ENERGY STAR®
Product Specification for Imaging Equipment

Eligibility Criteria
Draft 2, Version 3.0

Following is the Draft 2, Version 3.0 ENERGY STAR Product Specification for Imaging Equipment. A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

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 the core functions of a Printer and Scanner. 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.

8) Professional Imaging Product: A printer or MFD marketed as intended for producing deliverables for sale, with the following features:

   a) Supports paper with basis weight greater than or equal to 141 g/m$^{2;}$

   b) A3-capable;

   c) If product is monochrome, monochrome product speed equal to or greater than 86 ipm;

d) If product is color, color product speed equal to or greater than 50 ipm;

Note: One stakeholder requested that the monochrome product speed requirement shall not apply to color products. EPA has clarified that the monochrome and color criteria apply to their respective products.

e) Print resolution of 600 × 600 dots per inch or greater for each color;

f) Weight greater than 180 kg; and

Note: Two stakeholders asked EPA to revise the definition of Professional Imaging Products to differentiate clearly from office equipment, recommending criteria for the weight of the base engine at greater than either 180 or 200 kg. EPA shares stakeholders' concerns that there may not be clear differentiation between office and Professional Imaging Products, and EPA assumes that products will become lighter with dematerialization. Therefore, EPA proposes to adopt the additional weight requirement at 180 kg. EPA also welcomes further suggestions for ways to differentiate these products, including whether to remove some of the criteria that are often shared with office equipment.

Three of the following additional features, included standard with the Imaging Equipment product or as an accessory:

g) Paper capacity equal to or greater than 8,000 sheets;

h) Digital front-end (DFE);

i) Hole punch;

j) Case binding or ring binding;

k) Memory storage equal to or greater than 1,024 MB.

l) Third-party color certification (e.g., GRACol®, Japan Color Digital Printing Certification; if product is color capable); and

m) Coated paper compatibility.

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.

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.

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.

   a) A3-capable: Standard Format products with a paper path width equal to or greater than 275 mm.

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 Small, Standard, or Large Format.

E) Additional Terms:

1) Automatic Duplexing: The capability of an 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 a duplex output are included with the product upon shipment.

2) Data Connection: A connection that permits the exchange of information between the Imaging Equipment 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) Recovery Time: The time it takes for a device to return from a Sleep or Off Mode to a Ready State.

5) 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 Equipment.

   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 Equipment's internal power supply. A Type 1 DFE may be sold standard with the Imaging Equipment product or as an accessory.

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.

d) Professional Digital Front-end (DFE): A DFE which meets **all** of the following criteria:

i. Is sold with a product defined above as a Professional Imaging Product;
ii. has processor performance per socket[2] equal to or greater than 20;
iii. provides support for error-correcting code (ECC) and/or buffered memory (including both buffered dual in-line memory modules (DIMMs) and buffered on board (BOB) configurations).
iv. is packaged and sold with one or more ac-dc or dc-dc power supplies; and
v. is designed such that all processors have access to shared system memory.

Note: EPA received stakeholder feedback that certain DFEs previously captured in the Type 1 DFE category use computer server hardware to support higher color counts, print speeds, and resolutions in professional imaging products. EPA is proposing to define these DFEs as professional DFEs to separate them out due to their increased energy consumption and performance. This definition borrows relevant characteristics from the ENERGY STAR computer server definition found in the computer server specification. EPA welcomes feedback on this new definition and its ability to effectively distinguish between typical Type 1 DFEs and this more powerful option intended for professional use cases.

e) Auxiliary Processing Accelerator (APA): A computing expansion add-in card installed in a general-purpose add-in expansion slot of the DFE (e.g., GPGPU installed in a PCI slot).

6) Network Connection: A connection that permits the exchange of information between the Imaging Equipment and one or more external powered devices.

7) 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.

8) 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.

9) 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.

2 Processor performance per socket = [# of processor cores] x [processor clock speed (GHz)], where # of cores represents the number of physical cores and processor clock speed represents the Max TDP core base frequency for a given processor.

10) Marking Engine: The fundamental engine of an Imaging Equipment 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.

11) 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.

12) 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.

13) 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.

14) Product Family: A group of product models that are (1) made by the same manufacturer, (2) subject to the same ENERGY STAR certification 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 certification 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, including Type 1 and Type 2 DFEs.

