

ENGINEERING
TOMORROW



High-pressure pumps for ultra-pure water

All we add is pressure

Zero

contamination risk

- No oil lubricants means no oil leaks
- Low maintenance
- Ultra compact



Axial piston pump technology: Pure reliability at extreme pressure

The last thing ultra-pure water (UPW) applications need is oil contamination from a pump. That's one reason why more and more engineers are specifying Danfoss axial piston pumps: the only lubricant needed is the pumped media itself. The other reasons? Best-in-class reliability, market-leading efficiency and compact design.

The Danfoss Group has pioneered the development of axial piston pumps for demanding hydraulics applications in a broad range of industries for over 40 years. Today, Danfoss is a world leader in axial piston pump technology for pumps made of stainless steel and carbon-reinforced PEEK, bringing all the advantages of positive displacement pumps to applications that require liquids at high pressure.

Exactng precision

Axial piston pumps depend on precision engineering to perform efficiently and reliably. That's why Danfoss PAHT pumps are engineered and produced with extremely small tolerances to deliver the high performance our customers have come to expect and depend on.

With more than 15 patents and second-to-none production technology, Danfoss High Pressure Pumps Division designs and produces axial piston pumps that punch way above their weight class.

PAHT: Axial piston technology for DI water and UPW

Danfoss PAHT pumps deliver all the benefits of axial piston pump technology to applications that require deionized (DI) water or ultra-pure water at high pressure. There are numerous advantages compared to plunger pumps:

- **Outstanding reliability:** Fewer moving parts and much less maintenance. Pumps typically run at least 8,000 hours before service.

- **Energy efficient:** With up to 97 % volumetric efficiency, Danfoss PAHT pumps drastically reduce energy bills and lower CO₂ emissions.
- **Compact size, low weight:** The best power-to-footprint ratio on the market allows flexible configuration.
- **Market-leading total cost of ownership (TCO):** Thanks to low energy and maintenance costs, TCO for Danfoss PAHT pumps are lower than any other pump for a growing number of applications.



Humidification/adiabatic cooling

See pages 4 – 5



Parts cleaning

See pages 6 – 7



Gas turbines

See pages 8 – 9

Axial piston pumps are different from other pumps. Check out the video to see how the technology works.



A quick look at Danfoss axial piston pump design

Less downtime

Fewer moving parts mean there is less wear and simpler maintenance schedules. No belts, stacks, pulsation dampeners or suction stabilizers are needed.

Patented design

Danfoss's patented ball and socket design improves pump performance and efficiency.



Self-lubricating

The pumped medium provides all necessary lubrication – so there is no need for oil lubrication or troublesome lube schedules.



Constant flow

regardless of pressure variations. Wide flow range with Danfoss variable frequency drives (VFDs).

Danfoss PAHT pumps

replace traditional crankshafts with a unique swash plate that features rotating pistons.

Between five and nine pistons reduce flow pulsations.

Traditional suction/pressure valves and membranes are replaced by a simple port and valve plate, further reducing pump complexity and maintenance worries.

Because Danfoss PAHT pumps contain so much power in a compact design, it is now possible to build the entire pump – inside and out – from stainless steel and carbon-reinforced PEEK. Even when the pumped medium is DI water or UPW, corrosion resistance in moving parts is ensured.

Humidification and adiabatic cooling: Reliable performance whatever the weather

Wherever no-fail dependability is a must, Danfoss high-pressure PAHT pumps help control air humidity and save energy – and completely eliminate the risk of oil contamination.

Maintaining proper air humidity is critical to the health and well-being of humans, animals and plants. Stable humidity levels are also key to many manufacturing processes in which humidification is a vital tool in controlling everything from electrostatic charges and dust to air temperature and materials in storage.

High-pressure water mist humidification saves energy

Humidification technologies have made rapid strides in recent years, not least because of rising energy prices and efforts to reduce CO₂ emissions.

