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Desktop and notebook computers — Measurement of energy consumption

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The UK participation in its preparation was entrusted to Technical Committee EPL/100, Audio, video and multimedia systems and equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

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(IEC 62623:2012)

Ordinateurs de bureau et ordinateurs portables -
Mesure de la consommation d'énergie
(CEI 62623:2012)

Desktop- und Notebook-Computer –
Messung des Energieverbrauchs
(IEC 62623:2012)

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CENELEC

European Committee for Electrotechnical Standardization
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Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 108/490/FDIS, future edition 1 of IEC 62623, prepared by IEC/TC 108 "Safety of electronic equipment within the field of audio/video, information technology and communication technology" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62623:2013.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2013-09-04
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2015-12-04

This standard is based on ECMA-383.

In this standard, the following print types or formats are used:
– requirements proper and normative annexes: in roman type;
– notes/explanatory matter: in smaller roman type;
– terms that are defined in 3.1: **bold**.

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Endorsement notice

The text of the International Standard IEC 62623:2012 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 62075	NOTE Harmonized as EN 62075.
IEC 62301	NOTE Harmonized as EN 62301.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
ECMA-389	-	Procedure for the Registration of Categories for ECMA-383 2nd edition	-	-

CONTENTS

INTRODUCTION ... 6
1 Scope ... 7
2 Normative references ... 7
3 Terms, definitions and abbreviations ... 7
3.1 Terms and definitions ... 7
3.2 Abbreviations ... 10
4 Specifications for EUT ... 11
4.1 Computer descriptions ... 11
4.1.1 Desktop computer ... 11
4.1.2 Notebook computer ... 11
4.1.3 Integrated desktop computer ... 11
4.2 Power modes ... 11
4.2.1 Off mode ... 11
4.2.2 P_{off} ... 12
4.2.3 Sleep mode ... 12
4.2.4 P_{sleep} ... 12
4.2.5 $P_{sleepWoL}$ ... 12
4.2.6 On mode ... 12
4.2.7 P_{on} ... 12
4.2.8 Idle modes ... 12
4.2.9 Active (work) mode ... 13
4.2.10 P_{work} ... 13
4.3 Profile attributes ... 13
4.3.1 Profile ... 13
4.3.2 Majority profile ... 13
4.3.3 Minority profile ... 13
4.3.4 Profile study ... 13
4.3.5 Product active power ratio ... 14
4.3.6 PAPR ... 14
4.3.7 PAWR ... 14
4.3.8 Product TEC error ... 14
4.3.9 Profile TEC error ... 14
4.4 Categorisation attributes ... 14
4.4.1 General ... 14
4.4.2 Cores ... 14
4.4.3 Channels of memory ... 14
4.4.4 System memory ... 14
4.4.5 System fan ... 14
4.4.6 TEC adders ... 15
5 Test procedure and conditions, categorisation, TEC formula, meter specifications and results reporting ... 15
5.1 General ... 15
5.2 Test setup ... 15
5.3 Test procedure ... 17
5.3.1 General ... 17

5.3.2 Measuring off mode ... 17
5.3.3 Measuring sleep mode ... 17
5.3.4 Measuring long idle mode ... 17
5.3.5 Measuring short idle mode ... 17
5.3.6 Measuring active mode (optional, see 5.6) ... 18
5.4 Test conditions ... 18
5.5 Categorisation ... 19
5.5.1 General ... 19
5.5.2 ULE category ... 19
5.5.3 TEC adders ... 19
5.6 Annualised energy consumption formulas ... 20
5.6.1 General ... 20
5.6.2 Estimated annualised energy consumption formula (estimated active workload) ... 20
5.6.3 Measured annualised energy consumption formula (with an active workload) ... 20
5.6.4 Criteria for an active workload ... 21
5.7 True RMS watt meter specification ... 22
5.8 True RMS watt meter accuracy ... 22
5.9 Ambient light meter specification ... 24
5.10 Reporting of results ... 24
Annex A (informative) Overview of profile methodology ... 26
Annex B (informative) Majority profile ... 28
Annex C (informative) Method for conducting a profile study ... 30
Annex D (informative) Sample TEC calculations ... 34
Annex E (informative) ENERGY STAR V5 compliant testing methodology ... 37
Annex F (informative) Power measurement methodology ... 39
Annex G (normative) Procedure for the registration of categories for IEC 62623 ... 43
Bibliography ... 45

Figure 1 – Typical test setup ... 16
Figure 2 – Example of estimated annualised energy consumption formula (estimated active workload) ... 20
Figure 3 – Measured annualised energy consumption formula (with an active workload) ... 21
Figure A.1 – Example of a typical profile ... 27
Figure B.1 – TEC error summary chart ... 29

Table 1 – Test conditions ... 18
Table B.1 – Duty cycle attributes for the enterprise majority profile duty cycle study ... 28
Table B.2 – Summary of the enterprise energy study ... 29
Table C.1 – Profile study 1 ... 31
Table C.2 – ENERGY STAR® V5 computer study ... 31
Table C.3 – Profile study, duty cycles ... 32
Table C.4 – Profile study, TEC_{actual} and $TEC_{estimated}$ calculations ... 32
Table E.1 – Duty cycle attributes for V5 compliant testing ... 38

INTRODUCTION

This standard is based on ECMA-383 and complements the guidance given in IEC 62075. It includes the definitions of energy saving modes and generic energy saving guidance for designers of desktop and notebook computers, by defining a methodology on how to measure the energy consumption of a product whilst providing categorisation criteria that enable energy consumption comparisons of similar products.

DESKTOP AND NOTEBOOK COMPUTERS – MEASUREMENT OF ENERGY CONSUMPTION

1 Scope

This International Standard covers personal computing products. It applies to desktop and notebook computers as defined in 4.1 that are marketed as final products and that are hereafter referred to as the equipment under test (EUT) or product.

This standard specifies:

– a test procedure to enable the measurement of the power and/or energy consumption in each of the EUT's power modes;
– formulas for calculating the **typical energy consumption** (**TEC**) for a given period (normally annual);
– a majority profile that should be used with this standard which enables conversion of average power into energy within the **TEC** formulas;
– a system of categorisation enabling like for like comparisons of energy consumption between EUTs;
– a pre-defined format for the presentation of results.

This standard does not set any pass/fail criteria for the EUTs. Users of the test results should define such criteria.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ECMA-389, *Procedure for the Registration of Categories for ECMA-383 2nd edition*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
active workload
simulated amount of productive or operative activity that the EUT performs as represented in the P_{work} (see 4.2.10) and $\boldsymbol{T}_{\textbf{work}}$ (see 3.1.13.6) attributes of the **TEC** equation (see 5.6)

3.1.2
category
grouping of EUT configurations

3.1.3
duty cycle
divisions of time the EUT spends in each of its individual power modes

Note 1 to entry: A duty cycle is expressed as a percentage totalling 1.

3.1.4
energy use
energy used by a product then measured from the mains power supply over a given period of time

Note 1 to entry: Energy is measured in kilowatt hour.

3.1.5
external power supply
EPS
equipment contained in a separate physical enclosure external to the computer casing and designed to convert mains power supply to lower d.c. voltage(s) for the purpose of powering the computer

Note 1 to entry: This note applies to the French language only.

Note 2 to entry: The **EPS** is sometimes referred to as an a.c. brick.

Note 3 to entry: A reference to a document which outlines the testing procedures for measuring **EPS** efficiencies (External Power Supply Efficiency Test Method) can be found in the Bibliography.

3.1.6
internal power supply
IPS
component contained in the same physical enclosure to the computer casing and designed to convert mains power supply to lower d.c. voltage(s) for the purpose of powering the computer

Note 1 to entry: This note applies to the French language only.

Note 2 to entry: A reference to a document which outlines the testing procedures for measuring **IPS** efficiencies (Generalized Internal Power Supply Efficiency Test Protocol) can be found in the Bibliography.

3.1.7
local area network
LAN
computer network located on a user's premises within a limited geographical area

[SOURCE : IEC 60050-732:2010, 732-01-04]

Note 1 to entry: This note applies to the French language only.

Note 2 to entry: Currently the two primary technologies used in computers are IEEE 802.3 Ethernet or Wired **LAN**, and IEEE 802.11 WiFi or Wireless **LAN.**

3.1.8
manufacturer
organization responsible for the design, development and production of a product in view of its being placed on the market, regardless of whether these operations are carried out by that organization itself or on its behalf

3.1.9
red green blue
RGB
primary colours that make up a pixel on a computer display

Note 1 to entry: The **RGB** values represent the intensity settings of each colour of that pixel to specify an exact colour.

3.1.10
typical energy consumption
TEC
number for the consumption of energy of a computer that is used to compare the energy performance of like computers, which focuses on the typical energy consumed by an EUT for a given profile while in normal operation during a representative period of time

Note 1 to entry: This note applies to the French language only.

Note 2 to entry: For desktops and notebook computers, the key criterion of the **TEC** approach is a value for typical annual **energy use**, measured in kilowatt-hours (kWh), using measurements of average operational mode power levels scaled by an assumed typical **duty cycle** that represent annualized use for a profile.

3.1.11
actual energy consumption
TEC measured using P_{work}

Note 1 to entry: The **actual energy consumption** is referenced as $\mathbf{TEC}_{\mathbf{actual}}$.

3.1.12
estimated energy consumption
TEC estimated by substituting P_{sidle} for P_{work}

Note 1 to entry: The **estimated energy consumption** is referenced as $\mathbf{TEC}_{\mathbf{estimated}}$.

Note 2 to entry: P_{sidle} is defined in detail in 4.2.

Note 3 to entry: P_{work} is defined in detail in 4.2.

3.1.13
duty cycle attributes
the percentage of time the EUT spends in each of its individual power modes

Note 1 to entry: Examples of **duty cycle attributes** are defined in 3.1.13.1 to 3.1.13.6.

3.1.13.1
off component of duty cycle
$T_{\mathbf{off}}$
percentage of time the EUT is in the off mode

3.1.13.2
sleep component of duty cycle
$T_{\mathbf{sleep}}$ **and** $T_{\mathbf{sleepWoL}}$
percentage of time the EUT is in the sleep modes

3.1.13.3
on components of duty cycle
$T_{\mathbf{on}}$
percentage of time the EUT is in the on mode

Note 1 to entry: The $T_{\mathbf{on}}$ **duty cycle** is equal to the sum of the $T_{\mathbf{work}} + T_{\mathbf{sidle}} + T_{\mathbf{idle}}$.

3.1.13.4
short idle component of duty cycle
$T_{\mathbf{sidle}}$
percentage of time the EUT is in the short idle mode

3.1.13.5
long idle component of duty cycle
$T_{\mathbf{idle}}$
percentage of time the EUT is in the long idle mode

3.1.13.6
active component of duty cycle
$T_{\mathbf{work}}$
percentage of time the EUT is in the active (work) mode

3.1.14
user of the test results
entity that will utilise the test results to apply to their needs

Note 1 to entry: Examples of such an entity are voluntary agreement owners, regulators, private companies, etc.

