Commercial Clothes Dryers

Codes and Standards Enhancement (CASE) Initiative
For PY 2014: Title 20 Standards Development

Additional Market Data and
Standard Proposal Refinement

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The California Investor Owned Utilities (CA IOUs) are submitting the following comments and data to provide support to the California Energy Commission (CEC) in developing Title 20 appliance efficiency standards for commercial clothes dryers. The document provides clarification and refinement of the proposed standard presented in the CASE report submitted to the CEC on July 30, 2013 (Docket #12-AAER-2D). Additional market data regarding on-premise laundry (OPL) applications are provided to address CEC's question on standard development in this area. Stakeholder comments on the CASE study proposal are also addressed.

1 Summary of Refined Title 20 Regulation Proposal

In the Commercial Clothes Dryer CASE report (referred as the CASE study in this document) submitted to the CEC on July 30, 2013 (Docket #12-AAER-2D), CA IOUs submitted a CASE study on commercial clothes dryers and proposed to the CEC to adopt a test standard for all tumble-type commercial clothes dryers and minimum energy performance standards for **gas** dryers with drum capacity less than 13 cubic feet. The IOU CASE study team would like to provide additional information to address comments from the CEC and other stakeholders and to propose a refined standard proposal.

On January 15, 2014, the CEC conducted a webinar and presented its comments on proposed Title 20 standard for commercial dryers[1]. The CEC brought up the following concerns:

- The proposal contained test results that were based on the test method for residential clothes dryers.
- The scope of the proposal applied to commercial dryers and did not include large commercial and industrial dryers.

The CEC further called for comments and proposals that include:

- A new test procedure to measure the energy consumption of coin-operated and commercial industrial clothes dryers, or modify the scope of existing DOE's residential clothes dryer's test procedure to include commercial clothes dryers.
- Minimum efficiency standards or design standards based on test data collected from modified or new test procedure.

The CASE study team would like to clarify that the proposed test procedure is based on the existing DOE's residential clothes dryer's test procedure with modification of test load requirements according to commercial clothes dryer capacity characteristics. The revised test load covers all dryer capacities found in the market. Therefore, the proposed test procedure is applicable to coin operated and commercial industrial clothes dryers.

The test results presented in the CASE study were based on the modified test procedure for commercial dryers. The CASE study team conducted the laboratory tests in collaboration with the University of California, Davis and used these test results to develop the proposed minimum efficiency standards. Because the team only tested multi-family dryers (residential-style dryers) and 30-lb gas dryers, the scope of minimum efficiency standards only cover those dryers.

[1] http://www.energy.ca.gov/appliances/2013rulemaking/documents/2014-01-15_webinar/2014-01-15_Staff_Presentation.pdf

The CASE study team conducted the laboratory test during 2009 and 2010. Since then, commercial clothes dryer manufacturers have rolled out new dryer models into the market. The test results may not comprehensively reflect the energy performance levels of dryers found in today's market. The effectiveness of the proposed minimum efficiency standards is uncertainly. In addition, the CASE study team has further refined the test procedure to incorporate the applicable changes made by the Department of Energy (DOE) to the residential clothes dryer test procedure, including the measurement of standby and off mode consumption. The test results provided in the CASE study report do not include standby and off mode performance and cannot be used to develop minimum efficiency standards that are consistent with the refined test procedure. Therefore, the CASE study team would like to withdraw the previous proposal on minimum efficiency standards and recommend that minimum efficiency standards be developed in future based on the submitted test results from manufacturers.

In summary, the IOU CASE study team recommends the following refinement to its original proposal:

- Maintain the proposed test procedure that covers all commercial clothes dryers. The detailed test procedure language is updated to be consistent with the latest DOE's residential clothes dryer's test procedure, with modified test load based on commercial clothes dryer characteristics.
- No minimum efficiency standards or design standards are recommended. Manufacturers are required to test dryer models to be sold in California starting from January 1, 2017 and to report the test results to the CEC for publication in the CEC Appliance Efficiency Database.

The following sections provide detailed information on additional market data for OPLs, the refined test procedures, benefits of the proposed standards, and response to stakeholder comments.

2 Additional Market Data for OPLs

In response to CEC's emphasis on efficiency for large commercial and industrial dryers, the CASE study team has been conducting market study on OPLs to provide additional market data to support CEC's rulemaking analysis. The market study effort surveys different OPL sectors (listed in Table 1) to collection information on number and types of installed dryers and average daily laundry load at each facility. This market study is planned to be completed in January 2015. So far, the CASE study team has contacted 195 facilities and successfully collected data from 84 facilities. Table 2 present the preliminary analysis results based on the survey data collected to date for number and types of installed dryers.

The preliminary OPL market survey results indicate that there are about 30,000 commercial installed clothes dryers in California with an average dryer capacity of 80 pound. The total installed capacity is about 2,400,000 pound. The CASE study provided an estimated total installed OPL dryer capacity of 1,400,000 pound without information on size breakdown of installed dryers.

The OPL market survey is expected to be completed in January 2015. The final survey report will provide more complete market assessment data, including daily laundry load information for each type of OPL facility, which would allow the team to refine the standard impact analysis.

Table 1. Estimated Total On-premise Laundry Facilities by Market Sector Type

OPL Market Sector	Estimated No. Facility[2]	% with On-premise Laundry
Hotels & Motels	6,500	73%
Health Clubs	3,223	50%
Nursing Homes	1,600	92%
State Prisons	593	100%
Fire Stations	835	100%
Law Enforcement	510	13%
Ind. Laundry Serv.	81	88%
Hospitals	508	0%
Dry Cleaners	TBD	57%
Restaurants	62,000	TBD
TOTAL	76,000	TBD

[2] Sources for estimated number of facilities located in the appendix.

