Honeywell | Blowing Agents

THE POWER OF CONNECTED

Solstice® Liquid Blowing Agent

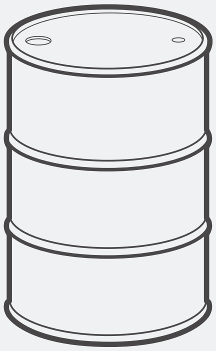
A Quick Reference Guide

# Maximizing Performance of Spray Foam Systems Formulated with Solstice LBA

# Introduction

Honeywell Solstice® Liquid Blowing Agent (LBA), based on hydrofluoro-olefin HFO technology, is an ideal ultra-low global-warming-potential (GWP) replacement for HFC foam blowing agents commonly used in closed-cell spray polyurethane foam (ccSPF) systems. A growing number of companies have already adopted Solstice LBA or are making the switch. Not only does Solstice LBA help their systems comply with current and future regulations, it is providing better performance (insulation, yield, sprayability, etc.) compared to current systems.

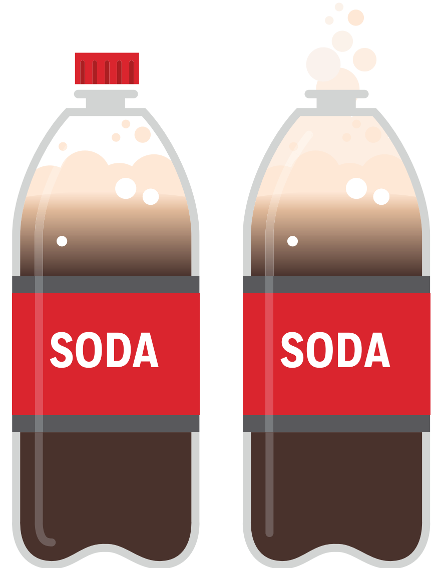
To help facilitate that transition, we've assembled this quick reference guide. We offer suggestions intended to help formulators (systems houses) and contractors maximize the performance of their polyol preblend formulated with Solstice LBA. When developing a system with Solstice LBA, it is important to consider packaging design, storage, and transportation. Processing conditions and equipment are also important factors. We've provided some troubleshooting tips to help you manage potential challenges that can arise, including the impact of vapor pressure and the possibility of frothing of the polyol blend that can occur when it's exposed to high ambient temperatures or severe agitation.



This reference guide is not intended to replace comprehensive technical literature and safety data sheets (SDS) for Solstice LBA that are also available from Honeywell.

# Understanding Contributors to Vapor Pressure and Frothing

Many factors contribute to the vapor pressure of a fluid, including the concentration of a low boiling material, the viscosity and surface tension of the solution, the solubility of the low boiling material in the solution, and of course, the solution temperature. Polyol blends are typically stored and shipped in 208 liter/55 gallon drums that are sometimes exposed to elevated temperatures in the field. Pressure builds in a closed container, such as a drum, when a solution containing a low boiling material is heated above the boiling point of the material. If the container is opened quickly and the pressure is released, the dissolved gas from the low boiling point liquid is quickly released from the solution and frothing may occur. This is like what happens if a warm bottle of soda is opened quickly.




If a soda bottle is shaken and then opened, liquid soda and bubbles will froth out of the bottle. If the soda bottle is allowed to settle after being shaken, it is far less likely to froth. This a similar effect that can be seen with polyol blends.

# Proper Shipping and Handling of Material Can Reduce Frothing

This brochure offers guidance on what precautions can be taken to reduce the potential for the polyol blend to froth when a drum is opened in the field. The potential for a fluid to froth is a function of many of the same factors that influence vapor pressure, but frothing and vapor pressure are independent phenomenons and not always linked. Contributing factors include the concentration of the low boiling material, the temperature of the polyol blend relative to the boiling point of the material, the surface tension, the viscosity of the fluid, the uniformity of the polyol blend, and the miscibility of the blowing agent in the polyol blend.

