Schedule - 14

Laptop/ Notebook Computers

1. Scope

(i.) This standard specifies the energy labeling requirements for notebook/ laptop computers, imported, or sold in India for household and similar use.

(ii.) Below is the product specification for BEE labeled qualified notebook/ laptop computers. A product must meet all of the identified criteria to be labeled as BEE labeled product by its manufacturer.

(iii.) This Standard is being prepared on the basis of Energy Star specification for computers http://www.energystar.gov/index developed by US EPA. In the absence of BIS standard for desktops and notebooks this standard follows the version 5.0[1] specification of Energy Star program for computers.

2. Definitions: The definitions of the various terms used in this standard is as follows:

Below is a brief description of computers, components, their types and other terms as relevant to the labeling scheme:

a) Computer: A device which performs logical operations and processes data. Computers are composed of, at a minimum: (1) a central processing unit (CPU) to perform operations; (2) user input devices such as a keyboard, mouse, digitizer or game controller; and (3) a computer display screen to output information. For the purposes of this specification, computers include both stationary and portable units, including desktop computers, gaming consoles, integrated desktop computers, notebook computers, small-scale servers, thin clients, and workstations. Although computers must be capable of using input devices and computer displays, as noted in numbers 2 and 3 above, computer systems do not need to include these devices on shipment to meet this definition.

Components:

b) Computer Display: A display screen and its associated electronics encased in a single housing, or within the computer housing (e.g., notebook or integrated desktop computer), that is capable of displaying output information from a computer via one or more inputs, such as a VGA, DVI, Display Port, and/or IEEE

[1] http://www.energystar.gov/index.cfm?c=computers.pr_crit_computers

1394. Examples of computer display technologies are the cathode-ray tube (CRT) and liquid crystal display (LCD).

c) **Discrete Graphics Processing Unit (GPU):** A graphics processor with a local memory controller interface and a local, graphics-specific memory.

d) **External Power Supply:** A component contained in a separate physical enclosure external to the computer casing and designed to convert line voltage ac input from the mains to lower dc voltage(s) for the purpose of powering the computer. An external power supply must connect to the computer via a removable or hard-wired male/female electrical connection, cable, cord or other wiring.

e) **Internal Power Supply:** A component internal to the computer casing and designed to convert ac voltage from the mains to dc voltage(s) for the purpose of powering the computer components. For the purposes of this specification, an internal power supply must be contained within the computer casing but be separate from the main computer board. The power supply must connect to the mains through a single cable with no intermediate circuitry between the power supply and the mains power. In addition, all power connections from the power supply to the computer components, with the exception of a DC connection to a computer display in an Integrated Desktop Computer, must be internal to the computer casing (i.e., no external cables running from the power supply to the computer or individual components). Internal dc-to-dc converters used to convert a single dc voltage from an external power supply into multiple voltages for use by the computer are not considered internal power supplies.

Computer Types:

f) **Desktop Computer:** A computer where the main unit is intended to be located in a permanent location, often on a desk or on the floor. Desktops are not designed for portability and utilize an external computer display, keyboard, and mouse. Desktops are designed for a broad range of home and office applications.

g) **Integrated Desktop Computer:** A desktop system in which the computer and computer display function as a single unit which receives its ac power through a single cable. Integrated desktop computers come in one of two possible forms: (1) a system where the computer display and computer are physically combined into a single unit; or (2) a system packaged as a single system where the computer display is separate but is connected to the main chassis by a dc power cord and both the computer and computer display are powered from a single power supply. As a subset of desktop computers, integrated desktop computers are typically designed to provide similar functionality as desktop systems.

h) **Notebook Computer:** A computer designed specifically for portability and to be operated for extended periods of time either with or without a direct connection to an ac power source. Notebooks must utilize an integrated computer display and be capable of operation off of an integrated battery or other portable power source. In addition, most notebooks use an external power supply and have an integrated keyboard and pointing device. Notebook computers are typically designed to provide similar functionality to desktops, including operation of software similar in functionality as that used in desktops. For the purposes of this specification, docking stations are considered accessories and therefore, the performance levels associated with notebooks presented in Section 3, below, do not include them. Tablet PCs, which may use touch-sensitive screens along with or instead of other input devices, are considered Notebook Computers in this specification.

Operational Modes:

i) **Off Mode:** The power consumption level in the lowest power mode which cannot be switched off (influenced) by the user and that may persist for an indefinite time when the appliance is connected to the main electricity supply and used in accordance with the manufacturer's instructions. For systems where ACPI standards are applicable, Off Mode correlates to ACPI System Level S5 state.

j) **Sleep Mode:** A low power state that the computer is capable of entering automatically after a period of inactivity or by manual selection. A computer with sleep capability can quickly "wake" in response to network connections or user interface devices with a latency of ≤ 5 seconds from initiation of wake event to system becoming fully usable including rendering of display. For systems where ACPI standards are applicable, Sleep mode most commonly correlates to ACPI System Level S3 (suspend to RAM) state.

k) **Idle State:** The state in which the operating system and other software have completed loading, a user profile has been created, the machine is not asleep, and activity is limited to those basic applications that the system starts by default.

l) **Active State:** The state in which the computer is carrying out useful work in response to a) prior or concurrent user input or b) prior or concurrent instruction over the network. This state includes active processing, seeking data from storage, memory, or cache, including idle state time while awaiting further user input and before entering low power modes.

m) **Typical Energy Consumption (TEC):** A method of testing and comparing the energy performance of computers, which focuses on the typical electricity consumed by a product while in normal operation during a representative period of time. For Desktops and Notebooks, the key criterion of the TEC approach is a

value for typical annual electricity use, measured in kilowatt-hours (kWh), using measurements of average operational mode power levels scaled by an assumed typical usage model (duty cycle). For Workstations, requirements are based on a TEC power value calculated from operational mode power levels, maximum power, and an assumed duty cycle.

