Operation and Fueling (O/F) Workgroup Meeting Notes from November 3, 2016 Teleconference

(Note: Voting Members are in bold-face)

Meeting led by **John Crouch** (HPBA, Co-Chair of O/F Workgroup) and **Lisa Rector** (NESCAUM, Co-Chair of Steering Committee)

Meeting Invitees (not necessarily all present): Bob Lebens (WESTAR, Co-Chair of Steering Committee), **Rod Tinnemore** (Washington) **& Phil Swartzendruber** (Puget Sound Clean Air Agency), **Marc Cohen** (Massachusetts), **Cindy Heil** (Alaska), John Wakefield (Vermont), **Lisa Herschberger** (Minnesota), Anne Jackson (Minnesota), **Randy Orr** (New York) **& John Barnes** (New York), Adam Baumgart-Getz (EPA OAQPS, Wood Heater NSPS Group Leader), Amanda Aldridge (EPA OAQPS, Wood Heater NSPS Lead), Stef Johnson (EPA OAQPS, Measurement Group Leader), Mike Toney (EPA OAQPS, Measurement Group), Bob Ferguson (Consultant to HPBA, President of Ferguson, Andors & Company), **Tom Butcher** (Brookhaven National Lab, BNL), Rebecca Trojanowski (BNL), Adam Bennett (BNL), **Gregg Achman** (Hearth & Home Technologies), **Allen Carroll** (Applied Ceramics), Rick Curkeet (Intertek), **Ben Myren** (Myren Labs), **John Voorhees** (US Stove), **Tom Morrissey** (Woodstock Soapstone), Dan Henry (5G3 Consulting), Mark Champion (Hearth Lab Solutions), John Steinert (Dirigo lab), Doug Towne (Dirigo lab), Gaetan Piedalue (Polytests lab), Jared Sorenson (OMNI lab), Sebastian Button (OMNI lab), Alex Tiegs (OMNI lab), Kelli O'Brien (ClearStak), Jeff Hallowell (Biomass Controls), Lee Mitchell (Applied Catalysts), Martin Morrill (Applied Catalysts), Jill Mozier (EPA contractor, meeting note taker)

Primary Conclusions from Meeting:

- The November 17th meeting will be a primer on EPA Method 28 and attendance is optional. The upcoming O/F workgroup meetings are on November 17th, December 15th and January 5th.

- EPA is currently funding foundational research into the effect of species on burn rates and emissions. Mark Champion is measuring burn rates and sampling emissions in a pre-NSPS (essentially uncontrolled) stove burning crib wood from the following species: Douglas fir, Red Oak, White Pine, Red Maple, White Birch and Ash. After the crib testing, 1 to 3 of these species will be chosen to be tested as cordwood. One objective of this testing is to inform a data bridge from the Method 28 Douglas fir crib database to other species available in cordwood. Furthermore, NESCAUM has provided a TEOM being used during testing, so continuous minute data is being collected which provides a sense of when emissions are highest and lowest during the burn cycle. Adam Baumgart-Getz will present some of the data collected to-date from this species testing during the December 15th workgroup meeting.

- John Voorhees gave a slide presentation entitled "EPA vs EU 13240 Emission Results" which is available on Basecamp. In European wood stove testing, the weight of the fuel is based entirely on the rating (kW output) of the stove which is declared by the manufacturer, not on the dimensions of the firebox. (In Europe, the manufacturer can classify the stove as "intermittent" or "continuous", depending on the length of the burn in the stove.) European testing is performed with the wood stove set at nominal air settings and there is no set minimum burn requirement. The minimum burn is determined by the stove and manufacturer, rather than by the method. The Din+ is a partial cycle sampling method (testing occurs during the optimal part of the burn, but not during the full cycle) while EPA sampling is full cycle sampling. Another key

difference is that the Din+ uses a heated filter which results in a big difference in the amount of condensables captured/measured. In EPA's M28, the filter temperature can't exceed 90 degrees F in the dilution tunnel, whereas the temperature of the filter in the European method is 180 degrees Celsius because it's a heated filter line and filter.

- Another European Union program called Ecodesign is set to be implemented across Europe in 2022. Ecodesign sets limits for CO_2, NOx, CO and efficiency [in addition to PM] and is more restrictive than EN 13240, although it uses EN 13240/16510 test methods.