Table 2. Total Number of Dryers

OPL Market Sector	Total No. of Dryers	Distribution of Dryers					
		<30 lbs.	≥30 & <50	≥50 & <65	≥65 & <80	≥80 & <150	≥150
Hotels & Motels	15,786	0%	0%	60%	40%	0%	0%
		0	0	19,500	13,000	0	0
Health Clubs	5,372	0%	0%	100%	0%	0%	0%
		0	0	12,892	0	0	0
Nursing Homes	3,900	0%	8%	12%	73%	8%	0%
		0	3,200	4,800	30,400	3,200	0
State Prisons	2,372	0%	0%	0%	0%	14%	86%
				0	0		
Fire Stations	835	0%	100%	0%	0%	0%	0%
		0	1,670	0	0	0	0
Law Enforcement	765	0%	0%	0%	100%	0%	0%
		0	0	0	510	0	0
Ind. Laundry Serv.	174	0%	0%	0%	3%	15%	82%
		0	0	0	162	972	5,184
Hospitals	0	0%	0%	0%	0%	0%	0%
		0	0	0	0	0	0
Dry Cleaners	TBD	80%	0%	20%	0%	0%	0%
		TBD	TBD	TBD	TBD	TBD	TBD
Restaurants	TBD	TBD	TBD	TBD	TBD	TBD	TBD
		TBD	TBD	TBD	TBD	TBD	TBD
Total	**29,579**	**9%**	**5%**	**29%**	**37%**	**5%**	**15%**

3 Proposed Test Procedure

The CASE study team developed the proposed test method for commercial clothes dryers by modifying the existing DOE appliance efficiency test procedure for residential clothes dryers. All tumbler-type dryers use the same thermal process to evaporate and remove moisture in clothes. Dryers with different sizes for commercial and residential applications have similar mechanical configurations and controls. The general performance measurement methodology and processes established in the DOE residential clothes dryer test procedure is suitable for all tumbler-type clothes dryers.

The refined test procedure is based on the newly amended DOE residential dryer test procedure effective January 1, 2015. The detailed language of the proposed test procedure for commercial clothes dryers is provided in the last section of this document.

Test Load

In order to make the test procedure applicable to commercial dryers, definition of test load needs to be revised to reflect those found for commercial dryers. The CASE study team researched and characterized the commercial dryer capacities based on all dryer models offered by most, if not all, manufacturers. The results are presented in Section 2.1 in the CASE study report. The test load specification provided in the proposed test procedure was developed based on these market study results and, therefore, adequately covers all commercial clothes dryers found in California market.

Commercial clothes dryers have a wide capacity range measured in either weight capacity or drum volume. Appendix A in the CASE study report provides capacity specifications of all commercial dryers found by the CASE study team. In general, commercial dryer weight capacity is linearly proportional to dryer drum volume size, but not with one-to-one correlation. Figure 2.3 and 2.4 in the CASE study report show that the correlation coefficient, defined as filling factor, is between 2.5 and 3.47 pound/cubic foot.

The proposed test load (in unit of pound) is defined according to dryer drum volume, instead of dryer weight capacity, for two reasons. First, drum volume specification can be verified with reasonable measurement accuracy, while weight capacity specification cannot be easily validated rigorously. Second, heat exchange and moisture removal processes are greatly affected by air flow patterns inside dryer drums, which depends on how the drum volume is filled, instead of the clothes weight.

The proposed test load was defined to be less than dryer capacity because not all dryer loads were expected to be close to dryer capacity. Coined collectors in coin-operated dryers certainly accept different amounts of coin input for different load options. The laboratory tests conducted by the CASE study team indicated that increasing test load reduced performance difference between dryers. This is because high drum loadings do not allow free air movements and, therefore, diminish the advantages of efficient drum air flow designs. For the above reasons, test load should not be the same as the dryer capacity.

The proposed test load for commercial dryers is specified as 1.6×(drum volume) in unit of pound.

Auto-termination Control

In the DOE test procedure for residential dryers, the measured dryer energy use is multiplied by a field use factor to capture the field energy use differences between control technologies. The field

use factor for clothes dryers equipped only with timer controls is 1.18, and 1.04 for dryers with automatic termination control functions.

Automatic termination controls are used in commercial clothes dryers, especially in OPL applications in the past. When standard automatic termination control is not commonly used in coin-operated dryers, there is at least one innovative automatic termination control strategy being used in coin-operated applications. The description below is quoted from the product specification sheet for the EcoDry product series provided by American Dryer Corporation. It demonstrates that automatic termination control technology is feasible for coin-operated dryers, if implemented properly.

"EcoDry utilizes a unique Residual Moisture Control (Coin RMC) sensing system to measure the presence of moisture in the load. The patented system will save the coin laundry owner utility costs as it senses when the load is dry even if there is time left on the coin meter. Coin RMC reduces the heat input while it continues to run the tumbler and provides the end-user with dry, warm clothes. Coin RMC ensures full revenue for the laundry owner while at the same time reducing utility costs."[3]

It is important and necessary that efficiency test procedure be able to properly reflect dryer energy performance, including the benefit provided by energy efficiency technologies. Given that automatic termination control technologies are used in all commercial applications, they should be included in the test procedure. Therefore, the CASE study team recommends the approach of using field use factor to differentiate performance difference between controls be retained for commercial dryer testing.

[3] http://www.adclaundry.com/wp-content/themes/liofolio/library/manuals/on-premise/ES20_OPL.pdf

4 Energy Savings and Benefits of the Proposed Regulation

Savings per Dryer

Utility bill cost associated with dryer energy consumption represents a very significant share of the total operation cost of commercial laundromats. Improving dryer efficiency through Title 20 regulations would benefit businesses and consumers in California financially through utility bill reduction. The CASE study report indicated that dryer price is weakly correlated to dryer efficiency and dryers with higher efficiencies do not necessarily cost more than those with lower efficiencies. The CASE study estimated that the potential efficiency improvement for the proposed standards is 1.6% for MFL (residential style) dryers and 6.6% for 30-pound dryers. The present value (PV) of lifecycle benefits are $63/unit and $820/unit for MFL and 30-pound dryers, respectively. The CASE study team assumes that commercial dryer with capacity larger than 30 pounds can achieve the same level of efficiency improvement as that for 30 pound dryers and, therefore, same amount of financial benefits. For example, for a 50 pound dryer, the PV of lifecycle benefits is $1367/unit.

