[6450-01-P]

DEPARTMENT OF ENERGY

10 CFR Parts 429 and 431

[Docket No. EERE-2010-BT-TP-0044]

RIN: 1904-AC37

Energy Conservation Program: Test Procedures for High-Intensity Discharge Lamps

AGENCY: Office of Energy Efficiency and Renewable Energy, Department of Energy.

ACTION: Supplemental notice of proposed rulemaking.

SUMMARY: On December 15, 2011, the U.S. Department of Energy (DOE) issued a notice of proposed rulemaking (NOPR) to establish test procedures (TP) for high-intensity discharge (HID) lamps (herein referred to as the December 2011 TP NOPR). In this supplemental notice of proposed rulemaking (SNOPR), DOE updates the industry standards proposed to be incorporated by reference in the December 2011 TP NOPR and proposes to revise or eliminate certain definitions relevant to HID lamps. DOE also provides clarification and additional background information on ambient temperature conditions, and revises proposed ambient air speed requirements. DOE revises its proposed sampling plan as well. In addition, DOE removes the directional lamp requirements and proposed lumen maintenance test method included in the December 2011 TP NOPR. The other provisions of the December 2011 TP NOPR are unaffected by this SNOPR.

DATES: DOE will accept comments, data, and information regarding this SNOPR submitted no later than **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].** See section IV, "Public Participation," for details.

ADDRESSES: Any comments submitted must identify the SNOPR for test procedures for high-intensity discharge lamps and provide docket number EERE-2010-BT-TP-0044 and/or regulatory information number (RIN) 1904-AC37. Comments may be submitted using any of the following methods:

1. Federal eRulemaking Portal: www.regulations.gov. Follow the instructions for submitting comments.
2. Email: HIDLamps-2010-TP-0044@ee.doe.gov. Include the docket number (EERE-2010-BT-TP-0044) and/or RIN (1904-AC37) in the subject line of the message. Submit electronic comments in WordPerfect, Microsoft Word, PDF, or ASCII file format, and avoid the use of special characters or any form of encryption.
3. Postal Mail: Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Office, Mailstop EE-5B, 1000 Independence Avenue, SW., Washington, DC 20585-0121. If possible, please submit all items on a compact disk CD, in which case it is not necessary to include printed copies.
4. Hand Delivery/Courier: Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Office, 950 L'Enfant Plaza, SW., Suite 600, Washington, DC 20024. Phone: (202) 586-2945. If possible, please submit all items on a CD, in which case it is not necessary to include printed copies.

DOCKET: The docket, which includes Federal Register notices, public meeting attendee lists and transcripts, comments, and other supporting documents/materials, is available for review at regulations.gov. All documents in the docket are listed in the regulations.gov index. However, not all documents listed in the index may be publicly available, such as information that is exempt from public disclosure.

Instructions: All submissions received must include the agency name and docket number and/or RIN for this rulemaking. No facsimiles (faxes) will be accepted.

A link to the docket web page can be found at: www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/21. This web page contains a link to the docket for this notice on the www.regulations.gov site. The www.regulations.gov webpage will contain instructions on how to access all documents, including public comments, in the docket. See section IV for information on how to submit comments through www.regulations.gov.

For further information on how to submit a comment and review other public comments, contact Ms. Brenda Edwards at (202) 586-2945 or by email: Brenda.Edwards@ee.doe.gov.

FOR FURTHER INFORMATION CONTACT:

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I. Authority and Background

Title III, Part B of the Energy Policy and Conservation Act of 1975 (Pub. L. 94-163, 42 U.S.C. 6291, et seq. "EPCA" or "the Act") sets forth a variety of provisions designed to improve energy efficiency and established the Energy Conservation Program for Consumer Products

Other Than Automobiles.[1] Part C of title III, "Certain Industrial Equipment" (42 U.S.C. 6311–6317), establishes an energy conservation program for such equipment.[2] Although HID lamps are defined in 42 U.S.C. 6291(46), DOE is required to set standards for HID lamps in 42 U.S.C. 6317(a)(1). Therefore, DOE has determined that the provisions of Part C are applicable to HID lamps.

Under EPCA, the energy conservation program consists essentially of four parts: (1) testing, (2) labeling, (3) Federal energy conservation standards, and (4) certification and enforcement procedures. The testing requirements consist of test procedures that manufacturers of covered products must use as the basis for (1) certifying to DOE that their products comply with the applicable energy conservation standards adopted under EPCA (42 U.S.C. 6295(s) and 6316(a)), and (2) making representations about the efficiency of those products (42 U.S.C. 6315(b)). Similarly, DOE must use these test procedures to determine whether the products comply with any relevant standards promulgated under EPCA (42 U.S.C. 6295(s) and 6316(a)(1)).

EPCA requires DOE to prescribe testing requirements for HID lamps within 30 months after issuance of a positive determination that energy conservation standards are technologically feasible and economically justified, and would result in significant energy savings. (42 U.S.C. 6317(a)(1)) DOE published a positive final determination for HID lamps on July 1, 2010. 75 FR 37975.

[1] All references to EPCA in this document refer to the statute as amended through the American Energy Manufacturing Technical Corrections Act (AEMTCA), Pub. L. 112-210 (Dec. 18, 2012).
[2] For editorial reasons, Parts B and C were re-designated as Parts A and A-1 on codification in the U.S. Code.

General Test Procedures Rulemaking Process

Under 42 U.S.C. 6314, EPCA sets forth the criteria and procedures DOE must follow when prescribing or amending test procedures for covered equipment. EPCA provides in relevant part that any test procedures prescribed or amended under this section shall be reasonably designed to produce test results that measure energy efficiency, energy use, or estimated annual operating cost of a covered product or equipment during a representative average use cycle or period of use, as determined by the Secretary of Energy, and shall not be unduly burdensome to conduct. (42 U.S.C. 6314(a)(2))

Background

DOE published a NOPR on December 15, 2011 (herein referred to as the December 2011 TP NOPR) proposing test procedures for HID lamps to measure efficacy, color characteristics, and lumen maintenance. 76 FR 77914. DOE presented the December 2011 TP NOPR at a public meeting on January 19, 2012 (herein referred to as the January 2012 TP public meeting). Comments received in response to the December 2011 TP NOPR and a transcript of the public meeting are available at www.regulations.gov. DOE received comments from interested parties suggesting that the DOE HID lamps test procedures should be aligned with similar international standards and test procedures, and that DOE should pursue using test data already collected in accordance with international requirements. DOE also received comments on its proposals to measure lamp color characteristics, lumen maintenance, and directional lamp characteristics. Other comments were received on the proposed sampling plan, laboratory accreditation requirements, and the instrumentation requirements for test apparatuses.

Based on comments received on the December 2011 TP NOPR, and subsequent additional research, DOE proposes to revise and clarify the proposed HID lamp test procedures. In this SNOPR, DOE provides interested parties with an opportunity to comment on these revised and new proposals, described in section II.

II. Discussion of the Supplemental Notice of Proposed Rulemaking

In this SNOPR, DOE updates the industry standards proposed to be incorporated by reference in the December 2011 TP NOPR and proposes revisions to three elements of the December 2011 TP NOPR: (1) definitions; (2) ambient testing conditions for temperature and air speed; and (3) sampling plan. These revisions address comments from interested parties and incorporate recent research on HID lamps. This SNOPR also removes the directional lamp and lumen maintenance testing requirements included in the December 2011 TP NOPR.

In this SNOPR, DOE revises the December 2011 TP NOPR proposed definitions relevant to HID lamps in 10 CFR part 431 for "basic model," "directional lamp," "lamp efficacy," and "lamp wattage," and proposes to eliminate the terms "beam angle," "lamp electrical power input," and "lumen maintenance." DOE also proposes to add a definition for "initial lumen output." DOE also clarifies the proposed requirements for ambient temperature conditions and provides additional background information in support of these requirements. In addition, DOE revises its proposed ambient air speed requirements to eliminate as unwarranted an explicit air

speed limit. Finally, DOE revises its sampling plan requirements for sample size and statistical representation.

A. Industry Standards and Test Procedures

In the December 2011 TP NOPR, DOE proposed to incorporate by reference six industry standards and test procedures. 77 FR 77914, 77916 (Dec. 15, 2011). These references were American National Standards Institute (ANSI) C78.379-2006, "For Electric Lamps—Classification of the Beam Patterns of Reflector Lamps"; ANSI C78.389-R2009, "For Electric Lamps—High Intensity Discharge—Methods of Measuring Characteristics" (sections 1.0, 2.0, 3.0, and Figure 1); International Commission on Illumination (CIE) 13.3-1995, "Technical Report: Method of Measuring and Specifying Colour Rendering Properties of Light Sources"; CIE 15:2004, "Technical Report: Colorimetry"; Illuminating Engineering Society of North America (IES) LM-51-00, "Approved Method for the Electrical and Photometric Measurements of High Intensity Discharge Lamps" (sections 1.0, 3.2, 9.0, 10.0, 11.0, and 12.0); and IES LM-47-01, "Approved Method for Life Testing of High Intensity Discharge Lamps." In today's SNOPR, DOE proposes to update its references to incorporate IES LM-51-13, "Approved Method for the Electrical and Photometric Measurements of High Intensity Discharge Lamps." DOE also proposes to incorporate by reference one additional standard: IES LM-78-07, "IESNA Approved Method for Total Luminous Flux Measurement of Lamps Using an Integrating Sphere Photometer."

During the January 2012 HID TP public meeting, Intertek commented that IES LM-47-01 was more than 10 years old and had been updated. (Intertek, Public Meeting Transcript, No. 5

at p. 121)[3] IES subsequently released LM-47-12. DOE no longer proposes to measure lumen maintenance; therefore DOE no longer proposes to incorporate by reference in this SNOPR LM-47-12.

Intertek also commented during the January 2012 HID TP public meeting that IES LM-51-00 was expected to be revised in the latter part of 2012. (Intertek, Public Meeting Transcript, No. 5 at p. 121) DOE notes that a revised version of IES LM-51 (IES LM-51-13) has been released, which DOE proposes to incorporate by reference in this SNOPR.

The National Electrical Manufacturers Association (NEMA) expressed general support for LM-51, but requested more specificity related to instrumentation, and suggested that DOE incorporate by reference IES LM-78-07. (NEMA, No. 6 at p. 8)[4] DOE reviewed this test method and proposes to incorporate by reference IES LM-78-07, "IESNA Approved Method for Total Luminous Flux Measurement of Lamps Using an Integrating Sphere Photometer," sections 3.1 and 6.3, in this SNOPR.

B. Definitions

In the December 2011 TP NOPR, DOE proposed definitions for the following terms based on the EPCA definitions of these terms: "ballast" (42 U.S.C. 6291(58)), "color rendering index" (42 U.S.C. 6291(30)(J)), "correlated color temperature" (42 U.S.C. 6291(30)(K)), "high-

[3] A notation in the form "Intertek, Public Meeting Transcript, No. 5 at p. 121" identifies a comment that DOE has received during a public meeting and has included in the docket of this rulemaking. This particular notation refers to a comment: (1) submitted by Intertek; (2) transcribed from the public meeting in document number 5 of the docket, and (3) appearing on page 121 of that document.

[4] A notation in the form "NEMA, No. 6 at p. 8" identifies a written comment that DOE has received and included in the docket of this rulemaking. This particular notation refers to a comment: (1) submitted by National Electric Manufacturer's Association; (2) in document number 6 of the docket; and (3) on page 8 of that document.

intensity discharge lamp" (42 U.S.C. 6291(46)), "mercury vapor lamp" (42 U.S.C. 6291(47)(A)), and "metal halide lamp" (42 U.S.C. 6291(63)). 76 FR 77914, 77917–18 (Dec. 15, 2011). These EPCA definitions remain unchanged by this SNOPR.

As explained in section II.B.1 of this SNOPR, DOE proposed to establish definitions of "beam angle," "directional lamp," "high-pressure sodium lamp," "lamp electrical power input," "lamp efficacy," "lamp wattage," "lumen maintenance," "rated luminous flux or rated lumen output," and "self-ballasted lamp" in the December 2011 TP NOPR. Many of the proposed definitions were identical or very similar to the definitions set forth in 10 CFR part 430 for consumer products. Since the publication of the December 2011 TP NOPR, DOE has determined that changes are warranted for some of the proposed definitions, and that others are not necessary (("beam angle," "lamp electrical power input," "lumen maintenance," and "rated luminous flux or rated lumen output") to include in the test procedures for HID lamps.

As discussed in sections II.B.2 and II.B.3 of this SNOPR, respectively, DOE also proposed in the December 2011 TP NOPR to amend the definition of "ballast efficiency" and to establish a definition of "basic model" for HID lamps. In this SNOPR, DOE withdraws the amendment proposed in the December 2011 TP NOPR and proposes to retain the existing definition of "ballast efficiency." In addition, DOE proposes revisions to the definition of "basic model" for HID lamps set forth in the December 2011 TP NOPR.

1. Definitions Relevant to High-Intensity Discharge Lamps

a. Beam Angle

In the December 2011 TP NOPR, DOE proposed to define "beam angle" as "the beam angle (or angles) as measured according to the requirements of ANSI C78.379, including complex beam angles as described in ANSI C78.379." 76 FR 77914, 77917 (Dec. 15, 2011). In comments on the NOPR, NEMA agreed with the proposed definition of beam angle (NEMA, No. 6 at p. 4), and DOE received no other comments supporting or opposing this proposed definition. DOE notes, however, that, as stated in the April 2013 HID lamps energy conservation standards (ECS) Interim Analysis public meeting. DOE is not considering standards for directional lamps in the HID lamps energy conservation standards (Docket No. EERE-2010-BT-STD-0043, DOE, Public Meeting Transcript, No. 23, at p. 18).[5] For this reason, in this SNOPR, DOE withdraws the proposed definition of "beam angle" in the HID test procedures.

b. Color Rendering Index

In the December 2011 TP NOPR, DOE proposed to adopt a definition of "color rendering index" (CRI) based on the EPCA definition of the same term. 76 FR 77914, 77917 (Dec. 15, 2011); see also 42 U.S.C. 6291(30)(J). The proposed definition was adopted from 10 CFR 430.2, which defines CRI as "the measured degree of color shift objects undergo when illuminated by a light source as compared with the color of those same objects when illuminated by a reference

[5] A notation in this form provides a reference for information that is in the docket of DOE's "Energy Conservation Program for Certain Commercial and Industrial Equipment: Energy Conservation Standards for High-Intensity Discharge Lamps" (Docket No. EERE-2010-BT-STD-0043), which is maintained at www.regulations.gov. This notation indicates that the statement preceding the reference is document number 00023 in the docket for the metal halide lamp ballasts test procedures rulemaking, and appears at page 18 of that document.

source of comparable color temperature."[6]. DOE received no comments supporting or opposing this proposed definition and maintains the proposal for this SNOPR.

c. Correlated Color Temperature

In the December 2011 TP NOPR, DOE proposed to adopt the EPCA definition of "correlated color temperature" (CCT) (42 U.S.C. 6291(30)(K)), which defines the term as "the absolute temperature of a blackbody whose chromaticity most nearly resembles that of the light source." 76 FR 77914, 77917 (Dec. 15, 2011). DOE received no comments supporting or opposing this proposed definition and maintains the proposal for this SNOPR.

d. Directional Lamp

In the December 2011 TP NOPR, DOE proposed to define "directional lamp" as "a lamp emitting at least 80 percent of its light output within a solid angle of π steradians (corresponding to a cone with an angle of 120 degrees)." 76 FR 77914, 77917 (Dec. 15, 2011). NEMA agreed with the proposed definition of directional lamp. (NEMA, No. 6 at p. 4) DOE received no other comments supporting or opposing the proposed definition. DOE proposes to modify the definition to also incorporate the construction of the lamp. DOE proposes a revised definition of "directional lamp" as "a lamp with an integral reflector, emitting at least 80 percent of its light output within a solid angle of π steradians (corresponding to a cone with an angle of 120 degrees)" in this SNOPR to clarify the lamp type that DOE is considering excluding from

[6] The definitions of "color rendering index" in EPCA and 10 CFR 430.2 are substantively identical, excluding a minor wording difference. The EPCA definition uses the phrase "measure of the degree of color shift" whereas the CFR definition uses the phrase "measured degree of color shift." 42 U.S.C. 6291(30)(J); 10 CFR 430.2.

coverage in the ongoing HID lamps standards rulemaking (Docket No. EERE-2010-BT-STD-0043).

e. Initial Lumen Output

In this SNOPR, DOE proposes to add a definition of "initial lumen output" to provide additional clarity. Initial lumen output is the measured amount of light that a lamp provides at the beginning of its life. An initial lumen output measurement is required to calculate lamp efficacy. Therefore, DOE proposes a definition of "initial lumen output" as "the measured lumen output after the lamp is seasoned, then initially energized and stabilized, using the lamp seasoning and stabilization procedures in section 10 CFR 431.454(b)(1)."[7]

f. High-Pressure Sodium Lamp

In the December 2011 TP NOPR, DOE proposed to define "high-pressure sodium lamp" (HPS) as "a high-intensity discharge lamp in which the major portion of the light is produced by radiation from sodium vapor operating at a partial pressure of about 6,670 pascals (approximately 0.066 atmospheres or 50 torr) or greater." 76 FR 77914, 77917 (Dec. 15, 2011). NEMA agreed with the proposed definition of "high-pressure sodium lamp" (NEMA, No. 6 at p. 5), and DOE received no other comments supporting or opposing this proposed definition. Therefore, DOE retains this definition in this SNOPR.

[7] 10 CFR 431.454(b)(1) is a new section proposed by this SNOPR.

g. Lamp Efficacy

In the December 2011 TP NOPR, DOE proposed a definition for "lamp efficacy" similar to that set forth at 10 CFR part 430, subpart B, appendix R,[8] where "lamp efficacy" is defined as "the ratio of measured lamp lumen output in lumens to the measured lamp electrical power input in watts, rounded to the nearest tenth, in units of lumens per watt." DOE proposed to replace "lamp lumen output" with "rated luminous flux or rated lumen output" and to add the abbreviation "lm/W" after "lumens per watt." DOE further stated that the term "rated luminous flux or rated lumen output" is consistent with DOE's proposed definition for "lumen maintenance," and means the same thing as "lamp lumen output." Therefore, DOE proposed a definition for "lamp efficacy" as follows: "the ratio of rated lumen output (or rated luminous flux) to the measured lamp electrical power input in watts, rounded to the nearest tenth, in units of lumens per watt (lm/W)." 76 FR 77914, 77918 (Dec. 15, 2011).

NEMA disagreed with DOE's use of "rated luminous flux or rated lumen output" as an equivalent to "measured lamp lumen output," stating that the terms "rated" and "measured" are not interchangeable. (NEMA, No. 6 at pp. 2, 5) NEMA suggested that DOE instead use the definition for lamp efficacy in IES RP-16-10, "Nomenclature and Definitions for Illuminating Engineering" (RP-16). (NEMA, No. 6 at p. 5) NEMA refined its comments during the March 2012 framework public meeting for the HID lamps energy conservation standards (herein referred to as the March 2012 ECS public meeting), stating that upon a second review of RP-16,

[8] 10 CFR 430.2 defines lamp efficacy as "the measured lumen output of a lamp in lumens divided by the measured lamp electrical power input in watts expressed in units of lumens per watt (LPW)." 10 CFR part 430, subpart B, appendix R defines "lamp efficacy" as "the ratio of measured lamp lumen output in lumens to the measured lamp electrical power input in watts, rounded to the nearest tenth, in units of lumens per watt." The primary difference between the definitions is the rounding of the values.