In addition to the properties of the fluid that are addressed with vapor pressure, how the material is handled also plays a significant role in determining whether frothing will occur. Agitation of the polyol blend during shipping or handling, and/or inserting warm drum pumps, can impact the potential for frothing by affecting the miscibility of the “low boiling point liquid” in the polyol blend. By allowing the polyol blend drum to rest after potentially being agitated or shaken during transport, the internal pressure can equilibrate and the sudden release of pressure when opening the drum can be reduced or eliminated.

# Formulation Additives Can Help Mitigate Frothing

When considering ways to control and reduce system frothing, the addition of small amounts of certain additives to the polyol blend can be helpful.

**Even under worst-case conditions (elevated temperature and extreme agitation), tests have shown that the time needed to minimize or eliminate frothing can be reduced by up to 50% with as little as 0.2-0.6 weight percent of additive in a polyol blend containing Solstice LBA.**[1]

Below is a table with possible additives to consider when working to mitigate frothing in a Solstice LBA polyol blend.

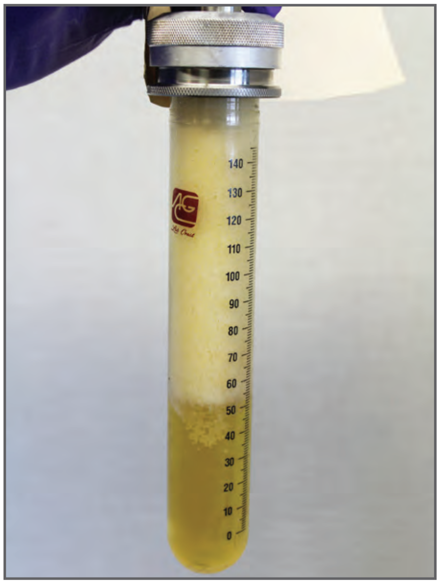
| ADDITIVE* | AMOUNT OF ADDITIVE IN POLYOL BLEND[2] (WEIGHT PERCENT) | FROTHING BEHAVIOR (RATING PER TEST AFTER 20 MIN.) |
|---|---|---|
| Dimethoxymethane (Methylal) | 0.2 | Excellent |
| Methyl Formate | 0.2 | Excellent |
| Dabco® PM301 Surfactant[3] | 0.6 | Excellent |
| Trans-1,2-Dichloroethylene (TDCE) | 0.6 | Acceptable |

*These additives must be fully tested in the specific formulation under study to determine suitability. The final determination of suitability, including flashpoint, is the responsibility of the system formulator.

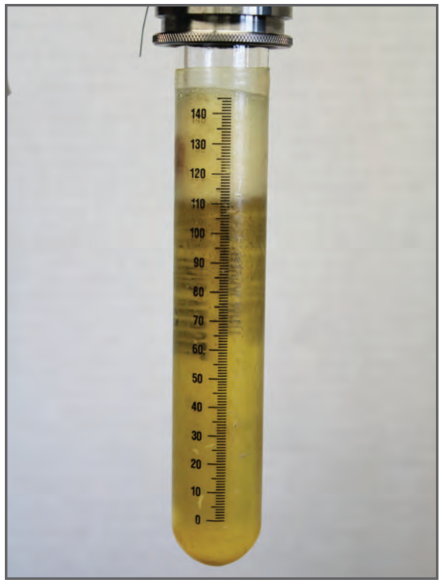
## Certain Additives Can Reduce Frothing Time by 50% in Polyol Blends Containing Solstice LBA

