

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

Honeywell

Before handling the refrigerant, it is essential that you read the Material Safety Data Sheet (MSDS) for the Solstice[®] zd Refrigerant Grade. Special attention should be given to section 2 on hazards identification, 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 the end-user 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, 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 being 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 MSDS 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

- Personnel should know product hazards and have access to MSDSs
- Personnel should be trained to handle refrigerants and hold appropriate certifications
- There should be a written emergency response plan and each person know his/her responsibility in case of an emergency and is properly trained

Off loading Procedure – General Indications

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 off loading cylinders and tanks, compared to other products:

- 1. Before off loading the product, it is suggested to store the container indoor overnight, if possible**
 - 2. The use of a heating blanket will facilitate the off loading, 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 hearing leaks
 - do not leave connection hoses suspended
 - do not step over pressurised hoses
 - Continuously check pressure values during the whole process
 - Read the Material Safety Data Sheet (MSDS). A paper copy of the MSDS is included in the shipping documents.
 - Always Use Personal Protection Equipment (PPE), minimally, chemical resistant goggles (eyes) and gloves (hands).

Off loading from a Cylinder

- Cylinders should be stored in a covered environment, no direct sunlight
- A standard cylinder contains 70 kg of product
- The tare weight of the cylinder is 28 kg
- Standard cylinder dimensions are: 1.1m height x 0.3m diameter
- The standard valve outlet thread is DIN 477 (21.8mm)
- Weigh the cylinder to verify initial value (tare can vary slightly)
- Position the cylinder in the work area
- An internal dip tubes reaches the lowest point inside the cylinder, to extract all liquid
- Connect the transfer hoses to the valve outlet and the pump, and install a pressure gauge
- Install a sight indicator on the line to process (or pump outlet)
- Open liquid phase valve and start pump, to start the outlet flow; perform a leak check
- 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
- Once the product is transferred completely, close the valve on cylinder
- Depressurise liquid line from cylinder valve to pump
- DO NOT leave liquid filled piping blocked with no pressure relief
- Disconnect hoses
- Store in suitable storage area
- Return the empty cylinder to Honeywell



Off loading from a Vertical Drum (VD)

- VDs should be stored in a covered environment, no direct sunlight
- A standard VD contains 1000 kg of product
- The tare weight of the VD is approximately 600 kg
- Standard VD dimensions are: 1.8m height x 0.8m diameter

- The standard valve outlet thread is 1¼ BSW
- Weigh the VD on a scale to verify initial value (tare can vary slightly)
- Position the VD in the work area
- The valves are identified, the liquid phase valve has an internal dip tube that reaches the lowest point inside, to extract all liquid

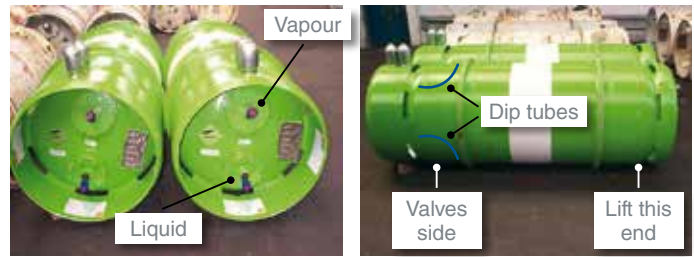


- Connect the transfer hose to the liquid valve outlet and the pump, and install a pressure gauge. Depending on the application, a vapour return line can be connected to the vapour side valve (loop setup)
- Install a sight indicator on liquid line to process (or pump outlet)
- Open liquid phase valve and pump to start the outlet flow to process (perform a leak check)
- If liquid flow stops, please check the following:
 - The VD may be empty. This can be confirmed by verifying the weight
 - Check pressure difference (VD compared to process)
 - Check pump for cavitation
- Once the product is transferred completely, close the valves on the VD
- Depressurise liquid line from VD to pump
- DO NOT leave liquid filled piping blocked with no pressure relief
- Disconnect hoses
- Store in suitable storage area
- Return the empty VD to Honeywell

Off loading from a Roll Drum (RD)

- Roll drum storage: Covered environment, no direct sunlight
- A standard Roll Drum contains 907 kg of product
- The tare weight of the Roll Drum is 472 kg
- Standard Roll Drum dimensions are: 2.4m length x 0.8m diameter
- The standard valve outlet thread is 1¼ BSW
- Weigh the roll drum to verify initial value
- Position the roll drum in the work area, levelled horizontally, or slightly tilted (lift the end opposite to the valves, about 10 cm)
- Align valves along a vertical line. The valve in the lower position will be the liquid phase

- With the roll drum in this position, the dip tubes will reach the lowest and highest points, respectively for liquid and vapour



- Connect the transfer hoses to the valves outlet, and install a pressure gauge on each side:
 - Connect the bottom valve (Liquid) to pump suction or process pipe
 - Depending on the use, a vapour return line can be connected to the vapour side valve (loop setup)
- Open liquid phase valve to start the outlet flow to process (perform a leak check)
- Install a sight indicator on liquid line to process (or pump outlet)
- If liquid flow stops, please check the following:
 - The Roll Drum may be empty. This can be confirmed by verifying the weight on a scale
 - Check pressure difference (roll drum compared to process)
 - If using a pump, check for cavitation
- Once the product is transferred completely, close the valves on roll drum
- Depressurise liquid line from roll drum valve to process
- DO NOT leave liquid filled piping blocked with no pressure relief
- Disconnect hoses
- Store in suitable storage area
- Return the empty Roll Drum to Honeywell

Possible causes of inability to completely empty the container

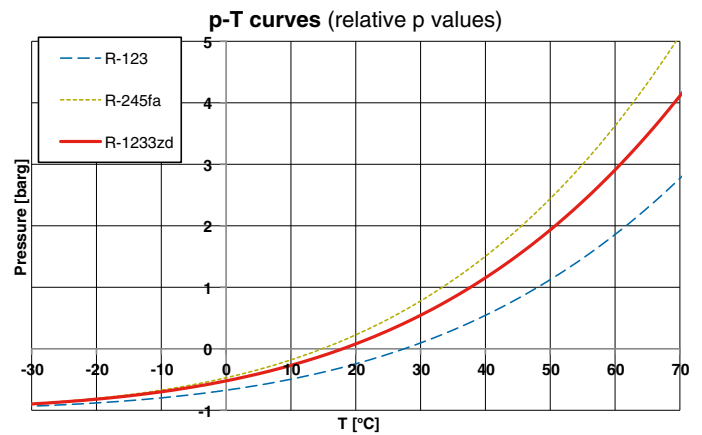
- Insufficient pressure in the roll drum will cause the liquid flow to stop
- Excessive pressure in the roll drum leads to expansion across outlet valve
- High pressure in the receiving vessel the refrigerant is being transferred to
- Low ambient temperatures will increase the liquid density, and make 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 roll drums 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
- Constant monitoring for leaks is required during off loading 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
- In the event of a leak exceeding 1.5 vol%:
 - Remove personnel and ventilate the area

Solstice zd compared to similar products



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

	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

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

For any questions on Honeywell
Solstice® zd Refrigerant, please contact:

Honeywell Belgium N.V.

Interleuvenlaan 15i
3001 Heverlee, Belgium
Phone: +32 16 391 212
Fax: +32 16 391 371
E-mail: fluorines.europe@honeywell.com

Please visit us at

www.honeywell-refrigerants.com/europe

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RESPONSIBLE CARE

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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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