



Storage Systems Can Now Get ENERGY STAR Labels and Why You Should Care

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Agenda

- **About Demartek**
- **Energy Efficiency in the Home and in Data Centers**
- **Power Supplies**
- **SNIA Emerald Specification**
- **EPA ENERGY STAR Data Center Storage**
- **Demartek Experience Running Emerald/EPA Tests**
- **Demartek Free Resources**

Demartek Video



Click to view this one minute video
(available in 720p and 1080p)

Demartek YouTube Channel:

<http://www.youtube.com/user/Demartek/videos>

- **Industry Analysis and ISO 17025 accredited test lab**
- **Lab includes servers, networking & storage**
 - ◆ **Fibre Channel: 4, 8 & 16 Gbps**
 - ◆ **Ethernet: 1, 10 & 40 Gbps: NFS, SMB (CIFS), iSCSI, FCoE and SR-IOV**
 - ◆ **Servers 8+ cores, large RAM**
 - ◆ **Virtualization: VMware, Hyper-V, Xen**
- **We run storage performance tests and power efficiency tests, among other things**
- **Website: www.demartek.com**

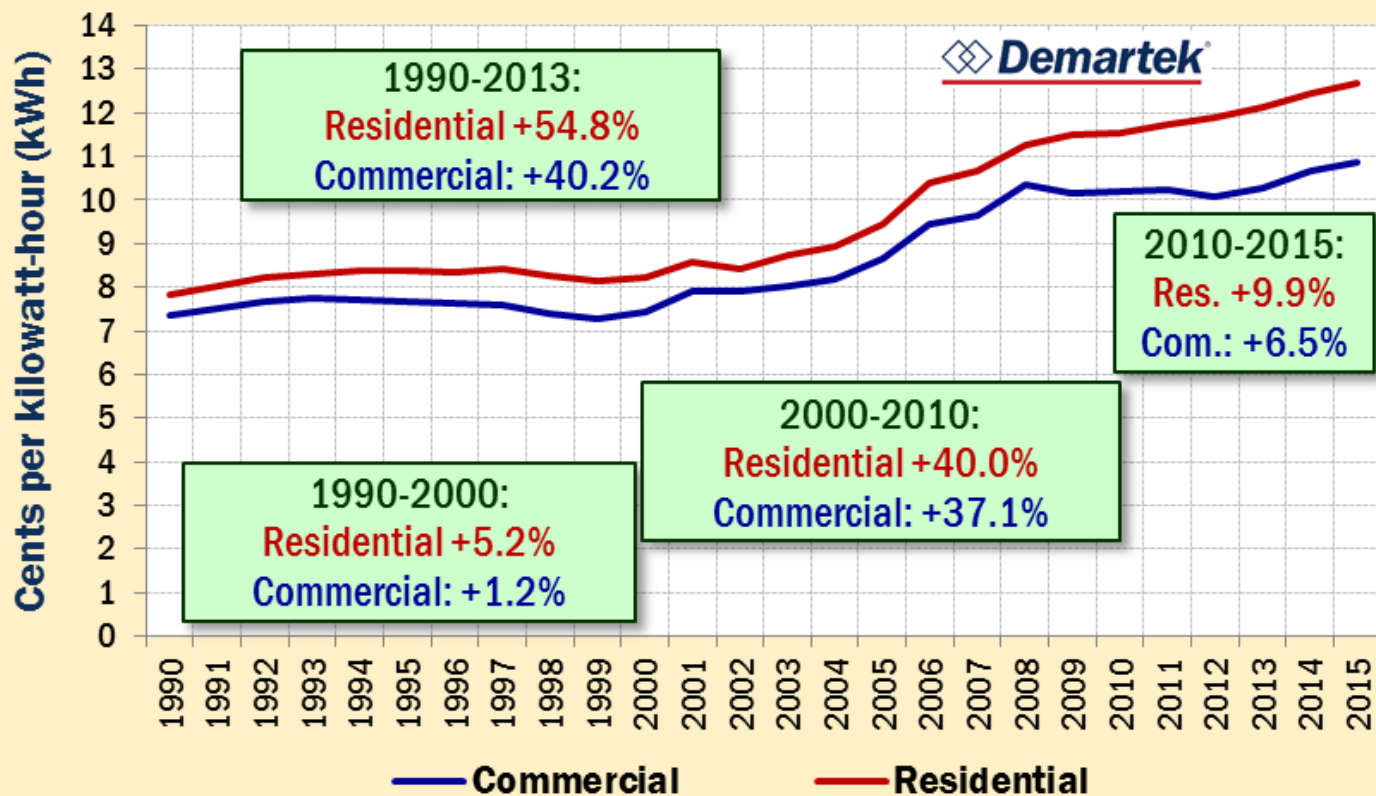


Is this your man-cave?

“Tonight, an in-depth look at what each of us can do to help conserve electricity.”

Electricity Price Trends

Average US Electricity Retail Prices



Source: US Energy Information Administration. Actuals through 2013. Projections start in 2014.

Yearly average increase, 1990-2013:
Res. 1.9%
Com. 1.5%

Prices tend to be above average in New England, the middle Atlantic States, California, Alaska and Hawaii.

