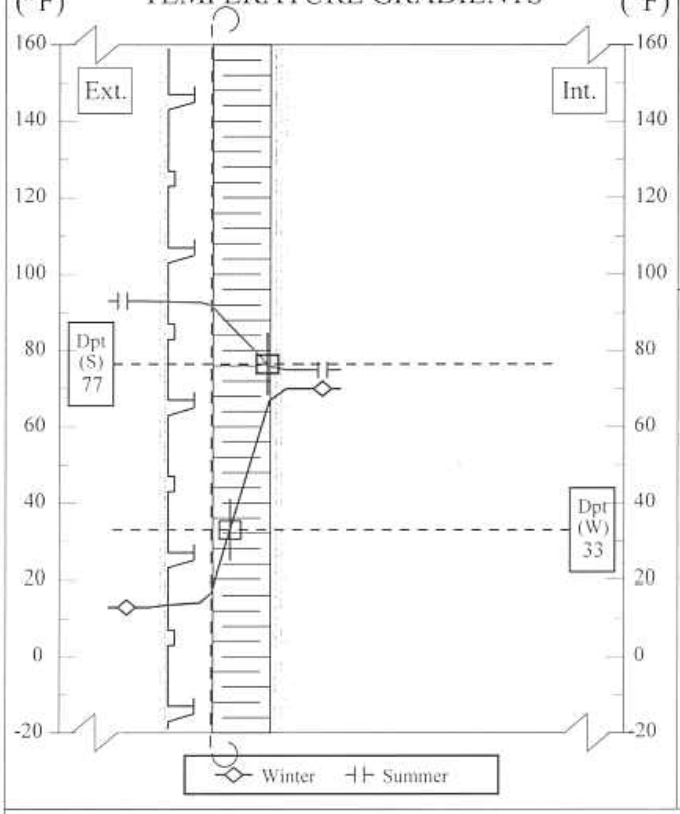
APPENDIX I.A: HEAT AIR AND MOISTURE (HAM) WALL REPORTS

Baseline Spandrel Wall for NYTB

R VALUE ANALYSIS

The Heat, Air and Moisture Building Science Toolbox - V.1B-E/U (11)

WALL SECTION AND TEMPERATURE GRADIENTS



PROJECT

Name	New York Times Building
Number	1
City	New York, NY
Date	2/8/2010
Analysis by:	Peter Clarke
Wall Type	
Option	

CLIMATIC CONDITIONS

	Winter		Summer	
	Int.	Ext.	Int.	Ext.
Temp (°F)	70	13	75	93
RH (%)	25	80	50	57
DPT (°F)	33	8	56	77

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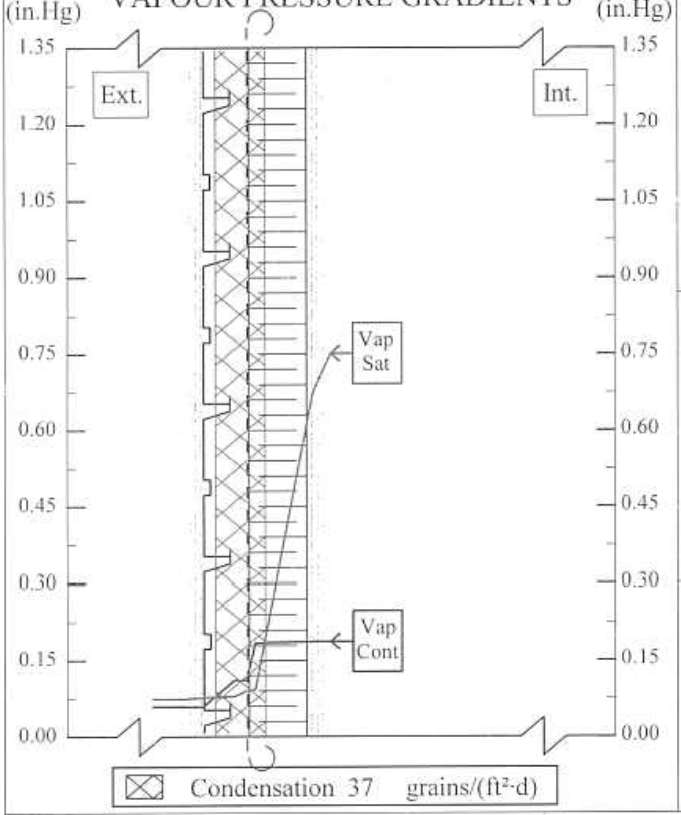
	Generic Material	Manufacturer	Model No.	Thick (in.)	RVal (R)	W.Temp. (°F)	S.Temp. (°F)
1	air film (ext), 3/4 in.	No Recor...	Generic...	0.75	0.17	13.6	92.9
2	aluminum clad.(unvntd), 1-1/2 in	No Recor...	Generic...	1.50	0.12	14.2	92.7
3	cavity, 1/2 in.	No Recor...	Generic...	0.50	0.52	16.8	91.9
4	poly film, (6mil)	No Recor...	Generic...	0.01	0.12	17.4	91.7
5	rigid ins.,(expand.), 2-1/2 in.	No Recor...	Generic...	2.50	9.88	66.8	76.0
6	air film (int), 3/4 in.	No Recor...	Generic...	0.75	0.64	70.0	75.0
	Total or (Layer 0)			4.50	11.44	(12.7)	(93.2)

Baseline Spandrel Wall for NYTB

CONDENSATION ANALYSIS

The Heat, Air and Moisture Building Science Toolbox - V.1B-E/U (11a)

WALL SECTION AND VAPOUR PRESSURE GRADIENTS



PROJECT

Name	New York Times Building
Number	1
City	New York, NY
Date	2/8/2010
Analysis by:	Peter Clarke
Wall Type	
Option	

CLIMATIC CONDITIONS

	Winter		Summer	
	Int.	Ext.	Int.	Ext.
Temp (°F)	70	13		
RH (%)	25	80		
DPT (°F)	33	8		

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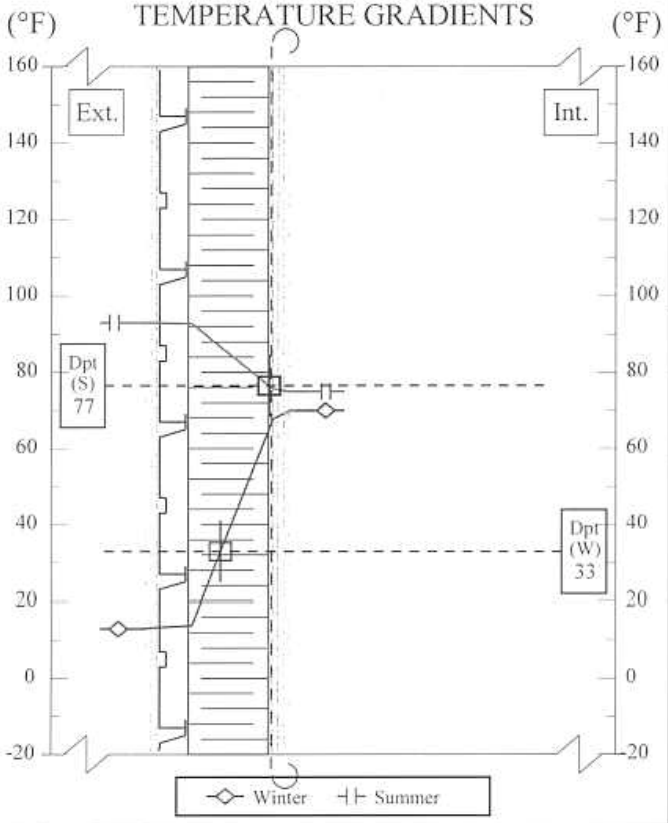
	Material	Manufacturer	Model No.	Rvap (1/M)	Temp (°F)	VapSat (in.Hg)	VapCont (in.Hg)
1	air film (ext), 3/4 in.	No Recor...	Generic...	0.001	13.9	0.076	0.058
2	aluminum clad.(unvntd), 1-1/2 in.	No Recor...	Generic...	11.443	14.4	0.078	0.109
3	cavity, 1/2 in.	No Recor...	Generic...	0.006	17.0	0.089	0.109
4	poly film, (6mil)	No Recor...	Generic...	16.827	17.6	0.092	0.182
5	rigid ins.,(expand.), 2-1/2 in.	No Recor...	Generic...	0.643	66.8	0.664	0.185
6	air film (int), 3/4 in.	No Recor...	Generic...	0.006	70.0	0.740	0.185
7							
8							
9							
10							
11							
12							
	TOTAL or (Layer 0)			29.046	(13.0)	(0.073)	(0.058)

Redesigned Spandrel Wall for NYTB

R VALUE ANALYSIS

The Heat, Air and Moisture Building Science Toolbox - V.1B-E/U (11)

WALL SECTION AND TEMPERATURE GRADIENTS



PROJECT

Name	New York Times Building
Number	1
City	New York, NY
Date	2/8/2010
Analysis by:	Peter Clarke
Wall Type	
Option	

CLIMATIC CONDITIONS

	Winter		Summer	
	Int.	Ext.	Int.	Ext.
Temp (°F)	70	13	75	93
RH (%)	25	80	50	57
DPT (°F)	33	8	56	77

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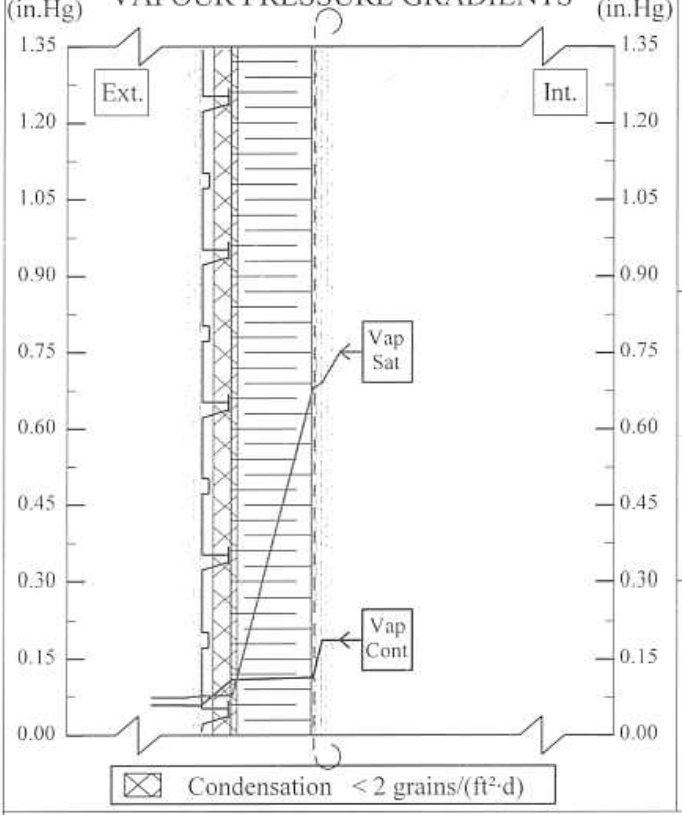
	Generic Material	Manufacturer	Model No.	Thick (in.)	RVal (R)	W.Temp. (°F)	S.Temp. (°F)
1	air film (ext), 3/4 in.	No Recor...	Generic...	0.75	0.17	13.4	93.0
2	aluminum clad.(unvntd), 1-1/2 in.	No Recor...	Generic...	1.50	0.12	13.9	92.8
3	rigid ins.,(expand.), 3-1/2 in.	No Recor...	Generic...	3.50	13.83	67.1	75.9
4	poly film, (6mil)	No Recor...	Generic...	0.01	0.12	67.6	75.8
5	air film (int), 3/4 in.	No Recor...	Generic...	0.75	0.64	70.0	75.0
	Total or (Layer 0)			5.00	14.87	(12.7)	(93.2)

Redesigned Spandrel Wall for NYTB

CONDENSATION ANALYSIS

The Heat, Air and Moisture Building Science Toolbox - V.1B-E/U (11a)

WALL SECTION AND VAPOUR PRESSURE GRADIENTS



PROJECT

Name	New York Times Building
Number	1
City	New York, NY
Date	2/8/2010
Analysis by:	Peter Clarke
Wall Type	
Option	

CLIMATIC CONDITIONS

	Winter		Summer	
	Int.	Ext.	Int.	Ext.
Temp (°F)	70	13		
RH (%)	25	80		
DPT (°F)	33	8		

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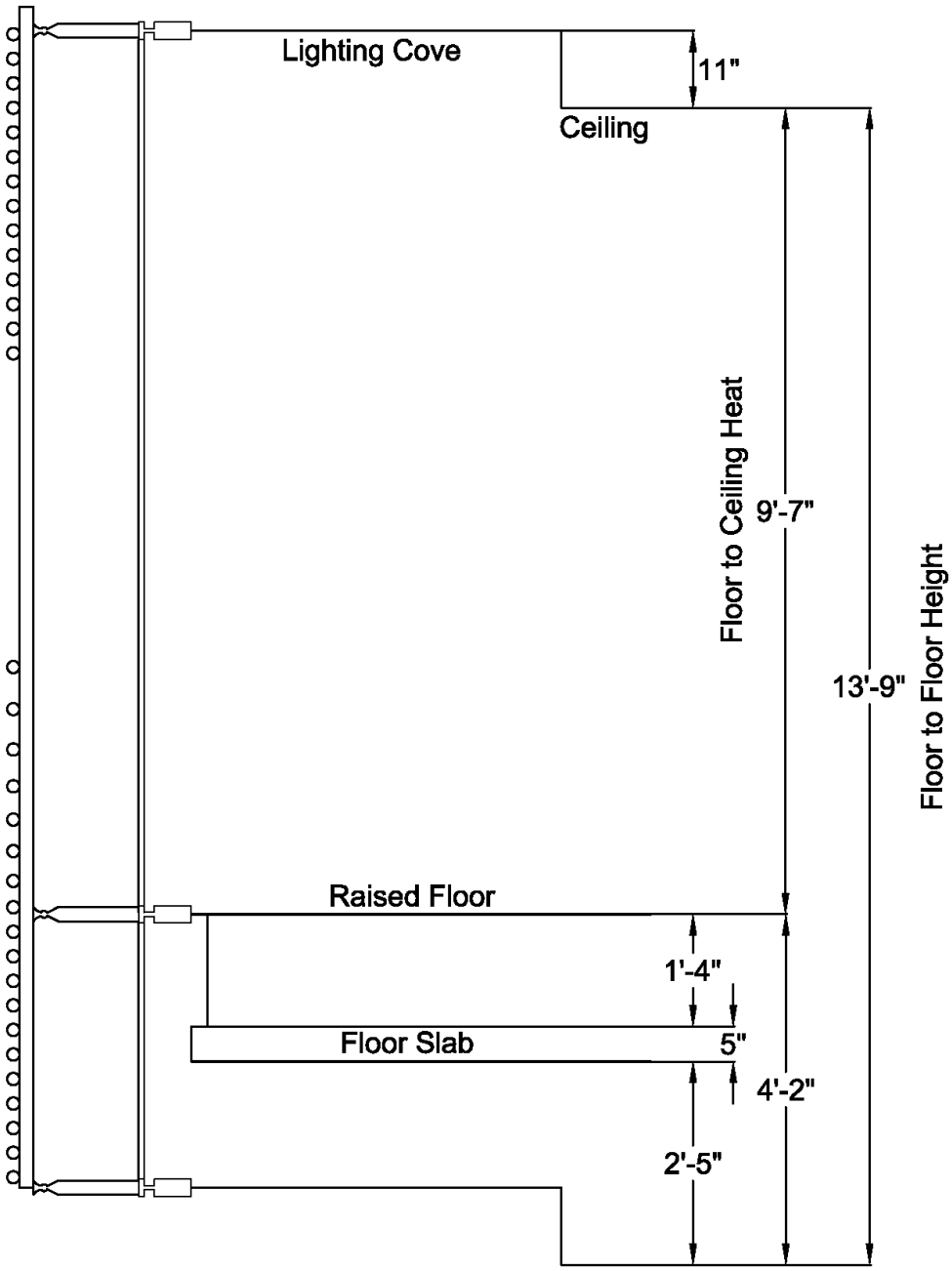
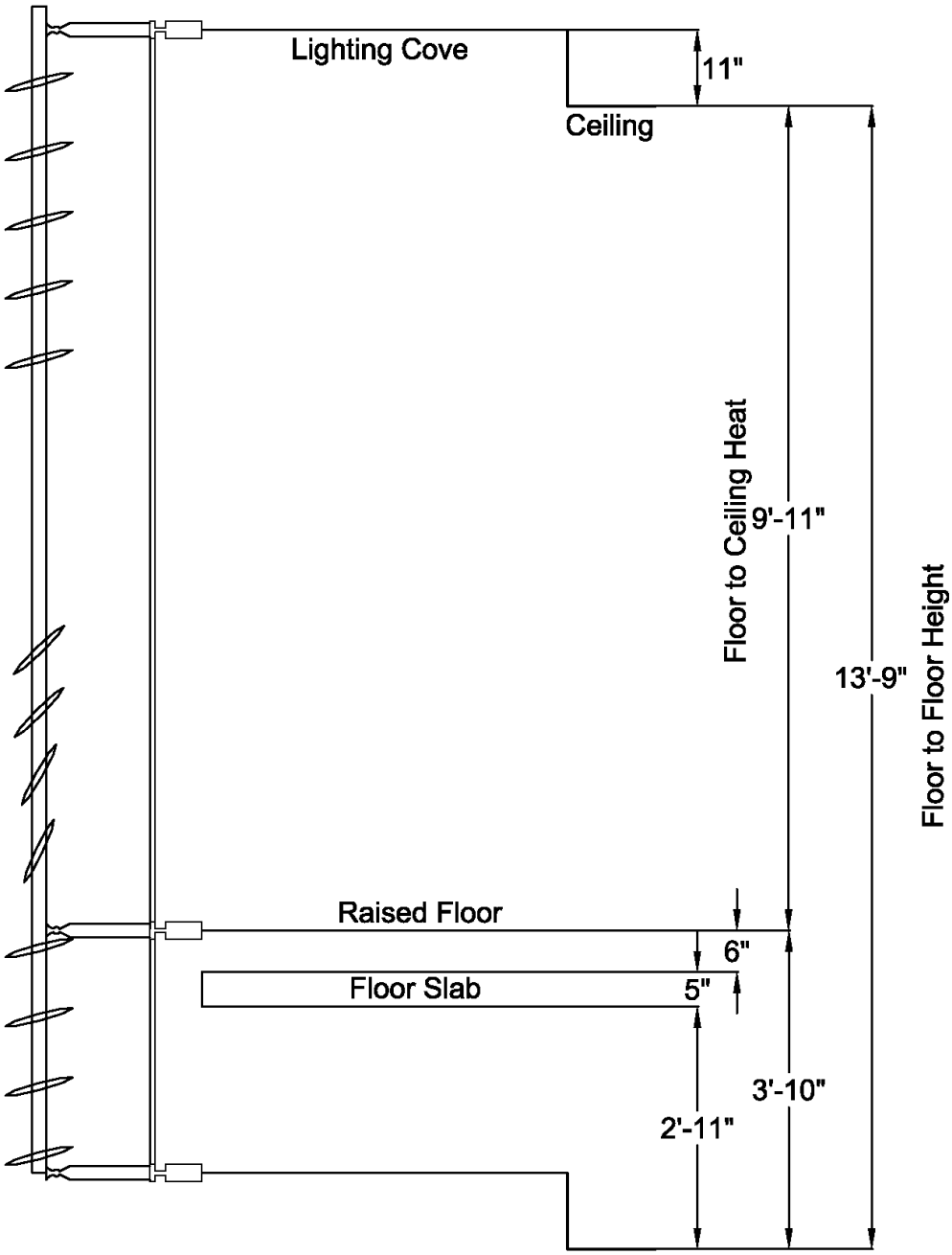
	Material	Manufacturer	Model No.	Rvap (1/M)	Temp (°F)	VapSat (in.Hg)	VapCont (in.Hg)
1	air film (ext), 3/4 in.	No Recor...	Generic...	0.001	13.7	0.076	0.058
2	aluminum clad.(unvntd), 1-1/2 in	No Recor...	Generic...	11.443	14.1	0.077	0.108
3	rigid ins.,(expand.), 3-1/2 in.	No Recor...	Generic...	0.894	67.1	0.670	0.112
4	poly film, (6mil)	No Recor...	Generic...	16.827	67.6	0.681	0.185
5	air film (int), 3/4 in.	No Recor...	Generic...	0.006	70.0	0.740	0.185
6							
7							
8							
9							
10							
11							
12							
	TOTAL or (Layer 0)			29.292	(13.0)	(0.073)	(0.058)

APPENDIX I.B: WALL SECTIONS



Baseline Wall Section for the New York Times Building



Redesigned Wall Section for the New York Times Building

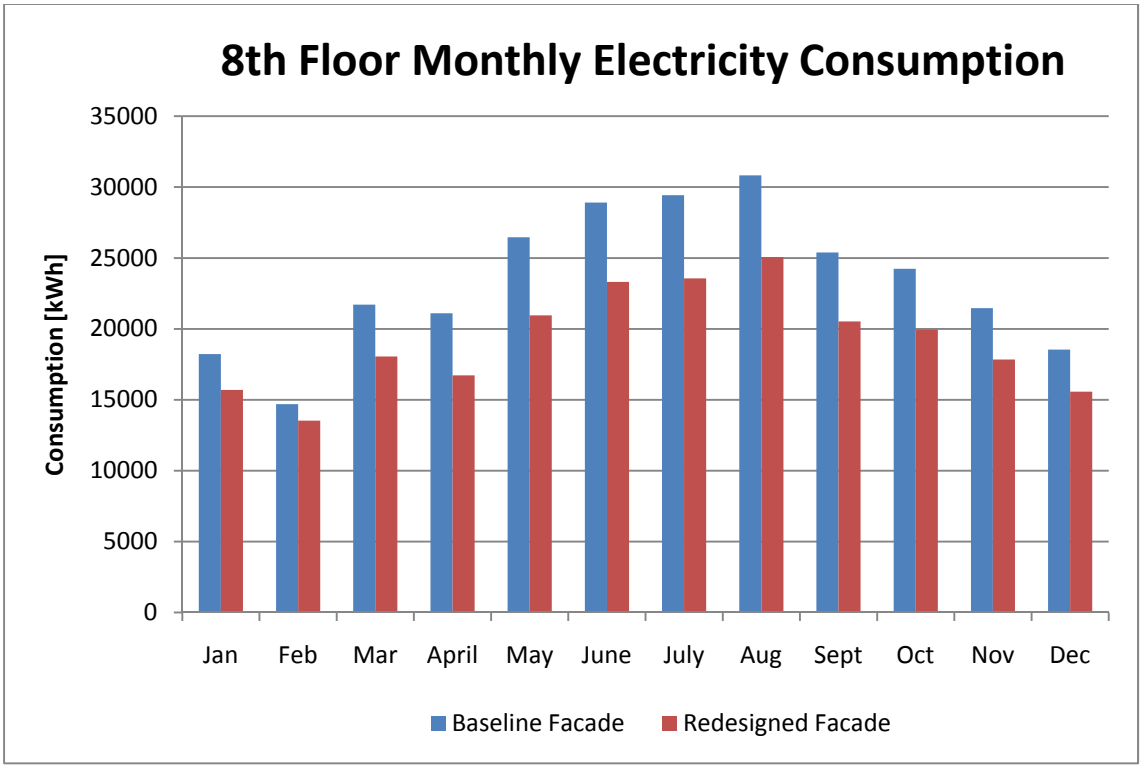
APPENDIX I.C: ENERGY MODELING REPORTS

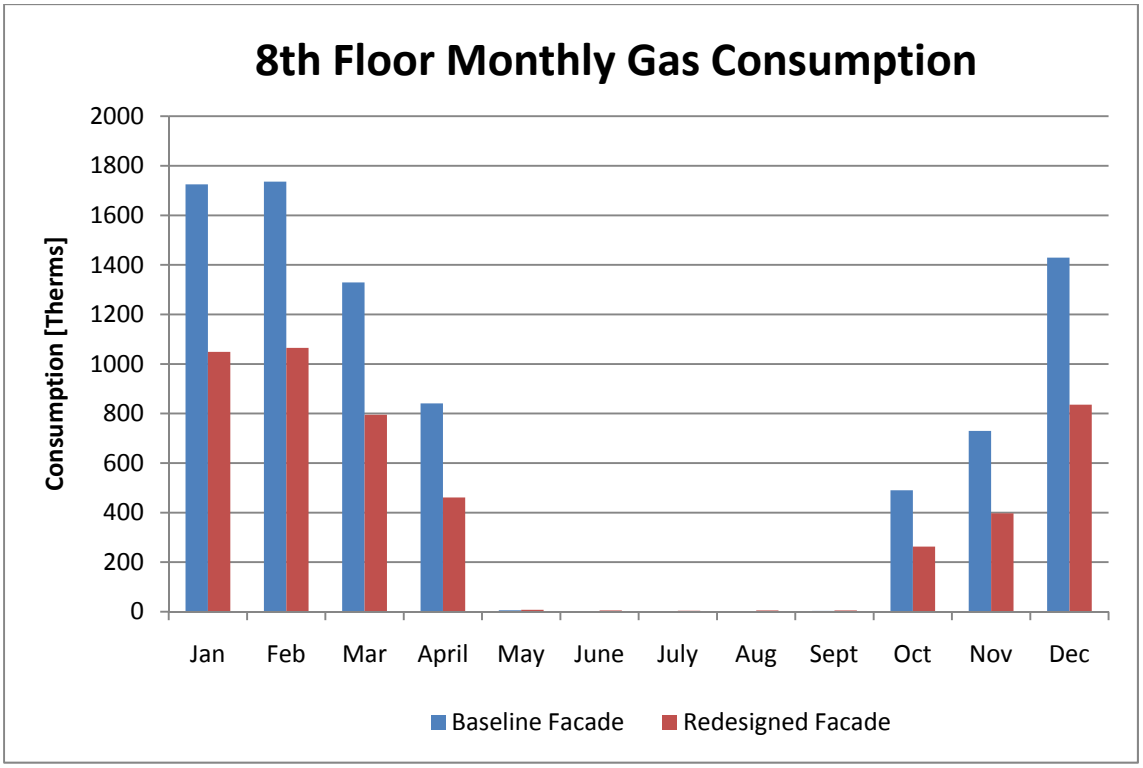
Trane TRACE Results Summary

		Baseline	Redesign	Percent Reduction [%]
Envelope Loads				
	Cooling Coil Peak [Btu/h]	447,375	182,861	59.1
	Heating Coil Peak [Btu/h]	321,391	182,164	43.3
Internal Loads				
	Cooling Coil Peak [Btu/h]	194,499	194,499	NA
	Heating Coil Peak [Btu/h]	0	0	NA
Total Loads				
	Cooling Coil Peak [Btu/h]	843,642	544,623	35.4
	Heating Coil Peak [Btu/h]	460,150	364,238	20.8
Energy Density				
	Cooling Density [Btu/hr-ft^2]	39.7	25.7	35.3
	Heating Density [Btu/hr-ft^2]	51.9	30.6	41.1
Energy Consumption				
	Electrical Consumption [kWh]	281,009	230,785	17.9
	Natural Gas Consumption [kBtu]	829,277	489,163	41.0
	Total Building Energy [kBtu/yr]	1,788,361	1,276,830	28.6
	Total Source Energy [kBtu/yr]	3,750,464	2,878,147	23.3

IES Results Summary

	Baseline	Redesign	Percent Reduction [%]
Cooling Peak Load [Btu/h]	824,700	479,900	41.8
Heating Peak Load [Btu/h]	536,200	454,100	15.3
Cooling Density [Btu/hr-ft^2]	34.0	20.0	41.2
Heating Density [Btu/hr-ft^2]	26.0	19.0	26.9


8th Floor Monthly Electricity Consumption
Consumption [kWh]
35000
30000
25000
20000
15000
10000
5000
0
Jan
Feb
Mar
April
May
June
July
Aug
Sept
Oct
Nov
Dec
Baseline Facade
Redesigned Facade


8th Floor Monthly Gas Consumption
Consumption [Therms]
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Jan
Feb
Mar
April
May
June
July
Aug
Sept
Oct
Nov
Dec
Baseline Facade
Redesigned Facade

Baseline Facade - 8th Floor NYTB

System Checksums

By Trial

Core VAV

Variable Volume Reheat (30% Min Flow Default)

COOLING COIL PEAK / CLG SPACE PEAK

Cooling Coil Peak — Peaked at Time: Mo/Hr: 7 / 15; Outside Air: OADB/WB/HR: 87 / 72 / 94

CLG Space Peak — Mo/Hr: 7 / 15; OADB: 87

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads						
Skylite Solar	0	0	0	0	0	0
Skylite Cond	0	0	0	0	0	0
Roof Cond	0	0	0	0	0	0
Glass Solar	0	0	0	0	0	0
Glass/Door Cond	0	0	0	0	0	0
Wall Cond	0	0	0	0	0	0
Partition/Door	0		0	0	0	0
Floor	0		0	0	0	0
Adjacent Floor	0	0	0	0	0	0
Infiltration	19,073		19,073	7	7,580	8
Sub Total ==>	19,073	0	19,073	7	7,580	8
Internal Loads						
Lights	25,178	20,819	45,998	18	25,178	26
People	48,131	0	48,131	19	27,634	28
Misc	24,766	0	24,766	10	24,766	25
Sub Total ==>	98,076	20,819	118,896	46	77,578	79
Ceiling Load	10,221	-10,221	0	0	10,221	10
Ventilation Load	0	0	122,008	48	0	0
Adj Air Trans Heat	0		0	0	0	0
Dehumid. Ov Sizing			0	0		
Ov/Undr Sizing	2,235		2,235	1	2,257	2
Exhaust Heat		-13,812	-13,812	-5		
Sup. Fan Heat			4,295	2		
Ret. Fan Heat		3,210	3,210	1		
Duct Heat Pkup		0	0	0		
Underflr Sup Ht Pkup			0	0		
Supply Air Leakage		0	0	0		
Grand Total ==>	129,605	-3	255,904	100.00	97,636	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design; OADB: 15

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	0	0.00
Glass Solar	0	0	0.00
Glass/Door Cond	0	0	0.00
Wall Cond	0	0	0.00
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0
Infiltration	-34,741	-34,741	19.83
Sub Total ==>	-34,741	-34,741	19.83
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	0	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	0	0	0.00
Exhaust Heat		0	0.00
OA Preheat Diff.		-140,494	80.17
RA Preheat Diff.		0	0.00
Additional Reheat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-34,741	-175,235	100.00

TEMPERATURES

	Cooling	Heating
SADB	50.8	86.7
Ra Plenum	77.6	70.0
Return	78.4	70.0
Ret/OA	87.0	70.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.2	0.0
Fn Frict	0.7	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	3,625	1,871
Terminal	3,625	1,871
Main Fan	3,625	1,871
Sec Fan	0	0
Nom Vent	3,625	0
AHU Vent	3,625	0
Infil	567	567
MinStop/Rh	1,871	1,871
Return	3,611	2,380
Exhaust	3,611	509
Rm Exh	580	58
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	100.0	0.0
cfm/ft²	0.30	0.15
cfm/ton	169.97	
ft²/ton	574.53	
Btu/hr-ft²	20.89	-25.02
No. People	111	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	21.3	255.9	150.4	3,624	87.0	71.9	93.8	49.8	49.7	52.9
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	21.3	255.9								

AREAS

	Gross Total	Glass ft²	Glass (%)
Floor	12,252		
Part	0		
Int Door	0		
ExFlr	0		
Roof	0	0	0
Wall	0	0	0
Ext Door	0	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-76.9	1,871	49.8	86.7
Aux Htg	0.0	0	0.0	0.0
Preheat	-140.5	3,625	15.0	49.8
Humidif	-89.1	4,191	2.4	32.7
Opt Vent	0.0	0	0.0	0.0
Total	-306.5			

Project Name: IPD/BIM Thesis - NYTB
Dataset Name: NYTB_MANUAL_BASELINE.TRC

TRACE® 700 v6.2.4 calculated at 07:50 PM on 03/20/2010
Alternative - 1 System Checksums Report Page 1 of 2

Baseline Facade - 8th Floor NYTB

System Checksums

By Trial

Perimeter VAV — **VAV w/Baseboard Skin Heating**

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 7 / 17
Outside Air: OADB/WB/HR: 86 / 71 / 92

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	0	0	0
Glass Solar	324,310	0	324,310	55
Glass/Door Cond	35,950	0	35,950	6
Wall Cond	17,212	37,950	55,162	9
Partition/Door	0		0	0
Floor	0		0	0
Adjacent Floor	0	0	0	0
Infiltration	12,880		12,880	2
Sub Total ==>	390,352	37,950	428,302	73
Internal Loads				
Lights	17,351	16,247	33,597	6
People	27,236	0	27,236	5
Misc	14,770	0	14,770	3
Sub Total ==>	59,356	16,247	75,603	13
Ceiling Load	4,317	-4,317	0	0
Ventilation Load	0	0	26,683	5
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		-3,287	-3,287	-1
Sup. Fan Heat			34,325	6
Ret. Fan Heat		26,112	26,112	4
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	454,025	72,704	587,738	100.00

CLG SPACE PEAK

Mo/Hr: 7 / 17
OADB: 86

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	324,310	75
Glass/Door Cond	35,950	8
Wall Cond	17,212	4
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	4,886	1
Sub Total ==>	382,357	88
Internal Loads		
Lights	17,351	4
People	15,131	3
Misc	14,770	3
Sub Total ==>	47,251	11
Ceiling Load	4,317	1
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing	0	0
Grand Total ==>	433,926	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 15

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	0	0.00
Glass Solar	0	0	0.00
Glass/Door Cond	-187,956	-187,956	65.97
Wall Cond	-23,391	-73,319	25.73
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0
Infiltration	-25,375	-25,375	8.91
Sub Total ==>	-236,721	-286,650	100.61
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-10,659	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	0	0	0.00
Exhaust Heat		1,734	-0.61
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-247,381	-284,915	100.00

TEMPERATURES

	Cooling	Heating
SADB	61.6	0.0
Ra Plenum	76.5	0.0
Return	77.3	0.0
Ret/OA	77.6	0.0
Fn MtrTD	0.1	0.0
Fn BltTD	0.2	0.0
Fn Frict	0.7	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	28,962	9,141
Terminal	28,962	9,141
Main Fan	28,962	9,141
Sec Fan	0	0
Nom Vent	857	0
AHU Vent	857	0
Infil	414	414
MinStop/Rh	9,141	9,141
Return	29,376	9,555
Exhaust	1,271	0
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	3.0	0.0
cfm/ft²	3.24	1.02
cfm/ton	591.32	
ft²/ton	182.71	
Btu/hr-ft²	65.68	-89.03
No. People	61	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	49.0	587.7	551.1	28,962	77.6	63.6	65.6	60.5	56.9	63.7
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	49.0	587.7								

AREAS

	Gross Total ft²	Glass ft²	Glass (%)
Floor	8,949		
Part	0		
Int Door	0		
ExFlr	0		
Roof	0	0	0
Wall	9,665	5,412	56
Ext Door	0	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	0.0	0	0.0	0.0
Aux Htg	-247.4	0	0.0	0.0
Preheat	-43.5	857	15.0	60.5
Reheat	-96.9	9,141	60.5	70.0
Humidif	-656.4	30,885	2.4	32.7
Opt Vent	0.0	0	0.0	0.0
Total	-1,044.1			

Project Name: IPD/BIM Thesis - NYTB
Dataset Name: NYTB_MANUAL_BASELINE.TRC

TRACE® 700 v6.2.4 calculated at 07:50 PM on 03/20/2010
Alternative - 1 System Checksums Report Page 2 of 2

Baseline Facade - 8th Floor NYTB

ENERGY CONSUMPTION SUMMARY

By Trial

	Elect Cons. (kWh)	Gas Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 1						
Primary heating						
Primary heating		829,277		46.4 %	829,277	872,923
Other Htg Accessories	10,056			1.9 %	34,322	102,977
Heating Subtotal	**10,056**	**829,277**		**48.3 %**	**863,599**	**975,900**
Primary cooling						
Cooling Compressor	46,422			8.9 %	158,439	475,364
Tower/Cond Fans	19,750		305	3.8 %	67,408	202,244
Condenser Pump	6,801			1.3 %	23,211	69,641
Other Clg Accessories	4,563			0.9 %	15,574	46,725
Cooling Subtotal....	**77,536**		**305**	**14.8 %**	**264,632**	**793,974**
Auxiliary						
Supply Fans	28,383			5.4 %	96,870	290,639
Pumps	9,552			1.8 %	32,601	97,813
Stand-alone Base Utilities				0.0 %	0	0
Aux Subtotal....	37,935			7.2 %	129,471	388,453
Lighting						
Lighting	102,728			19.6 %	350,612	1,051,940
Receptacle						
Receptacles	52,754			10.1 %	180,048	540,197
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	**281,009**	**829,277**	**305**	**100.0 %**	**1,788,361**	**3,750,464**

* Note: Resource Utilization factors are included in the Total Source Energy value.
** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

Project Name: IPD/BIM Thesis - NYTB
Dataset Name: NYTB_MANUAL_BASELINE.TRC

TRACE® 700 v6.2.4 calculated at 07:50 PM on 03/20/2010
Alternative - 1 Energy Consumption Summary report page 1

Baseline Facade - 8th Floor NYTB

MONTHLY ENERGY CONSUMPTION

By Trial

------- Monthly Energy Consumption -------

Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Alternative: 1	**NYTB 8th floor - with shading**												
Electric													
On-Pk Cons. (kWh)	18,229	14,697	21,713	21,103	26,465	28,910	29,428	30,826	25,390	24,241	21,463	18,543	281,009
On-Pk Demand (kW)	82	81	78	88	102	114	123	116	104	93	91	83	123
Gas													
On-Pk Cons. (therms)	1,725	1,736	1,329	841	6	2	1	2	3	490	730	1,429	8,293
On-Pk Demand (therms/hr)	4	5	3	2	0	0	0	0	0	1	2	3	5
Water													
Cons. (1000gal)	4	0	9	14	35	49	60	56	40	20	13	5	305

Energy Consumption		
Building	84,353	Btu/(ft2-year)
Source	176,900	Btu/(ft2-year)
Floor Area	21,201	ft2

Environmental Impact Analysis	
CO2	475,342 lbm/year
SO2	1,821 gm/year
NOX	555 gm/year

Project Name: IPD/BIM Thesis - NYTB
Dataset Name: NYTB_MANUAL_BASELINE.TRC

TRACE® 700 v6.2.4 calculated at 07:50 PM on 03/20/2010
Alternative - 1 Monthly Energy Consumption report Page 1 of 1

Redesigned Facade - 8th Floor NYTB

System Checksums

By PENN STATE UNIVERSITY

Core VAV

Variable Volume Reheat (30% Min Flow Default)

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 7 / 15
Outside Air: OADB/WB/HR: 87 / 72 / 94

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	0	0	0
Glass Solar	0	0	0	0
Glass/Door Cond	0	0	0	0
Wall Cond	0	0	0	0
Partition/Door	0		0	0
Floor	0		0	0
Adjacent Floor	0	0	0	0
Infiltration	20,644		20,644	8
Sub Total ==>	20,644	0	20,644	8
Internal Loads				
Lights	25,178	20,819	45,998	18
People	48,131	0	48,131	19
Misc	24,766	0	24,766	10
Sub Total ==>	98,076	20,819	118,896	46
Ceiling Load	10,203	-10,203	0	0
Ventilation Load	0	0	122,612	47
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	2,864		2,864	1
Exhaust Heat		-13,839	-13,839	-5
Sup. Fan Heat			4,312	2
Ret. Fan Heat		3,221	3,221	1
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	131,786	-1	256,709	100.00

CLG SPACE PEAK

Mo/Hr: 7 / 15
OADB: 87

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	0	0
Glass/Door Cond	0	0
Wall Cond	0	0
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	8,195	8
Sub Total ==>	8,195	8
Internal Loads		
Lights	25,178	25
People	27,634	28
Misc	24,766	25
Sub Total ==>	77,578	78
Ceiling Load	10,203	10
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Dehumid. Ov Sizing		
Ov/Undr Sizing	2,870	3
Exhaust Heat		
Sup. Fan Heat		
Ret. Fan Heat		
Duct Heat Pkup		
Underflr Sup Ht Pkup		
Supply Air Leakage		
Grand Total ==>	98,846	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 15

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	0	0.00
Glass Solar	0	0	0.00
Glass/Door Cond	0	0	0.00
Wall Cond	0	0	0.00
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0
Infiltration	-37,559	-37,559	16.96
Sub Total ==>	-37,559	-37,559	16.96
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	0	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	0	0	0.00
Exhaust Heat		0	0.00
OA Preheat Diff.		-140,181	63.30
RA Preheat Diff.		-43,703	19.74
Additional Reheat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-37,559	-221,443	100.00

TEMPERATURES

	Cooling	Heating
SADB	50.6	87.6
Ra Plenum	77.6	70.0
Return	78.4	70.0
Ret/OA	87.0	70.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.2	0.0
Fn Frict	0.7	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	3,638	1,918
Terminal	3,638	1,918
Main Fan	3,638	1,918
Sec Fan	0	0
Nom Vent	3,638	0
AHU Vent	3,638	0
Infil	613	613
MinStop/Rh	1,918	1,918
Return	3,624	2,468
Exhaust	3,624	550
Rm Exh	627	63
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	100.0	0.0
cfm/ft²	0.30	0.16
cfm/ton	168.76	
ft²/ton	568.30	
Btu/hr-ft²	21.12	-25.45
No. People	111	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	21.6	258.7	151.8	3,638	87.0	71.9	93.8	49.6	49.5	52.5
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	21.6	258.7								

AREAS

	Gross Total ft²	Glass ft²	Glass (%)
Floor	12,252		
Part	0		
Int Door	0		
ExFlr	0		
Roof	0	0	0
Wall	0	0	0
Ext Door	0	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-81.3	1,918	49.6	87.6
Aux Htg	0.0	0	0.0	0.0
Preheat	-140.2	3,638	15.0	49.6
Humidif	-90.4	4,251	2.4	32.7
Opt Vent	0.0	0	0.0	0.0
Total	-311.8			

Project Name: IPD/BIM Thesis - NYTB
Dataset Name: NYTB_MANUAL_SHADING.trc

TRACE® 700 v6.2.4 calculated at 04:18 PM on 02/26/2010
Alternative - 1 System Checksums Report Page 1 of 2

Redesigned Facade - 8th Floor NYTB

System Checksums

By PENN STATE UNIVERSITY

Perimeter VAV — **VAV w/Baseboard Skin Heating**

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 7 / 17
Outside Air: OADB/WB/HR: 86 / 71 / 92

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	0	0	0
Glass Solar	79,647	0	79,647	28
Glass/Door Cond	6,471	0	6,471	2
Wall Cond	43,060	19,159	62,219	22
Partition/Door	0		0	0
Floor	0		0	0
Adjacent Floor	0	0	0	0
Infiltration	13,880		13,880	5
Sub Total ==>	143,058	19,159	162,217	57
Internal Loads				
Lights	17,351	16,247	33,597	12
People	27,236	0	27,236	10
Misc	14,770	0	14,770	5
Sub Total ==>	59,356	16,247	75,603	26
Ceiling Load	6,544	-6,544	0	0
Ventilation Load	0	0	30,290	11
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		-4,929	-4,929	-2
Sup. Fan Heat			12,763	4
Ret. Fan Heat		9,970	9,970	3
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	208,958	33,903	285,914	100.00

CLG SPACE PEAK

Mo/Hr: 7 / 17
OADB: 86

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	79,647	42
Glass/Door Cond	6,471	3
Wall Cond	43,060	23
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	5,282	3
Sub Total ==>	134,460	71
Internal Loads		
Lights	17,351	9
People	15,131	8
Misc	14,770	8
Sub Total ==>	47,251	25
Ceiling Load	6,544	3
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing	0	0
Grand Total ==>	188,255	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 15

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	0	0.00
Glass Solar	0	0	0.00
Glass/Door Cond	-32,895	-32,895	23.04
Wall Cond	-58,519	-84,277	59.02
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0
Infiltration	-27,433	-27,433	19.21
Sub Total ==>	-118,847	-144,605	101.27
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-10,288	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	0	0	0.00
Exhaust Heat		1,810	-1.27
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-129,135	-142,795	100.00

TEMPERATURES

	Cooling	Heating
SADB	59.3	0.0
Ra Plenum	77.3	0.0
Return	78.1	0.0
Ret/OA	78.8	0.0
Fn MtrTD	0.1	0.0
Fn BltTD	0.2	0.0
Fn Frict	0.7	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	10,769	3,342
Terminal	10,769	3,342
Main Fan	10,769	3,342
Sec Fan	0	0
Nom Vent	976	0
AHU Vent	976	0
Infil	447	447
MinStop/Rh	3,342	3,342
Return	11,216	3,790
Exhaust	1,424	0
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	9.1	0.0
cfm/ft²	1.20	0.37
cfm/ton	451.97	
ft²/ton	375.59	
Btu/hr-ft²	31.95	-37.67
No. People	61	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	23.8	285.9	246.5	10,769	78.8	64.4	67.5	58.3	55.7	62.3
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	23.8	285.9								

AREAS

	Gross Total ft²	Glass ft²	Glass (%)
Floor	8,949		
Part	0		
Int Door	0		
ExFlr	0		
Roof	0	0	0
Wall	9,665	2,126	22
Ext Door	0	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	0.0	0	0.0	0.0
Aux Htg	-129.1	0	0.0	0.0
Preheat	-47.1	976	15.0	58.3
Reheat	-43.8	3,342	58.3	70.0
Humidif	-246.3	11,588	2.4	32.7
Opt Vent	0.0	0	0.0	0.0
Total	-466.3			

Project Name: IPD/BIM Thesis - NYTB
Dataset Name: NYTB_MANUAL_SHADING.trc

TRACE® 700 v6.2.4 calculated at 04:18 PM on 02/26/2010
Alternative - 1 System Checksums Report Page 2 of 2

Redesigned Facade - 8th Floor NYTB

ENERGY CONSUMPTION SUMMARY

By PENN STATE UNIVERSITY

	Elect Cons. (kWh)	Gas Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 1						
Primary heating						
Primary heating		489,163		38.3 %	489,163	514,908
Other Htg Accessories	8,640			2.3 %	29,489	88,475
Heating Subtotal	**8,640**	**489,163**		**40.6 %**	**518,651**	**603,383**
Primary cooling						
Cooling Compressor	24,581			6.6 %	83,894	251,708
Tower/Cond Fans	11,636		165	3.1 %	39,713	119,152
Condenser Pump	3,988			1.1 %	13,612	40,839
Other Clg Accessories	4,145			1.1 %	14,147	42,445
Cooling Subtotal....	**44,350**		**165**	**11.9 %**	**151,366**	**454,144**
Auxiliary						
Supply Fans	16,180			4.3 %	55,221	165,681
Pumps	6,133			1.6 %	20,932	62,802
Stand-alone Base Utilities				0.0 %	0	0
Aux Subtotal....	22,313			6.0 %	76,153	228,483
Lighting						
Lighting	102,728			27.5 %	350,612	1,051,940
Receptacle						
Receptacles	52,754			14.1 %	180,048	540,197
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	**230,785**	**489,163**	**165**	**100.0 %**	**1,276,830**	**2,878,147**

* Note: Resource Utilization factors are included in the Total Source Energy value.

** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

Project Name: IPD/BIM Thesis - NYTB
Dataset Name: NYTB_MANUAL_SHADING.trc

TRACE® 700 v6.2.4 calculated at 04:18 PM on 02/26/2010
Alternative - 1 Energy Consumption Summary report page 1

Redesigned Facade - 8th Floor NYTB

MONTHLY ENERGY CONSUMPTION

By PENN STATE UNIVERSITY

------- Monthly Energy Consumption -------

Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Alternative: 1	**NYTB 8th floor - with shading**												
Electric													
On-Pk Cons. (kWh)	15,692	13,533	18,051	16,724	20,956	23,319	23,560	25,058	20,522	19,953	17,842	15,575	230,785
On-Pk Demand (kW)	50	51	54	59	71	77	83	80	74	64	60	51	83
Gas													
On-Pk Cons. (therms)	1,049	1,065	795	461	8	5	4	5	5	263	397	836	4,892
On-Pk Demand (therms/hr)	3	4	3	2	0	0	0	0	0	1	1	2	4
Water													
Cons. (1000gal)	0	0	2	4	17	29	39	36	24	9	4	1	165

Energy Consumption		
Building	60,225	Btu/(ft2-year)
Source	135,755	Btu/(ft2-year)
Floor Area	21,201	ft2

Environmental Impact Analysis	
CO2	339,378 lbm/year
SO2	1,300 gm/year
NOX	395 gm/year

Project Name: IPD/BIM Thesis - NYTB
Dataset Name: NYTB_MANUAL_SHADING.trc

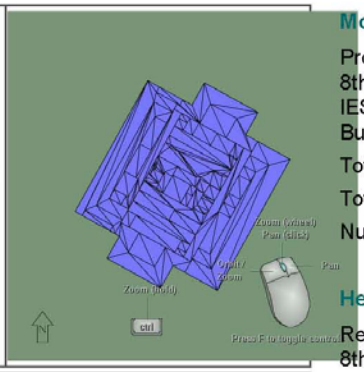
TRACE® 700 v6.2.4 calculated at 04:18 PM on 02/26/2010
Alternative - 1 Monthly Energy Consumption report Page 1 of 1

INTEGRATED ENVIRONMENTAL SOLUTIONS

8th floor mechanical model - Baseline - IESiesve.mit
13/Mar/2010

Project summary

Building



Model data:

Project file
8th floor mechanical model - Baseline - IESiesve.mit

Building floor area	24356.35 ft^2
Total conditioned floor area	21328.68 ft^2
Total conditioned volume	283499.66 ft^3
Number of conditioned rooms	45

Heating calculation data:

Results file
8th floor mechanical model - Baseline - IESiesve.htg

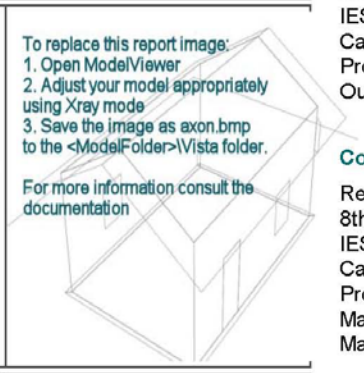
Calculated	18:10 13/Mar/2010
Profile month	January
Outdoor winter design temp	13.1 °F

Cooling calculation data:

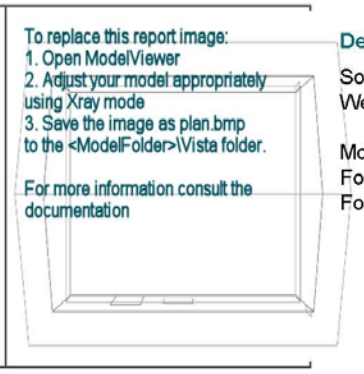
Results file
8th floor mechanical model - Baseline - IESiesve.clg

Calculated	18:10 13/Mar/2010
Profile month	May - Sep
Max outdoor temp. dry bulb	95.7 °F
Max outdoor temp. wet bulb	76.6 °F

Building Form



Building Plan



Design weather:

Source ASHRAE design weather database
Weather location
New York/JFK Int'l Airport, New York
Monthly percentile:

For heating loads design weather	99.6 %
For cooling loads design weather	0.4 %

ASHRAE Loads provides the heating and cooling loads for the building and rooms using the ASHRAE Heat Balance Method. For each analyzed zone, the Heat Balance Method calculates the conductive, convective, and radiative heat balance for each room surface and a heat balance for the room air.

The Heat Balance Method directly solves these equations and reports the results of each calculation. It also allows for a great deal of customization of the simulation inputs.

A detailed description of the Heat Balance Method can be found in the 2005 ASHRAE Fundamentals Handbook.

ASHRAE system loads

	System name	Room heating plant load(kBtu/h)		Outdoor primary air load (kBtu/h)		Plant load	
		Sensible	Humid	Mech vent	Aux Vent	kBtu/h	Btu/h•ft^2
	A-Z	Hi/Lo	Hi/Lo	Hi/Lo	Hi/Lo	Hi/Lo	Hi/Lo
ASHRAE - system heating loads	Central Heating Radiators	0.0	0.0	0.0	0.0	0.0	n/a
	V A V Single Duct	536.2	0.0	0.0	0.0	628.5	30.4
	Fan Coil System	0.0	0.0	0.0	0.0	0.0	0.0

Heating loads:

	System name	Peak time	Room cooling plant load (kBtu/h)		Outdoor primary air load (kBtu/h)				Peak plant load	
			Sens	Dehum	Mech vent sens	Mech vent lat	Aux vent sens	Aux vent lat	kBtu/h	Btu/h•ft²
ASHRAE - system cooling loads	A-Z		Hi/Lo	Hi/Lo	Hi/Lo	Hi/Lo	Hi/Lo	Hi/Lo	Hi/Lo	Hi/Lo
	Central Heating Radiators	May 00:30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
	VAV Single Duct	Jul 17:30	734.0	72.4	0.0	0.0	0.0	0.0	824.4	39.9
	Fan Coil System	Sep 19:30	0.0	0.3	0.0	0.0	0.0	0.0	0.3	0.5

Total central plant load kBtu/h 536.2 kBtu/h
Cooling loads: 26 Btu/h•ft² 628.5

ASHRAE room loads

Total room plant load 806.7 kBtu/h
Total central plant load 824.7 kBtu/h
34 Btu/h•ft²

Air flow rates:

Total room air flows	FALSE8th floor mec
	FALSE8th floor mec

System assignments:

VAV Single Duct	VAV Single Duct	VAV Single Duct

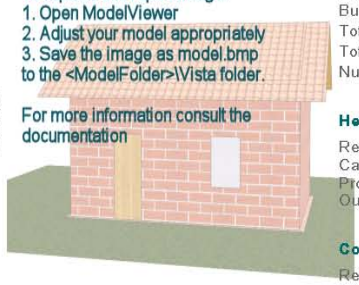
INTEGRATED ENVIRONMENTAL SOLUTIONS

NYTB - Redesign.mit
13/Mar/2010

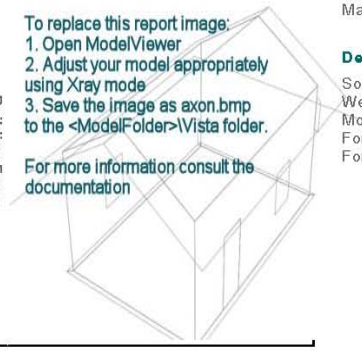
Contents: Project Summary (Model, Calc. data, Weather) ASHRAE system loads (Heating loads, Cooling loads) ASHRAE room loads (Heating loads, Cooling loads, Cooling airflow)

Project summary

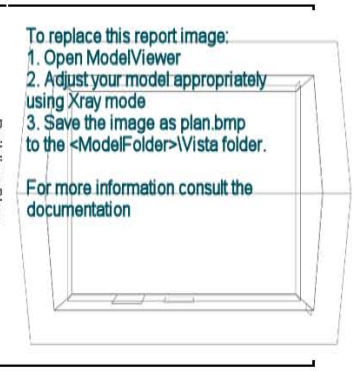
Building



Building Form



Building Plan



Model data:

Project file	NYTB - Redesign.mit
Building floor area	24356.35 ft^2
Total conditioned floor area	21328.68 ft^2
Total conditioned volume	231422.17 ft^3
Number of conditioned rooms	45

Heating calculation data:

Results file	NYTB - Redesign.htg
Calculated	19:39 13/Mar/2010
Profile month	January
Outdoor winter design temp	13.1 °F

Cooling calculation data:

Results file	NYTB - Redesign.clg
Calculated	19:39 13/Mar/2010
Profile month	May - Sep
Max outdoor temp. dry bulb	95.7 °F
Max outdoor temp. wet bulb	76.6 °F

Design weather:

Source	ASHRAE design weather database
Weather location	New York/JFK Int'l Airport, New York
Monthly percentile:	
For heating loads design weather	99.6 %
For cooling loads design weather	0.4 %

ASHRAE Loads provides the heating and cooling loads for the building and rooms using the ASHRAE Heat Balance Method. For each analyzed zone, the Heat Balance Method calculates the conductive, convective, and radiative heat balance for each room surface and a heat balance for the room air.

The Heat Balance Method directly solves these equations and reports the results of each calculation. It also allows for a great deal of customization of the simulation inputs.

A detailed description of the Heat Balance Method can be found in the 2005 ASHRAE Fundamentals Handbook.

ASHRAE system loads

ASHRAE - system heating loads

System name	Room heating plant load (kBtu/h)		Outdoor primary air load (kBtu/h)		Plant load	
	Sensible	Humid	Mech vent	Aux Vent	kBtu/h	Btu/h•ft²
A Z	Hi/Lo	Hi/Lo	Hi/Lo	Hi/Lo	Hi/Lo	Hi/Lo
Central Heating Radiators	0.0	0.0	0.0	0.0	0.0	n/a
V A V Single Duct	387.4	0.0	0.0	0.0	454.1	22.0
Fan Coil System	0.0	0.0	0.0	0.0	0.0	0.0

ASHRAE - system cooling loads

System name	Peak time	Room cooling plant load (kBtu/h)		Outdoor primary air load (kBtu/h)				Peak plant load	
		Sens	De hum	Mech vent sens	Mech vent lat	Aux vent sens	Aux vent lat	kBtu/h	Btu/h•ft²
A Z		Hi/Lo	Hi/Lo	Hi/Lo	Hi/Lo	Hi/Lo	Hi/Lo	Hi/Lo	Hi/Lo
Central Heating Radiators	May 00:30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a
V A V Single Duct	Jul 17:30	400.5	68.7	0.0	0.0	0.0	0.0	479.7	23.2
Fan Coil System	Jul 18:30	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.3

Heating loads:

Total room plant load	387.4 kBtu/h
Total central plant load	454.1 kBtu/h
	19 Btu/h•ft²

Cooling loads:

Total room plant load	469.4 kBtu/h
Total central plant load	479.9 kBtu/h
	20 Btu/h•ft²

Air flow rates:

Total room air flows	FALSENYTB - Red
	FALSENYTB - Red /

System assignments:

V A V Single Duct	V A V Single Duct	V A V Single Duct
sp-3-Office	sp-47-Toilets	sp-71-N_Per_Office
sp-4-Conference	sp-48-Pantry	
sp-5-Office	sp-49-Mail	
sp-6-Office	sp-50-Corridor	
sp-21-Copy	sp-52-Int_Stairs	
sp-26-Office	sp-53-Int_Stairs	
sp-27-Copy	sp-61-N_Ext_Stair	
sp-28-Closet		
sp-32-Office		

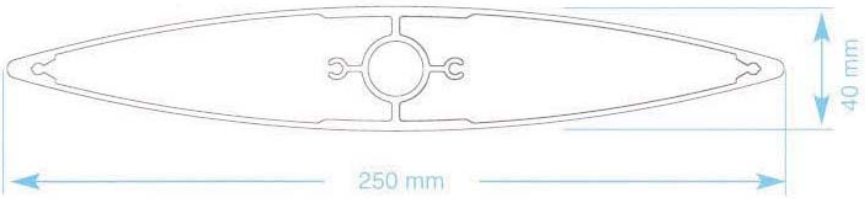
APPENDIX I.D: NACO BLADE DESIGN BROCHURE

EXTRUDED SUNBREAKER

BLADE 25 E

This blade is 250 mm wide, 40 mm thick and weighs 3800 g/m. Its ellipsoid shape recalls, in a smaller scale, that of the other sections. The aluminium is 18/10 thick.
The endcaps are in 3 mm thick aluminium and are screwed on the blade by means of 4 self-tapping steel screws per side.
Accessories, frames and controls are those used for ellipsoid blades type 15 and 21.

25 E



TYPE 21

Table for calculating number of blades

In the closed position the installation should allow a gap of 5 mm each side, so that the blades do not foul the walls or structure.
The width A of the opening must thus be larger than or equal to B. For the height H of the opening and the distance between the supporting brackets, in case of embossed application, the maximum tolerance is ± 1 cm.

The standard thread is 20 cm, for the blades overlap 1 cm. Thus the standard formula:

$$B = (N \times 20\ cm) + 2\ cm \quad \text{with} \quad N = \frac{B\text{-}2\ cm}{20\ cm}$$

where N indicates the number of blades and B the modular width in cm.

APPENDIX I.E: EXTERIOR LIGHTING FIXTURE CUT SHEETS

Date: _____ Type: _____

Firm Name: _____

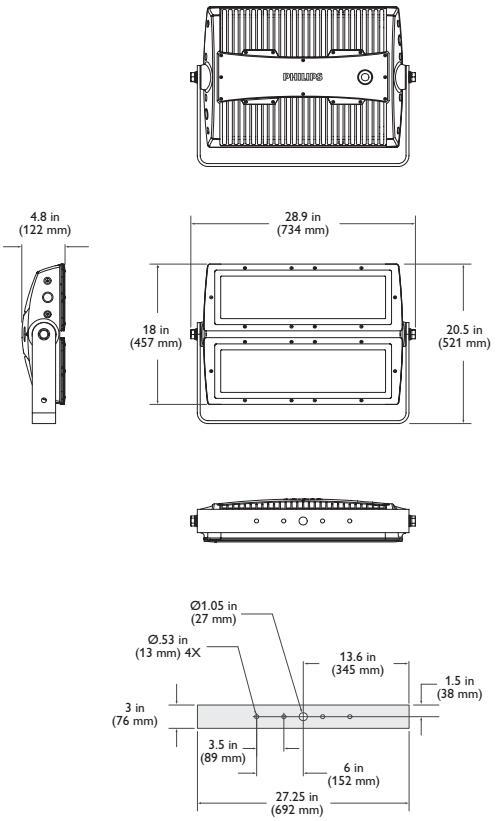
Project: _____

iW Reach Powercore

8° Spread Lens

Intelligent white LED floodlight for signature façades and structures

iW® Reach Powercore, the intelligent white light version of our flagship, high-performance exterior architectural floodlight, is the first LED fixture powerful enough to brilliantly illuminate large architectural façades with washes of white light in color temperatures ranging from a warm 2700 K to a cool 6500 K. iW Reach Powercore combines all the benefits of LED-based lighting in an elegant fixture specifically designed for large-scale installations, such as commercial skyscrapers, casinos, large retail exteriors, bridges, piers, public monuments, and themed attractions. With significantly more lumen output than any other competitive fixture and unprecedented light projection of over 800 ft (243.8 m), this powerful fixture represents the next generation in exterior illumination.



- Integrates Powercore® technology — Powercore technology rapidly, efficiently, and accurately controls power output to iW Reach Powercore fixtures directly from line voltage. The Philips iW Data Enabler merges line voltage with control data and delivers them to the fixture over a single standard wire, dramatically simplifying installation and lowering total system cost.
- Unparalleled light output — With an output of over 10,000 lumens and light projection of over 800 ft (243.8 m), iW Reach Powercore is the first fixture to offer legitimate LED-based, color-controllable white light illumination of large-scale structures and objects.
- Wide range of color temperature and brightness — Channels of warm white and cool white LEDs produce color temperatures ranging from 2700 K to 6500 K. Fixture brightness can be adjusted while varying or maintaining constant color temperature.
- Versatile optics — Exchangeable spread lenses of 8°, 13°, 23°, 40°, 63°, and an asymmetric 5° x 17° support a variety of photometric distributions for a multitude of applications, including spotlighting, wall grazing, and asymmetric wall washing. Bezel and gasket ship with spread lenses for easy user installation.
- Simple fixture positioning — Rugged, slim-profile mounting bracket allows simple positioning and fixture rotation through a full 360°. Side locking bolts reliably secure fixture with standard wrench.
- Universal power input range — iW Reach Powercore accepts a universal power input range of 100 to 240 VAC, allowing simple, location-independent installation.

For detailed product information, please refer to the iW Reach Powercore Product Guide at www.colorkinetics.com/ls/intelliwhite/iwreach/

PHILIPS

Specifications

Due to continuous improvements and innovations, specifications may change without notice.

Item	Specification	Details
Output	Beam Angle	8° / 13° / 23° / 40° / 63° spread lenses, 5° x 17° asymmetric spread lens
	Lumens†	4,902 (8° spread lens, half unit)
	Color Temperature	2700 K – 6500 K
	Efficacy (lm/W)	39.2 (8° spread lens, half unit)
	CRI	68.5
	Mixing Distance	50 ft (15.2 m) to uniform light
	Lumen Maintenance‡	70,000 hours L_{70} @ 25° C 37,000 hours L_{70} @ 50° C 90,000 hours L_{50} @ 25° C 68,000 hours L_{50} @ 50° C
Electrical	Input Voltage	100 – 240 VAC, auto-switching, 50 / 60 Hz
	Power Consumption	250 W maximum at full output, steady state (full unit)
	Power Factor	.981 (8° spread lens, half unit)
Physical	Dimensions *(Height x Width x Depth)*	20.5 x 28.9 x 4.8 in (521 x 734 x 122 mm)
	Weight	75 lb (34 kg)
	Effective Projected Area (EPA)	0.42 m^2
	Housing	Die-cast aluminium, powder-coated finish
	Lens	Tempered glass
	Fixture Connections	6 ft (1.8 m) unified power / data cable
	Operating Temperature	-40° – 122° F (-40° – 50° C) Operating -4° – 122° F (-20° – 50° C) Startup
	Humidity	0 – 95%, non-condensing
	Fixture Run Lengths Per iW Data Enabler*	5 @ 110 VAC 6 @ 120 VAC 11 @ 220 VAC 12 @ 240 VAC *Configuration:* *20 A circuit, standard 6 ft (1.8 m) Leader Cables, 5 ft (1.5 m) jumper cables*
Certification and Safety	Certification	UL / cUL, FCC Class A, CE
	LED Class	Class 2 LED product
	Environment	Dry / Damp / Wet Location, IP66

† Lumen measurement complies with IES LM-79-08

‡ See iW Reach Powercore Product Guide for specific applications

* These figures, provided as a guideline, are accurate for this configuration only. Changing the configuration can affect the fixture run lengths.

Fixtures and Accessories

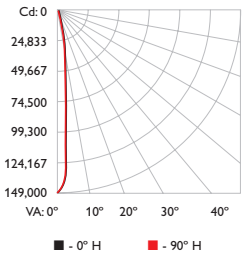
Item	Type	Item Number	Philips 12NC
iW Reach Powercore *Includes 6 ft (1.8 m) leader cable*	UL / cUL and CE / PSE	523-000045-00	910503700625
Replacement Leader Cable 6 ft (1.8 m)	UL / cUL	108-000043-02	910503700453
	CE / PSE	108-000043-03	910503700454
iW Reach Powercore Spread Lens with bezel	13°	120-000068-00	910503700506
	23°	120-000068-01	910503700507
	40°	120-000068-02	910503700508
	63°	120-000068-03	910503700509
	5° x 17°	120-000068-04	910503700510
	8°	120-000068-05	910503700511
iW Data Enabler	UL / cUL	506-000001-00	910503700190
iW Data Enabler / Data Enabler Aux *For CE / PSE installations only*		506-000001-01	910503700791
iW Scene Controller		503-000001-00	910503700189

Use Item Number when ordering in North America.

Photometrics

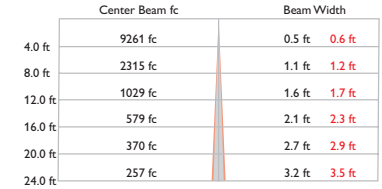
8° Spread Lens

Polar Candela Distribution



	0	22.5	44	67.5	90
0	148168	148168	148168	148168	148168
5	44700	46114	49240	52562	54461
15	1284	1410	2059	4818	15513
25	452	474	566	749	1525
35	294	241	273	317	409
45	134	143	146	179	224
55	9	16	40	74	108
65	2	1	6	18	40
75	0	0	0	0	9
85	0	0	0	0	0
90	0	0	0	0	0

Illuminance at Distance



385 ft (117.3 m)
1 fc maximum distance

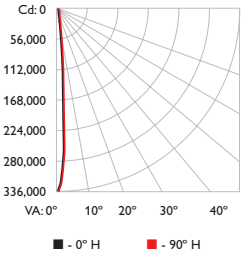
Vert. Spread: 7.6°
Horiz. Spread: 8.3°

Power Consumption	125 W
Lumens	4,902
Efficacy	39.2 lm/W

For lux multiply fc by 10.7

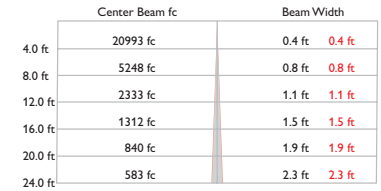
Without spread lens, half unit

Polar Candela Distribution



	0	22.5	44	67.5	90
0	335892	335892	335892	335892	335892
5	40839	40961	41410	40649	40264
15	1558	1586	1571	1556	1565
25	475	492	482	463	472
35	315	320	304	275	270
45	201	208	148	158	165
55	0	0	0	0	0
65	0	0	0	0	0
75	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0

Illuminance at Distance



579 ft (176.5 m)
1 fc maximum distance

Vert. Spread: 5.4°
Horiz. Spread: 5.4°

Power Consumption	125 W
Lumens	5,406
Efficacy	43.2 lm/W

iW Reach Powercore fixtures are part of a complete line-voltage system which includes fixtures and:

- One or more iW Data Enablers.
- One Leader Cable to connect each fixture to a junction box or iW Data Enabler.
- 4-conductor copper wire to connect fixtures in series or in parallel.
- iW Scene Controller (up to four per single run of iW Data Enablers).

For detailed product information, please refer to the iW Reach Powercore Product Guide at www.colorkinetics.com/ls/intelliwhite/iwreach/

Philips Color Kinetics
3 Burlington Woods Drive
Burlington, Massachusetts 01803 USA
Tel 888.385.5742
Tel 617.423.9999
Fax 617.423.9998
www.colorkinetics.com

DAS-000030-02 R01 08-09

Date: _____ Type: _____

Firm Name: _____

Project: _____

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13° Spread Lens

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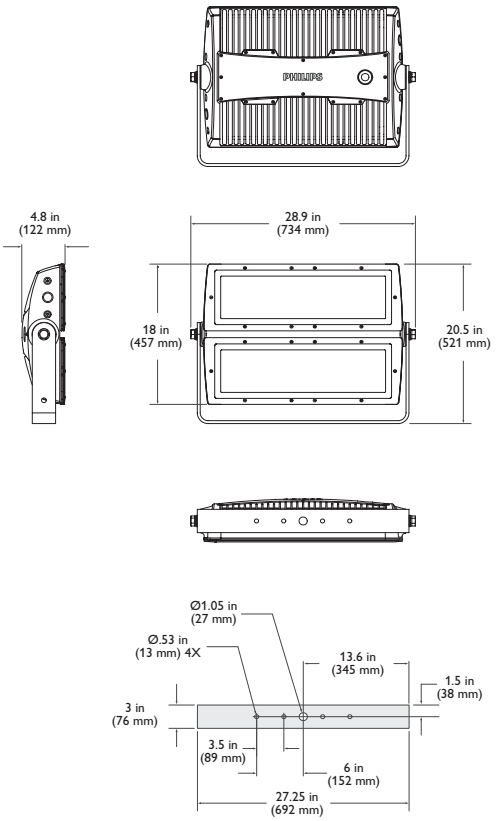

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PHILIPS

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	Lumens†	4,873 (13° spread lens, half unit)
	Color Temperature	2700 K – 6500 K
	Efficacy (lm/W)	38.9 (13° spread lens, half unit)
	CRI	68.5
	Mixing Distance	50 ft (15.2 m) to uniform light
	Lumen Maintenance‡	70,000 hours L70 @ 25° C 37,000 hours L70 @ 50° C 90,000 hours L50 @ 25° C 68,000 hours L50 @ 50° C
Electrical	Input Voltage	100 – 240 VAC, auto-switching, 50 / 60 Hz
	Power Consumption	250 W maximum at full output, steady state (full unit)
	Power Factor	.981 (13° spread lens, half unit)
Physical	Dimensions *(Height x Width x Depth)*	20.5 x 28.9 x 4.8 in (521 x 734 x 122 mm)
	Weight	75 lb (34 kg)
	Effective Projected Area (EPA)	0.42 m^2
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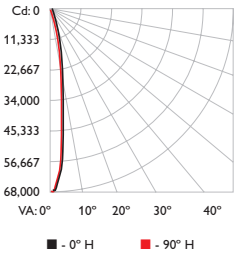

	0	22.5	44	67.5	90
0	67171	67171	67171	67171	67171
5	42926	43031	43006	42931	43002
15	3400	3373	3317	3282	3269
25	624	618	624	628	622
35	284	281	297	315	312
45	151	149	152	179	179
55	42	40	40	48	48
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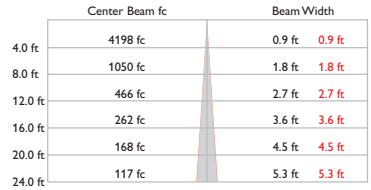
75	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0

Illuminance at Distance



259 ft (78.9 m)
1 fc maximum distance

Vert. Spread: 12.7°
Horiz. Spread: 12.7°

Power Consumption	125 W
Lumens	4,873
Efficacy	38.9 lm/W

For lux multiply fc by 10.7

Without spread lens, half unit

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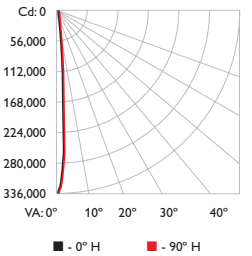

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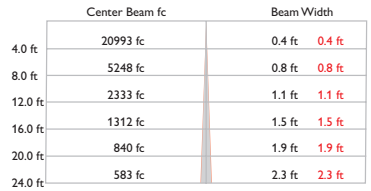
15	1558	1586	1571	1556	1565
25	475	492	482	463	472
35	315	320	304	275	270
45	201	208	148	158	165
55	0	0	0	0	0
65	0	0	0	0	0
75	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0

Illuminance at Distance



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Firm Name: _____

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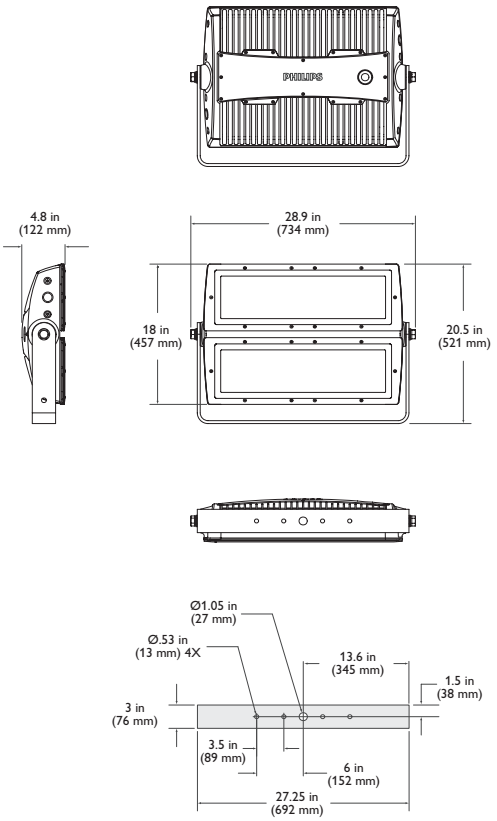
Intelligent white LED floodlight for signature façades and structures

iW® Reach Powercore, the intelligent white light version of our flagship, high-performance exterior architectural floodlight, is the first LED fixture powerful enough to brilliantly illuminate large architectural façades with washes of white light in color temperatures ranging from a warm 2700 K to a cool 6500 K. iW Reach Powercore combines all the benefits of LED-based lighting in an elegant fixture specifically designed for large-scale installations, such as commercial skyscrapers, casinos, large retail exteriors, bridges, piers, public monuments, and themed attractions. With significantly more lumen output than any other competitive fixture and unprecedented light projection of over 800 ft (243.8 m), this powerful fixture represents the next generation in exterior illumination.



- Integrates Powercore® technology — Powercore technology rapidly, efficiently, and accurately controls power output to iW Reach Powercore fixtures directly from line voltage. The Philips iW Data Enabler merges line voltage with control data and delivers them to the fixture over a single standard wire, dramatically simplifying installation and lowering total system cost.
- Unparalleled light output — With an output of over 10,000 lumens and light projection of over 800 ft (243.8 m), iW Reach Powercore is the first fixture to offer legitimate LED-based, color-controllable white light illumination of large-scale structures and objects.
- Wide range of color temperature and brightness — Channels of warm white and cool white LEDs produce color temperatures ranging from 2700 K to 6500 K. Fixture brightness can be adjusted while varying or maintaining constant color temperature.
- Versatile optics — Exchangeable spread lenses of 8°, 13°, 23°, 40°, 63°, and an asymmetric 5° x 17° support a variety of photometric distributions for a multitude of applications, including spotlighting, wall grazing, and asymmetric wall washing. Bezel and gasket ship with spread lenses for easy user installation.
- Simple fixture positioning — Rugged, slim-profile mounting bracket allows simple positioning and fixture rotation through a full 360°. Side locking bolts reliably secure fixture with standard wrench.
- Universal power input range — iW Reach Powercore accepts a universal power input range of 100 to 240 VAC, allowing simple, location-independent installation.

For detailed product information, please refer to the iW Reach Powercore Product Guide at www.colorkinetics.com/ls/intelliwhite/iwreach/

PHILIPS

Specifications

Due to continuous improvements and innovations, specifications may change without notice.

Item	Specification	Details
Output	Beam Angle	8° / 13° / 23° / 40° / 63° spread lenses, 5° x 17° asymmetric spread lens
	Lumens†	4,766 (23° spread lens, half unit)
	Color Temperature	2700 K – 6500 K
	Efficacy (lm/W)	38.1 (23° spread lens, half unit)
	CRI	68.5
	Mixing Distance	50 ft (15.2 m) to uniform light
	Lumen Maintenance‡	70,000 hours L70 @ 25° C 37,000 hours L70 @ 50° C 90,000 hours L50 @ 25° C 68,000 hours L50 @ 50° C
Electrical	Input Voltage	100 – 240 VAC, auto-switching, 50 / 60 Hz
	Power Consumption	250 W maximum at full output, steady state (full unit)
	Power Factor	.981 (23° spread lens, half unit)
Physical	Dimensions *(Height x Width x Depth)*	20.5 x 28.9 x 4.8 in (521 x 734 x 122 mm)
	Weight	75 lb (34 kg)
	Effective Projected Area (EPA)	0.42 m^2
	Housing	Die-cast aluminium, powder-coated finish
	Lens	Tempered glass
	Fixture Connections	6 ft (1.8 m) unified power / data cable
	Operating Temperature	-40° – 122° F (-40° – 50° C) Operating -4° – 122° F (-20° – 50° C) Startup
	Humidity	0 – 95%, non-condensing
	Fixture Run Lengths Per iW Data Enabler*	5 @ 110 VAC 6 @ 120 VAC 11 @ 220 VAC 12 @ 240 VAC *Configuration:* *20 A circuit, standard 6 ft (1.8 m) Leader Cables, 5 ft (1.5 m) jumper cables*
Certification and Safety	Certification	UL / cUL, FCC Class A, CE
	LED Class	Class 2 LED product
	Environment	Dry / Damp / Wet Location, IP66

† Lumen measurement complies with IES LM-79-08

‡ See iW Reach Powercore Product Guide for specific applications

* These figures, provided as a guideline, are accurate for this configuration only. Changing the configuration can affect the fixture run lengths.

Fixtures and Accessories

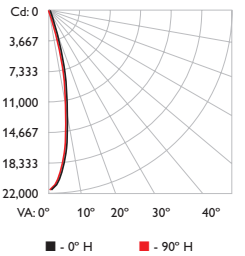
Item	Type	Item Number	Philips 12NC
iW Reach Powercore *Includes 6 ft (1.8 m) leader cable*	UL / cUL and CE / PSE	523-000045-00	910503700625
Replacement Leader Cable 6 ft (1.8 m)	UL / cUL	108-000043-02	910503700453
	CE / PSE	108-000043-03	910503700454
iW Reach Powercore Spread Lens with bezel	13°	120-000068-00	910503700506
	23°	120-000068-01	910503700507
	40°	120-000068-02	910503700508
	63°	120-000068-03	910503700509
	5° x 17°	120-000068-04	910503700510
	8°	120-000068-05	910503700511
iW Data Enabler	UL / cUL	506-000001-00	910503700190
iW Data Enabler / Data Enabler Aux *For CE / PSE installations only*		506-000001-01	910503700791
iW Scene Controller		503-000001-00	910503700189

Use Item Number when ordering in North America.

Photometrics

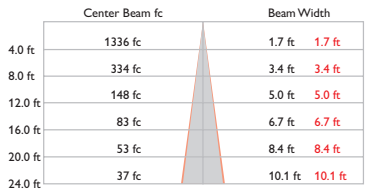
23° Spread Lens

Polar Candela Distribution



	0	22.5	44	67.5	90
0	21368	21368	21368	21368	21368
5	18824	18854	18849	18826	18871
15	7159	7155	7165	7166	7187
25	1426	1415	1403	1404	1411
35	353	352	360	368	368
45	161	161	168	182	183
55	77	77	79	91	92
65	27	27	28	34	35
75	0	0	2	4	5
85	0	0	0	0	0
90	0	0	0	0	0

Illuminance at Distance



146 ft (44.5 m)
1 fc maximum distance

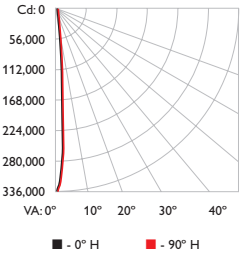
Vert. Spread: 23.7°
Horiz. Spread: 23.8°

Power Consumption	125 W
Lumens	4,766
Efficacy	38.1 lm/W

For lux multiply fc by 10.7

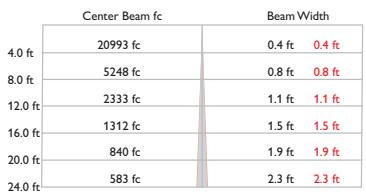
Without spread lens, half unit

Polar Candela Distribution



	0	22.5	44	67.5	90
0	335892	335892	335892	335892	335892
5	40839	40961	41410	40649	40264
15	1558	1586	1571	1556	1565
25	475	492	482	463	472
35	315	320	304	275	270
45	201	208	148	158	165
55	0	0	0	0	0
65	0	0	0	0	0
75	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0

Illuminance at Distance



579 ft (176.5 m)
1 fc maximum distance

Vert. Spread: 5.4°
Horiz. Spread: 5.4°

Power Consumption	125 W
Lumens	5,406
Efficacy	43.2 lm/W

iW Reach Powercore fixtures are part of a complete line-voltage system which includes fixtures and:

- One or more iW Data Enablers.
- One Leader Cable to connect each fixture to a junction box or iW Data Enabler.
- 4-conductor copper wire to connect fixtures in series or in parallel.
- iW Scene Controller (up to four per single run of iW Data Enablers).

For detailed product information, please refer to the iW Reach Powercore Product Guide at www.colorkinetics.com/ls/intelliwhite/iwreach/

Philips Color Kinetics
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Burlington, Massachusetts 01803 USA
Tel 888.385.5742
Tel 617.423.9999
Fax 617.423.9998
www.colorkinetics.com

DAS-000030-04 R01 08-09

Date: _____ Type: _____

Firm Name: _____

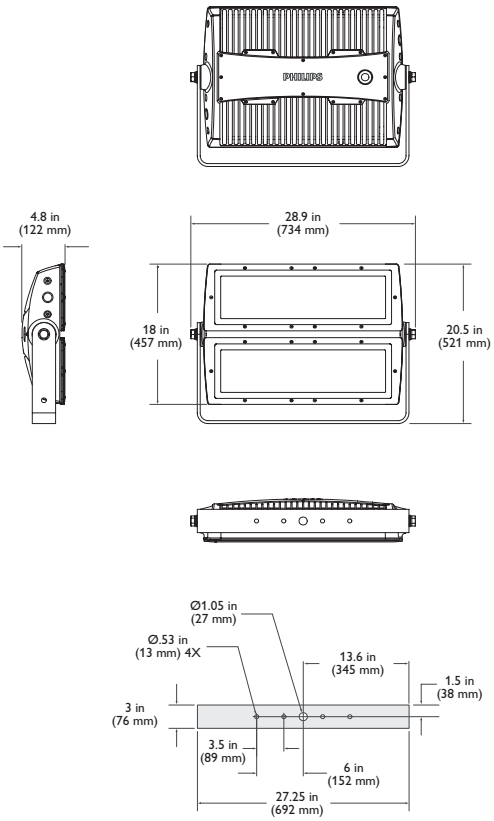
Project: _____

iW Reach Powercore

40° Spread Lens

Intelligent white LED floodlight for signature façades and structures

iW® Reach Powercore, the intelligent white light version of our flagship, high-performance exterior architectural floodlight, is the first LED fixture powerful enough to brilliantly illuminate large architectural façades with washes of white light in color temperatures ranging from a warm 2700 K to a cool 6500 K. iW Reach Powercore combines all the benefits of LED-based lighting in an elegant fixture specifically designed for large-scale installations, such as commercial skyscrapers, casinos, large retail exteriors, bridges, piers, public monuments, and themed attractions. With significantly more lumen output than any other competitive fixture and unprecedented light projection of over 800 ft (243.8 m), this powerful fixture represents the next generation in exterior illumination.



