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CGATS.11/PIMA IT2.11-1999

AMERICAN NATIONAL STANDARD

Graphic technology and photography — Reflection and transmission metrology — Certified reference materials — Documentation and procedures for use, including determination of combined standard uncertainty

SECRETARIAT

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Foreword

(This Foreword is not a part of American National Standard CGATS.11/PIMA IT2.11-1999, Graphic technology and photography - Reflection and transmission metrology - Certified reference materials - Documentation and procedures for use, including determination of combined standard uncertainty.)

This standard specifies documentation for certified reference materials (CRMs), procedures for the use of CRMs, and procedures for the computation and reporting of combined standard uncertainty, as applicable to the calibration, performance characterization and verification, and routine use of reflectance and transmittance measurement systems in the graphic arts, photographic, and other imaging processes.

This standard was initially developed by CGATS SC3, Metrology, for use in the graphic arts industry. During the later stage of development it was determined that the content of this document was equally applicable to the photographic and other imaging industries. The PIMA IT2-28 Subcommittee, Densitometry, provided significant contributions; the decision was made to co-designate this standard as CGATS.11/ PIMA IT2.11.

The Committee for Graphic Arts Technologies Standards (CGATS) was accredited by the American National Standards Institute in 1989 to serve as the coordinator of graphic arts standards activities. CGATS identifies areas in which standards are needed and desired, respecting the established activities of existing accredited standards committees and industry standards developers. CGATS writes standards only where the need exists and no other committee is undertaking the writing.

The Photographic & Imaging Manufacturers Association, Inc. (PIMA) Technical Committee on Image Technology, IT2, has served the interests of photographic products manufacturers since 1946. IT2 develops standards pertaining to instruments and methods for the quantitative evaluation of photographic printing and other imaging systems. The IT2-28 Subcommittee addresses standards related to densitometry.

CGATS and PIMA recommend the adoption and use of this standard by all imaging industries and suppliers at their earliest convenience.

Requests for interpretation must be sent in writing to the Secretariat. This request will be forwarded to the appropriate committee, which will respond in writing. A statement, written or oral, that is not processed in accordance with the procedures noted above will not be considered the official position of CGATS, and should not be relied upon as a Formal Interpretation.

Suggestions for improving this standard are welcomed. They should be sent to the CGATS Secretariat, NPES The Association for Suppliers of Printing, Publishing and Converting Technologies, 1899 Preston White Drive, Reston, VA 20191-4367.

This standard was prepared by CGATS Subcommittee 3 (Metrology) and PIMA IT2-28 (Densitometry) and was processed and approved by both committees for submittal to ANSI. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time this standard was approved the leadership of CGATS and PIMA IT2 was as follows:

CGATS Chairman, Walter Zawacki
CGATS Vice Chairman, Eric Wolferman
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At the time it approved this standard, CGATS had the following membership:

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At the time it approved this standard, CGATS SC3 had the following members:

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	Eliot Siegel (Alt)
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At the time it approved this standard, PIMA Subcommittee IT2-28 (Densitometry) had the following membership:

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Kodak Polychrome Graphics	Lawrence Steele
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Fuji Photo Film USA	Larry Warter
Flexographic Technical Association	Michael Wiest
Iford Imaging	Robert Whittall

Introduction

The International Organization for Standardization (ISO), in Guide 30:1992 *Terms and definitions used in connection with reference materials*, defines a certified reference material (CRM) as a "reference material, accompanied by a certificate, one or more of whose property values are certified by a procedure which establishes traceability to an accurate realization of the unit in which the property values are expressed, and for which each certified value is accompanied by an uncertainty at a stated level of confidence." Thus, CRMs are well-characterized materials with values traceable to stated references (see 3.13). They may be used to calibrate or to determine the performance characteristics of measurement systems in order to facilitate the exchange of data and to assist in quality control. Their use will help to assure the long-term adequacy and integrity of the measurement and quality control processes.

Densitometers, colorimeters and spectrophotometers are widely used to make measurements for quality and process control in the graphic arts, photographic and imaging industries. The intent of this standard is to establish documentation requirements that describe characteristics of reflection and transmission certified reference materials which may be used for verifying performance of these instruments. In many areas (e.g., cyan, magenta, yellow colorants, etc.) no known references are readily available that are traceable to national standards. This standard can still provide guidance in such circumstances by showing how to determine the reproducibility of results of measurement, even in the absence of CRMs.

