



## **Honeywell Enovate® 245fa TECHNICAL INFORMATION**



## Introduction

Honeywell Enovate® 245fa blowing agent (HFC-245fa, 1,1,1,3,3,-pentafluoropropane) is a liquid hydrofluorocarbon, which has been developed as a blowing agent for rigid insulating foams. It is a replacement for HCFC-141b and other fluorocarbon and non-fluorocarbon blowing agents. Enovate is a nonflammable liquid having a boiling point slightly below room temperature. It is non-ozone-depleting and it is Volatile Organic Compound (VOC) -exempt per the U.S. EPA. The physical properties of Enovate are summarized in Table 1 below.



| Table 1: Physical Properties of Enovate |                                       |                                      |
|---|---------------------------------------|--------------------------------------|
| Molecular Formula                       |                                       | $\text{CF}_3\text{CH}_2\text{CHF}_2$ |
| Molecular Weight                        |                                       | 134.0                                |
| Boiling Point                           | (°F)                                  | 59.5                                 |
|   | (°C)                                  | 15.3                                 |
| Liquid Density                          | (g/cc) @ 20°C                         | 1.32                                 |
|   |                                       |                                      |
| Freezing Point                          | (°F)                                  | <-160                                |
|   | (°C)                                  | <-107                                |
| Vapor Pressure:                         | (psia @ 68°F)                         | 17.8                                 |
|   | (kPa @ 20°C)                          | 123                                  |
| Vapor Thermal Conductivity*             | (BTU in / ft <sup>2</sup> hr°F)@25 °C | 0.0832                               |
|   | (mW/mK) @25                           | 12.50                                |
| Water Solubility (in Enovate)           |                                       | 1600 ppm                             |
| Flash Point **                          |                                       | None                                 |
| Vapor Flame Limits ***                  |                                       | None                                 |

\*Source: Geller, Bivens, Yokozeki, "Transport Properties and Surface Tension of Hydrofluorocarbons HFC 236fa and HFC-245fa 20th International Congress of Refrigeration, IIR/IIF, Sydney, 1999.

\*\*Flashpoint by ASTM D 3828-87; ASTM D 1310-86

\*\*\*Flame Limits measured at ambient temperature and pressure using ASTM E 681-85 with electrically heated match ignition, spark ignition and fused wire ignition; ambient air.

## Toxicity

Enovate® is currently listed on the U.S. EPA TSCA Inventory, the European EINECS Inventory, REACH, and the Japanese MITI Inventory. Extensive toxicity testing indicates that Enovate is of low toxicity. Overall results from a series of genetic studies indicate that Enovate is non-mutagenic and non-teratogenic. The American Industrial Hygiene Association has established a Workplace Environmental Exposure Level (WEEL) of 300 ppm. Anyone who uses or handles Enovate should carefully review the SDS and product label prior to use.

| <b>Table 2: Regulatory and Environmental Information on Enovate® 245fa</b> |                       |
|--|-----------------------|
| CAS Number   | 460-73-1              |
| ELINCS Number  | 419-170-6             |
| Ozone Depletion Potential  | 0                     |
| U.S. VOC status  | Exempt                |
| Exposure Guidelines  |                       |
| ACGIH TLV  | None                  |
| OSHA PEL   | None                  |
| WEEL (AIHA) TWA 8 hrs  | 300 ppm               |
| TSCA Inventory Status  | Listed                |
| SNAP Approval  | All Foam Applications |
| REACH  | Registered            |

## Environmental

Enovate® blowing agent is a fluorinated hydrocarbon. Follow all applicable regulatory guidelines when treating or disposing of wastes generated from the use of this product. Enovate is not considered a "hazardous waste" by the Resource Conservation and Recovery Act if discarded unused. Care should be taken to avoid releases into the environment.

## Applications

Enovate has been evaluated in a variety of foam systems and applications. Its superior thermal insulating characteristics, physical properties and compatibility with other materials make it ideal as a blowing agent for rigid polyurethane foams. Enovate replaces HCFC-141b in rigid polyurethane foam applications. Foams formulated with Enovate generally have thermal properties equivalent to those of HCFC-141b foams and better dimensional stability and compressive strength properties. The U.S. EPA has given SNAP approval for the use of Enovate as a replacement in all foam applications.

It should be noted that on October 15, 2016, delegates to the Montreal Protocol agreed in Kigali, Rwanda to an historic amendment that adds high-GWP HFCs to the Protocol and establishes schedules for their phase down in developed and developing countries. The accord will further accelerate the adoption of HFC substitutes such as Honeywell's Solstice® blowing agents (based on HFO technology) used for aerosols, foam insulation, and air conditioning and refrigeration equipment.