Prices can fluctuate during different times of day.

Home vs. Data Center

► Electric power efficiency topics

► Home

- ◆ Install more power-efficient devices
- ◆ Devices usually have one power supply
- ◆ Some devices always on
- ◆ Turn off devices when not in use

► Data Center

- ◆ Install more power-efficient devices
- ◆ Devices often have redundant power supplies
- ◆ Most devices always on
- ◆ Achieve 99.999% uptime

Home and Data Center have different needs with respect to electric power consumption

- **Data center equipment is becoming more dense**
 - ◆ New server designs with more processors and memory per rack unit
 - ◆ Increasing use of 2.5-inch drives for storage
- **Data center power consumption grew +6.8% in North America during 2013**
 - ◆ Source: DCD Industry Census 2013
- **Average power density: ~ 6 – 8.5 kW per rack (depending on which survey you read)**

Data Center Power: PUE and DCiE

► Developed by the Green Grid

- **PUE = Power Usage Effectiveness**
- **DCiE = Data Center infrastructure Effectiveness**
- **PUE is one of the measures of power efficiency in a data center**
- $$PUE = \frac{\text{Total Facility Energy}}{\text{IT Equipment Energy}} \qquad DCiE = \frac{1}{PUE}$$
- **The ideal PUE is 1.0, but very difficult to achieve**
 - ◆ **A PUE of 2.0 means that for every 2 watts of power delivered to the data center, 1 watt reaches the computing equipment**
- **These metrics are for the entire data center, not individual devices**

