



LOWEST GWP, NON FLAMMABLE (A1) REPLACEMENT FOR R-404A FOR
LOW AND MEDIUM TEMPERATURE REFRIGERATION EQUIPMENT

Properties, Guidelines and Retrofits

Honeywell Solstice® N40

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Introduction

Honeywell Solstice® N40 (a blend of HFC- 32/HFC-125/HFC-134a/ HFO-1234yf and HFO-1234ze assigned R-448A by ASHRAE) serves as a Low GWP alternative to HFC-404A and also as a non-ozone depleting replacement for HCFC-22 in various commercial refrigeration applications, particularly in medium and low temperature applications.

Since Solstice N40 is a close match to HFC-404A and HCFC-22, it also serves as a retrofit fluid in applications where HFC-404A and HCFC-22 are used. Solstice N40 is also the best performing lower global-warming-potential refrigerant for new supermarket installations with improved energy efficiency compared to other HFCs. It is a better alternative to R-404A in both low- and medium-temperature supermarket applications since it has a higher capacity and efficiency than R-404A.

Applications

Solstice N40 is well-suited as a replacement for HFC-404A and HCFC-22 in low- and medium-temperature commercial refrigeration applications such as supermarket freezer cases, display cases, reach-in coolers, transport refrigeration, and ice machines. Solstice N40 is a direct replacement to R-404A. In the case of R-22 replacement, lubricants such as mineral oil and alkylbenzene that have traditionally been used with R-22 are immiscible with Solstice N40. Miscible synthetic lubricants such as polyol esters should be used to ensure adequate oil return.

Also, Solstice N40 is well suited for new installations as a replacement for R-404A in supermarket applications. Conversion existing R-404A supermarket systems to Solstice N40 will result in significant reduction in their carbon footprint, with reduction in power consumption.

Solstice N40 is a blend refrigerant. It is essential that systems be charged with liquid from the cylinder. Vapour charging Solstice N40 may result in the wrong refrigerant composition and could damage the system. A throttling valve should be used to control the flow of refrigerant to the suction side to ensure that a liquid slug does not enter the compressor. For more details about proper retrofitting procedures, see "Servicing Considerations" and "Retrofitting Existing Systems" in this brochure.

Physical properties

Solstice® N40 (R-448A)	
Class/Type	Zeotropic blend
Formula	26%/26%/21%/7%/20% R-32/R-125/R-134a/R-1234ze/R-1234yf
Kind	HFC / HFO
Appearance	Colourless
ODP (ODP-R11=1)	0
GWP rev 3rd/4th/5th IPCC	1300 / 1387 / 1273
Flammability Limits – ASTM E681-04 @ 21°C	Non Flammable
ASHRAE Std. 34 Safety Class	A1
ATEL/ODL (kg/m ³)	0.390
Practical limit kg/m ³	0.390
LFL (% vol)	Non flammable
REACH	Registered
Units	SI
Molecular weight	86.3 g/mol
Boiling temperature	-45.9°C
Critical temperature	83.7°C
Critical pressure	46.6 bar
Critical volume	0.00208 m ³ /kg
Critical density	480.2 kg/m ³
Vapour density at boiling point	4.701 kg/m ³
Liquid density at 0°C	1192.5 kg/m ³
Liquid density at 25°C	1092.3 kg/m ³
Vapour density at 25°C	48.5 kJ/kg °K
Liquid heat capacity at 25°C	1.553 kJ/kg °K
Vapour heat capacity at 25°C	1.165 kJ/kg °K
Heat of vaporisation at boiling point	241.1 kJ/kg
Vapour pressure at 25°C	1107.1 kPa
Liquid thermal conductivity at 25°C	80.6 W/m °K
Vapour thermal conductivity at 25°C	14.6 W/m °K
Liquid viscosity at 25°C	138.1 µPa sec
Vapour viscosity at 25°C	12.5 µPa sec

Servicing Considerations

Solstice® N40 is a blend of HFC-32/HFC-125/HFC-134a/HFO-1234yf/HFO-1234ze. This product was developed to be used in low and medium-temperature commercial refrigeration applications, especially for retrofitting existing HFC-404A and HCFC-22.

Unlike pure fluids and azeotropes, blends boil and condense at varying temperatures for a given pressure. The range over which the temperature varies is referred to as temperature glide. Solstice N40 has a moderate temperature glide between about 3°K and 6°K, depending upon pressure. When dealing with blends, pressure-temperature tables are presented with two pressures listed for each temperature: the dew pressure and the bubble pressure. The dew pressure is used for determining the system pressure when the refrigerant is in a saturated vapour or superheated condition (i.e., on the suction and discharge sides of the compressor). The bubble pressure is used for determining the system pressure when the refrigerant is in a saturated liquid or subcooled condition (i.e., at the inlet to the expansion valve or capillary tube).

