

December 20, 2017

VIA EMAIL ONLY: Godwin.Dave@epa.gov

Mr. Reid P. Harvey
Acting Director
Office of Atmospheric Programs
U.S. Environmental Protection Agency
Washington, DC 20460

Dear Acting Director Harvey:

Thank you very much for your November 13th letter regarding NAMA's petition to extend the acceptability of certain refrigerants for vending machines. We very much appreciate the opportunity to comment further on the industry's challenges with effectively and safely meeting the EPA's 2019 transition date for all newly manufactured refrigerated vending machines.

As the industry began to prepare for transition away from HFC's – a transition our industry is committed to making – it was initially thought the greatest challenge was re-engineering, design, and procurement of component parts. As the industry has continued toward a full transition, a second hurdle, larger than that of those related to manufacturing, has been identified. This hurdle relates to the placement restrictions imposed by UL, CSA and other standards bodies when using flammable refrigerants.

Several manufacturers have produced a beverage vending machine that is listed by UL. However, while listed by UL, these machines cannot be placed in customary vending locations such as hallways, lobbies, or locations of egress or ingress. This limitation, if left unchanged, will erode the viability of the industry, eliminate jobs and remove the opportunity for consumers to conveniently obtain food and beverages in these locations where they work and play.

As you know, R-290 refrigerant is a flammable chemical designated A-3 by ASHRAE 34. In addition, UL 541, CSA C22.2 No. 128 and ASHRAE 15 have jurisdiction over these products. They are considered commercial products and must comply with these safety standards in the US and Canada. One thing exists in common with both standards: the requirement for manufacturers to inform all users that the machines are not recommended to be placed in locations of ingress, egress, or lobby areas of commercial buildings. These restricted locations are the primary locations for many of NAMA member's refrigerated vending machines and compliance would greatly limit the marketing and sales of these products, limit consumer convenience and the industry's viability. In addition, owners of commercial buildings must comply with local, state and national building codes which reference the applicable ASHRAE, UL and CSA standards, imposing yet another challenge.

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20 North Wacker Drive, Suite 3500
Chicago, IL 60606
P: 312.346.0370

EASTERN OFFICE

1600 Wilson Blvd., Suite 650
Arlington, VA 22209
P: 571.346.1900

WESTERN OFFICE

80 South Lake Avenue, Suite 538
Pasadena, CA 91101
P: 626.229.0900

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Because of the flammable nature of refrigerants such as R-290 and R-600a, as well as many blends that contain HFO materials which are rated A2L or mildly flammable by ASHRAE 34, the components inside the vending machines must be changed to “sparkless” or inherently safe according to the components standards to reduce the risk of ignition of the refrigerant should a leak occur.

Until the UL 541, CSA 128, and ASHRAE 15 standards are changed, our industry is unable to proceed to fully comply with the 2019 transition date. It is not uncommon for changes and/or updates to UL and CSA standards to take 2 years and changes to ASHRAE standards can take up to 3 years. Until these standards are changed, it would be impossible for our manufacturers to fully transition all products, engineer all models, transition the purchasing of components and plan production.

The more common vending machine – one serving both snacks and beverages which utilizes a spiral mechanism for vending product and commonly called a “combination machine” – has yet to be produced because of the inability to find proper component parts that meet the standards to be used with a flammable refrigerant. We will expand further on this challenge later in this letter.

The industry is committed to moving from HFC’s to other refrigerants however it will take time to solve the current challenges. Those challenges include sourcing of essential components and product redesign and modifications to various product safety standards to allow hydrocarbon (HC) machines to be placed in the most common, highly trafficked locations.

Below are anonymized and aggregated responses to questions posed in your November 13th letter with input from our association and our vending machine manufacturing members.

Q1. Please provide additional information regarding your members’ experience testing and utilizing R-290 in vending machines.

- a. Have any models using R-290 been produced, displayed, and/or put into use? If so, please indicated the locations, when the equipment was first displayed and/or put into use, and if that equipment remains in place today?*

NAMA Answer: Some manufacturers have indicated they have developed prototype machines for testing and development work. One manufacturer has indicated that in August 2016 they placed thirty R-290 machines for a customer in Florida and South Carolina for testing purposes – these machines are beverage only and do not use the typical 40 -80 vend motors but rather use only 2 specialty motors to manipulate a robotic arm. The motors used for the robotic arm do not generate sparks and would not work in non-beverage applications utilizing the customary “spiral” vend format. Additionally, the test machines placed in service were limited by the UL placement restrictions. These machines are still in place in the market outside of the UL restricted areas.

