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To: All parties interested in the 2013 Building Energy Efficiency Standards Rulemaking, Docket No. 12-BSTD-01.

Regarding: Use of non-powered[1] flow hood devices for measuring residential central space conditioning system air-handling unit airflow, for determining compliance under proposed updates to the Building Energy Efficiency Standards.

Background:
On November 07, 2011, Energy Commission staff conducted a public workshop to present proposed revisions to the Building Energy Efficiency Standards' Reference Appendices, including Reference Residential Appendix Section RA3.3. Staff proposed to eliminate non-powered flow hood devices as one of the allowable options for airflow measurement devices, and substitute a specification for powered[2] flow hood devices. This proposed change was based on recommendations in research reports published by the Lawrence Berkeley National Laboratory (LBNL). These proposed revisions were subsequently published on February 24, 2011, for comment and possible adoption by the Energy Commission – referred to as the "45-Day language".

The proposal to eliminate use of non-powered flow hoods has raised concern from heating ventilating and air conditioning (HVAC) contractors, Home Energy Rating System (HERS) Raters, and flow hood manufacturers who have asserted that non-powered flow hoods are sufficiently accurate for use for Section RA3.3 residential central system air-handling unit airflow measurements, and that measurements performed with non-powered flow hoods were easier to perform than with the two other methods available for use with the RA3.3 protocol (plenum pressure matching and flow grid). HVAC contractors and HERS Raters have also expressed concern that not being able to use flow hoods that they had purchased represented a significant loss.

ASHRAE Standard 152, *Method of Test for Determining the Design and Seasonal Efficiencies of Residential Thermal Distribution Systems*, provides test procedures for measuring residential system air-handling unit airflow utilizing the Plenum Pressure Matching and Flow Grid methods, both of which are methods available for use with the Reference Residential Appendix Section RA3.3 protocol. ASTM Standard E1554, *Standard Test Methods for Determining Air Leakage of Air Distribution Systems by Fan Pressurization,* also provides test procedures for measuring residential system air-handling unit airflow utilizing the Plenum Pressure Matching method. There are no flow hood measurement standards available that specify methods of test that could be used to rate the accuracy of flow hood devices in these residential applications.

[1] also known as "standard" flow hoods or "commercially available" flow hoods or "passive" flow hoods.
[2] also known as "active" flow hoods.

Energy Commission Staff Conclusion:
In response to these concerns, Staff is considering recommending that non-powered flow hood devices continue to be allowed for residential central system air-handling unit airflow measurement in upcoming proposed "15-day" revisions to Reference Residential Appendix Section RA3.3.

Despite making this recommendation, Staff remains concerned by research by LBNL concluding that

> commercially available flow hoods are poor at measuring flows in residential systems. There is also evidence in this and other studies that flow hoods can have significant errors even when used on the non-residential systems they were originally developed for. The measurement uncertainties arise from poor calibrations and the sensitivity of exiting flow hoods to non-uniformity of flows entering the device. The errors are usually large – on the order of 20% of measured flow, which is unacceptably high for most applications. Active flow hoods that have flow measurement devices that are insensitive to the entering air flow pattern were found to be clearly superior to commercially available flow hoods. In addition, it is clear that current calibration procedures for flow hoods may not take into account any field application problems and a new flow hood measurement standard should be developed to address this issue.

Walker, I.S., Wray, C.P., Dickerhoff, D.J., and Sherman, M.H. 2001. *Evaluation of flow hood measurements for residential register flows.* Lawrence Berkeley National Laboratory, Berkeley, CA, LBNL 47382, available at: http://epb.lbl.gov/publications/lbnl-47382.pdf.

Staff has concluded that an industry standard (e.g., ASTM International, or the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)) should be developed to provide the basis for flow hood accuracy ratings to measure residential system airflow pursuant to Appendix RA3.3.

California's Public Interest Energy Research (PIER) program has allocated funding for flow hood research to develop the needed flow hood measurement standard with the intention that the new standard could be adopted by ASTM or ASHRAE for reference in the next revision of the Building Energy Efficiency Standards, effective in 2017. Once the new flow hood accuracy test standard is available, it would be used to verify that flow hoods meet the accuracy required by the Reference Residential Appendix Section RA3.3 protocol (i.e., ± 7% of reading or ± 5 cfm whichever is greater) to be allowed to be used after the next revision of the Standards becomes effective in 2017.

Staff anticipates recommending the inclusion in the upcoming 15-day proposed language for Section RA3.3 of a new requirement for all powered and non-powered flow hood manufacturers to publish in their product documentation specifications for how their flow hood product(s) are to be used for accurately measuring residential system airflow at residential system return grilles of single and multiple return systems. Flow hood manufacturers would be required to certify to the Energy Commission that use of

the flow hood product(s) in accordance with the manufacturer's specifications in the manufacturer's product documentation will produce measurement results that are within the accuracy required by Section RA3.3 (i.e., ± 7% of reading or ± 5 cubic feet per minute (cfm), whichever is greater). The flow hood manufacturers' model numbers and specifications for flow hood use to accurately measure residential system airflow at residential system return grilles for flow hood products, which are certified to the Commission as meeting the accuracy required by Reference Residential Appendix Section RA3.3, will be posted on the Energy Commission website, making the information available to all people involved in the airflow verification compliance process. Manufacturer certification of flow hood measurement device accuracy and submittal of flow hood use specifications documentation would be prerequisites for allowing the flow hood product to be used for conducting the airflow verifications in the Section RA3.3 protocol for demonstrating compliance with the 2013 Standards.

Staff expects to make available for review a draft of the recommended changes to the 45-day language for Reference Residential Appendix Section RA3.3 in advance of the publishing of the 15-day revisions.

Thank you for your participation in the public review of the proposals for improvements to the 2013 California Building Energy Efficiency Standards. You will be notified when additional proposed changes to the Standards are available.

Sincerely

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