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- Unparalleled light output — With an output of over 10,000 lumens and light projection of over 800 ft (243.8 m), iW Reach Powercore is the first fixture to offer legitimate LED-based, color-controllable white light illumination of large-scale structures and objects.
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- Versatile optics — Exchangeable spread lenses of 8°, 13°, 23°, 40°, 63°, and an asymmetric 5° x 17° support a variety of photometric distributions for a multitude of applications, including spotlighting, wall grazing, and asymmetric wall washing. Bezel and gasket ship with spread lenses for easy user installation.
- Simple fixture positioning — Rugged, slim-profile mounting bracket allows simple positioning and fixture rotation through a full 360°. Side locking bolts reliably secure fixture with standard wrench.
- Universal power input range — iW Reach Powercore accepts a universal power input range of 100 to 240 VAC, allowing simple, location-independent installation.

For detailed product information, please refer to the iW Reach Powercore Product Guide at www.colorkinetics.com/ls/intelliwhite/iwreach/

PHILIPS

Specifications

Due to continuous improvements and innovations, specifications may change without notice.

Item	Specification	Details
Output	Beam Angle	8° / 13° / 23° / 40° / 63° spread lenses, 5° x 17° asymmetric spread lens
	Lumens†	4,692 (40° spread lens, half unit)
	Color Temperature	2700 K – 6500 K
	Efficacy (lm/W)	37.5 (40° spread lens, half unit)
	CRI	68.5
	Mixing Distance	50 ft (15.2 m) to uniform light
	Lumen Maintenance‡	70,000 hours L70 @ 25° C 37,000 hours L70 @ 50° C 90,000 hours L50 @ 25° C 68,000 hours L50 @ 50° C
Electrical	Input Voltage	100 – 240 VAC, auto-switching, 50 / 60 Hz
	Power Consumption	250 W maximum at full output, steady state (full unit)
	Power Factor	.981 (40° spread lens, half unit)
Physical	Dimensions *(Height x Width x Depth)*	20.5 x 28.9 x 4.8 in (521 x 734 x 122 mm)
	Weight	75 lb (34 kg)
	Effective Projected Area (EPA)	0.42 m^2
	Housing	Die-cast aluminium, powder-coated finish
	Lens	Tempered glass
	Fixture Connections	6 ft (1.8 m) unified power / data cable
	Operating Temperature	-40° – 122° F (-40° – 50° C) Operating -4° – 122° F (-20° – 50° C) Startup
	Humidity	0 – 95%, non-condensing
	Fixture Run Lengths Per iW Data Enabler*	5 @ 110 VAC 6 @ 120 VAC 11 @ 220 VAC 12 @ 240 VAC *Configuration:* *20 A circuit, standard 6 ft (1.8 m) Leader Cables, 5 ft (1.5 m) jumper cables*
Certification and Safety	Certification	UL / cUL, FCC Class A, CE
	LED Class	Class 2 LED product
	Environment	Dry / Damp / Wet Location, IP66

† Lumen measurement complies with IES LM-79-08

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* These figures, provided as a guideline, are accurate for this configuration only. Changing the configuration can affect the fixture run lengths.

Fixtures and Accessories

Item	Type	Item Number	Philips 12NC
iW Reach Powercore *Includes 6 ft (1.8 m) leader cable*	UL / cUL and CE / PSE	523-000045-00	910503700625
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	CE / PSE	108-000043-03	910503700454
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	23°	120-000068-01	910503700507
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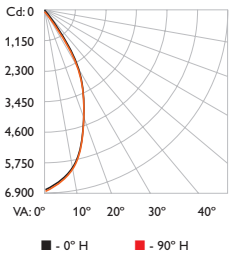
	63°	120-000068-03	910503700509
	5° x 17°	120-000068-04	910503700510
	8°	120-000068-05	910503700511
iW Data Enabler	UL / cUL	506-000001-00	910503700190
iW Data Enabler / Data Enabler Aux *For CE / PSE installations only*		506-000001-01	910503700791
iW Scene Controller		503-000001-00	910503700189

Use Item Number when ordering in North America.

Photometrics

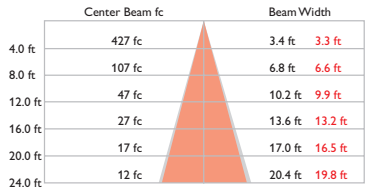
40° Spread Lens

Polar Candela Distribution



	0	22.5	44	67.5	90
0	6833	6833	6833	6833	6833
5	6541	6548	6544	6525	6537
15	5057	5049	5016	4974	4972
25	3024	3002	2946	2895	2887
35	1300	1285	1251	1222	1216
45	408	403	399	403	405
55	144	144	148	158	160
65	67	67	69	77	80
75	17	18	23	27	30
85	0	0	0	0	0
90	0	0	0	0	0

Illuminance at Distance



82.5 ft (25.1 m)
1 fc maximum distance

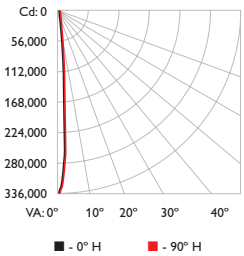
Vert. Spread: 46.2°
Horiz. Spread: 44.9°

Power Consumption	125 W
Lumens	4,692
Efficacy	37.5 lm/W

For lux multiply fc by 10.7

Without spread lens, half unit

Polar Candela Distribution



	0	22.5	44	67.5	90
0	335892	335892	335892	335892	335892
5	40839	40961	41410	40649	40264
15	1558	1586	1571	1556	1565
25	475	492	482	463	472
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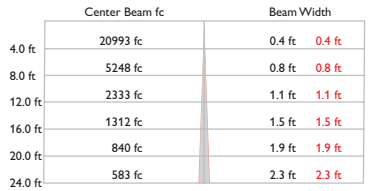
45	201	208	148	158	165
55	0	0	0	0	0
65	0	0	0	0	0
75	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0

Illuminance at Distance



579 ft (176.5 m)
1 fc maximum distance

Vert. Spread: 5.4°
Horiz. Spread: 5.4°

Power Consumption	125 W
Lumens	5,406
Efficacy	43.2 lm/W

iW Reach Powercore fixtures are part of a complete line-voltage system which includes fixtures and:

- One or more iW Data Enablers.
- One Leader Cable to connect each fixture to a junction box or iW Data Enabler.
- 4-conductor copper wire to connect fixtures in series or in parallel.
- iW Scene Controller (up to four per single run of iW Data Enablers).

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DAS-000030-05 R01 08-09

Date: _____ Type: _____

Firm Name: _____

Project: _____

iW Reach Powercore

63° Spread Lens

Intelligent white LED floodlight for signature façades and structures

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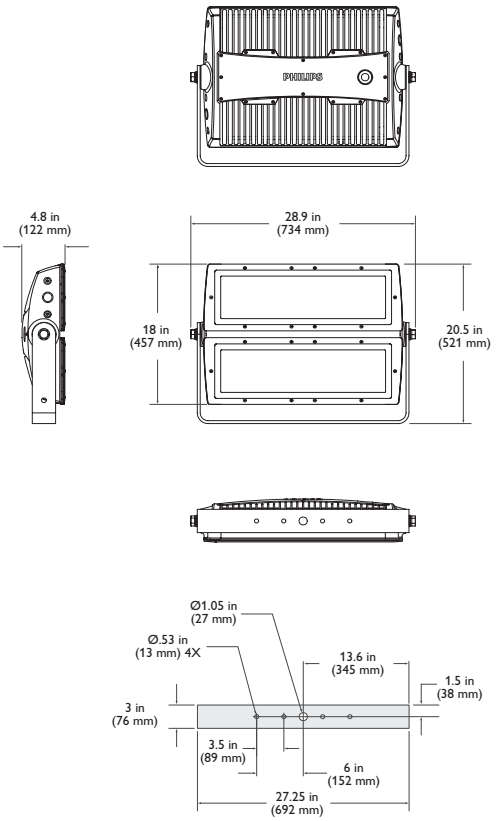

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For detailed product information, please refer to the iW Reach Powercore Product Guide at www.colorkinetics.com/ls/intelliwhite/iwreach/

PHILIPS

Specifications

Due to continuous improvements and innovations, specifications may change without notice.

Item	Specification	Details
Output	Beam Angle	8° / 13° / 23° / 40° / 63° spread lenses, 5° x 17° asymmetric spread lens
	Lumens†	4.626 (63° spread lens, half unit)
	Color Temperature	2700 K – 6500 K
	Efficacy (lm/W)	37.0 (63° spread lens, half unit)
	CRI	68.5
	Mixing Distance	50 ft (15.2 m) to uniform light
	Lumen Maintenance‡	70,000 hours L_{70} @ 25° C 37,000 hours L_{70} @ 50° C 90,000 hours L_{50} @ 25° C 68,000 hours L_{50} @ 50° C
Electrical	Input Voltage	100 – 240 VAC, auto-switching, 50 / 60 Hz
	Power Consumption	250 W maximum at full output, steady state (full unit)
	Power Factor	.981 (63° spread lens, half unit)
Physical	Dimensions *(Height x Width x Depth)*	20.5 x 28.9 x 4.8 in (521 x 734 x 122 mm)
	Weight	75 lb (34 kg)
	Effective Projected Area (EPA)	0.42 m^2
	Housing	Die-cast aluminium, powder-coated finish
	Lens	Tempered glass
	Fixture Connections	6 ft (1.8 m) unified power / data cable
	Operating Temperature	-40° – 122° F (-40° – 50° C) Operating -4° – 122° F (-20° – 50° C) Startup
	Humidity	0 – 95%, non-condensing
	Fixture Run Lengths Per iW Data Enabler*	5 @ 110 VAC 6 @ 120 VAC 11 @ 220 VAC 12 @ 240 VAC *Configuration:* *20 A circuit, standard 6 ft (1.8 m) Leader Cables, 5 ft (1.5 m) jumper cables*
Certification and Safety	Certification	UL / cUL, FCC Class A, CE
	LED Class	Class 2 LED product
	Environment	Dry / Damp / Wet Location, IP66

† Lumen measurement complies with IES LM-79-08

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Fixtures and Accessories

Item	Type	Item Number	Philips 12NC
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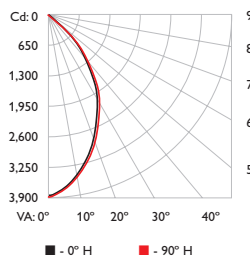
Replacement Leader Cable 6 ft (1.8 m)	UL / cUL	108-000043-02	910503700453
	CE / PSE	108-000043-03	910503700454
iW Reach Powercore Spread Lens with bezel	13°	120-000068-00	910503700506
	23°	120-000068-01	910503700507
	40°	120-000068-02	910503700508
	63°	120-000068-03	910503700509
	5° x 17°	120-000068-04	910503700510
	8°	120-000068-05	910503700511
iW Data Enabler	UL / cUL	506-000001-00	910503700190
iW Data Enabler / Data Enabler Aux *For CE / PSE installations only*		506-000001-01	910503700791
iW Scene Controller		503-000001-00	910503700189

Use Item Number when ordering in North America.

Photometrics

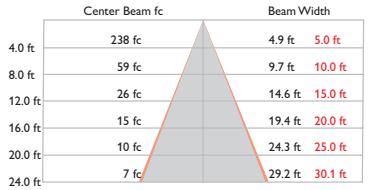
63° Spread Lens

Polar Candela Distribution



	0	22.5	44	67.5	90
0	3807	3807	3807	3807	3807
5	3696	3700	3700	3697	3705
15	3103	3109	3114	3117	3129
25	2393	2400	2413	2425	2438
35	1610	1623	1649	1668	1679
45	881	895	923	948	959
55	366	375	398	420	429
65	130	133	145	161	166
75	35	37	44	53	56
85	0	0	0	0	1
90	0	0	0	0	0

Illuminance at Distance



61.7 ft (18.8 m)
1 fc maximum distance

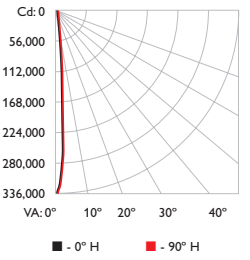
Vert. Spread: 62.6°
Horiz. Spread: 64.1°

Power Consumption	125 W
Lumens	4,626
Efficacy	37.0 lm/W

For lux multiply fc by 10.7

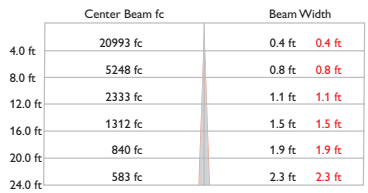
Without spread lens, half unit

Polar Candela Distribution



	0	22.5	44	67.5	90
0	335892	335892	335892	335892	335892
5	40839	40961	41410	40649	40264
15	1558	1586	1571	1556	1565
25	475	492	482	463	472
35	315	320	304	275	270
45	201	208	148	158	165
55	0	0	0	0	0
65	0	0	0	0	0
75	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0

Illuminance at Distance



579 ft (176.5 m)
1 fc maximum distance

Vert. Spread: 5.4°
Horiz. Spread: 5.4°

Power Consumption	125 W
Lumens	5,406
Efficacy	43.2 lm/W

iW Reach Powercore fixtures are part of a complete line-voltage system which includes fixtures and:

- One or more iW Data Enablers.
- One Leader Cable to connect each fixture to a junction box or iW Data Enabler.
- 4-conductor copper wire to connect fixtures in series or in parallel.
- iW Scene Controller (up to four per single run of iW Data Enablers).

For detailed product information, please refer to the iW Reach Powercore Product Guide at www.colorkinetics.com/ls/intelliwhite/iwreach/

Philips Color Kinetics
3 Burlington Woods Drive
Burlington, Massachusetts 01803 USA
Tel 888.385.5742
Tel 617.423.9999
Fax 617.423.9998
www.colorkinetics.com

DAS-000030-06 R01 08-09

Date: _____ Type: _____

Firm Name: _____

Project: _____

iW Data Enabler

Data formatting and power for IntelliWhite series fixtures

For device mounting details, refer to the Installation Instructions included in the product packaging, or download documentation from www.colorkinetics.com/ls/pds/iwdataenabler/

iW® Data Enabler is a data formatting power / data supply designed for IntelliWhite® series LED lighting fixtures employing Powercore® technology from Philips Color Kinetics.

Engineered for use in zone control network configurations, iW Data Enabler is compatible iW Scene Controller.

iW Data Enabler accommodates input voltages ranging from 100 VAC to 240 VAC where the maximum connected base load does not exceed 20 Amps.

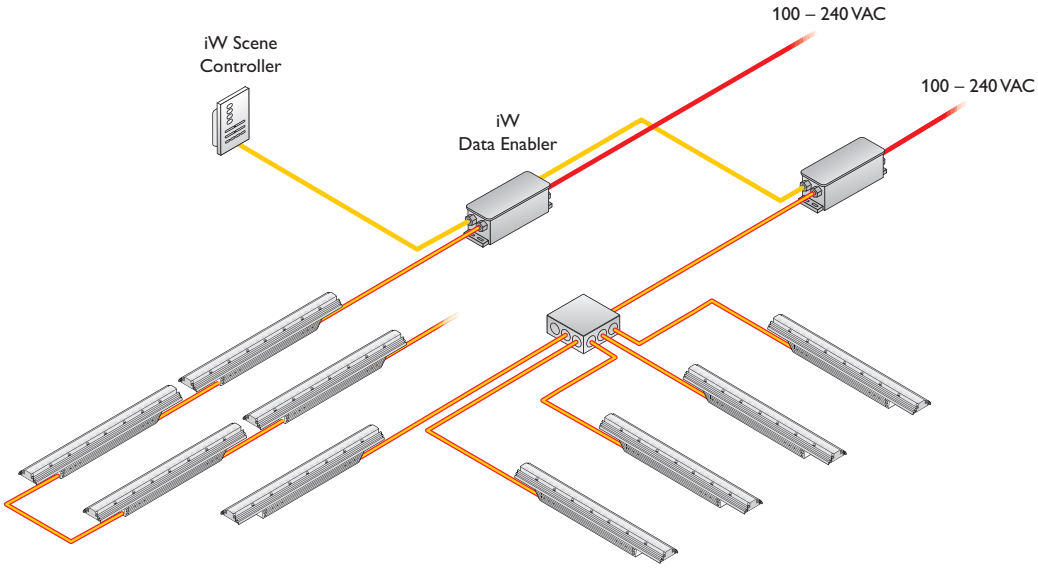
Featuring a NEMA 4 (IP66) enclosure, iW Data Enabler installs in dry, damp, and wet locations.

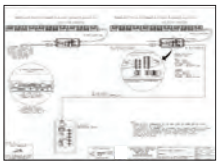
Multiple conduit entries accommodate 3/4 in (19 mm) NPT conduit.

Compatible Fixtures

IntelliWhite series fixtures employing Powercore technology from Philips Color Kinetics — intelligent white light fixtures with onboard power processing technology

To calculate the number of fixtures your specific installation can support, download the Configuration Calculator from www.colorkinetics.com/support/install_tool/





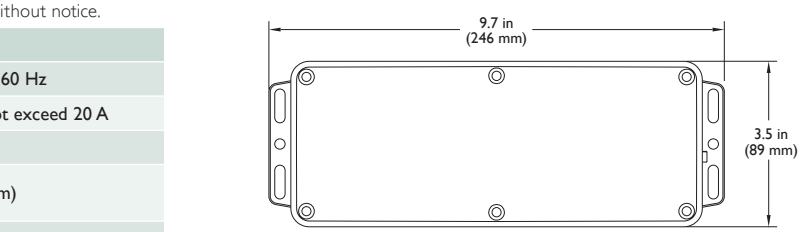
iW Data Enabler wiring diagrams are available online at www.colorkinetics.com/support/wiring/

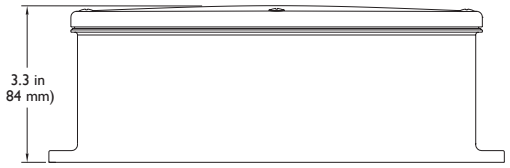
PHILIPS

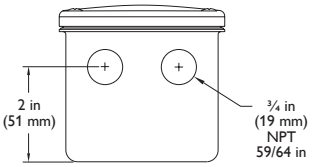
Specifications

Due to continuous improvements and innovations, specifications may change without notice.

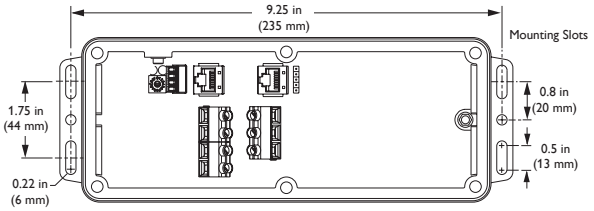
Item	Specification	Details	
Electrical	Input Voltage	100 – 240 VAC, auto-switching, 50 / 60 Hz	
	Maximum Input Current	Maximum connected load should not exceed 20 A	
	Internal Load	10 W	
Physical	Dimensions *(Height x Width x Depth)*	3.3 x 3.5 x 9.7 in (84 x 89 x 246 mm)	
	Weight	2.5 lb (1.1 kg)	
	Construction	NEMA 4 enclosure, cast aluminum, with slots for surface mounting	
	Finish	Gray matte	
	Connectors	Data Input	4-wire terminal block controller input; RJ-45 connector
		Power Input	3-wire terminal block connector
		Power / Data Output	4-wire terminal block connector
	Operating Temperature	-40° – 122° F (-40° – 50° C)	
	Humidity	0 – 95%, non-condensing	
	Cooling	Convection	
	Heat Dissipation	10 W	
	Data Input Source	iW Scene Controller	
Certification and Safety	Certification	UL / cUL, CE, PSE	
	Environment	Dry / Damp / Wet Location, IP66	







Overall Dimensions



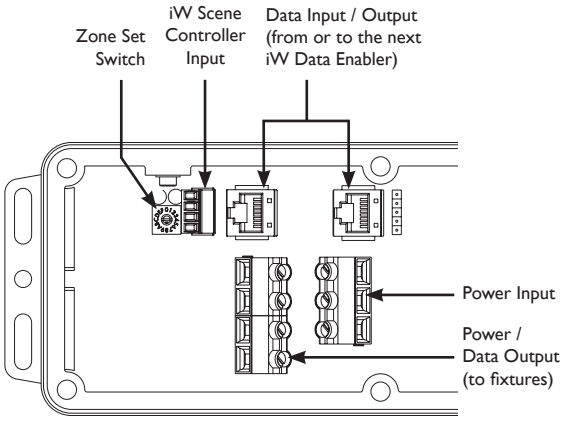
Mounting Dimensions

Ordering Information

Item	Included Components	Item Number	Philips 12NC
iW Data Enabler	iW Data Enabler with cover and attaching screws, gasket, (4) NPT threaded seal plugs, and Installation Instructions	506-000001-00	910503700190
iW Scene Controller	iW Scene Controller with leader cable, standard single-gang wall box, (2) self-threading flathead screws, and Decora® style faceplate	503-000001-00	910503700189

Use Item Number when ordering in North America.

iW Data Enabler uses a zone set switch to assign zone control settings. For complete iW Data Enabler configuration instructions, refer to the *Addressing and Configuration Guide* available online at www.colorkinetics.com/support/addressing/



Philips Color Kinetics
3 Burlington Woods Drive
Burlington, Massachusetts 01803 USA
Tel 888.385.5742
Tel 617.423.9999
Fax 617.423.9998
www.colorkinetics.com

DAS-000055-01 R00 12-09

APPENDIX I.F: OFFICE LIGHTING FIXTURE CUT SHEETS

Recessed

Armstrong® TechZone™ Compatible

Fluorescent
One or Two Lamp
T5, T5 HO, T8

Recessed Bivergence®

6" x 4'
6" x 5'

Applications: The Bivergence fixture is a high performance recessed mounted fixture guaranteeing photometric accuracy and high efficiency. The superior louver design provides maximum visual comfort through perfect control of glare and veiling reflections. The Bivergence range provides high performance lighting for such critical environments as VDT-intensive office spaces, retail spaces, laboratories and open plan offices.

online Find it Fast 288

Meets RP-1-04 for intensive (C 1285 and 1328) and normal (C 1545, 2285, 2328, 1355, 1805 and 2355) VDT-use offices.

Type: Open Office

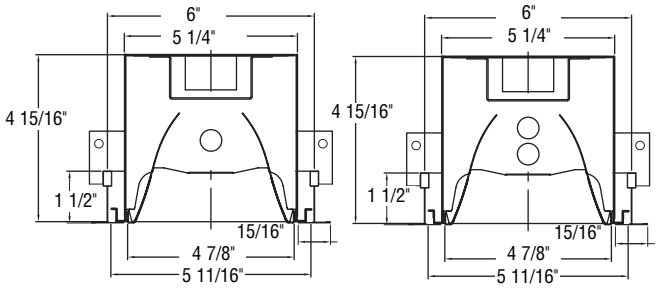
Project: New York Times Building
Thesis - Redesign

ORDERING NOTE: Specify fixture/ceiling type, louver, length, lamping, voltage and options.

▼ Fixture/Ceiling Type	▼ Louver	▼ Length	▼ Lamping	▼ Voltage	▼ Options
RB_	**DX**	**65**	**1355**	**DD**	**WN**
RBU Recessed Bivergence, 15/16" Lay-In, Flush 9/16" Slot-Grid, Flush 9/16" Lay-In, Tegular **RBF** Recessed Bivergence, 9/16" Lay-In, Flush ***See page R-16A for TechZone and common ceiling mounting details***	**C** Matte **DX** Specular	**64** 6" x 4' **65** 6" x 5'	**1285** (1) 28W T5 **1545** (1) 54W T5 HO **2285** (2) 28W T5 **1328** (1) 32W T8 **2328** (2) 32W T8 **2545** (2) 54W T5 HO **1355** (1) 35W T5 **2355** (2) 35W T5 **1805** (1) 80W T5 HO **1408** (1) 40W T8 **2408** (2) 40W T8	**U** Universal 120/277V **347** 347V (consult factory for availability; not available with EM, dimming) **DA_*** Dimming, Analog (0-10V) **DD_*** Dimming, DALI (consult factory) **DE_*** Dimming, Lutron ECO-10™ **DH_*** Dimming, Lutron Hi-Lume® **DSC_*** Dimming, Lutron EcoSystem Control Fixture **DSN_*** Dimming, Lutron EcoSystem Non-control Fixture	**WF** Whip Flex 3/8" x 6' 14/3 AWG **WN_*** Whip Flex 3/8" x 6' 14/3 AWG (NYC) **EM1_*** Standby Battery Pack for 1-Lamp Operation **SS** Separate Switching (consult factory) **F** Fusing **AR** Air Return **CP** Chicago Plenum

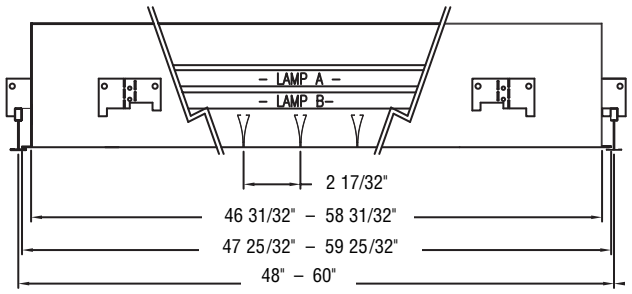
* Indicate 120V (1) or 277V (2). Some lamp types may not be available. Consult factory for availability.

End View – (1) Lamp T5 Fixture **End View – (2) Lamp T5 Fixture**



See page R-16A for TechZone and common ceiling mounting details

Side View – (2) Lamp T5 Fixture **NOTE: (2) Lamp T8 positioned side by side.**



c UL us LISTED

Suitable for damp locations
NYC Approved

IBEW Union Made

1. Housing - 20 gauge cold rolled steel. Fixtures are painted white.

2. Sockets - Bi-pin. Twist lock lamp installation.

3. Lamping - One or two 28W T5 (4'), 35W T5 (5'), 54W T5 HO (4'), 32W T8 (4') or 40W T8 (5'), or one 80W T5 HO (5'), fluorescent lamps, supplied by others. Access to lamps is from below the fixture after the removal of the louver.

4. Ballast - Universal voltage electronic 120/277V ballast is mounted in housing of luminaire.

5. Louvers - Matte silver or specular anodized aluminum. Louver blades are 1 7/16" deep and 2 1/2" on center. The 4' unit has a total of 18 cells, and the 5' unit has a total of 23 cells. Louver is held by internal spring clips and can be suspended from one side for maintenance.

6. Mounting - Fixtures for mounting in lay-in ceilings. Depth of housing is 4 7/8". Electrical access plate in housing top. Fixtures can mounted in continuous run.

7. Stand-by Battery Pack - Integral stand-by battery pack for one lamp operation with integral test switch. Light and test switch located on wireway cover.

8. Weight - 16.0 lbs.

ECO-10 and EcoSystem are trademarks of Lutron Electronics Co., Inc. HiLume is a registered trademark of Lutron Electronics Co., Inc.

In a continuing effort to offer the best product possible we reserve the right to change, without notice, specifications or materials. Technical specification sheets that appear on www.zumtobel.us are the most recent version and supersede all other versions that exist in any other printed or electronic form.

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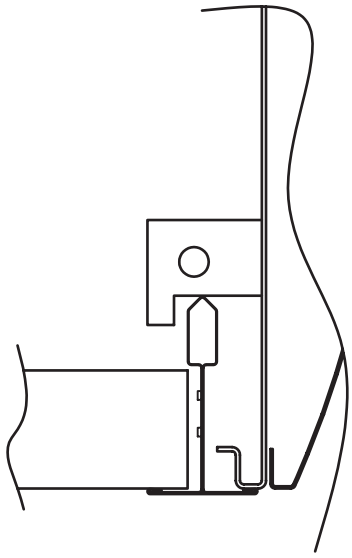
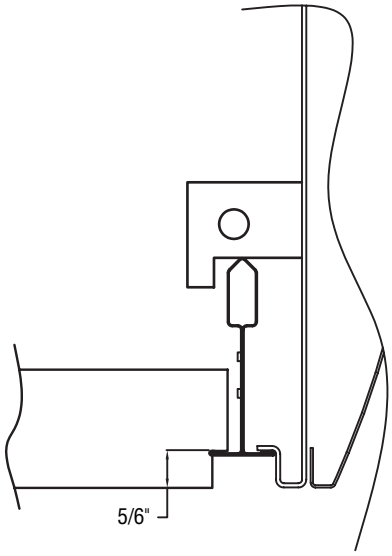
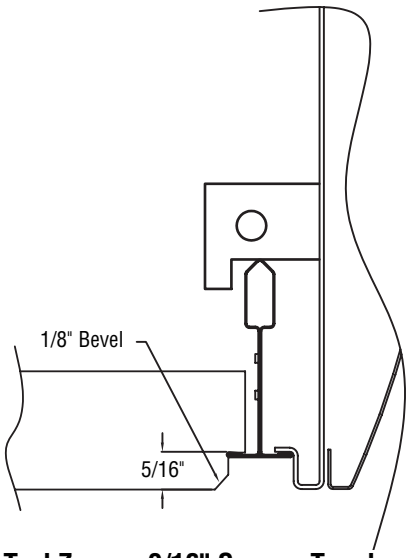
Ceiling Mounting Details



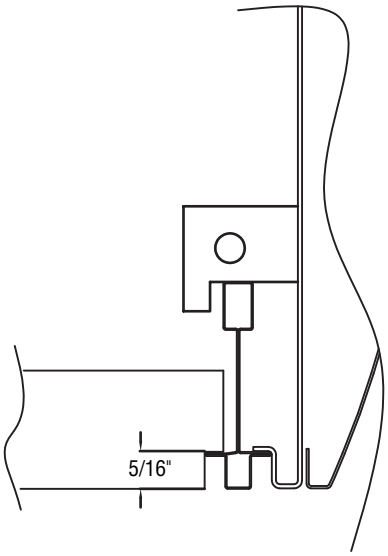
TechZone – 15/16" Square Lay-In Prelude (15/16" Lay-In Flush)



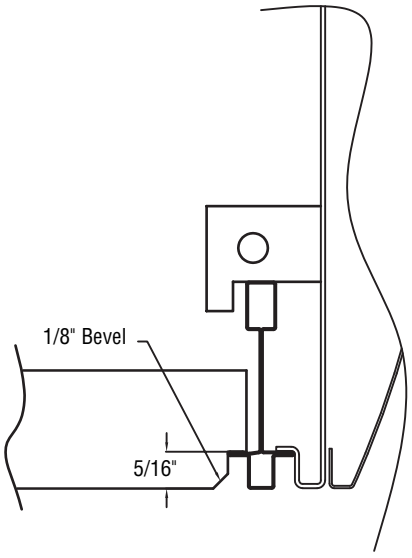
TechZone – 9/16" Square Tegular Suprafine (9/16" Lay-In Tegular)



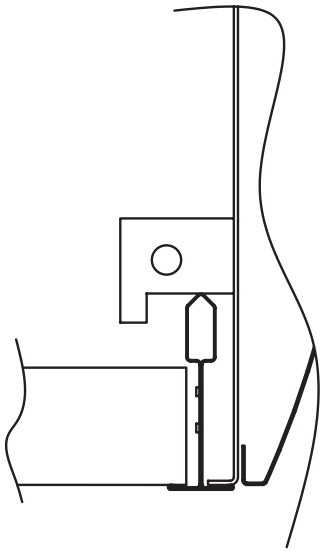
TechZone – 9/16" Square Tegular Suprafine (9/16" Lay-In Tegular)



TechZone – 9/16" Square Tegular Interlude (9/16" Slot-Grid)



TechZone – 9/16" Beveled Tegular Interlude (9/16" Slot-Grid)



9/16" Lay-In Flush

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ZUMTOBEL

Photometric Data

RB C 64 1285 (1) 28W T5

6" x 4' RECESSED BIVERGENCE, MATTE SILVER LOUVER

LTL 11046

Total Luminaire Efficiency 64%

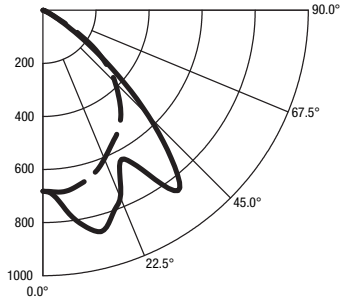
0% Uplight 100% Downlight

Spacing Criteria

Lateral Plane	0°	90°
	1.2	1.7

TOTAL LAMP LUMENS = 2610
INPUT WATTS = 33

Candela Distribution



Vertical Angle	Horizontal Angle 0°	45°	90°	Zonal Lumens
0°	682	682	682	
5°	688	709	725	65.4
15°	658	815	862	220.9
25°	585	753	686	323.9
35°	509	559	816	401.2
45°	385	588	562	394.3
55°	208	262	163	202.3
65°	32	36	20	40.2
75°	9	6	4	7.0
85°	1	0	0	0.6
90°	0	0	0	

Luminance Data in Candela / Sq. Meter

Angle in Vertical°	Average 0°	Average 45°	Average 90°
45°	4218	6441	6156
55°	2809	3538	2201
65°	587	660	367
75°	269	180	120
85°	89	0	0

Coefficients of Utilization

Effective Floor Cavity Reflectance = 20%

pcc	0.8				0.7				0.5			0.3		
pw	0.7	0.5	0.3	0.1	0.7	0.5	0.3	0.1	0.5	0.3	0.1	0.5	0.3	0.1
0	76	76	76	76	74	74	74	74	71	71	71	68	68	68
1	71	69	67	65	70	68	66	64	65	64	62	63	61	60
2	66	62	59	56	65	61	58	56	59	56	54	57	55	53
3	62	56	52	49	60	55	51	48	53	50	47	52	49	47
4	57	51	46	43	56	50	46	42	48	45	42	47	44	41
5	53	46	41	37	52	45	41	37	44	40	37	43	39	37
6	49	42	37	33	48	41	37	33	40	36	33	39	35	33
7	46	38	33	30	45	38	33	30	37	33	29	36	32	29
8	43	35	30	27	42	35	30	27	34	30	27	33	29	26
9	40	32	27	24	39	32	27	24	31	27	24	30	27	24

RB C 64 1328 (1) 32W T8

6" X 4' RECESSED BIVERGENCE, MATTE SILVER LOUVER

PRORATED FROM LTL 11085

Total Luminaire Efficiency 56%

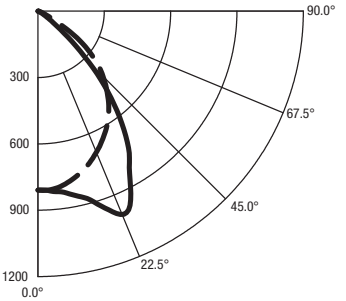
0% Uplight 100% Downlight

Spacing Criteria

Lateral Plane	0°	90°
	1.1	1.4

TOTAL LAMP LUMENS = 2900
INPUT WATTS = 31

Candela Distribution



Vertical Angle	Horizontal Angle 0°	45°	90°	Zonal Lumens
0°	809	809	809	
5°	807	816	819	72.7
15°	754	820	879	232.4
25°	667	843	980	378.8
35°	559	748	696	420.2
45°	416	456	326	326.3
55°	228	156	64	148.0
65°	45	23	12	32.2
75°	11	5	2	6.7
85°	2	1	0	1.2
90°	0	0	0	

Luminance Data in Candela / Sq. Meter

Angle in Vertical°	Average 0°	Average 45°	Average 90°
45°	4560	4991	3566
55°	3083	2109	859
65°	823	429	224
75°	335	141	57
85°	169	80	0

Coefficients of Utilization

Effective Floor Cavity Reflectance = 20%

pcc	0.8				0.7				0.5			0.3		
pw	0.7	0.5	0.3	0.1	0.7	0.5	0.3	0.1	0.5	0.3	0.1	0.5	0.3	0.1
0	67	67	67	67	66	66	66	66	63	63	63	60	60	60
1	63	61	60	58	62	60	58	57	58	56	55	56	55	54
2	59	56	53	50	58	55	52	50	53	50	49	51	49	48
3	55	50	47	44	54	50	46	44	48	45	43	47	44	42
4	51	46	42	39	50	45	41	39	44	41	38	43	40	38
5	48	42	38	35	47	41	37	34	40	37	34	39	36	34
6	44	38	34	31	43	38	34	31	37	33	31	36	33	30
7	42	35	31	28	41	35	31	28	34	30	28	33	30	27
8	39	32	28	25	38	32	28	25	31	28	25	31	27	25
9	36	30	26	23	36	29	26	23	29	25	23	28	25	23

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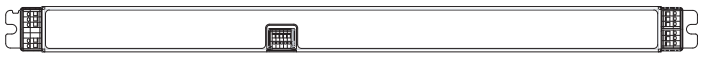
EcoSystem Multiple Control Input Ballasts

Digital electronic dimming ballasts maximize the benefits of a lighting management system. *EcoSystem* Ballasts offer 100% to 10% dimming; ideal for use where saving energy, increasing flexibility, and maximizing productivity are the goals of the lighting design.

***EcoSystem* case type G**



***EcoSystem* case type J**

Features

- Continuous, flicker-free dimming from 100% to 10%
- Provides power for and responds to one occupancy sensor, one photo sensor, and one personal control input (infrared receiver or wallstation)
- Communicates status and sensor inputs over the *EcoSystem* Bus
- Programmed rapid start design ensures full rated lamp life while dimming and cycling
- Lamps turn on to any dimmed level without flashing to full brightness
- Low harmonic distortion throughout the entire dimming range
- Frequency of operation ensures that ballast does not interfere with infrared devices
- End-of-lamp-life protection circuitry ensures safe operation throughout entire lamp life
- Ultra-quiet operation
- Nonvolatile memory restores all ballast settings after power failure
- Ballasts maintain consistent light output for linear lamp lengths (i.e. 4 ft., 3 ft., 2 ft. have same relative output)
- 100% performance tested at factory

Job Name:	Model Numbers:
Job Number:	

Specifications

Standards

- California Energy Commission (CEC) Listed
- UL Listed (evaluated to the requirements of UL935)
- CSA certified (evaluated to the requirements of C22.2 No. 74)
- NOM Listed for 32 W T8 Ballasts
- S Mark Certified
- Class P thermally protected
- Meets ANSI C82.11 High Frequency Ballast Standard
- Meets FCC Part 18 Non-Consumer requirements for EMI/RFI emissions
- Meets ANSI C62.41 Category A surge protection standards up to and including 4 kV
- Manufacturing facilities employ ESD reduction practices that comply with the requirements of ANSI/ESD S20.20
- Lutron Quality Systems registered to ISO 9001.2000

Performance

- Operating Voltage: 120, 220/240, 277 V~ at 50 or 60 Hz
- Grounding: ballast and fixture must be grounded for proper dimming
- Dimming Range: 100% to 10% measured relative light output
- Lamp Starting: programmed rapid start
- Lamp Current Crest Factor: less than 1.7
- Light Output Variation: Constant ±2% light output for line voltage variations of ±10%
- Lamp Life: Average lamp life meets or exceeds specified lamp ratings
- Power Factor: 0.95 minimum
- Total Harmonic Distortion (THD): Less than 20%
- Inaudible in a 27 dBA ambient
- Maximum Inrush Current: 3 A per ballast at 277 V~, 7A per ballast at 120 V~
- Class 2 Output: +20 V⎓, 50mA maximum (one daylight sensor, one keypad and one occupancy sensor can be connected)

Environment

- Minimum lamp starting temperature: 50 °F (10 °C)
- Relative humidity: less than 90% non-condensing
- Sound Rating: inaudible in a 27 dB ambient
- Maximum ballast case temperature: 75 °C (167 °F)

Ballast Wiring & Mounting

- Ballast is grounded by a mounting screw to the fixture
- Terminal blocks on the ballast accept the following wire gauges:
  Power Wiring, Lamp Wiring, and *EcoSystem* Bus:
  only one #18 AWG solid per terminal
  Class 2 Sensors:
  only one #22 AWG solid per terminal
- Only one wire per terminal
- Class 2 sensor wiring must be separated from all power and Class 1 wiring, consult all applicable local and national codes
- Ballast mounts using two screws (or sheet metal feature and one screw) within a fluorescent fixture
- Wiring from the ballast to lamp sockets shall not exceed 7 ft. for T8, T5, and T5HO lamps
- Wiring from the ballast to lamps sockets shall not exceed 3 ft. for T5 Twin Tube lamps

Lamp Seasoning

Refer to lamp manufacturer for lamp seasoning requirements prior to dimming

EcoSystem Ballasts for linear and U bend T8 Lamps

Lamp	No. of Lamps	Model	Case Size	Input Voltage (VAC)	Input Current (A)	Input Power (W)	Ballast Factor (BF)	System Lumens (lm)	System Efficacy (lm/W)	Ballast Efficacy Factor	Relative Efficacy (RSE)
F32T8 (48 in)	1	EC5 T832 J UNV 1	J	277 240 120	0.11 0.13 0.26	31.6 31.0 31.3	0.85 0.85 0.85	2550 2550 2550	81 82 81	2.69 2.74 2.72	0.86 0.87 0.87
	2	EC5 T832 G UNV 2L	G	277 240 120	0.22 0.25 0.49	59.6 57.6 58.8	0.85 0.85 0.85	5100 5100 5100	86 89 87	1.43 1.48 1.45	0.91 0.94 0.93
		EC5 T832 J UNV 2	J	277 240 120	0.21 0.25 0.49	57.4 59.0 59.1	0.85 0.85 0.85	5100 5100 5100	89 86 86	1.48 1.44 1.44	0.95 0.92 0.92
	3	EC5 T832 G UNV 3L	G	277 240 120	0.31 0.36 0.72	86.5 84.0 85.9	0.85 0.85 0.85	7650 7650 7650	88 89 89	0.98 1.01 0.99	0.94 0.97 0.95
		EC5 T832 G UNV 317L	G	277 240 120	0.41 0.47 0.95	105.7 106.5 106.8	1.17 1.17 1.17	10,530 10,530 10,530	100 99 99	1.11 1.10 1.10	1.06 1.05 1.05
F25T8 (36 in)	1	EC5 T825 J UNV 1	J	277 240 120	0.10 0.11 0.23	27.6 27.0 26.9	0.85 0.85 0.85	1828 1828 1828	66 68 68	3.08 3.15 3.16	0.77 0.79 0.79
	2	EC5 T825 J UNV 2	J	277 240 120	0.18 0.20 0.41	48.9 49.0 49.0	0.85 0.85 0.85	3665 3665 3665	75 75 75	1.74 1.73 1.73	0.87 0.87 0.87
F17T8 (24 in)	1	EC5 T817 J UNV 1	J	277 240 120	0.08 0.08 0.17	20.6 20.0 20.1	0.85 0.85 0.85	1190 1190 1190	68 60 70	4.13 4.25 4.23	0.70 0.72 0.72
	2	EC5 T817 J UNV 2	J	277 240 120	0.13 0.15 0.31	36.2 37.0 37.0	0.85 0.85 0.85	2380 2380 2380	66 64 64	2.35 2.30 2.30	0.80 0.78 0.78

Job Name:	Model Numbers:
Job Number:	

EcoSystem Ballasts for linear T5 Lamps

Lamp	No. of Lamps	Model	Case Size	Input Voltage (VAC)	Input Current (A)	Input Power (W)	Ballast Factor (BF)	System Lumens (lm)	System Efficacy (lm/W)	Ballast Efficacy Factor	Relative Efficacy (RSE)
F35T5 (57.1 in) 	1	EC5 T535 J UNV 1	J	277 240 120	0.15 0.18 0.35	42.0 42.3 42.2	1.0 1.0 1.0	3650 3650 3650	87 87 87	2.38 2.38 2.38	0.83 0.83 0.83
F28T5 (45.2 in)	1	EC5 T528 J UNV 1	J	277 240 120	0.12 0.14 0.27	32.6 32.9 32.9	1.0 1.0 1.0	2900 2900 2900	89 88 88	3.07 3.04 3.04	0.86 0.85 0.85
	2	EC5 T528 J UNV 2	J	277 240 120	0.23 0.27 0.54	64.5 65.0 65.2	1.0 1.0 1.0	5800 5800 5800	90 89 89	1.55 1.54 1.53	0.87 0.86 0.86
F21T5 (33.4 in)	1	EC5 T521 J UNV 1	J	277 240 120	0.09 0.12 0.22	25.8 25.8 25.8	1.0 1.0 1.0	2100 2100 2100	81 81 81	3.88 3.88 3.88	0.81 0.81 0.81
	2	EC5 T521 J UNV 2	J	277 240 120	0.17 0.20 0.39	46.0 47.2 47.2	1.0 1.0 1.0	4200 4200 4200	91 89 89	2.17 2.12 2.12	0.91 0.89 0.89
F14T5 (21.6 in)	1	EC5 T514 J UNV 1	J	277 240 120	0.07 0.08 0.16	19.0 19.2 19.2	1.0 1.0 1.0	1350 1350 1350	71 70 70	5.26 5.21 5.21	0.74 0.74 0.74
	2	EC5 T514 J UNV 2	J	277 240 120	0.12 0.14 0.28	32.8 33.3 33.3	1.0 1.0 1.0	2700 2700 2700	82 81 81	3.05 3.00 3.00	0.85 0.85 0.85

Job Name:	Model Numbers:
Job Number:	

EcoSystem Ballasts for linear T5 HO Lamps

Lamp	No. of Lamps	Model	Case Size	Input Voltage (VAC)	Input Current (A)	Input Power (W)	Ballast Factor (BF)	System Lumens (lm)	System Efficacy (lm/W)	Ballast Efficacy Factor	Relative Efficacy (RSE)
F54T5 (45.2 in)	1	EC5 T554 J UNV 1	J	277 240 120	0.21 0.24 0.48	56.5 58.0 57.9	1.0 1.0 1.0	5000 5000 5000	88 86 86	1.77 1.73 1.73	0.96 0.93 0.93
	2	EC5 T554 J UNV 2	J	277 240 120	0.40 0.52 0.99	110.1 119.0 119.3	1.0 1.0 1.0	10,000 10,000 10,000	91 84 84	0.91 0.84 0.84	0.98 0.91 0.91
F39T5 (33.4 in)	1	EC5 T539 J UNV 1	J	277 240 120	0.16 0.18 0.37	43.3 44.0 44.0	1.0 1.0 1.0	3500 3500 3500	81 80 80	2.31 2.27 2.27	0.90 0.89 0.89
	2	EC5 T539 J UNV 2	J	277 240 120	0.30 0.35 0.70	83.0 84.0 84.3	1.0 1.0 1.0	7000 7000 7000	84 83 83	1.20 1.19 1.19	0.94 0.93 0.93
F24T5 (21.6 in)	1	EC5 T524 J UNV 1	J	277 240 120	0.11 0.13 0.24	30.0 28.8 28.8	1.0 1.0 1.0	2000 2000 2000	67 69 69	3.33 3.47 3.47	0.80 0.83 0.83
	2	EC5 T524 J UNV 2	J	277 240 120	0.20 0.23 0.45	54.8 54.0 53.9	1.0 1.0 1.0	4000 4000 4000	73 74 74	1.82 1.85 1.86	0.89 0.89 0.89

Job Name:	Model Numbers:
Job Number:	

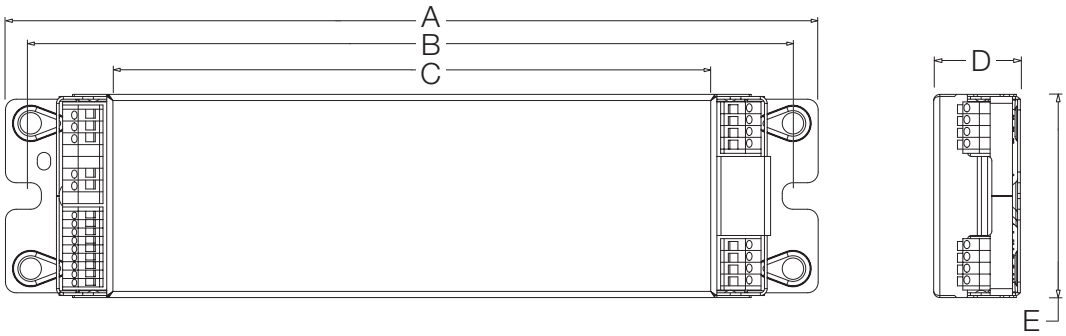
EcoSystem Ballasts for T5 Twin Tube Lamps

Lamp	No. of Lamps	Model	Case Size	Input Voltage (VAC)	Input Current (A)	Input Power (W)	Ballast Factor (BF)	System Lumens (lm)	System Efficacy (lm/W)	Ballast Efficacy Factor	Relative Efficacy (RSE)
FT55 (20.7 in)	1	EC5 T555 J UNV 1	J	277 240 120	0.20 0.23 0.46	55.4 55.2 55.2	0.9 0.9 0.9	4320 4320 4320	70 70 70	1.62 1.63 1.63	0.89 0.90 0.90
	2	EC5 T555 J UNV 2	J	277 240 120	0.40 0.46 0.92	110.8 110.4 110.4	0.9 0.9 0.9	8640 8640 8640	78 78 78	0.81 0.82 0.82	0.99 0.90 0.90
FT50 (22.5 in)	1	EC5 T550 J UNV 1	J	277 240 120	0.20 0.23 0.45	55.4 54.0 54.0	1.0 1.0 1.0	4000 4000 4000	72 72 74	1.81 1.85 1.85	0.90 0.93 0.93
	2	EC5 T550 J UNV 2	J	277 240 120	0.36 0.42 0.84	99.7 100.8 100.8	1.0 1.0 1.0	8000 8000 8000	80 79 79	1.00 0.99 0.99	1.00 0.99 0.99
FT40 (22.5 in)	1	EC5 T540 J UNV 1	J	277 240 120	0.16 0.18 0.36	44.3 43.2 43.2	1.0 1.0 1.0	3100 3100 3100	70 72 72	2.26 2.31 2.31	0.90 0.93 0.93
	2	EC5 T540 J UNV 2	J	277 240 120	0.27 0.32 0.64	74.8 76.8 76.8	1.0 1.0 1.0	6200 6200 6200	83 81 81	1.34 1.30 1.30	1.07 1.04 1.04
	3	EC5 T540 G UNV 3L	G	277 240 120	0.40 0.47 0.95	111.3 112.4 113.2	1.0 1.0 1.0	9300 9300 9300	84 83 82	0.90 0.89 0.88	1.08 1.07 1.06
FT39 FT36 (15.5 in)	1	EC5 T536 J UNV 1	J	277 240 120	0.14 0.17 0.33	38.8 39.6 39.6	1.0 1.0 1.0	2850 2850 2850	74 72 72	2.57 2.53 2.53	0.93 0.91 0.91
	2	EC5 T536 J UNV 2	J	277 240 120	0.26 0.31 0.61	72.0 73.2 73.2	1.0 1.0 1.0	5700 5700 5700	79 78 78	1.39 1.37 1.37	1.00 0.98 0.98

Job Name:	Model Numbers:
Job Number:	

EcoSystem Ballast Case Dimensions

G Case



G Case Dimensions

A = 9.5 in (241 mm)

B = 8.9 in (226 mm)

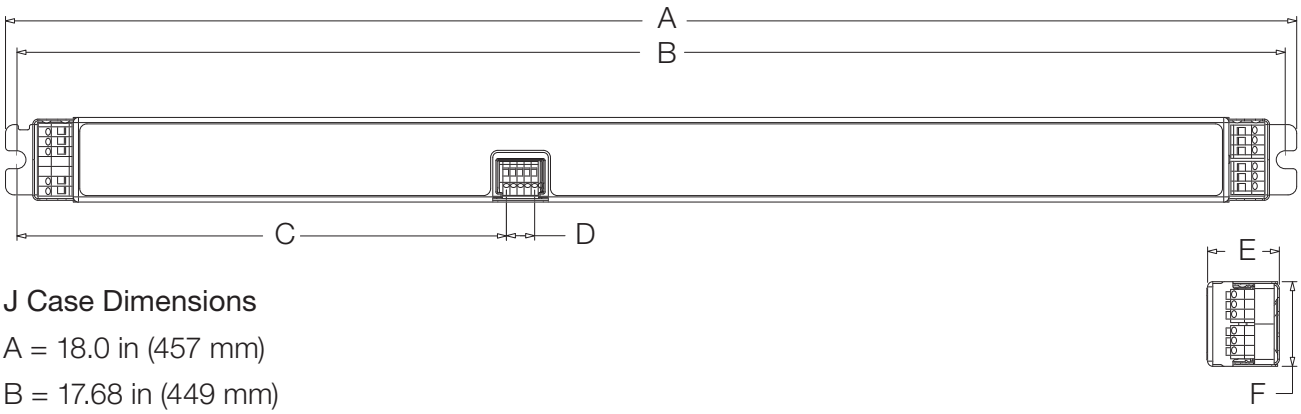
C = 7.1 in (180 mm)

D = 1.0 in (25 mm)

E = 2.38 in (60 mm)

G case ballasts ship with 36 in. leads for lamp connections and 18 in. leads for Hot, Neutral, E1 and E2 connections

J Case



J Case Dimensions

A = 18.0 in (457 mm)

B = 17.68 in (449 mm)

C = 6.82 in (173 mm)

D = .394 in (10 mm)

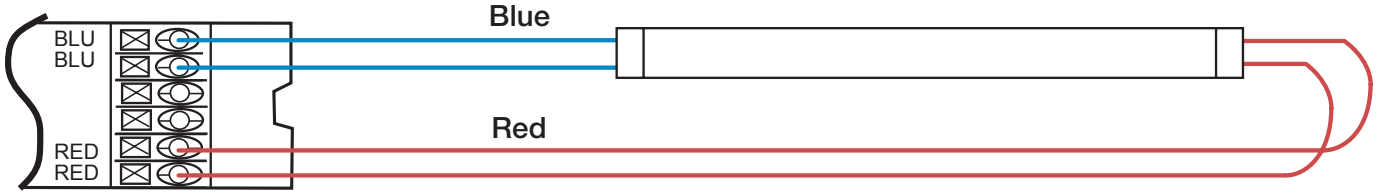
E = 1.0 in (25 mm)

F = 1.18 in (30 mm)

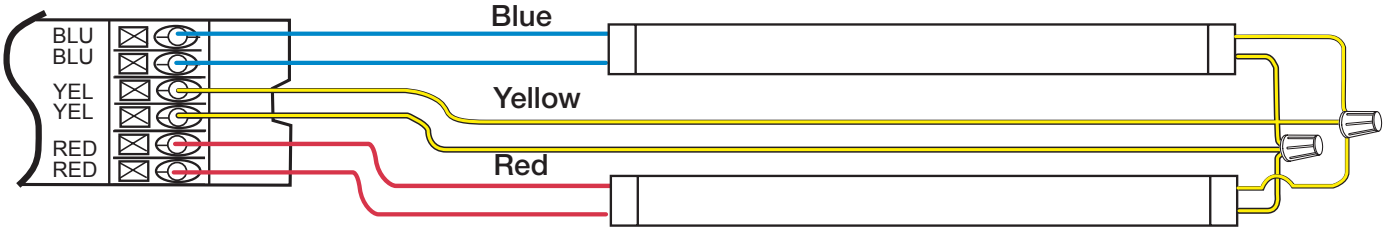
Job Name:	Model Numbers:
Job Number:	

EcoSystem Ballast Wiring Diagrams - T8, T5, T5 HO

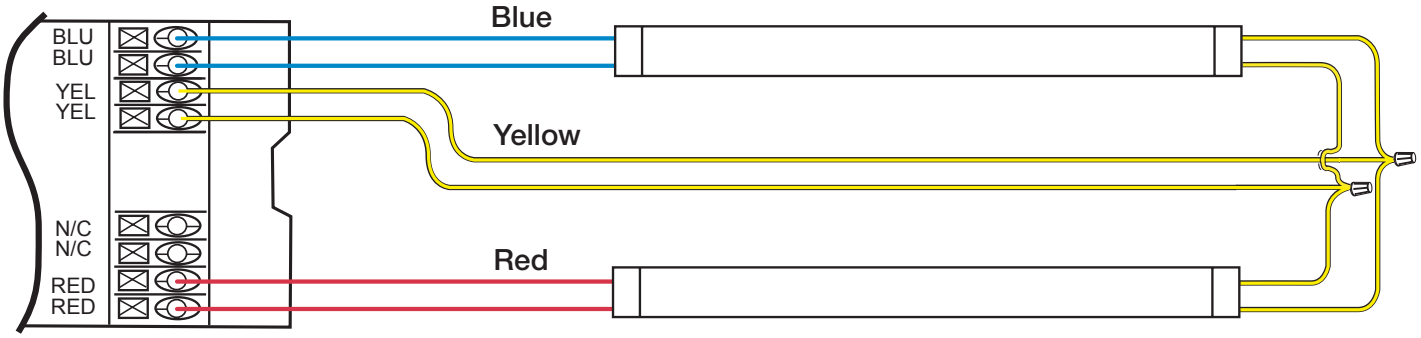
Wiring to One Lamp (J case shown)



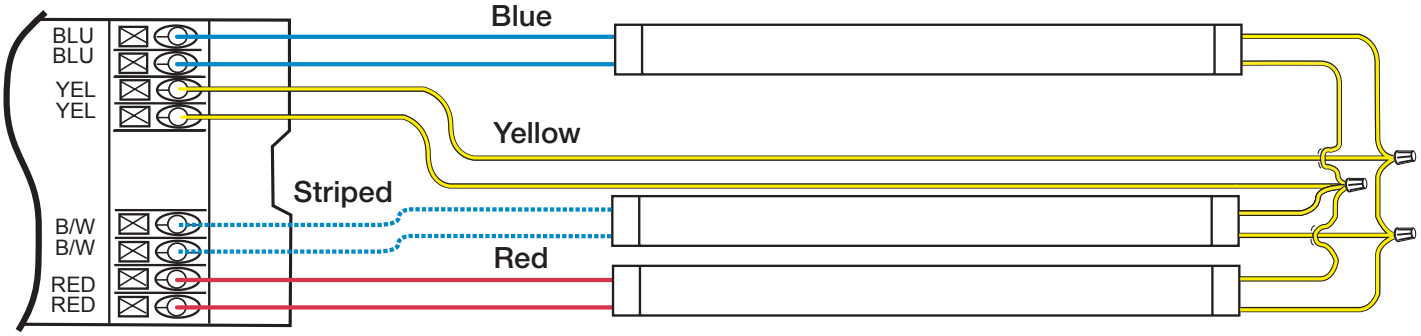
Wiring to Two Lamps (J case shown)



Wiring to Two Lamps (G case shown)



Wiring to Three Lamps (G case shown)



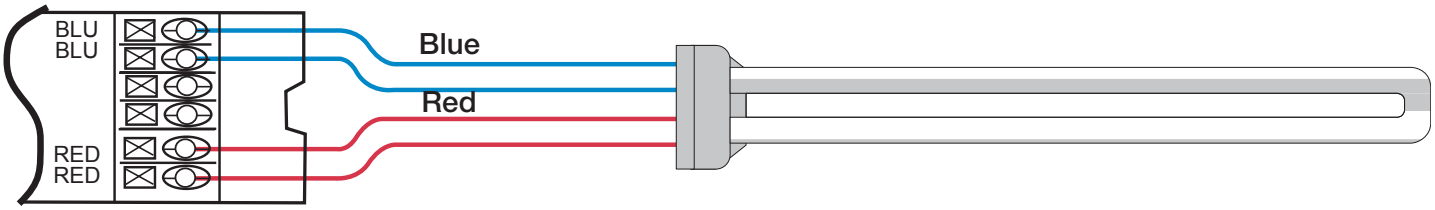
NOTICE

- Maximum ballast to lamp socket lead length is 7 feet (2 m)
- Wire colors shown are labeled on the ballast, but may vary depending upon fixture construction

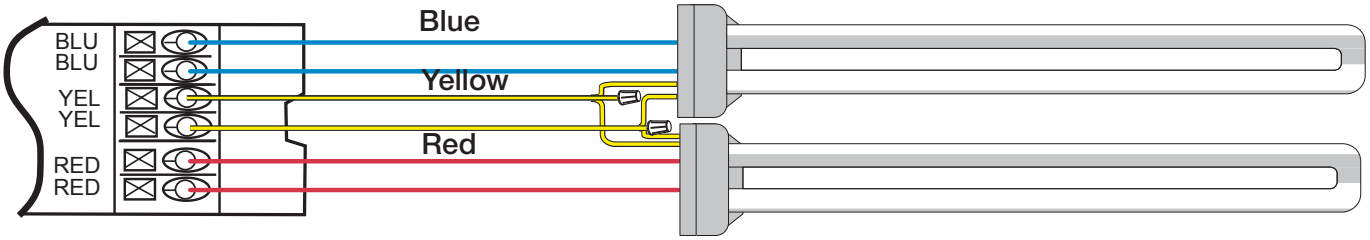
Job Name:	Model Numbers:
Job Number:	

EcoSystem Ballast Wiring Diagrams - T5 Twin-Tube

Wiring to One Lamp



Wiring to Two Lamps



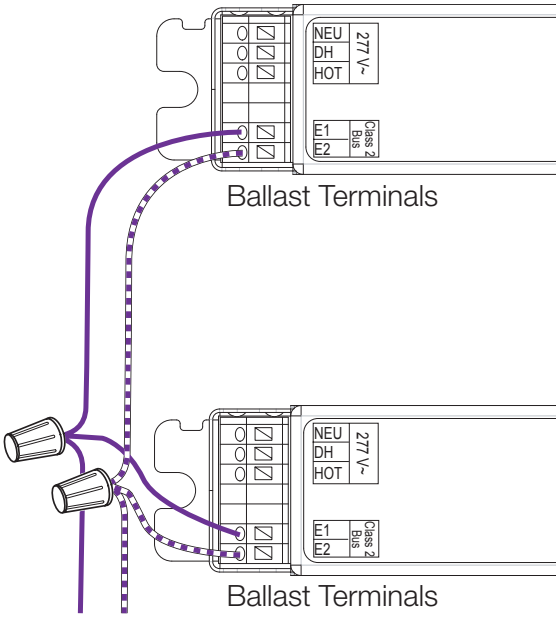
NOTICE

- Maximum ballast to lamp socket lead length is 3 feet (1 m)
- Wire colors shown are labeled on the ballast, but may vary depending upon fixture construction

EcoSystem Ballast Wiring: *EcoSystem* Bus

EcoSystem Bus Overview

- The *EcoSystem* Bus wiring (E1 and E2) connects the digital ballasts together to form a lighting control system
- Each *EcoSystem* Bus supports up to 64 digital ballasts, 32 occupant sensors, 8 daylight sensors, and 64 wallstations or IR receivers
- E1 and E2 (*EcoSystem* bus wires) are polarity insensitive and can be wired in any topology
- An *EcoSystem* Bus Supply provides power for the *EcoSystem* Bus and supports system programming
- All *EcoSystem* Bus programming is completed by using the *EcoSystem* Programmer



To the *EcoSystem* Bus Supply & up to 64 total ballasts

EcoSystem Bus Wiring

- Ballast *EcoSystem* Bus terminals only accept one #18 AWG solid wire
- Make sure that the supply breaker to the Digital Ballast and *EcoSystem* Bus Supply is OFF when wiring
- Connect the two conductors to the two Digital Ballast terminals E1 and E2 as shown
- Using two different colors for E1 and E2 will reduce confusion when wiring several ballasts together
- The *EcoSystem* bus may be wired Class 1 or Class 2. Consult applicable electrical codes for proper wiring practices

Notes

- The *EcoSystem* Bus Supply does not have to be located at the end of the Digital Loop
- E1 and E2 wires are not polarity sensitive
- *EcoSystem* Bus length is limited by the wire gauge used for E1 and E2 as follows:

Wire Gauge	Bus Length (max)
12 AWG	2200 ft (670 m)
14 AWG	1400 ft (427 m)
16 AWG	900 ft (274 m)

Job Name:	Model Numbers:
Job Number:	

EcoSystem Ballast Wiring: Class 2 Sensors

Electrical Contractors and Engineers:

- Always follow applicable national and local electrical code requirements when connecting circuits to *EcoSystem* devices
- All field installed Class 2 wiring must be separated from line voltage wiring by at least 0.25 in. (6.4 mm)
- Some local electrical codes require Class 2 wiring to be separately routed in a metal conduit
- Ballasts Class 2 Sensor terminals only accept 22 AWG solid conductors

Lutron Requires:

- Keep class 1 and class 2 wiring separate.
- Where separation is not possible, use a 600 V insulated cable with an internal shield. Connect the shield to ground to provide better noise immunity for low voltage circuits
- Refer to Application note #142 for additional information

Fixture Manufacturers:

- UL 1598 6.17.1 allows:
  Factory installed power limited wiring and branch circuit wiring that come in random contact within the luminaire shall have insulation rated for the maximum voltage that exists in any of the circuits. (*EcoSystem* ballast circuits require minimum 600 V insulated wire)
- UL 1598 6.17.2.1 requires:
  Luminaires designed for the field installation of power limited circuits shall be provided with a means of segregating or separating the field-installed power limited circuit wiring from the branch circuit wiring within the luminaire (see UL 1598 6.17 for details)

Lutron Requires:

- Keep class 1 and class 2 wiring separate
- Where separation is not possible, use a 600 V insulated cable with an internal shield. Connect the shield to ground to provide better noise immunity for low voltage circuits

Job Name:	Model Numbers:
Job Number:	

EcoSystem Ballast Wiring: Daylight Sensor

Wiring to a Daylight Sensor

- Sensor wiring summary:

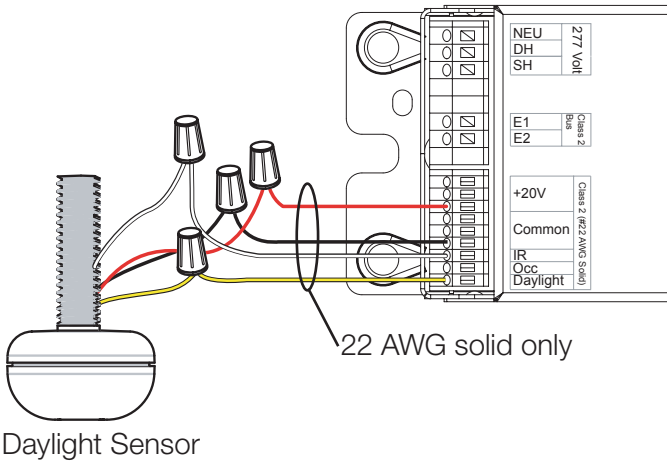
Sensor Wire	Ballast Terminal	Terminal Color
Red	+20 V⎓	Red
Black	Common	Black
White	IR	White
Yellow	Daylight	Yellow

- Make sure that the supply breaker to the Digital Ballast is OFF when wiring.
- Connect the four conductors to the four Digital Ballast terminals as shown.
- Daylight sensor must be placed within 50 feet (15 m) of the ballast.
- Ballast Class 2 terminals only accept one 22 AWG solid wire.

Notes

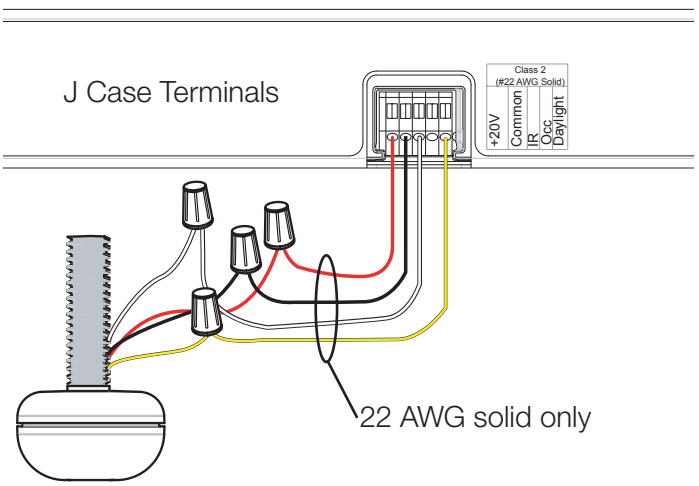
- Consult the daylight sensor specification sheet to properly locate the sensor.
- Do not place the sensor above pendant fixtures, directly below lighting fixtures, or within skylight wells.
- When wiring both a wallstation and daylight sensor to one ballast, only connect the IR wire (white) from the keypad, cap off the white wire from the daylight sensor.
- All sensor and wallstation wiring is Class 2. Follow all applicable national and local codes for proper circuit separation and protection.

G Case Terminals



Daylight Sensor

J Case Terminals



Daylight Sensor

Job Name:	Model Numbers:
Job Number:	

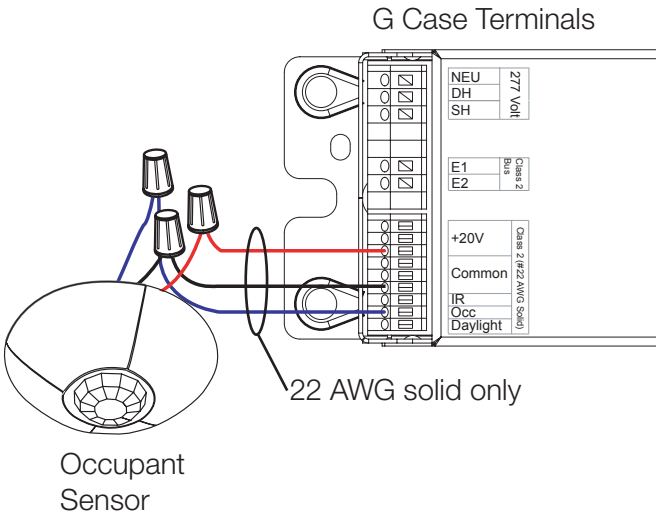
EcoSystem Ballast Wiring: Occupancy Sensor

Wiring to a Lutron Occupant Sensor (LOS-XX)

- Sensor wiring summary:

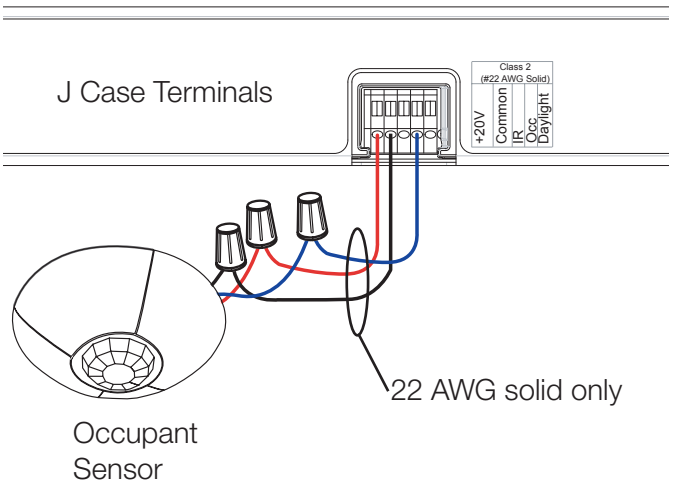
Sensor Wire	Ballast Terminal	Terminal Color
Red Black Blue	+20 V⎓ Common Occ	Red Black Blue

- Make sure that the supply breaker to the Digital Ballast is OFF when wiring
- Connect the three conductors to the three ballast terminals as shown
- Occupant sensor must be placed within 50 feet (15 m) of the ballast
- Ballast Class 2 terminals only accept one 22 AWG solid wire



Notes

- Occupant sensors from other manufacturers may be used with *EcoSystem* ballasts if the sensor meets the following criteria:
  Vin = +20 V⎓, current draw less than 35 mA
- If other manufacturer's occupant sensors are used terminal colors and sensor wire colors may not match
- All sensor and wallstation wiring is Class 2. Follow all applicable national and local codes for proper circuit separation and protection.



EcoSystem Ballast Wiring Diagrams (continued)

Wiring to an IR Receiver and Wallstation

- Wiring summary:

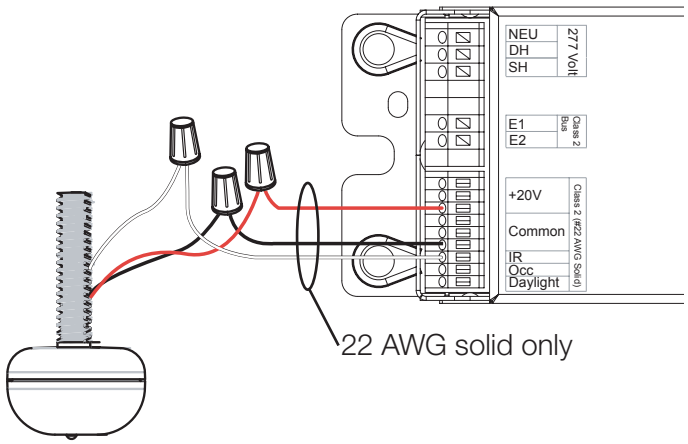
Sensor Wire	Ballast Terminal	Terminal Color
Red	+20 V⎓	Red
Black	Common	Black
White	IR	White

- Make sure that the supply breaker to the Digital Ballast is OFF when wiring
- Connect the three conductors to the three Digital Ballast terminals as shown
- Receiver must be placed within 50 feet (15 m) of the ballast
- Ballast Class 2 terminals only accept one 22 AWG solid wire

Notes

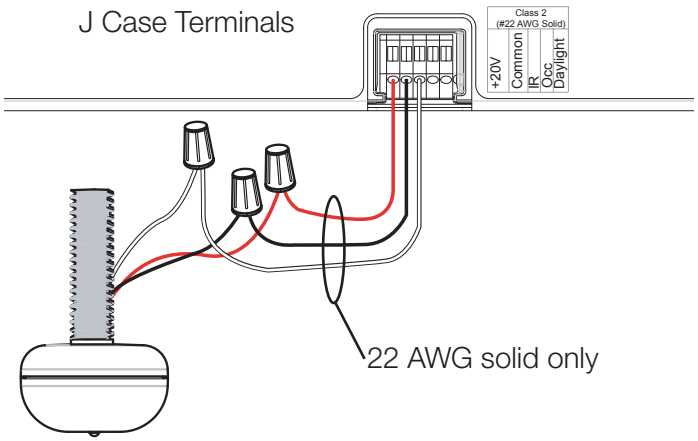
- Only one wallstation or IR receiver can be wired to a digital ballast
- If a daylight sensor and wallstation/IR receiver are connected to one ballast, do not connect the daylight sensor's IR output
- All sensor and wallstation wiring is Class 2. Follow all applicable national and local codes for proper circuit separation and protection.

G Case Terminals



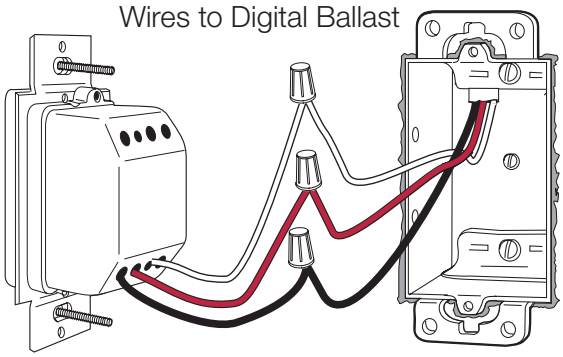
IR Receiver

J Case Terminals



IR Receiver

Wires to Digital Ballast



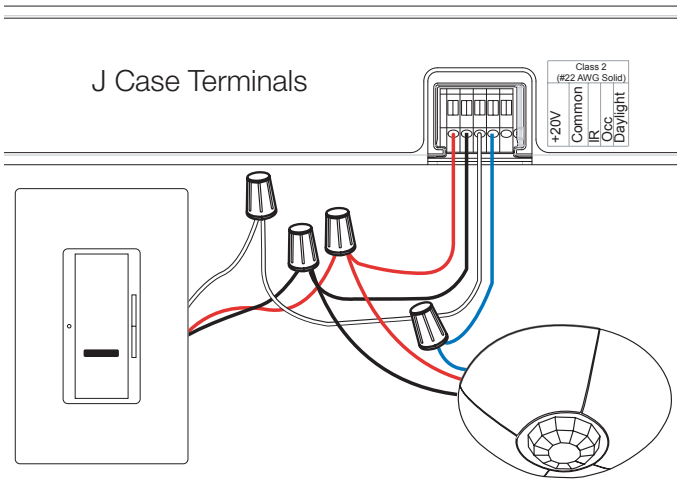
Wallstation

Job Name:	Model Numbers:
Job Number:	

EcoSystem Ballast Wiring: Multiple Devices

Multiple Sensors with One Ballast

- *EcoSystem* ballasts accept wiring for one daylight sensor input, one occupant sensor input and one IR input (wallstation or IR receiver)
- *EcoSystem* daylight sensors have IR outputs that allow the device to operate as a programming port. In applications where a daylight sensor and wallstation are wired to the same ballast, do not connect the white wire of the daylight sensor to the ballast. The wallstation operates as the programming port through its integral IR receiver
- Use the chart below as a guide for wiring multiple devices to a ballast



How to Use the Chart

Connect a senor to a ballast from the “Devices” column (in bold). Along the selected device row, are “Y’s” and “N’s”. Where a “Y” is placed, the device at the top of that column can also be connected to the same ballast. An “N” indicates no connection allowed.

Devices	**Daylight sensor (with IR)**	**Occupant sensor**	**Wallstation or IR receiver**	**Daylight Sensor (no IR)**
Daylight sensor (with IR)		Y	N	N
Occupant sensor	Y		Y	Y
Wallstation or IR Receiver	N	Y		Y
Daylight sensor (no IR)	N	Y	Y	

Example: When a Daylight Sensor with its internal IR are connected to a ballast, then only an occupancy sensor can be added for the system to properly function.

EcoSystem Ballast Wiring: Line Voltage Dimmers

EcoSystem Ballasts and 3-wire dimmers

- Lutron 3-wire dimmers only control the ballast they are wired to; *EcoSystem* does not support grouping of 3-wire control input.

3-Wire Control Wiring

- Make sure that the supply breaker to the Digital Ballast is OFF when wiring.

- Wire as shown

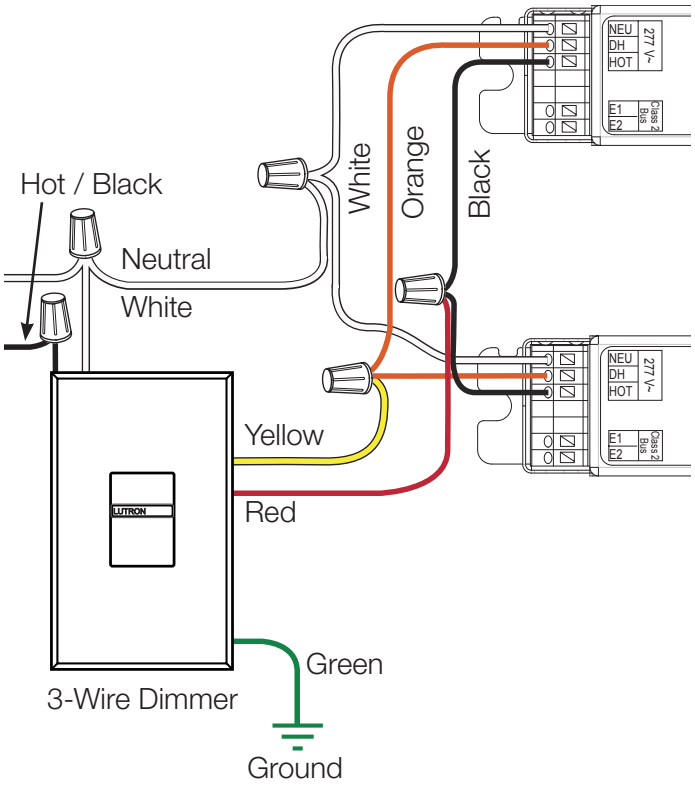
Line input	Connects to
Hot	Dimmer Black Wire
Neutral	Dimmer White Wire

Dimmer wire	Connects to
Yellow	Ballast Orange (DH)
Red	Ballast Black (HOT)
White	Ballast White (NEU)
Green	Earth Ground

- *EcoSystem* ballast line voltage and 3-wire input terminals only accept one 18 AWG solid wire.

Emergency and 3-wire

- *EcoSystem* ballasts controlled by a wallbox dimmer should not be used for emergency/egress lighting unless an external emergency ballast is used in the fixture. See Lutron Ap. Note #50.
- *EcoSystem* ballasts may be used for emergency/ egress lighting when controlled by a Lutron dimming panel (GP); where the panel is a dedicated emergency panel.



Notice

3-Wire control turns off digital ballasts when the control is in the off position. The digital ballast inputs: daylight sensor, wallstation, occupant sensor, and IR receiver will not function when the digital ballast is turned off

Attention Electricians and Fixture Manufacturers

Ballast/Socket Leads

Lead lengths from ballast to socket must not exceed 7 feet (2 m) for linear lamps (T5, T5HO, T8). Lead lengths must not exceed 3 feet (1 m) for T5 twin tube lamps.

Lamp Sockets

Lamp sockets as per IEC 60400 are required to ensure positive lamp-pin to socket contact.

Mounting for T5 and T5HO Lamps

Mount lamps 3/8 in. ± 1/8 in. away from the grounded metal surface.

Mounting for T8 & T5 Twin Tube Lamps

Mount lamps 1/2 in. ± 1/4 in. away from the grounded metal surface.

Having a lamp too close to the grounded metal will reduce lamp life. Having a fluorescent lamp too far away from the grounded metal will make the lamp flicker or not turn on at all.

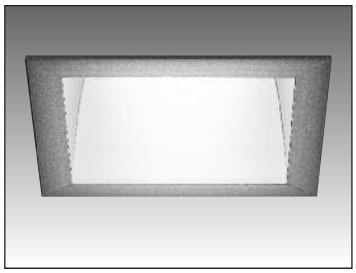
Lamp Seasoning Requirements

Some fluorescent lamp manufacturers recommend that new fluorescent lamps be operated at full output (“seasoned”) before they can be dimmed, to render lamp impurities inert, ensuring proper dimming performance and average rated lamp life. Please contact your lamp manufacturer for seasoning requirements.

Further Information

For further information please visit www.lutron.com/ecosystem or contact our 24-hour Technical Support Center at 1-800-523-9466

Job Name:	Model Numbers:
Job Number:	



BASYS™	Recessed	Square	Non-IC	4"
Downlight	Horizontal	13W	GX24q-1	

Type: Open Office

Project: Thesis - Redesign

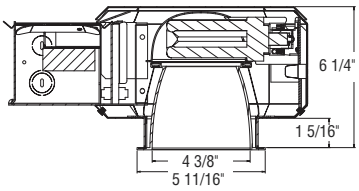
Compact Fluorescent

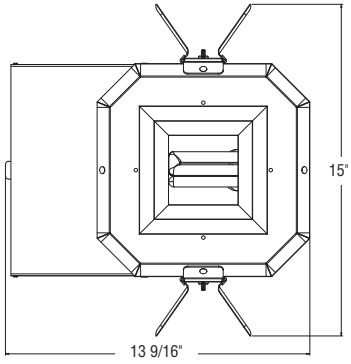
online Find it Fast 354

BRS4N1D	1H13GX24Q1	U	MS	CB	W	DCA	

FIXTURE	BALLAST/VOLTAGE	DISTRIBUTION	TRIM FINISH	FLANGE	LENS OPTIONS	OPTIONS
BASYS **Recessed Square** **4" Aperture** **Non-IC Downlight** Horizontal, 13W GX24q-1 Base	**U** Universal 120V/277V **S3** Dedicated 347V	**MS** Medium Distribution	**CB** Clear Brushed (Semi Specular) **CM** Clear Matte **WH** White Matte	**N** Unfinished **W** White **C** Custom	**DCA** Clear Acrylic, Damp Location **DMP** Micro-Pyramidal, Damp Location **DOP** Opal, Damp Location	**EM** Standby Battery Pack - Standard Lumen **EH** Standby Battery Pack - High Lumen **F** Fusing **9930** 2 - 27" C-Channel mounting bars **9952** 2 - 52" C-Channel mounting bars **9956** 2 - 28" 10-gauge, one-piece universal mounting bars **CP** Chicago Plenum

VIEWS





Ceiling cutout 5 1/4" x 5 1/4"
Weight - 8.5 lbs

MECHANICAL

Housing
Enclosed octagonal housing is of 20-gauge cold-rolled steel, post-painted in black powder coat finish to diminish inter-reflected light within the housing.