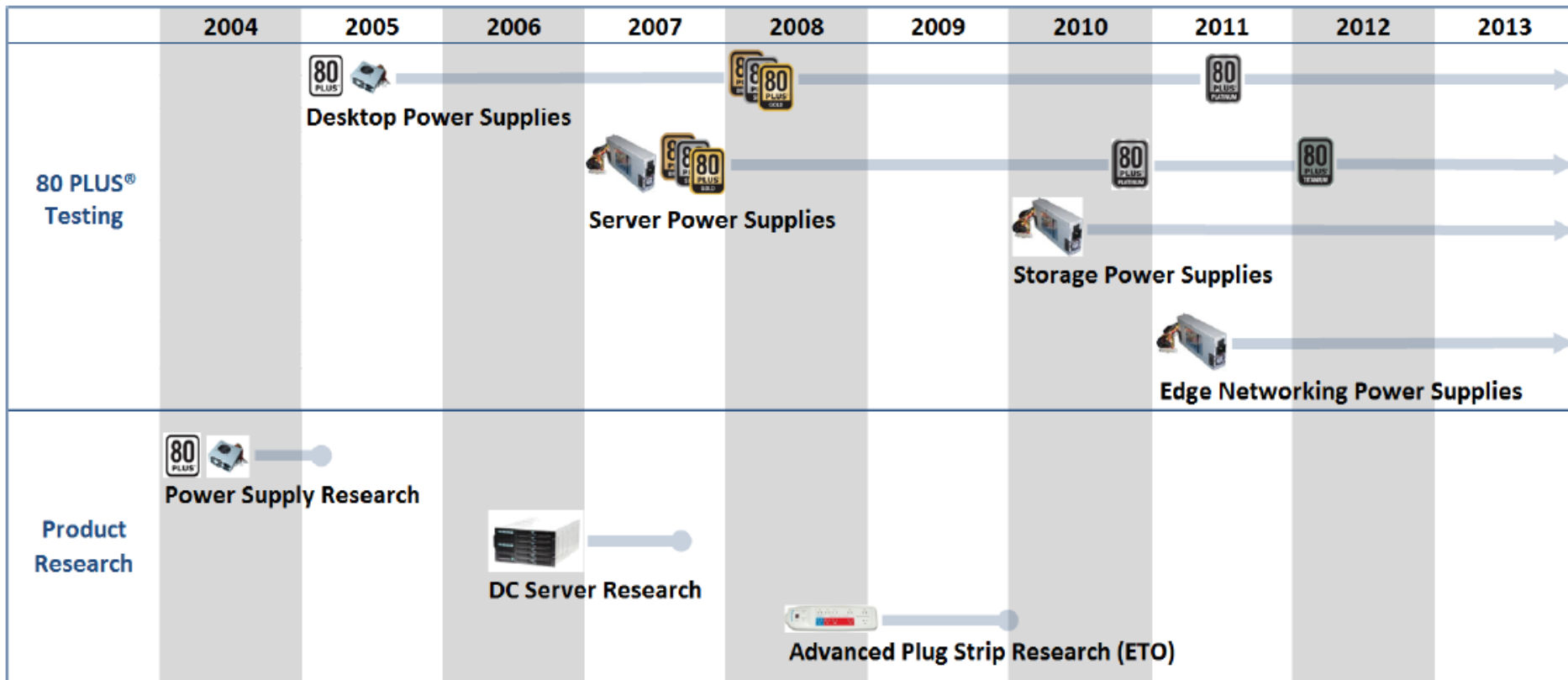
- **Power supply efficiency measures how efficiently power is delivered from the “wall power” to the components inside a computing device such as a server or storage system.**
 - ◆ **A 60% efficient power supply will draw 1000 watts from the grid in order deliver 600 watts to the components inside the computer or storage system. The other 400 watts would be wasted as heat.**
 - ◆ **Higher efficiency power supplies waste less energy, are cooler and quieter.**



- **Started in 2004**
- **A voluntary certification program**
- **Certifies that power supplies are at least 80% efficient at 20%, 50% and 100% of rated load.**
- **Power factor of 0.9 or greater at 100% load**
- **Measured at 115v and 230v**




