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Proposal Information Template for:
Commercial Clothes Dryers

Submitted to:
California Energy Commission
In consideration for the 2011 Rulemaking Proceeding on Appliance Efficiency Regulations,
Docket number 11-AAER-1

Prepared for:
Pacific Gas and Electric Company
San Diego Gas & Electric
Southern California Edison
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Please note: all savings estimates and information in this document are preliminary and are based on data available to the authors at the time of the report. If the CEC moves forward with this topic, we anticipate updating our estimates and recommendations based upon additional input from stakeholders.

Proposal Information Template – Commercial Clothes Dryer

2011 Appliance Efficiency Standards

Prepared for: Pacific Gas and Electric Company, San Diego Gas & Electric, Southern California Edison, Southern California Gas Company

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Purpose

This document is a report template to be used by researchers who are evaluating proposed changes to the California Energy Commission's (Commission) appliance efficiency regulations (Title 20, Cal. Code Regulations, §§ 1601 – 1608) This report specifically covers commercial clothes dryers.

Background

Clothes dryers are designed to dry fabrics in a tumble-type drum with heated air circulation, which is generated by an electric motor driven blower coupled with either a natural gas burner or an electric resistance heater. This study investigated both gas-fired and electric commercial clothes dryers.

Commercial clothes dryers are used in three distinct sectors: multi-family, coin-operated and on-premise laundromats. Multi-family dryers are used in apartment complexes, serving domestic laundry needs. Coin-op dryers are used in typical laundromats, and on-premise dryers are used in facilities such as hotel/motels, hospitals and various institutions. Multi-family dryers are comparable to residential dryers in capacity and performance, whereas coin-op and on-premise dryer designs are generally larger in capacity and have greater emphasis on durability and drying speed. This CASE study focuses on multi-family clothes dryers, which usually have a drying capacity of 18 lb, and coin-op and on-premise dryers with drying capacity less than 30 lb. Dryers with capacity larger than 30 lb are less standardized and are used in a broader range of applications, where load conditions can have a large variation. Our test study did not have enough resources to characterize performance of these dryers. Therefore, we are not proposing any testing or performance requirements for them.

This proposal aims to develop Title 20 test procedures and minimum performance requirement for commercial clothes dryers. Energy efficiency of commercial clothes dryers is not currently regulated by federal or California standards, while residential clothes dryer

efficiency is regulated by federal standards. Commercial dryers and residential dryers are in some instance similar regarding designs and operation. Therefore, the residential dryer test procedures can be adopted to regulate commercial clothes dryer efficiencies. This CASE study conducted a detailed laboratory test study to develop a test procedure based on the federal residential clothes dryer standard and to assess efficiency of dryers from all major manufacturers to develop minimum performance standards.

Overview

Description of Standards Proposal	Clothes dryers are designed to dry fabrics in a tumble-type drum with heated air circulation, which is generated by an electric motor driven blower coupled with either a natural gas burner or an electric resistance heater. This study covers both gas-fired and electric commercial clothes dryers used in commercial applications. Commercial clothes dryers are used in three types of application, multi-family, laundromat, and on-premise. On -premise application includes those in a broad range of buildings, such as hotel/motel, nursing homes, hospitals, restaurants, university dormitories, and fire/police departments. Commercial clothes dryers can also be classified according to their capacities, measured based on weight of dryer clothes. The smallest models typical have a capacity of 18 pounds. They have very similar design to their residential dryer counterparts and are used in multi-family buildings. Laundromats mostly use dryers with 30 pounds drying capacity. Two 30-lb dryers are usually stacked together to save space. This class of dryers are also widely used in on-premise applications. Dryers with larger drying capacities are less standardized than 18-lb and 30-lb dryers. They are used in on-premise and industrial applications for a very broad range of fabric types. In California, about 95% of the multi-family dryers are natural gas based and the rest 5% are electric based; while 30-lb dryers are all natural gas based. Energy performance of commercial clothes dryers can be assessed following the federal residential clothes dryer efficiency standards by comparing their Energy Factors (EF), which is defined as pounds of clothes dried per kWh power consumption. For gas dryers, natural gas energy consumption in Btu is converted to kWh to support EF calculation. In general, EF is affected by test fabric type, load weight, initial and final moisture content level, and temperature settings. This proposal includes a test procedure, developed based on the federal residential clothes dryer standards and test studies on commercial clothes dryers, to assess EF of commercial dryers. The CASE study followed closely to recent DOE standard development efforts to make sure the proposed commercial dryer test procedures are consistent with the new DOE standards for residential dryers. This CASE study proposes the adoption of test procedures for commercial

gas and electric dryers with capacity equal to or less than 30 pounds. The CASE study also proposes minimum performance standards for commercial gas clothes dryers.

