

SUMMARY OF NEW TEST REPORT

HEAT RECOVERY PERFORMANCE WITH HIGH SEER A/C USING R410A

Testing was performed on June 4, 2009, in Miami FL, by Applied Research Laboratories (ARL), in accordance with ARI Standard 470-2001; using a 5 ton Rheem 15 S.E.E.R. matched air handler and condensing unit, with R410 refrigerant, and an AQUEFIER model R6K-410 Heat Recovery Unit (HRU). The testing determined the rate of heat transfer between the A/C and water heater. This heat transfer is expressed both as the flow of BTU's per hour of compressor run time and the number of gallons of water heated per hour of compressor run time. Testing also compared the power consumption of the condenser both with and without HRU operation. This is expressed both as a % reduction in power and also as an effective change in S.E.E.R.

TEST RESULTS, as follows:

1. **Heat Transfer Rate:** the rate of heat transfer into the water heater varies as a function of water temperature in the water heater. As the water temperature went from 90F to 120F, the heat transfer rate went from 9400 btu/hr to 4800 btu/hr. This equates to a range of 22.5 to 11.5 gallons of water heated per hour (50F rise); with an average water heating rate of 20 gallons per hour.
2. **Comparative power consumption:** Condenser power consumption dropped from 4500 watts, without HRU operation, down to 4100 watts with the HRU operating on 90F water. Taking HRU power consumption into account, this test indicated a 9% reduction in condenser power consumption resulting from HRU operation. This equates to an effective change in S.E.E.R. from 15 to 16.4, as a result of adding the HRU to the system.

Details of the actual Testing are contained in the full report. These are not Manufacturer's Test Results. SO, Yes....Heat Recovery still works on 15 S.E.E.R. equipment; even with using R410A refrigerant.

APPLIED



RESEARCH LABORATORIES

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PERFORMANCE REPORT

L/N 50021

**Doucette Industries
4190 112th Terrace North
Clearwater, FL 33762**

**Desuperheater
Model: R6K-HP-410**



Lab Number: 50021
Client: Doucette Industries
4190 112th Terrace North
Clearwater, FL 33762
Test Method: ARI 470 (2006)
Product: Desuperheater
Model: R6K-HP-410

REPORT OF TEST

1 INTRODUCTION

- 1.1 Doucette Industries, of Clearwater, FL, retained Applied Research Laboratories (ARL) to conduct a performance according to ARI Standard 470 (2006) on a Desuperheater, Model R6K-HP-410.
- 1.2 Testing was performed by ARL Project Engineer E. John Lanager on Thursday, June 4, 2009.
- 1.3 The testing program was authorized by an ARL Work Authorization Form (Form WAF-00) signed by Mr. John Lebo, President of Doucette Industries, on Tuesday, May 12, 2009.

2 SAMPLE DESCRIPTION

- 2.1 The client supplied ARL with one (1) Desuperheater manufactured by Doucette Industries, Inc., one (1) Condensing Unit and one (1) Air Handling Unit.
- 2.2 Sample information is found below.

Desuperheater
Manufacturer: Doucette Industries, Inc.
Model: R6K-HP-410
230V, 60Hz, 1-phase
1Hp, 0.6A
150psi



2.2 continued

Condenser Unit

Manufacturer: Rheem

Model: RPQL-060JAZ

Serial Number: 7959 M4308 11318

208/230V, 60Hz, 1-phase

Compressor: 26.4/26.4 RLA, 134 LRA

Fan Motor: 2.8 FLA, 1/3Hp

MCA: 40/40A

Air Handler:

Manufacturer: Rheem

Model: RHLL-HM6024JA

Serial Number: M2007 04538

208/240V, 60Hz, 1-phase

Fan Motor: ¾ Hp, 4.6 RLA

3 TEST METHOD

- 3.1 The Desuperheater, Condensing Unit and Air Handler were installed in the Psychrometric Room at ARL.
- 3.2 The system was installed and instrumented in accordance with ARI Standard 470 (2006) for Desuperheater/Water Heaters and manufacturer's instructions.
- 3.3 The following data was measured:
 1. Entering and Leaving Water Temperatures, °F
 2. Entering and Leaving Refrigerant Temperatures, °F
 3. Entering refrigerant pressure, psig
 4. Water-side Pressure Drop, psi
 5. Refrigerant-side Pressure Drop, psi
 6. Water Flow Rate, gpm
 7. Refrigerant Mass Flow Rate, lb/h
 8. Ambient Temperature
- 3.4 The system was charged using R-410a refrigerant.



4 DATA

4.1 The following test data was collected:

120°F Entering Water Temperature

Entering Water Temperature, °F	119.8
Leaving Water Temperature, °F	123.8
Entering Water Pressure, psi	61
Leaving Water Pressure, psi	58
Water-side Pressure Drop, psi	3
Entering Refrigerant Temperature, °F	151.4
Leaving Refrigerant Temperature, °F	130.4
Entering Refrigerant Pressure, psig	352
Entering Refrigerant Pressure, psia	366.7
Leaving Refrigerant Pressure, psig	341
Leaving Refrigerant Pressure, psia	355.7
Refrigerant-side Pressure Drop, psi	11
Low Side Refrigerant Pressure, psig	125
Water Flow Rate, gpm	2.4
Refrigerant Mass Flow Rate, lb/h	761
Ambient Temperature, °F	89
Voltage, V	229.9
Condenser Current w/ DSU	17.89
Condenser Current w/o DSU	19.56



