ENERGY STAR® Program Requirements
Product Specification for Data Center Storage

Draft Test Method
Rev. April 2020

> **Note:** EPA has been coordinating with the Storage Networking Industry Association (SNIA) as it develops the Emerald Version 4.0.0 test method in an effort to utilize the latest test method as part of the ENERGY STAR Version 2.0 Data Center Storage specification testing protocol. EPA is pleased to update the ENERGY STAR test method to incorporate the new Emerald Version 4.0.0 test method and associated updates. EPA has not amended any other elements of the test method at this time. It is the Agency's understanding that results from the previous Emerald test method may be used to certify products to the Version 2.0 specification.

1   OVERVIEW

The following test method shall be used for determining compliance with requirements in the ENERGY STAR Product Specification for Data Center Storage.

2   APPLICABILITY

The following test method is applicable to all products eligible for certification under the ENERGY STAR Product Specification for Data Center Storage.

3   DEFINITIONS

Unless otherwise specified, all terms used in this document are consistent with the definitions in the ENERGY STAR Eligibility Criteria for Data Center Storage.

4   TEST SETUP

A) <u>Input Power</u>: Input power shall be as specified in Table 1 and Table 2. The frequency for input power shall be as specified in Table 3.

B) <u>Ambient Temperature</u>: Ambient temperature shall be no less than 18 °C and no greater than 28 °C over the duration of the test.

C) <u>Relative Humidity</u>: Relative humidity shall be within 15% and 80%.

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24 **Table 1: Input Power Requirements for Products with Nameplate Rated Power Less Than or Equal to 1500 W**

Product Type	Supply Voltage	Voltage Tolerance	Maximum Total Harmonic Distortion
Storage Products with Ac-Dc Single-Output PSUs	230 volts (V) ac or 115 V ac	+/- 1.0 %	2.0 %
Storage Products with Ac-Dc Multi-Output PSUs	230V ac or 115V ac		
Optional Testing Conditions For Ac-Dc Japanese Market	100V ac		
Three-phase Storage Products (North American Market)	208V ac		
Three-phase Storage Products (European Market)	400V ac		

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26 **Table 2: Input Power Requirements for Products with Nameplate Rated Power Greater Than 1500 W**

Product Type	Supply Voltage	Voltage Tolerance	Maximum Total Harmonic Distortion
Storage Products with Ac-Dc Single-Output PSUs	230 volts (V) ac or 115 V ac	+/- 5.0 %	5.0 %
Storage Products with Ac-Dc Multi-Output PSUs	230V ac or 115V ac		
Optional Testing Conditions For Ac-Dc Japanese Market	100V ac		
Three-phase Storage Products (North American Market)	208V ac		
Three-phase Storage Products (European Market)	400V ac		

27   **Table 3: Input Frequency Requirements for All Products**

Supply Voltage	Frequency	Frequency Tolerance
100 V ac	50 or 60 Hz	±1.0%
115 V ac	60 Hz	
230 V ac	50 Hz or 60 Hz	
Three-phase	50 Hz or 60 Hz	

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29   D) Power Meter: Power Meter(s) shall report true Root Mean Square (RMS) power and at least two
30   of the following measurement units: voltage, current and power factor. Power Meter(s) shall
31   possess the following attributes:

32   1) Calibration: The meter shall be calibrated within the past one year of the test date, by a
33   standard traceable to National Institute of Science and Technology (USA) or a counterpart
34   national metrology institute in other countries.

35   2) Crest Factor: An available current crest factor of 3 or more at its rated range value. For
36   analyzers that do not specify the current crest factor, the analyzer must be capable of
37   measuring an amperage spike of at least 3 times the maximum amperage measured during
38   any 1 second sample.

39   3) Minimum Frequency Response: 3.0 kHz

40   4) Minimum Resolution:

41   i.   0.01 W for measurement values less than 10 W;

42   ii. 0.1 W for measurement values from 10 W to 100 W; and

43   iii. 1.0 W for measurement values greater than 100 W.

44   5) Logging: The reading rate supported by the meter shall be at least 1 set of measurements
45   per second, where set is defined as watts. The data averaging interval of the analyzer shall
46   equal the reading interval. Data averaging interval is defined as the time period over which all
47   samples captured by the high-speed sampling electronics of the analyzer are averaged to
48   provide the measurement set.