"lamp efficacy" is not defined, but "luminous efficacy" is defined, and encouraged DOE to use "luminous efficacy" as the appropriate term. (Docket No. EERE-2010-BT-STD-0043, NEMA, Public Meeting Transcript, No. 6 at p. 40) The RP-16 definition for "luminous efficacy of a source of light" is "…the quotient of the luminous flux emitted by the total lamp power input. It is expressed in lm/W."

DOE acknowledges that "lamp efficacy" is not defined in RP-16, but notes that "lamp efficacy," rather than "luminous efficacy," is used for all other covered lamps and is the common term in the lighting industry. Therefore, in this SNOPR, DOE proposes to keep the term "lamp efficacy," but to revise the definition proposed in the December 2011 TP NOPR.

DOE acknowledges NEMA's statement that a rated value is a value declared by the manufacturer to represent the long-term average of any given parameter. (NEMA, No. 6 at p. 2) DOE proposes to revise the definition of "lamp efficacy" to be consistent with the definition of "lamp efficacy" in EPCA and simply use the terms "lumen output" and "wattage." DOE includes additional language in its test procedures that qualifies lamp lumen output and wattage as "measured."

The proposed definition for "lamp efficacy" in the December 2011 TP NOPR specified that efficacy values (lumens per watt) be rounded to the nearest tenth. Lamp manufacturers OSRAM SYLVANIA and Philips Electronics (Philips) commented that HID lamp measurements vary widely because of the lamp chemistry used in HID lamps, the operating characteristics of high-lumen-output HID lamps, and the sheer light output of HID lamps (ranging from a few

thousand to over a hundred thousand lumens), and stated that rounding calculated efficacies to the nearest tenth implies a measurement accuracy that is not achievable. (OSRAM SYLVANIA, Public Meeting Transcript, No. 5 at p. 32; Philips, Public Meeting Transcript, No. 5 at p. 32) NEMA agreed with OSRAM SYLVANIA and Philips that rounding to the nearest tenth (of a lumen per watt) is inappropriate for HID lamps because of the large potential for measurement variation. NEMA also commented that rounding of lamp efficacy values should be addressed in reporting requirements rather than the definition. (NEMA, No. 6 at p. 5)

DOE's proposed definition for "lamp efficacy" was based on the definition in the test procedures for general service fluorescent lamps, general service incandescent lamps, and incandescent reflector lamps (GSFL/GSIL/IRL) at 10 CFR part 430, subpart B, appendix R. For GSFL/GSIL/IRL, rounding lamp efficacy values to the nearest tenth is appropriate given the equipment and instrumentation used to measure lumen output and lamp wattage for these lamp types. Because the same equipment and instrumentation is used to measure these quantities for HID lamps, DOE believes lamp efficacy for HID lamps should also be rounded to the nearest tenth of a lumen per watt. DOE agrees with NEMA, however, that rounding requirements should not be part of the definition of lamp efficacy, and believes that rounding should instead be addressed in any future reporting requirements for HID lamps.

DOE notes that manufacturers have commented that HID lamps exhibit more measurement variation than other lighting technologies. DOE plans to account for measurement variation in the energy conservation standards rulemaking for HID lamps and welcomes comments on sources of measurement variation and any supporting data in that rule process.

DOE reviewed comments received on the December 2011 TP NOPR as well as alternative definitions of lamp efficacy. To be consistent with EPCA, DOE proposes to revise the definition of "lamp efficacy" for HID lamps as follows: "the lumen output of a lamp divided by its wattage, expressed in lumens per watt (LPW)."

h. Lamp Electrical Power Input

In the December 2011 TP NOPR, DOE proposed to define "lamp electrical power input" as "the total electrical power input to the lamp, including both arc and cathode power where appropriate, at the reference condition, in units of watts." 76 FR 77914, 77918 (Dec. 15, 2011). This definition is the same as that set forth at 10 CFR part 430, subpart B, appendix R.

NEMA disagreed with the proposed definition, noting that HID lamps do not have cathodes (or use cathode power), and that arc power constitutes total lamp input power. (NEMA, Public Meeting Transcript, No. 5 at pp. 44–45) DOE received no other comments related to the proposed definition.

DOE acknowledges that arc power constitutes total lamp electrical power input for HID lamps. "Lamp electrical power input" is therefore the same as "lamp wattage," which DOE also defined in the December 2011 TP NOPR. 76 FR 77914, 77918 (Dec. 15, 2011). As discussed earlier in this document, DOE proposes to use the term "lamp wattage" instead of "lamp electrical power input" in its revised definition for "lamp efficacy." Therefore, in this SNOPR,

DOE withdraws the proposed definition of "lamp electrical power input" for HID lamps as proposed in the December 2011 TP NOPR. Id.

i. Lamp Wattage

In the December 2011 TP NOPR, DOE proposed to define "lamp wattage" as "the total electrical power required by a lamp in watts, measured following the initial aging period referenced in the relevant industry standard." The proposed definition interpreted the EPCA definition of "lamp wattage" for this rulemaking. 76 FR 77914, 77918 (Dec. 15, 2011); see also 42 U.S.C. 6291(30)(O).[9] NEMA agreed with the proposed definition of lamp wattage. (NEMA, No. 6 at p. 5) DOE received no other comments supporting or opposing this proposed definition.

In this SNOPR, DOE proposes to modify its original proposed definition of "lamp wattage" to more closely parallel the EPCA definition of "lamp wattage," and to reference the applicable IES lamp seasoning provisions required to support lamp wattage measurements. Specifically, DOE proposes to replace "measured following the initial aging period referenced in the relevant industry standard" with "after the initial seasoning period referenced in section 6.2.1 of IES LM-51-13."

Therefore, DOE proposes in this SNOPR to define "lamp wattage" as "the total electrical power consumed by a lamp in watts, after the initial seasoning period referenced in section 6.2.1 of IES LM-51-13."

[9] The EPCA definition for "lamp wattage" is "the total electrical power consumed by a lamp in watts, after the initial seasoning period referenced in the appropriate IES standard test procedures and including, for fluorescent, arc watts plus cathode watts."

As previously discussed in this SNOPR, DOE is proposing a new definition of "lamp efficacy" in which the term "measured lamp electrical power in watts" is replaced with "wattage." DOE defined "lamp wattage" in the December 2011 TP NOPR and interprets it as equivalent to the term "wattage."

j. Lumen Maintenance

In the December 2011 TP NOPR, DOE proposed to define "lumen maintenance" as "the luminous flux or lumen output at a given time in the life of the lamp and expressed as a percentage of the rated luminous flux or rated lumen output, respectively." 76 FR 77914, 77918 (Dec. 15, 2011). This definition is the same as that set forth for medium-base compact fluorescent lamps (CFLs) at 10 CFR part 430, subpart B, appendix W, section (2)(c).

Pacific Gas and Electric Company, San Diego Gas and Electric, Southern California Gas Company, and Southern California Edison (herein referred to as the California Investor Owned Utilities (CA IOUs)), together with the Appliance Standards Awareness Project, American Council for an Energy-Efficient Economy, and the Natural Resources Defense Council jointly filed a comment (herein referred to as the Joint Comment) that supported measuring lumen maintenance for HID lamps, but did not comment specifically on the proposed definition. (CA IOUs, No. 8 at p. 1; Joint Comment, No. 9 at p. 1) NEMA disagreed with the definition, citing inconsistent references to measured and rated values. NEMA disagreed with DOE's use of "rated luminous flux or rated lumen output" as an equivalent to "measured lamp lumen output," stating that the terms "rated" and "measured" are not interchangeable. According to NEMA, because

measured values were expected to be reported, possible confusion and misreporting could arise if rated values were reported instead. (NEMA, No. 6 at pp. 2, 5–6)

DOE no longer proposes to measure lumen maintenance. Therefore, in this SNOPR, DOE withdraws the proposed definition of "lumen maintenance" for HID lamps as proposed in the December 2011 TP NOPR. 76 FR 77914, 77918 (December 15, 2011).

k. Rated Luminous Flux or Rated Lumen Output

In the December 2011 TP NOPR, DOE proposed to define "rated luminous flux or rated lumen output" as "the initial lumen rating (100 hour) declared by the manufacturer, which consists of the lumen rating of a lamp at the end of 100 hours of operation." This is the same definition set forth for medium-base CFLs at 10 CFR part 430, subpart B, appendix W, section (2)(d), and proposed in the December 2011 TP NOPR. 76 FR 77914, 77918 (Dec. 15, 2011). NEMA agreed with the proposed definition of "rated luminous flux or rated lumen output." (NEMA, No. 6 at p. 4) DOE received no other comments supporting or opposing this proposed definition.

DOE has removed the term "rated luminous flux or rated lumen output" from the proposed definition of "lamp efficacy" in this SNOPR. Therefore, in this SNOPR, DOE proposes to withdraw the proposed definition of "rated luminous flux or rated lumen output" for HID lamps as proposed in the December 2011 TP NOPR. 76 FR 77914, 77918 (Dec. 15, 2011).

l. Self-Ballasted Lamp

In the December 2011 TP NOPR, DOE proposed to define "self-ballasted lamp" as "a lamp unit that incorporates all elements that are necessary for the starting and stable operation of the lamp in a permanent enclosure and that does not include any replaceable or interchangeable parts." 76 FR 77914, 77918 (Dec. 15, 2011).[10] NEMA agreed with the proposed definition, and DOE received no other comments supporting or opposing this proposed definition. (NEMA, No. 6 at p. 4) Therefore, DOE retains the December 2011 TP NOPR proposed definition in this SNOPR.

2. Definition of "Ballast Efficiency" for Metal Halide Lamp Fixtures

In the December 2011 TP NOPR, DOE proposed an amended definition of "ballast efficiency" for HID fixtures, currently set forth at 10 CFR 431.322. 76 FR 77914, 77918 (Dec. 15, 2011). Currently, "ballast efficiency" for an HID fixture means, in relevant part, "the efficiency of a lamp and ballast combination, expressed as a percentage, and calculated in accordance with the following formula:

Efficiency = P_{out}/P_{in}

where:

(1) P_{out} equals the measured operating lamp wattage;

(2) P_{in} equals the measured operating input wattage…"

10 CFR 431.322

[10] This definition is based in part on the definition of "self-ballasted CFL lamp" found at 10 CFR part 430, subpart B, appendix W, section (2)(h).

In the December 2011 TP NOPR, DOE noted that the definition of the term "P_{out}" is the same as the definition DOE proposed for "lamp electrical power input." In order to avoid possible confusion between "P_{out}" and "lamp electrical power input," DOE proposed in the December 2011 TP NOPR to amend the definition of "ballast efficiency" as follows: "'Ballast efficiency' means, in the case of a high-intensity discharge fixture, the efficiency of a lamp and ballast combination, expressed as a percentage, and calculated in accordance with the following formula:

Efficiency = Lamp electrical power input / ballast power input

where:

(1) Lamp electrical power input means the total electrical power input to the lamp, including both arc and cathode power where appropriate, at the reference condition, in units of watts;

(2) Ballast power input equals the measured operating input wattage…"

76 FR 77914, 77198 (Dec. 15, 2011).

NEMA commented that the proposed definition would produce inaccurate results for ballast efficiency because the lamp and ballast power inputs are measured at reference and non-reference conditions, respectively. (NEMA, No. 6 at pp. 6–7) DOE received no other comments related to the proposed definition of "ballast efficiency."

Upon review, DOE determined that HID lamp testing and MH lamp ballast testing are conducted separately, which effectively eliminates any overlap and confusion of electrical power terms. As discussed earlier in this document, DOE proposes to use the term "wattage" instead of

"lamp electrical power input" in its revised definition for "lamp efficacy." Therefore, in this SNOPR, DOE withdraws the proposed definition of "lamp electrical power input" for HID lamps. In addition, DOE acknowledges that testing inaccuracies could arise from the proposed definition for "ballast efficiency," which was intended to prevent confusion between the terms "P_{out}" and "lamp electrical power input." Because HID lamp testing and MH lamp ballast testing are conducted separately and DOE no longer proposes to define "lamp electrical power input," this potential confusion should not materialize. Therefore, DOE is not proposing to amend the current definition of "ballast efficiency" at 10 CFR 431.322 in this SNOPR.

3. Definition of "Basic Model" for High-Intensity Discharge Lamps

In the December 2011 TP NOPR, DOE proposed defining "basic model" for the HID lamp test procedures as follows: "'Basic model' with respect to HID lamps means all units of a given type of covered equipment (or class thereof) manufactured by one manufacturer, having the same primary energy source and which have essentially identical electrical, physical, and functional (or hydraulic) characteristics that affect energy consumption, energy efficiency, water consumption, or water efficiency, and are rated to operate a given lamp type and wattage." 76 FR 77914, 77918 (Dec. 15, 2011).[11]

NEMA commented that the definition of "basic model" should be addressed in the HID lamps standards, and not the test procedures. (NEMA, Public Meeting Transcript, No. 5 at p. 32) Because provisions regarding the definition of basic model relate closely to the sampling plan

[11] DOE discussed the concept of "basic model" extensively in the September 2010 NOPR for certification, compliance, and enforcement (September 2010 CC&E NOPR). 75 FR 56796, 56798–99 (Sept. 16, 2010). DOE provided additional discussion and responded to comments received related to the September 2010 CC&E NOPR in the March 2011 certification, compliance, and enforcement final rule. 76 FR 12422, 12428–30 (March 7, 2011).

and test burdens that the test procedures address, DOE addresses the definition of basic model in its test procedures rulemaking. DOE will consider comments submitted to the ongoing HID lamps standards rulemaking (Docket No. EERE-2010-BT-STD-0043) to develop the definition of "basic model," and DOE will use the same definition of "basic model" in the standards rulemaking.

At the January 2012 TP public meeting, General Electric (GE) commented that the terms "hydraulic" or "water consumption" in the definition of "basic model" for HID lamps are potentially confusing and should be removed. (GE, Public Meeting Transcript, No. 5 at p. 33) In response to GE's comment, DOE reviewed the definition of "basic model" for MH lamp fixtures at 10 CFR 431.322. The definition of "basic model" at 10 CFR 431.322 is the same as the definition that DOE proposed in the December 2011 TP NOPR. DOE also reviewed the "basic model" definition for GSFL/GSIL/IRL at 10 CFR 430.2 and notes that this definition of basic model is general and applies to faucets and showerheads in addition to the various lamp types. But DOE acknowledges that the terms identified by GE may cause confusion with respect to HID lamps. DOE also notes that the definition of "basic model" proposed in the December 2011 TP NOPR contains the phrase "and are rated to operate a given lamp type and wattage," which applies to lamp ballasts (i.e., for MH lamp fixtures in 10 CFR 431.322), but does not apply to HID lamps. Further, DOE notes that "efficacy" is a more appropriate term for describing the energy efficiency of HID lamps than the term "energy efficiency" used in the proposed definition of "basic model." To more accurately characterize HID lamps, DOE proposes to remove the phrase "and are rated to operate a given lamp type and wattage" from the definition of "basic

model," and revise the remaining text by replacing the term "energy efficiency" with the term "efficacy."

Therefore, in this SNOPR, DOE proposes to define "basic model" for HID lamp test procedures to read as follows: "'Basic model' means all units of a given type of covered equipment (or class thereof) manufactured by one manufacturer, that have the same primary energy source, and that have essentially identical electrical, physical, and functional characteristics that affect energy consumption or efficacy."

C. Test Procedures for Measuring Energy Efficiency of High-Intensity Discharge Lamps

1. Test Setup and Conditions

DOE has determined that changes are warranted for certain test setup and condition requirements proposed in the December 2011 TP NOPR. In the discussion that follows, DOE describes the December 2011 TP NOPR proposals for ambient conditions, power supply characteristics, reference ballasts, and instrumentation. DOE also describes the changes being proposed in this SNOPR and notes those provisions that remain unaffected.

a. Ambient Conditions

In the December 2011 TP NOPR, DOE proposed a requirement that the test apparatus be operated in a location where ambient conditions (e.g., ambient temperature) are stable. 76 FR 77914, 77919 (Dec. 15, 2011). As described in the following paragraphs, in this SNOPR, DOE proposes to revise certain specifications necessary to meet the requirement for stable ambient conditions.

i. Ambient Test Temperature

In the December 2011 TP NOPR, DOE proposed an ambient temperature requirement of 25 °C ±5 °C for HID lamp testing in accordance with ANSI C78.389. 76 FR 77914, 77919 (Dec. 15, 2011). This is the industry standard temperature for testing most ballasted and non-ballasted light sources (both HID and other lamp types). It is also the temperature required by the MH lamp ballast TP final rule, wherein DOE stated that ambient temperature is not critical to MH lamp operation and light output, but can affect lamp electrical performance. 75 FR 10950, 10956 (March 9, 2010).

NEMA agreed with the proposed ambient test temperature for HID lamps (25 °C ±5 °C), but noted that other lamp types have a ±1 °C tolerance for photometric testing. (NEMA, No. 6 at p. 7) OSRAM SYLVANIA commented that, unlike fluorescent lamps, HID lamps are not significantly affected by ambient temperature. OSRAM SYLVANIA also stated that the ambient temperature required in IES standard LM-51 is intended to benefit the measurement instrumentation, which is more sensitive to ambient temperature variations than the HID lamps being tested. (OSRAM SYLVANIA, Public Meeting Transcript, No. 5 at pp. 49, 54)

DOE reviewed applicable ANSI and IES documents for testing discharge lamps (fluorescent and HID) and fixtures. Table II.1 compares the recommended ambient test temperatures from these documents.

Table II.1 Comparison of Recommended Ambient Test Temperatures

Document	Light Source	Ambient Test Temperature
LM-51-13, "IESNA Approved Method for the Electrical and Photometric Measurements of High-Intensity Discharge Lamps"	HID	25 °C ±5 °C
LM-73-04 (R2010), "IESNA Approved Method for Photometric Testing of Entertainment Lighting Luminaires Using Incandescent Filament Lamps or High Intensity Discharge Lamps"	HID	25 °C ±5 °C
ANSI C78.389, "American National Standard for Electric Lamps – High Intensity Discharge – Methods of Measuring Characteristics"	HID	25 °C ±5 °C
LM-09-09, "Electrical and Photometric Measurements of Fluorescent Lamps"	Fluorescent	25 °C ±1 °C
LM-66-11, "Electrical and Photometric Measurements of Single-Ended Compact Fluorescent Lamps"	Fluorescent	25 °C ±1 °C
ANSI C78.375 – 1997, "American National Standard for Fluorescent Lamps – Guide for Electrical Measurements"	Fluorescent	25 °C ±1 °C

DOE acknowledges that for fluorescent sources, the tolerance in these documents for ambient test temperature is ±1 °C. DOE also agrees with OSRAM SYLVANIA that ambient temperature is not critical to HID lamp operation and light output. Therefore, in this SNOPR, DOE retains the ambient temperature and tolerance of 25 °C ±5 °C proposed in the December 2011 TP NOPR. However, as discussed in section II.C.1.a.ii, DOE proposes referencing the 25 °C ±5 °C requirement in IES LM-51-13 based on the absence of the associated maximum air speed requirement.

ii. Air Speed

In the December 2011 TP NOPR, DOE proposed a specific air speed limit of ≤0.5 meters per second (m/s) for HID lamp testing because the ANSI C78.389 requirement for "draft-free" conditions is unclear because no definition of the term "draft-free" is provided in the standard. In the MH lamp ballast TP final rule, DOE researched different air speed limits from different test procedures and adopted an air speed limit of ≤0.5 m/s. 75 FR 10950, 10956 (March 9, 2010). In

its comments on the December 2011 TP NOPR, OSRAM SYLVANIA stated that air speed is relevant for ballast measurements, but not for HID lamps. OSRAM SYLVANIA elaborated by stating that the typical "lamp within a lamp" construction of HID lamps (i.e., arc tube within an outer glass envelope) makes them insensitive to ambient air movement. (OSRAM SYLVANIA, Public Meeting Transcript, No. 5 at pp. 47–50) NEMA agreed with this assessment. (NEMA, No. 6 at p. 8)

In the December 2011 TP NOPR, DOE reviewed LM-51-13, ANSI C78.389, and LM-73-04 for the ambient test temperature requirements discussed previously. Table II.2 provides the review of air speed limits for HID lamp and fixture testing.

