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

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Table of Contents

List of Appendices

Table of Contents (continued)

List of Tables

List of Figures

Table of Contents (continued)

List of Figures (continued)

Table of Contents (continued)

List of Figures (continued)

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, www.seql.org) 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 refrigerant-based 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.

SEQL Region

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.

<u>Project Objectives</u>

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:

<u>Task 1: Baseline Testing</u>
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.

<u>Task 2: Test Procedure Comparison with Traditional Data Logger Analysis</u>
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.

<u>Task 3: Measure the Change in EER of HVAC Units in the SEQL Area</u>
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.

<u>Task 4: Develop a Tool for Prediction of HVAC Degradation</u>
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.

<u>Task 5: Utility Bill Verification of Savings</u>
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 post-treatment. 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.

FIGURE 3-1
Pre-Adsil HVAC Spreadsheet

Manufacturer:	Carrier	**Published EER:**	11.3	Btu/W-hr (CU Only)
Model Number:	50TJQ009-601	**Calculated EER:**	11.3	Btu/W-hr (CU Only)
Serial Number	4598G30510	**Nominal Capacity:**	8.41	tons
Equipment Type:	Package HP	**Age**	6	years
Year Manufactured:	1998	**Coil Conditon**	6%	(% degraded)
Location	Concord Admin	**Present Condition EER**	10.5	Btu/W-hr
Tag	RTU-5	**kW/ton**	1.14	

Compressor Data

Running load Amps:	7.2	Amps	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:	0.70	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:	2.60	Amps	Power supply:	3-Phase
Nameplate Voltage:	460	Volts	Phase adjustment:	1.73
Adjust FLA to RLA:	0.70		Fan quantity:	1

Calculated compressor load:	**8.5**	kW
Calculated condensing fan load:	**0.45**	kW
Calculated evaporator fan load	**0.84**	kW
Total calculated load for equipment:	**8.93**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **5.7%** **Performance Degradation**

Overall Unit Condition		
	New	
	Average	**1**
	Fair	
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	**x**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

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

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 addition to these variables the instruments used are accurate to within a small error band with 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.

Figure 4-1 Unit 1 Baseline Study
HVAC Data Sheet and 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	(CU Only)
Serial Number		**Nominal Capacity:**	4.96	tons	
Equipment Type:	Split system	**Age**	**13**	years	
Year Manufactured:	1991	**Coil Conditon**	**18%**	(% degraded)	
Location	Gainesville	**Present Condition EER**	**7.4**	Btu/W-hr	
Tag	Toms Home unit	**kW/ton**	**1.62**		

Compressor Data				
Running load Amps:	30.8	Amps	Power supply:	1-Phase
Nameplate Voltage:	208	Volts	Phase adjustment:	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
Evaporator fan 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 **18.2%** **Performance Degradation**

Overall Unit Condition		
	New	
	Average	x
	Fair	
	Poor	
Coil Cleanliness		
	Coated	**1**
	Clean	**0.3**
	Dirty	**0.2**
	Clogged	**0.3**
	Plugged	**0.2**
Fin Condition		
	Like New	
	Some Bent	**0.05**
	Smashed	**0**
	Dull/rough	**0.95**
	Corroded	**0**
	Pitted	**0**
	Flaking	**0**
Fin-Tube Attachment		
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

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

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

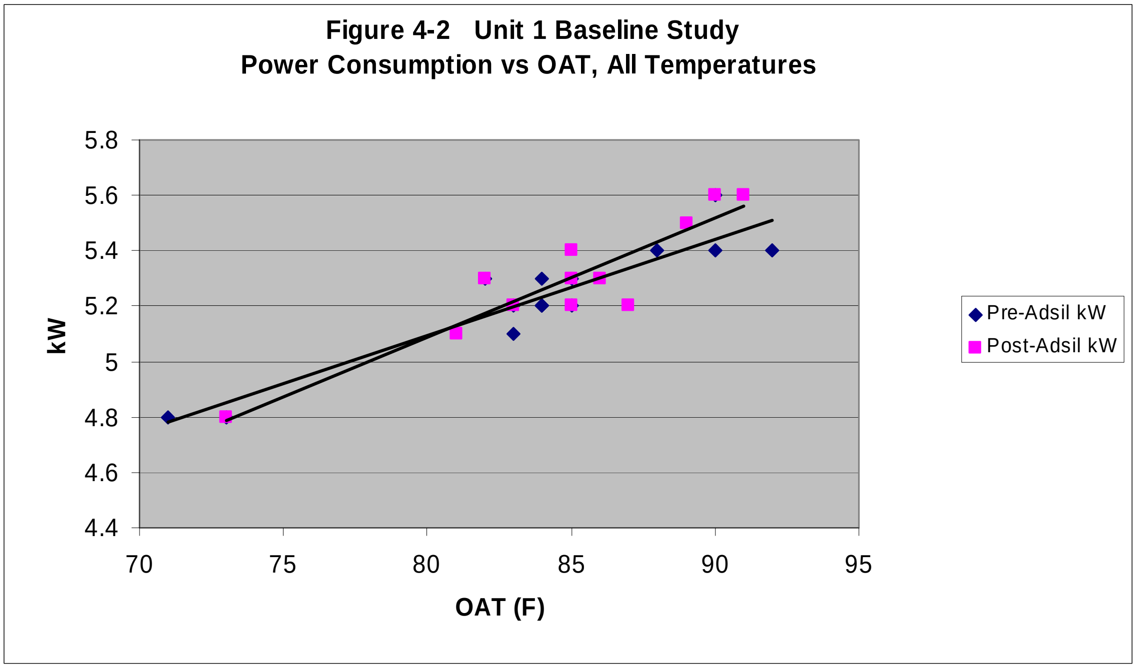
The protocol for this procedure is described in Section 3.2 of this report. Per this procedure, the power consumption was observed to increase as temperature increased, as shown in Figure 4-2 and Figure 4-3. It may also be seen in these two figures that the slope of the curve post-Adsil treatment is 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.

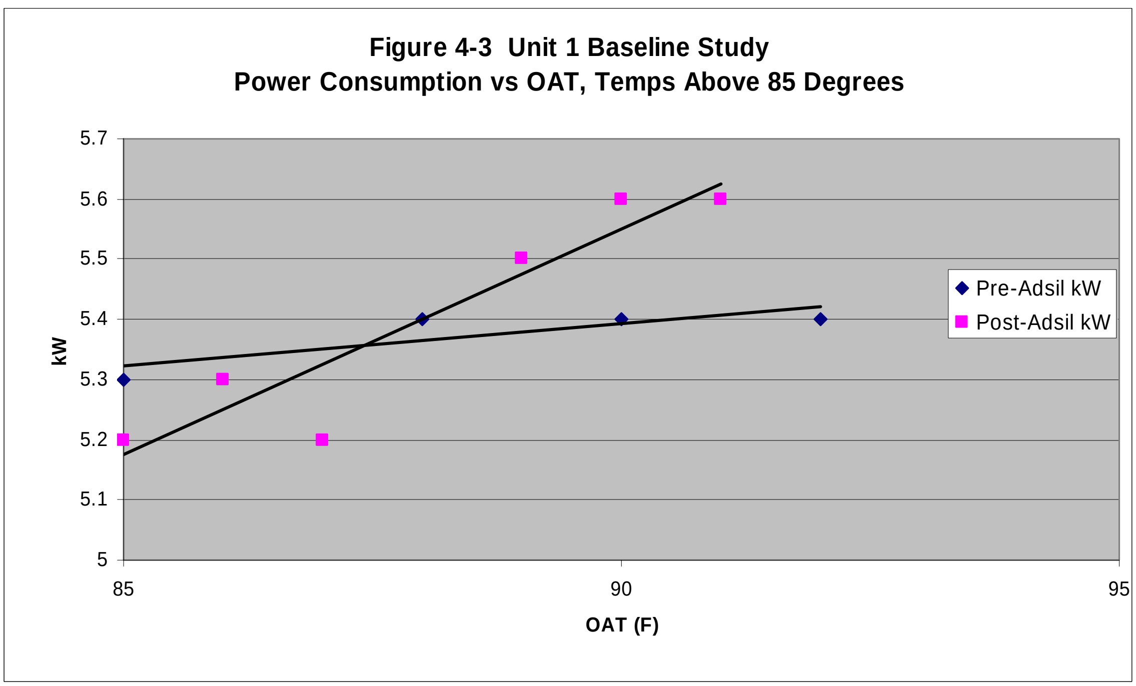
The average EER gain using this methodology was determined to be in excess of 70% as shown in Table 4-1 for all temperatures and 49% for tests conducted at 85 degrees and higher. However, the high variation of the flow rates pre-treatment may invalidate the results of this protocol for this unit. Figure 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_



Source: MACTEC, 2004.
Prepared by: _TBL_
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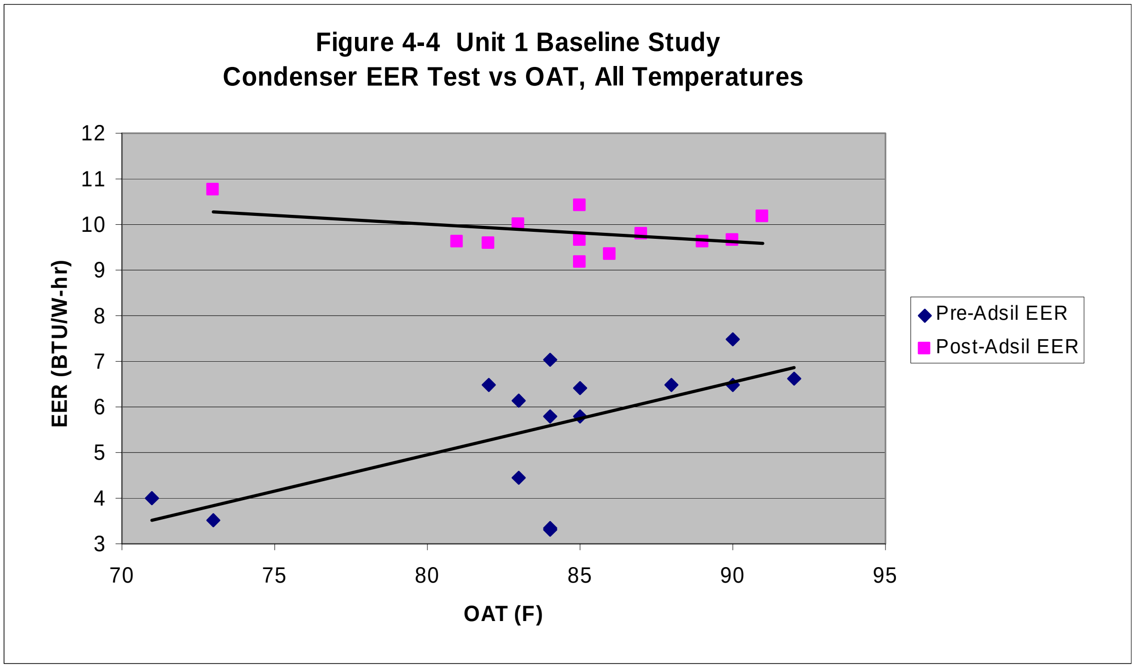

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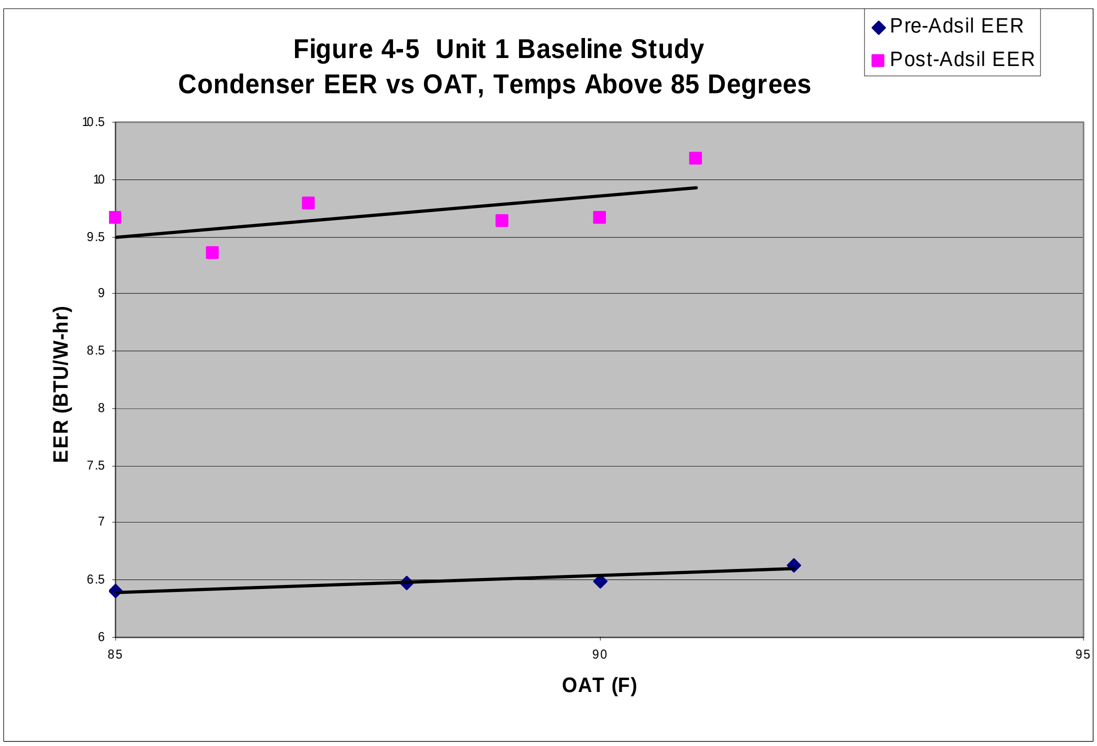


Source: MACTEC, 2004.
Prepared by: _TBL_
Checked by: _CDM_

TABLE 4-1
Unit 1 Baseline Study
Generic Compressor Test Summary-All Temperatures

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	

Test Date	HVAC Service Assistant						Physical Power and Capacity Measurements							
							Cond Air, deg F		Cond Air					
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER	cfm adj
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
		AVERAGES	**86.8%**	**84.6%**					**12.55**		**1.75**		**14.42**	**0.38**
POST ADSIL	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER	cfm adj
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
		AVERAGES	**90.7%**	**89.0%**					**13.38**		**2.97**		**25.83**	**0.38**
		Change	**4.4%**	**5.1%**					**6.6%**		**70.1%**		**79.1%**	**0.0%**

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

TABLE 4-2
Unit 1 Baseline Study
Generic Compressor Test Summary at Ambient 85 Degrees or Higher
(Maximum of 1 Test per Temperature)

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	

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments							
							Cond Air, deg F		Cond Air					
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER	cfm adj
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
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**	
POST ADSIL	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER	cfm adj
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
		AVERAGES	**92.7%**	**91.7%**					**13.43**		**3.00**		**25.56**	
		Change	**5.0%**	**3.6%**					**12.4%**		**33.1%**		**49.4%**	

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

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.

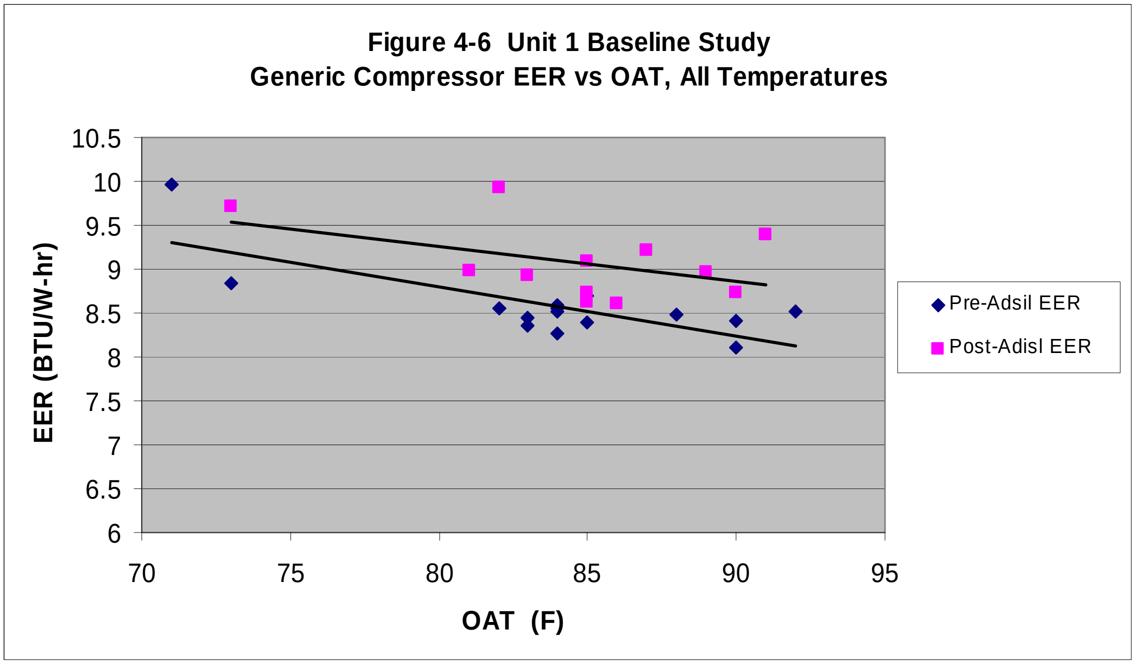
Service Assistant Test Description for Copeland Compressor Model

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.

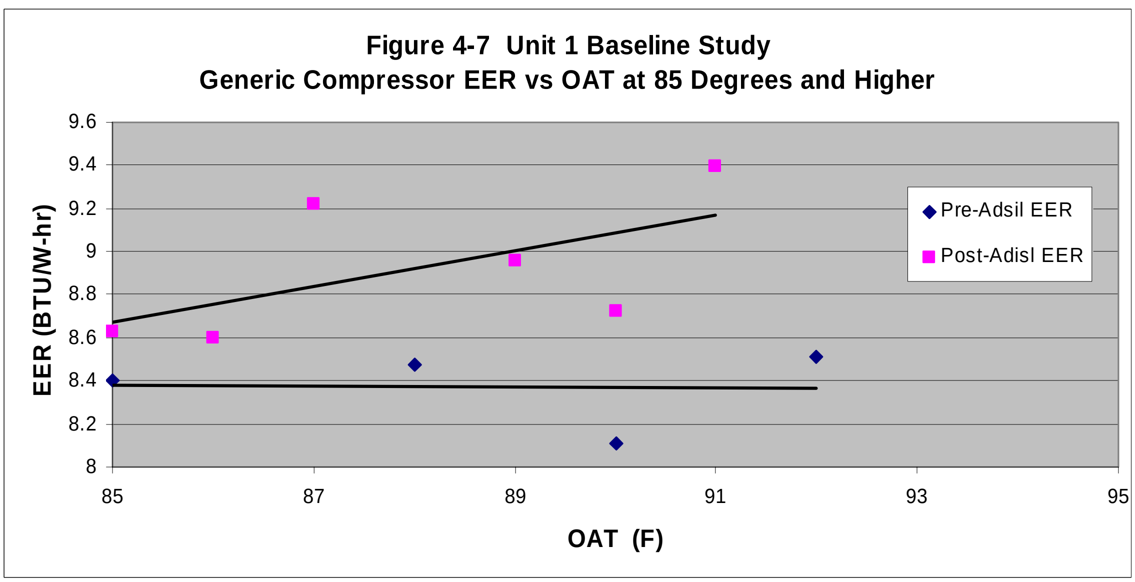
Figure 4-8 shows the EER improvement associated with the Adsil process as measured with the Service Assistant Copeland compressor over the temperature range from 73 to 92 degrees F. The average EER improvement measured with this process is 6.1% and the average capacity increase is seen to be 6.0% in 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

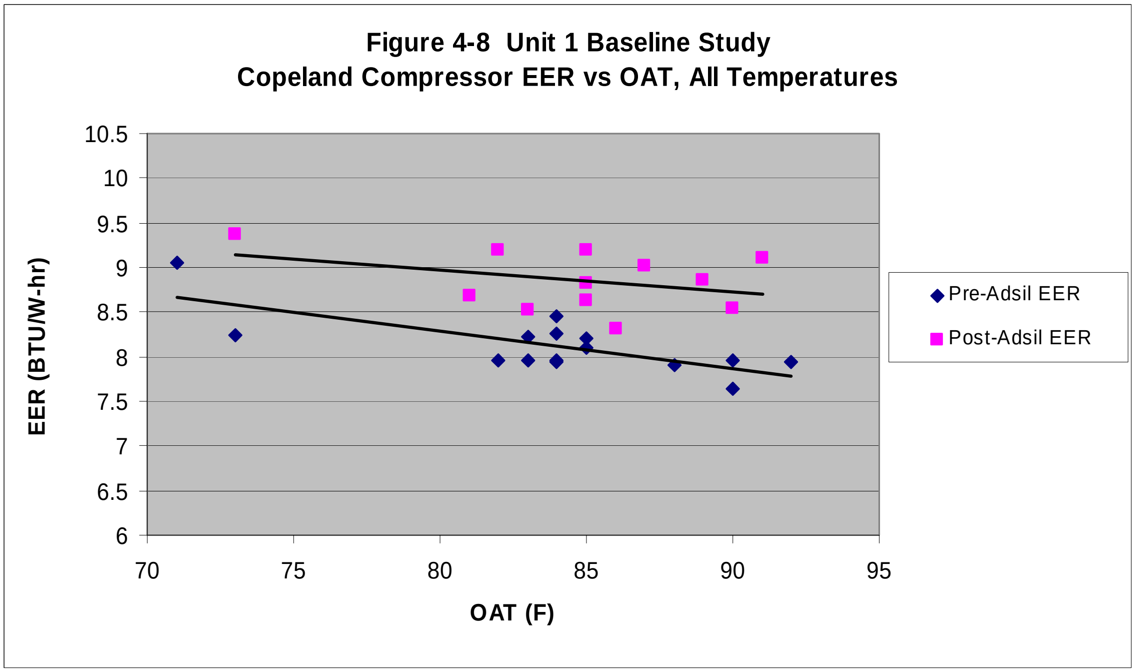
All three test procedures showed a measurable increase in EER for Unit 1. Figure 4-10 shows change in EER after Adsil treatment for all three procedures. Consistent trend lines are observed when comparing the generic compressor curve test to the Copeland compressor test although the generic test underestimates 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.



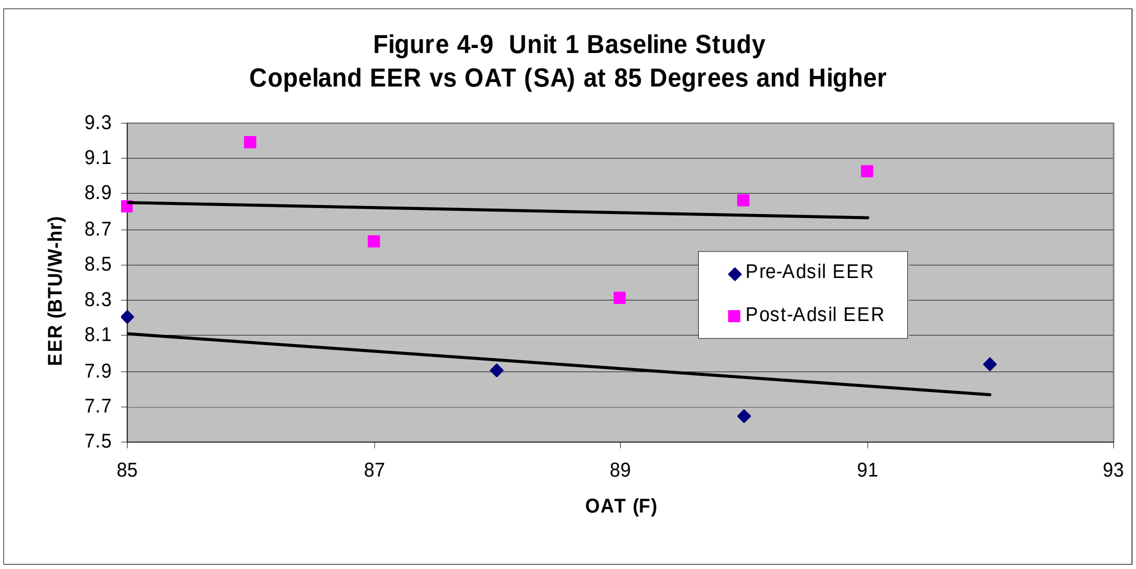
Source: MACTEC, 2004.
Prepared by: _TBL_
Checked by: _CDM_



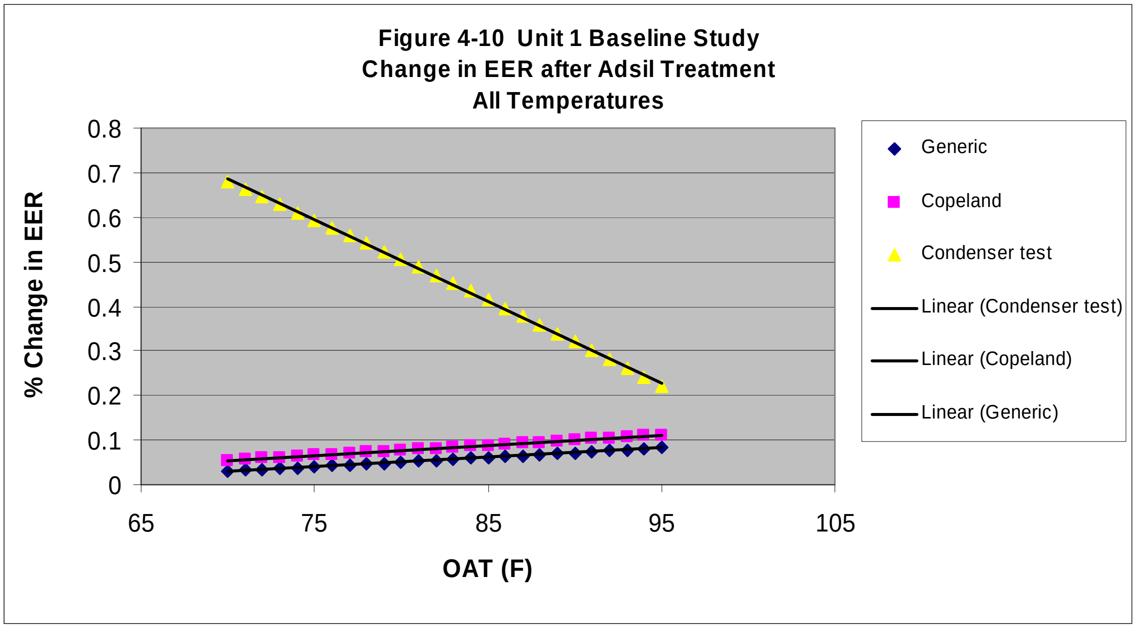
Source: MACTEC, 2004.
Prepared by: _TBL_
Checked by: _CDM_



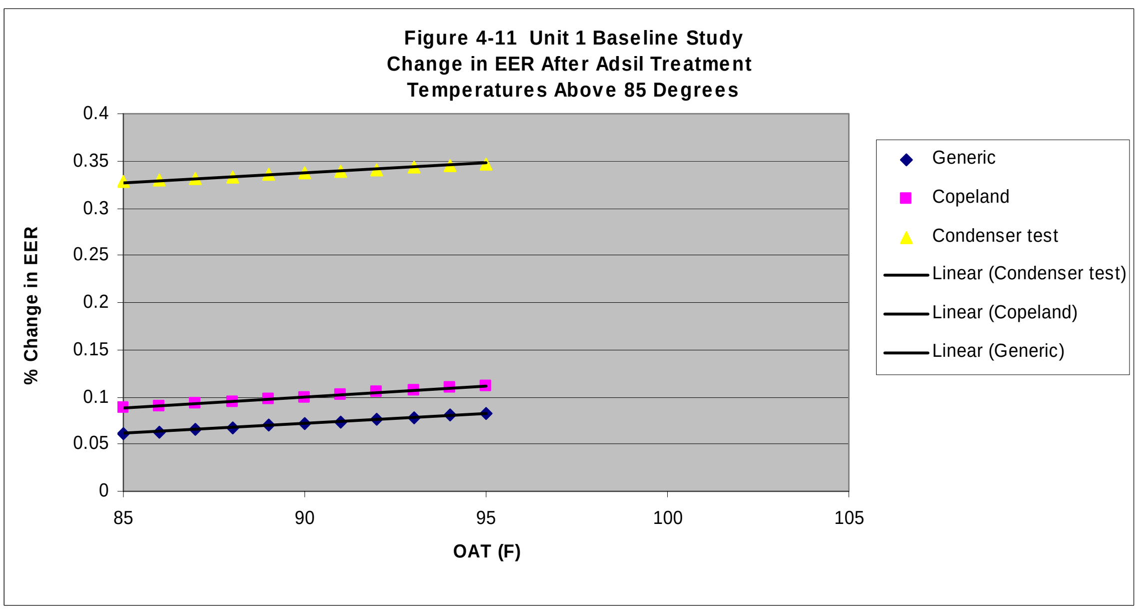
Source: MACTEC, 2004.
Prepared by: _TBL_
Checked by: _CDM_



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_

TABLE 4-3
Unit 1 Baseline Study
Copeland Compressor Test Summary-All Temperatures

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	

Test Date	HVAC Service Assistant						Physical Power and Capacity Measurements						
							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**	**106**	**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**
June 2-C3	**84**	**56**	**86%**	**78%**	**8.5**	**5.5**	**84**	**106**	**12.2**	**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**	**12.2**	**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**	**17.07**
May 08-C	**90**	**59**	**85%**	**81%**	**8.0**	**4.8**	**90**	**116**	**14.4**	**5.6**	**2.22**	**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**
			83.4%	**77.0%**					**12.6**		**1.7**		**14.4**
POST ADSIL	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER
August 21-C	**73**	**59**	**83%**	**74%**	**9.4**	**4.6**	**72**	**96**	**13.3**	**4.8**	**2.96**	**11.31**	**28.27**
August 20-C	**81**	**59**	**84%**	**76%**	**8.7**	**4.6**	**79**	**102**	**12.8**	**5.1**	**2.94**	**10.74**	**25.28**
August 23-C	**82**	**63**	**88%**	**84%**	**9.2**	**4.8**	**82**	**106**	**13.3**	**5.3**	**2.92**	**11.12**	**25.18**
August 20-C	**83**	**60**	**84%**	**78%**	**8.5**	**4.7**	**83**	**107**	**13.3**	**5.2**	**2.99**	**11.39**	**26.29**
August 20-C	**85**	**60**	**89%**	**81%**	**8.8**	**4.7**	**84**	**107**	**12.8**	**5.3**	**2.92**	**10.66**	**24.14**
August 20-C	**85**	**65**	**89%**	**81%**	**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**	**59**	**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**	**92%**	**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**	**25.83**
		Change	**6.1%**	**6.0%**					**6.3%**		**70.1%**		**79.3%**

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

Condensing Unit Summary - Ambient Conditions									Condensing Unit Summary - ARI Conditions						
		Test Data			Percent Difference			Test Data			Percent Difference				
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SA/CU	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU
64-C	Power (kW)	4.6	4.800	4.85	95%	99%	96%	6.0	6.2	6.32	95%	99%	96%	-	-
	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%
66-C	Power (kW)	5.0	4.600	4.92	102%	93%	109%	6.4	5.9	6.32	102%	93%	109%	-	-
	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%
71-C	Power (kW)	4.6	4.8	5.09	90%	94%	96%	5.7	6.0	6.32	90%	94%	96%	-	-
	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%
82-C	Power (kW)	4.7	5.3	5.50	85%	96%	89%	5.4	6.1	6.32	85%	96%	89%	-	-
	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%
83-C	Power (kW)	4.7	5.1	5.46	86%	93%	92%	5.4	5.9	6.32	86%	93%	92%	-	-
	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%
83-C1	Power (kW)	4.7	5.2	5.46	86%	95%	90%	5.4	6.0	6.32	86%	95%	90%	-	-
	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%
84-C1	Power (kW)	4.7	5.3	5.54	85%	96%	89%	5.4	6.0	6.32	85%	96%	89%	-	-
	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%
84-C2	Power (kW)	4.6	5.2	5.50	84%	95%	88%	5.3	6.0	6.32	84%	95%	88%	-	-
	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%
84-C3	Power (kW)	5.5	5.2	5.52	100%	94%	106%	6.3	6.0	6.32	100%	94%	106%	-	-
	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%
84-C3	Power (kW)	4.7	5.2	5.50	86%	95%	90%	5.4	6.0	6.32	86%	95%	90%	-	-
	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%
85-C1	Power (kW)	5.5	5.2	5.58	99%	93%	106%	6.2	5.9	6.32	99%	93%	106%	-	-
	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%
85-C2	Power (kW)	4.7	5.2	5.63	84%	92%	90%	5.3	5.8	6.32	84%	92%	90%	-	-
	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%
85-C3	Power (kW)	4.8	5.3	5.56	86%	95%	91%	5.5	6.0	6.32	86%	95%	91%	-	-
	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%
88-C	Power (kW)	4.7	5.4	5.70	82%	95%	87%	5.2	6.0	6.32	82%	95%	87%	-	-
	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%
90-C	Power (kW)	4.7	5.4	5.71	82%	95%	87%	5.2	6.0	6.32	82%	95%	87%	-	-
	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%
90-C1	Power (kW)	4.8	5.6	5.79	83%	97%	86%	5.2	6.1	6.32	83%	97%	86%	-	-
	Capacity (Tons)	3.66	9.17	4.52	81%	203%	40%	4.0	10.1	4.96	81%	203%	40%	-	-
	EER	7.95	19.65	9.35	85%	210%	40%	8.0	19.8	9.42	85%	210%	40%	92%	37%
92-C	Power (kW)	4.7	5.4	5.76	82%	94%	87%	5.2	5.9	6.32	82%	94%	87%	-	-
	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%	96%	5.6	5.8	6.32	88%	92%	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%
81-C	Power (kW)	4.6	5.1	5.49	84%	93%	90%	5.3	5.9	6.32	84%	93%	90%	-	-
	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%
82-C	Power (kW)	4.8	5.3	5.66	85%	94%	91%	5.4	5.9	6.32	85%	94%	91%	-	-
	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%
83-C	Power (kW)	4.7	5.2	5.58	84%	93%	90%	5.3	5.9	6.32	84%	93%	90%	-	-
	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%
85-C2	Power (kW)	5.5	5.2	5.58	99%	93%	106%	6.2	5.9	6.32	99%	93%	106%	-	-
	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%
86-C	Power (kW)	4.6	5.3	5.66	81%	94%	87%	5.1	5.9	6.32	81%	94%	87%	-	-
	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%
87-C	Power (kW)	5.5	5.2	5.58	99%	93%	106%	6.2	5.9	6.32	99%	93%	106%	-	-
	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%
89-C	Power (kW)	5.8	5.5	5.67	102%	97%	105%	6.5	6.1	6.32	102%	97%	105%	-	-
	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%
91-C	Power (kW)	5.8	5.6	5.78	100%	97%	104%	6.3	6.1	6.32	100%	97%	104%	-	-
	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%

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

TABLE 4-4
Unit 1 Baseline Study
Copeland Compressor Test Summary at Ambient of 85 Degrees or Higher
(Maximum of 1 Test Per Temperature)

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	

Test Date	HVAC Service Assistant						Physical Power and Capacity Measurements						
							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%**	**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**	**89%**	**81%**	**0.0**	**4.7**	**84**	**107**	**12.8**	**5.3**	**2.92**	**10.66**	**24.14**
August 20-C	**85**	**65**	**89%**	**81%**	**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**	**92%**	**87%**	**0.0**	**5.8**	**89**	**114**	**13.9**	**5.5**	**2.93**	**11.62**	**25.35**
August 6-C	**91**	**60**	**96%**	**91%**	**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**

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

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.

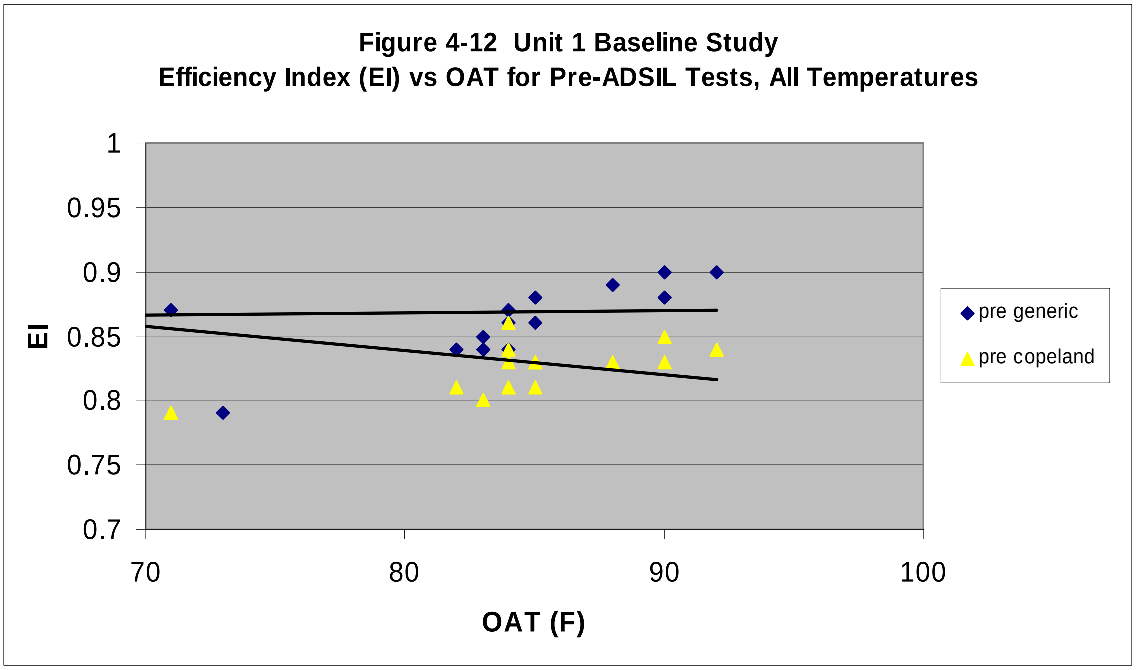
Two testing procedures were used in each of the eight evaluations. The first procedure was the condenser test measurement described in Section 3.2. The second test was the generic compressor Service Assistant test. The generic test uses a generic compressor curve to determine the operating efficiency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

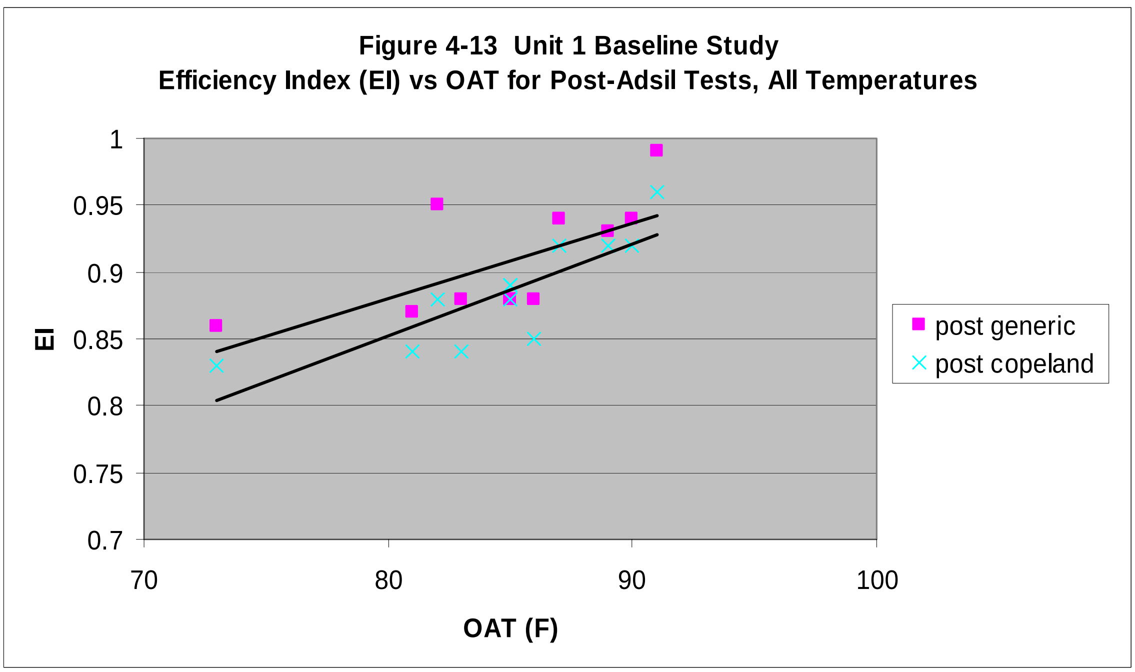
Condenser Heat Rejection and Power Measurement

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.

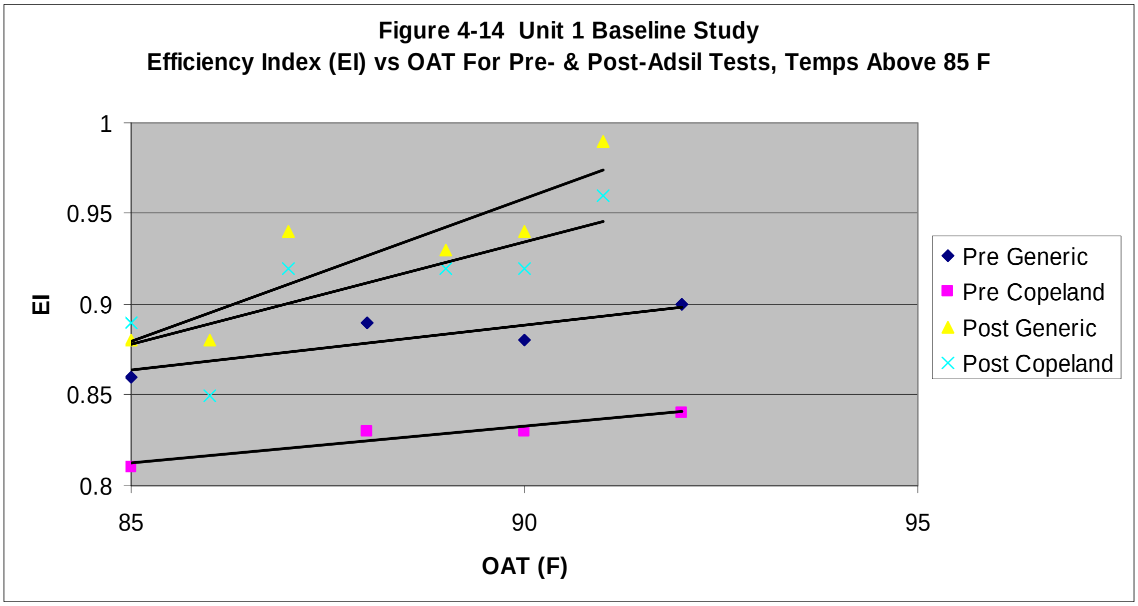
A comparison of the measured EER using this procedure shows great variation prior to and after Adsil application. EER values ranged from 7.6 to 11.2 for all temperature ranges before application and from 9.7 to 13.9 after application. This variation is due primarily to very inconsistent fan flow measurements 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.



