CASE STUDY

Replacing R-410A with low GWP RS-53 (R470A) Refrigerant

in a Commercial Air Conditioning A/C Heat Pump

SUMMARY

The performance results of the new refrigerant RS-53 (R470A) tested in a commercial Air Conditioning A/C Heat Pump prove that this product has an excellent energetic efficiency giving high cooling capacity with similar energy consumption. Moreover, RS-53 is an ideal product to retrofit R-410A equipment with ease.

INTRODUCTION

RS-53 is a new refrigerant made and distributed by ComStar International Inc., the world's most comprehensive manufacturer of environmentally safe, industrial-strength chemical products. RS-53 (R470A) was formulated to replace R-410A in existing R-410A systems of all types. The trial aims to prove the ease of retrofitting the R-410A system with RS-53 and to prove the suitability of RS-53 in commercial equipment. The case study also aims to see if the glide difference between RS-53 and R-410A has an effect on the air conditioning or heating performance.

The equipment tested is an inverter AC/Heat Pump unit, in which the fractionation will be checked and compared to RS-53. Additionally, several tests were conducted on the equipment to measure the Coefficient of Performance (COP), cooling and heating capacity, and discharge pressure in both hot and cold settings.

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CASE STUDY

OBJECTIVE

Evaluate RS-53 (R-470A) and R-410A to determine the energy efficiency and capacity of the new RS-53 (R-470A).

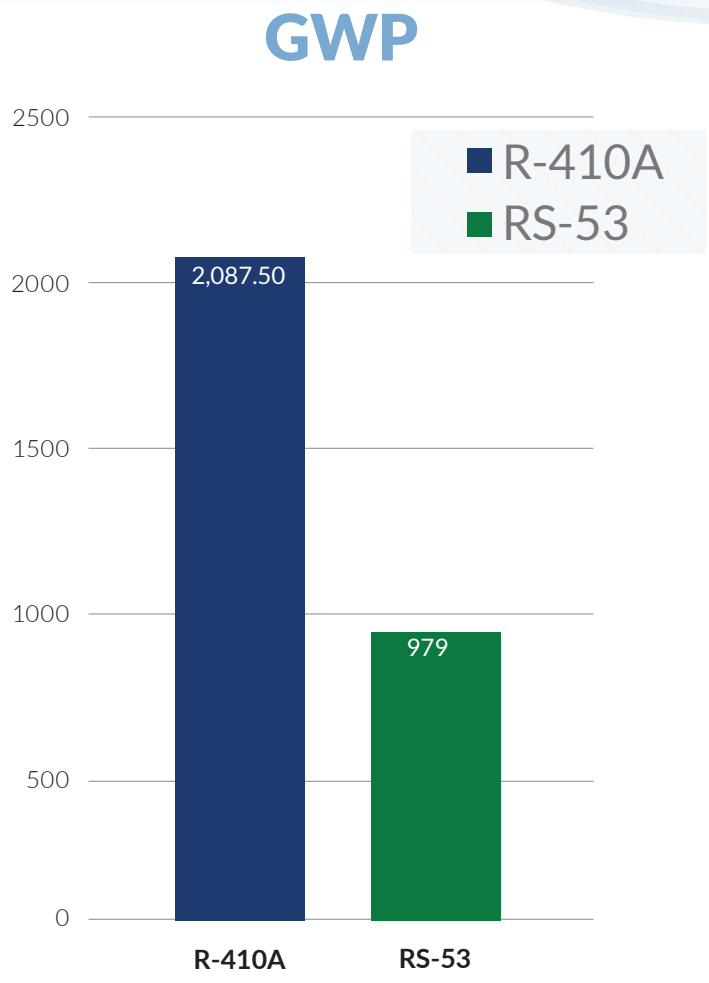
Prove that retrofitting a R-410A system with RS-53 (R-470A) will not adversely affect the performance of the equipment, making it a viable option to meet increasing Federal and State regulations to eliminate refrigerants with a high GWP.

REFRIGERANTS

- **R-410A**
- **RS-53 (R-470A)**

TEST LOCATION

GRIT (Gases, Research, Innovation & Technology, S.L.U.), a refrigerant manufacturer and distributor of RS refrigerants in Europe, conducted the trial at its plant in Avinyo, Spain, using a commercial air conditioning heat pump system.



EXPERIMENTAL SET-UP

AC/Heat Pump equipment //Designed for R-410A

The unit used in this study is adapted specifically to be able to measure the operating characteristics of each refrigerant. The unit is a commercial inverter model used to test the retrofit suitability of the RS-53 (R-470A).

