



ENERGY STAR® Program Requirements for Imaging Equipment

Partner Commitments

Following are the terms of the ENERGY STAR Partnership Agreement as it pertains to the manufacture and labeling of ENERGY STAR qualified products. The ENERGY STAR Partner must adhere to the following partner commitments:

Qualifying Products

1. Comply with current ENERGY STAR Eligibility Criteria, which define performance requirements and test procedures for Imaging Equipment. A list of eligible products and their corresponding Eligibility Criteria can be found at www.energystar.gov/specifications.
2. **Prior to associating the ENERGY STAR name or mark with any product**, obtain written certification of ENERGY STAR qualification from a Certification Body recognized by EPA for Imaging Equipment. As part of this certification process, products must be tested in a laboratory recognized by EPA to perform Imaging Equipment testing. A list of EPA-recognized laboratories and certification bodies can be found at www.energystar.gov/testingandverification.

Using the ENERGY STAR Name and Marks

3. Comply with current ENERGY STAR Identity Guidelines, which define how the ENERGY STAR name and marks may be used. Partner is responsible for adhering to these guidelines and ensuring that its authorized representatives, such as advertising agencies, dealers, and distributors, are also in compliance. The ENERGY STAR Identity Guidelines are available at www.energystar.gov/logouse.
4. Use the ENERGY STAR name and marks only in association with qualified products. Partner may not refer to itself as an ENERGY STAR Partner unless at least one product is qualified and offered for sale in the U.S and/or ENERGY STAR partner countries.
5. Provide clear and consistent labeling of ENERGY STAR qualified Imaging Equipment.
 - 5.1. The ENERGY STAR mark must be clearly displayed:
 - 5.1.1. Either on the top/front of product or through electronic messaging that is pre-approved by EPA. Labeling on the top/front of product may be permanent or temporary. All temporary labeling must be affixed to the top/front of product with an adhesive or cling-type application;
 - 5.1.2. On the manufacturer's Internet site where information about ENERGY STAR qualified models is displayed. Specific guidance on using the ENERGY STAR mark on Internet sites is provided in the Web-Based Tools for Partners document;
 - 5.1.3. Either in product literature (e.g., user manuals, specification sheets, etc.) or in a separate box insert that provides educational language about the product's ENERGY STAR settings; and
 - 5.1.4. On product packaging/boxes for products sold at retail.

Verifying Ongoing Product Qualification

6. Participate in third-party verification testing through a Certification Body recognized by EPA for Imaging Equipment, providing full cooperation and timely responses, EPA/DOE may also, at its

discretion, conduct tests on products that are referred to as ENERGY STAR qualified. These products may be obtained on the open market, or voluntarily supplied by Partner at the government's request.

Providing Information to EPA

7. Provide unit shipment data or other market indicators to EPA annually to assist with creation of ENERGY STAR market penetration estimates, as follows:
 - 7.1. Partner must submit the total number of ENERGY STAR qualified Imaging Equipment shipped in the calendar year or an equivalent measurement as agreed to in advance by EPA and Partner. Partner shall exclude shipments to organizations that rebrand and resell the shipments (unaffiliated private labelers).
 - 7.2. Partner must provide unit shipment data segmented by meaningful product characteristics (e.g., type, capacity, presence of additional functions) as prescribed by EPA.
 - 7.3. Partner must submit unit shipment data for each calendar year to EPA or an EPA-authorized third party, preferably in electronic format, no later than March 1 of the following year.Submitted unit shipment data will be used by EPA only for program evaluation purposes and will be closely controlled. If requested under the Freedom of Information Act (FOIA), EPA will argue that the data is exempt. Any information used will be masked by EPA so as to protect the confidentiality of the Partner;
8. Report to EPA any attempts by recognized laboratories or Certification Bodies (CBs) to influence testing or certification results or to engage in discriminatory practices.
9. Notify EPA of a change in the designated responsible party or contacts within 30 days using the My ENERGY STAR Account tool (MESA) available at www.energystar.gov/mesa.

Performance for Special Distinction

In order to receive additional recognition and/or support from EPA for its efforts within the Partnership, the ENERGY STAR Partner may consider the following voluntary measures, and should keep EPA informed on the progress of these efforts:

- Provide quarterly, written updates to EPA as to the efforts undertaken by Partner to increase availability of ENERGY STAR qualified products, and to promote awareness of ENERGY STAR and its message.
- Consider energy efficiency improvements in company facilities and pursue benchmarking buildings through the ENERGY STAR Buildings program.
- Purchase ENERGY STAR qualified products. Revise the company purchasing or procurement specifications to include ENERGY STAR. Provide procurement officials' contact information to EPA for periodic updates and coordination. Circulate general ENERGY STAR qualified product information to employees for use when purchasing products for their homes.
- Feature the ENERGY STAR mark(s) on Partner website and other promotional materials. If information concerning ENERGY STAR is provided on the Partner website as specified by the ENERGY STAR Web Linking Policy (available in the Partner Resources section of the ENERGY STAR website), EPA may provide links where appropriate to the Partner website.
- Ensure the power management feature is enabled on all ENERGY STAR qualified displays and computers in use in company facilities, particularly upon installation and after service is performed.
- Provide general information about the ENERGY STAR program to employees whose jobs are relevant to the development, marketing, sales, and service of current ENERGY STAR qualified products.
- Provide a simple plan to EPA outlining specific measures Partner plans to undertake beyond the program requirements listed above. By doing so, EPA may be able to coordinate, and communicate Partner's activities, provide an EPA representative, or include news about the event in the ENERGY STAR newsletter, on the ENERGY STAR website, etc. The plan may be as simple as providing a list

of planned activities or milestones of which Partner would like EPA to be aware. For example, activities may include: (1) increasing the availability of ENERGY STAR qualified products by converting the entire product line within two years to meet ENERGY STAR guidelines; (2) demonstrating the economic and environmental benefits of energy efficiency through special in-store displays twice a year; (3) providing information to users (via the website and user's manual) about energy-saving features and operating characteristics of ENERGY STAR qualified products; and (4) building awareness of the ENERGY STAR Partnership and brand identity by collaborating with EPA on one print advertorial and one live press event.

- Join EPA's SmartWay Transport Partnership to improve the environmental performance of the company's shipping operations. The SmartWay Transport Partnership works with freight carriers, shippers, and other stakeholders in the goods movement industry to reduce fuel consumption, greenhouse gases, and air pollution. For more information on SmartWay, visit www.epa.gov/smartway.
- Join EPA's Green Power Partnership. EPA's Green Power Partnership encourages organizations to buy green power as a way to reduce the environmental impacts associated with traditional fossil fuel-based electricity use. The partnership includes a diverse set of organizations including Fortune 500 companies, small and medium businesses, government institutions as well as a growing number of colleges and universities. For more information on Green Power, visit www.epa.gov/greenpower.