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_

Figure 4-15 Unit 2 Baseline Study
HVAC Data Sheet and EER Calculation at ARI Conditions

Manufacturer:	Carrier	**Published EER:**	67.0	Btu/W-hr	(CU Only)
Model Number:	38YCC060	**Calculated EER:**	9.2	Btu/W-hr	(CU Only)
Serial Number		**Nominal Capacity:**	4.64	tons	
Equipment Type:	SS Heat pump	**Age**	3	years	
Year Manufactured:	2001	**Coil Conditon**	3%	(% degraded)	
Location	MACTEC Hendrickson	**Present Condition EER**	9.0	Btu/W-hr	
Tag	HP-7	**kW/ton**	1.33		

Compressor Data

Running load Amps:	17.0	Amps	Power supply:	3-phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1.73
Power factor:	0.86		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 applicable)

Full load Amps:	5.40	Amps	Power supply:	1-Phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.11		Fan quantity:	1

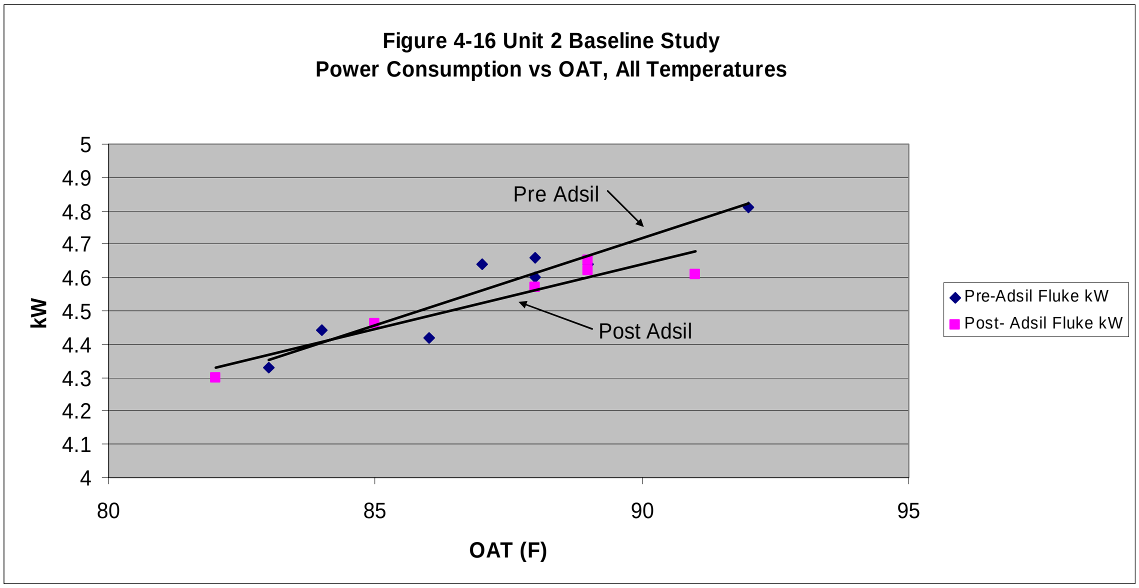
Calculated compressor load:	**5.8**	kW
Calculated condensing fan load:	**0.23**	kW
Calculated evaporator fan load	**0.13**	kW
Total calculated load for equipment:	**6.04**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **3.2%** **Performance Degradation**

Overall Unit Condition		
	New	
	Average	**X**
	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	**x**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

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



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

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-Adsil™ 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.

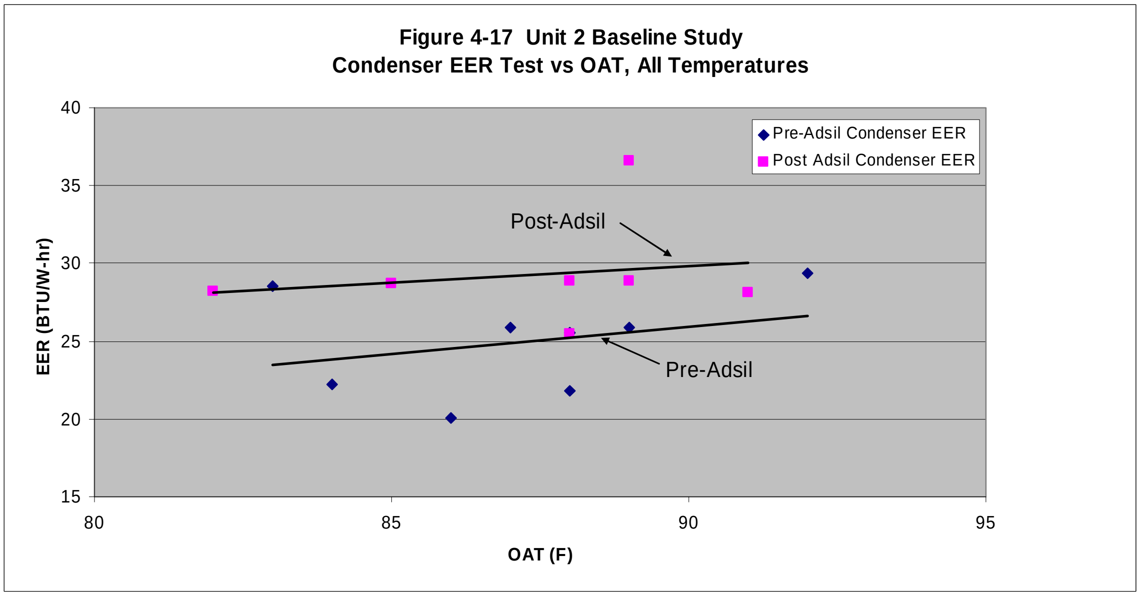
Summary of Test Results for Unit 2

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.

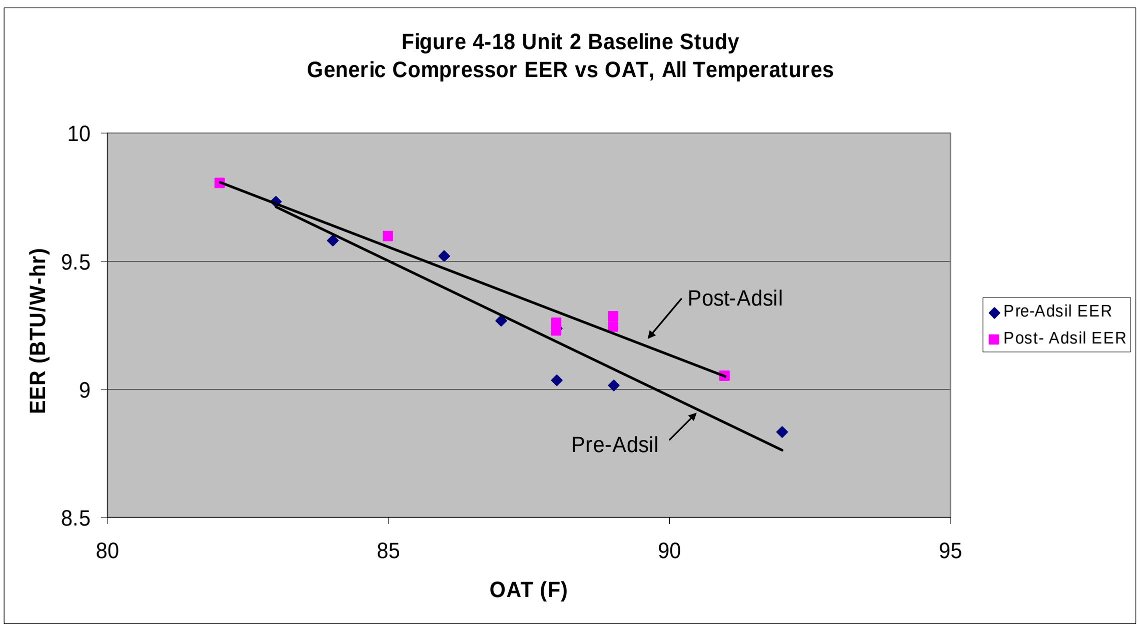
Figure 4-20 shows the variability in measuring the efficiency index of the unit for pre- and post-treatment over the tested temperature ranges. Inspection of these graphs indicate that the efficiency index, a measure of the actual efficiency divided by the benchmark efficiency of the unit when new, increases 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_



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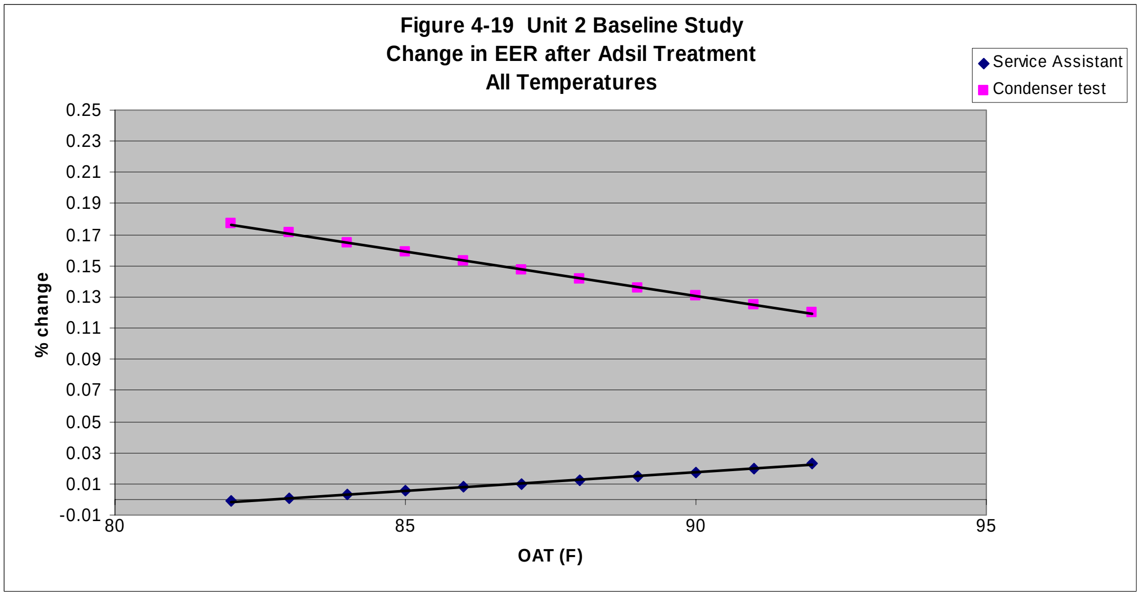

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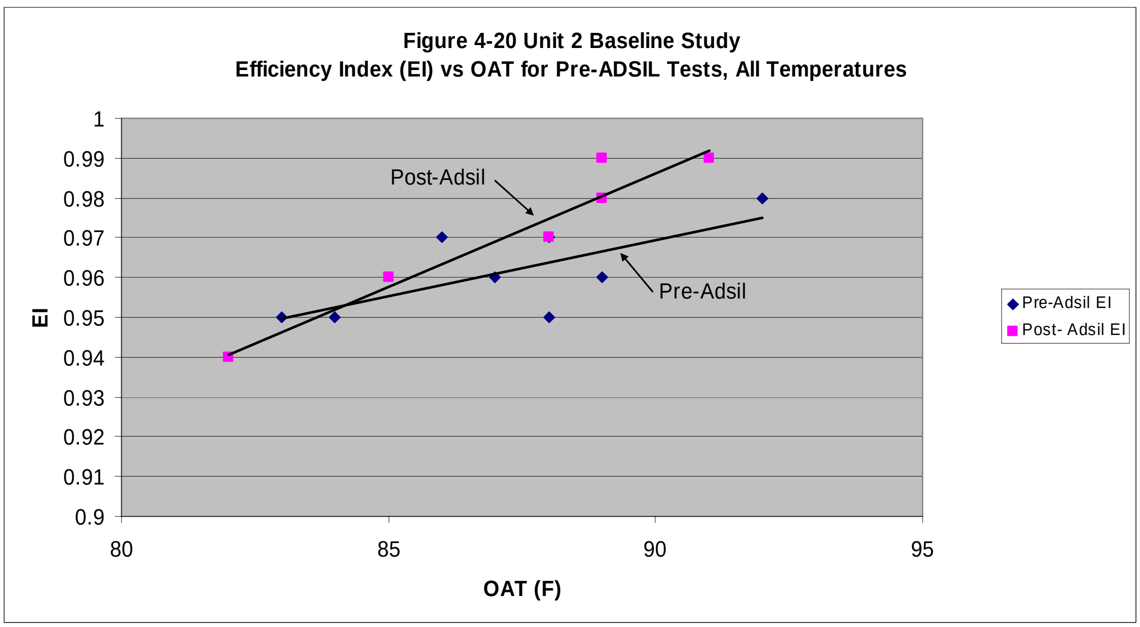


Source: MACTEC, 2004.
Prepared by: _TBL_
Checked by: _CDM_

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 pre-treatment 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

EER at ARI Conditions	9.27	BTU/W-h
Condensing unit CFM	3300	CFM (Listed)
Capacity at ARI	4.67	tons
Coil Area	22	sq-ft
Predicted EER =	9.07	BTU/W-h

Test Date		HVAC Service Assistant							Physical Power and Capacity measurments							
									Cond Air, deg F		Cond Air					
		OAT	EWB	EI	CI	EER	Cap	kW	inlet	exhaust	DT (K)	kW	(kg/sec)	tons	EER	cfm adj
PRE	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
	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
	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**
POST	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
	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		**97%**	**94%**		**4.16**				**8.65**		**4.47**		**29.26**	**0.38**
		Change		**1.1%**	**-0.64%**		**-0.54%**				**2.11%**		**14.29%**		**17.45%**	

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

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.

<u>Multiple Compressors, Common Condenser Circuit</u>

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.

<u>Dual Compressors, Dedicated Condenser</u>
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.

<u>Multiple Compressors, Shared Condenser</u>
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 5-1
Summary of All Tests at All Temperatures

					Service Assistant					Condensing					Spreadshee	
Site	Unit	Age	Pre-test OAT	Post-test OAT	Tons tested	Pre-Adsil EER	Post Adsil EER	% Change	Ton weighted avg.	Tons tested	Pre-Adsil EER	Post Adsil EER	% Change	Ton weighted avg.	Pre-Adsil EER	Post Adsil EER
Concord Admin	RTU-5	6	93	93	8	11.76	11.76	0.0%	0.0%	8.41	17.45	36.04	106.6%	896.6%	10.50	11.08
	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-1	5	81	87	5	11.76	12.00	2.0%	10.7%	5.23	NA	NA	NA	NA	11.65	11.88
	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-3	2	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
	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
Granite Quarry	SS-1	13	79	95	5	8.47	8.66	2.2%	10.5%	4.78	NA	NA	NA	NA	NA	NA
	SS-2	9	77	94	5	7.95	9.79	23.2%	115.9%	5.00	NA	NA	NA	NA	NA	NA
	SS-3	3	77	92	5	9.11	NA	NA	NA	5.00	NA	NA	NA	NA	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-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-14	12	88	80	6	NA	10.76	NA	NA	6.30	18.59	17.54	-5.7%	-35.7%	9.18	9.96
	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-1	7	93	87	3	12.55	12.98	3.4%	10.2%	3.00	NA	NA	NA	NA	11.65	11.88
	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-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-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-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	7.82	8.91	13.9%	73.0%	5.25	16.59	16.34	-1.5%	-1.1%	10.17	10.56
	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-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	10.19
	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
	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	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
	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	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	9.89	-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 - 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	7.19	8.23
	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	10.23
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)				137.83	(tons not counted)					
	Per Unit				395.01			8.02%		292.46			36.6%			
	Ton-Weighted								9.90%					30.0%		
						standard deviation		9.7%			standard deviation		43.5%		standard deviation	
							count	42				count	29			count
							standard error	1.5%				standard error	8.1%			standard error

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

Table 5-2
Summary of Valid Tests at All Temperatures

Site	Unit	Age	Pre-test OAT	Post-test OAT	Service Assistant: Tons tested	Service Assistant: Pre-Adsil EER	Service Assistant: Post Adsil EER	Service Assistant: % Change	Service Assistant: Ton weighted avg.	Condensing: Tons tested	Condensing: Pre-Adsil EER	Condensing: Post Adsil EER	Condensing: % Change	Condensing: Ton weighted avg.	Spreadshee: Pre-Adsil EER	Spreadshee: Post Adsil 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
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	11.88
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
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
	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	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	10.23
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
					0.00	(tons not counted)				90.65	(tons not counted)					
	Per Unit				286.83			9.33%		196.18			32.6%			
	Ton-Weighted								11.31%					27.2%		
						standard deviation		9.7%			standard deviation		35.1%		standard deviation	
							count	30				count	20			count
							standard error	1.8%				standard error	7.9%			standard error

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

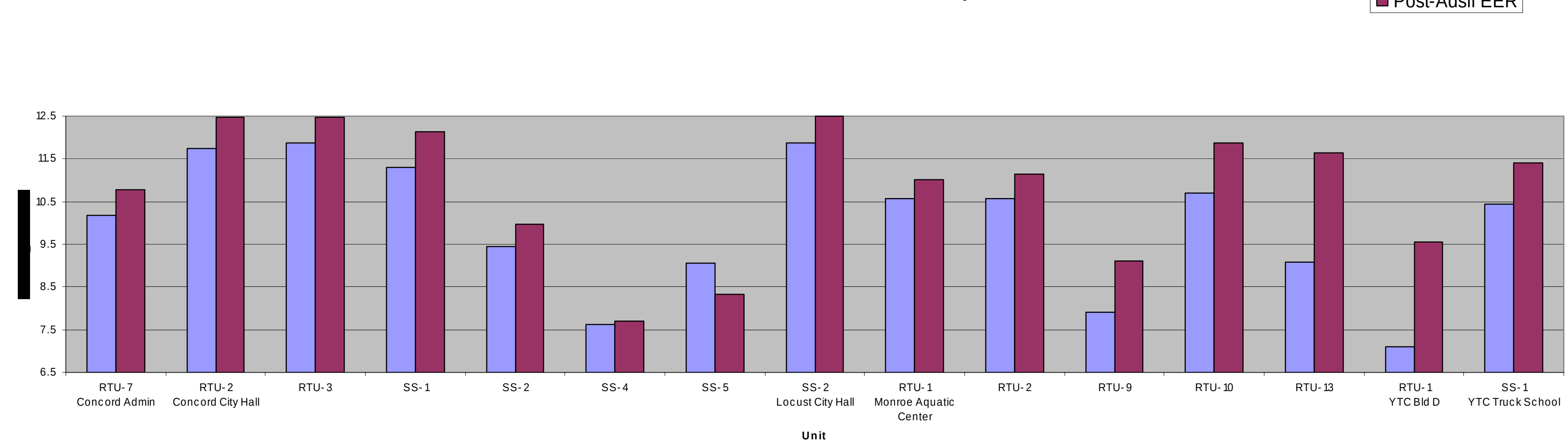
Table 5-3
Summary of Valid Tests at Literature Temperatures

					Service Assistant					Condensing					Spreadshee	
Site	Unit	Age	Pre-test OAT	Post-test OAT	Tons tested	Pre-Adsil EER	Post Adsil EER	% Change	Ton weighted avg.	Tons tested	Pre-Adsil EER	Post Adsil EER	% Change	Ton weighted avg.	Pre-Adsil EER	Post Adsil 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 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 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 counted)					
	Per Unit				107.44			9.07%		87.24			35.6%			
	Ton-Weighted								12.33%					19.9%		
						standard deviation		10.1%			standard deviation		28.5%		standard deviation	
							count	15				count	10			count
							standard error	2.6%				standard error	9.0%			standard error

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.

Figure 5-1
Service Assistant, Valid Tests at Literature Temperatures



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

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 Name
Capacity of HVAC Units

ECP Savings:	**371.67**	Electric Demand kW	**461,440**	Electric Energy kWh
	$36,915	Electric Energy Cost Savings	**1,574**	Electric Energy MMBtu
Total ECP Savings:	**$36,915**	Total Annual Cost Savings	**1,574**	Total Annual MMBtu Savings
ECP Cost:	**$165,425**			
Payback:	**4.48**	yrs (excluding maint savings)		

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

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%
Nominal capacity is total tonnage at facility. Available from equipment nameplate data. May be estimated by taking total facility square footage and dividing by 400.
CDD from website http://lwf.ncdc.noaa.gov/oa/climate/online/ccd/nrmcdd.html

1644	CDD	use website to get CDD for your city
1,315	FLEOH	
$0.000	Demand Cost per kW	
$0.08000	Energy Cost per kWh	use blended electric rate
0.003412	MMBtu/kWh	
12.3%	EER gain	use default of 12.3% or value from degradation tool

HVAC System Data

Condensing Unit Data from:	SEQL Area		Nominal Capacity:	2545.0	tons
Condensing Unit Consumption:	3393.33	kW	Present Condition EER:	9.0	Btu/W-hr
Calculated EER:	10.1	Btu/W-hr	kW/ton=	1.33	

EER after coil application=	**10.11**
kW/ton after coil application=	**1.19**
Demand Consumption=	**3021.67**

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

FIGURE 6-1 ENERGY SAVINGS PROJECTION TOOL (continued)

Facility: Your Facility Name
Capacity of HVAC Units

Current Run-time Adjustment Factors

Night Setback:	1.000	Note 1	Excess Capacity:	1.000	
FLEOH Conversion:	0.800		Weekend Setback:	1.000	Note 2
			Cooling Set Point:	72.00	Degrees F

Proposed Run-time Adjustment Factors

Night Setback:	1.000	Excess Capacity:	1.000	
FLEOH Conversion:	0.800	Weekend Setback:	1.000	
		Cooling Set Point:	72.00	Degrees F

Run-time Estimates

Current condensing unit:	1,242	hours - annually
Proposed condensing unit:	1,242	hours - annually

	kW	**kWh**
Current	3393.333	4,212,989
Proposed	3021.668	3,751,548
Savings	**371.665**	**461,440**

Installation Costs

Nominal capacity:	2,545	tons
Cost associated to install coating (parts & labor):	$65	per ton (total installed cost) (vendor quotation)
Total project cost:	$165,425	

Note 1: Use a night setback value of .95 if HAVC equipment does not run at night after 6:00 P.M. Use 1 if no setback is used.

Note 2: Use a weekend setback value of .75 is HVAC is turned off for the weekend. Use .875 if it is turned off for one day during the weekend.

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

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.

FIGURE 7-1 Degradation Prediction Tool

Manufacturer:	Brand X	**Published EER:**	10.2	Btu/W-hr	(CU Only)
Model Number:	Big Guy 60	**Calculated EER:**	10.8	Btu/W-hr	(CU Only)
Serial Number	123456	**Nominal Capacity:**	5.00	tons	
Equipment Type:	Split-System	**Age**	5	years	
Year Manufactured:	1999	**Coil Conditon**	12%	(% degraded)	
Location	ACME Warehouse	**Present Condition E**	9.6	Btu/W-hr	
Tag	SS-2	**kW/ton**	1.25		

Compressor Data					
Running load Amps:	18.0	Amps	Power supply:	3-phase	
Nameplate Voltage:	208	Volts	Phase adjustment:	1.73	(=1.0 if single 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	(=1.0 if single phase)
Adjust FLA to RLA:	0.70		Fan quantity:	1	

Evaporator fan data (if applicable)				
Full load Amps:	NA	Amps	Power supply:	1 or 3-phase
Nameplate Voltage:	NA	Volts	Phase adjustment:	1 or 1.73
Adjust FLA to RLA:	0.70		Fan quantity:	NA

Calculated compressor load:	**5.2**	kW
Calculated condensing fan load:	**0.35**	kW
Calculated evaporator fan load	**#VALUE!**	kW
Total calculated load for equipment:	**5.53**	kW - Condensing side only

Assumptions

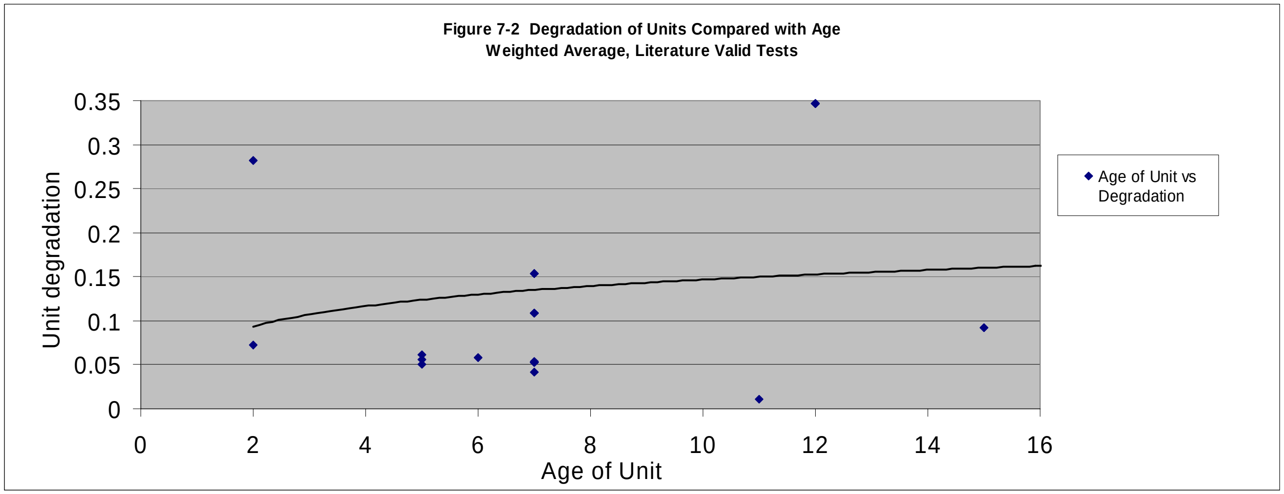
Condenser Coil Assessment		**12.3%**	**Performance Degradation**
Age of Unit			
	New		Put a "1" in the appropr
	2-9 years		correspond with the a
	10-14 years		
	15 or more	**1**	
Coil Cleanliness			
	Coated		Put a "1" if unit is currently coated
	Clean	**0.7**	Place a percentage (.01-1) to represent
	Dirty	**0.2**	percentage of the fins that are considered
	Clogged	**0.1**	to be clean, dirty, clogged, or plugged. These
	Plugged		must sum to 100%
Fin Condition			
	Like New	**0.1**	Percentage in "like new" condition
	Some Bent	**0.05**	Percentage "bent"
	Smashed		Percentage "smashed"
	Dull/rough	**0.9**	Percentage "dull/rough, corroded, pitted,
	Corroded		& flaking" plus percentage "like new",
	Pitted		must equal 100%.
	Flaking		
Fin-Tube Attachment			
	Like New	**1**	Place a"1" in the appropriate cell
	Corrosion		
	Some Loose		
	Many Loose		
Tubes			
	Clean Cu	**1**	Place a"1" in the appropriate cell
	Corrosion		
	Pitting		
	Leaks		

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

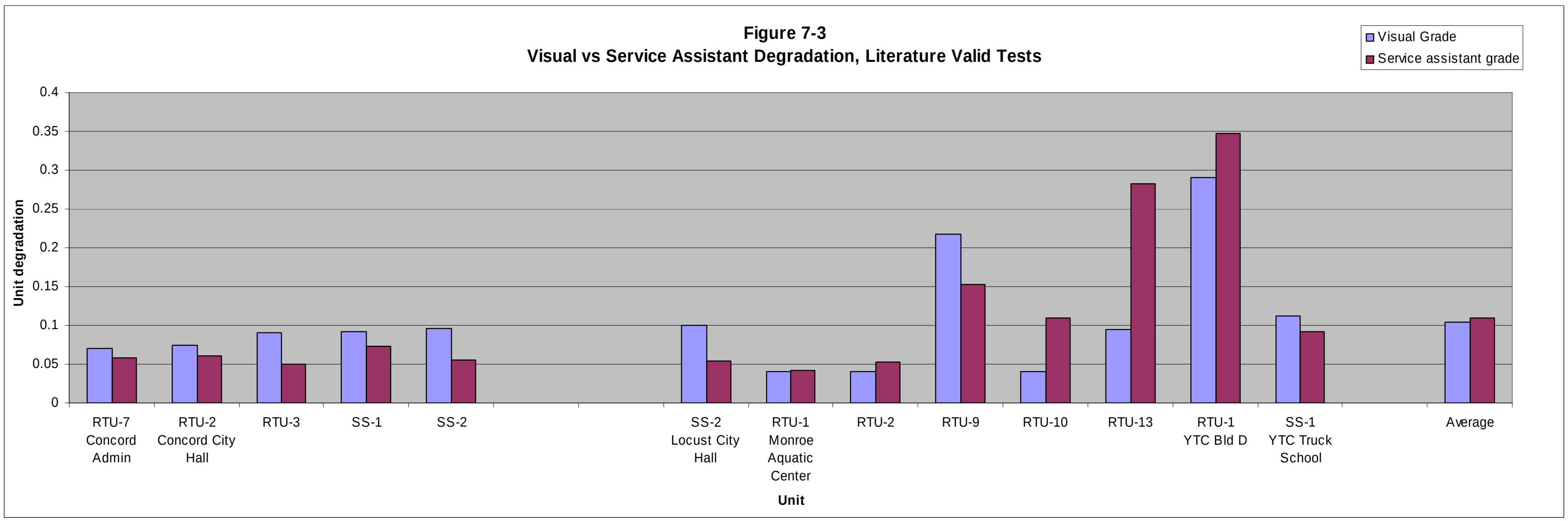
The impact of various factors on the degradation of the unit are included in Appendix H. It is of interest to note that the age of the unit had little impact on the degradation of the coil (see Figure 7-2). Figure 7-3 graphically depicts the comparison of spreadsheet predicted EER degradation with actual 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.

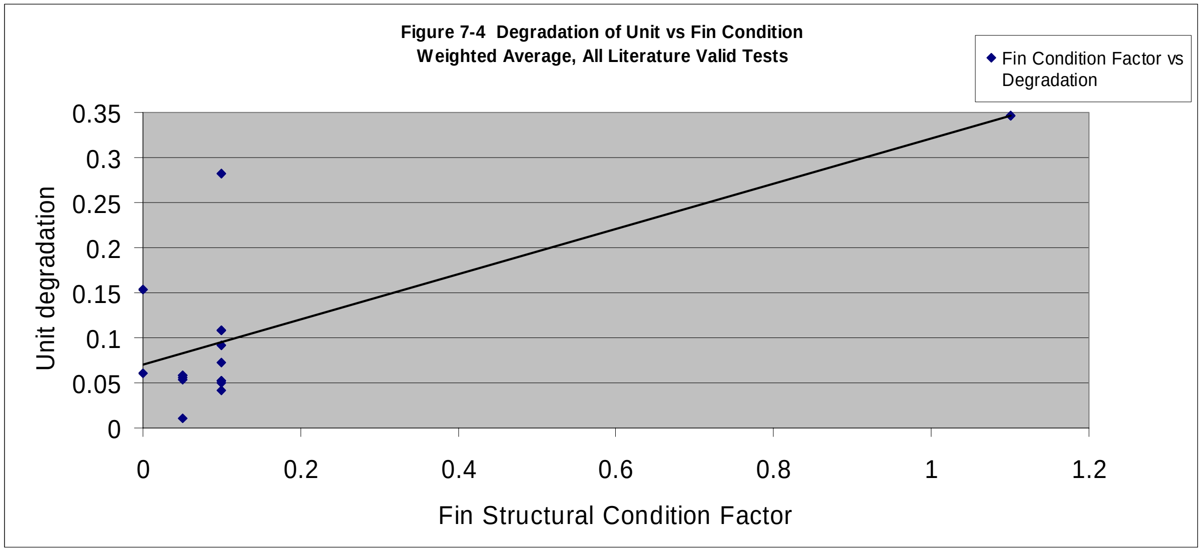
The accuracy of this tool has not been tested in significantly different climactic areas and there may be additional attributes which need to be considered in these cases.



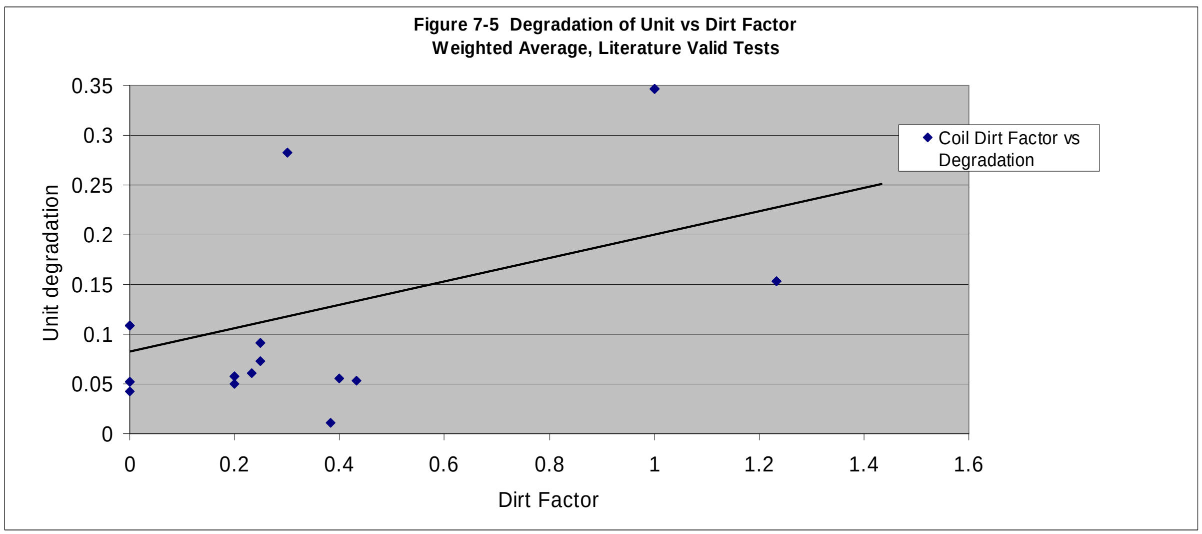
Source: MACTEC, 2004. Prepared by: _TBL_ Checked by: _CDM_



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

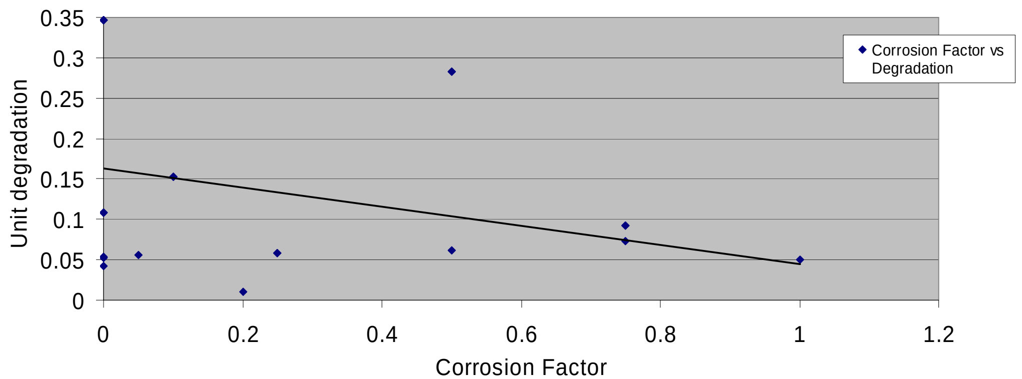


Source: MACTEC, 2004. Prepared by: _TBL_ Checked by: _CDM_



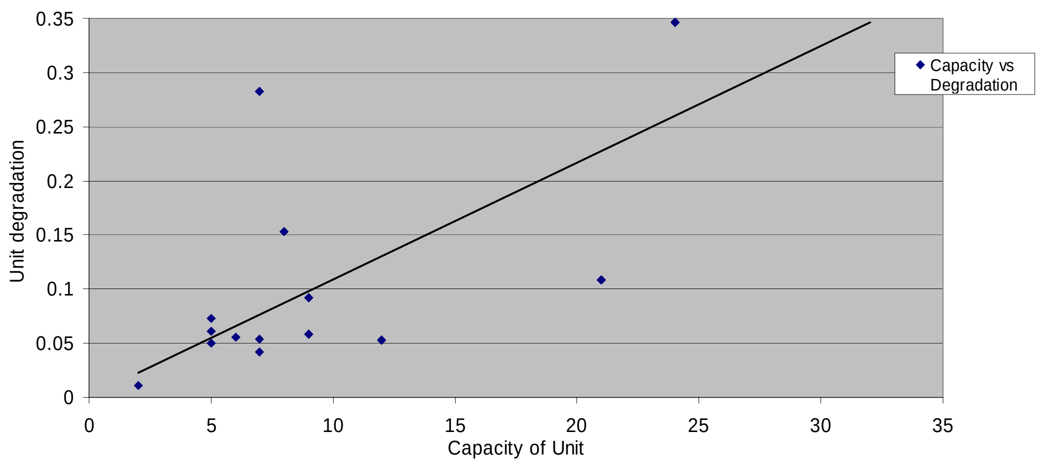
Source: MACTEC, 2004. Prepared by: _TBL_ Checked by: _CDM_

Figure 7-6 Degradation of Unit vs Corrosion Weighted Average, Literature Valid Tests



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

Figure 7-7 Degradation of Unit vs Capacity Weighted Average, All Literature Valid Tests



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 refrigerant-based 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 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.

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

Building		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

Manufacturer:	Carrier	**Published EER:**	9.4	Btu/W-hr	(CU Only)
Model Number:	38TH060300	**Calculated EER:**	**9.4**	Btu/W-hr	(CU Only)
Serial Number		**Nominal Capacity:**	4.96	tons	
Equipment Type:	Split system	**Age**	**13**	years	
Year Manufactured:	1991	**Coil Conditon**	**18%**	(% degraded)	
Location	Gainesville	**Present Condition EER**	**7.4**	Btu/W-hr	
Tag	Toms Home unit	**kW/ton**	**1.62**		

Compressor Data

Running load Amps:	30.8	Amps	Power supply:	1-Phase
Nameplate Voltage:	208	Volts	Phase adjustment:	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

Evaporator fan 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 **18.2%** **Performance Degradation**

Overall Unit Condition	
New	
Average	x
Fair	
Poor	
Coil Cleanliness	
Coated	1
Clean	0.3
Dirty	0.2
Clogged	0.3
Plugged	0.2
Fin Condition	
Like New	
Some Bent	0.05
Smashed	0
Dull/rough	0.95
Corroded	0
Pitted	0
Flaking	0
Fin-Tube Attachment	
Like New	x
Corrosion	
Some Loose	
Many Loose	
Tubes	
Clean Cu	x
Corrosion	
Pitting	
Leaks	

FLUKE METER MEASUREMENTS

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 Assistant Measurement

Input SEER	10	
RAT	NA	F
SAT	NA	F
RAH	NA	%
SAH	NA	%
EI	NA	%
CI	NA	%
Input Cap	NA	Tons
OAT	NA	F
Predicted KW	NA	kW

CU Capacity Estimates

Ambient	67 F	293 K
CU Exhaust	89 F	305 K
Coil Length	73.5 in	
Coil Width	28 in	
Area	15.0 sq-ft	
Listed Fan CFM	1115	
Air Mass Flow	0.63 kg/sec	

Capacity	2.21 Tons
Efficiency	5.76 EER
Efficiency	2.08 kW/Ton

CU Fan CFM Calculation

Measurement Number	ft/sec
1	2.9
2	4.5
3	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	2.7
2	3.5
3	3.3
4	3.9
5	3.7
6	3.5
7	3.5
8	3.1
9	3.3
10	3.1
11	3.7
12	3.5
13	3.5
14	2.7
15	2.9
16	2.9
17	2.5
18	2.5
19	3.1
20	3.9
21	4.1
Average	3.281 ft/sec

Area= 4.5 sq ft
CFM= 885.8571

1	3.1
2	2.9
3	2.1
4	2.7
5	2.5
6	2.5
7	3.5
8	3.7
9	3.3
Average	2.922

Area= 1 sq ft
CFM= 175.3333

Total Blower CFM= 1061.19

Published= 2000

Error= 47%

Blower Data April 10

1	4.1
2	4.1
3	4.1
4	3.9
5	3.7
6	2.9
7	3.7
8	3.9
9	4.3
10	4.3
11	3.9
12	3.9
13	4.3
14	4.1
15	4.1
16	4.1
17	4.1
18	4.3
19	4.7
20	4.9
21	5.3
Average	4.129 ft/sec

Area= 4.575 sq ft
CFM= 1133.293

Total Blower CFM= 1133.293

Published= 2000

Error= 43%

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

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	241	23.8	5.4	0.95

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-270	
Input SEER	12		12	
Input Cap	5		5	
SP	63		63	
ST	45		45	
LP	236		236	
LT	97		97	
OAT	92		92	
ET	36		36	Low
SH	9		9	
SC	15		15	
CT	112		112	
COA	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 Estimates

Ambient	95	F	308	K
CU Exhaust	115	F	319	K
Coil Length		in		
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	4365			
Air Mass Flow	2.47	kg/sec		

Capacity	7.86	Tons
Efficiency	17.46	EER
Efficiency	0.69	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:	Carrier
Model Number:	38TH060300
Serial Number	
Equipment Type:	Split system
Year Manufactured:	1991
Location	Gainesville
Tag	Toms Home unit

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	241	23.8	5.4	0.95

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-270	
Input SEER	12		12	
Input Cap	5		5	
SP	63		63	
ST	45		45	
LP	236		231	
LT	97		97	
OAT	92		92	
ET	36		36	Low
SH	9		9	
SC	15		14	
CT	112		112	
COA	20		19	
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 Estimates

Ambient	95 F	308 K	
CU Exhaust	115 F	319 K	
Coil Length	in		
Coil Width	in		
Area	15.0 sq-ft		
Fan CFM	4365		
Air Mass Flow	2.47 kg/sec		

Capacity	7.86 Tons
Efficiency	17.46 EER
Efficiency	0.69 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 90 Degrees
July 8 2004 1:45 PM

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	240	24.4	5.6	0.95

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-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	7		7	Low
SC	16		16	
CT	112		112	
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 Estimates

Ambient	90	F	305	K
CU Exhaust	116	F	320	K
Coil Length		in		
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	3920			
Air Mass Flow	2.22	kg/sec		

Capacity	9.17	Tons
Efficiency	19.65	EER
Efficiency	0.61	kW/Ton

CU Fan CFM Calculation

Measurement Number	ft/sec
1	5.1
2	5.3
3	5.5
4	4.7
5	3.7
6	3.1
7	5.5
8	4.7
9	3.7
10	4.1
11	4.3
12	4.1
13	3.5
14	4.7
15	4.3
16	4.3
17	3.7
18	4.1
Average	4.356

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

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	241	23.8	5.4	0.95

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-27(	
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	
CT	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 Estimates

Ambient	90	F	305	K
CU Exhaust	111	F	317	K
Coil Length		in		
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	4065			
Air Mass Flow	2.30	kg/sec		

Capacity	7.68	Tons
Efficiency	17.07	EER
Efficiency	0.70	kW/Ton

CU Fan CFM Calculation

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	243	21.5	5.4	0.94

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-270	
Input SEER	12		12	
Input Cap	5		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	
CT	108		108	
COA	20		20	
RAT	80	F	80	F
SAT	48	F	48	F
RAH	25%	%	25%	%
SAH	85%	%	85%	%
EI	89%	%	83%	%
CI	88%	%	77%	%
Predicted KW	5	kW	4.7	kW

CU Capacity Estimates

Ambient	86 F		303 K
CU Exhaust	108 F		315 K
Coil Length	in		
Coil Width	in		
Area	15.0 sq-ft		
Fan CFM	3870		
Air Mass Flow	2.19 kg/sec		

Capacity	7.66 Tons
Efficiency	17.03 EER
Efficiency	0.70 kW/Ton

CU Fan CFM Calculation

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	241	23.4	5.3	0.95

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-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	
CT	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 Estimates

Ambient	86	F	303	K
CU Exhaust	109	F	316	K
Coil Length		in		
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	3600			
Air Mass Flow	2.04	kg/sec		

Capacity	7.45	Tons
Efficiency	16.87	EER
Efficiency	0.71	kW/Ton

CU Fan CFM Calculation

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
Tag	Toms Home unit

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	241	23.1	5.2	0.94

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-270	
Input SEER				
Input Cap				
SP				
ST				
LP				
LT				
OAT				
ET				
SH				
SC				
CT				
COA				
RAT		F	75	F
SAT		F	46	F
RAH		%	30	%
SAH		%	87	%
EI		%	81%	%
CI		%	72%	%
Predicted KW		kW	5.5	kW

CU Capacity Estimates

Ambient	85	F	303	K
CU Exhaust	108	F	315	K
Coil Length		in		
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	1870			
Air Mass Flow	1.06	kg/sec		

Capacity	3.87	Tons
Efficiency	8.93	EER
Efficiency	1.34	kW/Ton

CU Fan CFM Calculation

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	243	23.1	5.2	0.94

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-270	
Input SEER	12		12	
Input Cap	5		5	
SP	60		60	
ST	51		49	
LP	212		213	
LT	91		91	
OAT	85		85	
ET	34		34	
SH	17		15	
SC	13		14	
CT	104		105	
COA	20		21	
RAT	77	F	77	F
SAT	48	F	48	F
RAH	33%	%	33	%
SAH	85%	%	85	%
EI	88%	%	83%	%
CI	84%	%	76%	%
Predicted KW	4.9	kW	4.7	kW

CU Capacity Estimates

Ambient	85	F	303	K
CU Exhaust	108	F	315	K
Coil Length		in		
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	3200			
Air Mass Flow	1.81	kg/sec		

Capacity	6.62	Tons
Efficiency	15.29	EER
Efficiency	0.79	kW/Ton

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	243	22.6	5.2	0.94

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-270	
Input SEER	10		10	
Input Cap	5		5	
SP	59		59	
ST	46		46	
LP	206		206	
LT	89		89	
OAT	84		84	
ET	33		33	
SH	12		12	Low
SC	15		15	
CT	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 Estimates

Ambient	84	F	302	K
CU Exhaust	106	F	314	K
Coil Length		in		
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	1915			
Air Mass Flow	1.08	kg/sec		

Capacity	3.79	Tons
Efficiency	8.75	EER
Efficiency	1.37	kW/Ton

CU Fan CFM Calculation

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	243	22.8	5.2	0.94

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-270	
Input SEER	12		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	
CT	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 Estimates

Ambient	84 F		302 K
CU Exhaust	107 F		315 K
Coil Length	in		
Coil Width	in		
Area	15.0 sq-ft		
Fan CFM	3195		
Air Mass Flow	1.81 kg/sec		

Capacity	6.61 Tons
Efficiency	15.26 EER
Efficiency	0.79 kW/Ton

CU Fan CFM Calculation

Measurement Number	ft/sec
1	4.5
2	3.9
3	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
Tag	Toms Home unit

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	243	23	5.2	0.94

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-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	
CT	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	kW

CU Capacity Estimates

Ambient	85 F		303 K
CU Exhaust	106 F		314 K
Coil Length	in		
Coil Width	in		
Area	15.0 sq-ft		
Fan CFM	3705		
Air Mass Flow	2.10 kg/sec		

Capacity	7.00 Tons
Efficiency	16.16 EER
Efficiency	0.74 kW/Ton

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	243	23.3	5.3	0.94

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-27C	
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	
CT	106		105	
COA	21		22	
RAT	75	F	75	F
SAT	46	F	46	F
RAH	30%	%	30	%
SAH	87%	%	87	%
EI	86%	%	83%	%
CI	84%	%	76%	%
Predicted KW	5.2	kW	4.7	kW

CU Capacity Estimates

Ambient	84 F	302 K	
CU Exhaust	107 F	315 K	
Coil Length	in		
Coil Width	in		
Area	15.0 sq-ft		
Fan CFM	1870		
Air Mass Flow	1.06 kg/sec		

Capacity	3.87 Tons
Efficiency	8.76 EER
Efficiency	1.37 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

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

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	243	22.6	5.1	0.94

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-270	
Input SEER	12		12	
Input Cap	5		5	
SP	57		56	
ST	43		43	
LP	201		201	
LT	90		89	
OAT	83		83	
ET	31		31	Low
SH	12		12	
SC	11		12	
CT	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 Estimates

Ambient	83	F	301	K
CU Exhaust	105	F	314	K
Coil Length		in		
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	2515			
Air Mass Flow	1.42	kg/sec		

Capacity	4.98	Tons
Efficiency	11.72	EER
Efficiency	1.02	kW/Ton

CU Fan CFM Calculation

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	242	23.1	5.3	0.95

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-270	
Input SEER	12		12	
Input Cap	5		5	
SP	60		60	
ST	40		40	
LP	207		207	
LT	89		89	
OAT	82		82	
ET	34		34	Low
SH	6		6	
SC	15		15	
CT	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 Estimates

Ambient	85 F	303 K	
CU Exhaust	107 F	315 K	
Coil Length	in		
Coil Width	in		
Area	15.0 sq-ft		
Fan CFM	3815		
Air Mass Flow	2.16 kg/sec		

Capacity	7.55 Tons
Efficiency	17.10 EER
Efficiency	0.70 kW/Ton

CU Fan CFM Calculation

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
Tag	Toms Home unit

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	244	21.5	4.8	0.92

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-270	
Input SEER	10		10	
Input Cap	5		5	
SP				
ST				
LP				
LT				
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 Estimates

Ambient	73	F
CU Exhaust	95	F
Coil Length	NA	in
Coil Width	NA	in
Area	15.0	sq-ft
Fan CFM	1870	
Air Mass Flow	1.06	kg/sec

Capacity	3.70	Tons
Efficiency	9.26	EER
Efficiency	1.30	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

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

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	244	21.5	4.8	0.92

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-27(	
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	
CT	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 Estimates

Ambient	71	F
CU Exhaust	96	F
Coil Length	NA	in
Coil Width	NA	in
Area	15.0	sq-ft
Fan CFM	1870	
Air Mass Flow	1.06	kg/sec

Capacity	4.21	Tons
Efficiency	10.52	EER
Efficiency	1.14	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 66 Degrees
April 14, 2004 6:30 P.M.