3.1.15
wake on LAN
WoL
functionality that allows a computer to wake from sleep or off when directed by a network request via Ethernet

Note 1 to entry: This note applies to the French language only.

3.2 Abbreviations

For the purposes of this document, the following abbreviations apply.

ACPI Advanced Configuration and Power Interface

NOTE 1 ACPI specification can be found here: http://www.acpi.info/.

CF Crest Factor

CFR Crest Factor Ratio

CPU Central Processing Unit

EPS External Power Supply

EUT Equipment Under Test

NOTE 2 Also referred to as product in this standard and sometimes referred to as UUT (Unit Under Test) in other specifications.

FB_BW Frame Buffer Bandwidth

HDD Hard Disk Drive

IPS Internal Power Supply

LAN Local Area Network

MCF Meter Crest Factor

MCR Maximum Current Ratio

OS Operating System

PAPR Profile Active Power Ratio

PAWR Profile Active Workload Ratio

PCF Product Crest Factor

PF Power Factor

RAM Random Access Memory

RGB red green blue

RMS Root Mean Square

SSD Solid State Drive

TEC Typical Energy Consumption

THD Total Harmonic Distortion

ULE	Ultra Low Energy
UPS	Uninterruptible Power Supply
WoL	Wake on LAN

4 Specifications for EUT

4.1 Computer descriptions

4.1.1 Desktop computer

A desktop computer is a computer where the main unit is intended to be located in a permanent location, often on a desk or on the floor. Desktops are not designed for portability and utilize an external computer display, keyboard, and mouse. Desktops are designed for a broad range of home and office applications.

4.1.2 Notebook computer

A notebook computer is a computer designed specifically for portability and intended to be operated for extended periods of time either with or without a direct connection to a mains power supply. Notebooks utilize an integrated computer display and are capable of operation from an integrated battery. In addition, most notebooks use an EPS or a.c. brick and have an integrated keyboard and pointing device. Notebook computers are typically designed to provide similar functionality to desktops, including operation of software similar in functionality as that used in desktops. For the purposes of this standard, docking stations are considered accessories and therefore, should not be considered as part of the EUT. Tablet computers, which may use touch-sensitive screens along with, or instead of, other input devices, are considered notebook computers in this standard. Netbook computers which are typically identified by a smaller screen size (constrained) and base memory size are also considered notebook computers in this standard.

4.1.3 Integrated desktop computer

An integrated desktop computer is a desktop computer where the computer and computer display function as a single unit receiving its a.c. power through a single mains cable. Integrated desktop computers come in one of two possible forms:

– a product where the computer display and computer are physically combined into a single unit; or

– a product packaged as a single product where the computer display is separate but is connected to the main chassis by a d.c. power cord and both the computer and computer display are powered from a single power supply.

As a subset of desktop computers, integrated desktop computers are typically designed to provide similar functionality as desktop computers.

NOTE An integrated desktop computer can also be referred to as an all-in-one computer.

4.2 Power modes

4.2.1 Off mode

Off mode is the lowest power mode which cannot be switched off (influenced) by the user and that may persist for an indefinite time when the EUT is connected to the main electricity supply and used in accordance with the **manufacturer's** instructions. For products where ACPI standards are applicable, off mode correlates to ACPI system level S5 state.

NOTE Some international regulations also refer to this mode as standby mode.

4.2.2 P_{off}

P_{off} represents the average power measured in the off mode.

4.2.3 Sleep mode

Sleep mode is the lowest power mode that the EUT is capable of entering automatically after a period of inactivity or by manual selection. An EUT with sleep capability can quickly wake in response to network connections or user interface devices with a latency of ≤ 5 s from initiation of wake event to product becoming fully usable including rendering of display. For products where ACPI standards are applicable, sleep mode most commonly correlates to ACPI system level S3 (suspend to RAM) state. When the EUT is tested with the **WoL** capability disabled in the sleep state, it is referred to as sleep mode. When the EUT is tested with the **WoL** capability enabled in the sleep state, it is referred to as **WoL** sleep mode.

4.2.4 P_{sleep}

P_{sleep} represents the average power measured in the sleep mode with the **WoL** capability disabled.

4.2.5 $P_{sleepWoL}$

$P_{sleepWoL}$ represents the average power measured in the sleep mode with the **WoL** capability enabled.

4.2.6 On mode

The on mode represents the mode the EUT is in when not in the sleep or off modes. The on mode has several sub-modes that include the long idle mode, the short idle mode and the active (work) mode.

4.2.7 P_{on}

P_{on} represents the average power measured when in the on mode.

4.2.8 Idle modes

4.2.8.1 General

The idle modes are modes in which the operating system and other software have completed loading, the product is not in sleep mode, and activity is limited to those basic applications that the product starts by default. There are two forms of idle that comprise the idle modes: short idle mode (see 4.2.8.2) and long idle mode (see 4.2.8.4).

4.2.8.2 Short idle mode

Short idle is the mode where the EUT has reached an idle condition (for example, 5 min after OS boot or after completing an **active workload** or after resuming from sleep, one can also use 15 min in order to conform to legacy testing procedures), the screen is on for at least 30 min to allow it to warm up, and set to at least a brightness level detailed in test procedure 5.3, and long idle power management features should not have engaged (for example, HDD (if available) is spinning and the EUT is prevented from entering sleep mode).

4.2.8.3 P_{sidle}

P_{sidle} represents the average power measured when in the short idle mode.

4.2.8.4 Long idle mode

Long idle mode is the mode where the EUT has reached an idle condition (for example, 15 min after OS boot or after completing an **active workload** or after resuming from sleep), the screen of the primary display has just blanked but EUT remains in the working mode (ACPI G0/S0). Power management features, if configured as shipped, should have engaged (for example, primary display is on, HDD may have spun-down) but the EUT is prevented from entering sleep mode.

NOTE The screen has just blanked" refers to the main computer display (integrated panel or external display) having entered a low power state where the screen contents cannot be observed (for example, backlight has been turned off turning the screen black).

4.2.8.5 P_{idle}

P_{idle} represents the average power measured when in the long idle mode.

4.2.9 Active (work) mode

Active mode is the mode in which the EUT is carrying out work in response to

– prior or concurrent user input; or
– prior or concurrent instruction over the network.

This mode includes active processing, seeking data from storage, memory, or cache, while awaiting further user input and before entering other power modes. In this mode, the screen is on and set to as-shipped brightness.

4.2.10 P_{work}

P_{work} represents the average power measured when in the active mode.

4.3 Profile attributes

4.3.1 Profile

A profile is a combination of **duty cycle attributes** and a given use case (for example, office users, home users, gamers).

NOTE Refer to Annex A, Annex B and Annex C for further information on profiles.

4.3.2 Majority profile

The majority profile is the most common profile of users for desktop and notebook computers.

The majority profile should be used with this standard and is documented in Annex B. It provides the **duty cycle attributes** and the profile **TEC** error that is used to determine the **TEC** equation to be used in 5.6.

4.3.3 Minority profile

The minority profiles represent less common profiles of users of desktop and notebook computers that are not represented in the majority profile. As an example, extreme gamers represent a very specific profile but are a very small percentage of computer users.

4.3.4 Profile study

A profile study is a study performed to create a new profile for this standard. The study shall generate, together with supporting data, the following:

– all the **duty cycle attributes**;

– the PAPR (see 4.3.6);
– the profile **TEC** error (see 4.3.9);
– the PAWR (see 4.3.7).

All data shall be derived from a statistically significant sample size that is representative of the user population as a whole. Annex C provides guidance on how to conduct a profile study.

4.3.5 Product active power ratio

The product active power ratio is the ratio of P_{on}/P_{sidle}, or the average on power divided by short idle power for an individual product within a profile study.

4.3.6 PAPR

PAPR is the average of all the product active power ratios recorded in a profile study.

4.3.7 PAWR

PAWR represents the average ratio of P_{work}/P_{sidle} conducted on profile study products and is used to validate that the **active workload** closely matches the profile study (through its PAWR).

4.3.8 Product TEC error

The product **TEC** error is the percent error calculation used in a profile study to evaluate how much error exists for an individual product when directly measuring **TEC** versus estimating **TEC** by substituting the static “short idle” power measurement for the measured P_{work} power.

4.3.9 Profile TEC error

The profile **TEC** error is the average of the product **TEC** error in a profile study.

4.4 Categorisation attributes

4.4.1 General

Below are some examples of categorisation attributes; additional examples should be found in the **category** registry (see 5.5).

4.4.2 Cores

The cores attribute is the number of physical CPU cores in the EUT.

4.4.3 Channels of memory

Channels of memory is expressed by the total number of channels the EUT is capable of supporting (they do not have to be populated). Each channel has a separate data path.

4.4.4 System memory

System memory is the amount of memory measured in gigabytes.

4.4.5 System fan

A system fan is any fan used in the EUT, excluding fans integrated into the power supply.

4.4.6 TEC adders

A **TEC** adder is a power allowance expressed in kilowatt hour per year that when added or configured to the EUT will increase its **TEC** by some amount. Examples could be:

– graphics cards, memory, TV tuners, sound cards, hard disk drives, solid state disk drives, etc.;

– for an integrated desktop computer, the screen shall be treated as an adder.

5 Test procedure and conditions, categorisation, TEC formula, meter specifications and results reporting

5.1 General

The following procedure shall be used when measuring the power or energy consumption of the EUT.

The user of this standard shall measure a sample of the EUT. The size of the sample shall be appropriate to demonstrate compliance to the requirements set by the **user of the test results**.

5.2 Test setup

The EUT and test conditions shall be set up as defined below.

a) The EUT shall be configured in accordance with the instructions provided with the product (unless otherwise stated in this test procedure) including all hardware accessories and software shipped by default. The EUT shall also be configured using the following requirements for all tests:

   1) Desktop and integrated desktop computers shipped without an input device shall be configured with a **manufacturer's** recommended input device (for example, mouse and/or keyboard). No other external peripherals shall be connected.

   2) Desktop computers shall be configured with an external computer display (the external display energy consumption is not included as part of the **TEC** calculation).

   3) Notebook computers need not include a separate keyboard or mouse when equipped with an integrated pointing device or digitizer.

   4) Notebook computers shall be connected to the mains power source using the EPS shipped with the product. Battery pack(s) shall be removed for all tests. For an EUT where operation without a battery pack is not a supported configuration, the test shall be performed with fully charged battery pack(s) installed, making sure to report this configuration in the test results.

   5) The screen shall be configured with a "desktop background" (wallpaper) of a solid colour defined by a bitmap set to the **RGB** values of 130, 130, and 130. The screen brightness shall be set as-shipped or to a specified luminance level condition as appropriate.