80 PLUS History



Source: Ecova

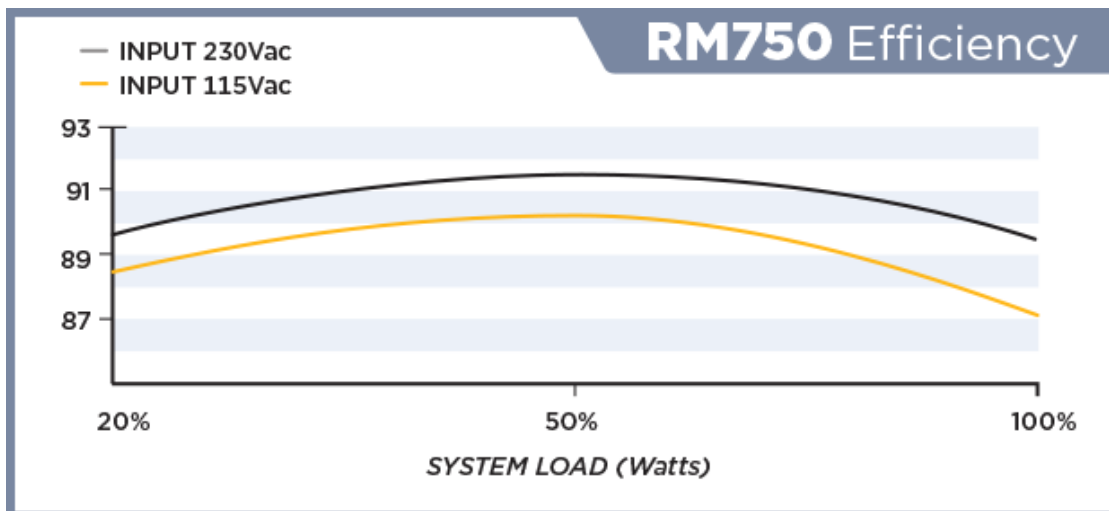
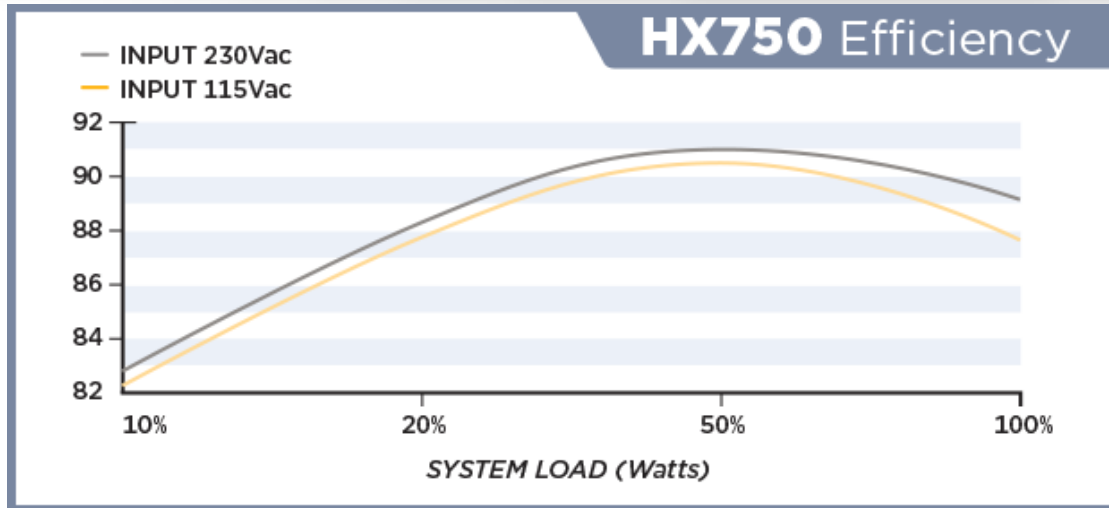
80 PLUS Ratings



 Demartek	115v Internal Non-Redundant				230v Internal Redundant			
% of Rated Load	10%	20%	50%	100%	10%	20%	50%	100%
80 PLUS	—	80%	80%	80% PFC.90	—	—	—	—
80 PLUS Bronze	—	82%	85% PFC .90	82%	—	81%	85% PFC .90	81%
80 PLUS Silver	—	85%	88% PFC .90	85%	—	85%	89% PFC .90	85%
80 PLUS Gold	—	87%	90% PFC .90	87%	—	88%	92% PFC .90	88%
80 PLUS Platinum	—	90%	92% PFC .95	89%	—	90%	94% PFC .90	91%
80 PLUS Titanium	90%	92% PFC .95	94%	90%	90%	94% PFC .95	96%	91%