California Stock and Sales

Dryer Type	Current Stock	Annual Sales /Replacement Rate
18-lb Multi-Family	259,750	7.30%
30-lb Coin-Op	39,137	7.30%
30-lb On-Premise	40,000-72,000	7.30%

No projected annual growth rate is assumed for the study.

Energy Savings and Demand Reduction

Per unit savings

Dryer Type	Electric Savings (kWh/yr)	Gas Savings (Therm/yr)
18-lb Multi-Family	0	4
30-lb Coin-Op & On-Premise	0	56

California energy savings: after entire stock turnover

Electric Savings (MWh/yr)	Gas Savings (Million Therm/yr)
0	13

Demand energy savings are expected to be very small because the proposed performance standards are only applicable to gas dryers.

Economic Analysis

Commercial clothes dryer costs are not directly correlated with dryer efficiency. Test study results indicated that high-efficiency dryers on the market do not cost more than dryers that are less efficient. The proposed standards will not introduce any incremental costs and, therefore, is cost effective. The recommended code changes are not expected to change overall dryer sales. Therefore, no negative impact to overall dryer manufacturing industry is expected. The lifetime energy savings benefit per dryer is listed in the following table.

<table>
<tr><td></td><td>Present Value energy savings per dryer:
<table><tr><th>Dryer Type</th><th>PV Energy Savings</th></tr><tr><td>18-lb Multi-Family</td><td>$ 41</td></tr><tr><td>30-lb Coin-Op & On-Premise</td><td>$507</td></tr></table></td></tr>
<tr><td>Non-Energy Benefits</td><td>No non-energy benefits are expected.</td></tr>
<tr><td>Environmental Impacts</td><td>The proposed measure will reduce air pollution emissions from reduction in natural gas and electricity consumptions.</td></tr>
<tr><td>Acceptance Issues</td><td>There will be no acceptance issues associated with the proposed measure because it does not change the dryer operation and does not increase cost.</td></tr>
<tr><td>Federal Preemption or other Regulatory or Legislative Considerations</td><td>Energy efficiency of commercial clothes dryers is not regulated by any federal standards at this point.</td></tr>
</table>

Methodology and Modeling used in the Development of the proposal

The CASE study team conducted market studies, energy consumption analysis, and dryer performance laboratory test to develop this code change proposal. To assess commercial clothes dryer market status, the team collected dryer model specs from manufacturer websites and surveyed various local commercial dryer distributors, Coin Laundry Association, and Multi-Housing Laundry Association. For commercial dryer population and energy use baseline estimates, the team reviewed resources including Consortium for Energy Efficiency's (CEE) commercial clothes washers initiative and AHAM's commercial washer sales information, since data on dryers were not directly available. Commercial clothes washers and dryers are used together in the same market sectors, so market data on commercial washers can be effectively used to assess market status of commercial dryers. In the absence of state-level information, the team utilized census data to further approximate the dryer population in California. The team designated this way of estimating dryer population the "washer-to-dryer" approach for reference purposes.

However, estimation of dryer population in the on-premise market sector was difficult due to the large diversity in dryer size and facility type under this sector. The team thus adopted the "end use" approach from a study developed for the California Urban Water Conservation Council (Riesenberger 2006). With the "end use" approach, the team skipped the step of figuring out dryer population, and instead estimated the annual end use load and the associated annual dryer energy consumption. For each facility type (ie. Motel/hotel,

hospitals, institutions etc.), the annual end use load depends on the number of facility or user population, as well as load size and frequency. For each facility type:

Annual end use load= number of facility x load size x frequency of load
[lb/yr] = [# in the state] x [lb/load] x [load/yr]

Translation from the annual end use load to the annual dryer energy consumption is described later at the end the "Methodology" section.

The team then conducted lab testing of commercial dryers to develop test procedures appropriate for determining energy performances of commercial clothes dryers and benchmark their performance and assess potential improvement levels. The lab test study first identified operational variables and quantified their effects on energy consumption. This first portion helped identify possible improvement to the DOE residential testing procedures and provide data to estimate energy consumption of commercial dryers in real operating conditions. The second part of the study involved testing dryers from major manufacturers using the proposed test procedures to collect performance statistics, in order to establish appropriate energy efficiency standards (in terms of Energy Factors) for commercial dyers. The team selected and procured commercial dryers that are representative of models available on the market, based on the knowledge gained from the market study. The test procedure developed was based on DOE's test procedures for residential dryers (see Reference). Test matrix used is shown below in Table 1. IMC and RMC stand for initial and remaining moisture content of the test load respectively. They represent the water left in the test load *before* and *after* the drying process, and they are in the unit of % bone dry load weight. The difference between the IMC and RMC determines the amount of water the dryer extract from the test load during the drying process.