Others:

n) **Family of models:** Family of models is the range of models of one particular brand, to which a single set of test reports is applicable and where each of the models has the same relevant physical characteristics, total energy consumption (TEC), and performance characteristics. The term 'model' is synonymous with 'family of models'.

o) **Variant:** A model variant is an alternative version of a model which has the same sales specification and the same model number or other form of designation as another version of the model, and offers the same performance except that it has different total energy consumption (TEC).

p) **Model Number:** A unique marketing name that applies to a specific hardware/software configuration (i.e. operating system, types or processors, memory, GPU, etc.) that is either predefined, or a configuration that is selected by the customer.

q) **Model Name:** A marketing name that includes reference to both the PC model family number, a short description of the product, or branding references.

3. **Qualification Criteria:** the qualification criteria for participation in the BEE labeling program for computers is as follows:-

(i.) The computers shall confirm to the relevant standards.
(ii.) Only notebook/ laptop computers are covered under this scheme.
(iii.) Computers must meet the computer definition as well as one of the product type definitions provided in Section 2, above, to qualify as BEE labeled product.

4. **Energy Efficiency and Power Management Criteria:** Computers must meet the requirements below to qualify as BEE labeled product.

(A) Power Supply Efficiency Requirements - Requirements are applicable to all product categories covered by this Specification:

Computers Using an Internal Power Supply: 85% minimum efficiency at 50% of rated output and 82% minimum efficiency at 20% and 100% of rated output, with Power Factor $\geq$ 0.9 at 100% of rated output.

Computers Using an External Power Supply: External Power Supplies sold with computers must be ENERGY STAR qualified or meet the no-load and active mode efficiency levels provided in the ENERGY STAR program requirements for Single Voltage External Ac-Ac and Ac-Dc Power Supplies, Version 2.0. The ENERGY STAR specification and qualified product list can be found at www.energystar.gov/powersupplies and also attached with this schedule as an Annexure 2.

(B) Efficiency and Performance Requirements:

1) Notebook Levels:

Laptop/ Notebook Categories for TEC Criteria: For the purposes of determining TEC levels, notebooks must qualify under Categories A, B, or C as defined below:

Category A: All notebook computers that do not meet the definition of Category B or Category C below will be considered under Category A for qualification.

Category B: To qualify under Category B, notebooks must have:

- A Discrete GPU.

Category C: To qualify under Category C, notebooks must have:

- Greater than or equal to 2 Physical Cores;
- Greater than or equal to 2 gigabytes (GB) of System Memory; and
- A GPU with a Frame Buffer Width greater than 128-bit.

TEC (Laptop/ Notebook product categories): The following tables indicate the required TEC levels for the BEE Specification. Table 1 below lists TEC requirements, while Table 2 gives weightings for each operational mode by product type.

TEC will be determined using the formula below:

$$E_{TEC}\ (kWh) = (8760/1000) * (Poff * Toff + Psleep * Tsleep + Pidle * Tidle)$$

where all Px are power values in watts, all Tx are Time values in % of year, and the TEC E_{TEC} is in units of kWh and represents annual energy consumption based on mode weightings in Table 2.

Table 1: E_{TEC} Requirement – Laptops/ Notebooks

	Notebook Computers (kWh)
TEC (kWh)	Category A: ≤ 40.0
	Category B: ≤ 53.0
	Category C: ≤ 88.5
Memory	0.4 kWh (per GB over 4)
Premium Graphics (*for Discrete GPUs with specified Frame Buffer Widths*)	Cat. B: 3 kWh (FB Width > 64-bit)
Additional Internal Storage	3 kWh

Table 2: Operational Mode Weighting – Laptops/ Notebooks

	Notebooks
Toff	60%
Tsleep	10%
Tidle	30%

5. Testing Procedure:

To qualify as BEE Star labeled product, the units must be tested according to the ENERGY STAR test protocol outlined in **Appendix A** this scheme.

Manufacturers are required to perform tests and self-certify those models that meet the BEE Star Label requirements:

- The test results must be reported to BEE.
- The test results must be reported in the format outlines in Appendix B

Detailed Test Procedures for Measuring Operational Modes are defined in Appendix A.

6. Tolerance limits: There is **no negative tolerance in the energy consumption criteria** for obtaining the BEE endorsement label (BEE STAR Ver 1). All tested products must meet the minimum threshold as specifies in table 1 including manufacturing tolerance and other variations.

7. Label Design and Manner of Display: The label design and manner of display will be as defined as follows:

- For initial six months from date of the launch of the program, manufacturers can affix the BEE Star label either on the carton box or on product in software or on the products itself.
- After six months, it is mandatory for manufacturers to put the label both on carton and on products (in software or affixed on the machine).

8. Labeling Fees: Labeling fee for affixation of label on each piece of qualified product is INR 10.0 (Ten only).

9. Future Specification Revisions

BEE reserves the right to revise the specification should technological and/or market changes affect its usefulness to consumers or industry or its impact on the environment. In keeping with current policy, revisions to the specification will be discussed with stakeholders. In the event of a specification revision, please note that BEE qualification is not automatically granted for the life of a product model. To qualify as Star labeled product, a product model must meet the BEE's specification in effect on the model's date of manufacture.

