Evaluation of Savings from the Application of AdsilTM in the NC/SC Charlotte Area



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> By: MACTEC Prepared By 404 SW 140th Terrace Gainesville, Florida

Prepared for: Melissa McCullough Office of Air Quality Planning and Standards

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List of Acronyms and Abbreviations

A/C	air conditioner
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
CDD	cooling degree days
cfm	cubic feet per minute
CO2	carbon dioxide
COG	Councils of Government
EER	energy efficiency ratio
EI	efficiency index
EPA	United States Environmental Protection Agency
FLEOH	Full Load Equivalent Operating Hours
HVAC	heating, ventilating and air conditioning
kg/sec	kilogram per second
kWh	kilowatt-hours
MACTEC	MACTEC Engineering and Consulting, Inc.
NOAA	National Oceanic and Atmospheric Administration
NOx	nitrogen oxide
OAT	outdoor air temperature
PDA	personal digital assistant
SEQL	Sustainable Environment for Quality of Life
SO2	sulfur dioxide

Executive Summary

The SEQL Project (Sustainable Environment for Quality of Life, <u>www.seql.org</u>) is an integrated environmental improvement project in a 15-county North Carolina/South Carolina region surrounding Charlotte, NC. One aspect of this project is to explore using energy efficiency to benefit air quality. The SEQL desired to evaluate a new coating, Adsil, which previous studies have shown that, when applied to evaporators, condensers and fans of an air conditioner (A/C) unit, can bring the efficiency of that unit virtually back to that of a new unit, as well as prevent age-related efficiency loss due to the deterioration of heat transfer surfaces, saving both electrical power and early replacement costs. The ability to model expected energy savings with widespread use of Adsil in various types of locations (in relation to corrosive and fouling influences) would be beneficial and transferable to other communities nationwide. Energy savings reduce costs, limit the need for new generating capacity, and could under certain circumstances benefit air quality. However, quantifiable air quality benefits would depend on the amount of energy savings and the extent to which, and where, fossil fuel-fired power plants reduced emissions as a result of those energy savings.

In order to further evaluate this opportunity, the United States Environmental Protection Agency (EPA), working with SEQL, competitively selected an engineering firm, MACTEC Engineering and Consulting, Inc. (MACTEC) to conduct a pilot program. This pilot was required to evaluate the possible energy-related benefits of coating A/C units in the SEQL area with Adsil and to provide a method to predict the energy savings from similar applications on a widespread basis elsewhere. The total tonnage of air conditioning units included in this study is approximately 2,500 tons.

There were three primary objectives for this project:

- 1. Provide the EPA with a spreadsheet-based calculation methodology to accurately predict the degradation in energy efficiency ratio (EER) for air-cooled heating, ventilating and air conditioning (HVAC) equipment coils;
- 2. Document the EER improvement for air-cooled HVAC equipment cleaned and coated with Adsil cleansers and coatings; and
- 3. Provide a tool for estimating the energy savings for an HVAC unit cleaned and coated using this protocol.

MACTEC evaluated the impact of Adsil application to 45 HVAC units in the SEQL area and to three units outside the SEQL area. The results of this evaluation show that the Adsil treatment can be expected to improve the efficiency of existing HVAC units by approximately 12% based on the ton-weighted average method used in this project. The

data was statistically evaluated and determined to be significant at the 99% confidence level.

Utility bill analysis was determined to be an inappropriate measurement tool for EER changes and therefore actual efficiency measurements for each HVAC unit were performed. Three tests were used including a calculation method, a power and capacity measurement, and a refrigerantbased measurement using the Service Assistant as available from Honeywell Controls.

Two baseline studies were conducted to establish the accuracy of each testing protocol and which involved repeated tests on two units. Repeatability in measurements was demonstrated in these tests and it was determined that the Service Assistant instrument provided the most repeatable and accurate measurements of HVAC EER. The generic compressor curve used for many of the SEQL area tests was found to underestimate the actual savings demonstrated in the pilot baseline study tests. The condenser test methodology was generally less accurate but showed greater increases in EER as a result of the Adsil treatment.

A degradation prediction tool for HVAC units was created in this pilot program. This spreadsheet-based tool was calibrated against actual EER measurements and was found to be very accurate in predicting the EER degradation of a population of HVAC units in the SEQL area.

An energy savings projection tool was also created based on the results of this study. This tool can be easily adapted by facility owners and operators to estimate their energy savings, dollar savings, and avoided pollution emissions as a result of the application of Adsil to air-cooled HVAC equipment. This tool estimates that annual dollar savings for the 150 units coated in the SEQL area will exceed \$37,000 based on a blended electric rate of \$0.08 per kWh..

MACTEC believes that this product demonstrated significant savings for air-cooled HVAC equipment.

1. Introduction and Project Objectives

The SEQL Project (Sustainable Environment for Quality of Life) is an integrated environmental improvement project in the North Carolina/South Carolina region surrounding Charlotte, NC. This project is led by the region's Councils of Government (COGs) —the Centralina COG on the NC side of the border and the Catawba COG on the SC side. One aspect of this project is to use energy efficiency to benefit air quality.



The SEQL desired to evaluate a new coating, Adsil, which when applied to evaporators, condensers and fans of an air conditioner (A/C) unit, can bring the efficiency of that unit virtually back to that of a new unit, as well as prevent age-related efficiency loss due to the deterioration of heat transfer surfaces, saving both electrical power and early replacement costs. This coating has been well tested for this benefit in other climactic areas, including the Naval Air Station in Jacksonville, FL. The increases in unit efficiency in these tests has been well documented (this documentation is available at www.adsil.com). The ability to model expected energy savings with widespread use of Adsil in various types of locations (in relation to corrosive and fouling influences) would be beneficial and transferable to other communities nationwide. Energy

savings reduce costs, limit the need for new generating capacity, and could be used in some areas to benefit air quality. However, quantifiable air quality benefits would depend on where and what kind of plants changed power production as a result of energy savings.

In order to further evaluate this opportunity, the United States Environmental Protection Agency (EPA), working with SEQL, competitively selected an engineering firm, MACTEC Engineering and Consulting, Inc. (MACTEC) to conduct a pilot program. This pilot was required to evaluate the possible energy-related benefits of coating A/C units in the SEQL area with Adsil and to provide a method to predict the energy savings from similar applications on a widespread basis elsewhere. To develop a prediction model, additional data was required to be collected to supplement existing data. For example, to evaluate possible benefits, EPA required data to be collected on the degradation curve of A/C units related to pollution and other corrosive or fouling influences. This included data collection for units besides those being coated. This pilot, funded by the US EPA, was to include as many as 30 buildings' units and be completed by September of 2004. The preliminary list of buildings/units is shown in Table A-1 in Appendix A for information purposes. The total tonnage of air conditioning units included in this study is approximately 2,500 tons.

Project Objectives

There were three primary objectives for this project:

- 1. Provide the EPA with a spreadsheet-based calculation methodology to accurately predict the degradation in energy efficiency ratio (EER) for air-cooled heating, ventilating and air conditioning (HVAC) equipment coils;
- 2. Document the EER improvement for air-cooled HVAC equipment cleaned and coated with Adsil cleansers and coatings; and
- 3. Provide a tool for estimating the energy savings for an HVAC unit cleaned and coated using this protocol.

An overview of the tasks used to provide data to meet these objectives are provided in the next section.

2. Description of Tasks

A number of tasks were completed in order to ensure accurate and credible tools were created. These tasks are described below:

Task 1: Baseline Testing

MACTEC selected two units in the Gainesville, Florida area as control tests. One unit is a 1991 5-ton split-system air conditioner. The other unit is a 2001 split-system heat pump. The efficiency of each of these units was measured between 10 and 20 times at various outdoor air temperatures and differing indoor wet bulb temperatures to ensure that the testing processes were repeatable and accurate. Three methods were used (see Section 3 for description) to determine the EER of these two pieces of equipment before cleaning and coating with Adsil. Multiple tests were conducted post-Adsil application and the results were compared for repeatability. These results may be seen in Appendices B and C.

Task 2: Test Procedure Comparison with Traditional Data Logger Analysis

In order to further support the proposed testing process, MACTEC, in conjunction with the Adsil company conducted a multi-week study at a commercial property near the west coast of Florida. A 10-ton package heat pump was selected and sensors and data loggers were used to collect data for two weeks prior to cleaning and coating. Data was then collected for two weeks post-cleaning. The units were then cleaned and coated per Adsil protocol. Data was then collected for a final two weeks. In conjunction with this test, MACTEC conducted our standard test procedure using the spreadsheet, condenser heat rejection, and Service Assistant methodologies. The results of these tests and comparisons may be seen in Appendix D.

Task 3: Measure the Change in EER of HVAC Units in the SEQL Area

After establishing the protocol for measurement of HVAC efficiency in Tasks 1 and 2, measurement of the EER of 45 HVAC units in the SEQL area was conducted pre- and post-treatment. Prior to treatment MACTEC graded the units using our spreadsheet calculation.

Task 4: Develop a Tool for Prediction of HVAC Degradation

MACTEC developed a spreadsheet-based tool for predicting the degradation of HVAC equipment based on objective data. This spreadsheet can be used by a facility owner or operator to estimate the degradation of air-cooled HVAC equipment based on objective data inputs. The algorithms used in this spreadsheet were correlated to the actual measured change in efficiencies of the HVAC units pre- and post-Adsil treatment.

Task 5: Utility Bill Verification of Savings

MACTEC determined that it would not be possible to use utility bills at the tested facilities for determination of electric consumption savings. There were many reasons for this, including an inability to collect utility bills for some of the facilities. Adding to this difficulty was the fact that

many of the facilities shared a common meter. Shared metering masks the effect of the efficiency improvements since the savings would be attributed to facilities with units being treated as well as facilities with no units being treated.

A third difficulty is attributed to an inability to collect a minimum of 12 months of bills posttreatment. Application of Adsil was completed in June of 2004, requiring collection of bills until June of 2005 to acquire 12 months of usage; however, this was not feasible based on schedule requirements of the project. In many cases the units were coated in two phases several months apart, rendering a meaningful comparison nearly impossible as 12 months of utility bills would need to be collected prior to any units being treated and requiring 12 months of bills to be collected after the last unit was coated. There would be 6-8 months of bills between events which would have to be disregarded.

A fourth and final difficulty was that some facilities had only a small percentage of their total tonnage cleaned and coated. In these cases it would be impossible to measure savings on the utility bills.

Even without the aforementioned difficulties, it would be difficult to use utility bill savings as a significant measuring tool in an experiment such as this one. The reason is in our experience the total amount of energy consumed by compressors and condensing units in the type of facilities in this pilot typically account for approximately 30% of the total electricity consumption. Based on measurements pre- and post-treatment, the typical energy savings with Adsil is around 10%. This HVAC savings would equate to an overall utility savings of 3%, a value very difficult to capture in utility bill comparisons due to natural fluctuations of 10% to 20% from weather and usage variations from one year to the next. Therefore, MACTEC used actual efficiency measurements for the 45 units in the SEQL area and three units outside the SEQL area to create the tools and form the conclusions presented in this report.

3. EER Measurement Procedures

Initially there were 150 units included in the proposed SEQL area sample. In calendar year 2003, prior to MACTEC's involvement, 75 of these units were coated with Adsil. EPA and MACTEC decided to determine the efficiency of as many of these remaining units as possible for the allocated budget. Traditional efficiency measurements of HVAC units require multiple temperature sensors, humidity sensors, kW sensors, and flow sensors to feed data to data loggers over a period of time, typically 1-2 weeks, and then repeat the data collection post-HVAC modification. Data is compared, analyzed, trended, and efficiency changes over a wide range of operating temperatures (ambient and inside) are recorded and efficiency changes are determined. It is easy to see why this methodology, while accurate, is expensive, and would have limited the number of HVAC units being evaluated to a small percentage of the number being treated.

MACTEC proposed a different methodology requiring a one-time EER determination, pre- and post-Adsil treatment, for each unit. Three different methodologies were used, ranging from simplest to most complex. Results of the tests are provided in Section 5. A description of each of the procedures is provided below:

3.1 Spreadsheet Calculation

MACTEC developed a spreadsheet calculation to estimate the degradation of condenser coils. The spreadsheet uses a compilation of objectively acquired data (see Figure 3-1) including coil age, dirt accumulation, bent and smashed fins, degree of corrosion, presence of coil coating, and fin-tube attachment to estimate the degradation in efficiency of coils. Results were obtained from this procedure on a total of 45 units and the ton-weighted average degradation was calculated. Post-treatment, units were again evaluated and the EER degradation was compared to the pre-treatment estimation. The difference in the values was recorded as the EER improvement. This method is the easiest to use but was determined to be the least accurate. It fails to take into account the effects of low refrigerant charge and other variables not visible in a site inspection. Its accuracy is also dependent on the algorithms used to project the EER based on the input. These were later refined, as described in Section 7 of this report.

			Pr		IGURE 3-1 HVAC Spreadsheet		
Manufacturer: Model Number Serial Number Equipment Typ Year Manufactu Location Tag	r: pe:	Carrier 50TJQ009-6 4598G3051 Package HF 1998 Concord Ad RTU-5	601 0		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	11.3 11.3 8.41 6 6% 10.5 1.14	Btu/W-hr (CU Only Btu/W-hr (CU Only tons years (% degraded) Btu/W-hr
Compressor Da	ata						
Running load Ar Nameplate Volta Power factor:	mps:	7.2 460 0.74	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 2	
Condensing Fa	an Data						
Full load Amps: Nameplate Volta Adjust FLA to R	age:	0.70 460 0.70	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 2	
Evaporator fan	n data (if app	licable)					
Full load Amps: Nameplate Volta Adjust FLA to R	age:	2.60 460 0.70	Amps Volts		Power supply: Phase adjustment: Fan quantity:	3-Phase 1.73 1	
Calculated con Calculated con Calculated eva	ndensing fan Iporator fan	load: load		8.5 0.45 0.84	kW kW kW - Condensing side only		
	ed load for ed	quipment:		8.93	kw - Condensing side only		
Assumptions Condenser Coi	il Assessme		5.7%		ance Degradation		
Total calculate Assumptions Condenser Coi Overall Unit Cor	il Assessme ndition		5.7%				
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Assumptions Condenser Coi Overall Unit Cor	il Assessme ndition New Average		5.7%				
Assumptions Condenser Coi Overall Unit Cor , ,	il Assessme ndition New Average Fair	nt	5.7%				
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Assumptions Condenser Coi Dverall Unit Cor Coil Cleanliness	il Assessmer ndition New Average Fair Poor s Coated Clean Dirty Clogged Plugged Like New Some Bent Smashed	nt 1 0.85 0.15 0.15 0.1 0.1 0.05	5.7%				
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3.2 Condenser Measurement

The second method used in EER calculation was a straight-forward condenser power consumption and heat rejection calculation. For this method, a Fluke 41 meter was used to measure actual power consumption of the condenser (total power of the condenser fan, compressor(s), and blower motor if a package unit). Heat rejection of the condenser was measured by determining the available flow area of the condenser, measuring the entry air velocity into the condenser, and measuring the change in temperature of the air flow across the condenser. Inaccuracies in this procedure include a calculated air flow higher than actual due to the coil restrictions, a measured air flow impacted by the presence of wind, and compressor heat rejection being included in the EER calculation. As a result, the EERs of the equipment using this methodology were on average almost twice what is expected (due in large part to the inclusion of the coil and fin obstructions in the available air flow area). However, as the compressor heat and available flow area were not germane to the comparison of before and after EER values (they cancel one another out), no effort was made to determine the values of these constants and subtract them from the equations. Every effort was made to minimize the impact of wind, but in some cases the tests were thrown out because the wind velocity was sufficient to impact our measurements.

Ambient temperatures, return air temperature, and return air humidity were also recorded. Manufacturer's data was then used to "adjust" the measured EER at actual conditions to an EER at ARI conditions of 95 degrees dry bulb (ambient temperature) and 67 degrees wet bulb (evaporator temperature). In cases where the supply air cubic feet per minute (cfm) was not available, MACTEC used the value most closely approximating a value of 400 cfm/ton in the manufacturer's data.

3.3 Service Assistant Measurements

The third method used in EER determination was the employment of a Service Assistant as available from Honeywell Controls. This tool has five sensors for measuring the liquid pressure (downstream of the condenser coil but upstream of the expansion valve) or the discharge from the compressor; the suction pressure before the compressor; the suction temperature before the compressor; the liquid temperature after the condenser; and the ambient temperature. Supply air temperature and humidity and return air humidity are measured via separate instrumentation (not provided with the Service Assistant) and entered into a hand-held personal digital assistant (PDA) which provides the interface. Software on the PDA includes input for Copeland compressor models, or for the capacity and EER of the compressor for compressor models other than Copeland. Using the supplied input and the measured values, the efficiency index, capacity index, and power index are determined by comparing inputs with compressor tables stored in the proprietary software. These values could be calculated manually but the software does it quickly

and reliably with what MACTEC believes to be accurate results. A detailed description of the Service Assistant is provided in Appendix E.

MACTEC believes that this method provided the most reliable results. Disadvantages of this method include disassembly of the HVAC units for access, thorough knowledge of HVAC equipment and circuitry for proper location of sensors, and EPA certification in order to attach refrigerant hoses to active HVAC equipment. Total instrumentation cost for methods 2 and 3 are considered to be approximately similar.

4. Testing Procedure Repeatability and Accuracy

Achieving repeatable and accurate results is integral to the success of the HVAC efficiency measurement process. Many variables impact the measurement of the efficiency of an HVAC unit. These variables include outdoor air temperature (typically an increase in outdoor air temperature (OAT) decreases the efficiency); return air wet bulb temperature (generally higher wet bulb temperatures result in higher efficiencies); blower air flow rate (constant for these control tests); condenser air flow rate (increased after application of Adsil and generally decreases with air density increase); electrical measurements (power consumed is dependent on voltage, current, load factor, and power factor); and the presence or absence of low temperature ambient controls on individual units (simulate harsh conditions and decrease efficiency). In additional error being potentially introduced by the reading of the instruments. Measuring the capacity and power consumption of a dynamic piece of equipment involves professional judgment at times in conjunction with the methodology being employed.

In order to minimize the magnitude of the errors associated with our protocol, MACTEC selected two units to use in a baseline study. Unit 1 is a 14-year old Carrier 5-ton split-system considered to be in good condition relative to its age. Unit 2 is a two-year old Carrier heat pump considered to be in excellent condition.

Unit 1 Protocol

This unit was evaluated 17 times prior to the Adsil application and the initial assessment is shown in Figure 4-1. The ambient temperature ranged from 64 degrees to 92 degrees F and the return air wet bulb temperature varied from 53 degrees to 59 degrees F during the testing period from April 2004 through July 2004. The blower air flow was held constant and the condenser air flow was observed to increase after Adsil treatment. The complete test results are presented in Appendix B.

Three testing procedures were used in each of the 17 evaluations. The first procedure was the condenser test measurement described in Section 3.2. The second and third tests compared the compressor-specific Service Assistant test to the generic Service Assistant test. The generic test uses a generic compressor curve to determine the operating efficiency of a condenser based on the measurements described in Section 3.3. The compressor-specific test uses the actual compressor model of the identified piece of equipment to determine the operating efficiency. At the time of our study, only Copeland compressor models were available in the software. As many different compressor brands were encountered in our study it was decided that it would be necessary to compare the results of using a generic compressor with the results of the actual compressor model.

					Baseline Study nd EER Calculation	at ARI Conditions			
			HVAC Da	na sneet a	IN EER Calculation	at ARI CONDITIONS			
Manufacturer:		Carrier			Published EER:		9.4	Btu/W-hr	(CU Only
Model Number:		38TH060300			Calculated EER:		9.4	Btu/W-hr	
Serial Number					Nominal Capacity	r:	4.96	tons	()
Equipment Type	e:	Split system			Age		13	years	
Year Manufactu		1991			Coil Conditon		18%	(% degrad	led)
Location	incu.	Gainesville			Present Condition	EED	7.4	Btu/W-hr	icu)
Tag		Toms Home	unit		kW/ton		1.62	Dlu/W-III	
Tay			um		KW/ION		1.02		
Compressor Da	ita								
Running load Arr	nps:	30.8	Amps		Power supply:	1.	Phase		
Nameplate Volta	ige:	208	Volts		Phase adjustment:		1		
Power factor:		0.96			Compressor quant	ity:	1		
Condensing Fa	n Data								
Full load Amps:	n Data	1.40	Amps		Power supply:	1	Phase		
Nameplate Volta		208	Volts		Phase adjustment:		1		
			VOILS		•				
Adjust FLA to RL	_A:	0.70			Fan quantity:		1		
Evaporator fan	data (if app	licable)							
Full load Amps:		7.10	Amps		Power supply:	1-	-Phase		
Nameplate Volta	iqe:	122	Volts		Phase adjustment:		1		
Adjust FLA to RL		0.77			Fan quantity:		1		
Calculated com				6.1 0.20	kW kW	Published Total; Sy			6.9 6.3
Calculated cond						Condensing Unit kV			
Calculated evap				0.67	kW	Capacity at ARI Cor	naitions=	=	4.9
Total calculated Assumptions	load for ec	quipment:		6.32	kW - Condensing s	side only			
Condenser Coil	Assassma	nt	18 2%	Perform	ance Degradation				
		nt	18.2%	Perform	ance Degradation				
Overall Unit Con		nt	18.2%	Perform	ance Degradation				
Overall Unit Con	dition lew		18.2%	Perform	ance Degradation				
Overall Unit Con N A	dition Jew Average	nt x	18.2%	Perform	ance Degradation				
Overall Unit Con N A F	dition New Average Fair		18.2%	Perform	ance Degradation				
A F P	dition Jew Average		18.2%	Perform	ance Degradation				
Overall Unit Cond A F P Coil Cleanliness	dition New Average Fair Poor	x	18.2%	Perform	ance Degradation				
Overall Unit Com A F P Coil Cleanliness	dition New Average Fair Poor Coated	x	18.2%	Perform	ance Degradation				
Overall Unit Com A F P Coil Cleanliness C C	dition New Average Fair Poor Coated Clean	x 1 0.3	18.2%	Perform	ance Degradation				
Overall Unit Com A F Coil Cleanliness Coil Cleanliness C C C C C C C C C C C C C C C C C C	dition New Average Fair Poor Coated Clean Dirty	x 1 0.3 0.2	18.2%	Perform	ance Degradation				
Overall Unit Com A F Coil Cleanliness Coil Cleanliness C C C C C C C C C C C C C C C C C C	dition New Average Fair Poor Coated Clean	x 1 0.3	18.2%	Perform	ance Degradation				
Overall Unit Con A F Coil Cleanliness C C C C C C C C C C C C C C C C C C	dition New Average Fair Poor Coated Clean Dirty	x 1 0.3 0.2	18.2%	Perform	ance Degradation				
Overall Unit Con A F Coil Cleanliness C C C C C C C C C C C C C C C C C C	dition New Average Fair Poor Coated Clean Dirty Clogged	x 1 0.3 0.2 0.3	18.2%	Perform	ance Degradation				
Overall Unit Con A F P Coil Cleanliness C C C C F Fin Condition	dition New Average Fair Poor Coated Clean Dirty Clogged	x 1 0.3 0.2 0.3	18.2%	Perform	ance Degradation				
Overall Unit Con A F Coil Cleanliness C C C C C C C C C C C C C C C C C C	dition New Average Fair Poor Coated Clean Dirty Clogged Plugged	x 1 0.3 0.2 0.3	18.2%	Perform	ance Degradation				
Overall Unit Com A F Coil Cleanliness C C C C C Fin Condition L S	dition New Average Fair Poor Coated Clean Dirty Clogged Plugged Some Bent	x 1 0.3 0.2 0.3 0.2 0.2	18.2%	Perform	ance Degradation				
Overall Unit Con A F Coil Cleanliness C C C C C Fin Condition L S S	dition New Average Fair Poor Coated Clean Dirty Clogged Plugged Like New Some Bent Smashed	x 1 0.3 0.2 0.3 0.2 0.05 0	18.2%	Perform	ance Degradation				
Overall Unit Con A F Coil Cleanliness C C C C C C C C C C C C C C C C C C	dition New Average Fair Poor Coated Clean Dirty Clogged Plugged Like New Some Bent Smashed Dull/rough	x 1 0.3 0.2 0.3 0.2 0.2 0.05 0 0.95	18.2%	Perform	ance Degradation				
Overall Unit Con A F Coil Cleanliness C C C C C C C C C C C C C C C C C C	dition New Average Fair Poor Coated Clean Dirty Clogged Plugged Like New Some Bent Smashed Dull/rough Corroded	x 1 0.3 0.2 0.3 0.2 0.05 0 0.95 0	18.2%	Perform	ance Degradation				
Overall Unit Con A F Coil Cleanliness C C C C C C C C C C C C C C C C C C	dition New Average Fair Poor Coated Clean Dirty Clogged Plugged Nugged Some Bent Smashed Dull/rough Corroded Pitted	x 1 0.3 0.2 0.3 0.2 0.05 0 0.05 0 0.95 0 0	18.2%	Perform	ance Degradation				
Overall Unit Com A F Coil Cleanliness C C C C C C C C C C C C C C C C C C	dition New Average Fair Poor Coated Clean Dirty Clogged Plugged Nugged Some Bent Smashed Dull/rough Corroded Pitted Flaking	x 1 0.3 0.2 0.3 0.2 0.05 0 0.95 0	18.2%	Perform	ance Degradation				
Overall Unit Com A F Coil Cleanliness C C C C C C C C C C C C C C C C C C	dition New Average Fair Poor Coated Clean Dirty Clogged Plugged Nugged Some Bent Smashed Dull/rough Corroded Pitted Flaking ment	x 1 0.3 0.2 0.3 0.2 0.05 0 0.95 0 0 0 0 0	18.2%	Perform	ance Degradation				
Overall Unit Com A F Coil Cleanliness C C C C C C C C C C C C C C C C C C	dition New Average Fair Poor Coated Clean Dirty Clogged Plugged Some Bent Somashed Dull/rough Corroded Pitted Flaking ment Like New	x 1 0.3 0.2 0.3 0.2 0.05 0 0.05 0 0.95 0 0	18.2%	Perform	ance Degradation				
Overall Unit Con A F Coil Cleanliness C C C C C C C C C C C C C C C C C C	dition New Average Fair Poor Coated Clean Dirty Clogged Plugged Nugged Some Bent Smashed Dull/rough Corroded Pitted Flaking ment	x 1 0.3 0.2 0.3 0.2 0.05 0 0.95 0 0 0 0 0	18.2%	Perform	ance Degradation				
Overall Unit Com A F P Coil Cleanliness C C C C C C C C C C C C C C C C C C	dition New Average Fair Poor Coated Clean Dirty Clogged Plugged Some Bent Somashed Dull/rough Corroded Pitted Flaking ment Like New	x 1 0.3 0.2 0.3 0.2 0.05 0 0.95 0 0 0 0 0	18.2%	Perform	ance Degradation				
Overall Unit Con A F Coil Cleanliness C C C C C C C C C C C C C C C C C C	dition New Average Fair Poor Coated Clean Dirty Clogged Plugged Some Bent Somashed Dull/rough Corroded Pitted Flaking ment Like New Corrosion	x 1 0.3 0.2 0.3 0.2 0.05 0 0.95 0 0 0 0 0	18.2%	Perform	ance Degradation				
Overall Unit Con A F Coil Cleanliness C C C C C C C C C C C C C C C C C C	dition New Average Fair Poor Coated Clean Dirty Clogged Plugged New Some Bent Smashed Dull/rough Corroded Pitted Flaking ment Like New Corrosion Some Loose Many Loose	x 1 0.3 0.2 0.3 0.2 0.05 0 0.95 0 0 0 x x	18.2%	Perform	ance Degradation				
Overall Unit Com A F Coil Cleanliness C C Fin Condition F Fin Condition F Fin-Tube Attachr C S S S S S S S S S S S S S S S S S S	dition New Average Fair Poor Coated Clean Dirty Clogged Plugged New Some Bent Smashed Dull/rough Corroded Pitted Flaking ment Like New Corrosion Some Loose Many Loose	x 1 0.3 0.2 0.3 0.2 0.05 0 0.95 0 0 0 0 0	18.2%	Perform	ance Degradation				
Overall Unit Com A F Coil Cleanliness C C Fin Condition F Fin Condition F Fin-Tube Attachr C S Tubes C C C C C C C C C C C C C C C C C C C	dition New Average Fair Poor Coated Clean Dirty Clogged Plugged Some Bent Smashed Dull/rough Corroded Pitted Flaking ment Like New Corrosion Some Loose Many Loose Clean Cu Corrosion	x 1 0.3 0.2 0.3 0.2 0.05 0 0.95 0 0 0 x x	18.2%	Perform	ance Degradation				
Overall Unit Con A F Coil Cleanliness C C C C C C C C C C C C C C C C C C	dition New Average Fair Poor Coated Clean Dirty Clogged Plugged New Some Bent Smashed Dull/rough Corroded Pitted Flaking ment Like New Corrosion Some Loose Many Loose	x 1 0.3 0.2 0.3 0.2 0.05 0 0.95 0 0 0 x x	18.2%	Perform	ance Degradation				
Overall Unit Com A F Coil Cleanliness C C Fin Condition F Fin Condition F Fin-Tube Attachr C S Tubes C C C C C C C C C C C C C C C C C C C	dition New Average Fair Poor Coated Clean Dirty Clogged Plugged Some Bent Smashed Dull/rough Corroded Pitted Flaking ment Like New Corrosion Some Loose Many Loose Clean Cu Corrosion	x 1 0.3 0.2 0.3 0.2 0.05 0 0.95 0 0 0 x x	18.2%	Perform	ance Degradation				

This unit was cleaned with a garden hose prior to initiation of pre-Adsil testing. After completion of pre-testing, the unit was cleaned and coated per Adsil protocol on August 3, 2004. Post-Adsil testing began at this time and continued through August 23, 2004. Twelve tests were conducted post-treatment and comparisons were made to the pre-treatment results.

Condenser Heat Rejection and Power Measurement

The protocol for this procedure is described in Section 3.2 of this report. Per this procedure, the power consumption was observed to increase as temperature increased, as shown in Figure 4-2 and Figure 4-3. It may also be seen in these two figures that the slope of the curve post-Adsil treatment is steeper than the pre-treatment curve suggesting that power consumption on this tested unit increased after treatment. The intercept for this phenomenon occurs at approximately 88 degrees F in Figure 4-3.

A comparison of the measured EER values using this procedure shows great variation prior to Adsil application. EER values ranged from 3.5 to 7.5 in the 70-95 degree temperature range. This variation is due primarily to very inconsistent fan flow measurements prior to the Adsil treatment, as may be seen in Table 4-1. The average flow rate was measured to be 0.66 kilogram per second (kg/sec) with a range of 0.40 kg/sec to 0.94 kg/sec. Post-treatment the fan flow rate averaged 1.13 kg/sec with a range between 1.11 kg/sec and 1.16 kg/sec. Flow post-treatment was very consistent and uniform.

The average EER gain using this methodology was determined to be in excess of 70% as shown in Table 4-1 for all temperatures and 49% for tests conducted at 85 degrees and higher. However, the high variation of the flow rates pre-treatment may invalidate the results of this protocol for this unit. Figure 4-4 shows a very large increase in EER post-treatment with a trend of the EER improvement to decrease post-treatment with increasing ambient temperatures. Figure 4-5 also shows a large increase in EER post-treatment with a trend of the EER to increase slightly post-treatment (with increasing ambient temperatures) when only tests 85 degrees and higher are considered.

Service Assistant Test Description for Generic Compressor Model

The results for this procedure are summarized in Table 4-2. The accuracy and repeatability in the tests improved with an increase in OAT using this procedure. At temperatures below 85 degrees, the data had greater scatter. For instance, in the generic tests the range of achieved efficiency as a percent of theoretical efficiency was between 80% and 102%. However, at temperatures of 85 degrees and higher, the range can be observed to be restricted to between 86% and 90% efficient. Similarly, in the post-treatment tests the range is 86% to 99% at temperatures 73 and above. At temperatures 87 degrees and higher, the range is 89% to 99% efficient. It was interesting to note that the greatest efficiency improvements occurred at the harsher conditions and at lower ambient temperatures there appeared to be little benefit from the treatment process.



Source: MACTEC, 2004. Prepared by: _TBL_ Checked by: _CDM_







	Generic Co	mpresso	r Test Su	Immary-A	li iem	peratu	res									
EER at ARI Con	ditions			9.4	BTU/W-I	h										
Condensing unit					CFM (Lis											
Capacity at ARI			4.96 tons													
Coil Area				15	sq-ft											
Predicted EER	=	7.40 Physical Power and Capacity Measurements														
		HVAC	Service As	sistant				Physi	cal Power a	and Capacit	y Measurer	nents				
Test Date							Cond Ai	r, deg F		Cond Air						
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER	cfm a		
April 12-G	64	57	80%	73%	9.9	5.7	66	89	12.8	4.8	1.06	3.9	9.68	0.38		
April 14-G	66	56	102%	102%	12.4	4.9	66	88	12.2	4.6	1.76	6.2	16.06	0.38		
April 12G	71	57	87%	82%	10.0	6.6	71	96	13.9	4.8	1.06	4.2	10.52	0.38		
April 8G	73	57	79%	73%	8.8	5.5	73	95	12.2	4.8	1.06	3.7	9.26	0.38		
July 8-G	82	58	84%	83%	8.5	4.7	85	107	12.2	5.3	2.16	7.6	17.10	0.38		
April 28G	83	55	85%	80%	8.5	4.7	83	105	12.2	5.1	1.42	5.0	11.72	0.38		
July 8-G	83	53	84%	82%	8.4	5.1	85	106	11.7	5.2	2.10	7.0	16.16	0.38		
April 10G	84	57	86%	84%	8.5	5.2	84	107	12.8	5.3	1.06	3.9	8.76	0.38		
April 28G	84	55	84%	80%	8.3	4.8	84	107	12.8	5.2	1.81	6.6	15.26	0.38		
June 2-G3	84	56	87%	84%	8.6	6.3	84	106	12.2	5.2	1.08	3.8	8.75	0.38		
July 8 G4	84	55	87%	86%	8.6	5.1	82	106	13.3	5.2	2.10	8.0	18.52	0.38		
April 28G	85	59	88%	84%	8.7	4.9	85	108	12.8	5.2	1.81	6.6	15.29	0.38		
July 8G	85	56	86%	88%	8.4	4.9	86	109	12.8	5.3	2.04	7.5	16.87	0.38		
May 8G	88	58	89%	88%	8.5	5.0	86	108	12.2	5.4	2.19	7.7	17.03	0.38		
May 8G	90	55	88%	88%	8.1	5.0	90	111	11.7	5.4	2.30	7.7	17.07	0.38		
July 8G	90	59	90%	92%	8.4	4.8	90	116	14.4	5.6	2.22	9.2	19.65	0.38		
May 8G	92	59	90%	90%	8.5	5.0	95	115	11.1	5.4	2.47	7.9	17.46	0.38		
	Δ	VERAGES	86.8%	84.6%					12.55		1.75		14.42			
POST ADSIL	OAT	EWB	El	CI	EER	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER	cfm a		
August 21-G	73	59	86%	81%	9.7	4.7	72	96	13.3	4.8	2.96	11.31	28.27	0.38		
August 20-G	81	59	87%	85%	9.0	4.9	79	102	12.8	5.1	2.94	10.74	25.28	0.38		
August 23-G	82	63	95%	95%	9.9	5.0	82	106	13.3	5.3	2.92	11.12	25.18	0.38		
August 20-G	83	60	88%	87%	8.9	4.9	83	107	13.3	5.2	2.99	11.39	26.29	0.38		
August 20-G	85	60	88%	85%	8.7	4.9	84	107	12.8	5.3	2.92	10.66	24.14	0.38		
August 20-G	85	65	88%	85%	9.1	5.6	82	108	14.4	5.4	2.98	12.32	27.38	0.38		
August 10-G	85	57	88%	85%	8.6	5.8	84	107	12.8	5.2	3.01	11.01	25.41	0.38		
August 21-G	86	59	88%	87%	8.6	4.9	85	108	12.8	5.3	2.98	10.88	24.63	0.38		
August 10-G1	87	58	94%	90%	9.2	5.8	82	105	12.8	5.2	3.06	11.17	25.77	0.38		
August 6-G	89	60	93%	95%	9.0	6.1	89	114	13.9	5.5	2.93	11.62	25.35	0.38		
August 6-G1	91	60	99%	97%	9.4	5.9	89	115	14.4	5.6	3.02	12.49	26.77	0.38		
August 18-G	90	65	94%	96%	8.7	6.2	90	115	13.9	5.6	2.99	11.87	25.43	0.38		
		VERAGES	90.7%	89.0%					13.38		2.97		25.83			

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	TABLE 4-																
		seline Stu	-														
	Generic C	ompresso	r Test Su	ummary a	t Ambi	ent 85	Degrees	or Highe	er								
		1 Test per Te					U	U									
EER at ARI Co	nditions	•	• •	9.4	BTU/W-	n											
Condensing un	it CFM			3000	CFM (Lis	sted)											
Capacity at ARI	l			4.96	5 tons												
Coil Area				15	sq-ft												
Predicted EER	=			7.40)												
		HVAC	Service As	ssistant				Phys	ical Power	and Capac	ity measurm	nents					
Test Date							Cond Ai	r, deg F		Cond Air	-						
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER	cfm a			
luly 8G	85	56	86%	88%	8.4	4.9	86	109	12.8	5.3	2.04	7.5	16.87	0.38			
May 8G	88	58	89%	88%	8.5	5.0	86	108	12.2	5.4	2.19	7.7	17.03	0.38			
May 8G	90				55	88%	88%	8.1	5.0	90	111	11.7	5.4	2.30	7.7	17.07	0.38
May 8G	92	59	90%	90%	8.5	5.0	95	115	11.1	5.4	2.47	7.9	17.46	0.38			
		AVERAGES	88.3%	88.5%					11.94		2.25		17.11				
	0.47									1.1.4/							
POST ADSIL	OAT	EWB	El	CI	EER	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER	cfm a			
August 10-G	85	57	88%	85%	8.6	5.8	84	107	12.8	5.2	3.01	11.01	25.41	0.38			
August 21-G	86	59	88%	87%	8.6	4.9	85	108	12.8	5.3	2.98	10.88	24.63	0.38			
August 10-G1	<u>87</u> 89	<u>58</u> 60	<u>94%</u> 93%	<u>90%</u> 95%	9.2 9.0	<u>5.8</u> 6.1	<u>82</u> 89	105 114	<u>12.8</u> 13.9	<u>5.2</u> 5.5	3.06 2.93	<u>11.17</u> 11.62	25.77 25.35	0.38			
August 6-G	<u> </u>	60	93%	95% 97%	9.0	5.9	<u>89</u> 89	114	13.9	5.6	3.02	11.62	25.35	0.38			
August 6-G1 August 18-G	91	65	99%	97%	9.4	5.9 6.2	89 90	115	14.4	5.6	2.99	12.49	25.43	0.38			
hugust 10-0	90	00	34 /0	90%	0.7	0.2		115	13.9	5.0	2.99	11.07	20.40	0.30			
		AVERAGES	92.7%	91.7%					13.43		3.00		25.56				
		Change	5.0%	3.6%					12.4%		33.1%		49.4%				

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Figure 4-6 shows the EER improvement associated with the Adsil process as measured with the Service Assistant generic compressor over the temperature range from 73 to 92 degrees F. The average EER improvement measured with this process is 4.4% and the average capacity increase is seen to be 5.1% in Table 4-1. When temperatures 85 degrees and above are considered, the improvement in EER is seen to be 5.0% but the capacity increase is less than before with a 3.6% increase. Table 4-2 and Figure 4-7 show these results.

Service Assistant Test Description for Copeland Compressor Model

The second test employs the actual Copeland compressor model currently in use on the unit. Comparing these results in a similar manner as before, the EER as a percent of the theoretical EER is seen to vary between 79% and 103%. The accuracy and repeatability in these tests also increased with an increase in OAT. At temperatures below 85 degrees, the data had greater scatter. At temperatures of 85 degrees and higher, the range can be observed to be restricted to between 81% and 85% efficient. Similarly, in the post-treatment tests the range is 83% to 96% at temperatures 73 and above. At temperatures 87 degrees and higher, the range is 92% to 96% efficient. It was interesting to note that the greatest efficiency improvements occurred at the harsher conditions and that at low ambient temperatures there appeared to be little benefit from the treatment process.

Figure 4-8 shows the EER improvement associated with the Adsil process as measured with the Service Assistant Copeland compressor over the temperature range from 73 to 92 degrees F. The average EER improvement measured with this process is 6.1% and the average capacity increase is seen to be 6.0% in Table 4-3. When temperatures 85 degrees and above are considered, the improvement in EER is seen to be 5.0% but the capacity increase is less than before with a 3.6% increase. Table 4-4 and Figure 4-9 show these results.

Summary of Test Results for Unit 1

All three test procedures showed a measurable increase in EER for Unit 1. Figure 4-10 shows change in EER after Adsil treatment for all three procedures. Consistent trend lines are observed when comparing the generic compressor curve test to the Copeland compressor test although the generic test underestimates the Copeland test efficiency gains. The condenser test in this figure shows a much larger increase in EER over the temperature range of 73 degrees to 92 degrees. Figure 4-11 presents the results of tests at 85 degrees and higher. These three curves are approximately parallel and indicate that the EER gains are higher for all three tests at higher temperatures. The condenser test continues to overestimate the gains because of the poor condenser air flow measurements during pre-treatment testing.











Source: MACTEC, 2004. Prepared by: _TBL_ Checked by: _CDM_



	TABLE 4-3 Unit 1 Base	ling Study											
	Copeland Co		Test Sum	mary-All	Tempe	erature	S						
EER at ARI Co	nditions			9.4	BTU/W-I	า							
Condensing un	it CFM			3000	CFM (Lis	sted)							
Capacity at AR	I			4.96	tons								
Coil Area				15	sq-ft								
Predicted EER	=			7.40	-								
		HVAC S	Service Assis	stant				Physic	al Power a	nd Capaci	ity Measure	ements	
Test Date							Cond Air	, deg F		Cond Air	-		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER
April 12-C	64	57	79%	72%	9.8	4.6	66	89	12.8	4.8	1.06	3.87	9.68
April 14-C	66	56	103%	103%	12.5	5.0	66	88	12.2	4.6	1.76	6.16	16.06
April 12-C	71	57	79%	71%	9.0	4.6	71	96	13.9	4.8	1.06	4.21	10.52
July 8-C	82	58	81%	75%	8.2	4.7	85	107	12.2	5.3	2.16	7.55	17.10
April 28-C	83	55	80%	72%	8.0	4.7	83	105	12.2	5.1	1.42	4.98	11.72
July 8-C1	83	53	80%	73%	8.0	4.7	85	105	11.7	5.2	2.10	7.00	16.16
April 10-C1	84	57	83%	76%	8.2	4.7	84	107	12.8	5.3	1.06	3.87	8.76
April 28-C2	84	55	81%	73%	8.0	4.6	84	107	12.8	5.2	1.81	6.61	15.26
une 2-C3	84	56	86%	78%	8.5	5.5	84	107	12.0	5.2	1.08	3.79	8.75
July 8 C4	84	55	84%	77%	8.3	4.7	82	106	13.3	5.2	2.10	8.0	18.52
April 9-C1	85	57	81%	72%	7.9	5.5	85	108	12.8	5.2	1.06	3.87	8.93
April 28-C2	85	59	83%	76%	8.2	4.7	85	108	12.8	5.2	1.81	6.62	15.29
July 8-C3	85	56	83%	78%	8.1	4.8	86	109	12.8	5.3	2.04	7.5	16.87
May 08-C	88	58	83%	77%	7.9	4.7	86	108	12.0	5.4	2.19	7.66	17.03
May 08-C	90	55	83%	77%	7.6	4.7	90	111	11.7	5.4	2.30	7.68	17.03
May 08-C	90	59	85%	81%	8.0	4.8	90	116	14.4	5.6	2.30	9.17	19.65
May 08-C	92	59	84%	78%	7.9	4.7	95	115	11.1	5.4	2.47	7.86	17.46
	JZ		83.4%	77.0%	7.5	4./	35	115	12.6	J.4	1.7	7.00	140
			03.4 /0	11.0 /0					12.0		1.7		14
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	DT (K)	kW		tons	EER
August 21-C	73	<u>59</u>	83%	74%	9.4	4.6	72	96	13.3	4.8	(kg/sec) 2.96	11.31	28.27
August 21-C	81	59	84%	74% 76%	9.4 8.7	4.0	72	<u>96</u> 102	13.3	<u>4.0</u> 5.1	2.96	10.74	25.28
August 20-C	81	63	88%	<u> </u>	<u>8.7</u> 9.2	<u>4.0</u> 4.8	82	102	12.0	5.1	2.94	11.12	
August 23-C	82	60	88% 84%	84% 78%	9.2 8.5	<u>4.8</u> 4.7	82 83	106	13.3	5.3 5.2	2.92	11.12	25.18 26.29
August 20-C	<u>83</u> 85												
		<u>60</u>	<u>89%</u>	81%	8.8	4.7	84	107	12.8	5.3	2.92	10.66	24.14
August 20-C	85	65	89%	81% 70%	9.2	5.6	82	108	14.4	5.4	2.98	12.32	27.38
August 10-C	85	57	88%	79%	8.6	5.5	84	107	12.8	5.2	3.01	11.01	25.41
August 21-C	86	<u>59</u>	85%	78%	8.3	4.6	85	108	12.8	5.3	2.98	10.88	24.63
August 10-C	87	58	92%	82%	9.0	5.5	82	105	12.8	5.2	3.06	11.17	25.77
August 6-C	89	60	92%	87%	8.9	5.8	89	114	13.9	5.5	2.93	11.62	25.35
August 6-C	91	60	96%	91%	9.1	5.8	89	115	14.4	5.6	3.02	12.49	26.77
August 18-C	90	65	<mark>92%</mark>	88%	8.5	5.8	90	115	13.9	5.6	2.99	11.87	25.43
			88.5%	81.6%			83.42	107.50	13.38	5.29	2.97	11.38	25.
		Change		6.0%					6.3%		70.1%		79.3%

	C	Condensing Unit Summary - ARI Conditions													
			Percent Difference			Test Data			Percent Difference						
ΟΑΤ		SA	си	Lit	SA/Lit	CU/Lit	SA/CU	SA	CU	Literature		CU/Lit	SA/CU	Predicted/SA	Predicted/CU
	Power (kW)	4.6	4.800	4.85	95%	99%	96%	6.0	6.2	6.32	95%	99%	96%	-	-
64-C	Capacity (Tons)	3.61	3.87	5.01	72%	77%	93%	3.6	3.8	4.96	72%	77%	93%	-	-
	EER	9.8	9.68	12.40	79%	78%	101%	7.4	7.4	9.42	79%	78%	101%	99%	101%
	Power (kW)	5.0	4.600	4.92	102%	93%	109%	6.4	5.9	6.32	102%	93%	109%	-	-
66-C	Capacity (Tons)	5.12	6.16	4.97	103%	124%	83%	5.1	6.1	4.96	103%	124%	83%	-	-
	EER	12.5	16.06	12.12	103%	133%	78%	9.7	12.5	9.42	103%	133%	78%	76%	59%
	Power (kW)	4.6	4.8	5.09	90%	94%	96%	5.7	6.0	6.32	90%	94%	96%	-	-
71-C	Capacity (Tons)	3.45	4.21	4.86	71%	87%	82%	3.5	4.3	4.96	71%	87%	82%	-	-
	EER	9.0	10.52	11.45	79%	92%	86%	7.4	8.7	9.42	79%	92%	86%	99%	86%
	Power (kW)	4.7	5.3	5.50	85%	96%	89%	5.4	6.1	6.32	85%	96%	89%	-	-
82-C	Capacity (Tons)	3.50	7.55	4.66	75%	162%	46%	3.7	8.0	4.96	75%	162%	46%	-	-
	EER	8.2	17.10	10.17	81%	168%	48%	7.6	15.8	9.42	81%	168%	48%	97%	47%
	Power (kW)	4.7	5.1	5.46	86%	93%	92%	5.4	5.9	6.32	86%	93%	92%	-	-
83-C	Capacity (Tons)	3.26	4.98	4.52	72%	110%	65%	3.6	5.5	4.96	72%	110%	65%	-	-
	EER	8.0	11.72	9.94	80%	118%	68%	7.5	11.1	9.42	80%	118%	68%	98%	67%
	Power (kW)	4.7	5.2	5.46	86%	95%	90%	5.4	6.0	6.32	86%	95%	90%	-	-
83-C1	Capacity (Tons)	3.30	7.00	4.52	73%	155%	47%	3.6	7.7	4.96	73%	155%	47%	-	-
	EER	8.0	16.16	9.94	80%	163%	49%	7.5	15.3	9.42	80%	163%	49%	98%	48%
	Power (kW)	4.7	5.3	5.54	85%	96%	89%	5.4	6.0	6.32	85%	96%	89%	-	-
84-C1	Capacity (Tons)	3.48	3.87	4.58	76%	85%	90%	3.8	4.2	4.96	76%	85%	90%	-	-
	EER	8.23	8.76	9.91	83%	88%	94%	7.8	8.3	9.42	83%	88%	94%	95%	89%
	Power (kW)	4.6	5.2	5.50	84%	95%	88%	5.3	6.0	6.32	84%	95%	88%	-	-
84-C2	Capacity (Tons)	3.29	6.61	4.50	73%	147%	50%	3.6	7.3	4.96	73%	147%	50%	-	-
	EER	7.97	15.26	9.83	81%	155%	52%	7.6	14.6	9.42	81%	155%	52%	97%	51%
	Power (kW)	5.5	5.2	5.52	100%	94%	106%	6.3	6.0	6.32	100%	94%	106%	-	-
84-C3	Capacity (Tons)	3.54	3.79	4.54	78%	83%	93%	3.9	4.1	4.96	78%	83%	93%	-	-
	EER	8.46	8.75	9.83	86%	89%	97%	8.1	8.4	9.42	86%	89%	97%	91%	88%
	Power (kW)	4.7	5.2	5.50	86%	95%	90%	5.4	6.0	6.32	86%	95%	90%	-	-
84-C3	Capacity (Tons)	3.47	8.02	4.50	77%	178%	43%	3.8	8.8	4.96	77%	178%	43%	-	-
	EER	8.26	18.52	9.83	84%	188%	45%	7.9	17.7	9.42	84%	188%	45%	94%	42%
	Power (kW)	5.5	5.2	5.58	99%	93%	106%	6.2	5.9	6.32	99%	93%	106%	-	-
85-C1	Capacity (Tons)	3.28	3.87	4.56	72%	85%	85%	3.6	4.2	4.96	72%	85%	85%	-	-
	EER	7.94	8.93	9.81	81%	91%	89%	7.6	8.6	9.42	81%	91%	89%	97%	86%
	Power (kW)	4.7	5.2	5.63	84%	92%	90%	5.3	5.8	6.32	84%	92%	90%	-	-
85-C2	Capacity (Tons)	3.52	6.62	4.63	76%	143%	53%	3.8	7.1	4.96	76%	143%	53%	-	-
	EER	8.20	15.29	9.88	83%	155%	54%	7.8	14.6	9.42	83%	155%	54%	95%	51%
	Power (kW)	4.8	5.3	5.56	86%	95%	91%	5.5	6.0	6.32	86%	95%	91%	-	-
85-C3	Capacity (Tons)	3.53	7.45	4.52	78%	165%	47%	3.9	8.2	4.96	78%	165%	47%	-	-
	EER	8.11	16.87	9.77	83%	173%	48%	7.8	16.3	9.42	83%	173%	48%	95%	45%
_	Power (kW)	4.7	5.4	5.70	82%	95%	87%	5.2	6.0	6.32	82%	95%	87%	-	-
88-C	Capacity (Tons)	3.49	7.66	4.53	77%	169%	46%	3.8	8.4	4.96	77%	169%	46%	-	-
	EER	7.91	17.03	9.53	83%	179%	46%	7.8	16.8	9.42	83%	179%	46%	95%	44%
	Power (kW)	4.7	5.4	5.71	82%	95%	87%	5.2	6.0	6.32	82%	95%	87%	-	-
90-C	Capacity (Tons)	3.38	7.68	4.39	77%	175%	44%	3.8	8.7	4.96	77%	175%	44%	-	-
	EER	7.65	17.07	9.22	83%	185%	45%	7.8	17.4	9.42	83%	185%	45%	95%	42%
	Power (kW)	4.8	5.6	5.79	83%	97%	86%	5.2	6.1	6.32	83%	97%	86%	-	-
90-C1	Capacity (Tons)	3.66	9.17	4.52	81%	203%	40%	4.0	10.1	4.96	81%	203%	40%	-	-
<u>.</u>	EER	7.95	19.65	9.35	85%	210%	40%	8.0	19.8	9.42	85%	210%	40%	92%	37%
	Power (kW)	4.7	5.4	5.76	82%	94%	87%	5.2	5.9	6.32	82%	94%	87%	-	-
92-C	Capacity (Tons)	3.49	7.66	4.54	77%	169%	46%	3.8	8.4	4.96	77%	169%	46%	-	-
	EER	7.91	17.03	9.46	84%	180%	46%	7.9	17.0	9.42	84%	180%	46%	94%	44%

Table 4-3. Unit 1 Baseline Study, Copeland Compressor Test Summary-All Temperatures (continued)

	POST ADSIL														
73-C	Power (kW)	4.6	4.8	5.23	88%	92%	<mark>96%</mark>	5.6	5.8	6.32	88%	<mark>92%</mark>	96%	-	-
	Capacity (Tons)	3.64	11.31	4.92	74%	230%	32%	3.7	11.4	4.96	74%	230%	32%	-	-
	EER	9.37	28.27	11.29	83%	250%	33%	7.8	23.6	9.42	83%	250%	33%	95%	31%
	Power (kW)	4.6	5.1	5.49	84%	93%	90%	5.3	5.9	6.32	84%	<mark>93%</mark>	90%	-	-
81-C	Capacity (Tons)	3.59	10.74	4.73	76%	227%	33%	3.8	11.3	4.96	76%	227%	33%	-	-
	EER	8.68	25.28	10.33	84%	245%	34%	7.9	23.1	9.42	84%	245%	34%	94%	32%
	Power (kW)	4.8	5.3	5.66	85%	94%	91%	5.4	5.9	6.32	85%	94%	91%	-	-
82-C	Capacity (Tons)	4.14	11.12	4.93	84%	226%	37%	4.2	11.2	4.96	84%	226%	37%	-	-
	EER	9.20	25.18	10.45	88%	241%	37%	8.3	22.7	9.42	88%	241%	37%	89%	33%
	Power (kW)	4.7	5.2	5.58	84%	93%	90%	5.3	5.9	6.32	84%	93%	90%	-	-
83-C	Capacity (Tons)	3.68	11.39	4.72	78%	241%	32%	3.9	12.0	4.96	78%	241%	32%	-	-
	EER	8.52	26.29	10.14	84%	259%	32%	7.9	24.4	9.42	84%	259%	32%	94%	30%
85-C	Power (kW)	4.7	5.3	5.65	83%	94%	89%	5.3	5.9	6.32	83%	94%	89%	-	-
	Capacity (Tons)	3.78	10.66	4.67	81%	228%	35%	4.0	11.3	4.96	81%	228%	35%	-	-
	EER	8.83	24.14	9.92	89%	243%	37%	8.4	22.9	9.42	89%	243%	37%	88%	32%
85-C1	Power (kW)	5.6	5.4	5.87	95%	92%	104%	6.0	5.8	6.32	95%	92%	104%	-	-
	Capacity (Tons)	4.09	12.32	5.05	81%	244%	33%	4.0	12.1	4.96	81%	244%	33%	-	-
	EER	9.19	27.38	10.33	89%	265%	34%	8.4	25.0	9.42	89%	265%	34%	88%	30%
	Power (kW)	5.5	5.2	5.58	99%	93%	106%	6.2	5.9	6.32	99%	93%	106%	-	-
85-C2	Capacity (Tons)	3.60	11.01	4.56	79%	242%	33%	3.9	12.0	4.96	79%	242%	33%	-	-
	EER	8.63	25.41	9.81	88%	259%	34%	8.3	24.4	9.42	88%	259%	34%	89%	30%
	Power (kW)	4.6	5.3	5.66	81%	94%	87%	5.1	5.9	6.32	81%	94%	87%	-	-
86-C	Capacity (Tons)	3.60	10.88	4.61	78%	236%	33%	3.9	11.7	4.96	78%	236%	33%	-	-
	EER	8.31	24.63	9.77	85%	252%	34%	8.0	23.7	9.42	85%	252%	34%	92%	31%
	Power (kW)	5.5	5.2	5.58	99%	93%	106%	6.2	5.9	6.32	99%	93%	106%	-	-
87-C	Capacity (Tons)	3.74	11.17	4.56	82%	245%	33%	4.1	12.1	4.96	82%	245%	33%	-	-
	EER	9.02	25.77	9.81	92%	263%	35%	8.7	24.8	9.42	92%	263%	35%	85%	30%
	Power (kW)	5.8	5.5	5.67	102%	97%	105%	6.5	6.1	6.32	102%	97%	105%	-	-
89-C	Capacity (Tons)	3.96	11.62	4.55	87%	255%	34%	4.3	12.7	4.96	87%	255%	34%	-	-
	EER	8.86	25.35	9.63	92%	263%	35%	8.7	24.8	9.42	92%	263%	35%	85%	30%
	Power (kW)	5.8	5.6	5.78	100%	97%	104%	6.3	6.1	6.32	100%	97%	104%	-	-
91-C	Capacity (Tons)	4.16	12.49	4.57	91%	273%	33%	4.5	13.5	4.96	91%	273%	33%	-	-
	EER	9.11	26.77	9.49	96%	282%	34%	9.0	26.6	9.42	96%	282%	34%	82%	28%
90-C Clean Evap	Power (kW)	5.8	5.6	5.85	99%	96%	104%	6.3	6.1	6.32	99%	96%	104%	-	-
	Capacity (Tons)	3.98	11.87	4.52	88%	262%	34%	4.4	13.0	4.96	88%	262%	34%	-	-
	EER	8.54	25.43	9.28	92%	274%	34%	8.7	25.8	9.42	92%	274%	34%	85%	29%

Table 4-3. Unit 1 Baseline Study, Copeland Compressor Test Summary-All Temperatures (continued)

TABLE 4-4 Unit 1 Baseline Study

Copeland Compressor Test Summary at Ambient of 85 Degrees or Higher (Maximum of 1 Test Per Temperature)

Predicted EER =	7.40
Coil Area	15 sq-ft
Capacity at ARI	4.96 tons
Condensing unit CFM	3000 CFM (Listed)
EER at ARI Conditions	9.4 BTU/W-h

		H	VAC Servio	ce Assistar	nt		Physical Power and Capacity Measurements								
Test Date							Cond A	ir, deg F		Cond Air					
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER		
April 9-C1	85	57	81%	72%	0.0	5.5	85	108	12.8	5.2	1.06	3.87	8.93		
May 08-C	88	58	83%	77%	0.0	4.7	86	108	12.2	5.4	2.19	7.66	17.03		
May 08-C	90	55	83%	77%	0.0	4.7	90	111	11.7	5.4	2.30	7.68	17.07		
May 08-C	92	59	84%	78%	0.0	4.7	95	115	11.1	5.4	2.47	7.86	17.46		
			82.8%	76.0%											
POST ADSIL	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER		
August 20-C	85	60	<mark>89%</mark>	<mark>81%</mark>	0.0	4.7	84	107	12.8	5.3	2.92	10.66	24.14		
August 20-C	85	65	89%	<mark>81%</mark>	0.0	5.6	82	108	14.4	5.4	2.98	12.32	27.38		
August 21-C	86	59	85%	78%	0.0	4.6	85	108	12.8	5.3	2.98	10.88	24.63		
August 10-C	87	58	92%	82%	0.0	5.5	82	105	12.8	5.2	3.06	11.17	25.77		
August 6-C	89	60	<mark>92%</mark>	87%	0.0	5.8	89	114	13.9	5.5	2.93	11.62	25.35		
August 6-C	91	60	<mark>96%</mark>	<mark>91%</mark>	0.0	5.8	89	115	14.4	5.6	3.02	12.49	26.77		
August 18-C	90	65	92%	88%	0.0	5.8	90	115	13.9	5.6	2.99	11.87	25.43		
			90.7%	84.0%			85.86	110.29	13.57	5.41	2.98	11.57	25.64		

Figure 4-12 shows the variability in measuring the efficiency index of the unit pre-treatment over the temperature range of 73 degrees to 92 degrees. Figure 4-13 shows the same indices for the post-treatment unit. Results of this inspection show more uniform results after Adsil treatment. Figure 4-14 shows the indices for temperatures of 85 degrees or higher. Inspection of these graphs indicate that the efficiency index, a measure of the actual efficiency divided by the benchmark efficiency of the unit when new, increases with increasing temperatures. This increase is observed to be more pronounced after the Adsil application.

Unit 2 Protocol

This unit was evaluated eight times prior to the Adsil application. The ambient temperature ranged from 83 degrees to 92 degrees F and the return air wet bulb temperature varied from 54 degrees to 57 degrees F during the testing period from May 2004 through August 2004. The blower air flow was held constant and the average condenser air flow was observed to increase after Adsil treatment. The complete test results are presented in Appendix C. Figure 4-15 provides the initial assessment of the unit prior to Adsil treatment.

Two testing procedures were used in each of the eight evaluations. The first procedure was the condenser test measurement described in Section 3.2. The second test was the generic compressor Service Assistant test. The generic test uses a generic compressor curve to determine the operating efficiency of a condenser based on the measurements described in Section 3.3.

This unit was not cleaned prior to initiation of pre-Adsil testing. After completion of pre-testing, the unit was cleaned and coated per Adsil protocol on August 3, 2004. Post-Adsil testing began at this time and continued through August 31, 2004. Seven tests were conducted post-treatment and comparisons were made to the pre-test process.

Condenser Heat Rejection and Power Measurement

The protocol for this procedure is described in Section 3.2 of this report. Per this procedure the power consumption was observed to increase as temperature increased, as shown in Figure 4-16 and Table 4-5. It may also be seen in these two figures that the slope of the post-Adsil treatment curve is less than the pre-treatment curve suggesting that power consumption on this tested unit decreased after treatment. The intercept for this phenomenon occurs at approximately 84 degrees F.

A comparison of the measured EER using this procedure shows great variation prior to and after Adsil application. EER values ranged from 7.6 to 11.2 for all temperature ranges before application and from 9.7 to 13.9 after application. This variation is due primarily to very inconsistent fan flow measurements as may be seen in Table 4-5. The average pre-application flow rate was measured to be 3.91 kg/sec with a range of 3.33 kg/sec to 4.63 kg/sec. Post-treatment the fan flow rate averaged 4.47 kg/sec with a range between 4.07 kg/sec and 4.92 kg/sec.






					Baseline Study		
			HVAC Da	ta Sheet a	nd EER Calculation at ARI Cond	aitions	
Manufactur	er:	Carrier			Published EER:	67.0	Btu/W-hr (CU Only
Model Num	ber:	38YCC060			Calculated EER:	9.2	Btu/W-hr (CU Only
Serial Numl	ber				Nominal Capacity:	4.64	tons
Equipment		SS Heat pun	ηp		Age	3	years
Year Manuf	actured:	2001			Coil Conditon	3%	(% degraded)
Location		MACTEC He	endrickson		Present Condition EER	9.0	Btu/W-hr
Тад		HP-7			kW/ton	1.33	
Compresso	r Data						
Running loa		17.0	Amps		Power supply:	3-phase	
Nameplate \	/oltage:	230	Volts		Phase adjustment:	1.73	
Power factor	r:	0.86			Compressor quantity:	1	
Condensing	n Fan Data						
Full load Am		1.40	Amps		Power supply:	1-Phase	
Nameplate \	•	230	Volts		Phase adjustment:	1	
Adjust FLA t		0.70			Fan quantity:	1	
					quantity.		
Evaporator Full load Am	fan data (if app		Amee		Power supply:	1 Phone	
Nameplate \		5.40	Amps		Power supply:	1-Phase	
		230	Volts		Phase adjustment:	1	
Adjust FLA t	0 RLA:	0.11			Fan quantity:	1	
Calculated	compressor loa	ad:		5.8	kW		
	condensing far			0.23	kW		
	evaporator fan			0.13	kW		
Total calcul	ated load for e	quipment:		6.04	kW - Condensing side only		
Assumption	าร						
Condenser Overall Unit		nt	3.2%	Performa	ance Degradation		
	New		4				
	Average	x	4				
	Fair		4				
	Poor		4				
Coil Cleanlin	less						
	Coated						
	Clean	0.9	T				
	Dirty	0.1	7				
	Clogged		1				
	Plugged		1				
Fin Conditio		<u> </u>	1				
	Like New	1	1				
	Some Bent	<u> </u>	1				
	Smashed		1				
	Dull/rough	0.5	+				
	Corroded	0.5	+				
			4				
	Pitted		4				
	Flaking	L	4				
Fin-Tube Att			4				
	Like New	x	4				
	Corrosion	ļ					
	Some Loose		1				
	Many Loose		1				
Tubes			4				
	Clean Cu	x	4				
	Corrosion	ļ	1				
	Pitting						
	Laslas	I	1				
	Leaks						



The average EER gain using this methodology was determined to be 17% for all tested temperatures as shown in Table 4-5. The variations of the flow rates tend to invalidate the results of this protocol for this unit. Figure 4-17 shows the trend of the EER to increase post-treatment with increasing ambient temperatures.

Service Assistant Test Description for Generic Compressor Model

The results for this procedure are summarized in Table 4-5. The Service Assistant test for Unit 2 showed an average operating efficiency of 96% for tests conducted prior to Adsil application. For these tests the efficiency index (EI) ranged from 95% to 98% and tended to increase with increasing ambient temperature. After application, Unit 2 had an average operating EI of 97%. The post-treatment range varied from 94% to 99% and tended to increase with increasing ambient temperature. The EER for Unit 2 had an average increase of 1% over the range of ambient conditions tested. Figure 4-18 shows the linear profile of the EER over this range and suggests that the unit performance (for pre- and post-Adsil applications) tends to converge around 83 F.

The average Service Assistant capacity for pre- and post-AdsilTM applications decreased from 4.18 to 4.16 tons of cooling over the range of tested ambient conditions. The capacity measured tends to converge with increasing ambient temperature and has an average difference of negative 0.54%. The Service Assistant capacity measurement results are presented in Table 4-5.

Summary of Test Results for Unit 2

Both test procedures showed a measurable increase in EER for Unit 2. Figure 4-19 presents the results of tests at all temperatures. The results show an increase in EER % change for the Service Assistant test with increasing ambient temperature, and a decrease in % EER change for the condenser test with increasing ambient temperatures.

Figure 4-20 shows the variability in measuring the efficiency index of the unit for pre- and posttreatment over the tested temperature ranges. Inspection of these graphs indicate that the efficiency index, a measure of the actual efficiency divided by the benchmark efficiency of the unit when new, increases with increasing temperatures. This increase is observed to be more pronounced after the Adsil application.

Conclusions-Units 1 and 2

Test results at temperatures of 85 degrees or greater are considered to be more accurate and viable for the process. The Service Assistant methodology was determined to be the most accurate method for measuring the EER of HVAC equipment.



Source: MACTEC, 2004. Prepared by: _TBL_ Checked by: _CDM_









Comparison with Data Logger Evaluation

Traditional measurements of HVAC efficiency have been conducted by collecting data over an extended period of time. This method is believed to be the most accurate for measuring true operating efficiency of HVAC equipment, if the equipment is instrumented properly and sensors are accurate. Ideally, actual air flow and enthalpy changes across the evaporator will be collected and compared to the true power required to produce this cold air flow. Actual power measurements require that the voltage, amperage, and power factor be measured.

In the comparison test performed at a commercial property in Clearwater near the Florida west coast, a Carrier 12-1/2-ton, dual-compressor package unit was chosen. Instrumentation of this unit was performed by a third party and the analysis of the data was also performed by a third party. This report is included as Appendix D in this report. The third party testing began on April 27, 2004 with the unit, RTU-2, being instrumented. On May 5, 2004 the unit was cleaned and coated per standard operating procedures of the owner. On May 19, 2004, the unit was cleaned and coated per the Adsil process.

Data collection was conducted from April 27 through May 31, 2004. Unfortunately, the actual power was not measured, only the amperage; constant values of 0.85 for power factor and 208 volts for the voltage were assumed and used to estimate the power. Capacity measurements were not made although the data could be used to determine capacity if compressor curves and tables were incorporated in the calculation procedure. The unit had dual compressors which further complicated the measurement process since the cycling of the second compressor had significant impacts to both the power consumption and the condenser efficiency.

Refrigerant temperature drop across the condenser, ambient temperature, and refrigerant low and high side pressures were recorded; however, capacity measurements of the condenser were not provided by the third party study. Consequently, EER values were not determined by this third party study complicating the comparison process. The study did provide a multiple linear regression model to determine the daily energy variation with ambient temperature for the unit pre-and post-treatment. Based on the results of this comparison, the energy savings resulting from the treatment process were 3.9%.

MACTEC performed our standard Service Assistant and condenser efficiency determinations for this same unit. By using jumper cables on the panel board we manually controlled the compressor operation to energize both the first and second stage during our testing. We did pretreatment testing on May 13 (ambient temperature of 78 degrees) and post-treatment testing on July 21 (ambient temperature of 88 degrees). The data and results of this test may be seen in Appendix D. The Service Assistant test showed a 20.6% increase in EER and the condenser test showed a -5.9% change in efficiency.

Conclusions

The low ambient temperature pre-test (78 degrees) during MACTEC's pre-treatment test has been shown to have the potential to skew test data (see the Unit 1 Baseline Study in Section 4 of this report). For this reason MACTEC believes that the results of our Service Assistant test are not reliable for this site. The condenser test was conducted on a roof where there were measurable breezes present, compromising the integrity of the flow measurements. The third party evaluation predicted a 3.9% savings in energy consumption but used assumptions which, in MACTEC's experience could skew the range of predicted savings by as much as 150%, giving a potential range of between -2% and 10% as the bounds on savings.

MACTEC does not think that conclusive results regarding this comparison were obtained.

TABLE 4-5 Unit 2 Baseline Study

Generic Compressor Test Summary-All Temperatures

		RI Conditions			BTU/W-h	N										
		ng unit CFM			CFM (Listed	1)										
	Capacity				tons											
	Coil Area			22	sq-ft											
	Predicted	EER =		9.07	BTU/W-h											
			Н	VAC Servic	e Assistant							Physical Po	ower and Ca	pacity mea	asurments	
Те	st Date								Cond Ai	r, deg F		Cond Air				
		OAT	EWB	EI	CI	EER	Cap	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER	cfm adj
·	24-May	92	57	98%	98%	8.83	4.24	5.60	94	110	8.9	4.81	4.63	11.76	29.35	0.38
	1-Jul	89	55	96%	95%	9.01	4.16	5.60	90	105	8.3	4.64	4.20	10.01	25.89	0.38
	1-Jul	88	55	97%	97%	9.24	4.26	5.60	87	103	8.9	4.66	3.90	9.92	25.55	0.38
PRE	1-Jul	88	54	95%	93%	9.04	4.08	5.51	88	102	7.8	4.60	3.75	8.35	21.78	0.38
FRE	1-Jul	87	54	96%	94%	9.27	4.14	5.51	87	103	8.9	4.64	3.94	10.02	25.90	0.38
	1-Jul	86	56	97%	96%	9.52	4.26	5.51	86	100	7.8	4.42	3.33	7.40	20.09	0.38
	1-Jul	84	54	95%	93%	9.58	4.15	5.51	86	100	7.8	4.44	3.70	8.23	22.23	0.38
	1-Jul	83	55	95%	92%	9.73	4.13	5.42	82	99	9.4	4.33	3.81	10.29	28.52	0.38
		Averages		96%	95%		4.18				8.47		3.91		24.92	0.38
	16-Aug	91	57	99%	98%	9.05	4.26	5.51	90	105	8.3	4.61	4.53	10.81	28.13	0.38
	16-Aug	89	54	99%	96%	9.28	4.20	5.51	87	103	8.9	4.65	4.40	11.20	28.90	0.38
	11-Aug	89	59	98%	94%	9.24	4.13	5.42	87	105	10.0	4.62	4.92	14.09	36.59	0.38
POST	11-Aug	85	59	96%	95%	9.60	4.25	5.51	86	101	8.3	4.46	4.48	10.67	28.72	0.38
	31-Aug	82	57	94%	90%	9.80	4.07	5.80	84	99	8.3	4.3	4.24	10.10	28.18	0.38
	31-Aug	88	54	97%	93%	9.23	4.08	5.80	90	105	8.3	4.57	4.61	10.98	28.84	0.38
	31-Aug	88	57	97%	93%	9.26	4.10	5.80	89	104	8.3	4.57	4.07	9.70	25.47	0.38
		Averages Change		97% 1.1%	94% -0.64%		4.16 -0.54%				8.65 2.11%		4.47 14.29%		29.26 17.45%	0.38

Source: MACTEC, 2004. Prepared by: _TBL_ Checked by: _CDM_

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5. Measurements in EER

The majority of the units evaluated in this study were under preventive maintenance programs. As part of these programs, coils are reported to be regularly cleaned. No specific cleaning of the coils was performed by MACTEC or Adsil prior to commencement of pre-treatment testing. Many of the units were graded out to be very clean according to MACTEC's site inspection, supporting the claims for regular coil cleanings. The impact of cleaning alone on the performance of these units is not addressed in this report.

In previous sections of this report it was determined that the Service Assistant testing methodology was the most accurate and reliable form of instantaneous efficiency measurement procedure. This section of the report will address the results of EER measurement in the SEQL area. Unless otherwise specified, results recorded here are based on the Service Assistant methodology.

Initially there were 150 units included in the proposed SEQL area sample. In calendar year 2003, prior to MACTEC's involvement, 75 of these units were coated with Adsil, effectively eliminating them from the subject population. MACTEC inspected each of the remaining 75 units and successfully completed testing on 45 of these units. The reasons for not testing the other 30 units included the size (either too large or too small for the instruments we were using); lack of electrical power disconnect at the unit; and inability to get the unit(s) to operate.

Many of these units contained a single compressor and circuit. These units were the most straight-forward to test and data was collected and analyzed as described in the baseline tests.

Other variations included multiple compressors with a common condenser, evaporator and power source; dual compressors in a single package unit with each compressor having a dedicated condenser but sharing the same evaporator circuit and power; and dual compressors sharing a common condenser, evaporator, and power disconnect. A description of how each of these types of equipment was analyzed is presented below.

Multiple Compressors, Common Condenser Circuit

Many of the package Trane units encountered at York Technical College possessed this configuration. Two or more compressors discharged into a common manifold which went into a single condenser coil. When only one stage was energized, the efficiency of this type of unit is higher than when both compressors are energized. All power measurements were made at the local disconnect and included all operating compressors and condenser fans as well as the blower. In most cases all compressors were energized during both pre- and post-treatment testing. The recorded tonnage was equal to the tonnage of the active compressors. All pre- and post-treatment tests were conducted with the same compressor configuration operating. If conditions could not

be replicated in the post-treatment test, the data was marked invalid and was not used in this report.

Dual Compressors, Dedicated Condenser

Many of the York package units encountered at the Monroe Aquatic Center possessed this configuration. A single package unit contained two independent circuits housed in separate compartments with individual condenser fans and condenser housings with an intertwined evaporator circuit. These units shared a single power source. In some cases both compressors were energized and both circuits were independently measured and analyzed. In other cases only one circuit was energized. Pre- and post-treatment tests were conducted on the same number of circuits so as to ensure reliability of test measurements. Recorded tonnage was the nameplate value of the unit. In most cases both circuits were energized.

Multiple Compressors, Shared Condenser

Some of the units, including those at the York Technical College Library, had this configuration. In the event that only one stage is energized the condenser may work more efficiently than if both compressors are energized since the rejected heat from one circuit is not partially absorbed by the 2nd circuit as when both are energized. Pre- and post-treatment tests were conducted identically and in most cases both circuits were energized.

Results-All Tests

A total of 395 tons of HVAC equipment was tested in this sample of 45 units over a temperatures range of 70 to 96 degrees. The average increase in EER is presented in Table 5-1. The most significant number presented in the table is the increase in EER for the ton-weighted average. This value is seen to be 9.9% with a standard error of 1.5%.

Results-Valid Tests at All Temperatures

The validity of 15 of the tests was questionable due to several changes in conditions which were considered to be significant. These included nine (9) units with low refrigerant charge; one (1) unit which had refrigerant added after the first test; and five (5) tests with differing condenser and compressor operation. After eliminating these conditions, 30 tests were deemed valid representing a total of 287 tons of HVAC equipment tested over a temperatures range of 70 to 96 degrees. Table 5-2 summarizes the results of these 30 tests. The ton-weighted average EER improvement was determined to be 11.3% with a standard error of 1.8%.

Results-Valid Tests at Literature Temperatures

The validity of 15 of the tests was questionable due to tests being conducted at temperatures below those published in the performance data for the HVAC equipment. Different manufacturers rate their equipment over different temperature ranges with data being available for all of the units at temperatures of 85 degrees and above. Data was available at temperatures above 75 degrees on only three of the units and at temperatures above 80 degrees on only four of

the units. The most rigorous presentation of results requires that the results of these tests be eliminated since the determination of efficiency below the supplied data requires assumptions and extrapolations which may or may not be accurate. Additionally, test results in our baseline testing indicate that results are more significant when ambient temperatures exceed 85 degrees. After eliminating these conditions, 15 tests were deemed valid representing a total of 107 tons of HVAC equipment tested over a temperatures range of 85 to 94 degrees. A summary of these test results is provided in Table 5-3.

