ENERGY STAR®
Product Specification for Imaging Equipment

Eligibility Criteria
Draft 2 Version 2.0

Following is the Version 2.0 ENERGY STAR Product Specification for Imaging Equipment. A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

1 DEFINITIONS

A) Product Types:

1) Printer: A product whose primary function is to generate paper output from electronic input. A printer is capable of receiving information from single-user or networked computers, or other input devices (e.g., digital cameras). This definition is intended to cover products that are marketed as printers, and printers that can be field-upgraded to meet the definition of an MFD.

2) Scanner: A product whose primary function is to convert paper originals into electronic images that can be stored, edited, converted, or transmitted, primarily in a personal computing environment. This definition is intended to cover products that are marketed as scanners.

3) Copier: A product whose sole function is to produce paper duplicates from paper originals. This definition is intended to cover products that are marketed as copiers, and upgradeable digital copiers (UDCs).

4) Facsimile (Fax) Machine: A product whose primary functions are (1) to scan paper originals for electronic transmission to remote units, and (2) to receive electronic transmissions for conversion to paper output. A fax machine may also be capable of producing paper duplicates. Electronic transmission is primarily over a public telephone system, but may also be via a computer network or the Internet. This definition is intended to cover products that are marketed as fax machines.

5) Multifunction Device (MFD): A product that performs two or more of the core functions of a Printer, Scanner, Copier, or Fax Machine. An MFD may have a physically integrated form factor, or it may consist of a combination of functionally integrated components. MFD copy functionality is considered to be distinct from single-sheet convenience copying functionality sometimes offered by fax machines. This definition includes products marketed as MFDs, and “multi-function products” (MFPs).

6) Digital Duplicator: A product sold as a fully-automated duplicator system through the method of stencil duplicating with digital reproduction functionality. This definition is intended to cover products that are marketed as digital duplicators.

7) Mailing Machine: A product whose primary function is to print postage onto mail pieces. This definition is intended to cover products that are marketed as mailing machines.

B) Marking Technologies:

1) Direct Thermal (DT): A marking technology characterized by the burning of dots onto coated print media that is passed over a heated print head. DT products do not use ribbons.

2) Dye Sublimation (DS): A marking technology characterized by the deposition (sublimation) of dye onto print media as energy is supplied to heating elements.

3) Electro-photographic (EP): A marking technology characterized by the illumination of a photoconductor in a pattern representing the desired output image via a light source, development of the image with particles of toner using the latent image on the photoconductor to define the presence or absence of toner at a given location, transfer of the toner to the final print media, and fusing to cause the output to become durable. For purposes of this specification, Color EP products simultaneously offer three or more unique toner colors, while Monochrome EP products simultaneously offer one or two unique toner colors. This definition includes Laser, Light Emitting Diode (LED), and Liquid Crystal Display (LCD) illumination technologies.

4) Impact: A marking technology characterized by the formation of the desired output image by transferring colorant from a "ribbon" to the print media via an impact process. This definition includes Dot Formed Impact and Fully Formed Impact.

5) Ink Jet (IJ): A marking technology characterized by the deposition of colorant in small drops directly to the print media in a matrix manner. For purposes of this specification, Color IJ products offer two or more unique colorants at one time, while Monochrome IJ products offer one colorant at a time. This definition includes Piezo-electric (PE) IJ, IJ Sublimation, and Thermal IJ. This definition does not include High Performance IJ.

6) High Performance IJ: An IJ marking technology that includes nozzle arrays that span the width of a page and/or the ability to dry ink on the print media via supplemental media heating mechanisms. High-performance IJ products are used in business applications usually served by electro-photographic marking products.

7) Solid Ink (SI): A marking technology characterized by ink that is solid at room temperature and liquid when heated to the jetting temperature. This definition includes both direct transfer and offset transfer via an intermediate drum or belt.

8) Stencil: A marking technology characterized by the transfer of images onto print media from a stencil that is fitted around an inked drum.

9) Thermal Transfer (TT): A marking technology characterized by the deposition of small drops of solid colorant (usually colored waxes) in a melted/fluid state directly to print media in a matrix manner. TT is distinguished from IJ in that the ink is solid at room temperature and is made fluid by heat.

C) Operational Modes:

1) On Mode:

a) Active State: The power state in which a product is connected to a power source and is actively producing output, as well as performing any of its other primary functions.

b) Ready State: The power state in which a product is not producing output, has reached operating conditions, has not yet entered into any lower-power Modes, and can enter Active State with minimal delay. All product features can be enabled in this state, and the product is able to return to Active State by responding to any potential inputs, including external electrical stimulus (e.g., network stimulus, fax call, or remote control) and direct physical intervention (e.g., activating a physical switch or button).

2) Off Mode: The power state that the product enters when it has been manually or automatically switched off but is still plugged in and connected to the mains. This mode is exited when stimulated by an input, such as a manual power switch or clock timer to bring the unit into Ready State. When this state is resultant from a manual intervention by a user, it is often referred to as Manual Off, and when it is resultant from an automatic or predetermined stimuli (e.g., a delay time or clock), it is often referred to as Auto-off.[1]

3) Sleep Mode: A reduced power state that a product enters either automatically after a period of inactivity (i.e., Default Delay Time), in response to user manual action (e.g., at a user-set time of day, in response to a user activation of a physical switch or button), or in response to external electrical stimulus (e.g., network stimulus, fax call, remote control). For products evaluated under the TEC test method, Sleep Mode permits operation of all product features (including maintenance of network connectivity), albeit with a possible delay to transition into Active State. For products evaluated under the OM test method, Sleep Mode permits operation of a single active network interface, as well as a fax connection if applicable, albeit with a possible delay to transition into Active State.

Note: EPA has revised the Sleep Mode definition to note the appropriate network connections intended to be active during Sleep Mode.

