REVIEW (PART 2a)

of

ASSESSMENT OF EPA's RESIDENTIAL WOOD HEATER CERTIFICATION PROGRAM

Test Report Review: Stoves & Central Heaters

Written by NESCAUM, March 2021

and

ALT-140 Test Method

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REVIEW (PART 2a)

of "ASSESSMENT OF EPA's RESIDENTIAL WOOD HEATER CERTIFICATION PROGRAM"

and IDCTM (now ALT-140 Test Method)

Part 1 of this review concluded with 3 short paragraphs about NESCAUM/ADEC's criticism of the ASTM E-3053 method, because the medium burn rate in ASTM E-3053 was not at least 0.30 kg/hr higher than the low burn rate.

There is no regulatory basis for the medium burn rate to be at least 0.30 kg/hr above the low burn rate. Nevertheless, the "Assessment" identifies "Medium burn rates within 0.3 kg/hr of low burn rates" as <u>one of 7 serious deficiencies of ASTM E-3053</u>.[1] Since this is featured prominently in the NESCAUM/ADEC list of flaws with ASTM E-3053, it deserves a more thorough review than just three paragraphs.

The "Assessment" states:

> "Analysis of the 69 ASTM E-3053 tests found that almost two thirds (46) of the medium air setting's burn rates were within 0.30 kg/hr of the burn rate for the low burn. For example, the range of allowable burn rates in Method 28R for Category 2 is 0.80 to 1.24 kg/hr." ("Assessment," page 39-40).

It is interesting that the "Assessment" compares this "deficient" characteristic of ASTM E-3053 to M28R, rather than its own IDCTM. We shall see why they chose to make this comparison on the following pages.

After eliminating duplicate ADEC Test Summary sheets and sheets with very little data, I come up with 42 (not 46) stoves getting "Flagged" for violating this arbitrary requirement. Eight of the 42 cases cited by NESCAUM/ADEC, were the result of arithmetic errors by NESCAUM/ADEC, where the value NESCAUM/ADEC got after subtracting the low burn from the medium burn was in error – i.e., in each case

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[1] The 7 deficiencies are 1) "debarking" and 2) "squaring" of cordwood fuel which were discussed at length in Part 1 of this series. 3) is the separation of medium and low burns by more than 0.30 kg/hr, which is discussed at length here. The final 4 deficiencies relate to firebox calculations and fuel loading protocols, which will be discussed in a later review.

the medium burn was at higher than the low burn by 0.30 kg/hour or more. These 8 cases are highlighted below.

The yellow column under “<0.30” indicates that these stoves were identified and “flagged” for “non-representative” runs because the medium burn rates were not at least 0.30 kg/hr above the low rates. The medium burn rates are listed in the column under “M,” and the burn rate by which medium is above low is in the right hand column (“M less L”).

STOVES FLAGGED AS FAILING THE 0.30 SEPARATION BETWEEN MEDIUM AND LOW

BASED ON ARITHMETIC ERRORS BY NESCAUM

Manufacture	Model	Test Methoc	<0.30	H	M	L	M less L
Innovative He	S160TGL,	ASTM E3053	Yes	3.47	1.71	1.15	**0.56**
Travis Industri	Liberty	ASTM E3053	Yes	4.81	1.74	1.18	**0.56**
Travis Industri	Hybrid Fyre	ASTM E3053	Yes	4.49	1.49	1.08	**0.41**
Stove Builder	Solution 3.5,	ASTM E3053	Yes	3.90	1.70	1.30	**0.40**
Stove Builder	Osborn 3300,	ASTM E3053	Yes	4.30	1.50	1.20	**0.30**
Pacific Enegy I	FP25AR LE	ASTM E3053	Yes	4.10	1.20	0.84	**0.36**
Pacific Enegy I	NEO 2.5 Inser	ASTM E3053	Yes	4.43	1.60	1.15	**0.45**
Woodstock So	210 Ideal Stee	ASTM E3053	Yes	3.30	1.03	0.64	**0.39**

NESCAUM/ADEC "Yellow Flagged" these 8 s[illegible]s for having Medium Burn Rates that were within 0.30 kg/hr of low burn rates. Each "yellow flag" was the result of an arithmetic error (see far right column).

Clearly, none of these stoves failed the 0.30 kg/hr separation. In a few other cases, ASTM E-3053 test reports were “flagged” for having medium burn rates that were *lower* than high burn rates. In many cases the reviewers openly questioned why the damper setting used to achieve the medium burn rates wasn’t altered to achieve a higher medium burn. Below and to the right is a representative sample of this type of comment:

Low	Medium	Startup & High				TM doesn't require kg/hr - basis but
1.1	1.25	2.74				essentially the same heat output. Why
0.78	0.89	3.58				wasn't a higher air setting used.
3.77	3.48	5.31				H: max" open
yes	yes	yes				M: 0.5" open
5.6	7	4				L: .min" open
no	no	no				need instructions to understand variation

The point of reporting on the arithmetic errors and the snarky margin comments is not that they are a big deal in and of themselves. They are presented here to provide context.