Increasingly, high-pressure water mist humidification is making inroads into applications where evaporative, steam and ultrasonic humidifiers previously dominated. This comes as no surprise: while steam-based humidifiers easily use up to 800 watts per liter, the latest misting humidifiers built with Danfoss PAHT high-pressure pumps use as few as 3 watts per liter.

Adiabatic cooling depends on reliable pumps

For many applications, adiabatic cooling systems that atomize UPW droplets and evaporate them into warm air are much

more energy efficient than any other technology on the market. This is especially true when using Danfoss's efficient axial piston technology, which also uses the pumped medium as the only lubricant to completely eliminate the risk of oil contamination.

More and more humidification and adiabatic cooling systems rely on low-maintenance, corrosion-proof and energy-efficient Danfoss PAHT pumps to provide pressure when the pumped medium is DI water or UPW. PAHT pumps comply with VDI 6022 and HACCP.

Danfoss PAHT pumps for UPW applications



Adiabatic cooling

Increasingly used in server farms, switching systems, heat-generating production facilities and greenhouses to reduce air temperature and save energy.



HVAC

Pre-cooling inlet air saves energy and extends compressor life. In-duct misting maintains ideal humidity levels in residential, commercial and industrial settings.



Industrial humidification

Humidification systems keep humidity levels safe and comfortable for staff, but also control dust and electrostatic charges. Many materials and processes depend on consistent humidity levels.



Agriculture/greenhouses

Humidification systems in greenhouses rely on demineralized water at high pressure to maintain temperature and humidity as well as save energy.

Danfoss PAHT pumps keep things cool at Facebook's first European data center

100%
uptime is a must
Reliability and low maintenance play a major role

When Facebook chose Condair to provide an evaporative cooling and humidification system for a new data center in Luleaa, Sweden, Condair called on Danfoss to provide the high-pressure pumps.



THE CHALLENGE:

Reliable, low energy, high pressure and no contamination risks

The engineers who designed Facebook's massive data center in northern Sweden planned it to be one of the most energy efficient of its kind. Evaporative cooling plays a key role in this, but it also has a potential risk: oil contamination from a high-pressure pump, spread through atomized water droplets, would help bacteria proliferate and endanger both staff and equipment. Condair required pumps that are as contamination-free as they are energy-efficient – and reliable.

THE SOLUTION:

Condair's ML System® with Danfoss high-pressure PAHT pumps:

Condair humidifies and cools 28,000 m² for Facebook. In conjunction with other energy-saving measures, its ML System® slashes nearly 50% of energy costs compared to traditional cooling methods.

"Danfoss PAHT pumps set the standard for clean evaporative cooling and

humidification systems," says Condair's managing director, Marianne Jager.

"The pumped medium does the lubrication, and when this is mineral-free water, this places incredible demands on the pumps' metallurgical makeup and tolerances. We choose PAHT pumps for their cleanliness, but in a data center where 100% uptime is a must, reliability and low maintenance play a major role as well."

THE RESULT:

One of the most energy-efficient data centers ever built is also one of the world's cleanest

Facebook's Luleaa data center came on line in December 2012 and has since proven to be one of the world's most advanced and energy efficient with power usage efficiency (PUE) of just 1.05. It gets its electricity exclusively from hydropower and is 100% reliant on renewable energy resources.



Case story:
Industrial humidification:
Merlin Technology



Case story:
Agricultural/greenhouses:
Van der Ende Pumpen

**Download the full
Facebook case story**



Parts cleaning: No oil, no sweat

Even one drop of oil dispersed at pressure can do a lot of damage to a clean environment. That's why Danfoss's axial piston technology uses the pumped medium – DI water or UPW, not oil – to lubricate the pump.

More and more manufacturers who rely on high-pressure DI water to get critical parts clean are choosing Danfoss's oil-free pumps to supply the pressure.

