Heating, Refrigeration and Air Conditioning
Institute of Canada
2350 Matheson Blvd. East, Suite 10, Mississauga, ON
905-602-4700 hraimail@hrai.ca
www.hrai.ca

AIR-CONDITIONING, HEATING, & REFRIGERATION INSTITUTE
we make life better™
2311 Wilson Blvd, Suite 400, Arlington, VA USA
703-524-8800 ahri@ahrinet.org
www.ahrinet.org

June 7, 2021

Laureen Chung
Manager, HVAC Standards Development
Homes and Communities Division
Office of Energy Efficiency
Natural Resources Canada
930 Carling Avenue, Building 3, 1st Floor
Ottawa, Ontario
K1A 0Y3
Email: laureen.chung@canada.ca

Re: AHRI-HRAI Comments on Technical Bulletin and Webinar Regarding Central Air Conditioners and Heat Pumps

Dear Ms. Chung,

We are writing to you on behalf of the Air Conditioning, Heating, and Refrigeration Institute (AHRI) and the Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI) collectively referred to as the "Joint Commenters." Our associations collectively represent the large majority of manufacturers and distributors of heating, refrigeration, and air conditioning products and systems sold into the Canadian and U.S. markets.

These comments respond to the May 18, 2021, technical bulletin webinar on Central Air Conditioners and Heat Pumps.

The Joint Commenters support the proposed direction of harmonization with the U.S. Department of Energy (DOE) on the 10 CFR 430 Appendix M1 (Appendix M1) test procedure and adoption of the energy conservation standard for residential central air conditioners and heat pumps (CAC/HP) but note that only through complete alignment will end users in both countries reap the full benefits of lower cost and greater product availability. It is possible for Canadian consumers to find products that perform well at colder climates – a stated goal of NRCan – without imposing additional test and compliance burdens on the manufacturers. Fundamentally, the Appendix M1 test procedure, while offering an option for testing at 5°F (-15°C) ($H4_2$), provides all the relevant information for the calculation of the capacity and performance of the

products at 5°F (-15°C), without conducting the test at that temperature. Data submitted by the Joint Commenters to NRCan in March 2020 showed there is minimal difference (around 3-percent) between performance and capacity derived through calculation or testing at 5°F.

Technically, there are few, if any, reasons to deviate from the Appendix M1 test procedure to justify the significant cost associated with the proposed changes. Not only will costs be passed along to Canadian consumers, but product choices will also likely be limited. With the challenges of successfully conducting the 5°F test and controlling the wet bulb temperature coupled with the dearth of laboratory availability to conduct testing, manufacturers may have no choice but to rate fewer models to the Region V climate. Currently, there is simply no laboratory capability to support the number of products shipped to Canada and manufacturers would prioritize the testing and certification of minimum efficiency products.

Appendix M1 cold climate mandatory testing is an improvement over CSA C656.

Indeed, the Appendix M1 test procedure is more stringent than U.S. DOE's Appendix M (CSA C656) and was negotiated in 2015 with a diverse group of stakeholders, including manufacturers, energy efficiency advocates, government official, and utilities. Appendix M1 metrics (EER2, SEER2, HSPF2) are the result of new testing and calculation procedures. These changes improve accuracy of the field conditions where the units operate. To briefly summarize changes:

1. Minimum fan static pressure rise across the indoor air handler is increased to better reflect typical installations

Product Class	2015*	2023
	Minimum static pressure (in. WC)	
Conventional Ducted AC/HP	0.10 / 0.15 / 0.20	0.50
Space-Constrained (indoor and single-packaged units)	0.10 / 0.15 / 0.20	0.30
Ceiling-Mount and Wall-Mount	0.10 / 0.15 / 0.20	0.30
Low Static Blower Coil‡	0.10 / 0.15 / 0.20	0.10
Mid Static Blower Coil‡	0.10 / 0.15 / 0.20	0.30
Mobile Home	0.10 / 0.15 / 0.20	0.30
Small Duct, High Velocity	1.10 / 1.15 / 1.20	1.15

