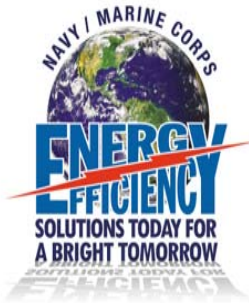




Results From The Navy Technology Validation (Techval) Program



Techval

Energy Efficient Technologies For
Government Buildings – New And Retrofits
Fifth Industry Workshop
January 27&30, 2009
Chicago, IL
Paul Kistler, PE CEM
Naval Facilities Engineering Service Center
Port Hueneme CA

Navy Techval



CURRENT PROJECTS

- **Boiler Controls**
 - *NA Annapolis MD*
- **Sand Filters**
 - *NAS Lemoore CA*
- **Desuperheater**
 - *NS Norfolk VA*
- **Ceiling Fans**
 - *NAS Lemoore*
- **Waterless Urinals**
 - *NBVC Port Hueneme CA*
 - *SNI CA*
 - *NB San Diego CA*
- **Walk in Cooler Fan Controller**
 - *NBVC Port Hueneme CA*
- **RF Plug Controller**
 - *NBVC Port Hueneme CA*
- **HVAC CO2 Controls**
 - *NAB Little Creek VA*
 - *NAVSUPPACT Mid-South TN*
 - *NB Kitsap Bremerton WA*
- **HVAC Occupancy Controls**
 - *NAS Oceana VA*
- **EMP Water Treatment**
 - *NADEP San Diego CA*
- **Wrap around heat pipe**
 - *NAS Pensacola FL*
- **LED Parking Lot Lights**
 - *NBVC Port Hueneme CA*
- **State Of The Art Lighting**
 - *NBVC Port Hueneme CA*
- **Plug Occupancy Sensor**
 - *NBVC Port Hueneme CA*

Navy Techval



COMPLETED PROJECTS

- **Duct Sealants**
 - *NSA Orlando FL*
 - *NS Newport RI*
 - *NSY Puget Sound WA*
 - *NB San Diego CA*
- **EER+ Retrofit**
 - *NSWC Corona CA*
 - *NB San Diego CA*
 - *NWS Yorktown VA*
 - *NAWS China Lake*
- **Spectrally Enhanced Lighting**
 - *NBVC Port Hueneme*
 - *Navy Yard Washington DC*
- **Power conditioner**
 - *SUBASE New London CT*
- **Fuel oil fired 30KW Microturbine**
 - *SUBASE New London CT*
- **Thermal destratifiers**
 - *NSWC Crane IN*
 - *NSWCCD West Bethesda MD*
 - *NAS Oceana VA*
- **Magnetic Bearing Chiller Compressor**
 - *NUWC Newport RI*
 - *NRSW San Diego CA*
 - *NAS Jacksonville FL*
- **Boiler Combustion Controls**
 - *NB Kitsap Bremerton WA*
- **HID dimming**
 - *NBVC Port Hueneme CA*
- **Cool Roof**
 - *NS Pearl Harbor HI*
- **Wrap around heat pipe**
 - *NS Pearl Harbor HI*

Navy Techval



Reports Currently Available

- Vending Machine Occupancy Sensor
- LED Airfield Lighting
- Thermal Destratifiers
- Magnetic Bearing Chiller Compressor I
- Premium Air Filters
- HID Dimmers
- Super T8 Lamps
- Interior Storm Windows
- Power Conditioners
- Microturbines
- Day Lighting
- 75 ECM's
- Duct Sealants

Reports Currently in Final Review

- Heat Pipes
- Magnetic Bearing Chiller Compressor II
- Cool Roofs
- Walk-in Cooler Fan Controller
- Video Game Controller

Green Light Technologies

- Oil Free Magnetic Bearing Chiller Compressor
- Vending Machine Occupancy Sensor
- Cool Roof
- Thermal Destratifiers
- Airfield LED lighting
- Super T8 lighting
- Day Lighting
- Spectrally Enhanced Lighting
- Heat Pipes
- Duct Sealants
- HID Dimming
- Photo Luminescent Exit Signs
- Video Game Occupancy Sensors
- Video Game Timers

Yellow Light Technologies

- Desuperheaters
- Sand Filters
- EMP Water Treatment
- Boiler Combustion Controls
- HVAC Occupancy Sensors
- CO2 HVAC Control
- LED Lighting
- Walk in Cooler Fan Controller
- RF Plug Controller
- Exterior Insulation
- Induction Lighting
- Air Cooled Magnetic Bearing Compressor

Navy Techval



- ❖ Magnetic Bearing Chiller Compressor
- ❖ Spectrally Enhanced Lighting
- ❖ Duct Sealants
 - What is it, how does it work?
 - Data from projects
 - Where does it work best?

