ARROWHEAD PRODUCTS

August 7, 2025

Hydrofluorocarbon Reduction
California Air Resources Board
1001 I Street,
Sacramento, CA 95814

Reference: Attestation to Arrowhead Products' HFC Variance Application

To whom it may concern,

I, Richelle Stewart, in my capacity as Space Programs Director at Arrowhead Products hereby attest to the following claims made in Arrowhead Products' application requesting a variance from certain portions of the "Prohibitions on Use of Certain Hydrofluorocarbons in Stationary Refrigeration, Chillers, Aerosols—Propellants, and Foam End-Uses," which was originally submitted to CARB on May 12, 2025:

1. **Arrowhead Products is bound by the provisions of its current contract with NASA to exclusively use Utah Foam STM 0878, which contains HFC-245fa, for manufacturing ducts in support of NASA's SLS program.**
   Below outlines the contractual flow-down for this requirement:
   Government Contract – NASA
   ↓
   Boeing Supplier Statement of Work
   ↓
   Boeing Source Control Drawings
   ↓
   Boeing Material Specification for Foam, Polyurethane, Pour-in-Place
   ↓
   Arrowhead Products Purchase Order

2. **Arrowhead Products is unable to certify any alternative foam beyond what is outlined in the existing contract with NASA.**
   Boeing and NASA are responsible for qualifying a lower risk HFC-245fa substitute; Arrowhead Products is unable to initiate the process. However, while qualification of a new substitute is outside of Arrowhead Products' control, we are committed to an expeditious transition to NASA's lower risk substitute upon confirmation that it is qualified for use.

3. **To Arrowhead Products' knowledge, a NASA-approved substitute for HFC-245fa does not currently exist, and the timeline for certifying alternative materials can take up to 8 years once a viable substitute to HFC-245fa is identified. Arrowhead Products is not involved with NASA's certification process and thus is not able to use a lower risk substitute until NASA approves a viable alternative.**
   The certification timeline is conservatively estimated to take eight (8) years once a viable substitute is identified. An overview of the certification timeline is provided below:
   - Phased Development Approach - ~2 years.
   - Qualification - ~2 years.
   - Engineering Documentation Updates - ~1.5 years.
   - Scale Up, Verification, and Validation - ~2.5 years.

This attestation is based on current contractual obligations and information available at the time of this statement. I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Sincerely,

Richelle Stewart
Digitally signed by Richelle Stewart
Date: 2025.08.07 11:26:16 -07'00'

Richelle Stewart 8/7/2025
Space Programs Director

Annex 1 – Requirement Flow-Down with Document/Specification Numbers

This response contains confidential information protected as trade secret under California Public Records Act and may not be disclosed to the public pursuant to Section 7924.510 of the California Government Code.

[redacted]

ARROWHEAD PRODUCTS

July 14, 2025

Hydrofluorocarbon Reduction
California Air Resources Board
1001 I Street,
Sacramento, CA 95814

Reference: Arrowhead Products' Variance Application Revised – REDACTED CLEAN VERSION

To whom it may concern,

We are writing to provide an updated version of an application requesting a variance from requirements in Sections 95374 and 95375 of the "Prohibitions on Use of Certain Hydrofluorocarbons in Stationary Refrigeration, Stationary Air-conditioning, and Other End-Uses" regulation. In this revised application, we have attempted to address comments received from CARB on our earlier submittal.

This application "contains confidential information protected as trade secret under California Public Records Act and may not be disclosed to the public pursuant to Section 7924.510 of the California Government Code." Accordingly, Arrowhead Products is submitting three versions – one unredacted version for review by CARB staff only, one tracked unredacted version for review by CARB staff only with edits made to the original submittal clearly shown, and one redacted version suitable for review by the public. The enclosed submittal contains the redacted clean version. The other two versions will be submitted separately.

We thank you for your time and if you should have any questions or concerns, please contact Eric Sramek at 562-217-1199 or esramek@arrowheadproducts.net, or Richelle Stewart at 714-822-2741 or rstewart@arrowheadproducts.net.

Sincerely,

Eric Sramek *7/14/2025*

Eric Sramek
Director, EH&S
562-217-1199
esramek@arrowheadproducts.net

Richelle Stewart Digitally signed by Richelle Stewart
Date: 2025.07.15 13:01:30 -07'00' *7/14/2025*

Richelle Stewart
Space Programs Director
714-822-2741
rstewart@arrowheadproducts.net

VARIANCE APPLICATION TO THE CALIFORNIA AIR RESOURCES BOARD

Respectfully Submitted by Arrowhead Products

July 14, 2025

A. Administrative Information

Name of Applicant: Arrowhead Products (AP)

Ownership Status: Subsidiary of Industrial Manufacturing Company, LLC

Address: 4411 Katella Ave, Los Alamitos, CA, 90720

Telephone Number: Eric Sramek: 562-217-1199; Richelle Stewart: 714-822-2741

E-mail Address: esramek@arrowheadproducts.net; rstewart@arrowheadproducts.net

B. Please describe your business activity or product description

AP, a subsidiary of Industrial Manufacturing Company, LLC, is a leading manufacturer of complex metallic and composite systems for aviation, defense, and space. AP designs, develops, and manufactures aerospace ducting systems and rocket propulsion lines intended to serve commercial, military, and US space launch vehicles. AP is also committed to manufacturing products in a sustainable manner. Current onsite initiatives to promote sustainability include tracking greenhouse gas (GHG) emissions based on energy usage, exploring the possibility of adding onsite solar panels, and minimizing emissions from their manufacturing process.