## Miscibility

As reflected in the statistics below, Enovate has exhibited acceptable miscibility in a wide range of polyols. To determine miscibility, a mixture containing 40 wt.% Enovate and 60 wt.% polyol is prepared in a calibrated miscibility tube. The mixture is thoroughly mixed at an elevated temperature. The tube is then placed in a constant temperature bath for 24 hours. The height of the polyol and the Enovate is measured and the miscibility is calculated.





| <b>Table 3: Miscibility of Enovate® in Polyols @70 °F (21 °C)</b> |                   |
|---|-------------------|
| <b>Polyol</b>   | <b>% Miscible</b> |
| <b>Polyethers</b>   |                   |
| (Sucrose)   |                   |
| Dow Voranol® 360  | >40               |
| (Sucrose- Amine)  |                   |
| Huntsman Rubinol® R 170   | >40               |
| Huntsman Rubinol® P 180   | >40               |
| (Aromatic-Amine)  |                   |
| Huntsman Rubinol® R 144   | >40               |
| Huntsman Rubinol® R159  | 21                |
| (TDA)   |                   |
| BASF Pluracol® -824   | 35.4              |
| Dow Voranol® 490  | >40               |
| <b>Polyester</b>  |                   |
| Invista Terate® 2541  | 23.3              |
| Invista Terate® 2541L   | 27.9              |
| Invista Terate® 2031  | 18.8              |
| Invista Terate® 2542  | 21.5              |
| Invista Terate® 5521  | 23.0              |
| Invista Terate® 254   | 23.4              |
| Stepan Stepanol® 2352   | 32.3              |
| Great Lakes PHT 4 Diol®   | 6.2               |

## Stability

Laboratory tests indicate that Enovate® blowing agent has a high degree of thermal and hydrolytic stability. In sealed tube studies, the material showed no signs of decomposition after six weeks of exposure to temperatures ranging from 75°C to 200°C in the presence and absence of water (at 300 ppm), and in the presence and absence of metals (3003 aluminum and/or 316 stainless steel). A separate study was also conducted with cold rolled steel rod exposed to Enovate in the presence and absence of air and water for a period of two to six weeks at temperatures ranging from 25°C to 100°C. Again, Enovate did not show any signs of decomposition.

## Compatibility

Enovate blowing agent is non-reactive and non-corrosive toward all commonly used metals in polyurethane processing equipment. This includes carbon steel, stainless steel, copper and brass. There is a concern with the use of aluminum in contact with any halogenated material, which includes Enovate, due to the reactive nature of aluminum. This is particularly so if aluminum fines are present and if the oxide layer on the surface of the aluminum is removed.

In general, Enovate is less aggressive toward plastics and elastomers than HCFC-141b. Gaskets and seals that were changed to accommodate HCFC-141b should be compatible with Enovate. Honeywell has evaluated plastics and elastomers for use

with Enovate. Table 3 below reports the findings of this study. Elastomers that may find application in both static conditions (for example, gasketing between flanges) versus dynamic conditions (for example, seals on rotating shafts) may have varying degrees of suitability in use.



## Storage & Handling

Enovate® 245fa should be stored in a cool, well-ventilated area. The material should only be stored in an approved cylinder. Please consult Honeywell's Technical Service Department prior to storage of the material in anything other than its original shipping cylinder to ensure that the new container meets all safety requirements. The container and its fittings should be protected from physical damage. It should neither be punctured or dropped, nor exposed to open flames, excessive heat or direct sunlight. The container's valves should be tightly closed after use and when the container is empty.

Based on experience with other HFCs, Enovate should not be mixed with either air or oxygen at pressures above atmospheric pressure. If pressurization is required in your application, the use of nitrogen is recommended.

For additional information on the use of cylinders, please consult the appropriate handling, storage and unloading bulletin (available from a Honeywell Technical Service Representative).