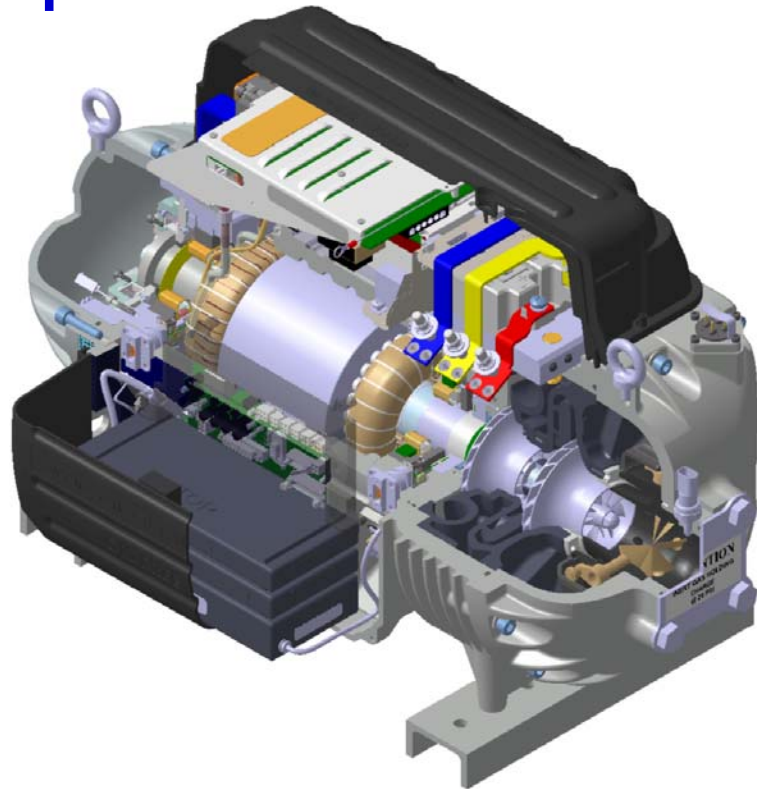


Techval

Navy Techval



The Magnetic Bearing Chiller Compressor at a Glance



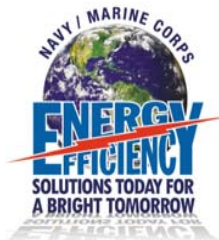
Drawing courtesy of Danfoss
TurboCor Compressors, Inc.