Table II.2 Comparison of Air Speed Limits for HID Lamp and Fixture Testing

Document	Air Speed Requirements
LM-51-13, "IESNA Approved Method for the Electrical and Photometric Measurements of High-Intensity Discharge Lamps"	No special precautions against normal room air movement are necessary
LM-73-04 (R2010), "IESNA Approved Method for Photometric Testing of Entertainment Lighting Luminaires Using Incandescent Filament Lamps or High Intensity Discharge Lamps"	None specified
ANSI C78.389, "American National Standard for Electric Lamps – High Intensity Discharge – Methods of Measuring Characteristics"	Draft free

DOE agrees with OSRAM SYLVANIA and NEMA that HID lamps are typically insensitive to ambient air movement because the light-generating component of the lamp (i.e., the arc tube) is physically isolated from the surrounding environment by an outer glass envelope, effectively eliminating any convection cooling. Therefore, in this SNOPR, DOE proposes not to prescribe an explicit air speed limit in the HID lamps test procedures. Instead, DOE proposes to incorporate by reference section 4.3 of LM-51-13, which specifies that no special precautions against normal air movement are necessary in HID lamp test procedures.

b. Power Supply Characteristics

In the December 2011 TP NOPR, DOE proposed power supply characteristics (voltage waveshape, voltage regulation, and power supply impedance) for the HID lamps test procedures based on ANSI C78.389 and LM-51. 76 FR 77914, 77919 (Dec. 15, 2011). NEMA agreed with DOE's proposal (NEMA, No. 6 at p. 8), and DOE received no other comments on these characteristics. As a result, the power supply characteristics are not affected by this SNOPR.

c. Reference Ballasts

In the December 2011 TP NOPR, DOE proposed to adopt the reference ballast requirements of ANSI C78.389 for HID lamp testing. Based on a review of industry literature, communication with independent testing laboratories, and comments from industry, DOE determined that reference ballasts are readily available and that their use is likely to provide repeatable and consistent measurements. 76 FR 77914, 77920 (Dec. 15, 2011). In this SNOPR, DOE addresses several comments and questions received in response to the December 2011 TP NOPR regarding: (1) lamps for electronic ballasts only; (2) self-ballasted lamps; (3) multi-start type ballasts; and (4) effects of lamp orientation (position) on reference ballasts. Each of these items is discussed herein.

i. Lamps for Electronic Ballasts Only

In a written comment, the CA IOUs suggested that DOE develop reference specifications for lamps that can operate only on electronic ballasts. (CA IOUs, No. 8 at p. 3) During the January 2012 TP public meeting, GE commented that HID lamps currently designed to operate

only on electronic ballasts do not have reference ballasts. (GE, Public Meeting Transcript, No. 5 at p. 63) NEMA encouraged DOE not to attempt to define reference ballasts where they do not exist because of potential conflicts with ongoing industry efforts. NEMA also stated that lamps for which there are no ANSI standard ballasts should be measured in accordance with the manufacturer's guidance. (NEMA, No. 6 at p. 8)

DOE acknowledges that currently there are no reference ballasts for lamps operating only with electronic ballasts. HID lamps operating only with electronic ballasts are a new and emerging technology and represent an insignificant portion of the market. Current manufacturer guidance for testing these types of lamps is inconsistent or incomplete, and the industry has not yet developed standard testing guidance. Therefore, in this SNOPR DOE does not propose test procedures for lamps that only can be operated with electronic ballasts.

ii. Self-Ballasted Lamps and Reference Ballasts

During the January 2012 TP public meeting, GE commented that self-ballasted lamps do not have reference ballasts. (GE, Public Meeting Transcript, No. 5 at p. 63). In the December 2011 TP NOPR, DOE did not require reference ballasts for self-ballasted HID lamps. DOE further notes that in the April 2013 HID lamps ECS Interim Analysis public meeting, DOE is not considering standards for self-ballasted HID lamps (Docket No. EERE-2010-BT-STD-0043, DOE, Public Meeting Transcript, No. 23, at p. 18). Therefore, DOE is not proposing test procedures for self-ballasted HID lamps.

iii. Reference Ballasts for Multi-Start Type Metal Halide Lamps

During the January 2012 TP public meeting, the CA IOUs questioned whether the December 2011 TP NOPR provided enough guidance for testing multi-start type HID lamps that can operate on multiple ballast types (e.g., pulse-start or probe-start). (CA IOUs, Public Meeting Transcript, No. 5 at p. 69−70). OSRAM SYLVANIA explained that the lamp type indicates usage. For example, a pulse-start MH lamp designed as a direct replacement for probe-start lamps may have a reference ballast with probe-start characteristics. (OSRAM SYLVANIA, Public Meeting Transcript, No. 5 at p. 70) In this SNOPR, DOE provides clarification on reference ballast characteristics for multi-start type MH lamps.

DOE reviewed manufacturer catalog data sheets and found that manufacturers of multi-start type MH lamps identify the ANSI lamp designations that the lamps have been designed to replace (e.g., M58, M138, M153, C184). ANSI lamp designation data sheets include the characteristics of reference ballasts to be used with the specific lamp (i.e., rated input voltage, reference current, and impedance).

DOE also reviewed independent testing of multi-start type MH lamps conducted by the California Lighting Technology Center (CLTC), which directly compared the measured performance of ten 205-watt multi-start type MH lamps operated by a pulse-start ballast (for lamps designated M153) and ten 205-watt multi-start type MH lamps operated by a probe-start ballast (for lamps designated M58). The results of CLTC testing indicated that, for pulse-start operation, the mean values for lamp power and light output were 7 percent and 6 percent higher,

respectively, than for probe-start operation. The mean value for lamp efficacy for pulse-start operation was within 1 percent of that for probe-start operation (see Table II.3).[12]

Table II.3 Comparison of 205-W Multi-Start Lamp Operated on Both a Probe-Start and Pulse-Start Ballast

Operating Type Ballast	Light Output lumens	Lamp Power watts	Lamp Efficacy lm/W
Pulse-Start Ballast	21,524	221	97
Probe-Start Ballast	20,344	207	98

CLTC's limited testing of multi-start type lamps suggests that these lamps provide nearly identical efficacy with probe-start and pulse-start operation. However, DOE recognizes that clear guidance is needed for selecting reference ballast characteristics from multiple compatible ANSI lamp designations. In this SNOPR, DOE proposes that multi-start type HID lamps be tested using the characteristics for a compatible probe-start ballast. DOE proposes that the probe-start ANSI lamp designation data sheets be the primary source of reference ballast characteristics used for testing multi-start type HID lamps, due to the greater prevalence of existing probe-start MH systems.[13] Given that multi-start type MH lamps are primarily intended for use in existing systems, DOE believes that probe-start operation is most representative of actual operation for multi-start type MH lamps.

Most of the ANSI lamp designation codes referenced in the manufacturer literature for multi-start type MH lamps are included in ANSI C78.43-2013, "ANSI Standard for Electric

[12] California Energy Commission's Public Interest Energy Research Program, Philips Energy Advantage CDM lamps with AllStart™ Technology. June 2011. Sacramento, CA. http://cltc.ucdavis.edu/sites/default/files/files/publication/20110600-pier-philips-hid-lamp-test.pdf

[13] Probe-start represents the majority of MH lamp shipments in 2008, and then starts to decline. Based on NEMA's historical lamp shipments, the DOE shipments model estimates that the installed stock of probe-start MH systems remain in the majority in 2017. See sections 10.2.1 and 10.3.1.3 of chapter 10 (shipments) of the HID ECS interim analysis TSD at: http://www.regulations.gov/#!documentDetail;D=EERE-2010-BT-STD-0043-0016.

Lamps: Single-Ended Metal Halide Lamps." These lamp designations (e.g., M58, M138, M165, C185) are assigned sequentially, with lower numbers indicating older lamp types. DOE proposes that multi-start type MH lamps be tested on a reference ballast compatible with a probe-start ANSI lamp designation with the lowest ANSI lamp designation. DOE believes this proposed approach best encompasses and represents actual operation on a variety of older and newer probe-start ballast types. If no probe-start ANSI lamp designation is listed by the manufacturer, DOE proposes the lamps be tested on a reference ballast with characteristics of the lowest ANSI lamp designation listed. For example, if a lamp is advertised as a multi-start type lamp, but the catalog or data sheet only lists compatible ballast codes of M128, M135, and M172 (all pulse-start ballasts), the lamp would be tested with a reference ballast with characteristics matching M128 (the lowest code listed).

In summary, DOE proposes in this SNOPR that the multi-start type MH lamps be tested on a reference ballast with the characteristics defined in the equivalent probe-start ANSI lamp designation as listed in the lamp catalog or manufacturer data sheets with the lowest ANSI lamp designation. If no probe-start ANSI lamp designation is listed by the manufacturer, DOE then proposes that the lamp be tested on a reference ballast with the characteristics defined in the lowest ANSI lamp designation listed.

iv. Lamp Orientation and Reference Ballasts

The CA IOUs commented that it was unclear in ANSI C82.5 whether lamp orientation had any bearing on the selection of reference ballasts. (CA IOUs, Public Meeting Transcript, No. 5 at p. 72) Philips noted that lamp orientation does not affect the choice of reference ballast to be

used since the lamp operating position does not change the HID lamp wattage. (Philips, Public Meeting Transcript, No. 5 at p. 74) The electrical properties of the lamp are intrinsic to the lamp; as a result, they should not differ based on lamp orientation. Because lamp orientation does not affect lamp wattage, DOE does not propose to specify lamp orientation for the selection of reference ballasts.

d. Instrumentation

In the December 2011 TP NOPR, DOE proposed to adopt the electrical and photometric instrumentation requirements of ANSI C78.389 and LM-51, respectively, for its HID lamp test procedures. 76 FR 77914, 77920 (Dec. 15, 2011). The instruments proposed for electrical measurements are described in ANSI C78.389, section 3.8. DOE received no comments on these requirements, and they are unaffected by this SNOPR. The instruments proposed for photometric instruments are described in LM-51-13, section 7.0, which includes the same instruments described in LM-51-00, section 9.0, as referenced in the December 2011 TP NOPR. The proposed instrumentation requirements for photometric measurements are detailed in the following sections.

In the December 2011 TP NOPR, DOE proposed that the photometer have a relative spectral responsivity that approximates that of the human eye (i.e., the V-lambda (V(λ)) function). 76 FR 77914, 77920 (Dec. 15, 2011). DOE proposed to allow the use of either an integrating sphere or a goniophotometer for the photometric measurements. Id. DOE further proposed that photometric measurements of color characteristics be specified in terms of the CIE colorimetry system and CRI. Id.

As described in the following paragraphs, DOE proposes additional specificity for these measurements in this SNOPR, and proposes to allow only the use of an integrating sphere for the photometric measurements. DOE also clarifies, as discussed further in section II.D.3, that CRI is being considered in the HID lamps ECS rulemaking (Docket No. EERE-2010-BT-STD-0043) only to define the CRI above which standards will not be considered for HID lamps. (Docket No. EERE-2010-BT-STD-0043, DOE, Public Meeting Transcript, No. 23 at pp. 15–18)

i. Integrating Sphere

For integrating sphere measurements, DOE stated in the December 2011 TP NOPR that the spectral responsivity would take into account the relative spectral throughput of the sphere and detector spectral responsivity.[14] 76 FR 77914, 77920 (Dec. 15, 2011). DOE also stated that the detector used in an integrating sphere measurement must have a wide field of view (approximating a cosine response) to maximize the sampled area of the sphere wall during measurement. Id. If a diffuser is used on the detector, DOE proposed that its surface would need to be mounted flush with the sphere wall. Id.

DOE also proposed that an integrating sphere for luminous flux measurements must be large enough to allow the sphere's interior temperature to reach thermal equilibrium at the specified ambient temperature and to permit the internal baffle(s) to be small relative to the size of the integrating sphere. 76 FR 77914, 77920 (Dec. 15, 2011).

[14] The relative spectral throughput of an integrating sphere is the ratio of the spectral irradiance on the detector port of the sphere by a reference light source and the spectral irradiance of the same source measured outside the integrating sphere.

GE commented that NEMA members needed more detailed specifications for the integrating sphere diameter, and suggested that CIE standards might provide guidance. (GE, Public Meeting Transcript, No. 5 at p. 77) NEMA stated that it accepted DOE instrumentation requirements in principle, but requested more detailed guidance on integrating sphere diameter, suggesting that DOE reference IES LM-78-07, "IESNA Approved Method for Total Luminous Flux Measurement of Lamps Using an Integrating Sphere Photometer." (NEMA, No. 6 at pp. 8–9) DOE reviewed LM-78 and notes that sections 3.1, "Size of the Sphere," and 6.3, "Sources of Errors and Corrections," provide detailed guidance on integrating sphere diameter. DOE also reviewed CIE 84, "Measurement of Luminous Flux," and determined that those sphere size specifications are already incorporated into LM-78. Therefore, DOE proposes that luminous flux be determined as specified in section 7.0 of IES LM-51-13 and. when using an integrating sphere, determined as specified in sections 3.1 and 6.3 of IES LM-78-07.

ii. Goniophotometer

In the December 2011 TP NOPR, DOE proposed that for measurements using a goniophotometer, the detector required for intensity distribution would have a cosine response. 76 FR 77914, 77920 (Dec. 15, 2011). DOE did not receive any comments related to the use of goniophotometers in response to the 2011 TP NOPR. Because directional HID lamps are not covered in this SNOPR (see section II.C.3), DOE is revising its proposed test procedures to omit intensity measurements for directional lamps. Upon review of measurement correlation, testing burden, and relative incidence of use between goniophotometers and integrating spheres, DOE

also proposes using an integrated sphere, rather than a goniometer system, to carry out all photometric measurements of HID lamps.

While DOE recognizes that the integrating sphere and goniophotometer (a goniometer fitted with a photometer as the light detector) are both valid means of photometric measurement, DOE is concerned about the potential for a difference in the measured values. A test procedure that yields more than one possible value depending on instrumentation presents problems for certification and enforcement. If DOE and the manufacturer use different test methods, DOE could find that a lamp certified as compliant could be tested as non-compliant during a verification or enforcement proceeding. IES LM-51-13 does not explicitly specify the scanning resolution (i.e., quantity and location of measurements around the lamp). DOE also determined that further specification of the goniophotometer method is unreasonable, because the scanning resolution specification would need to be adequate for the lamp that requires the finest resolution. This would likely present an overly burdensome test method for many other lamps that could be measured at a lower resolution. In contrast, use of an integrating sphere enables photometric characteristics of the HID lamp to be determined with a single measurement. Therefore, integrating spheres are the preferred method for photometric measurement due to the reduction in time required for testing.

In consideration of the lack of measurement correlation between goniophotometers and integrating spheres and the reduced burden and much higher incidence of use of integrating spheres, DOE proposes in the SNOPR to require all photometric measurements for HID lamps to be carried out in an integrating sphere and that goniometer systems must not be used. DOE

invites interested parties to comment on the proposal to require all photometric values be measured by an integrating sphere (via photometer or spectroradiometer).

2. Lamp Selection and Setup

a. Basic Model

In the December 2011 TP NOPR, DOE proposed test procedures for HID lamp testing to determine the energy efficiency characteristics of each basic model. 76 FR 77914, 77921 (Dec. 15, 2011). As discussed in section III.A.3 of the December 2011 TP NOPR, a "basic model" is a group of lamp models that are essentially identical in design and performance. Id. The revised definition of "basic model" proposed in today's SNOPR does not change these relevant aspects. The performance characteristics proposed to be measured (e.g., lumen output, power, and CCT) must be similar for all of the lamps represented by a basic model. 76 FR 77914, 77918 (Dec. 15, 2011).

b. Sampling Plans

In the December 2011 TP NOPR, DOE proposed a HID lamp sampling method similar to that used for GSFL/GSIL/IRL at 10 CFR 429.27(a)(2)(i)–(ii), as follows.

For each basic model of HID lamps, samples of production lamps from a minimum sample size of 21 lamps are to be tested, and the results for all samples are to be averaged over a consecutive 12-month period. The manufacturer is to randomly select a minimum of three lamps from each month of production for a minimum of 7 months out of the 12-month period. If production occurs during fewer than 7 of the 12 months, the manufacturer is to randomly select

three or more lamps from each month of production, and the number of lamps selected for each month is to be distributed as evenly as practicable among the months of production to obtain a minimum sample of 21 lamps. Due to inherent uncertainty in any sample measurement, the confidence limit is set to 95 percent based on the sample's statistical t-test.[15] Any represented characteristic value of a basic model is to be based on this sample, and this characteristic value is to be no greater than the lower of:

(A) The mean of the sample, where:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

and $\bar{x}$ is the sample mean,[16]

n is the number of samples, and

x_i is the i^{th} sample;

Or,

(B) The lower 95-percent confidence limit of the characteristic value true mean divided by 0.97, where:

$$LCL = \bar{x} - t_{0.95}\left(\frac{s}{\sqrt{n}}\right)$$

and $\bar{x}$ is the sample mean,

s is the sample standard deviation,

n is the number of samples, and

[15] A t-test is used to determine if two sample groups from the same population are "statistically" different, e.g., variability of distribution about the sample mean. The t-test evaluates this statistical difference by calculating the ratio of sample group mean difference to group variance. This ratio is analogous to a signal to noise ratio: the higher the ratio, the less likely it is that the difference between the two groups is random.

[16] The characteristic value represents the individual observations within a sample.

$t_{0.95}$ is the t statistic for a 95-percent one-tailed confidence interval with n-1 degrees of freedom (from statistical tables).

76 FR 77914, 77921 (Dec. 15, 2011).

In the paragraphs that follow, DOE discusses its proposals in the December 2011 TP NOPR for sample size, statistical representation, and the divisor. DOE proposes changes to the sampling rate and lower confidence limit (LCL) as a result of comments received on the December 2011 TP NOPR.

i. Sample Size

In formulating the proposed sampling plan requirements, DOE reviewed sample size requirements for European Union (EU) testing and sample size requirements for other HID and fluorescent lighting technologies, as well as US testing and sample size regulations for other lighting technologies.

EU sample size requirements are set forth in Commission Regulation (EC) No. 245, published in the Official Journal of the European Union in 2009 (herein referred to as Commission Regulation (EC) No. 245/2009). This document includes both energy efficiency standards and testing requirements for fluorescent and HID lamps. Annex IV of the regulation defines the sample size for all lamps as a total of 20 lamps of the same model and from the same manufacturer, randomly selected. The sample must be considered to comply with the regulation if the average results of the sample do not vary from the limit, threshold, or declared values by more than 10 percent.

DOE surveyed the sample size for other covered lamps. Table II.4 compares the sample size for each of the covered lamps and the different metrics that are tested.