APPENDIX A:

ENERGY STAR Test Procedure for Determining the Power Use of Computers

The following protocol should be followed when measuring power consumption levels of computers for compliance with the Off, Sleep, and Idle levels provided in the ENERGY STAR Version 5.0 Computer Specification. Partners must measure a representative sample of the configuration as shipped to the customer. However, the Partner does not need to consider power consumption changes that may result from component additions, BIOS and/or software settings made by the computer user after sale of product. *This procedure is intended to be followed in order and the mode being tested is labeled where appropriate.*

*Computers must be tested with configuration and settings as shipped, unless otherwise specified in the test procedure in this Appendix A. Steps requiring alternative setup are marked with an asterisk (" * ").*

I. **Definitions**

Unless otherwise specified, all terms used in this document are consistent with the definitions contained in the Version 5.0 ENERGY STAR Eligibility Criteria for Computers.

UUT

UUT is an acronym for "unit under test," which in this case refers to the computer being tested.

UPS

UPS is an acronym for "Uninterruptible Power Supply," which refers to a combination of converters, switches and energy storage means, for example batteries, constituting a power supply for maintaining continuity of load power in case of input power failure.

II. **Testing Requirements**

Approved Meter

Approved meters will include the following attributes[2]:

- Power resolution of 1 mW or better;
- An available current crest factor of 3 or more at its rated range value; and
- Lower bound on the current range of 10mA or less.

The following attributes in addition to those above are suggested:

- Frequency response of at least 3 kHz; and

[2] *Characteristics of approved meters taken from IEC 62301 Ed 1.0: Measurement of Standby Power*

- Calibration with a standard that is traceable to the U.S. National Institute of Standards and Technology (NIST).

It is also desirable for measurement instruments to be able to average power accurately over any user selected time interval (this is usually done with an internal math's calculation dividing accumulated energy by time within the meter, which is the most accurate approach). As an alternative, the measurement instrument would have to be capable of integrating energy over any user selected time interval with an energy resolution of less than or equal to 0.1 mWh and integrating time displayed with a resolution of 1 second or less.

Accuracy

Measurements of power of 0.5 W or greater shall be made with an uncertainty of less than or equal to 2% at the 95% confidence level. Measurements of power of less than 0.5 W shall be made with an uncertainty of less than or equal to 0.01 W at the 95% confidence level. The power measurement instrument shall have a resolution of:

- 0.01 W or better for power measurements of 10 W or less;
- 0.1W or better for power measurements of greater than 10 W up to 100 W; and
- 1W or better for power measurements of greater than 100 W.

All power figures should be in watts and rounded to the second decimal place. For loads greater than or equal to 10 W, three significant figures shall be reported.

Test Conditions

Supply Voltage:	North America/Taiwan:	115 (± 1%) Volts AC, 60 Hz (± 1%)
	Europe/Australia/New/ India	230 (± 1%) Volts AC, 50 Hz (± 1%)
	Zealand: Japan:	100 (± 1%) Volts AC, 50 Hz (± 1%)/60 Hz (± 1%) *Note:* For products rated for > 1.5 kW maximum power, the voltage range is ± 4%
Total Harmonic Distortion (THD) (Voltage):	< 2% THD (< 5% for products which are rated for > 1.5 kW maximum power)	
Ambient Temperature:	23°C ± 5°C	
Relative Humidity:	10 – 80 %	

(Reference IEC 62301: Household Electrical Appliances – Measurement of Standby Power, Sections 4.2, 4.3, 4.4)

Test Configuration
Power consumption of a computer shall be measured and tested from an ac source to the UUT. If the UUT supports Ethernet, it must be connected to an Ethernet network switch capable of the UUT's highest and lowest network speeds. The network connection must be live during all tests.

III. **Test Procedure for Off, Sleep and Idle for All Computer Products**
Measurement of ac power consumption of a computer should be conducted as follows:

UUT Preparation
1) Record the manufacturer and model name of the UUT.
2) Ensure that the UUT is connected to network resources as detailed below, and that the UUT maintains this live connection for the duration of testing, disregarding brief lapses when transitioning between link speeds.

   - Desktops, Integrated Desktops, Notebooks, Thin Clients, and Small-Scale Servers with Ethernet (IEEE 802.3) capability shall be connected to a live Ethernet network switch and any wireless radios shall be turned off. The computer shall maintain this live connection to the switch for the duration of testing, disregarding brief lapses when transitioning between link speeds.

   - Thin Clients shall run intended terminal/remote connection software during all tests.
   - Desktops, Integrated Desktops, and Notebook Computers without Ethernet capability shall maintain a live wireless connection to a wireless router or network access point, which supports the highest and lowest data speeds of the client radio, for the duration of testing.
   - The network connection shall be live during all tests.

3) Connect an approved meter capable of measuring true power to an ac line voltage source set to the appropriate voltage/frequency combination for the test.
4) Plug the UUT into the measurement power outlet on the meter. No power strips or UPS units should be connected between the meter and the UUT. For a valid test to take place the meter should remain in place until all Off, Sleep, and Idle power data is recorded.
5) Record the ac voltage and frequency.
6) Boot computer and wait until the operating system has fully loaded. If necessary, run the initial operating system setup and allow all preliminary file indexing and other one-time/periodic processes to complete.

