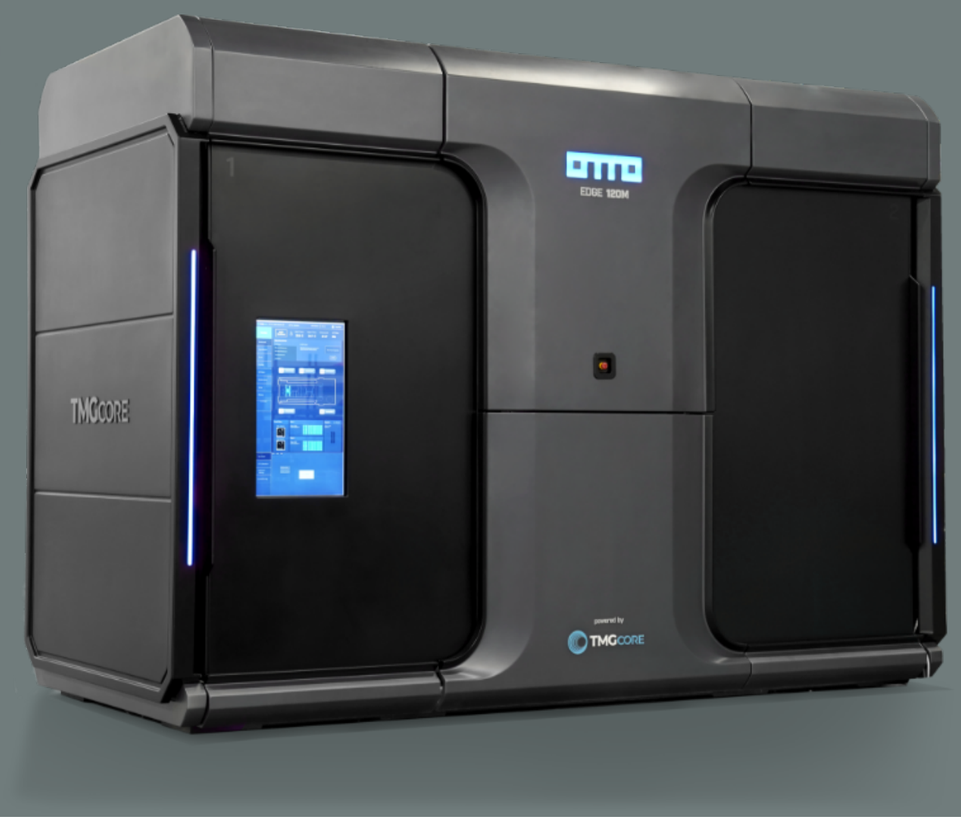
DEATON ENGINEERING
YOUR VISION, OUR PRECISION

CASE STUDY

TMGCore and Deaton bring revolutionary improvements to data center design and operation.



The Client: TMGCore

TMGcore collaborates with global industry experts to design, create, and commercialize the next generation of high-performance computing solutions.

High-performance computing (HPC) used to be (back in the late 1990s and early 2000s) the exclusive domain of university-based and federally funded national laboratories.

Think: Sprawling, old-school, expensive data centers that were anything but energy-efficient.

Because of greater volumes of data (requiring sophisticated analytics), lower hardware costs, and the arrival of machine learning and AI, the opportunity and need for HPC has gone mainstream. It's the best way for your business to keep up with ever-more-demanding customers. Because, let's face it, we're all in the data and analytics business now.

Until recently, though, there's been an open question: *If the need for HPC is obvious—and it is—how do you get a new data center that fully addresses your requirements for, among other things, a smaller footprint plus lower capital and operational expenditures?*

The Challenge: Understand, Design, and Build the High-Density Data Center

At Deaton, we're comfortable going where nobody has gone before. And that's what TMGCore invited us to do. We are thankful for such invitations.

TMGcore hired us to design, engineer, build prototypes, and create a DFM package for a high-density data center using *two-phase liquid immersion cooling technology.*

TMGCore's OTTO platform had to deliver first-of-their-kind improvements so that companies could deploy infrastructure at unprecedented densities beyond the threshold of traditional air-cooled strategies.

Companies (TMGCore clients) realize they need the business-transforming power of high-performance computing. And the words "reliable," "scalable," "affordable," "automated," "environmentally friendly," "cost-efficient" have to be in the mix.

Challenge accepted. Data center redefined.