Dryer	Load Weight (lbs.)	Fabric Type	IMC (% Bone dry)	RMC (% Bone dry)	Temp Setting
18-lb Dryers (Gas & electric)	8.45 lb ±.085 lb	Standard Test Material	47% ± 2.3%	4.5% ± 0.25%, 2.5% ± 0.25%	High
30-lb Dryers (Gas)	20.0 lb ±.20 lb	Standard Test Material	47% ± 2.3%	4.5% ± 0.25%, 2.5% ± 0.25%	High

***Table 1:* Dryer Test Matrix**

Energy performance of commercial clothes dryers can be assessed following the federal residential clothes dryer efficiency standards and comparing their Energy Factors (EF). EF is defined as pounds of clothes dried per kWh energy consumption. In general, EF is affected by test fabric type, load weight, initial and final moisture content level, and temperature settings. This proposal includes a test procedure, developed based on the federal residential clothes dryer standards and test studies on commercial clothes dryers, to assess EF of commercial dryers. The CASE study closely followed the recent DOE standard development efforts to make sure the proposed commercial dryer test procedures are consistent with the new DOE standards for residential dryers.

The test EF was used to estimate baseline annual energy consumption of commercial dryers ("current practice"):

for multi-family and coin-op sectors:

Per unit annual energy consumption = test EF x load frequency x load size

Market sector annual energy consumption = per unit annual energy consumption x market sector dryer population

OR

for on-premise sector:

Market sector annual energy consumption = test EF x annual end use load

Total annual energy consumption = ∑ market sector annual energy consumption

Equation 1: Annual Energy Consumption

The proposed efficiency levels are based on raising the energy performance of commercial dryers up to the best performers of the set of dryers tested. The per unit and statewide energy savings from proposed standards are then calculated based on the difference between the average and maximum EFs.

Data, Analysis, and Results

The dryer populations in the multi-family and coin-op commercial dryer market sectors were estimated utilizing knowledge gained from our market study.
Combining the dryer population, end user load and test result EFs, the baseline annual energy consumption results were calculated and are shown in Table 2.

Market Sector (dryer capacity)	Baseline Calculation Approach	Dryer Population	End Use Load	Baseline Annual Energy Consumption		
		#	lb/yr	GWh/yr	MMT/yr	% total
MF (18-lb)	"Washer-to-Dryer" approach	260,000		142	36	33%
Coin-Op (30-lb)		39,000		28	29	10%
On-Premise	"End Use" approach					
30-lb units			6700 mil	121	126	45%
other units			1700 mil	30	31	11%
TOTAL				321	222	100%

***Table 2:* Baseline Annual Energy Consumption by Market Sector**

The laboratory dryer test results showed that 18-lb capacity dryers (multi-family) had EF within a 5% difference range, whereas 30-lb capacity dryers (coin-op and on-premise dryers) had EF within a 16% difference range. This indicates that there is a large variation in energy performance in 30-lb commercial clothes dryers. Thus we can expect a difference in energy efficiency improvement potential between the two types of commercial dryers. Table 3

presents energy savings potential based on the difference between the average and highest EF from the dryer test results.

Market Sector (dryer capacity)	Annual Energy Consumption after Stock Turnover		Energy Savings after Stock Turnover	
	GWh/yr	MMT/yr	GWh/yr	MMT/yr
MF (18-lb)	142	35	0	1
Coin-Op (30-lb)	27	27	0	2
On-Premise	151	148		
30 lb units	121	117	0	9
75 lb units	30	31		
TOTAL	321	210	0	13

***Table 3:* Energy Savings from Proposed Change - Entire Stock Turnover**

Proposed Standards and Recommendations

The CASE study recommends test and performance standards for commercial dryers with capacities equal to or less than 30 pounds.
The recommended test procedure for commercial clothes dryers is based on existing method laid forth by the DOE for residential dryers (10 CFR Part 430 Subpart B, appendix D, "Uniform Test Method for Measuring the Energy Consumption of Clothes Dryers" in the Reference section). Commercial clothes dryers will be tested following the same procedures with only difference in test load weight. Manufacturers will be required to submit certified test results to show the energy performance of their products under the framework of Title 20 section 1606.
The CASE study also plans to propose minimum performance standards for gas dryers based on the test results and communications with stakeholders during CEC's rulemaking process. Since our test study did not test different electric dryers, we do not plan to propose performance standards for electric models.