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	244	20.6	4.6	0.92

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-270	
Input SEER	12		12	
Input Cap	5		5	
SP	67		69	
ST	64		64	
LP	157		155	
LT	69		68	
OAT	66		66	
ET	39		40	
SH	24		22	
SC	17		17	
CT	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 Estimates

Ambient	66	F
CU Exhaust	88	F
Coil Length	NA	in
Coil Width	NA	in
Area	15.0	sq-ft
Fan CFM	3110	
Air Mass Flow	1.76	kg/sec

Capacity	6.16	Tons
Efficiency	16.06	EER
Efficiency	0.75	kW/Ton

CU Fan CFM Calculation

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	246	21.2	4.8	0.91

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-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	
ET	28		28	Low
SH	36		37	High
SC	19		18	
CT	87		87	
COA	24		22	
RAT	75	F	75	F
SAT	46	F	46	F
RAH	30	%	30	%
SAH	87	%	87	%
EI	80%	%	79%	%
CI	73%	%	72%	%
Predicted KW	5.7	kW	4.6	kW

CU Capacity Estimates

Ambient	66	F
CU Exhaust	89	F
Coil Length	NA	in
Coil Width	NA	in
Area	15.0	sq-ft
Fan CFM	1870	
Air Mass Flow	1.06	kg/sec

Capacity	3.87	Tons
Efficiency	9.68	EER
Efficiency	1.24	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

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	243	22.9	5.2	0.94

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-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	
CT	103		103	
COA	19		19	
RAT	75	F	75	F
SAT	48	F	48	F
RAH	26%	%	0.26	%
SAH	85%	%	0.85	%
EI	87%	%	84%	%
CI	86%	%	77%	%
Predicted KW	5.1	kW	4.7	kW

CU Capacity Estimates

Ambient	82	F	301	K
CU Exhaust	106	F	314	K
Coil Length		in		
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	3715			
Air Mass Flow	2.10	kg/sec		

Capacity	8.02	Tons
Efficiency	18.52	EER
Efficiency	0.65	kW/Ton

CU Fan CFM Calculation

Measurement Number	ft/sec
1	3.9
2	4.7
3	5.5
4	4.1
5	2.7
6	2.7
7	4.5
8	3.9
9	3.3
10	3.5
11	4.1
12	3.9
13	6.2
14	5.5
15	4.3
16	3.9
17	3.9
18	3.7
Average	4.128

TABLE 4-1
Unit 1 Baseline Study
Generic Compressor Test Summary-All Temperatures

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	

Test Date	HVAC Service Assistant						Physical Power and Capacity Measurements									
							Cond Air, 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
		AVERAGES	**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
		AVERAGES	**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%**

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions								
		Test Data			Percent Difference			Test Data			Percent Difference					
OAT		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)	5.7	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!	-	-	-
	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!	-	-	-
83G	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)	5.1	5.2	#REF!	#REF!	#REF!	98%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
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)	#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)	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															
73-G	Power (kW)	4.7	4.8	#REF!	#REF!	#REF!	98%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
81-G	Power (kW)	4.9	5.1	#REF!	#REF!	#REF!	96%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
82-G	Power (kW)	5.0	5.3	#REF!	#REF!	#REF!	94%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
83-G	Power (kW)	4.9	5.2	#REF!	#REF!	#REF!	94%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
85-G	Power (kW)	4.9	5.3	#REF!	#REF!	#REF!	92%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
85-G1	Power (kW)	5.6	5.4	#REF!	#REF!	#REF!	104%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
85-G2	Power (kW)	5.8	5.2	#REF!	#REF!	#REF!	112%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
86-G	Power (kW)	4.9	5.3	#REF!	#REF!	#REF!	92%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
87-G	Power (kW)	5.8	5.2	#REF!	#REF!	#REF!	112%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
89-G	Power (kW)	6.1	5.5	#REF!	#REF!	#REF!	111%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
91-G	Power (kW)	5.9	5.6	#REF!	#REF!	#REF!	105%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
90-G Clean Evap	Power (kW)	6.2	5.6	#REF!	#REF!	#REF!	111%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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)

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	

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments								
							Cond Air, 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%**

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions								
		Test Data			Percent Difference			Test Data			Percent Difference					
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SA/CU	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Estimated Degradation
85G	Power (kW)	4.9	5.3	#REF!	#REF!	#REF!	92%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
88G	Power (kW)	5.0	5.4	#REF!	#REF!	#REF!	93%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
90G	Power (kW)	5.0	5.4	#REF!	#REF!	#REF!	93%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
92G	Power (kW)	5.0	5.4	#REF!	#REF!	#REF!	93%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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															
85-G2	Power (kW)	**5.8**	**5.2**	**#REF!**	**#REF!**	**#REF!**	**112%**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**-**	**-**	**-**
	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!**
86-G	Power (kW)	**4.9**	**5.3**	**#REF!**	**#REF!**	**#REF!**	**92%**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**-**	**-**	**-**
	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!**
87-G	Power (kW)	**5.8**	**5.2**	**#REF!**	**#REF!**	**#REF!**	**112%**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**-**	**-**	**-**
	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!**
89-G	Power (kW)	**6.1**	**5.5**	**#REF!**	**#REF!**	**#REF!**	**111%**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**-**	**-**	**-**
	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!**
91-G	Power (kW)	**5.9**	**5.6**	**#REF!**	**#REF!**	**#REF!**	**105%**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**-**	**-**	**-**
	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!**
90-G Clean Evap	Power (kW)	**6.2**	**5.6**	**#REF!**	**#REF!**	**#REF!**	**111%**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**#REF!**	**-**	**-**	**-**
	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 B-1

Copeland Compressor Test Summary-All Temperatures

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 Assistant						Physical Power and Capacity Measurements						
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%	#REF!	4.6	66	89	12.8	4.8	1.06	3.87	9.68
April 14-C	66	56	103%	103%	#REF!	5.0	66	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	81%	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	56	86%	78%	#REF!	5.5	84	106	12.2	5.2	1.08	3.79	8.75
July 8 C4	84	55	84%	77%	#REF!	4.7	82	106	13.3	5.2	2.10	8.0	18.52
April 9-C1	85	57	81%	72%	#REF!	5.5	85	108	12.8	5.2	1.06	3.87	8.93
April 28-C2	85	59	83%	76%	#REF!	4.7	85	108	12.8	5.2	1.81	6.62	15.29
July 8-C3	85	56	83%	78%	#REF!	4.8	86	109	12.8	5.3	2.04	7.5	16.87
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	90	59	85%	81%	#REF!	4.8	90	116	14.4	5.6	2.22	9.17	19.65
May 08-C	92	59	84%	78%	#REF!	4.7	95	115	11.1	5.4	2.47	7.86	17.46
			83.4%	77.0%					12.6		1.7		14.4
POST ADSIL	OAT	EWB	EI	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	2.96	11.31	28.27
August 20-C	81	59	84%	76%	#REF!	4.6	79	102	12.8	5.1	2.94	10.74	25.28
August 23-C	82	63	88%	84%	#REF!	4.8	82	106	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	25.83
		Change	**6.1%**	**6.0%**					**6.3%**		**70.1%**		**79.3%**

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions								
		Test Data			Percent Difference			Test Data			Percent Difference					
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SA/CU	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Estimated Degradation
64-C	Power (kW)	4.6	4.800	#REF!	#REF!	#REF!	96%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
66-C	Power (kW)	5.0	4.600	#REF!	#REF!	#REF!	109%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
71-C	Power (kW)	4.6	4.8	#REF!	#REF!	#REF!	96%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
82-C	Power (kW)	4.7	5.3	#REF!	#REF!	#REF!	89%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
83-C	Power (kW)	4.7	5.1	#REF!	#REF!	#REF!	92%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
83-C1	Power (kW)	4.7	5.2	#REF!	#REF!	#REF!	90%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
84-C1	Power (kW)	4.7	5.3	#REF!	#REF!	#REF!	89%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
84-C2	Power (kW)	4.6	5.2	#REF!	#REF!	#REF!	88%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
84-C3	Power (kW)	5.5	5.2	#REF!	#REF!	#REF!	106%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
84-C3	Power (kW)	4.7	5.2	#REF!	#REF!	#REF!	90%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
85-C1	Power (kW)	5.5	5.2	#REF!	#REF!	#REF!	106%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
85-C2	Power (kW)	4.7	5.2	#REF!	#REF!	#REF!	90%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
85-C3	Power (kW)	4.8	5.3	#REF!	#REF!	#REF!	91%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
88-C	Power (kW)	4.7	5.4	#REF!	#REF!	#REF!	87%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
90-C	Power (kW)	4.7	5.4	#REF!	#REF!	#REF!	87%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
90-C1	Power (kW)	4.8	5.6	#REF!	#REF!	#REF!	86%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
92-C	Power (kW)	4.7	5.4	#REF!	#REF!	#REF!	87%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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															
73-C	Power (kW)	4.6	4.8	#REF!	#REF!	#REF!	96%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
81-C	Power (kW)	4.6	5.1	#REF!	#REF!	#REF!	90%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
82-C	Power (kW)	4.8	5.3	#REF!	#REF!	#REF!	91%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
83-C	Power (kW)	4.7	5.2	#REF!	#REF!	#REF!	90%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
85-C	Power (kW)	4.7	5.3	#REF!	#REF!	#REF!	89%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
85-C1	Power (kW)	5.6	5.4	#REF!	#REF!	#REF!	104%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
85-C2	Power (kW)	5.5	5.2	#REF!	#REF!	#REF!	106%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
86-C	Power (kW)	4.6	5.3	#REF!	#REF!	#REF!	87%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
87-C	Power (kW)	5.5	5.2	#REF!	#REF!	#REF!	106%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
89-C	Power (kW)	5.8	5.5	#REF!	#REF!	#REF!	105%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
91-C	Power (kW)	5.8	5.6	#REF!	#REF!	#REF!	104%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
90-C Clean Evap	Power (kW)	5.8	5.6	#REF!	#REF!	#REF!	104%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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 B-2

Copeland Compressor Test Summary at Ambient of 85 Degrees or Higher

(Maximum of 1 Test Per Temperature)

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	

Test Date	HVAC Service Assistant						Physical Power and Capacity Measurements						
							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 Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions								
		Test Data			Percent Difference			Test Data			Percent Difference					
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SA/CU	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Estimated Degradation
85-C1	Power (kW)	5.5	5.2	#REF!	#REF!	#REF!	106%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
88-C	Power (kW)	4.7	5.4	#REF!	#REF!	#REF!	87%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
90-C	Power (kW)	4.7	5.4	#REF!	#REF!	#REF!	87%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
92-C	Power (kW)	4.7	5.4	#REF!	#REF!	#REF!	87%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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															
85-C	Power (kW)	4.7	5.3	#REF!	#REF!	#REF!	89%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
85-C1	Power (kW)	5.6	5.4	#REF!	#REF!	#REF!	104%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
86-C	Power (kW)	4.6	5.3	#REF!	#REF!	#REF!	87%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
87-C	Power (kW)	5.5	5.2	#REF!	#REF!	#REF!	106%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
89-C	Power (kW)	5.8	5.5	#REF!	#REF!	#REF!	105%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
91-C	Power (kW)	5.8	5.6	#REF!	#REF!	#REF!	104%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!
90-C Clean Evap	Power (kW)	5.8	5.6	#REF!	#REF!	#REF!	104%	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	-	-	-
	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!

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

POST ADSIL

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	242	24.5	5.6	0.95

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-270	
Input SEER	10		10	
Input Cap	5		5	
SP	62		69	
ST	79		63	
LP	221		231	
LT	95		96	
OAT	91		91	
ET	36		40	
SH	40		22	
SC	14		16	
CT	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 Estimates

Ambient	89	F	305	K
CU Exhaust	115	F	319	K
Coil Length		in		
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	5340			
Air Mass Flow	3.02	kg/sec		

Capacity	12.49	Tons
Efficiency	26.77	EER
Efficiency	0.45	kW/Ton

CU Fan CFM Calculation

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.

POST ADSIL, CLEAN EVAP

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	241	24.5	5.6	0.95

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-270	
Input SEER	10		10	
Input Cap	5		5	
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	
CT	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 Estimates

Ambient	90	F	305	K
CU Exhaust	115	F	319	K
Coil Length		in		
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	5275			
Air Mass Flow	2.99	kg/sec		

Capacity	11.87	Tons
Efficiency	25.43	EER
Efficiency	0.47	kW/Ton

CU Fan CFM Calculation

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	243	24	5.5	0.94

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-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	
CT	109		109	
COA	20		20	
RAT	80	F	80	F
SAT	55	F	55	F
RAH	30%	%	30%	%
SAH	85%	%	85%	%
EI	93%	%	92%	%
CI	95%	%	87%	%
Predicted KW	6.1	kW	5.8	kW

CU Capacity Estimates

Ambient	89 F	305 K	
CU Exhaust	114 F	319 K	
Coil Length	in		
Coil Width	in		
Area	15.0 sq-ft		
Fan CFM	5165		
Air Mass Flow	2.93 kg/sec		

Capacity	11.62 Tons
Efficiency	25.35 EER
Efficiency	0.47 kW/Ton

CU Fan CFM Calculation

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	244	23	5.2	0.94

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-27C	
Input SEER	10		10	
Input Cap	5		5	
SP	61		60	
ST	48		44	
LP	201		204	
LT	87		88	
OAT	87		88	
ET	34		34	Low
SH	13		10	
SC	15		15	
CT	102		103	
COA	15		15	
RAT	76	F	76	F
SAT	59	F	59	F
RAH	35%	%	35%	%
SAH	85%	%	85%	%
EI	94%	%	92%	%
CI	90%	%	82%	%
Predicted KW	5.8	kW	5.5	kW

CU Capacity Estimates

Ambient	82	F	301	K
CU Exhaust	105	F	314	K
Coil Length		in		
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	5395			
Air Mass Flow	3.06	kg/sec		

Capacity	11.17	Tons
Efficiency	25.77	EER
Efficiency	0.47	kW/Ton

CU Fan CFM Calculation

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	241	23.4	5.3	0.95

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-270	
Input SEER	12		12	
Input Cap	5		5	
SP	61		61	
ST	42		42	
LP	208		208	
LT	91		91	
OAT	86		86	
ET	35		35	
SH	7		7	
SC	14		14	
CT	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 Estimates

Ambient	85	F	303	K
CU Exhaust	108	F	315	K
Coil Length		in		
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	5255			
Air Mass Flow	2.98	kg/sec		

Capacity	10.88	Tons
Efficiency	24.63	EER
Efficiency	0.49	kW/Ton

CU Fan CFM Calculation

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	244	22.9	5.2	0.94

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-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	
CT	102		102	
COA	18		18	
RAT	75	F	75	F
SAT	60	F	60	F
RAH	30%	%	30%	%
SAH	85%	%	85%	%
EI	88%	%	88%	%
CI	85%	%	79%	%
Predicted KW	5.8	kW	5.5	kW

CU Capacity Estimates

Ambient	84	F	302	K
CU Exhaust	107	F	315	K
Coil Length		in		
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	5320			
Air Mass Flow	3.01	kg/sec		

Capacity	11.01	Tons
Efficiency	25.41	EER
Efficiency	0.47	kW/Ton

CU Fan CFM Calculation

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	242	23.5	5.4	0.95

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-270	
Input SEER	12		12	
Input Cap	5		5	
SP	59		63	
ST	70		69	
LP	200		207	
LT	91		90	
OAT	85		85	
ET	34		36	
SH	36		32	
SC	11		14	
CT	102		104	
COA	18		19	
RAT	83	F	83	F
SAT	53	F	53	F
RAH	37%	%	37%	%
SAH	85%	%	85%	%
EI	88%	%	89%	%
CI	85%	%	81%	%
Predicted KW	5.6	kW	5.6	kW

CU Capacity Estimates

Ambient	82	F	301	K
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

CU Fan CFM Calculation

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	241	23.1	5.3	0.95

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-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	16		16	
CT	104		104	
COA	19		19	
RAT	76	F	76	F
SAT	48	F	48	F
RAH	40%	%	40%	%
SAH	85%	%	85%	%
EI	88%	%	89%	%
CI	85%	%	81%	%
Predicted KW	4.9	kW	4.7	kW

CU Capacity Estimates

Ambient	84	F	302	K
CU Exhaust	107	F	315	K
Coil Length		in		
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	5150			
Air Mass Flow	2.92	kg/sec		

Capacity	10.66	Tons
Efficiency	24.14	EER
Efficiency	0.50	kW/Ton

CU Fan CFM Calculation

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	242	22.9	5.2	0.94

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-270	
Input SEER	12		12	
Input Cap	5		5	
SP	61		61	
ST	42		42	
LP	206		206	
LT	88		88	
OAT	83		83	
ET	35		35	
SH	8		8	
SC	15		15	
CT	103		103	
COA	20		20	
RAT	76	F	76	F
SAT	48	F	48	F
RAH	40%	%	40%	%
SAH	85%	%	85%	%
EI	88%	%	84%	%
CI	87%	%	78%	%
Predicted KW	4.9	kW	4.7	kW

CU Capacity Estimates

Ambient	83	F	301	K
CU Exhaust	107	F	315	K
Coil Length		in		
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	5275			
Air Mass Flow	2.99	kg/sec		

Capacity	11.39	Tons
Efficiency	26.29	EER
Efficiency	0.46	kW/Ton

CU Fan CFM Calculation

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	243	23.1	5.3	0.94

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-270	
Input SEER	12		12	
Input Cap	5		5	
SP	66		66	
ST	57		57	
LP	203		203	
LT	84		84	
OAT	82		82	
ET	38		38	
SH	18		18	
SC	18		18	
CT	102		102	
COA	21		21	
RAT	80	F	80	F
SAT	52	F	52	F
RAH	40%	%	40%	%
SAH	85%	%	85%	%
EI	95%	%	88%	%
CI	95%	%	84%	%
Predicted KW	5	kW	4.8	kW

CU Capacity Estimates

Ambient	82	F	301	K
CU Exhaust	106	F	314	K
Coil Length		in		
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	5150			
Air Mass Flow	2.92	kg/sec		
Capacity	11.12	Tons		
Efficiency	25.18	EER		
Efficiency	0.48	kW/Ton		

CU Fan CFM Calculation

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	242	22.4	5.1	0.94

HVAC Service Assistant Measurement

	Generic		Copeland 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	
CT	98		98	
COA	18		18	
RAT	74	F	74	F
SAT	46	F	46	F
RAH	40%	%	40%	%
SAH	85%	%	85%	%
EI	87%	%	84%	%
CI	85%	%	76%	%
Predicted KW	4.9	kW	4.6	kW

CU Capacity Estimates

Ambient	79	F	299	K
CU Exhaust	102	F	312	K
Coil Length		in		
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	5190			
Air Mass Flow	2.94	kg/sec		

Capacity	10.74	Tons
Efficiency	25.28	EER
Efficiency	0.47	kW/Ton

CU Fan CFM Calculation

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

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	245	21.4	4.8	0.92

HVAC Service Assistant Measurement

	Generic		Copeland 6CRN5-0500-PFV-270	
Input SEER	12		12	
Input 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	
CT	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 Estimates

Ambient	72	F	295	K
CU Exhaust	96	F	309	K
Coil Length		in		
Coil Width		in		
Area	15.0	sq-ft		
Fan CFM	5235			
Air Mass Flow	2.96	kg/sec		

Capacity	11.31	Tons
Efficiency	28.27	EER
Efficiency	0.42	kW/Ton

CU Fan CFM Calculation

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

HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	9.3	Btu/W-hr	(CU Only)
Model Number:	38YCC060	**Calculated EER:**	9.3	Btu/W-hr	(CU Only)
Serial Number		**Nominal Capacity:**	4.67	tons	
Equipment Type:	SS Heat pump	**Age**	3	years	
Year Manufactured:	2001	**Coil Conditon**	3%	(% degraded)	
Location	MACTEC Hendrickson	**Present Condition EER**	9.1	Btu/W-hr	
Tag	HP-7	**kW/ton**	1.32		

Compressor Data

Running load Amps:	17.0	Amps	Power supply:	3-phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1.73
Power factor:	0.86		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 applicable)

Full load Amps:	5.40	Amps	Power supply:	1-Phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.11		Fan quantity:	1

Calculated compressor load:	**5.8**	kW
Calculated condensing fan load:	**0.23**	kW
Calculated evaporator fan load	**0.13**	kW
Total calculated load for equipment:	**6.04**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **3.2%** **Performance Degradation**

Overall Unit Condition		
	New	
	Average	**X**
	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	**x**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	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 Assistant Measurment

Input SEER	10	
RAT	76	F
SAT	56	F
RAH	25	%
SAH	85	%
EI	95%	
CI	92%	
Input Cap	5	Tons
OAT	83	F
Predicted KW	5.80	kW

CU Capacity Estimates

Ambient	82	F	301	K
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

HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	9.3	Btu/W-hr (CU Only)
Model Number:	38YCC060	**Calculated EER:**	9.3	Btu/W-hr (CU Only)
Serial Number		**Nominal Capacity:**	4.67	tons
Equipment Type:	SS Heat pump	**Age**	3	years
Year Manufactured:	2001	**Coil Conditon**	3%	(% degraded)
Location	MACTEC Hendrickson	**Present Condition EER**	9.1	Btu/W-hr
Tag	HP-7	**kW/ton**	1.32	

Compressor Data

Running load Amps:	17.0	Amps	Power supply:	3-phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1.73
Power factor:	0.86		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 applicable)

Full load Amps:	5.40	Amps	Power supply:	1-Phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.11		Fan quantity:	1

Calculated compressor load:	**5.8**	kW
Calculated condensing fan load:	**0.23**	kW
Calculated evaporator fan load	**0.13**	kW
Total calculated load for equipment:	**6.04**	kW - Condensing side only
Assumptions		

Condenser Coil Assessment **3.2%** **Performance Degradation**

Overall Unit Condition		
	New	
	Average	X
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
3-Phase	212.0	15.9	4.6	0.78
		kW 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	0.41
TOTAL			4.44	

HVAC Service Assistant Measurment

Input SEER	10	
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 Estimates

Ambient	86	F	303	K
CU Exhaust	100	F	311	K
Coil Length	90	in		
Coil Width	35	in		
Area	22	sq-ft		
Measured Fan CFM	6530			
Air Mass Flow	3.70	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

HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	9.3	Btu/W-hr (CU Only)
Model Number:	38YCC060	**Calculated EER:**	9.3	Btu/W-hr (CU Only)
Serial Number		**Nominal Capacity:**	4.67	tons
Equipment Type:	SS Heat pump	**Age**	3	years
Year Manufactured:	2001	**Coil Conditon**	3%	(% degraded)
Location	MACTEC Hendrickson	**Present Condition EER**	9.1	Btu/W-hr
Tag	HP-7	**kW/ton**	1.32	

Compressor Data

Running load Amps:	17.0	Amps	Power supply:	3-phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1.73
Power factor:	0.86		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 applicable)

Full load Amps:	5.40	Amps	Power supply:	1-Phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.11		Fan quantity:	1

Calculated compressor load:	**5.8**	kW
Calculated condensing fan load:	**0.23**	kW
Calculated evaporator fan load	**0.13**	kW
Total calculated load for equipment:	**6.04**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **3.2%** **Performance Degradation**

Overall Unit Condition

New	
Average	X
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	x
Corrosion	
Some Loose	
Many Loose	
Tubes	
Clean Cu	x
Corrosion	
Pitting	
Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
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 Assistant Measurment

Input SEER	10	
RAT	73	F
SAT	53	F
RAH	30	%
SAH	85	%
EI	97%	
CI	96%	
Input Cap	5	Tons
OAT	86	F
Predicted KW	5.90	kW

CU Capacity Estimates

Ambient	86 F		303 K
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	3.33 kg/sec		
Capacity	7.40 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

HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	9.3 Btu/W-hr (CU Only)
Model Number:	38YCC060	**Calculated EER:**	9.3 Btu/W-hr (CU Only)
Serial Number		**Nominal Capacity:**	4.67 tons
Equipment Type:	SS Heat pump	**Age**	3 years
Year Manufactured:	2001	**Coil Conditon**	3% (% degraded)
Location	MACTEC Hendrickson	**Present Condition EER**	9.1 Btu/W-hr
Tag	HP-7	**kW/ton**	1.32

Compressor Data

Running load Amps:	17.0	Amps	Power supply:	3-phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1.73
Power factor:	0.86		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 applicable)

Full load Amps:	5.40	Amps	Power supply:	1-Phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.11		Fan quantity:	1

Calculated compressor load:	**5.8**	kW
Calculated condensing fan load:	**0.23**	kW
Calculated evaporator fan load	**0.13**	kW
Total calculated load for equipment:	**6.04**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **3.2%** **Performance Degradation**

Overall Unit Condition		
	New	
	Average	X
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

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			4.64	

HVAC Service Assistant Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	24	%
SAH	85	%
EI	96%	
CI	94%	
Input Cap	5	Tons
OAT	87	F
Predicted KW	5.90	kW

CU Capacity Estimates

Ambient	87	F	304	K
CU Exhaust	103	F	313	K
Coil Length	90	in		
Coil Width	35	in		
Area	22	sq-ft		
Measured Fan CFM	6956			
Air Mass Flow	3.94	kg/sec		
Capacity	10.02	Tons		
Efficiency	25.90	EER		

CU Fan CFM Calculation

Measurement Number	ft/sec
1	5.8
2	5.8
3	4.8
4	4.8
Average	5.3

HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	9.3	Btu/W-hr (CU Only)
Model Number:	38YCC060	**Calculated EER:**	9.3	Btu/W-hr (CU Only)
Serial Number		**Nominal Capacity:**	4.67	tons
Equipment Type:	SS Heat pump	**Age**	3	years
Year Manufactured:	2001	**Coil Conditon**	3%	(% degraded)
Location	MACTEC Hendrickson	**Present Condition EER**	9.1	Btu/W-hr
Tag	HP-7	**kW/ton**	1.32	

Compressor Data

Running load Amps:	17.0	Amps	Power supply:	3-phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1.73
Power factor:	0.86		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 applicable)

Full load Amps:	5.40	Amps	Power supply:	1-Phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.11		Fan quantity:	1

Calculated compressor load:	**5.8**	kW
Calculated condensing fan load:	**0.23**	kW
Calculated evaporator fan load	**0.13**	kW
Total calculated load for equipment:	**6.04**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **3.2%** **Performance Degradation**

Overall Unit Condition		
	New	
	Average	X
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
3-Phase	213.0	13.7	4.0	0.80
		kW 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 Assistant Measurment

Input SEER	10	
RAT	73	F
SAT	53	F
RAH	24	%
SAH	85	%
EI	95%	
CI	93%	
Input Cap	5	Tons
OAT	88	F
Predicted KW	5.90	kW

CU Capacity 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	3.75	kg/sec		
Capacity	8.35	Tons		
Efficiency	21.78	EER		

CU Fan CFM Calculation

Measurement Number	ft/sec
1	5.4
2	5.4
3	4.4
4	5.0
Average	5.1

HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	9.3	Btu/W-hr (CU Only)
Model Number:	38YCC060	**Calculated EER:**	9.3	Btu/W-hr (CU Only)
Serial Number		**Nominal Capacity:**	4.67	tons
Equipment Type:	SS Heat pump	**Age**	3	years
Year Manufactured:	2001	**Coil Conditon**	3%	(% degraded)
Location	MACTEC Hendrickson	**Present Condition EER**	9.1	Btu/W-hr
Tag	HP-7	**kW/ton**	1.32	

Compressor Data

Running load Amps:	17.0	Amps	Power supply:	3-phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1.73
Power factor:	0.86		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 applicable)

Full load Amps:	5.40	Amps	Power supply:	1-Phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.11		Fan quantity:	1

Calculated compressor load:	**5.8**	kW
Calculated condensing fan load:	**0.23**	kW
Calculated evaporator fan load	**0.13**	kW
Total calculated load for equipment:	**6.04**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **3.2%** **Performance Degradation**

Overall Unit Condition		
	New	
	Average	X
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
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 Assistant 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 Estimates

Ambient	87	F	304	K
CU Exhaust	103	F	313	K
Coil Length	90	in		
Coil Width	35	in		
Area	22	sq-ft		
Measured Fan CFM	6891			
Air Mass Flow	3.90	kg/sec		
Capacity	9.92	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

HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	9.3	Btu/W-hr	(CU Only)
Model Number:	38YCC060	**Calculated EER:**	9.3	Btu/W-hr	(CU Only)
Serial Number		**Nominal Capacity:**	4.67	tons	
Equipment Type:	SS Heat pump	**Age**	3	years	
Year Manufactured:	2001	**Coil Conditon**	3%	(% degraded)	
Location	MACTEC Hendrickson	**Present Condition EER**	9.1	Btu/W-hr	
Tag	HP-7	**kW/ton**	1.32		

Compressor Data

Running load Amps:	17.0	Amps	Power supply:	3-phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1.73
Power factor:	0.86		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 applicable)

Full load Amps:	5.40	Amps	Power supply:	1-Phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.11		Fan quantity:	1

Calculated compressor load:	**5.8**	kW
Calculated condensing fan load:	**0.23**	kW
Calculated evaporator fan load	**0.13**	kW
Total calculated load for equipment:	**6.04**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **3.2%** **Performance Degradation**

Overall Unit Condition		
	New	
	Average	X
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
3-Phase	213.0	16.4	4.8	0.79
		kW Difference	0.16	

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 Assistant Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	26	%
SAH	85	%
EI	96%	
CI	95%	
Input Cap	5	Tons
OAT	89	F
Predicted KW	6.00	kW

CU Capacity Estimates

Ambient	90	F	305	K
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	10.01	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

HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	9.3 Btu/W-hr (CU Only)
Model Number:	38YCC060	**Calculated EER:**	9.3 Btu/W-hr (CU Only)
Serial Number		**Nominal Capacity:**	4.67 tons
Equipment Type:	SS Heat pump	**Age**	3 years
Year Manufactured:	2001	**Coil Conditon**	3% (% degraded)
Location	MACTEC Hendrickson	**Present Condition EER**	9.1 Btu/W-hr
Tag	HP-7	**kW/ton**	1.32

Compressor Data

Running load Amps:	17.0	Amps	Power supply:	3-phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1.73
Power factor:	0.86		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 applicable)

Full load Amps:	5.40	Amps	Power supply:	1-Phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.11		Fan quantity:	1

Calculated compressor load:	**5.8**	kW
Calculated condensing fan load:	**0.23**	kW
Calculated evaporator fan load	**0.13**	kW
Total calculated load for equipment:	**6.04**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **3.2%** **Performance Degradation**

Overall Unit Condition		
	New	
	Average	**X**
	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	**x**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
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 Assistant Measurment

Input SEER	10	
RAT	76	F
SAT	56	F
RAH	25	%
SAH	85	%
EI	98%	
CI	98%	
Input Cap	5	Tons
OAT	92	F
Predicted KW	6.00	kW

CU Capacity Estimates

Ambient	94 F	308 K
CU Exhaust	110 F	316 K
Coil Length	90 in	
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

Measurement Number	ft/sec
1	5.9
2	6.9
3	6.7
4	5.4
Average	6.2

HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	9.3	Btu/W-hr	(CU Only)
Model Number:	38YCC060	**Calculated EER:**	9.3	Btu/W-hr	(CU Only)
Serial Number		**Nominal Capacity:**	4.67	tons	
Equipment Type:	SS Heat pump	**Age**	3	years	
Year Manufactured:	2001	**Coil Conditon**	0%	(% degraded)	
Location	MACTEC Hendrickson	**Present Condition EER**	9.4	Btu/W-hr	
Tag	HP-7	**kW/ton**	1.28		

Compressor Data

Running load Amps:	17.0	Amps	Power supply:	3-phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1.73
Power factor:	0.86		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 applicable)

Full load Amps:	5.40	Amps	Power supply:	1-Phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.11		Fan quantity:	1

Calculated compressor load:	**5.8**	kW
Calculated condensing fan load:	**0.23**	kW
Calculated evaporator fan load	**0.13**	kW
Total calculated load for equipment:	**6.04**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

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

FLUKE METER MEASURMENTS

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 Assistant Measurment

Input SEER	10	
RAT	76	F
SAT	56	F
RAH	34	%
SAH	85	%
EI	98%	
CI	94%	
Input Cap	5	Tons
OAT	89	F
Predicted KW	5.80	kW

CU Capacity Estimates

Ambient	87	F	304	K
CU Exhaust	105	F	314	K
Coil Length	90	in		
Coil Width	35	in		
Area	22	sq-ft		
Measured Fan CFM	8695			
Air Mass Flow	4.92	kg/sec		
Capacity	14.09	Tons		
Efficiency	36.59	EER		

CU Fan CFM Calculation

Measurement Number	ft/sec
1	6.8
2	7.3
3	7.0
4	5.4
Average	6.6

HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	9.3	Btu/W-hr (CU Only)
Model Number:	38YCC060	**Calculated EER:**	9.3	Btu/W-hr (CU Only)
Serial Number		**Nominal Capacity:**	4.67	tons
Equipment Type:	SS Heat pump	**Age**	3	years
Year Manufactured:	2001	**Coil Conditon**	0%	(% degraded)
Location	MACTEC Hendrickson	**Present Condition EER**	9.4	Btu/W-hr
Tag	HP-7	**kW/ton**	1.28	

Compressor Data

Running load Amps:	17.0	Amps	Power supply:	3-phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1.73
Power factor:	0.86		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 applicable)

Full load Amps:	5.40	Amps	Power supply:	1-Phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.11		Fan quantity:	1

Calculated compressor load:	**5.8**	kW
Calculated condensing fan load:	**0.23**	kW
Calculated evaporator fan load	**0.13**	kW
Total calculated load for equipment:	**6.04**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

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

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
3-Phase	213.0	15.6	4.5	0.79
		kW 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 Assistant Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	40	%
SAH	85	%
EI	96%	
CI	95%	
Input Cap	5	Tons
OAT	85	F
Predicted KW	5.90	kW

CU Capacity Estimates

Ambient	86	F	303 K
CU Exhaust	101	F	311 K
Coil Length	90	in	
Coil Width	35	in	
Area	22	sq-ft	
Measured Fan CFM	7908		
Air Mass Flow	4.48	kg/sec	
Capacity	10.67	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

HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	9.3	Btu/W-hr (CU Only)
Model Number:	38YCC060	**Calculated EER:**	9.3	Btu/W-hr (CU Only)
Serial Number		**Nominal Capacity:**	4.67	tons
Equipment Type:	SS Heat pump	**Age**	3	years
Year Manufactured:	2001	**Coil Conditon**	0%	(% degraded)
Location	MACTEC Hendrickson	**Present Condition EER**	9.4	Btu/W-hr
Tag	HP-7	**kW/ton**	1.28	

Compressor Data

Running load Amps:	17.0	Amps	Power supply:	3-phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1.73
Power factor:	0.86		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 applicable)

Full load Amps:	5.40	Amps	Power supply:	1-Phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.11		Fan quantity:	1

Calculated compressor load:	**5.8**	kW
Calculated condensing fan load:	**0.23**	kW
Calculated evaporator fan load	**0.13**	kW
Total calculated load for equipment:	**6.04**	kW - Condensing side only
Assumptions		

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

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

FLUKE METER MEASURMENTS

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	212	13.8	1.25	0.43
TOTAL			4.65	

HVAC Service Assistant Measurment

Input SEER	10	
RAT	73	F
SAT	53	F
RAH	28	%
SAH	85	%
EI	99%	
CI	96%	
Input Cap	5	Tons
OAT	89	F
Predicted KW	5.90	kW

CU Capacity Estimates

Ambient	87	F	304	K
CU Exhaust	103	F	313	K
Coil Length	90	in		
Coil Width	35	in		
Area	22	sq-ft		
Measured Fan CFM	7777			
Air Mass Flow	4.40	kg/sec		
Capacity	11.20	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

HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	9.3	Btu/W-hr	(CU Only)
Model Number:	38YCC060	**Calculated EER:**	9.3	Btu/W-hr	(CU Only)
Serial Number		**Nominal Capacity:**	4.67	tons	
Equipment Type:	SS Heat pump	**Age**	3	years	
Year Manufactured:	2001	**Coil Conditon**	0%	(% degraded)	
Location	MACTEC Hendrickson	**Present Condition EER**	9.4	Btu/W-hr	
Tag	HP-7	**kW/ton**	1.28		

Compressor Data

Running load Amps:	17.0	Amps	Power supply:	3-phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1.73
Power factor:	0.86		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 applicable)

Full load Amps:	5.40	Amps	Power supply:	1-Phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.11		Fan quantity:	1

Calculated compressor load:	**5.8**	kW
Calculated condensing fan load:	**0.23**	kW
Calculated evaporator fan load	**0.13**	kW
Total calculated load for equipment:	**6.04**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

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

FLUKE METER MEASURMENTS

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 Assistant Measurment

Input SEER	10	
RAT	76	F
SAT	56	F
RAH	29	%
SAH	85	%
EI	94%	
CI	90%	
Input Cap	5	Tons
OAT	82	F
Predicted KW	5.80	kW

CU Capacity Estimates

Ambient	84	F	302	K
CU Exhaust	99	F	310	K
Coil Length	90	in		
Coil Width	35	in		
Area	22	sq-ft		
Measured Fan CFM	7481			
Air Mass Flow	4.24	kg/sec		
Capacity	10.10	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

HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	9.3 Btu/W-hr (CU Only)
Model Number:	38YCC060	**Calculated EER:**	9.3 Btu/W-hr (CU Only)
Serial Number		**Nominal Capacity:**	4.67 tons
Equipment Type:	SS Heat pump	**Age**	3 years
Year Manufactured:	2001	**Coil Conditon**	0% (% degraded)
Location	MACTEC Hendrickson	**Present Condition EER**	9.4 Btu/W-hr
Tag	HP-7	**kW/ton**	1.28

Compressor Data

Running load Amps:	17.0	Amps	Power supply:	3-phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1.73
Power factor:	0.86		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 applicable)

Full load Amps:	5.40	Amps	Power supply:	1-Phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.11		Fan quantity:	1

Calculated compressor load:	**5.8**	kW
Calculated condensing fan load:	**0.23**	kW
Calculated evaporator fan load	**0.13**	kW
Total calculated load for equipment:	**6.04**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

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

FLUKE METER MEASURMENTS

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 Assistant Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	35	%
SAH	85	%
EI	99%	
CI	98%	
Input Cap	5	Tons
OAT	91	F
Predicted KW	5.90	kW

CU Capacity Estimates

Ambient	90	F	305 K
CU Exhaust	105	F	314 K
Coil Length	90	in	
Coil Width	35	in	
Area	22	sq-ft	
Measured Fan CFM	8006		
Air Mass Flow	4.53	kg/sec	
Capacity	10.81	Tons	
Efficiency	28.13	EER	

CU Fan CFM Calculation

Measurement Number	ft/sec
1	6.2
2	7.1
3	6
4	5.1
Average	6.1

HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	9.3	Btu/W-hr (CU Only)
Model Number:	38YCC060	**Calculated EER:**	9.3	Btu/W-hr (CU Only)
Serial Number		**Nominal Capacity:**	4.67	tons
Equipment Type:	SS Heat pump	**Age**	3	years
Year Manufactured:	2001	**Coil Conditon**	0%	(% degraded)
Location	MACTEC Hendrickson	**Present Condition EER**	9.4	Btu/W-hr
Tag	HP-7	**kW/ton**	1.28	

Compressor Data

Running load Amps:	17.0	Amps	Power supply:	3-phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1.73
Power factor:	0.86		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 applicable)

Full load Amps:	5.40	Amps	Power supply:	1-Phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.11		Fan quantity:	1

Calculated compressor load:	**5.8**	kW
Calculated condensing fan load:	**0.23**	kW
Calculated evaporator fan load	**0.13**	kW
Total calculated load for equipment:	**6.04**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

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

FLUKE METER MEASURMENTS

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 Assistant Measurment

Input SEER	10	
RAT	76	F
SAT	56	F
RAH	21	%
SAH	85	%
EI	97%	
CI	93%	
Input Cap	5	Tons
OAT	88	F
Predicted KW	5.80	kW

CU Capacity Estimates

Ambient	90	F	305 K
CU Exhaust	105	F	314 K
Coil Length	90	in	
Coil Width	35	in	
Area	22	sq-ft	
Measured Fan CFM	8138		
Air Mass Flow	4.61	kg/sec	
Capacity	10.98	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

HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	9.3 Btu/W-hr (CU Only)
Model Number:	38YCC060	**Calculated EER:**	9.3 Btu/W-hr (CU Only)
Serial Number		**Nominal Capacity:**	4.67 tons
Equipment Type:	SS Heat pump	**Age**	3 years
Year Manufactured:	2001	**Coil Conditon**	0% (% degraded)
Location	MACTEC Hendrickson	**Present Condition EER**	9.4 Btu/W-hr
Tag	HP-7	**kW/ton**	1.28

Compressor Data

Running load Amps:	17.0	Amps	Power supply:	3-phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1.73
Power factor:	0.86		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 applicable)

Full load Amps:	5.40	Amps	Power supply:	1-Phase
Nameplate Voltage:	230	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.11		Fan quantity:	1

Calculated compressor load:	**5.8**	kW
Calculated condensing fan load:	**0.23**	kW
Calculated evaporator fan load	**0.13**	kW
Total calculated load for equipment:	**6.04**	kW - Condensing side only

Assumptions

Condenser Coil Assessment 0.0% **Performance Degradation**

Overall Unit Condition

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

FLUKE METER MEASURMENTS

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 Assistant Measurment

Input SEER	10	
RAT	76	F
SAT	56	F
RAH	29	%
SAH	85	%
EI	97%	
CI	93%	
Input Cap	5	Tons
OAT	88	F
Predicted KW	5.80	kW

CU Capacity Estimates

Ambient	89	F	305	K
CU Exhaust	104	F	313	K
Coil Length	90	in		
Coil Width	35	in		
Area	22	sq-ft		
Measured Fan CFM	7186			
Air Mass Flow	4.07	kg/sec		
Capacity	9.70	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

EER at ARI Conditions	9.27	BTU/W-h
Condensing unit CFM	3300	CFM (Listed)
Capacity at ARI	4.67	tons
Coil Area	22	sq-ft
Predicted EER =	9.07	BTU/W-h

Test Date		HVAC Service Assistant							Physical Power and Capacity measurments								
									Cond Air, deg F		Cond Air						
		OAT	EWB	EI	CI	EER	Cap	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER	cfm adj	EER Adj
PRE	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
	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
	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**
POST	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
	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		**97%**	**94%**						**8.65**		**4.47**		**29.26**	**0.38**	**11.12**
		Change		**1.1%**	**-0.64%**						**2.11%**		**14.29%**		**17.45%**		**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:

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

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 cooling[1], 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.