      NOTE 1 The as-shipped screen brightness is defined as a level the **manufacturer** deems to be appropriate for how an end user would want to use the product.

   6) A notebook and integrated desktop computer shall include the power used by the integrated display in reported results.

      NOTE 2 Additional specified luminance level conditions may be measured (see 5.3.5) and disclosed in the reported results.

   7) The sleep timer of the EUT shall be disabled or set to 30 min to prevent the EUT from entering the sleep state during the idle or active tests.

Figure 1 illustrates a typical test setup for a notebook and a desktop computer.

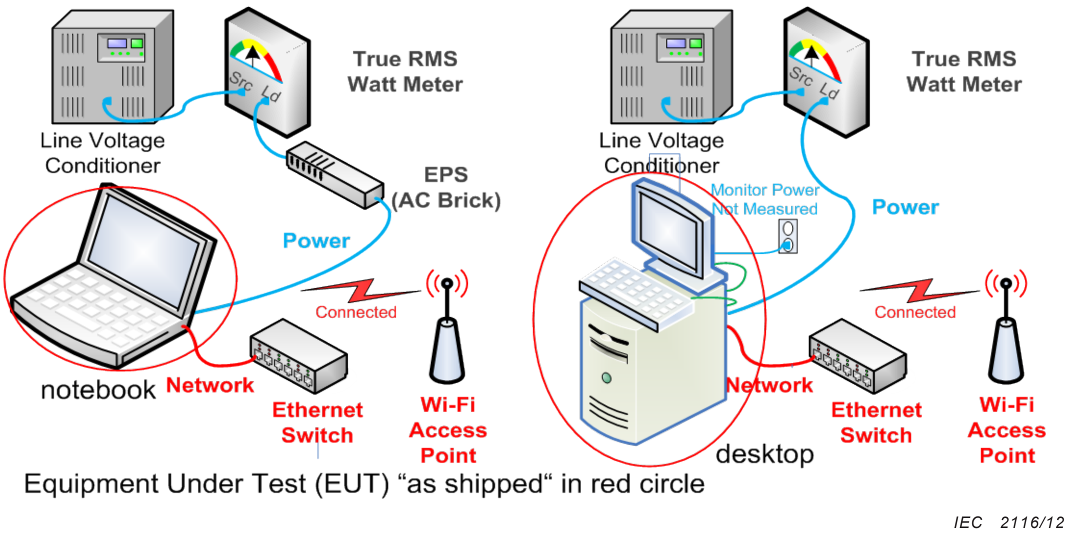


Figure 1 – Typical test setup

NOTE 3 Figure 1 shows wired and wireless connections. Only one is connected during test per 5.2c).

b) A true r.m.s. watt meter that meets the meter requirements in 5.7 is placed between the mains power supply and the EUT power supply. No power strips or UPS units shall be connected between the meter and the EUT. The meter shall remain in place until all required power mode data is recorded. The mains power supply shall meet the requirements in 5.4.

c) For sleep, long idle, short idle and the optional active measurements, the EUT energy consumption shall be measured with network connectivity in one of the two states described below.

   1) For an EUT with Ethernet support, the EUT shall be connected to an active network switch that supports the highest link speed supported by the EUT (the network switch does not need to be connected to a live network). Only a single network connection needs to be made in the case of an EUT with multiple network connections. It shall also support the minimum requirements needed to support additional power management functions that are supported by the EUT.

   As an example, IEEE 802.3az-2010 specification supports power management of Ethernet links that shall be supported by both the EUT and network switch.

   To test this function, the switch shall also support this function. Power to alternative network devices such as wireless radios shall be turned off for all tests. This applies to wireless network adapters or device-to-device wireless protocols (for example, Bluetooth).

   NOTE 4 For examples of wireless network adapters, see IEEE 802.11.

   2) For an EUT that does not support Ethernet, but supports some other sort of wired network connectivity, that network shall be turned on and be in a connected state.

   3) For an EUT with only wireless connectivity, a live wireless connection to a wireless router or network access point, which supports the highest and lowest data speeds of the client radio, shall be maintained for the duration of testing.

d) Record the EUT description as required in 5.10.

e) Measure the test conditions as defined in 5.4 and record as required in 5.10.

f) The ambient light conditions of the test room shall be measured using a meter that meets the requirements in 5.9 and set to the appropriate levels called for in 5.4.

5.3 Test procedure

5.3.1 General

The test procedures are listed in order of energy consumption. The specific procedure for measuring each power mode shall be followed. However, the power measurements of each energy mode can be made in any order and, if a **TEC** result is not required, the user does not need to test all of the power modes.

5.3.2 Measuring off mode

To measure the off mode:

– place the EUT in off mode (see 4.2.1);
– set the meter to begin accumulating true power values at an interval of one or more readings per second; and
– accumulate power values for 5 min and record the average (arithmetic mean) value observed during that 5 min period as P_{off}.

5.3.3 Measuring sleep mode

To measure the sleep mode:

– switch on the EUT;
– once logged in with the operating system fully loaded and ready, close any open windows so that the standard operational desktop screen or equivalent ready screen is displayed, and place the EUT in sleep mode (see 4.2.3);
– reset the meter (if necessary) and begin accumulating true power values at an interval of one or more readings per second;
– accumulate power values for 5 min and record the average (arithmetic mean) value observed during that 5 min period as P_{sleep};
– if testing both **WoL** enabled and **WoL** disabled for sleep, wake the EUT and change the **WoL** from sleep setting through the operating system settings or by other means. Place the EUT back in sleep mode and repeat test, recording sleep power necessary for this alternate configuration as P_{sleepWoL}.

5.3.4 Measuring long idle mode

To measure long idle mode:

– switch on the EUT;
– once logged in with the operating system fully loaded and ready, close any open windows so that the standard operational desktop screen or equivalent ready screen is displayed, and place the EUT in long idle mode (see 4.2.8.4);
– once the EUT has entered the long idle mode, reset the meter (if necessary) and begin accumulating true power values at an interval of one or more readings per second;
– accumulate power values for 5 min and record the average (arithmetic mean) value observed during that 5 min period as P_{idle}.

5.3.5 Measuring short idle mode

To measure short idle mode:

– switch on the EUT;
– once logged in with the operating system fully loaded and ready, close any open windows so that the standard operational desktop background screen or equivalent ready screen is displayed, and the image has been scaled to completely fill the display area, set to at least a brightness level of 90 cd/m^2 for a notebook computer or at least 150 cd/m^2 for integrated

desktop computers, or if these levels are not attainable, set the product brightness level to the nearest achievable level and place the EUT in short idle mode (see 4.2.8.2);

– once the EUT has entered short idle mode, reset the meter (if necessary) and begin accumulating true power values at an interval of one or more readings per second;

– accumulate power values for 5 min and record the average (arithmetic mean) value observed during that 5 min period as P_{sidle}.

5.3.6 Measuring active mode (optional, see 5.6)

To measure active mode:

– switch on the EUT;

– once logged in with the operating system fully loaded and ready, close any open windows so that the standard operational desktop screen or equivalent ready screen is displayed, and place the EUT in short idle mode (see 4.2.8.2);

– load the **active workload** and prepare it to run;

– reset the meter (if necessary) and start the **active workload**. Begin accumulating true power values at an interval of one or more readings per second;

– when the **active workload** indicates it has finished, record the average power as P_{work}.

NOTE Criteria for the **active workload** is defined in 5.6.4.

5.4 Test conditions

All tests carried out on the EUT shall take place under the conditions in Table 1.

Table 1 – Test conditions

Mains power supply voltage	North America/Taiwan:	115 (±1 %) V a.c., 60 Hz (±1 %)
	Europe/Australia/New Zealand/China:	230 (±1 %) V a.c., 50 Hz (±1 %)
	Japan:	100 (±1 %) V a.c., 50 Hz (±1 %) or 60 Hz (±1 %)
		For products rated > 1,5 kW maximum power, the voltage range is ±4 %
THD (voltage)	< 2 % THD (< 5 % for products which are rated for > 1,5 kW maximum power)	
Ambient temperature	(23 ±5) °C	
Relative humidity	10 % to 80 %	
Ambient light	(250 ±50) Lux	

NOTE 1 The voltage and frequency tolerances defined in Table 1 can only be achieved through the use of a line conditioner.

NOTE 2 It is recognised that the nominal voltage of some countries vary from the voltages defined above (for example, China is 220 V and India is typically 240 V), however this standard has limited the number of voltages to be tested for worldwide compliance to three in order to minimise test overheads. Whilst the mains power supply voltage and frequency will have some impact on the overall **TEC** score, the variation that will be seen between 230 V, 220 V and 240 V will be minimal and well within the natural variation expected from testing to this standard.

NOTE 3 Ambient light setting is only required if the display is sensitive to ambient light control.

5.5 Categorisation

5.5.1 General

Categorisation is a grouping of product configurations enabling their relative **energy use** to be compared. ECMA-389 includes the procedure for the registration of categories in accordance with ECMA-383.

To be responsive to market and technology changes, the categories used with this standard are posted in International Registers on the following Ecma maintained, publicly available web site: http://www.ecma-international.org/publications/standards/Categories_to_be_used_with_Ecma-383.htm. This categorisation system is separate from the standard as computer categories change on a much quicker timescale than standards due to changing market needs (local and international). See Annex G for the maintenance procedures for the registration of categories.

5.5.2 ULE category

This **category** identifies products that have very low energy consumption, which are EUTs with an annualised **TEC** calculation below a certain kilowatt hour target with no other attributes or adders. Once a product qualifies as being in the ULE **category**, it does not qualify to fit within any of the other categories. If a product does not meet the ULE criteria it will fall within one of the other categories.

NOTE Refer to the **category** web site defined in 5.5 for the current annualised energy consumption target for a product to qualify as an ULE.

5.5.3 TEC adders

Since the configurations of base EUTs as defined in 5.6 can be altered with additional features, this standard provides for **TEC** adders. **TEC** adders are intended to increment the **TEC** limit (provided by the **user of the test results**) for a given **category** of EUTs that include the attribute identified by the **TEC** adder.

TEC adders may be provided for items such as memory, graphics, TV tuners, additional HDD, use of an SSD, discrete sound cards, discrete network cards, etc. The **user of the test results** should provide the energy adders to be applied.

Where the discrete graphics component is treated as an adder, the FB_BW shall be used to determine the adder value.

In the case of an integrated desktop computer, the screen shall be treated as an adder.

To calculate the **TEC** adder energy consumption:

– determine which **TEC** adders apply and based on the allowances provided by the **user of the test results** calculate the **TEC** adder value in kilowatt hour per **TEC** adder;
– apply any appropriate weighting that the **user of the test results** provides;
– report the overall **TEC** adder energy as defined in 5.10.

NOTE 1 Adders are defined in kilowatt hour/adder/year. The **user of the test results** provides the energy adder information. Annex D provides examples on how adders are included in a **TEC** calculation.

NOTE 2 The ULE **category** does not use adders.