Although the calibration reference materials provided with many reflection and transmission instruments used in graphic arts and photography are not identified as CRMs, they often meet the requirements of CRMs. Instrument manufacturers are encouraged to document the characteristics of their calibration materials as CRMs, where appropriate.

The terms "Standard Reference Material" and "SRM" are often misused to describe physical reference materials. It should be noted that the National Institute of Standards and Technology (NIST) has defined a Standard Reference Material (SRM) as "a special class of CRMs that have been carefully analyzed and certified by NBS." (NIST was formerly known as The National Bureau of Standards, NBS). Both of these are registered trade marks of NIST and the federal government of the United States. This standard uses accepted terms from metrology-related national and international guidelines and standards. The accepted term shown in this standard is certified reference material or CRM (3.2).

This standard describes practical procedures to determine values that represent components of the uncertainty of measurements for the graphic arts, photography and other image technology industries. A computational procedure is also provided to combine these components to determine "combined standard uncertainty" (See 3.3). A more rigorous and detailed approach is described in the ISO *Guide to the Expression of Uncertainty in Measurement*. For application of this standard, it is assumed that the input variables are independent of each other, have normal distribution and that their standard deviations are each much smaller than the absolute magnitude of the corresponding input variable. While these assumptions are not always correct, they provide a reasonable basis for the practical use of a CRM. For cases where these assumptions may not be valid, such as color difference and chroma, users should follow the concepts and rules shown in the ISO *Guide to the Expression of Uncertainty in Measurement*.

Furthermore, general procedures are identified for the use and maintenance of these certified reference materials. Through use of this standard, manufacturers of CRMs can provide consistent general use information for the verification of measurement system performance described above.

This standard lists appropriate documentation that should accompany CRMs, including:

- areas where a CRM is and is not applicable;
- physical characteristics of CRMs for density, color values, uniformity, etc. (see annex A);
- traceability of CRM values to stated reference;
- expected lifetime;
- care and storage; and
- general procedures on how to use the CRM.

Other useful documents providing guidance in metrology and the uncertainty of measurement can be found in annex D, Bibliography.

This standard provides guidance and is a resource for manufacturers and users of CRMs. Using CRMs as part of quality assurance activities is essential for verification and calibration of measurement systems and can increase confidence in data obtained from measurement instruments. It provides support for ISO 9000 registration by providing information relevant to graphic arts, photographic and other imaging industries.

Graphic technology and photography — Reflection and transmission metrology — Certified reference materials — Documentation and procedures for use, including determination of combined standard uncertainty

1 Scope and field of application

This standard specifies documentation for certified reference materials (CRMs), procedures for the use of CRMs, and procedures for the computation and reporting of combined standard uncertainty, as applicable to the calibration, performance characterization and verification, and routine use of reflectance and transmittance measurement systems in the graphic arts, photographic, and other imaging processes. Applicable measurement systems include, but are not restricted to, densitometers, colorimeters, spectrophotometers, reflectometers, glossmeters, and spectroradiometers.

This standard references and draws upon the appropriate ISO guides in developing requirements and procedures specific to the needs of the graphic arts, photographic, and other imaging processes.

This standard is not applicable to measurement results that do not show a statistically normal distribution but some provisions may be applied by analogy.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid standards.

ISO Guide 30, *Terms and definitions used in connection with reference materials*, Second edition, 1992

ISO *Guide to the Expression of Uncertainty in Measurement*, 1995

ISO *International Vocabulary of Basic and General Terms in Metrology*, Second Edition, 1993

3 Definitions

For the purposes of this standard, the following definitions shall apply:

3.1

calibration

set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards

[ISO *International Vocabulary of Basic and General Terms in Metrology*]

NOTE Contrary to a common usage, calibration is not the process of adjusting a measurement system such that it produces values that are believed to be correct. Calibration permits either the assignment of values of measurands to the indications (creating a reference table) or the decision to reset or adjust the device. Following the resetting or adjusting of the device, a calibration should be repeated to ensure that the new device setting(s) provide indications within the accepted values.