49   6) Measurement Accuracy: Measurement uncertainty as introduced by the instrument that
50   measures the input power to the product under test, including any external shunts.

51   i.   Power measurements with a value greater than or equal to 0.5 W shall be made with an
52   uncertainty of less than or equal to 2% at the 95% confidence level.

53   ii. Power measurements with a value less than 0.5 W shall be made with an uncertainty of
54   less than or equal to 0.01 W at the 95% confidence level.

55   E) Temperature Sensor: The temperature sensor shall possess the following attributes:

56   1) Logging: The sensor shall have a minimum reading rate of 4 samples per minute.

57   2) Measurement Accuracy: Temperature must be measured no more than 50 mm in front of
58   (upwind of) the main airflow inlet of the UUT and reported by the sensor with an overall
59   accuracy of ± 0.5 °C or better.

60 # 5 TEST CONDUCT

61 ## 5.1 Guidance for Implementation of SNIA Emerald™ Power Efficiency Measurement
62   Specification Version 4.0.0

63
64   A) Storage products shipped with COMs must disable all COMs that are capable of being disabled
65   during the following tests:

66   1) SUT Pre-fill Test (7.3.3)

67   2) SUT Conditioning Test (7.3.4)

68   3) Block Access Active State Test (7.3.5, if applicable)

69   4) File Access Active Test (7.4, if applicable)

70   5) Ready State Idle Test (7.5)

71   6) Following the completion of the Ready Idle State Test, COMs shipped with the storage
72   product shall be enabled and COM Validation Testing (7.6) shall be performed for all COMs
73   present in the product.
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75   B) Products that are to be certified using Block I/O capability shall be tested using the Block I/O
76   Active State Test. Block I/O products with File I/O capability shall be tested under the following
77   additional requirements:

78   1) All usable Storage Devices shall be allocated to Block I/O for all testing with the exception of:

79   i. Storage Devices needed to enable a minimal File I/O capability in the system;

80   ii. Limitations imposed by the system for maximum allowable Block I/O capacity.

81   2) File I/O functionality shall be enabled during all testing.

82   3) No external File I/O storage requests shall be presented to a system during testing. (File I/O
83   functionality shall be in a Ready-Idle state).

84   C) Products that are to be certified using File I/O capability shall be tested using the File I/O Active
85   State Test.

86 # 6 TEST PROCEDURES FOR ALL PRODUCTS

87 ## 6.1 SUT Pre-fill Test

88 The SUT pre-fill test shall be performed according to the SNIA Emerald™ Power Efficiency Measurement
89 Specification Version 4.0.0: Section 7.3.3: *Pre-fill Test*.

90 ## 6.2 SUT Conditioning Test

91 The SUT conditioning shall be performed according to the SNIA Emerald**™** Power Efficiency
92 Measurement Specification Version 4.0.0*: Section 7.3.4: Conditioning Test.*

93 ## 6.3 Block I/O Active State Test

94 The Block I/O active state performance shall be measured according to the SNIA Emerald**TM** Power
95 Efficiency Measurement Specification Version 4.0.0*: Section 7.3.5: Block Access Active Test;* with the
96 additional guidance in Section 5 of this document.

6.4   File I/O Active State Test

98 The File I/O active state performance shall be measured according to the SNIA Emerald**TM** Power
99 Efficiency Measurement Specification Version 4.0.0*: Section 7.4: File Access Active Test;* with the
100 additional guidance in Section 5 of this document.

6.5   Ready Idle State Test

102 The Ready Idle state performance shall be measured according to the SNIA Emerald**TM** Power Efficiency
103 Measurement Specification Version 4.0.0*: Section 7.5: Random Block and File Access Ready Idle Test;*
104 with the additional guidance in Section 5 of this document.

6.6   COM Validation Test

106 The validation of COM functionality shall be recorded according to the SNIA Emerald™ Power Efficiency
107 Measurement Specification Version 4.0.0: *Section 7.6: Random Block and File Access Capacity*
108 *Optimization Test*; with the additional guidance in Section 5 of this document.
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110   A) Verification testing of COM features specified by the storage product shall be executed at least
111   once using storage devices of the vender's choice. Once verified there is no requirement to re-
112   execute the verification testing procedure with different storage devices.

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