Currently, AP is contracted by the Boeing Company (Boeing) to manufacture ducts that are used in the National Aeronautics and Space Administration's (NASA) Space Launch System (SLS) to support the Artemis campaign[1]. The Artemis campaign is a national priority related to space exploration which has the following mission statement[2]:

> *With NASA's Artemis campaign, we are exploring the Moon for scientific discovery, technology advancement, and to learn how to live and work on another world as we prepare for human missions to Mars. We will collaborate with commercial and international partners and establish the first long-term presence on the Moon.*

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[1] NASA. 2024. Space Launch System. Available at: https://www.nasa.gov/humans-in-space/space-launch-system/. Accessed: April 10, 2025.

[2] NASA. 2025. Artemis. Available at: https://www.nasa.gov/humans-in-space/artemis/. Accessed: April 10, 2025.

As a manufacturer of materials that are used on NASA missions, AP is committed to engineering materials that can withstand the demands of launch environments and to manufacturing reliable parts ensuring mission success. To accomplish this, AP is required by NASA to use materials that have undergone vigorous testing to ensure they can withstand the unforgiving environments associated with launching the SLS. For insulation, this includes the use of qualified HFC-245fa. Throughout this application, the term "qualified" means a material that has met NASA's certification requirements for use in the SLS. Therefore, "qualified HFC-245fa" is approved by NASA as a material that is qualified to be used in the SLS.

C. Relationship to the product

AP uses Utah Foam Products 503-2.5-45P-R.1, also referred to as Utah Foam STM0878 pour foam (STM0878), when manufacturing ducts to provide insulation for the SLS. It is a two-part foam insulation and contains 16% ± 2% of HFC-245fa.

D. Specific Sections of the Regulation from which a variance is requested.

AP is requesting a variance from the following parts of the California Air Resources Board (CARB) Prohibitions on Use of Certain Hydrofluorocarbons in Stationary Refrigeration, Chillers, Aerosols—Propellants, and Foam End-Uses[3]:

- § 95374 – Table 1, Table 2, and Table 3: End Use and Prohibited Substances
- § 95375 – Prohibitions, Exceptions, Registration, Recordkeeping, Reporting, Labeling, and Disclaimer Requirements

If a variance is granted to allow for 50 gallons of HFC-245fa usage by January 1, 2036, AP plans to voluntarily track HFC-245fa usage to demonstrate that actual usage is below 50 gallons of HFC-245fa.

E. Provide an explanation and description of the reasons for seeking a variance.

AP is requesting to continue using HFC-245fa to fulfill the current prime contract in place with NASA (Contract ID: 80MSFC20C0052). A NASA-approved substitute for qualified HFC-245fa currently does not exist, and the timeline for certifying alternative materials takes close to 8 years. The below sections provide more insight into NASA's requirements to continue using

[3] California Code of Regulations. 2025. Prohibitions on Use of Certain Hydrofluorocarbons in Stationary Refrigeration, Chillers, Aerosols—Propellants, and Foam End-Uses. Available at: https://govt.westlaw.com/calregs/Browse/Home/California/CaliforniaCodeofRegulations?guid=I07F770405A2111EC8227000D3A7C4BC3&originationContext=documenttoc&transitionType=Default&contextData=(sc.Default). Accessed: April 10, 2025.

qualified HFC-245fa in the SLS and existing federal regulations that support the continued usage of HFC-245fa in space vehicles.

NASA Requirements to Use Qualified HFC-245fa

The ducts that AP manufactures for the NASA SLS support propellant loading to the engines, which is crucial to the success of the Artemis campaign. The Thermal Protection System (TPS) that incorporates the qualified HFC-245fa maintains these ducts' temperature and pressure during launch and aids in preventing ice formation on the surface of the vehicle and inside the engine section. NASA requires the use of pour foam insulation systems in insulating materials, such as the ducts that AP manufactures for the SLS, to withstand the rigors of launch environments.

NASA requires the use of qualified Utah Foam STM0878 pour foam in the manufacturing process because HFC-245fa has proven durability to adequately insulate crucial parts associated with the SLS, such as the core stage. STM0878 foam was previously qualified for the SLS under the *Qualification Test Report, D950-11520-1, Material Qualification of Utah Pour Foam 503-2.5-45P-R.1 (DPM13158) for Space Launch Systems.* The SLS core stage functions to provide propellant to the engines and consists of two cryogenic propellant tanks and the associated cryogenic supply lines. The specific parts that AP manufactures transport hydrogen and oxygen, both in gaseous and liquid form, to key parts of the engine. Qualified HFC-245fa is required as part of the insulation specification by NASA to withstand temperature variations, pressure variations, deflections, and random shocks/vibrations that the SLS may be subject to during takeoff.

At the time of this application, NASA has not identified and approved a technologically feasible alternative substitute for qualified HFC-245fa due to the long certification timeline required to approve an alternate material. The certification timeline is conservatively estimated to take 8 years once a viable substitute is identified. An overview of the certification timeline is provided below:

1. Phased Development Approach – Involves development testing to characterize durability and an analysis of the expanded processing window. **Approximately 2 years.**

2. Qualification – Testing from the "Phased Development Approach" is repeated with additional oversight to generate material property data with the requisite pedigree for flight. **Approximately 2 years.**

3. Engineering Documentation Updates – Involves making the required updates to drawings, models, analysis, design, specifications, build paper, training, and other relevant engineering documentation. **Approximately 1.5 years.**

4. Scale Up, Verification, and Validation – Begins with full scale process execution and first inspection. Followed by the development and qualification of foam applications process to have a robust, repeatable process to apply foam to flight hardware that meets engineering requirements. **Approximately 2.5 years.**

Due to delays and supply chain issues, NASA will not be able to approve a viable foam substitute in the near future. In addition to this, as stated above, the process to approve a qualified substitute once one is identified is likely to take 8 years. Qualification testing involves rigorously testing various components and systems of the SLS rocket, including the TPS, to verify they perform as predicted in various scenarios, both expected and abnormal. The TPS must meet specific performance requirements to provide adequate thermal protection, particularly for the core stage, including the fuel tanks, and for preventing propellant boil-off. This includes testing for insulative properties, such as low conductivity and high capacitance, and considering how factors like ice/frost formation and initial temperatures affect performance. Testing includes analyzing how the TPS performs in the launch environments, such as ambient conditions and cryogenic temperatures, in addition to aerodynamics, vibrations and the external temperature fluctuations.