Annual Shipment

The CASE study estimated that the annual shipment for MFL dryers (residential style dryers) was 20,500 gas models and 900 electric model. AHAM reported in its comment letter dated July 29 2013 that "for commercial dryers that are built on the same platform as residential dryers, there were approximately 5,250-5,750 electric and 14,250-14,750 gas commercial dryers shipped to California)". The combined shipment of gas and electric residential style dryers is 19,500 – 20,500 units per year, which is very close to the CASE study estimate but with a higher fraction of electric models.

For COL applications, the CASE study team estimated that the annual shipment of 30 pound dryers was about 8,800 units. Alliance Laundry Service LLC provided a comment letter to the CEC on May 9, 2013 and reported that "for models 25 and 30 pound including 30 pound stacked model, we estimate that the market has annual shipments of less than 1,500 units. Almost all are gas-fired heat type." The average annual shipment of the two estimates, about 5,000 unit, is used for current analysis. The CASE team can conduct further market survey to refine COL dryer shipment estimate.

For OPL market, the CASE study team is conducting market survey to collect more detailed market information (described in a section 2). The preliminary survey results suggest that the CASE study underestimated the installed OPL dryer capacity by about 70%.

Total Benefit of Title 20 Test and List Standard

Because there is no state or federal test standards for commercial dryers, energy performance for these appliance are not available to businesses and consumers in California to choose efficient dryer models. Therefore, it is critical to adopt the proposal test procedure into Title 20 and require manufacturers to provide test results to be published in the CEC appliance database so that energy performance information is available to be public in order to promote high-efficiency dryers. Adoption of the proposed test and list regulation would also allow the IOU incentive programs, under the supervision of the California Public Utility Commission (CPUC), to increase the market adoption of high-efficiency dryers.

The benefits for a test-and-list standard depends on the level of market adoption of efficient dryers and is expected to be smaller than a mandatory efficiency standard. For a conservative estimation, it is assumed that the adopted test and list standard, with utility incentive program support, will lead to 15% increase in market share of the efficient models. The estimated energy savings and net benefits for the overall commercial clothes dryer market are shown in Table 3 and Table 4, respectively.

Table 3. Energy Savings for the Proposed Standards

Product Class	Annual Shipment Savings		Stock Turnover Savings	
	Electricity (GWh/Year)	Natural Gas (MMT/Year)	Electricity (GWh/Year)	Natural Gas (MMT/Year)
MFL	0.07	0.009	0.96	0.12
COL (30 pound dryers)	0.00	0.042	0	0.58
OPL (excluding 30 pound dryers)	0.00	0.043	0	0.60
Total	0.1	0.1	1.0	1.3

Table 4. Lifecycle Costs and Benefits for the Proposed Standards

Product Class	Net Present Value ($)[a]		
	Per Unit	First Year Sales	After Entire Stock Turnover
MFL	$63	$189,000	$2,646,000
COL (30 pound dryers)	$820	$615,000	$8,610,000
OPL (excluding 30 pound dryers)	$1367	$632,726	$8,858,160
Total		$1,436,726	$20,114,160

a. This calculation assumes a constant NPV for each year's sales until entire stock turnover (14 years).

5 Response to Stakeholder Comments

Besides CA IOUs, three parties provided responses to the CEC regarding commercial clothes dryer rulemaking:

1. National Resource Defense Council (NRDC) provided a comment letter to the CEC on July 29, 2013 to support IOUs' CASE study proposal.
2. The Association of Home Appliance Manufacturers (AHAM) response to the CEC on May 9, 2013 in response to the CEC *Invitation to Participatein the Development of Appliance Energy Efficiency Measures*. It provided comprehensive comments regarding commercial clothes dryer standard development in the document titled *AHAM Proposal for No Efficiency Standards for Commercial Dryers* (dated July 29, 2013).
3. Alliance Laundry Service LLC provided a comment level to the CEC (dated May 9, 2013), which presented similar information as those in the AHAM's letter dated May 9, 2013.

This section addresses the key comments presented in the document *AHAM Proposal for No Efficiency Standards for Commercial Dryers*.

Comment 1 – regarding cost effectiveness of standard development

"The time and resources needed to develop a test procedure, and analyze possible levels and the related cost/benefit analysis for manufacturers and consumers, would not be justified."

Response

The updated benefit estimate presented in Section 4 demonstrates that the proposed standard will generate substantial net financial benefits for California business and consumers, which outweigh the cost associated with the time and resources needed to develop the standard.

Implementation of the proposed standard will also drive dryer technology improvements for further efficiency gains, which are not include in the benefit analysis and should be considered in rulemaking decisions.

Comment 2 – regarding impact to California businesses and residents

"Further the negative impact to thousands of small business and the many California residents that use these dryers does not justify a mandatory standard that would most assuredly increase the costs for people who use these dryers, many of whom are in economically stressful situations already and do not have dryers of their own."

Response

The CASE study analysis and additional analysis presented in this document show that California business and residents would benefit tremendously from a new Title 20 commercial clothes dryer standard. Without a test standard to provide energy performance information, California businesses and consumers will not be able to choose efficient dryer models to take advantage of the associated financial benefits.

Comment 3 – regarding applicability of proposed test procedure

"The current Department of Energy test procedure for residential dryers is not applicable to residential style commercial dryers."

"First, The DOE test procedure load size is inappropriate for commercial dryers. Commercial dryers need to be designed to dry heavier loads than standard residential units because they are generally coin-operated and people are trying to dry as many clothes as possible at the lowest cost. Also, the cycle time for coin-operated dryers is shorter because Laundromat customers want to spend as little time as possible at the Laundromat drying clothes."

Response

The proposed test procedure proposed in the CASE study report includes a modified load size specification, which is developed based on analysis of commercial clothes dryer characteristics (see section 2 for details).

The test load in the CASE study proposal is defined as 1.2×(drum volume) in unit of pound. For MFL dryers (residential style dryers), the median drum volume is 7.0 cubic feet based on CASE study market study. The corresponding test load of 8.4 pound, which is close to the standard test load of 8.5 pound for residential dryers specified in the DOE residential dryer test procedure. In response to the above AHAM comments that commercial clothes dryers have higher loads, the CASE study team propose to increase the test load to 1.6×(drum volume), which increase the median test load for MFL dryers (residential style dryers) to 11.2 pound.

