

The 3M logo is in red, followed by the tagline "Science. Applied to Life.™" in white. The background is a blue gradient with a close-up of water bubbles at the top.

3M Science.
Applied to Life.™

3M Immersion Cooling

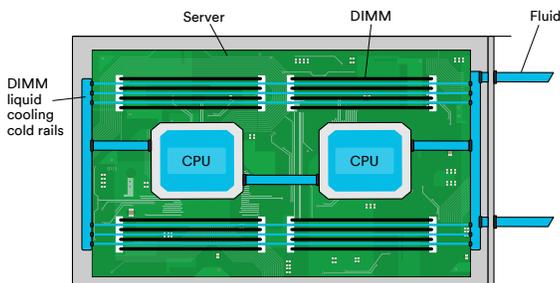
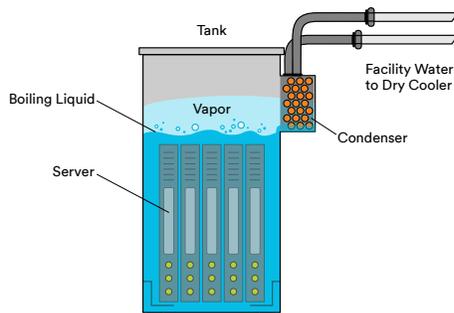
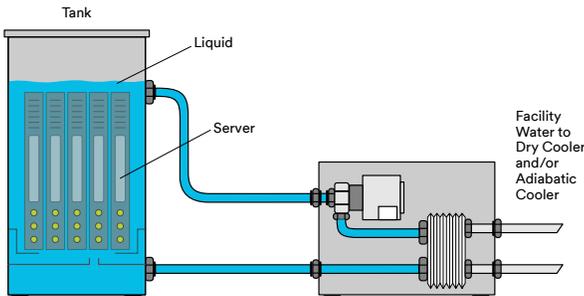
**The next
generation of
data centers
is here.**

The rise of the data economy is fundamentally changing the way we live and our always-on, highly-integrated world is pushing businesses to operate at an ever-increasing pace. Almost every aspect of our daily lives — smart devices, homes, cities and autonomous vehicles — relies on what is happening inside data centers.

However, these centers come at a tremendous cost in energy consumption, water use, footprint and more. It's clear — we need faster, smarter, more energy-efficient and more sustainable data centers.

Liquid cooling techniques enabled by 3M fluids

3M fluids can be used for single-phase and two-phase immersion cooling applications, as well as single-phase and two-phase direct-to-chip applications.



By transitioning data centers from traditional cooling methods to immersion cooling with 3M fluids, businesses can better prepare for the unprecedented performance requirements of the future while managing costs and the impact on our natural resources.

Enter what would otherwise be impossible — a new era of data centers.

Single-phase immersion cooling

In single-phase immersion cooling, fluid remains in its liquid phase. Electronic components are directly immersed in dielectric liquid in a sealed but readily-accessible enclosure where heat from electronic components is transferred to the fluid. Pumps are often used to flow the heated fluid to a heat exchanger, where it is cooled and cycled back into the enclosure.

Two-phase immersion cooling

In two-phase immersion cooling, fluid is boiled and condensed, exponentially increasing heat transfer efficiency. Electronic components are directly immersed in dielectric liquid in a sealed but readily-accessible enclosure where heat from electronic components causes the fluid to boil, producing vapor that rises from the liquid. The vapor condenses on a heat exchanger (condenser) within the tank, transferring heat to facility water that flows outside of the data center.

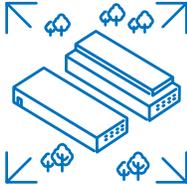
Direct-to-chip cooling

Direct-to-chip cooling rejects heat by pumping fluid through cold plates attached to electronic components. The fluid never makes direct contact with electronics. While non-dielectric fluids (e.g., water glycol) are often used in direct-to-chip cooling, dielectric fluids can be used in direct-to-chip applications to mitigate risks associated with leaks, increasing hardware/IT equipment reliability. Direct-to-chip cooling can be implemented using single-phase and two-phase technologies.