Current vendors for foam containing qualified HFC-245fa have committed to supplying NASA with necessary materials past January 1, 2025, which is the date that CARB prohibitions went into effect for foam used in space- and aerospace-related end uses[4].

Federal Regulations Allowing for the Use of HFC-245fa in Space Vehicles

Upon realizing that no viable alternatives exist for the STM0878 foam that contains HFC-245fa, NASA requested an exemption from the United States Environmental Protection Agency (USEPA) to continue using pour foam in space vehicles. This exemption is granted in the final rule for Title 40 CFR Part 84: Phasedown of Hydrofluorocarbons (HFCs): Restrictions on the Use of Certain HFCs Under the American Innovation and Manufacturing (AIM) Act of 2020, which states in 40 CFR 84.54(a)(15) that "spray and pour foams that are for use in space vehicles…are not subject to a use restriction"[5]. USEPA provides the following justification for this exemption when it initially went into effect back in 2023[6]:

> *This rule also excludes spray and pour foams used in space vehicles, as defined in 40 CFR 84.3 from the use restrictions.* ***Such equipment faces unparalleled and highly demanding operating conditions and requires long lead-times for its operation to be certified.*** *This approach is consistent with EPA's CAA regulations where space vehicles were either exempted or given additional time to transition to substitute foam blowing*

[4] California Code of Regulations. 2025. Prohibitions on Use of Certain Hydrofluorocarbons in Stationary Refrigeration, Chillers, Aerosols—Propellants, and Foam End-Uses. Available at: https://govt.westlaw.com/calregs/Browse/Home/California/CaliforniaCodeofRegulations?guid=I07F770405A2111EC8227000D3A7C4BC3&originationContext=documenttoc&transitionType=Default&contextData=(sc.Default). Accessed: April 10, 2025.

[5] Code of Federal Regulations. 2024. Title 40 CFR 84: Phasedown of Hydrofluorocarbons: Management of Certain Hydrofluorocarbons and Substitutes Under the American Innovation and Manufacturing Act of 2020. Available at: https://www.federalregister.gov/documents/2024/10/11/2024-21967/phasedown-of-hydrofluorocarbons-management-of-certain-hydrofluorocarbons-and-substitutes-under-the. Accessed: April 10, 2025.

[6] Code of Federal Regulations. 2023. Title 40 CFR 84: Phasedown of Hydrofluorocarbons: Management of Certain Hydrofluorocarbons and Substitutes Under the American Innovation and Manufacturing Act of 2020. Available at: https://www.federalregister.gov/documents/2023/10/24/2023-22529/phasedown-of-hydrofluorocarbons-restrictions-on-the-use-of-certain-hydrofluorocarbons-under-the. Accessed: April 10, 2025.

agents. EPA proposed to exclude spray foams used in this application but has learned that pour foams requiring the use of HFCs are also used in space vehicles. EPA is exempting the use of both foam types in space vehicles from the restrictions in this final rule.

While considering this application for a variance, AP requests that the justification for providing an exemption for pour foam in space vehicles at the federal level is considered. STM0878 is used by NASA since it can withstand the demanding operating conditions of space exploration. When NASA approves a lower risk substitute for STM0878, AP will transition to using that substitute. As current requirements for manufacturing ducts for the SLS require the use of STM0878, AP is requesting this variance to fulfill NASA's prime contact or until a viable, lower-risk substitute is approved.

F. Type of Variance Requested

AP is requesting a variance for reasons of impossibility – the applicant has exercised best efforts but is still unable to comply with the regulatory requirements (for reasons beyond his or her control despite exercising foresight to prevent the noncompliance).

G. If seeking an Impossibility variance please provide clear and convincing evidence demonstrating how all of the following Impossibility variance criteria have been met:

1. A lower risk substitute is not currently or potentially available.

Because of the highly demanding operating conditions that space parts are subject to, there are an extremely limited number of alternatives that could be used in space vehicles. The only potentially viable substitute that NASA has identified for STM0878 that does not contain HFC-245fa is Opteon 1100. Opteon 1100 is made in China and remains untested for aerospace-related use by NASA. Because NASA has not yet identified or approved a lower risk substitute for use, AP will be required to continue using STM0878, which contains HFC-245fa, until NASA approves a lower risk substitute.

The process to approve a lower risk substitute will take approximately 8 years which is discussed further in AP's response to Part E. AP is accounting for this timeline in the variance request.

