

# SOLSTICE<sup>®</sup> AIR HFO-1234ze(E), cGMP

An Ultra-low Global Warming Potential (GWP)  
Aerosol Propellant for Metered Dose Inhalers

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Metered dose inhalers (MDIs) have been in use for more than 65 years. The chlorofluorocarbons (CFCs) used in the first MDIs were replaced with hydrofluoroalkane (HFA) propellants after 2012 in accordance with the Montreal Protocol. However, concerns around the use of HFAs have grown since these compounds can be potent greenhouse gases. In fact, according to the Climate and Clean Air Coalition, phasing down all use of HFAs worldwide can avoid up to 0.5° Celsius of global warming by the turn of the century.<sup>1</sup>



Honeywell's Solstice® Air (HFO-1234ze(E), cGMP) uses Hydrofluoroolefin (HFO) technology, a sustainable alternative to HFAs in MDIs. With an ultra-low GWP, Solstice® Air is a breakthrough medical propellant currently in clinical development for MDIs with the ability to reduce greenhouse gas emissions of propellant by up to 99.9% vs current inhaler propellant.

Solstice® Air does not contribute to ground-level ozone creation and is VOC-exempt per the U.S. Environmental Protection Agency (EPA) and the California Air Resource Board (CARB).

#### A PROVEN SAFETY PROFILE

Solstice® Air has undergone an extensive battery of toxicology studies that are able to support FDA Investigational New Drug (IND) filings. Pre-clinical toxicology studies include: acute inhalation exposure, repeated dose inhalation exposure, genotoxicity, and reproductive and developmental toxicity in multiple species. Additional long-term repeated dose studies are on-going in multiple species. In a human clinical study, Solstice® Air was not found to be a human skin sensitizer. The results of those studies concluded that

Solstice® Air exhibited a good safety profile for its use in Metered Dose Inhalers as well as other potential drug delivery systems.

#### FLAMMABILITY

Solstice® Air does not exhibit vapor flame limits under standard test conditions. It is therefore classified as non-flammable according to EC Testing Method A11: Flammability of Gases, and by the U.S. Department of Transportation (DOT) standard (tested according to ASTM E681). HFO-1234ze(E) is non-flammable in the ASTM flame projection test; and it is found to be non-flammable in the ignition distance test and the enclosed space ignition test (closed drum test).<sup>2</sup>

#### DRUG MASTER FILE

A Drug Master File (DMF) was filed with the U.S. FDA in June 2020 containing information as it pertains to Honeywell's manufacturing, quality, toxicology studies, and container closure systems. The DMF has been used to successfully support an IND, allowing Phase 1 clinical trials to commence. Additionally,

a DMF has been submitted to CFDA in China and filed in Japan.

#### REGULATORY COMPLIANCE

As an alternative solution to anticipated HFA phase-down by the Environmental Protection Agency (EPA) and other governing bodies, Solstice® Air complies with global regulations. It is registered in Europe under REACH (Regulation 1907/2006) for tonnages of more than 1,000 tonnes/ annum. Solstice technology has been SNAP listed in various end-use applications since 2010, and is also registered or in compliance with chemical inventories in Japan, China, Canada, Australia, New Zealand, South Korea, Russia, Taiwan, Thailand, and Vietnam.

#### AVAILABILITY

Samples of Solstice® Air are available for testing. Information about commercial quantities is available upon request.

1. [EPA Phasedown of Hydrofluorocarbons](#)  
 2. [Flammability Assessment](#)  
 3. [IPCC Assessment Report 5](#)

#### PHYSICAL PROPERTIES COMPARED WITH HFA PROPELLANTS\*

| ATTRIBUTE  | SOLSTICE® AIR<br>HFO-1234ZE(E)                 | HFA-134A                                       | HFA-152A                                       |
|--|--|--|--|
| Global Warming Potential (GWP) vs. CO <sub>2</sub> , 100-year ITH <sup>3</sup> | <1   | 1300   | 138  |
| Volatile Organic Compound (VOC)  | No   | No   | No   |
| Flammability <sup>2</sup>  | No   | No   | Yes  |
| LFL / UFL<br>(Vol. % in Air @21°C)   | NONE   | NONE   | 3.9/16.9                                       |
| Molecular Weight   | 114  | 102  | 66   |
| Boiling Point (°C)   | -19  | -26  | -25  |
| Vapor Pressure<br>@ 70°F/21°C<br>@ 130°F/54°C                                  | 64.2 PSIA (4.42 bar)<br>161.7 PSIA (11.15 bar) | 85.8 PSIA (5.92 bar)<br>213.4 PSIA (14.71 bar) | 77.0 PSIA (5.31 bar)<br>190.6 PSIA (13.14 bar) |
| KB Value   | 12   | 9  | 11   |
| Specific Gravity @21°C   | 1.17   | 1.22   | 0.91   |

\*These are just some of a mosaic of properties that must be considered in identifying a suitable propellant.