Removable top secured with latch pins allows for ventilation and top housing access. Lamp module with socket and reflector is removable for ease of top relamping.

20-gauge aluminum plaster frame in black powder coat finish has a fixed throat of 1 5/16" to accommodate double-thickness plasterboard.

Rigid mounting brackets provide 4" vertical adjustment from inside aperture and plenum side of housing. Brackets accommodate 1½" C-Channel, ½" EMT, ¾" lathing channel, and Caddy 517A, B, and C-Channels for flexibility in mounting (mounting bars ordered as an optional accessory).

Code Compliance/Listing
c UL us LISTED UL Listed for Damp Locations. Fixtures with standby battery packs are rated for Dry Locations only. Approved for thru wiring. Above ceiling access not required.

ELECTRICAL

Thru Wire Box
Oversized junction box is 18-gauge steel, post powder coat painted in Titan.

Two combination ½" - ¾" knockouts allow straight through conduit runs, additional six ½" knockouts allow for installation flexibility. UL Listed for thru wiring (4 in and 4 out at 90°C) and has 7/8" and 1 1/8" knockouts.

Captive swing-open ballast door provides access to ballast and thru wire box through fixture aperture.

Ballast
Unitized ballast tray can be pulled either through aperture or back of thru wire box for replacement and ease of wire connection.

Electronic 120/277 universal voltage Class P electronic ballast is thermally-protected, high power factor, with auto-reset shutdown circuit for one compact fluorescent lamp.

Socket
Swing-down socket holder allows for ease of re-lamping by visually aligning the socket base pins.

OPTICAL SYSTEM

Upper Reflector
Reflector is spun anodized aluminum of high specularity, vacuum metalized, designed to provide highest efficiency and effective beam distribution.

Lower Reflector
Compound parabolic reflector provides optical and physical 45-degree cutoff. Square extruded aluminum reflector designed to provide precise mitered corners with integral self-trim providing iridescent-free finish.

Lower Reflector Finishes
Brushed – High specularity finish provides lower visual luminance providing and up to a 15% increase in overall efficiency over Matte. Extrusion finish visually accentuates the square shape.

Matte – Soft, diffused and evenly illuminated surface provides a congruous appearance between the downlight and the ceiling.

Optional Micro-Pyramidal structure lens provides innovative cross-patterned layers to provide maximum efficiency and cutoff.

COMPANION DOWNLIGHTS USING SAME SOCKET/WATTAGE

TYPE	CATALOG NUMBER	FIF #	SPEC SHEET PAGE
Vertical Lamp Downlight	BRS4N3D1V13GX24Q1	353	BSA-1
Lensed Wallwasher	BRS4N1W1H13GX24Q1	355	BSA-3

PHOTOMETRICS

REFLECTOR	REPORT #	%EFF	NOTES
Brushed	LTL #13015	42.0 %	Osram CFT Lamp
Matte	LTL #12643-13W	34.4 %	Prorated

Zumtobel Lighting Inc. ©2010
3300 Route 9W
Highland, NY 12528-2630

TEL (845) 691-6262
(800) 932-0633
FAX (845) 691-6289

www.zumtobel.us

ZUMTOBEL

LTL LUMINAIRE TESTING LABORATORY, INC.
SUSTAINING MEMBER of the IESNA
905 Harrison Street · Allentown, PA 18103 · 610-770-1044 · Fax 610-770-8912 · www.LuminaireTesting.com

LTL NUMBER: 13015 DATE: 05-13-2008
PREPARED FOR: ZUMTOBEL LIGHTING, INC.
CATALOG NUMBER: BRS4N1D1H13GX24Q1UMSBSC
LUMINAIRE: FORMED STEEL HOUSING, SPUN SPECULAR ALUMINUM UPPER REFLECTOR, FORMED "BRUSHED" ALUMINUM LOWER REFLECTOR, NO ENCLOSURE.
LAMP: ONE HORIZONTAL 13 WATT TRIPLE TUBE COMPACT FLUORESCENT LAMP RATED AT 900 LUMENS.
LAMP CATALOG NUMBER: SYLVANIA CF13DT/E/835
BALLAST: ONE UNIVERSAL LIGHTING TECHNOLOGIES C213UNVBE
MOUNTING: RECESSED
TOTAL INPUT WATTS = 12.8 AT 120.0 VOLTS
THE 0 DEGREE PLANE IS PARALLEL WITH THE LAMPS.

CANDELA DISTRIBUTION

	0.0	22.5	45.0	67.5	90.0	112.5	135.0	157.5	180.0	FLUX
0	347	347	347	347	347	347	347	347	347	
5	345	343	340	337	337	338	340	342	342	32
15	302	305	308	299	296	295	288	281	276	83
25	214	235	254	229	222	239	227	205	194	104
35	132	158	146	148	147	168	173	153	130	94
45	52	63	64	64	58	70	77	53	42	49
55	12	13	9	12	12	12	10	11	10	11
65	4	4	4	3	4	4	3	3	3	3
75	2	2	2	2	2	2	2	2	2	2
85	0	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0	

ZONAL LUMEN SUMMARY

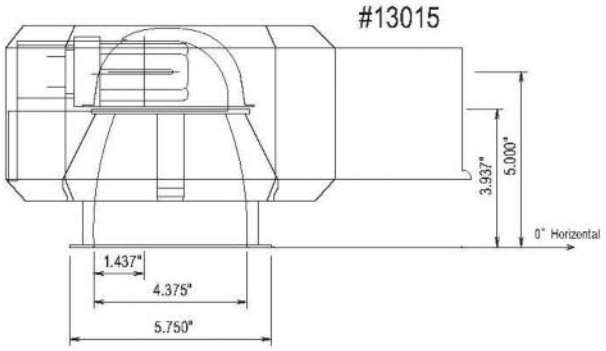
ZONE	LUMENS	%LAMP	%FIXT
0- 30	219	24.3	58.0
0- 40	313	34.8	82.9
0- 60	373	41.5	98.8
0- 90	378	42.0	100.0
90-180	0	0.0	0.0
0-180	378	42.0	100.0

TOTAL LUMINAIRE EFFICIENCY: 42.0%
CIE TYPE: DIRECT

PLANE:	0-DEG	90-DEG	180-DEG
SPACING CRITERIA:	0.9	0.9	0.8
LUMINOUS LENGTH:	4.375	4.375	

LUMINANCE IN CANDELA PER SQUARE METER

ANGLE IN DEG	AVERAGE 0-DEG	AVERAGE 45-DEG	AVERAGE 90-DEG
0	28098.	28098.	28098.
45	5955.	7329.	6642.
55	1694.	1271.	1694.
65	766.	766.	766.
75	626.	626.	626.
85	0.	0.	0.



Approved By: MG

THIS REPORT BASED ON LM-41 AND OTHER PERTINENT IESNA PROCEDURES.

LTL LUMINAIRE TESTING LABORATORY, INC.
SUSTAINING MEMBER of the IESNA
905 Harrison Street · Allentown, PA 18103 · 610-770-1044 · Fax 610-770-8912 · www.LuminaireTesting.com

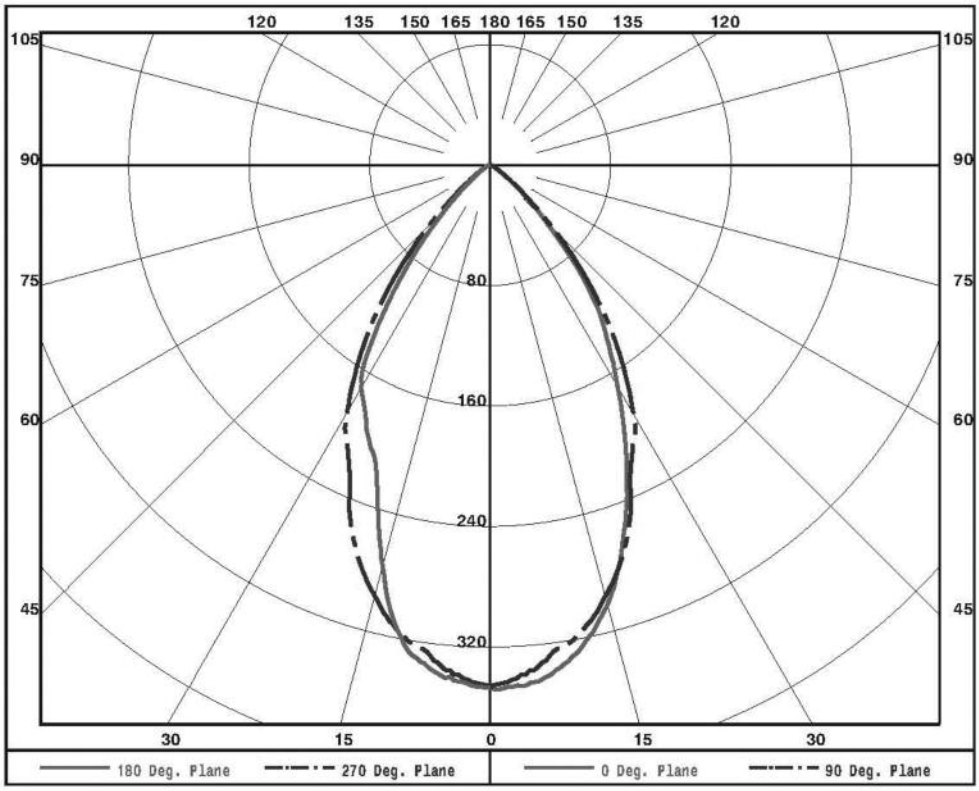
LTL NUMBER: 13015 DATE: 05-13-2008
PREPARED FOR: ZUMTOBEL LIGHTING, INC.

CANDELA DISTRIBUTION

	0.0	22.5	45.0	67.5	90.0	112.5	135.0	157.5	180.0
0	347	347	347	347	347	347	347	347	347
5	345	343	340	337	337	338	340	342	342
10	329	326	320	321	320	316	318	325	325
15	302	305	308	299	296	295	288	281	276
20	260	274	284	273	265	269	252	234	221
25	214	235	254	229	222	239	227	205	194
30	170	193	205	191	191	207	201	184	172
35	132	158	146	148	147	168	173	153	130
40	93	115	99	102	102	121	130	101	81
45	52	63	64	64	58	70	77	53	42
50	27	30	27	29	28	31	29	23	21
55	12	13	9	12	12	12	10	11	10
60	5	6	5	5	7	7	5	6	5
65	4	4	4	3	4	4	3	3	3
70	2	2	2	2	2	2	2	2	2
75	2	2	2	2	2	2	2	2	2
80	1	1	1	1	1	1	1	1	0
85	0	0	0	0	0	0	0	0	0
90	0	0	0	0	0	0	0	0	0

ZONAL LUMEN SUMMARY

0- 5	8.
5- 10	24.
10- 15	37.
15- 20	46.
20- 25	51.
25- 30	53.
30- 35	51.
35- 40	43.
40- 45	32.
45- 50	17.
50- 55	8.
55- 60	4.
60- 65	2.
65- 70	1.
70- 75	1.
75- 80	1.
80- 85	0.
85- 90	0.



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PREPARED FOR: ZUMTOBEL LIGHTING, INC.

COEFFICIENTS OF UTILIZATION - ZONAL CAVITY METHOD

EFFECTIVE FLOOR CAVITY REFLECTANCE 0.20

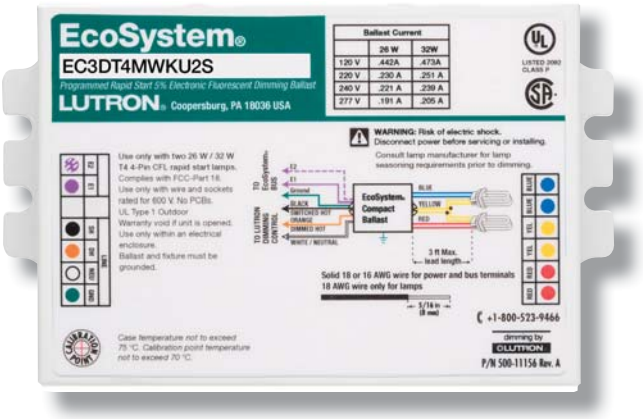
RC	80				70				50			30			10			0
RW	70	50	30	10	70	50	30	10	50	30	10	50	30	10	50	30	10	0
0	50	50	50	50	49	49	49	49	47	47	47	45	45	45	43	43	43	42
1	48	46	45	44	47	46	45	44	44	43	42	42	42	41	41	40	40	39
2	45	43	41	40	44	42	41	39	41	40	38	40	39	38	39	38	37	36
3	43	40	38	36	42	39	37	36	38	37	35	37	36	35	36	35	34	33
4	40	37	35	33	40	37	34	33	36	34	32	35	33	32	34	33	31	31
5	38	34	32	30	37	34	31	30	33	31	29	32	31	29	32	30	29	28
6	36	32	29	27	35	32	29	27	31	29	27	30	29	27	30	28	27	26
7	34	30	27	25	33	29	27	25	29	27	25	28	26	25	28	26	25	24
8	32	28	25	23	31	27	25	23	27	24	23	26	24	23	26	24	23	22
9	30	25	23	21	29	25	22	21	25	22	21	24	22	21	24	22	20	20
10	28	23	21	19	27	23	21	19	23	20	19	23	20	19	22	20	19	18

NOTE: THE ZONAL CAVITY CALCULATION TECHNIQUE IS ACCURATE WHEN LUMINAIRES WITH SYMMETRIC CANDELA DISTRIBUTIONS ARE EMPLOYED AND WHEN THE LUMINAIRES ARE LOCATED SYMMETRICALLY THROUGHOUT THE ROOM. THIS UNIT HAS SPECIAL CHARACTERISTICS AND THEREFORE THESE COEFFICIENTS SHOULD BE USED WITH CAUTION.

THIS TEST WAS CONDUCTED USING RELATIVE PHOTOMETRY TECHNIQUES ACCORDING TO STANDARD IESNA PROCEDURES. THE USER MUST THEREFORE USE CAUTION IN THE FOLLOWING SITUATIONS: 1) THIS TEST WAS PERFORMED USING A SPECIFIC BALLAST/LAMP COMBINATION. EXTRAPOLATION OF THESE DATA FOR OTHER BALLAST/LAMP COMBINATIONS MAY PRODUCE ERRONEOUS RESULTS. 2) ACCORDING TO IESNA PROCEDURES, THE BALLAST(S) AND LAMP(S) ARE PRESUMED TO PRODUCE 100% OF RATED OUTPUT. AN APPROPRIATE BALLAST FACTOR MUST BE APPLIED TO THE LUMEN OUTPUT RATINGS AND LUMINOUS INTENSITY VALUES GIVEN. 3) THIS TEST WAS CONDUCTED IN A CONTROLLED LABORATORY ENVIRONMENT WHERE THE AMBIENT TEMPERATURE WAS HELD AT 25°C ±1°C. FIELD PERFORMANCE MAY DIFFER PARTICULARLY IN REGARDS TO CHANGE IN LUMINOUS OUTPUT AS A RESULT OF DIFFERENCE IN AMBIENT TEMPERATURE AND METHOD OF MOUNTING THE LUMINAIRE.

EcoSystem Digital Ballasts

EcoSystem compact ballasts provide high-performance dimming for any compact fluorescent application, including within an *EcoSystem*. *EcoSystem* compact ballasts offer 100% to 5% dimming, providing both energy savings and lighting flexibility.



***EcoSystem* case type K**

Features

- Continuous, flicker-free dimming from 100% to 5%
- Compatible with *EcoSystem* Digital Bus control, GRAFIK Eye® QS, and Quantum®, allowing for integration into an existing/planned *EcoSystem*
- Supports standard 3-wire line-voltage phase control technology
- Programmed rapid start design ensures full-rated lamp life while dimming and cycling
- Lamps turn on to any dimmed level without flashing to full brightness
- Low harmonic distortion throughout the entire dimming range
- Frequency of operation ensures that ballast does not interfere with infrared devices
- Inrush current limiting circuitry eliminates circuit breaker tripping, switch arcing, and relay failure
- Ultra-quiet operation
- Protected from miswires of any input power to control lead, or from lamp leads to each other and/or ground
- 100% performance tested at factory
- 5-year limited warranty with Lutron field service commissioning (3-year standard warranty) from date of purchase.

Job Name:	Model Numbers:	
Job Number:		

Specifications

Standards

- UL Listed (evaluated to the requirements of UL935)
- UL Type 1 Outdoor for damp locations
- CSA Certified (evaluated to the requirements of C22.2 No. 74)
- Class P thermally protected
- Meets ANSI C82.11 High Frequency Ballast Standard
- Meets FCC Part 18 Non-Consumer requirements for EMI/RFI emissions
- Meets ANSI C62.41 Category A surge protection standards up to and including 4 kV
- Manufacturing facilities employ ESD reduction practices that comply with the requirements of ANSI/ESD S20.20
- Lutron Quality Systems registered to ISO 9001.2000

Performance

- Operating Voltage: 120, 220/240, 277 V~ at 50 or 60 Hz
- Grounding: ballast and fixture must be grounded for proper dimming
- Dimming Range: 100% to 5% measured relative light output
- Lamp Starting: programmed rapid start
- Lamp Current Crest Factor: less than 1.7
- Light Output Variation: Constant ±2% light output for line voltage variations of ±10%
- Lamp Life: Average lamp life meets or exceeds specified lamp ratings
- Power Factor: 0.95 minimum
- Total Harmonic Distortion (THD): Less than 20%
- Inaudible in a 27 dBA ambient
- Maximum Inrush Current: 3 A per ballast at 277 V~, 7A per ballast at 120 V~
- Standby power: Less than 1 W

Environment

- Minimum lamp starting temperature: 50 °F (10 °C)
- Relative humidity: less than 90% non-condensing
- Sound Rating: inaudible in a 27 dB ambient
- Maximum ballast case temperature: 75 °C (167 °F)

Ballast Wiring & Mounting

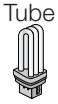
- Ballast is grounded by the specified terminal or by a mounting screw to the fixture
- Terminal blocks on the ballast accept the following wire gauges:
  Power Wiring and *EcoSystem* Bus:
  only one 18 AWG solid per terminal
  Lamp Wiring:
  only one 18 AWG solid per terminal
- Only one wire per terminal
- Ballast mounts using two mounting tabs or studs within a fluorescent fixture
- Wiring from the ballast to lamp sockets shall not exceed 3 feet for T4 compact lamps
- Ballast does not have sensor terminals

Lamp Seasoning

Refer to lamp manufacturer for lamp seasoning requirements prior to dimming

Job Name:	Model Numbers:	
Job Number:		

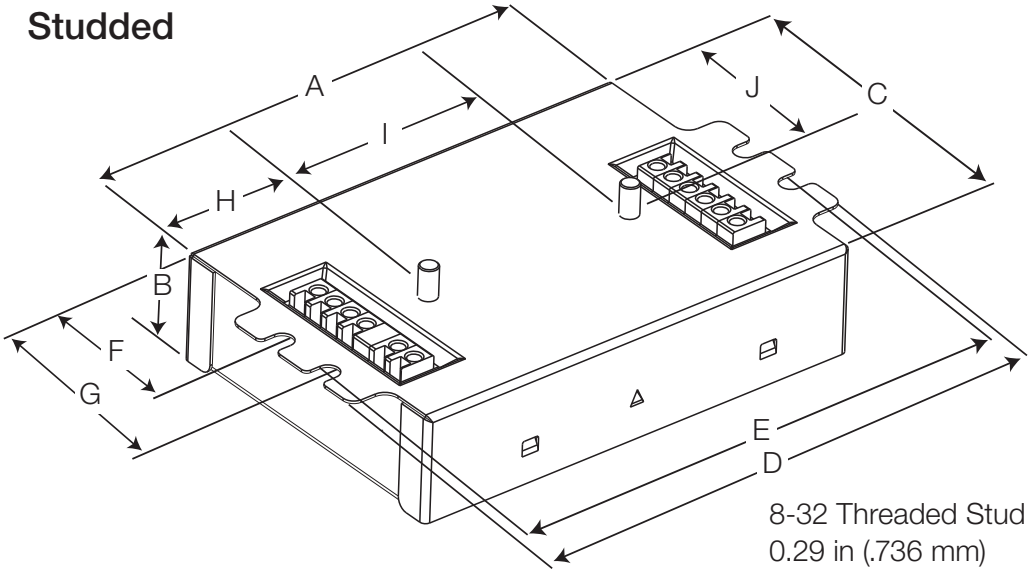
EcoSystem Compact Fluorescent Ballast Models

Lamp Type	Lamp Watts	No. of Lamps	Model	Case Size	Input Voltage (VAC)	Input Current (A)	Input Power (W)	Ballast Factor (BF)	System Lumens (lm)	System Efficacy (lm/W)	Ballast Efficacy Factor	Relative Efficacy (RSE)
T4 4-Pin Quad-Tube or Triple-Tube 	18 W	1	EC3DT418KU1S (Studded) EC3DT418KU1 (Non-studded)	K	120	0.180	21.3	0.95	1140	53.5	4.46	0.80
				K	220	0.098	21.1	0.95	1140	54.0	4.50	0.81
				K	240	0.092	21.4	0.95	1140	53.3	4.44	0.80
				K	277	0.080	20.8	0.95	1140	54.8	4.57	0.82
		2	EC3DT418KU2S (Studded) EC3DT418KU2 (Non-studded)	K	120	0.34	41.1	0.95	2280	55.5	2.31	0.83
				K	220	0.18	39.6	0.95	2280	57.6	2.40	0.86
				K	240	0.17	39.4	0.95	2280	57.9	2.41	0.87
				K	277	0.15	39.9	0.95	2280	57.1	2.38	0.86
	26 W	1	EC3DT4MWKU1S (Studded) EC3DT4MWKU1 (Non-studded)	K	120	0.22	26.4	0.95	1710	64.8	3.60	0.94
				K	220	0.12	26.8	0.95	1710	63.9	3.55	0.92
				K	240	0.11	26.9	0.95	1710	63.7	3.54	0.92
				K	277	0.10	27.0	0.95	1710	63.4	3.52	0.92
		2	EC3DT4MWKU2S (Studded) EC3DT4MWKU2 (Non-studded)	K	120	0.43	51.6	0.95	3420	66.3	1.84	0.96
				K	220	0.23	49.9	0.95	3420	68.5	1.90	0.99
				K	240	0.21	50.6	0.95	3420	67.5	1.88	0.98
				K	277	0.19	51.4	0.95	3420	66.6	1.85	0.96
T4 4-Pin Triple-Tube 	32 W	1	EC3DT4MWKU1S (Studded) EC3DT4MWKU1 (Non-studded)	K	120	0.27	32.4	0.95	2280	70.4	2.93	0.94
				K	220	0.14	31.6	0.95	2280	72.1	3.00	0.96
				K	240	0.13	31.7	0.95	2280	72.0	3.00	0.96
				K	277	0.11	31.7	0.95	2280	71.9	3.00	0.96
		2	EC3DT4MWKU2S (Studded) EC3DT4MWKU2 (Non-studded)	K	120	0.55	66.0	0.95	4560	69.1	1.44	0.92
				K	220	0.29	64.5	0.95	4560	70.7	1.47	0.94
				K	240	0.26	63.0	0.95	4560	72.3	1.51	0.96
				K	277	0.24	65.5	0.95	4560	69.7	1.45	0.93
	42 W	1	EC3DT442KU1S (Studded) EC3DT442KU1 (Non-studded)	K	120	0.36	43.2	0.95	3040	70.4	2.20	0.92
				K	220	0.20	42.9	0.95	3040	70.8	2.21	0.93
				K	240	0.18	42.7	0.95	3040	71.2	2.23	0.93
				K	277	0.15	42.6	0.95	3040	71.3	2.23	0.94
		2	EC3DT442KU2S (Studded) EC3DT442KU2 (Non-studded)	K	120	0.73	87.6	0.95	6080	69.4	1.08	0.91
				K	220	0.39	85.9	0.95	6080	70.8	1.11	0.93
				K	240	0.35	85.1	0.95	6080	71.5	1.12	0.94
				K	277	0.31	85.4	0.95	6080	71.2	1.11	0.93

NOTE: The "S" at the end of the ballast model number indicates a studded option. Remove the "S" for a non-studded ballast.

EcoSystem Compact Fluorescent Ballast Case Dimensions

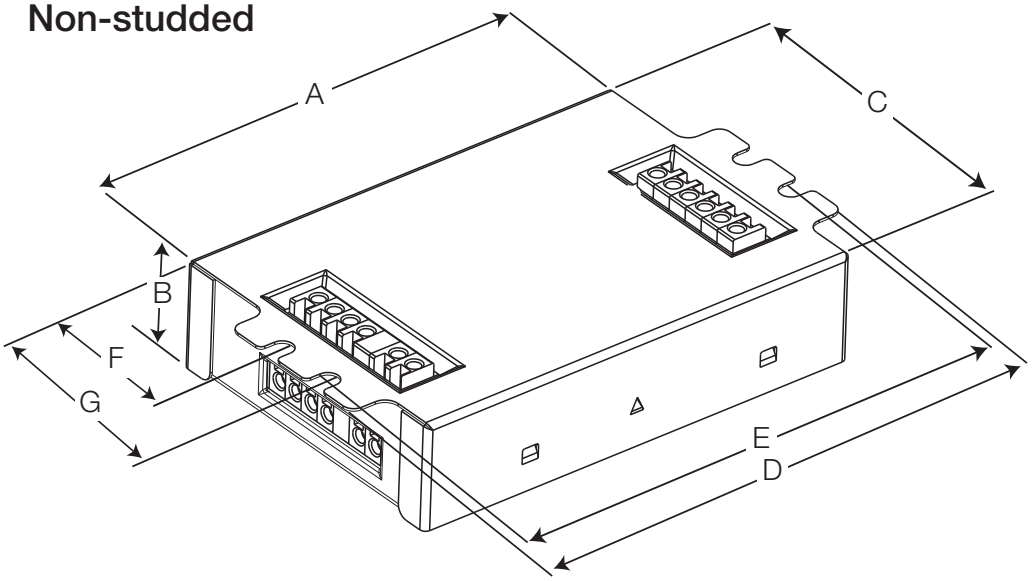
Studded



A	4.20 in (107 mm)
B	1.00 in (25 mm)
C	3.00 in (76 mm)
D	4.90 in (124 mm)
E	4.60 in (117 mm) (mounting centers)
F	1.42 in (36 mm)
G	1.99 in (51 mm)
H	1.09 in (28 mm)
I	2.00 in (51 mm)
J	1.60 in (41 mm)

NOTE: Studded version does not have side connectors.

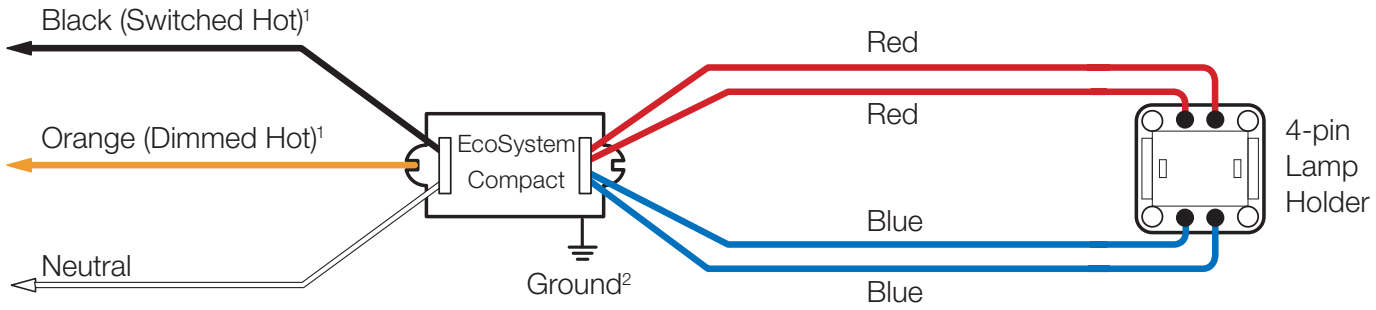
Non-studded



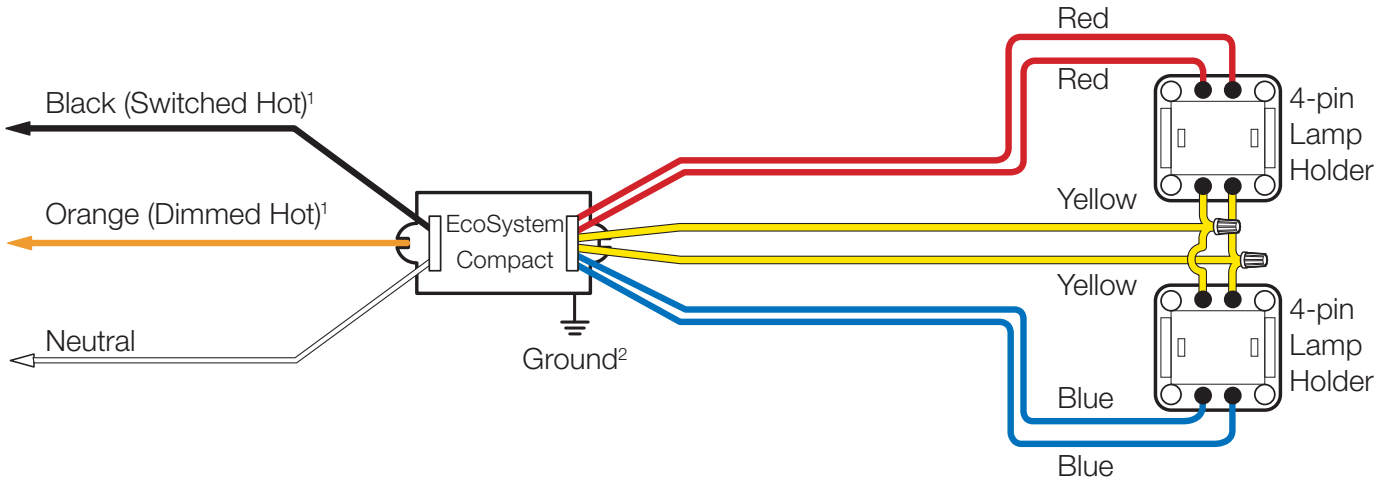
A	4.20 in (107 mm)
B	1.00 in (25 mm)
C	3.00 in (76 mm)
D	4.90 in (124 mm)
E	4.60 in (117 mm) (mounting centers)
F	1.42 in (36 mm)
G	1.99 in (51 mm)

Wiring Diagrams

One Compact Fluorescent Lamp



Two Compact Fluorescent Lamps



[1] Wire colors shown are for Lutron controls and ballasts only. Dimming control wires may not match ballast wire colors.
[2] Ballast is grounded via the case or terminal.

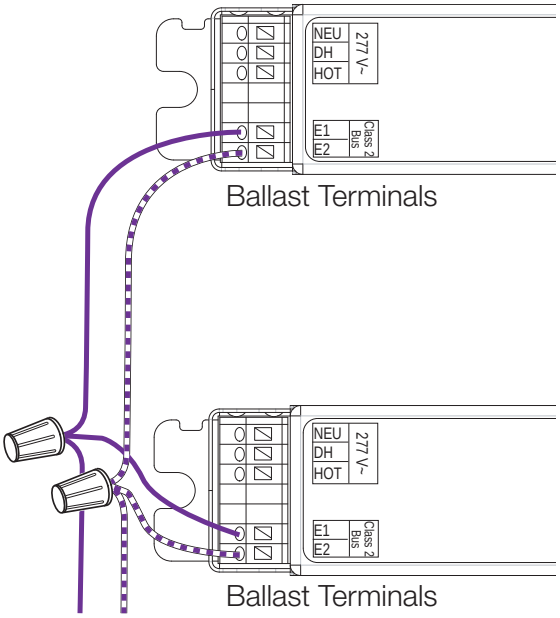
Note: For T4 compact lamps, maximum lamp-to-ballast wire length is 3 feet (1 m) to guarantee proper performance.

Job Name:	Model Numbers:	
Job Number:		

EcoSystem Bus Wiring Diagrams

EcoSystem Bus Overview

- The *EcoSystem* Bus wiring (E1 and E2) connects the digital ballasts together to form a lighting control system
- Each *EcoSystem* Bus supports up to 64 digital ballasts, 32 occupant sensors, 8 daylight sensors, and 64 wallstations or IR receivers
- Sensors do not directly connect to *EcoSystem* compact ballasts
- E1 and E2 (*EcoSystem* bus wires) are polarity insensitive and can be wired in any topology
- An *EcoSystem* Bus Supply provides power for the *EcoSystem* Bus and supports system programming
- All *EcoSystem* Bus programming is completed by using the *EcoSystem* Programmer, GRAFIK Eye® QS with *EcoSystem,* or Quantum™



To the *EcoSystem* Bus Supply & up to 64 total ballasts

EcoSystem Bus Wiring

- Ballast *EcoSystem* Bus terminals only accept one 16 AWG or 18 AWG solid wire
- Make sure that the supply breaker to the Digital Ballast and *EcoSystem* Bus Supply is OFF when wiring
- Connect the two conductors to the two Digital Ballast terminals E1 and E2 as shown
- Using two different colors for E1 and E2 will reduce confusion when wiring several ballasts together
- The *EcoSystem* bus may be wired Class 1 or Class 2. Consult applicable electrical codes for proper wiring practices

Notes

- The *EcoSystem* Bus Supply does not have to be located at the end of the Digital Loop
- *EcoSystem* Bus length is limited by the wire gauge used for E1 and E2 as follows:

Wire Gauge	Bus Length (max)
12 AWG	2200 ft (670 m)
14 AWG	1400 ft (427 m)
16 AWG	900 ft (274 m)

ELECTRICIANS AND CONTRACTORS

Ballast/Socket Leads

Lead lengths from ballast to socket must not exceed 3 feet (1 m) for T4 linear lamps.

Lamp Sockets

Lamp sockets as per IEC 60400 are required to ensure positive lamp-pin to socket contact. T4 compact sockets must be the 4-pin type, and must be used with 4-pin compact lamps.

Ballast Operating Temperature

Ballast case temperature must not exceed 75 °C at any point on ballast. Calibration point temperature must not exceed 70 °C.

Wiring and Grounding

Ballast and lighting fixture must be effectively grounded. Ballasts must be installed per national and local electrical codes.

FACILITIES MANAGERS

PERFORMANCE

Lamp Seasoning Requirements

Some fluorescent lamp manufacturers recommend that new fluorescent lamps be operated at full output (“seasoned”) before they can be dimmed to render lamp impurities inert, ensuring proper dimming performance and average rated lamp life. Please contact your lamp manufacturer for seasoning requirements.

SERVICE

Replacement Parts

Use replacement parts with exact Lutron model numbers. Consult Lutron if you have any questions.

Further Information

For further information, please visit us at www.lutron.com/ballasts or contact our 24-hour Technical Support Center at 1-800-523-9466.

System Overview

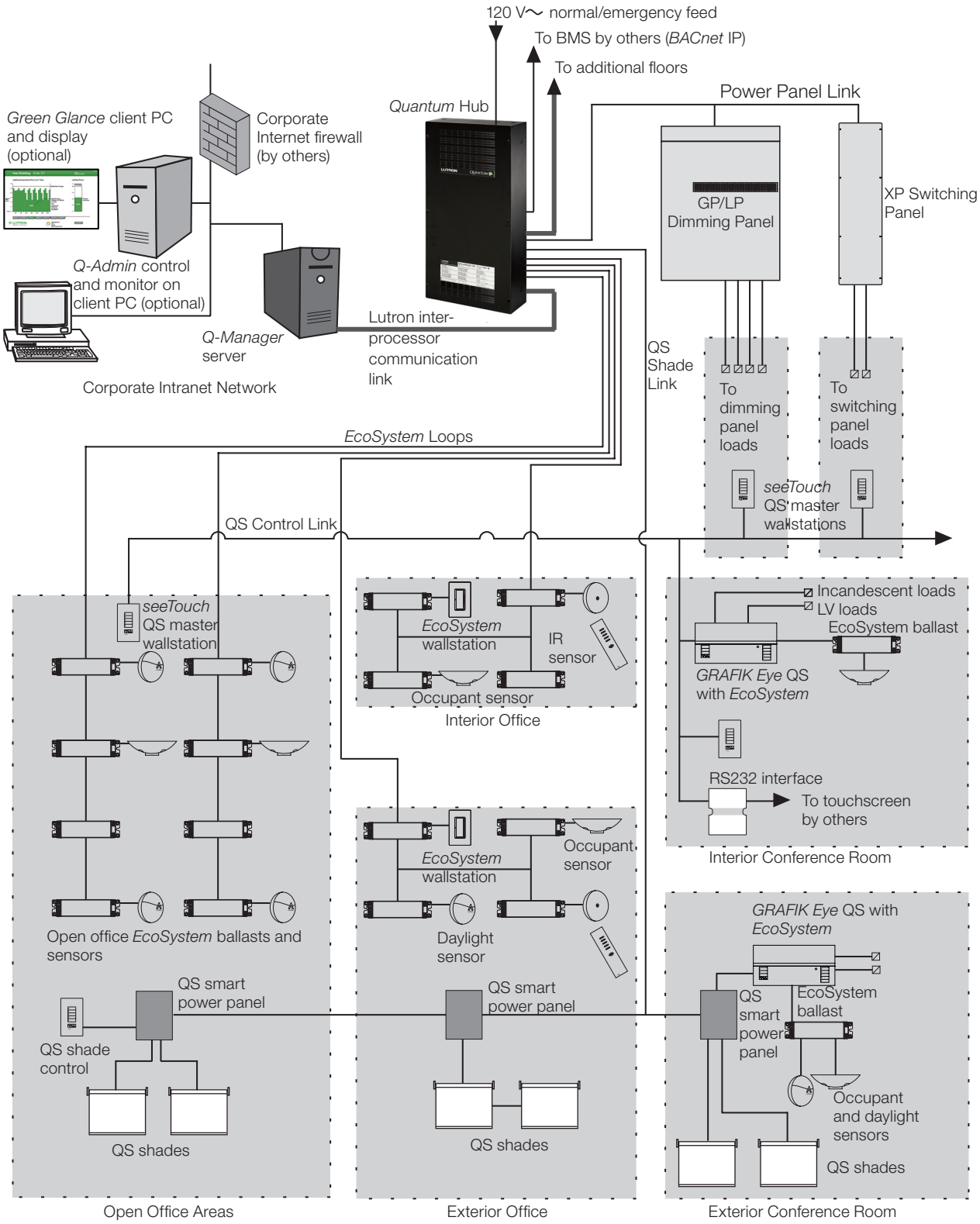
Quantum is a facility management solution that creates a flexible, productive, and energy-efficient environment for an entire building or campus. A single system provides dimming, switching, motorized shade control, system integration and energy management. It is used to manage the electric and natural light in multiple spaces using both automatic and manual control options.

Features

- Saves energy through occupancy/vacancy controls, daylighting, light level space tuning, shade control, and IntelliDemand load shedding.
- Increases productivity through maintaining optimal light level needed for tasks by daylighting, space tuning, and wallstation controls to activate desired preset scenes for the given activity.
- Centrally manage, monitor, and control EcoSystem® ballasts, *EcoSystem* ballast modules, Grafik Eye® dimming and switching panels, *Grafik Eye* QS scene controller, and Sivoia® QS shades in a building or whole campus environment.
- Uses Lutron's Q-Admin™ Graphical User Interface for easy management of the system
- Built-in timeclock allows scheduling of events based on time of day and relative to local sunrise and sunset.
- Easily interfaces with audiovisual equipment, security systems, fire alarms, and building management systems.
- Partitioned space control combines/separates control station and occupancy control based on the status of movable walls.
- Controls can be programmed using recommended templates or on a button-by-button basis.

Job Name:	Model Numbers:	
Job Number:		

System Overview



Job Name:	Model Numbers:	
Job Number:		

System Components and Capacities

Light Management Hubs (LMH)

- 16 processors per sub-system. 8 to 16 LMHs per sub-system, depending on number of processors per hub.
- Up to 128 sub-systems, for a total of 2048 processors (1024 to 2048 LMH).
- Control links can be configured as *EcoSystem*, QS control links, or *Grafik Eye* power panel.
- Up to 4 control links per LMH (2 per processor).
- One configurable link pre-configured as an *EcoSystem* link for communication to EcoSystem bus supply modules, which are normally internal to the LMH.
- 5-port Ethernet device for connecting LMHs together and connection to the Q-Manager™ server.
- 3 configurable links can supply power for up to 32 keypad/control stations. For more controls on the QS link, additional power supplies are needed.

Control Links:

EcoSystem® Link

- Up to 4 *EcoSystem* bus supplies for up to 8 *EcoSystem* loops (per bus supply).
- to 64 ballasts per EcoSystem loop
- to 8 daylight sensors per loop
- to 32 occupant sensors per loop

Wire Gauge	Bus Length (max)
12 AWG (4.0 mm2)	2200 ft (671 m)
14 AWG (2.5 mm2)	1400 ft (427 m)
16 AWG (1.5 mm2)	900 ft (275 m)
18 AWG (1.0 mm2)	570 ft (175 m)

Job Name:	Model Numbers:	
Job Number:		

QS Control Link

- Up to 99 QS controls per link
- Up to 512 switch legs or zones per link

QS Device Consumption Rules

The table below lists the devices available on the QS link. See below for each device's count toward the link maximums for zones, switch legs, and devices.

A *Quantum* QS link can have up to 512 switch legs (outputs), 99 devices, and 32 power draw units.

QS Device Description	Switch Leg Count	Device Count	Power Draw Units
3-zone GRAFIK Eye® QS	3	1	0
4-zone *GRAFIK Eye* QS	4	1	0
6-zone *GRAFIK Eye* QS	6	1	0
seeTouch® QS	0	1	1
Sivoia® QS Roller 64™	1	1	0
Sivoia QS Roller 100™	1	1	0
Sivoia QS Roller 225™	1	1	0
6-Zone *GRAFIK Eye* QS with EcoSystem®	up to 64	1	0
8-Zone *GRAFIK Eye* QS with *EcoSystem*	up to 64	1	0
16-Zone *GRAFIK Eye* QS with *EcoSystem*	up to 64	1	0
QS contact closure interface	up to 5	1	3
QS network interface	0	1	2
QS smart power panel	0	1	0

Wiring Rules

- Free wiring topology (daisy chain, T-tap, etc.).
- No link terminators needed.
- Total length of control link must not exceed 2000 ft (610 m).
- Up to 3 link repeaters each adding an additional 2000 ft (610 m).

Wire Gauge	Bus Length (max) (recommended GRX-CBL-46L)
12 AWG (4.0 mm^2)	2000 ft (600 m)
16 AWG (1.5 mm^2)	800 ft (250 m)
18 AWG (1.0 mm^2)	500 ft (150 m)

Power Panel Link

- Up to 32 power panels per link.
- Daisy chain wiring only.
- LT-1 link terminators needed on each end of the link.
- Power panel link connects the processor to the power panels, including: GP, LP, XP, CCP, JDP, JCP, DCI, and DP.
- PELV (Class 2: USA) wiring link requires:
  - Two 12 AWG (2.5 mm^2) conductors for control power.
  - One twisted, shielded pair of 18 AWG (1.0 mm^2) for data link.
  - One 18 AWG (1.0 mm^2) conductor for emergency (essential) sense line, from panel to panel.
  - Total length of control link may be no more than 2000 ft (600 m).
  - If MUX-RPTR interface and GRX-CBL-46L cable is used, length may be up to 4000 ft. (1200 m).

Q-Manager™ System Server

The *Q-Manager* server is used to collect and record data from the *Quantum* system components. It is also required for communicating to the *Q-Admin* client software and the *Green Glance* client display.

Q-Admin™ System Management Software

- Up to two clients.
- *Q-Admin* is *Quantum*'s software that allows facilities staff to manage their electric light and daylight for maximum energy efficiency, comfort, and productivity.
- Allows control of lights on an area basis for sending lights to a level, enabling and disabling of occupancy, and changing target light levels for areas that are daylighting.
- Monitors light status, occupancy status, and energy consumption.
- Real-time diagnostics of ballast lamp failures and equipment failures.

Green Glance™

- Up to six displays.
- The screen displays lighting energy savings, real-time lighting power savings, and equivalent savings such as coal not burned or CO_2 not emitted. Data are organized into an easy-to-read format intended for public viewing.

Control Strategies

Scheduling

- Built-in timeclock allows scheduling of events based on time of day and relative to local sunrise and sunset.
- Create separate timeclocks for each related group of outputs, i.e., parking lots, common spaces, landscape lighting, etc.
- Each timeclock can contain different daily schedules.
- Astronomic events can be set up to 2 hours before or after sunrise or sunset.
- Daylight savings time can be defined according to any system used anywhere in the world.

Vacancy/Occupancy Detection

- Use occupant sensors to automatically turn the lights off in an area a fixed time after it becomes vacant.
- Use occupant sensors to automatically turn the lights on in an area when it becomes occupied and to automatically turn the lights off in an area a fixed time after it becomes vacant.
- Multiple areas may be grouped together to respond to vacancy/occupancy together.
- Each area's occupied level/scene and unoccupied level/scene can be programmed.
- Dependent occupancy groups allow you to keep an areas lights on when adjacent areas are occupied.

Daylighting

Automatically dim the electric lights in an area based on the amount of natural light entering through the windows.

Control Station Programming

- Select lighting scenes and/or shade presets in an area.
- Control individual lighting zones and/or shade groups using button-by-button programming.
- LED indicator displays the status of programmed lights.

Job Name:	Model Numbers:	
Job Number:		

Integration

Contact closures

- Simple integration with fire alarms systems, security systems, and audio/visual systems.

RS-232

- Advanced integration primarily used with audio/visual systems.

Telnet® via Ethernet

- Advanced integration primarily used with audio/visual systems.

BACnet® IP

- Integrate with the building management system.

Q-Admin™ Software

Control of Lights and Shades

Allows the building manager to control and monitor the lighting and shading system as follows:

Lights

- Area lights can be monitored for on/off status.
- All lights in an area can be turned on/off or sent to a specific level.
- For areas that have been zoned, these areas may be sent to a predefined lighting scene, and individual zones may be controlled.
- Area lighting scenes can be modified in real time, changing the levels zones go to when a scene is activated.

Shades

- Area shades can be monitored for current preset or position.
- Area shades can be opened/closed, sent to a preset, or sent to a specific position.

Occupancy

Occupancy allows the building manager (or security guard) to monitor occupancy status and make occupancy-setting changes as follows:

- Area occupancy can be monitored.
- Area occupancy can be disabled to override occupancy control or in case of occupant sensor problems.
- Area occupancy settings, including level lights turn on to when area is occupied, and level lights turn off to when area is unoccupied, can be changed in real time.

Daylighting

Daylighting allows the building manager to control and monitor the daylighting settings as follows:

- Daylighting can be enabled/disabled. This can be used to override the control currently taking place in the space.
- Daylight target levels can be changed for each daylit area. This is particularly useful when new departments move into a space.

IntelliDemand Load Shedding

Load shedding allows the building manager to monitor whole-building lighting power usage and apply a load shed reduction to selected areas, thereby reducing a building's power usage.

Scheduling

Schedule time of day and astronomic timeclock events to automate functions for lights and shades.

Job Name:	Model Numbers:	
Job Number:		

Reporting

Reports allow the building manager to gather real-time and historical information about the system as follows:

- Energy Reports: Show a comparison of cumulative energy used over a period of time for one or more areas.
- Power Reports: Show power usage trend over a period of time for one or more areas.
- Activity Report: Shows what activity has taken place over a period of time for one or more areas. Activity includes occupancy activities (i.e., areas going occupied/unoccupied, wall controls being pressed), building manager operation (controlling/changing areas using the control and monitor tool), and device failures (keypads, ballasts, etc. not responding).
- Lamp Failure Report: Shows which areas are currently reporting lamp failures.

Diagnostics

Diagnostics allow the building manager to check on the status of all equipment in the lighting control system. Devices will be listed with a reporting status of OK, missing, or unknown.

Administration

The administration tab appears only for users who have been assigned the role “Admin” when their user account was created or last modified. The administration features are as follows:

- Users: Allows new user accounts to be created and existing user accounts to be edited.
- Publish Graphical Floor Plan: Allows admin user to publish new graphical floor plan files, allowing users to monitor the status of lights, occupancy of areas, and daylighting status.
- Back-up Project Database: Allows admin user to backup the project database. The project database holds all the configuration information for the system, including keypad programming, area scenes, daylighting, occupancy programming, emergency levels, night lights, and timeclock. The Control and Monitor tool can be used to adjust some of these settings, and thus it is important to back up the project database prior to changing settings in the Design and Setup tool.
- Publish Project Database: Allows the admin user to send a new project database to the server and download the new configuration to the system. The project database holds all the configuration information for the system, including keypad programming, area scenes, daylighting, occupancy programming, emergency levels, night lights, and timeclock.

Graphical Floor Plan Design Service

The Q-Admin™ system navigation and status reporting can be performed using customized CAD-based drawings of your building. Pan and zoom feature allows for easy navigation.

- Contact Lutron for hourly rate for graphics creation.
- Customer must supply vector-based (.dwg, .dxf, .wmf, etc.) drawings for each floor plan to be displayed.

Job Name:	Model Numbers:	
Job Number:		

Dual Technology Ceiling Mount Sensor

The LOS-CDT Series ceiling-mount dual-technology sensors can integrate into Lutron systems or function as stand-alone controls using a Lutron power pack. The technology eliminates manual sensitivity and timer adjustments during installation and over the life of the product.

Features

- Intelligent, continually adapting sensor
- Ultrasonic (US) combined with passive infrared (PIR) sensing provide high sensitivity, high noise immunity, and excellent false tripping immunity
- Suited for complex environments that are difficult to control with single-technology sensors
- Snap-locks to ceiling-mounted cover plate
- Non-Volatile Memory: settings saved in protected memory are not lost during power outages
- 500 to 2000 sq.ft. (46 to 186 m^2) coverage when mounted on an 8 - 12 ft. (2.4 to 3.7 m) ceiling; 180° and 360° field of view
- Affords choice of turning lights off or dimming to a preset level in the unoccupied state when integrated with a Lutron system.

Models Available

Cat. No.	Color	Coverage	Field of View
LOS-CDT-500-WH	White	500 sq.ft. (46 m^2)	180°
LOS-CDT-500R-WH	White	500 sq.ft. (46 m^2)	180°
LOS-CDT-1000-WH	White	1000 sq.ft. (93 m^2)	180°
LOS-CDT-1000R-WH	White	1000 sq.ft. (93 m^2)	180°
LOS-CDT-2000-WH	White	2000 sq.ft. (186 m^2)	360°
LOS-CDT-2000R-WH	White	2000 sq.ft. (186 m^2)	360°

Self-Adaptive Feature

The LOS-CDT Series ceiling-mount occupant sensors combine both (US) motion detection for maximum sensitivity and passive infrared (PIR) motion detection for false triggering immunity. The self-adapting internal microprocessor analyzes the composite sum of both signals to eliminate time-consuming adjustments and callbacks found in non-intelligent sensors.

Job Name:	Model Numbers:	
Job Number:		

Specifications

Timer Adjustment

- Automatic mode: Continually adapting sensor automatically adjusts settings to the space
- Manual mode: 8 to 30 minutes
- Test mode: 8 seconds

LED Lamp

- Red: infrared motion detected
- Green: ultrasonic motion detected

Housing

- Rugged, high-impact, injection-molded plastic
- Color-coded leads 6 in. (15 cm)

Power

- Operating voltage: 20 - 24 V⎓, PELV (Class 2: USA) low-voltage
- Operating current: 33 mA nominal
- Control output: 20 - 24 V⎓ active high logic control signal with short-circuit protection, open collector when unoccupied

Operating Environment

- Temperature: 32 to 104 °F (0 to 40 °C)
- Relative humidity: less than 95%, non-condensing
- For indoor use only

Adaptive Functions

- Installation: 60 minutes
- Learning: 4 weeks for response to error conditions, air current adaptation, and timer optimization
- Post-learning occupancy periods
  - —24-hour circadian occupancy periods learned
  - —Weekly occupancy periods learned
- Adjustments in post-learning period
  - —Generally occupied periods (threshold = high-sensitivity mode)
  - —Generally unoccupied periods (threshold = miser mode)

Contact Rating (R Models only)

- SPDT 500 mA rated at 24 V⎓ isolated relay

Photo Cell (R Models only)

- Prevents light from turning on when there is sufficient natural light
- Sensitivity: 0 - 1,000 LUX adjustable

Dimensions

Front View

Side View

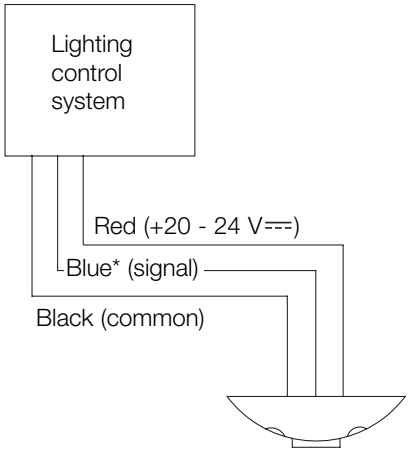
Measurements are in inches (mm)

Job Name:	Model Numbers:	
Job Number:		

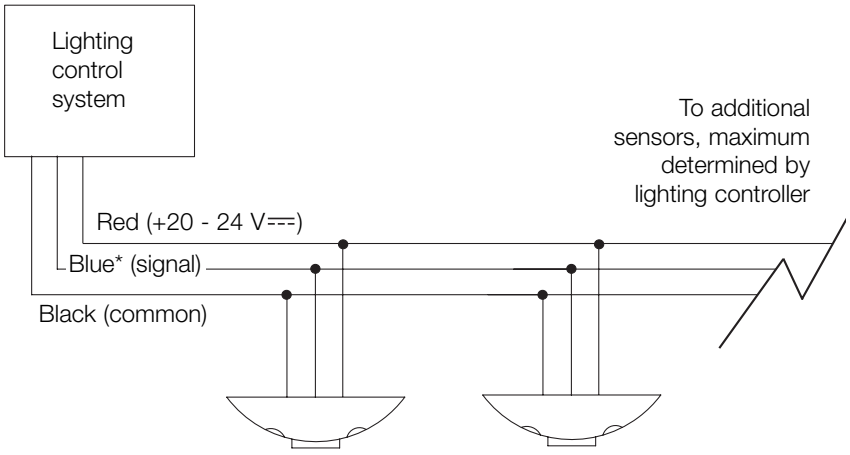
Wiring

Note: Power pack may be required when interfaced to lighting control system; see below.

Single Sensor to System



2 or More Sensors to System



*Note: Use gray wire for -R model.

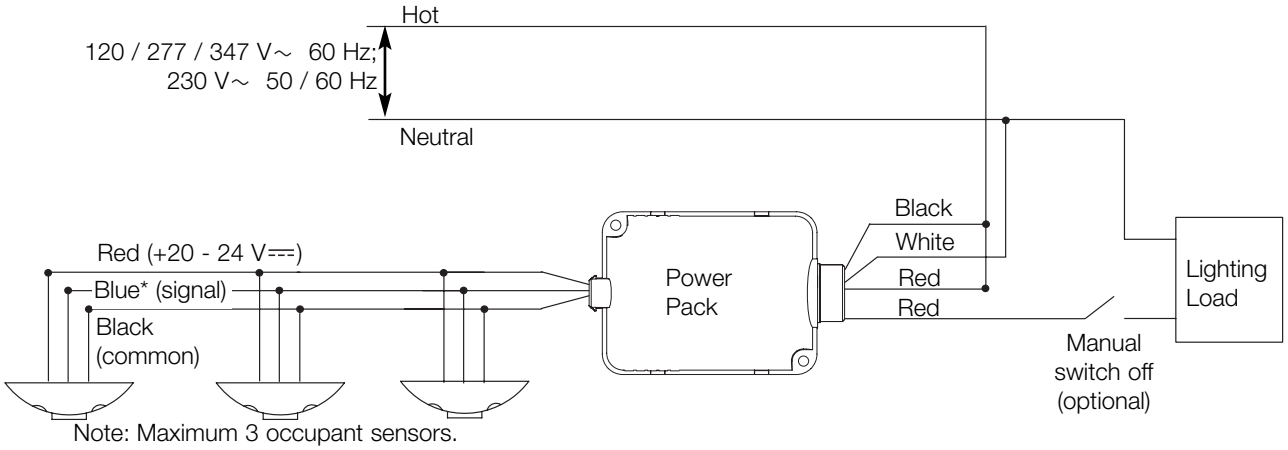
Power Supply Options

Lutron Lighting Control System	Power Pack Required?
Digital microWATT™	No
EcoSystem®	No
GRAFIK 5000 / 6000 / 7000™	No, when used with seeTouch® wallstations with occupant sensor connections.
GRAFIK Eye® 3000 / 4000	Yes
HomeWorks®	Yes
LCP128™	No, when used with *seeTouch* wallstations with occupant sensor connections.
microWATT®	No
RadioRA®	Yes
RadioTouch®	No
Softswitch128®	No, when used with *seeTouch* wallstations with occupant sensor connections.

Job Name:	Model Numbers:	
Job Number:		

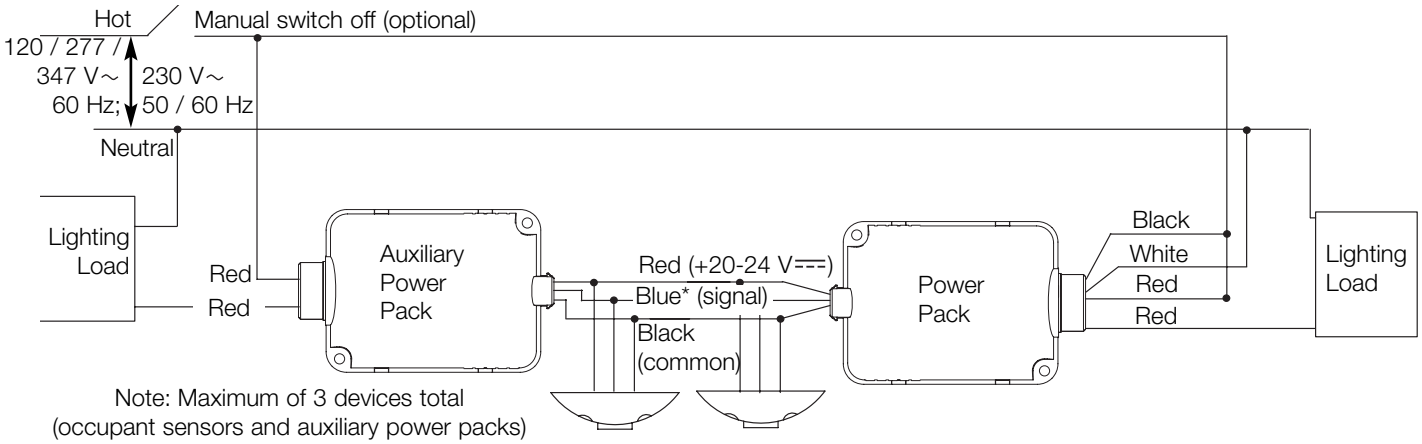
Wiring: Stand-Alone Control

1 to 3 Sensors with Power Pack



Note: Maximum 3 occupant sensors.

Switching Multiple Loads with Auxiliary Power Packs



Note: Maximum of 3 devices total (occupant sensors and auxiliary power packs) can be connected to a power pack.

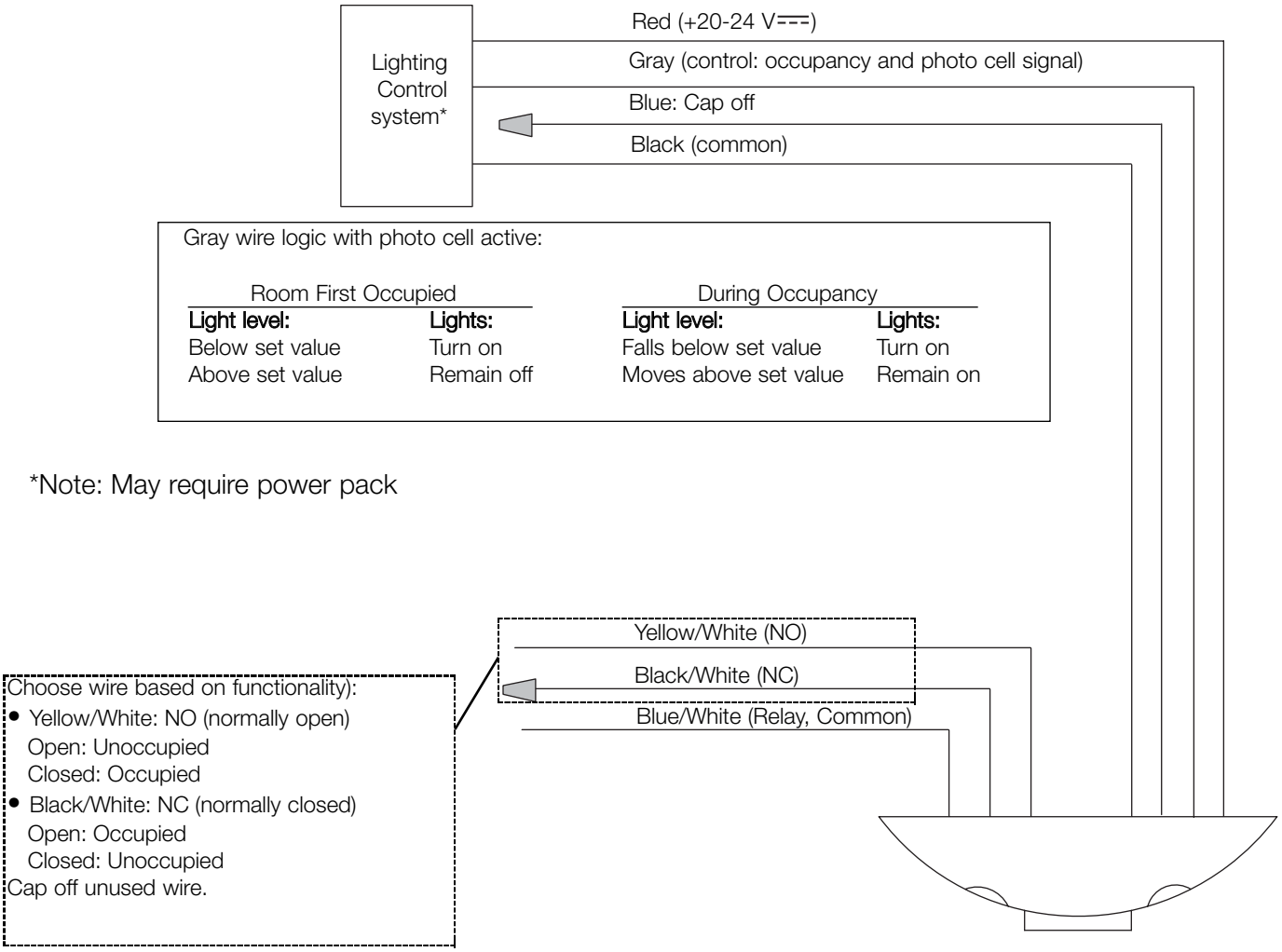
*Note: Use gray wire for -R model.

Job Name:	Model Numbers:	
Job Number:		

Wiring

Relay Model Option

LOS-CDT-xxxxR only



*Note: May require power pack

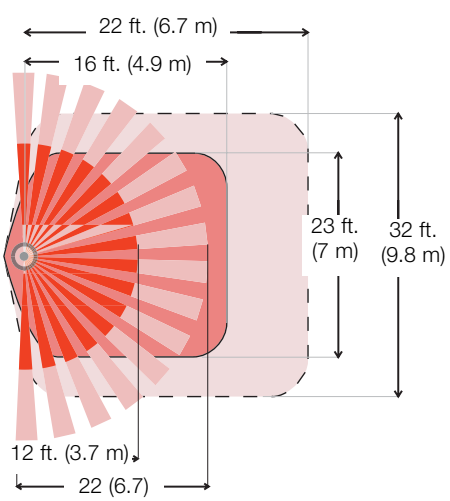
Job Name:	Model Numbers:	
Job Number:		

Installation

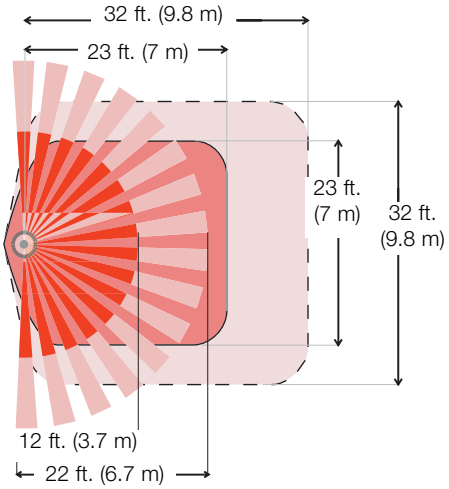
Sensor Placement

- The occupant sensor must have an unobstructed view of the room. Do not mount behind or near tall cabinets, shelves, indirect hanging fixtures, etc.
- Keep the occupant sensor away from air flow from ventilation outlets, windows, fans, etc.
- If installing a 180° occupant sensor (500 and 1000 models), place the sensor on the same wall as the doorway so that traffic in a hallway will not affect the sensor; otherwise, place in center of room.
- Closely follow the diagrams shown concerning major and minor motion coverage. The sensor can detect major motion (such as a person taking a half-step) at a greater distance than it can detect minor motion (such as writing or typing at a desk).
- Decrease total coverage area by 15% for “soft” rooms (for example, heavy draperies or heavy carpeting).

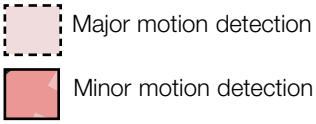
Range Diagrams

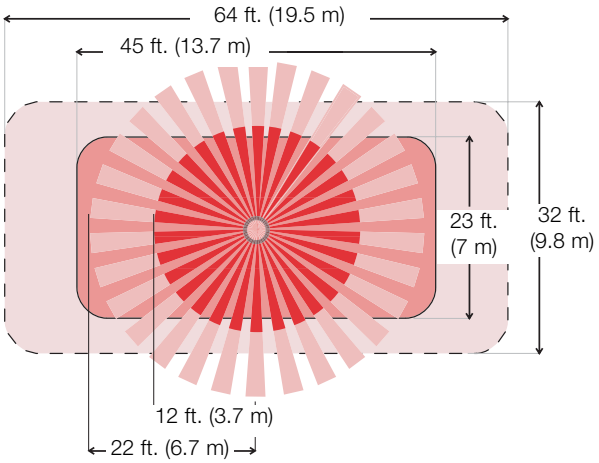


LOS-CDT-500



LOS-CDT-1000





LOS-CDT-2000

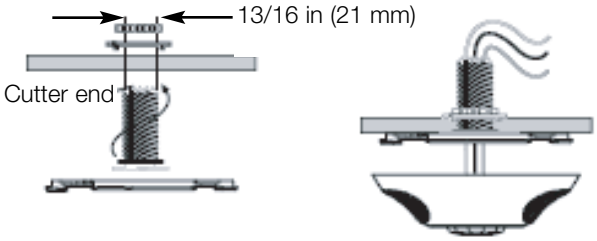
Job Name:	Model Numbers:	
Job Number:		

Installation

Mounting

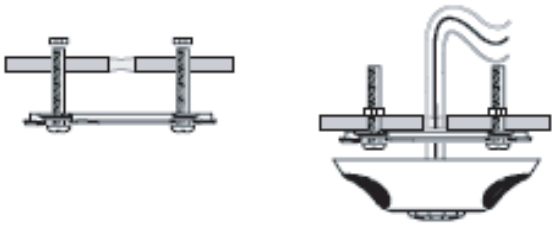
Normal Mounting

Twist and lock threaded mounting post onto cover plate. Drill through ceiling tile with assembly, using cutter end of the threaded mounting post. Secure with washer and nut.

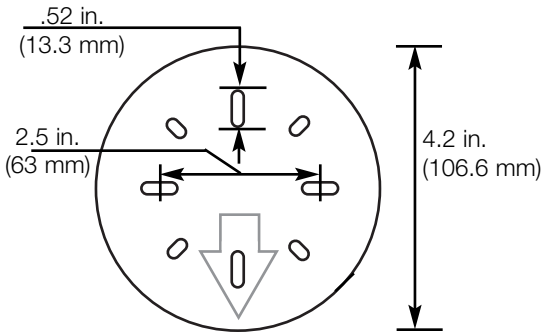


Mounting to Non-Standard Ceiling or Fixture

Mount twist-lock cover plate using mounting screws, nuts, and washers (included). Drill/punch wire routing hole through ceiling tile at center of cover plate.



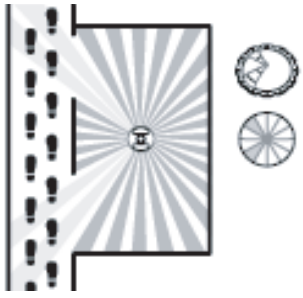
Mounting Plate Dimensions



Wire Lengths

# Sensors	1	2	3	1	2	1
# Aux. PP	0	0	0	1	1	2
22 AWG	750 ft.	375 ft.	250 ft.	375 ft.	250 ft.	250 ft.
0.5 mm^2	365 m	180 m	120 m	90 m	120 m	120 m
20 AWG	1200 ft.	600 ft.	400 ft.	600 ft.	400 ft.	400 ft.
0.75 mm^2	730 m	365 m	240 m	365 m	240 m	365 m
18 AWG	2400 ft.	1200 ft.	800 ft.	1200 ft.	800 ft.	800 ft.

Using the Infrared Mask



Center Ceiling Mount
(Mask blocks sensor seeing out doorway into hall)

Corner Ceiling Mount
(No mask needed)

Typical Mask Patterns

Conference Room Mask

180° Mask

Full Mask

Rectangular Areas

Over the Door

Specific Areas You Wish to Mask

Job Name:	Model Numbers:	
Job Number:		

Sensor Adjustments

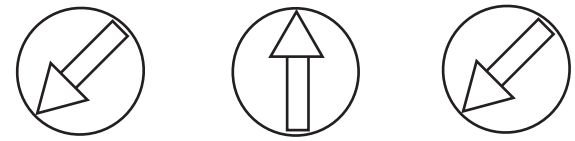
Override Settings

A		Off (Default)	On
Auto/Manual	1	Automatic (Normal)	Manual on/off (Override)
Threshold	2	Auto Threshold Adjustment	High Sensitivity (Low turn-on threshold)
LED Motion Indicator	3	Lights indicate motion	Disable LED Indicator
Reset Learned Settings	4	Retain Settings (Normal)	Erase all learned settings, restart Learning (Toggle On)

B		Off	On
Strong Airflow Compensation	1	Disable Compensation (Normal)	Enable Compensation
Over Doorway Installation	2	No (Normal)	Yes (Use increased turn-on threshold)
Timer Adjust	3	Adjust Timer Automatically	Use Manual Setting (No adjustment)
Auto Sensitivity	4	Adjust Sensitivity Automatically	Adjust Sensitivity Manually

Timer Test Mode

1. Remove the retainer cover.
2. Rotate the black timer adjustment knob to about midway (12 o'clock).
3. Return setting to minimum setting (full CCW).

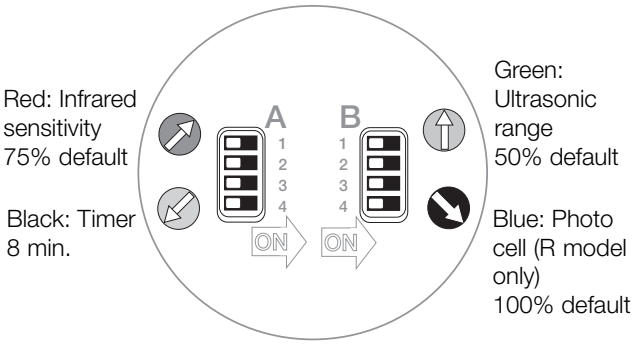


Factory Settings 12 o'clock Full CCW

Note: The timer will remain in the 8-second test mode for 1 hour, then automatically reset to 8 minutes.

4. To manually take the timer out of the 8-second test mode, turn the timer adjustment approximately 1/16" clockwise to make the setting slightly above minimum (just above the 8-minute setting).

Factory Settings



Job Name:	Model Numbers:	
Job Number:		

Installation

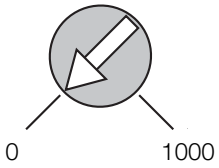
Adjusting the "Lights Not On" Level

LOS-CDT-xxxxR only

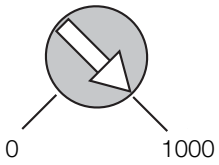
1. Place timer in Test Mode (see page 7).
2. Set photo cell to max.
   Turn the blue knob full clockwise (lights on no matter how bright the natural light is), then about 30 degrees counterclockwise.
3. Check for Lights-Out.
   Move from underneath the sensor, and remain still until the lights turn off. Move around normally to turn the light on.
4. Adjust to desired level.
   If lights remain off, adjust the blue knob another 30 degrees counterclockwise and repeat step 3 until the lights turn on.
   Note: Set blue knob to 100% to disable photo cell functionality and leave secondary dry contact closure output functionality intact.

Control Settings (Blue Knob)

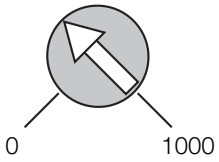
LOS-CDT-xxxxR only



Minimum (low):
Lights will never come on, even though room is occupied.



Maximum (high):
Photo cell has no effect on operation (factory setting).



Normal:
200 to 600 LUX is normal range.

Job Name:	Model Numbers:	
Job Number:		

LP Dimming Panels

LP Dimming Panels are ideal for projects with many small loads. Each panel provides power and dimming for up to 32 dimming legs.

Features

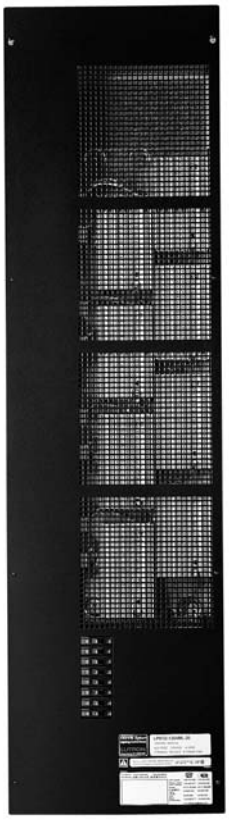
- Work directly with incandescent, magnetic low voltage, and neon/cold cathode lighting, as well as Lutron TuWire™ Fluorescent Dimming Ballasts.
- Work with electronic low voltage lighting via Power Interfaces.
- Work with 3-wire AC motors through motor modules.
- Panels are prewired - just bring in feed and load wiring.
- Surface or recess mount between 16" center to center studs.

Models available with:

- 100-127 V, 220-240 V (non CE), or 230 V (CE) input power.
- 1 to 8 Dimming Modules for 4 to 32 dimming legs.
- Different feed types and breakers.

LP Dimming Panels work with:

- GRX-4000 Control Units.
- GRAFIK 5000™, GRAFIK 6000®, and GRAFIK 7000® Systems.
- GP Dimming Panels and XP Switching Panels.
- DMX512 dimming systems via the 2LINK™ option.



Standard-Size
LP4/28–LP8/32

Mini
LP1/4–LP3/12

Job Name:	Model Numbers:	
Job Number:		

Specifications

Standards

- UL Listed (Reference: UL File 42071).
- Complies with CSA, NOM, or CE (where appropriate).

Power

- Input power: 100-127 V, 220-240 V (non CE), and 230 V (CE). All voltages 50/60 Hz, phase-to-neutral.
- Branch Circuit Breakers: UL-rated thermal magnetic.
  AIC ratings:
  100-127 V – 10,000
  220-240 V – 6,000
  230 V (CE) – 6,000
- Lighting strike protection: Meets ANSI/IEEE standard 62.41-1980. Can withstand voltage surges of up to 6000 V and current surges of up to 3000 A.
- 10-year power failure memory: Automatically restores lighting to scene selected prior to power interruption.

Short Circuit Current Ratings (other ratings available)

Panel Type	Voltage	Std. SCCR Rating
LP Main Lug Panels (all sizes)	120	25,000 A

Sources/Load Types

Operate these sources with a smooth continuous Square Law dimming curve or on a full-conduction non-dim basis:

- Incandescent (Tungsten)/Halogen
- Magnetic Low Voltage Transformer
- Lutron Tu-Wire™ Electronic Fluorescent Dimming Ballasts
- Neon/Cold Cathode

Operate these sources via Power Interfaces:

- Electronic Low Voltage Transformer via dedicated internal Dimming Modules or external Power Interfaces.
- Lutron Electronic Fluorescent Dimming Ballasts via external Power Interfaces.

Operate HID sources on a full conduction non-dim basis.

Dimming Modules

- Each Dimming Module can handle a fully loaded electrical circuit - up to four dimming legs per Module.
- Maximum Ratings:

Voltage	Capacity per Dimming Module	Capacity per Dimming Leg
100-127 V	16 A	16 A
220-240 V (non-CE)	16 A	16 A
230 V (CE)	13 A	10 A

- RTISS™ filter circuit technology compensates for incoming line voltage variations: No visible flicker with +/-2% change in RMS voltage/cycle and +/-2% Hz change in frequency/second.

Wiring

- Internal: Prewired by Lutron.
- System communications: Low-voltage Class 2 (PELV) wiring connects Dimming Panels to other components.
- Line (mains) voltage: Feed and load wiring only. No other wiring or assembly required.

Setup

Circuit Selector electronically assigns dimming legs to zones and sources. Permits reassignment of zones and sources without rewiring.

Physical Design

- Enclosure: NEMA-Type 1, IP-20 protection; #16 U.S. Gauge Steel. Indoors only.
- Weight: 27 lb (13 kg) for Mini LP, 63 lb (29 kg) for Standard-Size LP.

Mounting

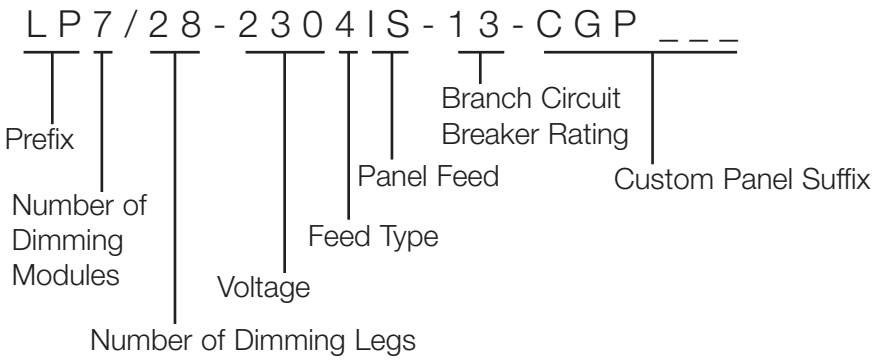
- Surface mount or recess mount between 16 in. (40 cm) studs.
- Allow space for ventilating.

Environment

32-104 °F (0-40 °C). Relative humidity less than 90% non-condensing.

Job Name:	Model Numbers:	
Job Number:		

How to Build a LP Model Number



Prefix:

LP for LP Dimming Panel

Number of Dimming Modules:

Indicates number of dimming modules in the panel.
Also indicates number of full load circuits.

Number of Dimming Legs:

Indicates number of dimming legs in the panel.
Each module has four dimming legs.

Voltage:

120 for 100-127 V
230 for 230 V (CE)
240 for 220-240 V (non-CE)

Feed Type:

2 for 1 phase 2 wire
3 for 1 phase 3 wire (split phase)
4 for 3 phase 4 wire

Panel Feed:

ML for Main Lugs only
Mxx for Main Breaker with **xx** = breaker size in Amps (custom panel option)
IS for Isolation Switch (CE/non-CE only)

Branch Circuit Breaker Rating:

20 for 20 A branch circuit breakers (120 V only)
15 for 15 A branch circuit breakers (120 V only)
13 for 13 A branch circuit breakers (230 V CE only)
16 for 16 A branch circuit breakers (240 V non-CE only)

Custom Panel Suffix:

Indicates panel with special options

Job Name:	Model Numbers:	
Job Number:		

Mini LP Models

Only standard Panels listed. Consult Lutron for further options.

100 - 127V Power

Number Of Dimming Modules	Number Of Dimming Legs	Feed Type	Maximum Feed	Panel Feed
LP1	4	1Ø, 2W	20 A	15 A or 20 A[1] Branch Circuit Breakers
LP2	8	1Ø, 2W	40 A	
		1Ø, 3W	20 A	
LP3	12	1Ø, 2W	40 A	
		1Ø, 3W	40 A	
		3Ø, 4W	20 A	

220 - 240V (non CE) Power

Number Of Dimming Modules	Number Of Dimming Legs	Feed Type	Maximum Feed	Panel Feed
LP1	4	1Ø, 2W	16 A	16 A Branch Circuit Breakers
LP2	8	1Ø, 2W	32 A	
LP3	12	1Ø, 2W	48 A	
		3Ø, 4W	16 A	

Wire Sizes

Feed Wiring

Power (Hot/Live) (connect directly to Branch Circuit Breakers):

100-127 V #14 AWG (2.0 mm^2) to #10 AWG (4.0 mm^2)

220-240 V #18 AWG (1.0 mm^2) to #4 AWG (25 mm^2)

Neutral (connects to Neutral Lug):

100-127 V #14 AWG (2.0 mm^2) to #2/0AWG (70 mm^2)

220-240 V #14 AWG (2.0 mm^2) to #8 AWG (6.0 mm^2)

Load Wiring

All Models #14 AWG (2.0 mm^2) to #10 AWG (4.0 mm^2)

[1] 20/16A, 15/12A continuous load rating.

Job Name:	Model Numbers:	
Job Number:		

Standard-Size LP Models

Only standard Panels listed. Consult Lutron for further options.