Because they use the pumped medium for lubrication, the Danfoss range of axial piston PAHT pumps requires no additional oil lubricants to run efficiently. And because all wetted parts are made from pure stainless steel and carbon-reinforced PEEK, they can easily withstand the corrosive effects of DI water without pitting or other damage.

Market-leading reliability

Keeping a billion-dollar wafer fabrication plant waiting because of a high-pressure pump failure is not an option.

Pump reliability is essential because parts-cleaning systems are integrated into a wide spectrum of demanding manufacturing environments that often run three shifts a day, all year round. Danfoss high-pressure PAHT pumps provide parts cleaners with the market's best dependability, typically with up to 8,000 hours of maintenance-free operation.

Compact design

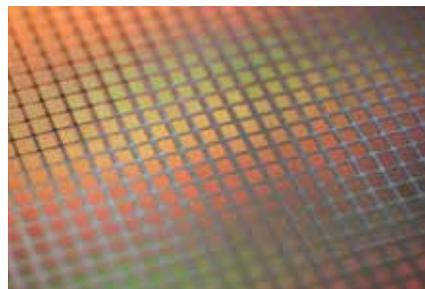
In-line parts cleaners are often integrated into production floors so that the cleaned parts are ready for use when and where they are needed. With the outstanding footprint-to-power ratio enabled by axial piston technology, Danfoss makes it easy for OEMs to find room for an efficient PAHT pump even in crowded cabinets. ATEX compliant solutions are also available.

Clean it before you use it



Wafer

Cleaning of tools for grinding wafers.



Flat panels

LCD manufacturers use ultra-pure water at high pressure to make glass ultra clean before assembly.



Automotive

Many automotive parts are cleaned with UPW at high pressure prior to being welded or glued.

SLE Technology keeps parts clean with Danfoss PAHT pumps

0%

contamination
risk

The pumped
medium is the only
lubricant

SLE Technology produces a broad range of innovative parts-cleaning equipment for everything from German cars to Swiss watches and Japanese medical equipment, using nothing but demineralized water, high pressure and advanced engineering skills.



THE CHALLENGE:
Design parts-cleaning systems
for some of the most demanding
manufacturers in the world –
without solvents or lubricants

SLE Technology makes high-pressure in-line cleaning systems for continuous materials such as wire, foil

and strips before these materials are welded, glued or soldered. Whereas manufacturers used to rely on mineral-based solvents to do the cleaning, environmental and cost concerns have increasingly led customers to use DI water under high pressure. Unfortunately, the same properties that make DI water an effective cleaner also make it harsh on high-pressure pumps, especially when these must be completely free of contamination risk from lubricants.

THE SOLUTION:
Demineralized water under high
pressure from Danfoss PAHT axial
piston pumps

Danfoss's axial piston technology uses the pumped medium – even a highly aggressive one such as DI water – to supply all the lubrication necessary so there is no risk of the pump contaminating the parts to be cleaned. Many of SLE Technology's parts cleaners are installed in production facilities that run 24/7, 365 days a year, so dependability and



long intervals between service are key parameters. Danfoss PAHT pumps are also considerably smaller than plunger pumps, making it easier for SLE to integrate them into their compact cabinets.

THE RESULT:
Low-maintenance, high-
performance parts cleaning and
deal-winning total cost
of ownership

Total cost of ownership calculations are part of practically every project negotiation for SLE Technology. Since high-pressure pumps represent such a significant portion of the overall production and maintenance costs for a cleaning system, pump life cycle costs are critical to the Bavarian company's competitiveness and key to its continuing success.



Download the full
SLE Technology case story



Gas turbines: Cooler, cleaner and more powerful

Efficient gas turbines rely on UPW for power augmentation and NOx reduction. That's why more energy companies depend on Danfoss to keep UPW flowing at pressure.

Gas turbine operators rely on fogging systems powered by Danfoss PAHT pumps to improve turbine efficiency, lower costs and reduce NOx emissions.

