

Solstice® N40 (R-448A)



**One step beyond with
Solstice N40 (R-448A)**

Honeywell

Tewis

“After this laboratory test, we are convinced that R-448A complements the current portfolio of alternatives for refrigeration systems by providing the lowest GWP, safest, maximum savings refrigerant for optimized characteristics in an R-404A direct retrofit.”

Javier Atencia, Tewis Smart Solutions International



Background, context and issues

Industrial and commercial installations of all types must comply with increasingly strict standards of sustainability, environmental impact and energy efficiency.

In the majority of the more developed countries in the world – regulation, legislation and the potential application of fines involved, result in constant adaptation on the part of these installations to meet these high standards.

Furthermore, industry itself is gradually taking on a commitment to reduce possible harmful effects to the environment, such as by establishing green or sustainable agendas that set goals to reduce the impact of their activity.

There is one clear strategic factor in this scenario that fully affects refrigeration systems, which are vital, in preserving dairy, fresh and frozen products in supermarkets, as well as in many other sectors. The efficient operation of a refrigeration system largely depends on the properties of the refrigerant used.

At the same time, aiming at even lower GWP while keeping the performance and energy efficiency features, any gain in achieving safer performance and closer retrofit conditions at warmer temperatures provides even more benefits.

The characteristics of this fluid, essential for maintaining a variety of perishable products in perfect condition, are being increasingly valued by businesses in the industry. Hence, some firms like Honeywell have research and development departments that are continuously working on replacing refrigerant gases that have been used until now with others that are safer, harmless to the environment and efficient; and other companies, such as Tewis Smart Solutions International, are focusing their technological research on designs and systems that result in the lowest possible TEWI (Total Environmental Warming Impact) through savings in energy consumption and environmental properties. It is in this context that Tewis has undertaken this test for the purpose of estimating the energy saving potential of the refrigerant R-448A (Solstice® N40).

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An optimal refrigeration system largely depends on the properties of the refrigerant used ”

Tewis Smart Solutions International: committed to energy efficiency

Tewis Smart Solutions International, one of the leading energy consulting firms with operations in five countries on three continents, decided to undertake a rigorous and meticulous comparative assessment of the properties of the refrigerant Solstice® N40 (R-448A) compared to other gases that it could substitute (R-404A, in this case).

Tewis has focused its business on continuous development and concern for research and identification of new solutions and controls for refrigeration, directed toward the implementation of more efficient, less energy consuming systems. This goal has led them to open their own laboratory at their Valencia facilities, a pioneering step in this field in Spain.



A conclusive trial with an added seal of warranty

The Tewis team has set up a controlled laboratory trial with a well-defined objective: to analyse the energy consumption of a medium temperature refrigeration installation with two different refrigerants – R-448A and R-404A – under similar weather conditions and with a short time difference.

The data resulting from the study must allow evaluation of possible energy savings based on the use of refrigerant R-448A in comparison with its predecessor, R-404A, with the same compatibility characteristics for the existing installation as with the former (additional value for Solstice® N40).

To provide the greatest possible accuracy, consistency and reliability for the entire trial, the test was conducted in the Tewis laboratory, which holds different certificates of quality, accuracy and good practices.

