INTERNATIONAL STANDARD

ISO/IEC 28360

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Information technology — Office equipment — Determination of chemical emission rates from electronic equipment

Technologies de l'information — Équipement de bureau — Détermination des taux d'émission chimique d'un équipement électronique

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Contents

Page

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 28360 was prepared by Ecma International (as ECMA-328) and was adopted, under a special “fast-track procedure”, by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in parallel with its approval by national bodies of ISO and IEC.

Introduction

Globally, governmental agencies, academic institutions, environmental organizations and manufacturers have developed methods to determine chemical emissions from electronic equipment. These attempts however, resulted in a range of tests from which the results are not necessarily comparable, either qualitatively or quantitatively.

Following the publications of the first edition of ECMA-328 and the “Test method for the determination of emissions from Hard Copy Devices” (RAL-UZ 122), experts from the German Federal Insitute for Materials Research and Testing (BAM) and Ecma have collaborated to harmonise methods to determine the chemical emission rates from information and communication technology and consumer electronics equipment in this International Standard (second edition of ECMA-328).

In addition to stricter test procedures, this International Standard uses generalised emission formulae, and their derivations developed in Annex B, to calculate emission rates from concentrations of analytes that are measured in Emission Test Chambers.

Information technology — Office equipment — Determination of chemical emission rates from electronic equipment

1 Scope

This International Standard specifies methods to determine chemical emission rates of analytes from information and communication technology and consumer electronics equipment during intended operation in an Emission Test Chamber (ETC).

The methods comprise preparation, sampling (or monitoring) in a controlled ETC, storage and analysis, calculation and reporting of emission rates.

This International Standard includes specific methods for equipment using consumables, such as printers, and equipment not using consumables, such as monitors and PCs. Annex A specifies monochrome and colour print patterns for use in the operating phase of EUT using *paper* consumables.

Examples of equipment under test (EUT) that do not use consumables are:

- monitors and TV sets (CRT, plasma, LCD, rear projector, beamer);
- video (VCR, DVD player/recorder, camcorder);
- SAT receiver (set-top box);

- audio units (CD player/recorder, home theatre systems, audio home systems, micro-/mini-, midi-systems, amplifier, receiver);
- portable audio (CD player, MP 3 player, radio recorder, clock radio, etc.);
- computer (desktop, tower, server), portable computers (notebooks).

Emission rates from EUT using consumables may also be determined according to additional requirements identified by “RAL-UZ 122 Option”.

Calculations use the generalised model and approximations thereof as developed in Annex B.

The emission rates determined with this method may be used to compare equipment in the same class.

Predictions of “real indoor” *concentrations* from the determined *emission rates* are outside the scope of this International Standard.

2 Conformance

Determinations of emission rates conform to this International Standard when:

1) executed using a Quality Assurance Project Plan, Quality Assurance and Quality Control as specified in ISO 16000-9;

2) tested in a controlled ETC as specified in Clause 7 and in 8.1;

3) sampled/monitored and calculated as specified in Clause 8;

4) reported as specified in Clause 9.

For EUT using consumables, determinations according to additional requirements identified by "RAL-UZ 122 Option" herein conform to the RAL-UZ 122 Option.

3 Normative references

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

CIE 15:2004, *Colorimetry*, 3rd edition, Commission Internationale de l'Eclairage

ECMA-74, *Measurement of Airborne Noise Emitted by Information Technology and Telecommunications Equipment* (2005)

ISO 554:1976, *Standard atmospheres for conditioning and/or testing — Specifications*

ISO 13655:1996, *Graphic technology — Spectral measurement and colorimetric computation for graphic arts images*

ISO 16000-3:2001, *Indoor air — Part 3: Determination of formaldehyde and other carbonyl compounds — Active sampling method*

ISO 16000-6:2004, *Indoor air — Part 6: Determination of volatile organic compounds in indoor and test chamber air by active sampling on Tenax TA sorbent, thermal desorption and gas chromatography using MS/FID*

ISO 16000-9:2006, *Indoor air — Part 9: Determination of the emission of volatile organic compounds from building products and furnishing — Emission test chamber method*

ISO 16017-1:2000, *Indoor, ambient and workplace air — Sampling and analysis of volatile organic compounds by sorbent tube/thermal desorption/capillary gas chromatography — Part 1: Pumped sampling*