Power Supply Efficiency Variations

► Two different models of 750 watt supplies, same vendor



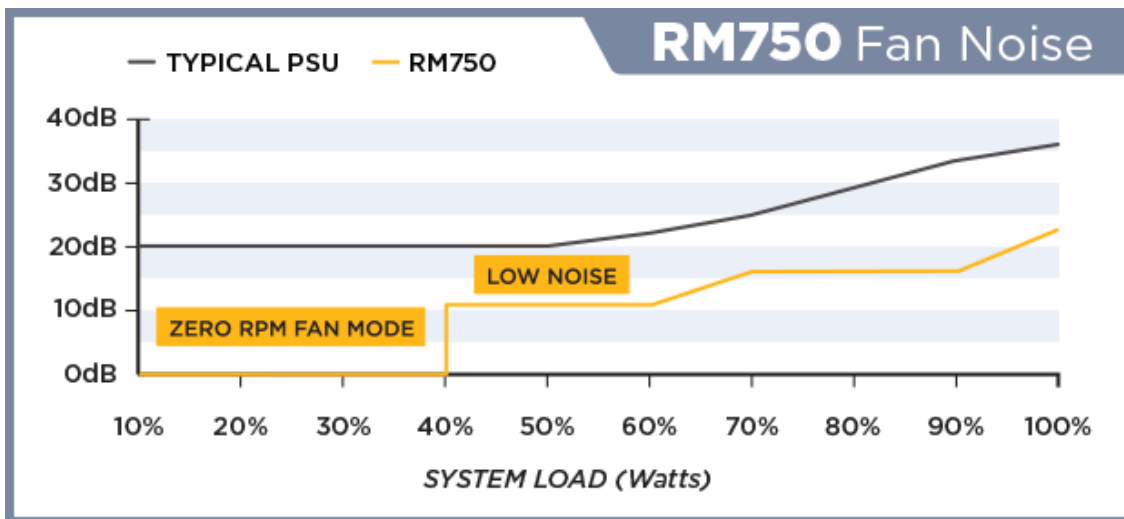
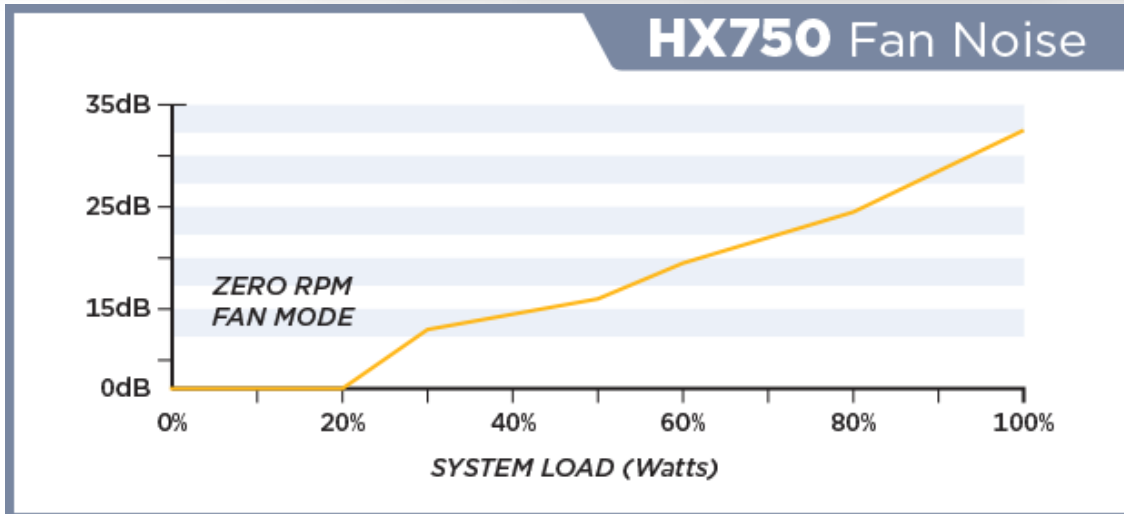
Both are rated
80 PLUS Gold.



Which one is more
efficient for a
typical desktop
computer?

Power Supply Noise Variations

▶ Two different models of 750 watt supplies, same vendor



Both are rated
80 PLUS Gold.



Which one would
you rather have
next to your desk?