7) Record basic information about the computer's configuration – computer type, operating system name and version, processor type and speed, and total and available physical memory, etc.
8) Record basic information about the video card or graphics chipset (if applicable) - video card/chipset name, frame buffer width, resolution, amount of onboard memory, and bits per pixel.
9) Ensure that the UUT is configured as shipped including all accessories, WOL enabling, and software shipped by default. UUT should also be configured using the following requirements for all tests:

   a. *Desktop* systems shipped without accessories should be configured with a standard mouse, keyboard and external computer display.

   b. *Notebooks* should include all accessories shipped with the system, and need not include a separate keyboard or mouse when equipped with an integrated pointing device or digitizer.

   c. *Notebooks* should have the battery pack(s) removed for all tests. For systems where operation without a battery pack is not a supported configuration, the test may be performed with fully charged battery pack(s) installed, making sure to report this configuration in the test results.

   e. For Computers with Ethernet capability, power to wireless radios should be turned off for all tests. This applies to wireless network adapters (e.g., 802.11) or device-to-device wireless protocols. For Computers without Ethernet capability, power to a wireless LAN radio (e.g. IEEE 802.11) should remain on during testing and must maintain a live wireless connection to a wireless router or network access point, which supports the highest and lowest data speeds of the client radio, for the duration of testing.

   f. Primary hard drives may not be power managed ("spun-down") during Idle testing unless containing non-volatile cache integral to the drive (e.g. "hybrid" hard drives). If more than one internal hard drive is installed as shipped, the non-primary, internal hard drive(s) may be tested with hard drive power management enabled as shipped. If these additional drives are not power managed when shipped to customers, they must be tested without such features implemented.

9.1 10. * The following guidelines should be followed to configure power settings for computer displays (adjusting no other power management settings):
9.2 a. For computers with external computer displays (most desktops): use the computer display power management settings to prevent the display from powering down to ensure it stays on for the full length of the Idle test as described below.

9.3 b. For computers with integrated computer displays (notebooks and integrated systems): use the power management settings to set the display to power down after 1 minute.

10) Shut down the UUT.

Off Mode Testing

With the UUT shut down and in Off, set the meter to begin accumulating true power values at an interval of less than or equal to 1 reading per second. Accumulate power values for 5 additional minutes and record the average (arithmetic mean) value observed during that 5 minute period.[2]

Idle Mode Testing

Switch on the computer and begin recording elapsed time, starting either when the computer is initially switched on, or immediately after completing any log in activity necessary to fully boot the system. Once logged in with the operating system fully loaded and ready, close any open windows so that the standard operational desktop screen or equivalent ready screen is displayed. Between 5 and 15 minutes after the initial boot or log in, set the meter to begin accumulating true power values at an interval of greater than or equal to 1 reading per second. Accumulate power values for 5 additional minutes and record the average (arithmetic mean) value observed during that 5 minute period.

Sleep Mode Testing

1 After completing the Idle measurements, place the computer in Sleep mode. Reset the meter (if necessary) and begin accumulating true power values at an interval of greater than or equal to 1 reading per second. Accumulate power values for 5 additional minutes and record the average (arithmetic mean) value observed during that 5 minute period.

2 If testing both WOL enabled and WOL disabled for Sleep, wake the computer and change the WOL from Sleep setting through the operating system settings or by other means. Place the computer back in Sleep mode and repeat step 14, recording Sleep power necessary for this alternate configuration.

Reporting Test Results

The test results must be reported to BEE, as appropriate, taking care to ensure that all required information has been included, including modal power values and eligible capability adjustments for Desktops, Integrated Desktops, and Notebooks.

APPENDIX B:

Format for reporting the test results

Applicant		Manufacturer	
Model No./Name		Model Family Name	

1. Product Type: Desktop/Laptop

2. Select Business Category of the product:

≤ Business desktop PC
≤ Home and Home office desktop PC
≤ Integrated PC
≤ Business notebook PC
≤ Home & Home office notebook PC

2. Product Category: A/B/C/D

3. Product Configuration:

Processor Make and Common Model Name	Processor Number of CPU Cores	Total System Memory (GB)	Number of Discrete GPUs Installed*	Frame Buffer Width	No.of storage Devices.

*Should not include any GPUs integrated into the motherboard

4. Qualifying Criteria:

Power supply Type: Internal/ external

For Internal Power Supplies:

SMPS Manufacturer	Model Name	100% Load efficiency	PF at 100% Load	50% Load Efficiency	20% Load Efficiency

For External Power Supplies:

Note: External Power Supplies sold with computers must be ENERGY STAR qualified or meet the no-load and active mode efficiency levels provided in the ENERGY STAR program Requirements for Single Voltage External Ac-Ac and Ac-Dc Power Supplies, Version 2.0.

Does your external power supply meet the ENERGY STAR program Requirements for Single Voltage External Ac-Ac and Ac-Dc Power Supplies, Version 2.0?

5. Total Energy Consumption (TEC)

Poff	Pidle	Psleep	TEC(Calculated)	TEC Base	TEC Allowance	TEC Total

6. Summary

Declaration:

Name

Date :

Annexure-I

Label Design and Manner of Display:

10. Material and Shape:

The label shall be of durable cardboard, if it is to be attached as a swing tag, or be self adhesive and shall be cut to one of the outlines shown in figure 1.1 as applicable.

Annexure-II

ENERGY STAR program requirements for Single Voltage External Ac-Ac and Ac-Dc Power Supplies, Version 2.0 (Starts from Next Page)

ENERGY STAR® Program Requirements for Single Voltage External Ac-Dc and Ac-Ac Power Supplies

Eligibility Criteria (Version 2.0)
Final

Table of Contents

Section 1: Definitions 2

Section 2: Qualifying Products 3

Section 3: Energy-Efficiency Specifications for Qualifying Products 3

- Table 1: Energy-Efficiency Criteria for Active Mode: Standard Models 3
- Table 2: Energy-Efficiency Criteria for Active Mode: Low Voltage Models 3
- Table 3: Examples of Minimum Average Efficiency in Active Mode 4
- Table 4: Energy Consumption Criteria for No-Load 5

Section 4: Test Methodology 5

Section 5: Effective Date 6

Section 6: Effective Date for ENERGY STAR Product Specifications 6

- Table 5: Version 1.1 Energy-Efficiency Criteria for Active Mode 7
- Table 6: Version 1.1 Energy Consumption Criteria for No-Load 7

Section 7: Future Specification Revisions 7

Section 8: International Efficiency Marking Protocol 7

- Figure 1: Illustration of International Efficiency Mark 8

ENERGY STAR® Program Requirements for Single Voltage External Ac-Dc and Ac-Ac Power Supplies

Eligibility Criteria (Version 2.0)

Final

Below is the product specification (Version 2.0) for ENERGY STAR qualified single voltage external ac-ac and ac-dc power supplies. A product must meet all of the identified criteria if it is to be qualified as ENERGY STAR by its manufacturer.