NOTE 3 For notebook computers a screen adder is not applicable as the screen power is part of the base **category** power.

5.6 Annualised energy consumption formulas

5.6.1 General

TEC is a weighted average of measured average power in specific EUT power modes: Off, sleep/**WoL** sleep, long idle, short idle and active.

It is recommended that the majority profile found in Annex B be used with this standard.

Should the user of this standard choose to use a different profile, a profile study shall be completed (4.3.4) and the profile **TEC** error determined.

If the profile **TEC** error is ≤ 15 %, the user of this standard shall use 5.6.2.

If the profile **TEC** error is >15 %, the user of this standard shall use 5.6.3 and an **active workload** shall be created that meets the criteria in 5.6.4.

NOTE Annex D provides some examples of **TEC** calculations.

5.6.2 Estimated annualised energy consumption formula (estimated active workload)

$$TEC_{estimate} = (8\,760/1\,000) \times [P_{off} \times \boldsymbol{T_{off}} + P_{sleep} \times \boldsymbol{T_{sleep}} + P_{idle} \times \boldsymbol{T_{idle}} + P_{sidle} \times (\boldsymbol{T_{sidle}} + \boldsymbol{T_{work}})]$$

$$100\ \% = \boldsymbol{T_{off}} + \boldsymbol{T_{sleep}} + \boldsymbol{T_{idle}} + \boldsymbol{T_{sidle}} + \boldsymbol{T_{work}}$$

where T_x are components of the **duty cycle** and represent the weighted averages of the time spent in each of the P_x power modes.

$\boldsymbol{T_{off}}$ the percent time the product annually spends in the off mode;

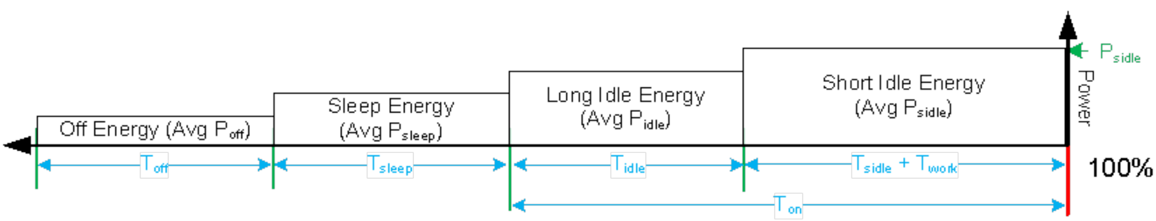
$\boldsymbol{T_{sleep}}$ the percent time the product annually spends in the sleep mode;

$\boldsymbol{T_{idle}}$ the percent time the product is annually on and in the long idle mode (screen blanked);

$\boldsymbol{T_{sidle}}$ the percent time the product is annually on and in the short idle mode (screen not blanked);

$\boldsymbol{T_{work}}$ the percent time the product is annually on and in the active mode (screen not blanked).

This is further illustrated in Figure 2.



NOTE Figure 2 not to scale.

IEC 2117/12

Figure 2 – Example of estimated annualised energy consumption formula (estimated active workload)

5.6.3 Measured annualised energy consumption formula (with an active workload)

$$TEC_{actual} = (8\,760/1\,000) \times (P_{off} \times \boldsymbol{T_{off}} + P_{sleep} \times \boldsymbol{T_{sleep}} + P_{idle} \times \boldsymbol{T_{idle}} + P_{sidle} \times \boldsymbol{T_{sidle}} + P_{work} \times \boldsymbol{T_{work}})$$

100 % = $\boldsymbol{T}_{\textbf{off}} + \boldsymbol{T}_{\textbf{sleep}} + \boldsymbol{T}_{\textbf{idle}} + \boldsymbol{T}_{\textbf{sidle}} + \boldsymbol{T}_{\textbf{work}}$

where T_x are components of the **duty cycle** and represent the weighted averages of the time spent in each of the P_x power modes.

$\boldsymbol{T}_{\textbf{off}}$ the percent time the product annually spends in the off mode;

$\boldsymbol{T}_{\textbf{sleep}}$ the percent time the product annually spends in the sleep mode;

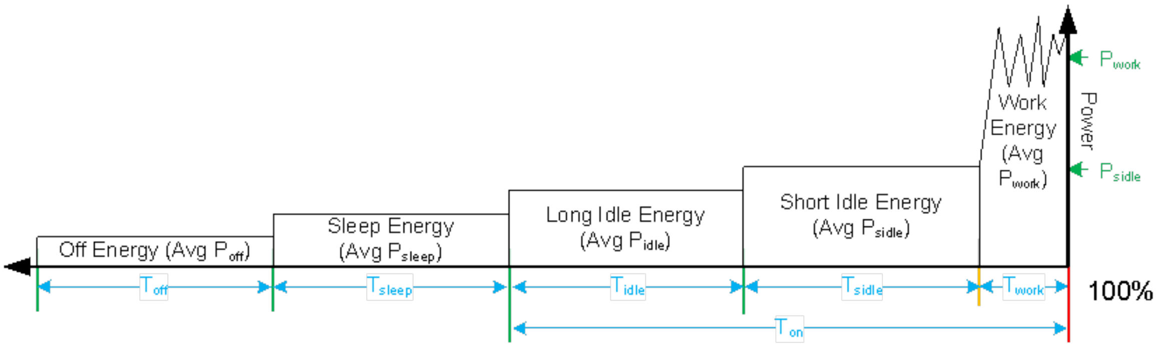
$\boldsymbol{T}_{\textbf{idle}}$ the percent time the product is annually on and in the long idle mode (screen blanked);

$\boldsymbol{T}_{\textbf{sidle}}$ the percent time the product is annually on and in the short idle mode (screen not blanked);

$\boldsymbol{T}_{\textbf{work}}$ the percent time the product is annually on and in the active mode (screen not blanked).

where P_{work} is measured using an **active workload** created based on the criteria in 5.6.4.

This is further illustrated in Figure 3.



NOTE Figure 3 not to scale.

IEC 2118/12

Figure 3 – Measured annualised energy consumption formula (with an active workload)

5.6.4 Criteria for an active workload

Should the profile **TEC** error be greater than the error defined in 5.6 an **active workload** shall be created and the TEC_{actual} formula in 5.6.3 used.

The workload shall be created to ensure that the PAPR, determined as a result of a profile study, comes within 15 % of the PAWR, determined by running the workload on the study computers. The **active workload** shall consist of workload fragments representative of the targeted profile:

– PAPR = P_{on}/P_{sidle}

– PAWR = P_{work}/P_{sidle}

– 15 % > |(PAPR - PAWR)|/PAPR (absolute values)

The P_{on} formula is defined as $P_{on} = (P_{idle} \times \boldsymbol{T}_{\textbf{idle}} + P_{sidle} \times \boldsymbol{T}_{\textbf{sidle}} + P_{work} \times \boldsymbol{T}_{\textbf{work}})/\boldsymbol{T}_{\textbf{on}}$

$E_{onwl} - E_{onstdy}/E_{onstdy}$

where E_{onwl} is the "on energy" calculated from the developed workload, and E_{onstdy} is the "on energy" calculated from the energy study; or,

$E_{onwl} = P_{idle} \times \boldsymbol{T}_{\textbf{idle}} + P_{sidle} \times \boldsymbol{T}_{\textbf{sidle}} + P_{work} \times \boldsymbol{T}_{\textbf{work}}$

$E_{\text{onstdy}} = P_{\text{on}} \times \boldsymbol{T}_{\textbf{on}}$

$\boldsymbol{T}_{\textbf{on}} = \boldsymbol{T}_{\textbf{idle}} + \boldsymbol{T}_{\textbf{sidle}} + \boldsymbol{T}_{\textbf{work}}$

Resulting in the equation:

$$15\ \% > |P_{\text{idle}} \times \boldsymbol{T}_{\textbf{idle}} + P_{\text{sidle}} \times \boldsymbol{T}_{\textbf{sidle}} + P_{\text{work}} \times \boldsymbol{T}_{\textbf{work}} - P_{\text{on}} \times \boldsymbol{T}_{\textbf{on}}| / (P_{\text{on}} \times \boldsymbol{T}_{\textbf{on}})$$

5.7 True RMS watt meter specification

Approved meters shall include the following attributes:

– An available current crest factor of 3 or more at its rated range value. For meters that do not specify the crest factor, the analyser shall be capable of measuring an amperage spike of at least three times the maximum current measured during any 1 s sample of the measurement.
– Report true r.m.s. power (watts) and at least two of the following measurement units:
  - voltage,
  - current, and
  - power factor (PF).

The power measuring instrument shall be capable of meeting the requirements of 5.8 when measuring the following:

- DC,
- AC with a frequency from 10 Hz to 2 000 Hz.

If the power meter contains a bandwidth limiting filter, it should be capable of being taken out of the measurement circuit.

– The following attributes in addition to those above should be considered: the meter shall be able to be calibrated by a standard traceable to International System of Units. The analyser shall have been calibrated within the past year.
– If the meter is used in an automated setup, it shall have an interface that allows its measurements to be read by the SPEC PTDaemon (see Bibliography). The reading rate supported by the analyzer shall be at least one set of measurements per second, where a set is defined as Watts and at least two of the following readings: Volts, Amperes and power factor. The data averaging interval of the analyser shall be either 1 time (preferred) or 2 times the reading interval. "Data averaging interval" is defined as the time period over which all samples captured by the high-speed sampling electronics of the analyser are averaged to provide the measurement set.

It is also desirable for measurement instruments to be able to average power accurately over any user selected time interval (this is usually done with an internal math calculation dividing accumulated energy by time within the meter, which is the most accurate approach). As an alternative, the measurement instrument shall be capable of integrating energy over any user selected time interval with an energy resolution of less than or equal to 0,1 mWh and integrating time displayed with a resolution of 1 s or less.

5.8 True RMS watt meter accuracy

Measurements of power of 1,0 W or greater shall be made with an accuracy of 2 % or better at the 95 % confidence level. Measurements of power of less than 1,0 W shall be made with an accuracy of 0,02 W or better at the 95 % confidence level. The power measurement instrument shall have a resolution of:

– 0,01 W or better for power measurements of 10 W or less;
– 0,1 W or better for power measurements of greater than 10 W up to 100 W; and
– 1,0 W or better for power measurements of greater than 100 W.

All power figures shall be in watts and rounded to the second decimal place. For loads greater than or equal to 10 W, three significant figures shall be reported.