ENERGY STAR[®] Program Requirements Product Specification for Imaging Equipment

Eligibility Criteria Version 1.2

Following is the Version 1.2 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 hard-copy 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 hard copy 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 hard copy duplicates from hard copy 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 hard copy originals for electronic transmission to remote units, and (2) to receive electronic transmissions for conversion to hard copy output. A fax machine may also be capable of producing hard copy 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 hard copy 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 hard copy 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 hard copy 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 all product features considered Primary Function adders, albeit with a possible delay to transition into Active State.
- 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.
- 2) **Data Connection:** A connection that permits the exchange of information between the imaging product and one external powered device or storage medium.

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.

- 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) 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
 - b) 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.
 - c) 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).
- 5) External Power Supply (EPS): For the purposes of this specification, an External Power Supply:
 - a) is designed to convert line voltage AC input into lower voltage AC or DC output;
 - b) is able to convert to only one output voltage at a time;
 - c) is sold with, or intended to be used with, a separate end-use product that constitutes the primary load;
 - d) is contained in a separate physical enclosure³ from the end-use product;
 - e) is connected to the end-use product via a removable or hard-wired male/female electrical connection, cable, cord or other wiring;
 - f) does not have batteries or battery packs that physically attach directly (including those that are removable) to the power supply unit;

³ "Physical enclosure" refers to the housing of the products themselves, not their retail packaging.

- g) does not have a battery chemistry or type selector switch AND an indicator light or state of charge meter (e.g., a product with a type selector switch AND a state of charge meter is excluded from this specification; a product with only an indicator light is still covered by this specification); and
 - h) has nameplate output power less than or equal to 250 watts.
- 6) Network Connection: A connection that permits the exchange of information between the imaging product and one or more external powered devices.
 - 7) Functional Adder: Data and network interface 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. Functional adders are classified by the state in which the interface is required to remain while the imaging product is in Sleep Mode.
 - a) Primary Functional Adder: A Functional Adder that remains active while the imaging equipment product is in Sleep Mode.
 - b) Secondary Functional Adder: A Functional Adder that can be inactive while the imaging equipment product is in Sleep Mode.
 - 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.
 - 10) 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.
 - 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 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 voltage and frequency,
- d) Input or output paper-handling accessories, or
- e) Any of the functional adders specified in Table 8.

2 SCOPE

2.1 Included Products

2.1.1 Commercially-available imaging equipment products that meet one of the Product Type 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.

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 | 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 |
| 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 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 meet the eligibility requirements for other ENERGY STAR product specifications,
- ii. 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 performed with actual measured or observed values. Only the final result of a calculation shall be rounded. Calculated results shall be rounded to the nearest significant digit as expressed in the corresponding specification limit.
- 3.1.2 Unless otherwise specified, compliance with specification limits shall be evaluated using exact values without any benefit from further rounding.

3.2 General Requirements

- 3.2.1 External Power Supply (EPS): If the product is shipped with an 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.
- External Power Supplies 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*.
- 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.
- 3.2.4 Type 1 DFE Requirements: To qualify as ENERGY STAR, an imaging equipment product that is sold with a Type 1 DFE shall use a DFE that meets the Digital Front End Power Supply Efficiency Requirements listed in Section 3.5.
- 3.2.5 Type 2 DFE Requirements: To qualify as ENERGY STAR an imaging equipment product that is sold with a Type 2 DFE, manufacturers should subtract the DFE's energy consumption in Ready mode for TEC products or exclude when measuring Sleep and Standby for OM products.
- Section 3.3.2 provides further detail on adjusting TEC values for DFEs for TEC products;
 - Section 3.4.2 provides further detail for excluding DFEs from OM Sleep and Standby levels.
 - It is EPA's intent that, whenever possible, the power associated with the DFE (Type 1 or Type 2) should be excluded or subtracted from the TEC energy and OM power measurements.

3.3 Requirements for Typical Electricity Consumption (TEC) Products

- 3.3.1 Automatic Duplexing Capability:
- For color copiers, color MFDs, and color printers subject to the TEC test method, automatic duplexing capability shall be present at the time of purchase as specified in Table 2.

Table 2: Automatic Duplexing Requirements for Color Copiers, Color MFDs, and Color Printers

| Monochrome Product Speed, s , as Calculated in the Test Method (ipm) | Automatic Duplexing Requirement |
|--|--|
| $s \leq 19$ | None |
| $19 < s < 40$ | Integral to the base product or offered as an optional accessory |
| $s \geq 40$ | Integral to the base product |

- ii. For monochrome copiers, monochrome MFDs, and monochrome 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 Monochrome Copiers, Monochrome MFDs, and Monochrome Printers

| Monochrome Product Speed, s , as Calculated in the Test Method (ipm) | Automatic Duplexing Requirement |
|--|--|
| $s \leq 24$ | None |
| $24 < s < 45$ | Integral to the base product or offered as an optional accessory |
| $s \geq 45$ | Integral to the base product |

3.3.2 Typical Electricity Consumption:

- i. Calculated Typical Electricity Consumption (TEC) per Equation 1 or Equation 2 shall be less than or equal to the Maximum TEC Requirement (TEC_{MAX}) specified in Table 4, to the nearest 0.1 kilowatt-hour.
- ii. For imaging products with a Type 2 DFE, 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 must not interfere with the ability of the imaging product to enter or exit its lower-power modes. 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.

Example: A printer's total TEC result is 24.5 kWh/week and its internal DFE consumes 50W in Ready mode. $50W \times 168 \text{ hours/week} = 8.4 \text{ kWh/week}$, which is then subtracted from the tested TEC value: $24.5 \text{ kWh/week} - 8.4 \text{ kWh/week} = 16.1 \text{ kWh/week}$. 16.1 kWh/week is then compared to the following criteria.

- iii. For printers, fax machines, digital duplicators with print capability, and MFDs with print capability, TEC shall be calculated per Equation 1.

Equation 1: TEC Calculation for Printers, Fax Machines, Digital Duplicators with Print Capability, and MFDs with Print Capability

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

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 3, in kWh;
- *E_{FINAL}* is the final energy, as measured in the test procedure in 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, in hours;
- *E_{SLEEP}* is the Sleep energy, as measured in the test procedure in kWh; and
- *t_{SLEEP}* is the Sleep time, as measured in the test procedure, in hours.

- iv. For copiers, digital duplicators without print capability, and MFDs without print capability, TEC shall be calculated per Equation 2.

Equation 2: TEC Calculation for Copiers, Digital Duplicators without Print Capability, and MFDs without Print Capability

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

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 3, in kWh;
- *E_{FINAL}* is the final energy, as measured in the test procedure, in 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, in hours;
- *E_{AUTO}* is the Auto-off energy, as measured in the test procedure, in kWh; and
- *t_{AUTO}* is the Auto-off time, as measured in the test procedure, in hours.

- v. Daily Job Energy shall be calculated per Equation 3.

Equation 3: 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, in kWh; and
- *N_{JOBS}* is the number of jobs per day, as calculated in the test procedure.