100 - 127 V Power

Number Of Dimming Modules	Number Of Dimming Legs	Feed Type	Maximum Feed	Panel Feed	Branch Circuit Breakers
LP4	16	3Ø,4W	175 A	Main Lugs Only	15 A or 20 A[1]
LP5	20	3Ø,4W	175 A		
LP6	24	3Ø,4W	175 A		
LP7	28	3Ø,4W	175 A		
LP8	32	3Ø,4W	175 A		

220 - 240 V (non CE) Power

Number Of Dimming Modules	Number Of Dimming Legs	Feed Type	Maximum Feed	Panel Feed	Branch Circuit Breakers
LP4	16	3Ø,4W	125 A	Isolation Switch Only	16 A
LP5	20	3Ø,4W	125 A		
LP6	24	3Ø,4W	125 A		
LP7	28	3Ø,4W	125 A		
LP8	32	3Ø,4W	125 A		

Wire Sizes

Feed Wiring to Main Lugs (100-127 V Only):

Power (Hot/Live) (3) #14 AWG (2.0 mm^2) to #2/0 AWG (70 mm^2)
Neutral (1) #14 AWG (2.0 mm^2) to #2/0 AWG (70 mm^2)

Feed Wiring to Isolation Switch (CE/non-CE only):

Power (Hot/Live) (3) 2.5 mm^2 to 35 mm^2
Neutral (1) 2.5 mm^2 to 35 mm^2

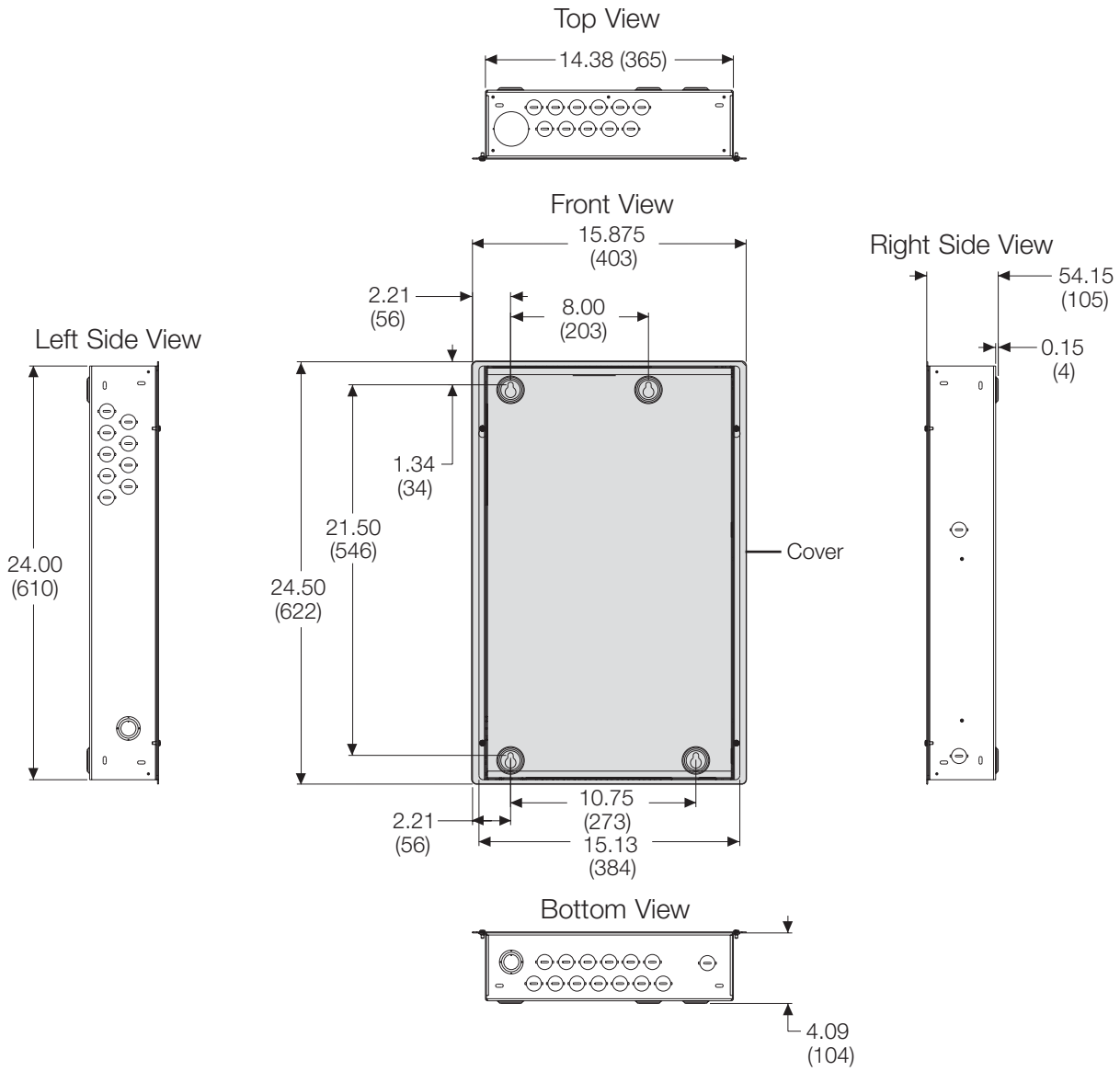
Load Wiring

All Models #14 AWG (2.0 mm^2) to #10 AWG (4.0 mm^2)

[1] 20/16A, 15/12A continuous load rating.

Job Name:	Model Numbers:	
Job Number:		

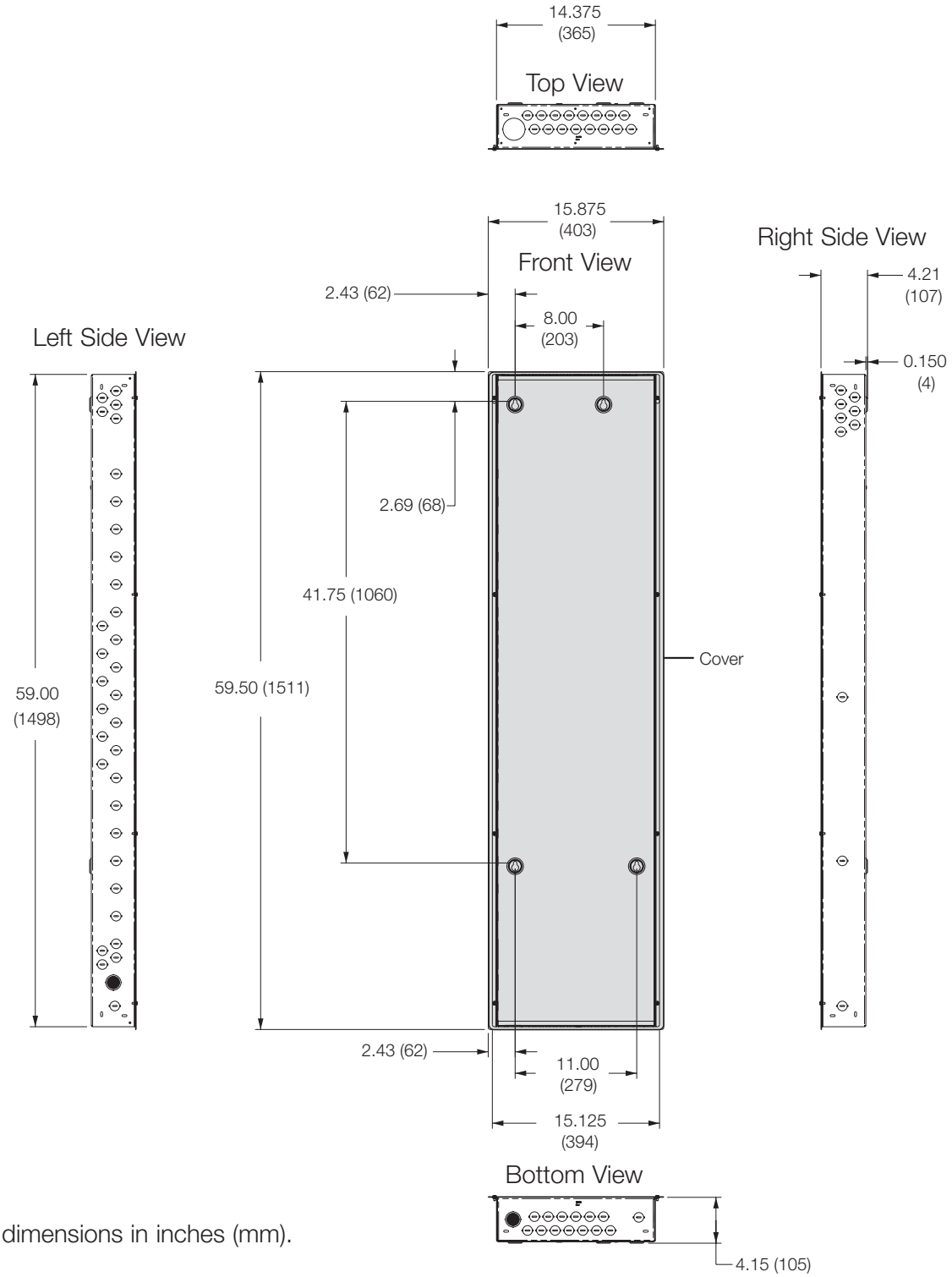
Mini LP Dimensions



All dimensions in inches (mm).

Job Name:	Model Numbers:	
Job Number:		

Standard-Size LP Dimensions



All dimensions in inches (mm).

Job Name:	Model Numbers:	
Job Number:		

Mini LP Mounting

- Surface or recess mount indoors.
- Consult Dimensions page for dimensions and conduit knockout locations.
- Panel generates heat. Mount only where ambient temperature is 32 - 104 °F (0 - 40 °C).
- This equipment is air-cooled.
  Do not block vents or warranty will be void.
- Mount Panels where audible noise is acceptable (internal relays click).
- Mount Panels so line (mains) voltage wiring is at least 6 feet (1.8 m) from sound or electronic equipment and wiring.
- Mount Panel within 7° of true vertical.

Panel	Maximum BTUs/hour	Weight Without Packaging
LP1	90	33 lb (15 kg)
LP2	170	35 lb (16 kg)
LP3	250	37 lb (17 kg)

Maximum Feed and Wire Sizes
Consult Wiring Overview page.

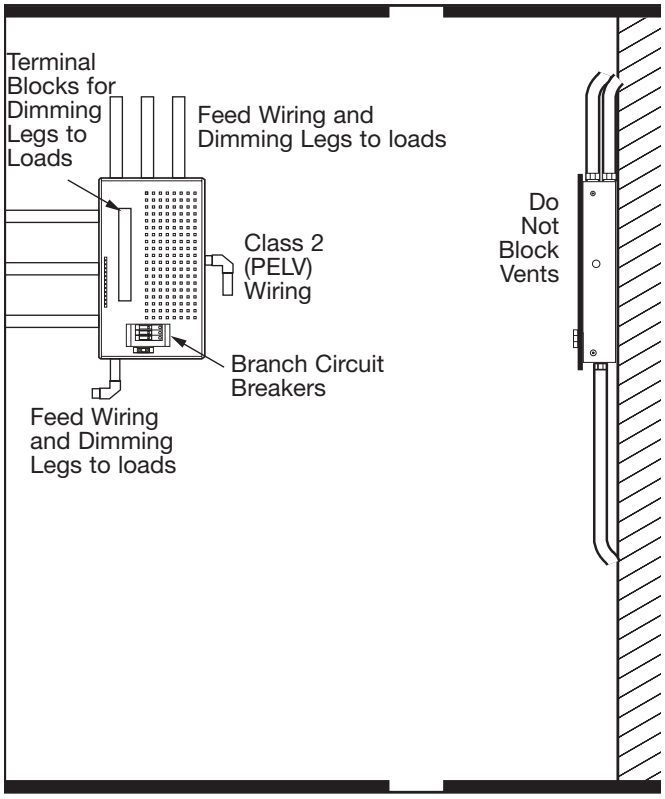
Surface Mounting

- Surface mounting keyholes accept 1/4 in. (6 mm) mounting bolts. This size is recommended.

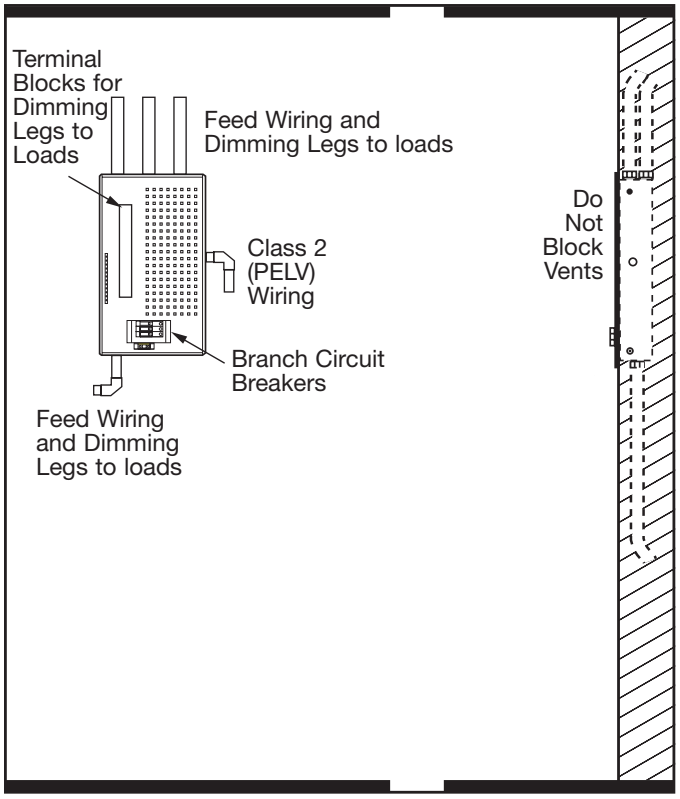
Recess Mounting

- Mount Panel flush to 1/8 in. (3mm) below finished wall surface.
- Allow room for top cover. Leave 1 1/2 in. (38mm) clearance to each side of Panel.

Front View **Side View**

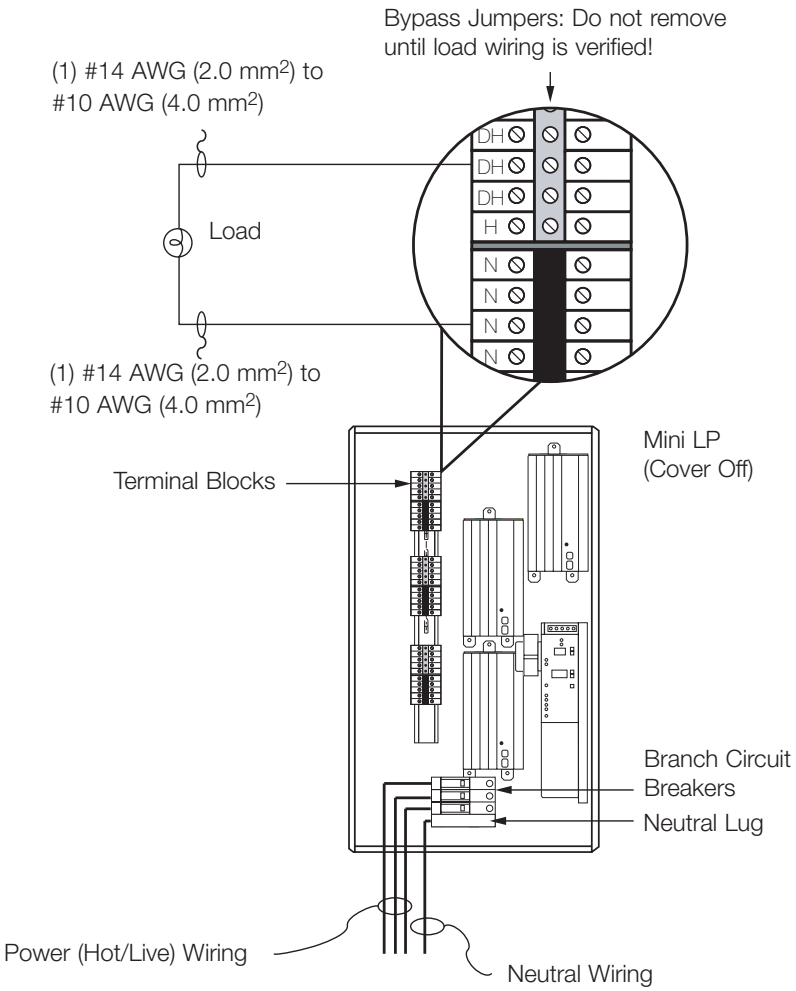


Front View **Side View**



Job Name:	Model Numbers:	
Job Number:		

Mini LP Wiring



Wiring Tips

Wire the Mini LP similar to wiring a lighting Distribution Panel:

- Run feed and load wiring. No other wiring or assembly required.
- Run separate neutrals for each module - no common neutrals across phases.

The Mini LP can provide temporary lighting:

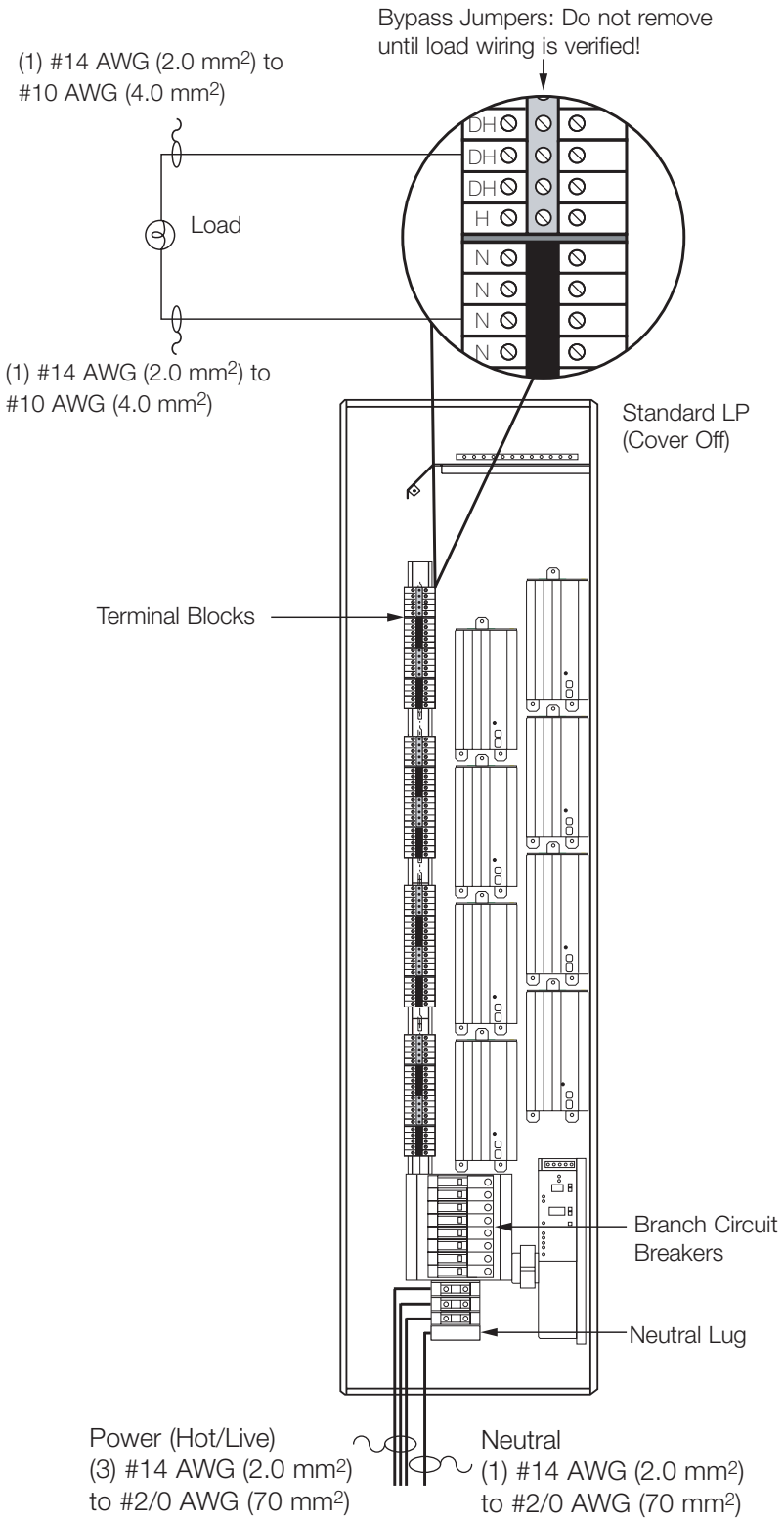
- Wire all loads.
- Do not remove the bypass jumpers that protect the Dimming Modules.
- Use Branch Circuit Breakers to switch lights on and off.

Power (Hot/Live)	
100-127 V	#14 AWG (2.0 mm2) to #10 AWG (4.0 mm2)
220-240 V 230 V (CE)	#18 AWG (1.0 mm2) to #4 AWG (25 mm2)

Neutral	
100-127 V	#14 AWG (2.0 mm2) to #2/0 AWG (70 mm2)
220-240 V 230 V (CE)	#14 AWG (2.0 mm2) to #8 AWG (6.0 mm2)

Job Name:	Model Numbers:	
Job Number:		

Standard-Size LP Wiring



Wiring Tips

Wire the Mini LP similar to wiring a lighting Distribution Panel:

- Run feed and load wiring. No other wiring or assembly required.
- Run separate neutrals for each module - no common neutrals across phases.

The LP can provide temporary lighting:

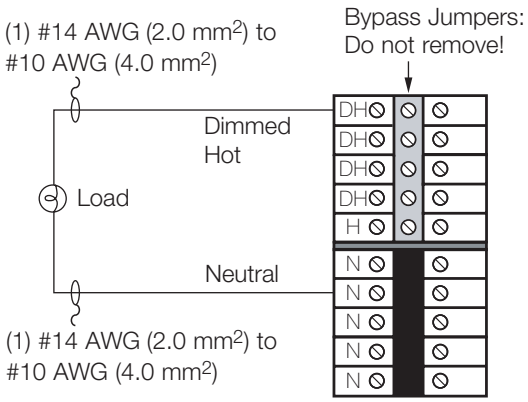
- Wire all loads.
- Do not remove the bypass jumpers that protect the Dimming Modules.
- Use Branch Circuit Breakers to switch lights on and off.

Job Name:	Model Numbers:	
Job Number:		

Typical Dimming Legs for 100-127 V

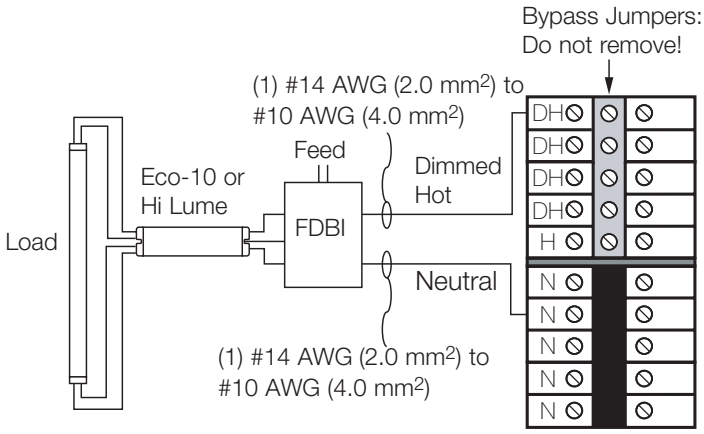
All Load Types except

- Lutron Hi-lume® or Eco-10™ (ECO-Series) Fluorescent Dimming Ballasts
- Electronic Low Voltage



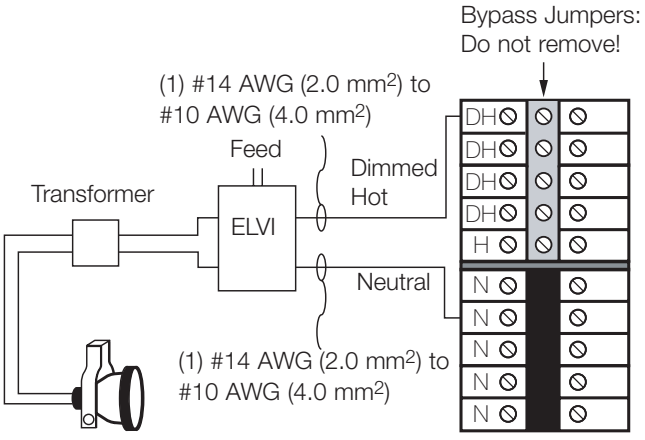
Lutron Hi-lume or Eco-10 (ECO-Series) Fluorescent Dimming Ballasts

- Use Lutron FDBI Fluorescent Dimming Ballast Interface.



Electronic Low Voltage

- Use Lutron ELVI Electronic Low Voltage Interface.
- Consult ELVI Specification Submittal for more details.



Job Name:	Model Numbers:	
Job Number:		

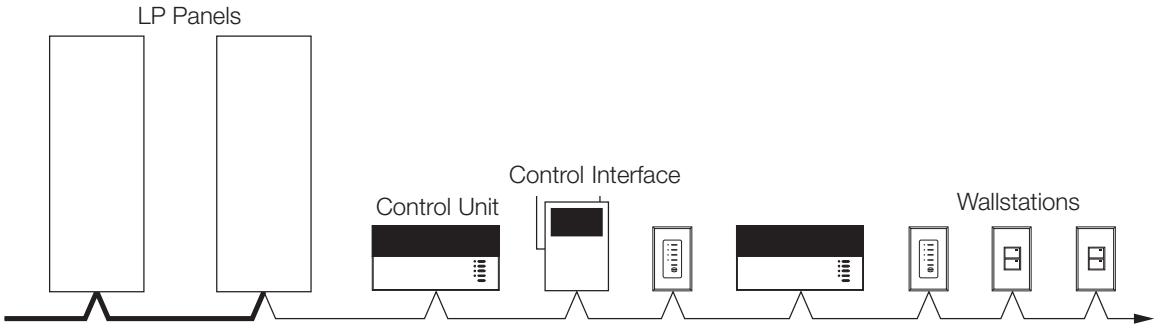
Low-Voltage Class 2 (PELV) Wiring (All Models)

System communications use low-voltage Class 2 wiring.
Wiring must be daisy-chained.
Wiring must run separately from line (mains) voltage.

GRAFIK Eye® 4000 System

Class 2 (PELV) wiring link requires:
Two #12 AWG (2.5 mm²) conductors for control power.
One twisted, shielded pair of #18 AWG (1.0 mm²) for data link.
One #18 AWG (1.0 mm²) conductor for Emergency (Essential) sense line, from panel to panel.

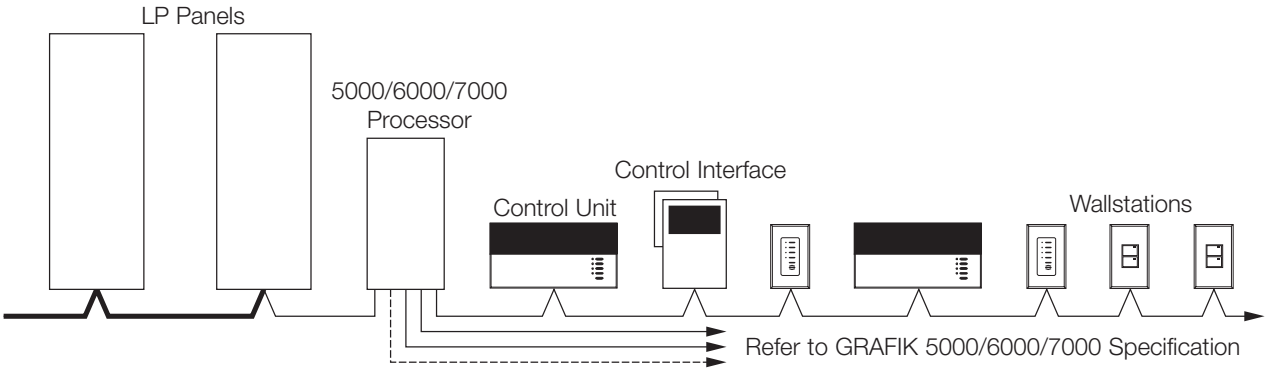
Total length of Control Link may be no more than 2,000 ft. (610 m).
Approved low-voltage cable is available from Lutron,[1] Belden, and Liberty. These are approved with #22 AWG data link wires.



GRAFIK 5000™/6000®/7000® System

Class 2 (PELV) wiring link requires:
Two #12 AWG (2.5 mm²) conductors for control power.
One twisted, shielded pair of #18 AWG (1.0 mm²) for data link.
One #18 AWG (1.0 mm²) conductor for emergency (essential) sense line, from panel to panel.

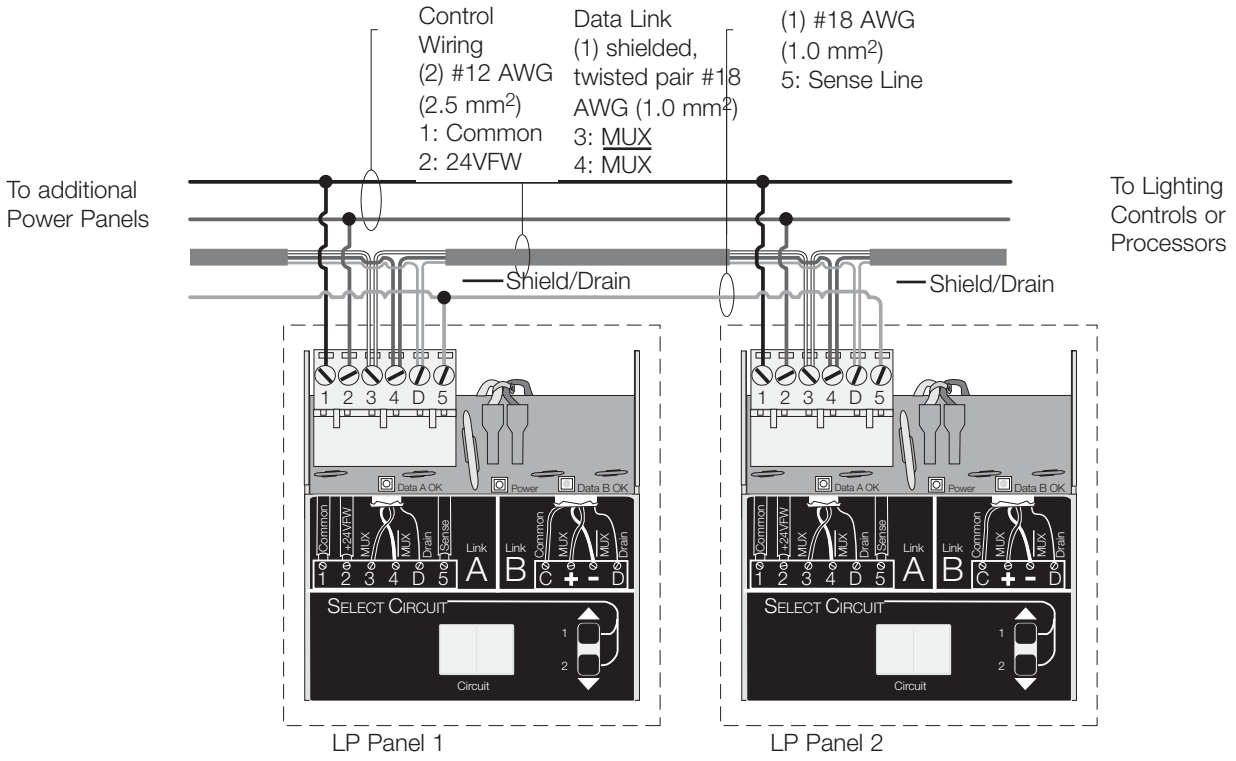
Total length of Control Link may be no more than 2,000 ft. (600 m).
If MUX-RPTR interface and GRX-CBL-46L cable[1] is used, length may be up to 4,000 ft. (1200 m).



[1] GRX-CBL-46L Class 2 (PELV) wiring cable is available from Lutron and contains:
Two #12 AWG (2.5 mm²) conductors for control power.
One twisted, shielded pair of #22 AWG (0.625 mm²) for data link.
One #18 AWG (1.0 mm²) conductor for emergency (essential) sense line.

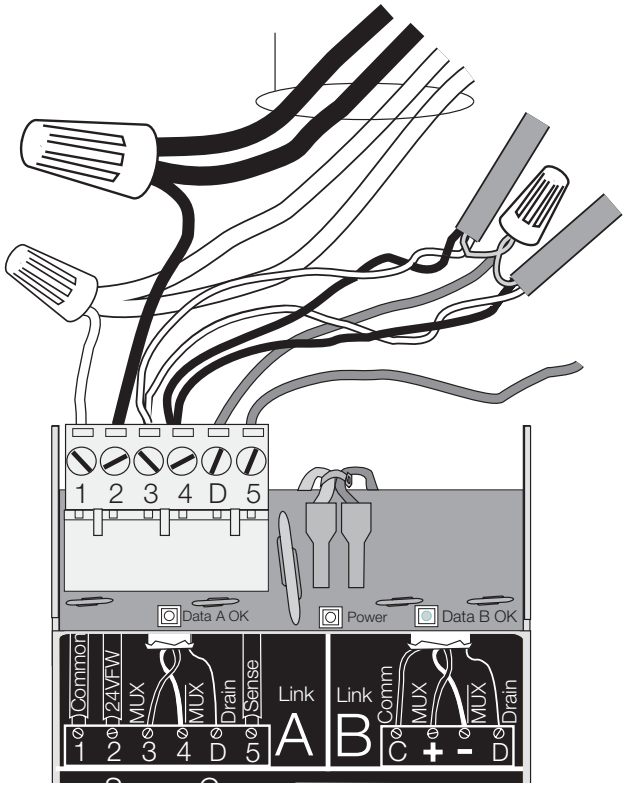
Job Name:	Model Numbers:	
Job Number:		

Class 2 (PELV) Panel-to-Panel Wiring (All Models)



Notes:

- Emergency Power: The additional #18 AWG (1.0 mm²) wire is a “sense” line from terminal 5 of another Panel. This sense line allows an Emergency (Essential) Lighting Panel to “sense” when Normal (Non-Essential) power is lost. If more than one Emergency Lighting Panel needs to sense from a specific Normal Panel, a dedicated wire between each pair of Normal (Non-Essential) and Emergency (Essential) panels may be required.
- Shield/Drain: Connect shielding as shown. Do not connect to Ground (Earth) or circuit board of Circuit Selector. Connect the bare drain wires and cut off the outside shield.



Class 2 (PELV) Terminal Connections

Each low-voltage Class 2 (PELV) terminal can accept only two #18 AWG (1.0 mm²) wires. Two #12 AWG (2.5 mm²) conductors won't fit. Connect as shown using appropriate wire connectors.

Job Name:	Model Numbers:	
Job Number:		

Options

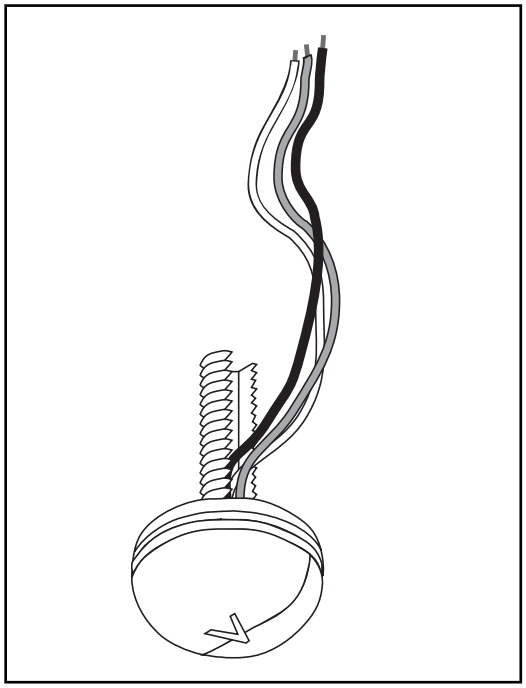
Consult Lutron for ordering information and model numbers. Dimensions and wiring may change based on options chosen.

Option	Description	Application
Double Lug Sets	Allows multiple Panels to be fed from the same feed.	A single feed and multiple LP Dimming Panels are required.
Branch Circuit Protection	Branch Circuit Breakers with higher AIC ratings than those on standard Panels. Panels can also have Branch Circuit Breakers with special ratings such as: • GFI (Ground Fault Interrupt) • ELB (Earth Leakage Breaker) • RCD (Residual Circuit Device).	
Lutron Ten Volt Module (TVM)	Allows Panels to operate fluorescent ballasts that meet IEC 929 standards for 0-10V control including: • Lutron's TVE ballasts • 0-10 V neon • PWM fluorescent • Tridonic DSI (Digital Serial Interface). The TVM can sink or source 50 mA (typically 25-50 ballasts) on each circuit.	Jobs with fluorescent ballasts that require 0-10 V, PWM, or DSI control.
2Link™	• Allows a DMX512 theatrical console to operate Dimming Panels' load circuits. • Allows a GRAFIK Eye® 4000 Series to handle 128 zone (two links of 64 zones). The two links are independent and do not communicate. Contact Lutron for further details.	• Control of architectural lighting from a DMX512 theatrical console is required. • A mix of architectural and theatrical lighting exists on the job.

Tridonic is a registered trademark of Zumtobel AG.

Job Name:	Model Numbers:	
Job Number:		

Fixture Mountable Daylight Sensor



This daylight sensor is designed specifically to work with Lutron's Lighting Control Systems to implement daylight harvesting. It allows the Lighting Control System to automatically dim the lights when the available daylight is high, and brighten the lights when the available daylight is low, in order to maintain a specific light level in the space.

Features

- Meets IEC 801-2. Tested to withstand 15kV electrostatic discharge without damage or memory loss.
- Photopic response matches human eye.
- Constructed of Flame retardant material with UL94 HB rating.
- Mounts easily on any ceiling tile or fixture with 3/8 in. (10mm) diameter hole.
- Threaded mounting stud (may be shortened for applications with limited fixture height).
- Calibrated for daylight sensitivity through the Lighting Control System to which it is attached.
- Designed to replace the MW-PS in any application.

Job Name:	Model Numbers:	
Job Number:		

Specifications

Standards

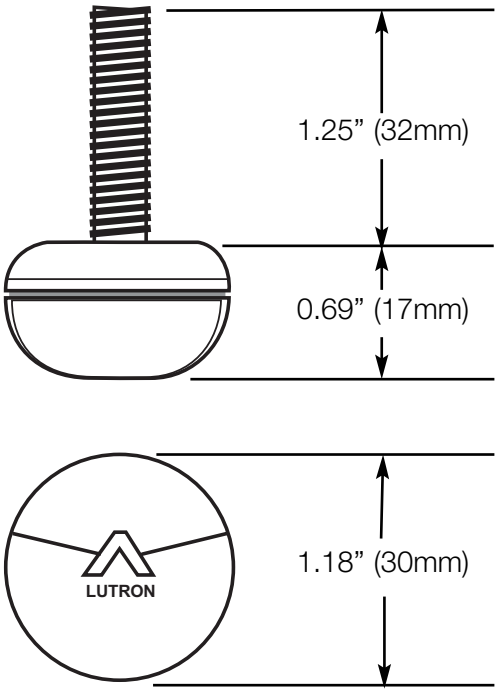
- Designed for Class 2 operation only. Voltages do not exceed 35VDC. Complies with requirements of NFPA 70, of the National Electric Code (NEC)
- Follow all applicable national and/or local wiring regulations when installing this sensor
- Designed to give a linear response to changes in viewed light level
- For use with Lutron products only

Power

- Operating Voltage: Low-voltage Class 2, 15VDC
- Analog Signal: 0 - 500uA

Environment

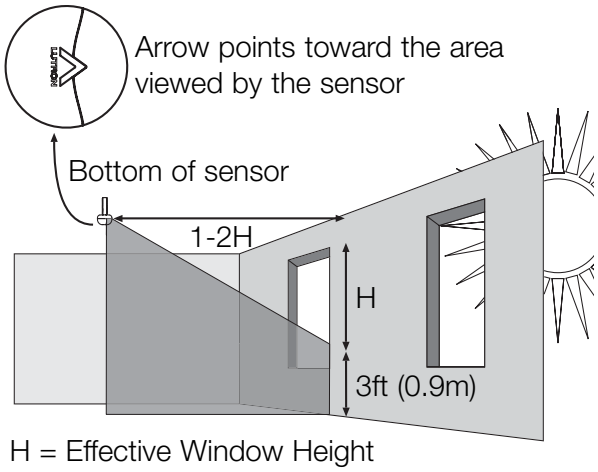
- Temperature: 32-113°F (0-45°C)
- Relative humidity: less than 90% non-condensing



Dimensions

Sensor lead length = 4” (101mm) minimum beyond threaded stud.
Total wire length from sensor to device must not exceed 200 ft (61m).
Threaded Stud Diameter = 3/8” (9.5mm) maximum.
Use 3/8-16 wing nut (provided) for mounting.

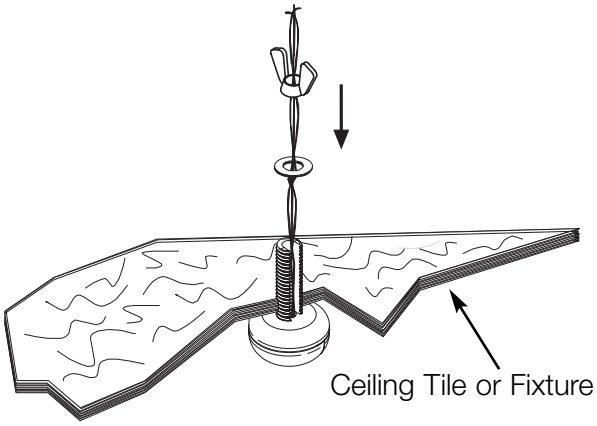
Job Name:	Model Numbers:	
Job Number:		



Mounting

Determine the proper location of the Daylight Sensor using the adjacent diagrams.

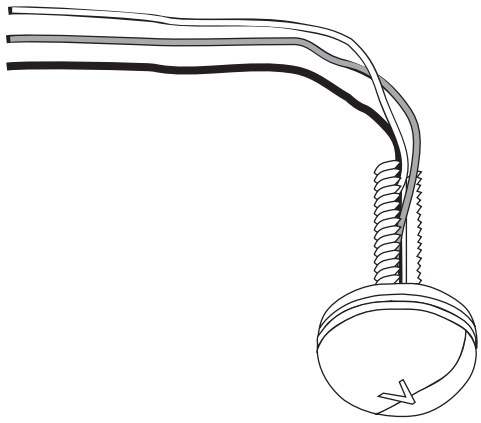
- The arrow on the Daylight Sensor defines the viewing direction
- Place the daylight sensor so its viewing area is centered upon the nearest window at a distance of between 1-2 H from the window
- The effective window height, H, starts 3 feet up from the floor or at the windowsill, whichever is higher, and ends at the top of the window.
- Ensure that the view of the Daylight Sensor is not obstructed
- Do not position the Daylight Sensor in the well of a skylight or above indirect lighting fixtures



Mount the Daylight Sensor

- Drill a 3/8 in. (10mm) diameter hole in the ceiling tile or indirect fixture mounting surface
- Thread the wires up through the hole
- Install the Daylight Sensor into the hole
- Secure the Daylight Sensor with the mounting hardware provided (hand tighten only).

  Note - If the stem of the Daylight Sensor must be shortened due to its location (for instance, in a pendant fixture) this should be done prior to wiring.



Wiring

- Wire color designations:
  Yellow = Daylight
  Black = Common
  Red = 15VDC

To a Lighting Control System

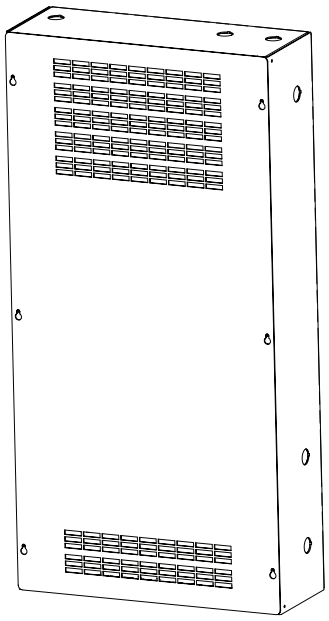
- Make sure that the supply breaker to the control system is OFF
- Connect the three conductors to the appropriate terminals of the lighting control system

Job Name:	Model Numbers:	
Job Number:		

Light Management Hub

Description

The *Quantum* light management hub provides a centralized connection point for Lutron EcoSystem® digital ballast modules, Lutron power panels, GRAFIK Eye® QS, and Sivoia® QS shades.



Features

- Designed to control, manage, and monitor *EcoSystem* lighting, Lutron power panels, *GRAFIK Eye* QS, and *Sivoia* QS shade systems in a building or whole campus.
- Supports both astronomic and time-of-day events to automatically control the lights and shades in the system.
- Simple reconfiguration of a space without rewiring.
- Individually control, monitor, and adjust any light or shade in a space.
- *GRAFIK Eye* QS control links are topology-free.
- Accepts one normally closed (NC) emergency input per *Quantum* bus supply.
- *EcoSystem* bus may be wired NEC® Class 1 or PELV (Class 2: USA).

Panel Capabilities

- Supports up to 8 *EcoSystem* loops, (4 *Quantum* bus supplies)
- Each loop can have a combination of 64 ballasts and ballast modules, plus a maximum of 16 daylight sensors and 32 occupant sensors.
- Each *Quantum* bus supply has one normally closed emergency input.
- Supports up to 2 *Quantum* processors with 2 links each that can be individually configured as:
  - *EcoSystem* bus supply
  - Lutron power panels
  - *GRAFIK Eye* QS
  - *Sivoia* QS shades

Job Name:	Model Numbers:	
Job Number:		

Specifications

Power

- Input voltage: 120 V~, normal/emergency feeder.
  50 / 60 Hz 15 A
- Output: *EcoSystem* - 18 V⎓ 250 mA per loop
  Processor - 24 V⎓ 1 A per link

Physical Design

- Enclosure: NEMA Type 1, IP-20 protection
  16 U.S. gauge steel
- Weight: 45 pounds (20.4 kg)

Mounting

- Surface mount only

Environment

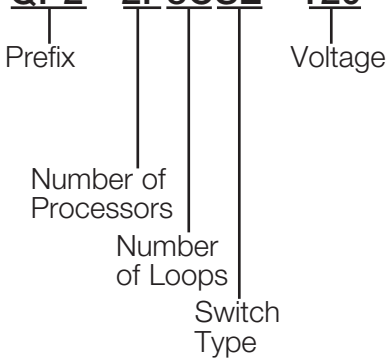
- For indoor use only
- 32 - 104 ºF (0 - 40 ºC)
- Relative humidity less than 90% non-condensing

Job Name:	Model Numbers:	
Job Number:		

How to Build a Model Number

Example

QP2 - 2P8CSE - 120



Prefix
QP2 = *Quantum* Processor

Number of Processors
0P = 0 *Quantum* processors
1P = 1 *Quantum* processor
2P = 2 *Quantum* processors

Number of Loops
0C = 0 EcoSystem® loops
2C = 2 *EcoSystem* loops
4C = 4 *EcoSystem* loops
6C = 6 *EcoSystem* loops
8C = 8 *EcoSystem* loops

Switch Type
SE = Ethernet 5-port

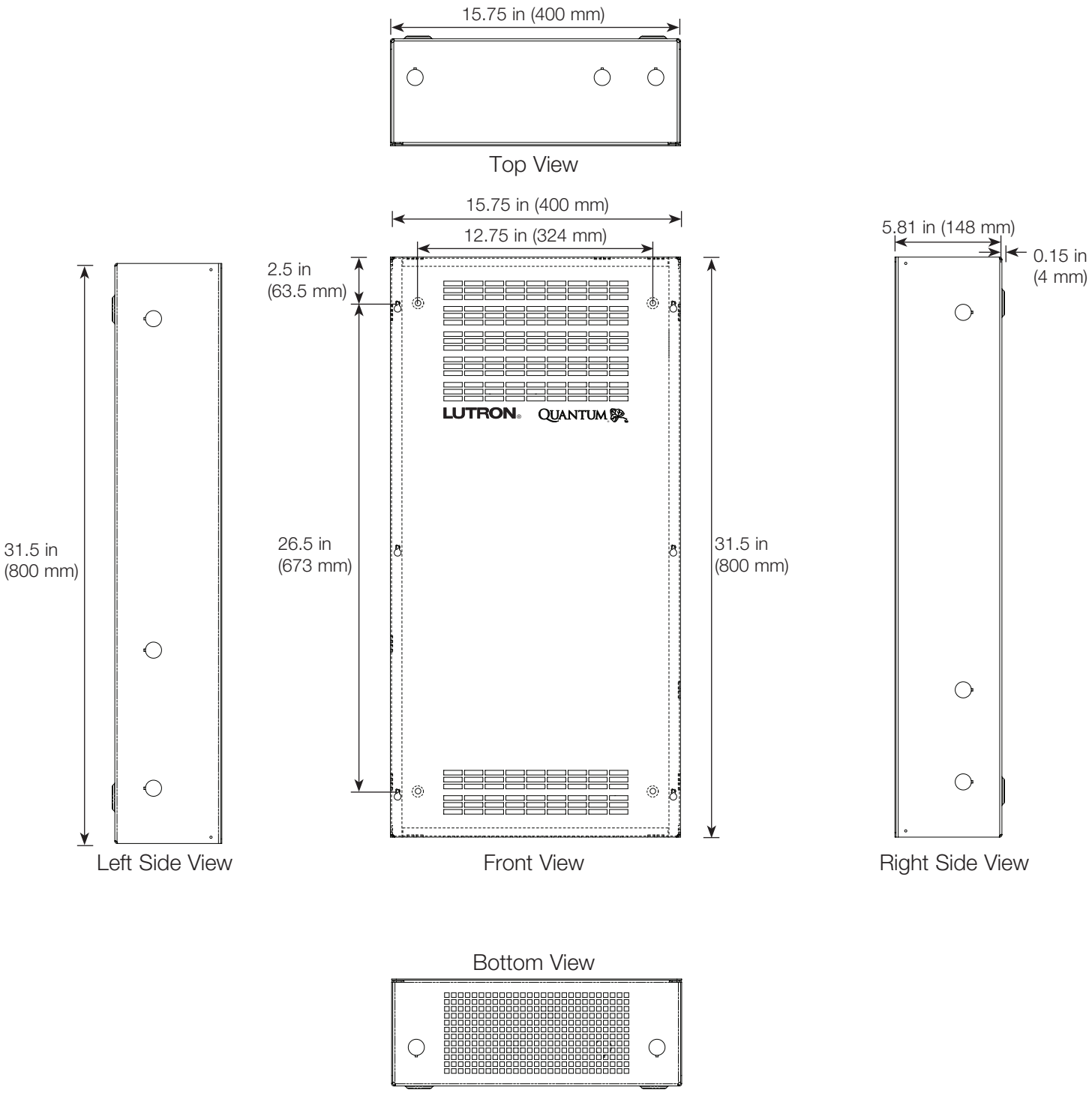
Voltage
120 for 120 V~

Available Model Numbers

Contact Lutron for options not listed below.

QP2-0P0CSE-120 (for rough-in use)
QP2-1P0CSE-120
QP2-1P2CSE-120
QP2-1P4CSE-120
QP2-1P6CSE-120
QP2-1P8CSE-120
QP2-2P0CSE-120
QP2-2P2CSE-120
QP2-2P4CSE-120
QP2-2P6CSE-120
QP2-2P8CSE-120

Dimensions



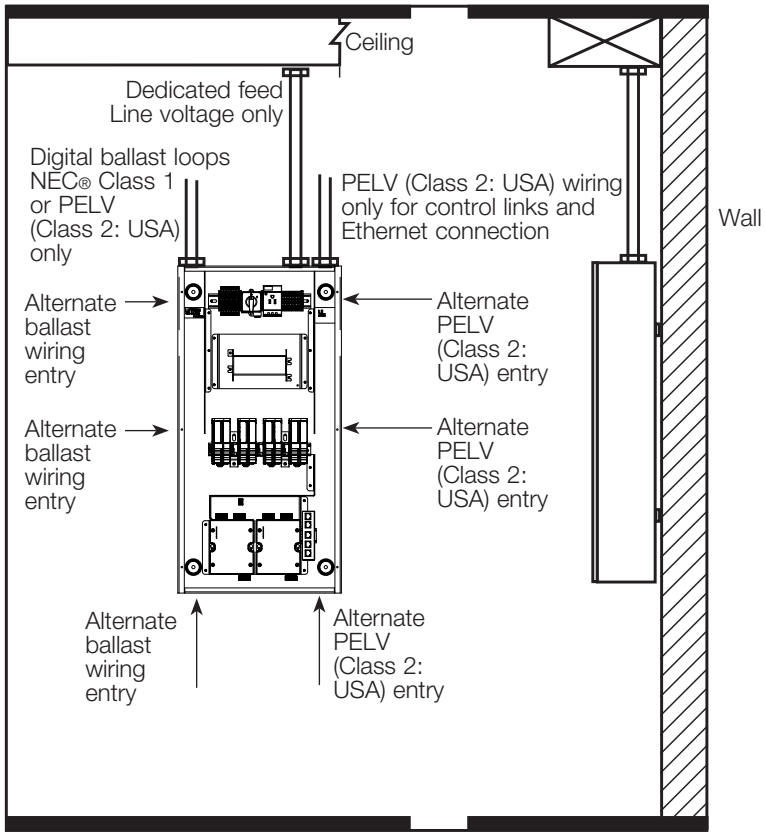
Job Name:	Model Numbers:	
Job Number:		

Mounting and Conduit Entry

- Surface mount indoors.
- Panel generates heat. Mount only where temperature will be 0 - 40 ˚C (32 - 104 ˚F).
- This equipment is air-cooled. Do not block vents or warranty will be void. A minimum of 12 in (305 mm) of unobstructed space is required in front of and below the panel for ventilation.
- Water damages equipment. Mount in a location where the panel and processors will not get wet. Mount within 7˚ of true vertical.
- Digital ballast wiring can be Class 1 or Class 2; always keep Class 1 and Class 2 wiring separate, and follow all applicable local and national electric codes.
- Reinforce wall structure for weight and local codes.

Panel	Maximum BTUs/Hour	Weight (without packaging)
All models	220	40 lb (18 kg)

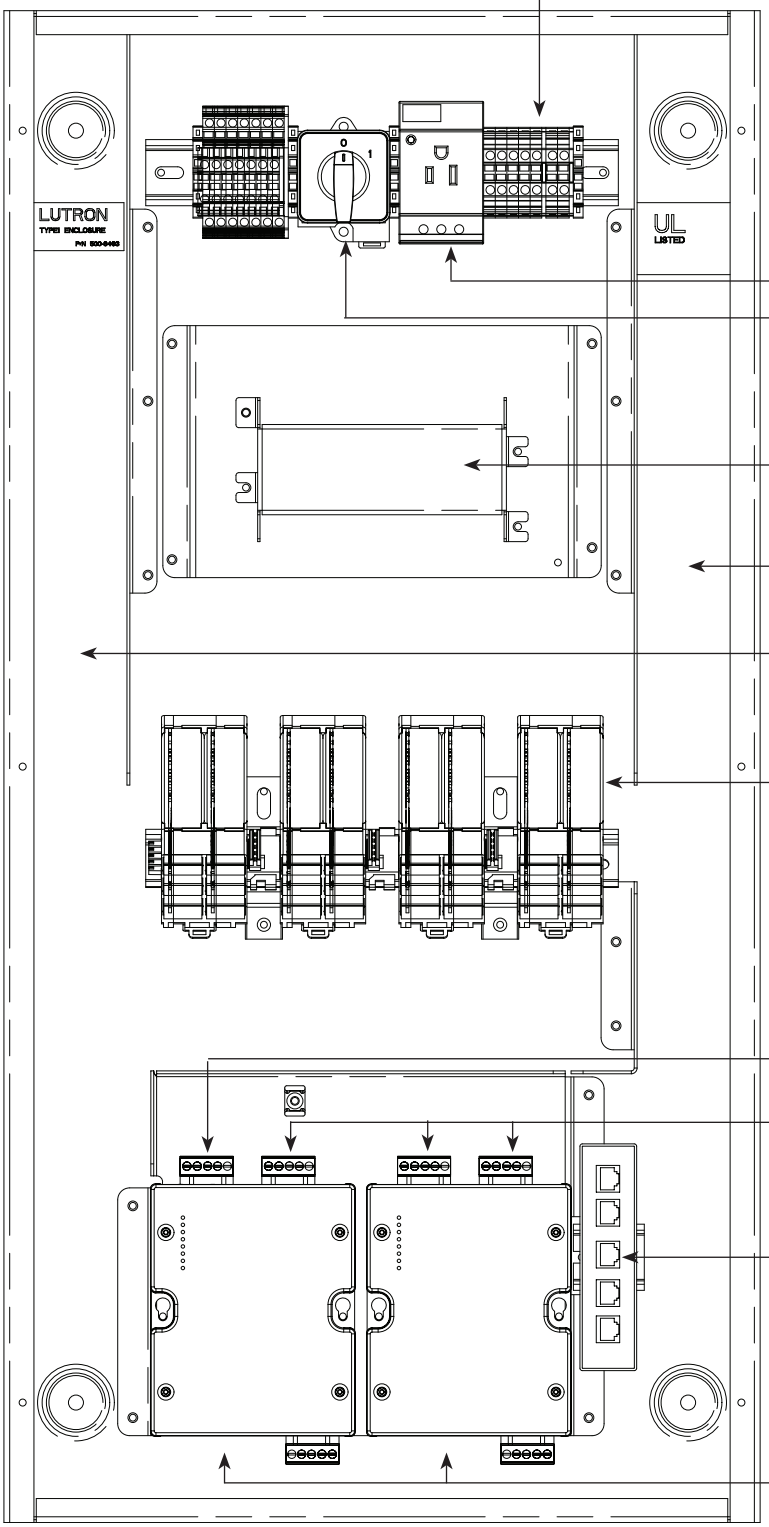
- Mount panels so line (mains) voltage wiring is at least 6 feet (1.8 m) from sound or electric equipment and wiring.



Front View Side View

Job Name:	Model Numbers:	
Job Number:		

Panel Overview



Line voltage input, normal/emergency feed

Receptacle (for Lutron service use only)

Panel power switch

PELV (Class 2: USA) power supply board

PELV (Class 2: USA) wire trough

Ballast wire trough

Quantum bus supplies (4 modules, 2 loops per module maximum)

Factory configured *Quantum* bus supply link

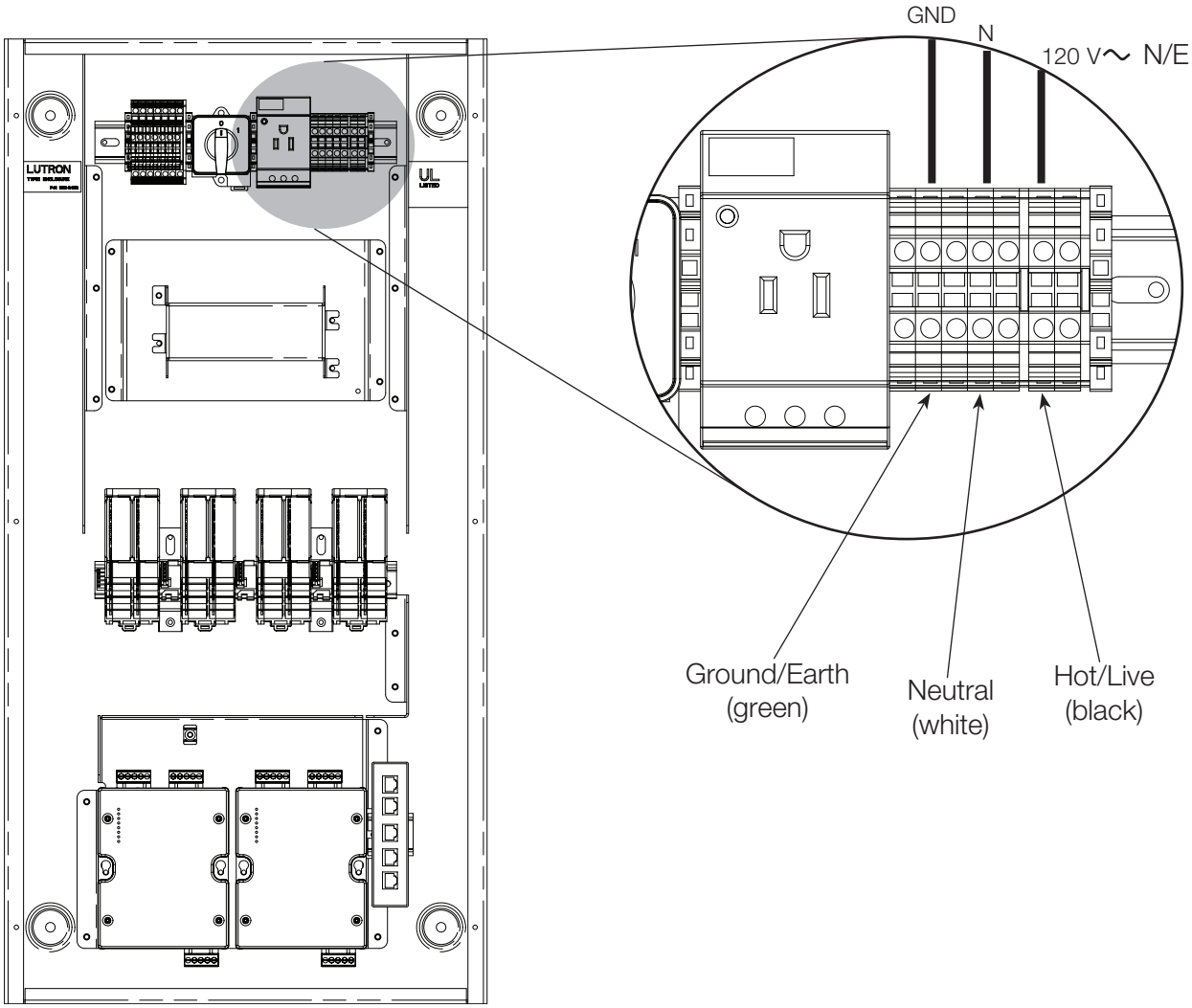
Configurable links (power panel, Lutron QS, or *Quantum* bus supply)

5-port Ethernet device

Quantum processors (2 maximum)

Job Name:	Model Numbers:	
Job Number:		

Line Voltage Wiring

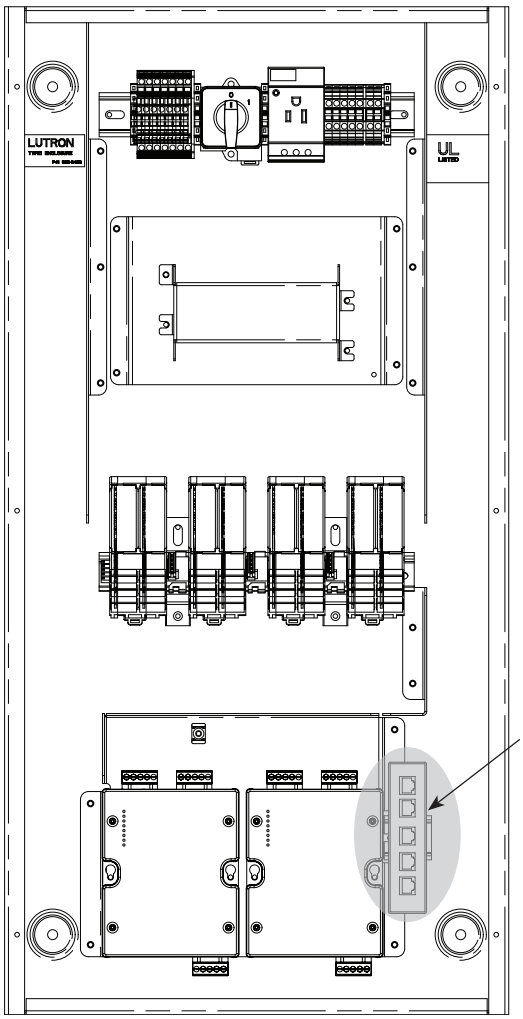


Notes

- Line voltage must enter panel from top right of panel
- Run a dedicated 120 V~ normal/emergency feed
- Lutron recommends that no more than four Light Management Hubs are powered by a single derated 20 A circuit
- Run wiring so line (mains) Class 1 voltage is separate from PELV (Class 2: USA) wiring

Job Name:	Model Numbers:	
Job Number:		

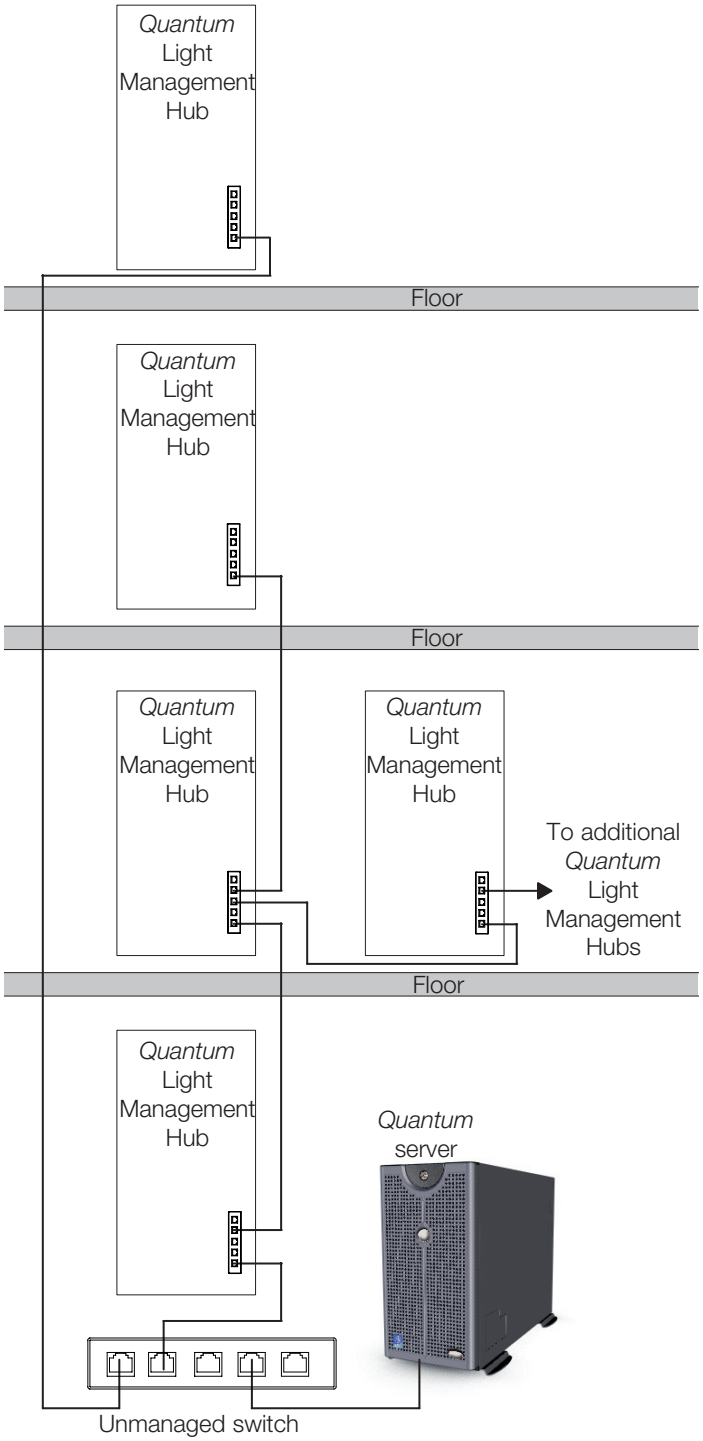
Quantum Inter-Processor Link Wiring



Notes

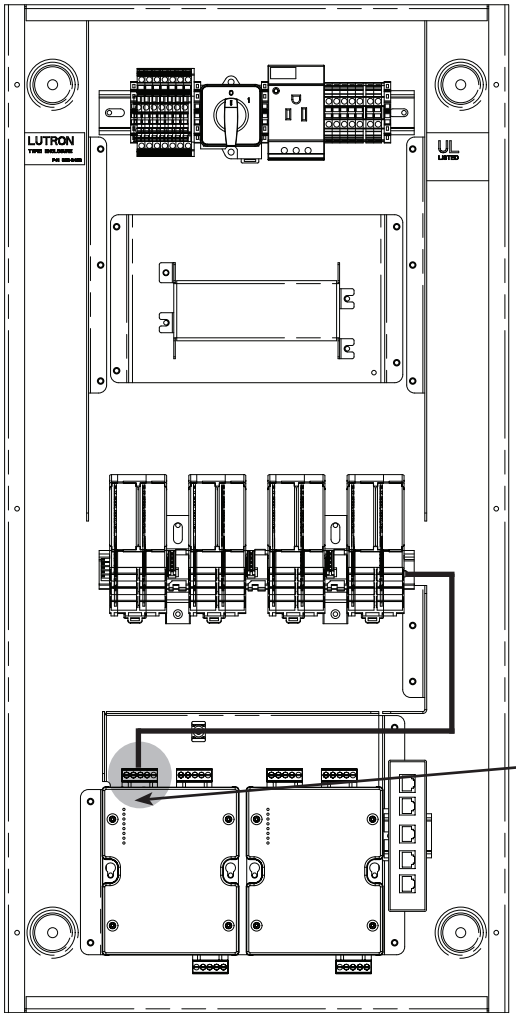
- The inter-processor wiring is considered PELV (Class 2: USA); do not run in the same conduit as line (mains) voltage wiring.
- Wiring distance for any single link segment is 330 ft (100 m) max; use Lutron-provided Ethernet switches for longer distances.
- Processors cannot be more than 6 “hops” from the server.
- Processors communicate over the interprocessor link using multicast UDP; a dedicated network must be used for the lighting control system.

Example of Inter-Processor Wiring: Riser Diagram



Job Name:	Model Numbers:	
Job Number:		

Dedicated *Quantum* Bus Supply Link



QP2-2P8CSE-120 shown

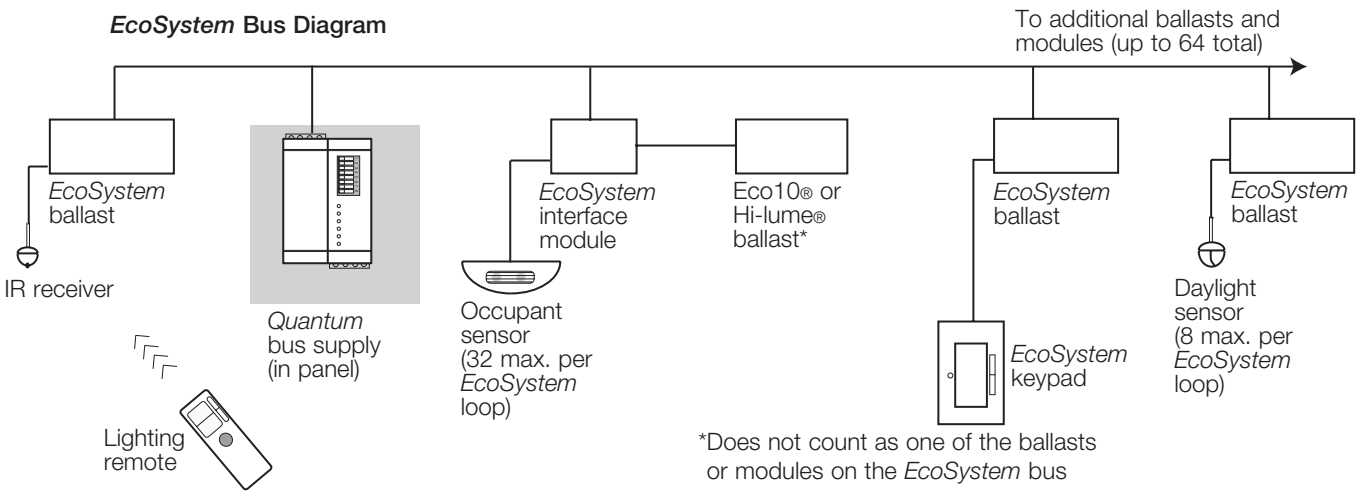
Notes

- EcoSystem® bus may be wired in accordance with NEC® Class 1 or PELV (Class 2: USA) practices
- Sensors and *Quantum* bus supply contact closures must be wired PELV (Class 2: USA)

Dedicated *Quantum* bus supply link; prewired by Lutron to *Quantum* Bus Supply located in panel

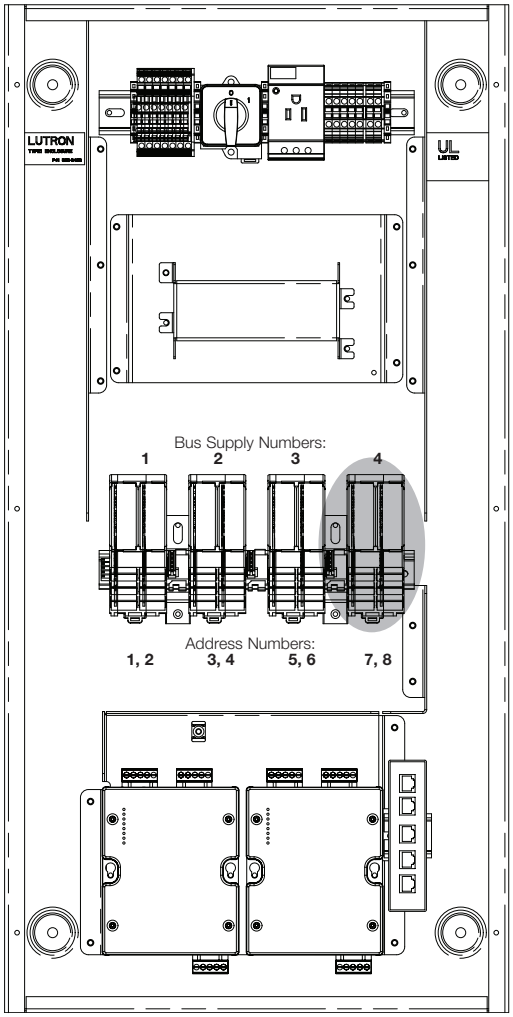
Note: If *Quantum* bus supply link is not required, this can be used as a configurable link. Power is not available from the *Quantum* panel on this link. An external power supply is required to power devices on this link.

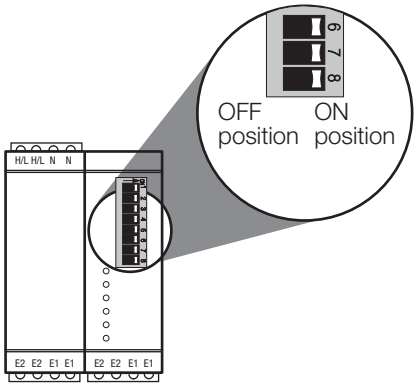
EcoSystem Bus Diagram



Job Name:	Model Numbers:	
Job Number:		

Quantum Bus Supply OPT Switches and LEDs



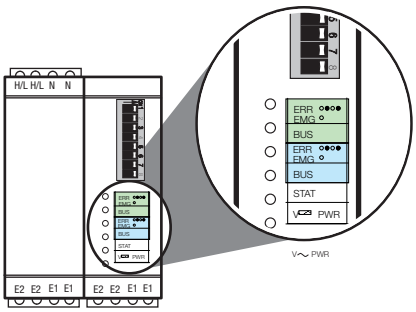


OPT Switches

OPT switches are used to configure the Bus Supply. The tables below describe the options. To place an OPT switch in the OFF position, slide the switch to the left; away from the switch's number. Default is ON (next to the switch's number).

OPT Switch Functions

1 2 3	Addressing Set address for bus supply's loops (2 loops per bus supply)	Bus Supply 1 Addresses 1, 2	Bus Supply 2 Addresses 3, 4	Bus Supply 3 Addresses 5, 6	Bus Supply 4 Addresses 7, 8
4 5	Green Loop (right side) Manual override levels	Lights stay at current level	Lights go to "high" level	Lights go to "low" level	Lights go to Off
6 7	Blue Loop (left side) Manual Override levels	Lights stay at current level	Lights go to "high" level	Lights go to "low" level	Lights go to Off
8	Manual Override	Manual override levels will be used		Lights will go to the level specified by the system	



Status LEDs

LEDs on the *Quantum* Bus Supply indicate network status. The specific LEDs, color and flashing method is detailed below.

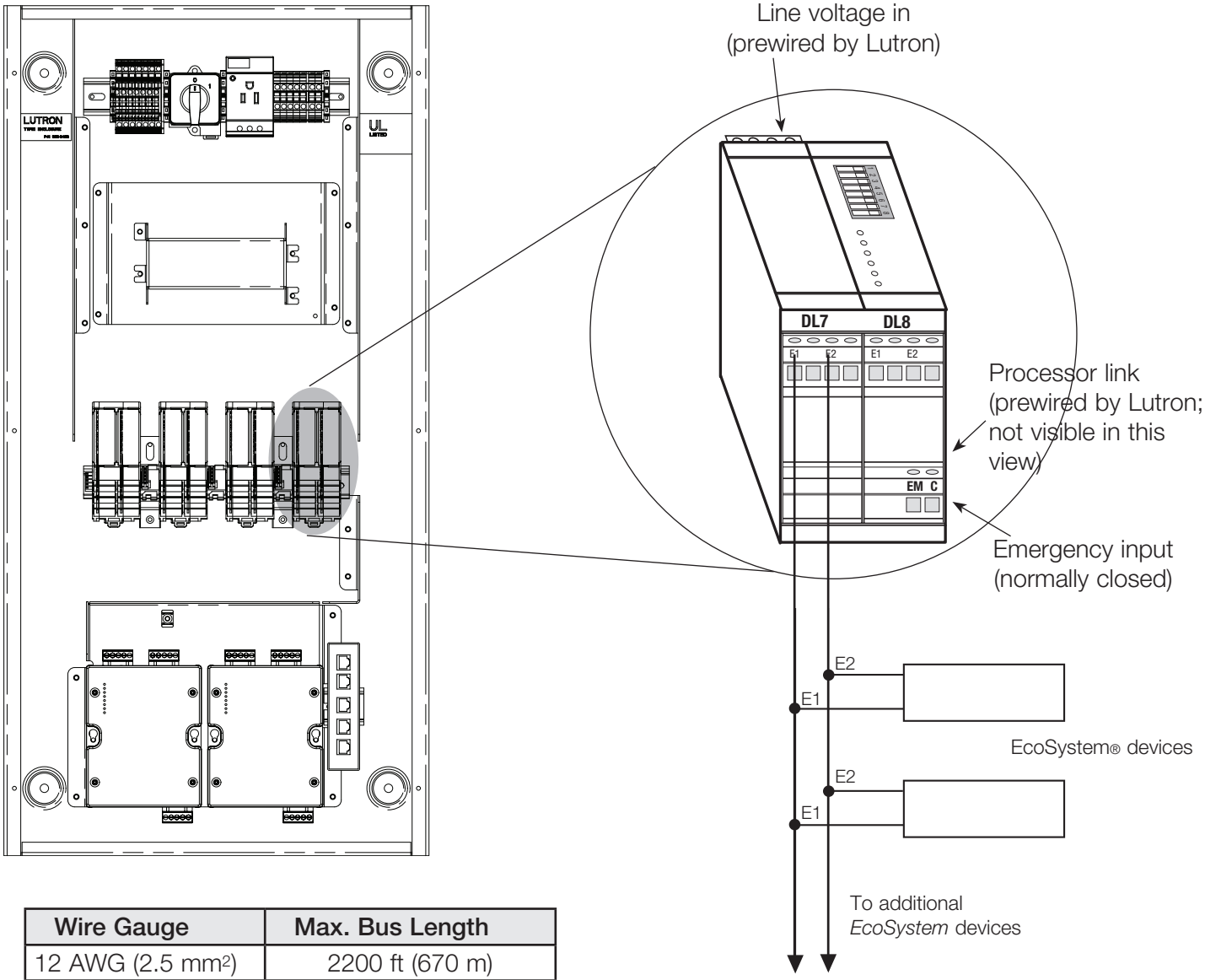
LED	Normal Operation	Problem Indicator	Probable Cause
V ~ PWR	On	Off	No Mains power
STAT	Steady flash	Off	No Mains power or unit fault
		On	Unit fault
BUS	Intermittent flash or Off	On	Unit fault
ERR / EMG	Off	On	Emergency contact closure is active
		Steady flash	Miswire detected on corresponding bus

Job Name:

Job Number:

Model Numbers:

Quantum Bus Supply Wiring



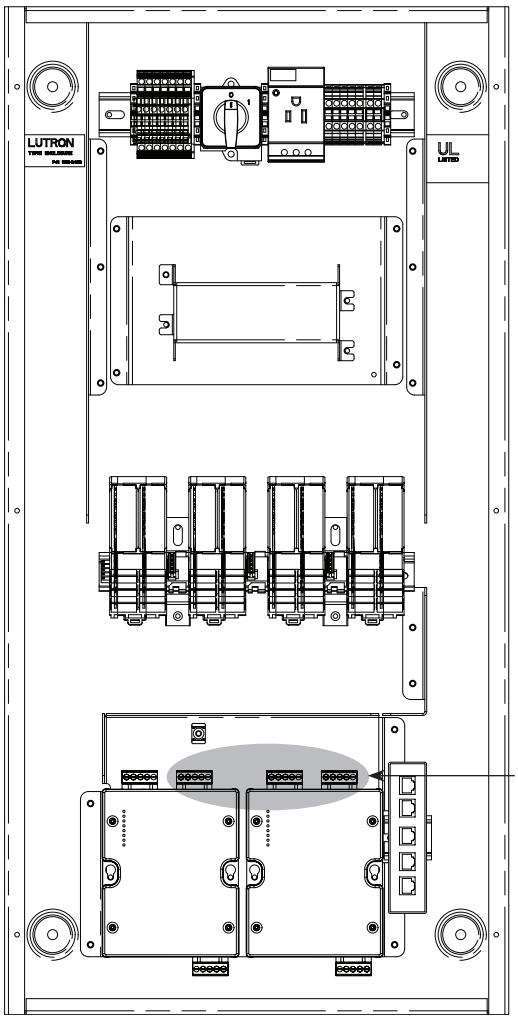
Wire Gauge	Max. Bus Length
12 AWG (2.5 mm²)	2200 ft (670 m)
14 AWG (2.5 mm²)	1400 ft (427 m)
16 AWG (1.5 mm²)	900 ft (274 m)
18 AWG (1.0 mm²)	570 ft (175 m)

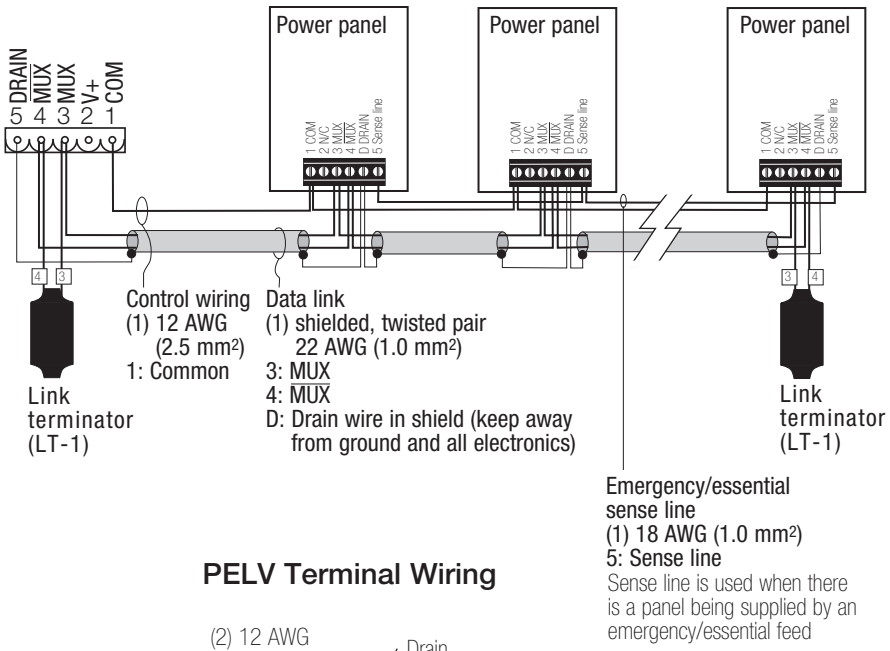
Notes

- E1 and E2 wires are not polarity sensitive.
- Hot/live, neutral, and ground wires are also connected to each lighting fixture; some may have an emergency feed.
- Free wire topology.
- If 15 V⎓ +/- 1 V⎓ is not present between E1 and E2, check the *Quantum* bus supply wiring. A short between E1 and E2 will cause the bus supply to stop providing voltage on the bus and will cause the ERR indicator to flash. Removing the short between E1 and E2 will allow the bus supply to operate properly.
- To wire the *Quantum* bus supply for PELV (Class 2: USA), the *Quantum* bus supply wires must be separated from the mains wiring. Otherwise, the PELV wiring must be classified as NEC® Class 1.