## This Additive Approach Has Been Found To Have Little To No Impact On Foam Quality

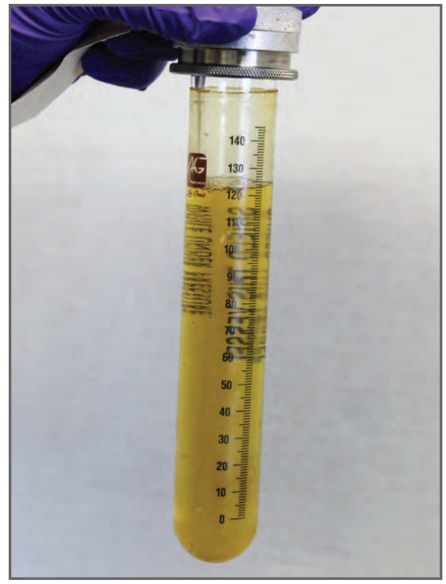
# Frothing Behavior Rating



**UNACCEPTABLE**
Bubbles
Frothing out of tube



**ACCEPTABLE**
Some bubbles
No frothing out of tube



**EXCELLENT**
No bubbles
No frothing out of tube

**Test Methodology (Shaking Method):**

- Tube containing the formulation[2] was put into the oven for conditioning at 45°C
- Tube was shaken vigorously for 20 seconds and was put back into the oven at 45°C
  Note: These test conditions were intended to simulate an excessive, worst-case scenario in the field where drums could be at elevated temperatures and experience extreme agitation
- Tube was then taken out of the oven after a specific amount of time for evaluation
- Valve on the tube was then opened to observe and record frothing behavior
- Additives with frothing behavior rated “unacceptable” are not included

[1]The 50% time reduction to achieve “excellent” or “acceptable” frothing behavior with these additives was measured against a benchmark of time to achieve excellent frothing behavior (no bubbles, no frothing out of tube) with a generic, neat Solstice LBA polyol blend. Results shown in the table were achieved after 20 minutes of resting the formulation in the tube.

[2]The formulation tested with additives was a polyol blend containing Solstice LBA without water and catalyst. The blowing agent plus additive/co-blowing agent dosage was approximately 21wt%, or 30php, of the polyol blend.

[3]Dabco® PM301 surfactant is a Registered Trademark of Evonik.

# Packaging

Choice of packaging when using a polyol preblend that includes Solstice LBA, or any foam blowing agent, is an important consideration. As mentioned, drums are commonly used across the spray foam industry for polyol preblend, which contains a mixture of polyol, blowing agent, catalyst, surfactant, and other ingredients. Other packaging options, such as cylinders, totes or larger bulk containers, are also available. Packaging options vary depending on the region.

### Vapor Pressure Management

When selecting polyol preblend packaging, vapor pressure management is an important consideration. Factors impacting vapor pressure of a polyol preblend are complex. As mentioned, it can be impacted by the boiling point of the blowing agent (Solstice LBA has a boiling point of 19°C/66°F), the amount of blowing agent in the polyol preblend, and the temperature of the blend. Other factors that contribute to vapor pressure include the solubility of the blowing agent in the polyol, the presence of other gases or volatile liquids in the preblend, including air, and the method used to measure the vapor pressure. It is important to understand these factors and to manage the temperature of the system per the formulator's guidelines. By doing so, this will help control the internal vapor pressure of the package.

Factors impacting vapor pressure of a polyol preblend are complex.

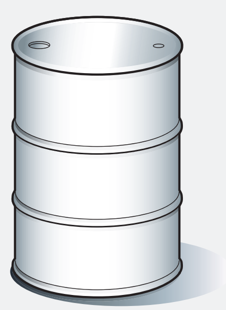
### Packaging Considerations

**Drums** 1 2

- Vendors of drums conform to U.S. DOT Hazardous Materials Regulations (49 CFR)
- The UN Performance Packaging concept no longer specifies gauge thickness – only test criteria. A typical drum package might be labeled: 1A1 / Y1.4 / 250 / 04 / USA / BK123. (See page 7)†
- Honeywell recommends a minimum service pressure of 22 psi/1.51 Bar/151.7 kPa. **Note:** While it is recognized that some distortion is likely at this internal pressure, it is unlikely that failure would occur