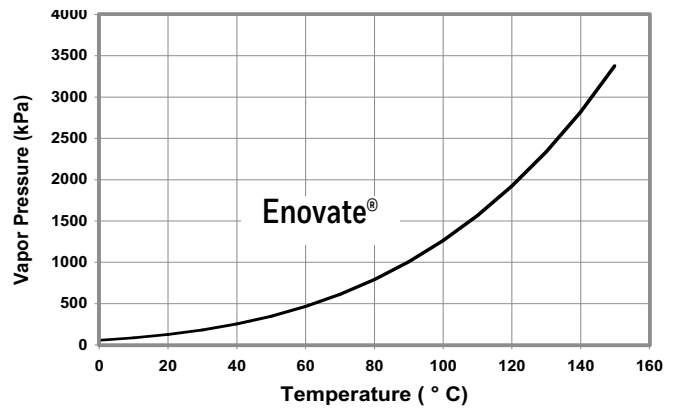
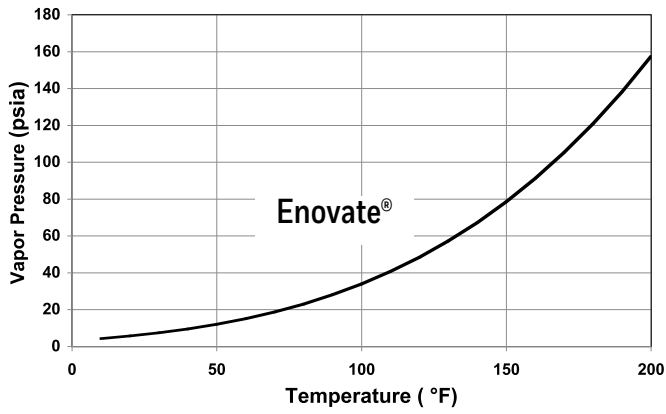
**Table 3: Materials Compatibility**

| <b>Plastics</b>    |                       |                       |                      |                         |
|--------------------|-----------------------|-----------------------|----------------------|-------------------------|
| <b>Application</b> | <b>% Weight Delta</b> | <b>% Length Delta</b> | <b>% Width Delta</b> | <b>%Thickness Delta</b> |
| Acetal             | Negligible            | Negligible            | Negligible           | Negligible              |
| Acrylic            | Dissolving            |                       |                      |                         |
| HDPE               | Negligible            | Negligible            | Negligible           | Negligible              |
| Nylon              | Negligible            | Negligible            | Negligible           | Negligible              |
| Polycarbonate      | Negligible            | Negligible            | Negligible           | Negligible              |
| Polyetherimide     | Negligible            | Negligible            | Negligible           | Negligible              |
| Polypropylene      | Negligible            | Negligible            | Negligible           | Negligible              |
| PET                | Negligible            | Negligible            | Negligible           | Negligible              |
| PVC                | Negligible            | Negligible            | Negligible           | Negligible              |
| PVDF               | Negligible            | Negligible            | Negligible           | Negligible              |
| PTFE               | Negligible            | Negligible            | Negligible           | Negligible              |
| <b>Elastomers</b>  |                       |                       |                      |                         |
| <b>Application</b> | <b>% Weight Delta</b> | <b>% Length Delta</b> | <b>% Width Delta</b> | <b>%Thickness Delta</b> |
| Butyl Rubber       | Negligible            | Negligible            | Negligible           | Negligible              |
| Fluoroelastomer    | 76.5                  | 24.8                  | 26.9                 | 27.7                    |
| EPDM               | Negligible            | Negligible            | Negligible           | Negligible              |
| Epichlorohydrin    | 10.4                  | 3.7                   | 3.4                  | 25.5                    |
| EthylenePropylene  | 1.2                   | 0.8                   | Negligible           | Negligible              |
| Neoprene           | Negligible            | Negligible            | Negligible           | Negligible              |
| Nitrile Rubber     | 4.2                   | Negligible            | Negligible           | Negligible              |
| Silicone           | 6.0                   | Negligible            | Negligible           | 2.4                     |
| Urethane           | 20.5                  | 2.3                   | 5.0                  | 9.1                     |

**Notes:** Fluoroelastomer: "Viton A": Trademark of DuPont Dow Elastomers  
Nitrile Rubber: "Buna N"  
PTFE: "Teflon": Trademark of the E. I. du Pont de Nemours and Company

PVDF: "Kynar": Trademark of Arkema Inc.  
Polyetherimide: "Ultem": Trademark of The General Electric Company

