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Illuminating
ENGINEERING SOCIETY

TECHNICAL MEMORANDUM:
RAY FILE FORMAT FOR DESCRIPTION OF THE EMISSION PROPERTIES OF LIGHT SOURCES

AN AMERICAN NATIONAL STANDARD

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Prepared by the IES Computer Committee.
IES Computer Committee

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1.0 Introduction and Scope

1.1 Introduction

In the past few decades, the optical design of illumination systems (non-imaging optics) has benefited greatly from the advances in computer hardware and software. Many commercially available ray-tracing optical design and simulation software programs have been developed to support a wide variety of optical design tasks. All of these software packages can use ray files as source models. Ray files are typically generated by light source manufacturers using either an optical simulation or physical measurements using near field goniometers. These ray files are then put in a specific format for each optical design program, which allows optical engineers to integrate the light source characteristics into their optical system design simulations. Ray files describe light sources by a large number of rays with individual start location, direction, flux, and optional spectral and/or polarization data.

Ray files are mainly intended for optical engineers, who are designing optical systems using light sources. Ray files are a characterization of the near field characteristics of a light source. Users may also be familiar with files formatted according to *ANSI/IES LM-63-19, IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information*. These are typically called "IES files" and are far-field characterizations of a lamp or luminaire. IES files are used by lighting engineers and designers to calculate predicted light levels. Although these far-field files are useful for calculating lighting application layouts, they are not adequate when designing optics placed in close proximity to the light source.

One complication in providing ray files for light source characterization is that each ray file can be very large, containing millions of rays and using more than 250 MB of data per file. Currently, a manufacturer needs to provide ray files for all of its light sources, in up to 16 unique file formats since none of the commercially available ray tracing software uses the same file format. This situation leads to a large amount of data that has to be created, managed, stored, and distributed to ray file users.

Because all ray files store essentially the same data, the industry has come together to create a single standard ray file format that all light source manufacturers can distribute and all optical design software can use for simulations. The format has been created by a group that includes LED manufacturers, optical simulation software vendors, near-field goniometer vendors, and academia. The new format is meant to allow simple conversion of all existing ray files into the new format, and it will be generally backward compatible in future revisions.

This document defines the IES standardized ray file format to describe the emission properties of light sources that can be used in all commercially available design, analysis, and metrology software.

(*Note:* IES TM-25-13 Addendum A has been incorporated into this document. Refer to **Section 3.21** for information on the polarization ellipse definition that was added via the Addendum.)

1.2 Scope

This document provides recommendations for a standard ray file format to describe the emission properties of light sources. The ray file format contains information necessary to interface between ray tracing or other optical design, simulation, analysis and metrology software used in lighting applications.