4.1 continued

90°F Entering Water Temperature

Entering Water Temperature, °F	90.6
Leaving Water Temperature, °F	98.8
Entering Water Pressure, psi	57
Leaving Water Pressure, psi	55
Water-side Pressure Drop, psi	3
Entering Refrigerant Temperature, °F	352
Leaving Refrigerant Temperature, °F	130.4
Entering Refrigerant Pressure, psig	350
Entering Refrigerant Pressure, psia	164.7
Leaving Refrigerant Pressure, psig	340
Leaving Refrigerant Pressure, psia	354.7
Refrigerant-side Pressure Drop, psi	10
Low Side Refrigerant Pressure, psig	125
Water Flow Rate, gpm	2.4
Refrigerant Mass Flow Rate, lb/h	759
Ambient Temperature, °F	90
Voltage, V	229.8
Condenser Current w/ DSU	17.89
Condenser Current w/o DSU	19.56

5.0 EQUATIONS

5.1 The following equation was used to calculate the Heating Capacity on the Water Side of the System (Btu/h_{water}):

$$\text{Btu/h}_{\text{water}} = [60 \text{ (minutes/hour)}] * [\text{flow rate (gpm)}] * [8.33 \text{ (lbs/gallon of water)}] * [\Delta T \text{ (°F)}]$$

5.2 The following equation was used to calculate the Heating Capacity on the Refrigerant Side of the System (Btu/h_{refrigerant}):

$$\text{Btu/h}_{\text{refrigerant}} = [\text{refrigerant flow rate (lbs/hr)}] * [\Delta \text{ Enthalpy of refrigerant (Btu/lb)}]$$

5.2.1 A standard Pressure-Enthalpy Diagram for R-410a Refrigerant was used to determine the enthalpy of the refrigerant. The points corresponding to refrigerant pressure and temperature were located on the diagram. With this information, the enthalpy was determined.



6.0 RESULTS

6.1 120°F Entering Water Temperature

6.1.1 Water Side

$$\text{Btu/h}_{\text{water}} = [60 \text{ (minutes/hour)}] * [\text{flow rate (gpm)}] * [8.33 \text{ (lbs/gallon of water)}] * [\Delta T \text{ (°F)}]$$

$$\text{Btu/h}_{\text{water}} = [60 \text{ (minutes/hour)}] * [2.4 \text{ (gpm)}] * [8.33 \text{ (lbs/gallon of water)}] * [123.8 - 119.8 \text{ (°F)}]$$

$$\text{Btu/h}_{\text{water}} = 4,798.08 \text{ Btu/h}$$

6.1.2 Refrigerant Side

From the Pressure-Enthalpy chart, the enthalpy of the refrigerant entering was found to be 136.84 Btu/lb.

From the Pressure-Enthalpy chart, the enthalpy of the refrigerant leaving was found to be 130.57 Btu/lb.

$$\text{Btu/h}_{\text{refrigerant}} = [\text{refrigerant flow rate (lbs/hr)}] * [\Delta \text{ Enthalpy of refrigerant (Btu/lb)}]$$

$$\text{Btu/h}_{\text{refrigerant}} = [761 \text{ (lbs/hour)}] * [136.84 - 130.57 \text{ (Btu/h)}]$$

$$\text{Btu/h}_{\text{refrigerant}} = 4,771.47 \text{ Btu/h}$$

$$\text{Heat Balance} = 100 * [1 - (\text{Btu/h}_{\text{refrigerant}} / \text{Btu/h}_{\text{water}})] = 100 * [1 - (4,771.08 / 4,798.08)]$$

$$\text{Heat Balance} = 0.56\%$$

The heat balance calculated between the water-side and the refrigerant side is within 5%.



6.2 90°F Entering Water Temperature

6.2.1 Water Side

$$\text{Btu/h}_{\text{water}} = [60 \text{ (minutes/hour)}] * [\text{flow rate (gpm)}] * [8.33 \text{ (lbs/gallon of water)}] * [\Delta T \text{ (}^\circ\text{F)}]$$

$$\text{Btu/h}_{\text{water}} = [60 \text{ (minutes/hour)}] * [2.4 \text{ (gpm)}] * [8.33 \text{ (lbs/gallon of water)}] * [98.8 - 90.6 \text{ (}^\circ\text{F)}]$$

$$\text{Btu/h}_{\text{water}} = 9,836.064 \text{ Btu/h}$$

6.2.2 Refrigerant Side

From the Pressure-Enthalpy chart, the enthalpy of the refrigerant entering was found to be 136.16 Btu/lb.

From the Pressure-Enthalpy chart, the enthalpy of the refrigerant leaving was found to be 123.82 Btu/lb.

$$\text{Btu/h}_{\text{refrigerant}} = [\text{refrigerant flow rate (lbs/hr)}] * [\Delta \text{ Enthalpy of refrigerant (Btu/lb)}]$$

$$\text{Btu/h}_{\text{refrigerant}} = [759 \text{ (lbs/hour)}] * [136.16 - 123.82 \text{ (Btu/h)}]$$

$$\text{Btu/h}_{\text{refrigerant}} = 9,366.06 \text{ Btu/h}$$

$$\text{Heat Balance} = 100 * [1 - (\text{Btu/h}_{\text{refrigerant}} / \text{Btu/h}_{\text{water}})] = 100 * [1 - (9,366.06 / 9836.064)]$$

$$\text{Heat Balance} = 4.79\%$$

The heat balance calculated between the water-side and the refrigerant side is within 5%.



- 6.3 The results discussed here pertain only to the units that were tested and may not be representative of ongoing production and/or other configurations or variations.

END OF REPORT

Report by:

E. John Lanager,
Project Engineer

Reviewed by:

Luis D. Martinez, PE
Director of Engineering

Date:

6/5/09

Date:

6-5-09

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