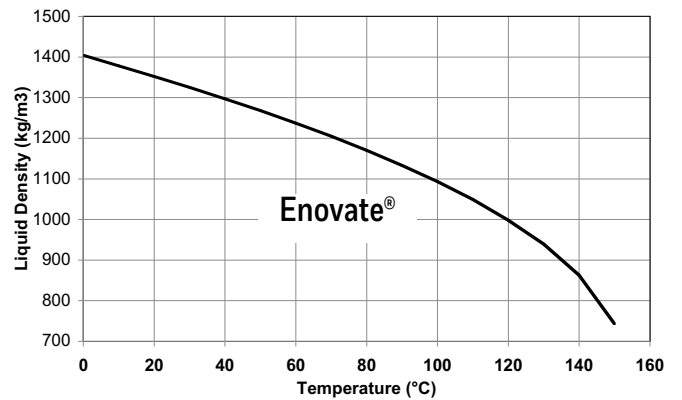
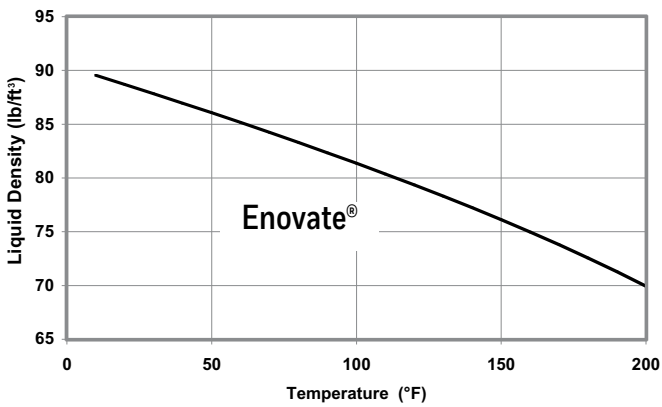
# Temperature vs Pressure



| Temperature [°F] | Pressure [psia] | Temperature [°F] | Pressure [psia] |
|------------------|-----------------|------------------|-----------------|
| 10               | 4.3             | 110              | 40.7            |
| 20               | 5.7             | 120              | 48.4            |
| 30               | 7.4             | 130              | 57.2            |
| 40               | 9.5             | 140              | 67.2            |
| 50               | 12              | 150              | 78.5            |
| 60               | 15.1            | 160              | 91.1            |
| 70               | 18.7            | 170              | 105.2           |
| 80               | 23              | 180              | 120.2           |
| 90               | 38.1            | 190              | 138.2           |
| 100              | 33.9            | 200              | 157.4           |

| Temperature [°C] | Pressure [kPa] | Temperature [°C] | Pressure [kPa] |
|------------------|----------------|------------------|----------------|
| 0                | 54             | 80               | 789            |
| 10               | 83             | 90               | 1004           |
| 20               | 124            | 100              | 1261           |
| 30               | 179            | 110              | 1565           |
| 40               | 252            | 120              | 1921           |
| 50               | 345            | 130              | 2335           |
| 60               | 464            | 140              | 2817           |
| 70               | 610            | 150              | 3380           |

# Temperature vs Density



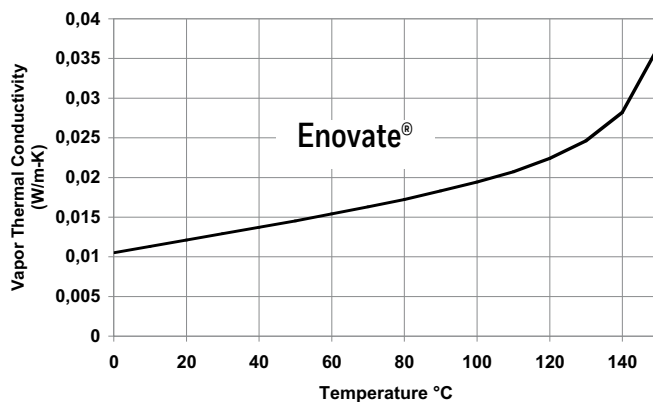
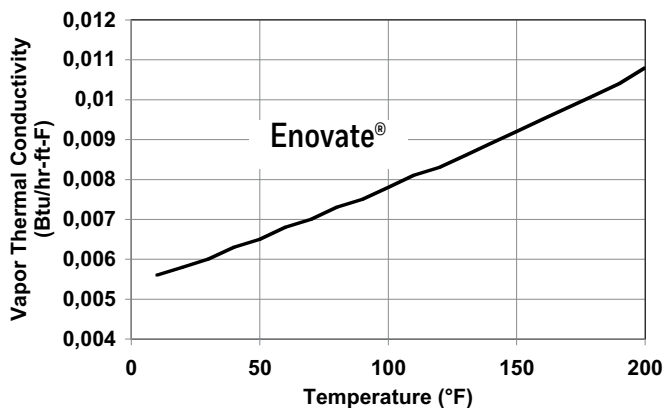


