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Document Title:	Cost estimate to perform IOU-proposed commercial tumble dryer protocol
Description:	IOU proposed test procedure cost analysis
Filer:	Ryan Nelson
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MEMORANDUM

TO: Ryan Nelson, California Energy Commission
FROM: Suzanne Foster Porter, Kannah Consulting, on behalf of California IOUs
CC: Ed Elliott, Ed Jerome, Mary Anderson, PG&E
DATE: May 10, 2017
SUBJECT: Cost estimate to perform IOU-proposed commercial tumble dryer protocol

Per the California Energy Commission's request, this memo contains an estimate of labor cost to perform one test series on one commercial tumble dryer according to the requirements of the IOU-proposed commercial tumble dryer test procedure.¹ This estimate is based on PG&E's ATS lab experience running more than 100 test runs on ten different dryers in 2016 and early 2017. This cost estimate only includes labor for the performance of the test series. Labor costs associated with the purchase, calibration, set-up, and maintenance of any related test equipment used for the test series are excluded from this estimate.

The cost of labor to conduct the test is between \$560 and \$1145 per dryer. This cost is developed by taking the hours of labor time needed to conduct the test and multiplying that by the labor cost per hour. The methodology used to develop this estimate is described in detail below.

Estimate of Labor Time

The number of hours required to test one dryer is between 13 and 26 hours, with the range dependent on these three variables:

- 1) Whether the technician performs some test runs that cannot be reported because they do not match the requirements of the test procedure. For example, a test run may be invalid because the dryer terminates outside the required final textile load remaining moisture content (RMC) range allowed by the procedure.²
- 2) Whether the dryer has the automatic termination feature that requires the sixth test run in the series.
- 3) Whether the dryer is tested in an engineering environment (e.g. PG&E's ATS Lab) or performed in a lab focused on throughput volume (e.g. UL). The time estimates herein are based on experience in ATS's engineering lab. We expect that once the test procedure is finalized and refined, labs focused on test volume throughput will

¹ As found in docket 17-AAER-01 Available at: http://docketpublic.energy.ca.gov/PublicDocuments/17-AAER-01/TN215802_20170207T123831_Commercial_Dryer_Test_Protocol_v25.pdf

² The number of invalid runs of this nature are expected to be lower when manufacturers perform the test, as technicians would have detailed knowledge of the working of the dryer and better be able to estimate the length of time the dryer needs to hit the target range RMC required by the procedure.

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be able to find efficiencies that reduce the overall testing time by at least 10%, and possibly more.

Details of the labor time estimate are shown in Table 1.

Table 1. Time Estimate to Perform Commercial Tumble Dryer Test Series

	Minimum Time^c in hours Engineering Lab (Throughput Volume Lab)	Maximum Time^d in hours Engineering Lab (Throughput Volume Lab)	Range in hours
Test set-up ^a (X)	2.0 (1.75)	2.5 (2.25)	1.75 to 2.5
Five-run test series ^b for dryers <u>without</u> automatic termination (Y1)	12.5 (11.25)	20.0 (18.0)	11.25 to 20.0
Six-run test series ^b for dryers <u>with</u> automatic termination (Y2)	15.0 (13.5)	23.75 (21.5)	13.5 to 23.75
Range of total time (in hours) expected for 5 run series (X + Y1):			13.0 to 22.5
Range of total time (in hours) expected for 6 run series (X + Y2):			15.25 to 26.25

^a Test set up includes removing the tumble dryer previously under test, bringing the dryer into the chamber, plumbing the natural gas, attaching electrical, and adjusting the instrumentation placement. Because set up occurs for every dryer, the effort occurs once for each dryer.

^b Test series includes building the textiles loads, wetting the textiles, drying the textiles, recording required data, and processing the data into a file of useful record. The time for the testing is dependent on the number of individual test runs required by the test procedure.

^c Minimum time assumes that all test runs performed on the dryer are valid.

^d Maximum time assumes that some test runs performed on the dryer are invalid. We assume an average of 8 runs for a five-run series and an average of 8.5 runs for a six-run series.

Estimate of Hourly Labor Costs

Two labor classes as defined by the U.S. Bureau of Labor Statistics were used to develop hourly labor estimates and are shown in Table 2.

Table 2. Labor Class Hourly Cost Summary

Labor class	Cost per hour (U.S. Dollars)
Engineering Technician^a	\$42
Engineer^b	\$56

^a Engineering technician median salary in the U.S., approximately \$30 per hour. The salary is multiplied by 1.4 to estimate employer taxes and benefits for a total of \$42 per hour. Source is U.S. Bureau of Labor Statistics accessed 1 May 2017 <https://www.bls.gov/oes/current/oes173029.htm>

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^b Mechanical and civil engineers have a median salary of \$40 per hour. The salary is multiplied by 1.4 to estimate employer taxes and benefits for a total of \$56 per hour. Source is U.S. Bureau of Labor Statistics accessed 1 May 2017
<https://www.bls.gov/ooh/architecture-and-engineering/mechanical-engineers.htm>

Estimates of time required from each of these classes for both the five-run and six-run test series are given in Table 3. To estimate the cost of each of the test series, the cost per hour for each labor class is multiplied by the hours needed by each labor class to complete the full test series.

For example, the minimum estimate of time for the five-test series includes 12 hours of Engineering Technician time and 1 hour of Engineer time (12 hours x \$42 per hour + 1 hour x \$56 per hour = \$560). Table 3 summarizes the labor cost ranges for both the five-run and six-run test series, with labor costs totaling \$560 on the lower end and \$1145 on the upper.

Table 3. Estimated Cost of IOU-proposed Commercial Tumble Dryer Test Series

Labor class	Total five-run test series (including set-up)	Total six-run test series (including set-up)
Engineering technician time (hours)	12 to 20	14 to 23.25
Engineer time (hours)	1 to 2.5	1.25 to 3
Total cost range (dollars)	\$560 to \$980	\$658 to \$1145

Comparison

This level of effort is expected to be lower compared to its similar appliance counterpart. The DOE residential washing machine test procedure requires nine test runs per series on three washers. The IOU-proposed test procedure for commercial tumble dryers requires six test runs on one dryer.