



Immersion cooling for modern data centers



Data center infrastructure is evolving due to increased demand for remote work, cloud computing and business digitalization in both the commercial and consumer sectors.

Traditional data centers require significant energy resources to maintain the proper environment for optimal efficiency. Immersion cooling serves as an emerging solution to this multifaceted dilemma. This technology utilizes non-conductive fluids to mitigate thermal output. This method offers data center operators an array of benefits, which may include reduced energy needs and cost savings.

As data center facilities transition to utilizing immersion-cooled technology, installed systems must meet applicable safety and performance criteria requirements. Systems for the immersion cooling hardware, installed information technology (IT) equipment and insulating fluids must demonstrate compatibility for safe and optimal operation. UL is excited to play a role in offering an additional, independent source of trust for this emerging field.

Immersion cooling certification categories

We offer certification services across three core areas of immersion cooling: liquid immersion hardware, insulating liquids and installed IT equipment. UL takes a comprehensive approach to help data center operators achieve safe and compatible performance.

Liquid immersion hardware

To respond to the growing acceptance of this technology, UL's certification personnel have developed a two-pronged approach for immersion cooling hardware, from components to cabinets.

- **Fully configured systems** – These complete systems involve installed IT equipment and can achieve certification to CSA/IEC/UL 62368-1, the Standard for Safety of Audio/Video, Information and Communication Technology Equipment - Part 1: Safety Requirements.

- **Configurable systems** – This includes unconfigured systems or those the customer can configure that can achieve certification to UL 2416, the Standard for Audio/Video, Information and Communication Technology Equipment Cabinet, Enclosure and Rack Systems. This Standard's updates include immersion cooling cabinets featuring insulating liquids. The testing and certification of immersion cooling cabinets to UL 2416 requires testing one representative system that features the relevant cabinet system hardware, insulating liquid and the maximum electrical load typical of servers, power supplies, cabling and other components.



Relevant standards

UL 2416

This ANSI/UL Standard applies to air-cooled racks and cabinets that may include power distribution, fans and other components that are not considered complete systems. A new certification category now specifically addresses immersion cooling cabinets with insulating liquids.

IEC 62368-1

This IEC-based standard covers audio, video and information and communication technology equipment and covers a wide range of data center equipment and components. It is also a globally recognized and harmonized standard.

The following clauses of the standard reference requirements related to immersion cooling and insulating liquids.

- **Clause 3.3.5.4:** Insulating liquid terms and definition
- **Clause 4.1.8:** Liquids and liquid-filled components
- **Clause 4.4.4:** Displacement of a safeguard by an insulating liquid
- **Clause 5.4.12.1:** General requirements
- **Clause 5.4.12.2:** Electric strength of an insulating liquid
- **Clause 5.4.12.3:** Compatibility of an insulating liquid
- **Clause 5.4.12.4:** Container for insulating liquid
- **Clause 6.4.9:** Flammability of an insulating liquid

Insulating liquids

As a critical component in the complete immersion cooling system, UL will evaluate the critical characteristics of the dielectric insulating liquids, including autoignition temperature, flashpoint and dielectric breakdown voltage.

A UL Recognized Component certification is under development to separately certify these dielectric insulating liquids. UL Recognition of dielectric insulating liquids will allow cooling system manufacturers to pre-select these fluids with the appropriate critical characteristics, thereby reducing the cost and time for their system certification.

Installed information technology equipment

UL understands that data center operations must be flexible to meet changing business needs. We've developed two testing and certification programs applicable to installed IT equipment such as servers.

- **Designed for immersion cooling** – Manufacturers of installed IT equipment originally created for use in immersion cooling may submit products for testing and certification to CSA/IEC/UL 62368-1
- **Modifications** – Manufacturers of certified products that have been modified for use for immersion cooling may retest certified IT equipment for compatibility with specific insulating liquids. If the equipment meets the Standard's requirements, the manufacturers may add these modified models as alternate construction to their existing safety certification file.

Rising to developments in data center technology

Data center owners are eager to embrace immersion cooling technology to save energy and operating costs and reduce the impact on the environment while keeping customers' data safe, secure and accessible.

UL's certification capabilities are constantly evolving to meet these challenges and help manufacturers demonstrate that their liquid immersion hardware, insulating liquids and installed information technology equipment meet applicable standards.

To learn more about our testing and certification solutions or to get started, please visit [UL.com/datacenters](https://www.ul.com/datacenters).



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