Table II.4 Comparison of Sample Size for Covered Lamps

CFR Citation	Lamp Type	Metric	Sample Size
10 CFR 429.27	General service incandescent and fluorescent lamps	Lamp efficacy	≥21
		CRI	
		Watts input	
		Lumens	
	General service incandescent lamps	Watts input	≥21
		CRI	
		Lumen	
		Rated lifetime	
	Incandescent reflector lamps	Lamp efficacy	≥21
10 CFR 429.35	Medium-base compact fluorescent lamps	Efficacy	≥5
		1,000-hour lumen maintenance	≥5
		Lumen maintenance	≥5
		Rapid-cycle stress test	≥6
		Average rated lamp life	≥10
10 CFR 429.40	Candelabra base and intermediate base incandescent lamps	Lamp wattage	≥21

Based on its review of sample size requirements, DOE proposed in the December 2011 TP NOPR to use a sample size of 21 for HID lamps. 76 FR 77914, 77921 (Dec. 15, 2011). NEMA stated that a sample size of 21 lamps is not appropriate for HID lamps because of the significant capital investment and electricity costs for long-term lumen maintenance testing, and that having to test 21 samples of numerous basic models (200 basic models by Philips' estimate) would further compound these costs. NEMA provided best and worst case cost estimates of $150,000 to $450,000 for testing the DOE proposed 21 samples for 50 basic models – this cost range is for both initial efficacy measurements and lumen maintenance measurements. (NEMA, No. 6 at p. 10) NEMA noted that lamp production can be interrupted based on changing demand, which could compel manufacturers to sample as many as 21 lamps from a first production run, as well as lamps from any additional runs within a 12-month reporting period. NEMA stated that

because of demand fluctuations for certain lamps, some lamps may not have continuous (or multiple) production runs within the same calendar year. Therefore, manufacturers might test 21 lamps in the first production run to meet the proposed sample size requirement, in case future production runs of that lamp type did not occur in that year. NEMA suggested that, to meet DOE's proposed monthly sampling rate requirements, manufacturers might then have to test another sample of three or more lamps later in that same year if customer demand required additional production runs.

NEMA also raised the logistical concern of lumen maintenance testing, which NEMA stated requires many thousands of hours with staggered start times. (NEMA, No. 6 at p. 10) To mitigate this ongoing testing requirement, NEMA proposed an initial sample of 21 lamps for lumen maintenance testing with an additional 2 lamps per production run sampled over the rest of the reporting year for 100-hour confirmation testing. (NEMA, No. 6 at p. 10) In response to the February 2012 HID lamps ECS Framework document, Venture Lighting (Venture) supported a bifurcated approach of testing a large initial sample set for initial values and then using the same sample for lumen maintenance testing, performing supplemental efficacy testing with a smaller additional sample set(s). Venture also noted that NEMA's working group for lamp statistics was still determining optimal sample sizes. (Docket No. EERE-2010-BT-STD-0043, Venture, Public Meeting Transcript, No. 6 at pp. 167–168)

DOE reviewed NEMA's concerns regarding sample size, which can be categorized as follows: (1) sampling rate; (2) sample size required for lamp efficacy, CCT, and CRI testing; and (3) sample size required for lumen maintenance testing. DOE notes it has withdrawn the

proposal to establish a test method for lumen maintenance and has withdrawn the proposal to establish a sampling plan for CRI measurements. However, DOE's review includes those elements because NEMA based their concerns, cost scenarios, and examples on their inclusion in the testing requirements.

Sampling Rate

In the December 2011 TP NOPR, DOE proposed a sampling rate of three lamps per month for a minimum of 7 months in a given reporting year. 76 FR 77914, 77921 (Dec. 15, 2011). NEMA proposed a sampling rate based on production runs, but did not define a production run. Based on its review of business terminology, DOE understands a production run to be a group of similar or related equipment produced using particular manufacturing procedures, processes, or conditions. Production run size will depend on customer demand for lamps produced, as well as the costs to set up production and carry excess inventory. This general description underscores some of the challenges manufacturers might face in balancing costs and inventory with changes in customer demand and challenges for DOE to administer regulations based on production runs.

DOE surveyed the sampling rate for other covered lamps. Table II.5 compares the sample size and sampling rate for each of the covered lamps and related metrics.

Table II.5 Comparison of Sample Size and Sampling Rate for Covered Lamps

CFR Citation	Lamp Type	Metric	Sampling Rate
10 CFR 429.27	General service incandescent and fluorescent lamps	Lamp efficacy	Randomly select three lamps from each month of production for a minimum of 7 months
		CRI	
		Watts input	
		Lumens	
	General service incandescent lamps	Watts input	Randomly select three lamps from each month of production for a minimum of 7 months
		CRI	
		Lumen	
		Rated lifetime	
	Incandescent reflector lamps	Lamp efficacy	Randomly select three lamps from each month of production for a minimum of 7 months
10 CFR 429.35	Medium-base compact fluorescent lamps	Efficacy	Randomly selected
		1,000-hour lumen maintenance	
		Lumen maintenance	
		Rapid-cycle stress test	None specified
		Average rated lamp life	None specified
10 CFR 429.40	Candelabra base and intermediate base incandescent lamps	Lamp wattage	Randomly selected

In its comments on the December 2011 TP NOPR, NEMA expressed concern about different sample size requirements in the United States and Europe, and expressed its desire to use existing testing data for domestic and international reporting where possible. (NEMA, Public Meeting Transcript, No. 5 at pp. 43, 79–80) Commission Regulation (EC) No. 245/2009 requires a minimum sample size of 20 HID lamps, but does not specify the frequency or rate at which the 20 lamps are to be sampled during a reporting year.

LSD 63-2012 recommends a sampling plan for lamps not regulated (as of the year 2012) in the Code of Federal Regulations, stating that the samples must be "randomly selected from at least four different manufacturing dates. If the manufacturing dates of the samples are not available, the samples are recommended to be procured from at least four different locations." As discussed previously, HID lamp production may be intermittent based on demand, with fewer

than four manufacturing dates within a calendar year. Production may also be limited to fewer than four different manufacturing locations, depending on the manufacturer. Therefore, DOE does not propose adoption of the sampling rate requirements of LSD 63-2012.

Because of the fluctuating demand for certain HID lamp types and the challenge of defining production runs for this equipment, DOE proposes a sampling rate requirement for HID lamps that allows random selection. This is consistent with the sampling rate requirements of the EU, as well as for some other covered lamp types, and would allow manufacturer discretion in sampling rate, e.g., a single sampling event or multiple sampling events.

Sample Size Required for Lamp Efficacy and Correlated Color Temperature, Testing

DOE originally proposed a total sample size of 21 lamps in the December 2011 TP NOPR. 76 FR 77914, 77921 (Dec. 15, 2011). NEMA objected to the proposed sample size, citing potentially prohibitive electricity costs and capital investment for testing facilities (particularly for lumen maintenance testing). (NEMA, No. 6 at p. 10)

The LSD 63-2012 recommended sampling plan for lamps not covered in the Code of Federal Regulations states, "The minimum sample size for verification testing of lamps shall be 21 samples randomly selected from at least four different manufacturing dates. If the manufacturing dates of the samples are not available, the samples are recommended to be procured from at least four different locations." Thus, NEMA's LSD 63-2012 supports DOE's original proposed sample size of 21.

DOE understands that electricity costs are a component of testing burden, and are affected by sample size. (Testing burden for HID lamps is discussed in section III.B of this SNOPR.) DOE notes that it no longer proposes lumen maintenance testing for potential energy conservation standards for HID lamps. Because DOE no longer proposes testing for lumen maintenance, NEMA's comment related to testing burden over a subsequent period of time is moot.

DOE proposed a sample size of 21 lamps for CCT testing in the December 2011 TP NOPR. 76 FR 77914, 77921 (Dec. 15, 2011). DOE received no comments supporting or opposing this proposal. DOE proposes that the sample size for CCT be the same as it is for lamp efficacy for potential energy conservation standards. Therefore, DOE proposes a minimum sample size of 21 for CCT for potential energy conservation standards.

In this SNOPR, DOE does not propose a sample size requirement for CRI because CRI is being considered in the standards rulemaking only to define an exemption for lamps.

Review of Sample Sizes

In review, for the HID lamps that have the potential to be subject to future energy conservation standards, DOE proposes the sample sizes shown in Table II.6.

Table II.6 DOE Proposed Sample Sizes

Measurement / Calculation	Minimum Number of Samples
Lamp Efficacy	21
Correlated Color Temperature	21

ii. Statistical Representation

In the December 2011 TP NOPR, DOE proposed that any represented value of lamp efficacy or color characteristics for a basic model be based on a sample of 21 lamps and be less than or equal to the lower of either the sample mean or the LCL of the characteristic value true mean[17] divided by 0.97. 76 FR 77914, 77921 (Dec. 15, 2011). NEMA commented that DOE's proposed statistical approach is an application of the statistical t-test that results in more stringent tolerances than EU requirements, and could unnecessarily put U.S. manufacturers at a competitive disadvantage in the EU marketplace. (NEMA, No. 6 at p. 9)

DOE reviewed its application of the t-test and interprets NEMA's concerns about application of the t-test as applying to instances where the sample mean is less than the quotient of the LCL and divisor (currently set at 0.97). DOE recognizes that in the absence of a divisor, the LCL of a sample will always be lower than the sample mean. However, as the divisor decreases from 1.00 to 0, the resulting quotient (LCL divided by the divisor) can be greater than the sample mean. Based on this calculation, DOE proposed in the December 2011 TP NOPR that any represented characteristic value be the lower of either (1) the sample mean or (2) the LCL of the characteristic value true mean divided by the divisor. 76 FR 77914, 77921 (Dec. 15, 2011).

The EU requires the average (mean) of the sample to be within 10 percent of the limit, threshold, or declared values. Under EU requirements, a significant portion of the sample could be less than the declared (or required standard) value and still be considered compliant because

[17] "True mean" is the population mean of all manufacturer-produced lamps. This characterizes the mean (average) value of all lamps of the same basic model produced by the manufacturer. In contrast, the sample mean refers to the mean (average) of the sample set and the sample size is defined accordingly in the proposed rule.

mean values can be skewed by outliers or extreme values. In contrast, DOE proposed in the December 2011 TP NOPR to use the confidence interval of 95 percent to calculate the LCL, which approximates the proportion of a sample that may be expected to contain the true mean. 76 FR 77914, 77921 (Dec. 15, 2011). To better represent differences in manufacturing variability between HID lamp types, DOE revises its proposed confidence intervals in this SNOPR (as discussed in section II.C.2.b.iii).

NEMA also commented that the sample mean calculation does not provide tolerance for manufacturing and measurement uncertainties. NEMA stated that there is inherent variation in HID lamp manufacturing and measurement uncertainties across different National Voluntary Laboratory Accreditation Program (NVLAP)-accredited laboratories. (NEMA, No. 6 at p. 9)

DOE acknowledges that there are uncertainties related to both lamp manufacturing and testing. DOE addressed this issue previously in the May 1997 fluorescent and incandescent lamp test procedures rulemaking (herein referred to as the May 1997 FL/IL TP final rule). 62 FR 29222 (May 29, 1997). During the rulemaking process for the May 1997 FL/IL TP final rule, NEMA and other manufacturers proposed different derating values for both the sample mean and the LCL. 62 FR 29222, 29230 (May 29, 1997). DOE, NEMA, and NIST met during the rulemaking process to discuss the sampling plan, variability, and uncertainties. 62 FR 29222, 29230 (May 29, 1997). In the May 1997 FL/IL TP final rule, DOE stated that all variability was accounted for by the confidence limit equation using the “t-test” and the derating factor (divisor) applied only to the LCL, and not to the mean. 62 FR 29222, 29230 (May 29, 1997).

The LCL is a function of the sample mean and encompasses manufacturing variations. Historically, DOE has not applied the divisor to the sample mean lumen per watt value. Id. at 29229–30. However, sample mean lumen per watt is not derated because the NIST uncertainty in the lumen output of the standard lamps is randomly distributed. Id. at 29230, DOE based its December 2011 TP NOPR proposal on the method adopted in the May 1997 FL/IL TP final rule and applied the divisor only to the LCL and not to the mean. This proposal is unchanged in today's SNOPR.

iii. Lower Confidence Limit

In the December 2011 TP NOPR, DOE proposed a confidence interval of 95 percent to calculate the LCL, which reflects the inherent uncertainty in any sample measurement resulting from manufacturing variations. This proposal included the same certification requirements that were used in 10 CFR 429.27 for GSFLs (a related gas-discharge lamp). Based on comments received and additional research, DOE proposes in this SNOPR to specify two separate confidence intervals applicable to: 1) MH lamps; and 2) MV and HPS lamps.

In response to the December 2011 TP NOPR, GE commented that the tolerances in DOE's statistical approach should be modified because HID lamps have much wider manufacturing tolerances for lumen output than fluorescent and incandescent lamps. (GE, Public Meeting Transcript, No. 5 at p. 82) OSRAM SYLVANIA agreed, noting that it is difficult to report HID lamp lumen output beyond the nearest 100 lumens. (OSRAM SYLVANIA, Public Meeting Transcript, No. 5 at pp. 31–32). During the March 2012 ECS public meeting, Venture commented that the physical complexity of metal halide (e.g., containing 10 components as

opposed to 1–2 components for other lamp types) contributes to manufacturing variation. (Docket No. EERE-2010-BT-STD-0043, Venture, Public Meeting Transcript, No. 8 at p. 91)

NEMA provides long-term manufacturing data variability as a ratio of the observed long term standard deviation (s_{LT}) compared to the mean (μ) (written as s_{LT}/μ) in LSD 63-2012 based on industry consensus for many lamp and ballast types, including HID lamps. Table II.7 provides an excerpt of the incandescent, fluorescent, and HID variability values from LSD 63-2012.

Table II.7 Industry Consensus Long-Term Manufacturing Data Variability (s_{LT}/μ)

Lamp Type	Luminous Flux	Lamp Efficacy	CRI	CCT
Tungsten filament lamp	0.040	0.047	---	0.030
Medium-base CFL	0.060	0.096	0.040	0.045
Double-based fluorescent lamp	0.050	0.056	0.040	0.025
Pulse-start quartz metal halide lamp	0.070	0.070	0.045	0.065
Pulse-start ceramic metal halide lamp	0.065	0.065	0.040	0.050
High-pressure sodium lamp	0.040	0.040	0.020	0.025

There is significant variability in luminous flux for HID lamps, with pulse-start quartz MH lamps showing the highest variability for all HID lamp types discussed in LSD 63-2012. LSD 63-2012 does not provide variability values for MV lamps, but DOE believes these values would be comparable to those of HPS lamps because MV lamps have similar, comparatively simple lamp chemistry. Because HID lamps are measured at a fixed power value (per LM-51-13), this variation in lumens correlates to the same variation in lamp efficacy.

DOE agrees with the findings of LSD 63-2012, which indicate less manufacturing variability for HPS lamps than for MH lamps. Due to the difference in inherent uncertainty in a typical sample of each of the different HID lamp types, DOE proposes to set the confidence

intervals differently for MH versus HPS and MV lamps. Based on LSD 63-2012, MH lamps have more manufacturing variation than GSFLs, while HPS (and by association MV lamps) have less variation than GSFLs. Using these values, DOE calculated confidence intervals so that the values of the LCL divided by the sample mean for all HID lamps types are consistent with those values used in test procedures for GSFLs.[18] 74 FR 31829, 31836 (July 6, 2009) Therefore, to calculate the LCL, DOE proposes in this SNOPR to specify a confidence interval of 99 percent for MV and HPS lamps and a confidence interval of 90 percent for MH lamps.

iv. Divisor

In the December 2011 TP NOPR, DOE proposed that the LCL be divided by a divisor of 0.97, which translates to an expected variation of 3 percent. 76 FR 77914, 77921 (Dec. 15, 2011). In written comments, NEMA stated that CRI and CCT should be given tolerances of 3 and 4 percent, respectively. (NEMA, No. 6 at p. 3) NEMA also described a typical 4 percent measurement variation between testing laboratories. (NEMA, Public Meeting Transcript, No. 5 at p. 102) DOE received no other comments related to the divisor.

DOE uses various divisors for other covered light sources. General service fluorescent lamps (10 CFR 429.27) and general service incandescent lamps (10 CFR 429.27) use a divisor of 0.97. In contrast, medium base CFLs (10 CFR 429.35) and candelabra-base and intermediate-base incandescent lamps (10 CFR 429.40) use a divisor of 0.95. In the December 2011 TP

[18] DOE calculated the t-statistics for confidence intervals from 90% to 99% in increments of 0.5% (90%, 90.5%, 91%, etc.). DOE then scaled the t-statistic based on the ratio of the long term manufacturing variability for the different light sources from LSD-63. DOE then found the confidence interval that corresponded with scaled t-statistic.

NOPR, DOE proposed a divisor of 0.97 (76 FR 77914, 77921 (Dec. 15, 2011)). In this SNOPR, DOE continues to propose a divisor of 0.97 for all HID lamps.

NEMA has commented on this topic in previous rulemakings. In its comments on the September 2010 CC&E NOPR, NEMA provided a formula for calculating divisors:

$$D = 1 \pm \left(t \div \sqrt{n}\right)(\sigma \div \mu)$$

where "t" is a function of the specified confidence limit, "n" is the sample size, "σ" is the standard deviation, and "μ" is the true mean, as well as a table of divisors for different sample sizes and LCLs of 95 percent. NEMA also provided a table (Table II.8 is a reprint of the table provided by NEMA) showing different divisors for both different sample sizes and different ratios of standard of deviations to the mean. (Docket No. EERE-2010-BT-CE-0014, NEMA, No. 85 at pp. 38 – 39)

Table II.8 – NEMA's Divisors for Lower Confidence Limit

σ/ μ ratio	**Minimum sample size**				
	4	**5**	**6**	**10**	**21**
0.01	0.99	0.99	0.99	0.99	1.00
0.02	0.98	0.98	0.98	0.99	0.99
0.03	0.96	0.97	0.98	0.98	0.99
0.04	0.95	0.96	0.97	0.98	0.98
0.05	0.94	0.95	0.96	0.97	0.98
0.10	0.88	0.90	0.92	0.94	0.96
0.15	0.82	0.86	0.88	0.91	0.94
0.20	0.76	0.81	0.84	0.88	0.92
0.25	0.71	0.76	0.79	0.86	0.91
0.30	0.68	0.71	0.75	0.83	0.89
0.35	0.59	0.67	0.71	0.80	0.87
0.40	0.53	0.62	0.67	0.77	0.85

In the December 2011 TP NOPR, DOE proposed a sample size of 21 lamps and an LCL divisor of 0.97.[19] 76 FR 77914, 77921 (Dec. 15, 2011). As shown in Table II.9, this corresponds to σ/μ ratios between 0.05 and 0.10.

Table II.9 Divisors for Varying LCLs with Sample Size of 21 Lamps

σ/μ Ratio	**99%**	**97%**	**95%**
0.05	0.97	0.98	0.98
0.10	0.95	0.96	0.96

Finally, NEMA commented that NVLAP's "Proficiency Testing for Energy Efficient Lighting Products" shows lab-to-lab variations of more than 4 percent, depending on the lamp technology. (NEMA, No. 6 at p. 13) According to NEMA, the overall uncertainty for any lamp measurement will include variation of the measured characteristics. Therefore, for highly variable characteristics such as light output and color, the measurement uncertainty may be significantly greater than just the variation of the characteristic itself (which is typical for discharge lamps). (NEMA, No. 6 at p. 13) In this SNOPR, DOE proposes to retain an LCL divisor of 0.97 for all HID lamps.

v. Proposed Sampling Plan for Potential Energy Conservation Standards

DOE proposes, for each basic model of HID lamp, randomly selected samples of production lamps shall be tested and the results averaged. A minimum of 21 lamps shall be tested. Any represented value of lamp efficacy of a basic model shall be less than or equal to the lower of:

[19] This is the same sample size and LCL divisor used for GSFL and GSIL lamps.