Table 4: Maximum TEC Requirement

| Color Capability | Product Type | | | | | Monochrome Product Speed, s , as Calculated in the Test Method (ipm) | TEC _{MAX} (kWh, to the nearest 0.1 kWh) | |
|------------------|--------------|-------------|--------------------|---------|----------------------|--|--|--------------------------|
| | Copier | Fax Machine | Digital Duplicator | Printer | Multifunction Device | | | |
| Monochrome | x | x | x | x | | $s \leq 15$ | 1.0 | |
| | | | | | | $15 < s \leq 40$ | $(s \times 0.10) - 0.5$ | |
| | | | | | | $40 < s \leq 82$ | $(s \times 0.35) - 10.3$ | |
| | | | | | | $s > 82$ | $(s \times 0.70) - 39.0$ | |
| | | | | | | x | $s \leq 10$ | 1.5 |
| | | | | | | | $10 < s \leq 26$ | $(s \times 0.10) + 0.5$ |
| | | | | | | | $26 < s \leq 68$ | $(s \times 0.35) - 6.0$ |
| | | | | | | | $s > 68$ | $(s \times 0.70) - 30.0$ |
| Color | x | x | x | x | | $s \leq 32$ | $(s \times 0.10) + 2.8$ | |
| | | | | | | $32 < s \leq 58$ | $(s \times 0.35) - 5.2$ | |
| | | | | | | $s > 58$ | $(s \times 0.70) - 26.0$ | |
| | | | | | | x | $s \leq 26$ | $(s \times 0.10) + 3.5$ |
| | | | | | | | $26 < s \leq 62$ | $(s \times 0.35) - 3.0$ |
| | | | | | | | $s > 62$ | $(s \times 0.70) - 25.0$ |

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, the power consumption of the DFE 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. The DFE must not interfere with the ability of the imaging product to enter or exit its lower-power modes. 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:

- i. Measured Default Delay Time to Sleep (t_{SLEEP}) shall be less than or equal to the Maximum Default Delay Time to Sleep ($t_{\text{SLEEP_MAX}}$) requirement specified in Table 5 and Table 6.
- ii. All OM products must be shipped with a maximum machine delay less than or equal to 4 hours, which is only adjustable by the manufacturer. This maximum machine delay time cannot be influenced by the user and typically cannot be modified without internal, invasive product manipulation.

- iii. 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.

Table 5: Maximum Default Delay Time to Sleep for OM Products, Except Mailing Machines

| Product Type | Media Format | Monochrome Product Speed, s , as Calculated in the Test Method (ipm) | Default Delay Time to Sleep (minutes) |
|--------------|-------------------|--|---------------------------------------|
| Copier | Large | $s \leq 30$ | 30 |
| | | $s > 30$ | 60 |
| Fax Machine | Small or Standard | All | 5 |
| MFD | Small or Standard | $s \leq 10$ | 15 |
| | | $10 < s \leq 20$ | 30 |
| | | $s > 20$ | 60 |
| | Large | $s \leq 30$ | 30 |
| $s > 30$ | | 60 | |
| Printer | Small or Standard | $s \leq 10$ | 5 |
| | | $10 < s \leq 20$ | 15 |
| | | $20 < s \leq 30$ | 30 |
| | | $s > 30$ | 60 |
| | Large | $s \leq 30$ | 30 |
| | | $s > 30$ | 60 |
| Scanner | All | All | 15 |

Table 6: Maximum Default Delay Time to Sleep for Mailing Machines

| Product Type | Media Format | Product Speed, s , as Calculated in the Test Method (mppm) | Default Delay Time to Sleep (minutes) |
|-----------------|--------------|--|---------------------------------------|
| Mailing Machine | All | $s \leq 50$ | 20 |
| | | $50 < s \leq 100$ | 30 |
| | | $100 < s \leq 150$ | 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 4, subject to the following conditions:

- i. Only those interfaces that are present and available for use in the “as-shipped” product configuration may be considered functional adders.
- ii. Product functionality offered through a DFE shall not be considered either a Primary or Secondary functional adder.
- iii. Manufacturers may apply no more than three Primary functional adders to each product model, but may apply as many Secondary adders as present (with Primary adders in excess of three included as Secondary adders).
- iv. For products with multiple interfaces, each interface shall be considered separately.
- v. A single interface that performs multiple functions may be counted only once.
- vi. Any interface that meets more than one interface type definition shall be classified according to its primary functionality
- vii. 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 4: Calculation of Maximum Sleep Mode Power Consumption Requirement for OM products

$$P_{SLEEP_MAX} = P_{MAX_BASE} + \sum_1^n Adder_{PRIMARY} + \sum_1^m Adder_{SECONDARY}$$

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 7, in watts;
- $Adder_{PRIMARY}$ is the power allowance for one of three applicable Primary functional adders, as selected by the manufacturer from Table 8, in watts;
- n is the number of Primary adder allowances claimed, and is less than or equal to 3
- $Adder_{SECONDARY}$ is the power allowance for any applicable Secondary functional adder or Primary functional adder in excess of three (and therefore counted as a Secondary adder), as selected by the manufacturer from Table 8, in watts; and
- m is the number of Secondary adder allowances being claimed (including for any Primary adders beyond the n claimed under the Primary adder allowance).

Table 7: Sleep Mode Power Allowance for Base Marking Engine

| Color Capability | Product Type | Media Format | Marking Technology | | | | | | | | P _{MAX_BASE} (watts) | | |
|------------------|-----------------|--------------|--------------------|-----------|-----------------|----------------------|--------|---------|------------------|----------------|-------------------------------|------|------|
| | | | Direct Thermal | Solid Ink | Dye Sublimation | Electro-photographic | Impact | Ink Jet | Thermal Transfer | Not Applicable | | | |
| Monochrome | Copier | Large | x | | x | x | | | | x | | 30.0 | |
| | Fax Machine | Standard | | | | | | | x | | | 1.4 | |
| | Mailing Machine | N/A | x | | | x | | | x | x | | 7.0 | |
| | MFD | Standard | | | | | | | | x | | 1.4 | |
| | | Large | x | | x | x | | | | x | | 30.0 | |
| | Printer | Small | | x | | x | x | x | x | x | x | | 9.0 |
| | | Standard | | | | | | | x | | | | 4.6 |
| | | | | | | | | | | x | | | 1.4 |
| | | Large | | x | | x | x | x | | | x | | 14.0 |
| | | | | | | | | | x | | | 15.0 | |
| Color | Copier | Large | | x | x | x | | | | x | | 30.0 | |
| | Fax Machine | Standard | | | | | | | x | | | 1.4 | |
| | MFD | Standard | | | | | | | | x | | 1.4 | |
| | | Large | | | | | | | | x | | 15.0 | |
| | | | | x | x | x | | | | x | | 30.0 | |
| | Printer | Small | | | x | x | x | x | x | x | x | | 9.0 |
| | | Standard | | | | | | | x | | | | 4.6 |
| | | | | | | | | | | x | | | 1.4 |
| | | Large | | | x | x | x | x | | | x | | 14.0 |
| | | | | | | | | x | | | 15.0 | | |
| Not Applicable | Scanner | Any | | | | | | | | x | 4.3 | | |