2 SCOPE

2.1 Included Products

2.1.1 Commercially-available products that meet one of the Imaging Equipment definitions in Section 1.A) 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 certification, 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.

Table 1: Evaluation Methods for Imaging Equipment

Equipment Type	Media Format	Marking Technology	ENERGY STAR Evaluation Method
Digital Duplicator	Standard	Stencil	TEC
Mailing Machine	All	DT, EP, IJ, TT	OM
Multifunction Device (MFD)	Standard	High Performance IJ, DT, DS, EP, SI, TT	TEC
		IJ, Impact	OM

Equipment Type	Media Format	Marking Technology	ENERGY STAR Evaluation Method
	Large	High Performance IJ, 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
	Large	High Performance IJ	OM
	Small	High Performance IJ	TEC
Scanner	All	N/A	OM

2.2 Excluded Products

2.2.1 Products that are covered under other ENERGY STAR product specifications are not eligible for certification 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 certification under this specification:

i. Products that are designed to operate directly on three-phase power;
ii. Professional Imaging Products
iii. Standalone Copiers; and
iv. Standalone Fax Machines.

3 CERTIFICATION 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): Single- and Multiple-voltage EPSs shall meet the Level VI or higher performance requirements under the International Efficiency Marking Protocol when tested according to the Uniform Test Method for Measuring the Energy Consumption of External Power Supplies, Appendix Z to 10 CFR Part 430.

i. Single-voltage EPSs shall include the Level VI or higher marking.
ii. Multiple-voltage EPSs meeting Level VI or higher shall include the Level VI or higher marking.
iii. Additional information on the Marking Protocol is available at http://www.regulations.gov/#!documentDetail;D=EERE-2008-BT-STD-0005-0218.
iv. The above requirements shall not apply to any EPSs shipped with a Digital Front End (DFE).

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 certified handset, or one that meets the ENERGY STAR Telephony specification when tested to the ENERGY STAR test method on the date the Imaging Equipment product is certified 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 certification.

3.2.4 DFE Requirements: The Typical Electricity Consumption (TEC_{DFE}) of a Type 1 or Type 2 DFE sold with an Imaging Equipment product at the time of sale 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.

Note: Stakeholders commented against reporting TEC on a yearly basis (kWh/year) noting that this is inconsistent with how customers think of energy usage in this category. To avoid consumer confusion and enable historical comparisons, stakeholders requested EPA to revert to kWh/week. EPA will continue to show both kWh/week and kWh/year on the ENERGY STAR website.

i. The TEC value or Ready State 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 3.3.2 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.
iv. DFEs that fail to meet these requirements will not only not have their power subtracted from that of the Imaging Equipment product as a whole, but will disqualify the product from ENERGY STAR. Therefore, such DFEs may not be sold with ENERGY STAR qualified Imaging Equipment.
v. The TEC_{DFE} requirements in Section 3.2.4 are not applicable to DFEs which meet the Professional DFE definition, though their energy consumption shall be reported with the ENERGY STAR certified Imaging Equipment.

Note: EPA has clarified that due to an inability to differentiate based on limited data within the relatively niche professional DFE market, professional DFEs will not be subject to TEC_{DFE} requirements in Version 3.0. Their energy consumption will still be reported in the same way energy is reported for all other DFEs in the specification.

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 for reporting;*
- *P_{DFE_READY} is Ready State 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 for reporting;*
- *P_{DFE_READY} is the DFE Ready State power measured in the test procedure in watts.*
- *P_{DFE_SLEEP} is the DFE Sleep Mode power measured in the test procedure in watts.*

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

DFE Category	Category Description	Maximum TEC_{DFE} (kWh/week)	
		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 certification.	7	3
B	To qualify under Category B DFEs must have: 2 or more physical CPUs or 1 CPU and ≥ 1 discrete Auxiliary Processing Accelerators (APAs)	12	3

Note: EPA has changed the Draft 1 DFE requirements to kWh/week for consistency with the Imaging Equipment TEC requirements.