2. An exemption will not increase the overall risk to human health or the environment

AP anticipates using 50 total gallons of HFC-245fa as part of this variance request which has the potential to emit 64.33 metric tons (MT) of carbon dioxide equivalent (CO_2e). As discussed in Part N, 50 gallons of HFC-245fa usage is a conservative estimate that factors in 13.44 gallons for manufacturing parts as part of the remaining contract, 3.46 gallons for repairing parts that were already made, 5.12 gallons as part of an active request for proposal (RFP), and 27.98 gallons conservatively included to allow AP to support NASA's next phase of the SLS. Therefore, the 64.33 MT CO_2e estimate, which is unlikely to increase risk to human health or the environment, is a conservative estimate of AP's usage. To minimize the potential to harm the environment, AP is committed to obtaining 64.33 MT CO_2e of verified carbon offsets to cover potential emissions requested as part of the variance. Verified carbon offsets are further discussed in Part P.

AP's manufacturing process builds in protections to minimize risk to human health. STM0878 is not sprayed, but rather poured into closed mold, which helps minimize residual HFC-245fa exposure. All AP staff who actively work on molding are also provided with proper personal protective equipment (PPE). After the foaming cycle is complete, tape is applied to portions of the closed mold to reduce HFC-245fa exposure to the environment. Foamed hardware is typically shipped outside of the State of California within 180 days of foaming. These aspects of the manufacturing process aim to reduce the potential risk of HFC-245fa emissions to human health and the environment.

3. The Applicant has used best efforts to anticipate and address the impossibility and any potential noncompliance.

As discussed in Part E, AP is required by NASA's prime contract to use qualified Utah Foam STM0878 pour foam, which contains HFC-245fa. Therefore, it was impossible for AP to transition to a lower risk substitute prior to California's January 1, 2025, prohibition date for aerospace-related applications for foam end-uses.

STM0878 is required as part of the insulation specification by NASA to withstand temperature variations, pressure variations, deflections, and random shocks/vibrations that the SLS may be subject to during takeoff. AP is unable to use substitutes until NASA approves a viable alternative which, as discussed previously, is anticipated to take a minimum of 8 years.

When NASA approves a viable substitute, AP is committed to quickly transitioning to using the lower risk substitute as part of its manufacturing process.

H. If seeking a Force Majeure Event variance please provide clear and convincing evidence demonstrating how all of the following Force Majeure variance criteria has been met

AP is not seeking a Force Majeure Event variance; therefore, a response to Part H is not provided.

I. Please attach supporting documentation for attributing noncompliance to Impossibility or a Force Majeure Event. Supporting documentation must be written in English. Please list the supporting documentation that is attached to this application.

The following documentation is provided as appendices to support the variance request:

- Appendix 1: Excerpt from Title 40 CFR 84 explaining USEPA's exemption for spray and pour foam used in space vehicles.

- Appendix 2: Utah Foam Products Quality Control Certificate.

- Appendix 3: Pathway for Consideration of HFC-245fa Alternatives.

J. Provide a description of all efforts made to timely fulfill the requirements of the section(s) from which a variance is being requested.

Please refer to Part E and Part G which provide detailed responses to this question.

K. Please provide the length of the variance requested as well as the earliest date when compliance will be achieved.

AP is requesting a variance with an expected end date of January 1, 2036. This date is anticipated to include 50 gallons of HFC-245fa usage beyond the January 1, 2025 prohibition date for aerospace-related applications for foam end-uses.

While AP does not anticipate using HFC-245fa beyond January 1, 2036, AP is required to fulfill the terms of their current prime contract with NASA. As part of this contract, AP may be asked to extend the contract for subsequent phases of the SLS. 50 gallons of HFC-245fa is a conservative estimate of total usage that factors in manufacturing parts under the remaining contract, repairing parts, and future work that may be required for NASA. This means that any possible change in end date would still result in AP using less than 50 gallons of HFC-245fa.

Although NASA has not yet identified a viable substitute for STM0878, a lower risk substitute could become a viable replacement for STM0878 within AP's 11-year variance timeline if NASA identifies and qualifies a suitable candidate. Because Boeing and NASA are the responsible parties for qualifying a lower risk HFC-245fa substitute, AP is unable to initiate the process to test and qualify a new substitute. The 11-year timeline proposed by AP takes these dependencies into consideration (including NASA's 8 year timeline for qualifying a substitute) to ensure compliance can be met by January 1, 2036. While qualifying a new substitute is outside of AP's control, AP is committed to working expeditiously to transition to a lower risk substitute when NASA confirms that a lower risk substitute can be used as part of the SLS. In the event that AP anticipates using HFC-245fa beyond January 1, 2036, to fulfil the requirements of NASA's contract, AP will inform CARB as soon as possible and seek out all required approvals.

L. Provide a compliance plan which describes in detail how, if a variance is granted, compliance will be achieved as expeditiously as possible including all of the following:

i. The method by which compliance will be achieved

Although AP is requesting a variance until January 1, 2036 to use 50 additional gallons of HFC-245fa, compliance may be achieved earlier once NASA approves a lower risk substitute to replace STM0878 in the manufacturing process.

ii. Milestone dates

As discussed in Part P, AP intends to purchase 64.33 MT CO_2e worth of carbon offsets within one year of being granted a variance to account for GHG emissions from the continued use of qualified HFC-245fa.

Milestone dates for identifying a substitute are fluid since identifying a lower risk substitute to replace STM0878 is reliant on NASA's approval.

iii. Milestone achievements

Two milestone achievements involve the purchase of voluntary carbon offsets to account for the continued usage of HFC-245fa, and the completion of the prime contract with NASA which involves the usage of up to 50 additional gallons of HFC-245fa.

A potential milestone achievement would be transitioning to a lower risk substitute which is contingent on NASA identifying a viable alternative.

