Air Conditioning and heat pumps
Session III
System Drop-in Test of R-410A
Alternative Refrigerant DR-5 and ARM-70a in an Air to Water Heat Pump
Outline/Agenda

• Work motivation
• Conditions for a drop in refrigerant
• Experimental setup and procedure
• Results and discussion
• Conclusions
Work motivation (1)

- R-410A is the major refrigerant used in A/C and heat pump sector
- R-410A has a high GWP
- Global effort for low GWP replacement candidate
- R-32 is studied in Japan
- EU F-gas directive is under revision; this is favoring new generation of refrigerant
Work motivation (2)

- Air to water heat pumps biggest market share in Europe
- High performance (COP and Heating capacity) requirement for high water temperature
Conditions for a drop in

• Drop in allows keeping most of the components

• Low cost for OEM and allows existing equipment conversion

• Optimization when using a drop in replacement candidate is usually a soft operation

• Hard matching of capacity and performance
Experimental setup and procedure (1)

- Within AREP initiative test two low GWP candidates replacement of R-410A: ARM-70a (GWP=470) and DR-5 (GWP=490)
- Air to water European type heat pump tested in drop in (Nominal heating capacity 6.26 kW/21360 Btu/h )
- Tests are conducted following the AHRI 551/591-2011 standard
Experimental setup and procedure (2)

• Three full capacity testing conditions
  – TC1: Air DB temperature -8°C/17.6 F, -9°C/15.8 F WB and water inlet temperature to the heat pump of 35°C/95 F;
  – TC2: Air DB temperature 8°C/46.4 F, 6°C/42.8 F WB and water inlet temperature to the heat pump of 35°C/95 F;
  – TC3: Air DB temperature 8°C/46.4 F, 6°C/42.8 F WB and water inlet temperature to the heat pump of 45°C/113 F;

• Three refrigerant charge for each replacement candidate

• Comparing: heating capacity, COP and system COP
Experimental setup and procedure (3)
Results and discussions (1)
Results and discussions (2)

System COP comparison
Results and discussions (3)

• Highest refrigerant charge for both replacement candidates are not favorable for the COP

• ARM-70a is matching R-410A capacity for almost the 3 TC while DR-5 presents higher capacities

• Difference in COP between both replacement refrigerants is maximal for TC2 where the water temperature difference is maximal (~5.5K)
Conclusions

• Both candidates are suitable for drop in
• For both alternative refrigerants, system COP is improved by 5 to 10% due most probably to temperature glide
• Heating capacity is 10% higher with DR-5 and equivalent to higher with ARM-70a
Questions?

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