3.2.5 Default Delay Time: Measured Default Delay Time to Sleep ($t_{DEFAULT}$) shall be less than or equal to the Required Default Delay Time to Sleep ($t_{DEFAULT\_REQ}$) requirement specified in Table 3, subject to the following conditions:

i. 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 certification purposes; however, the default-delay time provided must correspond with whichever level is used.

ii. Default Delay Time does not apply to OM products that can meet Sleep Mode requirements in Ready State.

iii. The Default Delay Time to Sleep may not be adjusted by the user to be greater than the Maximum Delay Times to Sleep Adjustable by the User, as specified in Table 4.

Table 3: Required Default Delay Time to Sleep for OM and TEC Products

Monochrome Product Speed, *s*, as Calculated in the Test Method (ipm or mppm)	Required Default Delay Time to Sleep, $t_{DEFAULT\_REQ}$ for MFDs, Scanners, Mailing Machines, and Digital Duplicators with Copying Capability (minutes)	Required Default Delay Time to Sleep, $t_{DEFAULT\_REQ}$, for Printers and Digital Duplicators without Copying Capability (minutes)
$s \leq 10$	15	5
$10 < s \leq 20$	30	15
$20 < s \leq 30$	45	30
$30 < s \leq 50$	45	45
$s > 50$	45	45

* Measured Default Delay Time to Sleep (t_{SLEEP}) shall be less than or equal to the Required Default Delay Time to Sleep (t_{SLEEP_REQ}), as specified in Section 3.2.5.

Table 4: Maximum Delay Times to Sleep Adjustable by the User

All Devices with a Monochrome Product Speed, *s*	Maximum Delay Times for Sleep Mode Adjustable by the User (min)
$s \leq 30$	60
$s > 30$	120

3.3 Requirements for Typical Electricity Consumption (TEC) Products

3.3.1 Automatic Duplexing Capability: For all MFDs and printers subject to the TEC test method, automatic duplexing capability shall be integral to the base product and enabled by default for products with speed equal to or greater than those specified in Table 5. Printers whose intended function is to print on special single-sided media for the purpose of single sided printing (e.g., release coated paper for labels, direct thermal media, etc.) are exempt from this requirement.

Table 5: Automatic Duplexing Requirements for all TEC MFDs and Printers

Product Type	Product Speed (ipm)
Color	19
Monochrome	24

Note: Stakeholders opposed the Draft 1 proposal to require duplexing at lower speeds (Color at 16-20 images per minute (ipm) and Monochrome at 11-25 ipm) because of the small proportion of products meeting the requirement, lack of consumer demand, and limited savings due to lack of use of duplexing at lower speeds. Following a detailed review of the requirements proposed in Draft 1 and the comments received, EPA has modified the requirements in line with comments. More specifically, EPA found that there are instances where double-sided printing may not be needed at all, such as hotel receipt printing, and therefore no savings would be accrued. In addition, EPA found that there are duplex capable products that are available at the lower speed levels which would allow a consumer the choice between products, depending on need. As such, EPA is proposing to revise the duplexing requirement in line with Blue Angel, by requiring duplexing by default over the current speed bins. EPA is also proposing to require that Imaging Equipment at intermediate speed bins (20-34 color; 25-36 monochrome) provide duplexing as part of the base product, rather than an optional accessory. The vast majority of products did not utilize the optional accessory option and it is not anticipated that this change will impact many products and will simplify the criteria.

3.3.2 Typical Electricity Consumption: Calculated Typical Electricity Consumption (TEC_{2017}) per Equation 3 or Equation 4 shall be less than or equal to the Maximum TEC Requirement (TEC_{REQ}) specified in Equation 6.

i. For Imaging Equipment with a Type 2 DFE that meet the Type 2 DFE maximum TEC_{DFE} requirement in Table 2, the measured energy consumption of the DFE shall be divided by 0.80 to account for internal power supply losses and then excluded when comparing the product's measured TEC value to TEC_{MAX} and for reporting.
ii. The DFE shall not interfere with the ability of the Imaging Equipment to enter or exit its lower-power modes.
iii. The energy use of a DFE can only be excluded if it meets the Type 2 DFE definition in Section 1 and is a separate processing unit that is capable of initiating activity over the network.