- b. Do these models meet the Department of Energy (DOE) energy conservation standards and if not, are there plans to increase the energy efficiency?*

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P: 312.346.0370

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1600 Wilson Blvd., Suite 650
Arlington, VA 22209
P: 571.346.1900

WESTERN OFFICE

80 South Lake Avenue, Suite 538
Pasadena, CA 91101
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NAMA Answer: All manufacturers indicated that R-290 machines currently meet or will meet the DOE 2012 and 2019 requirements.

- c. How and where were such models produced? What actions would be required, and how much time would be needed, for those manufacturers to modify their current production methods to increase current demand?*

NAMA Answer: All manufacturers indicated that their R-290 machines/prototypes were manufactured in the United States. As mentioned above, the industry needs additional time to have all standards changed and components available for a smooth transition of all models of refrigerated vending machines. To manufacture R-290 vending machines commercially, the manufacturing facility must undergo significant changes to ensure that its manufacturing processes are capable of meeting customer demand/capacity needs as well as to demonstrate compliance with numerous industry safety regulations for the use and processing of flammable refrigerants. New production equipment must be equipped to handle flammable refrigerants and the work space must meet OSHA, NFPA, and NEC standards within these manufacturing facilities. Due to current conditions, it is not possible to accomplish these facility upgrades by January 2019.

- d. Do your members' have knowledge and experience of the use of R-290 or other hydrocarbons in refrigeration equipment other than vending machines? If so, could you identify whether there are components from such equipment that may be used in vending machines or what must be done to redesign such components for use in vending machines?*

NAMA Answer: Vending machines are composed of two basic systems: 1) the refrigeration system, and 2) the product vending system. Some manufacturers have experience with R-600 and R-290 refrigerators, freezers, and display cases and have evaluated them for solutions that can be utilized in the refrigeration system of a vending machine. Manufacturers noted the unique challenge (and cost) for vending is changing out brushed motors to brushless which make up the product vending system. The machines currently being tested are beverage-only machines with only two specialized motors – not the more typical glass-front machines with 40+ vending motors. Replacing 40 to 80 motors, instead of two, greatly increases machine cost and currently motors acceptable for this application do not exist in full scale production. It is estimated that brushless motors will cost between 350% - 400% higher than motors currently being used. This cost differential makes it non-viable for our industry. In further answer to your question, no, the experience from one vending machine to the glass-front units is not applicable. The challenge is not the manufacturer's knowledge of the issue, but the availability of reasonably priced component parts.

Q2: Can you provide additional information regarding the statement in your petition that there are some readily available components using R-290?

- a. What components for R-290 are readily available?*

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Chicago, IL 60606
P: 312.346.0370

EASTERN OFFICE

1600 Wilson Blvd., Suite 650
Arlington, VA 22209
P: 571.346.1900

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80 South Lake Avenue, Suite 538
Pasadena, CA 91101
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NAMA Answer: Manufacturers indicate that the components necessary for refrigeration are all available; however, as mentioned above the components specific to the vend application are not readily available in sufficient supply, if at all.

- b. What components for R-290 are not available? When would these be expected to become available? What will not be available by 2019?*

NAMA Answer: Brushless vend motors, micro switches, fuse holders, wiring harnesses and fuses are not currently available or are not in full scale production. Samples of some of these are expected by one manufacturer in June 2018. Receiving a sample in June 2018 does not provide adequate time to give manufacturers the ability to perform testing necessary to ensure long term reliability to complete a transition by January 2019. At least one manufacturer has been unable to confirm that these components would be fully developed, tested, and available, for commercial use by 2019.

A further complication related to components are the coin and banknote payment and processing equipment used on a vending machine, which use motors. In the case of the banknote acceptor the motors have a form factor that is a flattened cylinder. We are not aware of any supplier of brushless motors that have this shape available. Adapting the design of the banknote acceptor to use a motor in a circular form factor would require re-tooling of the gearbox at a minimum. However, manufacturers are not certain that this would work without re-tooling of the banknote path as well. Effectively banknote processing would need to be completely redesigned, which is not believed to be possible by the January 2019 compliance date.