To-Do List:

- John Voorhees will identify the third wood species allowed under the European EN 13240 testing (in addition to Birch and Beech) and will e-mail the group regarding the permissible species. John (with assistance from Rick Curkeet) will also provide the workgroup test results from his presentation in g/hr at each burn rate, as well as results for other parameters measured, including CO and organics. Finally, John will share with the group information about the European Union program called Ecodesign, set to be implemented across Europe in 2022.

- Lisa Rector will identify and distribute any information/data from the 2009 NESCAUM study in which OMNI tested a European stove using M28 and EN 13240 with hot filters instead of a dilution tunnel.

- Lisa Rector will clarify the intended use of the beReal method when she is in Europe for the conference in January and will inform the O/F workgroup of what she learns. Lisa will also find Christoph's results from when beReal ran a dilution tunnel and a hot filter. Finally, Lisa will find and post to Basecamp a paper on this subject by Thomas Nitzbaumer.

- The O/F Workgroup should think about what pieces from today's discussion would be useful in the US/EPA test method (e.g., loading weights, testing based on a stove's rating as intermittent versus continuous, appropriate filter temperature during testing, should the test method essentially design the stove or should the method be flexible enough to allow for different stove designs/ratings/settings).

Highlights from Meeting:

- Lisa Rector noted that the following people were in attendance at the beginning of the meeting: Amanda Aldridge, George Allen, Jack (from Minnesota), Adam Baumgart-Getz, Bob Lebens, Gaetan Piedalue, Gregg Achman, Cindy Heil, John Barnes, John Crouch, John Voorhees, Kelli O'Brien, Lisa Herschberger, Randy Orr, Rick Curkeet, Bob Ferguson, Rod Tinnemore, Tom Butcher, Tom Morrissey, Rebecca Trojanowski, Mike Toney, John Wakefield, and possibly others on the phone who did not announce themselves.

- John Crouch opened the meeting, noting the agenda on the screen including an update on future meetings, an EPA Research Update, and an EPA vs EN Emission Results presentation by John Voorhees. Regarding the update on future meetings, John noted there's no O/F meeting

next Thursday, but a Steering Committee meeting on November 14th to discuss PM Measurement recommendations. Lisa noted that the next OF meeting is November 17th.

- Lisa understands that industry will be travelling on November 17th. Therefore, the plan for that day is to do a Method 28 discussion/primer regarding the differences with other methods. This will provide regulators with a basic understanding of M28. Industry folks may not need to participate, so participation on 11/17/16 is optional. Lisa noted that on December 1st almost all regulators will be absent due to a NESCAUM meeting in Albany, therefore the December 1st meeting should be moved. [It was later decided that instead of December 1st, the next meeting after November 17th would be December 15th.]

- John asked Adam to brief the group regarding the woodstove testing EPA was involved in.

- Adam Baumgart-Getz gave a brief update, noting that EPA is currently doing foundational work regarding how fuel species impacts emissions. In the draft ASTM, a range of densities is allowed – that is, any species within that density range may be used as the test fuel and it's a fairly generous range. This [allowable density range] gave EPA pause in terms of how such a wide range might contribute to test method variability. Therefore, EPA put together a contract to examine the impact of species. Currently crib wood testing is being done using Douglas fir, Red Oak, White Pine, Red Maple, White Birch and Ash. These are the species that the labs indicated they thought they could obtain as cordwood [except for the Douglas fir]. Adam explained that the testing is first examining how they burn as crib wood, then 1 to 3 species [from that list of 6 species] will be identified to examine how these 1 to 3 species burn as cordwood.

- Adam further explained that this testing is meant to inform a data bridge to take us from the Method 28 Douglas fir crib database to other species available in cordwood. The testing currently consists of 5 burns per species using crib wood. Adam noted that the testing will therefore not provide a robust/large database, but will provide a sense of which direction to head. Some results from Mark Champion's testing [under this contract] are in and these results will be shared with everyone after the Quality Assurance Project Plan (QAPP) is reviewed and approved. EPA is reviewing the QAPP now and hopes to approve it by next week, although it may take longer. Grossly summarized, the results so far indicate that burn rates vary with these species. The specific gravity of each tested species will also be measured and how density affects burn rate will also be examined, in addition to species. The goal is to identify 1 to 3 cordwood species to move forward with further testing. Adam noted that EPA hoped to start sharing the testing results during the next few weeks.