TABLE 5-1Summary of All Tests at All Temperatures

Sie Pre-test Post-est Post-est Post-fail Formation Torn Pre-Adal Post-Adal Post-Adal <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th>Se</th> <th>rvice Assis</th> <th>tant</th> <th></th> <th></th> <th>(</th> <th>Condensing</th> <th>3</th> <th></th> <th></th> <th>Spreadshee</th>							Se	rvice Assis	tant			(Condensing	3			Spreadshee
Site Unit Age OAT OAT OAT Each Ea										Ton			Ì	Í	Ton		
Site Unit Age OAT OAT Easted EER E				Pre-test	Post-test	Tons	Pre-Adsil	Post Adsil			Tons	Pre-Adsil	Post Adsil		weighted	Pre-Adsil	Post Adsil
Cencord Admin RTU-5 6 93 93 8 11.76 11.76 11.76 0.7% 0.7% 441 17.45 30.04 1102.5% 196.5% 10.50% 11.32 11.42 Concord City Hall RTU-5 88 95 11.13 11.62 Concord City Hall RTU-5 88 95 11.76 11.26 8.8% 45.41% 3.31 47.97 56.62 11.09% 15.79% 11.32 11.42 RTU-3 5 88 98 5 11.78 12.48 6.1% 22.9% 5.23 NA NA NA NA NA 11.9 11.82 RTU-3 5 88 98 5 11.78 12.48 6.1% 22.9% 5.23 NA NA NA NA NA 11.19 11.82 SS 1 2 87 88 5 1 1.38 12.48 6.1% 22.9% 5.23 NA NA NA NA NA 11.19 11.82 SS 1 2 87 88 5 1 1.38 12.48 6.1% 22.9% 5.23 NA NA NA NA NA 11.19 11.82 SS 1 2 87 88 5 1 1.38 12.48 6.1% 22.9% 5.23 NA NA NA NA NA NA 11.19 11.82 SS 1 2 87 88 5 1 1.38 12.01 SS 5 7 88 85 7 88 85 7 188 87 3 0.00 8.34 7.79% 72.5% 73.5% 145.5% 70.7 7.39 SS 5 7 88 87 3 0.00 8.34 7.79% 72.48% 72.5% 10.10 12.24 71.79 19.35 7.82% 44.5% 0.07 12.39 SS 5 7 88 87 3 0.00 8.34 7.79% 72.48% 72.5% 10.10 12.24 71.79 19.35 7.82% 44.5% 0.07 17.39 SS 5 7 88 87 3 0.00 8.34 7.79% 72.48% 7.70 19.35 71.82% 42.5% 0.01% 4.48% 1.40% 8.48% 70.00 7.749 SS 1 1 3 79 6 5 7.96 9.79 22.2% 11.69% 5.78 NA NA NA NA NA NA NA NA NA NA SS 2 9 77 94 6 7.96 0.79 2.2% 11.69% 5.78 NA NA NA NA NA NA NA NA NA NA SS 2 9 77 94 6 7.96 0.79 2.2% 11.69% 5.78 NA NA NA NA NA NA NA NA SS 2 9 77 94 6 7.96 0.79 2.2% 11.69% 5.78 NA NA NA NA NA NA NA NA NA SS 2 9 77 94 6 7.96 0.79 2.2% 11.69% 5.78 NA NA NA NA NA NA NA NA SS 2 9 77 94 6 7.96 0.79 2.2% 11.69% 5.78 NA NA NA NA NA NA NA NA RTU-1 12 87 75 3 0.70 10.17 4.4% 14.5% 10.97 10.79 12.52.50 66.0% 197.5% 6.00 6.80 RTU-1 12 8 86 6 0.07 0.10 8 M/M NA NA NA NA NA NA NA NA NA NA RTU-1 12 87 75 3 0.70 10.17 4.4% 14.5% 10.27 10.79 12.52.50 60.60% 197.5% 6.00 6.80 RTU-1 12 8 86 6 0.07 0.10 8 M/M NA NA RTU-1 12 8 77 3 8 6 0 0.07 0.10 8 M/M NA	Site	Unit	Aae				EER	EER	% Change	-					Ŭ	EER	EER
$ \begin{array}{c} \label{eq:rescale} \\ \mbox{Concord City Hall} \\ \mbox{RTU-1} & 6 \\ \mbox{RTU-2} & 6 \\ \mbox{RTU-2} & 6 \\ \mbox{RTU-3} & 7 \\ \mbox{RTU-4} & 7 \\ \mbox{RTU-6} &$			-											0	0		
Concord City Hall RTU-1 5 81 97 5 11.76 12.00 20.7% 52.33 NA																	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Concord City Hall																
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			5		89	5											
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		RTU-3	5	86	88	5	11.88	12.48	5.1%	26.4%	5.23	NA	NA	NA	NA	11.14	11.88
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		SS-1	2		88	5	11.30	12.13		40.0%	5.48	14.79	27.07	83.0%	455.2%	11.35	
SS-3 2 91 88 4 10.67 10.01 6.3% 2.2% 2.1% 2.2% 2.2% 1.2% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.1% 2.2% 1.1% 2.1% 2.2% 1.1% 2.1% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.2% 1.1% 2.1% 2.00 NA NA<					92	6	9.45	9.97		31.7%	5.71	15.61	27.88	78.6%		9.84	10.39
SS-5 7 86 97 3 9.06 8.34 7.9% 2.1% 2.75 NA				91	89	4	10.67	10.01	-6.3%	-23.9%	3.83	22.24	21.75	-2.2%	-8.4%	10.77	11.32
Grante Quary Si-1 13 9 95 5 8.47 8.66 2.2% 10.2% 4.78 NA N		SS-4	11	93	89	2	7.61	7.69	1.1%	2.5%	2.35	18.70	19.83	6.1%	14.3%	7.05	7.49
Si-2 9 77 94 5 7.95 9.79 23.28 115.9% 5.00 NA		SS-5	7	88	87	3	9.06	8.34	-7.9%	-21.8%	2.75	NA	NA	NA	NA	7.43	8.70
SS3 3 77 92 5 9.11 NA NA NA NA NA NA NA redell Health Center RTU-13 12 87 80 5 9.20 9.79 6.4% 2.97 11.859 17.58 21.62 22.0% 119.1% 8.51 9.57% 9.06 8.80 Locust City Hall S5.1 7 93 3 9.70 9.69% 2.07 3.2.07 9.57% 9.18 9.96 Locust City Hall S5.1 7 93 3 1.70 9.69% 2.0% 3.00 NA NA NA NA NA NA 1.18 9.96 Locust City Hall S5.2 7 94 89 3 11.147 1.0.57 7.49 2.454 2.266 7.6% 0.05% 1.0.74 1.0.81 Monce Aquatic Center RTU-2 7 88 5 7.128 3.9 9.0 5.25 16.59 1.2.476%	Granite Quarry	SS-1	13	79	95	5	8.47	8.66	2.2%	10.5%	4.78	NA	NA	NA	NA	NA	NA
Iredel Health Center RTU-1 12 87 79 3 9.70 10.77 4.9% 12.75 12.66 66.6% 197.5% 8.00 8.80 RTU-14 12 87 80 6 NA 10.76 NA NA 6.30 18.50 17.56 21.62 23.0% 19.1% 8.51 9.06 8.80 Locust City Hall SS.1 7 93 87.70 9.99 2.0% 5.3% 2.297 2.44 2.042 8.9% -26.3% 8.06 6.80 8.80 Locust City Hall SS.2 7 94 89 3 11.97 12.51 5.4% 16.1% 3.00 NA	-	SS-2	9	77	94	5	7.95	9.79	23.2%	115.9%	5.00	NA	NA	NA	NA	NA	NA
RTU-13 12 87 60 5 9.20 9.79 6.4% 33.1% 5.19 17.58 21.62 23.0% 11.91% 8.51 9.06 Coust City Hall S5-1 7 93 9.70 9.89 2.0% 5.8% 2.97 22.41 20.42 8.9% 8.06 8.80 Locust City Hall S5-1 7 93 87 3 12.55 12.298 3.4% 10.2% 3.00 NA		SS-3	3	77	92	5	9.11	NA	NA	NA	5.00	NA	NA	NA	NA	NA	NA
RTU-14 12 88 80 6 NA 10.76 NA NA 6.30 15.59 17.54 5.57% 9.18 9.96 Locust City Hall SS-1 7 93 67 3 12.55 12.98 3.4% 10.2% 3.00 NA NA <	Iredell Health Center	RTU-1	12	87	79	3	9.70	10.17	4.9%	14.5%	2.97	19.79	32.96	66.6%	197.5%	8.00	8.80
RTU-3 12 83 79 3 9.70 9.89 2.0% 5.8% 2.97 22.41 20.42 -8.9% -26.3% 8.06 8.80 Locust City Hall S5-2 7 94 89 3 118.7 12.55 12.88 3.4% 10.2% 3.00 NA NA <td></td> <td>RTU-13</td> <td>12</td> <td>87</td> <td>80</td> <td>5</td> <td>9.20</td> <td>9.79</td> <td>6.4%</td> <td>33.1%</td> <td>5.19</td> <td>17.58</td> <td>21.62</td> <td>23.0%</td> <td>119.1%</td> <td>8.51</td> <td>9.06</td>		RTU-13	12	87	80	5	9.20	9.79	6.4%	33.1%	5.19	17.58	21.62	23.0%	119.1%	8.51	9.06
Locust City Hall SS-1 T P S S S T S S S T S S S T S S S S T S S S S S S S S S S S S S S S S S S S S		RTU-14	12	88	80	6	NA	10.76	NA	NA	6.30	18.59	17.54	-5.7%	-35.7%	9.18	9.96
SS-2 7 94 88 3 11.87 12.51 5.4% 10.74 NA NA NA NA NA I1.65 11.88 Monroe Aquatic Center RTU-2 7 85 87 10.58 11.14 1.03 -7.5% 7.49 24.54 22.68 7.6% 0.6% 10.74 10.83 RTU-2 7 85 85 5 8.59 9.23 7.6% 0.80% 5.25 11.69 11.63 10.39 10.56 11.14 10.75 11.14 10.75 11.14 10.75 3.3% -20.4% 5.25 11.63 11.45.5% 10.17 10.56 RTU-8 7 95 88 5 11.19 10.24 14.3% 20.4% 5.25 11.63 14.95% 42.42 9.39 10.22 RTU-8 7 88 87 12.791 9.12 11.83 10.82% 5.25 12.02 14.5% 42.63 3.52 10.05		RTU-3	12	83	79	3	9.70	9.89	2.0%	5.8%	2.97	22.41	20.42	-8.9%	-26.3%	8.06	8.80
Monroe Aquatic Center RTU-2 RTU-2 7 88 91 7 11.14 11.05 -7.5% 7.49 24.54 22.68 -7.6% 0.074 10.83 RTU-4 7 90 85 5 8.58 9.23 7.6% 39.9% 5.25 14.03 20.07 43.1% 17.2% 10.39 10.56 RTU-5 7 93 84 5 7.62 8.91 13.9% 73.0% 5.25 16.59 16.34 -1.5% -1.1% 10.17 10.56 RTU-8 7 97 85 21 8.96 10.24 14.3% 29.5% 20.71 8.09 20.16 149.5% 442.3% 9.35 10.19 Monroe Aquatic Center RTU-10 7 85 86 10.71 11.87 18.84 17.47 -1.3% 420.4% 423.3% 9.35 10.12 Monroe Aquatic Center RTU-13 7 92 32 9.07 11.63 28.3% 7	Locust City Hall	SS-1	7	93	87	3	12.55	12.98	3.4%	10.2%	3.00	NA	NA		NA	11.65	11.88
RTU-2 7 85 86 7 10.58 11.14 5.3% 39.4% 7.49 16.44 24.28 47.6% 18.8% 10.74 10.83 RTU-5 7 93 84 5 7.86 39.9% 5.25 14.03 20.07 43.1% 17.2% 10.39 10.56 RTU-6 7 95 85 11.19 10.75 3.3% 72.04% 5.25 16.59 16.34 -1.5% -1.1% 10.17 10.56 RTU-8 7 97 85 21 8.96 10.24 14.3% 20.71 8.09 20.18 149.5% 44.23% 9.35 10.19 RTU-10 7 88 87 11.87 10.9% 83.0% 7.63 19.25 22.06 14.5% 12.1% 10.070 10.77 Monroe Aquatic Center RTU-15 2 96 80 5 11.87 10.82 28.3% 7.44 26.63 23.25 11.0%		SS-2	7	94	89	3	11.87	12.51	5.4%	16.1%	3.00	NA	NA	NA	NA	11.65	11.88
RTU-4 7 90 85 5 8.58 9.23 7.6% 39.9% 5.25 14.03 20.07 43.1% 17.2% 10.39 10.56 RTU-6 7 95 88 5 11.19 10.75 -3.9% -20.4% 5.25 16.59 16.34 -1.5% 44.0% 10.17 10.56 RTU-8 7 97 85 21 8.96 10.24 14.3% 295.9% 20.71 8.09 20.18 149.5% 442.3% 9.35 10.12 RTU-9 7 86 87 12 7.91 9.12 15.3% 182.84 17.47 7.73% 5.30 49.2% 9.39 10.22 Monroe Aquatic Center RTU-13 7 92 93 21 9.07 11.63 28.2% 564.8% 20.71 15.57 23.30 49.7% 10.7% 10.21 RTU-16 2 96 80 5 8.11 8.57 5.6%	Monroe Aquatic Center	RTU-2	7	88	91	7	11.14	11.03	-1.0%	-7.5%	7.49	24.54	22.68	-7.6%	0.6%	10.74	10.81
RTU-5 7 93 84 5 7.82 8.91 13.9% 73.0% 5.25 16.59 16.34 -1.1% 10.17 10.56 RTU-6 7 95 88 5 11.19 10.75 -3.9% -20.4% 525 19.36 24.02 24.0% -4.9% 10.17 10.56 RTU-8 7 97 85 21 8.06 10.24 14.3% 295.9% 20.71 8.09 20.18 149.5% 44.23% 9.39 10.22 Monroe Aquatic Center RTU-10 7 85 8 10.71 11.187 10.9% 83.0% 7.64 22.05 14.5% 12.1% 10.07 10.7 Monroe Aquatic Center RTU-16 2 96 80 5 8.11 8.57 5.6% 29.3% 5.21 22.06 21.93 0.04% 9.49 9.40 9.44 9.45 YTC Hold Center RTU-10 13 77 NA NA		RTU-2	7	85	88	7		11.14	5.3%		7.49	16.44	24.28	47.6%	18.8%	10.74	
RTU-6 7 95 88 5 11.19 10.75 -3.9% -20.4% 5.25 19.36 24.02 24.0% -4.9% 10.17 10.56 RTU-9 7 88 87 12 7.91 9.12 15.3% 182.2% 11.88 18.84 17.47 -7.3% 4.32% 9.36 10.12 Monroe Aquatic Center RTU-13 7 92 93 21 9.07 11.63 82.8% 58.48% 20.71 15.57 23.30 49.7% 29.04% 9.98 10.42 Monroe Aquatic Center RTU-16 2 96 80 5 8.11 8.57 5.6% 29.3% 5.21 22.06 21.33 -0.6% -0.2% 9.25 9.26 YTC- Hood Center RTU-1 4 88 85 4 7.09 9.55 34.7% 133.7% 4.00 NA NA NA 23.98 11.72 9.32 20.5% -49.1% 8.58 8.58		RTU-4	7	90	85	5	8.58	9.23	7.6%	39.9%	5.25	14.03	20.07	43.1%	17.2%	10.39	10.56
RTU-8 7 97 85 21 8.96 10.24 14.3% 295.9% 20.18 149.5% 442.3% 9.35 10.19 RTU-9 7 88 87 12 7.91 9.12 15.3% 182.2% 11.88 18.84 17.47 -7.3% -13.2% 9.39 10.22 Monroe Aquatic Center RTU-13 7 92 93 21 9.07 11.63 28.2% 584.8% 20.71 15.57 23.30 49.7% 290.4% 9.88 10.41 RTU-16 2 96 80 5 8.11 8.57 5.6% 29.3% 7.44 26.63 23.52 -11.6% -3.2% 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 <td></td> <td>RTU-5</td> <td>7</td> <td>93</td> <td>84</td> <td>5</td> <td>7.82</td> <td>8.91</td> <td>13.9%</td> <td>73.0%</td> <td>5.25</td> <td>16.59</td> <td>16.34</td> <td>-1.5%</td> <td>-1.1%</td> <td>10.17</td> <td>10.56</td>		RTU-5	7	93	84	5	7.82	8.91	13.9%	73.0%	5.25	16.59	16.34	-1.5%	-1.1%	10.17	10.56
RTU-9 7 88 87 12 7.91 9.12 15.3% 18.22% 11.88 18.84 17.47 -7.3% -13.2% 9.39 10.22 Monroe Aquatic Center RTU-13 7 92 93 21 9.07 11.63 28.2% 584.8% 20.71 15.57 23.30 49.7% 20.4% 9.88 10.42 RTU-15 2 94 79 7 10.52 10.92 3.8% 28.3% 7.44 26.63 23.52 11.18% -3.3% 10.19 10.21 YTC BID RTU-1 4 88 4 7.09 9.55 34.7% 138.7% 4.00 NA NA NA 8.64 9.49 9.49 9.85 34.7% 138.7% 4.00 NA NA NA 8.64 9.49 9.49 9.85 34.7% 138.7% 4.00 NA NA NA 8.64 9.49 9.85 34.7% 138.7% 4.00 NA				95	88	5											
RTU-10 7 85 89 8 10.71 11.87 10.9% 83.0% 7.63 19.25 22.05 14.5% 12.1% 10.70 10.77 Monroe Aquatic Center RTU-13 7 92 93 21 9.07 11.63 28.2% 584.8% 20.71 15.57 23.30 49.7% 290.4% 9.98 10.44 RTU-15 2 96 5 8.11 8.57 5.6% 29.3% 5.21 22.06 21.93 -0.0% -0.2% 9.25 9.26 YTC BId D RTU-10 13 77 NA 24 9.62 9.72 1.0% 24.00 NA			-		85						20.71						
Monroe Aquatic Center RTU-13 7 92 93 21 9.07 11.63 28.2% 584.8% 20.71 15.57 23.30 49.7% 290.4% 9.98 10.44 RTU-15 2 94 79 7 10.52 10.92 3.8% 28.3% 7.44 26.63 23.52 -11.6% -3.3% 10.19 10.21 YTC BId D RTU-1 4 88 5 4 7.09 9.55 34.7% 138.7% 4.00 NA NA NA 8.82 YTC-Hood Center RTU-10 13 77 NA 24 6.35 NA NA NA 23.98 11.72 9.32 -20.5% 4.91.1% 8.59 8.82 RTU-5 12 80 77 24 9.62 9.72 1.0% 24.30 NA NA NA NA NA 8.82 RTU-7 13 70 85 24 7.65 10.56 38.0%				88													
RTU-15 2 94 79 7 10.52 10.92 3.8% 28.3% 7.44 26.63 23.52 -11.6% -3.3% 10.19 10.21 YTC Bld D RTU-16 2 96 80 5 8.11 8.57 5.6% 29.3% 5.21 22.06 21.93 -0.6% -0.2% 9.25 9.26 YTC Hood Center RTU-10 13 77 NA 24 6.35 NA NA <t< td=""><td></td><td></td><td>7</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>			7														
RTU-16 2 96 80 5 8.11 8.57 5.6% 29.3% 5.21 22.06 21.93 -0.6% -0.2% 9.25 9.26 YTC Bld D RTU-1 4 88 85 4 7.09 9.55 34.7% 138.7% 4.00 NA NA NA NA NA NA NA NA 9.25 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.26 9.27 1.0% 23.98 21.13 16.08 -23.9% -57.3% 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85 8.85	Monroe Aquatic Center																
YTC Bld D RTU-1 4 88 85 4 7.09 9.55 34.7% 138.7% 4.00 NA NA NA NA 8.04 9.45 YTC-Hood Center RTU-10 13 77 NA 24 6.35 NA NA NA 23.98 11.72 9.32 -20.5% -491.1% 8.59 8.82 RTU-5 12 80 77 24 9.62 9.72 1.0% 24.0% 23.98 21.13 16.08 -23.9% -573.3% 8.85 8.85 RTU-6 13 84 78 29 9.99 9.88 -1.0% -27.9% 28.74 NA NA <td></td>																	
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RTU-5 12 80 77 24 9.62 9.72 1.0% 24.0% 23.98 21.13 16.08 -23.9% -573.3% 8.85 8.85 RTU-6 13 84 78 29 9.99 9.89 -1.0% -27.9% 28.74 NA N						-											
RTU-6 13 84 78 29 9.99 9.89 -1.0% -27.9% 28.74 NA	YTC- Hood Center																
RTU-7 13 70 85 24 7.65 10.56 38.0% 922.9% 24.30 NA NA NA NA 8.08 8.93 RTU-8 13 76 78 18 11.63 12.41 6.7% 122.7% 18.41 19.76 17.04 -13.7% -253.1% 7.81 8.86 RTU-9 12 76 90 23 9.18 10.36 12.8% 291.2% 22.67 13.15 24.74 88.1% 1997.4% 9.21 9.53 HP-1 4 79 82 3 9.84 10.78 9.5% 27.1% 2.84 15.47 25.34 68.8% 8.93 9.37 HP-2 12 77 74 5 7.03 8.22 16.9% 81.4% 4.82 NA NA NA 8.93 9.37 YTC - Library Unit 1 13 75 85 17 8.53 -7.7% -133.0% 17.29 6.00 15.15 152.3% 263.7% 9.08 9.32 YTC Student Center																	
RTU-8 13 76 78 18 11.63 12.41 6.7% 122.7% 18.41 19.76 17.04 -13.7% -253.1% 7.81 8.86 RTU-9 12 76 90 23 9.18 10.36 12.8% 291.2% 22.67 13.15 24.74 88.1% 1997.4% 9.21 9.53 HP-1 4 79 82 3 9.84 10.78 9.5% 27.1% 2.84 15.47 25.34 63.8% 181.2% 8.93 9.37 YTC - Library Unit 1 13 75 85 17 8.53 9.45 10.7% 185.2% 17.29 7.42 15.81 113.2% 1956.7% 8.82 9.32 YTC - Library Unit 1 13 75 85 17 9.25 8.53 -7.7% -133.0% 17.29 7.42 15.81 113.2% 1956.7% 8.82 9.32 YTC Student Center Ground Un 10 81 84 24 7.84 8.89 13.5% 325.9% 24.17 NA NA																	
RTU-9 12 76 90 23 9.18 10.36 12.8% 291.2% 22.67 13.15 24.74 88.1% 1997.4% 9.21 9.53 HP-1 4 79 82 3 9.84 10.78 9.5% 27.1% 2.84 15.47 25.34 63.8% 181.2% 8.93 9.37 YTC - Library Unit 1 13 75 85 17 8.53 9.45 10.7% 185.2% 17.29 7.42 15.81 113.2% 1956.7% 8.82 9.32 YTC - Library Unit 2 13 75 85 17 8.53 9.45 10.7% 185.2% 17.29 7.42 15.81 113.2% 1956.7% 8.82 9.32 YTC Student Center Ground Un 10 81 84 24 7.84 8.89 13.5% 325.9% 24.17 NA NA NA NA 9.10 9.51 YTC Student Services HP-1 13 74 83 7 10.14 12.15 19.8% 146.4% 7.40 NA																	
HP-1 4 79 82 3 9.84 10.78 9.5% 27.1% 2.84 15.47 25.34 63.8% 181.2% 8.93 9.37 HP-2 12 77 74 5 7.03 8.22 16.9% 81.4% 4.82 NA NA NA NA 8.76 9.16 YTC - Library Unit 1 13 75 85 17 8.53 9.45 10.7% 185.2% 17.29 7.42 15.81 113.2% 1956.7% 8.82 9.32 YTC - Library Unit 2 13 77 88 17 9.25 8.53 -7.7% -133.0% 17.29 6.00 15.15 152.3% 2633.7% 9.08 9.32 YTC Student Center Ground Un 10 81 84 24 7.84 8.89 13.5% 325.9% 24.17 NA NA NA NA 9.10 9.51 YTC Student Services HP-1 13 74 83 7 10.14 12.15 19.8% 146.4% 7.40 NA NA																	
HP-2 12 77 74 5 7.03 8.22 16.9% 81.4% 4.82 NA NA NA NA NA 8.76 9.16 YTC - Library Unit 1 13 75 85 17 8.53 9.45 10.7% 185.2% 17.29 7.42 15.81 113.2% 1956.7% 8.82 9.32 YTC - Library Unit 2 13 77 88 17 9.25 8.53 -7.7% -133.0% 17.29 6.00 15.15 152.3% 2633.7% 9.08 9.32 YTC Student Center Ground Un 10 81 84 24 7.84 8.89 13.5% 325.9% 24.17 NA NA <td></td>																	
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YTC - Library Unit 2 13 77 88 17 9.25 8.53 -7.7% -133.0% 17.29 6.00 15.15 152.3% 2633.7% 9.08 9.32 YTC Student Center Ground Un 10 81 84 24 7.84 8.89 13.5% 325.9% 24.17 NA NA NA NA NA 7.19 8.23 YTC Student Center Ground Un 10 81 84 24 7.84 8.89 13.5% 325.9% 24.17 NA NA NA NA NA 9.08 9.32 YTC Student Services HP-1 13 74 83 7 10.14 12.15 19.8% 146.4% 7.40 NA NA NA 9.10 9.57 10.23 YTC Truck School SS-1 15 85 86 9 10.44 11.40 9.2% 84.4% 9.19 10.91 14.82 35.9% 329.4% 9.13 9.60 35.28 (tons not counted) 395.01 8.02% 292.46 36.6% 36.6%																	
YTC Student Center Ground Un 10 RTU-25 81 RTU-25 84 84 84 86 24 7.84 8.89 13.5% 325.9% 24.17 NA			-	-													
RTU-25 13 84 86 5 7.89 8.40 6.6% 34.1% 5.19 NA NA NA NA 9.10 9.51 YTC Student Services YTC Truck School HP-1 13 74 83 7 10.14 12.15 19.8% 146.4% 7.40 NA NA NA NA NA 9.10 9.51 YTC Truck School SS-1 15 85 86 9 10.44 11.40 9.2% 84.4% 9.19 10.91 14.82 35.9% 329.4% 9.13 9.60 Set Unit Ton-Weighted 35.28 (tons not counted) 137.83 (tons not counted) 137.83 (tons not counted) 36.6% 9.90% 9.90% 30.0% 30.0% 30.0% 30.0% 30.0%																	
YTC Student Services YTC Truck School HP-1 13 74 83 7 10.14 12.15 19.8% 146.4% 7.40 NA NA NA NA 9.57 10.23 YTC Truck School SS-1 15 85 86 9 10.44 11.40 9.2% 84.4% 9.19 10.91 14.82 35.9% 329.4% 9.13 9.60 SS-1 15 85 86 9 10.44 11.40 9.2% 84.4% 9.19 10.91 14.82 35.9% 329.4% 9.13 9.60 Per Unit Ton-Weighted 35.28 (tons not counted) 395.01 8.02% 292.46 36.6% 9.90% 30.0%																	
YTC Truck School SS-1 15 85 86 9 10.44 11.40 9.2% 84.4% 9.19 10.91 14.82 35.9% 329.4% 9.13 9.60 35.28 (tons not counted) 35.28 (tons not counted) 137.83 (tons not counted) Per Unit 395.01 8.02% 292.46 36.6% Ton-Weighted 9.90% 30.0%	VTC Student Services																
35.28 (tons not counted) 137.83 (tons not counted) Per Unit 395.01 8.02% 292.46 36.6% Ton-Weighted 9.90% 30.0%						-											
Per Unit 395.01 8.02% 292.46 36.6% Ton-Weighted 9.90% 30.0%		001	15	00	00	3	10.44	11.40	J.Z /0	07.470	5.13	10.31	17.02	55.370	525.470	5.15	5.00
Ton-Weighted 9.90% 30.0%						35.28	(tons not a	counted)			137.83	(tons not o	counted)				
Ton-Weighted 9.90% 30.0%		Per Unit				395.01			8.02%		292.46			36.6%			
standard deviation 9.7% standard deviation 43.5% standard deviation		Ton-Weig	phted							9.90%					30.0%		
							standard d	leviation	9.7%			standard d	eviation	43.5%		standard d	eviation

42

1.5%

count

standard error

Source. MACILC. 2004 .	Source:	MACTEC, 2004.	
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Prepared by: _TBL_ Checked by: _CDM_

count

standard error

29

8.1%

count

standard error

Table 5-2 Summary of Valid Tests at All Temperatures

					Sei	vice Assis	tant				Condensing			Spreadshee	
								Ton					Ton		
		Pre-test	Post-test	Tons		Post Adsil	%	weighted	Tons		Post Adsil	%	weighted	Pre-Adsil	
Site Unit	Age	OAT	OAT	tested	EER	EER	Change	avg.	tested	EER	EER	Change	avg.	EER	EER
Concord Admin RTU-7	6	92	93	9	10.19	10.78	5.8%	54.1%	9.31	47.97	56.62	18.0%	167.9%	11.32	11.6
Concord City Hall RTU-2	5	86	89	5	11.76	12.48	6.1%	32.0%	5.23	NA	NA	NA	NA	11.19	11.8
RTU-3	5	86	88	5	11.88	12.48	5.1%	26.4%	5.23	NA	NA	NA	NA	11.14	11.8
SS-1	2	85	88	5	11.30	12.13	7.3%	40.0%	5.48	14.79	27.07	83.0%	455.2%	11.35	12.0
SS-2	5	87	92	6	9.45	9.97	5.6%	31.7%	5.71	15.61	27.88	78.6%	448.9%	9.84	10.3
SS-4	11	93	89	2	7.61	7.69	1.1%	2.5%	2.35	18.70	19.83	6.1%	14.3%	7.05	7.49
SS-5	7	88	87	3	9.06	8.34	-7.9%	-21.8%	2.75	NA	NA	NA	NA	7.43	8.70
Iredell Health Center RTU-1	12	87	79	3	9.70	10.17	4.9%	14.5%	2.97	19.79	32.96	66.6%	197.5%	8.00	8.80
RTU-13	12	87	80	5	9.20	9.79	6.4%	33.1%	5.19	17.58	21.62	23.0%	119.1%	8.51	9.06
RTU-3	12	83	79	3	9.70	9.89	2.0%	5.8%	2.97	22.41	20.42	-8.9%	-26.3%	8.06	8.80
Locust City Hall SS-2	7	94	89	3	11.87	12.51	5.4%	16.1%	3.00	NA	NA	NA	NA	11.65	11.8
Monroe Aquatic Center RTU-1	7	94	91	7	10.58	11.03	4.2%	31.5%	7.49	17.50	22.68	29.6%	9.3%	10.74	10.8
RTU-2	7	85	88	7	10.58	11.14	5.3%	39.4%	7.49	16.44	24.28	47.6%	18.8%	10.74	10.8
RTU-9	7	88	87	12	7.91	9.12	15.3%	182.2%	11.88	18.84	17.47	-7.3%	-13.2%	9.39	10.2
RTU-10	7	85	89	8	10.71	11.87	10.9%	83.0%	7.63	19.25	22.05	14.5%	12.1%	10.70	10.7
Monroe Aquatic Center RTU-13	7	92	93	21	9.07	11.63	28.2%	584.8%	20.71	15.57	23.30	49.7%	290.4%	9.98	10.4
RTU-15	2	94	79	7	10.52	10.92	3.8%	28.3%	7.44	26.63	23.52	-11.6%	-3.3%	10.19	10.2
RTU-16	2	96	80	5	8.11	8.57	5.6%	29.3%	5.21	22.06	21.93	-0.6%	-0.2%	9.25	9.26
YTC BId D RTU-1	4	88	85	4	7.09	9.55	34.7%	138.7%	4.00	NA	NA	NA	NA	8.04	9.45
YTC- Hood Center RTU-5	12	80	77	24	9.62	9.72	1.0%	24.0%	23.98	21.13	16.08	-23.9%	-573.3%	8.85	8.85
RTU-6	13	84	78	29	9.99	9.89	-1.0%	-27.9%	28.74	NA	NA	NA	NA	7.96	8.89
RTU-7	13	70	85	24	7.65	10.56	38.0%	922.9%	24.30	NA	NA	NA	NA	8.08	8.93
RTU-8	13	76	78	18	11.63	12.41	6.7%	122.7%	18.41	19.76	17.04	-13.7%	-253.1%	7.81	8.86
RTU-9	12	76	90	23	9.18	10.36	12.8%	291.2%	22.67	13.15	24.74	88.1%	1997.4%	9.21	9.53
HP-1	4	79	82	3	9.84	10.78	9.5%	27.1%	2.84	15.47	25.34	63.8%	181.2%	8.93	9.37
HP-2	12	77	74	5	7.03	8.22	16.9%	81.4%	4.82	NA	NA	NA	NA	8.76	9.16
YTC - Library Unit 1	13	75	85	17	8.53	9.45	10.7%	185.2%	17.29	7.42	15.81	113.2%	1956.7%	8.82	9.32
YTC Student Center RTU-25	13	84	86	5	7.89	8.40	6.6%	34.1%	5.19	NA	NA	NA	NA	9.10	9.51
YTC Student Services HP-1	13	74	83	7	10.14	12.15	19.8%	146.4%	7.40	NA	NA	NA	NA	9.57	10.2
YTC Truck School SS-1	15	85	86	9	10.44	11.40	9.2%	84.4%	9.19	10.91	14.82	35.9%	329.4%	9.13	9.60
Per Unit Ton-Wei	ahted			0.00 286.83	(tons not	counted)	9.33%	11.31%	90.65 196.18	(tons not o	counted)	32.6%	27.2%		
	ginea				standard o	leviation count ndard error	9.7% 30 1.8%	11.0170		standard d	leviation count ndard error			standard c	leviation co ndard e

Table 5-3 Summary of Valid Tests at Literature Temperatures

			ſ		Ser	vice Assist	tant			C	Condensing	1		5	Spreadshee
								Ton					Ton		
		Pre-test P	Post-test	Tons	Pre-Adsil	Post Adsil	%	weighted	Tons	Pre-Adsil	Post Adsil	%	weighted	Pre-Adsil	Post Adsil
Site Unit	Age	OAT	OAT	tested	EER	EER	Change	avg.	tested	EER	EER	Change	avg.	EER	EER
Concord Admin RTU-7	6	92	93	9	10.19	10.78	5.8%	54.1%	9.31	47.97	56.62	18.0%	167.9%	11.32	11.62
Concord City Hall RTU-2	5	86	89	5	11.76	12.48	6.1%	32.0%	5.23	NA	NA	NA	NA	11.19	11.88
RTU-3	5	86	88	5	11.88	12.48	5.1%	26.4%	5.23	NA	NA	NA	NA	11.14	11.88
SS-1	2	85	88	5	11.30	12.13	7.3%	40.0%	5.48	14.79	27.07	83.0%	455.2%	11.35	12.01
SS-2	5	87	92	6	9.45	9.97	5.6%	31.7%	5.71	15.61	27.88	78.6%	448.9%	9.84	10.39
SS-4	11	93	89	2	7.61	7.69	1.1%	2.5%	2.35	18.70	19.83	6.1%	14.3%	7.05	7.49
SS-5	7	88	87	3	9.06	8.34	-7.9%	-21.8%	2.75	NA	NA	NA	NA	7.43	8.70
Locust City Hall SS-2	7	94	89	3	11.87	12.51	5.4%	16.1%	3.00	NA	NA	NA	NA	11.65	11.88
Monroe Aquatic Center RTU-1	7	94	91	7	10.58	11.03	4.2%	31.5%	7.49	17.50	22.68	29.6%	9.3%	10.74	10.81
RTU-2	7	85	88	7	10.58	11.14	5.3%	39.4%	7.49	16.44	24.28	47.6%	18.8%	10.74	10.83
RTU-9	7	88	87	12	7.91	9.12	15.3%	182.2%	11.88	18.84	17.47	-7.3%	-13.2%	9.39	10.22
RTU-10	7	85	89	8	10.71	11.87	10.9%	83.0%	7.63	19.25	22.05	14.5%	12.1%	10.70	10.77
RTU-13	7	92	93	21	9.07	11.63	28.2%	584.8%	20.71	15.57	23.30	49.7%	290.4%	9.98	10.44
YTC BId D RTU-1	4	88	85	4	7.09	9.55	34.7%	138.7%	4.00	NA	NA	NA	NA	8.04	9.45
YTC Truck School SS-1	15	85	86	9	10.44	11.40	9.2%	84.4%	9.19	10.91	14.82	35.9%	329.4%	9.13	9.60
				0.00	(tons not	counted)			20.20	(tons not a	counted)				
Per Unit				107.44	•	bounted)	9.07%		87.24		bounted)	35.6%			
Ton-Wei	abted			107.11			0.01 /0	12.33%	07.21			00.070	19.9%		
	ginou				standard d	leviation	10.1%			standard d	eviation	28.5%		standard d	leviation
						count	10.170				count	20.070			count
					eta	ndard error	2.6%			star	ndard error	9.0%		sta	ndard error
	11 7		11 (310		2.070			314		5.070		310	

Source: MACTEC, 2004.

Prepared by: _TBL_ Checked by: _CDM_

The increase in EER varied from a low of 9.9% in the Service Assistant test for all units to a high of 30% using the condenser test methodology on the same sample. It is MACTEC's opinion that the test results from the Service Assistant tests conducted within the range of manufacturer's published EER values provide the most reliable prediction of energy savings. The increase in efficiency of the units in this study is therefore estimated to be 12.3%. Complete results are provided in Appendix F. Figure 5-1 graphically depicts the change in EER based on the Service Assistant measurements on this sample.



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6. Projected Energy Savings

A total of 150 units in the SEQL area were cleaned and coated with Adsil representing a total of 2,545 tons of HVAC equipment. Based on MACTEC's measurement of the change in EER, an improvement in efficiency of 12.3% is expected in this population. Appendix G contains the calculation details and assumptions but for convenience the key elements are repeated. The National Oceanic and Atmospheric Administration (NOAA) lists the cooling degree days (CDD) for the Charlotte area at 1,648. This number represents the amount of time that the temperatures are above 65 degrees with each degree above 65 being weighted heavier than the one before. Twenty-four hours of a 66-degree temperature represent one CDD; conversely, one hour of 89 degree temperature also represents one CDD. The American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) suggests that the number of Full Load Equivalent Operating Hours (FLEOH) of a piece of equipment is roughly equal to 80% of the CDDs.

Using these inputs and others detailed in Appendix G, MACETC estimates that the application of Adsil to this population will result in an annual energy savings of 461,400 kilowatt-hours (kWh) and an annual cost savings in excess of \$37,000. These energy savings result in lowered production from power plants and should, consequently, result in decreased emissions. However, because of the complexities of the power transfers over the power grid, it is difficult to verify or quantify pollution benefits and to do so is beyond the scope of this project.

A tool for projecting energy savings at an individual facility or group of facilities is provided in Figure 6-1. Required inputs are highlighted in yellow. Providing data to these fields will automatically estimate annual energy and cost savings for a facility or facility group.

FIGURE 6-1 ENERGY SAVINGS PROJECTION TOOL										
Facility:	Your Facility Capacity of H									
ECP Savings:	371.67 \$36,915	Electric De Electric Er	emand kW hergy Cost Sav		461,440 1,574	Electric Ene Electric Ene		tu		
Total ECP Savings: ECP Cost:	\$165,425		ual Cost Savin	-	1,574	Total Annua	I MMBtu	Savings		
Payback:	4.48	yrs (exclu	iding maint sav	vings)						
Calculations										
Assumptions:	 New e Existir Equipt Equipt The protectiv Charlotte are Full-load equipt Decrease in I and capacity Savings to he Average EER Average EER Nominal capa 	equipment og equipmen ment with fir e corrosion a has 1644 ivalent oper EER is assu y degradatio eat pumps o R gain =12.3 acity is total mated by ta	luring the heat	ce of mino eful life rer croGuard (e days (CI FLEOH= (th an incre ting seaso cility. Avai cility. Avai	r environr maining (TM) proc DD) per N 0.8*CDD ease in po n are not ilable fron footage a	mental damag luct from Ads IOAA wer consump included n equipment r und dividing by	il (TM) otion nameplate y 400.			
	1644	CDD	use website t	o get CDE	<mark>) for your</mark>	city				
	1,315 \$0.000		Cost per kW							
	\$0.08000 0.003412	•••	ost per kWh Vh	<mark>ι</mark>	use blend	ed electric rat	e			
	12.3%		use default of	f 12.3% or	r value fro	om degradatio	n tool			
HVAC System Data Condensing Unit Data fro Condensing Unit Consur Calculated EER:		SEQL Are 3393.33 10.1		Pre		al Capacity: <mark>-</mark> dition EER: kW/ton=	<mark>2545.0</mark> 9.0 1.33	tons Btu/W-hr		
EER after coil applicati kW/ton after coil applic Demand Consumption	ation=	10.11 1.19 3021.67								

			SAVINGS PR		_		
	Your Facility N Capacity of H						
Current Run-time Adjus	tment Factor	ſS					
Night Setback:	1.000	Note 1	Exce	ess Ca	apacity:	1.000	
FLEOH Conversion:	0.800				Setback:	1.000	Note 2
			Coo	ing S	et Point:	72.00	Degrees F
Proposed Run-time Adj	ustment Fact	tors					
Night Setback:	1.000		Exce	ess Ca	apacity:	1.000	
FLEOH Conversion:	0.800				Setback:	1.000	
			Coo	ing S	et Point:	72.00	Degrees F
Run-time Estimates							
Current condensing unit:		1,242	hours - annually	,			
Proposed condensing uni	t:	1,242	hours - annually				
		kW	k	Wh			
	Current	3393.333	4,21	2,989)		
	Proposed	3021.668	3,75	1,548	3		
	Savings	371.665	461	,440			
		I	Installation Cost	s			
Nominal capacity:			2,	545	tons		
Cost associated to install	coating (parts	s & labor):	\$	65	per ton (tot (vendor qu		d cost)
	Total project o	cost:	\$16	5,425	i		
Note 1: Use a night setba setback is used. Note 2: Use a weekend s for one day during	etback value	of .75 is H			-		

7. Estimated Degradation in HVAC Performance

The estimation of air conditioning condensing unit performance degradation was based on a combination of objective input factors. The development of degradation prediction equations was based on empirical data we collected from testing in this program. MACTEC has previously found that degradation of HVAC equipment is influenced by many factors, including compressor wear, evaporator coil fouling and deterioration (resulting primarily in increased equipment run time and decreased capacity) and condenser coil degradation (resulting in a decrease in efficiency and an increase in power consumption). It is inherently difficult to predict equipment degradation over time. This is due in part to the difficulty in conducting a statistically significant study that controls or measures the large number of variables involved (compressor type, age and condition; condenser coil coating and condition; evaporator coil condition; indoor temperature and humidity conditions; under/overcharge of refrigerant; ambient weather conditions; and quality of equipment installation to name a few).

To begin the process, nameplate data for each of 45 units being tested was field-collected and the efficiency of the unit when new was determined from manufacturer's literature at a range of ambient conditions. MACTEC then measured the efficiency of each HVAC unit and determined the degradation in EER, compared with published data at the same conditions (ambient temperature and entering wet-bulb temperature) when new.

A spreadsheet was developed which weighted various condenser conditions, including age, coil cleanliness, fin condition, fin-tube attachment, and corrosion. These categories are objectively graded by algorithms contained in this degradation prediction tool, shown in Figure 7-1. The results of the spreadsheet EER degradation prediction model was compared with the results of the Service Assistant measurements for the two sample groups: Valid Test Results, and Valid Test Results at Literature Temperatures.

The spreadsheet model predicted an EER degradation of 11.49% compared with a Service Assistant degradation of 11.50% (ton-weighted average) and 10.31% (unit average). These results are presented in Appendix H. A second comparison was made with the results compiled from the summary tests of the population of units contained in the tests performed within the realm of literature published temperatures. In this case, the spreadsheet model predicted an EER degradation of 10.45%. The Service Assistant measurements resulted in an EER degradation of 13.14% (ton-weighted average) and 11.00% (unit average). These results are also presented in Appendix H.

	F	IGURE 7-	1 Degrad	lation Prediction To	lool		
Manufacturer:	Brand X			Published EER:	10.2	Btu/W-br	(CU Only)
Model Number:	Big Guy 60	h		Calculated EER:	10.2		(CU Only)
Serial Number	123456	5		Nominal Capacity:	5.00	tons	(CO Only)
		m			5		
Equipment Type: Year Manufactured:	Split-Syste	ern		Age Coil Conditon		years	had)
	1999				12%	(% degrad	lea)
Location Tag	ACME Wa SS-2	irenouse		Present Condition E kW/ton	9.6 1.25	Btu/W-hr	
Compressor Data							
Running load Amps:	18.0	Amps		Power supply:	3-phase		
Nameplate Voltage:	208	Volts		Phase adjustment:	1.73	(=1.0 if sir	ngle phase)
Power factor:	0.80			Compressor quantity:	1		
Condensing Fan Data							
Full load Amps:	1.40	Amps		Power supply:	3-phase		
Nameplate Voltage:	208	Volts		Phase adjustment:	1.73		ngle phase)
Adjust FLA to RLA:	0.70			Fan quantity:	1		5 1
	011 0						
Evaporator fan data (i		•		_			
Full load Amps:	NA	Amps			1 or 3-phas		
Nameplate Voltage:	NA	Volts		Phase adjustment:	1 or 1.73		
Adjust FLA to RLA:	0.70			Fan quantity:	NA		
Calculated compresso	or load:		5.2	kW			
Calculated condensin			0.35	kW			
	-						
Calculated evanorato	r fan Ioad		#VALUE!	kW/			
Calculated evaporator Total calculated load		nt.	#VALUE!		only		
Calculated evaporator Total calculated load f Assumptions		ent:	#VALUE! 5.53	kW kW - Condensing side	e only		
Total calculated load Assumptions Condenser Coil Asses	for equipme	ent: 12.3%	5.53		e only		
Total calculated load Assumptions	for equipme		5.53	kW - Condensing side			
Total calculated load Assumptions Condenser Coil Asses Age of Unit New	for equipme		5.53	kW - Condensing side nce Degradation Put a "1" in the approp	;		
Total calculated load a Assumptions Condenser Coil Asses Age of Unit New 2-9 years	for equipme ssment		5.53	kW - Condensing side	;		
Total calculated load a Assumptions Condenser Coil Asses Age of Unit New 2-9 years 10-14 years	for equipme		5.53	kW - Condensing side nce Degradation Put a "1" in the approp	;		
Total calculated load a Assumptions Condenser Coil Asses Age of Unit New 2-9 years 10-14 years 15 or more	for equipme ssment		5.53	kW - Condensing side nce Degradation Put a "1" in the approp	;		
Total calculated load a Assumptions Condenser Coil Asses Age of Unit New 2-9 years 10-14 years 15 or more Coil Cleanliness	for equipme		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a	- (d	
Total calculated load a Assumptions Condenser Coil Asses Age of Unit New 2-9 years 10-14 years 15 or more Coil Cleanliness Coated	for equipme		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr	ently coate		
Total calculated load a Assumptions Condenser Coil Asses Age of Unit 2-9 years 10-14 years 15 or more Coil Cleanliness Coated Clean	for equipme		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr Place a percentage (.	ently coate 01-1) to rep	present	
Total calculated load a Assumptions Condenser Coil Asses Age of Unit New 2-9 years 10-14 years 15 or more Coil Cleanliness Coated Clean Dirty	for equipme ssment		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr Place a percentage (. percentage of the fins	ently coate 01-1) to rep that are co	present onsidered	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Total calculated load a Assumptions Age of Unit New 2-9 years 10-14 years 15 or more Coil Cleanliness Coated Clean Dirty Clogged	for equipme		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr Place a percentage (. percentage of the fins to be clean, dirty, clog	ently coate 01-1) to rep that are co	present onsidered	se
Total calculated load a Assumptions Age of Unit New 2-9 years 10-14 years 15 or more Coil Cleanliness Coated Clean Dirty Clogged Plugged	for equipme ssment		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr Place a percentage (. percentage of the fins	ently coate 01-1) to rep that are co	present onsidered	se
Total calculated load a Assumptions Age of Unit New 2-9 years 10-14 years 15 or more Coil Cleanliness Coated Clean Dirty Clogged Plugged Fin Condition	for equipme ssment 1 0.7 0.2 0.1		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr Place a percentage (percentage of the fins to be clean, dirty, clog must sum to 100%	ently coate 01-1) to rep that are co iged, or plu	present onsidered Igged. The	se
Total calculated load a Assumptions Age of Unit New 2-9 years 10-14 years 15 or more Coil Cleanliness Coated Clean Dirty Clogged Plugged Fin Condition Like New	for equipme ssment 1 0.7 0.2 0.1 0.1		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr Place a percentage (. percentage of the fins to be clean, dirty, clog must sum to 100% Percentage in "like ne	ently coate 01-1) to rep that are co iged, or plu	present onsidered Igged. The	se
Total calculated load a Assumptions Age of Unit New 2-9 years 10-14 years 15 or more Coil Cleanliness Coated Clean Dirty Clogged Plugged Fin Condition Like New Some Bent	for equipme ssment 1 0.7 0.2 0.1		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr Place a percentage (. percentage of the fins to be clean, dirty, clog must sum to 100% Percentage in "like ne Percentage "bent"	ently coate 01-1) to rep that are co gged, or plu ww" conditio	present onsidered Igged. The	se
Total calculated load a Assumptions Condenser Coil Asses Age of Unit New 2-9 years 10-14 years 15 or more Coil Cleanliness Coated Clean Dirty Clogged Plugged Fin Condition Like New Some Bent Smashed	for equipme ssment 1 0.7 0.2 0.1 0.1 0.05		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr Place a percentage (. percentage of the fins to be clean, dirty, clog must sum to 100% Percentage in "like ne Percentage "bent" Percentage "smashed	ently coate 01-1) to rep that are co iged, or plu ew" conditio	present onsidered lgged. The	se
Total calculated load Assumptions Condenser Coil Asses Age of Unit Vew 2-9 years 10-14 years 15 or more Coil Cleanliness Coated Clean Dirty Clogged Plugged Fin Condition Like New Some Bent Smashed Dull/rough	for equipme ssment 1 0.7 0.2 0.1 0.1		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr Place a percentage (. percentage of the fins to be clean, dirty, clog must sum to 100% Percentage in "like ne Percentage "bent" Percentage "smashed Percentage "dull/roug	ently coate 01-1) to rep that are co ged, or plu w" conditio g" h, corrodec	present onsidered lgged. The on d, pitted,	se
Total calculated load a Assumptions Age of Unit New 2-9 years 10-14 years 15 or more Coil Cleanliness Coated Clean Dirty Clogged Plugged Fin Condition Like New Some Bent Smashed Dull/rough Corroded	for equipme ssment 1 0.7 0.2 0.1 0.1 0.05		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr Place a percentage (. percentage of the fins to be clean, dirty, clog must sum to 100% Percentage in "like ne Percentage "bent" Percentage "smashed Percentage "dull/roug & flaking" plus percent	ently coate 01-1) to rep that are co ged, or plu w" conditio g" h, corrodec	present onsidered lgged. The on d, pitted,	se
Total calculated load a Assumptions Age of Unit New 2-9 years 10-14 years 15 or more Coil Cleanliness Coated Clean Dirty Clogged Plugged Fin Condition Like New Some Bent Smashed Dull/rough Corroded Pitted	for equipme ssment 1 0.7 0.2 0.1 0.1 0.05		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr Place a percentage (. percentage of the fins to be clean, dirty, clog must sum to 100% Percentage in "like ne Percentage "bent" Percentage "smashed Percentage "dull/roug	ently coate 01-1) to rep that are co ged, or plu w" conditio g" h, corrodec	present onsidered lgged. The on d, pitted,	se
Total calculated load a Assumptions Age of Unit New 2-9 years 10-14 years 15 or more Coil Cleanliness Coated Clean Dirty Clogged Plugged Fin Condition Like New Some Bent Smashed Dull/rough Corroded Pitted Flaking	for equipme ssment 1 0.7 0.2 0.1 0.1 0.05		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr Place a percentage (. percentage of the fins to be clean, dirty, clog must sum to 100% Percentage in "like ne Percentage "bent" Percentage "smashed Percentage "dull/roug & flaking" plus percent	ently coate 01-1) to rep that are co ged, or plu w" conditio g" h, corrodec	present onsidered lgged. The on d, pitted,	se
Total calculated load a Assumptions Age of Unit New 2-9 years 10-14 years 15 or more Coil Cleanliness Coated Clean Dirty Clogged Plugged Fin Condition Like New Some Bent Smashed Dull/rough Corroded Pitted Flaking Fin-Tube Attachment	for equipme ssment 1 0.7 0.2 0.1 0.1 0.9		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr Place a percentage (. percentage of the fins to be clean, dirty, clog must sum to 100% Percentage in "like ne Percentage ismashed Percentage "bent" Percentage "dull/roug & flaking" plus percent must equal 100%.	ently coate 01-1) to rep that are co ged, or plu w" conditio g" h, corrodeo tage "like r	present onsidered lgged. The on d, pitted, new",	se
Total calculated load a Assumptions Age of Unit New 2-9 years 10-14 years 10-14 years Coaled Clean Dirty Clogged Plugged Fin Condition Like New Some Bent Smashed Dull/rough Corroded Pitted Flaking Fin-Tube Attachment Like New	for equipme ssment 1 0.7 0.2 0.1 0.1 0.05		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr Place a percentage (. percentage of the fins to be clean, dirty, clog must sum to 100% Percentage in "like ne Percentage "bent" Percentage "smashed Percentage "dull/roug & flaking" plus percent	ently coate 01-1) to rep that are co ged, or plu w" conditio g" h, corrodeo tage "like r	present onsidered lgged. The on d, pitted, new",	se
Total calculated load a Assumptions Age of Unit New 2-9 years 10-14 years 15 or more Coil Cleanliness Coated Clean Dirty Clogged Plugged Fin Condition Like New Some Bent Smashed Dull/rough Corroded Pitted Flaking Fin-Tube Attachment Like New Corrosion	for equipme ssment 1 0.7 0.2 0.1 0.1 0.05 0.9		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr Place a percentage (. percentage of the fins to be clean, dirty, clog must sum to 100% Percentage in "like ne Percentage ismashed Percentage "bent" Percentage "dull/roug & flaking" plus percent must equal 100%.	ently coate 01-1) to rep that are co ged, or plu w" conditio g" h, corrodeo tage "like r	present onsidered lgged. The on d, pitted, new",	se
Total calculated load a Assumptions Age of Unit New 2-9 years 10-14 years 15 or more Coil Cleanliness Coated Clean Dirty Clogged Plugged Fin Condition Like New Some Bent Smashed Dull/rough Corroded Pitted Flaking Fin-Tube Attachment Like New Corrosion Some Loose	for equipme ssment 1 0.7 0.2 0.1 0.1 0.05 0.9		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr Place a percentage (. percentage of the fins to be clean, dirty, clog must sum to 100% Percentage in "like ne Percentage ismashed Percentage "bent" Percentage "dull/roug & flaking" plus percent must equal 100%.	ently coate 01-1) to rep that are co ged, or plu w" conditio g" h, corrodeo tage "like r	present onsidered lgged. The on d, pitted, new",	se
Total calculated load a Assumptions Age of Unit New 2-9 years 10-14 years 15 or more Coil Cleanliness Coated Clean Dirty Clogged Plugged Fin Condition Like New Some Bent Smashed Dull/rough Corroded Pitted Flaking Fin-Tube Attachment Like New Corrosion Some Loose Many Loose	for equipme ssment 1 0.7 0.2 0.1 0.1 0.05 0.9		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr Place a percentage (. percentage of the fins to be clean, dirty, clog must sum to 100% Percentage in "like ne Percentage ismashed Percentage "bent" Percentage "dull/roug & flaking" plus percent must equal 100%.	ently coate 01-1) to rep that are co ged, or plu w" conditio g" h, corrodeo tage "like r	present onsidered lgged. The on d, pitted, new",	se
Total calculated load a Assumptions Age of Unit New 2-9 years 10-14 years 15 or more Coil Cleanliness Coated Clean Dirty Clogged Plugged Fin Condition Like New Some Bent Smashed Dull/rough Corroded Pitted Flaking Fin-Tube Attachment Like New Corrosion Some Loose Many Loose	for equipme ssment 1 0.7 0.2 0.1 0.1 0.05 0.9 1		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr Place a percentage (. percentage of the fins to be clean, dirty, clog must sum to 100% Percentage in "like ne Percentage "bent" Percentage "smashed Percentage "dull/roug & flaking" plus percen must equal 100%. Place a"1" in the appr	ently coate 01-1) to rep that are co ged, or plu w" condition y" h, corrodeo tage "like r opriate cell	present onsidered lgged. The on d, pitted, new",	se
Total calculated load a Assumptions Age of Unit New 2-9 years 10-14 years 15 or more Coil Cleanliness Coated Clean Dirty Clogged Plugged Fin Condition Like New Some Bent Smashed Dull/rough Corroded Pitted Flaking Fin-Tube Attachment Like New Corrosion Some Loose Many Loose Tubes	for equipme ssment 1 0.7 0.2 0.1 0.1 0.05 0.9		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr Place a percentage (. percentage of the fins to be clean, dirty, clog must sum to 100% Percentage in "like ne Percentage ismashed Percentage "bent" Percentage "dull/roug & flaking" plus percent must equal 100%.	ently coate 01-1) to rep that are co ged, or plu w" condition y" h, corrodeo tage "like r opriate cell	present onsidered lgged. The on d, pitted, new",	se
Total calculated load a Assumptions Age of Unit New 2-9 years 10-14 years 15 or more Coil Cleanliness Coated Clean Dirty Clogged Plugged Fin Condition Like New Some Bent Smashed Dull/rough Corroded Pitted Flaking Fin-Tube Attachment Like New Corrosion Some Loose Many Loose	for equipme ssment 1 0.7 0.2 0.1 0.1 0.05 0.9 1		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr Place a percentage (. percentage of the fins to be clean, dirty, clog must sum to 100% Percentage in "like ne Percentage "bent" Percentage "smashed Percentage "dull/roug & flaking" plus percen must equal 100%. Place a"1" in the appr	ently coate 01-1) to rep that are co ged, or plu w" condition y" h, corrodeo tage "like r opriate cell	present onsidered lgged. The on d, pitted, new",	se
Total calculated load a Assumptions Age of Unit New 2-9 years 10-14 years 15 or more Coil Cleanliness Coated Clean Dirty Clogged Plugged Fin Condition Like New Some Bent Smashed Dull/rough Corroded Pitted Flaking Fin-Tube Attachment Like New Corrosion Some Loose Many Loose Tubes	for equipme ssment 1 0.7 0.2 0.1 0.1 0.05 0.9 1		5.53	kW - Condensing side nce Degradation Put a "1" in the approp correspond with the a Put a "1" if unit is curr Place a percentage (. percentage of the fins to be clean, dirty, clog must sum to 100% Percentage in "like ne Percentage "bent" Percentage "smashed Percentage "dull/roug & flaking" plus percen must equal 100%. Place a"1" in the appr	ently coate 01-1) to rep that are co ged, or plu w" condition y" h, corrodeo tage "like r opriate cell	present onsidered lgged. The on d, pitted, new",	se

The impact of various factors on the degradation of the unit are included in Appendix H. It is of interest to note that the age of the unit had little impact on the degradation of the coil (see Figure 7-2). Figure 7-3 graphically depicts the comparison of spreadsheet predicted EER degradation with actual measured degradation. This must be differentiated from the degradation of the unit as a whole because the scope of this project was confined to the recoverable portion of the EER due to Adsil treatment and did not address other contributing factors (compressor wear, evaporator degradation, refrigerant charge, etc.) which would not be impacted by condenser coil restoration. The fin condition and the dirt factor were observed to have the greatest impact on the decrease in performance, as shown in Figure 7-4 and Figure 7-5. Corrosion was observed to have a negative impact on the degradation of these units (see Figure 7-6); however, this may be misleading due to the almost complete lack of corrosion present in this population. Because the corrosion was minimal, other contributing factors controlled the degradation resulting in an apparent increase in EER when compared with corrosion factor as a stand-alone attribute. In aggressive environments or corroded coil units, this attribute would be expected to contribute to the decrease in performance. A comparison was also done to compare the EER Degradation vs capacity. Figure 7-7 shows that the larger units had greater degradation. This has a measurable impact on the comparison of the unit average degradation as compared with the weighted-average degradation. Further discussion on this issue will be presented in Section 8.

There is a large variance in the data which is shown by low correlation coefficients for each of these comparisons. This may result in a potentially large error when a single HVAC unit is evaluated using this spreadsheet. However, this error should be normalized when used in larger populations resulting in a more accurate prediction of population EER degradation. This position is supported by the close correlation in EER population degradations (Spreadsheet vs Service Assistant methodologies) as discussed earlier.

The accuracy of this tool has not been tested in significantly different climactic areas and there may be additional attributes which need to be considered in these cases.



Source: MACTEC, 2004. Prepared by: _TBL_ Checked by: _CDM_



Source: MACTEC, 2004. Prepared by: _TBL_

Checked by: _CDM_



Source: MACTEC, 2004. Prepared by: _TBL_ Checked by: _CDM_



Source: MACTEC, 2004. Prepared by: _TBL_ Checked by: _CDM_



Source: MACTEC, 2004. Prepared by: _TBL_ Checked by: _CDM_



Source: MACTEC, 2004. Prepared by: _TBL_ Checked by: _CDM_

8. Statistical Significance

The results of the SEQL area testing were evaluated to determine the statistical significance of the study. This statistical testing was based on individual unit results; however, the EER improvements realized for the ton-weighted average were greater than for the unit average. A clearly defensible statistical method for evaluating units on a ton-weighted average was not easily discerned so it was decided to measure the significance based on a unit average and apply the results to the ton-weighted average approach.

For each unit with both pre- and post-Adsil treatment EER results, the % difference in efficiency {100 x (EER, post-treatment – EER, pre-treatment)/EER, pre-treatment} was tabulated. Thus a positive change indicates an efficiency improvement. This data set (% Change in EER) was tested to determine if it exhibited a normal distribution. Statistical tests were performed in SYSTAT 10 (SPSS, Inc. 2000), and the test for normality was Lilliefors and the level of significance selected was 0.05 (indicating 95% confidence that the data were drawn from a normal population). If the data passed the test of normality, then the 't' test was used to determine whether the average improvement was significantly greater than zero. This procedure is equivalent to performing a paired 't' test on the two (pre- and post-) data sets. The significance was evaluated at a level of 0.05. In fact all data sets exhibited significant improvement with significance less than 0.01, indicating 99% confidence that Adsil treatment resulted in an improvement in efficiency.

If the % Change in EER data sets did not follow a normal distribution, then the nonparametric equivalent of a paired 't' test, the Wilcoxon signed rank test, was used to determine the effect of Adsil treatment.

All data sets showed an improvement in EER post-Adsil treatment, when compared with pre-treatment EER. The model results are presented in Appendix I.

The relationship between EER improvement and unit capacity (tons) was demonstrated in Section 7 and shown in Figure 7-7; therefore ton-weighted averages are expected to exhibit similar improvement as the results obtained from individual unit comparisons, and ton-weighted improvements are also expected to be statistically significant.

After determining that each data set exhibited significant improvement, the average and standard error for each data set was determined, as well as the upper and lower confidence intervals of the average improvement. These results indicate typical improvements that may be expected in various populations, as well as the range in potential improvements.

9. Summary of Results and Conclusions

MACTEC evaluated the impact of Adsil application to 45 HVAC units in the SEQL area and to three units outside the SEQL area. The results of this evaluation show that the Adsil treatment can be expected to improve the efficiency of existing HVAC units by approximately 12% based on the ton-weighted average method used in this project. The data was statistically evaluated and determined to be significant at the 99% confidence level.

Utility bill analysis was determined to be an inappropriate measurement tool for EER changes and therefore actual efficiency measurements for each HVAC unit were performed. Three tests were used including a calculation method, a power and capacity measurement, and a refrigerantbased measurement using the Service Assistant as available from Honeywell Controls.

Two baseline studies were conducted to establish the accuracy of each testing protocol and which involved repeated tests on two units. Repeatability in measurements was demonstrated in these tests and it was determined that the Service Assistant instrument provided the most repeatable and accurate measurements of HVAC EER. The generic compressor curve used for many of the SEQL area tests was found to underestimate the actual savings demonstrated in the pilot baseline study tests. The condenser test methodology was generally less accurate but showed greater increases in EER as a result of the Adsil treatment.

A degradation prediction tool for HVAC units was created in this pilot program. This spreadsheet-based tool was calibrated against actual EER measurements and was found to be very accurate in predicting the EER degradation of a population of HVAC units in the SEQL area.

An energy savings projection tool was also created based on the results of this study. This tool can be easily adapted by facility owners and operators to estimate their energy savings, dollar savings, and possibly avoided pollution emissions as a result of the application of Adsil to aircooled HVAC equipment. This tool estimates that annual dollar savings for the 150 units coated in the SEQL area will exceed \$37,000 based on a blended electric rate of \$0.08 per kWh.

MACTEC believes that this product demonstrated significant savings for air-cooled HVAC equipment.

10. Recommendations

MACTEC recommends that the units in this study be evaluated for EER improvements on an annual basis. The instantaneous results form the Adsil treatment indicated that the EER improved 12%. There is no data currently available to support or refute that these improvements will be maintained. It would be very valuable to conclusively identify the long-term impact of the product on HVAC efficiency.

Appendix A

Preliminary Application List

APPENDIX A

Table A-1

Preliminary Application List

Buildi	ng	Tons
1	City of Concord Admin Building	83
2	City of Concord - City Hall	58.5
3	City of Monroe Rec Center	6
4	City of Monroe Arts Building	9
5	City of Monroe Recreation Buildings	183
6	Town of Stallings Govt Office	9.5
7	City of Salisbury - Rec Building	33
8	Rowan County Office Building	80
9	County of Anson Building "C"	20
10	Town of Granite Quarry Town Hall	15
11	lredell County - Health Building	169
12	Char/ Meck Samuel Billings Center	125
13	Char/ Meek Wallace Kuralt Center	550
14	Gaston County Mental Health Home	8
15	Town of Badin -Town Hall	9
16	City of Locust Town Hall & Rec Bldg	12
17	YTC Building "C"	80
18	YTC-Building "B"	120
19	YTC Building "D"	42.5
20	YTC-Building "F"	11
21	YTC - Maintenance Building	7
22	YTC Student Services	84
23	YTC Truck Driving School	7.5
24	YTC - Student Center	39
25	YTC - Library	80
26	YTC Building "A"	155
27	YTC - Science Building	270
28	YTC Hood Center	310.5
	Totals	2576.5
Appendix B

Residential Split System Tests

HVAC Data Sheet and EER Calculation

Compressor Data Running load Amps: 30.8 Amps Power supply: 1-Phase Nameplate Voltage: 208 Voits Phase adjustment: 1 Power factor: 0.96 Compressor quantity: 1 Condensing Fan Data Full load Amps: 1.40 Amps Power supply: 1-Phase Full load Amps: 1.40 Amps Power supply: 1 1-Phase Adjust FLA to RLA: 208 Voits Phase adjustment: 1 Adjust FLA to RLA: 0.70 Fan quantity: 1
Nameplate Voltage: 208 Volts Phase adjustment: 1 Power factor: 0.96 Compressor quantity: 1 Condensing Fan Data Full load Amps: 1.40 Full load Amps: 2.08 Volts Phase adjustment: 1 Nameplate Voltage: 2.08 Volts Phase adjustment: 1 Adjust FLA to RLA: 0.70 Fan quantity: 1
Power factor: 0.96 Compressor quantity: 1 Condensing Fan Data Full load Amps: 1.40 Amps Power supply: 1-Phase Nameplate Voltage: 208 Volts Phase adjustment: 1 Adjust FLA to RLA: 0.70 Fan quantity: 1
Condensing Fan Data Full load Amps: 1.40 Amps Power supply: 1-Phase Nameplate Voltage: 208 Volts Phase adjustment: 1 Adjust FLA to RLA: 0.70 Fan quantity: 1
Full load Amps: 1.40 Amps Power supply: 1-Phase Nameplate Voltage: 208 Volts Phase adjustment: 1 Adjust FLA to RLA: 0.70 Fan quantity: 1
Nameplate Voltage: 208 Volts Phase adjustment: 1 Adjust FLA to RLA: 0.70 Fan quantity: 1
Adjust FLA to RLA: 0.70 Fan quantity: 1
Evaporator for data (if applicable)
Full load Amps: 7.10 Amps Power supply: 1-Phase
Nameplate Voltage: 122 Volts Phase adjustment: 1
Adjust FLA to RLA: 0.77 Fan quantity: 1
Calculated compressor load: 6.1 kW Published Total; System kW 6.99
Calculated condensing fan load: 0.20 kW Condensing Unit kW at ARI conditons 6.32
Calculated evaporator fan load 0.67 kW Capacity at ARI Conditions= 4.96
Total calculated load for equipment: 6.32 kW - Condensing side only

Assumptions Present condition EER based on degradation of 2% per year after year 4 plus additional degradation of condenser coil

Condenser Coil Assessment Overall Unit Condition 18.2% Performance Degradation

	Junion	
	New	
	Average	x
	Fair	
	Poor	
Coil Cleanlines	s	
	Coated	1
	Clean	0.3
	Dirty	0.2
	Clogged	0.3
	Plugged	0.2
Fin Condition	00	
	Like New	
	Some Bent	0.05
	Smashed	0
	Dull/rough	0.95
	Corroded	0
	Pitted	0
	Flaking	0
Fin-Tube Attac	hment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes	-	
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

Y-measurment				
Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	244	20.8	4.6	0.92
2 to 3				
TOTAL				
HVAC Service Assis	tant Measure	ment		
Input SEER	1	0		
RAT	N	AF		
SAT	N	AF		
RAH	N	A %		
SAH	N	A %		
EI	N	A %		
CI	N	A %		
Input Cap	N	A Tons		
OAT	N	AF		
Predicted KW	N	A kW		
	CU Capaci	ty Estimates		
Ambient		7 F	293	K
CU Exhaust		9 F	293	
Coil Length		9 F 5 in	305	ĸ
Coll Length Coll Width		sin 8 in		
Area	_	o in 0 sq-ft		
Listed Fan CFM	111			
Air Mass Flow		3 kg/sec		
	0.0	0 119,000		
Capacity	2.2	1 Tons		
Efficiency		6 EER		
Efficiency		8 kW/Ton		

Measurement	
Number	ft/sec
1	2.9
2	4.5
	2
4	4.5
5	3.1
6	0
7	3.5
8	0
9	0
10	1.8
11	0
12	0
13	0
14	0
15	0
16	0
17	0
18	0
Average	1.239

	Blower Data April 8			1 2 3	4.1 4.1 4.1	-	Blower Data April 10	
1	2.7	1 3.1		4	3.9			
2	3.5	2 2.9		5	3.7			
3	3.3	3 2.1		6	2.9			
4	3.9	4 2.7		7	3.7			
5	3.7	5 2.5		8	3.9			
6	3.5	6 2.5		9	4.3			
7	3.5	7 3.5		10	4.3			
8	3.1	8 3.7		11	3.9			
9	3.3	9 3.3		12	3.9			
10	3.1	Average 2.922		13	4.3			
11	3.7			14	4.1			
12	3.5		sq ft	15	4.1			
13	3.5	CFM= 175.3333		16	4.1			
14	2.7			17	4.1			
15	2.9			18	4.3		Total Blower CFM=	1133.293
16	2.9			19	4.7			
17	2.5			20	4.9		Published=	2000
18	2.5	Total Blower CFM=	1061.19	21	5.3			
19	3.1						Error=	43%
20	3.9	Published=	2000	Average	4.129	ft/sec		
21	4.1					_		
		Error=	47%	Area=	4.575	sq ft		
Average	3.281 ft/sec			CFM=	1133.293			
Area= CFM=	4.5 sq ft 885.8571							

Test at 90 Degrees May 8, 2004 3:00 P.M.

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag

Carrier 38TH060300

Split system 1991 Gainesville Toms Home unit

Delta Measurem	ent			
Phase	Volts	Amps	kW	PF
1 to 2	241	23.8	5.4	0.95
	HVAC Servi			
r	Generic	Cope		0500-PFV-270
nput SEER	12		12	
nput Cap	5		5	_
SP	63	-	63	_
ST .	45		45	_
LP	236		236	_
LP LT	236	-	236 97	
DAT	97	-	97	
ET	92 36		92 36	Low
SH .	9		9	LOW
SC .	15		9 15	_
CT	112	-	112	_
COA	20	-	20	_
	20		20	-
RAT	77	F	77	F
SAT	49	F	49	F
RAH	33%	%	33%	%
SAH	85%	%	85%	%
EI	90%	%	84%	%
CI	90%	%	78%	%
Predicted KW	5	kW	4.7	kW
CU Capacity Es	timates			
Ambient	95	F	20	08 K
CU Exhaust	95			9 K
Coil Length	115	in	3	
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	4365			
Air Mass Flow		kg/sec		
		2		
Capacity		Tons		
Efficiency		EER		
Efficiency	0.60	kW/Ton		

CU Fan CFM Calculation				
Measurement				
Number	ft/sec			
1	5.9			
2	5.3			
3	5.1			
4	4.7			
5	4.1			
6	4.1			
7	5.3			
8	4.3			
9	4.1			
10	4.1			
11	4.7			
12	4.1			
13	4.6			
14	6.6			
15	6.2			
16	5.7			
17	4.3			
18	4.1			
Average	4.850			

Test at 92 Degrees May 8, 2004 2:00 P.M.

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag

Carrier 38TH060300

Split system 1991 Gainesville Toms Home unit

Delta Measurem				
Phase	Volts	Amps	kW	PF
1 to 2	241	23.8	5.4	0.95
		ice Assistan		
	Generic	Copel		0500-PFV-270
Input SEER	12	-1 -	12	
Input Cap	5	-	5	
SP	63	-1 F	63	_
SP ST	45	-1 }	45	
LP	236	-1 }	231	_
	97	-1 ł	97	
OAT	97	-1 -	97	
ET	36	-1 }	36	Low
SH	9	-1 ł	9	LOW
SC	15	-1 -	14	
CT	112	-1 -	112	
COA	20	- +	112	
COA	20	- +	19	
RAT	77	F	77	F
SAT	49		49	
RAH	33%	%	33	%
SAH	85%	%	85	%
		- 17		
EI	90%	%	84%	%
CI	90%	%	78%	%
Predicted KW	5	kW	4.7	kW
CU Capacity Es	stimates			
Amelainet	0		0	
Ambient CU Exhaust		5 F 5 F		08 K 19 K
	11		3	ıэк
Coil Length Coil Width		in in		
Area	15			
Fan CFM	436	0 sq-ft 5		
Air Mass Flow		o 7 kg/sec		
	2.4	1 119/300		

Capacity Efficiency Efficiency 7.86 Tons 17.46 EER 0.69 kW/Ton

Measurement	
Number	ft/sec
1	5.9
2	5.3
3	5.1
4	4.7
5	4.1
6	4.1
7	5.3
8	4.3
9	4.1
10	4.1
11	4.7
12	4.1
13	4.6
14	6.6
15	6.2
16	5.7
17	4.3
18	4.1
Average	4.850

Test at 90 Degrees July 8 2004 1:45 PM

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag

Carrier 38TH060300

Split system 1991 Gainesville Toms Home unit

Phase	Volts	Amps	kW	PF
1 to 2	240	24.4	5.6	0.95
	•		•	•
	HVAC Service		nt Measureme	
	Generic	Cope	eland 6CRN5-0	500-PFV-270
Input SEER	12		12	
Input Cap	5		5	
SP	66		66	
ST	46		46	
LP	231		231	
LT	97		97	
OAT	90		90	
ET	38		38	
SH SC	7		7	Low
SC CT	112		112	
COA	21		21	
COA	21		21	
RAT	79	F	79	F
SAT	50	F	50	F
RAH	29%	%	29%	%
SAH	85%	%	85%	%
EI	90%	%	85%	%
CI	92%	%	81%	%
Predicted KW	4.8	kW	4.8	kW
CU Capacity E	stimates			
Ambient	90	-	305	K
Amplent CU Exhaust	90 116	-	305	
Co Exhaust	110	r in	320	IX
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	3920			
Air Mass Flow		kg/sec		
		ž		
Capacity		Tons		
Efficiency	19.65			
Efficiency	0.61	kW/Ton		

ft/sec			
5.1			
5.3			
5.5			
4.7			
3.7			
3.1			
5.5			
4.7			
3.7			
4.1			
4.3			
4.1			
3.5			
4.7			
4.3			
4.3			
3.7			
4.1			
4.356			

Test at 90 Degrees May 8, 2004 3:00 P.M.

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag

Carrier 38TH060300

Split system 1991 Gainesville Toms Home unit

Delta Measuren Phase	Volts	Amps	kW	PF
1 to 2	241	23.8	5.4	0.95
1102	271	20.0	0.4	0.00
	HVAC Servi	ce Assista	nt Measurem	ent
	Generic			-0500-PFV-270
Input SEER	12		12	
Input Cap	5		5	
SP	61		62	
ST	43		43	
LP	227		234	
LT	96		97	
OAT	90		91	
ET	35		36	Low
SH	8		7	
SC	16		16	
СТ	112		112	
COA	21		21	
RAT	88	F	88	F
SAT	49	F	49	F
RAH	33%	%	33%	%
SAH	85%	%	85%	%
		_		
EI	88%	%	83%	%
CI	88%	%	77%	%
Predicted KW	5	kW	4.7	kW
CU Capacity Es	stimates			
Ambient	90	F	30	05 K
CU Exhaust	111		31	17 K
Coil Length		in		
Coil Width		in		
Area		sq-ft		
Fan CFM	4065			
Air Mass Flow	2.30	kg/sec		
Capacity	7 69	Tons		
Efficiency		EER		
Efficiency		kW/Ton		

Measurement	
Number	ft/sec
1	5.7
2	4.7
3	4.3
4	4.5
5	3.7
6	3.9
7	4.3
8	4.1
9	4.1
10	3.7
11	3.5
12	3.7
13	5.1
14	6.4
15	6.1
16	5.7
17	4.3
18	3.5
Average	4.517

Test at 88 Degrees May 8, 2004 6:30 P.M.

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag

Carrier 38TH060300

Split system 1991 Gainesville Toms Home unit

Delta Measurem		A	1.3.47	DE
Phase	Volts	Amps	kW	PF
1 to 2	243	21.5	5.4	0.94
	HVAC Servi	ce Assista	nt Measureme	ent
	Generic		eland 6CRN5-0	
Input SEER	12	1	12	
Input Cap	5	1	5	
SP	62		61	
ST	45		42	
LP	220		220	
LT	92]	93	
OAT	88		88	
ET	35		35	
SH	9		7	Low
SC	16		15	
СТ	108		108	
COA	20	_	20	
		_		
RAT	80	F	80	F
SAT	48	F	48	F
RAH	25%	%	25%	%
SAH	85%	%	85%	%
EI	00%	%	000/	%
	89% 88%	%	83% 77%	
Predicted KW	5	⁷⁶ kW	4.7	
Fledicled KW	5	KVV	4.7	KVV
CU Capacity Es	stimates			
Ambient	86			3 K
CU Exhaust	108		31	5 K
Coil Length		in		
Coil Width		in		
Area		sq-ft		
Fan CFM	3870			
Air Mass Flow	2.19	kg/sec		
Capacity	7 66	Tons		
Efficiency	17.03			
Efficiency	0.70	kW/Ton		

Capacity Efficiency Efficiency

Measurement	
Number	ft/sec
1	5.7
2	4.3
3	4.5
4	4.1
5	3.3
6	3.7
7	4.1
8	3.1
9	3.9
10	3.7
11	3.5
12	3.5
13	4.9
14	6.1
15	6.1
16	4.9
17	4.3
18	3.7
Average	4.300

Test at 85 Degrees July 8 2004 2:40 P.M.