EN 55013:2001, *Sound and television broadcast receivers and associated equipment — Radio disturbance characteristics — Limits and methods of measurement*

RAL-UZ 122, *Test method for the determination of emissions from Hard Copy Devices*

4 Terms and definitions

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

4.1
air exchange rate, n
ratio of the volume of clean air brought into the ETC per hour [m^3/h] to the unloaded ETC volume [m^3]

4.2
air velocity
air speed [m/s] measured in the unloaded ETC

4.3
analyte
Volatile Organic Compounds, carbonyl compounds, ozone and particulate matter

4.4
consumables
toner, ink, paper and ribbon

4.5
Emission Test Chamber
ETC
enclosure with controlled operational parameters for testing analyte mass emitted from EUT

4.6
Equipment Under Test
EUT
functional and complete, including consumables and accessories if applicable, ICT or CE equipment, from which chemical emission rates are determined as specified herein

4.7
loading factor
ratio of the EUT volume to the volume of the unloaded ETC

4.8
Hard Copy Devices
class of EUT using consumables that includes printers, (photo)copiers and Multi Functional Devices (MFD)

4.9
operating phase
phase in which the EUT is performing its intended functions

4.10
particulate matter
airborne particles

4.11
pre-operating phase
phase in which the EUT is connected to an electrical supply, which may include warming-up and energy saving modes; before the EUT is able to enter the operating phase

4.12
post-operating phase
phase following the operating phase,which may include energy saving modes

4.13
Total Volatile Organic Compounds
TVOC
sum of the concentrations of identified **Volatile Organic Compounds** and the concentrations of the converted areas of unidentified peaks using the toluene response factor

4.14
unit specific emission rate
SER
mass, in micrograms, of a specific analyte emitted per unit per hour

4.15
Volatile Organic Compounds
VOC
compounds that elute between n-hexane and n-hexadecane on an unpolar GC-column

5 Acronyms, abbreviations and symbols

5.1 Acronyms and abbreviations

CE	Consumer Electronics
DNPH	2,4-dinitrophenylhydrazine
ETC	Emission Test Chamber
EUT	Equipment Under Test
FID	Flame Ionisation Detector
GC/MS	Gas Chromatography/Mass Spectrometry
ICT	Information and Communication Technology
MFD	Multi Functional Device
PTFE	polytetrafluoroethene
PVC	polyvinylchloride
rH	relative Humidity
SER	unit Specific Emission Rate
TVOC	Total Volatile Organic Compounds
VOC	Volatile Organic Compounds

5.2 Symbols

C_s	Average concentration [µg/m^3]
C_{bg}	Background concentration [µg/m^3]
C_{max}	Maximum ozone concentration [µg/m^3]
C_0	Initial concentration [µg/m^3]
C_{pre}	Average concentration during pre-operating phase [µg/m^3]
C_{ope}	Average concentration during operating phase and optionally during post-operating phase [µg/m^3]
H’	Ozone half-life [min]: the period of time for the ozone concentration to drop from C_{max} to $C_{max}/2$
k	Ozone decay constant, without ventilation [min^{-1}]
k’	Ozone decay constant with ventilation (k’ = k + n/60) [min^{-1}]
m_{after}	Sample filter mass [µg] after sampling

m_{before}	Sample filter mass [µg] before sampling
m_{bg}	Sampled mass for chamber background [µg]
m_{pm}	Mass of particulate matter [µg] deposited on the filter
$m_{ref\text{-}after}$	Reference filter mass [µg] after sampling
$m_{ref\text{-}before}$	Reference filter mass [µg] before sampling
m_s	Sampled mass [µg]
m_{pre}	Sampled mass [µg] during pre-operating phase
m_{ope}	Sampled mass [µg] during operating and optionally post-operating phase
n	Air exchange rate [h^{-1}]
P	Atmospheric pressure [Pa]
SER_{bg}	Background SER [µg/h]
SER_{ope}	SER during operating and optionally post-operating phase [µg/h]
SER_{O3}	SER for ozone [µg/min]
SER_{pm}	SER for particulate matter [µg/h]
SER_{pre}	SER during pre-operating [µg/h]
T	Ambient temperature [K]
t_{ope}	Operating phase duration [h]
t_G	Sampling time during operating and optionally post-operating phase [h]
t_{pre}	Pre-operating phase duration [h]
u	Number of EUT units
V	ETC volume [m^3]
V_s	Sampled air volume [m^3]
V_{bg}	Sampled air volume [m^3] for determination of C_{bg}
V_{pre}	Sampled air volume [m^3] in pre-operating phase
V_{ope}	Sampled air volume [m^3] in operating and optionally post-operating phase

6 Method overview

The flowchart in Figure 1 illustrates the method; clause numbers are indicated in brackets.