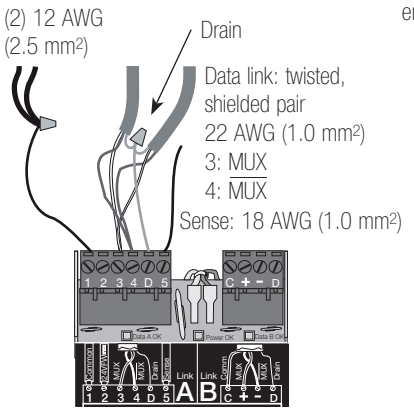
Job Name:	Model Numbers:	
Job Number:		

Configurable Link Wiring: Power Panel Link





PELV Terminal Wiring

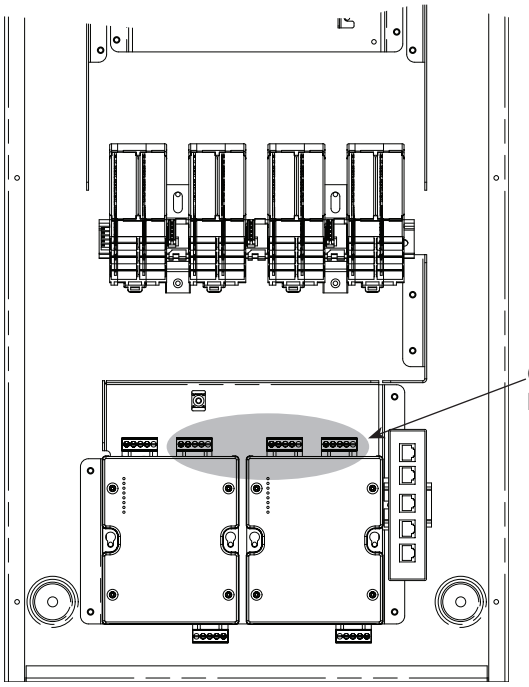


Notes

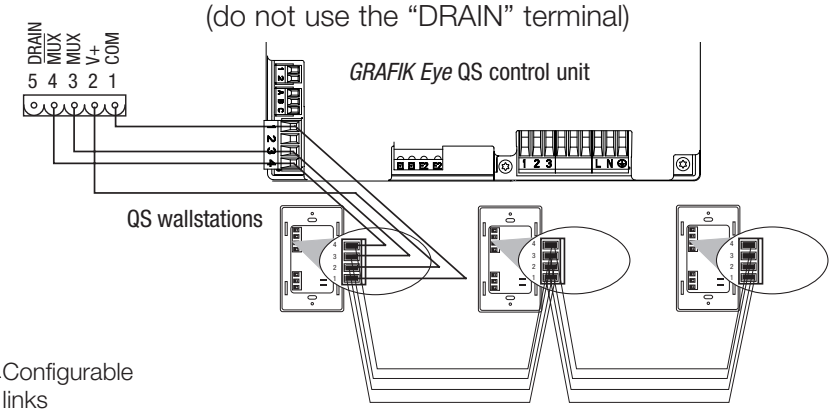
- Power panel link must be daisy-chained (no T-taps).
- Maximum of 32 power panels per link.
- It is not necessary to have the Quantum panel at the end of the link.
- The sense wire (terminal 5) is used whenever there is a panel being supplied by an emergency/essential feed; see power panel instructions for details.
- Each low-voltage PELV (Class 2: USA) terminal can accept only two 18 AWG (1.0 mm²) wires. Two 12 AWG (2.5 mm²) conductors will not fit. Connect as shown using appropriate wire connectors.
- Total length of control link may be no more than 2000 ft. (600 m). If MUX-RPTR interface and GRX-CBL-46L cable are used, length may be up to 4000 ft. (1200 m).
- GRX-CBL-46L PELV (Class 2: USA) wiring cable is available from Lutron and contains two 12 AWG (2.5 mm²) conductors for control power, one twisted, shielded pair of 22 AWG (1.0 mm²) for data link, and one 18 AWG (1.0 mm²) conductor for emergency (essential) sense line.

Job Name:	Model Numbers:	
Job Number:		

Configurable Link Wiring: GRAFIK Eye® QS and Sivoia® QS Shades

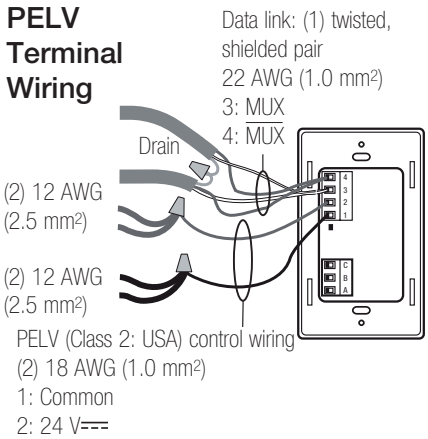


GRAFIK Eye QS Link
(do not use the "DRAIN" terminal)

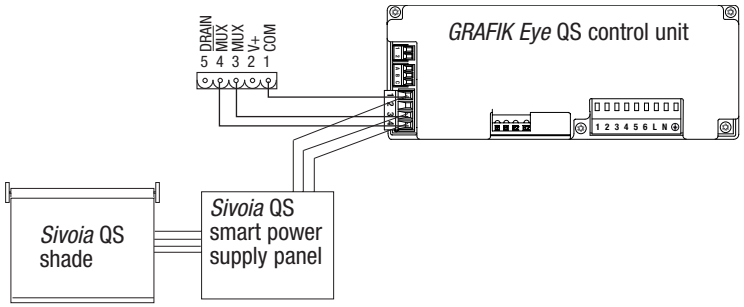


Note: Wallstations are powered directly from the lighting management panel (not the *GRAFIK Eye* QS control unit)

PELV Terminal Wiring



Sivoia QS Shade Link
(do not use the "DRAIN" terminal)



V+ and COM Wire Gauge	QS Link Max. Total Length
12 AWG (2.5 mm²)	2000 ft (600 m)
16 AWG (1.5 mm²)	800 ft (250 m)
18 AWG (1.0 mm²)	500 ft (150 m)

Notes

- System communication uses PELV (Class 2: USA) low-voltage wiring.
- Follow all local and national electrical codes when installing PELV (Class 2: USA) wiring with line voltage/mains wiring.
- Each terminal accepts up to two 18 AWG (1.0 mm²) wires.
- Total length of control link must not exceed 2000 ft (600 m); extend using up to 3 link repeaters (each adds 2000 ft/600 m).
- Make all connections in the control unit's wallbox.
- A *Quantum* QS link can have up to 512 switch legs (outputs), 99 devices, and 32 power draw units (see table on next page).
- Wiring can be T-tapped or daisy-chained.
- Wire sizes:
  - Two 12 AWG (2.5 mm²) conductors for control power.
  - One twisted, shielded pair of 22 AWG (1.0 mm²) for data link.
  - Cable is available from Lutron: GRX-CBL-46L.

Job Name:	Model Numbers:	
Job Number:		

QS Device Consumption Rules

The table below lists the devices available on the QS link. See below for each device's count toward the link maximums for zones, switch legs, and devices.

A *Quantum* QS link can have up to 512 switch legs (outputs), 99 devices, and 32 power draw units.

QS Device Description	Switch Leg Count	Device Count	Power Draw Units
3-zone GRAFIK Eye® QS	3	1	0
4-zone *GRAFIK Eye* QS	4	1	0
6-zone *GRAFIK Eye* QS	6	1	0
seeTouch® QS	0	1	1
Sivoia® QS Roller 64	1	1	0
Sivoia QS Roller 100	1	1	0
Sivoia QS Roller 225	1	1	0
6-zone *GRAFIK Eye* QS with EcoSystem®	up to 64	1	0
8-zone *GRAFIK Eye* QS with *EcoSystem*	up to 64	1	0
16-zone *GRAFIK Eye* QS with *EcoSystem*	up to 64	1	0
QS contact closure interface	up to 5	1	3
QS network interface for audio-visual integration	0	1	2
QS smart power panel	0	1	0

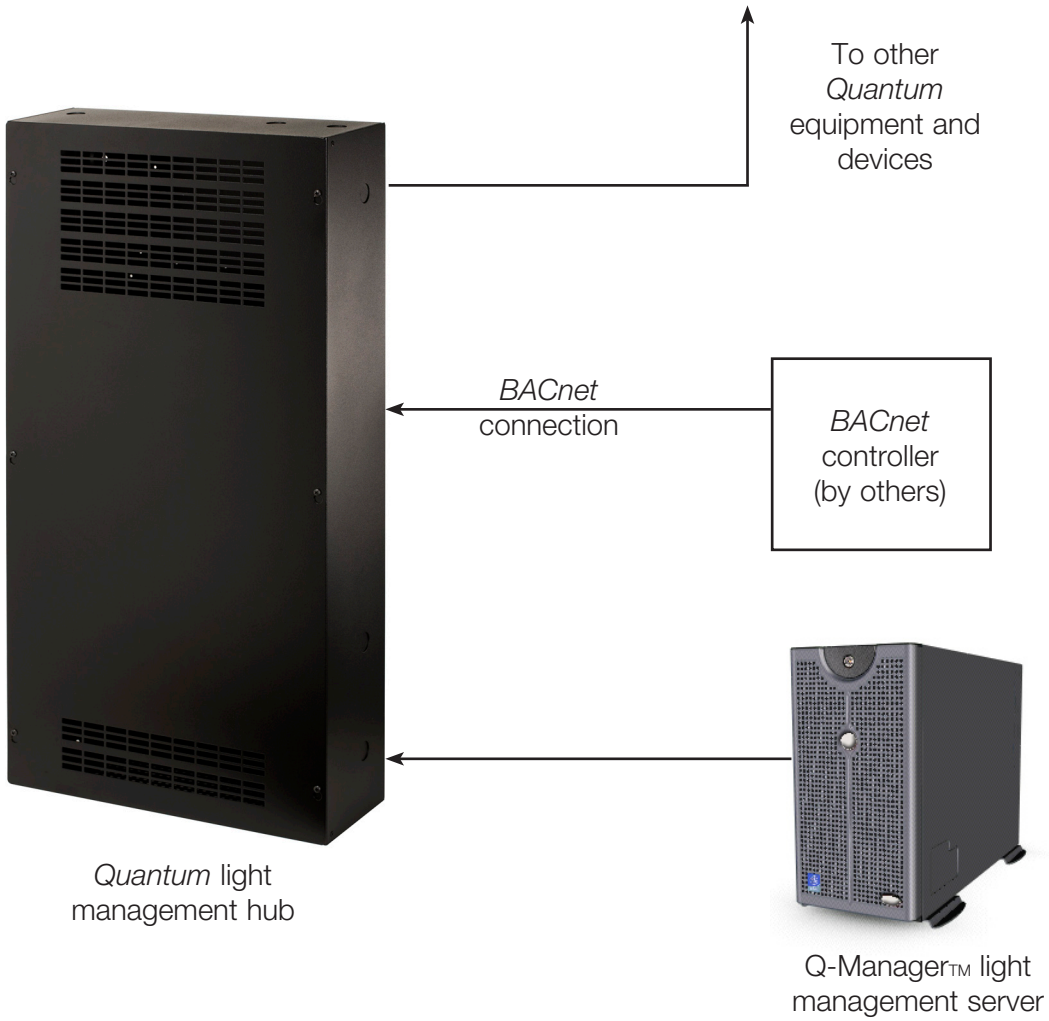
BACnet® Software License for *Quantum* Lights

Description

This license for *BACnet* software enables a building management system to control, monitor, and manage energy for lights in the *Quantum* system. This license must be activated by a Lutron Field Service Engineer. One license is required for each processor.

System Network Diagram

Note: Requires use of Q-Admin™ software package



Job Name:	Model Numbers:	
Job Number:		

BACnet® Protocol Implementation Conformance Statement (PICS)

Date: January 20, 2010
Vendor Name: Lutron Electronics Co., Inc.
Product Name: *Quantum BACnet* Integration
Product Model Number: QSW-BAC-L-PP-A
Applications Software Version: 1.9
Firmware Revision: 1.9
BACnet® Protocol Revision: 4

Version History

Applications Software Versions: 1.6, 1.7, 1.8
Firmware Revisions: 1.6, 1.7, 1.8
BACnet® Protocol Revision: 2

Product Description

License for *Quantum* light management hub to enable *BACnet* IP Integration. Allows control of *Quantum* system components. *BACnet* IP is embedded in the *Quantum* light management hub.

BACnet Interoperability Building Blocks Supported (Annex K):

K.1.1 BIBB	Data Sharing	ReadProperty-B (DS-RP-B)
K.1.8 BIBB	Data Sharing	WriteProperty-B (DS-WP-B)
K.1.4 BIBB	Data Sharing	ReadPropertyMultiple-B (DS-RPM-B)
K.1.10 BIBB	Data Sharing	WritePropertyMultiple-B (DS-WPM-B)
K.1.12 BIBB	Data Sharing	DS-COV-B
K.5.2 BIBB	Device Management	DynamicDeviceBinding-B (DM-DDB-B)
K.5.6 BIBB	Device Management	DeviceCommunicationControl-B (DM-DCC-B)

***BACnet* Standardized Device Profile (Annex L):**

BACnet Application Specific Controller (B-ASC)

Segmentation Capability:

Segmented requests supported? **No.** Window Size: **n/a**
Segmented responses supported? **No.** Window Size: **n/a**

Non-Standard Application Services:

Non-standard application services are not supported.

Standard Object Types Supported:

Device

1. Dynamically creatable using *BACnet*'s CreateObject service? **No.**
2. Dynamically deletable using *BACnet*'s DeleteObject service? **No.**
3. List of optional properties supported: **None.**
4. List of all properties that are writable where not otherwise required by this standard: **None.**
5. List of proprietary properties: **None.**
6. List of any property value range restrictions: **None.**

Job Name:	Model Numbers:	
Job Number:		

Analog Value

1. Dynamically creatable using the *BACnet*® CreateObject service? **No.**
2. Dynamically deletable using *BACnet*'s DeleteObject service? **No.**
3. List of optional properties supported: **Min, Max.**
4. List of all properties that are writable where not otherwise required by this standard: **None.**
5. List of proprietary properties: **None.**
6. List of any property value range restrictions: **See Table.**

Binary Value

1. Dynamically creatable using *BACnet*'s CreateObject service? **No.**
2. Dynamically deletable using *BACnet*'s DeleteObject service? **No.**
3. List of optional properties supported: **None.**
4. List of all properties that are writable where not otherwise required by this standard: **None.**
5. List of proprietary properties: **None.**
6. List of any property value range restrictions: **See Table.**

Multi-State Value

1. Dynamically creatable using *BACnet*'s CreateObject service? **No.**
2. Dynamically deletable using *BACnet*'s DeleteObject service? **No.**
3. List of optional properties supported: **None.**
4. List of all properties that are writable where not otherwise required by this standard: **None.**
5. List of proprietary properties: **None.**
6. List of any property value range restrictions: **See Table.**

Data Link Layer Options:

BACnet IP

Device Address Binding:

Is static device binding supported? No.

Networking Options:

None

Character Sets Supported:

Indicating support for multiple character sets does not imply that they can all be supported simultaneously.

ANSI X3.4

If this product is a communication gateway, describe the types of non-*BACnet* equipment/network(s) that the gateway supports:

The device is a communication gateway between the *BACnet* protocol and EcoSystem® ballasts and modules in Lutron's *Quantum* light control system.

Job Name:	Model Numbers:	
Job Number:		

BACnet® Objects

Area Device	Read	Write	Type	Instance	{Area Name}	COV Supported	Units	Min PV	Max PV	Active Text	Inactive Text	State Text
Lighting Level: Allows you to set all the lights in an area to a level.	X1	X	AV	2	Lighting Level		%	0	100 101=Mixed On			
Lighting State: Control/Monitor the lights in an area. On indicates that there is at least one light on in the area. Off indicates that all lights are off in the area.	X	X	BV	3	Lighting State	X		0	1	On (1)	Off (0)	
Lighting Scene: Control/Monitor the lighting scenes in an area.	X	X	MSV	4	Lighting Scene			1	Total Scenes +1			{Scene Name}
Daylighting Enabled: Control/Monitor the daylighting function in the area.	X	X	BV	5	Daylighting Enabled			0	1	Enabled (1)	Disabled (0)	
Daylighting Level: Configuration parameter to adjust the daylighting target level in the area.	X	X	AV	6	Daylighting Amount		none	0	90			
Permanently Disable Occupancy: Prevent any occupancy events or occupancy mode changes from having any effect.	X	X	BV	7	Permanently Disable Occupancy			0	1	True (1)	False (0)	
Occupancy State: Indicates if an area is currently occupied.	X		MSV	8	Occupancy State	X		1	4			1 = Unoccupied, 2 = Occupied, 3 = After Hours, 4 = Unknown
Unoccupied Level: Configuration parameter to adjust the level the lights in an area should go to when it becomes unoccupied.	X	X	AV	9	Unoccupied Level		%	0	100 101=Unaffected 102=Daylighting			
Occupied Level: Configuration parameter to adjust the level the lights in an area should go to when it becomes occupied.	X	X	AV	10	Occupied Level		%	0	100 101=Unaffected 102=Daylighting			
Additional Occupied Timeout: Configuration parameter to adjust the occupancy timeout.	X	X	AV	11	Additional Occupied Timeout		min	0	42			

(continued on the next page)

BACnet® Objects												
Area Device	**Read**	**Write**	**Type**	**Instance**	**{Area Name}**	**COV Supported**	**Units**	**Min PV**	**Max PV**	**Active Text**	**Inactive Text**	**State Text**
Loadshed Allowed: Indicates if an area is allowed to load shed.	X	X1	BV	12	Loadshed Allowed			0	1	Yes (1)	No (0)	
Loadshed Goal: Indicates how much load an area will shed when the load shed function is enabled.	X	X1	AV	13	Loadshed Goal		none	0	90			
Occupancy Mode: Control/ monitor the occupancy mode in an area	X	X	MSV	14	Occupancy Mode			1	4			1 = Inactive, 2 = Occupancy & Vacancy, 3 = Vacancy, 4 = Not applicable
Number of Lamp Failures: Indicates the number of failed lamps in an area.	X		AV	15	Number of Lamp Failures	X	none	0	none			
Number of Devices Not Responding: Indicates the number of control devices not responding in an area.	X		AV	16	Number of Devices Not Responding	X	none	0	none			
Zone Level: Control/Monitor the level of individual lighting zones in an area.	X	X	AV	1000 - 1999	{ZoneName} Level		%	0	100 101=Unaffected 102=Daylighting			
System Device					**{System Name}**							
Master Loadshed Enabled: Control/Monitor the system-wide load shed function.	X	X	BV	2	Master Loadshed Enabled	X		0	1	Enabled (1)	Disabled (0)	
Timeclock Enabled: Control/ Monitor the state of each system timeclock.	X	X	BV	1000 - 1999	{TimeclockName} Enabled			0	1	Enabled (1)	Disabled (0)	

AV = Analog Value
BV = Binary Value
MSV = Multi-State Value
COV = Change of Value
PV = Present Value
{ } = Name specified in the system by Lutron

1 = Features only available in Quantum 1.7 or later.
2 = “Timeclock” will be prefixed if the name does not include the word “Timeclock”.

Job Name:
Job Number:
Model Numbers:

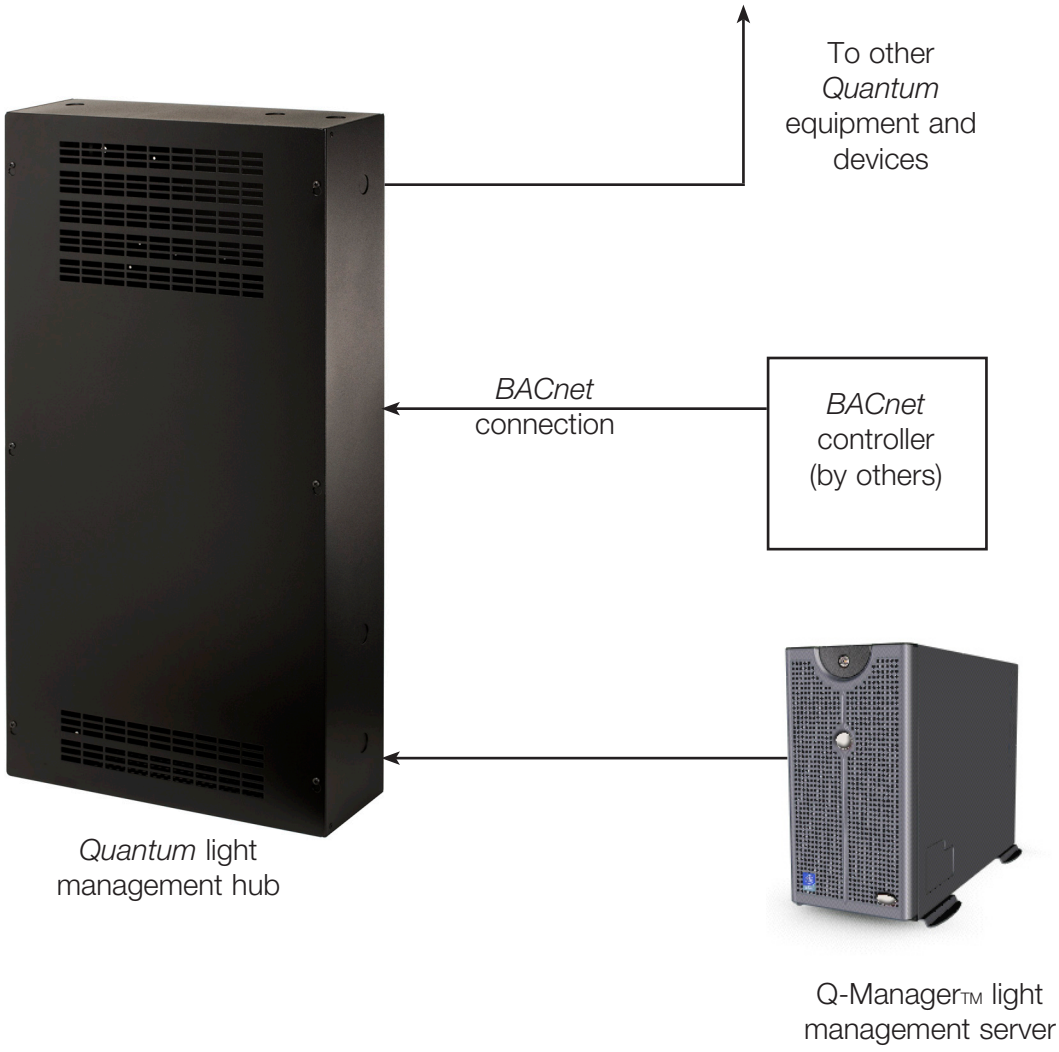
BACnet® Software License for *Quantum* Shades

Description

This license for *BACnet* software enables a building management system to control, monitor, and manage energy for shades in the *Quantum* system. This license must be activated by a Lutron Field Service Engineer. One license is required for each processor.

System Network Diagram

Note: Requires use of Q-Admin™ software package



Job Name:	Model Numbers:	
Job Number:		

BACnet® Protocol Implementation Conformance Statement (PICS)

Date: September 10, 2008
Vendor Name: Lutron Electronics Co., Inc.
Product Name: *Quantum BACnet* Integration
Product Model Number: QSW-BAC-L-PP-A
Applications Software Version: 1.9
Firmware Revision: 1.9
BACnet® Protocol Revision: 4

Version History

Applications Software Versions: 1.6, 1.7, 1.8
Firmware Revisions: 1.6, 1.7, 1.8
BACnet® Protocol Revision: 2

Product Description

License for *Quantum* light management hub to enable *BACnet* IP Integration. Allows control of *Quantum* system components. *BACnet* IP is embedded in the *Quantum* light management hub.

BACnet Interoperability Building Blocks Supported (Annex K):

K.1.1 BIBB	Data Sharing	ReadProperty-B (DS-RP-B)
K.1.8 BIBB	Data Sharing	WriteProperty-B (DS-WP-B)
K.1.4 BIBB	Data Sharing	ReadPropertyMultiple-B (DS-RPM-B)
K.1.10 BIBB	Data Sharing	WritePropertyMultiple-B (DS-WPM-B)
K.5.2 BIBB	Device Management	DynamicDeviceBinding-B (DM-DDB-B)
K.5.6 BIBB	Device Management	DeviceCommunicationControl-B (DM-DCC-B)

***BACnet* Standardized Device Profile (Annex L):**

BACnet Application Specific Controller (B-ASC)

Segmentation Capability:

Segmented requests supported? **No.** Window Size: **n/a**
Segmented responses supported? **No.** Window Size: **n/a**

Non-Standard Application Services:

Non-standard application services are not supported.

Standard Object Types Supported:

Device

1. Dynamically creatable using *BACnet*'s CreateObject service? **No.**
2. Dynamically deletable using *BACnet*'s DeleteObject service? **No.**
3. List of optional properties supported: **None.**
4. List of all properties that are writable where not otherwise required by this standard: **None.**
5. List of proprietary properties: **None.**
6. List of any property value range restrictions: **None.**

Analog Value

1. Dynamically creatable using the BACnet® CreateObject service? **No.**
2. Dynamically deletable using *BACnet*'s DeleteObject service? **No.**
3. List of optional properties supported: **Min, Max.**
4. List of all properties that are writable where not otherwise required by this standard: **None.**
5. List of proprietary properties: **None.**
6. List of any property value range restrictions: **See Table.**

Binary Value

1. Dynamically creatable using *BACnet*'s CreateObject service? **No.**
2. Dynamically deletable using *BACnet*'s DeleteObject service? **No.**
3. List of optional properties supported: **None.**
4. List of all properties that are writable where not otherwise required by this standard: **None.**
5. List of proprietary properties: **None.**
6. List of any property value range restrictions: **See Table.**

Multi-State Value

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2. Dynamically deletable using *BACnet*'s DeleteObject service? **No.**
3. List of optional properties supported: **None.**
4. List of all properties that are writable where not otherwise required by this standard: **None.**
5. List of proprietary properties: **None.**
6. List of any property value range restrictions: **See Table.**

Data Link Layer Options:

BACnet IP

Device Address Binding:

Is static device binding supported? No.

Networking Options:

None

Character Sets Supported:

Indicating support for multiple character sets does not imply that they can all be supported simultaneously.

ANSI X3.4

If this product is a communication gateway, describe the types of non-*BACnet* equipment/network(s) that the gateway supports:

The device is a communication gateway between the *BACnet* protocol and EcoSystem® ballasts and modules in Lutron's *Quantum* light control system.

BACnet® Objects												
Area Device	**Read**	**Write**	**Type**	**Instance**	**{Area Name}**	**COV Supported**	**Units**	**Min PV**	**Max PV**	**Active Text**	**Inactive Text**	**State Text**
Hyperion Enabled [1]	X	X	BV	17	Hyperion Enabled			0	1	Enabled (1)	Disabled (0)	
Shade Group Level: Control/Monitor the position of a shade group in an area.	X	X	AV	2000-2999	{GroupName} Level		%	0	100 101=Mixed On 102=Unknown			
Shade Group Preset: Control/Monitor the preset positions for a shade group in an area.	X	X	MSV	3000-3999	{GroupName} Preset		--	1	34			{Preset Name}
System Device					**{System Name}**							
Master Hyperion Enabled [1]	X	X	BV	3	Master Hyperion Enabled			0	1	Enabled	Disabled	
AV = Analog Value												
BV = Binary Value												
MSV = Multi-State Value												
COV = Change of Value												
PV = Present Value												
{ } = Name specified in the system by Lutron												

1 = Features only available in Quantum 1.7 or later.

2 = “Shade Group” will be prefixed if the name does not include the phrase “Shade Group”.

APPENDIX I.G: OFFICE LIGHTING ELECTRICAL DESIGN

PANELBOARD SCHEDULE

VOLTAGE: 480Y/277V,3PH,4W
SIZE/TYPE BUS: 225A
SIZE/TYPE MAIN: 225A/3P C/B

PANEL TAG: LP-8-1
PANEL LOCATION: 8th Floor Electrical (1)
PANEL MOUNTING: SURFACE

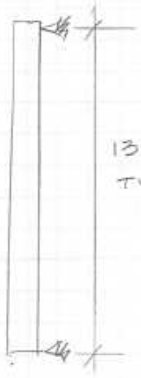
MIN. C/B AIC: 10K
OPTIONS:

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	SW	2695	20A/1P	1	*			2	20A/1P	2268	S	Lighting
Lighting	SE	2895	20A/1P	3		*		4	20A/1P	2895	NW	Lighting
Lighting	N	2268	20A/1P	5			*	6	20A/1P	2695	NE	Lighting
SPARE	0	0	20A/1P	7	*			8	20A/1P	0	0	SPARE
SPARE		0	20A/1P	9		*		10	20A/1P	0		SPARE
SPARE		0	20A/1P	11			*	12	20A/1P	0		SPARE
SPACE		0	20A/1P	13	*			14	100A/3P	40000		Subfeed
SPACE		0	20A/1P	15		*		16	100A/3P	40000	Transformer	Subfeed
SPACE		0	20A/1P	17			*	18	100A/3P	40000		Subfeed
		0	20A/1P	19	*			20	20A/1P	0		
		0	20A/1P	21		*		22	20A/1P	0		
		0	20A/1P	23			*	24	20A/1P	0		
		0	20A/1P	25	*			26	20A/1P	0		
		0	20A/1P	27		*		28	20A/1P	0		
		0	20A/1P	29			*	30	20A/1P	0		
		0	20A/1P	31	*			32	20A/1P	0		
		0	20A/1P	33		*		34	20A/1P	0		
		0	20A/1P	35			*	36	20A/1P	0		
		0	20A/1P	37	*			38	20A/1P	0		
		0	20A/1P	39		*		40	20A/1P	0		
		0	20A/1P	41			*	42	20A/1P	0		

CONNECTED LOAD (KW) - A Ph.	44.96	TOTAL DESIGN LOAD (KW)	162.86
CONNECTED LOAD (KW) - B Ph.	45.79	POWER FACTOR	0.99
CONNECTED LOAD (KW) - C Ph.	44.96	TOTAL DESIGN LOAD (AMPS)	197

APPENDIX I.H: STRUCTURAL MULLION CALCULATION

MULLION SIZING : SAMPLE
N-S TIMES



bay width = 5'

max wind pressure = 52 psf @ TOP

$w = 5' \cdot 52 = 260$ plf

$M_{max} = wL^2/8 = (260)(13.75)^2/8\,(12) = 73734$ #·in

@ middle of mullion

$V_{max} = wL/2 = (260)(13.75)/2 = 1787.5$ # @ supports

$\Delta_{max} = \frac{5wL^4}{384EI} = \frac{5(260)(13.75)^4(1728)}{384(10000)I} = 20.91/I$

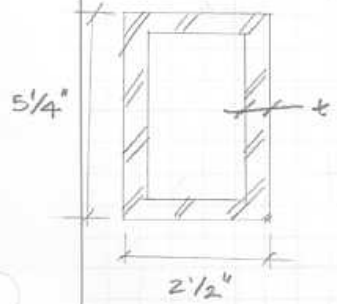
vs. $\Delta_{allow} = \begin{cases} \frac{13.75 \cdot 12}{180} = 0.917" \\ 20\,mm = 0.787" \text{ controls} \end{cases}$

bending :

$\sigma_{bend} = \frac{Mc}{I} = \frac{M}{S} = 10005$ psi allowable

[69 N/mm² * 145 = 10005 psi]

$S_{req} = 73734/10005 = 7.37\ in^3$ (EXTERIOR MULLION DIMENSIONS KEPT THE SAME AS EXISTING)



$7.37 \le \frac{\frac{1}{12}(2.5)(5.25)^3 - \frac{1}{12}(2.5-2t)(5.25-2t)^3}{5.25/2}$

$232.2 \le 2.5(5.25)^3 - (2.5-2t)(5.25-2t)^3$

$129.6 \ge (2.5-2t)(5.25-2t)^3$

try $t = 1/2"$: $129.6 \ge 115.1$ OK check $t = 1/2"$

shear:

$\sigma_{shear} = 5365$ psi

$\tau_{max} = \frac{3}{2}\frac{V}{A} \rightarrow A_{req'd} \geq \frac{3}{2}\cdot\frac{1768}{5365} = 0.50\ in^2$

$A_{prov} = 5.25(2.5) - (4.25)(1.5) = 6.75\ in^2 >> 0.50\ in^2$

OK for shear

deflection:

$\Delta_{max} = 20.91/I \rightarrow I \geq \frac{20.91}{0.787"} = 26.6\ in^4$

$I_{prov} = \frac{1}{12}(2.5)(5.25)^3 - \frac{1}{12}(2.5-2(1/2))(5.25-2(1/2))^3$

$= 20.6\ in^4 < 26.6\ in^4$ NG → try 7/8" thickness

$I_{prov} = 27.5\ in^4 > 26.6\ in^4$ OK check t = 7/8"

bearing:

shear @ support b = $V_{max} = 1768$ #

bolt size required: $\sigma_{bry} = 117\ N/mm^2 = 16965$ psi

$16965 = \frac{V_{max}}{2t \cdot D_b} \rightarrow D_b \geq \frac{1768}{16965(2\cdot 7/8)} = 0.0602"$

so, a standard 1/2" bolt would be sufficient for this load.

∴ USE A 5 1/4 × 2 1/2 × 7/8" MULLION WITHIN THE UNITIZED PANEL.

AT THE SPLIT MULLIONS BETWEEN PANELS, THE THICKNESS WILL LIKELY NEED TO INCREASE TO 1".

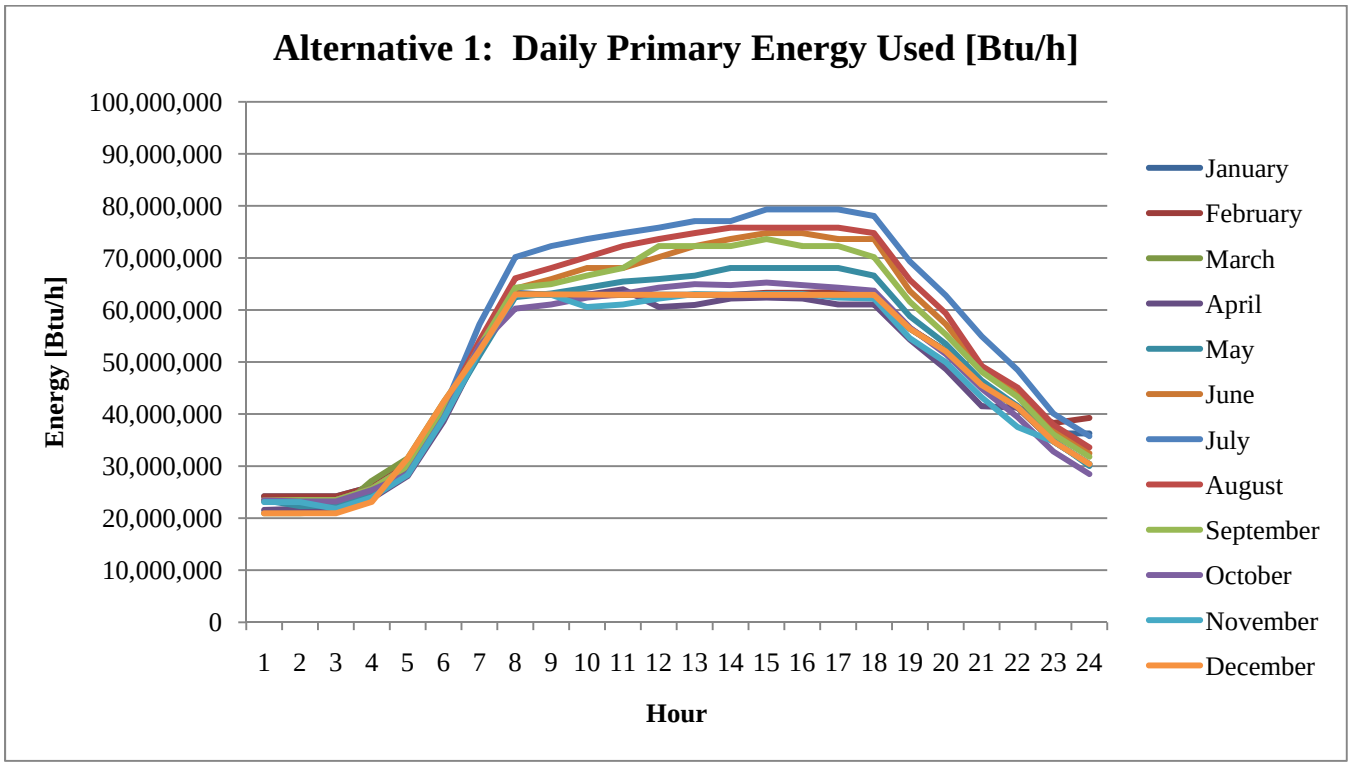
From ASCE Fig. 6-17	
GC_p	0.8
	-1.53
GC_{pi}	0.18
A_{net}	68.8 sf

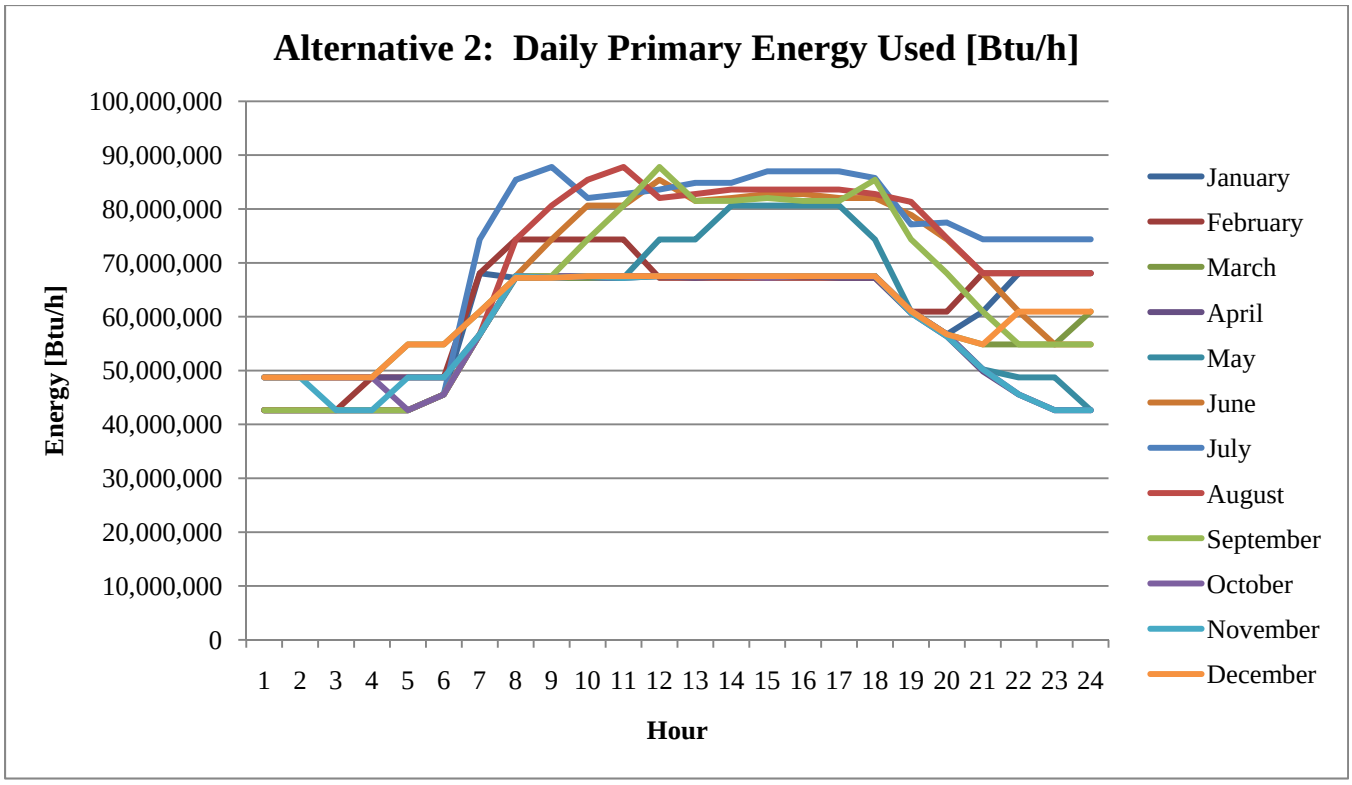
COMPONENTS & CLADDING WIND PRESSURE

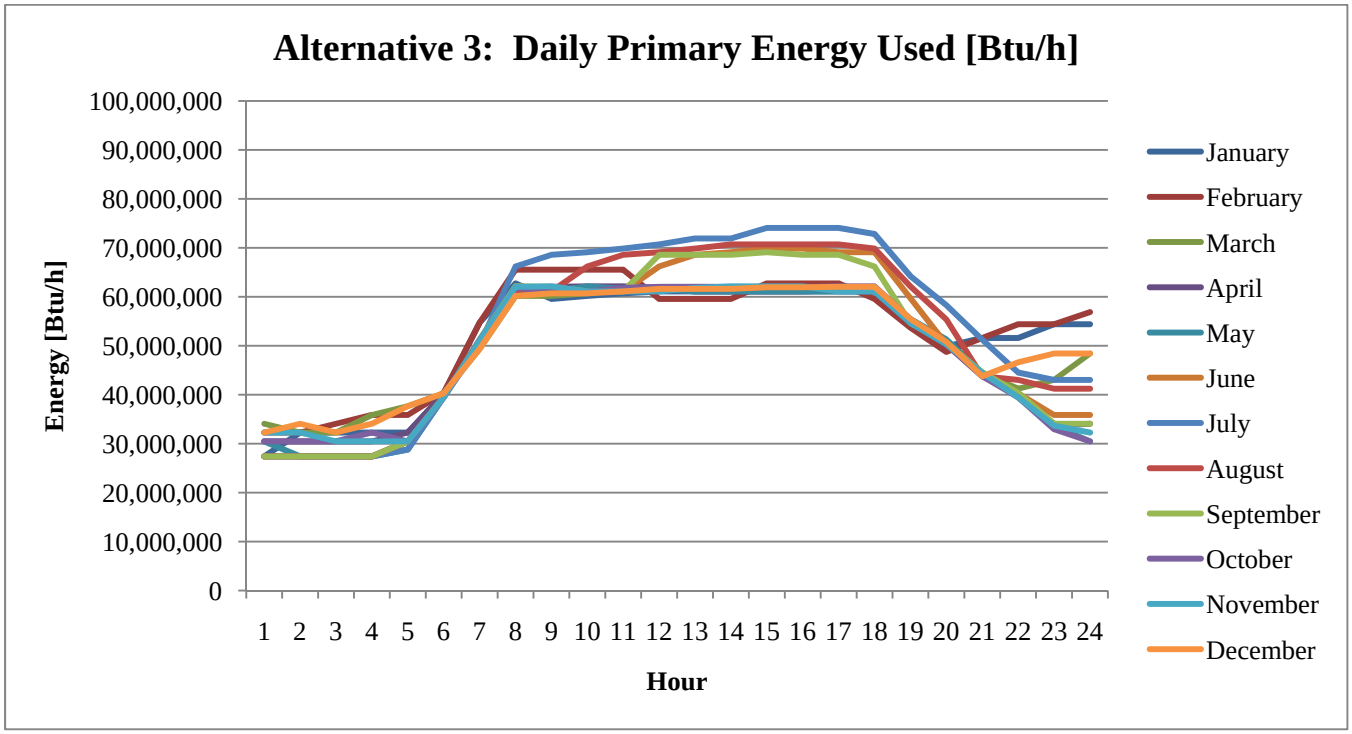
				ext	int	net pressure	
floor	*height*	K_z [a]	*q*	qGC_p	$q_h GC_{pi}$	*ext - int*	*ext + int*
ROOF	732	1.75	52.8	42.3	9.5	32.8	51.8
52	711	1.73	52.4	41.9	9.4	32.5	51.4
51	697	1.72	52.1	41.7	9.4	32.3	51.1
50	684	1.71	51.8	41.5	9.3	32.1	50.8
49	670	1.70	51.5	41.2	9.3	31.9	50.5
48	656	1.69	51.2	41.0	9.2	31.8	50.2
47	642	1.68	50.9	40.7	9.2	31.6	49.9
46	629	1.67	50.6	40.5	9.1	31.4	49.6
45	615	1.66	50.3	40.2	9.0	31.2	49.3
44	601	1.65	50.0	40.0	9.0	31.0	49.0
43	587	1.64	49.6	39.7	8.9	30.8	48.6
42	574	1.63	49.3	39.4	8.9	30.6	48.3
41	560	1.62	48.9	39.2	8.8	30.3	48.0
40	546	1.61	48.6	38.9	8.7	30.1	47.6
39	532	1.59	48.2	38.6	8.7	29.9	47.3
38	519	1.58	47.9	38.3	8.6	29.7	46.9
37	505	1.57	47.5	38.0	8.6	29.5	46.6
36	491	1.56	47.2	37.7	8.5	29.2	46.2
35	477	1.54	46.8	37.4	8.4	29.0	45.8
34	464	1.53	46.4	37.1	8.3	28.8	45.5
33	450	1.52	46.0	36.8	8.3	28.5	45.1
32	436	1.51	45.6	36.5	8.2	28.3	44.7
31	422	1.49	45.2	36.1	8.1	28.0	44.3
30	402	1.47	44.5	35.6	8.0	27.6	43.6
29	381	1.45	43.8	35.1	7.9	27.2	43.0
28	367	1.43	43.4	34.7	7.8	26.9	42.5
27	353	1.42	42.9	34.3	7.7	26.6	42.0
26	339	1.40	42.4	33.9	7.6	26.3	41.6
25	325	1.38	41.9	33.5	7.5	26.0	41.1
24	312	1.37	41.4	33.1	7.5	25.7	40.6
23	298	1.35	40.9	32.7	7.4	25.3	40.1
22	284	1.33	40.3	32.3	7.3	25.0	39.5
21	270	1.31	39.8	31.8	7.2	24.6	39.0
20	257	1.29	39.2	31.3	7.0	24.3	38.4
19	243	1.27	38.6	30.8	6.9	23.9	37.8
18	229	1.25	37.9	30.3	6.8	23.5	37.2
17	215	1.23	37.3	29.8	6.7	23.1	36.5
16	202	1.21	36.6	29.3	6.6	22.7	35.9
15	188	1.18	35.9	28.7	6.5	22.2	35.1
14	174	1.16	35.1	28.0	6.3	21.7	34.4
13	160	1.13	34.2	27.4	6.2	21.2	33.6
12	147	1.10	33.4	26.7	6.0	20.7	32.7
11	133	1.07	32.4	26.0	5.8	20.1	31.8
10	119	1.04	31.5	25.2	5.7	19.5	30.8
9	105	1.00	30.4	24.3	5.5	18.8	29.8
8	92	0.96	29.2	23.3	5.3	18.1	28.6
7	86	0.95	28.7	22.9	5.2	17.8	28.1
6	78	0.92	27.9	22.3	5.0	17.3	27.3
5	64	0.87	26.3	21.0	4.7	16.3	25.8
4	49	0.81	24.4	19.5	4.4	15.1	23.9
3	33	0.72	21.9	17.5	3.9	13.6	21.4
2	15	0.57	17.4	13.9	3.1	10.8	17.1
Leeward	All	---	53.1	-81.3	9.6	-90.8	-71.7

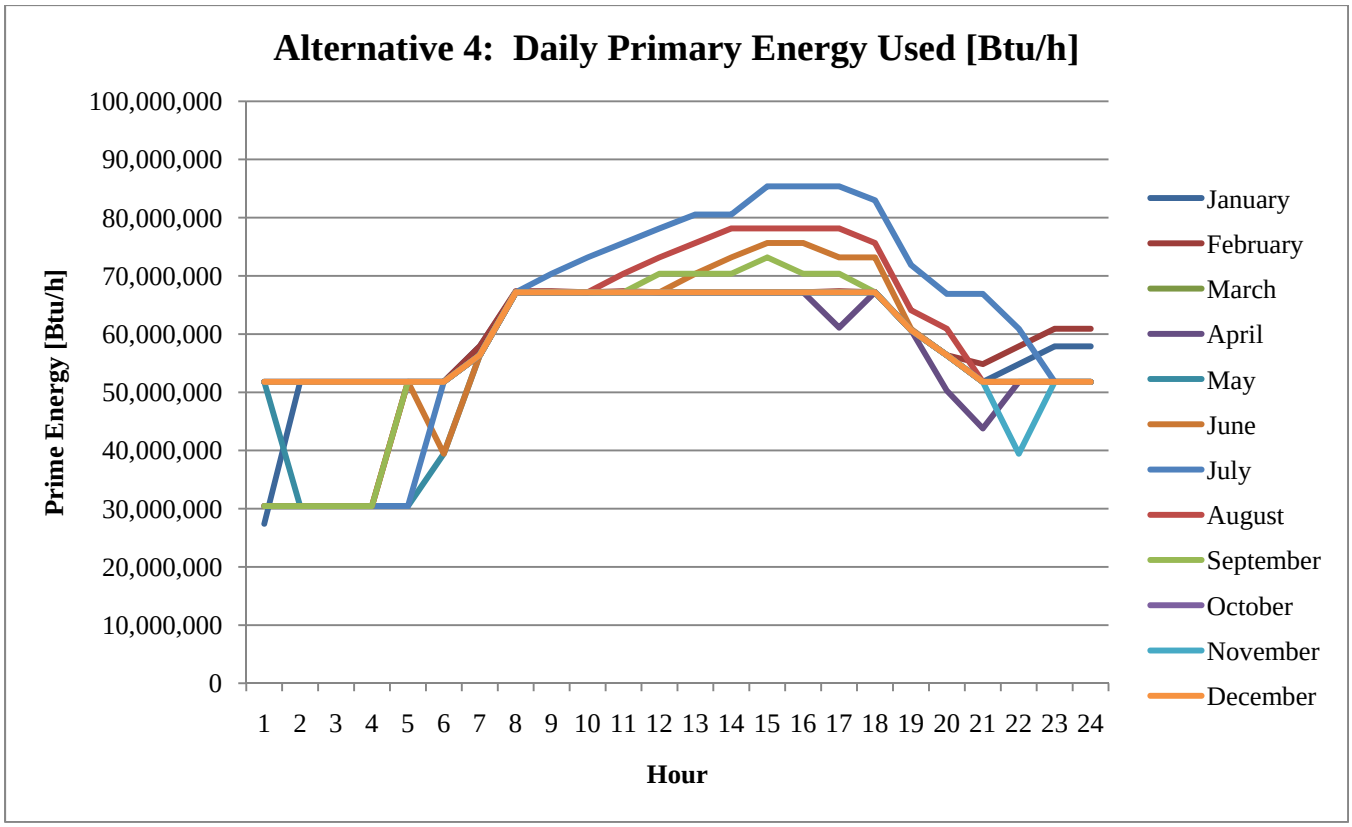
APPENDIX II.A: RESULTS FROM PLANT ALTERNATIVE STUDY

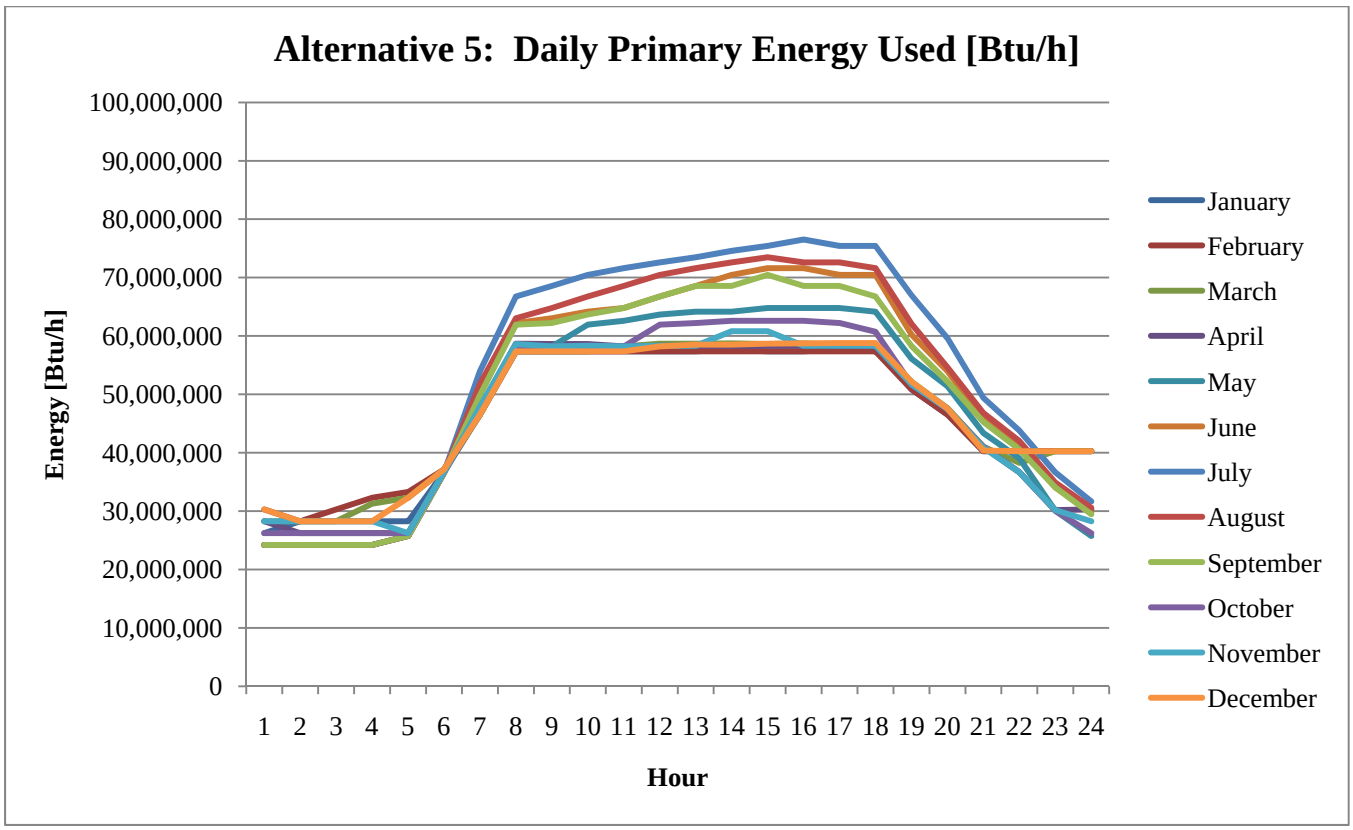
Chiller and CHP Plant Alternatives						
		Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 4**	**Alternative 5**
Chiller Plant	**Low range CV**	Electric	Absorption (1-stage)	Absorption (2-stage)	Absorption (2-stage)	Absorption (2-stage)
	Mid range VFD	Electric	Absorption (1-stage)	Absorption (2-stage)	Steam Comp. (2-stage)	Electric
	High range VFD	Electric	Electric	Electric	Steam Comp. (2-stage)	Electric
Prime Movers	**Low range**	IC Engine (VFD)	Gas Turbine (CV)	Gas Turbine (CV)	Gas Turbine (CV)	IC Engine (VFD)
	Mid range	Gas Turbine (CV)	Steam Generator (VFD)	IC Engine (VFD)	Gas Turbine (CV)	Gas Turbine (CV)
	High range	IC Engine (VFD)		Steam Gen. (VFD)	Steam Gen. (VFD)	IC Engine (VFD)




Alternative 2: Daily Primary Energy Used [Btu/h]
Energy [Btu/h]
100,000,000
90,000,000
80,000,000
70,000,000
60,000,000
50,000,000
40,000,000
30,000,000
20,000,000
10,000,000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour
January
February
March
April
May
June
July
August
September
October
November
December


Alternative 3: Daily Primary Energy Used [Btu/h]
Energy [Btu/h]
100,000,000
90,000,000
80,000,000
70,000,000
60,000,000
50,000,000
40,000,000
30,000,000
20,000,000
10,000,000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour
January
February
March
April
May
June
July
August
September
October
November
December


Alternative 4: Daily Primary Energy Used [Btu/h]
Prime Energy [Btu/h]
100,000,000
90,000,000
80,000,000
70,000,000
60,000,000
50,000,000
40,000,000
30,000,000
20,000,000
10,000,000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour
January
February
March
April
May
June
July
August
September
October
November
December


Alternative 5: Daily Primary Energy Used [Btu/h]
Energy [Btu/h]
100,000,000
90,000,000
80,000,000
70,000,000
60,000,000
50,000,000
40,000,000
30,000,000
20,000,000
10,000,000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour
January
February
March
April
May
June
July
August
September
October
November
December

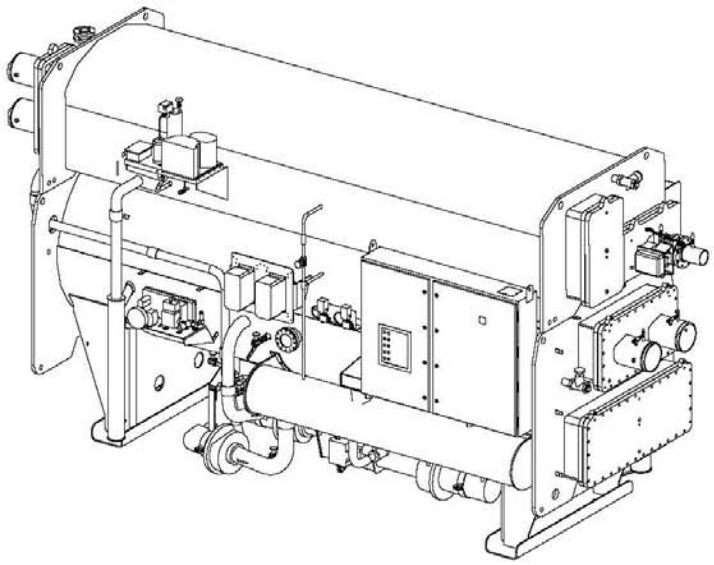
APPENDIX II.B: MANUFACTURER DATA FOR PLANT EQUIPMENT

TRANE

Operation/ Maintenance

Horizon™

Single-Stage Steam or Hot Water Absorption Chiller



Unit Model: ABSD

X39640542-02 **ABS-M-10A**

TRANE

General Information

Nameplate
The ABSD unit nameplate is located on the chiller control panel. The nameplate illustrated is an ABSD 800 ton, Single - Stage Steam Absorption.

Note: For temperature, pressure drops, and water flow data see the order write-up.

The Unit Nameplate contains very important service information such as the unit serial number, sales order number and the service model number. Always have this information readily available when requesting service.

Nameplate

TRANE

Trane Horizon Absorption Series
Single-Stage Absorption Liquid Chiller

Catalog Model Number
ABSD800

Service Model Number
ABSD080GF0KXXXXXANXXAVAMBEEBGAHDCAXXXXAXAXXXX0

Sales Order Number	Unit Serial Number
AXB123	L00D12345M

Maximum Inlet Steam Pressure: 14PSIG

Electrical Characteristics

Rated Voltage:	460 Volt 60 HZ 3 PH
Voltage Utilization Range:	414-506 VAC
Rated Current:	39.0 Amps
Minimum Circuit Ampacity:	47.0 Amps
Max Overcurrent Protective Device:	50.0 Amps
Purge Compressor RLA:	4.8 Amps
Control Circuit:	115 VAC 2000VA

Motors	KW	FLA
Purge Pump:	.19	4.4
Refrigerant Pump:	3.7	2.0
Absorber Solution Pump:	5.6	15.0
Low Temp Solution Pump:	3.7	12.0

Service Literature

Installation Manual	ABS-IN-10A
Oper/Maint. Manual	ABS-M-10A

Manufactured Under the Following U.S. Patents:
4223539, Other Patents Pending

This advanced model ABSD HORIZON Single-Stage Absorption Unit was developed with the assistance of the Gas Research Institute.

Product Description:

MODL ABSD	DSEQ FO	NTON 800
VOLT 460	BURN NSEL	BOPA NSEL
FTAA NSEL	SMHC NSEL	ENSR STM
ENPR 50	PVCN STD	PURG AUTO
LGTM SB04	HGTM NSEL	CDTM SB09
EVTM ES12	ABTM SB00	GNWA GN02
CAWA CA17	EVWA EV01	CAWC RERE
EVWC LEFR	CAFT WTR	EVFT WTR
EVLV BF03	EVIN FACT	EVPN SSTL
UPNT SFPT	WCNM SNMP	SPKG DAU
ELPP SELP	PPCO NFDS	LCLD CLDO
WVUO YES	OPTM YES	AFDS YES

TRANE

General Information

Service Model Number
Single Stage Absorption
Standard Options Only

Service Model digit / variable		Description	Selection
1 - 4		Absorption Unit Model	
	ABSD		Single Stage Absorption
5 - 7		Unit Nominal Tonnage	
	050		500 Nominal Tons
	060		600 Nominal Tons
	070		700 Nominal Tons
	080		800 Nominal Tons
	097		975 Nominal Tons
	110		1100 Nominal Tons
	122		1225 Nominal Tons
	135		1350 Nominal Tons
8		Unit Voltage	
	A		190 Volt - 50 HZ
	B		200 Volt - 60 HZ
	C		220 Volt - 50 HZ
	D		230 Volt - 60 HZ
	E		380 Volt - 50 HZ
	F		415 Volt - 50 HZ
	G		460 Volt - 60 HZ
	H		575 Volt - 60 HZ
9		Unit Energy Source	
	J		Steam Energy Source
	G		Hot Water Energy Source
10		Design Sequence	
11		Design Sequence	
12		Generator Waterbox Design Pressure	
	K		Steam - 50 PSIG ASME Required
	M		Hot Water - 150 PSIG ASME Required
	N		Hot Water - 400 PSIG ASME Required
	E		Pressure Vessel Construction Standard construction (includes ASME generator)
13	X	Not Applicable	
14	X	Not Applicable	
15	X	Not Applicable	
16	X	Not Applicable	
17	X	Not Applicable	
18 - 19		Low-Temperature Generator Tubes	
	AN		.028 Wall 90-10 CUNI Smooth Surface
	AP		.035 Wall 90-10 CUNI Smooth Surface
	AR		.049 Wall 90-10 CUNI Smooth Surface
	BD		.028 wall 409 SST Smooth Surface
20	X	Not Applicable	
21	X	Not Applicable	

TRANE

Sequence of Operation

To understand the Horizon chiller operation, a thorough understanding of the various aspects of the machine are required. This section of the manual, therefore, explains the lithium bromide cycle, the controls utilized to control the lithium bromide cycle, and the sequence of operation of the cycle and associated controls.

Machine Solution Cycle

The machine solution cycle is discussed in this section. Refer to the cooling cycle schematic, Figure 3, during the cycle explanation and reference Table 1.

Figure 3 – Single-Stage Absorption Refrigeration Cycle

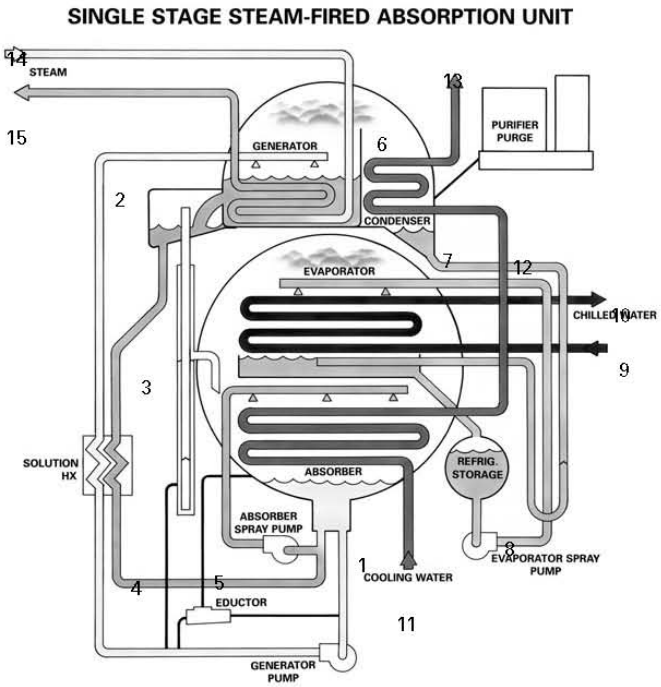


Table 1 – Machine Cooling Cycle (Ref. Figure 3) (Typical Temperatures)

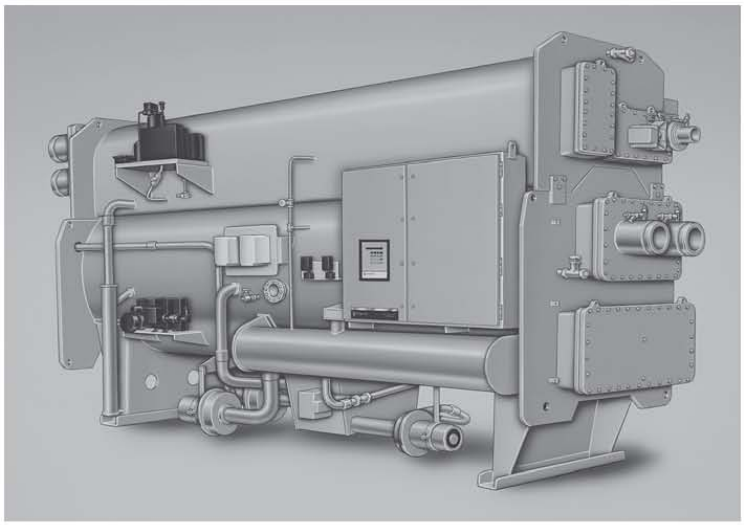
Point	LiBr Solution or Refrigerant Water	Concentration %	Temperature (°F)	Temperature (°C)
1	Absorber Dilute Solution	60.8	107	42
2	Absorber Dilute Solution Entering the LTG	60.8	185	85
3	Solution Leaving the LTG	64.4	216	102
4	Solution Entering ABS Sump/Spray Pump	64.4	129	54
5	ABS Spray Solution (Mixed w/abs dilute)	63.1	121	49
6	LTG Refrigerant Vapor	NA	208	98
7	Condensed Refrigerant	NA	110	43
8	Evaporator Pump Refrigerant	NA	41	5
9	System Chilled Water/Entering	NA	54	12
10	System Chilled Water/Leaving	NA	44	7
11	Absorber Cooling Water	NA	85	29
12	Absorber Leaving/Condenser Entering Cooling Water	NA	94	34
13	Condenser Leaving Cooling Water	NA	101.6	38.6
14a	Steam Entering Unit @12 psig @ Sea Level	NA	244	118
14b	Hot Water Entering Unit @270°F (option)	NA	270	132
15a	Condensate Leaving Generator	NA	244	118
15b	Hot Water Leaving Generator (option)	NA	222	106

TRANE

Trane Horizon™ Absorption Series

Two-Stage Steam-Fired or Hot Water Absorption Water Chillers 380-1650 Tons – 50-60 Hz

Built for Industrial and Commercial Applications



September 2005 ABS-PRC004-EN

TRANE

Features and Benefits

Refrigeration Cycle

Absorption Refrigeration Cycle
Figure FB-1 is an example of typical machine operation at a standard rating point condition (i.e., 85° tower, 44° leaving chilled water) at full load. Dilute solution is a relatively high refrigerant content and low lithium bromide content. An intermediate solution is a mixture of dilute and concentrated solutions. A concentrated solution is one with a relatively low refrigerant content and high lithium bromide content.

High Temperature Generator (1)
Solution (intermediate) enters the bottom of the high temperature generator where the refrigerant water vapor is separated from the solution via the energy source inside the tube bundle (steam or hot water). The refrigerant vapor travels to the low temperature generator. The now concentrated solution returns to the absorber through the high and low temperature heat exchangers.

Solution 300 F (149 C), Refrigerant Vapor 300 F (149 C), Tube Bundle 115 PSIG steam or 346 F (174 C)

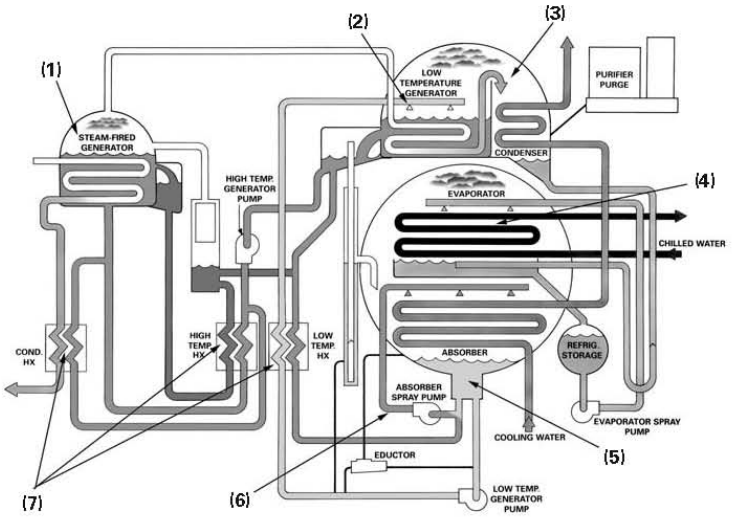
Low Temperature Generator (2)
Solution (dilute) is pumped into the low temperature generator where the solution is boiled creating additional refrigerant vapor via the refrigerant vapor inside the tube bundle. The refrigerant vapor then condenses and flows to the condenser. The now intermediate solution then flows to one of two locations: the absorber spray system to mix with strong concentrated solution from the high temperature generator or to the high temperature generator.

Solution 180 F (82 C), Vapor 190 F (88 C)

Condenser (3)
Refrigerant vapor (produced by the low temperature generator) and refrigerant liquid (via the tube bundle) enter the condenser to be reduced in pressure/ temperature via expansion device for delivery to the evaporator. The heat of condensation is rejected to the cooling water inside the tube bundle.

Refrigerant 100 F (38 C), Entering/ Leaving Cooling Water 93 F/97 F (34 C/36 C)

Figure FB-1 – Absorption Refrigeration Cycle



Evaporator (4)
System water runs through the tube bundle where its heat is transferred to the refrigerant causing the refrigerant to vaporize/boil. The refrigerant vapor flows to the slightly lower pressure in the absorber.

Entering/Leaving System Water 54 F/44 F (12 C/7 C), Evaporator Pump Refrigerant 42 F (6 C)

Absorber (5)
Refrigerant vapor is absorbed by the lithium bromide solution (dilute) to be circulated and cycled again. The solution is pumped to the low temperature generator. Heat (acquired in the evaporator) is rejected via the cooling water inside the tube bundle.

Leaving Solution 95 F (35 C), Entering / Leaving Cooling Water 85 F/93 F (29 C/34 C)

Absorption Process (6)
Solution (concentrated) enters the spray system from the high and low temperature generators enters the spray system wetting the tubes and providing a liquid surface for the refrigerant vapor from the evaporator to absorb into the lithium bromide solution. The solution temperature/concentration sprayed in the absorber controls the absorber pressure thereby controlling the evaporator refrigerant temperature.

Entering Solution 112 F (44 C)

Low, High and Condensate Heat Exchangers (7)
Solution flows through the high and low temperature heat exchangers to be preheated reducing the heat energy required to induce boiling within the generators and to decrease the temperature of the solution being returned to the absorber, thus decreasing the load on the cooling tower.

TRANE

Application Considerations General

General
The Horizon two-stage steam-fired or hot water absorption chiller is designed to provide 40 F to 60 F (+4.4 C - +15.6 C) chilled water for comfort or process cooling applications within all three market segments – commercial, industrial and institutional. The primary advantage of the absorption chiller over other chiller options, is its ability to use steam or hot water to provide energy-saving cooling.

Operating Limits
Trane two-stage absorption chillers operate with nominal 120 PSIG steam or nominal 370 F hot water. In all applications, superheat should be limited so steam temperature does not exceed 400 F. Hot water machines can use up to 370 F hot water.

Water flows within the limits indicated on the appropriate selection charts will insure tube water velocities not exceeding 10 feet per second in copper tubes and 11 feet per second in cupronickel tubes. Changes in condenser water temperature should not exceed 1-degree F per minute between the range of 75 -95 F.

Sound and Vibration
Absorption units are well suited for areas where low sound levels are required. The Trane Horizon two-stage steam absorption chiller will operate under normal load conditions at less than an 85 dBA sound pressure level. During operation there is no vibration of any components that could be damaging to the chiller or could transmit objectionable sound or vibration to the building.

Chiller Installation
The following should be taken into consideration when installing an absorption chiller:
- Rigging and service clearances
- Foundation support
- Chiller isolation for sound/vibration reduction
- Condensate handling
- Steam supply control
- Condenser water temperature control
- Chilled water flow control
- Chilled and condenser water flow limit
- Generator hot water application

Cooling Tower Water Flow
The ARI standard gpm/ton for absorption chillers is 4.0 but lower flow through the condenser and absorber section will present an opportunity for a smaller tower and smaller condenser pump. By designing a system around lower flows there will likely be significant annual chiller plant electrical energy savings. For more information on lower flows on the cooling tower water circuit refer to the appropriate engineering bulletin.

Water Treatment
The use of untreated or improperly treated water may result in scaling, erosion, and corrosion, algae or slime. It is recommended that the services of a qualified water treatment specialist be used to determine what treatment, if any is advisable. The Trane Company assumes no responsibility for the results of untreated, or improperly treated water.

Combination Systems
Peak energy savings can be achieved when using a combination of electric chillers and absorption chillers for air conditioning loads. The absorption chiller is used to shave seasonal billable peak power demands during summer operation, and the electric chiller is run below the allowed demand limit, reducing costly demand charges. Trane offers both electric chillers and absorption chillers with the unit control panel (UCP2) as standard. Although the chillers have different features and modes of operation, the chiller control panel looks and acts the same across all chiller lines. Each control panel is programmed to monitor the particular chiller for which it was designed but maintenance and service personnel need only become familiar with one control panel. Combined with a Trane Tracer™ system a chiller plant has almost unlimited operational flexibility and all equipment is supplied from a single source.

Multiple Machines
The Trane absorption machine can be applied to series or parallel chilled water flow depending upon the design requirement. Accurate chilled water temperatures can be maintained on individual machines between 100 percent and 10 percent chiller load which allows for a wide range of control options. Each chiller has a stand-alone control system to manage the desired water temperature and also the ability to receive remote commands to support various system demands from a control center. This versatility of control makes the management of more than one machine relatively easy.

Parallel flow allows minimum chilled water pressure drop through the machines. However, with one machine "off," it is not usually possible to maintain the design chilled water temperature unless one machine is valved-off and the chilled water flow decreased.

Series flow permits design chilled water temperature at light loads with one machine "off." However, at all operating conditions, the chilled water pressure drop through the machine is high.

A decision concerning which arrangement is best for an individual system should be based on an analysis of system water and temperature rise requirements, system and machine pressure drop characteristics, and installation cost.

TRANE

Selection Procedure

Model Number Description

Selection

Product Coding Description
The coding block precisely identifies all characteristics of a any Horizon™ Two-Stage Steam-Fired or Hot Water Absorption Chiller.

Table S-1 — Product Coding Description

MODL - Absorption Unit Model
ABTF Horizon Two-Stage

DSEQ - Unit Design Sequence
E0 Design Sequence

NTON - Unit Nominal Tonnage
380 380 Tons
440 440 Tons
500 500 Tons
575 575 Tons
660 660 Tons
750 750 Tons
850 850 Tons
950 950 Tons
1050 1050 Tons
1150 1150 Tons
1200 1200 Tons
1350 1350 Tons
1500 1500 Tons
1650 1650 Tons

VOLT - Unit Voltage
190 190/50/3
200 200/60/3
220 220/50/3
230 230/60/3
380 380/50/3
415 415/50/3
460 460/60/3
575 575/60/3

ENSR - Unit Energy Source
HOTW Hot Water
STM Steam

ENPR - Unit Energy Pressure
115 115 Psig Steam
400 400 Psig Hot Water

PVCN - Pressure Vessel Construction
ASME ASME Evp-Abs-Cds
ISPL Ispesl Evp-Abs-Cds
LMIN Les-Mines Evp-Abs-Cds
TUV Tuv Evp-Abs-Cds
STD Standard

LGTM - Low-Temp Generator Tube Material/ Surface
SB01 .028 Wall 95-5 CuNi Smooth
SB04 .028 Wall 90-10 CuNi Smooth
SB05 .035 Wall 90-10 CuNi Smooth
SB06 .049 Wall 90-10 CuNi Smooth

HGTM - High-Temp Generator Tube Material/ Surface
SB16 .028 Wall 409 Sstl Smooth

EVTM - Evaporator Tube Material/Surface
ES01 .028 Wall 95-5 CuNi Enhanced
ES11 .025 Wall 90-10 CuNi Enhanced
ES05 .035 Wall 90-10 CuNi Enhanced
ES09 .028 Wall Copper Enhanced
ES12 .025 Wall Copper Enhanced

CDTM - Condenser Tube Material
SB04 .028 Wall 90-10 CuNi Smooth
SB05 .035 Wall 90-10 CuNi Smooth
SB06 .049 Wall 90-10 CuNi Smooth
SB09 .028 Wall Copper Smooth
SB10 .035 Wall Copper Smooth

ABTM - Absorber Tube Material/Surface
SB00 .022 Wall 95-5 CuNi Smooth
SB01 .028 Wall 95-5 CuNi Smooth
SB02 .035 Wall 95-5 CuNi Smooth
SB03 .049 Wall 95-5 CuNi Smooth
SB04 .028 Wall 90-10 CuNi Smooth
SB05 .035 Wall 90-10 CuNi Smooth
SB06 .049 Wall 90-10 CuNi Smooth

GNWA - Generator Water Box Arrangement
GN02 1-Pass 150 PSI Non-Marine RF Flange
GN04 2-Pass 150 PSI Non-Marine RF Flange

CAWA - Condenser and Absorber Water Box Arrangement
CA01 1-Pass Cond, 2-Pass Abs 150 PSI Marine Victaulic
CA02 1-Pass Cond, 2-Pass Abs 150 PSI Marine RF Flange
CA05 2-Pass Cond, 2-Pass Abs 150 PSI Marine Victaulic
CA06 2-Pass Cond, 2-Pass Abs 150 PSI Marine RF Flange

EVWA - Evaporator Water Box Arrangement
EV01 2-Pass 150 Psi Non-Marine Victaulic
EV02 2-Pass 150 Psi Non-Marine RF Flange

CAWC - Condenser and Absorber Water Connections
LELE In LH End - Out LH End
LERE In LH End - Out RH End
RERE In RH End - Out RH End

EVWC - Evaporator Water Connections
LEBK Inlet Connection Left Back
LEFR Inlet Connection Left Front
REBK Inlet Connection Right Back
REFR Inlet Connection Right Front
LEND Inlet LH End
REND Inlet RH End

CAFT - Condenser and Absorber Water Box Fluid Type
WTR Water
EGLY Ethylene Glycol Solution
PGLY Propylene Glycol Solution

EVFT - Evaporator Water Box Fluid Type
WTR Water
EGLY Ethylene Glycol Solution
PGLY Propylene Glycol Solution

TRANE

Performance Data

Table PD-1 — Performance Data at ARI Conditions

English Units*

Model	Capacity (Tons)	Coefficient of Performance	Steam Rate (lbm/ton/hr)	Chilled Water Flow Rate (gpm)	Chilled Water Press. Drop (ft Wtr)	Cond/Abs Water Flow Rate (gpm)	Cond/Abs Water Pr. Drop (ft Wtr)
ABTF-380	360	1.21	9.73	861	13.7	1520	26.5
ABTF-440	426	1.21	9.69	1018	14.6	1760	30.5
ABTF-500	493	1.22	9.65	1178	15.6	2000	34.9
ABTF-575	558	1.21	9.65	1333	26.9	2300	19.4
ABTF-660	659	1.22	9.62	1576	29.1	2640	20.9
ABTF-750	765	1.22	9.63	1833	31.6	3000	22.9
ABTF-850	915	1.24	9.51	2187	13.7	3400	13.3
ABTF-950	1030	1.24	9.51	2462	19.1	3800	17.5
ABTF-1050	1145	1.24	9.49	2736	25.8	4200	22.5
ABTF-1150	1259	1.24	9.48	3010	33.9	4600	28.3
ABTF-1200	1264	1.19	9.83	3022	13.2	4800	16.0
ABTF-1350	1419	1.19	9.84	3391	18.2	5400	21.2
ABTF-1500	1573	1.19	9.84	3759	24.4	6000	27.2
ABTF-1650	1721	1.20	9.77	4113	31.7	6600	34.1

SI Units**

Model	Capacity (kW)	Coefficient of Performance	Steam Rate (kg/kw-hr)	Chilled Water Flow Rate (m^3/hr)	Chilled Water Press. Drop (m wg)	Cond/Abs Water Flow Rate (m^3/hr)	Cond/Abs Water Pr. Drop (m wg)
ABTF-380	1266	1.20	1.25	196	4.5	345	8.7
ABTF-440	1498	1.21	1.25	231	4.8	400	10.0
ABTF-500	1734	1.21	1.24	268	5.1	454	11.5
ABTF-575	1963	1.21	1.24	303	8.8	522	6.4
ABTF-660	2318	1.22	1.24	358	9.5	600	6.9
ABTF-750	2691	1.21	1.24	416	10.4	681	7.5
ABTF-850	3218	1.23	1.23	497	4.5	772	4.4
ABTF-950	3623	1.23	1.23	559	6.3	863	5.7
ABTF-1050	4027	1.24	1.22	621	8.5	954	7.4
ABTF-1150	4428	1.24	1.22	684	11.1	1045	9.3
ABTF-1200	4446	1.19	1.27	686	4.3	1090	5.2
ABTF-1350	4991	1.19	1.27	770	6.0	1226	7.0
ABTF-1500	5533	1.19	1.27	854	8.0	1363	8.9
ABTF-1650	6053	1.20	1.26	934	10.4	1499	11.2

*English:
4.0 gpm/nominal ton, Pstm = 120 psig, TctwS = 85 F, TcwS = 44 F, TcwR = 54 F, 0.0001 Evaporator fouling and 0.00025 Absorber/Condenser fouling.

**Metric:
.26 m^3/kWh, Pstm = 120 psig, TctwS = 29.44 C, TcwS = 6.67 C, TcwR =12.2 C, 0.0001 Evaporator fouling and 0.00025 Absorber/Condenser fouling.

TRANE

Performance Data

Table PD-2 — Performance Data at Trane Rated Conditions

English Units*

Model	Capacity (Tons)	Coefficient of Performance	Steam Rate (lbm/ton/hr)	Chilled Water Flow Rate (gpm)	Chilled Water Press. Drop (ft Wtr)	Cond/Abs Water Flow Rate (gpm)	Cond/Abs Water Pr. Drop (ft Wtr)
ABTF-380	334	1.18	9.98	665	8.2	1368	21.7
ABTF-440	395	1.18	9.93	787	8.7	1584	25.0
ABTF-500	457	1.19	9.9	909	9.3	1800	28.5
ABTF-575	517	1.19	9.9	1029	15.7	2070	16.0
ABTF-660	611	1.19	9.86	1216	16.9	2376	17.2
ABTF-750	710	1.19	9.88	1413	18.3	2700	18.8
ABTF-850	843	1.21	9.76	1679	7.9	3060	11.0
ABTF-950	951	1.21	9.74	1893	11.0	3420	14.5
ABTF-1050	1058	1.21	9.73	2106	14.9	3780	18.6
ABTF-1150	1165	1.21	9.71	2319	19.6	4140	23.4
ABTF-1200	1167	1.16	10.09	2324	7.6	4320	13.2
ABTF-1350	1311	1.16	10.09	2611	10.5	4860	17.4
ABTF-1500	1455	1.16	10.09	2897	14.1	5400	22.4
ABTF-1650	1595	1.17	10.01	3175	18.4	5940	28.1

SI Units**

Model	Capacity (kW)	Coefficient of Performance	Steam Rate (kg/kw-hr)	Chilled Water Flow Rate (m^3/hr)	Chilled Water Press. Drop (m wg)	Cond/Abs Water Flow Rate (m^3/hr)	Cond/Abs Water Pr. Drop (m wg)
ABTF-380	1175	1.17	1.29	151	2.7	311	7.1
ABTF-440	1389	1.18	1.28	179	2.9	360	8.2
ABTF-500	1607	1.18	1.28	206	3.1	409	9.4
ABTF-575	1819	1.18	1.28	234	5.2	470	5.2
ABTF-660	2149	1.19	1.27	276	5.5	540	5.6
ABTF-750	2497	1.19	1.27	321	6.0	613	6.2
ABTF-850	2965	1.20	1.26	381	2.6	695	3.6
ABTF-950	3345	1.20	1.26	430	3.6	777	4.8
ABTF-1050	3721	1.21	1.25	478	4.9	858	6.1
ABTF-1150	4098	1.21	1.25	527	6.4	940	7.7
ABTF-1200	4105	1.16	1.30	528	2.5	981	4.3
ABTF-1350	4611	1.16	1.30	593	3.4	1104	5.7
ABTF-1500	5118	1.16	1.30	658	4.6	1226	7.3
ABTF-1650	5610	1.17	1.29	721	6.0	1349	9.2

*English:
4.0 gpm/nominal ton, Pstm = 120 psig, TctwS = 85 F, TcwS = 44 F, TcwR = 54 F, 0.0001 Evaporator fouling and 0.00025 Absorber/Condenser fouling.

**Metric:
.26 m^3/kWh, Pstm = 120 psig, TctwS = 29.44 C, TcwS = 6.67 C, TcwR =12.2 C, 0.0001 Evaporator fouling and 0.00025 Absorber/Condenser fouling.