4) Standby: The lowest power consumption state which cannot be switched off (influenced) by the user and that may persist for an indefinite time when the product is connected to the main electricity supply and used in accordance with the manufacturer's instructions.[1,2] Standby is the product's minimum power state. For Imaging Equipment products addressed by this specification, the "Standby" Mode usually corresponds to Off Mode, but may correspond to Ready State or Sleep Mode. A product cannot exit Standby and reach a lower power state unless it is physically disconnected from the main electricity supply as a result of manual manipulation.

D) Media Format:

1) Large Format: Products designed for A2 media and larger, including those designed to accommodate continuous-form media greater than or equal to 406 mm wide. Large-format products may also be capable of printing on standard-size or small-format media.

2) Standard Format: Products designed for standard-sized media (e.g., Letter, Legal, Ledger, A3, A4, B4), including those designed to accommodate continuous-form media between 210 mm and 406 mm wide. Standard-size products may also be capable of printing on small-format media.

3) Small Format: Products designed for media sizes smaller than those defined as Standard (e.g., A6, 4"x6", microfilm), including those designed to accommodate continuous-form media less than 210 mm wide.

4) Continuous Form: Products that do not use a cut-sheet media format, and that are designed for applications such as printing of bar codes, labels, receipts, banners, and engineering drawings. Continuous form products can be of small, standard, or large format.

E) Additional Terms:

1) Automatic Duplexing: The capability of a copier, fax machine, MFD, or printer to produce images on both sides of an output sheet, without manual manipulation of output as an intermediate step. A product is considered to have automatic duplexing capability only if all accessories needed to produce duplex output are included with the product upon shipment.

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1 For the purposes of this specification "mains" or the "main electricity supply" refers to the input power source, including a dc power supply for products that operate solely off dc power.
2 IEC 62301 Ed. 1.0 – Household electrical appliances – Measurement of standby power.

2) Data Connection: A connection that permits the exchange of information between the imaging product and one external powered device or storage medium.

3) Default Delay Time: The time set by the manufacturer prior to shipping that determines when the product will enter a lower-power Mode (e.g., Sleep, Auto-off) following completion of its primary function.

4) Digital Front-end (DFE): A functionally-integrated server that hosts other computers and applications and acts as an interface to imaging equipment. A DFE provides greater functionality to the imaging product.

   a) A DFE offers three or more of the following advanced features:

      i. Network connectivity in various environments;
      ii. Mailbox functionality;
      iii. Job queue management;
      iv. Machine management (e.g., waking the imaging equipment from a reduced power state);
      v. Advanced graphic user-interface (UI);
      vi. Ability to initiate communication with other host servers and client computers (e.g., scanning to email, polling remote mailboxes for jobs); or
      vii. Ability to post-process pages (e.g., reformatting pages prior to printing).

   b) Type 1 DFE: A DFE that draws its dc power from its own ac power supply (internal or external), which is separate from the power supply that powers the imaging equipment. This DFE may draw its ac power directly from a wall outlet, or it may draw it from the ac power associated with the imaging product's internal power supply. A third party Type 1 DFE must be sold in conjunction with the product it supports in order to be covered by this specification.

   c) Type 2 DFE: A DFE that draws its dc power from the same power supply as the imaging equipment with which it operates. Type 2 DFEs must have a board or assembly with a separate processing unit that is capable of initiating activity over the network and can be physically removed, isolated, or disabled using common engineering practices to allow power measurements to be made.

Note: EPA has added the substance of Type 3 DFE definition to the Type 1 definition. With this change, EPA intends to make clear that the ENERGY STAR program does not cover stand alone DFEs, only DFEs that are a component to the imaging product that are eligible for qualification.

5) Network Connection: A connection that permits the exchange of information between the imaging product and one or more external powered devices.

6) Functional Adder: A data or network interface or other component that adds functionality to the marking engine of an imaging equipment product and provides a power allowance when qualifying products according to the OM method.

7) Operational Mode (OM): For the purposes of this specification, a method of comparing product energy performance via an evaluation of power (measured in watts) in various operating states, as specified in Section 9 of the ENERGY STAR Imaging Equipment test method.

8) Typical Electricity Consumption (TEC): For the purposes of this specification, a method of comparing product energy performance via an evaluation of typical electricity consumption (measured in kilowatt-hours) during normal operation over a specified period of time, as specified in Section 8 of the ENERGY STAR Imaging Equipment test method.

9) Marking Engine: The fundamental engine of an imaging product that drives image production. A marking engine relies upon functional adders for communication ability and image processing. Without functional adders and other components, a marking engine cannot acquire image data for processing and is non-functional.

10) Base Product: The most fundamental configuration of a particular Product Model, which possesses the minimum number of functional adders available. Optional components and accessories are not considered part of a base product.

11) Accessory: A piece of peripheral equipment that is not necessary for the operation of the Base Product, but that may be added before or after shipment in order to add functionality. An accessory may be sold separately under its own model number, or sold with a base product as part of a package or configuration.

12) Product Model: An imaging equipment product that is sold or marketed under a unique model number or marketing name. A product model may be comprised of a base product or a base product plus accessories.

Note: EPA has removed the definition of representative model, since it is detailed in Section 4.2.1.

13) Product Family: A group of product models that are (1) made by the same manufacturer, (2) subject to the same ENERGY STAR qualification criteria, and (3) of a common basic design. Product models within a family differ from each other according to one or more characteristics or features that either (1) have no impact on product performance with regard to ENERGY STAR qualification criteria, or (2) are specified herein as acceptable variations within a product family. For Imaging Equipment, acceptable variations within a product family include:

    a) Color,

    b) Housing,

    c) Input or output paper-handling accessories,

    d) Electronic components not associated with the marking engine of the Imaging Equipment product.

Note: EPA has removed "input voltage and frequency" from the list of allowable variations to prevent conflict with international market qualification, as required in Section 4.3.

Additionally, EPA has increased the scope of allowable variation within a product family to include electronic components that are not associated with the marking engine of the Imaging Equipment Product. As noted in Section 4.2.1.ii, products are tested and qualified with the most featured and highest energy using configuration within a family. Any changes or additions of electronic components in the system that lead to greater power consumption than the qualified representative model will require requalification.