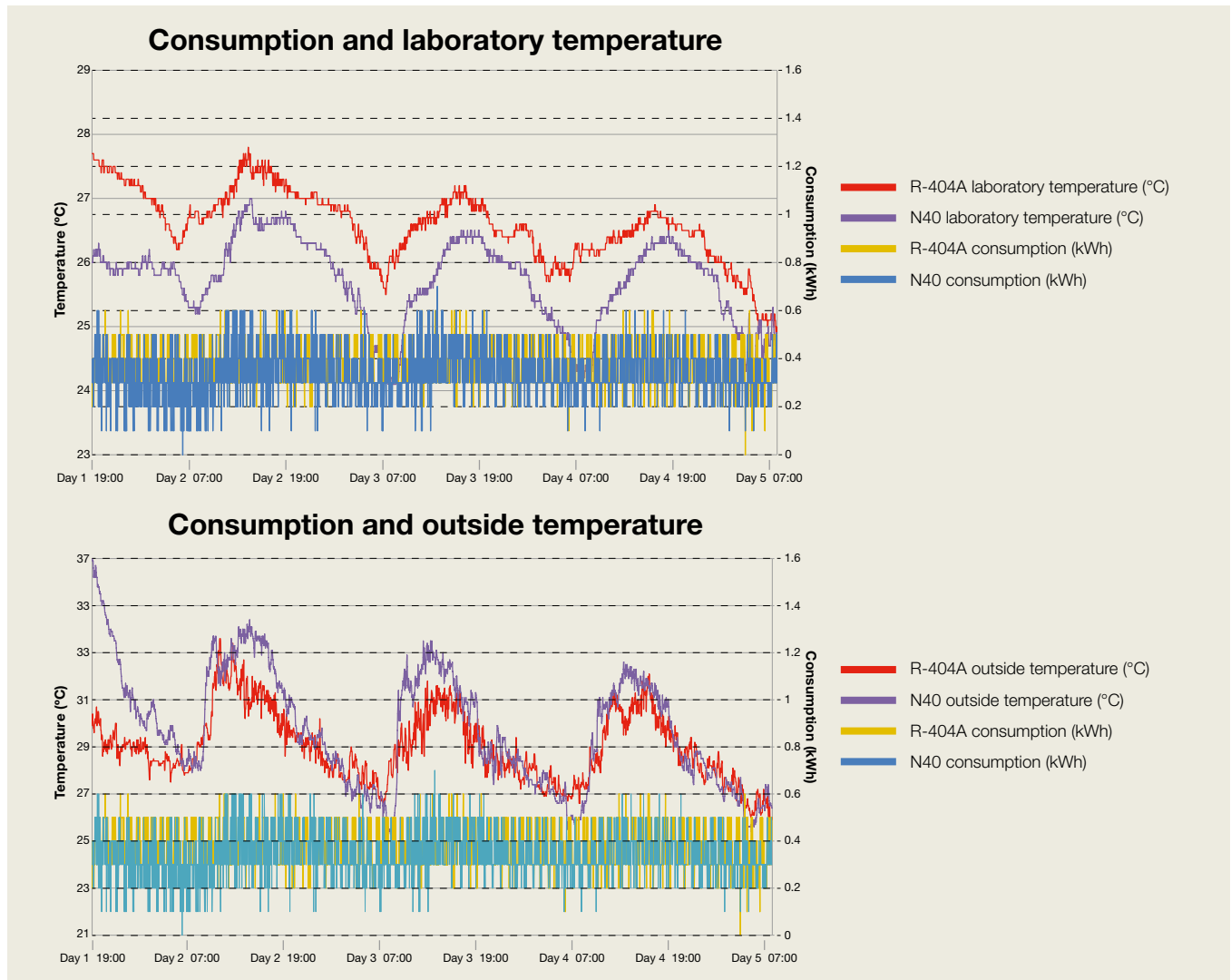
After two 85-hour operational cycles of a compressor pack connected to a series of refrigerated display cases, each using one of the two refrigerants for comparison, the results demonstrated the energy saving potential of R-448A, as well as the advantages of a discharge temperature very close to that from R-404A.

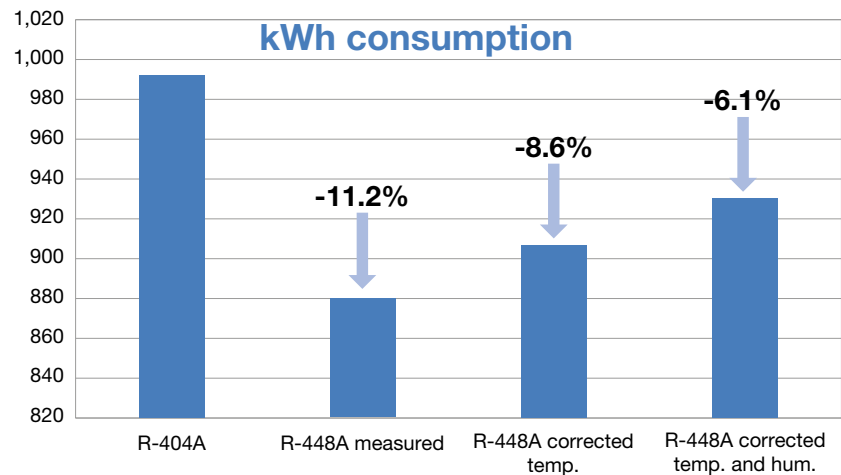
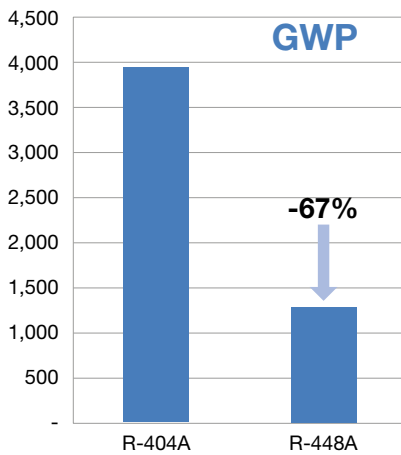
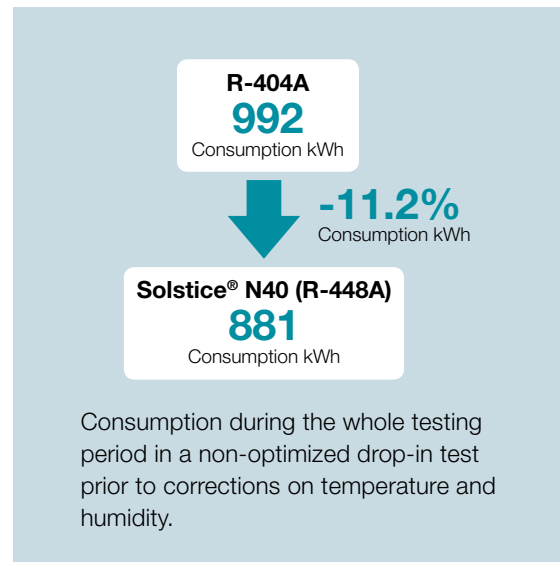
The new refrigerant developed by Honeywell showed a reduction in energy consumption of more than 8% kilowatts/hour than when the system ran on R-404A.

