical NMRs come in three kinds of magnetic field generation: electromagnetic, permanent magnet, and superconducting. Electromagnetic field generation would be of interest for us. The coils consume tens of KW and must be kept at constant reproducible temperature. High flows and precise temperature control are very important. NMR is a phenomenon, which occurs when the nuclei of certain atoms are immersed in a static magnetic field and exposed to a second oscillating magnetic field. NMR spectroscopy is routinely used by chemists to study chemical structure.</p> <p>A measure, by means of applying an external magnetic field to a solution in a constant radio frequency field, of the magnetic moment of atomic nuclei to determine the structure of organic compounds. This technique is used in magnetic resonance imaging (qv).</p>
	<p>Peltier Devices</p>	<ul style="list-style-type: none"> • Refrigerated Circulators <p>Peltier devices, also known as thermoelectric (TE) modules, are small, solid-state devices that function as heat pumps. It is a sandwich formed by two ceramic plates with an array of small Bismuth Telluride cubes ("couples") in between. When a DC current is applied, heat is moved from one side of the device to the other - where it must be removed with a heat sink, such as a PolyScience Refrigerated Circulator. The "cold" side is commonly used to cool an electronic device, such as a microprocessor, CCD camera, or a photodetector.</p>
	<p>Petroleum Testing</p>	<ul style="list-style-type: none"> • Heated Circulators <p>See "Viscosity Measurement."</p>
	<p>PET Scanners</p>	<ul style="list-style-type: none"> • 6000 & DuraChill™ Series Chillers <p>*Turbine pump configurations are recommended.</p> <p>Positron Emission Tomography (PET) Scanners are used to look for places in the human body where biochemical changes are happening at an accelerated rate. Used most often in scanning for cancer. Chillers cool the high powered electronics inside the machines that are the latest in medical diagnostic tools.</p>

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	Photographic Solution Tempering	<ul style="list-style-type: none"> Refrigerated Circulators Heated Circulators 	Photographic solutions require precise temperature control in order to produce consistent and repeatable results.
	Pilot Plants	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	A pilot plant is a small version of a larger plant (like a prototype) which is operated to generate information about the behavior of the system for use in design of larger facilities. A variety of temperature control devices may be needed depending on the specific processes being tested.
	Plasma Etching	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	Plasma is often described as “the fourth state of matter.” The first three states being solid, liquid, and gas. Plasma etching technology can remove organic and inorganic contamination, increase wettability, increase bond strength, and remove residue. If effective surface treatment is critical to the efficiency of a process or the reliability of a product, plasma technology may be the best answer. Thermal loads are a few hundred watts for lab systems. Precise temperature control is not important. Temperature is normally 20°C. Cooling passages are small, but pressures are not high, 5-10 psi or so. Cooling passages within a single device are ~3/16” diameter and 3 inches long.
	Plasma Thawing	<ul style="list-style-type: none"> Refrigerated Circulators Heated Circulators General Purpose Water Baths 	Preparation of frozen blood or cryoprecipitate extraction. Cryoprecipitate is a human blood component obtained from fresh frozen plasma (FFP) prepared from a unit of whole blood (WB). When FFP is thawed in the cold, a cryoprecipitate forms, which is rich in fibrinogen, factor VIII, von Willebrand factor, factor XIII, and fibronectin.



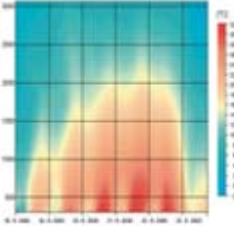

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	Plasma Torch Cutting	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	Used to cut steel and other metals, by forming an electrical arc through a stream of high speed, inert gas which turns gas into plasma. The plasma is hot enough to melt or cut the metal. Cooling is needed to maintain tolerances.
	Plastic Injection Molding	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers <p>*High flow pumps are typically required.</p>	See "Injection Molding."
	Polarimeter	<ul style="list-style-type: none"> Refrigerated Circulators 	An instrument used to measure the angle of rotation of polarized light passing through an optical structure or sample. After sample preparation, many samples require cooling and this can be accomplished through the use of a Refrigerated Circulator.
	Polymer Studies	<ul style="list-style-type: none"> Heated Circulators 	This can involve the study of thermal annealing - determination of a plastic's properties at different temperatures.