Solstice N40 must be only liquid charged into a system to ensure proper refrigerant composition and system performance. (See "Retrofit Procedures" for more information.)

Materials Compatibility

Honeywell does not recommend the use of chlorinated solvents to clean refrigeration systems or components.

Desiccants

Desiccant driers compatible with Solstice N40 are commercially available. Individual drier manufacturers should be contacted for specific recommendations.

Compatibility of Plastics and Elastomers

The following table summarizes expected materials compatibility data for Solstice N40. It is based on test results for the individual refrigerant components and R-32/R-125/ R-134a/HFO-1234yf/HFO-1234ze blends performed by Honeywell and other worldwide industry organizations.

This data should be used only as a guide to the compatibility of materials with Solstice N40. When retrofitting existing systems to Solstice N40, Honeywell recommends that service technicians consult with original equipment manufacturers for their approved replacement parts. 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. The rankings in the table should be used with caution since they are judgments based on limited samplings. Customers should consult with the manufacturer or conduct further independent testing.

Safety & Toxicity

Honeywell recommends reading the MSDS before using Solstice N40.

Packaging

Solstice N40 is available in 825 kg rolldrum and ISO Bulk. For other packing sizes please contact Honeywell distribution network.

Materials Compatibility Solstice® N40 Plastics/Elastomers

Ethylene-Propylene Diene Terpolymer	S
Ethylene-Propylene Copolymer	S
Chlorosulfonated Polyethylene	S
Chlorinated Polyethylene	D
Neoprene (Chloroprene)	S
Epichlorohydrin	D
Fluorinated Rubbers	U
Silicone	D
Polyurethane	D
Nitriles	D
H-NBR	D
Butyl Rubber	D
Polysulfide	S
Nylon	S
Polytetrafluoroethylene	S
PEEK	S
ABS	U
Polypropylene	D
Polyphenyl Sulfide	U
Polyethylene Terephthalate	D
Polysulfone	D
Polyimide	S
Polyetherimide	S
Polyphthalamide	D
Polyamideimide	S
Acetal	D
Phenolic	S

S = Suitable

U = Unsuitable

D = Suitability depends on formulation

Pressure and temperature

Pressure (absolute) kPa	Liquid (bubble) Temperature °C	Vapour (Dew) Temperature °C
100	-46.2	-40.0
150	-37.5	-31.4
200	-30.8	-24.8
250	-25.3	-19.4
300	-20.6	-14.7
350	-16.5	-10.6
400	-12.8	-7.0
450	-9.4	-3.7
500	-6.4	-0.6
550	-3.5	2.2
600	-0.8	4.8
650	1.7	7.3
700	4.1	9.6
750	6.3	11.8
800	8.5	13.9
850	10.5	15.9
900	12.4	17.8
950	14.3	19.7
1000	16.1	21.4
1050	17.9	23.1
1100	19.5	24.8
1150	21.2	26.4
1200	22.7	27.9
1250	24.2	29.4
1300	25.7	30.8
1350	27.2	32.2
1400	28.6	33.6
1450	29.9	34.9
1500	31.2	36.2
1550	32.5	37.4
1600	33.8	38.6
1650	35.0	39.8
1700	36.2	41.0
1750	37.4	42.1
1800	38.6	43.2
1850	39.7	44.3
1900	40.8	45.4
1950	41.9	46.5
2000	43.0	47.5
2050	44.0	48.5
2100	45.1	49.5
2200	47.1	51.4
2300	49.0	53.2
2400	50.9	55.0
2500	52.7	56.8
2600	54.5	58.4
2700	56.2	60.1
2800	57.9	61.6
2900	59.5	63.2

Storage and Handling

Bulk and Cylinder

Some special handling and storage procedures are required for Solstice® N40 to minimize or prevent liquid compositional changes, particularly those occurring during liquid level depletion or vapour leaks from the storage container. Because these procedures and/or systems are sometimes site specific for designed leak storage systems, contact a Honeywell Technical Service representative to discuss each application. Among the most important handling practices that must be followed for Solstice N40 is transfer of the refrigerant as liquid from one vessel to another. This practice will help minimize compositional changes in the liquid phase and, as a result, provide a more consistent product. Solstice N40 cylinders must be kept in a cool, dry and properly ventilated storage area away from heat, flames, corrosive chemicals, fumes, explosives – and be otherwise protected from damage. Under no circumstances should anything be put into an empty cylinder. Once empty, properly close the cylinder valve and replace the valve cap. Return empty cylinders to your Solstice Distributor. Disposable JUG™ should be discarded in an environmentally safe manner in accordance with all applicable laws and regulations.