- **Many of today's power supplies are rated for a range of voltages, such as 100v – 240v or sometimes broader.**
 - ◆ **Applies to many consumer and enterprise devices and systems**
- **These power supplies are more efficient at 230v or 240v than they are at 115v or 120v.**
- **Demartek labs runs 80% of its racks at 230v/240v and 20% of its racks at 115v/120v.**

- **The SNIA Emerald program provides storage system power usage and efficiency information to the public.**
 - ◆ **Part of the Green Storage Initiative (GSI)**
- **It uses a well-defined test procedure to provide performance/watt and capacity/watt results for storage systems, known as the *SNIA Emerald Power Efficiency Measurement Specification*.**
- **Website: <http://snia.org/emerald>**

SNIA Emerald™ Taxonomy



	Online	Near Online	Removable Media Library	Virtual Media Library
Consumer / Component	Online 1*	Near Online 1*	Removable 1	Virtual 1
Low-end	Online 2	Near Online 2	Removable 2	Virtual 2
Mid-range	Online 3	Near Online 3	Removable 3	Virtual 3
	Online 4	—	—	—
High-end	Online 5	Near Online 5	Removable 5	Virtual 5
Mainframe	Online 6	Near Online 6	Removable 6	Virtual 6

* Online 1 and Near Online 1 are not covered in the current version of the specification.



- **Online**: storage systems that can consistently retrieve the first data of a data block within 80ms (milliseconds), generally disk-based.
- **Near Online**: not as fast as online but can support random and sequential I/O.
- **Removable Media**: tape libraries and optical juke boxes.
- **Virtual Media Library**: can meet the 80ms time to first data. Generally disk-based for sequential I/O.



- **Vdbench is used as the disk I/O workload generator. Vdbench is maintained by Oracle Corp.**
- **The scripts for the workloads include:**
 - ◆ **Pre-fill Test (phase)**
 - ◆ **SUT Conditioning Test (12 hours of run time)**
 - ◆ **Active Test**
 - ◆ **Ready Idle Test**
 - ◆ **Capacity Optimization Method (COM) Test**
- **Power meters and temperature sensors are required.**



➤ **Measurements include:**

- ◆ **Random Read IOPS/watt**
- ◆ **Random Write IOPS/watt**
- ◆ **Sequential Read MBPS/watt**
- ◆ **Sequential Write MBPS/watt**
- ◆ **Hot band workload IOPS/watt**
- ◆ **Achieve the best performance/watt results while maintaining < 20ms latency**
- ◆ **Capacity/watt (idle)**
- ◆ **Pass the COM (capacity optimization) tests**

SNIA Emerald™ Output



Output is a multi-page spreadsheet that combines the technical performance data, power measurements, and information about the model under test.

Some data fields are mandatory and some are optional.

SNIA Emerald Test Data Report version 2.0.2-01

The SNIA Emerald Test Data Report

Disclosure for storage systems and products

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Product Description	
Company	Manufacturer Name
Address (address line 2) (address line 3)	Manufacturer Address
Municipality	City, State ZIP <small>Not App. for...</small>
Product Name	Model number
Taxonomy Category	online 3
Product Release Date	16-Dec-2013
Description	Description of product including model number and other pertinent information
Product Web Page	www.demartek.com
List Price (optional)	USD
Raw capacity	16.2 TB (14.734 TiB)
Submission Date	Last status change
Document Status	SNIA tracking #
	Mandatory items per taxonomy Optional items

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1

SNIA Emerald Test Data Report version 2.0.2-01

Operational Power			
Idle power test			
Average watts	391.45 W		
Raw capacity tested	16.2 TB		
EP _{RI}	41.4 GB/W		
Standard idle metric: GB per Watt			
Active power tests			
EP _{RR}	1.83	run length (minutes) 30	Average latency 19.81 ms
Small random reads	I/Os per second per Watt		RT _{App} (1000) <= 20 ms
EP _{RW}	3.08	run length (minutes) 30	Average latency 19.53 ms
Small random writes	I/Os per second per Watt		RT _{App} (1000) <= 20 ms
EP _{SR}	0.89	run length (minutes) 30	Average latency 15.68 ms
Large sequential reads	MIB per second per Watt		
EP _{SW}	0.54	run length (minutes) 30	Average latency 14.45 ms
Large sequential writes	MIB per second per Watt		
EP _{HB}	7.96	run length (minutes) 30	Average latency 17.8 ms
Hot band workload	I/Os per second per Watt		RT _{App} (1000) <= 20 ms
Random + sequential workload w/ hot spots			Public average latency data: no
NOTE: power-related numbers are required to be reported to three significant digits			
Capacity Optimizations			
Deduplication	no	On during test?	Available in SUT? yes
Compression	no		yes
Thin provisioning	no		yes
Parity RAID	yes		yes
Read-only delta snapshots	no		yes
Writeable delta snapshots	no		yes
Other mandatory disclosures, per spec			

