Setting Standards for Excellence

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Submitted via email: docket@energy.ca.gov

Mr. Andrew McAllister
Commissioner
California Energy Commission
1516 Ninth Street
Sacramento, California 95814

NEMA Comments on Staff Analysis of HVAC Air Filters, Dimming Fluorescent Ballasts, and Heat Pump Water Chilling Packages

Dear Commissioner McAllister,

The National Electrical Manufacturers Association (NEMA) appreciates the opportunity to provide the attached comments on the California Energy Commission's staff analysis for Fluorescent Dimming Ballasts. These comments are submitted on behalf of NEMA Lamp and Ballast Product Sections.

As you may know, NEMA is the association of electrical equipment and medical imaging manufacturers, founded in 1926 and headquartered in Arlington, Virginia. Its 400-plus member companies manufacture a diverse set of products including power transmission and distribution equipment, lighting systems, factory automation and control systems, and medical diagnostic imaging systems. The U.S. electroindustry accounts for more than 7,000 manufacturing facilities, nearly 400,000 workers, and over $100 billion in total U.S. shipments.

Please find our detailed comments below. We look forward to working with you further on this important project. If you have any questions on these comments, please contact Alex Boesenberg of NEMA at 703-841-3268 or alex.boesenberg@nema.org.

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NEMA Comments on Staff Analysis of HVAC Air Filters, Dimming Fluorescent Ballasts, and Heat Pump Water Chilling Packages

NEMA thanks the Commission for the opportunity to comment on and participate in their efforts to develop and adopt energy standards for Fluorescent Dimming Ballasts. NEMA supports practical, feasible energy performance requirements for electrical products and shares the Commission's desire to save energy in the State of California. We understand the Commission's desire to establish standards for fluorescent dimming ballasts since newly adopted Title 24 Building Energy Efficiency Regulations will begin to proliferate them more widely beginning this year.

NEMA has several reservations with the draft proposal as written and we request the Commission closely review our comments in effort to avoid potential pitfalls and confusion which could result if the proposal was to be adopted as written. We conclude this document with our own suggested regulatory language, to be incorporated or substituted for the draft language of the Staff Report as noted.

We submit the following comments, considerations and proposals.

1. Scope. The CEC does not make clear in the proposed regulatory language the exact scope of products affected by this proposal. One can interpret the language to apply to any fluorescent dimming ballast (T12 notwithstanding due to Federal preemption) such as: T5 products, T8 products, smaller diameter and less than 4' fluorescent products, U-bend fluorescent lamp ballasts, circline lamp ballasts, externally-ballasted Compact Fluorescent Lamp ballasts, step dimming technology ballasts, continuous dimming technology ballasts and potentially others. We note that the tested ballasts submitted by the California Investor Owned Utility (IOU) working group display performance consistent with continuous dimming products. On subsequent discussion with the IOU testing team we learned that only F32T8 products were tested. We are concerned about the representative suitability of the data given that only 34 discrete products were tested. NEMA is concerned that the number and technology of products tested does not adequately represent the full range of products, and we suggest several scope adjustments to accommodate this. To accurately and fairly establish requirements for fluorescent dimming ballasts within the range of products tested (i.e. the readily available data) the CEC should limit the current proposal to 1 and 2 lamp T8 continuous dimming products and clearly identify this in the proposed regulatory language. When more test data becomes available, perhaps in the next code cycle, then additional products could be considered. NEMA is interested in participating directly in the development of a test plan for additional ballast types, to include identification of representative products, test protocol development, and, if needed, round robin testing to examine repeatability and confirm results.
   Proposal: Limit the scope of this first iteration of the regulation to ballasts designed for use with 4' linear F32 T8 one and two lamp systems employing continuous dimming technology.

2. Step Dimming. In amplification of our mention of step dimming technology above, NEMA understands that the current version of Title 24 allows four-step dimming ballasts to be installed in buildings, and so it makes sense from that standpoint that the CEC Staff Report attempts to accommodate this on page 35/63 in terms of test points in the