2 SCOPE

2.1 Included Products

2.1.1 Commercially-available products that meet one of the Imaging Equipment definitions in Section 1 and are capable of being powered from (1) a wall outlet, (2) a data or network connection, or (3) both a wall outlet and a data or network connection, are eligible for ENERGY STAR qualification, with the exception of products listed in Section 2.2.

2.1.2 An imaging equipment product must further be classified as either “TEC” or “OM” in Table 1, below, depending on the method of ENERGY STAR evaluation.

Note: EPA review of market conditions and the role ENERGY STAR plays in the market supports retaining scanners and fax machines in the scope of this specification. Therefore, both product types have been retained in Draft 2.

Table 1: Evaluation Methods for Imaging Equipment

Equipment Type	Media Format	Marking Technology	ENERGY STAR Evaluation Method
Copier	Standard	DT, DS, EP, SI, TT	TEC
	Large	DT, DS, EP, SI, TT	OM
Digital Duplicator	Standard	Stencil	TEC
Fax Machine	Standard	DT, DS, EP, SI, TT	TEC
		IJ	OM
Mailing Machine	All	DT, EP, IJ, TT	OM
Multifunction Device (MFD)	Standard	High Performance IJ, DT, DS, EP, SI, TT	TEC
		IJ, Impact	OM
	Large	DT, DS, EP, IJ, SI, TT	OM
Printer	Standard	High Performance IJ, DT, DS, EP, SI, TT	TEC
		IJ, Impact	OM
	Large or Small	DT, DS, EP, Impact, IJ, SI, TT	OM
	Small	High Performance IJ	TEC
Scanner	All	N/A	OM

Note: Stakeholders have expressed concern about the applicability of the TEC test method to small-format high-performance ink jet printers. In the test method, small-format products can be tested under the TEC test method. EPA believes that small format high performance inkjet printers should be treated and tested using the TEC test method, as it is consistent with our approach for testing products that are in constant use rather that those products that remain idle for long periods of time. EPA welcomes further stakeholder feedback on this approach and the test method applicability.

2.2 Excluded Products

2.2.1 Products that are covered under other ENERGY STAR product specifications are not eligible for qualification under this specification. The list of specifications currently in effect can be found at www.energystar.gov/products.

2.2.2 Products that satisfy one or more of the following conditions are not eligible for ENERGY STAR qualification under this specification:

i. Products that are designed to operate directly on three-phase power.

3 QUALIFICATION CRITERIA

3.1 Significant Digits and Rounding

3.1.1 All calculations shall be carried out with directly measured (unrounded) values.

3.1.2 Unless otherwise specified, compliance with specification limits shall be evaluated using directly measured or calculated values without any benefit from rounding.

3.1.3 Directly measured or calculated values that are submitted for reporting on the ENERGY STAR website shall be rounded to the nearest significant digit as expressed in the corresponding specification limit.

3.2 General Requirements

3.2.1 External Power Supply (EPS):

i. If the product is shipped with a single-voltage EPS, the EPS shall meet the level V performance requirements under the International Efficiency Marking Protocol and include the level V marking. Additional information on the Marking Protocol is available at www.energystar.gov/powersupplies.

- Single-output EPS shall meet level V requirements when tested using the Test Method for Calculating the Energy Efficiency of Single-Voltage External Ac-Dc and Ac-Ac Power Supplies, Aug. 11, 2004.

- Multi-output EPS shall meet the level V requirements when tested using the *EPRI 306 Generalized Internal Power Supply Efficiency Test Protocol, Rev. 6.6.* Power Supply data generated using Rev. 6.4.2 (as required in Version 1.2) is acceptable provided the test was conducted prior to the effective date of Version 2.0.

Note: EPA has clarified how single-output and multi-output EPS shall be tested for Imaging Equipment.

Additionally, EPA has clarified that legacy EPS data generated using the revision of the test protocol incorporated in Version 1.2 will be accepted if the data was generated prior to Version 2.0 taking effect. Such an approach allows Partners to avoid unnecessary retesting, and EPA believes that the changes implemented in the test protocol do not impact the consistency of the data requested in this specification.

3.2.2 Additional Cordless Handset: Fax machines and MFDs with fax capability that are sold with additional cordless handsets shall use an ENERGY STAR qualified handset, or one that meets the ENERGY STAR Telephony specification when tested to the ENERGY STAR test method on the date the imaging product is qualified as ENERGY STAR. The ENERGY STAR specification and test method for telephony products may be found at www.energystar.gov/products.

3.2.3 Functionally Integrated MFD: If an MFD consists of a set of functionally integrated components (i.e., the MFD is not a single physical device), the sum of the measured energy or power consumption for all components shall be less than the relevant MFD energy or power consumption requirements for ENERGY STAR qualification.

Note: EPA has determined that the development of an acceptable wakeup test was beyond the timeline for the development of the ENERGY STAR test method. As such, EPA is electing not to address wake up in this specification revision.

3.2.4 DFE Requirements: The Typical Electricity Consumption of a Type 1 or Type 2 DFE sold with an Imaging Equipment product (TEC_{DFE}) shall be calculated using Equation 1 for a DFE without sleep mode or Equation 2 for a DFE with sleep mode. The resulting TEC_{DFE} value shall be less than or equal to the maximum TEC_{DFE} requirement specified in Table 2 for the given DFE type.

i. The TEC value or ready mode power of a DFE that meets the maximum TEC_{DFE} requirements should be excluded or subtracted from the TEC energy and OM power measurements of the Imaging Equipment product as appropriate.
ii. Section 3.3.2i provides further detail on subtracting TEC_{DFE} values from TEC products;
iii. Section 3.4.2 provides further detail for excluding DFEs from OM Sleep and Standby levels.