The context is that the "Assessment" presents 7 disqualifying characteristics of ASTM E-3053. Arithmetic errors are evidence of poor data control and inaccurate reporting. If the medium burn rate really should be at least 0.30 kg/hr *above* low burn rate, then NESCAUM's IDCTM itself is a complete failure as a replacement. The IDCTM results reported in the "21-02 Interim Report Development of Integrated Duty Cycle Test Method Cordwood Stove" ("Interim Report") are uniformly much worse than the ASTM E-3053 tests that NESCAUM criticizes in the "Assessment". They are also worse than the ASTM E-3053 tests performed by NESCAUM itself, and reported in the "Interim Report"

The IDCTM Completely Fails to Create Medium and Low Burn Rates that Are "Representative," Under NESCAUM's Own Definition of "Representative"

I have reviewed data from the NESCAUM's "Interim Report" to see if the IDCTM method produced test results where the medium burn was consistently at least 0.30 kg/hr above the low burn rate. In the "Interim Report" NESCAUM presents summary data (no raw data) from tests that it performed using the Final "IDCTM" protocol. Of the following 24 test results from 7 stoves, 18 had low burns that were *higher than medium,* and just 5 had results where the *low burn was actually lower than the medium burn* (see chart, following). Only 1 of 24 test runs (run #11) had results that fell within the definition of "representative" separation between low and medium burn rates (i.e., medium burn at least 0.30 kg/hr more than the low burn rate) that NESCAUM/ADEC claimed was necessary to be a "representative" medium burn rate.

NESCAUM IDCTM CORDWOOD TEST METHOD								*0.30*
Representative Medium Burn Rate Must Be 0.30 Above Low								***Metric***
#	Test #	Method	Fuel	Medium kg/hr	Low Burn kg/hr		Difference	***Pass Fail?***
1	S1-18-08-08	IDC Final	Maple	2.37	2.72	**low> med**	**0.35**	**fail**
2	S1-18-08-09	IDC Final	Maple	2.13	2.82	**low> med**	**0.69**	**fail**
3	S1-18-08-10	IDC Final	Maple	1.99	2.46	**low> med**	**0.47**	**fail**
4	S2-18-10-23	IDC Final	Maple	1.09	1.53	**low> med**	**0.44**	**fail**
5	S2-18-10-24	IDC Final	Maple	1.55	1.56	**low> med**	**0.01**	**fail**
6	S2-18-10-25	IDC Final	Maple	1.34	1.5	**low> med**	**0.16**	**fail**
7	S2-19-01-07	IDC Final	Maple	1.59	1.41	**low<med**	**(0.18)**	**fail**
8	S2-19-01-08	IDC Final	Maple	1.12	1.25	**low> med**	**0.13**	**fail**
9	S2-19-01-09	IDC Final	Maple	1.24	1.24	**same**	**0.00**	**fail**
10	S4-18-10-16	IDC Final	Maple	0.9	1.18	**low> med**	**0.28**	**fail**
11	S4-18-10-17	IDC Final	Maple	1.51	0.98	**conforms**	**(0.53)**	**pass**
12	S4-18-10-18	IDC Final	Maple	1.04	1.55	**low> med**	**0.51**	**fail**
13	S5-18-08-01	IDC Final	Maple	1.66	2.4	**low> med**	**0.74**	**fail**
14	S5-18-08-02	IDC Final	Maple	1.56	1.67	**low> med**	**0.11**	**fail**
15	S5-18-08-03	IDC Final	Maple	1.59	2.31	**low> med**	**0.72**	**fail**
16	S6-18-07-18	IDC Final	Maple	1.5	1.43	**low<med**	**(0.07)**	**fail**
17	S6-18-07-19	IDC Final	Maple	1.55	1.64	**low> med**	**0.09**	**fail**
18	S6-18-07-20	IDC Final	Maple	1.3	1.61	**low> med**	**0.31**	**fail**
19	S7-18-07-25	IDC Final	Maple	1.17	1.42	**low> med**	**0.25**	**fail**
20	S7-18-07-26	IDC Final	Maple	1.06	1.37	**low> med**	**0.31**	**fail**
21	S7-18-07-27	IDC Final	Maple	1.34	1.23	**low<med**	**(0.11)**	**fail**
22	S8-19-03-06	IDC Final	Maple	3.64	3.44	**low< med**	**(0.20)**	**fail**
23	S8-19-03-07	IDC Final	Maple	3.15	3.76	**low> med**	**0.61**	**fail**
24	S8-19-03-08	IDC Final	Maple	2.98	3.49	**low> med**	**0.51**	**fail**
		TESTS 1-21	***AVG:***	***1.46***	***1.68***			**fail**
		TESTS 1-21	***MEDIA***	***1.50***	***1.53***			**fail**
(AVG/MEDIAN omits Stove 8, which is a single burn rate stove)								
The "Assessment" and the "Basis" suggest that a Medium Burn Rate in Cordwood Testing should be at least 0.30 kg/hour above the Low Burn Rate for the same Test. The IDCTM fails to comply with this requirement in 23 of 24 tests.								