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CLA, Coin Laundry Industry Overview, Coin Laundry Association website, http://www.coinlaundry.org/

MLA, Multihousing Laundry Association, http://www.mla-online.com/

Reference

"APPENDIX D TO SUBPART B OF PART 430—UNIFORM TEST METHOD FOR MEASURING THE ENERGY CONSUMPTION OF CLOTHES DRYERS"

1. Definitions

1.1 ''AHAM'' means the Association of Home Appliance Manufacturers.
1.2 ''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.
1.3 ''Compact'' or "compact size'' means a clothes dryer with a drum capacity of less than 4.4 cubic feet.
1.4 ''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.
1.5 ''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.
1.6 ''Drum capacity'' means the volume of the drying drum in cubic feet.
1.7 ''HLD–1'' means the test standard promulgated by AHAM and titled ''AHAM Performance Evaluation Procedure for Household Tumble Type Clothes Dryers'', June 1974, and designated as HLD–1.
1.8 ''HLD–2EC'' means the test standard promulgated by AHAM and titled ''Test Method for Measuring Energy Consumption of Household Tumble Type Clothes Dryers,'' December 1975, and designated as HLD–2EC.
1.9 ''Standard size'' means a clothes dryer with a drum capacity of 4.4 cubic feet or greater.
1.10 ''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.
1.11 ''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. A mark 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.
1.12 ''Temperature sensing control'' means a system which monitors dryer exhaust air temperature and automatically terminates the dryer cycle.
1.13 ''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.

2. Testing Conditions

2.1 Installation.
Install the clothes dryer in accordance with manufacturer's instructions.

The dryer exhaust shall be restricted by adding the AHAM exhaust simulator described in 3.3.5 of HLD–1. All external joints should be taped to avoid air leakage. Disconnect all console light or other lighting systems on the clothes dryer which do not consume more than 10 watts during the clothes dryer test cycle.

2.2 Ambient temperature and humidity.

Maintain the room ambient air temperature at 75 ±3 °F and the room relative humidity at 50±10 percent relative humidity.

2.3 Energy supply.

2.3.1 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 test at the highest voltage specified by the manufacturer.

2.3.2 Gas supply.

2.3.2.1 Natural gas. Maintains the gas supply to the clothes dryer at a normal inlet test pressure immediately ahead of all controls at 7 to 10 inches of water column. If the clothes dryer is equipped with a gas appliance pressure regulator, the regulator outlet pressure at the normal test 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 Btu's per standard cubic foot. The actual heating value, Hn2, in Btu's 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 2.4.6 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 2.4.6.

2.3.2.2 Propane gas. Maintain the gas supply to the clothes dryer at a normal inlet test pressure immediately ahead of all controls at 11 to 13 inches of water column. If the clothes dryer is equipped with a gas appliance pressure regulator, the regulator outlet pressure at the normal test 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 Btu's per standard cubic foot. The actual heating value, Hp, in Btu's 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 2.4.6 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 2.4.6.

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

2.4.1 Weighing scale for test cloth. The scale shall have a range of 0 to a maximum of 30 pounds with a resolution of at least 0.2 ounces and ae maximum error no greater than 0.3 percent of any measured value within the range of 3 to 15 pounds.

2.4.1.2 Weighing scale for drum capacity measurements. The scale should have a range of 0 to a maximum of 500 pounds with resolution of 0.50 pounds and a maximum error no greater than 0.5 percent of the measured value.

2.4.2 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.

2.4.3 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.

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

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

2.4.6 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.

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

2.6 Test cloths.

2.6.1 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 four percent on the length and width.

(c) The number of test runs on the same energy test cloth shall not exceed 25 runs.

2.6.2 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 four 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.

2.6.3 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 1.2.

(2) Place 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 6.0 grams of AHAM Standard Test Detergent, IIA, per gallon of water. Wash water temperature is to 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 1.2 and weigh the load.

(5) This procedure is repeated until there is a weight change of one percent or less.

(6) A final cycle is to be a hot water wash with no detergent, followed by two warm water rinses.

