# RS-44b (R453A)

# New Low GWP Drop-In Replacement For R22

## Performance Comparison with Six Existing Refrigerants

### Summary

Independent tests were conducted on RS-44b and six other refrigerants under the same conditions. The results demonstrate that RS-44b has good energy efficiency providing a high cooling capacity with a lower power input and so can be used satisfactorily as a replacement for R22.

### 1. Refrigerants

Gases, Research, Innovation & Technology S.L (GRIT), a Barcelona based refrigeration company, provided 6 unnamed samples of refrigerants to DIRA S.L. (Desenvolupament, Investigació i Recerca Aplicada S.L.) for testing in a suitable calorimeter. Only the identity of R22 was known to DIRA before the trials started. The identities of the other refrigerants were declared at the end of the tests:

- Sample 1 - RS-44b
- Sample 2 - R22
- Sample 3 - R438A (MO99)
- Sample 4 - R422D (MO29)
- Sample 5 - R417A (MO59)
- Sample 6 - R424A (RS-44)
- Sample 7 - R434A (RS-45)

### 2. Calorimeter Cycle

Calorimeter cycle used to carry out the different tests was specifically designed to measure refrigerants' performance.

#### COMPRESSOR

GELPHA 1,5 HP K7.2X model
Wide range of working temperatures

#### CONDENSER

Air-cooled
HRT/4-400-5PN model

#### EXPANSION VALVE

Danfoss TES2 model

#### EVAPORATOR AND COOLING LOAD

The cooling load consisted of a mixture of 25 litres of propylene glycol and 25 litres of water, contained in a cylinder of 50 litres and was stirred in order to ensure good heat transfer and rapid approach to thermal equilibrium. The evaporator was formed of three copper coils (15 metres each coil), wound around the cooling load cylinder and contained within an outer cylinder. The narrow space between the inner outer cylinders was filled with a mixture of ethylene glycol and water (5 litres of each) which provided good heat transfer from the thermal cooling load to the evaporator coils.

#### MEASUREMENTS

All the tests were carried out under the same conditions with the same refrigeration circuit and equipment. Pressures were recorded with a Testo 570-2 device, while temperatures were measured using three other Testo devices. Power input was measured with Landis Gyr counters.
With these instruments it was possible to record:

- Condensation and evaporation pressures.
- Temperature at the end of the condenser.
- Temperature in the middle of the condenser.
- Discharge temperature.
- Liquid temperature condenser outlet.
- Temperature of the top of the outside cylinder.
- Temperature in the middle point of the outside cylinder.
- Temperature of the bottom of the outside cylinder.
- Evaporator outlet temperature.
- Temperature at the inlet of the expansion valve.
- Temperature of the thermal inertia load.
- Power input.

#### SUCTION SUPERHEAT

During the different tests, refrigerant identities were unknown (except R22), so it was not possible to calculate suction superheat using thermodynamic tables. As a consequence, it was necessary to use temperature probes at different evaporator levels.
Average evaporation temperature was estimated according to R22 data. The bubble point temperature was obtained adding half of the glide to the average evaporation temperature. From this last temperature, the aim was to reach an evaporator outlet superheat of about 41°F.

### 3. Test Results - Graphs

#### 3.1 COOLING CAPACITY

The cooling capactiy of RS-44b is shown to virtually match R22 and higher than all the other refrigerants tested.

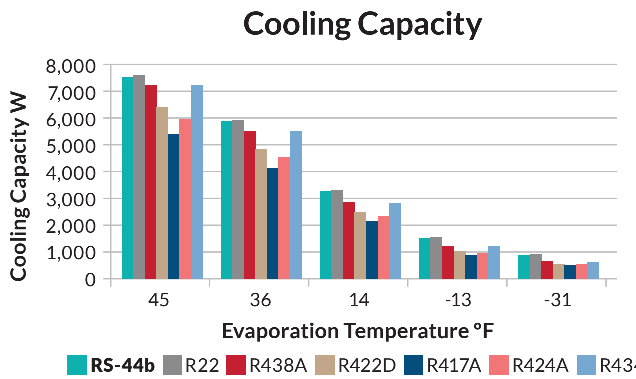


*Figure 1 - Cooling capacity as a function of evaporation temperature*

## 3.2 POWER INPUT

RS-44b requires lower energy.

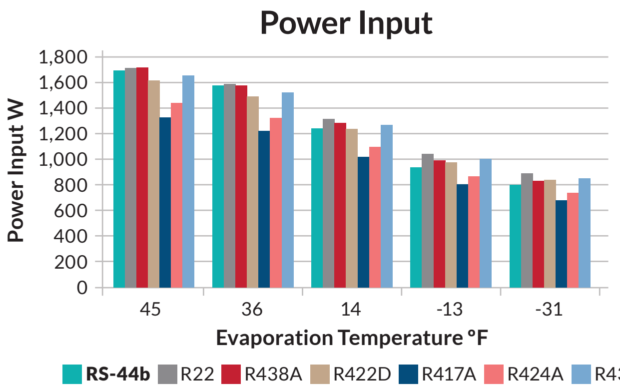


*Figure 2 - Power input as a function of evaporation temperature*

## 3.3 COEFFICIENT OF PERFORMANCE

This graph shows that the COP of RS-44b (sample 1) is comparable to R22 COP (sample 2). In other words, RS-44b reaches a high cooling capacity with a low power input.

