



ENERGY STAR® Program Requirements Product Specification for Medical Imaging Equipment

Draft Test Method For Determining Medical Imaging Equipment Energy Use Rev. – May 2023

1 OVERVIEW

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

2 APPLICABILITY

The proposed test method shall be used to determine the energy efficiency of all products under the ENERGY STAR Product Specification for Medical Imaging Equipment. Medical Imaging Equipment and all products identified below are defined in this test method in Section 3.B).

2.1 Products Included in Scope

- A) Computed Tomography (CT)
- B) General Radiography (X-ray)
- C) Magnetic Resonance Imaging (MRI)
- D) Mammography Equipment
- E) Nuclear Imaging
- F) Ultrasound Imaging/Sonography

2.2 Products excluded from scope

- A) Endoscopy
- B) Photoacoustic Imaging
- C) Thermography

3 DEFINITIONS

A) Acronyms and Units:

- 1) ac: Alternating Current
- 2) CT: Computed Tomography
- 3) dc: Direct Current
- 4) IEC: International Electrotechnical Commission
- 5) MIE: Medical Imaging Equipment
- 6) MRI: Magnetic Resonance Imaging
- 7) PET: Positron Emission Tomography

- 28 8) PSU: Power Supply Unit
29 9) RF: Radio Frequency
30 10) SPECT: Single Proton Emission Computed Tomography
31 11) UPS: Uninterruptible Power Supply
32 12) UUT: Unit Under Test
33 13) W: Watts

34 B) Definitions:

- 35 1) Computed Tomography: Technology that creates a computer-generated 3D image from a large
36 series of two-dimensional X-ray images taken around a single axis of rotation. Computed
37 Tomography (CT) scans use X-rays to produce precise cross-sectional images of anatomical
38 structures and spaces within objects.
- 39 2) Cyberknife: Frameless robotic radiosurgery system composed of (1) a linear accelerator and, (2)
40 a robotic arm that directs the X-ray. The X-ray is used to destroy cancer cells.
- 41 3) Endoscopy: Use of small camera directly inserted into the body to examine the interior of a hollow
42 organ or cavity in the body.
- 43 4) Fluoroscope: Device that obtains real time images of internal structures. The fluoroscope
44 employs an X-ray source and a fluorescent screen that go on either side of a patient.
- 45 5) General Radiography (X-ray): An X-ray image is produced when a small amount of ionizing
46 radiation passes through the body. The ability of X-rays to penetrate tissues and bones varies
47 according to the tissue's composition and mass. Examples of devices using general radiography
48 include a cyberknife, fluoroscope, and linear accelerator.
- 49 6) Linear Accelerator: Device that delivers a uniform dose of high energy X-ray to a tumor or other
50 cancerous cells. The X-rays can destroy cancer cells while sparing the normal tissue surrounding
51 a tumor.
- 52 7) Low power mode: This mode represents the minimum energy consumption state that the user
53 can select according to the user manual. The power consumption is lower than Ready-to-scan
54 and higher than Off mode (e.g., sleep mode, service/evaluation mode).
- 55 8) Magnetic Resonance Imaging: Technology used to obtain highly refined images of the body's
56 interior. It employs magnets that polarize and excite hydrogen nuclei in water molecules within
57 tissues and creates 2D images.
- 58 9) Mammography Equipment: Equipment that uses low-dose X-rays to examine the human breast
59 for tumors and cysts. Mammography equipment can be either analog, projecting low-dose X-rays
60 on film, or digital, converting X-rays into electrical signals that produce digital images.
- 61 10) Medical Imaging Equipment: Medical imaging equipment employs technologies, such as
62 radiology and sonography, to create images of the human body. This type of equipment is used
63 to reveal, diagnose, and examine patients for clinical purposes, or to study human anatomy and
64 physiology for the purposes of medical science.
- 65 11) Nuclear Imaging: A patient consumes short-lived isotopes which emit radiation that is measured,
66 commonly with the use of a gamma camera. Scintigraphy, single proton emission computed
67 tomography (SPECT), and positron emission tomography (PET) are types of nuclear imaging
68 technologies. Scintigraphy produces 2D images, while SPECT and PET technologies produce 3D
69 images.
- 70 12) Off mode: The system is shut down with ac mains off, according to the user manual. The system
71 consumes no energy.
- 72 13) Photoacoustic Imaging: A non-ionizing technique that uses low-energy lasers with an infrared
73 wavelength. The wavelength can penetrate deep into the body with sensitive ultrasonic detectors
74 capturing 2D and 3D images from the way the light is absorbed by various tissues.

- 75 14) Ready-to-scan mode: This mode represents the state of the system between individual scans,
76 where no scan has been prescribed (e.g., during patient handling, data archiving, examination
77 planning, or contrast agent injection). This mode does not include potential mechanical
78 movements such as X-ray tube rotor or gantry rotation.
- 79 15) Scan mode: The system is actively scanning the patient to generate images. The computing
80 system interprets the data and generates the image. This mode also includes any potential
81 mechanical movements such as X-ray tube rotor or gantry rotation.
- 82 16) Thermography: A diagnostic technique where an infrared camera is used to capture temperature
83 variations on the surface of the body, revealing sites of abnormal tissue growth below the skin.
- 84 17) Ultrasound Imaging/Sonography: Technology that exposes a body part to high-frequency sound
85 waves that are reflected by tissues in the body to produce real-time 2D and 3D images.