- John Crouch asked if the testing was being performed on a conventional stove. Adam replied that there is no perfect solution as to what kind of stove to perform the testing in, whether catalytic or non-catalytic. One goal of the test design was to eliminate stove technology's effect/interference on emissions [to be able to compare emissions from various species under a simple/raw burn, thereby eliminating a potential variability factor]. Therefore, testing is being performed in a refurbished pre-1988 stove with minimal control technology. There are some flaws and downsides to this decision – for example, the stove is not designed to burn at low

burn rates. However, EPA determined that removing control technology [as much as possible] as a variable was important.

- Adam also pointed out that NESCAUM provided a TEOM to be used during testing, so continuous minute data is being collected during the test which provides a sense of when emissions are highest and lowest. The R-squared value of the filter vs TEOM data is 0.99 – so the data between the two measurement techniques is a very good match. Adam noted that EPA is not going to require a TEOM in certification testing. The TEOM is being used in this testing to determine where emissions are occurring [e.g., at what point of the burn cycle] and to inform answers to other questions such as where to cut off the test for certain burn rates, etc. Adam asked the group to please bring up questions in the next teleconference or feel free to contact Adam directly, with more pressing questions. Adam noted that the group could have a more detailed discussion about this testing in the next couple of weeks.

- Lisa Rector and John Crouch decided that the next teleconference would be on December 15th, during which Adam would present EPA's species testing in more detail. Adam and Mike Toney agreed the QAPP should be approved before then. John requested that the EPA testing data be posted to Basecamp a day or two before the December 15th presentation, so group members can review the data and formulate their questions for Adam.

- John noted that a longer meeting on December 15th makes sense – for Adam's presentation for to discuss any issues that the state regulators have raised so far with Lisa and Bob Lebens. It was agreed that November 17th would be the Method 28 review meeting and December 15th would be a longer teleconference to discuss priority topics and EPA's testing work so far. It was further agreed that there would be no meeting on December 29th, so only one meeting would occur in December on the 15th. John noted that after that the next teleconference would be on January 5, 2017. Lisa noted that she would change the Outlook invites and also send out e-mail invitations, as some people have issues with Outlook.

- Prior to John Voorhees beginning his presentation, Lisa clarified that John's presentation would regard the EN certification test results, not the beReal protocol results. Lisa had previously sent out the draft beReal protocol to the group and further noted that she would confirm with Christoph Schmidl regarding the plans for beReal's method. Lisa noted that there is some confusion about beReal because we have heard both that beReal is merely a concept and that beReal will be used for an incentive and labeling program in 2017 with an aim to be used for certification in 2020. It's not clear how finalized these plans are. But for today's meeting, Lisa wanted to clarify that John Voorhees is not talking about beReal, but rather about the EN certification method. John Crouch noted that HPBA will be speaking to German trade organization to clarify with them as well, while Lisa clarifies the nature of the beReal effort with her contacts. Lisa noted that she will discuss beReal with the Europeans in the January conference and will clarify this with the O/F workgroup in February.

- John Voorhees agreed, noting that things are not clear regarding the future of certification in Europe. John explained that EN 13240 is being used but is in the process of being phased out

with EN 16510 taking its place. EN 16510 is currently being vetted. Also, the beReal protocol is not a requirement, it's more of a labelling option. BeReal is not vetted through the TC295 group in Europe that authorizes test protocols and therefore it's a bit of a quagmire regarding how beReal will be used. John further noted that EN 16510 hasn't been promulgated yet to take over EN 13240, due to technical difficulties with labeling and other issues. John explained that the European group is attempting to get the entire European Union to agree, which is complicated. John clarified again that what he will present today has nothing to do with beReal.

John Voorhee's Presentation on EPA versus EU 13240 Emission Results:

- In response to a request from John Crouch that John Voorhees introduce himself again to the O/F workgroup, John noted that he has worked in the hearth industry for 18 years. He worked in labs for 15 years, including with Intertek, and was involved in hearth products and testing for all those 15 years. Since 2014, John has been the director of product development at U.S. Stove Company.