The goal of this ENERGY STAR external power supply specification is to recognize those models with an efficient ac-ac or ac-dc conversion process. This specification along with its complement, the specification for products with battery charging systems (BCSs), intends to comprehensively cover the full range of energy conversion products. Manufacturers shall carefully examine their product designs and compare them to the detailed definitions (Section 1) and qualifying product descriptions (Section 2) for an external power supply and battery charging system (visit http://www.energystar.gov/products) to determine the appropriate specification for ENERGY STAR qualification. Manufacturers may only qualify individual models under the one specification (i.e., external power supply OR battery charging system) that best reflects the power supply and product design.

1) **Definitions**: EPA has prepared detailed definitions of single voltage external ac-ac and ac-dc power supplies and other related terms as relevant to ENERGY STAR.

   A. External Power Supply (EPS): For the purposes of this specification, an external power supply:
      a) is designed to convert line voltage ac input into lower voltage ac or dc output;
      b) is able to convert to only one output voltage at a time;
      c) is sold with, or intended to be used with, a separate end-use product that constitutes the primary load;
      d) is contained in a separate physical enclosure[1] from the end-use product;
      e) is connected to the end-use product via a removable or hard-wired male/female electrical connection, cable, cord or other wiring;
      f) does not have batteries or battery packs that physically attach directly (including those that are removable) to the power supply unit;
      g) does not have a battery chemistry or type selector switch **AND** an indicator light or state of charge meter (e.g., a product with a type selector switch AND a state of charge meter is excluded from this specification; a product with only an indicator light is still covered by this specification); and
      h) has nameplate output power less than or equal to 250 watts.

   B. Ac-Ac External Power Supply: An external ac-ac power supply is an EPS designed to convert line voltage ac input into lower voltage ac output.

   C. Ac-Dc External Power Supply: An external ac-dc power supply is an EPS designed to convert line voltage ac input into lower voltage dc output.

   D. Low Voltage External Power Supply: For the purposes of this specification, a low voltage model is an EPS with a nameplate output voltage of less than 6 volts and a nameplate output current greater than or equal to 550 milliamps.

   E. Model: An EPS that is sold or marketed under a unique model number or marketing name. Any variation in the nameplate information (e.g., the rated input or output voltage, amperage, or wattage), circuitry, or output cord size is considered a unique model.

[1] "Physical enclosure" refers to the housing of the products themselves, not their retail packaging.

F. Active Mode: The condition in which the input of a power supply is connected to line voltage ac and the output is connected to an ac or a dc load drawing a fraction of the power supply's nameplate power output greater than zero.

G. No-Load Mode: The condition in which the input of a power supply is connected to an ac source consistent with the power supply's nameplate ac voltage, but the output is not connected to a product or any other load.

H. Power Factor (True): The true power factor is the ratio of the active, or real, power (P) consumed in watts to the apparent power (S), drawn in volt-amperes (VA).

$$PF = \frac{P}{S}$$

This definition of power factor includes the effect of both distortion and displacement.

2) **Qualifying Products**: In order to qualify as ENERGY STAR, an external power supply model must meet the definition in Section 1.A, as well as either the definition in 1.B or 1.C, and the specification requirements provided in Section 3, below.

3) **Energy-Efficiency Specifications for Qualifying Products**: Only those products in Section 2 that meet all of the following criteria for Active Mode, No-Load Mode, and power factor (if applicable) may qualify as ENERGY STAR.

A. Active Mode

To be eligible for ENERGY STAR qualification, an external power supply model must meet or exceed a minimum average efficiency for Active Mode, which varies based on the model's nameplate output power. Tables 1 and 2, below, outline the equations for determining minimum average efficiency, where P_{no} stands for nameplate output power and Ln refers to the natural logarithm. Table 1 addresses all standard EPSs, while Table 2 gives separate equations for a subset of low voltage EPSs that meet the appropriate definition in Section 1.D. All efficiency values shall be expressed in decimal form and rounded to the hundredths place.

Table 1: Energy-Efficiency Criteria for Ac-Ac and Ac-Dc External Power Supplies in Active Mode: Standard Models

Nameplate Output Power (P_{no})	Minimum Average Efficiency in Active Mode (expressed as a decimal) [2]
0 to ≤ 1 watt	≥ 0.480 * P_{no} + 0.140
> 1 to ≤ 49 watts	≥ [0.0626 * Ln (P_{no})] + 0.622
> 49 watts	≥ 0.870

Table 2: Energy-Efficiency Criteria for Ac-Ac and Ac-Dc External Power Supplies in Active Mode: Low Voltage Models

Nameplate Output Power (P_{no})	Minimum Average Efficiency in Active Mode (expressed as a decimal) [2]
0 to ≤ 1 watt	≥ 0.497 * P_{no} + 0.067
> 1 to ≤ 49 watts	≥ [0.0750 * Ln (P_{no})] + 0.561
> 49 watts	≥ 0.860

[2] (a) "Ln" refers to the natural logarithm. The algebraic order of operations requires that the natural logarithm calculation be performed first and then multiplied by 0.0626 (or 0.0750 for low voltage models), with the resulting output added to 0.622 (or 0.561 for low voltage models). (b) An efficiency of 0.87 or 0.86 in decimal form corresponds to the more familiar value of 87% or 86% when expressed as a percentage.

