

Appendices

The Appendix for this thesis report contains all the information that was too extensive to include in the actual body of the report.

The Appendix contains the following sections:

Appendix A – Chiller Selection

Appendix B – Cooling Tower Selection

Appendix C – Pump Selection

Appendix D – Heat Exchanger Selection

Appendix E – Air Handling Unit and Rooftop Unit Selection

Appendix F – Dedicated Outdoor Air System Unit Selection

Appendix G – Fan Coil Unit Selection

Appendix H – Typical Guest Room Lighting Renderings

Appendix J – Lighting Selection

Appendix K – Acoustical Analysis

Appendix L – Overall Cost Analysis

Appendix M – HAP Report Files

Please Note: Not all the pages of the Appendix are numbered. Manufacturer's equipment cut sheets, HAP and EEA outputs, and other external sources are just included in their appropriate sections.

Appendix A – Chiller Selection

This appendix contains the cut sheets and other data for the manufacturer information provided for the chillers used as a part of the design process. There is data from Trane, Carrier, York, and McQuay included.

Please see the all the chiller information on the following pages.



Centrifugal Chiller

Job Information

Name	Nathan	Tag	CH-1B
Address		Quantity	1
Sales Team	Washington DC	Model Number	CVHE0450
Comments			

Base unit module

Hot gas by pass	Without hot gas bypass	Accessory line item 1	Accessory line item 1
Accessory line item 2	Accessory line item 2		

General

Manufacturing Facility	La Crosse	Agency Listing	No agency listing (Export use only)
Motor frequency	60 Hz	Motor voltage	460
Model	CVHE	Compressor size	450
Motor size	231	Impeller size	213
Orifice size	400	Distribution	North America region
Primary power	184.30 kW	Primary efficiency	0.526 kW/ton
NPLV	0.343 kW/ton	Primary RLA	257.10 A
Motor LRA	2234.00 A	Min circuit ampacity	331.00 A
Max over current protection	500.00 A	ARI std 550/590-98 classification	Certified
Selection code revision level	55077.00 Each	HCFC 123 refrigerant charge	950.0 lb
Shipping weight	19687.0 lb	Operating weight	22274.0 lb
Full load sound pressure	0 dBA	IGV position	90.00 deg
Compressor speed	3555 rpm	ASHRAE 90.1 compliance	Yes
Max 90.1 IPLV/NPLV	0.558 kW/ton	Max 90.1 efficiency	0.585 kW/ton
Green Seal certification	Yes	Heat rejected into equip room	3.15 MBh
Selection ID	1111111100.00 Each		

Evaporator

Cooling capacity	350.00 tons	Evap leaving temp	44.00 F
Evap flow rate	696.70 gpm	Evap flow/capacity	1.99 gpm/ton
Evap entering temp	56.00 F	Evap fouling factor	0.00010 hr-sq ft-deg F/Btu
Evap water box type	non-marine	Evap fluid type	water
Evap fluid concentration	0.00 %	Evap passes	2
Evap tube thickness	0.025"	Evap tube type	TECU
Evap shell size	050L	Evap bundle size	500
Evap pressure drop	13.18 ft H2O	Evap refig saturation temp	42.28 F
Evap fluid velocity	4.67 ft/s	Evap min flow rate	298.40 gpm

Condenser

Cond entering temp	85.00 F	Cond flow rate	976.80 gpm
Cond flow/capacity	2.79 gpm/ton	Cond leaving temp	95.00 F
Cond fouling factor	0.00025 hr-sq ft-deg F/Btu	Cond water box type	non-marine
Cond fluid type	water	Cond fluid concentration	0.00 %
Cond tube thickness	0.028"	Cond tube type	TECU
Cond shell size	050L	Cond bundle size	500
Cond pressure drop	19.95 ft H2O	Cond refig saturation temp	96.08 F
Cond fluid velocity	6.34 ft/s	Cond shell construction	Standard condenser construction



Starter			
AFD model	AFDE	AFD frame size	405 max RLA
Nameplate power	184.30 kW	Nameplate RLA	257.10 A
Nameplate MCA	331.00 A	Nameplate MOP	500.00 A
Adaptive frequency drive	AFD		

Submittal Only			
Search level	Comprehensive	Evap water box pressure	150 psig evap. water pressure
Cond water box pressure	150 psig cond. water pressure	Evap water box connection	Victaulic connection evap.
Cond water box connection	Victaulic connection cond.	Evap water box arrgmt	In RH end - out RH end
Cond water box arrgmt	In RH end - out RH end	Evap water box weld type	Standard waterbox construction
Cond water box weld type	Standard waterbox construction	Free cooling option	Without free cooling
Gas powered chiller	No gas powered chiller	Industrial chiller package	Without industrial chiller package
Enhanced protection	Without enhanced protection		

Settings			
Search level	Comprehensive	Optimization mode	kW / TON
Impeller optimization	Yes	Additional condenser	Without additional condenser
Application type	Standard cooling	Minimum unload point	25.00 %
Operating status	Operating Status	Trane supplied refrigerant	Trane Supplied Refrig.

Test Targets	
Factory performance test	Standard air run and vibration.

Test Tolerances			
Factory tolerance test (SEE NOTES)	Standard air run and vibration	Apply special kW/ton tolerance	No
Apply special ton tolerance	No		

Warranty	
Labor 1st year	1st year labor warranty whole unit



Evergreen Chiller Performance Outputs

Project Name: Untitled
Sales Office: Philadelphia

03/28/2006
07:14 PM

Tag Name: Selection1

Chiller

Chiller Model 19XRV2022206BHS64
Starter / VFD VFD - Unit Mounted
Refrigerant Type R-134a

Cooler

Size 20
Waterbox Type Nozzle-in-Head, 150 psi
Passes 2
Tubing Super E2 (SUPE2), .025 in, Copper
Fluid Type Fresh Water
Fouling Factor (hr-sqft-F)/BTU 0.00010

Compressor

Size 206

Flow Controls

Float Valve Size 3
Flasc Orifice 21

Weights

Total Rigging Weight 11331 lb
Total Operating Weight 12829 lb
Refrigerant Weight 570 lb

Condenser

Size 22
Waterbox Type Nozzle-in-Head, 150 psi
Passes 2
Tubing Spike Fin III (SPK3), .025 in, Copper
Fluid Type Fresh Water
Fouling Factor (hr-sqft-F)/BTU 0.00025

Motor

Size BHS
Line Voltage/Hertz 460-3-60

Output Type	Full Load
Percent Load	100.00
Chiller Capacity	350 Tons
Chiller Input kW	231 kW
Chiller Input Power	0.661 kW/Ton
Cooler	
Entering Temp.	54.0 F
Leaving Temp.	44.0 F
Flow Rate	840.0 gpm
Pressure Drop	26.8 ft wg
Condenser	
Leaving Temp.	94.5 F
Entering Temp.	85.0 F
Flow Rate	1050.0 gpm
Pressure Drop	17.4 ft wg
Motor	
Motor Rated Load Amps	341
Motor OLTA	368
Motor LRDA	1732
Chiller Rated Line Amps	319
Chiller Inrush Amps	319
Max Fuse/CB Amps	600
Min Circuit Ampacity	399

Messages:

- (1) Certified in accordance with the ARI Water-Chilling Packages using the Vapor Compression Cycle Certification Program, which is based on ARI Standard 550/590-2003.



YK MAXE CHILLER PERFORMANCE SPECIFICATION

Unit Tag	Qty	Model No.	Capacity (tons)	Power	Refrigerant
CH-1,2	2	YKACADQ3-CKF	350	460/3/60	R-134A

Unit Data	Evaporator	Condenser
EWT (°F):	56.00	85.00
LWT (°F):	44.00	94.31
Flow Rate (gpm):	700	1050
Pressure Drop (ft):	11.5	10.9
Fluid Type (%):	WATER	WATER
Circuit No. of Passes:	2	2
Fouling Factor (ft ² °F hr / Btu):	0.00010	0.00025
Tube No. / Description:	271 - 0.025" Enhanced Copper	260 - 0.025" CSL Enhanced Copper
Design Working Pressure (psig):	150	150
Entering Water Nozzle @ Location:	C	R
Leaving Water Nozzle @ Location:	B	S
Water Box Weight, ea (lbs) :	209	170
Cover Plate Weight , ea (lbs):	N/A	N/A
Return Head Weight (lbs):	165	132
Water Weight (lbs):	716	848

Performance Data		Electrical Data		Other	
Job KW:	216	Job FLA:	311	Operating Wt. (lbs):	17876
Motor KW:	212	Motor FLA:	301	Per Isolator (lbs):	4469
KW/Ton:	0.617	LRA:	1950	Refrigerant Wt. (lbs):	1250
NPLV (1):	0.381	Inrush Amps:	311	Oil Charge (gal):	10
Shaft HP:	266	Min Circuit Ampacity (Amps):	388	Motor Wt. (lbs):	1460
		Max Fuse/Breaker:	600	Compressor Wt. (lbs):	1807
				Starter Wt. (lbs):	1150
				Shipping Wt. (lbs):	16312
		Type Starter: Variable Speed Drive			

Notes:

(1) Chiller NPLV value calculated to ARI Standard 550/590 equation.

JOB NAME	BJ0652	REP. OFFICE	TriState HVAC-York
JOB DESCRIPTION	PSU Project	SALESMAN	SW
		CUSTOMER	
MODEL NUMBER	WSC087LBD35R/E2612-BE-2*A/C2612-DLYY-2*AYYY/R134-BAABM		
UNIT TAGGING	CH-1 (350 Ton w/ VFD)	VERSION	4.61

GENERAL DATA	
Approval	ETL Listed / ETL Listed to Canadian Safety Standards (ETL Label / ETLc Label)

COMPRESSOR DATA			
Type / quantity-size	Centrifugal / 1 - 087		
Capacity control	VFD	Refrigerant charge (lbs)	891
Refrigerant	R134-a	Oil cooler type	Water cooled

EVAPORATOR DATA		CONDENSER DATA	
Flow (US gpm)	700.00	Flow (US gpm)	1050.00
LWT (°F)	44.00	EWL (°F)	85.00
Number of passes	2	Number of passes	2
Fouling factor	0.00010	Fouling factor	0.00025
Tube material	Cu	Tube material	Cu
Tube wall thickness (in)	0.025	Tube wall thickness (in)	0.025
Fluid type	Water	Fluid type	Water
Percentage of fluid	100	Percentage of fluid	100

MOTOR / STARTER DATA			
Unit voltage (V/Hz/P)	460 / 60 / 3	MCA (A)	370.9
RLA (amps) per compressor	292	MOCP (A)	516.8
Starter type	VFD	LRA (A) per compressor	2273
Enclosure type	NEMA 1	Model number	VFD047YMW
Location	Terminal mounted	Approval listing	ETL/ETLc Label
Disconnect type	Circuit breaker high interrupt	Motor protection	Standard
Control circuit transformer	Without taps	Surge capacitor	None
Ammeter with selector switch	Yes	Ground fault	No
Voltmeter with selector switch	Yes	Auxiliary control relay	None
Phase / voltage protection	Yes	Indicator lights	None
Lightening arrestors	No	P.F. correction (Kvar)	Inherent
Power factor	0.858	Corrected power factor	0.96
Shipped loose with bracket and cable kit	No	Inrush value	350.26

DESIGN PERFORMANCE											
Capacity	Power	Performance	RLA	IPLV NPLV	75% load	50% load	25% load	Evaporator		Condenser	
(Tons)	(kW)	(kW/Ton)	(A)	(kW/Ton)	(kW/Ton)	(kW/Ton)	(kW/Ton)	PD (ft)	T in (°F)	PD (ft)	T out (°F)
350.0	207.6	0.593	292	0.394	0.444	0.345	0.439	16.0	56.0	16.9	94.2

PART LOAD PERFORMANCE							
P#	%load	Capacity	Input	Perf	RLA	Evaporator	Condenser

(CH-1)

McQUAY CENTRIFUGAL CHILLER - TECHNICAL BREAKDOWN

Date saved : April 6, 2006

	request	(Tons)	power (kW)	(kW/Ton)	(A)	Flow (US gpm)	T in (°F)	T out (°F)	PD (ft)	Flow (US gpm)	T in (°F)	T out (°F)	PD (ft)
1	100.0	350.0	207.6	0.593	292	700.0	56.0	44.0	16.0	1050.0	85.0	94.2	16.9
2	75.0	262.5	116.6	0.444	187	700.0	53.0	44.0	16.1	1050.0	75.0	81.6	17.6
3	50.0	175.0	60.4	0.345	131	700.0	50.0	44.0	16.1	1050.0	65.0	69.2	18.3
4	25.0	87.5	38.4	0.438	112	700.0	47.0	44.0	16.2	1050.0	65.0	67.1	18.4

SOUND DATA

Sound data (in dB RE 10⁻¹² Pa) measured in accordance with ARI 575 (without sound insulation)

63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	Overall
69.0	67.0	69.0	71.0	76.0	78.0	78.0	74.0	83.5
							75% load	81.5
							50% load	81.5
							25% load	82.5

SERVICE PERFORMANCE

P#	Refrig Charge (lb)	LRAD (A)	PD capacity	SH	SC	Evaporator			Condenser		
						Temp (°F)	Pressure (psi)	Velocity (fps)	Temp (°F)	Pressure (psi)	Velocity (fps)
1	891	2273	1869	1.0	8.5	43.0	38.6	6.3	95.5	115.6	6.8
2	891	2273	1869	1.0	6.5	43.2	38.9	6.3	82.6	91.7	6.8
3	891	2273	1869	1.0	4.4	43.5	39.1	6.3	70.0	71.7	6.8
4	891	2273	1869	1.0	2.3	43.7	39.4	6.3	67.5	68.1	6.8

NOTES:

The ARI 60 hertz Certification Program covers models that:

- are rated up to 2000 tons (7032 kW cooling) at ARI Standard Rating Conditions
- have voltages less than or equal to 5000 volts
- are within the scope of the Application Rating Conditions of ARI Standard 550/590-2003
- have a leaving chilled water temperature of 40 to 48 °F (4.4 to 8.9 °C)
- have an entering condenser water temperature of 65 to 105 °F (18.3 to 40.6 °C)

The ARI Certification Program specifically excludes:

- chillers above 2000 tons (7032 kW cooling)
- chillers with voltages above 5000 volts
- secondary coolant ratings other than water (e.g. glycol ratings)

Chiller performance is certified in accordance with the latest edition of ARI Standard 550/590-2003.

Above RLA values are per compressor. kW values are total unit kW.

- WSC/WDC063, 079, 087, 100, 113, 126 models utilize water-cooled oil cooler as standard equipment
- WSC/WDC050's utilize a refrigerant-cooled oil cooler as standard equipment.

JOB NAME	BJ0652	REP. OFFICE	TriState HVAC-York
JOB DESCRIPTION	PSU Project	SALESMAN	SW
		CUSTOMER	
MODEL NUMBER	WDC087LBD35R/E3016-SE-2*A/C3016-SLYY-2*AYYY/R134-BCCCM		
UNIT TAGGING	CH-2 (700 Ton Dual)	VERSION	4.61

GENERAL DATA	
Approval	ETL Listed / ETL Listed to Canadian Safety Standards (ETL Label / ETLc Label)

COMPRESSOR DATA			
Type / quantity-size	Centrifugal / 2 - 087		
Capacity control	Inlet guide vanes	Refrigerant charge (lbs)	1936
Refrigerant	R134-a	Oil cooler type	Water cooled

EVAPORATOR DATA		CONDENSER DATA	
Flow (US gpm)	1400.00	Flow (US gpm)	2100.00
LWT (°F)	44.00	EWL (°F)	85.00
Number of passes	2	Number of passes	2
Fouling factor	0.00010	Fouling factor	0.00025
Tube material	Cu	Tube material	Cu
Tube wall thickness (in)	0.025	Tube wall thickness (in)	0.025
Fluid type	Water	Fluid type	Water
Percentage of fluid	100	Percentage of fluid	100

MOTOR / STARTER DATA			
Unit voltage (V/Hz/P)	460 / 60 / 3	MCA (A)	359.8
RLA (amps) per compressor	283	MOCP (A)	501.3
Starter type	Wye-Delta	LRA (A) per compressor	2273
Enclosure type	NEMA 1 gasketed	Model number	BSRD3WT31
Location	Terminal mounted	Approval listing	CSA ETL
Disconnect type	Circuit breaker	Motor protection	Standard
Control circuit transformer	Without taps	Surge capacitor	Standard
Ammeter with selector switch	None	Ground fault	No
Voltmeter with selector switch	None	Auxiliary control relay	None
Phase / voltage protection	Yes	Indicator lights	None
Lightening arrestors	No	P.F. correction (Kvar)	None
Power factor	0.894	Corrected power factor	None
Shipped loose with bracket and cable kit	No		

DESIGN PERFORMANCE											
Capacity (Tons)	Power (kW)	Performance (kW/Ton)	RLA (A)	IPLV NPLV (kW/Ton)	75% load (kW/Ton)	50% load (kW/Ton)	25% load (kW/Ton)	Evaporator		Condenser	
								PD (ft)	T in (°F)	PD (ft)	T out (°F)
700.0	403.0	0.576	283	0.443	0.515	0.375	0.537	21.3	56.0	23.8	94.2

PART LOAD PERFORMANCE													
P#	%load request	Capacity (Tons)	Input power (kW)	Perf (kW/Ton)	RLA (A)	Evaporator				Condenser			
						Flow (US gpm)	T in (°F)	T out (°F)	PD (ft)	Flow (US gpm)	T in (°F)	T out (°F)	PD (ft)

(CH-1A)

1	100.0	700.0	403.0	0.576	283	1400.0	56.0	44.0	21.3	2100.0	85.0	94.2	23.8
2	75.0	525.0	270.2	0.515	204	1400.0	53.0	44.0	21.4	2100.0	75.0	81.8	24.7
3	50.0	350.0	131.4	0.375	201	1400.0	50.0	44.0	21.5	2100.0	65.0	69.4	25.8
4	25.0	175.0	94.0	0.537	161	1400.0	47.0	44.0	21.6	2100.0	65.0	67.2	25.9

SOUND DATASound data (in dB RE 10⁻¹² Pa) measured in accordance with ARI 575 (without sound insulation)

63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	Overall
69.0	68.0	70.0	74.0	78.0	81.0	81.0	77.0	86.5
							75% load	84.5
							50% load	80.5
							25% load	79.5

SERVICE PERFORMANCE

P#	Refrig Charge (lb)	LRAD (A)	PD capacity	SH	SC	Evaporator			Condenser		
						Temp (°F)	Pressure (psi)	Velocity (fps)	Temp (°F)	Pressure (psi)	Velocity (fps)
1	1936	2273	2751	1.0	8.3	42.5	38.1	6.3	95.1	114.8	7.0
2	1936	2273	2751	1.0	6.5	42.5	38.1	6.3	82.5	91.5	7.0
3	1936	2273	2751	1.0	3.9	43.8	39.4	6.3	69.7	71.4	7.0
4	1936	2273	2751	1.0	2.2	43.9	39.5	6.3	67.4	68.0	7.0

NOTES:

The ARI 60 hertz Certification Program covers models that:

- are rated up to 2000 tons (7032 kW cooling) at ARI Standard Rating Conditions
- have voltages less than or equal to 5000 volts
- are within the scope of the Application Rating Conditions of ARI Standard 550/590-2003
- have a leaving chilled water temperature of 40 to 48 °F (4.4 to 8.9 °C)
- have an entering condenser water temperature of 65 to 105 °F (18.3 to 40.6 °C)

The ARI Certification Program specifically excludes:

- chillers above 2000 tons (7032 kW cooling)
- chillers with voltages above 5000 volts
- secondary coolant ratings other than water (e.g. glycol ratings)

Chiller performance is certified in accordance with the latest edition of ARI Standard 550/590-2003.

Above RLA values are per compressor. kW values are total unit kW.

- WSC/WDC063, 079, 087, 100, 113, 126 models utilize water-cooled oil cooler as standard equipment
- WSC/WDC050's utilize a refrigerant-cooled oil cooler as standard equipment.

JOB NAME	BJ0652	REP. OFFICE	TriState HVAC-York
JOB DESCRIPTION	PSU Project	SALESMAN	SW
		CUSTOMER	
MODEL NUMBER	WDC087LBD35R/E3016-SE-2*A/C3016-SLYY-2*AYYY/R134-BCCCM		
UNIT TAGGING	CH-3 (700 Ton Dual VFD)	VERSION	4.61

GENERAL DATA	
Approval	ETL Listed / ETL Listed to Canadian Safety Standards (ETL Label / ETLc Label)

COMPRESSOR DATA			
Type / quantity-size	Centrifugal / 2 - 087		
Capacity control	VFD	Refrigerant charge (lbs)	1936
Refrigerant	R134-a	Oil cooler type	Water cooled

EVAPORATOR DATA		CONDENSER DATA	
Flow (US gpm)	1400.00	Flow (US gpm)	2100.00
LWT (°F)	44.00	EWL (°F)	85.00
Number of passes	2	Number of passes	2
Fouling factor	0.00010	Fouling factor	0.00025
Tube material	Cu	Tube material	Cu
Tube wall thickness (in)	0.025	Tube wall thickness (in)	0.025
Fluid type	Water	Fluid type	Water
Percentage of fluid	100	Percentage of fluid	100

MOTOR / STARTER DATA			
Unit voltage (V/Hz/P)	460 / 60 / 3	MCA (A)	373.2
RLA (amps) per compressor	294	MOCP (A)	520.1
Starter type	VFD	LRA (A) per compressor	2273
Enclosure type	NEMA 1	Model number	VFD047YMW
Location	Terminal mounted	Approval listing	ETL/ETLc Label
Disconnect type	Circuit breaker high interrupt	Motor protection	Standard
Control circuit transformer	Without taps	Surge capacitor	None
Ammeter with selector switch	Yes	Ground fault	No
Voltmeter with selector switch	Yes	Auxiliary control relay	None
Phase / voltage protection	Yes	Indicator lights	None
Lightening arrestors	No	P.F. correction (Kvar)	Inherent
Power factor	0.859	Corrected power factor	0.96
Shipped loose with bracket and cable kit	No	Inrush value	352.55

DESIGN PERFORMANCE											
Capacity	Power	Performance	RLA	IPLV NPLV	75% load	50% load	25% load	Evaporator		Condenser	
(Tons)	(kW)	(kW/Ton)	(A)	(kW/Ton)	(kW/Ton)	(kW/Ton)	(kW/Ton)	PD (ft)	T in (°F)	PD (ft)	T out (°F)
700.0	418.2	0.597	294	0.386	0.451	0.355	0.318	21.3	56.0	23.8	94.2

PART LOAD PERFORMANCE							
P#	%load	Capacity	Input	Perf	RLA	Evaporator	Condenser

(CH-1A VFD)

McQUAY CENTRIFUGAL CHILLER - TECHNICAL BREAKDOWN

Date saved : April 6, 2006

	request	(Tons)	power (kW)	(kW/Ton)	(A)	Flow (US gpm)	T in (°F)	T out (°F)	PD (ft)	Flow (US gpm)	T in (°F)	T out (°F)	PD (ft)
1	100.0	700.0	418.2	0.597	294	1400.0	56.0	44.0	21.3	2100.0	85.0	94.2	23.8
2	75.0	525.0	236.7	0.451	189	1400.0	53.0	44.0	21.4	2100.0	75.0	81.6	24.7
3	50.0	350.0	124.2	0.355	133	1400.0	50.0	44.0	21.5	2100.0	65.0	69.3	25.8
4	25.0	175.0	55.7	0.318	127	1400.0	47.0	44.0	21.6	2100.0	65.0	67.1	25.9

SOUND DATA

Sound data (in dB RE 10⁻¹² Pa) measured in accordance with ARI 575 (without sound insulation)

63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	Overall
69.0	68.0	70.0	74.0	78.0	81.0	81.0	77.0	86.5
							75% load	84.5
							50% load	80.5
							25% load	79.5

SERVICE PERFORMANCE

P#	Refrig Charge (lb)	LRAD (A)	PD capacity	SH	SC	Evaporator			Condenser		
						Temp (°F)	Pressure (psi)	Velocity (fps)	Temp (°F)	Pressure (psi)	Velocity (fps)
1	1936	2273	2751	1.0	8.2	42.5	38.1	6.3	95.1	114.8	7.0
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4	1936	2273	2751	1.0	2.1	43.9	39.5	6.3	67.3	67.8	7.0

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Above RLA values are per compressor. kW values are total unit kW.

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- WSC/WDC050's utilize a refrigerant-cooled oil cooler as standard equipment.

**TRANE®**

Proposal

Trane
A Division of American Standard Inc.

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Prepared For:
M.Contractor: Southland Industries

Date: March 31, 2006

Proposal Number: E2-68290-1

Job Name:
Nathan

Engineer:
Southland Industries
22960 Shaw Road
Suite 800
Sterling, VA 20166

Delivery Terms:
Freight Allowed and Prepaid - F.O.B. Factory

Payment Terms:
Net 30 Days

Trane is pleased to provide the enclosed proposal for your review and approval.

Tag Data - Centrifugal Water Chillers (Qty: 4)

Item	Tag(s)	Qty	Description	Model Number
A1	CH-1A	1	Centrifugal Chiller (CTV)	CVHE0450
A2	CH-1B	1	Centrifugal Chiller (CTV)	CVHE0450
A3	CH-2A	1	Centrifugal Chiller (CTV)	CVHE0450
A4	CH-2B	1	Centrifugal Chiller (CTV)	CVHE0450

Product Data - Centrifugal Water Chillers

All Units

North America region
Centrifugal liquid chiller with 3 stage compressor R-123 refrigerant
Compressor size: 450 nominal tons
Without industrial chiller package
Compressor hertz: 60
Compressor voltage: 460 volt 3 phase
Compressor impeller cutback: 213
Standard cooling
Evaporator shell size: 050 long
Evaporator bundle size: 500 nominal tons
Evaporator tubes: 0.75 inch (19.1 mm) dia. internally enhanced copper
Evaporator tube wall: .025 inch (0.6 mm) thick
Evaporator fluid type: Water
Evaporator waterbox type: Non-marine
Evaporator waterbox construction: Standard
Evaporator waterbox passes: Two pass
Evaporator waterbox pressure: 150 psig (1034 kPa)
Evaporator waterbox connection: Victaulic
Evaporator waterbox arrangement: in RH end - out RH end
Condenser shell size: 050 long
Condenser bundle size: 500 nominal tons
Condenser tube: 0.75 inch (19.1 mm) internally enhanced copper
Condenser tube wall: .028 inch (0.7 mm) thick
Condenser shell construction: Standard

Condenser fluid type: Water
 Condenser waterbox type: 2 pass non-marine
 Condenser waterbox construction: Standard
 Condenser waterbox pressure: 150 psig (1034 kPa)
 Condenser waterbox connection: Victaulic
 Condenser waterbox arrangement: in RH end - out RH end
 Orifice size: 400 nominal tons
 Factory performance test: Standard air run and vibration test
 Factory tolerance test: Standard air run and vibration test
 Don't apply special ton tolerance
 Don't apply special kW/ton tolerance
 Complies with all versions of ASHRAE/IESNA 90.1
 Operating Status
 Without enhanced protection
 Accessory line item 1
 Accessory line item 2
 Trane Supplied Refrigerant
 1st Year Labor Warranty Whole Unit with Trane Supplied Starter

Item: A1, A3 Qty: 2 Tag(s): CH-1A, CH-2A

60 hz Compressor motor power: 204 kW
 Green Seal not qualified
 Low Voltage Wye-Delta Starters
 Starter type: Unit Mounted Wye-Delta
 Starter maximum RLA: 346 Amps
 Starter power connection: Non-fused Disconnect Switch
 Starter power connection maximum RLA: 296 Amps

Item: A2, A4 Qty: 2 Tag(s): CH-1B, CH-2B

60 hz Compressor motor power: 231 kW
 Green Seal certified
 Refrigerant Cooled AFD CH530 Development
 Unit mounted adaptive frequency drive
 Adaptive frequency drive maximum RLA: 405 amps

Total Net Price CH-1A (<i>Excluding Sales Tax</i>)	\$ 114,518.00
Total Net Price CH-1B (<i>Excluding Sales Tax</i>)	\$ 137,186.00
Total Net Price CH-2A (<i>Excluding Sales Tax</i>)	\$ 114,518.00
Total Net Price CH-2B (<i>Excluding Sales Tax</i>)	\$ 137,186.00

Trane is pleased to offer you an opportunity to maximize the value of your purchase by offering you savings with the Anticipation Discount Program (ADP). Contact your Trane representative for more details or an ADP discount calculation.

Sincerely,

Jim Fusco - Trane

12320 Parklawn Drive
 Rockville, MD 20852-1726
 Phone: (301)984-2400
 Fax: (301)881-4787

Appendix B – Cooling Tower Selection

This appendix contains the cut sheets and other data for the Marley cooling towers studied and compared as a part of the design process.

Please see the all the cooling towers information on the following pages.

Job Information

Hilton Hotel at BWI Airport
Nathan Patrick
Linthicum Heights, MD

Selected By**SPX Cooling Technologies Contact**

Marley Cooling Technologies, Inc.
7401 W. 129 Street Tel 1-800-462-7539
Overland Park, KS 66213
info@marleyct.spx.com

Cooling Tower Definition

Manufacturer	Marley	Fan Motor Speed	1200 rpm
Product	NC Class	Fan Motor Capacity per cell	15.00 BHp
Model	NC8306EL2	Fan Motor Output per cell	15.00 BHp
Cells	2	Fan Motor Output total	30.00 BHp
CTI Certified	Yes	Air Flow per cell	122000 cfm
Fan	10.00 ft, 8 Blades	Air Flow total	244000 cfm
Fan Speed	191 rpm, 6000.4 fpm	ASHRAE 90.1 Performance	99.4 gpm/Hp
Fans per cell	1		

Conditions

Tower Water Flow	2100 gpm	Air Density In	0.07076 lb/ft³
Hot Water Temperature	95.00 °F	Air Density Out	0.07117 lb/ft³
Range	10.00 °F	Humidity Ratio In	0.01779
Cold Water Temperature	85.00 °F	Humidity Ratio Out	0.02931
Approach	6.00 °F	Wet-Bulb Temp. Out	88.12 °F
Wet-Bulb Temperature	79.00 °F	Estimated Evaporation	23 gpm
Relative Humidity	50 %	Total Heat Rejection	10463000 Btu/h

- This selection meets your design conditions.

Weights & Dimensions

	Per Cell	Total
Shipping Weight	10170 lb	20340 lb
Max Operating Weight	21980 lb	43960 lb
Width	19.83 ft	19.83 ft
Length	11.90 ft	24.08 ft
Height	12.98 ft	
Static Lift	12.23 ft	

Minimum Enclosure Clearance

Clearance required on air inlet sides of tower without altering performance. Assumes no air from below tower.

Solid Wall	8.70 ft
50 % Open Wall	6.00 ft

Weights and dimensions do not include options; refer to sales drawings. For CAD layouts refer to file NC8306.dxf

Cold Weather Operation

Heater Sizing (to prevent freezing in the collection basin during periods of shutdown)

Heater kW/Cell	24.0	18.0	15.0	12.0	9.0	7.5	6.0
Ambient Temperature °F	-25.81	-8.25	0.53	9.31	18.09	22.48	26.87

Job Information

Hilton Hotel at BWI Airport
Nathan Patrick
Linthicum Heights, MD

Selected by

Penn State
104 Engineering Unit A
University Park, PA
wpb5@psu.edu

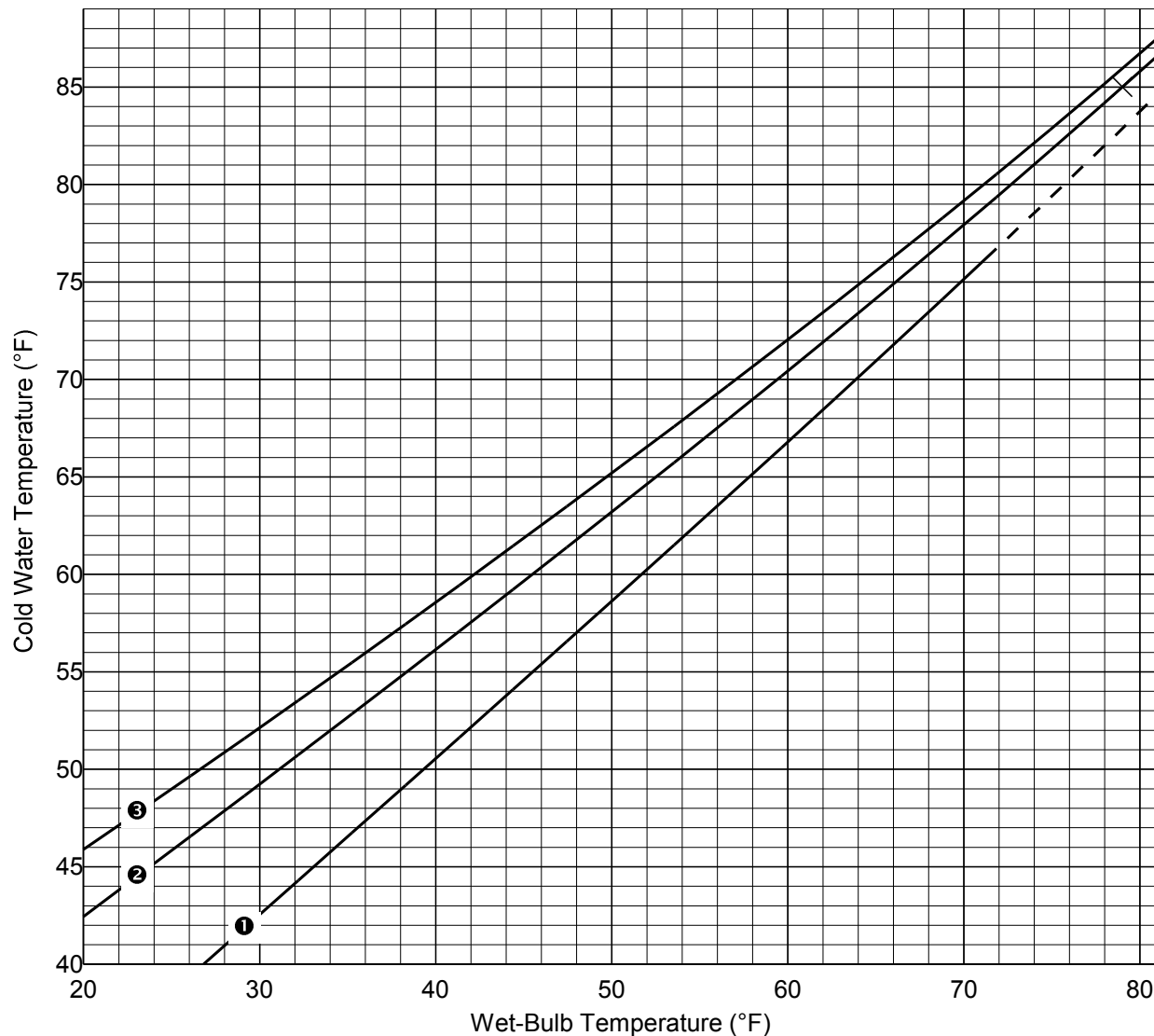
PSUAE

Tel 814-863-2076

Fax

Cooling Tower Definition

Manufacturer	Marley
Product	NC Class
Model	NC8306EL2
Cells	2
Fan	10.00 ft, 8 Blades
Fans per cell	1
Fan Motor Capacity per cell	15.00 BHp



Design Conditions

Tower Water Flow	2100 gpm
Hot Water Temperature	95.00 °F
Cold Water Temperature	85.00 °F
Wet-Bulb Temperature	79.00 °F

Curve Conditions

Tower Water Flow (100.0 %)	2100 gpm
Fan Speed (100.0 %)	191 rpm
Fan Motor Speed (100.0 %)	1200 rpm
Fan Motor Output per cell	15.00 BHp
Fan Motor Output total	30.00 BHp

Legend

- ① 6 °F Range
- ② 10 °F Range
- ③ 12 °F Range
- × Design Point

Job Information

Hilton Hotel at BWI Airport
Nathan Patrick
Linthicum Heights, MD

Selected By**SPX Cooling Technologies Contact**

Marley Cooling Technologies, Inc.
7401 W. 129 Street Tel 1-800-462-7539
Overland Park, KS 66213
info@marleyct.spx.com

Cooling Tower Definition

Manufacturer	Marley	Fan Motor Speed	1200 rpm
Product	NC Class	Fan Motor Capacity per cell	20.00 BHp
Model	NC8305FL2	Fan Motor Output per cell	20.00 BHp
Cells	2	Fan Motor Output total	40.00 BHp
CTI Certified	Yes	Air Flow per cell	114400 cfm
Fan	8.000 ft, 8 Blades	Air Flow total	228800 cfm
Fan Speed	313 rpm, 7866.5 fpm	ASHRAE 90.1 Performance	72.6 gpm/Hp
Fans per cell	1		

Conditions

Tower Water Flow	2100 gpm	Air Density In	0.07076 lb/ft³
Hot Water Temperature	95.00 °F	Air Density Out	0.07108 lb/ft³
Range	10.00 °F	Humidity Ratio In	0.01779
Cold Water Temperature	85.00 °F	Humidity Ratio Out	0.02985
Approach	6.00 °F	Wet-Bulb Temp. Out	88.68 °F
Wet-Bulb Temperature	79.00 °F	Estimated Evaporation	23 gpm
Relative Humidity	50 %	Total Heat Rejection	10463000 Btu/h

- This selection meets your design conditions.

Weights & Dimensions

	Per Cell	Total
Shipping Weight	8870 lb	17740 lb
Max Operating Weight	19170 lb	38330 lb
Width	18.750 ft	18.750 ft
Length	10.896 ft	22.083 ft
Height	12.979 ft	
Static Lift	12.234 ft	

Minimum Enclosure Clearance

Clearance required on air inlet sides of tower without altering performance. Assumes no air from below tower.

Solid Wall	8.829 ft
50 % Open Wall	6.234 ft

Weights and dimensions do not include options; refer to sales drawings. For CAD layouts refer to file NC8305.dxf

Cold Weather Operation

Heater Sizing (to prevent freezing in the collection basin during periods of shutdown)

Heater kW/Cell	18.0	15.0	12.0	9.0	7.5	6.0	4.5
Ambient Temperature °F	-16.14	-6.05	4.04	14.13	19.17	24.22	29.26

Job Information

Hilton Hotel at BWI Airport
Nathan Patrick
Linthicum Heights, MD

Selected By**SPX Cooling Technologies Contact**

Marley Cooling Technologies, Inc.
7401 W. 129 Street Tel 1-800-462-7539
Overland Park, KS 66213
info@marleyct.spx.com

Cooling Tower Definition

Manufacturer	Marley	Fan Motor Speed	1800 rpm
Product	NC Class	Fan Motor Capacity per cell	20.00 BHp
Model	NC8305F2	Fan Motor Output per cell	20.00 BHp
Cells	2	Fan Motor Output total	40.00 BHp
CTI Certified	Yes	Air Flow per cell	116100 cfm
Fan	8.000 ft, 6 Blades	Air Flow total	232100 cfm
Fan Speed	370 rpm, 9299.1 fpm	ASHRAE 90.1 Performance	73.8 gpm/Hp
Fans per cell	1		

Conditions

Tower Water Flow	2100 gpm	Air Density In	0.07076 lb/ft³
Hot Water Temperature	95.00 °F	Air Density Out	0.07110 lb/ft³
Range	10.00 °F	Humidity Ratio In	0.01779
Cold Water Temperature	85.00 °F	Humidity Ratio Out	0.02973
Approach	6.00 °F	Wet-Bulb Temp. Out	88.55 °F
Wet-Bulb Temperature	79.00 °F	Estimated Evaporation	23 gpm
Relative Humidity	50 %	Total Heat Rejection	10463000 Btu/h

- This selection meets your design conditions.

Weights & Dimensions

	Per Cell	Total
Shipping Weight	8730 lb	17460 lb
Max Operating Weight	19030 lb	38050 lb
Width	18.750 ft	18.750 ft
Length	10.896 ft	22.083 ft
Height	12.979 ft	
Static Lift	12.234 ft	

Minimum Enclosure Clearance

Clearance required on air inlet sides of tower without altering performance. Assumes no air from below tower.

Solid Wall	8.795 ft
50 % Open Wall	6.201 ft

Weights and dimensions do not include options; refer to sales drawings. For CAD layouts refer to file NC8305.dxf

Cold Weather Operation

Heater Sizing (to prevent freezing in the collection basin during periods of shutdown)

Heater kW/Cell	18.0	15.0	12.0	9.0	7.5	6.0	4.5
Ambient Temperature °F	-16.14	-6.05	4.04	14.13	19.17	24.22	29.26

Job Information

Hilton Hotel at BWI Airport
Nathan Patrick
Linthicum Heights, MD

Selected By**SPX Cooling Technologies Contact**

Marley Cooling Technologies, Inc.
7401 W. 129 Street Tel 1-800-462-7539
Overland Park, KS 66213
info@marleyct.spx.com

Cooling Tower Definition

Manufacturer	Marley	Fan Motor Speed	1800 rpm
Product	NC Class	Fan Motor Capacity per cell	15.00 BHp
Model	NC8307E2	Fan Motor Output per cell	15.00 BHp
Cells	2	Fan Motor Output total	30.00 BHp
CTI Certified	Yes	Air Flow per cell	121100 cfm
Fan	10.00 ft, 6 Blades	Air Flow total	242300 cfm
Fan Speed	241 rpm, 7571.2 fpm	ASHRAE 90.1 Performance	103 gpm/Hp
Fans per cell	1		

Conditions

Tower Water Flow	2100 gpm	Air Density In	0.07076 lb/ft³
Hot Water Temperature	95.00 °F	Air Density Out	0.07116 lb/ft³
Range	10.00 °F	Humidity Ratio In	0.01779
Cold Water Temperature	85.00 °F	Humidity Ratio Out	0.02937
Approach	6.00 °F	Wet-Bulb Temp. Out	88.18 °F
Wet-Bulb Temperature	79.00 °F	Estimated Evaporation	23 gpm
Relative Humidity	50 %	Total Heat Rejection	10463000 Btu/h

- This selection meets your design conditions.

Weights & Dimensions

	Per Cell	Total
Shipping Weight	11040 lb	22070 lb
Max Operating Weight	26090 lb	52190 lb
Width	22.42 ft	22.42 ft
Length	11.90 ft	24.08 ft
Height	13.31 ft	
Static Lift	12.57 ft	

Minimum Enclosure Clearance

Clearance required on air inlet sides of tower without altering performance. Assumes no air from below tower.

Solid Wall	8.19 ft
50 % Open Wall	5.44 ft

Weights and dimensions do not include options; refer to sales drawings. For CAD layouts refer to file NC8307.dxf

Cold Weather Operation

Heater Sizing (to prevent freezing in the collection basin during periods of shutdown)

Heater kW/Cell	24.0	18.0	15.0	12.0	9.0	7.5	6.0
Ambient Temperature °F	-17.30	-1.86	5.85	13.57	21.28	25.14	29.00

Appendix C – Pump Selection

This appendix contains the cut sheets and other data for the Bell & Gossett pumps used as a part of the design process.

Please see the all the pump information on the following pages.

Pump Selection Charts

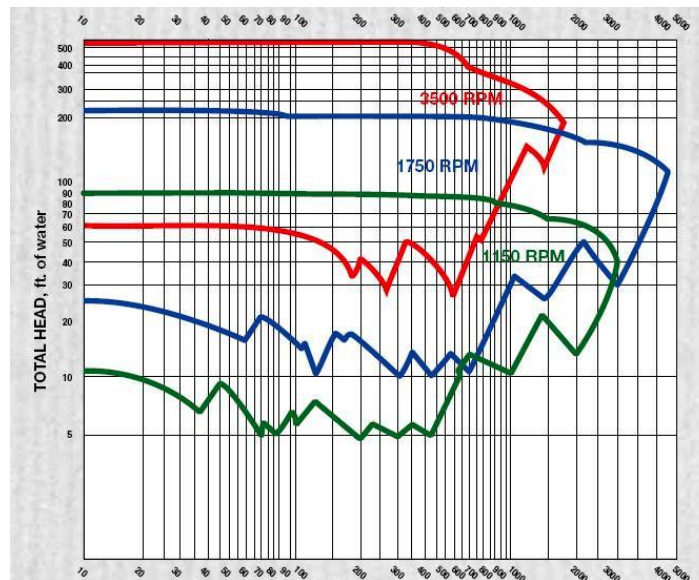


Figure C1 - Pump Selection Curves

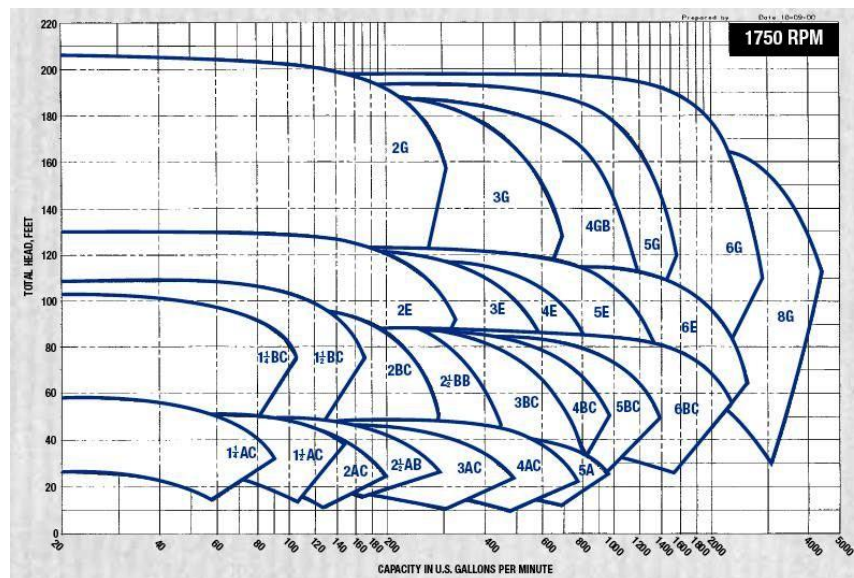


Figure C2 - 1750 rpm Performance Curves

To: Nathan

Job Name: Thesis

Engineer:

3/31/06

Quote Number:

***** Quotation ***** Quotation *****

Item	Quantity	Description	Unit Price	Extended Price
<u>Chilled Water Pumps P-1</u>				
1)	1	Bell & Gossett End Suction Pump Series: 1510 Model: 5 G 700 GPM @ 110.7 'TDH 40 HP 1800 RPM 460/3/60 Inverter Duty Frame: 324T ODP High Efficiency Motor Dodge Para-Flex Coupling Shipping Weight: 1055 lbs.	\$5,164.00	\$5,164.00
<u>Condenser Water Pumps P-2</u>				
2)	1	Bell & Gossett End Suction Pump Series: 1510 Model: 5 E 1050 GPM @ 70.8 'TDH 25 HP 1800 RPM 460/3/60 Inverter Duty Frame: 284T ODP High Efficiency Motor Dodge Para-Flex Coupling Shipping Weight: 710 lbs.	\$4,337.00	\$4,337.00
<u>Geothermal Pumps P-3</u>				
3)	1	Bell & Gossett End Suction Pump Series: 1510 Model: 4 BC 570 GPM @ 54 'TDH 15 HP 1800 RPM 460/3/60 Inverter Duty Frame: 254T ODP High Efficiency Motor Dodge Para-Flex Coupling Shipping Weight: 475 lbs.	\$3,050.00	\$3,050.00



10901 Pump House Road Annapolis Junction, Md 20701
Washington: 301-953-9370 Baltimore: 410-792-4230 Fax: 301-490-7156

To: Nathan

Job Name: Thesis

Engineer:

3/31/06

Quote Number:

***** Quotation ***** Quotation *****

Item	Quantity	Description	Unit Price	Extended Price
		<u>Geothermal Pumps P-5</u>		
4)	1	Bell & Gossett End Suction Pump Series: 1510 Model: 5 A 570 GPM @ 27 'TDH 7.5 HP 1800 RPM 460/3/60 Inverter Duty Frame: 213T ODP High Efficiency Motor Dodge Para-Flex Coupling Shipping Weight: 455 lbs.	\$2,812.00	\$2,812.00
		<u>Variable Speed Drive P-1</u>		
5)	1	AC Tech Model: MCH4400BG 40 HP 480/400/3/60 52/60 amps Basic Drive With Manual By Pass, NEMA 1 Enclosure Standard Features : Bypass AC Line Terminals 3 Contactor Manual Transfer Bypass Class 10 Thermal Overload VFD Input Fuses Hand - Off - Automatic Switch Drive Mode - Off - Bypass Mode Switch Drive Normal - Off - Drive Test Switch Lights: Power On, Drive Mode, Bypass Mode, Safety Fail Circuit 120 VAC Transformer (2) Form C Relays For Logic Output Communication Protocol : Modbus RTU 2 Year Warranty Parts And Labor Motor Fuses 2 Year Warranty Parts And Labor	\$3,225.00	\$3,225.00



10901 Pump House Road Annapolis Junction, Md 20701
Washington: 301-953-9370 Baltimore: 410-792-4230 Fax: 301-490-7156

To: Nathan

Job Name: Thesis

Engineer:

3/31/06

Quote Number:

***** Quotation ***** Quotation *****

Item	Quantity	Description	Unit Price	Extended Price
------	----------	-------------	------------	----------------

Variable Speed Drive P-2

6)	1	AC Tech Model: MCH4250BG15 25 HP 480/400/3/60 34/39 amps Basic Drive With Manual By Pass, NEMA 1 Enclosure Standard Features : Bypass AC Line Terminals 3 Contactor Manual Transfer Bypass Class 10 Thermal Overload VFD Input Fuses Hand - Off - Automatic Switch Drive Mode - Off - Bypass Mode Switch Drive Normal - Off - Drive Test Switch Lights: Power On, Drive Mode, Bypass Mode, Safety Fail Circuit 120 VAC Transformer (2) Form C Relays For Logic Output Communication Protocol : Modbus RTU Disconnect Motor Fuses 2 Year Warranty Parts And Labor	\$2,649.00	\$2,649.00
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Variable Speed Drive P-3

7)	1	AC Tech Model: MCH4150BG 15 HP 480/400/3/60 21/24 amps Basic Drive With Manual By Pass, NEMA 1 Enclosure Standard Features : Bypass AC Line Terminals 3 Contactor Manual Transfer Bypass Class 10 Thermal Overload VFD Input Fuses Hand - Off - Automatic Switch Drive Mode - Off - Bypass Mode Switch Drive Normal - Off - Drive Test Switch Lights: Power On, Drive Mode, Bypass Mode, Safety Fail Circuit	\$1,886.00	\$1,886.00
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Submitted By: Jae Chon

Quotation Is Valid For Fourteen (30) Days

Document2

Bell & Gossett

SUBMITTAL

B-229.3E

JOB: Thesis Report

REPRESENTATIVE: Cummins-Wagner Co., Inc.

UNIT TAG: P-1

ORDER NO.

DATE: 3/31/2006

ENGINEER:

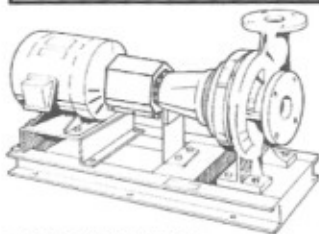
SUBMITTED BY:

DATE:

CONTRACTOR:

APPROVED BY:

DATE:



5G Series 1510 Centrifugal Pumps - Base Mounted

SPECIFICATIONS

FLOW	700 (GPM)	HEAD	110.7 (FT)
HP	40	RPM	1800
VOLTS			230/460
CYCLE	60	PHASE	3
Lincoln ODP Inverter Duty			
APPROX. WEIGHT	1019		
SPECIALS	Special Coupling(Dodge Paraflex)		

Note: Equipped with EPDM coupling

MATERIALS OF CONSTRUCTION

☒ BRONZE FITTED ☐ ALL IRON

FEATURES

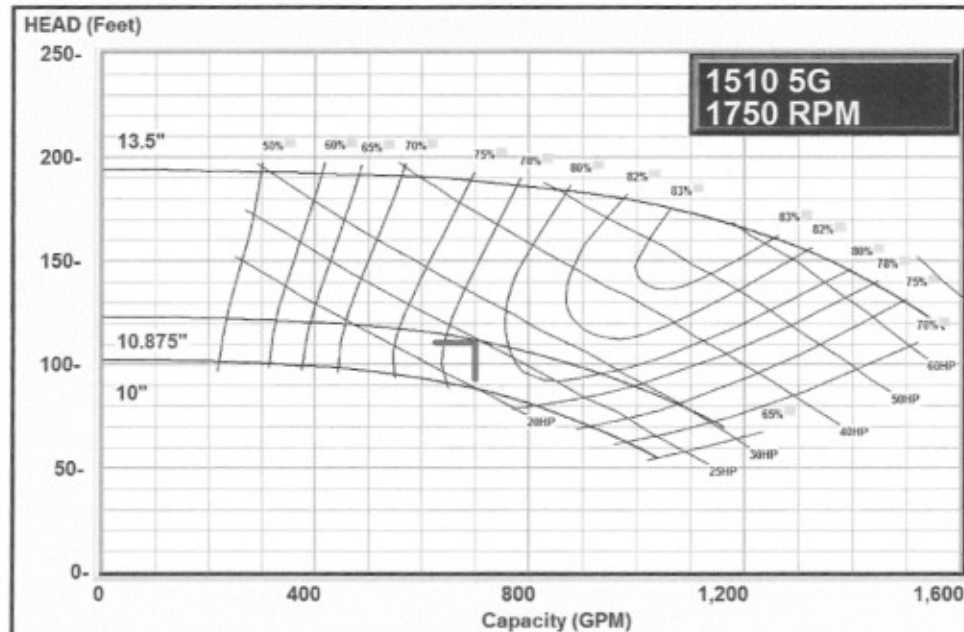
- ☒ ANSI/OSHA Coupling Guard
- ☒ Center Drop Out Spacer Coupling
- ☒ Fabricated Heavy Duty Baseplate

MAXIMUM WORKING PRESSURE

- ☒ 175 psi (12 bar) W.P.
w/ 125# ANSI flange drilling
- ☐ 250 psi (17 bar) W.P.
w/ 250# ANSI flange drilling (requires 1510-S)

TYPE OF SEAL

- ☒ 1510 Standard Seal
(Buna-Carbon/Ceramic)
- ☐ 1510 -F Standard Seal w/ Flush Line
(Buna-Carbon/Ceramic)
- ☐ 1510 -S Stuffing Box construction w/ Flush
Mechanical Single Seal
(EPR-Tungsten Carbide/Carbon)
- ☐ 1510 -D Stuffing Box construction w/
Flushed Double Mechanical Seal
(EPR-Carbon/Ceramic)
Requires external water source
- ☐ 1510 -PF Stuffing Box Construction w/
Packing
(Graphite Impregnated Teflon)



Design Capacity = 700.0 GPM
Design Head = 110.7 Feet

Suction Size = 6 "
Suct. Velocity = 7.8 fps
Discharge Size = 5 "
Disc. Velocity = 11.2 fps

Min. Imp. Dia. = 10 "
Max. Imp. Dia. = 13.5 "
Cut Dia. = 10.875 "

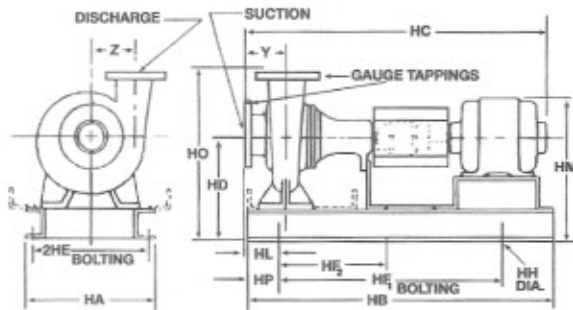
Max. Flow = 1194 GPM
B.E.P. Flow = 840 GPM

Eff. @ Duty-Point = 79.19 %
Motor Size = 40 HP

B.H.P. @
Duty-Point = 24.91 BHP
Max. B.H.P. for
Imp. Cut = 30.32 BHP

Series 1510 5G Centrifugal Pump Submittal

B-229.3E



FLANGE DIMENSIONS IN INCHES (MM)			
	SIZE	THICKNESS	O.D.
Discharge	5" (127)	1-3/8 (35)	10-3/4 (273)
Suction	6" (152)	1-7/16 (37)	12-1/8 (308)

FLANGES ARE: 125# ANSI - STANDARD
250# ANSI - AVAILABLE

DIMENSIONS - Inches (mm)

STANDARD SEAL 1510, 1510-F

MOTOR FRAME	HA	HB	HC MAX	HD	2HE	HF ₁	HF ₂	HH	HL	HM MAX	HO	HP	Y	Z
"L" FRAME														
254T	24 (610)	56 (1422)	47-1/8 (1197)	16-1/2 (419)	21-1/2 (546)	44 (1118)	22 (559)	1 (25)	5-7/16 (138)	23-3/8 (594)	29-1/2 (749)	6 (152)	6 (152)	9 (229)
256T	24 (610)	56 (1422)	48-7/8 (1241)	16-1/2 (419)	21-1/2 (546)	44 (1118)	22 (559)	1 (25)	5-7/16 (138)	23-3/8 (594)	29-1/2 (749)	6 (152)	6 (152)	9 (229)
284T	24 (610)	56 (1422)	49-7/8 (1267)	16-1/2 (419)	21-1/2 (546)	44 (1118)	22 (559)	1 (25)	5-7/16 (138)	24-1/2 (622)	29-1/2 (749)	6 (152)	6 (152)	9 (229)
286T	24 (610)	56 (1422)	51-3/8 (1305)	16-1/2 (419)	21-1/2 (546)	44 (1118)	22 (559)	1 (25)	5-7/16 (138)	24-1/2 (622)	29-1/2 (749)	6 (152)	6 (152)	9 (229)
324T	24 (610)	56 (1422)	53-3/8 (1356)	16-1/2 (419)	21-1/2 (546)	44 (1118)	22 (559)	1 (25)	5-7/16 (138)	25-5/8 (651)	29-1/2 (749)	6 (152)	6 (152)	9 (229)
326T	24 (610)	56 (1422)	54-7/8 (1394)	16-1/2 (419)	21-1/2 (546)	44 (1118)	22 (559)	1 (25)	5-7/16 (138)	25-5/8 (651)	29-1/2 (749)	6 (152)	6 (152)	9 (229)
364T	24 (610)	56 (1422)	57-1/8 (1451)	16-1/2 (419)	21-1/2 (546)	44 (1118)	22 (559)	1 (25)	5-7/16 (138)	26-3/4 (679)	29-1/2 (749)	6 (152)	6 (152)	9 (229)
365T	24 (610)	56 (1422)	58-1/8 (1476)	16-1/2 (419)	21-1/2 (546)	44 (1118)	22 (559)	1 (25)	5-7/16 (138)	26-3/4 (679)	29-1/2 (749)	6 (152)	6 (152)	9 (229)

STUFFING BOX 1510-PF, 1510-S, 1510-D

MOTOR FRAME	HA	HB	HC MAX	HD	2HE	HF ₁	HF ₂	HH	HL	HM MAX	HO	HP	Y	Z
"L" FRAME														
254T	24 (610)	56 (1422)	49-1/2 (1257)	16-1/2 (419)	21-1/2 (546)	44 (1118)	22 (559)	1 (25)	5-7/16 (138)	23-3/8 (594)	29-1/2 (749)	6 (152)	6 (152)	9 (229)
256T	24 (610)	56 (1422)	51-1/4 (1302)	16-1/2 (419)	21-1/2 (546)	44 (1118)	22 (559)	1 (25)	5-7/16 (138)	23-3/8 (594)	29-1/2 (749)	6 (152)	6 (152)	9 (229)
284T	24 (610)	56 (1422)	52-1/4 (1327)	16-1/2 (419)	21-1/2 (546)	44 (1118)	22 (559)	1 (25)	5-7/16 (138)	24-1/2 (622)	29-1/2 (749)	6 (152)	6 (152)	9 (229)
286T	24 (610)	56 (1422)	53-3/4 (1365)	16-1/2 (419)	21-1/2 (546)	44 (1118)	22 (559)	1 (25)	5-7/16 (138)	24-1/2 (622)	29-1/2 (749)	6 (152)	6 (152)	9 (229)
324T	24 (610)	56 (1422)	55-3/4 (1416)	16-1/2 (419)	21-1/2 (546)	44 (1118)	22 (559)	1 (25)	5-7/16 (138)	25-5/8 (651)	29-1/2 (749)	6 (152)	6 (152)	9 (229)
326T	24 (610)	56 (1422)	57-1/4 (1454)	16-1/2 (419)	21-1/2 (546)	44 (1118)	22 (559)	1 (25)	5-7/16 (138)	25-5/8 (651)	29-1/2 (749)	6 (152)	6 (152)	9 (229)
364T	24 (610)	56 (1422)	59-1/2 (1511)	16-1/2 (419)	21-1/2 (546)	44 (1118)	22 (559)	1 (25)	5-7/16 (138)	26-3/4 (679)	29-1/2 (749)	6 (152)	6 (152)	9 (229)
365T	24 (610)	56 (1422)	60-1/2 (1537)	16-1/2 (419)	21-1/2 (546)	44 (1118)	22 (559)	1 (25)	5-7/16 (138)	26-3/4 (679)	29-1/2 (749)	6 (152)	6 (152)	9 (229)

Dimensions are subject to change. Not to be used for construction purposes unless certified.



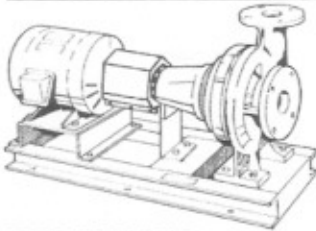
Bell & Gossett

SUBMITTAL
B-226C
JOB: Thesis Report

REPRESENTATIVE: Cummins-Wagner Co., Inc.

UNIT TAG: P-2

ORDER NO.
DATE: 3/31/2006

ENGINEER:
SUBMITTED BY:
DATE:
CONTRACTOR:
APPROVED BY:
DATE:


5E Series 1510 Centrifugal Pumps - Base Mounted

SPECIFICATIONS

FLOW 1050 (GPM) HEAD 70.8 (FT)
 HP 25 RPM 1800
 VOLTS 230/460
 CYCLE 60 PHASE 3
 Lincoln ODP Inverter Duty
 APPROX. WEIGHT 632
 SPECIALS Special Coupling(Dodge Paraflex)

Note: Equipped with EPDM coupling

MATERIALS OF CONSTRUCTION
☒ BRONZE FITTED ☐ ALL IRON

FEATURES

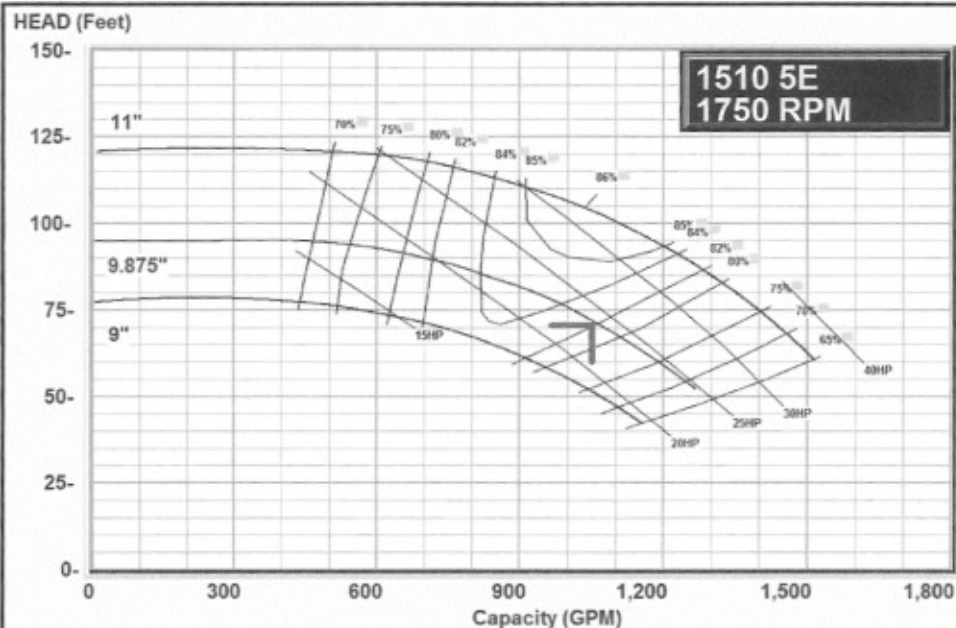
☒ ANSI/OSHA Coupling Guard
☒ Center Drop Out Spacer Coupling
☒ Fabricated Heavy Duty Baseplate

MAXIMUM WORKING PRESSURE

☒ 175 psi (12 bar) W.P.
 w/ 125# ANSI flange drilling
☐ 250 psi (17 bar) W.P.
 w/ 250# ANSI flange drilling (requires 1510-S)

TYPE OF SEAL

☒ 1510 Standard Seal
 (Buna-Carbon/Ceramic)
☐ 1510 -F Standard Seal w/ Flush Line
 (Buna-Carbon/Ceramic)
☐ 1510 -S Stuffing Box construction w/ Flush
 Mechanical Single Seal
 (EPR-Tungsten Carbide/Carbon)
☐ 1510 -D Stuffing Box construction w/
 Flushed Double Mechanical Seal
 (EPR-Carbon/Ceramic)
 Requires external water source
☐ 1510 -PF Stuffing Box Construction w/
 Packing
 (Graphite Impregnated Teflon)



Design Capacity = 1050.0 GPM
 Design Head = 70.8 Feet

Suction Size = 6 "
 Suct. Velocity = 11.7 fps
 Discharge Size = 5 "
 Disc. Velocity = 16.8 fps

Min. Imp. Dia. = 9 "
 Max. Imp. Dia. = 11 "
 Cut Dia. = 9.875 "

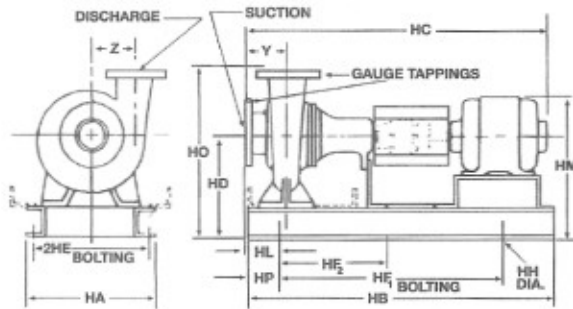
Max. Flow = 1303 GPM
 B.E.P. Flow = 898 GPM

Eff. @ Duty-Point = 82.14 %
 Motor Size = 25 HP

B.H.P. @
 Duty-Point = 23.16 BHP
 Max. B.H.P. for
 Imp. Cut = 24.8 BHP

Series 1510 5E Centrifugal Pump Submittal

B-226C



FLANGE DIMENSIONS IN INCHES (MM)			
	SIZE	THICKNESS	O.D.
Discharge	5" (127)	1-3/8" (35)	10-3/4" (273)
Suction	6" (152)	1-7/16" (37)	12-1/8" (308)

MAXIMUM WORKING PRESSURE 250 PSI

FLANGES ARE 125# ANSI - STANDARD
250# ANSI - AVAILABLE

DIMENSIONS - Inches (mm)

STANDARD SEAL 1510, 1510-F

MOTOR FRAME	HA	HB	HC MAX	HD	2HE	HF ₁	HF ₂	HH	HL	HM MAX	HO	HP	Y	Z
"L" FRAME														
254T	16 (406)	46-1/2 (1181)	46-3/4 (1187)	15 (381)	14 (356)	36-1/2 (927)	18-1/4 (464)	7/8 (22)	4-7/16 (113)	21-7/8 (556)	25-1/2 (648)	5 (127)	5-7/16 (138)	7-15/16 (202)
256T	16 (406)	46-1/2 (1181)	48-1/2 (1232)	15 (381)	14 (356)	36-1/2 (927)	18-1/4 (464)	7/8 (22)	4-7/16 (113)	21-7/8 (556)	25-1/2 (648)	5 (127)	5-7/16 (138)	7-15/16 (202)
284T	16 (406)	51-3/4 (1314)	49-1/4 (1251)	15 (381)	14 (356)	41-3/4 (1060)	20-7/8 (530)	7/8 (22)	4-7/16 (113)	23 (584)	25-1/2 (648)	5 (127)	5-7/16 (138)	7-15/16 (202)
286T	16 (406)	51-3/4 (1314)	50-3/4 (1289)	15 (381)	14 (356)	41-3/4 (1060)	20-7/8 (530)	7/8 (22)	4-7/16 (113)	23 (584)	25-1/2 (648)	5 (127)	5-7/16 (138)	7-15/16 (202)
324T	16 (406)	51-3/4 (1314)	53 (1346)	15 (381)	14 (356)	41-3/4 (1060)	20-7/8 (530)	7/8 (22)	4-7/16 (113)	24-1/8 (613)	25-1/2 (648)	5 (127)	5-7/16 (138)	7-15/16 (202)

STUFFING BOX 1510-PF, 1510-S, 1510-D

MOTOR FRAME	HA	HB	HC MAX	HD	2HE	HF ₁	HF ₂	HH	HL	HM MAX	HO	HP	Y	Z
"L" FRAME														
254T	16 (406)	51-3/4 (1314)	49-1/8 (1248)	15 (381)	14 (356)	41-3/4 (1060)	20-7/8 (530)	7/8 (22)	4-7/16 (113)	21-7/8 (555)	25-1/2 (648)	5 (127)	5-7/16 (138)	7-15/16 (202)
256T	16 (406)	51-3/4 (1314)	50-7/8 (1292)	15 (381)	14 (356)	41-3/4 (1060)	20-7/8 (530)	7/8 (22)	4-7/16 (113)	21-7/8 (555)	25-1/2 (648)	5 (127)	5-7/16 (138)	7-15/16 (202)
284T	16 (406)	51-3/4 (1314)	51-5/8 (1311)	15 (381)	14 (356)	41-3/4 (1060)	20-7/8 (530)	7/8 (22)	4-7/16 (113)	23 (584)	25-1/2 (648)	5 (127)	5-7/16 (138)	7-15/16 (202)
286T	16 (406)	51-3/4 (1314)	53-1/8 (1349)	15 (381)	14 (356)	41-3/4 (1060)	20-7/8 (530)	7/8 (22)	4-7/16 (113)	23 (584)	25-1/2 (648)	5 (127)	5-7/16 (138)	7-15/16 (202)
324T	16 (406)	51-3/4 (1314)	55-3/8 (1407)	15 (381)	14 (356)	41-3/4 (1060)	20-7/8 (530)	7/8 (22)	4-7/16 (113)	24-1/8 (613)	25-1/2 (648)	5 (127)	5-7/16 (138)	7-15/16 (202)

Dimensions are subject to change. Not to be used for construction purposes unless certified.



Appendix D – Heat Exchanger Selection

This appendix contains the cut sheets and other data for the Bell & Gossett heat exchanger used as a part of the design process.

Please see the all the heat exchanger information on the following pages.



10901 Pump House Road Annapolis Junction, Md 20701
Washington: 301-953-9370 Baltimore: 410-792-4230 Fax: 301-490-7156

To: Nathan

Job Name: Thesis

Engineer:

4/1/06

Quote Number:

***** Quotation ***** Quotation *****

Item	Quantity	Description	Unit Price	Extended Price
------	----------	-------------	------------	----------------

Heat Exchanger

1) 1

Bell & Gossett Plate And Frame Heat Exchanger

Model: P41

Side # 1:

777 GPM @ 54 F. EWT to 44 F. LWT

Side # 2:

1300 GPM @ 42 F. EWT to 48 F. LWT

Shipping Weight: 3352 lbs.

Total Price Items \$ 28,150.00

Full Freight Allowed

Cummins - Wagner Is Only Responsible For The Quantities And Materials Of Construction Listed.
The Material Listed Is Our Interpretation Of The Requirements.

Quotation Is Valid For Thirty (30) Days

Subject To Owner's Approval.

Att.

Item 3

Ref.

PHE-Type	P41-260-TMTL-70	Hot side	Cold side
Flowrate	(g.p.m.)	777.18	1300.00
Inlet temperature	(°F)	54.00	42.00
Outlet Temp. Cond./Fluid	(°F)	44.00	47.97
Pressure drop	(PSI)	3.77	10.08
Heat exchanged	(Btu/h)	3900000	
Thermodynamic properties:		Water	Water
Density	(Lb/Ft³)	62.37	62.39
Specific heat	(Btu/Lb*F)	1.00	1.00
Thermal conductivity	(Btu/h*Ft*F)	0.34	0.33
Mean viscosity	(cP)	1.34	1.44
Wall viscosity	(cP)	1.44	1.34
LMTD	(°F)	3.7	
Excess Surface	(%)	0.0	
Inlet branch		F1	F3
Outlet branch		F4	F2
Design of Frame / Plates:		1 x 129 + 0 x 0	1 x 130 + 0 x 0
Plate arrangement (passes*channe		260	
Number of plates		1,194.15	
Effective heat surface	(Ft²)	892 / 892	
Overall K-value Duty/Clean	(Btu/Ft²*h*F)	0.0157 inch	AISI 304
Plate material		NITRIL LOCK	
Gasket material		257	
Max. working temperature	(°F)	150.0 / 195.0	
Working/test pressure	(PSI)	IS	
Frame type		6.00 "	Unlined studded port, 150 # ANSI
Connections HOT side		6.00 "	Unlined studded port, 150 # ANSI
Connections COLD side		11.43	
Liquid volume	(Ft³)	6.56	Max. No. of Plates 300
Carry Bar Length	(Ft)		
Net weight	(Lb)		
		Approval	ASME code

PRINT

RETURN

Appendix E – Air Handling Unit and Rooftop Unit Selection

This appendix contains the cut sheets and other data for the Carrier air handling units and rooftop units used as a part of the design process.

Please see the all the air handling unit and rooftop unit information on the following pages.

Project Name: Nathan- Thesis Project

Mark For: AHU-1

Unit Parameters

Unit Size: Size 50 39MN

Insulation: R-13 Double Wall Sealed Panel

Exterior Finish: Galvanized Exterior Panels

Interior Finish: Galvanized Interior Panels

Level I Thermal Break

Filter Mixing Box

Damper: Top Standard Parallel

Damper: Rear Standard Opposed

2In. Angle Filter

Field Supplied 2in. Throwaway Filter

Qty (18) 16in. x 20in.

Qty (12) 16in. x 25in.

Hot Water Coil

Hot Water 50.6 sq.ft 1 Row 11 FPI Half Circuit

Coil Connection Right Side

1/2 in. Tube Diameter

AL fins Galv. Casing

Steel Header

No Coating

Heating Performance Ratings

Altitude, ft	0
Face Vel., fpm	408.4
Site Airflow, CFM	20650
Std. Airflow, CFM	20650
Heating Cap., MBH	1283.67
Flow Rate, gpm	92.7
Fluid PD, ft wg	7.7
Fluid Vel., ft/s	5.6
EWT, °F	180.00
LWT, °F	152.3
Drop, °F	27.7
Cv Rating	41.5
EAT, °F	22.50
LAT, °F	79.35
Air Friction, in wg	0.17

Chilled Water Coil

Shipping Split - Aero Latches

Standard Drain Pan Right Side Drain

Chilled Water 50.6 sq.ft 8 Row 14 FPI Double Circuit

Coil Connection Right Side
 1/2 in. Tube Diameter
 AL fins Galv. Casing
 Steel Header
 No Coating

Cooling Performance Ratings

Altitude, ft	0
Face Vel., fpm	408.4
Site Airflow, CFM	20650
Std. Airflow, CFM	20650
Total Clg. Cap, MBH	1386.45
Sen. Clg. Cap, MBH	824.29
Flow Rate, gpm	226.8
Fluid PD, ft wg	10.6
Fluid Vel., ft/s	3.4
EWT, °F	44.00
LWT, °F	56.22
Rise, °F	12.2
Cv Rating	101.4
EADB, °F	87.00
EAWB, °F	71.80
LADB, °F	50.50
LAWB, °F	50.44
Air Friction, in wg	0.97

Note: .

Draw-Thru Supply Fan

Horizontal

Rear Inlet

Performance Ratings

Site Airflow, CFM	20650
Altitude, ft	0
Std. Airflow, CFM	20650
Upstream Ext. Static, in wg	0.00
DownStream Ext. Static, in wg	2.00
Clg. Coil Static, in wg	0.97
Htg. Coil Static, in wg	0.17
Other Losses, in wg	0.00
Accessories Static, in wg	0.41
Total Static, in wg	3.55
Calculated Fan Speed, rpm	1348
Calculated Motor BHP	20.0

Acoustic Data:

Freq.	Disch.	Inlet	Casing
63 hz	106	103	99
125 hz	98	95	90
250 hz	106	100	94
500 hz	97	91	87
1000 hz	92	86	80
2000 hz	86	81	75
4000 hz	84	79	73
8000 hz	79	74	69

Fan Sled

1348 FanRPM Class II

AirFoil Standard Wheel AFMV01301

Top Horiz. Front Discharge

Right Side Fan Motor Location

Spring Fan Isolation

25 HP High Efficiency ODP 200/230/460 3Ph 60Hz 1800 RPM

Variable Frequency Drive 208/230 Volts 3 Phase 60Hz

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1.5 Service Factor

Fixed Pitch Drive

Project Name: Nathan- Thesis Project

Mark For: AHU-2

Unit Parameters

Unit Size: Size 40 39MN

Insulation: R-13 Double Wall Sealed Panel

Exterior Finish: Galvanized Exterior Panels

Interior Finish: Galvanized Interior Panels

Level I Thermal Break

Filter Mixing Box

Damper: Top Standard Parallel

Damper: Rear Standard Opposed

2In. Angle Filter

Field Supplied 2in. Throwaway Filter

Qty (24) 16in. x 25in.

Hot Water Coil

Hot Water 40.0 sq.ft 1 Row 8 FPI Half Circuit

Coil Connection Right Side

1/2 in. Tube Diameter

AL fins Galv. Casing

Steel Header

No Coating

Heating Performance Ratings

Altitude, ft	0
Face Vel., fpm	469.4
Site Airflow, CFM	18777
Std. Airflow, CFM	18777
Heating Cap., MBH	917.70
Flow Rate, gpm	76.8
Fluid PD, ft wg	6.6
Fluid Vel., ft/s	5.4
EWT, °F	180.00
LWT, °F	156.1
Drop, °F	23.9
Cv Rating	34.3
EAT, °F	15.20
LAT, °F	59.89
Air Friction, in wg	0.17

Chilled Water Coil

Shipping Split - Aero Latches

Standard Drain Pan Right Side Drain

Chilled Water 40.0 sq.ft 8 Row 12 FPI Double Circuit

Coil Connection Right Side

5/8 in. Tube Diameter

AL fins Galv. Casing

Steel Header

No Coating

Cooling Performance Ratings

Altitude, ft	0
Face Vel., fpm	469.4
Site Airflow, CFM	18777
Std. Airflow, CFM	18777
Total Clg. Cap, MBH	1407.94
Sen. Clg. Cap, MBH	834.53
Flow Rate, gpm	247.2
Fluid PD, ft wg	11.3
Fluid Vel., ft/s	3.4
EWT, °F	44.00
LWT, °F	55.39
Rise, °F	11.4
Cv Rating	110.6
EADB, °F	91.40
EAWB, °F	73.90
LADB, °F	50.76
LAWB, °F	50.68
Air Friction, in wg	1.30

Draw-Thru Supply Fan

Horizontal

Rear Inlet

Performance Ratings

Site Airflow, CFM	18777
Altitude, ft	0
Std. Airflow, CFM	18777
Upstream Ext. Static, in wg	0.00
DownStream Ext. Static, in wg	2.00
Clg. Coil Static, in wg	1.30
Htg. Coil Static, in wg	0.17
Other Losses, in wg	0.00
Accessories Static, in wg	0.43
Total Static, in wg	3.90
Calculated Fan Speed, rpm	1629
Calculated Motor BHP	21.8

Acoustic Data:

Freq.	Disch. Inlet Casing		
63 hz	110	107	103
125 hz	99	96	91
250 hz	108	102	96
500 hz	100	94	90
1000 hz	95	89	83
2000 hz	90	85	79
4000 hz	87	82	76
8000 hz	83	78	73

Fan Sled

1629 FanRPM Class II

AirFoil Standard Wheel AFMV01271

Top Horiz. Front Discharge

Right Side Fan Motor Location

Spring Fan Isolation

25 HP High Efficiency ODP 200/230/460 3Ph 60Hz 1800 RPM

Variable Frequency Drive 208/230 Volts 3 Phase 60Hz

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1.5 Service Factor

Fixed Pitch Drive

Project Name: Nathan- Thesis Project

Mark For: AHU-3

Unit Parameters

Unit Size: Size 21 39MN

Insulation: R-13 Double Wall Sealed Panel

Exterior Finish: Galvanized Exterior Panels

Interior Finish: Galvanized Interior Panels

Level I Thermal Break

Filter Mixing Box

Damper: Top Standard Parallel

Damper: Rear Standard Opposed

2In. Angle Filter

Field Supplied 2in. Throwaway Filter

Qty (12) 16in. x 25in.

Skid (factory)

Hot Water Coil

Hot Water 21.44 sq.ft 2 Row 8 FPI Full Circuit

Coil Connection Right Side

1/2 in. Tube Diameter

AL fins Galv. Casing

Steel Header

No Coating

Heating Performance Ratings

Altitude, ft	0
Face Vel., fpm	393.8
Site Airflow, CFM	8444
Std. Airflow, CFM	8444
Heating Cap., MBH	645.08
Flow Rate, gpm	59.8
Fluid PD, ft wg	3.1
Fluid Vel., ft/s	2.7
EWT, °F	180.00
LWT, °F	158.4
Drop, °F	21.6
Cv Rating	26.7
EAT, °F	11.00
LAT, °F	80.86
Air Friction, in wg	0.13

Chilled Water Coil

Shipping Split - Aero Latches

Standard Drain Pan Right Side Drain

Chilled Water 21.44 sq.ft 10 Row 14 FPI Double Circuit

Coil Connection Right Side

1/2 in. Tube Diameter

AL fins Galv. Casing

Steel Header

No Coating

Cooling Performance Ratings

Altitude, ft	0
Face Vel., fpm	393.8
Site Airflow, CFM	8444
Std. Airflow, CFM	8444
Total Clg. Cap, MBH	715.21
Sen. Clg. Cap, MBH	409.71
Flow Rate, gpm	121.7
Fluid PD, ft wg	8.5
Fluid Vel., ft/s	3.3
EWT, °F	44.00
LWT, °F	55.75
Rise, °F	11.7
Cv Rating	54.4
EADB, °F	93.00
EAWB, °F	75.00
LADB, °F	48.63
LAWB, °F	48.62
Air Friction, in wg	1.15

Draw-Thru Supply Fan

Horizontal

Rear Inlet

Performance Ratings

Site Airflow, CFM	8444
Altitude, ft	0
Std. Airflow, CFM	8444
Upstream Ext. Static, in wg	0.00
DownStream Ext. Static, in wg	2.00
Clg. Coil Static, in wg	1.15
Htg. Coil Static, in wg	0.13
Other Losses, in wg	0.00
Accessories Static, in wg	0.43
Total Static, in wg	3.71
Calculated Fan Speed, rpm	1889

Calculated Motor BHP 8.0

Acoustic Data:

Freq.	Disch.	Inlet	Casing
63 hz	100	92	91
125 hz	95	88	86
250 hz	97	82	81
500 hz	92	76	76
1000 hz	89	75	73
2000 hz	86	72	70
4000 hz	81	68	56
8000 hz	76	60	51

Fan Sled

1889 FanRPM Class I

AirFoil Standard Wheel AFMV01201

Top Horiz. Front Discharge

Right Side Fan Motor Location

Spring Fan Isolation

10 HP High Efficiency ODP 200/230/460 3Ph 60Hz 1800 RPM

Variable Frequency Drive 208/230 Volts 3 Phase 60Hz

5Factor

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1.5 Service Factor

Variable Pitch Drive

Skid (factory)

Project Name: Nathan- Thesis Project

Mark For: AHU-4

Unit Parameters

Unit Size: Size 12 39MN

Insulation: R-13 Double Wall Sealed Panel

Exterior Finish: Galvanized Exterior Panels

Interior Finish: Galvanized Interior Panels

Level I Thermal Break

Filter Mixing Box

Damper: Top Standard Parallel

Damper: Rear Standard Opposed

2In. Angle Filter

Field Supplied 2in. Throwaway Filter

Qty (6) 20in. x 20in.

Skid (factory)

Hot Water Coil

Hot Water 12.64 sq.ft 1 Row 11 FPI Half Circuit

Coil Connection Right Side

1/2 in. Tube Diameter

AL fins Galv. Casing

Steel Header

No Coating

Heating Performance Ratings

Altitude, ft	0
Face Vel., fpm	385.0
Site Airflow, CFM	4867
Std. Airflow, CFM	4867
Heating Cap., MBH	331.12
Flow Rate, gpm	31.2
Fluid PD, ft wg	6.0
Fluid Vel., ft/s	3.8
EWT, °F	180.00
LWT, °F	158.8
Drop, °F	21.2
Cv Rating	14.0
EAT, °F	12.90
LAT, °F	75.12
Air Friction, in wg	0.15

Chilled Water Coil

Shipping Split - Aero Latches

Standard Drain Pan Right Side Drain

Chilled Water 12.64 sq.ft 10 Row 14 FPI Full Circuit

Coil Connection Right Side

1/2 in. Tube Diameter

AL fins Galv. Casing

Steel Header

No Coating

Cooling Performance Ratings

Altitude, ft	0
Face Vel., fpm	385.0
Site Airflow, CFM	4867
Std. Airflow, CFM	4867
Total Clg. Cap, MBH	409.46
Sen. Clg. Cap, MBH	236.24
Flow Rate, gpm	71.1
Fluid PD, ft wg	15.5
Fluid Vel., ft/s	4.3
EWT, °F	44.00
LWT, °F	55.51
Rise, °F	11.5
Cv Rating	27.4
EADB, °F	92.20
EAWB, °F	74.40
LADB, °F	47.81
LAWB, °F	47.81
Air Friction, in wg	1.12

Draw-Thru Supply Fan

Horizontal

Rear Inlet

Performance Ratings

Site Airflow, CFM	4867
Altitude, ft	0
Std. Airflow, CFM	4867
Upstream Ext. Static, in wg	0.00
DownStream Ext. Static, in wg	2.00
Clg. Coil Static, in wg	1.12
Htg. Coil Static, in wg	0.15
Other Losses, in wg	0.00
Accessories Static, in wg	0.43
Total Static, in wg	3.70
Calculated Fan Speed, rpm	2301

Calculated Motor BHP 5.0

Acoustic Data:

Freq.	Disch.	Inlet	Casing
63 hz	105	97	96
125 hz	95	88	86
250 hz	96	81	80
500 hz	92	76	76
1000 hz	88	74	72
2000 hz	85	71	69
4000 hz	80	67	55
8000 hz	74	58	49

Fan Sled

2301 FanRPM Class II

AirFoil Standard Wheel AFMV01161

Top Horiz. Front Discharge

Right Side Fan Motor Location

Spring Fan Isolation

7.5 HP High Efficiency ODP 200/230/460 3Ph 60Hz 1800 RPM

Variable Frequency Drive 208/230 Volts 3 Phase 60Hz

5Factor

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Mount

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Bypas

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1.5 Service Factor

Variable Pitch Drive

Skid (factory)

Project Name: Nathan- Thesis Project

Mark For: RTU-1

Unit Parameters

Unit Size: Size 06 39MW
Insulation: R-13 Double Wall Sealed Panel
Exterior Finish: Galvanized Exterior Panels
Interior Finish: Galvanized Interior Panels
Level II Thermal Break
Ahu Curb Factory Supplied 14in. Curb
Coil Connection House Curb
24in. Deep Coil Connection Housing Single Wall

Filter Mixing Box

Damper: Rear Standard Opposed
Hood Rear
Damper: Bottom Standard Parallel
2in. Angle Filter
Construction Filter (disposable panel filter)
Field Supplied 2in. Throwaway Filter
Qty (4) 16in. x 20in.

Hot Water Coil

Hot Water 5.9 sq.ft 1 Row 8 FPI Half Circuit
Coil Connection Right Side
1/2 in. Tube Diameter
AL fins Galv. Casing
Steel Header
No Coating

Heating Performance Ratings

Altitude, ft	0
Face Vel., fpm	484.9
Site Airflow, CFM	2861
Std. Airflow, CFM	2861
Heating Cap., MBH	73.52
Flow Rate, gpm	3.0
Fluid PD, ft wg	0.1
Fluid Vel., ft/s	0.5
EWT, °F	180.00
LWT, °F	131.0
Drop, °F	49.0
Cv Rating	1.3

EAT, °F	41.50
LAT, °F	65.00
Air Friction, in wg	0.18

Skid

Chilled Water Coil

Standard Drain Pan Right Side Drain

Chilled Water 5.9 sq.ft 8 Row 11 FPI Double Circuit

Coil Connection Right Side

1/2 in. Tube Diameter

AL fins Galv. Casing

Steel Header

No Coating

Cooling Performance Ratings

Altitude, ft	0
Face Vel., fpm	484.9
Site Airflow, CFM	2861
Std. Airflow, CFM	2861
Total Clg. Cap, MBH	110.14
Sen. Clg. Cap, MBH	85.03
Flow Rate, gpm	18.4
Fluid PD, ft wg	1.2
Fluid Vel., ft/s	0.9
EWT, °F	44.00
LWT, °F	55.97
Rise, °F	12.0
Cv Rating	8.2
EADB, °F	84.00
EAWB, °F	68.60
LADB, °F	56.82
LAWB, °F	56.58
Air Friction, in wg	1.06

Note: Fluid velocity for this application is outside the scope of ARI Std. 410.

Hot Water Coil

Hot Water 5.9 sq.ft 2 Row 8 FPI Half Circuit

Coil Connection Right Side

1/2 in. Tube Diameter

AL fins Galv. Casing

Steel Header

No Coating

Heating Performance Ratings

Altitude, ft	0
Face Vel., fpm	484.9

Site Airflow, CFM	2861
Std. Airflow, CFM	2861
Heating Cap., MBH	160.18
Flow Rate, gpm	16.0
Fluid PD, ft wg	3.0
Fluid Vel., ft/s	2.7
EWT, °F	180.00
LWT, °F	160.0
Drop, °F	20.0
Cv Rating	7.2
EAT, °F	45.00
LAT, °F	96.20
Air Friction, in wg	0.20

Draw-Thru Supply Fan

Horizontal

Rear Inlet

Performance Ratings

Site Airflow, CFM	2861
Altitude, ft	0
Std. Airflow, CFM	2861
Upstream Ext. Static, in wg	0.00
DownStream Ext. Static, in wg	2.00
Clg. Coil Static, in wg	1.06
Htg. Coil Static, in wg	0.37
Other Losses, in wg	0.00
Accessories Static, in wg	0.75
Total Static, in wg	4.18
Calculated Fan Speed, rpm	3434
Calculated Motor BHP	4.0

Acoustic Data:

Freq.	Disch.	Inlet	Casing
63 hz	101	93	92
125 hz	95	88	86
250 hz	93	78	77
500 hz	95	79	79
1000 hz	89	75	73
2000 hz	87	73	71
4000 hz	82	69	57
8000 hz	77	61	52

Fan Sled

3434 FanRPM Class II

Project Name: Nathan- Thesis Project

Mark For: RTU-2

Unit Parameters

Unit Size: Size 30 39MW
Insulation: R-13 Double Wall Sealed Panel
Exterior Finish: Galvanized Exterior Panels
Interior Finish: Galvanized Interior Panels
Level II Thermal Break
Ahu Curb Factory Supplied 14in. Curb
Coil Connection House Curb
24in. Deep Coil Connection Housing Single Wall

Filter Mixing Box

Damper: Rear Standard Opposed
Hood Rear
Damper: Bottom Standard Parallel
2In. Angle Filter
Construction Filter (disposable panel filter)
Field Supplied 2in. Throwaway Filter
Qty (16) 16in. x 25in.

Hot Water Coil

Hot Water 30.35 sq.ft 1 Row 8 FPI Half Circuit
Coil Connection Right Side
1/2 in. Tube Diameter
AL fins Galv. Casing
Steel Header
No Coating

Heating Performance Ratings

Altitude, ft	0
Face Vel., fpm	502.1
Site Airflow, CFM	15238
Std. Airflow, CFM	15238
Heating Cap., MBH	657.11
Flow Rate, gpm	30.4
Fluid PD, ft wg	3.0
Fluid Vel., ft/s	2.7
EWT, °F	180.00
LWT, °F	136.8
Drop, °F	43.2
Cv Rating	13.6

EAT, °F	11.00
LAT, °F	50.44
Air Friction, in wg	0.18

Skid

Chilled Water Coil

Standard Drain Pan Right Side Drain

Chilled Water 30.35 sq.ft 4 Row 8 FPI Double Circuit

Coil Connection Right Side

1/2 in. Tube Diameter

AL fins Galv. Casing

Steel Header

No Coating

Cooling Performance Ratings

Altitude, ft	0
Face Vel., fpm	502.1
Site Airflow, CFM	15238
Std. Airflow, CFM	15238
Total Clg. Cap, MBH	469.41
Sen. Clg. Cap, MBH	364.90
Flow Rate, gpm	60.9
Fluid PD, ft wg	1.2
Fluid Vel., ft/s	1.4
EWT, °F	44.00
LWT, °F	59.41
Rise, °F	15.4
Cv Rating	27.2
EADB, °F	92.40
EAWB, °F	74.80
LADB, °F	70.50
LAWB, °F	66.72
Air Friction, in wg	0.49

Hot Water Coil

Hot Water 30.35 sq.ft 1 Row 8 FPI Half Circuit

Coil Connection Right Side

1/2 in. Tube Diameter

AL fins Galv. Casing

Steel Header

No Coating

Heating Performance Ratings

Altitude, ft	0
Face Vel., fpm	502.1
Site Airflow, CFM	15238

Std. Airflow, CFM	15238
Heating Cap., MBH	586.35
Flow Rate, gpm	58.7
Fluid PD, ft wg	10.5
Fluid Vel., ft/s	5.3
EWT, °F	180.00
LWT, °F	160.0
Drop, °F	20.0
Cv Rating	26.3
EAT, °F	45.00
LAT, °F	80.19
Air Friction, in wg	0.20

Draw-Thru Supply Fan

Horizontal

Rear Inlet

Performance Ratings

Site Airflow, CFM	15238
Altitude, ft	0
Std. Airflow, CFM	15238
Upstream Ext. Static, in wg	0.00
DownStream Ext. Static, in wg	2.00
Clg. Coil Static, in wg	0.49
Htg. Coil Static, in wg	0.38
Other Losses, in wg	0.00
Accessories Static, in wg	1.08
Total Static, in wg	3.95
Calculated Fan Speed, rpm	2226
Calculated Motor BHP	19.2

Acoustic Data:

Freq.	Disch.	Inlet	Casing
63 hz	102	94	93
125 hz	98	91	89
250 hz	102	87	86
500 hz	100	84	84
1000 hz	98	84	82
2000 hz	94	80	78
4000 hz	90	77	65
8000 hz	87	71	62

Fan Sled

2226 FanRPM Class II

AirFoil Standard Wheel AFMV01221

Project Name: Nathan- Thesis Project

Mark For: RTU-3

Unit Parameters

Unit Size: Size 12 39MW
Insulation: R-13 Double Wall Sealed Panel
Exterior Finish: Galvanized Exterior Panels
Interior Finish: Galvanized Interior Panels
Level II Thermal Break
Ahu Curb Factory Supplied 14in. Curb
Coil Connection House Curb
24in. Deep Coil Connection Housing Single Wall

Filter Mixing Box

Damper: Rear Standard Opposed
Hood Rear
Damper: Bottom Standard Parallel
2in. Angle Filter
Construction Filter (disposable panel filter)
Field Supplied 2in. Throwaway Filter
Qty (6) 20in. x 20in.

Hot Water Coil

Hot Water 12.64 sq.ft 1 Row 8 FPI Half Circuit
Coil Connection Right Side
1/2 in. Tube Diameter
AL fins Galv. Casing
Steel Header
No Coating

Heating Performance Ratings

Altitude, ft	0
Face Vel., fpm	481.6
Site Airflow, CFM	6088
Std. Airflow, CFM	6088
Heating Cap., MBH	152.79
Flow Rate, gpm	5.0
Fluid PD, ft wg	0.2
Fluid Vel., ft/s	0.6
EWT, °F	180.00
LWT, °F	118.9
Drop, °F	61.1
Cv Rating	2.2

EAT, °F	41.50
LAT, °F	64.45
Air Friction, in wg	0.18

Skid

Chilled Water Coil

Standard Drain Pan Right Side Drain

Chilled Water 12.64 sq.ft 4 Row 11 FPI Full Circuit

Coil Connection Right Side

1/2 in. Tube Diameter

AL fins Galv. Casing

Steel Header

No Coating

Cooling Performance Ratings

Altitude, ft	0
Face Vel., fpm	481.6
Site Airflow, CFM	6088
Std. Airflow, CFM	6088
Total Clg. Cap, MBH	111.20
Sen. Clg. Cap, MBH	106.95
Flow Rate, gpm	13.0
Fluid PD, ft wg	0.8
Fluid Vel., ft/s	0.9
EWT, °F	44.00
LWT, °F	61.10
Rise, °F	17.1
Cv Rating	5.8
EADB, °F	78.40
EAWB, °F	66.40
LADB, °F	62.34
LAWB, °F	60.77
Air Friction, in wg	0.42

Note: Fluid velocity for this application is outside the scope of ARI Std. 410.

Hot Water Coil

Hot Water 12.64 sq.ft 1 Row 8 FPI Half Circuit

Coil Connection Right Side

1/2 in. Tube Diameter

AL fins Galv. Casing

Steel Header

No Coating

Heating Performance Ratings

Altitude, ft	0
Face Vel., fpm	481.6

Site Airflow, CFM	6088
Std. Airflow, CFM	6088
Heating Cap., MBH	216.48
Flow Rate, gpm	21.6
Fluid PD, ft wg	2.9
Fluid Vel., ft/s	2.6
EWT, °F	180.00
LWT, °F	160.0
Drop, °F	20.0
Cv Rating	9.7
EAT, °F	51.60
LAT, °F	84.12
Air Friction, in wg	0.18

Draw-Thru Supply Fan

Horizontal

Rear Inlet

Performance Ratings

Site Airflow, CFM	6088
Altitude, ft	0
Std. Airflow, CFM	6088
Upstream Ext. Static, in wg	0.00
DownStream Ext. Static, in wg	2.00
Clg. Coil Static, in wg	0.42
Htg. Coil Static, in wg	0.36
Other Losses, in wg	0.00
Accessories Static, in wg	0.81
Total Static, in wg	3.59
Calculated Fan Speed, rpm	2553
Calculated Motor BHP	6.8

Acoustic Data:

Freq.	Disch.	Inlet	Casing
63 hz	107	99	98
125 hz	97	90	88
250 hz	97	82	81
500 hz	96	80	80
1000 hz	92	78	76
2000 hz	88	74	72
4000 hz	84	71	59
8000 hz	78	62	53

Fan Sled

2553 FanRPM Class II

Project Name: Nathan- Thesis Project

Mark For: RTU-7

Unit Parameters

Unit Size: Size 06 39MW
Insulation: R-13 Double Wall Sealed Panel
Exterior Finish: Galvanized Exterior Panels
Interior Finish: Galvanized Interior Panels
Level II Thermal Break
Ahu Curb Factory Supplied 14in. Curb
Coil Connection House Curb
24in. Deep Coil Connection Housing Single Wall

Filter Mixing Box

Damper: Rear Standard Opposed
Hood Rear
Damper: Bottom Standard Parallel
2In. Angle Filter
Construction Filter (disposable panel filter)
Field Supplied 2in. Throwaway Filter
Qty (4) 16in. x 20in.

Hot Water Coil

Hot Water 5.9 sq.ft 1 Row 8 FPI Half Circuit
Coil Connection Right Side
1/2 in. Tube Diameter
AL fins Galv. Casing
Steel Header
No Coating

Heating Performance Ratings

Altitude, ft	0
Face Vel., fpm	422.4
Site Airflow, CFM	2492
Std. Airflow, CFM	2492
Heating Cap., MBH	72.53
Flow Rate, gpm	3.0
Fluid PD, ft wg	0.1
Fluid Vel., ft/s	0.5
EWT, °F	180.00
LWT, °F	131.7
Drop, °F	48.3
Cv Rating	1.3

EAT, °F	38.40
LAT, °F	65.02
Air Friction, in wg	0.14

Skid

Chilled Water Coil

Standard Drain Pan Right Side Drain

Chilled Water 5.9 sq.ft 6 Row 11 FPI Double Circuit

Coil Connection Right Side

1/2 in. Tube Diameter

AL fins Galv. Casing

Steel Header

No Coating

Cooling Performance Ratings

Altitude, ft	0
Face Vel., fpm	422.4
Site Airflow, CFM	2492
Std. Airflow, CFM	2492
Total Clg. Cap, MBH	82.35
Sen. Clg. Cap, MBH	56.34
Flow Rate, gpm	11.8
Fluid PD, ft wg	0.8
Fluid Vel., ft/s	0.9
EWT, °F	44.00
LWT, °F	57.95
Rise, °F	14.0
Cv Rating	5.3
EADB, °F	81.60
EAWB, °F	70.20
LADB, °F	60.93
LAWB, °F	60.49
Air Friction, in wg	0.66

Note: Fluid velocity for this application is outside the scope of ARI Std. 410.

Hot Water Coil

Hot Water 5.9 sq.ft 1 Row 8 FPI Half Circuit

Coil Connection Right Side

1/2 in. Tube Diameter

AL fins Galv. Casing

Steel Header

No Coating

Heating Performance Ratings

Altitude, ft	0
Face Vel., fpm	422.4

Site Airflow, CFM	2492
Std. Airflow, CFM	2492
Heating Cap., MBH	96.36
Flow Rate, gpm	9.7
Fluid PD, ft wg	0.9
Fluid Vel., ft/s	1.6
EWT, °F	180.00
LWT, °F	160.0
Drop, °F	20.0
Cv Rating	4.3
EAT, °F	45.00
LAT, °F	80.36
Air Friction, in wg	0.14

Draw-Thru Supply Fan

Horizontal

Rear Inlet

Performance Ratings

Site Airflow, CFM	2492
Altitude, ft	0
Std. Airflow, CFM	2492
Upstream Ext. Static, in wg	0.00
DownStream Ext. Static, in wg	2.00
Clg. Coil Static, in wg	0.66
Htg. Coil Static, in wg	0.28
Other Losses, in wg	0.00
Accessories Static, in wg	0.64
Total Static, in wg	3.58
Calculated Fan Speed, rpm	3121
Calculated Motor BHP	2.9

Acoustic Data:

Freq.	Disch.	Inlet	Casing
63 hz	99	91	90
125 hz	94	87	85
250 hz	92	77	76
500 hz	92	76	76
1000 hz	87	73	71
2000 hz	84	70	68
4000 hz	79	66	54
8000 hz	74	58	49

Fan Sled

3121 FanRPM Class II

Project Name: Nathan- Thesis Project

Mark For: RTU-8

Unit Parameters

Unit Size: Size 03 39MW
Insulation: R-13 Double Wall Sealed Panel
Exterior Finish: Galvanized Exterior Panels
Interior Finish: Galvanized Interior Panels
Level II Thermal Break
Ahu Curb Factory Supplied 14in. Curb
Coil Connection House Curb
24in. Deep Coil Connection Housing Single Wall

Filter Mixing Box

Damper: Rear Standard Parallel
Hood Rear
Damper: Bottom Standard Parallel
2In. Angle Filter
Construction Filter (disposable panel filter)
Field Supplied 2in. Throwaway Filter
Qty (2) 16in. x 25in.

Hot Water Coil

Hot Water 3.47 sq.ft 1 Row 8 FPI Half Circuit
Coil Connection Right Side
1/2 in. Tube Diameter
AL fins Galv. Casing
Steel Header
No Coating

Heating Performance Ratings

Altitude, ft	0
Face Vel., fpm	427.4
Site Airflow, CFM	1483
Std. Airflow, CFM	1483
Heating Cap., MBH	60.81
Flow Rate, gpm	4.0
Fluid PD, ft wg	0.2
Fluid Vel., ft/s	0.7
EWT, °F	180.00
LWT, °F	149.6
Drop, °F	30.4
Cv Rating	1.8

EAT, °F	11.00
LAT, °F	48.50
Air Friction, in wg	0.14

Skid

Chilled Water Coil

Standard Drain Pan Right Side Drain

Chilled Water 3.47 sq.ft 8 Row 11 FPI Full Circuit

Coil Connection Right Side

1/2 in. Tube Diameter

AL fins Galv. Casing

Steel Header

No Coating

Cooling Performance Ratings

Altitude, ft	0
Face Vel., fpm	427.4
Site Airflow, CFM	1483
Std. Airflow, CFM	1483
Total Clg. Cap, MBH	70.58
Sen. Clg. Cap, MBH	43.32
Flow Rate, gpm	8.9
Fluid PD, ft wg	0.6
Fluid Vel., ft/s	0.9
EWT, °F	44.00
LWT, °F	59.85
Rise, °F	15.9
Cv Rating	4.0
EADB, °F	86.60
EAWB, °F	73.30
LADB, °F	59.89
LAWB, °F	59.73
Air Friction, in wg	0.92

Note: Fluid velocity for this application is outside the scope of ARI Std. 410.

Hot Water Coil

Hot Water 3.47 sq.ft 1 Row 8 FPI Half Circuit

Coil Connection Right Side

1/2 in. Tube Diameter

AL fins Galv. Casing

Steel Header

No Coating

Heating Performance Ratings

Altitude, ft	0
Face Vel., fpm	427.4

Site Airflow, CFM	1483
Std. Airflow, CFM	1483
Heating Cap., MBH	52.15
Flow Rate, gpm	5.2
Fluid PD, ft wg	0.3
Fluid Vel., ft/s	0.9
EWT, °F	180.00
LWT, °F	160.0
Drop, °F	20.0
Cv Rating	2.3
EAT, °F	45.00
LAT, °F	77.16
Air Friction, in wg	0.15

Draw-Thru Supply Fan

Horizontal

Rear Inlet

Performance Ratings

Site Airflow, CFM	1483
Altitude, ft	0
Std. Airflow, CFM	1483
Upstream Ext. Static, in wg	0.00
DownStream Ext. Static, in wg	2.00
Clg. Coil Static, in wg	0.92
Htg. Coil Static, in wg	0.28
Other Losses, in wg	0.00
Accessories Static, in wg	0.79
Total Static, in wg	3.99
Calculated Fan Speed, rpm	4000
Calculated Motor BHP	2.8

Acoustic Data:

Freq.	Disch.	Inlet	Casing
63 hz	105	97	96
125 hz	92	85	83
250 hz	89	74	73
500 hz	93	77	77
1000 hz	87	73	71
2000 hz	85	71	69
4000 hz	81	68	56
8000 hz	77	61	52

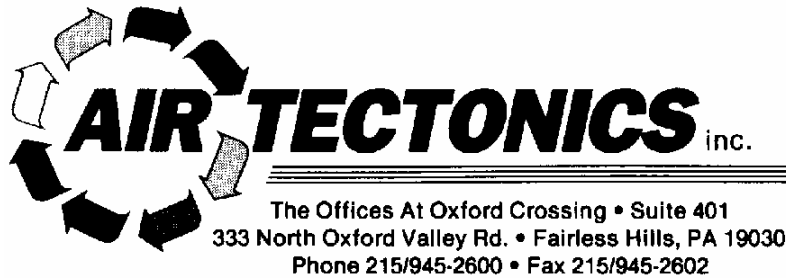
Fan Sled

4000 FanRPM Class II

Appendix F – Dedicated Outdoor Air System Unit Selection

This appendix contains the cut sheets and other data for the Semco dedicated outdoor air system units used as a part of the design process.

Please see the all the dedicated outdoor air system unit information on the following pages.



LANCASTER OFFICE – 717-665-3971 FAX – 717-665-3976

MARCH 29, 2006

TO: Nathan Patrick

FROM: RITCHIE HALL

RE: Hilton Hotel - BWI location

Budget Quotation

PVS-13 (Unit Tag - ERU-1)

Unit Width - 98"

Unit Height - 86" _____

Unit Length - 295" _____

Max Module Weight - 13,700 _____

Number Of Modules - 1 _____

- SEMCO standard panels consisting of 2" thick dual wall 18 ga. Galvanized solid exterior skins and 22 ga. Galvanized steel solid interior skins enclosing 2" thick 3 pcf mineral wool insulation with a u-factor of 0.10 BTU/(hr-sq.ft.-deg). An all-welded painted structural base will support the housing. The base includes a welded floor with 3 pcf mineral wool insulation. The base is self-flashing when set on a properly sized curb. Floor openings have perimeter lip and are covered by protective grate. Lifting lugs will be welded to the base.
- Outdoor construction including 22 gauge galvanized steel standing seam sheet metal roof, door gutters and hoods on intake and exhaust openings.
- Self-flashing base is designed for curb mounting. Curb must provide support at all field joints. Contact SEMCO for more detail.
- Automated Logic Corporation DDC control package.
- Variable speed enthalpy recovery wheel with 3A molecular sieve desiccant and acid-resistant coating, variable speed drive motor , 480/3 inverter and 24 volt temperature controller.
- Variable speed aluminum dehumidification energy recovery wheel which is coated to prohibit corrosion, media surfaces coated with a non-migrating solid adsorbent layer, variable speed drive motor , 460/3/60 inverter and 24 volt temperature controller.
- 20 hp, EPACT compliant, ODP supply fan motor in centrifugal plenum type fan.
- 20 hp, EPACT compliant, ODP exhaust fan motor in centrifugal plenum type fan.
- Chilled water cooling coil consisting of round seamless 5/8 inch O.D. by .020 inch thick copper tube on 1.5 inch centers, secondary surface of .006 inch rippled aluminum plate fins, casings of galvanized steel, headers of seamless copper, and galvanized steel holding racks mounted in an insulated pitched 304 stainless steel condensate pan.
- Hot water coil consisting of primary surface of round seamless 5/8 inch O.D. by .020 inch thick copper tube on 1.5 inch centers, secondary surface of .0075 inch rippled aluminum plate fins, casings of galvanized steel, headers of seamless copper, and galvanized steel holding racks.

- Single point control panel, 480/3/60, including motor starters, motor short circuit and overload protection, low voltage transformer, damper interlocks and local HOA switch.
- Vapor tight lights wired to a single switch on the unit exterior and GFI receptacle mounted next to the light switch with separate 120 volt power connection at the GFI receptacle to provide power for the lights and receptacle.
- 30%, Class 2, 4-inch pleated filters in outdoor airstream.
- 65%, Class 2, 12-inch high efficiency pleated filters.
- 30%, Class 2, 2-inch pleated filters in return airstream.
- Outside air damper, galvanized steel frames and blades and two position electric actuators.
- Exhaust air damper, gravity back draft, aluminum frames and blades.

Price (Freight Allowed)..... \$90,193.00 (2nd Half-06)

PVS-18 (Unit Tag - ERU-2)

Unit Width - 122"

Unit Height - 98" _____

Unit Length - 308" _____

Max Module Weight - 10,000 _____

Number Of Modules - 2 _____

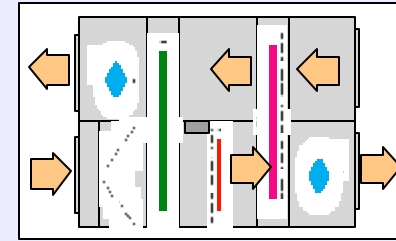
- SEMCO standard panels consisting of 2" thick dual wall 18 ga. Galvanized solid exterior skins and 22 ga. Galvanized steel solid interior skins enclosing 2" thick 3 pcf mineral wool insulation with a u-factor of 0.10 BTU/(hr-sq.ft.-deg). An all-welded painted structural base will support the housing. The base includes a welded floor with 3 pcf mineral wool insulation. The base is self-flashing when set on a properly sized curb. Floor openings have perimeter lip and are covered by protective grate. Lifting lugs will be welded to the base.
- Outdoor construction including 22 gauge galvanized steel standing seam sheet metal roof, door gutters and hoods on intake and exhaust openings.
- Self-flashing base is designed for curb mounting. Curb must provide support at all field joints. Contact SEMCO for more detail.
- Automated Logic Corporation DDC control package.
- Variable speed enthalpy recovery wheel with 3A molecular sieve desiccant and acid-resistant coating, variable speed drive motor, 480/3 inverter and 24 volt temperature controller.
- Variable speed aluminum dehumidification energy recovery wheel which is coated to prohibit corrosion, media surfaces coated with a non-migrating solid adsorbent layer, variable speed drive motor, 460/3/60 inverter and 24 volt temperature controller.
- 25 hp, EPACT compliant, ODP supply fan motor in centrifugal plenum type fan.
- 20 hp, EPACT compliant, ODP exhaust fan motor in centrifugal plenum type fan.
- Chilled water cooling coil consisting of round seamless 5/8 inch O.D. by .020 inch thick copper tube on 1.5 inch centers, secondary surface of .006 inch rippled aluminum plate fins, casings of galvanized steel, headers of seamless copper, and galvanized steel holding racks mounted in an insulated pitched 304 stainless steel condensate pan.
- Hot water coil consisting of primary surface of round seamless 5/8 inch O.D. by .020 inch thick copper tube on 1.5 inch centers, secondary surface of .0075 inch rippled aluminum plate fins, casings of galvanized steel, headers of seamless copper, and galvanized steel holding racks.
- Single point control panel, 480/3/60, including motor starters, motor short circuit and overload protection, low voltage transformer, damper interlocks and local HOA switch.
- Vapor tight lights wired to a single switch on the unit exterior and GFI receptacle mounted next to the light switch with separate 120 volt power connection at the GFI receptacle to provide power for the lights and receptacle.
- 30%, Class 2, 4-inch pleated filters in outdoor airstream.
- 65%, Class 2, 12-inch high efficiency pleated filters.
- 30%, Class 2, 2-inch pleated filters in return airstream.
- Outside air damper, galvanized steel frames and blades and two position electric actuators.
- Exhaust air damper, gravity back draft, aluminum frames and blades.

Price (Freight Allowed)..... \$102,993.00 (2nd Half-06)

SEMCO PVS System Modeling Program**Input Parameters:**

Unit #: ERU-1

Project Name:	Hilton Hotel	
Location:	Baltimore, Md	Choose System from below:
PVS Model Selected:	PVS-13	PVS-13 ▼

**Airflow Conditions**

Supply Air (SCFM):	7,680
Return Air (SCFM):	6,400

External Static Pressures:

Supply Air (inwg):	5
Return Air (inwg):	5

ESA Weather Data:

Austin, TX	▲
Baltimore, MD	
Billings, MT	
Birmingham, AL	
Bismarck, ND	▼

Supply Air Conditions:

	Cooling Season	Heating Season	Suggestions
Dry Bulb Temp (DegF):	51.5	75.0	Input minimum grain level required for peak indoor latent load when sizing cooling capacity
Humidity (Grains):	46.0	20.0	

Outdoor Air Design Conditions:

	Cooling Season	Heating Season	Suggestions
Dry Bulb Temp (DegF):	95.0	10.0	For Accurate Design Data for City Selected:
Humidity (Grains):	130.0	0.5	

Space Design Conditions:

	Cooling Season	Heating Season	Suggestions
Dry Bulb Temp (DegF):	75.0	72.0	Input space temperature and relative humidity desired. (50% RH maximum recommended for cooling season design)
Humidity Level (%RH):	50%	30%	
Humidity (Grains): (calculated Value)	65.3	35.2	



Project: Hilton Hotel

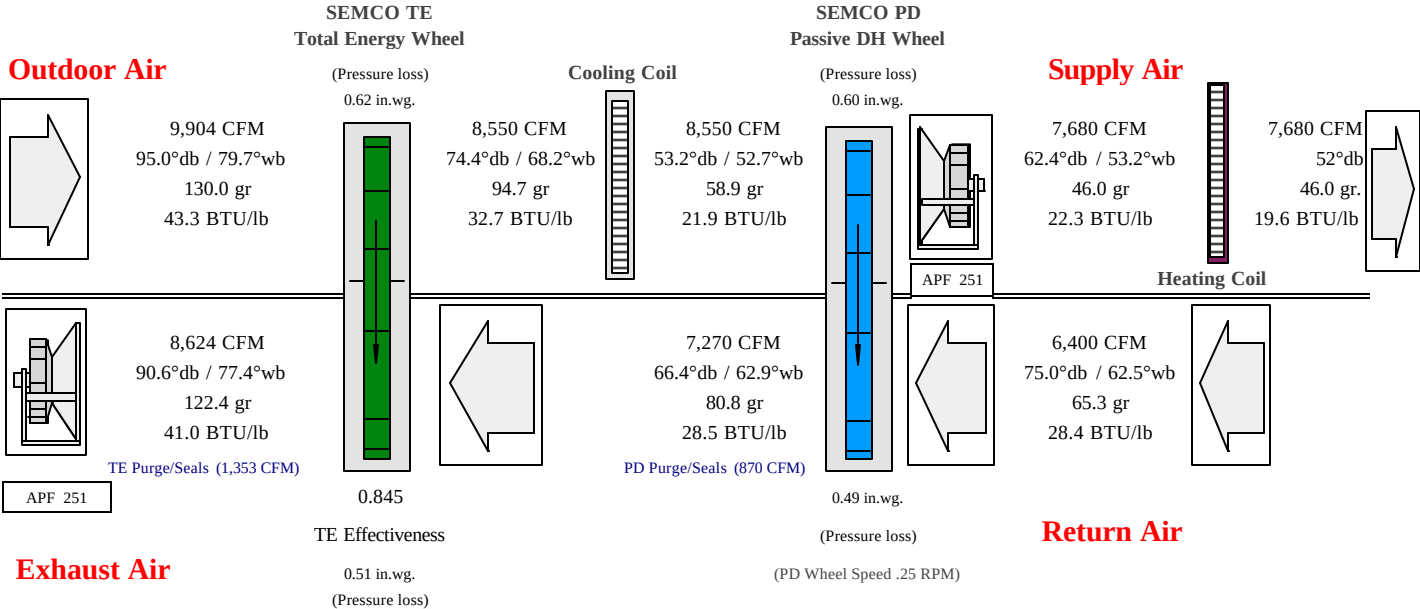
Location: Baltimore, Md

Model: PVS-13

Operating Mode:

Peak Space Latent Load

Unit #: ERU-1

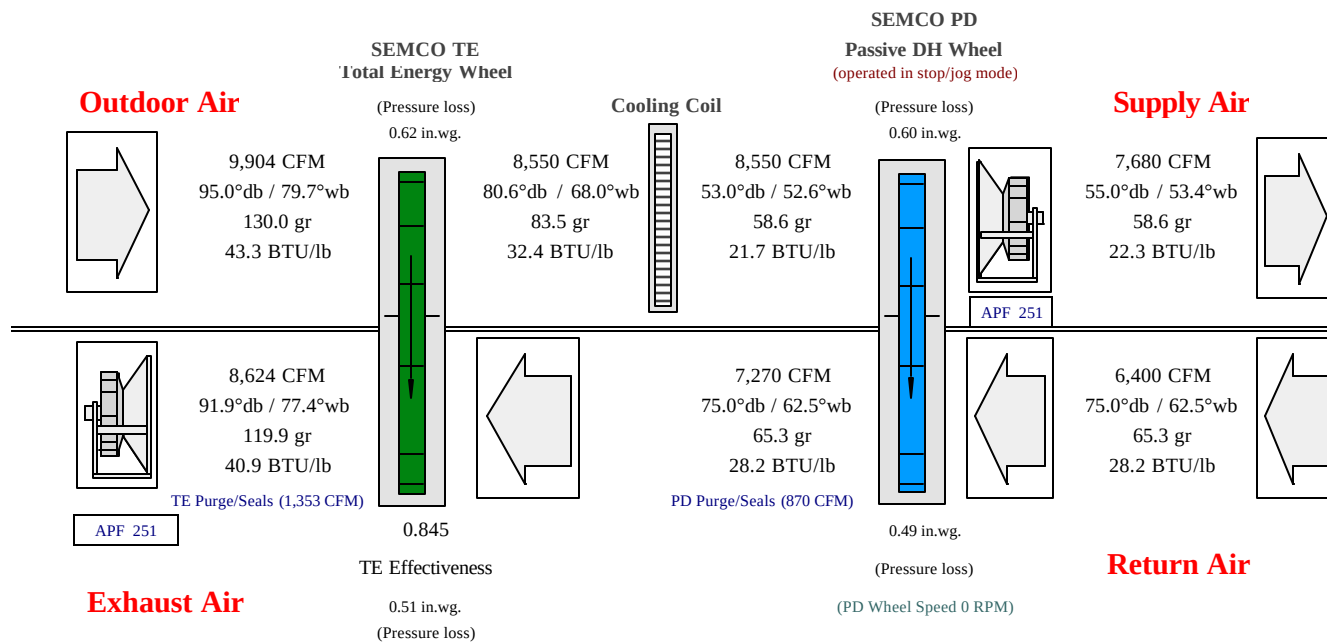


Operating Season: Cooling	Operating Mode: Peak Latent Load
SEMCO PVS Performance Analysis:	
Total Cooling Load Delivered:	60.60 Tons of Total cooling provided
Latent Cooling Load Delivered:	36.56 Tons of Latent cooling provided
Cooling Capacity Input Required:	34.54 Tons of cooling Input required
Dewpoint Delivered to Space:	45.9 Degree F dewpoint
Dewpoint Leaving Coil:	52.2 Degree F dewpoint
Comparison with Conventional Approach:	
Cooling Capacity Required:	69.47 Tons of cooling Input required
Reheat Energy Required:	24,551 BTU/Hr. Reheat required
Dewpoint Delivered to Space:	Not Met Degree F dewpoint
Dewpoint Leaving Coil:	48.0 Degree F dewpoint



Model: **PVS-13**

Unit #: ERU-1



Operating Season: Cooling	Operating Mode: Peak Sensible Load
SEMCO PVS Performance Analysis:	
Total Cooling Load Delivered:	60.49 Tons of Total cooling provided
Latent Cooling Load Delivered:	31.08 Tons of Latent cooling provided
Cooling Capacity Input Required:	34.54 Tons of cooling Input required
Dewpoint Delivered to Space:	52.1 Degree F dewpoint
Dewpoint Leaving Coil:	52.1 Degree F dewpoint
Comparison with Conventional Approach:	
Cooling Capacity Required:	60.49 Tons of cooling Input required
Reheat Energy Required:	N/A BTU/Hr. Reheat required
Dewpoint Delivered to Space:	52.1 Degree F dewpoint
Dewpoint Leaving Coil:	52.1 Degree F dewpoint



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Project: Hilton Hotel

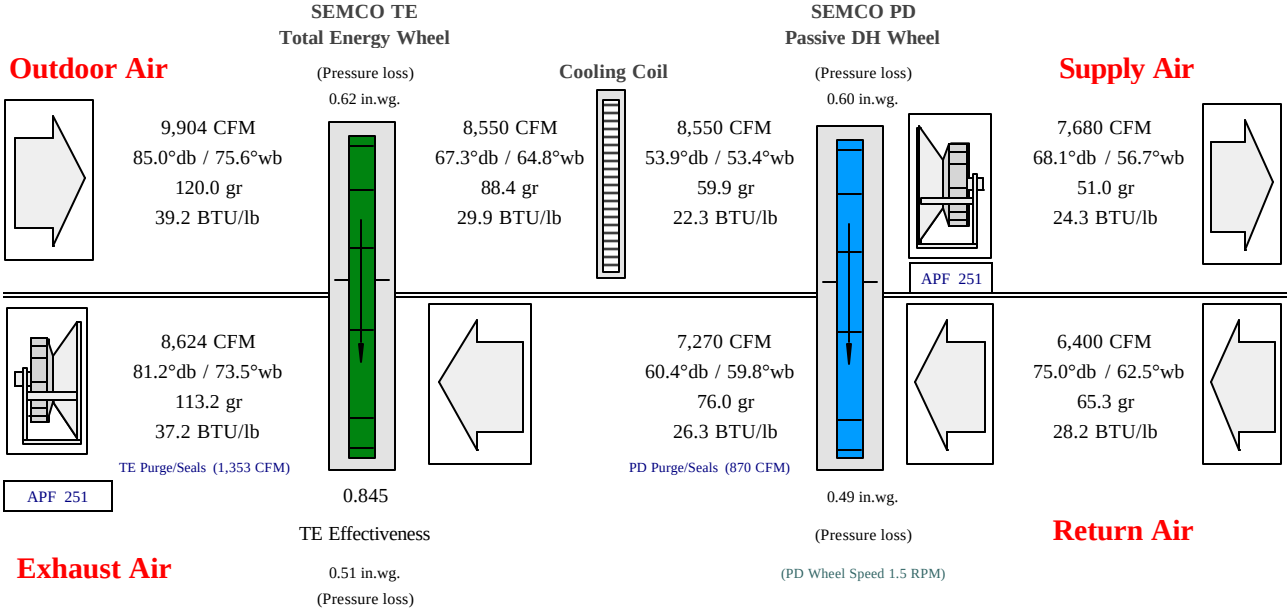
Location: Baltimore, Md

Model: PVS-13

Operating Mode:

Typical Part Load Condition *

Unit #: ERU-1



Operating Season: Cooling	Operating Mode: Part Load Condition
SEMCO PVS Performance Analysis:	
Total Cooling Load Delivered:	43.08 Tons of Total cooling provided
Latent Cooling Load Delivered:	30.03 Tons of Latent cooling provided
Cooling Capacity Input Required:	24.51 Tons of cooling Input required
Dewpoint Delivered to Space:	48.6 Degree F dewpoint
Dewpoint Leaving Coil:	52.9 Degree F dewpoint
Comparison with Conventional Approach:	
Cooling Capacity Required:	56.86 Tons of cooling Input required
Reheat Energy Required:	161,389 BTU/Hr. Reheat required
Dewpoint Delivered to Space:	48.6 Degree F dewpoint
Dewpoint Leaving Coil:	48.6 Degree F dewpoint

Part Load Conditions: Outdoor Air (Manual Input!)	Temperature	Humidity Content
	85°db	120.0 Grains



Project: Hilton Hotel

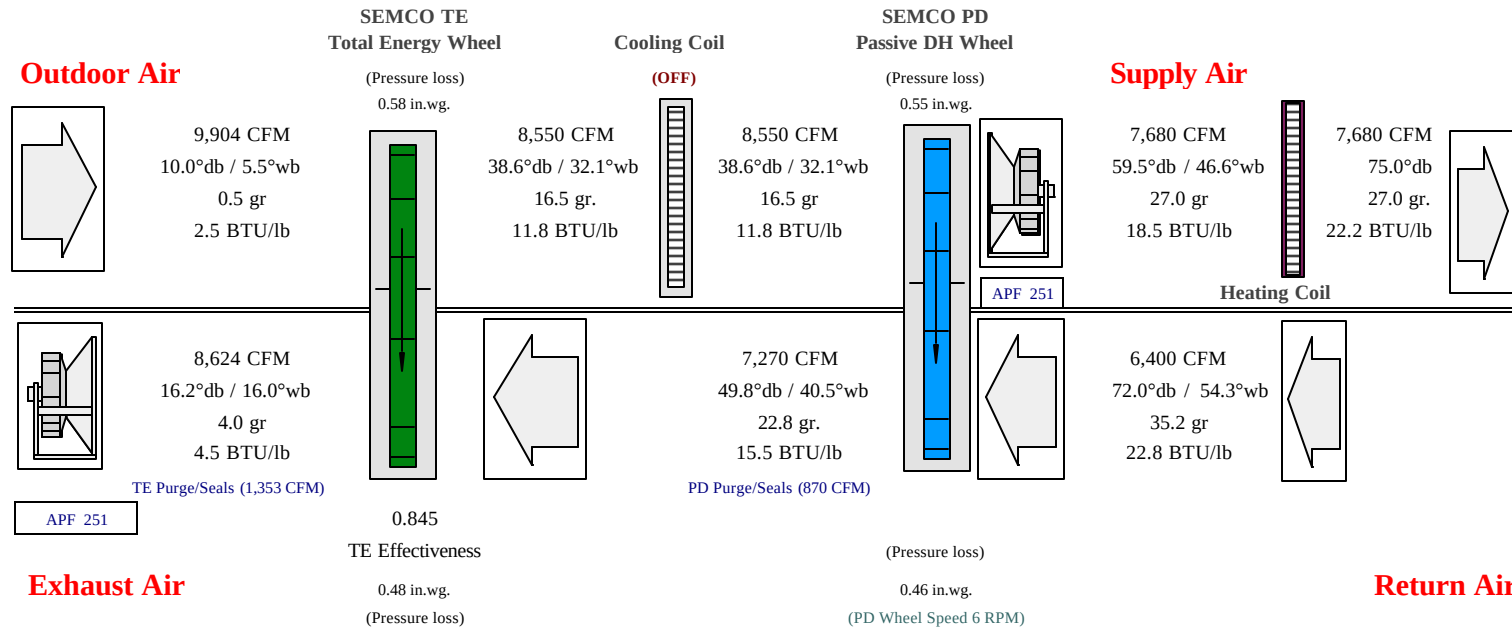
Location: Baltimore, Md

Model: **PVS-13**

Operating Mode:

Peak Heating Load

Unit #: ERU-1



Operating Season: Heating	Operating Mode: Peak Heating Load
SEMCO PVS Performance Analysis:	
Total Heating/Humid. Delivered:	682,492 BTU/Hr provided
Humidification Load Delivered:	131 Pounds of Humidification/Hr.
Heating and/or Humid. Capacity Rqd:	128,920 BTU/Hr required
Comparison with Conventional Approach:	
Heating/Humid. Capacity Required:	644,624 BTU/Hr required

PD Wheel Analyzer

PD Wheel		Manual Input Value
Reheat Effectiveness (automatic=1, manual=0)	0 Mode	55 % Max PD Wheel Eff.

Note: Keep in mode 1 for automatic modulation of PD wheel.
Use mode 0 for manual override to reheat beyond setpoint

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Performance Schedule: PVS System

Project:	Hilton Hotel	SEMCO Model:	PVS-13
Location:	Baltimore, Md	Supply Fan:	APF 251
Unit #:	ERU-1	Exhaust Fan:	APF 251

Fan Data				
Airstream	Airflow Quantity (SCFM)	Airflow+Purge/Seal (SCFM)	External Static Pressure (inwg)	Fan Horsepower (Installed)
Supply	7680	7680	5	
Return	6400	8624	5	

Design Data				
	Outdoor Air Design (Cooling)	Return Air Design (Cooling)	Outdoor Air Design (Heating)	Return Air Design (Heating)
Temperature (DB)	95.0	75.0	10.0	72.0
Temperature (WB)	79.7	62.5	5.5	54.3
Humidity (Gr.)	130.0	65.3	0.5	35.2
Enthalpy (btu/lb)	43.3	28.4	2.5	22.8

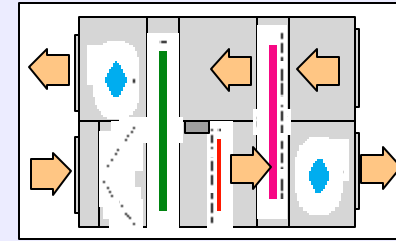
Delivered Conditions				
	TE Energy Wheel (Cooling)	PD DH Wheel (Cooling)	TE Energy Wheel (Heating)	PD DH Wheel (Heating)
Temperature (DB)	74.4	62.4	25.6	61.9
Humidity (Gr.)	94.7	46.0	9.2	28.3
Enthalpy (btu/lb)	32.7	22.3	7.6	19.3
Pressure Loss				
Supply Side	0.62	0.60	0.58	0.55
Return Side	0.51	0.49	0.48	0.46
TE Effectiveness	0.84		0.84	

Coil Data				
	Cooling Coil (Entering)	Cooling Coil (Leaving)	Heating Coil (Entering)	Heating Coil (Leaving)
Temperature (DB)	74.4	53.2	61.9	75.0
Humidity (Gr.)	94.7	58.9	28.3	20.0
Enthalpy (btu/lb)	32.7	21.9	19.3	21.1
Air Pressure Loss				
Capacity MBH	414,435		109,053	
Fluid Temperature				
GPM Fluid Flow				
Fluid Pressure Loss				

SEMCO PVS System Modeling Program**Input Parameters:**

Unit #: ERU-2

Project Name:	Hilton Hotel	
Location:	Baltimore, Md	Choose System from below:
PVS Model Selected:	PVS-18	PVS-18 ▼

**Airflow Conditions**

Supply Air (SCFM):	9,600
Return Air (SCFM):	8,000

External Static Pressures:

Supply Air (inwg):	5
Return Air (inwg):	5

ESA Weather Data:

Austin, TX	▲
Baltimore, MD	
Billings, MT	
Birmingham, AL	
Bismarck, ND	▼

Supply Air Conditions:

	Cooling Season	Heating Season	Suggestions
Dry Bulb Temp (DegF):	51.5	75.0	Input minimum grain level required for peak indoor latent load when sizing cooling capacity
Humidity (Grains):	46.0	20.0	

Outdoor Air Design Conditions:

	Cooling Season	Heating Season	Suggestions
Dry Bulb Temp (DegF):	95.0	10.0	For Accurate Design Data for City Selected:
Humidity (Grains):	130.0	0.5	

Space Design Conditions:

	Cooling Season	Heating Season	Suggestions
Dry Bulb Temp (DegF):	75.0	72.0	Input space temperature and relative humidity desired. (50% RH maximum recommended for cooling season design)
Humidity Level (%RH):	50%	30%	
Humidity (Grains): (calculated Value)	65.3	35.2	



Project: Hilton Hotel

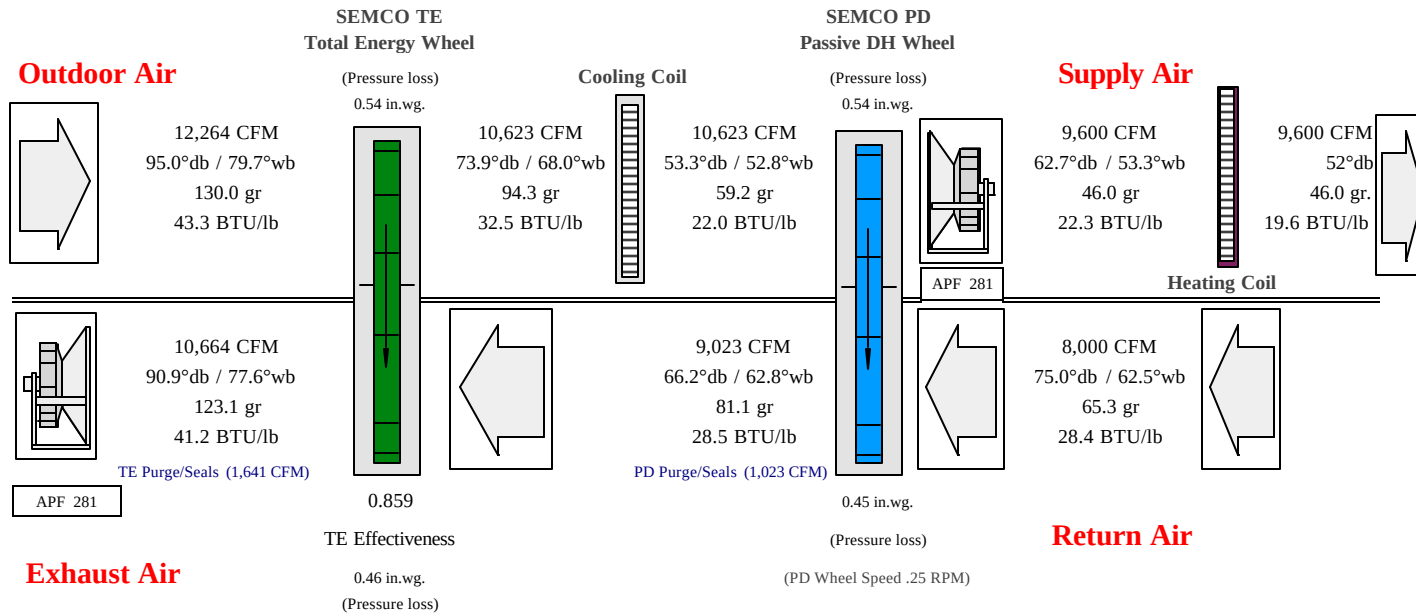
Location: Baltimore, Md

Model: **PVS-18**

Operating Mode:

Peak Space Latent Load

Unit #: ERU-2



Operating Season: Cooling	Operating Mode: Peak Latent Load
SEMCO PVS Performance Analysis:	
Total Cooling Load Delivered:	75.48 Tons of Total cooling provided
Latent Cooling Load Delivered:	45.70 Tons of Latent cooling provided
Cooling Capacity Input Required:	41.93 Tons of cooling Input required
Dewpoint Delivered to Space:	45.9 Degree F dewpoint
Dewpoint Leaving Coil:	52.3 Degree F dewpoint
Comparison with Conventional Approach:	
Cooling Capacity Required:	86.84 Tons of cooling Input required
Reheat Energy Required:	30,689 BTU/Hr. Reheat required
Dewpoint Delivered to Space:	Not Met Degree F dewpoint
Dewpoint Leaving Coil:	48.0 Degree F dewpoint

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Project: Hilton Hotel

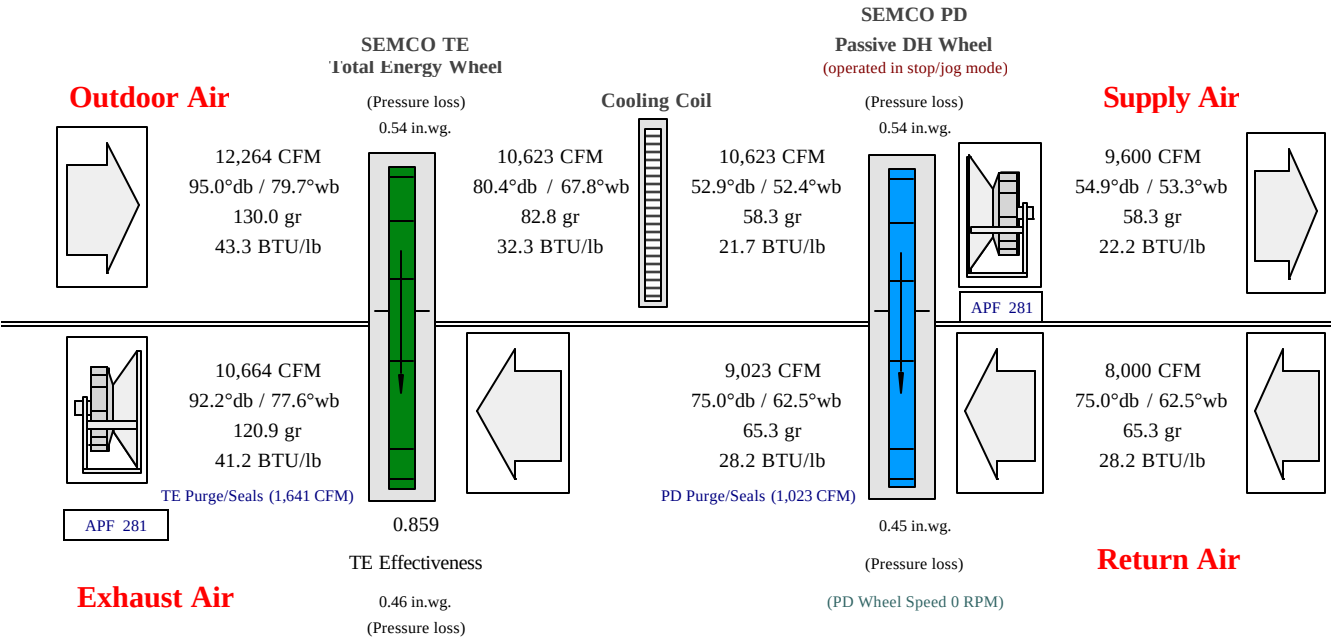
Location: Baltimore, Md

Model: PVS-18

Operating Mode:

Peak Space Sensible Load

Unit #: ERU-2



Operating Season: Cooling	Operating Mode: Peak Sensible Load
SEMCO PVS Performance Analysis:	
Total Cooling Load Delivered:	75.86 Tons of Total cooling provided
Latent Cooling Load Delivered:	38.99 Tons of Latent cooling provided
Cooling Capacity Input Required:	41.93 Tons of cooling Input required
Dewpoint Delivered to Space:	51.9 Degree F dewpoint
Dewpoint Leaving Coil:	51.9 Degree F dewpoint
Comparison with Conventional Approach:	
Cooling Capacity Required:	75.86 Tons of cooling Input required
Reheat Energy Required:	N/A BTU/Hr. Reheat required
Dewpoint Delivered to Space:	51.9 Degree F dewpoint
Dewpoint Leaving Coil:	51.9 Degree F dewpoint



Project: Hilton Hotel

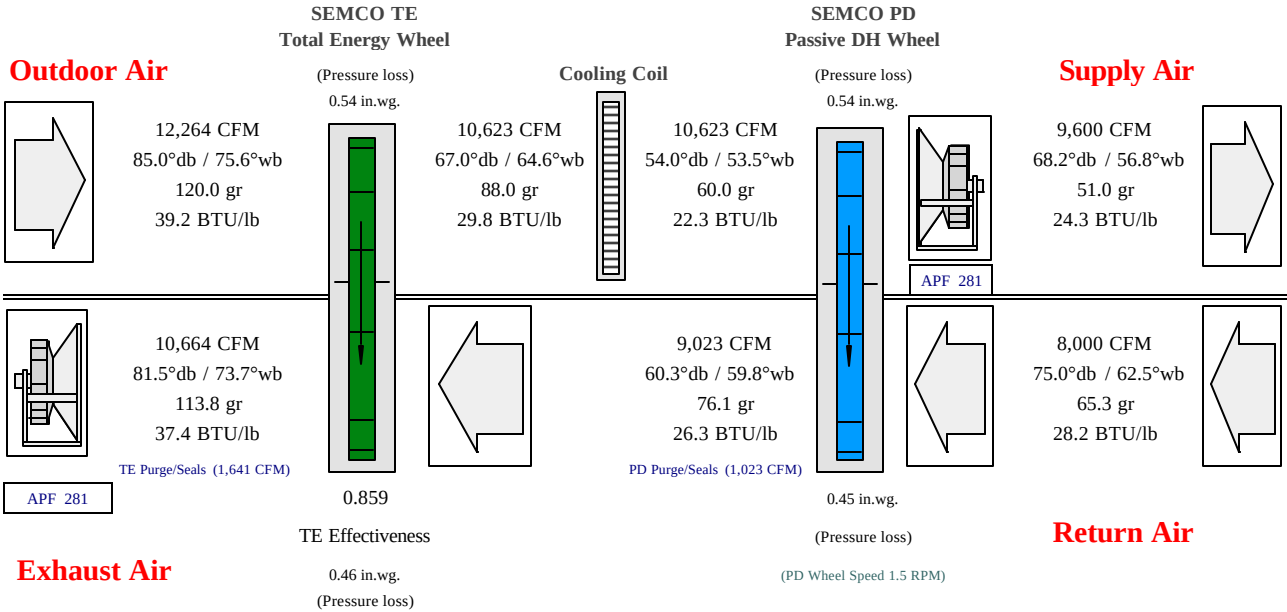
Location: Baltimore, Md

Model: PVS-18

Operating Mode:

Typical Part Load Condition *

Unit #: ERU-2



Operating Season: Cooling	Operating Mode: Part Load Condition
SEMCO PVS Performance Analysis:	
Total Cooling Load Delivered:	53.70 Tons of Total cooling provided
Latent Cooling Load Delivered:	37.54 Tons of Latent cooling provided
Cooling Capacity Input Required:	29.68 Tons of cooling Input required
Dewpoint Delivered to Space:	48.6 Degree F dewpoint
Dewpoint Leaving Coil:	53.0 Degree F dewpoint
Comparison with Conventional Approach:	
Cooling Capacity Required:	71.07 Tons of cooling Input required
Reheat Energy Required:	203,458 BTU/Hr. Reheat required
Dewpoint Delivered to Space:	48.6 Degree F dewpoint
Dewpoint Leaving Coil:	48.6 Degree F dewpoint

Part Load Conditions: Outdoor Air (Manual Input!)	Temperature	Humidity Content
	85°db	120.0 Grains



Project: Hilton Hotel

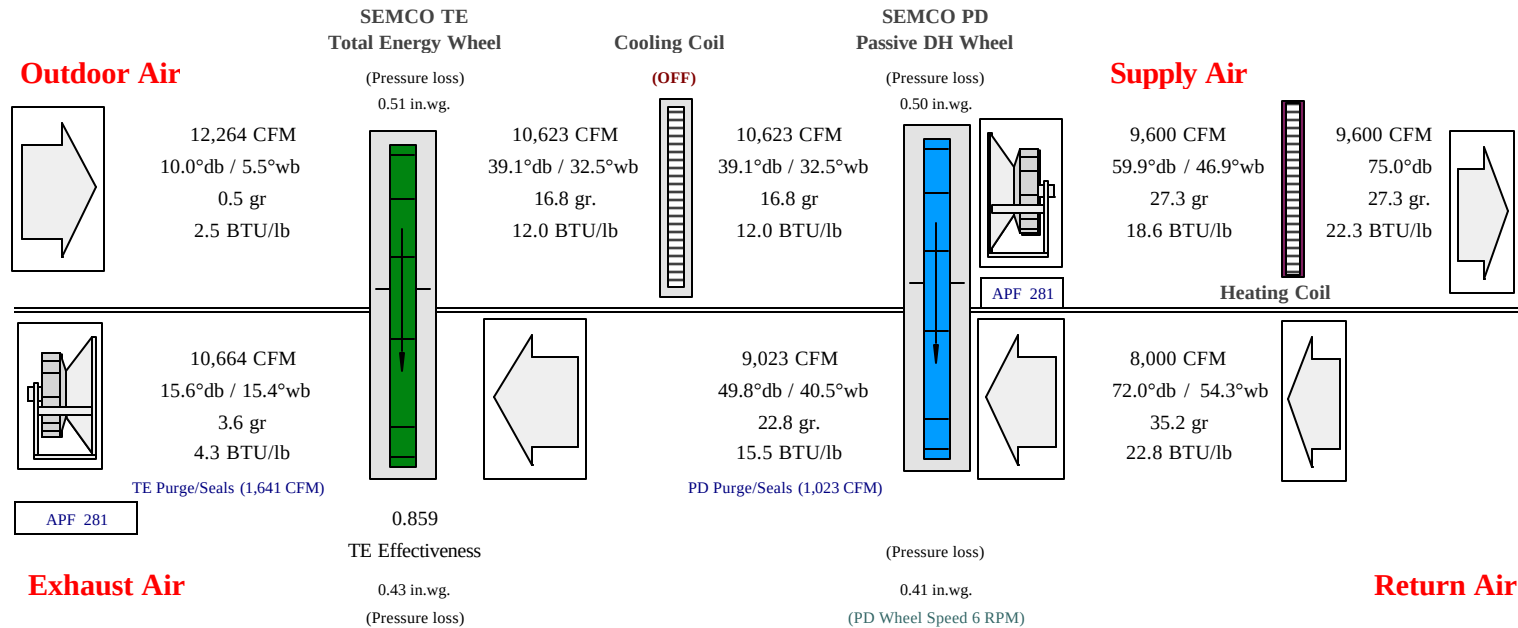
Location: Baltimore, Md

Model: **PVS-18**

Operating Mode:

Peak Heating Load

Unit #: ERU-2



Operating Season: Heating	Operating Mode: Peak Heating Load
SEMCO PVS Performance Analysis:	
Total Heating/Humid. Delivered:	854,848 BTU/Hr provided
Humidification Load Delivered:	165 Pounds of Humidification/Hr.
Heating and/or Humid. Capacity Rqd:	156,481 BTU/Hr required
Comparison with Conventional Approach:	
Heating/Humid. Capacity Required:	805,780 BTU/Hr required

PD Wheel Analyzer

PD Wheel		Manual Input Value
Reheat Effectiveness (automatic=1, manual=0)	0 Mode	55 % Max PD Wheel Eff.

Note: Keep in mode 1 for automatic modulation of PD wheel
Use mode 0 for manual override to reheat beyond setpoint

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Performance Schedule: PVS System

Project:	Hilton Hotel	SEMCO Model:	PVS-18
Location:	Baltimore, Md	Supply Fan:	APF 281
Unit #:	ERU-2	Exhaust Fan:	APF 281

Fan Data				
Airstream	Airflow Quantity (SCFM)	Airflow+Purge/Seal (SCFM)	External Static Pressure (inwg)	Fan Horsepower (Installed)
Supply	9600	9600	5	
Return	8000	10664	5	

Design Data				
	Outdoor Air Design (Cooling)	Return Air Design (Cooling)	Outdoor Air Design (Heating)	Return Air Design (Heating)
Temperature (DB)	95.0	75.0	10.0	72.0
Temperature (WB)	79.7	62.5	5.5	54.3
Humidity (Gr.)	130.0	65.3	0.5	35.2
Enthalpy (btu/lb)	43.3	28.4	2.5	22.8

Delivered Conditions				
	TE Energy Wheel (Cooling)	PD DH Wheel (Cooling)	TE Energy Wheel (Heating)	PD DH Wheel (Heating)
Temperature (DB)	73.9	62.7	39.1	59.9
Humidity (Gr.)	94.3	46.0	16.8	27.3
Enthalpy (btu/lb)	32.5	22.3	12.0	18.6
Pressure Loss				
Supply Side	0.54	0.54	0.51	0.50
Return Side	0.46	0.45	0.43	0.41
TE Effectiveness	0.86		0.86	

Coil Data				
	Cooling Coil (Entering)	Cooling Coil (Leaving)	Heating Coil (Entering)	Heating Coil (Leaving)
Temperature (DB)	73.9	53.3	59.9	75.0
Humidity (Gr.)	94.3	59.2	27.3	20.0
Enthalpy (btu/lb)	32.5	22.0	18.6	21.1
Air Pressure Loss				
Capacity MBH	503,182		156,481	
Fluid Temperature				
GPM Fluid Flow				
Fluid Pressure Loss				

Appendix G – Fan Coil Unit Selection

This appendix contains the cut sheets and other data for the manufacturer information provided for the fan coil units used as a part of the design process. There is data from Carrier and Enviro-Tec included.

Please see the all the dedicated outdoor air system unit information on the following pages.

Fan Coil Unit Zones

Table G1 - Fan Coil Unit Zones

FCU-1			FCU-2		
Floors	4-10	11	Floors	4-10	11
Zone No	Space		Zone No	Space	
1	02	04	1	01	01
2	04	04	2	03	03
3	06	06	3	05	05
4	08	08	4	07	07
5	10	10	5	09	09
6	12	12	6	11	11
7	14	14	7	13	13
8	20	20	8	15	15
9	22	22	9	17	15
10	24	24	10	19	15
11	26	26	11	21	21
12	28	28	12	23	21
13	30	30	13	25	21
14	32	30	14	27	27
15	-	32	15	29	29
16	-	32	16	31	31
17	-	-	-	33	-
18	-	-	-	35	-

Table G2 - Hotel Guest Rooms

Floor	Room Types	No of Guestrooms														Total	
3	K/S	1	3	5	7	9	11	12	14	20	22	28	30	35	13		
3	QQ/S	4	6	17	19	25	27	29	31	33					9		
3	QQ/T	2	8	10	13	15	21	23	24	26					9		
3	QQ/AT	32													1		
4-10	K/S	1	3	5	7	9	11	12	14	19	20	28	30	35	13	x7	
4-10	K/AT	17	22												2	x7	
4-10	QQ/S	4	6	25	27	29	31	33							7	x7	
4-10	QQ/T	2	8	10	13	15	21	23	24	26	32				10	x7	
11	K/S	1	3	5	6	7	9	11	12	14	20	22	28	31	13		
11	K/T	13													1		
11	QQ/S	27	29												2		
11	QQ/T	8	10	24	26										4		
11	SK/AT	4													1		
11	SK/ST	30	32												2		
	Total														279	rooms	

SAMPLE GUEST ROOM - NORTH SIDE

DOAS + FCU

ASHRAE PSYCHROMETRIC CHART NO. 1

Chart 1a

NORMAL TEMPERATURE
BAROMETRIC PRESSURE 29.921 INCHES OF MERCURY

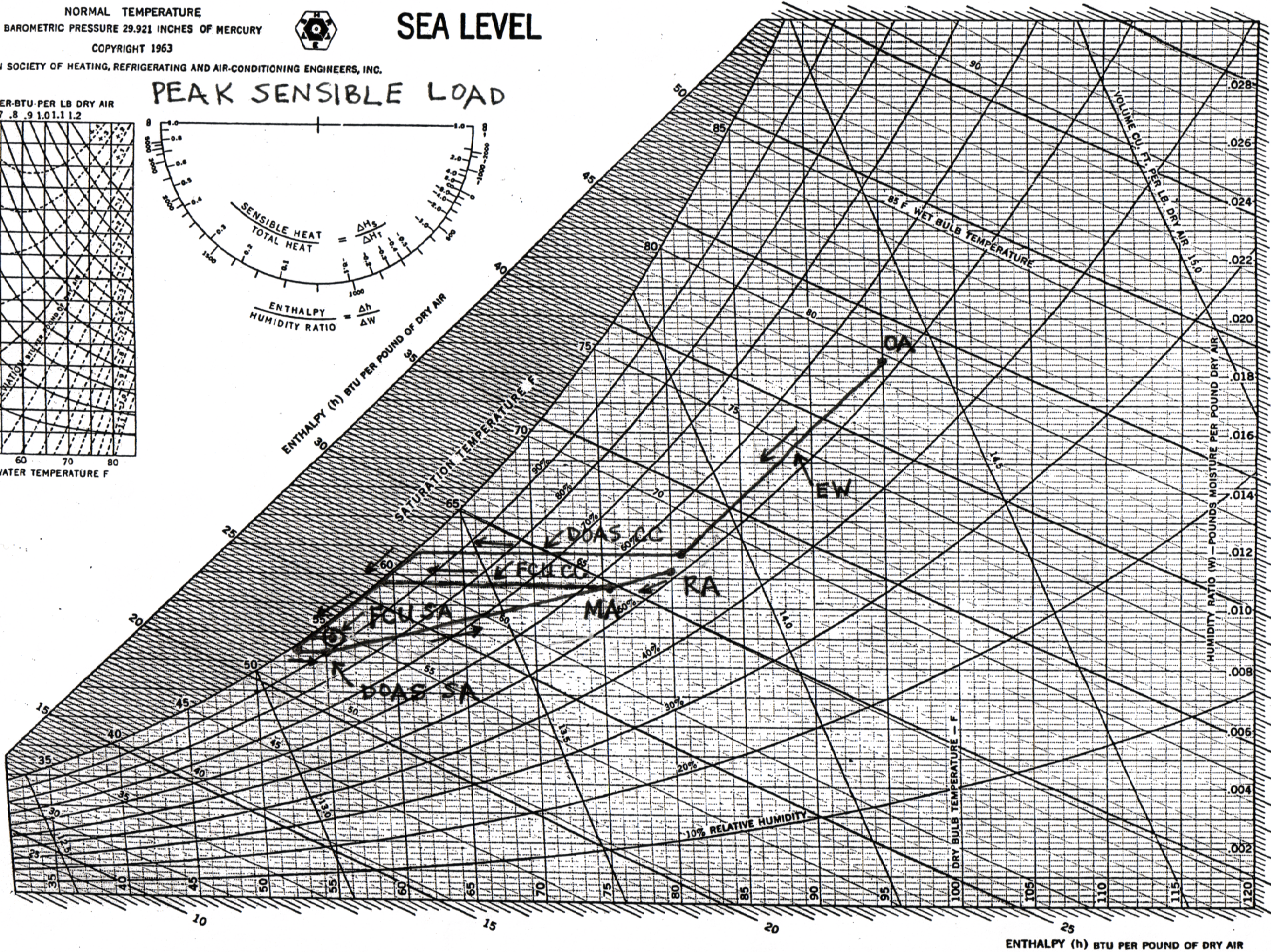
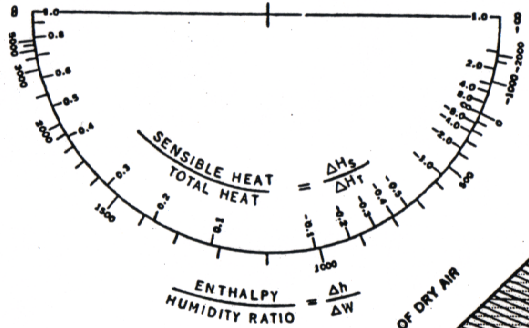
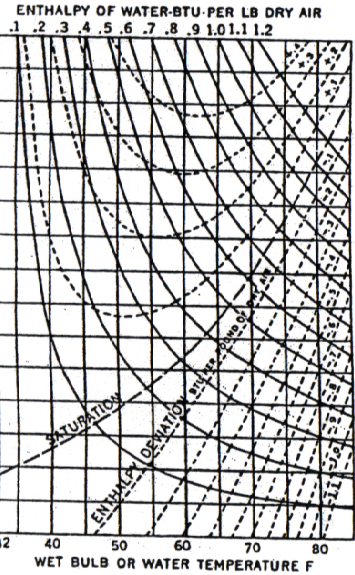


SEA LEVEL

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AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.

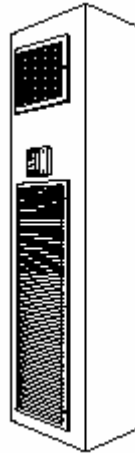
PEAK SENSIBLE LOAD



Unit Report For FCU-1

Project: Nathan- Thesis Project FCUs
Prepared By:

03/29/2006
03:56PM



Unit Parameters

Tag Name:.....FCU-1
Quantity: 1
Unit Model:42SGA03
Unit Type:42SGA Concealed Modular Unit
Unit Size: 300
System Type:4-Pipe Heating and Cooling
Cooling Coil: Cold Fluid Cooling
Cooling Coil Rows: 3 Rows
Heating Coil: Hot Fluid Heating
Heating Coil Rows: 1 Row
Shipping Options:Standard
Fan Speed: High
Motor/Drive:Standard

Dimensions

Unit Length: 17.00 in
Unit Width: 17.00 in
Unit Height: 88.00 in
Shipping Weight: 225 lb

Electrical

Motor Voltage: 208-1-60 V-Ph-Hz

Warranty Information

First Year - Parts Only (Standard)

Ordering Information

Part Number	Description	Quantity
Base Unit		
	42SGA03	1
	4-Pipe Heating and Cooling	
	208-1-60 Motor Voltage	
	1 in. Throwaway Glass-Fiber	
	Bar Type Alum Finish Return Air Grille (Mod Panel 3)	
	Field Supplied/Inst Remote-Mtd Therm	
	Full Riser Chase	
	Std. Tufskin II Insulation	
	3 Rows Cooling, 1 Row Heating, Same end	
	Front Return / Front Supply	
	Std. Cabinet Size, Std. 88 in. Cabinet Height, Std. Riser Piping Order	
	Riser, Cooling Coil, Return, 3/4 in., Type L Copper, 1/2 in. Insulation	
	Riser, Cooling Coil, Supply, 1 in., Type L Copper, 1/2 in. Insulation	
	Riser, Drain, 1 in., Type L Copper, 1/2 in. Insulation	
	Riser, Heating Coil, Return, 3/4 in., Type L Copper, 1/2 in. Insulation	
	Riser, Heating Coil, Supply, 3/4 in., Type L Copper, 1/2 in. Insulation	

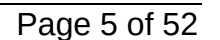
Unit Report For FCU-1

Project: Nathan- Thesis Project FCUs
Prepared By:

03/29/2006
03:56PM

	(1) Ball Valve, Return Line, Cooling Coil	
	(1) Ball Valve, Supply Line, Cooling Coil	
	(1) Ball Valve, Return Line, Heating Coil	
	(1) Ball Valve, Supply Line, Heating Coil	
	110 in. Floor to Floor Height	
	112 in. Risers	

03/29/2006
03:56PM



Performance Summary For FCU-1

Project: Nathan- Thesis Project FCUs
Prepared By:

03/29/2006
03:56PM

Unit Parameters

Tag Name:.....FCU-1
Quantity: 1
Unit Model:42SGA03
Unit Type:42SGA Concealed Modular Unit
Unit Size: 300
System Type:4-Pipe Heating and Cooling
Cooling Coil: Cold Fluid Cooling
Cooling Coil Rows:3 Rows
Heating Coil:Hot Fluid Heating
Heating Coil Rows: 1 Row
Shipping Options:Standard
Fan Speed: High
Motor/Drive:Standard

Unit Performance

Actual Airflow: 330.0 CFM
Altitude: 0 ft
External Static Pressure:10 in wg
Voltage:208-1-60 V-Ph-Hz

Cooling Data

Coil Type: Cold Fluid Cooling
Coil Rows:3 Rows
Fluid Type:Fresh Water
Total Capacity: 12633 BTU/hr
Sensible Capacity: 8825 BTU/hr
Entering Air Dry Bulb Temperature: 80.0 F
Entering Air Wet Bulb Temperature: 67.0 F
Leaving Air Dry Bulb Temperature: 55.5 F
Leaving Air Wet Bulb Temperature: 54.6 F
Fluid Flow Rate: 2.1 gpm
Fluid Pressure Drop: 21.86 ft wg
Fluid Entering Temperature: 44.0 F
Fluid Leaving Temperature: 56.0 F

Heating Data

Coil Type:Hot Fluid Heating
Coil Rows: 1 Row
Fluid Type:Fresh Water
Sensible Capacity: 19597 BTU/hr
Entering Air Temperature: 60.0 F
Leaving Air Temperature: 114.3 F
Fluid Flow Rate: 2.0 gpm
Fluid Pressure Drop: 4.75 ft wg
Fluid Entering Temperature: 180.0 F
Fluid Leaving Temperature: 160.0 F

Electrical Data

Motor Voltage:208-1-60 V-Ph-Hz
Motor Nominal HP: 1/30 hp
Total Motor Watts: 122
Total Motor Amps: 0.31

Acoustical Data

N/A
Sound Power 125 dB: 64.5
Sound Power 250 dB: 57
Sound Power 500 dB: 52.5
Sound Power 1000 dB: 49
Sound Power 2000 dB: 41

Performance Summary For FCU-1

Project: Nathan- Thesis Project FCUs
Prepared By:

03/29/2006
03:56PM

Sound Power 4000 dB:..... **39**
Sound Power 8000 dB:..... **35.5**
Sound A Weight in dB: **55**

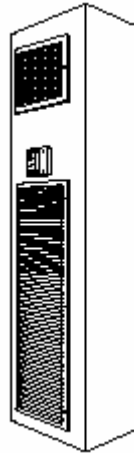
Factory-Installed Options

Coil Connections: **Same end**
Return:..... **Front Return**
Supply: **Front Supply**
Filters:..... **1 in. Throwaway Glass-Fiber**
Drain Pans:..... **Standard Main Drain Pan**
Return Air Options:..... **Bar Type Alum Finish (#3)**
Cabinet Size: **Standard Cabinet Size (17 in.)**
Cabinet Height:..... **Std.**
AAV / Drains:..... **Manual Air Vents only**
Control Packages: **Field Supplied/Inst Remote-Mtd Therm**
Single Power Source: **No**
Riser Chase:..... **Full Riser Chase**
Riser Piping Order:..... **Std.**

Unit Report For FCU-2

Project: Nathan- Thesis Project FCUs
Prepared By:

03/29/2006
03:56PM



Unit Parameters

Tag Name:.....FCU-2
 Quantity: 1
 Unit Model:42SGA04
 Unit Type:42SGA Concealed Modular Unit
 Unit Size: 400
 System Type:4-Pipe Heating and Cooling
 Cooling Coil: Cold Fluid Cooling
 Cooling Coil Rows: 3 Rows
 Heating Coil: Hot Fluid Heating
 Heating Coil Rows: 1 Row
 Shipping Options:Standard
 Fan Speed: High
 Motor/Drive:Standard

Dimensions

Unit Length: 17.00 in
 Unit Width: 17.00 in
 Unit Height: 88.00 in
 Shipping Weight: 225 lb

Electrical

Motor Voltage: 208-1-60 V-Ph-Hz

Warranty Information

First Year - Parts Only (Standard)

Ordering Information

Part Number	Description	Quantity
Base Unit		
	42SGA04	1
	4-Pipe Heating and Cooling	
	208-1-60 Motor Voltage	
	1 in. Throwaway Glass-Fiber	
	Bar Type Alum Finish Return Air Grille (Mod Panel 3)	
	Field Supplied/Inst Remote-Mtd Therm	
	Full Riser Chase	
	Std. Tufskin II Insulation	
	3 Rows Cooling, 1 Row Heating, Same end	
	Front Return / Front Supply	
	Std. Cabinet Size, Std. 88 in. Cabinet Height, Std. Riser Piping Order	
	Riser, Cooling Coil, Return, 3/4 in., Type L Copper, 1/2 in. Insulation	
	Riser, Cooling Coil, Supply, 1 in., Type L Copper, 1/2 in. Insulation	
	Riser, Drain, 1 in., Type L Copper, 1/2 in. Insulation	
	Riser, Heating Coil, Return, 3/4 in., Type L Copper, 1/2 in. Insulation	
	Riser, Heating Coil, Supply, 3/4 in., Type L Copper, 1/2 in. Insulation	

Unit Report For FCU-2

Project: Nathan- Thesis Project FCUs
Prepared By:

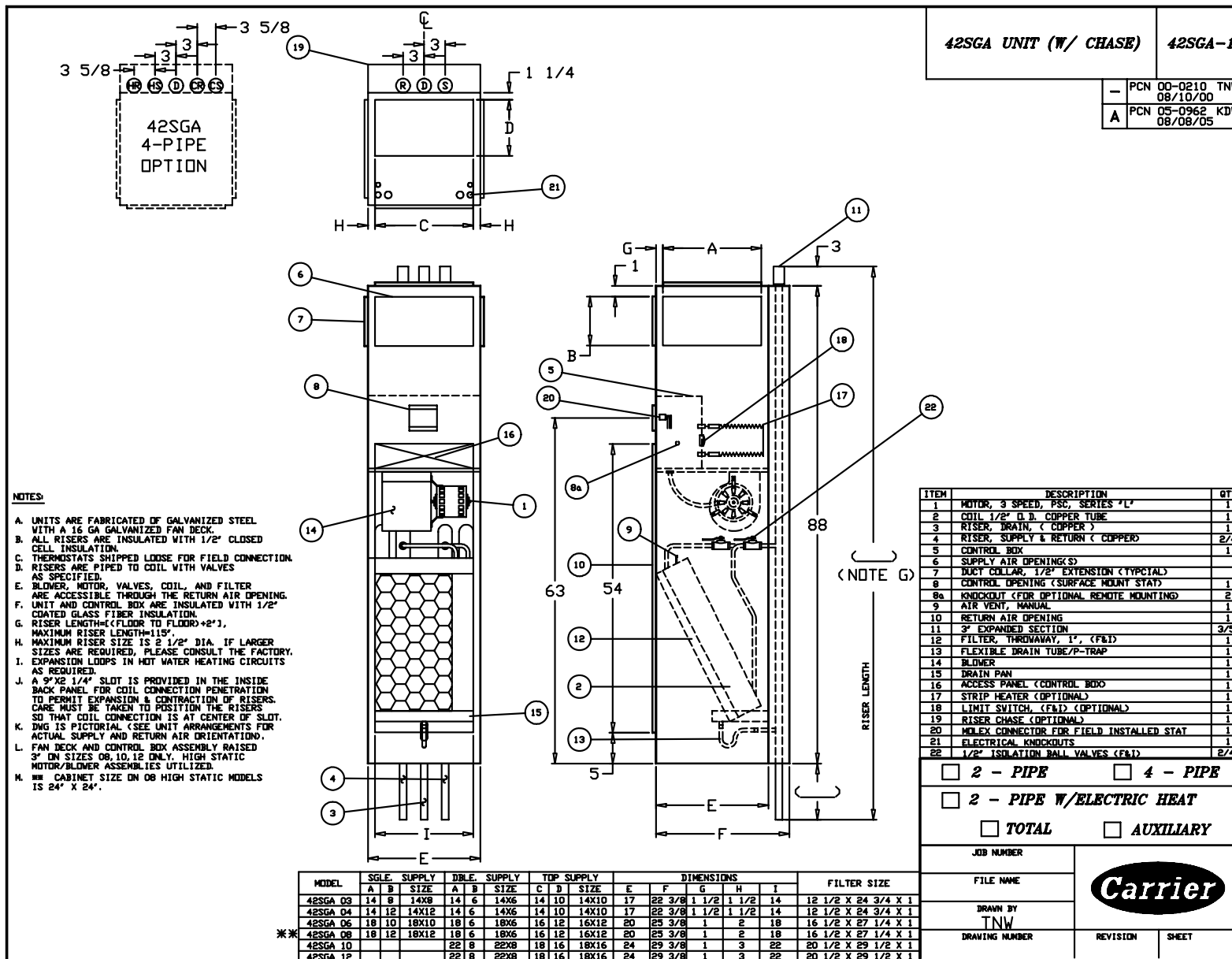
03/29/2006
03:56PM

	(1) Ball Valve, Return Line, Cooling Coil	
	(1) Ball Valve, Supply Line, Cooling Coil	
	(1) Ball Valve, Return Line, Heating Coil	
	(1) Ball Valve, Supply Line, Heating Coil	
	110 in. Floor to Floor Height	
	112 in. Risers	

Certified Drawing for FCU-2

Project: Nathan- Thesis Project FCUs
Prepared By:

03/29/2006
03:56PM



Performance Summary For FCU-2

Project: Nathan- Thesis Project FCUs
Prepared By:

03/29/2006
03:56PM

Unit Parameters

Tag Name:.....FCU-2
Quantity: 1
Unit Model:42SGA04
Unit Type:42SGA Concealed Modular Unit
Unit Size: 400
System Type:4-Pipe Heating and Cooling
Cooling Coil: Cold Fluid Cooling
Cooling Coil Rows:3 Rows
Heating Coil:Hot Fluid Heating
Heating Coil Rows: 1 Row
Shipping Options:Standard
Fan Speed: High
Motor/Drive:Standard

Unit Performance

Actual Airflow: 400.0 CFM
Altitude: 0 ft
External Static Pressure:15 in wg
Voltage:208-1-60 V-Ph-Hz

Cooling Data

Coil Type: Cold Fluid Cooling
Coil Rows:3 Rows
Fluid Type:Fresh Water
Total Capacity: 13877 BTU/hr
Sensible Capacity: 9924 BTU/hr
Entering Air Dry Bulb Temperature: 80.0 F
Entering Air Wet Bulb Temperature: 67.0 F
Leaving Air Dry Bulb Temperature: 57.3 F
Leaving Air Wet Bulb Temperature: 55.9 F
Fluid Flow Rate: 2.3 gpm
Fluid Pressure Drop: 26.37 ft wg
Fluid Entering Temperature: 44.0 F
Fluid Leaving Temperature: 56.0 F

Heating Data

Coil Type:Hot Fluid Heating
Coil Rows: 1 Row
Fluid Type:Fresh Water
Sensible Capacity: 21020 BTU/hr
Entering Air Temperature: 60.0 F
Leaving Air Temperature: 108.1 F
Fluid Flow Rate: 2.1 gpm
Fluid Pressure Drop: 5.46 ft wg
Fluid Entering Temperature: 180.0 F
Fluid Leaving Temperature: 160.0 F

Electrical Data

Motor Voltage:208-1-60 V-Ph-Hz
Motor Nominal HP: 1/20 hp
Total Motor Watts: 114
Total Motor Amps: 0.6

Acoustical Data

N/A
Sound Power 125 dB: 69
Sound Power 250 dB: 59.5
Sound Power 500 dB: 55.5
Sound Power 1000 dB: 50.5
Sound Power 2000 dB: 41.5

Performance Summary For FCU-2

Project: Nathan- Thesis Project FCUs
Prepared By:

03/29/2006
03:56PM

Sound Power 4000 dB:..... **39.5**
Sound Power 8000 dB:..... **36.5**
Sound A Weight in dB: **58**

Factory-Installed Options

Coil Connections: **Same end**
Return:..... **Front Return**
Supply: **Front Supply**
Filters:..... **1 in. Throwaway Glass-Fiber**
Drain Pans:..... **Standard Main Drain Pan**
Return Air Options: **Bar Type Alum Finish (#3)**
Cabinet Size: **Standard Cabinet Size (17 in.)**
Cabinet Height:..... **Std.**
AAV / Drains:..... **Manual Air Vents only**
Control Packages: **Field Supplied/Inst Remote-Mtd Therm**
Single Power Source: **No**
Riser Chase:..... **Full Riser Chase**
Riser Piping Order:..... **Std.**



Project Name: PSU Arch Project

Line #: 1 Tag:

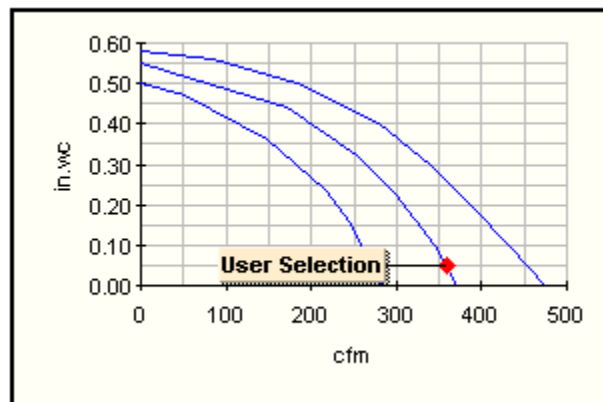
Date: 3/30/2006 8:45:34 AM ET Selection Version: 1.0.7

Selection Method: Fixed ESP/Nominal Airflow Elevation: 0 ft.

Notes:

General												
Mfg	Model	Unit Size	Airflow (cfm)	ESP (in.wc)	Motor (Hp)	Motor RPM	Fan Amps	Fan Watts	Fan Qty	V/P/Hz	Motor Speed	Weight* (lb)
Enviro-Tec	VHC	04	358	0.05	(1) 1/25	800	1	118	1	115/1/60	Medium	254

* Weight does not include accessories.



Fan selection and performance is shown at elevation of 0 ft.

Chilled Water Coil												
EAT DB/WB (deg.F)	LAT DB/WB (deg.F)	Total Capacity (Btuh)	Sensible Capacity (Btuh)	EWT/LWT (deg.F)	Fluid Flow (gpm)	Fluid PD (ft.)	Air PD (in.wc)	Coil Rows	Coil FPI	No. Circuits	Fin Material	Tube Wall
75 / 63	55.2 / 53.4	9992	7688	44 / 56	1.66	4.38	0.08	3	14	2	0.0055 in. Al	0.016 in.

Hot Water Coil											
EAT DB (deg.F)	LAT DB (deg.F)	Sensible Capacity (Btuh)	EWT/LWT (deg.F)	Fluid Flow (gpm)	Fluid PD (ft.)	Air PD (in.wc)	Coil Rows	Coil FPI	No. Circuits	Fin Material	Tube Wall
70	123.2	20630	180 / 160	2.12	11.07	0.02	1	14	1	0.0055 in. Al	0.016 in.

Sound Power By Octave Band (dB Re 10 ⁻¹² Watts)							
Band	2	3	4	5	6	7	8
Frequency	125	250	500	1000	2000	4000	8000
Total	52	45	42	36	35	27	27

- Unit data is certified in accordance with ARI 440.
- Coils are manufactured in accordance with ARI 410.
- Sound data tested in accordance with ARI 350-2000.
 - Total sound power level data based on Model VHC with fan CFM at corresponding motor tap with 115/1/60 volt motor, 4 row coil, 1" throwaway filter, 0.05" external static pressure and standard rated internal pressure losses.
- Unit pressure drop and CFM based upon dry coil as required by ARI 440.
- Scheduled motor information is for Hi Speed.
- The coil selection has been made at Standard conditions.
- Outside Airflow is a user input value for scheduling purposes.



Project Name: PSU Arch Project

Line #: 2 Tag: FCU-2

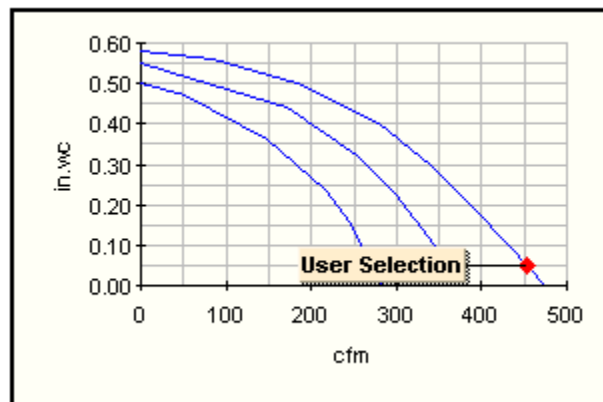
Date: 3/30/2006 8:46:32 AM ET Selection Version: 1.0.7

Selection Method: Fixed ESP/Nominal Airflow Elevation: 0 ft.

Notes:

General												
Mfg	Model	Unit Size	Airflow (cfm)	ESP (in.wc)	Motor (Hp)	Motor RPM	Fan Amps	Fan Watts	Fan Qty	V/P/Hz	Motor Speed	Weight* (lb)
Enviro-Tec	VHC	04	454	0.05	(1) 1/25	800	1	118	1	115/1/60	High	254

* Weight does not include accessories.



Fan selection and performance is shown at elevation of 0 ft.

Chilled Water Coil												
EAT DB/WB (deg.F)	LAT DB/WB (deg.F)	Total Capacity (Btuh)	Sensible Capacity (Btuh)	EWT/LWT (deg.F)	Fluid Flow (gpm)	Fluid PD (ft.)	Air PD (in.wc)	Coil Rows	Coil FPI	No. Circuits	Fin Material	Tube Wall
75 / 63	56.2 / 54.1	11854	9263	44 / 56	1.97	5.43	0.12	3	14	2	0.0055 in. Al	0.016 in.

Hot Water Coil											
EAT DB (deg.F)	LAT DB (deg.F)	Sensible Capacity (Btuh)	EWT/LWT (deg.F)	Fluid Flow (gpm)	Fluid PD (ft.)	Air PD (in.wc)	Coil Rows	Coil FPI	No. Circuits	Fin Material	Tube Wall
70	119.7	24423	180 / 160	2.5	15.31	0.02	1	14	1	0.0055 in. Al	0.016 in.

Sound Power By Octave Band (dB Re 10 ⁻¹² Watts)							
Band	2	3	4	5	6	7	8
Frequency	125	250	500	1000	2000	4000	8000
Total	57	49	47	40	36	30	27

- Unit data is certified in accordance with ARI 440.
- Coils are manufactured in accordance with ARI 410.
- Sound data tested in accordance with ARI 350-2000.
 - Total sound power level data based on Model VHC with fan CFM at corresponding motor tap with 115/1/60 volt motor, 4 row coil, 1" throwaway filter, 0.05" external static pressure and standard rated internal pressure losses.
- Unit pressure drop and CFM based upon dry coil as required by ARI 440.
- Scheduled motor information is for Hi Speed.
- The coil selection has been made at Standard conditions.
- Outside Airflow is a user input value for scheduling purposes.

Appendix H – Typical Guest Room Lighting Renderings

Base Case – Incandescent Lamps

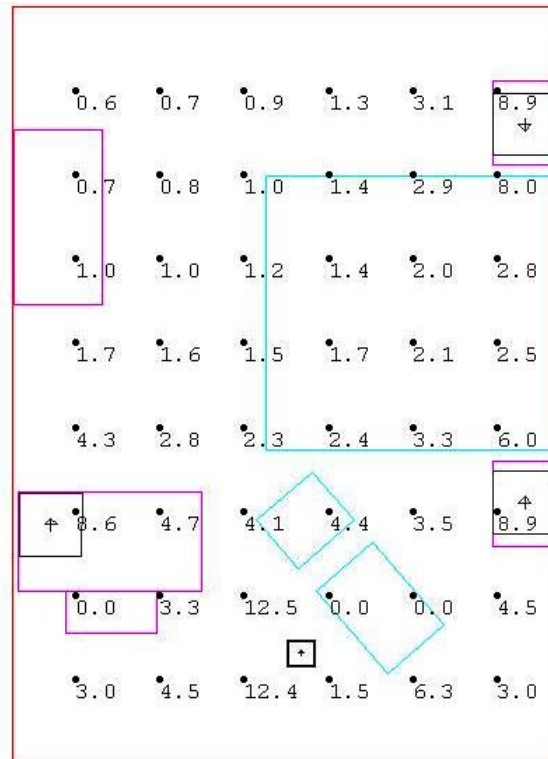
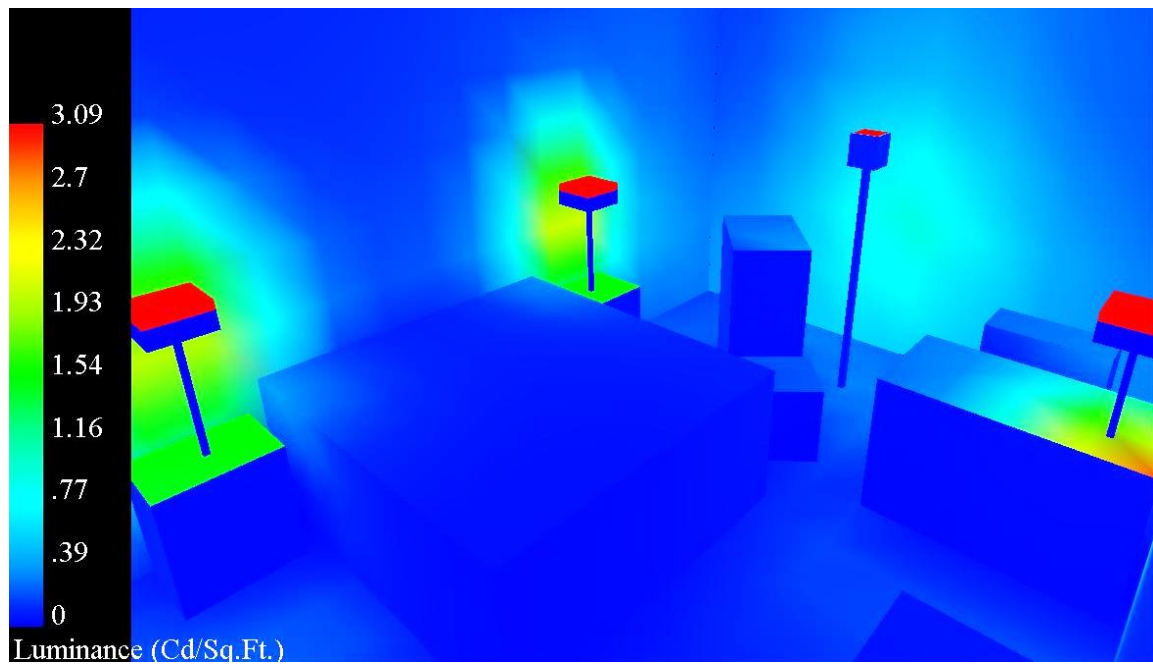
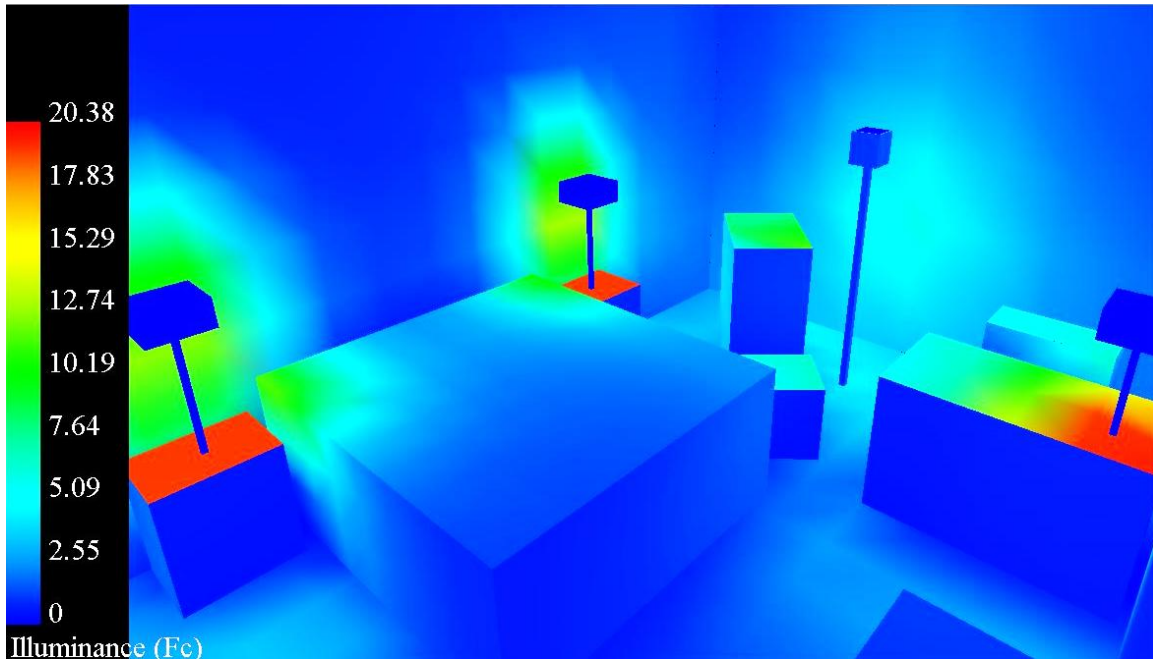
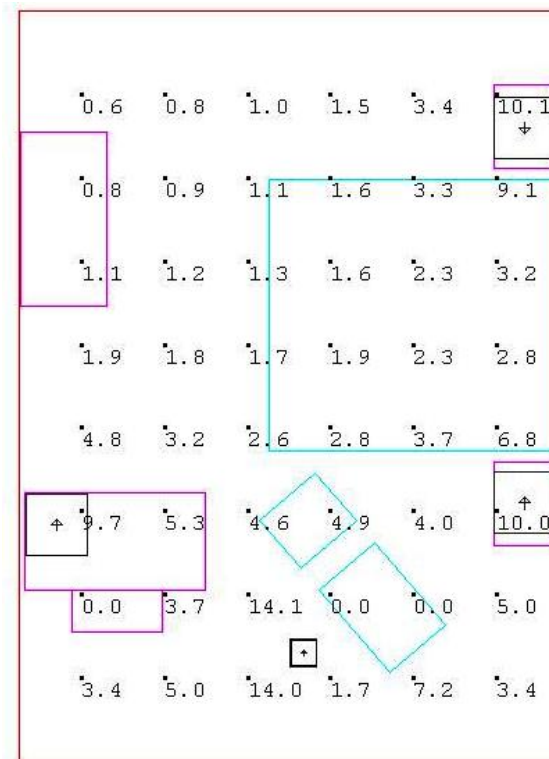
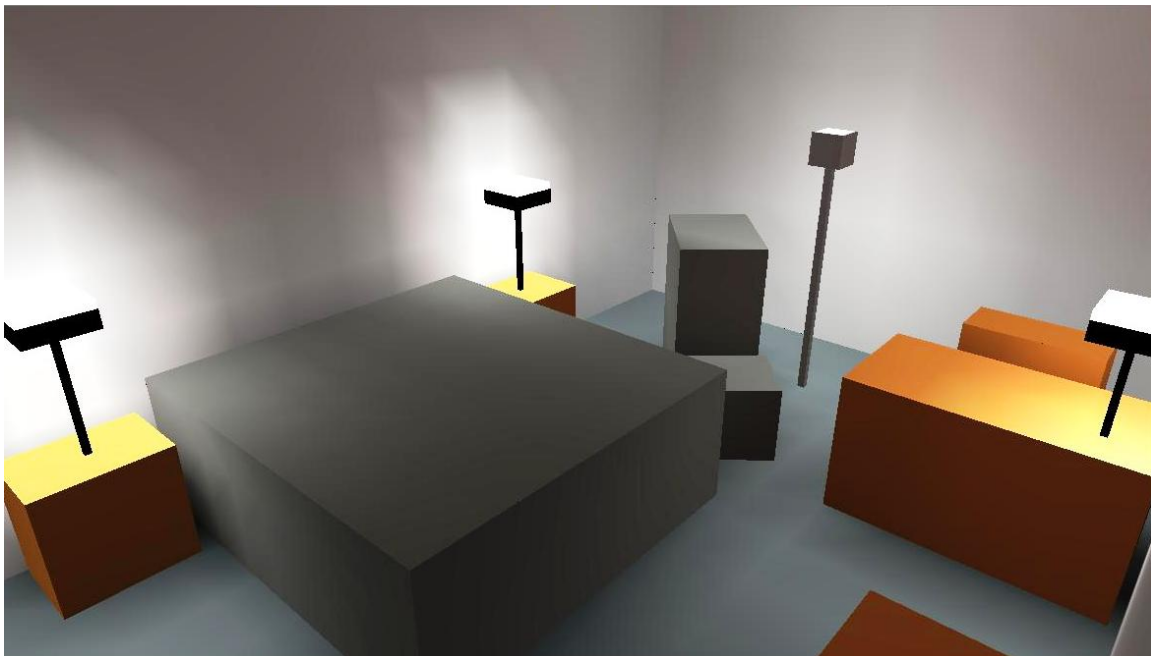


Figure H1 - Base Case Plan (footcandles)



Figure H2 - Base Case Rendering



Option 1 – Compact Fluorescent Lamps**Figure H5 - Option 1 Plan (footcandles)****Figure H6 - Option 1 Rendering**

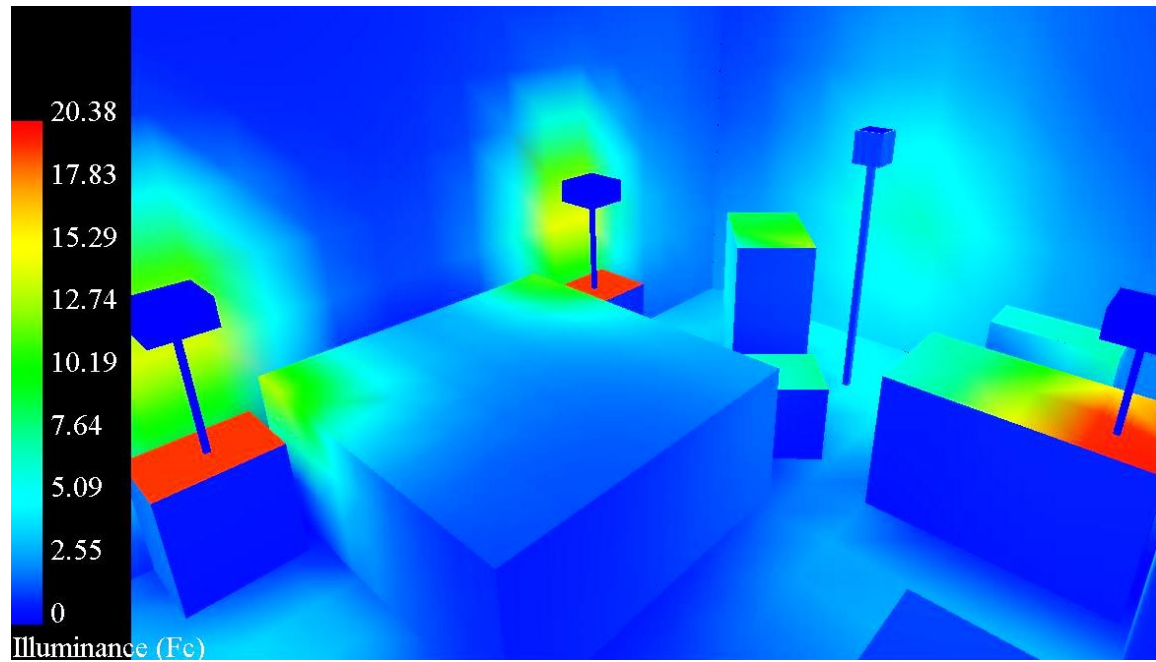


Figure H7 - Option 1 Illuminance

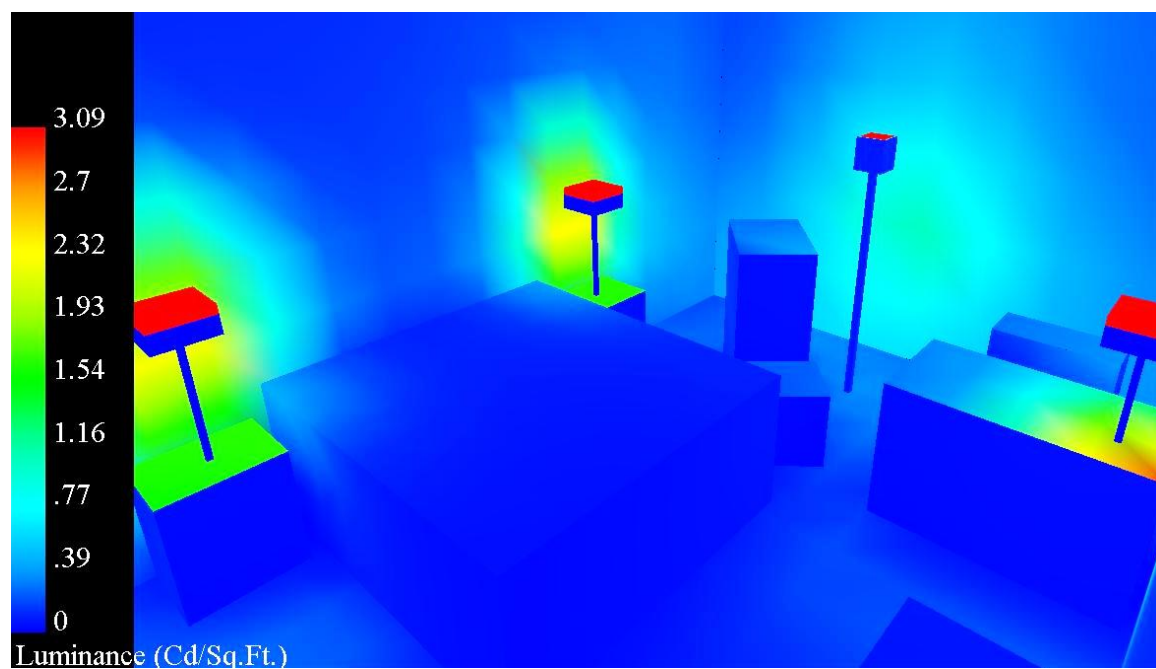


Figure H8 - Option 1 Luminance

Option 4 – Surface Mounted Spectral Fluted Disk

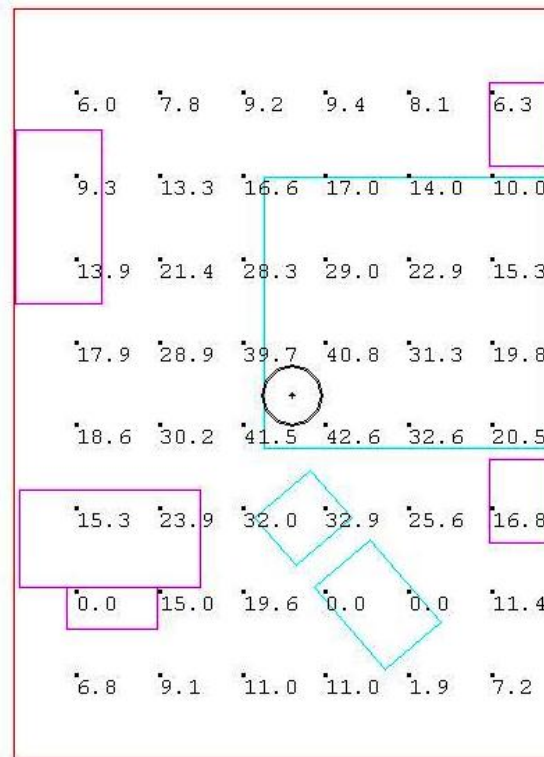


Figure H9 - Option 4 Plan (footcandles)



Figure H10 - Option 4 Rendering

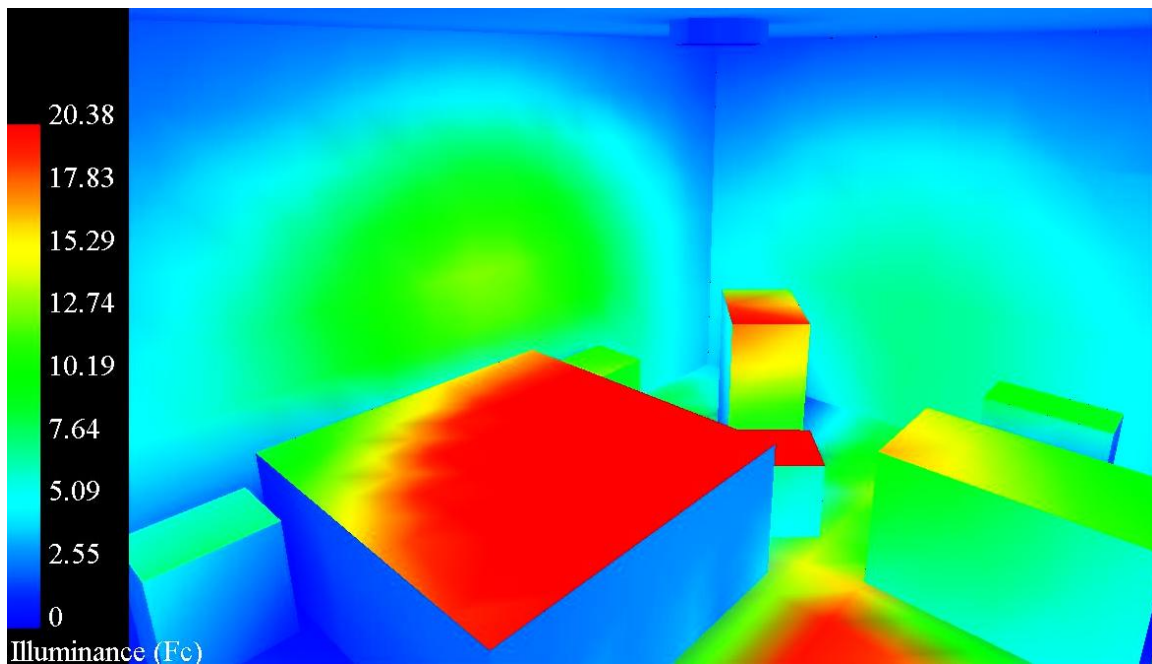


Figure H11 - Option 4 Illuminance

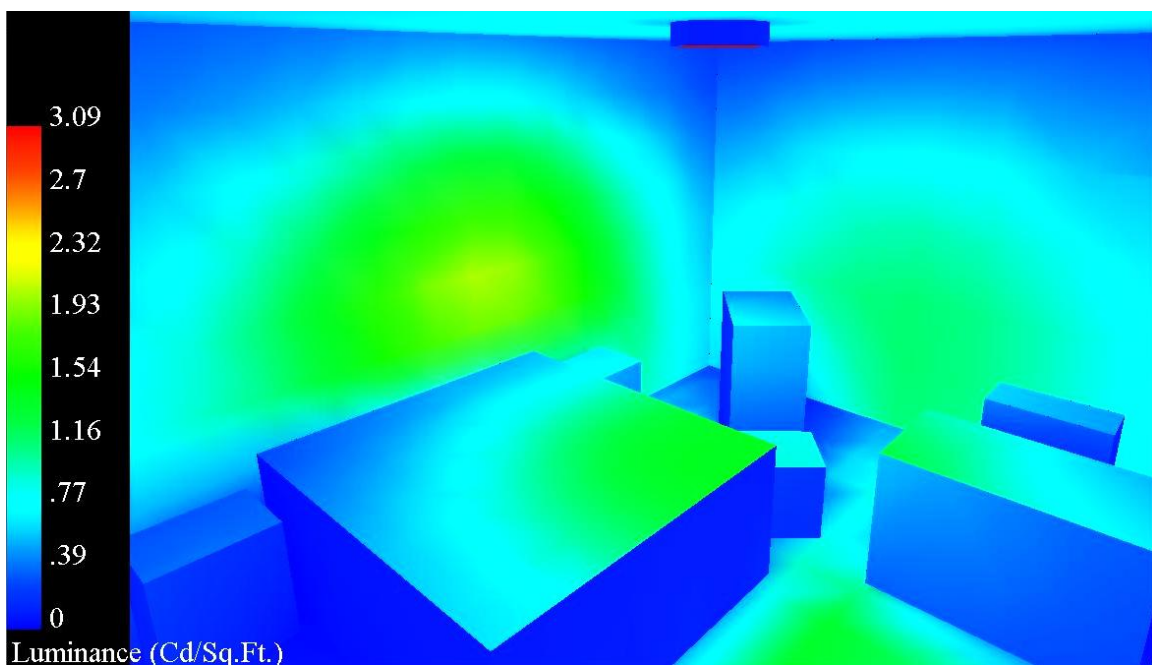
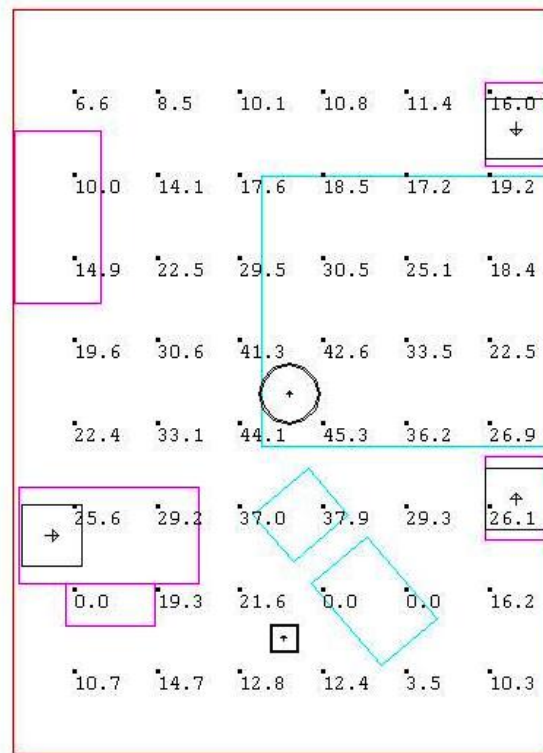
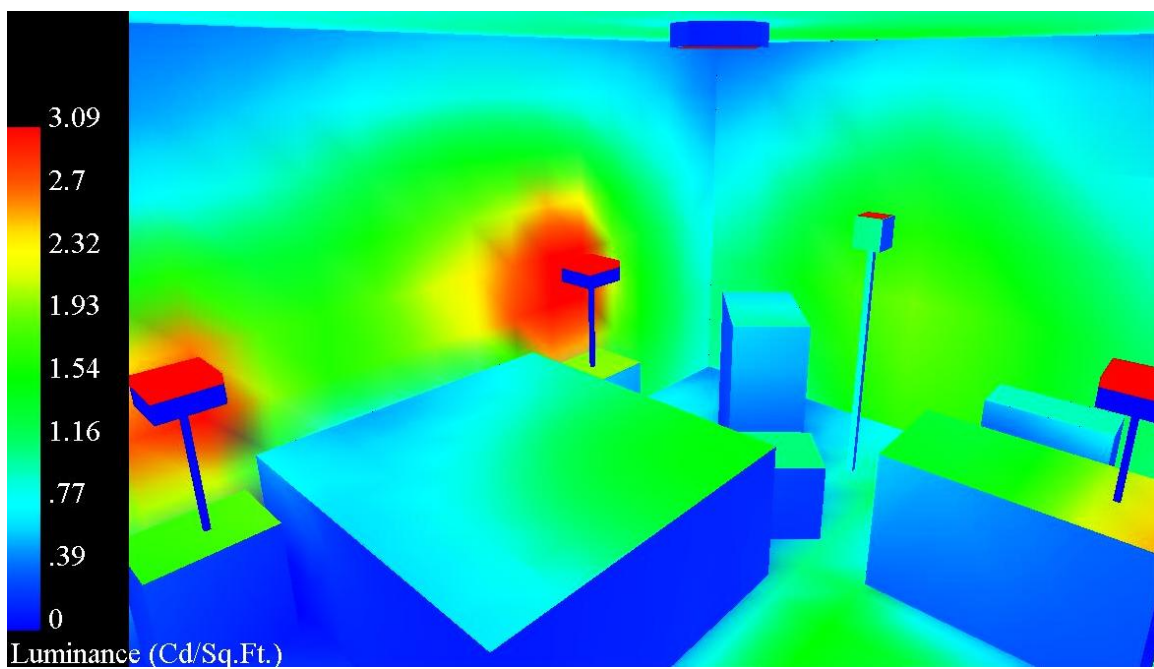
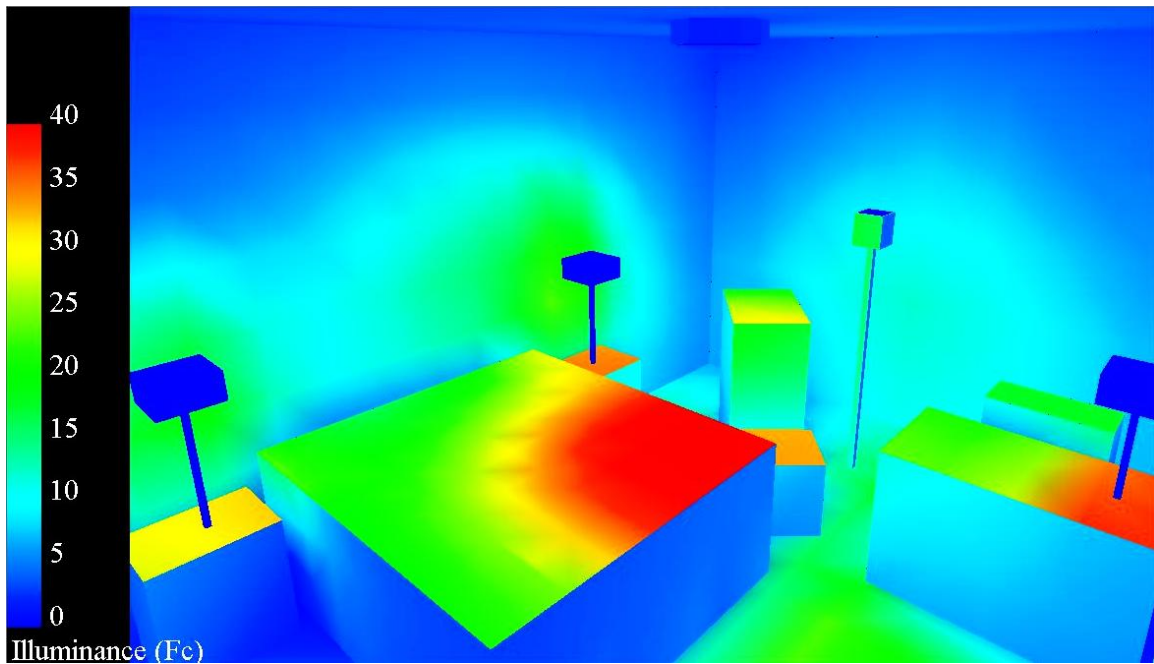


Figure H12 - Option 4 Luminance

Option 6 – Ceiling Fixture with Task Lighting**Figure H13 - Option 6 Plan (footcandles)****Figure H14 - Option 6 Rendering**



Appendix J – Lighting Selection

This appendix contains the cut sheets and other data for the manufacturer information provided for the lighting fixtures and lamps used as a part of the lighting breadth work. There is data from Philips and Lightolier included.

Please see the all the lighting information on the following pages.

DuraMax™

LONG LIFE **SOFT WHITE**



Ideal for table and floor lamps

► **Lasts At Least One Year!***

Tired of changing light bulbs that burn out too frequently? DuraMax™ Soft White light bulbs now last at least one year!

► **Provides Soft White Light**

Ideal for use in table and floor lamps.

► **Consumer Friendly Packaging**

Fresh, new packaging graphics make life, lumen and wattage information easy to find and read.

► **Full Family of Products**

Available in a variety of wattages, as well as popular 3-Way versions.

* See back page for details.



PHILIPS

Philips Lighting Company
200 Franklin Square Drive
P.O. Box 6800
Somerset, NJ 08875-6800
1-800-555-0050

A Division of Philips Electronics North America Corporation

Updated 7/04

www.philips.com

Philips Lighting
281 Hillmount Road
Markham, Ontario
Canada L6C 2S3
1-800-555-0050
A Division of Philips Electronics Ltd.

P-8493

DuraMax™ Long Life Soft White

Electrical, Technical and Ordering Data (Subject to change without notice)

DuraMax Product Number	Previous Product Number	Product Description	Bulb Finish	Nominal Watts	Bulb Type	Base Type	Volts	Published Lumens	Rated Avg Life (Hrs.)	Life, In Years*	M.O.L (In.)	Operating Position
A-Line Single Wattages												
168609	302562	15A/W/L 120V 12/2	Soft White	15	A-15	MED.	120	115	3000	2	3 1/2	ANY
168682	204339	25A/W/L 120V 12/2	Soft White	25	A-19	MED.	120	235	3000	2	4 7/16	ANY
168690	263723	40A/W/L 120V 12/4	Soft White	40	A-19	MED.	120	475	1500	1	4 7/16	ANY
167379	297754	40A/W/L 120V 24/4	Soft White	40	A-19	MED.	120	475	1500	1	4 7/16	ANY
168740	263764	60A/W/L 120V 12/4	Soft White	60	A-19	MED.	120	830	1500	1	4 7/16	ANY
167387	266023	60A/W/L 120V 24/4	Soft White	60	A-19	MED.	120	830	1500	1	4 7/16	ANY
168765	312140	60A/W/L/TP SR2 120V 12/8	Soft White	60	A-19	MED.	120	830	1500	1	4 7/16	ANY
168799	263814	75A/W/L 120V 12/4	Soft White	75	A-19	MED.	120	1040	1500	1	4 7/16	ANY
167395	266031	75A/W/L 120V 24/4	Soft White	75	A-19	MED.	120	1040	1500	1	4 7/16	ANY
168815	312157	75A/W/L/TP SR2 120V 12/8	Soft White	75	A-19	MED.	120	1040	1500	1	4 7/16	ANY
168625	263822	100A/W/L 120V 12/4	Soft White	100	A-19	MED.	120	1550	1500	1	4 7/16	ANY
167403	266064	100A/W/L 120V 24/4	Soft White	100	A-19	MED.	120	1550	1500	1	4 7/16	ANY
168633	312173	100A/W/L/TP SR2 120V 12/8	Soft White	100	A-19	MED.	120	1550	1500	1	4 7/16	ANY
168666	204438	150A/W/L 120V 12/1	Soft White	150	A-21	MED.	120	2310	2000	1	5 5/16	ANY
168674	389395	200A/W/L 120V 6/1	Soft White	200	A-21	MED.	120	3300	1500	1	5 5/16	ANY
168674	204479	200A/W/L 120V 6/1	Soft White	200	A-21	MED.	120	3300	1500	1	5 5/16	ANY
Case Pk—Single Wattage												
168773	391540	60A/W/L 120V 120/4	Soft White	60	A-19	MED.	120	830	1500	1	4 7/16	ANY
168823	389403	75A/W/L 120V 120/4	Soft White	75	A-19	MED.	120	1040	1500	1	4 7/16	ANY
168641	389387	100A/W/L 120V 120/4	Soft White	100	A-19	MED.	120	1550	1500	1	4 7/16	ANY
Display—Single Wattage												
167189	291716	PAM60AW/L 60/75/100 120V 1/240	Soft White	60, 75, 100	A-19	MED.	120	830, 1040, 1550	1500	1	4 7/16	ANY
A-Line—3-Way Wattages												
169474	204511	30/100A/W/L 120V 12/1	Soft White	30/70/100	A-21	3CT. MED.	120	285/920/1205	1750	1	5 5/16	BASE DOWN
169482	204537	50/150A/W/L 120V 12/1	Soft White	50/100/150	A-21	3CT. MED.	120	575/1440/2015	1750	1	5 5/16	BASE DOWN
169565	293597	50/150A/W/L 120V 12/2	Soft White	50/100/150	A-21	3CT. MED.	120	575/1440/2015	1750	1	5 5/16	BASE DOWN
169532	267963	50/150A/W/L 120V 4/3	Soft White	50/100/150	A-21	3CT. MED.	120	575/1440/2015	1750	1	5 5/16	BASE DOWN
169490	204545	50/250A/W/L 120V 12/1	Soft White	50/200/250	A-21	3CT. MED.	120	575/3120/3695	1750	1	5 5/16	BASE DOWN
Display—3 Way Wattage												
167171	277533	50/150A/W/L 120V 48/1	Soft White	50/100/150	A-21	3CT. MED.	120	575/1440/2015	1750	1	5 5/16	BASE DOWN

Shipping Data (Subject to change without notice)

DuraMax Product Number	Product Description	UPC Code	Outer Bar Code	Lamps Per SKU	Case Qty. Per SKU	Case Wt. (lbs.)	Case Cube (cu. ft.)	Pallet Qty. Per SKU	Pallet Qty. Per Case	Pallet Wt. (lbs.)	Pallet Cube (cu. ft.)	SKUs Per Layer	Layers High	SKU Dimension (in.) W x D x H	Case Dimension (in.) W x D x H	Pallet Dimension (in.) W x D x H
A-Line Single Wattages																
168609	15A/W/L 120V 12/2	16860 5	16860 0	2	12/2	2	0.22	2520	210	420.0	46.20	252	10	3.4 x 2.1 x 3.6	13.1 x 7.1 x 4.2	49.4 x 39.2 x 41.9
168682	25A/W/L 120V 12/2	16868 1	16868 6	2	12/2	2	0.39	1800	150	300.0	58.50	180	10	3.9 x 2.6 x 4.6	16.1 x 8.1 x 5.2	48.4 x 40.7 x 51.9
168690	40A/W/L 120V 12/4	16869 8	16869 3	4	12/4	4	0.65	1008	84	336.0	54.60	144	7	4.9 x 2.5 x 6.5	15.4 x 10.4 x 7.0	46.1 x 41.5 x 49.0
167379	40A/W/L 120V 24/4	16869 8	16737 5	4	24/4	9	1.25	864	36	324.0	45.00	288	3	4.9 x 2.5 x 6.5	15.4 x 10.4 x 13.5	46.1 x 41.5 x 40.5
168740	60A/W/L 120V 12/4	16874 2	16874 7	4	12/4	4	0.65	1008	84	336.0	54.60	144	7	4.9 x 2.5 x 6.5	15.4 x 10.4 x 7.0	46.1 x 41.5 x 49.0
167387	60A/W/L 120V 24/4	16874 2	16738 2	4	24/4	9	1.25	864	36	324.0	45.00	288	3	4.9 x 2.5 x 6.5	15.4 x 10.4 x 13.5	46.1 x 41.5 x 40.5
168765	60A/W/L/TP SR2 120V 12/8	16876 6	16876 1	8	12/8	9	1.25	432	36	324.0	45.00	144	3	9.8 x 2.5 x 6.5	15.4 x 10.4 x 13.5	46.1 x 41.5 x 40.5
168799	75A/W/L 120V 12/4	16879 7	16879 2	4	12/4	4	0.65	1008	84	336.0	54.60	144	7	4.9 x 2.5 x 6.5	15.4 x 10.4 x 7.0	46.1 x 41.5 x 49.0
167395	75A/W/L 120V 24/4	16879 7	16739 9	4	24/4	9	1.25	864	36	324.0	45.00	288	3	4.9 x 2.5 x 6.5	15.4 x 10.4 x 13.5	46.1 x 41.5 x 40.5
168815	75A/W/L/TP SR2 120V 12/8	16881 0	16881 5	8	12/8	9	1.25	432	36	324.0	45.00	144	3	9.8 x 2.5 x 6.5	15.4 x 10.4 x 13.5	46.1 x 41.5 x 40.5
168625	100A/W/L 120V 12/4	16862 9	16862 4	4	12/4	4	0.65	1008	84	336.0	54.60	144	7	4.9 x 2.5 x 6.5	15.4 x 10.4 x 7.0	46.1 x 41.5 x 49.0
167403	100A/W/L 120V 24/4	16862 9	16740 5	4	24/4	9	1.25	864	36	324.0	45.00	288	3	4.9 x 2.5 x 6.5	15.4 x 10.4 x 13.5	46.1 x 41.5 x 40.5
168633	100A/W/L/TP SR2 120V 12/8	16863 6	16863 1	8	12/8	9	1.25	432	36	324.0	45.00	144	3	9.8 x 2.5 x 6.5	15.4 x 10.4 x 13.5	46.1 x 41.5 x 40.5
168666	150A/W/L 120V 12/1LP	16866 7	16866 2	1	12/1	1.9	0.38	1536	128	243.2	48.64	192	8	2.8 x 2.8 x 5.4	11.9 x 9.1 x 6.1	47.5 x 36.2 x 49.0
168674	200A/W/L 120V 6/1	16867 4	16867 9	1	6/1	1.4	0.20	1536	256	358.4	51.20	192	8	2.8 x 2.8 x 5.4	9.2 x 6.1 x 6.1	49.0 x 36.8 x 49.0
Case Pk—Single Wattage																
168773	60A/W/L 120V 120/4	16874 2	16877 8	4	120/4	43	6.87	720	6	258.0	41.22	720	1	4.9 x 2.5 x 6.5	21.0 x 16.8 x 33.8	50.3 x 42.0 x 33.8
168823	75A/W/L 120V 120/4	16879 7	16882 2	4	120/4	43	6.87	720	6	258.0	41.22	720	1	4.9 x 2.5 x 6.5	21.0 x 16.8 x 33.8	50.3 x 42.0 x 33.8
168641	100A/W/L 120V 120/4	16862 9	16864 8	4	120/4	43	6.87	720	6	258.0	41.22	720	1	4.9 x 2.5 x 6.5	21.0 x 16.8 x 33.8	50.3 x 42.0 x 33.8
Display—Single Wattage																
167189	PAM60AW/L 60/75/100 120V 1/240	**	16718 4	4	60/4	22.6	3.22	720	12	271.2	38.64	180	4	4.9 x 2.5 x 6.5	32.9 x 15.4 x 11.0	46.1 x 32.9 x 44.0
A-Line—3 Way Wattages																
169474	30/100A/W/L 120V 12/1	16947 3	16947 8	1	12/1	1.9	0.38	1536	128	243.2	48.64	192	8	2.8 x 2.8 x 5.4	11.9 x 9.1 x 6.1	47.5 x 36.2 x 49.0
169482	50/150A/W/L 120V 12/1	16948 0	16948 5	1	12/1	1.9	0.38	1536	128	243.2	48.64	192	8	2.8 x 2.8 x 5.4	11.9 x 9.1 x 6.1	47.5 x 36.2 x 49.0
169565	50/150A/W/L 120V 12/2	16956 5	16956 0	2	12/2	3	0.56	1152	96	288.0	53.76	144	8	4.3 x 2.8 x 5.6	13.1 x 12.1 x 6.1	48.2 x 39.2 x 49.0
169532	50/150A/W/L 120V 4/3	16953 4	16953 5	3	4/3	1.9	0.38	1536	128	243.2	48.64	64	8	2.8 x 2.8 x 5.4	11.9 x 9.1 x 6.1	47.5 x 36.2 x 49.0
169490	50/250A/W/L 120V 12/1	16949 7	16949 2	1	12/1	1.9	0.38	1536	128	243.2	48.64	192	8	2.8 x 2.8 x 5.4	11.9 x 9.1 x 6.1	47.5 x 36.2 x 49.0
Display—3 Way Wattage																
167171	50/150A/W/L 120V 48/1	16948 0	16717 7	1	48/1	10.6	2.59	720	15	159.0	38.85	144	5	2.8 x 2.8 x 5.4	14.8 x 11.9 x 17.3	47.8 x 41.6 x 51.9

* Based on 4 hours usage per day/7 days per week

** See "Case Pk—Single Wattage" for UPC code of each product.



Marathon[™]

**ENERGY SAVER
TABLE LAMP**



***Ideal for table and standing
floor lamps***

► **Provides Soft, White Light**

► **Fits into Standard
Incandescent Sockets**

► **Super Long Life**

Lasts 5 years, based on 3–4 hours average daily usage, 7 days per week (up to 7 times longer than standard incandescent lamps)

► **Energy Savings**

Saves up to 70% in electricity costs compared to standard incandescent lamps

► **ENERGY STAR[®] Qualified**

For more information on ENERGY STAR, visit www.energystar.gov



PHILIPS

Marathon™ Table Lamp

Electrical, Technical and Ordering Data (Subject to change without notice)

Product Number	Description	Volts	Nom. Watts	Approx. Incand. Equiv./Lumens	Base	Color Temp. (Kelvin)	CRI	Approx. Initial Lumens	MOL (In.)	Rated Avg. Life (Hrs.) ¹	Min. Starting Temp. (°F) ²	Max. Ambient Temp. (°F)	Lumen Maint. ³
37082-5	Marathon Table Lamp EL/T 34	120	34	120W/1848	Med. (E26)	2700K	82	2100	6.2	7000	-10°F/-20°C	120°F/48°C	85%
37084-1	Marathon Table Lamp BC-EL/T 34	120	34	120W/1848	Med. (E26)	2700K	82	2100	6.2	7000	-10°F/-20°C	120°F/48°C	85%
37086-6	Marathon Table Lamp BC-EL/T 34 Canada	120	34	120W/1848	Med. (E26)	2700K	82	2100	6.2	7000	-10°F/-20°C	120°F/48°C	85%

Shipping Data

Product Number	SKU UPC (0-46677)	Outer Bar Code (5-00-46677)	Case Qty.	Case Weight (lbs.)	Case Cube (cu. ft.)	Pallet Qty.	SKUs Per Layer	Layers High	SKU Dimensions (W x D x H) (In.)	Case Dimensions (W x D x H) (In.)	Pallet Dimensions (W x D x H) (In.)
37082-5	37082-4	37082-9	6	2.0	0.20	1440	240	6	2.6 x 2.6 x 6.3	5.8 x 8.3 x 7.3	45.5 x 41.5 x 43.9
37084-1	37084-8	37084-3	6	3.0	0.67	384	96	4	5.36 x 2.69 x 9.91	6.1 x 18.1 x 10.6	36.3 x 48.5 x 42.3
37086-6	37084-8	37086-7	6	3.0	0.67	384	96	4	5.36 x 2.69 x 9.91	6.1 x 18.1 x 10.6	36.3 x 48.5 x 42.3

1) Do not use in recessed cans or totally enclosed indoor fixtures. Use base down only.

2) Suitable for indoor or outdoor use down to -10°F. UL listed for damp locations. Outdoor use requires an enclosed or weather-protected fixture.

3) Percentage of initial lumens at 40% of rated average life (2800 hours).

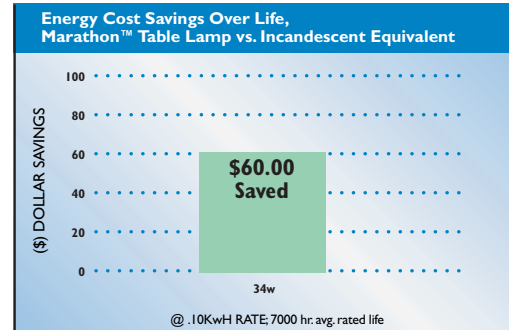
Marathon™											
Bulb Type	Bulb Shape	Wattage Comparison*	Table/Floor Lamps	Outdoor Post Lights	Wall Sconce	Surface Mount	Enclosed Indoor Fixture	Reading Lamp	Border Lights	Recessed Lighting	Open Hanging
UNIVERSAL		15/20/25 = 60/75/100	✓	✓	✓	✓	✓	✓	✓	✓	✓
DECO, TWISTER		15/20/23 = 60/75/90	✓		✓			✓			✓
MINI-DECO, TWISTER		15 = 60	✓		✓			✓			✓
HOUSEHOLD		20 = 75	✓	✓	✓			✓			✓
MINI-HOUSEHOLD		16 = 60	✓	✓	✓			✓	✓		✓
3-WAY		18/26/34 = 60/90/150	✓								
DIMMABLE		15/20/23 = 60/75/90	✓		✓					✓	✓
TABLE		34 = 120	✓		✓			✓			
OUTDOOR		15 = 60 18 = 75		✓							✓
BUG-A-WAY		15 = 60		✓							✓
FLOOD		15 = 65 20 = 85								✓	✓
REFLECTOR FLOOD		16 = 65								✓	✓
DIMMABLE FLOOD		20 = 85								✓	✓
DÉCOR GLOBE		16 = 75 20 = 100									✓
VANITY GLOBE		12 = 40									✓

*Comparison shows Marathon wattage(s) and their equivalent to standard incandescent bulb wattages(s).

CAUTION: Risk of electric shock—do not use where directly exposed to water, rain or snow. Do not use with dimmers.

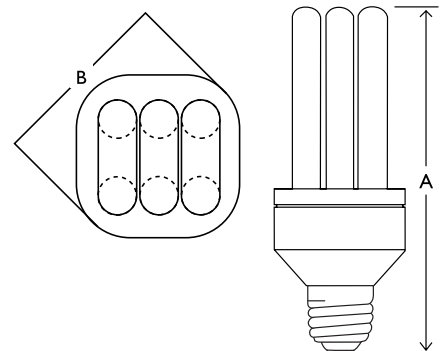
Before using this product with electronic timing or photocell devices, check to determine whether device is compatible with electronic compact fluorescent lamps. Use with incompatible devices will cause premature lamp failure. Do not use in recessed cans or totally enclosed indoor fixtures. Use base down only.

This product complies with Part 18 of the FCC rules. These products may cause interference with radios, cordless telephones, and remote control devices. Interference may cease after a brief 90 second lamp warm-up period. If interference continues, relocate the lamp away from the device or plug into a different outlet.



Lamp Dimensions

	EL/T 34
MOL A	6.2"/157mm
Max. Diameter B	2.6"/66mm
Weight (oz./g)	4.8 oz./135g
Lamp Harp Fit	9"



Philips Marathon® Energy Saver Decorative Twister



Ideal for light fixtures where a smaller bulb size is desired, including table lamps, wall sconces and open ceiling fixtures

► **Similar Light Output as Standard Incandescent Light Bulbs**

► **Compact Size**

Reduced size fits many smaller fixtures

► **Instant On**

Excellent starting performance and fast light run-up time

► **Super Long Life**

Lasts 6 years, based on 3–4 hours average daily usage, 7 days per week (up to 13 times longer than standard incandescent lamps)

► **Terrific Energy Savings**

Saves up to \$86 over the life of the lamp compared to standard incandescent lamps¹—a real impact to your bottom line!

► **ENERGY STAR® Qualified²**

1) Energy savings based on 8,000 hours per year at \$0.10 kWh/hr.

2) As an ENERGY STAR® Partner, Philips has determined that these products meet the ENERGY STAR guidelines for energy efficiency.



PHILIPS

Philips Marathon™ Energy Saver Decorative Twister

Electrical, Technical and Ordering Data (Subject to change without notice)

Product Number	Description	Volts	Nom. Watts	Approx. Incand. Equiv.	Base	Color Temp. (Kelvin)	CRI	Approx. Initial Lumens ¹	MOL (In.)	Diam. (In.)	Rated Avg. Life (Hrs.) ²	Power Factor	Lamp Current (mAmps)	Min. Starting Temp.	Max. Ambient Temp.
13804-0	Mini Dec Twister EL/mdT 11W	120	11	40A19	Med.	2700K	82	675	4%	2.65	8000	.50-.60	150	-10°F/-20°C	120°F/48°C
13581-4	Mini Dec Twister EL/mdT 15W	120	15	60A19	Med.	2700K	82	900	4%	2.65	10,000	.50-.60	220	-10°F/-20°C	120°F/48°C
13805-7	Mini Dec Twister EL/mdT 20W	120	20	75A19	Med.	2700K	82	1250	5%	2.65	10,000	.50-.60	290	-10°F/-20°C	120°F/48°C
13715-8	Mini Dec Twister EL/mdT 27W	120	27	100A19	Med.	2700K	82	1750	5%	3.00	10,000	.50-.60	390	-10°F/-20°C	120°F/48°C
13948-5	Decorative Twister EL/dT 42W	120	42	150A19	Med.	2700K	82	2600	7%	3.20	8000	.50-.60	390	-10°F/-20°C	120°F/48°C

Shipping Data (Subject to change without notice)

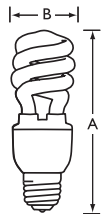
Product Number	SKU UPC (0-46677)	Outer Bar Code (5-00-46677)	Case Qty.	Case Weight (lbs.)	Case Cube (cu. ft.)	Pallet Qty.	SKUs Per Layer	Layers High	SKU Dimensions (W x D x H) (In.)	Case Dimensions (W x D x H) (In.)	Pallet Dimensions (W x D x H) (In.)
13804-0	138042	138047	6	1.2	.55	540	108	5	5.0 x 2.7 x 8.1	5.75 x 18.6 x 8.9	48.8 x 40 x 44.7
13581-4	135812	135817	6	1.2	.55	540	108	5	5.0 x 2.7 x 8.1	5.75 x 18.6 x 8.9	48.8 x 40 x 44.7
13805-7	138059	138054	6	1.2	.55	540	108	5	5.0 x 2.7 x 8.1	5.75 x 18.6 x 8.9	48.8 x 40 x 44.7
13715-8	137151	137156	6	1.2	.55	540	108	5	5.0 x 2.7 x 8.1	5.75 x 18.6 x 8.9	48.8 x 40 x 44.7
13948-5	139483	139488	6	2.7	.93	240	60	4	6.9 x 3.2 x 9.6	10.3 x 21 x 7.3	43.1 x 36.3 x 41

1) Approximate initial lumens. The lamp lumen output is based upon lamp performance after 100 hours of operating life under standard laboratory conditions.

2) Average life under specified test conditions with lamps turned off and restarted no more frequently than once every 3 operating hours. Use in recessed cans or enclosed indoor fixtures could result in reduced lamp life.

ENERGY STAR®

Marathon® Bulb Type	Table/Floor Lamp	Outdoor Postlight	Wall Sconce	Surface Mount	Reading Lamp	Border Lights	Recessed Fixture	Open Hanging	Vanity Strip
Decorative Twister	●	●	●	●	●	●	●	●	●
Universal	●	●	●	●	●	●	●	●	●
Table Lamps	●	●	●	●	●	●	●	●	●
Dimmable	●	●	●	●	●	●	●	●	●
3-Way	●	●	●	●	●	●	●	●	●
Reflector Flood	●	●	●	●	●	●	●	●	●
Dimmable Reflector Flood	●	●	●	●	●	●	●	●	●
Candle	●	●	●	●	●	●	●	●	●
Vanity & Décor Globe	●	●	●	●	●	●	●	●	●
Soft White Plus	●	●	●	●	●	●	●	●	●
Outdoor	●	●	●	●	●	●	●	●	●
Bug-A-Way	●	●	●	●	●	●	●	●	●
Circline Adapter System	●	●	●	●	●	●	●	●	●



Lamp Dimensions

	11W	15W	20W	27W	42W
MOL A	4.49"	4.49"	5.24"	5.43"	7.08"
Max. Diameter B	2.65"	2.65"	2.65"	3.00"	3.20"

CAUTION: Risk of electric shock—do not use where directly exposed to water, rain or snow. Do not use with dimmers.

Before using this product with electronic timing or photocell devices, check to determine whether device is compatible with electronic compact fluorescent lamps. Use with incompatible devices will cause premature lamp failure. Do not use in totally enclosed indoor fixtures.

This product complies with Part 18 of the FCC rules. These products may cause interference with radios, cordless telephones, and remote control devices. Interference may cease after a brief 90 second lamp warm-up period. If interference continues, relocate the lamp away from the device or plug into a different outlet.

Energy Cost Savings Over Life

42W Marathon® Twister vs.
 150W Standard Incandescent Lamps Operated
 for an Equivalent Number of Hours

Energy savings based on \$.10 kW/hr

150W Incandescents 42W Marathon Twister



SILHOUETTE™ Series T5 Circular Fluorescent Lamps

Ultra-slim lamps with improved color rendering, higher efficacy and longer life



*Ideal for decorative
and architectural lighting*



► Slim Profile Lamp and Ballast

- T5 diameter tube, available in 9" and 12" sizes
- Fixtures can be 45% smaller than T9 Circline systems

► Trichromatic Phosphors

- 85 CRI
- 85% lumen maintenance
- Available in 3000, 3500 and 4100K

► High Lamp Efficacy

- Up to 83 lumens per watt

► 33% Longer Life than T9 Circline Lamps

- 16,000 hours rated average life

► Operates on Programmed Start Electronic Ballasts

- High system efficacy
- Quiet, flicker-free operation
- Dimmable

PHILIPS

SILHOUETTE™ Series Circular Fluorescent Lamps

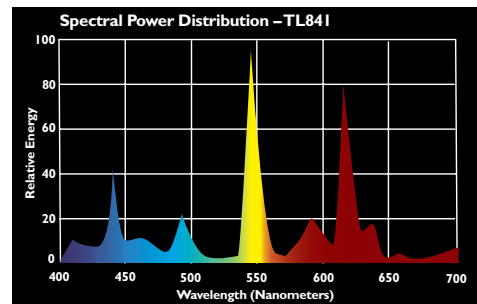
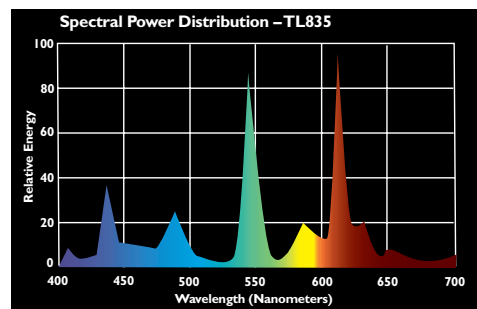
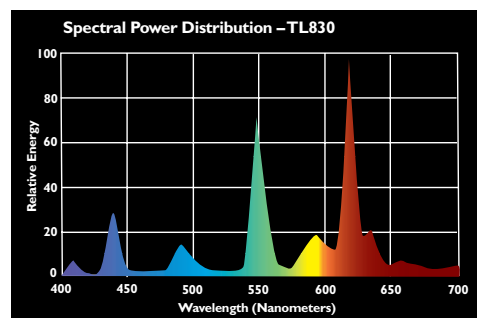
Electrical, Technical and Ordering Data (Subject to change without notice)

Product Number	Description	Nominal Watts	Bulb	Base	Std. Pkg. Qty.	Color Temp. (K)	Color Rendering (CRI)	Max. Outer Diameter (Inches)	Rated Life (Hours) ⁽¹⁾	Initial Lumens	Design Lumens ⁽²⁾
29010-6	FC9T5/830	22	T5	2GX13	10	3000	85	9	16,000	1800	1530
29011-4	FC9T5/835	22	T5	2GX13	10	3500	85	9	16,000	1800	1530
29012-2	FC9T5/841	22	T5	2GX13	10	4100	85	9	16,000	1800	1530
29014-8	FC12T5/830	40	T5	2GX13	10	3000	85	12	16,000	3300	2805
29016-3	FC12T5/835	40	T5	2GX13	10	3500	85	12	16,000	3300	2805
29017-1	FC12T5/841	40	T5	2GX13	10	4100	85	12	16,000	3300	2805

(1) Average rated life under specified test conditions with lamps turned off and restarted once every 3 operating hours.

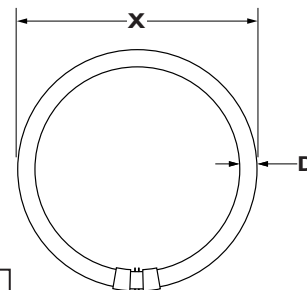
(2) Approximate lumens at 40% of rated average life (6400 Hours).

Spectral Power Distribution



Lamp Dimensions

Lamp Type	X		D	
	inches	mm	inches	mm
FC9T5	8.8	225.0	0.63	16.0
FC12T5	11.79	300.0	0.63	16.0

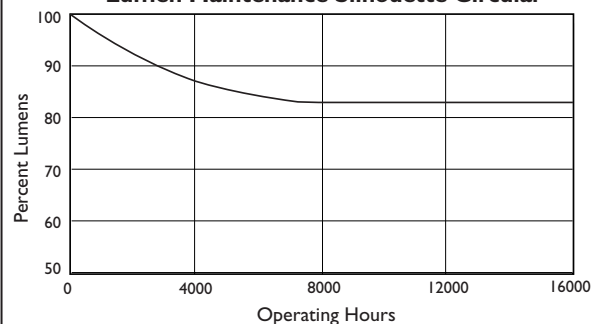


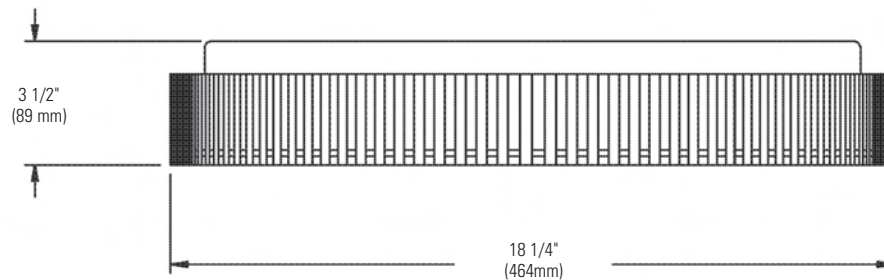
SILHOUETTE Lamp Specification

Lamps shall be Philips Silhouette Circular T5 lamps having:

- ▶ Color rendering index of 85
- ▶ T5 diameter bulb
- ▶ 2GX13 bases
- ▶ Color temperature of _____ K (3000, 3500 or 4100)
- ▶ Initial lumens of _____ (1800 or 3300)
- ▶ Design lumens of _____ (1530 or 2805)
- ▶ Nominal wattage of _____ (22 or 40)
- ▶ Powered by electronic ballasts

Lumen Maintenance Silhouette Circular





Ordering Guide (complete unit only)

Cat. No.	Lamp (circular)	Volt	Finish
SL203APZU	1-22W / 1-40W CT5	120/277V	Anodized Aluminum & Sand Blasted Glass

Features

- Form:** Round form fabricated from slitted corrugated anodized aluminum. Slits hold the sand blasted glass and reflector element. The illuminated edge of the glass is visible through the corrugations.
- Glass:** Center sand blasted glass with clear outer ring. Image of lamps seen through the glass to create a geometric pattern on the wall or ceiling.
- Housing:** Spun painted steel construction. Mounting plate houses the ballast and lamp sockets.

Mounting

Mounting: Surface mounting to wall or ceiling surfaces.

Lamp Change: Fluted housing simply twists-off. Held in place by 3 locking pins.

Luminaire Weight: 10.5 lbs.

Electrical

Ballast: Electronic Program Rapid Start T5 circular lamps ballast. Universal voltage "U" ballast automatically detect 120 volts or 277 volts operation. Ballast use cathode heater shut-off to increase T5 round lamp life.

Lampholder: 2GX13 base, 4 Pin.

Options and Accessories

Double Switching: Consult your Lightolier representative for more information.

Perforated Form: Consult your Lightolier representative for more information.

Dimming Ballast: Consult your Lightolier representative for more information.

Finish

Anodized corrugated aluminum sheet with precise flutes. All painted parts are with powder coat paint process.

Labels

UL "c/us" Listed. Suitable for damp locations.

Job Information

Type:

Job Name:

Cat. No.:

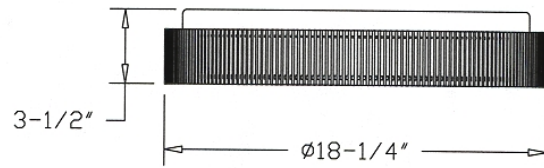
Lamp(s):

Notes:

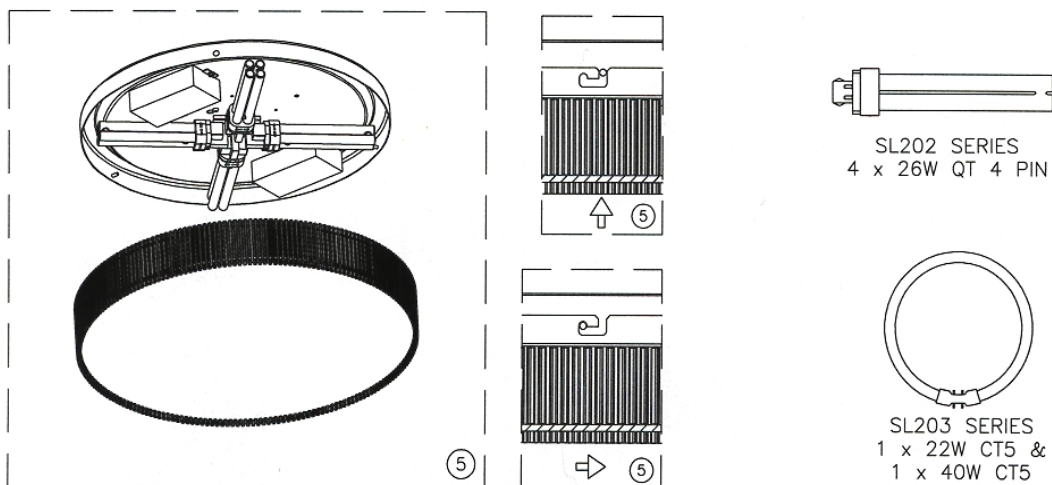
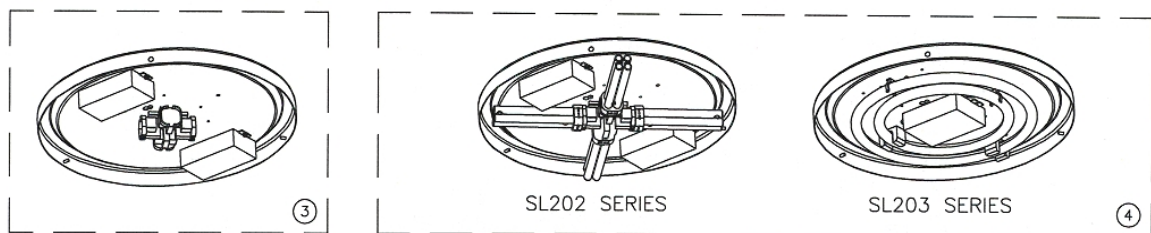
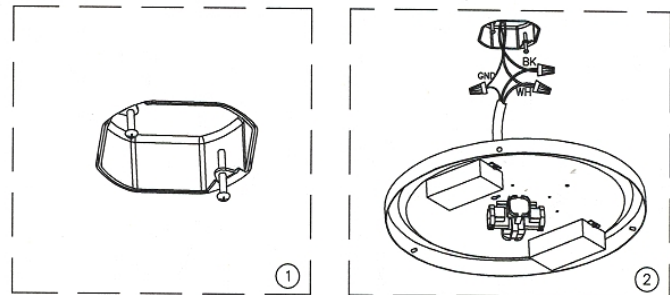
INSTALLATION INSTRUCTIONS

READ AND UNDERSTAND THESE INSTRUCTIONS BEFORE INSTALLING

Turn off electricity at fuse box before proceeding. Consult a qualified electrician to ensure that this luminaire is installed with the local application code. RETAIN THESE INSTRUCTIONS FOR MAINTENANCE REFERENCE.



1. POSITION THE SCREWS ON THE OCTAGONAL BOX.
2. GROUND THE LUMINAIRE WITH THE GREEN WIRES. CONNECT THE WHITE (NEUTRAL) WIRES TOGETHER AND THE BLACK (120V OR 277V) OR RED (347V) TOGETHER.
3. INSTALL THE LUMINAIRES OVER THE OCTAGONAL BOX.
4. INSTALL THE LAMPS IN THE LUMINAIRE.
5. ALIGN THE PIN IN THE CANOPY WITH THE SLOT ON THE GLASS HOUSING PUSH UP AND TURN TO LOCK.



Appendix K – Acoustical Analysis

This appendix contains the cut sheets and other data for the manufacturer information provided for chillers, fan coil units, and cooling towers used as a part of the acoustical breadth work. There is data from York, Carrier, and Marley included.

Please see the all the acoustical information on the following pages.



Issue Date: 03/06
 Project: Project
 Engineer: Sales Eng
 Customer: customer

Program: LTC
 Rev: v1_57.idd
 Date: 03/29/06
 Page: 2 of 2

MODEL	YKACADQ3-CKF	(MOTOR SELECTED BY USER)	
REFRIGERANT	134A	GEAR CODE	XC(SPEC)
RATED CAPACITY (TR)	350	SPECIFIED CAPACITY (TR)	350
INPUT POWER (KW)	216	MAX MOTOR LOAD (KW)	213
VOLTAGE / HZ	460 / 60		
ORIFICE (VARY)	VALVE:2	DIFFUSER	FIXED
FLA	311	LRA	1950
MIN CIR. AMPS.	388	MAX C.B.	600
FULL LOAD (kW/TR)	0.617	NPLV	0.381

STARTER TYPE (10) VARIABLE SPEED DRIVE

	Evaporator	Condenser
FLUID	WATER*	WATER*
% BY WEIGHT	0.0*	0.0*
TUBE MTI NO.	271*	260*
PASSES	2*	2*
FOUL FACTOR	0.00010*	0.00025*
FLUID ENT TEMP (°F)	56.00	85.00*
FLUID LEV TEMP (°F)	44.00*	94.31
FLUID FLOW (gpm)	700.0*	1050.0*
FLUID PRDROP (ft)	11.5	10.9

(*) Designates Specified Input

YORK CENTRIFUGAL LIQUID CHILLER SOUND PRESSURE LEVELS- Cooling (ARI 550)

SOUND PRESSURE LEVELS IN DB RE 20 MICROPASCALS (STANDARD)									
PCT LOAD	OCTAVE BAND CENTER FREQUENCY, HZ								A- WEIGHTED DBA
	63	125	250	500	1000	2000	4000	8000	
100.0	75.0	75.0	75.0	74.0	74.0	75.0	71.0	67.0	79.5
75.0	75.0	74.0	72.0	70.5	71.0	72.0	70.0	65.0	77.0
50.0	75.0	73.5	70.5	68.0	68.0	69.0	68.0	62.0	74.5
25.0	75.0	80.0	78.0	76.0	75.0	78.0	76.0	69.0	82.5

The octave and A-Weighted sound pressure levels are the levels expected to be obtained if measurements are performed in accordance with ARI Standard 575-94, Method of measuring machinery sound within equipment rooms.

TOLERANCES: The sound level of identical unit selections can vary due to manufacturing tolerance and test repeatability. Variations of +3 DBA on the A-Weighted levels and +5 DB on the octave band levels are possible.

Rating certified in accordance with ARI STD. 550/590.

Water-chilling packages using the vapor compression cycle certification program.

Materials and construction per mechanical specifications - Form 160.73-EG1.

Acoustic Summary For FCU-1

Project: Nathan- Thesis Project FCUs
Prepared By:

03/29/2006
03:56PM

Unit Parameters

Tag Name:.....FCU-1
Quantity: 1
Unit Model:42SGA03
Unit Type:42SGA Concealed Modular Unit
Unit Size: 300
System Type:4-Pipe Heating and Cooling
Cooling Coil: Cold Fluid Cooling
Cooling Coil Rows:3 Rows
Heating Coil:Hot Fluid Heating
Heating Coil Rows: 1 Row
Shipping Options:Standard
Fan Speed: High
Motor/Drive:Standard

Standard Fan Coil:

Octave Band Center Frequency, Hz	125	250	500	1k	2k	4k	8k	dBA
Sound Power, dB	64.5	57	52.5	49	41	39	35.5	
A-Weighted Sound Power, dBA								55

Notes

Estimated Sound Power levels – dB re: 1 picowatt

Estimated Sound Power levels given above are assumed to originate at the acoustic center of the fan coil.

Calculation methods used in this program are patterned after the ASHRAE Guide; other ASHRAE Publications and the ARI Acoustical Standards. While a very significant effort has been made to insure the technical accuracy of this program, it is assumed that the user is knowledgeable in the art of system sound estimation and is aware of the tolerances involved in real world acoustical estimation. This program makes certain assumptions as to the dominant sound sources and sound paths which may not always be appropriate to the real system being estimated. Because of this, no assurances can be offered that this software will always generate an accurate sound prediction from user supplied input data. If in doubt about the estimation of expected sound levels in a space, an Acoustical Engineer or a person with sound prediction expertise should be consulted.

Acoustic Summary For FCU-2

Project: Nathan- Thesis Project FCUs
Prepared By:

03/29/2006
03:56PM

Unit Parameters

Tag Name:.....FCU-2
Quantity: 1
Unit Model:42SGA04
Unit Type:42SGA Concealed Modular Unit
Unit Size: 400
System Type:4-Pipe Heating and Cooling
Cooling Coil: Cold Fluid Cooling
Cooling Coil Rows:3 Rows
Heating Coil:Hot Fluid Heating
Heating Coil Rows: 1 Row
Shipping Options:Standard
Fan Speed: High
Motor/Drive:Standard

Standard Fan Coil:

Octave Band Center Frequency, Hz	125	250	500	1k	2k	4k	8k	dBA
Sound Power, dB	69	59.5	55.5	50.5	41.5	39.5	36.5	
A-Weighted Sound Power, dBA								58

Notes

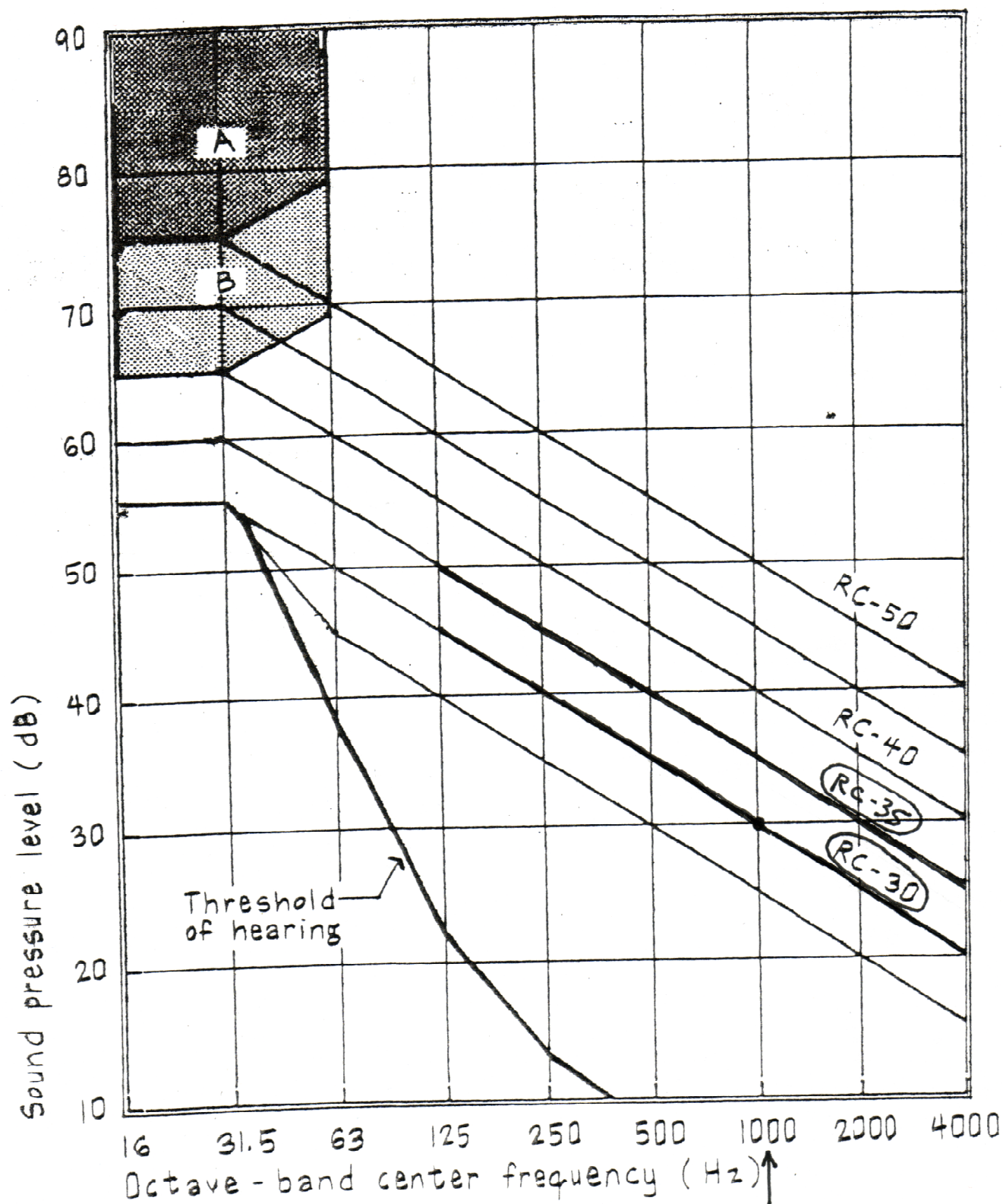
Estimated Sound Power levels – dB re: 1 picowatt

Estimated Sound Power levels given above are assumed to originate at the acoustic center of the fan coil.

Calculation methods used in this program are patterned after the ASHRAE Guide; other ASHRAE Publications and the ARI Acoustical Standards. While a very significant effort has been made to insure the technical accuracy of this program, it is assumed that the user is knowledgeable in the art of system sound estimation and is aware of the tolerances involved in real world acoustical estimation. This program makes certain assumptions as to the dominant sound sources and sound paths which may not always be appropriate to the real system being estimated. Because of this, no assurances can be offered that this software will always generate an accurate sound prediction from user supplied input data. If in doubt about the estimation of expected sound levels in a space, an Acoustical Engineer or a person with sound prediction expertise should be consulted.

CHILLER AND FAN COIL UNIT ACOUSTICS

Room Criteria (RC) Curves



CHILLER:

MECHANICAL ROOM
TO RESTAURANT
USE RC-35

FAN COIL UNIT:

GUEST ROOM
RC-30

Appendix L – Overall Cost Analysis

This appendix contains the information used for the life cycle cost analyses for the chillers, cooling towers, and mechanical systems used as a part of the design process.

Please see the all the life cycle cost information on the following pages.

Lifecycle Summary

Project: Hilton Hotel at BWI Airport
Prepared By: The Pennsylvania State University

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Chiller Selection

Life Cycle Cost Analysis

Type of Analysis	Private Sector Lifecycle Analysis
Type of Design Alternatives	Mutually Exclusive
Length of Analysis	20 yrs
Minimum Attractive Rate of Return	8.00 %
Income Taxes	Not Considered

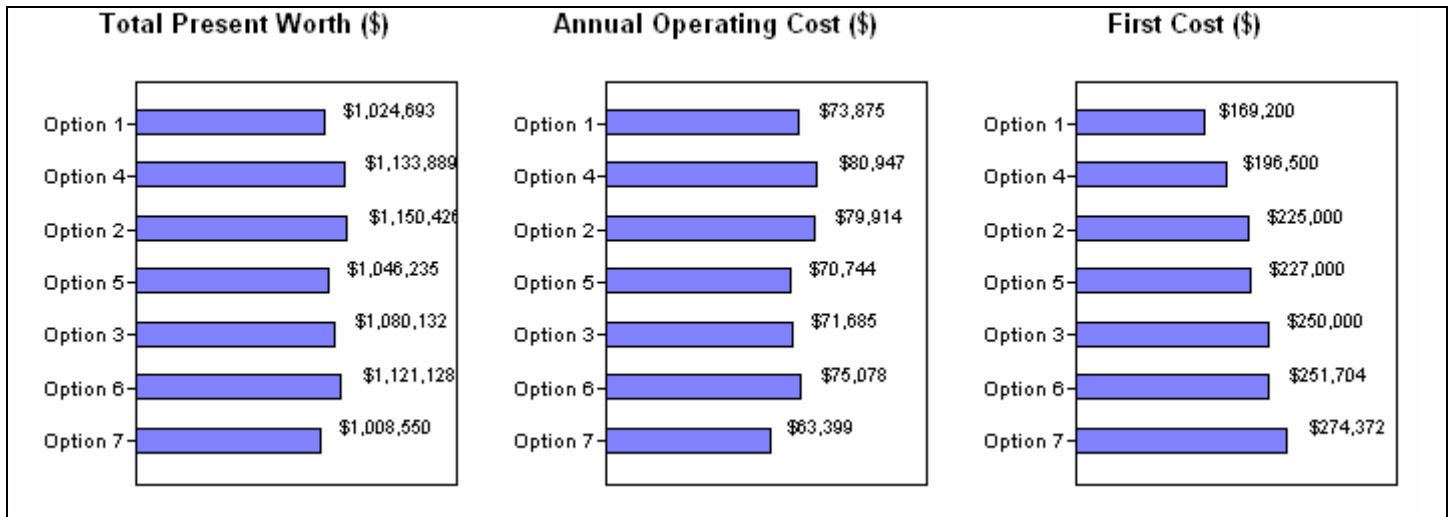


Table 1. Executive Summary

Economic Criteria	Best Design Case for Each Criteria	Value (\$)
Incremental NPW Savings Analysis	Option 7 - (2) Trane CTV-AFD (12F)	-
Lowest Total Present Worth	Option 7 - (2) Trane CTV-AFD (12F)	\$1,008,550
Lowest Annual Operating Cost	Option 7 - (2) Trane CTV-AFD (12F)	\$63,399
Lowest First Cost	Option 1 - (2) Carrier 19XRVs	\$169,200

Lifecycle Summary

Project: Hilton Hotel at BWI Airport
Prepared By: The Pennsylvania State University

4/5/2006
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Table 2. Design Cases Ranked by First Cost

Design Case Name	Design Case Short Name	Total Present Worth (\$)	Annual Operating Cost (\$/yr)	First Cost (\$)
Option 1 - (2) Carrier 19XRVs	Option 1	\$1,024,693	\$73,875	\$169,200
Option 4 - (1) McQuay WDC w/ IGV	Option 4	\$1,133,889	\$80,947	\$196,500
Option 2 - (2) York MaxEs	Option 2	\$1,150,426	\$79,914	\$225,000
Option 5 - (1) McQuay WDC w/ VFD	Option 5	\$1,046,235	\$70,744	\$227,000
Option 3 - (2) McQuay WSCs	Option 3	\$1,080,132	\$71,685	\$250,000
Option 6 - (1) Trane CTV, (1) CTV-AFD (12F)	Option 6	\$1,121,128	\$75,078	\$251,704
Option 7 - (2) Trane CTV-AFD (12F)	Option 7	\$1,008,550	\$63,399	\$274,372

Table 3. Incremental Analysis Data

Challenger	Base Case	Additional First Cost (\$)	NPW Savings (\$)	IRR (%)	Payback Period (yrs)
Option 4	Option 1 [Winner]	\$27,300	\$-109,196	n/a	n/a
Option 2	Option 1 [Winner]	\$55,800	\$-125,733	n/a	n/a
Option 5	Option 1 [Winner]	\$57,800	\$-21,542	2.79	n/a
Option 3	Option 1 [Winner]	\$80,800	\$-55,439	n/a	n/a
Option 6	Option 1 [Winner]	\$82,504	\$-96,435	n/a	n/a
Option 7 [Winner]	Option 1	\$105,172	\$16,143	9.86	15.6

Total Present Worth Profiles

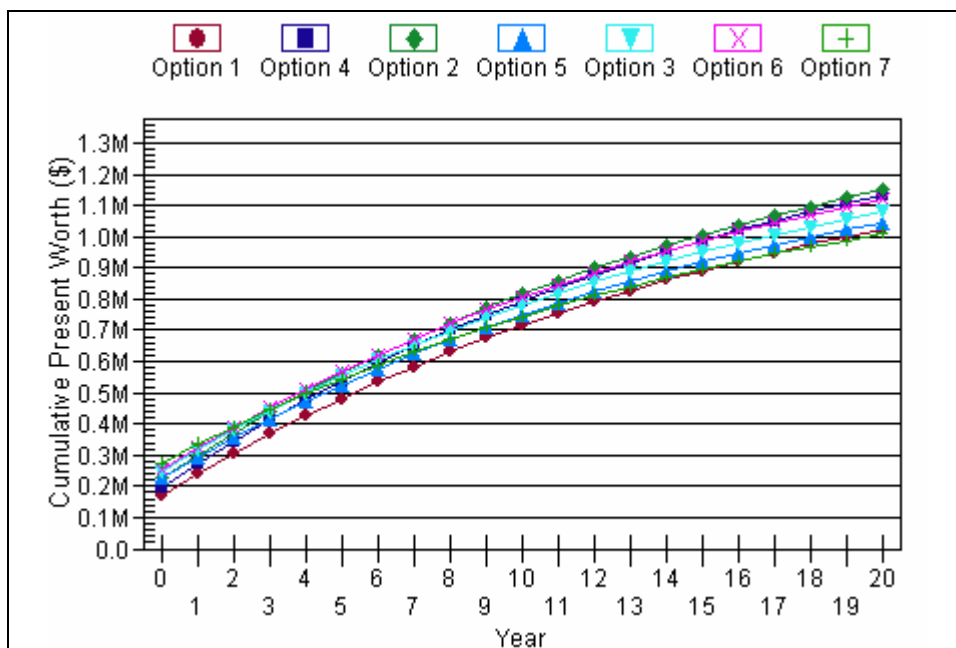
Project: Hilton Hotel at BWI Airport
Prepared By: The Pennsylvania State University

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Chiller Selection

Life Cycle Cost Analysis

Type of Analysis Private Sector Lifecycle Analysis
Type of Design Alternatives Mutually Exclusive
Length of Analysis 20 yrs
Minimum Attractive Rate of Return 8.00 %
Income Taxes Not Considered



Design Cases Ranked by First Cost

Design Case Name	Design Case Short Name	Total Present Worth (\$)	Annual Operating Cost (\$/yr)	First Cost (\$)
Option 1 - (2) Carrier 19XRVs	Option 1	\$1,024,693	\$73,875	\$169,200
Option 4 - (1) McQuay WDC w/ IGW	Option 4	\$1,133,889	\$80,947	\$196,500
Option 2 - (2) York MaxEs	Option 2	\$1,150,426	\$79,914	\$225,000
Option 5 - (1) McQuay WDC w/ VFD	Option 5	\$1,046,235	\$70,744	\$227,000
Option 3 - (2) McQuay WSCs	Option 3	\$1,080,132	\$71,685	\$250,000
Option 6 - (1) Trane CTV, (1) CTV-AFD (12F)	Option 6	\$1,121,128	\$75,078	\$251,704
Option 7 - (2) Trane CTV-AFD (12F)	Option 7	\$1,008,550	\$63,399	\$274,372

Lifecycle Summary

Project: Hilton Hotel at BWI Airport
Prepared By: The Pennsylvania State University

4/4/2006
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Cooling Tower Selection

Life Cycle Cost Analysis

Type of Analysis Private Sector Lifecycle Analysis
Type of Design Alternatives Mutually Exclusive
Length of Analysis 20 yrs
Minimum Attractive Rate of Return 8.00 %
Income Taxes Not Considered

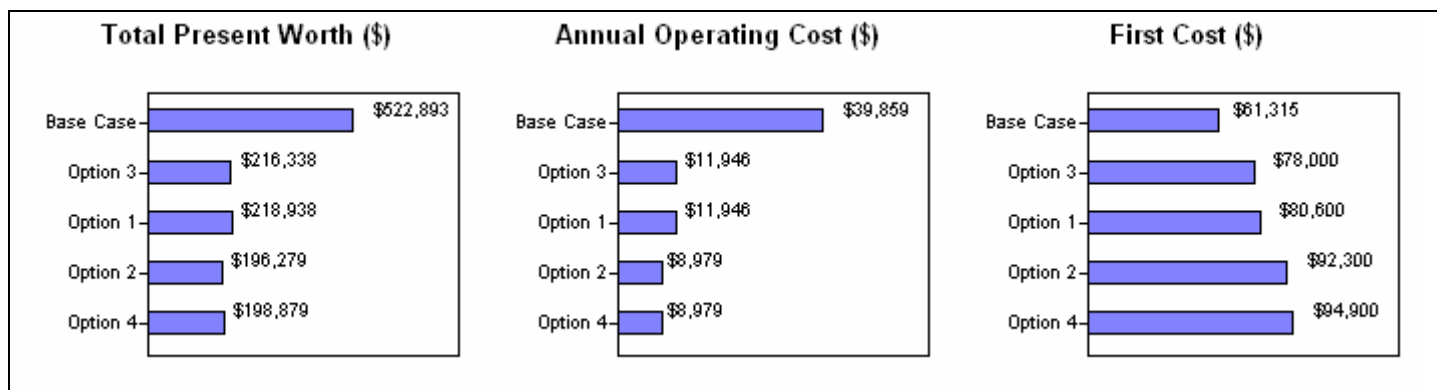


Table 1. Executive Summary

Economic Criteria	Best Design Case for Each Criteria	Value (\$)
Incremental NPW Savings Analysis	Option 2 - Marley NC8306EL2	-
Lowest Total Present Worth	Option 2 - Marley NC8306EL2	\$196,279
Lowest Annual Operating Cost	Option 2 - Marley NC8306EL2	\$8,979
Lowest First Cost	Base Case - Original Design	\$61,315

Table 2. Design Cases Ranked by First Cost

Design Case Name	Design Case Short Name	Total Present Worth (\$)	Annual Operating Cost (\$/yr)	First Cost (\$)
Base Case - Original Design	Base Case	\$522,893	\$39,859	\$61,315
Option 3 - Marley NC8305F2	Option 3	\$216,338	\$11,946	\$78,000
Option 1 - Marley NC8305FL2	Option 1	\$218,938	\$11,946	\$80,600
Option 2 - Marley NC8306EL2	Option 2	\$196,279	\$8,979	\$92,300
Option 4 - Marley NC8307E2	Option 4	\$198,879	\$8,979	\$94,900

Table 3. Incremental Analysis Data

Challenger	Base Case	Additional First Cost (\$)	NPW Savings (\$)	IRR (%)	Payback Period (yrs)
Option 3 [Winner]	Base Case	\$16,685	\$306,555	172.63	0.6
Option 1	Option 3 [Winner]	\$2,600	\$-2,600	n/a	n/a
Option 2 [Winner]	Option 3	\$14,300	\$20,059	22.63	5.8
Option 4	Option 2 [Winner]	\$2,600	\$-2,600	n/a	n/a

Total Present Worth Profiles

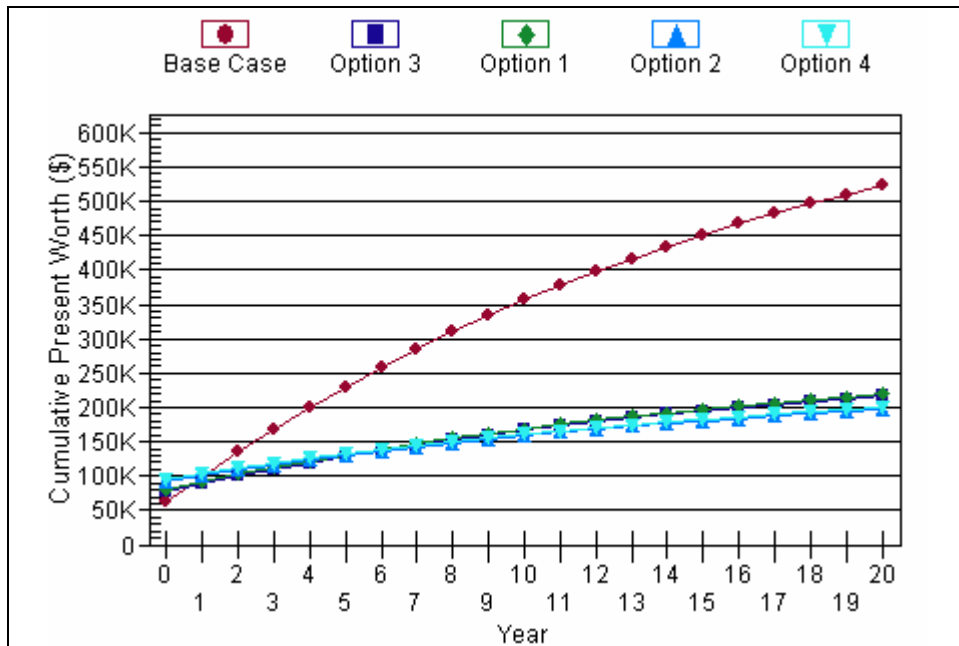
Project: Hilton Hotel at BWI Airport
Prepared By: The Pennsylvania State University

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Cooling Tower Selection

Life Cycle Cost Analysis

Type of Analysis	Private Sector Lifecycle Analysis
Type of Design Alternatives	Mutually Exclusive
Length of Analysis	20 yrs
Minimum Attractive Rate of Return	8.00 %
Income Taxes	Not Considered



Design Cases Ranked by First Cost

Design Case Name	Design Case Short Name	Total Present Worth (\$)	Annual Operating Cost (\$/yr)	First Cost (\$)
Base Case - Original Design	Base Case	\$522,893	\$39,859	\$61,315
Option 3 - Marley NC8305F2	Option 3	\$216,338	\$11,946	\$78,000
Option 1 - Marley NC8305FL2	Option 1	\$218,938	\$11,946	\$80,600
Option 2 - Marley NC8306EL2	Option 2	\$196,279	\$8,979	\$92,300
Option 4 - Marley NC8307E2	Option 4	\$198,879	\$8,979	\$94,900

Lifecycle Summary

Project: Hilton Hotel at BWI Airport
Prepared By: The Pennsylvania State University

4/5/2006
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Mechanical Systems

Life Cycle Cost Analysis

Type of Analysis	Private Sector Lifecycle Analysis
Type of Design Alternatives	Mutually Exclusive
Length of Analysis	20 yrs
Minimum Attractive Rate of Return	8.00 %
Income Taxes	Not Considered

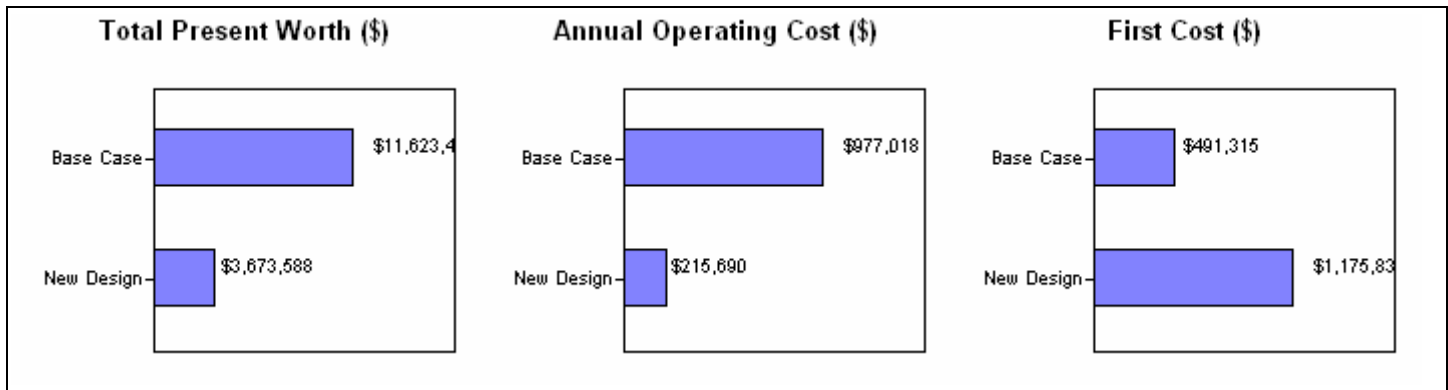


Table 1. Executive Summary

Economic Criteria	Best Design Case for Each Criteria	Value (\$)
Incremental NPW Savings Analysis	Chilled Water Plant Design	-
Lowest Total Present Worth	Chilled Water Plant Design	\$3,673,588
Lowest Annual Operating Cost	Chilled Water Plant Design	\$215,690
Lowest First Cost	Base Case - Original Design	\$491,315

Table 2. Design Cases Ranked by First Cost

Design Case Name	Design Case Short Name	Total Present Worth (\$)	Annual Operating Cost (\$/yr)	First Cost (\$)
Base Case - Original Design	Base Case	\$11,623,441	\$977,018	\$491,315
Chilled Water Plant Design	New Design	\$3,673,588	\$215,690	\$1,175,838

Table 3. Incremental Analysis Data

Challenger	Base Case	Additional First Cost (\$)	NPW Savings (\$)	IRR (%)	Payback Period (yrs)
New Design [Winner]	Base Case	\$684,523	\$7,949,854	114.23	1.0

Total Present Worth Profiles

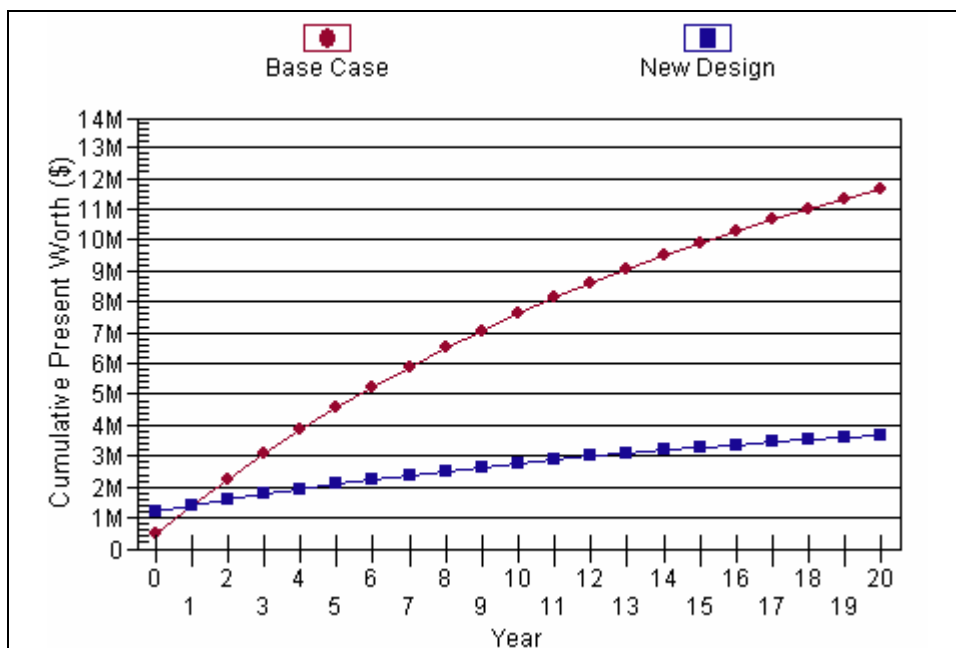
Project: Hilton Hotel at BWI Airport
Prepared By: The Pennsylvania State University

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Mechanical Systems

Life Cycle Cost Analysis

Type of Analysis	Private Sector Lifecycle Analysis
Type of Design Alternatives	Mutually Exclusive
Length of Analysis	20 yrs
Minimum Attractive Rate of Return	8.00 %
Income Taxes	Not Considered



Design Cases Ranked by First Cost

Design Case Name	Design Case Short Name	Total Present Worth (\$)	Annual Operating Cost (\$/yr)	First Cost (\$)
Base Case - Original Design	Base Case	\$11,623,441	\$977,018	\$491,315
Chilled Water Plant Design	New Design	\$3,673,588	\$215,690	\$1,175,838

Analysis Details

Project: Hilton Hotel at BWI Airport
Prepared By: The Pennsylvania State University

4/5/2006
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Mechanical Systems

Life Cycle Cost Analysis

Type of Analysis Private Sector Lifecycle Analysis
Type of Design Alternatives Mutually Exclusive
Length of Analysis 20 yrs
Minimum Attractive Rate of Return 8.00 %
Income Taxes Not Considered

1A. Summary of Results

Base Case	Base Case - Original Design [Base Case]
Challenger [Winner]	Chilled Water Plant Design [New Design]
[Base Case] Total Present Worth (\$)	\$11,623,441
[New Design] Total Present Worth (\$)	\$3,673,588
Net Present Worth Savings (\$)	\$7,949,854
Internal Rate of Return	114.2 %
Payback Period (yrs)	1.0 years

1B. Comparative Analysis Details

Year	Date	Cash Flow (Present Worth \$)			SIR and Payback Calculation (Present Worth \$)				
		[Base Case] Cash Flow (\$)	[New Design] Cash Flow (\$)	Net Present Worth Savings (\$)	Operating Cost Savings (\$)	Cumulative Operating Cost Savings (\$)	Additional Investment Cost (\$)	Cumulative Additional Investment Cost (\$)	Year-End SIR
0	Initial	491,315	1,175,838	-684,523	0	0	684,523	684,523	0.000
1	1	922,739	203,707	719,032	719,032	719,032	0	684,523	1.050
2	2	856,212	192,390	663,821	663,821	1,382,853	0	684,523	2.020
3	3	808,644	181,702	626,942	626,942	2,009,796	0	684,523	2.936
4	4	763,720	171,607	592,112	592,112	2,601,908	0	684,523	3.801
5	5	721,291	162,074	559,217	559,217	3,161,125	0	684,523	4.618
6	6	681,219	153,069	528,150	528,150	3,689,275	0	684,523	5.390
7	7	643,373	144,566	498,808	498,808	4,188,083	0	684,523	6.118
8	8	607,631	136,534	471,096	471,096	4,659,179	0	684,523	6.806
9	9	573,873	128,949	444,924	444,924	5,104,103	0	684,523	7.456
10	10	541,991	121,785	420,206	420,206	5,524,310	0	684,523	8.070
11	11	511,881	115,019	396,862	396,862	5,921,171	0	684,523	8.650
12	12	483,443	108,629	374,814	374,814	6,295,985	0	684,523	9.198
13	13	456,585	102,594	353,991	353,991	6,649,976	0	684,523	9.715
14	14	431,219	96,895	334,325	334,325	6,984,300	0	684,523	10.203
15	15	407,263	91,512	315,751	315,751	7,300,051	0	684,523	10.664
16	16	384,637	86,428	298,209	298,209	7,598,260	0	684,523	11.100
17	17	363,268	81,626	281,642	281,642	7,879,902	0	684,523	11.512
18	18	343,087	77,091	265,995	265,995	8,145,898	0	684,523	11.900
19	19	324,026	72,808	251,218	251,218	8,397,115	0	684,523	12.267
20	20	306,025	68,764	237,261	237,261	8,634,377	0	684,523	12.614
Totals		11,623,441	3,673,588	7,949,854	8,634,377		684,523		

Mechanical Equipment First Costs**Table L1 - Mechanical Equipment Options First Costs**

Equipment	Option	Manufacturer	Model	Quantity	Price Each	Total Price	Option Total
Chillers							
	1	Carrier	19XRV	2	\$84,600	\$169,200	\$169,200
	2	York	MaxE	2	\$112,500	\$225,000	\$225,000
	3	McQuay	WSC	2	\$125,000	\$250,000	\$250,000
	4	McQuay	WDC-IGV	1	\$196,500	\$196,500	\$196,500
	5	McQuay	WDC-VFD	1	\$227,000	\$227,000	\$227,000
	6	Trane	CTV	1	\$114,518	\$251,704	\$251,704
	6	Trane	CTV-AFD	1	\$137,186	-	-
	7	Trane	CTV-AFD	2	\$137,186	\$274,372	\$274,372
Cooling Towers							
	1	Marley	NC8305FL2	2	\$40,300	\$80,600	\$80,600
	2	Marley	NC8306EL2	2	\$46,150	\$92,300	\$92,300
	3	Marley	NC8305F2	2	\$39,000	\$78,000	\$78,000
	4	Marley	NC8307E2	2	\$47,450	\$94,900	\$94,900
Air Handling Units							
	1	Carrier	39MN-50	1	\$30,100	\$30,100	\$90,900
	1	Carrier	39MN-40	1	\$29,500	\$29,500	-
	1	Carrier	39MN-21	1	\$17,600	\$17,600	-
	1	Carrier	39MN-12	1	\$13,700	\$13,700	-
Rooftop Units							
	1	Carrier	39MW-06	1	\$17,600	\$17,600	\$101,800
	1	Carrier	39MW-30	1	\$30,400	\$30,400	-
	1	Carrier	39MW-12	1	\$20,400	\$20,400	-
	1	Carrier	39MW-06	1	\$17,400	\$17,400	-
	1	Carrier	39MW-03	1	\$16,000	\$16,000	-
Dedicated Outside Air Units							
	1	Semco	PVS-13	1	\$90,193	\$90,193	\$193,186
	1	Semco	PVS-18	1	\$102,993	\$102,993	-
Fan Coil Units							
	1	Carrier	42S-300	128	\$1,335	\$170,880	\$386,880
	1	Carrier	42S-400	160	\$1,350	\$216,000	-
	2	Enviro-Tec	VHC-04	128	\$1,850	\$236,800	\$532,800
	2	Enviro-Tec	VHC-04	160	\$1,850	\$296,000	-
Pumps							
	1	Bell&Gossett	1510-5G	2	\$8,389	\$16,778	\$30,750
	1	Bell&Gossett	1510-5BC	2	\$6,986	\$13,972	-
Heat Exchanger							
	1	Bell&Gossett	P41	1	28150	\$28,150	\$28,150

Table L2 - Mechanical Equipment Selected First Costs

Equipment Costs	Option No	Manufacturer	Model No	Qty	Price Each	Total Price	Option Total	Annual Energy Costs
Chillers								
First Cost	1	Carrier	19XRV	2	\$84,600	\$169,200	\$169,200	\$73,875
Operating Cost	7	Trane	CTV-AFD	2	\$137,186	\$274,372	\$274,372	\$63,399
Selected	7	Trane	CTV-AFD	2	\$137,186	\$274,372	\$274,372	\$63,399
Cooling Towers								
First Cost	3	Marley	NC8305F2	2	\$39,000	\$78,000	\$78,000	\$11,946
Operating Cost	2	Marley	NC8306EL2	2	\$46,150	\$92,300	\$92,300	\$8,979
Selected	2	Marley	NC8306EL2	2	\$46,150	\$92,300	\$92,300	\$8,979
Fan Coil Units								
First Cost	1	Carrier	42S	288	\$2,685	\$386,880	\$386,880	\$5 < Option 2
Operating Cost	1	Carrier	42S	288	\$2,685	\$386,880	\$386,880	\$5 < Option 2
Selected	1	Carrier	42S	288	\$2,685	\$386,880	\$386,880	\$5 < Option 2
Air Handling Units								
Selected (incl all)	1	Carrier	39MN	1	\$90,900	\$90,900	\$90,900	N/A
Rooftop Units								
Selected (incl all)	1	Carrier	39MW	1	\$79,300	\$79,300	\$79,300	N/A
Dedicated Outdoor Air Units								
Selected (incl all)	1	Semco	PVS	1	\$193,186	\$193,186	\$193,186	N/A
Pumps								
Selected (incl all)	1	Bell & Gossett	1510	2	\$15,375	\$30,750	\$30,750	N/A
Heat Exchanger								
Selected	1	Bell & Gossett	P41	1	\$28,150	\$28,150	\$28,150	N/A

Mechanical System Total Equipment First Cost:**\$1,175,838**

Appendix M - HAP Report Files

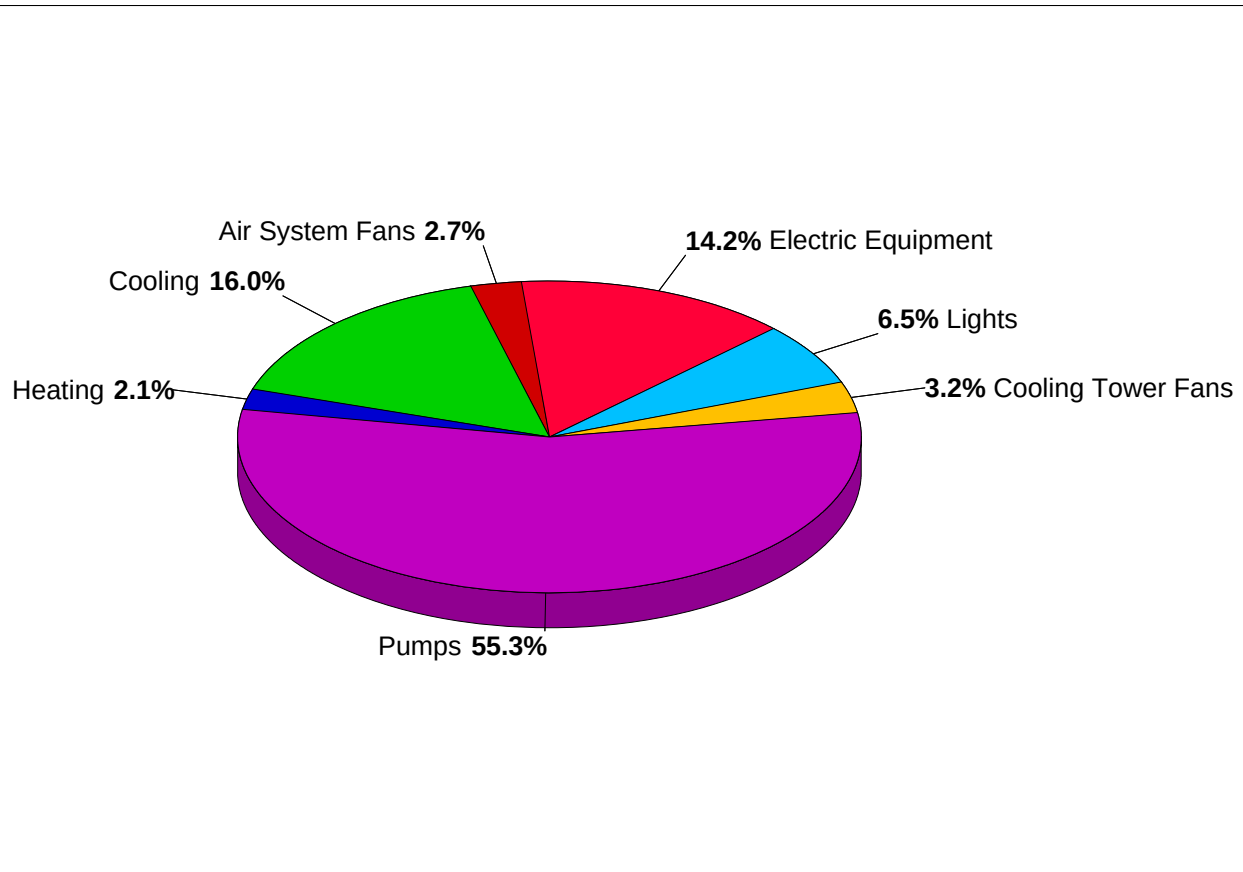
This appendix contains selected HAP report files design process. The files for the base case are listed first. The files for the new mechanical systems design are listed last.

Please see the all the HAP report files on the following pages.

Annual Component Costs - Hilton Hotel at BWI Airport

BWI Hilton Base Case
The Pennsylvania State University

03/24/2006
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1. Annual Costs

Component	Annual Cost (\$)	(\$/ft²)	Percent of Total (%)
Air System Fans	32,896	0.167	2.7
Cooling	196,737	1.001	16.0
Heating	26,399	0.134	2.1
Pumps	681,072	3.467	55.3
Cooling Tower Fans	39,859	0.203	3.2
HVAC Sub-Total	976,962	4.973	79.3
Lights	80,260	0.409	6.5
Electric Equipment	174,776	0.890	14.2
Misc. Electric	0	0.000	0.0
Misc. Fuel Use	0	0.000	0.0
Non-HVAC Sub-Total	255,036	1.298	20.7
Grand Total	1,231,999	6.271	100.0

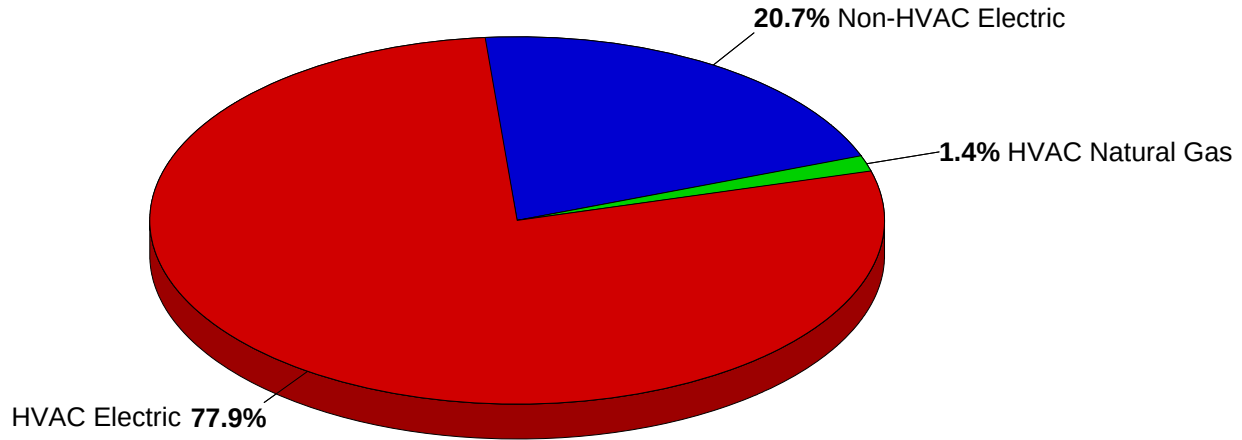
Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area **196455.0** ft²
Conditioned Floor Area **196455.0** ft²

Annual Energy Costs - Hilton Hotel at BWI Airport

BWI Hilton Base Case
The Pennsylvania State University

03/24/2006
09:51PM



1. Annual Costs

Component	Annual Cost (\$/yr)	(\$/ft²)	Percent of Total (%)
HVAC Components			
Electric	959,905	4.886	77.9
Natural Gas	17,113	0.087	1.4
Fuel Oil	0	0.000	0.0
Propane	0	0.000	0.0
Remote Hot Water	0	0.000	0.0
Remote Steam	0	0.000	0.0
Remote Chilled Water	0	0.000	0.0
HVAC Sub-Total	977,018	4.973	79.3
Non-HVAC Components			
Electric	255,027	1.298	20.7
Natural Gas	0	0.000	0.0
Fuel Oil	0	0.000	0.0
Propane	0	0.000	0.0
Remote Hot Water	0	0.000	0.0
Remote Steam	0	0.000	0.0
Non-HVAC Sub-Total	255,027	1.298	20.7
Grand Total	1,232,045	6.271	100.0

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area 196455.0 ft²
Conditioned Floor Area 196455.0 ft²

Energy Budget by System Component - Hilton Hotel at BWI Airport

BWI Hilton Base Case
The Pennsylvania State University

03/24/2006
09:51PM

1. Annual Coil Loads

Component	Load (kBTU)	(kBTU/ft²)
Cooling Coil Loads	24,961,130	127.058
Heating Coil Loads	6,538,300	33.281
Grand Total	31,499,434	160.339

2. Energy Consumption by System Component

Component	Site Energy (kBTU)	Site Energy (kBTU/ft²)	Source Energy (kBTU)	Source Energy (kBTU/ft²)
Air System Fans	1,611,165	8.201	5,754,161	29.290
Cooling	9,513,890	48.428	33,978,184	172.957
Heating	8,109,678	41.280	9,323,703	47.460
Pumps	33,560,676	170.831	119,859,576	610.112
Cooling Towers	1,964,605	10.000	7,016,446	35.715
HVAC Sub-Total	54,760,014	278.741	175,932,070	895.534
Lights	3,954,558	20.130	14,123,420	71.891
Electric Equipment	8,611,752	43.836	30,756,254	156.556
Misc. Electric	0	0.000	0	0.000
Misc. Fuel Use	0	0.000	0	0.000
Non-HVAC Sub-Total	12,566,310	63.965	44,879,674	228.448
Grand Total	67,326,323	342.706	220,811,744	1123.981

Notes:

1. 'Cooling Coil Loads' is the sum of all air system cooling coil loads.
2. 'Heating Coil Loads' is the sum of all air system heating coil loads.
3. Site Energy is the actual energy consumed.
4. Source Energy is the site energy divided by the electric generating efficiency (28.0%).
5. Source Energy for fuels equals the site energy value.
6. Energy per unit floor area is based on the gross building floor area.
 Gross Floor Area **196455.0** ft²
 Conditioned Floor Area **196455.0** ft²

Energy Budget by Energy Source - Hilton Hotel at BWI Airport

BWI Hilton Base Case
The Pennsylvania State University

03/24/2006
09:51PM

1. Annual Coil Loads

Component	Load (kBTU)	(kBTU/ft²)
Cooling Coil Loads	24,961,130	127.058
Heating Coil Loads	6,538,300	33.281
Grand Total	31,499,434	160.339

2. Energy Consumption by Energy Source

Component	Site Energy (kBTU)	Site Energy (kBTU/ft²)	Source Energy (kBTU)	Source Energy (kBTU/ft²)
HVAC Components				
Electric	47,125,188	239.878	168,304,240	856.706
Natural Gas	7,637,556	38.877	7,637,556	38.877
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Hot Water	0	0.000	0	0.000
Remote Steam	0	0.000	0	0.000
Remote Chilled Water	0	0.000	0	0.000
HVAC Sub-Total	54,762,744	278.755	175,941,796	895.583
Non-HVAC Components				
Electric	12,565,848	63.963	44,878,028	228.439
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Hot Water	0	0.000	0	0.000
Remote Steam	0	0.000	0	0.000
Non-HVAC Sub-Total	12,565,848	63.963	44,878,028	228.439
Grand Total	67,328,592	342.718	220,819,824	1124.022

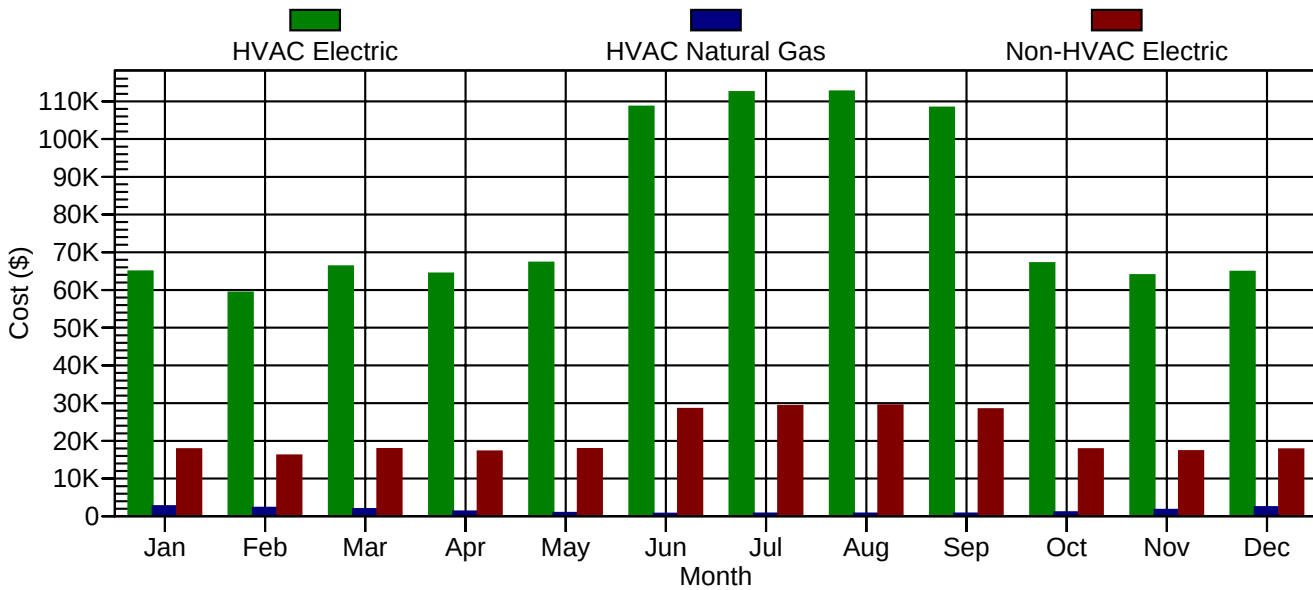
Notes:

1. 'Cooling Coil Loads' is the sum of all air system cooling coil loads.
2. 'Heating Coil Loads' is the sum of all air system heating coil loads.
3. Site Energy is the actual energy consumed.
4. Source Energy is the site energy divided by the electric generating efficiency (28.0%).
5. Source Energy for fuels equals the site energy value.
6. Energy per unit floor area is based on the gross building floor area.
 Gross Floor Area **196455.0** ft²
 Conditioned Floor Area **196455.0** ft²

Monthly Energy Costs - Hilton Hotel at BWI Airport

BWI Hilton Base Case
The Pennsylvania State University

03/24/2006
09:51PM



1. HVAC Costs

Month	Electric (\$)	Natural Gas (\$)	Fuel Oil (\$)	Propane (\$)	Remote Hot Water (\$)	Remote Steam (\$)	Remote Chilled Water (\$)
January	64,899	2,697	0	0	0	0	0
February	59,320	2,236	0	0	0	0	0
March	66,263	1,893	0	0	0	0	0
April	64,337	1,295	0	0	0	0	0
May	67,209	911	0	0	0	0	0
June	108,612	706	0	0	0	0	0
July	112,470	719	0	0	0	0	0
August	112,627	731	0	0	0	0	0
September	108,324	750	0	0	0	0	0
October	67,112	1,076	0	0	0	0	0
November	63,926	1,692	0	0	0	0	0
December	64,806	2,407	0	0	0	0	0
Total	959,905	17,113	0	0	0	0	0

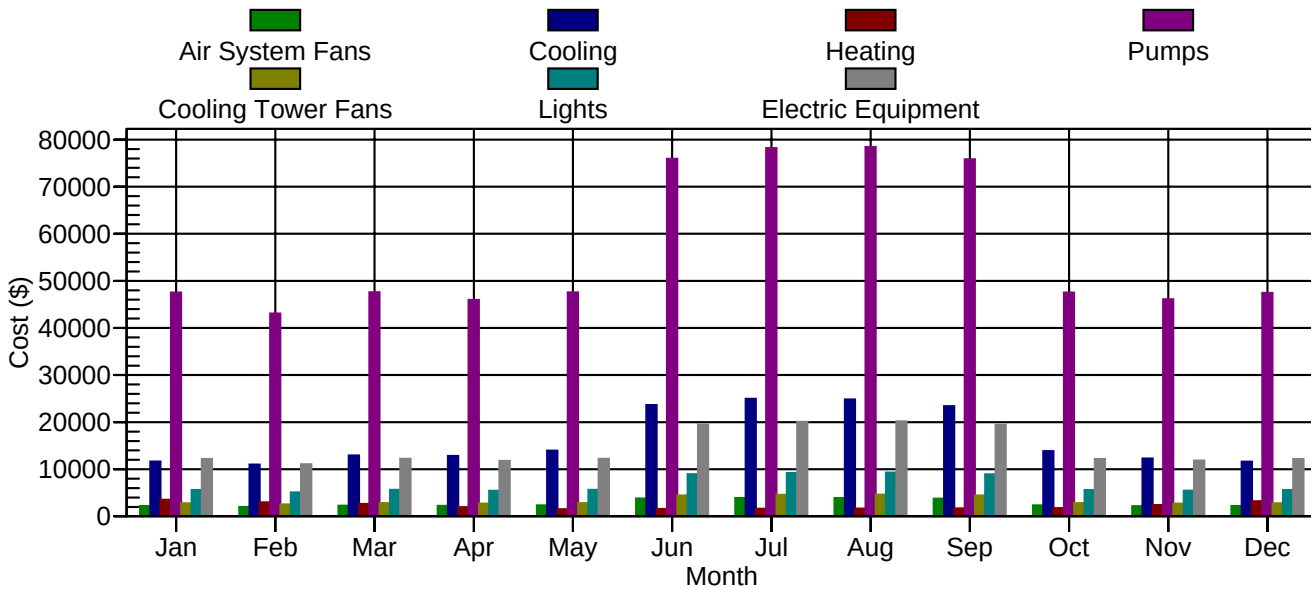
2. Non-HVAC Costs

Month	Electric (\$)	Natural Gas (\$)	Fuel Oil (\$)	Propane (\$)	Remote Hot Water (\$)	Remote Steam (\$)
January	17,771	0	0	0	0	0
February	16,131	0	0	0	0	0
March	17,838	0	0	0	0	0
April	17,173	0	0	0	0	0
May	17,832	0	0	0	0	0
June	28,458	0	0	0	0	0
July	29,230	0	0	0	0	0
August	29,413	0	0	0	0	0
September	28,400	0	0	0	0	0
October	17,770	0	0	0	0	0
November	17,269	0	0	0	0	0
December	17,741	0	0	0	0	0
Total	255,027	0	0	0	0	0

Monthly Component Costs - Hilton Hotel at BWI Airport

BWI Hilton Base Case
The Pennsylvania State University

03/24/2006
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1. HVAC Component Costs

Month	Air System Fans (\$)	Cooling (\$)	Heating (\$)	Pumps (\$)	Cooling Towers (\$)	HVAC Total (\$)
January	2,171	11,608	3,526	47,517	2,770	67,592
February	1,990	10,996	2,969	43,074	2,523	61,552
March	2,252	12,920	2,621	47,568	2,790	68,151
April	2,205	12,826	1,938	45,964	2,696	65,629
May	2,317	13,946	1,512	47,553	2,789	68,117
June	3,761	23,606	1,583	75,919	4,442	109,311
July	3,888	24,941	1,598	78,194	4,562	113,183
August	3,904	24,790	1,640	78,434	4,582	113,350
September	3,757	23,397	1,671	75,806	4,438	109,069
October	2,317	13,844	1,725	47,511	2,787	68,184
November	2,163	12,283	2,395	46,071	2,702	65,614
December	2,171	11,579	3,220	47,461	2,778	67,209
Total	32,896	196,737	26,399	681,072	39,859	976,962

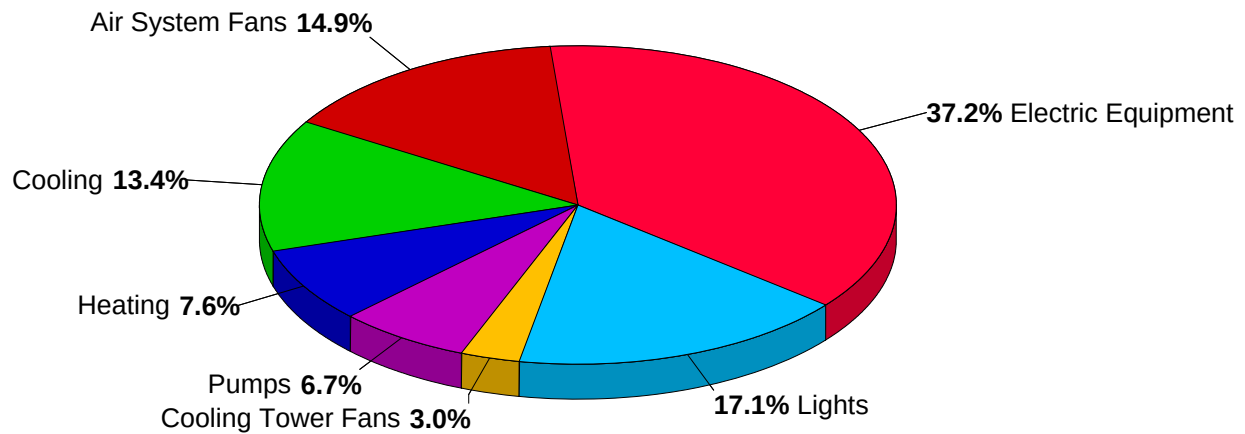
2. Non-HVAC Component Costs

Month	Lights (\$)	Electric Equipment (\$)	Misc. Electric (\$)	Misc. Fuel Use (\$)	Non-HVAC Total (\$)	Grand Total (\$)
January	5,592	12,181	0	0	17,772	85,364
February	5,077	11,055	0	0	16,132	77,684
March	5,619	12,220	0	0	17,839	85,990
April	5,397	11,777	0	0	17,174	82,803
May	5,617	12,216	0	0	17,833	85,950
June	8,962	19,497	0	0	28,459	137,770
July	9,189	20,042	0	0	29,231	142,414
August	9,265	20,149	0	0	29,414	142,764
September	8,936	19,465	0	0	28,401	137,470
October	5,591	12,179	0	0	17,770	85,954
November	5,438	11,832	0	0	17,270	82,884
December	5,577	12,165	0	0	17,742	84,951
Total	80,260	174,776	0	0	255,036	1,231,998

Annual Component Costs - Hilton Hotel at BWI Airport

BWI Hilton - New Mechanical System Design
The Pennsylvania State University

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1. Annual Costs

Component	Annual Cost (\$)	(\$/ft²)	Percent of Total (%)
Air System Fans	70,277	0.245	14.9
Cooling	63,402	0.221	13.4
Heating	36,124	0.126	7.6
Pumps	31,683	0.110	6.7
Cooling Tower Fans	14,213	0.050	3.0
HVAC Sub-Total	215,698	0.751	45.7
Lights	80,812	0.282	17.1
Electric Equipment	175,979	0.613	37.2
Misc. Electric	0	0.000	0.0
Misc. Fuel Use	0	0.000	0.0
Non-HVAC Sub-Total	256,791	0.895	54.3
Grand Total	472,490	1.646	100.0

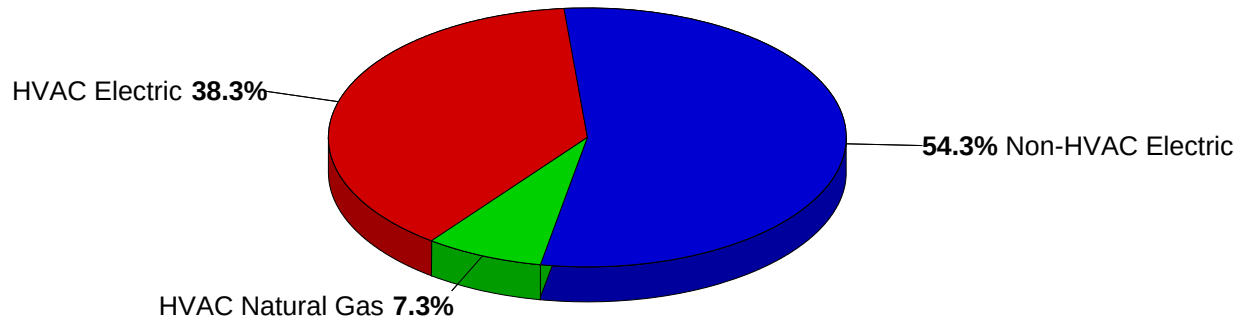
Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area **287071.0** ft²
 Conditioned Floor Area **287071.0** ft²

Annual Energy Costs - Hilton Hotel at BWI Airport

BWI Hilton - New Mechanical System Design
The Pennsylvania State University

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1. Annual Costs

Component	Annual Cost (\$/yr)	(\$/ft²)	Percent of Total (%)
HVAC Components			
Electric	181,074	0.631	38.3
Natural Gas	34,616	0.121	7.3
Fuel Oil	0	0.000	0.0
Propane	0	0.000	0.0
Remote Hot Water	0	0.000	0.0
Remote Steam	0	0.000	0.0
Remote Chilled Water	0	0.000	0.0
HVAC Sub-Total	215,690	0.751	45.7
Non-HVAC Components			
Electric	256,782	0.895	54.3
Natural Gas	0	0.000	0.0
Fuel Oil	0	0.000	0.0
Propane	0	0.000	0.0
Remote Hot Water	0	0.000	0.0
Remote Steam	0	0.000	0.0
Non-HVAC Sub-Total	256,782	0.895	54.3
Grand Total	472,472	1.646	100.0

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area **287071.0** ft²
 Conditioned Floor Area **287071.0** ft²

Energy Budget by System Component - Hilton Hotel at BWI Airport

BWI Hilton - New Mechanical System Design
The Pennsylvania State University

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1. Annual Coil Loads

Component	Load (kBTU)	(kBTU/ft²)
Cooling Coil Loads	33,247,980	115.818
Heating Coil Loads	13,632,590	47.489
Grand Total	46,880,564	163.307

2. Energy Consumption by System Component

Component	Site Energy (kBTU)	Site Energy (kBTU/ft²)	Source Energy (kBTU)	Source Energy (kBTU/ft²)
Air System Fans	3,423,614	11.926	12,227,194	42.593
Cooling	2,735,189	9.528	9,768,529	34.028
Heating	17,442,574	60.761	17,649,220	61.480
Pumps	1,527,502	5.321	5,455,364	19.004
Cooling Towers	618,064	2.153	2,207,370	7.689
HVAC Sub-Total	25,746,942	89.688	47,307,677	164.794
Lights	3,954,558	13.776	14,123,420	49.198
Electric Equipment	8,611,752	29.999	30,756,254	107.138
Misc. Electric	0	0.000	0	0.000
Misc. Fuel Use	0	0.000	0	0.000
Non-HVAC Sub-Total	12,566,310	43.774	44,879,674	156.337
Grand Total	38,313,252	133.463	92,187,351	321.131

Notes:

1. 'Cooling Coil Loads' is the sum of all air system cooling coil loads.
2. 'Heating Coil Loads' is the sum of all air system heating coil loads.
3. Site Energy is the actual energy consumed.
4. Source Energy is the site energy divided by the electric generating efficiency (28.0%).
5. Source Energy for fuels equals the site energy value.
6. Energy per unit floor area is based on the gross building floor area.
 Gross Floor Area **287071.0** ft²
 Conditioned Floor Area **287071.0** ft²

Energy Budget by Energy Source - Hilton Hotel at BWI Airport

BWI Hilton - New Mechanical System Design
The Pennsylvania State University

04/05/2006
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1. Annual Coil Loads

Component	Load (kBTU)	(kBTU/ft²)
Cooling Coil Loads	33,247,980	115.818
Heating Coil Loads	13,632,590	47.489
Grand Total	46,880,564	163.307

2. Energy Consumption by Energy Source

Component	Site Energy (kBTU)	Site Energy (kBTU/ft²)	Source Energy (kBTU)	Source Energy (kBTU/ft²)
HVAC Components				
Electric	8,384,262	29.206	29,943,796	104.308
Natural Gas	17,362,210	60.481	17,362,210	60.481
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Hot Water	0	0.000	0	0.000
Remote Steam	0	0.000	0	0.000
Remote Chilled Water	0	0.000	0	0.000
HVAC Sub-Total	25,746,472	89.687	47,306,006	164.789
Non-HVAC Components				
Electric	12,565,848	43.773	44,878,028	156.331
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Hot Water	0	0.000	0	0.000
Remote Steam	0	0.000	0	0.000
Non-HVAC Sub-Total	12,565,848	43.773	44,878,028	156.331
Grand Total	38,312,320	133.459	92,184,034	321.119

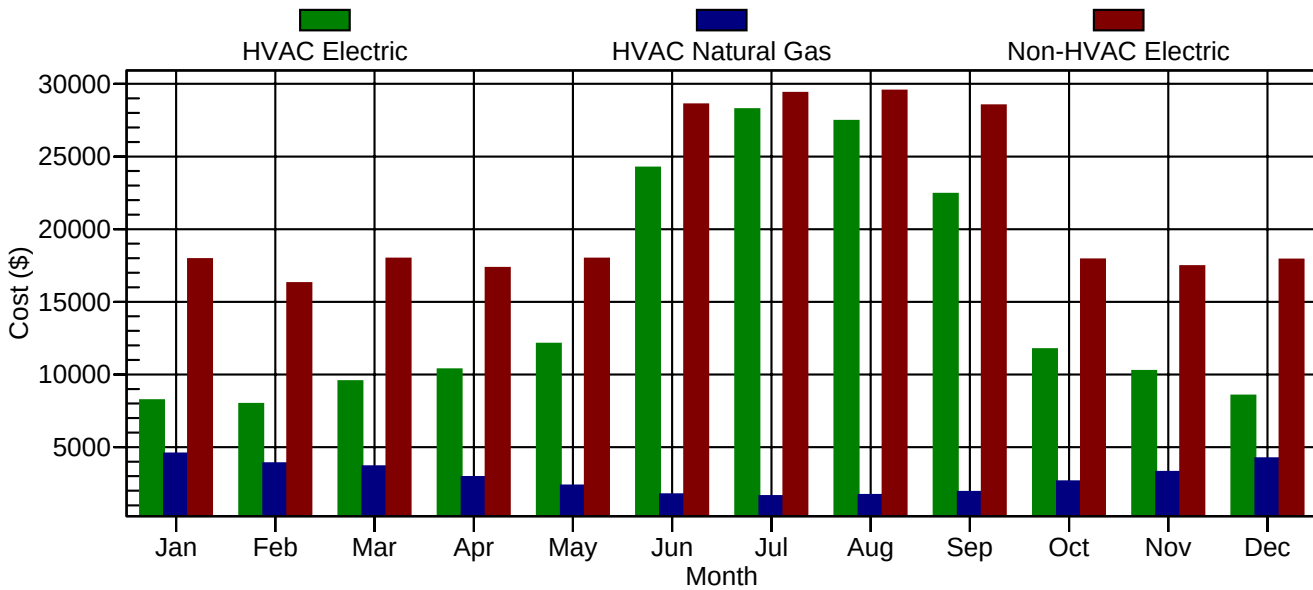
Notes:

1. 'Cooling Coil Loads' is the sum of all air system cooling coil loads.
2. 'Heating Coil Loads' is the sum of all air system heating coil loads.
3. Site Energy is the actual energy consumed.
4. Source Energy is the site energy divided by the electric generating efficiency (28.0%).
5. Source Energy for fuels equals the site energy value.
6. Energy per unit floor area is based on the gross building floor area.
 Gross Floor Area **287071.0** ft²
 Conditioned Floor Area **287071.0** ft²

Monthly Energy Costs - Hilton Hotel at BWI Airport

BWI Hilton - New Mechanical System Design
The Pennsylvania State University

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1. HVAC Costs

Month	Electric (\$)	Natural Gas (\$)	Fuel Oil (\$)	Propane (\$)	Remote Hot Water (\$)	Remote Steam (\$)	Remote Chilled Water (\$)
January	8,226	4,561	0	0	0	0	0
February	7,972	3,886	0	0	0	0	0
March	9,533	3,684	0	0	0	0	0
April	10,354	2,946	0	0	0	0	0
May	12,107	2,359	0	0	0	0	0
June	24,236	1,749	0	0	0	0	0
July	28,258	1,636	0	0	0	0	0
August	27,452	1,709	0	0	0	0	0
September	22,425	1,917	0	0	0	0	0
October	11,734	2,643	0	0	0	0	0
November	10,235	3,296	0	0	0	0	0
December	8,543	4,231	0	0	0	0	0
Total	181,074	34,616	0	0	0	0	0

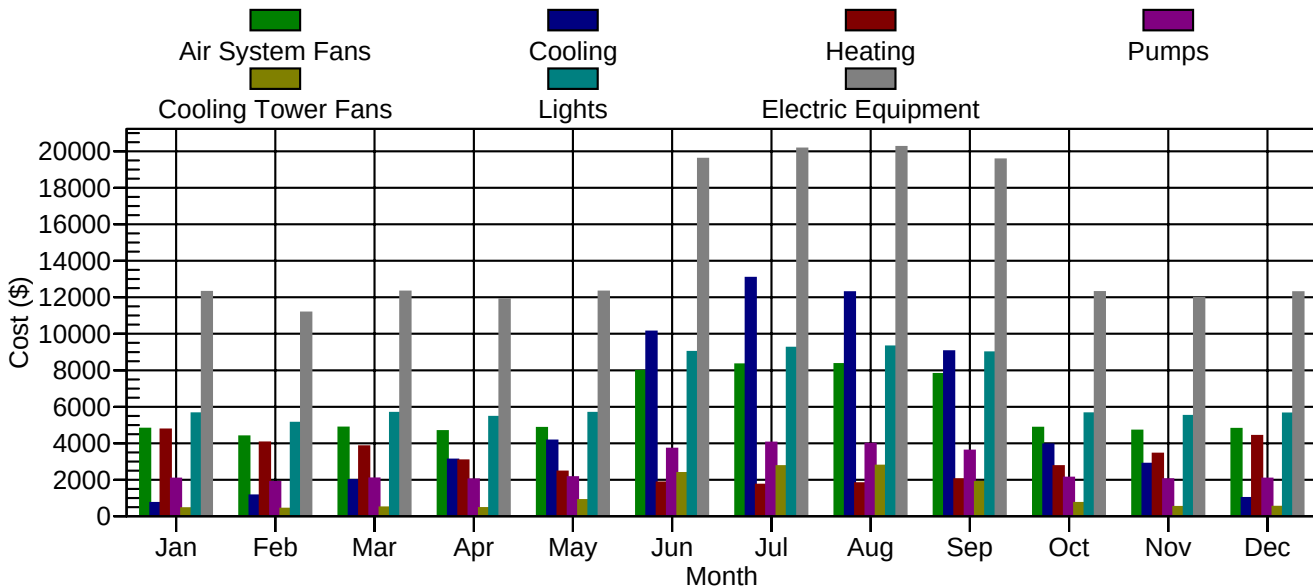
2. Non-HVAC Costs

Month	Electric (\$)	Natural Gas (\$)	Fuel Oil (\$)	Propane (\$)	Remote Hot Water (\$)	Remote Steam (\$)
January	17,929	0	0	0	0	0
February	16,285	0	0	0	0	0
March	17,971	0	0	0	0	0
April	17,336	0	0	0	0	0
May	17,972	0	0	0	0	0
June	28,585	0	0	0	0	0
July	29,379	0	0	0	0	0
August	29,534	0	0	0	0	0
September	28,518	0	0	0	0	0
October	17,914	0	0	0	0	0
November	17,459	0	0	0	0	0
December	17,900	0	0	0	0	0
Total	256,782	0	0	0	0	0

Monthly Component Costs - Hilton Hotel at BWI Airport

BWI Hilton - New Mechanical System Design
The Pennsylvania State University

04/05/2006
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1. HVAC Component Costs

Month	Air System Fans (\$)	Cooling (\$)	Heating (\$)	Pumps (\$)	Cooling Towers (\$)	HVAC Total (\$)
January	4,794	734	4,751	2,065	445	12,789
February	4,377	1,143	4,045	1,876	417	11,858
March	4,856	1,979	3,832	2,071	480	13,218
April	4,668	3,102	3,060	2,017	453	13,300
May	4,841	4,150	2,447	2,140	889	14,467
June	7,960	10,114	1,849	3,698	2,365	25,986
July	8,323	13,059	1,726	4,035	2,750	29,893
August	8,339	12,275	1,805	3,974	2,767	29,160
September	7,795	9,043	2,029	3,596	1,880	24,343
October	4,846	3,935	2,745	2,118	733	14,377
November	4,690	2,872	3,429	2,031	511	13,533
December	4,789	996	4,406	2,060	524	12,775
Total	70,277	63,402	36,124	31,683	14,213	215,698

2. Non-HVAC Component Costs

Month	Lights (\$)	Electric Equipment (\$)	Misc. Electric (\$)	Misc. Fuel Use (\$)	Non-HVAC Total (\$)	Grand Total (\$)
January	5,641	12,289	0	0	17,930	30,719
February	5,126	11,160	0	0	16,286	28,144
March	5,661	12,311	0	0	17,972	31,190
April	5,448	11,889	0	0	17,337	30,637
May	5,661	12,311	0	0	17,972	32,439
June	9,002	19,584	0	0	28,586	54,572
July	9,236	20,144	0	0	29,380	59,273
August	9,303	20,232	0	0	29,535	58,695
September	8,973	19,546	0	0	28,519	52,862
October	5,636	12,278	0	0	17,914	32,291
November	5,498	11,962	0	0	17,460	30,993
December	5,627	12,274	0	0	17,901	30,676
Total	80,812	175,979	0	0	256,791	472,490