Equation 1: TEC_{DFE} Calculation for Digital Front Ends without Sleep Mode

$$TEC_{DFE} = \frac{168 \times P_{DFE\_READY}}{1000}$$

Where:

- *TEC_{DFE} is the typical weekly energy consumption for DFEs, expressed in kilowatt-hours (kWh) and rounded to the nearest 0.1 kWh;*
- *P_{DFE_READY} is ready mode power measured in the test procedure in watts.*

Equation 2: TEC_{DFE} Calculation for Digital Front Ends with Sleep Mode

$$TEC_{DFE} = \frac{\left(45 \times P_{DFE\_READY}\right) + \left(123 \times P_{DFE\_SLEEP}\right)}{1000}$$

Where:

- *TEC_{DFE} is the typical weekly energy consumption for DFEs, expressed in kilowatt-hours (kWh) and rounded to the nearest 0.1 kWh;*
- *P_{DFE_READY} is ready mode power measured in the test procedure in watts.*
- *P_{DFE_SLEEP} is sleep mode power measured in the test procedure in watts.*

Note: As shown above in Equation 1, for products with no Sleep Mode, the Ready Mode power measured in the test method is multiplied by 168 hours to obtain the TEC_{DFE} value for a one week period.

As shown above in Equation 2, for products with a functional Sleep Mode, the Ready Mode power measured in the test method is multiplied by 45 hours to represent 5 business days during a one week period. The remainder of time in the week, 123 hours, is multiplied by the Sleep Mode power measured in the test method to obtain the total TEC_{DFE} value for one week. This approach is intended to meet stakeholder requests from Draft 1 to address Sleep Mode capable DFEs using a weekly consumption calculation. Using this formula rewards implementation of energy saving Sleep Mode in DFEs.

Table 2: Maximum TEC_{DFE} Requirements for Type 1 and Type 2 DFEs

DFE Category	Category Description	Maximum TEC_{DFE} (kWh/week, rounded to the nearest 0.1 kWh/week for reporting)	
		Type 1 DFE	Type 2 DFE
A	All DFEs that do not meet the definition of Category B will be considered under Category A for ENERGY STAR qualification.	10.9	9.2

DFE Category	Category Description	Maximum TEC_{DFE} (kWh/week, rounded to the nearest 0.1 kWh/week for reporting)	
		Type 1 DFE	Type 2 DFE
B	To qualify under Category B DFEs must have: 2 or more physical CPUs or 1 CPU and ≥ 1 discrete graphic processing units (GPUs)	22.7	19.3

Note: Ready mode requirements have been converted into maximum TEC_{DFE} requirements to recognize DFEs that may have a higher ready mode power, but implement a functional network capable Sleep Mode, allowing lower overall power consumption over the period of a week.

EPA intends to continue to treat lower functionality DFEs similarly to small scale servers in the ENERGY STAR 5.2 Computer specification, as they have similar hardware and software functionality. EPA is aware that higher performance DFEs are necessary for high speed color printing applications, and that these systems compare to high-end desktops rather than small scale servers. Using data from the ENERGY STAR Version 6.0 Draft Computer specification revised desktops dataset, EPA has developed new requirements for DFEs that incorporate multiple physical CPUs, or a CPU and GPU combination, for greater functionality. The new requirements also account for increased memory and HDD requirements for higher performance DFEs.

All desktop and small scale server products analyzed from the revised computer dataset contain multicore CPU technology—single core products are no longer represented in the current desktop and small scale server market offerings. Therefore differentiation between single core and multicore has been removed in this Draft 2.

Finally, EPA also plans to present the TEC_{DFE} in kilowatt-hours/year (based on 8760 hours per year, and rounded to the third significant digit) on the qualified products list (QPL). Although kilowatt-hours/week will continue to be used for qualification, kilowatt-hours/year may be displayed on the qualified products list for easier comparison to other ENERGY STAR products, which typically express their energy consumption in annual terms.

3.3 Requirements for Typical Electricity Consumption (TEC) Products

3.3.1 Automatic Duplexing Capability:

i. For all copiers, MFDs, and printers subject to the TEC test method, automatic duplexing capability shall be present at the time of purchase as specified in Table 3.

Table 3: Automatic Duplexing Requirements for all TEC Copiers, MFDs, and Printers

Monochrome Product Speed, *s*, as Calculated in the Test Method (ipm)	Automatic Duplexing Requirement
$s \leq 26$	None
$s > 26$	Integral to the base product

Note: Stakeholders noted that for some lower speed products, automatic duplexing is not practical and may have the potential effect of discouraging lower-cost ENERGY STAR qualified printers, EPA recognizes this concern and as such has revised the proposed automatic duplexing requirement to apply to all TEC Copiers, MFDs, and Printers whose monochrome print speed is greater than 26 ipm.

Note: EPA is proposing revision to the following guidance in a Version 1.0 clarification memo from 2007:

> A partner may label their base product (that meets the energy efficiency requirements associated with the ENERGY STAR Version 1.0 Imaging Specification - and may or may not be bundled with a duplex tray). The partner must, in this case, make clear in their product literature, on their Web site, and in institutional sales literature that although the product meets the ENERGY STAR energy efficiency requirements, the product only fully qualifies for ENERGY STAR when bundled with or used with a duplexer tray. EPA asks that partners use the following language to convey this message to customers:
>
> "Achieves ENERGY STAR energy savings; product fully qualifies when packaged with (or used with) a duplex tray."

Due to the maturation of the printer market, EPA proposed to remove this allowance to ensure consistency of the program requirements and avoid consumers misunderstanding caused by associating ENERGY STAR with higher speed non-duplexing products. All Imaging Equipment products must meet the automatic duplexing requirements in Table 3 as shipped to be labeled as ENERGY STAR.

3.3.2 Typical Electricity Consumption: Calculated Typical Electricity Consumption (TEC) per Equation 3 or Equation 4 shall be less than or equal to the Maximum TEC Requirement (TEC_{MAX}) specified in Table 4, to the nearest 0.1 kilowatt-hour.

i. For imaging products with a Type 2 DFE that meet the Type 2 DFE maximum TEC_{DFE} requirement found in Table 2,, the energy consumption of the DFE, calculated per the example below, should be excluded when comparing the product's measured TEC value to TEC_{MAX}. The DFE shall not interfere with the ability of the imaging product to enter or exit its lower-power modes. The energy use of a DFE can only be excluded if it meets the DFE definition in Section 1 and that has a separate processing unit that is capable of initiating activity over the network, may be subtracted from the measured DFE.