Examples to Illustrate the Active Mode Approach: Average Active Mode efficiency and ENERGY STAR qualification shall be determined as follows:

- Determine whether the product meets the definition for low voltage products by comparing the nameplate output voltage and nameplate output current to the definition found in Section 1.D.
- Calculate the model's single average Active Mode efficiency for each test voltage by testing at 100%, 75%, 50%, and 25% of rated current output and then computing the simple arithmetic average of these four values, as specified in the Test Method found in Section 4.
- Based on the model's nameplate output power, select the appropriate equation from Table 1 or 2 and calculate the minimum average efficiency required by ENERGY STAR.
- Compare the model's actual average efficiency to the minimum average efficiency required by ENERGY STAR. If the actual average efficiency is greater than or equal to the minimum average efficiency, the model has satisfied ENERGY STAR's Active Mode requirement.

To provide an example using the criteria in Table 1 and Table 2, the minimum average efficiencies required of six sample power supplies are provided in Table 3, below. Power supplies 1 through 6 would meet the ENERGY STAR Active Mode requirement if they had average efficiencies greater than or equal to the corresponding values shown in the far right column. Therefore, if Power Supply 3 in Table 3 had an actual average efficiency of 80%, it would satisfy the Active Mode requirement because it surpassed the ENERGY STAR minimum average efficiency of 79%.

Table 3: Examples of Minimum Average Efficiency in Active Mode

Sample	Nameplate Output Power (P_{no})	Nameplate Output Voltage	Nameplate Output Current	Average Efficiency in Active Mode (expressed as a decimal)
PS 1	0.75 watts	1V	750 mA	0.497 * 0.75 + 0.067 = 0.4398 or 0.44
PS 2	0.75 watts	10V	75 mA	0.480 * 0.75 + 0.140 = 0.5000 or 0.50
PS 3	20 watts	5V	4000 mA	[0.0750 * Ln (20)] + 0.561 = 0.7857 or 0.79
PS 4	20 watts	10V	2000 mA	[0.0626 * Ln (20)] + 0.622 = 0.8095 or 0.81
PS 5	75 watts	5V	15000 mA	0.86
PS 6	75 watts	10V	7500 mA	0.87

B. Power Factor Correction (PFC)

In addition to the Active Mode efficiency requirements found above, power supplies with greater than or equal to 100 watts *input* power must have a true power factor of 0.9 or greater at 100% of rated load when tested at 115 volts @ 60Hz.

Note: In the most recent round of comments, several stakeholders noted that power factor losses are less significant at 230 volts, because with half the current, the conduction losses are one-quarter of what they would be at 115 volts. Stakeholders also noted that EPS units meeting a 0.9 power factor at 115 volts will also generally have a high power factor at 230 volts (although slightly lower than 0.9 in some cases). Further, products sold in Europe must already meet the requirements for harmonic currents (EN 61000-3-2), and thus are effectively covered for power quality at 230 volts.

In addition, other manufacturers have noted that the 0.9 power factor requirement at 230 volts could eliminate the single stage PFC architecture, which is a cost effective approach to designing efficient EPSs with improved power quality. While a dual stage PFC architecture is capable of meeting a 0.9 power factor requirement at 230 volts, it is a more resource intensive design and may lead to decreases in Active Mode efficiency.

For these reasons, EPA has revised the final power factor requirement to only apply to testing at 115 volts, with no power factor requirement at 230 volts. Products designed to operate at *both* 115 volts and 230 volts must meet the power factor requirement when tested at 115 volts, but not when tested at 230 volts.

C. No-Load Mode

The third element of the ENERGY STAR specification is the No-Load power requirement, which specifies the maximum ac power that may be used by a qualifying ac-ac external power supply or ac-dc external power supply in the No-Load condition. Maximum power consumption levels for No-Load Mode are provided in Table 4, below.

Table 4: Energy Consumption Criteria for No-Load

Nameplate Output Power (P_{no})	Maximum Power in No-Load	
	Ac-Ac EPS	**Ac-Dc EPS**
0 to < 50 watts	≤ 0.5 watts	≤ 0.3 watts
≥ 50 to ≤ 250 watts	≤ 0.5 watts	≤ 0.5 watts

4) **Test Methodology**

The specifics for testing the energy efficiency of an external power supply model are outlined in a separate document titled "Test Method for Calculating the Energy Efficiency of Single-Voltage External Ac-Dc and Ac-Ac Power Supplies (August 11, 2004)," which is available on the ENERGY STAR Web site. The test results produced by this procedure shall be used to determine if a model qualifies as ENERGY STAR. In addition, below are five ENERGY STAR-specific testing requirements.

A. Safety Standards: ENERGY STAR qualified external power supplies shall comply with applicable safety standards from UL, CSA, and other global standards organizations. Relevant standards include, but are not limited to:

- *UL 1012, Standard for Power Units Other Than Class 2, Edition 7, April 29, 2005*
- *UL 1310, Standard for Class 2 Power Units, Edition 5, May 3, 2005*

It is the Partner's responsibility to ensure that its products meet applicable local safety standards based on where the product will be sold.

B. Number of Units Required for Test: Testing shall be conducted by the manufacturer or its authorized representative on three randomly chosen units of the same model. Manufacturers shall measure and maintain the Active Mode, No-Load Mode, and power factor values (if applicable) for all three units as well as the average values. To qualify as ENERGY STAR, all three units must meet the ENERGY STAR specification; only the average values will be displayed on ENERGY STAR's qualifying product list (see Section 4.E below).