Manufacturer: **Panasonic**

Condenser: **CU-RE12NKE**

Split**: CS-RE12NKE**

Working range: **from 60.8°F (17°C) to 86°F (30°C)**

Condenser: **Cooled by air through a fan**

Expansion device: **Capillary tube**

Refrigerant charge: **The mass of each refrigerant is the same mass that is indicated in the technical specification of the AC unit (780g). The refrigerant is added from a recently prepared 12L cylinder. The test room is closed off during all the experimentation. Its size is 6.5x3.5x2.5 m.**

METHODOLOGY

To minimize discrepancies, the inverter unit's internal auto adjustments are configured identically for each trial. This includes a cooling mode of 60.8°F (17°C), a heating mode of 86° F (30°C), and a maximum split fan speed. The trial applied the following procedure:

1. Initially, a vacuum pump purges the system. Then the gas is added, measuring the quantity dosed by weight.

2. When the gas is added, the unit is initiated with the previously described set points.

3. Using the measured variables, the following parameters are calculated:

- Electric energy consumed
- Heat power generated
- Experimental coefficient of performance (COP)

MEASURES

All the trials are done using the same refrigeration setup, under the same conditions, and using the same monitoring equipment.

The measured variables are:

- Room temperature
- Split outlet temperature
- Split inlet temperature
- Split air velocity
- Suction pressure
- Discharge pressure
- Consumed intensity

SPAIN

Results

ROOM TEMPERATURE VARIATION: HEATING MODE

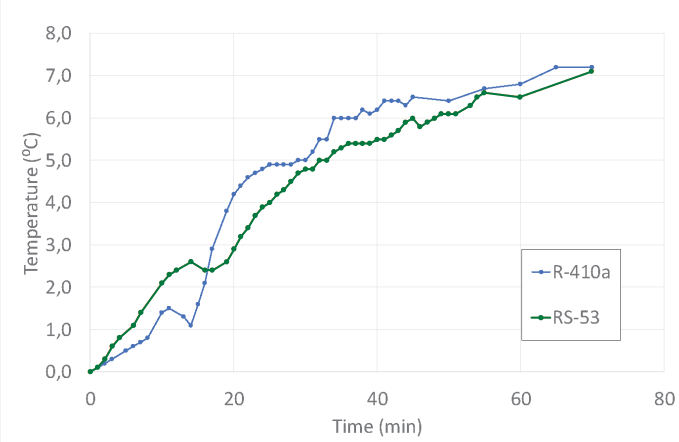


figure 1

Figure 1 Room temperature variation heating mode

As seen from the start, there are differences in how the room temperature increases. Still, when the stationary runtime is reached, the temperature difference using both gases is practically the same. In conclusion, the heating capacity is similar thus proving that the RS-53 (R470A) can be a sufficient drop-in to replace R-410A in heat pump mode.

ROOM TEMPERATURE VARIATION: COOLING MODE

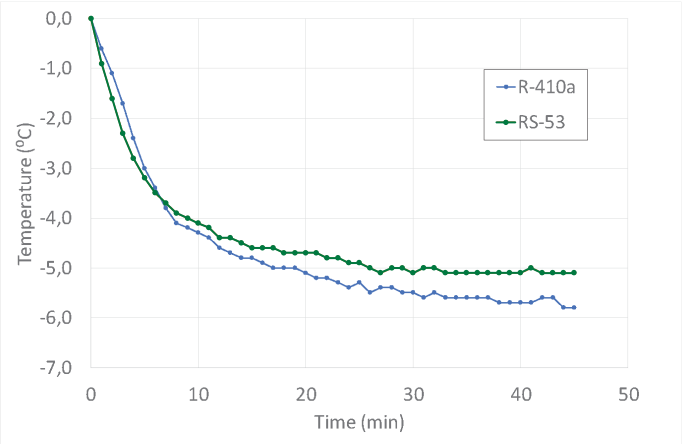


figure 2

Figure 2 Room temperature variation cooling mode

As in the previous case, the difference between both room temperature variations is less than 33.8°F (1°C) between both gases. It can be concluded that the heating capacity is similar, verifying again that the RS-53 (R-470A) could be a sufficient drop-in replace R-410A in cooling mode.

DISCHARGE PRESSURE: HEATING MODE

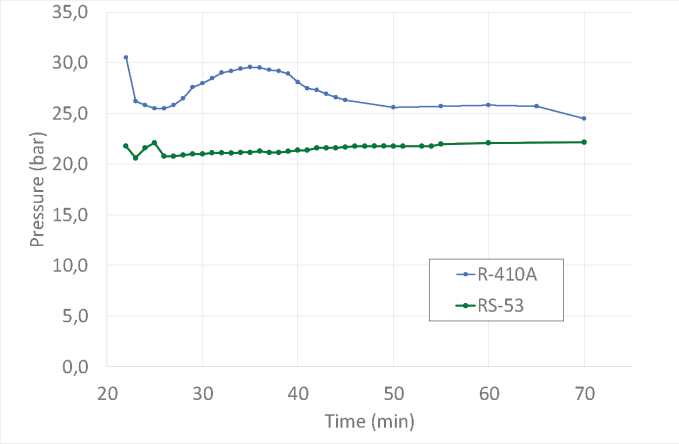


figure 3

Figure 3 Discharge pressure heating mode

Focusing on the stationary runtime, on can see that the discharge pressure using RS-53 (R- 470A) is lower than using R-410A in heating mode.