- John Voorhees began his presentation entitled "EPA vs EU 13240". These slides are posted to Basecamp. John noted that all testing results he will be showing were performed by ISO accredited /notified body labs. Furthermore, all the stoves were certified to EPA's standard before being tested in EU/UK Labs. The Din+ Method comprises 3 runs which are averaged. PD 6434 comprises 5 runs on high that are averaged and 5 runs on low that are averaged.

- John noted that Birch or Beech is burned in the UK and Europe, although everything he saw used for fuel was Beech. John showed a slide with a photo of Beech showing half of the bark off. John noted that most cord wood used in Europe has bark still attached because Birch and Beech wood tend to keep bark. All tests [discussed in his presentation] used wood with bark still on.

- Regarding a slide entitled fuel weight comparison, John noted that it shows the different fuel weights used for the emission testing under EPA, EU and ASTM, as well as the volumes used. Three models are shown – A, B, C – and John noted that the B and C models are the same firebox with merely exterior cosmetic differences. John explained that the European testing Din+ uses a [fuel weight] figure related to how the manufacturer decides to rate the stove in kilowatts and has nothing to do with the actual size of the firebox. John further explained that the two ASTM numbers shown (6.59/7.91 kg) are different because one is for the high burn and the other one is for the medium and low burn. Regarding the European fuel weight, John again noted that because the manufacturer can declare what the heat output of the stove is, the weights for models B (2.23 kg) and C (1.32 kg) are different. The European testing can use different weights of fuel in the same firebox, because they may be rated at different kilowatts.

- Regarding the test results slide, John noted that he didn't know the formula for conversion, but the results are in g/hr under EPA testing and in mg/m^3 under the EU Din+ testing. The UK method results are in g/hr with two different emission results – one g/hr result for high burn and one g/hr for low burn. Rick Curkeet noted he had looked at the numbers and converted them, but needed to know the burn rate and efficiency and what standard was used for the

oxygen in the flue gas (13%) for the 2 kg/hr burn rate. Rick estimated that the converted results were 0.48, 0.51 and 0.86 g/hr under Din+.

- Regarding the Highlights of EU Testing slide, John noted that 8", 10" or 12" long pieces were used depending on the size of firebox – that is, sometimes longer pieces are used in longer fireboxes. However, the weight of the fuel is based entirely on the rating (kW output) of the stove, not on the dimensions of the firebox. John noted that all the testing is done at "nominal" air settings and there is no minimum burn requirement under European testing. For example, one stove can burn at 1.5 kg/hr while another stove may only go down to 2 kg/hr. John further noted that under the UK method, the minimum burn rate must be set at whatever the manufacturer requires.

- Lisa noted that for the British/UK method, while there is no requirement to burn at x kg/hr burn rate, testing must be performed at the lowest burn rate the manufacturer plans to sell the stove at. John agreed this was correct, noting that consumers can't set the stove lower and this prevents smoldering.

- John continued, noting that the moisture content of the EU fuel must be 16% ± 4% vs. EPA crib fuel must have a moisture content in the range of 19-25%. The moisture content for the ASTM Cordwood Method is 19-25%. All the testing John witnessed used Beech as the fuel species, although they can also use Birch and possibly a third species. Beech is readily available. The Din+ is a partial cycle sampling method (they sample during the optimal part of the burn, but not during the full cycle) while EPA sampling is full cycle sampling.

- Regarding the Highlights of UK testing, 10 tests are performed (5 high burn and 5 low burn tests). Sampling is with an electrostatic particle precipitator in the exhaust stream at the exit from the chimney. No minimum burn rate is required. Fuel moisture is the same as Din+. John noted that most of the fuel was in the 12-14% moisture content (dry basis) range.

- John concluded his presentation, noting that it was short and sweet, but he wanted people to have a general sense of the differences between the methods.

- John Crouch noted that the UK does not use a dilution tunnel, but is rather just dealing with the exhaust stream as-is. The Norwegians, however, do use a dilution tunnel. John Voorhees agreed this was the case, noting that the fueling protocol is similar to USA's crib method except that the manufacturer can declare the minimum burn rate for their stove. John explained that there are 2 different steps regarding the minimum burn rate, which can go down to 1.15 kg/hr.