C. Models Capable of Operating at Multiple Voltage/Frequency Combinations: For switchmode power supplies capable of operating at multiple voltages and frequencies, testing shall be conducted at both 115 volts @ 60 Hz and 230 volts @ 50 Hz, with the least efficient set of test values used to determine if products qualify for the Active Mode, No-Load Mode, and power factor (only applicable at 115 volts @ 60 Hz) specifications.

D. Multiple Tap or Switch Selectable Models: Manufacturers shall test a multiple tap or switch selectable model at the highest and the lowest voltage outputs of the power supply. If the model meets or exceeds the ENERGY STAR requirements at both the highest and the lowest voltage outputs, then it qualifies as ENERGY STAR.

E. Submittal of Qualified Product Data to EPA: Partners are required to self-certify those product models that meet the ENERGY STAR guidelines and report information to EPA. ENERGY STAR qualifying product lists, including information about new models as well as notification of discontinued models, must be provided on a quarterly basis, or more frequently if desired by the manufacturer. If no new models are introduced during a particular quarter, manufacturer should notify EPA to ensure its partnership status is maintained.

All unique EPS models, as defined in Section 1.E, must be separately tested and reported for ENERGY STAR qualification. However, in some cases, a partner may have a base model number

with several extensions to reflect various input pin and output connector configurations. If the only variation between the models is the physical connector configuration (provided that the nameplate information, circuit design, and output cord length and gauge are the same), partners may test one representative model and qualify it using a generic "XX" designation for the extension in the model number.

When qualifying EPSs as ENERGY STAR, partners also have the option of qualifying a family of EPSs that **all** meet the ENERGY STAR requirements, rather than individually submitting each model. For ENERGY STAR's purposes, an EPS model family is defined as **a group of switching-mode external power supplies that feature the same design (e.g., circuitry and components), transformer, and output wattage, but differ in rated output voltage.** To qualify a model family, partners must provide the efficiency data (average of three test units) for the highest and lowest output voltage members of the EPS model family that meet the ENERGY STAR specification. When submitting model families, manufacturers continue to be held accountable for any efficiency claims made about their external power supply products. In other words, even though data may not be submitted to ENERGY STAR on each model, manufacturers are still responsible for ensuring (and if challenged by another party, defending) each model's compliance with ENERGY STAR within the model family.

5) **Effective Date for EPS Manufacturers**: The ENERGY STAR single voltage external ac-ac and ac-dc power supplies specification (Version 2.0) effective date is November 1, 2008. Any previously executed agreement on the subject of ENERGY STAR qualified EPSs shall be terminated effective October 31, 2008.

Note: The following sentence has been removed in the Final specification: "The date that manufacturers may begin to promote products as ENERGY STAR under Version 2.0 will be defined as the *effective date* of the agreement." Because products that meet Version 2.0 also meet the ENERGY STAR specification in effect (Version 1.1) prior to November 1, 2008, EPA agrees that manufacturers may begin qualifying and promoting their Version 2.0 products as ENERGY STAR prior to its effective date.

A. Product Qualification under Version 2.0: Prior to November 1, 2008, EPA will begin accepting product qualifications under Version 2.0 through the ENERGY STAR online product submittal system. All products, including models originally qualified under Version 1.1, with a date of manufacture on or after November 1, 2008 must meet the new Version 2.0 requirements in order to qualify as ENERGY STAR. The date of manufacture is specific to each unit and is the date (e.g., month and year) on which a unit is considered to be completely assembled.

6) **Effective Date for ENERGY STAR Product Specifications**

A. Computer and Imaging Equipment Specifications: To qualify as ENERGY STAR under the Computer Version 4.0 Tier 1 and Imaging Equipment Version 1.0 Tier 1 specifications, computers and imaging equipment with an EPS must meet the following requirements as provided in Tables 5 and 6. These requirements are identical to the EPS Version 1.1 specification, which was in effect upon completion and implementation of the Computer and Imaging Tier 1 specifications, and do not include a power factor requirement as specified in this Version 2.0 specification. **Computers qualified under the Version 5.0 specifications (effective July 2009) and Imaging Equipment qualified under the Version 1.1 Tier 2 specifications (effective April 2009) will need to meet the EPS Version 2.0 requirements, regardless of the EPS's date of manufacture. Refer to Section 3, Energy-Efficiency Specifications for Qualifying Products, of this document for the detailed Version 2.0 EPS requirements.**

Note: Two changes have been made to Section 6.A, above. The first change was to update the reference to the latest Computer specification from Version 4.0 Tier 2 to Version 5.0 and similarly to change the reference to the latest Imaging Equipment specifications from Version 1.0 Tier 2 to Version 1.1 Tier 2. The second change was to clarify that once the latest Computer (Version 5.0) and Imaging Equipment (Version 1.1 Tier 2) specifications take effect, qualifying models with an EPS must include an EPS that meets the EPS Version 2.0 requirements, even if the EPS manufacture date is prior to July 2009 or April 2009, respectively.

- Computers and Imaging Equipment products that make use of an EPS must ensure that their EPS meets or exceeds a minimum average efficiency for Active Mode, which varies based on the model's nameplate output power. The following table outlines the equations for determining minimum average efficiency where P_{no} stands for nameplate output power and Ln refers to the natural logarithm. Efficiency shall be expressed in decimal form and rounded to the hundredths place.