AHAM suggested that the cycle time for coin-operated dryers was shorter than those of residential dryers and, therefore, the residential dryer test procedure was not feasible for coin-operated dryers. The CASE study team has the following responses:

1. The need for assessing energy efficiency of commercial dryers should not be affected by the possible expectations of shorter dryer times. Businesses and customers deserve the right to know dryer energy performance information to make proper choices to reduce their energy bill costs, along with other application considerations include dry speed.
2. The proposed Title 20 regulation on commercial dryers is for comparing energy performance of same class of commercial dryers, not for comparing performance between commercial dryers and residential dryers. Therefore, comparison of cycle time between residential and commercial dryers is irrelevant to commercial dryer standard development.
3. AHAM's comment letter dated July 29, 2013 states that "Residential style commercial clothes dryers are very similar mechanically to residential clothes dryers". Therefore, the DOE test procedure for residential dryers is feasible for measuring energy performance of residential style dryers.
4. Dryer initial moisture contents (IMC) is the dominant factor for cycle time. Due to continued improvements in clothes washer efficiency standards, washer residual moisture content (RMC), which is the dryer IMC, has been substantially reduced in recent years. The reduced dryer IMC should be considered if the CEC wants to consider dryer cycle time in dryer standard development.

Comment 4 – regarding field use factor penalty

"Further, customers of commercial dryers want to receive the same drying time for the same price so coin-operated dryers generally use timed-drying to ensure customer satisfaction. The DOE test procedure severely penalizes timed-dry dryers. The field use factor in the DOE test procedure for

clothes dryers with only time termination control systems is 1.18, which is a severe energy penalty for manufacturing and selling timed-dry only residential dryers."

Response

Please see discussion on automatic termination control in section 3.

Comment 5 – regarding possible confliction with California's Division of Measurement Standards Training Manual for Weights and Measures officials

"Another reason not to pursue mandatory efficiency standards for commercial dryers is that other state laws and policies would conflict with this objective."

"Another reason not to pursue mandatory efficiency standards for commercial dryers is that other state laws and policies would conflict with this objective. There are states with laws (e.g., New York CLS Gen Bus § 399-f and Massachusetts ALM GL ch. 93, § 18B) that require Laundromats to post signs stating how much drying time the consumer receives when they put in their coins to start the dryer. Should CEC pursue efficiency standards, they should undergo an exhaustive review of current California laws to ensure the effort does not cause conflicting requirements. However, to ensure the most efficient market place for commercial dryers, it is important to have a North American marketplace for these products. Hence, these laws in other states should be of concern to CEC to prevent Californians from having to buy specialized products that are designed just for California. We realize California has pursued policies that would lead to a California-specific product, e.g., vehicle smog equipment, but AHAM doubts the benefits would out-weigh the costs and resources for a similar endeavor for a few commercial dryers. With that said, we are aware that California Weights & Measures officials verify time that is purchased for products throughout the state. In California's Division of Measurement Standards Training Manual for Weights and Measures officials, it specifically states the example of buying time for clothes dryers --

Time is a commodity because we can buy things by units of time. Examples could be hiring a person to work for us by the hour, or buying a certain amount of time in a clothes dryer (emphasis added).

These state laws and local Weights and Measures verification programs reinforce our view that customers for commercial dryers that are built on the same platform as residential dryers expect the dryer to run the same amount of time based on how much money they pay. Therefore, auto-termination controls are not generally used, and, hence, using the DOE test procedure for residential dryers that severely penalizes timed dryers would not be appropriate for use with commercial dryers."

Response

The CASE study team would like to point out the commercial clothes washers for coin-operated application have been required to comply with the DOE energy conservation standards since 2007. There is no conflict between the DOE commercial clothes washer standards and any state laws. Therefore, conflicts with California state laws are not expected regarding Title 20 regulation on commercial clothes dryers.

It should be further noted that the innovative automatic termination control developed by American Dryer Corporation stops heat input after sensing the clothes have been dried, but does not stop dryer operation. Therefore, it does not violate the requirement from the California's

Division of Measurement Standards Training Manual referenced by AHAM. This demonstrates that state laws do not prevent innovative efficiency technologies.

6 Recommendations

This section provides proposed changes to Title 20 language expand existing sections in Title 20 for residential clothes dryers to include commercial clothes dryers as well. The proposed test procedure for commercial clothes dryers is based on the federal test standard for consumer (residential) clothes dryers (CRF PART 430 SUBPART B APPENDIX D1) with modifications according to commercial dryer specifications and application conditions.

In the following text, additions to the original Title 20 language are shown underlined and deletions are shown in strikeout.

Section 1601 (q) Clothes dryers that are federally-regulated consumer products and commercial clothes dryers

Section 1602 (q) Clothes dryers.
Add the following definitions:

"Commercial clothes dryer" means a clothes dryer that is used in multi-family, coin operated, or on-premise laundromats and is not covered by 10 CFR 430.32(h)(3).

"Consumer clothes dryer" means a clothes dryer that is federally-regulated as a consumer product according to 10 CFR 430.32(h)(3).

Section 1604 (q) Clothes dryers.

(1) The test methods for consumer and commercial clothes dryers are shown in Table Q-1~~is 10 CFR Section 430.23(d) (Appendix D to Subpart B of Part 430) (2008)~~.