- John Crouch noted that there is also a difference in terms of fuel length and asked John Voorhees to explain for the group what it would be here [in the US]. John Voorhees noted that for the [US] crib method, 5/6th the length of firebox is the optimally prescribed fuel length and 7 lb/cubic ft. Therefore, John noted, it's customized to the stove in the US. In Europe, the fuel length is based on the manufacturer's recommendations. John explained that in Europe, the manufacturer can classify the stove as "intermittent" or "continuous", depending on the length

of the burn in the stove. For a continuous rating, the stove must burn more than 4 hours on one fuel load. However, John noted that 95% of stoves that he has seen are rated as intermittent. Intermittent stoves must burn at least 45 minutes on one fuel load, although most burn for an hour or 1.5 hours at a nominal setting.

- Lisa Rector asked who decides what species is used in the certification test. John Voorhees replied that EN 13240 specifies the testing fuel as either Birch, Beech or maybe a third species (which John will look up). Among those 2 or 3 choices, John noted that the lab chooses the species based on what the lab has available to burn. John noted that he would send out an e-mail confirming what the third permissible species is for certification testing under EN 13240.

- Lisa Herschberger asked if organics are collected/measured or just dust [particulate]. John Voorhees replied that organics and NOx are collected/reported but not regulated. CO, CO_2, and OGC (as a general organics percentage) are reported, but not broken down further [according to specific organics]. Lisa Rector noted that some countries do regulate those different pollutants, but that's a patchwork. John Voorhees agreed it was a large, widely-varying patchwork [regarding European regulations]. Different [European] countries require different pollutants [to be regulated and reported], different efficiencies, and different CO [allowances]. Lisa asked John if he could provide numbers for all pollutants listed on the test results and provide g/hr at each burn rate. John said he could and would speak with Rick Curkeet to obtain those numbers. Lisa asked if John could provide the other parameters measured and John said he would, that there were no secrets. John noted that he can provide the CO numbers, will look for data on organics and will provide whatever values he has.

- Lisa Herschberger asked if these were the only stoves he had data on and John confirmed that these were the only stoves that the manufacturers provided John data for. John noted that it's possible that he may be able to obtain information from other manufacturers. He had reached out to two [originally], but he could reach out to others. John also clarified that he didn't look at stoves tested with the Australian method for this analysis. The Australian method uses wood logs [i.e., it's a cordwood method] and Australia recently updated standards on hearth products, according to John. John noted that therefore the O/F group may want to look at the Australian method as well and further noted that he would love to involve additional manufacturers.

- Lisa Rector noted that in 2009 NESCAUM funded a study that did the converse of the study John Voorhees was presenting – that is, NESCAUM sent a European stove to OMNI and they tested it using EPA M28 and EN 13240 with hot filters, not a dilution tunnel. The results did not come out as expected. John Voorhees noted that too much information was left out of that study (e.g., did they use the correct weight of fuel and were the stoves tested at nominal setting). Lisa Rector offered to dig into the test reports and pull out the information.

- Lisa Rector further noted that she'd like to understand how Europeans regulate – Lisa's understanding is that there isn't a single passing grade, but rather classes. John noted that he has a sheet from the labs showing the specific requirements for each country, including what the passing grade is for that country. However, John further noted that these standards/passing

grades are always under discussion regarding what the future requirements will be. Lisa Rector noted that she thought there were different levels of certification for some of the northern European countries.

- John Voorhees noted that there's another European Union program called Ecodesign set to be implemented across Europe in 2022 that does set limitations for CO_2, NOx, CO and efficiency. Ecodesign is more restrictive than EN 13240 and it will be mandated, using EN 13240/16510 test methods, but with stricter requirements. John noted that he would share that information too. John noted that therefore there's beReal and Ecodesign and that he thinks Ecodesign is country-specific (although is not sure).