2. Fan power input and fan heat capacity adjustment for coil-only air conditioners with no indoor blower fans
    a. Current standard (Appendix M)
        i. Fan power: 365 W/1000 scfm*
        ii. Fan heat capacity adjustment: 1250 Btu/h/1000 scfm
    b. Revised Non-mobile home coil-only systems
        i. Fan power: 441 W/1000 scfm
        ii. Fan heat capacity adjustment: 1505 Btu/h/1000 scfm
    c. Revised space-constrained and mobile home coil-only systems
        i. Fan power: 406 W/1000 scfm
        ii. Fan heat capacity adjustment: 1385 Btu/h/1000 scfm

3. Heating load calculation changed to improve accuracy of ratings in cold climates
    a. Zero load temperature changed from a constant 65°F to a lower temperate that varies with climate region (55°F - 58°F)
    b. Fractional bin hours changed to reflect the new zero load temperatures
    c. Different heating load line equation slope factor for variable speed products (1.07 in Region IV) than for single/two-stage products (1.15 in Region IV).
4. Heating mode test
    a. Optional $H4_2$ low temperature test for heat pumps (5°F Dry Bulb, Max 3°F Wet Bulb, <=53% RH)
    b. Manufacturers must indicate if the H42 test is used
5. Variable speed factor for SEER2
    a. Applies to SEER2 calculation when calculating the building cooling load (BL)
        i. V represents a factor of 0.93 for variable speed heat pumps
        ii. 1.0 for single/two speed heat pumps
6. Off-mode power test
    a. Off-mode power test does not affect SEER2/HSPF2 and is regulated separately
    b. Revised test only impacts units with self-regulating crankcase heaters or heater system, where crankcase heater power is affected by the ambient temperature

The Joint Commenters note that very few laboratories, either Nationally Recognized Testing Laboratories (NRTLs) or manufacturers' private facilities, have the capability to hold the conditions necessary to perform the optional H_{42} low temperature test for heat pumps (5°F Dry Bulb, Max 3°F Wet Bulb, <=53% RH). The Joint Commenters are only aware of three test cells that are capable of holding 5°F Dry Bulb and at least one of these facilities can only achieve a minimum 4°F Wet Bulb, which is not sufficient to run the testing proposed to be mandatory by NRCan in the Technical Bulletin.

One would not expect to see significant difference between testing and calculation as Tables 12 and 13 of Appendix M1 require $H4_2$ testing to be conducted at the same compressor speed and heating air volume rate as $H1_2$ and $H3_2$ for single-speed, two-stage heat pumps. Appendix M1 requires that all heat pumps for which the 5°F full-speed test is not conducted, the extrapolation approach using test results for 17°F and 47°F temperatures (or the standardized slope factors for variable-speed heat pumps which do not use the same speed for these tests) would be used to represent performance for all ambient temperatures below 17°F. The 5°F test is optional because the limited data has shown there is only a small improvement in accuracy in exchange for a significant test burden increase.

For variable-speed systems, DOE's Appendix M1 test procedure specifies the same compressor speed for all "full load" heating tests, as given in Table 14 of DOE Appendix M1. Notably, the "Compressor Speed" for $H1_2$, $H2_2$, $H3_2$, and $H4_2$ are all

"Heating Full." All but the $H4_2$ test specify footnote 4. For some variable speed heat pumps, the $H4_2$ test will have the exact same speed as all the other "full load" tests. In those cases, as demonstrated above, the performance will be linear and there will be no advantage to performing the $H4_2$ test. There will be some cases, especially for cold climate heat pumps, where the unit will be able to increase the compressor speed, in which case there will be a benefit for Canadian consumers.

HSPF2 for Region V in Energy Efficiency Report has potential to improve representativeness.

NRCan's proposal to mandate the reporting of HSPF2 for Region V in the energy efficiency report submitted to NRCan is by far the biggest opportunity for improvement in the availability of the most representative HP performance data for Canadian consumers. An actual HSPF2 for Region V rating, rather than a Region V rating generated by a simple multiplier to the Region IV rating, affords the opportunity to manufacturers who have products performing better at 5°F to run the $H4_2$ test and show their better rating, without adding a burden to the products to which it will give no benefit.

Disharmonizing with Appendix M1 is not cost justified.

We have some concerns with NRCan proposals presented in the Technical Bulletin that deviate from DOE's Appendix M1. Disharmonizing from Appendix M1 will increase the cost of compliance with the regulation, costs which, will ultimately be passed on the Canadian consumer. The Joint Commenters collected data from manufacturers to capture the costs of NRCan's regulatory proposal more accurately, specifically, costs associated with certifying equipment if the $H4_2$ heating mode test condition is made mandatory for the calculation of HSPF2.