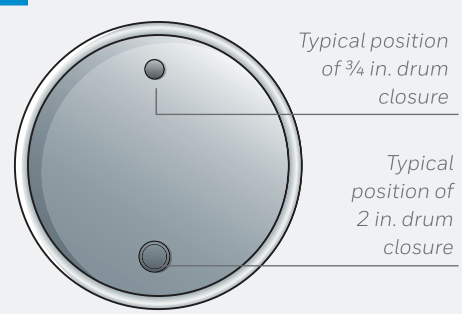
Note: Consult your drum vendor for design specifications.

**Example of 208 Liter/55 Gallon Drum**



1

2 **Overhead View Of Typical Drum**




Note: The measurement of drum openings (bung holes) may vary by region, though typically they are similar in size to the openings indicated.

## Packaging Considerations Continued

### Solid Drum Closures

In conjunction with drum choice, the matter of pressure management (or pressure relief) and the choice of drum closure is of equal importance.

Solid drum closures are commonly used. When opening a drum using solid drum closures, safety measures should be taken in the event of internal vapor pressure build-up. It is important to work closely with the system formulator to define safe use and handling procedures. Ensure that personnel responsible for handling and opening drums are wearing proper personal protective equipment (PPE) and are well trained on all safe use and handling procedures.

**Here are some suggested steps:**

1. The smaller drum closure (¾ in.) 3 should be opened first, slowly and partially to allow relief of any internal pressure
2. Next, this ¾ in. closure can be removed to ensure there is no pressure in the drum
3. With zero pressure confirmed, the larger solid drum closure (2 in.) 4 should also be removed to accommodate a drum pump

### Vented Drum Closures

A variety of vented drum closures are also available for consideration. Safety precautions must also be applied when handling drums with vented drum closures.

- Vented drum closures (2 in.) 5 are used extensively to help ensure that the drum has an internal pressure less than design relief pressure of the closure
- The recommended vented closure is the type that opens at a pre-set pressure (typically 12-15 psi/0.82-1.03 Bar/82.7 – 103.4 kPa) and closes automatically at a pre-set pressure (typically 8 psi/0.55 Bar/55.2 kPa). This type of closure minimizes blowing agent losses

Vented drum closures have been used in the field for over 10 years with no weight loss or significant change in foam density reported.

Note: A smaller ¾ in. solid drum closure is typically used in conjunction with the 2 in. vented drum closure.

† Example of typical drum package label: 1A1 / Y1.4 / 250 / 04 / USA / BK123.

Where:

| | | |
|---|---|---|
| UN | = | United Nations (globally accepted) |
| 1 | = | Drum |
| A | = | Steel |
| 1 | = | Closed Head (bung) |
| Y | = | Drum is acceptable for hazmat in packaging group II and III only |
| 1.4 | = | Maximum specific gravity of the liquid in the drum |
| 250 | = | Hydrostatic test pressure for the drum (250 kPa) |
| 04 | = | Year of manufacture |
| USA | = | Country of authorization |
| BK123 | = | Registered symbol or code of the testing entity |

**Solid Drum Closures**

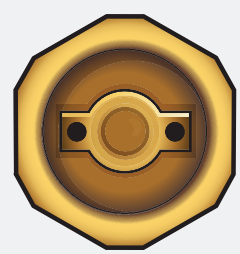
Typical ¾ in. solid drum closure

3

Typical 2 in. solid drum closure

4

**Vented Drum Closure**



5 Example of 2 in. vented drum closure

6

# Climate Controlled Storage and Transportation

When formulating spray foam systems using blowing agents and other components, formulators must follow manufacturers' safe use and handling guidelines provided in safety data sheets (SDS) for all ingredients. When handling, storing, and transporting these systems for use in the field, contractors must also carefully adhere to safe use and handling guidelines provided by the formulator, including the use of proper PPE.