Table 8: Sleep Mode Power Allowances for Functional Adders

| Adder Type | Connection Type | Max. Data Rate, r (Mbit/second) | Details | Primary Functional Adder Allowance (watts) | Secondary Functional Adder Allowance (watts) |
|-------------------------------------|--------------------------------|-----------------------------------|--|--|--|
| Data or Network Connection | Wired | $r < 20$ | Includes: USB 1.x, IEEE 488, IEEE 1284/Parallel/ Centronics, RS232, Fax Modem | 0.3 | 0.2 |
| | | $20 \leq r < 500$ | Includes: USB 2.x, IEEE 1394/ FireWire/i.LINK, 100Mb Ethernet | 0.5 | 0.2 |
| | | $r \geq 500$ | Includes: 1G Ethernet | 1.5 | 0.5 |
| | | Any | Includes: Flash memory-card/smart-card readers, camera interfaces, PictBridge | 0.5 | 0.1 |
| | Wireless, Radio-frequency (RF) | Any | Includes: Bluetooth, 802.11 | 3.0 | 0.7 |
| | | Any | 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 |
| Wireless, Infrared (IR) | Any | Includes: IrDA. | 0.2 | 0.2 | |
| Internal Storage Drive | N/A | N/A | Includes: internal drives only (e.g., disk drives, DVD drives, Zip drives), and applies to each separate drive. Does not cover interfaces to external drives (e.g., SCSI) or internal memory. | - | 0.2 |
| 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. | - | 1.0 W per GB |
| Scanner | N/A | N/A | 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 |
| Personal Computer (PC)-Based System | N/A | N/A | Applies to imaging products that rely on an external computer for significant resources, such as memory and data processing, to perform basic functions commonly performed by imaging products independently, such as page rendering. Does not apply to products that simply use a computer as a source or destination for image data. | - | - 0.5 |

| Adder Type | Connection Type | Max. Data Rate, r (Mbit/second) | Details | Primary Functional Adder Allowance (watts) | Secondary Functional Adder Allowance (watts) |
|--------------|-----------------|-----------------------------------|--|--|--|
| 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. | - | $0.02 \times (P_{OUT} - 10.0)$ |

3.4.5 Standby Mode 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 Mode power requirement specified in Table 9.

Table 9: Maximum Standby Power Requirement

| Product Type | Maximum Standby Power (watts) |
|-----------------|-------------------------------|
| All OM Products | 1.0 |

3.5 Digital Front End Power Supply Efficiency Requirements:

3.5.1 To qualify as ENERGY STAR under this specification, an imaging equipment product with a Type 1 DFE must use a DFE that meets the following requirements.

- i. Internal Power Supplies (IPSS): Internal Power Supplies used with DFEs eligible under this specification shall meet the requirements specified in Table 10 when tested using the *EPR1 Generalized Internal Power Supply Efficiency Test Protocol, Rev. 6.4.2* (available at www.efficientpowersupplies.org).
 - Power supply test data and test reports from testing entities recognized by EPA to perform power supply testing shall be accepted for the purpose of qualifying the ENERGY STAR product.

Table 10: Efficiency and Power Factor Requirements for DFE Internal Power Supplies

| Loading Level as a Percentage of Nameplate Output Current | Minimum Efficiency | Minimum Power Factor |
|---|--------------------|----------------------|
| 20% | 0.80 | - |
| 50% | 0.80 | - |
| 100% | 0.80 | 0.9 |

- ii. External Power Supplies (EPSs): External Power Supplies used with DFEs eligible under this specification 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.
 - External Power Supplies 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*.

4 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 ENERGY STAR qualification.

Table 11: Test Methods for ENERGY STAR Qualification

| Product Type | Test Method |
|--------------|--|
| All Products | IEC 62301 Ed 1.0: Household Electrical Appliances – Measurement of Standby Power |
| All Products | ENERGY STAR Imaging Equipment Test Method, Rev. Aug-2010 |

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.

- i. For products subject to the requirements in section 3.3 of this specification (TEC products), if the initial unit tested has TEC test results that meet the eligibility criteria but fall within 10% of the criteria level, one additional unit of the same model must also be tested. Manufacturers shall report values for both units. To qualify as ENERGY STAR, both units must meet the ENERGY STAR specification.
- ii. For products subject to the requirements in section 3.4 of this specification (OM products), if the initial unit tested has OM test results that meet the eligibility criteria but fall within 15% of the criteria level in any of the specified operating modes for that product type, then two more units shall be tested. To qualify as ENERGY STAR, all three units must meet the ENERGY STAR specification. All tested units shall meet ENERGY STAR qualification requirements.

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 1.2 ENERGY STAR Imaging Equipment specification shall take effect on the date specified in Table 12. 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.
- 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.

Table 12: Specification Effective Date

| Effective Date |
|----------------|
| July 1, 2009 |



ENERGY STAR® Program Requirements Product Specification for Imaging Equipment

Test Method

1 OVERVIEW

The following test method shall be used for determining product compliance with requirements in the ENERGY STAR Eligibility Criteria for Imaging Equipment.

2 APPLICABILITY

ENERGY STAR test requirements are dependent upon the feature set of the product under evaluation. Table 1 shall be used to determine the applicability of each section of this document:

Table 1: Test Procedure Applicability

| Product 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 | 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 |
| Scanner | All | N/A | OM |

3 DEFINITIONS

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

- A) Unit Under Test (UUT): The specific sample of a Representative Model undergoing measurement, which includes the base product and any accessories packaged with it.

4 TEST SETUP

A) AC Input Power: Products intended to be powered from AC mains shall be connected to a voltage source appropriate for the intended market, as specified in Table 2 or Table 3.

- 1) Products shipped with external power supplies (EPSs) shall first be connected to the EPS and then to the voltage source specified in Table 2 or Table 3.
- 2) If a product is designed to operate at a voltage/frequency combination in a specific market that is different from the voltage/frequency combination for that market (e.g., 230 volts, 60 hertz in North America), the manufacturer should test the product at the regional combination that most closely matches the product's design capabilities and note this fact on the test reporting sheet.

Table 2: Input Power Requirements for Products with Nameplate Rated Power Less Than or Equal to 1500 W

| Market | Voltage | Voltage Tolerance | Maximum Total Harmonic Distortion | Frequency | Frequency Tolerance |
|--------------------------------|---------|-------------------|-----------------------------------|-------------|---------------------|
| North America, Taiwan | 115 Vac | +/- 1.0 % | 2.0 % | 60 Hz | +/- 1.0 % |
| Europe, Australia, New Zealand | 230 Vac | +/- 1.0 % | 2.0 % | 50 Hz | +/- 1.0 % |
| Japan | 100 Vac | +/- 1.0 % | 2.0 % | 50 Hz/60 Hz | +/- 1.0 % |

Table 3: Input Power Requirements for Products with Nameplate Rated Power Greater than 1500 W

| Market | Voltage | Voltage Tolerance | Maximum Total Harmonic Distortion | Frequency | Frequency Tolerance |
|--------------------------------|---------|-------------------|-----------------------------------|-------------|---------------------|
| North America, Taiwan | 115 Vac | +/- 4.0 % | 5.0 % | 60 Hz | +/- 1.0 % |
| Europe, Australia, New Zealand | 230 Vac | +/- 4.0 % | 5.0 % | 50 Hz | +/- 1.0 % |
| Japan | 100 Vac | +/- 4.0 % | 5.0 % | 50 Hz/60 Hz | +/- 1.0 % |

B) Low-voltage DC Input Power:

- 1) Products may only be powered with a low-voltage DC source (e.g., via network or data connection) if the DC source is the only acceptable source of power for the product (e.g., no AC plug or EPS is included with the product).
- 2) Products powered by low-voltage DC shall be configured with an AC source of the DC power for testing (e.g., an AC-powered USB hub).