Navy Techval



2 ea. 60 ton chiller compressors with magnetic bearings
NAS Jacksonville FL

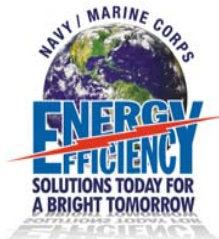
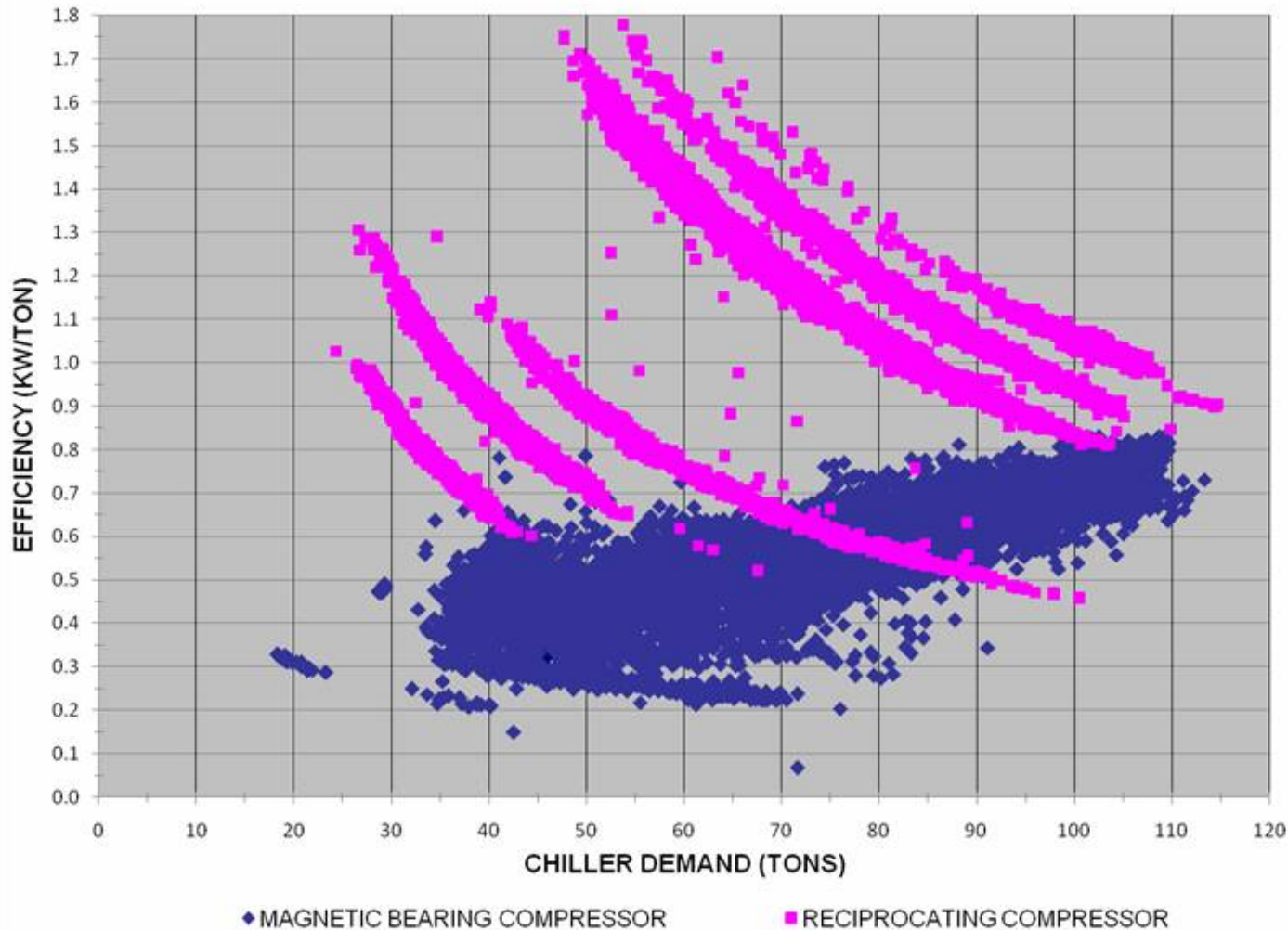


Techval

Navy Techval



MAGNETIC BEARING VS. RECIPROCATING COMPRESSORS
COMPRESSOR EFFICIENCY



Techval

Navy Techval



JAX Data

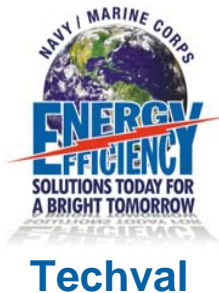
	Compressor Efficacy	Plant Efficacy	Average Load	Average Compressor Power	Cooling Tower Power	Plant Power
New	.57 kW/ton	.61 kW/ton	75.4 ton	45.9kW	2.44kW	48.3 kW
Existing	1.02 kW/ton	1.04 kW/ton	76.7 ton	78.5kW	1.55kW	80.1 kW

Navy Techval



Cost for installation in Jacksonville

Mechanical Subcontractor (including compressor)	\$95,150
DDC Subcontractor	<u>\$12,442</u>
Total	\$107,592



Techval

Navy Techval



The Table below presents a synopsis of the data collected for these three projects:

Project Site	Project Type	\$/KWH	Tons	Annual kWh savings	Annual Energy \$ Savings	% Savings	Cost	\$/Ton	Payback (years)
San Diego 2006	Add 3 rd compressor	\$0.121	240	176,717	\$21,206	40%	\$178,787	\$744	8.4
Newport Sep/Nov 2005	New Chiller	\$0.115	80	227,760	\$26,192	65%	\$100,783	\$1260	3.8
JAX Dec/Apr 2006/2007	Compressor Retrofit with Cond. Water reset	\$0.054	120	284,407	\$15,358	41%	\$107,592	\$897	7.0

Navy Techval



The Table below is the simple payback using the incremental cost:

Project Site	Tons	Annual Energy \$ Savings	Incremental Cost	Payback (years)
San Diego 2006	240	\$21,206	\$24,000	<u>1.1</u>
Newport Sep/Nov 2005	80	\$26,192	\$8,000	<u>0.3</u>
JAX 2006/2007	120	\$15,358	\$12,000	<u>0.8</u>

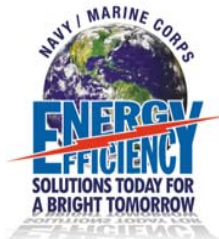
Navy Techval



Maintenance

- | | |
|---|---|
| 1. Quarterly tightening of terminal screws
(could be done in conjunction with #2
once per year) | 2 work-hours per service |
| 2. Annual blowing dust off circuit boards | 2 work-hours per service |
| 3. Change capacitors every five years | 8 work-hours per service
plus \$250 for capacitors |

Over 10 years that would be 96 work-hours plus \$500 for capacitors.