For loads with a calculated effective maximum current ratio (MCR), as described below, of more than 5, the uncertainty is adjusted using the following equation:

$$\mathrm{CFR} = \frac{\mathrm{PCF}}{\mathrm{MCF}}$$

If the calculated value of CFR is less than 1,0 then the value of CFR used in subsequent calculations shall be taken to be 1,0.

$$\mathrm{MCR} = \frac{\mathrm{CFR}}{\mathrm{PF}}$$

where

– the PCF is the measured peak current drawn by the product divided by the measured r.m.s. current drawn by the product;
– the PF is a characteristic of the power consumed by the product. It is the ratio of the measured real power to the measured apparent power.

a) Permitted uncertainty for values of MCR $\leq$10

For measured power values of greater than or equal to 1,0 W, the maximum permitted relative uncertainty introduced by the power measurement equipment, shall be equal to or less than 2 % of the measured power value at the 95 % confidence level.

For measured power values of less than 1,0 W, the maximum permitted absolute uncertainty introduced by the power measurement equipment, U_{ma}, shall be equal to or less than 0,02 W at the 95 % confidence level.

b) Permitted uncertainty for values of MCR $>$10

The value of U_{pc} shall be determined using the following equation:

$$U_{\mathrm{pc}} = 0{,}02 \times \left[1 + \left(0{,}08 \times \left\{\mathrm{MCR} - 10\right\}\right)\right]$$

where U_{pc} is the maximum permitted relative uncertainty for cases where the MCR $>$ 10.

For measured power values of greater than or equal to 1,0 W, the maximum permitted relative uncertainty introduced by the power measurement equipment shall be equal to or less than U_{pc} at the 95 % confidence level.

For measured power values of less than 1,0 W, the permitted absolute uncertainty shall be the greater of U_{ma} (0,02 W) or U_{pc} when expressed as an absolute uncertainty in W ($U_{\mathrm{pc}} \times$ measured value) at the 95 % confidence level.

For ease in making the measurements, it is recommended that the power measuring instrument detects, indicates, signals and records any “out of range” conditions.

NOTE Although a specification for the power meter in terms of allowable crest factor is not included here, it is important that the peak current of the measured waveform does not exceed the permitted measurable peak current for the range selected, otherwise the uncertainty requirements above will not be achieved.

For products connected to more than one phase, the power measuring instrument shall be capable of measuring the total power of all phases connected.

Where the power is measured using the accumulated energy method (see 5.3.3) the calculated power measurement uncertainty shall meet the above requirements.

5.9 Ambient light meter specification

If the EUT supports an automatic display luminance control, then the EUT shall be tested in an environment that meets the ambient light requirements defined in 5.4.

A meter used to measure the ambient light conditions shall measure illumination and shall meet the following requirements.

Resolution	Accuracy
10 Lux	± 5 %

5.10 Reporting of results

The following minimum information shall be reported. The format is an example format only; the user of the standard may use any format of choice.

1. EUT description

Manufacturer
____

EUT code / Model number
____

EUT Type:
Notebook computer ☐ Desktop computer ☐ Integrated desktop computer ☐

Operating System: Windows ☐ Mac OS ☐ Other ______________________________

Operating system version details: ____

For notebook computers:
Battery pack removed during test Yes ☐ No ☐
If no then:
Fully charged battery pack used Yes ☐

2. EUT category (only required if a TEC result is recorded)

Category (include the date extension): ________________

List any **TEC** adders applied (not applicable for ULE **category**):
____
____
____

3. Results

All boxes shall be completed if a **TEC** result is recorded.

Power mode	Recorded average Watts (P)
Off mode (P_{off})	
Sleep mode (P_{sleep})	
Sleep mode ($P_{sleepWoL}$)	
Long idle (P_{idle})	
Short idle (P_{sidle})	
Active mode (P_{work})*	

*If applicable

TEC (no **WoL**): _______________
TEC (with **WoL**): _______________
TEC adder allowances (if applicable) _______________

Majority profile used

Yes ☐ No ☐

If No – description of profile used:

____
____

4. Test conditions

Sample size tested: ____________
Name/model of meter used: ____________
Supply voltage (V): ____________
Supply frequency (Hz) ____________
THD (voltage) (%): ____________
Ambient temperature (°C): ____________
Relative humidity (%): ____________
Ambient light (Lux): ____________

5. Declaration

Name: __________________________
Position in company: __________________________
Signed: __________________________
Date: __________________________

Annex A
(informative)

Overview of profile methodology

Profiles are an important concept in this standard and the approach taken is to focus on a single (majority) profile for measuring **TEC** versus supporting multiple profiles. This Annex outlines the reasons for this approach, and other approaches explored in the development of this standard.

The computer is a general purpose device, and the **TEC** consumed by that device is very dependent on how it is used. While a computer can be described through categorisation, this only defines the attributes of the computer hardware and software. This computer (defined by a **category**) can then be used in many ways (defined by a profile) that will result in different **TEC** values (on the same computer).

For example, a computer "C1" is being purchased by users "U1" and "U2". U1 works in a large enterprise and primarily uses a suite of office applications over an office day (typically five days per week and allowing for holidays). He will get a **TEC** value of T1. U2 uses the same computer at home for Internet access and email with family members and gets a different **TEC** value of T2. The values of T1 and T2 are different, yet were generated by the same computer. Both **TEC** results are correct, but as this example demonstrates, the **TEC** value is influenced based on the usage profile.

So when trying to get an accurate value of **TEC**, it is important to not only note the **category** of the computer, but to also describe the profile of how it is used.

Creating a standard which produces multiple **TEC** estimates for a single computer is confusing, and overly complicated. Therefore the approach taken by this standard is to focus the **TEC** value on a single profile which represents a "typical" user and to base the profile attributes (T_{off}, T_{sleep}, T_{idle}, T_{sidle}, T_{work}) around this single typical profile called the majority profile.

For this standard, a typical profile is defined as a profile that represents how a majority of users use a computer. Consider the user base as a bell curve where the majority of users fall within the majority profile and the other minority profiles fall outside this range, as shown in Figure A.1.

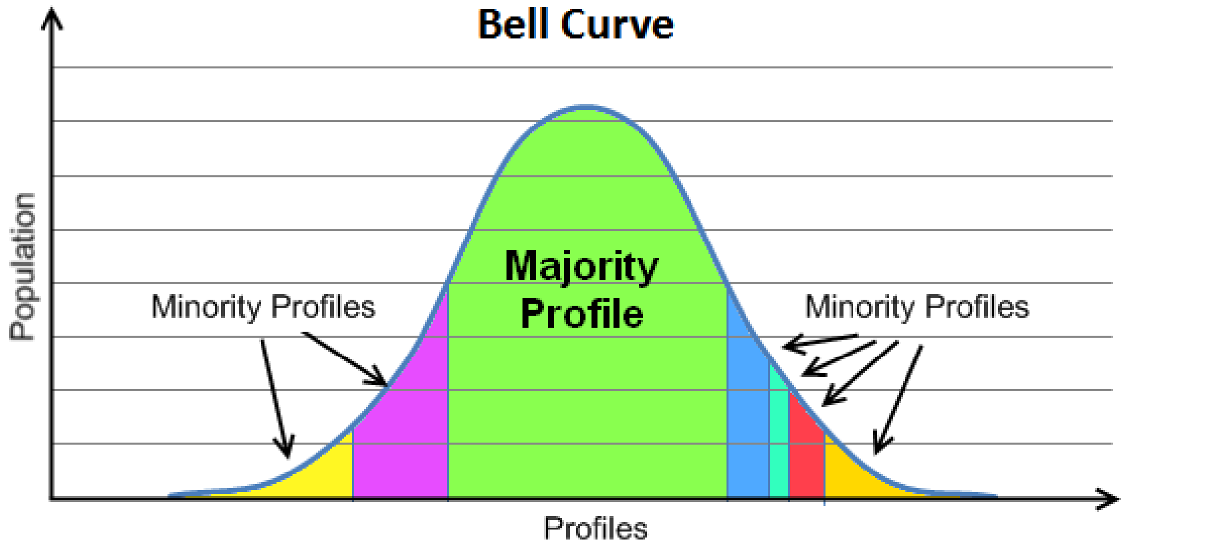


Figure A.1 – Example of a typical profile

Statistical data for profiles is readily available to determine a majority profile (and the minority profiles). This standard focuses on the majority profile and creates **duty cycle attributes** based on that profile to generate the **TEC** values. It is recognized that users of computers who do not match the majority profile will experience different TEC_{actual} values based on their usage of the computer, however the methodology makes a compromise to reduce the complexity and use of **TEC** such that a majority of users will experience accurate $TEC_{estimated}$ values based on their “majority usage”.

A similar approach has been taken in other industries such as estimating kilometres per litre for automobiles. Here there are two profiles of usage (highway and city driving) that are used to describe the efficiency of cars globally. But this represents how a majority of users would use that automobile, and actual mileage will vary based on how that user actually drives. The majority of users will experience fuel mileage close to the estimates, but for a minority of users the mileage will vary.

Annex B
(informative)

Majority profile

Duty cycle attributes of a profile are defined in 4.3.1. The use of the majority profile is recommended in 4.3.2. The recommended majority profile for use with this standard is based on enterprise users (people using computers in small to large businesses primarily focused on office productivity applications) and is documented in Table B.1.

A profile study on enterprise users was conducted on over 500 computers, involving large enterprises from industry conducted geographically across China, Japan, Europe and the USA and the results are documented in Table B.1.

Table B.1 – Duty cycle attributes for the enterprise majority profile duty cycle study

	Desktop computer	**Notebook computer**
T_{off}	45 %	25 %
$T_{sleep} + T_{sleepWoL}$	5 %	35 %
T_{idle}	15 %	10 %
T_{sidle}	35 %	30 %
T_{work}	0 %	0 %

The percentages provided above were created through an enterprise profile study conducted in 2010 by the ECMA-383 workgroup.

