



Honeywell

THE POWER OF **CONNECTED**

**Cool Technology
Brings New
Benefits for
Personal Care**



When it comes to personal care, formulators need ingredients that provide exceptional versatility for the development of exciting and novel products. As a global innovation leader, Honeywell is offering breakthrough materials based on next-generation hydrofluoroolefin (HFO) technology, **Solstice® Enhance** and **Solstice® Propellant**. They are ideally suited for personal care formulations. Solstice Enhance and Solstice Propellant are nonflammable (ASTM E-681) and can help reduce environmental impact. They are VOC-exempt (per U.S. EPA), non-ozone-depleting, and have a global warming potential (GWP) of 1 or less.

Solstice® Enhance – Delivering New Possibilities

Solstice Enhance enables the development of innovative and novel personal care formulations for face, body, and hair products. Consumers will experience unique sensations due to the innovative benefits it could provide for your products such as:



EXCELLENT COOLING AND FOAMING ACTION

ABSORBS HEAT FROM SKIN:

High heat of vaporization provides a refreshing, cooling skin sensation

EXCELLENT FOAMING ACTION:

Crackling effect enables visual cues to create a strong reason to believe in your formulations. Works to deliver a moisturizing, cushiony feel in viscous formulations.



SUPERIOR SOLUBILITY (vs. alcohols and hydrofluorocarbons)

SOLUBILIZES HEAVY OIL-BASED INGREDIENTS: Create formulations with a light texture and feel

SOLUBILIZES A WIDE VARIETY OF INGREDIENTS: Examples include protic solvents, ethers, sunscreen ingredients, triglycerides, esters, hydrocarbons, silicones, liquid fatty acids, and oxygen carrying solvents like perfluorodecalin. It may also help solubilize actives to improve formulation efficacy.

MISCIBLE WITH LIQUID

SURFACTANTS: Develop revolutionary

emulsions. Excellent miscibility with surfactants such as polysorbate 20, laureth 4, and oleth-2.

SUPERIOR REMOVAL OF OILS ON SKIN: Readily dissolves natural skin oils and other oily ingredients¹ in rinse-off applications for a clean, refreshing sensation



IMPROVES SURFACE WETTING AND SPREADING (vs. hydrocarbon-based formulations)

EXCELLENT SURFACE WETTING FOR DELIVERY OF ACTIVE INGREDIENTS: Extremely low surface tension enables delivery of actives for enhanced efficacy even on rough, wrinkled, or uneven skin

BETTER SPREADABILITY:

Enables even spreading of the product over a larger surface area

PENETRATES NOOKS AND

CRANNIES: Delivers actives and lifts oils/particulates in rinse-off products

EXCEPTIONAL CARRIER: Non-VOC carrier fluid for active ingredients





FAST DRYING

EVAPORATES QUICKLY: Leaves behind pure product/active and minimizes waiting.

IDEALLY SUITED FOR HAIR

APPLICATIONS: Create dry formulations for hair sprays, dry shampoos, and other styling products.



EXCELLENT DISPERSION OF SOLIDS-BASED AEROSOL PRODUCTS

A POWERFUL COMBO: Solstice Enhance can be combined with Solstice Propellant to provide excellent dispersion of solids-based aerosol products.

PHYSICAL PROPERTIES OF SOLSTICE ENHANCE

Chemical Name	trans-1-chloro-3,3,3-trifluoropropene
INCI Name	Chlorotrifluoropropene
Molecular Formula	CF ₃ - CH = CClH
Molecular Weight	130
Boiling Point	66 °F (19 °C)
Latent Heat of Vaporization at Boiling Point	83.4 BTU/lb / 194 kJ/kg
Freezing Point	-161 °F (-107 °C)
Vapor Pressure at 77 °F (25 °C)	18.6 psia 4.1 psig = 0.3 bars 126 kPa
Liquid Density at 77 °F (25 °C)	10.5 lb/gal / 1.26 gm/mL
Surface Tension at 77 °F (25 °C)	12.7 dyne/cm
Liquid Viscosity at 77 °F (25 °C)	0.446 cP
Solubility of Water in Solvent at 25 °C	460 ppm
Kb Value	25
pH Range (stable over studied range)	3.5 - 11.7

MATERIALS COMPATIBILITY

Solstice Enhance is highly compatible with a wide variety of commonly used plastics and elastomers. Additional information can be provided about compatibility with specific materials.

SAFETY

Solstice Enhance exhibits no vapor flame limits² and has no flash point³. Because its boiling point is <20°C, Solstice Enhance is classified by the U.S. Department of Transportation (DOT) as a UN class 2.2 nonflammable liquefied gas.

The results of extensive toxicity testing support the conclusion that Solstice Enhance exhibits a very low order of toxicity. Accordingly, the American Industrial Hygiene Association (AIHA) has assigned a Workplace Environmental Exposure Limit (WEEL) of 800 PPM (8-hour time-weighted average).

However, Solstice Enhance has not been tested for use in every personal care formulation and it is the customer's responsibility to determine whether it is appropriate for use in its specific formulation and to conduct required testing.



