



# **SOLSTICE<sup>®</sup>** **BLOWING** **AGENTS**

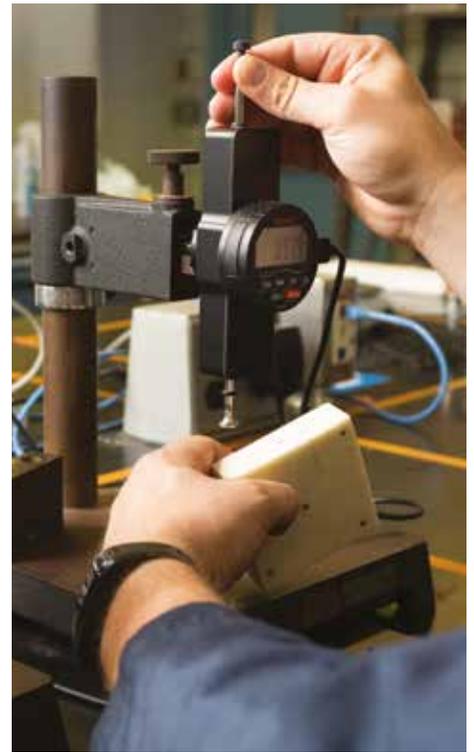
Honeywell – The Innovation Leader

**Honeywell**

# AT THE FOREFRONT OF BLOWING AGENT SOLUTIONS

The first fluorocarbon blowing agents were invented in the 1940s and Honeywell has remained at the forefront of every major improvement in fluorocarbon blowing agent technology since then.

As the world transitions to lower global warming potential (GWP) solutions, Honeywell and its suppliers have completed investments of over \$900 million in R&D and new manufacturing capacity to produce foam blowing agents, refrigerants, solvents, and propellants based on our hydrofluoro-olefin (HFO) technology. Our portfolio of solutions, under the Solstice® brand, helps customers lower their carbon footprint without sacrificing end-product performance. For the foam industry, Honeywell offers Solstice Liquid Blowing Agent (LBA) (HFO-1233zd(E)) and Solstice Gas Blowing Agent (GBA) (HFO-1234zd(E)). They are being widely adopted as replacements for HFCs, HCFCs, and other blowing agents in a variety of foam applications around the globe.



## WORLD-SCALE MANUFACTURING CAPABILITIES

We operate state-of-the-art production facilities in the U.S. and China. Our proven track record in supply chain reliability is based on decades of experience, delivering tens of thousands of metric tons of foam blowing agent per year from our production facilities.

As demand continues to grow, we are continually investing in our assets and expanding capacity. For example, Honeywell Sinochem Lantian New Materials Co., Ltd. started up a new world-scale production facility for Solstice LBA in China in March, 2019. We are also expanding Solstice GBA capacity at our facility in Baton Rouge, Louisiana in late 2020.



*The Honeywell Sinochem Lantian New Materials Co., Ltd. joint venture produces HFO-1233zd(E) in China.*

# UNMATCHED RESEARCH, DEVELOPMENT, AND TECHNICAL SUPPORT

Our leadership in advancing blowing agent technology and serving customers is due to our highly dedicated global research and technical support team. The team consists of 20 experienced professionals, plus supporting lab technicians, who work in leading-edge technology centers located across the globe. This team is unmatched in the industry.

## 1. RESEARCH LABORATORIES (BUFFALO)

- Global R&D Center
- Applications Development: Americas
- Technical Support: North America
- Fully equipped foam laboratory

## 2. REGIONAL TECH SUPPORT (MEXICO CITY)

- Technical Support: Latin America

## 3. REGIONAL TECH SUPPORT (BARCELONA)

- Technical Support: Europe

## 4. REGIONAL TECH SUPPORT (DUBAI)

- Technical Support: Middle-East and Africa

## 5. INDIA TECHNOLOGY CENTER (GURGAON)

- Applications Development: India, Middle-East, Africa
- Technical Support: India
- Fully equipped foam laboratory

## 6. RESEARCH LABORATORIES (SHANGHAI)

- Applications Development: Asia
- Technical Support: Asia
- Fully equipped foam laboratory

## TECHNICAL TEAM FACTS

Collectively our blowing agents research/technical team represents:

- Over 260 years of foam/polymer industry expertise
- Over 125 years of Honeywell experience – from CFCs to HFOs
- Industry-trained technical personnel
- Educational disciplines that encompass chemistry, polymer chemistry, polymer science and engineering, chemical/environmental engineering, and more.



## STATE-OF-THE-ART LABORATORIES

Our global technology centers for foam blowing agent research, development, and technical support are equipped with state-of-the-art high-pressure foam machines, spray foam machines, foam thermal conductivity testing equipment, and a full array of mechanical property testing equipment, including compression/ tensile testers, rate of rise measurement instruments, environmental chambers, pycnometers, optical microscopes, and other essential equipment. In addition, these laboratories are fully equipped with analytical equipment to test polyol premixes for a variety of properties and foam for cell gas content.