TRANE

Performance Data

Figure PD-1 – ABTF Capacity vs. Chilled Water Supply Temperature at Various Cooling Water Supply Temperatures

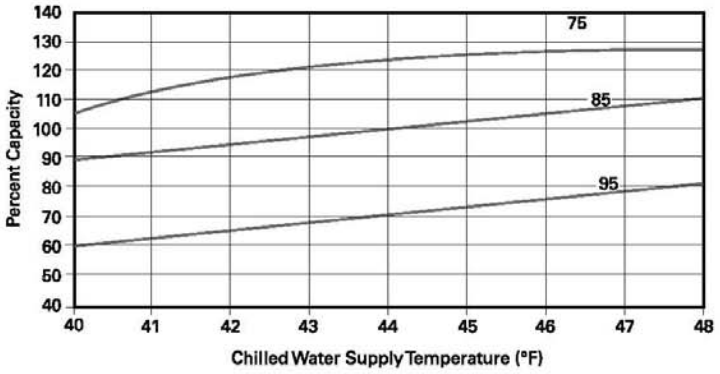
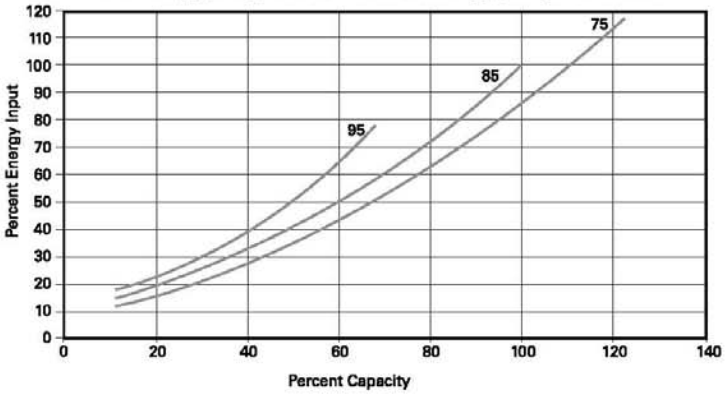


Figure PD-2 – ABTF Part Load Performance – Energy Input vs. Capacity at Various Cooling Water Supply Temperatures – Chilled Water Supply Temperature = 44 F



TRANE

Product Catalog

EarthWise™ CenTraVac™ Water-Cooled Liquid Chillers

170–3950 Tons, 50 and 60 Hz

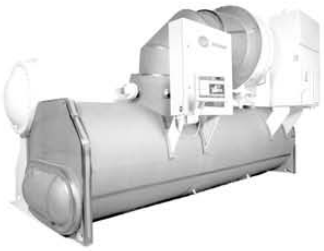
Tonnage Ranges By CenTraVac Model Number

CVHE — Three-Stage Single Compressor CenTraVac — 50/60 Hz

170 500

CVHF — Two-Stage Single Compressor CenTraVac — 60 Hz

325 2000



CVHG — Three-Stage Single Compressor CenTraVac — 50 Hz

450 1300

CDHG — Dual Compressor CenTraVac — 50 Hz

1200 2500

CDHF — Dual Compressor CenTraVac — 60 Hz

1500 3950

GPC — Gas Powered CenTraVac Package — 60Hz

170 3950

CVHE/CVHF/CVHG
CDHF/CDHG

January 2008

CTV-PRC007-EN

TRANE

Features and Benefits

Features and Benefits

Comparing the Attributes of Low Pressure Chiller Operation to High Pressure Chiller Operation

Trane CenTraVac™ chillers continue to offer time-tested and proven low-pressure refrigerants, including environmental friendly HCFC-123. Trane CenTraVac chillers provide the safety of low pressure with continued product improvement in leak proof design. Consider the benefits of low-pressure over high-pressure chillers:

Table 1. Low pressure to high pressure comparison at ARI conditions

	Low Pressure	Medium/High Pressure
Evaporator	• Always at negative pressure • Air leaks inward at low rate • Refrigerant lost: (# air leak in) x purge efficiency[a] • No refrigerant loss into equipment room (vented to the relief line via purge)	• Always at positive pressure • Refrigerant leaks outward at moderate rate • Refrigerant loss is into equipment room
Condenser	• Usually at negative pressure during inactivity (air leaks inward) • At slightly positive pressure during operation • Refrigerant leaks outward at very low rate during operation	• Always at high positive pressure • Refrigerant leaks outward at very high rate

Monitoring of leak rate	• Trane EarthWise™ purge is able to continuously monitor in-leakage with the run meter.
	• Refrigerant monitor as required by ASHRAE.
	• Purge can be connected to a building automation system for notification of increased purge operation (in-leak). Similarly, the refrigerant monitor can be connected to the building automation system.
		• Only ways to monitor leak rate on high pressure chiller are:
		  • periodic leak checks
		  • purchase refrigerant monitor
		• Refrigerant monitor as required by ASHRAE.
		• Normally the only time that a leak is detected on a high pressure chiller is during spring startup. This means that a chiller which develops a leak in the summer may leak continuously until the following spring.

Typical Pressures (38°F evap.) (100°F cond.)	**HCFC-123** Evap: -9.2 psig (-18.1 in. Hg) Cond: 6.1 psig	**HFC-134a** Evap: 33.1 psig Cond: 124.1 psig

(a) Trane EarthWise purge efficiency does not exceed 0.02 lb·refrigerant/lb·air

TRANE

Performance Data

Evaporator Flow Rates

Performance Data

Table 3. Minimum and maximum evaporator flow rates (gpm)

Shell Size	Bundle Size	One Pass						Two Pass						Three Pass					
		IMCU		TECU		IECU		IMCU		TECU		IECU		IMCU		TECU		IECU	
EVSZ	EVBS	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
032S	200	154	1129	241	1324	155	1136	77	564	121	662	78	568	52	376	81	441	52	379
032S	230	178	1302	271	1485	179	1311	89	651	135	742	90	655	60	434	90	495	60	437
032S	250	190	1389	298	1635	191	1399	95	694	149	817	96	699	64	463	100	545	64	466
032S/L	280	217	1584	340	1865	218	1595	109	782	170	932	109	797	72	528	114	622	73	531
032S/L	320	246	1801	379	2084	248	1814	13	901	190	1042	124	907	82	600	127	694	83	605
032S/L	350	270	1975	—	—	272	1988	135	987	—	—	136	994	90	658	—	—	91	662
050S	320	249	1823	379	2084	251	1836	125	911	190	1042	126	918	83	607	127	694	84	612
050S	360	273	1997	428	2349	275	2010	137	998	214	1174	138	1005	91	665	143	783	92	670
050S	400	305	2235	474	2602	307	2251	153	1118	237	1301	154	1125	102	745	158	867	103	750
050S/L	450	347	2540	539	2959	349	2557	174	1270	270	1480	175	1278	1116	847	180	986	117	852
050S/L	500	388	2843	597	3281	391	2962	194	1421	299	1641	196	1431	130	948	199	1093	131	954
050S/L	550	427	3126	—	—	430	3147	214	1563	—	—	215	1573	143	1042	—	—	144	1049
080S	500	388	2843	597	3281	391	2862	194	1421	299	1641	196	1431	130	948	199	1093	131	954
080S	560	430	3148	673	3696	433	3169	215	1573	337	1848	217	1584	144	1049	224	1232	145	1056
080S	630	486	3561	754	4145	489	3584	243	1780	377	2072	245	1792	162	1187	252	1382	163	1194
080S/L	710	551	4038	846	4652	555	4065	276	2018	423	2325	279	2032	184	1346	282	1551	185	1355
080S/L	800	619	4537	961	5286	623	4567	310	2268	481	2642	312	2284	207	1512	321	1761	208	1522
080S/L	890	690	5058	—	—	695	5093	345	2529	—	—	348	2546	230	1685	—	—	232	1697
142M/L	890	693	5080	964	5297	692	5069	347	2540	482	2648	346	2534	231	1693	321	1765	231	1689
142M/L	980	770	5645	1079	5930	769	5632	385	2822	540	2965	384	2816	257	1881	360	1976	256	1877
142M/L	1080	868	6361	1200	6598	866	6347	434	3180	600	3299	433	3173	290	2120	400	2199	289	2115
142M/L/E	1220	963	7056	1349	7416	961	7040	482	3528	675	3708	480	3520	321	2351	450	2472	320	2346
142M/L/E	1420	1120	8206	1502	8256	1116	8188	560	4103	751	4128	559	4094	373	2735	501	2752	373	2729
210L	1610	1232	9031	1470	8083	1229	9011	616	4515	735	4041	615	4506	411	3010	490	2694	410	3003
210L	1760	1383	10139	1642	9029	1380	10117	692	5069	821	4514	690	5058	461	3379	548	3009	460	3372
210L	1900	1528	11203	1824	10030	1525	11178	764	5601	912	5014	763	5589	510	3734	608	3343	509	3726
210L	2100	1623	11898	2010	11055	1619	11871	812	5948	1005	5527	810	8935	541	3965	670	3685	540	3957
250E	2280	1587	11637	1935	10642	1590	11663	793	5819	967	5321	795	5832	Not Applicable					
250E	2300	1750	12832	2174	11953	1762	12917	875	6415	1087	5976	881	6458	584	4277	725	3984	588	4306
250E	2480	1757	12882	2127	11699	1761	12911	878	6441	1064	5850	880	6456	Not Applicable					
250E	2500	1916	14047	2394	13162	1929	14141	958	7023	1197	6581	965	7070	639	4682	798	4387	643	4713
210D	1610	1216	8913	1421	7814	1224	8973												
210D	1850	1388	10175	1680	9239	1397	10243	Not Applicable						Not Applicable					
210D	2100	1557	11414	1935	10641	1567	11490												
250D	2100	1557	11414	1943	10686	1567	11490												
250D	2300	1724	12633	2101	11554	1735	12717	Not Applicable						Not Applicable					
250D	2500	1887	13830	2314	12723	1899	13922												
250M	2100	1557	11414	1943	10686	1567	11490												
250M	2300	1724	12633	2101	11554	1735	12717	Not Applicable						Not Applicable					
250M	2500	1887	13830	2314	12723	1899	13922												
250X	2100	1557	11414	1943	10686	1567	11490												
250X	2300	1724	12633	2101	11554	1735	12717	Not Applicable						Not Applicable					
250X	2500	1887	13830	2314	12723	1899	13922												

Note: The minimum evaporator water velocity is 1.5 ft/sec for IECU tubes and 2.0 ft/sec for all other tubes. For a variable evaporator water flow system, the minimum GPME is generally not applicable at full load, and may be limited by other factors such as glycol. Confirm actual minimum and maximum flows for each selection before operating near flow boundaries. In the above table, 0.025" wall tubes were used for M, L, S, and E bundles and 0.028" wall tubes were used for D, M, and X bundles.

TRANE

Performance Data

Evaporator Flow Rates

Minimum and maximum evaporator flow rates (liter/second)

Shell Size	Bundle Size	One Pass						Two Pass						Three Pass					
		IMCU		TECU		IECU		IMCU		TECU		IECU		IMCU		TECU		IECU	
EVSZ	EVBS	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
032S	200	10	71	15	84	10	72	5	36	8	42	5	36	3	24	5	28	3	24
032S	230	11	82	17	94	11	83	6	41	9	47	6	41	4	27	6	31	4	28
032S	250	12	88	19	103	12	88	6	44	9	52	6	44	4	29	6	34	4	29
032S/L	280	14	100	21	118	14	101	7	49	11	59	7	50	5	33	7	39	5	34
032S/L	320	16	114	24	131	16	114	8	57	12	66	8	57	5	38	8	44	5	38
032S/L	350	17	125	—	—	17	125	9	62	—	—	9	63	6	42	—	—	6	42
050S	320	16	115	24	131	16	116	8	57	12	66	8	58	5	38	8	44	5	39
050S	360	17	126	27	148	17	127	9	63	14	74	9	63	6	42	9	49	6	42
050S	400	19	141	30	164	19	142	10	71	15	82	10	71	6	47	10	55	6	47
050S/L	450	22	160	34	187	22	161	11	80	17	93	11	81	7	53	11	62	7	54
050S/L	500	24	179	38	207	25	187	12	90	19	104	12	90	819	60	13	69	8	60
050S/L	550	27	197	—	—	27	199	14	99	—	—	14	99	9	66	—	—	9	66
080S	500	24	17	38	207	25	181	12	90	19	104	12	90	8	60	13	69	8	60
080S	560	27	199	42	233	27	200	14	99	21	117	14	100	9	66	14	78	9	67
080	630	31	225	48	262	31	226	15	112	24	13	115	113	10	75	16	87	10	75
080S/L	710	35	255	53	293	35	256	17	127	27	147	18	128	12	85	18	98	12	85
080S/L	800	39	286	61	333	39	288	20	143	30	167	20	144	13	95	20	111	13	96
080S/L	890	44	319	—	—	44	321	22	160	—	—	22	161	15	106	—	—	15	107
142M/L	890	44	320	61	334	44	320	22	160	30	167	22	160	15	107	20	111	15	107
142M/L	980	49	356	68	374	49	355	24	178	34	187	24	178	16	119	23	125	16	118
142M/L	1080	55	401	76	416	55	400	27	201	38	208	7	200	18	134	25	139	18	133
142M/L/E	1220	61	445	85	468	61	444	30	223	43	234	30	222	20	148	28	156	20	148
142M/L/E	1420	71	518	95	521	70	517	35	259	47	260	35	258	24	173	32	174	24	172
210L	1610	78	570	93	510	78	569	39	285	46	25	39	284	26	190	31	170	26	189
210L	1760	87	640	104	570	87	638	44	320	52	285	44	319	29	213	35	190	29	213
210L	1900	96	707	115	633	96	705	48	353	58	316	48	353	32	236	38	211	32	235
210L	2100	102	751	127	697	102	749	51	375	63	349	51	564	34	250	42	232	34	250
250E	2280	100	934	122	671	100	736	50	367	61	336	50	368	Not Applicable					
250E	2300	110	810	137	754	111	815	55	405	69	377	56	407	37	270	46	251	37	272
250E	2480	111	813	134	738	111	815	55	406	67	369	56	407	Not Applicable					
250E	2500	121	886	151	830	122	892	60	443	76	415	61	446	40	295	50	277	41	297
210D	1610	77	562	90	493	77	566												
210D	1850	88	642	106	583	88	646	Not Applicable						Not Applicable					
210D	2100	98	720	122	671	99	725												
250D	2100	98	720	123	674	99	725												
250D	2300	109	797	133	729	109	802	Not Applicable						Not Applicable					
250D	2500	119	873	14	803	120	878												
250M	2100	98	720	123	674	99	725												
250M	2300	109	797	133	729	109	802	Not Applicable						Not Applicable					
250M	2500	119	873	146	803	120	878												
250X	2100	98	720	123	674	99	725												
250X	2300	109	797	133	729	109	802	Not Applicable						Not Applicable					
250X	2500	119	873	146	803	120	878												

Note: The minimum evaporator water velocity is .457 m/s for IECU tubes and .610 m/s for all other tubes. For a variable evaporator water flow system, the minimum LPS is generally not applicable at full load, and may be limited by other factors such as glycol. Confirm actual minimum and maximum flows for each selection before operating near flow boundaries. In the above table, 0.025" wall tubes were used for M, L, S, and E bundles and 0.028" wall tubes were used for D, M, and X bundles.

TRANE

Performance Data

Condenser Flow Rates

Table 4. Minimum and Maximum condenser flow rates (gpm)

Shell Size CDSZ	Bundle Size CDBS	Two Pass							
		SBCU		TECU		IECU		IMCU	
		Min	Max	Min	Max	Min	Max	Min	Max
032S	230	214	784	209	763	217	795	216	792
032S/L	250	239	877	233	854	245	896	244	892
032S/L	280	267	980	261	954	272	997	271	992
032S/L	320	295	1083	288	1055	305	1117	304	1112
050S	360	336	1233	328	1201	347	1269	345	1263
050S/L	400	378	1388	369	1351	391	1430	389	1423
050S/L	450	26	1563	416	1522	440	1611	438	1604
050S/L	500	473	1733	461	1688	489	1792	787	1784
080S	500	473	1733	461	1688	489	1792	487	1784
080S	560	529	1940	516	1889	547	2004	545	1995
080S/L	630	595	2182	580	2126	613	2246	610	2235
080S/L	710	691	2466	656	2402	687	2518	584	2506
080S/L	800	756	2770	736	2698	772	2830	769	2821
142L	890	853	3125	834	3055	874	3203	870	3190
142L	980	949	3476	927	3398	973	3565	968	3549
142L	1080	1060	3884	1036	3796	1088	3988	1083	3970
142L	1220	1185	4343	1158	4245	1215	4452	1209	4431
142L	1420	1335	4895	1305	4785	1404	5147	1398	5123
210L	1610	1331	4879	1301	4769	1492	5469	1301	4769
210L	1760	1473	5400	1440	5279	1651	6053	1644	6025
210L	1900	1615	5921	1579	5788	1808	6627	1800	6597
210L	2100	1760	6452	1721	6307	1959	7181	1950	7148
250L	2100	1760	6452	1721	6307	1956	7171	1947	7138
250L	2300	1935	7092	1891	6932	2149	7876	2139	7840
250L	2500	2103	7747	2066	7573	2338	8571	2327	8532
						One Pass			
210D	1610	2662	9758	2602	9539	2984	10938	2970	10888
120D	1760	2946	10800	2880	10558	3302	12107	3287	12051
210D	1900	3231	11873	3158	11576	2616	13255	3599	13194
210D	2100	3520	12906	3441	12615	3918	14363	3900	14297
250D	2100	3520	12906	3441	12615	3912	14343	3894	14297
250D	2300	3869	14186	3782	13865	4297	15753	4277	15680
250D	2500	4226	15494	4131	15146	4676	17143	4654	17064
250M	2100	3520	12906	3441	12615	3912	14343	3894	14277
250M	2300	3959	14186	3782	13865	4297	15753	4277	15680
250M	2500	4226	15494	4131	15146	4676	171743	4654	17064
250X	2100	3520	12906	3441	12615	3912	14343	3894	14277
250X	2300	3869	14186	3782	13865	4297	15753	4277	15680
250X	2500	4226	15494	4131	15146	4676	17143	654	17064

Note: The minimum condenser water velocity is 3 ft/sec and the maximum is 11 ft/sec, and may be limited by other factors such as glycol. Confirm actual minimum and maximum flows for each selection before operating near flow boundaries. Table values based on 0.028" wall tubes.

TRANE

Performance Data

Condenser Flow Rates

Minimum and maximum condenser flow rates (liter/second)

Shell Size CDSZ	Bundle Size CDBS	Two Pass							
		SBCU		TECU		IECU		IMCU	
		Min	Max	Min	Max	Min	Max	Min	Max
032S	230	14	49	13	48	14	50	14	50
032S/L	250	15	55	15	54	15	57	15	56
032S/L	280	17	62	16	60	17	63	17	63
032S/L	320	19	68	18	67	19	70	19	70
050S	360	21	78	21	76	22	80	22	80
050S/L	400	24	88	23	85	25	90	25	90
050S/L	450	27	99	26	96	28	102	28	101
050S/L	500	30	109	29	106	31	113	31	113
080S	500	30	109	29	106	31	113	31	113
080S	560	33	122	33	119	35	126	34	126
080S/L	630	38	138	37	134	39	142	38	141
080S/L	710	44	156	41	152	43	159	37	158
080S/L	800	48	175	46	170	49	179	49	178
142L	890	54	197	53	193	55	202	55	201
142L	980	60	219	58	214	61	225	61	224
142L	1080	67	245	65	239	69	252	68	250
142L	1220	75	274	73	268	77	281	76	280
142L	1420	84	309	82	302	89	325	88	323
210L	1610	84	308	82	301	94	345	82	301
210L	1760	93	341	91	333	104	382	104	380
210L	1900	102	374	100	365	114	418	114	416
210L	2100	111	407	109	398	124	453	123	451
250L	2100	111	407	109	398	123	452	123	450
250L	2300	122	447	119	437	136	497	135	495
250L	2500	133	489	130	478	148	541	147	538
						One Pass			
210D	1610	168	616	164	602	188	690	187	687
210D	1760	186	681	182	666	208	764	207	760
210D	1900	204	747	199	730	165	836	227	832
210D	2100	222	814	217	796	247	906	246	902
250D	2100	222	814	217	796	247	905	246	902
250D	2300	244	895	239	875	271	994	270	989
250D	2500	267	978	261	956	295	1082	294	1077
250M	2100	222	814	217	796	247	905	246	901
250M	2300	250	895	239	875	271	994	270	989
250M	2500	267	978	261	956	295	1082	294	1077
250X	2100	222	814	217	796	247	905	246	901
250X	2300	244	895	239	975	271	994	270	989
250X	2500	267	978	261	956	295	1082	294	1077

Note: The minimum condenser water velocity is 0.914 m/s, and the maximum is 3.35 m/s, and may be limited by other factors such as glycol. Confirm actual minimum and maximum flows for each selection before operating near flow boundaries. Table values based on 0.028" wall tubes.

G3516 TA

GAS ENGINE TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED:	1200	FUEL:	NAT GAS
COMPRESSION RATIO:	9:1	FUEL SYSTEM:	HPG IMPCO
AFTERCOOLER - MAX. INLET (°F):	130		
JACKET WATER - MAX. OUTLET (°F):	210	FUEL PRESS. RANGE (PSIG):	35.0 - 40.0
COOLING SYSTEM:	JW+OC, AC	MIN. METHANE NUMBER:	80
IGNITION SYSTEM:	EIS	RATED ALTITUDE (FT):	5000
EXHAUST MANIFOLD:	WC	AT AIR TO TURBO. TEMP. (°F):	77
COMBUSTION:	STANDARD	EXHAUST O2 EMISSION LEVEL:	2.0 %O2
		FUEL LHV (BTU/SCF):	905
		APPLICATION:	60 Hz GENSET

RATING AND EFFICIENCY		NOTES	LOAD	100%	75%	50%
ENGINE POWER	(WITHOUT FAN)	(1)	BHP	1053	790	526
GENERATOR POWER	(WITHOUT FAN)	(2)	EKW	740	555	370
ENGINE EFFICIENCY	**(ISO 3046/1)**	**(3)**	**%**	**33.9**	**32.2**	**29.3**
ENGINE EFFICIENCY	(NOMINAL)	(3)	%	33.9	32.2	29.3
THERMAL EFFICIENCY	(NOMINAL)	(4)	%	51.7	53.4	55.8
TOTAL EFFICIENCY	(NOMINAL)	(5)	%	85.5	85.6	85.1

ENGINE DATA						
FUEL CONSUMPTION	**(ISO 3046/1)**	**(6)**	**BTU/bhp-hr**	**7514**	**7909**	**8676**
FUEL CONSUMPTION	(NOMINAL)	(6)	BTU/bhp-hr	7514	7909	8676
AIR FLOW (77 °F, 14.7 psi)		(7)	SCFM	1555	1244	964
AIR FLOW		(7)	lb/hr	6892	5514	4271
COMPRESSOR OUT PRESSURE			in. HG (abs)	61.3	59.1	52.2
COMPRESSOR OUT TEMPERATURE			°F	268	240	202
AFTERCOOLER AIR OUT TEMPERATURE			°F	129	129	129
INLET MAN. PRESSURE		(8)	in. HG (abs)	58.7	49.6	40
INLET MAN. TEMPERATURE	(MEASURED IN PLENUM)	(9)	°F	134	133	133
TIMING		(10)	°BTDC	23	23	23
EXHAUST STACK TEMPERATURE		(11)	°F	864	840	793
EXHAUST GAS FLOW (@ stack temp.)		(12)	CFM	4267	3350	2489
EXHAUST MASS FLOW		(12)	lb/hr	7291	5829	4501

EMISSIONS DATA					
NOx (as NO2)	(13)	g/bhp-hr	24.22	21.29	16.97
CO	(14)	g/bhp-hr	1.16	1.25	1.32
THC (molecular weight of 15.84)	(14)	g/bhp-hr	1.42	1.54	2.06
NMHC (molecular weight of 15.84)	(14)	g/bhp-hr	0.22	0.24	0.31
EXHAUST O2	(15)	% DRY	2.0	1.6	1.3
LAMBDA			1.09	1.10	1.16

HEAT BALANCE DATA					
LHV INPUT	(16)	BTU/min	131833	104073	76110
HEAT REJECTION TO JACKET (JW)	(17) (22)	BTU/min	44248	36955	29044
HEAT REJECTION TO ATMOSPHERE	(18)	BTU/min	4554	3795	3037
HEAT REJECTION TO LUBE OIL (OC)	(19) (22)	BTU/min	6599	5511	4332
HEAT REJECTION TO EXHAUST (LHV to 77°F)	(20)	BTU/min	26959	20896	15158
HEAT REJECTION TO EXHAUST (LHV to 350°F)	(20)	BTU/min	17245	13127	9102
HEAT REJECTION TO A/C (AC)	(21) (23)	BTU/min	3853	2457	1242
HEAT REJECTION TO ENGINE PUMPS		BTU/min	977.2	977.2	977.2

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1STD. REF. CONDITIONS OF 77°F, 29.6 IN HG BAROMETRIC PRESSURE, 500 FT ALTITUDE). NO OVERLOAD PERMITTED AT RATING SHOWN. CONSULT ALTITUDE CHARTS FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE.

EMISSION LEVELS ARE BASED ON THE ENGINE OPERATING AT STEADY STATE CONDITIONS. EMISSION TOLERANCES SPECIFIED ARE DEPENDANT UPON FUEL QUALITY. METHANE NUMBER CANNOT VARY MORE THAN ± 3. PUBLISHED PART LOAD DATA MAY REQUIRE ENGINE ADJUSTMENT.

ENGINE RATING IS WITH 2 ENGINE DRIVEN WATER PUMPS.

FOR NOTES INFORMATION CONSULT PAGE THREE.

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G3516 GAS ENGINE TECHNICAL DATA

CATERPILLAR®

FUEL USAGE GUIDE

CAT METHANE NUMBER	<30	30	35	40	45	50	55	60	65	70	75	80-100
IGNITION TIMING	-	14	15	16	17	14	15	16	16	18	20	23
DERATION FACTOR	0	0.59	0.59	0.59	0.59	9.00	9.00	9.00	1.00	1.00	1.00	1.00

ALTITUDE DERATION FACTORS

AIR TO TURBO (°F)	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1.00	1.00	1.00	0.98	0.95	0.91	0.88	0.84	0.81	0.78	0.75	0.72	0.69
120	1.00	1.00	1.00	1.00	0.96	0.93	0.89	0.86	0.82	0.79	0.76	0.73	0.70
110	1.00	1.00	1.00	1.00	0.98	0.94	0.91	0.87	0.84	0.80	0.77	0.74	0.71
100	1.00	1.00	1.00	1.00	1.00	0.96	0.92	0.89	0.85	0.82	0.79	0.75	0.72
90	1.00	1.00	1.00	1.00	1.00	0.98	0.94	0.90	0.87	0.83	0.80	0.77	0.74
80	1.00	1.00	1.00	1.00	1.00	0.99	0.96	0.92	0.88	0.85	0.81	0.78	0.75
70	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.94	0.90	0.86	0.83	0.80	0.76
60	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.95	0.92	0.88	0.85	0.81	0.78
50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.94	0.90	0.86	0.83	0.79

ALTITUDE (FEET ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS (ACHRF)

AIR TO TURBO (°F)	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1.48	1.56	1.64	1.73	1.82	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91
120	1.38	1.46	1.54	1.63	1.71	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
110	1.28	1.36	1.44	1.53	1.61	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
100	1.19	1.26	1.34	1.43	1.51	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59
90	1.09	1.17	1.24	1.32	1.41	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49
80	1.00	1.07	1.14	1.22	1.30	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38
70	1.00	1.00	1.04	1.12	1.20	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28
60	1.00	1.00	1.00	1.02	1.10	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18
50	1.00	1.00	1.00	1.00	1.00	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07

ALTITUDE (FEET ABOVE SEA LEVEL)

FREE FIELD MECHANICAL & EXHAUST NOISE

100% Load Data			dB(A)	(dB)							
Free Field Mechanical	DISTANCE FROM THE ENGINE (FEET)	3.2	96.3	95.5	92.1	86.3	87.3	90.0	91.6	88.4	80.0
		22.9	86.7	85.9	82.5	76.7	77.7	80.4	82.0	78.8	70.4
		49.2	81.3	80.6	77.2	71.4	72.4	75.1	76.7	73.5	65.0
Free Field Exhaust	DISTANCE FROM THE ENGINE (FEET)	4.9	111.6	99.8	103.6	105.7	102.2	103.0	105.1	106.9	100.3
		22.9	98.3	89.5	91.8	93.2	89.6	92.0	91.8	92.2	85.2
		49.2	91.6	82.9	85.2	86.6	83.0	85.4	85.2	85.6	78.5
			Overal SPL	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 khz

Octave Band Center Frequency (OBCF)

FUEL USAGE GUIDE:
This table shows the derate factor required for a given fuel. Note that deration occurs as the methane number decreases. Methane number is a scale to measure detonation characteristics of various fuels. The methane number of a fuel is determined by using the Caterpillar Methane Number Calculation program.

ALTITUDE DERATION FACTORS:
This table shows the deration required for various air inlet temperatures and altitudes. Use this information along with the fuel usage guide chart to help determine actual engine power for your site.

ACTUAL ENGINE RATING:
It is important to note that the Altitude/Temperature deration and the Fuel Usage Guide deration are not cumulative. They are not to be added together. The same is true for the Low Energy Fuel deration (reference the Caterpillar Methane Number Program) and the Fuel Usage Guide deration. However, the Altitude/Temperature deration and Low Energy Fuel deration are cumulative; and they must be added together in the method shown below. To determine the actual power available, take the lowest rating between 1) and 2).

1) (Altitude/Temperature Deration) + (Low Energy Fuel Deration)
2) Fuel Usage Guide Deration

Note: For NA's always add the Low Energy Fuel deration to the Altitude/Temperature deration. For TA engines only add the Low Energy Fuel deration to the Altitude/Temperature deration whenever the Altitude/Temperature deration is less than 1.0 (100%). This will give the actual rating for the engine at the conditions specified.

AFTERCOOLER HEAT REJECTION FACTORS (ACHRF):
Aftercooler heat rejection is given for standard conditions of 77°F and 500 ft altitude. To maintain a constant air inlet manifold temperature, as the air to turbo temperature goes up, so must the heat rejection. As altitude increases, the turbocharger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor (ACHRF) to adjust for ambient and altitude conditions. Multiply this factor by the standard aftercooler heat rejection. Failure to properly account for these factors could result in detonation and cause the engine to shutdown or fail.

SOUND DATA:
Data determined by methods similar to ISO Standard DIS-8528-10. Accuracy Grade 3. SPL = Sound Pressure Level.

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G3516 **GAS ENGINE TECHNICAL DATA** CATERPILLAR®

NOTES

1 ENGINE RATING IS WITH 2 ENGINE DRIVEN WATER PUMPS. TOLERANCE IS ± 3% OF FULL LOAD.

2 GENERATOR POWER DETERMINED WITH AN ASSUMED GENERATOR EFFICIENCY OF 94.27% AND POWER FACTOR OF 0.8 [GENERATOR POWER = ENGINE POWER x GENERATOR EFFICIENCY].

3 ISO 3046/1 ENGINE EFFICIENCY TOLERANCE IS (+)0, (-)5% OF FULL LOAD % EFFICIENCY VALUE. NOMINAL ENGINE EFFICIENCY TOLERANCE IS ± 5% OF FULL LOAD % EFFICIENCY VALUE.

4 THERMAL EFFICIENCY: JACKET HEAT + LUBE OIL HEAT + EXH. HEAT TO 350°F.

5 TOTAL EFFICIENCY = ENGINE EFF. + THERMAL EFF. TOLERANCE IS ± 10% OF FULL LOAD DATA.

6 ISO 3046/1 FUEL CONSUMPTION TOLERANCE IS (+)5, (-)0% OF FULL LOAD DATA. NOMINAL FUEL CONSUMPTION TOLERANCE IS ± 5 % OF FULL LOAD DATA.

7 UNDRIED AIR. FLOW TOLERANCE IS ± 5 %

8 INLET MANIFOLD PRESSURE TOLERANCE IS ± 5 %

9 INLET MANIFOLD TEMPERATURE TOLERANCE IS ± 9°F.

10 TIMING INDICATED IS FOR USE WITH THE MINIMUM FUEL METHANE NUMBER SPECIFIED. CONSULT THE APPROPRIATE FUEL USAGE GUIDE FOR TIMING AT OTHER METHANE NUMBERS.

11 EXHAUST STACK TEMPERATURE TOLERANCE IS (+)63°F, (-)54°F.

12 WET EXHAUST. FLOW TOLERANCE IS ± 6 %

13 NOX VALUES ARE "NOT TO EXCEED".

14 CO, CO2, THC, and NMHC VALUES ARE "NOT TO EXCEED".

15 O2% TOLERANCE IS ± 0.5.

16 LHV INPUT TOLERANCE IS ± 5%.

17 HEAT REJECTION TO JACKET TOLERANCE IS ± 10 % OF FULL LOAD DATA, BASED ON TREATED WATER.

18 HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA, BASED ON TREATED WATER.

19 HEAT REJECTION OF LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA, BASED ON TREATED WATER.

20 HEAT REJECTION TO EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA, BASED ON TREATED WATER.

21 HEAT REJECTION TO A/C TOLERANCE IS ± 5 % OF FULL LOAD DATA, BASED ON TREATED WATER.

SITE SPECIFIC COOLING SYSTEM SIZING EQUATIONS (WITH TOLERANCES)

22 TOTAL JACKET CIRCUIT (JW+OC) = (JW x 1.1) + (OC x 1.2).

23 TOTAL AFTERCOOLER CIRCUIT (AC) = AC x ACHRF x 1.05.

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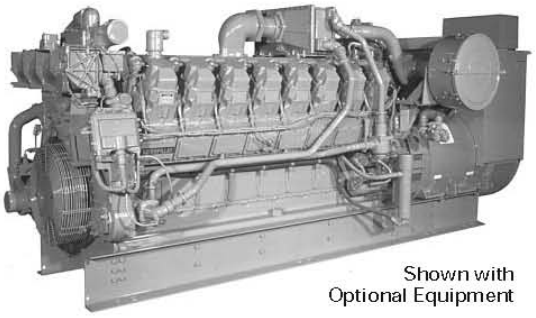
CATERPILLAR®

Gas Generator Set

G3516
1800 rpm
1040 ekW 60 Hz

Standby Power



Shown with Optional Equipment

CATERPILLAR® ENGINE SPECIFICATIONS

V-16, 4-Stroke-Cycle Spark-Ignited
Bore — in (mm) 6.7 (170)
Stroke — in (mm) 7.5 (190)
Displacement — cu in (L) 4210 (67.4)
Aspiration ..... Turbocharged-Aftercooled
Compression ratio 11:1

CATERPILLAR ENGINE FACILITIES ISO 9001 CERTIFIED

FEATURES

- **CATERPILLAR® FACTORY PACKAGE**
  Factory designed, assembled, and tested. Supported by Caterpillar parts and labor warranty through your local Caterpillar dealer.
- **DIESEL STRENGTH BUILT IN**
  Blocks, crankshafts, liners, and connecting rods are common with higher loaded Cat® diesel engines. Robust design provides prolonged life at lower gas engine loads.
- **ELECTRONIC IGNITION SYSTEM WITH DETONATION SENSITIVE TIMING**
  The Caterpillar Electronic Ignition System (EIS) provides optimized spark timing for all operating conditions. Timing is automatically controlled to maintain continuous detonation protection.
- **LOW EXHAUST EMISSIONS**
  2.0 gram/bhp-hr NO_x. Lower emissions are achievable for selected applications; consult your Caterpillar dealer.

CATERPILLAR® SR4B GENERATOR

Type ..... Static regulator, brushless excited
Construction ..... Single bearing, close coupled
Three phase ..... Wye connected
Insulation ..... Class H
Enclosure ..... Drip proof IP/22, guarded
Alignment ..... Caterpillar pilot shaft
Overspeed capability 150%
Waveform ..... Less than 5% deviation
Voltage regulator ..... 3-phase sensing with Volts-per-Hertz response
Voltage regulation ..... Less than ± 1%
Voltage gain ..... Adjustable to compensate for engine speed droop and line loss
TIF ..... Less than 50
THF ..... Less than 5%

CATERPILLAR CONTROL PANEL

24 Volt DC Control
Terminal box mounted
Vibration isolated
NEMA 1/IP 22 enclosure
Electrically dead front
Lockable door
Generator instruments meet ANSI C-39-1

Voltages Available
60 Hz
240, 480

(Adjustable a minimum of ±10%)
Other voltages available – consult your Caterpillar dealer.
Some voltages require derating.

CATERPILLAR®

G3516 GAS GENERATOR SET

STANDARD EQUIPMENT

Engine
Air cleaner with service indicator
Breather, crankcase
Cooler, lubricating oil
EMCP II, generator control, engine start/stop logic
Filter, lubricating oil, RH
Flywheel housing, SAE No. 0
Governor, Woodward 2301A
Ignition system, Caterpillar EIS
Instrument panel, RH intake manifold pressure, intake manifold temperature, oil pressure differential, exhaust pyrometer, and thermocouples
Jacket water heater
Lifting eyes
Manifold, exhaust, watercooled
Paint, Caterpillar yellow
Protection devices
Pumps, aftercooler water, lubricating oil, jacket water, gear driven
Rails, mounting, 13 inch
SAE standard rotation
Thermostats and housing
Torsional vibration damper
Valve, 24V gas shutoff

Generator
All metal components are plated or painted
Optimum winding pitch for minimum total harmonic distortion
Self excitation (300% short circuit current)
Standards: meets or exceeds the requirements of IEC 34-1, NEMA MG1-22, BS4999, VDE0530, UTE5100, CSA 22.2, ISO 8528-3
Three-phase sensing automatic voltage regulator
VR3 voltage regulator
Wet layer wound rotors individually tested to 125% overspeed; prototypes to 150% @ 338° F (170° C)
Windings coated with a fungus-resistant varnish

OPTIONAL EQUIPMENT

Engine
Battery chargers
Battery, rack, and cables
Air inlet adapters
Customer Communications Module (CCM)
Exhaust fittings
Muffler
Power takeoffs
Prelube pump
Lube oil

Generator
DVR – Digital Voltage Regulator, adjustable volts/H_3 regulation for large block loads. Diode monitor, under- and over-voltage protection
Extra dips and bakes of insulating resins
Manual voltage control
RFI filter – 82/499/EEC, VDE 875/10.84 A2 Level N, BS800 standards, and MIL-STD-461B (conducted, radiated, and susceptibility
VR3F for enhanced transient response and block loading
Permanent magnet excitation

ENGINE AND GENERATOR CONTROLS

The EMCP II comes complete with many control features competitive manufacturers only offer as options.

Standard Features
Adjustable purge cycle from 0-20 seconds (factory set at 5 seconds)
Auto start-stop engine control with programmable safety shutdowns
Cooldown timer, adjustable from 0 to 30 minutes
Cycle cranking, with adjustable crank/rest periods of 1 to 60 seconds
Delayed ignition (magneto) "kill" after gas valve is closed. Five second delay
Emergency stop button
Flashing LED indicators for protection and diagnostics, including: low oil pressure, high coolant temperature, low coolant level (when optional coolant sensor is installed), overspeed, overcrank, emergency stop, fault shutdown, spare fault alarm
Generator voltage adjust potentiometer
Indicator/display test switch
LCD digital readout for: engine oil pressure, coolant temperature, engine rpm, system DC volts, generator AC volts and amps, and generator frequency
NEMA 1/IP 22 enclosure
Programmable for energize to shutoff or energize to run
Spare alarm and fault inputs for customer use

Optional Features
Alarm modules and remote annunciators to meet NFPA 99 or NFPA 110 codes
Auxiliary relay
Coolant loss sensor
Customer interface module
Dustproof enclosure
Frequency adjust potentiometer
Panel lights
Reverse power relay
Synchronizing modules

G3516 GAS GENERATOR SET

CATERPILLAR

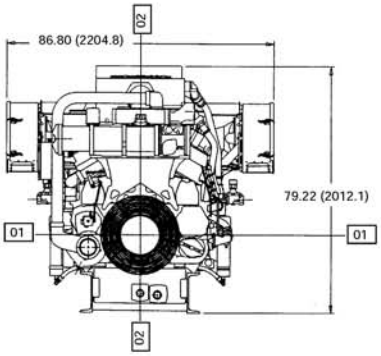
TECHNICAL DATA

G3516 LE Standby Power Gas Generator Sets — 1800 rpm		
Power Rating @ 0.8 PF without Fan	ekW kV•A	1040 1300
Generator Frame Size		693
Engine Lubricating Oil Capacity	gal	106
System Backpressure (Max Allowable)	in water	27
Exhaust Flange Size — (Internal Diameter)	in	7.1
Length	in	187.9
Width	in	86.8
Height	in	79.2
Shipping Weight	lbs	20 560
Engine Coolant Capacity with Radiator	gal	
100% Load Fuel Consumption (100% load) with Fan per ISO3046/1: +5%, -0% tolerance	BTU/bhp-hr	7899
Motor Starting (35% voltage dip)	SkVA (volt)	2626 (480)
Combustion Air Inlet Flow Rate	ft^3/min	3435
Exhaust Gas Flow Rate (at stack temp)	ft^3/min	8583
Heat Rejection to Aftercooler	BTU/min	9746
Heat Rejection to Exhaust (total)	BTU/min	54 853
Heat Rejection to Jacket Water (total)	BTU/min	58 557
Heat Rejection to Atmosphere from Engine	BTU/min	7155
Heat Rejection to Atmosphere from Generator	BTU/min	2821
Exhaust Gas Stack Temperature	Deg F	1603
Deration for Engine Altitude – 3.5% per 500 feet above 2% per 10° F above	 ft Deg F	 4000 77
* Note: For permitting see TMI data.		

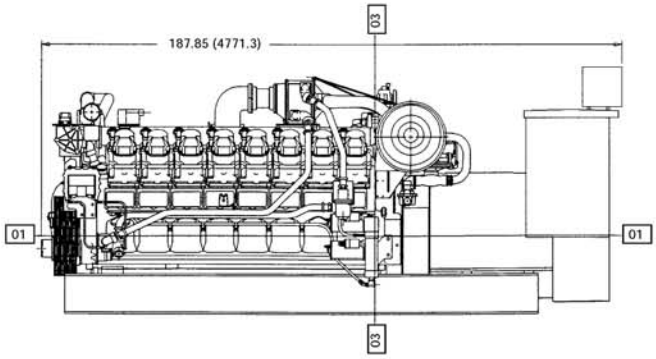
CATERPILLAR®

G3516 GAS GENERATOR SET

FRONT VIEW



SIDE VIEW



01 Centerline of Crankshaft

02 Centerline of Engine

03 Rear Face of Cylinder Block

See general dimension drawing 127-8351 for additional information.

Dimensions are in in (mm).

Note: General configuration not to be used for installation.

RATINGS DEFINITIONS AND CONDITIONS

Ratings are based on SAE J1349 standard conditions of 29.61 in Hg (100 kPa) and 77° F (25° C). These ratings also apply at ISO3046/1, DIN6271, and BS5514 standard conditions of 29.61 in Hg (100 kPa) and 81° F (27° C); and API 7B-11C standard conditions of 29.38 in Hg (99 kPa) and 85° F (29° C) also apply.

Ratings are based on dry natural gas having a low heat value of 905 btu/ft³ (35.22 MJ/m³). Variations in altitude, temperature, and gas composition from standard conditions may require a reduction in engine horsepower.

Turbocharged-aftercooled ratings apply to 4000 ft (1525 m) and 77° F (25° C). For applications which exceed these limits consult your Caterpillar dealer.

Standby — Output available with varying load for the duration of the interruption of the normal source power. Fuel stop power in accordance with ISO3046/1, AS2789, DIN6271, and BS5514.

Additional ratings may be available for specific customer requirements. Consult your Caterpillar representative for details.

Materials and specifications are subject to change without notice. The International System of Units (SI) is used in this publication.

LEHX7576

Solar Turbines
A Caterpillar Company

SATURN 20
Gas Turbine Compressor Set

Oil & Gas Applications

General Specifications

Saturn® 20 Gas Turbine

- Industrial, Two-Shaft
- Axial Compressor
  - 8-Stage
  - Pressure Ratio: 6.7:1
  - Inlet Airflow: 6.4 kg/sec (14.2 lb/sec)
- Combustion Chamber
  - Annular-Type
  - 12 Fuel Injectors
  - Torch Ignitor System
- Gas Producer Turbine
  - 2-Stage, Reaction
  - Max. Speed: 15,000 rpm
- Power Turbine
  - 1-Stage, Reaction
  - Max. Speed: 22,300 rpm
- Bearings
  - Journal: Multi-Ramp Sleeve
  - Thrust: Fixed Tapered Land
- Coatings
  - Compressor: Inorganic Aluminum
  - Turbine and Nozzle Blades: Precious Metal Diffusion Aluminide
- Velocity Vibration Transducer

Key Packages Features

- Base Frame with Drip Pans
- Compressor
  - Compressor Auxiliary Systems
- 316L Stainless Steel Piping ≤4" dia
- Compression-Type Tube Fittings
- Digital Gauge Panel
  - Fluid Gauges
  - Electrical System Options
  - NEC, Class I, Group D, Div. 1
  - CENELEC, Zone 1
- *Turbotronic*™ Microprocessor Control System
  - Freestanding Control Console
  - Color Video Display
  - Vibration Monitoring
- Control Options
  - 24-VDC Control Battery/Charger System
  - Turbine and Package Temperature Monitoring
  - Serial Link Supervisory Interface
  - Turbine Performance Map
  - Compressor Performance Map
  - Historical Displays
  - Printer/Logger
  - Process Controls
  - Compressor Anti-Surge Control
  - Field Programming
- Start Systems
  - Pneumatic
  - Direct-Drive AC
- Fuel System
  - Natural Gas
- Integrated Lube Oil System
  - Turbine-Driven Accessories
  - Tank Vent Separator
  - Flame Trap
- Oil System Options
  - Oil Cooler
  - Oil Heater
- Axial Compressor Cleaning Systems
  - On-Crank/On-Line
  - Cleaning Tank
- Gearbox (if applicable)
  - Speed Increaser
  - Speed Decreaser
- Air Inlet and Exhaust System Options
- Enclosure and Associated Options
- Factory Testing of Turbine and Package
- Documentation
  - Drawings
  - Quality Control Data Book
  - Inspection and Test Plan
  - Test Reports
  - Operation and Maintenance Manuals

Solar Turbines
A Caterpillar Company

SATURN 20
Gas Turbine Compressor Set

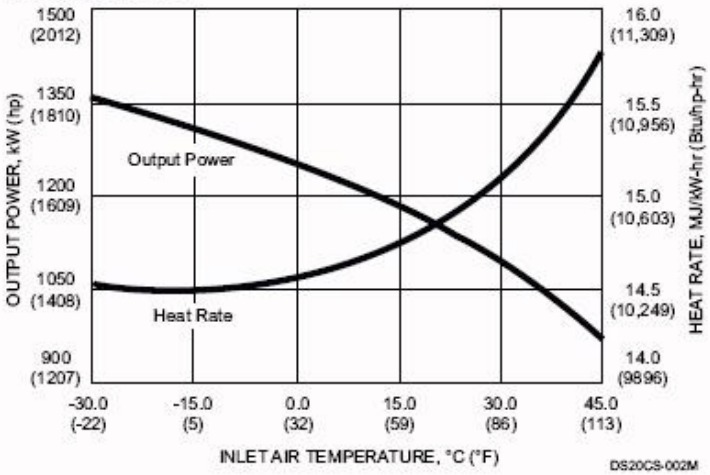
Oil & Gas Applications

Performance

Output Power	1185 kW (1590 hp)
Heat Rate	14 670 kJ/kW-hr (10,370 Btu/hp-hr)
Exhaust Flow	23 410 kg/hr (51,615 lb/hr)
Exhaust Temp.	520°C (970°F)

Nominal Rating – per ISO
At 15°C (59°F), at sea level
No inlet/exhaust losses
Relative humidity 60%
Natural gas fuel with
LHV = 35 MJ/nm³ (940 Btu/scf)
Optimum power turbine speed
AC-driven accessories
Engine efficiency: 24.5%

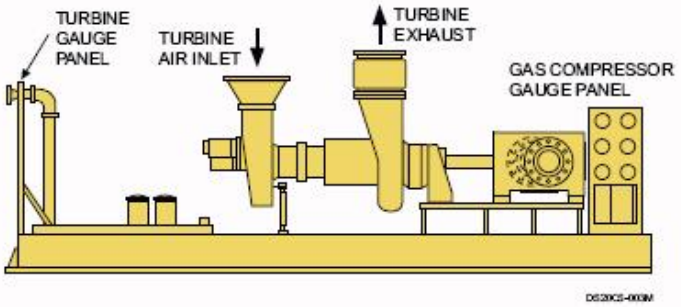
Available Power



Package Dimensions*

Length: 4.7 m (15' 4")
Width: 1.9 m (6' 1")
Height: 2.0 m (6' 8")
Typical Weight: 6805 kg (15,000 lb)

**Driver package only*



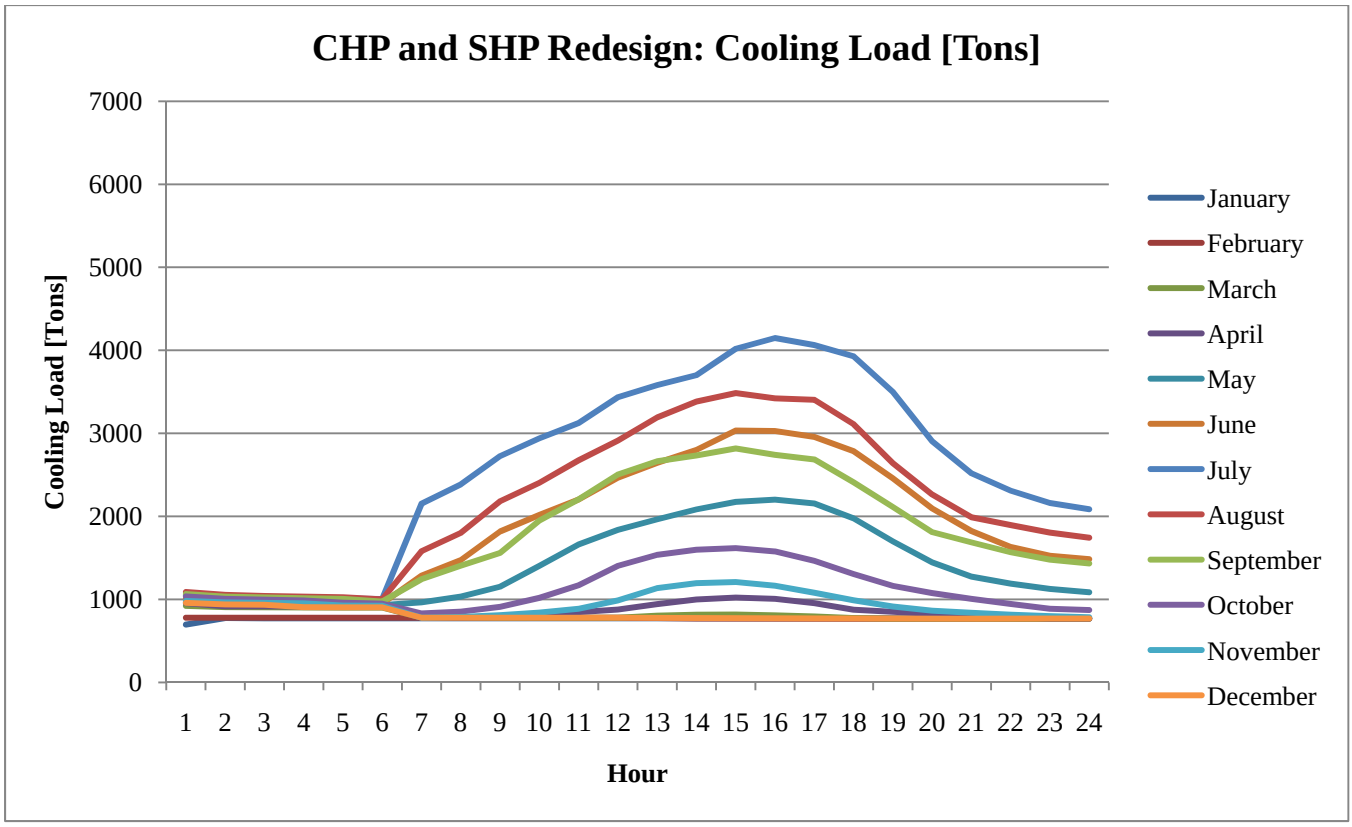
Solar Turbines Incorporated
P.O. Box 85376
San Diego, CA 92186-5376

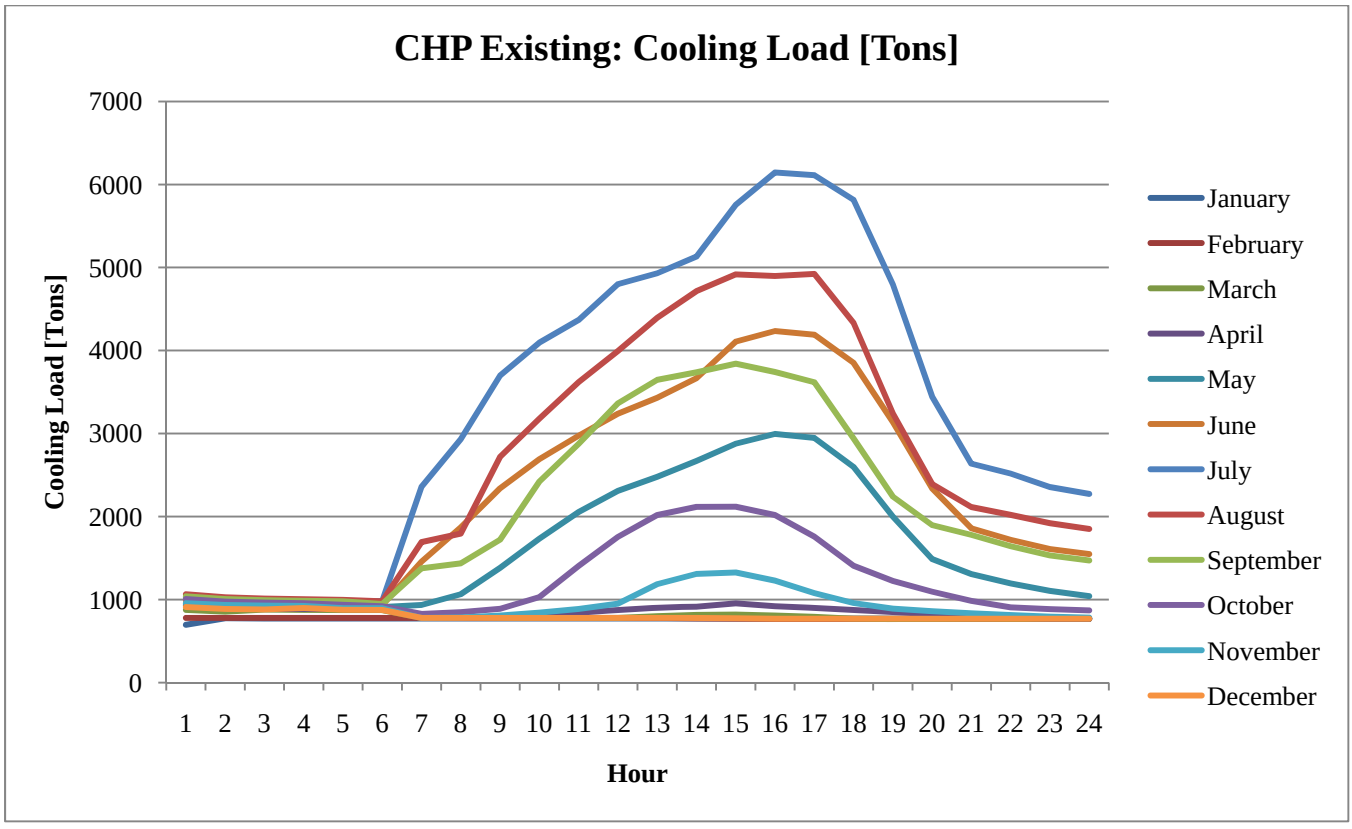
DS20CS/1106/EO

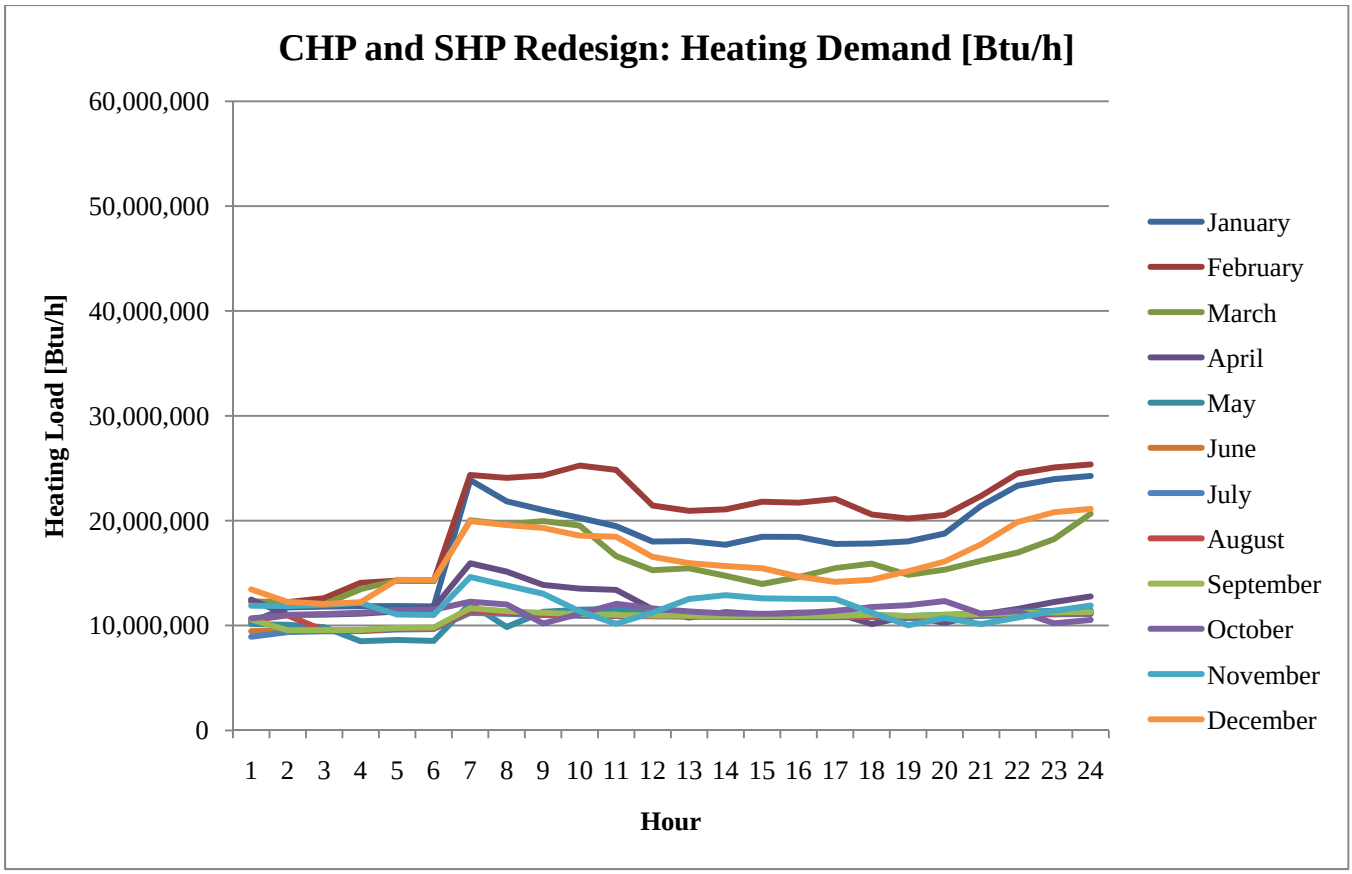
FOR MORE INFORMATION
Telephone: (+1) 619-544-5352
Internet: www.solarturbines.com

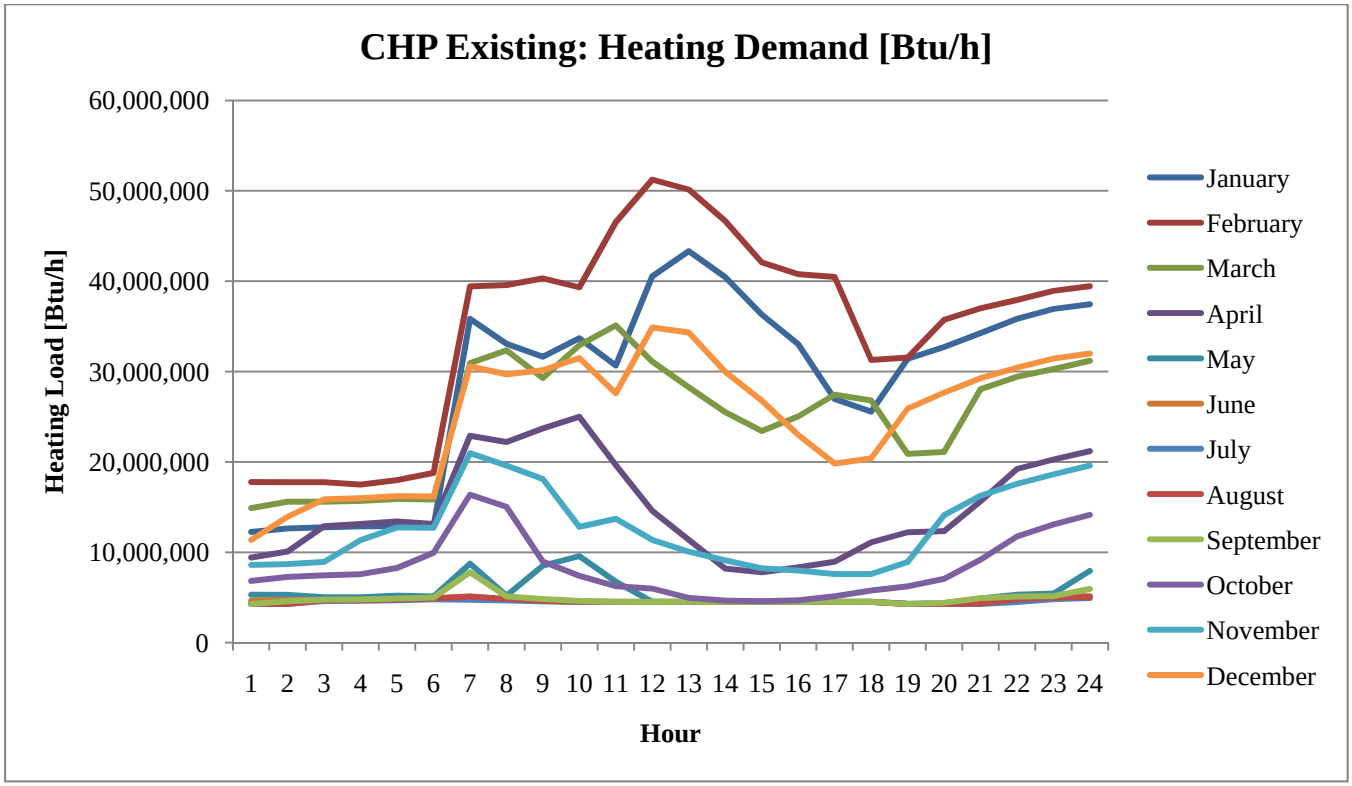
DNV

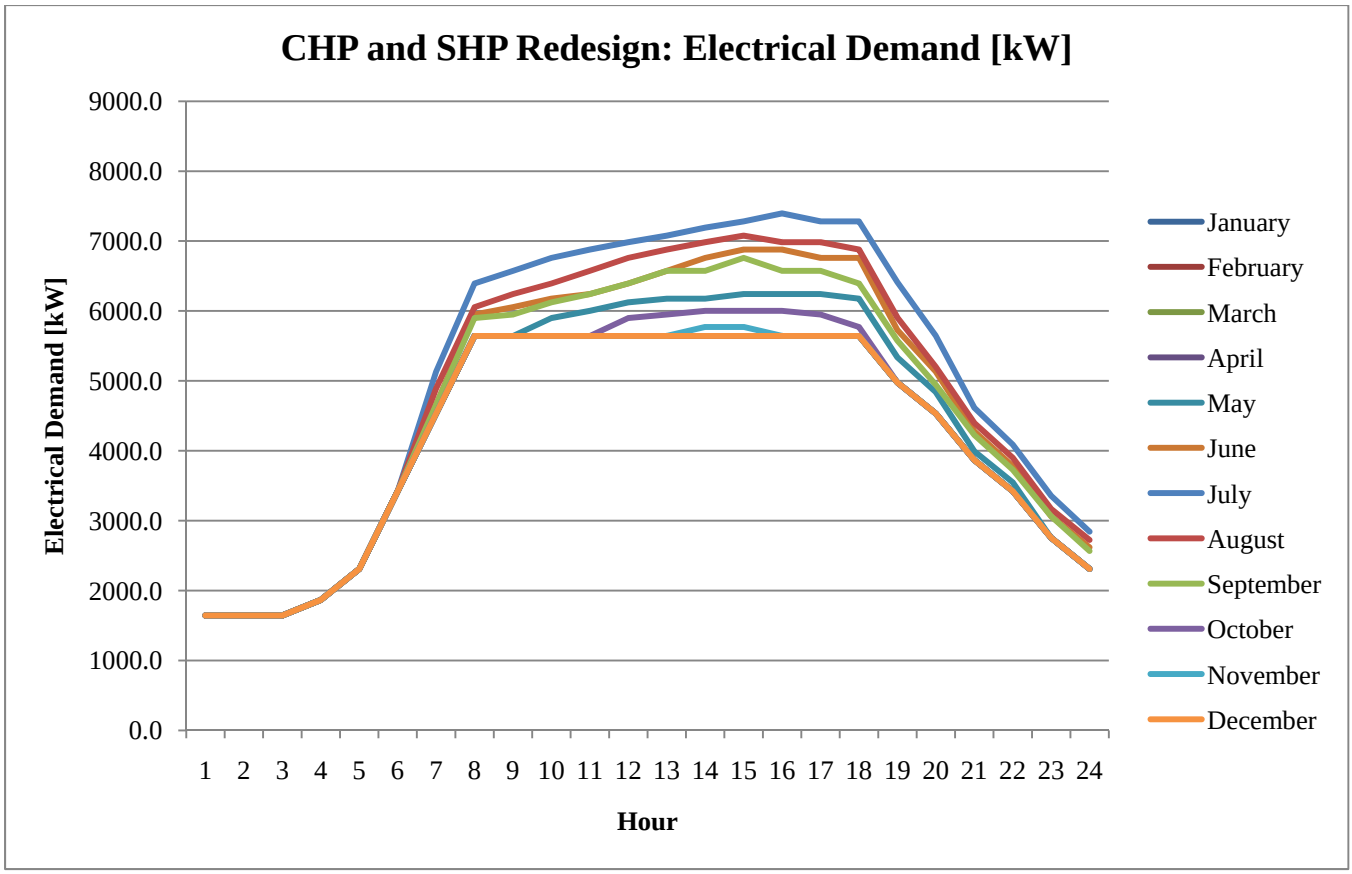
APPENDIX II.C: RESULTS FROM DETAILED CHP SIMULATION

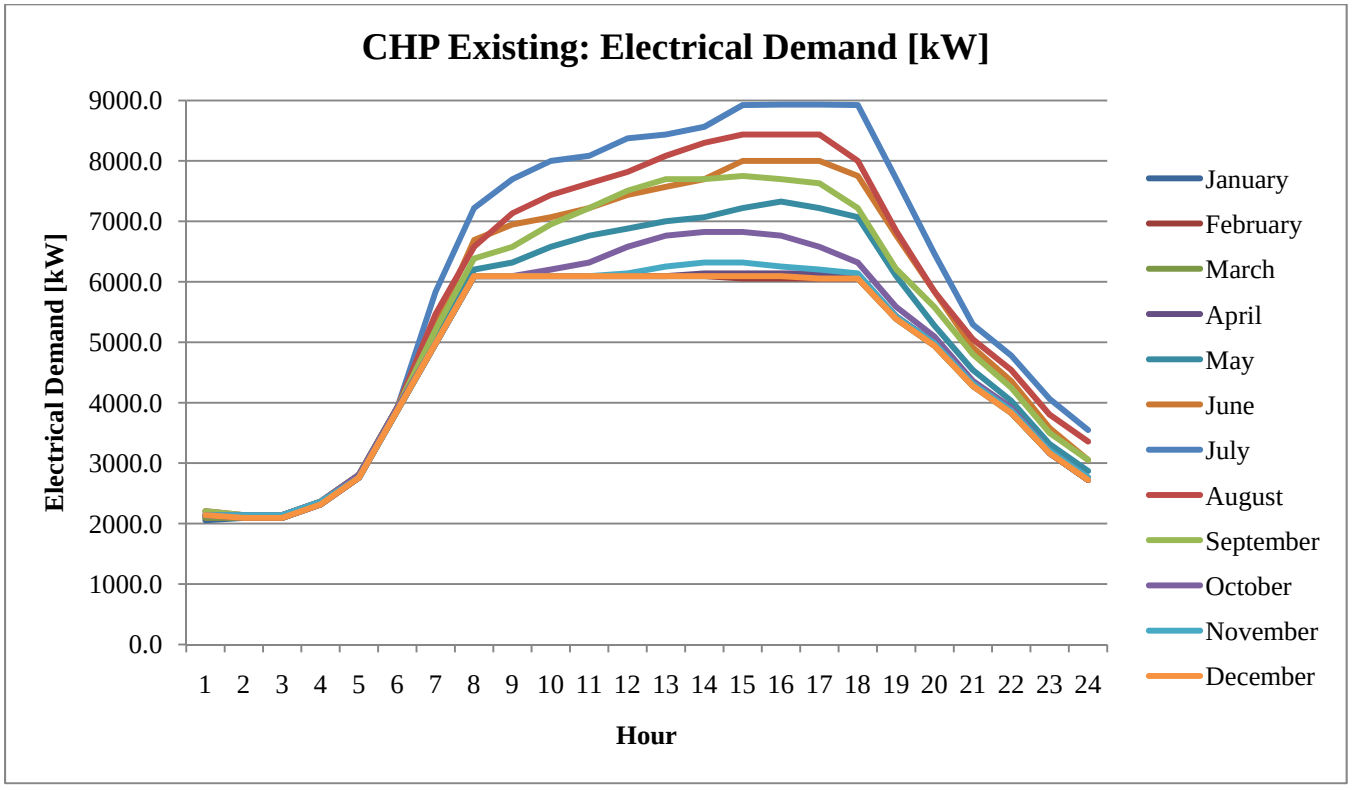

CHP and SHP Redesign: Cooling Load [Tons]
Cooling Load [Tons]
7000
6000
5000
4000
3000
2000
1000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour
January
February
March
April
May
June
July
August
September
October
November
December


CHP Existing: Cooling Load [Tons]
Cooling Load [Tons]
7000
6000
5000
4000
3000
2000
1000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour
January
February
March
April
May
June
July
August
September
October
November
December


CHP and SHP Redesign: Heating Demand [Btu/h]
Heating Load [Btu/h]
60,000,000
50,000,000
40,000,000
30,000,000
20,000,000
10,000,000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour
January
February
March
April
May
June
July
August
September
October
November
December


CHP Existing: Heating Demand [Btu/h]
Heating Load [Btu/h]
60,000,000
50,000,000
40,000,000
30,000,000
20,000,000
10,000,000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour
January
February
March
April
May
June
July
August
September
October
November
December


CHP and SHP Redesign: Electrical Demand [kW]
Electrical Demand [kW]
9000.0
8000.0
7000.0
6000.0
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour
January
February
March
April
May
June
July
August
September
October
November
December


CHP Existing: Electrical Demand [kW]
Electrical Demand [kW]
9000.0
8000.0
7000.0
6000.0
5000.0
4000.0
3000.0
2000.0
1000.0
0.0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour
January
February
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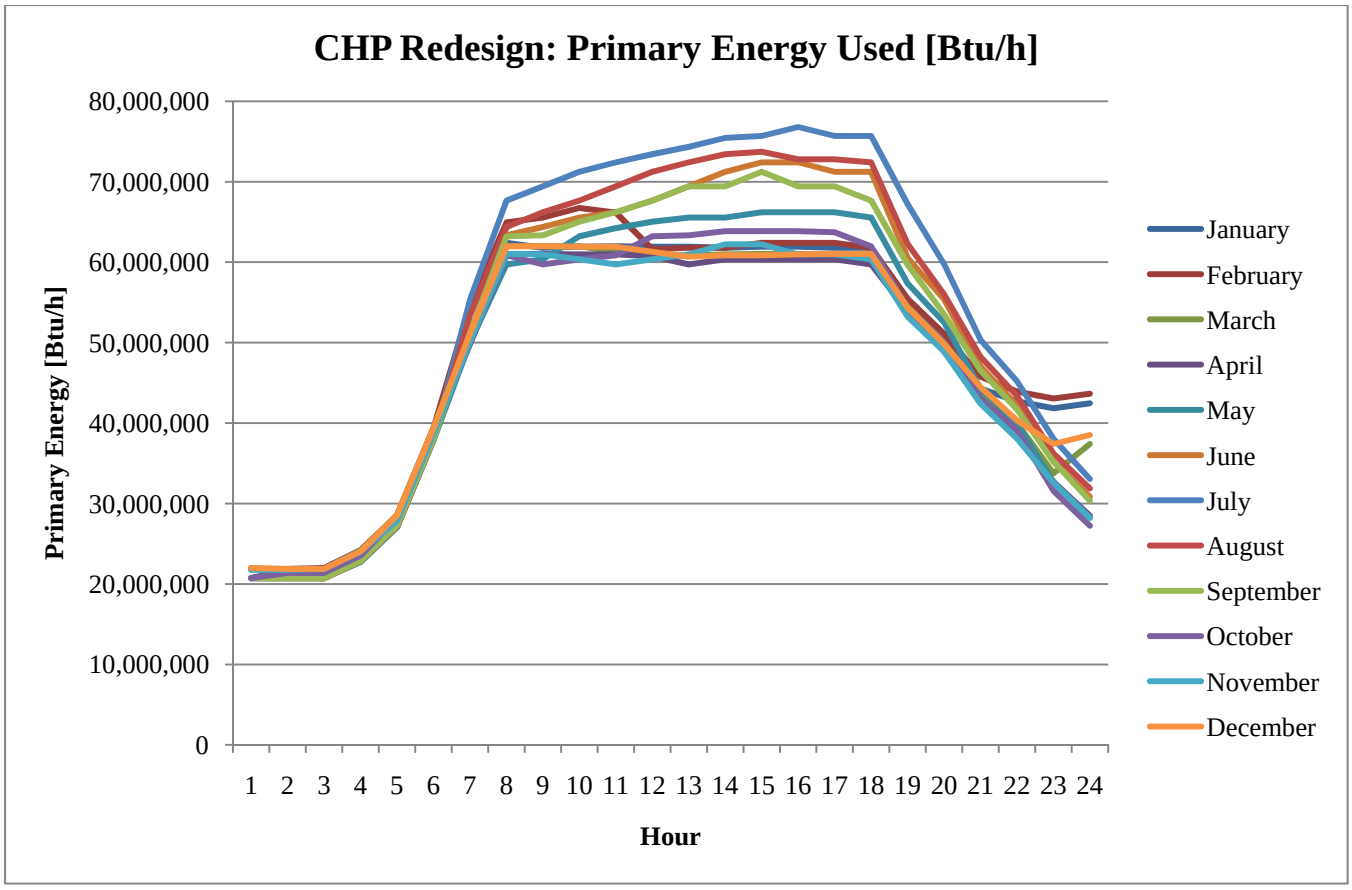
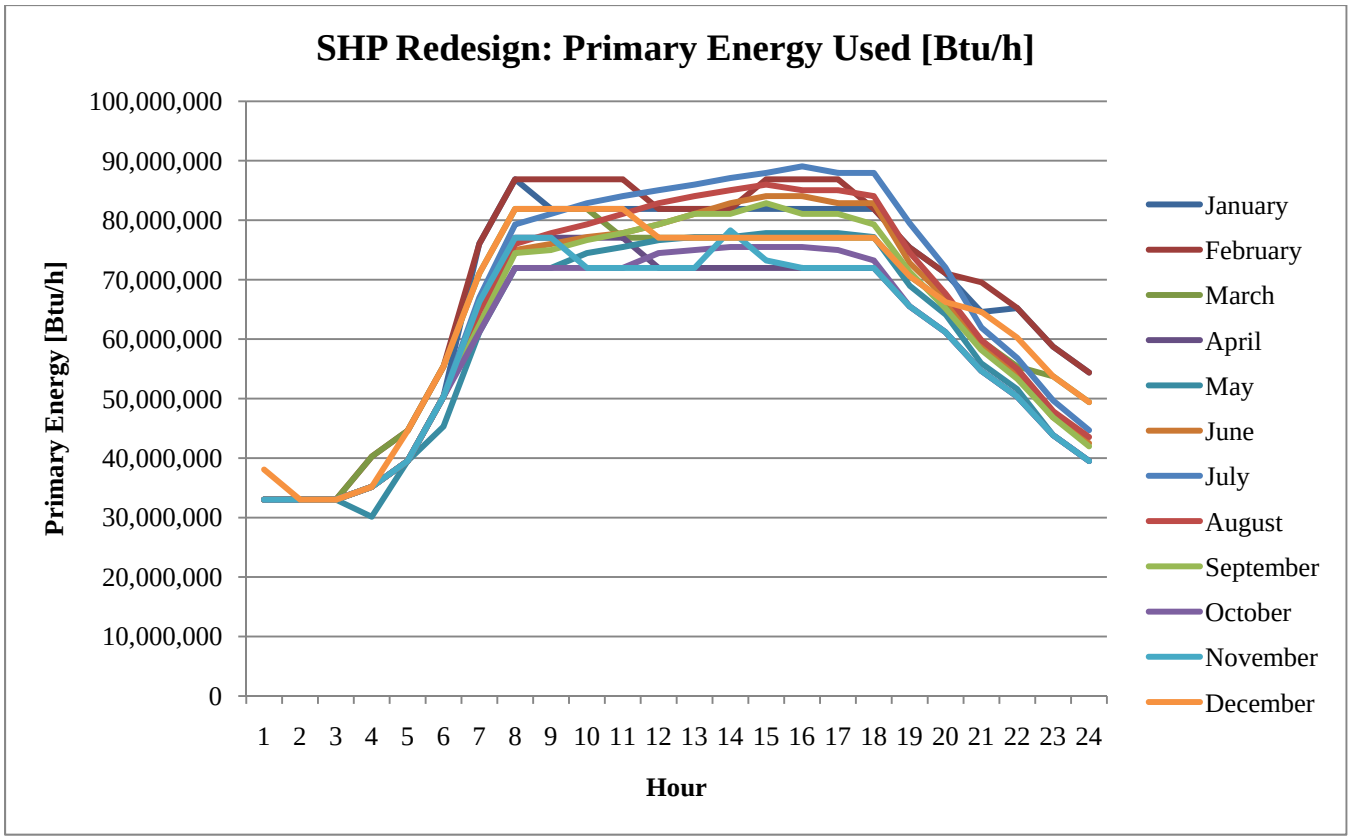
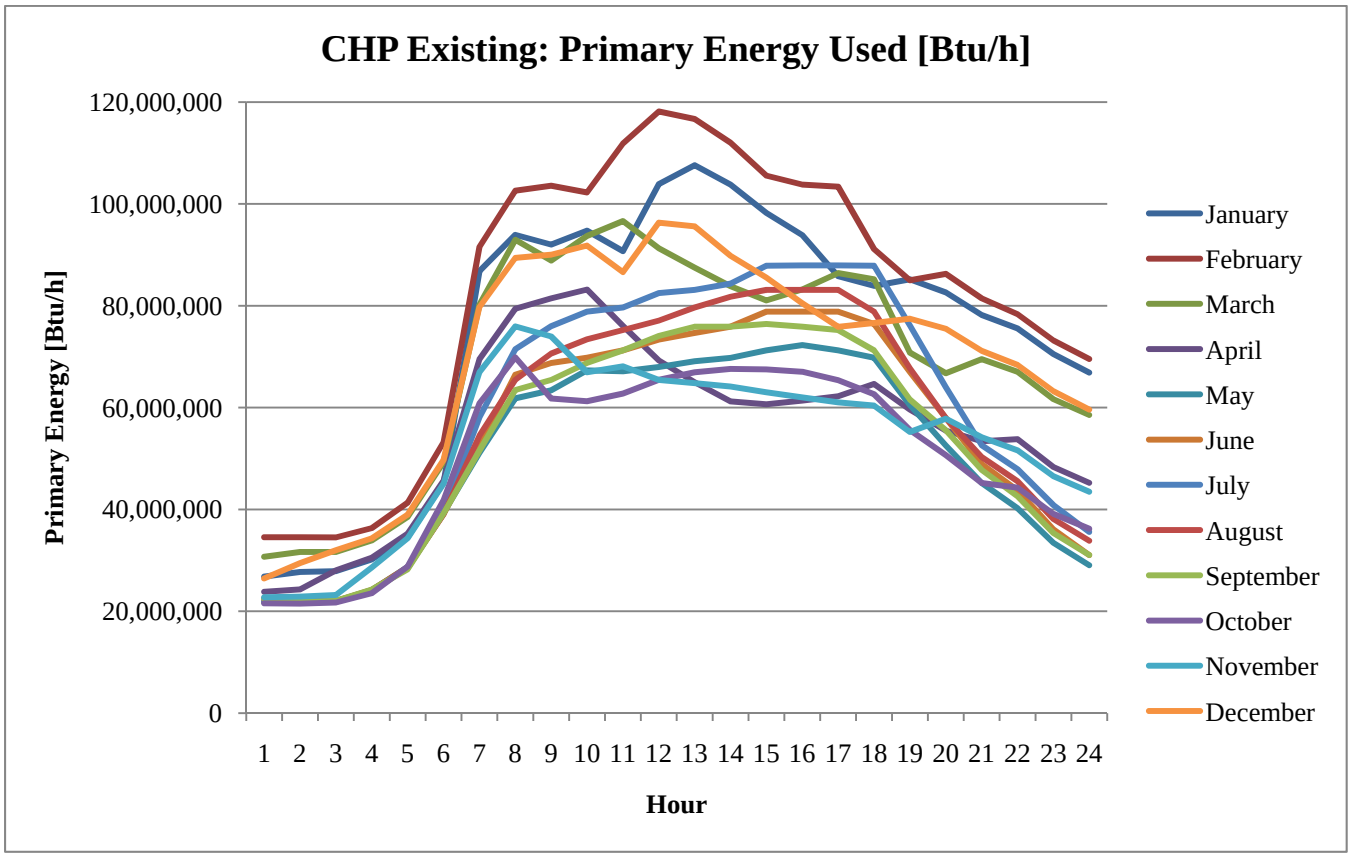
June
July
August
September
October
November
December


CHP Redesign: Primary Energy Used [Btu/h]
Primary Energy [Btu/h]
80,000,000
70,000,000
60,000,000
50,000,000
40,000,000
30,000,000
20,000,000
10,000,000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour
January
February
March
April
May
June
July
August
September
October
November
December


SHP Redesign: Primary Energy Used [Btu/h]
Primary Energy [Btu/h]
100,000,000
90,000,000
80,000,000
70,000,000
60,000,000
50,000,000
40,000,000
30,000,000
20,000,000
10,000,000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour
January
February
March
April
May
June
July
August
September
October
November
December


CHP Existing: Primary Energy Used [Btu/h]
Primary Energy [Btu/h]
120,000,000
100,000,000
80,000,000
60,000,000
40,000,000
20,000,000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour
January
February
March
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July
August
September
October
November
December