One manufacturer utilizes a small spark generator for acoustic sensing to determine the quantity of coins available for payout as change for a consumer purchase. The acoustic system works using a sonar system to measure the height of a column of coins stored in a payout tube. The thickness of a dime is 1.3mm, at the typical speed of sound this distance is covered in 4 millionths of a second. In order to measure to this accuracy a sound generator that produces a fast pulse with minimal resonance is required. A small spark is an ideal sound source for this measurement. Finding an equivalent replacement sound source is an R&D activity of unknown duration and outcome.

- c. Can you describe the function of the two components mentioned in your petition – vend motors and vending machine controllers – in more detail and how the use of R-290 might affect the testing and verification of them?*

NAMA Answer: Vend motors operate under the control of the Vending Machine Controller and function to deliver purchased products. There are anywhere from 40 - 80 of these motors in each machine. These motors are brush type, DC motors. They turn the spiral to vend the product and create sparking when operated. These sparks cannot be tolerated in an R-290 machine. Currently there are no known brushless vend motors of this type on the market. Once brushless motors are available they will require a re-design and re-testing of the Vending Machine Controller which is the component that interfaces with the consumer and verifies payment, controls refrigeration, and signals the vend motors to vend a product. The R-290 machines currently being tested in the field

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20 North Wacker Drive, Suite 3500
Chicago, IL 60606
P: 312.346.0370

EASTERN OFFICE

1600 Wilson Blvd., Suite 650
Arlington, VA 22209
P: 571.346.1900

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80 South Lake Avenue, Suite 538
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do not contain these types of motors and the motors used in these beverage only machines would not be usable in a glass-front machine featuring several different types of products vended by a rotating spiral controlled by a vend motor.

Q3. Please explain how NAMA determined the basis for a 3-year extension in the change of status date, from 2019 to 2022. How was this date calculated? For example, how did it account for alternatives evaluation, equipment testing and certification, modifications at manufacturing facilities based on product types? Can the market transition sooner?

NAMA Answer: Currently, UL 541 prohibits vending machines from being placed in specific locations referenced earlier in this letter. This language will have to be amended before the industry can fully transition. Modification to UL 541 will also require changes to ASHRAE 15. To accomplish both of these it will likely require research, testing, and possible redesign which is anticipated to take more than two to three years to accomplish all of these standards changes. And once these changes are completed, UL has indicated that it could take several years for local officials to update various building codes. Following standards updates, machines would need to be produced in limited numbers, tested, and sent to UL/CSA for certification. Such a major change would result in large numbers of models requiring testing all at once and could make it difficult for safety certification bodies to complete all testing within 6-9 months. A three-year time frame is appropriate for this to happen and would allow component manufacturers to deliver brushless vend motors to manufacturers. These manufacturers would then have the appropriate time to test model platforms and designs.

Furthermore, it is absolutely essential that the proper technical training be conducted for anyone involved with the life-cycle of the equipment. Design engineers, technicians, manufacturing personnel and service technicians all must be thoroughly educated and trained to raise awareness and gain specific skill and knowledge pertaining to safe storage, handling, processing and servicing of HC systems. The industry needs time to work with customers to create awareness and to educate and train on how to safely work with this new refrigerant. As our industry is made up not only of large corporations but also thousands of independent operators to reach all of them effectively with such a significant change will take time and an extension of the current transition date will allow sufficient time.

Also, the 2022 date aligns with the equivalent European Union regulations and coincides with the expected redesign and availability of components.

Q4: Please provide additional information regarding your members' experience testing and utilizing R-744 in vending machines and other products they make or purchase.

- a. Approximately how many such units were produced/purchased by your members? Are they still in operation and if so, in which countries?*

NAMA Answer: Several manufacturers noted that they had no experience with R-744 while others noted that they had limited experienced. Manufacturers produced around 12,000 machines in the United States with most still in operation. R-744 (aka Carbon Dioxide) requires vending machines

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Chicago, IL 60606
P: 312.346.0370

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1600 Wilson Blvd., Suite 650
Arlington, VA 22209
P: 571.346.1900

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80 South Lake Avenue, Suite 538
Pasadena, CA 91101
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to be redesigned for much higher pressures than common HFC or HC refrigerants and requires a very specialized compressor, tubing, seals, valves, and pressure fittings.