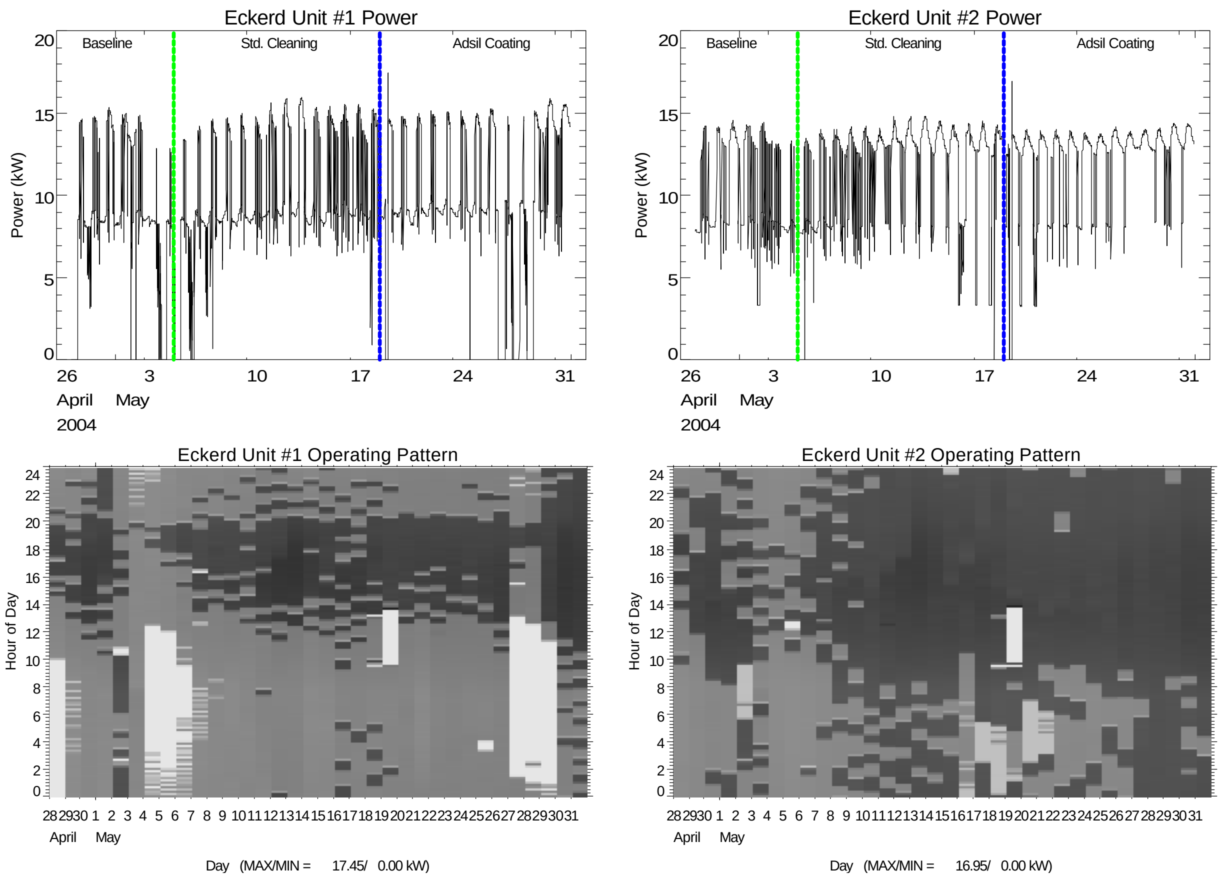


Figure 1. Rooftop Unit Operating Patterns

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.

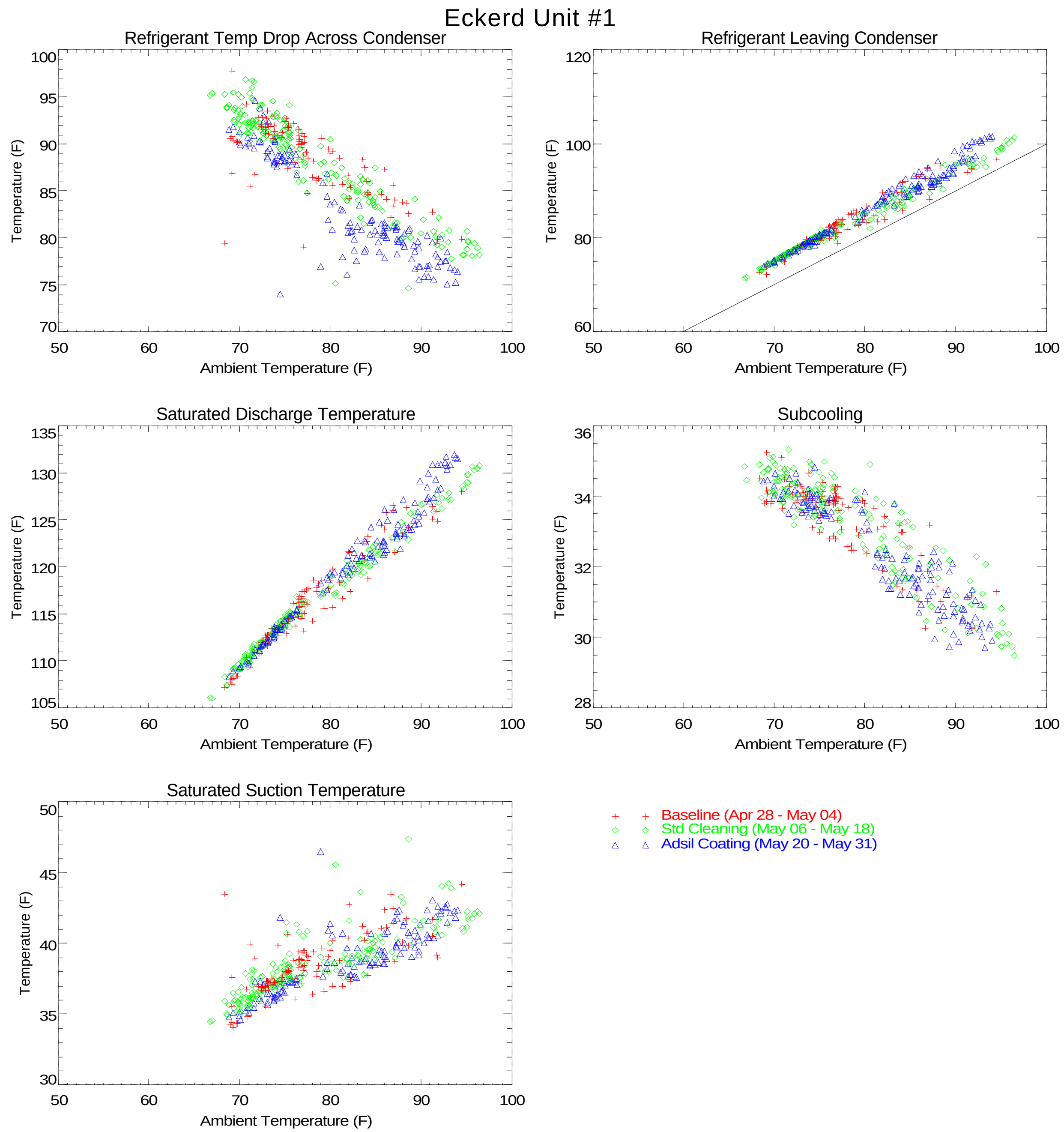


Figure 2. Condenser Performance - Unit 1

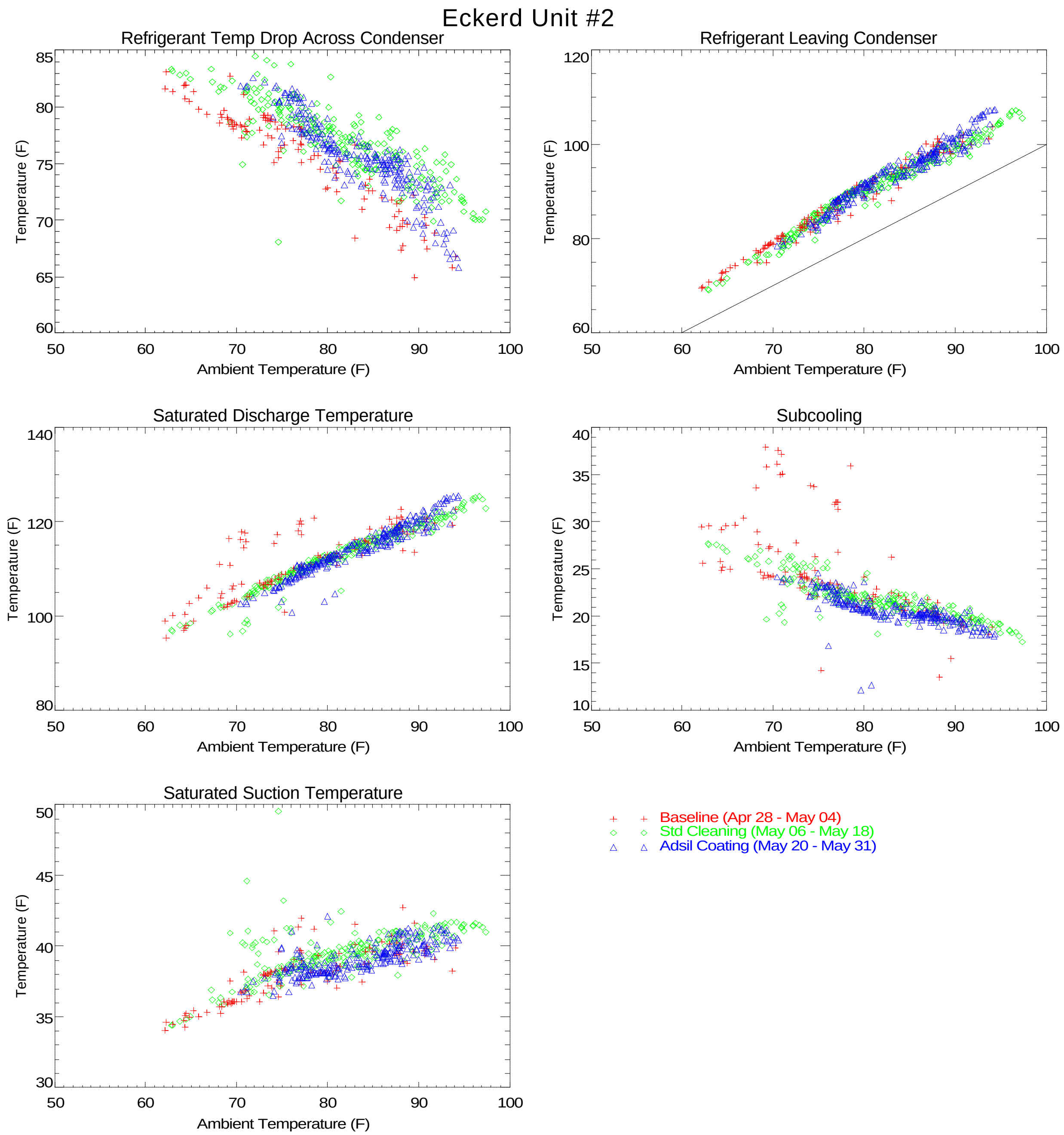


Figure 3. Condenser Performance - Unit 2

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.

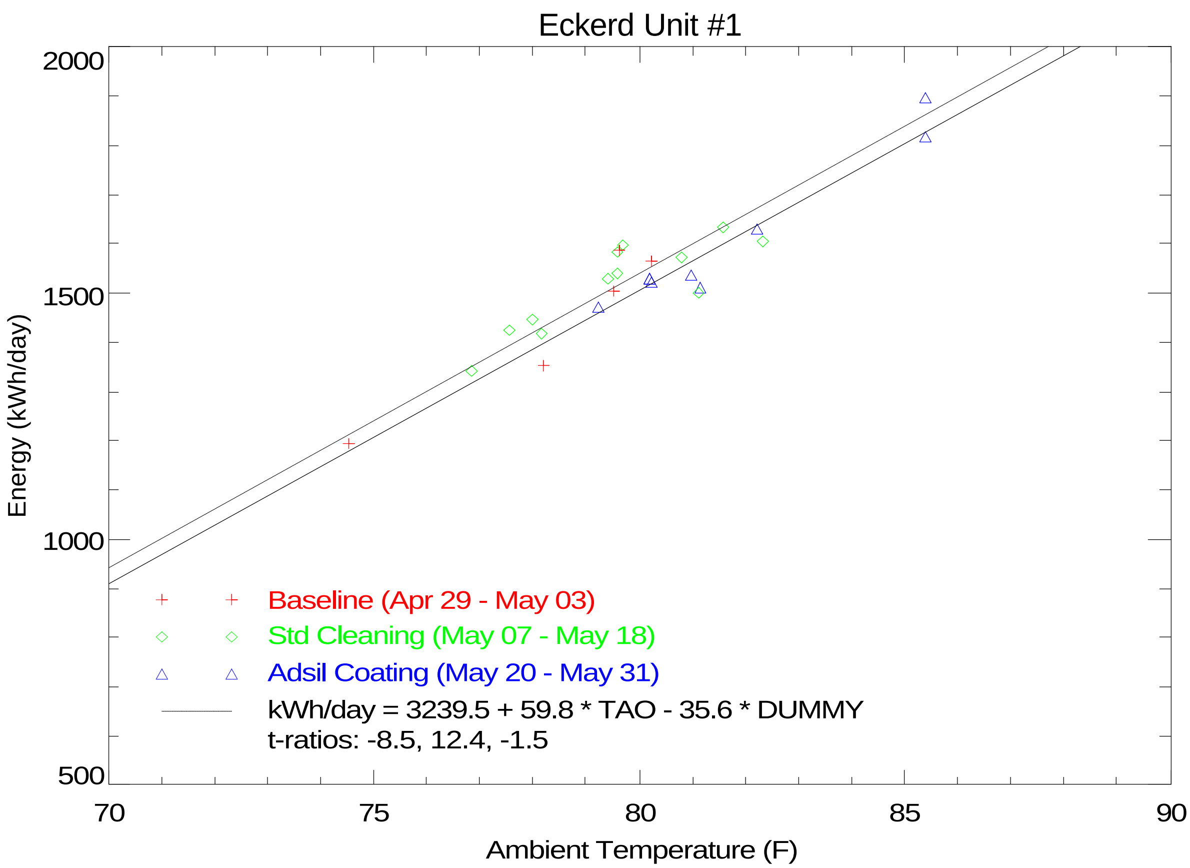


Figure 4. Unit 1 Daily Energy Variation with Ambient

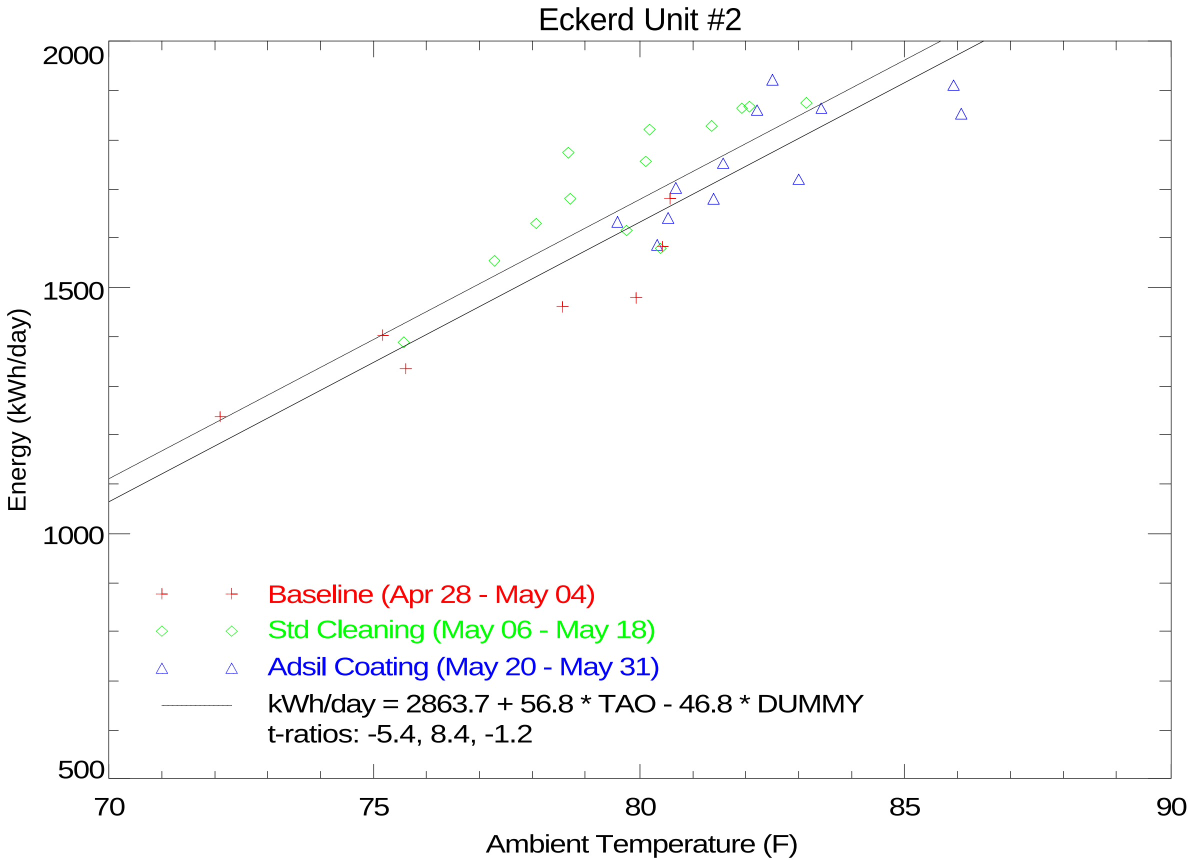


Figure 5. Unit 2 Daily Energy Variation with Ambient

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

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:
    - Packaged equipment (including rooftop units)
    - Split systems (including standard residential a/c units)
    - 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...)

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
    - Visit our office for a demonstration of the Service Assistant directly for the development team!
    - Print this Honeywell cut sheet for a clear definition of the product and ask your local Honeywell distribution or sales representative for a demonstration.
    - Contact Field Diagnostic Services for help arranging for a product demonstration.

Free Downloads

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

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	10.7	Btu/W-hr (CU Only)
Model Number:	38AE-012-500	**Calculated EER:**	10.7	Btu/W-hr (CU Only)
Serial Number	T890439	**Nominal Capacity:**	9.19	tons
Equipment Type:	Split System	**Age**	15	years
Year Manufactured:	1989	**Coil Conditon**	6%	(% degraded)
Location	YTC Truck School	**Present Condition EER**	9.1	Btu/W-hr
Tag	SS-1	**kW/ton**	1.31	

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:	0.50	Amps (Average of 2)	Power supply:	1-Phase
Nameplate Voltage:	208	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.70		Fan quantity:	2

Evaporator fan data (if applicable)

Full load Amps:		Amps	Power supply:	
Nameplate Voltage:		Volts	Phase adjustment:	
Adjust FLA to RLA:	0.70		Fan quantity:	

Calculated compressor load:	**10.2**	kW
Calculated condensing fan load:	**0.15**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**10.34**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **5.7%** **Performance Degradation**

Overall Unit Condition	
New	
Average	**1**
Fair	
Poor	
Coil Cleanliness	
Coated	
Clean	**0.75**
Dirty	**0.25**
Clogged	
Plugged	
Fin Condition	
Like New	
Some Bent	**0.1**
Smashed	
Dull/rough	**0.75**
Corroded	
Pitted	
Flaking	
Fin-Tube Attachment	
Like New	**x**
Corrosion	
Some Loose	
Many Loose	
Tubes	
Clean Cu	**x**
Corrosion	
Pitting	
Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
1				
2				
3				

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	208	24.0	6.1	0.99
2 to 3	208	30.4	3.4	0.54
TOTAL				

HVAC Service Assistant Measurment

Input SEER	10	
RAT	77	F
SAT	57	F
RAH	33	%
SAH	85	%
EI	98%	
CI	97%	
Input Cap	10	Tons
OAT	85	F
Predicted KW	11.80	kW

CU Capacity Estimates

Ambient	89	F	305	K
CU Exhaust	104.5	F	313	K
Coil Length	133	in		
Coil Width	31	in		
Area	28.6	sq-ft		
Measured Fan CFM	7215			
Air Mass Flow	4.09	kg/sec		
Capacity	10.06	Tons		
Efficiency	12.71	EER		
Efficiency	0.94	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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	10.7	Btu/W-hr (CU Only)
Model Number:	38AE-012-500	**Calculated EER:**	10.7	Btu/W-hr (CU Only)
Serial Number	T890439	**Nominal Capacity:**	9.2	tons
Equipment Type:	Split System	**Age**	15	years
Year Manufactured:	1989	**Coil Conditon**	0%	(% degraded)
Location	YTC Truck School	**Present Condition EER**	9.6	Btu/W-hr
Tag	SS-1	**kW/ton**	1.25	

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 applicable)

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:	**10.2**	kW
Calculated condensing fan load:	**0.15**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**10.34**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

New	X
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	x
Corrosion	
Some Loose	
Many Loose	
Tubes	
Clean Cu	x
Corrosion	
Pitting	
Leaks	

FLUKE METER MEASURMENTS

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	209	28.9	3.2	0.56

TOTAL

HVAC Service Assistant Measurment

Input SEER	10	
RAT	77	F
SAT	57	F
RAH	33	%
SAH	85	%
EI	107%	
CI	103%	
Input Cap	10	Tons
OAT	86	F
Predicted KW	11.60	kW

CU Capacity Estimates

Ambient	88 F		304 K
CU Exhaust	97 F		309 K
Coil Length	133 in		
Coil Width	31 in		
Area	28.63 sq-ft		
Measured Fan CFM	15762		
Air Mass Flow	8.93 kg/sec		
Capacity	12.77 Tons		
Efficiency	17.21 EER		
Efficiency	0.70 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 Truck School SS-1 Summary

EER at ARI Conditions	10.7	BTU/W-h	Equipment age	15 years
Condensing unit CFM	7215	CFM (Measured)		
Capacity at ARI	9.19	tons		
Capacity used for SA	10.00	tons		
Coil Area	28.63	sq-ft		
Predicted EER =	9.13	pre	9.60 post	

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	ST-SH	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	85	42	98%	97%	12.2	10.84	89	104.5	8.6	9.5	4.09	10.06	12.71
Post Adsil Measurements													
16-Jun	86	43	107%	103%	13.2	10.66	88	97	5.0	8.9	8.93	12.77	17.21

		Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions								
		Test Data			Percent Difference			Test Data			Percent Difference					
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	10.84	9.5	9.85	110%	96%	100%	11.4	9.9	10.31	110%	96%	114%	-	-	-
	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%
Post-Adsil	Power (kW)	10.66	8.9	10.00	107%	89%	100%	11.0	9.2	10.31	107%	89%	120%	-	-	-
	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 Changes

	Service Assistant	Condenser Test	Spreadsheet
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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	11.1	Btu/W-hr (CU Only)
Model Number:	38ASQ008	**Calculated EER:**	11.1	Btu/W-hr (CU Only)
Serial Number	1396G00194	**Nominal Capacity:**	7.40	tons
Equipment Type:	Split Heat Pump	**Age**	13	years
Year Manufactured:	1991	**Coil Conditon**	7.5%	(% degraded)
Location	YTC Student Services	**Present Condition EER**	9.6	Btu/W-hr
Tag	HP-1	**kW/ton**	1.25	

Compressor Data

Running load Amps:	14.1	Amps	Power supply:	3-Phase
Nameplate Voltage:	460	Volts	Phase adjustment:	1.73
Power factor:	0.66		Compressor quantity:	1

Condensing Fan Data

Full load Amps:	1.90	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 applicable)

Full load Amps:		Amps	Power supply:	
Nameplate Voltage:		Volts	Phase adjustment:	
Adjust FLA to RLA:			Fan quantity:	

Calculated compressor load:	**7.4**	kW
Calculated condensing fan load:	**0.61**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**8.02**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **7.5%** **Performance Degradation**

Overall Unit Condition		
	New	x
	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	X
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	X
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

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 Assistant Measurment

	COMP 1	
Input SEER	10	
RAT		F
SAT		F
RAH		%
SAH		%
EI	91%	
CI	82%	
Input Cap	7.5	Tons (Each)
OAT	74	
Predicted KW	7.10	kW

CU Capacity Estimates

Ambient	-	F	-	K
CU Exhaust	-	F	-	K
Coil Length	-	in		
Coil Width	-	in		
Area	-	sq-ft		
Measured Fan CFM	-	(From Product 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	-

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	11.1	Btu/W-hr (CU Only)
Model Number:	38ASQ008	**Calculated EER:**	11.1	Btu/W-hr (CU Only)
Serial Number	1396G00194	**Nominal Capacity:**	7.40	tons
Equipment Type:	Split Heat Pump	**Age**	13	years
Year Manufactured:	1991	**Coil Conditon**	0%	(% degraded)
Location	YTC Student Services	**Present Condition EER**	10.2	Btu/W-hr
Tag	HP-1	**kW/ton**	1.17	

Compressor Data

Running load Amps:	14.1	Amps	Power supply:	3-Phase
Nameplate Voltage:	460.0	Volts	Phase adjustment:	1.73
Power factor:	0.7		Compressor quantity:	1

Condensing Fan Data

Full load Amps:	1.9	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 applicable)

Full load Amps:		Amps	Power supply:	
Nameplate Voltage:		Volts	Phase adjustment:	
Adjust FLA to RLA:			Fan quantity:	

Calculated compressor load:	**7.4**	kW
Calculated condensing fan load:	**0.61**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**8.02**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

New	X
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	x
Corrosion	
Some Loose	
Many Loose	
Tubes	
Clean Cu	x
Corrosion	
Pitting	
Leaks	

FLUKE METER MEASURMENTS

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 Assistant Measurment

	COMP 1	
Input SEER	10	
RAT	-	F
SAT	-	F
RAH	-	%
SAH	-	%
EI	109%	
CI	101%	
Input Cap	7.5	Tons
OAT	83	F
Predicted KW	8.50	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		
Capacity	-	Tons		
Efficiency	-	EER		

CU Fan CFM Calculation

Measurement Number	ft/sec
1	-
2	-
3	-
4	-
Average	-

YTC Student Services HP-1 Summary

EER at ARI Conditions	11.1 BTU/W-h		Equipment age	13 years
Condensing unit CFM	NA CFM (Measured)			
Nominal Unit Capacity	7.40			
Capacity used for SA	7.50 tons			
Coil Area	NA sq-ft			
Predicted EER =	9.57 pre	10.23 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	74	60	91%	82%	12.2	7.01	NA	NA	NA	NA	NA	NA	NA
Post Adsil Measurements													
14-Jun	83	60	109%	101%	13.1	8.39	NA	NA	NA	NA	NA	NA	NA

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions								
		Test Data@ Field Conditions			Percent Difference			Test Data @ARI			Percent Difference					
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	7.01	NA	6.59	106%	NA	101%	8.5	NA	7.97	106%	NA	NA			
	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%
Post-Adsil	Power (kW)	8.39	NA	7.07	119%	NA	101%	9.5	NA	7.97	119%	NA	NA			
	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 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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	10.4	Btu/W-hr (CU Only)
Model Number:	48DJE006630	**Calculated EER:**	**10.4**	Btu/W-hr (CU Only)
Serial Number	2891G07552	**Nominal Capacity:**	5.19	tons
Equipment Type:	Package Cool	**Age**	**13**	years
Year Manufactured:	1991	**Coil Conditon**	**5%**	(% degraded)
Location	YTC Student Center	**Present Condition EER**	**9.1**	Btu/W-hr
Tag	RTU-25	**kW/ton**	**1.32**	

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 applicable)

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 load:	**5.4**	kW
Calculated condensing fan load:	**0.56**	kW
Calculated evaporator fan load	**1.93**	kW
Total calculated load for equipment:	**5.96**	kW - Condensing side only

Assumptions

Condenser Coil Assessment 2.7% **Performance Degradation**

Overall Unit Condition		
	New	
	Average	X
	Fair	
	Poor	
Coil Cleanliness		
	Coated	
	Clean	1
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	0.5
	Smashed	
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Attachment		
	Like New	X
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	X
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
1				
2				
3				

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 Assistant Measurment

	COMP 1	
Input SEER	10	
RAT	72	F
SAT	52	F
RAH	55	%
SAH	85	%
EI	76%	
CI	82%	
Input Cap	5	Tons
OAT	84	
Predicted KW	3.00	kW

CU Capacity Estimates

Ambient	84 F	302 K
CU Exhaust	97 F	309 K
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
Average	NA

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	10.4	Btu/W-hr	(CU Only)
Model Number:	48DJE006630	**Calculated EER:**	**10.4**	Btu/W-hr	(CU Only)
Serial Number	2891G07552	**Nominal Capacity:**	5.19	tons	
Equipment Type:	Package Cool	**Age**	**13**	years	
Year Manufactured:	1991	**Coil Conditon**	**0%**	(% degraded)	
Location	YTC Student Center	**Present Condition EER**	**9.5**	Btu/W-hr	
Tag	RTU-25	**kW/ton**	**1.26**		

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 applicable)

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 fan load:	**0.56**	kW
Calculated evaporator fan load	**1.93**	kW
Total calculated load for equipment:	**5.96**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.1%** **Performance Degradation**

Overall Unit Condition

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

FLUKE METER MEASURMENTS

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 Assistant Measurment

	COMP 1	
Input SEER	10	
RAT		F
SAT		F
RAH		%
SAH		%
EI	81%	
CI	88%	
Input Cap	5	Tons
OAT	86	F
Predicted KW	6.40	kW

CU Capacity Estimates

Ambient	NA	F	NA	K
CU Exhaust	NA	F	NA	K
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 Student Center RTU-25 Summary

EER at ARI Conditions	10.4 BTU/W-h		Equipment age	13 years
Condensing unit CFM	- CFM (Measured)			
Nominal Unit Capacity	5.19			
Capacity used for SA	5.00 tons			
Coil Area	- sq-ft			
Predicted EER =	9.10 Pre	9.51 Post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	84	61	76%	82%	8.4	3.11	NA	NA	NA	NA	NA	NA	NA
Post Adsil Measurements													
	86	61	81%	88%	8.7	6.64	NA	NA	NA	NA	NA	NA	NA

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions									
		Test Data@ Field Conditions			Percent Difference			Test Data @ARI			Percent Difference						
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	3.11	NA	5.34	58%	NA	99%	3.5	NA	6.00	58%	NA	NA			
	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%
Post-Adsil	Power (kW)	6.64	NA	5.41	123%	NA	99%	7.4	NA	6.00	123%	NA	NA			
	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 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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	8.8	Btu/W-hr (CU Only)
Model Number:	38AD028610	**Calculated EER:**	8.8	Btu/W-hr (CU Only)
Serial Number	A494368	**Nominal Capacity:**	24.17	tons
Equipment Type:	Split System	**Age**	10	years
Year Manufactured:	1994	**Coil Conditon**	16%	(% degraded)
Location	YTC Student Center	**Present Condition EER**	7.2	Btu/W-hr
Tag	Ground Unit	**kW/ton**	1.67	

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:	3.00	Amps (Average of 2)	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 applicable)

Full load Amps:		Amps	Power supply:	
Nameplate Voltage:		Volts	Phase adjustment:	
Adjust FLA to RLA:	0.70		Fan quantity:	

Calculated compressor load:	**27.9**	kW
Calculated condensing fan load:	**5.01**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**32.94**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **16.5%** **Performance Degradation**

Overall Unit Condition		
	New	
	Average	
	Fair	**1**
	Poor	
Coil Cleanliness		
	Coated	
	Clean	
	Dirty	**0.5**
	Clogged	**0.1**
	Plugged	
Fin Condition		
	Like New	
	Some Bent	**0.1**
	Smashed	**0.25**
	Dull/rough	**0.65**
	Corroded	**0.1**
	Pitted	
	Flaking	
Fin-Tube Attachment		
	Like New	
	Corrosion	
	Some Loose	**x**
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

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 Assistant Measurment

Input SEER	10	
RAT	74	F
SAT	56	F
RAH	40	%
SAH	85	%
EI	89%	
CI	70%	
Input Cap	30	Tons
OAT	81	F
Predicted KW	30.20	kW

CU Capacity 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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	8.8	Btu/W-hr (CU Only)
Model Number:	38AD028610	**Calculated EER:**	8.8	Btu/W-hr (CU Only)
Serial Number	A494368	**Nominal Capacity:**	24.2	tons
Equipment Type:	Split System	**Age**	10	years
Year Manufactured:	1994	**Coil Conditon**	1%	(% degraded)
Location	YTC Student Center	**Present Condition EER**	8.2	Btu/W-hr
Tag	Ground Unit	**kW/ton**	1.46	

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 applicable)

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 fan load:	**5.01**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**32.94**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **1.0%** **Performance Degradation**

Overall Unit Condition	
New	
Average	x
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	x
Corrosion	
Some Loose	
Many Loose	
Tubes	
Clean Cu	x
Corrosion	
Pitting	
Leaks	

FLUKE METER MEASURMENTS

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 Assistant Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	40	%
SAH	85	%
EI	101%	
CI	91%	
Input Cap	30	Tons
OAT	84	F
Predicted KW	11.60	kW

CU Capacity 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

YTC Student Center Ground Unit Summary

EER at ARI Conditions	8.8 BTU/W-h		Equipment age	10 years
Condensing unit CFM	NA CFM (Measured)			
Capacity at ARI	24.17 tons			
Capacity used for SA	30.00 tons			
Coil Area	NA sq-ft			
Predicted EER =	7.19 pre	8.23 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	ST-SH	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	81	26	89%	70%	7.9	24.33	NA	NA	NA	NA	NA	NA	NA
Post Adsil Measurements													
16-Jun	84	30	101%	91%	9.0	9.35	NA	NA	NA	NA	NA	NA	NA

		Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions								
		Test Data			Percent Difference			Test Data			Percent Difference					
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Predicted/ Original
Pre-Adsil	Power (kW)	24.33	NA	27.92	87%	NA	109%	26.4	NA	30.25	87%	NA	NA	-	-	-
	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%
Post-Adsil	Power (kW)	9.35	NA	29.49	32%	NA	109%	9.6	NA	30.25	32%	NA	NA	-	-	-
	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 Changes

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	7.9	NA	7.19
Post Adsil EER	9.0	NA	8.23
ARI Adjusted			
Pre-Adsil EER	7.8	NA	7.19
Post Adsil EER	8.9	NA	8.23
Change	13.5%	NA	14.5%

Weighted Average 404.5% 434.8%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Trane	**Published EER:**	10.2	Btu/W-hr (CU Only)
Model Number:	YCH210B4	**Calculated EER:**	10.2	Btu/W-hr (CU Only)
Serial Number	F14627920	**Nominal Capacity:**	17.29	tons
Equipment Type:	RTU-Gas	**Age**	13	years
Year Manufactured:	1991	**Coil Conditon**	3%	(% degraded)
Location	YTC - Library	**Present Condition EER**	9.1	Btu/W-hr
Tag	Unit 2	**kW/ton**	1.32	

Compressor Data

Running load Amps:	14.5	Amps	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	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:	7.60	Amps	Power supply:	3-Phase
Nameplate Voltage:	460	Volts	Phase adjustment:	1.73
Adjust FLA to RLA:	0.70		Fan quantity:	1

Calculated compressor load:	**17.1**	kW
Calculated condensing fan load:	**3.34**	kW
Calculated evaporator fan load	**2.45**	kW
Total calculated load for equipment:	**20.42**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **3.0%** **Performance Degradation**

Overall Unit Condition		
	New	
	Average	**1**
	Fair	
	Poor	
Coil Cleanliness		
	Coated	
	Clean	**0.95**
	Dirty	**0.05**
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	**0.1**
	Smashed	**0.1**
	Dull/rough	**0.2**
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Attachment		
	Like New	**1**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**1**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

Y-measurement

Phase	Volts	Amps	kW	PF
1				
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 Assistant Measurement

Input SEER	10	
RAT	73	F
SAT	53	F
RAH	50	%
SAH	85	%
	Circuit 1 (only)	
EI	91%	
CI	94%	
Input Cap	10	Tons
OAT	77	F
Predicted KW	12.40	kW

CU Capacity Estimates

Ambient	77 F	298 K
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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Trane	**Published EER:**	10.2	Btu/W-hr (CU Only)
Model Number:	YCH210B4	**Calculated EER:**	10.2	Btu/W-hr (CU Only)
Serial Number	F14627920	**Nominal Capacity:**	17.29	tons
Equipment Type:	RTU-Gas	**Age**	13	years
Year Manufactured:	1991	**Coil Conditon**	0%	(% degraded)
Location	YTC - Library	**Present Condition EER**	9.3	Btu/W-hr
Tag	Unit 2	**kW/ton**	1.29	

Compressor Data

Running load Amps:	14.5	Amps	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	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 applicable)

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 fan load	**2.45**	kW
Total calculated load for equipment:	**20.42**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition		
	New	X
	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	1
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

Y-measurement

Phase	Volts	Amps	kW	PF
1				
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 Assistant Measurement

Input SEER	10	
RAT	73	F
SAT	53	F
RAH	50	%
SAH	85	%
	Circuit 1 (only)	
EI	84%	
CI	96%	
Input Cap	10	Tons
OAT	88	F
Predicted KW	13.40	kW

CU Capacity Estimates

Ambient	88 F	304 K
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	4.87 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 - Library   Unit 2 Summary

EER at ARI Conditions	10.2 BTU/W-h		Equipment age	13 years
Condensing unit CFM	6613 CFM (Measured)			
Nominal Unit Capacity	17.29 tons			
Capacity used for SA	10.00 tons			
Coil Area	30.33 sq-ft			
Predicted EER =	9.08 pre	9.32 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	77	61	91%	94%	11.6	10.72	77	92	8.3	14.2	3.74	8.93	7.54
Post Adsil Measurements													
14-Jun	88	61	84%	96%	8.8	11.58	88	112	13.3	14.3	4.87	18.57	15.59

		Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions									
		Test Data			Percent Difference			Test Data			Percent Difference						
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	10.72	14.2	8.27	130%	172%	100%	13.2	17.5	10.21	130%	172%	75%	-	-	-
	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%
Post-Adsil	Power (kW)	11.58	14.3	9.40	123%	152%	100%	12.6	15.5	10.21	123%	152%	81%	-	-	-
	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 Changes

	Service Assistant	Condenser Test	Spreadsheet
Pre-Adsil EER	11.6	7.54	9.08
Post Adsil EER	8.8	15.59	9.32
ARI Adjusted			
Pre-Adsil EER	9.2	6.00	9.08
Post Adsil EER	8.5	15.15	9.32
Change	-7.7%	152.3%	2.7%
Weighted Average	-76.9%	1523.3%	27.1%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Trane	**Published EER:**	10.2	Btu/W-hr (CU Only)
Model Number:	YCH210B4	**Calculated EER:**	10.2	Btu/W-hr (CU Only)
Serial Number	F14627920	**Nominal Capacity:**	17.29	tons
Equipment Type:	RTU-Gas	**Age**	13	years
Year Manufactured:	1991	**Coil Conditon**	6%	(% degraded)
Location	YTC - Library	**Present Condition EER**	8.8	Btu/W-hr
Tag	Unit 1	**kW/ton**	1.36	

Compressor Data

Running load Amps:	14.5	Amps	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	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:	7.60	Amps	Power supply:	3-Phase
Nameplate Voltage:	460	Volts	Phase adjustment:	1.73
Adjust FLA to RLA:	0.70		Fan quantity:	1

Calculated compressor load:	**17.1**	kW
Calculated condensing fan load:	**3.34**	kW
Calculated evaporator fan load	**2.45**	kW
Total calculated load for equipment:	**20.42**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **6.2%** **Performance Degradation**

Overall Unit Condition	
New	
Average	**1**
Fair	
Poor	
Coil Cleanliness	
Coated	
Clean	**0.9**
Dirty	**0.1**
Clogged	
Plugged	
Fin Condition	
Like New	
Some Bent	**0.4**
Smashed	**0.1**
Dull/rough	**0.5**
Corroded	
Pitted	
Flaking	
Fin-Tube Attachment	
Like New	**1**
Corrosion	
Some Loose	
Many Loose	
Tubes	
Clean Cu	**1**
Corrosion	
Pitting	
Leaks	