Additionally the energy study was performed on 17 machines which conclusively showed that no **active workload** is needed for the enterprise profile, as the average **TEC** error across all machines averaged to be approximately 1,2 % (see Table B.2 and Figure B.1); well below the 15 % error criteria for requiring an **active workload**:

Table B.2 – Summary of the enterprise energy study

	Measured AC power					TEC Error Calculation		
Users	**Active**	**Short idle**	**Long idle**	**Sleep**	**Off**	**TECact**	**TECcalc**	**% Error**
1	45,8	42,7	36,7	1,5	0,5	160	160	0,1
2	32,1	32,0	26,0	1,5	0,5	120	120	0,3
3	33,8	33,9	23,9	1,5	0,5	123	123	0,2
4	36,2	35,7	29,7	1,5	0,5	134	134	0,5
5	21,2	21,0	15,0	1,5	0,5	79	78	0,6
6	33,2	33,2	25,6	1,5	0,5	123	123	0,1
7	35,1	35,0	26,1	1,5	0,5	128	128	0,2
8	22,2	21,9	20,5	1,5	0,5	87	87	0,7
9	40,4	39,7	33,7	1,5	0,5	149	149	0,4
10	44,4	42,6	37,7	1,5	0,5	165	161	2,5
11	28,4	27,9	17,7	1,5	0,5	101	100	1,2
12	25,3	25,3	18,6	1,5	0,5	94	94	0,0
13	22,1	22,1	10,8	1,5	0,5	77	77	0,0
14	19,9	18,6	17,8	1,5	0,5	75	75	0,4
15	30,4	29,6	21,8	1,5	0,5	111	109	1,7
16	12,0	9,0	9,0	1,5	0,5	43	39	8,7
17	72,4	35,9	29,9	1,5	0,5	139	134	3,0

Avg. Error = 1,2 %

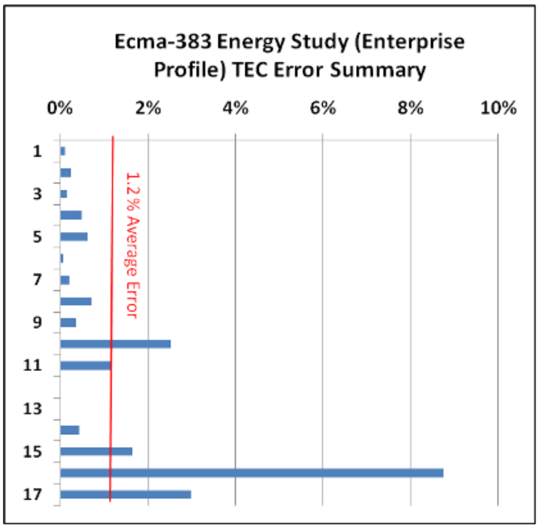


Figure B.1 – TEC error summary chart

This results in the following **TEC** equations for the enterprise majority profile:

Desktop $TEC_{estimate} = 8,76 \times (P_{off} \times 45\ \% + P_{sleep} \times 5\ \% + P_{idle} \times 15\ \% + P_{sidle} \times 35\ \%)$;

Notebook $TEC_{estimate} = 8,76 \times (P_{off} \times 25\ \% + P_{sleep} \times 35\ \% + P_{idle} \times 10\ \% + P_{sidle} \times 30\ \%)$.

These numbers will be further validated for future editions of this standard through additional profile studies.

Annex C
(informative)

Method for conducting a profile study

C.1 General

If the majority profile is not used with this standard, the user should ensure that the profile used has been created through a profile study.

C.2 Profile study example

A majority of client users of computers consist of enterprise (for example, office) users, so a profile study is performed around “enterprise users” as the majority profile.

A large statistically significant number of computers are instrumented to gather utilisation data based around how the computers are used. The **duty cycle attributes** $\boldsymbol{T}_{\mathbf{off}}$, $\boldsymbol{T}_{\mathbf{sleep}}$, and $\boldsymbol{T}_{\mathbf{on}}$ are recorded. This study is performed for a minimum of one year. The average value of $\boldsymbol{T}_{\mathbf{off}}$, $\boldsymbol{T}_{\mathbf{sleep}}$ and $\boldsymbol{T}_{\mathbf{on}}$ are then reported as part of the study along with the sample time and number of samples.

The second stage of the study requires computers to be instrumented and used by users that fit within the study profile to measure their on power and capture on utilisation ($\boldsymbol{T}_{\mathbf{idle}}$, $\boldsymbol{T}_{\mathbf{sidle}}$ and $\boldsymbol{T}_{\mathbf{work}}$). While this sample of computers cannot be as large as the first sample (cost reasons), it should be a large enough sample to draw a number of conclusions with a mix of different computers from different client computer categories:

- the average $\boldsymbol{T}_{\mathbf{idle}}$, $\boldsymbol{T}_{\mathbf{sidle}}$ and $\boldsymbol{T}_{\mathbf{work}}$ ratios for this given profile;
- the PAPR;
- the profile **TEC** error.

The profile study should provide a description and attributes of the computers used in the study including how the data was collected and calculated.

The example in Table C.1 illustrates some data from a profile study and shows eight computers with measured P_{idle}, P_{sidle} and P_{on}. The product active power ratio is calculated for each computer ($P_{\mathrm{on}}/P_{\mathrm{sidle}}$) and then the PAPR is calculated by taking the average of all of the product active power ratios.

Table C.1 – Profile study 1

Measurement	NB1	NB2	NB3	DT1	DT2	DT3	DT4	DT5
P_{off}	1	1	1	1,6	1,6	1,6	1,6	1,6
P_{sleep}	1,5	1,5	1,5	2,8	2,8	2,8	2,8	2,8
P_{idle}	22,7	19,3	22	39,3	55	120,9	210,5	168,1
P_{sidle}	32,8	28,2	28,1	39,3	55	120,9	210,5	168,1
P_{on}	34	28,7	30,3	40	56,5	122,8	227,3	168,7
Product active power ratio	1,03	1,02	1,08	1,02	1,03	1,02	1,08	1
PAPR	1,04							
NB = Notebook computer DT = Desktop computer								

The product active power ratio is a good way of representing the computer's active power and shows how much higher it is than when the product is in a short idle state. Because this is a ratio, it allows various products with different absolute power values to be examined together (notice the ratios for desktops which are in the 100 W range can be combined with notebook ratios which are in the 20 W to 30 W range).

The PAPR is then used as an attribute to describe what the **active workload** should look like (if needed). In the case of this profile, the **active workload** is very close to the short idle power measurement.

Additionally the profile study needs to provide **duty cycle attributes** for the profile. This can be done in two parts, the first to determine the **duty cycle attributes** of off, sleep and on modes for the computer (T_{off}, T_{sleep} and T_{on}), and the second to determine the components of the on mode **duty cycles** (T_{idle}, T_{sidle} and T_{work}).

Table C.2 shows an existing study used for the ENERGY STAR® V5 specification to determine the off, sleep and on mode **duty cycle attributes**:

Table C.2 – ENERGY STAR® V5 computer study

	Desktop computer	Notebook computer
T_{off}	55 %	60 %
T_{sleep}	5 %	10 %
T_{on}	40 %	30 %

The T_{on} components of the **duty cycle attributes** will be created through the profile study. Continuing the example from above, the data in Table C.3 shows how the **duty cycle attributes** break down for each of the computers used in the profile study, the profile T_{idle}, T_{sidle} and T_{work} is then calculated from the averages of the sample products (in this case the profile has separated desktop and notebooks).

Table C.3 – Profile study, duty cycles

Measurement	NB1	NB2	NB3	DT1	DT2	DT3	DT4	DT5
$\boldsymbol{T}_{\mathbf{idle}}$	1,6 %	4,6 %	1,3 %	0,0 %	0,0 %	0,0 %	0,0 %	0,0 %
$\boldsymbol{T}_{\mathbf{sidle}}$	15,9 %	19,9 %	11,2 %	37,2 %	21,3 %	26,7 %	6,3 %	36,5 %
$\boldsymbol{T}_{\mathbf{work}}$	12,6 %	5,5 %	17,5 %	2,8 %	18,7 %	13,3 %	33,7 %	3,5 %
	NB	DT						
Profile $\boldsymbol{T}_{\mathbf{idle}}$	2,5 %	0,0 %						
Profile $\boldsymbol{T}_{\mathbf{sidle}}$	15,7 %	25,6 %						
Profile $\boldsymbol{T}_{\mathbf{work}}$	11,9 %	14,4 %						
NB = Notebook computer DT = Desktop computer								

With this data, the TEC_{actual} and $TEC_{estimated}$ values can then be calculated. The TEC_{actual} is calculated by using the P_{on} for the average on power, while the $TEC_{estimated}$ is calculated using the measured P_{idle}, P_{sidle}, $\boldsymbol{T}_{\mathbf{idle}}$, $\boldsymbol{T}_{\mathbf{sidle}}$, $\boldsymbol{T}_{\mathbf{work}}$ and using P_{sidle} as an approximation of the P_{work} power. This is summarized in Table C.4.

Table C.4 – Profile study, TEC_{actual} and $TEC_{estimated}$ calculations

Measurement	NB1	NB2	NB3	DT1	DT2	DT3	DT4	DT5
TEC_{actual}	96,0	82,1	86,3	149,1	206,9	439,2	805,4	600,1
$TEC_{estimated}$	90,7	78,8	79,2	146,6	201,7	432,6	746,5	598,0
Product **TEC** error	5,6 %	4,0 %	8,3 %	1,6 %	2,5 %	1,5 %	7,3 %	0,4 %
PAPR	3,9 %							
NB = Notebook computer DT = Desktop computer								

An example of TEC_{actual} and $TEC_{estimated}$ calculations are shown below for the NB1 data:

$$TEC_{actual} = 8{,}76 \times (\boldsymbol{T}_{\mathbf{off}} \times P_{off} + \boldsymbol{T}_{\mathbf{sleep}} \times P_{sleep} + (\boldsymbol{T}_{\mathbf{idle}}+\boldsymbol{T}_{\mathbf{sidle}}+\boldsymbol{T}_{\mathbf{work}}) \times P_{on})$$

$$TEC_{actual} = 8{,}76 \times (60\ \% \times 1\ W + 10\ \% \times 1{,}5\ W + (2{,}5\ \% + 15{,}7\ \% + 11{,}9\ \%) \times 34\ W)$$

$$TEC_{actual} = 96{,}2\ KWh$$

The TEC_{actual} is calculated by using the measured P_{on} which is the average power of the computer measured over the time for which the computer was on (hence the weighting factor was the sum of all of the active weightings: $\boldsymbol{T}_{\mathbf{idle}}$, $\boldsymbol{T}_{\mathbf{sidle}}$ and $\boldsymbol{T}_{\mathbf{work}}$).

$TEC_{estimated}$ uses the measured $\boldsymbol{T}_{\mathbf{idle}}$ and $\boldsymbol{T}_{\mathbf{sidle}}$ with the appropriate weighting factors, but then substituting P_{sidle}, which is statically measured, with the P_{work} value:

$$TEC_{estimated} = 8{,}76 \times (\boldsymbol{T}_{\mathbf{off}} \times P_{off} + \boldsymbol{T}_{\mathbf{sleep}} \times P_{sleep} + \boldsymbol{T}_{\mathbf{idle}} \times P_{idle} + (\boldsymbol{T}_{\mathbf{sidle}}+\boldsymbol{T}_{\mathbf{work}}) \times P_{sidle})$$

$$TEC_{estimated} = 8{,}76 \times (60\ \% \times 1\ W + 10\ \% \times 1{,}5\ W + 2{,}5\ \% \times 22{,}7\ W + (15{,}7\ \% + 11{,}9\ \%) \times 32{,}8\ W)$$

$$TEC_{estimated} = 90{,}8\ KWh$$

To understand how the estimated value (which does not require the testing of an actual workload) impacts the product **TEC** error the following calculation is used:

$$[TEC_{actual} - TEC_{estimated}] / (TEC_{actual})$$

(96,2 – 90,8)/96,2 = 5,6 % error

These same calculations are done for all of the products, and then the product **TEC** error is averaged to give the profile **TEC** error of 3,9 %.