Table Q-1

Clothes Dryer Test Methods

Appliance	**Test Method**
Consumer clothes dryers	10 CFR Section 430.23(d1) (Appendix D1 to Subpart B of Part 430) (2008)
Commercial clothes dryers	Section 1604 (q) (2)

(2) **Commercial clothes dryers**. The test method for commercial clothes dryers is as follows and is based on the test standard for consumer clothes dryers with modifications according to sizes of commercial clothes dryers:

(A) Definitions

1. "Active mode" means a mode in which the clothes dryer is connected to a main power source, has been activated and is performing the main function of tumbling the clothing with or without heated or unheated forced air circulation to remove moisture from the clothing, remove wrinkles or prevent wrinkling of the clothing, or both.
2. "AHAM" means the Association of Home Appliance Manufacturers.
3. "AHAM HLD–1" means the test standard published by the Association of Home Appliance Manufacturers, titled "Household Tumble Type Clothes Dryers" (2009), AHAM HLD–1–2009 (incorporated by reference; see §430.3).
4. "Automatic termination control" means a dryer control system with a sensor which monitors either the dryer load temperature or its moisture content and with a controller which automatically terminates the drying process or dryer heat input. A mark, detent, or other visual indicator or detent which indicates a preferred automatic termination control setting must be present if the dryer is to be classified as having an "automatic termination control." A mark is a visible single control setting on one or more dryer controls. If automatic termination control is included in all control modes of a dryer, the dryer can be classified as having an "automatic termination control."
5. "Bone dry" means a condition of a load of test clothes which has been dried in a dryer at maximum temperature for a minimum of 10 minutes, removed, and

weighed before cool down, and then dried again for 10-minute periods until the final weight change of the load is 1 percent or less.

~~"Compact" or "compact size" means a clothes dryer with a drum capacity of less than 4.4 cubic feet.~~

6. "Conventional clothes dryer" means a clothes dryer that exhausts the evaporated moisture from the cabinet.

7. "Cool down" means that portion of the clothes drying cycle when the added gas or electric heat is terminated and the clothes continue to tumble and dry within the drum.

8. "Cycle" means a sequence of operation of a clothes dryer which performs a clothes drying operation, and may include variations or combinations of the functions of heating, tumbling, and drying.

9. "Drum capacity" means the volume of the drying drum in cubic feet.

10. "IEC 62301" means the test standard published by the International Electrotechnical Commission ("IEC"), titled "Household electrical appliances–Measurement of standby power," Publication 62301 (first edition June 2005) (incorporated by reference; see §430.3).

11. "Inactive mode" means a standby mode that facilitates the activation of active mode by remote switch (including remote control), internal sensor, or timer, or that provides continuous status display.

12. "Moisture content" means the ratio of the weight of water contained by the test load to the bone-dry weight of the test load, expressed as a percent.

13. "Moisture sensing control" means a system which utilizes a moisture sensing element within the dryer drum that monitors the amount of moisture in the clothes and automatically terminates the dryer cycle.

14. "Off mode" means a mode in which the clothes dryer is connected to a main power source and is not providing any active or standby mode function, and where the mode may persist for an indefinite time. An indicator that only shows the user that the product is in the off position is included within the classification of an off mode.

~~"Standard size" means a clothes dryer with a drum capacity of 4.4 cubic feet or greater.~~

15. "Standby mode" means any product modes where the energy using product is connected to a main power source and offers one or more of the following user-oriented or protective functions which may persist for an indefinite time:
(a) To facilitate the activation of other modes (including activation or deactivation of active mode) by remote switch (including remote control), internal sensor, or timer.
(b) Continuous functions, including information or status displays (including

clocks) or sensor-based functions. A timer is a continuous clock function (which may or may not be associated with a display) that provides regular scheduled tasks (e.g., switching) and that operates on a continuous basis.

16. "Temperature sensing control" means a system which monitors dryer exhaust air temperature and automatically terminates the dryer cycle

17. "Ventless clothes dryer" means a clothes dryer that uses a closed-loop system with an internal condenser to remove the evaporated moisture from the heated air. The moist air is not discharged from the cabinet.

(B).Testing Conditions

1. Installation. Install the clothes dryer in accordance with manufacturer's instructions. For conventional clothes dryers, as defined in (A) 6, the dryer exhaust shall be restricted by adding ~~the AHAM~~ an exhaust simulator based on the one described in 3.3.5.1 of AHAM HLD–1 ~~(incorporated by reference; see §430.3)~~. The exhaust simulator shall consist of a straight section of 13.5 inches (344 mm) and a tapered section of 13.25 inches (338 mm). The straight section shall have an inside diameter matching the exhaust pipe diameter of the dryer being tested. The tapered section shall have a linear diameter reduction from the diameter of the straight section to 2 and 9/16 inches (65mm). For ventless clothes dryers, as defined in (A) 21, the dryer shall be tested without the AHAM exhaust simulator. Where the manufacturer gives the option to use the dryer both with and without a duct, the dryer shall be tested without the exhaust simulator. All external joints should be taped to avoid air leakage. If the manufacturer gives the option to use a ventless clothes dryer, as defined in (A) 21, with or without a condensation box, the dryer shall be tested with the condensation box installed. For ventless clothes dryers, the condenser unit of the dryer must remain in place and not be taken out of the dryer for any reason between tests. For drying testing, disconnect all console lights or other lighting systems on the clothes dryer which do not consume more than 10 watts during the clothes dryer test cycle. For standby and off mode testing, the clothes dryer shall also be installed in accordance with section 5, paragraph 5.2 of IEC 62301 (incorporated by reference; see §430.3). For standby and off mode testing, do not disconnect console lights or other lighting systems.

2. Ambient temperature and humidity.

   2.1. For drying testing, maintain the room ambient air temperature at 75 ±3 °F and the room relative humidity at 50 ±10 percent relative humidity.

   2.2. For standby and off mode testing, maintain room ambient air temperature conditions as specified in section 4, paragraph 4.2 of IEC 62301 (incorporated by reference; see §430.3).

3. Energy supply.

   3.1. Electrical supply. Maintain the electrical supply at the clothes dryer terminal block within 1 percent of 120/240 or 120/208Y or 120 volts as applicable to the

particular terminal block wiring system and within 1 percent of the nameplate frequency as specified by the manufacturer. If the dryer has a dual voltage conversion capability, conduct the test at the highest voltage specified by the manufacturer.