Cylinders of Solstice N40 should be kept out of direct sunlight, especially in warm weather. Liquid Solstice N40 expands significantly when heated, reducing the amount of vapour space left in the cylinder. Once the cylinder becomes liquid-full, any further rise in temperature can cause it to burst, potentially resulting in severe personal injury. Never allow a cylinder to get warmer than 52°C (125°F). Always store cylinders above dirt or damp floors to prevent rusting, using a platform or parallel rails. Secure cylinders in place by means of a rack, chain or rope to prevent them from tipping, falling, rolling or accidentally striking each other or any other object. If the cylinder valve is broken off, rapid escape of the high pressure contents will propel the cylinder, which could potentially result in serious injury. Keep cylinder caps in place until the cylinder is in use. The storage area should be away from corrosive chemicals or fumes to avoid damaging effects on the cylinder and threaded areas of the valve. Follow similar precautions for bulk storage and transport systems, ensuring that proper design and operation satisfies the required pressure rating and also avoids external corrosive conditions, over-heating or over-filling.

Any evidence of a leak, whether visually or by a leak detector (see leak detection section), should be corrected immediately by either stopping the leak or transferring all products from the leaking container into a secure container to allow for repairs.

Only attempt transfer and repair if these actions can be performed safely. If there are concerns or questions, contact Honeywell Refrigerants Technical Service for assistance.

Maintenance

A thorough pre-job review must be done to determine respiratory protection requirements, as well as any other safety equipment needed. Maintenance in areas where Solstice N40 has accumulated should be performed only after confirming that work area concentrations are below the permissible exposure level (PEL). This may be determined using a vapour-in-air analyser capable of measuring the amount of airborne Solstice N40. These vapours are heavier than air and can accumulate at floor level. When vapour concentrations are above the PEL, the area should be ventilated to reduce the vapour concentration to below the PEL before entry. Ventilate the area using fans and other

air movers as necessary. If entry must be made to areas where vapour concentrations are above the PEL, appropriate respiratory protection should be used.

Federal occupational health and safety agencies often have legal requirements and guidelines for proper selection and use of respiratory protection. It is often the responsibility of the employer to ensure the safety of the employees performing the maintenance. Be sure to comply with applicable laws and guidelines for proper selection and use of respiratory protection. If the airborne concentration of refrigerant is unknown or at a particular threshold, the law may require the use of supplied air respirators. Particular work team and work zone entry procedures may also apply. Vessels, containers, transfer lines, pumps and other equipment should not be exposed to high-temperature sources (such as welding, brazing and open flames) until they have been thoroughly cleaned and found free of vapours. Exposure to these circumstances can cause fire, explosion and decomposition of refrigerant. This may result in the formation of toxic or corrosive compounds. Potential sources for further vapour releases should also be eliminated if possible. When possible, maintenance or cleaning of equipment should be performed without entering the vessel. A tank or storage vessel may be a confined space. These spaces may have a configuration that can hinder activities and/or expose personnel to the risk of physical injury from entrapment, engulfment, or hazardous atmospheres. Depending on conditions and applicable regulations, a permit may be required to enter such vessels. If a tank must be entered, personnel should be required to use a formal tank entry procedure based on recognized safety principles and comply with all applicable regulations. The procedure would provide guidance for critical items such as but not limited to respiratory protection, safety equipment, work practice, and communication. Among the possible requirements of these procedures is the use of a fully qualified work team and placement of a confined space entry permit at the job site.

Leak Detection

Use leak detectors for pinpointing specific leaks or for monitoring an entire room on a continual basis. Leak detectors are important for refrigerant conservation, equipment protection and performance, reduction of emissions and protection of those coming in contact with the system. Leak testing should not be performed with mixtures of air and Solstice N40. Also, make sure you comply with all new requirements of F-gas regulation (EU) No 517/2014.

Types of Leak Detectors

There are two types of leak detectors – leak pin pointers and area monitors. Before selecting either type, several equipment factors should be considered, including detection limits, sensitivity and selectivity. With selectivity, there are three categories of leak detectors: non-selective, halogen selective or compound selective. In general, the complexity and cost of a leak detector increases as its specificity increases. Fluorescent dyes approved for use by the equipment manufacturer can be added to systems to help pinpoint leaks.