2.7 Test loads.

2.7.1 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 100° ±5 °F and consists of 0 to 17 parts per million hardness for approximately two 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 66.5 percent to 73.5 percent of the bone-dry weight of the test load.

2.7.2 Standard size dryer load. Prepare a bone-dry test load of energy cloths which weighs 7.00 pounds ±.07 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 100° ±5 °F and consists of 0 to 17 parts per million hardness for approximately two 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 66.5 percent to 73.5 percent of the bone-dry weight of the test load.

2.7.3 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. 2.8 Clothes dryer preconditioning. 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.

3. Test Procedures and Measurements

3.1 Drum capacity. Measure the drum capacity by sealing all openings in the drum except the loading port with a plastic bag, and ensure 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 dryer, 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.

3.2 Dryer loading. Load the dryer as specified in 2.7.

3.3 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 test load until the moisture content of the test load is between 2.5 percent to 5.0 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.

3.4 Data recording. Record for each test cycle:

3.4.1 Bone-dry weight of the test load described in 2.7.

3.4.2 Moisture content of the wet test load before the test, as described in 2.7.

3.4.3 Moisture content of the dry test load obtained after the test described in 3.3.

3.4.4 Test room conditions, temperature and percent relative humidity described in 2.2.

3.4.5 For electric dryers—the total kilowatt- hours of electric energy, Et, consumed during the test described in 3.3.

3.4.6 For gas dryers:

3.4.6.1 Total kilowatt-hours of electrical energy, Ete, consumed during the test described in 3.3.

3.4.6.2 Cubic feet of gas per cycle, Etg, consumed during the test described in 3.3.

3.4.6.3 On gas dryers using a continuously burning pilot light—the cubic feet of gas, Epg, consumed by the gas pilot light in one hour.

3.4.6.4 Correct the gas heating value, GEF, as measured in 2.3.2.1 and 2.3.2.2, to standard pressure and temperature conditions in accordance with U.S. Bureau of Standards, circular C417, 1938. A sample calculation is illustrated in Appendix E of HLD–1.

3.5 Test for automatic termination field use factor credits. Credit for automatic termination can be claimed for those dryers which meet the requirements for either

temperature- sensing control, 1.12, or moisture sensing control, 1.13, and having present the appropriate mark or detent feed defined in 1.11.

4. Calculation of Derived Results From Test Measurements

4.1 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=[66/Ww-Wd)]×Ett×FU
Et=the energy recorded in 3.4.5.
66=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.
FU=Field use factor.
=1.18 for time termination control systems.
=1.04 for automatic control systems which meet the requirements of the definitions for automatic termination controls in 1.11.1, 1.12 and 1.13.
Ww=the moisture content of the wet test load as recorded in 3.4.2.
Wd=the moisture content of the dry test load as recorded in 3.4.3.

4.2 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=[66/(Ww-Wd)]×Ete×FU
ETE=the energy recorded in 3.4.6.1
FU, 66, Ww, Wd as defined in 4.1

4.3 Per-cycle gas dryer gas energy consumption.
Calculate the gas dryer gas energy consumption per cycle, Ege. expressed in Btu's per cycle as defined as:

EGG=[66/(Ww-Wd)]×Etg×FU×GEF
ETG=the energy recorded in 3.4.6.2
GEF=corrected gas heat value (Btu per cubic feet) as defined in 3.4.6.4
FU, 66, Ww Wd as defined in 4.1

4.4 Per-cycle gas dryer continuously burning pilot light gas energy consumption.
Calculate the gas dryer continuously burning pilot light gas energy consumption per cycle, Eup expressed in Btu's per cycle and defined as:

Eup=Epg×(8760-140/416)×GEF
Epg=the energy recorded in 3.4.6.3
8760=number of hours in a year
416=representative average number of clothes dryer cycles in a year
140=estimated number of hours that the continuously burning pilot light is on during the operation of the clothes dryer for the representative average use cycle for clothes dryers (416 cycles per year)
GEF as defined in 4.3

4.5 Total per-cycle gas dryer gas energy consumption expressed in Btu's. Calculate the total gas dryer energy consumption per cycle, Eg, expressed in Btu's per cycle and defined as:

Eg=Egg+Eup

Egg as defined in 4.3
Eup as defined in 4.4

4.6 Total per-cycle gas dryer energy consumption expressed in kilowatt-hours. Calculate the total gas dryer energy consumption per cycle, Ecg, expressed in kilowatthours per cycle and defined as:

Ecg=Ege+(Eg/3412 Btu/k Wh)
Ege as defined in 4.2
Eg as defined in 4.5