

**OFFICE OF ENERGY EFFICIENCY & RENEWABLE ENERGY**

[Home](#) » [Products & Technologies](#) » [Technology Deployment](#) » [Magnetic-Bearing Chiller Compressors](#)

## MAGNETIC-BEARING CHILLER COMPRESSORS

Centrifugal, two-stage, magnetic-bearing chiller compressors equipped with variable-speed drives are a relatively new technology that operates at a high efficiency. Based on this case study, independent analysis by the U.S. Department of the Navy has verified that magnetic bearing compressors operate more efficiently than reciprocating and screw compressors, especially during partial load conditions.

The magnetic bearings allow the compressor to operate without the use of oil for lubrication, which reduces energy losses due to friction and increases the heat transfer efficiency of the chiller, because no oil enters the evaporator or the condenser. A variable speed drive on the motor allows the compressor to operate much more efficiently at partial loads than standard compressors. The oil-free system also eliminates the need for oil maintenance, resulting in operations and maintenance savings.

### AGENCY TECHNOLOGY EVALUATION PROGRAM

Magnetic-bearing chiller compressors are oil-free, variable speed compressors that can be installed as a retrofit to an existing chiller or within a new chiller. Digital, internally controlled, magnetic bearings reduce friction and eliminate the need for oil lubrication. The compressor is manufactured by a single company, but many manufacturers include this new compressor as part of a chiller package.

### NAVY TECHNOLOGY VALIDATION PROGRAM

The Navy Technology Validation Program (Navy Techval) was established in 2004 to identify technologies that show large energy savings, show promise in a variety of applications and locations, reduce maintenance costs, lower the Navy's energy bill, meet federal mandates, and reduce technology implementation barriers.

The Navy Techval Program demonstrates commercially available emerging technologies that look promising for use at shore facilities but are not yet in widespread use. This technology brief highlights the drivers, savings, and benefits found in the demonstration of the magnetic bearing chiller compressors.

### POTENTIAL APPLICATIONS

- Nationwide application
- Partial load applications on chillers achieve the most savings

### WHAT WERE THE BENEFITS?

Magnetic-bearing compressors feature:

- Quiet operation

- Light weight: Allows for faster installation
- Low startup draw: About 2 amps, which can reduce capacity/peak power requirements for a backup generator
- Reduced maintenance costs due to no oil use.

## NAVY TECHVAL PROGRAM BENEFITS

Magnetic-bearing compressor benefits identified by the Navy Techval include:

- 49% average power savings achieved
- 6.4 years average return on investment
- Quiet operation
- Light weight
- Low start-up power draw
- Reduced maintenance costs.

## WHAT WERE THE SAVINGS?

Power savings averaged 49% across three case study sites. Magnetic bearing compressors were installed in each of the sites shown in the table below. The San Diego, California, and Jacksonville, Florida, studies were both compressor retrofits, while the Newport, Rhode Island, study involved installation of a new chiller. In these case studies, the largest savings were experienced at the Newport, Rhode Island, location.

Energy savings were assessed for retrofits in three different Navy facilities as part of the Navy's Technical program between 2005 and 2007. The results are presented in the table below.

### NEW CHILLER TECHNOLOGY TECHVAL DEMONSTRATION SUMMARY

Project Site	Project Type	\$/kWh	Tons	Annual kWh savings	Annual Energy \$ Savings	% Savings	Cost	\$/Ton	Payback (years)
"San Diego"	Add a third compressor	\$0.121	240	176,717	\$21,206	40%	\$178,787	\$744	8.4
"Newport"	Install a new chiller	\$0.115	80	227,760	\$26,192	65%	\$100,783	\$1260	3.8
"JAX"	Retrofit compressor with condensing water reset	\$0.054	120	284,407	\$15,358	41%	\$107,592	\$897	7.0

## OPERATIONS AND MAINTENANCE

Based on manufacturer recommendations over 10 years, maintenance labor and costs are estimated to be approximately 96 person-hours in labor and \$500 in materials.

## POTENTIAL APPLICATIONS

A magnetic-bearing chiller compressor can be installed as part of a new chiller installation or a retrofit on an existing chiller when the existing evaporator and condenser are in good condition. The technology is ideally suited for chillers that run at partial load for most of the year. Energy savings are reduced at, or near, full load. The technology may require an upgrade of controls to extract the most savings from a retrofit. Magnetic bearing compressors can be applied to air-cooled and water-cooled chillers.

## LESSONS LEARNED

---

The Jacksonville demonstration revealed another opportunity for increased energy savings. The new compressor technology is capable of operating with lower condenser water supply temperatures compared to some conventional compressor systems. This resulted in an additional improvement in efficiency.

The new variable-speed centrifugal compressor technology is a notable improvement over existing reciprocating and screw compressors. In addition to energy and cost savings, the new technology is lighter and quieter.

## ACHIEVING ENERGY SAVINGS IN YOUR FACILITY

---

Magnetic-bearing chiller compressors can help meet federal laws and requirements.

- Conduct an inventory of existing chiller compressors
- Identify older chillers that are due to be replaced
- Create a replacement schedule and evaluate the feasibility of magnetic bearing chiller compressors when chillers are being replaced.
- Monitor the energy savings associated with the compressor. If savings are evident in only a few locations, identify what's different about those locations and replicate in similar locations.
- The Federal Energy Management Program (FEMP) provides support to federal agencies looking to fund energy efficiency projects.
- FEMP's [Project Financing](#) section provides detailed information and identifies where assistance is available to implement energy projects.

## EXPLORE FEMP'S TECHNOLOGY DEPLOYMENT PAGES

---

- [Efficient Technologies and Products for Federal Facilities](#)
- [Outdoor Solid-State Lighting Technology Deployment](#)
- [Technology Deployment Case Studies](#)

## FEMP CONTACTS

---

**Nicolas Baker**

U.S. Department of Energy

202-586-8215