- Lisa Rector asked if there were any major changes between EN 13240 and EN 16510. John Voorhees replied that EN 16510 harmonizes EN 13229 and EN 13240 with another couple of standards into one standard. There will be EN 16510-1 and 16510-2, etc. John explained that there will likely be some improvements to the methods which will be vetted through the European TC groups. However, John concluded that he is not aware of any huge changes between EN 13240 and EN 16510.

- John Crouch noted that John Voorhees had alluded to a heated filter train. John Voorhees explained that there is no filter train in the UK method, because it's electrostatic. But Din+ uses a heated filter. John further explained that in EPA's M28 the filter temperature can't exceed 90 degrees F in the dilution tunnel, whereas the temperature of the filter in the European method is 180 degrees Celsius because it's a heated filter line and filter. This results in a big difference with regards to condensables. John concluded that the major difference is that the filter temperature can't exceed 90 degrees F in the EPA testing.

- Regarding why the dilution tunnel can't exceed 90 F, Mike Toney noted that it is related to how EPA defines particulate. Mike noted that Stef Johnson had sent out in an e-mail awhile back that there was some discussion of going to 110 degrees, but that was put down. Mike noted that Rick Curkeet says more studies should be done before changing the filter temperature requirement. Mike further noted that John Kinsey has also explained that EPA's definition of particulate is a policy decision [reflected in the filter temperature requirement]. Stef explained that EPA has chosen 85 F as the cutpoint for ambient PM. Therefore, once the stack gas cools to 85 F, the primary particulate [by definition] is formed.

- John Crouch thanked John, Mike and Stef for calling attention to this difference and noted that European stoves have a hard time with EPA M28, as it's more restrictive regarding filter temperature and the minimum burn rate requirement. John opined that the filter temperature [requirement] is a fundamental disconnect. Rick Curkeet noted that it's complicated.

- Lisa Rector noted that the condensable fraction changes with the specific combustion characteristics of each stove [model]. Rick agreed with Lisa, noting that the condensable fraction is related to the temperature and efficiency of the stove, which is why the results are so variable. Rick explained that almost all is condensable with very little as solid. Therefore, as the

temperature cools down, liquid droplets start forming that collect in the filter. Rick noted that he was involved in a brief study looking at going to 100 degrees and that the condensation problem disappears completely at 100 F. Rick explained that the study looked at filters run at different temperatures, which were put in the oven and dried to a constant weight to see how much mass was lost. Approximately 2 to 10% of mass with a boiling point in the 100-degree F range was lost consistently. Rick noted that if the filter was heated to 350F/180C [like European method], huge differences would have been seen.

- Lisa Rector noted that the condensable fraction from larger boilers tested with Methods 201 and 202 is typically 10 to 35%. Lisa further noted that the general rule is: the cleaner the device, the lower the condensable fraction.

- Lisa Rector noted that George Allen from NESCAUM has a TEOM running [during Mark Champion's testing for EPA] and the filter temperature can be changed on that easily to observe differences with different filter temperatures. Lisa explained that George can run a pair of TEOMS – one at 80 C and one at 100 C – and the difference will be seen.

- Lisa Rector further noted that many recognize the shortcomings of the EN 13240 test method, but it's interesting to consider in terms of policy. That is, rather than have the rule set the design parameters, instead the manufacturer declares the stove as intermittent or continuous. John Voorhees agreed, noting it's a marketing decision rather than a technical/design decision. For example, some stoves burn overnight and some don't and this is not dictated by the manufacturer doing something to stove.

- Lisa Rector continued, noting that the question is: do we want a test method to set the design parameters (as the EPA method currently does). Lisa noted that the complementary question is, if this group wants to move away from that, what does EPA think of this change. John Voorhees opined that it would be a plus [to move away from the method setting the design parameters] as it would prevent the consumer from loading a stove with fuel with a high moisture content and letting it smolder. John explained that in Europe the stove cannot be turned down that low, so neither can consumers turn the stove down low there [and allow it to smolder]. John further noted that Europeans also wonder why the EPA test method requires overloading of the stove.

- Regarding what EPA would be open to, Adam noted that it's essentially Stef's decision, in that EPA is open to whatever the data suggests is a good direction. But EPA needs to see data [to support any change]. As an aside, Adam noted that he has been involved in wood burning in Germany and Americans load stoves much higher than Germans do.