In almost every study of in-home woodstove use (like the well known Klamath Falls OR, and Portland OR studies in 1998-99, which logged over 5,000 actual hours of burn time), the *average burn rate* was about 1 kg/hr. A tug-of-war has been going on for decades between manufacturers and regulators about where to place low-burn testing requirements (with regulators almost always wanting lower burn rates, and manufacturers almost always wanting to ease the low burn rate requirement). <u>No one has ever suggested that a low burn should be higher than a medium burn... until NESCAUM and the IDCTM.</u>

If NESCAUM/ADEC consider the ASTM E-3053 separation between medium and low burn rates to be such a big problem, *why is the separation between medium and low burn rates using the IDCTM Method so much worse than ASTM E-3053*?

Put another way, why is the NESCAUM/ADEC IDCTM test method unable to achieve an average low burn rate below about 1.5 kg/hr? And further, why is it unable to achieve a low burn rate lower than its medium burn rate on 18 of 24 (75%) of its reported runs?

NESCAUM also ran ASTM E-3053 tests on 3 stoves described in the "Interim Report." Emissions for the ASTM E-3053 tests were measured with a TEOM. The most significant difference between the ASTM E-3053 and IDCTM runs was the fuel loading protocol – i.e., size and timing of each load.

The ASTM E-3053 results are comparatively much better than the IDCTM results applying NESCAUM's own criteria. The average and median ASTM E-3053 low burns are lower than the ASTM E-3053 medium burns, as they should be, and the ASTM E-3053 low burns look more like, well, low burns.

"ASTM COMPARISON" in INTERIM REPORT Burn Rate Differential Between Medium and Low					
				Medium Burn	**Low Burn**
Stove	Test #	Method	Fuel	kg/hr	kg/hr
1	S1-18-05-31	ASTM/NESCAUM	Maple	2.1	
1	S1-18-06-04-:	ASTM/NESCAUM	Maple		1.9
6	S6-18-06-08-:	ASTM/NESCAUM	Maple	1.33	
6	S6-19-01-31-:	ASTM/NESCAUM	Maple	1.07	
6	S6-19-02-01-:	ASTM/NESCAUM	Maple	1.11	
6	S6-19-06-07-:	ASTM/NESCAUM	Maple		1.05
6	S6-19-02-05-:	ASTM/NESCAUM	Beech		0.8
6	S6-19-02-08-:	ASTM/NESCAUM	Oak		1.12
7	S7-19-02-25-:	ASTM/NESCAUM	Maple		1.07
7	S7-19-02-27-:	ASTM/NESCAUM	Maple	1.27	
	AVERAGE MEDIUM AND LOW			***1.376***	***1.188***
	MEDIAN MEDIUM AND LOW			***1.27***	***1.07***
	(AVG/MEDIAN omits Stove 8, which is a single burn rate stove)				

The "Interim Report" states: "researchers compared stove data ... that *suggest*[2] that ASTM E-3053 procedures result in an artificially high temperature at the beginning of that (low) test phase." (pg. 322) It continues by claiming that IDCTM results in a "lower average temperature before the beginning (of) the final phase (RL3), the phase which simulates long, low-burn periods." ("Interim Report," pg. 322). It's too bad this claim is false. The IDCTM low burns are high because coal beds are deeper, and stove temperatures higher than in the ASTM E-3053 tests.