Retrofitting Existing R-22 Systems

As the industry moves away from the use of HCFCs, refrigerant service personnel will play a key role in the transition to alternatives through retrofitting. Honeywell has prepared the following guidelines to help service technicians better understand the various technical and operational aspects of performing retrofits on refrigeration systems using Solstice® N40. Although the information can be helpful as a general guide, it should not be used as a substitute for the equipment manufacturer's specific recommendations. For this reason, Honeywell recommends contacting the equipment manufacturer for detailed information on retrofitting the specific equipment under consideration. Always refer to the Material Safety Data Sheet (MSDS) for safety information on the use of Solstice N40.

Retrofit

Solstice N40 can be used successfully as a retrofit fluid but may require some system modifications such as changing the lubricant. Mineral oils and alkylbenzene lubricants, which have been used traditionally with HCFC-22, are immiscible with Solstice N40 and must be replaced with miscible lubricants such as polyol esters. Consult the original equipment manufacturer for the recommended lubricants.

Retrofit Procedures

1. Record Baseline Data

Prior to retrofitting, it is desirable to record system performance data to establish the normal operating conditions for the equipment. Data should include temperature and pressure measurements throughout the system, including the evaporator, compressor suction and discharge, condenser and expansion device. These measurements will be useful when adjusting the system to Solstice N40 during the retrofit.

2. Return Lubricant

Run each circuit through a defrost cycle to return as much lubricant as possible to the condensing unit. This aids in consolidating lubricant that may have been in circulation throughout the system and makes it easier to isolate for later removal.

3. Isolate HCFC-22 Charge

The HCFC-22 charge should be isolated from the rest of the system by pumping it down into the condensing unit or receiver. If no receiver is present, the refrigerant must be removed from the system using a certified recovery machine capable of meeting or exceeding the required levels of evacuation. The charge must be collected in a recovery cylinder.

4. Record the Amount of HCFC-22 Recovered

It is important to have a record of the amount of HCFC-22 recovered since this will be the basis for determining the Solstice N40 charge amount in Step 16.

5. Choose Compressor Lubricant

Mineral oil or alkylbenzenes are typically used as the lubricants for HCFC-22 compressors. A miscible lubricant such as a polyol ester is commonly used. Honeywell recommends using a lubricant approved by the compressor manufacturer. Differences among the various lubricants make it difficult to assume they are interchangeable. Check with the compressor manufacturer for the approved viscosity grade and brand of lubricant for the compressor in the system being retrofitted.

6. Drain the Lubricant

Since many small hermetic compressors do not have oil drains, it may be necessary to remove the compressor from the system to drain the lubricant. The suction line of the compressor is the best point to drain the lubricant. Using this procedure, it is possible to drain nearly 95 percent of the lubricant. Small hand-operated pumps are available which permit insertion of a tube into the compressor access port for removal of the mineral oil without removing the compressor from the system. Remember that most of the oil must be removed from the system before adding the replacement lubricant. For larger systems, the oil should be drained from multiple points in the system. Particular attention should be paid to low spots around the evaporator where lubricant often collects. The oil also should be drained from oil separators and/or suction accumulators.

7. Measuring Existing Lubricant

Measure and record the volume of lubricant removed from the system. Compare this amount with the amount recommended by the manufacturer to ensure that the majority of lubricant has been removed. This volume also will be used as a guide to determine the amount of lubricant to add in step 9.

8. Change Lubricant Filters if Present

It is good practice to change lubricant filters if the system is so equipped. New filters will help to protect the system.

9. Recharge Compressor with a Miscible Lubricant

Add to the compressor the same volume of miscible lubricant, for example, polyol ester, as the volume of the mineral oil drained in step 6.

10. Evaluate Need for Multiple Lubricant Flushes

Past retrofit practice would have been to recharge the HCFC-22 and run for at least 24 hours to return residual mineral oil to the compressor(s) and oil management system. Typically, 5% residual mineral oil was targeted. Recent field experience suggests that a single oil change may be adequate prior to addition of Solstice N40. Consult Honeywell Refrigerants Technical Service for guidance. (When only one oil change is needed, go to Step 11 below. If R-22 is to be circulated with the new lubricant to further reduce the mineral oil residual, continue with Step 10 as below.)

If the system R-22 charge was pumped into the receiver, the balance of the system should be evacuated and then the receiver valves opened. If the original charge was collected in a recovery cylinder, the system should be evacuated and then recharged with the original HCFC-22. It may be necessary to "top off" the refrigerant charge to compensate for the small amount lost in draining the lubricant.