Example: A printer's total TEC result is 24.5 kWh/week and its TEC_{DFE} value calculated in Section 3.2.4 is 9.0 kWh/week. The TEC_{DFE} value is subtracted from the tested TEC value: 24.5 kWh/week – 9.0 kWh/week = 15.5 kWh/week. 15.5 kWh/week is then compared to the relevant TEC_{MAX}.

ii. For printers, fax machines, digital duplicators with print capability, and MFDs with print capability, TEC shall be calculated per Equation 3.

Equation 3: TEC Calculation for Printers, Fax Machines, Digital Duplicators with Print Capability, and MFDs with Print Capability

$$TEC = 5 \times \left[E_{JOB\_DAILY} + (2 \times E_{FINAL}) + \left[24 - (N_{JOBS} \times 0.25) - (2 \times t_{FINAL}) \right] \times \frac{E_{SLEEP}}{t_{SLEEP}} \right] + 48 \times \frac{E_{SLEEP}}{t_{SLEEP}},$$

Where:

- *TEC is the typical weekly energy consumption for printers, fax machines, digital duplicators with print capability, and MFDs with print capability, expressed in kilowatt-hours (kWh) and rounded to the nearest 0.1 kWh;*
- E_{JOB_DAILY} *is the daily job energy, as calculated per Equation 5, in kWh;*

- E_{FINAL} *is the final energy, as measured in the test procedure, converted to kWh;*
- N_{JOBS} *is the number of jobs per day, as calculated in the test procedure,*
- t_{FINAL} *is the final time to Sleep, as measured in the test procedure, converted to hours;*
- E_{SLEEP} *is the Sleep energy, as measured in the test procedure, converted to kWh; and*
- t_{SLEEP} *is the Sleep time, as measured in the test procedure, converted to hours.*

iii. For copiers, digital duplicators without print capability, and MFDs without print capability, TEC shall be calculated per Equation 4.

Equation 4: TEC Calculation for Copiers, Digital Duplicators without Print Capability, and MFDs without Print Capability

$$TEC = 5 \times \left[E_{JOB\_DAILY} + (2 \times E_{FINAL}) + \left[24 - (N_{JOBS} \times 0.25) - (2 \times t_{FINAL})\right] \times \frac{E_{AUTO}}{t_{AUTO}} \right] + 48 \times \frac{E_{AUTO}}{t_{AUTO}},$$

Where:

- *TEC is the typical weekly energy consumption for copiers, digital duplicators without print capability, and MFDs without print capability, expressed in kilowatt-hours (kWh) and rounded to the nearest 0.1 kWh;*
- E_{JOB_DAILY} *is the daily job energy, as calculated per Equation 5, in kWh;*
- E_{FINAL} *is the final energy, as measured in the test procedure, converted to kWh;*
- N_{JOBS} *is the number of jobs per day, as calculated in the test procedure;*
- t_{FINAL} *is the final time to Sleep, as measured in the test procedure, converted to hours;*
- E_{AUTO} *is the Auto-off energy, as measured in the test procedure, converted to kWh; and*
- t_{AUTO} *is the Auto-off time, as measured in the test procedure, converted to hours.*

iv. Daily Job Energy shall be calculated per Equation 5.

Equation 5: Daily Job Energy Calculation for TEC Products

$$E_{JOB\_DAILY} = (2 \times E_{JOB1}) + \left((N_{JOBS} - 2) \times \frac{E_{JOB2} + E_{JOB3} + E_{JOB4}}{3} \right),$$

Where:

- E_{JOB_DAILY} *is the daily job energy, expressed in kilowatt-hours (kWh);*
- E_{JOBi} *is the energy of the* i^{th} *job, as measured in the test procedure, converted to kWh; and*
- N_{JOBS} *is the number of jobs per day, as calculated in the test procedure.*

Table 4: Maximum TEC Requirement

Color Capability	Monochrome Product Speed, *s*, as Calculated in the Test Method (ipm)	TEC_{MAX} (kWh/week, to the nearest 0.1 kWh/week for reporting)
Monochrome Non-MFD	$s \leq 5$	0.3
	$5 < s \leq 20$	(**s** x 0.04) + 0.1
	$20 < s \leq 30$	(**s** x 0.06) – 0.3
	$30 < s \leq 40$	(**s** x 0.11) – 1.8
	$40 < s \leq 65$	(**s** x 0.16) – 3.8
	$65 < s \leq 90$	(**s** x 0.2) – 6.4
	$s > 90$	(**s** x 0.55) – 37.9
Monochrome MFD	$s \leq 5$	0.4
	$5 < s \leq 30$	(**s** x 0.07) + 0.05
	$30 < s \leq 50$	(**s** x 0.11) – 1.15
	$50 < s \leq 80$	(**s** x 0.25) – 8.15
	$s > 90$	(**s** x 0.6) – 36.15
Color Non-MFD	$s \leq 10$	1.3
	$10 < s \leq 15$	(**s** x 0.06) + 0.7
	$15 < s \leq 30$	(**s** x 0.15) – 0.65
	$30 < s \leq 75$	(**s** x 0.2) – 2.15
	$s > 75$	(**s** x 0.7) – 39.65
Color MFD	$s \leq 10$	1.5
	$10 < s \leq 15$	(**s** x 0.1) + 0.5
	$15 < s \leq 30$	(**s** x 0.13) + 0.05
	$30 < s \leq 70$	(**s** x 0.2) – 2.05
	$70 < s \leq 80$	(**s** x 0.7) – 37.05
	$s > 80$	(**s** x 0.75) – 41.05

Note: EPA has reverted to the current practice of separating the TEC requirement for MFD and non-MFD products to create the most accurate levels possible across all product categories. The adjustments to proposed levels reflect qualified data up through March 15, 2012. Pass/fail analysis was performed on the new levels, based on bins of product speed (ipm) for each TEC category.