The Joint Commenters are aware that NRCan requires HVACR and heat pump manufacturers to disclose certified energy efficiency information, as specified in Canada's Energy Efficiency Act (Act) and Section 5 of the Energy Efficiency Regulations (the Regulations). Manufacturers that comply with this requirement incur costs that must be reflected in NRCan's cost-benefit analysis (CBA), especially with the proposal to make $H4_2$ mandatory. Based on a review of certification data by the Joint Commenters, nearly 16,000 models of air conditioning and heat pump equipment[1] must be certified as a condition of entering into commerce in Canada. At current certification rates, this equates to $112.7M USD in costs to manufacturers that is mandated by the Regulations. These costs are already over and above the cost of compliance with DOE regulations. The 5°F heating mode test condition imposes additional burdens to a significant portion of these models.

[1] Using NRCan's definition that central air conditioners and heat pumps are air-source air conditioners and heat pumps, with rated capacity of less than 19 kW (65,000 Btu/h). These include single package, split system (single-split, multi-head mini-split, multi-split including variable refrigerant flow (VRF), multi-circuit systems), ducted, ductless, space-constrained, and small-duct, high-velocity air conditioners and heat pumps.

The Joint Commenters understand that the cost to upgrade a laboratory to test to the new condition will require significant investment and imposes new testing costs to manufacturers. Based on conversations with Nationally Recognized Testing Laboratories (NRTLs), testing heat pumps to NRCan's new test condition will likely add an additional shift to testing. The Joint Commenters surveyed impacted manufacturers and found that these new tests will take upwards of 50,000 additional testing hours for the thousands of heat pump models for sale in Canada at a cost of over $8.7M USD. Manufacturers must also add development time and resources to heat pumps subject to this new condition, which is estimated to impose an additional $3.4M USD in cost. Any products that have already been tested for compliance to DOE Appendix M1 standards will need to be retested entirely if the 5°F test point is made mandatory. Simply testing the designated tested combination (DTC) or basic model group (BMG) to $H4_2$ would not produce the test report required for compliance.

Currently, laboratories do not have the capacity to test equipment to the proposed test condition. The Joint Commenters estimate that the cost to upgrade one laboratory could reach $75,000 USD and needs to be repeated across each laboratory intending on testing to 5°F heating mode test condition. The total cost to upgrade the labs necessary to test equipment to this new condition in a timely manner is between $7.5 to $13.1M USD.

In sum, NRCan's proposal to make $H4_2$ mandatory is likely to incur $12.1M USD (plus lab upgrades) in additional costs over the $112.7M USD spent on certifying air conditioners and heat pumps for sale in Canada. NRCan's CBA must accurately reflect the additional costs imposed by current NRCan certification requirements and the proposal to disharmonize test standards.

Flaws exist in NRCan's analysis to develop the proposed MEP for heating.

The Joint Commenters continue to be concerned with NRCan's use of the Northeast Energy Efficiency Partnerships (NEEP) Cold Climate Air-Source Heat Pump Specification (Version 3.0)[2] test data in its analysis. Not only is the NEEP data entirely comprised of variable speed products – not representative of the market – it is also derived exclusively through calculation.

NEEP's performance requirements are for COP at 5°F ≥ 1.75 (*at maximum capacity operation*) [emphasis added]. The spec requires manufacturers to input laboratory testing data or engineering data for the conditions shown below in Figure 1. "Minimum" and "Maximum" refer to the steady-state heating capacities and input power at each condition that the rated outdoor equipment model can deliver continuously (without cycling), during normal operation using the equipment's built-in controls (e.g., not using fixed speed test modes).

[2] NEEP Cold Climate Air-Source Heat Pump Specification (Version 3.0), https://neep.org/sites/default/files/media-files/cold_climate_air-source_heat_pump_specification-version_3.0_final.pdf, (Accessed on June 3, 2021.)