On the limited number of stoves (Stove 1, 6, and 7) where NESCAUM ran both IDCTM and ASTM tests, the ASTM tests were slightly longer, (*by virtue of having lower medium and low burn rates*). On two of the stoves tested, emissions per kilogram[3] of fuel were almost identical (stoves 1 and 7). On stove 6, the emissions using an "ASTM protocol" administered by NESCAUM were approximately one third of emissions using IDCTM (*<u>on a gm/kg basis</u>*), even though the IDCTM is alleged to be a more rigorous method.[4]

The "90% TEOM Workaround"

Part of the problem with the IDCTM is what I call the "90% TEOM Workaround". The "90% TEOM Workaround" was a decision to stop every segment of every test when 90% of the fuel was burned. Although NESCAUM makes various arguments for stopping at 90% of each load (less test time, theoretically less expense, theoretically a more real-life loading pattern, and so

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[2] The word "*suggest*" is doing a lot of work in this sentence. I am sure that if NESCAUM had data to *<u>prove</u>* this point, they would provide it. The fact of the matter is that this claim is false, misleading, and not supported by the evidence. In fact, the evidence is exactly the opposite, which is why the ASTM low burns are so much more representative than the IDCTM low burns.

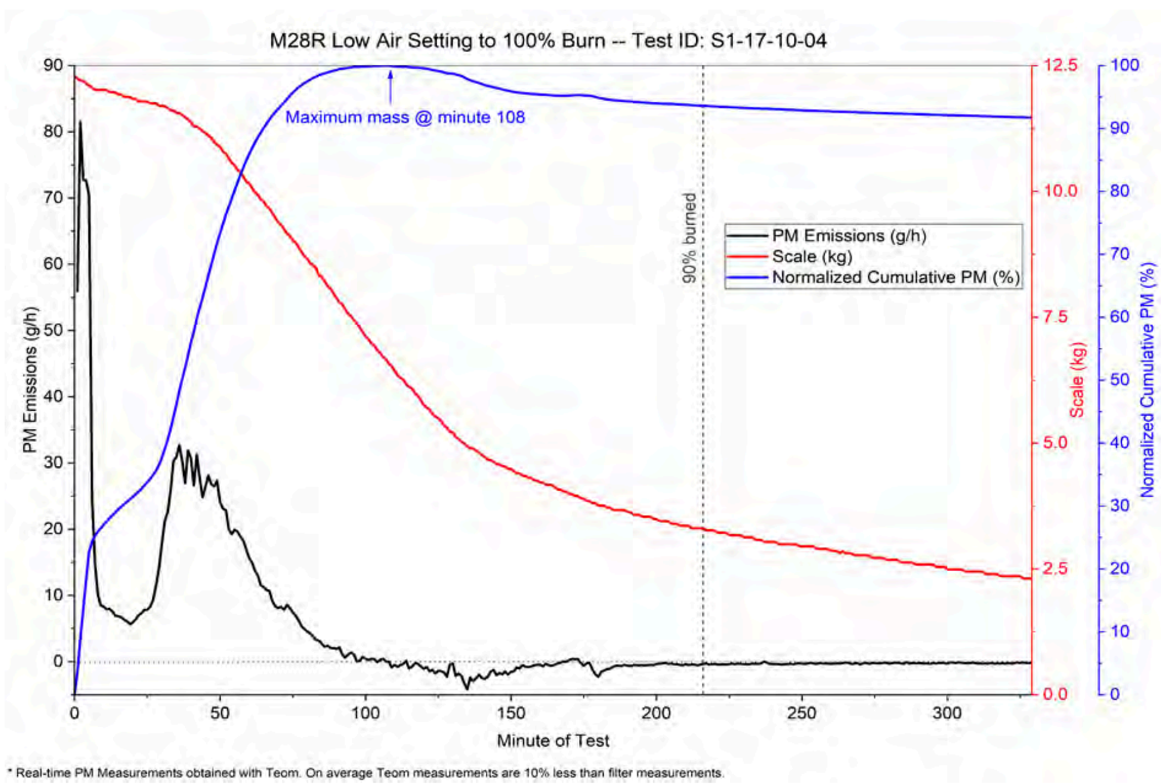
[3] I am comparing stove emissions in this case by emissions per unit of fuel (g/kg), so we don't have to argue about the problems with measuring emissions over time.

[4] The IDCTM is NOT a more rigorous method; rather, it is an extended medium burn test. It will be much more costly, however, because the tests will take a minimum of three days instead of two, and therefore likely to cost 50% more in lab time. It is also likely to produce significantly different (lower) calculations of efficiency which cannot be reconciled with current methods.

on), I submit that the real reason is that the TEOM tends to shed collected PM toward the end of the test which actually reduces the particulate catch if the test is continued through a long coal-bed phase.[5] On page 95 of the "Interim Report" NESCAUM comments on low and medium runs using ASTM E-3053 as follows:

> "In all low and medium fire runs, most of the PM was emitted early in the run and ***PM was volatized from the filters later in the run, as is the case in the M28 runs. In the three low-fire phase runs, the PM measurements at the end of the phase was 9%-19% lower than at the maximum. For the four of the five medium phase runs, 13%-21% of the maximum PM was lost.*** In one of the medium phase runs that burned red maple, S6019-01-31, only 1% of total PM was lost, although the maximum occurred after 25% of the run. ("Interim Report", page 95, emphasis added)

Note the TEOM shedding PM from Minute 108 to the termination of the test.