- 3) Reported UUT power shall be equal to the AC power consumption of the low-voltage DC source with the UUT as the load, minus the AC power consumption of the low-voltage DC source with no load (P_S), as measured per section 5 of this procedure.
- C) Ambient Temperature: Ambient temperature shall be $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.
- D) Relative Humidity: Relative humidity shall be from 10% to 80%.
- E) Power Meter: Power meters shall possess the following attributes:
- 1) Minimum Frequency Response (Recommended): 3.0 kHz
 - 2) Minimum Resolution:
 - i) 0.01 W for measurement values less than 10 W;
 - ii) 0.1 W for measurement values from 10 W to 100 W;
 - iii) 1 W for measurement values from 100 W to 1.5 kW; and
 - iv) 10 W for measurement values greater than 1.5 kW.
 - v) Measurements of accumulated energy should have resolutions which are generally consistent with these values when converted to average power. For accumulated energy measurements, the figure of merit for determining required accuracy is the maximum power value during the measurement period, not the average, since it is the maximum that determines the metering equipment and setup.
- F) Measurement Accuracy:
- 1) Measurements made with these procedures shall in all cases have an accuracy of 5% or better, though manufacturers will usually achieve better than this. Test procedures may specify greater accuracy than 5% for some measurements. With knowledge of the power levels of current imaging products and the meters available, manufacturers can calculate the maximum error based on the reading and the range utilized for the reading.
 - 2) For measurements of 0.50 W or less, the required accuracy is 0.02 W.
- G) Time Measurement: Time measurements may be performed with an ordinary stopwatch with resolution of at least 1 second.
- H) Paper Specifications:
- 1) Standard format products shall be tested in accordance with Table 4.
 - 2) Large, small, and continuous format products shall be tested using any compatible paper size.

Table 4: Paper Size and Weight Requirements

| Market | Paper Size | Basis Weight (g/m²) |
|----------------------------------|-------------------|---------------------------------------|
| North America / Taiwan | 8.5" x 11" | 75 |
| Europe / Australia / New Zealand | A4 | 80 |
| Japan | A4 | 64 |

5 LOW-VOLTAGE DC SOURCE MEASUREMENT FOR ALL PRODUCTS

- 1) Connect the DC source to the power meter and relevant AC supply as specified in Table 2.
- 2) Verify that the DC source is unloaded.
- 3) Allow the DC source to warm up for a minimum of 30 minutes.
- 4) Measure and record the unloaded DC source power (P_s) according to IEC 62301 Ed. 1.0.

6 PRE-TEST UUT CONFIGURATION FOR ALL PRODUCTS

6.1 General Configuration

- A) Product Speed for Calculations and Reporting: The product speed for all calculations and reporting, shall be the highest speed as claimed by the manufacturer per the following criteria, expressed in images-per-minute (ipm) and rounded to the nearest integer:
- 1) In general, for Standard-size products, a single A4 or 8.5" x 11" sheet printed/copied/scanned on one side in a minute is equal to one image-per-minute (ipm)
 - 2) For all products, the product speed shall be based on:
 - i) The manufacturer-claimed print speed, unless the product cannot print, in which case,
 - ii) The manufacturer-claimed copy speed, unless the product cannot print or copy, in which case,
 - iii) The manufacturer-claimed scan speed.
 - 3) For non-continuous-form products, with the exception of mailing machines, the product speed shall be calculated per Table 5. If the maximum claimed speeds differ when producing images on A4 or 8.5" x 11" paper, the higher of the two shall be used.

Table 5: Calculation of Product Speed for Standard, Small, and Large Format Products with the Exception of Mailing Machines

| Media Format | Media Size | Product Speed, s (ipm) |
|--------------|------------|---|
| | | Where: s_P is the maximum claimed monochrome speed in pages-per-minute when processing the given media |
| Standard | 8.5" x 11" | s_P |
| | A4 | s_P |
| Small | 4" x 6" | $0.25 \times s_P$ |
| | A6 | $0.25 \times s_P$ |
| Large | A2 | $4 \times s_P$ |
| | A0 | $16 \times s_P$ |

- 4) For continuous-form products, product speed shall be calculated per Equation 1

Equation 1: Calculation of Product Speed

$$s = 16ws_L$$

Where:

- s is the product speed, in images per minute (ipm),
- w is the width of the media, in meters (m),
- s_L is the maximum claimed monochrome speed, in length-meters-per-minute.

- 5) For Mailing Machines, product speed shall be reported in units of mail-pieces-per-minute (mppm).

- B) Color: Color-capable products shall be tested making monochrome images unless incapable of doing so.
- C) Network Connections: Products that are capable of being network-connected as-shipped shall be connected to a network.
- 1) The type of network connection (or other data connection if not capable of being networked) is at the discretion of the manufacturer, and the type used shall be reported.

6.2 Configuration for Fax Machines

- A) Fax machines need not be connected to a telephone line unless the telephone line is necessary for performing the test.
- B) Unless sending jobs via phone line, originals may be placed in the document feeder before the test begins.
- 1) Products without a document feeder may make all images off a single original placed on the platen.
- 2) Fax machines shall be tested with one image per job.

6.3 Configuration for Digital Duplicators

- A) Except as noted below, digital duplicators shall be configured and tested as printers, copiers, or MFDs, depending on their capabilities as shipped.
 - 1) Digital duplicators shall be tested at maximum claimed speed, which is also the speed that should be used to determine the job size for performing the test, not at the default speed as-shipped, if different.
 - 2) For digital duplicators, there shall be only one original image.

7 PRE-TEST UUT INITIALIZATION FOR ALL PRODUCTS

- A) Prior to the start of testing, the UUT shall be initialized as follows:
 - 1) Set up the UUT per the instructions in the Manufacturer's Instructions or documentation.
 - i) Accessories such as paper source and finishing hardware that are intended to be installed or attached by the end-user shall be installed; however, their use in the test is at the manufacturer's discretion (e.g., any paper source may be used).
 - 2) Connect the UUT to its power source.
 - 3) Power on the UUT and perform initial system configuration, as applicable. Verify that default delay times are configured according to product specifications and/or manufacturer recommendations.
 - i) Product Speed for Testing: The product shall be tested with speed settings in their default as-shipped configuration.
 - ii) Auto-off for TEC Products: If a printer, digital duplicator or MFD with print-capability, or fax machine has an Auto-off capability and it is enabled as shipped, it shall be disabled prior to the test.
 - iii) Auto-off for OM Products: If a product has an Auto-off Mode enabled as shipped, it shall be enabled prior to performing the test.
 - 4) User-controllable anti-humidity features may be turned off or disabled for the duration of testing.
 - 5) Let the UUT sit for at least 15 minutes, or until it has completed initialization and is ready for use.
 - 6) For products designed to operate on battery power when not connected to the mains, the battery shall be either:
 - i) Removed from the product; or
 - ii) Fully charged for at least 24 hours before beginning the test and left in place for the test.