Run the Compressor

Run the compressor with the new lubricant and the HCFC-22 for at least 5 hours for smaller systems and 24 hours for larger ones. Next, drain the lubricant and recharge with a new charge of lubricant. Check the lubricant that was drained to see if the residual mineral oil content is below 5%. Test kits are available from several lubricant suppliers that check for residual mineral oil content. Generally, it will require about one to three charges to get the mineral oil content down to the acceptable level.

Continue to Flush the System

Repeat steps 8 and 9 until the residual mineral oil content is below 5%. The lubricant that was removed from the compressors in the flushing procedure must be disposed of properly.

11. Evaluate the Expansion Device

Honeywell recommends consulting with the equipment manufacturer before retrofitting. Most HCFC-22 systems with either expansion valves or capillary tubes will operate satisfactorily with Solstice® N40.

12. Replace Sealing Devices

Evaluate and replace all elastomeric seals and gaskets including receiver float, alarm and level control gaskets. HFC refrigerants typically do not swell the “R-22 service” elastomers to the same extent. Sealing devices may also have a certain amount of heat set and/or compression set that can affect their resiliency.

13. Replace the Filter Drier

Following system maintenance, a recommended service practice is to replace the filter drier. There are two types of filter driers commonly used in refrigeration equipment – loose-fill and solid-core. Contact your distributor to obtain a replacement filter drier compatible with Solstice N40.

14. Check for System Leaks

Check the system for leaks using normal service practices.

15. Reconnect the System and Evacuate

Use normal service practices to reconnect and evacuate the system. To remove air and other non-condensables, Honeywell recommends evacuating the system to a full vacuum of 1000 microns or less from both sides of the system. Attempting to evacuate a system with the pump connected to only the low side of the system will not adequately remove moisture and non-condensables such as air. Use a good electronic gauge to measure the vacuum. An accurate reading cannot be made with a refrigeration gauge.

16. Charge System with Solstice N40

When charging the system with Solstice N40, it is important to remember that this product is a blend and not an azeotrope. For this reason, special charging procedures are required to ensure optimal system performance. It is essential when using Solstice N40 that the system be liquid charged by removing only liquid from the cylinder. Never charge the system with vapour from a Solstice N40 cylinder. Vapour-charging Solstice N40 may result in the wrong refrigerant composition and could damage the system. A throttling valve should be used to control the flow of refrigerant to the suction side to prevent liquid slugs from entering the compressor.

NOTE: To prevent compressor damage, do not charge liquid into the suction line of the unit.

Honeywell recommends initially charging the system with 85 percent by weight of the original HCFC-22 charge. For example, if the original HCFC-22 charge was 10 kg, initially charge 8.5 kg of Solstice N40.

17. Check System Operation

Start the system and let conditions stabilize. Compressor suction pressures for the Solstice N40 after stabilization should be similar to that of normal system operating pressure with HCFC-22 for most applications. Compressor discharge pressures typically will be higher (about 20%) than normal system operation with HCFC-22. The condenser fan and ambient controls may require adjustment. It may be necessary to reset the high pressure cutout to compensate for the higher discharge pressures of the Solstice N40 system. This procedure should be done carefully to avoid exceeding the recommended operating limits of the compressor and other system components.

18. Adjust Refrigerant Charge, if Necessary

Systems being charged with Solstice N40 require a smaller charge size than those using HCFC-22. The charge typically will be about 95 percent by weight of the original HCFC-22 charge. If the system is undercharged, add additional Solstice N40 in increments of 5 percent by weight of the original HCFC-22 charge. For example, if the original charge was 10 kg, charge in increments of 0.5 kg. Continue until desired operating conditions are achieved. Use dew-point pressure as a reference in determining the appropriate saturated temperature for a superheat setting. To determine the saturated temperature for a subcooling calculation, use bubble-point pressure.

To avoid overcharging, it is best to charge the system by first measuring the operating conditions (including discharge and suction pressures, suction line temperature, compressor amps, super heat) before using the liquid-level sight glass as a guide.

19. Label Components and System

After retrofitting the system with Solstice N40, label the system components to identify the type of refrigerant (Solstice N40) and specify type of lubricant (by brand name) and viscosity grade in the system. This will help ensure that the proper refrigerant and lubricant will be used to service the equipment in the future.

20. Monitor the System

Observe system operating parameters. Check the condition of the lubricant. It may become necessary to change lubricant filters or suction filters since the retrofit activity and the solvency of synthetic lubricants can return material to the condensing unit.