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2



- **SNIA is developing the SNIA Emerald Recognized Tester Program (RTP)**
- **Organizations can become recognized testers by demonstrating knowledge of and proficiency with the SNIA Emerald test specification. An on-site audit is required.**




- **The US Environmental Protection Agency (EPA) has defined the ENERGY STAR program to encourage energy efficiency with a wide variety of consumer and business products.**
- **Electronics and Office Equipment programs include:**
 - ◆ **Computers**
 - ◆ **Data Center Storage**
 - ◆ **Displays**
 - ◆ **Enterprise Servers**
 - ◆ **Small Network Equipment**
 - ◆ **Uninterruptible Power Supplies**
- **Future programs include**
 - ◆ **Large Network Equipment**



- ◆ **The most recent new EPA ENERGY STAR program is for Data Center Storage.**
- ◆ **Storage systems that pass the tests can get listed on the EPA's Data Center Storage product list and have the ENERGY STAR label.**
 - ◆ **US federal government agencies are required to purchase ENERGY STAR products if available.**
- ◆ **First storage systems were listed in March 2014.**

- **EPA ENERGY STAR Data Center Storage uses the SNIA Emerald test specification.**
 - ◆ EPA adds requirement for tight voltage variations and total harmonic distortion measurements.
 - ◆ EPA requires temperature and humidity measurements.
 - ◆ EPA requires 80PLUS Silver or better power supplies in the storage systems under test.
- **EPA-recognized testers must be ISO 17025 accredited test labs**
- **Submissions for EPA can be tested or modeled.**

Demartek Emerald / EPA Testing

- We have been deploying storage systems from  many different vendors in our test lab for several years.
- We added A/C sources to meet EPA ENERGY STAR electrical requirements.
- We were the test lab for one of the storage vendors and their many submissions on EPA's website.
- We ran multiple configurations in parallel and completed 24 test configurations in one month.
- We have automated the process of collecting the performance data, power meter data and temperature sensor data to produce the SNIA Emerald TDR.
 - ◆ This data is used for the EPA ENERGY STAR submissions

➤ EPA ENERGY STAR Data Center Storage certified products:

<https://data.energystar.gov/Government/ENERGY-STAR-Certified-Data-Center-Storage/gqtf-hp7x>

Demartek Free Resources

- ◆ Demartek SSD Deployment Guide
www.demartek.com/Demartek_SSD_Deployment_Guide.html
- ◆ Demartek Video Library -
http://www.demartek.com/Demartek_Video_Library.html
- ◆ Demartek FC Zone - www.demartek.com/FC
- ◆ Demartek iSCSI Zone - www.demartek.com/iSCSI
- ◆ Demartek SSD Zone - www.demartek.com/SSD



Performance reports,
Deployment Guides and
commentary available
for free download.

Demartek Storage Interface Comparison



Contents

- ◆ Acronyms
- ◆ Storage Networking Interface Comparison Table
- ◆ Transfer Rate, Bits vs. Bytes, and Encoding Schemes
- ◆ History
- ◆ Roadmaps
- ◆ Cables: Fiber Optics and Copper
- ◆ Connector Types
- ◆ PCI Express® (PCIe®)

- ◆ Downloadable interactive PDF version now available.
- ◆ www.demartek.com/Demartek_Interface_Comparison.html
- ◆ Or search for “storage interface comparison” in your favorite search engine.

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*also on the back of Dennis' business card

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