

LOW- AND MEDIUM- TEMPERATURE REFRIGERATION WITH SOLSTICE[®] L40X (R-455A)

Long-term refrigerant solution for condensing units, waterloop and plug-in systems



Honeywell



APPLICATIONS

Solstice® L40X (R-455A) is an optimal long-term, F-Gas compliant refrigerant solution for applications such as:

- Condensing units and racks
- Waterloop systems for discount stores and small supermarkets
- Plug-ins (low- and medium-temperature)
- Monoblock refrigeration systems
- Food service and collective kitchen
- Low-temperature side of cascade systems

With a GWP of only 146, minimal flammability risk profile, high efficiency, high critical temperature and low critical pressure, Solstice L40X is also a potential match for other applications such as chillers, heat pumps, or transport refrigeration.

Solstice L40X has already been adopted by reputable equipment manufacturers and refrigeration contractors in these segments, and new references are being added everyday.

Using Solstice L40X, retailers, equipment manufacturers and contractors are experiencing:

- Better efficiency and close capacity match when compared to R-404A
- Minimal flammability profile (see “Safety and Flammability”), allowing it to be used in larger charges than competitive products and hydrocarbons, and to cover higher capacity ranges, which reduces the number of circuits to be built
- Possibility to use Solstice L40X for all heat transfer applications in their store or production site (low- and medium-temperature, heat recovery, air-conditioning, heating and hot water), allowing the design of new, eco-efficient system architectures

KEY FEATURES OF SOLSTICE L40X

Solstice L40X (R-455A) is a zeotropic blend, mildly flammable refrigerant (A2L) designed to serve as an alternative for low-, medium-, and high-temperature applications in new systems. Its GWP of only 146 (IPCC AR5) makes it a long-term, F-Gas-compliant solution. It provides

a close capacity match to R-404A, a similar operating envelope when compared to propane, and high energy efficiency.

- GWP of 146 (IPCC AR5) / 148 (IPCC AR4)
- A2L refrigerant with minimal flammability profile
- High efficiency, high critical temperature, and low critical pressure
- Low discharge temperature, similar to R-404A/R-507
- 30 % lower mass flow compared to R-404A/R-507 provides for more compact systems



SAFETY AND FLAMMABILITY

According to ASHRAE 34 / ISO 817, Solstice L40X (R-455A) is classified in safety group A2L, (mildly flammable). This refrigerant is safe to use due to its unique flammability profile:

- It has a relatively high LFL (lower flammability limit) at 11.8 % (431 gr/m³). This is the minimum concentration of the product that one needs to reach in the air in order to have a gas mixture which could potentially be flammable (and only if other relevant conditions are reached at the same time). This is more than 10 times higher than the LFL of propane.
- The upper flammability limit (UFL) is at 12.9% (471 gr/m³). This means that the potentially flammable concentration range (the difference between the LFL and the UFL) is just 1.1%. If a gas mixture of Solstice L40X (R-455A) and air, within the flammability range, should start to burn, the composition of the mixture would immediately change and bring the concentration of this refrigerant outside the flammability range. This is an intrinsic additional safety feature, given by the properties of Solstice L40X (R-455A) itself.
- The minimum ignition energy (MIE), required to bring a potential flammable mixture to create a flame, is high (317 mJ), more than 1000 times higher than propane.

- In case of a flame occurring with Solstice L40X (R-455A), the burning velocity is low at less than 1.5 cm/s. The heat of combustion is also very low at 10.2 MJ/kg.

All the specific characteristics listed above show that Solstice L40X (R-455A) can be safely used in refrigeration systems.

TEMPERATURE GLIDE

When developing blends with low flammability, high performance and low GWP, the glide of the refrigerant is often a resulting trade-off, which needs to be taken into account for system design.

Zeotropic blends have been used for many years without issues. Heat exchangers can be designed to even take advantage of the glide through an optimized flow configuration.

Based on a recent scientific study, the composition of Solstice L40X (R-455A) remains very stable in a system, even in case of leakages.