Example: A printer's total TEC result is 24.50 kWh/wk and its Type 2 TEC_{DFE} value calculated in Section 3.2.4 is 9.0 kWh/wk. The TEC_{DFE} value is then divided by 0.80 to account for internal power supply losses with the Imaging Equipment in Ready State, resulting in 11.25 kWh/wk. The power supply adjusted value is subtracted from the tested TEC value: 24.50 kWh/wk – 11.25 kWh/wk = 13.25 kWh/wk. This 13.25 kWh/wk result is then compared to the relevant TEC_{MAX} to determine certification.

iv. For printers, 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

$$TEC_{2017} = \left[5 \times \left(E_{JOB\_DAILY} + (2 \times E_{FINAL}) + \left[24 - \frac{N_{JOBS}}{16} - (2 \times t_{FINAL}) \right] \times \frac{E_{SLEEP}}{t_{SLEEP}} \right) + 48 \times \frac{E_{SLEEP}}{t_{SLEEP}} \right],$$

Where:

- *TEC_{2017} 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 for reporting;*
- *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.*

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

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

$$TEC_{2017} = \left[5 \times \left(E_{JOB\_DAILY} + (2 \times E_{FINAL}) + \left[24 - \frac{N_{JOBS}}{16} - (2 \times t_{FINAL}) \right] \times \frac{E_{AUTO}}{t_{AUTO}} \right) + 48 \times \frac{E_{AUTO}}{t_{AUTO}} \right],$$

Where:

- *TEC is the typical weekly energy consumption for digital duplicators without print capability and MFDs without print capability, expressed in kilowatt-hours (kWh) and rounded to the nearest 0.1 kWh for reporting;*
- 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..*

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

Equation 5: Daily Job Energy Calculation for TEC Products

$$E_{JOB\_DAILY} = \frac{1}{4}\left[2 \times E_{JOB1} + (N_{JOBS} - 2) \times \frac{E_{JOB2}+E_{JOB3}+E_{JOB4}}{3}\right],$$

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.*

Equation 6: Maximum TEC Requirement Calculation

$$TEC_{MAX} = TEC_{REQ} + Adder_{A3} + Adder_{Wi-Fi},$$

Where:

- TEC_{MAX} *is the maximum TEC requirement in kilowatt-hours per week (kWh/wk), rounded to the nearest 0.1 kWh/wk for reporting;*
- TEC_{REQ} *is the TEC requirement specified in Table 5, in kWh;*
- $Adder_{A3}$ *is a 0.05 kWh/wk allowance provided for A3-capable products; and*
- $Adder_{Wi-Fi}$ *is a 0.1 kWh/wk allowance provided for products where Wi-Fi is the interface functional adder used during the test.*

Note: In response to Draft 1, two stakeholders asked to maintain the current A3 adder, since A3 models require more power than A4. After updating the dataset, EPA did see a difference in pass rates between A3 and non-A3 models, and proposes a 0.05 kWh/week adder allowance to ensure even pass rates across these product categories and consumer choice.

In addition, stakeholders requested that ENERGY STAR include a Wi-Fi adder for TEC products, as Wi-Fi uses more power than USB. Because the current ENERGY STAR test method prioritizes USB over Wi-Fi, the current dataset does not fully reflect the performance of Wi-Fi models. Based on an analysis of 20 TEC models with Wi-Fi, EPA observed that models with Wi-Fi and USB (tested with Wi-Fi disconnected under the current test method) were able to meet the proposed requirements at a higher rate than models with Wi-Fi and no USB (tested with Wi-Fi connected), indicating that the Wi-Fi interface does require more power on average. A 0.1 kWh/wk allowance (equivalent to 0.6 W continuous) provided to the Wi-Fi-only models resulted in equivalent pass rates and is within the range of Wi-Fi allowances in other ENERGY STAR specifications. EPA therefore proposes to include this allowance in Equation 6, above. EPA welcomes feedback on this allowance.

Table 6: TEC Requirement

Color Capability	Monochrome Product Speed, *s*, as Calculated in the Test Method (ipm)	TEC_{REQ} (kWh/wk, to the nearest 0.01 kWh/wk for reporting)
Monochrome Non-MFD	s ≤ 20	0.242
	20 < s ≤ 40	0.017 × s – 0.115
	40 < s ≤ 60	0.022 × s – 0.320
	60 < s ≤ 135	0.050 × s – 2.028
	s > 135	0.183 × s – 20.116
Monochrome MFD	s ≤ 20	0.263
	20 < s ≤ 40	0.018 × s – 0.115
	40 < s ≤ 60	0.013 × s + 0.090
	60 < s ≤ 80	0.036 × s – 1.313
	s > 80	0.087 × s – 5.444
Color Non-MFD	s ≤ 20	0.275
	20 < s ≤ 40	0.032 × s – 0.397
	40 < s ≤ 60	0.002 × s + 0.833
	s > 60	0.100 × s – 5.145
Color MFD	s ≤ 20	0.254
	20 < s ≤ 40	0.021 × s – 0.187
	40 < s ≤ 60	0.013 × s + 0. 141
	60 < s ≤ 80	0.056 × s – 2.482
	s > 80	0.167 × s – 11.473

