Solstice™ ze (HFO-1234ze) Refrigerant

Honeywell

LOW GWP HYDROFLUOROOLEFINS (HFO)

The environmental alternative to traditional refrigerants

Fourth Generation Refrigerants for the 21st Century

Honeywell has been at the forefront of every major development of fluorocarbon refrigerants technology. As the world seeks new, lower-global-warming-potential solutions, Honeywell delivers again, with its Solstice™ brand of hydrofluoroolefins (HFOs), a family of unique products that offer comparable performance to today's most widely-used stationary and mobile refrigerants, blowing agents and aerosol propellants. However, unlike their more common counterparts, the molecular structure of Solstice products causes them to have short atmospheric lifetimes, which means they have very low global warming potential (GWP) index.

Honeywell's Solstice brand reflects the products' break-through environmental properties, including their insulating capabilities for foam and their superior cooling capabilities for automotive air conditioning and stationary refrigerant applications.

Solstice ze Refrigerant

Applications

Honeywell's new Solstice™ ze Refrigerant (HFO-1234ze) is the best medium pressure, low GWP refrigerant on the market when considering the balance of all properties. It is an energy-efficient alternative to traditional refrigerants in air-cooled and water-cooled chillers for supermarkets and commercial buildings, as well as in other medium temperature applications like heat pumps, fridges, vending machines, beverage dispensers, air dryers, CO_2 cascade systems in commercial refrigeration, etc.

Multi-awarded by the industry, Solstice ze meets the criteria that are most important to refrigerants customers: Performance, Cost Effectiveness, Environmental Impact and Safety.

Performance

Field tests of air-cooled chillers in similar systems comparing Solstice ze with propane (R-290) show significantly lower energy consumption. In addition, compared to traditional refrigerants, the properties and operating characteristics of Solstice ze are a very good match, but without the environmental penalty of high GWP HFCs.

After modifications are made to compensate for it lower capacity than HFC-134a the advantage of Solstice ze is comparable on higher energy efficiency or Coefficient of Performance (CoP) than 134a across a range of applications and conditions. According to compressors experts, performance with HFOs can be further improved with optimisation of compressor design. Reciprocating, scroll, screw and centrifugal compressors can be used.

Cost-effectiveness

Fast Implementation

Solstice ze exhibits similar performance to medium-pressure refrigerants like 134a, so only minor changes are required to use Solstice ze.

Longer life of compressors

Solstice ze Refrigerant lower discharge pressure results in less mechanical stress, thus extending the life of the compressor.

Energy Efficiency

Solstice ze is more energy efficient in hot regions than competitive LGWP alternatives for this type of equipment.

Global Solution

Solstice ze refrigerant provides efficient cooling in all global climate zones and is commercially available.

Environmental impact

Solstice ze has a GWP of 6, exceeding existing climate protection goals.

- Helps with eco-design directives
- Reduces direct CO_2 emissions by 99.6 percent
- Reduces indirect CO_2 emissions due to the lower energy consumption

Also, atmospheric life is only 18 days, much lower than the 13 years of 134a.

Safety

Solstice ze Refrigerant is significantly safer in use than alternatives such as hydrocarbons and ammonia, which are either extremely flammable or highly toxic.

Physical properties

Solstice ze (HFO1234ze)		
Chemical Name	trans-1,3,3,3-Tetrafluoroprop-1-ene	
Molecular Formula	CHF=CHCF3	
Appearance	Colourless	
Molecular Weight	114 g/mol	
ODP	0	
GWP	6	
Units	**English**	**SI**
ASHRAE Std. 34 Safety Classification	A2L	
Flammability Limits - ASTM E681-04 @ 21°C	Non Flammable	
Flammability Limits - ASHRAE 34 @ 100°C	7% - 12% (by volume)	
Boiling Temperature	-2.1 °F	-19 °C
Critical Temperature	228.9 °F	109.4 °C
Critical Pressure	512.7 psig	36.36 bar
Liquid Density @ 86°F / 30°C	71.56 (lb/ft^3)	1146.26 (kg/m^3)
Specific Heat Liquid @ 86°F / 30°C	0.3349 BTU/lb-°F	1.4012 kJ/kg-°C
Specific Heat Vapor @ 86°F (Atm pressure)	0.21398 BTU/lb-°F	0.89532 kJ/kg-°C

Materials compatibility

Honeywell does not recommend the use of chlorinated solvents to clean refrigeration systems or components. POE oil is recommended for using Solstice ze.

Desiccants

Desiccant driers compatible with Solstice ze are commercially available. Individual drier manufacturers should be contacted for specific recommendations.

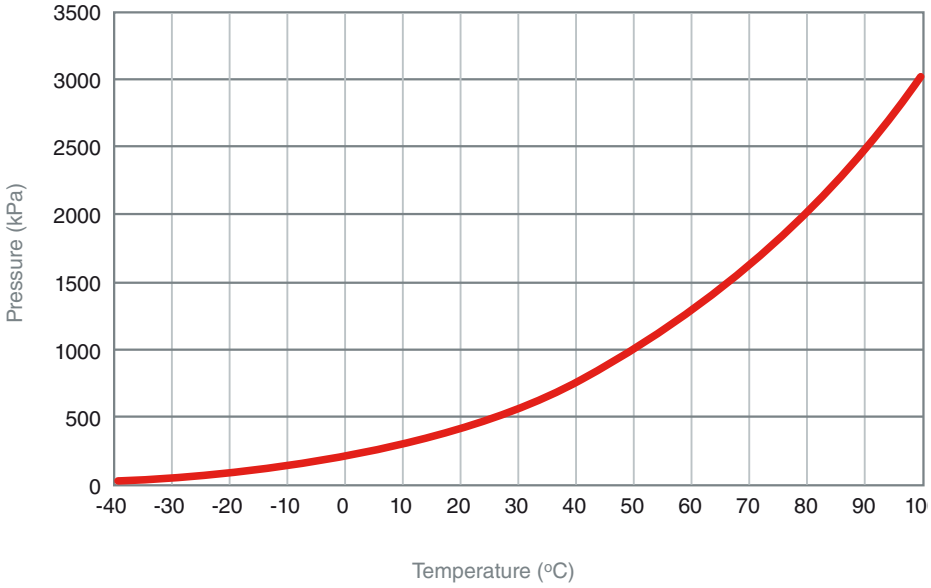
Compatibility of Plastics and Elastomers

