

# American National Standard

*for Photography –  
Black-and-White, Continuous-Tone Films –  
Photographic Modulation Transfer Function*

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**American National Standards Institute**

11 West 42nd Street  
New York, New York  
10036

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**ANSI/PIMA IT2.39-1998**

Revision and redesignation of  
ANSI PH2.39-1977 (R1990)

American National Standard  
for Photography –

**Black-and-White, Continuous-Tone Films –  
Photographic Modulation Transfer Function**

Secretariat

**Photographic & Imaging Manufacturers Association, Inc.**

Approved March 26, 1998

**American National Standards Institute, Inc.**

## American National Standard

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**Foreword** (This foreword is not part of American National Standard ANSI/PIMA IT2.39-1998.)

Modulation transfer curves have become an accepted means of describing certain characteristics relating to the sharpness of sensitized photographic materials. This standard describes a method for measuring the photographic modulation transfer function of black-and-white, continuous-tone films that have an emulsion coated on one side of a transparent support. Color photographic materials have been specifically excluded from the scope of this standard due to the complexity of specifying the input modulation of the actinic exposure and the associated readout of the resulting images.

When certain conditions are fulfilled, the modulation transfer curve for one component of a system can be cascaded with the modulation transfer curves representing other components of the system. Although such cascading is useful and desirable in systems that include photographic components, this standard does not claim that the modulation transfer function will necessarily give a representative system response when it is cascaded with other components of the system.

Factors beyond the scope of this standard have to be included when precise predictions of the density of fine detail in photographic reproductions are to be derived by cascading the modulations transfer curves of system components. A method for predicting the densities of fine detail in photographic images has been proposed by C. N. Nelson [3].<sup>1)</sup>

It is important to note that the photographic modulation transfer function, as it is defined in this standard, is a measure of the apparent scattering of light within an *unprocessed* emulsion: it is *not* a measure of the transmittance of the *processed* photographic image. The gradient of the density log exposure curve provides a very approximate factor relating the modulation associated with the light scattered within the *unprocessed* emulsion with the modulation associated with the light transmitted by the *processed* emulsion. A more exact relationship can be obtained by means of the more detailed procedures given in Nelson's paper.

This standard has been written in such a way as to allow the use of the basic camera system, except for optics, that meets the requirements of ANSI/PIMA IT2.38-1998, *Photography – Photographic materials – Determination of ISO resolving power*.

This standard contains six annexes that are informative and are not considered part of the standard.

Suggestions for improvement of this standard will be welcome. They should be sent to the Photographic & Imaging Association, Inc., 550 Mamaroneck Avenue, Suite 307, Harrison, NY 10528-1612; e-mail: natlstds@pima.net.

This standard was processed and approved for submittal to ANSI by PIMA Technical Committee on Image Evaluation, IT2. 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 IT2 Committee had the following members:

Michael R. Goodwin, Chairman  
Jack Holm, Vice-Chairman  
James E. Harvey, Secretary

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<sup>1)</sup> Numbers in brackets correspond to references listed in annex F.

<i>Organization Represented</i>	<i>Name of Representative</i>
Photographic & Imaging Manufacturers Association, Inc. ....	Carolyn Franceschi Michael R. Goodwin Thomas McKeehan (Alt.) Alex Pendleton Thomas Lumenello (Alt.) Robert L. Seyfert Daniel E. Sinto Joseph Helm (Alt.) Robert A. Uzenoff Robert D. Whittall David W. Butcher (Alt.) Peter Krause (Alt.)
American Roentgen Ray Society .....	Joel Gray
Association for Engineering Graphics and Imaging Systems .....	Susan S. Y. Johnson
Association for Information & Image Management (Liaison) .....	Marilyn Wright
Azon Corporation .....	Bill Neithardt
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## American National Standard for Photography –

# Black-and-White, Continuous-Tone Films – Photographic Modulation Transfer Function

## 1 Scope

This standard describes a method for measuring the photographic modulation transfer function of black-and-white, continuous-tone films that have an emulsion coated on one side of a transparent support.

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards and publications are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards and publications listed below.

ANSI/ISO 5-3-1995, ANSI/NAPM IT2.18-1996, *Photography – Density measurements – Part 3: Spectral conditions*

ANSI/ISO 3028-1984 (R1994), ANSI/NAPM IT2.28-1985 (R1996), *Photography – Camera flash illuminants – ISO Spectral distribution index*

ANSI/ISO 7589-1984 (R1994), ANSI/NAPM IT2.29-1985 (R1995), *Photography (Sensitometry) – Illuminants for sensitometry – Specifications for daylight and incandescent tungsten*

## 3 Definitions

For the purpose of this standard, the following definitions apply.

**3.1 modulation:** For a sinusoidal distribution of irradiance, it is defined as:

$$M = \frac{E_2 - E_1}{E_2 + E_1}$$

where

$E_2$  is the maximum irradiance measured in the sinusoidal pattern;

$E_1$  is the minimum irradiance measured in the sinusoidal pattern.

**3.2 photographic modulation transfer factor (PMTF):** For a given spatial frequency, it is the ratio of the apparent modulation of the exposure pattern in the emulsion, as measured by photographic radiometry using the emulsion as its own radiometer, to the actual modulation of the sinusoidal pattern incident on the emulsion surface (see annex A).