It should be noted that the initial trial indicators showed an even greater saving in favour of Solstice® N40 – specifically over 11% – but given that there was a slight variation in the outside temperature (less than one degree) in the two periods during which the tests were run, a correction factor was applied that

provides even greater precision in the final results.

The conclusion is that the potential for reduction in energy consumption that Solstice N40 (R-448A) provides, combined with the improved capacity and with lower CO₂ emissions compared with its competitors, makes it the most suitable replacement for the more common refrigerants used in Commercial Refrigeration today. The potential for improving overall profitability of operations involving refrigeration makes it a key product for increasingly sustainable industries.





The Solid Advantages of R-448A:

1. Reduction of carbon emissions.

Previously conducted tests have already made it possible to establish the better performance of R-448A gas compared with other gases that it is gradually replacing, such as R-404A; its global warming potential (1273, according to IPCC rev5) is about 68% less than refrigerant R-404A (3943), and lower than any other alternative used in commercial refrigeration.

2. Savings on energy bills.

In terms of energy consumption, the >8% savings indicated in the Tewis trial (a saving due strictly to the refrigerant and under the worst conditions and with very restrictive criteria regarding the influence of differences in ambient temperature) confirm the potential to increase such efficiency to even higher savings on an optimized systems.

3. Application in already existing installations

There is no need to replace refrigeration systems in order to use R-448A. With a series of minor adjustments, Solstice® N40 can be used with no problem in existing systems. In this way, the necessary remodelling of gas refrigeration installation groups that commercial and industrial establishments face has a major ally in this new refrigerant.

4. Approval by major manufacturers of components, and can be handled by technicians and installers.

R-448A is in advanced to final stage of approval by major manufacturers of compressors, valves and other component OEM's, and there is no significant difference in its handling for regular technicians and installers, so that it can be handled safely and with no major changes.

A Rigorous Testing Methodology Endorsed by Tewis Quality Certificates

- The refrigeration system in the Tewis laboratory was charged with 80 kg of R-404A refrigerant, and run uninterruptedly for 85 hours from 28th August to 1st September 2014.
- The same schedule was repeated for Solstice® N40 (R-448A) from 11th to 15th September with the same charge load.
- The key parameters were recorded in both cases: average power (every 2 minutes); outdoor ambient temperature (every 2 minutes); temperature in the refrigerated cases (every 2 minutes) and laboratory temperature (every 2 minutes).
- The main parameter, electricity consumption in the compressor pack, was measured with a calibrated network analyser.
- The tested parameters were measured for the average time of both tests (85 hours) to eliminate transients effects in the system. The two tests were conducted during two consecutive weeks so temperature conditions were practically the same. As the temperature was not exactly the same despite all efforts, a series of corrections were applied based on the thermal difference between the temperatures of the refrigerated case and the outside.
- The conditions for the regulation and operation of the installation were as follows for both tests:
 - Compressor suction setting: **-10°C**
 - Compressor discharge setting: **40°C**
 - Temperature setting at cases: **2°C**
 - Case loading: **operating empty (without food products)**
 - No system optimization for Solstice® N40 (R-448A)
 - No benefit for R-448A from superheat adjustment

