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California Investor Owned Utilities' Tub Spout Diverter Test Plan

Additional submitted attachment is included below.

California Title 20 Appliance Efficiency

2017 Pre-Rulemaking

Tub Spout Diverters – Test Plan

September 18, 2017

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Introduction

The four California Investor Owned Utilities (CA IOUs) – Pacific Gas and Electric Company (PG&E), San Diego Gas & Electric (SDG&E), Southern California Edison (SCE), and SoCalGas® (also referred to as the Team) – are writing a Title 20 Codes and Standards Enhancement (CASE) Report on tub spout diverters and will facilitate laboratory research to help inform the Report. The Team participated in the Energy Commission meetings on tub spout diverters held on May 11, 2017,[1] and July 20, 2017.[2] The Team has also reviewed the associated stakeholder comments,[3] and the documents on EPA's WaterSense webpage,[4] including the EPA testing research proposal.[5] The Team subsequently interviewed three manufacturers (one of which does their own Title 20 testing), a plumbing manufacturer trade organization, and two independent test labs.

The Team concluded that there are four main topics worthy of laboratory research: automatic reset versus manual reset diverters, data accuracy, water quality issues, and savings factor. Where possible, the test plan aligns with the EPA testing research proposal. The Team has additional test ideas beyond those outlined below that are intended to evaluate a) performance over an extended life cycle; and b) the variability of performance of products of the same brand and model as an indicator of quality control. However, these tests will not be posed until after this research has been completed and the results have been reviewed, so that their usefulness can be determined from the data.

The Team requests that the laboratory submit their results, aside from the lengthy water quality tests, as soon as possible. The water quality test results should be submitted as soon as possible thereafter.

Automatic Reset versus Manual Reset Diverters

Manufacturers stated that automatic reset diverters require a small amount of inherent leakage to function properly, whereas manual reset diverters do not. They also stated that most diverters located in tub spouts have automatic reset, while most "within-wall" mounted diverters have manual reset, which typically control different combinations of outlets rather than simply a tub spout and showerhead. The Team would like to obtain data on this topic to determine the feasibility of reducing leakage rates while maintaining automatic reset as a feature for those product subgroups where it is common, and users value it.

Data Accuracy

The ASME A112.18.1/CSA B125.1-2012 test procedure allows the use of either flow meters or containers, but doesn't mandate instrument accuracy. The Title 20 regulations require data reporting to two decimal places for gallons per minute (gpm), and state that rounding up is required. A significant percentage of products in the Title 20 database are rated at 0 gpm, but it's possible these regulations are being interpreted inconsistently and/or that instrumentation accuracy is not sufficient. The Team

[1] http://docketpublic.energy.ca.gov/PublicDocuments/17-AAER-05/TN217523_20170510T135340_Invitation_to_Participate_Presentation.pdf

[2] http://docketpublic.energy.ca.gov/PublicDocuments/17-AAER-05/TN220257_20170719T094511_Presentation__Results_of_Invitation_to_Participate__Tub_Spout_D.pdf

[3] https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=17-AAER-09

[4] https://www.epa.gov/watersense/bath-and-shower-diverters

[5] https://www.epa.gov/sites/production/files/2017-07/documents/ws-products-bath-and-shower-diverter-research-proposal.pdf

would like to obtain data on this topic to determine whether the Title 20 regulations can be improved to yield more accurate results.

ASME A112.18.1/CSA B125.1-2012 section 5.4.2.2 allows flow rates to be measured via fluid meters or the "time/volume method". However, low non-continuous flow rates are difficult to measure with flow meters, and very low volumes are difficult to measure with graduated cylinders. Graduated cylinder calibration is often verified by comparing the measured volume of water to a calculated volume using its mass and known densities at different temperatures. For this reason, a container and laboratory balance shall be used to conduct all tests.

Water Quality Issues

Numerous manufacturers stated that poor water quality, poor maintenance, and slow replacement cycles are to blame for reduced diverter performance over time, and the leakage rates from field studies cited by EPA are not indicative of the aged performance of current products. A test lab stated that each cycle in the ASME life cycle test is approximately 6 seconds, which means that the test doesn't account for degradation due to corrosion or scale forming. The Team would like to obtain data on this topic to determine how various diverters perform after being exposed to poor water quality for extended periods.