In this case the profile study would recommend that for this profile the **TEC** does not require an **active workload** and all submitted **TEC** values for this profile can be estimated using the short idle **TEC** estimation.

For the case where the profile study showed a much higher profile **TEC** error, then the **active workload** would have to be created to allow the P_{work} attribute to be measured. The **active workload** would have to be created from code fragments represented by the profile usages, but shall also guarantee that the PAPR is within 15 % of the PAWR, as shown in 5.6.4:

– PAPR = P_{on}/P_{sidle}
– PAWR = P_{work}/P_{sidle}
– 15 % > |(PAPR - PAWR)|/PAPR (absolute values).

or

– 15 % > $TEC_{actual} - TEC_{estimated} / TEC_{actual}$

where,

$$TEC_{actual} = 8{,}76 \times (P_{off} \times T_{\mathbf{off}} + P_{sleep} \times T_{\mathbf{sleep}} + P_{idle} \times T_{\mathbf{idle}} + P_{sidle} \times T_{\mathbf{sidle}} + P_{work} \times T_{\mathbf{work}})$$

$$TEC_{estimated} = 8{,}76 \times (P_{off} \times T_{\mathbf{off}} + P_{sleep} \times T_{\mathbf{sleep}} + P_{idle} \times T_{\mathbf{idle}} + P_{sidle} \times (T_{\mathbf{sidle}} + T_{\mathbf{work}}))$$

Resulting in the following formula to qualify the Energy Study for the need of an **active workload**:

– 15 % > $(P_{work} \times \boldsymbol{T}_{\mathbf{work}} - P_{sidle} \times \boldsymbol{T}_{\mathbf{work}})/(P_{off} \times \boldsymbol{T}_{\mathbf{off}} + P_{sleep} \times \boldsymbol{T}_{\mathbf{sleep}} + P_{idle} \times \boldsymbol{T}_{\mathbf{idle}} + P_{sidle} \times \boldsymbol{T}_{\mathbf{sidle}} + P_{work} \times \boldsymbol{T}_{\mathbf{work}})$

Annex D
(informative)

Sample TEC calculations

D.1 General

This annex will go through two **TEC** calculation examples: notebook computers and desktop computers.

D.2 Notebook computer example

A notebook computer is to measure its **TEC** value, and has a configuration as follows:

- 2 core CPU;
- 15 in (38,1 cm). display;
- 2 memory channel capability;
- 4 Gbytes of memory;
- integrated graphics controller.

The user then takes the notebook computer and performs the tests outlined in Clause 5 and summarizes the results below:

P_{off} = 1,4 W
P_{sleep} = 4,3 W
P_{idle} = 8,7 W
P_{sidle} = 13,2 W

The majority profile dictates the use of the **TEC** formulae:

Notebook $TEC_{estimate} = 8,76 \times (P_{off} \times 25\ \% + P_{sleep} \times 35\ \% + P_{idle} \times 10\ \% + P_{sidle} \times 30\ \%)$;

and filling in the measured values:

Notebook $TEC_{estimate} = 8,76 \times (1,4 \times 25\ \% + 4,3 \times 35\ \% + 8,7 \times 10\ \% + 13,2 \times 30\ \%)$;

therefore,

Notebook $TEC_{estimate}$ = 58,6 kWh/Year.

For users who want to then compare this **TEC** value to some specified limit associated with the **category**, there might be a need to apply adders to the limit (the value of these adders is provided by the **user of the test results**).

In accessing the **category** registry (see 5.5), it shows that this product falls into the “NBX category” which, by way of an example, is defined as (note this is an example not based on an actual **category** from the registry, the real **category** registry will change over time):

≤2 CPU cores, ≥1 channel memory, ≥2 Gbytes memory, integrated graphics and a screen size ≤13,3”.

Additionally, the registry states that the **TEC** limit would have an adder of x kWh/Gbyte of memory above the base (2 Gbytes). So the user of this specification would then take the **category** limit and add this to the adder (2*x kWh/Gbyte since there were 2 Gbyte of memory over the base **category** definition).

In this case the user of the specification would determine if the **TEC** value passed or failed depending on the value of the calculated limit:

Pass: 58,6 kWh ≤ [**TEC** Limit + 2*x]

Fail: 58,6 kWh > [**TEC** Limit + 2*x]

D.3 Desktop computer example

An all-in-one desktop computer is to measure its **TEC** value, and has a configuration as follows:

- 3 core CPU;
- 20” display;
- 3 memory channel capability;
- 4 Gbytes of memory;
- integrated graphics controller.

The user then takes the all-in-one desktop computer and performs the tests outlined in Clause 5 and summarizes the results below:

P_{off} = 2,2 W

P_{sleep} = 4,1 W

P_{idle} = 25,7 W

P_{sidle} = 33,6 W

The majority profile dictates the use of the **TEC** formulae:

$$\text{Desktop TEC}_{\text{estimate}} = 8{,}76 \times (P_{\text{off}} \times 45\ \% + P_{\text{sleep}} \times 5\ \% + P_{\text{idle}} \times 15\ \% + P_{\text{sidle}} \times 35\ \%);$$

and filling in the measured values:

$$\text{Desktop TEC}_{\text{estimate}} = 8{,}76 \times (2{,}2 \times 45\ \% + 4{,}1 \times 5\ \% + 25{,}7 \times 15\ \% + 33{,}6 \times 35\ \%);$$

therefore,

$$\text{Desktop TEC}_{\text{estimate}} = 147{,}3\ \text{kWh/Year}.$$

For users who want to then compare this **TEC** value to some specified limit associated with the **category**, there might be a need to apply adders to the limit (the value of these adders is provided by the **user of the test results**).

In accessing the **category** registry (see 5.5), it shows that this product falls into the “DTX category” which, by way of example, is defined as (note this is an example not based on an actual **category** from the registry, the real **category** registry will change over time):

≥ 2 CPU cores, ≥ 2 channel memory, ≥ 2 Gbyte memory

Additionally, the registry states that the **TEC** limit would have an adder of x kWh/Gbyte of memory above the base (2 Gbyte). So the user of this specification would then take the

category limit and add this to the adder (2*x kWh/Gbyte since there were 2 Gbytes of memory over the base **category** definition).

Additionally the registry states that the **TEC** limit would have an adder of y kWh for the integrated display. In this case the user of the specification would determine if the **TEC** value passed or failed depending on the value of the calculated limit:

Pass: 147,3 kWh ≤ [**TEC** Limit + 2(x + y)]

Fail: 147,3 kWh > [**TEC** Limit + 2(x + y)].

Annex E
(informative)

ENERGY STAR V5 compliant testing methodology

E.1 General

IEC 62623 was developed to be compliant with the ENERGY STAR V6 testing methodology, however many are building regulations based around The ENERGY STAR V5/V5.2 testing methodology. In general the testing methodology is identical except in regards to the testing of short idle and long idle. This informative Annex provides ENERGY STAR V5 compliant testing methodology for the short and long idle testing. The **duty cycle attributes** for V5 compliance testing are provided in Table E.1.

In ENERGYSTAR V5 and V5.2 specification only the terminology of "Idle" is used. There are different testing methodologies for how to measure idle on systems with integrated displays versus measuring idle on systems with external displays. IEC 62623 uses terminology of "Long Idle" to refer to how ENERGYSTAR V5 and V5.2 to test systems with integrated displays (for example, notebooks, All-In-One desktops, … are tested with screen OFF or blanked) and the terminology of "Short Idle" to refer to how ENERGYSTAR V5 and V5.2 to test systems with external displays (for example, tower desktop computer, …, are tested with screen ON).

E.2 Measuring ENERGY STAR V5.2 compliant long idle mode

– Switch the EUT on.
– Once logged in with the operating system fully loaded and ready, close any open windows so that the standard operational desktop screen or equivalent ready screen is displayed, and place the EUT in long idle mode which is defined as:

  The mode where the EUT has reached an idle condition (for example, 15 min after OS boot or after completing an **active workload** or after resuming from sleep), the screen has just blanked but remains in the working mode (ACPI G0/S0). Power management features, configured as shipped, should have engaged (for example, display is on, …), but the EUT is prevented from entering sleep mode, and the HDD (where applicable) is not allowed to be power managed ("spun-down") during testing unless containing non-volatile cache integral to the drive (for example, "hybrid" hard drives). If more than one internal hard drive is installed as shipped, the non-primary, internal hard drive(s) may be tested with hard drive power management enabled as shipped. If these additional drives are not power managed when shipped to customers, they shall be tested without such features implemented.
– Once the EUT has entered the long-idle mode, reset the meter (if necessary) and begin accumulating true power values at an interval of one or more readings per second.
– Accumulate power values for 5 min and record the average (arithmetic mean) value observed during that 5 min period as P_{idle}.

E.3 Measuring ENERGY STAR V5.2 short idle mode

– Switch the EUT on.
– Once logged in with the operating system fully loaded and ready, close any open windows so that the standard operational desktop screen or equivalent ready screen is displayed, and place the EUT in short idle mode which is defined as:

  The mode where the EUT has reached an idle condition (for example, 15 min after OS boot or after completing an **active workload** or after resuming from sleep), the screen is on (system is re-configured to prevent the display from blanking or turning off) and set to as shipped brightness and long idle power management features should not have engaged (for example, HDD is spinning and the EUT is prevented from entering sleep mode), low brightness control by the timer should be prohibited.

– Once the EUT has entered short idle mode, reset the meter (if necessary) and begin accumulating true power values at an interval of one or more readings per second.
– Accumulate power values for 5 min and record the average (arithmetic mean) value observed during that 5 min period as P_{sidle}.

Table E.1 – Duty cycle attributes for V5 compliant testing

	Desktop computer	**Notebook computer**
T_{off}	55 %	60 %
$T_{sleep} + T_{sleepWoL}$	5 %	10 %
T_{idle}	0 %	30 %
T_{sidle}	40 %	0 %
T_{work}	0 %	0 %

Annex F
(informative)

Power measurement methodology

F.1 General

This annex follows current procedures outlined in CENELEC standard EN 50564:2011. It includes power measurement methods for unstable, cyclic or limited duration modes. These methods are intended to improve the repeatability and reproducibility of measurement results, particularly for low power measurements.

Within this standard, power consumption should be determined by:

– sampling method: by the use of an instrument to record power measurements at regular intervals throughout the measurement period (see F.2). Sampling is the preferred method of measurement for all modes and product types under this standard. For modes where power varies in a cyclic fashion or is unstable, or for limited duration modes, sampling is the only measurement method which should be used under this standard, or;

– average reading method: where the power value is stable and the mode is stable, by averaging the instrument power readings over a specified period or, alternatively by recording the energy consumption over a specified period and dividing by the time (see F.3 for details of when this method is valid), or;

– direct meter reading method: where the power value is stable and the mode is stable, by recording the instrument power reading (see F.4 for details of when this method is valid).