M. Provide a description of the damage or harm that will result to the Applicant from immediate compliance with the regulatory requirements, including if compliance would result in an extraordinary economic hardship, such as closure of the entire facility or loss of a large portion or the revenue:

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The total revenue from AP's prime contract with NASA is estimated to be [redacted]. If a variance is not granted, AP estimates incurring a significant financial loss due to the inability to manufacture parts currently on contract. This amount could further increase if NASA requests additional work as part of subsequent stages of the SLS. This amount does not include the economic loss that NASA and other SLS contractors will face. Given that approving this variance request will only result in 64.33 MT CO_2e emissions, the cost per ton loss if a variance is not granted will be significant.

On top of this, the inability to operate and the lost inventory of pre-purchased HFC-245fa will add to this loss. The inability to use qualified HFC-245fa will cause significant delays to AP, NASA, other SLS contractors, and federal space exploration goals.

N. If applying for an Impossibility variance please provide quantification of current Greenhouse Gas (GHG) emissions resulting from normal business-as-usual operations as it directly relates to the continued use of any substance in end-uses listed in Table 1, section 95374 (a); Table 2, section 95374 (b); Table 3, section 95374 (c); or Table 4, section 95374 (d). This includes quantification of the direct GHG emissions resulting from refrigerant leaks or HFC emissions and indirect GHG emissions resulting from energy use (where applicable), with all calculations, based on the average lifetime of the equipment or product that will continue to use prohibited substances. Applicant must include all calculations used to calculate GHG emissions estimates, including emission factors (i.e., charge size as defined in section 95373, leak rate as defined in 40 C.F.R. Part 82.152, and refrigerant used over the average lifetime of the equipment, system, or product). Please see the bottom of this application template for an example calculation.

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AP conservatively estimates that 50 gallons of qualified HFC-245fa are needed to ensure full support of the SLS contract. As shown in **Table 1**, this amount accounts for parts on NASA's prime contract that still need to be made, parts that may be sent back for reapplication, potential parts that may be needed in the future based of ongoing RFPs, and an additional work buffer to cover any remaining contract needs for future stages of the SLS.

Table 1: Anticipated HFC-245fa Usage

Use Sector	Required HFC-245fa (gal)
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
Total	50.00

A brief description of the process used to calculate gallons of HFC-245fa is described in this section. AP uses a two-part foam insulation composed of Isocyanate (Component A) and Polyol (Component B) at a 1.2:1 ratio. According to the SDS, Component B contains 10-20% HFC-245fa. Based on AP's usage records, the actual percentage of HFC-245fa ranges from 16 ± 2%. To calculate the amount of HFC-245fa needed in gallons, the total amount of foam insulation was first partitioned into Component B using the volumetric mixing ratio, and then into the amount of pure HFC-245fa using a component weight of 18%. The 50-gallon estimate was calculated, and converted into total pounds using the following equation:

$$\text{HFC}_{245\text{fa}}\ (\text{lb}) = \text{Total Insulation (gal)} * \text{Component B Ratio} * \%\ \text{HFC}_{245\text{fa}} * \text{Density HFC}_{245\text{fa}}\ \left(\frac{\text{lb}}{\text{gal}}\right)$$

Where the component B ratio is 1.2:1, the % HFC-245fa in component B is conservatively assumed to be 18%, and the density of HFC-245fa is assumed to be 11.02 lb/gal[7].

Following the protocol recommended by CARB in their variance application template[8], AP has calculated GHG emissions (CO_2e equivalent) that will result from the use of 50 gallons of qualified HFC-245fa. GHG emissions are based on the average lifetime, average annual leak rate, and average end-of-life loss rate of the foam end use sector.

Emissions Due to Annual Leakage:

Emissions of 50 gallons of HFC-245fa (total lbs.) due to annual leakage are estimated using the following equation:

$$\text{Leakage Emissions (lb)} = \text{HFC}_{245\text{fa}}\text{ (lb)} * \text{ equipment lifetime (yr)} * \%_{\text{annual leak rate}}$$

Results from this portion of the calculation and notes about assumptions are included in **Table 2**.

Table 2: Emissions Due to Annual Leakage of HFC-245fa

Use Sector	HFC-245fa Total Usage (lb)	Average Lifetime (yr)[1]	Average Annual Leak (loss) Rate[2]	Average Annual Leak Rate Emissions (lb)
[redacted]	[redacted]	10	1%	[redacted]
[redacted]	[redacted]			[redacted]
[redacted]	[redacted]			[redacted]
[redacted]	[redacted]			[redacted]
Total lb. HFC-245 emitted due to annual leakage				**55.08**

Notes
1. Average lifetime of HFC-245fa is provided by AP.
2. Average annual leak loss rate taken from CARB[9]

End-of-Life Emissions:

Emissions of HFC-245fa can also occur at the end of the product's life. End-of-life emissions corresponding to 50 gallons of HFC-245fa (total lbs.) are estimated using the following equation:

[7] Honeywell. 2018. Honeywell Enovate 245fa Technical Information. Available at: https://prod-edam.honeywell.com/content/dam/honeywell-edam/pmt/oneam/en-us/blowing-agents/documents/pmt-am-enovate245fa-datasheet.pdf. Accessed: April 18, 2025.
[8] CARB. 2025. Variance Application Template. Available at: https://ww2.arb.ca.gov/our-work/programs/california-significant-new-alternatives-policy-snap/variances/applications. Accessed: April 18, 2025.
[9] CARB. 2018. Appendix B: Emissions Estimates. Available at: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2018/casnap/isorappb.pdf. Accessed: April 18, 2025.

$$\text{End of Life Emissions (lb)} = \text{HFC}_{245\text{fa}}\ \text{(lb)} * \%_{\text{end-of-life leak rate}}$$

Results from this portion of the calculation and notes about assumptions are included in **Table 3**.