(A) The mean of the sample, where:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

$\bar{x}$ is the sample mean,

n is the number of samples, and

x_i is the i^{th} sample;

Or,

(B) The lower confidence limit (LCL) of the true mean divided by 0.97, where:

$$LCL = \bar{x} - t\left(\frac{s}{\sqrt{n}}\right)$$

$\bar{x}$ is the sample mean,

s is the sample standard deviation,

n is the number of samples, and

t is the t statistic for a 90-percent one-tailed confidence interval with n-1 degrees of freedom (from appendix A) for MH lamps, or the t statistic for a 99-percent one-tailed confidence interval with n-1 degrees of freedom (from appendix A) for HPS and MV lamps.

For each basic model of HID lamp, the CCT must be measured from the same lamps selected for the lamp efficacy measurements (i.e., the manufacturer must measure all lamps for lumens, input power, and CCT). The CCT must be represented as the mean of a minimum sample of 21 lamps, where:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

$\bar{x}$ is the sample mean,

n is the number of samples, and

x_i is the i^{th} sample.

c. Lamp Seasoning and Stabilization

In the December 2011 TP NOPR, DOE proposed that lamps be seasoned (i.e., operated or aged) for at least 100 hours in the same orientation in which they will be used.[20] 76 FR 77914, 77921–22 (Dec. 15, 2011). Standard lamp orientation (burning position) would be base-up unless otherwise designated by the manufacturer.[21] Id. This is consistent with ANSI C78.389, section 3.7.2. NEMA supported this approach. (NEMA, No. 6 at p. 10).

DOE received additional comments on testing orientation for lamps with no specified operating position. The CA IOUs and the Joint Comment suggested that DOE examine other testing orientations, but did not disagree that the lamps should be seasoned and stabilized in the testing orientation. (CA IOUs, No. 8 at pp. 2–3; Joint Comment, No. 9 at p. 2) Therefore, DOE proposes in this SNOPR to require that HID lamps with no specified operating position (including universal position lamps) be seasoned and stabilized in the position in which they will be tested (vertical base-up position as discussed in section II.C.1.c.iv).

In the December 2011 TP NOPR, DOE also proposed a lamp stabilization method (warm-up and stabilization criteria) based on ANSI C78.389, section 3.7. 76 FR 77914, 77922

[20] For example, if the lamp is to be operated in the base-down position, the lamp must be operated ("burned in" or "aged") in that base-down position.

[21] Lamp position is designated in the lamp designation (catalog code) and included in manufacturer catalogs, specification sheets, and the packaging.

(Dec. 15, 2011). NEMA concurred with using the stabilization criteria of ANSI C78.389 for the HID lamp test procedures. (NEMA, No. 6 at p. 10) DOE received no other comments on its proposed approach. Therefore, the warm-up and stabilization criteria are unaffected by this SNOPR.

d. Lamp/Circuit Transfer

In the December 2011 TP NOPR, DOE proposed to adopt the lamp cool-down and re-stabilization methods of ANSI C78.389, section 3.7, for HID lamp test procedures. 76 FR 77914, 77922–23 (Dec. 15, 2011). HID lamps are sensitive to movement once they are warmed up and stabilized. Therefore, any significant movement or disturbance could destabilize the lamp operation, altering its output or electrical characteristics and requiring the lamp to be re-stabilized prior to testing. The re-stabilization time varies by lamp type, whether the lamp arc has been extinguished, and whether lamp orientation has changed. Lamp cool-down, in contrast, is needed only when the lamp arc is extinguished prior to relocating the lamp in the integrating sphere.

The lamp cool-down and re-stabilization requirements of ANSI C78.389, section 3.7, are shown in Table II.10. In the December 2011 TP NOPR, DOE proposed using the re-stabilization requirements in ANSI C78.389, rather than LM-51, because ANSI C78.389 provides specific guidance for re-stabilization requirements for each of the HID lamp types, whereas LM-51 provides only general guidance. 76 FR 77914, 77922 (Dec. 15, 2011). DOE received no negative comments regarding its proposed requirements as they relate to lamps that are extinguished and/or changed in orientation prior to relocation.

Table II.10 ANSI C78.389 HID Lamp Cool-Down and Re-stabilization Requirements

Lamp Type	Cooling Requirement	Re-stabilization Time
MV	None	Not in standard Reconfirm stabilized operations upon transfer/restrike
HPS	Allow to cool for 1 hour minimum before relocating	Not in standard Reconfirm stabilized operations upon transfer/restrike
MH	Cool to below 60 °C if relocating	No relocation no reorientation – 30 minutes Relocation with no reorientation – 30 minutes Reorientation – 6 hours

During the January 2012 TP public meeting, OSRAM SYLVANIA explained an industry practice where HID lamps are energized, stabilized, and moved into the integrating sphere. There is no cool-down or re-stabilization because the lamps are not extinguished. (OSRAM SYLVANIA, Public Meeting Transcript, No. 5 at pp. 85–86) NEMA provided further details on how the lamps are moved into the integrating sphere while operating, and how stabilization is reconfirmed inside the sphere. (NEMA, No. 6 at p. 11) NEMA stated that this methodology is more efficient than extinguishing, cooling, and re-stabilizing the lamp. (NEMA, No. 6 at p. 11) NEMA also stated that this method generally requires a maximum stabilization time of only 15 minutes. NEMA was concerned that DOE's proposed cool-down and re-stabilization requirements would apply unnecessarily to lamps that remain operating with no change in orientation. (NEMA, No. 6 at p. 11) According to NEMA, "The table [Table II.10], as written seems to apply to lamps that are turned off before locating them in the sphere. This should not apply to the lamps that remain lighted with no change in orientation." (NEMA, No. 6 at p.11) DOE understands that this methodology is an industry practice but is not documented in any industry standards.

DOE agrees with NEMA's distinction, and proposes that lamps that remain energized with no change in orientation when moved should be operated for the minimum time needed to verify lamp stabilization prior to measurements. If the lamps are changed in orientation and/or

extinguished and then moved, DOE proposes to apply the cool-down and re-stabilization requirements from the NOPR (shown in Table II.10).

e. Lamp Orientation

In the December 2011 TP NOPR, DOE proposed to adopt the lamp orientation requirements of ANSI C78.389, section 3.6, for HID lamp testing. 76 FR 77914, 77923 (Dec. 15, 2011). As discussed herein, industry procedures have been developed to ensure that the correct orientation is maintained for consistent electrical and photometric measurements.

ANSI C78.389, section 3.6, requires that a lamp marked or designated on the lamp's data sheet for use in a specific operating position be tested in that position. If no operating position is specified or the lamp is marked "universal," this industry standard directs that the lamp is to be operated in the vertical base-up position.

In contrast, LM-51 does not contain lamp orientation requirements for testing, except to note that lamp orientation during warm-up must be the same as that during photometry. LM-51 also states that the manufacturer's specifications should be consulted for any restrictions on lamp orientation.

During the January 2012 TP public meeting, the CA IOUs asked whether HID lamps performed best in a vertical operating position. (CA IOUs, Public Meeting Transcript, No. 5 at pp. 89–90) OSRAM SYLVANIA stated that it measures lumen output for universal position lamps in horizontal and vertical orientations. (OSRAM SYLVANIA, Public Meeting Transcript,

No. 5 at pp. 90–91) Manufacturers further elaborated that universal position lamps are often used in floodlights where the aiming angle is unknown, and it would be burdensome to test them in additional orientations. (OSRAM SYLVANIA, Public Meeting Transcript, No. 5 at pp. 91–93; GE, Public Meeting Transcript, No. 5 at pp. 92–93)

In their comments, the CA IOUs expressed concern that universal position lamps were less efficacious and, because they are less expensive than position-dedicated lamps, they might be substituted in position-dedicated applications. (CA IOUs, No. 8 at pp. 2–3) The CA IOUs urged DOE to require testing universal position lamps at multiple orientations, suggesting that two or three additional orientations would not add significant testing burden. (CA IOUs, No. 8 at pp. 2–3) The Joint Comment agreed, encouraging DOE to examine the range of efficacy levels of universal position lamps when operated in a horizontal position. (Joint Comment, No. 9 at p. 2) NEMA stated that it agreed with ANSI C78.389, which limits testing to a lamp's specified orientation or a vertical base-up orientation if not specified (including universal position lamps). (NEMA, No. 6 at p. 11)

DOE reviewed manufacturer performance data for horizontal position only lamps, vertical base-up position only lamps, and universal position lamps (tested in a vertical, base-up position). In its review, DOE found the data reported in catalogs did not provide conclusive evidence of differences in efficacy between these lamp types. DOE also reviewed published data, such as manufacturer catalogs, for universal orientation lamps when operated in vertical base-up and horizontal orientations. This data suggests that universal position lamps are generally less efficacious when operated in a horizontal orientation.

DOE acknowledges that manufacturers cannot know the orientation in which universal lamps will be operated, and agrees that testing at multiple orientations would impose an undue burden. At the January 2012 TP public meeting, OSRAM SYLVANIA and GE stated that universal orientation lamps are most commonly used in a vertical position. (OSRAM SYLVANIA, Public Meeting Transcript, No. 5 at p. 91; GE, Public Meeting Transcript, No. 5 at p. 92)

Vertical position specifies the orientation of the lamp, but does not denote whether the base is up or down in the orientation. Of the HID lamps, only MH lamps are affected by operating position. Vertical burning MH lamps are available in base-up, base-down, and base-up/base-down designations.

Universal lamps are specified for projects for two major reasons: (1) the fixture can be aimed (e.g., a floodlight) and is going to be aimed at angle that is not entirely vertical or horizontal; and (2) there are multiple types of fixtures at the site (e.g., a bollard with a base-down socket, an area lighting fixture with a base-up socket, or a downlight fixture with a base-up socket) that use the same type of lamp. By specifying the universal lamp, the one lamp type can be stocked for each type of fixture, simplifying maintenance at the site. Vertical base up is the most common orientation of MH lamps because more fixtures (e.g., high-bay; low-bay;

downlights; parking structure fixtures; most pole-mounted area "shoeboxes" fixtures) need this orientation for optical reasons to distribute the light.[22]

In this SNOPR, DOE retains its original proposal that HID lamps with a manufacturer-specified operating position be tested in the position specified, and that HID lamps with no specified operating position (including universal orientation lamps) be tested in the vertical base-up orientation.

3. Special Considerations for Directional Lamps

Directional lamps, which are typically reflector lamps with a discernible beam pattern, have different setup and measurement requirements than omni-directional lamps. In the December 2011 TP NOPR, DOE proposed set-up and measurement requirements of directional lamps in accordance with ANSI C78.379, which provides classification of beam patterns and specification of directional lamp measurement and evaluation. 76 FR 77914, 77923 (Dec. 15, 2011).

The CA IOUs and the Joint Comment supported DOE's proposal to develop a new metric and test procedures for directional HID lamps. (CA IOUs, No. 8 at p. 4; Joint Comment, No. 9 at p. 1) NEMA agreed with using ANSI C78.379, but noted that industry standards and technical guidance are being developed for directional lamps, and recommended that DOE not include directional lamps in its rulemakings until the new industry references are available. (NEMA, No. 6 at p. 11)

[22] Base down requires the socket to be at the "bottom" of the fixture and the socket occludes light, causing a dark spot directly below the fixture.

In the February 2013 HID lamps ECS Interim Analysis document, DOE stated that it was considering excluding directional HID lamps from standards coverage, citing their small market share and the fact that this application is replacing less-efficient halogen lamps. (Docket No. EERE-2010-BT-STD-0043) As a result, DOE is not including directional lamp testing in this SNOPR.

D. Test Measurements and Calculations

1. Measurement and Calculation of Efficacy

In the December 2011 TP NOPR, DOE proposed that HID lamp efficacy be calculated as the initial lumen output divided by the measured input lamp wattage, with the resulting quotient rounded off to the nearest tenth of a lumen per watt. 76 FR 77914, 77923 (Dec. 15, 2011). This requirement is consistent with the 2009 GSFL/GSIL/IRL test procedures final rule, in which DOE required testing to a tenth of a lumen per watt. 74 FR 31829, 31836 (July 6, 2009).

In this SNOPR, DOE proposes specific provisions for initial lumen output and lamp input power measurements for clarity. DOE proposes that the initial lumen output be measured in accordance with section II.C.1.d, in which DOE maintained its proposal from the NOPR that photometric testing be conducted per IES LM-51-2013. For lamp input power, DOE proposes measurements be conducted in accordance with section 3.5, 3.9, and 3.10 of ANSI C78.389. Section 3.5 details the circuit types that can be used for the connecting the required measurement instrumentation, including the reference ballast, voltmeter, wattmeter, and/or ammeter to the HID lamp. Section 3.9 describes the methods necessary to compensate for the presence of

instruments in the lamp circuit when taking the measurements. Lastly, section 3.10 (which applies exclusively to HPS lamps) gives instructions for the measurement of lamp amperes and volts at nominal lamp wattage. To measure the wattage of an HID lamp, if a voltmeter and ammeter are used then the product of the measured voltage and the current is the lamp wattage (input electrical power) of the HID lamp. If a wattmeter is used, then the measured value in watts is the lamp wattage of the HID lamp. DOE did not receive any comments following the December 2011 TP NOPR regarding input power measurements for HID lamps. In this SNOPR, DOE proposes to calculate HID lamp efficacy as the measured initial lumen output divided by the measured input power in watts, with the resulting quotient rounded off to the nearest tenth of a lumen per watt. DOE requests comment on the input power and lumen output measurements necessary to calculate lamp efficacy.

2. Measurement and Calculation of Center Beam Intensity and Beam Angle

In the December 2011 TP NOPR, DOE proposed measuring center beam intensity and calculating the beam angle for directional lamps using the procedures described in ANSI C78.379. 76 FR 77914, 77923 (Dec. 15, 2011). During the January 2012 TP public meeting, NEMA expressed general concern about DOE's directional HID lamp requirements. (NEMA, Public Meeting Transcript, No. 5 at pp. 88–89) GE clarified that NEMA agreed with using ANSI C78.379, but that its concern was related to the specific metrics and related tolerances once the measurements were completed. (GE, Public Meeting Transcript, No. 5 at p. 89) NEMA elaborated that measuring the beam performance of directional lamps increases the measurement variation if zonal lumens are used to set efficiency limits. (NEMA, No. 6 at p. 11)

As discussed in section II.C.3, DOE is considering excluding directional lamps from its HID lamps ECS rulemaking. For this reason, DOE is not including center beam intensity or beam angle calculation provisions in this SNOPR.

3. Measurement and Calculation of Correlated Color Temperature and Color Rendering Index

In the December 2011 TP NOPR, DOE proposed to adopt CCT and CRI measurement methods based on CIE 15 and CIE 13.3. 76 FR 77914, 77924 (Dec. 15, 2011). DOE previously incorporated these standards in the GSFL/GSIL/IRL test procedures final rule. 74 FR 31829, 31834 (July 6, 2009).

During the January 2012 TP public meeting, the CA IOUs asked NEMA to distinguish its position on the proposed methodology for color quality measurements from its disagreement of using color quality to establish equipment classes in the HID lamps ECS. (CA IOUs, Public Meeting Transcript, No. 5 at pp. 106–107) NEMA responded that it had no issue with the proposed methods for measuring color quality of HID lamps. (NEMA, Public Meeting Transcript, No. 5 at p. 107)

NEMA commented that test standards are appropriate for CCT and CRI for lamps at 100 hours. NEMA further elaborated that the industry does not endorse the concept of CRI or CCT maintenance. (NEMA, No. 6 at p. 3) DOE acknowledges that after HID lamps have been seasoned (operated for 100 hours), the color characteristics can be measured. Although DOE is considering using initial CCT and CRI to determine scope and equipment classes in the HID

lamps ECS rulemaking, DOE is not considering CCT or CRI maintenance requirements. (Docket No. EERE-2010-BT-STD-0043)

DOE acknowledges that the color shift of HID lamps occurs over time and is not possible to predict. Therefore, DOE proposes that after the initial seasoning period (100 hours of operation), manufacturers would measure CCT values for 21 HID lamps (see section II.C.2.b.i for a discussion of proposed sample size requirements). The sample mean CCT values would be the representative values for the basic model. CRI values would be tested in the same manner. DOE proposes test procedures for CRI only because CRI is being considered in the standards rulemaking to define the CRI above which standards will not be considered for lamps. DOE and manufacturers would use the proposed CRI test method to determine whether lamps are subject to the potential standards.

i. Correlated Color Temperature

In the past, DOE has used CCT to define and categorize certain kinds of lamps (e.g., modified-spectrum fluorescent and incandescent lamps, and general service fluorescent lamps). DOE is considering CCT as a means to define equipment classes for HID lamps. For HID lamp testing, in the December 2011 TP NOPR, DOE proposed to adopt the procedures and methods in CIE 15 to determine HID lamp CCT. 76 FR 77914, 77924 (Dec. 15, 2011).

Ushio commented that DOE should establish CCT requirements for MH lamps used in general lighting applications, but not for MH lamps used for special applications such as disinfection, curing, and aquariums. (Ushio, No. 7 at p. 1) In the concurrent HID lamps ECS

rulemaking, DOE is considering excluding certain HID lamps in a given CCT range from coverage because they are used only for specialty applications. DOE will address comments related to CCT requirements as part of the standards rulemaking.

NEMA stated that if CCT requirements are established, CCT should have a tolerance of 4 percent. (NEMA, No. 6 at p. 3) DOE researched CCT and considered three options related to tolerances for CCT values for HID lamps:

1. Set a fixed tolerance of at least 4 percent for the CCT value as proposed by NEMA in written comments. For other covered products (i.e., general service fluorescent lamps), however, DOE does not apply a percent tolerance to CCT values. Therefore, DOE found that this percentage-based tolerance would be inconsistent with other lighting products and does not propose to use this tolerance method.

2. Define the x,y coordinates for the different nominal CCTs, and then apply a seven-step MacAdam ellipse to the center of the x,y value. If the measured x,y values corresponding to a lamp's CCT were within that ellipse, the lamp would be characterized by that nominal CCT. This is the standard protocol for lighting industry chromaticity standards.

   No industry chromaticity standards are currently defined for HID lamps. DOE researched available chromaticity standards for fluorescent lamps (ANSI C78.376-2001) and solid-state lighting (SSL) (ANSI C78.377-2011). DOE notes that in the

ENERGY STAR November 30, 2012 letter, EPA stated that there is no industry standard to reference.[23]

DOE researched publicly available chromaticity data for HID lamps found in manufacturer catalogs, and found that the graphed x,y coordinates for many HID lamps would not fall within the seven-step MacAdam ellipses for nominal fluorescent lamp CCT values in ANSI C78.376-2001. Because of the lack of industry chromaticity standards for HID lamps, and DOE's findings that HID lamps often do not fall within the seven-step MacAdam ellipses for fluorescent lamps, DOE rejects this method of testing CCT values in HID lamps.

3. Round the mean of the sample of lamps' CCT values to the nearest 10 kelvin, as is prescribed in test procedures for general service fluorescent lamps in 10 CFR part 430, subpart B, appendix R. In the 2012 GSFL/GSIL/IRL test procedures final rule, DOE discussed originally requiring rounding to the nearest single kelvin, but increased it to the nearest 10 kelvin per a recommendation from NEMA and in consultation with NIST. 77 FR 4203, 4207 (Jan. 27, 2012).

Therefore, DOE proposes that the HID lamps be measured for CCT and, like the rounding approach used in the GSFL/GSIL/IRL test procedures, that CCT values be rounded to the nearest 10 kelvin.