The CA IOUs prefer to test water quality issues using an industry accepted method and propose sections 15.1 and 15.2 of ASME A112.18.3-2002.

Savings Factor

Savings factor is defined as the ratio of *saved water* to *tub spout leakage water* when a tub spout leak is corrected. Savings factor is not always 100 percent, because fixing a leak increases the system water pressure. If the showerhead is not pressure-compensating, the increase in system water pressure will increase the flow through the showerhead to some degree, and the savings factor is less than 100 percent. If a showerhead is pressure-compensating, the increase in system water pressure will not increase flow through the showerhead, and the savings factor is 100 percent.

In Taitem's "Leaking Shower Diverters" report,[6] the authors measured savings factor for a variety of conditions, and they concluded that a 70% savings factor was appropriate and conservative for tub spout diverter retrofits. However, they did not perform any tests below a leakage rate of 0.05 gpm, which is the appropriate range for new construction in California. The CA IOUs would like to perform tests similar to Taitem's, but at leakage rates in that omitted range.

General Test Setup and Methodology

Objectives and Methodology

1. Evaluate automatic and manual reset diverters, per the product sampling section below, in accordance with all marked tests for "fitting type" of "bath or shower with diverter" in Table B.1 in ASME A112.18.1/CSA B125.1-2012; and the Title 20 regulations; but with the following directives and additions:

   Directives:

[6] http://www.taitem.com/wp-content/uploads/Diverter-Valve-Tech-Tip-2011.7.20.pdf.

ASME A112.18.1/CSA B125.1-2012 section 5.4.2.2 allows flow rates to be measured via fluid meters or the "time/volume method." Then, it states, "if the time/volume method is used, the container shall be of sufficient size to hold the collected water for at least 1 min." The CA IOUs require that the "time/volume method" be used with the following conditions, which are not specified in ASME A112.18.1/CSA B125.1-2012 or the Title 20 regulations, but that nevertheless comply:

- Use container(s) and calibrated laboratory scale(s) (not flow meters)
- The container(s) shall meet the requirements of its respective laboratory scale (e.g., less than or equal to the maximum tare weight)
- The laboratory scale(s) shall have the following specifications:
    - Maximum capacity: At least 500 grams (g)
    - Readability: At least 0.1 g
    - Repeatability: At least 0.1 g
- For leakage tests, report measured leakage mass to the greatest accuracy of the instrumentation, and report the related measurement duration. The maximum error of the duration measurement shall be +- 0.5 seconds.
- Convert mass and duration to flow rate in gpm, following Annex A "Unit conversion and rounding criteria" from ASME A112.18.1/CSA B125.1-2012, and using the following equation:

$$(volumetric\ flow\ rate\ [gpm]) = \left(\frac{(mass\ [grams])}{(duration\ [minutes])}\right) x \left(\frac{1}{992{,}200\frac{grams}{meter^3}}\right) x (264.172\frac{gallons}{meter^3})$$

Additions:

These additional tests go beyond ASME A112.18.1/CSA B125.1-2012 without invalidating it:

- Report leakage mass for the 1 minute starting at diverter closure, and ending at the beginning of the ASME mandated measurement window. Also, convert to gpm per above.
- For automatic reset diverters, measure time from shower termination to the automatic release of the tub spout diverter.
- For each test, or at least once per day, measure and report the water quality of the water source used for the tests. The water quality measurements shall include pH, calcium concentration, hardness, dissolved solids content, and Langelier Saturation Index (LSI; a measure of water corrosivity).[7] A different measure of water corrosivity can be proposed by the laboratory.
- If an automatic reset diverter "fails" per ASME A112.18.1/CSA B125.1-2012 section 5.6.1.5.2, still report all other test results since it could simply be that the product was misidentified as automatic reset.
- For a subset of products (10 automatic reset diverters across the product sampling categories below), perform the non-life-cycle leakage test at 80 pounds per square inch gauge (psig) as well as, and after, the 10 psig tests. This will allow the Team to explore

[7] This list was chosen upon review of the section "Detecting Corrosive Water Problems" at http://extension.psu.edu/natural-resources/water/drinking-water/water-testing/pollutants/corrosive-water-problems.

diverter performance at the high end of water pressure that might occur in a residential building.

