

ENERGY STAR[®] Qualified Imaging Equipment
Typical Electricity Consumption (TEC) Test Procedure Rationale
July 11, 2005

This document provides details and rationale regarding the contents of the final TEC test procedure, dated July 11, 2005, and provides an account of the key changes in this version from the final draft test procedure distributed on April 15, 2005.

Introduction

The TEC test procedure and corresponding materials present a method to measure and compare the relative energy consumption of imaging equipment products in a precise and repeatable manner.

The methodology and content of the final TEC test procedure, dated July 11, 2005, are the culmination of careful consideration of all stakeholder feedback received to date, particularly in response to the following four drafts:

- First Draft TEC Test Procedure – distributed in June 2004;
- Clarified Draft TEC Test Procedure – distributed in September 2004;
- Revised Draft TEC Test Procedure – distributed in February 2005; and
- Final Draft TEC Test Procedure – distributed in April 2005.

This document is intended to highlight the key changes made to the final TEC test procedure from the previous version, respond to feedback, and provide background on why revisions to the previous version were made.

It should be emphasized again that **the TEC method is not meant to precisely replicate real-life operating patterns**. EPA has structured the method to resemble a typical work week. However, due to the wide variation of imaging equipment, both in usage and functionality, it is impossible to mimic real usage in all cases. Rather, the TEC test procedure, which results in a TEC value, is a consistent method of measuring imaging equipment and comparing the energy performance of similar products. The TEC procedure does not replace the usefulness or need for more sophisticated measurements such as the ASTM test procedures.

Color vs. Monochrome

Color-capable products shall be tested in monochrome.

Some stakeholders have suggested that testing of color machines should incorporate both monochrome and color images to better assess the energy usage of various types of color-production processes. The February 16, 2005 and April 15, 2005 drafts of the TEC test procedure specified that all testing should be performed in monochrome. However, EPA extended an invitation for additional color test data over a period of several weeks to make a final determination on whether color images needed to be incorporated into the TEC test procedure.

One aspect that spurred the evaluation of color test data was the question of whether a monochrome or color test image affects the feasibility of grouping all color printers together when setting criteria in the specification, or whether serial and parallel color printers should have separate specification categories. While EPA has not made a final determination on whether there should be one or two color categories in the specification, it has been decided that there is value in a single test image across all products. Based on this and the data received from stakeholders, the TEC test procedure continues to specify a standard monochrome text-only test pattern from ISO/IEC Standard 10561:1999.

In summary, in response to the final draft TEC test procedure distributed in April 2005, three stakeholder entities submitted monochrome and color test data addressing the question of whether a color job or

image is needed in the TEC test procedure. These data, representing 16 products, have confirmed EPA's assessment that color testing is not necessary.

Making up the dataset were 12 parallel color printers and four serial color printers, with most of the printers in the 30-40 ipm speed range, with a few in lower speed ranges. For the 12 parallel color printers, the energy consumption for monochrome and color jobs was virtually identical. For the four serial color printers, color imaging was notably more energy-intensive than monochrome.

EPA excluded four models from the 16-model dataset due to the fact that these data points were collected through instantaneous power measurements, and ranked the remaining 12 printers according to the calculated TEC result while printing in monochrome. These printers were then re-ranked according to their TEC result using only color imaging. In three cases where serial color units were involved, the job energy ranking for color printing as compared to monochrome printing changed slightly. When the serial data points were removed, the parallel units showed no change in ranking when comparing the color and monochrome printing.

However, a test involving 100% color imaging, as implied through color-only ranking, is not realistic. For example, one proposed ASTM test procedure for color-capable products includes approximately equal rates of monochrome and color imaging embodied in the job tables. When the 12-printer dataset from above was re-ranked with half monochrome and half color imaging, there is only one very small difference from the monochrome-only ranking, resulting from a serial machine. Thus, a monochrome-only ranking essentially provides the same result as a mixed ranking.

International Testing

The environmental conditions and equipment specifications for testing imaging equipment can be found in the document, **Test Conditions for Determining the ENERGY STAR Qualification Status of Imaging Equipment Products**.