8 TYPICAL ELECTRICITY CONSUMPTION (TEC) TEST PROCEDURE

8.1 Job Structure

A) Jobs per Day: The number of jobs per day (N_{JOBS}) is specified in Table 6.

Table 6: Number of Jobs per Day (N_{JOBS})

| Monochrome Product Speed, s (ipm) | Jobs per Day (N_{JOBS}) |
|-------------------------------------|-----------------------------|
| $s \leq 8$ | 8 |
| $8 < s < 32$ | s |
| $s \geq 32$ | 32 |

B) Images per Job:

- 1) Except for fax machines, the number of images shall be computed according to Equation 2, below. For convenience, Table 10 at the end of this document provides the resultant images per job computation for each integer product speed up through 100 images per minute (ipm).

Equation 2: Calculation of Number of Images per Job

$$N_{IMAGES} = \text{int} \left[\frac{(0.5 \times s^2)}{N_{JOBS}} \right],$$

Where:

- N_{IMAGES} is the number of images per job, rounded down (truncated) to the nearest integer,
- s is the (monochrome) maximum reported speed in images per minute (ipm), calculated in section 6.1.A), of this test procedure, and
- N_{JOBS} is the number of jobs per day, as calculated per Table 6.

C) Test Image: Test Pattern A from ISO/IEC standard 10561:1999 shall be used as the original image for all testing.

- 1) Test images shall be rendered in 10 point size in a fixed-width Courier font (or nearest equivalent)
- 2) German-specific characters need not be reproduced if the product is incapable of German character reproduction.

D) Print Jobs: Print jobs for the test may be sent over non-network connections (e.g., USB), even on those units that are network-connected.

- 1) Each image in a print job shall be sent separately, i.e., all images may be part of the same document, but shall not be specified in the document as multiple copies of a single original image (unless the product is a digital duplicator).
- 2) For printers and MFDs that can interpret a page description language (PDL) (e.g., PCL, Postscript), images shall be sent to the product in a PDL.

E) Copy Jobs:

- 1) For copiers with speed less than or equal to 20 ipm, there shall be one original per required image.
- 2) For copiers with speed greater than 20 ipm, it may not be possible to match the number of required original images (e.g., due to limits on document feeder capacity). In this case, it is permissible to make multiple copies of each original, and the number of originals shall be greater than or equal to ten.

Example: For a 50 ipm unit that requires 39 images per job, the test may be performed with four copies of 10 originals or three copies of 13 originals.

- 3) Originals may be placed in the document feeder before the test begins.
 - i) Products without a document feeder may make all images off of a single original placed on the platen.

8.2 Measurement Procedures

- A) Measurement of TEC shall be conducted according to Table 7 for printers, fax machines, digital duplicators with print capability, and MFDs with print capability, and Table 8 for copiers, digital duplicators without print capability and MFDs without print capability, subject to the following provisions:
- 1) Paper: There shall be sufficient paper in the device to perform the specified print or copy jobs.
 - 2) Duplexing: Products shall be tested in simplex mode. Originals for copying shall be simplex images.
 - 3) Service/Maintenance Modes: Service/maintenance modes (including color calibration) should generally not be included in TEC measurements.
 - i) Any service/maintenance modes that occur during the test shall be noted.
 - ii) If a service/maintenance mode occurs during a job other than the first job, the results from the job with the service/maintenance mode may be replaced with results from a substitute job. In this case, the substitute job shall be inserted into the test procedure immediately following Job 4. The 15-minute job interval shall be maintained at all times.
 - 4) Accuracy: The specifications of the metering equipment and ranges used in each measurement shall be reported. Measurements must be conducted so as to result in a total potential error of the TEC value of no more than 5%. Accuracy does not need to be reported for cases where the potential error is below 5%. When the potential measurement error is close to 5%, manufacturers should take measures to confirm that it complies with the 5% limit.
 - 5) Energy Measurement Method: All measurements shall be recorded as accumulated energy over time, in watt-hours (Wh); all time shall be recorded in seconds or minutes.
 - i) "Zero meter" references may be accomplished by recording the accumulated energy consumption at that time rather than literally zeroing the meter.

**Table 7: TEC Test Procedure for Printers, Fax Machines,
Digital Duplicators with Print Capability, and MFDs with Print Capability**

| Step | Initial State | Action | Record (at end of step) | Unit of Measure | Possible States Measured |
|------|------------------|--|--|-----------------|--------------------------------|
| 1 | Off | Connect the unit under test to the meter. Ensure the unit is powered and in Off Mode. Zero the meter; measure energy over 5 minutes or more. Record both energy and time. | Off energy | Watt-hours (Wh) | Off |
| | | | Testing Interval time | Hours (h) | |
| 2 | Off | Turn on unit. Wait until unit indicates it is in Ready Mode. | – | – | – |
| 3 | Ready | Print a job of at least one output image but no more than a single job per Job Table. Measure and record time to first sheet exiting unit. | Active0 time | Hours (h) | – |
| 4 | Ready (or other) | Wait until the meter shows that the unit has entered its final Sleep Mode or 4 hours. | – | – | – |
| 5 | Sleep | Zero meter; measure energy and time over 1 hour. Record the energy and time. | Sleep energy, E_{SLEEP} | Watt-hours (Wh) | Sleep |
| | | | Sleep time, t_{SLEEP} (≤ 1 hour) | Hours (h) | |
| 6 | Sleep | Zero meter and timer. Print one job (calculated above). Measure energy and time. Record time to first sheet exiting unit. Measure energy over 15 minutes from job initiation. The job must finish within the 15 minutes. | Job1 energy, E_{JOB1} | Watt-hours (Wh) | Recovery, Active, Ready, Sleep |
| | | | Active1 time | Hours (h) | |
| 7 | Ready (or other) | Repeat Step 6. | Job2 energy, E_{JOB2} | Watt-hours (Wh) | Same as above |
| | | | Active2 time | Hours (h) | |
| 8 | Ready (or other) | Repeat Step 6 (without Active time measurement). | Job3 energy, E_{JOB3} | Watt-hours (Wh) | Same as above |
| 9 | Ready (or other) | Repeat Step 6 (without Active time measurement). | Job4 energy, E_{JOB4} | Watt-hours (Wh) | Same as above |
| 10 | Ready | Zero meter and timer. Measure energy and time until meter and/or unit shows that unit has entered Sleep Mode or the final Sleep Mode for units with multiple Sleep modes, or 4 hours. | Final energy, E_{FINAL} | Watt-hours (Wh) | Ready, Sleep |
| | | | Final time, t_{FINAL} | Hours (h) | |

Notes:

- Steps 4 and 10 – It may be unclear to independent testers which Sleep Mode is the final one and therefore a 4 hour time limit is provided.