### Hot conditions

If the ambient temperature is higher than the recommended temperature for the polyol preblend, a number of methods can be employed to help prevent unwanted vapor pressure build-up that can potentially lead to frothing or spouting from the drum.

## TEMPERATURE CONSIDERATIONS

### Handling and Storage 6

- Adhere to recommended temperature ranges for system components during the blending operation
- Always follow the manufacturer's safe use and handling procedures (refer to Safety Data Sheets) when working with polyol preblend
- Climate controlled warehousing may be beneficial
- Store drums on pallets at the recommended temperatures
- Avoid storing in direct sunlight

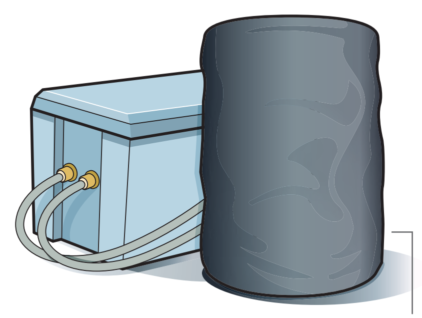
### Temperature Control

- A cooling blanket 7 on the drum can help prevent internal vapor pressure build-up when the polyol preblend may be exposed to high temperatures and/or direct sunlight
- Various cooling blankets options are available from manufacturers so we recommend exploring a type best suited to your needs and region

### Transportation

- Follow the formulator's instructions for transportation guidance
- During loading and unloading, handle drums with care. Do not drop or roll the drum
- Ensure proper ventilation, such as fans, are used in the work environment, including the rig/trailer
- When possible, refrigerated (air conditioned) trucks/trailers may be beneficial in hot conditions to help maintain desired temperatures and control internal drum vapor pressure
- An alternative method is to apply a cooling blanket over the drum
- Consideration must be given to the time allotted to rest a drum after transport and handling before it is opened, particularly if the drum has been shaken or has been exposed to hot temperatures. With a robust formulation and an adequate resting period, frothing can be reduced and in some cases, eliminated. This is formulation dependent and results will vary.

7



*Typical cooling blanket shown. This one features a modified cooler box with pump, filled with ice and water.*

While we've presented some of the common methods to help manage internal vapor pressure of drums, Honeywell highly recommends that all schemes to manage vapor pressure be reviewed with the system supplier before implementation.

