

RS-53 (R-470A): New drop-in for R-410A equipment with low GWP.

Summary

The performance results of the new refrigerant RS-53 (R-470A) tested in a commercial AC prove that this product has a good energetic efficiency giving high cooling capacity with a similar energy consumption. That demonstrate it can be a suitable product to retrofit R-410A equipment.

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1. Objective

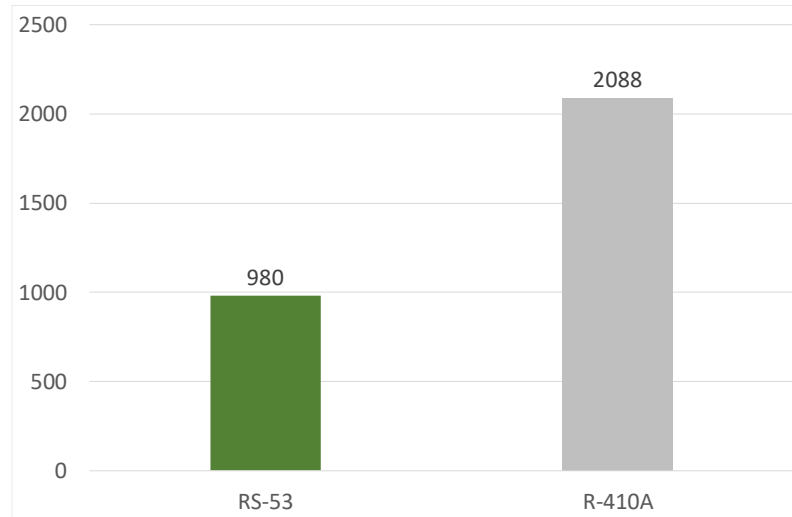
GRIT S.L.U. (Gases, Research, Innovation & Technology S.L.U.), with headquarters in Barcelona and plant in Avinyó, has done a comparative study between RS-53 (R-470A) and R-410A in order to evaluate the energy efficiency and other properties of the new RS-53 (R-470A).

These trials have been done in GRIT's Avinyó plant using a commercial AC equipment.

2. Refrigerants

The refrigerants used in this study are:

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



The GWP of the RS-53 (R-470A) is significantly lower than the one from R-410A allowing a better adaptability of the F-gas regulation and having, in the case of Spain, a lower especial tax.

3. Experimental set up

3.1. AC equipment

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

Equipment:

Manufacturer: Panasonic

Condenser: CU-RE12NKE

Split: CS-RE12NKE

Equipment designed for R-410A

Working range: from 17°C to 30°C

Condenser: Cooled by air through a fan

Expansion device: Expansion through a capillary tube

Refrigerant charge:

The mass of each refrigerant is the same that is indicated in the technical specification of the AC (780 g). The refrigerant is added from a recently prepared 12L bottle.

The test room is maintained closed during all the experimentation. Its size is about 6.5x3.5x2.5 m.

3.2. Measures

All the trials are done using the same refrigeration set up, 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

4. Methodology

In order to avoid as much as possible internal auto adjustments of the inverter AC the operating modes are set in the same configuration for each trial. 17°C in cooling mode, 30°C in heating mode and at the maximum split fan speed.

All the trials are done applying the following procedure:

Initially a vacuum pump is used in order to purge all the system. Then the gas is added measuring the quantity dosed by weigh.

When all the gas is added the AC is initiated with the previously described set points.