[23] ENERGY STAR Lighting Stakeholder - www.energystar.gov/products/specs/sites/products/files/ES_Luminiares_1%202_Letter_FINAL.pdf – last accessed October 26, 2013

ii. Color Rendering Index

In the December 2011 TP NOPR, DOE proposed a test method to measure CRI because DOE was considering CRI as a means to define the scope of coverage for HID lamps for potential energy conservation standards. DOE proposed to adopt the methods and procedures set forth in CIE 13.3 to determine lamp CRI. 76 FR 77914, 77924 (Dec. 15, 2011).

The CA IOUs supported the proposed color quality measurements. (CA IOUs, No. 8 at p. 2) NEMA commented that CCT and CRI have little relevance to the energy efficiency of HID lamps. (NEMA, No. 6 at p. 3) However, in commenting on the February 2012 HID lamps ECS Framework document, NEMA supported using CRI as a metric for possible exclusion of certain lamps (e.g., high CRI, low CCT lamps), also noting that CRI could affect an equation-based efficacy standard. (Docket No. EERE-2010-BT-STD-0043, NEMA, No. 7 at pp. 5, 21)

In the HID lamps ECS rulemaking, DOE is considering a CRI above which lamps would not be considered for standards. (Docket No. EERE-2010-BT-STD-0043) DOE and manufacturers would use the proposed CRI test method to determine whether a lamp is subject to standards based on CRI applied to a basic model of lamp. In this SNOPR, DOE proposes that the CRI of HID lamps be rounded to the nearest whole number, as is consistent with rounding for other lighting technologies.

NEMA stated that if CRI requirements are established, CRI measurements should be given a tolerance of at least 3 percent. (NEMA, No. 6 at p. 3) In the HID lamps ECS rulemaking,

DOE is only considering using CRI to determine whether a particular lamp model is considered for standards. The CRI itself is not under consideration for being regulated or reported. (Docket No. EERE-2010-BT-STD-0043) Because of this, DOE did not give further consideration to the tolerance of at least 3 percent requested by NEMA.

4. Test Method for Measuring Lumen Maintenance

In the December 2011 TP NOPR, DOE proposed measuring lumen maintenance for HID lamps at 40 percent and 70 percent of rated lamp life, as described in LM-47. 76 FR 77914, 77923–24, 77934 (Dec. 15, 2011).

The Joint Comment supported measuring lumen maintenance, which is used in lighting design calculations to estimate future light output and energy use in lighting systems more accurately. The Joint Comment stated that improved lumen maintenance results in energy savings in the field and encouraged DOE to include lumen maintenance in the test procedures. (Joint Comment, No. 9 at p. 1) The CA IOUs also supported DOE's proposal to measure lumen maintenance for HID lamps. (CA IOUs, No. 8 at p. 1)

NEMA raised a number of logistical issues related to the proposal and was generally not supportive of lumen maintenance testing. NEMA cited particular concerns about lumen maintenance testing for HID lamps, including: (1) the significant capital investment and operating expenses for long-term testing of 21 or more samples for tens or hundreds of basic models, ranging in wattage from 50 to 1,000 watts; (2) the difficulty of obtaining NVLAP accreditation for manufacturer testing facilities for lumen maintenance; and (3) the potential

delays in new product introduction while long-term lumen maintenance data is gathered. (NEMA, No. 6 at pp. 2, 3, 12, 13) NEMA stated that new product introduction to the market could be delayed if testing at 40 percent of rated life is required before a lamp can be introduced. (NEMA, No. 6 at p. 3)

At this time, DOE does not plan to include lumen maintenance requirements in potential energy conservation standards for HID lamps, and therefore does not propose to require lumen maintenance measurement to demonstrate compliance with any final standards. In this SNOPR, DOE addresses comments on lumen maintenance testing regarding updated industry test standards, measured points in rated life, and test burden.

In the December 2011 TP NOPR, DOE referenced LM-47-01. 76 FR 77914, 77916–17, 77923–24 (Dec. 15, 2011). Intertek commented on the use of older versions of IES standards (i.e., LM-47), stating they may have been recently revised or be under revision. (Intertek, Public Meeting Transcript, No. 5 at p. 121) DOE is no longer proposing to incorporate LM-47 because DOE no longer proposes in this SNOPR to measure the lumen maintenance of HID lamps.

NEMA commented that the 2012 version of the IES Design Guide 10 (DG-10-12) states "mean lumens are defined as the lumens emitted at 40 percent (fluorescent and HID) or 50 percent (other sources) of rated lamp life." (NEMA, No. 6 at p. 3) NEMA stated that this definition is incorrect, and should specify 40 percent for MH/MH lamps and 50 percent for HPS lamps. (NEMA, No. 6 at pp. 2−3) NEMA stated that it has alerted IES to the error. NEMA stated that the accepted industry practice is to measure lumen maintenance at 40 percent of rated life for

MH lamps. (NEMA, No. 6 at pp. 2−3) For HPS and MV lamps, NEMA stated that the accepted industry practice is to measure lumen maintenance at 50 percent of rated life. (NEMA, No. 6 at pp. 2−3)

The CA IOUs were supportive of measuring lumen output at one defined point in the rated lamp life for all HID lamp types. The CA IOUs further encouraged lumen maintenance testing even if the proposed 40 percent and 70 percent measurement points had to be modified to accommodate industry concerns. (CA IOUs, No. 8 at pp. 1–2) NEMA commented that HID lamps can have very long operating lifetimes (e.g., greater than 40,000 hours), and that measuring at 70 percent of life could require multiple years of lamp operation. (NEMA, No. 6 at p. 2) NEMA speculated that the proposed measurement at 70 percent of life was derived from the "L_{70}" value for SSL products, which designates the operating hours at which an SSL product still maintains 70 percent of initial light output. (NEMA, No. 6 at pp. 2–3) The CA IOUs supported a second lumen maintenance test at 70 percent of rated lamp life, stating that lumen maintenance is a significant factor in the specification of HID lamp and ballast systems. (CA IOUs, No. 8 at pp. 1–2) The Joint Comment stated that most lighting systems are designed based on the mean light output of the lamps. (Joint Comment, No. 9 at p. 1) DOE understands the 40 and 50 percent of rated lamp lifetimes are the traditional points in time when lumen maintenance is measured. DOE notes that LM-47 contains the 70 percent of rated lamp lifetime and DOE was not conflating it with L_{70} value for SSL. DOE no longer proposes to measure lumen maintenance as part of this SNOPR.

NEMA also stated that if 40 percent of life lumen maintenance is required, for newly introduced products DOE should allow projection of lumen maintenance values using manufacturer-accepted practices. (NEMA, No. 6 at p. 3) NEMA stressed that existing data should be used, where possible, to reduce potential delays to market. (NEMA, No. 6 at pp. 2, 13; NEMA, Public Meeting Transcript, No. 5 at pp. 35–36, 39–42) The CA IOUs also supported lumen maintenance testing and suggested that standardizing on a measurement point of 40 percent of rated lamp life for all HID lamps would not be overly burdensome to manufacturers, and would facilitate comparison of lamps. (CA IOUs, No. 8 at pp. 1–2) DOE reviewed technical reports, industry test procedures, and other literature and could not find a lumen maintenance extrapolation methodology for HID lamps.[24] DOE understands both the potential burden and advantage of standardizing on a point in lamp life to reduce the burden to manufacturers. However, lumen maintenance is not under consideration for use in the HID lamps ECS rulemaking. (Docket No. EERE-2010-BT-STD-0043) Because of this, DOE no longer proposes testing lumen maintenance in this SNOPR.

E. Active Modes – Less Than Full Output (Dimming)

1. Measurement of Dimming Performance for Potential Energy Conservation Standards

In the December 2011 TP NOPR, DOE proposed a requirement that the HID lamp be energized before efficiency testing was conducted. 76 FR 77914, 77921 (Dec. 15, 2011). DOE did not propose testing at reduced light output. At the January 2012 TP public meeting, the CA IOUs asked about HID lamps designed to operate on dimming systems, to which OSRAM

[24] DOE researched the use of lumen maintenance extrapolation in industry standards and test procedures from ANSI, CIE, IESNA, and NEMA and did not find any details on lumen maintenance extrapolation. DOE also did a general search of publicly available peer-reviewed lighting literature, technical reports, manufacturer data sheets, and did not find test procedures to extrapolate the lumen maintenance of HID lamps.

SYLVANIA responded that HID lamps are typically not designed for dimming, but can be dimmed in compatible lamp and ballast systems. (CA IOUs, Public Meeting Transcript, No. 5 at pp. 113–114; OSRAM SYLVANIA, Public Meeting Transcript, No. 5 at p. 114) In written comments, the CA IOUs noted that dimming performance can vary significantly among HID lamp technologies, and encouraged DOE to develop a procedure to test and measure the performance of HID lamps in a dimmed state. (CA IOUs, No. 8 at p. 4) The Joint Comment agreed. (Joint Comment, No. 9 at p. 2)

In the April 2010 HID lamps notice of proposed determination, DOE stated that dimming (operating the lamps at less than full power) HID lamps is uncommon. 76 FR 22031, 22034 (April 27, 2010). NEMA responded that there were currently no industry standards for dimming HID lamp and ballast systems, although an industry task force had been organized to address the issue. (Docket No. EE-DET-03-001, NEMA, No. 2 at p. 2) NEMA also directed DOE to NEMA LSD 14-2010, "Guidelines on the Application of Dimming High-Intensity Discharge Lamps." (Docket No. EE-DET-03-001, NEMA, No. 2 at p. 2) DOE has since reviewed LSD 14-2010 and identified three major issues related to dimming HID lamps:

1. HID lamps should not be dimmed below 50 percent of rated lamp wattage.
2. Color, lamp life, lumen depreciation, and efficacy can be affected by dimming.
3. Lamps, ballasts, and control systems could have compatibility issues because each component of the HID system would be required to be designed for use with dimming (i.e., a dimmable HID lamp could not be placed on any existing ballast and be dimmed, it would have to be placed specifically on a dimmable ballast in order for the lamp to be dimmed).

In the February 2013 HID lamps ECS Interim Analysis document, DOE stated that it plans to assess HID lamp performance at full light output only. (Docket No. EERE-2010-BT-STD-0043, DOE, Framework Document, No. 2 at pp. 15) Therefore, in this SNOPR, DOE is not proposing to require testing of HID lamps in the dimmed state for potential energy conservation standards.

F. Standby Mode and Off Mode Energy Usage

In the December 2011 TP NOPR, DOE stated that HID lamps do not operate in standby or off mode and, thus, energy use in those states would not be measured. 76 FR 77914, 77924 (Dec. 15, 2011). DOE received no comments on its proposed approach. This proposal is unaffected by this SNOPR.

G. Laboratory Accreditation Program

In the December 2011 TP NOPR, DOE proposed that testing be conducted by test laboratories accredited by NVLAP or an accrediting organization recognized by NVLAP. 76 FR 77914, 77923 (Dec. 15, 2011). NVLAP establishes standards for the accreditation of laboratories that test for compliance with relevant industry standards pursuant to 15 CFR 285.3. Id. A manufacturer's or importer's own laboratory, if accredited, may be used to conduct the applicable testing. 15 CFR 285.3.

DOE received comments on the following related topics: (1) additional accrediting organizations; (2) color measurements; (3) lab-to-lab measurement variations; and (4) lumen maintenance testing and NVLAP.

NEMA generally supported DOE's proposed laboratory accreditation requirements but stated that NVLAP does not recognize other accrediting organizations. NEMA cautioned DOE against involving other accrediting organizations, citing additional administrative and cost burdens, and recommended that DOE limit its laboratory accreditation requirements to NVLAP-accredited laboratories only. (NEMA, No. 6 at p. 12) NEMA also stated that any CCT or CRI measurements should be performed by an NVLAP-accredited facility. (NEMA, No. 6 at p. 3)

NEMA stated that almost all HID lamp lumen maintenance testing occurs at lamp manufacturing facilities, which are typically not NVLAP-accredited. (NEMA, No. 6 at p. 13) During the March 2012 ECS public meeting, Venture elaborated by stating that manufacturers support using NVLAP-accredited laboratories for testing color and efficacy, but that lumen maintenance testing could overload these external laboratories. Venture stated that this was a similar problem with GSIL life testing. (Docket No. EERE-2010-BT-STD-0043, Venture, No. 7 at pp. 166–167) DOE recognizes these comments related to lumen maintenance but no longer proposes lumen maintenance as part of this SNOPR.

DOE finds that the benefits from testing in NVLAP-accredited laboratories only do not outweigh the costs, both in terms of financial costs and additional time before new lamp models are approved for commercial sale. Because of this, DOE does not propose that testing related to

efficacy and color measurements be performed in NVLAP-accredited laboratories only. DOE requests comment on the proposal to not require testing to be performed in NVLAP-accredited laboratories only.

NEMA directed DOE to NVLAP's "Proficiency Testing for Energy Efficient Lighting Products," which shows lab-to-lab measurement variations of more than 4 percent, depending on the lamp technology. (NEMA, No. 6 at p. 13) DOE researched this document and determined that the "Proficiency Testing for Energy Efficient Lighting Products" document is still being developed and not available.

H. Effective Date and Compliance Date for the Test Procedures and Compliance Date for Submitting High-Intensity Discharge Lamp Certification Reports

1. Effective Date for the Test Procedures

The test procedures will be effective 30 days after publication of any final rule in the Federal Register**.**

2. Compliance Date for the Test Procedures

The compliance date for making any representations of the energy efficiency of covered HID lamps is 180 days from the date of the publication of any final rule in the Federal Register. On or after that date, any such representations, including those made on marketing materials and product labels, would be required to be based on results generated under the final test procedures and the applicable sampling plans.

3. Compliance Date for Submitting High-Intensity Discharge Lamp Certification Reports

Until DOE establishes energy conservation standards for HID lamps, manufacturers, including importers, are not required to submit compliance statements or certification reports for HID lamps. DOE will address these requirements should DOE establish energy conservation standards for HID lamps.

III. Procedural Issues and Regulatory Review

A. Review Under Executive Order 12866

The Office of Management and Budget (OMB) has determined that test procedures rulemakings do not constitute "significant regulatory actions" under section 3(f) of Executive Order 12866, "Regulatory Planning and Review," 58 FR 51735 (Oct. 4, 1993). Accordingly, this action was not subject to review under the Executive Order by the Office of Information and Regulatory Affairs (OIRA) in the OMB.

B. Review Under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 et seq.) requires preparation of a regulatory flexibility analysis for any rule that by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by Executive Order 13272, "Proper Consideration of Small Entities in Agency Rulemaking," 67 FR 53461 (Aug. 16, 2002), DOE published procedures and policies to ensure that the potential impacts of its rules on small entities are properly considered during the DOE rulemaking process. 68 FR 7990 (Feb. 19,

2003). DOE has made its procedures and policies available on the Office of the General Counsel's website: http://energy.gov/gc/office-general-counsel.

DOE reviewed the test procedures considered in today's SNOPR under the provisions of the Regulatory Flexibility Act (RFA) and the policies and procedures published on February 19, 2003. As discussed in more detail below, DOE found that because the proposed test procedures have not previously been required of manufacturers, all manufacturers, including small manufacturers, may potentially experience a financial burden associated with new testing requirements. While examining this issue, DOE determined that it could not certify that the proposed rule, if promulgated, would not have a significant impact on a substantial number of small entities. Therefore, DOE has prepared an Initial Regulatory Flexibility Analysis (IRFA) for this rulemaking. The IRFA describes the potential impacts on small businesses associated with HID lamp testing and labeling requirements. DOE has transmitted a copy of this IRFA to the Chief Counsel for Advocacy of the Small Business Administration (SBA) for review.

1. Estimated Small Business Burden

SBA has set a size threshold for electric lamp manufacturers to describe those entities that are classified as "small businesses" for the purposes of the IRFA. DOE used the SBA's small business size standards to determine whether any small manufacturers of HID lamps would be subject to the requirements of the rule. 65 FR 30836, 30849 (May 15, 2000), as amended at 65 FR 53533, 53545 (Sept. 5, 2000) and codified at 13 CFR part 121. The size standards are listed by North American Industry Classification System (NAICS) code and industry descriptions are available at http://www.sba.gov/sites/default/files/files/Size_Standards_Table.pdf.

In the December 2011 TP NOPR, DOE stated that none of the HID lamp manufacturers surveyed would be considered a small business under SBA size standards – NAICS code 335110 and under 1,000 employees. 76 FR 77914, 77925 (Dec. 15, 2011). In making this determination, DOE developed a list of potential manufacturers by referring to the energy conservation standards (Docket EERE-2010-BT-STD-0043), reviewing NEMA membership, and surveying the lighting industry. After developing the list of potential manufacturers, DOE researched each manufacturer to determine if the manufacturer was domestic and how many employees the manufacturer employed. DOE received no comments on its statement on small businesses following the December 2011 TP NOPR. However, DOE's additional review identified two small manufacturers that potentially qualify for a small business under NAICS 335110 because these companies had fewer than 1,000 employees, were domestic, and not owned by a subsidy or owned by a larger company.

DOE also acknowledges Philips and NEMA's comments that DOE underestimated testing expenses in the December 2011 TP NOPR. Philips stated in the HID TP public meeting that annual electricity cost alone for lumen maintenance testing would exceed $200 per individual lamp, extrapolating to $4,200 for a sample size of 21 lamps. Philips estimated their catalog represents 200 basic models and thus the total cost of electricity could be over $2.3 million (accounting for the fact that lumen maintenance testing could require two to three years to complete). (Public Meeting Transcript, No. 5 at pp. 110 – 111) NEMA reiterated that electricity costs for lumen maintenance testing were $200 per lamp (or more than $4,200 for 21 lamps of a basic model per year). (NEMA, No. 6 at p. 13) DOE determined that GE, Philips, and OSRAM SYLVANIA (none of which qualify as small HID lamp manufacturers) each possibly

have more than 200 basic models of HID lamps, and used an estimated number of basic models from these manufacturers' catalogs to estimate the potential annual electricity costs per manufacturer for lumen maintenance testing. As stated previously, DOE no longer proposes lumen maintenance testing for use with the possible energy conservation standard.

Labor and operating costs associated with conducting the input power, lumen output, CCT and CRI testing contribute to overall burden. However, DOE believes that calculating the efficacy of an HID lamp does not result in any incremental testing burden beyond the cost of carrying out lumen output and input power testing. DOE expects that the majority of manufacturers are already testing for lumen output, input power, CCT and CRI, as these metrics are well-established and most manufacturers report the values in their catalogs. However, DOE's sample size and other requirements may differ from those selected for a manufacturer's existing data. Therefore, DOE included the cost of carrying out these tests in its assessment of testing burden.

Table III.1 lists representative rated lamp wattages and the ballast input power required to operate the corresponding lamps. DOE calculated the annual costs of operating the lamps for representative ballast input power values. Table III.1 facilitates comparison of representative lamp wattages.

Table III.1 Rated Lamp Power and Associated Ballast Input Power

HPS		MV		Quartz Probe (MH)		Quartz Pulse (MH)		Ceramic Pulse (MH)	
Rated Lamp Wattage	Input Power W	Rated Lamp Wattage	Input Power W	Rated Lamp Wattage	Input Power W	Rated Lamp Wattage	Input Power W	Rated Lamp Wattage	Input Power W
35	44	---	---	---	---	---	---	---	---
50	60	50	68	---	---	50	70	50	70
70	94	---	---	---	---	70	98	70	98

---	---	75	93	---	---	---	---	---	---
100	122	100	125	---	---	100	125	100	125
150	185	---	---	---	---	150	185	150	185
---	---	175	202	175	208	175	209	---	---
200	230	---	---	---	---	---	---	---	---
250	295	250	283	250	291	250	285	250	285
---	---	---	---	---	---	320	367	320	367
---	---	---	---	360	400	350	400	350	400
400	465	400	454	400	456	400	458	400	458
1000	1100	1000	1080	1000	1080	1000	1060	---	---
---	---	---	---	1500	1610	---	---	---	---

The potential total number of lamps tested is a function of the number of basic models and the required sample size. In the December 2011 TP NOPR, DOE proposed a sample size of 21 for lamp efficacy, CCT, and lumen maintenance. As previously stated in this SNOPR, DOE only plans to test lamp efficacy and CCT in setting potential HID lamps energy conservation standards (and CRI for excluding certain types of lamps from standards coverage). In addition, DOE continues to propose in this SNOPR to use a sample size for lamp efficacy and CCT of 21 lamps per basic model.