At the proposed TEC levels for the four product classes, EPA expects a broad selection of models from multiple manufacturers to be eligible for the ENERGY STAR. EPA notes that qualification rates, based on the EPA revised data set, are somewhat larger than normal due to some uncertainty around the impact of the revised test method.

Lastly, EPA intends to display the TEC values of ENERGY STAR qualified Imaging Equipment in both the kilowatt-hours per year and kilowatt-hours per week on the qualified products list (QPL) for easier comparison to other ENERGY STAR products, which typically express energy consumption in annual terms.

3.3.3 Additional Test Results Reporting Requirements: Recovery time (Active 1 time) and Default Delay Time shall be reported for all products test using the TEC test method.

Note: Since recovery time (Active1 time) and Default Delay Time to Sleep are useful to consumers and potentially a useful parameter for evaluating the impact of the Version 2.0 requirements on usability, EPA proposes to require reporting of both recovery time (Active1 time) and Default Delay Time to Sleep for all TEC products.

Additionally, EPA proposes including this information on the Version 2.0 Qualified Product List (QPL).

3.4 Requirements for Operational Mode (OM) Products

3.4.1 Multiple Sleep Modes: If a product is capable of automatically entering multiple successive Sleep Modes, the same Sleep Mode shall be used to determine qualification under the default delay time to sleep requirements specified in Section 3.4.3 and the Sleep Mode power consumption requirements specified in Section 3.4.4.

3.4.2 DFE Requirements: For imaging products with a functionally-integrated DFE that relies on the imaging product for its power, and that meets the appropriate maximum TEC_{DFE} requirement found in Table 2, the ready mode power of the DFE, measured in the test method, should be excluded when comparing the product's measured Sleep Mode power to the combined marking-engine and functional-adder criteria limits below and when comparing the measured Standby Mode power to the Standby criteria limits below.

i. The DFE must not interfere with the ability of the imaging product to enter or exit its lower-power modes.
ii. In order to take advantage of this exclusion, the DFE must meet the definition in Section 1 and be a separate processing unit that is capable of initiating activity over the network.

3.4.3 Default Delay Time: Measured Default Delay Time to Sleep (t_{SLEEP}) shall be less than or equal to the Maximum Default Delay Time to Sleep (t_{SLEEP_MAX}) requirement specified in Table 5, subject to the following conditions:

i. The maximum machine delay time shall be less than or equal to 4 hours, which is set by the manufacturer. This maximum machine delay time can be adjusted by the user to a value less than or equal to 4 hours.
ii. When reporting data and qualifying products that can enter Sleep Mode in multiple ways, partners should reference a Sleep level that can be reached automatically. If the product is capable of automatically entering multiple, successive Sleep levels, it is at the manufacturer's discretion which of these levels is used for qualification purposes; however, the default-delay time provided must correspond with whichever level is used.
iii. Default Delay Time does not apply to OM products that can meet sleep mode requirements in ready mode.

Table 5: Maximum Default Delay Time to Sleep for OM Products

Product Type	Media Format	Monochrome Product Speed, *s*, as Calculated in the Test Method (ipm or mppm)	Default Delay Time to Sleep (minutes)
Copier	Large	***s*** ≤ 30	30
		s > 30	60
Fax Machine	Small or Standard	All	5
MFD	Small or Standard	***s*** ≤ 10	15
		10 < ***s*** ≤ 20	30
		s > 20	60
	Large	***s*** ≤ 30	30
		s > 30	60
Printer	Small or Standard	***s*** ≤ 10	5
		10 < ***s*** ≤ 20	15
		20 < ***s*** ≤ 30	30
		s > 30	60
	Large	***s*** ≤ 30	30
		s > 30	60
Scanner	All	All	15
Mailing Machine	All	***s*** ≤ 50	20
		50 < ***s*** ≤ 100	30
		100 < ***s*** ≤ 150	40
		s > 150	60

3.4.4 Sleep Mode Power Consumption: Measured Sleep Mode power consumption (P_{SLEEP}) shall be less than or equal to the maximum Sleep Mode power consumption requirement (P_{SLEEP_MAX}) determined per Equation 6, subject to the following conditions:

i. Only those interfaces that are present and used during the test, including any fax interface, may be considered functional adders.
ii. Product functionality offered through a DFE shall not be considered a functional adder.
iii. A single interface that performs multiple functions may be counted only once.
iv. Any interface that meets more than one interface type definition shall be classified according to the functionality used during the test.
v. For products that meet the Sleep Mode power requirement in Ready State, no further automatic power reductions are required to meet Sleep Mode requirements.

Note: EPA received stakeholder feedback that OM products that have no distinct Sleep Mode but meet the maximum Standby requirements should not be allowed to qualify. EPA wishes to clarify its proposal: All OM products shall meet the Sleep and Standby power requirements; however, they do not necessarily need to meet them in Sleep Mode. EPA has seen numerous products that do not have a distinct Sleep Mode, but can nonetheless meet the Sleep Mode requirement (and sometimes even the Standby Requirement) in Ready Mode.

More generally, an Imaging Equipment product can meet a power requirement pertaining to one mode while operating in another mode, as long as the other mode has more functions available and it can still meet the power limit of the original requirement.