[5] If their reasoning is close to correct, they could just stop emissions sampling when 50% of the load is consumed, or after 3 hours, whichever comes first. But the IDCTM has been concocted in secret, so we don't know what other alternatives were even considered.

The caption at the bottom of the graph on the previous page states "Real-time PM Measurements with Teom. On average Teom measurements are 10% less than filter measurements." (Graph (previous page is from page 12, "Interim Report"). We don't actually know how emissions are calculated using IDCTM, because NYSERDA *owns* the IDCTM Method, and they refuse to provide any data, or the basis for any of their calculations. Are NESCAUM IDCTM emissions measurements based on actual collected PM, or is there some averaging?

The chart below provides summary data for the graph on the previous page (Test S1-17-10-03), and the run graphed is the low burn described in the summary data below.[6] This is a "Modified M28 Test Run" from NESCAUM.

Table 5. Stove 1—Modified M28 Test Run Metrics

	Test Time (min)		Dry-Burn Rate (kg/h)		Total PM (g)		PM Emission Rate (g/h)		PM Emission Factor (g/kg)		HHV Efficiency (%)
% Burn	*90%*	*100%*	*90%*	*100%*	*90%*	*100%*	*90%*	*100%*	*90%*	*100%*	*100%*
High	90	123	5.21	4.20	12.14	11.71	8.09	5.67	1.55	1.35	33.4
Medium	168	262	2.64	1.88	13.02	12.76	4.65	2.92	1.76	1.55	49.7
Low	216	327	2.08	1.52	24.20	23.76	6.72	4.36	3.22	2.84	50.8

Note that 100% burn rate (low) is 111 minutes longer than NESCAUM's 90% termination point. "Total PM (g)" is lower at 100% of Burn than at 90% of Burn in every run, no matter how short (even in the high burn). NESCAUM has chosen to terminate all runs when 90% of each load has been consumed as a "workaround" for weaknesses in the TEOM. We don't know if NESCAUM also compensates for the TEOM measurements in their final PM calculations (based on their assessment that "Teom measurements are 10% less than filter measurements") because NYERDA refuses to publicly disclose any of their raw data or calculations – *even to EPA!*

[6] The efficiency numbers in the right hand column of this summary data chart set off alarm bells and first piqued my interest in NESCAUM's efficiency calculations –described on pp. 10-14, following.

<u>4 Loads</u> + <u>Only 2 Damper Settings (Fully Open/Fully Closed)</u> + <u>"90% TEOM Workaround"</u> = <u>Huge Coal-beds</u>

The IDCTM requires 4 fuel loadings for each run (kindling, high burn, medium burn, and low burn). These successive burns are all conducted at just two different damper settings: *all the way open* (kindling and high burn) and *all the way closed* (for "medium" and "low"). Each load is placed on a coal-bed that is progressively larger than the one preceding it. Over the complete run, the cumulative coal-bed becomes deeper and deeper, and the medium and low burns become just a steady state medium burn on an ever-larger coal-bed. The IDCTM could be aptly renamed the "STEADY STATE MEDIUM BURN TEST METHOD".

The Interim Report attempts to dismiss the "90% TEOM Workaround" and the attendant problem of massive coal-beds by presenting it as a FNAB ("feature, not a bug"):

> "Existing methods do not require assessing how the appliance performs with different coal-bed conditions. The IDC assesses three different coal-bed conditions. The loads are burned to 90%, <u>with</u> coal-bed <u>conditions at approximately 10%, 15%, and 20% of total firebox volume</u>." (Interim Report, page 323, emphasis added.)

A New, and Not Very Informative, Efficiency Calculation

<u>*The IDCTM does not make any attempt to 1.) calculate the amount of energy in these massive coal-beds, or 2.) calculate how much of the energy in the final remainder coal-bed is transferred from the stove to the area it heats. This is why the IDCTM efficiency measurements are significantly lower than similar calculations used for M28R and ASTM E-3053*</u>*.* <u>*The formula used in M28R and ASTM methods calculates the amount of energy in a fuel load, and then ultimately calculates how much of that energy is transferred to the room, including energy in the coal-bed.*</u>

Thus, M28R and ASTM E-3053 are designed to measure combustion efficiency and heat transfer efficiency for burning a defined load of wood (in both cases, the full charge of wood).

The "90% TEOM Workaround" forces NESCAUM to come up with another method of measuring efficiency, because the full load is not burned. The start and end points are different for each load. To compensate, the IDCTM measures "instantaneous efficiency".