Note: EPA received comments that the TEC requirements should be reconsidered utilizing an amended dataset which would include all products currently on the market (regardless of date introduced to the market) and non-certified products. EPA received data or a confirmation that the dataset was adequate for level setting purposes from 13 stakeholders and believes that this dataset is the best dataset available at this time. The amended dataset has removed models no longer being sold, added older models still being sold, as well as non-certified products. EPA notes that for those products not ENERGY STAR certified, the energy information was not collected and EPA took a conservative approach and assumed these to be less energy efficient than the V2.0 requirements and therefore would not meet the Version 3.0 requirements either.

Specifically, the current dataset includes the latest ENERGY STAR certified model data, across all years. EPA then removed models that are:
1. OM, or TEC copiers and fax machines
2. Members of the same product family based on Product Type, Speed, Color, Size, and TEC Test Procedure Measurements (i.e., not just the final TEC result)
3. Sold Only Outside the United States
4. With Document Width Reported as less than Standard Format (210 mm)
5. With No Color Capability

EPA continued to remove multiple entries for product family models as some Brand Owners qualify product family models separately while others do so under one parent model, so removing the multiples ensures fairness between brands.

After considering the new dataset and levels, EPA found that the above proposal differentiates the top quartile of the market in each of the four categories of products. In addition, EPA considered the most common speed bins (21 ipm – 40 ipm and 41 ipm – 60 ipm) and found that in each of these bins the pass rates also identify the top quartile, ranging from 25%-33% of products in a given bin.

3.3.3 Additional Test Results Reporting Requirements:

i. DFE model name/number, Ready State power, Sleep Mode power, and TEC_{DFE} shall be reported for any Type 1 DFE sold with an Imaging Equipment product, including those not tested with the Imaging Equipment product as part of the highest energy using configuration per Section 1.1.1iii.

3.3.4 Recovery Time: Recovery Time, t_R as calculated per Equation 7, shall be less than the Maximum Recovery Time, t_{R_MAX}, subject to the following requirements:

i. For models with a shorter Default Delay Time to Sleep as found in Table 7, t_{R_MAX} shall be calculated per Equation 8.
ii. For models with a longer Default Delay Time to Sleep as found in Table 7, t_{R_MAX} shall be calculated per Equation 9.
iii. For models with a Default Delay Time to Sleep greater than any found in Table 7, t_{R_MAX} shall not be subject to a Recovery Time requirement.
iv. Recovery times from various modes (Active 0, Active 1, Active 2 times) shall be reported for all products tested using the TEC test method.

Equation 7: Recovery Time

$$t_R = t_{Active1} - t_{Active0},$$

Where:

- t_R *is Recovery Time;*
- $t_{Active1}$ *is the time from Sleep Mode to the first sheet exiting the unit, in minutes, as measured per the test method; and*
- $t_{Active0}$ *is the time from Ready State to the first sheet exiting the unit, in minutes, as measured per the test method.*

Note: Stakeholders provided multiple comments regarding the proposed recovery time requirements, including that harmonization with Blue Angel would increase test burden, the Blue Angel recovery time requirements are inappropriate for ENERGY STAR due to the different paper used during testing, and the requirement is not needed due to market forces. EPA investigated these comments and found that stakeholders are already conducting a recovery time test as part of ENERGY STAR and therefore there is no additional testing burden. In addition, EPA investigated the differences between tests with different paper and found that the median difference in recovery time was 1 second, which EPA believes makes the Blue Angel requirements appropriate for the US market as well, despite the slight differences in testing. Finally, EPA reviewed the ENERGY STAR certified product list and found that over 70% of products meet the Recovery Time Requirements indicating that the requirements represent a fair backstop to ensure a good consumer experience

Additionally, stakeholders proposed a change to the Recovery Time equation in Draft 1. EPA revised the above equation for recovery time in response to refer to $t_{Active0}$ rather than $t_{Active2}$. The quantity $t_{Active0}$ is measured immediately after the TEC model is placed in Ready State, so is a more reliable measure of response time from that State.