Table 5: Version 1.1 Energy-Efficiency Criteria for Ac-Ac and Ac-Dc External Power Supplies in Active Mode

Nameplate Output Power (P_{no})	Minimum Average Efficiency in Active Mode (expressed as a decimal)
0 to ≤ 1 watt	≥ 0.49 * P_{no}
> 1 to ≤ 49 watts	≥ [0.09 * Ln (P_{no})] + 0.49
> 49 watts	≥ 0.84

- External Power Supplies must meet a No-Load power requirement, which specifies the maximum ac power that may be used by a qualifying external power supply in the No-Load condition. Maximum power consumption levels for No-Load Mode are provided in the table below.

Table 6: Version 1.1 Energy Consumption Criteria for No-Load

Nameplate Output Power (P_{no})	Maximum Power in No-Load
0 to < 10 watts	≤ 0.5 watts
≥ 10 to ≤ 250 watts	≤ 0.75 watts

B. Primarily Portable Products with Qualified EPSs: To qualify as ENERGY STAR, the EPS associated with primarily portable products that are not otherwise covered by the ENERGY STAR program (e.g., mobile phones, MP3 speaker systems, water filtration systems) must meet the EPS Version 2.0 specification as of its November 1, 2008 effective date, as outlined in Section 5, above. Visit http://www.energystar.gov/index.cfm?c=ext_power_supplies_pd.CE_manufacturers for more information about this product category.

Note: Based on stakeholder feedback, EPA has extended the effective date for Primarily Portable Products with Qualified EPSs from July 1 to November 1, 2008. This change provides interested partners with additional time to begin including Version 2.0 EPSs in their end-use product designs and also simplifies the specification overall by aligning effective dates.

C. Other Electronic Product Specifications: EPA is committed to advancing power supply efficiency in all products as quickly as is reasonable. For Telephony, the EPSs are a central part of this specification and thus must meet Version 2.0 as of its effective date of November 1, 2008, as outlined in Section 5, above. For Monitors, Televisions, Set-top Boxes, and Audio/DVD, updated specifications will specifically require that any EPSs meet the Version 2.0 requirements. Manufacturers should refer to the latest electronic product category specification for relevant effective dates.

7) **Future Specification Revisions**: EPA reserves the right to change the specification should technological and/or market changes affect its usefulness to consumers, industry, or the environment. In keeping with current policy, revisions to the specification are arrived at through stakeholder discussions. In the event of a specification revision, please note that ENERGY STAR qualification is not automatically granted for the life of a product model. To qualify as ENERGY STAR, a product model must meet the ENERGY STAR specification in effect on the model's date of manufacture. The date of manufacture is specific to each unit and is the date on which a unit is considered to be completely assembled.

8) **International Efficiency Marking Protocol**: ENERGY STAR partners shall follow the international efficiency marking protocol to indicate the energy performance of their ENERGY STAR qualified

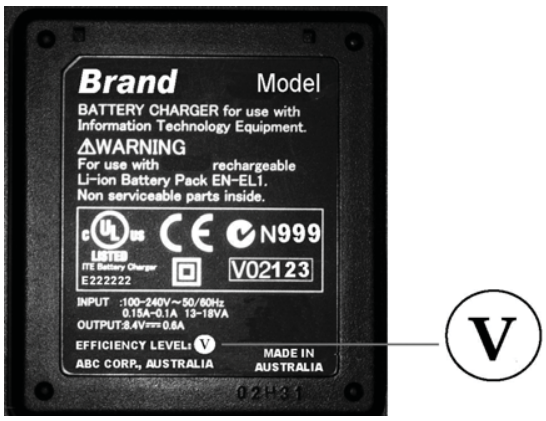
power supplies. (See Figure 1 for an illustration of the international efficiency mark.) In addition, the efficiency level, as denoted by a Roman numeral under the protocol, shall be reported to EPA as part of the qualified product data submission process. Further information about the endorsers of the marking protocol and its intent will be available at www.energystar.gov/powersupplies.

ENERGY STAR partners shall clearly and permanently mark (e.g., imprint, label, etc.) the nameplate of their qualifying external power supplies with the appropriate Roman numeral (I – VI) that corresponds to specific minimum Active and No-Load efficiency levels and power factor requirements (where applicable). (See www.energystar.gov/powersupplies and click on "International Efficiency Marking Protocol" for energy performance requirements at each Roman numeral.) Partners shall determine the appropriate Roman numeral by: 1) comparing the unit's Active, No-Load, and power factor test data (when tested in accordance with the ENERGY STAR Test Method and at each relevant test voltage and frequency value) with the performance requirements at each level of the Roman numeral scale; and 2) choosing the highest Roman numeral where the power supply meets the Active, No-Load, and power factor (where applicable) requirements.

Note: EPA updated the International Efficiency Marking Protocol text above to address power factor requirements, where applicable, given that power factor is one of the performance criteria covered under the ENERGY STAR Version 2.0 EPS specification.

The Protocol will be amended with the new requirements for level V and only EPSs with level V efficiency levels will qualify as ENERGY STAR. In addition, EPA plans to include updated information about the marking protocol on its ENERGY STAR Web site in the near future.

Figure 1: Illustration of International Efficiency Mark



When applied by a manufacturer, the mark shall conform to the following characteristics:

Format:	Roman numeral: I, II, III, IV, V, or VI.
Font:	Times Roman preferred (or other plain serif fonts).
Size:	Legible and indelible.
Color:	Text to contrast with the nameplate background.
Placement:	On the power supply nameplate; however, the exact location is at the discretion of the manufacturer. The text "Efficiency Level" shown above is optional.
Example:	Any external power supply meeting the performance requirements for level V and above would qualify as ENERGY STAR (Version 2.0). Power supplies with performance levels of I - IV would not qualify under the Version 2.0 specification.