second to last paragraph where the last two sentences read: “The dimming state that is between 35 percent and 65 percent full arc power and is closest to 50 percent can be used as a substitute measurement for 50 percent dimming where 50 percent full arc power is not achievable. If a dimming ballast cannot achieve dimming at 80 percent or 50 percent arc power, or dimming within the alternative ranges, then staff proposes that no measurement be taken as substitutes.” This wording conflicts with the requirements of Title 24, quoted on the preceding page of the Staff Report, where dimming ranges which include 80% and 50% arc power are required by Title 24. For this reason the proposed language on page 48/63 should be modified. However, per our comments in item 1, since no step dimming ballasts were tested it cannot be assured that the proposed energy usage requirements are technically feasible, and therefore step-dimming ballasts in fairness should be removed from scope until they can be tested. Additionally, we note that none of our manufacturers currently offer a four-step dimming ballast and none appear in the Title 24 qualified products database as of this writing. So, until such time as these products exist for testing, it is impractical and unnecessary to establish energy efficiency requirements for them.
Proposals: Eliminate step-dimming products from the scope of these requirements by identifying the scope as applicable only to T8 continuous dimming products as noted in items 1 and 2 above. Strike sentences in the proposed regulatory language for 1604(j)(3)(B) “~~If a step dimming ballast or a ballast that can only turn connected lamps on or off has dimming steps other than 80 and 50 percent, then the closest step that is between 90 and including 65 percent shall be used for 80 percent testing, and the closest step that is between 65 and including 35 percent shall be used for 50 percent testing. If no step exists in the above prescribed ranges, then no result shall be recorded for that percentage dimming test.~~”

3. Standby power. The current draft proposal attempts to address standby power requirements by employing a Zero Arc Power variable. The amount of weight given this variable is substantial, since most lighting products are in the off state for a significant amount of time, as is evidenced by the Hours of Use multiplier given in the staff report (page 39/63). This multiplier is three times higher than any other. We contend that this approach unfairly prejudices the equation and regulations toward phase-control products and 0-10V control products due their typically low or non-existent standby power needs, potentially eliminating or at least severely limiting the ability of digitally addressable ballasts to qualify. This is in conflict with the CEC’s clearly stated desires in Title 24 to encourage and proliferate demand-response technologies throughout the State. Standby power should be made a separate requirement, so that products can compete in terms of dimming efficiency in a head-to-head format. We note to the Commission that standby power needs vary greatly depending on the digital technology employed, and it is easy to defer to setting lower levels of standby power when considering a limit, but increased standby power typically accompanies greatly increased function and flexibility. The amount of standby power consumed by a digitally addressable product is most often tied to functionality and options more so than simple inefficiency. Dimmable ballasts with higher (2-5W) standby power requirements often employ wireless communications and thus satisfy consumer needs and demands for greater connectivity flexibility as a result. Wired digital control products tend to have lower standby power requirements, but they require additional wiring that might not be practical in some system designs. NEMA contends that connectivity flexibility options should be retained and encouraged by the CEC, so that installation designs can satisfy the wide range of needs for new construction and retrofit and whole-building energy savings approaches.

In NEMA Standard BL-3, "Dimming Ballast Energy Performance"[1], industry recommends a standby power consumption allowance of up to 2.5W, to accommodate systems with high degrees of connectivity. While some programs, such as EPA ENERGY STAR, have lower limits, often 1W, we disagree with such restrictive limits for this technology especially in light of the goal of implementing widespread demand-response potential in California.
Proposal: Remove standby power requirements from the ballast annual energy usage calculations by eliminating the 0% arc power and T0 considerations. Establish a separate standby power consumption limit of 2.5W for ballasts with standby power needs to be measured in accordance with U.S. 10 CFR 430 Appendix Q (which references ANSI C82.2).

4. Clarifying zero percent power conditions. NEMA understands the intent behind measurements and calculations concerning instances of zero arc power. However, because ballast designs vary, specific ballast and lamp performance can vary greatly by combination and for a given system maximum dim level, which per the measurement method is the zero arc power point. In some cases lamps remain lit, and power consumption is significant, while in other cases the ballast interprets the maximum dim order as a shutoff command, ceasing power consumption. We feel this wide range of potential power levels leaves the zero power consideration at conflict with the staff's perceived intent of addressing standby power consumption in the annual energy use equation. So, in addition to our comments above, we reiterate our suggestion that zero arc power considerations be removed from the proposed regulation.
Proposal: Eliminate zero arc power calculations and considerations in favor of standby power allowances.

5. Multi-Lamp Ballasts. In the proposed definition of Arc Power, the use of the plural in the words "delivered to attached lamps" implies that CEC acknowledges that arc power is needed for each lamp in a fixed amount on a per-lamp basis, and thus a multi-lamp ballast will need more arc power than a single-lamp ballast. We suggest this be more clearly stated.
Proposal: Adjust definition of arc power to read ""Arc power" means the power delivered to all attached lamps, the overall output power of the ballast."