Techval

Other advantages of the compressor

- **Quiet** – In San Diego the chilled water pumps make more noise than the chiller. Could be a plus if installation is in an area where noise is an issue.
- **Light weight** – If compressor needs to be changed out, can be accomplished manually by two persons.
- **Low startup draw** – about 2 amps. Could be a plus if you are replacing or installing a backup generator since generator can be downsized to handle full load draw, not startup. Smaller generator may pay for incremental cost of compressor.

Navy Techval



Problems

Newport

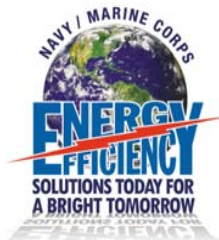
- Thermister failed. Thermister was replaced and problem has not recurred.
- Automatic Expansion Valve not tuned properly. Valve was adjusted and problem has not recurred.

San Diego

- Insulated Gate Bipolar Transistor (IGBT) failed. Decision was made to replace compressor since it was relatively easy to do. Replacement took two hours. Problem has not recurred.
- Power surge damaged one of three compressors. Compressor was replaced. Manufacturer has stated that electronics have been improved since this compressor was installed.
- Electronics were not sealed sufficiently resulting in moisture damage. Sealing has been improved.

Jacksonville

- None



Techval

Best Places To Install Magnetic Bearing Chiller Compressors

- Relatively high electric rates ($> \$0.07$ kWh)
- Long run hours at part load
- Where existing compressor is in need of replacement

Spectrally Enhanced Lighting (SEL)

What Is It?

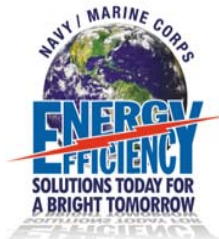
- **Conventional practice utilizes lamps with color correlated temperature (CCT) of 3000K to 4100K**
- **The eye is more sensitive to light in the higher CCT range (bluer, closer to the color of natural sunlight)**
- **Spectrally Enhanced Lighting (SEL) uses lamps with a CCT of 5000K**
- **Since eye is more sensitive to light with higher CCT, lower ballast factor ballast can be used to dim the lights which is not apparent to the eye.**

Navy Techval



Building 166 Washington Navy Yard

	<u>PRE</u>	<u>POST</u>
Predominant Fixture	2X4 Troffer	2X4 Troffer
Total Fixtures	810	810
Total Lamps	2877	1789
Ave Lamps/Fixture	3.55	2.21
Nominal Lamp Wattage	32	32
Lamp Color	741	850
Ballast Factor (BF)	0.88	0.78
Watts/luminaire	100	63



Techval

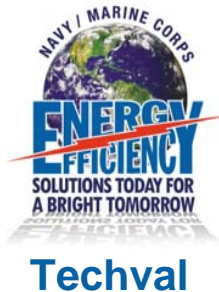
Navy Techval



Building 166 Washington Navy Yard

Simple Payback (Energy Savings Only)

Total Installed Cost	\$107,104
Annual Savings	\$7897
Payback (Yrs)	14



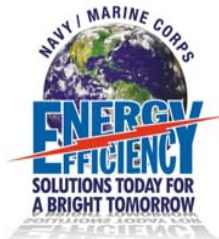
Techval

Navy Techval



Where To Use SEL

- **Determine the following pre-retrofit conditions**
 - **Existing lamp type**
 - Lumen output
 - Wattage
 - Technology
 - S/P value
 - **Ballast Type**
 - Input wattage
 - Start type
 - Internal wiring
 - **Luminaire switching and wiring**
 - Tandem wiring, no. between luminaires
 - Two level switching
 - Can delamping be performed
- **Perform LCC analysis to determine best lamp/ballast combination**