Testing voltage and frequency shall be appropriate for the market where the product is sold.

Product testing should be performed at the relevant voltage/frequency combination(s) for the intended market of the product, since energy consumption values may vary according to the input voltage/frequency combination. This has been the general procedure for ENERGY STAR testing across product categories in the U.S., and as the ENERGY STAR program develops an increasingly international scope, EPA has determined that it is important to confirm that products meet the new specification at the representative market conditions where the products are sold and qualified.

The number of voltage/frequency combinations has been reduced since the final draft TEC test procedure was distributed in April 2005 to only those markets where there is official ENERGY STAR country participation. These markets include the European Union (EU), Australia, New Zealand, Japan, Taiwan, and North America. Since the voltage/frequency combinations are very similar between certain regions, the test conditions specify only three unique combinations, which are provided below:

- North America/Taiwan: 115 Volts AC, 60 Hz
- Europe/Australia/New Zealand: 230 Volts AC, 50 Hz
- Japan: 100 Volts AC, 50 Hz/60 Hz

Some products are designed to operate at a specific voltage/frequency combination other than the representative combination listed for a certain region (e.g., copiers designed to operate at 230 Volts AC, 60 Hz rather than at 115 Volts AC, 60 Hz in the U.S.). Therefore, these products cannot be tested at the specified regional combination. EPA asks that the manufacturer 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.

Paper size and weight has been specified for Taiwan.

Corresponding to the addition of Taiwan as an international testing region in the Test Conditions, this region's standard paper size and weight have also been specified for testing purposes.

Recovery and Default Times

The measurement of recovery time has been reinstated in the TEC test procedure.

The February 16, 2005 version of TEC test procedure included two distinct recovery time measurements which resulted in a calculated value for the product's incremental recovery time. These measurements collected the time from job initiation to paper output for one job initiated from ready mode and for another job initiated from sleep. Based on stakeholder input, EPA decided to remove these measurements from the final draft test procedure distributed in April. However, since that time, EPA has decided to reinstate the measurements in the final version, along with a third such measurement (Active2). Though EPA stands by its decision not to specify recovery time within the TEC test procedure, concern from a majority of stakeholders supports the continued collection of incremental recovery time so as to monitor these values.

As noted in the final draft TEC test procedure, dated April 15, 2005, and further emphasized in the final TEC test procedure, dated July 11, 2005, EPA expects manufacturers to test their products to the TEC test procedure as they are shipped and recommended for use. EPA does not support requiring specific default delay times to low power modes and recovery times from these modes within the framework of the TEC test procedure due to the broad range of products covered by TEC, as well as to the fact that certain types of fuser technology are patent-protected. A desktop personal printer does not have the same default settings and consumer tolerances as a production printer, nor do all manufacturers have access to patented fuser technology that would allow for very quick recovery times from sleep or off. EPA also considers that the TEC test procedure indirectly accounts for default and recovery settings without the need for specific settings requirements.

In addition to the measurements for collecting incremental recovery time, EPA has also included a field on the TEC test data worksheet to collect the manufacturer default-delay-time-to-sleep settings, which are the default delay-times set by the manufacturer. EPA will use these data to monitor the settings shipped and recommended by manufacturers and their corresponding recovery times to help EPA ensure that they are reasonable. These time values should be entered in parallel fashion (e.g., 30, 60, 90) if a product has more than one sleep mode. While EPA does not expect manufacturers to set unreasonably short delay settings to reduce the TEC value, monitoring this data will help deter any manufacturers who consider doing this. EPA remains attentive to whether excessively long recovery times could encourage consumers to disable power management, and will consider options for amending the specification if data shows that this is a problem.

Types of Products Covered

Products addressed by the TEC test procedure are now clearly specified in the test procedure itself rather than the rationale.

In the final TEC test procedure, EPA has added a new section to outline the products covered by the test procedure, which, in previous drafts, have been specified in the accompanying rationale. By including this information in the test procedure itself, along with the illustrations of the TEC test procedure process at the end of the procedure (Figures 1 and 2), EPA hopes that the TEC test procedure will serve as a more complete and stand-alone document.