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag

Carrier 38TH060300 Split system 1991 Gainesville Toms Home unit

Phase	Volts	Amps	kW	PF
1 to 2	241	23.4	5.3	0.95
	•		•	
	HVAC Service	ce Assista	Int Measureme	<u>n</u> t
	Generic	Сор	eland 6CRN5-0	500-PFV-270
Input SEER	12		12	
Input Cap	5		5	
SP	62		62	
ST	41		41	
LP	214		214	
LT	91		91	
OAT	85		85	
ET	35		35	
SH	6		6	Low
SC	16		16	
СТ	107		107	
COA	22		22	
RAT	76	F	76	F
SAT	48	F	48	F
RAH	26%	%	0.26	%
SAH	85%	%	0.85	%
EI	86%	%	83%	%
CI	88%	%	78%	%
Predicted KW	4.9	kW	4.8	kW
CU Capacity E	stimates			
Ambient	86	F	303	к
CU Exhaust	109	-	316	
Coil Length	109	in	510	
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	3600			
Air Mass Flow		kg/sec		

Capacity Efficiency Efficiency 16.87 EER 0.71 kW/Ton

Measurement	
Number	ft/sec
1	3.3
2	2.7
3	3.9
4	3.3
5	2.7
6	2.5
7	4.3
8	4.3
9	3.7
10	4.9
11	4.1
12	3.5
13	5.3
14	5.9
15	5.5
16	5.1
17	3.5
18	3.5
Average	4.000

Test at 85 Degrees April 9, 2004 4:45 P.M.

Manufacturer:	Carrier
Model Number:	38TH060300
Serial Number	
Equipment Type:	Split system
Year Manufactured:	1991
Location	Gainesville
Тад	Toms Home ι

Type: Split system cctured: 1991 Gainesville Toms Home unit Delta Measurement Phase Volts Amos

Delta Measuren		A	kW	PF
Phase 1 to 2	Volts 241	Amps	5.2	r
1 to 2	241	23.1	5.2	0.94
			nt Measureme	
	Generic	Соре	eland 6CRN5-0	500-PFV-270
Input SEER			-	
Input Cap				
0.0				
SP				
ST				
LP				
LT				
OAT				
ET				
SH				
SC				
СТ				
COA				
RAT		F	75	F
SAT		F	46	F
RAH		%	30	%
SAH		%	87	%
				1
EI		%	81%	%
CI		%	72%	%
Predicted KW		kW	5.5	kW
				1
CU Capacity E	stimates			
Ambient	85	F	303	к
CU Exhaust	108	F	315	к
Coil Length		in		
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	1870			
Air Mass Flow		kg/sec		
Capacity	3 97	Tons		

Capacity	3.87 Tons
Efficiency	8.93 EER
Efficiency	1.34 kW/Ton

Measurement		
Number	ft/sec	
1	4.7	Not Updated
2	2.7	
3	4.7	
4	4.9	
5	3.1	
6	0	
7	4.5	
8	3.5	
9	2.5	
10	2	
11	1.8	
12	1	
13	2	
14	0	
15	0	
16	0	
17	0	
18	0	
Average	2.078]

Test at 85 Degrees April 28, 2004 3:00 P.M.

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag

Carrier 38TH060300 Split system 1991 Gainesville Toms Home unit

Phase	Volts	Amps	kW	PF
1 to 2	243	23.1	5.2	0.94
	HVAC Servi		nt Measureme	
	Generic	Cop	eland 6CRN5-0	500-PFV-270
nput SEER	12		12	
nput Cap	5		5	
		_		
SP	60	-	60	
ST	51		49	
_P	212		213	
_T	91	-	91	
DAT	85	-	85	
ET	34	-	34	
SH	17	-	15	
SC CT	13	-	14	
COA	104 20	-	105 21	
JUA	20	-	21	
RAT	77	F	77	F
SAT	48	F	48	F
RAH	33%	%	33	%
SAH	85%	%	85	%
ΞI	88%	%	83%	%
CI	84%	%	76%	%
Predicted KW	4.9	kW	4.7	kW
		-		
CU Capacity Es	stimates			
Ambient	85	F	303	к
CU Exhaust	108	5 F	315	к
Coil Length		in		
Coil Width		in		
Area	15.0) sq-ft		
Fan CFM	3200			
Air Mass Flow	1.81	kg/sec		
Capacity	6 60	Tons		
Efficiency		E E E R		
Efficiency		kW/Ton		

CIL Ean CEM Calculation

CU Fan CFM Calculation			
Measurement			
Number	ft/sec		
1	4.5		
2	3.9		
3	2.7		
4	4.1		
5	4.9		
6	3.1		
7	3.9		
8	3.3		
9	3.1		
10	2.9		
11	2.7		
12	2.7		
13	3.9		
14	4.5		
15	2.9		
16	5.3		
17	3.5		
18	2.1		
Average	3.556		

Test at 84 Degrees June 2, 2004 at 10:25 AM

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag

Carrier 38TH060300 Split system 1991 Gainesville Toms Home unit

Phase	Volts	Amps	kW	PF
1 to 2	243	22.6	5.2	0.94
			nt Measureme	
	Generic	Cop	eland 6CRN5-0	0500-PFV-270
Input SEER	10		10	_
Input Cap	5	_	5	_
SP	50		50	_
SP ST	59 46	-	59 46	_
LP	206		206	_
	89		89	
OAT	84	1	84	-
ET	33	1	33	-
SH	12	1	12	Low
SC	15		15	LOW
СТ	103		103	
COA	19		19	
RAT	78	F	78	F
SAT	47	F	47	F
RAH	25%	%	25%	%
SAH	85%	%	85%	%
EI	87%	%	86%	%
CI	84%	%	78%	%
Predicted KW	6.3	kW	5.5	kW
CU Capacity E	stimates			
Ambient	8/	1 F	30,	2 K
CU Exhaust	106			4 K
Coil Length	100	in	01	- 10
Coil Width		in		
Area	15.0) sq-ft		
Fan CFM	1915			
Air Mass Flow	1.08	3 kg/sec		
<u> </u>				
Capacity Efficiency		9 Tons 5 EER		
Efficiency		7 kW/Ton		
Lindency	1.57	NW/TOIL		

Measurement	
Number	ft/sec
1	3.5
2	2.7
3	0
4	2
5	0
6	0
7	3.1
8	5.5
9	4.5
10	2.9
11	1.8
12	0
13	2.7
14	2.7
15	1.4
16	3.5
17	2
18	0
Average	2.128

Test at 84 Degrees April 28, 2004 4:00 P.M.

Manufacturer:CarrierModel Number:38TH060300Serial NumberEquipment Type:Equipment Type:Split systemYear Manufactured:1991LocationGainesvilleTagToms Home unit

Delta Measuren	nont			
Phase	Volts	Amps	kW	PF
1 to 2	243	22.8	5.2	0.94
1.02	2.0	22.0	0.2	0.01
	HVAC Servi	ce Assista	Int Measurem	ent
	Generic			0500-PFV-270
Input SEER	12	1 .	12	
Input Cap	5		5	
SP	58		58	
ST	44		44	
LP	204		207	
LT	91		91	
OAT	84		84	
ET	32		32	Low
SH	13		12	
SC	12		13	
СТ	102		104	
COA	19	-	20	_
RAT	76	F	77	F
SAT	45	F	45	F
RAH	24%	%	24	%
SAH	85%	%	85	%
EI	84%	%	81%	%
CI	80%	%	73%	%
Predicted KW	4.8	kW	4.6	kW
CU Capacity E	stimates			
Ambient	84	١F	30	02 K
CU Exhaust	107			5 K
Coil Length		in		
Coil Width		in		
Area	15.0) sq-ft		
Fan CFM	3195	•		
Air Mass Flow		kg/sec		
Capacity	6.61	Tons		

Capacity6.61 TonsEfficiency15.26 EEREfficiency0.79 kW/Ton

Measurement	
Number	ft/sec
1	4.5
23	3.9
	3.1
4	4.1
5	3.9
6	3.1
7	3.7
8	3.3
9	2.7
10	1.8
11	1.8
12	2
13	4.9
14	5.3
15	3.3
16	5.7
17	4.5
18	2.3
Average	3.550

Test at 83 Degrees July 8 2004 10:55 A.M.

Manufacturer:	Carrier
Model Number:	38TH060300
Serial Number	
Equipment Type:	Split system
Year Manufactured:	1991
Location	Gainesville
Тад	Toms Home unit

Phase	Volts	Amps	kW	PF
1 to 2	243	23	5.2	0.94
	HVAC Servi		nt Measurem	
	Generic	Cop		0500-PFV-270
Input SEER	12		12	
Input Cap	5		5	
SP	59		59	
ST	40		40	
LP	208		208	
LT	91		91	
OAT	83		83	
ET	34		34	Low
SH	6		6	
SC	13		13	
СТ	104		104	
COA	21		21	
RAT	72	F	72	F
SAT	48	F	48	F
RAH	27%	%	27%	%
SAH	85%	%	85%	%
EI	84%	%	80%	%
CI	82%	%	73%	%
Predicted KW	5.1	kW	4.7	kŴ
	0.1			
CU Capacity E	stimates			
Ambient	85	F	30	3 K
CU Exhaust	106			4 K
Coil Length		in		
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	3705	•		
Air Mass Flow	2.10	kg/sec		
Capacity		Tons		
Efficiency	16.16			
Efficiency	0.74	kW/Ton		

CU Fan CFM	A Calculation
Measurement	
Number	ft/sec
1	2.3
2	4
3	4.7
4	3.9
5	3.7
6	3.5
7	5.1
8	4.7
9	4.7
10	4.3
11	2.7
12	2.9
13	4.7
14	6.1
15	5.5
16	4.9
17	3.5
18	2.9
Average	4.117

Test at 84 Degrees April 10, 2004 5:00 P.M.

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag

Carrier 38TH060300 Split system 1991 Gainesville Toms Home unit

Phase	nent Volts	Amps	kW	PF
1 to 2	243	23.3	5.3	0.94
1102	243	23.3	5.5	0.94
	HVAC Servi	ce Assista	nt Measurem	ent
	Generic			0500-PFV-270
Input SEER	12		12	
Input Cap	5		5	
SP	60		60	
ST	49		50	
LP	214		209	
LT	90		90	
OAT	84		84	
ET	34		34	Low
SH	15		16	
SC	16		16	
СТ	106		105	
COA	21	_	22	_
		_		
RAT	75	F	75	F
SAT	46	F	46	F
RAH	30%	%	30	%
SAH	87%	%	87	%
	0.001	<i></i>	000/	
EI CI	86%	% %	83%	%
CI Predicted KW	84% 5.2	% kW	76% 4.7	- % kW
Predicted KW	5.2	KVV	4.7	KVV
CU Capacity E	stimates			
		_		
Ambient	84	-		2 K
CU Exhaust	107		31	5 K
Coil Length Coil Width		in in		
Coil Width	45.0	in log ft		
Area Fan CFM	15.0	sq-ft		
Air Mass Flow		i kg/sec		
THI MIASS I IUW	1.00	Ny/SEC		
Capacity	3.87	Tons		
Efficiency		EER		
Efficiency	1 37	' kW/Ton		

Measurement				
Number	ft/sec			
1	4.7			
2	2.7			
3	4.7			
4	4.9			
5	3.1			
6	0			
7	4.5			
8	3.5			
9	2.5			
10	2			
11	1.8			
12	1			
13	2			
14	0			
15	0			
16	0			
17	0			
18	0			
Average	2.078			

Test at 83 Degrees April 28, 2004 5:00 P.M.

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag

Carrier 38TH060300

Split system 1991 Gainesville Toms Home unit

Phase	Volts	Amps	kW	PF
1 to 2	243	22.6	5.1	0.94
	HVAC Servi		int Measureme	
	Generic	Сор	eland 6CRN5-0	500-PFV-270
Input SEER	12		12	
Input Cap	5		5	
SP	57	-	56	
ST	43	-	43	
LP	201	-	201	
	90		89	
OAT	83	1	83	1
ET	31	-	31	Low
SH	12	-	12	2011
SC	11	-	12	
СТ	102		102	
COA	18		20	
RAT	74	F	74	F
SAT	44	F	44	F
RAH	25%	%	25	%
SAH	85%	%	85	%
EI	85%	%	80%	%
CI	80%	%	72%	%
Predicted KW	4.7	kW	4.6	kW
	_	-		-
CU Capacity Es	timates			
Ambient	83	F	301	к
CU Exhaust	105	Γ	314	К
Coil Length		in		
Coil Width		in		
Area) sq-ft		
Fan CFM	2515	5		
Air Mass Flow		kg/sec		

4.98 Tons 11.72 EER 1.02 kW/Ton Capacity Efficiency Efficiency

00101011	ouloulution
Measurement	
Number	ft/sec
1	4.1
2	3.5
3	2.5
4	3.1
5	2.9
6	2
7	2.5
8	2.3
9	2.1
10	1.8
11	2
12	0
13	4.9
14	5.1
15	2.1
16	5.3
17	4.1
18	0
Average	2.794

Test at 83 Degrees July 8 2004 9:55 A.M.

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag

Carrier 38TH060300

Split system 1991 Gainesville Toms Home unit

Phase	Volts	Amps	kW	PF
1 to 2	242	23.1	5.3	0.95
	HVAC Serv		nt Measurem	
	Generic	Cope	eland 6CRN5	-0500-PFV-27
nput SEER	12		12	
nput Cap	5		5	
		_		
SP	60	_	60	
ST	40	4	40	_
_P	207	4	207	_
_T	89	4	89	_
TAC	82		82	
ΞT	34		34	Low
SH	6		6	
SC	15		15	
СТ	104		104	
COA	21	_	21	_
RAT	75	F	75	F
SAT	49	F	49	F
RAH	34%	%	34%	%
SAH	85%	%	85%	%
EI	84%	%	81%	%
CI	83%	%	75%	%
Predicted KW	4.7	kW	4.7	kW
CU Capacity Es	stimates			
Ambient		5 F		03 K
CU Exhaust	10	7 F	31	15 K
Coil Length		in		
Coil Width		in		
Area		0 sq-ft		
Fan CFM	381			
Air Mass Flow	2.1	6 kg/sec		

Capacity7.55 TonsEfficiency17.10 EEREfficiency0.70 kW/Ton

Measurement	
Number	ft/sec
1	3.1
2	3.7
3	3.3
4	3.9
5	3.7
6	3.7
7	5.5
8	5.1
9	4.7
10	4.7
11	3.3
12	3.5
13	3.9
14	6.2
15	5.7
16	5.3
17	3.3
18	3.7
Average	4.239

Test at 73 Degrees April 8, 2004 5:00 P.M. Generic Compressor Curve

Manufacturer:	Carrier
Model Number:	38TH060300
Serial Number	
Equipment Type:	Split system
Year Manufactured:	1991
Location	Gainesville
Тад	Toms Home unit

Delta Measurer Phase	Volts	Amps	kW	PF
1 to 2	244	21.5	4.8	0.92
			•	•
	HVAC Serv		nt Measurem	
	Generic	Cope	eland 6CRN5-0	0500-PFV-270
Input SEER	10		10	
Input Cap	5		5	_
0.0				_
SP				_
ST LP		_		_
		_		-
LT	<u> </u>	-		
OAT		-		
ET SH		-		
		_		-
SC CT		_		-
		_		_
COA		_		-
RAT	NA	F	NA	F
SAT	NA	F	NA	- F
RAH	NA	%	NA	%
SAH	NA	%	NA	%
EI	79%	%	79	%
CI	73%	%	73	%
Predicted KW	5.5	kW	5.5	kW
	-			-
CU Capacity E	stimates			
Ambient	7	3 F		
CU Exhaust		5 F		
Coil Length	NA	in		
Coil Width	NA	in		
Area		0 sq-ft		
Fan CFM	187			
Air Mass Flow		6 kg/sec		
		J J		
Capacity	3.7	0 Tons		
Efficiency	9.2	6 EER		
Efficiency	1.3	0 kW/Ton		

001411011	i calculation		
Measurement			
Number	ft/sec		
1	4.7		
2	2.7		
3	4.7		
4	4.9		
5	3.1		
6	0		
7	4.5		
8	3.5		
9	2.5		
10	2		
11	1.8		
12	1		
13	2		
14	0		
15	0		
16	0		
17	0		
18	0		
Average	2.078		

Test at 71 Degrees April 12, 2004 7:30 P.M.

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag Carrier 38TH060300 Split system 1991 Gainesville Toms Home unit

Delta Measurem Phase	Volts	Amps	kW	PF
1 to 2	244	21.5	4.8	0.92
			•	•
	HVAC Serv	ice Assista	nt Measurem	<u>nen</u> t
	Generic	Сор	eland 6CRN5	-0500-PFV-270
Input SEER	12		12	
Input Cap	5		5	
		_		
SP	58	_	56	
ST	69	_	69	
LP	177		176	
LT	74	_	73	
OAT	71		71	
ET	32		31	Low
SH	37		38	High
SC	19		19	
СТ	93		93	
COA	23	_	22	
		_		
RAT	75	F	75	F
SAT	46	F	46	F
RAH	30	%	30	%
SAH	87	%	87	%
EI	87%	%	79%	%
CI	82%	%	71%	%
Predicted KW	6.6	kW	4.6	kW
CU Capacity Es	stimates			
Ambient	7'	1 F		
CU Exhaust	96	6 F		
Coil Length	NA	in		
Coil Width	NA	in		
Area	15.0) sq-ft		
Fan CFM	1870)		
Air Mass Flow	1.00	6 kg/sec		
Canacity	4.0	1 Tana		
Capacity		1 Tons 2 EER		
Efficiency Efficiency		2 EER 4 kW/Ton		
LINCICIICY	1.14			

CU Fan CFM Calculation

Measurement		
Number	ft/sec	
1	4.7	
2	2.7	
3	4.7	
4	4.9	
5	3.1	
6	0	
7	4.5	
8	3.5	
9	2.5	
10	2	
11	1.8	
12	1	
13	2	
14	0	
15	0	
16	0	
17	0	
18	0	
Average	2.078	

Fan Not Measured-Used previous numbers

Test at 66 Degrees April 14, 2004 6:30 P.M.

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag

Carrier 38TH060300 Split system 1991 Gainesville Toms Home unit

Phase	nent Volts	Amps	kW	PF
1 to 2	244	20.6	4.6	0.92
	HVAC Serv Generic		nt Measureme eland 6CRN5-0	<u>ent</u> 0500-PFV-270
Input SEER	12		12	7
nput Cap	5		5	
SP	67		69	
ST	64		64	
LP	157		155	
LT	69		68	
DAT	66		66	
ET	39		40	
SH	24		22	
SC	17		17	
СТ	85		85	
COA	19		19	
RAT	72	F	72	F
SAT	41	F	41	F
RAH	35	%	35	%
SAH	85	%	85	%
EI	102%	%	103%	%
CI	102%	%	103%	%
Predicted KW	4.9	kW	5	kW
CU Capacity E	stimates			
Ambient	6	6 F		
CU Exhaust		8 F		
Coil Length	NA	in		
Coil Width	NA	in		
Area	15.	0 sq-ft		
Fan CFM	3110			
Air Mass Flow		6 kg/sec		
		ž		
Capacity		6 Tons		
Efficiency	16.06 EER			
Efficiency	0.7	5 kW/Ton		

00101011	i ouloulution
Measurement	
Number	ft/sec
1	2.1
2	5.5
3	3.7
4	6.1
5	5.3
6	2.1
7	4.5
8	3.5
9	2.9
10	3.1
11	3.5
12	2.7
13	3.1
14	3.7
15	3.5
16	2.5
17	2.1
18	2.3
Average	3.456

Test at 64 Degrees April 12, 2004 8:00 A.M.

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag

Carrier 38TH060300

Split system 1991 Gainesville Toms Home unit

Phase	Volts	Amps	kW	PF
1 to 2	246	21.2	4.8	0.91
			int Measurem	
	Generic	Сор		0500-PFV-270
Input SEER	12		12	
Input Cap	5	_	5	
~~		_		
SP	53	_	52	_
ST	64	_	64	_
LP	162	_	160	_
LT	68	_	69	_
OAT	64	_	64	<u> </u>
ET	28	_	28	Low
SH	36	_	37	High
SC CT	19	_	18	_
	87	_	87	_
COA	24	_	22	_
RAT	75	F	75	F
SAT	75 46	F	75	F
RAH	30	- 	46 30	
SAH	30 87	%	30 87	%
ЗАП	07	70	67	70
EI	80%	%	79%	%
CI	73%	%	72%	%
Predicted KW	5.7	kW	4.6	kW
CU Capacity E	stimates			
Ambient	6	6 F		
CU Exhaust		9 F		
Coil Length	NA	in		
Coil Width	NA	in		
Area		0 sq-ft		
Fan CFM	187			
Air Mass Flow		6 kg/sec		
		-		
Capacity		7 Tons		
Efficiency		8 EER		
Efficiency	1.2	4 kW/Ton		

CU Fan CFM Calculation

Measurement		
Number	ft/sec	
1	4.7	
2	2.7	
3	4.7	
4	4.9	
5	3.1	
6	0	
7	4.5	
8	3.5	
9	2.5	
10	2	
11	1.8	
12	1	
13	2	
14	0	
15	0	
16	0	
17	0	
18	0	
Average	2.078	

Fan Not Measured-Used previous numbers

Test at 84 Degrees Jul8 2004 3:45 PM- Cleaned Coil with Hose

Model Number: 38TH060300
Serial Number
Equipment Type: Split system
Year Manufactured: 1991
Location Gainesville
Tag Toms Home unit

Phase	Volts	Amps	kW	PF
1 to 2	243	22.9	5.2	0.94
			int Measurem	
	Generic	Сор		0500-PFV-270
Input SEER	12		12	
Input Cap	5	_	5	_
SP	60	-	60	_
ST	39		39	
LP	205		205	
LT	86		86	-
OAT	84		84	
ET	34		34	Low
SH	5		5	-
SC	17		17	
СТ	103		103	
COA	19]	19	
DAT	75	F	75	F
RAT SAT	75 48	F	75 48	F
RAH	26%		0.26	
SAH	85%	%	0.20	%
SAN	0376	70	0.65	70
EI	87%	%	84%	%
CI	86%	%	77%	%
Predicted KW	5.1	kW	4.7	kW
CU Capacity E				
	sumates			
Ambient		2 F	30	01 K
CU Exhaust	10	6 F	31	4 K
Coil Length		in		
Coil Width		in		
Area		0 sq-ft		
Fan CFM	371			
Air Mass Flow	2.1	0 kg/sec		
Capacity	8.0	2 Tons		

Capacity8.02 TonsEfficiency18.52 EEREfficiency0.65 kW/Ton

ft/sec
3.9
4.7
5.5
4.1
2.7
2.7
4.5
3.9
3.3
3.5
4.1
3.9
6.2
5.5
4.3
3.9
3.9
3.7
4.128

TABLE 4-1Unit 1 Baseline StudyGeneric Compressor Test Summary-All Temperatures

	EER at ARI Co Condensing ur Capacity at AF Coil Area Predicted EER	nit CFM RI			3000 4.96	BTU/W-ł CFM (Lis tons sq-ft		
ſ	redicted EER =		HVAC	C Service As	sistant			
	Test Date							
		OAT	EWB	EI	CI	EER	kW	
	April 12-G	64	57	80%	73%	#REF!	5.7	
- 6	A	00	50	4000/	4000/		4.0	

Test Date							Cond Ai	r, deg F		Cond Air						
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER	cfm adj	EER, Adj	kg/sec, adj
April 12-G	64	57	80%	73%	#REF!	5.7	66	89	12.8	4.8	1.06	3.9	9.68	0.38	3.68	0.40
April 14-G	66	56	102%	102%	#REF!	4.9	66	88	12.2	4.6	1.76	6.2	16.06	0.38	6.10	0.67
April 12G	71	57	87%	82%	#REF!	6.6	71	96	13.9	4.8	1.06	4.2	10.52	0.38	4.00	0.40
April 8G	73	57	79%	73%	#REF!	5.5	73	95	12.2	4.8	1.06	3.7	9.26	0.38	3.52	0.40
July 8-G	82	58	84%	83%	#REF!	4.7	85	107	12.2	5.3	2.16	7.6	17.10	0.38	6.50	0.82
April 28G	83	55	85%	80%	#REF!	4.7	83	105	12.2	5.1	1.42	5.0	11.72	0.38	4.45	0.54
July 8-G	83	53	84%	82%	#REF!	5.1	85	106	11.7	5.2	2.10	7.0	16.16	0.38	6.14	0.80
April 10G	84	57	86%	84%	#REF!	5.2	84	107	12.8	5.3	1.06	3.9	8.76	0.38	3.33	0.40
April 28G	84	55	84%	80%	#REF!	4.8	84	107	12.8	5.2	1.81	6.6	15.26	0.38	5.80	0.69
June 2-G3	84	56	87%	84%	#REF!	6.3	84	106	12.2	5.2	1.08	3.8	8.75	0.38	3.32	0.41
July 8 G4	84	55	87%	86%	#REF!	5.1	82	106	13.3	5.2	2.10	8.0	18.52	0.38	7.04	0.80
April 28G	85	59	88%	84%	#REF!	4.9	85	108	12.8	5.2	1.81	6.6	15.29	0.38	5.81	0.69
July 8G	85	56	86%	88%	#REF!	4.9	86	109	12.8	5.3	2.04	7.5	16.87	0.38	6.41	0.77
May 8G	88	58	89%	88%	#REF!	5.0	86	108	12.2	5.4	2.19	7.7	17.03	0.38	6.47	0.83
May 8G	90	55	88%	88%	#REF!	5.0	90	111	11.7	5.4	2.30	7.7	17.07	0.38	6.49	0.87
July 8G	90	59	90%	92%	#REF!	4.8	90	116	14.4	5.6	2.22	9.2	19.65	0.38	7.47	0.84
May 8G	92	59	90%	90%	#REF!	5.0	95	115	11.1	5.4	2.47	7.9	17.46	0.38	6.63	0.94
	A	VERAGES	86.8%	84.6%					12.55		1.75		14.42	0.38	5.48	0.66
POST ADSIL	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER	cfm adj	EER, Adj	kg/sec, adj
August 21-G	73	59	86%	81%	#REF!	4.7	72	96	13.3	4.8	2.96	11.31	28.27	0.38	10.74	1.13
August 20-G	81	59	87%	85%	#REF!	4.9	79	102	12.8	5.1	2.94	10.74	25.28	0.38	9.61	1.12
August 23-G	82	63	95%	95%	#REF!	5.0	82	106	13.3	5.3	2.92	11.12	25.18	0.38	9.57	1.11
August 20-G	83	60	88%	87%	#REF!	4.9	83	107	13.3	5.2	2.99	11.39	26.29	0.38	9.99	1.14
August 20-G	85	60	88%	85%	#REF!	4.9	84	107	12.8	5.3	2.92	10.66	24.14	0.38	9.17	1.11
August 20-G	85	65	88%	85%	#REF!	5.6	82	108	14.4	5.4	2.98	12.32	27.38	0.38	10.40	1.13
August 10-G	85	57	88%	85%	#REF!	5.8	84	107	12.8	5.2	3.01	11.01	25.41	0.38	9.66	1.14
August 21-G	86	59	88%	87%	#REF!	4.9	85	108	12.8	5.3	2.98	10.88	24.63	0.38	9.36	1.13
August 10-G1	87	58	94%	90%	#REF!	5.8	82	105	12.8	5.2	3.06	11.17	25.77	0.38	9.79	1.16
August 6-G	89	60	93%	95%	#REF!	6.1	89	114	13.9	5.5	2.93	11.62	25.35	0.38	9.63	1.11
August 6-G1	91	60	99%	97%	#REF!	5.9	89	115	14.4	5.6	3.02	12.49	26.77	0.38	10.17	1.15
August 18-G	90	65	94%	96%	#REF!	6.2	90	115	13.9	5.6	2.99	11.87	25.43	0.38	9.66	1.14
	- A	VERAGES	90.7%	89.0%					13.38		2.97		25.83	0.38	9.81	1.13
		Change	4.4%	5.1%					6.6%		70.1%		79.1%	0.0%	79.1%	70.1%

Physical Power and Capacity Measurements

	Condens	ing unit s		mbient Cor							Condens	ing onit Su	ininary - Ar	RI Conditions		
			Test Data	l	Per	cent Diff	erence		Test Data	3			Pe	ercent Differenc	e	
																Estimated
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SA/CU	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Degradatio
	Power (kW)	5.7	4.8	#REF!	#REF!	#REF!	119%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
64G	Capacity (Tons)	#REF!	3.87	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	9.68	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.9	4.6	#REF!	#REF!	#REF!	107%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
66G	Capacity (Tons)	#REF!	6.16	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	16.06	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	6.6	4.8	#REF!	#REF!	#REF!	138%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
71G	Capacity (Tons)	#REF!	4.21	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	10.52	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.5	4.8	#REF!	#REF!	#REF!	115%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
73G	Capacity (Tons)	#REF!	3.70	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	9.26	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.7	5.3	#REF!	#REF!	#REF!	89%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	
82G	Capacity (Tons)	#REF!	7.55	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
020	EER	#REF!	17.10	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.7	5.1	#REF!	#REF!	#REF!	92%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#RET :	-	#1(11)
83G	Capacity (Tons)	#REF!	4.98	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
030	EER	#REF!	4.96	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	- #REF!	- #REF!	- #REF!
		#REF! 5.1	5.2	#REF!	#REF!	#REF!	98%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#NEF!		#REF!
83G1	Power (kW)														-	-
83G1	Capacity (Tons)	#REF!	7.00	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	16.16	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.2	5.3	#REF!	#REF!	#REF!	98%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
84G1	Capacity (Tons)	#REF!	3.87	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	8.76	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
-	Power (kW)	4.8	5.2	#REF!	#REF!	#REF!	92%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
84G2	Capacity (Tons)	#REF!	6.61	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	15.26	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	6.3	5.2	#REF!	#REF!	#REF!	121%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
84G3	Capacity (Tons)	#REF!	3.79	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	8.75	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.1	5.2	#REF!	#REF!	#REF!	98%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
84G4	Capacity (Tons)	#REF!	8.02	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	18.52	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.9	5.2	#REF!	#REF!	#REF!	94%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
85G	Capacity (Tons)	#REF!	6.62	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	15.29	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.9	5.3	#REF!	#REF!	#REF!	92%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
85G	Capacity (Tons)	#REF!	7.45	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	16.87	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.0	5.4	#REF!	#REF!	#REF!	93%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
88G	Capacity (Tons)	#REF!	7.66	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	17.03	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF
	Power (kW)	5.0	5.4	#REF!	#REF!	#REF!	93%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
90G	Capacity (Tons)	#REF!	7.68	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	17.07	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.8	5.6	#REF!	#REF!	#REF!	86%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
90G1	Capacity (Tons)	4.0 #REF!	9.17	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	
3001	EER	#REF!	9.17 19.65	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	- #REF!	#REF!	- #REF!
92G	Power (kW)	5.0	5.4	#REF!	#REF!	#REF!	93%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
4214	Capacity (Tons)	#REF!	7.66	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	

	POST ADSIL				1						1					
	Power (kW)	4.7	4.8	#REF!	#REF!	#REF!	98%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
73-G	Capacity (Tons)	#REF!	11.31	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	28.27	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.9	5.1	#REF!	#REF!	#REF!	96%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
81-G	Capacity (Tons)	#REF!	10.74	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	25.28	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.0	5.3	#REF!		#REF!	94%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
82-G	Capacity (Tons)	#REF!	11.12	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	25.18	#REF!		#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.9	5.2	#REF!	#REF!	#REF!	94%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
83-G	Capacity (Tons)	#REF!	11.39	#REF!		#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	26.29	#REF!		#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.9	5.3	#REF!	#REF!		92%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
85-G	Capacity (Tons)	#REF!	10.66	#REF!		#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	24.14	#REF!		#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.6	5.4	#REF!		#REF!	1 0 4%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
85-G1	Capacity (Tons)	#REF!	12.32	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	27.38	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.8	5.2	#REF!	#REF!	#REF!	112%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
85-G2	Capacity (Tons)	#REF!	11.01	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	25.41	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.9	5.3	#REF!	#REF!	#REF!	92%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
86-G	Capacity (Tons)	#REF!	10.88	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	24.63	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.8	5.2	#REF!	#REF!	#REF!	112%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
87-G	Capacity (Tons)	#REF!	11.17	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	25.77	#REF!		#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	6.1	5.5	#REF!		#REF!	111%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
89-G	Capacity (Tons)	#REF!	11.62	#REF!		#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	25.35	#REF!		#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.9	5.6	#REF!		#REF!	105%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
91-G	Capacity (Tons)	#REF!	12.49	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	26.77	#REF!		#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
90-G Clean	Power (kW)	6.2	5.6	#REF!		#REF!	111%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
Evap	Capacity (Tons)	#REF!	11.87	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	25.43	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!

TABLE A-2

Generic Compressor Test Summary at Ambient 85 Degrees or Higher (Maximum of 1 Test per Temperature)

(waximum or i rest	
EER at ARI Conditions	9.4 BTU/W-h
Condensing unit CFM	3000 CFM (Listed)
Capacity at ARI	4.96 tons
Coil Area	15 sq-ft
Predicted EER =	7.40

		HVAC	Service As	ssistant				Phys	ical Power	and Capaci	ity measurn	nents			
Test Date							Cond Ai	r, deg F		Cond Air					
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER	cfm adj	EER, adj
July 8G	85	56	86%	88%	#REF!	4.9	86	109	12.8	5.3	2.04	7.5	16.87	0.38	6.41
May 8G	88	58	89%	88%	#REF!	5.0	86	108	12.2	5.4	2.19	7.7	17.03	0.38	6.47
May 8G	90	55	88%	88%	#REF!	5.0	90	111	11.7	5.4	2.30	7.7	17.07	0.38	6.49
May 8G	92	59	90%	90%	#REF!	5.0	95	115	11.1	5.4	2.47	7.9	17.46	0.38	6.63
		AVERAGES	88.3%	88.5%					11.94		2.25		17.11		6.50
POST ADSIL	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER	cfm adj	EER, adj
August 10-G	85	57	88%	85%	#REF!	5.8	84	107	12.8	5.2	3.01	11.01	25.41	0.38	9.66
August 21-G	86	59	88%	87%	#REF!	4.9	85	108	12.8	5.3	2.98	10.88	24.63	0.38	9.36
August 10-G1	87	58	94%	90%	#REF!	5.8	82	105	12.8	5.2	3.06	11.17	25.77	0.38	9.79
August 6-G	89	60	93%	95%	#REF!	6.1	89	114	13.9	5.5	2.93	11.62	25.35	0.38	9.63
August 6-G1	91	60	99%	97%	#REF!	5.9	89	115	14.4	5.6	3.02	12.49	26.77	0.38	10.17
August 18-G	90	65	94%	96%	#REF!	6.2	90	115	13.9	5.6	2.99	11.87	25.43	0.38	9.66
		AVERAGES	92.7%	91.7%					13.43		3.00		25.56		9.71
		Change	5.0%	3.6%					12.4%		33.1%		49.4%		49.4%

	Condens	ing Unit S	Summary - A	mbient Con	ditions						Condensi	ing Unit Su	mmary - AR	I Conditions		
			Test Data	1	Per	cent Diff	erence		Test Data	a			Pe	ercent Differenc	e	
ΟΑΤ		SA	CU	Lit	SA/Lit	CU/Lit	SA/CU	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Estimated Degradation
	Power (kW)	4.9	5.3	#REF!	#REF!	#REF!	92%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
85G	Capacity (Tons)	#REF!	7.45	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	16.87	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.0	5.4	#REF!	#REF!	#REF!	93%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
88G	Capacity (Tons)	#REF!	7.66	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	17.03	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.0	5.4	#REF!	#REF!	#REF!	93%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
90G	Capacity (Tons)	#REF!	7.68	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	17.07	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.0	5.4	#REF!	#REF!	#REF!	93%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
92G	Capacity (Tons)	#REF!	7.66	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	17.03	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	POST ADSIL															
	Power (kW)	5.8	5.2	#REF!	#REF!	#REF!	112%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
85-G2	Capacity (Tons)	#REF!	11.01	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	25.41	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.9	5.3	#REF!	#REF!	#REF!	92%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
86-G	Capacity (Tons)	#REF!	10.88	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	24.63	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.8	5.2	#REF!	#REF!	#REF!	112%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
87-G	Capacity (Tons)	#REF!	11.17	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	25.77	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	6.1	5.5	#REF!	#REF!	#REF!	111%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
89-G	Capacity (Tons)	#REF!	11.62	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	25.35	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.9	5.6	#REF!	#REF!	#REF!	1 05%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
91-G	Capacity (Tons)	#REF!	12.49	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	26.77	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	6.2	5.6	#REF!	#REF!	#REF!	111%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
0-G Clean	Capacity (Tons)	#REF!	11.87	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
Evap	EER	#REF!	25.43	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!

TABLE B-1

Copeland Compressor Test Summary-All Temperatures

EER at ARI Con Condensing unit Capacity at ARI	t CFM			3000	BTU/W-h CFM (Lis tons								
Coil Area					sq-ft								
Predicted EER	=			7.40									
		HVAC S	ervice Assi	stant							ity Measure	ements	
Test Date							Cond Air			Cond Air	-		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER
April 12-C	64	57	79%	72%	#REF!	4.6	<mark>66</mark>	89	12.8	4.8	1.06	3.87	9.68
April 14-C	66	56	103%	103%	#REF!	5.0	<mark>66</mark>	88	12.2	4.6	1.76	6.16	16.06
April 12-C	71	57	79%	71%	#REF!	4.6	71	96	13.9	4.8	1.06	4.21	10.52
July 8-C	82	58	<mark>81%</mark>	75%	#REF!	4.7	85	107	12.2	5.3	2.16	7.55	17.10
April 28-C	83	55	80%	72%	#REF!	4.7	83	105	12.2	5.1	1.42	4.98	11.72
July 8-C1	83	53	80%	73%	#REF!	4.7	85	106	11.7	5.2	2.10	7.00	16.16
April 10-C1	84	57	83%	76%	#REF!	4.7	84	107	12.8	5.3	1.06	3.87	8.76
April 28-C2	84	55	81%	73%	#REF!	4.6	84	107	12.8	5.2	1.81	6.61	15.26
June 2-C3	84 84	56 55	86% 84%	78%	#REF!	5.5	84	106 106	12.2	5.2 5.2	1.08 2.10	3.79	8.75 18.52
July 8 C4	84 85	57	84% 81%	77% 72%	#REF! #REF!	4.7 5.5	82 85	106	13.3 12.8	5.2	1.06	8.0 3.87	8.93
April 9-C1	85 85	-	81%	72%	#REF!		85	108	12.8	5.2		6.62	15.29
April 28-C2	85 85	59 56	83%	76%	#REF!	4.7 4.8	80 86	108	12.8	5.2	1.81 2.04	7.5	15.29
July 8-C3 May 08-C	88	58	83%	78%	#REF!	4.8	80	109	12.8	5.3 5.4	2.04	7.5	16.87
May 08-C May 08-C	90	55	83%	77%	#REF!	4.7	90	100	12.2	5.4 5.4	2.19	7.68	17.03
May 08-C	90	55	85%	81%	#REF!	4.7	90	116	11.7	5.4 5.6	2.30	9.17	19.65
May 08-C May 08-C	92	59	84%	78%	#REF!	4.0	95	115	11.1	5.4	2.22	7.86	17.46
way uo-c	92	59	83.4%	77.0%	#REF!	4.7	90	115	12.6	3.4	2.47	7.00	17.40
			03.4%	11.0%					12.0		1.7		14
POST ADSIL	OAT	EWB	El	CI	EER	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER
August 21-C	73	59	83%	74%	#REF!	4.6	72	96	13.3	4.8	(kg/3ec) 2.96	11.31	28.27
August 21-C	81	59	84%	76%	#REF!	4.6	72	102	12.8	5.1	2.94	10.74	25.28
August 23-C	82	63	88%	84%	#REF!	4.8	82	102	13.3	5.3	2.92	11.12	25.18
August 20-C	83	60	84%	78%	#REF!	4.7	83	107	13.3	5.2	2.99	11.39	26.29
August 20-C	85	60	89%	81%	#REF!	4.7	84	107	12.8	5.3	2.92	10.66	24.14
August 20-C	85	65	89%	81%	#REF!	5.6	82	108	14.4	5.4	2.98	12.32	27.38
August 10-C	85	57	88%	79%	#REF!	5.5	84	107	12.8	5.2	3.01	11.01	25.41
August 21-C	86	59	85%	78%	#REF!	4.6	85	108	12.8	5.3	2.98	10.88	24.63
August 10-C	87	58	92%	82%	#REF!	5.5	82	105	12.8	5.2	3.06	11.17	25.77
August 6-C	89	60	92%	87%	#REF!	5.8	89	114	13.9	5.5	2.93	11.62	25.35
August 6-C	91	60	96%	91%	#REF!	5.8	89	115	14.4	5.6	3.02	12.49	26.77
August 18-C	90	65	92%	88%	#REF!	5.8	90	115	13.9	5.6	2.99	11.87	25.43
			88.5 %	81.6%			83.42	107.50	13.38	5.29	2.97	11.38	25.8
		Change	6.1%	6.0%					6.3%		70.1%		79.3%

		Condensing U		- Ambient (C	ondensing		ary - ARI Condition		
			Test Data		Per	cent Diff	ference		Test Data				P	ercent Difference	e	
ΟΑΤ		SA	си	Lit	SA/Lit	CU/Lit	SA/CU	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Estimated Degradation
	Power (kW)	4.6	4.800	#REF!	#REF!	#REF!	96%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
64-C	Capacity (Tons)	#REF!	3.87	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	9.68	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.0	4.600	#REF!	#REF!	#REF!	109%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
66-C	Capacity (Tons)	#REF!	6.16	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	16.06	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.6	4.8	#REF!	#REF!	#REF!	96%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
71-C	Capacity (Tons)	#REF!	4.21	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	10.52	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.7	5.3	#REF!	#REF!	#REF!	89%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
82-C	Capacity (Tons)	#REF!	7.55	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	17.10	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.7	5.1	#REF!	#REF!	#REF!	92%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
83-C	Capacity (Tons)	#REF!	4.98	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	11.72	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.7	5.2	#REF!	#REF!	#REF!	90%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
83-C1	Capacity (Tons)	#REF!	7.00	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	16.16	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.7	5.3	#REF!	#REF!	#REF!	89%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
84-C1	Capacity (Tons)	#REF!	3.87	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	8.76	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.6	5.2	#REF!	#REF!	#REF!	88%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
84-C2	Capacity (Tons)	#REF!	6.61	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	15.26	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.5	5.2	#REF!	#REF!	#REF!	106%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
84-C3	Capacity (Tons)	#REF!	3.79	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	8.75	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.7	5.2	#REF!	#REF!	#REF!	90%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
84-C3	Capacity (Tons)	#REF!	8.02	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	18.52	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.5	5.2	#REF!	#REF!	#REF!	106%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
85-C1	Capacity (Tons)	#REF!	3.87	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	8.93	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.7	5.2	#REF!	#REF!	#REF!	90%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
85-C2	Capacity (Tons)	#REF!	6.62	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	15.29	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.8	5.3	#REF!	#REF!	#REF!	91%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
85-C3	Capacity (Tons)	#REF!	7.45	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	16.87	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.7	5.4	#REF!	#REF!	#REF!	87%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
88-C	Capacity (Tons)	#REF!	7.66	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	17.03	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.7	5.4	#REF!	#REF!	#REF!	87%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
90-C	Capacity (Tons)	#REF!	7.68	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	17.07	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.8	5.6	#REF!	#REF!	#REF!	86%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
90-C1	Capacity (Tons)	#REF!	9.17	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	19.65	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.7	5.4	#REF!	#REF!	#REF!	87%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
92-C	Capacity (Tons)	#REF!	7.66	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	17.03	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!

	POST ADSIL										1					
	Power (kW)	4.6	4.8	#REF!	#REF!	#REF!	96%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
73-C	Capacity (Tons)	#REF!	11.31	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	28.27	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.6	5.1	#REF!	#REF!	#REF!	90%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
81-C	Capacity (Tons)	#REF!	10.74	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	25.28	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.8	5.3	#REF!	#REF!	#REF!	91%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
82-C	Capacity (Tons)	#REF!	11.12	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	25.18	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.7	5.2	#REF!	#REF!	#REF!	90%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
83-C	Capacity (Tons)	#REF!	11.39	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	26.29	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.7	5.3	#REF!	#REF!	#REF!	89%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
85-C	Capacity (Tons)	#REF!	10.66	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	24.14	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.6	5.4	#REF!	#REF!	#REF!	1 0 4%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
85-C1	Capacity (Tons)	#REF!	12.32	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	27.38	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.5	5.2	#REF!	#REF!	#REF!	1 0 6%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
85-C2	Capacity (Tons)	#REF!	11.01	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	25.41	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.6	5.3	#REF!	#REF!	#REF!	87%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
86-C	Capacity (Tons)	#REF!	10.88	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	24.63	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.5	5.2	#REF!	#REF!	#REF!	106%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
87-C	Capacity (Tons)	#REF!	11.17	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	25.77	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.8	5.5	#REF!	#REF!		1 05 %	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
89-C	Capacity (Tons)	#REF!	11.62	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	25.35	#REF!		#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.8	5.6	#REF!		#REF!	104%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
91-C	Capacity (Tons)	#REF!	12.49	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	26.77	#REF!		#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
90-C Clean	Power (kW)	5.8	5.6	#REF!	#REF!	#REF!	1 04%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
Evap	Capacity (Tons)	#REF!	11.87	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
Lindb	EER	#REF!	25.43	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!

TABLE B-2

Copeland Compressor Test Summary at Ambient of 85 Degrees or Higher (Maximum of 1 Test Per Temperature)

EER at ARI Co	onditions		,	9.4	BTU/W-ł	1							
Condensing ur				3000	CFM (Lis	ted)							
Capacity at AR					tons	,							
Coil Area				15	sq-ft								
Predicted EER	=			7.40)								
		HVAC	Service Assi	stant				Physic	al Power a	nd Capaci	ity Measure	ments	
Test Date							Cond Air	, deg F		Cond Air			
-	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER
April 9-C1	85	57	81%	72%	#REF!	5.5	85	108	12.8	5.2	1.06	3.87	8.93
May 08-C	88	58	83%	77%	#REF!	4.7	86	108	12.2	5.4	2.19	7.66	17.03
May 08-C	90	55	83%	77%	#REF!	4.7	90	111	11.7	5.4	2.30	7.68	17.07
May 08-C	92	59	84%	78%	#REF!	4.7	95	115	11.1	5.4	2.47	7.86	17.46
			82.8%	76.0%									
POST ADSIL	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER
August 20-C	85	60	89%	81%	#REF!	4.7	84	107	12.8	5.3	2.92	10.66	24.14
August 20-C	85	65	89%	81%	#REF!	5.6	82	108	14.4	5.4	2.98	12.32	27.38
August 21-C	86	59	85%	78%	#REF!	4.6	85	108	12.8	5.3	2.98	10.88	24.63
August 10-C	87	58	92%	82%	#REF!	5.5	82	105	12.8	5.2	3.06	11.17	25.77
August 6-C	89	60	92%	87%	#REF!	5.8	89	114	13.9	5.5	2.93	11.62	25.35
August 6-C	91	60	96%	91%	#REF!	5.8	89	115	14.4	5.6	3.02	12.49	26.77
August 18-C	90	65	92%	88%	#REF!	5.8	90	115	13.9	5.6	2.99	11.87	25.43
		-	90.7%	84.0%			85.86	110.29	13.57	5.41	2.98	11.57	25.64

	(Condensing U	nit Summary	/ - Ambient (Co	ondensing		ary - ARI Conditio		
			Test Data		Per	cent Diff	erence		Test Data				P	ercent Difference)	
ΟΑΤ		SA	CU	Lit	SA/Lit	CU/Lit	SA/CU	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Estimated Degradation
	Power (kW)	5.5	5.2	#REF!	#REF!	#REF!	106%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
85-C1	Capacity (Tons)	#REF!	3.87	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	8.93	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.7	5.4	#REF!	#REF!	#REF!	87%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
88-C	Capacity (Tons)	#REF!	7.66	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	17.03	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.7	5.4	#REF!	#REF!	#REF!	87%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
90-C	Capacity (Tons)	#REF!	7.68	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	17.07	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.7	5.4	#REF!	#REF!	#REF!	87%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
92-C	Capacity (Tons)	#REF!	7.66	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	17.03	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	POST ADSIL															
	Power (kW)	4.7	5.3	#REF!	#REF!	#REF!	89%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
85-C	Capacity (Tons)	#REF!	10.66	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	24.14	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.6	5.4	#REF!	#REF!	#REF!	104%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
85-C1	Capacity (Tons)	#REF!	12.32	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	27.38	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	4.6	5.3	#REF!	#REF!	#REF!	87%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
86-C	Capacity (Tons)	#REF!	10.88	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	24.63	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.5	5.2	#REF!	#REF!	#REF!	106%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
87-C	Capacity (Tons)	#REF!	11.17	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	25.77	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.8	5.5	#REF!	#REF!	#REF!	105%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
89-C	Capacity (Tons)	#REF!	11.62	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	25.35	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
	Power (kW)	5.8	5.6	#REF!	#REF!	#REF!	104%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
91-C	Capacity (Tons)	#REF!	12.49	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	EER	#REF!	26.77	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
0-C Clean	Power (kW)	5.8	5.6	#REF!	#REF!	#REF!	1 04%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
Evap	Capacity (Tons)	#REF!	11.87	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
Evap	EER	#REF!	25.43	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!

Test at 91 Degrees August 6, 2004 3:00 P.M.

POST ADSIL

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag

Carrier 38TH060300 Split system 1991 Gainesville Toms Home unit

Phase	Volts	Amps	kW	PF
1 to 2	242	24.5	5.6	0.95
			nt Measurem	
	Generic	Cope		0500-PFV-270
Input SEER	10	_	10	
Input Cap	5	_	5	
SP		-		_
	62	-	69	
ST LP	79	-	63	
LP LT	221	-	231	
OAT	95 91	-	96 91	
ET	36		40	
SH	40	-	22	
SC	14		16	
СТ	109	-	111	
COA	18	-	21	
RAT	80	F	80	F
SAT	55	F	55	F
RAH	30%	%	30%	%
SAH	85%	%	85%	%
EI	99%	%	96%	%
CI	97%	%	91%	%
Predicted KW	5.9	kW	5.8	kW
CU Capacity E	stimates			
Ambient	8	9 F	30	5 K
CU Exhaust		5 F		9 K
Coil Length		in	01	-
Coil Width		in		
Area	15.0	0 sq-ft		
Fan CFM	5340			
Air Mass Flow	3.0	2 kg/sec		
Capacity	10.4	9 Tons		
Efficiency		7 EER		
Efficiency	20.77 EER 0.45 kW/Ton			
	0.4			

Measurement	
Number	ft/sec
1	6.7
2	6.7
3	6.1
4	5.9
5	5.5
6	5.5
7	6.1
8	6.3
9	6.6
10	5.9
11	5.3
12	5.7
13	5.1
14	5.3
15	5.7
16	5.9
17	5.5
18	7
Average	5.933

Test at 90 Degrees August 18, 2004 3:50 P.M.

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag

POST ADSIL, CLEAN EVAP Carrier 38TH060300

Split system 1991 Gainesville Toms Home unit

Delta Measuren		A	1.3.47	55
Phase	Volts	Amps	kW	PF
1 to 2	241	24.5	5.6	0.95
		ion Accieta	nt Measurem	ant
	Generic			0500-PFV-270
Input SEER	10		10	-0500-11 V-270
Input Cap	5	-	5	-
input oup				-
SP	67		67	_
ST	49		48	
LP	226		225	
LT	94		93	
OAT	89		89	
ET	39		39	
SH	11		10	Low
SC	16		16	
СТ	109		109	
COA	20		20	
RAT	82	F	82	F
SAT	53	F	53	F
RAH	40%	%	40%	%
SAH	85%	%	85%	%
EI	94%	%	92%	%
CI	96%	%	88%	%
Predicted KW	6.2	kW	5.8	kW
CU Capacity Es	-time te e			
	stimates			
Ambient	9	0 F	30)5 K
CU Exhaust	11	5 F	31	19 K
Coil Length		in		
Coil Width		in		
Area	15.	0 sq-ft		
Fan CFM	5275			
Air Mass Flow	2.9	9 kg/sec		
0	44.0	7		
Capacity Efficiency		7 Tons 3 EER		
Efficiency		3 EER 7 kW/Ton		
LINCIENCY	0.4	/ KVV/10/1		

Measurement	
Number	ft/sec
1	6
2	6
3	6.8
4	7.2
5	5.6
6	5.4
7	6.3
8	6.3
9	6.7
10	5.3
11	5
12	4.4
13	6.8
14	6.2
15	5.3
16	5.5
17	5.5
18	5.2
Average	5.861

Test at 89 Degrees August 6, 2004 3:30 P.M.

POST ADSIL

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag

Carrier 38TH060300 Split system 1991 Gainesville Toms Home unit

Delta Measurem Phase	Volts	Amps	kW	PF
1 to 2	243	24	5.5	0.94
	HVAC Serv	ice Assista	nt Measureme	<u>en</u> t
	Generic	Cope	eland 6CRN5-0	0500-PFV-270
Input SEER	10		10	
Input Cap	5		5	
SP	66		66	
ST	48		48	
LP	225		225	
LT	93		93	_
OAT	89		89	_
ET	38		38	
SH	9		9	Low
SC	16		16	_
СТ	109		109	_
COA	20		20	_
RAT	80	F	80	F
SAT	55	F	55	F
RAH	30%	г %	30%	
SAH	85%	%	85%	- ⁷⁰ %
341	0378	/0	0576	70
EI	93%	%	92%	%
CI	95%	%	87%	%
Predicted KW	6.1	kW	5.8	kW
CU Capacity Es	stimates			
Ambient	89) F	30	5 K
CU Exhaust	114	4 F	31	9 K
Coil Length		in		
Coil Width		in		
Area	15.0) sq-ft		
Fan CFM	516	5		
Air Mass Flow	2.93	3 kg/sec		
Canaaitu	11.0	2 Tons		
Capacity Efficiency		2 Tons 5 EER		
Efficiency		7 kW/Ton		
Linciency	0.4	KWW/TOTT		

Measurement	
Number	ft/sec
1	6.5
2	5.9
3	4.5
4	5.4
5	5.6
6	6.1
7	5.6
8	5.6
9	5.8
10	6.5
11	4.8
12	5
13	6.1
14	6.2
15	6.8
16	5.5
17	5.6
18	5.8
Average	5.739

Test at 87 Degrees August 10, 2004 10:50 A.M.

POST ADSIL

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag

38TH060300 Split system 1991 Gainesville Toms Home unit

Carrier

Phase	Volts	Amps	kW	PF
1 to 2	244	23	5.2	0.94
	•		•	•
	HVAC Servi	ce Assista	nt Measurem	ent
	Generic	Cope	eland 6CRN5-	0500-PFV-270
Input SEER	10		10	
Input Cap	5		5	_
				_
SP	61	-	60	_
ST	48	-	44	_
LP	201	-	204	_
LT	87	-	88	_
OAT	87	4	88	-l.
ET	34	_	34	Low
SH	13	-	10	_
SC CT	15	-	15	_
COA	102 15	-	103 15	_
CUA	15	-	15	_
RAT	76	F	76	F
SAT	59	F	59	
RAH	35%	%	35%	. %
SAH	85%	%	85%	%
0/11	0070	/0	0070	
EI	94%	%	92%	%
CI	90%	%	82%	%
Predicted KW	5.8	kW	5.5	kW
		-		
CU Capacity E	stimates			
Ambient	82	2 F	30	01 K
CU Exhaust	105	5 F	31	4 K
Coil Length		in		
Coil Width		in		
Area	15.0) sq-ft		
Fan CFM	5395			
Air Mass Flow	3.06	6 kg/sec		
Capacity	11 17	7 Tons		
Efficiency		ZEER		
Efficiency		/ kW/Ton		

Measurement	
Number	ft/sec
1	6.6
2	6.8
3	5.5
4	6.1
5	5.5
6	5.5
7	6.2
8	6.1
9	5.9
10	5.7
11	5.3
12	5.1
13	6.8
14	6.6
15	7.2
16	6.2
17	5.5
18	5.3
Average	5.994
Test at 86 Degrees August 21, 2004 11:40 A.M.

POST ADSIL

Manufacturer: Model Number: Serial Number Carrier 38TH060300 Equipment Type: Year Manufactured: Location Split system 1991 Gainesville Toms Home unit Tag

Delta Measuren		A	1.3.47	DE
Phase	Volts	Amps	kW	PF
1 to 2	241	23.4	5.3	0.95
	HVAC Servi	ce Assista	nt Measureme	ent
	Generic		eland 6CRN5-0	
Input SEER	12	7	12	7
Input Cap	5		5	
SP	61		61	
ST	42		42	
LP	208		208	
LT	91		91	
OAT	86	1	86	
ET	35		35	
SH	7		7	
SC	14		14	
СТ	105		105	
COA	19		19	
RAT	74	F	74	F
SAT	48	F	48	F
RAH	40%	%	40%	%
SAH	85%	%	85%	%
EI	88%	%	85%	%
CI	87%	%	78%	%
Predicted KW	4.9	kW	4.6	kW
CU Capacity E	stimates			
Ambient	85	F	30	зк
CU Exhaust	108			5 K
Coil Length		in	0.0	
Coil Width		in		
Area	15.0) sq-ft		
Fan CFM	5255			
Air Mass Flow	2.98	kg/sec		
		_		
Capacity		Tons		
Efficiency		BEER		
Efficiency	0.49	kW/Ton		

Measurement	
Number	ft/sec
1	6.1
2	6.8
3	6
4	5.8
5	5.6
6	5.5
7	5.4
8	5.6
9	5.2
10	6.1
11	6.3
12	5.6
13	6.5
14	6.4
15	6.4
16	5.8
17	5.4
18	4.6
Average	5.839

Test at 85 Degrees August 10, 2004 11:15 A.M.

POST ADSIL

Manufacturer:CarrierModel Number:38TH060300Serial NumberEquipment Type:Equipment Type:Split systemYear Manufactured:1991LocationGainesvilleTagToms Home unit

Delta Measuren	ant			
Phase	Volts	Amps	kW	PF
1 to 2	244	22.9	5.2	0.94
	1			
	HVAC Servi	ce Assista	nt Measureme	nt
	Generic	Cop	eland 6CRN5-0	500-PFV-270
Input SEER	10		10	
Input Cap	5		5	
SP	60		60	
ST	41		41	
LP	201		201	
LT	88		88	
OAT	85		85	
ET	33		33	Low
SH	8		8	
SC	14		14	_
СТ	102		102	_
COA	18	-	18	-
RAT	75	F	75	F
SAT	60	F	60	F
RAH	30%	%	30%	%
SAH	85%	%	85%	%
-	000/	~	000/	
EI CI	88% 85%	% %	88% 79%	% %
CI Predicted KW	5.8	‰ kW	5.5	ww
Fledicled KW	5.6	KVV	5.5	KVV
CU Capacity E	stimates			
Ambient	84	F	302	ĸ
CU Exhaust	107		315	
Coil Length		in	0.10	
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	5320			
Air Mass Flow	3.01	kg/sec		
Capacity	11 01	Tons		
Capacity	25.44			

Efficiency 25.41 EER Efficiency 0.47 kW/Ton

Measurement	
Number	ft/sec
1	6.8
2	7
3	5.7
4	5.9
5	5.9
6	6.1
7	5.7
8	5.9
9	6.1
10	6.2
11	4.9
12	5.1
13	6.8
14	6.4
15	4.9
16	5.3
17	5.5
18	6.2
Average	5.911

Test at 85 Degrees August 20, 2004 3:15 P.M.

POST ADSIL

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag

Carrier

38TH060300

Split system . 1991

Gainesville

Toms Home unit Delta Measurement Phase kW PF Volts Amps 23.5 0.95 1 to 2 242 5.4 HVAC Service Assistant Measurement Generic Copeland 6CRN5-0500-PFV-270 Input SEER 12 12 . Input Cap 5 5 SP 59 63 ST LP LT OAT ET 70 69 200 207 91 90 85 85 34 36 36 11 SH 32 SC 14 СТ 102 104 COA 18 19 RAT 83 83 SAT 53 53 RAH 37% % % 37% SAH 85% % 85% % 88% 89% ΕI % % CI 85% % 81% % Predicted KW 5.6 kW 5.6 kW CU Capacity Estimates 82 F 301 K Ambient CU Exhaust 108 F 315 K Coil Length in Coil Width in Area 15.0 sq-ft Fan CFM 5265 Air Mass Flow 2.98 kg/sec Capacity 12.32 Tons Efficiency 27.38 EER

Efficiency 0.44 kW/Ton

Measurement	
Number	ft/sec
1	5.8
2	6.2
3	6.7
4	6.8
5	5.7
6	5.3
7	5.1
8	5.5
9	5.5
10	6.1
11	6.2
12	5.1
13	6.4
14	6.8
15	6.6
16	5.5
17	5.3
18	4.7
Average	5.850

Test at 85 Degrees August 20, 2004 5:15 P.M.

POST ADSIL

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag Carrier 38TH060300 Split system 1991 Gainesville Toms Home unit

Phase	Volts	Amps	kW	PF
1 to 2	241	23.1	5.3	0.95
	HVAC Servi		nt Measurem	
	Generic	Cope		0500-PFV-270
Input SEER	12		12	
Input Cap	5		5	
SP	62	_	62	_
ST	43		43	
LP	208	_	208	_
LT	88	_	88	_
OAT	85	_	85	_
ET	35	_	35	
SH	8		8	_
SC CT	16	_	16 104	_
COA	104 19	_	104	_
CUA	19	-	19	
RAT	76	F	76	F
SAT	48	F	48	
RAH	40%	%	40%	
SAH	85%	%	85%	%
0AIT	0070	/0	0070	/0
EI	88%	%	89%	%
CI	85%	%	81%	%
Predicted KW	4.9	kW	4.7	kW
CU Capacity Es	stimates			
Ambient	84	4 F	30	2 K
CU Exhaust	107	7 F	31	5 K
Coil Length		in		
Coil Width		in		
Area	15.0) sq-ft		
Fan CFM	5150	-		
Air Mass Flow	2.92	2 kg/sec		
Capacity	10 64	Tone		
Capacity Efficiency		6 Tons 4 EER		

Measurement	
Number	ft/sec
1	6.4
2	6.2
3	5.7
4	5.5
5	5.7
6	5.7
7	5.2
8	6.2
9	5.5
10	6.1
11	5.1
12	5.1
13	6.2
14	6.4
15	6.6
16	5.1
17	5.5
18	4.8
Average	5.722

Test at 83 Degrees August 20, 2004 5:30 P.M.

POST ADSIL

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag Carrier 38TH060300 Split system 1991 Gainesville Toms Home unit

Delta Measuren Phase	Volts	Amps	kW	PF
1 to 2	242	22.9	5.2	0.94
	HVAC Serv Generic		nt Measureme eland 6CRN5-0	
Input SEER	12		12	7
Input Cap	5		5	
1	-			
SP	61		61	
ST	42		42	
LP	206		206	
LT	88		88	
OAT	83	7	83	
ET	35		35	
SH	8		8	
SC	15		15	
СТ	103		103	
COA	20		20	
RAT	76	F	76	F
SAT	48	F	48	F
RAH	40%	%	40%	%
SAH	85%	%	85%	%
El	88%	%	84%	%
CI	87%	%	78%	%
Predicted KW	4.9	kW	4.7	kW
CU Capacity E	stimates			
Amelainet	0	3 F		4.17
Ambient CU Exhaust	-	3 F 7 F		1 K
CO Exhaust	10	in in	31	5 K
Coil Length		in		
Area	15	0 sq-ft		
Fan CFM	527			
Air Mass Flow		9 kg/sec		
	2.0			
Capacity	11.3	9 Tons		
Efficiency	26.2	9 EER		
Efficiency	0.4	6 kW/Ton		

Measurement	
Number	ft/sec
1	6.8
2	6.6
3	5.8
4	5.9
5	5.8
6	5.7
7	5.5
8	6
9	5.2
10	6.4
11	6.2
12	5.3
13	6.3
14	6.4
15	6.5
16	5.4
17	5.2
18	4.5
Average	5.861

Test at 82 Degrees August 23, 2004 5:30 P.M.

POST ADSIL

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag

Carrier 38TH060300 Split system 1991 Gainesville Toms Home unit

Delta Measuren Phase	Volts	Amps	kW	PF
1 to 2	243	23.1	5.3	0.94
1102	243	20.1	5.5	0.34
	HVAC Serv	ice Assista	Int Measureme	ent
	Generic	Сор	eland 6CRN5-0	0500-PFV-270
Input SEER	12		12	
Input Cap	5		5	
		_		_
SP	66	_	66	_
ST	57	_	57	_
LP	203	_	203	_
LT	84	4	84	4
OAT	82	-	82	4
ET	38	4	38	-
SH	18	4	18	-
SC	18	-	18	-
CT	102	_	102	_
COA	21	-	21	_
RAT	80	F	80	F
SAT	52	F	52	
RAH	40%	%	40%	. %
SAH	85%	%	85%	%
		- 11		
EI	95%	%	88%	%
CI	95%	%	84%	%
Predicted KW	5	kW	4.8	kW
CU Capacity E	stimates			
Ambient	8	2 F	30	1 K
CU Exhaust	-	5 F		4 K
Coil Length		in		
Coil Width		in		
Area	15.0	0 sq-ft		
Fan CFM	515			
Air Mass Flow	2.9	2 kg/sec		
		. .		
Capacity		2 Tons		
Efficiency		8 EER 8 kW/Ton		
Efficiency	0.46			

Measurement	
Number	ft/sec
1	6.4
2	6.8
3	6.2
4	5.7
5	5.5
6	5.7
7	5.3
8	6.2
9	5.1
10	5.1
11	5.1
12	5.5
13	6.2
14	6.2
15	6.4
16	5.4
17	5.1
18	5.1
Average	5.722

Test at 81 Degrees August 20, 2004 6:40 P.M.

POST ADSIL

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag

Carrier 38TH060300 Split system 1991 Gainesville Toms Home unit

1 to 2		Amps	kW	PF
	242	22.4	5.1	0.94
			•	•
	HVAC Serv	ice Assista	nt Measurem	<u>en</u> t
	Generic	Cop	eland 6CRN5-	0500-PFV-270
Input SEER	12		12	
Input Cap	5		5	
		_		
SP	59	_	59	
ST	40		40	
LP	191	_	191	
LT	84	_	84	
OAT	81	_	81	
ET	33	_	33	
SH	6	_	6	
SC	15	_	15	
СТ	98	_	98	
COA	18	_	18	
RAT	74	F	74	F
SAT	74 46	F	74 46	F
RAH	-	F %	-	- F
SAH	40% 85%	%	40% 85%	%
ЗАП	65%	70	65%	70
EI	87%	%	84%	%
CI	85%	%	76%	%
Predicted KW	4.9	kW	4.6	- kW
Fieulcieu Kw	4.5	KVV	4.0	KVV
CU Capacity Es	stimates			
Ambient		9 F		9 K
CU Exhaust	10	2 F	31	2 K
Coil Length		in		
Coil Width		in		
Area		0 sq-ft		
Fan CFM	519			
Air Mass Flow	2.94	4 kg/sec		
o "	10.7	4 Tons		
Capacity Efficiency		BEER		

Measurement	
Number	ft/sec
1	6.6
2	6.6
3	6.1
4	5.6
5	5.8
6	5.4
7	6.2
8	5.8
9	5.6
10	6
11	4.1
12	4.9
13	6.3
14	6.3
15	6.2
16	5.9
17	5.3
18	5.1
Average	5.767

Test at 73 Degrees August 21, 2004 3:00 P.M.