Compact power

Danfoss's axial piston technology delivers more power per cubic centimeter than any other high-pressure pump for DI water and UPW.

Easy to install in tight places either horizontally or vertically, Danfoss PAHT pumps provide more flexibility for turbine builders.

Simple maintenance, outstanding TCO

Typically, no maintenance is necessary for the first 8,000 hours of operation, but this is only the beginning. Because axial piston pumps have fewer moving

parts, no stacks and only one seal, lifetime maintenance is radically simplified and turbine downtime significantly reduced. Before you configure your next fogging or wet compression unit for a gas turbine, be sure to include a Danfoss PAHT pump in your total costs of ownership calculations. ATEX and API compliant solutions are available.

Wherever UPW adds value



Power augmentation

Inlet cooling reverses decreased power output due to high ambient temperature.

Injection into compressor section boosts the power output.

NOx reduction

By injecting atomized DI water into the combustor, engineers can reduce flame temperature and NOx formation.

Turbine wash

Keep turbines clean with DI water at high pressure instead of stopping the turbine and using detergents.

Danfoss PAHT pumps boost efficiency at California power plant

15%

increased output
and efficiency
through wet
compression
technology.

Things get hot in Kingsburg, where the cooling cost index is more than two times higher than the California average. As a result, PurEnergy asked Caldwell Energy Company to provide wet compression technology to increase the output and efficiency of its combustion turbine, thus increasing profitability and reducing NOx emissions.



some research opted to try out axial piston technology: a Danfoss PAHT 25 pump was selected to handle the high-pressure requirements. The fact that the pumped medium is the only lubricant was critical, but reduced maintenance costs also played a vital role in the decision.

The retrofit was easy because the PAHT pump has a small footprint compared to plunger pumps and can be mounted either horizontally or vertically.

THE CHALLENGE:
Plunger pumps require time-consuming service routines and still leak oil

Caldwell Energy Company has extensive experience with a variety of cooling technologies for combustion turbine inlets. Its wet compression technology, which has been installed in hundreds of turbines throughout the US, relies on high-pressure pumps to get the job done.

Caldwell Energy Company traditionally used plunger pumps to deliver the necessary flow and pressure, but the

Kingsburg plant proved to be different. Costs for servicing pumps were high due to broken valves and belt drives, and oil leaks from the pump affected the gas turbine's performance.

After six years and two types of plunger pumps that did not even last a year, Caldwell Energy Company was ready to try something new.

THE SOLUTION:
Axial piston technology with Danfoss PAHT pumps

Caldwell Energy Company's engineers decided to try a new approach, and after

THE RESULT:
Contamination-free performance and no maintenance issues

Since installation, the Danfoss PAHT pump has run maintenance-free and the risk of oil contamination has been eliminated. Caldwell Energy Company now specifies Danfoss PAHT axial piston pumps for all new and retrofit installations.

Read more about
PAHT pumps



A full range of pumps and accessories

Danfoss High Pressure Pumps supplies a full range of pumps, valves, power packs and nozzles ideal for use with UPW.



PAHT Pumps

Danfoss PAHT pumps are available with flow rates from 0.7 to 354 liters per minute.