FLUKE METER MEASUREMENTS

Y-measurement

Phase	Volts	Amps	kW	PF
1				
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 Assistant Measurement

Input SEER	10	
RAT	73	F
SAT	53	F
RAH	50	%
SAH	85	%
	Circuit 1 (only)	
EI	84%	
CI	90%	
Input Cap	10	Tons
OAT	75	F
Predicted KW	12.70	kW

CU Capacity Estimates

Ambient	75	F	297	K
CU Exhaust	92	F	306	K
Coil Length	91	in		
Coil Width	48	in		
Area	30.3	sq-ft		
Measured Fan CFM	7488			
Air Mass Flow	4.24	kg/sec		
Capacity	11.46	Tons		
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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Trane	**Published EER:**	10.2	Btu/W-hr (CU Only)
Model Number:	YCH210B4	**Calculated EER:**	10.2	Btu/W-hr (CU Only)
Serial Number	F14627920	**Nominal Capacity:**	17.29	tons
Equipment Type:	RTU-Gas	**Age**	13	years
Year Manufactured:	1991	**Coil Conditon**	0%	(% degraded)
Location	YTC - Library	**Present Condition EER**	9.3	Btu/W-hr
Tag	Unit 1	**kW/ton**	1.29	

Compressor Data

Running load Amps:	14.5	Amps	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	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 applicable)

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 fan load	**2.45**	kW
Total calculated load for equipment:	**20.42**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

	New	X
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

Y-measurement

Phase	Volts	Amps	kW	PF
1				
2				
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 Assistant Measurement

Input SEER	10	
RAT	73	F
SAT	53	F
RAH	50	%
SAH	85	%
	Circuit 1 (only)	
EI	93%	
CI	85%	
Input Cap	10	Tons
OAT	85	F
Predicted KW	11.10	kW

CU Capacity Estimates

Ambient	86 F	303 K
CU Exhaust	95 F	308 K
Coil Length	91 in	
Coil Width	48 in	
Area	30.3 sq-ft	
Measured Fan CFM	22068	
Air Mass Flow	12.50 kg/sec	
Capacity	16.88 Tons	
Efficiency	17.17 EER	

CU Fan CFM Calculation

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

YTC - Library Unit 1 Summary

EER at ARI Conditions	10.2	BTU/W-h		Equipment age	13 years
Condensing unit CFM	7488	CFM (Measured)			
Nominal Unit Capacity	17.29	tons			
Capacity used for SA	10.00	tons			
Coil Area	30.33	sq-ft			
Predicted EER =	8.82	pre	9.32 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	75	61	84%	90%	11.1	10.98	75	92	9.4	14.2	4.24	11.46	9.68
Post Adsil Measurements													
14-Jun	85	61	93%	85%	10.3	9.60	86	94.5	4.7	11.8	12.50	16.88	17.17

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions								
		Test Data			Percent Difference			Test Data			Percent Difference					
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	10.98	14.2	8.06	136%	176%	100%	13.9	18.0	10.21	136%	176%	77%	-	-	-
	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%
Post-Adsil	Power (kW)	9.60	11.8	9.09	106%	130%	100%	10.8	13.3	10.21	106%	130%	81%	-	-	-
	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 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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	American Standard	**Published EER:**	9.9	Btu/W-hr	(CU Only)
Model Number:	TWA060A400A2	**Calculated EER:**	9.9	Btu/W-hr	(CU Only)
Serial Number	G06289343	**Nominal Capacity:**	4.82	tons	
Equipment Type:	Split-System	**Age**	12	years	
Year Manufactured:	1992	**Coil Conditon**	5%	(% degraded)	
Location	YTC Hood Center	**Present Condition EER**	8.8	Btu/W-hr	
Tag	HP-2	**kW/ton**	1.37		

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 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 fan load	**0.00**	kW
Total calculated load for equipment:	**5.87**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **NA** **Brush Coils**

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	
Fin-Tube Attachment	
Like New	
Corrosion	
Some Loose	
Many Loose	
Tubes	
Clean Cu	
Corrosion	
Pitting	
Leaks	

FLUKE METER MEASUREMENTS

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 Assistant 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	-	K
CU Exhaust	-	F	-	K
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

Number	ft/sec
1	
2	
3	
4	
Average	

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	American Standard	**Published EER:**	9.9	Btu/W-hr	(CU Only)
Model Number:	TWA060A400A2	**Calculated EER:**	**9.9**	Btu/W-hr	(CU Only)
Serial Number	G06289343	**Nominal Capacity:**	4.82	tons	
Equipment Type:	Split-System	**Age**	**12**	years	
Year Manufactured:	1992	**Coil Conditon**	**0%**	(% degraded)	
Location	YTC Hood Center	**Present Condition EER**	**9.2**	Btu/W-hr	
Tag	HP-2	**kW/ton**	**1.31**		

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 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 fan load	**0.00**	kW
Total calculated load for equipment:	**5.87**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition		
	New	X
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

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 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		
Capacity	-	Tons		
Efficiency	-	EER		

CU Fan CFM Calculation

Number	ft/sec
1	
2	
3	
4	
Average	

YTC Hood Center HP-2 Summary

EER at ARI Conditions	9.9	BTU/W-h	Equipment age	12 years
Condensing unit CFM	NA	CFM (Measured)		
Nominal Unit Capacity	4.82			
Capacity used for SA	5.00	tons		
Coil Area	NA	sq-ft		
Predicted EER =	8.76	pre	9.16	post

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	77	62	71%	44%	8.5	4.05	NA	NA	NA	NA	NA	NA	NA
Post Adsil Measurements													
	74	62	83%	79%	10.4	5.59	NA	NA	NA	NA	NA	NA	NA

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions								
		Test Data@ Field Conditions			Percent Difference			Test Data @ARI			Percent Difference					
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	4.05	NA	4.88	83%	NA	101%	4.8	NA	5.84	83%	NA	NA			
	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%
Post-Adsil	Power (kW)	5.59	NA	4.75	118%	NA	101%	6.9	NA	5.84	118%	NA	NA			
	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 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%

Pre-Adsil HVAC Data Sheet and EER Calculation

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	3200E19247	**Nominal Capacity:**	2.84	tons
Equipment Type:	Split System cool	**Age**	4	years
Year Manufactured:	2000	**Coil Conditon**	5%	(% degraded)
Location	YTC Hood Center	**Present Condition EER**	8.9	Btu/W-hr
Tag	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 applicable)

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 fan load:	**0.23**	kW
Calculated evaporator fan load	**0.11**	kW
Total calculated load for equipment:	**3.63**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **5.0%** **Performance Degradation**

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

FLUKE METER MEASUREMENTS

Y-measurment

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 Assistant Measurment

	COMP 1	
Input SEER	10	
RAT	72	F
SAT	55	F
RAH	50	%
SAH	85	%
EI	105%	
CI	99%	
Input Cap	3	Tons
OAT	79	
Predicted KW	3.50	kW

CU Capacity Estimates

Ambient	79	F	299	K
CU Exhaust	87	F	304	K
Coil Length	90	in		
Coil Width	23	in		
Area	14.4	sq-ft		
Measured Fan CFM	5,348			
Air Mass Flow	3.03	kg/sec		
Capacity	3.85	Tons		
Efficiency	17.30	EER		

CU Fan CFM Calculation

Number	ft/sec
1	6.2
2	6.2
3	6.2
4	6.2
Average	6.2

Post-Adsil HVAC Data Sheet and EER Calculation

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	3200E19247	**Nominal Capacity:**	2.8	tons
Equipment Type:	Split System cool	**Age**	4	years
Year Manufactured:	2000	**Coil Conditon**	0%	(% degraded)
Location	YTC Hood Center	**Present Condition EER**	9.4	Btu/W-hr
Tag	HP-1	**kW/ton**	1.28	

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 applicable)

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 fan load:	**0.23**	kW
Calculated evaporator fan load	**0.11**	kW
Total calculated load for equipment:	**3.63**	kW - Condensing side only

Assumptions

Condenser Coil Assessment 0.0% **Performance Degradation**

Overall Unit Condition		
	New	X
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

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 Assistant Measurment

	COMP 1	
Input SEER	10	
RAT	72	F
SAT	52	F
RAH	50	%
SAH	85	%
EI	115%	
CI	117%	
Input Cap	3	Tons
OAT	82	F
Predicted KW	3.60	kW

CU Capacity Estimates

Ambient	76	F	298	K
CU Exhaust	87	F	304	K
Coil Length	90	in		
Coil Width	23	in		
Area	14.4	sq-ft		
Measured Fan CFM	5865			
Air Mass Flow	3.32	kg/sec		
Capacity	5.81	Tons		
Efficiency	27.43	EER		

CU Fan CFM Calculation

Number	ft/sec
1	6.2
2	6.4
3	7.6
4	7.0
Average	6.8

YTC Hood Center HP-1 Summary

EER at ARI Conditions	9.4 BTU/W-h		Equipment age	4 years
Condensing unit CFM	5,348 CFM (Measured)			
Nominal Unit Capacity	2.84 tons			
Capacity used for SA	3.00 tons			
Coil Area	14.38 sq-ft			
Predicted EER =	8.93 pre	9.37 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	79	60	105%	99%	11.0	3.32	79	87	4.4	2.67	3.03	3.85	17.30
Post Adsil Measurements													
13-Jun	82	60	115%	117%	11.7	3.41	76	87	6.1	2.54	3.32	5.81	27.43

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions									
		Test Data@ Field Conditions			Percent Difference			Test Data @ARI			Percent Difference						
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Predicted/ Original
Pre-Adsil	Power (kW)	3.32	2.67	3.19	104%	84%	100%	3.8	3.0	3.64	104%	84%	124%	-	-	-
	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%
Post-Adsil	Power (kW)	3.41	2.54	3.25	105%	78%	100%	3.8	2.8	3.64	105%	78%	134%	-	-	-
	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 Changes

	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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Trane	**Published EER:**	10.3	Btu/W-hr (CU Only)
Model Number:	YCH300B4	**Calculated EER:**	10.3	Btu/W-hr (CU Only)
Serial Number	G071427640	**Nominal Capacity:**	22.67	tons
Equipment Type:	RTU-Gas	**Age**	12	years
Year Manufactured:	1992	**Coil Conditon**	4%	(% degraded)
Location	YTC - Hood Center	**Present Condition EER**	9.2	Btu/W-hr
Tag	RTU-9	**kW/ton**	1.30	

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:	3.00	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:	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 load:	**24.5**	kW
Calculated condensing fan load:	**1.93**	kW
Calculated evaporator fan load	**3.54**	kW
Total calculated load for equipment:	**26.44**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **3.7%** **Performance Degradation**

Overall Unit Condition

	New	
	Average	**1**
	Fair	
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

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 Assistant Measurement

Input SEER	10			
RAT	70	F		
SAT	50	F		
RAH	50	%		
SAH	85	%		
	Circuit 1		Circuit 2	
EI	88%		91%	
CI	90%		91%	
Input Cap	12.5	Tons	12.5	Tons
OAT	76	F	76	F
Predicted KW	15.30	kW	15.10	kW

CU Capacity Estimates

Ambient	73	F	296	K
CU Exhaust	108.5	F	316	K
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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Trane	**Published EER:**	10.3	Btu/W-hr (CU Only)
Model Number:	YCH300B4	**Calculated EER:**	10.3	Btu/W-hr (CU Only)
Serial Number	G071427640	**Nominal Capacity:**	22.67	tons
Equipment Type:	RTU-Gas	**Age**	12	years
Year Manufactured:	1992	**Coil Conditon**	0%	(% degraded)
Location	YTC - Hood Center	**Present Condition EER**	9.5	Btu/W-hr
Tag	RTU-9	**kW/ton**	1.26	

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 fan load	**3.54**	kW
Total calculated load for equipment:	**26.44**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

	New	X
	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	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

Y-measurement

Phase	Volts	Amps	kW	PF
1				
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

HVAC Service Assistant Measurement

Input SEER	10	
RAT	72	F
SAT	52	F
RAH	50	%
SAH	85	%

	Circuit 1		Circuit 2	
EI	102%		100%	
CI	103%		100%	
Input Cap	12.5	Tons	12.5	Tons
OAT	90	F	88	F
Predicted KW	15.20	kW	14.90	kW

CU Capacity Estimates

Ambient	85 F	303 K
CU Exhaust	105 F	314 K
Coil Length	109 in	
Coil Width	48 in	
Area	36.3 sq-ft	
Measured Fan CFM	30084	
Air Mass Flow	17.04 kg/sec	
Capacity	54.15 Tons	
Efficiency	24.25 EER	

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 - Hood Center RTU-9 Summary

EER at ARI Conditions	10.3 BTU/W-h	Equipment age	12 years
Condensing unit CFM	12063 CFM (Measured)		
Nominal Unit Capacity	22.67 tons		
Capacity used for SA	25.00 tons		
Coil Area	36.33 sq-ft		
Predicted EER =	9.21 pre	9.53 post	

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	76	60	90%	91%	11.4	27.56	73	108.5	19.7	28.2	6.83	38.54	16.40
Post Adsil Measurements													
14-Jun	90	60	101%	91%	10.2	27.29	85	105	11.1	26.8	17.04	54.15	24.25

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions								
		Test Data			Percent Difference			Test Data			Percent Difference					
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	27.56	28.2	22.42	123%	126%	94%	34.5	35.3	28.05	123%	126%	98%	-	-	-
	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%
Post-Adsil	Power (kW)	27.29	26.8	26.35	104%	102%	94%	29.0	28.5	28.05	104%	102%	102%	-	-	-
	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 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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Trane	**Published EER:**	9.6	Btu/W-hr (CU Only)
Model Number:	YCH300B4	**Calculated EER:**	9.6	Btu/W-hr (CU Only)
Serial Number	G071427640	**Nominal Capacity:**	23.98	tons
Equipment Type:	RTU-Gas	**Age**	12	years
Year Manufactured:	1992	**Coil Conditon**	0%	(% degraded)
Location	YTC - Hood Center	**Present Condition EER**	8.8	Btu/W-hr
Tag	RTU-5	**kW/ton**	1.36	

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:	3.00	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 load:	**26.8**	kW
Calculated condensing fan load:	**3.34**	kW
Calculated evaporator fan load	**3.54**	kW
Total calculated load for equipment:	**30.11**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

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	
Fin-Tube Attachment	
Like New	
Corrosion	
Some Loose	
Many Loose	
Tubes	
Clean Cu	
Corrosion	
Pitting	
Leaks	

FLUKE METER MEASUREMENTS

Y-measurement

Phase	Volts	Amps	kW	PF
1				
2				
3				

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 Assistant Measurement

Input SEER	10	
RAT	72	F
SAT	52	F
RAH	50	%
SAH	85	%
	Circuit 1 (only)	
EI	100%	
CI	98%	
Input Cap	15	Tons
OAT	80	F
Predicted KW	17.80	kW

CU Capacity Estimates

Ambient	80 F	300 K
CU Exhaust	91 F	306 K
Coil Length	109 in	
Coil Width	48 in	
Area	36.3 sq-ft	
Measured Fan CFM	29793	
Air Mass Flow	16.87 kg/sec	
Capacity	29.49 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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Trane	**Published EER:**	9.6 Btu/W-hr (CU Only)
Model Number:	YCH300B4	**Calculated EER:**	9.6 Btu/W-hr (CU Only)
Serial Number	G071427640	**Nominal Capacity:**	23.98 tons
Equipment Type:	RTU-Gas	**Age**	12 years
Year Manufactured:	1992	**Coil Conditon**	0% (% degraded)
Location	YTC - Hood Center	**Present Condition EER**	8.8 Btu/W-hr
Tag	RTU-5	**kW/ton**	1.36

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 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:	**26.8**	kW
Calculated condensing fan load:	**3.34**	kW
Calculated evaporator fan load	**3.54**	kW
Total calculated load for equipment:	**30.11**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition		
	New	X
	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	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

Y-measurement

Phase	Volts	Amps	kW	PF
1				
2				
3				

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	488	23.4	11.1	0.99
2 to 3	488	19.1	3.7	0.40

TOTAL

HVAC Service Assistant Measurement

Input SEER	10	
RAT	72	F
SAT	52	F
RAH	50	%
SAH	85	%
	Circuit 1 (only)	
EI	101%	
CI	103%	
Input Cap	15	Tons
OAT	77	F
Predicted KW	18.30	kW

CU Capacity Estimates

Ambient	78	F	299	K
CU Exhaust	87	F	304	K
Coil Length	109	in		
Coil Width	48	in		
Area	36.3	sq-ft		
Measured Fan CFM	29021			
Air Mass Flow	16.44	kg/sec		
Capacity	23.51	Tons		
Efficiency	19.06	EER		

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 - Hood Center RTU-5 Summary

EER at ARI Conditions	9.6 BTU/W-h		Equipment age	12 years
Condensing unit CFM	29793 CFM (Measured)			
Nominal Unit Capacity	23.98 tons			
Capacity used for SA	15.00 tons			
Coil Area	36.33 sq-ft			
Predicted EER =	8.85 pre	8.85 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	80	60	100%	98%	10.8	14.23	80	91	6.1	14.9	16.87	29.49	23.75
Post Adsil Measurements													
14-Jun	77	60	101%	103%	11.5	14.63	78	87	5.0	14.8	16.44	23.51	19.06

Condensing Unit Summary - Ambient Conditions									Condensing Unit Summary - ARI Conditions								
		Test Data			Percent Difference			Test Data			Percent Difference						
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	14.23	14.9	12.97	110%	115%	101%	16.4	17.2	14.95	110%	115%	95%	-	-	-
	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%
Post-Adsil	Power (kW)	14.63	14.8	12.50	117%	118%	101%	17.5	17.7	14.95	117%	118%	99%	-	-	-
	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%

EER 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%
Weighted Average	15.0%	-358.7%	0.0%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Trane	**Published EER:**	9.7	Btu/W-hr (CU Only)
Model Number:	SFHD030	**Calculated EER:**	9.7	Btu/W-hr (CU Only)
Serial Number	J97M72722	**Nominal Capacity:**	28.74	tons
Equipment Type:	RTU-Gas	**Age**	13	years
Year Manufactured:	1991	**Coil Conditon**	13%	(% degraded)
Location	YTC - Hood Center	**Present Condition EER**	8.0	Btu/W-hr
Tag	RTU-6	**kW/ton**	1.51	

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 applicable)

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 fan load	**3.48**	kW
Total calculated load for equipment:	**35.60**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **12.7%** **Performance Degradation**

Overall Unit Condition		
	New	
	Average	**1**
	Fair	
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

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 Assistant Measurement

Input SEER	10	
RAT	72	F
SAT	52	F
RAH	50	%
SAH	85	%
	Circuit 1	Two comp. on one circuit
EI	103%	
CI	98%	
Input Cap	30	Tons
OAT	84	F
Predicted KW	34.50	kW

CU Capacity Estimates

Ambient	NA	F	NA	K
CU Exhaust	NA	F	NA	K
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
Average	NA

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Trane	**Published EER:**	9.7	Btu/W-hr (CU Only)
Model Number:	SFHD030	**Calculated EER:**	9.7	Btu/W-hr (CU Only)
Serial Number	J97M72722	**Nominal Capacity:**	28.74	tons
Equipment Type:	RTU-Gas	**Age**	13	years
Year Manufactured:	1991	**Coil Conditon**	0%	(% degraded)
Location	YTC - Hood Center	**Present Condition EER**	8.9	Btu/W-hr
Tag	RTU-6	**kW/ton**	1.35	

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 applicable)

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 load:	**32.6**	kW
Calculated condensing fan load:	**3.01**	kW
Calculated evaporator fan load	**3.48**	kW
Total calculated load for equipment:	**35.60**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition		
	New	X
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

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 Assistant Measurement

Input SEER	10	
RAT	70	F
SAT	50	F
RAH	65	%
SAH	85	%
	Circuit 1 (only)	
EI	102%	
CI	99%	
Input Cap	30	Tons
OAT	78	F
Predicted KW	35.00	kW

CU Capacity Estimates

Ambient	NA	F	NA	K
CU Exhaust	NA	F	NA	K
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 - Hood Center RTU-6 Summary

EER at ARI Conditions	9.7	BTU/W-h	Equipment age	13 years
Condensing unit CFM	NA	CFM (Measured)		
Nominal Unit Capacity	28.74	tons		
Capacity used for SA	30.00	tons		
Coil Area	NA	sq-ft		
Predicted EER =	7.96	pre	8.89	post

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	84	60	103%	98%	11.1	33.05	NA	NA	NA	NA	NA	NA	NA
Post Adsil Measurements													
14-Jun	78	59	102%	99%	11.9	33.53	NA	NA	NA	NA	NA	NA	NA

Condensing Unit Summary - Ambient Conditions									Condensing Unit Summary - ARI Conditions									
		Test Data			Percent Difference			Test Data			Percent Difference						
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Predicted/ Original
Pre-Adsil	Power (kW)	33.05	NA	30.00	110%	NA	100%	39.2	NA	35.57	110%	NA	NA	-	-	-
	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%
Post-Adsil	Power (kW)	33.53	NA	27.66	121%	NA	100%	43.1	NA	35.57	121%	NA	NA	-	-	-
	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%

EER Changes

	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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Trane	**Published EER:**	9.7	Btu/W-hr (CU Only)
Model Number:	SFHCC25	**Calculated EER:**	9.7	Btu/W-hr (CU Only)
Serial Number	J91M72724	**Nominal Capacity:**	24.30	tons
Equipment Type:	RTU-Gas	**Age**	13	years
Year Manufactured:	1991	**Coil Conditon**	11%	(% degraded)
Location	YTC - Hood Center	**Present Condition EER**	8.1	Btu/W-hr
Tag	RTU-7	**kW/ton**	1.48	

Compressor Data

Running load Amps:	27.3	Amps	Power supply:	3-phase
Nameplate Voltage:	460	Volts	Phase adjustment:	1.73
Power factor:	0.62		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 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:	**26.9**	kW
Calculated condensing fan load:	**3.01**	kW
Calculated evaporator fan load	**2.35**	kW
Total calculated load for equipment:	**29.95**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **11.5%** **Performance Degradation**

Overall Unit Condition		
	New	
	Average	**1**
	Fair	
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

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 Assistant Measurement

Input SEER	10	
RAT	70	F
SAT	50	F
RAH	55	%
SAH	85	%
	Circuit 1	
EI	79%	
CI	82%	
Input Cap	25	Tons
OAT	70	F
Predicted KW	30.80	kW

CU Capacity Estimates

Ambient	NA	F	NA	K
CU Exhaust	NA	F	NA	K
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
Average	NA

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Trane	**Published EER:**	9.7	Btu/W-hr (CU Only)
Model Number:	SFHCC25	**Calculated EER:**	9.7	Btu/W-hr (CU Only)
Serial Number	J91M72724	**Nominal Capacity:**	24.30	tons
Equipment Type:	RTU-Gas	**Age**	13	years
Year Manufactured:	1991	**Coil Conditon**	0%	(% degraded)
Location	YTC - Hood Center	**Present Condition EER**	8.9	Btu/W-hr
Tag	RTU-7	**kW/ton**	1.34	

Compressor Data

Running load Amps:	27.3	Amps	Power supply:	3-phase
Nameplate Voltage:	460	Volts	Phase adjustment:	1.73
Power factor:	0.62		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 applicable)

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 load:	**26.9**	kW
Calculated condensing fan load:	**3.01**	kW
Calculated evaporator fan load	**2.35**	kW
Total calculated load for equipment:	**29.95**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

New	X
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	x
Corrosion	
Some Loose	
Many Loose	
Tubes	
Clean Cu	x
Corrosion	
Pitting	
Leaks	

FLUKE METER MEASUREMENTS

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 Assistant Measurement

Input SEER	10	
RAT	70	F
SAT	50	F
RAH	65	%
SAH	85	%
	Circuit 1 (only)	
EI	109%	
CI	108%	
Input Cap	25	Tons
OAT	85	F
Predicted KW	29.60	kW

CU Capacity Estimates

Ambient	NA	F	NA	K
CU Exhaust	NA	F	NA	K
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 - Hood Center RTU-7 Summary

EER at ARI Conditions	9.7	BTU/W-h	Equipment age	13 years
Condensing unit CFM	NA	CFM (Measured)		
Nominal Unit Capacity	24.30	tons		
Capacity used for SA	25.00	tons		
Coil Area	NA	sq-ft		
Predicted EER =	8.08	pre	8.93	post

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	70	60	79%	82%	10.2	29.94	NA	NA	NA	NA	NA	NA	NA
Post Adsil Measurements													
14-Jun	85	62	109%	108%	11.4	28.77	NA	NA	NA	NA	NA	NA	NA

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions									
		Test Data			Percent Difference			Test Data			Percent Difference						
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Predicted/ Original
Pre-Adsil	Power (kW)	29.94	NA	22.25	135%	NA	99%	40.5	NA	30.11	135%	NA	NA	-	-	-
	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%
Post-Adsil	Power (kW)	28.77	NA	26.83	107%	NA	99%	32.3	NA	30.11	107%	NA	NA	-	-	-
	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%

EER Changes

	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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Trane	**Published EER:***	9.7	Btu/W-hr (CU Only)
Model Number:	SFHCC20	**Calculated EER:**	9.7	Btu/W-hr (CU Only)
Serial Number	J91M72723	**Nominal Capacity:**	18.41	tons
Equipment Type:	RTU-Gas	**Age**	13	years
Year Manufactured:	1991	**Coil Conditon**	15%	(% degraded)
Location	YTC - Hood Center	**Present Condition EER**	7.8	Btu/W-hr
Tag	RTU-8	**kW/ton**	1.54	

Compressor Data

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

Assumptions

Condenser Coil Assessment **14.8%** **Performance Degradation**

Overall Unit Condition	
New	
Average	
Fair	**1**
Poor	
Coil Cleanliness	
Coated	
Clean	
Dirty	**0.25**
Clogged	**0.75**
Plugged	
Fin Condition	
Like New	
Some Bent	
Smashed	
Dull/rough	**1**
Corroded	
Pitted	
Flaking	
Fin-Tube Attachment	
Like New	**1**
Corrosion	
Some Loose	
Many Loose	
Tubes	
Clean Cu	**1**
Corrosion	
Pitting	
Leaks	

FLUKE METER MEASUREMENTS

Y-measurement

Phase	Volts	Amps	kW	PF
1				
2				
3				

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	490	20.7	9.7	0.96
2 to 3	490	19.1	2.3	0.25

TOTAL

HVAC Service Assistant Measurement

Input SEER	10	
RAT	70	F
SAT	50	F
RAH	60	%
SAH	85	%
	Circuit 1	
EI	120%	
CI	116%	
Input Cap	10	Tons
OAT	76	F
Predicted KW	11.80	kW

CU Capacity Estimates

Ambient	76 F	298 K
CU Exhaust	89 F	305 K
Coil Length	63 in	
Coil Width	71 in	
Area	31.1 sq-ft	
Measured Fan CFM	20719	
Air Mass Flow	11.73 kg/sec	
Capacity	24.24 Tons	
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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Trane	**Published EER:**	9.7	Btu/W-hr (CU Only)
Model Number:	SFHCC20	**Calculated EER:**	9.7	Btu/W-hr (CU Only)
Serial Number	J91M72723	**Nominal Capacity:**	18.41	tons
Equipment Type:	RTU-Gas	**Age**	13	years
Year Manufactured:	1991	**Coil Conditon**	0%	(% degraded)
Location	YTC - Hood Center	**Present Condition EER**	8.9	Btu/W-hr
Tag	RTU-8	**kW/ton**	1.35	

Compressor Data

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:	1.8	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 applicable)

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 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

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

	New	X
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

Y-measurement

Phase	Volts	Amps	kW	PF
1				
2				
3				

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	488	23.4	11.1	0.99
2 to 3	488	19.1	3.7	0.40

TOTAL

HVAC Service Assistant Measurement

Input SEER	10	
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 Estimates

Ambient	79	F	299	K
CU Exhaust	91	F	306	K
Coil Length	63	in		
Coil Width	71	in		
Area	31.1	sq-ft		
Measured Fan CFM	23483			
Air Mass Flow	13.30	kg/sec		
Capacity	25.36	Tons		
Efficiency	20.56	EER		

CU Fan CFM Calculation

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

YTC - Hood Center RTU-8 Summary

EER at ARI Conditions	9.7 BTU/W-h		Equipment age	13 years
Condensing unit CFM	20719 CFM (Measured)			
Nominal Unit Capacity	18.41 tons			
Capacity used for SA	10.00 tons			
Coil Area	31.06 sq-ft			
Predicted EER =	7.81 pre	8.86 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	76	61	120%	116%	14.3	10.86	76	89	7.2	12	11.73	24.24	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	20.56

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions									
		Test Data			Percent Difference			Test Data			Percent Difference						
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	10.86	12	9.11	119%	132%	100%	13.6	15.0	11.39	119%	132%	91%	-	-	-
	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%
Post-Adsil	Power (kW)	11.14	14.8	9.35	119%	158%	100%	13.6	18.0	11.39	119%	158%	75%	-	-	-
	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 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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Trane	**Published EER:**	9.6	Btu/W-hr (CU Only)
Model Number:	YCH240B4	**Calculated EER:**	9.6	Btu/W-hr (CU Only)
Serial Number	F501422580	**Nominal Capacity:**	23.98	tons
Equipment Type:	RTU-Gas	**Age**	13	years
Year Manufactured:	1991	**Coil Conditon**	3%	(% degraded)
Location	YTC- Hood Center	**Present Condition EER**	8.6	Btu/W-hr
Tag	RTU-10	**kW/ton**	1.40	

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 load:	**26.6**	kW
Calculated condensing fan load:	**3.34**	kW
Calculated evaporator fan load	**3.54**	kW
Total calculated load for equipment:	**29.93**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **3.0%** **Performance Degradation**

Overall Unit Condition		
	New	
	Average	**1**
	Fair	
	Poor	
Coil Cleanliness		
	Coated	
	Clean	**0.85**
	Dirty	**0.15**
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	**0.2**
	Smashed	
	Dull/rough	**0.2**
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Attachment		
	Like New	**1**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**1**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

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 Assistant Measurement

Input SEER	10	
RAT	72	F
SAT	52	F
RAH	55	%
SAH	85	%
	Circuit 1 (only)	
EI	66%	
CI	74%	
Input Cap	10	Tons
OAT	77	F
Predicted KW	13.20	kW

CU Capacity Estimates

Ambient	77 F	298 K
CU Exhaust	115 F	319 K
Coil Length	99 in	
Coil Width	48 in	
Area	33.0 sq-ft	
Measured Fan CFM	9306	
Air Mass Flow	5.27 kg/sec	
Capacity	31.82 Tons	
Efficiency	13.17 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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Trane	**Published EER:**	9.6	Btu/W-hr (CU Only)
Model Number:	YCH240B4	**Calculated EER:**	9.6	Btu/W-hr (CU Only)
Serial Number	F501422580	**Nominal Capacity:**	23.98	tons
Equipment Type:	RTU-Gas	**Age**	13	years
Year Manufactured:	1991	**Coil Conditon**	0%	(% degraded)
Location	YTC- Hood Center	**Present Condition EER**	8.8	Btu/W-hr
Tag	RTU-10	**kW/ton**	1.36	

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 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:	**26.6**	kW
Calculated condensing fan load:	**3.34**	kW
Calculated evaporator fan load	**3.54**	kW
Total calculated load for equipment:	**29.93**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition		
	New	X
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

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

HVAC Service Assistant Measurement

Input SEER		
RAT		F
SAT		F
RAH		%
SAH		%
	Circuit 1 (only)	
EI		
CI		
Input Cap		Tons
OAT		F
Predicted KW		kW

CU Capacity Estimates

Ambient	78	F	299	K
CU Exhaust	87	F	304	K
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	22.13	Tons		
Efficiency	11.04	EER		

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

YTC- Hood Center RTU-10 Summary

EER at ARI Conditions	9.6 BTU/W-h	Equipment age	13 years
Condensing unit CFM	9306 CFM (Measured)		
Nominal Unit Capacity	23.98 tons		
Capacity used for SA	10.00 tons		
Coil Area	33.00 sq-ft		
Predicted EER =	8.59 pre	8.82 post	

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	77	60	66%	74%	7.1	15.83	77	115	21.1	29	5.27	31.82	13.17
Post Adsil Measurements	Could not douplicate pre-test conditions												
14-Jun	NA	NA	NA	NA	NA	NA	78	87	5.0	24.05	15.47	22.13	11.04

		Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions									
		Test Data			Percent Difference			Test Data			Percent Difference						
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Predicted/ Original
Pre-Adsil	Power (kW)	15.83	29	12.97	122%	224%	100%	36.5	66.9	29.90	122%	224%	55%	-	-	-
	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%
Post-Adsil	Power (kW)	NA	24.05	12.50	NA	192%	100%	NA	57.5	29.90	NA	192%	NA	-	-	-
	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 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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	NA	**Published EER:**	NA	Btu/W-hr (CU Only)
Model Number:	558CPX048000	**Calculated EER:**	9.5	Btu/W-hr (CU Only)
Serial Number	NA	**Nominal Capacity:**	4.00	tons
Equipment Type:	RTU-Gas	**Age**	4	years
Year Manufactured:	2000	**Coil Conditon**	21%	(% degraded)
Location	YTC Bld D	**Present Condition EER**	7.8	Btu/W-hr
Tag	RTU-1	**kW/ton**	1.54	

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 applicable)

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 fan load:	**0.28**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**5.08**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **21.4%** **Performance Degradation**

Overall Unit Condition

	New	
	Average	
	Fair	
	Poor	**1**
Coil Cleanliness		
	Coated	
	Clean	
	Dirty	**1**
	Clogged	
	Plugged	
Fin Condition		
	Like New	
	Some Bent	**0.8**
	Smashed	**1**
	Dull/rough	
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Attachment		
	Like New	**x**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
1				
2				
3				

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	206	17.1	3.5	0.98
2 to 3	203	18.7	2.1	0.56
TOTAL				

HVAC Service Assistant Measurment

Input SEER	10	
RAT		F
SAT		F
RAH		%
SAH		%
EI	75%	
CI	83%	
Input Cap	4	Tons
OAT	88	F
Predicted KW	5.10	kW

CU Capacity Estimates

Ambient	88	F
CU Exhaust	101	F
Coil Length	72	in
Coil Width	37	in
Area	18.5	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	-
2	-
3	-
Average	-

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	NA	**Published EER:**	NA	Btu/W-hr (CU Only)
Model Number:	558CPX048000	**Calculated EER:**	9.5	Btu/W-hr (CU Only)
Serial Number	NA	**Nominal Capacity:**	4.00	tons
Equipment Type:	RTU-Gas	**Age**	4	years
Year Manufactured:	2000	**Coil Conditon**	0%	(% degraded)
Location	YTC Bld D	**Present Condition EER**	9.5	Btu/W-hr
Tag	RTU-1	**kW/ton**	1.27	

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 applicable)

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 fan load:	**0.28**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**5.08**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

	New	x
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

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 Assistant Measurment

Input SEER	10	
RAT	NA	F
SAT	NA	F
RAH	NA	%
SAH	NA	%
EI	101%	
CI	90%	
Input Cap	4	Tons
OAT	85	F
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	NA	kg/sec
Capacity	NA	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

EER at ARI Conditions	9.5	BTU/W-h		Equipment age	4 years
Condensing unit CFM	NA	CFM (Measured)			
Capacity at ARI	4.00	tons			
Capacity used for SA	4.00	tons			
Coil Area	18.50	sq-ft			
Predicted EER =	7.79	pre	9.45 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	88	61	75%	83%	7.1	5.10	88	101	7.2	5.6	NA	NA	NA
Post Adsil Measurements													
16-Jun	85	61	101%	90%	9.5	4.30	NA	NA	NA	NA	NA	NA	NA

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions								
		Test Data			Percent Difference			Test Data			Percent Difference					
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	5.10	5.6	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	7.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Post-Adsil	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 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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Trane	**Published EER:**	9.1	Btu/W-hr (CU Only)
Model Number:	YCS060A4EMAOXD	**Calculated EER:**	9.1	Btu/W-hr (CU Only)
Serial Number	236101276L	**Nominal Capacity:**	5.21	tons
Equipment Type:	RTU-Gas	**Age**	2	years
Year Manufactured:	2002	**Coil Conditon**	0%	(% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	9.3	Btu/W-hr
Tag	RTU-16	**kW/ton**	1.30	

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 applicable)

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 load:	**6.5**	kW
Calculated condensing fan load:	**0.39**	kW
Calculated evaporator fan load	**1.03**	kW
Total calculated load for equipment:	**6.89**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.1%** **Performance Degradation**

Overall Unit Condition		
	New	x
	Average	
	Fair	
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

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

HVAC Service Assistant Measurement

Input SEER	10	
RAT	72	F
SAT	52	F
RAH	50	%
SAH	85	%
EI	89%	
CI	89%	
Input Cap	5	Tons
OAT	96	F
Predicted KW	6.00	kW

CU Capacity Estimates

Ambient	92	F	306	K
CU Exhaust	114	F	319	K
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	11.72	Tons		
Efficiency	19.82	EER		

CU Fan CFM Calculation

Measurement Number	ft/sec
1	10.7
2	10.9
Average	10.8

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Trane	**Published EER:**	9.1	Btu/W-hr (CU Only)
Model Number:	YCS060A4EMAOXD	**Calculated EER:**	9.1	Btu/W-hr (CU Only)
Serial Number	236101276L	**Nominal Capacity:**	5.21	tons
Equipment Type:	RTU-Gas	**Age**	2	years
Year Manufactured:	2002	**Coil Conditon**	0%	(% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	9.3	Btu/W-hr
Tag	RTU-16	**kW/ton**	1.30	

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:	1.2	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 applicable)

Full load Amps:	3.2	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:	**6.5**	kW
Calculated condensing fan load:	**0.39**	kW
Calculated evaporator fan load	**1.03**	kW
Total calculated load for equipment:	**6.89**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition		
	New	**X**
	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	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

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 Assistant Measurement

Input SEER	10	
RAT	72	F
SAT	52	F
RAH	50	%
SAH	85	%
EI	94%	
CI	90%	
Input Cap	5	Tons
OAT	80	F
Predicted KW	5.80	kW

CU Capacity Estimates

Ambient	78	F	299	K
CU Exhaust	100	F	311	K
Coil Length	47	in		
Coil Width	28	in		
Area	9.1	sq-ft		
Measured Fan CFM	6306			
Air Mass Flow	3.57	kg/sec		
Capacity	12.48	Tons		
Efficiency	25.74	EER		

CU Fan CFM Calculation

Measurement Number	Ft/Sec
1	10.7
2	11.1
3	12.7
Average	11.5

Monroe Aquatic Center RTU-16 Summary

EER at ARI Conditions	9.1 BTU/W-h		Equipment age	2 years
Condensing unit CFM	5922 CFM (Measured)			
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		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (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			Percent Difference			Test Data			Percent Difference						
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Predicted/ Original
Pre-Adsil	Power (kW)	6.25	7.1	6.86	91%	104%	100%	6.3	7.1	6.86	91%	104%	88%	-	-	-
	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%
Post-Adsil	Power (kW)	6.04	5.82	5.76	105%	101%	100%	7.2	6.9	6.86	105%	101%	104%	-	-	-
	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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Trane	**Published EER:**	10.0	Btu/W-hr (CU Only)
Model Number:	YCS090A4ELAO	**Calculated EER:**	10.0	Btu/W-hr (CU Only)
Serial Number	236101222L	**Nominal Capacity:**	7.44	tons
Equipment Type:	RTU-Gas	**Age**	2	years
Year Manufactured:	2002	**Coil Conditon**	0%	(% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	10.2	Btu/W-hr
Tag	RTU-15	**kW/ton**	1.18	

Compressor Data

Running load Amps:	13.6	Amps	Power supply:	3-phase
Nameplate Voltage:	460	Volts	Phase adjustment:	1.73
Power factor:	0.75		Compressor quantity:	1

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:	1

Evaporator fan data (if applicable)

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 load:	**8.1**	kW
Calculated condensing fan load:	**0.81**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**8.92**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.1%** **Performance Degradation**

Overall Unit Condition

	New	x
	Average	
	Fair	
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

Y-measurement

Phase	Volts	Amps	kW	PF
1				
2				
3				

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	488	15.9	1.9	0.25
2 to 3	488	13.8	6.6	0.99

TOTAL

HVAC Service Assistant 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 Estimates

Ambient	92	F	306	K
CU Exhaust	112	F	318	K
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	Tons		
Efficiency	24.41	EER		

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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Trane	**Published EER:**	10.0	Btu/W-hr (CU Only)
Model Number:	YCS090A4ELAO	**Calculated EER:**	10.0	Btu/W-hr (CU Only)
Serial Number	236101222L	**Nominal Capacity:**	7.44	tons
Equipment Type:	RTU-Gas	**Age**	2	years
Year Manufactured:	2002	**Coil Conditon**	0%	(% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	10.2	Btu/W-hr
Tag	RTU-15	**kW/ton**	1.18	

Compressor Data

Running load Amps:	13.6	Amps	Power supply:	3-phase
Nameplate Voltage:	460	Volts	Phase adjustment:	1.73
Power factor:	0.75		Compressor quantity:	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 applicable)

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 fan load	**0.00**	kW
Total calculated load for equipment:	**8.92**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition		
	New	X
	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	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

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				

HVAC Service Assistant Measurement

Input SEER	10	
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 Estimates

Ambient	77	F	298 K
CU Exhaust	96	F	309 K
Coil Length	70	in	
Coil Width	36	in	
Area	17.5	sq-ft	
Measured Fan CFM	10185		
Air Mass Flow	5.77	kg/sec	
Capacity	17.42	Tons	
Efficiency	27.86	EER	

CU Fan CFM Calculation

Measurement Number	ft/sec
1	8.2
2	8.6
3	12.3
Average	9.7

Monroe Aquatic Center RTU-15 Summary

EER at ARI Conditions	10.0 BTU/W-h		Equipment age	2 years
Condensing unit CFM	9608 CFM (Measured)			
Nominal Unit Capacity	7.44 tons			
Capacity used for SA	7.50 tons			
Coil Area	17.50 sq-ft			
Predicted EER =	10.19 pre	10.21 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	94	60	105%	103%	9.6	8.72	92	112	11.1	8.5	5.44	17.29	24.41
Post Adsil Measurements													
14-Jun	79	60	109%	104%	12.9	8.63	77	96	10.6	7.5	5.77	17.42	27.86

Condensing Unit Summary - Ambient Conditions									Condensing Unit Summary - ARI Conditions								
		Test Data			Percent Difference			Test Data			Percent Difference						
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	8.72	8.5	8.73	100%	97%	100%	8.9	8.7	8.91	100%	97%	103%	-	-	-
	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%
Post-Adsil	Power (kW)	8.63	7.5	7.39	117%	101%	100%	10.4	9.0	8.91	117%	101%	115%	-	-	-
	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 Changes

	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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	York	**Published EER:**	10.7	Btu/W-hr (CU Only)
Model Number:	D2CG240N24046FDE	**Calculated EER:**	10.7	Btu/W-hr (CU Only)
Serial Number	SNFHM080298	**Nominal Capacity:**	20.71	tons
Equipment Type:	RTU-Gas	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	5%	(% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	10.0	Btu/W-hr
Tag	RTU-13	**kW/ton**	1.20	

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:	2.10	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:		Amps	Power supply:	3-Phase
Nameplate Voltage:		Volts	Phase adjustment:	1.73
Adjust FLA to RLA:	0.70		Fan quantity:	1

Calculated compressor load:	**20.8**	kW
Calculated condensing fan load:	**2.34**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**23.12**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **4.7%** **Performance Degradation**

Overall Unit Condition

	New	
	Average	X
	Fair	
	Poor	
Coil Cleanliness		
	Coated	
	Clean	0.7
	Dirty	0.3
	Clogged	
	Plugged	
Fin Condition		
	Like New	0.5
	Some Bent	0.1
	Smashed	
	Dull/rough	0.5
	Corroded	0
	Pitted	0
	Flaking	0
Fin-Tube Attachment		
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
1				
2				
3				

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	486	39.3	19	1
2 to 3	484	39.6	8.2	0.43