NOTE Determination of average power from accumulated energy over a time period is equivalent to averaging. Energy accumulators are more common than functions to average power over an operator specified period.

F.2 Sampling method

This method should be used where the power is cyclic, or unstable, or the mode is of limited duration. It also provides the fastest test method when the mode is stable. However, it may also be used for all modes and is the recommended approach for all measurements under this standard. It should be used if there is any doubt regarding the behaviour of the product or stability of the mode.

Connect the product to the power supply and power measuring instrument. Select the product mode to be measured (this could require a sequence of operations, including waiting for the product to automatically enter the desired mode) and commence recording the power. Power readings, together with other key parameters such as voltage and current, should be recorded at equal intervals of not more than 1 s for the minimum period specified.

Data collection at equal intervals of 0,25 s or faster is recommended for loads that are unsteady or where there are any regular or irregular power fluctuations.

Where the power consumption within a mode is not cyclic, the average power is assessed as follows:

The product should be energized for not less than 15 min, this is the total period.

Any data from the first one third of the total period is always discarded. Data recorded in the second two thirds of the total period is used to determine stability.

Establishment of stability depends on the average power recorded in the second two thirds of the total period. For input powers less than or equal to 1 W, stability is established when a linear regression through all power readings for the second two thirds of the total period has a slope of less than 10 mW/h. For input powers of more than 1 W, stability is established when a linear regression through all power readings for the second two thirds of the total period has a slope of less than 1 % of the measured input power per hour.

Where a total period of 15 min does not result in the above stability criteria being satisfied, the total period is continuously extended until the relevant criteria above is achieved (in the second two thirds of the total period).

Once stability is achieved, the result is taken to be the average power consumed during the second two thirds of the total period.

NOTE If stability cannot be achieved within a total period of 3 h, the raw data is assessed to see whether there is any periodic or cyclic pattern present.

Where the power consumption within a mode is cyclic (i.e. a regular sequence of power states that occur over several minutes or hours), the average power over a minimum of four complete cycles is assessed as follows:

– The product should be energized for an initial operation period of not less than 10 min. Data during this period is not to be used to assess the power consumption of the product.
– The product is then energized for a time sufficient to encompass two comparison periods, where each period should include not less than two cycles and have a duration of not less than 10 min (comparison periods shall contain the same number of cycles).
– Calculate the average power for each comparison period.
– Calculate the mid-point in time of each comparison period in hours.
– Stability is established where the power difference between the two comparison periods divided by the time difference of the mid points of the comparison periods has a slope of less than:
  - 10 mW/h, for products where the input powers is less than or equal to 1 W, or;
  - 1 % of the measured input power per hour, for products where the input powers is greater than 1 W.

Where the above stability criteria is not satisfied, additional cycles are added equally to each comparison period until the relevant criteria above is achieved.

Once stability is achieved, the power is determined as the average of all readings from both comparison periods.

Where cycles are not stable or are irregular, sufficient data should be measured to adequately characterise the power consumption of the mode (a minimum of 10 cycles is recommended).

In all cases it is recommended that power for the period where data is recorded be represented in graphical form to assist in the establishment of any warm up period, cyclic pattern, instability and stability period.

F.3 Average reading method

This method should not be used for cyclic loads or limited duration modes.

NOTE A shorter measurement period is possible using the sampling method (see F.2).

Connect the product to the power supply and power measuring instrument. Select the mode to be measured (this may require a sequence of operations and it could be necessary to wait for the product to automatically enter the desired mode) and monitor the power. After the product has been allowed to stabilize for at least 30 min, assess the stability of two adjacent measurement periods. The average power over the measurement periods is determined using either the average power or accumulated energy methods as follows:

Select two comparison periods, each made up of not less than 10 min duration (periods should be approximately the same duration), noting the start time and duration of each period.

Determine the average power for each comparison period.

Stability is established where the power difference between the two comparison periods divided by the time difference of the mid points of the comparison periods has a slope of less than:

- 10 mW/h, for products where the input powers is less than or equal to 1 W, or;
- 1 % of the measured input power per hour, for products where the input powers is greater than 1 W.

Where the above stability criteria is not satisfied, longer periods of approximately equal duration are added until the relevant criteria above is achieved.

Once stability is achieved, the power is determined as the average of readings from both comparison periods.

Where stability cannot be achieved with comparison periods of 30 min duration each, the sampling method in F.2 should be used.

There are two approaches:

- Average power approach: where the power measuring instrument can record a true average power over an operator selected period, the period selected should not be less than 10 min.
- Accumulated energy approach: where the power measuring instrument can measure energy over an operator selected period, the period selected should not be less than 10 min. The integrating period should be such that the total recorded value for energy and time is more than 200 times the resolution of the meter for energy and time. Determine the average power by dividing the measured energy by the time for the monitoring period.

To ensure consistent units, it is recommended that watt-hours and hours be used above, to give watts.

If an instrument has a time resolution of approximately 1 s, then a minimum of 200 s (3,33 min) is required for integration on such an instrument.

If an instrument has an energy resolution of approximately 0,1 mWh, then a minimum of 20 mWh is required for the accumulation of energy on such an instrument (at a load of 0,1 W this would take approximately 12 min, at 1 W this would take 1,2 min). Note that both the time and energy resolution requirements should be satisfied by the reading, as well as the minimum recording period specified above (10 min).

F.4 Direct meter reading method

The direct meter reading method should only be used where the mode does not change and the power reading displayed on the measuring instrument is stable. This method should not be used for verification purposes. Any result using the methods specified in F.2 or F.3 should take precedence over results using this method in the case of a dispute.

NOTE A shorter measurement period is possible using the sampling method (see F.2).

Power consumption using the direct reading method is assessed as follows:

Connect the product to be tested to the power supply and measuring instrument, and select the mode to be measured.

Allow the product to operate for at least 30 min. If the power appears to be stable, take a power measurement reading from the instrument. If the reading still appears to be varying the 30 min period is extended until stability appears to have occurred.

After a period of not less than 10 min, take an additional power measurement reading and note the time between the power measurement readings in hours.

The result is the average of the two readings, providing that the difference in power between the two readings divided by the time interval between readings is less than:

- 10 mW/h, for products where the input powers is less than or equal to 1 W, or;
- 1 % of the measured input power per hour, for products where the input powers is greater than 1 W.

Where the relevant criterion above is not met the direct meter reading method should not be used.

Annex G
(normative)

Procedure for the registration of categories for IEC 62623

G.1 General

This annex specifies the procedure to be followed by the Registration Authority in preparing, maintaining and publishing International Registers of desktop, notebook and ULE computer categories for use with IEC 62623.

G.2 International registers

There are three registers:

1) Notebook computer categories:
   Grouping of notebook computer configurations.
2) Desktop computer categories:
   Grouping of desktop computer configurations.
3) Ultra low energy (ULE) **category**:
   Products exhibiting annual energy consumption below a certain level.

G.3 Registration authority

G.3.1 Appointment

Ecma International is the Registration Authority for the International Registers defined in G.2.

G.3.2 Duties

G.3.2.1 Publication of public content of International Registers

The Registration Authority shall publish, at no cost, the International Registers in G.2. for public access at

http://www.ecma-international.org/publications/standards/Categories_to_be_used_with_Ecma-383.htm.

G.3.2.2 Maintenance of International Registers

The Registration Authority shall maintain the International Registers specified in items 1) and 2) of G.2 by following the change request procedure in G.4 and registration procedure in G.5.

G.3.2.3 Inform a change requestor of the decision

The Registration Authority shall inform the requestor of changes to existing categories of the decision to accept or reject such a request.

G.4 Change requests

Using the form to be found at the web link below, implementers of IEC 62623 may send comments for consideration by the registration authority for modifications to categories specified in G.2.

Such comments shall be fit for use with IEC 62623 and comply with the following minimum criteria:

– Comments requesting the creation of a new **category** shall:
  - be able to demonstrate that the new **category** is distinguishable via attributes from other existing or requested categories within a given register;
  - be able to show a 15 % **TEC** increase from an existing lower adjacent **category**, or show 10 % **TEC** decrease from the adjacent **category** above, or 10 % decrease from lowest **TEC category**.
– Comments requesting a modification to an existing **category** shall:
  - be able to demonstrate that it does not change the ability to distinguish via attributes from other existing categories or requested new categories within a given register;
  - be able to demonstrate that a minimum of a 10 % difference in **TEC** score is maintained between categories in a given register.

Web Link:

http://www.ecma-international.org/publications/standards/Ecma-383_comments_to_categories.php.

G.5 Registration procedure

The Registration Authority shall:

1) review registration comments as specified in G.4;
2) ascertain that registration comments are in accordance with this annex;

   If required, indicate to the requestor the changes needed to meet the requirements of this Annex.
3) manage multiple comments in a manner that minimises updates to the International Register and takes into account conflicting or supporting comments from different parties;
4) approve or reject the comments;
5) in case of approval and before modification of the International Register, the registration authority shall
   a) maintain a minimum of 6 months between changes to the International Registers.
   b) take into account all comment approvals and manage the registers in a manner that minimises the number of updates.
6) inform the requestor of approval or rejection within 30 business days.

G.6 Appeal procedure

Appeals shall be filed using the form at the web link below within 30 business days of receipt of the decision from the Registration Authority.

The Registration Authority shall respond to the appeal within 30 business days after receipt of the appeal.

Web link:

http://www.ecma-international.org/publications/standards/Ecma-383_appeals_for_rejected_comments.php.

Bibliography

IEC 60050-732:2010, *International Electrotechnical Vocabulary – Part 732: Computer network technology*

IEC 62075, *Audio/video, information and communication technology equipment – Environmentally conscious design*

IEC 62301, *Household electrical appliances – Measurement of standby power*

EN 62301-1, *Electrical and electronic household and office equipment – Measurement of low power consumption*

IEEE 802.3, *IEEE Standard for Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications* (free download from http://standards.ieee.org/getieee802/802.3.html)

IEEE 802.11, *IEEE Standard for Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY*) Specifications (download from http://standards.ieee.org/findstds/standard/802.11-2012.html)

ECMA-383, *Measuring the Energy Consumption of Personal Computing Products* (3rd edition)

SPEC PTDaemon, www.spec.org/power/docs/SPECpower-Design_ptd.pdf

EPS, *Test Method for Calculating the Energy Efficiency of Single-Voltage External Ac-Dc and Ac-Ac Power supplies*. Available from the EPRI methods website via www.epri.com at http://www.efficientpowersupplies.org/pages/External_Power_Supply_Efficiency_Test_Method_8-11-04.pdf

IPS, *Generalized Test Protocol for Calculating the Energy Efficiency of Internal Ac-Dc and Dc-Dc Power Supplies Revision 6.4.3*. Available from the EPRI methods website via www.epri.com at http://efficientpowersupplies.epri.com/pages/Latest_Protocol/Generalized_Internal_Power_Supply_Efficiency_Test_Protocol_R6.4.3.pdf

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