R-22: Retrofit Checklist for Honeywell Solstice® N40



Retrofit Checklist

1. Record baseline data on original system performance (amp draw, suction pressure, discharge pressure, super heat, sub cooling).
2. Run each circuit through a defrost cycle to return as much lubricant as possible to the condensing unit.
3. Recover HCFC-22 refrigerant charge using appropriate recovery equipment.
4. Record the amount of HCFC recovered.
5. Choose compressor lubricant. Consult compressor manufacturer for lubricant recommendations. Note that lubricants from various manufacturers must not be mixed.
6. Drain the existing lubricant from the compressors, separators and oil reservoirs.
7. Measure amount of lubricant removed.
8. Change lubricant filters if present.
9. Recharge the system with synthetic lubricant, use the same amount that was removed.
10. Traditionally at this point the R-22 would be returned to the system and the system run for at least 24 hours to return as much of the residual mineral oil in the system to the compressors and oil management system. Typically an acceptable residual mineral oil content of 5% was the target. Recent field data suggests the possibility of a successful retrofit with only one oil change performed before the addition of Solstice N40. Consult Honeywell Refrigerants Technical Service for guidance.
11. Evaluate the expansion devices; consult the valve manufacturers for recommendations. No change is necessary in most cases.
12. Evaluate and replace all elastomeric seals including receiver float, alarm and level control gaskets.
13. Replace filter driers and suction filters.
14. Leak check the system and make repairs as required.
15. Evacuate the system.
16. Charge the system with Solstice N40. Remove only liquid from the charging cylinder. Initial charge should be approximately 85% of the R-22 charge by weight. Record the amount of refrigerant charged.
17. Check system operation and operating controls. The discharge pressure of Solstice N40 is slightly higher and condenser fan and ambient controls may require adjustment.
18. Adjust refrigerant charge if necessary, final charge should not exceed 95% of the original R-22 charge.
19. Label components and the system with the type of refrigerant and lubricant.
20. Monitor the system and pay particular attention to the condition of the lubricant. Change lubricant filters or suction filters if necessary. The retrofit activity and synthetic lubricant acting as a solvent may return material to the condensing unit.

Retrofitting Existing R-404A Systems

Solstice® N40 is an HFC-based refrigerant that utilizes synthetic lubricants. The mass flow differences as well as the higher discharge temperature, particularly in low temperature applications, should be evaluated. Check with the compressor manufacturer to determine if the existing lubricant is acceptable. The compressor manufacturer should be consulted regarding acceptable discharge temperature as well. The retrofit procedures listed here have been developed by Honeywell to address these issues and to help technicians perform successful retrofits of R-404A systems utilizing positive-displacement (reciprocating, rotary, scroll or screw) compressors.

When considering replacement of R-404A/R-507 with a refrigerant having lower mass flow relative to 404/507, such as Solstice N40, first confirm that the existing piping is acceptable. It is recommended that piping sizing be checked to determine that pressure drops and velocities would be acceptable with the new refrigerant. Checking piping sizing will confirm that capacity and efficient oil return are not being negatively affected. The TXV must be evaluated to determine its suitability with the reduced (-40%) mass flows relative to R-404A/R-507. Many retrofits already performed have demonstrated the suitability of some installed valves to operate satisfactorily with Solstice N40. Electronic expansion devices may require very little to no adjustment.

Retrofit Procedures

A word about system preparation: In retrofitting an existing refrigeration system, material compatibility and the condition of the existing seals and gaskets must be taken into account. Heat set, compression set, and seal shrinkage can all impact the condition of an existing seal or gasket. When the system is put under vacuum, the sealing device can be displaced, creating the potential for leakage.

1. Record Baseline Data

Before making any hardware changes, compare current system operating data with normal operating data. Correct any deficiencies and record final data as a performance baseline. Data should include temperature and pressure measurements throughout the system including the evaporator, compressor suction and discharge, condenser and expansion device. These measurements will be useful when adjusting the system with an alternative Solstice Refrigerant.

2. Isolate R-404/R-507 Refrigerant Charge

The HFC refrigerant charge should be isolated from the system by pumping it down into the receiver. If no receiver is present, the refrigerant must be removed from the system using a recovery machine capable of meeting or exceeding the required levels of evacuation. The charge must be collected in a recovery cylinder.

DO NOT VENT THE REFRIGERANT

Knowing the recommended R-404/R-507 refrigerant charge size for the system is helpful. If it is not known, weigh the entire amount of refrigerant removed. This amount can be used as a guide for the initial quantity of alternative Solstice Refrigerant to be charged to the system.