The IDCTM measures instantaneous efficiency per atom of carbon in the exhaust, and then it reaches an overall efficiency by averaging all of those individual calculations.[7] What is inadequate about the IDCTM is that the test protocol produces a huge coal-bed at the termination of the test – much bigger than M28 or ASTM E-3053 – and then the IDCTM simply ignores this huge coal-bed for the purpose of calculating efficiency. IDCTM just pretends that the energy in its huge-coal beds aren't relevant (at best) or don't exist (at worst).

Why Would A Manufacturer Agree To Pay To Use A Test Method That: A) Calculates Significantly Lower Efficiency For Each Stove Tested by Arbitrarily Changing the Endpoint of the Test, and B)Arbitrarily Decides NOT TO MEASURE The Energy In HUGE Terminal Coal-Beds, or The Heat Transfer From Those HUGE Coal-Beds?

[7] With respect to calculating efficiency the IDCTM is a "secret method," at least so far. The triumvirate (NESCAUM/ADEC/NYSEDA) has refused to provide any raw data, or explain how it averages efficiency calculations, except to provide the basic equation for calculating efficiency at the end of the test report. It's hard to "back-into" their calculations without good raw data. More to the point, people employed by state and federal agencies are public servants, so the extreme secrecy of NESCAUM/ADEC/NYSERDA seems like an odd stance; as if they had something to hide (like the fact that that the reported efficiency for every stove tested with their method will go down, compared with the way stove efficiency is understood and calculated today).

I was surprised that not even EPA has back-up data or complete sample calculations for how efficiency is measured in the IDCTM. The only thing that EPA has, as far as I know, is one locked spreadsheet indicating that a successful emissions test was performed on two stoves – but even EPA has no information on how anything was actually calculated. *Transparency, anyone?*

Currently, there is a 26% federal tax credit for woodstoves that are over 75% HHV efficient. I believe that most stoves that meet this 75% efficiency requirements today would not qualify for the tax credit if their efficiencies were calculated using the IDCTM - not because the stoves are inefficient, but because the IDCTM protocol produces VERY LARGE COAL-BEDS that are completely ignored in its efficiency calculations.

Some stove designers deliberately design stoves that have extremely long tails – not to game the test method(s), but because a long tail is a very desirable and highly sought after consumer benefit. We design mechanisms to keep reducing the airflow and maintain the coal-bed to extend the time required between re-loadings. The extended burn time, and the heat transferred during that extended time are <u>important benefits to consumers.</u>

Two of the most frequently asked questions by consumers are: "How long will the your stove burn?" (meaning: how long will it hold coals until I have to reload it?)" and "How much less wood will I have to burn with your stove?" (meaning: will the efficiency of the stove reduce my wood consumption?). The IDCTM cannot answer either of these questions. In fact, the IDCTM will only introduce confusion on both issues.