For stabilization and related testing, DOE assumed 7 hours of operation for the MH lamps and 3 hours for HPS and MV lamps. That ballast input power required to operate the lamps (shown in Table III.1) was multiplied by the respective hours and an electricity rate of $0.1052 per kilowatt-hour (kWh).[25]

The costs in the table were calculated as follows:

[25] The electricity rate of $0.1052 per kWh is the average commercial rate year from January through February 2014 from the U.S. Energy Information Administration's (EIA's) Electric Power Monthly, October 2013, Table 5.3, available at: www.eia.gov/electricity/monthly/ (last accessed April 4, 2014).
NEMA's written comments reference an electricity cost of $0.10 per kWh. These rates should be considered the same for most purposes.

Number of basic models (per lamp type) x sample size × input power × operating hours × $0.1052/kWh

Table III.2 shows the operating costs for MV lamps for a possible manufacturer. The number of basic models is multiplied by the sample size by the input power (see Table III.1) by the operating hours (seasoning plus testing operation) and finally multiplied by the electricity cost per kilowatt-hour. The total cost for electricity for testing this family of lamps can be determined by summing the total electricity costs for the lamps—$1,218.52. The cost per basic model for electricity can be determined by dividing the total electricity costs ($1,218.52) by the total number of basic models (16), which is a cost per basic model of $76.16.

Table III.2 Example Operating Electricity Costs for MV Lamps

Rated Lamp Power	# Basic Models	Samples	Input Power	Operating Hours	Electricity Rate	Total Electricity Cost
50	1	21	68	103	$0.1052	$15.47
75	1	21	93	103	$0.1052	$21.16
100	4	21	125	103	$0.1052	$113.77
175	3	21	202	103	$0.1052	$137.89
250	2	21	283	103	$0.1052	$128.79
400	3	21	454	103	$0.1052	$309.92
1000	2	21	1080	103	$0.1052	$491.50
Total cost for electricity for testing this family of lamps						$1,218.52

NEMA requested in its review of estimated testing costs that labor-year costs be added into the analysis. (NEMA, No. 6 at p. 13) DOE reviewed the 2012 median pay for electrical and electronic engineering technicians ($57,850), electrical and electronics engineers ($89,630) and electro-mechanical technicians ($51,820), and calculated an average annual salary of $66,433 from the U.S. Department of Labor Bureau of Labor Statistics.[26] This average was divided by 1,920 hours per year (40 hours per week for 48 weeks per year) to develop an hourly rate of

[26] United States Department of Labor. Bureau of Labor Statistics Occupational Outlook Handbook. Washington, DC. (Last accessed April 7, 2014.) www.bls.gov/ooh/Architecture-and-Engineering/home.htm.

$34.06. The hourly rate was multiplied by 31 percent[27] to account for benefits[28] to calculate an estimated total cost per hour of $45.32.

DOE assumed that the testing technician would not be needed for the entire time because the technician can perform other tasks not related to testing the lamp while the lamp is being stabilized. Therefore, DOE multiplied the full labor rate by 50 percent of the expected total operation time of the lamp.

Table III.3 shows the labor costs for MV lamps for a possible manufacturer. The number of basic models is multiplied by the sample size by the hourly labor rate by the testing time by the time utilization of the technician (50 percent of the technician's time during testing) to determine the total labor costs. The total example labor costs can be determined by summing all of the values in the total labor costs column to equal $22,841.28. The total example labor cost per basic model can be determined by dividing the total labor costs ($22,481.28) by the total quantity of basic models (16) to equal about $1,427.58.

Table III.3 Example Labor Costs for Testing MV Lamps

# Basic Models	Samples	Lamp Power	Hourly Labor Rate	Hours	Time Utilization	Total Labor Costs
1	21	50	$45.32	3	50%	$1,427.58
1	21	75	$45.32	3	50%	$1,427.58
4	21	100	$45.32	3	50%	$5,710.32
3	21	175	$45.32	3	50%	$4,282.74
2	21	250	$45.32	3	50%	$2,855.16
3	21	400	$45.32	3	50%	$4,282.74
2	21	1000	$45.32	3	50%	$2,855.16

[27] Obtained from the Bureau of Labor Statistics (News Release: Employer Cost For Employee Compensation – December 2012, U.S. Department of Labor (December 2012), www.bls.gov/news.release/ecec.nr0.htm.
[28] Additional benefits include: paid leave, supplemental pay, insurance, retirement and savings, Social Security, Medicare, unemployment insurance and workers compensation.

The process of determining the electricity costs (depicted in Table III.2) and determining the labor costs (depicted in Table III.3) was repeated for MH and HPS lamps. In summary, the cost for electricity per HPS basic model was $55.88 and per MH basic model was $59.81. The labor costs per HPS basic model was $1,427.58 and the labor costs per MH basic model was $3,331.02.

In the August 30, 2013, memorandum documenting ex parte communication, NEMA indicated further reservations concerning future interpretation of the proposed definition of "basic model," stating that because HID lamps are not classified into families, every HID lamp could potentially be identified as a separate basic model requiring testing and significantly increasing costs. (Docket EERE-2010-BT-STD-0043, NEMA No. 29 at p. 2) In response to NEMA's comment about the lack of families for HID lamps, DOE analyzed a large number of potential basic models for each type of HID lamp.

DOE was able to collect annual revenue estimates for the two small business HID lamp manufacturers using Hoovers.com company profile database. DOE determined that the mean revenue of the identified small business manufacturers is $10,300,000.[29] DOE then analyzed the potential burden on one of the two small manufacturers as a proxy for all the small manufacturers. For this manufacturer, DOE identified 36 different wattage MH lamps, 13 different wattage HPS lamps, and 5 different wattage MV lamps offered by the manufacturer. For each wattage and type of lamp, the manufacturer could possibly have between one and five

[29] According to Hoovers.com, the smallest of the two small business HID lamp manufacturers had revenues of $6.1 million per year.

different basic models. DOE estimated the total cost to test 21 samples, assuming that each lamp type/wattage combination was a basic model, to be $145,613.16. DOE estimated that a maximum total cost to test 21 samples, assuming that each lamp offered was treated as a different basic model, would be $321,681.36. According to DOE's calculations, the proposed testing cost represents between 1.39 percent and 3.06 percent of the mean revenues of the two small business manufacturers. DOE requests comment on the estimated number of small businesses that would be affected by the proposed rulemaking.

The final cost per manufacturer primarily depends on the number of basic models of that lamp type that a manufacturer sells. Some lamp types have more basic models than others. These are not annual costs because DOE does not require manufacturers to retest a basic model annually. The initial test results used to generate a certified rating for a basic model remain valid as long as the basic model has not been modified from the tested design in a way that makes it less efficient or more consumptive, which would require a change to the certified rating. If a manufacturer has modified a basic model in a way that makes it more efficient or less consumptive, new testing is required only if the manufacturer wishes to make representations of the new, more efficient rating.

DOE seeks comments on its determination that it could not certify that the proposed rule, if promulgated, would not have a significant impact on a substantial number of small entities. DOE also seeks comment on the methodologies and data used to reach this determination, including data on the average number of years a basic model remains unchanged (and therefore does not require annual retesting).

C. Review Under the Paperwork Reduction Act of 1995

There is currently no information collection requirement related to the test procedures for HID lamps. In the event that DOE proposes an energy conservation standard with which manufacturers must demonstrate compliance, or otherwise proposes to require the collection of information derived from the testing of HID lamps according to these test procedures, DOE will seek OMB approval of such information collection requirement.

Manufacturers of covered products must certify to DOE that their products comply with any applicable energy conservation standard developed by DOE. In certifying compliance, manufacturers must test their products according to the applicable DOE test procedure, including any amendments adopted for that test procedure.

DOE established regulations for the certification and recordkeeping requirements for certain covered consumer products and commercial equipment. 76 FR 12422 (March 7, 2011). The collection-of-information requirement for the certification and recordkeeping was subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement was approved by OMB under OMB Control Number 1910-1400. Public reporting burden for the certification was estimated to average 20 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

As stated above, if DOE proposes an energy conservation standard for HID lamps with which manufacturers must demonstrate compliance, DOE will seek OMB approval of the

associated information collection requirement. DOE will seek approval either through a proposed amendment to the information collection requirement approved under OMB Control Number 1910-1400 or as a separate proposed information collection requirement.

Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless that collection of information displays a currently valid OMB Control Number.

D. Review Under the National Environmental Policy Act of 1969

In this proposed rule, DOE proposes test procedures that it expects will be used to develop and implement future energy conservation standards for HID lamps. DOE has determined that this rule falls into a class of actions that are categorically excluded from review under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.) and DOE's implementing regulations at 10 CFR part 1021. Specifically, this proposed rule would establish test procedures without affecting the amount, quality, or distribution of energy usage, and therefore would not result in any environmental impacts. Thus, this rulemaking is covered by Categorical Exclusion A6 under 10 CFR part 1021, subpart D, which applies to any rulemaking that interprets or amends an existing rule without changing the environmental effect of that rule. Accordingly, neither an environmental assessment nor an environmental impact statement is required.

E. Review Under Executive Order 13132

Executive Order 13132, "Federalism," 64 FR 43255 (Aug. 4, 1999), imposes certain requirements on agencies formulating and implementing policies or regulations that preempt State law or that have Federalism implications. The Executive Order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive Order also requires agencies to have an accountable process to ensure meaningful and timely input by State and local officials in the development of regulatory policies that have Federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. DOE has examined this proposed rule and has determined that it would not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the equipment that is the subject of today's proposed rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297(d)) No further action is required by Executive Order 13132.

F. Review Under Executive Order 12988

Regarding the review of existing regulations and the promulgation of new regulations, section 3(a) of Executive Order 12988, "Civil Justice Reform," 61 FR 4729 (Feb. 7, 1996), imposes on Federal agencies the general duty to adhere to the following requirements: (1) eliminate drafting errors and ambiguity; (2) write regulations to minimize litigation; (3) provide

a clear legal standard for affected conduct rather than a general standard; and (4) promote simplification and burden reduction. Section 3(b) of Executive Order 12988 specifically requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) clearly specifies the preemptive effect, if any; (2) clearly specifies any effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct while promoting simplification and burden reduction; (4) specifies the retroactive effect, if any; (5) adequately defines key terms; and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. Section 3(c) of Executive Order 12988 requires Executive agencies to review regulations in light of applicable standards in sections 3(a) and 3(b) to determine whether they are met or it is unreasonable to meet one or more of them. DOE has completed the required review and determined that, to the extent permitted by law, the proposed rule meets the relevant standards of Executive Order 12988.

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Pub. L. 104-4, sec. 201 (codified at 2 U.S.C. 1531). For a proposed regulatory action likely to result in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of $100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal

governments on a proposed "significant intergovernmental mandate," and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect small governments. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820; also available at http://energy.gov/gc/office-general-counsel. DOE examined today's proposed rule according to UMRA and its statement of policy and determined that these requirements do not apply because the rule contains neither an intergovernmental mandate nor a mandate that may result in the expenditure of $100 million or more in any year.

H. Review Under the Treasury and General Government Appropriations Act, 1999

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105-277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. This rule would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

I. Review Under Executive Order 12630

DOE has determined, under Executive Order 12630, "Governmental Actions and Interference with Constitutionally Protected Property Rights," 53 FR 8859 (March 18, 1988), that this regulation would not result in any takings that might require compensation under the Fifth Amendment to the U.S. Constitution.

J. Review Under the Treasury and General Government Appropriations Act, 2001

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516 note) provides for agencies to review most disseminations of information to the public under guidelines established by each agency pursuant to general guidelines issued by OMB. OMB's guidelines were published at 67 FR 8452 (Feb. 22, 2002), and DOE's guidelines were published at 67 FR 62446 (Oct. 7, 2002). DOE has reviewed today's proposed rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under Executive Order 13211

Executive Order 13211, "Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use," 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to OMB a Statement of Energy Effects for any proposed significant energy action. A "significant energy action" is defined as any action by an agency that promulgated or is expected to lead to promulgation of a final rule, and that: (1) is a significant regulatory action under Executive Order 12866, or any successor order; and (2) is likely to have a significant adverse effect on the supply, distribution, or use of energy; or (3) is designated by the Administrator of OIRA as a significant energy action. For any proposed significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use should the proposal be implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

Today's regulatory action to create the test procedures for measuring the energy efficiency of HID lamps is not a significant regulatory action under Executive Order 12866. Moreover, it would not have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as a significant energy action by the Administrator of OIRA. Therefore, it is not a significant energy action, and, accordingly, DOE has not prepared a Statement of Energy Effects.

L. Review Under Section 32 of the Federal Energy Administration Act of 1974

Under section 301 of the Department of Energy Organization Act (Pub. L. 95-91; 42 U.S.C. 7101), DOE must comply with section 32 of the Federal Energy Administration Act of 1974, as amended by the Federal Energy Administration Authorization Act of 1977. (15 U.S.C. 788; FEAA) Section 32 essentially provides in relevant part that, where a proposed rule authorizes or requires use of commercial standards, the notice of proposed rulemaking must inform the public of the use and background of such standards. In addition, section 32(c) requires DOE to consult with the Attorney General and the Chairman of the Federal Trade Commission (FTC) concerning the impact of the commercial or industry standards on competition.

The proposed test procedures incorporate testing methods contained in the following commercial standards:

1. ANSI C78.389-R2009, "American National Standard for Electric Lamps—High Intensity Discharge—Methods of Measuring Characteristics" (sections 1.0, 2.0, 3.0, and Figure 1);

2. CIE 13.3-1995, "Technical Report: Method of Measuring and Specifying Colour Rendering Properties of Light Sources";
3. CIE 15:2004, "Technical Report: Colorimetry";
4. IES LM-51-13, "Approved Method for the Electrical and Photometric Measurements of High Intensity Discharge Lamps" (sections 1.0, 5.2, 7.0, and 8.0); and
5. IES LM-78-07, "IESNA Approved Method for Total Luminous Flux Measurement of Lamps Using an Integrating Sphere Photometer" (sections 3.1 and 6.3).

DOE evaluated these standards and is unable to conclude whether they fully comply with the requirements of section 32(b) of the Federal Energy Administration Act, (i.e., that they were developed in a manner that fully provides for public participation, comment, and review). Before prescribing a final rule, DOE will consult with the Attorney General and the Chairman of the FTC about the effect of these test procedures on competition.

IV. Public Participation

A. Submission of Comments

DOE will accept comments, data, and information regarding this proposed rule no later than the date provided in the DATES section at the beginning of this proposed rule. Interested parties may submit comments using any of the methods described in the ADDRESSES section at the beginning of this notice.

Submitting comments via www.regulations.gov. The www.regulations.gov web page will require you to provide your name and contact information. Your contact information will be viewable to DOE Building Technologies staff only. Your contact information will not be publicly viewable except for your first and last names, organization name (if any), and submitter representative name (if any). If your comment is not processed properly because of technical difficulties, DOE will use this information to contact you. If DOE cannot read your comment due to technical difficulties and cannot contact you for clarification, DOE may not be able to consider your comment.

However, your contact information will be publicly viewable if you include it in the comment or in any documents attached to your comment. Any information that you do not want to be publicly viewable should not be included in your comment, nor in any document attached to your comment. Otherwise, persons viewing comments will see only first and last names, organization names, correspondence containing comments, and any documents submitted with the comments.

Do not submit to www.regulations.gov information for which disclosure is restricted by statute, such as trade secrets and commercial or financial information (hereinafter referred to as Confidential Business Information (CBI)). Comments submitted through regulations.gov cannot be claimed as CBI. Comments received through www.regulations.gov will waive any CBI claims for the information submitted. For information on submitting CBI, see the Confidential Business Information section.

DOE processes submissions made through www.regulations.gov before posting. Normally, comments will be posted within a few days of being submitted. However, if large volumes of comments are being processed simultaneously, your comment may not be viewable for up to several weeks. Please keep the comment tracking number that www.regulations.gov provides after you have successfully uploaded your comment.

Submitting comments via email, hand delivery/courier, or mail. Comments and documents submitted via email, hand delivery/courier, or mail also will be posted to www.regulations.gov. If you do not want your personal contact information to be publicly viewable, do not include it in your comment or any accompanying documents. Instead, provide your contact information in a cover letter. Include your first and last names, email address, telephone number, and optional mailing address. The cover letter will not be publicly viewable as long as it does not include any comments

Include contact information each time you submit comments, data, documents, and other information to DOE. If you submit via mail or hand delivery/courier, please provide all items on a CD, if feasible, in which case it is not necessary to submit printed copies. No facsimiles (faxes) will be accepted.

Comments, data, and other information submitted to DOE electronically should be provided in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format. Provide documents that are not secured, written in English, and free of any defects or viruses.

Documents should not contain special characters or any form of encryption and, if possible, they should carry the electronic signature of the author.

Campaign form letters. Please submit campaign form letters by the originating organization in batches of between 50 to 500 form letters per PDF or as one form letter with a list of supporters' names compiled into one or more PDFs. This reduces comment processing and posting time.

Confidential Business Information. Pursuant to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit via email, postal mail, or hand delivery/courier two well-marked copies: one copy of the document marked "confidential," including all the information believed to be confidential, and one copy of the document marked "non-confidential," with the information believed to be confidential deleted. Submit these documents via email or on a CD, if feasible. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

Factors of interest to DOE when evaluating requests to treat submitted information as confidential include: (1) A description of the items; (2) whether and why such items are customarily treated as confidential within the industry; (3) whether the information is generally known by or available from other sources; (4) whether the information has previously been made available to others without obligation concerning its confidentiality; (5) an explanation of the competitive injury to the submitting person which would result from public disclosure; (6) when

such information might lose its confidential character due to the passage of time; and (7) why disclosure of the information would be contrary to the public interest.

It is DOE's policy that all comments may be included in the public docket, without change and as received, including any personal information provided in the comments (except information deemed to be exempt from public disclosure).