Heating Performance

			Capacity Level		
Outdoor Dry Bulb (°F)	Indoor Dry Bulb (°F)		Minimum	Rated	Maximum
47°F	70°F	Btu/h			
		kW			
		COP			
17°F	70°F	Btu/h			
		kW			
		COP			
5°F	70°F	Btu/h		[redacted]	
		kW			
		COP			

Figure 1. NEEP Heating Performance Submission Requirements[3]

In the March 5, 2021 "Discussion with HRAI and AHRI Central Air Conditions and Heat Pumps" presentation, NRCan described the process it used to develop proposed MEPs. NRCan analyzed 7,500 of the 25,377 Heat Pumps in the NEEP Database.[4] In the presentation, NRCan noted that the heating capacity at maximum and minimum compressor speed were among the data collection points; however, it was not disclosed if NRCan used maximum compressor speed at 5°F, minimum compressor speed at 5°F, or both in its analysis. As Figure 1, above, shows, there is no rated capacity at 5°F available in the NEEP database. NRCan confirmed at the May 18 Technical Bulleting webinar it has not conducted a single test at 5°F to validate its analysis. NRCan must correct flaws in its analysis and conduct testing to validate to support the significant cost associated with disharmonizing from U.S. regulations.

The Joint Commenters urge NRCan to include a proposal to harmonize large air conditioners and heat pumps with DOE January 1, 2023 standards in Amendment 17.

On January 1, 2023, more stringent energy efficiency standards will go into effect for large air conditioners (commercial or industrial unitary air conditioner with a cooling capacity of at least 19 kW (65,000 Btu/h) but less than 223 kW (760,000 Btu/h)) and large heat pumps (commercial or industrial unitary heat pump that is intended for air-conditioning and space-heating applications and that has a cooling capacity of at least 19 kW (65,000 Btu/h) but less than 223 kW (760,000 Btu/h)). For these large air conditioners and heat pumps, the lifetime energy savings is 14.8 quads

[3] *Ibid.*
[4] NEEP's Cold Climate Air Source Heat Pump List, https://ashp.neep.org/#!/product_list/. (Accessed June 3, 2021)

(2018-2048), a 24 percent savings relative to the energy use of these products in the no-new-standards case.[5] Using DOE's methodology to calculate the energy savings from the new minimum efficiency standards, we estimate that Canada harmonizing the new efficiency standards for residential central AC and HP could save 1.65 petajoules per year, a savings of 2.88-percent over the no-new-standards case. The Joint Commenters encourage the urgent publication of Amendment 17 to include minimum energy performance levels and test procedures harmonized with the U.S. DOE for large air conditioners and heat pumps.

Summary

In summary, the Joint Commenters request NRCan revise the proposal to require testing at 5°F (-15°C) to calculate HSPF2 for Region V. Instead, the Joint Commenters strongly suggest that the 5°F (-15°C) test point remain optional, and the efficiency report should permit the COP at 5°F (-15°C) and the rated capacity at 5°F (-15°C) to be reported based on calculation. This is a reasonable request, given that the more accurate heating rating in Appendix M1, the significant cost to make $H4_2$ mandatory, and flaws in the use of NEEP data in NRCan's analysis. For heat pumps where performance at low temperatures is improved by the increased compressor speed, such as cold climate heat pumps, manufacturers will be incented to perform the optional 5°F ($H4_2$) to show improved HSPF2. This will help Canada realize a decrease in energy use and ensure customers have a wide selection of product. Without harmonization, equipment manufactures may not have the capacity to design higher efficiency equipment for the Canadian market—hindering consumer choice and eliminating the energy savings that could have been realized otherwise. Lastly, NRCan should include in Amendment 17 a proposal to harmonize minimum energy performance levels and test procedures with the U.S. DOE for large air conditioners and heat pumps.

Please feel free to contact us with any questions or concerns.

Sincerely,

Stephen Chartrand

Laura Petrillo-Groh

Stephen Chartrand
Government Relations Specialist,
Federal Regulations
HRAI

Laura Petrillo-Groh
Senior Regulatory Advisor,
Cooling Technology
AHRI

[5] DOE's direct final rule (DFR) pertaining to energy conservation standards for Air Conditioners and Heat Pumps 82 FR 1786 (January 6, 2017) was a result of formal negotiations at the DOE that concluded in 2015.

Cc: M. Carpizo, AHRI
H. Walter-Terrinoni, AHRI
M. Luymes, HRAI
S. McLeod, HRAI
K. Curran, NRCan
M. Suami, NRCan