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	<p>Pour Point Testing</p>	<ul style="list-style-type: none"> Refrigerated Circulators 	<p>Pour Point: The lowest temperature at which an oil or other liquid will pour under given conditions. In some industries, these tests may have specific standards, such as ASTM for petroleum.</p>
	<p>Printing</p>	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	<p>See "Lithographic Equipment" and "Hydraulics Cooling."</p>
	<p>Product Quality Analysis</p>	<ul style="list-style-type: none"> 75L Circulating Bath 	<p>Many aspects of determining a product's quality involve testing that requires temperature control. Viscosity is the most common example.</p>
	<p>Quick Cooling</p>	<ul style="list-style-type: none"> Immersion Probe and Flow-Through Coolers 	<p>Low temperatures and good flow rate are important. Temperatures well below 0°C; the lower the better.</p>

	Application	PSC Products	Application Description
	Reaction Vessel	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	<p>Normally a jacketed vessel of varying size (10L to 30L), in which a thermal reaction is occurring. A Chiller is used to control the vessel temperature by circulation throughout the vessel's jacketed surface.</p>
	Refractometers	<ul style="list-style-type: none"> Refrigerated Circulators Heated Circulators 6000 & DuraChill™ Series Chillers 	<p>A refractometer is an instrument used to measure the refractive index of a substance. All materials refract light (alter its angle). The amount by which light is refracted is an important feature of every medium. The measure of a material's refractivity is known as its refractive index or R.I. Substances with a known refractive index at a specific temperature are more readily identified by maintaining the sample at the correct temperature with a Circulator or Chiller.</p>
	Rotary Evaporators	<ul style="list-style-type: none"> Refrigerated Circulators Benchtop Chillers (LS/LM/MM) Recirculating Coolers 6000 & DuraChill™ Series Chillers 	<p>Rotary evaporators (also called "rotovaps" in lab slang) are used to remove solvents from reaction mixtures and can accommodate volumes as large as 3 liters. The main components of a rotary evaporator are a vacuum system, consisting of a vacuum pump and a controller, a rotating evaporation flask, which can be heated in a heated fluid bath, and a water-cooled condenser with a condensate collecting flask. They are found in almost every organic laboratory. A Chiller or Refrigerated Circulating Bath will help cool the vapor in the condenser, allowing faster collection of the components for further analysis or disposal.</p>
	RTD Calibration	<ul style="list-style-type: none"> Calibration Baths 	See "Calibration."

	Application	PSC Products	Application Description
	Sample Testing	<ul style="list-style-type: none"> • Heated Circulators • MX Immersion Circulators 	<p>Tests effects of temperature on samples to determine efficacy in real world applications. Samples can be cooled, heated, or ramped between cold and heat to learn what properties of the sample will be changed at what point. Viscosity testing is an example of sample testing.</p>
	Scanning Electron Microscope	<ul style="list-style-type: none"> • 6000 & DuraChill™ Series Chillers 	<p>Large computer driven microscope capable of looking at the electron level of elements. A vacuum is maintained in the exciter chamber and a Chiller is used to cool the vacuum pump. Should the vacuum pump go down, the SEM will shut down, resulting in a potential loss of revenue.</p> <p>An instrument producing three-dimensional images magnified 10-200,000 times, by scanning a surface with a fine beam of electrons, focused by electromagnets.</p>
	Solvent Trapping	<ul style="list-style-type: none"> • Immersion Probe and Flow-Through Coolers 	<p>Designed to capture solvent vapors from extractions, often to comply with the safety requirements.</p>
	Sous Vide Cooking	<ul style="list-style-type: none"> • MX Immersion Circulators 	<p>Sous Vide is a cooking technique that relies on a precise, temperature controlled circulator. Food is vacuum sealed and cooked at a gentle temperature in a precisely controlled water bath.</p>

	Application	PSC Products	Application Description
	Spectrophotometer	<ul style="list-style-type: none"> • Refrigerated Circulators • Recirculating Coolers • 6000 & DuraChill™ Series Chillers 	<p>An instrument used to measure the amount of light reflected from a specimen when illuminated by a controlled light source. This measurement generates a spectral curve (fingerprint) of a product, which can be used in the numerical identification and the calculation of color difference between samples.</p>
	Sputtering System	<ul style="list-style-type: none"> • 6000 & DuraChill™ Series Chillers 	<p>Vacuum disposition system for successful coating of film used in semiconductor applications. System promotes adhesion, densifies coating, and creates residual compressive stress in the film.</p>
	Temperature Gradients	<ul style="list-style-type: none"> • Heated Circulators 	<p>Temperature gradient is a local characterization of the fluid under investigation. The temperature gradient is defined only at those spatial scales at which temperature (more generally, fluid thermodynamics) itself is defined.</p> <p>Note: The PolyScience product is selected on the basis of the desired temperature.</p>
	Thawing Frozen Samples	<ul style="list-style-type: none"> • Heated Circulators • MX Immersion Circulators • General Purpose Water Baths • Cryoprecipitate Bath 	<p>While the process is self-explanatory in that the sample is being defrosted, there are differing techniques when changing a sample from a frozen state. Many frozen products can be steeped in a warm Heated Circulator for rapid thaw, while other, more fragile products need to be brought to temperature slowly at temperatures at or below ambient. One technique for thawing of frozen plasma is the use of our Cryoprecipitate Bath, which operates at a fixed 4°C.</p>

