Honeywell
THE POWER OF CONNECTED | Refrigerants

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 is included in the shipping documents.
- Always use PPE, minimally, chemical resistant goggles (eyes) and gloves (hands).

Offloading from a Cylinder

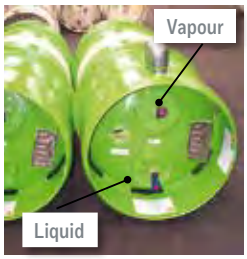
Package Specifications	Cylinder
Product weight (kg	70 kg
Tare weight (kg)	28 kg
Cylinder dimensions	1.1m X 0.3m (height X Dia)
Outlet connection	DIN 477 (21.8mm)

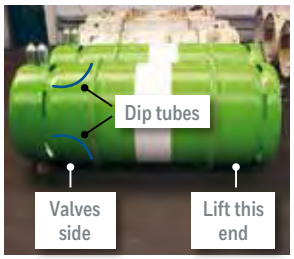
1. Weigh the cylinder to verify initial value (tare can vary slightly)
2. Position the cylinder in the work area
3. An internal dip tubes reaches the lowest point inside the cylinder, to extract all liquid
4. Connect the transfer hoses to the valve outlet and the pump, and install a pressure gauge
5. 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 Vertical Drum (VD)

Package Specifications	Vertical Drum
Product weight (kg	100 kg
Tare weight (kg)	600 kg
Cylinder dimensions	1.8m X 0.8m (height X Dia)
Outlet connection	1¼ BSW

1. Weigh the VD on a scale to verify initial value (tare can vary slightly)
2. Position the VD in the work area
3. The valves are identified, the liquid phase valve has an internal dip tube that reaches the lowest point inside, to extract all liquid
4. 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)
5. Install a sight indicator on liquid line to process (or pump outlet)





6. Open liquid phase valve and pump to start the outlet flow to process (perform a leak check)
7. 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
8. Once the product is transferred completely, close the valves on the VD
9. Depressurise liquid line from VD 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 VD to Honeywell

Offloading from a Roll Drum (RD)

Package Specifications	Roll Drum
Product weight (kg	970 kg
Tare weight (kg)	472 kg
Cylinder dimensions	2.4m X 0.8m (height X Dia)
Outlet connection	1¼ BSW

1. Weigh the roll drum to verify initial value
2. Position the roll drum 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 roll drum 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:
   - 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)
6. Open liquid phase valve to start the outlet flow to process (perform a leak check)
7. Install a sight indicator on liquid line to process (or pump outlet)
8 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

9. Once the product is transferred completely, close the valves on roll drum
10. Depressurise liquid line from roll drum valve to process
11. DO NOT leave liquid-filled piping blocked with no pressure relief
12. Disconnect hoses
13. Store in suitable storage area
14. Return the empty roll drum to Honeywell

Troubleshooting Guide

Inability to Empty Cylinder

- 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 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 roll drums are small diameter, as well as the orifice in the valve. Excessive flow rate leads to expansion across the valve.

Leak Detection

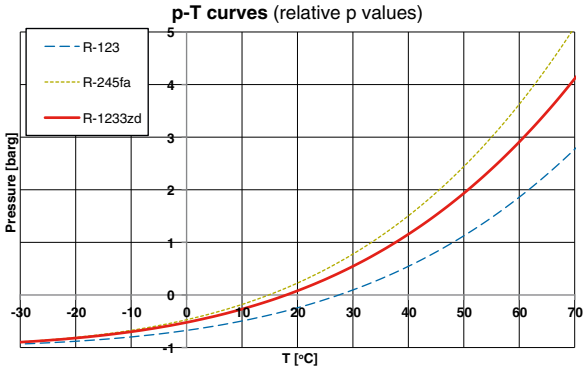
- Periodic leak checks are required during storage
- **In the event of a leak exceeding 1.5 vol%: remove personnel and ventilate the area**
- Constant monitoring for leaks is required during offloading operations
- Continuous refrigerant leak detection equipment
  - Continuous monitoring systems provide 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

www.honeywell-refrigerants.com/europe

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R-1233ZD				
Liquid Temperature (°F)	Liquid Pressure (psia)		Liquid Temperature (°F)	Liquid Pressure (psia)
-20	1.6		116	38.5
-18	1.7		118	39.8
-16	1.8		120	41.2
-14	2		122	42.5
-12	2.1		124	44
-10	2.2		126	45.4
-8	2.4		128	46.9
-6	2.5		130	48.5
-4	2.7		132	50
-2	2.8		134	51.6
0	3		136	53.3
2	3.2		138	55
4	3.3		140	56.7
6	3.5		142	58.5
8	3.7		144	60.3
10	4		146	62.1
12	4.2		148	64
14	4.4		150	66
16	4.6		152	67.9
18	4.9		154	70
20	5.2		156	72
22	5.4		158	74.2
24	5.7		160	76.3
26	6		162	78.5
28	6.3		164	80.8
30	6.6		166	83.1
32	7		168	85.5
34	7.3		170	87.9
36	7.7		172	90.3
38	8.1		174	92.8
40	8.5		176	95.4
42	8.9		178	98
44	9.3		180	100.7
46	9.7		182	103.4
48	10.2		184	106.2
50	10.6		186	109
52	11.1		188	111.9
54	11.6		190	114.8
56	12.2		192	117.8
58	12.7		194	120.9
60	13.3		196	124
62	13.8		198	127.2
64	14.4		200	130.4
66	15		202	133.7
68	15.7		204	137.1
70	16.3		206	140.5
72	17		208	144
74	17.7		210	147.5
76	18.5		212	151.2
78	19.2		214	154.9
80	20		216	158.6
82	20.8		218	162.4
84	21.6		220	166.3
86	22.4		222	170.3
88	23.3		224	174.3
90	24.2		226	178.4
92	25.1		228	182.6
94	26.1		230	186.8
96	27.1		232	191.1
98	28.1		234	195.5
100	29.1		236	200
102	30.2		238	204.5
104	31.3		240	209.2
106	32.4		242	213.9
108	33.5		244	218.6
110	34.7		246	223.5
112	35.9		248	228.4
114	37.2		250	233.5