Solstice Propellant – Product Innovation Propelled

As aerosol-based personal care products become even more competitive, there is a growing trend toward propellants that enable packaging design that can set your products apart from the crowd. Aerosols are becoming increasingly popular among consumers⁴. In a survey of 1,000 U.S. adults⁵, two-thirds said they would use some type of food and household product if it were available as an aerosol due to their ease of use.

However, consumers also said that safety and environmental impact, such as recyclability of aerosol cans, are considerations when deciding whether to purchase aerosol products. With that in mind, Solstice Propellant has been introduced as an exciting advancement for aerosol-based personal care products. Here are some of its many benefits:



BETTER FOR THE ENVIRONMENT

STAY AHEAD OF CHANGING

REQUIREMENTS: With the Kigali Amendment to the Montreal Protocol, many countries are eventually phasing out hydrofluorocarbons (HFCs) due to high GWPs. Solstice Propellant offers an ultra-low GWP alternative to HFC-152a and other HFCs.

MEETS VOC TARGETS: Solstice Propellant is VOC-exempt (U.S. EPA).



EASY AND EFFICIENT CONVERSION

MINIMAL CONVERSION COSTS: Honeywell's experienced team helps ensure a smooth, efficient transition.

COMPATIBLE WITH EXISTING EQUIPMENT: Few changes to existing storage and filling equipment are required.

FOCUS ON SAFETY: It is the only nonflammable, ultra-low GWP liquefied gas propellant available today. Hydrocarbons may require special flammable materials handling equipment.



DELIVERS A QUICK DRYING SPRAY

FAST EVAPORATION: Spray small-sized droplets for quick dry time.



MAXIMIZES PACKAGING DESIGN FLEXIBILITY

Only liquefied propellant that enables packaging in plastic aerosol bottles:

- Nonflammable liquefied gas propellant allows formulation of nonflammable products which can be transported under current regulations⁶
- Suitable vapor pressure range for developing formulations compliant with U.S. DOT plastic aerosol pressure restrictions
- Compatible with PET plastic aerosol bottles: No degradation after > 12 months at 104°F (40°C)
- Very low loss rate: Diffusion rate through PET is 1/29th that of carbon dioxide



CONSISTENT, EFFECTIVE SPRAY PERFORMANCE

MEDIUM PRESSURE (49 PSIG at 70°F /21°C): Provides even, consistent spray with minimal overspray. Ideal for hair and facial applications.

HIGHER LIQUID DENSITY (1.17 g/cc at 70°F/21°C): Enables better solubility in viscous formulations. Works very well in formulations containing inorganics, such as zinc oxide.

PHYSICAL PROPERTIES OF SOLSTICE PROPELLANT	
Chemical Name	trans-1,3,3,3-tetrafluoroprop-1-ene
INCI Name	Tetrafluoropropene
Molecular Formula	CHF=CHCF ₃
Molecular Weight	114
Boiling Point	-2.2°F (-19°C)
Vapor Pressure at 70°F (21°C) at 130°F (54°C)	49 psig 3.4 bars 147 psig 10 bars
Liquid Density at 70°F (21°C)	1.17 g/cc
Vapor Flame Limits (Vol. % in Air) Measure at 70°F (21°C)	None
Solubility of Water in 1234ze at 68°F (20°C)	225 ppm
Solubility of 1234ze in Water at 68°F (20°C)	373 ppm

MATERIALS COMPATIBILITY

Solstice Propellant can be blended with other common propellants such as HFC-152a, DME, butane, isobutane and propane, and commonly-used solvents including alcohols, acetone, halogenated and hydrocarbon solvents. It is thermally and hydrolytically stable and exhibits good compatibility with plastics, elastomers, and metals. Additional information can be provided about compatibility with specific materials.

SAFETY

Solstice Propellant is a UN class 2.2 nonflammable liquefied gas. The results of extensive toxicity testing support the conclusion that it exhibits a very low order of toxicity. Accordingly, the American Industrial Hygiene Association (AIHA) has assigned a Workplace Environmental Exposure Limit (WEEL) of 800 PPM (8-hour time-weighted average).

However, Solstice Propellant has not been tested for use in every personal care formulation and it is the customer's responsibility to determine whether it is appropriate for use in its specific formulation and to conduct required testing.

LEARN MORE

Whether it's for new formulations or aerosol-based products, Solstice Enhance and Solstice Propellant can propel your personal care product's success. Contact us today.



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1. Per Honeywell internal ingredient solubility test completed Jan. 2017.
2. Exhibits no vapor flame limits as determined by ASTM E-681 testing.
3. Exhibits no flash point as determined by Seta Flash closed-cup flash point test at 70°F per ASTM D3278
4. Business Wire, Dec. 11, 2017: <https://www.businesswire.com/news/home/20171211005595/en/Aerosol-Market-2017-2023-Forecast-Grow-CAGR-6.5>.
5. Based on a 2015 Honeywell survey.
6. U.S. DOT does not allow transport of flammable plastic aerosol products at time of publication.

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