- b. Which compressor manufacturer(s) offered R-744 compressors for vending machines in the past? Which was the last one that will be ceasing production as mentioned in the September 8, 2017 email?*

NAMA Answer: Several compressor manufacturers produced R-744 compressors for vending including: Sanden, Sanyo, Danfoss, Tecumseh, and Embraco. All have ceased production except Sanden, which stated it will be ceasing R-744 compressor manufacturing for the vending industry by March 2018 leaving **zero** companies manufacturing R-744 compressors for the vending industry. Additionally, no R-744 machines will meet the 2019 Department of Energy (DOE) energy conservation standards.

- c. Were there any performance-based or technical reasons why components or vending machines using R - 744 are no longer being produced?*

NAMA Answer: Efficiency is the largest performance and technical challenge for R-744 machines. The operating pressures for operating a R-744 system compared to a R-134a system is 10x greater. R-744 systems also require higher starting torque and thicker tubing. This means a machine using R-744 would be more expensive (because of materials cost) than R-134a and R-290 systems. In addition, there is concern of the long-term reliability of these systems (especially in hot climates) due to the incredibly high pressure required for cooling. These machines will not meet DOE standards. R-744 is not a viable alternative for the industry.

Q5: Please provide additional information regarding any experience evaluating or using R-450a, R-513a, or other blends containing hydrofluoroolefins (HFOs).

- a. Have your members conducted component or model tests with such refrigerants?*

NAMA Answer: Only one manufacturer indicated they have tested HFOs. All others believe that HFOs are not suitable for vending because (1) there are currently no manufacturers producing a full line of HFO compressors for vending, (2) the high cost compared to alternative refrigerants (R-290), and (3) the fact that HFOs will not be permitted in European markets because of their GWP. One manufacturer noted that an HFO machine could likely meet 2019 DOE standards but not a new ENERGY STAR standard (stricter than the 2014 standard). The fact that HFOs will not be permitted in Europe in the coming years is a large hurdle for HFO adoption – by using HFOs, manufacturers would have to develop at least two refrigeration lines – greatly increasing the cost of manufacturing.

- b. The September 8, 2017 email indicated that HFOs cost approximately \$14 per pound. Was this the cost of the HFO itself and if so, which one(s) (e.g., HFO-1234yf or HFO-1234ze(E))? Or was this the cost of a blend containing an HFO and if so, which one(s) (E.g. R-450a or R-513s)?*

NAMA Answer: One manufacturer received a quote of \$15.99 per pound of R-513a. For reference the current market price is less than \$4 per pound for R-134a. To the best of our knowledge, the blends, R1234yf, R1234ze, R450A and R513A are proprietary products where direct competition is limited. A second manufacturer noted these blends are five to six times more expensive than R-134a. Note that because of what was stated earlier, HFO blends are not a viable option for the industry.

- c. What steps would be required to test and approve compressors and other components for R-450a or R-513a? What steps would then be required to design and certify products and begin the manufacturing process? How long would these steps take?*

NAMA Answer: This is a complicated process. A manufacturer designs the refrigeration system around the available compressor. Once the compressor is selected the rest of the refrigeration system will need to be designed and sourced – and these components need to be compatible with the chosen chemical, operating pressure and energy efficiency. Additionally, fan motors and fans will need to be sized and specified to comply with performance and energy efficiency requirements. All of this needs to be done while maximizing efficiency and cooling. Rigorous testing under various operating conditions will need to be performed, including operating at high and low ambient temperatures. This entire process will likely require several design changes and repetition. Additional manufacturing lines will need to be designed and built. Lastly, a final machine will need to be approved by a safety certification body such as UL, CSA, ETL or others, and certified by ENERGY STAR. The entire process takes approximately 3 years. One manufacturer noted that an investment of this sort would be a waste of engineering dollars as products containing these chemicals would not be permitted in the EU and the compatible compressors are not available.

Q6. Besides HFC-134a, are any of the other 19 refrigerants that are changing status to unacceptable used in manufacturing vending machines, such as R-404a?

NAMA Answer: One manufacturer noted they also use R-404a. R-404A is a blend of 3 HFC refrigerants. As mentioned above, these refrigerants would not be allowed in Europe or other countries with similar climate change requirements.

Q7: Can you explain in more detail how the language from UL 541 Standard Supplement A6.2.3 (“UL 541”) as quoted in your petition affects today’s use of R-290?