86 4 TEST SETUP

- 87 A) General Testing Conditions: General testing conditions shall be as specified in Section 9 of
88 International Electrotechnical Commission (IEC) 62354 Ed. 3.0.
- 89 B) Input Power: Input power shall be as specified in Section 10 of IEC 62354 Ed 3.0.
- 90 C) Ambient Temperature: Ambient temperature shall be within $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ over the duration of the test.
- 91 D) Relative Humidity: Relative humidity shall be within 20% and 80%.
- 92 E) Power Meter: General requirements for power meters shall be as specified in Section 11.1 of IEC
93 62354 Ed. 3.0.
- 94 1) Accuracy: The accuracy of power meters shall be as specified in Section 11.2 of IEC 62354 Ed.
95 3.0.
- 96 2) Calibration: Power meter calibration shall be as specified in Section 11.4 of IEC 62354 Ed. 3.0.
- 97 3) Polyphase: Power meters shall be capable of measuring either single phase or polyphase voltage
98 and current.

99 5 TEST CONDUCT

- 100 A) As-shipped Condition: Products shall be tested in their “as-shipped” configuration, which includes
101 both hardware configuration and system settings, unless otherwise specified in this test method.
- 102 B) Measurement Location: All power measurements shall be taken at a point between the ac or dc
103 power source and the Unit Under Test (UUT). For MIE devices that do not simply plug into a wall
104 outlet, the power meter shall be installed onto the input to the main disconnect panel of the system to
105 ensure that all energy consumption of the MIE is captured (e.g., cooling equipment, cryogen
106 compressor, water heat exchanger, peripheral computer terminal).
- 107 C) Air Flow Management: Any air flow directly surrounding the UUT during testing shall only be
108 generated by fans or cooling devices that are standard components of the UUT. The use of external
109 fans or cooling devices to purposefully direct air at, or away from, the UUT during testing is
110 prohibited.
- 111 D) Power Supplies: All power supply units (PSUs) must be connected and operational.
- 112 E) Power Management: All power management and/or power-saving features available on the UUT shall
113 be disabled during testing
- 114 1) The entire Medical Imaging Equipment Test Method may be voluntarily repeated with power
115 management and/or power-saving features enabled.

116 2) For the purposes of ENERGY STAR certification, testing with power management and/or power-
117 saving features enabled is mandatory for data collected as part of the certification process. Data
118 measured with power management and/or power-saving features disabled will not be collected as
119 part of ENERGY STAR certification.

120 **Note:** DOE has clarified that while the general test method aligns with COCIR in defaulting to power
121 management and/or power-saving features being disabled during test, that for any results generated
122 for ENERGY STAR certification, those features must be enabled.

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124 **6 TEST PROCEDURES FOR ALL PRODUCTS**

125 **6.1 UUT Preparation**

- 126 A) Record the UUT manufacturer, model name, and system configuration details.
- 127 B) The MIE system shall be installed and calibrated according to its specification, including all system-
128 critical items needed to perform a basic scan (e.g., gradient amplifiers, Radio Frequency (RF) unit,
129 reconstruction engine(s), gantry, X-ray generator and tube, power supplies, controllers,
130 console/computer, cryogen compressor, water heat exchanger, patient table, etc.).
131
- 132 Any equipment and accessories beyond the basic product offering that is not required for a basic
133 scan (e.g., customer-provided equipment, optional supplier equipment, patient vital signs
134 accessories, facility-provided cooling water equipment, hardware for advanced medical applications,
135 etc.) shall not be included in the measurements below.
- 136 C) Connect the UUT to an appropriate ac or dc voltage source using the following guidelines:
- 137 1) No uninterruptible power supply (UPS) units shall be connected between the power meter and
138 the UUT;
- 139 2) The power meter shall remain connected until all testing is complete;
- 140 3) Power values shall be recorded from the power meter in a way that is consistent with the
141 requirements in Section 4.E) of this document.
- 142 D) Verify that the UUT is configured in its as-shipped configuration.
- 143 E) Power on the UUT, either by switching it on or connecting it to mains power.
- 144 F) Let the UUT stabilize for 15 minutes

145 **6.2 Ready-to-scan Mode Testing**

- 146 A) Ensure that the power meter is on and functioning.
- 147 B) Prescribe a patient and execute any scan to ensure that the UUT is functioning.
- 148 C) After the scan completes, wait 5 minutes, and then record the average power draw (rate of energy
149 consumption), for a period of 12 minutes. Record this value, in kW.

150 **6.3 Low-power Mode Testing**

- 151 A) Ensure that the power meter is on and functioning.
- 152 B) Select the Low-power mode as specified in the user manual.
- 153 C) Wait to ensure that all applicable system elements of the UUT have adapted to this mode.

- 154 D) Measure the average power draw (rate of energy consumption), for a period of at least 10 minutes. If
155 the system has a variable power usage in this mode, the measurement duration shall be amended to
156 one complete power usage cycle, which shall be taken to be the cycle from minimum to maximum
157 usage.
- 158 E) Record this value, in kW.

159 **7 REFERENCES**

- 160 A) IEC 62354 Ed. 3.0 (2014) – General testing procedures for medical electrical equipment.
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