POST ADSIL

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag

Carrier 38TH060300 Split system 1991 Gainesville Toms Home unit

Phase	Volts	Amps	kW	PF
1 to 2	245	21.4	4.8	0.92
			•	•
	HVAC Serv	ice Assista	Int Measurem	<u>en</u> t
	Generic	Сор	eland 6CRN5-	0500-PFV-270
Input SEER	12		12	
nput Cap	5		5	_
SP	56	_	56	_
ST	47		47	_
LP	170		170	_
LT	76		76	_
OAT	73	_	73	
ET	31		31	_
SH	16		16	
SC	15		15	
СТ	91		91	
COA	18		18	
RAT	74	F	74	F
SAT	46	F	46	F
RAH	40%	%	40%	%
SAH	85%	%	85%	%
EI	86%	%	83%	%
CI	81%	%	74%	%
Predicted KW	4.7	kW	4.6	kW
CU Capacity E	timatas			
	Sumates			
Ambient		2 F	29	5 K
CU Exhaust	9	6 F	30	9 K
Coil Length		in		
Coil Width		in		
Area	15.	0 sq-ft		
Fan CFM	523			
Air Mass Flow	2.9	6 kg/sec		
Capacity	11 2	1 Tons		
Efficiency		7 EER		
Efficiency		2 kW/Ton		

Measurement	
Number	ft/sec
1	6.3
2	7.2
3	6
4	5.9
5	5.7
6	5.5
7	6.2
8	6.3
9	6.6
10	5.5
11	5.3
12	4.3
13	5.6
14	6.2
15	6
16	5.6
17	5.2
18	5.3
Average	5.817

Appendix C

Commercial 5-Ton Split-system Tests

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38YCC060 SS Heat pur 2001 MACTEC He HP-7	•		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.3 9.3 4.67 3 3% 9.1 1.32	Btu/W-hr Btu/W-hr tons years (% degrac Btu/W-hr	(CU Only) (CU Only) led)
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	17.0 230 0.86	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1		
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.40 230 0.70	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1		
Evaporator fan data (if ap Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	plicable) 5.40 230 0.11	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1		
Calculated compressor lo Calculated condensing fa Calculated evaporator far Total calculated load for Assumptions	in load: 1 load		5.8 0.23 0.13 6.04	kW kW kW kW - Condensing side only			

Condenser Coil Assessment Overall Unit Condition New Average Х Fair Poor Coil Cleanliness Coated Clean 0.9 Dirty 0.1 Clogged Plugged Fin Condition Like New 1 Some Bent Smashed Dull/rough 0.5 Corroded Pitted Flaking

Like New

Corrosion Some Loose Many Loose

Clean Cu

Corrosion Pitting Leaks х

х

Fin-Tube Attachment

Tubes

Y-measurment Phase	Volts	Amno	kW	PF				
Phase	VOItS	Amps	KVV	PF				
3-Phase	212.0	15.7	4.5	0.78				
	kW	Difference	0.17					
Delta Measurement								
Phase	Volts	Amps	kW	PF				
1 to 2	211	15.4	3.2	0.99				
2 to 3	212	12.9	1.13	0.41				
TOTAL			4.33					
HVAC Service Assista	nt Measurment	_						
Input SEER	10							
RAT	76	F						
SAT	56 F							
RAH	25	25 %						
SAH	85	85 %						
-	050/							
EI CI	95% 92%							
		+						
Input Cap OAT	5 Tons 83 F							
OAI Predicted KW								
Predicted KW	5.80	KVV						
	CU Capacity I	Estimates						
Ambient	82	F	301	к				
CU Exhaust	99 F 310 K							
Coil Length	90 in							
Coil Width	35 in							
Area	22	sq-ft						
Measured Fan CFM	6727	•						
Air Mass Flow	3.81	kg/sec						
Capacity	10.29	Tons						
Efficiency	28.52	EER						

CU Fan CFM Calculation						
Measurement						
Number	ft/sec					
1	4.6					
2	5.5					
3	5.4					
4	5.0					
Average	5.1					

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38YCC060 SS Heat pur 2001 MACTEC H HP-7			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.3 9.3 4.67 3 3% 9.1 1.32	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	17.0 230 0.86	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.40 230 0.70	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if ap Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	plicable) 5.40 230 0.11	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Calculated compressor lo Calculated condensing fa Calculated evaporator far Total calculated load for Assumptions	in load: i load		5.8 0.23 0.13 6.04	kW kW kW kW - Condensing side only		

Condenser Coil Assessment Overall Unit Condition New Average Х Fair Poor Coil Cleanliness Coated Clean 0.9 Dirty 0.1 Clogged Plugged Fin Condition Like New 1 Some Bent Smashed Dull/rough 0.5 Corroded Pitted

Flaking

Like New

Corrosion Some Loose Many Loose

Clean Cu

Corrosion Pitting Leaks х

х

Fin-Tube Attachment

Tubes

Y-measurment Phase	Volts	Amps	kW	PF			
FildSe	VOILS	Amps	K V V	FF			
3-Phase	212.0	15.9	4.6	0.78			
		Difference	0.16				
Delta Measurement							
Phase	Volts	Amps	kW	PF			
1 to 2	212	15.8	3.3	0.99			
2 to 3	212	13.05	1.14	0.33			
TOTAL	/ _	.0.00	4.44	0.41			
HVAC Service Assista	nt Measurment						
Input SEER	10	i i					
RAT	73	F					
SAT	53 F						
RAH	24 %						
SAH	85	%					
EI	95%						
CI	93%						
Input Cap	5	Tons					
OAT	84 F						
Predicted KW	5.90	kW					
	CU Capacity E	Estimates					
Ambient	86	F	303	ĸ			
CU Exhaust	00 F 303 K 100 F 311 K						
Coil Length	90 in						
Coil Width	35						
Area		sq-ft					
Measured Fan CFM	6530	•					
Air Mass Flow		kg/sec					
Capacity	8.23	Tons					
Efficiency	22.23	EER					

CU Fan CFM Calculation						
Measurement						
Number	ft/sec					
1	4.4					
2	5.9					
3	5.2					
4	4.4					
Average	5.0					
Average	5.0					

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38YCC060 SS Heat pur 2001 MACTEC H HP-7			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.3 9.3 4.67 3 3% 9.1 1.32	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	17.0 230 0.86	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.40 230 0.70	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if ap Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	plicable) 5.40 230 0.11	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Calculated compressor lo Calculated condensing fa Calculated evaporator far Total calculated load for e Assumptions	n load: I load		5.8 0.23 0.13 6.04	kW kW kW kW - Condensing side only		

Condenser Coil Assessment Overall Unit Condition New Х Average Fair Poor Coil Cleanliness Coated Clean 0.9 Dirty 0.1 Clogged Plugged Fin Condition Like New 1 Some Bent

Smashed Dull/rough

Corroded Pitted Flaking

Like New

Corrosion Some Loose Many Loose

Clean Cu

Corrosion Pitting Leaks

Fin-Tube Attachment

Tubes

0.5

х

х

Y-measurment Phase	Volts	Amps	kW	PF			
FildSe	Voits	Апрэ	NVV	F I			
3-Phase	215.0	15.9	4.6	0.78			
	kW	Difference	0.18				
Delta Measurement							
Phase	Volts	Amps	kW	PF			
1 to 2	214	15.5	3.3	0.99			
2 to 3	215	13.23	1.12	0.40			
TOTAL			4.42				
HVAC Service Assistar	nt Measurment	_					
Input SEER	10	I					
RAT	73	F					
SAT	53 F						
RAH	30 %						
SAH	85 %						
EI	97%	ł					
CI	96%						
Input Cap	5 Tons						
OAT	86 F						
Predicted KW	5.90	kW					
	CU Capacity I	Estimates					
Ambient	86	F	303	к			
CU Exhaust	100 F 311 K						
Coil Length	90 in						
Coil Width	35 in						
Area	22	sq-ft					
Measured Fan CFM	5873						
Air Mass Flow		kg/sec					
Capacity		Tons					
Efficiency	20.09	EER					

CU Fan CFM Calculation					
Measurement					
Number	ft/sec				
1	4.3				
2	5.4				
3	3.8				
4	4.4				
Average	4.5				

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38YCC060 SS Heat pur 2001 MACTEC H HP-7			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.3 9.3 4.67 3 3% 9.1 1.32	Btu/W-hr Btu/W-hr tons years (% degrac Btu/W-hr	(CU Only) (CU Only) led)
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	17.0 230 0.86	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1		
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.40 230 0.70	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1		
Evaporator fan data (if ap Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	plicable) 5.40 230 0.11	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1		
Calculated compressor lo Calculated condensing fa Calculated evaporator fan Total calculated load for e Assumptions	n load: load		5.8 0.23 0.13 6.04	kW kW kW kW - Condensing side only			

Condenser Coil Assessment Overall Unit Condition New Х Average Fair Poor Coil Cleanliness Coated Clean 0.9 Dirty 0.1 Clogged Plugged Fin Condition Like New 1 Some Bent Smashed Dull/rough 0.5 Corroded Pitted Flaking Fin-Tube Attachment Like New х Corrosion

Some Loose Many Loose

Clean Cu

Corrosion Pitting Leaks х

3.2% Performance Degradation

Y-measurment							
Phase	Volts	Amps	kW	PF			
3-Phase	212.0	13.5	4.0	0.82			
	kW	Difference	0.61				
Delta Measurement							
Phase	Volts	Amps	kW	PF			
1 to 2	212	16.1	3.4	0.99			
2 to 3	212	13.6	1.24	0.43			
TOTAL	212	10.0	4.64	0.40			
HVAC Service Assistant Measurment							
Input SEER	10	Ī					
RAT	74	F					
SAT	54 F						
RAH	24	24 %					
SAH	85	%					
		Ī					
EI	96%	I					
CI	94%	I					
Input Cap	5	Tons					
OAT	87	F					
Predicted KW	5.90	kW					
	CU Capacity I	Estimates					
		_					
Ambient	87 F 304 K						
CU Exhaust	103 F 313 K 90 in						
Coil Length							
Coil Width	35						
Area Measured Fan CFM	22 6956	sq-ft					
Air Mass Flow		kg/sec					
Capacity		Tons					
Efficiency	25.90						

CU Fan CFM Calculation							
Measurement							
Number	ft/sec						
1	5.8						
2	5.8						
3	4.8						
4	4.8						
Average	5.3						

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38YCC060 SS Heat pu 2001 MACTEC H HP-7			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.3 9.3 4.67 3 3% 9.1 1.32	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	17.0 230 0.86	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.40 230 0.70	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if ap Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	pplicable) 5.40 230 0.11	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Calculated compressor lo Calculated condensing fa Calculated evaporator far Total calculated load for Assumptions	an load: n load		5.8 0.23 0.13 6.04	kW kW kW kW - Condensing side only		

Condenser Coil Assessment Overall Unit Condition New Average Х Fair Poor Coil Cleanliness Coated Clean 0.9 Dirty 0.1 Clogged Plugged Fin Condition Like New 1 Some Bent Smashed Dull/rough 0.5 Corroded Pitted Flaking

Like New

Corrosion Some Loose Many Loose

Clean Cu

Corrosion Pitting Leaks х

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Fin-Tube Attachment

Tubes

Y-measurment Phase	Valta	A	1414/	PF				
Phase	Volts	Amps	kW	PF				
3-Phase	213.0	13.7	4.0	0.80				
		/ Difference	0.6					
Delta Measurement								
Phase	Volts	Amps	kW	PF				
1 to 2	212	16.3	3.4	0.99				
2 to 3	213	13.7	1.2	0.41				
TOTAL			4.60					
HVAC Service Assista		т						
Input SEER	10	•						
RAT	73 F							
SAT	53 F							
RAH		%						
SAH	85	%						
EI	95%	ł						
CI	93%	1						
Input Cap	5	Tons						
OAT .	88 F							
Predicted KW	5.90							
	CU Capacity I	Estimates						
		_						
Ambient	88 F 304 K							
CU Exhaust	102 F 312 K							
Coil Length	90 in							
Coil Width	35 in							
Area	22 sq-ft							
Measured Fan CFM	6628							
Air Mass Flow		kg/sec						
Capacity Efficiency	8.35 21.78	8.35 Tons						

CU Fan CFM Calculation						
surement						
umber ft/se	ec					
1 5.4	Ļ					
2 5.4	-					
3 4.4	ł					
4 5.0)					
verage 5.1						
1 5.4 2 5.4 3 4.4 4 5.0	 					

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38YCC060 SS Heat pur 2001 MACTEC H HP-7			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.3 9.3 4.67 3 % 9.1 1.32	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	17.0 230 0.86	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.40 230 0.70	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if ap Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	plicable) 5.40 230 0.11	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Calculated compressor lo Calculated condensing fa Calculated evaporator far Total calculated load for e Assumptions	n load: 1 load		5.8 0.23 0.13 6.04	kW kW kW kW - Condensing side only		

Condenser Coil Assessment Overall Unit Condition New Х Average Fair Poor Coil Cleanliness Coated Clean 0.9 Dirty 0.1 Clogged Plugged Fin Condition Like New 1 Some Bent Smashed Dull/rough 0.5 Corroded Pitted Flaking Fin-Tube Attachment Like New х Corrosion Some Loose

Many Loose

Clean Cu

Corrosion Pitting Leaks х

3.2% Performance Degradation

Y-measurment Phase	Volts	Amps	kW	PF		
Thubb	Volto	7 unpo				
3-Phase	213.0	13.8	4.1	0.82		
	kW	Difference	0.54			
Delta Measurement						
Phase	Volts	Amps	kW	PF		
1 to 2	213	16.15	3.4	0.99		
2 to 3	213	13.8	1.26	0.43		
TOTAL	•		4.66			
HVAC Service Assista	nt Measurment	_				
Input SEER	10					
RAT	74 F					
SAT	54 F					
RAH	28					
SAH	85	%				
EI	97%					
CI	97%					
Input Cap	5	Tons				
OAT	88	F				
Predicted KW	6.00	kW				
	CU Capacity E	Estimates				
Ambient	87	F	304	ĸ		
CU Exhaust	103	313				
Coil Length	90 in					
Coil Width	35 in					
Area	22 sq-ft					
Measured Fan CFM	6891					
Air Mass Flow		kg/sec				
Capacity		Tons				
Efficiency	25.55	EER				

CU Fan CFM Calculation							
Measurement							
Number	ft/sec						
1	5.4						
2	6.0						
3	4.6						
4	5.0						
Average	5.3						

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38YCC060 SS Heat pur 2001 MACTEC H HP-7			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.3 9.3 4.67 3 3% 9.1 1.32	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	17.0 230 0.86	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.40 230 0.70	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if ap Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	plicable) 5.40 230 0.11	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Calculated compressor lo Calculated condensing fa Calculated evaporator far Total calculated load for o Assumptions	n load: 1 load		5.8 0.23 0.13 6.04	kW kW kW kW - Condensing side only		

Condenser Coil Assessment Overall Unit Condition New Х Average Fair Poor Coil Cleanliness Coated Clean 0.9 Dirty 0.1 Clogged Plugged Fin Condition Like New 1 Some Bent Smashed Dull/rough 0.5 Corroded Pitted Flaking Fin-Tube Attachment Like New х Corrosion

Some Loose Many Loose

Clean Cu

Corrosion Pitting Leaks х

3.2% Performance Degradation

Y-measurment								
Phase	Volts	Amps	kW	PF				
3-Phase	213.0	16.4	4.8	0.79				
5-1 Hase		Difference	0.16	0.75				
Delta Measurement								
Phase	Volts	Amps	kW	PF				
1 to 2	214	16.1	3.4	0.99				
2 to 3	214	13.8	1.24	0.42				
TOTAL			4.64					
HVAC Service Assist		T						
Input SEER	10	•						
RAT		74 F						
SAT	54 F							
RAH		26 %						
SAH	85	85 %						
-	0.00/							
El	96%	+						
	95%							
Input Cap OAT		Tons						
• ····	89							
Predicted KW	6.00	6.00 kW						
	CU Capacity I	Estimates						
Ambient	90	F	305	к				
CU Exhaust	105 F 314 K							
Coil Length	90 in							
Coil Width	35	in						
Area	22	sq-ft						
Measured Fan CFM		7416						
Air Mass Flow	4.20	kg/sec						
Capacity		Tons						
Efficiency	25.89	EER						

CU Fan CFM Calculation						
Measurement						
Number	ft/sec					
1	5.6					
2	6.1					
3	4.9					
4	6.0					
Average	5.7					

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38YCC060 SS Heat pur 2001 MACTEC H HP-7			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.3 9.3 4.67 3 3% 9.1 1.32	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	17.0 230 0.86	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.40 230 0.70	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if ap Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	plicable) 5.40 230 0.11	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Calculated compressor lo Calculated condensing fa Calculated evaporator far Total calculated load for Assumptions	in load: i load		5.8 0.23 0.13 6.04	kW kW kW kW - Condensing side only		

Condenser Coil Assessment Overall Unit Condition New Average Х Fair Poor Coil Cleanliness Coated Clean 0.9 Dirty 0.1 Clogged Plugged Fin Condition Like New 1 Some Bent Smashed Dull/rough 0.5 Corroded Pitted Flaking Fin-Tube Attachment Like New х Corrosion

Some Loose Many Loose

Clean Cu

Corrosion Pitting Leaks х

3.2% Performance Degradation

Y-measurment Phase	Volts	Amps	kW	PF			
1 Hubb	Volto	7 anpo					
3-Phase	213.0	16.7	5.0	0.8			
Delta Measurement							
Phase	Volts	Amps	kW	PF			
1 to 2	212	16.5	3.5	0.99			
2 to 3	212	14.1	1.31	0.44			
TOTAL							
HVAC Service Assista	nt Measurment	-					
Input SEER	10	•					
RAT	76						
SAT	56 F						
RAH	25 %						
SAH	85	%					
EI	98%	ł					
CI	98%	1					
Input Cap	5	Tons					
OAT	92	F					
Predicted KW	6.00	kW					
	CU Capacity I	Estimates					
Ambient	94	F	308	к			
CU Exhaust	110	-	316				
Coil Length		in	210				
Coil Width	35	in					
Area	22	sq-ft					
Measured Fan CFM	8170	•					
Air Mass Flow	4.63	kg/sec					
Capacity	11.76	Tons					
Efficiency	29.35	EER					

CU Fan CFM Calculation							
ft/sec							
5.9							
6.9							
6.7							
5.4							
6.2							

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38YCC060 SS Heat pur 2001 MACTEC He HP-7	•		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.3 9.3 4.67 3 0% 9.4 1.28	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	17.0 230 0.86	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.40 230 0.70	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if ap Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	5.40 5.40 230 0.11	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Calculated compressor lo Calculated condensing fa Calculated evaporator far Total calculated load for Assumptions	an load: n load		5.8 0.23 0.13 6.04	kW kW kW kW - Condensing side only		

Condenser Coil Assessment Overall Unit Condition New X Average Fair Poor Coil Cleanliness Coated Clean 1 Dirty 0 Clogged Plugged Fin Condition

Like New

Like New

Corrosion Some Loose Many Loose

Clean Cu

Corrosion Pitting Leaks

Fin-Tube Attachment

Tubes

Some Bent Smashed Dull/rough Corroded Pitted Flaking 1

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Y-measurment Phase	Volts	Amps	kW	PF		
3-Phase	213.0	16.0	4.8	0.81		
	kW	Difference	0.18			
Delta Measurement						
Phase	Volts	Amps	kW	PF		
1 to 2	212	16.1	3.4	0.99		
2 to 3	213	13.9	1.22	0.41		
TOTAL			4.62			
HVAC Service Assista	nt Measurment	_				
Input SEER	10					
RAT	76 F					
SAT	56 F					
RAH	34 %					
SAH	85 %					
EI	98%					
CI	94%					
Input Cap	5	Tons				
OAT	89					
Predicted KW	5.80					
	CU Capacity I	Estimates				
Ambient	87	F	304	к		
CU Exhaust	105 F 314 K					
Coil Length	90					
Coil Width	35					
Area		sq-ft				
Measured Fan CFM	8695	•				
Air Mass Flow	4.92	kg/sec				
Capacity		Tons				
Efficiency	36.59	EER				

CU Fan CFM Calculation							
ft/sec							
6.8							
7.3							
7.0							
5.4							
6.6							

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38YCC060 SS Heat pur 2001 MACTEC He HP-7	•		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.3 9.3 4.67 3 0% 9.4 1.28	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	17.0 230 0.86	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.40 230 0.70	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if ap Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	5.40 5.40 230 0.11	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Calculated compressor lo Calculated condensing fa Calculated evaporator far Total calculated load for Assumptions	an load: n load		5.8 0.23 0.13 6.04	kW kW kW kW - Condensing side only		

Condenser Coil Assessment Overall Unit Condition New X Average Fair Poor Coil Cleanliness

	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	1
	Dirty	0
	Clogged	
	Plugged	
Fin Condition		
	Like New	1
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	х
	Corrosion	
	Pitting	
	Leaks	

Y-measurment							
Phase	Volts	Amps	kW	PF			
3-Phase	213.0	15.6	4.5	0.79			
	kV	/ Difference	0.04				
Delta Measurement							
Phase	Volts	Amps	kW	PF			
1 to 2	212	15.6	3.3	0.99			
2 to 3	213	13.3	1.16	0.41			
TOTAL			4.46				
HVAC Service Assista		-					
Input SEER	10						
RAT	74 F						
SAT	54 F						
RAH	40 %						
SAH	85	%					
El	96% 95%						
•••		Tons					
Input Cap		-					
OAT		F					
Predicted KW	5.90	kW					
	CU Capacity	Estimates					
Ambient	86	F	303	к			
CU Exhaust	101 F 311 K						
Coil Length	90) in					
Coil Width	35	i in					
Area	22	sq-ft					
Measured Fan CFM	7908	3					
Air Mass Flow		kg/sec					
Capacity		Tons					
Efficiency	28.72	EER					

CU Fan CFM Calculation							
Measurement							
Number	ft/sec						
1	5.5						
2	6.8						
3	5.9						
4	5.9						
Average	6.0						

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38YCC060 SS Heat pur 2001 MACTEC He HP-7	•		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.3 9.3 4.67 3 0% 9.4 1.28	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	17.0 230 0.86	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.40 230 0.70	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if ap Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	5.40 5.40 230 0.11	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Calculated compressor lo Calculated condensing fa Calculated evaporator far Total calculated load for Assumptions	an load: n load		5.8 0.23 0.13 6.04	kW kW kW kW - Condensing side only		

Condenser Coil Assessment Overall Unit Condition New X Average Fair Poor Coil Cleanliness Coated Clean 1 Dirty 0 Clogged Plugged Fin Condition

Like New

Like New

Corrosion Some Loose Many Loose

Clean Cu

Corrosion Pitting Leaks

Fin-Tube Attachment

Tubes

Some Bent Smashed Dull/rough Corroded Pitted Flaking 1

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0.0% Performance Degradation

Y-measurment							
Phase	Volts	Amps	kW	PF			
3-Phase	212.0	16.1	4.8	0.81			
	kW	Difference	0.15				
Delta Measurement							
Phase	Volts	Amps	kW	PF			
1 to 2	211	16.2	3.4	0.99			
2 to 3	211	13.8	1.25	0.99			
TOTAL	212	10.0	4.65	0.40			
HVAC Service Assista	nt Measurment						
Input SEER	10	Ī					
RAT	73 F						
SAT	53 F						
RAH	28	%					
SAH	85 %						
		Ĩ					
El	99%	Ι					
CI	96%						
Input Cap	5	Tons					
OAT	89	F					
Predicted KW	5.90	kW					
	CU Capacity I	Estimates					
Ambient	07	-	204	K			
Ampient CU Exhaust	87 F 304 K						
Coil Length	103 F 313 K 90 in						
Coil Length		in					
Area		sq-ft					
Measured Fan CFM	7777						
Air Mass Flow		kg/sec					
Capacity		Tons					
Efficiency	28.90	EER					

CU Fan CFM Calculation Measurement Number ft/sec 1 5.5 2 6.8 3 5.9 4 5.5 Average 5.9

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38YCC060 SS Heat pur 2001 MACTEC He HP-7	•		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.3 9.3 4.67 3 0% 9.4 1.28	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	17.0 230 0.86	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.40 230 0.70	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if ap Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	pplicable) 5.40 230 0.11	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Calculated compressor lo Calculated condensing fa Calculated evaporator far Total calculated load for Assumptions	an load: n load		5.8 0.23 0.13 6.04	kW kW kW kW - Condensing side only		

Condenser Coil Assessment Overall Unit Condition New X Average Fair Poor Coil Cleanliness Coated Clean 1 Dirty 0 Clogged Plugged Fin Condition

	Clean	
	Dirty	0
	Clogged	
	Plugged	
Fin Condition	00	
	Like New	1
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Attac	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

Y-measurment							
Phase	Volts	Amps	kW	PF			
3-Phase	214.0	16.4	4.9	0.80			
	kW	Difference	0.6				
Delta Measurement							
Phase	Volts	Amps	kW	PF			
1 to 2	211	15.1	3.2	0.99			
2 to 3	213	12.7	1.1	0.41			
TOTAL			4.30				
HVAC Service Assist		.					
Input SEER	10	•					
RAT	76	+					
SAT	56 F						
RAH		29 %					
SAH	85	%					
EI	94%	ł					
CI	94%	•					
Input Cap		Tons					
OAT	82						
Predicted KW	5.80						
	5.60	TIZAA					
	CU Capacity I	Estimates					
Ambient	84	F	302	к			
CU Exhaust	99	F	310	к			
Coil Length	90	in					
Coil Width	35	in					
Area	22	sq-ft					
Measured Fan CFM	7481						
Air Mass Flow		kg/sec					
Capacity		Tons					
Efficiency	28.18	EER					

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	5.8
2	6.4
3	5.4
4	5.2
Average	5.7

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38YCC060 SS Heat pu 2001 MACTEC H HP-7			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.3 9.3 4.67 3 0% 9.4 1.28	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	17.0 230 0.86	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.40 230 0.70	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if ap Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	pplicable) 5.40 230 0.11	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Calculated compressor lo Calculated condensing fa Calculated evaporator far Total calculated load for Assumptions	an load: n load		5.8 0.23 0.13 6.04	kW kW kW kW - Condensing side only		

Condenser Coil Assessment Overall Unit Condition New X Average Fair Poor Coil Cleanliness Coated Clean 1 Dirty 0 Clogged Plugged Fin Condition

Like New

Like New

Corrosion Some Loose Many Loose

Clean Cu

Corrosion Pitting Leaks

Fin-Tube Attachment

Tubes

Some Bent Smashed Dull/rough Corroded Pitted Flaking 1

х

х

0.0% Performance Degradation	0.0%	Performance	Degradation
------------------------------	------	-------------	-------------

FLUKE METER MEAS	SURMENTS			
Y-measurment				
Phase	Volts	Amps	kW	PF
3-Phase	214.0	16.4	4.9	0.80
	kW	Difference	0.29	
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	213	16.1	3.4	0.99
2 to 3	214	13.7	1.21	0.41
TOTAL			4.61	
HVAC Service Assista		T		
Input SEER	10			
RAT	74	-		
SAT	54			
RAH		%		
SAH	85	%		
EI	99%			
CI	98%	+		
Input Cap		Tons		
OAT	91			
Predicted KW	5.90	•		
	CU Capacity I	Estimates		
		_		
Ambient	90		305	
CU Exhaust	105		314	К
Coil Length	90			
Coil Width	35			
Area		sq-ft		
Measured Fan CFM	8006			
Air Mass Flow		kg/sec		
Capacity		Tons		
Efficiency	28.13	EEK		

CU Fan CFM Calculation				
Measurement				
Number	ft/sec			
1	6.2			
2	7.1			
3	6			
4	5.1			
Average	6.1			

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38YCC060 SS Heat pur 2001 MACTEC He HP-7	•		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.3 9.3 4.67 3 0% 9.4 1.28	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	17.0 230 0.86	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.40 230 0.70	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if ap Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	pplicable) 5.40 230 0.11	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Calculated compressor lo Calculated condensing fa Calculated evaporator far Total calculated load for Assumptions	an load: n load		5.8 0.23 0.13 6.04	kW kW kW kW - Condensing side only		

Condenser Coil Assessment Overall Unit Condition New X Average Fair Poor Coil Cleanliness Coated Clean 1 Dirty 0 Clogged Plugged Fin Condition

Like New

Like New

Corrosion Some Loose Many Loose

Clean Cu

Corrosion Pitting Leaks

Fin-Tube Attachment

Tubes

Some Bent Smashed Dull/rough Corroded Pitted Flaking 1

х

х

Y-measurment				
Phase	Volts	Amps	kW	PF
3-Phase	214.0	15.9	4.7	0.80
	kW	Difference	0.13	
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	213	15.9	3.4	0.99
2 to 3	214	13.22	1.17	0.41
TOTAL			4.57	
HVAC Service Assista	nt Measurment	-		
Input SEER	10	•		
RAT	76	F		
SAT	56			
RAH		%		
SAH	85	%		
EI	97%			
EI CI	97%	•		
Input Cap		Tons		
OAT	88			
Predicted KW	5.80	•		
	5.60			
	CU Capacity I	Estimates		
Ambient	90	F	305	к
CU Exhaust	105	F	314	к
Coil Length	90	in		
Coil Width	35	in		
Area	22	sq-ft		
Measured Fan CFM	8138			
Air Mass Flow		kg/sec		
Capacity		Tons		
Efficiency	28.84	EER		

CU Fan CFM Calculation				
Measurement				
Number	ft/sec			
1	6.7			
2	6.3			
3	5.9			
4	5.9			
Average	6.2			

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38YCC060 SS Heat pur 2001 MACTEC He HP-7	•		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.3 9.3 4.67 3 0% 9.4 1.28	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	17.0 230 0.86	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.40 230 0.70	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if ap Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	pplicable) 5.40 230 0.11	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Calculated compressor lo Calculated condensing fa Calculated evaporator far Total calculated load for Assumptions	an load: n load		5.8 0.23 0.13 6.04	kW kW kW kW - Condensing side only		

Condenser Coil Assessment Overall Unit Condition New X Average Fair Poor Coil Cleanliness Coated Clean 1 Dirty 0 Clogged Plugged Fin Condition

Like New

Like New

Corrosion Some Loose Many Loose

Clean Cu

Corrosion Pitting Leaks

Fin-Tube Attachment

Tubes

Some Bent Smashed Dull/rough Corroded Pitted Flaking 1

х

х

FLUKE METER MEAS	URMENTS						
Y-measurment							
Phase	Volts	Amps	kW	PF			
3-Phase	212.0	15.9	4.7	0.80			
	kW	Difference	0.13				
Delta Measurement							
Phase	Volts	Amps	kW	PF			
1 to 2	212	16	3.4	0.99			
2 to 3	212	13.28	1.17	0.41			
TOTAL			4.57				
HVAC Service Assista	nt Measurment	_					
Input SEER	10						
RAT	76	F					
SAT	56 F						
RAH	29 %						
SAH	85 %						
EI	97%						
CI	93%						
Input Cap	-	Tons					
OAT	88 F						
Predicted KW	5.80 kW						
	CU Capacity I	Estimates					
Ambient	89	F	305	к			
CU Exhaust	104	313					
Coil Length	90 in						
Coil Width	35 in						
Area	22 sq-ft						
Measured Fan CFM	7186						
Air Mass Flow	4.07 kg/sec						
Capacity		Tons					
Efficiency	25.47 EER						

CU Fan CFM Calculation					
Measurement					
Number	ft/sec				
1	4.9				
2	5.0				
3	6.5				
4	5.5				
Average	5.5				

TABLE 4-5

Unit 2 Baseline Study

Generic Compressor Test Summary-All Temperatures

Tost Data				
		HVAC Service Assistant		
Predicted E	ER =	9.07 BTU/W-h		
Coil Area		22 sq-ft		
Capacity at	ARI	4.67 tons		
Condensing unit CFM		3300 CFM (Listed)		
EER at AR	I Conditions	9.27 BTU/W-h		

	Predicted				BIU/W-h							Dhycical Dr	wor and Ca	nacity mos	curmonto		
Test Date			HVAC Service Assistant					Physical Power and Capacity me Cond Air, deg F Cond Air				Suments					
		OAT	EWB	El	CI	EER	Сар	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons	EER	cfm adj	EER Adj
	24-May	92	57	98%	98%	8.83	4.24	5.60	94	110	8.9	4.81	4.63	11.76	29.35	0.38	11.15
	1-Jul	89	55	96%	95%	9.01	4.16	5.60	90	105	8.3	4.64	4.20	10.01	25.89	0.38	9.84
	1-Jul	88	55	97%	97%	9.24	4.26	5.60	87	103	8.9	4.66	3.90	9.92	25.55	0.38	9.71
PRE	1-Jul	88	54	95%	93%	9.04	4.08	5.51	88	102	7.8	4.60	3.75	8.35	21.78	0.38	8.28
FIL	1-Jul	87	54	96%	94%	9.27	4.14	5.51	87	103	8.9	4.64	3.94	10.02	25.90	0.38	9.84
	1-Jul	86	56	97%	96%	9.52	4.26	5.51	86	100	7.8	4.42	3.33	7.40	20.09	0.38	7.63
	1-Jul	84	54	95%	93%	9.58	4.15	5.51	86	100	7.8	4.44	3.70	8.23	22.23	0.38	8.45
	1-Jul	83	55	95%	92%	9.73	4.13	5.42	82	99	9.4	4.33	3.81	10.29	28.52	0.38	10.84
		Averages		96%	95%						8.47		3.91		24.92	0.38	9.47
	16-Aug	91	57	99%	98%	9.05	4.26	5.51	90	105	8.3	4.61	4.53	10.81	28.13	0.38	10.69
	16-Aug	89	54	99%	96%	9.28	4.20	5.51	87	103	8.9	4.65	4.40	11.20	28.90	0.38	10.98
	11-Aug	89	59	98%	94%	9.24	4.13	5.42	87	105	10.0	4.62	4.92	14.09	36.59	0.38	13.90
POST	11-Aug	85	59	96%	95%	9.60	4.25	5.51	86	101	8.3	4.46	4.48	10.67	28.72	0.38	10.91
	31-Aug	82	57	94%	90%	9.80	4.07	5.80	84	99	8.3	4.3	4.24	10.10	28.18	0.38	10.71
	31-Aug	88	54	97%	93%	9.23	4.08	5.80	90	105	8.3	4.57	4.61	10.98	28.84	0.38	10.96
	31-Aug	88	57	97%	93%	9.26	4.10	5.80	89	104	8.3	4.57	4.07	9.70	25.47	0.38	9.68
		Averages Change		97% 1.1%	94% -0.64%						8.65 2.11%		4.47 14.29%		29.26 17.45%	0.38	11.12 17.45%

Appendix D

Eckerd's and MACTEC

Eckerd Rooftop Units

Two rooftop units on an Eckerd drug store in Clearwater, Florida were instrumented by ADSIL, prior to a routine condenser cleaning (per standard operating procedures), and followed later by cleaning and coating using the Adsil treatment. The testing/cleaning schedule for the units was as follows:

Date	Event
April 27, 2004	Units instrumented and data collection begins
May 5, 2004 (8:00 AM – 4:00 PM)	Condensers cleaned using standard methods (per SOP)
May 19, 2004 (9:30 AM – 2:00 PM)	Condensers cleaned and coated using ADSIL treatment
May 31, 2004	Data collection ends

Eight data points were collected at 10-minute intervals for each unit. Data collected included refrigerant temperature entering and leaving the condenser, refrigerant suction and discharge pressures, ambient temperature, and current for each of the three phases on the unit's main electrical service. The current measurements were converted to power (assuming a constant power factor of 0.85) by:

$$Power(kW) = \frac{208 \times \sqrt{3} \times Avg(Ia, Ib, Ic) \times 0.85}{1000}$$

Figure 1 displays the observed operating patterns of the two units during the monitoring period. The units displayed two typical operating powers near 8 kW and 15 kW, corresponding to first and second stage cooling operation. With the exception of a few hours where unit #2 operated the fan without any cooling¹, the units operated the first stage compressor nearly continuously. The second stage compressor is observed to cycle on during the afternoon hours, coincident with the peak cooling load.

The bottom plots are shade plots of the unit power. On the shade plot each day is represented by a vertical strip consisting of 144 10-minute data records. Periods of high power consumption are shown by darker shades of grey. Periods of missing data (such as where the units were being cleaned and coated by Adsil) are shown in bright white. The shade plot reveals that unit #2 operated in second stage cooling more frequently than unit #1. Periods where unit #1 was observed to be off (May 4-7 and May 27-30, midnight to noon) are readily observed.

¹ In mid-May there were several hours with an operating power of 3 kW for this unit, a typical value for the supply fan on this size unit.



Figure 1. Rooftop Unit Operating Patterns

The following figure displays the observed condenser performance across the three periods. The data were averaged to hourly values to reduce the amount of scatter. No significant difference was observed between any of the periods. Most significant is the lack of any impact on either the saturated discharge temperature or liquid temperature leaving the condenser. These two parameters tend to have the largest impact on any increase in efficiency from condenser treatment.

Also shown is the saturated suction temperature variation with ambient. Again, little change can be observed between the three periods, indicating that no change would have occurred in the supply air temperature.



Figure 2. Condenser Performance - Unit 1



Figure 3. Condenser Performance - Unit 2

Figure 4 and Figure 5 displays the daily energy variation with ambient temperature for each unit. The high degree of cycling operation between first and second stage cooling observed required summing the power data collected to daily data for analysis purposes.

To assess the impact of the Adsil coating on the daily energy, a multiple linear regression (MLR) model was developed. The model incorporated a dummy variable to describe the impact of the coating (dummy = 1 for the Adsil period, dummy = 0 for the baseline period). Also shown on the plot are the t-ratios for the regression coefficients. The t-ratio describes the statistical significance of each coefficient. Coefficients with t-ratio with an absolute value greater than 2.0 indicate that the coefficients are statistically significant at the 95% confidence interval.



Figure 4. Unit 1 Daily Energy Variation with Ambient



Figure 5. Unit 2 Daily Energy Variation with Ambient

The regression coefficients indicate that after the Adsil coating was applied, compared to the baseline, unit #1 used 35.6 less kilowatt-hours per day and unit #2 used 46.8 less kilowatt-hours per day. Annual savings were determined by applying the regression model to daily temperature data for Tampa, FL from the Department of Energy typical meteorological year data set (TMY2). Savings calculations assume no cooling operation when the average daily temperature is less than 50°F (15 days/year). Unfortunately, the t-ratio for the dummy variable (the savings coefficient) was not greater than 2.0, indicating that the savings were not statistically significant.

Table 1. Annual Impact From Adsil Coating

Unit	Baseline Energy Use (kWh/year)	Energy Use After Adsil Coating (kWh/year)	Savings (kWh/year / %)	Statistically Significant (t-ratio > 2.0)
Unit #1	384,402	371,942	12,460 / 3.2%	No
Unit #2	439,142	422,753	16,389 / 3.9%	No

A visual inspection of the daily energy data indicates that the standard cleaning had no impact on the energy consumption of the units. In fact, for unit #2 energy consumption appears to have slightly increased.

Appendix E

Honeywell Service Assistant



ASHRAE's Most Innovative Product of the Year 2003

HVAC Service Provider Multi-Unit Facility Manager HVAC Service Assistant Virtual Mechanic

HVAC Service Asistant







Highlights

- 2003 AHR Expo Innovation Award Winner Use award winning technology to increase sales and improve productivity.
- First Efficiency Estimating Tool The Service Assistant's patented technology instantly displays the energy efficiency of a/c units. This revolutionary index identifies energy savings opportunities and provides objective documentation of the benefits.
- Honeywell provides worldwide distribution The Service Assistant complements a family of Honeywell products designed to reduce HVAC operating costs through energy savings in commercial buildings.
Service Assistant Features

- Automated objective performance data collection
- Integrated fault detection (service needed? y/n) and diagnostics (what service?)
- Record and display the raw data and its interpretations on the PDA and its designated database
- Displays efficiency and capacity estimates with potential energy savings (more...)
- Estimates indoor air flow in cfm/ton
- Create customized task lists to standardize service procedures and field data collection
- Allows technicians to note required follow up work
- Technician can print for customer a UNIT REPORT CARD (see example) on site (optional printer required)
- Equipment applications include:
 - O Packaged equipment (including rooftop units)
 - O Split systems (including standard residential a/c units)
 - O Full diagnostics of cooling only and heat pumps operating in cooling mode
- ServiceAssistantOnline Web Service Communicate to clients, management, and end users recent service activity and resulting benefits (more...)

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Features in Development

- Heat pump in heating mode diagnostics
- Diagnose units under cooler outdoor temperatures, helping to extend your cooling service/sales season
- Improve efficiency through sophisticated service recommendations when diagnostics indicates "No Faults Detected"

.....

Accessories

Single and two stage sensor arrays expand the Service Assistant's measurement capabilities.

Product Demonstrations

- Download the Service Assistant Palm application running in an emulator on your PC (7MB) Run a full featured demonstration on your PC with demo data.
- Inquire about a live Service Assistant demonstration
 - O Visit our office for a demonstration of the Service Assistant directly for the development team!
 - O Print this Honeywell cut sheet for a clear definition of the product and ask your local Honeywell distribution or sales representative for a demonstration.
 - O Contact Field Diagnostic Services for help arranging for a product demonstration.

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Free Downloads

- Download for FREE... SACalc a refrigeration cycle analysis Palm Pilot application
 - O Easily enter pressure and temperature measurements ...like using a hand calculator.
 - O Performance indices are calculated including evaporating and condensing temperatures, condensing temperature over ambient, superheat and subcooling based on integrated refrigerant property tables.
 - O Superheat for fixed orifice units is evaluated based on entered data.

More Information

- Honeywell Catalog page for the Service Assistant See Honeywell's presentation of Service Assistant benefits and features. Download cut sheets and instructions that are
 provided with the tool. Get list prices.
- American Express and Honeywell team up to provide leasing for the Service Assistant Easily achieve positive cash flow in the first month with the Service Assistant's leasing option.
- Honeywell HVAC Service Assistant product cut sheet The cut sheet is a compact (2 sides of 1 page) full color description of the product.
- Refrigeration Cycle Diagnostics Overview This detailed document explains the technical underpinnings of how the Service Assistant analyzes data to provide diagnostics. It
 includes a discussion of the more challenging aspects of data interpretation.
- Estimating Efficiency and Capacity with the Service Assistant This Q&A document answers common questions about the Service Assistant's proprietary patented efficiency and capacity estimator technology.
- Technology Report A Tool for Reducing Electrical Power Demand and Energy Consumption This technology report describes how the Service Assistant is used to reduce
 electric power demand and consumption. It is helpful for utility program managers and facility managers interested is applying the Service Assistant's patented technology
 to cost effectively reduce utility bills.
- User Experiences with the Honeywell Service Assistant These testimonials describe how our customers use the Service Assistant to create value in their organizations.
- ServiceAssistantOnline web service helps all HVAC service stake holders better communicate.
- Before and After Report documents energy savings from strategically servicing units on a big box retail store.
- Service Assistant Wins 2003 AHR Expo Innovative Product Award The Service Assistant is the most innovative "Tool, Instrument, or Software" for 2003 in the HVAC Industry.
- Field Diagnostic Services Inc. is a leading edge developer of HVAC equipment monitoring and diagnostic technology.

Purchasing the Service Assistant

- Contact your local Honeywell sales representative or distributor. Print this Honeywell cut sheet for a clear definition of the product and its Honeywell part numbers.
- Contact Field Diagnostic Services directly to learn how to purchase a Service Assistant.

Appendix F

EER Test Data from Units in SEQL Area

Manufacturer Model Numbe Serial Numbe Equipment Ty Year Manufac Location Tag	er: r /pe:	Carrier 38AE-012-50 T890439 Split System 1989 YTC Truck S SS-1		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EE kW/ton	ĒR	10.7 10.7 9.19 15 6% 9.1 1.31	Btu/W-hr Btu/W-hr tons years (% degrac Btu/W-hr	(CU Only) (CU Only) led)
Compressor Running load Nameplate Vo Power factor:	Amps:	43.6 208 0.65	Amps Volts	Power supply: Phase adjustment: Compressor quantity:		3-phase 1.73 1		
Condensing I Full load Amps Nameplate Vo Adjust FLA to	s: Itage:	0.50 208 0.70	Amps (Average of 2) Volts	Power supply: Phase adjustment: Fan quantity:		1-Phase 1 2		
Evaporator fa Full load Amps Nameplate Vo Adjust FLA to	s: Itage:	olicable) 0.70	Amps Volts	Power supply: Phase adjustment: Fan quantity:				
Calculated co Calculated co Calculated ev Total calculated Assumptions	ondensing far aporator fan ted load for e	i load: load	10.2 0.15 0.00 10.34	kW kW kW kW - Condensing side	only			
Condenser C Overall Unit C		ent	5.7% Performa	nce Degradation				
	New Average Fair	1		FLUKE METER MEAS Y-measurment	URMENTS			
Coil Cleanline	Poor		-	Phase 1	Volts	Amps	kW	PF
	Coated			2				
	Clean Dirty Clogged	0.75	-	3 Delta Measurement				
Fig. Operativity	Plugged		-	Phase	Volts	Amps	kW	PF
Fin Condition	Like New		-	1 to 2 2 to 3	208 208	24.0 30.4	6.1 3.4	0.99
	Some Bent Smashed Dull/rough Corroded Pitted Flaking	0.1	-	TOTAL HVAC Service Assista Input SEER RAT SAT RAH	10 77	F F %		
Fin-Tube Attac	chment Like New Corrosion	x		SAH	85 98%	%		
Tubes	Some Loose Many Loose Clean Cu		-	CI Input Cap OAT Predicted KW	97% 10 85 11.80			
	Corrosion Pitting Leaks		-		CU Capacity E			
	Loans	L	-	Ambient CU Exhaust Coil Length Coil Width Area Measured Fan CFM Air Mass Flow Capacity	10.06	F in in sq-ft kg/sec Tons		5 K 3 K
CU Fan CFN Measurement	I Calculation	1		Efficiency Efficiency	12.71 0.94	EER kW/Ton		

CU Fan CFM Calculation						
Measurement						
Number	ft/sec					
1	4.3					
2	4.1					
3	3.9					
4	4.3					
5	3.7					
6	4.9					
Average	4.2					

HVAC Data Sheet Page 1 of 3 EPA Adsil Evaluation York Technical College Truck School SS-1

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38AE-012-5 T890439 Split Syster 1989 YTC Truck SS-1	n		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.7 10.7 9.2 15 0% 9.6 1.25	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	43.6	Amps		Power supply:	3-phase	
Nameplate Voltage:	208	Volts		Phase adjustment:	1.73	
Power factor:	0.65			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	0.5	Amps		Power supply:	1-Phase	
Nameplate Voltage:	208	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.7			Fan quantity:	2	
Evaporator fan data (if a	pplicable)					
Full load Amps:	ó	Amps		Power supply:	0	
Nameplate Voltage:	0	Volts		Phase adjustment:	0	
Adjust FLA to RLA:	0.7			Fan quantity:	0	
Calculated compressor	load:		10.2	kW		
Calculated condensing f	an load:		0.15	kW		
Calculated evaporator fa	an load		0.00	kW		
Total calculated load for	equipment:		10.34	kW - Condensing side only		

0.0% Performance Degradation

Condenser Coil Assessment Overall Unit Condition New Х Average Fair Poor Coil Cleanliness Coated Clean 1 Dirty Clogged Plugged Fin Condition Like New Some Bent Smashed Dull/rough Corroded Pitted Flaking Fin-Tube Attachment Like New х Corrosion Some Loose Many Loose Tubes Clean Cu х Corrosion Pitting Leaks

Assumptions

Y-measurment							
Phase	Volts	Amps	kW	PF			
1							
2							
3							
Delta Measurement							
Phase	Volts	Amps	kW	PF			
1 to 2	207	29.6	5.7	0.99			
2 to 3	207	28.9	3.2	0.56			
TOTAL	200	20.0	0.2	0.00			
HVAC Service Assistan	t Measurment						
Input SEER		0					
RAT		7 F					
SAT	57 F						
RAH	33 %						
SAH	85 %						
0/11	0	0,00					
EI	107%						
CI	1039						
Input Cap		0 Tons					
OAT		6 F					
Predicted KW		0 kW					
	11.0						
	CU Capacity	Estimates					
Ambient	8	8 F	304	к			
CU Exhaust	9	7 F	309	К			
Coil Length	13	3 in					
Coil Width	3	1 in					
Area	28.6	3 sq-ft					
Measured Fan CFM	1576	•					
Air Mass Flow	8.9	3 kg/sec					
Capacity	12.7	7 Tons					
Efficiency		1 EER					
Efficiency	0.7	0 kW/Ton					

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	10.2
2	5.5
3	10.5
4	10.5
Average	9.2

YTC Tru	ick School		SS-1	Summa	ry								
EER at ARI	Conditions			10.7	BTU/W-	n	Equ	ipment age	15	15 years			
Condensing	unit CFM			7215	CFM (M	easured)							
Capacity at	ARI			9.19	tons								
Capacity us	ed for SA			10.00	tons								
Coil Area				28.63	sq-ft								
Predicted E	ER =			9.13	pre	9.60	post						
		HVAC	HVAC Service Assistant					Physical Power and Capacity measurmer					
Test Date							Cond Ai	r, deg F		Cond Air			
[OAT	ST-SH	El	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons	
24-May	85	42	98%	97%	12.2	10.84	89	104.5	8.6	9.5	4.09	10.06	
		42	98%	97%	12.2	10.84	89	104.5	8.6	9.5	4.09	10.06	
	85 Neasurements	42							8.6	9.5	4.09		
		42 43	98%	97% 103%	12.2 13.2	10.84	89 88	104.5 97	8.6 5.0	9.5	4.09	10.06	

Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions										
		Test Data Percent Difference					Test Data Percent Difference									
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	10.84	9.5	9.85	110%	96%	100%	11.4	9.9	10.31	110%	96%	114%	-	-	-
Pre-Adsil	Capacity (Tons)	9.88	10.06	10.19	97%	99%	100%	8.9	9.1	9.19	97%	99%	98%	-	-	-
	EER	12.2	12.71	12.42	98%	102%	85%	10.5	10.9	10.69	98%	102%	96%	87%	83%	85%
	Power (kW)	10.66	8.9	10.00	107%	89%	100%	11.0	9.2	10.31	107%	89%	120%	-	-	-
Post-Adsil	Capacity (Tons)	10.62	12.77	10.31	103%	124%	100%	9.5	11.4	9.19	103%	124%	83%	-	-	-
	EER	13.2	17.21	12.38	107%	139%	90%	11.4	14.9	10.69	107%	139%	77%	80%	61%	90%

EER

12.71

17.21

tons 10.06

12.77

EER Changes

	Service Assistant	Condenser Test	Spreadsheet
	OCIVICE ASSISTANT	Condenser rest	opredusileet
Pre-Adsil EER	12.2	12.71	9.13
Post Adsil EER	13.2	17.21	9.60
ARI Adjusted			
Pre-Adsil EER	10.4	10.91	9.13
Post Adsil EER	11.4	14.82	9.60
Change	9.2%	35.9%	5.1%
Weighted Average	91.8%	358.6%	51.4%

EPA Adsil Evaluation York Technical College Truck School SS-1

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38ASQ008 1396G00194 Split Heat Pump 1991 YTC Student Ser HP-1	vices	Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	11.1 11.1 7.40 13 7.5% 9.6 1.25	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data					
Running load Amps:	14.1 An	nps	Power supply:	3-Phase	
Nameplate Voltage:	460 Vo	lts	Phase adjustment:	1.73	
Power factor:	0.66		Compressor quantity:	1	
Condensing Fan Data					
Full load Amps:	1.90 An	nps	Power supply:	1-Phase	
Nameplate Voltage:	460 Vo	lts	Phase adjustment:	1	
Adjust FLA to RLA:	0.70		Fan quantity:	1	
Evaporator fan data (if a	applicable)				
Full load Amps:	An	nps	Power supply:		
Nameplate Voltage:	Vo	lts	Phase adjustment:		
Adjust FLA to RLA:			Fan quantity:		
Calculated compressor	load:	7.4	kW		
Calculated condensing	fan load:	0.61	kW		
Calculated evaporator fa	an load	0.00	kW		
Total calculated load for	r equipment:	8.02	kW - Condensing side only		

Condenser Coil Assessment Overall Unit Condition New х Average Fair Poor Coil Cleanliness Coated Clean 1 Dirty Clogged Plugged Fin Condition Like New Some Bent 1 Smashed 0.25 Dull/rough Corroded Pitted Flaking Fin-Tube Attachment Like New v Corrosion Some Loose Many Loose Tubes Clean Cu х Corrosion Pitting Leaks

Assumptions

7.5% Performance Degradation

Y-measurment				
Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	Volto	7		r
2 to 3				
HVAC Service Assistar				
	COMP 1 10	1		
Input SEER RAT	10	_		
		F		
SAT RAH		⊢ %		
SAH		%		
SAH		%		
	010/			
El	91% 82%			
			- \	
Input Cap OAT		Tons (Each	1)	
OAT Predicted KW	74			
Predicted KVV	7.10 CU Capacity E			
	CU Capacity i	stimates		
Ambient	-	F	-	к
CU Exhaust	-	F	-	к
Coil Length	-	in		
Coil Width	-	in		
Area	-	sq-ft		
Measured Fan CFM	-	(From Proc	duct Data)	
Air Mass Flow	-	kg/sec	,	
Capacity	-	Tons		
Efficiency	-	EER		

CU Fan CFM Calculation						
Measurement						
Number	ft/sec					
1	-					
2	-					
3	-					
4	-					
5	-					
6	-					
Average	-					

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38ASQ008 1396G0019 Split Heat P 1991 YTC Studer HP-1	ump		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	11.1 11.1 7.40 13 0% 10.2 1.17	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	14.1 460.0 0.7	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-Phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.9 460.0 0.7	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if a Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	pplicable)	Amps Volts		Power supply: Phase adjustment: Fan quantity:		
Calculated compressor Calculated condensing f Calculated evaporator fa Total calculated load for Assumptions	fan load: an load		7.4 0.61 0.00 8.02	kW kW kW kW - Condensing side only		
Condenser Coil Assessi Overall Unit Condition	ment	0.0%	Performa	ance Degradation		

	oil Assessme	nt
Overall Unit C	ondition	
	New	X
	Average	
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	-	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes	. ,	
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	
	200.00	

FLUKE METER MEAS	SURMENTS			
Y-measurment				
Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	VOILS	Amps	KVV	PF
2 to 3				
2.00	1	I	1	I
SAT RAH SAH CI Input Cap OAT	- - - 109% 101% 7.5 83	Tons		
	-	•		
Predicted KW	8.50			
	CU Capacity E	sumatés		
Ambient	-	F	-	к
CU Exhaust	-	F	-	К
Coil Length	-	in		
Coil Width	-	in		
Area	-	sq-ft		
Measured Fan CFM	-			
Air Mass Flow	-	kg/sec		
Capacity	-	Tons		
Efficiency		EER		

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	-
2	-
3	-
4	-
Average	-

YTC Stu	dent Services		HP-1	Summa	ry							
EER at ARI	Conditions			11.1	BTU/W-I	h	Equ	uipment age	13	years		
Condensing	unit CFM			NA	CFM (M	easured)				-		
Nominal Uni	it Capacity			7.40)							
Capacity use	ed for SA			7.50) tons							
Coil Area				NA	sq-ft							
Predicted E	ER =			9.57	pre	10.23	post					
		HVAC	Service As	sistant				Phys	ical Power	and Capac	ity measurn	nents
Test Date							Cond A	ir, deg F		Cond Air		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
24-May	74	60	91%	82%	12.2	7.01	NA	NA	NA	NA	NA	NA
Post Adsil M	leasurements											
14-Jun	83	60	109%	101%	13.1	8.39	NA	NA	NA	NA	NA	NA

	Condensing Unit Summary - Ambient Conditions					Condensing Unit Summary - ARI Conditions										
		Test Da	ta@ Field C	onditions	Per	rcent Diff	ference	T	Test Data @ARI Percent Difference				e			
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	7.01	NA	6.59	106%	NA	101%	8.5	NA	7.97	106%	NA	NA			
Pre-Adsil	Capacity (Tons)	6.03	NA	7.35	82%	NA	100%	6.1	NA	7.40	82%	NA	NA			
	EER	12.2	NA	13.39	91%	NA	86%	10.1	NA	11.15	91%	NA	NA	94%	NA	86%
	Power (kW)	8.39	NA	7.07	119%	NA	101%	9.5	NA	7.97	119%	NA	NA			
Post-Adsil	Capacity (Tons)	7.15	NA	7.08	101%	NA	100%	7.5	NA	7.40	101%	NA	NA			
	EER	13.1	NA	12.02	109%	NA	92%	12.1	NA	11.15	109%	NA	NA	79%	NA	92%

EER NA

NA

EER Changes									
	Service Assistant	Condenser Test	Spreadsheet						
Pre-Adsil EER	12.2	NA	9.57						
Post Adsil EER	13.1	NA	10.23						
ARI Adjusted									
Pre-Adsil EER	10.1	NA	9.57						
Post Adsil EER	12.1	NA	10.23						
Change	19.8%	NA	6.9%						
Weighted Average	148.4%	NA	51.6%						

EPA Adsil Evaluation York Technical College Student Services HP-1

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 48DJE006630 2891G07552 Package Cool 1991 YTC Student Center RTU-25			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.4 10.4 5.19 13 5% 9.1 1.32	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	7.8	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Power factor:	0.87			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	1.00	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Evaporator fan data (if ar	oplicable)					
Full load Amps:	3.00	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.70			Fan quantity:	2	
Calculated compressor la Calculated condensing fa Calculated evaporator fa Total calculated load for	an load: n load		5.4 0.56 1.93 5.96	kW kW kW kW - Condensing side only		

Condenser C Overall Unit C	oil Assessme ondition	nt
	New	
	Average	Х
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	0.5
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Attac	chment	
	Like New	Х
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	х
	Corrosion	
	Pitting	
	Leaks	

Assumptions

2.7% Performance Deg	radation
----------------------	----------

Y-measurment) <i>(</i> - 14 -	A	1.3.47	DE
Phase	Volts	Amps	kW	PF
1 2				
3				
	1	I		
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	474	9	4.4	1
2 to 3	475	9	1.8	0.42
HVAC Service Assista				
	COMP 1	т		
Input SEER	10	+		
RAT		F		
SAT		2 F		
RAH		5 %		
SAH	85	5 %		
EI	76%	1		
CI	82%	-		
Input Cap		Tons		
OAT	84	+		
Predicted KW	3.00	kW		
	CU Capacity	-		
Ambient	84	١F	302	к
CU Exhaust	-	'F	309	
Coil Length	•••	in	000	
Coil Width		, in		
Area		sq-ft		
Measured Fan CFM	NA	•		
Air Mass Flow	NA	kg/sec		
Capacity		Tons		
Efficiency	NA	EER		

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	NA
2	NA
3	NA
Average	NA

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	2891G07552 Package Co 1991	BDJE006630 391G07552 ackage Cool 991 TC Student Center		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.4 10.4 5.19 13 0% 9.5 1.26	Btu/W-hr (CU C Btu/W-hr (CU C tons years (% degraded) Btu/W-hr	
Compressor Data							
Running load Amps:	7.8	Amps		Power supply:	3-Phase		
Nameplate Voltage:	460.0	Volts		Phase adjustment:	1.73		
Power factor:	0.9			Compressor quantity:	1		
Condensing Fan Data							
Full load Amps:	1.0	Amps		Power supply:	3-Phase		
Nameplate Voltage:	460.0	Volts		Phase adjustment:	1.73		
Adjust FLA to RLA:	0.7			Fan quantity:	1		
Evaporator fan data (if a	pplicable)						
Full load Amps:	3.00	Amps		Power supply:	3-Phase		
Nameplate Voltage:	460.00	Volts		Phase adjustment:	1.73		
Adjust FLA to RLA:	0.70			Fan quantity:	2.00		
Calculated compressor	load:		5.4	kW			
Calculated condensing f			0.56	kW			
Calculated evaporator fa			1.93	kW			
Total calculated load for			5.96	kW - Condensing side only			
•	• •			5			

Condenser Coil Assessment Overall Unit Condition New Х Average Fair Poor Coil Cleanliness Coated Clean 1 Dirty Clogged Plugged Fin Condition Like New 0.01 Some Bent Smashed Dull/rough Corroded Pitted Flaking Fin-Tube Attachment Like New х Corrosion Some Loose Many Loose Tubes Clean Cu х Corrosion Pitting Leaks

Assumptions

0.1%	Performance Degradation
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Y-measurment				
Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2				
2 to 3				
HVAC Service Assista	nt Measurmen	ıt		
	COMP 1			
Input SEER		10		
RAT		F		
SAT		F		
RAH		%		
SAH		%		
EI	8	1%		
CI	88	3%		
Input Cap		5 Tons		
OAT		86 F		
Predicted KW	6.	.40 kW		
	CU Capacit	ty Estimates		
Ambient	NA	F	NA	к
CU Exhaust	NA	F	NA	ĸ
Coil Length	NA	in		
Coil Width	NA	in		
Area	NA	sq-ft		
Measured Fan CFM	NA	- 1 -		
Air Mass Flow	NA	kg/sec		
Capacity	NA	Tons		
Efficiency	NA	EER		

CU Fan CFM Calculation							
ft/sec							
NA							
NA							
NA							
NA							
NA							

YTC Stu	udent Center		RTU-25	Summa	ry							
EER at AR	I Conditions			10.4	BTU/W-I	h	Eq	uipment age	13	years		
Condensing	g unit CFM			-	CFM (M	easured)						
Nominal Ur	nit Capacity			5.19								
Capacity us	sed for SA			5.00	tons							
Coil Area				-	sq-ft							
Predicted E	ER =			9.10	Pre	9.51	Post					
		HVAC S	Service Ass	sistant				Phys	ical Power	and Capaci	ty measurr	nents
Test Date							Cond A	ir, deg F		Cond Air		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
24-May	84	61	76%	82%	8.4	3.11	NA	NA	NA	NA	NA	NA
Post Adsil	Measurements											
	86	61	81%	88%	8.7	6.64	NA	NA	NA	NA	NA	NA

Condensing Unit Summary - Ambient Conditions					Condensing Unit Summary - ARI Conditions											
		Test Da	ta@ Field C	onditions	Per	rcent Diff	erence	Т	est Data @	ARI			Pe	ercent Difference	e	
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	3.11	NA	5.34	58%	NA	99%	3.5	NA	6.00	58%	NA	NA			
Pre-Adsil	Capacity (Tons)	4.02	NA	4.90	82%	NA	100%	4.3	NA	5.19	82%	NA	NA			
	EER	8.4	NA	11.02	76%	NA	88%	7.9	NA	10.38	76%	NA	NA	115%	NA	88%
	Power (kW)	6.64	NA	5.41	123%	NA	99%	7.4	NA	6.00	123%	NA	NA			
Post-Adsil	Capacity (Tons)	4.27	NA	4.85	88%	NA	100%	4.6	NA	5.19	88%	NA	NA			
	EER	8.7	NA	10.77	81%	NA	92%	8.4	NA	10.38	81%	NA	NA	108%	NA	92%

EER

NA

NA

	EER Changes								
	Service Assistant	Condenser Test	Spreadsheet						
Pre-Adsil EER	8.4	NA	9.10						
Post Adsil EER	8.7	NA	9.51						
ARI Adjusted									
Pre-Adsil EER	7.9	NA	9.10						
Post Adsil EER	8.4	NA	9.51						
Change	6.6%	NA	4.5%						
Weighted Average	32.9%	NA	22.7%						

EPA Adsil Evaluation York Technical College Student Center RTU-25

Model Numbe Serial Numbe Equipment Ty Year Manufac Location Tag	r /pe:	Carrier 38AD028610 A494368 Split System 1994 YTC Student Ground Unit		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition E kW/ton	ER	8.8 8.8 24.17 10 16% 7.2 1.67	Btu/W-hr Btu/W-hr tons years (% degrad Btu/W-hr	(CU Only) (CU Only) ed)
Compressor I				D		6 haaa		
Running load / Nameplate Vo		54.4 460	Amps Volts	Power supply: Phase adjustment:		3-phase 1.73		
Power factor:	llage.	460 0.65	Voits	Compressor quantity:		1.75		
Condensing I	Fan Data							
Full load Amps		3.00	Amps (Average o	f 2) Power supply:		3-Phase		
Nameplate Vo	Itage:	460	Volts	Phase adjustment:		1.73		
Adjust FLA to	RLA:	0.70		Fan quantity:		3		
	ın data (if app	licable)						
Full load Amps			Amps	Power supply:				
Nameplate Vo			Volts	Phase adjustment:				
Adjust FLA to	RLA:	0.70		Fan quantity:				
Calculated co Calculated ev	ompressor loa ondensing fan vaporator fan l ted load for ec	load: oad	27. 5.0 0.0 32.9	1 kW 0 kW	e only			
Condenser C		nt	16.5% Perfo	rmance Degradation				
Condenser C Overall Unit C	ondition	nt	16.5% Perfo	rmance Degradation				
	ondition New	nt	16.5% Perfo					
	ondition New Average		16.5% Perfo	FLUKE METER MEA	SURMENTS			
	ondition New Average Fair	nt 1	16.5% Perfo	FLUKE METER MEA		A	1.104	
Overall Unit C	ondition New Average Fair Poor		16.5% Perfo	FLUKE METER MEA Y-measurment Phase	SURMENTS Volts	Amps	kW	PF
Overall Unit C	ondition New Average Fair Poor ss		16.5% Perfo	FLUKE METER MEA Y-measurment Phase 1		Amps	kW	PF
Overall Unit C	ondition New Average Fair Poor ss Coated		16.5% Perfo	FLUKE METER MEA Y-measurment Phase 1 2		Amps	kW	PF
	ondition New Average Fair Poor ss Coated Clean	1	16.5% Perfo	FLUKE METER MEA Y-measurment Phase 1		Amps	kW	PF
Overall Unit C	ondition New Average Fair Poor SS Coated Clean Dirty	0.5	16.5% Perfo	FLUKE METER MEA Y-measurment Phase 1 2 3		Amps	kW	PF
Overall Unit C	ondition New Average Fair Poor SS Coated Clean Dirty Clogged	1	16.5% Perfo	FLUKE METER MEA: Y-measurment Phase 1 2 3 Delta Measurement	Volts			
Overall Unit C	ondition New Average Fair Poor SS Coated Clean Dirty	0.5	16.5% Perfo	FLUKE METER MEA Y-measurment Phase 1 2 3 Delta Measurement Phase	Volts	Amps	kW	PF
Overall Unit C	ondition New Average Fair Poor SS Coated Clean Dirty Clogged Plugged	0.5	16.5% Perfo	FLUKE METER MEA Y-measurment Phase 1 2 3 Delta Measurement Phase 1 to 2	Volts Volts Volts NA	Amps	kW	PF
Overall Unit C	ondition New Average Fair Poor Sss Coated Clean Dirty Clogged Plugged Like New	0.5	16.5% Perfo	FLUKE METER MEA Y-measurment Phase 1 2 3 Delta Measurement Phase 1 to 2 2 to 3	Volts	Amps	kW	PF
Overall Unit C	ondition New Average Fair Poor Sss Coated Clean Dirty Clogged Plugged Like New Some Bent	1 0.5 0.1 0.1	16.5% Perfo	FLUKE METER MEA Y-measurment Phase 1 2 3 Delta Measurement Phase 1 to 2 2 to 3 TOTAL	Volts Volts NA NA	Amps	kW	PF
Overall Unit C	ondition New Average Fair Poor Ss Coated Clean Dirty Clogged Plugged Like New Some Bent Smashed	0.5 0.1 0.1 0.25	16.5% Perfo	FLUKE METER MEA Y-measurment Phase 1 2 3 Delta Measurement Phase 1 to 2 2 to 3 TOTAL HVAC Service Assista	Volts Volts NA NA ant Measurment	Amps NA NA	kW	PF
Overall Unit C	ondition New Average Fair Poor SS Coated Clean Dirty Clogged Plugged Like New Some Bent Some Bent Smashed Dull/rough	1 0.5 0.1 0.1 0.25 0.65	16.5% Perfo	FLUKE METER MEA Y-measurment Phase 1 2 3 Delta Measurement Phase 1 to 2 2 to 3 TOTAL HVAC Service Assista Input SEER	Volts Volts NA NA ant Measurment 10	Amps NA NA	kW	PF
Overall Unit C	ondition New Average Fair Poor SS Coated Clean Dirty Clogged Plugged Like New Some Bent Smashed Dull/rough Corroded	0.5 0.1 0.1 0.25	16.5% Perfo	FLUKE METER MEA Y-measurment Phase 1 2 3 Delta Measurement Phase 1 to 2 2 to 3 TOTAL HVAC Service Assista Input SEER RAT	Volts Volts NA NA ant Measurment 10 74	Amps NA NA	kW	PF
Overall Unit C	ondition New Average Fair Poor SS Coated Clean Dirty Clogged Plugged Like New Some Bent Smashed Dull/rough Corroded Pitted	1 0.5 0.1 0.1 0.25 0.65	16.5% Perfo	FLUKE METER MEA Y-measurment Phase 1 2 3 Delta Measurement Phase 1 to 2 2 to 3 TOTAL HVAC Service Assista Input SEER RAT SAT	Volts Volts NA NA ant Measurment 10 74 56	Amps NA NA F F	kW	PF
Overall Unit C	ondition New Average Fair Poor Sss Coated Clean Dirty Clogged Plugged Like New Some Bent Smashed Dull/rough Corroded Filted Flaking	1 0.5 0.1 0.1 0.25 0.65	16.5% Perfo	FLUKE METER MEA Y-measurment Phase 1 2 3 Delta Measurement Phase 1 to 2 2 to 3 TOTAL HVAC Service Assista Input SEER RAT SAT RAH	Volts Volts NA NA ant Measurment 10 74 56 40	Amps NA NA F F %	kW	PF
Overall Unit C	ondition New Average Fair Poor Sss Coated Clean Dirty Clogged Plugged Like New Some Bent Smashed Dull/rough Corroded Filted Flaking	1 0.5 0.1 0.1 0.25 0.65	16.5% Perfo	FLUKE METER MEA Y-measurment Phase 1 2 3 Delta Measurement Phase 1 to 2 2 to 3 TOTAL HVAC Service Assista Input SEER RAT SAT	Volts Volts NA NA ant Measurment 10 74 56	Amps NA NA F F %	kW	PF
Overall Unit C	ondition New Average Fair Poor Sss Coated Clean Dirty Clogged Plugged Like New Some Bent Smashed Dull/rough Corroded Pitted Flaking chment Like New	1 0.5 0.1 0.1 0.25 0.65	16.5% Perfo	FLUKE METER MEA Y-measurment Phase 1 2 3 Delta Measurement Phase 1 to 2 2 to 3 TOTAL HVAC Service Assista Input SEER RAT SAT RAH SAH	Volts Volts NA NA ant Measurment 10 74 566 40 85	Amps NA NA F F %	kW	PF
Overall Unit C	ondition New Average Fair Poor SS Coated Clean Dirty Clogged Plugged Like New Some Bent Smashed Dull/rough Corroded Pitted Flaking chment Like New Corrosion	1 0.5 0.1 0.1 0.25 0.65 0.1	16.5% Perfo	FLUKE METER MEA Y-measurment Phase 1 2 3 Delta Measurement Phase 1 to 2 2 to 3 TOTAL HVAC Service Assista Input SEER RAT SAT RAH	Volts Volts NA NA ant Measurment 10 74 56 40	Amps NA NA F F %	kW	PF
Overall Unit C	ondition New Average Fair Poor SS Coated Clean Dirty Clogged Plugged Like New Some Bent Smashed Dull/rough Corroded Pitted Flaking chment Like New Corrosion Some Loose	1 0.5 0.1 0.1 0.25 0.65	16.5% Perfo	FLUKE METER MEA Y-measurment Phase 1 2 3 Delta Measurement Phase 1 to 2 2 to 3 TOTAL HVAC Service Assista Input SEER RAT SAT RAH SAH EI CI	Volts Volts NA NA ant Measurment 10 74 56 40 855 89% 70%	Amps NA NA F F % %	kW	PF
Overall Unit Co Coil Cleanlines Fin Condition	ondition New Average Fair Poor SS Coated Clean Dirty Clogged Plugged Like New Some Bent Smashed Dull/rough Corroded Pitted Flaking chment Like New Corrosion	1 0.5 0.1 0.1 0.25 0.65 0.1	16.5% Perfo	FLUKE METER MEA Y-measurment Phase 1 2 3 Delta Measurement Phase 1 to 2 2 to 3 TOTAL HVAC Service Assista Input SEER RAT SAT RAH SAH EI CI Input Cap	Volts Volts NA NA ant Measurment 10 74 56 40 85 89% 70% 30	Amps NA NA F F % %	kW	PF
Overall Unit C	ondition New Average Fair Poor Sss Coated Clean Dirty Clogged Plugged Like New Some Bent Smashed Dull/rough Corroded Fitted Flaking chment Like New Corrosion Some Loose Many Loose	1 0.5 0.1 0.1 0.25 0.65 0.1	16.5% Perfo	FLUKE METER MEA: Y-measurment Phase 1 2 3 Delta Measurement Phase 1 to 2 2 to 3 TOTAL HVAC Service Assista Input SEER RAT SAT RAH SAH EI CI Input Cap OAT	Volts Volts NA NA NA ant Measurment 10 74 56 40 85 40 85 70% 30 81	Amps NA NA F F F % % %	kW	PF
Overall Unit Co Coil Cleanlines Fin Condition	ondition New Average Fair Poor Sss Coated Clean Dirty Clogged Plugged Like New Some Bent Smashed Dullrough Corroded Pitted Flaking chment Like New Corrosion Some Loose Many Loose Clean Cu	1 0.5 0.1 0.1 0.25 0.65 0.1	16.5% Perfo	FLUKE METER MEA Y-measurment Phase 1 2 3 Delta Measurement Phase 1 to 2 2 to 3 TOTAL HVAC Service Assista Input SEER RAT SAT RAH SAH EI CI Input Cap	Volts Volts NA NA ant Measurment 10 74 56 40 85 89% 70% 30	Amps NA NA F F F % % %	kW	PF
Overall Unit Co Coil Cleanlines Fin Condition	ondition New Average Fair Poor SS Coated Clean Dirty Clogged Plugged Like New Some Bent Smashed Dull/rough Corroded Flaking chiment Like New Corrosion Some Loose Many Loose Clean Cu Corrosion	1 0.5 0.1 0.1 0.25 0.65 0.1	16.5% Perfo	FLUKE METER MEA: Y-measurment Phase 1 2 3 Delta Measurement Phase 1 to 2 2 to 3 TOTAL HVAC Service Assista Input SEER RAT SAT RAH SAH EI CI Input Cap OAT	Volts Volts NA NA NA ant Measurment 10 74 566 400 89% 70% 300 811 30.20	Amps NA NA F F F % % % % %	kW	PF
Overall Unit Co Coil Cleanlines Fin Condition	ondition New Average Fair Poor Sss Coated Clean Dirty Clogged Plugged Like New Some Bent Smashed Dullrough Corroded Pitted Flaking chment Like New Corrosion Some Loose Many Loose Clean Cu	1 0.5 0.1 0.1 0.25 0.65 0.1	16.5% Perfo	FLUKE METER MEA: Y-measurment Phase 1 2 3 Delta Measurement Phase 1 to 2 2 to 3 TOTAL HVAC Service Assista Input SEER RAT SAT RAH SAH EI CI Input Cap OAT	Volts Volts NA NA NA ant Measurment 10 74 56 40 85 40 85 70% 30 81	Amps NA NA F F F % % % % %	kW	PF

EI	89%	
CI	70%	
Input Cap	30	Tons
OAT	81	F
Predicted KW	30.20	kW
	CU Capacity E	Estimates
Ambient	NA	F
CU Exhaust	NA	F
Coil Length	NA	in
Coil Width	NA	in
Area	NA	sq-ft
Measured Fan CFM	NA	
Air Mass Flow	NA	kg/sec
Capacity	NA	Tons
Efficiency	NA	EER
Efficiency	NA	kW/Ton

CU Fan CFM Calculation						
Measurement						
Number	ft/sec					
1	NA					
2	NA					
3	NA					
4	NA					
5	NA					
6	NA					
Average	NA					

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38AD028610 A494368 Split System 1994 YTC Student Ground Unit	t Center		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	8.8 8.8 24.2 10 1% 8.2 1.46	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	54.4	Amps		Power supply:	3-phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Power factor:	0.65			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	3	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.7			Fan quantity:	3	
Evaporator fan data (if a	pplicable)					
Full load Amps:	0	Amps		Power supply:	0	
Nameplate Voltage:	0	Volts		Phase adjustment:	0	
Adjust FLA to RLA:	0.7			Fan quantity:	0	
Calculated compressor	load:		27.9	kW		
Calculated condensing f			5.01	kW		
Calculated evaporator fa	an load		0.00	kW		
Total calculated load for Assumptions			32.94	kW - Condensing side only		

1.0% Performance Degradation

Condenser Coil Assessment Overall Unit Condition New Average х Fair Poor Coil Cleanliness Coated Clean 0.95 Dirty 0.05 Clogged Plugged Fin Condition Like New 1 Some Bent 0.1 Smashed Dull/rough Corroded Pitted Flaking Fin-Tube Attachment Like New х Corrosion Some Loose Many Loose Tubes Clean Cu х Corrosion Pitting Leaks

Y-measurment				
Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amno	kW	PF
1 to 2	NA	Amps NA	NA	NA
2 to 3	NA	NA	NA	NA
Z to 3	INA	INA	INA	INA
HVAC Service Assistant	Measurmen	+		
Input SEER		10		
RAT		74 F		
SAT		74 F 54 F		
RAH		40 %		
SAH		40 % 85 %		
ЗАП		05 %		
EI	101	1%		
		1%		
Input Cap		30 Tons		
		84 F		
Predicted KW		60 kW		
Predicted KW	11.	<u>ou</u> kw		
	CU Capacit	y Estimates		
Ambient	NA	F		
CU Exhaust	NA	F		
Coil Length	NA	in		
Coil Width	NA	in		
Area	NA	sq-ft		
Measured Fan CFM	NA			
Air Mass Flow	NA	kg/sec		
Capacity	NA	Tons		
Efficiency	NA	EER		
Efficiency	NA	kW/Ton		

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	NA
2	NA
3	NA
4	NA
Average	NA
Average	INA

YTC Stu	udent Center		Ground	Unit	Sumn	nary						
EER at ARI	Conditions			8.8	B BTU/W-	h	Equ	ipment age	10	years		
Condensing	g unit CFM			NA	A CFM (M	easured)						
Capacity at	ARI			24.1	7 tons							
Capacity us	sed for SA			30.00) tons							
Coil Area				NA	A sq-ft							
Predicted E	ER =			7.19	9 pre	8.23	post					
		HVAC	C Service As	ssistant				Phys	ical Power	and Capaci	ity measurn	nents
Test Date							Cond Air	r, deg F		Cond Air		
	OAT	ST-SH	El	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons
24-May	81	26	89%	70%	7.9	24.33	NA	NA	NA	NA	NA	NA
Poet Adeil M	Veasurements											
16-Jun	84	30	101%	91%	9.0	9.35	NA	NA	NA	NA	NA	NA
TO-JUIT	04	50	10170	5170	3.0	3.55	INA.		INA.	INA		

Condensing Unit Summary - Ambient Conditions					Condensing Unit Summary - ARI Conditions											
			Test Data	l	Per	rcent Diff	erence		Test Data	l			Pe	rcent Differenc	e	
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	24.33	NA	27.92	87%	NA	109%	26.4	NA	30.25	87%	NA	NA	-	-	-
Pre-Adsil	Capacity (Tons)	14.40	NA	20.57	70%	NA	120%	14.1	NA	20.18	70%	NA	NA	-	-	-
	EER	7.9	NA	8.84	89%	NA	90%	7.1	NA	8.01	89%	NA	NA	101%	NA	90%
	Power (kW)	9.35	NA	29.49	32%	NA	109%	9.6	NA	30.25	32%	NA	NA	-	-	-
Post-Adsil	Capacity (Tons)	19.83	NA	21.79	91%	NA	120%	18.4	NA	20.18	91%	NA	NA	-	-	-
	EER	9.0	NA	8.87	101%	NA	103%	8.1	NA	8.01	101%	NA	NA	89%	NA	103%

EER NA

NA

EER Changes

Service Assistant	Condenser Test	Spreadsheet						
7.9	NA	7.19						
9.0	NA	8.23						
7.8	NA	7.19						
8.9	NA	8.23						
13.5%	NA	14.5%						
	7.9 9.0 7.8 8.9	7.9 NA 9.0 NA 7.8 NA 8.9 NA						

Weighted Average 404.5%

434.8%

EPA Adsil Evaluation York Technical College Student Center Ground Unit

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Trane YCH210B4 F14627920 RTU-Gas 1991 YTC - Library Unit 2		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.2 10.2 17.29 13 3% 9.1 1.32	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data					
Running load Amps:	14.5 Amp		Power supply:	3-phase	
Nameplate Voltage:	460 Volts		Phase adjustment:	1.73	
Power factor:	0.74		Compressor quantity:	2	
Condensing Fan Data					
Full load Amps:	3.00 Amp		Power supply:	3-Phase	
Nameplate Voltage:	460 Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.70		Fan quantity:	2	
Evaporator fan data (if a	pplicable)				
Full load Amps:	7.60 Amp		Power supply:	3-Phase	
Nameplate Voltage:	460 Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.70		Fan quantity:	1	
Calculated compressor	load:	17.1	kW		
Calculated condensing	fan load:	3.34	kW		
Calculated evaporator fa	an load	2.45	kW		
Total calculated load for Assumptions		20.42	kW - Condensing side only		

Condenser C Overall Unit C	oil Assessme	nt			
	New				
	Average	1			
	Fair				
	Poor				
Coil Cleanline	SS				
	Coated				
	Clean	0.95			
	Dirty	0.05			
	Clogged				
	Plugged				
Fin Condition	Fin Condition				
	Like New				
	Some Bent	0.1			
	Smashed	0.1			
	Dull/rough	0.2			
	Corroded				
	Pitted				
	Flaking				
Fin-Tube Atta	chment				
	Like New	1			
	Corrosion				
	Some Loose				
	Many Loose				
Tubes					
	Clean Cu	1			
	Corrosion				
	Pitting				
	Leaks				

3.0% P	erformance	Degradation
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FLUKE METER MEAS Y-measurement	SUREIVIEN 15							
Phase	Volts	Amps	kW	PF				
1	10110	7 anpo						
2								
3								
Delta Measurement								
Phase	Volts	Amps	kW	PF				
1 to 2	484	22.2	10.7	1.0				
2 to 3	485	17.6	3.5	0.41				
TOTAL								
HVAC Service Assista	ant Measurement	_						
Input SEER	10	I						
RAT	73	F						
SAT	53	53 F						
RAH		%						
SAH	85	%						
	Circuit 1 (only)							
EI	91%	I						
CI	94%							
Input Cap	10	Tons						
OAT	77	F						
Predicted KW	12.40	kW						
	CU Capacity I	Estimates						
Ambient	77	F	298	к				
CU Exhaust	92 F 306 K							
Coil Length	91 in							
Coil Width	48 in							
Area	30.3 sq-ft							
Measured Fan CFM	6613							
Air Mass Flow	3.74	kg/sec						
Capacity	8.93 Tons							
Efficiency	7.54	EER						

CU Fan CFM Calculation							
Measurement							
Number	ft/sec						
1	2.7						
2	5.1						
3	4.9						
4	3.1						
5	2.7						
6	3.3						
Average	3.6						

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Trane YCH210B4 F14627920 RTU-Gas 1991 YTC - Libra Unit 2			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.2 10.2 17.29 13 0% 9.3 1.29	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps:	14.5	Amps		Power supply:	3-phase	
Nameplate Voltage: Power factor:	460 0.74	Volts		Phase adjustment: Compressor quantity:	1.73 2	
Condensing Fan Data						
Full load Amps:	3	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.7			Fan quantity:	2	
Evaporator fan data (if a	pplicable)					
Full load Amps:	7.6	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.7			Fan quantity:	1	
Calculated compressor	load:		17.1	kW		
Calculated condensing	fan load:		3.34	kW		
Calculated evaporator fa	an load		2.45	kW		
Total calculated load for Assumptions	r equipment:		20.42	kW - Condensing side only		
Condenser Coil Assess	ment	0.0%	Performa	ance Degradation		

Condenser C Overall Unit C	Coil Assessme Condition	nt
	New	Х
	Average	
	Fair	
	Poor	
Coil Cleanline	ess	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	1
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	1
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	х
	Corrosion	
	Pitting	
	Leaks	

Y-measurement Phase	Volts	Amps	kW	PF				
1	1013	Апрэ	NVV					
2								
3								
Delta Measurement								
Phase	Volts	Amps	kW	PF				
1 to 2	481	21	10.1	1.0				
2 to 3	483	18.9	4.2	0.45				
TOTAL								
HVAC Service Assista	int Measurement	_						
Input SEER	10	I						
RAT	73	F						
SAT	53 F							
RAH	50	%						
SAH	85 %							
	Circuit 1 (only)]						
EI	84%	I						
CI	96%							
Input Cap	10	Tons						
OAT	88	F						
Predicted KW	13.40	kW						
	CU Capacity	Estimates						
Ambient	88	F	304	к				
CU Exhaust	112 F 318 K							
Coil Length	91 in							
Coil Width	48 in							
Area	30.3 sq-ft							
Measured Fan CFM	8600							
Air Mass Flow		kg/sec						
Capacity	18.57 Tons							
Efficiency	15.59	EER						

CU Fan CFM Calculation								
Measurement								
Number	ft/sec							
1	1.2							
2	6.1							
3	6.4							
4	5.2							
Average	4.73							

YTC - Li	ibrary	Unit 2	Summa	ry								
EER at ARI	Conditions			10.2	BTU/W-	h	Eq	uipment age	13	years		
Condensing	g unit CFM			6613	B CFM (M	easured)						
Nominal Un	it Capacity			17.29) tons							
Capacity us	ed for SA			10.00) tons							
Coil Area				30.33	3 sq-ft							
Predicted E	ER =			9.08	3 pre	9.32	post					
		HVAC	C Service As	sistant				Phys	ical Power	and Capac	ity measurr	nents
Test Date							Cond A	vir, deg F		Cond Air		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
24-May	77	61	91%	94%	11.6	10.72	77	92	8.3	14.2	3.74	8.93
Post Adsil N	<i>Aeasurements</i>											
14-Jun	88	61	84%	96%	8.8	11.58	88	112	13.3	14.3	4.87	18.57

	Conder			Condensing Unit Summary - ARI Conditions												
	Test Data Percent Difference								Test Data	a			Pe	rcent Differenc	e	
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	10.72	14.2	8.27	130%	172%	100%	13.2	17.5	10.21	130%	172%	75%	-	-	-
Pre-Adsil	Capacity (Tons)	8.27	8.93	8.80	94%	101%	100%	8.1	8.8	8.64	94%	101%	93%	-	-	-
	EER	11.6	7.54	12.77	91%	59%	89%	9.2	6.0	10.16	91%	59%	154%	98%	151%	89%
	Power (kW)	11.58	14.3	9.40	123%	152%	100%	12.6	15.5	10.21	123%	152%	81%	-	-	-
Post-Adsil	Capacity (Tons)	7.86	18.57	8.19	96%	227%	100%	8.3	19.6	8.64	96%	227%	42%	-	-	-
	EER	8.8	15.59	10.45	84%	149%	92%	8.5	15.1	10.16	84%	149%	56%	106%	60%	92%

EER

7.54

15.59

EER Changes

Service Assistant	Condenser Test	Spreadsheet	
11.6	7.54	9.08	
8.8	15.59	9.32	
9.2	6.00	9.08	
8.5	15.15	9.32	
-7.7%	152.3%	2.7%	
76.0%	1522 3%	27 10/	
	11.6 8.8 9.2 8.5	11.6 7.54 8.8 15.59 9.2 6.00 8.5 15.15 -7.7% 152.3%	11.6 7.54 9.08 8.8 15.59 9.32 9.2 6.00 9.08 8.5 15.15 9.32 -7.7% 152.3% 2.7%