- Regarding the test load slide, John Crouch noted that the ASTM level of loading is even higher than M28. In response to a question from John Voorhees, Bob Ferguson clarified that under the ASTM method the lower loading density is for the high burn rate and the higher loading density is for the low and medium burn rates. Bob explained that the rationale for the higher density loading at the lower burn rates is that the low burn rates is to represent an overnight burn. Bob noted that there are different philosophies regarding how stoves are operated in different parts

of the world. John Crouch agreed, noting that he just wanted to make it clear that the proposed ASTM method envisions three times as much fuel as the EU method.

- In response to a question from Lisa Herschberger regarding the choice of the manufacturer, John Voorhees explained that in the European method the amount of fuel is dictated by expected efficiency and a lower calorific value of fuel. However, the fuel amount is based on a formula which is dictated by how the manufacturer chooses to rate that stove (e.g., if the manufacturer rates their stove at 5 kilowatts, that rating will drive the fuel calculations in the European method). That rating also plays into [the measured and marketed] efficiency – so it's a double-edged sword, John noted. The test results are different, based on the manufacturer's rating – so the manufacturer chooses the optimal rating and then that dictates the fuel.

- John Barnes (from New York) noted that presumably the user can do whatever they want, however. John Voorhees agreed. John Barnes asked for confirmation that the European method doesn't really monitor what the user does. John Voorhees confirmed that was correct, noting that there are user manual indications about what is optimal and the European standard does dictate that the manufacturer must specify and reveal to the consumer regarding how to operate the stove optimally. This is very clearly called out. John Voorhees thanked everyone for their attention.

- Lisa Rector noted it was a great discussion regarding thinking about pieces that are interesting and would be useful in the US/EPA test method (e.g., loading weight, the stove rating as intermittent versus continuous). These pieces should be captured for future discussions. Lisa noted that the other important point to consider is does/should the test method design the stove or not. John Crouch noted that filter temperature is another aspect the O/F group needs to think about. John noted that the first-time people witness the European method, they invariably mention the heated filters. John further noted that the stakeholders have lived with this filter temperature limit for 30 years, so it boggles the mind to see these hotter filter temperatures.

- Lisa Rector noted that the PM Measurement Workgroup does have a recommendation as to filter temperature, but perhaps it'd be helpful to determine what this O/F Workgroup would specify regarding filter temperature. Lisa noted that she can see the issue in terms of comparing test results, to get results equivalent to dilution tunnel results, noting that it is unknown if the conversion is correct. John Crouch agreed this was the bottom line.

- Lisa Rector noted that it may be helpful to review Christoph's results from where they ran a dilution tunnel and a hot filter. Lisa further noted that there's also a good paper on this by Thomas Nitzbaumer (spelling?) that Lisa can post to Basecamp regarding temperature and PM. John Crouch agreed that it was a good idea to post the paper and asked if anyone had any last questions.

- Lisa Herschberger asked if anyone wanted to share the rationale for using an older stove to compare emissions from different species [under the current EPA-funded testing]. Specifically,

Lisa wondered how the data from the older stove would transfer to newer catalytic and non-catalytic stoves. Stef noted that it was not possible to make assumptions about how the data would translate under different control technologies. Lisa asked if EPA went to a pre-NSPS stove to capture differences in emissions, as if from a campfire, without other variables [such as control technology] affecting the emissions too much. Stef confirmed this was the rationale – that is, the goal of the experimental design was to avoid the control technology changing/impacting the species testing/emissions.

- John Crouch noted that the EPA testing sounds like original baseline work and he noted he was glad EPA was doing it. The funds weren't available in the 80s to do such baseline work in support of the Oregon method, according to John.

- Stef noted that there isn't a "magic bullet species" that exists everywhere [and is allowed to be shipped to labs across the country]. Therefore, the effect of species [on emissions and burn rates] needs to be determined.

- John Crouch and Lisa noted that there will be an optional tutorial on M28 during the next meeting of the O/F Workgroup on November 17th. Then there will be a full/mandatory meeting on December 15th with hard recent data to look at on that date. John noted that several people will gather on December 1st in Albany and lab or industry people can contact John Crouch with questions.

- Lisa thanked everyone for participating, noting it was a good call today.

- **Meeting adjourned.**