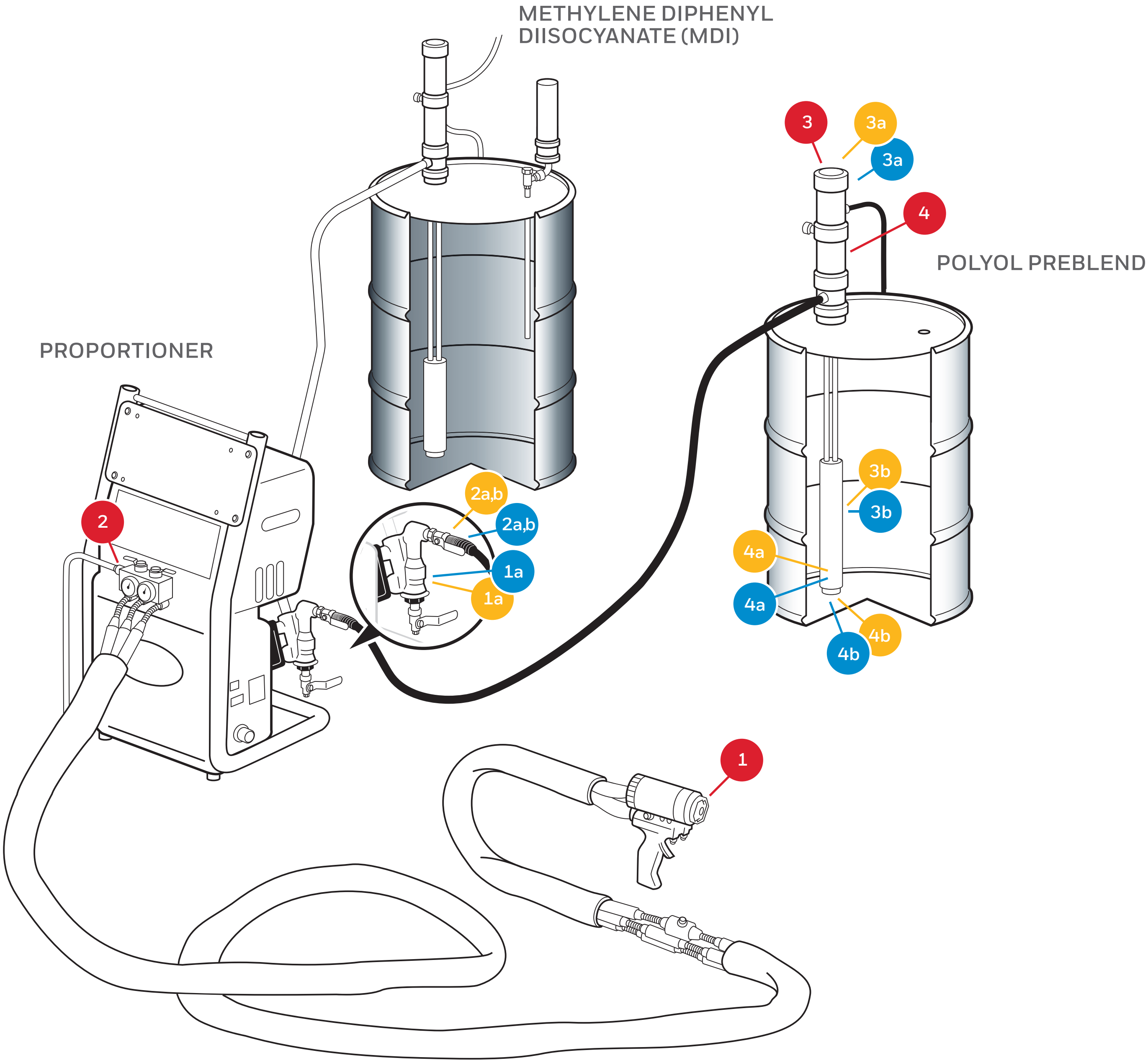
# Processing Considerations

To maximize performance when spraying a ccSPF system, it is essential that processing parameters for that formulation are carefully followed. Humidity, ambient temperature, and equipment settings are just some of the factors that can impact processing performance. If you are experiencing foam performance issues after carefully following the formulator's processing recommendations, it may be beneficial to determine whether mechanical factors are contributing.

## Spray foam equipment and components

The choice of spray machine and related components, such as transfer pumps, can directly impact the ease of processing. Different model types are available for contractors. Choosing inadequate or unsuitable components may cause processing issues, such as cavitation or cross-contamination, when spraying the system. Here are some troubleshooting tips to consider that can help prevent and/or address processing-related issues.

| SYMPTOMS | | POSSIBLE CAUSE(S) | | TROUBLESHOOTING TIPS | |
|---|---|---|---|---|---|
| 1 | Off-ratio foam, such as rich MDI or Polyol preblend | 1a | Screen is clogged at proportioner, causing cavitation | 1a | Clean or replace screen |
| 2 | Spray pressure fluctuation, such as creeping upward | 2a | Ball valve isn't opening completely | 2a | Fully open ball valve |
| | | 2b | Worn-out seat in ball valve assembly | 2b | Replace ball valve |
| 3 | Upstroke stalls | 3a | Air-cap conical spring failure | 3a | Replace spring |
| | | 3b | Worn or broken pump packing | 3b | Clean or replace pump packing |
| 4 | Erratic pump movement | 4a | Worn or dirty check valve | 4a | Clean or replace check valve |
| | | 4b | Loose or separated foot valve | 4b | Tighten foot valve |




This guide is intended to help address some of the more common factors that can impact polyol preblend performance. If your system is still not performing as expected after applying these troubleshooting tips, there are some additional factors that you may want to consider. These include determining whether the system being used is at an elevated temperature, or if the system has been recently agitated. We recognize that every system is unique and factors that can impact its performance are varied. Our Honeywell technical team is ready to assist with your formulation requirements and can discuss additional ways to help you maximize your system's performance.