Table 8: TEC Test Procedure for Copiers, Digital Duplicators without Print Capability, and MFDs without Print Capability

| Step | Initial State | Action | Record | Unit of Measure | Possible States Measured |
|------|------------------|---|-----------------------------|-----------------|--|
| 1 | Off | Connect the unit under test to the meter. Ensure the unit is powered and in Off Mode. Zero the meter; measure energy over 5 minutes or more. Record both energy and time. | Off energy | Watt-hours (Wh) | Off |
| | | | Testing Interval time | Hours (h) | |
| 2 | Off | Turn on unit. Wait until unit has entered Ready Mode. | – | – | – |
| 3 | Ready | Copy a job of at least one image but no more than a single job per Job Table. Measure and record time to first sheet exiting unit | Active0 time | Hours (h) | – |
| 4 | Ready (or other) | Wait until the meter shows that the unit has entered its final Sleep Mode or 4 hours. | – | – | – |
| 5 | Sleep | Zero meter; measure energy and time over 1 hour or until unit enters Auto-Off Mode. Record the energy and time. | Sleep energy | Watt-hours (Wh) | Sleep |
| | | | Sleep time (≤ 1 hour) | Hours (h) | |
| 6 | Sleep | Zero meter and timer. Copy one job (calculated above). Measure and record energy and time to first sheet exiting unit. Measure energy over 15 minutes from job initiation. The job must finish within the 15 minutes. | Job1 energy, E_{JOB1} | Watt-hours (Wh) | Recovery, Active, Ready, Sleep, Auto-off |
| | | | Active1 time | Hours (h) | |
| 7 | Ready (or other) | Repeat Step 6. | Job2 energy, E_{JOB2} | Hours (h) | Same as above |
| | | | Active2 time | Watt-hours (Wh) | |
| 8 | Ready (or other) | Repeat Step 6 (without Active time measurement). | Job3 energy, E_{JOB3} | Watt-hours (Wh) | Same as above |
| 9 | Ready (or other) | Repeat Step 6 (without Active time measurement). | Job4 energy, E_{JOB4} | Watt-hours (Wh) | Same as above |
| 10 | Ready (or other) | Zero meter and timer. Measure energy and time until meter and/or unit shows that unit has entered its Auto-off Mode or 4 hours. Record energy and time; if unit began this step already in Auto-off Mode, report both energy and time values as zero. | Final energy, E_{FINAL} | Watt-hours (Wh) | Ready, Sleep |
| | | | Final time, t_{FINAL} | Hours (h) | |
| 11 | Auto-off | Zero the meter; measure energy and time over 5 minutes or more. Record both energy and time. | Auto-off energy, E_{AUTO} | Watt-hours (Wh) | Auto-off |
| | | | Auto-off time, t_{AUTO} | Hours (h) | |

Notes:

- *Steps 4 and 10 – It may be unclear to independent testers which Sleep Mode is the final one and therefore a 4 hour time limit is provided.*

9 OPERATIONAL MODE (OM) TEST PROCEDURE

9.1 Measurement Procedures

A) Measurement of OM power and delay times shall be conducted according to Table 9, subject to the following provisions:

- 1) All power figures shall be recorded in watts (W) in accordance with IEC 62301, unless otherwise specified in this document.
- 2) Accuracy: The accuracy requirement for this OM test procedure is 2% for all measurements except for Ready power, where it is 5%. The 2% figure is consistent with IEC 62301, although the IEC standard expresses it as a confidence level.
- 3) Service/Maintenance Modes: Service/maintenance modes (including color calibration) generally should not be included in measurements. Any adaptation of the procedure needed to exclude such modes that occur during the test shall be noted.

Table 9: Operational Mode (OM) Test Procedure

| Step | Initial State | Action(s) | Record | Unit of Measure |
|------|---------------|--|--|-----------------|
| 1 | Off | Plug the unit into meter. Turn on unit. Wait until unit indicates it is in Ready Mode. | – | |
| 2 | Ready | Print, copy, or scan a single image. | – | |
| 3 | Ready | Measure Ready power. | Ready power, P_{READY} | Watts (W) |
| 4 | Ready | Wait and measure default delay-time to Sleep. | Sleep default-delay time, t_{SLEEP} | Minutes (min) |
| 5 | Sleep | Measure Sleep power. | Sleep power, P_{SLEEP} | Watts (W) |
| 6 | Sleep | Wait and measure default delay time to Auto-off. (Disregard if no Auto-off Mode) | Auto-off default-delay time | Minutes (min) |
| 7 | Auto-off | Measure Auto-off power. (Disregard if no Auto-off Mode) | Auto-off power $P_{AUTO-OFF}$ | Watts (W) |
| 8 | Auto-off | Manually turn device off and wait until unit is off. (If no manual on-off switch, note and wait for lowest-power Sleep state). | – | – |
| 9 | Off | Measure Off power. (If no manual on-off switch, note and measure Sleep Mode power). | Off power P_{OFF} | Watts (W) |

Notes:

- *Step 1 – If the unit has no Ready indicator, use the time at which the power consumption level stabilizes to the Ready level, and note this detail when reporting the product test data.*
- *Steps 4 and 5 – For products with more than one Sleep level, repeat these steps as many times as necessary to capture all successive Sleep levels and report this data. Two Sleep levels are typically used in large-format copiers and MFDs that use high-heat marking technologies. For products lacking this Mode, disregard Steps 4 and 5.*
- *Steps 4 and 6 – Default-delay time measurements are to be measured in parallel fashion, cumulative from the start of Step 4. For example, a product set to enter a Sleep level in 15 minutes and enter a second Sleep level 30 minutes after entering the first Sleep level will have a 15-minute default-delay time to the first level and a 45 minute default-delay time to the second level.*

10 TEST PROCEDURES FOR PRODUCTS WITH A DIGITAL FRONT END (DFE)

This step applies only to products that have a DFE as defined in Section 1 of the ENERGY STAR Program Requirements for Imaging Equipment.

- A) If the DFE has a separate mains power cord, regardless of whether the cord and controller are internal or external to the imaging product, a five-minute energy measurement of the DFE alone shall be made while the main product is in Ready Mode. The unit must be connected to a network if network-capable as shipped.

- B) If the DFE does not have a separate mains power cord, the manufacturer shall document the AC power required for the DFE when the unit as a whole is in a Ready Mode. This will most commonly be accomplished by taking an instantaneous power measurement of the DC input to the DFE and increasing this power level to account for losses in the power supply.

11 REFERENCES

- A) ISO/IEC 10561:1999. Information technology — Office equipment — Printing devices — Method for measuring throughput — Class 1 and Class 2 printers.
- B) IEC 62301:2005. Household Electrical Appliances – Measurement of Standby Power.