EPA Adsil Evaluation York Technical College Library Unit 2

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Trane YCH210B4 F14627920 RTU-Gas 1991 YTC - Library Unit 1	/		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton		10.2 10.2 17.29 13 6% 8.8 1.36	Btu/W-hr Btu/W-hr tons years (% degrad Btu/W-hr	(CU Only)
Compressor Data								
Running load Amps:	14.5	Amps		Power supply:		3-phase		
Nameplate Voltage: Power factor:	460	Volts		Phase adjustment:		1.73		
Power factor:	0.74			Compressor quantity:		2		
Condensing Fan Data								
Full load Amps:	3.00	Amps		Power supply:		3-Phase		
Nameplate Voltage:	460	Volts		Phase adjustment:		1.73		
Adjust FLA to RLA:	0.70			Fan quantity:		2		
Evaporator fan data (if a	nnlicable)							
Full load Amps:	7.60	Amps		Power supply:		3-Phase		
Nameplate Voltage:	460	Volts		Phase adjustment:		1.73		
Adjust FLA to RLA:	0.70	•		Fan quantity:		1		
Calculated compressor I Calculated condensing f Calculated evaporator fa Total calculated load for Assumptions	fan load: an load [,] equipment:		17.1 3.34 2.45 20.42	kW kW kW kW - Condensing side or	nly			
Condenser Coil Assesser Overall Unit Condition	nent	6.2%	Performa	nce Degradation				
New								
Average	1			FLUKE METER MEASU	REMENTS			
Fair				Y-measurement				
Poor				Phase	Volts	Amps	kW	PF
Coil Cleanliness				1				
Coated				2		Τ		T
Clean	0.9			3				
Dirty	0.1							
Clogged				Delta Measurement				
Plugged		-		Phase	Volts	Amps	kW	PF
1.109900		_		1 11400	10110	T		

Delte Measurement				
Delta Measurement) (- It-	A	1.1.47	DE
Phase	Volts	Amps	kW	PF
1 to 2 2 to 3	484 485	22.2 17.6	10.7 3.5	1.0 0.41
Z to 3	485	17.6	3.5	0.41
HVAC Service Assista		1		
Input SEER RAT	10	_		
	73			
SAT	53			
RAH	50	%		
SAH	85	%		
	Circuit 1 (only)			
El	84%			
CI	90%			
Input Cap		Tons		
OAT	75			
Predicted KW	12.70	kW		
	CU Capacity E	stimates		
Ambient	75	F	297	к
CU Exhaust	92	F	306	К
Coil Length	91	in		
Coil Width	48	in		
Area	30.3	sq-ft		
Measured Fan CFM	7488			
Air Mass Flow		kg/sec		
Capacity	11.46			
Efficiency	9.68	EER		

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	5.9
2	6.1
3	4.5
4	3.9
5	2.3
6	3.4
7	2.7
Average	4.1

Fin Condition

Fin-Tube Attachment

Tubes

Like New Some Bent

Smashed

Dull/rough

Corroded Pitted Flaking

Like New

Corrosion Some Loose Many Loose

Clean Cu

Corrosion Pitting Leaks 0.4

0.1

0.5

1

1

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Trane YCH210B4 F14627920 RTU-Gas 1991 YTC - Libra Unit 1			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.2 10.2 17.29 13 0% 9.3 1.29	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	14.5 460 0.74	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 2	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	3 460 0.7	Amps Volts		Power supply: Phase adjustment: Fan quantity:	3-Phase 1.73 2	
Evaporator fan data (if a Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	pplicable) 7.6 460 0.7	Amps Volts		Power supply: Phase adjustment: Fan quantity:	3-Phase 1.73 1	
Calculated compressor I Calculated condensing f Calculated evaporator fa Total calculated load for Assumptions	an load: In load		17.1 3.34 2.45 20.42	kW kW kW kW - Condensing side only		
Condenser Coil Assess	ment	0.0%	Performa	ance Degradation		

Condenser C Overall Unit C	oil Assessme	nt
	New	Х
	Average	
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	1
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

Y-measurement												
Phase	Volts	Amps	kW	PF								
1 2												
2 3												
3												
Delta Measurement												
Phase	Volts	Amps	kW	PF								
1 to 2 480 20.2 9.6 0.99												
2 to 3	484	14.8	2.2	0.30								
TOTAL				, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,								
HVAC Service Assista	nt Measurement											
Input SEER	10	T										
RAT	73	F										
SAT 53 F												
RAH 50 %												
SAH	85 %											
Circuit 1 (only)												
EI	93%	1										
CI	85%	1										
Input Cap	10	Tons										
OAT	85	F										
Predicted KW	11.10	kW										
	CU Capacity I	Estimates										
Ambient	86	F	303	к								
CU Exhaust	95	F	308	К								
Coil Length	91	in										
Coil Width	48	in										
Area		sq-ft										
Measured Fan CFM	22068											
Air Mass Flow		kg/sec										
Capacity		Tons										
Efficiency	17.17	FFR										

CU Fan CFM Calculation

Measurement	
Number	ft/sec
1	12.7
2	12.9
3	11.4
4	11.5
Average	12.13

YTC - Li	ibrary	Unit 1	Summa	ry								
EER at ARI	Conditions			10.2	BTU/W-	h	E	quipment age	13	years		
Condensing	g unit CFM			7488	CFM (M	easured)						
Nominal Un	it Capacity			17.29	tons							
Capacity us	ed for SA			10.00) tons							
Coil Area				30.33	sq-ft							
Predicted E	ER =			8.82	2 pre	9.32	post					
		HVAC	C Service As	ssistant				Phys	ical Power	and Capaci	ity measurn	nents
Test Date							Cond	Air, deg F		Cond Air		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
24-May	75	61	84%	90%	11.1	10.98	75	92	9.4	14.2	4.24	11.46
Post Adsil N	/leasurements											
14-Jun	85	61	93%	85%	10.3	9.60	86	94.5	4.7	11.8	12.50	16.88

	Conder			Condensing Unit Summary - ARI Conditions												
		Test Data			Percent Difference			Test Data					Pe	ercent Differenc	e	
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	10.98	14.2	8.06	136%	176%	100%	13.9	18.0	10.21	136%	176%	77%	-	-	-
Pre-Adsil	Capacity (Tons)	8.02	11.46	8.91	90%	129%	100%	7.8	11.1	8.64	90%	129%	70%	-	-	-
	EER	11.1	9.68	13.26	84%	73%	87%	8.5	7.4	10.16	84%	73%	115%	103%	119%	87%
	Power (kW)	9.60	11.8	9.09	106%	130%	100%	10.8	13.3	10.21	106%	130%	81%	-	-	-
Post-Adsil	Capacity (Tons)	7.10	16.88	8.35	85%	202%	100%	7.3	17.5	8.64	85%	202%	42%	-	-	-
	EER	10.3	17.17	11.03	93%	156%	92%	9.4	15.8	10.16	93%	156%	60%	93%	56%	92%

EER

9.68

17.17

EER Changes

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	11.1	9.68	8.82
Post Adsil EER	10.3	17.17	9.32
ARI Adjusted			
Pre-Adsil EER	8.5	7.42	8.82
Post Adsil EER	9.4	15.81	9.32
Change	10.7%	113.2%	5.7%

Weighted Average 107.1% 1131.7%

56.9%

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	American S TWA060A4 G06289343 Split-Syster 1992 YTC Hood 9 HP-2	00A2 n		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	 9.9 Btu/W 9.9 Btu/W 4.82 tons 12 years 5% (% de 8.8 Btu/W 1.37 	r-hr (CU Only) graded)
Compressor Data						
Running load Amps:	9.1	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Power factor:	0.77			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	0.90	Amps		Power supply:	1-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Evaporator fan data (if a	oplicable)					
Full load Amps:		Amps		Power supply:		
Nameplate Voltage:		Volts		Phase adjustment:		
Adjust FLA to RLA:				Fan quantity:		
Calculated compressor Calculated condensing Calculated evaporator fa Total calculated load for	fan Ioad: an Ioad		5.6 0.29 0.00 5.87	kW kW kW kW - Condensing side only		

Assumptions

Condenser C	oil Assessme	ent
Overall Unit C	ondition	
	New	
	Average	
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	
	Corrosion	
	Pitting	
	Leaks	

CU Fan CFM Calculation								
Number	ft/sec							
1								
2								
3								
4								
Average								

Brush Coils NA

FLUKE METER MEASUREMENTS									
Y-measurment	N / - 11 -		1.1.47	55					
Phase	Volts	Amps	kW	PF					
1 2									
3									
3									
Delta Measurement									
Phase	Volts	Amps	kW	PF					
1 to 2	Volto	7 anpo	NVV						
2 to 3									
HVAC Service Assistar	nt Measurment								
	COMP 1								
Input SEER	10								
RAT	77	F							
SAT	55	F							
RAH	43	%							
SAH	85	%							
EI	71%								
CI	44%								
Input Cap	5	Tons							
OAT	77								
Predicted KW	4.20	kW							
	CU Capacity	Estimates							
Ambient	-	F	-	К					
CU Exhaust	-	F	-	К					
Coil Length	-	in							
Coil Width	-	in							
Area	-	sq-ft							
Measured Fan CFM	-								
Air Mass Flow	-	kg/sec Tons							
Capacity Efficiency	-	EER							
LINCICIUCY	-	LER							

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	American Si TWA060A40 G06289343 Split-Systen 1992 YTC Hood 0 HP-2	00A2 1		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.9 9.9 4.82 12 0% 9.2 1.31	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	9.1	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460.0	Volts		Phase adjustment:	1.73	
Power factor:	0.8			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	0.9	Amps		Power supply:	1-Phase	
Nameplate Voltage:	460.0	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.7			Fan quantity:	1	
Evaporator fan data (if a	applicable)					
Full load Amps:	••••	Amps		Power supply:		
Nameplate Voltage:		Volts		Phase adjustment:		
Adjust FLA to RLA:				Fan quantity:		
Calculated compressor	load:		5.6	kW		
Calculated condensing	fan load:		0.29	kW		
Calculated evaporator fa			0.00	kW		
Total calculated load for Assumptions	r equipment:		5.87	kW - Condensing side only		
Condenser Coil Assess	ment	0.0%	Performa	ance Degradation		

Condenser C Overall Unit C	oil Assessmer	nt
Overall Onit C	New	x
	Average	^
	Fair	
0 1 01 1	Poor	
Coil Cleanline		
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	1
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Attac	0	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

CU Fan CFM Calculation								
Number	ft/sec							
1								
2								
3								
4								
Average								

FLUKE METER MEASURMENTS Y-measurment PF 1 - 2 - 3 - Delta Measurement Amps kW PF 1 to 2 - 2 to 3 - - HVAC Service Assistant Measurment COMP 1 Input SEER 10 RAT 72 F 52 RAH 50 % SAH 85 % EI 83% CI 79% Input Cap 5 OAT 74 Predicted KW 5.80 kW CU Capacity Estimates Ambient - F Ci Length - in Area - sq-ft Measured Fan CFM - in Air Mass Flow - Kg/sec Capacity - Tons										
Phase Volts Amps kW PF 1		JRMENTS								
1 1 2		1/-14-	A	1.3.67	DE					
2		Volts	Amps	KVV	PF					
3 Amps kW PF 1 to 2 2 to 3 2 to 3 1 1 HVAC Service Assistant Measurment COMP 1 Input SEER 10 RAT 72 SAT 52 RAH 50 SAH 85 EI 83% CI 79% Input Cap 5 OAT 74 Predicted KW 5.80 kW CU Capacity Estimates Ambient - - F Ci Length - - in Coil Width - - in Area - - sq-ft Measured Fan CFM - Air Mass Flow -	•									
Delta Measurement Phase Volts Amps kW PF 1 to 2										
Phase Volts Amps kW PF 1 to 2	5									
Phase Volts Amps kW PF 1 to 2	Delta Measurement									
1 to 2 1 2 to 3 Imput Set Assistant Measurment Input SEER 10 RAT 72 SAT 52 RAH 50 SAH 85 El 83% CI 79% Input Cap 5 OAT 74 Predicted KW 5.80 KW CU Capacity Estimates Ambient - Ci Length - Coil Length - Area - Area - Area - Air Mass Flow -		Volts	Amns	kW/	PF					
2 to 3 Image: Comp 1 HVAC Service Assistant Measurment COMP 1 Input SEER 10 RAT 72 SAT 52 RAH 50 % SAH 85 % EI 83% CI 79% Input Cap 5 Tons OAT 74 F Predicted KW 5.80 kW CU Capacity Estimates Ambient - F Coil Length - in Coil Width - in Area - sq-ft Measured Fan CFM - kg/sec		Volto	7 unpo							
HVAC Service Assistant Measurment COMP 1 Input SEER 10 RAT 72 F SAT 52 F RAH 50 % SAH 85 % EI 83% CI 79% Input Cap 5 Tons OAT 74 F Predicted KW 5.80 kW CU Capacity Estimates Ambient - F - K CU Exhaust - F - K Coil Length - in Coil Width - in Area - sq-ft Measured Fan CFM - Air Mass Flow - kg/sec										
COMP 1 Input SEER 10 RAT 72 SAT 52 RAH 50 SAH 85 EI 83% CI 79% Input Cap 5 OAT 74 Predicted KW 5.80 kW CU Capacity Estimates Ambient - CU Exhaust - Coil Length - - in Coil Width - Area - Area - Air Mass Flow - Kg/sec -		1								
Input SEER 10 RAT 72 SAT 52 RAH 50 SAH 85 Base 6 CI 79% Input Cap 5 OAT 74 Predicted KW 5.80 kW CU Capacity Estimates Ambient - CU Exhaust - Coil Length - - in Coil Width - - in Area - Area - Air Mass Flow - Kg/sec -	HVAC Service Assistar	t Measurment								
RAT 72 F SAT 52 F RAH 50 % SAH 85 % EI 83% 6 CI 79% 74 Input Cap 5 Tons OAT 74 F Predicted KW 5.80 kW CU Capacity Estimates Ambient - F - CU Exhaust - F - Coil Length - in Area - sq-ft Measured Fan CFM - kg/sec		COMP 1								
SAT 52 RAH 50 SAH 85 SAH 85 El 83% CI 79% Input Cap 5 OAT 74 F F Predicted KW 5.80 KW CU Capacity Estimates Ambient - F - K C01 Length - in Coil Length - - in Area - Area - Air Mass Flow - Kg/sec	Input SEER	10	ĺ							
RAH 50 % SAH 85 % EI 83% CI 79% Input Cap 5 Tons OAT 74 F Predicted KW 5.80 kW CU Capacity Estimates Ambient - F - K CU Exhaust - F - K Coil Length - in - Coil Width Area - sq-ft Measured Fan CFM - kg/sec		72	F							
SAH 85% EI 83% CI 79% Input Cap 5Tons OAT 74 F Predicted KW 5.80 kW CU Capacity Estimates Ambient - F - K CU Exhaust - F - K Coil Length - in Coil Width - in Area - sq-ft Measured Fan CFM - Air Mass Flow - kg/sec	SAT	52	F							
El 83% CI 79% Input Cap 5 OAT 74 Predicted KW 5.80 KW CU Capacity Estimates Ambient - F CU Exhaust - F Coil Length - in Coil Vidth - in Area - sq-ft Measured Fan CFM - kg/sec	RAH	50	%							
CI 79% Input Cap 5 Tons OAT 74 F Predicted KW 5.80 kW CU Capacity Estimates Ambient - F - K Coil Length - in Coil Width - in Area - sq-ft Measured Fan CFM - Air Mass Flow - kg/sec	SAH	85	%							
CI 79% Input Cap 5 Tons OAT 74 F Predicted KW 5.80 kW CU Capacity Estimates Ambient - F - K Coil Length - in Coil Width - in Area - sq-ft Measured Fan CFM - Air Mass Flow - kg/sec										
Input Cap 5 OAT 74 F Predicted KW 5.80 kW CU Capacity Estimates Ambient - F - K CU Exhaust - F - K Coil Length - in Coil Width - in Area - sq-ft Measured Fan CFM - Air Mass Flow - kg/sec	EI	83%								
OAT 74 Predicted KW 5.80 kW CU Capacity Estimates Ambient - F - K CU Exhaust - F - K Coil Length - in Coil Width - in Area - sq-ft Measured Fan CFM - Air Mass Flow - kg/sec	CI	79%								
Predicted KW 5.80 kW CU Capacity Estimates Ambient - F - K CU Exhaust - F - K Coil Length - in Coil Width - in Area - sq-ft Measured Fan CFM - Air Mass Flow - kg/sec	Input Cap	5	Tons							
CU Capacity Estimates Ambient - F - K CU Exhaust - F - K Coil Length - in - Coil Width - in Area - sq-ft - - - - - Measured Fan CFM - - kg/sec - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -	OAT	74	F							
Ambient - F - K CU Exhaust - F - K Coil Length - in - Coil Width - in Area - sq-ft - sq-ft - Areasured Fan CFM - - Kg/sec	Predicted KW	5.80	kW							
CU Exhaust - F - K Coil Length - in Coil Width - in Area - sq-ft Measured Fan CFM - Air Mass Flow - kg/sec		CU Capacity E	stimates							
CU Exhaust - F - K Coil Length - in Coil Width - in Area - sq-ft Measured Fan CFM - Air Mass Flow - kg/sec	A		-		K					
Coil Length - in Coil Width - in Area - sq-ft Measured Fan CFM - Air Mass Flow - kg/sec		-	-	-						
Coil Width - in Area - sq-ft Measured Fan CFM - Air Mass Flow - kg/sec		-	•	-	n					
Area - sq-ft Measured Fan CFM - Air Mass Flow - kg/sec		-								
Measured Fan CFM - Air Mass Flow - kg/sec		-								
Air Mass Flow - kg/sec		-	oy-ii							
5		-	ka/sec							
	Capacity	-	Tons							
Efficiency - EER		-								

YTC Ho EER at ARI Condensing Nominal Un Capacity us	unit CFM it Capacity		HP-2	NA 4.82	TY BTU/W-I CFM (Month tons			lipment age	12	years			
Coil Area				NA	sq-ft								
Predicted E	ER =			8.76	pre	9.16	post						
		HVAC S	ervice Ass	istant				Phys	ical Power	and Capaci	ity measurr	nents	
Test Date							Cond Air, deg F Cond Air				Ī		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons	Τ
24-May	77	62	71%	44%	8.5	4.05	NA	NA	NA	NA	NA	NA	T
Post Adsil M	leasurements												Τ
	74	62	83%	79%	10.4	5.59	NA	NA	NA	NA	NA	NA	Ĩ
													l

Condensing Unit Summary - Ambient Conditions					Condensing Unit Summary - ARI Conditions											
		Test Dat	a@ Field Co	onditions	Per	rcent Diff	ference	Te	est Data @	ARI			Pe	rcent Differenc	e	
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	4.05	NA	4.88	83%	NA	101%	4.8	NA	5.84	83%	NA	NA			
Pre-Adsil	Capacity (Tons)	2.14	NA	4.87	44%	NA	100%	2.1	NA	4.82	44%	NA	NA			
	EER	8.5	NA	11.98	71%	NA	89%	7.0	NA	9.90	71%	NA	NA	125%		88%
	Power (kW)	5.59	NA	4.75	118%	NA	101%	6.9	NA	5.84	118%	NA	NA			
Post-Adsil	Capacity (Tons)	3.91	NA	4.95	79%	NA	100%	3.8	NA	4.82	79%	NA	NA			
	EER	10.4	NA	12.49	83%	NA	93%	8.2	NA	9.90	83%	NA	NA	107%		93%

EER NA

NA

EER Changes											
Service Assistant Condenser Test Spreadsheet											
Pre-Adsil EER	8.5	NA	8.76								
Post Adsil EER	10.4	NA	9.16								
ARI Adjusted											
Pre-Adsil EER	7.0	NA	8.76								
Post Adsil EER	8.2	NA	9.16								
Change	16.9%	NA	4.6%								
Weighted Average	84.5%	NA	23.1%								

Manufacturer:	Carrier			Published EER:	9.4	Btu/W-hr (CU Only)	
Model Number:	38YCC036			Calculated EER:	9.4	Btu/W-hr (CU Only)	
Serial Number	3200E1924	7		Nominal Capacity:	2.84	tons	
Equipment Type:	Split Syster	n cool		Age	4	years	
Year Manufactured:	2000			Coil Conditon	5%	(% degraded)	
Location	YTC Hood	Center		Present Condition EER	8.9	Btu/W-hr	
Тад	HP-1			kW/ton	1.34		
Compressor Data							
Running load Amps:	11.1	Amps		Power supply:	3-Phase		
Nameplate Voltage:	230	Volts		Phase adjustment:	1.73		
Power factor:	0.77			Compressor quantity:	1		
Condensing Fan Data							
Full load Amps:	1.40	Amps		Power supply:	1-Phase		
Nameplate Voltage:	230	Volts		Phase adjustment:	1		
Adjust FLA to RLA:	0.70			Fan quantity:	1		
Evaporator fan data (if ap	plicable)						
Full load Amps:		Amps		Power supply:			
Nameplate Voltage:		Volts		Phase adjustment:			
Adjust FLA to RLA:				Fan quantity:			
Calculated compressor lo	oad:		3.4	kW			
Calculated condensing fa			0.23	kW			
Calculated evaporator far			0.11	kW			
Total calculated load for e			3.63	kW - Condensing side only			
Assumptions	•			5 ,			

Assumptions

Condenser C Overall Unit C	oil Assessme ondition	nt
	New	Х
	Average	
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	1
	Clean	
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	1
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	х
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	Х
	Corrosion	
	Pitting	
	Leaks	

CU Fan CFM	Calculation
Number	ft/sec
1	6.2
2	6.2
3	6.2
4	6.2
Average	6.2

5.0% Performance Degradation

FLUKE METER MEAS Y-measurment	UREMENTS			
Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	202	9.4	1.92	1
2 to 3	205	8.23	0.75	0.43
HVAC Service Assista				
	COMP 1	1		
Input SEER	10			
RAT	72			
SAT	55			
RAH	50			
SAH	85	%		
EI	105%			
CI	99%			
Input Cap	-	Tons		
OAT	79			
Predicted KW	3.50			
	CU Capacity E	stimates		
Ambient	79	F	299	к
CU Exhaust	87	-	304	
Coil Length	90	-	504	IX .
Coil Width	23			
Area		sq-ft		
Measured Fan CFM	5,348			
Air Mass Flow		kg/sec		
Capacity		Tons		
Efficiency	17.30	EER		

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38YCC036 3200E19247 Split System 2000 YTC Hood C HP-1	n cool		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.4 9.4 2.8 4 0% 9.4 1.28	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	11.1	Amps		Power supply:	3-Phase	
Nameplate Voltage:	230.0	Volts		Phase adjustment:	1.7	
Power factor:	0.77			Compressor quantity:	1.0	
Condensing Fan Data						
Full load Amps:	1.4	Amps		Power supply:	1-Phase	
Nameplate Voltage:	230.0	Volts		Phase adjustment:	1.0	
Adjust FLA to RLA:	0.7			Fan quantity:	1.0	
Evaporator fan data (if a	pplicable)					
Full load Amps:		Amps		Power supply:		
Nameplate Voltage:		Volts		Phase adjustment:		
Adjust FLA to RLA:				Fan quantity:		
Calculated compressor	load:		3.4	kW		
Calculated condensing	an load:		0.23	kW		
Calculated evaporator fa	an load		0.11	kW		
Total calculated load for Assumptions	equipment:		3.63	kW - Condensing side only		

0.0% Performance Degradation

Y-measurment				
Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	205	7.8	0.68	0.44
2 to 3	203	9.2	1.86	1.00
HVAC Service Assistar	t Moosurmont			
TIVAC SERVICE ASSISTER	COMP 1			
Input SEER	10			
RAT	72	F		
SAT	52	F		
RAH	50	%		
SAH	85	%		
EI	115%			
CI	117%			
Input Cap		Tons		
OAT	82			
Predicted KW	3.60			
	CU Capacity E			
Ambient	76	-	298	K
CU Exhaust	76 87	-	298 304	
	87 90	-	304	IX.
Coil Length Coil Width	90 23			
Area	14.4			
Measured Fan CFM	5865	oq−n		
Air Mass Flow		kg/sec		
Capacity		Tons		
Efficiency	27.43	FFR		

Condenser Coil Assessment Overall Unit Condition

Coil Cleanliness

Fin Condition

Fin-Tube Attachment

Tubes

New

Average Fair Poor

Coated Clean

Dirty Clogged Plugged

Like New

Like New

Corrosion Some Loose Many Loose

Clean Cu

Corrosion Pitting Leaks

> ft/sec 6.2

6.4

7.6

7.0

6.8

CU Fan CFM Calculation

Number

1

3

4

Average

Some Bent Smashed Dull/rough Corroded Pitted Flaking Х

1

1

х

x

YTC Hoo	od Center		HP-1	Summa	ry								
EER at ARI (Conditions			9.4	BTU/W-I	h	Eq	uipment age	4	years			
Condensing	unit CFM			5,348	CFM (M	easured)							
Nominal Unit	Capacity			2.84	tons								
Capacity use	ed for SA			3.00	tons								
Coil Area				14.38	sq-ft								
Predicted EE	R =			8.93	pre	9.37	post						
		HVAC	Service As	sistant				Phys	ical Power	and Capac	ity measurn	nents	
Test Date							Cond A	ir, deg F		Cond Air			
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons	1
24-May	79	60	105%	99%	11.0	3.32	79	87	4.4	2.67	3.03	3.85	1
Post Adsil M	easurements												1
13-Jun	82	60	115%	117%	11.7	3.41	76	87	6.1	2.54	3.32	5.81	Ī
													Ţ

	Conden	sing Unit S	Summary - A	mbient Con	ditions						Condensi	ng Unit Su	mmary - AR	I Conditions		
		Test Da	ata@ Field C	onditions	Per	rcent Diff	erence	Te	est Data @	ARI			Pe	rcent Differenc	9	
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	3.32	2.67	3.19	104%	84%	100%	3.8	3.0	3.64	104%	84%	124%	-	-	-
Pre-Adsil	Capacity (Tons)	2.76	3.85	2.79	99%	138%	100%	2.8	3.9	2.84	99%	138%	72%	-	-	-
	EER	11.0	17.30	10.48	105%	165%	95%	9.8	15.5	9.37	105%	165%	64%	91%	58%	95%
	Power (kW)	3.41	2.54	3.25	105%	78%	100%	3.8	2.8	3.64	105%	78%	134%	-	-	-
Post-Adsil	Capacity (Tons)	3.22	5.81	2.75	117%	211%	100%	3.3	6.0	2.84	117%	211%	55%	-	-	-
	EER	11.7	27.43	10.15	115%	270%	100%	10.8	25.3	9.37	115%	270%	43%	83%	35%	100%

EER 17.30

27.43

	EER Change	es	
	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	11.0	17.30	8.93
Post Adsil EER	11.7	27.43	9.37
ARI Adjusted			
Pre-Adsil EER	9.8	15.47	8.93
Post Adsil EER	10.8	25.34	9.37
Change	9.5%	63.8%	5.0%
Weighted Average	28.6%	191.3%	15.0%

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Trane YCH300B4 G071427640 RTU-Gas 1992 YTC - Hood Center RTU-9		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.3 10.3 22.67 12 4% 9.2 1.30	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor: Condensing Fan Data	17.7 Amps 460 Volts 0.87		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 2	
Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	3.00 Amps 460 Volts 0.70 Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 2	
Evaporator fan data (if ap Full load Amps: Nameplate Voltage: Adjust FLA to RLA: Calculated compressor I Calculated condensing fa Calculated evaporator fa	11.00 Amps 460 Volts 0.70 oad: an load:	24.5 1.93 3.54	Power supply: Phase adjustment: Fan quantity: kW kW kW	3-Phase 1.73 1	
Total calculated load for Assumptions		26.44	kW - Condensing side only		

Condenser C Overall Unit C	oil Assessme	nt
	New	
	Average	1
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	0.9
	Dirty	0.1
	Clogged	
	Plugged	
Fin Condition		
	Like New	0.9
	Some Bent	0.1
	Smashed	
	Dull/rough	0.5
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	
	Corrosion	
	Pitting	
	Leaks	

3.7% Performance Degradation

FLUKE METER MEAS	UREMENTS			
Y-measurement				
Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	486	40.4	19.6	1
2 to 3	485	37.6	8.6	0.47
TOTAL	•			
HVAC Service Assista	nt Measurement			
Input SEER	10	Ι		
RAT	70	F		
SAT	50	F		
RAH	50	%		
SAH	85	%		
	Circuit 1	Ι	Circuit 2	
EI	88%	Ι	91%	
CI	90%	I	91%	
Input Cap	12.5	Tons	12.5	Tons
OAT	76	F	76	F
Predicted KW	15.30	kW	15.10	kW
	CU Capacity I	Estimates		
Ambient	73	F	296	к
CU Exhaust	108.5		316	
Coil Length	109	in		
Coil Width	48	in		
Area	36.3	sq-ft		
Measured Fan CFM	12063			
Air Mass Flow	6.83	kg/sec		
Capacity	38.54	Tons		
Efficiency	16.40	EER		

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	3.9
2	2.9
3	10.2
4	10.2
5	2.7
6	3.3
Average	5.5

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Trane YCH300B4 G07142764 RTU-Gas 1992 YTC - Hooo RTU-9	10		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.3 10.3 22.67 12 0% 9.5 1.26	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	17.7	Amps		Power supply:	3-phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Power factor:	0.87			Compressor quantity:	2	
Condensing Fan Data						
Full load Amps:	3	Amps		Power supply:	1-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.7			Fan quantity:	2	
Evaporator fan data (if	applicable)					
Full load Amps:	11	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.7			Fan quantity:	1	
Calculated compressor	· load:		24.5	kW		
Calculated condensing	fan load:		1.93	kW		
Calculated evaporator			3.54	kW		
Total calculated load for	or equipment:		26.44	kW - Condensing side only		
•	• •			5,		

Total calculated load for equipment: Assumptions

Condenser Coil Assessment Overall Unit Condition

Overall Unit C	onation	
	New	х
	Average	
	Fair	
	Poor	
Coil Cleanline	ss	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	0
	Smashed	0
	Dull/rough	
	Corroded	0
	Pitted	0
	Flaking	0
Fin-Tube Attac	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

0.0% Performance Degradation

Y-measurement Phase	Volts	Amps	kW	PF
1	V GIRG	7 11100		
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	483	38.2	18.5	1
2 to 3	484	16.3	8.3	0.48
TOTAL	.04	. 5.0	0.0	5.40
HVAC Service Assista	nt Measurement			
Input SEER	10			
RAT	72	F		
SAT	52	F		
RAH	50			
SAH	85			
	Circuit 1		Circuit 2	T
EI	102%		100%	Ì
CI	103%		100%	1
Input Cap	12.5	Tons	12.5	Tons
OAT	90	F	88	F
Predicted KW	15.20	kW	14.90	kW
	CU Capacity E	stimates		
Ambient	85	F	303	к
CU Exhaust	105	F	314	К
Coil Length	109	in		
Coil Width	48	in		
Area	36.3	sq-ft		
Measured Fan CFM	30084			
Air Mass Flow		kg/sec		
Capacity	54.15	Tons		

CU Fan CFM	Calculation
Measurement	
Number	Ft/Sec
1	16.0
2	6.8
3	15.8
4	13.9
5	12.2
6	15.6
7	17.0
8	13.1
Average	13.8

YTC - Ho	od Center		RTU-9	Summa	ry							
EER at ARI C	Conditions			10.3	BTU/W-	h	Equ	ipment age	12	years		
Condensing u	unit CFM			12063	B CFM (M	easured)						
Nominal Unit	Capacity			22.67	7 tons							
Capacity use	d for SA			25.00) tons							
Coil Area				36.33	3 sq-ft							
Predicted EE	R =			9.21	l pre	9.53	post					
		HVAC	C Service A	ssistant				Phys	ical Power	and Capac	ity measurn:	nents
Test Date		HVAC	Service A	ssistant			Cond Ai	,	ical Power	and Capac Cond Air	ity measurn	nents
Test Date	OAT	HVAC EWB	EI	CI	EER	kW	Cond Ai inlet	,	ical Power ∆T (K)		(kg/sec)	nents tons
Test Date	OAT 76				EER 11.4	kW 27.56		r, deg F		Cond Air		
24-May	76	EWB	EI	CI			inlet	r, deg F exhaust	ΔT (K)	Cond Air kW	(kg/sec)	tons
	76	EWB	EI	CI			inlet	r, deg F exhaust	ΔT (K)	Cond Air kW	(kg/sec)	tons

Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions										
			Test Data	l	Percent Difference			Test Data Per				rcent Differenc	cent Difference			
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	27.56	28.2	22.42	123%	126%	94%	34.5	35.3	28.05	123%	126%	98%	-	-	-
Pre-Adsil	Capacity (Tons)	21.63	38.54	23.90	91%	161%	95%	21.7	38.7	23.98	91%	161%	56%	-	-	-
	EER	11.4	16.40	12.79	90%	128%	90%	9.2	13.2	10.26	90%	128%	70%	100%	70%	90%
	Power (kW)	27.29	26.8	26.35	104%	102%	94%	29.0	28.5	28.05	104%	102%	102%	-	-	-
Post-Adsil	Capacity (Tons)	19.98	54.15	22.08	91%	245%	95%	21.7	58.8	23.98	91%	245%	37%	-	-	-
	EER	10.2	24.25	10.05	101%	241%	93%	10.4	24.7	10.26	101%	241%	42%	89%	37%	93%

EER

16.40

24.25

tons 38.54

54.15

EER Changes

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	11.4	16.40	9.21
Post Adsil EER	10.2	24.25	9.53
ARI Adjusted			
Pre-Adsil EER	9.2	13.15	9.21
Post Adsil EER	10.4	24.74	9.53
Change	12.8%	88.1%	3.4%
Weighted Average	321.2%	2203.0%	85.6%

EPA Adsil Evaluation York Technical College RTU-9

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Trane YCH300B4 G071427640 RTU-Gas 1992 YTC - Hood Center RTU-5		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.6 9.6 23.98 12 0% 8.8 1.36	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data					
Running load Amps:	17.7 Amp		Power supply:	3-phase	
Nameplate Voltage:	460 Volts		Phase adjustment:	1.73	
Power factor:	0.95		Compressor quantity:	2	
Condensing Fan Data					
Full load Amps:	3.00 Amp		Power supply:	3-Phase	
Nameplate Voltage:	460 Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.70		Fan quantity:	2	
Evaporator fan data (if a	pplicable)				
Full load Amps:	11.00 Amp		Power supply:	3-Phase	
Nameplate Voltage:	460 Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.70		Fan quantity:	1	
Calculated compressor	oad:	26.8	kW		
Calculated condensing f	an load:	3.34	kW		
Calculated evaporator fa	in load	3.54	kW		
Total calculated load for Assumptions		30.11	kW - Condensing side only		

Condenser C Overall Unit C	oil Assessme	nt
	New	
	Average	
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	
	Corrosion	
	Pitting	
	Leaks	

0.0% Performa	ance Degradation
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FLUKE METER MEAS	SUREMENTS			
Y-measurement Phase	Volts	A.m.n.o.	L/M/	PF
1	VOILS	Amps	kW	PF
2				
3				
0				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	488	22.7	11	1
2 to 3	488	18.9	3.9	0.42
TOTAL				
HVAC Service Assista	nt Measurement	_		
Input SEER	10	-		
RAT		F		
SAT		F		
RAH		%		
SAH	85	%		
	Circuit 1 (only)			
El	100%			
CI	98%			
Input Cap	15	Tons		
OAT	80	F		
Predicted KW	17.80	kW		
	CU Capacity	Estimates		
Ambient	90	F	300	K
CU Exhaust		F	300	
Coil Length	109		300	IX.
Coil Width		in		
Area		sq-ft		
Measured Fan CFM	29793	•		
Air Mass Flow		kg/sec		
Capacity		Tons		
Efficiency	23.75	EER		

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	15.2
2	14.5
3	12.7
4	12.5
5	15.4
6	11.7
Average	13.667

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Trane YCH300B4 G07142764 RTU-Gas 1992 YTC - Hood RTU-5	-		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.6 9.6 23.98 12 0% 8.8 1.36	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	17.7	Amps		Power supply:	3-phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Power factor:	0.95			Compressor quantity:	2	
Condensing Fan Data						
Full load Amps:	3	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.7			Fan quantity:	2	
Evaporator fan data (if a	pplicable)					
Full load Amps:	11	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.7			Fan quantity:	1	
Calculated compressor I	load:		26.8	kW		
Calculated condensing f	an load:		3.34	kW		
Calculated evaporator fa	an load		3.54	kW		
Total calculated load for Assumptions	equipment:		30.11	kW - Condensing side only		

Performance Degradation

ſ

0.0%

Condenser Coil Assessment Overall Unit Condition New Х Average Fair Poor Coil Cleanliness Coated Clean 1 Dirty Clogged Plugged Fin Condition Like New Some Bent 0 Smashed 0 Dull/rough Corroded 0 Pitted 0 Flaking 0 Fin-Tube Attachment Like New x Corrosion Some Loose Many Loose Tubes Clean Cu х Corrosion Pitting

Leaks

Y-measurement						
Phase	Volts	Amps	kW	PF		
1						
2						
3						
Dalla Marana						
Delta Measurement	14-16-	A	1.1.4/			
Phase	Volts	Amps	kW	PF		
1 to 2	488	23.4	11.1	0.99		
2 to 3 TOTAL	488	19.1	3.7	0.40		
HVAC Service Assistan	t Maaauramant					
Input SEER	t Measurement 10	7				
RAT		r F				
SAT		F				
RAH						
SAH	50 % 85 %					
бап	Circuit 1 (only)	70				
EI	101%	-				
CI	101%					
•••		Tons				
Input Cap OAT		F				
OAT Predicted KW						
Predicted KW	18.30	KVV				
	CU Capacity	Estimates				
Ambient	78	F	299	к		
CU Exhaust	87	F	304	к		
Coil Length	109	in				
Coil Width	48	in in				
Area	36.3	sq-ft				
Measured Fan CFM	29021					
Air Mass Flow	16.44	kg/sec				
Capacity	23.51	Tons				
Efficiency	19.06					

CU Fan CFM Calculation							
Measurement							
Number	ft/sec						
1	15.4						
2	12.7						
3	14.6						
4	13.9						
5	12.9						
6	11.1						
7	15.2						
8	10.7						
Average	13.31						

YTC - He	ood Center		RTU-5	Summa	ry							
EER at ARI	Conditions			9.6	BTU/W-	h	Equ	ipment age	12	years		
Condensing	unit CFM			29793	CFM (M	easured)						
Nominal Uni	it Capacity			23.98	tons							
Capacity us	ed for SA			15.00	tons							
Coil Area				36.33	sq-ft							
Predicted El	ER =			8.85	pre	8.85	post					
		HVAC	C Service A	ssistant				Phys	ical Power	and Capac	ity measurn	nents
Test Date		HVAC	C Service A	ssistant			Cond Air		ical Power	and Capac Cond Air	ity measurn	nents
Test Date	OAT	HVA0 EWB	EI	cl	EER	kW	Cond Air		ical Power ∆T (K)		ity measurn (kg/sec)	nents tons
Test Date 24-May	OAT 80	-			EER 10.8	kW 14.23		, deg F		Cond Air		
		EWB	EI	CI			inlet	, deg F exhaust	ΔТ (К)	Cond Air kW	(kg/sec)	tons
24-May		EWB	EI	CI			inlet	, deg F exhaust	ΔТ (К)	Cond Air kW	(kg/sec)	tons

Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions										
			Test Data	l	Per	rcent Diff	erence		Test Data Percent Difference						e	
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	14.23	14.9	12.97	110%	115%	101%	16.4	17.2	14.95	110%	115%	95%	-	-	-
Pre-Adsil	Capacity (Tons)	11.46	29.49	11.69	98%	252%	100%	11.7	30.2	11.99	98%	252%	39%	-	-	-
	EER	10.8	23.75	10.82	100%	220%	92%	9.6	21.1	9.62	100%	220%	46%	92%	42%	92%
	Power (kW)	14.63	14.8	12.50	117%	118%	101%	17.5	17.7	14.95	117%	118%	99%	-	-	-
Post-Adsil	Capacity (Tons)	12.24	23.51	11.88	103%	198%	100%	12.3	23.7	11.99	103%	198%	52%	-	-	-
	EER	11.5	19.06	11.41	101%	167%	92%	9.7	16.1	9.62	101%	167%	60%	91%	55%	92%

tons

29.49

23.51

EER

23.75

19.06

EER	Changes
	Changes

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	10.8	23.75	8.85
Post Adsil EER	11.5	19.06	8.85
ARI Adjusted			
Pre-Adsil EER	9.6	21.13	8.85
Post Adsil EER	9.7	16.08	8.85
Change	1.0%	-23.9%	0.0%
Mainhtad Average	15.0%	250 70/	0.0%
Weighted Average	15.0%	-358.7%	0.0%

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Trane SFHD030 J97M72722 RTU-Gas 1991 YTC - Hood RTU-6			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.7 9.7 28.74 13 13% 8.0 1.51	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	27.3	Amps		Power supply:	3-phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Power factor:	0.75			Compressor quantity:	2	
Condensing Fan Data						
Full load Amps:	1.80	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.70			Fan quantity:	3	
Evaporator fan data (if a	pplicable)					
Full load Amps:	10.80	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Calculated compressor	load:		32.6	kW		
Calculated condensing	fan load:		3.01	kW		
Calculated evaporator fa	an load		3.48	kW		
Total calculated load for	r equipment:		35.60	kW - Condensing side only		
•				• •		

Assumptions

Condenser Coil Assessment Overall Unit Condition

Overall Unit C	onulion	
	New	
	Average	1
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	
	Dirty	0.5
	Clogged	0.4
	Plugged	0.1
Fin Condition		
	Like New	
	Some Bent	0.05
	Smashed	
	Dull/rough	0.75
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	
	Corrosion	
	Pitting	
	Leaks	

CU Fan CFM Calculation							
Measurement							
Number	ft/sec						
1	NA						
2	NA						
3	NA						
Average	NA						

V_meas

12.7% Performance Degradation

Y-measurement									
Phase	Volts	Amps	kW	PF					
1									
2									
3									
Delta Measurement									
Phase	Volts	Amps	kW	PF					
1 to 2	NA	NA	NA	NA					
2 to 3	NA	NA	NA	NA					
TOTAL		•							
HVAC Service Assistar	t Measurement								
Input SEER	10	1							
RAT	72	F							
SAT	52	F							
RAH	50	%							
SAH	85	%							
	Circuit 1	Two comp.	on one cir	cuit					
El	103%								
CI	98%								
Input Cap	30	Tons							
OAT	84	F							
Predicted KW	34.50	kW							
CU Capacity Estimates									
Ambient	NA	F	NA	к					
CU Exhaust	NA	F	NA	K					
Coil Length	NA	in		IX I					
Coil Width	NA	in							
Area	NA	sq-ft							
Measured Fan CFM	NA	0 9 -11							
Air Mass Flow	NA	kg/sec							
Capacity	NA	Tons							
Efficiency	NA	EER							

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Trane SFHD030 J97M72722 RTU-Gas 1991 YTC - Hood RTU-6			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.7 9.7 28.74 13 0% 8.9 1.35	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	27.3	Amps		Power supply:	3-phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Power factor:	0.75			Compressor quantity:	2	
Condensing Fan Data						
Full load Amps:	1.8	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.7			Fan quantity:	3	
Evaporator fan data (if a	oplicable)					
Full load Amps:	10.8	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.7			Fan quantity:	1	
Calculated compressor I	oad:		32.6	kW		
Calculated condensing fa	an load:		3.01	kW		
Calculated evaporator fa	n load		3.48	kW		
Total calculated load for Assumptions	equipment:		35.60	kW - Condensing side only		

Condenser C Overall Unit C	oil Assessme ondition	nt
	New	х
	Average	
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	1
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

0.0% Pe	rformance	Degradation
---------	-----------	-------------

FLUKE METER MEAS	SUREMENTS							
Y-measurement								
Phase	Volts	Amps	kW	PF				
1								
2								
3								
Delta Measurement								
Phase	Volts	Amps	kW	PF				
1 to 2								
2 to 3								
TOTAL								
HVAC Service Assista	nt Measurement							
Input SEER	1()						
RAT	70) F						
SAT	50) F						
RAH	65	5 %						
SAH	85	5 %						
	Circuit 1 (only)							
EI	102%	Ó						
CI	99%	, D						
Input Cap	30) Tons						
OAT	78	3 F						
Predicted KW	35.00	kW						
CU Capacity Estimates								
Ambient	NA	F	NA	к				
CU Exhaust	NA	F	NA	К				
Coil Length	NA	in						
Coil Width	NA	in						
Area	NA	sq-ft						
Measured Fan CFM	NA	-						
Air Mass Flow	NA	kg/sec						
Capacity	NA	Tons						
Efficiency	NA	EER						

CU Fan CFM Calculation						
Measurement						
Number	ft/sec					
1	NA					
2	NA					
3	NA					
4	NA					
Average	NA					

YTC - H	lood Center		RTU-6	Summa	ry							
EER at AR	I Conditions			9.7	BTU/W-	h	Equ	uipment age	13	3 years		
Condensing	g unit CFM			NA	CFM (M	easured)						
Nominal Ur	nit Capacity			28.74	tons							
Capacity us	sed for SA			30.00	tons							
Coil Area				NA	sq-ft							
Predicted E	ER =			7.96	pre	8.89	post					
		HVAC	C Service A	ssistant				Phys	ical Powe	r and Capa	city measurn	nents
Test Date							Cond A	ir, deg F		Cond Air		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
24-May	84	60	103%	98%	11.1	33.05	NA	NA	NA	NA	NA	NA
Doot Adoil	Veasurements											
PUSt AdSILL	vieasurements											

11.9

33.53

NA

Condensing Unit Summary - Ambient Conditions							Condensing Unit Summary - ARI Conditions									
			Test Data	l	Per	rcent Diff	erence		Test Data	1	Percent Difference					
ΟΑΤ		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Predicted/ Original
	Power (kW)	33.05	NA	30.00	110%	NA	100%	39.2	NA	35.57	110%	NA	NA	-	-	-
Pre-Adsil	Capacity (Tons)	26.31	NA	26.85	98%	NA	100%	28.2	NA	28.74	98%	NA	NA	-	-	-
	EER	11.1	NA	10.74	103%	NA	82%	10.0	NA	9.70	103%	NA	NA	80%	NA	82%
	Power (kW)	33.53	NA	27.66	121%	NA	100%	43.1	NA	35.57	121%	NA	NA	-	-	-
Post-Adsil	Capacity (Tons)	26.72	NA	26.99	99%	NA	100%	28.5	NA	28.74	99%	NA	NA	-	-	-
	EER	11.9	NA	11.71	102%	NA	92%	9.9	NA	9.70	102%	NA	NA	81%	NA	92%

NA

NA

NA

NA

EER

NA

NA

tons NA

NA

EED	Changes	
EER	Changes	

102%

99%

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	11.1	NA	7.96
Post Adsil EER	11.9	NA	8.89
ARI Adjusted			
Pre-Adsil EER	10.0	NA	7.96
Post Adsil EER	9.9	NA	8.89
Change	-1.0%	NA	11.7%
Weighted Average	-29.1%	NA	349.5%

EPA Adsil Evaluation York Technical Center RTU-6

14-Jun

78

59
Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Trane SFHCC25 J91M72724 RTU-Gas 1991 YTC - Hood Center RTU-7		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.7 9.7 24.30 13 11% 8.1 1.48	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	27.3 Amps 460 Volts 0.62		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 2	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.80 Amps 460 Volts 0.70		Power supply: Phase adjustment: Fan quantity:	3-Phase 1.73 3	
Evaporator fan data (if a Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	pplicable) 7.30 Amps 460 Volts 0.70		Power supply: Phase adjustment: Fan quantity:	3-Phase 1.73 1	
Calculated compressor Calculated condensing Calculated evaporator fa Total calculated load for Assumptions	fan Ioad: an Ioad	26.9 3.01 2.35 29.95	kW kW kW kW - Condensing side only		

11.5% Performance Degradation

Condenser C Overall Unit C	oil Assessme ondition	nt
	New	
	Average	1
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	
	Dirty	0.5
	Clogged	0.5
	Plugged	
Fin Condition		
	Like New	1
	Some Bent	
	Smashed	
	Dull/rough	0.75
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	
	Corrosion	
	Pitting	
	Leaks	

CU Fan CFM Calculation							
Measurement							
Number	ft/sec						
1	NA						
2	NA						
3	NA						
Average	NA						

FLUKE METER MEAS	JREMENTS								
Y-measurement									
Phase	Volts	Amps	kW	PF					
1									
2									
3									
Della Managerat									
Delta Measurement				55					
Phase	Volts	Amps	kW	PF					
1 to 2	NA	NA	NA	NA					
2 to 3	NA	NA	NA	NA					
TOTAL									
HVAC Service Assistar									
Input SEER		10							
RAT		70 F							
SAT		50 F							
RAH	Į	55 %							
SAH	8	35 %							
	Circuit 1								
EI	79	%							
CI	82%								
Input Cap	25 Tons								
OAT		70 F							
Predicted KW		30 kW							
	CU Capacity	y Estimates							
Ambient	NA	F	NA	к					
CU Exhaust	NA	F	NA	к					
Coil Length	NA	in	-						
Coil Width	NA	in							
Area	NA	sq-ft							
Measured Fan CFM	NA	54 10							
Air Mass Flow	NA	kg/sec							
Capacity	NA	Tons							
Efficiency	NA	EER							

EPA Adsil Evaluation York Technical College RTU-7

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Trane SFHCC25 J91M72724 RTU-Gas 1991 YTC - Hood RTU-7			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.7 9.7 24.30 13 0% 8.9 1.34	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	27.3 460 0.62	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 2	
Condensing Fan Data Full load Amps: Nameplate Voltage:	1.8 460	Amps Volts		Power supply: Phase adjustment:	2 3-Phase 1.73	
Adjust FLA to RLA:	0.7	VOIIS		Fan quantity:	3	
Full load Amps:	7.3	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.7			Fan quantity:	1	
Calculated compressor Calculated condensing f Calculated evaporator fa Total calculated load for Assumptions	fan load: an load		26.9 3.01 2.35 29.95	kW kW kW kW - Condensing side only		
Condenser Coil Assess Overall Unit Condition	ment	0.0%	Performa	ance Degradation		

	Marin	v
	New	Х
	Average	
	Fair	
	Poor	
Coil Cleanline		
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	1
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	0	
	Like New	x
	Corrosion	^
	Some Loose	
	Many Loose	
Tubes	wany Loose	
Tubes	01	
	Clean Cu	X
	Corrosion	
	Pitting	
	Leaks	

Y-measurement Phase	Volts	Amps	kW		PF				
1	Volto	741100		1					
2									
3									
Dalla Manager									
Delta Measurement	1/-14-	A	1.14/		DE				
Phase	Volts	Amps	kW	1	PF				
1 to 2				_					
2 to 3 TOTAL			I						
HVAC Service Assistant									
Input SEER 10 RAT 70 F									
	50 F								
SAT RAH	65 %								
SAH		85 %							
	Circuit 1 (only								
EI	109%								
CI	108%								
Input Cap	25 Tons								
OAT	85 F								
Predicted KW	29.	60 kW							
	CU Capacit	y Estimates							
Ambient	NA	F	NA	к					
CU Exhaust	NA	F	NA	к					
Coil Length	NA	in							
Coil Width	NA	in							
Area	NA	sq-ft							
Measured Fan CFM	NA	-							
Air Mass Flow	NA	kg/sec							
Capacity	NA	Tons							
Efficiency	NA	EER							

Calculation
ft/sec
NA

YTC - H	ood Center		RTU-7	Summai	ry							
EER at AR	I Conditions			9.7	BTU/W-	h	Equ	ipment age	13	years		
Condensing	g unit CFM			NA	CFM (M	easured)						
Nominal Ur	nit Capacity			24.30	tons							
Capacity us	sed for SA			25.00	tons							
Coil Area				NA	sq-ft							
Predicted E	ER =			8.08	pre	8.93	post					
		HVAC	C Service A	ssistant				Phys	ical Power	and Capac	ity measurr	nents
Test Date							Cond Air	Cond Air, deg F Cond Air				
	OAT	EWB	El	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
24-May	70	60	79%	82%	10.2	29.94	NA	NA	NA	NA	NA	NA
Post Adsil N	Measurements											

11.4

28.77

NA

108%

Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions										
			Test Data	l	Per	rcent Diff	erence		Test Data	1	Percent Difference					
ΟΑΤ		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Predicted/ Original
	Power (kW)	29.94	NA	22.25	135%	NA	99%	40.5	NA	30.11	135%	NA	NA	-	-	-
Pre-Adsil	Capacity (Tons)	19.54	NA	23.83	82%	NA	100%	19.9	NA	24.30	82%	NA	NA	-	-	-
	EER	10.2	NA	12.85	79%	NA	83%	7.7	NA	9.69	79%	NA	NA	106%	NA	83%
	Power (kW)	28.77	NA	26.83	107%	NA	99%	32.3	NA	30.11	107%	NA	NA	-	-	-
Post-Adsil	Capacity (Tons)	25.21	NA	23.34	108%	NA	100%	26.2	NA	24.30	108%	NA	NA	-	-	-
	EER	11.4	NA	10.44	109%	NA	92%	10.6	NA	9.69	109%	NA	NA	77%	NA	92%

NA

NA

NA

NA

EER

NA

NA

tons NA

NA

EER Changes

109%

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	10.2	NA	8.08
Post Adsil EER	11.4	NA	8.93
ARI Adjusted			
Pre-Adsil EER	7.7	NA	8.08
Post Adsil EER	10.6	NA	8.93
Change	38.0%	NA	10.5%
Weighted Average	949.4%	NA	262.6%

NA

262.6%

EPA Adsil Evaluation York Technical College RTU-7

14-Jun

85

62

Compressor Data	led)
Running load Amps: 18.2 Amps Power supply: 3-phase	
Nameplate Voltage: 460 Volts Phase adjustment: 1.73	
Power factor: 0.72 Compressor quantity: 2	
Condensing Fan Data	
Full load Amps: 1.80 Amps Power supply: 3-Phase	
Nameplate Voltage: 460 Volts Phase adjustment: 1.73	
Adjust FLA to RLA: 0.70 Fan quantity: 2	
Evaporator fan data (if applicable)	
Full load Amps: 7.30 Amps Power supply: 3-Phase	
Nameplate Voltage: 460 Volts Phase adjustment: 1.73	
Adjust FLA to RLA: 0.70 Fan quantity: 1	
Calculated compressor load: 20.9 kW	
Calculated condensing fan load: 2.01 kW	
Calculated evaporator fan load 2.35 kW	
Total calculated load for equipment: 22.86 kW - Condensing side only	

Total calculated load for equipment: Assumptions

Condenser Coil Assessment Overall Unit Condition



14.8% Performance Degradation

FLUKE METER MEA Y-measurement	SUREMENTS			
Phase	Volts	Amps	kW	PF
1				
2				
3				
Della Manager				
Delta Measurement	1 (- 1) -	A	1.3.67	
Phase	Volts	Amps	kW	PF
1 to 2	490	20.7	9.7	0.96
2 to 3 TOTAL	490	19.1	2.3	0.25
HVAC Service Assista		1		
Input SEER RAT	10	-		
SAT				
	50			
RAH	60			
SAH	85	%		
-	Circuit 1			
El	120%			
CI	116%			
Input Cap		Tons		
OAT	76			
Predicted KW	11.80	kW		
	CU Capacity E	stimates		
Ambient	76	F	298	к
CU Exhaust	89		305	
Coil Length	63		200	
Coil Width	71			
Area	31.1	sq-ft		
Measured Fan CFM	20719	•		
Air Mass Flow		kg/sec		
Capacity	24.24			
Efficiency	24.24	EER		

CU Fan CFM Calculation						
Measurement						
Number	ft/sec					
1	12.3					
2	10.9					
3	10.9					
4	12.1					
5	10.9					
6	9.6					
Average	11.1					

Note: * Published EER value from 25-ton Trane model YCH300B4. ARI efficiency data not available for this unit

		1 031	Ausinn	VAC Dat		Conculation			
Manufacturer Model Numbe	er:	Trane SFHCC20			Published EER: Calculated EER:		9.7 9.7	Btu/W-hr Btu/W-hr	(CU Only (CU Only
Serial Numbe		J91M72723			Nominal Capacity:		18.41	tons	
Equipment T		RTU-Gas			Age		13	years	
Year Manufac	ctured:	1991 VTC Upod	Contor		Coil Conditon		0%	(% degrad	led)
Location		YTC - Hood	Center		Present Condition E	EK	8.9	Btu/W-hr	
Тад		RTU-8			kW/ton		1.35		
Compressor									
Running load		18.2	Amps		Power supply:		3-phase		
Nameplate Vo	ltage:	460	Volts		Phase adjustment:		1.73		
Power factor:		0.72			Compressor quantity:		2		
Condensing	Fan Data								
Full load Amp	s:	1.8	Amps		Power supply:		3-Phase		
Nameplate Vo	ltage:	460	Volts		Phase adjustment:		1.73		
Adjust FLA to	RLA:	0.7			Fan quantity:		2		
Evaporator fa	an data (if app	olicable)							
Full load Amp		7.3	Amps		Power supply:		3-Phase		
Nameplate Vo	ltage:	460	Volts		Phase adjustment:		1.73		
Adjust FLA to	RLA:	0.7			Fan quantity:		1		
Calculated co	ompressor loa	ad:		20.9	kW				
Calculated co	ondensing far	n load:		2.01	kW				
	aporator fan			2.35	kW				
Total calculat Assumptions	ted load for e	quipment:		22.86	kW - Condensing side	only			
Condenser C	oil Assessme	ant	0.0%	Performa	Ince Degradation				
Overall Unit C				i chonna	Segradation				
	New	х							
	Average		_		FLUKE METER MEAS	SUREMENTS			
	Fair				Y-measurement				
	Poor				Phase	Volts	Amps	kW	PF
Coil Cleanline	SS				1				
	Coated				2				
	Clean	1			3				
	Dirty								
	Clogged				Delta Measurement				
	Plugged		-		Phase	Volts	Amps	kW	PF
Fin Condition	i laggea		-		1 to 2	488	23.4	11.1	0.99
	Like New	1	-1		2 to 3	488	19.1	3.7	0.99
		<u> </u>	-		Z to 3 TOTAL	400	19.1	3.1	0.40
	Some Bent		-		-				
	Smashed		4		HVAC Service Assista				
	Dull/rough		_		Input SEER	10			
	Corroded				RAT	70			
	Pitted				SAT	50	F		
	Flaking				RAH	65	%		
Fin-Tube Atta	chment				SAH	85	%		
	Like New	x	1			Circuit 1 (only)			
	Corrosion		-1		EI	128%			
	Some Loose	. <u> </u>	-1		CI	129%			
		-	-1		Input Cap		Tons		
- .	Many Loose		-						
Tubes			-		OAT	78			
	Clean Cu	x	_		Predicted KW	12.10	kW		
	Corrosion								
	Pitting					CU Capacity E	stimates		
	Looko				1				

RAT	70	F	
SAT	50	F	
RAH	65	%	
SAH	85	%	
	Circuit 1 (only)		
EI	128%		
CI	129%		
Input Cap	10	Tons	
OAT	78	F	
Predicted KW	12.10	kW	
	CU Capacity E	stimates	
Ambient	CU Capacity E		299 K
Ambient CU Exhaust		F	299 K 306 K
	. , 79	F	
CU Exhaust	79 91	F F in	
CU Exhaust Coil Length	79 91 63	F F in in	
CU Exhaust Coil Length Coil Width Area Measured Fan CFM	79 91 63 71 31.1 23483	F F in sq-ft	
CU Exhaust Coil Length Coil Width Area Measured Fan CFM Air Mass Flow	79 91 63 71 31.1 23483 13.30	F F in sq-ft kg/sec	
CU Exhaust Coil Length Coil Width Area Measured Fan CFM	79 91 63 71 31.1 23483	F F in sq-ft Kg/sec Tons	

CU Fan CFM Calculation Measurement Ft/Sec 12.3 Number 1 12.5 12.5 12.3 12.9 13.1 12.6 2 3 4 5 6 Average

Leaks

YTC - H	lood Center		RTU-8	Summa	ry							
EER at AR	I Conditions			9.7	BTU/W-I	h	Ed	quipment age	13	years		
Condensin	g unit CFM			20719	CFM (M	easured)						
Nominal U	nit Capacity			18.41	tons							
Capacity us	sed for SA			10.00	tons							
Coil Area				31.06	sq-ft							
Predicted E	EER =			7.81	pre	8.86	post					
		HVAC	C Service A	ssistant				Phys	ical Power	and Capaci	ity measurn	nents
Test Date							Cond /	Air, deg F		Cond Air		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
24-May	76	61	120%	116%	14.3	10.86	76	89	7.2	12	11.73	24.24
Post Adsil	Measurements											
14-Jun	78	62	128%	129%	15.0	11.14	79	91	6.7	14.8	13.30	25.36

Condensing Unit Summary - Ambient Conditions							Condensing Unit Summary - ARI Conditions									
			Test Data	l	Per	Percent Difference			Test Data	1			Pe	rcent Differenc	e	
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	10.86	12	9.11	119%	132%	100%	13.6	15.0	11.39	119%	132%	91%	-	-	-
Pre-Adsil	Capacity (Tons)	10.47	24.24	9.03	116%	269%	100%	10.7	24.7	9.20	116%	269%	43%	-	-	-
	EER	14.3	24.24	11.89	120%	204%	81%	11.6	19.8	9.69	120%	204%	59%	67%	40%	81%
	Power (kW)	11.14	14.8	9.35	119%	158%	100%	13.6	18.0	11.39	119%	158%	75%	-	-	-
Post-Adsil	Capacity (Tons)	11.75	25.36	9.11	129%	278%	100%	11.9	25.6	9.20	129%	278%	46%	-	-	-
	EER	15.0	20.56	11.70	128%	176%	91%	12.4	17.0	9.69	128%	176%	73%	63%	46%	91%

EER

24.24

20.56

EER Changes

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	14.3	24.24	7.81
Post Adsil EER	15.0	20.56	8.86
ARI Adjusted			
Pre-Adsil EER	11.6	19.76	7.81
Post Adsil EER	12.4	17.04	8.86
Change	6.7%	-13.7%	13.5%
Weighted Average	66.7%	-137.5%	135.3%

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Trane YCH240B4 F50142258 RTU-Gas 1991 YTC- Hood RTU-10	-		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.6 9.6 23.98 13 3% 8.6 1.40	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	17.4	Amps		Power supply:	3-phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Power factor:	0.96			Compressor quantity:	2	
Condensing Fan Data						
Full load Amps:	3.00	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.70			Fan quantity:	2	
Evaporator fan data (if	applicable)					
Full load Amps:	11.00	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Calculated compressor	r load:		26.6	kW		
Calculated condensing			3.34	kW		
Calculated evaporator			3.54	kW		
Total calculated load for			29.93	kW - Condensing side only		
•	• •			5 ,		

Total calculated load for equipment: Assumptions

Condenser Coil Assessment Overall Unit Condition

0		Julion	
		New	
		Average	1
		Fair	
		Poor	
С	oil Cleanlines	s	
		Coated	
		Clean	0.85
		Dirty	0.15
		Clogged	
		Plugged	
Fi	n Condition		
		Like New	
		Some Bent	0.2
		Smashed	
		Dull/rough	0.2
		Corroded	
		Pitted	
		Flaking	
Fi	n-Tube Attac	hment	
		Like New	1
		Corrosion	
		Some Loose	
		Many Loose	
Т	ubes	-	
		Clean Cu	1
		Corrosion	
		Pitting	
		Leaks	

3.0% Performance Degradation

Y-measurement				
Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	480	38.8	9.4	0.51
2 to 3	480	40.6	19.6	1.00
TOTAL				
HVAC Service Assist	an <u>t Measurement</u>	-		
Input SEER	10)		
RAT	72	2 F		
SAT	52	2 F		
RAH	55	5 %		
SAH	85	5 %		
	Circuit 1 (only)			
El	66%	b		
CI	74%	b		
Input Cap	10) Tons		
OAT	77	7 F		
Predicted KW	13.20) kW		
	CU Capacity	Estimates		
Ambient	77	7 F	298	к
CU Exhaust	115	-	319	
Coil Length) in	010	
Coil Width		3 in		
Area) sq-ft		
Measured Fan CFM	9306	•		
Air Mass Flow		/ kg/sec		
Capacity		2 Tons		
Efficiency	13.17	7 EER		

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	4.1
2	5.7
3	5.9
4	3.1
5	5.5
6	3.7
7	4.7
8	4.9
Average	4.7

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Trane YCH240B4 F50142258(RTU-Gas 1991 YTC- Hood RTU-10	-		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.6 9.6 23.98 13 0% 8.8 1.36	Btu/W-hr Btu/W-hr tons years (% degrac Btu/W-hr	(CU Only) (CU Only) led)
Compressor Data							
Running load Amps:	17.4	Amps		Power supply:	3-phase		
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73		
Power factor:	0.96			Compressor quantity:	2		
Condensing Fan Data							
Full load Amps:	3	Amps		Power supply:	3-Phase		
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73		
Adjust FLA to RLA:	0.7			Fan quantity:	2		
Evaporator fan data (if a	pplicable)						
Full load Amps:	11	Amps		Power supply:	3-Phase		
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73		
Adjust FLA to RLA:	0.7			Fan quantity:	1		
Calculated compressor I	oad:		26.6	kW			
Calculated condensing f	an load:		3.34	kW			
Calculated evaporator fa			3.54	kW			
Total calculated load for Assumptions	equipment:		29.93	kW - Condensing side only			

Performance Degradation

Г

0.0%

Condenser Coil Assessment Overall Unit Condition New Х Average Fair Poor Coil Cleanliness Coated Clean 1 Dirty Clogged Plugged Fin Condition Like New 1 Some Bent Smashed Dull/rough Corroded Pitted Flaking Fin-Tube Attachment Like New Corrosion Some Loose Many Loose Tubes Clean Cu х

Corrosion Pitting Leaks

Y-measurement				
Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	485	34.7	16.7	0.99
2 to 3	483	32.3	7.35	0.47
TOTAL		02.0		0.71
HVAC Service Assistar	nt Measurement			
Input SEER		1		
RAT		F		
SAT		F		
RAH		%		
SAH		%		
-	Circuit 1 (only)	1		
EI	· · · · · (•····j/	1		
CI		1		
Input Cap		Tons		
OAT		F		
Predicted KW		kW		
		-		
	CU Capacity I	Estimates		
Ambient	78	F	299	к
CU Exhaust	87	F	304	к
Coil Length	99	in		
Coil Width	48	in		
Area	33.0	sq-ft		
Measured Fan CFM	27324			
Air Mass Flow	15.47	kg/sec		
Capacity		Tons		
Efficiency	11.04			

CU Fan CFM	Calculation
Measurement	
Number	Ft/Sec
1	15.2
2	12.5
3	15.2
4	14.8
5	14.6
6	12.5
7	13.3
8	12.3
Average	13.80

HVAC Data Sheet Page 2 of 3

YTC-H	ood Center		RTU-10	Summa	ry							
EER at AR	I Conditions			9.6	BTU/W-I	า	Ec	uipment age	13	years		
Condensin	g unit CFM			9306	CFM (Me	easured)						
Nominal U	nit Capacity			23.98	tons							
Capacity us	sed for SA			10.00	tons							
Coil Area				33.00	sq-ft							
Predicted E	ER =			8.59	pre	8.82	post					
		HVA	C Service As	ssistant				Phys	ical Power	and Capac	ity measurn	nents
Test Date							Cond A	Air, deg F		Cond Air		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
24-May	77	60	66%	74%	7.1	15.83	77	115	21.1	29	5.27	31.82
Post Adsil	Measurements	Could no	t douplicate	ore-test condi	tions							
14-Jun	NA	NA	NA	NA	NA	NA	78	87	5.0	24.05	15.47	22.13

Condensing Unit Summary - Ambient Conditions					Condensing Unit Summary - ARI Conditions											
			Test Data		Per	rcent Diff	erence		Test Data	1			Pe	ercent Differenc	e	
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	15.83	29	12.97	122%	224%	100%	36.5	66.9	29.90	122%	224%	55%	-	-	-
Pre-Adsil	Capacity (Tons)	8.65	31.82	11.69	74%	272%	100%	17.7	65.3	23.98	74%	272%	27%	-	-	-
	EER	7.1	13.17	10.82	66%	122%	89%	6.4	11.7	9.62	66%	122%	54%	135%	73%	89%
	Power (kW)	NA	24.05	12.50	NA	192%	100%	NA	57.5	29.90	NA	192%	NA	-	-	-
Post-Adsil	Capacity (Tons)	NA	22.13	11.88	NA	186%	100%	NA	44.7	23.98	NA	186%	NA	-	-	-
	EER	NA	11.04	11.41	NA	97%	92%	NA	9.3	9.62	NA	97%	NA	NA	92%	92%

EER

13.17

11.04

EER Changes

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	7.1	13.17	8.59
Post Adsil EER	NA	11.04	8.82
ARI Adjusted			
Pre-Adsil EER	6.4	11.72	8.59
Post Adsil EER	NA	9.32	8.82
Change	NA	-20.5%	2.7%
Weighted Average	NA	-204.8%	27.1%

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	NA 558CPX048 NA RTU-Gas 2000 YTC Bld D RTU-1	8000		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	NA 9.5 4.00 4 21% 7.8 1.54	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	15.7	Amps		Power supply:	3-phase	
Nameplate Voltage:	208	Volts		Phase adjustment:	1.73	
Power factor:	0.85			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	1.90	Amps		Power supply:	1-Phase	
Nameplate Voltage:	208	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Evaporator fan data (if a	pplicable)					
Full load Amps:	/	Amps		Power supply:		
Nameplate Voltage:		Volts		Phase adjustment:		
Adjust FLA to RLA:				Fan quantity:		
Calculated compressor	load:		4.8	kW		
Calculated condensing f	an load:		0.28	kW		
Calculated evaporator fa	in load		0.00	kW		
Total calculated load for	equipment:		5.08	kW - Condensing side only		
Assumptions						
Condenser Coil Assessr Overall Unit Condition	nent	21.4%	Performa	ance Degradation		
New						
Average		-		FLUKE METER MEASURMENTS		
Fair		-1		Y-measurment		
i aii		-		i -measument		

Y-measurment				
Phase	Volts	Amps	kW	_
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	
1 to 2	206	17.1	3.5	
2 to 3	203	18.7	2.1	
TOTAL				
HVAC Service Assistan	t Measurment			
Input SEER	10	1		
RAT		F		
SAT		F		
RAH		%		
SAH		%		
EI	75%			
CI	83%			
Input Cap		Tons		
OAT	88			
Predicted KW	5.10			
	CU Capacity E	Estimates		
Ambient	88	F		
CU Exhaust	101			
Coil Length	72			
Coil Width	37			
Area		sq-ft		
Measured Fan CFM	NA			
Air Mass Flow		kg/sec		
Capacity		Tons		
Efficiency	NA	EER		

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	-
2	-
3	-
Average	-

Poor

Coated Clean Dirty

Clogged Plugged

Like New

Some Bent Smashed

Dull/rough Corroded Pitted Flaking

Like New

Corrosion Some Loose Many Loose

Clean Cu

Corrosion Pitting Leaks

Coil Cleanliness

Fin Condition

Fin-Tube Attachment

Tubes

1

1

0.8

1

х

x

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	NA 558CPX048 NA RTU-Gas 2000 YTC Bld D RTU-1	3000		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	NA 9.5 4.00 4 0% 9.5 1.27	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	15.7	Amps		Power supply:	3-phase	
Nameplate Voltage:	208	Volts		Phase adjustment:	1.73	
Power factor:	0.85			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	1.9	Amps		Power supply:	1-Phase	
Nameplate Voltage:	208	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.7			Fan quantity:	1	
Evaporator fan data (if a	pplicable)					
Full load Amps:	0	Amps		Power supply:	0	
Nameplate Voltage:	0	Volts		Phase adjustment:	0	
Adjust FLA to RLA:	0			Fan quantity:	0	
Calculated compressor	load:		4.8	kW		
Calculated condensing f			0.28	kW		
Calculated evaporator fa			0.00	kW		
Total calculated load for	equipment:		5.08	kW - Condensing side only		

Condenser C Overall Unit C	oil Assessme ondition	nt						
	New	x						
	Average							
	Fair							
	Poor							
Coil Cleanline	Coil Cleanliness							
	Coated							
	Clean	1						
	Dirty							
	Clogged							
	Plugged							
Fin Condition								
	Like New	1						
	Some Bent							
	Smashed							
	Dull/rough							
	Corroded							
	Pitted							
	Flaking							
Fin-Tube Attac	chment							
	Like New	x						
	Corrosion							
	Some Loose							
	Many Loose							
Tubes								
	Clean Cu	x						
	Corrosion							
	Pitting							
	Leaks							

Assumptions

0.0% Performance Degradatio	n
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FLUKE METER MEAS	URMENTS								
Y-measurment									
Phase	Volts	Amps	kW	PF					
1									
2									
3									
Delta Measurement									
Phase	Volts	Amps	kW	PF					
1 to 2	NA	NA	NA	NA					
2 to 3	NA	NA	NA	NA					
TOTAL									
HVAC Service Assistar	nt Measurment	-							
Input SEER	10								
RAT	NA	+							
SAT	NA	+							
RAH	NA	%							
SAH	NA	%							
EI	101%	•							
CI	90%	+							
Input Cap		Tons							
OAT	85	+							
Predicted KW	4.30	kW							
CU Capacity Estimates									
Ambient	NA	F							
CU Exhaust	NA	F							
Coil Length	72	in							
Coil Width	37	in							
Area	18.5	sq-ft							
Measured Fan CFM	NA								
Air Mass Flow		kg/sec							
Capacity		Tons							
Efficiency	NA	EER							

CU Fan CFM Calculation					
Measurement					
Number	ft/sec				
1	NA				
2	NA				
3	NA				
Average	NA				

YTC Bld D RTU-1 Summary

			Gaillia									
EER at AR	I Conditions			9.5	5 BTU/W-	h	Eq	uipment age		4 years		
Condensin	g unit CFM			NA	CFM (M	easured)						
Capacity at	t ARI			4.00) tons							
Capacity us	sed for SA			4.00) tons							
Coil Area				18.50) sq-ft							
Predicted E	EER =			7.79) pre	9.45	post					
		HVAC	Service Ass	sistant				Phys	ical Powe	r and Capac	ity measurn	nents
Test Date							Cond A	ir, deg F		Cond Air		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
24-May	88	61	75%	83%	7.1	5.10	88	101	7.2	5.6	NA	NA
Post Adsil	Measurements											
16-Jun	85	61	101%	90%	9.5	4.30	NA	NA	NA	NA	NA	NA

	Conde	nsing Unit	Summary - A	Ambient Co	nditions						Condensi	ng Unit Su	mmary - AF	RI Conditions		
	Test Data Percent Difference				Test Data Percent Difference											
ΟΑΤ		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Predicted/ Original
	Power (kW)	5.10	5.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
Pre-Adsil	Capacity (Tons)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
	EER	7.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Power (kW)	4.30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
	Capacity (Tons)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
	EER	9.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

EER

NA

NA

EER Changes								
	Service Assistant	Condenser Test	Spreadsheet					
Pre-Adsil EER	7.1	NA	7.79					
Post Adsil EER	9.5	NA	9.45					
ARI Adjusted								
Pre-Adsil EER	7.1	NA	7.79					
Post Adsil EER	9.5	NA	9.45					
Change	34.7%	NA	21.4%					
Weighted Average	138.7%	NA	85.6%					

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Trane YCS060A4I 236101276L RTU-Gas 2002 Monroe Aqu RTU-16			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.1 9.1 5.21 2 0% 9.3 1.30	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	9.5	Amps		Power supply:	3-phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Power factor:	0.86			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	1.20	Amps		Power supply:	1-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Evaporator fan data (if a	oplicable)					
Full load Amps:	3.20	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Calculated compressor l	oad:		6.5	kW		
Calculated condensing f	an load:		0.39	kW		
Calculated evaporator fa	n load		1.03	kW		
Total calculated load for Assumptions	equipment:		6.89	kW - Condensing side only		

Condenser Coil Assessment
Overall Unit Condition
New
Average
Fair
Poor
Coil Cleanliness
Coated
Clean
Dirty
Clogged
Plugged
Fin Condition

Like New Some Bent

Smashed Dull/rough Corroded

Pitted

Flaking

Like New

Corrosion Some Loose Many Loose

Clean Cu

Corrosion Pitting Leaks

Fin-Tube Attachment

Tubes

0.02

0

0

0

x

х

0.1% Performance Degradation

FLUKE METER MEAS	SUREMENTS					
Y-measurement						
Phase	Volts	Amps	kW	PF		
1						
2						
3						
Delta Measurement						
Phase	Volts	Amps	kW	PF		
1 to 2	480	11.8	5.6	0.99		
2 to 3	480	8.6	1.5	0.37		
TOTAL	100	5.0		2.01		
HVAC Service Assista	int Measurement					
Input SEER	10					
RAT	72	F				
SAT		F				
RAH	50	%				
SAH		85 %				
EI	89%					
CI	89%					
Input Cap	5	Tons				
OAT	96	F				
Predicted KW	6.00	kW				
	CU Capacity I	Estimates				
Ambient	92	F	306	к		
CU Exhaust	114	F	319	к		
Coil Length	47	in				
Coil Width	28	in				
Area	9.1	sq-ft				
Measured Fan CFM	5922	•				
Air Mass Flow	3.35	kg/sec				
Capacity		Tons				
Efficiency	19.82	EER				

CU Fan CFM Calculation					
Measurement					
Number	ft/sec				
1	10.7				
2	10.9				
Average	10.8				

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Trane YCS060A4EMAOXD 236101276L RTU-Gas 2002 Monroe Aquatic Cente RTU-16	r	Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.1 9.1 5.21 2 0% 9.3 1.30	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	9.5 Amps 460 Volts 0.86		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.2 Amps 460 Volts 0.7		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if a Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	3.2 Amps 460 Volts 0.7		Power supply: Phase adjustment: Fan quantity:	3-Phase 1.73 1	
Calculated compressor Calculated condensing to Calculated evaporator fa Total calculated load for Assumptions	fan Ioad: an Ioad	6.5 0.39 1.03 6.89	kW kW kW kW - Condensing side only		

0.0% Performance Degradation

Condenser Coil Assessment Overall Unit Condition New

	New	х
	Average	
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	0
	Smashed	0
	Dull/rough	
	Corroded	0
	Pitted	0
	Flaking	0
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

CU Fan CFM Calculation						
Measurement						
Number	Ft/Sec					
1	10.7					
2	11.1					
3	12.7					
Average	11.5					

FLUKE METER MEAS	UREMENTS							
Y-measurement								
Phase	Volts	Amps	kW	PF				
1								
2								
3								
Delta Measurement								
Phase	Volts	Amps	kW	PF				
1 to 2	487	10.5	4.9	0.96				
2 to 3	485	7.2	0.92	0.26				
TOTAL								
HVAC Service Assista	nt Measurement							
Input SEER	10							
RAT	72	F						
SAT	52	F						
RAH	50	50 %						
SAH	85	%						
EI	94%							
CI	90%							
Input Cap	5	Tons						
OAT	80	F						
Predicted KW	5.80	kW						
	CU Capacity E	stimates						
		_						
Ambient	78		299					
CU Exhaust	100	-	311	к				
Coil Length	47							
Coil Width	28							
Area		sq-ft						
Measured Fan CFM	6306							
Air Mass Flow		kg/sec						
Capacity	12.48							
Efficiency	25.74	EER						