6. Testing Power Consumption as Dimming Levels Decrease. NEMA understands the desire of CEC and certain stakeholders to test efficiency at specific levels of dimming below 100% output. We agree with the CEC proposal to test down to 50% (P50) and not any lower. During the May 9th Staff Workshop some commenters favored even lower test points. NEMA disagrees with these suggestions for several reasons. First, measurement accuracy and repeatability suffer in low states of dim. The test meter used by both NEMA and by the PG&E study group, is the Yokogawa WT 1800 Power Analyzer. In the User's Manual for this product Yokogawa identify challenges with measurement accuracy and repeatability in very high frequency and very low power situations. These are exactly the situations at low levels of arc power for electronic fluorescent dimming ballasts. We have prepared a presentation on this subject for the Docket, to submit under filename "14-AAER-1 NEMA presentation on inaccuracy calculations for determining lamp power in dimming". Due to these inescapable limitations of the test equipment, we contend that energy efficiency test points below

[1] http://www.nema.org/Standards/Pages/Dimming-Ballast-Energy-Performance.aspx

50% arc power are not practical and could cause significant disruption, particularly in terms of enforcement.
Proposal: For this iteration of the proposed regulation, none, but no deeper dimming efficiency level test points in any future regulation.

7. Power Factor, Flicker or other Quality parameters. On the May 9th Workshop meeting and webinar, CEC staff mentioned interest in receiving PF, flicker and other quality parameters and requirements to consider adding to the proposed regulation. For the record, NEMA disagrees with setting any requirements beyond those addressed in the Staff Report, with our above comments taken into account. Power factor is not an effective energy efficiency metric, and there are no reliable, effective, repeatable test methods for flicker. Manufacturers today address these issues through consumer satisfaction processes and internal (proprietary) striation and flicker testing and we contend that they are sufficient.
Proposal: No additional quality metrics be added to the proposed regulation.

8. Cathode Cutout and Lamp-to-Ballast Compatibility. While not obvious in the ballast test data provided, due in part to the limited number of products sampled, these performance traits are interdependent. We understand that it can be easy to gravitate to aggressive cathode cutout requirements based on the small number of ballasts tested by the working group and the resulting limited amount of performance data gained. A larger test sample set might have revealed some other trends, such as cathode cutout and dimming efficiency trend areas which were populated by single manufacturer's products. In other words, a deeper study of ballast dimming performance might have identified ranges of performance based on brand, and thus evidenced existing underlying patent and intellectual property (IP) issues which NEMA and its members deal with in the course of standards development. The methods and solutions employed by fluorescent dimming ballasts from one manufacturer to the next are intertwined with manufacturer-specific IP. NEMA addressed these issues in NEMA Standard LL-9, "Dimming of T8 Fluorescent Ballast Systems"[2], in which we established a recommended range of cathode current for the dim state of fluorescent lamps. NEMA LL-9 establishes safe working ranges for arc power which take in to account not only the IP of the ballast design, but just as importantly the wide range of T8 fluorescent lamps in the marketplace. Also not evidenced in the IOU testing or arguments is the fact that different designs/brands of fluorescent lamp have differing needs for filament heating. Some lamps do not need as much filament heat, and a very strict penalty on ballasts which are more generous to lamp filaments, so as to satisfactorily work with a wider variety of lamp designs, could result in favoritism of certain lamp brands. While newly commissioned systems may tend to utilize same-manufacturer lamps and ballasts, the maintenance phase of the life cycle can often see differing combinations based on outside factors of personal preference and replacement lamp and ballast price and availability. To ensure maximum consumer satisfaction during the maintenance phase, NEMA recommends a more broad range of ballast energy allowances and thus greater potential lamp to ballast compatibility and interoperability in the field. The Staff Proposal as written could result in a dependence on same-manufacturer lamp and ballast pairing, short lamp life, and treads strongly into matters of IP, potentially favoring one manufacturer's products over another's. For additional information regarding lamp to ballast compatibility we invite interested parties to review a presentation given by NEMA members to the IEC about the findings of our 5-year lamp survivability test study which

[2] http://www.nema.org/Standards/Pages/Dimming-of-T8-Fluorescent-Lighting-Systems.aspx

examined lamp life based on lamp-to-ballast combination variation at multiple dimming levels. This presentation will be submitted to the docket under filename "14-AAER-1 NEMA LS-11 Paper_20070221_final".