B. Issues on Which DOE Seeks Comment

DOE requests comments and data on the HID lamp test procedures proposed in this SNOPR. Although comments are welcome on all aspects of this rulemaking, DOE is particularly interested in comments on the following:

1. Definitions

DOE seeks comments on all of the proposed definitions in this SNOPR.

a. Beam Angle

DOE requests comments on its proposal to withdraw the December 2011 TP NOPR proposed definition of "beam angle."

b. Color Rendering Index

DOE requests comments on its proposal to retain the December 2011 TP NOPR proposed definition of "color rendering index."

c. Correlated Color Temperature

DOE requests comments on its proposal to retain the December 2011 TP NOPR proposed definition of "correlated color temperature."

d. Directional Lamp

DOE requests comments on its proposal to revise the December 2011 TP NOPR proposed definition of "directional lamp."

e. High-Pressure Sodium Lamp

DOE requests comments on its proposal to retain the December 2011 TP NOPR proposed definition of "high-pressure sodium lamp."

f. Initial lumen output

DOE requests comments on its proposal to add a definition for "initial lumen output."

g. Lamp Efficacy

DOE requests comments on its proposal to revise the December 2011 TP NOPR proposed definition for "lamp efficacy."

h. Lamp Electrical Power Input

DOE requests comments on its proposal to withdraw the December 2011 TP NOPR proposed definition of "lamp electrical power input.".

i. Lamp Wattage

DOE requests comments on its proposal to revise to the December 2011 TP NOPR proposed definition of "lamp wattage."

j. Lumen Maintenance

DOE requests comments on its proposal to withdraw the December 2011 TP NOPR proposed definition of "lumen maintenance."

k. Mercury Vapor Lamp

DOE requests comments on its proposal to retain the December 2011 TP NOPR definition of "mercury vapor lamp."

l. Metal Halide Lamp

DOE requests comments on its proposal to retain the December 2011 TP NOPR definition of "metal halide lamp."

m. Rated Luminous Flux or Lumen Output

DOE requests comments on its proposal to withdraw December 2011 TP NOPR definition for "rated luminous flux or lumen output."

n. Self-Ballasted Lamp

DOE requests comments on its proposal to retain the December 2011 TP NOPR definition for "self-ballasted lamp."

o. Ballast Efficiency

DOE requests comments on its proposal to retain the definition of "ballast efficiency" for high-intensity discharge fixtures, currently set forth at 10 CFR 431.322.

p. Basic Model

DOE requests comments on its proposal to revise the December 2011 TP NOPR definition of "basic model."

2. Ambient Test Temperature

DOE requests comments on retaining the December 2011 TP NOPR proposed ambient test temperature requirements (25 °C ±5 °C) based on IES LM-51-13.

3. Air Speed

DOE requests comments on its proposal to eliminate the December 2011 TP NOPR proposed specific air speed requirements.

4. Reference Ballasts

DOE requests comments on its proposed approach for testing HID lamps for which there are no ANSI reference ballasts.

5. Instrumentation for Photometric Measurement

DOE requests comments on its proposal to incorporate by reference sections 3.1 and 6.3 of LM-78-07, and add related text that references LM-78-07 guidance on integrating sphere measurement errors and corrections.

6. Sampling Plan

DOE requests comments on its proposed sampling plan as summarized and discussed in section II.C.1.c, especially regarding sample size (21 units for lamp efficacy and correlated color temperature), statistical representation (confidence intervals of 90 percent for MH lamps, and 99 percent for HPS and MV lamps), and divisor (0.97).

7. Lamp Seasoning and Stabilization

DOE requests comments on its proposed requirement that HID lamps with no specified operating position (including universal position lamps) be operated in the vertical base-up orientation for seasoning and stabilization purposes.

8. Cool-Down and Re-stabilization

DOE requests comments on its proposed cool-down and re-stabilization requirements.

9. Lamp Orientation

DOE requests comments on its proposed requirement that HID lamps with no specified operating position (including universal position lamps) be tested in the vertical base up position.

10. Special Consideration for Directional Lamps

DOE requests comments on its proposal to exclude directional lamp testing in this SNOPR.

11. Efficacy

DOE requests comments on its proposed method of calculating HID lamp efficacy and reporting efficacy to the nearest tenth of a lumen per watt.

12. Measurement and Calculation of Correlated Color Temperature and Color Rendering Index

DOE requests comments on its proposed measurement methods for color characteristics (CCT and CRI).

13. Dimming

DOE requests comments on its proposal that eliminates testing HID lamps in a dimmed state.

14. Small Business Burden

DOE requests comment on its determination that it could not certify that the proposed rule, if promulgated, would not have a significant impact on a substantial number of small entities. DOE also seeks comment on the methodologies and data used to reach this determination.

15. Basic Model Introduction and Modification

DOE requests comment on the expected frequency of introductions of new basic models and the average number of years a basic model remains unmodified to potentially better determine the potential effects of this rule on small businesses.

V. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this supplemental notice of proposed rulemaking.

List of Subjects

10 CFR Part 429

Administrative practice and procedure, Buildings and facilities, Business and industry, Energy conservation, Grants programs – energy, Housing, Reporting and recordkeeping requirements, Technical assistance.

10 CFR Part 431

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Imports, Incorporation by reference, Reporting and recordkeeping requirements, Small business.

Issued in Washington, DC, on May 5, 2014.

Kathleen B. Hogan
Deputy Assistant Secretary for Energy Efficiency
Energy Efficiency and Renewable Energy

For the reasons stated in the preamble, DOE proposes to amend parts 429 and 431 of chapter II of title 10, Code of Federal Regulations as set forth below:

PART 429--CERTIFICATION, COMPLIANCE, AND ENFORCEMENT FOR CONSUMER PRODUCTS AND COMMERCIAL AND INDUSTRIAL EQUIPMENT

1. The authority citation for part 429 continues to read as follows:

Authority: 42 U.S.C. 6291–6317.

2. Section 429.11 is revised to read as follows:

§429.11 General sampling requirements for selecting units to be tested.

(a) When testing of covered products or covered equipment is required to comply with section 323(c) of the Act, or to comply with rules prescribed under sections 324, 325, or 342, 344, 345, or 346 of the Act, a sample composed of production units (or units representative of production units) of the basic model being tested must be selected at random and tested, and must meet the criteria found in §§429.14 through 429.55 of this subpart. Components of similar design may be substituted without additional testing if the substitution does not affect energy or water consumption. Any represented values of energy efficiency, water efficiency, energy consumption, or water consumption for all individual models represented by a given basic model must be the same.

(b) Unless otherwise specified, the minimum number of units tested must be no less than two (except where a different minimum limit is specified in §§429.14 through 429.55 of this subpart).

3. Section 429.55 is added to read as follows:

§429.55 High-intensity discharge (HID) lamps.

(a) Sampling plan for selection of units for testing. (1) The requirements of §429.11 are applicable to high-intensity discharge (HID) lamps. HID lamps include high-pressure sodium (HPS), mercury vapor (MV), and metal halide (MH) lamps.

(2)(i) For each basic model of HID lamp, a sample of sufficient size, but not less than 21 units, shall be randomly selected and tested to ensure that – any represented value of lamp efficacy of a basic model shall be less than or equal to the lower of:

(A) The mean of the sample, where:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

$\bar{x}$ is the sample mean,

n is the number of samples, and

x_i is the i^{th} sample;

Or,

(B) The lower confidence limit (LCL) of the true mean divided by 0.97, where:

$$LCL = \bar{x} - t\left(\frac{s}{\sqrt{n}}\right)$$

$\bar{x}$ is the sample mean,

s is the sample standard deviation,

n is the number of samples, and

t is the t statistic for a 90-percent one-tailed confidence interval with n-1 degrees of freedom (from appendix A) for MH lamps, and the t statistic for a 99-percent one-tailed

confidence interval with n-1 degrees of freedom (from appendix A) for HPS and MV lamps.

(ii) For each basic model of HID lamp, the correlated color temperature (CCT) must be measured from the same lamps selected for the lamp efficacy measurements in paragraph (a)(2)(i) of this section (i.e., the manufacturer must measure all lamps for lumens, input power, and CCT). The CCT must be represented as the mean of a minimum sample of 21 lamps, where:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

$\bar{x}$ is the sample mean,

n is the number of samples, and

x_i is the i^{th} sample.

(b) Certification reports.

[Reserved]

PART 431--ENERGY EFFICIENCY PROGRAM FOR CERTAIN COMMERCIAL AND INDUSTRIAL EQUIPMENT

1. The authority citation for part 431 continues to read as follows:

Authority: 42 U.S.C. 6291-6317.

2. Subpart 431.2 is amended by adding in alphabetical order, definitions for “ballast”, “high-intensity discharge lamp”, “high-pressure sodium (HPS) lamp”, “mercury vapor lamp”, and “metal halide lamp” to read as follows:

§431.2 Definitions.

* * * * *

Ballast means a device used with an electric discharge lamp to obtain necessary circuit conditions (voltage, current, and waveform) for starting and operating.

* * * * *

High-intensity discharge lamp means an electric-discharge lamp in which –

(i) The light-producing arc is stabilized by the arc tube wall temperature; and

(ii) The arc tube wall loading is in excess of 3 watts/cm^2, including such lamps that are high-pressure sodium, mercury vapor, and metal halide lamps.

High-pressure sodium (HPS) lamp means a high-intensity discharge lamp in which the major portion of the light is produced by radiation from sodium vapor operating at a partial pressure of about 6,670 pascals (approximately 0.066 atmospheres or 50 Torr) or greater.

* * * * *

Mercury vapor lamp means a high-intensity discharge lamp, including clear, phosphor-coated, and self-ballasted screw base lamps, in which the major portion of the light is produced by radiation from mercury typically operating at a partial vapor pressure in excess of 100,000 Pa (approximately 1 atm).

Metal halide lamp means a high-intensity discharge lamp in which the major portion of the light is produced by radiation of metal halides and their products of dissociation, possibly in combination with metallic vapors.

* * * * *

§ 431.282 [Amended]

3. Section 431.282 is amended by removing the definitions of “ballast”, “high intensity discharge lamp”, and “mercury vapor lamp”.

§ 431.322 [Amended]

4. Section 431.322 is amended by removing the definitions of “ballast” and “metal halide lamp.”

5. Subpart Y is added to part 431 to read as follows:

Subpart Y – High-Intensity Discharge Lamps

Sec.

431.451 Purpose and scope.
431.452 Definitions concerning high-intensity discharge lamps.
431.453 Materials incorporated by reference.
431.454 Uniform test method for calculation of lamp efficacy.
431.455 Energy conservation standards and their dates.

§431.451 Purpose and scope.

This subpart sets forth energy conservation requirements for high-intensity discharge lamps, pursuant to Parts A and A-1 of Title III of the Energy Policy and Conservation Act, as amended, and 42 U.S.C. 6291, et al.

§431.452 Definitions concerning high-intensity discharge lamps.

Basic model means all units of a given type of covered equipment (or class thereof) manufactured by one manufacturer, that have the same primary energy source, and that have essentially identical electrical, physical, and functional characteristics that affect energy consumption or efficacy.

Color rendering index or CRI means the measure of the degree of color shift objects undergo when illuminated by a light source as compared with the color of those same objects when illuminated by a reference source of comparable color temperature.

Correlated color temperature means the absolute temperature of a blackbody whose chromaticity most nearly resembles that of the light source.

Directional lamp means a lamp with an integral reflector, emitting at least 80 percent of its light output within a solid angle of π steradians (corresponding to a cone with an angle of 120 degrees).

Initial lumen output means the measured lumen output after the lamp is seasoned, then initially energized and stabilized, using the lamp seasoning and stabilization procedures in 10 CFR 431.454(b)(1).

Lamp efficacy means the lumen output of a lamp divided by its wattage, expressed in lumens per watt (LPW).

Lamp wattage means the total electrical power consumed by a lamp in watts, after the initial seasoning period referenced in section 6.2.1 of IES LM-51-13.

Self-ballasted lamp means a lamp unit that incorporates all elements that are necessary for the starting and stable operation of the lamp in a permanent enclosure and that does not include any replaceable or interchangeable parts.

§431.453 Materials incorporated by reference.

(a) General. DOE incorporates by reference the following standards into subpart Y of part 431. The material listed has been approved for incorporation by reference by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Any subsequent

amendment to a standard by the standard-setting organization will not affect the DOE regulations unless and until amended by DOE. Material is incorporated as it exists on the date of the approval, and a notice of any change in the material will be published in the Federal Register. All approved material is available for inspection at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030 or go to www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html. Also, this material is available for inspection at U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program, 6th Floor, 950 L'Enfant Plaza, SW, Washington, DC 20024, 202-586-2945. Standards can be obtained from the sources listed as follows.

(b) ANSI. American National Standards Institute, 25 W. 43rd Street, 4th Floor, New York, NY 10036, 212–642–4900, or go to www.ansi.org.

(1) ANSI C78.389-2004 (R2009) ("ANSI C78.389"), American National Standard for Electric Lamps - High Intensity Discharge - Methods of Measuring Characteristics, approved August 9, 2009, IBR approved for §431.454.

(b) Reserved.

(c) CIE. International Commission on Illumination (Commission Internationale de l'Eclairage) Central Bureau, Kegelgasse 27, A–1030, Vienna, Austria, 011+43 1 714 31 87 0, or go to www.cie.co.at.

(1) CIE 13.3-1995 ("CIE 13.3-1995"), Technical Report: Method of Measuring and Specifying Colour Rendering Properties of Light Sources, 1995. IBR approved for §431.454.

(2) CIE 15:2004 ("CIE 15-2004"), Technical Report: Colorimetry, 2004. IBR approved for §431.454.

(d) IES. Illuminating Engineering Society of North America, 120 Wall Street, Floor 17, New York, NY 10005-4001, 212-248-5000, or go to www.iesna.org.

(1) IES LM-51-13 ("LM-51-13"), Approved Method for the Electrical and Photometric Measurements of High Intensity Discharge Lamps, 2013. IBR approved for §431.454.

(2) IES LM-78-07 ("LM-78-07"), IESNA Approved Method for Total Luminous Flux Measurement of Lamps Using an Integrating Sphere Photometer, 2007. IBR approved for §431.454.

§ 431.454 Uniform test method for calculation of lamp efficacy and color characteristics.

Note: After [DATE 180 DAYS AFTER PUBLICATION OF TEST PROCEDURE FINAL RULE IN THE FEDERAL REGISTER], any representations made with respect to the efficacy, CCT, or CRI of HID lamps must be made in accordance with the results of testing pursuant to this test procedure.

(a) Test Setup and Conditions.

(1) Ambient conditions. The ambient conditions must be established in accordance with the specifications in section 4.0 of IES LM-51 (incorporated by reference; see §431.453).

(2) Power Supply Characteristics. The power supply characteristics must be established in accordance with section 3.2 of ANSI C78.389 (incorporated by reference; see §431.453).

(3) Reference Ballasts. For HID lamp testing, the reference ballast used must meet the requirements of ANSI C78.389. For HID lamp measurements (electrical and photometric), the

tested lamps must be operated with (i) a reference ballast with the matching ANSI rating or (ii) a reference ballast with variable impedance that can be set to match each lamp type to be tested. The reference ballast must have the impedance and the electrical characteristics required by ANSI for the lamp being tested. If electrical readings are to be taken on a lamp for which no ANSI standard exists, that lamp must be tested on a reference ballast with specifications that match the manufacturer specifications for the lamp such as those provided in a catalog or for marketing purposes online but not those provided for specific or limited uses, such as specifically for testing. If electrical readings are to be taken on a multi-start metal halide lamp, the lamp must be tested on a reference ballast with the characteristics defined in the equivalent probe-start ANSI lamp designation as listed in the lamp catalog or manufacturer data sheets with the lowest ANSI lamp designation. If no probe-start ANSI lamp designation is listed by the manufacturer, then the lamp must be tested on a reference ballast with the characteristics defined in the lowest ANSI lamp designation listed.

(4) Electrical instrumentation. Instrumentation for electrical measurements must meet the requirements of section 3.8 of ANSI C78.389 (incorporated by reference, see §431.453).

(5) Photometric instrumentation. Instrumentation for photometric measurements must meet the requirements of section 7.0 of IES LM-51, and sections 3.0 and 6.3 of IES LM-78 (incorporated by reference, see §431.453).

(b) Lamp Preparation

(1) Lamp Seasoning and Stabilization. The HID lamp must be seasoned for 100 hours per section 6.2.1 of IES LM-51 (incorporated by reference, see §431.453). During the seasoning period, the lamp must be operated in the same orientation in which it will be tested for lamp efficacy. HID lamps with no specified operating position (including universal lamps) must be

operated in the vertical base-up orientation for seasoning and stabilization. After this one-time seasoning process, a lamp being tested must achieve stable operation, prior to any measurements, using the lamp stabilization method specified in section 3.7 of ANSI C78.389 (incorporated by reference, see §431.453). As detailed in ANSI C78.389, HID lamp stabilization requirements vary with lamp technology. Table I lists the lamp warm-up, stabilization, and re-stabilization requirements for MV, HPS, and MH lamps.

Table I HID Lamp Warm-Up and Stabilization Criteria

Lamp Type	Lamp Warm-Up Time	Stabilization Criteria
MV	15–20 minutes	3 successive measurements (voltage and current) 5-minute measurement intervals Change in value < 1.0%*
HPS	1 hour	3 successive measurements (voltage and current) 10- to 15-minute measurement intervals Change in value < 1.0%*
MH	6 hours Operated within ±10% rated wattage	3 successive measurements (voltage and current) 10- to 15-minute measurement intervals Change in value < 3.0%**

* This is determined by $\text{measurement}_{(n+1)}$ / measurement_{n}, where the resultant value needs to be less than 101% and greater than 99% for the lamp to be considered stabilized.
** This is determined by $\text{measurement}_{(n+1)}$ / measurement_{n}, where the resultant value needs to be less than 103% and greater than 97% for the lamp to be considered stabilized.

(2) Lamp/Circuit Transfer. Lamp transfer and re-stabilization must be conducted according to section 3.7 of ANSI C78.389 (incorporated by reference, see §431.453). Lamps may either be (i) operated continuously and moved into the integrating sphere or (ii) extinguished and relocated. If the lamp is not-extinguished prior to transfer, the lamp must be stabilized prior to measurement. If the lamp is extinguished and transferred, the lamp cool-down and transfer must adhere to the requirements shown in Table II. The requirements vary with HID lamp type, as well as with the specifics of the lamp movement.

Table II Lamp Cool-Down and Re-stabilization Requirements

Lamp Type	Cooling Requirement	Re-stabilization Time
MV	None	Reconfirm stabilized operations upon transfer/restrike
HPS	If extinguished, allow to cool for 1 hour minimum before relocating.	Reconfirm stabilized operations upon transfer/restrike
MH	If extinguished, cool to below 60 °C if relocating.	No relocation and no reorientation – 30 minutes Relocation with no reorientation – 30 minutes Reorientation – 6 hours

(3) Lamp Orientation. Lamp orientation requirements are those specified in section 3.6 of ANSI C78.389 (incorporated by reference, see §431.453). A lamp marked or otherwise designated for use in a specific operating position must be tested in that position. If no operating position is specified or the lamp is marked "universal," the lamp must be operated in the vertical base-up position.

(c) Test Measurements and Calculations. Test measurements and calculations must be carried out in accordance with the test conditions, setup, and lamp preparation requirements of §431.454(a)-(b).

(1) Measurement and Calculation of Lamp Efficacy.

(i) Measure the initial lumen output as specified in section 7.0 of IES LM-51 (incorporated by reference, see §431.453).

(ii) Measure the input power in watts as specified in sections 3.5, 3.9, and 3.10 of ANSI C78.389 (incorporated by reference, see §431.453). If a voltmeter and ammeter are used for measurements, multiply the measured voltage and current values.

(iii) HID lamp efficacy must be calculated as the value from (c)(1)(i) divided by the value from (c)(1)(ii) of this section, with the resulting quotient rounded off to the nearest tenth of a lumen per watt.

(2) Measurement and Calculation of Correlated Color Temperature and Color Rendering Index

(i) Determine HID lamp CCT using the methods for measurement and characterizing color set forth in CIE 15 (incorporated by reference, see §431.453). The CCT value must be rounded to the nearest 10 kelvins.

(ii) Determine HID lamp CRI using the methods for measurement and characterizing color set forth in CIE 15 and CIE 13.3 (incorporated by reference, see §431.453). Measure HID lamp CRI if necessary to determine whether a lamp is subject to standards based on its CRI as specified in §431.455. The CRI must be rounded to the nearest whole number.

§431.455 Energy conservation standards and their compliance dates.

[Reserved]