Monroe Aquatic Center	RTU-16	Summary					
EER at ARI Conditions		9.1 BTU/W-I	h	Equi	ipment age	2	years
Condensing unit CFM		5922 CFM (M	easured)				
Nominal Unit Capacity		5.21 tons					
Capacity used for SA		5.00 tons					
Coil Area		9.14 sq-ft					
Predicted EER =		9.25 pre	9.26	post			
	HVAC Service A	ssistant			Phys	ical Power	and Cap
Test Date				Cond Air	, deg F		Cond A

i ioaiotoa i				0.20	P10	0.20	poor						
		HVA	C Service As	sistant				Phys	ical Power	and Capaci	ty measurn	nents	
Test Date							Cond Air	, deg F		Cond Air			
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons	EER
24-May	96	60	89%	89%	7.3	6.25	92	114	12.2	7.1	3.35	11.72	19.82
Post Adsil	Measurements												
14-Jun	80	60	94%	90%	10.1	6.04	78	100	12.2	5.82	3.57	12.48	25.74

	Condensing Unit Summary - Ambient Conditions			Condensing Unit Summary - ARI Conditions												
			Test Data	l	Per	Percent Difference Test Data			Percent Difference							
ΟΑΤ		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	си	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Predicted/ Original
	Power (kW)	6.25	7.1	6.86	91%	104%	100%	6.3	7.1	6.86	91%	104%	88%	-	-	-
Pre-Adsil	Capacity (Tons)	4.21	11.72	4.73	89%	248%	100%	4.6	12.9	5.21	89%	248%	36%	-	-	-
	EER	7.3	19.82	8.19	89%	242%	101%	8.1	22.1	9.11	89%	242%	37%	114%	42%	101%
	Power (kW)	6.04	5.82	5.76	105%	101%	100%	7.2	6.9	6.86	105%	101%	104%	-	-	-
Post-Adsil	Capacity (Tons)	4.68	12.48	5.20	90%	240%	100%	4.7	12.5	5.21	90%	240%	37%	-	-	-
	EER	10.1	25.74	10.70	94%	241%	102%	8.6	21.9	9.11	94%	241%	39%	108%	42%	102%

EER Changes

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	7.3	19.82	9.25
Post Adsil EER	10.1	25.74	9.26
ARI Adjusted			
Pre-Adsil EER	8.1	22.06	9.25
Post Adsil EER	8.6	21.93	9.26
Change	5.6%	-0.6%	0.1%
Weighted Average	28.1%	-3.0%	0.5%

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Trane YCS090A4ELAO 236101222L RTU-Gas 2002 Monroe Aquatic Ce RTU-15	nter	Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.0 10.0 7.44 2 0% 10.2 1.18	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	13.6 Amp 460 Volts 0.75		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	2.50 Amp 460 Volts 0.70		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if aj Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	pplicable) Amp Volts 0.70		Power supply: Phase adjustment: Fan quantity:	3-Phase 1.73 1	
Calculated compressor I Calculated condensing f Calculated evaporator fa Total calculated load for Assumptions	an load: n load	8.1 0.81 0.00 8.92	kW kW kW kW - Condensing side only		

0.1% Performance Degradation

Y-measurement		A	1.3.47	
Phase	Volts	Amps	kW	F
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	1
1 to 2	488	15.9	1.9	0
2 to 3	488	13.8	6.6	0
TOTAL				
HVAC Service Assistant	t Measurement			
Input SEER	10			
RAT	72	F		
SAT	52	F		
RAH	50	%		
SAH	85	%		
EI	105%			
CI	103%			
Input Cap	7.5	Tons		
OAT	94	F		
Predicted KW	8.80	kW		
	CU Capacity E	stimates		
Ambient	92	F	306	к
CU Exhaust	112	F	318	к
Coil Length	70	in		
Coil Width	36	in		
Area	17.5	sq-ft		
Measured Fan CFM	9608			
Air Mass Flow	5.44	kg/sec		
Capacity	17.29			
Efficiency	24.41	FFR		

Condenser (Overall Unit (Coil Assessme	nt
	New	x
	Average	
	Fair	
	Poor	
Coil Cleanline	ess	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	0.02
	Smashed	
	Dull/rough	
	Corroded	0
	Pitted	0
	Flaking	0
Fin-Tube Atta	achment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

CU Fan CFM Calculation						
Measurement						
Number	ft/sec					
1	7.6					
2	10.7					
Average	9.2					

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Trane YCS090A4ELAO 236101222L RTU-Gas 2002 Monroe Aquatic Ce RTU-15	nter	Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.0 10.0 7.44 2 0% 10.2 1.18	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps:	13.6 Amps	i	Power supply:	3-phase	
Nameplate Voltage: Power factor:	460 Volts 0.75		Phase adjustment: Compressor quantity:	1.73 1	
Condensing Fan Data					
Full load Amps:	2.5 Amps	;	Power supply:	1-Phase	
Nameplate Voltage:	460 Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.7		Fan quantity:	1	
Evaporator fan data (if a	pplicable)				
Full load Amps:	0 Amps	;	Power supply:	3-Phase	
Nameplate Voltage:	0 Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.7		Fan quantity:	1	
Calculated compressor	load:	8.1	kW		
Calculated condensing	fan load:	0.81	kW		
Calculated evaporator fa	an load	0.00	kW		
Total calculated load for Assumptions	equipment:	8.92	kW - Condensing side only		

0.0% Performance Degradation

Condenser Coil Assessment Overall Unit Condition

	New	х
	Average	
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	0
	Smashed	0
	Dull/rough	
	Corroded	0
	Pitted	0
	Flaking	0
Fin-Tube Atta	chment	
	Like New	х
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

CU Fan CFM Calculation					
Measurement					
Number	ft/sec				
1	8.2				
2	8.6				
3	12.3				
Average	9.7				

Y-measurement				
Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	487	11.6	5.2	0.93
2 to 3	484	13.1	2.3	0.36
TOTAL		L		
HVAC Service Assistar	nt Measurement			
Input SEER	10	1		
RAT	72	F		
SAT	52	F		
RAH	50	%		
SAH	85	%		
EI	109%			
CI	104%			
Input Cap	7.5	Tons		
OAT	79	F		
Predicted KW	8.70	kW		
	CU Capacity E	etimatos		
	ee eupuony i	-011110100		
Ambient	77	F	298	к
CU Exhaust	96	F	309	к
Coil Length	70	in		
Coil Width	36	in		
Area	17.5	sq-ft		
Measured Fan CFM	10185			
Air Mass Flow		kg/sec		
Capacity	17.42			
Efficiency	27.86	EER		

Monroe	Aquatic Ce	nter	RTU-15	Summa	ry							
EER at AR	Conditions			10.0	BTU/W-I	h	Eq	uipment age	2	years		
Condensing	g unit CFM			9608	B CFM (M	easured)						
Nominal Ur	nit Capacity			7.44	tons							
Capacity us	sed for SA			7.50) tons							
Coil Area				17.50) sq-ft							
Predicted E	ER =			10.19) pre	10.21	post					
		HVA	C Service A	ssistant				Phys	ical Power	and Capac	ity measurn	nents
Test Date							Cond A	lir, deg F		Cond Air		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
24-May	94	60	105%	103%	9.6	8.72	92	112	11.1	8.5	5.44	17.29
Post Adsil I	Measurements											
14-Jun	14-Jun 79 60			104%	12.9	8.63	77	96	10.6	7.5	5.77	17.42
			1	1	1	1	1	1		1		

	Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions							
Test Data Percent Differer			erence		Test Data	l	Percent Difference									
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	8.72	8.5	8.73	100%	97%	100%	8.9	8.7	8.91	100%	97%	103%	-	-	-
Pre-Adsil	Capacity (Tons)	6.98	17.29	6.78	103%	255%	100%	7.7	19.0	7.44	103%	255%	40%	-	-	-
	EER	9.6	24.41	9.19	105%	266%	102%	10.5	26.6	10.02	105%	266%	40%	97%	38%	102%
	Power (kW)	8.63	7.5	7.39	117%	101%	100%	10.4	9.0	8.91	117%	101%	115%	-	-	-
Post-Adsil	Capacity (Tons)	7.69	17.42	7.40	104%	235%	100%	7.7	17.5	7.44	104%	235%	44%	-	-	-
	EER	12.9	27.86	11.87	109%	235%	102%	10.9	23.5	10.02	109%	235%	46%	93%	43%	102%

EER

24.41

27.86

EER Changes	
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	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	9.6	24.41	10.19
Post Adsil EER	12.9	27.86	10.21
ARI Adjusted			
Pre-Adsil EER	10.5	26.63	10.19
Post Adsil EER	10.9	23.52	10.21
Change	3.8%	-11.6%	0.1%
Weighted Average	28.6%	-87.3%	0.8%

Manufacturer Model Numbe Serial Numbe Equipment Ty Year Manufac Location Tag	r r /pe:	York D2CG240N2 SNFHM08025 RTU-Gas 1997 Monroe Aqu RTU-13	98		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EE kW/ton	R	10.7 10.7 20.71 7 5% 10.0 1.20	Btu/W-hr Btu/W-hr tons years (% degrad Btu/W-hr	(CU Only) (CU Only) ed)
Compressor I Running load A Nameplate Vo Power factor:	Amps:	9.6 460 0.68	Amps Volts		Power supply: Phase adjustment: Compressor quantity:		3-phase 1.73 4		
		0.00					·		
Condensing I		0.40							
Full load Amps Nameplate Vo		2.10 460	Amps Volts		Power supply: Phase adjustment:		3-Phase 1.73		
Adjust FLA to		0.70	VOIIS		Fan quantity:		2		
Evaporator fa	n data (if ann	licable)							
Full load Amps		incable)	Amps		Power supply:		3-Phase		
Nameplate Vo			Volts		Phase adjustment:		1.73		
Adjust FLA to		0.70			Fan quantity:		1		
Total calculat Assumptions Condenser C Overall Unit C	oil Assessme		4.7%	23.12 Performa	kW - Condensing side of the condensity of the co	·			
	Poor		-		Phase	Volts	Amps	kW	PF
Coil Cleanline			-		1	Volto	7 unpo		
	Coated				2				
	Clean	0.7			3				
	Dirty	0.3							
	Clogged		-		Delta Measurement	\ (= =	A	134/	PF
Fig. Operativity	Plugged		-		Phase	Volts	Amps	kW	PF 1
Fin Condition	Like New	0.5	-		1 to 2 2 to 3	486 484	39.3	19 8.2	-
	Some Bent	0.5	-		TOTAL	404	39.6	0.2	0.43
	Some Bent	0.1	-		HVAC Service Assistar	Moouromont			
	Dull/rough	0.5	-		Input SEER	10		Measured	circuit 1
	Corroded	0.0	-		RAT	72	_	(compress	
	Pitted	0	-		SAT	52		· ·	ssors were
	Flaking	0	-		RAH	50		running du	
Fin-Tube Attac	0		-		SAH			test.	ing uic
I III-TUDE Alla	Like New	x	-		37.11	60	/0	Input capa	city and
	Corrosion	×	-		EI	85%			
	CONOSION	<u> </u>	-			85%		power proj	ections

multiplied by 2 CI Input Cap OAT 94% 20 Tons 92 F Predicted KW 30.00 kW CU Capacity Estimates 92 F 128.5 F Ambient CU Exhaust 306 K 327 K Coil Length 74 in Coil Width 29 in Coil Number 2 2 29.8 sq-ft 10015 5.67 kg/sec 32.90 Tons 14.51 EER Area Area Measured Fan CFM Air Mass Flow Capacity Efficiency

CU Fan CFM Calculation								
Measurement								
Number	ft/sec							
1	6.1							
2	6.2							
3	4.1							
4	7.6							
5	5.3							
6	4.3							
Average	5.6							

Some Loose

Many Loose

Clean Cu

Corrosion Pitting

Leaks

x

Tubes

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	York D2CG240N24046FE SNFHM080298 RTU-Gas 1997 Monroe Aquatic Cen RTU-13	_	Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.7 10.7 20.71 7 0% 10.4 1.15	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	9.6 Amps 460 Volts 0.68		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 4	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	2.1 Amps 460 Volts 0.7		Power supply: Phase adjustment: Fan quantity:	3-Phase 1.73 2	
Evaporator fan data (if a Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	pplicable) 0 Amps 0 Volts 0.7		Power supply: Phase adjustment: Fan quantity:	3-Phase 1.73 1	
Calculated compressor I Calculated condensing f Calculated evaporator fa Total calculated load for Assumptions	an load: In load	20.8 2.34 0.00 23.12	kW kW kW kW - Condensing side only		

Condenser C Overall Unit C	oil Assessme	nt
	New	х
	Average	
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	0
	Smashed	0
	Dull/rough	
	Corroded	0
	Pitted	0
	Flaking	0
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

0.0%	Performance	ce Degradation				
	Г					
	F	LUKE METER MEAS	UREMENTS			
	٢	/-measurement				
	F	Phase	Volts	Amps	kW	PF
		1				
		2				
		3				
	[Delta Measurement				
		Phase	Volts	Amps	kW	PF
		1 to 2	486	23.3	3.9	0.37
		2 to 3	490	23.4	11.2	0.98
	٦	TOTAL				
	ŀ	HVAC Service Assistar	nt Measurement			
	1	nput SEER	10		Measured (circuit 1
	F	RAT	72	F	(compresso	ors 1&2)
	S	SAT	52	F	Compresso	ors 3&4
	F	RAH	50	%	shut off dur	ing
	5	SAH	85	%	test.	
					Input capad	city and
	E	El	109%	•	power proje	
	(CI	106%	•	multiplied b	y 2
	1	nput Cap	20	Tons		
	C	DAT	93	F		
	F	Predicted KW	NA	kW		
			CU Capacity E	stimates		
	F	Ambient	87	F	304	к
	C	CU Exhaust	103	F	313	К
	C	Coil Length	74	in		
	(Coil Width	29	in		
	A	Area	29.8	sq-ft		
	N	Measured Fan CFM	18807			
		Air Mass Flow		kg/sec		
		Capacity	27.08			
	E	Efficiency	21.52	EER		

CU Fan CFM Calculation Measurement Number ft/sec 1 11.5 2 11.7 3 10.5 4 10 5 10.4 6 9 Average 10.5

Monroe	Aquatic Ce	nter	RTU-13	Summa	ry							
EER at ARI	I Conditions			10.7	BTU/W-	h	Equ	uipment age	7	years		
Condensing	g unit CFM			10015	5 CFM (M	easured)						
Nominal Un	nit Capacity			20.71	tons							
Capacity us	sed for SA			20.00) tons							
Coil Area				29.81	sq-ft							
Predicted E	ER =			9.98	pre	10.44	post					
		HVA	C Service As	ssistant				Phys	ical Power	r and Capac	ity measurn	nents
Task Data							Cond Ai	r dog E		Cond Air		
Test Date							CONTURA	i, ueg r		Cond All		
Test Date	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔΤ (Κ)	kW	(kg/sec)	tons
27-May	OAT 92	EWB 60	EI 85%	CI 94%	EER 8.5	kW 31.07		/ 0	∆T (K) 20.3		(kg/sec) 5.67	tons 32.9
				.			inlet	exhaust	()	kW	()	
27-May				.			inlet	exhaust	()	kW	()	
27-May	92			.			inlet	exhaust	()	kW	()	

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions								
	Test Data Percent Difference				Test Data Percent Difference											
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	31.07	27.2	22.10	141%	123%	99%	32.7	28.7	23.29	141%	123%	114%	-	-	-
Pre-Adsil	Capacity (Tons)	17.22	32.90	18.32	94%	180%	100%	19.5	37.2	20.71	94%	180%	52%	-	-	-
	EER	8.5	14.51	9.95	85%	146%	94%	9.1	15.6	10.67	85%	146%	58%	110%	64%	94%
	Power (kW)	NA	15.1	22.21	NA	68%	99%	NA	15.8	23.29	NA	68%	NA	-	-	-
Post-Adsil	Capacity (Tons)	19.34	27.08	18.24	106%	148%	100%	22.0	30.7	20.71	106%	148%	71%	-	-	-
	EER	10.7	21.52	9.86	109%	218%	98%	11.6	23.3	10.67	109%	218%	50%	86%	43%	98%

EER

14.51

21.52

tons 32.90

27.08

EER Changes

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	8.5	14.51	9.98
Post Adsil EER	10.7	21.52	10.44
ARI Adjusted			
Pre-Adsil EER	9.1	15.57	9.98
Post Adsil EER	11.6	23.30	10.44
Change	28.2%	49.7%	4.6%
Weighted Average	564.7%	993.1%	91.3%

EPA Adsil Evaluation Monroe Aquatics Center RTU-13

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	York D3CG090N NGFM09008 RTU-Gas 1997 Monroe Aqu RTU-10	8		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	11.1 11.1 7.63 7 1% 10.7 1.12	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	7.1	Amps		Power supply:	3-phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Power factor:	0.66			Compressor quantity:	2	
Condensing Fan Data						
Full load Amps:	1.30	Amps		Power supply:	1-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.70			Fan quantity:	2	
Evaporator fan data (if ar	oplicable)					
Full load Amps:	. ,	Amps		Power supply:	3-Phase	
Nameplate Voltage:		Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Calculated compressor le Calculated condensing fa Calculated evaporator fa Total calculated load for	an load: n load		7.4 0.84 0.00 8.25	kW kW kW kW - Condensing side only		

Condenser C Overall Unit C	oil Assessme ondition	nt
	New	0.9
	Average	0.1
	Fair	
	Poor	
Coil Cleanline	ss	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	0.9
	Some Bent	0.1
	Smashed	
	Dull/rough	
	Corroded	0
	Pitted	0
	Flaking	0
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

Assumptions

0.52%	Performance	Degradation
0.52 /0	Feriorinance	Degrauation

FLUKE METER MEAS	SUREMENTS			
Y-measurement				
Phase	Volts	Amps	kW	PF
1	, in the second se	7 11100		
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	484	16.2	3.1	0.4
2 to 3	487	14.2	6.6	0.94
TOTAL				2.01
HVAC Service Assista	int Measurement			
Input SEER	10			
RAT	74	F		
SAT	54	F		
RAH	42	%		
SAH	85	%		
	Circuit 1		Circuit 2	
EI	90%		103%	
CI	99%		103%	
Input Cap		Tons	3.5	Tons
OAT	85	F	86	F
Predicted KW	4.50	kW	4.20	kW
	CU Capacity E	stimates		
Ambient	84.5	-	302	
CU Exhaust	105.5		314	к
Coil Length	41			
Coil Width	29			
Area Measured Fan CFM		sq-ft		
Air Mass Flow	8984	kg/sec		
Capacity	5.09 16.98			
Efficiency	21.00			
	∠1.00	LUK		

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	6.2
2	5.3
3	8
4	11.7
5	11.5
6	11.7
Average	9.1

Manufacturer: Model Numbe Serial Number	r: r	York D3CG090N ² NGFM090088			Published EER: Calculated EER: Nominal Capacity:		11.1 11.1 7.63	Btu/W-hr Btu/W-hr tons	(CU Only) (CU Only)
Equipment Ty		RTU-Gas			Age		7	years	1)
Year Manufac Location	tured:	1997 Monroe Aqu	atia Contar		Coil Conditon Present Condition EE	B	0% 10.8	(% degrad Btu/W-hr	ea)
Tag		RTU-10	alle Genlei		kW/ton	ĸ	1.11	DLU/ VV-III	
Tag		1110-10			KW/tOII		1.11		
Compressor D	Data								
Running load A	Amps:	7.1	Amps		Power supply:		3-phase		
Nameplate Vol	tage:	460	Volts		Phase adjustment:		1.73		
Power factor:		0.656			Compressor quantity:		2		
Condensing F	an Data								
Full load Amps		1.3	Amps		Power supply:		1-Phase		
Nameplate Vol		460	Volts		Phase adjustment:		1		
Adjust FLA to I		0.7			Fan quantity:		2		
-		P 6 I - 1							
Evaporator fa Full load Amps		0	Amps		Power supply:		3-Phase		
Nameplate Vol		0	Volts		Phase adjustment:		1.73		
Adjust FLA to I		0.7	VOILS		Fan quantity:		1.75		
Calculated co				7.4	kW				
Calculated co				0.84	kW				
Calculated ev Total calculate				0.00 8.25	kW kW - Condensing side	anlı			
Assumptions	eu loau loi et	aupment.		0.25	kw - Condensing side	only			
Condenser Co		nt	0.0%	Performa	Ince Degradation				
Overall Unit Co			_						
	New	Х	_						
	Average		_		FLUKE METER MEAS	UREMENTS			
	Fair				Y-measurement				
	Poor				Phase	Volts	Amps	kW	PF
Coil Cleanlines	s				1				
	Coated				2				
	Clean	1			3				
	Dirty								
	Clogged				Delta Measurement				
	Plugged				Phase	Volts	Amps	kW	PF
Fin Condition					1 to 2	481	15.7	3	0.4
	Like New				2 to 3	485	14	6.35	0.93
	Some Bent	0			TOTAL	•			•
	Smashed	0			HVAC Service Assistar	nt Measurement			
	Dull/rough				Input SEER	10			
	Corroded	0			RAT	74	F		
	Pitted	0			SAT	54	F		
	Flaking	0	_		RAH	42			
Fin-Tube Attac	-				SAH	85			
I III I UDE AllaC	Like New	x	-			Circuit 1	70	Circuit 2	
	Corrosion		-		EI			106%	٦
			-			108%			
	Some Loose		4		CI	110%		108%	2

CI Input Cap OAT 110% 3.5 Tons 108% 3.5 Tons 89 F 87 F Predicted KW 4.30 kW 4.30 kW CU Capacity Estimates 89 F 106 F Ambient CU Exhaust 305 K 314 K Coil Length 41 in Coil Width 29 in Area 16.5 sq-ft Measured Fan CFM Air Mass Flow 11444 6.48 kg/sec 17.51 Tons Capacity Efficiency 22.47 EER

CU Fan CFM Calculation						
Measurement						
Number	ft/sec					
1	11.1					
2	11.1					
3	9.6					
4	12.5					
5	12.5					
6	12.5					
Average	11.6					

Many Loose

x

Clean Cu

Corrosion Pitting

Leaks

Tubes

Monroe	Aquatic Cer	nter	RTU-10	Summa	ry							
EER at AR	I Conditions			11.1	BTU/W-I	n	Equ	uipment age	7	years		
Condensing	g unit CFM			8984	CFM (M	easured)						
Capacity at	ARI			7.63	tons							
Capacity us	sed for SA			7.00	tons							
Coil Area				16.51	sq-ft							
Predicted E	ER =			10.72	pre	10.77	post					
		HVA	C Service As	sistant				Phys	ical Power	and Capaci	ty measurn	nents
Test Date		HVA	C Service As	sistant			Cond Ai	<u>,</u>	ical Power	and Capaci Cond Air	ty measurn	nents
Test Date	OAT	HVA EWB	El	CI	EER	kW	Cond Ai inlet	<u>,</u>	ical Power ∆T (K)		ty measurn (kg/sec)	nents tons
Test Date 13-May					EER 11.7	kW 9.48		r, deg F		Cond Air		
	OAT	EWB	EI	CI			inlet	r, deg F exhaust	ΔT (K)	Cond Air kW	(kg/sec)	tons
13-May	OAT	EWB	EI	CI			inlet	r, deg F exhaust	ΔT (K)	Cond Air kW	(kg/sec)	tons

3.5%

	Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions									
	Test Data Percent Difference				ference		Test Data	3			Pe	ercent Differenc	e			
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	9.48	9.7	7.18	132%	135%	102%	10.7	10.9	8.08	132%	135%	98%	-	-	-
Pre-Adsil	Capacity (Tons)	7.32	16.98	7.25	101%	234%	102%	7.6	17.5	7.49	101%	234%	43%	-	-	-
	EER	11.7	21.00	12.11	97%	173%	96%	10.7	19.3	11.12	97%	173%	56%	100%	56%	96%
	Power (kW)	9.37	9.35	7.52	125%	124%	102%	10.1	10.0	8.08	125%	124%	100%	-	-	-
Post-Adsil	Capacity (Tons)	7.72	17.51	7.08	109%	247%	102%	8.2	18.5	7.49	109%	247%	44%	-	-	-
	EER	12.1	22.47	11.31	107%	199%	97%	11.9	22.1	11.12	107%	199%	54%	90%	48%	97%

EER

21.00

22.47

EER Changes							
	Service Assistant	Condenser Test	Spreadsheet				
Pre-Adsil EER	11.7	21.00	10.72				
Post Adsil EER	12.1	22.47	10.77				
ARI Adjusted							
Pre-Adsil EER	10.7	19.25	10.72				
Post Adsil EER	11.9	22.05	10.77				
Change	10.9%	14.5%	0.5%				

Weighted Average 76.2% 101.8%

Compressor DataRunning load Amps:9.6AmpsPower supply:3-phaseNameplate Voltage:460VoltsPhase adjustment:1.73Power factor:0.78Compressor quantity:2Condensing Fan DataFull load Amps:2.50AmpsPower supply:1-PhaseNameplate Voltage:460VoltsPhase adjustment:1Adjust FLA to RLA:0.70Fan quantity:2Evaporator fan data (if applicable)Full load Amps:7.50AmpsPower supply:3-PhaseNameplate Voltage:460VoltsPhase adjustment:1Adjust FLA to RLA:0.70Fan quantity:23-PhaseNameplate Voltage:460VoltsPhase adjustment:1.73Adjust FLA to RLA:0.70Fan quantity:11Calculated compressor load:11.9kWCalculated condensing fan load:1.61Calculated evaporator fan load:2.42kWCandensing side only	Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	York D4CG150N NBFM02291: RTU-Gas 1997 Monroe Aqu RTU-9			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.5 10.5 11.88 7 9% 9.4 1.28	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Nameplate Voltage:460VoitsPhase adjustment:1.73Power factor:0.78Compressor quantity:2Condensing Fan DataFull load Amps:2.50AmpsPower supply:1-PhaseFull load Amps:2.50AmpsPhase adjustment:1Adjust FLA to RLA:0.70Phase adjustment:1Full load Amps:7.50AmpsPower supply:2Evaporator fan data (if applicable)Full load Amps:7.50AmpsPower supply:3-PhaseFull load Amps:7.50AmpsPower supply:1Adjust FLA to RLA:0.70Fan quantity:1Calculated compressor load:1.61KWCalculated evaporator fan load:2.42KW	Compressor Data						
Power factor: 0.78 Compressor quantity: 2 Condensing Fan Data Full load Amps: 2.50 Amps Power supply: 1-Phase Full load Amps: 2.50 Amps Power supply: 1-Phase Nameplate Voltage: 460 Volts Phase adjustment: 1 Adjust FLA to RLA: 0.70 Fan quantity: 2 Evaporator fan data (if applicable) Full load Amps: 7.50 Amps Power supply: 3-Phase Full load Amps: 7.50 Amps Power supply: 3-Phase Nameplate Voltage: 460 Volts Phase adjustment: 1.73 Adjust FLA to RLA: 0.70 Fan quantity: 1 Calculated compressor load: 11.9 kW Calculated condensing fan load: 1.61 kW Calculated evaporator fan load: 2.42 kW	Running load Amps:	9.6	Amps		Power supply:	3-phase	
Condensing Fan Data Full load Amps: 2.50 Amps Power supply: 1-Phase Nameplate Voltage: 460 Volts Phase adjustment: 1 Adjust FLA to RLA: 0.70 Fan quantity: 2 Evaporator fan data (if applicable) Full load Amps: 7.50 Amps Power supply: 3-Phase Full load Amps: 7.50 Amps Power supply: 1 3-Phase Nameplate Voltage: 460 Volts Phase adjustment: 1.73 Adjust FLA to RLA: 0.70 Fan quantity: 1 Calculated compressor load: 11.9 kW Calculated condensing fan load: 1.61 Calculated evaporator fan load 2.42 kW KW 1	Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Full load Amps: 2.50 Amps Power supply: 1-Phase Nameplate Voltage: 460 Volts Phase adjustment: 1 Adjust FLA to RLA: 0.70 Fan quantity: 2 Evaporator fan data (if applicable) Fan quantity: 3-Phase Full load Amps: 7.50 Amps Power supply: 3-Phase Nameplate Voltage: 460 Volts Phase adjustment: 1 Adjust FLA to RLA: 0.70 Fan quantity: 1 1 Calculated compressor load: 11.9 kW Calculated condensing fan load: 1.61 Calculated evaporator fan load: 2.42 kW KW 1	Power factor:	0.78			Compressor quantity:	2	
Nameplate Voltage: 460 Volts Phase adjustment: 1 Adjust FLA to RLA: 0.70 Fan quantity: 2 Evaporator fan data (if applicable) Full load Amps: 7.50 Amps Power supply: 3-Phase Nameplate Voltage: 460 Volts Phase adjustment: 1.73 Adjust FLA to RLA: 0.70 Fan quantity: 1 Calculated compressor load: 11.9 kW Calculated condensing fan load: 1.61 kW Calculated evaporator fan load 2.42 kW	Condensing Fan Data						
Adjust FLA to RLA: 0.70 Fan quantity: 2 Evaporator fan data (if applicable)	Full load Amps:	2.50	Amps		Power supply:	1-Phase	
Evaporator fan data (if applicable) Full load Amps: 7.50 Amps Power supply: 3-Phase Nameplate Voltage: 460 Volts Phase adjustment: 1.73 Adjust FLA to RLA: 0.70 Fan quantity: 1 Calculated condensing fan load: 1.61 kW Calculated evaporator fan load 2.42 kW	Nameplate Voltage:	460	Volts		Phase adjustment:	1	
Full load Amps: 7.50 Amps Power supply: 3-Phase Nameplate Voltage: 460 Volts Phase adjustment: 1.73 Adjust FLA to RLA: 0.70 Fan quantity: 1 Calculated compressor load: 11.9 kW Calculated condensing fan load: 1.61 kW Calculated evaporator fan load 2.42 kW	Adjust FLA to RLA:	0.70			Fan quantity:	2	
Nameplate Voltage: 460 Volts Phase adjustment: 1.73 Adjust FLA to RLA: 0.70 Fan quantity: 1 Calculated compressor load: 11.9 kW Calculated condensing fan load: 1.61 kW Calculated evaporator fan load: 2.42 kW	Evaporator fan data (if	applicable)					
Adjust FLA to RLA: 0.70 Fan quantity: 1 Calculated compressor load: 11.9 kW Calculated condensing fan load: 1.61 kW Calculated evaporator fan load 2.42 kW	Full load Amps:	7.50	Amps		Power supply:	3-Phase	
Calculated compressor load: 11.9 kW Calculated condensing fan load: 1.61 kW Calculated evaporator fan load 2.42 kW	Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Calculated condensing fan load: 1.61 kW Calculated evaporator fan load 2.42 kW	Adjust FLA to RLA:	0.70			Fan quantity:	1	
Calculated evaporator fan load 2.42 kW	Calculated compressor	load:		11.9	kW		
•	Calculated condensing	fan load:		1.61	kW		
•				2.42	kW		
	Total calculated load fo	r equipment:		13.53	kW - Condensing side only		

9.2% Performance Degradation

Condenser Coil Assessment Overall Unit Condition

Assumptions



FLUKE METER MEAS Y-measurment				
Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	490	26.9	13	1
2 to 3	490	20.9	4.6	0.34
TOTAL	107	21.0	7.0	0.04
HVAC Service Assista	ant Measurment			
Input SEER	10			
RAT	85	F		
SAT	65			
RAH	35			
SAH	85			
	Circuit 1		Circuit 2	
El	73%		77%	
CI	80%		80%	
Input Cap	6	Tons	6	Tons
OAT	88	F	84	F
Predicted KW	7.70	kW	7.30	kW
	CU Capacity E	stimates		
Ambient	86	F	303	к
CU Exhaust	115		319	
Coil Length	48		010	
Coil Width	40			
Area	28.0			
Measured Fan CFM	11424	•		
Air Mass Flow	6.47	kg/sec		
Capacity	29.81	Tons		
Efficiency	20.33	EER		

CU Fan CFM Calculation							
Measurement							
Number	ft/sec						
1	4.1						
2	4.1						
3	3.1						
4	3.3						
5	6.6						
6	5.9						
7	6.8						
8	5.9						
Average	5.0						

HVAC Data Sheet Page 1 of 3

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	York D4CG150N NBFM022912 RTU-Gas 1997 Monroe Aqu RTU-9	2		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.5 10.5 11.88 7 0% 10.2 1.17	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	9.6 460 0.78	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 2	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	2.5 460 0.7	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 2	
Evaporator fan data (if a Full load Amps: Nameplate Voltage: Adjust FLA to RLA: Calculated compressor Calculated condensing i Calculated evaporator fa Total calculated load for Assumptions	7.5 460 0.7 Ioad: fan Ioad: an Ioad	Amps Volts	11.9 1.61 2.42 13.53	Power supply: Phase adjustment: Fan quantity: kW kW kW kW - Condensing side only	3-Phase 1.73 1	

Condenser Coil Assessment Overall Unit Condition

	New	х
	Average	
	Fair	
	Poor	
Coil Cleanline	ss	
	Coated	
	Clean	0.98
	Dirty	0.02
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	0
	Smashed	0
	Dull/rough	
	Corroded	0
	Pitted	0
	Flaking	0
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes	-	
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

0.1% Performance Degradation

FLUKE METER MEA				
Y-measurement	SOILEMENTO			
Phase	Volts	Amps	kW	PF
1	1			
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	482	26.8	4.6	0.35
2 to 3	484	25.5	4.0	1.00
TOTAL	404	20.0	12.4	1.00
HVAC Service Assista	ant Measurment			
Input SEER	10			
RAT	87			
SAT	67			
RAH	45			
SAH	85			
0/11	Circuit 1	70	Circuit 2	
EI	85%		88%	Ī
CI	78%		84%	
Input Cap	6	Tons	6	Tons
OAT	87		85	F
Predicted KW	6.70	kW	6.90	
	CU Capacity E	stimates		
	ee eupaony i			
Ambient	87	F	304	к
CU Exhaust	110	F	316	к
Coil Length	48	in		
Coil Width	42	in		
Area	28.0	sq-ft		
Measured Fan CFM	15036			
Air Mass Flow	8.52	kg/sec		
Capacity	31.12			
Efficiency	21.97	EER		

CU Fan CFM Calculation							
Measurement							
Number	ft/sec						
1	10						
2	9.8						
3	8.4						
4	8.8						
5	9.8						
6	9.2						
7	8.8						
8	6.8						
Average	9.0						

Monroe	Aquatic Ce	nter	RTU-9	Summa	ry							
EER at AR	Conditions	10.5 BTU/W-h				Ec	quipment age	7	7 years			
Condensing	g unit CFM			11424	CFM (M	easured)						
Capacity at	ARI			11.88	3 tons							
Capacity us	sed for SA			12.00) tons							
Coil Area				28.00) sq-ft							
Predicted E	ER =			9.39) pre	10.22	post					
		HVAC	C Service As	ssistant				Phys	ical Power	and Capaci	ity measurn	nents
Test Date							Cond A	Air, deg F		Cond Air		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
13-May	88	65	75%	80%	8.5	14.85	86	115	16.1	17.6	6.47	29.81
Post Adsil I	Measurements											
16-Jun	87	70	87%	81%	11.5	13.46	87	110	12.8	17	8.52	31.12

Condensing Unit Summary - Ambient Conditions					Condensing Unit Summary - ARI Conditions											
			Test Data		Per	cent Dif	ference		Test Data	1			Pe	ercent Differenc	e	
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	14.85	17.6	12.85	116%	137%	100%	15.6	18.5	13.52	116%	137%	84%	-	-	-
Pre-Adsil	Capacity (Tons)	9.75	29.81	12.19	80%	245%	100%	9.5	29.1	11.88	80%	245%	33%	-	-	-
	EER	8.5	20.33	11.38	75%	179%	89%	7.9	18.8	10.54	75%	179%	42%	119%	50%	89%
	Power (kW)	13.46	17.0	13.09	103%	130%	100%	13.9	17.6	13.52	103%	130%	79%	-	-	-
Post-Adsil	Capacity (Tons)	10.67	31.12	13.17	81%	236%	100%	9.6	28.1	11.88	81%	236%	34%	-	-	-
	EER	11.5	21.97	13.26	87%	166%	97%	9.1	17.5	10.54	87%	166%	52%	103%	54%	97%

EER

20.33

21.97

EER Changes

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	8.5	20.33	9.39
Post Adsil EER	11.5	21.97	10.22
ARI Adjusted			
Pre-Adsil EER	7.9	18.84	9.39
Post Adsil EER	9.1	17.47	10.22
Change	15.3%	-7.3%	8.8%
Neighted Average	184.0%	-87.2%	105.9%

EPA Adsil Evaluation Monroe Aquatics Center RTU-9

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	York D2CG240N NGFM08994 RTU-Gas 1997 Monroe Aqu RTU-8	3		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.7 10.7 20.71 7 12% 9.4 1.28	Btu/W-hr Btu/W-hr tons years (% degrac Btu/W-hr	(CU Only) (CU Only) led)
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	9.6 460 0.68	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 4		
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	2.10 460 0.70	Amps Volts		Power supply: Phase adjustment: Fan quantity:	3-Phase 1.73 2		
Evaporator fan data (if ap Full load Amps: Nameplate Voltage: Adjust FLA to RLA: Calculated compressor la Calculated condensing fa Calculated evaporator fan Total calculated load for Assumptions	0.70 Dad: an load: n load	Amps Volts	20.8 2.34 0.00 23.12	Power supply: Phase adjustment: Fan quantity: kW kW kW kW - Condensing side only	3-Phase 1.73 1		

Condenser Coil Assessment Overall Unit Condition

12.0%	Performance	Degradation

Overall Unit C	ondition		
	New		
	Average	х	
	Fair		
	Poor		
Coil Cleanline	SS		
	Coated		
	Clean		
	Dirty	0.5	
	Clogged	0.5	
	Plugged		
Fin Condition			
	Like New	0.25	
	Some Bent	0.1	
	Smashed		
	Dull/rough	0.75	
	Corroded	0	
	Pitted	0	
	Flaking	0	
Fin-Tube Atta	chment		
	Like New	x	
	Corrosion		
	Some Loose		
	Many Loose		
Tubes			
	Clean Cu	x	
	Corrosion		
	Pitting		
	Leaks		

Y-measurment				
Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	487	41.3	8.2	0.41
2 to 3	487	41.4	20	0.99
TOTAL				
HVAC Service Assistar	nt Measurement			
Input SEER	10		Measured of	circuit 2
RAT	82	F	(compresso	ors 3&4)
SAT	62		All compres	ssors were
RAH	15	%	running du	ing the
SAH	85	%	test.	
			Input capad	city and
El	84%		power proje	ections
CI	96%		multiplied b	y 2
Input Cap	20	Tons		
OAT	97	F		
Predicted KW	26.80	kW		
	CU Capacity E	stimates		
Ambient	98	F	310	к
CU Exhaust	128.5	•	327	
Coil Length	74	-	021	IX .
Coil Width	29			
Coil Number	20			
Area	29.8	sq-ft		
Measured Fan CFM	6319			
Air Mass Flow		kg/sec		
Capacity	17.34			
Efficiency	7.38	EER		

CU Fan CFM Calculation Measurement Number ft/sec 1 3.9 2 3.3 3 4.5 4 4.1 5 3.3 6 2.1 Average 3.5

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	NGFM08994 RTU-Gas 1997			Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER	10.7 10.7 20.71 7 3% 10.2 1.18	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	9.6	Amps		Power supply:	3-phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Power factor:	0.68			Compressor quantity:	4	
Condensing Fan Data						
Full load Amps:	2.1	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.7			Fan quantity:	2	
Evaporator fan data (if a	pplicable)					
Full load Amps:	0	Amps		Power supply:	3-Phase	
Nameplate Voltage:	0	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.7			Fan quantity:	1	
Calculated compressor I	oad:		20.8	kW		
Calculated condensing f			2.34	kW		
Calculated evaporator fa	in load		0.00	kW		
Total calculated load for Assumptions	equipment:		23.12	kW - Condensing side only		

2.5% Performance Degradation

Condenser C Overall Unit C	oil Assessme ondition	nt
	New	Х
	Average	
	Fair	
	Poor	
Coil Cleanline	ss	
	Coated	
	Clean	1
	Dirty	
	Clogged	0.25
	Plugged	
Fin Condition		
	Like New	
	Some Bent	0
	Smashed	0
	Dull/rough	
	Corroded	0
	Pitted	0
	Flaking	0
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

Y-measurement Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	483	36.7	6.4	0.36
2 to 3	485	37	17.8	0.98
TOTAL				
HVAC Service Assistant	t Measurement			
Input SEER	10)	Measured	circuit 2
RAT	82	2 F	(compress	ors 3&4)
SAT	62	2 F	All compre	ssors were
RAH	15	5 %	running du	ring the
SAH	85	5 %	test.	-
		1	Input capa	city and
EI	96%	,	power proj	ections
CI	94%	,	multiplied I	oy 2
Input Cap	10) Tons		
OAT	85	F		
Predicted KW	23.60	kW		
	CU Capacity	Estimates		
Ambient	85	δF	303	к
CU Exhaust	110.5	5 F	317	К
Coil Length	74	l in		
Coil Width	29) in		
Area	29.8	3 sq-ft		
Measured Fan CFM	18092	2		
Air Mass Flow		5 kg/sec		
Capacity		2 Tons		
Efficiency	20.59	EER		

CU Fan CFM Calculation Measurement Number ft/sec 1 9.2 2 9.8 3 12.3 4 10.8 5 9.2 6 9.4 Average 10.1

Monroe	Aquatic Ce	RTU-8	Summa	ry								
EER at ARI Conditions			10.7 BTU/W-h			Equipment age			7 years			
Condensing	g unit CFM			6319 CFM (Measured)								
Nominal Ur	nit Capacity			20.7	1 tons							
Capacity us	sed for SA			20.00	0 tons							
Coil Area				29.8	1 sq-ft							
Predicted EER =			9.35 pre 10.19 p				post					
		HVAC	C Service As	Service Assistant				Physical Power and Capacity measurments				
Test Date							Cond	Air, deg F		Cond Air		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
27-May	97	55	84%	96%	8.2	27.75	98	128.5	16.9	28.2	3.58	17.34
Post Adsil I	Measurements											
17-Jun	85	55	96%	94%	10.5	24.44	85	110.5	14.2	24.2	10.25	41.52

	Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions									
			Test Data		Per	cent Diff	erence		Test Data	l	Percent Difference					
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	27.75	28.2	22.10	126%	128%	99%	29.2	29.7	23.29	126%	128%	98%	-	-	-
Pre-Adsil	Capacity (Tons)	17.22	17.34	17.94	96%	97%	100%	19.9	20.0	20.71	96%	97%	99%	-	-	-
	EER	8.2	7.38	9.74	84%	76%	88%	9.0	8.1	10.67	84%	76%	111%	104%	116%	88%
	Power (kW)	24.44	24.2	20.78	118%	116%	99%	27.4	27.1	23.29	118%	116%	101%	-	-	-
Post-Adsil	Capacity (Tons)	17.72	41.52	18.86	94%	220%	100%	19.5	45.6	20.71	94%	220%	43%	-	-	-
	EER	10.5	20.59	10.89	96%	189%	95%	10.2	20.2	10.67	96%	189%	51%	91%	46%	95%

EER

7.38

20.59

EER Changes

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	8.2	7.38	9.35
Post Adsil EER	10.5	20.59	10.19
ARI Adjusted			
Pre-Adsil EER	9.0	8.09	9.35
Post Adsil EER	10.2	20.18	10.19
Change	14.3%	149.5%	9.0%
Weighted Average	285.7%	2989.8%	179.1%

EPA Adsil Evaluation Monroe Aquatics Center RTU-8

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	York D7CG060N NGFM09100 RTU-Gas 1997 Monroe Aqu RTU-6			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.9 10.9 5.25 7 4% 10.2 1.18	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	8.0	Amps		Power supply:	3-phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Power factor:	0.87			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	0.80	Amps		Power supply:	1-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Evaporator fan data (if a	oplicable)					
Full load Amps:	3.30	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Calculated compressor l	oad:		5.5	kW		
Calculated condensing fa	an load:		0.26	kW		
Calculated evaporator fa	n load		1.06	kW		
Total calculated load for Assumptions	equipment:		5.80	kW - Condensing side only		

Condenser C Overall Unit C	oil Assessme ondition	nt
	New	
	Average	Х
	Fair	
	Poor	
Coil Cleanline	ss	
	Coated	
	Clean	0.75
	Dirty	0.25
	Clogged	
	Plugged	
Fin Condition		
	Like New	0.75
	Some Bent	0.25
	Smashed	
	Dull/rough	0.25
	Corroded	0
	Pitted	0
	Flaking	0
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

4.0%	Performance Degradation	

Y-measurement				
Phase 1	Volts	Amps	kW	PF
1 2				
3				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	485	11.6	0.7	0.13
2 to 3	485	10.75	5.2	1.00
TOTAL				
HVAC Service Assistan	t Measurement	-		
Input SEER	10			
RAT	75			
SAT	55			
RAH		%		
SAH	85	%		
EI	103%	ł		
CI	98%	•		
Input Cap		Tons		
OAT	95			
Predicted KW		kW		
	CU Capacity I	- stimates		
Ambient	95	F	308	к
CU Exhaust	114	F	319	К
Coil Length	74	in		
Coil Width	29	in		
Area	14.9	sq-ft		
Measured Fan CFM	5477			
Air Mass Flow		kg/sec		
Capacity		Tons		
Efficiency	19.05	EER		

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	6.4
2	6.2
3	5.7
4	6.2
Average	6.1

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	York D7CG060N NGFM09100 RTU-Gas 1997 Monroe Aqu RTU-6			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.9 10.9 5.25 7 0% 10.6 1.14	•	J Only) J Only)
Compressor Data							
Running load Amps:	8	Amps		Power supply:	3-phase		
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73		
Power factor:	0.87			Compressor quantity:	1		
Condensing Fan Data							
Full load Amps:	0.8	Amps		Power supply:	1-Phase		
Nameplate Voltage:	460	Volts		Phase adjustment:	1		
Adjust FLA to RLA:	0.7			Fan quantity:	1		
Evaporator fan data (if a	pplicable)						
Full load Amps:	3.3	Amps		Power supply:	3-Phase		
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73		
Adjust FLA to RLA:	0.7			Fan quantity:	1		
Calculated compressor	load:		5.5	kW			
Calculated condensing f	an load:		0.26	kW			
Calculated evaporator fa	n load		1.06	kW			
Total calculated load for Assumptions	equipment:		5.80	kW - Condensing side only			
Condenser Coil Assess	ment	0.0%	Performa	ance Degradation			

New X Average Fair Poor Coated Coated Clean Clean 1 Dirty Clogged Plugged Closen Fin Condition Come Bent Some Bent 0 Some Bent 0 Fin-Tube Attachment Like New Like New X Corrosion Some Loose	/erall Unit C	nt	
Fair Poor Coil Cleanliness Coated Clean 1 Dirty Clogged Plugged Fin Condition Like New Some Bent 0 Somashed 0 Dull/rough Corroded 0 Fin-Tube Attachment Like New X Corrosion Some Loose		New	х
Fair Poor Coil Cleanliness Coated Clean 1 Dirty Clogged Plugged Fin Condition Like New Some Bent 0 Somashed 0 Dull/rough Corroded 0 Fin-Tube Attachment Like New X Corrosion Some Loose		Average	
Coil Cleanliness Coated Clean 1 Dirty Clogged Plugged Fin Condition Like New Some Bent 0 Smashed 0 Dull/rough Corroded 0 Pitted 0 Fin-Tube Attachment Like New Corrosion Some Loose		•	
Coated Clean 1 Dirty Clogged Plugged Plugged Fin Condition Like New Some Bent Smashed Dull/rough Corroded Pitted 0 Fin-Tube Attachment Like New Corrosion Some Loose		Poor	
Clean 1 Dirty Clogged Plugged Fin Condition Like New Some Bent 0 Smashed 0 Dull/rough Corroded 0 Pitted 0 Fin-Tube Attachment Like New x Corrosion Some Loose	oil Cleanline	SS	
Fin Condition Like New Some Bent Smashed Dull/rough Corroded Plating Fin-Tube Attachment Like New Corrosion Some Loose		Coated	
Clogged Plugged Fin Condition Like New Some Bent Smashed Dull/rough Corroded Pitted Flaking Fin-Tube Attachment Like New Corrosion Some Loose		Clean	1
Clogged Plugged Fin Condition Like New Some Bent Smashed Dull/rough Corroded Pitted Flaking Fin-Tube Attachment Like New Corrosion Some Loose		Dirty	
Plugged Fin Condition Like New Some Bent Smashed Dull/rough Corroded Pitted Fin-Tube Attachment Like New Corrosion Some Loose			
Fin Condition Like New Some Bent Smashed Dull/rough Corroded Pitted Flaking Fin-Tube Attachment Like New Corrosion Some Loose			
Some Bent 0 Smashed 0 Dull/rough 0 Pitted 0 Flaking 0 Fin-Tube Attachment Like New x Corrosion Some Loose	n Condition	- 55	
Smashed 0 Dull/rough Corroded 0 Pitted 0 Flaking 0 Fin-Tube Attachment Like New x Corrosion Some Loose		Like New	
Dull/rough Corroded Pitted Flaking O Fin-Tube Attachment Like New Corrosion Some Loose		Some Bent	0
Corroded 0 Pitted 0 Flaking 0 Fin-Tube Attachment Like New x Corrosion Some Loose		Smashed	0
Pitted 0 Flaking 0 Fin-Tube Attachment Like New x Corrosion Some Loose		Dull/rough	
Flaking 0 Fin-Tube Attachment Like New x Corrosion Some Loose		Corroded	0
Fin-Tube Attachment Like New x Corrosion Some Loose		Pitted	0
Like New X Corrosion Some Loose		Flaking	0
Corrosion Some Loose	n-Tube Atta	chment	
Some Loose		Like New	x
		Corrosion	
		Some Loose	
Many Loose		Many Loose	
Tubes	ibes	-	
Clean Cu x		Clean Cu	x
Corrosion		Corrosion	
Pitting		Pitting	
Leaks		-	

FLUKE METER MEASUREMENTS								
Y-measurement Phase	Volts Amps kW PF							
1	VOITS AMPS KW PH							
2								
3								
5								
Delta Measurement								
Phase	Volts	Amps	kW	PF				
1 to 2	483	11	0.6	0.11				
2 to 3	485	11.7	5.2	1.00				
TOTAL								
HVAC Service Assistant	Measuremen	t						
Input SEER	1	0						
RAT	75 F							
SAT	55 F							
RAH	35 %							
SAH	85 %							
EI	99%							
CI	98%							
Input Cap	5 Tons							
OAT	88 F							
Predicted KW	6.0	0 kW						
F								
CU Capacity Estimates								
Ambient	87 F 304 K							
CU Exhaust	108 F 315 K							
Coil Length	74 in							
Coil Width	29 in							
Area	14.9 sq-ft							
Measured Fan CFM	6639							
Air Mass Flow	3.76 kg/sec							
Capacity		5 Tons						
Efficiency	25.96 EER							

ft/sec
7.2
7.4
7.5
7.6
7.425

Monroe	Aquatic Ce	nter	RTU-6	Summa	ry							
EER at ARI	I Conditions 10.9 BTU/W-h				h	Equipment age 7 years						
Condensing	unit CFM			5477	CFM (M	easured)						
Nominal Unit Capacity 5.25 tons												
Capacity us	ed for SA			5.00) tons							
Coil Area				14.90) sq-ft							
Predicted E	ER =			10.17	7 pre	10.56	post					
		HVAC	Service As	sistant				Phys	ical Power	and Capaci	ty measurn	nents
Test Date							Cond Ai	r, deg F		Cond Air		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
24-May	95	58	103%	98%	11.0	NA	95	114	10.6	5.9	3.10	9.36
Post Adsil M	leasurements											
15-Jun	88	58	99%	98%	11.6	6.30	87	108	11.7	5.8	3.76	12.55
				1		1		1		1		

	Condensing Unit Summary - Ambient Conditions					Condensing Unit Summary - ARI Conditions										
			Test Data		Per	cent Diff	erence		Test Data	1			Pe	rcent Differenc	e	
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	NA	5.9	5.90	NA	100%	100%	NA	5.8	5.80	NA	100%	NA	-	-	-
Pre-Adsil	Capacity (Tons)	5.15	9.36	5.25	98%	178%	100%	5.1	9.4	5.25	98%	178%	55%	-	-	-
	EER	11.0	19.05	10.68	103%	178%	94%	11.2	19.4	10.86	103%	178%	58%	91%	53%	94%
	Power (kW)	6.30	5.8	5.65	112%	103%	100%	6.5	6.0	5.80	112%	103%	109%	-	-	-
Post-Adsil	Capacity (Tons)	5.42	12.55	5.53	98%	227%	100%	5.1	11.9	5.25	98%	227%	43%	-	-	-
	EER	11.6	25.96	11.74	99%	221%	97%	10.8	24.0	10.86	99%	221%	45%	95%	42%	97%

EER

19.05

25.96

FFR	Changes	
	Changes	

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	11.0	19.05	10.17
Post Adsil EER	11.6	25.96	10.56
ARI Adjusted			
Pre-Adsil EER	11.2	19.36	10.17
Post Adsil EER	10.8	24.02	10.56
Change	-3.9%	24.0%	3.8%
Weighted Average	-19.4%	120.2%	19.2%

EPA Adsil Evaluation Monroe Aquatics Center RTU-6

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	York D7CG060N NGFM09101 RTU-Gas 1997 Monroe Aqu RTU-5			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.9 10.9 5.25 7 4% 10.2 1.18	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	8.0	Amps		Power supply:	3-phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Power factor:	0.87			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	0.80	Amps		Power supply:	1-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Evaporator fan data (if ap	oplicable)					
Full load Amps:	3.30	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Calculated compressor le	oad:		5.5	kW		
Calculated condensing fa	an load:		0.26	kW		
Calculated evaporator fa	n load		1.06	kW		
Total calculated load for Assumptions			5.80	kW - Condensing side only		

Condenser C Overall Unit C	nt						
	New						
	Average	Х					
	Fair						
	Poor						
Coil Cleanline	Coil Cleanliness						
	Coated						
	Clean	0.75					
	Dirty	0.25					
	Clogged						
	Plugged						
Fin Condition							
	Like New	0.75					
	Some Bent	0.25					
	Smashed						
	Dull/rough	0.25					
	Corroded	0					
	Pitted	0					
	Flaking	0					
Fin-Tube Atta	chment						
	Like New	x					
	Corrosion						
	Some Loose						
	Many Loose						
Tubes							
	Clean Cu	x					
	Corrosion						
	Pitting						
	Leaks						

4.0%	Performance Degradation
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FLUKE METER MEAS	SURMENTS					
Y-measurment						
Phase	Volts	Amps	kW	PF		
1						
2						
3						
Delta Measurement				55		
Phase	Volts	Amps	kW	PF		
1 to 2	480	11.25	0.9	0.17		
2 to 3 TOTAL	483	10.7	5.2	1.00		
HVAC Service Assista	nt Measurement					
Input SEER	10					
RAT		5 F				
SAT	5	5 F				
RAH	25 %					
SAH		5 %				
		1				
EI	72%	, D				
CI	68%					
Input Cap		5 Tons				
OAT		3 F				
Predicted KW	5.8	kW				
	CU Capacity	Estimates				
Ambient	9	1 F	306	К		
CU Exhaust	115 F 319 K					
Coil Length	74 in					
Coil Width	29	🤉 in				
Area		9 sq-ft				
Measured Fan CFM	389					
Air Mass Flow) kg/sec				
Capacity) Tons				
Efficiency	16.5	3 EER				

CU Fan CFM Calculation						
Measurement						
Number	ft/sec					
1	4.5					
2	5.3					
3	4.5					
4	3.1					
Average	4.4					

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	York D7CG060N NGFM09101 RTU-Gas 1997 Monroe Aqu RTU-5	1		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.9 10.9 5.25 7 0% 10.6 1.14	Btu/W-hr Btu/W-hr tons years (% degrad Btu/W-hr	(CU Only) (CU Only) led)
Compressor Data							
Running load Amps:	8	Amps		Power supply:	3-phase		
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73		
Power factor:	0.87			Compressor quantity:	1		
Condensing Fan Data							
Full load Amps:	0.8	Amps		Power supply:	1-Phase		
Nameplate Voltage:	460	Volts		Phase adjustment:	1		
Adjust FLA to RLA:	0.7			Fan quantity:	1		
Evaporator fan data (if a	pplicable)						
Full load Amps:	3.3	Amps		Power supply:	3-Phase		
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73		
Adjust FLA to RLA:	0.7			Fan quantity:	1		
Calculated compressor I	oad:		5.5	kW			
Calculated condensing f	an load:		0.26	kW			
Calculated evaporator fa	in load		1.06	kW			
Total calculated load for Assumptions	equipment:		5.80	kW - Condensing side only			

Condenser Coil Assessment Overall Unit Condition New X Average Fair Poor

	Poor	
Coil Cleanline		
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	0
	Smashed	0
	Dull/rough	
	Corroded	0
	Pitted	0
	Flaking	0
Fin-Tube Attac	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

0.0% Performance Degradation

Y-measurment								
Phase	Volts	Amps	kW	PF				
1								
2								
3								
Delta Measurement								
Phase	Volts	Amps	kW	PF				
1 to 2	485	10.5	0.3	0.07				
2 to 3	489	10.5	5	1.00				
TOTAL	409	10.3	5	1.00				
HVAC Service Assista	nt Measurement							
Input SEER	10	1						
RAT	68	F						
SAT	48 F							
RAH	50 %							
SAH	85 %							
		1						
EI	82%	1						
CI	74%							
Input Cap	5	Tons						
OAT	84	F						
Predicted KW	5.50	kW						
	CU Capacity E	stimates						
Ambient	84		302					
CU Exhaust	101 F 311 K							
Coil Length	74 in							
Coil Width	29							
Area	sq-ft							
Measured Fan CFM								
Air Mass Flow 3.03 kg/sec Capacity 8.17 Tons								
Capacity								

CU Fan CFM Calculation									
Measurement									
Number	ft/sec								
1	6.1								
2	6								
3	5.7								
4	6.1								
Average	6.0								

Monroe	Aquatic Ce	nter	RTU-5	Summa	ry								
EER at AR	I Conditions			10.9	9 BTU/W-I	h	Equipment age			7 years			
Condensing	g unit CFM			389	CFM (M	easured)							
Nominal Ur	nit Capacity			5.2	5 tons								
Capacity us	sed for SA			5.00) tons								
Coil Area				14.9	0 sq-ft								
Predicted E	ER =			10.1	7 pre	10.56	post						
	HVAC Service Assistant						Physical Power and Capacity measurments						
Test Date							Cond Air, deg F		Cond Air				
1	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons	
24-May	93	55	72%	68%	7.8	6.09	91	115	13.3	6.1	2.20	8.40	
Post Adsil	Measurements												
15-Jun	84	57	82%	74%	10.1	6.09	84	101	9.4	5.3	3.03	8.17	

Condensing Unit Summary - Ambient Conditions							Condensing Unit Summary - ARI Conditions										
			Test Data		Per	cent Diff	Difference Test Data					Percent Difference					
ΟΑΤ		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Predicted/ Original	
	Power (kW)	6.09	6.1	5.91	103%	103%	100%	6.0	6.0	5.80	103%	103%	100%	-	-	-	
Pre-Adsil	Capacity (Tons)	3.62	8.40	5.33	68%	158%	100%	3.6	8.3	5.25	68%	158%	43%	-	-	-	
	EER	7.8	16.53	10.82	72%	153%	94%	7.8	16.6	10.86	72%	153%	47%	130%	61%	94%	
	Power (kW)	6.09	5.3	5.54	110%	96%	100%	6.4	5.5	5.80	110%	96%	115%	-	-	-	
Post-Adsil	Capacity (Tons)	4.21	8.17	5.68	74%	144%	100%	3.9	7.6	5.25	74%	144%	51%	-	-	-	
	EER	10.1	18.51	12.30	82%	150%	97%	8.9	16.3	10.86	82%	150%	55%	114%	62%	97%	

EER 16.53

18.51

EER Changes

	Service Assistant	Condenser Test	Spreadsheet			
Pre-Adsil EER	7.8	16.53	10.17			
Post Adsil EER	10.1	18.51	10.56			
ARI Adjusted						
Pre-Adsil EER	7.8	16.59	10.17			
Post Adsil EER	8.9	16.34	10.56			
Change	13.9%	-1.5%	3.8%			
Weighted Average	69.4%	-7.5%	19.2%			
Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	York D7CG060N NGFM09101 RTU-Gas 1997 Monroe Aqu RTU-4	1		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.9 10.9 5.25 7 2% 10.4 1.16	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
-------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------	-------	------	-------------------------------------------------------------------------------------------------------------------	-------------------------------------------------	---------------------------------------------------------------------------------------
Compressor Data						
Running load Amps:	8.0	Amps		Power supply:	3-phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Power factor:	0.87			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	0.80	Amps		Power supply:	1-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Evaporator fan data (if ap	oplicable)					
Full load Amps:	3.30	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Calculated compressor le	oad:		5.5	kW		
Calculated condensing fa	an load:		0.26	kW		
Calculated evaporator fa	n load		1.06	kW		
Total calculated load for Assumptions			5.80	kW - Condensing side only		

Condenser Coil Assessment Overall Unit Condition								
	New							
	Average	x						
	Fair							
	Poor							
Coil Cleanline	ss							
	Coated							
	Clean	0.9						
	Dirty	0.1						
	Clogged							
	Plugged							
Fin Condition								
	Like New	0.9						
	Some Bent	0.1						
	Smashed							
	Dull/rough	0.1						
	Corroded	0						
	Pitted	0						
	Flaking	0						
Fin-Tube Atta	chment							
	Like New	x						
	Corrosion							
	Some Loose							
	Many Loose							
Tubes								
	Clean Cu	x						
	Corrosion							
	Pitting							
	Leaks							

1.7% Performance Degra

FLUKE METER MEAS	URMENTS							
Y-measurment								
Phase	Volts	Amps	kW	PF				
1								
2								
3								
Delta Measurement								
Phase	Volts	Amps	kW	PF				
1 to 2	480	10.5	5.1	1				
2 to 3	480	10.8	0.5	0.09				
TOTAL								
HVAC Service Assistar	nt Measurment	_						
Input SEER	10)						
RAT	68	3 F						
SAT	48	3 F						
RAH	50 %							
SAH	85	5 %						
		4						
El	79%	-						
CI	73%	-						
Input Cap		Tons						
OAT		F						
Predicted KW	5.70	kW						
	CU Capacity	Estimates						
Ambient	90) F	305	к				
CU Exhaust	105	5 F	314	К				
Coil Length	74 in							
Coil Width	29) in						
Area	14.9	9 sq-ft						
Measured Fan CFM	5074	1						
Air Mass Flow		7 kg/sec						
Capacity		5 Tons						
Efficiency	14.68	B EER						

CU Fan CFM Calculation								
Measurement								
Number	ft/sec							
1	4.9							
2	6.8							
3	5.5							
4	5.5							
Average	5.675							

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	York D7CG060N NGFM09101 RTU-Gas 1997 Monroe Aqu RTU-4			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.9 10.9 5.25 7 0% 10.6 1.14	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	8	Amps		Power supply:	3-phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Power factor:	0.87			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	0.8	Amps		Power supply:	1-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.7			Fan quantity:	1	
Evaporator fan data (if a	applicable)					
Full load Amps:	3.3	Amps		Power supply:	3-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.7			Fan quantity:	1	
Calculated compressor	load:		5.5	kW		
Calculated condensing	fan load:		0.26	kW		
Calculated evaporator fa	an load		1.06	kW		
Total calculated load for Assumptions	r equipment:		5.80	kW - Condensing side only		
Condenser Coil Assess	ment	0.0%	Performa	ance Degradation		

New Average Fair Poor Coil Cleanliness Coated Clean Dirty Clogged	X
Fair Poor Coil Cleanliness Coated Clean Dirty	1
Poor Coil Cleanliness Coated Clean Dirty	1
Coil Cleanliness Coated Clean Dirty	1
Coated Clean Dirty	1
Clean Dirty	1
Dirty	1
Clogged	
Plugged	
Fin Condition	
Like New	
Some Bent	0
Smashed	0
Dull/rough	
Corroded	0
Pitted	0
Flaking	0
Fin-Tube Attachment	
Like New	х
Corrosion	
Some Loose	
Many Loose	
Tubes	
Clean Cu	х
Corrosion	
Pitting	
Leaks	

Y-measurment								
Phase	Volts	Amps	kW	PF				
1								
2								
3								
Delta Measurement								
Phase	Volts	Amps	kW	PF				
1 to 2	484	10.7	0.4	0.07				
2 to 3	486	10.5	5.1	1.00				
TOTAL								
HVAC Service Assista		-						
Input SEER	10	+						
RAT	68	+						
SAT	48 F							
RAH	50 %							
SAH	85	%						
EI	85%	-						
СІ	78%	1						
Input Cap	5	Tons						
OAT	85	F						
Predicted KW	5.70	kW						
	CU Capacity	Estimates						
Ambient	86	F	303	к				
CU Exhaust	86 F 303 K 104 F 313 K							
Coil Length		in	210					
Coil Width	29	in						
Area	14.9	sq-ft						
Measured Fan CFM	6349	•						
Air Mass Flow		kg/sec						
Capacity		Tons						
Efficiency	22.44	EER						

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	7.0
2	7.0
3	7.2
4	7.2
Average	7.1

Monroe	Aquatic Ce	nter	RTU-4	Summa	ry								
EER at AR	Conditions			10.9	BTU/W-I	ı	Eq	uipment age	7	7 years			
Condensing	g unit CFM			5074	CFM (M	easured)							
Nominal Ur	nit Capacity			5.25	tons								
Capacity us	sed for SA			5.00	tons								
Coil Area				14.90	sq-ft								
Predicted E	ER =			10.39	pre	10.56	post						
		HVAC	C Service As	sistant			Physical Power and Capacity measurments					nents	
Test Date							Cond Air, deg F			Cond Air			
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons	
24-May	90	57	79%	73%	9.0	5.99	90	105	8.3	5.6	2.87	6.85	
Post Adsil I	Measurements												
15-Jun	85	57	85%	78%	10.3	5.99	86	104	10.0	5.5	3.60	10.28	
					1								

Condensing Unit Summary - Ambient Conditions					Condensing Unit Summary - ARI Conditions											
			Test Data		Per	Percent Difference			Test Data	1	Percent Difference					
						0 11/1 //	00/1 1/									Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	5.99	5.6	5.75	104%	97%	100%	6.0	5.7	5.80	104%	97%	107%	-	-	-
Pre-Adsil	Capacity (Tons)	3.98	6.85	5.45	73%	126%	100%	3.8	6.6	5.25	73%	126%	58%	-	-	-
	EER	9.0	14.68	11.37	79%	129%	96%	8.6	14.0	10.86	79%	129%	61%	121%	74%	96%
	Power (kW)	5.99	5.5	5.58	107%	99%	100%	6.2	5.7	5.80	107%	99%	109%	-	-	-
Post-Adsil	Capacity (Tons)	4.40	10.28	5.64	78%	182%	100%	4.1	9.6	5.25	78%	182%	43%	-	-	-
	EER	10.3	22.44	12.14	85%	185%	97%	9.2	20.1	10.86	85%	185%	46%	113%	52%	97%

EER

14.68

22.44

EER Changes

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	9.0	14.68	10.39
Post Adsil EER	10.3	22.44	10.56
ARI Adjusted			
Pre-Adsil EER	8.6	14.03	10.39
Post Adsil EER	9.2	20.07	10.56
Change	7.6%	43.1%	1.7%
Weighted Average	38.0%	215.5%	8.3%

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	York D3CG090N1304G0 NGFM090091 RTU-Gas 1997 Monroe Aquatic Ce RTU-2	-	Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	11.1 11.1 7.49 7 1% 10.8 1.12	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	7.1 Amp 460 Volts 0.64		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 2	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.30 Amp 460 Volts 0.70		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 2	
Evaporator fan data (if aj Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	oplicable) Amp Volts 0.70		Power supply: Phase adjustment: Fan quantity:	3-Phase 1.73 1	
Calculated compressor I Calculated condensing fr Calculated evaporator fa Total calculated load for Assumptions	an load: n load	7.2 0.84 0.00 8.07	kW kW kW kW - Condensing side only		

Condenser C Overall Unit C	oil Assessme	nt
	New	0.9
	Average	0.1
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	0.1
	Smashed	
	Dull/rough	
	Corroded	0
	Pitted	0
	Flaking	0
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

0.52%	Performance Degradation	n
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FLUKE METER MEA: Y-measurement	SUREMENTS			
Phase	Volts	Amps	kW	PF
1	VOIIS	Апрэ	NVV	
2				
3				
-				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	480	15.5	3	0.41
2 to 3	480	13.4	5.8	0.92
TOTAL				
HVAC Service Assista	ant Measurement	_		
Input SEER	10	+		
RAT	70	F		
SAT	50	F		
RAH	28	%		
SAH	85	%		
	Circuit 1	Ĩ	Circuit 2	
El	92%	Ĩ	98%	
CI	93%	Ĩ	96%	
Input Cap	3.5	Tons	3.5	Tons
OAT	85	F	86	F
Predicted KW	4.20	kW	4.10	kW
	011 0			
	CU Capacity I	sumates		
Ambient	83	F	301	к
CU Exhaust	105	F	314	к
Coil Length	41	in		
Coil Width	29	in		
Area	16.5	sq-ft		
Measured Fan CFM	6424	•		
Air Mass Flow	3.64	kg/sec		
Capacity	12.72			
Efficiency	17.34	EER		

CU Fan CFM Calculation							
Measurement							
Number	FPM						
1	7.2						
2	8.2						
3	5.3						
4	4.9						
5	7.8						
6	5.5						
Average	6.483						

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	York D3CG090N NGFM09009 RTU-Gas 1997 Monroe Aqu RTU-2			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	11.1 11.2 7.50 7 0% 10.8 1.11	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	7.1	Amps		Power supply:	3-phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Power factor:	0.64			Compressor quantity:	2	
Condensing Fan Data						
Full load Amps:	1.3	Amps		Power supply:	1-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.7			Fan quantity:	2	
Evaporator fan data (if a	pplicable)					
Full load Amps:	0	Amps		Power supply:	3-Phase	
Nameplate Voltage:	Ő	Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.7			Fan quantity:	1	
Calculated compressor Calculated condensing f Calculated evaporator fa Total calculated load for	fan load: an load		7.2 0.84 0.00 8.07	kW kW kW kW - Condensing side only		

Total calculated load for equipment: Assumptions

Condenser Coil Assessment

Overall Unit C	ondition	
	New	х
	Average	
	Fair	
	Poor	
Coil Cleanline	ss	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	0
	Smashed	0
	Dull/rough	
	Corroded	0
	Pitted	0
	Flaking	0
Fin-Tube Attac	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

0.0% Performance Degradation

Y-measurement Phase	Volts	Amps	kW	PF
1	VOILS	Amps	NVV	FF
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	480	15.2	2.9	0.4
2 to 3	485	13.4	6	0.92
TOTAL				
HVAC Service Assista				
Input SEER	10			
RAT	70			
SAT	50			
RAH	30	%		
SAH	85	%		
	Circuit 1		Circuit 2	
EI	100%		100%	
CI	99%		99%	
Input Cap	3.5	Tons	3.5	Tons
OAT	88	F	89	F
Predicted KW	4.10	kW	4.20	kW
	CU Capacity E	stimates		
Ambient	88.5	F	305	к
CU Exhaust	104.5	F	313	к
Coil Length	41	in		
Coil Width	29	in		
Area		sq-ft		
Measured Fan CFM	12509			
Air Mass Flow		kg/sec		
Capacity	18.01			
	24.29			

CU Fan CFM	Calculation
Measurement	
Number	FPM
1	11.5
2	11.7
3	11.9
4	12.5
5	11.5
6	11.5
7	14.3
8	13.9
9	11.1
10	14.6
11	13.5
12	13.5
Average	12.625

Monroe	Aquatic Ce	enter	RTU-2	Summa	ry							
EER at AR	I Conditions		11.1	1 BTU/W-ł	n	Eq	uipment age	7	7 years			
Condensin	g unit CFM			6424	4 CFM (Me	easured)						
Capacity at	ARI			7.49	9 tons							
Capacity u	sed for SA			7.00) tons							
Coil Area				16.5	1 sq-ft							
Predicted E	ER =			10.76	6 pre	10.83	post					
		HVA	C Service A	ssistant			Physical Power and Capacity measurments					nents
Test Date							Cond A	ir, deg F		Cond Air		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons
24-May	85	53	95%	95%	11.2	8.88	83	105	12.2	8.8	3.64	12.72
Post Adsil	Measurements											
16-Jun	88	53	100%	99%	11.1	8.88	88.5	104.5	8.9	8.9	7.08	18.01

Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions										
			Test Data	l	Per	cent Diff	erence		Test Data Percent Difference							
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	8.88	8.8	7.25	123%	121%	100%	9.9	9.8	8.08	123%	121%	101%	-	-	-
Pre-Adsil	Capacity (Tons)	6.70	12.72	7.09	95%	179%	100%	7.1	13.4	7.49	95%	179%	53%	-	-	-
	EER	11.2	17.34	11.75	95%	148%	97%	10.6	16.4	11.12	95%	148%	64%	102%	66%	97%
	Power (kW)	8.88	8.9	7.52	118%	118%	100%	9.5	9.6	8.08	118%	118%	100%	-	-	-
Post-Adsil	Capacity (Tons)	6.91	18.01	6.98	99%	258%	100%	7.4	19.3	7.49	99%	258%	38%	-	-	-
	EER	11.1	24.29	11.14	100%	218%	97%	11.1	24.2	11.12	100%	218%	46%	97%	44%	97%

EER 17.34

24.29

EER Changes										
	Spreadsheet									
Pre-Adsil EER	11.2	17.34	10.76							
Post Adsil EER	11.1	24.29	10.83							
ARI Adjusted										
Pre-Adsil EER	10.6	16.44	10.76							
Post Adsil EER	11.1	24.28	10.83							
Change	5.3%	47.6%	0.7%							
Weighted Average	36.8%	333.4%	4.6%							

EPA Adsil Evaluation Monroe Aquatics Center RTU-2

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	York D3CG090N1304GG NGFM090089 RTU-Gas 1997 Monroe Aquatic Center RTU-1			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	11.1 11.1 7.49 7 1% 10.8 1.12	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	7.1	Amps		Power supply:	3-phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Power factor:	0.64			Compressor quantity:	2	
Condensing Fan Data						
Full load Amps:	1.30	Amps		Power supply:	1-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.70			Fan quantity:	2	
Evaporator fan data (if ar	oplicable)					
Full load Amps:		Amps		Power supply:	3-Phase	
Nameplate Voltage:		Volts		Phase adjustment:	1.73	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Calculated compressor I Calculated condensing fa Calculated evaporator fa Total calculated load for	an load: n load		7.2 0.84 0.00 8.07	kW kW kW kW - Condensing side only		

Condenser C Overall Unit C	oil Assessme ondition	nt	0.52%	Performa	nce Degradation
	New	0.9			
	Average	0.1			FLUKE METER M
	Fair				Y-measurement
	Poor				Phase
Coil Cleanline	ss				1
	Coated				2
	Clean	1			3
	Dirty				
	Clogged				Delta Measureme
	Plugged				Phase
Fin Condition					1 to 2
	Like New				2 to 3
	Some Bent	0.1			TOTAL
	Smashed				HVAC Service As
	Dull/rough				Input SEER
	Corroded	0			RAT
	Pitted	0			SAT
	Flaking	0			RAH
Fin-Tube Atta	chment				SAH
	Like New	x			
	Corrosion				EI
	Some Loose				CI
	Many Loose				Input Cap
Tubes					OAT
	Clean Cu	x			Predicted KW
	Corrosion				
	Pitting				
	Leaks				
					A 1 - 1

Assumptions

Y-measurement				
Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	477	16.5	3.5	0.46
2 to 3	481	14.5	6.8	0.95
TOTAL				
HVAC Service Assista				
Input SEER	10			
RAT	74	1		
SAT	54	F		
RAH		%		
SAH	85	%		
	Circuit 1	I	Circuit 2	
EI	95%	I		
CI	102%			
Input Cap	3.5	Tons		Tons
OAT	94	F		F
Predicted KW	4.40	kW		kW
	CU Capacity I	Estimates		
Ambient	95	F	308	к
CU Exhaust	112.5		318	ĸ
Coil Length	41	in		
Coil Width	29	in		
Area	16.5	sq-ft		
Measured Fan CFM	9438	•		
Air Mass Flow	5.34	kg/sec		
Capacity		Tons		
Efficiency	17.32	EER		

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	4.7
2	12.7
3	6.4
4	14.3
Average	9.525

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	York D3CG090N1304GG NGFM090089 RTU-Gas 1997 Monroe Aquatic Cente RTU-1	r	Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	11.1 11.1 7.49 7 0% 10.8 1.11	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor: Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	7.1 Amps 460 Volts 0.64		Power supply: Phase adjustment: Compressor quantity: Power supply: Phase adjustment: Fan quantity:	3-phase 1.73 2 1-Phase 1 2	
Evaporator fan data (if a Full Ioad Amps: Nameplate Voltage: Adjust FLA to RLA: Calculated compressor Calculated condensing f Calculated evaporator fa Total calculated Ioad for Assumptions	0 Amps 0 Volts 0.7 Ioad: fan Ioad: an Ioad	7.2 0.84 0.00 8.07	Power supply: Phase adjustment: Fan quantity: kW kW kW kW kW - Condensing side only	3-Phase 1.73 1	

Condenser C Overall Unit C	oil Assessme	nt	0.0%	Performa	nce Degradation
	New	X			
	Average				FLUKE METER M
	Fair				Y-measurment
	Poor				Phase
Coil Cleanline	SS				1
	Coated				2
	Clean	1			3
	Dirty				
	Clogged				Delta Measureme
	Plugged				Phase
Fin Condition					1 to 2
	Like New				2 to 3
	Some Bent	0			TOTAL
	Smashed	0			HVAC Service As
	Dull/rough				Input SEER
	Corroded	0			RAT
	Pitted	0			SAT
	Flaking	0			RAH
Fin-Tube Atta	chment				SAH
	Like New	x			
	Corrosion				EI
	Some Loose				CI
	Many Loose				Input Cap
Tubes					OAT
	Clean Cu	x			Predicted KW
	Corrosion				
	Pitting				
	Leaks				
					Ambient