Using the measured variables, the following parameters are calculated:

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

5. Results

5.1. Room temperature variation

5.1.1. Heating mode

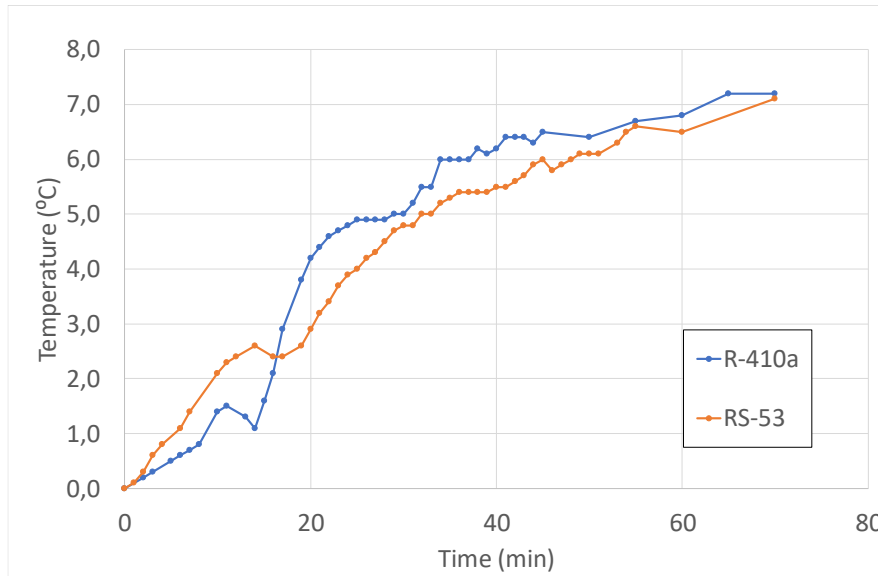


Figure 1 Room temperature variation heating mode

As it can be seen from the start, there are differences in the way the room temperature is increased but, when the stationary regime is reached, the temperature difference using both gases is practically the same. It can be concluded that the heating capacity is similar proving that the RS-53 (R-470A) could be a good drop-in to replace R-410A in head pump mode.