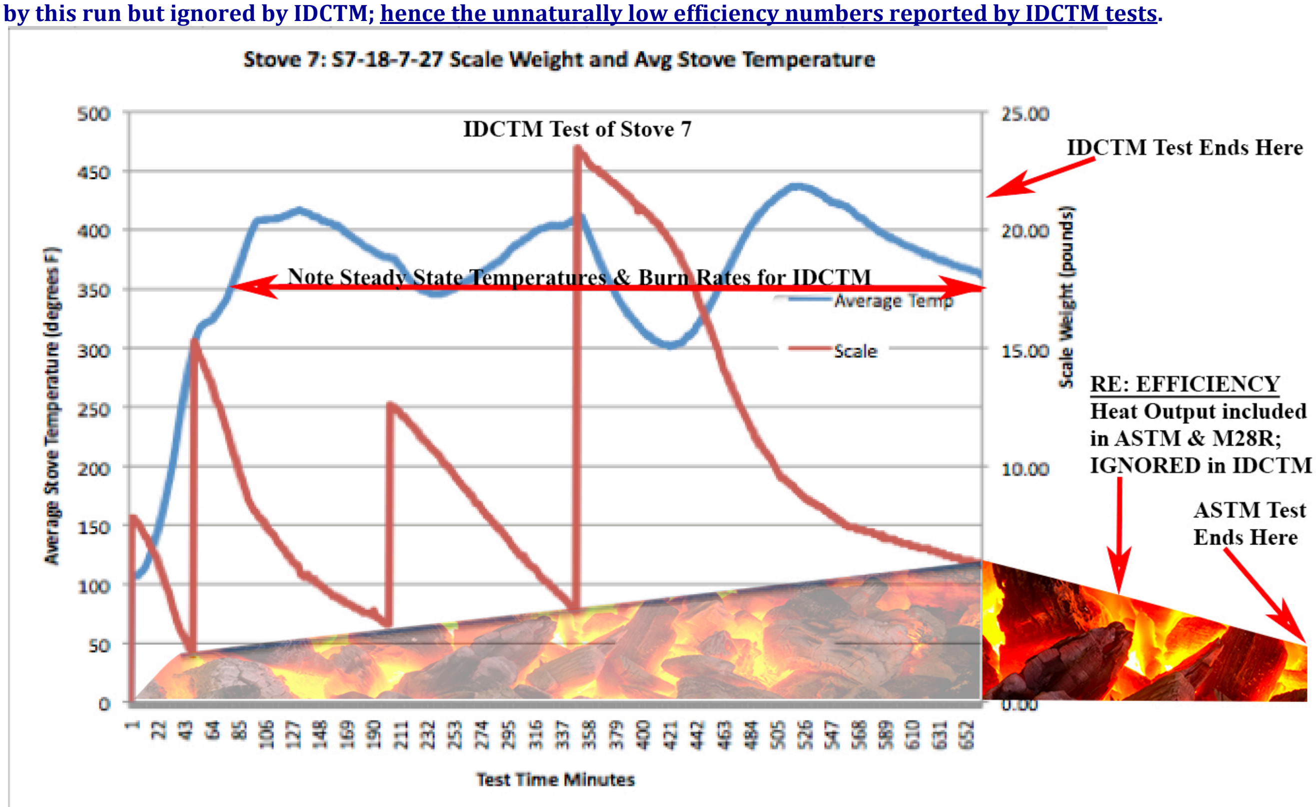
The IDCTM repeated loadings, combined with an ever-increasing coal-bed, produce almost steady state temperatures and prevent the stoves from being tested at low burn rates, or at reloads on small coal-beds. The example below shows a sample fueling sequence for Stove #7, a stove with a 1.9 cu ft. firebox. The cumulative loadings total 42.34 pounds of cordwood and result in a 5.9 pound coal-bed at the termination of the test, after 665 minutes (11.08 hours).

The chart below shows the loading sequence for Stove #7, the time required to burn each load and the size of the ending coal-bed. The final 5.9 pound coal-bed is a BIG coal-bed for this size stove.

Start ET	End ET	Ld, wet lb	MC, dry %	Start Coals, lb	End Coals, lb
0	46	7.59	17.5	0.0	2.0
46	199	13.33	19.0	2.0	3.3
199	339	9.32	19.9	3.3	3.9
339	661	19.69	21.2	3.9	5.9
0	661	42.34	20.2	0.0	5.9

Of equal importance is that the constantly building coal-bed and the frequent loading tends to produce almost steady-state stove temperatures. Far from subjecting the stove to a stress test at multiple different burn conditions, the IDCTM is basically just an extended medium burn, maintained by frequent loadings and an ever-increasing coal-bed.

The graph below is derived from the only set of data that I have for an IDCTM test. This data was provided by EPA, but neither they nor I have access to efficiency calculations or any other "back-end" calculations (for this or any other run). Those calculations are a big secret. But the graph below, using available data, does show the coal bed build-up, the steady state temperatures during the run, and the portion of heat output and heat transfer produced by this run but ignored by IDCTM; <u>hence the unnaturally low efficiency numbers reported by IDCTM tests</u>.



As the size of the firebox increases, so does the size of the load(s)*, and the cumulative size of the coal-bed*. Stove 17 has a 2.8 cu. ft. firebox (medium), so the size of the coal-bed increases over the time of the NESCAUM test (1145 minutes, or 19.08 hours) from 2.8 pounds after the 11.14 pounds of kindling and start-up fuel are burned, to 9.5 pounds at the end of the test. A 9.5 pound coal-bed in a stove with a 2.8 cu. ft. firebox is MASSIVE.

All of the IDCTM tests that I reviewed have what I would consider to be abnormally low efficiency numbers and abnormally large coal-beds. The IDCTM deliberately ignores the significant portion of the burn time, heat output, and heat transfer that occurs after their test endpoint. I would argue that all of these metrics (total burn time, total heat output, and efficiency including energy in terminal coal beds) should be measured in every test run regardless of the "method." These are important metrics of significant interest to consumers.

Understating the length of burn cycles, ignoring a significant portion of heat output, and choosing to calculate diminished heat transfer efficiencies is error, in my opinion. Why anyone would choose to test with the IDCTM, when other alternatives are available that accurately report these metrics, is a mystery to me.

I question whether any stove tested with the IDCTM would achieve the 75% HHV efficiency required to qualify for the 26% Federal Tax Credit, based on NESCAUM's reported efficiencies for stoves they have tested, and NESCAUM's unwillingness to produce sample raw data and efficiency calculations for stoves they have tested.