9. Minimum Dimming Ballast Efficiency Requirements: NEMA believes that two test points, selected to be outside the dimming ranges where proprietary protocols are most at play, can satisfy the desire in California to assess and regulate ballast efficiency with reduced risk of IP conflict. NEMA proposes CEC require testing of 1 and 2 lamp T8 fluorescent dimming ballasts at 100% and 50% arc power, and set minimum Ballast Luminous Efficiency (BLE) requirements for each based on an adapted version of the U.S. DOE's minimum BLE requirement for fixed output ballasts.
   See below for description and equations:

We refer to the DOE's Fluorescent Ballast Final Rule[3] of March 11, 2011 and its Table I.1 (copied below), where the equation for minimum BLE as a function of arc power is provided. For purposes of the California regulation, NEMA proposes that the factors B and C be copied from the DOE table's row for Program Start Ballasts. Factor A must be adjusted to account for the power consumption of dimming circuitry, which is not present in fixed output ballasts. Furthermore, since 0-10V ballasts tend to consume less power than ballasts with active communications (ex. WiFi), we propose that they have separate requirements, with slightly more allowance granted to ballasts with active communications due to their added functionality.

The adjustments to factor A for the two technologies is based on a 4% and 6% increased allowance over Federal minimums for fixed output ballasts to accommodate additional power needs for 0-10V and Active communications products, respectively.

Measured BLE at 100%
For minimum BLE calculations for 0-10V products, NEMA proposes factor A be 0.953
For minimum BLE calculations for active communications products, NEMA proposes factor A be 0.933
B and C are fixed constants, for each equation B=0.51 and C=0.37.

Equation: Minimum BLE = A / (1+B*arc power^{-C})
Or specifically,
0-10V Minimum BLE = 0.953 / (1+0.51*arc power$^{-0.37}$)
Active Minimum BLE = 0.933 / (1+0.51*arc power$^{-0.37}$)

Measured BLE at 50%:
For minimum BLE calculations for 0-10V products, NEMA proposes factor A be 0.758 (0.993 x 0.763 = .7576)
For minimum BLE calculations for active communications products, NEMA proposes factor A be 0.742 (.993 x .747 = .7418)
B and C are fixed constants, for each equation B=0.51 and C=0.37.

[3] http://www.regulations.gov/#!docketDetail;D=EERE-2007-BT-STD-0016

Proposal: measured BLE for products to be sold in California must equal or exceed the minimum BLE derived from the equation above with the same confidence level in reporting as is required by the DOE for fixed-output ballasts[4].

TABLE I.1—NEW AND AMENDED ENERGY CONSERVATION STANDARDS FOR FLUORESCENT LAMP BALLASTS

Fluorescent lamp ballasts * shall have a ballast luminous efficiency no less than A/(1 + B * total lamp arc power^-C) where A, B, and C are as follow:				Percent improvement over current standard or baseline **
Product Class	A	B	C	
Instant start and rapid start ballasts (not classified as residential) that are designed to operate 4-foot medium bipin lamps 2-foot U-shaped lamps 8-foot slimline lamps	0.993	0.27	0.25	5.7
Programmed start ballasts (not classified as residential) that are designed to operate 4-foot medium bipin lamps 2-foot U-shaped lamps 4-foot miniature bipin standard output lamps 4-foot miniature bipin high output lamps	0.993	0.51	0.37	10.8
Instant start and rapid start ballasts (not classified as sign ballasts) that are designed to operate 8-foot high output lamps	0.993	0.38	0.25	26.5
Programmed start ballasts (not classified as sign ballasts) that are designed to operate 8-foot high output lamps	0.973	0.70	0.37	26.2
Sign ballasts that operate 8-foot high output lamps	0.993	0.47	0.25	15.1
Instant start and rapid start residential ballasts that operate 4-foot medium bipin lamps 2-foot U-shaped lamps 8-foot slimline lamps	0.993	0.41	0.25	7.2
Programmed start residential ballasts that are designed to operate 4-foot medium bipin lamps 2-foot U-shaped lamps	0.973	0.71	0.37	5.8

* Fluorescent ballasts that are exempt from these standards are listed in section III.A.3.
** Percent improvement is applicable to the average of ballasts directly analyzed.