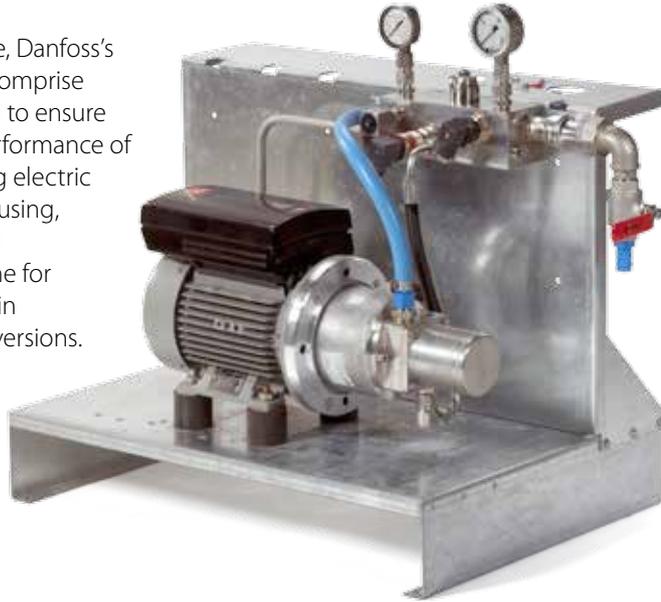
All pumps adhere to stringent hygiene requirements VDI 6022 and HACCP and are certified according to ISO 9001 and 14001.

ATEX certification is available for PAHT G, and API certification is available on request.

Pump size	Flow		Pressure	
	l/min	gpm	barg (min.-max.)	psig (min.-max.)
PAHT 2-6.3	0.7 – 16.5	0.2 – 4.7	30 – 100	435 – 1450
PAHT 10-12.5	7.6 – 27.7	2.0 – 7.2	30 – 140	435 – 2031
PAHT 20-32	10.8 – 73.5	2.8 – 19.1	30 – 160	435 – 2321
PAHT 50-90	28.6 – 149.6	7.4 – 38.9	30 – 160	435 – 2321
PAHT 256-308	89.6 – 354.2	23.3 – 92.1	30 – 120	435 – 1740

Power packs

Compact and flexible, Danfoss's water power packs comprise everything you need to ensure the best possible performance of your pump, including electric motor, aluminum housing, flexible coupling and galvanized steel frame for mounting. Available in standard or custom versions.



Nozzles

Our range of nozzles is designed to atomize water in a wide range of high-pressure water mist systems.

Valves

Our comprehensive range of stainless steel valves are the perfect accessory for your high-pressure system. Danfoss valves are dirt-tolerant, corrosion-proof and easy to clean. Highly reliable, they withstand high temperatures as well as high coil density. NEMA 4X/IP 67.



	Flow		Pressure	
	l/m	gpm	barg (min.-max.)	psig (min.-max.)
Solenoid 2/2-way valves				
VDHT 2E 1/4"	2 – 15	0.5 – 4.0	< 0	< 1450
VDHT 3/8-1/2"	30 – 60	7.9 – 15.9	< 210	< 3046
VDHT 3/4-1"	120 – 150	31.7 – 39.6	< 140	< 2031
Solenoid 3/2-way valves				
VDHT 2E	0 – 2	0 – 0.5	< 80	< 1160
VDHT 15E	0 – 15	0 – 4.0	< 160	< 2321
Pressure-relief valves				
VRH 5	5	1.3	25 – 100	363 – 1450
VRH 30	30	7.9	25 – 210	363 – 3046
VRH 60	60	15.9	25 – 140	363 – 2031
VRH 120	120	31.7	25 – 140	363 – 2031



Here **today**. Here **tomorrow**.

Danfoss is a leading global player within the development and production of mechanical and electronic products and controls.

Since 1933, our extensive know-how has made modern life easier and we continue to break new ground in our core business areas.

Every day, more than 250,000 items are produced at 70 factories in 25

countries. Impressive as these figures are, we are most proud of the way our dedicated employees apply the high-quality components in customer solutions, adding value to the end product.

Building strong partnerships is of great importance to us, because it is purely by understanding our customers' needs that we can meet the expectations of tomorrow.

Danfoss High Pressure Pumps brings decades of hydraulic experience to the design and manufacture of energy-saving pumps.

The Division designs and markets a broad range of high-performance pumps, including the groundbreaking PAHT pumps for ultra-pure water, as well as dedicated solutions for reverse osmosis and oil and gas applications.

Danfoss A/S, High Pressure Pumps

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