2. Evaluate the impact of water quality on diverter performance for a subset of products (10 automatic reset diverters across the product sampling categories below). This subset of products should be a second copy of those products. Conduct the water quality tests in sections 15.1 and 15.2 in ASME A112.18.3-2002. After these tests, perform both leakage tests from ASME A112.18.1/CSA B125.1-2012. For each specimen: perform the initial leakage test (clause 5.3.6.1.2) 3 times and report all individual results; perform the life cycle test (clause 5.6.1.5.1) 3 times, and report all individual results.

3. Perform "savings factor" tests similar to "Test 1" in Taitem,[8] but for leakage rates of 0.005 gpm, 0.01 gpm, 0.02 gpm, 0.03 gpm, 0.04 gpm, 0.05 gpm, and 0.8 gpm. Use system static pressures of 10, 20, 30, 40, 50, 60, 70, and 80 psig. Perform all these tests with five different showerheads: 1.8 gpm pressure-compensating showerhead, 1.8 gpm non-pressure-compensating shower head, 2.0 gpm pressure-compensating showerhead, 2.0 gpm non-pressure-compensating showerhead, and 2.5 gpm non-pressure-compensating showerhead. Allow the Team to review the selected showerhead products (i.e., make and model) prior to testing.

Product Sampling

New products in original packaging are to be selected for testing as follows: Select two automatic reset diverters and two manual reset diverters in each of the following groups, taking care to select products from various manufacturers (Note: When searching the Title 20 database, select "Add Date" after June 1, 2016):

1. Diverters that are rated at *0.00 gpm* and that are *lift-type* per the Title 20 database.
2. Diverters that are rated at *0.01 gpm* and that are *lift-type* per the Title 20 database.
3. Diverters that are rated at *0.00 gpm* and that are *pull-type* per the Title 20 database.
4. Diverters that are rated at *0.01 gpm* and that are *pull-type* per the Title 20 database.
5. Diverters that are rated at *0.00 gpm* and that are *turn-type* per the Title 20 database.
6. Diverters that are rated at *0.01 gpm* and that are *turn-type* per the Title 20 database.
7. Diverters that are rated at *0.00 gpm* and that are *push-type* per the Title 20 database.
8. Diverters that are rated at *0.01 gpm* and that are *push-type* per the Title 20 database.

The Team will assist the laboratory as needed to determine the above products, especially given the potential difficulty in determining which products are automatic reset versus manual reset. Allow the Team to review the lab's selected diverter products (i.e., make, model, and any info from below) prior to testing.

In addition, include the following two specific diverter products:

- Evolve Technologies auto-diverting tub spout system[9]
- Brasscraft Mixet Positive Action Shut Off Diverter (SWD0407)

[8] See Figure 5 in Taitem's report. Note, however, that data accuracy protocols of the Team's test plan are to be followed.
[9] http://thinkevolve.com/products/auto-diverting-tub-spout-system/.

For every diverter, list the following:

1. Make and model.
2. Pictures of the diverter and the test setup.
3. Activation mode in the Title 20 database (e.g., lift, pull, turn, or push). Include a product description, since the activation modes might be interpreted differently by manufacturers.
4. Automatic or manual reset. Indicate whether the manufacturer states the unit is automatic or not, if available. Some installation manuals may state “some leakage is standard.”
5. Leakage rates in the Title 20 database. Include the date it was added to the database.
6. The number of outlets that the diverter controls, and what those outlets are typically connected to (e.g., tub spout, showerhead, hand shower, etc.).
7. Cost and purchase location.
8. Start and finish time of each set of tests. Date and time of completion of the test. Duration of test.
9. Tests each specimen underwent.
10. Any claims by manufacturers or in their product literature about corrosion protection, scaling protection, and the use of special coatings.