The Solution: Doing What Hasn’t Been Done Before. And Doing It Like You’ve Done It Before

- ***There’s No Substitute for Being First:*** OTTO is the first-of-its-kind, commercial-ready, enterprise-grade, two phase liquid immersion cooling platform.
- ***Density? Oh, Yeah This Is Dense:*** Our design supports extreme, high-density computing blades consuming up to 6,000 watts per blade.
- ***Efficiency Pushed to the Max:*** OTTO has high-power flux of 3,750 watts per square foot vs. 150-200 watts per square foot in a typical air-cooled data center.
- ***Fully Autonomous Operations:*** A marketer might call it “OTTO-Pilot.” But whatever you want to call it, OTTO supports lights-out, self-healing, hands-off operation that enables all aspects of the platform to be remotely administered and monitored.
- ***Robotic Process Automation:*** Including edge deployments in lights-out facilities.
- ***Centralized Management:*** The OTTO Manager console is a management interface that enables monitoring and administration of the entire platform.
- ***Advanced Robotics:*** Deaton’s design fully automates the swap-out of installed blades for new blades while the machine is running. Translation: Zero down time. Additionally, we created a process to minimize vapor loss during these hot-swaps.
- ***Process Controls:*** We developed and implemented process controls, including pressure, temperature, fluid level, relative humidity, and more.
- ***Proprietary Components:*** We worked with fluid experts to conceptualize, develop, and test a Vapor Recovery System that mitigates elevated pressure and minimizes vapor loss. The system implements a “pervaporative membrane” to allow egress of water vapor from the machine without allowing fluid vapor through.

We could go on and on here, taking you even deeper into all that our collaboration with TMGCore has required or produced: customizable blades, finite element analysis, material compatibility, safety features, design for integration into a customer facility… and much more. We’re engineers. We love getting into the weeds.

Repeat business is a designed-in part of our Deaton’s success.

The proof of our successful collaboration is much simpler to detail. Here’s the bottom line:

Our success with OTTO has resulted in our working with TMGCore to develop several of its other machine lines.

Engineering Highlights:

- **The First in Its Type** – OTTO is a commercial ready, enterprise-grade, two-phase liquid immersion cooling platform.
- **Unparalleled Densities** – DEI’s design supports extreme high-density computing blades consuming up to 6,000 watts (6 kW) per blade.
- **Highly Efficient Machine** – OTTO has high power flux of 3,750 watts/SF vs. 150-200 watts/SF in typical air-cooled data centers.
- **Fully Autonomous Operations** - OTTO supports lights-out, self-healing, hands-off operation that allows all aspects of the platform to be administered and monitored remotely.
- **Robotic Process Automation** or remote & edge deployments in lights-out facilities.
- **Centralized Management** - The OTTO Manager console is a management interface that allows for the monitoring and administration of the entire OTTO platform.

- **Advanced Robotics** – DEI's design fully automates the replacement of installed blades inside the machine with new blades while the machine is running (hot-swapping), and with zero down time. In addition, Deaton created a process to minimize the vapor loss during hot-swaps.
- **Process Controls** – Process controls, including pressure, temperature, fluid level, relative humidity, and other controls have been developed and implemented by DEI.
- **Proprietary Components** – DEI worked with fluid experts to conceptualize, develop, and test a Vapor Recovery system that mitigates elevated pressure in the machine and minimizes fluid vapor loss. The system implements a "pervaporative membrane" to allow the egress of water vapor from the machine without allowing fluid vapor through.
- **Customizable Blades** – DEI developed mechanical, electrical and worked with partners on communications architecture for the blade/machine interface, which allows customers to have the flexibility to use their custom-built blades in the machine. Collaborating with partners of TMG, DEI developed an immersed power supply blades providing compute power.
- **FEA:** Engineers at DEI performed finite element analyses on critical machine components for verification of the design robustness.
- **Custom measures and off-the-shelf equipment** were implemented to identify critical process faults and report to control system
- **Fluid Choice** – The machine can be filled and operated with several compatible fluids.
- **Material Compatibility** – DEI conducted research and consulted with subject matter experts on the materials that would be compatible with the specialty fluids to avoid chemical reactions and/or physical changes or damages to the fluid, parts and components.
- **Safety Features** – DEI performed risk assessments to deliver design features that mitigate electrical, mechanical, and health safety issues related to operation of the machine.
- **Redundancy** – Deaton enhanced the reliability of the machine and minimize down time. Redundancy was implemented for most components.
- **Design for Integration into Customer Facility** – Deaton's design supported different types of power, such as 415V and 480V, and different facility water supply lines.
- **Design for Manufacturing and Assembly Support** – Deaton worked with high volume manufacturing partners to prepare the machine design for volume manufacturing.
- **Prototype Build, Testing, Debugging, Optimization:** DEI built a full-size prototype and tested the machine at system, subassembly, and component levels. If any issues arose during the testing, DEI's engineers debugged them, and optimized the performance to meet customer needs.
- **HMI (Human Machine Interface)** – In addition to autonomous control, as well as remote manual control, operators of the machine will be able to manually control at the machine via a user-friendly, large, high-resolution touch-screen.
- **Documentation** – developed documentation for testing, shipping readiness, installation, commissioning, user operation, maintenance, and many other critical documents.
- **Aesthetics** – DEI worked with our customer and their partner to include customer's vision of an aesthetic machine.
- **Project Management and Communication** – DEI diligently managed the project and created a strong effective communication with our customer, vendors, machine shops, and others.

In addition to OTTO 120, the first immersion cooling product of TMGcore, DEI has assisted TMGcore to develop several other machine lines with various capacities that met customer needs.

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