Equation 6: Calculation of Maximum Sleep Mode Power Consumption Requirement for OM products

$$P_{SLEEP\_MAX} = P_{MAX\_BASE} + \sum_{1}^{n} Adder_{INTERFACE} + \sum_{1}^{m} Adder_{OTHER}$$

Where:

- P_{SLEEP_MAX} *is the maximum Sleep Mode power consumption requirement, expressed in watts (W), and rounded to the nearest 0.1 watt;*
- P_{MAX_BASE} *is the maximum Sleep Mode power allowance for the base marking engine, as determined per Table 6 , in watts;*
- $Adder_{INTERFACE}$ *is the power allowance for the interface functional adders used during the test, including any fax capability and as selected by the manufacturer from Table 7, in watts;*
- *n is the number of allowances claimed for interface functional adders used during the test, including any fax capability and is less than or equal to 2*
- $Adder_{OTHER}$ *is the power allowance for any non-interface functional adders in use during the test, as selected by the manufacturer from Table 7, in watts; and*
- *m is the number of allowances claimed for any non-interface functional adders in use during the test.*

Table 6: Sleep Mode Power Allowance for Base Marking Engine

Product Type	Media Format	Marking Technology				$P_{MAX\ BASE}$ (watts)
		Impact	Ink Jet	All Other	Not Applicable	
Copier	Large			x		8.2
Fax Machine	Standard		x			0.6
Mailing Machine	N/A		x	x		5.0
MFD	Standard	x	x			0.6
	Large		x			4.9
				x		8.2
Printer	Small	x	x	x		4.0
	Standard	x	x			0.6
	Large	x		x		2.5
			x			4.9
Scanner	Any				x	2.5

Note: Following the publication of the Draft 1 Specification in February 2012 and the stakeholder face-to-face meeting in March, stakeholders raised the following concerns with the data analyzed in developing the Draft 1 Operational Mode (OM) sleep mode requirements. Concerns, responded to in full in the Draft 1 comment response document, included such topics as the age of products within the dataset, viability of some data points (e.g., Sleep Mode exceeded Ready Mode), and the unequal reductions in base allowances for various product types.

To address these concerns, EPA reviewed and revised the data set by adding in some recently qualified products (as of April 12, 2012), removing models older than 2010, and removing models with uncertain data (i.e., qualified models whose Sleep Mode power was greater than Ready Mode power, and models with no Sleep Mode value at 115 V).

Analysis of this revised dataset supported EPA's Draft 2 proposal to revert back to current practice of allowing a functional adder for larger power supplies, which serve as a proxy for additional functionality beyond what is captured by the adders. EPA considered functional adders, including the adder for power supplies, when analyzing the revised data set and developing the Draft 2 proposed base allowances. EPA also evaluated the impacts of DFEs on Imaging Equipment product qualification rates. The analysis did not find that the levels proposed in Draft 1 discriminated against products with DFEs. Thus, EPA did not adjust levels based on presence of a DFE. Lastly, EPA considered adjustments to many base allowances using the revised dataset. The resulting levels are summarized below:

OM Category	Version 1.2 Base	Draft 1	Draft 2	Rationale for change in Draft 2
Large Non Ink Jet MFD	30 W	7.4	8.2	**Increase**. Draft 2 analysis resulted in a higher base allowance once new data were factored in.
Standard Format IJ	1.4 W	0.60	0.60	**No change**. The new data and power supply adder did not call for a change to the base allowance.
Large Ink Jet Printer and MFD	15 W	4.9	4.9	**No change**. The new data and power supply adder did not call for a change to the base allowance.
Mailing Machines	7 W	5.6	5.0	**Decrease**. Draft 2 analysis resulted in lower energy base allowance once new data were factored in.
Small Format Printer	9 W	9.0	4.0	**Decrease**. Our qualified data represents a small part of the market, the qualified product models are able to meet this revised base allowance, so not a significant change.
Standard Format Impact Printers	4.6 W	2.3	0.60	**Decrease**. Draft 2 analysis resulted in lower energy base allowance once new data and power supply adder were factored in.
Scanners	4.3 W	2.7	2.5	**Decrease**. Draft 2 analysis excluded models with power supplies ≤ 10 W (potential USB) and using only qual models (limited market share) resulted in slight decrease .
Large Non-Ink Jet Printer	14 W	2.5	2.5	**No change**. The new data and power supply adder did not call for a change to the base allowance.

Table 7: Sleep Mode Power Allowances for Functional Adders

Adder Type	Connection Type	Max. Data Rate, *r* (Mbit/ second)	Details	Functional Adder Allowance (watts)
Interface	Wired	r < 20	Includes: USB 1.x, IEEE 488, IEEE 1284/Parallel/ Centronics, RS232	0.2
		20 ≤ r < 500	Includes: USB 2.x, IEEE 1394/ FireWire/i.LINK, 100Mb Ethernet	0.4
		r ≥ 500	Includes: USB 3.x,1G Ethernet	0.5

Adder Type	Connection Type	Max. Data Rate, *r* (Mbit/ second)	Details	Functional Adder Allowance (watts)
		Any	Includes: Flash memory-card/smart-card readers, camera interfaces, PictBridge	0.2
	Fax Modem	Any	**Applies to MFDs only.**	0.2
	Wireless, Radio-frequency (RF)	Any	Includes: Bluetooth, 802.11	2.0
	Wireless, Infrared (IR)	Any	Includes: IrDA.	0.1
Cordless Handset	N/A	N/A	Capability of the imaging product to communicate with a cordless handset. Applied only once, regardless of the number of cordless handsets the product is designed to handle. Does not address the power requirements of the cordless handset itself.	0.8
Memory	N/A	N/A	Applies to the internal capacity available in the imaging product for storing data. Applies to all volumes of internal memory and should be scaled accordingly for RAM. This adder does not apply to hard disk or flash memory.	0.5/GB
Scanner	N/A	N/A	**Applies to MFDs and Copiers only.** Includes: Cold Cathode Fluorescent Lamp (CCFL) or a technology other than CCFL, such as Light-Emitting Diode (LED), Halogen, Hot-Cathode Fluorescent Tube (HCFT), Xenon, or Tubular Fluorescent (TL) technologies. (Applied only once, regardless of the lamp size or the number of lamps/bulbs employed.)	0.5
Power Supply	N/A	N/A	Applies to both internal and external power supplies for standard-format, non-mailing machine products using Inkjet and Impact marking technologies with nameplate output power (P_{OUT}) greater than 10 watts.	0.02 x (P_{OUT} – 10.0)
Touch Panel Display	N/A	N/A	Applies to both monochrome and color touch panel displays.	0.2
Internal Disk Drives	N/A	N/A	Includes any high-capacity storage product, including hard-disk and solid-state drives. Does not cover interfaces to external drives.	0.15

Note: EPA has made a number of changes to Table 7, including:

- Renamed the "Data and Network Adders" "Interface Adders" for consistency with Equation 6

- Added a row specifically for fax capability, which was previously grouped with the low-data-rate network adders
- Added back the Power Supply Adder and Internal Disk Drive Adder, which had been removed in Draft 1.
- Added a touch panel adder. This is only intended to the capacitive touch functionality of small displays included with imaging equipment and does not apply to other displays covered by the ENERGY STAR Displays program.
- Clarified that the Memory Adder does not apply to hard disks or flash and that the Disk Drive Adder does not apply to external drives.
- Increased the Cordless Handset allowance to 0.8 W in Draft 2, which was the requirement under Version 1.2. A review of ENERGY STAR qualified Cordless Telephones indicates that the 0.5 W power consumption proposed in Draft 1 is only achievable for the Additional Handset of a Cordless Telephone system, not the Base Stations typically integrated into Imaging Equipment.