3. Choose Compressor Lubricant

In most instances, the lubricant in use with R-404 or R-507 is suitable for use with Honeywell Solstice N40 (R-448A). Honeywell recommends using a miscible lubricant approved by the compressor manufacturer. Differences among lubricants make it difficult to assume that they are interchangeable. Check with the compressor manufacturer for the correct viscosity grade and brand for the compressor in the system being retrofitted. If the lubricant is contaminated or an acid test indicates high levels of acidity, then a lubricant change is warranted (go to step 4). If the system is clean, go to step 11.

4. Drain the Lubricant

Many small hermetic compressors do not have oil drains, making it necessary to remove the compressor from the system to drain the lubricant. In this case, the best point in the system to drain the lubricant is the suction line of the compressor. Small hand-operated pumps are available which permit insertion of a tube into the compressor suction line. For compressors with an access port, the same hand-operated pump can be used to remove lubricant without removing the compressor from the system.

For larger systems, the oil should be drained from multiple points in the system. Pay particular attention to low spots in the system and piping close to evaporators.

5. Measure Existing Lubricant

Measure and record the volume of the lubricant removed from the system. Compare this amount with the amount recommended by the manufacturer to ensure that the majority of lubricant has been removed. This volume also will be used as a guide to determine the amount of new lubricant to add in the next step.

6. Recharge Compressor with Polyol Ester Lubricant

Check with the compressor manufacturer for the recommended lubricant. Add to the compressor the same volume of e.g., polyol ester lubricant as the volume of oil drained in Step 5. Follow the lubricant manufacturer's suggestion for handling polyol ester lubricant. For example, it is recommended that polyol ester lubricant be pumped rather than poured to avoid pick-up of atmospheric moisture. Likewise, systems charged with polyol ester lubricant should not be left open to the atmosphere for more than 10 to 15 minutes. Note that evacuation will not remove moisture from polyol ester lubricant. A filter/drier is the only effective means to remove moisture from polyol ester lubricant.

7. Reinstall the Compressor

Reinstall the compressor following standard service practices recommended by the manufacturer.

8. Evaluate the Expansion Device

Due to the difference in mass flow of Solstice[®] N40 as compared to Genetron AZ-50 and Genetron 404A, the replacement refrigerant requires that the existing thermostatic expansion valves be adjusted. Particular attention should be taken for low temperature application. Consult the valve manufacturer to confirm the suitability of the original valve when using Solstice N40. For systems equipped with a capillary tube refer to the table below for recommendations. Always consult the manufacturer of the equipment prior to retrofitting.

Capillary Tube Length

(Relative to R-404A, same diameter)

Solstice N40 Low Temperature	Medium Temperature
1.8 – 2.2	1.6 -2.0

Retrofit Conditions

38°C Liquid Temperature at Expansion Device Inlet
43°C Condensing Temperature
-40°C Compressor Suction Temperature
Low Evaporating Temperature: -32°C
Medium Evaporating Temperature: -50°C

9. Replace the Filter Drier

Following system maintenance, a recommended service practice is to replace the filter drier. There are two types of filter driers commonly used in refrigeration equipment – loosefill and solid-core.

Check with your distributor to make sure the replacement filter drier is compatible with the Solstice N40 Refrigerant being used.

When changing to an HFC-miscible lubricant, particularly to a more polar lubricant such as polyol ester, it may be beneficial to add a suction line filter.

10. Reconnect the System and Evacuate

Use normal service practices to reconnect and evacuate the system. To remove air and other non-condensables, Honeywell recommends evacuating the system to a full vacuum of 1,000 microns or less from both sides of the system. However, attempting to evacuate a system with the pump connected only to the low-side of the system will not adequately remove moisture and non-condensables such as air. Use a good electronic gauge to measure the vacuum. An accurate reading cannot be made with a refrigeration gauge.

11. Check the System for Leaks

Check the system for leaks using normal service practices.

12. Charge System with Solstice N40 Refrigerant

When replacing R-404A/R-507 with Solstice N40, use the same charging procedures that you would use for the refrigerant being replaced. When working with Solstice N40, it is important to remember that it is a blend refrigerant. It is essential that blend refrigerants be liquid charged by removing only liquid from the cylinder. **Never vapour charge the system with vapour from a 400 series refrigerant cylinder.** Vapour-charging may result in the wrong refrigerant composition and could damage the system.

A throttling valve should be used to control the flow of refrigerant to the suction side to ensure that the liquid is converted to vapour prior to entering the system. NOTE: To prevent compressor damage, do not charge liquid into the suction line of the unit.

Systems being charged with Solstice N40 require a slightly larger charge size than R-404A/R-507. For expansion valves or optimised capillary tube systems, the typical charge size relative to the R-404/R-507 being replaced appears below.