Table 3: End-of-Life Emissions from HFC-245fa			
Use Sector	**HFC-245fa Total Usage (lb)**	**Average Loss Rate at End-of-Life[1]**	**HFC-245fa End-of-Life Emissions (lb)**
[redacted]	[redacted]	15%	[redacted]
[redacted]	[redacted]		[redacted]
[redacted]	[redacted]		[redacted]
[redacted]	[redacted]		[redacted]
Total lb. HFC-245 emitted due to end-of-life emissions			**82.62**
Notes 1. Average loss rate at end-of-life taken from CARB[10]			

Total Emissions:

After calculating the total pounds of HFC-245fa emissions from annual leakage and end-of-life emissions, the following equation is used to estimate the total CO_2e emissions:

$$\frac{\left(\text{End of Life Emissions (lb)} + \text{Leakage emissions (lb)}\right) * \text{GWP}}{2204.62\,\frac{\text{lb}}{\text{metric ton}}} = CO_2e\ (metric\ ton)$$

Total CO_2e emissions from granting a variance for the usage of 50 lb of HFC-245fa are shown in **Table 4**.

Table 4: Total CO_2e emissions from 50 gallons of HFC-245fa.					
Use Sector	**HFC-245fa Leakage Emissions (lb)**	**HFC-245fa End-of-Life Emissions (lb)**	**HFC-245fa Total Emissions (lb)**	**GWP[1]**	**Total Emissions CO_2e (metric ton)**
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]		[redacted]
[redacted]	[redacted]	[redacted]	[redacted]		[redacted]
[redacted]	[redacted]	[redacted]	[redacted]		[redacted]
Total	55.08	82.62	137.70	--	**64.33**

[10] Ibid.

Notes
1. Global Warming Potential (GWP) of HFC-245fa taken from the summary table of GWPs used for the California Air Resources Board (ARB) current emission inventory[11].

Based on these emissions estimates, granting AP a variance involving the use 50 gallons of qualified HFC-245fa for manufacturing space parts for the NASA SLS **will result in emissions of 64.33 MT CO_2e**.

It should be noted that the calculation parameters used for these emission calculations are very conservative. Although the estimated lifetime of the parts foamed in HFC-245fa is estimated to be 10 years, the foam hardware typically resides in California for 180 days after being foamed. Most parts are also wrapped in a protective cover after being foamed, so the average annual leak rate is expected to be much lower. Additionally, the GWP of 1030 used for HFC-245fa, which is recommended by CARB, is based on the International Panel on Climate Change's (IPCC) fourth Assessment Report (AR4)[12]. In the fifth version of this report (AR5), a lower GWP for HFC-245fa of 858 is published[13]. If the AR5 GWP is used, CO_2e emissions would be estimated at a lower value of 53.59 MT CO_2e a year. However, for the sake of a conservative estimate, AP assumes the value of 64.33 MT CO_2e in this application.

O. Provide a description of any negative impacts to human health or the environment that may result from the granting of a variance.

AP acknowledges that HFC and other greenhouse gas emissions cause negative impacts to human health and the environment.

AP's requested variance will produce the lowest amount of CO_2e emissions compared to publicly available approved variance applications[14]. Since AP will obtain carbon offsets for 64.33 MT of CO_2e, which is based on a series of conservative assumptions about the amount of GHG emissions, AP anticipates purchasing a higher number of offsets than anticipated GHG emissions.

AP is committed to minimizing impacts to human health and the environment by following the mitigation plan discussed in Part P. Operational procedures to minimize the risk to human health are discussed above in Part G.

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[11] CARB. 2025. GHG Global Warming Potentials. Available at: https://ww2.arb.ca.gov/ghg-gwps. Accessed: April 18, 2025.
[12] Ibid.
[13] CARB. 2025. High-GWP Refrigerants. Available at: https://ww2.arb.ca.gov/resources/documents/high-gwp-refrigerants. Accessed: April 18, 2025.
[14] CARB. 2025. Applications. Available at: https://ww2.arb.ca.gov/our-work/programs/california-significant-new-alternatives-policy-snap/variances/applications. Accessed: April 18, 2025.

P. Provide a mitigation plan that demonstrates how you will reduce excess GHG emissions to a level equal to or below what would have been emitted had you been in compliance and how you will mitigate any negative impacts to human health or the environment. You must include all calculations used to calculate GHG emission estimates including emission factors (i.e., charge size as defined in section 95373, leak rate as defined in 40 C.F.R. Part 82.152, and refrigerant used over the average lifetime of the equipment, system, or product). This may include an analysis of prohibited substances, efforts to reduce leaks or venting of prohibited substances, and options to recycle or destroy high-Global Warming Potential refrigerants

To mitigate excess GHG emissions from the usage of 50 gallons of HFC-245fa, AP will obtain 64.33 MT CO_2e of offsets from a verified provider. Calculations showing how the 64.33 MT CO_2e estimate is determined are shown in Part N.

64.33 MT CO_2e is a conservative number that considers all GHG emissions from HFC-245fa and does not consider the difference between GHG emissions from continued usage versus GHG emissions from a substitute. Therefore, AP believes obtaining offsets in this amount will bring GHG emissions to a level of compliance. Additional conservative assumptions that were factored into the calculations include:

- The lifetime of HFC-245fa is assumed to be 10 years; however, foam hardware is typically shipped out of California within 180 days after foaming.
- Most parts are wrapped in a protective cover after being foamed which has the potential to lower the annual leak rate.
- The higher GWP value from AR4 is used in calculations rather than the more recent, and lower value, from AR5.