EXAMPLE:

- Mean evaporating temperature: - 10°C
- Mean condensing temperature: + 45°C
- Subcooling: 0 K
- Glide at evaporator: 6.3 K

FLAMMABILITY CHARACTERISTICS FOR SOLSTICE L40X (R-455A)

Upper Flammability Limit (UFL)	12.9 % / 0.471 kg/m ³
Lower Flammability Limit (LFL, based on WCF)	11.8 % / 0.431 kg/m ³
Minimum Ignition Energy	317-331 mJ
Autoignition Temperature	473-477 °C
Heat of Combustion	10.2 MJ/kg
Fundamental Burning Velocity	<1.5 cm/s



CHARGE LIMITATIONS AND RISK ASSESSMENT

It is important to maintain compliance with the instructions of the equipment manufacturer, the European and national safety standards and regulations, as well as the relevant building codes. Furthermore, in the European Union it is explicitly allowed to use a risk assessment in order to accommodate for appropriate refrigerant charge sizes.

General Safety in Use

Standard: ISO 5149 / EN 378

("Refrigeration systems, air-conditioning and heat pumps")

The 2L flammability classification is integrated in various international standards, also in the European EN 378 norm, which outlines the measures required for a safe use of 2L refrigerants. This standard provides for higher charge limitations in systems for 2L refrigerants due to the more favorable flammability profile in comparison with refrigerant classes 2 and 3.

Equipment Safety Standard: IEC/EN 60335-2-89

This is a product standard covering commercial appliances. It provides recommendations for electrical components as well as refrigerant charge limitations, and describes the conditions for using higher charges, in particular the risk assessment processes to be followed.

Comparisons of alternatives and charge limitations

In the standards ISO 5149 and EN 378 the maximum refrigerant charge is given as a function of the system location, occupancy type and refrigerant safety classification. Table 1 shows the maximum refrigerant charges which can be used without room size constraints, in a public space: We are already at a maximum charge of Solstice L40X 17 times higher than that for propane.

Respecting minimum room size conditions, larger refrigerant charges can be used as shown in Figure 1. Depending on level of risk mitigation, much higher charges of Solstice L40X can be used, up to 84kg per circuit.

GUIDANCE FOR USE IN NEW SYSTEMS

Honeywell can provide detailed recommendations for the use of Solstice L40X (R-455A) in various types of systems, including charging of the refrigerant as well as setting optimization. As improving COP of any system is a common trend within the industry, we recommend optimizing systems by proper charge, minimizing running superheat and reduce leaks. The relevant component manufacturer can provide further application advice.

Figure 1

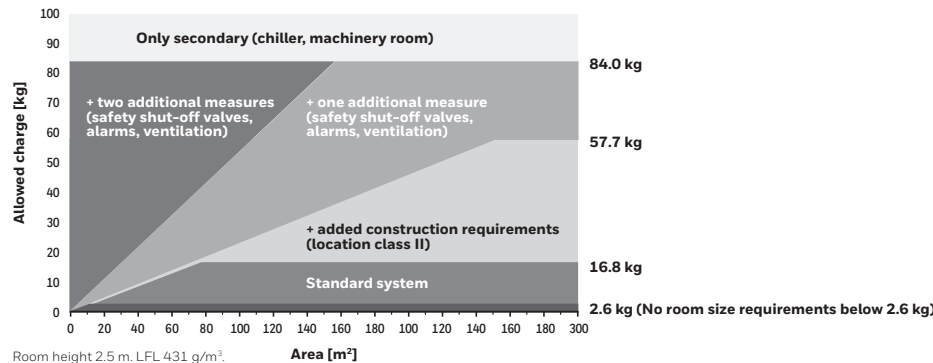


Table 1

MAX. REFRIGERANT CHARGE WITHOUT ROOM SIZE CONDITIONS	
Solstice L40X (R-455A)	2.60 kg
Propane (R-290)	0.15 kg



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