Relative Charge Size: Solstice
Refrigerant: Solstice N40 (R-448A)
R-404A or R-507 Replacement: 104%

As part of general procedure, Honeywell recommends initially charging the system with 85 percent by weight of the original charge.

13. Check System Operation

Start the system and allow conditions to stabilize. If the system is undercharged, add refrigerant in increments of 5 percent by weight of the original charge. Continue until desired operating conditions are achieved.

Compressor suction and discharge pressures for Solstice® N40 (R-448A) relative to R-404A are given below.

Comparative Suction and Discharge Pressure

Versus R-404A

Suction: 0-5 psi (0-35kPa) lower

Discharge: no difference in pressure

It may be necessary to reset the pressure cutouts to compensate for the different pressures of the replacement refrigerant. This procedure should be done carefully to avoid exceeding the recommended operating limits of the compressor and other system components. The use of an unoptimised capillary tube will make the system more sensitive to charge and/or operating conditions. As a result, system performance will change more quickly if the system is overcharged (or undercharged). To avoid overcharging, it is best to charge the system by first measuring the operating conditions (including discharge and suction pressures, suction line temperature, compressor amps, superheat) instead of using the liquid line sight glass as a guide.

For blend refrigerants, pressure-temperature data will include bubble pressure and dew pressure data. To determine superheat, use the dew pressure column. To determine subcooling, use the bubble pressure column. To find average evaporating or condensing temperature, find the measured pressure in both the bubble and dew columns and take the average of the two corresponding temperatures.

14. Label Components and System

After retrofitting the system with Solstice N40, label the system components to identify the specific refrigerant (Solstice N40) and specify the type of lubricant (by brand name) in the system. This will help ensure that the proper refrigerant and lubricant will be used to service the equipment in the future.

System labels are available through your distributor.

Retrofit Checklist for Honeywell R-404A



Retrofit Checklist

1. Record baseline data on original system performance.
2. Isolate R-404/R-507 Refrigerant Charge.
3. Choose compressor lubricant. Consult the compressor manufacturer's data to verify that the same synthetic grade and weight is suitable for use with Solstice® N40, this is generally the case.
4. If required, drain the existing lubricant from the compressors, separators and oil reservoirs.
5. Measure amount (volume) of lubricant removed.
6. Recharge the system with polyol ester lubricant, use the same amount (volume) that was removed.
7. Reinstall the Compressor.
8. Evaluate the expansion devices; consult the valve manufacturers for recommendations. No change is necessary in most cases.
9. Replace filter driers and suction filters.
10. Reconnect the System and Evacuate.
11. Leak check the system.
12. Charge the system with the new refrigerant. In the case of Solstice N40 (R-448A), remove only liquid from the charging cylinder. Initial charge should be approximately 85% of the R-404 charge by weight. Record the amount of refrigerant charged.
13. Check system operation and adjust TXVs and operating controls. The discharge pressure of R-448A is slightly higher and condenser fan and ambient controls may require adjustment.
14. Label components and the system with the type of refrigerant and lubricant.

Environmental Considerations

Solstice® N40 is a halogenated hydrocarbon. Treatment or disposal of wastes generated by use of this product may require special consideration, depending on the nature of the wastes and the means of discharge, treatment or disposal. For more information, refer to the Material Safety Data Sheet (MSDS).

If discarded unused, Solstice N40 is not considered a "hazardous waste" by the Resource Conservation Recovery Act (RCRA). Because Solstice N40 is considered to have minimum biodegradability, care should be taken to avoid releases to the environment.

The disposal of Solstice N40 may be subject to local regulations. Users should conduct disposal operations in compliance with applicable local laws and regulations. Appropriate regulatory agencies also should be consulted before discharging or disposing of waste materials.

Available tools

Simulation software

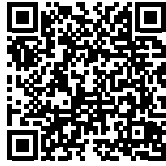
Honeywell's Genetron Software – for refrigerants modelling – allows you to simulate your system with the right refrigerant and export the results to Excel. It has recently been updated to include both Solstice N40 (R-448A) and Solstice N13 (R450A), so you can compare performance of multiple refrigerants, learn the line sizing and many more – all for free. It is available in English, German, Spanish, Portuguese and Italian.

Download the software from <http://www.honeywell-refrigerants.com/europe>

Smart phones apps

Download **Honeywell PT Chart Refrigerants EU** applications for **iOS and Android** free





Scan the QR code for more information

<http://www.honeywell-refrigerants.com/europe/product/solstice-n40/>

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FPR-011/2015-06

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