Y-measurment Phase	Volts	Amps	kW	PF
1	Volto	7 unpo		
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	476	15.6	3.2	0.42
2 to 3 TOTAL	483	14.1	6.5	0.95
HVAC Service Assistar	t Magaurmont			
		ī		
Input SEER RAT	10 74	_		
SAT	54			
RAH	50			
SAH	85			
ЗАП	00	70		
EI	99%			
CI	101%			
Input Cap		Tons		
ΩΑΤ	91			
Predicted KW	4.30			
	4.00			
	CU Capacity E	Estimates		
Ambient	90.5	-	306	K
CU Exhaust	90.5 106.5		306	
Coil Length	41		515	IX.
Coil Width	29			
Area		sq-ft		
Measured Fan CFM	12600			
Air Mass Flow		kg/sec		
Capacity	18.14			
Efficiency	22.44	EER		

Calculation
ft/sec
12.4
11.8
12.6
13.4
13.7
12.4
12.717

Monroe	Aquatic Ce	enter	RTU-1	Summa	ry							
EER at AR	Conditions		11.1 BTU/W-h				uipment age	7	7 years			
Condensing	unit CFM			9438	B CFM (M	easured)						
Capacity at	ARI			7.49) tons							
Capacity us	ed for SA			3.50) tons							
Coil Area				16.51	l sq-ft							
Predicted E	ER =			10.76	6 pre	10.81	post					
		HVA	C Service A	Assistant				Phys	ical Power	and Capac	ity measurn:	nents
Test Date							Cond A	vir, deg F		Cond Air		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons
24-May	94	61	95%	102%	10.5	9.41	95	112.5	9.7	10.3	5.34	14.86
		_						_				
Post Adsil I	leasurements											
16-Jun	91	61	99%	101%	10.9	9.20	90.5	106.5	8.9	9.7	7.14	18.14

	Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions									
		Test Data Percent Difference						Test Data	1	Percent Difference						
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	9.41	10.3	7.93	119%	130%	100%	9.6	10.5	8.08	119%	130%	91%	-	-	-
Pre-Adsil	Capacity (Tons)	7.07	14.86	6.93	102%	214%	100%	7.6	16.1	7.49	102%	214%	48%	-	-	-
	EER	10.5	17.32	10.49	100%	165%	97%	11.1	18.4	11.12	100%	165%	60%	97%	59%	97%
	Power (kW)	9.20	9.7	7.68	120%	126%	100%	9.7	10.2	8.08	120%	126%	95%	-	-	-
Post-Adsil	Capacity (Tons)	7.13	18.14	7.06	101%	257%	100%	7.6	19.3	7.49	101%	257%	39%	-	-	-
	EER	10.9	22.44	11.02	99%	204%	97%	11.0	22.7	11.12	99%	204%	49%	98%	47%	97%

EER 17.32

22.44

EER Changes									
	Service Assistant	Condenser Test	Spreadsheet						
Pre-Adsil EER	10.5	17.32	10.76						
Post Adsil EER	10.9	22.44	10.81						
ARI Adjusted									
Pre-Adsil EER	10.6	18.38	10.76						
Post Adsil EER	11.0	22.68	10.81						
Change	4.2%	23.4%	0.5%						
Neighted Average	14.7%	82.0%	1.8%						

EPA Adsil Evaluation Monroe Aquatics Center RTU-1

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Tempstar CH9536VKB2 L970880635 Split Heat pump 1997 Locust City Hall SS-2		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.6 10.6 3.00 7 6% 9.8 1.23	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor: Condensing Fan Data Full load Amps:	16.0 Am 208 Vol 0.96	is	Power supply: Phase adjustment: Compressor quantity: Power supply:	1-Phase 1 1	
Nameplate Voltage: Adjust FLA to RLA:	208 Vol 0.70		Phase adjustment: Fan quantity:	1 1	
Evaporator fan data (if ap Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	o plicable) Am Vol		Power supply: Phase adjustment: Fan quantity:		
Calculated compressor lo Calculated condensing fa Calculated evaporator fa Total calculated load for Assumptions	an load: n load	3.2 0.19 0.00 3.38	kW kW kW kW - Condensing side only		

Condenser C Overall Unit C	oil Assessme ondition	nt
	New	
	Average	1
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	1
	Clean	
	Dirty	0.1
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	0.05
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

5.95%	Performa	nce Degradation				
		FLUKE METER MEA	SURMENTS			
		Y-measurment				
		Phase	Volts	Amps	kW	PF
		1				
		2				
		3				
		Delta Measurement				
		Phase	Volts	Amps	kW	PF
		1 to 2	120	10.78	1.17	0.91
		2 to 3	120	10.56	1.18	0.93
		TOTAL				
		HVAC Service Assista	ant Measurment			
		Input SEER				
		RAT		F		
		SAT		F		
		RAH		%		
		SAH		%		
		EI	112%			
		CI	109%			
		Input Cap	3	Tons		
		OAT	94	F		
		Predicted KW	3.50	kW		
			CU Capacity E	stimates		
		Ambient	95	F	308	к
		CU Exhaust	104	F	313	к
		Coil Length	88	in		
		Coil Width	29	in		
		Area	17.7	sq-ft		
		Measured Fan CFM	5131			
		Air Mass Flow		kg/sec		
		Capacity		Tons		
		Efficiency	21.22	EER		

CU Fan CFM Calculation

Measurement	
Number	ft/sec
1	4.7
2	5.5
3	2.7
4	6.4
Average	4.825

L970880635 Split Heat p 1997	ump		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.6 10.6 3.00 7 0% 10.3 1.16	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
16 208 0.96	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	1-Phase 1 1	
1.3 208 0.7	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
pplicable) 0 0 load: fan load: an load	Amps Volts	3.2 0.19 0.00	Power supply: Phase adjustment: Fan quantity: kW kW kW	0 0 0	
	CH9536VKI L970880635 Split Heat p 1997 Locust City SS-2 16 208 0.96 1.3 208 0.7 pplicable) 0 0 0 0 0	CH9536VKB2 L970880635 Split Heat pump 1997 Locust City Hall SS-2 16 Amps 208 Volts 0.96 1.3 Amps 208 Volts 0.96 1.3 Oxtos 0.7 pplicable) 0 Amps 0 Volts 0 0 Volts 0 0 Volts 0	CH9536VKB2 L970880635 Split Heat pump 1997 Locust City Hall SS-2 16 Amps 208 Volts 0.96 1.3 Amps 208 Volts 0.96 pplicable) 0 Amps 0 Volts 0 0 Volts 0 Volts 0 Volts 0 0 Volts	CH9536VKB2 Calculated EER: L970880635 Nominal Capacity: Split Heat pump Age 1997 Coil Conditon Locust City Hall Present Condition EER SS-2 kW/ton 16 Amps 208 Volts 0.96 Power supply: 1.3 Amps 208 Volts 0.96 Power supply: 1.3 Amps 208 Volts 0.96 Power supply: 1.3 Amps Power supply: Phase adjustment: 0.7 Fan quantity: pplicable) Power supply: 0 Volts 0 Volts 0 Volts 0 Phase adjustment: 0 Volts 0 KW	CH9536VKB2 Calculated EER: 10.6 L970880635 Nominal Capacity: 3.00 Split Heat pump Age 7 1997 Coil Conditon 0% Locust City Hall Present Condition EER 10.3 SS-2 kW/ton 1.16 16 Amps Power supply: 1-Phase 208 Volts Phase adjustment: 1 0.96 Compressor quantity: 1 1.3 Amps Power supply: 1-Phase 208 Volts Phase adjustment: 1 0.96 Compressor quantity: 1 1.3 Amps Power supply: 1-Phase 0.7 Fan quantity: 1 pplicable) 0 Outs Phase adjustment: 0 0 Volts Phase adjustment: 0 0 0 S2

0.0% Performance Degradation

Condenser C Overall Unit C	oil Assessme	nt
	New	x
	Average	
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	1
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

Y-measurment Phase	Volts	Amps	kW	PF
1		/		
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	118	10.48	1.15	0.91
2 to 3	118	10.35	1.12	0.91
TOTAL				
HVAC Service Assistar	nt Measurment	_		
Input SEER	10)		
RAT	74	4 F		
SAT	54	1 F		
RAH	50) %		
SAH	85	5 %		
		T		
EI	118%	b		
CI	116%	b		
Input Cap	3	3 Tons		
OAT	89	F		
Predicted KW	3.60	kW		
	CU Capacity	Estimates		
Ambient	89) F	305	к
CU Exhaust	100) F	311	к
Coil Length	88	3 in		
Coil Width	29) in		
Area	17.7	7 sq-ft		
Measured Fan CFM	6726			
Air Mass Flow	3.81	l kg/sec		
Capacity		6 Tons		
Efficiency	35.20) EER		

CU Fan CFM Calculation								
ft/sec								
5.5								
6.8								
6.6								
6.4								
6.325								

Locust	City Hall	SS-2	Summa	ry								
EER at ARI	Conditions			10.	6 BTU/W-	h	E	quipment age	7	' years		
Condensing	unit CFM			513	1 CFM (M	easured)				-		
Capacity at	ARI			3.0) tons							
Capacity us	ed for SA			3.0) tons							
Coil Area				17.7	2 sq-ft							
Predicted E	ER =			9.7	6 pre	10.33	post					
		HVA	C Service A	ssistant				Phys	ical Power	r and Capac	ity measurn	nents
Test Date							Cond	Air, deg F		Cond Air		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
24-May	94	NA	112%	109%	11.9	3.50	95	104	5.0	2.35	2.91	4.16
Post Adsil N	leasurements											
16-Jun	89	NA	118%	116%	12.5	3.60	89	100	6.1	2.27	3.81	6.66
1												

	Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions									
		Test Da	ata@ Field C	onditions	Per	rcent Diff	erence	Te	Test Data @ARI Percent Difference				e			
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	3.50	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	-	-	-
Pre-Adsil	Capacity (Tons)	NA	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	-	-	-
	EER	11.9	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	NA	-	NA
	Power (kW)	3.60	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	-	-	-
Post-Adsil	Capacity (Tons)	NA	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	-	-	-
	EER	12.5	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	NA	-	NA

EER 21.22

35.20

	EER Changes								
	Service Assistant	Condenser Test	Spreadsheet						
Pre-Adsil EER	11.9	NA	11.7						
Post Adsil EER	12.5	NA	11.9						
ARI Adjusted									
Pre-Adsil EER	11.9	NA	11.7						
Post Adsil EER	12.5	NA	11.9						
Change	5.4%	NA	1.9%						
Weighted Average	16.1%	NA	5.8%						

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Tempstar CH9536VKB2 L970880635 Split Heat pump 1997 Locust City Hall SS-1		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.6 10.6 3.00 7 7% 9.7 1.24	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	16.0 Amp 208 Volts 0.96		Power supply: Phase adjustment: Compressor quantity:	1-Phase 1 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.30 Amp 208 Volts 0.70		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if ar Full load Amps: Nameplate Voltage: Adjust FLA to RLA: Calculated compressor h	Amp Volts		Power supply: Phase adjustment: Fan quantity: kW		
Calculated condensing fa Calculated evaporator fa Total calculated load for Assumptions	n load	0.19 0.00 3.38	kW kW kW - Condensing side only		

Condenser C Overall Unit C	coil Assessme	nt
	New	
	Average	1
	Fair	
	Poor	
Coil Cleanline	ss	
	Coated	1
	Clean	0.8
	Dirty	0.2
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	0.05
	Smashed	
	Dull/rough	0.2
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta		
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

7.2% Perfo	ormance Degradation				
	FLUKE METER MEAS				
	Y-measurment	JRIVIEINI 5			
	Phase	Volts	Amps	kW	PF
	1	VUILS	Amps	K V V	FF
	2				
	3				
	Delta Measurement				
	Phase	Volts	Amps	kW	PF
	1 to 2	120	12.7	1.41	0.98
	2 to 3	120	11.7	1.3	0.56
	TOTAL				
	HVAC Service Assistan	t Measurment			
	Input SEER	10	0		
	RAT	74	F		
	SAT	54	F		
	RAH		0 %		
	SAH		5 %		
	EI	118%	5		
	CI	114%			
	Input Cap	3	Tons		
	OAT	93	F		
	Predicted KW	3.50	kW		
			-		
		CU Capacity	Estimates		
	Ambient	93	3 F	307	к
	CU Exhaust	105	5 F	314	К
	Coil Length	88	3 in		
	Coil Width	29) in		
	Area	17.7	′ sq-ft		
	Measured Fan CFM	6486	•		
	Air Mass Flow	3.67	' kg/sec		
	Capacity) Tons		
	Efficiency	31.02	2 EER		

CU Fan CFM Calculation

Measurement	
Number	FPM
1	6.6
2	7.6
3	4.7
4	5.5
Average	6.100

Tempstar			Published EER:	10.6	Btu/W-hr (CU Only)
CH9536VK	B2		Calculated EER:	10.6	Btu/W-hr (CU Only)
L970880635			Nominal Capacity:	3.00	tons
Split Heat p	ump		Age	7	years
1997			Coil Conditon	0%	(% degraded)
Locust City	Hall		Present Condition EER	10.3	Btu/W-hr
SS-1			kW/ton	1.16	
16	Amps		Power supply:	1-Phase	
208	Volts		Phase adjustment:	1	
0.96			Compressor quantity:	1	
1.3	Amps		Power supply:	1-Phase	
208	Volts			1	
0.7			Fan quantity:	1	
pplicable)					
ó	Amps		Power supply:	0	
0	Volts			0	
0			Fan quantity:	0	
load:		3.2	kW		
		0.19	kW		
		0.00	kW		
equipment:		3.38	kW - Condensing side only		
	CH9536VK L970880635 Split Heat p 1997 Locust City SS-1 16 208 0.96 1.3 208 0.7 pplicable) 0 0 0 0 0 0	CH9536VKB2 L970880635 Split Heat pump 1997 Locust City Hall SS-1 16 Amps 208 Volts 0.96 1.3 Amps 208 Volts 0.7 pplicable) 0 Amps 0 Volts 0 Volts 0 Volts 0 Volts 0 Volts	CH9536VKB2 L970880835 Split Heat pump 1997 Locust City Hall SS-1 16 Amps 208 Volts 0.96 1.3 Amps 208 Volts 0.96 1.3 Ovlts 0.7 pplicable) 0 Amps 0 Volts 0 0 Volts 0 Volts 0 0 V Volts 0 0 V Volts 0 0 V Volts 0 0 V V V V V V V V V V V V V V V V V V	CH9336VKB2 Calculated EER: L970880635 Nominal Capacity: Split Heat pump Age 1997 Coil Conditon Locust City Hall Present Condition EER SS-1 kW/ton 16 Amps 208 Volts 0.96 Compressor quantity: 1.3 Amps 208 Volts 0.96 Compressor quantity: 1.3 Amps 208 Volts 0.96 Phase adjustment: 0.7 Fan quantity: pplicable) Power supply: 0 Volts 0 Volts 0 Volts 0 Phase adjustment: 0 Volts 0 Volts<	CH9536VKB2 Calculated EER: 10.6 L970880635 Nominal Capacity: 3.00 Split Heat pump Age 7 1997 Coil Conditon 0% Locust City Hall Present Condition EER 10.3 SS-1 kW/ton 1.16 16 Amps Power supply: 1-Phase 208 Volts Phase adjustment: 1 0.96 Compressor quantity: 1 1.3 Amps Power supply: 1-Phase 208 Volts Phase adjustment: 1 0.7 Fan quantity: 1 pplicable) 0 O Fan quantity: 0 Amps Power supply: 0 0 Volts Phase adjustment: 0 <

Condenser C Overall Unit C	oil Assessme	nt
	New	x
	Average	
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	1
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

Assumptions

0.0% Performa	ance Degradation
---------------	------------------

FLUKE METER MEAS	URMENTS			
Y-measurment				
Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	120	11.5	1.25	0.91
2 to 3	120	11.5	1.26	0.91
TOTAL				
HVAC Service Assista	nt Measurment			
Input SEER	10			
RAT	74			
SAT	54			
RAH	50			
SAH	85	%		
EI	122%			
CI	117%			
Input Cap	3	Tons		
OAT	87			
Predicted KW	3.50	kW		
	CU Capacity E	stimates		
Ambient	87		304	
CU Exhaust	101	-	311	К
Coil Length	88	in		
Coil Width	29	in		
Area		sq-ft		
Measured Fan CFM	8135			
Air Mass Flow		kg/sec		
Capacity	10.25			
Efficiency	49.00	EER		

CU Fan CFM	Calculation
Measurement	
Number	FPM
1	7.2
2	8.2
3	8.6
4	6.6
Average	7.650

Locust	City Hall	SS-1	Summa	ry								
EER at AR	Conditions			10.6	6 BTU/W-I	h	E	quipment age	7	years		
Condensing	g unit CFM			6486	6 CFM (M	easured)						
Capacity at	ARI			3.00) tons							
Capacity us	sed for SA			3.00) tons							
Coil Area				17.7	2 sq-ft							
Predicted E	ER =			9.6	5 pre	10.33	post					
		HVA	C Service As	ssistant				Phys	ical Power	and Capac	ity measurn	nents
Test Date							Cond	Air, deg F		Cond Air		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons
24-May	93	62	118%	114%	12.6	3.50	93	105	6.7	2.71	3.67	7.00
Post Adsil N	Measurements											
16-Jun	87	62	122%	117%	13.0	3.50	87	101	7.8	2.51	4.61	10.25

	Conden	ising Unit	t Summary -	Ambient Co	onditions						Condensi	ng Unit Su	mmary - AR	I Conditions		
		Test Da	ata@ Field C	Conditions	Pe	rcent Diff	erence	Te	est Data @	ARI			Pe	rcent Differenc	e	
ΟΑΤ		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Predicted/ Original
	Power (kW)	3.50	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	-	-	-
Pre-Adsil	Capacity (Tons)	NA	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	-	-	-
	EER	12.6	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	NA	-	NA
	Power (kW)	3.50	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	-	-	-
Post-Adsil	Capacity (Tons)	NA	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	-	-	-
	EER	13.0	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	NA	-	NA

EER

31.02

49.00

	EER Changes									
	Service Assistant	Condenser Test	Spreadsheet							
Pre-Adsil EER	12.6	NA	11.7							
Post Adsil EER	13.0	NA	11.9							
ARI Adjusted										
Pre-Adsil EER	12.6	NA	11.7							
Post Adsil EER	13.0	NA	11.9							
Change	3.4%	NA	1.9%							
Weighted Average	10.2%	NA	5.8%							

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 48DJE0046 0292G6468 RTU-Gas 1992 Iredell Heal RTU-3	3		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.5 9.5 2.97 12 10% 8.1 1.49	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	6.1	Amps		Power supply:	3-phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Power factor:	0.71			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	1.00	Amps		Power supply:	1-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Evaporator fan data (if a	pplicable)					
Full load Amps:	1.50	Amps		Power supply:	1-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Calculated compressor I	load:		3.4	kW		
Calculated condensing f	an load:		0.32	kW		
Calculated evaporator fa	in load		0.48	kW		
Total calculated load for	equipment:		3.74	kW - Condensing side only		
Assumptions						

10.0% Performance Degradation

hase 1	Volts	Amps	kW	PF
	Volta	Апрэ	IX V V	
2				
3				
elta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	466	5.7	1.2	0.4
2 to 3	467	5.4	2.5	0.9
OTAL				
IVAC Service Assistar	nt Measurment			
nput SEER	10	1		
RAT	74	F		
AT	54	F		
RAH	50	%		
AH	85	%		
	Circuit 1			
il i	102%			
	99%			
nput Cap	4	Tons		
DAT	83	F		
Predicted KW	3.53	kW		
	CU Capacity E	Estimates		
mbient	85	F	303	к
U Exhaust	94	F	308	К
oil Length	62	in		
coil Width	28	in		
rea	12.1	sq-ft		
leasured Fan CFM	9259			
ir Mass Flow		kg/sec		
Capacity				
ir Mass Flow	9259 5.24	kg/sec Tons		

Calculated evaporator fan load Total calculated load for equipment: Assumptions							
Condenser Co Overall Unit Co		nt					
	New						
	Average						
	Fair	1					
	Poor						
Coil Cleanlines	s						
	Coated						
	Clean	0.9					
	Dirty	0.1					
	Clogged						
	Plugged						
Fin Condition							
	Like New						
	Some Bent	0.1					
	Smashed	0.3					
	Dull/rough	1					
	Corroded						
	Pitted						
	Flaking						
Fin-Tube Attac							
	Like New	x					
	Corrosion						
	Some Loose						
	Many Loose						
Tubes							
	Clean Cu	x					
	Corrosion						
	Pitting						
	Leaks						

CU Fan CFM Calculation						
Measurement						
ft/sec						
12.5						
13.1						
12.8						

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 48DJE004630 0292C64683 RTU-Gas 1992 Iredell Health Center RTU-3		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.5 9.5 2.97 12 0% 8.8 1.36	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	6.1 Amps 460 Volts 0.71		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1 Amps 460 Volts 0.7		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if a Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	pplicable) 1.5 Amps 460 Volts 0.7		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Calculated compressor Calculated condensing Calculated evaporator fa Total calculated load for Assumptions	fan Ioad: an Ioad	3.4 0.32 0.48 3.74	kW kW kW kW - Condensing side only		

Performance Degradation

0.0%

Condenser Coil Assessment
Overall Unit Condition
New

	New	х
	Average	
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition	- 55	
	Like New	
	Some Bent	0
	Smashed	0
	Dull/rough	
	Corroded	0
	Pitted	0
	Flaking	0
Fin-Tube Atta	chment	
	Like New	х
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

CU Fan CFM Calculation						
Measurement						
Number	FPM					
1	13.9					
2	13.9					
Average	13.9					

FLUKE METER MEASURMENTS Y-measurment Phase Volts Amps kW PF 1 2 3 Delta Measurement Phase PF Volts Amps kW 1 to 2 467 0.46 5.8 1.2 2 to 3 469 5.7 2.5 1.00 TOTAL HVAC Service Assistant Measurment Input SEER 10 RAT 74 F SAT 54 F RAH 50 % SAH 85 % ΕI 104% CI 100% Input Cap 3 Tons 79 F OAT Predicted KW 3.50 kW CU Capacity Estimates Ambient 77 F 298 K CU Exhaust Coil Length 85 F 303 K 62 in Coil Width 28 in Area 12.1 sq-ft Measured Fan CFM 10054 Air Mass Flow 5.69 kg/sec Capacity 7.24 Tons Efficiency 23.48 EER

Iredell H	lealth Center	,	RTU-3	Summa	ry							
EER at AR	I Conditions			9.5	BTU/W-	h	Equ	uipment age	12	years		
Condensing	g unit CFM			9259	OFM (M	easured)						
Capacity at	ARI			2.97	' tons							
Capacity us	sed for SA			4.00) tons							
Coil Area				12.06	6 sq-ft							
Predicted E	ER =			8.06	6 pre	8.80	post					
		HVAC	C Service A	ssistant				Phys	ical Power	and Capa	city measurn	nents
Test Date							Cond Ai	ir, deg F		Cond Air		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
24-May	83	62	102%	99%	10.5	2.61	85	94	5.0	3.7	5.24	7.50
Post Adsil I	Veasurements											
16-Jun	79	62	104%	100%	11.4	2.60	77	85	4.4	3.7	5.69	7.24

37.0%

Condensing Unit Summary - Ambient Conditions					Condensing Unit Summary - ARI Conditions											
			Test Data	1	Per	cent Dif	ference		Test Data	1			Pe	rcent Differenc	e	
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	NA	3.7	3.37	NA	110%	100%	NA	4.1	3.75	NA	110%	NA	-	-	-
Pre-Adsil	Capacity (Tons)	2.87	7.50	2.90	99%	259%	100%	2.9	7.7	2.97	99%	259%	38%	-	-	-
	EER	10.5	24.32	10.32	102%	236%	85%	9.7	22.4	9.50	102%	236%	43%	83%	36%	85%
	Power (kW)	NA	3.7	3.28	NA	113%	100%	NA	4.2	3.75	NA	113%	NA	-	-	-
Post-Adsil	Capacity (Tons)	2.99	7.24	2.99	100%	242%	100%	3.0	7.2	2.97	100%	242%	41%	-	-	-
	EER	11.4	23.48	10.93	104%	215%	93%	9.9	20.4	9.50	104%	215%	48%	82%	39%	93%

EER

24.32

23.48

tons 7.50

7.24

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	10.5	24.32	8.06
Post Adsil EER	11.4	23.48	8.80
ARI Adjusted			
Pre-Adsil EER	9.7	22.41	8.06
Post Adsil EER	9.9	20.42	8.80
Change	2.0%	-8.9%	9.3%

Weighted Average 7.8% -35.5%

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 48DJD007 5291G6264 RTU-Gas 1992 Iredell Heal RTU-14			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.8 10.8 6.30 12 9% 9.2 1.30	Btu/W-hr Btu/W-hr tons years (% degrad Btu/W-hr	(CU Only) (CU Only) ed)
Compressor Data							
Running load Amps:	10.4	Amps		Power supply:	3-phase		
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73		
Power factor:	0.81			Compressor quantity:	1		
Condensing Fan Data							
Full load Amps:	1.00	Amps		Power supply:	1-Phase		
Nameplate Voltage:	460	Volts		Phase adjustment:	1		
Adjust FLA to RLA:	0.70			Fan quantity:	1		
Evaporator fan data (if a	pplicable)						
Full load Amps:	1.80	Amps		Power supply:	1-Phase		
Nameplate Voltage:	460	Volts		Phase adjustment:	1		
Adjust FLA to RLA:	0.70			Fan quantity:	1		
Calculated compressor	load:		6.7	kW			
Calculated condensing	fan load:		0.32	kW			
Calculated evaporator fa	an load		0.58	kW			
Total calculated load for	equipment:		7.03	kW - Condensing side only			
Assumptions							

8.6% Performance Degradation

Y-measurment	\/=lt=	A	1.1.47	05		
Phase	Volts	Amps	kW	PF		
1 2						
3						
3						
Delta Measurement						
Phase	Volts	Amps	kW	PF		
1 to 2	464	12.8	2.25	0.39		
2 to 3	465	13.9	6.35	0.98		
TOTAL		. 510		0.00		
HVAC Service Assista	nt Measurment					
Input SEER	10					
RAT	74					
SAT	54	F				
RAH	50	%				
SAH	85 %					
	Circuit 1					
EI	NA					
CI	NA					
Input Cap	6	Tons				
OAT	88	F				
Predicted KW	NA	kW				
	CU Capacity E	Estimates				
Ambient	88	F	304	к		
CU Exhaust	109 F 316 K					
Coil Length	62	in				
Coil Width	28 in					
Area	12.1 sq-ft					
Measured Fan CFM	7125					
Air Mass Flow		kg/sec				
Capacity	13.47					
Efficiency	18.79	EER				

Calculated ev Total calculat Assumptions		
Condenser Co Overall Unit Co		nt
	New	
	Average	0.5
	Fair	0.5
	Poor	
Coil Cleanlines	s	
	Coated	
	Clean	0.9
	Dirty	0.1
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	
	Smashed	0.25
	Dull/rough	1
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Attac	hment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

CU Fan CFM Calculation							
Measurement							
Number	ft/sec						
1	10.5						
2	9.2						
Average	9.9						

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 48DJD007 5291G62648 RTU-Gas 1992 Iredell Health Center RTU-14		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.8 10.8 6.3 12 0% 10.0 1.20	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	10.4 Amps 460 Volts 0.81		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1 Amps 460 Volts 0.7		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if a Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.8 Amps 460 Volts 0.7		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Calculated compressor Calculated condensing Calculated evaporator fa Total calculated load for Assumptions	fan Ioad: an Ioad	6.7 0.32 0.58 7.03	kW kW kW kW - Condensing side only		

0.0% Performance Degradation

Condenser Coil Assessment Overall Unit Condition

	New	Х
	Average	
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	1
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

CU Fan CFM Calculation					
Measurement					
Number	ft/sec				
1	12.1				
2	11.1				
Average	11.6				

HVAC Data Sheet Page 2 of 3

FLUKE METER MEAS	URMENTS			
Y-measurment	N / - 11 -			55
Phase	Volts	Amps	kW	PF
1 2				
3				
3	l			
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	465	12.3	1.9	0.34
2 to 3	466	13.5	6.0	0.97
TOTAL	100	10.0	0.0	0.07
HVAC Service Assista	nt Measurment			
Input SEER	10			
RAT	74	F		
SAT	54	F		
RAH	50			
SAH	85			
-				
EI	100%			
CI	103%			
Input Cap	5	Tons		
OAT	80	F		
Predicted KW	6.10	kW		
	CU Capacity E	stimates		
Ambient	79	F	299	к
CU Exhaust	96		309	
Coil Length	62	in		
Coil Width	28	in		
Area	12.1	sq-ft		
Measured Fan CFM	8391	-		
Air Mass Flow	4.75	kg/sec		
Capacity	12.84			
Efficiency	19.50	EER		

Iredell H	lealth Center	•	RTU-14	Summa	ry							
EER at ARI	I Conditions			10.8	BTU/W-I	ı	Equ	ipment age	12	years		
Condensing	g unit CFM			7125	5 CFM (M	easured)						
Capacity at	ARI			6.30) tons							
Capacity us	sed for SA			6.00) tons							
Coil Area				12.06	6 sq-ft							
Predicted E	ER =			9.23	3 pre	9.96	post					
		HVAC	Service As	sistant				Phys	ical Power	and Capac	ity measurn	nents
		111743								and sapas	ity incacation	
Test Date			001110074				Cond Ai			Cond Air		
Test Date	OAT	EWB	El	CI	EER	kW	Cond Ai inlet		Δ Τ (K)		(kg/sec)	tons
Test Date 24-May	OAT 88				EER NA	kW NA		r, deg F		Cond Air		
24-May	88	EWB	EI	CI			inlet	r, deg F exhaust	ΔT (K)	Cond Air kW	(kg/sec)	tons
24-May	-	EWB	EI	CI			inlet	r, deg F exhaust	ΔT (K)	Cond Air kW	(kg/sec)	tons

Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions										
			Test Data		Per	cent Diff	erence		Test Data	1			Pe	rcent Differenc	e	
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	NA	8.6	6.53	NA	132%	100%	NA	9.2	7.02	NA	132%	NA	-	-	-
Pre-Adsil	Capacity (Tons)	NA	13.47	5.92	NA	227%	100%	NA	14.3	6.30	NA	227%	NA	-	-	-
	EER	NA	18.79	10.87	NA	173%	86%	NA	18.6	10.78	NA	173%	NA	NA	50%	86%
	Power (kW)	6.41	7.9	6.21	103%	127%	100%	7.2	8.9	7.02	103%	127%	81%	-	-	-
Post-Adsil	Capacity (Tons)	6.38	12.84	6.19	103%	207%	100%	6.5	13.1	6.30	103%	207%	50%	-	-	-
	EER	12.0	19.50	11.96	100%	163%	92%	10.8	17.6	10.78	100%	163%	61%	86%	53%	92%

EER

18.79

19.50

tons 13.47

12.84

EER Changes

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	NA	18.79	9.23
Post Adsil EER	12.0	19.50	9.96
ARI Adjusted			
Pre-Adsil EER	NA	18.59	9.23
Post Adsil EER	10.8	17.54	9.96
Change	NA	-5.7%	8.0%
Weighted Average	NA	-34.0%	47.8%

EPA Adsil Evaluation Iredell Health Center, NC RTU-14

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 48DJD006 0492G68975 RTU-Gas 1992 Iredell Health Center RTU-13		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.8 9.8 5.19 12 6% 8.6 1.40	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	9.6 Amps 460 Volts 0.79		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.00 Amps 460 Volts 0.70		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if a Full load Amps: Nameplate Voltage: Adjust FLA to RLA: Calculated compressor I Calculated condensing f Calculated condensing f Total calculated load for Assumptions	1.80 Amps 460 Volts 0.70 load: fan load: in load	6.0 0.32 0.58 6.36	Power supply: Phase adjustment: Fan quantity: kW kW kW kW - Condensing side only	1-Phase 1 1	

6.35% Performance Degradation

FLUKE METER MEAS Y-measurment	URMENTS			
Phase	Volts	Amps	kW	
1		7 unpo		Т
2				T
3				Γ
Delta Measurement				
Phase	Volts	Amps	kW	
1 to 2	460	10	1.9	Т
2 to 3	460	10.1	4.65	Ī
TOTAL				_
HVAC Service Assistar	nt Measurment	i.		
Input SEER	10			
RAT	74			
SAT	54	F		
RAH	50	%		
SAH	85	%		
	Circuit 1			
EI	94%			
CI	97%			
Input Cap	5	Tons		
OAT	87	F		
Predicted KW	6.10	kW		
	CU Capacity E	stimates		
Ambient	83	F	301	ł
CU Exhaust	102	F	312	: 1
Coil Length	63	in		
Coil Width	29	in		
Area	12.7	sq-ft		
Measured Fan CFM	6090			
Air Mass Flow		kg/sec		
Capacity	10.41			
Efficiency	19.08	EER		

PF

PF 0.39 0.99

Condenser C Overall Unit C	oil Assessme ondition	nt
	New	
	Average	0.5
	Fair	0.5
	Poor	
Coil Cleanline	ss	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	0.15
	Smashed	0
	Dull/rough	1
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

CU Fan CFM Calculation				
Measurement				
Number	ft/sec			
1	8.0			
2	8.0			
Average	8.0			

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 48DJD006 0492G68979 RTU-Gas 1992 Iredell Healt RTU-13	-		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.8 9.8 5.2 12 0% 9.1 1.32	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	9.6	Amps		Power supply:	3-phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Power factor:	0.79			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	1	Amps		Power supply:	1-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.7			Fan quantity:	1	
Evaporator fan data (if a	pplicable)					
Full load Amps:	1.8	Amps		Power supply:	1-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.7			Fan quantity:	1	
Calculated compressor	load:		6.0	kW		
Calculated condensing	fan load:		0.32	kW		
Calculated evaporator fa	an load		0.58	kW		
Total calculated load for Assumptions	r equipment:		6.36	kW - Condensing side only		

Condenser Coil Assessment Overall Unit Condition New

	N	Y
	New	Х
	Average	
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	1
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Attac	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

CU Fan CFM Calculation							
Measurement							
Number	ft/sec						
1	12.5						
2	10.0						
Average	11.3						

FLUKE METER MEASURMENTS								
Y-measurment	er an Ei rite							
Phase	Volts	Amps	kW	PF				
1								
2								
3								
Delta Measurement								
Phase	Volts	Amps	kW	PF				
1 to 2	465	9.8	1.6	0.35				
2 to 3	465	9.9	4.5	0.98				
TOTAL								
HVAC Service Assista	nt Measurment							
Input SEER	10							
RAT	74							
SAT	54	F						
RAH	50	%						
SAH	85	%						
EI	100%							
CI	103%							
Input Cap	5	Tons						
OAT	80	F						
Predicted KW	6.10	kW						
	CU Capacity E	stimates						
Ambient	77	F	298	к				
CU Exhaust	93	-	307					
Coil Length	63		001					
Coil Width	29							
Area		sq-ft						
Measured Fan CFM	8564							
Air Mass Flow		kg/sec						
Capacity	12.33							
Efficiency	24.26	EER						

EPA Adsil Evaluation Iredell Health Center, NC RTU-13

0.0% Performance Degradation

Iredell F	lealth Center	•	RTU-13	Summa	ry							
EER at ARI	Conditions			9.8	BTU/W-I	h	Eq	uipment age	1	2 years		
Condensing	g unit CFM			6090	CFM (M	easured)						
Capacity at	ARI			5.19	tons							
Capacity us	sed for SA			5.00	tons							
Coil Area				12.69	sq-ft							
Predicted E	ER =			8.56	pre	9.06	post					
		HVAC	C Service As	sistant				Phys	ical Powe	r and Capao	city measurn	nents
Test Date							Cond A	ir, deg F		Cond Air		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
24-May	87	62	94%	97%	10.0	6.33	83	102	10.6	6.55	3.45	10.4
	Veasurements											

11.0

6.33

77

Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions										
			Test Data	l	Per	rcent Diff	erence		Test Data	l			Pe	rcent Differenc	e	
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	6.33	6.55	5.67	112%	116%	101%	7.1	7.3	6.32	112%	116%	97%	-	-	-
Pre-Adsil	Capacity (Tons)	4.87	10.41	5.02	97%	207%	100%	5.0	10.8	5.19	97%	207%	47%	-	-	-
	EER	10.0	19.08	10.62	94%	180%	87%	9.3	17.7	9.85	94%	180%	52%	92%	48%	87%
	Power (kW)	6.33	6.1	5.57	114%	110%	101%	7.2	6.9	6.32	114%	110%	104%	-	-	-
Post-Adsil	Capacity (Tons)	5.25	12.33	5.09	103%	242%	100%	5.3	12.6	5.19	103%	242%	43%	-	-	-
	EER	11.0	24.26	10.98	100%	221%	92%	9.8	21.7	9.85	100%	221%	45%	87%	39%	92%

8.9

6.1

4.85

93

EER

19.08

24.26

tons 10.41

12.33

EED	Changes	
EER	Changes	

100%

103%

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	10.0	19.08	8.56
Post Adsil EER	11.0	24.26	9.06
ARI Adjusted			
Pre-Adsil EER	9.2	17.58	8.56
Post Adsil EER	9.8	21.62	9.06
Change	6.4%	23.0%	5.9%
	0.1.00/	444.00%	00.19/
Neighted Average	31.9%	114.9%	29.4%

EPA Adsil Evaluation Iredell Health Center, NC RTU-13

16-Jun

80

62

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 48DJE00463 0292G64667 RTU-Gas 1992 Iredell Health RTU-1	,		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.5 9.5 2.97 12 11% 8.0 1.50	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	6.1	Amps		Power supply:	3-phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1.73	
Power factor:	0.71			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	1.00	Amps		Power supply:	1-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Evaporator fan data (if a	pplicable)					
Full load Amps:	1.50	Amps		Power supply:	1-Phase	
Nameplate Voltage:	460	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Calculated compressor	load:		3.4	kW		
Calculated condensing	fan Ioad:		0.32	kW		
Calculated evaporator fa	an load		0.48	kW		
Total calculated load for Assumptions	equipment:		3.74	kW - Condensing side only		

10.8% Performance Degradation

∕-measurment Phase	Volts	Amps	kW	Р
1	Volto	7 unpo		· ·
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	Р
1 to 2	467	5.5	1.3	0
2 to 3	466	5.1	2.4	0.9
OTAL			•	
IVAC Service Assistan	nt Measurment			
nput SEER	10			
RAT	74	F		
SAT	54	F		
RAH	50	%		
SAH	85	%		
	Circuit 1			
El	102%			
	97%			
nput Cap		Tons		
DAT	87	F		
Predicted KW	3.50	kW		
	CU Capacity E	stimates		
Ambient	85	F	303	к
CU Exhaust	93	F	307	К
Coil Length	62	in		
Coil Width	28	in		
Area	12.1	sq-ft		
leasured Fan CFM	8680			
Air Mass Flow		kg/sec		
Capacity Efficiency		Tons		

Assumptions							
Condenser Coil Assessment Overall Unit Condition							
	New						
	Average						
	Fair	1					
	Poor						
Coil Cleanlines	SS						
	Coated						
	Clean	0.8					
	Dirty	0.2					
	Clogged						
	Plugged						
Fin Condition							
	Like New						
	Some Bent	0.25					
	Smashed	0.25					
	Dull/rough	1					
	Corroded						
	Pitted						
	Flaking						
Fin-Tube Attac	chment						
	Like New	x					
	Corrosion						
	Some Loose						
	Many Loose						
Tubes							
	Clean Cu	x					
	Corrosion						
	Pitting						
	Leaks						

CU Fan CFM Calculation					
Measurement					
Number	ft/sec				
1	11.5				
2	12.5				
Average	12.0				

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 48DJE004630 0292G64667 RTU-Gas 1992 Iredell Health Center RTU-1		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.5 9.5 2.97 12 0% 8.8 1.36	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	6.1 Amps 460 Volts 0.705		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1 Amps 460 Volts 0.7		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if a Full load Amps: Nameplate Voltage: Adjust FLA to RLA: Calculated compressor f Calculated condensing f Calculated evaporator fa Total calculated load for Assumptions	1.5 Amps 460 Volts 0.7 Ioad: fan Ioad: an Ioad	3.4 0.32 0.48 3.74	Power supply: Phase adjustment: Fan quantity: kW kW kW kW - Condensing side only	1-Phase 1 1	

New X Average	
Fair Poor Coil Cleanliness Coated Clean 1 Dirty Clogged Plugged Fin Condition Like New 1 Some Bent Smashed Dull/rough Corroded Corroded Clean 1 Dirty Clogged Plugged Control	
Fin Condition Like New Some Bent Smashed Dull/rough Corroded	
Coil Cleanliness Coated Clean 1 Dirty Clogged Plugged Fin Condition Like New 1 Some Bent Smashed Dull/rough Corroded	
Coated Clean 1 Dirty Clogged Plugged Fin Condition Like New 1 Some Bent Smashed Dull/rough Corroded	
Fin Condition Like New Some Bent Smashed Dull/rough Corroded	
Fin Condition Like New Some Bent Smashed Dull/rough Corroded	
Clogged Plugged Fin Condition Like New 1 Some Bent Smashed Dull/rough Corroded	
Fin Condition Like New 1 Some Bent Smashed Dull/rough Corroded	
Fin Condition Like New 1 Some Bent Smashed Dull/rough Corroded	
Like New 1 Some Bent Smashed Dull/rough Corroded	
Some Bent Smashed Dull/rough Corroded	
Smashed Dull/rough Corroded	
Dull/rough Corroded	
Corroded	
Ditted	
Pittea	
Flaking	
Fin-Tube Attachment	
Like New X	
Corrosion	
Some Loose	
Many Loose	
Tubes	
Clean Cu x	
Corrosion	
Pitting	
Leaks	

0.0%	Performance Degradation
0.0%	Performance Degradation

FLUKE METER MEAS				
Y-measurment				
Phase	Volts	Amps	kW	PF
1 11030	Volta	Апрэ	NVV	
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	470	5.6	1.3	0.98
2 to 3	471	4.9	0.9	0.41
TOTAL				
HVAC Service Assista		r		
Input SEER	10	_		
RAT	74			
SAT	54			
RAH	50			
SAH	85	%		
	107%			
EI CI				
Input Cap	104%	Tons		
OAT	79			
OAT Predicted KW		•		
Predicted KVV	3.50	KVV		
	CU Capacity E	Estimates		
Ambient	75	F	297	к
CU Exhaust	84	F	302	К
Coil Length	62 in			
Coil Width	28	in		
Area	12.1	sq-ft		
Measured Fan CFM	8579			
Air Mass Flow		kg/sec		
Capacity		Tons		
Efficiency	37.90	EER		

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	13.1
2	12.7
3	10.9
4	12.4
5	10.2
Average	11.9
	-

Iredell H	lealth Center		RTU-1	Summa	ry							
EER at AR	I Conditions		9.5 BTU/W-h					uipment age	12	12 years		
Condensing	g unit CFM			8680	CFM (M	easured)						
Capacity at ARI				2.97	' tons							
Capacity us	sed for SA			3.00	tons							
Coil Area				12.06	i sq-ft							
Predicted E	ER =			8.00) pre	8.80	post					
		HVAC	C Service As	sistant				Phys	ical Power	and Capao	city measurm	nents
Test Date							Cond Ai	ir, deg F		Cond Air		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
24-May	87	62	102%	97%	9.9	3.46	85	93	4.4	3.7	4.92	6.25
Post Adsil N	Veasurements											
16-Jun	79	62	107%	104%	11.7	3.46	75	84	5.0	2.2	4.86	6.95
TO-JUIT	79	02	107 /0	104 /0	11.7	3.40	75	04	5.0	2.2	4.00	0.90

Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions										
			Test Data	1	Per	rcent Dif	erence		Test Data	1			Pe	rcent Differenc	e	
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	3.46	3.7	3.46	100%	107%	100%	3.8	4.0	3.75	100%	107%	94%	-	-	-
Pre-Adsil	Capacity (Tons)	2.72	6.25	2.80	97%	223%	100%	2.9	6.6	2.97	97%	223%	44%	-	-	-
	EER	9.9	20.27	9.74	102%	208%	84%	9.7	19.8	9.50	102%	208%	49%	83%	40%	84%
	Power (kW)	3.46	2.2	3.28	105%	67%	100%	3.9	2.5	3.75	105%	67%	157%	-	-	-
Post-Adsil	Capacity (Tons)	3.11	6.95	2.99	104%	232%	100%	3.1	6.9	2.97	104%	232%	45%	-	-	-
	EER	11.7	37.90	10.93	107%	347%	93%	10.2	32.9	9.50	107%	347%	31%	79%	24%	93%

EER

20.27

37.90

tons 6.25

6.95

EER	Changes	

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	9.9	20.27	8.00
Post Adsil EER	11.7	37.90	8.80
ARI Adjusted			
Pre-Adsil EER	9.7	19.79	8.00
Post Adsil EER	10.2	32.96	8.80
Change	4.9%	66.6%	10.0%
Weighted Average	14.7%	199.7%	29.9%

EPA Adsil Evaluation Iredell Health Center, NC RTU-1

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Lennox HS290609Y S801M14822 SS 2001 Granite Quarry SS-3		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	NA 9.7 5.00 3 7% 9.1 1.32	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	17.3 Amps 208 Volts 0.95		Power supply: Phase adjustment: Compressor quantity:	3-Phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.90 Amps 208 Volts 0.70		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if a Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	pplicable) Amps Volts		Power supply: Phase adjustment: Fan quantity:		
Calculated compressor I Calculated condensing f Calculated evaporator fa Total calculated load for Assumptions	an load: In load	5.9 0.28 0.00 6.19	kW kW kW kW - Condensing side only		

Condenser Coil Assessment Overall Unit Condition					
	New	1			
	Average				
	Fair				
	Poor				
Coil Cleanline	SS				
	Coated	1			
	Clean				
	Dirty	0.35			
	Clogged				
	Plugged				
Fin Condition					
	Like New	0.9			
	Some Bent	0.1			
	Smashed				
	Dull/rough	0.1			
	Corroded				
	Pitted				
	Flaking				
Fin-Tube Atta	chment				
	Like New	x			
	Corrosion				
	Some Loose				
	Many Loose				
Tubes					
	Clean Cu	x			
	Corrosion				
	Pitting				
	Leaks				

7.3% Performance D	egradation
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FLUKE METER MEAS	SURMENTS			
Y-measurment				
Phase	Volts	Amps	kW	PF
1	1010	7 unpo		
2				
3				
Delta Measurement	\/_H-	A	1.3.47	DE
Phase	Volts	Amps	kW	PF
1 to 2 2 to 3	199 199	12.2 15.9	2.4	0.99
Z to 3	199	15.9	2.2	0.70
HVAC Service Assista	int Measurment			
Input SEER	10			
RAT	74	F		
SAT	54	F		
RAH	50	%		
SAH	85	%		
El	94%	-		
CI	87%			
Input Cap		Tons		
OAT		F		
Predicted KW	5.60	kW		
	CU Capacity	Estimates		
Ambient	70	F	299	K
CU Exhaust	102	-	299	
Coil Length		in	512	IX .
Coil Width) in		
Area		sq-ft		
Measured Fan CFM	1351	•		
Air Mass Flow		kg/sec		
Capacity		Tons		
Efficiency	7.61	EER		

CU Fan CFM Calculation						
Measurement						
Number	ft/sec					
1	1.1					
2	2.7					
3	1.3					
4	1.5					
Average	1.6					

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Lennox HS290609\ S801M14822 SS 2001 Granite Qua SS-3	2		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	NA 9.7 5.00 3 0% 9.8 1.23	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	17.3	Amps		Power supply:	3-Phase	
Nameplate Voltage:	208	Volts		Phase adjustment:	1.73	
Power factor:	0.95			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	1.9	Amps		Power supply:	1-Phase	
Nameplate Voltage:	208	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.7			Fan quantity:	1	
Evaporator fan data (if a	oplicable)					
Full load Amps:	0	Amps		Power supply:	0	
Nameplate Voltage:	0	Volts		Phase adjustment:	0	
Adjust FLA to RLA:	0			Fan quantity:	0	
Calculated compressor	load:		5.9	kW		
Calculated condensing			0.28	kW		
Calculated evaporator fa			0.00	kW		
Total calculated load for			6.19	kW - Condensing side only		

Condenser C Overall Unit C	coil Assessme	nt
	New	x
	Average	
	Fair	
	Poor	
Coil Cleanline	ess	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	1
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

Assumptions

0.0% Performance Degradation	gradation
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FLUKE METER MEAS	URMENTS			
Y-measurment				
Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	197	13.7	2.6	0.97
2 to 3	200	18.5	2.6	0.70
TOTAL	•			-
HVAC Service Assista	nt Measurment	_		
Input SEER	10	I		
RAT	70	F		
SAT	50	F		
RAH	50	%		
SAH	85	%		
EI		ļ		
CI		ļ		
Input Cap		Tons		
OAT	92	+		
Predicted KW		kW		
	CU Capacity I	Estimates		
Ambient	92	F	306	к
CU Exhaust	121	F	323	К
Coil Length	66	in		
Coil Width	30	in		
Area	13.8	sq-ft		
Measured Fan CFM	5053			
Air Mass Flow		kg/sec		
Capacity	13.19			
Efficiency	30.43	EER		

CU Fan CFM Calculation							
ft/sec							
5.9							
6.2							
6.8							
5.6							
6.1							

Granite Quarry S	S-3	Summar	у								
EER at ARI Conditions			9.7	7 BTU/W-ł	า	Eq	uipment age	:	3 years		
Condensing unit CFM			1351	CFM (Me	easured)						
Capacity at ARI			5.00) tons							
Capacity used for SA			5.00) tons							
Coil Area			13.75	5 sq-ft							
Predicted EER =			9.12	2 pre	9.79	post					
	HVA	C Service As	sistant				Phys	ical Powe	r and Capac	ity measurn	nents
TIDI							ir. dea F		Cond Air		
Test Date						CONU A	al, acg i				
	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
	EWB 61	EI 94%	CI 87%	EER 9.1	kW 5.60		,	∆T (K) 13.3		(kg/sec) 0.77	tons 2.92
OAT			-			inlet	exhaust	()	kW	()	
OAT			-			inlet	exhaust	()	kW	()	

Condensing Unit Summary - Ambient Conditions					Condensing Unit Summary - ARI Conditions											
		Test Da	ata@ Field C	Conditions	Per	cent Diff	erence	T	est Data @	ARI			Pe	ercent Differenc	e	
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	5.60	4.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
Pre-Adsil	Capacity (Tons)	4.35	2.92	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
	EER	9.1	7.61	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA
	Power (kW)	NA	5.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
Post-Adsil	Capacity (Tons)	NA	13.19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
1	EER	NA	30.43	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA

EER

7.61

30.43

EER Changes						
	Service Assistant	Condenser Test	Spreadsheet			
Pre-Adsil EER	9.1	7.61	9.1			
Post Adsil EER	NA	30.43	9.8			
ARI Adjusted						
Pre-Adsil EER	NA	NA	NA			
Post Adsil EER	NA	NA	NA			
Change	NA	75.0%	6.8%			
Weighted Average	NA	374.9%	34.2%			

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Lennox HS29-653 5895D63302 SS 1995 Granite Quarry SS-2		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	NA 9.7 5.00 9 8% 8.6 1.40	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	17.3 Amp 208 Volts 0.95		Power supply: Phase adjustment: Compressor quantity:	3-Phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.90 Amp 208 Volts 0.70		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if a Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	pplicable) Amps Volts		Power supply: Phase adjustment: Fan quantity:		
Calculated compressor I Calculated condensing f Calculated evaporator fa Total calculated load for Assumptions	an load: n load	5.9 0.28 0.00 6.19	kW kW kW kW - Condensing side only		

Condenser C Overall Unit C	oil Assessme	nt
	New	
	Average	1
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	1
	Clean	0.5
	Dirty	0.5
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	0.05
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

7.7% Performance I	Degradation
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FLUKE METER MEAS	URMENTS			
Y-measurment				
Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	202	14.9	3.0	0.99
2 to 3	201	14.1	1.5	0.53
TOTAL				
HVAC Service Assista	nt Measurment	_		
Input SEER	1			
RAT		4 F		
SAT		4 F		
RAH		0 %		
SAH	8	5 %		
EI	82%	6		
	76%			
Input Cap		5 Tons		
OAT		7 F		
Predicted KW		0 kW		
	CU Capacity	Estimates		
Ambient	7	8 F	299	к
CU Exhaust	9	8 F	310	К
Coil Length	6	6 in		
Coil Width	3	0 in		
Area		8 sq-ft		
Measured Fan CFM	129			
Air Mass Flow		4 kg/sec		
Capacity		4 Tons		
Efficiency	6.2	4 EER		

Calculation
ft/sec
0.9
1.0
2.0
2.4
1.6

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Lennox HS29-653 5895D6330 SS 1995 Granite Qua SS-2	-		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	NA 9.7 5.00 9 0% 9.2 1.30	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	17.3	Amps		Power supply:	3-Phase	
Nameplate Voltage:	208	Volts		Phase adjustment:	1.73	
Power factor:	0.95			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	1.9	Amps		Power supply:	1-Phase	
Nameplate Voltage:	208	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.7			Fan quantity:	1	
Evaporator fan data (if a	pplicable)					
Full load Amps:	ó	Amps		Power supply:	0	
Nameplate Voltage:	0	Volts		Phase adjustment:	0	
Adjust FLA to RLA:	0			Fan quantity:	0	
Calculated compressor	load:		5.9	kW		
Calculated condensing			0.28	kW		
Calculated evaporator fa	an load		0.00	kW		
Total calculated load for			6.19	kW - Condensing side only		

Condenser C Overall Unit C		nt
	New	x
	Average	
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	1
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Attac	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

Assumptions

0.0% Performance Degradation

FLUKE METER MEAS	URMENTS			
Y-measurment				
Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	198	17.1	3.4	0.99
2 to 3	200	17.6	2.0	0.58
TOTAL				
HVAC Service Assista	nt Measurment			
Input SEER	10			
RAT	70	F		
SAT	50	F		
RAH	50	%		
SAH	85	i %		
EI	101%			
CI	105%			
Input Cap		Tons		
OAT		F		
Predicted KW	6.20	kW		
	CU Capacity	Estimates		
Ambient	94	F	308	к
CU Exhaust	120	F	322	к
Coil Length	66	i in		
Coil Width	30) in		
Area	13.8	sq-ft		
Measured Fan CFM	5569)		
Air Mass Flow		kg/sec		
Capacity		Tons		
Efficiency	28.96	i EER		

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	5.7
2	6.1
3	7.7
4	7.5
Average	6.8

Granite	Quarry	SS-2	Summa	ry								
EER at ARI	Conditions			9.7	BTU/W-I	ו	Equ	uipment age	ç) years		
Condensing	unit CFM			1299	CFM (M	easured)						
Capacity at	ARI			5.00	tons							
Capacity use	ed for SA			5.00	tons							
Coil Area				13.75	sq-ft							
Predicted E	ER =			8.60	pre	9.23	post					
		HVAC Service Assistant					Physical Power and Capacity measurments					
		HVA	C Service As	ssistant				Phys	ical Power	r and Capaci	ity measurn	nents
Test Date		HVA	C Service As	sistant			Cond A	Phys ir, deg F	ical Power	r and Capaci Cond Air	ity measurn	nents
Test Date	OAT	EWB	El	CI	EER	kW	Cond A inlet		ical Poweı ∆T (K)		(kg/sec)	nents tons
Test Date 24-May	OAT 77				EER 7.9	kW 5.70		ir, deg F		Cond Air		
	-	EWB	EI	CI			inlet	r, deg F exhaust	ΔΤ (Κ)	Cond Air kW	(kg/sec)	tons
24-May	-	EWB	EI	CI			inlet	r, deg F exhaust	ΔΤ (Κ)	Cond Air kW	(kg/sec)	tons

Condensing Unit Summary - Ambient Conditions							Condensing Unit Summary - ARI Conditions									
		Test Da	ata@ Field C	onditions	Per	cent Diff	erence	T	est Data @	ARI			Pe	ercent Differenc	e	
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	5.70	4.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-	-
Pre-Adsil	Capacity (Tons)	3.80	2.34	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-	-
	EER	7.9	6.24	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA	-	NA
	Power (kW)	6.20	5.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-	-
Post-Adsil	Capacity (Tons)	5.25	13.03	NA	NA	NA	NA	NA	NA	NA	NA	NA	-		-	-
	EER	9.8	28.96	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA	-	NA

EER

6.24

28.96

E	EER Changes (Ambient Condions)							
	Service Assistant	Condenser Test	Spreadsheet					
Pre-Adsil EER	7.9	6.24	8.6					
Post Adsil EER	9.8	28.96	9.2					
ARI Adjusted								
Pre-Adsil EER	7.9	NA	NA					
Post Adsil EER	9.8	NA	NA					
Change	18.8%	78.5%	6.8%					
Weighted Average	94.1%	392.3%	34.2%					

EPA Adsil Evaluation Granite Quarry SS-2

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Goodman CPKE36-18 9712425279 SS 1997 Concord City SS-5	Hall		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.0 9.0 2.75 7 17% 7.5 1.60	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	17.3 208 0.95	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	1-Phase 1 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	1.80 208 0.70	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if a Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	oplicable)	Amps Volts		Power supply: Phase adjustment: Fan quantity:		
Calculated compressor I Calculated condensing fr Calculated evaporator fa Total calculated load for Assumptions	an load: n load		3.4 0.26 0.00 3.68	kW kW kW kW - Condensing side only		

Overall Unit Co	oil Assessme ondition	nt
	New	
	Average	0.8
	Fair	0.2
	Poor	
Coil Cleanlines	s	
	Coated	1
	Clean	
	Dirty	0.7
	Clogged	0.3
	Plugged	
Fin Condition		
	Like New	
	Some Bent	
	Smashed	
	Dull/rough	1
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Attac	hment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	х
	Corrosion	
	Pitting	
	Leaks	

16.9%	Performance Degradation
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FLUKE METER MEAS	URMENTS									
Y-measurment										
Phase	Volts	Amps	kW	PF						
1										
2										
3										
Delta Measurement										
Phase	Volts	Amps	kW	PF						
1 to 2	120	13.8	1.58	0.97						
2 to 3	118	14.1	1.2	0.72						
TOTAL										
HVAC Service Assista	nt Measurment	_								
Input SEER	10									
RAT		F								
SAT	54	F								
RAH		%								
SAH	85	5 %								
EI	101%	,								
CI	93%									
Input Cap		Tons								
OAT		F								
Predicted KW		kW								
	CU Capacity	Estimates								
Ambient	00) F	305	K						
CU Exhaust	85 101		305							
			511	IX .						
Coil Width	Coil Length 86 in Coil Width 23 in									
Area		'sq-ft								
Measured Fan CFM	5027	•								
Air Mass Flow	••=-	kg/sec								
Capacity		Tons								
Efficiency	23.44	EER								

CU Fan CFM Calculation								
Measurement								
Number	ft/sec							
1	5.7							
2	6.4							
3	7.2							
4	5.1							
Average	6.1							

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Goodman CPKE36-18 9712425279 SS 1997 Concord Ci SS-5			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	9.0 9.0 2.75 7 0% 8.7 1.38	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	17.3	Amps		Power supply:	1-Phase	
Nameplate Voltage:	208	Volts		Phase adjustment:	1	
Power factor:	0.95			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	1.8	Amps		Power supply:	1-Phase	
Nameplate Voltage:	208	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.7			Fan quantity:	1	
Evaporator fan data (if a	pplicable)					
Full load Amps:	0	Amps		Power supply:	0	
Nameplate Voltage:	0	Volts		Phase adjustment:	0	
Adjust FLA to RLA:	0			Fan quantity:	0	
Calculated compressor I	oad:		3.4	kW		
Calculated condensing f	an load:		0.26	kW		
Calculated evaporator fa	in load		0.00	kW		
Total calculated load for Assumptions			3.68	kW - Condensing side only		

0.0% Performance Degradation

Condenser Coil Assessment Overall Unit Condition New Average Fair Poor Coil Cleanliness Coated Clean 1 Dirty Clogged Plugged Fin Condition Like New 1 Some Bent Smashed Dull/rough Corroded Pitted Flaking Fin-Tube Attachment Like New х Corrosion Some Loose Many Loose Tubes Clean Cu х Corrosion Pitting Leaks

Y-measurment								
Phase	Volts	Amps	kW	PF				
1								
2								
3								
Delta Measurement								
Phase	Volts	Amps	kW	PF				
1 to 2	120	14.3	1.64	0.96				
2 to 3	119	14.4	1.23	0.72				
TOTAL								
HVAC Service Assista	nt Measurment							
Input SEER	10	Ī						
RAT	74							
SAT	54	F						
RAH	50	%						
SAH	85 %							
EI	93%	Î						
CI	88%	Î						
Input Cap	3	Tons						
OAT	87	F						
Predicted KW	3.40	kW						
	CU Capacity E	Estimates						
Ambient	87	F	304	к				
CU Exhaust	99	F	310	к				
Coil Length	86	in						
Coil Width	23	in						
Area	13.7	sq-ft						
Measured Fan CFM	6140							
Air Mass Flow		kg/sec						
Capacity		Tons						
Efficiency	27.72	EER						

CU Fan CFM Calculation									
Measurement									
Number	ft/sec								
1	7.6								
2	6.6								
3	8.0								
4	7.6								
Average	7.5								

Concor	d City Hall	SS-5	Summa	у									
EER at AR	I Conditions			9.0	BTU/W-ł	ı	Equ	uipment age	7	Years			
Condensin	g unit CFM			5027	CFM (Me	easured)							
Capacity at	ARI			2.75	tons								
Capacity us	sed for SA			3.00	tons								
Coil Area				13.74	sq-ft								
Predicted E	ER =			7.48	pre	8.70	post						
	HVAC Service Assistant Physical Power and Capacity								ity measurn	nents			
Test Date							Cond Ai	ir, deg F		Cond Air			
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons	
24-May	88	61	61 101% 93% 9.1 3.12 89 101 6.7 2.78 2.85										

						oona / iii, dog i							
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons	EER
24-May	88	61	101%	93%	9.1	3.12	89	101	6.7	2.78	2.85	5.43	NA
Post Adsil	Measurements												
16-Jun	87	61	93%	88%	8.3	3.12	87	99	NA	NA	3.48	6.63	NA

Condensing Unit Summary - Ambient Conditions							Condensing Unit Summary - ARI Conditions									
		Test Data			Percent Difference			Test Data			Percent Difference					
ΟΑΤ		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Predicted/ Original
	Power (kW)	3.12	2.78	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
Pre-Adsil	Capacity (Tons)	2.56	5.43	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
	EER	9.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Power (kW)	3.12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
	Capacity (Tons)	2.42	6.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
	EER	8.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

EER Changes										
	Service Assistant	Condenser Test	Spreadsheet							
Pre-Adsil EER	9.1	NA	7.48							
Post Adsil EER	8.3	NA	8.70							
ARI Adjusted										
Pre-Adsil EER	9.1	NA	7.48							
Post Adsil EER	8.3	NA	8.70							
Change	-7.9%	NA	16.4%							
Weighted Average	-23.8%	NA	49.1%							
Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38CK036 3993E06985 Split System 1993 Concord City SS-4	1		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	8.0 8.0 2.35 11 7% 7.0 1.70	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr				
-------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------	-------	------	-------------------------------------------------------------------------------------------------------------------	-----------------------------------------------	---------------------------------------------------------------------------------------				
Compressor Data Running load Amps:	8.9	Amps		Power supply:	3-phase					
Nameplate Voltage: Power factor:	230 0.93	Volts		Phase adjustment: Compressor quantity:	1.73 1					
Condensing Fan Data										
Full load Amps:	1.40	Amps		Power supply:	1-Phase					
Nameplate Voltage:	230	Volts		Phase adjustment:	1					
Adjust FLA to RLA:	0.70			Fan quantity:	1					
Evaporator fan data (if a	pplicable)									
Full load Amps:		Amps		Power supply:						
Nameplate Voltage:		Volts		Phase adjustment:						
Adjust FLA to RLA:	0.70			Fan quantity:						
Calculated compressor	load:		3.3	kW						
Calculated condensing f	an load:		0.23	kW						
Calculated evaporator fa	an load		0.00	kW						
Total calculated load for Assumptions	equipment:		3.52	kW - Condensing side only						

Condenser C Overall Unit C	oil Assessme ondition	nt
	New	
	Average	1
	Fair	
	Poor	
Coil Cleanline	ss	
	Coated	1
	Clean	0.95
	Dirty	0.05
	Clogged	
	Plugged	
Fin Condition		
	Like New	0.8
	Some Bent	0.05
	Smashed	
	Dull/rough	0.2
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

6.7%	Performance Degradation
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Y-measurment Phase	Volts	Amps	kW	PF
1	Volta	Апрэ	NVV	
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	204	7.5	0.89	0.58
2 to 3	204	8.35	1.75	1.00
TOTAL	200	0.00	1.75	1.00
HVAC Service Assista	nt Measurment			
Input SEER	10	T		
RAT	74	+		
SAT	54	1		
RAH	50	+		
SAH		%		
0/11		/~		
EI	95%	Ì		
CI	82%	•		
Input Cap	3	Tons		
OAT	93	F		
Predicted KW	3.20	kW		
	CU Capacity E	Estimates		
Ambient	90	305	к	
CU Exhaust	102	F	312	к
Coil Length	62	in		
Coil Width	26	in		
Area	11.2	sq-ft		
Measured Fan CFM	4047			
Air Mass Flow	2.29	kg/sec		
Capacity		Tons		
Efficiency	19.86			
Efficiency	0.60	kW/Ton		

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	5.5
2	5.5
3	5.5
4	7.6
Average	6.0

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38CK036 3993E06985 Split Systen 1993 Concord Cit SS-4	ı		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	8.0 8.0 2.35 11 0% 7.5 1.60	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	8.9	Amps		Power supply:	3-phase	
Nameplate Voltage:	230	Volts		Phase adjustment:	1.73	
Power factor:	0.93			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	1.4	Amps		Power supply:	1-Phase	
Nameplate Voltage:	230	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.7			Fan quantity:	1	
Evaporator fan data (if a	pplicable)					
Full load Amps:	0	Amps		Power supply:	0	
Nameplate Voltage:	0	Volts		Phase adjustment:	0	
Adjust FLA to RLA:	0.7			Fan quantity:	0	
Calculated compressor I	oad:		3.3	kW		
Calculated condensing f	an load:		0.23	kW		
Calculated evaporator fa			0.00	kW		
Total calculated load for Assumptions			3.52	kW - Condensing side only		

Condenser C Overall Unit C	oil Assessme	nt
	New	Х
	Average	
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

0.0%	Performance	Degradation
0.0%	Performance	Degradation

FLUKE METER MEASU	JRMENTS			
Y-measurment				
Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	206	7.5	0.9	0.59
2 to 3	208	8.1	1.7	1.00
TOTAL				
HVAC Service Assistan	t Measurment			
Input SEER	10	I		
RAT	74	F		
SAT	54	F		
RAH	50	%		
SAH	85	%		
-				
EI	96%	+		
CI	84%			
Input Cap		Tons		
OAT	89	+		
Predicted KW	3.30	kW		
	CU Capacity I	Estimates		
Ambient	90	F	305	к
CU Exhaust	99	F	310	к
Coil Length	62	in		
Coil Width	26	in		
Area	11.19	sq-ft		
Measured Fan CFM	5524			
Air Mass Flow	3.13	kg/sec		
Capacity		Tons		
Efficiency	20.65			
Efficiency	0.58	kW/Ton		

CU Fan CFM Calculation										
Measurement										
Number	ft/sec									
1	7.5									
2	8.2									
3	8.2									
4	9.0									
Average	8.2									

Concor	d City Hall	SS-4	Summa	ry								
EER at ARI Conditions 8.0 BTU/W-h					n	Equ	uipment age	11	Years			
Condensing unit CFM 4047 CFM (Meas					easured)							
Capacity at	ARI			2.35	tons							
Capacity us	sed for SA			3.00	tons							
Coil Area				11.19	sq-ft							
Predicted E	ER =			7.05	pre	7.49	post					
		HVAC	Service As	sistant				Phys	ical Power	and Capac	ity measurn	nents
Test Date								r, deg F		Cond Air		
	OAT	ST-SH	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
O4 May	02	27	050/	000/	0 1	2 5 1	00	100	67	2.64	2.20	4 27

TCST DUIC			, ucg i		Oona Aii								
	OAT	ST-SH	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons	EER
24-May	93	37	95%	82%	8.1	2.51	90	102	6.7	2.64	2.29	4.37	19.86
Post Adsil I	Measurements												
16-Jun	89	31	96%	84%	8.0	2.58	90	99	5.0	2.6	3.13	4.47	20.65

	Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions								
		Test Data			Percent Difference				Test Data	1	Percent Difference						
ΟΑΤ		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA		Predicted/ Original	
	Power (kW)	2.51	2.64	3.49	72%	76%	97%	2.6	2.7	3.61	72%	76%	95%	-	-	-	
Pre-Adsil	Capacity (Tons)	2.03	4.37	2.48	82%	177%	91%	2.1	4.6	2.58	82%	177%	46%	-	-	-	
	EER	8.1	19.86	8.51	95%	233%	82%	8.2	20.0	8.58	95%	233%	41%	86%	35%	82%	
	Power (kW)	2.58	2.6	3.25	80%	80%	97%	2.9	2.9	3.61	80%	80%	99%	-	-	-	
Post-Adsil	Capacity (Tons)	1.90	4.47	2.26	84%	198%	91%	2.2	5.1	2.58	84%	198%	42%	-	-	-	
	EER	8.0	20.65	8.34	96%	248%	87%	8.2	21.2	8.58	96%	248%	39%	86%	33%	87%	

FED	Changes	
EER	Changes	

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	8.1	19.86	7.05
Post Adsil EER	8.0	20.65	7.49
ARI Adjusted			
Pre-Adsil EER	7.6	18.70	7.05
Post Adsil EER	7.7	19.83	7.49
Change	1.1%	6.1%	6.3%
Neighted Average	3.2%	18.3%	18.8%

Manufacturer: Model Number: Serial Number Equipment Type Year Manufactu Location Tag		Carrier 38CKC048-5 2802E15220 Split System 2002 Concord City SS-3			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition El kW/ton	ER	11.1 11.1 3.83 2 5% 10.8 1.11	Btu/W-hr Btu/W-hr tons years (% degrad Btu/W-hr	(CU Only)
Compressor Da Running load Am Nameplate Volta Power factor:	ips:	14.1 208 0.78	Amps Volts		Power supply: Phase adjustment: Compressor quantity:		3-phase 1.73 1		
Four factor.	ge:	1.40 208 0.70	Amps Volts		Power supply: Phase adjustment: Fan quantity:		ı 1-Phase 1 1		
Evaporator fan Full load Amps: Nameplate Volta Adjust FLA to RL	ge:	ble)	Amps Volts		Power supply: Phase adjustment: Fan quantity:				
Calculated com Calculated cond Calculated evap Total calculated Assumptions	lensing fan Ioa orator fan Ioad	l		3.9 0.20 1.00 4.14	kW kW kW (From Product Da kW - Condensing side				
Condenser Coil Overall Unit Con			5.0%	Performa	nce Degradation				
	New Average Fair Poor	x	-		FLUKE METER MEAS Y-measurment Phase	SURMENTS	Amps	kW	PF
Coil Cleanliness	Coated Clean	1 1			1 2 3		Апрэ		
Fin Condition	Dirty Clogged Plugged		-		Delta Measurement Phase 1 to 2	Volts 207	Amps 11.1	kW	PF 0.48
	Like New Some Bent Smashed	1	-		2 to 3 TOTAL HVAC Service Assista	208 ant Measurment	12.6	2.5	1.00
	Dull/rough Corroded Pitted Flaking		-		Input SEER RAT SAT RAH	10	F F %		
Fin-Tube Attachr	-	x	-		SAH El Cl	96%	%		
Tubes	Many Loose Clean Cu	x	-		Input Cap OAT Predicted KW				
	Corrosion Pitting Leaks		-		Ambient	CU Capacity E		306	sк
					CU Exhaust Coil Length Coil Width	109 61 25	F in	316	

Area

Area Measured Fan CFM Air Mass Flow Capacity Efficiency 10.6 sq-ft 3971

2.25 kg/sec 6.43 Tons 21.44 EER

CU Fan CFM C	CU Fan CFM Calculation								
Measurement									
Number	ft/sec								
1	6.4								
2	6.8								
3	6.1								
4	5.7								
Average	6.250								

Carrier 38CKC048-56 2802E15220 Split System 2002 Concord City H SS-3	lall	Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	11.1 11.1 3.83 2 0% 11.3 1.06	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
14.1 A	Amps	Power supply:	3-phase	
208 V	/olts	Phase adjustment:	1.73	
0.775		Compressor quantity:	1	
1.4 A	Amps	Power supply:	1-Phase	
208 V	/olts	Phase adjustment:	1	
0.7		Fan quantity:	1	
pplicable)				
0 A	Amps	Power supply:	0	
0 V	/olts	Phase adjustment:	0	
0		Fan quantity:	0	
oad:	3.9	kW		
an load:	0.20	kW		
	1.00	kW (From Product Data)		
equipment:	4.14	kW - Condensing side only		
	38CKC048-56 2802E15220 Split System 2002 Concord City H SS-3 14.1 4 208 1 0.775 1.4 4 0.775 1.4 4 0.77 pplicable) 0 4 0 1 0 4 0 1 0 4 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1	38CKC048-56 2802E15220 Split System 2002 Concord City Hall SS-3 14.1 Amps 208 Volts 0.775 1.4 Amps 208 Volts 0.775 1.4 Amps 0.7 pplicable) 0 Amps 0 Volts 0 0.200 n load 1.00	38CKC048-56 Calculated EER: 2802E15220 Nominal Capacity: Split System Age 2002 Coil Conditon Concord City Hall Present Condition EER SS-3 WWton 14.1 Amps 208 Volts 0.775 Power supply: 1.4 Amps 208 Volts 0.775 Power supply: 1.4 Amps 208 Volts 0.77 Phase adjustment: 0.7 Fan quantity: 0 Volts 0 Amps 0 Volts 0 KW an load: 0.20 NW	38CKC048-56 Calculated EER: 11.1 2802E15220 Nominal Capacity: 3.83 Split System Age 2 2002 Coil Conditon 0% Concord City Hall Present Condition EER 11.3 SS-3 KW/ton 1.06 14.1 Amps Power supply: 3-phase 208 Volts Phase adjustment: 1.73 0.775 Compressor quantity: 1 1.4 Amps Power supply: 1-Phase 208 Volts Phase adjustment: 1 0.77 Fan quantity: 1 0.77 Fan quantity: 1 0.77 Phase adjustment: 0 0.77 Phase adjustment: 0 0.77 Fan quantity: 0 0 Volts Phase adjustment: 0 0 Volts Phase adjustment:

Condenser C Overall Unit C	oil Assessme	nt
	New	х
	Average	
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	0
	Smashed	0
	Dull/rough	
	Corroded	0
	Pitted	0
	Flaking	0
Fin-Tube Atta		
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

0.0%	Performance	Degradation
0.070	renormance	Degradation

FLUKE METER MEAS	SURMENTS			
Y-measurment				
Phase	Volts	Amps	kW	PF
1	Volto	7 unpo		
2				
3				
Della Massarat				
Delta Measurement	\ / = It =	A	1.3.47	DE
Phase	Volts	Amps	kW 1	PF
1 to 2 2 to 3	208 206	10.6 11.8	2.4	0.45
TOTAL	200	11.0	2.4	0.99
HVAC Service Assista	int Measurment			
Input SEER	10	Ĩ		
RAT	74			
SAT	54			
RAH	50			
SAH	85			
EI	90%			
CI	79%			
Input Cap	3	Tons		
OAT	89	F		
Predicted KW	4.27	kW		
	CU Capacity E	Estimates		
Ambient	90	F	305	К
CU Exhaust	106	F	314	К
Coil Length	61	in		
Coil Width	25			
Area		sq-ft		
Measured Fan CFM	4257			
Air Mass Flow		kg/sec Tons		
Capacity Efficiency	21.64			
Enciency	21.64	CCR		

CU Fan CFM Calculation Measurement								
ft/sec								
6.8								
7.2								
7.0								
5.8								
6.7								

Concord City Hall SS-3 Summary

89

57

90%

79%

	ER at ARI Conditions ondensing unit CFM			DTUAN	-	F						
EER at ARI	Conditions			11.12	BTU/W-I	ר	Equ	ipment age	4	2 Years		
Condensing	unit CFM			3971	easured)							
Nominal Un	it Capacity		3.83	tons								
Capacity us	ed for SA	4.00 tons										
Capacity used for SA Coil Area				10.59) sq-ft							
Predicted E	ER =			10.77								
		HVAC	C Service As	sistant				Phys	ical Powe	r and Capao	ity measurn:	nents
Test Date		HVAC	C Service As	sistant			Cond Ai	<u>,</u>	ical Powe	r and Capao Cond Air	ity measurn:	nents
Test Date	OAT	HVAC EWB	El	CI	EER	kW	Cond Ai inlet	<u>,</u>	ical Powe ∆T (K)		(kg/sec)	nents tons
Test Date 24-May	OAT 91				EER 10.3	kW 4.40		r, deg F		Cond Air		
24-May		EWB	EI	CI			inlet	r, deg F exhaust	ΔТ (К)	Cond Air kW	(kg/sec)	tons

10.0

4.08

90

	Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions								
		Test Data			Percent Difference				Test Data	1	Percent Difference						
0.17			011	1.14	0.4.11.14	011/1.14	00/1 14		011	1.14	0.4 // 14	011/1 14	0.0/011		Due die te di Old	Predicted/	
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original	
	Power (kW)	4.40	3.6	3.82	115%	94%	100%	4.8	3.9	4.13	115%	94%	122%	-	-	-	
Pre-Adsil	Capacity (Tons)	3.07	6.43	3.41	90%	189%	100%	3.4	7.2	3.83	90%	189%	48%	-	-	-	
	EER	10.3	21.44	10.72	96%	200%	97%	10.7	22.2	11.12	96%	200%	48%	101%	48%	97%	
	Power (kW)	4.08	3.4	3.73	109%	91%	100%	4.5	3.8	4.13	109%	91%	120%	-	-	-	
	Capacity (Tons)	2.72	6.13	3.44	79%	178%	100%	3.0	6.8	3.83	79%	178%	44%	-	-	-	
	EER	10.0	21.64	11.06	90%	196%	102%	10.0	21.8	11.12	90%	196%	46%	108%	50%	102%	