3.1.1. Supply voltage waveform. For the clothes dryer standby mode and off mode testing, maintain the electrical supply voltage waveform indicated in section 4, paragraph 4.4 of IEC 62301 (incorporated by reference; see §430.3)

3.2. Gas supply.

3.2.1. Natural gas. Maintain the gas supply to the clothes dryer immediately ahead of all controls at a pressure of 7 to 10 inches of water column. If the clothes dryer is equipped with a gas appliance pressure regulator for which the manufacturer specifies an outlet pressure, the regulator outlet pressure shall be approximately that recommended by the manufacturer. The hourly Btu rating of the burner shall be maintained within ±5 percent of the rating specified by the manufacturer. The natural gas supplied should have a heating value of approximately 1,025 Btus per standard cubic foot. The actual heating value, Hn2, in Btus per standard cubic foot, for the natural gas to be used in the test shall be obtained either from measurements made by the manufacturer conducting the test using a standard continuous flow calorimeter as described in (B) 4.6 or by the purchase of bottled natural gas whose Btu rating is certified to be at least as accurate a rating as could be obtained from measurements with a standard continuous flow calorimeter as described in (B) 4.6.

3.2.2. Propane gas. Maintain the gas supply to the clothes dryer immediately ahead of all controls at a pressure of 11 to 13 inches of water column. If the clothes dryer is equipped with a gas appliance pressure regulator for which the manufacturer specifies an outlet pressure, the regulator outlet pressure shall be approximately that recommended by the manufacturer. The hourly Btu rating of the burner shall be maintained within ±5 percent of the rating specified by the manufacturer. The propane gas supplied should have a heating value of approximately 2,500 Btus per standard cubic foot. The actual heating value, Hp, in Btus per standard cubic foot, for the propane gas to be used in the test shall be obtained either from measurements made by the manufacturer conducting the test using a standard continuous flow calorimeter as described in (B) 4.6 or by the purchase of bottled gas whose Btu rating is certified to be at least as accurate a rating as could be obtained from measurement with a standard continuous calorimeter as described in (B) 4.6.

4. Instrumentation. Perform all test measurements using the following instruments as appropriate.

4.1. Weighing scale for test cloth. The scale shall have a range of 0 to a maximum ~~of~~ that is at least 10% higher than the dryer load defined in 7.1. ~~30 pounds with a~~ The resolution ~~of~~shall be at least 0.2 ounces for dryer load less than or equal to 75 pounds and at least 0.4 ounces for dryer load large than 75 pounds. The ~~and a~~ maximum error shall be no greater than 0.3 percent of the~~any~~ measured value ~~within the range of 3 to 15 pounds~~.

4.1.1. Weighing scale for drum capacity measurements. The scale should have a range of 0 to a maximum that is larger than 20% of the net weight of the test dryer and is not more than 2500 pounds. ~~of 500 pounds with~~The resolution ~~of~~shall be 0.50 pounds and ~~a~~the maximum error shall be no greater than 0.5 percent of the measured value.

4.2. Kilowatt-hour meter. The kilowatt-hour meter shall have a resolution of 0.001 kilowatt-hours and a maximum error no greater than 0.5 percent of the measured value.

4.3. Gas meter. The gas meter shall have a resolution of 0.001 cubic feet and a maximum error no greater than 0.5 percent of the measured value.

4.4. Dry and wet bulb psychrometer. The dry and wet bulb psychrometer shall have an error no greater than ±1 °F.

4.5. Temperature. The temperature sensor shall have an error no greater than ±1 °F.

4.6. Standard Continuous Flow Calorimeter. The calorimeter shall have an operating range of 750 to 3,500 Btu per cubic feet. The maximum error of the basic calorimeter shall be no greater than 0.2 percent of the actual heating value of the gas used in the test. The indicator readout shall have a maximum error no greater than 0.5 percent of the measured value within the operating range and a resolution of 0.2 percent of the full-scale reading of the indicator instrument.

4.7. Standby mode and off mode watt meter. The watt meter used to measure standby mode and off mode power consumption of the clothes dryer shall have the resolution specified in section 4, paragraph 4.5 of IEC 62301 (incorporated by reference; see §430.3). The watt meter shall also be able to record a "true" average power as specified in section 5, paragraph 5.3.2(a) of IEC 62301.

5. Lint trap. Clean the lint trap thoroughly before each test run.

6. Test Clothes.

6.1. Energy test cloth. The energy test cloth shall be clean and consist of the following:
(a) Pure finished bleached cloth, made with a momie or granite weave, which is a blended fabric of 50-percent cotton and 50-percent polyester and weighs within +10 percent of 5.75 ounces per square yard after test cloth preconditioning, and has 65 ends on the warp and 57 picks on the fill. The

individual warp and fill yarns are a blend of 50-percent cotton and 50-percent polyester fibers.
(b) Cloth material that is 24 inches by 36 inches and has been hemmed to 22 inches by 34 inches before washing. The maximum shrinkage after five washes shall not be more than 4 percent on the length and width.
(c) The number of test runs on the same energy test cloth shall not exceed 25 runs.

6.2. Energy stuffer cloths. The energy stuffer cloths shall be made from energy test cloth material, and shall consist of pieces of material that are 12 inches by 12 inches and have been hemmed to 10 inches by 10 inches before washing. The maximum shrinkage after five washes shall not be more than 4 percent on the length and width. The number of test runs on the same energy stuffer cloth shall not exceed 25 runs after test cloth preconditioning.

6.3. Test Cloth Preconditioning.
A new test cloth load and energy stuffer cloths shall be treated as follows:
(1) Bone dry the load to a weight change of ±1 percent, or less, as prescribed in section 1.5.
(2) Place the test cloth load in a standard clothes washer set at the maximum water fill level. Wash the load for 10 minutes in soft water (17 parts per million hardness or less), using 60.8 grams of AHAM standard test detergent Formula 3. Wash water temperature is to be controlled at 140 ° ±5 °F (60 ° ±2.7 °C). Rinse water temperature is to be controlled at 100 ° ±5 °F (37.7 ±2.7 °C).
(3) Rinse the load again at the same water temperature.
(4) Bone dry the load as prescribed in section 1.5 and weigh the load.
(5) This procedure is repeated until there is a weight change of 1 percent or less.
(6) A final cycle is to be a hot water wash with no detergent, followed by two warm water rinses.