Table 7: Determination of Maximum Recovery Time (Minutes)

Print Speed, *s* (ipm)	Maximum Default Delay Time to Sleep to Permit Applicability of Shorter Recovery Time in Equation 8 (min)	Maximum Default Delay Time to Sleep to Permit Applicability of Longer Recovery Time in Equation 9 (min)
$0 < s \leq 5$	5	10
$5 < s \leq 10$	10	15
$10 < s \leq 20$	10	20

Print Speed, s (ipm)	Maximum Default Delay Time to Sleep to Permit Applicability of Shorter Recovery Time in Equation 8 (min)	Maximum Default Delay Time to Sleep to Permit Applicability of Longer Recovery Time in Equation 9 (min)
$20 < s \leq 30$	10	45
$30 < s \leq 40$	10	45
$s > 40$	15	60

Equation 8: Maximum Recovery Time for Models with Shorter Default Delay Times to Sleep, as Indicated in Table 7

$$t_{R\_MAX} = \min(0.42 \times s + 5, 30),$$

Where:

- t_{R_MAX} *is Maximum Recovery Time, in seconds;*
- s *is the product speed; and*
- min *is the minimum function (i.e., the Maximum Recovery Time shall be the lesser of* $0.42 \times s + 5$ *or 30 seconds).*

Equation 9: Maximum Recovery Time for Models with Longer Default Delay Times to Sleep, as Indicated in Table 7

$$t_{R\_MAX} = \min(0.51 \times s + 15, 60),$$

Where:

- t_{R_MAX} *is Maximum Recovery Time, in seconds;*
- s *is the product speed; and*
- min *is the minimum function (i.e., the Maximum Recovery Time shall be the lesser of* $0.51 \times s + 15$ *or 60 seconds).*

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 certification under the Default Delay Time to Sleep requirements specified in Section 3.2.5 and the Sleep Mode power consumption requirements specified in Section 3.4.3.

3.4.2 DFE Requirements: For Imaging Equipment with a Type 2 DFE that relies on the Imaging Equipment for its power, and that meets the appropriate maximum TEC_{DFE} requirement found in Table 2, the DFE power shall be excluded subject to the following conditions:

i. Ready State power of the DFE, as measured in the test method, shall be divided by 0.60 to account for internal power supply losses.

- Sleep Mode Requirements: If the resultant power in Paragraph i, above, is less than or equal to the Ready State or Sleep Mode power of the Imaging Equipment product as a whole, then the power shall be excluded from the measured Ready State or Sleep Mode power of the Imaging Equipment product as a whole when comparing to the Sleep Mode requirements in Section 3.4.3, below, and for reporting.

  Otherwise, the Sleep Mode power of the DFE, as measured in the test method, shall be divided by 0.60 and excluded from the Ready or Sleep Mode power of the Imaging Equipment for comparing to the requirements, and for reporting.

- Standby Requirements: If the resultant power in Paragraph i, above, is less than or equal to the Ready State, Sleep Mode, or Off Mode power of the Imaging Equipment as a whole, then the power shall be excluded from the Ready State, Sleep Mode, or Off Mode power of the Imaging Equipment product as a whole when comparing to the Standby requirements in Section 3.4.4, below, and for reporting.

  Otherwise, the Sleep Mode power of the DFE, as measured in the test method, shall be divided by 0.60 and excluded from the Ready State, Sleep Mode, or Off Mode power of the Imaging Equipment for comparing to the requirements, and for reporting.

ii. The DFE must not interfere with the ability of the Imaging Equipment to enter or exit its lower-power modes.
iii. In order to take advantage of this exclusion, the DFE must meet the Type 2 DFE definition in Section 1 and be a separate processing unit that is capable of initiating activity over the network.

Examples: Product 1 is an Imaging Equipment product whose Type 2 DFE has no distinct sleep mode. The Type 2 DFE has measured Ready State and Sleep Mode power both equal to 30 watts. The measured Sleep Mode power of the product is 53 watts. When subtracting 50 watts (30 watts / 0.60) from the measured Sleep Mode power of the product, 53 watts, the resulting 3 watts is the Sleep Mode power of the product for use in the criteria limits below.