Component	Brand	Model
Compressors (x3)	Frascold	S 7 33Y
Condensers	Siarco	CN 523H
MT refrigerated cases	Frost-Trol	HMC-4/3750/465
Electronic control	Eliwell	EWCM9100 eo
Individual electronic control	Eliwell	ID985/E LX
Expansion valves	Eliwell	PXVB0AR8000
Network analyser	Carlo Gavazzi	EM26-.96

Below you can find a table summarising results:

Refrigerant	Consumption (kWh)	Relative humidity	Laboratory Temp (°C)	Case Temp (°C)
R-404A	991.8	61.95	26.58	4.10
R-448A	881.0	57.42	25.70	3.85



Methodology used to correct the effect of variation in the external temperature

Bearing in mind that the two testing periods were conducted with a sufficiently close time period, linear and proportional performance of energy consumption in relation to temperature is assumed; the thermal jump existing between the case and the ambient temperature within the laboratory where the test was conducted was considered the key variable of reference. This thermal difference could be considered, in a simplified manner, proportional to the heat extracted by the unit.

It means, the increase in this thermal difference is considered, as a simplified approximation, to be proportional to the increase in energy consumption*. By establishing a simple formula, it is possible to calculate the power consumption measured with R-448A under the temperature conditions that the refrigerant R-404A was tested with.

$$\text{Consumption}'_{R-448A} = \frac{\Delta T'_{R-448A}}{\Delta T_{R-448A}} \cdot \text{Consumption}_{R-448A}$$

Refrigerant	Consumption (kWh)	Temperature Gradient (°C)	Laboratory Temp (°C)	Case Temp (°C)
R-448A	881	22.48	26.58	4.10
R-448A'	906	21.45	25.70	3.85

* This approximation may be considered to be excessively rigorous, as the thermal difference is less than one degree and this difference could be within the tolerance of the temperature measuring devices.

To be even more rigorous, a further correction on humidity can be done to establish the most stringent comparison for Solstice N40 (R-448A), as humidity

during the R-404A testing period was higher. Thus, a correction factor recommended by case manufacturers is applied (HF).

$$\text{Corrected consumption}_{R-448A} = \frac{\Delta T'_{R-448A}}{\Delta T_{R-448A}} \cdot (\text{Consumption}_{R-448A} + \text{Consumption}_{R-448A} \cdot \text{HF})$$

Corrected consumption of R-448A = 931kWh

Considerable savings

The final achieved results show considerable advantages of energy consumption in a drop-in test (non-optimized system). Not only the final values have been achieved without using the benefits of superheat adjustment or other potential improvements, but also these results have been obtained in Spain in a warm climate, under strong influence of the temperature and humidity. Expected results in regions with colder climate conditions potentially involve further benefits.

Regarding the increase in regulatory control, the economic impact resulting from taxes in some countries on fluorinated greenhouse gases on all industries that use stationary refrigeration (supermarkets, hypermarkets, convenience stores, the food industry, vending machines, etc.) should be noted. These taxes set a new rate for industry, with the new amount to be determined by the type of refrigerant or blend, the

charge and the global warming potential (GWP) of the gas used in each case. Taxes seeks to stimulate leak containment, use of gases with lower environmental impact, levied especially on those with higher GWP, as well as recycled/reclaimed fluids.

In this context, the potential of Solstice® N40 (R-448A) is even more obvious. Besides the proven reduction of 8.61% of energy consumption, this refrigerant also has potential global warming credentials that make it an option that is difficult to beat: its GWP is 68% lower than R-404A, the gas that it will be replacing in most cases, and less than any other alternative that could be used as an immediate drop-in in commercial refrigeration. The potential for reduction of direct and indirect emissions that R-448A (N40) provides, aside from its environmental benefits, economic advantages that are far from insignificant.

Refrigerant	Consumption (kWh)	Discharge temperature	GWP (4th / 5th review)	Tax 20€/ton CO ₂ e
R-404A	991.8	68.33 °C	3922 / 3943	75.68 €/kg
R-448A	931	71.42 °C	1387 / 1273	27.60 €/kg



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Download the free software from Honeywell Genetron Properties Suite at:

<https://www.honeywell-refrigerants.com>

Download the **PT retrofit calculator applications for iOS and Android** free



More information about R-448A

You can find all the information about Solstice® N40 (R-448A) at our website.

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

For information and support on new applications, contact your local Honeywell representative, visit www.honeywell-refrigerants.com/europe or send us an email at fluorines.europe@honeywell.com

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