7. Test loads.

~~Compact size dryer load. Prepare a bone-dry test load of energy cloths which weighs 3.00 pounds ±.03 pounds. Adjustments to the test load to achieve the proper weight can be made by the use of energy stuffer cloths, with no more than five stuffer cloths per load. Dampen the load by agitating it in water whose temperature is 60 °F ±5 °F and consists of 0 to 17 parts per million hardness for approximately 2 minutes in order to saturate the fabric. Then, extract water from the wet test load by spinning the load until the moisture content of the load is between 54.0–61.0 percent of the bone-dry weight of the test load.~~

7.1. ~~Standard size d~~Dryer load. Prepare a bone-dry test load of energy cloths which weighs ~~8.45 pounds ±.085~~1.2×(drum volume) pounds. Adjustments to the test load to achieve the proper weight can be made by the use of energy stuffer cloths, with no more than five stuffer cloths per load. Dampen the load by agitating it in water whose temperature is 60 °F ±5 °F and consists of 0 to 17

parts per million hardness for approximately 2 minutes in order to saturate the fabric. Then, extract water from the wet test load by spinning the load until the moisture content of the load is between 54.0–61.0 percent of the bone-dry weight of the test load.

7.2. Method of loading. Load the energy test cloths by grasping them in the center, shaking them to hang loosely, and then dropping them in the dryer at random.

8. Clothes dryer preconditioning.

8.1. Conventional clothes dryers. For conventional clothes dryers, before any test cycle, operate the dryer without a test load in the non-heat mode for 15 minutes or until the discharge air temperature is varying less than 1 °F for 10 minutes—whichever is longer—in the test installation location with the ambient conditions within the specified test condition tolerances of 2.2.

8.2. Ventless clothes dryers. For ventless clothes dryers, before any test cycle, the steady-state machine temperature must be equal to ambient room temperature described in 2.2.1. This may be done by leaving the machine at ambient room conditions for at least 12 hours between tests.

(C) Test Procedures and Measurements

1. Drum Capacity. For dryer with a net weight less than 2000 pounds, ~~M~~measure the drum capacity by sealing all openings in the drum except the loading port with a plastic bag, and ensuring that all corners and depressions are filled and that there are no extrusions of the plastic bag through the opening in the drum. Support the dryer's rear drum surface on a platform scale to prevent deflection of the drum surface, and record the weight of the empty dryer. Fill the drum with water to a level determined by the intersection of the door plane and the loading port. Record the temperature of the water and then the weight of the dryer with the added water and then determine the mass of the water in pounds. Add or subtract the appropriate volume depending on whether or not the plastic bag protrudes into the drum interior. The drum capacity is calculated as follows:
   C = w/d

   C = capacity in cubic feet.

   W = weight of water in pounds.

   D = density of water at the measured temperature in pounds per cubic feet.

   Dryers with a net weight equal or larger than 2000 pounds are not required to test drum capacity. For these dryers, use the drum capacity specified by the manufacturer for the following test procedures.

2. Dryer Loading. Load the dryer as specified in (B) 7.

3. Test cycle Operate the clothes dryer at the maximum temperature setting and, if equipped with a timer, at the maximum time setting and dry the load until the moisture content of the test load is between 2.5 and 5 percent of the bone-dry

weight of the test load, but do not permit the dryer to advance into cool down. If required, reset the timer or automatic dry control. If the dryer automatically stops during a cycle because the condensation box is full of water, the test is stopped, and the test run is invalid, in which case the condensation box shall be emptied and the test re-run from the beginning. For ventless dryers, as defined in (A) 21, during the time between two cycles, the door of the dryer shall be closed except for loading (and unloading).

4. Data recording. Record for each test cycle:

   4.1. Bone-dry weight of the test load described in (B) 7.

   4.2. Moisture content of the wet test load before the test, as described in (B) 7.

   4.3. Moisture content of the dry test load obtained after the test described in (C) 3.

   4.4. Test room conditions, temperature, and percent relative humidity described in (B) 2.1.

   4.5. For electric dryers—the total kilowatt-hours of electric energy, Et, consumed during the test described in (C) 3.

   4.6. For gas dryers:

      4.6.1. Total kilowatt-hours of electrical energy, Ete, consumed during the test described in (C) 3.

      4.6.2. Cubic feet of gas per cycle, Etg, consumed during the test described in (C) 3.

      4.6.3. Correct the gas heating value, GEF, as measured in (B) 3.2.1 and (B) 3.2.2, to standard pressure and temperature conditions in accordance with U.S. Bureau of Standards, circular C417, 1938.

5. Test for automatic termination field use factor. The field use factor for automatic termination can be claimed for those dryers which meet the requirements for automatic termination control, defined in (A) 4.

6. Standby mode and off mode power. Establish the testing conditions set forth in Section (B) "Testing Conditions" of this appendix, omitting the requirement to disconnect all console light or other lighting systems on the clothes dryer that do not consume more than 10 watts during the clothes dryer test cycle in section (B) 1. If the clothes dryer waits in a higher power state at the start of standby mode or off mode before dropping to a lower power state, as discussed in section 5, paragraph 5.1, note 1 of IEC 62301 (incorporated by reference; see §430.3),wait until the clothes dryer passes into the lower power state before starting the measurement. Follow the test procedure specified in section 5, paragraph 5.3 of IEC 62301 for testing in each possible mode as described in (C) 6.1 and (C) 6.2, except allow the product to stabilize for 30 to 40 minutes and use an energy use measurement period of 10 minutes. For units in which power varies over a cycle, as described in section 5, paragraph 5.3.2 of IEC 62301, use the average power approach described in

paragraph 5.3.2(a) of IEC 62301, except allow the product to stabilize for 30 to 40 minutes and use an energy use measurement period not less than 10 minutes.

6.1. If a clothes dryer has an inactive mode, as defined in (A) 11, measure and record the average inactive mode power of the clothes dryer, PIA, in watts.