## Temperature vs Density (cont.)

| Temperature [°F] | Liquid Density [lb/ft <sup>3</sup> ] | Temperature [°F] | Liquid Density [lb/ft <sup>3</sup> ] |
|------------------|--------------------------------------|------------------|--------------------------------------|
| 10               | 89.5                                 | 110              | 80.4                                 |
| 20               | 88.7                                 | 120              | 79.3                                 |
| 30               | 87.8                                 | 130              | 78.3                                 |
| 40               | 86.9                                 | 140              | 77.2                                 |
| 50               | 86.1                                 | 150              | 76.1                                 |
| 60               | 85.2                                 | 160              | 75.0                                 |
| 70               | 84.2                                 | 170              | 73.8                                 |
| 80               | 83.3                                 | 180              | 72.6                                 |
| 90               | 82.3                                 | 190              | 71.3                                 |
| 100              | 81.4                                 | 200              | 69.9                                 |

| Temperature [°C] | Liquid Density [kg/m] | Temperature [°C] | Liquid Density [kg/m] |
|------------------|-----------------------|------------------|-----------------------|
| 0                | 1404                  | 100              | 1093                  |
| 10               | 1378                  | 110              | 1049                  |
| 20               | 1352                  | 120              | 998                   |
| 30               | 1325                  | 130              | 939                   |
| 40               | 1297                  | 140              | 863                   |
| 50               | 1268                  | 150              | 743                   |
| 60               | 1237                  |                  |                       |
| 70               | 1205                  |                  |                       |
| 80               | 1170                  |                  |                       |
| 90               | 1133                  |                  |                       |

## Temperature vs. Vapor Thermal Conductivity



| Temperature [°F] | Vapor Thermal Conductivity [Btu/hr-ft-F] | Temperature [°F] | Vapor Thermal Conductivity [Btu/hr-ft-F] |
|------------------|--|------------------|--|
| 10               | 0.0056                                   | 110              | 0.0081                                   |
| 20               | 0.0058                                   | 120              | 0.0083                                   |
| 30               | 0.0060                                   | 130              | 0.0086                                   |
| 40               | 0.0063                                   | 140              | 0.0089                                   |
| 50               | 0.0065                                   | 150              | 0.0092                                   |
| 60               | 0.0068                                   | 160              | 0.0095                                   |
| 70               | 0.0070                                   | 170              | 0.0098                                   |
| 80               | 0.0073                                   | 180              | 0.0101                                   |
| 90               | 0.0075                                   | 190              | 0.0104                                   |
| 100              | 0.0078                                   | 200              | 0.0108                                   |

| Temperature [°C] | Vapor Thermal Conductivity [W/m-k] | Temperature [°C] | Vapor Thermal Conductivity [W/m-k] |
|------------------|------------------------------------|------------------|------------------------------------|
| 0                | 0.0105                             | 80               | 0.0172                             |
| 10               | 0.0113                             | 90               | 0.0183                             |
| 20               | 0.0121                             | 100              | 0.0194                             |
| 30               | 0.0129                             | 110              | 0.0207                             |
| 40               | 0.0137                             | 120              | 0.0224                             |
| 50               | 0.0145                             | 130              | 0.0246                             |
| 60               | 0.0154                             | 140              | 0.0282                             |
| 70               | 0.0163                             | 150              | 0.0365                             |

**For more information:**

Please call: +1-800-631-8138

[www.honeywell-blowingagents.com](http://www.honeywell-blowingagents.com)

**Honeywell Advanced Materials**  
115 Tabor Road  
Morris Plains, NJ 07950

Although Honeywell International Inc. believes that the information contained herein is accurate and reliable, it is presented without guarantee or responsibility of any kind and does not constitute any representation or warranty of Honeywell International Inc., either expressed or implied. A number of factors may affect the performance of any products used in conjunction with user's materials, such as other raw materials, application, formulation, environmental factors and manufacturing conditions among others, all of which must be taken into account by the user in producing or using the products. The user should not assume that all necessary data for the proper evaluation these products are contained herein. Information provided herein does not relieve the user from the responsibility of carrying out its own tests and experiments, and the user assumes all risks and liabilities (including, but not limited to, risks relating to results, patent infringement, regulatory compliance and health, safety and environment) related to the use of the products and/or information contained herein.

Solstice is a registered trademark of Honeywell International Inc.



470 FP BA v4 | December 2018  
© 2018 Honeywell International Inc. All rights reserved.

**Honeywell**