*We use state-of-the-art spray foam machines, including third stream gas injection capability.*



*Our robotic machine can be used to ensure consistency and repeatability in spray test sample preparation.*

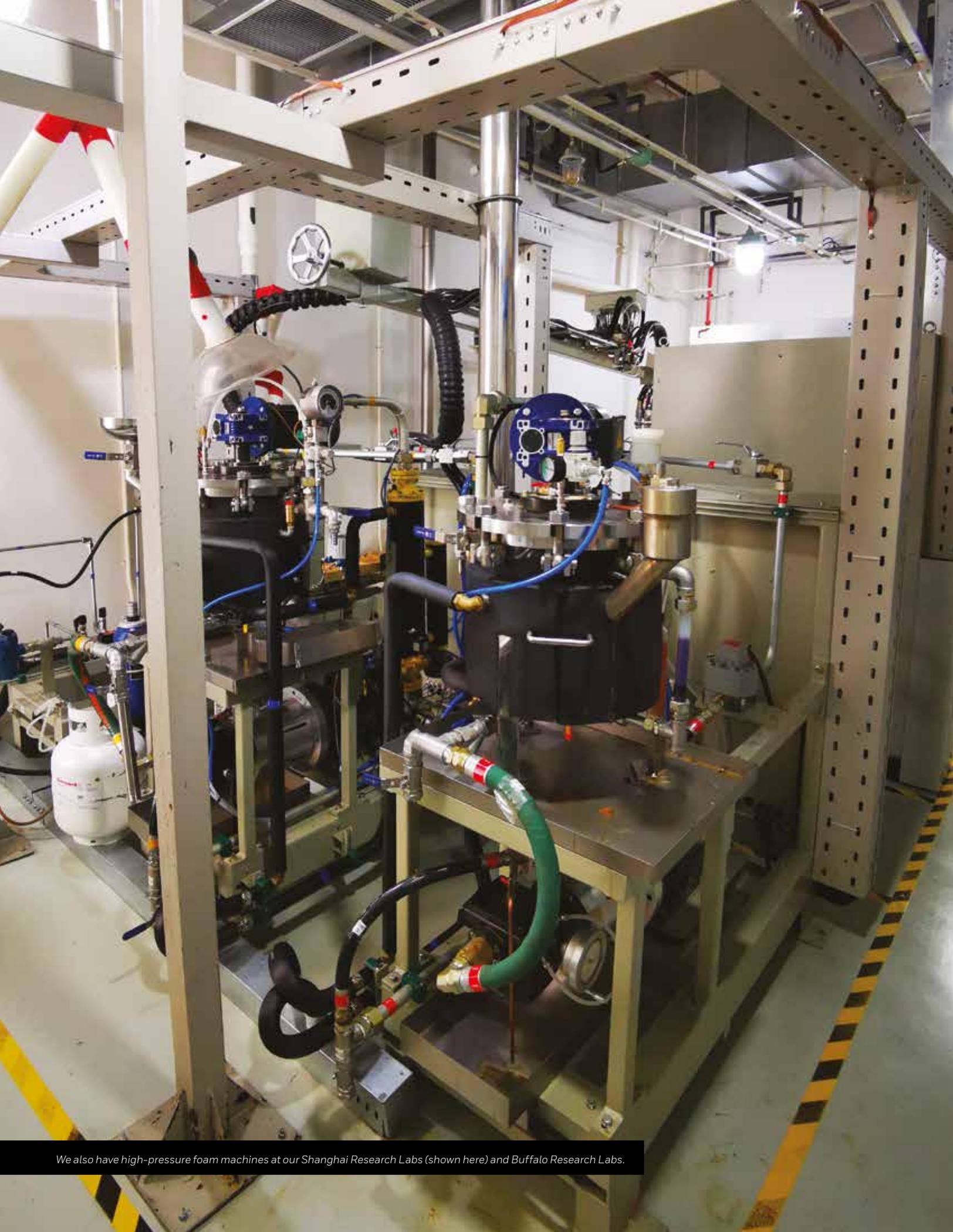


*We perform extensive foam thermal conductivity testing, including testing at cryogenic temperature.*





*Our high-pressure foam machines are capable of handling flammable blowing agents and can replicate appliance, panel, and pour-in-place operations. This one is located in our India Technology Center in Gurgaon.*



We also have high-pressure foam machines at our Shanghai Research Labs (shown here) and Buffalo Research Labs.