Techval

Navy Techval



Duct Sealing



Building 1268
NS Newport, RI



De Florez Building
NAVAIR Orlando, FL

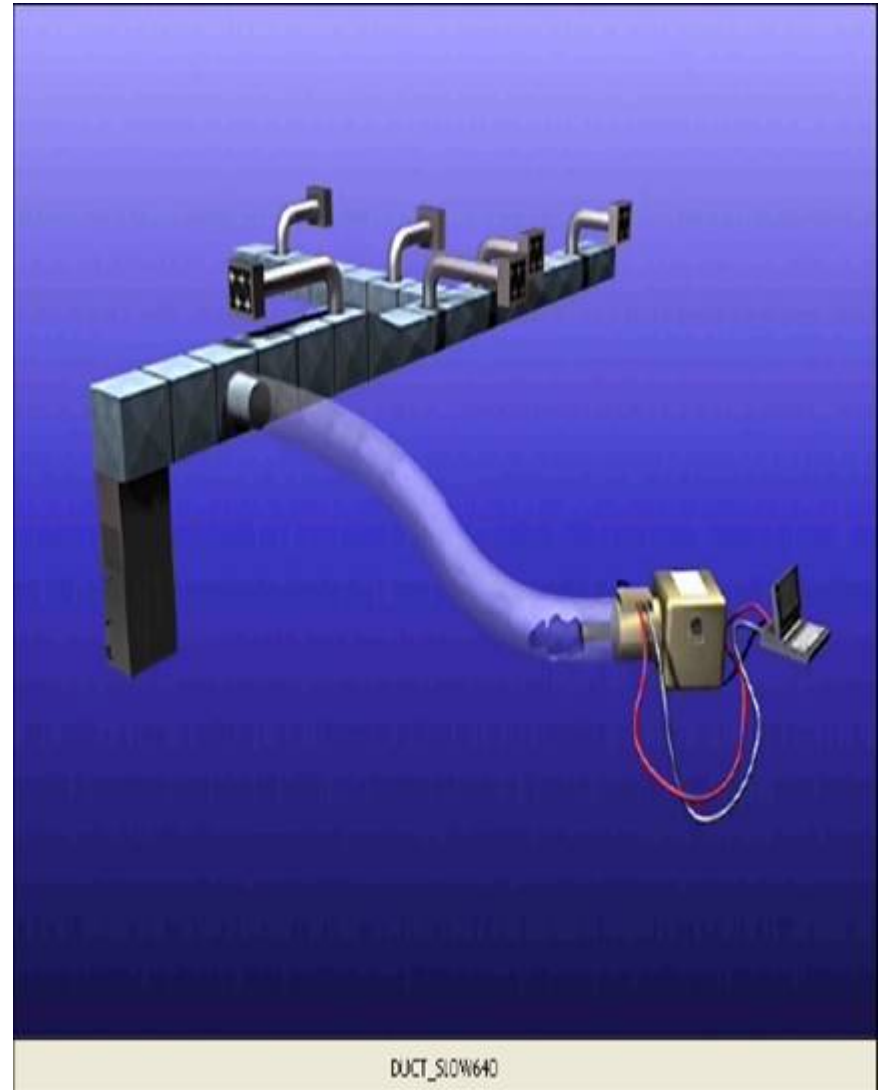


Building 865
NB Kitsap
Bremerton, WA



Building 3339
NB San Diego, CA

**What is
duct
sealing?**



Navy Techval



Interior of Duct After Sealing



Navy Techval



Economics

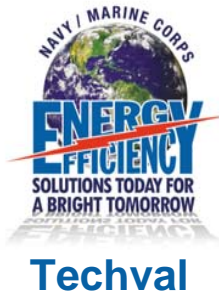
	De Florez Bldg Orlando	Bldg 1268 Newport	Bldg 865 Bremerton	Bldg 3339 San Diego
Annual energy savings (\$/yr)	\$8,125	\$2,880	\$2,007	\$2,045
Installation Costs (\$)				
-Aeroseal™	\$49,057	\$23,701	\$8,453	\$21,270
-New fan motor	n/a	n/a	8,512	n/a
-Variable-frequency drive	n/a	n/a	4,510	n/a
-Test, adjust and balance	n/a	n/a	2,680	n/a
-Total	\$49,057	\$23,701	\$24,155	\$21,270
Simple Payback (yr)	<u>6.0</u>	<u>8.2</u>	<u>12.0</u>	<u>10.4</u>

Navy Techval



Conditions where the technology application would be most cost effective are:

- High site energy costs ($> \$0.07/\text{kWh}$)
- Ducts to be sealed are in unconditioned space
- Heating and/or cooling energy loads primarily met by the air distribution system. Perimeter heating will severely limit the energy savings potential of the technology
- Duct systems that are known to be leaky
 - duct blaster tests on sections of the duct systems will confirm the degree of leakiness.



Techval

Navy Techval



Paul Kistler P.E. C.E.M.
Mechanical Engineer
NAVFAC Engineering Service Center
1100 23rd Ave.
Port Hueneme CA 93043
(805) 982-1387
Cell (805) 312-5504

Save The Date For GovEnergy 2009
August 9 – 12, 2009
Providence, RI
www.govenergy.gov



Techval