5.1.2. Cooling mode

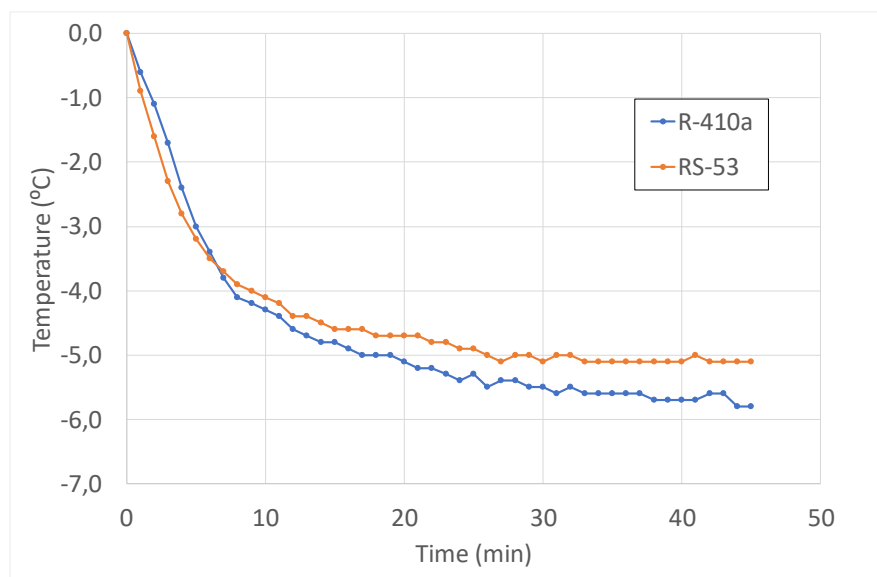


Figure 2 Room temperature variation cooling mode

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

5.2. Discharge pressure

5.2.1. Heating mode

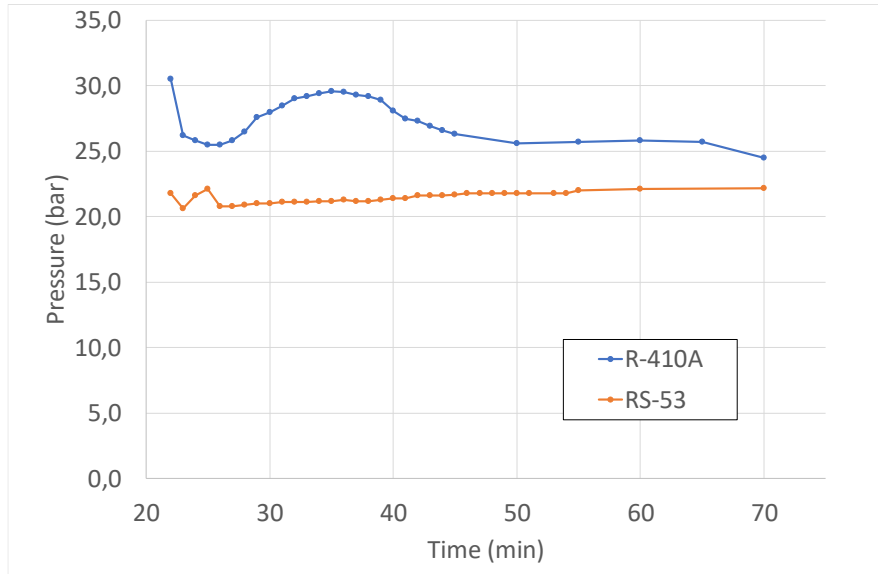


Figure 3 Discharge pressure heating mode

Focusing in the stationary regime, it can be seen that the discharge pressure using RS-53 (R-470A) is lower than using R-410A in heating mode.

5.2.2 Cooling mode

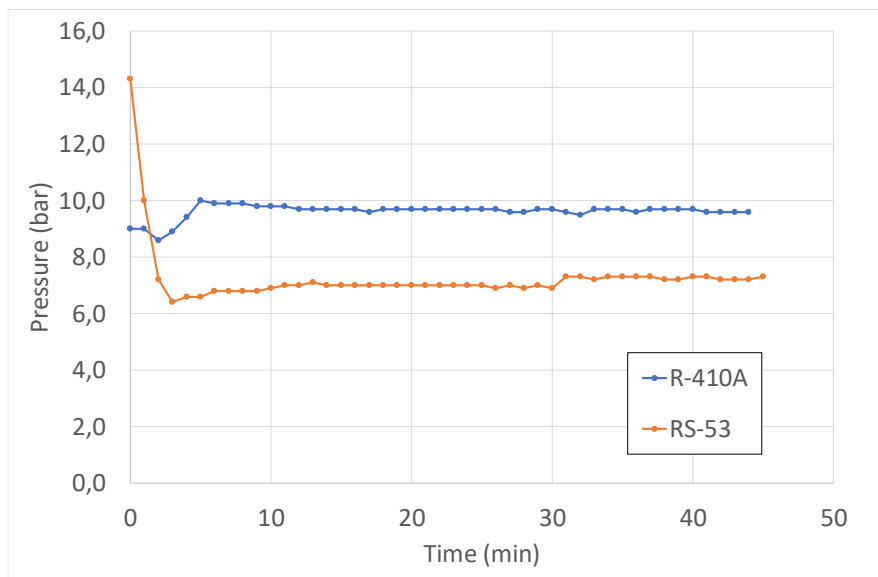


Figure 4 Discharge pressure cooling mode

As in the previous case the discharge pressure using RS-53 (R-470A) is lower than using R-410A in cooling mode.