When obtaining carbon offsets, AP is committed to ensuring that the offsets are verified by either the American Carbon Registry (ACR) or by Verra. Both programs aim to ensure that carbon offsets are reputable and result in verifiable emissions reductions. AP is committed to purchasing 64.33 MT CO_2e of offsets within one year of being granted a variance. Based on initial conversations with potential carbon offset providers, this is the expected timeframe required to develop a project and generate associated offsets.

Beyond carbon offsets, AP is exploring the use of solar panels at their Los Alamitos facility which would further reduce GHG emissions. As NASA considers exploring lower risk substitutes, AP will assist in ensuring that any approved substitute for qualified HFC-245fa in space parts is implemented into AP's manufacturing process in an efficient manner.

Q. Provide a detailed explanation of efforts that may be implemented to curtail noncompliance in lieu of obtaining a variance

ARROWHEAD PRODUCTS

Because AP is contractually obligated to use qualified HFC-245fa when manufacturing parts for the NASA SLS, there are no possible actions that AP can take to "curtail noncompliance". The only way to "curtail noncompliance" would be to fully stop manufacturing parts which would adversely impact local jobs in California and the ability for the NASA SLS to meet schedule.

R. By signing below, you (the Applicant) certify under penalty of perjury that you are a Responsible Official with full authority to submit the application and implement any provision of an Executive Order, and that all information provided is true and accurate to the best of your knowledge, after conducting due diligence. (Applications without this certification will be automatically denied.)

Eric Sramek **7/14/2025**

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Richelle Stewart Digitally signed by Richelle Stewart Date: 2025.07.15 13:02:54 -07'00' **7/14/2025**

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APPENDIX 1
Title 40 CFR 84 Justification for Pour Foam Exemption

construction uses, as well as foam for building breakers for pipelines. Polyurethane spray foam is broken down further into high-pressure two-component, low-pressure two-component, and one-component foam sealants. These three applications vary in the types of systems used to apply them (one-component or two-component, high-pressure or low-pressure), who uses such systems (contractors using personal protective equipment, or consumers), and how much is applied (large-scale applications within walls or on roofs of a residence or filling in cracks, leaks, and gaps in a residence). For further information on spray foam applications, *see* SNAP Rule 21 (81 FR 86778 at 86846–86847, December 1, 2016).

These restrictions apply to the manufacture and import of new foam products, including fully formulated polyols and foam insulation, the blowing of foam to manufacture new products containing foams, such as appliances, furniture, or vehicles, and the import of such foam products and products containing foams beginning January 1, 2025. Foam products and products containing foam with blowing agents that are HFCs or HFC blends with a GWP of 150 or greater (*e.g.*, HFC–134a) may no longer be sold, distributed, offered for sale or distribution, or exported beginning January 1, 2028.

The use restrictions (including labeling and reporting) finalized in this rule do not apply to any product that qualifies for application-specific HFC allowances under subsection (e)(4)(B) of the AIM Act. Specifically, this final action does not restrict the HFCs used in the manufacture of structural composite preformed polyurethane foam for marine use and trailer use or foams used in mission-critical military end uses as they have a current qualification for application-specific allowances.

This rule also excludes spray and pour foams used in space vehicles, as defined in 40 CFR 84.3 from the use restrictions. Such equipment faces unparalleled and highly demanding operating conditions and requires long lead-times for its operation to be certified. This approach is consistent with EPA's CAA regulations where space vehicles were either exempted or given additional time to transition to substitute foam blowing agents. EPA proposed to exclude spray foams used in this application but has learned that pour foams requiring the use of HFCs are also used in space vehicles. EPA is exempting the use of both foam types in space vehicles from the restrictions in this final rule.

HFCs have been widely used as blowing agents in rigid polyurethane insulation foam (*e.g.*, appliance, commercial refrigeration, sandwich panels, and spray foams) and polystyrene—extruded boardstock and billet in the United States since the phaseout of ODS blowing agents such as HCFC–141b and HCFC–142b, particularly where insulation value and flammability have been important considerations. Available substitutes have increased in the last decade and the uses for substitute blowing agents have also expanded.

There is interest in using newer foam blowing agents with lower GWP, often to improve energy efficiency of the foam products. SNAP has listed HCFO–1233zd(E) (GWP 4), HFO–1234ze(E) (GWP 1), HFO–1336mzz(E) (GWP 26), and HFO–1336mzz(Z) (GWP 2) as acceptable for some uses. These newer substitutes, which are either nonflammable or lower flammability, may prove appropriate for subsectors where higher-flammability blowing agents raise safety concerns. In addition, some nonfluorinated lower-GWP blowing agents are now being used more broadly, such as carbon dioxide (GWP 1), light saturated hydrocarbons with three to six carbons (GWPs from 1 to 4), and methyl formate (GWP 13). The process and timing for retooling facilities to use new blowing agents or that incorporate the foam product into another product will vary depending on the substitute selected. Manufacturing facilities such as household refrigerator manufacturers have already been transitioning to lower-GWP substitutes for foam-blowing. Production volumes for some of these newer substitutes are expanding rapidly to keep pace with growing commercial demands.

For some types of foam that have historically used gaseous blowing agents, HFC–152a or blends containing HFC–152a may be an available alternative. The GWP of HFC–152a is 124, compared to 794 for HFC–365mfc, 1,030 for HFC–245fa, 1,430 for HFC–134a, and 4,470 for HFC–143a. Some manufacturers of polystyrene—extruded boardstock and billet transitioning from HFC–134a have recently starting using blends of HFC–152a and non-HFCs such as CO_2, HFO–1234ze(E), and/or HFO–1336mzz(Z).