APPENDIX II.D: CRANE SELECTION

Manitowoc 16000

Product Guide

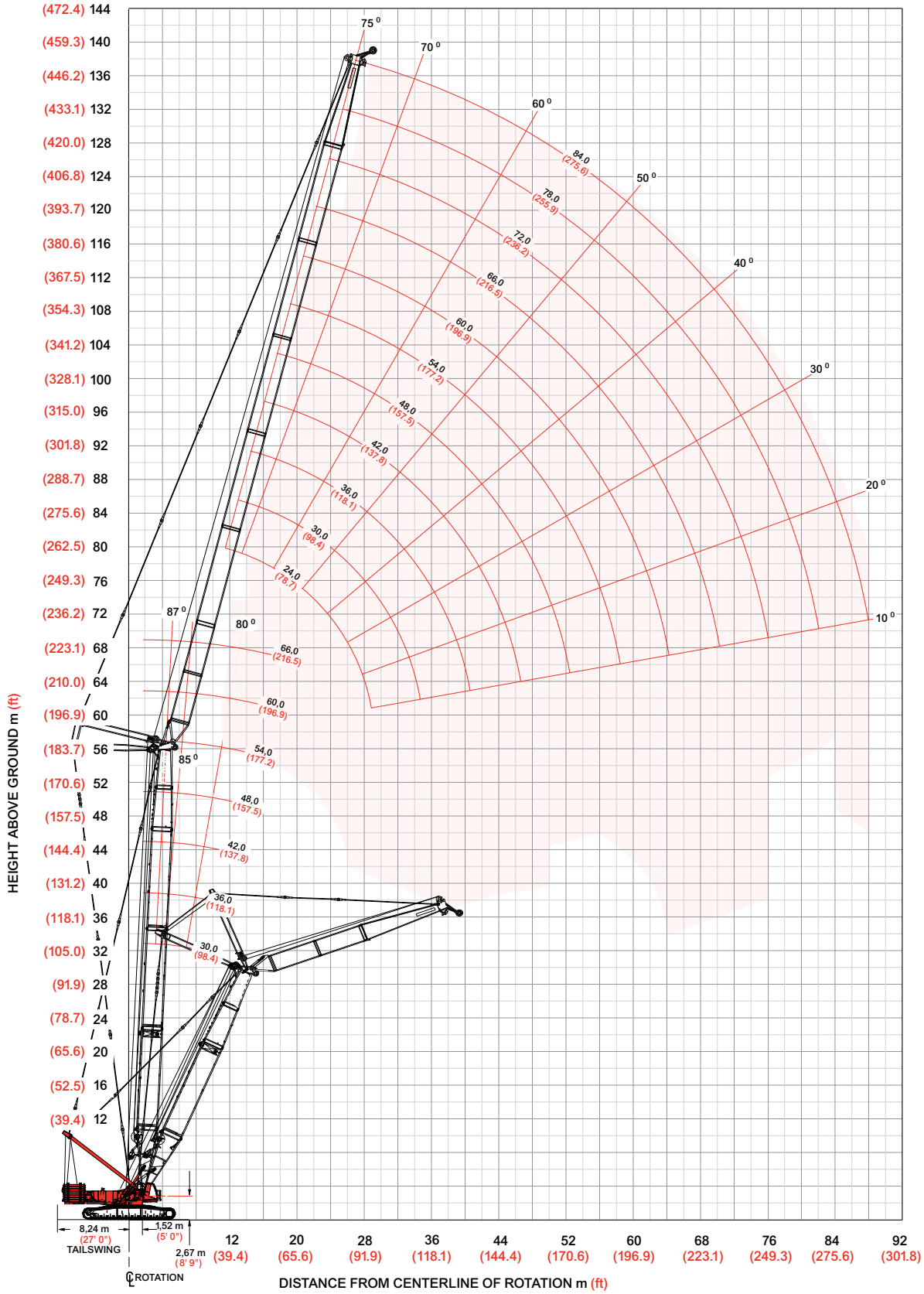
Features

- 400 m-ton (440 ton) capacity
- 2 599 m-ton (18,800 ft-kips) Maximum Load Moment
- 5 066 mton-m (36,405 ft-kips) Maximum Load Moment with MAX-ER®
- 96 m (315') Heavy-Lift Boom
- 138 m (453') Luffing Jib on Heavy-Lift Boom
- 372 kW (500 HP) engine

Luffing jib range diagram

ANSI B30.5

Liftcrane Boom Capacities - Model 16000 Series 3
No. 58 Heavy -lift Main Boom with No. 59 Luffing Jib



Luffing jib load charts

ANSI B30.5

Liftcrane Boom Capacities - Model 16000 Series 3
No. 59 Luffing Jib on No. 58 Heavy Lift Main Boom

150 590 kg (332,000 lb) Counterweight 54 430 kg (120,000 lb) Carbody Counterweight

360° Rating

kg (lb) x 1 000

87° Boom Angle

Luffing Jib Length 24,0 m (78.7 ft)

Boom m (ft)	30,0 (98.4)	42,0 (137.8)	54,0 (177.2)	66,0 (216.5)
Radius				
11,6 (38)	185,2 (408.5)			
14,0 (45)	157,7 (354.2)	151,0 (333.0)	117,4 (262.3)	99,6 (222.2)
18,0 (60)	121.1 (260.7)	112,6 (244.8)	97,8 (213.0)	84,8 (184.8)
22,0 (75)	92,7 (194.7)	92,7 (194.5)	82,2 (174.9)	72,3 (154.3)
26,0 (90)	74,6 (147.9)	73,9 (147.8)	69,5 (144.3)	62,1 (129.5)
32,0 (105)				
38,0 (125)				
44,0 (145)				
52,0 (175)				
56,0 (185)				
60,0 (195)				

Luffing Jib Length 36,0 m (118.1 ft)

Boom m (ft)	30,0 (98.4)	42,0 (137.8)	54,0 (177.2)	60,0 (196.9)
Radius				
15,2 (50)	136,1 (300.2)	116,8 (252.6)		
16,0 (55)	131,2 (278.3)	113,3 (242.0)	— (205.4)	— (194.5)
18,0 (60)	118,9 (258.6)	104,3 (227.5)	89,0 (194.3)	84,5 (184.4)
22,0 (75)	92,3 (193.7)	89,1 (190.3)	77,1 (165.1)	73,3 (157.0)
26,0 (90)	74,4 (153.3)	74,3 (152.9)	67,1 (141.2)	64,0 (134.6)
32,0 (105)	57,0 (125.8)	56,9 (125.5)	55,2 (121.7)	52,5 (115.8)
38,0 (125)	45,6 (100.2)	45,5 (100.0)	44,8 (98.5)	43,0 (94.7)
44,0 (145)				
52,0 (175)				
56,0 (185)				
60,0 (195)				

Luffing Jib Length 48,0 m (157.5 ft)

Boom m (ft)	30,0 (98.4)	42,0 (137.8)	54,0 (177.2)	60,0 (196.9)
Radius				
18,3 (60)	107,4 (236.8)	92,1 (203.2)		
22,0 (75)	91,9 (191.9)	81,6 (175.1)	70,3 (151.1)	66,6 (142.9)
24,0 (80)	81,6 (176.5)	75,6 (166.8)	66,2 (144.3)	62,6 (136.6)
30,0 (100)	61,2 (132.2)	61,0 (131.8)	55,5 (120.9)	52,6 (144.6)
34,0 (115)	52,0 (110.2)	51,8 (109.9)	49,5 (106.2)	47,0 (100.7)
38,0 (125)	44,9 (98.8)	44,8 (98.6)	44,4 (97.7)	42,0 (92.5)
42,0 (140)	39,3 (85.0)	39,2 (84.8)	39,1 (84.4)	37,6 (81.5)
46,0 (155)	34,8 (74,0)	34,7 (73.8)	34,5 (73.4)	33,7 (71.7)
52,0 (175)				27,0 (54.3)
56,0 (185)				
60,0 (195)				

Luffing Jib Length 60,0 m (196.9 ft)

Boom m (ft)	30,0 (98.4)	42,0 (137.8)	54,0 (177.2)	60,0 (196.9)
Radius				
21,3 (70)	86,0 (189.7)	73,5 (162.2)		
24,0 (80)	79,1 (172.5)	69,3 (151.1)	58,2 (128.1)	51,8 (114.1)
28,0 (95)	65,9 (139.2)	62,1 (133.6)	53,2 (114.7)	49,6 (107.3)
34,0 (115)	51,1 (108.2)	50,9 (107.8)	45,8 (98.3)	43,2 (92.8)
40,0 (135)	41,1 (87.2)	40,9 (86.9)	39,4 (84.4)	37,2 (79.7)
48,0 (160)	31,9 (69.0)	31,8 (68.7)	31,7 (68.3)	30,4 (65.9)
56,0 (185)	25,6 (55.9)	25,5 (355.7)	35,3 (55.3)	24,9 (54.4)
64,0 (210)	18,4 (40.7)	18,3 (40.5)	18,2 (40.3)	18,1 (40.1
72,0 (240)				
84,0 (280)				
88,0 (290)				

Luffing Jib Length 72,0 m (236.2 ft)

Boom m (ft)	30,0 (98.4)	42,0 (137.8)	54,0 (177.2)
Radius			
21,3 (70)			
24,0 (80)	— (132.1)	— (115.1)	
28,0 (95)	58.3 (127.7)	51,2 (112.4)	43,1 (94.6)
34,0 (115)	49.9 (105.8)	48,2 (103.7)	40,6 (88.0)
40,0 (135)	40.0 (84.8)	39,8 (84.5)	36,3 (78.1)
48,0 (160)	30.9 (66.6)	30.7 (66.3)	30.3 (65.7)
56,0 (185)	24.5 (53.5)	24.4 (53.3)	24.2 (52.9)
64,0 (210)	19.8 (43.7)	19.7 (43.5)	19.5 (43.2)
72,0 (240)	16.1 (34.6)	15,7 (32.5)	15,2 (31.6)
84,0 (280)			
88,0 (290)			

Luffing Jib Length 84,0 m (275.6 ft)

Boom m (ft)	30,0 (98.4)	42,0 (137.8)	54,0 (177.2)
Radius			
21,3 (70)			
24,0 (80)			
28,0 (95)	42,6 (93.3)	37,9 (83.3)	— (70.9)
34,0 (115)	40,7 (89.2)	36,7 (80.5)	31,4 (68.9)
40,0 (135)	38,7 (82.5)	35,4 (77.7)	30,0 (65.2)
48,0 (160)	29,8 (64.2)	29,6 (63.9)	26,4 (57.4)
56,0 (185)	23,4 (51.2)	23,3 (50.9)	22,7 (49.8)
64,0 (210)	18,8 (41.5)	18,6 (41.2)	18,5 (40.9)
72,0 (240)	15,2 (32.5)	15,1 (32.3)	14,9 (32.0)
84,0 (280)	10,6 (21.4)	9,6 (19.5)	9,1 (18.4)
88,0 (290)		6,8 (14.2)	6,6 (14.0)

Luffing jib load charts

ANSI B30.5

Liftcrane Boom Capacities - Model 16000 Series 3
No. 59 Luffing Jib on No. 58 Heavy Lift Main Boom

150 590 kg (332,000 lb) Counterweight 54 430 kg (120,000 lb) Carbody Counterweight

360° Rating

kg (lb) x 1 000

75° Boom Angle

Luffing Jib Length 24,0 m (78.7 ft)

Boom m (ft)	30,0 (98.4)	42,0 (137.8)	54,0 (177.2)	66,0 (216.5)
Radius				
24,0 (80)	75,6 (163.2)			
26,0 (90)	68,1 (140.3)	65,0 (133.9)		
28,0 (95)	61,9 (130.9)	59,1 (124.9)		
32,0 (105)	52,1 (114.9)	49,7 (109.7)	46,9 (103.4)	43,5 (96.0)
36,0 (120)		42,5 (91.8)	40,2 (213.0)	37,2 (80.5)
38,0 (125)			37,3 (82.1)	32,3 (76.3)
42,0 (140)				30,2 (65.1)
46,0 (155)				
52,0 (175)				
54,0 (180)				
56,0 (185)				

Luffing Jib Length 36,0 m (118.1 ft)

Boom m (ft)	30,0 (98.4)	42,0 (137.8)	54,0 (177.2)	60,0 (196.9)
Radius				
24,0 (80)				
26,0 (90)				
28,0 (95)	61,1 (128.9)			
32,0 (105)	51,4 (113.3)	48,7 (107.4)		
36,0 (120)	44,0 (95.2)	41,7 (90.2)	39,1 (84.4)	— (81.0)
38,0 (125)	41,0 (90,3)	38,9 (125.5)	36,3 (79.9)	34,9 (76.7)
42,0 (140)	35,9 (77.5)	34,0 (85.5)	31,8 (68.6)	30,4 (65.8)
46,0 (155)		30,0 (63.7)	28,0 (59.5)	26,8 (57.1)
52,0 (175)				22,4 (47.5)
54,0 (180)				
56,0 (185)				

Luffing Jib Length 48,0 m (157.5 ft)

Boom m (ft)	30,0 (98.4)	42,0 (137.8)	54,0 (177.2)	60,0 (196.9)
Radius				
34,0 (110)	46,4 (104.2)			
36,0 (120)	43,0 (92.9)	— (87.5)		
38,0 (125)	40,0 (87.9)	37,6 (82.8)		
40,0 (135)	37,3 (79.3)	35,1 (74.6)	32,6 (69.2)	
42,0 (140)	34,9 (75.5)	32,9 (71.0)	30,5 (65.8)	29,1 (62.8)
44,0 (145)	32,8 (71.9)	30,8 (67.6)	28,5 (62.6)	27,2 (59.8)
46,0 (155)	30,8 (65.6)	29,0 (61.6)	26,8 (56.9)	25,6 (54.3)
50,0 (165)	27,4 (60,0)	25,7 (56.3)	23,7 (52.0)	22,6 (49.6)
56,0 (185)	23,2 (50.6)	21,7 (47.5)	20,0 (43.7)	19,0 (41.6)
60,0 (200)		19,5 (41.8)	17,9 (38.6)	17,0 (36.7)
64,0 (215)			16,0 —	15,2 (32.2)

Luffing Jib Length 60,0 m (196.9 ft)

Boom m (ft)	30,0 (98.4)	42,0 (137.8)	54,0 (177.2)	60,0 (196.9)
Radius				
40,0 (135)	36,1 (76.7)			
44,0 (145)	31,6 (69.4)	29,6 (64.9)		
48,0 (160)	27,9 (60.3)	26,0 (56.2)	23,9 (51.5)	22,7 (48.9)
54,0 (180)	23,5 (50.6)	21,8 (47.0)	19,9 (42.9)	18,8 (40.6)
60,0 (200)	19,9 (42.9)	18,4 (39.8)	16,8 (36.1)	15,8 (34.0)
66,0 (220)	17,0 (36.6)	15,7 (33.8)	14,2 (30.5)	13,3 (28.7)
72,0 (240)		13,4 (28.6)	12,0 (25.8)	11,3 (24.2)
76,0 (250)			10,7 (23.6)	10,0 (22.1)
80,0 (265)				
84,0 (280)				
88,0 (300)				

Luffing Jib Length 72,0 m (236.2 ft)

Boom m (ft)	30,0 (98.4)	42,0 (137.8)	48,0 (157.5)
Radius			
40,0 (135)			
44,0 (145)			
48,0 (160)	26,6 (57.4)	24,7 (53.1)	
54,0 (180)	22,2 (47.8)	20,5 (44.1)	19,5 (41.9)
60,0 (200)	18,7 (40.2)	17,1 (36.9)	16,3 (35.0)
66,0 (220)	15,9 (31.4)	14,5 (31.1)	13,6 (29.3)
72,0 (240)	13,5 (28.9)	12,2 (26.2)	11,5 (24.7)
76,0 (250)	12,1 (26.7)	10,9 (24.1)	10,3 (22.6)
80,0 (265)		9,8 —	9,1 —
84,0 (280)		8,7 (18,2)	8,1 (17,1)
88,0 (300)			

Luffing Jib Length 84,0 m (275.6 ft)

Boom m (ft)	30,0 (98.4)
Radius	
40,0 (135)	
44,0 (145)	
48,0 (160)	
54,0 (180)	21,0 (45.1)
60,0 (200)	17,5 (37.6)
66,0 (220)	14,7 (31.5)
72,0 (240)	12,3 (26.4)
76,0 (250)	11,0 (24.2)
80,0 (265)	9,8 —
84,0 (280)	8,7 (18.5)
88,0 (300)	7,7 (15.2)

Luffing jib load charts

ANSI B30.5

Liftcrane Boom Capacities - Model 16000 Series 3
No. 59 Luffing Jib on No. 58 Heavy Lift Main Boom

150 590 kg (332,000 lb) Counterweight 54 430 kg (120,000 lb) Carbody Counterweight

360° Rating

kg (lb) x 1 000

65° Boom Angle

Luffing Jib Length 24,0 m (78.7 ft)

Boom m (ft)	30,0 (98.4)	42,0 (137.8)	54,0 (177.2)	66,0 (216.5)
Radius				
32,0 (105)	47,9 (105.7)			
36,0 (120)	41,0 (88.7)	— (80.8)		
40,0 (135)	61,9 —	32,4 (68.9)		
44,0 (145)		28,2 (61.9)	25,0 (60.6)	
48,0 (160)			21,9 (47.2)	18,5 (39.8)
52,0 (175)				16,2 (34.3)
56,0 (185)				
60,0 (200)				
62,0 (205)				
68,0 (225)				
72,0 (240)				

Luffing Jib Length 36,0 m (118.1 ft)

Boom m (ft)	30,0 (98.4)	42,0 (137.8)	54,0 (177.2)	60,0 (196.9)
Radius				
32,0 (105)				
36,0 (120)				
40,0 (135)	34,8 (74.0)			
44,0 (145)	30,6 (67.1)	27,4 (60.1)		
48,0 (160)	27,0 (58.4)	24,2 (52.2)	— (44.9)	
52,0 (175)		21,5 (45.7)	18,4 (39.2)	16,6 (35.4)
54,0 (180)		20,3 (43.7)	17,4 (34.3)	15,7 (33.8)
60,0 (200)			14,6 (31.2)	13,1 (28.2)
62,0 (205)				12,3 (26.9)
68,0 (225)				
72,0 (240)				

Luffing Jib Length 48,0 m (157.5 ft)

Boom m (ft)	30,0 (98.4)	42,0 (137.8)	54,0 (177.2)
Radius			
32,0 (105)			
36,0 (120)			
40,0 (135)			
44,0 (145)			
48,0 (160)	26,0 (56.1)		
52,0 (175)	23,1 (49.2)	20,3 (43.1)	
54,0 (180)	21,9 (47.1)	19,1 (41.2)	
60,0 (200)	18,5 (39.9)	16,2 (34.8)	13,3 (28.7)
62,0 (205)	17,5 (38.2)	15,3 (33.3)	12,6 (27.5)
68,0 (225)			10,6 (23.0)
72,0 (240)			9,3 (19.8)

Luffing Jib Length 60,0 m (196.9 ft)

Boom m (ft)	30,0 (98.4)	42,0 (137.8)
Radius		
54,0 (180)	20,6 (44.5)	
56,0 (185)	19,5 (42.6)	
58,0 (190)	18,4 (40.8)	15,7 (34.9)
60,0 (200)	17,4 (37.5)	14,8 (31.9)
64,0 (210)	15,6 (34.5)	13,2 (29.3)
68,0 (225)	14,0 (30.5)	11,8 (25.7)
72,0 (240)	12,6 (26.9)	10,5 (22.5)
74,0 (245)	11,8 (25.7)	9,9 (21.5)
76,0 (250)		9,3 (20.6)
80,0 (260)		— (18.7)
84,0 (280)		

Luffing Jib Length 72,0 m (236.2 ft)

Boom m (ft)	30,0 (98.4)
Radius	
54,0 (180)	
56,0 (185)	
58,0 (190)	
60,0 (200)	16,1 (34.5)
64,0 (210)	14,3 (31.6)
68,0 (225)	12,7 (27.7)
72,0 (240)	11,3 (24.3)
74,0 (245)	10,7 (23.2)
76,0 (250)	10,1 (22.2)
80,0 (260)	9,0 (20.3)
84,0 (280)	7,9 (16.8)

APPENDIX II.E: EXISTING SITE LOGISTICS PLANS

APPENDIX III.A: CALCULATIONS

SEISMIC FORCE CALCULATIONS								
		w_i (psf)						
floor	*area (sf)*	*floor*	*façade*	*wall area (sf)*	W_i *(lbs)*	h_x *(ft)*	h_i *(ft)*	$w_i * h_i^k$
1	21550	127	25	17639	3177814	25.2	25	2.02E+09
2	21550	127	25	10828	3007553	15.5	41	4.97E+09
3	21550	127	25	10828	3007553	15.5	56	9.48E+09
4	21550	127	25	10026	2987501	14.3	70	1.48E+10
5	21550	127	25	9625	2977475	13.8	84	2.11E+10
6	21550	127	25	9625	2977475	13.8	98	2.86E+10
7	21550	125	25	9625	2934375	13.8	112	3.66E+10
8	21550	125	25	9625	2934375	13.8	125	4.62E+10
9	21550	125	25	9625	2934375	13.8	139	5.69E+10
10	21550	125	25	9625	2934375	13.8	153	6.87E+10
11	21550	125	25	9625	2934375	13.8	167	8.16E+10
12	21550	125	25	9625	2934375	13.8	180	9.56E+10
13	21550	125	25	10442	2954792	14.9	195	1.13E+11
14	21550	123	25	8808	2870858	12.6	208	1.24E+11
15	21550	123	25	9625	2891275	13.8	222	1.42E+11
16	21550	123	25	9625	2891275	13.8	235	1.60E+11
17	21550	123	25	9625	2891275	13.8	249	1.80E+11
18	21550	123	25	9625	2891275	13.8	263	2.00E+11
19	21550	123	25	9625	2891275	13.8	277	2.21E+11
20	21550	121	25	9625	2848175	13.8	290	2.40E+11
21	21550	121	25	9625	2848175	13.8	304	2.64E+11
22	21550	121	25	9625	2848175	13.8	318	2.88E+11
23	21550	121	25	9625	2848175	13.8	332	3.13E+11
24	21550	121	25	9625	2848175	13.8	345	3.40E+11
25	21550	121	25	9625	2848175	13.8	359	3.68E+11
26	21550	119	25	9625	2805075	13.8	373	3.90E+11
27	21550	119	25	10179	2818929	14.5	388	4.23E+11
28	21550	119	25	19279	3046429	27.5	415	5.25E+11
29	21550	119	25	9625	2805075	13.8	429	5.16E+11
30	21550	119	25	9625	2805075	13.8	443	5.49E+11
31	21550	119	25	9625	2805075	13.8	456	5.84E+11
32	21550	117	25	9625	2761975	13.8	470	6.10E+11
33	21550	117	25	9625	2761975	13.8	484	6.46E+11
34	21550	117	25	9625	2761975	13.8	498	6.84E+11
35	21550	117	25	9625	2761975	13.8	511	7.22E+11
36	21550	117	25	9625	2761975	13.7	525	7.61E+11
37	21550	117	25	9625	2761975	13.8	539	8.02E+11
38	21550	115	25	9625	2718875	13.8	553	8.30E+11
39	21550	115	25	9625	2718875	13.8	566	8.72E+11
40	21550	115	25	9625	2718875	13.8	580	9.15E+11
41	21550	115	25	9625	2718875	13.8	594	9.59E+11
42	21550	115	25	9625	2718875	13.8	608	1.00E+12
43	21550	115	25	9625	2718875	13.8	621	1.05E+12
44	21550	113	25	9625	2675775	13.8	635	1.08E+12
45	21550	113	25	9625	2675775	13.8	649	1.13E+12
46	21550	113	25	9625	2675775	13.8	663	1.17E+12
47	21550	113	25	9625	2675775	13.8	676	1.22E+12
48	21550	113	25	9625	2675775	13.8	690	1.27E+12
49	21550	113	25	9625	2675775	13.8	704	1.33E+12
50	21550	111	25	10063	2643613	14.4	718	1.36E+12
51	21550	111	25	18664	2858658	26.7	745	1.59E+12
52	21550	111	25	12306	2699700	17.6	762	1.57E+12
ROOF	27400	111	25	0	3041400	0.0	762	1.77E+12
				ΣW	150381.475	k	$\Sigma w_i * h_i^k$	2.97504E+13

Table 1: Seismic force calculations

Soil Classification					
NYCBC:	2-65 (medium hard rock)				
	4-65 (soft rock)				
ASCE 7-05:	seismic design category C				
	Occ. Cat. III		*T 11.5-1*		
	Importance factor= 1.25				

Spectral Response Acceleration					
(using USGS Ground Motion Parameter Calculator)					
latitude: 40.756192			F_a= 1.2		
longitude: -73.990130			F_v= 1.7		

site class C					
T=0.2s			*T=1.0s*		
S_{MS}	0.436	g	S_{M1}	0.119	g
S_{DS}	0.291	g	S_{D1}	0.08	g

ASCE 7-05:	S_{DS} -> SDC B	*T 11.6-1*	therefore, use SDC B
	S_{D1} -> SDC B	*T 11.6-2*	

Period of Building				
$C_u * T_a$	4.93	s		
T	6.25	s	*via ETABS, min of E/W & N/S*	
T_L	6.00	s	$C_u*T_a < T_L < T$	: use 4.93 s for C_s calc
$T_a = C_t * h_n^{\ x}$ =	2.902	s		
C_t	0.02		*T 12.2.1.B*	
x	0.75		*T 11.5-1*	
h	762.4			

Seismic Base Shear				
$V = C_s * W$	1503.8	k	*12.8-1*	
$C_s = min\{$	0.1119		$S_{DS}/(R/I)$	
	0.0076		$S_{D1} * T_L/(T^2 * R/I)$	
		>=	0.01 min	: use 0.01 for E/W & N/S
R	3.25		*T 12.2.1.B*	
I	1.25		*T 11.5-1*	

Table 2A: Seismic force calculation variables

SEISMIC DRIFT CHECKS (inches)								
level	*E/W*	*story drift*	*allowable*	*check*	*N/S*	*story drift*	*allowable*	*check*
Roof	12.87	0.53	2.40	OK	11.91	1.42	2.40	OK
52	12.61	0.55	2.40	OK	11.16	0.47	2.40	OK
51	12.34	0.62	2.59	OK	10.91	0.52	3.16	OK
50	12.04	0.58	2.48	OK	10.64	0.50	2.59	OK
49	11.75	0.59	2.48	OK	10.38	0.54	2.48	OK
48	11.46	0.61	2.48	OK	10.09	0.51	2.48	OK
47	11.17	0.62	2.48	OK	9.82	0.51	2.48	OK
46	10.87	0.63	2.48	OK	9.55	0.52	2.48	OK
45	10.56	0.64	2.48	OK	9.28	0.52	2.48	OK
44	10.24	0.64	2.48	OK	9.00	0.53	2.48	OK
43	9.93	0.63	2.48	OK	8.73	0.53	2.48	OK
42	9.62	0.64	2.48	OK	8.45	0.53	2.48	OK
41	9.31	0.64	2.48	OK	8.17	0.53	2.48	OK
40	9.00	0.65	2.48	OK	7.89	0.54	2.48	OK
39	8.68	0.65	2.48	OK	7.61	0.54	2.48	OK
38	8.36	0.65	2.48	OK	7.32	0.54	2.48	OK
37	8.04	0.65	2.48	OK	7.04	0.53	2.48	OK
36	7.73	0.65	2.47	OK	6.76	0.53	2.47	OK
35	7.41	0.65	2.48	OK	6.48	0.53	2.48	OK
34	7.10	0.65	2.48	OK	6.20	0.53	2.48	OK
33	6.78	0.64	2.48	OK	5.93	0.52	2.48	OK
32	6.47	0.64	2.48	OK	5.65	0.52	2.48	OK
31	6.16	0.63	2.48	OK	5.38	0.50	2.48	OK
30	5.85	0.60	2.48	OK	5.12	0.50	2.48	OK
29	5.55	0.73	2.48	OK	4.85	1.11	2.48	OK
28	5.19	0.83	4.96	OK	4.27	0.47	4.96	OK
27	4.79	0.59	2.62	OK	4.02	0.47	2.62	OK
26	4.50	0.57	2.48	OK	3.77	0.46	2.48	OK
25	4.22	0.55	2.48	OK	3.53	0.44	2.48	OK
24	3.95	0.54	2.48	OK	3.30	0.42	2.48	OK
23	3.69	0.53	2.48	OK	3.08	0.41	2.48	OK
22	3.43	0.51	2.48	OK	2.86	0.40	2.48	OK
21	3.18	0.50	2.48	OK	2.65	0.39	2.48	OK
20	2.94	0.48	2.48	OK	2.45	0.37	2.48	OK
19	2.71	0.45	2.48	OK	2.25	0.34	2.48	OK
18	2.49	0.42	2.48	OK	2.07	0.33	2.48	OK
17	2.28	0.40	2.48	OK	1.90	0.31	2.48	OK
16	2.09	0.39	2.48	OK	1.74	0.30	2.48	OK
15	1.90	0.37	2.48	OK	1.58	0.29	2.48	OK
14	1.71	0.36	2.27	OK	1.43	0.27	2.27	OK
13	1.54	0.32	2.69	OK	1.29	0.25	2.69	OK
12	1.38	0.33	2.48	OK	1.16	0.25	2.48	OK
11	1.22	0.30	2.48	OK	1.03	0.23	2.48	OK
10	1.07	0.28	2.48	OK	0.90	0.21	2.48	OK
9	0.94	0.27	2.47	OK	0.79	0.21	2.47	OK
8	0.81	0.25	2.48	OK	0.68	0.20	2.48	OK
7	0.68	0.23	2.48	OK	0.58	0.18	2.48	OK
6	0.57	0.22	2.48	OK	0.49	0.17	2.48	OK
5	0.46	0.21	2.48	OK	0.40	0.16	2.48	OK
4	0.36	0.21	2.58	OK	0.31	0.10	2.58	OK
3	0.26	0.20	2.78	OK	0.26	0.18	2.78	OK
2	0.16	0.32	2.78	OK	0.16	0.30	2.78	OK

Table 3: Seismic drift calculation and checks

COLUMN INTERACTION CHECK (1.2D + 0.5L +1.6W)														
				M ('k)		Fe	ΦP$_n$ (k)		ΦM$_n$ ('k)		Interaction			
Dead Load (ksf)	Live Load (ksf)	Ext col Atrib (sf)	Ext col load (k)	E/W	N/S		E/W	N/S	E/W	N/S	E/W col	check	N/S col	check
0.11	0.04	750	5901	254	253	245	13550	13550	4830	768	0.68	OK	0.96	OK
0.11	0.04	750	5791	152	152	673	14308	14308	4830	768	0.62	OK	0.78	OK
0.11	0.04	750	5681	147	147	673	14308	14308	4830	768	0.61	OK	0.77	OK
0.11	0.04	750	5571	136	137	785	14372	14372	4830	768	0.59	OK	0.74	OK
0.11	0.04	750	5461	146	147	708	14330	14330	4830	768	0.58	OK	0.74	OK
0.11	0.04	750	5351	123	123	1044	14467	14467	4830	768	0.56	OK	0.70	OK
0.11	0.04	750	5241	138	138	852	14402	8606	4830	768	0.56	OK	0.71	OK
0.11	0.04	750	5131	140	141	852	14402	8606	4320	1008	0.55	OK	0.66	OK
0.11	0.04	750	5021	142	142	852	14402	8606	4320	1008	0.54	OK	0.65	OK
0.11	0.04	750	4911	143	144	852	14402	8606	4320	1008	0.53	OK	0.64	OK
0.11	0.04	750	4802	151	152	852	14402	8606	4320	1008	0.52	OK	0.63	OK
0.11	0.04	750	4692	147	148	852	14402	8606	4320	1008	0.51	OK	0.62	OK
0.11	0.04	750	4582	154	155	724	14208	7082	4320	1008	0.50	OK	0.62	OK
0.11	0.04	750	4472	137	138	1017	14327	7141	4320	1008	0.48	OK	0.59	OK
0.11	0.04	750	4362	151	152	852	14270	7113	4320	1008	0.48	OK	0.59	OK
0.11	0.04	750	4252	152	153	852	14270	7113	3750	1155	0.47	OK	0.56	OK
0.11	0.04	750	4142	153	155	852	14270	7113	3750	1155	0.46	OK	0.55	OK
0.11	0.04	750	4032	154	156	852	14270	7113	3750	1155	0.45	OK	0.54	OK
0.11	0.04	750	3922	156	157	852	13260	6454	3750	1155	0.47	OK	0.56	OK
0.11	0.04	750	3812	157	158	852	13260	6454	3750	1155	0.46	OK	0.55	OK
0.11	0.04	750	3702	158	160	852	13260	6454	3750	1155	0.45	OK	0.54	OK
0.11	0.04	750	3592	159	161	852	13260	6454	3750	1155	0.44	OK	0.53	OK
0.11	0.04	750	3482	160	162	852	13260	6454	3750	1155	0.42	OK	0.52	OK
0.11	0.04	750	3372	161	163	852	13260	6454	3120	1579	0.42	OK	0.47	OK
0.11	0.04	750	3262	167	169	852	14226	6454	3120	1579	0.39	OK	0.44	OK
0.11	0.04	750	3152	250	253	852	14226	6454	3120	1579	0.40	OK	0.48	OK
0.13	0.13	750	3042	262	265	757	14182	6435	3120	1579	0.39	OK	0.48	OK
0.11	0.04	750	2850	331	335	213	13215	5996	3120	1579	0.42	OK	0.53	OK
0.11	0.04	750	2740	166	169	852	14226	6454	3120	1579	0.33	OK	0.39	OK
0.11	0.04	750	2630	167	170	852	14226	6454	3120	1579	0.32	OK	0.38	OK
0.11	0.04	750	2520	168	170	852	8782	4435	3120	1579	0.47	OK	0.52	OK
0.11	0.04	750	2410	169	171	852	8782	4435	2430	1512	0.47	OK	0.51	OK
0.11	0.04	750	2300	169	172	852	8782	4435	2430	1512	0.45	OK	0.49	OK
0.11	0.04	750	2190	170	173	852	8782	4435	2430	1512	0.43	OK	0.48	OK
0.11	0.04	750	2080	171	174	852	8782	4435	2430	1512	0.41	OK	0.46	OK
0.11	0.04	750	1970	172	174	852	8782	4435	2430	1512	0.40	OK	0.44	OK
0.11	0.04	750	1860	172	175	852	8782	3319	2430	1512	0.38	OK	0.42	OK
0.11	0.04	750	1750	173	176	852	8782	3319	2430	1512	0.36	OK	0.41	OK
0.11	0.04	750	1640	174	177	852	8782	3319	2430	1512	0.34	OK	0.39	OK
0.11	0.04	750	1530	175	177	852	8782	3319	1680	1528	0.36	OK	0.37	OK
0.11	0.04	750	1420	175	178	852	8782	3319	1680	1528	0.34	OK	0.35	OK
0.11	0.04	750	1310	176	179	852	8782	3319	1680	1528	0.32	OK	0.33	OK
0.11	0.04	750	1200	177	180	852	7552	2507	1680	1528	0.34	OK	0.35	OK
0.11	0.04	750	1090	177	180	852	7552	2507	1680	1528	0.31	OK	0.33	OK
0.11	0.04	750	980	178	181	852	7552	2507	1680	1528	0.29	OK	0.31	OK
0.11	0.04	750	870	179	182	852	7552	2507	1680	1528	0.27	OK	0.29	OK
0.11	0.04	750	761	179	182	852	7552	2507	1680	1528	0.25	OK	0.27	OK
0.11	0.04	750	651	184	187	852	7552	2507	870	1456	0.34	OK	0.25	OK
0.11	0.04	750	541	271	276	852	7552	2108	870	1456	0.42	OK	0.29	OK
0.11	0.04	750	431	310	399	775	7534	2102	870	1456	0.44	OK	0.36	OK
0.11	0.04	750	321	341	440	897	7561	2110	870	1456	0.45	OK	0.36	OK
0.16	0.13	750	211	353	495	897	7580	2115	870	1456	0.45	OK	0.38	OK

Table 4: Column spot checks

Table 5: Bracing strength calculations

LATERAL SIZE CALCULATION BASED ON WIND LOAD

			Shear at Each Level (k)		Force in Each Frame (k)*		Axial Force per Brace (k)				Brace Axial Area Required (in^2)				Brace Section Required			
Level	*Elevation*	*Level Height*	*E/W*	*N/S*	*E/W*	*N/S*	*E/W Long Bay*	*E/W Short Bay*	*N/S Chevron*	*N/S Single Diag.*	*E/W (40' V)*	*E/W (25' V)*	*N/S (30' V)*	*N/S (30' diag)*	*E/W (40' V)*	*E/W (25' V)*	*N/S (30' V)*	*N/S (30' diag)*
Roof	745.5	13.4	0	0	0	0	0	0	0	0	0.0	0.0	0.0	0.0	W10X12	W10x12	W10x12	W10x12
52	732.1	13.4	254	262	152	157	46	52	42	34	1.0	1.1	0.9	0.7	W10X12	W10x12	W10x12	W10x12
51	718.7	14.4	469	483	281	290	87	100	80	64	1.8	2.1	1.7	1.4	W10X12	W10x12	W10x12	W10x12
50	704.3	13.8	666	644	400	386	121	139	105	85	2.6	2.9	2.2	1.8	W10X12	W10x12	W10x12	W10x12
49	690.5	13.8	800	753	480	452	146	167	123	99	3.1	3.5	2.6	2.1	W10X12	W10x12	W10x12	W10x12
48	676.8	13.8	930	859	558	515	169	194	140	113	3.6	4.1	3.0	2.4	W10X12	W10x12	W10x12	W10x12
47	663.0	13.8	1060	965	636	579	193	221	157	127	4.1	4.7	3.3	2.7	W10X12	W10X12	W10x12	W10x12
46	649.3	13.8	1189	1070	714	642	217	248	174	141	4.6	5.2	3.7	3.0	W10X15	W10X12	W10X12	W10x12
45	635.5	13.8	1318	1175	791	705	240	275	191	155	5.1	5.8	4.0	3.3	W10X17	W10X15	W10X12	W10X12
44	621.8	13.8	1447	1280	868	768	263	302	208	169	5.6	6.4	4.4	3.6	W10X17	W10X17	W10X15	W10X12
43	608.0	13.8	1575	1384	945	830	287	328	225	183	6.1	6.9	4.8	3.9	W10X19	W10X17	W10X17	W10X15
42	594.3	13.8	1702	1487	1021	892	310	355	242	196	6.5	7.5	5.1	4.1	W10X22	W10X19	W10X17	W10X17
41	580.5	13.8	1829	1591	1097	954	333	381	259	210	7.0	8.1	5.5	4.4	W10X22	W10X22	W10X19	W10X17
40	566.8	13.8	1956	1693	1173	1016	356	408	276	224	7.5	8.6	5.8	4.7	W10X22	W10X22	W10X22	W10X19
39	553.0	13.8	2082	1796	1249	1078	379	434	292	237	8.0	9.2	6.2	5.0	W14X26	W10X22	W10X22	W10X22
38	539.3	13.8	2207	1898	1324	1139	402	460	309	251	8.5	9.7	6.5	5.3	W14X26	W14X26	W10X22	W10X22
37	525.5	13.8	2332	1999	1399	1200	424	486	325	264	9.0	10.3	6.9	5.6	W14X30	W14X26	W14X26	W10X22
36	511.8	13.8	2456	2100	1474	1260	447	512	342	277	9.5	10.8	7.2	5.9	W14X30	W14X30	W14X26	W14X26
35	498.0	13.8	2580	2201	1548	1321	470	538	358	291	9.9	11.4	7.6	6.1	W10X33	W14X30	W14X30	W14X26
34	484.3	13.8	2703	2301	1622	1381	492	564	375	304	10.4	11.9	7.9	6.4	W12X35	W10X33	W14X30	W14X30
33	470.5	13.8	2826	2401	1696	1440	514	589	391	317	10.9	12.5	8.3	6.7	W12X35	W12X35	W10X33	W14X30
32	456.8	13.8	2948	2500	1769	1500	537	615	407	330	11.3	13.0	8.6	7.0	W14X38	W12X35	W12X35	W10X33
31	443.0	13.8	3070	2599	1842	1559	559	640	423	343	11.8	13.5	8.9	7.3	W12X40	W14X38	W12X35	W12X35
30	429.3	13.8	3191	2697	1914	1618	581	665	439	356	12.3	14.1	9.3	7.5	W12X40	W12X40	W14X38	W12X35
29	415.5	27.5	3311	2794	1987	1677	844	1079	700	455	21.1	26.9	17.5	11.3	W10X68	W12X40	W12X40	W14X38
28	388.0	14.6	3490	2940	2094	1764	648	749	492	392	13.8	15.9	10.5	8.3	W10X45	W10X68	W12X40	W12X40
27	373.4	13.8	3672	3087	2203	1852	668	765	503	408	14.1	16.2	10.6	8.6	W14X48	W10X45	W10X68	W12X40
26	359.7	13.8	3793	3185	2276	1911	690	791	519	420	14.6	16.7	11.0	8.9	W10X49	W14X48	W10X45	W10X68
25	345.9	13.8	3910	3280	2346	1968	712	815	534	433	15.0	17.2	11.3	9.2	W12X50	W10X49	W14X48	W10X45
24	332.2	13.8	4026	3374	2416	2024	733	839	549	445	15.5	17.7	11.6	9.4	W12X50	W12X50	W10X49	W14X48
23	318.4	13.8	4142	3468	2485	2081	754	863	564	458	15.9	18.2	11.9	9.7	W10X54	W12X50	W12X50	W10X49
22	304.7	13.8	4256	3560	2554	2136	775	887	580	470	16.4	18.8	12.3	9.9	W10X54	W10X54	W12X50	W12X50
21	290.9	13.8	4370	3653	2622	2192	796	911	595	482	16.8	19.3	12.6	10.2	W10X54	W10X54	W10X54	W12X50
20	277.2	13.8	4483	3744	2690	2246	816	935	609	494	17.3	19.8	12.9	10.4	W12X58	W10X54	W10X54	W10X54
19	263.4	13.8	4596	3835	2757	2301	837	958	624	506	17.7	20.2	13.2	10.7	W10X60	W12X58	W10X54	W10X54
18	249.7	13.8	4707	3925	2824	2355	857	981	639	518	18.1	20.7	13.5	11.0	W14X61	W10X60	W12X58	W10X54
17	235.9	13.8	4818	4014	2891	2408	877	1004	653	530	18.5	21.2	13.8	11.2	W14X61	W14X61	W10X60	W12X58
16	222.2	13.8	4927	4103	2956	2462	897	1027	668	542	19.0	21.7	14.1	11.4	W14X61	W14X61	W14X61	W10X60
15	208.4	12.6	5036	4190	3021	2514	892	1008	656	545	18.7	21.1	13.7	11.4	W14X61	W14X61	W14X61	W14X61
14	195.8	14.9	5139	4273	3083	2564	962	1116	723	573	20.5	23.8	15.4	12.2	W10X68	W14X61	W14X61	W14X61
13	180.9	13.8	5245	4359	3147	2616	955	1093	710	575	20.2	23.1	15.0	12.2	W10X68	W10X68	W14X61	W14X61
12	167.2	13.8	5355	4448	3213	2669	975	1116	724	587	20.6	23.6	15.3	12.4	W10X68	W10X68	W10X68	W14X61
11	153.4	13.8	5460	4532	3276	2719	994	1138	738	598	21.0	24.1	15.6	12.6	W10X68	W10X68	W10X68	W10X68
10	139.7	13.8	5563	4615	3338	2769	1013	1159	751	609	21.4	24.5	15.9	12.9	W12X72	W10X68	W10X68	W10X68
9	125.9	13.8	5664	4696	3399	2818	1031	1181	765	620	21.8	25.0	16.2	13.1	W12X72	W12X72	W10X68	W10X68
8	112.2	13.8	5764	4777	3459	2866	1049	1202	778	631	22.2	25.4	16.4	13.3	W14X74	W12X72	W12X72	W10X68
7	98.4	12.4	5863	4856	3518	2914	1035	1167	757	631	21.7	24.4	15.8	13.2	W12X72	W14X74	W12X72	W12X72
6	86.0	15.1	5960	4934	3576	2960	1120	1302	840	663	23.9	27.8	17.9	14.2	W12X79	W12X72	W14X74	W12X72
5	70.9	14.3	6055	5010	3633	3006	1117	1288	831	666	23.7	27.3	17.7	14.1	W12X79	W12X79	W12X72	W14X74
4	56.6	15.5	6151	5087	3690	3052	1166	1362	877	687	25.0	29.2	18.8	14.7	W14X82	W12X79	W12X79	W12X72
3	41.1	15.5	6249	5165	3749	3099	1185	1383	890	697	25.4	29.7	19.1	15.0	W14X82	W14X82	W12X79	W12X79
2	25.7	25.7	6348	5244	3809	3146	1549	1961	1247	828	37.6	47.5	30.2	20.1	W12X120	W14X82	W14X82	W12X79

* Force multiplied by 1.2 for a conservative estimate.

** Section decreases due to moment frame contribution on upper levels.

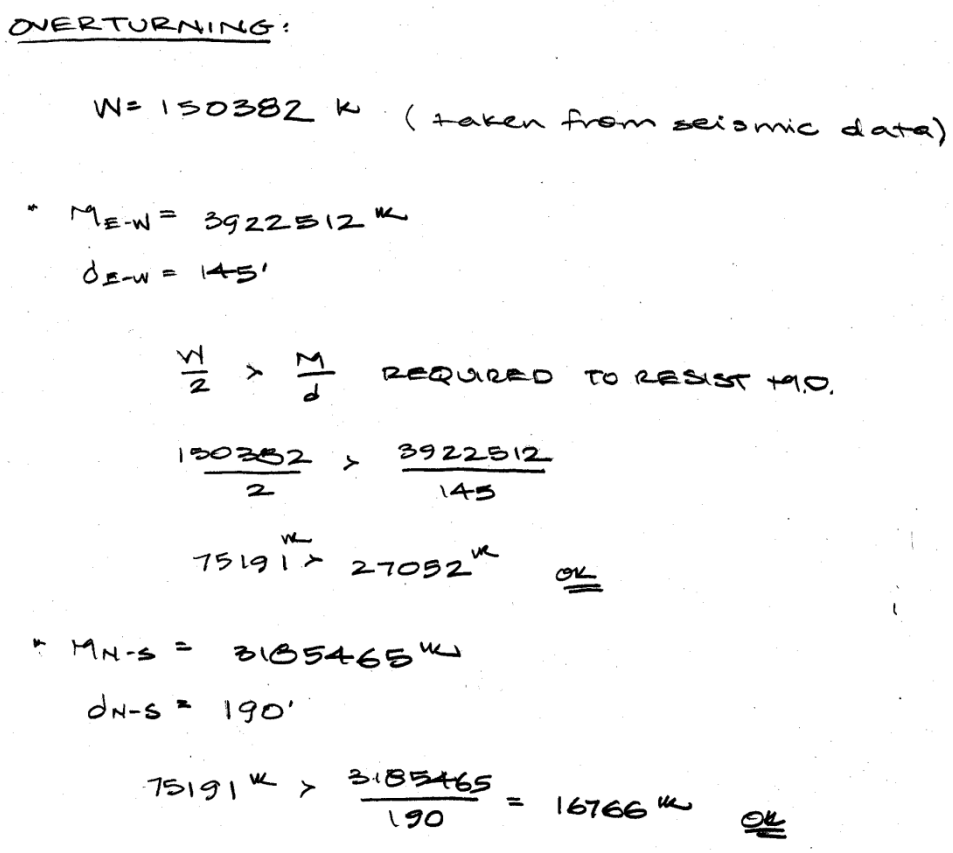


Figure 1: Overturning check

APPENDIX III.B: MEMBER SIZES

COLUMN SIZES (GENERALIZED)					
level	*new outrigger*	*corner*	*side*	*center*	*existing outrigger*
Roof	-	W14x342	W14X342	W14X311	W14x159
52	-	W14x342	W14X342	W14X311	W14x159
51	-	W14x342	W14X342	W14X311	W14x159
50	-	W14x342	W14X342	W14X311	W14x159
49	-	W14x605	W14X342	W14X311	W14X257
48	-	W14x605	W14X342	W14X311	W14X257
47	-	W14x605	W14X342	W14X311	W14X257
46	-	W14x605	W14X342	W14X311	W14X257
45	-	W14x605	W14X342	W14X311	W14X257
44	-	W14x605	W14X342	W14X311	W14X257
43	-	24.5x22x5.5"	W14X550	W14X550	W14X500
42	-	24.5x22x5.5"	W14X550	W14X550	W14X500
41	-	24.5x22x5.5"	W14X550	W14X550	W14X500
40	-	24.5x22x5.5"	W14X550	W14X550	W14X500
39	-	24.5x22x5.5"	W14X550	W14X550	W14X500
38	-	24.5x22x5.5"	W14X550	W14X550	W14X500
37	-	24.5x22x5.5"	W14X550	W14X550	W14X500
36	-	24.5x22x5.5"	W14X550	W14X550	W14X500
35	-	24.5x22x5.5"	W14X550	W14X550	W14X500
34	-	24.5x22x5.5"	W14X550	W14X550	W14X500
33	-	24.5x22x5.5"	W14X550	W14X550	W14X500
32	-	24.5x22x5.5"	W14X550	W14X550	W14X500
31	-	28x21x4.5"	24x21x6"	24x21x6"	W14x550
30	-	28x21x4.5"	24x21x6"	24x21x6"	W14x550
29	4"f x 2"w	28x21x4.5"	24x21x6"	24x21x6"	W14x550
28	4"f x 2"w	28x21x4.5"	24x21x6"	24x21x6"	W14x550
27	4"f x 2"w	28x21x4.5"	24x21x6"	24x21x6"	W14x550
26	4"f x 2"w	28x21x4.5"	24x21x6"	24x21x6"	W14x550
25	4"f x 2"w	28x21x4.5"	24x21x6"	24x21x6"	W14x550
24	4"f x 2"w	28x21x4.5"	24x21x6"	24x21x6"	W14x550
23	4"f x 2"w	28x21x4.5"	24x21x6"	24x21x6"	W14x550
22	4"f x 2"w	28x21x4.5"	24x21x6"	24x21x6"	W14x550
21	4"f x 2"w	28x21x4.5"	24x21x6"	24x21x6"	W14x550
20	4"f x 2"w	28x21x4.5"	24x21x6"	24x21x6"	W14x550
19	4"f x 2"w	28x21x4.5"	24x21x6"	24x21x6"	W14x665
18	4"f x 2"w	28x21x4.5"	24x21x6"	24x21x6"	W14x665
17	4"f x 2"w	28x21x4.5"	24x21x6"	24x21x6"	W14x665
16	4"f x 2"w	28x21x4.5"	24x21x6"	24x21x6"	W14x665
15	4"f x 2"w	28x21x4.5"	24x21x6"	24x21x6"	W14x665
14	4"f x 2"w	28x21x4.5"	24x21x6"	24x21x6"	W14x665
13	4"f x 2"w	30x28x8"	30x28x8"	30x28x8"	W14x665
12	4"f x 2"w	30x28x8"	30x28x8"	30x28x8"	W14x665
11	4"f x 2"w	30x28x8"	30x28x8"	30x28x8"	W14x665
10	4"f x 2"w	30x28x8"	30x28x8"	30x28x8"	W14x665
9	4"f x 2"w	30x28x8"	30x28x8"	30x28x8"	W14x665
8	4"f x 2"w	30x28x8"	30x28x8"	30x28x8"	W14x665
7	4"f x 2"w	30x30"solid	30x28x8"	30x28x8"	4"f x 2"w
6	4"f x 2"w	30x30"solid	30x28x8"	30x28x8"	4"f x 2"w
5	4"f x 2"w	30x30"solid	30x28x8"	30x28x8"	4"f x 2"w
4	4"f x 2"w	30x30"solid	30x28x8"	30x28x8"	4"f x 2"w
3	4"f x 2"w	30x30"solid	30x28x8"	30x28x8"	4"f x 2"w
2	4"f x 2"w	30x30"solid	30x28x8"	30x28x8"	4"f x 2"w
* column dimensions formatted as depth x width x thickness are built-up members					

Table 6: Existing and new column sizes

BRACING SIZES											
	N/S Brace Existing			E/W Brace Existing		Existing Structure	N/S Brace Proposed		E/W Brace Proposed		Proposed Structure
Level	*Chevron*	*Eccentric*	*Single Diag.*	*Long Chevron*	*Short Chevron*	**Weight (lbs)**	*Section*	*Weight*	*Section*	*Weight*	**Weight (lbs)**
Roof	W14x159	W14x193	W14x159	W14x82	W14x68	279782	W14	68	W14	53	281263
52	W14x159	W14x193	W14x159	W14x82	W14x68	279442	W14	68	W14	53	280935
51	W14x159	W14x193	W14x159	W14x82	W14x68	289846	W14	68	W14	53	290946
50	W14x159	W14x193	W14x159	W14x82	W14x68	283018	W14	68	W14	53	284378
49	W14x257	W14x159	W14x398	W14x90	W14x68	308197	W14	82	W14	61	303275
48	W14x257	W14x159	W14x398	W14x90	W14x68	308197	W14	82	W14	61	303275
47	W14x257	W14x159	W14x398	W14x90	W14x68	308197	W14	82	W14	61	303275
46	W14x257	W14x159	W14x398	W14x90	W14x68	308197	W14	82	W14	61	303275
45	W14x257	W14x159	W14x398	W14x90	W14x68	308197	W14	82	W14	61	303275
44	W14x257	W14x159	W14x398	W14x90	W14x68	308197	W14	82	W14	61	303275
43	W14x426	W14x211	W14x398	W14x90	W14x109	370434	W14	90	W14	68	353745
42	W14x426	W14x211	W14x398	W14x90	W14x109	370434	W14	90	W14	68	353745
41	W14x426	W14x211	W14x398	W14x90	W14x109	370434	W14	90	W14	68	353745
40	W14x426	W14x211	W14x398	W14x90	W14x109	370434	W14	90	W14	68	353745
39	W14x426	W14x211	W14x398	W14x90	W14x109	370434	W14	90	W14	68	353745
38	W14x426	W14x211	W14x398	W14x90	W14x109	370434	W14	90	W14	68	353745
37	W14x283	W14x342	W14x455	W14x109	W14x109	410387	W14	99	W12	74	393530
36	W14x283	W14x342	W14x455	W14x109	W14x109	410387	W14	99	W12	74	393530
35	W14x283	W14x342	W14x455	W14x109	W14x109	410387	W14	99	W12	74	393530
34	W14x283	W14x342	W14x455	W14x109	W14x109	410387	W14	99	W12	74	393530
33	W14x283	W14x342	W14x455	W14x109	W14x109	410387	W14	99	W12	74	393530
32	W14x283	W14x342	W14x455	W14x109	W14x109	410387	W14	99	W12	74	393530
31	W14x283	W14x342	W14x455	W14x109	W14x109	496969	W14	109	W14	82	492821
30	W14x283*	W14x342*	W14x455*	W14x109	W14x109	496969	W14	109	W14	82	492821
29	W14x176	W14x193	W14x159	W14x109	W14x90	843881	W14	109	W14**	82	809756
28	W14x176	W14x193	W14x159	W14x109	W14x90	651784	W14	109	W14	120	597785
27	W14x176	W14x193	W14x159	W14x109	W14x90	505205	W14	109	W14	120	478196
26	W14x176	W14x193	W14x159	W14x109	W14x90	505205	W14	109	W14	120	478196
25	W14x257	W14x120	W14x211	W14x109	W14x90	521027	W14	120	W14	132	493095
24	W14x257	W14x120	W14x211	W14x109	W14x90	521027	W14	120	W14	132	493095
23	W14x257	W14x120	W14x211	W14x109	W14x90	521027	W14	120	W14	132	493095
22	W14x257	W14x120	W14x211	W14x109	W14x90	521027	W14	120	W14	132	493095
21	W14x257	W14x120	W14x211	W14x120	W14x90	521027	W14	120	W14	132	493095
20	W14x257	W14x120	W14x211	W14x120	W14x90	521027	W14	120	W14	132	493095
19	W14x233	W14x132	W14x233	W14x120	W14x90	583366	W14	132	W14	145	558849
18	W14x233	W14x132	W14x233	W14x120	W14x90	583366	W14	132	W14	145	558849
17	W14x233	W14x132	W14x233	W14x120	W14x90	583366	W14	132	W14	145	558849
16	W14x233	W14x132	W14x233	W14x120	W14x90	583366	W14	132	W14	145	558849
15	W14x233	W14x132	W14x233	W14x120	W14x90	547860	W14	132	W14	145	523886
14	W14x233	W14x132	W14x233	W14x120	W14x90	618990	W14	132	W14	145	593903
13	W14x283	W14x90	W14x283	W14x120	W14x90	723811	W14	145	W14	159	700314
12	W14x283	W14x90	W14x283	W14x120	W14x90	723811	W14	145	W14	159	700314
11	W14x283	W14x90	W14x283	W14x120	W14x90	723811	W14	145	W14	159	700314
10	W14x283	W14x90	W14x283	W14x120	W14x90	723811	W14	145	W14	159	700314
9	W14x283	W14x90	W14x283	W14x120	W14x90	723811	W14	145	W14	159	700314
8	W14x283	W14x90	W14x283	W14x120	W14x90	723811	W14	145	W14	159	700314
7	W14x283	W14x159	W14x311	W14x132	W14x109	750343	W14	159	W14	176	729576
6	W14x283	W14x159	W14x311	W14x132	W14x109	875152	W14	159	W14	176	853346
5	W14x283	W14x159	W14x311	W14x132	W14x109	839493	W14	159	W14	176	817996
4	W14x283	W14x159	W14x311	W14x132	W14x109	893245	W14	159	W14	176	871279
3	W14x283	W14x159	W14x311	W14x132	W14x109	893245	W14	159	W14	176	871279
2	W14x283	W14x159	W14x311	W14x132	W14x109	1374909	W14	159	W14	176	1348106
						21.93 psf					**21.16 psf**

* Bracing sizes in the North-South direction increase above the outrigger level because one bracing line drops out.

Table 7: Existing and new bracing sizes

APPENDIX III.C: PROGRESSIVE COLLAPSE ANALYSIS

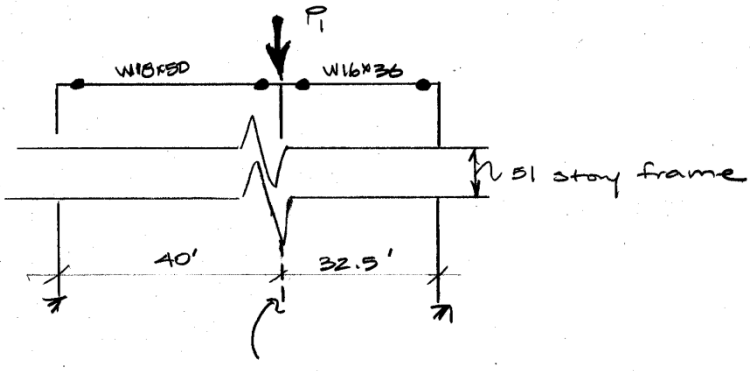
Table 8: Progressive collapse linear static analysis

PROGRESSIVE COLLAPSE LINEAR STATIC ANALYSIS																			
	beam shear (k)		beam moment ('k)		beam rotation (degrees)		allowable shear (k)					allowable moment (k)				required section			
	2, A&B	2, B&C	2, A&B	2, B&C	2, A&B	2, B&C	2, A&B	check	2, B&C	check		2, A&B	check	2, B&C	check	2, A&B	section	2, B&C	section
level	*W18x50*	*W16x36*	*W18x50*	*W16x36*	*W18x50*	*W16x36*	*W18x50*	*DCR<2*	*W16x36*	*DCR<2*		*W18x50*	*DCR<3*	*W16x36*	*DCR<3*	ΦM_p		ΦM_p	
2	190.90	198.40	3796.4	3214.1	8.04	4.42	192	OK	140	OK		379	NG!!	240	NG!!	1270	W30x108	1075	W30x99
3	189.82	199.01	3772.1	3222.4	7.96	9.73	192	OK	140	OK		379	NG!!	240	NG!!	1262	W30x108	1078	W30x99
4	188.73	199.65	3752.1	3234.2	7.96	9.73	192	OK	140	OK		379	NG!!	240	NG!!	1255	W30x108	1082	W30x99
5	187.62	199.99	3730.6	3239.9	7.88	9.77	192	OK	140	OK		379	NG!!	240	NG!!	1248	W30x108	1084	W30x99
6	186.67	200.16	3711.6	3242.6	7.84	9.77	192	OK	140	OK		379	NG!!	240	NG!!	1241	W30x108	1084	W30x99
7	185.85	200.23	3695.2	3243.7	7.84	9.77	192	OK	140	OK		379	NG!!	240	NG!!	1236	W30x108	1085	W30x99
8	185.11	200.19	3680.1	3237.4	7.80	9.77	192	OK	140	OK		379	NG!!	240	NG!!	1231	W30x108	1083	W30x99
9	184.43	200.02	3665.1	3240.3	7.76	9.77	192	OK	140	OK		379	NG!!	240	NG!!	1226	W30x108	1084	W30x99
10	183.29	199.82	3638.7	3237.0	7.88	10.06	192	OK	140	OK		379	NG!!	240	NG!!	1217	W30x108	1083	W30x99
11	182.59	199.70	3624.9	3235.0	7.88	10.06	192	OK	140	OK		379	NG!!	240	NG!!	1212	W30x108	1082	W30x99
12	181.96	199.51	3612.4	3231.9	7.84	10.06	192	OK	140	OK		379	NG!!	240	NG!!	1208	W30x108	1081	W30x99
13	181.44	199.31	3601.8	3228.6	7.80	10.06	192	OK	140	OK		379	NG!!	240	NG!!	1205	W30x108	1080	W30x99
14	181.02	199.07	3593.8	3224.8	7.80	10.02	192	OK	140	OK		379	NG!!	240	NG!!	1202	W30x108	1079	W30x99
15	180.54	198.82	3584.0	3220.6	7.76	10.02	192	OK	140	OK		379	NG!!	240	NG!!	1199	W30x108	1077	W30x99
16	179.94	198.61	3572.0	3216.6	7.76	10.02	192	OK	140	OK		379	NG!!	240	NG!!	1195	W30x108	1076	W30x99
17	179.40	198.16	3561.4	3208.2	7.72	10.02	192	OK	140	OK		379	NG!!	240	NG!!	1191	W30x108	1073	W30x99
18	179.06	197.72	3554.6	3201.0	7.72	9.99	192	OK	140	OK		379	NG!!	240	NG!!	1189	W30x108	1071	W30x99
19	178.75	197.30	3548.3	3194.1	7.72	9.95	192	OK	140	OK		379	NG!!	240	NG!!	1187	W30x108	1068	W30x99
20	178.38	196.82	3539.8	3186.4	7.68	9.95	192	OK	140	OK		379	NG!!	240	NG!!	1184	W30x108	1066	W30x99
21	177.94	196.34	3530.8	3178.7	7.68	9.99	192	OK	140	OK		379	NG!!	240	NG!!	1181	W30x108	1063	W30x99
22	177.59	195.94	3523.7	3172.1	7.68	9.95	192	OK	140	OK		379	NG!!	240	NG!!	1178	W30x108	1061	W30x99
23	177.27	195.55	3517.4	3165.9	7.64	9.95	192	OK	140	OK		379	NG!!	240	NG!!	1176	W30x108	1059	W30x90
24	176.99	195.18	3511.5	3159.9	7.64	9.91	192	OK	140	OK		379	NG!!	240	NG!!	1174	W30x108	1057	W30x90
25	176.73	194.82	3506.3	3154.1	7.64	21.06	192	OK	140	OK		379	NG!!	240	NG!!	1173	W30x108	1055	W30x90
26	176.40	194.45	3499.9	3147.9	7.61	9.88	192	OK	140	OK		379	NG!!	240	NG!!	1171	W30x108	1053	W30x90
27	175.71	194.03	3487.7	3140.5	7.57	9.88	192	OK	140	OK		379	NG!!	240	NG!!	1166	W30x99	1050	W30x90
28	175.36	193.60	3482.6	3133.4	7.57	9.84	192	OK	140	OK		379	NG!!	240	NG!!	1165	W30x99	1048	W30x90
29	174.94	193.01	3473.8	3123.5	7.53	9.80	192	OK	140	OK		379	NG!!	240	NG!!	1162	W30x99	1045	W30x90
30	174.79	192.82	3469.0	3120.7	7.53	9.80	192	OK	140	OK		379	NG!!	240	NG!!	1160	W30x99	1044	W30x90
31	174.89	192.61	3469.6	3118.0	7.57	9.80	192	OK	140	OK		379	NG!!	240	NG!!	1160	W30x99	1043	W30x90
32	174.31	192.35	3458.5	3113.3	7.53	9.80	192	OK	140	OK		379	NG!!	240	NG!!	1157	W30x99	1041	W30x90
33	173.63	191.71	3445.5	3105.6	7.53	9.80	192	OK	140	OK		379	NG!!	240	NG!!	1152	W30x99	1039	W30x90
34	173.39	191.28	3440.9	3098.6	7.49	9.80	192	OK	140	OK		379	NG!!	240	NG!!	1151	W30x99	1036	W30x90
35	173.17	190.92	3436.5	3092.7	7.49	9.77	192	OK	140	OK		379	NG!!	240	NG!!	1149	W30x99	1034	W30x90
36	172.94	190.59	3431.8	3087.2	7.49	9.77	192	OK	140	OK		379	NG!!	240	NG!!	1148	W30x99	1033	W30x90
37	172.71	190.28	3427.1	3082.2	7.49	9.73	192	OK	140	OK		379	NG!!	240	NG!!	1146	W30x99	1031	W30x90
38	172.49	189.99	3422.7	3077.4	7.45	9.73	192	OK	140	OK		379	NG!!	240	NG!!	1145	W30x99	1029	W30x90
39	172.28	189.72	3418.6	3073.0	7.45	9.70	192	OK	140	OK		379	NG!!	240	NG!!	1143	W30x99	1028	W30x90
40	172.09	189.46	3414.8	3068.9	7.45	9.70	192	OK	140	OK		379	NG!!	240	NG!!	1142	W30x99	1026	W30x90
41	171.93	189.22	3411.5	3065.0	7.45	9.70	192	OK	140	OK		379	NG!!	240	NG!!	1141	W30x99	1025	W30x90
42	171.84	189.02	3409.4	3061.5	7.45	9.66	192	OK	140	OK		379	NG!!	240	NG!!	1140	W30x99	1024	W30x90
43	171.68	188.76	3406.5	3057.6	7.45	9.66	192	OK	140	OK		379	NG!!	240	NG!!	1139	W30x99	1023	W30x90
44	170.84	187.98	3394.8	3047.9	7.37	9.66	192	OK	140	OK		379	NG!!	240	NG!!	1135	W30x99	1019	W30x90
45	169.22	186.54	3373.2	3030.1	7.29	9.77	192	OK	140	OK		379	NG!!	240	NG!!	1128	W30x99	1013	W30x90
46	169.22	186.28	3372.3	3025.6	7.33	9.73	192	OK	140	OK		379	NG!!	240	NG!!	1128	W30x99	1012	W30x90
47	169.19	186.01	3371.4	3021.1	7.29	9.73	192	OK	140	OK		379	NG!!	240	NG!!	1128	W30x99	1010	W30x90
48	169.19	185.74	3371.3	3016.6	7.29	9.70	192	OK	140	OK		379	NG!!	240	NG!!	1128	W30x99	1009	W30x90
49	169.27	185.45	3372.1	3012.2	7.29	9.70	192	OK	140	OK		379	NG!!	240	NG!!	1128	W30x99	1007	W30x90
50	168.88	184.31	3373.0	2994.9	7.21	9.66	192	OK	140	OK		379	NG!!	240	NG!!	1128	W30x99	1002	W30x90
51	169.16	182.53	3392.3	2964.6	7.17	9.62	192	OK	140	OK		379	NG!!	240	NG!!	1135	W30x99	991	W30x90
52	162.44	181.94	3306.0	2955.9	6.57	9.59	192	OK	140	OK		379	NG!!	240	NG!!	1106	W30x99	989	W30x90
roof	157.96	176.16	3241.6	2897.1	6.17	9.62	192	OK	140	OK		379	NG!!	240	NG!!	1084	W30x99	969	W30x90

PROGRESSIVE COLLAPSE ANALYLSIS: VIRTUAL WORK METHOD						
level	P_{prov}	P_{req}	*check*	Q_{UD}	$M_{p,req}$	*section*
roof	154.2	397.8	NG!!	2378	793	W24x84
52	308.2	795.6	NG!!	4755	1585	W33x130
51	462.2	1193.4	NG!!	7133	2378	W40x167
50	616.2	1591.2	NG!!	9511	3170	W40x199
49	770.2	1989	NG!!	11888	3963	W44x230
48	924.2	2386.8	NG!!	14266	4755	W44x262
47	1078.2	2784.6	NG!!	16644	5548	W44x335
46	1232.2	3182.4	NG!!	19021	6340	W40x392
45	1386.2	3580.2	NG!!	21399	7133	W40x431
44	1540.2	3978	NG!!	23777	7926	W36x487
43	1694.2	4375.8	NG!!	26154	8718	W40x593
42	1848.2	4773.6	NG!!	28532	9511	W40x593
41	2002.2	5171.4	NG!!	30910	10303	W40x593
40	2156.2	5569.2	NG!!	33287	11096	W36x800
39	2310.2	5967	NG!!	35665	11888	W36x800
38	2464.2	6364.8	NG!!	38042	12681	W36x800
37	2618.2	6762.6	NG!!	40420	13473	W36x800
36	2772.2	7160.4	NG!!	42798	14266	-
35	2926.2	7558.2	NG!!	45175	15058	-
34	3080.2	7956	NG!!	47553	15851	-
33	3234.2	8353.8	NG!!	49931	16644	-
32	3388.2	8751.6	NG!!	52308	17436	-
31	3542.2	9149.4	NG!!	54686	18229	-
30	3696.2	9547.2	NG!!	57064	19021	-
29	3850.2	9945	NG!!	59441	19814	-
28	4004.2	10342.8	NG!!	61819	20606	-
27	4158.2	10740.6	NG!!	64197	21399	-
26	4312.2	11138.4	NG!!	66574	22191	-
25	4466.2	11536.2	NG!!	68952	22984	-
24	4620.2	11934	NG!!	71330	23777	-
23	4774.2	12331.8	NG!!	73707	24569	-
22	4928.2	12729.6	NG!!	76085	25362	-
21	5082.2	13127.4	NG!!	78463	26154	-
20	5236.2	13525.2	NG!!	80840	26947	-
19	5390.2	13923	NG!!	83218	27739	-
18	5544.2	14320.8	NG!!	85596	28532	-
17	5698.2	14718.6	NG!!	87973	29324	-
16	5852.2	15116.4	NG!!	90351	30117	-
15	6006.2	15514.2	NG!!	92729	30910	-
14	6160.2	15912	NG!!	95106	31702	-
13	6314.2	16309.8	NG!!	97484	32495	-
12	6468.2	16707.6	NG!!	99862	33287	-
11	6622.2	17105.4	NG!!	102239	34080	-
10	6776.2	17503.2	NG!!	104617	34872	-
9	6930.2	17901	NG!!	106994	35665	-
8	7084.2	18298.8	NG!!	109372	36457	-
7	7238.2	18696.6	NG!!	111750	37250	-
6	7392.2	19094.4	NG!!	114127	38042	-
5	7546.2	19492.2	NG!!	116505	38835	-
4	7700.2	19890	NG!!	118883	39628	-
3	7854.2	20287.8	NG!!	121260	40420	-
2	8008.2	20685.6	NG!!	123638	41213	-

Table 9: Progressive collapse nonlinear static analysis: virtual work

VIRTUAL WORK:

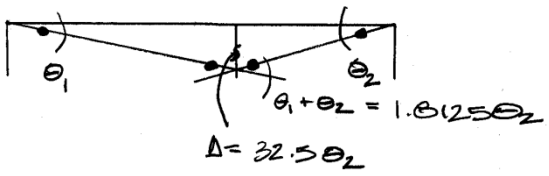


$P_1 = 2DL + 0.5LL$

$A_{red} = \min \begin{cases} 40(30) + 32.5(30) + 32.5(20) = 2825 \text{ sf} \\ 1800 \text{ sf} \leftarrow \text{controls} \end{cases}$

$P_1 = 2(1800 * 0.093) + 0.5(1800 * 0.070)$

$= 357.8 \text{ K}$ ACTUAL LOAD



$40\theta_1 = 32.5\theta_2$

$\therefore \theta_1 = 0.8125\theta_2$

$W_{internal} = W_{external}$

$W_i = M_{p1}(0.8125\theta_2) + M_{p1}(1.8125\theta_2) + M_{p2}(1.8125\theta_2) + M_{p2}(\theta_2)$

$= 2.625 M_{p1}\theta_2 + 2.8125 M_{p2}\theta_2$

Figure 2: Progressive collapse virtual work analysis

$M_{p1} = M_{p\ W18X50} = 379\ K$

$M_{p2} = M_{p\ W16X36} = 240\ K$

$\therefore W_i = 1669.875\theta_2$

$W_e = 32.5\theta_2 P_1$

$W_i = W_e \rightarrow 32.5\theta_2 P_1 = 1669.875\theta_2$

$\therefore P_1 = 51.4\ K \times DCR = 3 = 154.1\ K$

$397.8\ K >> 154.1\ K$ ultimate

→ members are not adequate, redesign is necessary

Figure 3: Progressive collapse virtual work analysis

APPENDIX IV.A: CIRCUIT BREAKER COORDINATION

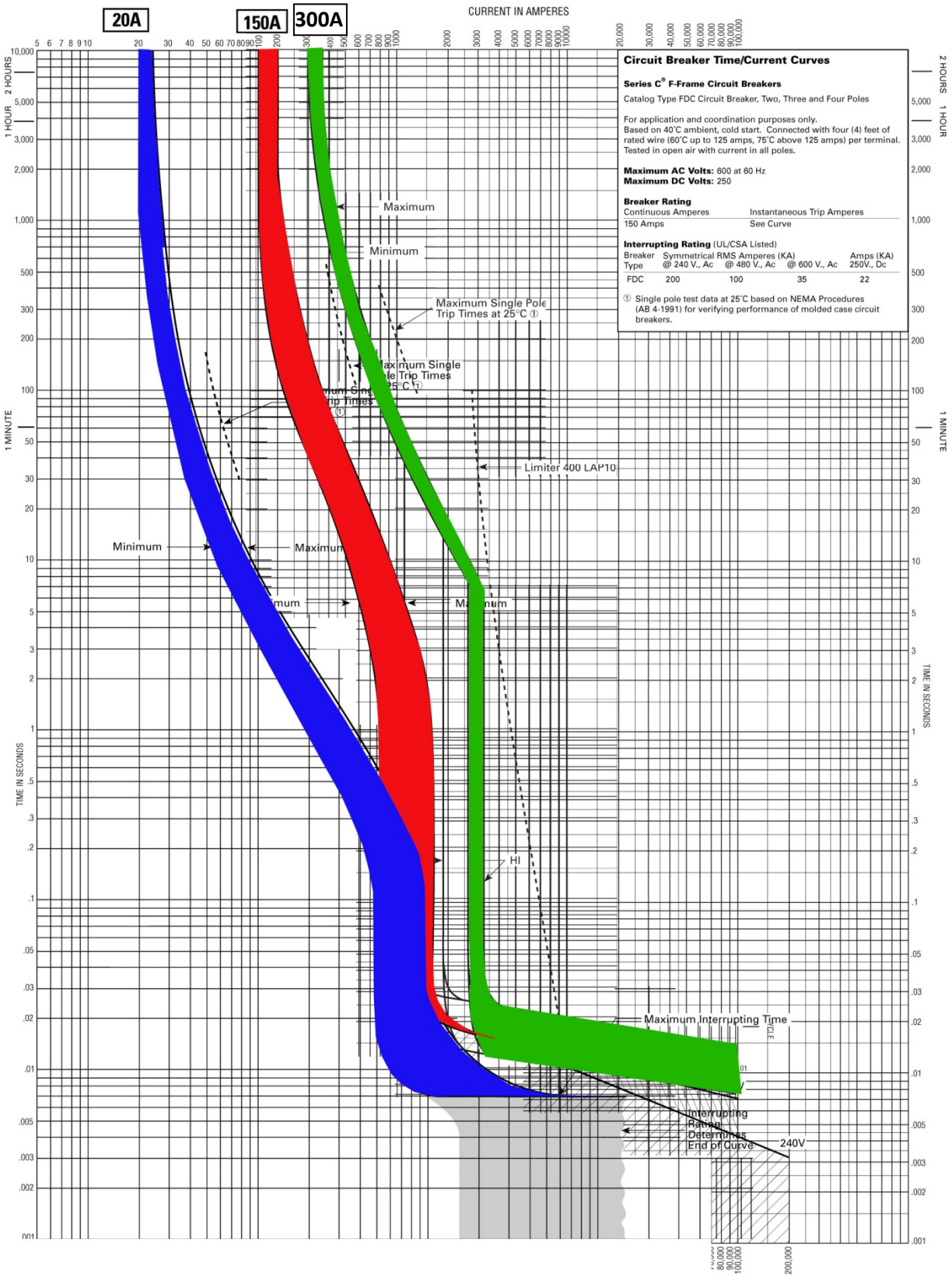
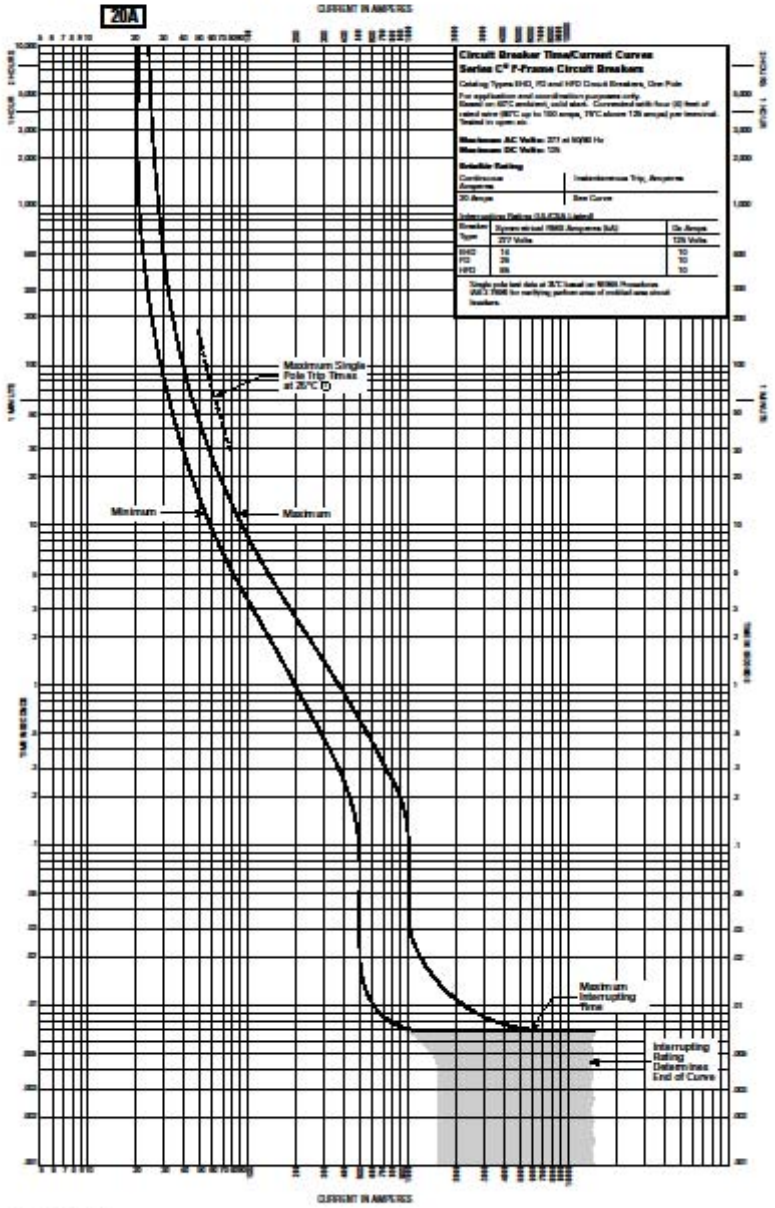


Figure 8: Circuit breaker timing curves

Application Data
29-167F
Page 4

AB DE-ION Circuit Breakers

Types EHD, FD and HFD 20 Amperes



Curve No. SC-4424-88A

October 1997

Figure 9: Circuit breaker timing curves

Application Data
29-167F

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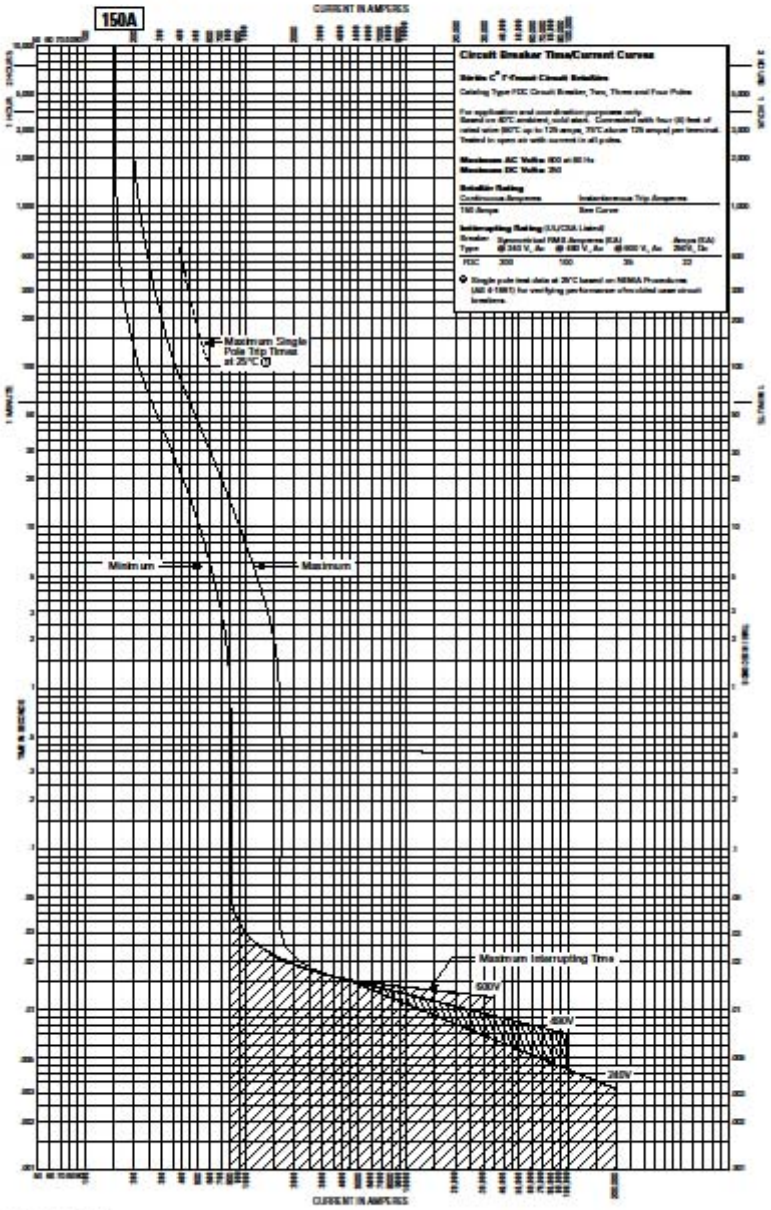
AB DE-ION Circuit Breakers

Type FDC 150 Amperes



Curve No. SC-5531-93A

October 1997

Figure 10: Circuit breaker timing curves

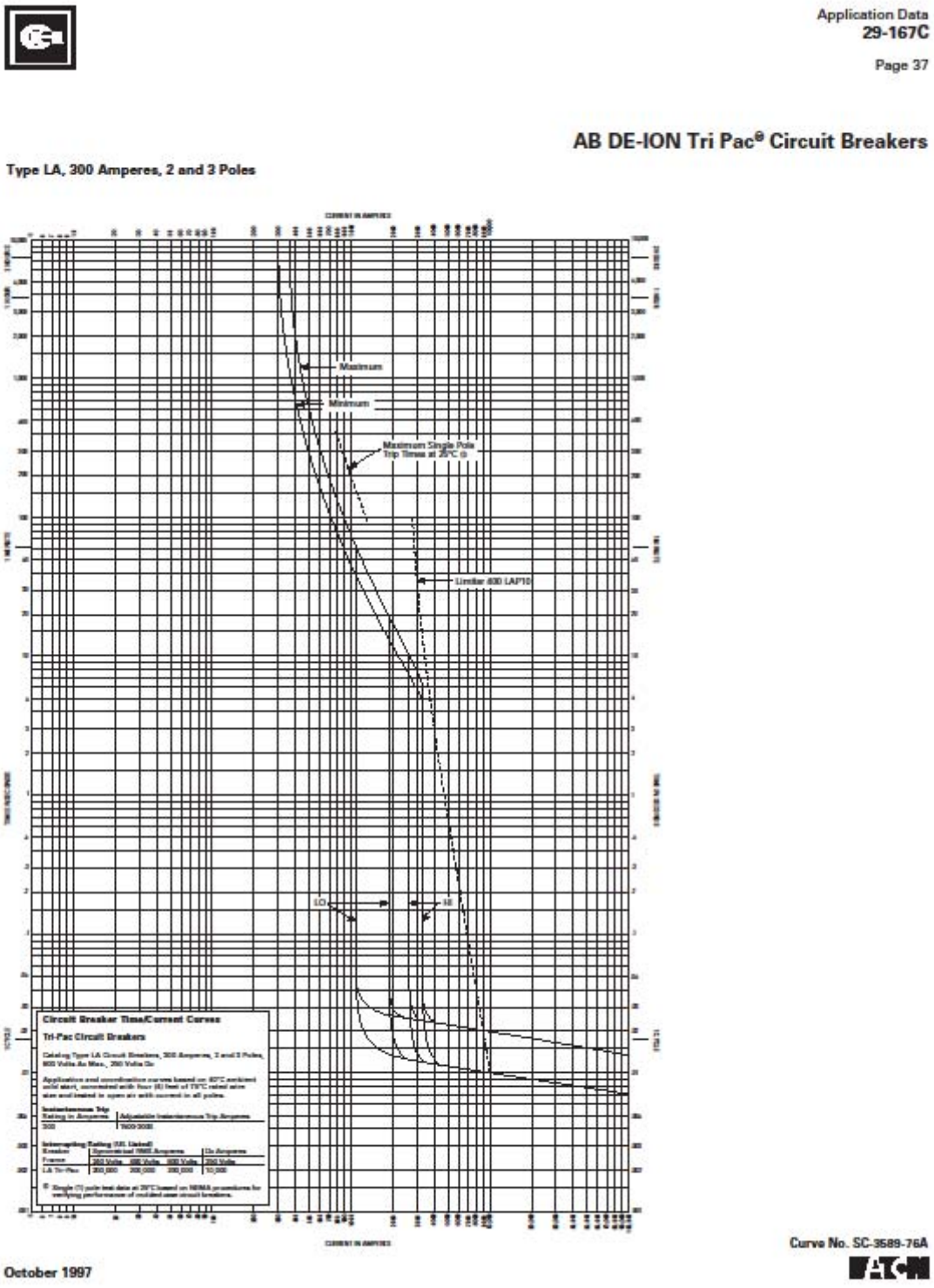


Figure 11: Circuit breaker timing curves

APPENDIX IV.B: PANEL BOARD SPECIFICATIONS

NF Circuit Breaker Panelboards

Catalog
1670CT0701

2008
Class 1670

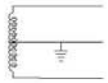
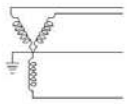
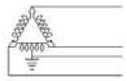
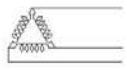
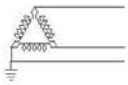
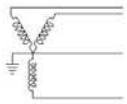
CONTENTS

SQUARE D
by Schneider Electric

Schneider Electric

Standards and Ratings

NF circuit breaker panelboards are for use on ac systems. They are UL® Listed under File E33139 and marked cULus. NF circuit breaker panelboards accept EDB, EGB, and EJB branch circuit breakers.