DOE Fluorescent Ballasts Final Rule November 14, 2011 Table I.1, for reference

[4] http://federalregister.regstoday.com/data/2011/070/FR2011-070548.pdf

Proposed changes to existing draft regulatory language in the CEC Staff Report of April 2014, CEC-400-2014-006-SD, beginning on page 47/63

Clauses that are not mentioned are left unmodified, changes are identified in underlined text or ~~strikethrough~~ and administrative notes are [bracketed] and are not intended to be part of the regulatory language

Section 1602. Definitions.
(j)
Modify definition of Arc Power per NEMA comment #5,
"Arc power" means the power delivered to all attached lamps, the overall output power of the ballast."
[add new definition]
"Ballast Luminous Efficiency (BLE)" means the ratio of lamp arc power to ballast input power

Section 1604. Test Method for Specific Appliances.
(j)
(3)
(B) ~~Three~~ Two sets of input power and arc power shall be measured using the federal test procedure with the total arc power tuned to 100~~, 80,~~ and 50 percent of the measured max arc power. ~~If a step dimming ballast or a ballast that can only turn connected lamps on or off has dimming steps other than 80 and 50 percent, then the closest step that is between 90 and including 65 percent shall be used for 80 percent testing, and the closest step that is between 65 and including 35 percent shall be used for 50 percent testing. If no step exists in the above prescribed ranges, then no result shall be recorded for that percentage dimming test.~~ The resulting input powers shall be recorded and referred to as P100~~, P80,~~ and P50.

~~(C) The ballast shall also be tested with a control input set to the lowest dimming state possible up to and including no light output. The input power to the ballast shall be measured and recorded as P0. The measurement must be taken 90 minutes after entering this state. P0 shall be recorded as the mean value of measurements taken at 5 second intervals over a 5-minute period.~~

[New Proposed Item C]

(C) Standby power. If the ballast has a standby power requirement, standby power will be tested in accordance with U.S. 10 CFR 430 Appendix Q and may not exceed 2.5W.

~~(D) The annual energy use shall be calculated, with the results in kWh/yr, using the following formula:~~

[Strikethrough formula]

~~Where power is in watts and time values (t100, t80, t50, t0) are taken from the appropriate tables below:~~
[Strike Standard Time Usage Table]

Section 1605.3 State Standards for Non-Federally Regulated Appliances.
(j)
(2) Deep-Dimming Fluorescent Ballasts

Effective January 1, 2016, deep-dimming fluorescent ballasts shall meet the following energy conservation standard:
[Strikethrough annual energy use formula]
Measured BLE at 100% and 50% arc power must meet or exceed the calculated minimum BLE based on the following equations:

For measured BLE at 100%
For 0-10V products Minimum BLE = $0.953 / (1+0.51*\text{arc power}^{-0.37})$
For products with Active communications Minimum BLE = $0.933 / (1+0.51*\text{arc power}^{-0.37})$

For measured BLE at 50%
For 0-10V products Minimum BLE = 0.758/ (1+0.51*arc power-0.37)
For products with Active communications Minimum BLE = 0.742 / (1+0.51*arc power-0.37)

Accuracy: the reported BLE will be per U.S. DOE regulations for fixed output ballasts as given in the November 14, 2011 Energy Conservation Standards for Fluorescent Lamp Ballasts, Final Rule.

Section 1606 Filing by Manufacturers; Listing of Appliances in Database

	Appliance	Required Information	Permissible
	Deep-Dimming Fluorescent Ballasts	*Ballast Input Voltage	120, 277, other (specify)
		*Number of Lamps	
		*Lamp type	T5, T8, other (specify)
		*Dimming Type	Continuous, stepped, individual lamp control, other (specify)
		*Control Type	3-wire, 0-10 volts, digital communication, phase, other (specify)
		*Start Type	Instant start, rapid start, program start, other (specify)
		~~P100~~Calculated minimum BLE arc power 100	
		Measured BLE at Arc Power 100	
		~~P80~~	
		~~Arc Power 80~~	~~(answer NA if not applicable)~~
		~~P50~~ Calculated minimum BLE at arc power 100	~~(answer NA if not applicable)~~
		Measured BLE at Arc Power 50	~~(answer NA if not applicable)~~
		~~P0~~	~~(answer NA if not applicable)~~
		~~Annual Energy Use~~	
		Standby Power (W)	(answer NA if not applicable)
		Power Factor	

* "Identifier" information as described in Section 1602(a).