Hydrocarbons are lower-GWP and cost-effective substitutes that have been available for years for large parts of the foam sector, particularly in polystyrene—extruded sheet, rigid polyurethane—slabstock, rigid polyurethane and polyisocyanurate laminated boardstock, phenolic insulation board and bunstock, and polyolefin. Hydrocarbons are used in most of the other foam subsectors, but less extensively. In EPA's consideration of the safety of available substitutes, flammability of foam blowing agents, including hydrocarbons, can be a concern, particularly for rigid polyurethane—two-component spray foam applications. Water is used broadly as a blowing agent in flexible polyurethane foam. Other non-fluorinated compounds such as methyl formate and methylal are also used as blowing agents, alone or in combination with other compounds, particularly in polyurethane foams.

There is little or no use of HFCs in the flexible polyurethane; integral skin polyurethane; polyolefin; polystyrene—extruded sheet; and rigid polyurethane and polyisocyanurate laminated boardstock subsectors. Water and hydrocarbons are commonly used available substitutes used as blowing agents for flexible polyurethane, polyolefin, polystyrene—extruded sheet, and rigid polyurethane and polyisocyanurate laminated boardstock. CO_2, and more recently, HFOs, are available substitutes used as blowing agents for integral skin polyurethane. Based upon comments and information received during the public comment period, EPA now understands that there is limited use of HFCs—in particular, HFC–152a—as foam-blowing agents in polystyrene—extruded sheet used as sheathing to insulate buildings.

Comment: Several commenters from the foam blowing industry raised concerns about the proposed GWP limit of zero for flexible polyurethane; integral skin polyurethane; polyolefin; polystyrene—extruded sheet; and rigid polyurethane and polyisocyanurate laminated boardstock. These comments requested that EPA clarify whether the GWP applies only to HFCs in a blend of blowing agents, or if it applies to the entire blowing agent. Some of the commenters suggested that if the GWP applies to the entire blowing agent that the GWP should be higher than zero for these five foam subsectors. One commenter suggested a GWP limit of less than 20 instead of zero, because non-HFC blowing agents such as hydrocarbons or HFOs have non-zero GWPs. Other commenters suggested GWPs of 50 or for blowing agent blends, either for all foam subsectors or at least for the subsectors for the commenters' products, to maintain a "level playing field" with other types of insulation. Two manufacturers of polystyrene—extruded sheet used as sheathing to provide insulation in buildings requested a GWP limit of 150 for all foam subsectors, or at least for

APPENDIX 2
Utah Foam Products Quality Control Certificate

UTAH FOAM PRODUCTS INC
QUALITY CONTROL CERTIFICATE

SYSTEM CODE:	503-2.5-45P-R.1	DATE:	9/19/2024
CUST PT#:		CUSTOMER:	ARROWHEAD
BATCH# "A":	11293	MEETS SPEC#	ROCKETDYNE RB0130-136
BATCH# "B":	11294	MEETS SPEC#	BOEING STM0878-REV J
LOT NUMBER ISO "A":	32524092424	MEETS SPEC#	ULA STM0878-REV D
LOT NUMBER POLY "B":	32524092424	MEETS SPEC#	BOEING D210-13573-1
MFG DATE:	09/18/2024	MEETS SPEC#	DPM13158 REV:(-)
EXPIRES:	03/19/2025	MEETS SPEC#	NGIS 1087-39110
CUST. PO/CONTRACT#:	225269	MEETS SPEC#	
#ORDERED:	UNITS:	MEETS SPEC#	
#SHIPPED:			

CONFORMANCE CRITERIA

SAMPLE SIZE	100	gm	RATIO	A% 56.0	B% 44.0		
MIX TIME	15	sec	RANGE	15-20	sec		
CREAM (POTLIFE)	25	sec	RANGE	22-45	sec		
STRING GELL TIME	116	sec	RANGE	110-155	sec		
RISE TIME	155	sec	RANGE	125-240	sec		
TACK FREE TIME	180	sec	RANGE	150-285	sec		
FREE RISE DENSITY	2.11	lb/cu ft	RANGE	1.9-2.5	lb/cu ft		
WATER CONTENT	1.0290	%	RANGE	.9-1.1	%		
BLOW AGENT CONTENT	16.02	%	RANGE	14-18	%		
A SPECIFIC GRAVITY	1.23		RANGE	1.21-1.25	@	72-82	°F
B SPECIFIC GRAVITY	1.16		RANGE	1.13-1.17	@	40-50	°F
COMPRESSIVE PARALLEL	41.55	psi	RANGE	>35 AVG, 33 MIN	psi		
COMPRESSIVE PERPENDICULAR	15.34	psi	RANGE	>13 AVG, 6 MIN	psi		

DENSITY METHOD: ASTM D1622

VISUAL INSPECTION:
LIQUID CLEAR AND FREE OF SOLIDS, PRODUCES FOAM PRODUCT TO MEET SPECIFICATIONS WHEN PROPERLY MIXED.

OBSERVATIONS-FOR INFORMATIONAL PURPOSES ONLY (OPTIONAL)

COMPONENT	TEMPERATURE	VISCOSITY (CPS)	NCO%
A	72	300	
B	62	1450	

Utah Foam Products, Inc. Certifies that this product meets the contractual requirements for which it has been manufactured. It has determined that the product is in conformance with required specifications.

APPROVED BY: MATTHEW HUNT APPROVAL DATE: 9/19/2024

APPENDIX 3
Pathway for Consideration of HFC-245fa Alternatives