

Storage, Handling and Use Guidelines for Solstice[®] zd Refrigerant

Before handling the refrigerant, it is essential that you read the Safety Data Sheet (SDS) for Solstice[®] zd refrigerant. Special attention should be given to section 2 on hazards identification, and section 4 on first aid measures.

Risk assessment and risk minimisation in facilities typically require evaluation on a case-by-case basis since facilities may vary from one another in many ways. To assist you in assessing and minimising risk in association with the use of Solstice zd, a number of general guidelines can be applied.

Cylinder Storage

- Store cylinders in a cool, well-ventilated area with low risk of fire and out of direct sunlight. Ensure that cylinders are properly strapped into place. Avoid dropping, denting or mechanically abusing containers.
- Store on elevated or concrete floors to avoid tank corrosion, and protect cylinders from moisture and rusting during storage.
- Do not store Solstice zd cylinders near sources of open flames and do not allow containers to exceed 50°C.
- Smoking should be prohibited in storage, handling, and servicing areas where Solstice zd is used.

Accidental Spillage

Solstice zd is a liquefied gas with a boiling temperature of 19°C. In case of accidental spillage, use non-combustible absorbent materials, (e.g., sand, earth vermiculite, diatomaceous earth), to contain and collect spillage (see SDS section 13). Place spilled material in an appropriate container for disposal according to local regulations.

Handling

Personal Protective Equipment (PPE)

- Gloves
 - Avoid cloth gloves (possible frostbite in contacting liquid)
 - Incidental liquid contact: wear PVA or neoprene gloves
 - Avoid repeated exposure or prolonged contact
- Eyewear
 - Safety glasses for normal operations
 - If liquid contact is probable, wear chemical safety goggles and self-contained breathing apparatus

- Respiratory Protection
 - None for adequately ventilated work areas
 - For accidents or non-ventilated work situations, wear self-contained breathing apparatus

Personnel Training

A written emergency response plan should exist and be available. In addition, personnel should:

- know product hazards and have access to SDSs
- be trained to handle refrigerants and hold appropriate certifications
- be properly trained and know his / her responsibility in case of an emergency

Offloading Procedure

Because of its properties, the use of Solstice zd requires attention in the equipment and setup.

The very low vapour pressure values require additional steps for offloading cylinders and tanks, compared to other products:

- 1. Before offloading the product, store the container indoor overnight, if possible**
- 2. The use of a heating blanket will facilitate the offloading, alone or in combination with 1**
- 3. The use of a pump is required, alone or in combination with 1 and 2**

- Make sure you always operate in a clean safe area.
 - Ensure enough clearance to walk around the container
 - Ensure connections are visible, to allow visual leak check
 - Keep environment noise low, to allow leaks to be audible
 - Do not leave connection hoses suspended
 - Do not step over pressurised hoses
- Continuously check pressure values during the whole process
- Read the SDS. A paper copy of is included in the shipping documents.
- Always use PPE, minimally, chemical resistant goggles (eyes) and gloves (hands).



Offloading from a 100-lb Cylinder

Package Specifications	100 lb Cylinder
Product weight (kg)	45.3 kg
Tare weight (kg)	31 kg
Cylinder dimensions	1.3m X 0.3m (Tall X Dia)
Outlet connection	CGA 660 (1.030" 14NGO RH-EXT)

1. Weigh the cylinder to verify initial value (tare can vary slightly)
2. Position the cylinder in the work area
3. An internal dip tubes reaches the lowest point inside the cylinder, to extract all liquid
4. Connect the transfer hoses to the valve outlet and the pump, and install a pressure gauge
5. Install a sight indicator on the line to process (or pump outlet)
6. Open liquid phase valve and start pump, to start the outlet flow; perform a leak check
7. If liquid flow stops, please check the following:
 - The cylinder may be empty. This can be confirmed by verifying the weight
 - Check pressure difference (cylinder compared to process)
 - Check the pump for cavitation
8. Once the product is transferred completely, close the valve on cylinder
9. Depressurise liquid line from cylinder valve to pump
10. DO NOT leave liquid-filled piping blocked with no pressure relief
11. Disconnect hoses
12. Store in suitable storage area
13. Return the empty cylinder to Honeywell



Offloading from a Ton Cylinder

Package Specifications	Ton Cylinder
Product weight (kg)	900 kg
Tare weight (kg)	645 kg
Cylinder dimensions	2.1 m X 0.8m (Length X Dia)
Outlet connection	CGA 660 (1.030" 14NGO RH-EXT)