This is a typical spray foam machine configuration. However, machine configurations may vary. Please check your manufacturer's specifications.
Illustration courtesy of Honeywell

## Worldwide Sales Offices

For more information contact your Honeywell representative


**United States**
Honeywell International
115 Tabor Road
Morris Plains, NJ 07950
Phone: 800-631-8138
Fax: 973-455-6395

**Latin America/Caribbean**
Honeywell Chemicals Mexico
Constituyentes 900
Col. Lomas Atlas
C.P. 950, Mexico DF
Mexico
Phone: 52-55-5549-0303
Fax: 52-55-5544-9803

**Canada**
Honeywell Asca. Inc.
3333 Unity Drive
Mississauga, Ontario
L5L 3S6
Phone: 905-608-6325
Fax: 905-608-6327

**Asia-Pacific**
Honeywell (China) Co., ltd.
No 430, Li Bing Road
Zhang Jiang Hi-Tech Park
Pudong New Area, Shanghai
201203
China
Phone: 86-21-2894-2000
Fax: 86-21-5855-2719

Honeywell Japan Inc.
New Pier Takeshiba
South Tower Building, 20th Floor
1-16-1 Kaigan, Minato-ku,
Tokyo 050022, Japan
Phone: 81-3-6730-7000
Fax: 81-3-6730-7221

Honeywell Chemicals, Korea
6F Janghakjaedan, B/D 44-1
Bangpo-Dong, Seocho-Ku
Seoul 137040, Korea
Phone: 8-22-595-0204
Fax: 8-22-595-4964

Honeywell Specialty Chemicals
(Singapore) Pte. Ltd.
17 Changi Business
Park Central 1
Honeywell Building
Singapore 486073
Phone: 65-6355-2828
Fax: 65-6783-2947

Honeywell Polymers
(Australia) Pty.
Limited
Gr. Lvl. 71 Queens Road
Melbourne. 3002
Australia
Phone: 61-3-9529-1411
Fax: 61-3-9510-9837

**Northern, Central, and Eastern Europe, Middle East and Africa**
Honeywell Belgium N.V.
Interleuvenlaan 15i 3001
Heverlee, Belgium
Phone: 32-16-391-212
Fax: 32-16-391-371
E-mail: fluorines.europe@honeywell.com

**Southern Europe, Turkey and Israel**
Honeywell Fluorine
Products Italia Srl
V. Le Milanofiori El
20090 Assago - MI - Italia
Phone: 39-02-892589600
Fax: 39-02-57500815


## Customer Service

To place an order from anywhere in the Continental United States, Hawaii and the Caribbean:


Phone: 800-522-8001
Fax: 800-458-9073

**Canada**
Phone: 800-553-9749
Fax: 800-553-9750

**Northern and Central Europe**
Phone: +32-16-391-209
Phone: +32-16-391-216
Fax: +32-16-391-235

**Southern Europe, Middle East and Africa**
Phone: +39-02-9379-6777
ext. 24 / 25 and 26
Fax: +39-02-9379-6761

**Outside these areas:**
Phone: 1-973-455-6300
Fax: 1-973-455-2763


### For more information

For assistance, please contact your formulation or equipment provider. Or contact Honeywell at **1-800-631-8138**. Visit **www.honeywell-blowingagents.com**.



Responsible Care®
Our commitment to sustainability


BA 1734 | September 2017



Honeywell