DISCHARGE PRESSURE: COOLING MODE

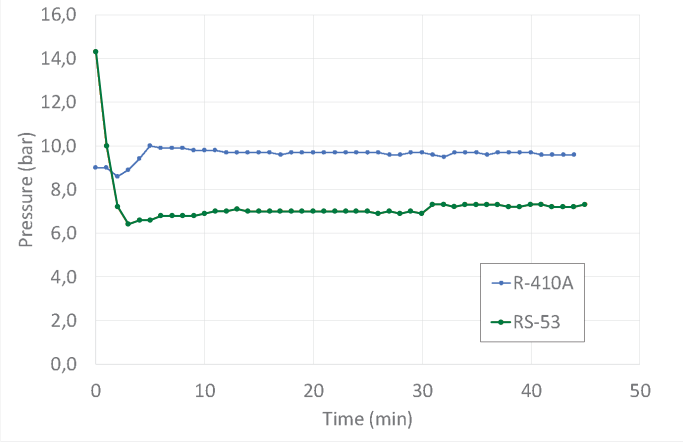


figure 4

Figure 4 Discharge pressure cooling mode

As in the heating mode, one can observe that the discharge pressure using RS-53 (R- 470A) is lower than R-410A in cooling mode.

COEFFICIENT OF PERFORMANCE (COP): HEATING MODE

figure 5

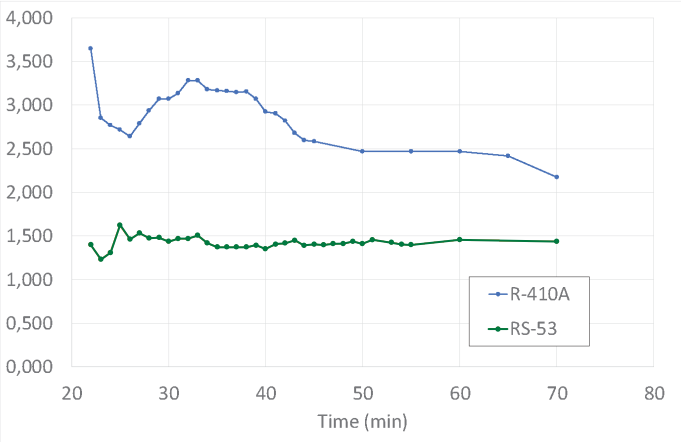


Figure 5 Experimental COP heating mode

Looking at the experimental COP values, in this specific case, the COP using R-410A is higher than the one using RS-53 (R-470A). However, an overall tendency to equalize at a higher working time can be seen. The longer the system is operated, the higher the COP of RS-53 (R-470A) compared to R-410A. Energy consumption is slightly lower by running the system longer vs. more on and off cycles.

COEFFICIENT OF PERFORMANCE (COP): COOLING MODE

figure 6

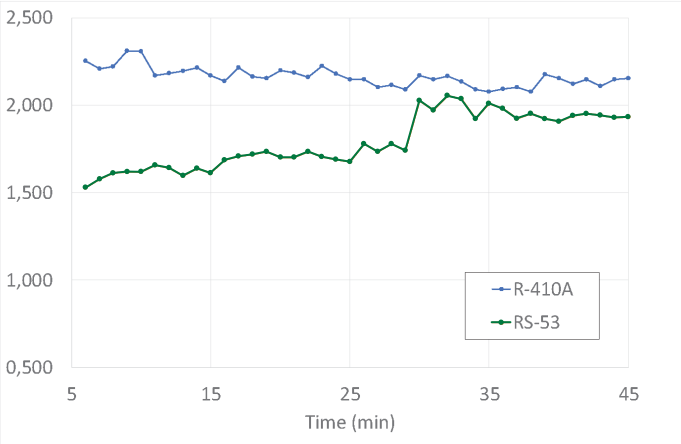


Figure 6 Experimental COP cooling mode

In this case, the COP of RS-53 (R-470A) is closer to R410A and increases over time to match that of R-410A.

Conclusion

Looking at all the data provided in this study the following conclusions can be stated:

- The new RS-53 (R470A) can be used in an Air Conditioning A/C Heat Pump.
- The room temperatures reached with both gases are similar.
- The RS-53 (R470A) discharge pressure is lower than using R-410A, thereby creating less wear and tear on the compressor.
- RS-53 (R470A)'s energy efficiency is acceptable according to expected use as demonstrated with the systems tested.
- The retrofit process is simple and fast because there is no need to modify equipment or change the oil.
- The RS-53 (R470A) has the same material compatibility as R-410A.
- The RS-53 (R470A) has a much lower environmental impact than the R-410A and is ASHRAE certified as an A1 (non-flammable and non-toxic) refrigerant.