Discover what 3M fluids can do for five different data center applications.

Immersion cooling with 3M™ Fluorinert™ Electronic Liquids and 3M™ Novec™ Engineered Fluids can help improve efficiency while reducing costs and dependency on natural resources center — from design and construction to maintenance and operations. A next-generation data center is right around the corner — let 3M science help get you there.

Hyperscale



Supercomputing



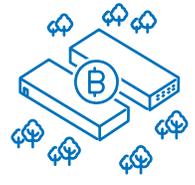
Enterprise HPC



Edge/5G



Cryptocurrency



Geographically and environmentally agnostic

Build more consistent cooling infrastructure globally, regardless of location decisions and environmental variations. Denser form factors also better enable space- and weight-sensitive applications.

Reduce capital and operational expenses

Reduce capital expenditure by minimizing or eliminating air-cooling infrastructure (e.g., chillers, CRACs, CRAHs, PDUs, RPPs, telecom/networking, facility footprint). With increased cooling efficiency, electricity costs dedicated to ancillary cooling needs can be reduced.

Greater performance and cooling efficiency

Elevate computing performance thanks to increased cooling efficiency and support new or more compute-intensive workloads that traditional cooling solutions struggle to cool in an efficient and cost-effective way.

Increase hardware reliability

Mitigate common hardware failures by minimizing moving parts (e.g., fans) that are necessary for traditional cooling methods.

Roadmap to future power density needs

Deploy high-density units with small form factors engineered to support current and future workloads.

Simpler data center designs to scale more efficiently

Enjoy smaller and simpler data center topologies (e.g., mechanical, electrical, networking). Simplify data center design by eliminating the need for complex airflow management.

Reduce Power Usage Effectiveness (PUE) and water usage

With PUEs as low as 1.03, build more power-efficient and sustainable data centers. Also, reduce or eliminate water waste with either single-phase or two-phase immersion cooling through the use of dry coolers.

Lower latency

Help reduce delays by running latency-sensitive workloads in denser, space-optimized units closer to the user.

Extend life of assets

Sealed but readily accessible units protect IT hardware from environmental contaminants such as dust and moisture. A reduction in moving parts also helps improve reliability and extends the life of units.

Discover the right 3M fluid for your liquid cooling needs

Both 3M™ Novec™ Engineered Fluids and 3M™ Fluorinert™ Electronic Liquids offer top-tier thermal management performance backed by 3M's research and expert guidance for single-phase and two-phase liquid cooling applications.

3M™ Fluorinert™ Electronic Liquids

3M Fluorinert Electronic Liquids have set the industry standard for direct-contact electronics cooling for over 60 years. These extremely inert, fully-fluorinated liquids have exceptionally high dielectric strength and excellent material compatibility. 3M Fluorinert Electronic Liquids are clear, odorless, non-flammable, non-oil-based, low in toxicity, non-corrosive, offer a wide temperature operating range and high thermal and chemical stability. 3M Fluorinert Electronic Liquids also have low dielectric constants making them ideal for single-phase and two-phase data center immersion cooling applications.

3M™ Novec™ Engineered Fluids

3M Novec Engineered Fluids are designed to balance performance with favorable environmental and worker safety properties. They are available for a wide variety of applications including heat transfer, cleaning, testing and lubricant deposition. These fluids are non-flammable, non-oil-based, low in toxicity, non-corrosive, have good material compatibility and thermal stability. 3M Novec Engineered Fluids also have a low global warming potential (GWP) and zero ozone depletion potential (ODP), giving data center owners an innovative, trusted and sustainable solution for their single-phase or two-phase data center liquid cooling (direct-to-chip and immersion cooling) applications. 3M currently recommends using hydrofluoroether-based (HFE) 3M Novec Engineered Fluids for data center liquid cooling applications.

As data center design evolves, our unique experience in immersion cooling can help you tackle your next data center project.

Get more information and answers to frequently asked questions by visiting our website www.3M.com/ImmersionCooling.

Safety Data Sheet: Consult Safety Data Sheet prior to use.

Regulatory: For regulatory information about this product, contact your 3M representative.

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