8.9

3.4

2.41

106

EER

21.44

21.64

tons 6.43

6.13

EER Changes

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	10.29	21.44	10.77
Post Adsil EER	9.95	21.64	11.32
ARI Adjusted			
Pre-Adsil EER	10.67	22.24	10.77
Post Adsil EER	10.01	21.75	11.32
Change	-6.3%	-2.2%	5.1%
Weighted Average	-25.0%	-8.8%	20.4%

EPA Adsil Evaluation Concord, NC City Hall SS-3

15-Jun

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38AK007501 1099G00176 Split System 1999 Concord City Hall SS-2		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton		:U Only) :U Only)
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	19.0 Amps 208 Volts 0.90		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	2.80 Amps 208 Volts 0.70		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if a Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	pplicable) Amps Volts 0.70		Power supply: Phase adjustment: Fan quantity:		
Calculated compressor I Calculated condensing f Calculated evaporator fa Total calculated load for Assumptions	an load: In load	6.1 0.41 0.00 6.53	kW kW kW - Condensing side only		

Condenser Coil Assessment Overall Unit Condition							
	New						
	Average	1					
	Fair						
	Poor						
Coil Cleanline	ss						
	Coated	0.9					
	Clean						
	Dirty	0.1					
	Clogged						
	Plugged						
Fin Condition							
	Like New	0.95					
	Some Bent	0.05					
	Smashed						
	Dull/rough	0.05					
	Corroded						
	Pitted						
	Flaking						
Fin-Tube Atta	chment						
	Like New	x					
	Corrosion						
	Some Loose						
	Many Loose						
Tubes							
	Clean Cu	x					
	Corrosion						
	Pitting						
	Leaks						

5.7% Performance De	gradation
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FLUKE METER MEASU	JRMENTS						
Y-measurment							
Phase	Volts	Amps	kW	PF			
1 2							
2 3							
3							
Delta Measurement							
Phase	Volts	Amps	kW	PF			
1 to 2	205	17.8	2.0	0.55			
2 to 3	207	18.9	3.8	0.99			
TOTAL							
HVAC Service Assistant	t Measurment						
Input SEER	10	Ī					
RAT	74	F					
SAT	54	F					
RAH	50	%					
SAH	85	%					
		Ī					
EI	90%	ĺ					
CI	91%						
Input Cap	6	Tons					
OAT	87 F						
Predicted KW	7.30	kW					
	CU Capacity I	Estimates					
Ambient	89	F	305	к			
CU Exhaust	112	F	318	к			
Coil Length	64	in					
Coil Width	28	in					
Area	12.4	sq-ft					
Measured Fan CFM	3995	•					
Air Mass Flow	2.26	kg/sec					
Capacity	8.27	Tons					
Efficiency	17.11	EER					
Efficiency	0.70	kW/Ton					

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	5.0
2	5.0
3	5.7
4	5.7
Average	5.35

HVAC Data Sheet Page 1 of 3

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38AK007501 1099G00176 Split System 1999 Concord City Hall SS-2		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.5 10.5 5.71 5 0% 10.4 1.15	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	19 Amps 208 Volts 0.895		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 1	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	2.8 Amps 208 Volts 0.7		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 1	
Evaporator fan data (if a Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	pplicable) 0 Amps 0 Volts 0.7		Power supply: Phase adjustment: Fan quantity:	0 0 0	
Calculated compressor Calculated condensing f Calculated evaporator fa Total calculated load for Assumptions	an load: In load	6.1 0.41 0.00 6.53	kW kW kW kW - Condensing side only		

Condenser C Overall Unit C	oil Assessme	nt
	New	х
	Average	
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

0.0% Per	ormance Degradation
----------	---------------------

Y-measurment	Valta	4.0000	1414/	DE
Phase 1	Volts	Amps	kW	PF
2				
3				
5				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	205	17.4	2.0	0.55
2 to 3	207	18.8	3.9	0.99
TOTAL				
HVAC Service Assistan	t Measurment			
Input SEER	10	Ĩ		
RAT	74	F		
SAT	54	F		
RAH	50	%		
SAH	85	%		
		Ĩ		
EI	95%	Ĩ		
CI	90%	Ι		
Input Cap	6	Tons		
OAT	92	F		
Predicted KW	6.90	kW		
	CU Capacity	Estimates		
Ambient	91	F	306	к
CU Exhaust	112	F	318	к
Coil Length	64	in		
Coil Width	28	in		
Area	12.44	sq-ft		
Measured Fan CFM	7541			
Air Mass Flow		kg/sec		
Capacity		Tons		
Efficiency	28.99			
Efficiency	0.41	kW/Ton		

CU Fan CFM Calculation Measurement							
ft/sec							
10.0							
10.2							
10.1							

Concor	d City Hall	66.2	Summai	~ /								
		33-2	Summai									
EER at ARI Conditions		10.5 BTU/W-h			Equipment age			5 Years				
Condensing	g unit CFM			3995	CFM (M	easured)						
Capacity at	ARI			5.71	tons							
Capacity us	sed for SA			6.00	tons							
Coil Area				12.44	sq-ft							
Predicted E	ER =			9.84	pre	10.39	post					
		HVAG	C Service As	sistant				Phys	ical Power	r and Capac	ity measurn	nents
Test Date							Cond Ai	r, deg F		Cond Air		
	OAT	ST-SH	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
24-May	87	39	90%	91%	10.4	6.95	89	112	12.8	5.8	2.26	8.27

10.4

6.56

91

	Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions									
	Test Data Percent Difference							Test Data	l	Percent Difference								
														Predicted/				
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original		
	Power (kW)	6.95	5.8	6.17	112%	94%	100%	7.3	6.1	6.53	112%	94%	120%	-	-	-		
Pre-Adsil	Capacity (Tons)	5.39	8.27	5.92	91%	140%	100%	5.2	8.0	5.71	91%	140%	65%	-	-	-		
	EER	10.4	17.11	11.50	90%	149%	94%	9.4	15.6	10.48	90%	149%	61%	104%	63%	94%		
	Power (kW)	6.56	5.9	6.42	102%	92%	100%	6.7	6.0	6.53	102%	92%	111%	-	-	-		
	Capacity (Tons)	5.25	14.25	5.83	90%	244%	100%	5.1	13.9	5.71	90%	244%	37%	-	-	-		
	EER	10.4	28.99	10.91	95%	266%	99%	10.0	27.8	10.48	95%	266%	36%	99%	35%	99%		

11.7

5.9

4.27

112

EER

17.11

28.99

tons 8.27

14.25

EER Changes	
-------------	--

95%

90%

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	10.4	17.11	9.84
Post Adsil EER	10.4	28.99	10.39
ARI Adjusted			
Pre-Adsil EER	9.4	15.61	9.84
Post Adsil EER	10.0	27.88	10.39
Change	5.6%	78.6%	5.6%
Mainhtad Average	22.20/	474 00/	22.0%
Weighted Average	33.3%	471.8%	33.9%

Post Adsil Measurements

92

40

16-Jun

		110-7	\u311117			Conculation			
Manufacturer Model Numbe Serial Numbe Equipment Ty Year Manufac Location Tag	er: r /pe:	Carrier 38ARZ007-5 4302G30009 Split System 2002 Concord City SS-1)		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition El kW/ton	ER	11.8 11.8 5.48 2 6% 11.4 1.06	Btu/W-hr Btu/W-hr tons years (% degrad Btu/W-hr	(CU Only)
Compressor	Data								
Running load		19.1	Amps		Power supply:		3-phase		
Nameplate Vo		208	Volts		Phase adjustment:		1.73		
Power factor:		0.78			Compressor quantity:		1		
Condensing I									
Full load Amps		0.90	Amps		Power supply:		1-Phase		
Nameplate Vo		208	Volts		Phase adjustment:		1		
Adjust FLA to	RLA:	0.70			Fan quantity:		2		
Evaporator fa		olicable)							
Full load Amps			Amps		Power supply:				
Nameplate Vo	•	0.70	Volts		Phase adjustment:				
Adjust FLA to	RLA:	0.70			Fan quantity:				
Calculated co Calculated co Calculated ev Total calculat Assumptions	ondensing fai aporator fan ed load for e	n load: Ioad		5.3 0.26 0.00 5.59	kW kW kW - Condensing side	eonly			
Condenser C	oil Assossme	ant	5.7%	Porforma	nce Degradation				
Overall Unit C		FIL	J.1 /0	renoma	nce Degradation				
	New	[0	C					
	Average	1	1		FLUKE METER MEAS				
	Fair	•	5		Y-measurment	SORMENTO			
	Poor		12	0		Volts	Amps	kW	PF
Coil Cleanline			12	0		VOIIS	лпръ	NVV	
Con Cleannine	Coated		25	0	-				
	Clean	0.75	0	0					
		0.25	25	6.25					
	Dirty	0.25		0.25					
	Clogged			0		Volto	٨٣٥٥	L\\/	PF
Fig. On a differen	Plugged		100		-	Volts	Amps	kW	
Fin Condition			0	C		208	18.1	1.9 3.3	0.51
	Like New					204	16.4	3.3	1.00
	Some Bent	0.1	25						
	Smashed	0.75	50 		HVAC Service Assista	10	r		
	Dull/rough Corroded	0.75	35		Input SEER RAT	74	-		
	Pitted		45		SAT	54			
			60		RAH	50			
Fin-Tube Attac	Flaking		- 00		SAH	85			
FIII-TUDE Alla	Like New	x	0	0		65	70		
	Corrosion	*	10		EI	96%	ŀ		
	Some Loose		25		CI	92%			
			50		Input Cap		Tons		
Tubes	Many Loose		50		OAT	85			
TUDES	Clean Cu	~	-	Ľ	Predicted KW	6.90			
	Clean Cu	x	-			6.90	L V V		
	Corrosion		-				atimate -		
	Pitting		-			CU Capacity E	sumates		
	Leaks	L	_		Ambient	~7	-		
					Ambient	87		304	
					CU Exhaust	96.5		309	n ri
					Coil Length		in		
					Coil Width		in 		
					Area	29.2	sa-ft		

Area

Efficiency

Area Measured Fan CFM Air Mass Flow Capacity Efficiency

in 29.2 sq-ft

0.74 kW/Ton

8234 4.66 kg/sec 7.04 Tons 16.25 EER

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	6.1
2	3.7
3	4.1
4	4.9
Average	4.700

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 38ARZ007-{ 4302G30009 Split System 2002 Concord Cit SS-1	1		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	11.8 11.8 5.48 2 0% 12.0 1.00	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	19.1	Amps		Power supply:	3-phase	
Nameplate Voltage:	208	Volts		Phase adjustment:	1.73	
Power factor:	0.775			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	0.9	Amps		Power supply:	1-Phase	
Nameplate Voltage:	208	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.7			Fan quantity:	2	
Evaporator fan data (if a	pplicable)					
Full load Amps:	0	Amps		Power supply:	0	
Nameplate Voltage:	0	Volts		Phase adjustment:	0	
Adjust FLA to RLA:	0.7			Fan quantity:	0	
Calculated compressor	load:		5.3	kW		
Calculated condensing f			0.26	kW		
Calculated evaporator fa	an load		0.00	kW		
Total calculated load for	r equipment:		5.59	kW - Condensing side only		

Condenser C Overall Unit C	oil Assessme ondition	nt
	New	Х
	Average	
	Fair	
	Poor	
Coil Cleanline	ss	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

Assumptions

0.0%	Performance Degradation
0.0%	Performance Degradation

FLUKE METER MEASU	JRMENTS							
Y-measurment								
Phase	Volts	Amps	kW	PF				
1								
2								
3								
Delta Measurement								
Phase	Volts	Amps	kW	PF				
1 to 2	209	17.3	1.7	0.48				
2 to 3	206	15.5	3.2	1.00				
TOTAL								
HVAC Service Assistant	t Measurment	_						
Input SEER	10	Ι						
RAT	74	F						
SAT	54							
RAH		%						
SAH 85 %								
	4000/	ł						
EI CI	103%	+						
-	92%	Tons						
Input Cap OAT	88							
Predicted KW	6.50	•						
	0.50	KVV						
	CU Capacity I	Estimates						
Ambient	89	F	305	к				
CU Exhaust	100	F	311	к				
Coil Length	0	in						
Coil Width	0	in						
Area	29.20	sq-ft						
Measured Fan CFM	12001							
Air Mass Flow		kg/sec						
Capacity		Tons						
Efficiency	29.09							
Efficiency	0.41	kW/Ton						

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	6.6
2	7.2
3	6.8
4	6.8
Average	6.9

Concord City Hall EER at ARI Conditions Condensing unit CFM Capacity at ARI Capacity used for SA Coil Area Predicted EER = Test Date OAT 24-May 85	SS-1	Summai	11.8 8234 5.48	3 BTU/W-I 4 CFM (M 3 tons) tons		Ed	quipment age	2	2 Years					
Coil Area) sq-ft									
	ER =			11.35	•	12.01	post							
		HVAC	Service As	ssistant			Physical Power and Capacity measurments							
Test Date							Cond /	Air, deg F		Cond Air				
-	OAT	ST-SH	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons		
24-May	85	35	96%	92%	12.4	6.31	87	96.5	5.3	5.2	4.66	7.04		
Post Adsil N	leasurements													
16-Jun	88	37	103%	92%	13.0	5.94	89	100	6.1	4.9	6.80	11.88		
Condensing unit Capacity at ARI Capacity used for Coil Area Predicted EER Test Date 24-May Post Adsil Meas														

	Condensing Unit Summary - Ambient Conditions									Condensing Unit Summary - ARI Conditions									
		Test Data Percent Difference							Test Data	1	Percent Difference								
												Predicted/							
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original			
	Power (kW)	6.31	5.2	4.90	129%	106%	100%	7.2	5.9	5.59	129%	106%	121%	-	-	-			
Pre-Adsil	Capacity (Tons)	4.86	7.04	5.28	92%	133%	100%	5.0	7.3	5.49	92%	133%	69%	-	-	-			
	EER	12.4	16.25	12.93	96%	126%	96%	11.3	14.8	11.77	96%	126%	76%	100%	77%	96%			
	Power (kW)	5.94	4.9	5.11	116%	96%	100%	6.5	5.4	5.59	116%	96%	121%	-	-	-			
Post-Adsil	Capacity (Tons)	4.96	11.88	5.39	92%	220%	100%	5.0	12.1	5.49	92%	220%	42%	-	-	-			
	EER	13.0	29.09	12.65	103%	230%	102%	12.1	27.1	11.77	103%	230%	45%	94%	42%	102%			

EER

16.25

29.09

	EER	Changes	
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	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	12.4	16.25	11.35
Post Adsil EER	13.0	29.09	12.01
ARI Adjusted			
Pre-Adsil EER	11.3	14.79	11.35
Post Adsil EER	12.1	27.07	12.01
Change	7.3%	83.0%	5.8%
Weighted Average	43.8%	498.1%	34.9%

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 50TJQ006 1399G2094 Package He 1999 Concord Cit RTU-3	at Pump		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	12.0 12.0 5.23 5 7% 11.1 1.08	CU Only) CU Only) ป)
Compressor Data						
Running load Amps:	15.4	Amps		Power supply:	3-Phase	
Nameplate Voltage:	230	Volts		Phase adjustment:	1.73	
Power factor:	0.81			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	1.50	Amps		Power supply:	1-Phase	
Nameplate Voltage:	230	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Evaporator fan data (if a	pplicable)					
Full load Amps:	5.90	Amps		Power supply:	1-Phase	
Nameplate Voltage:	208	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Calculated compressor	load:		5.0	kW		
Calculated condensing	fan load:		0.24	kW		
Calculated evaporator fa	an load		0.86	kW		
Total calculated load for			5.20	kW - Condensing side only		
				e ,		

Assumptions

Condenser Coil Assessment Overall Unit Condition New Х Average Fair Poor Coil Cleanliness Coated 0.8 0.2 Clean Dirty Clogged Plugged Fin Condition Like New Some Bent 0.1 Smashed Dull/rough 1 Corroded Pitted Flaking Fin-Tube Attachment Like New х Corrosion Some Loose Many Loose Tubes Clean Cu х Corrosion Pitting Leaks

6.7%	Performance	Degradation
6.7%	Performance	Degradation

Y-measurment Phase	Volts	Amps	kW	PF
1	Volto	7		
2				
3				
Delta Measurement				
Phase	Volts	4 mno	kW	PF
1 to 2	VOILS	Amps	KVV	PF
2 to 3	-	-		
2 10 3	I	1		
HVAC Service Assista	nt Measurment COMP 1	_		
Input SEER	10)		
RAT	74	4 F		
SAT	54	ι F		
RAH	50) %		
SAH	85	5 %		
El	99%	b		
CI	94%	b		
Input Cap	Ę	5 Tons		
OAT	86	6		
Predicted KW	5.80) kW		
Ambient		F		
CU Exhaust	-	F		
Coil Length	-	in		
Coil Width	-	in		
Area	_	sq-ft		
Measured Fan CFM		~~ ~		
Air Mass Flow	-	kg/sec		
Capacity	-	Tons		
Efficiency		EER		

CU Fan CFM Calculation										
Measurement										
Number	ft/sec									
1	-									
2	-									
3	-									
4	-									
5	-									
Average	-									
3 4 5	- - - -									

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 50TJQ006 1399G2094 Package He 1999 Concord Ci RTU-3	eat Pump		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	12.00 12.0 5.2261 5 0% 11.9 1.01	Btu/W-hr Btu/W-hr tons years (% degrad Btu/W-hr	(CU Only) (CU Only) ded)
Compressor Data Running load Amps: Nameplate Voltage:	15.4 230	Amps Volts		Power supply: Phase adjustment:	3-Phase 1.73		
Power factor:	0.81			Compressor quantity:	1		
Condensing Fan Data							
Full load Amps:	1.5	Amps		Power supply:	1-Phase		
Nameplate Voltage:	230	Volts		Phase adjustment:	1		
Adjust FLA to RLA:	0.7			Fan quantity:	1		
Evaporator fan data (if a	pplicable)						
Full load Amps:	5.9	Amps		Power supply:	1-Phase		
Nameplate Voltage:	208	Volts		Phase adjustment:	1		
Adjust FLA to RLA:	0.7			Fan quantity:	1		
Calculated compressor			5.0	kW			
Calculated condensing			0.24	kW kW			
Calculated evaporator fa			0.86				
Total calculated load for Assumptions	equipment:		5.20	kW - Condensing side only			
Condenser Coil Assessi	nent	0.0%	Performa	ance Degradation			

Condenser Overall Unit	Coil Assessme Condition	nt
	New	х
	Average	
	Fair	
	Poor	
Coil Cleanlin	ess	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	1
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Att	achment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEAS				
Phase	Volts	Amps	kW	PF
1	VORO	/ unpo		
2				
3				
Delta Measurement				
Phase	Volts	A	kW	PF
	VOILS	Amps	KVV	PF
1 to 2 2 to 3		+		
2 10 3		1		L
RAH SAH Cl Input Cap OAT Predicted KW	85 104% 101% 58			
	CU Capacity			
	oupdoily			
Ambient	-	F		
CU Exhaust	-	F		
Coil Length	-	in		
Coil Width	-	in		
Area	-	sq-ft		
Measured Fan CFM	-			
Air Mass Flow	-	kg/sec		
Capacity	-	Tons		
Efficiency		EER		

CU Fan CFM Calculation										
Measurement										
Number	ft/sec									
1	-									
2	-									
3	-									
4	-									
Average	-									
in ango										

Concor	d City Hall	RTU-3	Summa	ry								
EER at AR	I Conditions			12.0	BTU/W-I	า	Equ	ipment age	5	Years		
Condensin	g unit CFM			-	CFM (M	easured)						
Nominal U	nit Capacity			5.23								
Capacity us	sed for SA			5.00	tons							
Coil Area				-	sq-ft							
Predicted E	ER =			11.14								
Nominal Unit Capacity use Coil Area Predicted EE Test Date 24-May		HVAC	Service Ass	istant			Physical Power and Capacity measurments					
Test Date							Cond Ai	r, deg F		Cond Air		
Test Date	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
24-May	86	62	99%	94%	13.0	6.06	-	-	-	-	-	-
Post Adsil	Measurements											
16-Jun	88	62	104%	101%	13.2	5.85	-	-	-	-	-	-
Condensing I Nominal Unit Capacity use Coil Area Predicted EE Test Date 24-May Post Adsil Ma												

	Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions							
		Test Data@ Field Conditions			Percent Difference			Te	est Data @	ARI	Percent Difference					
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	6.06	NA	4.58	132%	NA	100%	6.9	NA	5.23	132%	NA	NA	-	-	-
	Capacity (Tons)	4.69	NA	4.99	94%	NA	100%	4.9	NA	5.23	94%	NA	NA	-	-	-
	EER	13.0	NA	13.08	99%	NA	93%	11.9	NA	12.00	99%	NA	NA	94%	-	93%
	Power (kW)	5.85	NA	4.69	125%	NA	100%	6.5	NA	5.23	125%	NA	NA	-	-	-
	Capacity (Tons)	5.00	NA	4.95	101%	NA	100%	5.3	NA	5.23	101%	NA	NA	-	-	-
	EER	13.2	NA	12.66	104%	NA	99%	12.5	NA	12.00	104%	NA	NA	89%	-	99%

EER -

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EER Changes										
Service Assistant Condenser Test Spreadsheet										
Pre-Adsil EER	13.0	NA	11.1							
Post Adsil EER	13.2	NA	11.9							
ARI Adjusted										
Pre-Adsil EER	11.9	NA	11.14							
Post Adsil EER	12.5	NA	11.88							
Change	5.1%	NA	6.6%							
Weighted Average	25.3%	NA	33.2%							

EPA Adsil Evaluation Concord, NC City Hall RTU-3

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 50TJQ006 1399G2093 Package He 1999 Concord Cit RTU-2	at Pump		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	12.0 12.0 5.23 5 6% 11.2 1.07	Btu/W-hr (CU Onl Btu/W-hr (CU Onl tons years (% degraded) Btu/W-hr	
Compressor Data							
Running load Amps:	15.4	Amps		Power supply:	3-Phase		
Nameplate Voltage:	230	Volts		Phase adjustment:	1.73		
Power factor:	0.81			Compressor quantity:	1		
Condensing Fan Data							
Full load Amps:	1.50	Amps		Power supply:	1-Phase		
Nameplate Voltage:	230	Volts		Phase adjustment:	1		
Adjust FLA to RLA:	0.70			Fan quantity:	1		
Evaporator fan data (if a	pplicable)						
Full load Amps:	5.90	Amps		Power supply:	1-Phase		
Nameplate Voltage:	208	Volts		Phase adjustment:	1		
Adjust FLA to RLA:	0.70			Fan quantity:	1		
Calculated compressor	load:		5.0	kW			
Calculated condensing	fan load:		0.24	kW			
Calculated evaporator fa	an load		0.86	kW			
Total calculated load for			5.20	kW - Condensing side only			

Assumptions

Condenser Coil Assessment Overall Unit Condition New Х Average Fair Poor Coil Cleanliness Coated 0.7 Clean 0.3 Dirty Clogged Plugged Fin Condition Like New 0.5 Some Bent Smashed Dull/rough 0.5 Corroded Pitted Flaking Fin-Tube Attachment Like New х Corrosion Some Loose Many Loose Tubes Clean Cu х Corrosion Pitting Leaks

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	-
2	-
3	-
4	-
5	-
Average	-

6.2% Performance Degradation

Y-measurment	Volts	A	kW	PF
Phase 1	VOILS	Amps	KVV	PF
2				
3				
0	1			
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2				
2 to 3				
HVAC Service Assista				
	COMP 1	_		
Input SEER		0		
RAT		4 F		
SAT	5	4 F		
RAH	5	0 %		
SAH	8	5 %		
EI	989	%		
CI	919	%		
Input Cap		5 Tons		
OAT	8	6		
Predicted KW	5.6	0 kW		
Ambient	-	F		
CU Exhaust	-	F		
Coil Length	-	in		
Coil Width	-	in		
Area	-	sq-ft		
Measured Fan CFM	-	•		
Air Mass Flow	-	kg/sec		
Capacity	-	Tons		
Efficiency	-	EER		

HVAC Data Sheet Page 1of 3

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 50TJQ006 1399G20939 Package Heat F 1999 Concord City Ha RTU-2		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	12.0 12.0 5.23 5 0% 11.9 1.01	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data					
Running load Amps:	15.4 A	mps	Power supply:	3-Phase	
Nameplate Voltage:	230.0 V	olts	Phase adjustment:	1.73	
Power factor:	0.8		Compressor quantity:	1	
Condensing Fan Data					
Full load Amps:	1.5 A	mps	Power supply:	1-Phase	
Nameplate Voltage:	230.0 V	olts	Phase adjustment:	1	
Adjust FLA to RLA:	0.7		Fan quantity:	1	
Evaporator fan data (if a	pplicable)				
Full load Amps:	•• •	mps	Power supply:	1-Phase	
Nameplate Voltage:	208.0 V	olts	Phase adjustment:	1	
Adjust FLA to RLA:	0.7		Fan quantity:	1	
Calculated compressor	load:	5.0	kW		
Calculated condensing		0.24	kW		
Calculated evaporator fa		0.86	kW		
Total calculated load for Assumptions		5.20	kW - Condensing side only		

Condenser Coil Assessment Overall Unit Condition							
	New	х					
	Average						
	Fair						
	Poor						
Coil Cleanline	ss						
	Coated						
	Clean	1					
	Dirty						
	Clogged						
	Plugged						
Fin Condition							
	Like New						
	Some Bent						
	Smashed						
	Dull/rough						
	Corroded						
	Pitted						
	Flaking						
Fin-Tube Atta	chment						
	Like New	x					
	Corrosion						
	Some Loose						
	Many Loose						
Tubes							
	Clean Cu	x					
	Corrosion						
	Pitting						
	Leaks						

Assumptions

0.0% Performance Degradation	Performance Deg	radation
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FLUKE METER MEA				
Y-measurment	SURIVIEN 13			
Phase	Volts	Amps	kW	PF
1 11030	10103	Апрэ	KVV	
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	1			
2 to 3				
HVAC Service Assist	ant Measurment			
	COMP 1			
Input SEER	10)		
RAT	74	F		
SAT	54	F		
RAH	50	%		
SAH	85	5 %		
]		
EI	104%	b		
CI	98%	-		
Input Cap		Tons		
OAT		F		
Predicted KW		kW		
	CU Capacity	Estimates		
Ambient	-	F		
CU Exhaust	-	F		
Coil Length	-	in		
Coil Width	-	in		
Area	-	sq-ft		
Measured Fan CFM	-			
Air Mass Flow	-	kg/sec		
Capacity	-	Tons		
Efficiency	-	EER		

CU Fan CFM Calculation								
Measurement								
Number	ft/sec							
1	-							
2	-							
3	-							
4	-							
Average	-							
, tronugo								

Concor	d City Hall	RTU-2	Summai	ry								
) BTU/W-I	-h Equipment age			5	5 Years			
Condensing	g unit CFM			-	CFM (M	easured)						
Nominal Un	it Capacity			5.23	3							
Capacity us	ed for SA			5.00) tons							
Coil Area					- sq-ft							
Predicted E	ER =			11.19)							
		HVAC	Service Ass	istant				Phys	ical Power	and Capac	ity measurn:	nents
Test Date							Cond A	Cond Air, deg F Cond Air				
1 1	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
24-May	86	62	98%	91%	12.8	5.85	-	-	-	-	-	-
Post Adsil N	/leasurements											
	89	62	104%	98%	13.0	6.06	-	-	-	-	-	-
16-Jun												

Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions										
		Test Da	ata@ Field C	onditions	Per	Percent Difference Test Data @ARI			Percent Difference							
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	5.85	NA	4.58	128%	NA	100%	6.7	NA	5.23	128%	NA	NA	-	-	-
Pre-Adsil	Capacity (Tons)	4.54	NA	4.99	91%	NA	100%	4.8	NA	5.23	91%	NA	NA	-	-	-
	EER	12.8	NA	13.08	98%	NA	93%	11.8	NA	12.00	98%	NA	NA	95%	-	93%
	Power (kW)	6.06	NA	4.75	128%	NA	100%	6.7	NA	5.23	128%	NA	NA	-	-	-
Post-Adsil	Capacity (Tons)	4.83	NA	4.93	98%	NA	100%	5.1	NA	5.23	98%	NA	NA	-	-	-
	EER	13.0	NA	12.45	104%	NA	99%	12.5	NA	12.00	104%	NA	NA	90%	-	99%

EER -

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EER Changes										
Service Assistant Condenser Test Spreadsheet										
Pre-Adsil EER	12.8	NA	11.2							
Post Adsil EER	13.0	NA	11.9							
ARI Adjusted										
Pre-Adsil EER	11.8	NA	11.2							
Post Adsil EER	12.5	NA	11.9							
Change	6.1%	NA	6.1%							
Weighted Average	30.6%	NA	30.7%							

EPA Adsil Evaluation Concord, NC City Hall RTU-2

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 50TJQ006 NA Package He 1999 Concord Cit RTU-1	•		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	12.0 12.0 5.23 5 2% 11.7 1.03	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data						
Running load Amps:	15.4	Amps		Power supply:	3-Phase	
Nameplate Voltage:	208	Volts		Phase adjustment:	1.73	
Power factor:	0.90			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	1.50	Amps		Power supply:	1-Phase	
Nameplate Voltage:	208	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Evaporator fan data (if ap	plicable)					
Full load Amps:	5.90	Amps		Power supply:	1-Phase	
Nameplate Voltage:	208	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.70			Fan quantity:	1	
Calculated compressor lo	oad:		5.0	kW		
Calculated condensing fa	in load:		0.22	kW		
Calculated evaporator far	n load		0.86	kW		
Total calculated load for e	equipment:		5.21	kW - Condensing side only		

Assumptions

Condenser C Overall Unit C	oil Assessme	nt
	New	
	Average	Х
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	0.9
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	1
	Some Bent	
	Smashed	
	Dull/rough	0.35
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

CU Fan CFM Calculation						
Number	ft/sec					
1	-					
2	-					
3	-					
4	-					
5	-					
Average	-					

2.0% Performance Degradation

·				
FLUKE METER MEAS	UREMENTS			
Y-measurment	Valta	A	1.1.47	DE
Phase 1	Volts	Amps	kW	PF
2				
3				
5				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	Volto	7 unpo		
2 to 3				
		•		
HVAC Service Assistar	t Measurment			
	COMP 1			
Input SEER	10]		
RAT	74	F		
SAT	54	F		
RAH	50			
SAH	85	%		
El	98%			
CI	93%			
Input Cap	5	Tons		
OAT	81			
Predicted KW	5.80	kW		
		_		
Ambient	-	F		
CU Exhaust	-	F		
Coil Length	-	in		
Coil Width Area	-	in og ft		
	-	sq-ft		
Measured Fan CFM Air Mass Flow	-	kg/sec		
Capacity	-	Tons		
Efficiency	_	EER		
,				

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 50TJQ006 NA Package He 1999 Concord Cit <u>i</u> RTU-1			Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	12.0 12.0 5.23 5 0% 11.9 1.01	 (CU Only) (CU Only) d)
Compressor Data						
Running load Amps:	15.4	Amps		Power supply:	3-Phase	
Nameplate Voltage:	208.0	Volts		Phase adjustment:	1.7	
Power factor:	0.9			Compressor quantity:	1	
Condensing Fan Data						
Full load Amps:	1.5	Amps		Power supply:	1-Phase	
Nameplate Voltage:	208.0	Volts		Phase adjustment:	1	
Adjust FLA to RLA:	0.7			Fan quantity:	1	
Evaporator fan data (if ap	plicable)					
Full load Amps:	5.9	Amps		Power supply:	1-Phase	
Nameplate Voltage:	208.0	Volts		Phase adjustment:	1.0	
Adjust FLA to RLA:	0.7			Fan quantity:	1.0	
Calculated compressor lo	oad:		5.0	kW		
Calculated condensing fa	an load:		0.22	kW		
Calculated evaporator fai			0.86	kW		
Total calculated load for			5.21	kW - Condensing side only		
•	· ·					

Assumptions

0.0% Performance Degradation

Condenser Co	0.0%	Performa		
Overall Unit Co				
	New	X		
	Average			
	Fair			
	Poor			
Coil Cleanlines	s			
	Coated			
	Clean	1		
	Dirty			
	Clogged			
	Plugged			
Fin Condition	0000			
	Like New			
	Some Bent			
	Smashed			
	Dull/rough			
	Corroded			
	Pitted			
	Flaking			
Fin-Tube Attac	•			
T III-T UDC ALLOC	Like New	x		
	Corrosion	^		
	Some Loose			
- .	Many Loose			
Tubes				
	Clean Cu	x		
	Corrosion			
	Pitting			
	Leaks			

CU Fan CFM	Calculation
Number	ft/sec
1	-
2	-
3	-
4	-
Average	-

FLUKE METER MEASU	JRMENTS			
Y-measurment				
Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
	Valta	A	1.1.1./	PF
Phase	Volts	Amps	kW	PF
1 to 2				
2 to 3				
HVAC Service Assistan	t Measurment			
	COMP 1			
Input SEER	10	Ī		
RAT	74	F		
SAT	54	F		
RAH	50	•		
SAH	85			
0/11		/0		
EI	100%	ł		
CI	92%	+		
Input Cap		Tons		
OAT	87			
Predicted KW	5.60	-		
Fieulcieu KW	CU Capacity E	1		
		sumates		
Ambient	-	F	-	к
CU Exhaust	-	F	-	К
Coil Length	-	in		
Coil Width	-	in		
Area	-	sq-ft		
Measured Fan CFM	-			
Air Mass Flow	-	kg/sec		
Capacity	-	Tons		
Efficiency	-	EER		

Concord City Hall RTU-1 Summary

				,								
EER at ARI Condensing	Conditions	12.0 BTU/W-h - CFM (Measured)				Equipment age 5 Years						
Nominal Un				5.23		casarca)						
Capacity us				5.00	tons							
Coil Area				-	sq-ft							
Predicted E	ER =			11.65								
		HVAC S	Service Assis	stant				Phys	ical Power	r and Capaci	ty measurm	nents
Test Date							Cond Air	r, deg F		Cond Air		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	∆T (K)	kW	(kg/sec)	tons
24-May	81	62	98%	93%	14.0	6.06	NA	NA	NA	NA	NA	NA
							-					
Post Adsil N	Measurements											
16-Jun	87	62	100%	92%	12.9	5.85	NA	NA	NA	NA	NA	NA

Condensing Unit Summary - Ambient Conditions					Condensing Unit Summary - ARI Conditions											
		Test Da	ta@ Field Co	onditions	Percent Difference			Test Data @ARI			Percent Difference					
																Predicted/
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original
	Power (kW)	6.06	NA	4.30	141%	NA	100%	7.4	NA	5.23	141%	NA	NA	-	-	-
Pre-Adsil	Capacity (Tons)	4.74	NA	5.10	93%	NA	100%	4.9	NA	5.23	93%	NA	NA	-	-	-
	EER	14.0	NA	14.25	98%	NA	97%	11.8	NA	12.00	98%	NA	NA	99%	-	97%
	Power (kW)	5.85	NA	4.64	126%	NA	100%	6.6	NA	5.23	126%	NA	NA	-	-	-
Post-Adsil	Capacity (Tons)	4.57	NA	4.97	92%	NA	100%	4.8	NA	5.23	92%	NA	NA	-	-	-
	EER	12.9	NA	12.87	100%	NA	99%	12.0	NA	12.00	100%	NA	NA	97%	-	99%

EER

NA

NA

EER Changes								
	Service Assistant	Condenser Test	Spreadsheet					
Pre-Adsil EER	14.0	NA	11.7					
Post Adsil EER	12.9	NA	11.9					
ARI Adjusted								
Pre-Adsil EER	11.8	NA	11.7					
Post Adsil EER	12.0	NA	11.9					
Change	2.0%	NA	1.9%					
Weighted Average	10.2%	NA	9.7%					

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 50TJQ009-6 4598G30510 Package HP 1998 Concord Adr RTU-5	Ì		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	11.3 11.3 8.41 6 6% 10.5 1.14	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	7.2 460 0.74	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 2	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	0.70 460 0.70	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 2	
Evaporator fan data (if a Full load Amps: Nameplate Voltage: Adjust FLA to RLA: Calculated compressor Calculated condensing to Calculated evaporator fa Total calculated load for Assumptions	2.60 460 0.70 Ioad: fan Ioad: an Ioad	Amps Volts	8.5 0.45 0.84 8.93	Power supply: Phase adjustment: Fan quantity: kW kW kW kW - Condensing side only	3-Phase 1.73 1	

Condenser Coil Assessment Overall Unit Condition						
	New					
	Average	1				
	Fair					
	Poor					
Coil Cleanline	SS					
	Coated					
	Clean	0.85				
	Dirty	0.15				
	Clogged					
	Plugged					
Fin Condition						
	Like New	0.1				
	Some Bent	0.05				
	Smashed					
	Dull/rough	0.9				
	Corroded					
	Pitted					
	Flaking					
Fin-Tube Atta	chment					
	Like New	x				
	Corrosion					
	Some Loose					
	Many Loose					
Tubes						
	Clean Cu	x				
	Corrosion					
	Pitting					
	Leaks					

3.7 /6 Ferrormance Degradation	5.7%	Performance Degradation	
--------------------------------	------	-------------------------	--

FLUKE METER MEAS				
Y-measurement	OREMENTO			
Phase	Volts	Amps	kW	PF
1	Volto	7 unpo		
2				
3				
Delta Measurement				
Phase	Volts	٨٣٥٥	kW	PF
1 to 2	495	Amps 13.6	куу 3.1	0.46
2 to 3	495	12.9	6.4	1.00
TOTAL	-93	12.5	0.4	1.00
HVAC Service Assista	nt Measurement			
Input SEER	10	Ī	4 compres	sors 2
RAT	74	F		4 on durring
SAT	54	F		o on during
RAH	50	%	SA test	3
SAH	85	%		
	Circuit 1			
EI	104%			
CI	99%			
Input Cap	3.5	Tons		
OAT	93	F		
Predicted KW	4.00	kW		
	CU Capacity	Estimates		
Ambient	96	F	309	к
CU Exhaust	103		313	
Coil Length	72		515	
Coil Width	36			
Area		sq-ft		
Measured Fan CFM	21168	•		
Air Mass Flow	=	kg/sec		
Capacity	13.33			
Efficiency	16.84	EER		

CU Fan CFM Calculation								
Measurement								
Number	ft/sec							
1	9.4							
2	9.8							
3	10.0							
4	10.0							
5	9.8							
Average	9.8							

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 50TJQ009- 4598G3051 Package HI 1998 Concord Ac RTU-5	10 P		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	11.3 11.3 8.41 6 0% 11.1 1.08	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	7.2 460 0.74	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 2	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	0.7 460 0.7	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 2	
Evaporator fan data (if a Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	pplicable) 2.6 460 0.7	Amps Volts		Power supply: Phase adjustment: Fan quantity:	3-Phase 1.73 1	
Calculated compressor Calculated condensing f Calculated evaporator fa Total calculated load for Assumptions	fan Ioad: an Ioad		8.5 0.45 0.84 8.93	kW kW kW kW - Condensing side only		
Condenser Coil Assess	ment	0.0%	Performa	ance Degradation		

Condenser C Overall Unit C	oil Assessme	nt
	New	х
	Average	
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	1
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

Y-measurement Phase	Volts	Amps	kW	PF
1	VUILS	Amps	KVV	FF
2				
3				
0	1		1	
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	495	13.6	3.1	0.46
2 to 3	495	12.9	6.4	1.00
TOTAL				
HVAC Service Assista	ant Measurement	_		
Input SEER	10		Both circuit	ts on
RAT	74	F	durring bot	h tests
SAT	54	F		
RAH	50	%		
SAH	85	%		
	Circuit 1	T		
El	104%			
CI	96%	T		
Input Cap	3.5	Tons		
OAT	93	F		
Predicted KW	4.00	kW		
	CU Capacity	Estimates		
		-		
Ambient	93	•	307	
CU Exhaust	106	-	314	ĸ
Coil Length		in		
Coil Width		in		
Area		sq-ft		
Measured Fan CFM	23544			
Air Mass Flow		kg/sec		
Capacity		Tons		
Efficiency	34.79			

CU Fan CFM Calculation Measurement Number 1 2 11.5 3 10.7 4 10.7 Average 10.9

Concord Admin RTU-5 Summary

			• anna										
EER at AR	I Conditions			11.3	3 BTU/W-	h	Eq	uipment Age		6 Years			
Condensing	g unit CFM			21168	B CFM (M	easured)							
Capacity at	ARI			8.41	1 tons								
Capacity us	sed for SA			3.50) tons								
Coil Area				36.00) sq-ft								
Predicted E	EER =			10.50) pre	11.08	post						_
		HVAC	Service Ass	sistant				Phys	ical Powe	er and Capac	ity measurn	nents	Ì
Test Date							Cond A	vir, deg F		Cond Air			
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	
13-May	93	62	104%	99%	11.4	9.62	96	103	3.9	9.5	11.99	13.33	-
Post Ads	sil Measurement												-
17-Jun	93	62	104%	96%	11.4	9.62	93	106	7.2	9.5	13.33	27.54	

	Condensing Unit Summary - Ambient Conditions							Condensing Unit Summary - ARI Conditions								
			Test Data		Per	Percent Difference			Test Data			Percent Difference				
ΟΑΤ		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	си	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA		Predicted/ Original
	Power (kW)	9.62	9.5	8.29	116%	115%	102%	10.2	10.1	8.79	116%	115%	101%	-	-	-
Pre-Adsil	Capacity (Tons)	7.46	13.33	7.54	99%	177%	102%	8.2	14.6	8.26	99%	177%	56%	-	-	-
	EER	11.4	16.84	10.92	104%	154%	93%	11.7	17.4	11.28	104%	154%	67%	89%	60%	93%
	Power (kW)	9.62	9.5	8.29	116%	115%	102%	10.2	10.1	8.79	116%	115%	101%	-	-	-
Post-Adsil	Capacity (Tons)	7.24	27.54	7.54	96%	365%	102%	7.9	30.2	8.26	96%	365%	26%	-	-	-
	EER	11.4	34.79	10.92	104%	319%	98%	11.7	36.0	11.28	104%	319%	33%	89%	29%	98%

EER

16.84

34.79

EER Changes							
	Service Assistant	Condenser Test	Spreadsheet				
Pre-Adsil EER	11.4	16.84	10.50				
Post Adsil EER	11.4	34.79	11.08				
ARI Adjusted							
Pre-Adsil EER	11.8	17.45	10.50				
Post Adsil EER	11.8	36.04	11.08				
Change	0.0%	106.6%	5.6%				
Weighted Average	0.0%	373.0%	19.6%				

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 50TJQ012-601 4598G30510 Package HP 1998 Concord Admin RTU-7		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.6 11.8 9.31 6 3% 11.3 1.06	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	8.6 Amps 460 Volts 0.66		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 2	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	0.70 Amps 460 Volts 0.70		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 2	
Evaporator fan data (if a Full load Amps: Nameplate Voltage: Adjust FLA to RLA: Calculated compressor Calculated condensing f Calculated evaporator fa Total calculated load for Assumptions	3.40 Amps 460 Volts 0.70 Ioad: fan Ioad: an Ioad	9.0 0.45 1.09 9.43	Power supply: Phase adjustment: Fan quantity: kW kW kW kW - Condensing side only	3-Phase 1.73 1	

2.7% Performance Degradation

Condenser C Overall Unit C	oil Assessme	nt
	New	
	Average	1
	Fair	
	Poor	
Coil Cleanline	SS	
	Coated	
	Clean	0.8
	Dirty	0.2
	Clogged	
	Plugged	
Fin Condition		
	Like New	1
	Some Bent	0.05
	Smashed	
	Dull/rough	0.25
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Atta	chment	
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEAS Y-measurement				
Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	493	19.4	2.0	0.21
2 to 3	493	18.4	8.9	0.98
TOTAL HVAC Service Assista	nt Measurement			
Input SEER	10		4 compress	
RAT	74		-	4 on durring
SAT	54	F	CU test; tw	o on during
RAH	50	%	SA test	
SAH	85	%		
	Circuit 1		Circuit 2	
El	82%		90%	
CI	85%		89%	
Input Cap	-	Tons	-	Tons
OAT	92		92	
Predicted KW	6.20	kW	6.00	kW
	CU Capacity	Estimates		
Ambient	92	F	306	к
CU Exhaust	112.5	F	318	к
Coil Length	61	in		
Coil Width	43	in		
Area	36.4	sq-ft		
Measured Fan CFM	20929			
Air Mass Flow		kg/sec		
Capacity	38.61			
Efficiency	42.51	EER		

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	10.0
2	9.6
3	9.3
4	9.4
Average	9.6

Manufacturer: Model Number: Serial Number Equipment Type: Year Manufactured: Location Tag	Carrier 50TJQ012- 4598G3051 Package HI 1998 Concord Ac RTU-7	0		Published EER: Calculated EER: Nominal Capacity: Age Coil Conditon Present Condition EER kW/ton	10.6 11.8 9.31 6 0% 11.6 1.03	Btu/W-hr (CU Only) Btu/W-hr (CU Only) tons years (% degraded) Btu/W-hr
Compressor Data Running load Amps: Nameplate Voltage: Power factor:	8.6 460 0.656	Amps Volts		Power supply: Phase adjustment: Compressor quantity:	3-phase 1.73 2	
Condensing Fan Data Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	0.7 460 0.7	Amps Volts		Power supply: Phase adjustment: Fan quantity:	1-Phase 1 2	
Evaporator fan data (if a Full load Amps: Nameplate Voltage: Adjust FLA to RLA:	pplicable) 3.4 460 0.7	Amps Volts		Power supply: Phase adjustment: Fan quantity:	3-Phase 1.73 1	
Calculated compressor I Calculated condensing f Calculated evaporator fa Total calculated load for Assumptions	an load: In load		9.0 0.45 1.09 9.43	kW kW kW kW - Condensing side only		
Condenser Coil Assessr	nent	0.0%	Performa	ance Degradation		

	Coil Assessme	nt
Overall Unit		
	New	X
	Average	
	Fair	
	Poor	
Coil Cleanlin	iess	
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition	n	
	Like New	1
	Some Bent	
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Att	0	
	Like New	х
	Corrosion	
	Some Loose	
	Many Loose	
Tubes	,0000	
	Clean Cu	x
	Corrosion	~
	Pitting	
	Leaks	
	LEAKS	

Phase	Volts	Amps	kW	PF
1				
2				
3				
Delta Measurement				
Phase	Volts	Amps	kW	PF
1 to 2	495	13.6	3.1	0.46
2 to 3	495	12.9	6.4	1.00
TOTAL HVAC Service Assista		T		
Input SEER	10		Both circui	
RAT	74	1.	durring bot	h tests
SAT	54	¥.		
RAH		%		
SAH		%		1
	Circuit 1	ļ	Circuit 2	
EI	92%	+	90%	
CI	92%		89%	
Input Cap		Tons		Tons
OAT	93	+	92	
Predicted KW	6.00	KVV	5.90	KVV
	CU Capacity I	Estimates		
Ambient	93	F	307	к
CU Exhaust	112	F	318	К
Coil Length	61	in		
Coil Width	43	in		
Area	36.4	sq-ft		
Measured Fan CFM	22897			
Air Mass Flow		kg/sec		
Capacity		Tons		
Efficiency	49.45	EEK		

CU Fan CFM	Calculation
Measurement	
Number	ft/sec
1	11.3
2	11.1
3	8.4
4	11.1
Average	10.5

	Concord Admin	RTU-7	Sumary									
EER at AR	I Conditions			11.8	BTU/W-ł	ı	Equ	ipment Age	6	Years		
Condensing	g unit CFM			20929	CFM (Me	easured)						
Capacity at	ARI			9.31	tons							
Capacity us	sed for SA			10.00	tons							
Coil Area				36.43	sq-ft							
Predicted E	ER =			11.32	pre	11.62	post					
		HVAC	C Service As	sistant				Phys	ical Power	and Capaci	ity measurn	nents
Test Date							Cond Ai	r, deg F		Cond Air		
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons
13-May	92	62	86%	87%	9.0	11.36	92	112.5	11.4	10.9	11.85	38.61

17-Jun	93	62	91%	91%	9.4	11.08	93	112	10.6	9.5	12.97	39.15	49.45					
														_				
	Conder	nsing Uni	t Summary -	Ambient Co	onditions	1					Condensi	ing Unit Su	mmary - AR	I Conditions				
			Test Data	1	Pe	rcent Dif	ference	e Test Data Percent Difference										
																Predicted/		
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Original		
	Power (kW)	11.36	10.9	9.85	115%	111%	90%	12.1	11.6	10.51	115%	111%	104%	-	-	-		
Pre-Adsil	Capacity (Tons)	7.50	38.61	8.62	87%	448%	100%	8.1	41.7	9.31	87%	448%	19%	-	-	-		
	EER	9.0	42.51	10.50	86%	405%	106%	9.1	43.0	10.63	86%	405%	21%	124%	26%	106%		
	Power (kW)	11.08	9.5	9.95	111%	95%	90%	11.7	10.0	10.51	111%	95%	117%	-	-	-		
Post-Adsil	Capacity (Tons)	7.77	39.15	8.58	91%	456%	100%	8.4	42.5	9.31	91%	456%	20%	-	-	-		
	EER	9.4	49.45	10.35	91%	478%	109%	9.7	50.8	10.63	91%	478%	19%	117%	22%	109%		

tons

38.61

EER

42.51

	EER Changes													
	Service Assistant	Condenser Test	Spreadsheet											
Pre-Adsil EER	9.0	42.51	11.32											
Post Adsil EER	9.4	49.45	11.62											
ARI Adjusted														
Pre-Adsil EER	10.2	47.97	11.32											
Post Adsil EER	10.8	56.62	11.62											
Change	5.8%	18.0%	2.6%											
Weighted Average	58.1%	180.4%	26.5%											

EPA Adsil Evaluation Concord, NC Admin Building RTU-6

Post Adsil Measurement

Appendix G

Energy Savings Calculations

Appendix G- Energy Savings Calculations

Increase the Life and Performance of Condenser Coils

The outdoor environment can be harsh on heat transfer surfaces. The application of the Adsil corrosion inhibitor will decrease the environmental damage to the condenser coils. As such, the life and performance of the coils is increased. This protection is easily applied to equipment.

Facility: S 1	SEQL Area 50 Units										
ECP Savings:	371.67 0.00 \$- - - - - - - - -	Other Fuels Water kgal Wastewater	Demand kW st Savings em Therms em Cost Savings Therms	461,440 1,574 \$36,915 - - - - - -	Electric Energy MMBtu						
-	\$36,915 \$165,425	Total Annua	I Cost Savings	1,574	Total Annua	I MMBtu S	Savings				
Payback:	4.48	yrs (includir	ng maint savings)	yrs (excludi	ng maint s	avings)					
			Calculations								
Assumptions: This recommendation is applied in the following instances: 1) New equipment 2) Existing equipment with evidence of minor environmental damage 3) Equipment with five years of useful life remaining Use blended utility rate of \$0.08 per kWh The protective corrosion inhibitor is MicroGuard (TM) product from Adsil (TM) Charlotte area has 1644 cooling degree days (CDD) per NOAA Full-load equivalent operating hours = FLEOH= 0.8*CDD Decrease in EER is assumed to be both an increase in power consumption and capacity degradation Savings to heat pumps during the heating season are not included Average EER=9.0 Average EER gain =12.3% 1644 CDD 1,315 FLEOH \$0.000 Demand Cost per kWh											
HVAC System Data Condensing Unit Data f Condensing Unit Consu Calculated EER:		SEQL Area 3393.33 10.1	kW Btu/W-hr	Nomin Present Cor	al Capacity: ndition EER: kW/ton=	2545.0 9.0 1.33	tons Btu/W-hr				
EER after coil applica kW/ton after coil appli Demand Consumption	ication=	10.11 1.19 3021.67									

•	SEQL Area 150 Units						
Current Run-time Ad j Night Setback: FLEOH Conversion:	justment Fa 1.000 0.800	ctors		Excess Cap Weekend So	etback:	1.000 1.000	
Proposed Run-time A	diustment	Factors		Cooling Set	Point:	72.00	Degrees F
Night Setback: FLEOH Conversion:	1.000 0.800			Excess Cap Weekend So Cooling Set	etback:	1.000 1.000 72.00	Degrees F
Run-time Estimates Current condensing un Proposed condensing		1,242 1,242		annually annually			
		kW		kWh			
	Current Proposed Savings	3393.333 3021.668 371.665	-	4,212,989 3,751,548 461,440	-		
			Install	ation Costs			
Nominal capacity: Cost associated to inst	all coating (p	oarts & labo	r):	2,545 \$65	tons per ton (total (vendor quot		cost)
-	Fotal project	cost:	\$165,425				

Appendix H

Spreadsheet EER Degradation

TABLE H-1 SPREADSHEET EER DEGRADATION COMPARED WITH SERVICE ASSISTANT FOR ALL VALID TESTS

287

ABLE THE OF READONEET EER DEC					nit Condition	OTTALE V			oil Cleanlin	ess		Fin Condition						-			
Site Unit	Ag	e Capacity	New	1-9 yrs	10-15 yrs	>15 yrs	Coated	Clean	Dirty	Clogged	Plugged	Like New	Some Ben	Smashed	Dull/rough	Corroded	Pitted	Flaking	Overall Grade	Service a	ssistant
Concord Admin RTU-7	6	9 .		1				0.8	0.2			1	0.05		0.25				7.00%	6%	0.541308
Concord City Hall RTU-2	5	5		1			0.7	0.3				0.5			0.5				7.50%	6%	32.0%
RTU-3	5	5		1				0.8	0.2				0.1		1				9.00%	5%	26.4%
SS-1	2	5		1				0.75	0.25				0.1		0.75				9.25%	7%	40.0%
SS-2	5	6		1			0.9		0.1			0.95	0.05		0.05				9.60%	6%	31.7%
SS-4	11	2			1		1	0.95	0.05			0.8	0.05		0.2				10.65%	1%	2.5%
		3																			0.0%
Iredell Health Center RTU-1	12	3			1			0.8	0.2				0.25	0.25	1				15.25%	5%	14.5%
RTU-13	12	5			1			1					0.15		1				7.50%	6%	33.1%
RTU-14	12	3			1			0.9	0.1					0.25	1				11.3%	2%	5.8%
RTU-3	7	3						0.9	0.1				0.1	0.3	1				9.00%	5%	16.1%
Locust City Hall SS-2	7	7		1			1		0.1				0.05						10.0%	4%	31.5%
Monroe Aquatic Center RTU-1	7	7		1				1					0.1						4.00%	5%	39.4%
RTU-2	7	12		1				1					0.1						4.00%	15%	182.2%
RTU-9	7	8		1					0.3	0.7		0.9			0.1				21.70%	11%	83.0%
RTU-10	7	21		1				1				0.9	0.1						4.00%	28%	584.8%
RTU-13	2	7		1				0.7	0.3			0.5	0.1		0.5				9.50%	4%	28.3%
RTU-15	2	5		1				1					0.02						3.20%	6%	29.3%
RTU-16	4	4		1				1					0.02						3.20%	35%	138.7%
YTC Bld D RTU-1	12	24			1				1	-			0.8	0.2				_	30.00%	1%	24.0%
YTC- Hood Center		29												-				_			0.0%
RTU-6	13	24			1				0.5	0.4	0.1		0.05	-	0.75			_	24.00%	38%	922.9%
RTU-7	13	18			1				0.5	0.5		1			0.75			-	23.00%	7%	122.7%
RTU-8	12	23		1	1				0.25	0.75					1			_	24.75%	13%	291.2%
RTU-9	4	3		1	4			0.9	0.1			0.9	0.1		0.5			-	6.50%	10%	27.1%
HP-1	12	5			1		1					1						_	9.00%	17%	81.4%
YTC - Library Unit 1	13	17			1			0.9	0.1				0.4	0.1	0.5				12.00%	11%	185.2%
YTC Student Center RTU-25	13	5			1			1					0.5	0.05					9.00%	7%	34.1%
YTC Student Services HP-1	13	1			1			1	0.05				1	0.25	0.75				17.75%	20%	146.4%
YTC Truck School SS-1	15	9			1		1	0.75	0.25				0.1		0.75				10.25%	9%	84.4%

Average

11.49% 10.31% 11.5%



					Overall Unit Condition				C	oil Cleanlin	ess	Fin Condition							
Site	Unit	Capacity	Age	New	1-9 yrs	10-15 yrs	>15 yrs	Coated	Clean	Dirty	Clogged	Plugged	Like New	Some Ben	Smashed	Dull/rough	Overall Grade	Service ass	sistant
Concord Admin	RTU-7	9	6		1				0.8	0.2			1	0.05		0.25	7.00%	5.8%	54%
	RTU-2	5	5		1			0.7	0.3				0.5			0.5	7.50%	6.1%	32%
	RTU-3	5	5		1				0.8	0.2				0.1		1	9.00%	5.1%	26%
	SS-1	5	2		1				0.75	0.25				0.1		0.75	9.25%	7.3%	40%
	SS-2	6	5		1			0.9		0.1			0.95	0.05		0.05	9.60%	5.6%	32%
											-							-	
Locust City Hall	SS-2	3	7		1			1		0.1				0.05			10.0%	5.4%	16%
	RTU-1	7	7		1				1					0.1			4.00%	4.2%	32%
	RTU-2	7	7		1				1					0.1			4.00%	5.3%	39%
	RTU-9	12	7		1					0.3	0.7		0.9			0.1	21.70%	15.3%	182%
	RTU-10	8	7		1				1				0.9	0.1			4.00%	10.9%	83%
	RTU-13	21	7		1				0.7	0.3			0.5	0.1		0.5	9.50%	28.2%	585%
YTC Bld D	RTU-1	4	4		1					1				0.8	0.2		29.00%	34.7%	139%
YTC Truck School	SS-1	9	15				1		0.75	0.25				0.1		0.75	11.25%	9.2%	84%
Average		102															10.45%	11.00%	13.14%

TABLE H-2 SPREADSHEET EER DEGRADATION COMPARED WITH SERVICE ASSISTANT FOR ALL LITERATURE VALID TESTS


Appendix I

Statistical Model

IMPORT successfully completed.

Kolmogorov-Smirnov One Sample Test using Normal(0.00,1.00) distribution

Variable N-of-Cases MaxDif Lilliefors Probability (2-tail)

EERCHANGE 42.000 0.160 0.009 IMPORT successfully completed.

42 cases and 2 variables processed and saved. SYSTAT Rectangular file P:\EAT\TUCKER\small projects\lowrey\EER Change\allsaprepost.SYD, created Fri Sep 03, 2004 at 10:05:18, contains variables:

PREADSILEE POSTADSILE

SYSTAT Rectangular file P:\EAT\TUCKER\small projects\lowrey\EER Change\allsaprepost.SYD, created Fri Sep 03, 2004 at 10:05:18, contains variables:

PREADSILEE POSTADSILE

Wilcoxon Signed Ranks Test Results

Counts of differences (row variable greater than column)

	PREADSILEE	POSTADSILE
PREADSILEE	0	6
POSTADSILE	35	0

Z = (Sum of signed ranks)/square root(sum of squared ranks)

	PREADSILEE		POSTADSILE	
PREADSILEE	000	0.		
POSTADSILE	503	4.	000	0.

Two-sided probabilities using normal approximation

	PREADSILEE		POSTADSILE	
PREADSILEE	000	1.		_
POSTADSILE	000	0.	000	1.

Post Adsil EER significantly greater than Pre for Service Assistant results.

0.000

	EERCHANGE
N of cases	42
Minimum	- 0.079
Maximum	0.380
Median	0.060
Mean	0.080
95% CI Upper	0.111
95% CI Lower	0.049
Std. Error	0.015
Standard Dev	0.099

IMPORT successfully completed. All condensing data

Kolmogorov-Smirnov One Sample Test using Normal(0.00,1.00) distribution

Variable N-of-Cases MaxDif Lilliefors Probability (2-tail) EERIMPROVEM 29.000 0.150 0.096 Data are normal. Use t test. One-sample t test of EERIMPROVEM with 29 cases; Ho: Mean =



	EERIMPROVEM
N of cases	29
Minimum	- 0.239
Maximum	1.52 3
Median	0.23 0
Mean	0.36 6
95% CI Upper	0.55 8
95% CI Lower	0.17 3
Std. Error	0.09 4
Standard Dev	0.50 5

IMPORT successfully completed. All Spreadsheet results. IMPORT successfully completed.

Kolmogorov-Smirnov One Sample Test using Normal(0.00,1.00) distribution

Variable N-of-Cases MaxDif Lilliefors Probability (2-tail)

EERCHANGE 42.000 0.141 0.034 **% Change results not normal. Use nonparametric test.** IMPORT successfully completed. EXPORT successfully completed.

Appendix I Statistical Model Page 3 of 10 Wilcoxon Signed Ranks Test Results

Counts of differences (row variable greater than column)

	PREADSILEE	POSTADSILE
PREADSILEE	0	0
POSTADSILE	41	0

Z = (Sum of signed ranks)/square root(sum of squared ranks)

	PREADSILEE		POSTADSILE	
PREADSILEE	000	0.		
POSTADSILE	000	5.		0.
I COTADOILL	579		000	

Two-sided probabilities using normal approximation

	PREADSILEE		POSTADSILE	
PREADSILEE	000	1.		
POSTADSILE	000	0.	000	1.

Post Adsil EER significantly greater than Pre.

IMPORT successfully completed.

	EERCHANGE
N of cases	42
Minimum	0.000
Maximum	0.176
Median	0.051
Mean	0.058
95% CI Upper	0.072
95% CI Lower	0.044
Std. Error	0.007
Standard Dev	0.044

Use valid data only. All temperatures. Service Assistant results. IMPORT successfully completed.

Kolmogorov-Smirnov One Sample Test using Normal(0.00,1.00) distribution

Variable N-of-Cases MaxDif Lilliefors Probability (2-tail)

EERCHANGE 30.000 0.215 0.001 Data are not normal. Use nonparametric test. IMPORT successfully completed. IMPORT successfully completed.

Wilcoxon Signed Ranks Test Results

Appendix I Statistical Model Page 4 of 10 Counts of differences (row variable greater than column)

	PREADSILEE	POSTADSILE
PREADSILEE	0	2
POSTADSILE	28	0

Z = (Sum of signed ranks)/square root(sum of squared ranks)

	PREADSILEE		POSTADSILE	
PREADSILEE	000	0.		
POSTADSILE		4.		0.
	391		000	

Two-sided probabilities using normal approximation

4		
1. 000		
0. 000	000	1.
	0. 000	0.

Post Adsil EER significantly greater than Pre.

IMPORT successfully completed.

	EERCHANGE
N of cases	30
Minimum	- 0.079
Maximum	0.380
Median	0.063
Mean	0.093
95% CI Upper	0.130
95% CI Lower	0.056
Std. Error	0.018
Standard Dev	0.099

Valid tests, all temperatures, condensing results. IMPORT successfully completed.

Kolmogorov-Smirnov One Sample Test using Normal(0.00,1.00) distribution

Variable N-of-Cases MaxDif Lilliefors Probability (2-tail)

EERCHANGE 20.000 0.098 1.000 Data are normal. Use t test.

One-sample t test of EERCHANGE with 20 cases; Ho: Mean = 0.000

Mean =	0.326	9	5.00	% CI =	0.140 to	0.512
SD =	0.397			t =	3.670	
		df =	19	Prob =	0.002	

Appendix I Statistical Model Page 5 of 10



	EERCHANGE
N of cases	20
Minimum	- 0.239
Maximum	1.132
Median	0.263
Mean	0.326
95% CI Upper	0.512
95% CI Lower	0.140
Std. Error	0.089
Standard Dev	0.397

Valid tests, all temperatures, Spreadsheet results. IMPORT successfully completed.

Kolmogorov-Smirnov One Sample Test using Normal(0.00,1.00) distribution

Variable N-of-Cases MaxDif Lilliefors Probability (2-tail)

EERCHANGE 30.000 0.165 0.036 Results not normally distributed. Use nonparametric test. IMPORT successfully completed.

Appendix I Statistical Model Page 6 of 10 IMPORT successfully completed.

Wilcoxon Signed Ranks Test Results

Counts of differences (row variable greater than column)

	PREADSILEE	POSTADSILE
PREADSILEE	0	0
POSTADSILE	29	0

Z = (Sum of signed ranks)/square root(sum of squared ranks)

	PREADSILEE		POSTADSILE	
PREADSILEE	000	0.		
POSTADSILE	703	4.	000	0.

Two-sided probabilities using normal approximation

	PREADSILEE		POSTADSILE	
PREADSILEE	000	1.		
POSTADSILE	000	0.	000	1.

Post Adsil EER significantly greater than Pre.

IMPORT successfully completed.

	EERCHANGE
N of cases	30
Minimum	0.000
Maximum	0.176
Median	0.057
Mean	0.061
95% CI Upper	0.078
95% CI Lower	0.043
Std. Error	0.009
Standard Dev	0.047

Valid results, temperatures previously tested in the literature. Service Assistant results. IMPORT successfully completed.

Kolmogorov-Smirnov One Sample Test using Normal(0.00,1.00) distribution

Variable N-of-Cases MaxDif Lilliefors Probability (2-tail)

EERCHANGE 15.000 0.235 0.026 Data are not normal. Use nonparametric test. IMPORT successfully completed. IMPORT successfully completed.

Wilcoxon Signed Ranks Test Results

Appendix I Statistical Model Page 7 of 10 Counts of differences (row variable greater than column)

	PREADSILEE	POSTADSILE
PREADSILEE	0	1
POSTADSILE	14	0

Z = (Sum of signed ranks)/square root(sum of squared ranks)

	PREADSILEE		POSTADSILE	
PREADSILEE	000	0.		
POSTADSILE	953	2.	000	0.

Two-sided probabilities using normal approximation

	PREADSILEE		POSTADSILE	
PREADSILEE	000	1.		
POSTADSILE	003	0.	000	1.

Post Adsil EER significantly greater than pre.

IMPORT successfully completed.

	EERCHANGE
N of cases	15
Minimum	- 0.079
Maximum	0.347
Median	0.058
Mean	0.091
95% CI Upper	0.148
95% CI Lower	0.033
Std. Error	0.027
Standard Dev	0.104

Valid results at temperatures previously tested in the literature. Condensing tests. IMPORT successfully completed.

Kolmogorov-Smirnov One Sample Test using Normal(0.00,1.00) distribution

Variable N-of-Cases MaxDif Lilliefors Probability (2-tail)

EERCHANGE 10.000 0.126 1.000 % change data are normal. Use t test.

One-sample t test of EERCHANGE with 10 cases; Ho: Mean = 0.000

Mean =	0.356	9	5.00	% CI =	0.143 to	0.568
SD =	0.297			t =	3.788	
		df =	9	Prob =	0.004	

Appendix I Statistical Model Page 8 of 10



Post Adsil improvement is statistically significant.

	EERCHANGE
N of cases	10
Minimum	- 0.073
Maximum	0.830
Median	0.327
Mean	0.356
95% CI Upper	0.568
95% CI Lower	0.143
Std. Error	0.094
Standard Dev	0.297

Valid results, temperatures previously tested in the literature. Spreadsheet results. IMPORT successfully completed.

Kolmogorov-Smirnov One Sample Test using Normal(0.00,1.00) distribution

Variable N-of-Cases MaxDif Lilliefors Probability (2-tail)

EERCHANGE 15.000 0.254 0.010 Data not normal. Use nonparametric test. IMPORT successfully completed.

Appendix I Statistical Model Page 9 of 10 Wilcoxon Signed Ranks Test Results

Counts of differences (row variable greater than column)

	PREADSILEE	POSTADSILE
PREADSILEE	0	0
POSTADSILE	15	0

Z = (Sum of signed ranks)/square root(sum of squared ranks)

	PREADSILEE		POSTADSILE	
PREADSILEE	000	0.		
POSTADSILE	408	3.	000	0.

Two-sided probabilities using normal approximation

	PREADSILEE		POSTADSILE	
PREADSILEE	000	1.		
POSTADSILE	001	0.	000	1.

Post Adsil EER significantly greater than pre.

IMPORT successfully completed.

	EERCHANGE
N of cases	15
Minimum	0.007
Maximum	0.176
Median	0.056
Mean	0.060
95% CI Upper	0.089
95% CI Lower	0.031
Std. Error	0.013
Standard Dev	0.052

IMPORT successfully completed.

Kolmogorov-Smirnov One Sample Test using Normal(0.00,1.00) distribution

Variable N-of-Cases MaxDif Lilliefors Probability (2-tail)

EERCHANGE 42.000 0.160 0.009 IMPORT successfully completed.

42 cases and 2 variables processed and saved. SYSTAT Rectangular file P:\EAT\TUCKER\small projects\lowrey\EER Change\allsaprepost.SYD, created Fri Sep 03, 2004 at 10:05:18, contains variables:

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PREADSILEE POSTADSILE

Wilcoxon Signed Ranks Test Results

Counts of differences (row variable greater than column)

	PREADSILEE	POSTADSILE
PREADSILEE	0	6
POSTADSILE	35	0

Z = (Sum of signed ranks)/square root(sum of squared ranks)

	PREADSILEE		POSTADSILE	
PREADSILEE	000	0.		
POSTADSILE	503	4.	000	0.

Two-sided probabilities using normal approximation

	PREADSILEE		POSTADSILE	
PREADSILEE	000	1.		_
POSTADSILE	000	0.	000	1.

Post Adsil EER significantly greater than Pre for Service Assistant results.

0.000

	EERCHANGE
N of cases	42
Minimum	- 0.079
Maximum	0.380
Median	0.060
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95% CI Lower	0.049
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	EERIMPROVEM
N of cases	29
Minimum	- 0.239
Maximum	1.52 3
Median	0.23 0
Mean	0.36 6
95% CI Upper	0.55 8
95% CI Lower	0.17 3
Std. Error	0.09 4
Standard Dev	0.50 5

IMPORT successfully completed. All Spreadsheet results. IMPORT successfully completed.

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Variable N-of-Cases MaxDif Lilliefors Probability (2-tail)

EERCHANGE 42.000 0.141 0.034 **% Change results not normal. Use nonparametric test.** IMPORT successfully completed. EXPORT successfully completed.

Appendix I Statistical Model Page 3 of 10 Wilcoxon Signed Ranks Test Results

Counts of differences (row variable greater than column)

	PREADSILEE	POSTADSILE
PREADSILEE	0	0
POSTADSILE	41	0

Z = (Sum of signed ranks)/square root(sum of squared ranks)

	PREADSILEE		POSTADSILE	
PREADSILEE	000	0.		
POSTADSILE	000	5.		0.
I COTADOILL	579		000	

Two-sided probabilities using normal approximation

	PREADSILEE		POSTADSILE	
PREADSILEE	000	1.		
POSTADSILE	000	0.	000	1.

Post Adsil EER significantly greater than Pre.

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	EERCHANGE
N of cases	42
Minimum	0.000
Maximum	0.176
Median	0.051
Mean	0.058
95% CI Upper	0.072
95% CI Lower	0.044
Std. Error	0.007
Standard Dev	0.044

Use valid data only. All temperatures. Service Assistant results. IMPORT successfully completed.

Kolmogorov-Smirnov One Sample Test using Normal(0.00,1.00) distribution

Variable N-of-Cases MaxDif Lilliefors Probability (2-tail)

EERCHANGE 30.000 0.215 0.001 Data are not normal. Use nonparametric test. IMPORT successfully completed. IMPORT successfully completed.

Wilcoxon Signed Ranks Test Results

Appendix I Statistical Model Page 4 of 10 Counts of differences (row variable greater than column)

	PREADSILEE	POSTADSILE
PREADSILEE	0	2
POSTADSILE	28	0

Z = (Sum of signed ranks)/square root(sum of squared ranks)

	PREADSILEE		POSTADSILE	
PREADSILEE	000	0.		
POSTADSILE		4.		0.
	391		000	

Two-sided probabilities using normal approximation

4		
1. 000		
0. 000	000	1.
	0. 000	0.

Post Adsil EER significantly greater than Pre.

IMPORT successfully completed.

	EERCHANGE
N of cases	30
Minimum	- 0.079
Maximum	0.380
Median	0.063
Mean	0.093
95% CI Upper	0.130
95% CI Lower	0.056
Std. Error	0.018
Standard Dev	0.099

Valid tests, all temperatures, condensing results. IMPORT successfully completed.

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Variable N-of-Cases MaxDif Lilliefors Probability (2-tail)

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One-sample t test of EERCHANGE with 20 cases; Ho: Mean = 0.000

Mean =	0.326	9	5.00	% CI =	0.140 to	0.512
SD =	0.397			t =	3.670	
		df =	19	Prob =	0.002	

Appendix I Statistical Model Page 5 of 10



	EERCHANGE
N of cases	20
Minimum	- 0.239
Maximum	1.132
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Mean	0.326
95% CI Upper	0.512
95% CI Lower	0.140
Std. Error	0.089
Standard Dev	0.397

Valid tests, all temperatures, Spreadsheet results. IMPORT successfully completed.

Kolmogorov-Smirnov One Sample Test using Normal(0.00,1.00) distribution

Variable N-of-Cases MaxDif Lilliefors Probability (2-tail)

EERCHANGE 30.000 0.165 0.036 Results not normally distributed. Use nonparametric test. IMPORT successfully completed.

Appendix I Statistical Model Page 6 of 10 IMPORT successfully completed.

Wilcoxon Signed Ranks Test Results

Counts of differences (row variable greater than column)

	PREADSILEE	POSTADSILE
PREADSILEE	0	0
POSTADSILE	29	0

Z = (Sum of signed ranks)/square root(sum of squared ranks)

	PREADSILEE		POSTADSILE	
PREADSILEE	000	0.		
POSTADSILE	703	4.	000	0.

Two-sided probabilities using normal approximation

	PREADSILEE		POSTADSILE	
PREADSILEE	000	1.		
POSTADSILE	000	0.	000	1.

Post Adsil EER significantly greater than Pre.

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	EERCHANGE
N of cases	30
Minimum	0.000
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Median	0.057
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95% CI Lower	0.043
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Standard Dev	0.047

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Kolmogorov-Smirnov One Sample Test using Normal(0.00,1.00) distribution

Variable N-of-Cases MaxDif Lilliefors Probability (2-tail)

EERCHANGE 15.000 0.235 0.026 Data are not normal. Use nonparametric test. IMPORT successfully completed. IMPORT successfully completed.

Wilcoxon Signed Ranks Test Results

Appendix I Statistical Model Page 7 of 10 Counts of differences (row variable greater than column)

	PREADSILEE	POSTADSILE
PREADSILEE	0	1
POSTADSILE	14	0

Z = (Sum of signed ranks)/square root(sum of squared ranks)

	PREADSILEE		POSTADSILE	
PREADSILEE	000	0.		_
POSTADSILE	953	2.	000	0.

Two-sided probabilities using normal approximation

	PREADSILEE		POSTADSILE	
PREADSILEE	000	1.		
POSTADSILE	003	0.	000	1.

Post Adsil EER significantly greater than pre.

IMPORT successfully completed.

	EERCHANGE
N of cases	15
Minimum	- 0.079
Maximum	0.347
Median	0.058
Mean	0.091
95% CI Upper	0.148
95% CI Lower	0.033
Std. Error	0.027
Standard Dev	0.104

Valid results at temperatures previously tested in the literature. Condensing tests. IMPORT successfully completed.

Kolmogorov-Smirnov One Sample Test using Normal(0.00,1.00) distribution

Variable N-of-Cases MaxDif Lilliefors Probability (2-tail)

EERCHANGE 10.000 0.126 1.000 % change data are normal. Use t test.

One-sample t test of EERCHANGE with 10 cases; Ho: Mean = 0.000

Mean =	0.356	9	5.00	% CI =	0.143 to	0.568
SD =	0.297			t =	3.788	
		df =	9	Prob =	0.004	

Appendix I Statistical Model Page 8 of 10



Post Adsil improvement is statistically significant.

	EERCHANGE
N of cases	10
Minimum	- 0.073
Maximum	0.830
Median	0.327
Mean	0.356
95% CI Upper	0.568
95% CI Lower	0.143
Std. Error	0.094
Standard Dev	0.297

Valid results, temperatures previously tested in the literature. Spreadsheet results. IMPORT successfully completed.

Kolmogorov-Smirnov One Sample Test using Normal(0.00,1.00) distribution

Variable N-of-Cases MaxDif Lilliefors Probability (2-tail)

EERCHANGE 15.000 0.254 0.010 Data not normal. Use nonparametric test. IMPORT successfully completed.

Appendix I Statistical Model Page 9 of 10 Wilcoxon Signed Ranks Test Results

Counts of differences (row variable greater than column)

	PREADSILEE	POSTADSILE
PREADSILEE	0	0
POSTADSILE	15	0

Z = (Sum of signed ranks)/square root(sum of squared ranks)

	PREADSILEE		POSTADSILE	
PREADSILEE	000	0.		
POSTADSILE	408	3.	000	0.

Two-sided probabilities using normal approximation

	PREADSILEE		POSTADSILE	
PREADSILEE	000	1.		
POSTADSILE	001	0.	000	1.

Post Adsil EER significantly greater than pre.

IMPORT successfully completed.

	EERCHANGE
N of cases	15
Minimum	0.007
Maximum	0.176
Median	0.056
Mean	0.060
95% CI Upper	0.089
95% CI Lower	0.031
Std. Error	0.013
Standard Dev	0.052

TECHNICAL REPORT DA	TA			
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4. TITLE AND SUBTITLE Evaluation of Savings from the Application of Adsil in the NC/SC Charlotte Area			5. REPORT DATE Nov. 5, 2004	
			6. PERFORMING ORGANIZ	ATION CODE
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 16. ABSTRACT This report contains the results of a Adsil. It was conducted as part of a improvement project in the 15-courapplied to air conditioner units, it c related efficiency loss, saving elect Adsil is beneficial and transferable and could under certain circumstan 1) A degradation prediction tool (sp predicting the EER degradation of 2) An energy savings projection too operators to estimate their energy s of Adsil to air-cooled HVAC equip 	the SEQL Project (Sustain nty NC/SC region surround an bring the efficiency of t rical power and early repla to other communities. Ene ces benefit air quality. Th preadsheet-based) calibrate a population of HVAC uni ol created based on the rest avings, dollar savings, and	able Environment for C ding Charlotte, NC. Pr that unit virtually back acement costs. The abi ergy savings reduce cost e report includes two to ed against actual EER n its in the SEQL area. ults of this study. This	Quality of Life), an integra revious studies have show to that of a new unit, as ility to model expected en- sts, limit the need for new ools: measurements and found tool can be adapted by fa	rated environmental vn that, when Adsil is well as prevent age- nergy savings with v generating capacity, to be very accurate in acility owners and
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