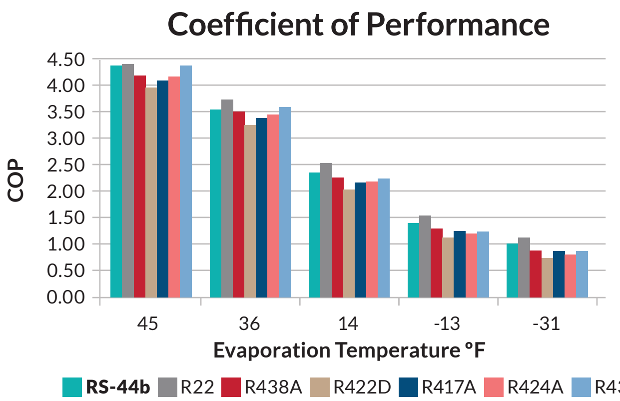


*Figure 3 - COP as a function of evaporation temperature*

## 3.4 SUCTION PRESSURE, DISCHARGE PRESSURE AND DISCHARGE TEMPERATURE

### 3.4.1 Suction Pressure

Pressures shown in the graph were obtained through experimental measurement. From this graph, it can be seen that RS-44b suction pressure is lower than R22.

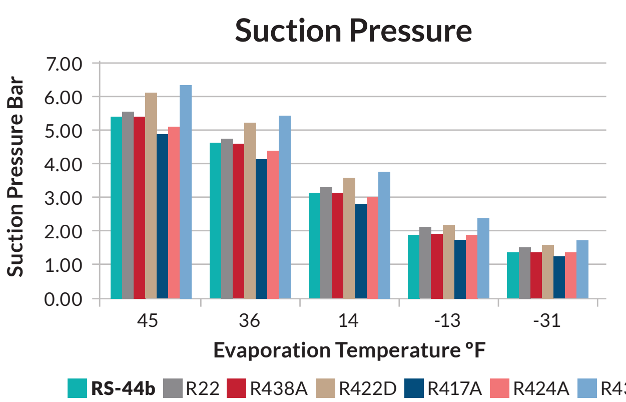


*Figure 4 - Suction pressure as a function of evaporation temperature*

### 3.4.2 Discharge Pressure

This graph shows that RS-44b discharge pressure is lower than R22.

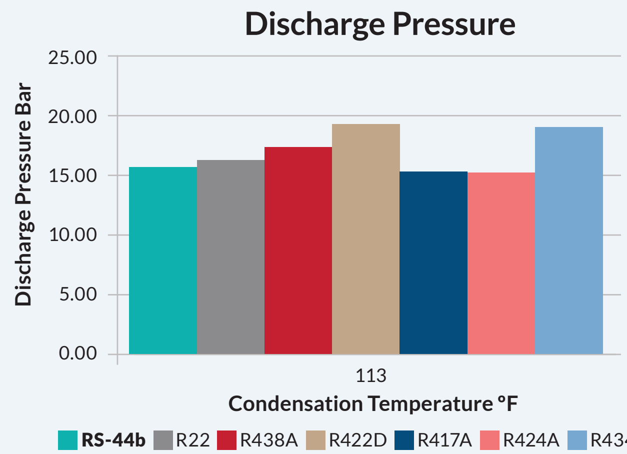


*Figure 5 - Discharge pressure as a function of condensation temperature*

### 3.4.3 Discharge Temperature

This graph shows that RS-44b discharge temperature is lower than R22 and all the other refrigerants with the exception of sample (RS-44).

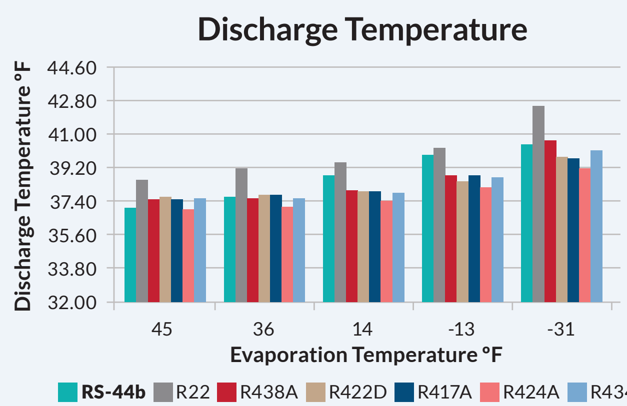


*Figure 6 - Discharge temperature as a function of evaporation temperature*

## 4. R22 replacement advantages of RS-44b

- Same flow rate as R22
- Zero ozone depletion
- Non-flammable & toxicity
- No oil change required
- No system component changes required
- Compatible with mineral, AB, and POE oils
- Lower discharge temperature than R22
- Use same service equipment as R22
- Replaces R22 in both A/C and refrigeration down to -20° F evap temp
- Lowest GWP HFC R22 replacement on the market at 1664 TAR
- Similar discharge pressure as R22
- Matches R22 cooling capacity
- Similar energy efficiency as R22

## 5. Conclusions

RS-44b compares favourably with the other five alternatives to R22, but with the lowest Global Warming Potential (GWP) thereby providing the optimum combination of good thermodynamic properties with environmental performance.

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