Table 10: Number of Images per Day Calculated for Product Speeds from 1 to 100 ipm.

| Speed | Interim | | | | | Speed | Interim | | | | |
|-------|----------|------------|------------|------------|------------|-------|----------|------------|------------|------------|------------|
| | Jobs/Day | Images/Day | Images/Job | Images/Job | Images/Day | | Jobs/Day | Images/Day | Images/Job | Images/Job | Images/Day |
| 1 | 8 | 1 | 0.06 | 1 | 8 | 51 | 32 | 1301 | 40.64 | 40 | 1280 |
| 2 | 8 | 2 | 0.25 | 1 | 8 | 52 | 32 | 1352 | 42.25 | 42 | 1344 |
| 3 | 8 | 5 | 0.56 | 1 | 8 | 53 | 32 | 1405 | 43.89 | 43 | 1376 |
| 4 | 8 | 8 | 1.00 | 1 | 8 | 54 | 32 | 1458 | 45.56 | 45 | 1440 |
| 5 | 8 | 13 | 1.56 | 1 | 8 | 55 | 32 | 1513 | 47.27 | 47 | 1504 |
| 6 | 8 | 18 | 2.25 | 2 | 16 | 56 | 32 | 1568 | 49.00 | 49 | 1568 |
| 7 | 8 | 25 | 3.06 | 3 | 24 | 57 | 32 | 1625 | 50.77 | 50 | 1600 |
| 8 | 8 | 32 | 4.00 | 4 | 32 | 58 | 32 | 1682 | 52.56 | 52 | 1664 |
| 9 | 9 | 41 | 4.50 | 4 | 36 | 59 | 32 | 1741 | 54.39 | 54 | 1728 |
| 10 | 10 | 50 | 5.00 | 5 | 50 | 60 | 32 | 1800 | 56.25 | 56 | 1792 |
| 11 | 11 | 61 | 5.50 | 5 | 55 | 61 | 32 | 1861 | 58.14 | 58 | 1856 |
| 12 | 12 | 72 | 6.00 | 6 | 72 | 62 | 32 | 1922 | 60.06 | 60 | 1920 |
| 13 | 13 | 85 | 6.50 | 6 | 78 | 63 | 32 | 1985 | 62.02 | 62 | 1984 |
| 14 | 14 | 98 | 7.00 | 7 | 98 | 64 | 32 | 2048 | 64.00 | 64 | 2048 |
| 15 | 15 | 113 | 7.50 | 7 | 105 | 65 | 32 | 2113 | 66.02 | 66 | 2112 |
| 16 | 16 | 128 | 8.00 | 8 | 128 | 66 | 32 | 2178 | 68.06 | 68 | 2176 |
| 17 | 17 | 145 | 8.50 | 8 | 136 | 67 | 32 | 2245 | 70.14 | 70 | 2240 |
| 18 | 18 | 162 | 9.00 | 9 | 162 | 68 | 32 | 2312 | 72.25 | 72 | 2304 |
| 19 | 19 | 181 | 9.50 | 9 | 171 | 69 | 32 | 2381 | 74.39 | 74 | 2368 |
| 20 | 20 | 200 | 10.00 | 10 | 200 | 70 | 32 | 2450 | 76.56 | 76 | 2432 |
| 21 | 21 | 221 | 10.50 | 10 | 210 | 71 | 32 | 2521 | 78.77 | 78 | 2496 |
| 22 | 22 | 242 | 11.00 | 11 | 242 | 72 | 32 | 2592 | 81.00 | 81 | 2592 |
| 23 | 23 | 265 | 11.50 | 11 | 253 | 73 | 32 | 2665 | 83.27 | 83 | 2656 |
| 24 | 24 | 288 | 12.00 | 12 | 288 | 74 | 32 | 2738 | 85.56 | 85 | 2720 |
| 25 | 25 | 313 | 12.50 | 12 | 300 | 75 | 32 | 2813 | 87.89 | 87 | 2784 |
| 26 | 26 | 338 | 13.00 | 13 | 338 | 76 | 32 | 2888 | 90.25 | 90 | 2880 |
| 27 | 27 | 365 | 13.50 | 13 | 351 | 77 | 32 | 2965 | 92.64 | 92 | 2944 |
| 28 | 28 | 392 | 14.00 | 14 | 392 | 78 | 32 | 3042 | 95.06 | 95 | 3040 |
| 29 | 29 | 421 | 14.50 | 14 | 406 | 79 | 32 | 3121 | 97.52 | 97 | 3104 |
| 30 | 30 | 450 | 15.00 | 15 | 450 | 80 | 32 | 3200 | 100.00 | 100 | 3200 |
| 31 | 31 | 481 | 15.50 | 15 | 465 | 81 | 32 | 3281 | 102.52 | 102 | 3264 |
| 32 | 32 | 512 | 16.00 | 16 | 512 | 82 | 32 | 3362 | 105.06 | 105 | 3360 |
| 33 | 32 | 545 | 17.02 | 17 | 544 | 83 | 32 | 3445 | 107.64 | 107 | 3424 |
| 34 | 32 | 578 | 18.06 | 18 | 576 | 84 | 32 | 3528 | 110.25 | 110 | 3520 |
| 35 | 32 | 613 | 19.14 | 19 | 608 | 85 | 32 | 3613 | 112.89 | 112 | 3584 |
| 36 | 32 | 648 | 20.25 | 20 | 640 | 86 | 32 | 3698 | 115.56 | 115 | 3680 |
| 37 | 32 | 685 | 21.39 | 21 | 672 | 87 | 32 | 3785 | 118.27 | 118 | 3776 |
| 38 | 32 | 722 | 22.56 | 22 | 704 | 88 | 32 | 3872 | 121.00 | 121 | 3872 |
| 39 | 32 | 761 | 23.77 | 23 | 736 | 89 | 32 | 3961 | 123.77 | 123 | 3936 |
| 40 | 32 | 800 | 25.00 | 25 | 800 | 90 | 32 | 4050 | 126.56 | 126 | 4032 |
| 41 | 32 | 841 | 26.27 | 26 | 832 | 91 | 32 | 4141 | 129.39 | 129 | 4128 |
| 42 | 32 | 882 | 27.56 | 27 | 864 | 92 | 32 | 4232 | 132.25 | 132 | 4224 |
| 43 | 32 | 925 | 28.89 | 28 | 896 | 93 | 32 | 4325 | 135.14 | 135 | 4320 |
| 44 | 32 | 968 | 30.25 | 30 | 960 | 94 | 32 | 4418 | 138.06 | 138 | 4416 |
| 45 | 32 | 1013 | 31.64 | 31 | 992 | 95 | 32 | 4513 | 141.02 | 141 | 4512 |
| 46 | 32 | 1058 | 33.06 | 33 | 1056 | 96 | 32 | 4608 | 144.00 | 144 | 4608 |
| 47 | 32 | 1105 | 34.52 | 34 | 1088 | 97 | 32 | 4705 | 147.02 | 147 | 4704 |
| 48 | 32 | 1152 | 36.00 | 36 | 1152 | 98 | 32 | 4802 | 150.06 | 150 | 4800 |
| 49 | 32 | 1201 | 37.52 | 37 | 1184 | 99 | 32 | 4901 | 153.14 | 153 | 4896 |
| 50 | 32 | 1250 | 39.06 | 39 | 1248 | 100 | 32 | 5000 | 156.25 | 156 | 4992 |