Extreme secrecy on the part of NESCAUM/ADEC/NYSERDA just fuels suspicions that they are hiding inadequate or contrived calculations.

Returning briefly to the issue of burn rates and what NESCAUM thinks is "representative,' we should take a brief look at how NESCAUM/ADEC interpret the requirement for 50 hours of "conditioning" before testing.

The “Assessment” not only criticizes medium burn rates in ASTM E-3053 tests, but they also “flag” the burn rates that are used to “condition” stoves for 50 hours prior to testing. Here are some sample comments taken from the ADEC Summary Sheets on the requirement for 50 hours of conditioning,:

> 1) Did not report aging dates and did not report fuel information per the method. 2) Only 11 out of 10 hours at medium burn rate (1.39 kg/hr, +/-0.5 kg/hr) based on med burn from test report. other info

> 1) Did not report dates and when fuel added per method. 2) Only 5 hours out of 50 hours at medium burn rate (1.31 kg/hr, +/-0.5 kg/hr) based on med burn from test report.

People who were reviewing test data for ADEC clearly thought (or were instructed to think) that the “50 hours of conditioning” had to be conducted at +/-0.50 kg/hr of the *medium burn rate as it was expressed on the test report, in kg/hr*. This is error, because the ASTM E-3053 Test Method requires no such thing for “conditioning.”

What ASTM E-3053 requires is that the conditioning should be conducted “for at least 50 hours at a medium combustion air setting.” There is a big difference between a “burn rate” and an “air setting,” and there is no requirement for the conditioning prior to an ASTM E-3053 test to be conducted at a particular “burn rate.”

When it comes to their own method (IDCTM now ALT-140), NESCAUM/ADEC/NYSERDA do seem to understand the distinction between “air setting” and “burn rate.” The IDCTM also does not require that conditioning be conducted at a specific burn rate, but it simply states that the appliance “shall be operated at a variety of burn rates” and the manufacturer shall report “air settings used, time spent in each air setting phase, the amount of fuel burned, and appliance burn rates." Implicit in both methods is that the appliance can be burned either at a "medium setting" (ASTM E-3053) or can be burned at different "air settings" (IDCTM).[8] In either case, if the appliance is left unattended, the burn rate will gradually drop, as fuel is consumed, but that is fine for conditioning purposes.

The comments made by ADEC reviewers about the burn rates during the 50 hour conditioning period are misplaced and yet another example of error in the "Assessment." In the case of the "50 hour conditioning requirement" the ADEC reviewers obviously didn't read the ASTM E-3053 test method before trying to determine if it was correctly applied

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Obviously there will also be a Part 2b, and a Part 3 of this Review, because there is so much more to unpack in both the "Assessment" and the IDCTM (now ALT-140).

Here's a final thought on the IDCTM efficiency calculation, which I find especially galling: Imagine that some baseball regulators came up with a way to determine whether a home run was hit by computing the speed that the ball left the bat, the launch angle, the exact trajectory and the likely arc. They would claim that this would void the need for replays, prevent outfielders from running into walls, provide more accurate hitting metrics, smooth out the physical differences

[8] Also included in the IDCTM section on "Conditioning" are requirements for appliances using catalytic combustors. This section on catalytic combustor conditioning requires the reporting of requirements listed in 8.1.1, but there is no 8.1.1 in the test method. This is just one of a significant number of drafting errors in the IDCTM. Here are just a couple more samples out of many:

Section 10.1.2.3 states that higher tunnel flows may be required to meet the parameters of 8.6.3. But there is no 8.6.3

CSA B415.1-2010 is not cited as a reference method, but it is referenced in the IDCTM, in "9.10. Flue Gas Analyzers" (*in an incomplete sentence!)* and in "Section 11.4.2. " Authors of the IDCTM should give the folks at CSA some credit, by listing CSA B415 as a reference method in section 2.

between ballparks (bye, bye “Fenway Monster” in left field), and generally make the game more scientifically accurate and “fair.” (Eyes roll.)

There is value in continuity of methods and metrics way beyond just stubbornness and resistance to change. The IDCTM proposes to change the way efficiency is measured, by calculating and averaging measurements of instantaneous efficiency, and then deliberately hiding these calculations from public scrutiny. Even EPA does not know how IDCTM calculates and averages efficiency: when asked, their answer is “ask NYSERDA”.

The IDCTM method of calculating efficiency is incompatible with the current method of calculating efficiency (which is generally accepted and understood by regulators, stove manufacturers, professional engineers, and the general public).

When Federal Agencies (here, EPA) begin approving Test Methods where they do not know or understand how the back-end calculations work, and the back-end calculations are far removed from decades of tribal knowledge, we are much closer to the baseball analogy than one might think.