- a. Your petition indicates that discussions with UL are on-going. Can you describe the discussions to date? What is the process and timeframe for concluding such discussion?*

NAMA Answer: Simply put the language in UL 541 requires that if a flammable refrigerant (R-290) is present in a vending machine, the installation instructions must state that the machine “shall not be intended for use in lobbies or locations of egress, such as a hallway or public corridor.” These are precisely the types of locations within these sites that have high traffic and transience throughout a workday or over time where consumers are looking for the choice and convenience

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Chicago, IL 60606
P: 312.346.0370

EASTERN OFFICE

1600 Wilson Blvd., Suite 650
Arlington, VA 22209
P: 571.346.1900

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80 South Lake Avenue, Suite 538
Pasadena, CA 91101
P: 626.229.0900

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of vending. These are the consumers that vending caters to and relies on to sustain its business model. Removing vending from “lobbies or locations of egress such as hallways or public corridors” would essentially eliminate vending as a choice for consumers and would be detrimental to the industry and consumers. UL 541 if left unchanged would drastically reduce the number of potential locations to site a vending machine and certainly cause local inspectors to seriously question the placement of every location. In doing this the manufacturers might be representing to potential customers that HC vending machines do not provide optimal safety in “typical” vending machine locations and the placement of machines will be severely limited. By not permitting “prime” placement the vending industry will be adversely impacted due to diminished sales in these locations.

Vending is based on convenience and if machines are not conveniently located they will not be utilized. The industry and NAMA have had extensive conversations with UL who state that their language is directly based off ASHRAE Standard 15, Section 7.5.1.2. To the best of our knowledge vending machines are the only product with this type of placement restriction. We have discussed with UL the process required to change both ASHRAE and UL and have discussed the timelines needed to conduct research, or submit queries, the process for discussions with stakeholders and committee members. At this stage, we are not in sight of a conclusion with UL because we first must seek clarification and seek a change in ASHRAE 15. UL staff has stated that they will not support a change to this standard without a change in ASHRAE first. Formal clarification has been requested from ASHRAE and is expected at their January 2018 meeting.

- b. Our understanding is that anyone can request a modification to a UL standard at any time. Has this been done or do you know of any plans to do so?*

NAMA Answer: This is our understanding as well. However, merely because a modification has been requested does not mean it will be granted. We have been told without a change to ASHRAE, the UL Standards Technical Panel is unlikely to make a change. Additionally, we have been told without additional research and design changes UL staff may not support a change to ASHRAE or the UL standard.

- c. You describe UL 541 requirements regarding locations where “vending machine(s) having flammable refrigerants shall not be intended for use” as “particularly burdensome.” Why is this so? How would manufacturers and installers implement this requirement if the UL standard is not changed by your requested 2022 change of status date?*

NAMA Answer: If after research and requests for modification UL and ASHRAE refuse to alter their placement restrictions or provide an exemption, the industry will either be forced to look at alternative refrigerants or keep older products in circulation longer. Given the changes taking place in the refrigerants space in residential and commercial applications utilizing flammable refrigerants we are conditionally optimistic that we can successfully change the standard so that R-290 vending machines can be placed in the most highly trafficked locations but this will take time.

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- d. *Are there different standards that are used for vending machines exported or placed in non-U.S. markets? What are those standards? How are they alike or different from UL 541? Do they have the same requirements limiting intended use of vending machines employing a flammable refrigerant? Have those standards addressed your concerns and if so how were those concerns resolved?*

NAMA Answer: In other parts of the world, the IEC standard is followed for safety compliance. We are not aware of any other standard or building codes in place anywhere in the world that restricts the placement location of a vending machine containing a flammable refrigerant. This restriction is solely limited to the UL and CSA standards and thus to the United States and Canada.

Thank you very much for the opportunity to provide additional information. As we have outlined the vending industry is committed to transitioning from R-134a to a new refrigerant. Because of various impediments, several chemicals available to the industry will not work. Compressor manufacturers do not exist for HFOs or R-744; R-744 requires too much energy and HFOs will not be permitted in Europe. Currently, R-290 is the only chemical that would work – however components still need to be designed and available for their use and the safety standards placement burdens must be resolved. We believe the best course of action is to provide the industry additional time to make a safe and efficient transition.

Please let me know if you have any additional questions.

Regards,

Jason S. Eberstein
Director, State & Federal Government Affairs

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Chicago, IL 60606
P: 312.346.0370

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1600 Wilson Blvd., Suite 650
Arlington, VA 22209
P: 571.346.1900

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80 South Lake Avenue, Suite 538
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