6.2. If a clothes dryer has an off mode, as defined in (A) 15, measure and record the average off mode power of the clothes dryer, POFF, in watts.

(D) Calculation of Derived Results From Test Measurements

1. Total Per-cycle electric dryer energy consumption. Calculate the total electric dryer energy consumption per cycle, Ece, expressed in kilowatt-hours per cycle and defined as:

   Ece= [53.5/(Ww−Wd)] × Ett× field use,

   Where:

   53.5 = an experimentally established value for the percent reduction in the moisture content of the test load during a laboratory test cycle expressed as a percent.

   field use = field use factor.

   = 1.18 for clothes dryers with time termination control systems only without any automatic termination control functions.

   = 1.04 clothes dryers with automatic control systems that meet the requirements of the definition for automatic control systems in 1.4, 1.14 and 1.18, including those that also have a supplementary timer control, or that may also be manually controlled.

   Ww= the moisture content of the wet test load as recorded in (C) 4.2.

   Wd= the moisture content of the dry test load as recorded in (C) 4.3.

2. Per-cycle gas dryer electrical energy consumption. Calculate the gas dryer electrical energy consumption per cycle, Ege, expressed in kilowatt-hours per cycle and defined as:
   Ege= [53.5/(Ww−Wd)] × Ete× field use,
   Where:
   Ete= the energy recorded in (C) 4.6.1 field use, 53.5, Ww, Wdas defined in (D) 1.

3. Per-cycle gas dryer gas energy consumption. Calculate the gas dryer gas energy consumption per cycle, Ege, expressed in Btus per cycle as defined as:
   Egg= [53.5/(Ww− Wd)] × Etg× field use × GEF
   Where:
   Etg= the energy recorded in (C) 4.6.2
   GEF = corrected gas heat value (Btu per cubic feet) as defined in (C) 4.6.3, field use, 53.5, Ww, Wdas defined in (D) 1.

4. Total per-cycle gas dryer energy consumption expressed in kilowatt-hours. Calculate the total gas dryer energy consumption per cycle, Ecg, expressed in kilowatt-hours per cycle and defined as:
   Ecg= Ege+ (Egg/3412 Btu/kWh)
   Where:
   Ege as defined in (D) 2
   Egg as defined in (D) 3

5. Per-cycle standby mode and off mode energy consumption. Calculate the dryer inactive mode and off mode energy consumption per cycle, ETSO, expressed in kWh per cycle and defined as:
   ETSO= [(PIA× SIA) + (POFF× SOFF)] × K/283
   Where:
   PIA= dryer inactive mode power, in watts, as measured in section (C) 6.1;
   POFF= dryer off mode power, in watts, as measured in section (C) 6.2.
   If the clothes dryer has both inactive mode and off mode, SIA and SOFF both equal 8,620 ÷ 2 = 4,310, where 8,620 is the total inactive and off mode annual hours;
   If the clothes dryer has an inactive mode but no off mode, the inactive mode annual hours, SIA, is equal to 8,620 and the off mode annual hours, SOFF, is equal to 0;
   If the clothes dryer has an off mode but no inactive mode, SIA is equal to 0 and SOFF is equal to 8,620
   Where:
   K = 0.001 kWh/Wh conversion factor for watt-hours to kilowatt-hours; and
   283 = representative average number of clothes dryer cycles in a year.

6. Per-cycle combined total energy consumption expressed in kilowatt-hours. Calculate the per-cycle combined total energy consumption, ECC,expressed in kilowatt-hours per cycle and defined for an electric clothes dryer as:
   ECC= Ece+ ETSO
   Where:
   Ece= the energy recorded in (D) 1, and
   ETSO= the energy recorded in (D) 7, and defined for a gas clothes dryer as:
   ECC= Ecg+ ETSO
   Where:
   Ecg= the energy recorded in (D) 4, and
   ETSO= the energy recorded in (D) 7.

7. Energy Factor in pounds per kilowatt-hour. Calculate the energy factor, EF, expressed in pounds per kilowatt-hour and defined for an electric clothes dryer as:
   EF = Wbonedry/Ece
   Where:
   Wbonedry= the bone dry test load weight recorded in (C) 4.1, and
   Ece= the energy recorded in (D) 1, and
   and defined for a gas clothes dryer as:
   EF = Wbonedry/Ecg

Where:
Wbonedry= the bone dry test load weight recorded in (C) 4.1, and
Ecg= the energy recorded in (D) 4,

8. Combined Energy Factor in pounds per kilowatt-hour. Calculate the combined energy factor, CEF, expressed in pounds per kilowatt-hour and defined as:
CEF = Wbonedry/ECC
Where:
Wbonedry= the bone dry test load weight (C) 4.1, and
ECC= the energy recorded in (D) 6

Section 1605.1 (q) Clothes dryers

Add the following at the end of the section:

Commercial clothes dryers are not regulated by federal energy efficiency standards.

Section 1605.2 (q) Clothes dryers

No change.

Section 1605.3 (q) Clothes dryers

No change.

Section 1606 . Clothes Dryers

Modify section Q in Table X:

	Appliance	Required Information	Permissible Answers
Q	Residential Clothes Dryers	Energy Source	Natural Gas, Electric
		Drum Capacity	Cubic feet ($ft^{3)}$
		Voltage	120 v, 240 v, other (specify)
		Combination Washer/Dryer	Yes, No
		Automatic Termination Control	Yes, No
		Energy Factor	
		Constant Burning Pilot Light (Gas Model only)	Yes, No
	Commercial Clothes Dryers	Energy Source	Natural Gas, Electric
		Drum Capacity	Cubic feet ($ft^{3)}$
		Voltage	120 v, 240 v, other (specify)
		Automatic Termination Control	Yes, No
		Total Per-cycle electric dryer energy consumption (Ece)	kWh
		Per-cycle gas dryer electrical energy consumption (Ege)	kWh
		Per-cycle gas dryer gas energy consumption (Egg)	Btu
		Per-cycle standby mode and off mode energy consumption (ETSO)	kWh
		Energy Factor	
		Combined Energy Factor	
		Constant Burning Pilot Light (Gas Model only)	Yes, No