3.4.5 Standby Power Consumption: Standby Mode power, which is the lesser of the Ready Mode Power, Sleep Mode Power, and Off Mode Power, as measured in the test procedure, shall be less than or equal to the Maximum Standby Power specified in Table 8..

i. The Imaging Equipment shall meet the Standby Power requirement independent of the state of any other devices (e.g., a host PC) connected to it.

Table 8: Maximum Standby Power Requirement

Product Type	Maximum Standby Power (watts)
All OM Products	0.5

Note: EPA would like to clarify that there is no Default Delay Time to Standby for Imaging Equipment products proposed at this time.

Note: Products intended for sale in the US market are subject to minimum toxicity and recyclability requirements. Please see ENERGY STAR Program Requirements for Imaging Equipment: Partner Commitments for details.

Note: To ensure that product designers are aware of Partner Commitments specific to toxicity and recyclability, EPA has inserted the above note.

4 TESTING

4.1 Test Methods

4.1.1 When testing Imaging Equipment products, the test methods identified in Table 9 shall be used to determine qualification for ENERGY STAR.

Table 9: Test Methods for ENERGY STAR Qualification

Product Type	Test Method
All Products	ENERGY STAR Imaging Equipment Test Method, Rev. May-2012

4.2 Number of Units Required for Testing

4.2.1 Representative Models shall be selected for testing per the following requirements:

i. For qualification of an individual product model, a product configuration equivalent to that which is intended to be marketed and labeled as ENERGY STAR is considered the Representative Model;

ii. For qualification of a product family, the highest energy using configuration within the family shall be considered the Representative Model. When submitting product families, manufacturers continue to be held accountable for any efficiency claims made about their imaging products, including those not tested or for which data was not reported.

4.2.2 A single unit of each Representative Model shall be selected for testing.

4.3 International Market Qualification

4.3.1 Products shall be tested for qualification at the relevant input voltage/frequency combination for each market in which they will be sold and promoted as ENERGY STAR.

5 USER INTERFACE

5.1.1 Manufacturers are encouraged to design products in accordance with the user interface standard IEEE 1621: Standard for User Interface Elements in Power Control of Electronic Devices Employed in Office/Consumer Environments. For details, see http://eetd.LBL.gov/Controls.

6 EFFECTIVE DATE

6.1.1 Effective Date: The Version 2.0 ENERGY STAR Imaging Equipment specification shall take effect on July 1, 2013. To qualify for ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect on its date of manufacture. 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.

Note: EPA anticipates releasing a Final Version 2.0 specification by October 2012. As such, the effective date provided above allows manufacturers time to work with certification bodies and update product literature as needed to comply with the new requirements. As of July 1, 2013, only those models that have been third-party certified by an EPA recognized Certification Body will remain on the ENERGY STAR Qualified Product List. For information on third-party certification visit: www.energystar.gov/3rdpartycert**.**

6.1.2 Future Specification Revisions: EPA reserves the right to change this 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 the ENERGY STAR qualification is not automatically granted for the life of a product model.

6.1.3 Items for Consideration in Future Revision:

i. **Network Proxy**: EPA will continue to monitor the implementation of proxying capability in imaging equipment hardware and consider the development of a test method to determine the presence of a network proxy (e.g. one compliant with ECMA-393 ProxZzzy for Sleeping Hosts).

ii. **Draft Mode**: Stakeholders raised concerns with the current method of qualifying TEC products. Specifically, assigning TEC limits based on the maximum claimed speed while testing using the default speed. EPA and DOE have clarified the test method to avoid the confusion between the two potentially different speeds and will continue to monitor qualifying products to assess the impacts of these differences and potential test method changes in future revisions.

iii. **Recovery Time for OM Products**: EPA is interested in a recovery time requirement for OM devices and welcomes stakeholder input on the benefits of providing this data to consumers on the qualified product list. If substantial benefits exist, EPA and DOE may include a recovery time measurement for OM products in the next version of the test method.

iv. **TEC Requirements in Kilowatt-hours per Year**: EPA has added columns to the TEC Tables expressing the requirements in kilowatt-hours per year in addition to the currently-used kilowatt-hours per week. Although this is purely informative, EPA will consider making this unit the only way to express TEC in a future specification revision as a way to address issues with reporting accuracy and comparisons between other ENERGY STAR products (which typically report in kilowatt-hours/year).

v. **Consistency of speed values:** While the maximum claimed print speed is used for purposes of calculation and qualification, the as-shipped speed is used within testing to emulate the end user's expected performance. EPA is interested in measuring as-shipped speed within the test method, and using this value for qualification purposes. Possible test methods for consideration include ISO/IEC 24734:2009 Method for measuring digital printing productivity and ISO/IEC 24735:2012 Method for measuring digital copying productivity.

vi. Wake Up Test Method: EPA' s intent is that ENERGY STAR qualified products use power management features, in the as-shipped condition, without requiring special configurations for use on the local network. If a fully networked machine is awoken by common network events, the energy associated with these events should be captured while testing for ENERGY STAR qualification. EPA and DOE are interested in working with stakeholders to develop a test method to standardize the wake up testing of units to capture this real world condition.