# BROAD INTELLECTUAL PROPERTY PORTFOLIO

Honeywell has invested extensive time and resources to develop Solstice blowing agents. We protect our investment in R&D through patents and we enable our customers to conduct business through the consistent delivery of high quality product. Our Solstice line of products includes compositions designed for maximized initial and aged R-value and enhanced mechanical properties, vapor pressure management, extended shelf life, among other things. Honeywell's patents cover a wide range of foam blowing agent solutions and applications.

Honeywell's patent portfolio is based on the following molecules: HFO-1233zd(E), HFO-1234ze(E), and HFO-1336mzzm. Below is a table that sets forth some of our patents that may be helpful as you consider your technology roadmaps and business plans. This is not intended to be an exhaustive list of Honeywell's global foam blowing agent patents portfolio.

PATENTS	
U.S. PATENT NUMBER	DESCRIPTION

## BLOWING AGENT BLENDS WHICH OPTIMIZE VALUE IN USE

### With other Hydrofluoro-olefins

9,499,729	Solstice LBA (HFO-1233zd(E)) and Solstice GBA (HFO-1234ze(E))
8,734,671	
8,962,707	Solstice LBA (HFO-1233zd(E)) and Solstice GBA (HFO-1234ze(E)) and a co-blowing agent
8,279,145	Solstice LBA (HFO-1233zd(E)) and Solstice GBA (HFO-1234ze(E)) in thermoplastic foam
9,029,430	Solstice LBA (HFO-1233zd(E)) and Solstice GBA (HFO-1234ze(E)) in polystyrene foam
9,410,024	Solstice LBA (HFO-1233zd(E)) and Solstice yf (HFO-1234yf)
9,145,480	Solstice LBA (HFO-1233zd(E)) and HFO-1336mzzm(Z) and/or HFO-1336mzzm(E) and a co-blowing agent
9,708,454	
10,344,136	
8,846,754	Solstice LBA (HFO-1233zd(E)) and HFO-1336mzzm(Z) and/or HFO-1336mzzm(E)

### With Hydrocarbons

8,420,706	Solstice LBA (HFO-1233zd(E)) and C4 - C6 hydrocarbons
9,701,782	Solstice LBA (HFO-1233zd(E)) and cyclopentane in pour-in-place polyurethane foam
9,000,061	
8,802,743	Solstice LBA (HFO-1233zd(E)) and n-pentane, isopentane, neopentane, isohexane

## PATENTS

### With Water

8,420,706	Solstice LBA (HFO-1233zd(E)) and water
9,592,413	HFO-1336mzzm(Z) and water

### With CO<sub>2</sub>

8,420,706	Solstice LBA (HFO-1233zd(E)) and carbon dioxide
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### With Alcohols, Ethers, Chlorocarbons, or HFCs

8,420,706	Solstice LBA (HFO-1233zd(E)) and C1-C5 alcohols
8,420,706	Solstice LBA (HFO-1233zd(E)) and C1-C4 ethers
7,935,268	Solstice LBA (HFO-1233zd(E)) and trans-1,2-dichloroethylene
8,946,312	Solstice LBA (HFO-1233zd(E)) and HFC-365mfc

## BLOWING AGENTS TO MEET GWP AND ODP REGULATIONS

9,303,162	Solstice LBA (HFO-1233zd(E)) in low k-factor foams
8,618,040	Solstice LBA (HFO-1233zd(E)) in spray foam
9,095,737	Solstice LBA (HFO-1233zd(E)), HFO-1336mzzm(Z), and/or HFO-1336mzzm(E) in spray foam
9,181,419	Low GWP refrigerator with Solstice LBA (HFO-1233zd(E)) blown foam and Solstice yf (HFO-1234yf) refrigerant

## METHODS AND ADDITIVES TO OPTIMIZE THE PERFORMANCE OF FOAM FORMULATIONS

9,556,303	Solstice LBA (HFO-1233zd(E)) plus zinc and/or bismuth-based catalysts and a tertiary amine
9,051,442	Solstice LBA (HFO-1233zd(E)) plus precipitation resistant metal catalysts and a tertiary amine
9,695,267	Solstice LBA (HFO-1233zd(E)) in low water containing polyol blends and methods to add water separately
9,453,115	Solstice LBA (HFO-1233zd(E)) plus acid blocked tertiary amine catalysts
10,066,071	
9,550,854	Solstice LBA (HFO-1233zd(E)) plus hindered tertiary amine catalysts
10,077,330	HFO-1336mzzm(Z) and/or HFO-1336mzzm(E) plus water and PMDETA catalyst

Honeywell's intellectual property covers a wide range of blends used today and anticipated to be used in the future. As the transition to low global warming solutions continues, we look forward to working with our customers in the development of new applications and material combinations that include Solstice LBA and Solstice GBA. Please contact us for a specific analysis of your product mix and to discuss ways we can support your product development needs.



#### Contact Us

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