	Application	PSC Products	Application Description
	Thermistor Calibration	<ul style="list-style-type: none"> • Calibration Baths 	See "Calibration."
	Thermometry Calibration	<ul style="list-style-type: none"> • Refrigerated Circulators • Calibration Baths • Heated Circulators • MX Immersion Circulator 	See "Calibration."
	Turbo-Molecular Pump	<ul style="list-style-type: none"> • Refrigerated Circulators • Immersion Probe and Flow-Through Coolers 	<p>Turbo-Molecular pumps are used in semiconductor processing. High and ultrahigh vacuum levels are required in processes such as ion implantation, coating, etching, evaporation, CVD/LPCVD, RTP, microlithography, and load lock chambers. In analytical instrumentation, these pumps are used in mass spectrometers, gas analyzers, and electron microscopes. There are two separate areas to look at. The first is cooling of the pump. Heat loads are typically small, a few hundred watts. Precise temperature is not important. The second area is the cooling of the trap that connects to the vacuum. Liquid nitrogen is often used for this, but an Immersion Probe Cooler is an excellent alternative.</p>
	Vacuum Forming	<ul style="list-style-type: none"> • 6000 & DuraChill™ Series Chillers 	<p>Also known as vacuforming, is a simplified version of thermoforming, whereby a sheet of plastic is heated to a forming temperature, stretched onto or into a single-surface mold and held against the mold by applying vacuum between the mold surface and the sheet. The vacuum forming process can be used to make things as diverse as product packaging, speaker casings, and car dashboards. Cooling keeps the mold at a consistent temperature to maintain tolerances in production; without cooling, the mold would expand with each application of heated plastic.</p>



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	Vacuum Systems	<ul style="list-style-type: none"> • Refrigerated Circulators • Immersion Probe and Flow-Through Coolers 	See "Vacuum Traps."
	Vacuum Traps	<ul style="list-style-type: none"> • Refrigerated Circulators • Immersion Probe and Flow-Through Coolers 	Cooling is used in conjunction with a cold trap to block liquids from entering the vacuum pump. For low temperature operation, the cold trap is immersed in a Dewar flask. These traps effectively remove solvent and reactant vapors.
	Viscosity Measurement	<ul style="list-style-type: none"> • Refrigerated Circulators • Heated Circulators • MX Immersion Circulators 	Viscosity is a measure of a fluid's resistance to flow. It describes the internal friction of a moving fluid. A fluid with high viscosity resists motion; a fluid with low viscosity flows easily. Precise temperature control is paramount as is traceability to temperature standards. The thermal load is very small. The viscometer is placed directly into the bath. Good circulation and uniformity of the bath are critical.
	Warming Culture Media	<ul style="list-style-type: none"> • Heated Circulators • MX Immersion Circulators • General Purpose Water Baths 	Culture media should be brought to the optimal required growth temperature prior to inoculation (usually 37°C). This warming process can be accomplished with the use of a Heated Circulator or General Purpose Water Bath.

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	Waterjet Cutting	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	<p>Capable of slicing into metal or other materials (such as granite) at high velocity and pressure, using a jet of water or a mixture of water and an abrasive substance. It is often used during fabrication or manufacture of parts for machinery and other devices. It is the preferred method when the materials being cut are sensitive to the high temperatures generated by other methods. It has found applications in a diverse number of industries from mining to aerospace where it is used for operations such as cutting, shaping, carving, and reaming.</p>
	Welders	<ul style="list-style-type: none"> Recirculating Coolers 	See "Welding."
	Welding	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	<p>The most common way of permanently joining metal parts. Heat is applied to permanently fuse pieces of metal together. For some pieces of welding equipment, heat needs to be removed from the welding head to preserve the integrity of parts of the head. Precise temperature control of cooling is not important, but needs lots of flow at high heat loads. Small TIG or MIG welders consume 2-3 kilowatts.</p>
	Whole Blood Thawing	<ul style="list-style-type: none"> Cryoprecipitate Bath 	See "Blood Thawing."

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	<p>Wine Fermentation</p>	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	<p>See "Fermentation."</p>
	<p>X-Ray Diffraction</p>	<ul style="list-style-type: none"> 6000 & DuraChill™ Series Chillers 	<p>The X-Ray tube must be cooled. Precise temperature control is not important. Heat loads are typically 2 kilowatts. Delivery pressures are on the high end due to small passage in the X-Ray tube. Loss of cooling will trip a switch to immediately shut down the power supply.</p>