5.3. Coefficient of Performance (COP)

5.3.1. Heating mode

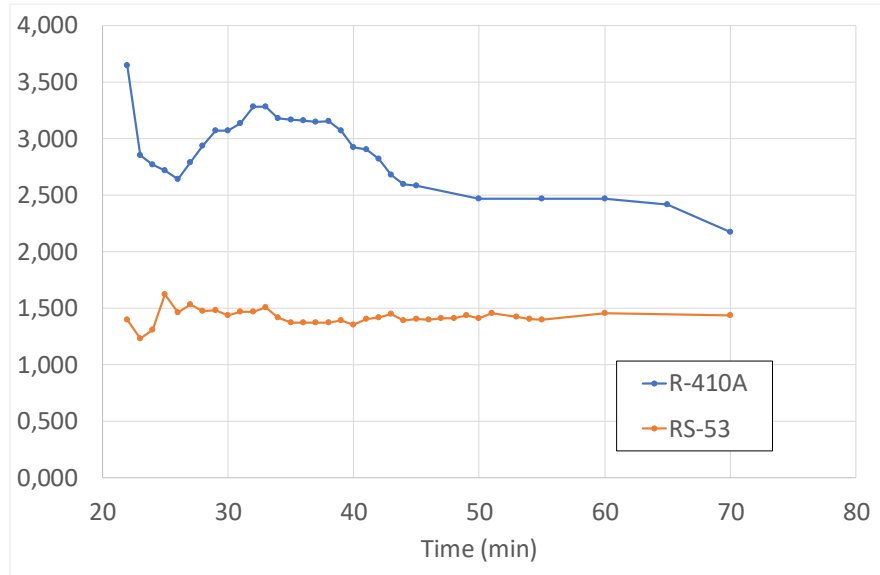


Figure 5 Experimental COP heating mode

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) despite it can be seen an overall tendency to equalize at higher working time. The longer the system is operated, the higher the COP of RS-53 (R-470A) compared to R410A.

5.3.2 Cooling mode

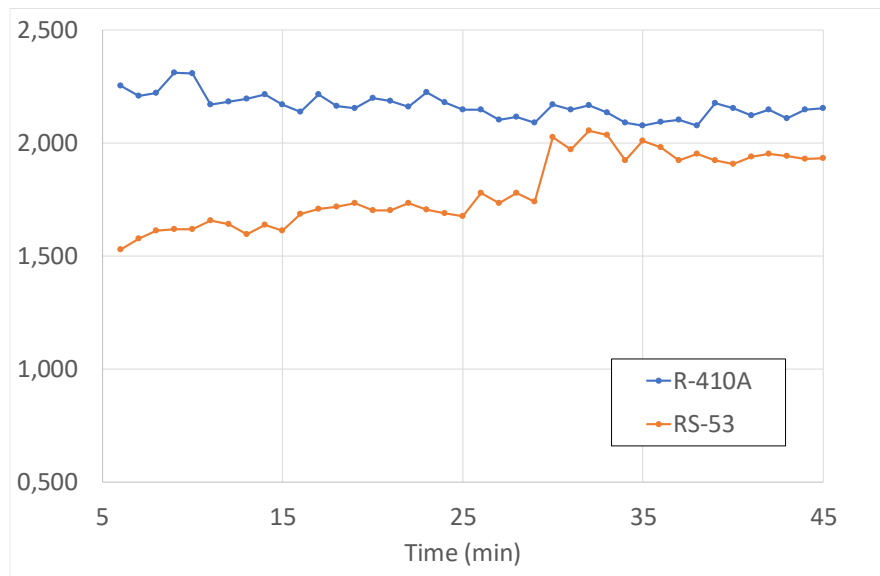


Figure 6 Experimental COP cooling mode



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

6. Conclusion

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

- The new RS-53 (R-470A) can be used as a heating pump and in cooling mode.
- The room temperatures reached with both gases are similar.
- The RS-53 (R-470A) discharge pressure is lower than using R-410A.
- The energy efficiency of RS-53 (R-470A) is acceptable under the expected use.
- The retrofit process is simple and fast because is not needed any further modifications nor in the equipment nor in the system oil.
- The RS-53 (R-470A) has the same material compatibility than the R-410A.
- The RS-53 (R-470A) has a lower environmental impact than the R-410A and it is an A1 solution (non-flammable and non-toxic).