1. Weigh the ton cylinder to verify initial value
2. Position the ton cylinder in the work area, levelled horizontally, or slightly tilted (lift the end opposite to the valves, about 10 cm)
3. Align valves along a vertical line. The valve in the lower position will be the liquid phase
4. With the ton cylinder in this position, the dip tubes will reach the lowest and highest points, respectively, for liquid and vapour
5. Connect the transfer hoses to the valves outlet, and install a pressure gauge on each side:
6. Connect the bottom valve (Liquid) to pump suction or process pipe
7. Depending on the use, a vapour return line can be connected to the vapour side valve (loop setup)
8. Open liquid phase valve to start the outlet flow to process (perform a leak check)
9. Install a sight indicator on liquid line to process (or pump outlet)
10. If liquid flow stops, please check the following:
 - The ton cylinder may be empty. This can be confirmed by verifying the weight on a scale
 - Check pressure difference (ton cylinder compared to process)
 - If using a pump, check for cavitation
11. Once the product is transferred completely, close the valves on ton cylinder
12. Depressurize liquid line from roll drum valve to process
13. DO NOT leave liquid-filled piping blocked with no pressure relief
14. Disconnect hoses
15. Store in suitable storage area
16. Return the empty ton cylinder to Honeywell
17. DO NOT leave liquid-filled piping blocked with no pressure relief
18. Disconnect hoses
19. Store in suitable storage area

Troubleshooting Guide

Inability to Empty Cylinder

- Insufficient pressure in the ton cylinder will cause the liquid flow to stop
- Excessive pressure in the ton cylinder leads to expansion across outlet valve
- High pressure in the receiving vessel to which the refrigerant is being transferred
- Low ambient temperatures will increase the liquid density, and make the liquid transfer more difficult
- High ambient temperatures will generate possible expansion through the outlet valve
- Pump cavitations, generated by expansion (high temperature) or density increase (low temperature)
- Attempting to achieve excessive flow rate: dip tubes in ton cylinders are small diameter, as well as the orifice in the valve. Excessive flow rate leads to expansion across the valve.

Leak Detection

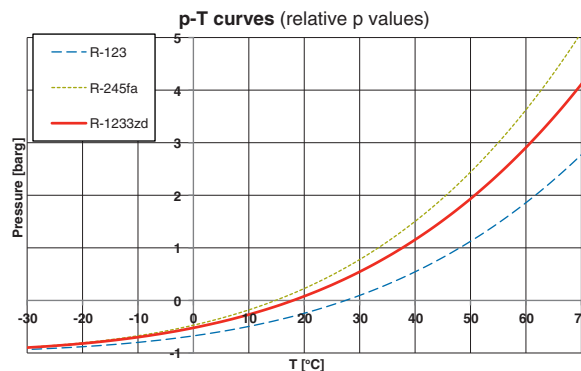
- Periodic leak checks are required during storage
- **In the event of a leak exceeding 1.5 vol%: remove personnel and ventilate the area**
- Constant monitoring for leaks is required during offloading operations
- Continuous refrigerant leak detection equipment
 - Continuous monitoring systems provide alerts to respond in a timely fashion
 - Detection levels of 1.5 vol% (15,000 ppm) are acceptable.
 - Most continuous monitoring equipment detect very low levels
 - Leak detector performance may vary. Consult the manufacturer
- Handheld or portable leak detectors
 - Valuable for maintenance operations and assembly line workers
 - Detect at extremely low levels (<4 g/year leak sizes)
- Add to scheduled routine maintenance operations
 - Check storage containers for leaks
 - Check piping for leaks

Solstice zd properties

Molar Mass	130.5kg/Kmol
Triple point temperature	-78°C
Normal Boiling point	18.32°C
Critical point	
Temperature	165.6°C
Pressure	3572.6kPa
Density	478.92 kg/m ³

T [°C]	Vapour p [Mpa]	Liquid Density [kg/m ³]
-10	0.03	1339.6
0	0.047	1326.7
10	0.072	1312.9
20	0.106	1298.1
30	0.152	1282.2
40	0.212	1265.1
50	0.29	1246.7
60	0.387	1226.7
70	0.508	1204.9
80	0.656	1181.2
90	0.835	1155.1
100	1.048	1126.3

Solstice zd compared to similar products



	Molar Mass	Critical T [°C]	Normal Boiling Point [°C]	GWP	ODP
R-11	137	197.6	23.71	4750	1.000
R-123	153	183.7	27.82	77	0.020
R-245fa	134	154.01	15.14	1030	0.000
Solstice zd	131	165.5	19.00	1	0.000

For more information

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