Solstice ze is compatible with most common materials. Since there are many different grades and formulations of these materials, we recommend that compatibility testing be performed on the specific grade of materials under consideration when designing new systems. Customers should consult with the manufacturer or conduct further independent testing. Please contact Honeywell for more specific information.

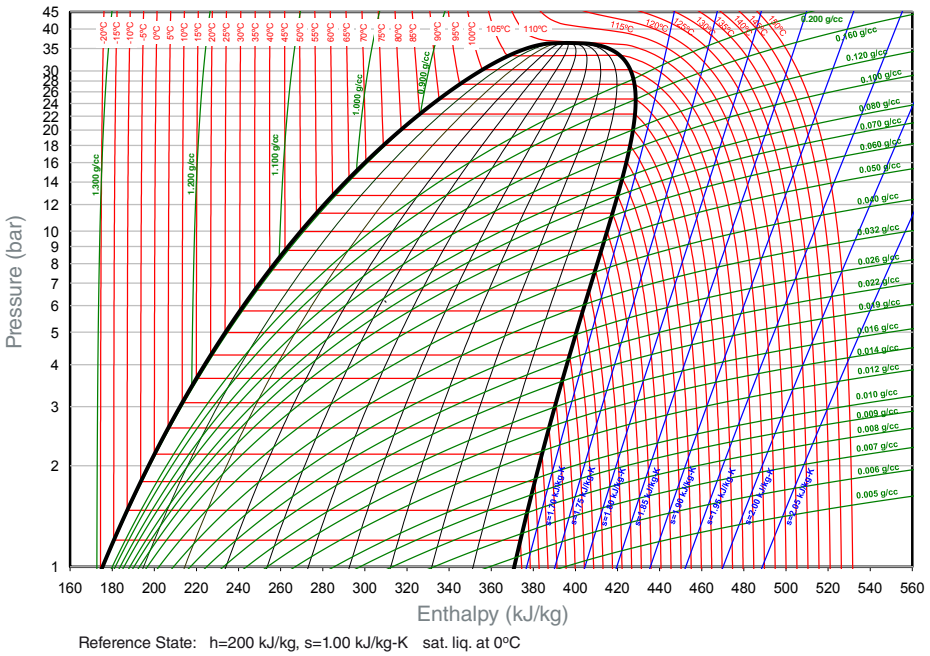
Safety & Toxicity

Honeywell recommends reading the MSDS before using Solstice ze.

Pressure and temperature



Pressure and enthalpy



Reference State: h=200 kJ/kg, s=1.00 kJ/kg-K sat. liq. at 0°C

"The HFO solution shows great promise as it combines good efficiency with very low global warming potential. If the ongoing monitoring of energy continues to prove successful, we plan to include HFO-based chillers in our choice of refrigeration platforms for stores in the future."

Jim Burnett, Waitrose.

Comparison 134a alternatives

	134a	1234ze	CO_2	R600	R290
ASHRAE class	A1	A2L	A1	A3	A3
GWP	1430	6	1	3	3
LFL (vol% in air)*	N/A	7% **	N/A	1.80%	2.10%
UFL (vol% in air)*	N/A	12% **	N/A	8.40%	9.50%
Heat of Combustion (kJ/g)	4.2	10.7	N/A	45.6	46.3
Burning Velocity (cm/s)	N/A	N/A	N/A	41	46
Minimum Ignition Energy (mJ)	N/A	61000 to 64000 ***	N/A	~0.25	0.25
PED (97/23/EC) class	2	2	2	1	1
Flammability for handling and storage	No	No	No	Yes	Yes
Commercial availability	Yes	Yes	Yes	Yes	Yes
Ease of adoption	Baseline	Moderate - Easy when systems can be designed	Difficult - Very sophisticated systems	Difficult - Flammability issues limit charge amounts	Difficult - Flammability issues limit charge amounts
Cost of adoption	Baseline	Moderate	High	High	High

Flame limits- ASTM E681-04 at 21°C; **(at 100°C); *(at 54°C)*

Storage and Handling

Solstice ze is has similar storage and handling, since according to the compressed gas classification it is non-flammable. For more information please contact Honeywell representatives.

Packaging

Solstice ze is available in 890 kg rolldrum and ISO bulk. For other packing sizes please contact Honeywell representatives.

Download **Genetron Properties Suite software** for free at **http://www.honeywell-refrigerants.com**

Available on the App Store

Download **Honeywell retrofit calculator** and **PT chart iPad Apps** for free on iTunes

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OUR COMMITMENT TO SUSTAINABILITY

RESPONSIBLE CARE
Honeywell Performance Materials and Technologies, as a member of the American Chemistry Council, has adopted Responsible Care® as the foundation of health, safety, and environmental (HS&E) excellence in our business. Responsible Care is the chemical industry's global voluntary initiative under which companies, through their national associations, work together to continuously improve their health, safety and environmental performance, and to communicate with stakeholders about their products and processes.

Our commitments:
The safety of our employees
The quality of our products
Being responsible stewards for the protection of the environment, the communities in which we operate and our customers

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