Product 2 is an Imaging Equipment product whose Type 2 DFE goes to sleep when the Imaging Equipment goes to sleep during testing. The Type 2 DFE has measured DFE Ready State and Sleep Mode power equal to 30 watts and 5 watts, respectively. The measured Sleep Mode power of the product is 12 watts. When subtracting 50 watts (30 watts / 0.60) from the measured Sleep Mode power of the product, 12 watts, the result is -38 watts. In this case, instead subtract 8.33 watts (5 watts / 0.60) from the measured Sleep Mode power of the product, 12 watts, resulting in 3.67 watts which is used in the criteria limits below.

3.4.3 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 10, 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.

Equation 10: 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 for reporting;*
- *P_{MAX_BASE} is the maximum Sleep Mode power allowance for the base marking engine, as determined per Table 8, 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 9, 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 8, in watts; and*
- *m is the number of allowances claimed for any non-interface functional adders in use during the test, and is unlimited.*

Table 8: 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	
Mailing Machine	N/A		x	x		5.0
MFD	Standard	x	x			1.1
	Large		x			5.4
				x		8.7
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

* "All Other" category includes High Performance Ink Jet.

Table 9: 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
		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

Adder Type	Connection Type	Max. Data Rate, *r* (Mbit/ second)	Details	Functional Adder Allowance (watts)
Memory	N/A	N/A	Applies to the internal capacity available in the Imaging Equipment 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
Power Supply	N/A	N/A	Applies to both internal and external power supplies of Mailing Machines and Standard Format 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

Note: In Draft 1, EPA solicited feedback on potential amendments to the adders for OM products, particularly Cordless Handsets and Internal Disk Drives. EPA received feedback that neither adder is necessary or used and proposes removing both of these adders from the specification.

3.4.4 Off Mode Power Consumption Off Mode power, as measured in the test procedure, shall be less than or equal to the Maximum Off Mode power specified in Table 10, subject to the following conditions.

i. For products that do not have an Off Mode, Sleep Mode power, as measured in the test procedure, shall be less than or equal to the Maximum Off Mode power.
ii. For products that do not have an Off Mode or Sleep Mode, Ready State power, as measured in the test procedure, shall be less than or equal to the Maximum Off Mode power.
iii. The Imaging Equipment shall meet the Off Mode Power requirement independent of the state of any other devices (e.g., a host PC) connected to it.

Table 10: Maximum Off Mode Power Requirement

Product Type	Maximum Off Mode Power (watts)
All OM Products	0.3

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.

TESTING

4.1 Test Methods

4.1.1 When testing Imaging Equipment products, the test methods identified in Table 11 shall be used to determine certification for ENERGY STAR.

Table 11: Test Methods for ENERGY STAR Certification

Product Type	Test Method
Professional Imaging Products	ENERGY STAR Test Method for Professional Imaging Products, Rev. July-2018
All Other Non-Professional Imaging Products	ENERGY STAR Imaging Equipment Test Method, Rev. July-2018

4.2 Number of Units Required for Testing

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

i. For certification 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 certification of a product family that does not include a Type 1 DFE, the highest energy using configuration within the family shall be considered the Representative Model. Any subsequent testing failures (e.g., as part of verification testing) of any model in the family will have implications for all models in the family.
iii. For certification of a product family that includes Type 1 DFE, the highest energy using configuration of the Imaging Equipment and highest energy using DFE within the family shall be tested for certification purposes. Any subsequent testing failures (e.g., as part of verification testing) of any model in the family and all Type 1 DFEs sold with the Imaging Equipment, including those not tested with the Imaging Equipment product, will have implications for all models in the family. Imaging Equipment products that do not incorporate a Type 1 DFE may not be added to this product family for certification and must be qualified as a separate family without a Type 1 DFE.

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

4.3 International Market Certification

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

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://eta.LBL.gov/Controls.

EFFECTIVE DATE

6.1.1 Effective Date: The Version 3 ENERGY STAR Imaging Equipment specification shall take effect on **TBD**. 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 on which a unit is considered to be completely assembled.

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 certification is not automatically granted for the life of a product model.

6.1.3 Items for Consideration in a Future Revision: