



1 March 2011

To: George Hampton, Standard Maintenance Company

From: Jerry Gatlin, Thompson Engineers, Inc.

Re: Ceramic Paint Coatings – Reflectance

THE FOLLOWING CALCULATIONS ARE BASED UPON TEMPERATURE MEASUREMENTS TAKEN BY STANDARD MAINTENANCE COMPANY AT 12:30 P.M.. ON JUNE 20, 2010. THE AMBIENT TEMPERATURE WAS 95°F, SKY WAS CLEAR. SURFACE TEMPERATURES WERE TAKEN OF TWO SIMILAR ROOF ASSEMBLIES:

ASSEMBLY NO. 1: BLACK EPDM ROOF MEMBRANE, 2" INSULATION AND METAL ROOF DECK. ASSEMBLY 1 ROOF TEMPERATURE READING WAS TAKEN FROM THE TOP SURFACE OF THE BLACK EPDM ROOF. A TEMPERATURE READING OF 190.8°F. WAS RECORDED. A SECOND TEMPERATURE READING WAS TAKEN FROM INSIDE THE BUILDING DIRECTLY BELOW THE ROOF WHERE THE 190.8°F TEMPERATURE WAS TAKEN. THE TEMPERATURE READING TAKEN BELOW THE ROOF WAS 103.0°F, RESULTING IN A TEMPERATURE DIFFERENCE OF 87.8°F.

ASSEMBLY NO. 2: BLACK EPDM ROOF MEMBRANE PAINTED WITH WHITE CERAMIC COATING, 2" INSULATION AND METAL ROOF DECK. ASSEMBLY 2 ROOF TEMPERATURE READING WAS TAKEN FROM THE TOP SURFACE OF THE

BLACK EPDM ROOF WHICH HAD BEEN COATED WITH A WHITE CERAMIC PAINT. A TEMPERATURE READING OF 121.0°F. WAS RECORDED. A SECOND TEMPERATURE READING WAS TAKEN FROM INSIDE THE BUILDING DIRECTLY BELOW THE ROOF WHERE THE 121.0°F TEMPERATURE WAS TAKEN. THE TEMPERATURE READING TAKEN BELOW THE ROOF WAS 95.0°F, RESULTING IN A TEMPERATURE DIFFERENCE OF 26.0°F.

THE “R” FOR THE ROOF ASSEMBLY WAS DETERMINED USING THE *ASHRAE HANDBOOK OF FUNDAMENTALS 2009* STANDARDS AS FOLLOWS:

0.17 TOP OF ROOF AIR FILM
0.33 BLACK EPDM ROOF MEMBRANE
10.00 2” FIBERGLASS INSULATION
0.00 METAL ROOF DECK
0.68 BOTTOM OF ROOF DECK AIR FILM
11.18 TOTAL “R”

THE ROOF “U” FACTOR IS EQUAL TO THE INVERSE OF THE “R” FACTOR OF 11.18 OR 0.0894.

THE THERMAL RESISTANCE OF THE ROOF BASED ON THE TEMPERATURES RECORDED ON JUNE 20, 2010 IS AS FOLLOWS:

THE FORMULA FOR THE THERMAL RESISTANCE IS $(T_1 - T_2) / (R_1 + R_2 + R_3 + R_4 + R_5) =$ BTU/HR/SF. RESISTANCES (“R”) FOR THE ROOF ASSEMBLY ARE AS INDICATED ABOVE.

THE THERMAL RESISTANCE FOR THE BLACK EPDM ROOF IS AS FOLLOWS:

$(190.8^\circ - 103.0^\circ) / (0.17 + 0.33 + 10.00 + 0.00 + .68) = 87.8 / 11.18 = 7.85 \text{ BTU/HR/SF.}$

THE THERMAL RESISTANCE FOR THE BLACK EPDM ROOF PAINTED WITH WHITE CERAMIC PAINT IS AS FOLLOWS: $(121.0^{\circ} - 95.0^{\circ}) / (0.17 + 0.33 + 10.00 + 0.00 + .68) = 26.0 / 11.18 = \mathbf{2.33 \text{ BTU/HR/SF}}$.

THE DIFFERENCE BETWEEN THE BLACK EPDM (LOW REFLECTANCE) ROOF AND THE WHITE EPDM (HIGH REFLECTANCE) ROOF REFLECTANCE IS 5.52 BTU/HR/SF. THE 5.52 BTU/HR/SF DIFFERENCE FOR THE 800,000 SF = 4,416,000 BTU/HR/SF. THE 4,416,000 BTU/HR / 12,000 BTU/HR/TON = 368 TONS OF EQUIPMENT SAVINGS.

KEEP IN MIND THAT THE CERAMIC PAINT ON THE ROOF WILL NOT CHANGE THE “U” FACTOR BUT DOES CHANGE THE REFLECTANCE.

IN ORDER TO VERIFY THE FINDINGS OF THE THERMAL RESISTANCE CALCULATIONS ABOVE A STANDARD HVAC LOAD CALCULATION WAS MADE. THE *CHVAC-FULL COMMERCIAL HVAC LOADS CALCULATION PROGRAM* WAS RUN TO INDICATE THE DIFFERENCE IN TONNAGE REQUIREMENTS FOR A LIGHT COLORED (HIGH REFLECTANCE) AND A DARK COLORED (LOW REFLECTANCE) ROOF . NO OTHER PARTS OF THE BUILDING WERE INCLUDED IN THE DESIGN CALCULATIONS IN ORDER THAT ONLY THE REFLECTANCE OF THE ROOF WOULD BE IN CONSIDERATION.

EXHIBIT 1A IS A PRINTOUT OF THE *CHVAC- FULL COMMERCIAL HVAC LOADS CALCULATION PROGRAM* SHOWING THAT A DARK COLORED (LOW REFLECTANCE) ROOF WILL REQUIRE 626.22 TONS OF EQUIPMENT TO COOL THE ROOF.

EXHIBIT 1B IS A PRINTOUT OF THE *CHVAC-FULL COMMERCIAL HVAC LOADS CALCULATION PROGRAM* SHOWING THAT A LIGHT COLORED (HIGH REFLECTANCE) ROOF WILL REQUIRE 326.68 TONS OF EQUIPMENT TO COOL THE ROOF.

THE CHVAC LOAD PROGRAM INDICATED A 299.54 TONS DIFFERENCE DUE TO THE COLOR (REFLECTANCE) OF THE ROOF.

THE DIFFERENCE BETWEEN THE THERMAL RESISTANCE CALCULATION AND THE *CHVAC-FULL COMMERCIAL HVAC LOADS CALCULATION PROGRAM* IS 68 TONS. THE *CHVAC-FULL COMMERCIAL HVAC LOADS CALCULATION PROGRAM* ONLY LOOKS AT THE AVERAGE VALUES FOR LIGHT (HIGH REFLECTANCE) AND DARK (LOW REFLECTANCE) ROOFS. THE THERMAL RESISTANCE TEMPERATURES WERE TAKEN AT A SPECIFIC POINT AND TIME. THE *CHVAC-FULL COMMERCIAL HVAC LOADS CALCULATION PROGRAM* CALCULATION ALSO CONSIDERS HOW THE ROOF MAY DISCOLOR OVER TIME. THE THERMAL RESISTANCE WAS AN INSTANTANEOUS READING.

REGARDLESS OF THE TWO SYSTEMS USED ABOVE THERE IS A MINIMUM OF 3,600,000 BTU/HR (300 TONS) TO BE SAVED BY CHANGING THE COLOR (REFLECTANCE) OF THE ROOF.

NOTHING IN THIS REPORT IS TO BE CONSTRUED TO BE AN ENDORSEMENT FOR, NOR IS IT A PROOF FOR THE ENERGY SAVINGS POTENTIAL FOR CERAMIC PAINT COATINGS. THE INTENT WAS TO SHOW, THROUGH TWO DIFFERENT CALCULATIONS, THAT THERE IS ENERGY SAVING TO BE GAINED FROM A LIGHT COLORED (HIGH REFLECTANCE) ROOF.



Air Handler #2 - Dark - Summary Loads

Zn No	Description Peak Time	Area People Volume	Htg.Loss Htg.CFM CFM/Sqft	Sen.Gain Clg.CFM CFM/Sqft	Lat.Gain S.Exh W.Exh	Htg.O.A. Req.CFM Act.CFM	Clg.O.A. Req.CFM Act.CFM
2	Dark Roof	801,025	4,325,535	6,468,277	0	None	None
	2pm August	0	192,508	349,140	0	0	0
		0	0.24	0.44	0	0	0
	Zone Peak Totals:	801,025	4,325,535	6,468,277	0		
	Total Zones: 1	0	192,508	349,140	0	0	0
	Unique Zones: 1	0	0.24	0.44	0	0	0

EXHIBIT 1A, PG 1



Air Handler #2 - Dark - Total Load Summary

Air Handler Description: Dark Constant Volume - Sum of Peaks
 Sensible Heat Ratio: 1.00 --- This system occurs 1 time(s) in the building. ---

Air System Peak Time: 2pm in August.
 Outdoor Conditions: 95° DB, 73° WB, 87.21 grains

Summer: Exhaust controls outside air, ---- Winter: Exhaust controls outside air.

Zone Space sensible loss:	4,325,535 Btuh	
Infiltration sensible loss:	0 Btuh	0 CFM
Outside Air sensible loss:	0 Btuh	0 CFM
Supply Duct sensible loss:	823,911 Btuh	
Return Duct sensible loss:	411,956 Btuh	
Return Plenum sensible loss:	0 Btuh	
Total System sensible loss:		5,561,402 Btuh

Heating Supply Air: $5,149,447 / (.991 \times 1.08 \times 25) =$	192,508 CFM
Winter Vent Outside Air (0.0% of supply) =	0 CFM

Zone space sensible gain:	6,468,277 Btuh	
Infiltration sensible gain:	0 Btuh	
Draw-thru fan sensible gain:	0 Btuh	
Supply duct sensible gain:	760,974 Btuh	
Reserve sensible gain:	0 Btuh	
Total sensible gain on supply side of coil:		7,229,251 Btuh

Cooling Supply Air: $7,229,251 / (.991 \times 1.1 \times 19) =$	349,140 CFM
Summer Vent Outside Air (0.0% of supply) =	0 CFM

Return duct sensible gain:	285,365 Btuh	
Return plenum sensible gain:	0 Btuh	
Outside air sensible gain:	0 Btuh	0 CFM
Blow-thru fan sensible gain:	0 Btuh	
Total sensible gain on return side of coil:		285,365 Btuh
Total sensible gain on air handling system:		7,514,616 Btuh

Zone space latent gain:	0 Btuh	
Infiltration latent gain:	0 Btuh	
Outside air latent gain:	0 Btuh	
Total latent gain on air handling system:		0 Btuh
Total system sensible and latent gain:		7,514,616 Btuh

Check Figures

Total Air Handler Supply Air (based on a 19° TD):	349,140 CFM
Total Air Handler Vent. Air (0.00% of Supply):	0 CFM
Total Conditioned Air Space:	801,025 Sq.ft
Supply Air Per Unit Area:	0.4359 CFM/Sq.ft
Area Per Cooling Capacity:	1,279.1470 Sq.ft/Ton
Cooling Capacity Per Area:	0.0008 Tons/Sq.ft
Total Heating Required With Outside Air:	5,561,402 Btuh
Total Cooling Required With Outside Air:	626.22 Tons



Air Handler #1 - Light - Summary Loads

Zn No	Description Peak Time	Area People Volume	Htg.Loss Htg.CFM CFM/Sqft	Sen.Gain Clg.CFM CFM/Sqft	Lat.Gain S.Exh W.Exh	Htg.O.A. Req.CFM Act.CFM	Clg.O.A. Req.CFM Act.CFM
1	Light Roof	801,025	4,325,535	3,374,318	0	None	None
	2pm August	0	192,508	182,136	0	0	0
		0	0.24	0.23	0	0	0
	Zone Peak Totals:	801,025	4,325,535	3,374,318	0		
	Total Zones: 1	0	192,508	182,136	0	0	0
	Unique Zones: 1	0	0.24	0.23	0	0	0



Air Handler #1 - Light - Total Load Summary

Air Handler Description: Light Constant Volume - Sum of Peaks
 Sensible Heat Ratio: 1.00 --- This system occurs 1 time(s) in the building. ---

Air System Peak Time: 2pm in August.
 Outdoor Conditions: 95° DB, 73° WB, 87.21 grains

Summer: Exhaust controls outside air, ----- Winter: Exhaust controls outside air.

Zone Space sensible loss:	4,325,535 Btuh	
Infiltration sensible loss:	0 Btuh	0 CFM
Outside Air sensible loss:	0 Btuh	0 CFM
Supply Duct sensible loss:	823,911 Btuh	
Return Duct sensible loss:	411,956 Btuh	
Return Plenum sensible loss:	0 Btuh	
Total System sensible loss:		5,561,402 Btuh

Heating Supply Air: $5,149,447 / (.991 \times 1.08 \times 25) =$	192,508 CFM
Winter Vent Outside Air (0.0% of supply) =	0 CFM

Zone space sensible gain:	3,374,318 Btuh	
Infiltration sensible gain:	0 Btuh	
Draw-thru fan sensible gain:	0 Btuh	
Supply duct sensible gain:	396,979 Btuh	
Reserve sensible gain:	0 Btuh	
Total sensible gain on supply side of coil:		3,771,297 Btuh

Cooling Supply Air: $3,771,297 / (.991 \times 1.1 \times 19) =$	182,136 CFM
Summer Vent Outside Air (0.0% of supply) =	0 CFM

Return duct sensible gain:	148,867 Btuh	
Return plenum sensible gain:	0 Btuh	
Outside air sensible gain:	0 Btuh	0 CFM
Blow-thru fan sensible gain:	0 Btuh	
Total sensible gain on return side of coil:		148,867 Btuh
Total sensible gain on air handling system:		3,920,164 Btuh

Zone space latent gain:	0 Btuh	
Infiltration latent gain:	0 Btuh	
Outside air latent gain:	0 Btuh	
Total latent gain on air handling system:		0 Btuh
Total system sensible and latent gain:		3,920,164 Btuh

Check Figures

Total Air Handler Supply Air (based on a 19° TD):	182,136 CFM
Total Air Handler Vent. Air (0.00% of Supply):	0 CFM
Total Conditioned Air Space:	801,025 Sq.ft
Supply Air Per Unit Area:	0.2274 CFM/Sq.ft
Area Per Cooling Capacity:	2,452.0150 Sq.ft/Ton
Cooling Capacity Per Area:	0.0004 Tons/Sq.ft
Total Heating Required With Outside Air:	5,561,402 Btuh
Total Cooling Required With Outside Air:	326.68 Tons