TOTAL

HVAC Service Assistant Measurement

Input SEER	10	
RAT	72	F
SAT	52	F
RAH	50	%
SAH	85	%
EI	85%	
CI	94%	
Input Cap	20	Tons
OAT	92	F
Predicted KW	30.00	kW

Measured circuit 1 (compressors 1&2) All compressors were running during the test. Input capacity and power projections multiplied by 2

CU Capacity Estimates

Ambient	92	F	306	K
CU Exhaust	128.5	F	327	K
Coil Length	74	in		
Coil Width	29	in		
Coil Number	2			
Area	29.8	sq-ft		
Measured Fan CFM	10015			
Air Mass Flow	5.67	kg/sec		
Capacity	32.90	Tons		
Efficiency	14.51	EER		

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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	York	**Published EER:**	10.7	Btu/W-hr (CU Only)
Model Number:	D2CG240N24046FDE	**Calculated EER:**	10.7	Btu/W-hr (CU Only)
Serial Number	SNFHM080298	**Nominal Capacity:**	20.71	tons
Equipment Type:	RTU-Gas	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	0%	(% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	10.4	Btu/W-hr
Tag	RTU-13	**kW/ton**	1.15	

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 applicable)

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:	**20.8**	kW
Calculated condensing fan load:	**2.34**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**23.12**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

	New	X
	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	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

Y-measurement

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
TOTAL				

HVAC Service Assistant Measurement

Input SEER	10	
RAT	72	F
SAT	52	F
RAH	50	%
SAH	85	%
EI	109%	
CI	106%	
Input Cap	20	Tons
OAT	93	F
Predicted KW	NA	kW

Measured circuit 1 (compressors 1&2) Compressors 3&4 shut off during test. Input capacity and power projections multiplied by 2

CU Capacity Estimates

Ambient	87	F	304	K
CU Exhaust	103	F	313	K
Coil Length	74	in		
Coil Width	29	in		
Area	29.8	sq-ft		
Measured Fan CFM	18807			
Air Mass Flow	10.65	kg/sec		
Capacity	27.08	Tons		
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 Center   RTU-13 Summary

EER at ARI Conditions	10.7 BTU/W-h		Equipment age	7 years
Condensing unit CFM	10015 CFM (Measured)			
Nominal Unit Capacity	20.71 tons			
Capacity used for SA	20.00 tons			
Coil Area	29.81 sq-ft			
Predicted EER =	9.98 pre	10.44 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
27-May	92	60	85%	94%	8.5	31.07	92	128.5	20.3	27.2	5.67	32.90	14.51
Post Adsil Measurements													
17-Jun	93	60	109%	106%	10.7	NA	87	103	8.9	15.1	10.65	27.08	21.52

		Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions									
		Test Data			Percent Difference			Test Data			Percent Difference						
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Predicted/ Original
Pre-Adsil	Power (kW)	31.07	27.2	22.10	141%	123%	99%	32.7	28.7	23.29	141%	123%	114%	-	-	-
	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%
Post-Adsil	Power (kW)	NA	15.1	22.21	NA	68%	99%	NA	15.8	23.29	NA	68%	NA	-	-	-
	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 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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	York	**Published EER:**	11.1	Btu/W-hr (CU Only)
Model Number:	D3CG090N1304GG	**Calculated EER:**	11.1	Btu/W-hr (CU Only)
Serial Number	NGFM090088	**Nominal Capacity:**	7.63	tons
Equipment Type:	RTU-Gas	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	1%	(% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	10.7	Btu/W-hr
Tag	RTU-10	**kW/ton**	1.12	

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 applicable)

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 load:	**7.4**	kW
Calculated condensing fan load:	**0.84**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**8.25**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.52%** **Performance Degradation**

Overall Unit Condition

Overall Unit Condition		
	New	**0.9**
	Average	**0.1**
	Fair	
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	**x**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

Y-measurement

Phase	Volts	Amps	kW	PF
1				
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

HVAC Service Assistant 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	3.5	Tons	3.5	Tons
OAT	85	F	86	F
Predicted KW	4.50	kW	4.20	kW

CU Capacity Estimates

Ambient	84.5 F	302 K	
CU Exhaust	105.5 F	314 K	
Coil Length	41 in		
Coil Width	29 in		
Area	16.5 sq-ft		
Measured Fan CFM	8984		
Air Mass Flow	5.09 kg/sec		
Capacity	16.98 Tons		
Efficiency	21.00 EER		

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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	York	**Published EER:**	11.1	Btu/W-hr (CU Only)
Model Number:	D3CG090N1304GG	**Calculated EER:**	11.1	Btu/W-hr (CU Only)
Serial Number	NGFM090088	**Nominal Capacity:**	7.63	tons
Equipment Type:	RTU-Gas	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	0%	(% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	10.8	Btu/W-hr
Tag	RTU-10	**kW/ton**	1.11	

Compressor Data

Running load Amps:	7.1	Amps	Power supply:	3-phase
Nameplate Voltage:	460	Volts	Phase adjustment:	1.73
Power factor:	0.656		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 applicable)

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:	**7.4**	kW
Calculated condensing fan load:	**0.84**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**8.25**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

	New	X
	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	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

Y-measurement

Phase	Volts	Amps	kW	PF
1				
2				
3				

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	481	15.7	3	0.4
2 to 3	485	14	6.35	0.93

TOTAL

HVAC Service Assistant Measurement

Input SEER	10			
RAT	74	F		
SAT	54	F		
RAH	42	%		
SAH	85	%		
	Circuit 1		Circuit 2	
EI	108%		106%	
CI	110%		108%	
Input Cap	3.5	Tons	3.5	Tons
OAT	89	F	87	F
Predicted KW	4.30	kW	4.30	kW

CU Capacity Estimates

Ambient	89	F	305	K
CU Exhaust	106	F	314	K
Coil Length	41	in		
Coil Width	29	in		
Area	16.5	sq-ft		
Measured Fan CFM	11444			
Air Mass Flow	6.48	kg/sec		
Capacity	17.51	Tons		
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

Monroe Aquatic Center RTU-10 Summary

EER at ARI Conditions	11.1	BTU/W-h	Equipment age	7 years
Condensing unit CFM	8984	CFM (Measured)		
Capacity at ARI	7.63	tons		
Capacity used for SA	7.00	tons		
Coil Area	16.51	sq-ft		
Predicted EER =	10.72	pre	10.77 post	

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
13-May	85	59	97%	101%	11.7	9.48	84.5	105.5	11.7	9.7	5.09	16.98	21.00
Post Adsil Measurements													
17-Jun	89	59	107%	109%	12.1	9.37	89	106	9.4	9.35	6.48	17.51	22.47

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions								
		Test Data			Percent Difference			Test Data			Percent Difference					
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Predicted/ Original
Pre-Adsil	Power (kW)	9.48	9.7	7.18	132%	135%	102%	10.7	10.9	8.08	132%	135%	98%	-	-	-
	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%
Post-Adsil	Power (kW)	9.37	9.35	7.52	125%	124%	102%	10.1	10.0	8.08	125%	124%	100%	-	-	-
	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 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%	3.5%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	York	**Published EER:**	10.5	Btu/W-hr (CU Only)
Model Number:	D4CG150N20046JSC	**Calculated EER:**	10.5	Btu/W-hr (CU Only)
Serial Number	NBFM022912	**Nominal Capacity:**	11.88	tons
Equipment Type:	RTU-Gas	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	9%	(% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	9.4	Btu/W-hr
Tag	RTU-9	**kW/ton**	1.28	

Compressor Data

Running load Amps:	9.6	Amps	Power supply:	3-phase
Nameplate Voltage:	460	Volts	Phase adjustment:	1.73
Power factor:	0.78		Compressor quantity:	2

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
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
Total calculated load for equipment:	**13.53**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **9.2%** **Performance Degradation**

Overall Unit Condition		
	New	
	Average	X
	Fair	
	Poor	
Coil Cleanliness		
	Coated	
	Clean	
	Dirty	0.3
	Clogged	0.7
	Plugged	
Fin Condition		
	Like New	0.9
	Some Bent	
	Smashed	
	Dull/rough	0.1
	Corroded	0
	Pitted	0
	Flaking	0
Fin-Tube Attachment		
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

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	487	27.8	4.6	0.34

TOTAL

HVAC Service Assistant Measurment

Input SEER	10			
RAT	85	F		
SAT	65	F		
RAH	35	%		
SAH	85	%		
	Circuit 1		Circuit 2	
EI	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 Estimates

Ambient	86	F	303	K
CU Exhaust	115	F	319	K
Coil Length	48	in		
Coil Width	42	in		
Area	28.0	sq-ft		
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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	York	**Published EER:**	10.5	Btu/W-hr (CU Only)
Model Number:	D4CG150N20046JSC	**Calculated EER:**	10.5	Btu/W-hr (CU Only)
Serial Number	NBFM022912	**Nominal Capacity:**	11.88	tons
Equipment Type:	RTU-Gas	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	0%	(% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	10.2	Btu/W-hr
Tag	RTU-9	**kW/ton**	1.17	

Compressor Data

Running load Amps:	9.6	Amps	Power supply:	3-phase
Nameplate Voltage:	460	Volts	Phase adjustment:	1.73
Power factor:	0.78		Compressor quantity:	2

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:	2

Evaporator fan data (if applicable)

Full load Amps:	7.5	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:	**11.9**	kW
Calculated condensing fan load:	**1.61**	kW
Calculated evaporator fan load	**2.42**	kW
Total calculated load for equipment:	**13.53**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.1%** **Performance Degradation**

Overall Unit Condition

	New	X
	Average	
	Fair	
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	**x**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

Y-measurement

Phase	Volts	Amps	kW	PF
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	12.4	1.00

TOTAL

HVAC Service Assistant Measurment

Input SEER	10			
RAT	87	F		
SAT	67	F		
RAH	45	%		
SAH	85	%		
	Circuit 1		Circuit 2	
EI	85%		88%	
CI	78%		84%	
Input Cap	6	Tons	6	Tons
OAT	87	F	85	F
Predicted KW	6.70	kW	6.90	kW

CU Capacity Estimates

Ambient	87 F	304 K	
CU Exhaust	110 F	316 K	
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 Tons		
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 Center RTU-9 Summary

EER at ARI Conditions	10.5 BTU/W-h		Equipment age	7 years
Condensing unit CFM	11424 CFM (Measured)			
Capacity at ARI	11.88 tons			
Capacity used for SA	12.00 tons			
Coil Area	28.00 sq-ft			
Predicted EER =	9.39 pre	10.22 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
13-May	88	65	75%	80%	8.5	14.85	86	115	16.1	17.6	6.47	29.81	20.33
Post Adsil Measurements													
16-Jun	87	70	87%	81%	11.5	13.46	87	110	12.8	17	8.52	31.12	21.97

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions								
		Test Data			Percent Difference			Test Data			Percent Difference					
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Predicted/ Original
Pre-Adsil	Power (kW)	14.85	17.6	12.85	116%	137%	100%	15.6	18.5	13.52	116%	137%	84%	-	-	-
	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%
Post-Adsil	Power (kW)	13.46	17.0	13.09	103%	130%	100%	13.9	17.6	13.52	103%	130%	79%	-	-	-
	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 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%
Weighted Average	184.0%	-87.2%	105.9%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	York	**Published EER:**	10.7	Btu/W-hr (CU Only)
Model Number:	D2CG240N24046FDE	**Calculated EER:**	10.7	Btu/W-hr (CU Only)
Serial Number	NGFM089948	**Nominal Capacity:**	20.71	tons
Equipment Type:	RTU-Gas	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	12%	(% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	9.4	Btu/W-hr
Tag	RTU-8	**kW/ton**	1.28	

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:	2.10	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:		Amps	Power supply:	3-Phase
Nameplate Voltage:		Volts	Phase adjustment:	1.73
Adjust FLA to RLA:	0.70		Fan quantity:	1

Calculated compressor load:	**20.8**	kW
Calculated condensing fan load:	**2.34**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**23.12**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **12.0%** **Performance Degradation**

Overall Unit Condition

	New	
	Average	X
	Fair	
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

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 Assistant Measurement

Input SEER	10	
RAT	82	F
SAT	62	F
RAH	15	%
SAH	85	%
EI	84%	
CI	96%	
Input Cap	20	Tons
OAT	97	F
Predicted KW	26.80	kW

Measured circuit 2 (compressors 3&4) All compressors were running during the test. Input capacity and power projections multiplied by 2

CU Capacity Estimates

Ambient	98	F	310	K
CU Exhaust	128.5	F	327	K
Coil Length	74	in		
Coil Width	29	in		
Coil Number	2			
Area	29.8	sq-ft		
Measured Fan CFM	6319			
Air Mass Flow	3.58	kg/sec		
Capacity	17.34	Tons		
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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	York	**Published EER:**	10.7	Btu/W-hr (CU Only)
Model Number:	D2CG240N24046FDE	**Calculated EER:**	10.7	Btu/W-hr (CU Only)
Serial Number	NGFM089948	**Nominal Capacity:**	20.71	tons
Equipment Type:	RTU-Gas	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	3%	(% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	10.2	Btu/W-hr
Tag	RTU-8	**kW/ton**	1.18	

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 applicable)

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:	**20.8**	kW
Calculated condensing fan load:	**2.34**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**23.12**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **2.5%** **Performance Degradation**

Overall Unit Condition		
	New	**X**
	Average	
	Fair	
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	**x**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

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 Measurement

Input SEER	10	
RAT	82	F
SAT	62	F
RAH	15	%
SAH	85	%
EI	96%	
CI	94%	
Input Cap	10	Tons
OAT	85	F
Predicted KW	23.60	kW

Measured circuit 2 (compressors 3&4) All compressors were running during the test. Input capacity and power projections multiplied by 2

CU Capacity Estimates

Ambient	85 F	303 K
CU Exhaust	110.5 F	317 K
Coil Length	74 in	
Coil Width	29 in	
Area	29.8 sq-ft	
Measured Fan CFM	18092	
Air Mass Flow	10.25 kg/sec	
Capacity	41.52 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 Center RTU-8 Summary

EER at ARI Conditions	10.7 BTU/W-h	Equipment age	7 years
Condensing unit CFM	6319 CFM (Measured)		
Nominal Unit Capacity	20.71 tons		
Capacity used for SA	20.00 tons		
Coil Area	29.81 sq-ft		
Predicted EER =	9.35 pre	10.19 post	

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
27-May	97	55	84%	96%	8.2	27.75	98	128.5	16.9	28.2	3.58	17.34	7.38
Post Adsil Measurements													
17-Jun	85	55	96%	94%	10.5	24.44	85	110.5	14.2	24.2	10.25	41.52	20.59

		Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions									
		Test Data			Percent Difference			Test Data			Percent Difference						
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Predicted/ Original
Pre-Adsil	Power (kW)	27.75	28.2	22.10	126%	128%	99%	29.2	29.7	23.29	126%	128%	98%	-	-	-
	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%
Post-Adsil	Power (kW)	24.44	24.2	20.78	118%	116%	99%	27.4	27.1	23.29	118%	116%	101%	-	-	-
	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 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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	York	**Published EER:**	10.9	Btu/W-hr (CU Only)
Model Number:	D7CG060N07946A	**Calculated EER:**	10.9	Btu/W-hr (CU Only)
Serial Number	NGFM091009	**Nominal Capacity:**	5.25	tons
Equipment Type:	RTU-Gas	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	4%	(% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	10.2	Btu/W-hr
Tag	RTU-6	**kW/ton**	1.18	

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 applicable)

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 load:	**5.5**	kW
Calculated condensing fan load:	**0.26**	kW
Calculated evaporator fan load	**1.06**	kW
Total calculated load for equipment:	**5.80**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **4.0%** **Performance Degradation**

Overall Unit Condition

	New	
	Average	X
	Fair	
	Poor	
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 Attachment		
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

Y-measurement

Phase	Volts	Amps	kW	PF
1				
2				
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 Assistant Measurement

Input SEER	10	
RAT	75	F
SAT	55	F
RAH	35	%
SAH	85	%
EI	103%	
CI	98%	
Input Cap	5	Tons
OAT	95	F
Predicted KW	NA	kW

CU Capacity Estimates

Ambient	95 F	308 K	
CU Exhaust	114 F	319 K	
Coil Length	74 in		
Coil Width	29 in		
Area	14.9 sq-ft		
Measured Fan CFM	5477		
Air Mass Flow	3.10 kg/sec		
Capacity	9.36 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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	York	**Published EER:**	10.9	Btu/W-hr (CU Only)
Model Number:	D7CG060N07946A	**Calculated EER:**	10.9	Btu/W-hr (CU Only)
Serial Number	NGFM091009	**Nominal Capacity:**	5.25	tons
Equipment Type:	RTU-Gas	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	0%	(% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	10.6	Btu/W-hr
Tag	RTU-6	**kW/ton**	1.14	

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 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 fan load	**1.06**	kW
Total calculated load for equipment:	**5.80**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

	New	X
	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	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

Y-measurement

Phase	Volts	Amps	kW	PF
1				
2				
3				

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 Measurement

Input SEER	10	
RAT	75	F
SAT	55	F
RAH	35	%
SAH	85	%
EI	99%	
CI	98%	
Input Cap	5	Tons
OAT	88	F
Predicted KW	6.00	kW

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	12.55	Tons		
Efficiency	25.96	EER		

CU Fan CFM Calculation

Measurement Number	ft/sec
1	7.2
2	7.4
3	7.5
4	7.6
Average	7.425

Monroe Aquatic Center RTU-6 Summary

EER at ARI Conditions	10.9 BTU/W-h		Equipment age	7 years
Condensing unit CFM	5477 CFM (Measured)			
Nominal Unit Capacity	5.25 tons			
Capacity used for SA	5.00 tons			
Coil Area	14.90 sq-ft			
Predicted EER =	10.17 pre	10.56 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	95	58	103%	98%	11.0	NA	95	114	10.6	5.9	3.10	9.36	19.05
Post Adsil Measurements													
15-Jun	88	58	99%	98%	11.6	6.30	87	108	11.7	5.8	3.76	12.55	25.96

		Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions									
		Test Data			Percent Difference			Test Data			Percent Difference						
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	NA	5.9	5.90	NA	100%	100%	NA	5.8	5.80	NA	100%	NA	-	-	-
	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%
Post-Adsil	Power (kW)	6.30	5.8	5.65	112%	103%	100%	6.5	6.0	5.80	112%	103%	109%	-	-	-
	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 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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	York	**Published EER:**	10.9 Btu/W-hr (CU Only)
Model Number:	D7CG060N07946A	**Calculated EER:**	10.9 Btu/W-hr (CU Only)
Serial Number	NGFM091011	**Nominal Capacity:**	5.25 tons
Equipment Type:	RTU-Gas	**Age**	7 years
Year Manufactured:	1997	**Coil Conditon**	4% (% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	10.2 Btu/W-hr
Tag	RTU-5	**kW/ton**	1.18

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 applicable)

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 load:	**5.5**	kW
Calculated condensing fan load:	**0.26**	kW
Calculated evaporator fan load	**1.06**	kW
Total calculated load for equipment:	**5.80**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **4.0%** **Performance Degradation**

Overall Unit Condition

	New	
	Average	**X**
	Fair	
	Poor	
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 Attachment		
	Like New	**x**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
1				
2				
3				

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	480	11.25	0.9	0.17
2 to 3	483	10.7	5.2	1.00

TOTAL

HVAC Service Assistant Measurement

Input SEER	10	
RAT	75	F
SAT	55	F
RAH	25	%
SAH	85	%
EI	72%	
CI	68%	
Input Cap	5	Tons
OAT	93	F
Predicted KW	5.80	kW

CU Capacity Estimates

Ambient	91 F	306 K
CU Exhaust	115 F	319 K
Coil Length	74 in	
Coil Width	29 in	
Area	14.9 sq-ft	
Measured Fan CFM	3890	
Air Mass Flow	2.20 kg/sec	
Capacity	8.40 Tons	
Efficiency	16.53 EER	

CU Fan CFM Calculation

Measurement Number	ft/sec
1	4.5
2	5.3
3	4.5
4	3.1
Average	4.4

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	York	**Published EER:**	10.9	Btu/W-hr (CU Only)
Model Number:	D7CG060N07946A	**Calculated EER:**	10.9	Btu/W-hr (CU Only)
Serial Number	NGFM091011	**Nominal Capacity:**	5.25	tons
Equipment Type:	RTU-Gas	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	0%	(% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	10.6	Btu/W-hr
Tag	RTU-5	**kW/ton**	1.14	

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 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 fan load	**1.06**	kW
Total calculated load for equipment:	**5.80**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition		
	New	X
	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	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

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	10.3	5	1.00

TOTAL

HVAC Service Assistant Measurement

Input SEER	10	
RAT	68	F
SAT	48	F
RAH	50	%
SAH	85	%
EI	82%	
CI	74%	
Input Cap	5	Tons
OAT	84	F
Predicted KW	5.50	kW

CU Capacity Estimates

Ambient	84	F	302	K
CU Exhaust	101	F	311	K
Coil Length	74	in		
Coil Width	29	in		
Area	14.9	sq-ft		
Measured Fan CFM	5343			
Air Mass Flow	3.03	kg/sec		
Capacity	8.17	Tons		
Efficiency	18.51	EER		

CU Fan CFM Calculation

Measurement Number	ft/sec
1	6.1
2	6
3	5.7
4	6.1
Average	6.0

Monroe Aquatic Center RTU-5 Summary

EER at ARI Conditions	10.9 BTU/W-h		Equipment age	7 years
Condensing unit CFM	3890 CFM (Measured)			
Nominal Unit Capacity	5.25 tons			
Capacity used for SA	5.00 tons			
Coil Area	14.90 sq-ft			
Predicted EER =	10.17 pre	10.56 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	93	55	72%	68%	7.8	6.09	91	115	13.3	6.1	2.20	8.40	16.53
Post Adsil Measurements													
15-Jun	84	57	82%	74%	10.1	6.09	84	101	9.4	5.3	3.03	8.17	18.51

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions									
		Test Data			Percent Difference			Test Data			Percent Difference						
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	6.09	6.1	5.91	103%	103%	100%	6.0	6.0	5.80	103%	103%	100%	-	-	-
	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%
Post-Adsil	Power (kW)	6.09	5.3	5.54	110%	96%	100%	6.4	5.5	5.80	110%	96%	115%	-	-	-
	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 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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	York	**Published EER:**	10.9	Btu/W-hr (CU Only)
Model Number:	D7CG060N07946A	**Calculated EER:**	10.9	Btu/W-hr (CU Only)
Serial Number	NGFM091011	**Nominal Capacity:**	5.25	tons
Equipment Type:	RTU-Gas	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	2%	(% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	10.4	Btu/W-hr
Tag	RTU-4	**kW/ton**	1.16	

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 applicable)

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 load:	**5.5**	kW
Calculated condensing fan load:	**0.26**	kW
Calculated evaporator fan load	**1.06**	kW
Total calculated load for equipment:	**5.80**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **1.7%** **Performance Degradation**

Overall Unit Condition		
	New	
	Average	**X**
	Fair	
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	**x**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

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 Assistant Measurment

Input SEER	10	
RAT	68	F
SAT	48	F
RAH	50	%
SAH	85	%
EI	79%	
CI	73%	
Input Cap	5	Tons
OAT	90	F
Predicted KW	5.70	kW

CU Capacity Estimates

Ambient	90	F	305	K
CU Exhaust	105	F	314	K
Coil Length	74	in		
Coil Width	29	in		
Area	14.9	sq-ft		
Measured Fan CFM	5074			
Air Mass Flow	2.87	kg/sec		
Capacity	6.85	Tons		
Efficiency	14.68	EER		

CU Fan CFM Calculation

Measurement Number	ft/sec
1	4.9
2	6.8
3	5.5
4	5.5
Average	5.675

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	York	**Published EER:**	10.9	Btu/W-hr (CU Only)
Model Number:	D7CG060N07946A	**Calculated EER:**	10.9	Btu/W-hr (CU Only)
Serial Number	NGFM091011	**Nominal Capacity:**	5.25	tons
Equipment Type:	RTU-Gas	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	0%	(% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	10.6	Btu/W-hr
Tag	RTU-4	**kW/ton**	1.14	

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 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 fan load	**1.06**	kW
Total calculated load for equipment:	**5.80**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition		
	New	**X**
	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	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

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 Assistant Measurment

Input SEER	10	
RAT	68	F
SAT	48	F
RAH	50	%
SAH	85	%
EI	85%	
CI	78%	
Input Cap	5	Tons
OAT	85	F
Predicted KW	5.70	kW

CU Capacity Estimates

Ambient	86 F		303 K
CU Exhaust	104 F		313 K
Coil Length	74 in		
Coil Width	29 in		
Area	14.9 sq-ft		
Measured Fan CFM	6349		
Air Mass Flow	3.60 kg/sec		
Capacity	10.28 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 Center RTU-4 Summary

EER at ARI Conditions	10.9 BTU/W-h		Equipment age	7 years
Condensing unit CFM	5074 CFM (Measured)			
Nominal Unit Capacity	5.25 tons			
Capacity used for SA	5.00 tons			
Coil Area	14.90 sq-ft			
Predicted EER =	10.39 pre	10.56 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	90	57	79%	73%	9.0	5.99	90	105	8.3	5.6	2.87	6.85	14.68
Post Adsil Measurements													
15-Jun	85	57	85%	78%	10.3	5.99	86	104	10.0	5.5	3.60	10.28	22.44

Condensing Unit Summary - Ambient Conditions									Condensing Unit Summary - ARI Conditions								
		Test Data			Percent Difference			Test Data			Percent Difference					
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	5.99	5.6	5.75	104%	97%	100%	6.0	5.7	5.80	104%	97%	107%	-	-	-
	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%
Post-Adsil	Power (kW)	5.99	5.5	5.58	107%	99%	100%	6.2	5.7	5.80	107%	99%	109%	-	-	-
	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 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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	York	**Published EER:**	11.1	Btu/W-hr (CU Only)
Model Number:	D3CG090N1304GG	**Calculated EER:**	11.1	Btu/W-hr (CU Only)
Serial Number	NGFM090091	**Nominal Capacity:**	7.49	tons
Equipment Type:	RTU-Gas	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	1%	(% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	10.8	Btu/W-hr
Tag	RTU-2	**kW/ton**	1.12	

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 applicable)

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 load:	**7.2**	kW
Calculated condensing fan load:	**0.84**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**8.07**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.52%** **Performance Degradation**

Overall Unit Condition		
	New	0.9
	Average	0.1
	Fair	
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

Y-measurement

Phase	Volts	Amps	kW	PF
1				
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 Assistant Measurement

Input SEER	10			
RAT	70	F		
SAT	50	F		
RAH	28	%		
SAH	85	%		
	Circuit 1		Circuit 2	
EI	92%		98%	
CI	93%		96%	
Input Cap	3.5	Tons	3.5	Tons
OAT	85	F	86	F
Predicted KW	4.20	kW	4.10	kW

CU Capacity Estimates

Ambient	83	F	301	K
CU Exhaust	105	F	314	K
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	Tons		
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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	York	**Published EER:**	11.1	Btu/W-hr (CU Only)
Model Number:	D3CG090N1304GG	**Calculated EER:**	11.2	Btu/W-hr (CU Only)
Serial Number	NGFM090091	**Nominal Capacity:**	7.50	tons
Equipment Type:	RTU-Gas	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	0%	(% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	10.8	Btu/W-hr
Tag	RTU-2	**kW/ton**	1.11	

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 applicable)

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:	**7.2**	kW
Calculated condensing fan load:	**0.84**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**8.07**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

New	X
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	x
Corrosion	
Pitting	
Leaks	

FLUKE METER MEASUREMENTS

Y-measurement

Phase	Volts	Amps	kW	PF
1				
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 Assistant Measurement

Input SEER	10	
RAT	70	F
SAT	50	F
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 Estimates

Ambient	88.5	F	305	K
CU Exhaust	104.5	F	313	K
Coil Length	41	in		
Coil Width	29	in		
Area	16.5	sq-ft		
Measured Fan CFM	12509			
Air Mass Flow	7.08	kg/sec		
Capacity	18.01	Tons		
Efficiency	24.29	EER		

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 Center RTU-2 Summary

EER at ARI Conditions	11.1	BTU/W-h		Equipment age	7 years
Condensing unit CFM	6424	CFM (Measured)			
Capacity at ARI	7.49	tons			
Capacity used for SA	7.00	tons			
Coil Area	16.51	sq-ft			
Predicted EER =	10.76	pre	10.83 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	85	53	95%	95%	11.2	8.88	83	105	12.2	8.8	3.64	12.72	17.34
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	24.29

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions								
		Test Data			Percent Difference			Test Data			Percent Difference					
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	8.88	8.8	7.25	123%	121%	100%	9.9	9.8	8.08	123%	121%	101%	-	-	-
	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%
Post-Adsil	Power (kW)	8.88	8.9	7.52	118%	118%	100%	9.5	9.6	8.08	118%	118%	100%	-	-	-
	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 Changes

	Service Assistant	Condenser Test	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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	York	**Published EER:**	11.1	Btu/W-hr (CU Only)
Model Number:	D3CG090N1304GG	**Calculated EER:**	11.1	Btu/W-hr (CU Only)
Serial Number	NGFM090089	**Nominal Capacity:**	7.49	tons
Equipment Type:	RTU-Gas	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	1%	(% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	10.8	Btu/W-hr
Tag	RTU-1	**kW/ton**	1.12	

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 applicable)

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 load:	**7.2**	kW
Calculated condensing fan load:	**0.84**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**8.07**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.52%** **Performance Degradation**

Overall Unit Condition

	New	**0.9**
	Average	**0.1**
	Fair	
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	**x**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

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 Assistant Measurement

	Circuit 1		Circuit 2	
Input SEER	10			
RAT	74	F		
SAT	54	F		
RAH	50	%		
SAH	85	%		
EI	95%			
CI	102%			
Input Cap	3.5	Tons		Tons
OAT	94	F		F
Predicted KW	4.40	kW		kW

CU Capacity Estimates

Ambient	95 F		308 K
CU Exhaust	112.5 F		318 K
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	14.86 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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	York	**Published EER:**	11.1	Btu/W-hr (CU Only)
Model Number:	D3CG090N1304GG	**Calculated EER:**	11.1	Btu/W-hr (CU Only)
Serial Number	NGFM090089	**Nominal Capacity:**	7.49	tons
Equipment Type:	RTU-Gas	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	0%	(% degraded)
Location	Monroe Aquatic Center	**Present Condition EER**	10.8	Btu/W-hr
Tag	RTU-1	**kW/ton**	1.11	

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 applicable)

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:	**7.2**	kW
Calculated condensing fan load:	**0.84**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**8.07**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition		
	New	X
	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	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
1				
2				
3				

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	476	15.6	3.2	0.42
2 to 3	483	14.1	6.5	0.95

TOTAL

HVAC Service Assistant Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	99%	
CI	101%	
Input Cap	3.5	Tons
OAT	91	F
Predicted KW	4.30	kW

CU Capacity Estimates

Ambient	90.5 F	306 K
CU Exhaust	106.5 F	315 K
Coil Length	41 in	
Coil Width	29 in	
Area	16.5 sq-ft	
Measured Fan CFM	12600	
Air Mass Flow	7.14 kg/sec	
Capacity	18.14 Tons	
Efficiency	22.44 EER	

CU Fan CFM Calculation

Measurement Number	ft/sec
1	12.4
2	11.8
3	12.6
4	13.4
5	13.7
6	12.4
Average	12.717

Monroe Aquatic Center RTU-1 Summary

EER at ARI Conditions	11.1 BTU/W-h	Equipment age 7 years
Condensing unit CFM	9438 CFM (Measured)	
Capacity at ARI	7.49 tons	
Capacity used for SA	3.50 tons	
Coil Area	16.51 sq-ft	
Predicted EER =	10.76 pre	10.81 post

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	94	61	95%	102%	10.5	9.41	95	112.5	9.7	10.3	5.34	14.86	17.32
Post Adsil Measurements													
16-Jun	91	61	99%	101%	10.9	9.20	90.5	106.5	8.9	9.7	7.14	18.14	22.44

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions								
		Test Data			Percent Difference			Test Data			Percent Difference					
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Predicted/ Original
Pre-Adsil	Power (kW)	9.41	10.3	7.93	119%	130%	100%	9.6	10.5	8.08	119%	130%	91%	-	-	-
	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%
Post-Adsil	Power (kW)	9.20	9.7	7.68	120%	126%	100%	9.7	10.2	8.08	120%	126%	95%	-	-	-
	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 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%
Weighted Average	14.7%	82.0%	1.8%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Tempstar	**Published EER:**	10.6	Btu/W-hr (CU Only)
Model Number:	CH9536VKB2	**Calculated EER:**	10.6	Btu/W-hr (CU Only)
Serial Number	L970880635	**Nominal Capacity:**	3.00	tons
Equipment Type:	Split Heat pump	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	6%	(% degraded)
Location	Locust City Hall	**Present Condition EER**	9.8	Btu/W-hr
Tag	SS-2	**kW/ton**	1.23	

Compressor Data

Running load Amps:	16.0	Amps	Power supply:	1-Phase
Nameplate Voltage:	208	Volts	Phase adjustment:	1
Power factor:	0.96		Compressor quantity:	1

Condensing Fan Data

Full load Amps:	1.30	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 applicable)

Full load Amps:		Amps	Power supply:	
Nameplate Voltage:		Volts	Phase adjustment:	
Adjust FLA to RLA:			Fan quantity:	

Calculated compressor load:	**3.2**	kW
Calculated condensing fan load:	**0.19**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**3.38**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **5.95%** **Performance Degradation**

Overall Unit Condition

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

FLUKE METER MEASURMENTS

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 Assistant 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 Estimates

Ambient	95 F	308 K	
CU Exhaust	104 F	313 K	
Coil Length	88 in		
Coil Width	29 in		
Area	17.7 sq-ft		
Measured Fan CFM	5131		
Air Mass Flow	2.91 kg/sec		
Capacity	4.16 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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Tempstar	**Published EER:**	10.6	Btu/W-hr (CU Only)
Model Number:	CH9536VKB2	**Calculated EER:**	10.6	Btu/W-hr (CU Only)
Serial Number	L970880635	**Nominal Capacity:**	3.00	tons
Equipment Type:	Split Heat pump	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	0%	(% degraded)
Location	Locust City Hall	**Present Condition EER**	10.3	Btu/W-hr
Tag	SS-2	**kW/ton**	1.16	

Compressor Data

Running load Amps:	16	Amps	Power supply:	1-Phase
Nameplate Voltage:	208	Volts	Phase adjustment:	1
Power factor:	0.96		Compressor quantity:	1

Condensing Fan Data

Full load Amps:	1.3	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 applicable)

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:	**3.2**	kW
Calculated condensing fan load:	**0.19**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**3.38**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

Overall Unit Condition		
	New	x
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

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 Assistant Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	118%	
CI	116%	
Input Cap	3	Tons
OAT	89	F
Predicted KW	3.60	kW

CU Capacity Estimates

Ambient	89 F	305 K	
CU Exhaust	100 F	311 K	
Coil Length	88 in		
Coil Width	29 in		
Area	17.7 sq-ft		
Measured Fan CFM	6726		
Air Mass Flow	3.81 kg/sec		
Capacity	6.66 Tons		
Efficiency	35.20 EER		

CU Fan CFM Calculation

Measurement Number	ft/sec
1	5.5
2	6.8
3	6.6
4	6.4
Average	6.325

Locust City Hall SS-2 Summary

EER at ARI Conditions	10.6 BTU/W-h		Equipment age	7 years
Condensing unit CFM	5131 CFM (Measured)			
Capacity at ARI	3.00 tons			
Capacity used for SA	3.00 tons			
Coil Area	17.72 sq-ft			
Predicted EER =	9.76 pre	10.33 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	94	NA	112%	109%	11.9	3.50	95	104	5.0	2.35	2.91	4.16	21.22
Post Adsil Measurements													
16-Jun	89	NA	118%	116%	12.5	3.60	89	100	6.1	2.27	3.81	6.66	35.20

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions								
		Test Data@ Field Conditions			Percent Difference			Test Data @ARI			Percent Difference					
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	3.50	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	-	-	-
	Capacity (Tons)	NA	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	-	-	-
	EER	11.9	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	NA	-	NA
Post-Adsil	Power (kW)	3.60	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	-	-	-
	Capacity (Tons)	NA	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	-	-	-
	EER	12.5	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	NA	-	NA

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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Tempstar	**Published EER:**	10.6	Btu/W-hr (CU Only)
Model Number:	CH9536VKB2	**Calculated EER:**	10.6	Btu/W-hr (CU Only)
Serial Number	L970880635	**Nominal Capacity:**	3.00	tons
Equipment Type:	Split Heat pump	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	7%	(% degraded)
Location	Locust City Hall	**Present Condition EER**	9.7	Btu/W-hr
Tag	SS-1	**kW/ton**	1.24	

Compressor Data

Running load Amps:	16.0	Amps	Power supply:	1-Phase
Nameplate Voltage:	208	Volts	Phase adjustment:	1
Power factor:	0.96		Compressor quantity:	1

Condensing Fan Data

Full load Amps:	1.30	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 applicable)

Full load Amps:		Amps	Power supply:	
Nameplate Voltage:		Volts	Phase adjustment:	
Adjust FLA to RLA:			Fan quantity:	

Calculated compressor load:	**3.2**	kW
Calculated condensing fan load:	**0.19**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**3.38**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **7.2%** **Performance Degradation**

Overall Unit Condition

Overall Unit Condition		
	New	
	Average	**1**
	Fair	
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	**x**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
1				
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 Assistant Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	118%	
CI	114%	
Input Cap	3	Tons
OAT	93	F
Predicted KW	3.50	kW

CU Capacity Estimates

Ambient	93 F	307 K
CU Exhaust	105 F	314 K
Coil Length	88 in	
Coil Width	29 in	
Area	17.7 sq-ft	
Measured Fan CFM	6486	
Air Mass Flow	3.67 kg/sec	
Capacity	7.00 Tons	
Efficiency	31.02 EER	

CU Fan CFM Calculation

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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Tempstar	**Published EER:**	10.6	Btu/W-hr	(CU Only)
Model Number:	CH9536VKB2	**Calculated EER:**	10.6	Btu/W-hr	(CU Only)
Serial Number	L970880635	**Nominal Capacity:**	3.00	tons	
Equipment Type:	Split Heat pump	**Age**	7	years	
Year Manufactured:	1997	**Coil Conditon**	0%	(% degraded)	
Location	Locust City Hall	**Present Condition EER**	10.3	Btu/W-hr	
Tag	SS-1	**kW/ton**	1.16		

Compressor Data

Running load Amps:	16	Amps	Power supply:	1-Phase
Nameplate Voltage:	208	Volts	Phase adjustment:	1
Power factor:	0.96		Compressor quantity:	1

Condensing Fan Data

Full load Amps:	1.3	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 applicable)

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:	**3.2**	kW
Calculated condensing fan load:	**0.19**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**3.38**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

Overall Unit Condition		
	New	**x**
	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	**x**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

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 Assistant Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	122%	
CI	117%	
Input Cap	3	Tons
OAT	87	F
Predicted KW	3.50	kW

CU Capacity Estimates

Ambient	87	F	304	K
CU Exhaust	101	F	311	K
Coil Length	88	in		
Coil Width	29	in		
Area	17.7	sq-ft		
Measured Fan CFM	8135			
Air Mass Flow	4.61	kg/sec		
Capacity	10.25	Tons		
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 Summary

EER at ARI Conditions	10.6 BTU/W-h		Equipment age	7 years
Condensing unit CFM	6486 CFM (Measured)			
Capacity at ARI	3.00 tons			
Capacity used for SA	3.00 tons			
Coil Area	17.72 sq-ft			
Predicted EER =	9.65 pre	10.33 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	93	62	118%	114%	12.6	3.50	93	105	6.7	2.71	3.67	7.00	31.02
Post Adsil Measurements													
16-Jun	87	62	122%	117%	13.0	3.50	87	101	7.8	2.51	4.61	10.25	49.00

		Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions								
		Test Data@ Field Conditions			Percent Difference			Test Data @ARI			Percent Difference					
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Predicted/ Original
Pre-Adsil	Power (kW)	3.50	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	-	-	-
	Capacity (Tons)	NA	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	-	-	-
	EER	12.6	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	NA	-	NA
Post-Adsil	Power (kW)	3.50	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	-	-	-
	Capacity (Tons)	NA	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	-	-	-
	EER	13.0	NA	NA	NA	-	NA	NA	-	NA	NA	-	-	NA	-	NA

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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	9.5	Btu/W-hr (CU Only)
Model Number:	48DJE004630	**Calculated EER:**	9.5	Btu/W-hr (CU Only)
Serial Number	0292G64683	**Nominal Capacity:**	2.97	tons
Equipment Type:	RTU-Gas	**Age**	12	years
Year Manufactured:	1992	**Coil Conditon**	10%	(% degraded)
Location	Iredell Health Center	**Present Condition EER**	8.1	Btu/W-hr
Tag	RTU-3	**kW/ton**	1.49	

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 applicable)

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 load:	**0.32**	kW
Calculated evaporator fan load	**0.48**	kW
Total calculated load for equipment:	**3.74**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **10.0%** **Performance Degradation**

Overall Unit Condition

	New	
	Average	
	Fair	**1**
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	**x**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
1				
2				
3				

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	466	5.7	1.2	0.45
2 to 3	467	5.4	2.5	0.99

TOTAL

HVAC Service Assistant Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
	Circuit 1	
EI	102%	
CI	99%	
Input Cap	4	Tons
OAT	83	F
Predicted KW	3.53	kW

CU Capacity Estimates

Ambient	85	F	303	K
CU Exhaust	94	F	308	K
Coil Length	62	in		
Coil Width	28	in		
Area	12.1	sq-ft		
Measured Fan CFM	9259			
Air Mass Flow	5.24	kg/sec		
Capacity	7.50	Tons		
Efficiency	24.32	EER		

CU Fan CFM Calculation	
Measurement Number	ft/sec
1	12.5
2	13.1
Average	12.8

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	9.5	Btu/W-hr (CU Only)
Model Number:	48DJE004630	**Calculated EER:**	9.5	Btu/W-hr (CU Only)
Serial Number	0292G64683	**Nominal Capacity:**	2.97	tons
Equipment Type:	RTU-Gas	**Age**	12	years
Year Manufactured:	1992	**Coil Conditon**	0%	(% degraded)
Location	Iredell Health Center	**Present Condition EER**	8.8	Btu/W-hr
Tag	RTU-3	**kW/ton**	1.36	

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	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 applicable)

Full load Amps:	1.5	Amps	Power supply:	1-Phase
Nameplate Voltage:	460	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.7		Fan quantity:	1

Calculated compressor load:	**3.4**	kW
Calculated condensing fan load:	**0.32**	kW
Calculated evaporator fan load	**0.48**	kW
Total calculated load for equipment:	**3.74**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition		
	New	X
	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	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
1				
2				
3				

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	467	5.8	1.2	0.46
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	%
EI	104%	
CI	100%	
Input Cap	3	Tons
OAT	79	F
Predicted KW	3.50	kW

CU Capacity Estimates

Ambient	77	F	298	K
CU Exhaust	85	F	303	K
Coil Length	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		

CU Fan CFM Calculation

Measurement Number	FPM
1	13.9
2	13.9
Average	13.9

Iredell Health Center RTU-3 Summary

EER at ARI Conditions	9.5 BTU/W-h		Equipment age	12 years
Condensing unit CFM	9259 CFM (Measured)			
Capacity at ARI	2.97 tons			
Capacity used for SA	4.00 tons			
Coil Area	12.06 sq-ft			
Predicted EER =	8.06 pre	8.80 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	83	62	102%	99%	10.5	2.61	85	94	5.0	3.7	5.24	7.50	24.32
Post Adsil Measurements													
16-Jun	79	62	104%	100%	11.4	2.60	77	85	4.4	3.7	5.69	7.24	23.48

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions									
		Test Data			Percent Difference			Test Data			Percent Difference						
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	NA	3.7	3.37	NA	110%	100%	NA	4.1	3.75	NA	110%	NA	-	-	-
	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%
Post-Adsil	Power (kW)	NA	3.7	3.28	NA	113%	100%	NA	4.2	3.75	NA	113%	NA	-	-	-
	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 Changes

	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%	37.0%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	10.8	Btu/W-hr	(CU Only)
Model Number:	48DJD007	**Calculated EER:**	10.8	Btu/W-hr	(CU Only)
Serial Number	5291G62648	**Nominal Capacity:**	6.30	tons	
Equipment Type:	RTU-Gas	**Age**	12	years	
Year Manufactured:	1992	**Coil Conditon**	9%	(% degraded)	
Location	Iredell Health Center	**Present Condition EER**	9.2	Btu/W-hr	
Tag	RTU-14	**kW/ton**	1.30		

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 applicable)

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 fan load	**0.58**	kW
Total calculated load for equipment:	**7.03**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **8.6%** **Performance Degradation**

Overall Unit Condition		
	New	
	Average	**0.5**
	Fair	**0.5**
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	**x**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
1				
2				
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

HVAC Service Assistant Measurment

Input SEER	10	
RAT	74	F
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 Estimates

Ambient	88	F	304	K
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	4.03	kg/sec		
Capacity	13.47	Tons		
Efficiency	18.79	EER		

CU Fan CFM Calculation

Measurement Number	ft/sec
1	10.5
2	9.2
Average	9.9

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	10.8	Btu/W-hr (CU Only)
Model Number:	48DJD007	**Calculated EER:**	10.8	Btu/W-hr (CU Only)
Serial Number	5291G62648	**Nominal Capacity:**	6.3	tons
Equipment Type:	RTU-Gas	**Age**	12	years
Year Manufactured:	1992	**Coil Conditon**	0%	(% degraded)
Location	Iredell Health Center	**Present Condition EER**	10.0	Btu/W-hr
Tag	RTU-14	**kW/ton**	1.20	

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	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 applicable)

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:	**6.7**	kW
Calculated condensing fan load:	**0.32**	kW
Calculated evaporator fan load	**0.58**	kW
Total calculated load for equipment:	**7.03**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition		
	New	X
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
1				
2				
3				

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

HVAC Service Assistant 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 Estimates

Ambient	79	F	299 K
CU Exhaust	96	F	309 K
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	Tons	
Efficiency	19.50	EER	

CU Fan CFM Calculation

Measurement Number	ft/sec
1	12.1
2	11.1
Average	11.6

Iredell Health Center RTU-14 Summary

EER at ARI Conditions	10.8	BTU/W-h	Equipment age	12 years
Condensing unit CFM	7125	CFM (Measured)		
Capacity at ARI	6.30	tons		
Capacity used for SA	6.00	tons		
Coil Area	12.06	sq-ft		
Predicted EER =	9.23	pre	9.96	post

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	88	62	NA	NA	NA	NA	88	109	11.7	8.6	4.03	13.47	18.79
Post Adsil Measurements													
16-Jun	80	62	100%	103%	12.0	6.41	79	96	9.4	7.9	4.75	12.84	19.50

Condensing Unit Summary - Ambient Conditions								**Condensing Unit Summary - ARI Conditions**									
		Test Data			**Percent Difference**			**Test Data**			**Percent Difference**						
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	NA	8.6	6.53	NA	132%	100%	NA	9.2	7.02	NA	132%	NA	-	-	-
	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%
Post-Adsil	Power (kW)	6.41	7.9	6.21	103%	127%	100%	7.2	8.9	7.02	103%	127%	81%	-	-	-
	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 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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	9.8	Btu/W-hr	(CU Only)
Model Number:	48DJD006	**Calculated EER:**	9.8	Btu/W-hr	(CU Only)
Serial Number	0492G68975	**Nominal Capacity:**	5.19	tons	
Equipment Type:	RTU-Gas	**Age**	12	years	
Year Manufactured:	1992	**Coil Conditon**	6%	(% degraded)	
Location	Iredell Health Center	**Present Condition EER**	8.6	Btu/W-hr	
Tag	RTU-13	**kW/ton**	1.40		

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:	1.00	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 applicable)

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:	**6.0**	kW
Calculated condensing fan load:	**0.32**	kW
Calculated evaporator fan load	**0.58**	kW
Total calculated load for equipment:	**6.36**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **6.35%** **Performance Degradation**

Overall Unit Condition	
New	
Average	**0.5**
Fair	**0.5**
Poor	
Coil Cleanliness	
Coated	
Clean	**1**
Dirty	
Clogged	
Plugged	
Fin Condition	
Like New	
Some Bent	**0.15**
Smashed	**0**
Dull/rough	**1**
Corroded	
Pitted	
Flaking	
Fin-Tube Attachment	
Like New	**x**
Corrosion	
Some Loose	
Many Loose	
Tubes	
Clean Cu	**x**
Corrosion	
Pitting	
Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
1				
2				
3				

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	460	10	1.9	0.39
2 to 3	460	10.1	4.65	0.99

TOTAL

HVAC Service Assistant Measurment

Input SEER	10	
RAT	74	F
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 Estimates

Ambient	83	F	301	K
CU Exhaust	102	F	312	K
Coil Length	63	in		
Coil Width	29	in		
Area	12.7	sq-ft		
Measured Fan CFM	6090			
Air Mass Flow	3.45	kg/sec		
Capacity	10.41	Tons		
Efficiency	19.08	EER		

CU Fan CFM Calculation

Measurement Number	ft/sec
1	8.0
2	8.0
Average	8.0

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	9.8	Btu/W-hr (CU Only)
Model Number:	48DJD006	**Calculated EER:**	9.8	Btu/W-hr (CU Only)
Serial Number	0492G68975	**Nominal Capacity:**	5.2	tons
Equipment Type:	RTU-Gas	**Age**	12	years
Year Manufactured:	1992	**Coil Conditon**	0%	(% degraded)
Location	Iredell Health Center	**Present Condition EER**	9.1	Btu/W-hr
Tag	RTU-13	**kW/ton**	1.32	

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 applicable)

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 fan load	**0.58**	kW
Total calculated load for equipment:	**6.36**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition		
	New	X
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

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 Assistant 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 Estimates

Ambient	77	F	298	K
CU Exhaust	93	F	307	K
Coil Length	63	in		
Coil Width	29	in		
Area	12.7	sq-ft		
Measured Fan CFM	8564			
Air Mass Flow	4.85	kg/sec		
Capacity	12.33	Tons		
Efficiency	24.26	EER		

CU Fan CFM Calculation

Measurement Number	ft/sec
1	12.5
2	10.0
Average	11.3

Iredell Health Center RTU-13 Summary

EER at ARI Conditions	9.8 BTU/W-h		Equipment age	12 years
Condensing unit CFM	6090 CFM (Measured)			
Capacity at ARI	5.19 tons			
Capacity used for SA	5.00 tons			
Coil Area	12.69 sq-ft			
Predicted EER =	8.56 pre	9.06 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	87	62	94%	97%	10.0	6.33	83	102	10.6	6.55	3.45	10.41	19.08
Post Adsil Measurements													
16-Jun	80	62	100%	103%	11.0	6.33	77	93	8.9	6.1	4.85	12.33	24.26

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions								
		Test Data			Percent Difference			Test Data			Percent Difference					
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	6.33	6.55	5.67	112%	116%	101%	7.1	7.3	6.32	112%	116%	97%	-	-	-
	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%
Post-Adsil	Power (kW)	6.33	6.1	5.57	114%	110%	101%	7.2	6.9	6.32	114%	110%	104%	-	-	-
	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%

EER Changes

	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%
Weighted Average	31.9%	114.9%	29.4%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	9.5	Btu/W-hr (CU Only)
Model Number:	48DJE004630	**Calculated EER:**	9.5	Btu/W-hr (CU Only)
Serial Number	0292G64667	**Nominal Capacity:**	2.97	tons
Equipment Type:	RTU-Gas	**Age**	12	years
Year Manufactured:	1992	**Coil Conditon**	11%	(% degraded)
Location	Iredell Health Center	**Present Condition EER**	8.0	Btu/W-hr
Tag	RTU-1	**kW/ton**	1.50	

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 applicable)

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 load:	**0.32**	kW
Calculated evaporator fan load	**0.48**	kW
Total calculated load for equipment:	**3.74**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **10.8%** **Performance Degradation**

Overall Unit Condition		
	New	
	Average	
	Fair	**1**
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	**x**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
1				
2				
3				

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	467	5.5	1.3	0.5
2 to 3	466	5.1	2.4	0.99

TOTAL

HVAC Service Assistant Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
	Circuit 1	
EI	102%	
CI	97%	
Input Cap	3	Tons
OAT	87	F
Predicted KW	3.50	kW

CU Capacity Estimates

Ambient	85	F	303	K
CU Exhaust	93	F	307	K
Coil Length	62	in		
Coil Width	28	in		
Area	12.1	sq-ft		
Measured Fan CFM	8680			
Air Mass Flow	4.92	kg/sec		
Capacity	6.25	Tons		
Efficiency	20.27	EER		

CU Fan CFM Calculation

Measurement Number	ft/sec
1	11.5
2	12.5
Average	12.0

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	9.5	Btu/W-hr (CU Only)
Model Number:	48DJE004630	**Calculated EER:**	9.5	Btu/W-hr (CU Only)
Serial Number	0292G64667	**Nominal Capacity:**	2.97	tons
Equipment Type:	RTU-Gas	**Age**	12	years
Year Manufactured:	1992	**Coil Conditon**	0%	(% degraded)
Location	Iredell Health Center	**Present Condition EER**	8.8	Btu/W-hr
Tag	RTU-1	**kW/ton**	1.36	

Compressor Data

Running load Amps:	6.1	Amps	Power supply:	3-phase
Nameplate Voltage:	460	Volts	Phase adjustment:	1.73
Power factor:	0.705		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 applicable)

Full load Amps:	1.5	Amps	Power supply:	1-Phase
Nameplate Voltage:	460	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.7		Fan quantity:	1

Calculated compressor load:	**3.4**	kW
Calculated condensing fan load:	**0.32**	kW
Calculated evaporator fan load	**0.48**	kW
Total calculated load for equipment:	**3.74**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

	New	X
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
1				
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 Assistant Measurement

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	107%	
CI	104%	
Input Cap	3	Tons
OAT	79	F
Predicted KW	3.50	kW

CU Capacity Estimates

Ambient	75	F	297 K
CU Exhaust	84	F	302 K
Coil Length	62	in	
Coil Width	28	in	
Area	12.1	sq-ft	
Measured Fan CFM	8579		
Air Mass Flow	4.86	kg/sec	
Capacity	6.95	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 Health Center RTU-1 Summary

EER at ARI Conditions	9.5 BTU/W-h		Equipment age	12 years
Condensing unit CFM	8680 CFM (Measured)			
Capacity at ARI	2.97 tons			
Capacity used for SA	3.00 tons			
Coil Area	12.06 sq-ft			
Predicted EER =	8.00 pre	8.80 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	87	62	102%	97%	9.9	3.46	85	93	4.4	3.7	4.92	6.25	20.27
Post Adsil Measurements													
16-Jun	79	62	107%	104%	11.7	3.46	75	84	5.0	2.2	4.86	6.95	37.90

Condensing Unit Summary - Ambient Conditions									**Condensing Unit Summary - ARI Conditions**								
		Test Data			**Percent Difference**			**Test Data**			**Percent Difference**						
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	3.46	3.7	3.46	100%	107%	100%	3.8	4.0	3.75	100%	107%	94%	-	-	-
	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%
Post-Adsil	Power (kW)	3.46	2.2	3.28	105%	67%	100%	3.9	2.5	3.75	105%	67%	157%	-	-	-
	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 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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Lennox	**Published EER:**	NA	Btu/W-hr (CU Only)
Model Number:	HS290609Y	**Calculated EER:**	9.7	Btu/W-hr (CU Only)
Serial Number	S801M14822	**Nominal Capacity:**	5.00	tons
Equipment Type:	SS	**Age**	3	years
Year Manufactured:	2001	**Coil Conditon**	7%	(% degraded)
Location	Granite Quarry	**Present Condition EER**	9.1	Btu/W-hr
Tag	SS-3	**kW/ton**	1.32	

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:	1.90	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 applicable)

Full load Amps:		Amps	Power supply:	
Nameplate Voltage:		Volts	Phase adjustment:	
Adjust FLA to RLA:			Fan quantity:	

Calculated compressor load:	**5.9**	kW
Calculated condensing fan load:	**0.28**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**6.19**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **7.3%** **Performance Degradation**

Overall Unit Condition

	New	**1**
	Average	
	Fair	
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	**x**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
1				
2				
3				

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	199	12.2	2.4	0.99
2 to 3	199	15.9	2.2	0.70

TOTAL

HVAC Service Assistant Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	94%	
CI	87%	
Input Cap	5	Tons
OAT	77	F
Predicted KW	5.60	kW

CU Capacity Estimates

Ambient	78 F	299 K
CU Exhaust	102 F	312 K
Coil Length	66 in	
Coil Width	30 in	
Area	13.8 sq-ft	
Measured Fan CFM	1351	
Air Mass Flow	0.77 kg/sec	
Capacity	2.92 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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Lennox	**Published EER:**	NA	Btu/W-hr (CU Only)
Model Number:	HS290609Y	**Calculated EER:**	9.7	Btu/W-hr (CU Only)
Serial Number	S801M14822	**Nominal Capacity:**	5.00	tons
Equipment Type:	SS	**Age**	3	years
Year Manufactured:	2001	**Coil Conditon**	0%	(% degraded)
Location	Granite Quarry	**Present Condition EER**	9.8	Btu/W-hr
Tag	SS-3	**kW/ton**	1.23	

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 applicable)

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 fan load:	**0.28**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**6.19**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

New	x
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	x
Corrosion	
Some Loose	
Many Loose	
Tubes	
Clean Cu	x
Corrosion	
Pitting	
Leaks	

FLUKE METER MEASURMENTS

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 Assistant Measurment

Input SEER	10	
RAT	70	F
SAT	50	F
RAH	50	%
SAH	85	%
EI		
CI		
Input Cap	5	Tons
OAT	92	F
Predicted KW		kW

CU Capacity Estimates

Ambient	92 F	306 K	
CU Exhaust	121 F	323 K	
Coil Length	66 in		
Coil Width	30 in		
Area	13.8 sq-ft		
Measured Fan CFM	5053		
Air Mass Flow	2.86 kg/sec		
Capacity	13.19 Tons		
Efficiency	30.43 EER		

CU Fan CFM Calculation

Measurement Number	ft/sec
1	5.9
2	6.2
3	6.8
4	5.6
Average	6.1

Granite Quarry SS-3 Summary

EER at ARI Conditions	9.7 BTU/W-h		Equipment age	3 years
Condensing unit CFM	1351 CFM (Measured)			
Capacity at ARI	5.00 tons			
Capacity used for SA	5.00 tons			
Coil Area	13.75 sq-ft			
Predicted EER =	9.12 pre	9.79 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	77	61	94%	87%	9.1	5.60	78	102	13.3	4.6	0.77	2.92	7.61
Post Adsil Measurements													
16-Jun	92	61	NA	NA	NA	NA	92	121	16.1	5.2	2.86	13.19	30.43

		Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions								
		Test Data@ Field Conditions			Percent Difference			Test Data @ARI			Percent Difference					
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	5.60	4.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
	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
Post-Adsil	Power (kW)	NA	5.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
	Capacity (Tons)	NA	13.19	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
	EER	NA	30.43	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	NA

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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Lennox	**Published EER:**	NA	Btu/W-hr (CU Only)
Model Number:	HS29-653	**Calculated EER:**	9.7	Btu/W-hr (CU Only)
Serial Number	5895D63302	**Nominal Capacity:**	5.00	tons
Equipment Type:	SS	**Age**	9	years
Year Manufactured:	1995	**Coil Conditon**	8%	(% degraded)
Location	Granite Quarry	**Present Condition EER**	8.6	Btu/W-hr
Tag	SS-2	**kW/ton**	1.40	

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:	1.90	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 applicable)

Full load Amps:		Amps	Power supply:	
Nameplate Voltage:		Volts	Phase adjustment:	
Adjust FLA to RLA:			Fan quantity:	

Calculated compressor load:	**5.9**	kW
Calculated condensing fan load:	**0.28**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**6.19**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **7.7%** **Performance Degradation**

Overall Unit Condition		
	New	
	Average	**1**
	Fair	
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

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 Assistant Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	82%	
CI	76%	
Input Cap	5	Tons
OAT	77	F
Predicted KW	5.70	kW

CU Capacity Estimates

Ambient	78 F	299 K
CU Exhaust	98 F	310 K
Coil Length	66 in	
Coil Width	30 in	
Area	13.8 sq-ft	
Measured Fan CFM	1299	
Air Mass Flow	0.74 kg/sec	
Capacity	2.34 Tons	
Efficiency	6.24 EER	

CU Fan CFM Calculation

Measurement Number	ft/sec
1	0.9
2	1.0
3	2.0
4	2.4
Average	1.6

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Lennox	**Published EER:**	NA	Btu/W-hr (CU Only)
Model Number:	HS29-653	**Calculated EER:**	9.7	Btu/W-hr (CU Only)
Serial Number	5895D63302	**Nominal Capacity:**	5.00	tons
Equipment Type:	SS	**Age**	9	years
Year Manufactured:	1995	**Coil Conditon**	0%	(% degraded)
Location	Granite Quarry	**Present Condition EER**	9.2	Btu/W-hr
Tag	SS-2	**kW/ton**	1.30	

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 applicable)

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 fan load:	**0.28**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**6.19**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

Overall Unit Condition	New	x
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

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 Assistant Measurment

Input SEER	10	
RAT	70	F
SAT	50	F
RAH	50	%
SAH	85	%
EI	101%	
CI	105%	
Input Cap	5	Tons
OAT	94	F
Predicted KW	6.20	kW

CU Capacity Estimates

Ambient	94 F	308 K	
CU Exhaust	120 F	322 K	
Coil Length	66 in		
Coil Width	30 in		
Area	13.8 sq-ft		
Measured Fan CFM	5569		
Air Mass Flow	3.15 kg/sec		
Capacity	13.03 Tons		
Efficiency	28.96 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 Summary

EER at ARI Conditions	9.7	BTU/W-h	Equipment age	9 years
Condensing unit CFM	1299	CFM (Measured)		
Capacity at ARI	5.00	tons		
Capacity used for SA	5.00	tons		
Coil Area	13.75	sq-ft		
Predicted EER =	8.60	pre	9.23	post

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	77	61	82%	76%	7.9	5.70	78	98	11.1	4.5	0.74	2.34	6.24
Post Adsil Measurements													
16-Jun	94	61	101%	105%	9.8	6.20	94	120	14.4	5.4	3.15	13.03	28.96

Condensing Unit Summary - Ambient Conditions								**Condensing Unit Summary - ARI Conditions**								
		Test Data@ Field Conditions			**Percent Difference**			**Test Data @ARI**			**Percent Difference**					
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	5.70	4.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-	-
	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
Post-Adsil	Power (kW)	6.20	5.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-	-
	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 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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Goodman	**Published EER:**	9.0	Btu/W-hr (CU Only)
Model Number:	CPKE36-18	**Calculated EER:**	9.0	Btu/W-hr (CU Only)
Serial Number	9712425279	**Nominal Capacity:**	2.75	tons
Equipment Type:	SS	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	17%	(% degraded)
Location	Concord City Hall	**Present Condition EER**	7.5	Btu/W-hr
Tag	SS-5	**kW/ton**	1.60	

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:	1.80	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 applicable)

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 fan load:	**0.26**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**3.68**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **16.9%** **Performance Degradation**

Overall Unit Condition

Overall Unit Condition		
	New	
	Average	**0.8**
	Fair	**0.2**
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	**x**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

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 Assistant Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	101%	
CI	93%	
Input Cap	3	Tons
OAT	88	F
Predicted KW	3.40	kW

CU Capacity Estimates

Ambient	89 F	305 K
CU Exhaust	101 F	311 K
Coil Length	86 in	
Coil Width	23 in	
Area	13.7 sq-ft	
Measured Fan CFM	5027	
Air Mass Flow	2.85 kg/sec	
Capacity	5.43 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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Goodman	**Published EER:**	9.0	Btu/W-hr (CU Only)
Model Number:	CPKE36-18	**Calculated EER:**	9.0	Btu/W-hr (CU Only)
Serial Number	9712425279	**Nominal Capacity:**	2.75	tons
Equipment Type:	SS	**Age**	7	years
Year Manufactured:	1997	**Coil Conditon**	0%	(% degraded)
Location	Concord City Hall	**Present Condition EER**	8.7	Btu/W-hr
Tag	SS-5	**kW/ton**	1.38	

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 applicable)

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:	**3.4**	kW
Calculated condensing fan load:	**0.26**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**3.68**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

New	x
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	x
Corrosion	
Some Loose	
Many Loose	
Tubes	
Clean Cu	x
Corrosion	
Pitting	
Leaks	

FLUKE METER MEASURMENTS

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 Assistant Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	93%	
CI	88%	
Input Cap	3	Tons
OAT	87	F
Predicted KW	3.40	kW

CU Capacity Estimates

Ambient	87 F	304 K	
CU Exhaust	99 F	310 K	
Coil Length	86 in		
Coil Width	23 in		
Area	13.7 sq-ft		
Measured Fan CFM	6140		
Air Mass Flow	3.48 kg/sec		
Capacity	6.63 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

Concord City Hall SS-5 Summary

EER at ARI Conditions	9.0	BTU/W-h	Equipment age	7 Years
Condensing unit CFM	5027	CFM (Measured)		
Capacity at ARI	2.75	tons		
Capacity used for SA	3.00	tons		
Coil Area	13.74	sq-ft		
Predicted EER =	7.48	pre	8.70	post

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (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					
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	3.12	2.78	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	-	-	-
	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
Post-Adsil	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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	8.0	Btu/W-hr (CU Only)
Model Number:	38CK036	**Calculated EER:**	8.0	Btu/W-hr (CU Only)
Serial Number	3993E06985	**Nominal Capacity:**	2.35	tons
Equipment Type:	Split System	**Age**	11	years
Year Manufactured:	1993	**Coil Conditon**	7%	(% degraded)
Location	Concord City Hall	**Present Condition EER**	7.0	Btu/W-hr
Tag	SS-4	**kW/ton**	1.70	

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:	1.40	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 applicable)

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 fan load:	**0.23**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**3.52**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **6.7%** **Performance Degradation**

Overall Unit Condition

New	
Average	**1**
Fair	
Poor	
Coil Cleanliness	
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 Attachment	
Like New	**x**
Corrosion	
Some Loose	
Many Loose	
Tubes	
Clean Cu	**x**
Corrosion	
Pitting	
Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
1				
2				
3				

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	204	7.5	0.89	0.58
2 to 3	206	8.35	1.75	1.00
TOTAL				

HVAC Service Assistant Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	95%	
CI	82%	
Input Cap	3	Tons
OAT	93	F
Predicted KW	3.20	kW

CU Capacity Estimates

Ambient	90	F	305	K
CU Exhaust	102	F	312	K
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	4.37	Tons		
Efficiency	19.86	EER		
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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	8.0	Btu/W-hr	(CU Only)
Model Number:	38CK036	**Calculated EER:**	8.0	Btu/W-hr	(CU Only)
Serial Number	3993E06985	**Nominal Capacity:**	2.35	tons	
Equipment Type:	Split System	**Age**	11	years	
Year Manufactured:	1993	**Coil Conditon**	0%	(% degraded)	
Location	Concord City Hall	**Present Condition EER**	7.5	Btu/W-hr	
Tag	SS-4	**kW/ton**	1.60		

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 applicable)

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:	**3.3**	kW
Calculated condensing fan load:	**0.23**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**3.52**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

New	X
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	x
Corrosion	
Some Loose	
Many Loose	
Tubes	
Clean Cu	x
Corrosion	
Pitting	
Leaks	

FLUKE METER MEASURMENTS

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 Assistant Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	96%	
CI	84%	
Input Cap	3	Tons
OAT	89	F
Predicted KW	3.30	kW

CU Capacity Estimates

Ambient	90	F	305 K
CU Exhaust	99	F	310 K
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	4.47	Tons	
Efficiency	20.65	EER	
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

Concord City Hall SS-4 Summary

EER at ARI Conditions	8.0 BTU/W-h		Equipment age	11 Years
Condensing unit CFM	4047 CFM (Measured)			
Capacity at ARI	2.35 tons			
Capacity used for SA	3.00 tons			
Coil Area	11.19 sq-ft			
Predicted EER =	7.05 pre	7.49 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	ST-SH	EI	CI	EER	kW	inlet	exhaust	ΔT (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 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			Percent Difference					
OAT		SA	CU	Lit	SA/Lit	CU/Lit	SS/Lit	SA	CU	Literature	SA/Lit	CU/Lit	SA/CU	Predicted/SA	Predicted/CU	Predicted/ Original
Pre-Adsil	Power (kW)	2.51	2.64	3.49	72%	76%	97%	2.6	2.7	3.61	72%	76%	95%	-	-	-
	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%
Post-Adsil	Power (kW)	2.58	2.6	3.25	80%	80%	97%	2.9	2.9	3.61	80%	80%	99%	-	-	-
	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%

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%
Weighted Average	3.2%	18.3%	18.8%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	11.1	Btu/W-hr (CU Only)
Model Number:	38CKC048-56	**Calculated EER:**	11.1	Btu/W-hr (CU Only)
Serial Number	2802E15220	**Nominal Capacity:**	3.83	tons
Equipment Type:	Split System	**Age**	2	years
Year Manufactured:	2002	**Coil Conditon**	5%	(% degraded)
Location	Concord City Hall	**Present Condition EER**	10.8	Btu/W-hr
Tag	SS-3	**kW/ton**	1.11	

Compressor Data

Running load Amps:	14.1	Amps	Power supply:	3-phase
Nameplate Voltage:	208	Volts	Phase adjustment:	1.73
Power factor:	0.78		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

Evaporator fan data (if applicable)

Full load Amps:		Amps	Power supply:	
Nameplate Voltage:		Volts	Phase adjustment:	
Adjust FLA to RLA:			Fan quantity:	

Calculated compressor load:	**3.9**	kW
Calculated condensing fan load:	**0.20**	kW
Calculated evaporator fan load	**1.00**	kW (From Product Data)
Total calculated load for equipment:	**4.14**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **5.0%** **Performance Degradation**

Overall Unit Condition

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

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
1				
2				
3				

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	207	11.1	1.1	0.48
2 to 3	208	12.6	2.5	1.00

TOTAL

HVAC Service Assistant Measurment

Input SEER	10	
RAT		F
SAT		F
RAH		%
SAH		%
EI	96%	
CI	90%	
Input Cap	4	Tons
OAT	91	F
Predicted KW	4.60	kW

CU Capacity Estimates

Ambient	91 F	306 K
CU Exhaust	109 F	316 K
Coil Length	61 in	
Coil Width	25 in	
Area	10.6 sq-ft	
Measured Fan CFM	3971	
Air Mass Flow	2.25 kg/sec	
Capacity	6.43 Tons	
Efficiency	21.44 EER	

CU Fan CFM Calculation

Measurement Number	ft/sec
1	6.4
2	6.8
3	6.1
4	5.7
Average	6.250

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	11.1 Btu/W-hr (CU Only)
Model Number:	38CKC048-56	**Calculated EER:**	11.1 Btu/W-hr (CU Only)
Serial Number	2802E15220	**Nominal Capacity:**	3.83 tons
Equipment Type:	Split System	**Age**	2 years
Year Manufactured:	2002	**Coil Conditon**	0% (% degraded)
Location	Concord City Hall	**Present Condition EER**	11.3 Btu/W-hr
Tag	SS-3	**kW/ton**	1.06

Compressor Data

Running load Amps:	14.1	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:	1.4	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 applicable)

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:	**3.9**	kW
Calculated condensing fan load:	**0.20**	kW
Calculated evaporator fan load	**1.00**	kW (From Product Data)
Total calculated load for equipment:	**4.14**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

Overall Unit Condition	New	X
	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	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
1				
2				
3				

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	208	10.6	1	0.45
2 to 3	206	11.8	2.4	0.99

TOTAL

HVAC Service Assistant Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	90%	
CI	79%	
Input Cap	3	Tons
OAT	89	F
Predicted KW	4.27	kW

CU Capacity Estimates

Ambient	90 F	305 K
CU Exhaust	106 F	314 K
Coil Length	61 in	
Coil Width	25 in	
Area	10.6 sq-ft	
Measured Fan CFM	4257	
Air Mass Flow	2.41 kg/sec	
Capacity	6.13 Tons	
Efficiency	21.64 EER	

CU Fan CFM Calculation

Measurement Number	ft/sec
1	6.8
2	7.2
3	7.0
4	5.8
Average	6.7

Concord City Hall SS-3 Summary

EER at ARI Conditions	11.12 BTU/W-h	Equipment age	2 Years
Condensing unit CFM	3971 CFM (Measured)		
Nominal Unit Capacity	3.83 tons		
Capacity used for SA	4.00 tons		
Coil Area	10.59 sq-ft		
Predicted EER =	10.77		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	91	57	96%	90%	10.3	4.40	91	109	10.0	3.6	2.25	6.43	21.44
Post Adsil Measurements													
15-Jun	89	57	90%	79%	10.0	4.08	90	106	8.9	3.4	2.41	6.13	21.64

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions									
		Test Data			Percent Difference			Test Data			Percent Difference						
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	4.40	3.6	3.82	115%	94%	100%	4.8	3.9	4.13	115%	94%	122%	-	-	-
	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%
Post-Adsil	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%

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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	10.5	Btu/W-hr (CU Only)
Model Number:	38AK007501	**Calculated EER:**	10.5	Btu/W-hr (CU Only)
Serial Number	1099G00176	**Nominal Capacity:**	5.71	tons
Equipment Type:	Split System	**Age**	5	years
Year Manufactured:	1999	**Coil Conditon**	6%	(% degraded)
Location	Concord City Hall	**Present Condition EER**	9.8	Btu/W-hr
Tag	SS-2	**kW/ton**	1.22	

Compressor Data

Running load Amps:	19.0	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:	2.80	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 applicable)

Full load Amps:		Amps	Power supply:	
Nameplate Voltage:		Volts	Phase adjustment:	
Adjust FLA to RLA:	0.70		Fan quantity:	

Calculated compressor load:	**6.1**	kW
Calculated condensing fan load:	**0.41**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**6.53**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **5.7%** **Performance Degradation**

Overall Unit Condition

	New	
	Average	**1**
	Fair	
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	**x**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
1				
2				
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 Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	90%	
CI	91%	
Input Cap	6	Tons
OAT	87	F
Predicted KW	7.30	kW

CU Capacity Estimates

Ambient	89	F	305	K
CU Exhaust	112	F	318	K
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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	10.5	Btu/W-hr (CU Only)
Model Number:	38AK007501	**Calculated EER:**	10.5	Btu/W-hr (CU Only)
Serial Number	1099G00176	**Nominal Capacity:**	5.71	tons
Equipment Type:	Split System	**Age**	5	years
Year Manufactured:	1999	**Coil Conditon**	0%	(% degraded)
Location	Concord City Hall	**Present Condition EER**	10.4	Btu/W-hr
Tag	SS-2	**kW/ton**	1.15	

Compressor Data

Running load Amps:	19	Amps	Power supply:	3-phase
Nameplate Voltage:	208	Volts	Phase adjustment:	1.73
Power factor:	0.895		Compressor quantity:	1

Condensing Fan Data

Full load Amps:	2.8	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 applicable)

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:	**6.1**	kW
Calculated condensing fan load:	**0.41**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**6.53**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

Overall Unit Condition		
	New	X
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
1				
2				
3				

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 Assistant Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	95%	
CI	90%	
Input Cap	6	Tons
OAT	92	F
Predicted KW	6.90	kW

CU Capacity Estimates

Ambient	91	F	306 K
CU Exhaust	112	F	318 K
Coil Length	64	in	
Coil Width	28	in	
Area	12.44	sq-ft	
Measured Fan CFM	7541		
Air Mass Flow	4.27	kg/sec	
Capacity	14.25	Tons	
Efficiency	28.99	EER	
Efficiency	0.41	kW/Ton	

CU Fan CFM Calculation

Measurement Number	ft/sec
1	10.0
2	10.2
Average	10.1

Concord City Hall SS-2 Summary

EER at ARI Conditions	10.5 BTU/W-h		Equipment age	5 Years
Condensing unit CFM	3995 CFM (Measured)			
Capacity at ARI	5.71 tons			
Capacity used for SA	6.00 tons			
Coil Area	12.44 sq-ft			
Predicted EER =	9.84 pre	10.39 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	ST-SH	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	87	39	90%	91%	10.4	6.95	89	112	12.8	5.8	2.26	8.27	17.11
Post Adsil Measurements													
16-Jun	92	40	95%	90%	10.4	6.56	91	112	11.7	5.9	4.27	14.25	28.99

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions								
		Test Data			Percent Difference			Test Data			Percent Difference					
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	6.95	5.8	6.17	112%	94%	100%	7.3	6.1	6.53	112%	94%	120%	-	-	-
	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%
Post-Adsil	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%

EER Changes

	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%
Weighted Average	33.3%	471.8%	33.9%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	11.8	Btu/W-hr (CU Only)
Model Number:	38ARZ007-501	**Calculated EER:**	11.8	Btu/W-hr (CU Only)
Serial Number	4302G30009	**Nominal Capacity:**	5.48	tons
Equipment Type:	Split System	**Age**	2	years
Year Manufactured:	2002	**Coil Conditon**	6%	(% degraded)
Location	Concord City Hall	**Present Condition EER**	11.4	Btu/W-hr
Tag	SS-1	**kW/ton**	1.06	

Compressor Data

Running load Amps:	19.1	Amps	Power supply:	3-phase
Nameplate Voltage:	208	Volts	Phase adjustment:	1.73
Power factor:	0.78		Compressor quantity:	1

Condensing Fan Data

Full load Amps:	0.90	Amps	Power supply:	1-Phase
Nameplate Voltage:	208	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.70		Fan quantity:	2

Evaporator fan data (if applicable)

Full load Amps:		Amps	Power supply:	
Nameplate Voltage:		Volts	Phase adjustment:	
Adjust FLA to RLA:	0.70		Fan quantity:	

Calculated compressor load:	**5.3**	kW
Calculated condensing fan load:	**0.26**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**5.59**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **5.7%** **Performance Degradation**

Overall Unit Condition				
New		0	0	
Average	**1**	1	1	
Fair		5	0	
Poor		12	0	
Coil Cleanliness			0	
Coated		25	0	
Clean	**0.75**	0	0	
Dirty	**0.25**	25	6.25	
Clogged		50	0	
Plugged		100	0	
Fin Condition			0	
Like New		0	0	
Some Bent	**0.1**	25	2.5	
Smashed		50	0	
Dull/rough	**0.75**	25	18.75	
Corroded		35	0	
Pitted		45	0	
Flaking		60	0	
Fin-Tube Attachment			0	
Like New	**x**	0	0	
Corrosion		10	0	
Some Loose		25	0	
Many Loose		50	0	
Tubes			0	
Clean Cu	**x**			
Corrosion				
Pitting				
Leaks				

FLUKE METER MEASURMENTS

Y-measurment

Phase	Volts	Amps	kW	PF
1				
2				
3				

Delta Measurement

Phase	Volts	Amps	kW	PF
1 to 2	208	18.1	1.9	0.51
2 to 3	204	16.4	3.3	1.00

TOTAL

HVAC Service Assistant Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	96%	
CI	92%	
Input Cap	6	Tons
OAT	85	F
Predicted KW	6.90	kW

CU Capacity Estimates

Ambient	87	F	304	K
CU Exhaust	96.5	F	309	K
Coil Length		in		
Coil Width		in		
Area	29.2	sq-ft		
Measured Fan CFM	8234			
Air Mass Flow	4.66	kg/sec		
Capacity	7.04	Tons		
Efficiency	16.25	EER		
Efficiency	0.74	kW/Ton		

CU Fan CFM Calculation

Measurement Number	ft/sec
1	6.1
2	3.7
3	4.1
4	4.9
Average	4.700

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	11.8	Btu/W-hr (CU Only)
Model Number:	38ARZ007-501	**Calculated EER:**	11.8	Btu/W-hr (CU Only)
Serial Number	4302G30009	**Nominal Capacity:**	5.48	tons
Equipment Type:	Split System	**Age**	2	years
Year Manufactured:	2002	**Coil Conditon**	0%	(% degraded)
Location	Concord City Hall	**Present Condition EER**	12.0	Btu/W-hr
Tag	SS-1	**kW/ton**	1.00	

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 applicable)

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 fan load:	**0.26**	kW
Calculated evaporator fan load	**0.00**	kW
Total calculated load for equipment:	**5.59**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

New	X
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	x
Corrosion	
Some Loose	
Many Loose	
Tubes	
Clean Cu	x
Corrosion	
Pitting	
Leaks	

FLUKE METER MEASURMENTS

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 Measurment

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	103%	
CI	92%	
Input Cap	6	Tons
OAT	88	F
Predicted KW	6.50	kW

CU Capacity Estimates

Ambient	89 F	305 K
CU Exhaust	100 F	311 K
Coil Length	0 in	
Coil Width	0 in	
Area	29.20 sq-ft	
Measured Fan CFM	12001	
Air Mass Flow	6.80 kg/sec	
Capacity	11.88 Tons	
Efficiency	29.09 EER	
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 SS-1 Summary

EER at ARI Conditions	11.8 BTU/W-h		Equipment age	2 Years
Condensing unit CFM	8234 CFM (Measured)			
Capacity at ARI	5.48 tons			
Capacity used for SA	6.00 tons			
Coil Area	29.20 sq-ft			
Predicted EER =	11.35 pre	12.01 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	ST-SH	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	85	35	96%	92%	12.4	6.31	87	96.5	5.3	5.2	4.66	7.04	16.25
Post Adsil Measurements													
16-Jun	88	37	103%	92%	13.0	5.94	89	100	6.1	4.9	6.80	11.88	29.09

Condensing Unit Summary - Ambient Conditions								Condensing Unit Summary - ARI Conditions								
		Test Data			Percent Difference			Test Data			Percent Difference					
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	6.31	5.2	4.90	129%	106%	100%	7.2	5.9	5.59	129%	106%	121%	-	-	-
	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%
Post-Adsil	Power (kW)	5.94	4.9	5.11	116%	96%	100%	6.5	5.4	5.59	116%	96%	121%	-	-	-
	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 Changes

	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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	12.0	Btu/W-hr (CU Only)
Model Number:	50TJQ006	**Calculated EER:**	**12.0**	Btu/W-hr (CU Only)
Serial Number	1399G20943	**Nominal Capacity:**	5.23	tons
Equipment Type:	Package Heat Pump	**Age**	**5**	years
Year Manufactured:	1999	**Coil Conditon**	**7%**	(% degraded)
Location	Concord City Hall	**Present Condition EER**	**11.1**	Btu/W-hr
Tag	RTU-3	**kW/ton**	**1.08**	

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 applicable)

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 fan load	**0.86**	kW
Total calculated load for equipment:	**5.20**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **6.7%** **Performance Degradation**

Overall Unit Condition

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

FLUKE METER MEASUREMENTS

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 Assistant Measurment

	COMP 1	
Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	99%	
CI	94%	
Input Cap	5	Tons
OAT	86	
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	-

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	12.00	Btu/W-hr (CU Only)
Model Number:	50TJQ006	**Calculated EER:**	**12.0**	Btu/W-hr (CU Only)
Serial Number	1399G20943	**Nominal Capacity:**	5.2261	tons
Equipment Type:	Package Heat Pump	**Age**	**5**	years
Year Manufactured:	1999	**Coil Conditon**	**0%**	(% degraded)
Location	Concord City Hall	**Present Condition EER**	**11.9**	Btu/W-hr
Tag	RTU-3	**kW/ton**	**1.01**	

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:	1.5	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 applicable)

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 load:	**5.0**	kW
Calculated condensing fan load:	**0.24**	kW
Calculated evaporator fan load	**0.86**	kW
Total calculated load for equipment:	**5.20**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition		
	New	X
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

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 Assistant Measurment

	COMP 1	
Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	104%	
CI	101%	
Input Cap	5	Tons
OAT	88	F
Predicted KW	5.60	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	-

Concord City Hall RTU-3 Summary

EER at ARI Conditions	12.0	BTU/W-h	Equipment age	5 Years
Condensing unit CFM	-	CFM (Measured)		
Nominal Unit Capacity	5.23			
Capacity used for SA	5.00	tons		
Coil Area	-	sq-ft		
Predicted EER =	11.14			

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	86	62	99%	94%	13.0	6.06	-	-	-	-	-	-	-
Post Adsil Measurements													
16-Jun	88	62	104%	101%	13.2	5.85	-	-	-	-	-	-	-

Condensing Unit Summary - Ambient Conditions									Condensing Unit Summary - ARI Conditions								
		Test Data@ Field Conditions			Percent Difference			Test Data @ARI			Percent Difference						
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	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%
Post-Adsil	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 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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	12.0	Btu/W-hr	(CU Only)
Model Number:	50TJQ006	**Calculated EER:**	**12.0**	Btu/W-hr	(CU Only)
Serial Number	1399G20939	**Nominal Capacity:**	5.23	tons	
Equipment Type:	Package Heat Pump	**Age**	**5**	years	
Year Manufactured:	1999	**Coil Conditon**	**6%**	(% degraded)	
Location	Concord City Hall	**Present Condition EER**	**11.2**	Btu/W-hr	
Tag	RTU-2	**kW/ton**	**1.07**		

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 applicable)

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 fan load	**0.86**	kW
Total calculated load for equipment:	**5.20**	kW - Condensing side only
Assumptions		

Condenser Coil Assessment **6.2%** **Performance Degradation**

Overall Unit Condition

	New	
	Average	X
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

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 Assistant Measurment

	COMP 1	
Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	98%	
CI	91%	
Input Cap	5	Tons
OAT	86	
Predicted KW	5.60	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	-

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	12.0	Btu/W-hr (CU Only)
Model Number:	50TJQ006	**Calculated EER:**	**12.0**	Btu/W-hr (CU Only)
Serial Number	1399G20939	**Nominal Capacity:**	5.23	tons
Equipment Type:	Package Heat Pump	**Age**	**5**	years
Year Manufactured:	1999	**Coil Conditon**	**0%**	(% degraded)
Location	Concord City Hall	**Present Condition EER**	**11.9**	Btu/W-hr
Tag	RTU-2	**kW/ton**	**1.01**	

Compressor Data

Running load Amps:	15.4	Amps	Power supply:	3-Phase
Nameplate Voltage:	230.0	Volts	Phase adjustment:	1.73
Power factor:	0.8		Compressor quantity:	1

Condensing Fan Data

Full load Amps:	1.5	Amps	Power supply:	1-Phase
Nameplate Voltage:	230.0	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.7		Fan quantity:	1

Evaporator fan data (if applicable)

Full load Amps:	5.9	Amps	Power supply:	1-Phase
Nameplate Voltage:	208.0	Volts	Phase adjustment:	1
Adjust FLA to RLA:	0.7		Fan quantity:	1

Calculated compressor load:	**5.0**	kW
Calculated condensing fan load:	**0.24**	kW
Calculated evaporator fan load	**0.86**	kW
Total calculated load for equipment:	**5.20**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition		
	New	X
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASURMENTS

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 Assistant Measurment

	COMP 1	
Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	104%	
CI	98%	
Input Cap	5	Tons
OAT	89	F
Predicted KW	5.80	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	-

Concord City Hall RTU-2 Summary

EER at ARI Conditions	12.0	BTU/W-h	Equipment age	5 Years
Condensing unit CFM	-	CFM (Measured)		
Nominal Unit Capacity	5.23			
Capacity used for SA	5.00	tons		
Coil Area	-	sq-ft		
Predicted EER =	11.19			

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	86	62	98%	91%	12.8	5.85	-	-	-	-	-	-	-
Post Adsil Measurements													
	89	62	104%	98%	13.0	6.06	-	-	-	-	-	-	-
16-Jun													

		Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions									
		Test Data@ Field Conditions			Percent Difference			Test Data @ARI			Percent Difference						
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	5.85	NA	4.58	128%	NA	100%	6.7	NA	5.23	128%	NA	NA	-	-	-
	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%
Post-Adsil	Power (kW)	6.06	NA	4.75	128%	NA	100%	6.7	NA	5.23	128%	NA	NA	-	-	-
	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 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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	12.0	Btu/W-hr	(CU Only)
Model Number:	50TJQ006	**Calculated EER:**	**12.0**	Btu/W-hr	(CU Only)
Serial Number	NA	**Nominal Capacity:**	5.23	tons	
Equipment Type:	Package Heat Pump	**Age**	**5**	years	
Year Manufactured:	1999	**Coil Conditon**	**2%**	(% degraded)	
Location	Concord City Hall	**Present Condition EER**	**11.7**	Btu/W-hr	
Tag	RTU-1	**kW/ton**	**1.03**		

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 applicable)

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:	**0.22**	kW
Calculated evaporator fan load	**0.86**	kW
Total calculated load for equipment:	**5.21**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **2.0%** **Performance Degradation**

Overall Unit Condition

	New	
	Average	X
	Fair	
	Poor	
Coil Cleanliness		
	Coated	
	Clean	**0.9**
	Dirty	
	Clogged	
	Plugged	
Fin Condition		
	Like New	**1**
	Some Bent	
	Smashed	
	Dull/rough	**0.35**
	Corroded	
	Pitted	
	Flaking	
Fin-Tube Attachment		
	Like New	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

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 Assistant Measurment

	COMP 1	
Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	98%	
CI	93%	
Input Cap	5	Tons
OAT	81	
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

Number	ft/sec
1	-
2	-
3	-
4	-
5	-
Average	-

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	12.0	Btu/W-hr (CU Only)
Model Number:	50TJQ006	**Calculated EER:**	**12.0**	Btu/W-hr (CU Only)
Serial Number	NA	**Nominal Capacity:**	5.23	tons
Equipment Type:	Package Heat Pump	**Age**	**5**	years
Year Manufactured:	1999	**Coil Conditon**	**0%**	(% degraded)
Location	Concord City Hall	**Present Condition EER**	**11.9**	Btu/W-hr
Tag	RTU-1	**kW/ton**	**1.01**	

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 applicable)

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 load:	**5.0**	kW
Calculated condensing fan load:	**0.22**	kW
Calculated evaporator fan load	**0.86**	kW
Total calculated load for equipment:	**5.21**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition	
New	X
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	x
Corrosion	
Some Loose	
Many Loose	
Tubes	
Clean Cu	x
Corrosion	
Pitting	
Leaks	

FLUKE METER MEASURMENTS

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 Assistant Measurment

	COMP 1	
Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
EI	100%	
CI	92%	
Input Cap	5	Tons
OAT	87	F
Predicted KW	5.60	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		
Capacity	-	Tons		
Efficiency	-	EER		

CU Fan CFM Calculation

Number	ft/sec
1	-
2	-
3	-
4	-
Average	-

Concord City Hall RTU-1 Summary

EER at ARI Conditions	12.0 BTU/W-h		Equipment age	5 Years
Condensing unit CFM	- CFM (Measured)			
Nominal Unit Capacity	5.23			
Capacity used for SA	5.00 tons			
Coil Area	- sq-ft			
Predicted EER =	11.65			

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
24-May	81	62	98%	93%	14.0	6.06	NA	NA	NA	NA	NA	NA	NA
Post Adsil Measurements													
16-Jun	87	62	100%	92%	12.9	5.85	NA	NA	NA	NA	NA	NA	NA

		Condensing Unit Summary - Ambient Conditions						Condensing Unit Summary - ARI Conditions								
		Test Data@ Field Conditions			Percent Difference			Test Data @ARI			Percent Difference					
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	6.06	NA	4.30	141%	NA	100%	7.4	NA	5.23	141%	NA	NA	-	-	-
	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%
Post-Adsil	Power (kW)	5.85	NA	4.64	126%	NA	100%	6.6	NA	5.23	126%	NA	NA	-	-	-
	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 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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	11.3 Btu/W-hr (CU Only)
Model Number:	50TJQ009-601	**Calculated EER:**	11.3 Btu/W-hr (CU Only)
Serial Number	4598G30510	**Nominal Capacity:**	8.41 tons
Equipment Type:	Package HP	**Age**	6 years
Year Manufactured:	1998	**Coil Conditon**	6% (% degraded)
Location	Concord Admin	**Present Condition EER**	10.5 Btu/W-hr
Tag	RTU-5	**kW/ton**	1.14

Compressor Data

Running load Amps:	7.2	Amps	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:	0.70	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:	2.60	Amps	Power supply:	3-Phase
Nameplate Voltage:	460	Volts	Phase adjustment:	1.73
Adjust FLA to RLA:	0.70		Fan quantity:	1

Calculated compressor load:	**8.5**	kW
Calculated condensing fan load:	**0.45**	kW
Calculated evaporator fan load	**0.84**	kW
Total calculated load for equipment:	**8.93**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **5.7%** **Performance Degradation**

Overall Unit Condition		
	New	
	Average	**1**
	Fair	
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	**x**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

Y-measurement

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 Assistant Measurement

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
	Circuit 1	
EI	104%	
CI	99%	
Input Cap	3.5	Tons
OAT	93	F
Predicted KW	4.00	kW

4 compressors 2 stages. All 4 on durring CU test; two on during SA test

CU Capacity Estimates

Ambient	96	F	309 K
CU Exhaust	103	F	313 K
Coil Length	72	in	
Coil Width	36	in	
Area	36.0	sq-ft	
Measured Fan CFM	21168		
Air Mass Flow	11.99	kg/sec	
Capacity	13.33	Tons	
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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	11.3	Btu/W-hr (CU Only)
Model Number:	50TJQ009-601	**Calculated EER:**	11.3	Btu/W-hr (CU Only)
Serial Number	4598G30510	**Nominal Capacity:**	8.41	tons
Equipment Type:	Package HP	**Age**	6	years
Year Manufactured:	1998	**Coil Conditon**	0%	(% degraded)
Location	Concord Admin	**Present Condition EER**	11.1	Btu/W-hr
Tag	RTU-5	**kW/ton**	1.08	

Compressor Data

Running load Amps:	7.2	Amps	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:	0.7	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:	2.6	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:	**8.5**	kW
Calculated condensing fan load:	**0.45**	kW
Calculated evaporator fan load	**0.84**	kW
Total calculated load for equipment:	**8.93**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition

New	X
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	x
Corrosion	
Some Loose	
Many Loose	
Tubes	
Clean Cu	x
Corrosion	
Pitting	
Leaks	

FLUKE METER MEASUREMENTS

Y-measurement

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 Assistant Measurement

Input SEER	10	
RAT	74	F
SAT	54	F
RAH	50	%
SAH	85	%
	Circuit 1	
EI	104%	
CI	96%	
Input Cap	3.5	Tons
OAT	93	F
Predicted KW	4.00	kW

Both circuits on durring both tests

CU Capacity Estimates

Ambient	93	F	307	K
CU Exhaust	106	F	314	K
Coil Length	72	in		
Coil Width	36	in		
Area	36.0	sq-ft		
Measured Fan CFM	23544			
Air Mass Flow	13.33	kg/sec		
Capacity	27.54	Tons		
Efficiency	34.79	EER		

CU Fan CFM Calculation

Measurement Number	ft/sec
1	10.7
2	11.5
3	10.7
4	10.7
Average	10.9

Concord Admin RTU-5 Summary

EER at ARI Conditions	11.3 BTU/W-h		Equipment Age	6 Years
Condensing unit CFM	21168 CFM (Measured)			
Capacity at ARI	8.41 tons			
Capacity used for SA	3.50 tons			
Coil Area	36.00 sq-ft			
Predicted EER =	10.50 pre	11.08 post		

Test Date	HVAC Service Assistant						Physical Power and Capacity measurments						
							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
13-May	93	62	104%	99%	11.4	9.62	96	103	3.9	9.5	11.99	13.33	16.84
Post Adsil Measurement													
17-Jun	93	62	104%	96%	11.4	9.62	93	106	7.2	9.5	13.33	27.54	34.79

Condensing Unit Summary - Ambient Conditions								**Condensing Unit Summary - ARI Conditions**								
		Test Data			**Percent Difference**			**Test Data**			**Percent Difference**					
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	9.62	9.5	8.29	116%	115%	102%	10.2	10.1	8.79	116%	115%	101%	-	-	-
	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%
Post-Adsil	Power (kW)	9.62	9.5	8.29	116%	115%	102%	10.2	10.1	8.79	116%	115%	101%	-	-	-
	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 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%

Pre-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	10.6	Btu/W-hr (CU Only)
Model Number:	50TJQ012-601	**Calculated EER:**	11.8	Btu/W-hr (CU Only)
Serial Number	4598G30510	**Nominal Capacity:**	9.31	tons
Equipment Type:	Package HP	**Age**	6	years
Year Manufactured:	1998	**Coil Conditon**	3%	(% degraded)
Location	Concord Admin	**Present Condition EER**	11.3	Btu/W-hr
Tag	RTU-7	**kW/ton**	1.06	

Compressor Data

Running load Amps:	8.6	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:	0.70	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:	3.40	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:	**9.0**	kW
Calculated condensing fan load:	**0.45**	kW
Calculated evaporator fan load	**1.09**	kW
Total calculated load for equipment:	**9.43**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **2.7%** **Performance Degradation**

Overall Unit Condition

Overall Unit Condition		
	New	
	Average	**1**
	Fair	
	Poor	
Coil Cleanliness		
	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 Attachment		
	Like New	**x**
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	**x**
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

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 Assistant Measurement

Input SEER	10			
RAT	74	F		
SAT	54	F		
RAH	50	%		
SAH	85	%		
	Circuit 1		Circuit 2	
EI	82%		90%	
CI	85%		89%	
Input Cap	5	Tons	5	Tons
OAT	92	F	92	F
Predicted KW	6.20	kW	6.00	kW

4 compressors 2 stages. All 4 on durring CU test; two on during SA test

CU Capacity Estimates

Ambient	92	F	306	K
CU Exhaust	112.5	F	318	K
Coil Length	61	in		
Coil Width	43	in		
Area	36.4	sq-ft		
Measured Fan CFM	20929			
Air Mass Flow	11.85	kg/sec		
Capacity	38.61	Tons		
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

Post-Adsil HVAC Data Sheet and EER Calculation

Manufacturer:	Carrier	**Published EER:**	10.6 Btu/W-hr (CU Only)
Model Number:	50TJQ012-601	**Calculated EER:**	11.8 Btu/W-hr (CU Only)
Serial Number	4598G30510	**Nominal Capacity:**	9.31 tons
Equipment Type:	Package HP	**Age**	6 years
Year Manufactured:	1998	**Coil Conditon**	0% (% degraded)
Location	Concord Admin	**Present Condition EER**	11.6 Btu/W-hr
Tag	RTU-7	**kW/ton**	1.03

Compressor Data

Running load Amps:	8.6	Amps	Power supply:	3-phase
Nameplate Voltage:	460	Volts	Phase adjustment:	1.73
Power factor:	0.656		Compressor quantity:	2

Condensing Fan Data

Full load Amps:	0.7	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:	3.4	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:	**9.0**	kW
Calculated condensing fan load:	**0.45**	kW
Calculated evaporator fan load	**1.09**	kW
Total calculated load for equipment:	**9.43**	kW - Condensing side only

Assumptions

Condenser Coil Assessment **0.0%** **Performance Degradation**

Overall Unit Condition		
	New	X
	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	x
	Corrosion	
	Some Loose	
	Many Loose	
Tubes		
	Clean Cu	x
	Corrosion	
	Pitting	
	Leaks	

FLUKE METER MEASUREMENTS

Y-measurement

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 Assistant Measurement

Input SEER	10		Both circuits on
RAT	74 F		durring both tests
SAT	54 F		
RAH	50 %		
SAH	85 %		
	Circuit 1		Circuit 2
EI	92%		90%
CI	92%		89%
Input Cap	5 Tons		5 Tons
OAT	93 F		92 F
Predicted KW	6.00 kW		5.90 kW

CU Capacity Estimates

Ambient	93 F	307 K
CU Exhaust	112 F	318 K
Coil Length	61 in	
Coil Width	43 in	
Area	36.4 sq-ft	
Measured Fan CFM	22897	
Air Mass Flow	12.97 kg/sec	
Capacity	39.15 Tons	
Efficiency	49.45 EER	

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 ARI Conditions	11.8	BTU/W-h		Equipment Age	6 Years
Condensing unit CFM	20929	CFM (Measured)			
Capacity at ARI	9.31	tons			
Capacity used for SA	10.00	tons			
Coil Area	36.43	sq-ft			
Predicted EER =	11.32	pre	11.62 post		

	HVAC Service Assistant						Physical Power and Capacity measurments						
Test Date							Cond Air, deg F		Cond Air				
	OAT	EWB	EI	CI	EER	kW	inlet	exhaust	ΔT (K)	kW	(kg/sec)	tons	EER
13-May	92	62	86%	87%	9.0	11.36	92	112.5	11.4	10.9	11.85	38.61	42.51
Post Adsil Measurement													
17-Jun	93	62	91%	91%	9.4	11.08	93	112	10.6	9.5	12.97	39.15	49.45

Condensing Unit Summary - Ambient Conditions								**Condensing Unit Summary - ARI Conditions**								
		Test Data			**Percent Difference**			**Test Data**			**Percent Difference**					
OAT		**SA**	**CU**	**Lit**	**SA/Lit**	**CU/Lit**	**SS/Lit**	**SA**	**CU**	**Literature**	**SA/Lit**	**CU/Lit**	**SA/CU**	**Predicted/SA**	**Predicted/CU**	**Predicted/ Original**
Pre-Adsil	Power (kW)	11.36	10.9	9.85	115%	111%	90%	12.1	11.6	10.51	115%	111%	104%	-	-	-
	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%
Post-Adsil	Power (kW)	11.08	9.5	9.95	111%	95%	90%	11.7	10.0	10.51	111%	95%	117%	-	-	-
	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%

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%

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: SEQL Area
150 Units

ECP Savings:	**371.67**	Electric Demand kW	**461,440**	Electric Energy kWh
	0.00	Equivalent Demand kW	**1,574**	Electric Energy MMBtu
	$ -	Demand Cost Savings	**$36,915**	Electric Energy Cost Savings
	-	Steam System Therms	**-**	Steam System MMBtu
	-	Steam System Cost Savings	**-**	Other Fuels MMBtu
	-	Other Fuels Therms	**-**	Other Fuels Cost Savings
	-	Water kgal	**-**	Water kgal Cost Savings
	-	Wastewater kgal	**-**	Wastewater kgal Cost Savings
	-	Maintenance Cost Savings		
Total ECP Savings:	**$36,915**	Total Annual Cost Savings	**1,574**	Total Annual MMBtu Savings
ECP Cost:	**$165,425**			
Payback:	**4.48**	yrs (including maint savings)	**4.48**	yrs (excluding maint savings)

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 kW
$0.08000	Energy Cost per kWh
0%	Demand Diversity

HVAC System Data

Condensing Unit Data from:	SEQL Area		Nominal Capacity:	2545.0	tons
Condensing Unit Consumption:	3393.33	kW	Present Condition EER:	9.0	Btu/W-hr
Calculated EER:	10.1	Btu/W-hr	kW/ton=	1.33	

EER after coil application= 10.11
kW/ton after coil application= 1.19
Demand Consumption= 3021.67

Facility: SEQL Area
150 Units

Current Run-time Adjustment Factors

Night Setback:	1.000	Excess Capacity:	1.000
FLEOH Conversion:	0.800	Weekend Setback:	1.000
		Cooling Set Point:	72.00 Degrees F

Proposed Run-time Adjustment Factors

Night Setback:	1.000	Excess Capacity:	1.000
FLEOH Conversion:	0.800	Weekend Setback:	1.000
		Cooling Set Point:	72.00 Degrees F

Run-time Estimates

Current condensing unit:	1,242	hours - annually
Proposed condensing unit:	1,242	hours - annually

	kW	**kWh**
Current	3393.333	4,212,989
Proposed	3021.668	3,751,548
Savings	**371.665**	**461,440**

Installation Costs

Nominal capacity:	2,545	tons
Cost associated to install coating (parts & labor):	$65	per ton (total installed cost) (vendor quotation)

Total project cost: $165,425

Appendix H

Spreadsheet EER Degradation

TABLE H-1 SPREADSHEET EER DEGRADATION COMPARED WITH SERVICE ASSISTANT FOR ALL VALID TESTS

				Overall Unit Condition				Coil Cleanliness					Fin Condition									
Site	Unit	Age	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 assistant	
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				0.25	0.75					1				24.75%	13%	291.2%
	RTU-9	4	3		1				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						9.00%	7%	34.1%
YTC Student Services	HP-1	13	7			1			1					1	0.25					17.75%	20%	146.4%
YTC Truck School	SS-1	15	9			1			0.75	0.25				0.1		0.75				10.25%	9%	84.4%
Average			287																	11.49%	10.31%	11.5%

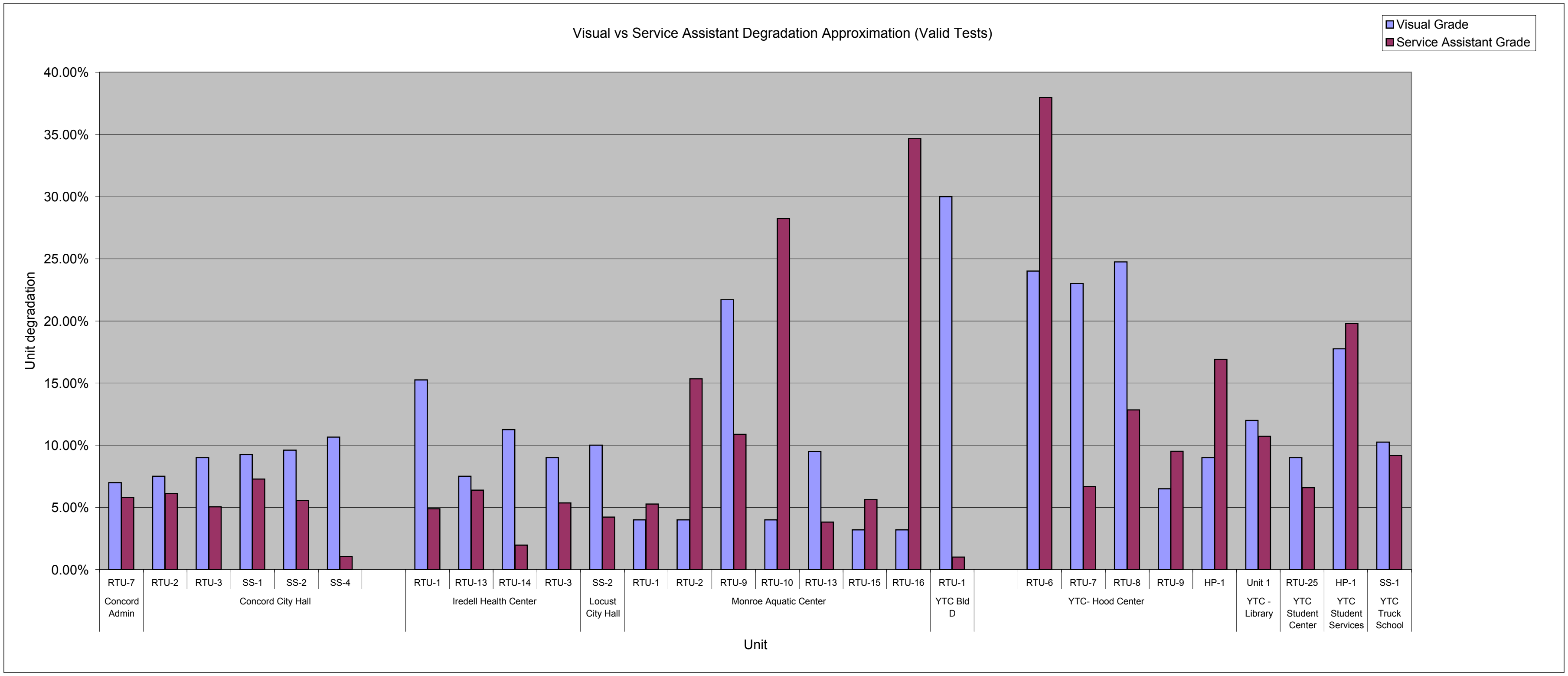
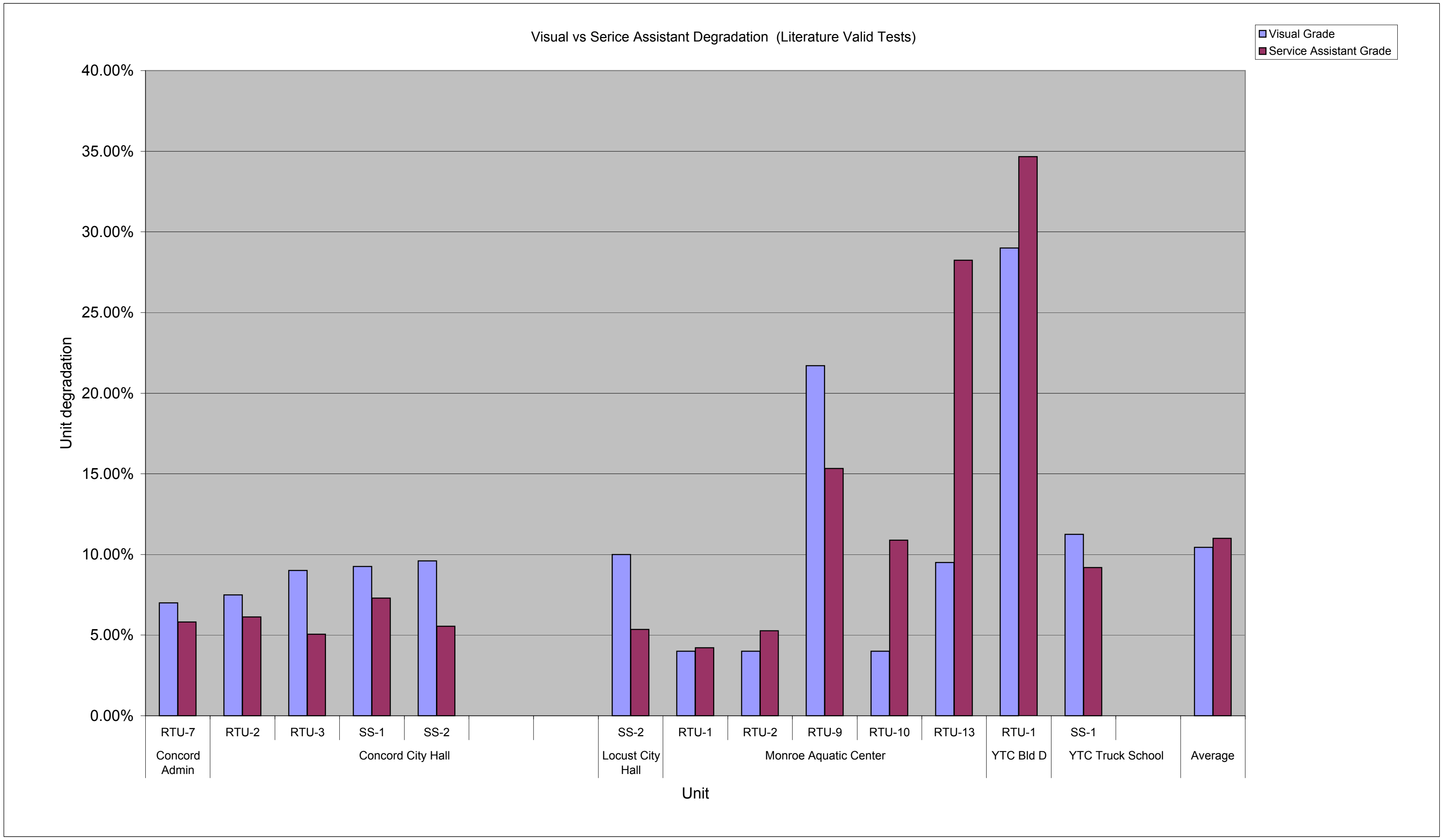

Visual vs Service Assistant Degradation Approximation (Valid Tests)
Visual Grade
Service Assistant Grade
40.00%
35.00%
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
Unit degradation
RTU-7
RTU-2
RTU-3
SS-1
SS-2
SS-4
RTU-1
RTU-13
RTU-14
RTU-3
SS-2
RTU-1
RTU-2
RTU-9
RTU-10
RTU-13
RTU-15
RTU-16
RTU-1
RTU-6
RTU-7
RTU-8
RTU-9
HP-1
Unit 1
RTU-25
HP-1
SS-1
Concord Admin
Concord City Hall
Iredell Health Center
Locust City Hall
Monroe Aquatic Center
YTC Bld D
YTC- Hood Center
YTC - Library
YTC Student Center
YTC Student Services
YTC Truck School
Unit

TABLE H-2 SPREADSHEET EER DEGRADATION COMPARED WITH SERVICE ASSISTANT FOR ALL LITERATURE VALID TESTS

					Overall Unit Condition					Coil Cleanliness				Fin Condition					
Site	Unit	Capacity	Age	New	1-9 yrs	10-15 yrs	>15 yrs	Coated	Clean	Dirty	Clogged	Plugged	Like New	Some Bent	Smashed	Dull/rough	Overall Grade	Service assistant	
Concord Admin	RTU-7	9	6		1				0.8	0.2			1	0.05		0.25	7.00%	5.8%	54%
Concord City Hall	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%
Monroe Aquatic Center	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%


Visual vs Serice Assistant Degradation (Literature Valid Tests)
Visual Grade
Service Assistant Grade
40.00%
35.00%
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
Unit degradation
RTU-7
RTU-2
RTU-3
SS-1
SS-2
SS-2
RTU-1
RTU-2
RTU-9
RTU-10
RTU-13
RTU-1
SS-1
Concord Admin
Concord City Hall
Locust City Hall
Monroe Aquatic Center
YTC Bld D
YTC Truck School
Average
Unit

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	0.000	
POSTADSILE	4.503	0.000

Two-sided probabilities using normal approximation

	PREADSILEE	POSTADSILE
PREADSILEE	1.000	
POSTADSILE	0.000	1.000

Post Adsil EER significantly greater than Pre for Service Assistant results.

	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

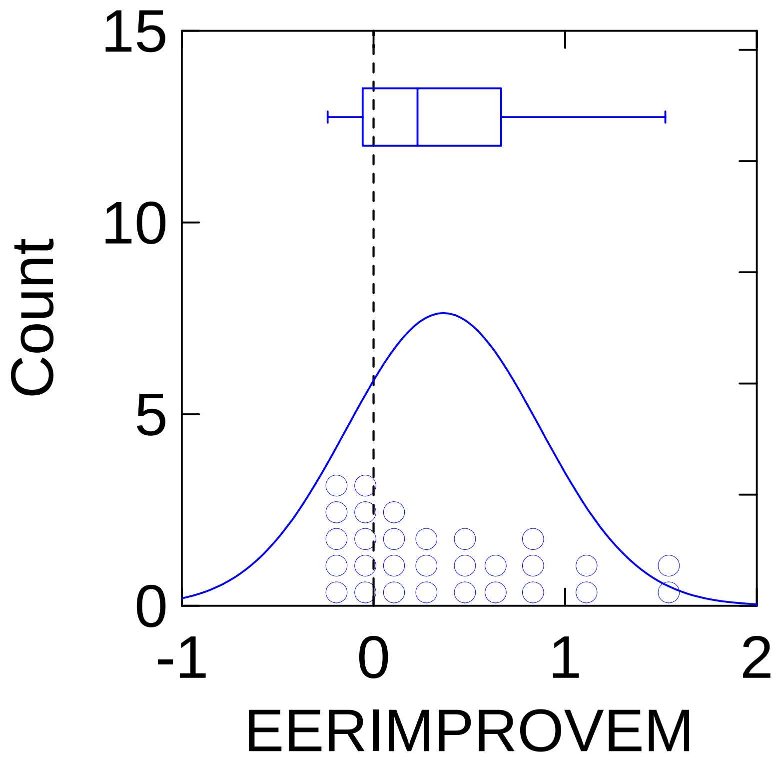
Kolmogorov-Smirnov One Sample Test using Normal(0.00,1.00) distribution

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 = 0.000

Mean = 0.366   95.00% CI = 0.173 to 0.558
SD = 0.505   t = 3.898
df = 28   Prob = 0.001



	EERIMPROVEM
N of cases	29
Minimum	-0.239
Maximum	1.523
Median	0.230
Mean	0.366
95% CI Upper	0.558
95% CI Lower	0.173
Std. Error	0.094
Standard Dev	0.505

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.

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	0.000	
POSTADSILE	5.579	0.000

Two-sided probabilities using normal approximation

	PREADSILEE	POSTADSILE
PREADSILEE	1.000	
POSTADSILE	0.000	1.000

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

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	0.000	
POSTADSILE	4.391	0.000

Two-sided probabilities using normal approximation

	PREADSILEE	POSTADSILE
PREADSILEE	1.000	
POSTADSILE	0.000	1.000

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.

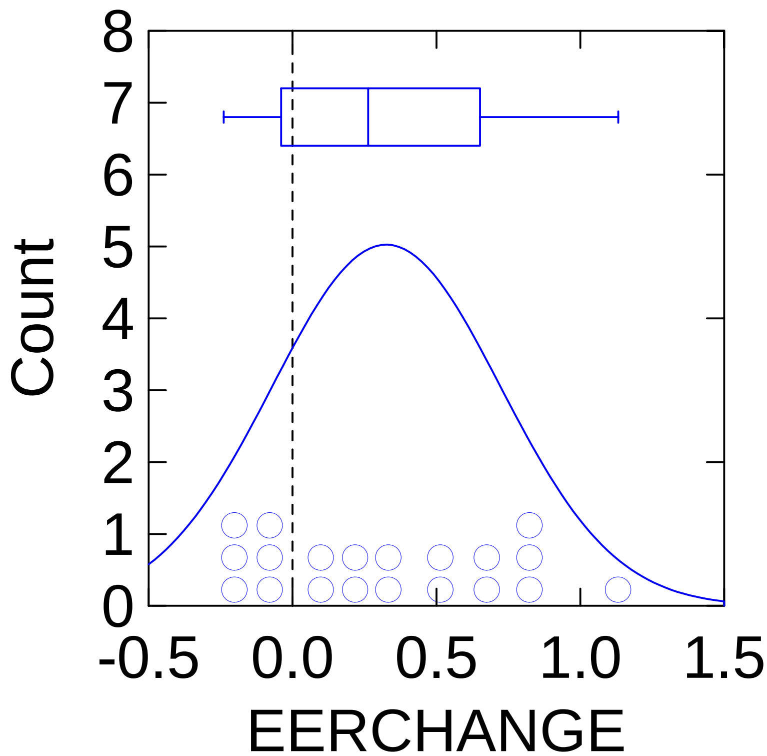
Kolmogorov-Smirnov One Sample Test using Normal(0.00,1.00) distribution

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 95.00% CI = 0.140 to 0.512
SD = 0.397 t = 3.670
df = 19 Prob = 0.002



	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.

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	0.000	
POSTADSILE	4.703	0.000

Two-sided probabilities using normal approximation

	PREADSILEE	POSTADSILE
PREADSILEE	1.000	
POSTADSILE	0.000	1.000

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

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	0.000	
POSTADSILE	2.953	0.000

Two-sided probabilities using normal approximation

	PREADSILEE	POSTADSILE
PREADSILEE	1.000	
POSTADSILE	0.003	1.000

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.

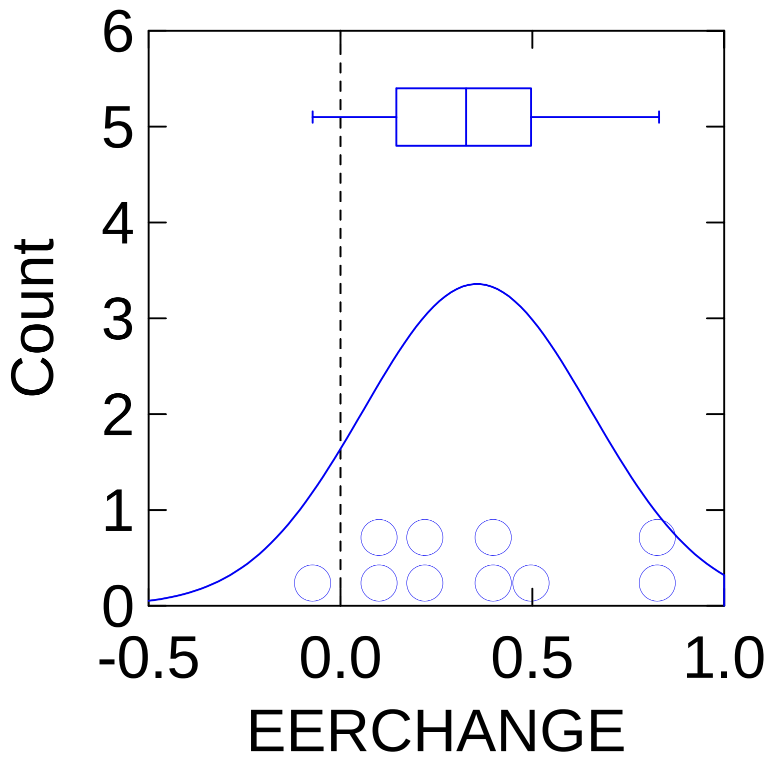
Kolmogorov-Smirnov One Sample Test using Normal(0.00,1.00) distribution

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 95.00% CI = 0.143 to 0.568
SD = 0.297 t = 3.788
df = 9 Prob = 0.004



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.

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	0.000	
POSTADSILE	3.408	0.000

Two-sided probabilities using normal approximation

	PREADSILEE	POSTADSILE
PREADSILEE	1.000	
POSTADSILE	0.001	1.000

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:

PREADSILEE POSTADSILE

SYSTAT Rectangular file P:\EAT\TUCKER\small projects\lowrey\EER Change\allsaprepost.SYD,
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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	0.000	
POSTADSILE	4.503	0.000

Two-sided probabilities using normal approximation

	PREADSILEE	POSTADSILE
PREADSILEE	1.000	
POSTADSILE	0.000	1.000

Post Adsil EER significantly greater than Pre for Service Assistant results.

	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

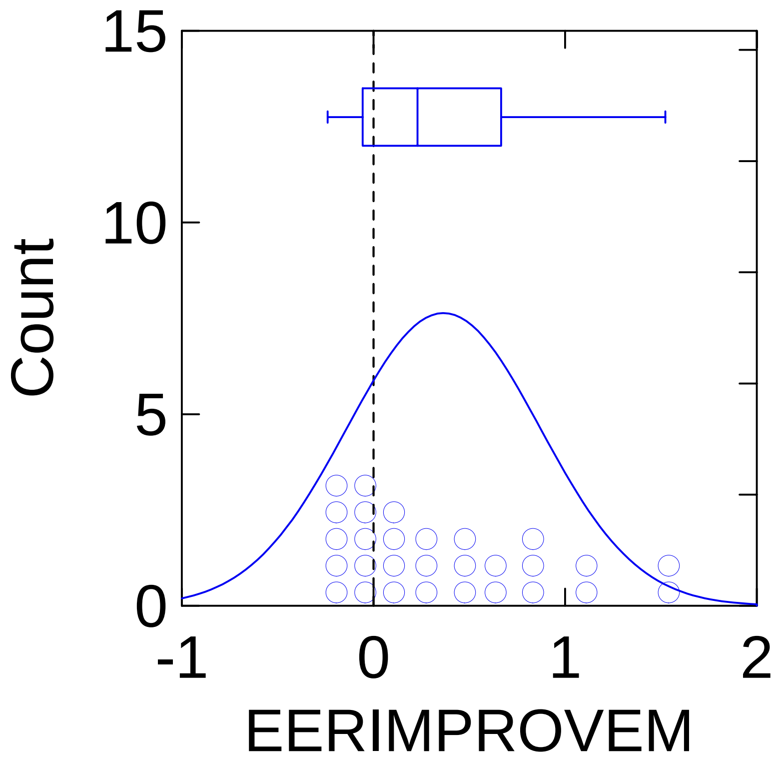
Kolmogorov-Smirnov One Sample Test using Normal(0.00,1.00) distribution

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 = 0.000

Mean = 0.366 95.00% CI = 0.173 to 0.558
SD = 0.505 t = 3.898
df = 28 Prob = 0.001



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N of cases	29
Minimum	-0.239
Maximum	1.523
Median	0.230
Mean	0.366
95% CI Upper	0.558
95% CI Lower	0.173
Std. Error	0.094
Standard Dev	0.505

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.

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	0.000	
POSTADSILE	5.579	0.000

Two-sided probabilities using normal approximation

	PREADSILEE	POSTADSILE
PREADSILEE	1.000	
POSTADSILE	0.000	1.000

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.

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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	0.000	
POSTADSILE	4.391	0.000

Two-sided probabilities using normal approximation

	PREADSILEE	POSTADSILE
PREADSILEE	1.000	
POSTADSILE	0.000	1.000

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.

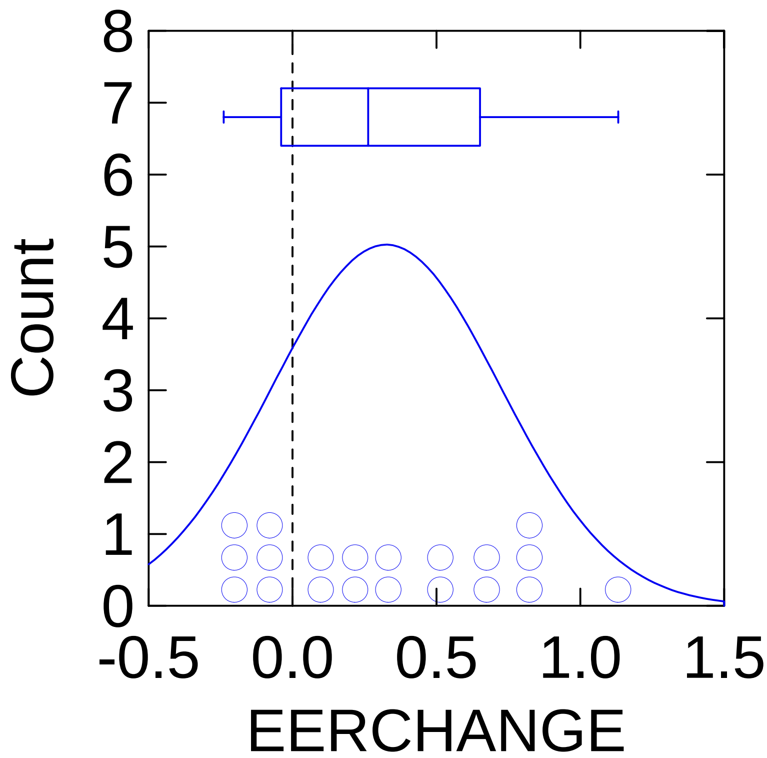
Kolmogorov-Smirnov One Sample Test using Normal(0.00,1.00) distribution

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 95.00% CI = 0.140 to 0.512
SD = 0.397 t = 3.670
df = 19 Prob = 0.002



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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.

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	0.000	
POSTADSILE	4.703	0.000

Two-sided probabilities using normal approximation

	PREADSILEE	POSTADSILE
PREADSILEE	1.000	
POSTADSILE	0.000	1.000

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

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	0.000	
POSTADSILE	2.953	0.000

Two-sided probabilities using normal approximation

	PREADSILEE	POSTADSILE
PREADSILEE	1.000	
POSTADSILE	0.003	1.000

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.

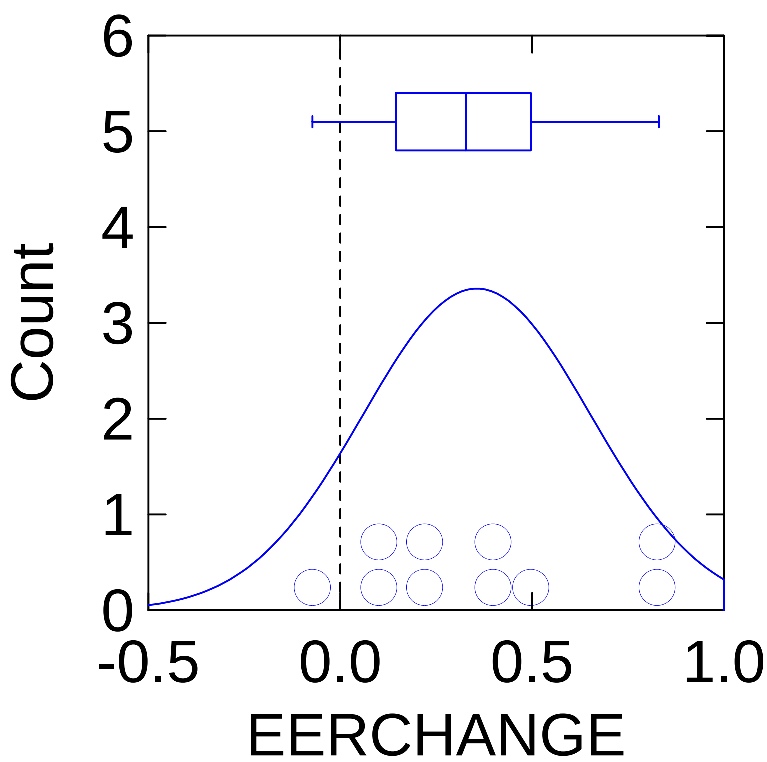
Kolmogorov-Smirnov One Sample Test using Normal(0.00,1.00) distribution

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 95.00% CI = 0.143 to 0.568
SD = 0.297 t = 3.788
df = 9 Prob = 0.004



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.

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	0.000	
POSTADSILE	3.408	0.000

Two-sided probabilities using normal approximation

	PREADSILEE	POSTADSILE
PREADSILEE	1.000	
POSTADSILE	0.001	1.000

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 DATA

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EPA-453/R-05-003		

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7. AUTHOR(S) Tom Lowery, PE Principal Chris Melton, PE Senior Engineer	8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Prepared for EPA by Mactec, 404 SW 140th Terrace, Newberry, FL	10. PROGRAM ELEMENT NO. 11. CONTRACT NO. 4D-6453-NTLX
12. SPONSORING AGENCY NAME AND ADDRESS Office of Air Quality Planning and Standards U.S. Environmental Protection Agency Research Triangle Park, NC 27711	13. TYPE OF REPORT AND PERIOD COVERED Technology evaluation Nov. 2003 – Nov. 2004 14. SPONSORING AGENCY CODE EPA/200/04

15. SUPPLEMENTARY NOTES

16. ABSTRACT

This report contains the results of a study in the Charlotte, NC/Rock Hill, SC region to evaluate the benefits of a new coating called Adsil. It was conducted as part of the SEQL Project (Sustainable Environment for Quality of Life), an integrated environmental improvement project in the 15-county NC/SC region surrounding Charlotte, NC. Previous studies have shown that, when Adsil is applied to air conditioner units, it can bring the efficiency of that unit virtually back to that of a new unit, as well as prevent age-related efficiency loss, saving electrical power and early replacement costs. The ability to model expected energy savings with Adsil is beneficial and transferable to other communities. Energy savings reduce costs, limit the need for new generating capacity, and could under certain circumstances benefit air quality. The report includes two tools:

1) A degradation prediction tool (spreadsheet-based) calibrated against actual EER measurements and found to be very accurate in predicting the EER degradation of a population of HVAC units in the SEQL area.
2) An energy savings projection tool created based on the results of this study. This tool can be adapted by facility owners and operators to estimate their energy savings, dollar savings, and potentially avoided pollution emissions as a result of the application of Adsil to air-cooled HVAC equipment.

17.KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Technology evaluation of energy efficiency technology	Energy efficiency Air quality Air conditioning	

18. DISTRIBUTION STATEMENT Release Unlimited	19. SECURITY CLASS *(Report)* Unclassified	21. NO. OF PAGES 61
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Postal information in this section where appropriate.