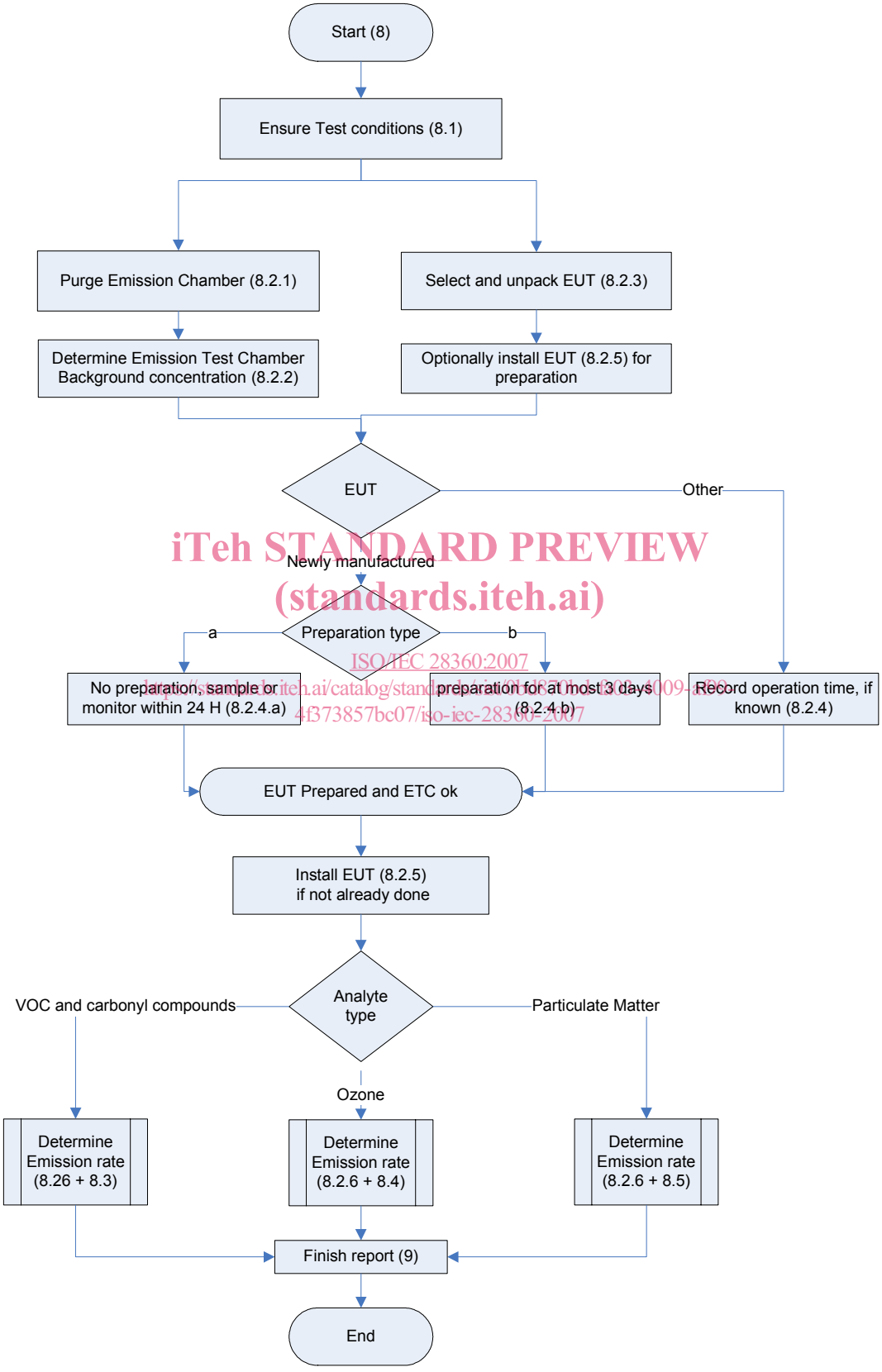

Figure 1 — Determination method overview