Voltage	System	System Diagram
120/240 Vac	1ϕ3W	
208Y/120 Vac	3ϕ4W	
240/120 Vac	3ϕ4W Delta	
240 Vac	3ϕ3W Delta	
240 Vac	3ϕ3W Grounded Bϕ Delta	
480Y/277 Vac	3ϕ4W	
600Y/347 Vac	3ϕ4W	

Standards

NF circuit breaker panelboards are designed, manufactured, and tested to comply with the following standards:

- UL 67—Standard for Panelboards
- UL 50—Enclosures for Electrical Equipment
- UL Listed Class CTL panelboard
- CSA C22.2, No. 29-M1989—Panelboards and Enclosed Panelboards
- CSA C22.2, No. 94-M91—Special Purpose Enclosures
- NEMA PB 1—Panelboards
- NFPA 70—National Electrical Code® (NEC®)
- Federal Specification W-P-115C Type I Class 1—Circuit Breaker Panelboards
- 2003 IBC, NFPA 5000, ASCE/SE17—Seismic Qualification

Ratings

- Main lugs: 125–800 A
- Main circuit breaker: 125–600 A

NF Circuit Breaker Panelboards
Main Circuit Breakers

Main Circuit Breakers

HDL

- 125 A maximum field-installable EDB, EGB, or EJB (110 A max at 600Y/347 Vac)
- 100 A maximum field-installable FI
- 125 A maximum field-installable HDL, HGL, HJL, or HLL
- 250 A maximum field-installable JDL, JGL, JJL, or JLL
- 400 A maximum field-installable LAL or LHL
- 400 A or 600 A maximum factory-installed LCL or LIL (LCL is 480Y/277 Vac maximum)

Factory-Installed Circuit Breaker Accessories

FIL, HDL, HGL, HJL, HLL, JDL, JGL, JJL, JLL, and KIL circuit breakers are available with shunt trip, ground fault shunt trip, undervoltage trip, time delay, auxiliary switches, and alarm switches.

JDL

Table 1: Main Circuit Breaker Adapter Kits (Circuit Breaker Not Included)

Adapter Kit Catalog Number	Ampere Rating	Main Circuit Breaker[1]
N100MFI	20–100 A	FIL
N150MH[2]	15–125 A[3]	HDL, HGL, HJL, HLL
N250MJ	150–250 A	JDL, JGL, JJL, JLL
N250MKC	110–250 A	KIL
N400M	125–400 A	LAL, LHL

1 Main circuit breakers are not included in the adapter kits. Order them separately.
2 For single phase applications of HDL and HGL, select a 3-pole main circuit breaker. For single-phase applications of HJL and HLL, select a 2-pole main circuit breaker.
3 RTI kit accepts maximum 125 A H-frame circuit breaker.

NOTE: See "Main Circuit Breaker Terminal Data" on page 18.

Field-Installable Circuit Breaker Accessories

LAL

Field-installable undervoltage release, alarm switch, shunt trip, and auxiliary contacts are available for LAL, LHL, LCL, and LIL 400 A main circuit breaker interiors.

NOTE: See Supplemental Digest for additional accessories.

N250MJ Main Circuit Breaker Kit

N400M Main Circuit Breaker Kit

Branch Circuit Breakers (Bolt-on)

Table 2: Standard Branches, 600Y/347 Vac Maximum

Branch Prefix	Availability			Short Circuit Current Rating[1]	
	1-Pole	2-Pole	3-Pole	at 480Y/277 Vac	at 600Y/347 Vac
EDB	15-70 A	15-125 A[2]	15-125 A[2]	18,000 A	14,000 A
EGB	15-70 A	15-125 A[2]	15-125 A[2]	35,000 A	18,000 A
EJB	15-70 A	15-125 A[2]	15-125 A[2]	65,000 A	25,000 A

1 Series ratings are also available.
In **Canada**: See Series Rating Guide (Data Bulletin #S1600PD0302EP).
In **USA**: See Switchboard/Panelboard Short Circuit Current Ratings (Data Bulletin #2700DB9901) or the Digest.

2 600Y/347 Vac is 110 A maximum.

Table 3: EPD Branches – 30 mA Ground Fault Equipment Protection Devices, 277 Vac Maximum

Branch Prefix	Availability 1-Pole[1]	Short Circuit Current Rating[2] at 277 Vac
EDB-EPD	15-70A	18,000 A
EGB-EPD	15-70A	35,000 A
EJB-EPD	15-70A	65,000 A

1 EPD branches are single-pole only, and require two pole spaces in the panelboard.

2 Also available with series ratings.

EDB Branch Circuit Breakers

Table 4: Standard and EPD Branches – Terminal Lug Data

Branch Circuit Breaker Prefix	Ampere Rating	Wire Size	
		Aluminum	Copper
EDB, EGB, EJB, EDB-EPD, EGB-EPD, EJB-EPD	15-30 A	#12 - #6	#14 - #6
	35-125 A	#12 - 2/0	#14 – 2/0

NF Circuit Breaker Panelboards
Interiors

250 A Maximum Main Lugs Interior (Deadfronts Installed)

Interiors

Main Lug Interiors

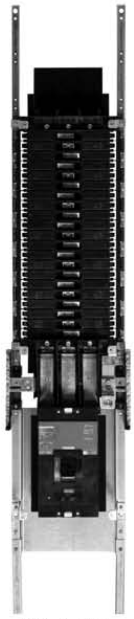
- Will accept bolt-on branch circuit breakers
- Top or bottom feed
- 65,000 A Short Circuit Current Rating (SCCR) maximum branch circuit breakers at 480Y/277 Vac
- 25,000 A SCCR maximum branch circuit breakers at 600Y/347 Vac
- Series rated to 200,000 A SCCR maximum when supplied by remote I-Limiter® circuit breaker at 480Y/277 Vac
- Series rated to 65,000 A SCCR maximum when supplied by remote I-Limiter circuit breaker at 600Y/347 Vac
- 125 A and 250 A interiors are suitable for use as cULus service entrance with back-fed EDB, EGB, or EJB circuit breakers
- Factory-installed main lugs on all interiors
- 125–400 A main lug interiors are convertible to main circuit breaker interiors by adding a main circuit breaker adapter kit and a main circuit breaker
- Several bus options:
  - — Silver-plated copper or tin-plated aluminum bus (aluminum is standard)
  - — Tin-plated copper bus is available as an option
  - — 600 A and 800 A only available with copper
- Branch connector fingers are tin-plated copper
  - — Silver-plated branch connector fingers are optional
- Line lugs are suitable for 75° C copper or aluminum wire

Factory-Installed Options for Main Lugs and Main Breaker Interiors

- Sub-Feed Lugs (on the Main)
  NOTE: Only available on 1ϕ or 3ϕ, 125–800 A main lug interiors
- Feed-Through Lugs
  NOTE: Available on 1ϕ or 3ϕ, 125–800 A main lug or 100–600 A main circuit breaker interiors
- Sub-Feed Circuit Breakers
  NOTE: Available on 1ϕ or 3ϕ, 125–800 A main lug or 100–600 A main circuit breaker interiors
  - — One sub-feed HDL, HGL, HJL, HLL, JDL, JGL, JJL, or JLL circuit breaker per 250 A panelboard
  - — Two sub-feed HDL, HGL, HJL, HLL, JDL, JGL, JJL, or JLL circuit breakers per 400 A panelboard
  - — One sub-feed LA, LH, LC, or LI circuit breaker (400 A maximum) and one HDL, HGL, HJL, HLL, JDL, JGL, JJL, or JLL circuit breaker, or two sub-feed HDL, HGL, HJL, HLL, JDL, JGL, JJL, or JLL circuit breakers per 600 A or 800 A panelboard
    NOTE: LC/LI circuit breakers cannot be combined with JJL or JLL circuit breakers
- Split bus
- Lighting contactors
- Compression lugs

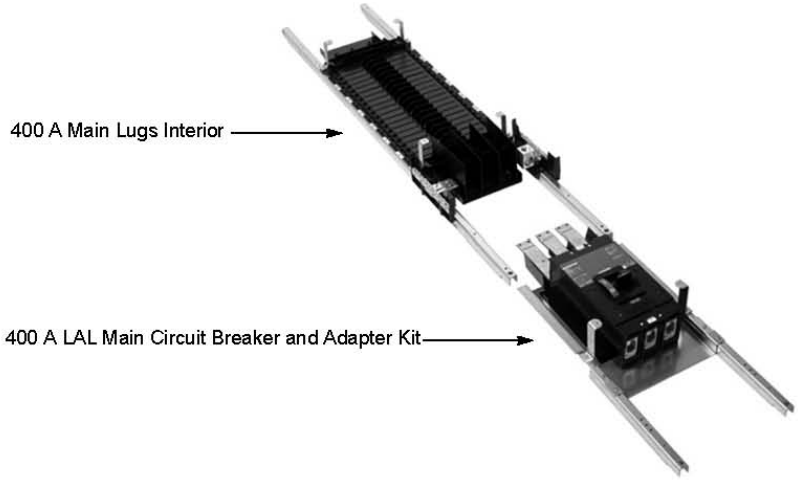
NF Circuit Breaker Panelboards
Interiors

Main Circuit Breaker Interiors



400 A LAL Main Circuit Breaker Interior

- Will accept bolt-on branch circuit breakers
- Suitable for use as UL service entrance (statement found on wiring label on back of deadfront); meets local electrical codes (CSA type service entrance available factory-assembled)
- Top or bottom feed
- 65 k AIR maximum branch circuit breakers at 480Y/277 Vac
- 25 K AIR maximum branch circuit breakers at 600Y/347 Vac
- Series rated to 200 k AIR maximum when supplied by remote I-Limiter circuit breaker at 480Y/277 Vac
- Series rated to 65 k AIR maximum when supplied by remote I-Limiter circuit breaker at 600Y/347 Vac
- Available with silver-plated copper or tin-plated aluminum bus (aluminum is standard). Tin-plated copper bus is available as an option; 600 A only available with copper
- Branch connector fingers are tin-plated copper; silver-plated branch connector fingers are optional
- 125 A at 480Y/277 Vac (110 A at 600Y/347 Vac) main circuit breaker interiors contain back-fed EDB, EGB, or EJB main circuit breakers
- 100–250 A main circuit breaker panelboards consist of:
  - Standard main lug interiors
  - Main circuit breaker adapter kit (N150MH, N100MFI, N250MKC, N250MJ)
  - Appropriate FIL, HDL, HGL, HJL, HLL, JDL, JGL, JJL, JLL, or KIL circuit breakers
  - Line lugs are suitable for 75° C copper or aluminum wire
- 400 A main circuit breaker panelboard consists of:
  - Standard main lug interior
  - Main circuit breaker adapter kit (N400M)
  - Appropriate LAL or LHL circuit breaker
  - Factory-installed LCL or LIL main circuit breaker with 8 in. (203 mm) deep enclosure (Type 1 only)
- 600 A main circuit breaker panelboard:
  - Factory-assembled only
  - Use LCL, LIL main circuit breakers
  - 8.75 in. (223 mm) deep enclosure (Type 1 only)



400 A Main Lugs Interior with 400 A Main Circuit Breaker and Adapter Kit

NF Circuit Breaker Panelboards
Interiors

400 A Main Lug Interior with Sub-Feed Lugs

400 A Sub-Feed Main Lug Kits

Compression Lugs

Field-Installable Options

- Feed-Through Lug Kits
  - — NF125FTL, NF250FTL, NF400FTL available for 125–400 A, 1ϕ or 3ϕ interiors
- Sub-Feed Circuit Breaker Kits
  - — NF250SFBH allows a single sub-feed HDL, HGL, HJL, or HLL circuit breaker on 250 A interiors
  - — NF250SFBJ allows a single sub-feed JDL, JGL, JJL, or JLL circuit breaker on 250 A interiors
  - — NF600SFBH allows twin sub-feed HDL, HGL, HJL OR HLL circuit breaker on 400 A main lug or main circuit breaker interiors and 600A main lug interiors
  - — N600SFBJ allows twin sub-feed JDL, JGL, JJL, or JLL circuit breakers on 400 A main lug or main circuit breaker interiors and 600 A main lug interiors
- Sub-Feed Lug Kits

Amperes	Catalog Number
125 A	NF125SFL
250 A	NF250SFL
400 A	NF400SFL

- 200% Neutral Kits

Amperes	Catalog Number
100 A	NFNL1
125 A	NFNL1
250 A	NFNL2
400 A	NFNL4[1]

[1] 200% neutrals not available with FTL, SFL, or SFB.

- Copper 100% Kits

Copper 100% Amperes	Copper Neutral Kits Catalog Number
125 A	NFN1CU
250 A	NFN2CU
400 A	NFN6CU
600 A	NFN6CU[1]

[1] Not to be used with SFL, FTL, or SFB. These combinations are factory-assembled only.

Compression Lugs

Compression lugs are available for 125–600 A main lug interiors and 100–400 A main circuit breaker interiors.

Neutrals

Neutral Assembly

- All lugs are suitable for copper or aluminum wire
- 125–250 A interiors have a split neutral located on the same end as the mains
- 400–800 A interior neutrals can be located on either end depending on the configuration
- Neutral may be bonded for use as a UL service entrance
- Branch terminals are suitable for #14-2/0 copper or aluminum and #14-#6 copper or aluminum
- Provisions for larger branch terminal lug kits are available as options
- Suitable lug provided on neutrals for termination of the grounding conductor
- All unused neutral terminals may be used to terminate equipment grounding conductors when the panelboard is used as UL service equipment
- 100% rated neutrals are standard; one neutral termination provided per circuit in the panelboard
- 200% rated neutrals are optional see, “200% Neutral Kits” below

Neutral Bonding Provisions

125–250 A Neutral Bonding Provisions

The bonding strap may be field installed for UL service equipment requirements on 125–800 A interiors. Not applicable for CSA service entrance panels in Canada.

Table 5: Copper 100% Neutral Kits for Use with Single or Three Phase 125-600 A Interiors

Amperage	125 A	250 A	400 A	600 A	800 A
Catalog Number	NFN1CU	NFN2CU	NFN6CU	NFN6CU[1]	Kit not available, Factory-assembled only

[1] Not to be used with SFL, FTL or SFB. These combinations are factory-assembled only.

200% Neutral Kits

Table 6: 200% Neutral Kits for Use with Single or Three Phase 125-400 A Interiors

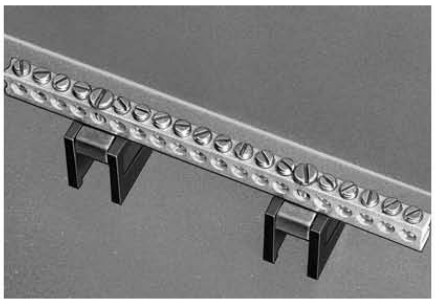
Amperage	125 A	250 A	400 A	600 A	800 A
Catalog Number	NFNL1	NFNL2	NFNL4[1]	Kit not available, Factory-assembled only	

[1] Not to be used with SFL, FTL or SFB. These combinations are factory-assembled only.

NFNL2

NF Circuit Breaker Panelboards
Ground Bar Kits

Ground Bar Kit



Ground Bar with Insulator Kit

Ground Bar Kits

- Field installable in all panelboards
- Wire size of terminals (refer to the technical information below)

Table 7: Ground Bar Kits

Catalog Number	Terminals	Material
PK23GTAL	23	AL
PK27GTA	25[1]	CU
PK27GTACU	27	AL

[1] 24 small terminals and 1 large terminal

- Order enough ground bar kits to accommodate all the ground conductors used in the panel

Ground Bar Insulator Kits (Catalog No. PKGTAB)

- The insulator kit isolates the standard panelboard ground bar from the panelboard
- The insulator kit is field installable, and panelboard enclosures have ground bar mounting provisions in all four corners

Technical Information

All PK equipment grounding kits are supplied with mounting screws, installation instructions, and an "Equipment Grounding Terminal" self-adhesive label.

Table 8: Technical Information

Catalog Number	Terminals			Approximate Overall Length Inches (mm)	Distance Between Mounting Holes Inches (mm)
	Number of Terminals	Quantity Available for Each Size			
		Material	I / II[1]		
PK23GTAL	24	AL	23 / 1	9.125 (232)	3.125 (79)
PK27GTA	27	AL	24 / 1	9.125 (232)	3.125 (79)
PK27GTACU	27	CU	27 / 0	9.125 (232)	3.125 (79)

[1] See wire range table below.

Table 9: Wire Range

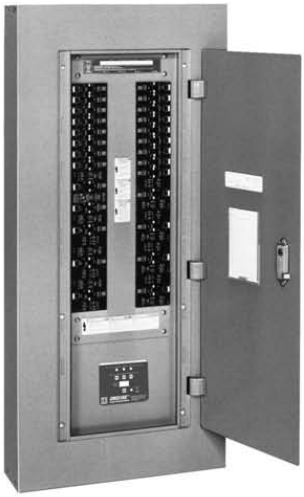
Size	Cu	Al
I	(1) #14 to #4 or (2) #14 or #12	(1) #12 to #4 or (2) #12 or #10
II	(1) #1 to 4/0	(1) #1 to 4/0

Surge Protection

The Surgelogic® IMA series surge protective device is a modular parallel transient voltage surge suppressor (TVSS). The IMA device is a multi-stage suppression circuit consisting of field-proven, fast-acting, 34 mm metal oxide varistors (MOVs).

A surge suppression path is provided for each mode, line-to-neutral (L-N), line-to-line (L-L), line-to-ground (L-G), and neutral-to-ground (N-G). Each surge suppression mode is individually fused and uses circuitry with thermal cutouts to isolate the TVSS and ensure shutdown in the event of MOV damage during severe overvoltages, even when operated on high fault current power systems.

The suppression elements are encapsulated in a UL recognized potting material—another performance element that provides additional protection. A filter provides a high level of EMI/RFI noise attenuation. On-line diagnostics continuously monitor the device status, and LEDs signal loss of a suppression circuit. An audible alarm with an enable/disable feature and dry contacts are included in the standard diagnostic package.



NF Main Lugs Panelboard with Integral TVSS

Table 10: NF Interiors with TVSS[1]

Mains Rating	Max Circuit Breaker Spaces	TVSS Rating		Interior Catalog Number[2]	Components for Adding a Vertical Main Circuit Breaker	
		Voltage	Surge Rating		Main Circuit Breaker Kit	Main Circuit Breaker Frames
250 A	42	480Y/277 Vac	120	NF442L2TVS412	N150MH[3]	HD, HG, HJ or HL
			160	NF442L2TVS416	N250MJ	JD, JG, JJ or, JL
		600Y/347 Vac	120	NF442L2TVS812	N250MKC	KI
400 A	42	480Y/277 Vac	120	NF442L4TVS412	N400M	LAL/LHL (LC and LI F/A only)
			160	NF442L4TVS416		
		600Y/347 Vac	120	NF442L4TVS812		

1 These interiors are available as catalog numbered devices. TVSS is not available as a field-installable kit.

2 To order an interior with copper bus, add a "C" to the end of the catalog number (example: NR442L2TVS412C).

3 RTI kit accepts maximum 125 A H-frame circuit breaker.

Table 11: IMA Series Voltage Specifications

Service Voltage	UL Suppression Voltage Rating (SVR)				
	L–N	L–G	N–G	L–L	MCOV[1]
120/240 Vac, 1-phase	400	400	400	800	150
208Y/120 Vac, 3-phase, 4-wire	400	400	400	800	150
240/120 Vac, 3-phase, high-leg delta	800/400	800/400	400	1500/800	275/150
480Y/277 Vac, 3-phase, 4-wire	800	800	800	1600	320
600Y/347 Vac, 3-phase, 4-wire	1200	1200	1200	2000	420

1 MCOV: maximum continuous operating voltage.

NF Circuit Breaker Panelboards
Surge Protection

Table 12: Performance Features

Surge Capacity	L–N	L–G	N–G (3-Phase Rating)
100 kA / phase	50 kA	50 kA	100 kA
120 kA / phase	60 kA	60 kA	120 kA
200 kA / phase	100 kA	100 kA	200 kA
160 kA / phase	80 kA	80 kA	120 kA
240 kA / phase	120 kA	120 kA	120 kA

Table 13: Specifications

Relative Humidity	0 to 95% non-condensing
Operating Frequency	47–63 Hz
Storage Temperature	-40 to +65 °C (-40 to +149 °F)
Operating Temperature	-40 to +65 °C (-40 to +149 °F)
Display Operating Temperature	-10 to +50 °C (+14 to +122 °F)
Standards	C-UL, UL 1449 Second Edition UL Category Section 37.3 (200 kA short-circuit current module rating)
Fusing	Individually fused suppression modules
Audible Alarm	Provides audible indication that there is a loss of protection
Dry Contacts	Provides remote indication of the TVSS device's operating status to a computer interface board or emergency management system

Table 14: Other Options

Option	Description
Surge Counter	Displays the combined total number of transient voltage surges detected from L–G, L–L, L–N, and N–G since the counter was last reset.
Remote Monitor	Displays the alarm status of the surge protective device up to 1,000 ft. (305 m) away from the unit. This option uses the dry contacts.

Design Features

- Individually fused suppression modules
- Thermal cutout
- Inline, copper bus bar connection
- Solid state bi-directional
- Push-to-Test on-line diagnostic display
- Audible alarm with enable/disable switch
- LED indicators indicate loss of protection, or fully operational circuit
- High-energy parallel design for IEEE C62.41 category A, B, and C3 applications
- Available in main circuit breaker and main lug only panelboards with sub-feed circuit breakers, feed-through lugs, or sub-feed lugs
- AC tracking filter with EMI/RFI filtering up to -50 dB from 100 kHz to 100 MHz

Enclosures

Enclosure Types

Mono-Flat Type 1 Enclosure for 100–250 A Interiors

Type	Environment	Protects Against
Type 1	Indoor	Contact with the enclosed equipment, falling dirt
Type 2	Indoor	Type 1, plus • Dripping and light splashing of non-corrosive liquids
Type 3R	Outdoor	Type 2, plus • Rain, snow, and sleet
Type 4	Indoor/outdoor	Type 3R, plus • Circulating dust, lint, fibers and flyings • Settling airborne dust, lint, fibers and flyings • Windblown dust • Hosedown and splashing water
Type 4X	Indoor/outdoor	Type 4, plus • Corrosive agents
Type 5	Indoor	Type 2, plus • Settling airborne dust, lint, fibers, and flyings
Type 12	Indoor	Type 2, plus • Circulating dust, lint, fibers, and flyings • Settling airborne dust, lint, fibers, and flyings • Oil and coolant seepage

Indoor Enclosures (Types 1 and 2)

Type 1 Enclosure for 400–800 A Interiors

MH type Box

- Standard boxes are 20 in. (508 mm) wide by 5.75 in. (223 mm) deep
- NF interiors with an LC or LI main circuit breaker or with an 800 A MLO interior require an 8.75 in. (223 mm) deep box — therefore, they are available factory-assembled and fully-assembled only
- Boxes are galvanized steel with removable endwalls. On standard 5 3/4 inch depth boxes, one endwall is provided with knockouts, and the other endwall is blank. On deeper boxes, both are blank. Endwalls are removable and interchangeable
- Box and interior mounting instructions are included in the documentation shipped with the interior
- Keyhole slots are located in the box backwall to ease installation

  NOTE: Interiors mount directly to studs in MH boxes. No interior mounting brackets are required.

  NOTE: 800 A interiors and interiors that have LC/LI main circuit breakers require elevating brackets, due to the requirement of an 8.75 in. (223 mm) deep box.
- Type 2 boxes include a drip hood (available with surface mounted trim only)

NF Circuit Breaker Panelboards
Enclosures

Type 1 and 2 Trim Fronts

- Finished with gray-baked enamel electrodeposited over cleaned, phosphatized steel (ANSI 49)
- Order flush or surface mounted
- Door with flush lock; uses NSR-251 key
- Directory card located on the inside of the door
- Mono-Flat® fronts on 100–250 A interiors mount to the interior trim with trim screws. Both trim mounting screws and door hinges are concealed; fronts are not removable with the door closed and locked
- Fronts for 400–800 A interiors are ventilated and mount to the enclosure with trim screws; door hinges are concealed
- Fronts 56 in. (1422 mm) high or more on 250 A interiors or 74 in. (1880 mm) high or more on 600 A and 800 A interiors have two flush locks
- Fronts 68 in. (1727 mm) high or more on interiors with LC/LI main circuit breakers or LC sub-feed circuit breakers use a sliding vault lock with 3-point latching

Key NSR-251
(Catalog No. LP9618)

Concealed Hinge for 100–800 A Trim Fronts

Interiors Mount Directly to Enclosure Studs

Standard Flush Lock
(Catalog No. PK4FL)

Optional Sliding Vault Lock (Catalog No. PK5FL)

MH Box

NF Circuit Breaker Panelboards
Enclosures

Type 3R, 5, and 12 Enclosures

Rainproof (Type 3R) Dust tight (Type 5 and 12)

- Finished with gray-baked enamel electrodeposited over cleaned, phosphatized galvanized steel (ANSI 49)
- Gasketed door with lockable vault handle (PK4NVL); uses NSR-251 key
- Directory card located on the inside of the door
- No knockouts in endwalls
- Trim kit included for end and side gutters
- Provisions for two ground bars
- 125 A, 250 A, 400 A main lug and main circuit breaker interiors
- 600 A and 800 A main lug only

Vault Handle with Lock
(Catalog No. PK4NLV)

Type 4X Enclosure

Corrosion-Resistant Fiberglass-Reinforced Polyester (Type 4X)

- Watertight and dust-tight
- Gasketed door with trunk latches
- Directory card located on the inside of the door

Stainless Steel (Type 4 and 4x)

- Water and dust tight
- Gasketed door
- Directory card located on inside of door

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NF Circuit Breaker Panelboards
Single Row (Column-Width) Panelboards

Single Row (Column-Width) Panelboards

Application Data

Column-Width Panelboard

Ratings

- Main lugs: 125 A, 225 A
- Main circuit breaker: 100 A, 225 A

Interiors

- 60 A maximum branch circuit breaker
- Bolt-on EDB/EGB/EJB circuit breakers
- Solid neutral opposite mains

Enclosures

- 8-5/8 in. (219 mm) wide by 5-5/8 in. (143 mm) deep for 10 in. (254 mm) H- or I-beam
- Galvanized steel
- Removable endwalls

Trim Fronts

- Screw mounted
- Door with two flush latches
- Finish: gray-baked enamel electrodeposited over cleaned, phosphatized steel

Line Lugs

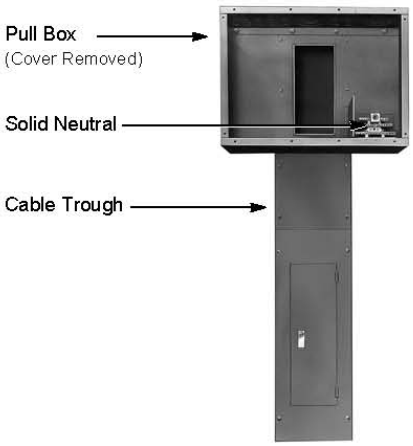
- All lugs are suitable for 75° C copper or aluminum wire

Table 15: Branch Circuit Breaker Short-Circuit Current Ratings

Branch Breaker Prefix 1, 2 and 3 pole 15 to 60A	Short Circuit Current Rating[1]	
	@ 480Y/277 Vac	@ 600Y/347 Vac
EDB	18,000 A	14,000 A
EGB	35,000 A	18,000 A
EJB	65,000 A	25,000 A

[1] Series ratings are also available.
Canada: See the Series Rating Guide (data bulletin S1600PD0302EP R__).
USA: See Switchboard/Panelboard Short-Circuit Ratings (data bulletin 2700DB9901), or the Digest (http://ecatalog.squared.com/category.cfm).

NF Circuit Breaker Panelboards
Single Row (Column-Width) Panelboards



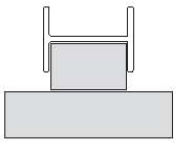
Single Row (Column-Width) Panelboard

Cable Trough

- Cable trough is stackable
- 8-5/8 in. (219 mm) wide by 5-5/8 in. (143 mm) deep for 10 in. (254 mm) I-beam or H-beam
- Galvanized steel trough uses enclosure endwall
- Screw-mounted two-piece front
  - — 15 in. (381 mm) long top piece of front removable for pull box mounting
  - — Finish: gray-baked enamel electrodeposited over cleaned, phosphatized steel

Table 16: Column-Width Cable Trough

Length of Cable Trough	Catalog No.
36 in. (914 mm)	NTX836
48 in. (1219 mm)	NTX848
56 in. (1422 mm)	NTX856
66 in. (1676 mm)	NTX866
84 in. (2134 mm)	NTX884
96 in. (2438 mm)	NTX896
104 in. (2642 mm)	NTX8104
112 in. (2845 mm)	NTX8112



Cable Trough Top View with I-Beam

Pull Box
(catalog number MPX81542)

- Mounts on cable trough
- 20 in. (508 mm) wide by 5-3/4 in. (146 mm) deep by 15 in. (381 mm) high
- Screw-mounted front
- Finish: gray-baked enamel electrodeposited over cleaned, phosphatized steel
- Removable top endwall with knockouts
- Solid neutral included

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NF Circuit Breaker Panelboards
Terminal Data

Terminal Data

Main Lugs Terminal Data

Table 17: Standard Aluminum and Copper Lugs

Amperes	Aluminum				Copper			
	Aluminum Mechanical		Aluminum Compression		Copper Mechanical		Copper Compression	
	Cat. #	Lug Wire Range	Cat. #	Lug Wire Range	Cat. #	Lug Wire Range	Cat. #	Lug Wire Range
125	NFALM1	(1) #6 - 2/0[1]	NFALV1	(1) #4-300 kcmil	NFCUM1	(1) #6 - 350 kcmil	NFCUV 1	(1) #6 - 1/0
250	NFAML2	(1) #6 - 350 kcmil	NFALV2	(1) 250-350 kcmil	NFCUM2	(1) #6 - 350 kcmil	NFCUV 2	(1) 2/0 - 300 kcmil
400	NFALM4	(1) 1/0-750 kcmil or (2) 1/0-350 kcmil	NFALV4	(2) 2/0-500 kcmil	NFCUM4	(1) 1/0-750 kcmil or (2) 1/0-350 kcmil	NFCUV 4	(1) 400-750 kcmil
600	NFALM6	(2) 1/0-600 kcmil	NFALV6	(2) 2/0-500 kcmil	NFCUM6	(2) 1/0-750 kcmil	NFCUV 6	(2) 250-750 kcmil
800	Contact the Technical Applications Group (TAG)							

[1] Neutral accepts #6-2/0 Al/Cu.

Main Circuit Breaker Terminal Data

See Digest section 7 for copper lugs.

Table 18: Standard Aluminum Mechanical Lugs

Panelboard Type	Ampere Rating	Circuit Breaker Type	Lug Wire Range
NF	100 A	FIL	(1) #14-1/0 Cu or (1) #12-1/0 Al
	125 A[1]	EDB, EGB, EJB	(1) #14-2/0 Al/Cu
	150 A	HDL, HGL, HJL, HLL	(1) #14-3/0 Al/Cu
	250 A	JDL, JGL, JJL, JLL, KI	(1) 3/0-350 kcmil Al/Cu
	400 A	LAL, LHL	(1) #1-600 kcmil Al/Cu or (2) #1-250 kcmil Al/Cu
	600 A	LCL, LIL, LEL, LXL LXIL	(2) 4/0-500 kcmil Al/Cu
	800 A	800 A main breaker panelboard not available.	

[1] 110 A maximum at 600Y/347 Vac.

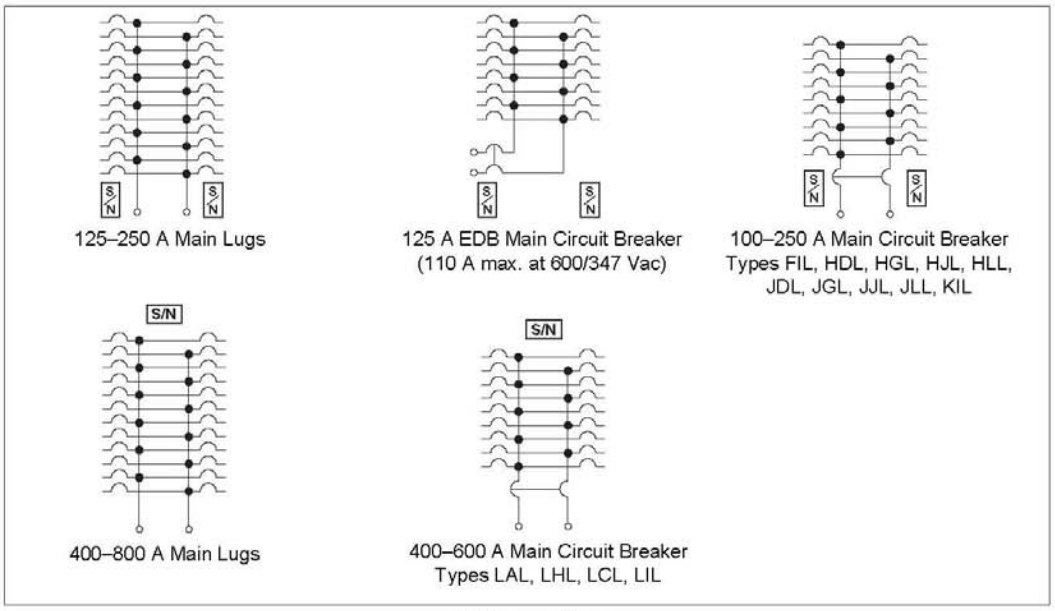
Table 19: Aluminum Compression Lugs

Panelboard Type	Ampere Rating	Circuit Breaker Type	Catalog No.	Lug Wire Range
NF	100 A	FC, FI	VC100FA	(1) #8-1/0 Al/Cu
	125 A[1]	ED, EG, EJ	VC100FD	(1) #8-1/0 Al/Cu
	150 A	HDL, HGL, HJL, HLL	YA150HD	(1) #1–4/0 Al/Cu
	250 A	JDL, JGL, JJL, JLL	YA250J35	(1) 3/0–350 kcmil Al/Cu
	250 A	KI	VC250KA3	(1) #4-300 kcmil Al/Cu
	400 A	LA, LH	VC400LA5[2]	(1) 2/0-500 kcmil Al/Cu
	600 A	LC, LI, LE, LX, LXI	—	—
	800 A	800 A main breaker panelboard not available.		

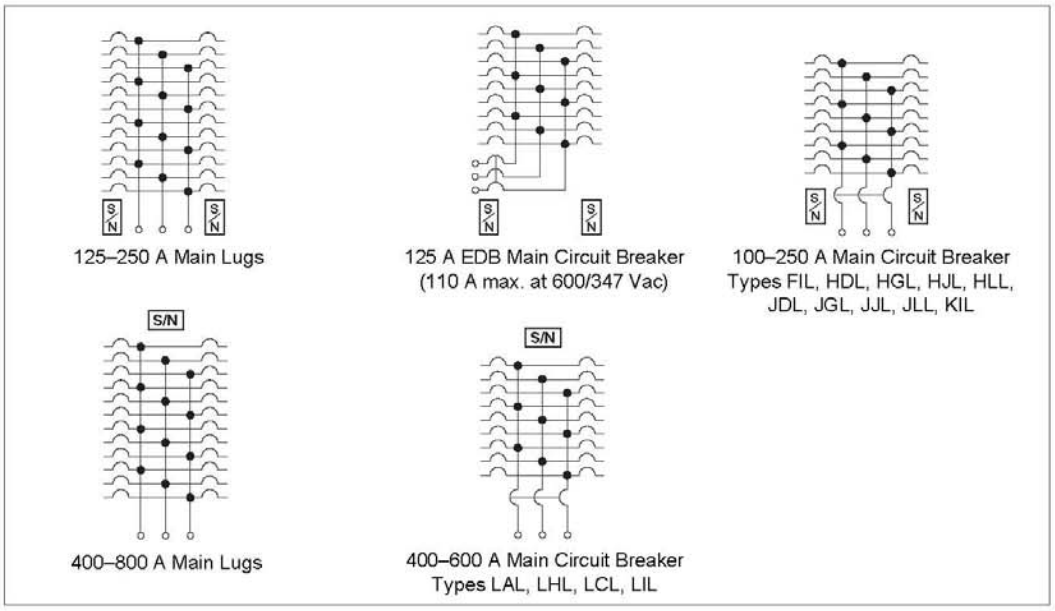
[1] 110 A maximum at 600Y/347 Vac.
[2] Other lug sizes available.

NF Circuit Breaker Panelboards
Typical Wiring Diagrams

Typical Wiring Diagrams



1-Phase, 3-Wire



3-Phase, 4-Wire

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APPENDIX IV.C: SHORT CIRCUIT ANALYSIS

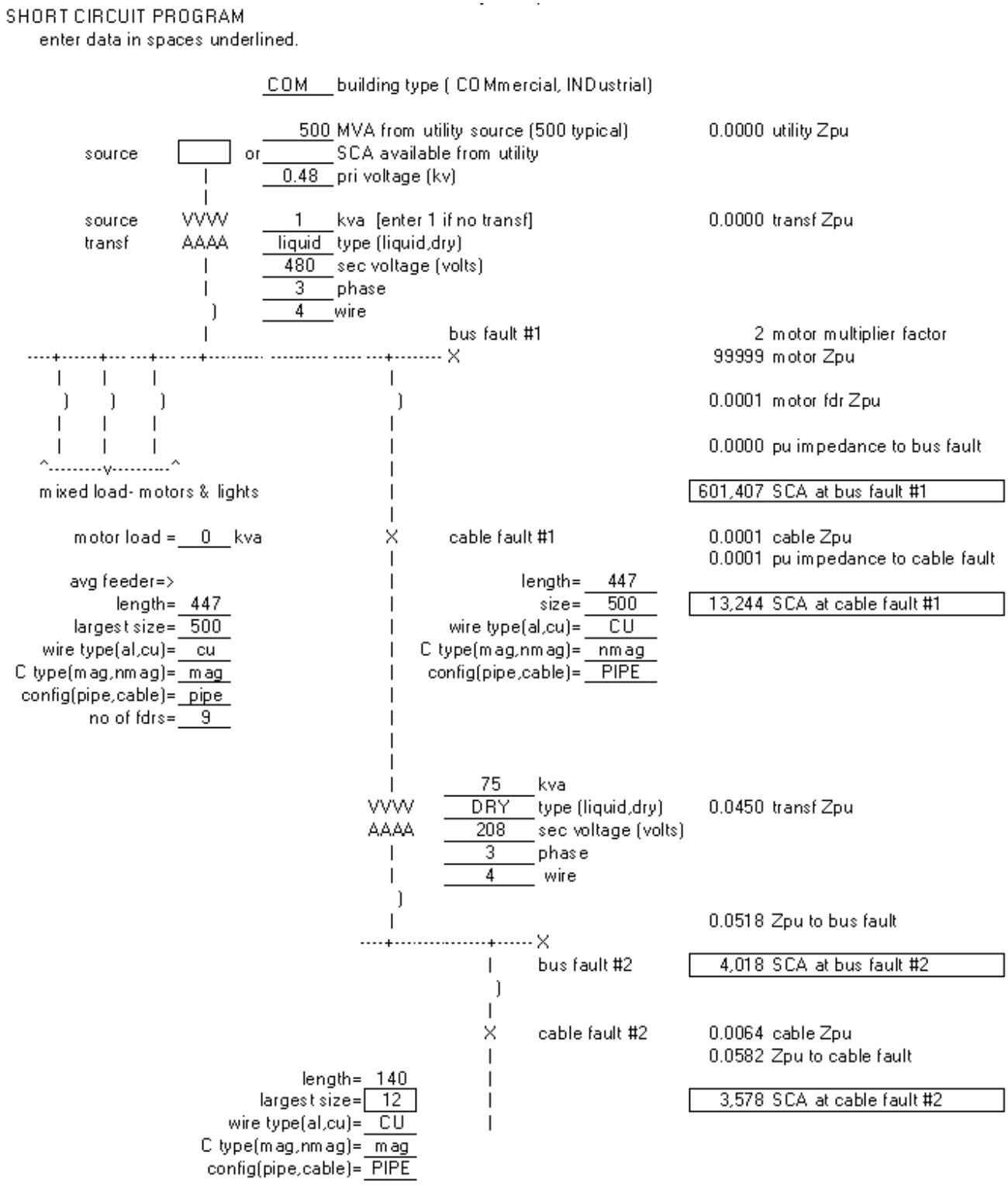


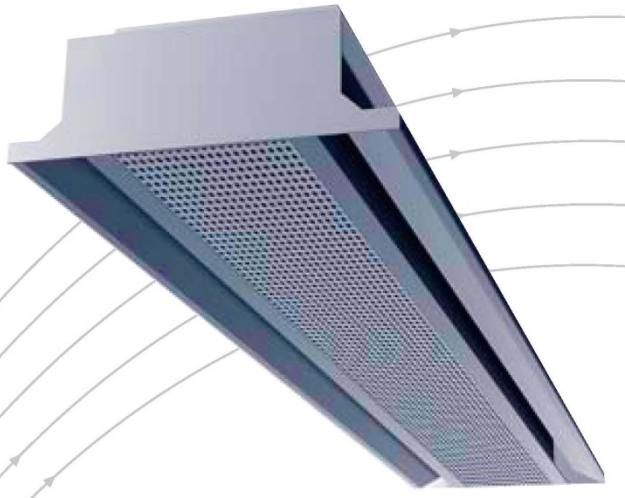
Figure 12: Short circuit analysis

APPENDIX IV.D: CHILLED BEAM CATALOGS

T 2.4/2/EN/1

Active Chilled Beams

Type DID300B

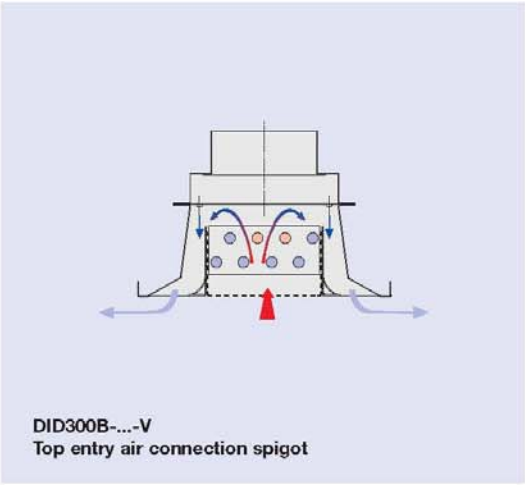


TROX® TECHNIK

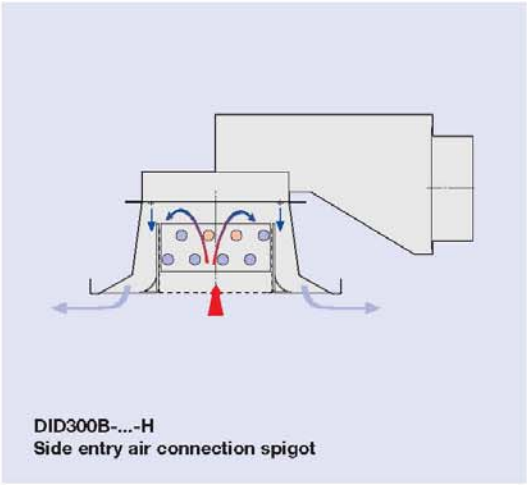
TROX GmbH
Heinrich-Trox-Platz
D-47504 Neukirchen-Vluyn

Telephone +49/28 45/2 02-0
Telefax +49/28 45/2 02-2 65
e-mail trox@trox.de
www.troxtechnik.com

Contents · Description



DID300B-...-V
Top entry air connection spigot



DID300B-...-H
Side entry air connection spigot

Description

TROX Active Chilled Beams type DID300B use a combination of air and water systems. They combine the air flow characteristics of ceiling diffusers with the energy benefits of load dissipation using water (heating/cooling).
The primary air volume flow required for fresh air supply enters the upper plenum box through a connecting spigot and is then discharged into the mixing zone via nozzles which are fitted into a diaphragm plate.
The induced air is drawn from the room through a water coil. In the mixing section of the DID300B the induced air is mixed with the primary air and the total discharged into the room via slots.
The DID300B can be used for cooling and/or heating.
An additional spigot for extract of exhaust air can be fitted adjacent to the primary air duct (supply and extract air construction).

Caution !
The cold water supply temperature must be selected such that it never falls below room dewpoint.

Max. pressure:
for 2-pipe and 4-pipe system
6 bar at 90°C
7 bar at 20°C
Other operating pressures available on request!

The type DID300B chilled beams are particularly suitable for use in low ceiling void spaces because of their shallow construction. Thus they are suitable not only for use in new buildings but are also excellent for refurbishment projects.
When connected appropriately, they can be used for both individual room control or form a grouped zone control.
The DID300B is available with either top or side entry air connection spigot for supply and extract air.
Between the upper and lower casing there is a diaphragm plate which contains two longitudinal rows of nozzles. These discharge nozzles are available in three different sizes, the selection depending on the volume flow rates required.
The induction grille can easily be removed for cleaning purposes.

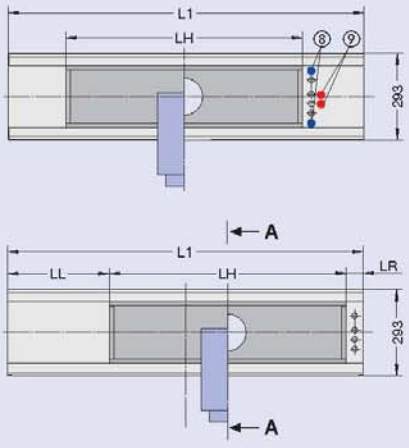
Materials
Casing, including the top plenum and perforated plate induction grille are made of galvanised steel sheet.
The standard finish of the casing and the induction grille is powder-coated white (RAL 9010), the top casing (plenum) and coil remain untreated - optionally can be finished in black (RAL 9005), nozzle plate only finished in black (RAL 9005).
The heat exchanger consists of copper tubes with formed aluminium fins. The flexible hose, available as an accessory, is made of special plastic with stainless steel sheathing.

Construction

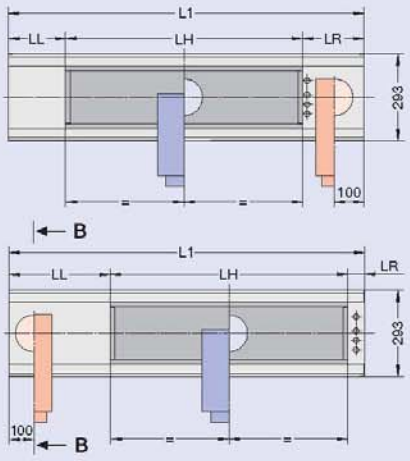
- (1a) Supply air top entry connecting spigot } L_N 900 to 1800 = Ø 123
- (1b) Supply air side entry connecting spigot } L_N 2100 to 3000 = Ø 158
- (2) Top of casing (plenum)
- (3) Discharge nozzles
- (4) Casing
- (5) Coil (pipe-Ø 12 mm)
- (6) Perforated plate induction grille
- (7) Discharge slots
- (8) Label chilled water (blue)
- (9) Label warm water (red)
- (10a) Extract air top connecting spigot
- (10b) Extract air side connecting spigot

L_1 = Total length (diffuser face)
L_N = Nominal length
(for dimensions of unit see page 5)

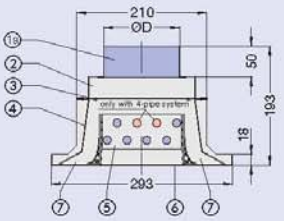
Construction with supply air spigot



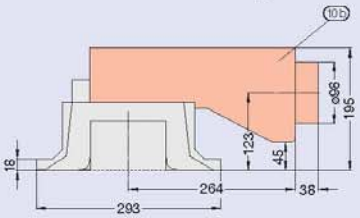
Construction with supply and extract air spigot



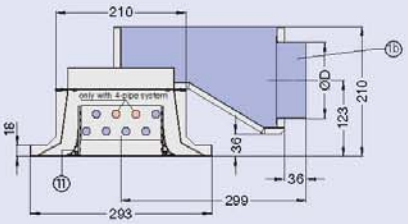
View **A - A**
Construction with top entry supply air spigot



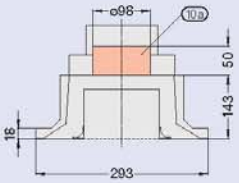
View **B - B**
Construction with side extract air spigot



View **A - A**
Construction with side entry supply air spigot

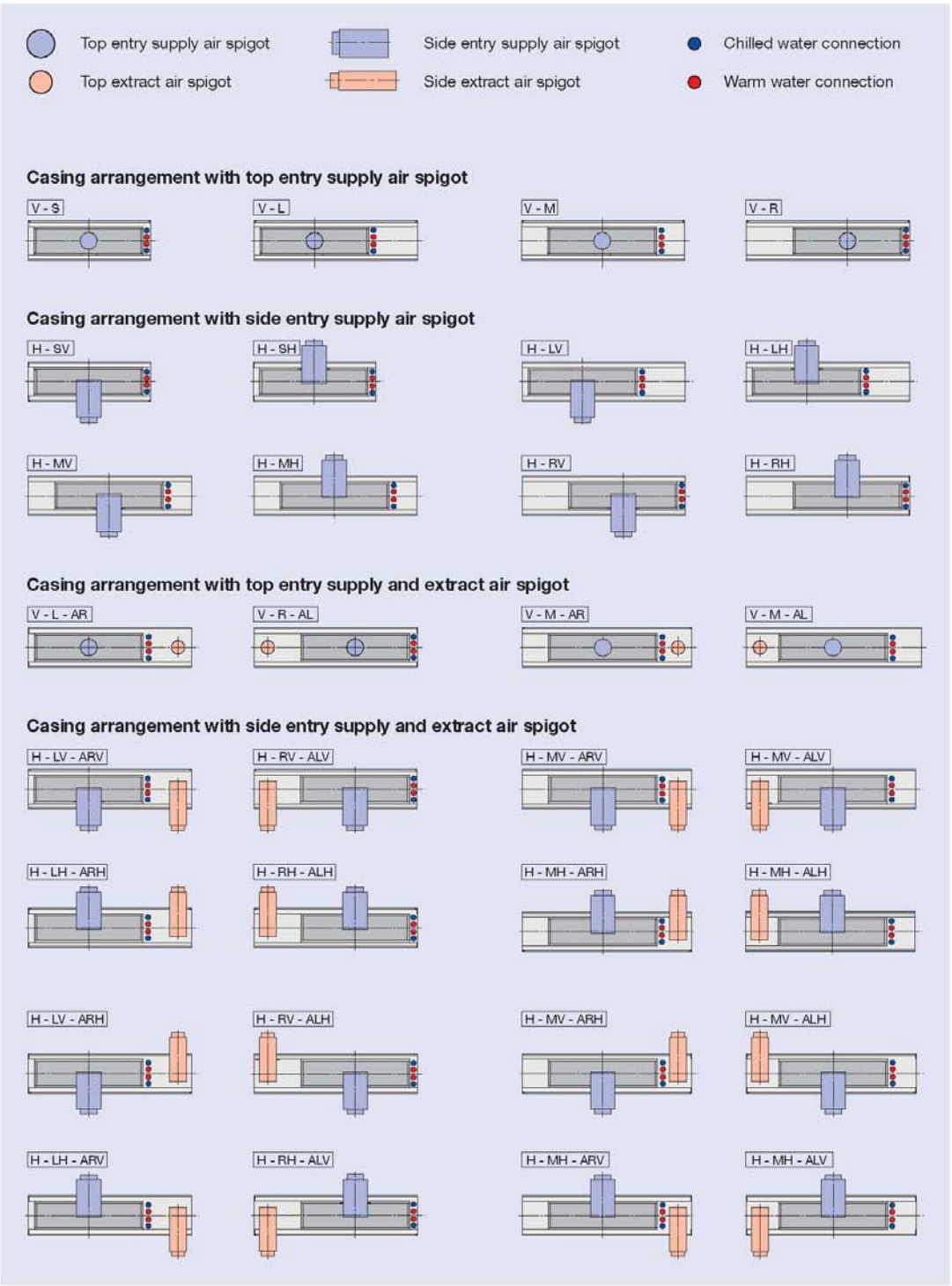


View **B - B**
Construction with top extract air spigot



3

Casing arrangements



4

Dimensions

V - S | H - SV | H - SH

Supply air		Arrangement of the top active plenum					
		Extends over total length (standard)					
L_N	L_H	L_L		L_R		L_1	
		min	max	min	max	min	max
900	800	40	43	54	58	893	900
1200	1100	40	43	54	58	1193	1200
1500	1400	40	43	54	58	1493	1500
1800	1700	40	43	54	58	1793	1800
2100	2000	40	43	54	58	2093	2100
2400	2300	40	43	54	58	2393	2400
2700	2600	40	43	54	58	2693	2700
3000	2900	40	43	54	58	2993	3000

V - L | H - LV | H - LH

Supply air		Arrangement of the top active plenum (plenum shorter than L_1)				
		left				
L_N	L_H	L_L	L_R		L_1	
			min	max	min	max
900	800	43	58	658	901	1500
1200	1100	43	58	658	1201	1800
1500	1400	43	58	658	1501	2100
1800	1700	43	58	658	1801	2400
2100	2000	43	58	658	2101	2700
2400	2300	43	58	658	2401	3000
2700	2600	43	58	358	2701	3000

V - M | H - MV | H - MH

Supply air		Arrangement of the top active plenum (plenum shorter than L_1)	
		middle	
L_N	L_H	L_1	
		min	max
900	800	901	1500
1200	1100	1201	1800
1500	1400	1501	2100
1800	1700	1801	2400
2100	2000	2101	2700
2400	2300	2401	3000
2700	2600	2701	3000

V - R | H - RV | H - RH

Supply air		Arrangement of the top active plenum (plenum shorter than L_1)				
		right				
L_N	L_H	L_L		L_R	L_1	
		min	max		min	max
900	800	43	643	58	901	1500
1200	1100	43	643	58	1201	1800
1500	1400	43	643	58	1501	2100
1800	1700	43	643	58	1801	2400
2100	2000	43	643	58	2101	2700
2400	2300	43	643	58	2401	3000
2700	2600	43	343	58	2701	3000

For construction and casing arrangements see pages 3 and 4

V - L - AR | H - LV - ARV | H - LH - ARV | H - LV - ARH | H - LH - ARH

Supply and extract air		Arrangement of the top active plenum (plenum shorter than L_1)				
		left				
L_N	L_H	L_L	L_R		L_1	
			min	max	min	max
900	800	43	253	658	1096	1500
1200	1100	43	253	658	1396	1800
1500	1400	43	253	658	1696	2100
1800	1700	43	253	658	1996	2400
2100	2000	43	253	658	2296	2700
2400	2300	43	253	658	2596	3000
2700	2600	43	253	358	2896	3000

V - M - AL | H - MV - ALV | H - MV - ARV | H - MH - ALV | H - MH - ARV | V - M - AR | H - MV - ALH | H - MV - ARH | H - MH - ALH | H - MH - ARH

Supply and extract air		Arrangement of the top active plenum (plenum shorter than L_1)	
		middle	
L_N	L_H	L_1	
		min	max
900	800	1290	1800
1200	1100	1590	1800
1500	1400	1890	2100
1800	1700	2190	2400
2100	2000	2490	2700
2400	2300	2790	3000

V - R - AL | H - RV - ALV | H - RH - ALV | H - RV - ALH | H - RH - ALH

Supply and extract air		Arrangement of the top active plenum (plenum shorter than L_1)				
		right				
L_N	L_H	L_L		L_R	L_1	
		min	max		min	max
900	800	238	643	58	1095	1500
1200	1100	238	643	58	1395	1800
1500	1400	238	643	58	1695	2100
1800	1700	238	643	58	1995	2400
2100	2000	238	643	58	2295	2700
2400	2300	238	643	58	2595	3000
2700	2600	238	343	58	2895	3000

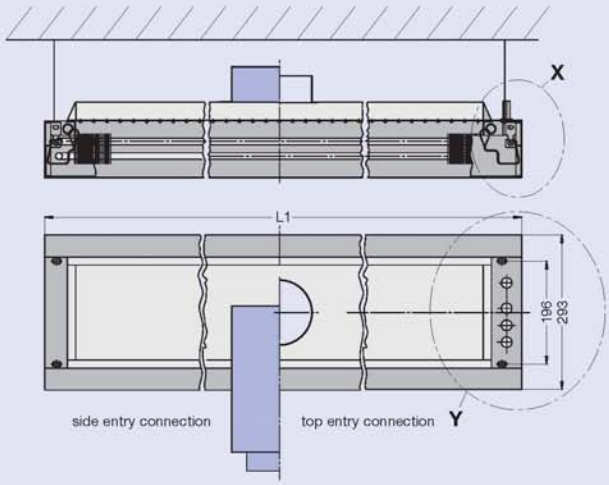
All dimensions in mm with normal tolerances for sheet construction!

5

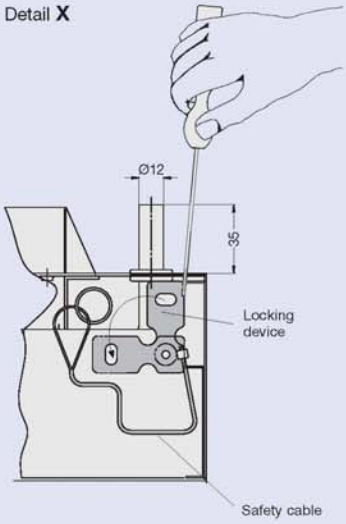
Assembly

Assembly
The two long sides of the DID300B are each provided with two suspension holes or for L_1 = 1500 4 holes are provided on each side. The assembly is installed on site using wire or metal hangers which must have the Building Authority certificate of approval. When the DID300B has been installed, 4 locking devices can be loosened with a screw driver (detail X) and the whole induction grille can be lowered down lengthways. The induction grille is supported by two safety cables.

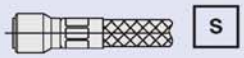
The coil is accessible when the induction grille is removed. The coil connections are on the outside of the DID300B unit. The connection options to the flow and return pipes are, solid soldered, push fit or compression fittings (internal or external threaded end fittings).
The air connection is either from the side or from the top, depending on the construction.



Detail **X**



Flexible hose (FS12),
for water connection Ø 12 mm

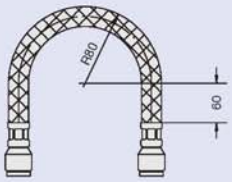


with push-fit connector
Ø 12 mm,
L = 500, 750, 1000 mm

with union nut 1/2",
compression fitting,
L = 500, 750, 1000 mm

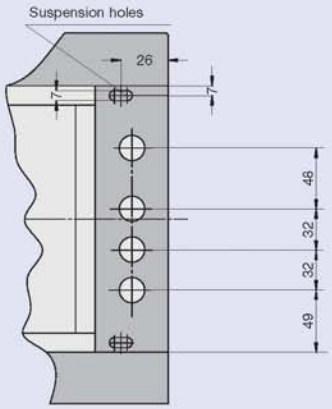
with external thread 1/2",
compression fitting,
L = 500, 750, 1000 mm

min. bend radius



Available connectors	
both ends	combination
FS12-S	FS12-S/U
	FS12-S/A

Detail **Y**



6

Installation

The DID300B unit is fitted with a border extrusion which is suitable for the usual range of ceiling constructions. This ensures the best possible ceiling design.

Installation into grid ceilings

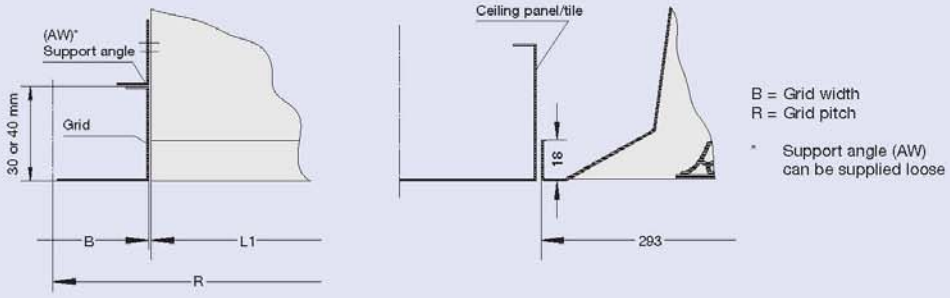
The DID300B can be installed on site at the ends using the support angles which are available as an accessory.
The support angles are supplied loose and can be fitted as appropriate for the grid on site. With this method it is no longer necessary to level the DID300B units.

Installation in T-bar ceilings or closed ceilings

These options allow for installation in a visible T-bar ceiling arrangement or in plasterboard or other closed ceiling systems.

Weight relative to the stability of the construction must be taken off the ceiling. Suspension holes are provided for this. The same also applies to preventing the units themselves from sagging.

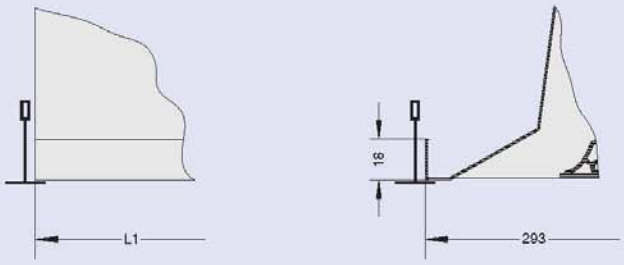
Installation in grid ceilings



B = Grid width
R = Grid pitch

* Support angle (AW) can be supplied loose

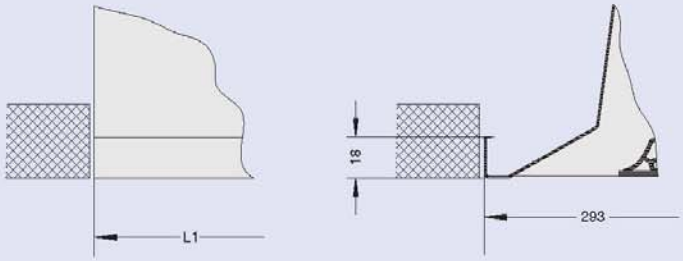
Installation in T-bar ceilings



Depending on the quality of the room air, there is the possibility of dust deposits as with all room air induction units.
If necessary the unit can be cleaned with ordinary, non-aggressive household cleaners. The coil can be cleaned with an industrial vacuum cleaner.

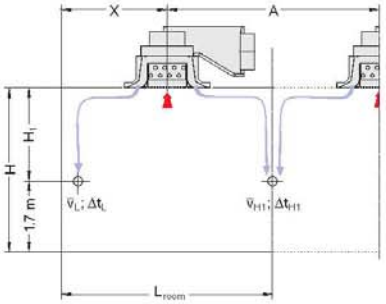
(See also VDI 6022, page 1 – "Hygiene requirements for room air-conditioning systems")

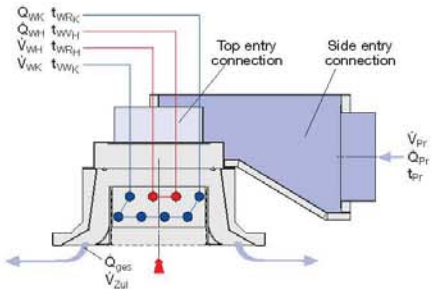
Installation in plasterboard ceilings or closed ceilings

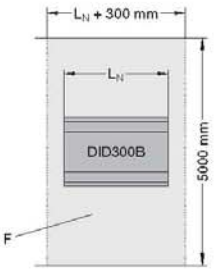


7

Nomenclature







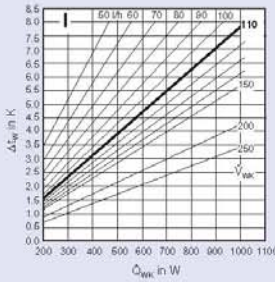
Δt_L	in K:	Temp. diff. between room air t_R and core t_L at distance L = X + H_1
Δt_{H1}	in K:	Temp. diff. between room air t_R and core t_{H1} at distance L = A/2 + H_1
Δt_{Pr}	in K:	Temp. diff. between room air and primary air
Δt_Z	in K:	Temp. diff. between room air and supply air into space
Δt_W	in K:	Water temperature difference
Δt_{RW_V}	in K:	Temp. diff. between room air and water flow temperature
Δp_I	in Pa:	Primary air pressure drop
Δp_W	in kPa:	Water pressure drop
t_R	in °C:	Room temperature
t_{WV_K}	in °C:	Water flow temperature – cooling
t_{WR_K}	in °C:	Water return temperature – cooling
t_{WV_H}	in °C:	Water flow temperature – heating
t_{WR_H}	in °C:	Water return temperature – heating
t_{Pr}	in °C:	Primary air temperature
$\dot{Q}_{W_K}$	in W:	Water cooling capacity
$\dot{Q}_{W_H}$	in Watt:	Water heating capacity
$\dot{Q}_{ges}$	in Watt:	Total cooling capacity $\dot{Q}_{Pr}$ + $\dot{Q}_S$
$\dot{Q}_{Pr}$	in Watt:	Primary air cooling capacity
$\dot{Q}_S$	in Watt:	Water side thermal capacity (for cooling $\dot{Q}_S = \dot{Q}_{W_K}$, for heating $\dot{Q}_S = \dot{Q}_{W_H}$)
$\dot{q}_{Zul}$	in W/m²:	Specific cooling capacity based on reference area F
$\dot{V}_{WK}$	in l/h:	Water volume flow rate – cooling
$\dot{V}_{WH}$	in l/h:	Water volume flow rate – heating
$\dot{V}_{Zul}$	in l/s:	Supply air volume flow rate to space
$\dot{V}_{Pr}$	in l/s:	Primary air volume flow rate
$\bar{v}_L$	in m/s:	Time average air velocity at distance L
$\bar{v}_{H_1}$	in m/s:	Time average air velocity at distance A/2 + H_1
L_{WA}	in dB(A):	A-weighted sound power level
A	in m:	Spacing between 2 diffusers
L	in m:	Horizontal plus vertical distance from diffuser, discharge down the wall L = X + H_1
X_{krit}	in m:	Horizontal distance from diffuser at which the supply air begins to separate from ceiling
H_1	in m:	Distance ceiling - occupied zone
H	in m:	Room height or height of installation
X	in m:	Distance from diffuser centre line to the wall
L_N	in mm:	Nominal length
F	in m²:	Reference area (L_N + 0.3) x 5

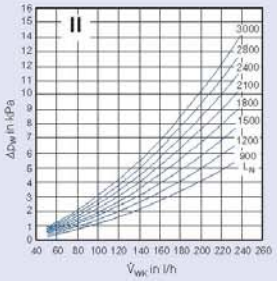
Performance overview – cooling

with 2-pipe and 4-pipe system

Correction factors

$\dot{V}_{WK}$ in l/h		50	70	90	110	140	180	200	250
L_N	900	0.71	0.85	0.94	1.00	1.07	1.12	1.14	1.18
	1200	0.69	0.83	0.93	1.00	1.07	1.14	1.15	1.20
	1500	0.68	0.82	0.93	1.00	1.08	1.15	1.18	1.23
	1800	0.67	0.81	0.92	1.00	1.09	1.16	1.19	1.25
	2100	0.55	0.67	0.76	0.83	0.90	0.97	1.00	1.05
	2400	0.53	0.66	0.75	0.82	0.90	0.97	1.00	1.05
	2700	0.52	0.64	0.74	0.81	0.89	0.97	1.00	1.05
	3000	0.51	0.63	0.73	0.80	0.89	0.97	1.00	1.05





Reference values

t_{WV_K} = t_{Pr} = 16 °C
$\dot{V}_{WK}$ = 110 l/h (L_N 900 up to 1800)
$\dot{V}_{WK}$ = 200 l/h (L_N 2100 up to 3000)
Δt_{Pr} = $t_{Pr} - t_R$ = –10 K
Δt_{RW_V} = $t_{WV_K} - t_R$ = –10 K

L_N	Type of nozzles	$\dot{V}_{Pr}$ l/s	$\dot{V}_{Pr}$ m³/h	$\dot{Q}_{Pr}$ (air) watts	$\dot{Q}_S$ (water) watts	$\dot{Q}_{geo}$ watts	Δt_W K	$\dot{q}_{Zul}$ W/m²	$\dot{V}_{Pr}$/m² l/(s·m²)	$\dot{V}_{Pr}$/m² m³/(h·m²)	L_{WA}, entry from top dB(A)	L_{WA}, entry from side dB(A)	ΔP_L (air) Pa	ΔP_W (water) kPa
900	K	3	11	36	116	152	0.9	25	0.5	1.8	< 20	< 20	29	1.3
		7	25	84	256	340	2.0	57	1.2	4.2	32.5	32.5	156	
		11	40	133	324	457	2.5	78	1.8	6.6	45.1	45.1	386	
	M	6	22	72	156	229	1.2	38	1.0	3.6	< 20	< 20	24	
		13	47	157	291	448	2.3	75	2.2	7.8	34.0	35.0	112	
		19	68	229	352	581	2.7	97	3.2	11.4	44.6	45.6	239	
	G	11	40	133	201	334	1.6	56	1.8	6.6	< 20	20.8	25	
		19	68	229	295	524	2.3	87	3.2	11.4	32.0	36.0	75	
		27	97	326	351	676	2.7	113	4.5	16.2	41.7	45.7	151	
1200	K	3	11	36	79	115	0.6	15	0.4	1.4	< 20	< 20	17	1.7
		8	29	96	303	399	2.4	53	1.1	3.8	31.4	31.4	124	
		13	47	157	399	556	3.1	74	1.7	6.2	44.9	44.9	326	
	M	8	29	96	202	298	1.6	40	1.1	3.8	< 20	< 20	24	
		15	54	181	347	528	2.7	70	2.0	7.2	33.1	34.1	85	
		23	83	277	437	714	3.4	95	3.1	11.0	45.0	46.0	201	
	G	15	54	181	267	448	2.1	60	2.0	7.2	22.5	26.5	28	
		23	83	277	363	640	2.8	85	3.1	11.0	34.4	38.4	65	
		30	108	362	418	780	3.3	104	4.0	14.4	41.8	45.8	110	
1500	K	4	14	48	113	161	0.9	18	0.4	1.6	< 20	< 20	21	2.0
		9	32	109	342	451	2.7	50	1.0	3.6	30.9	30.9	106	
		15	54	181	466	647	3.6	72	1.7	6.0	45.1	45.1	294	
	M	10	36	121	245	366	1.9	41	1.1	4.0	< 20	< 20	25	
		18	65	217	412	629	3.2	70	2.0	7.2	34.4	35.4	80	
		26	94	314	504	818	3.9	91	2.9	10.4	44.6	45.6	167	
	G	19	68	229	329	559	2.6	62	2.1	7.6	26.9	30.9	30	
		25	90	301	404	706	3.2	78	2.8	10.0	34.5	38.5	51	
		32	115	386	468	854	3.7	95	3.6	12.8	41.4	45.4	84	
1800	K	5	18	60	146	206	1.1	20	0.5	1.7	< 20	< 20	24	2.3
		11	40	133	406	539	3.2	51	1.0	3.8	34.3	33.3	115	
		17	61	205	527	732	4.1	70	1.6	5.8	46.5	45.5	275	
	M	12	43	145	287	432	2.2	41	1.1	4.1	< 20	21.0	25	
		21	76	253	472	725	3.7	69	2.0	7.2	34.5	36.5	76	
		29	104	350	565	915	4.4	87	2.8	9.9	43.5	45.5	146	
	G	22	79	265	374	639	2.9	61	2.1	7.5	26.1	32.1	28	
		29	104	350	462	811	3.6	77	2.8	9.9	33.8	39.8	49	
		36	130	434	526	960	4.1	91	3.4	12.3	39.8	45.8	76	
2100	K	6	22	72	199	271	0.9	23	0.5	1.8	< 20	< 20	26	7.6
		12	43	145	515	660	2.2	55	1.0	3.6	34.1	33.1	105	
		18	65	217	681	898	2.9	75	1.5	5.4	45.4	44.4	236	
	M	14	50	169	377	546	1.6	45	1.2	4.2	20.6	22.6	25	
		23	83	277	609	886	2.6	74	1.9	6.9	34.4	36.4	68	
		32	115	388	750	1136	3.2	95	2.7	9.6	43.6	45.6	132	
	G	26	94	314	503	817	2.2	68	2.2	7.8	29.2	35.2	30	
		32	115	386	598	984	2.6	82	2.7	9.6	35.0	41.0	46	
		38	137	458	673	1131	2.9	94	3.2	11.4	39.8	45.8	64	
2400	K	7	25	84	235	319	1.0	24	0.5	1.9	< 20	< 20	28	8.5
		13	47	157	555	711	2.4	53	1.0	3.5	34.1	33.1	98	
		19	68	229	729	958	3.1	71	1.4	5.1	44.7	43.7	208	
	M	16	58	193	425	618	1.8	46	1.2	4.3	22.0	24.0	25	
		25	90	301	659	961	2.8	71	1.9	6.7	34.5	36.5	62	
		34	122	410	807	1217	3.5	90	2.5	9.1	43.0	45.0	115	
	G	30	108	362	571	933	2.5	69	2.2	8.0	31.9	37.9	31	
		35	126	422	650	1072	2.8	79	2.6	9.3	36.2	42.2	43	
		40	144	482	715	1198	3.1	89	3.0	10.7	39.9	45.9	56	
2700	K	8	29	96	270	366	1.2	24	0.5	1.9	< 20	< 20	30	9.3
		14	50	169	592	761	2.5	51	0.9	3.4	34.2	33.2	92	
		21	76	253	797	1050	3.4	70	1.4	5.0	45.5	44.5	207	
	M	18	65	217	471	688	2.0	46	1.2	4.3	23.3	25.3	26	
		27	97	326	707	1033	3.0	69	1.8	6.5	34.6	36.6	58	
		37	133	446	873	1319	3.8	88	2.5	8.9	43.4	45.4	108	
	G	34	122	410	637	1047	2.7	70	2.3	8.2	34.2	40.2	33	
		37	133	446	684	1131	2.9	75	2.5	8.9	35.6	42.6	39	
		41	148	494	741	1235	3.2	82	2.7	9.8	39.4	45.4	47	
3000	K	9	32	109	304	413	1.3	25	0.5	2.0	20.1	< 20	32	10.2
		16	58	193	664	857	2.9	52	1.0	3.5	36.1	35.1	100	
		23	83	277	863	1140	3.7	69	1.4	5.0	46.2	45.2	207	
	M	20	72	241	517	758	2.2	46	1.2	4.4	24.4	26.4	26	
		30	108	362	773	1135	3.3	69	1.8	6.5	35.7	37.7	58	
		39	140	470	922	1393	4.0	84	2.4	8.5	43.0	45.0	98	
	G	38	137	458	701	1159	3.0	70	2.3	8.3	36.3	42.3	34	
		40	144	482	732	1214	3.1	74	2.4	8.7	37.7	43.7	37	
		43	155	518	775	1294	3.3	78	2.6	9.4	39.7	45.7	43	

9

Performance overview – heating

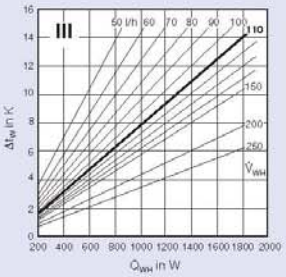
with 4-pipe system

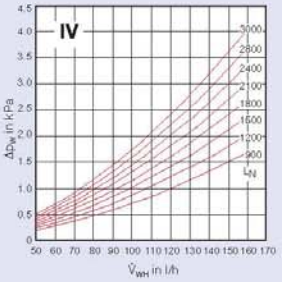
Correction factors

$\dot{V}_{WH}$ in l/h		30	50	70	90	110	130	150
L_N	900	0.70	1.00	1.18	1.30	1.38	1.44	1.49
	1200	0.70	1.00	1.19	1.32	1.41	1.47	1.52
	1500	0.69	1.00	1.20	1.34	1.43	1.50	1.56
	1800	0.69	1.00	1.21	1.35	1.45	1.53	1.59
	2100	0.47	0.68	0.83	0.93	1.00	1.06	1.10
	2400	0.46	0.67	0.82	0.93	1.00	1.06	1.10
	2700	0.45	0.67	0.81	0.92	1.00	1.06	1.11
	3000	0.44	0.66	0.81	0.92	1.00	1.06	1.11

Reference values

t_R = t_{PY} = 22 °C (isothermal)
$\dot{V}_{WH}$ = 50 l/h (L_N 900 up to 1800)
$\dot{V}_{WH}$ = 110 l/h (L_N 2100 up to 3000)
$\Delta t_{RW_V} = t_{WV_H} - t_R$ = 28 K





L_N	Type of nozzles	$\dot{V}_{Pr}$ l/s	$\dot{V}_{Pr}$ m³/h	$\dot{Q}_N = \dot{Q}_{grav}$ (water) watts	Δt_W K	$\dot{q}_{Zul}$ W/m²	$\dot{V}_{Pr}$/m² l/(s·m²)	$\dot{V}_{Pr}$/m² m³/(h·m²)	L_{WA}, entry from top dB(A)	L_{WA}, entry from side dB(A)	ΔP_t (air) Pa	ΔP_W (water) kPa
900	K	3	11	184	3.2	31	0.5	1.8	< 20	< 20	29	
		7	25	399	6.9	66	1.2	4.2	32.5	32.5	156	
		11	40	502	8.6	84	1.8	6.6	45.1	45.1	386	
	M	6	22	246	4.2	41	1.0	3.6	< 20	< 20	24	0.12
		13	47	452	7.8	75	2.2	7.8	34.0	35.0	112	
		19	68	543	9.3	90	3.2	11.4	44.6	45.6	239	
	G	11	40	316	5.4	53	1.8	6.6	< 20	20.8	25	
		19	68	457	7.9	76	3.2	11.4	32.0	36.0	75	
		27	97	542	9.3	90	4.5	16.2	41.7	45.7	151	
1200	K	3	11	125	2.2	17	0.4	1.4	< 20	< 20	17	
		8	29	469	8.1	63	1.1	3.8	31.4	31.4	124	
		13	47	613	10.5	82	1.7	6.2	44.9	44.9	326	
	M	8	29	316	5.4	42	1.1	3.8	< 20	< 20	24	
		15	54	536	9.2	72	2.0	7.2	33.1	34.1	85	0.14
		23	83	668	11.5	89	3.1	11.0	45.0	46.0	201	
	G	15	54	416	7.2	55	2.0	7.2	22.5	26.5	28	
		23	83	559	9.6	75	3.1	11.0	34.4	38.4	65	
		30	108	642	11.0	86	4.0	14.4	41.8	45.8	110	
1500	K	4	14	178	3.1	20	0.4	1.6	< 20	< 20	21	
		9	32	529	9.1	59	1.0	3.6	30.9	30.9	106	
		15	54	711	12.2	79	1.7	6.0	45.1	45.1	294	
	M	10	36	383	6.6	43	1.1	4.0	< 20	< 20	25	
		18	65	632	10.9	70	2.0	7.2	34.4	35.4	80	0.16
		26	94	767	13.2	85	2.9	10.4	44.6	45.6	167	
	G	19	68	509	8.8	57	2.1	7.6	26.9	30.9	30	
		25	90	621	10.7	69	2.8	10.0	34.5	38.5	51	
		32	115	714	12.3	79	3.6	12.8	41.4	45.4	84	
1800	K	5	18	229	3.9	22	0.5	1.7	< 20	< 20	24	
		11	40	624	10.7	59	1.0	3.8	34.3	33.3	115	
		17	61	800	13.8	76	1.6	5.8	46.5	45.5	275	
	M	12	43	446	7.7	43	1.1	4.1	< 20	21.0	25	
		21	76	720	12.4	69	2.0	7.2	34.5	36.5	76	0.18
		29	104	854	14.7	81	2.8	9.9	43.5	45.5	146	
	G	22	79	575	9.9	55	2.1	7.5	26.1	32.1	28	
		29	104	705	12.1	67	2.8	9.9	33.8	39.8	49	
		36	130	798	13.7	76	3.4	12.3	39.8	45.8	76	
2100	K	6	22	379	3.0	32	0.5	1.8	< 20	< 20	26	
		12	43	965	7.5	80	1.0	3.6	34.1	33.1	105	
		18	65	1264	9.9	105	1.5	5.4	45.4	44.4	236	
	M	14	50	711	5.6	59	1.2	4.2	20.6	22.6	25	
		23	83	1135	8.9	95	1.9	6.9	34.4	36.4	68	0.85
		32	115	1388	10.8	116	2.7	9.6	43.6	45.6	132	
	G	26	94	943	7.4	79	2.2	7.8	29.2	35.2	30	
		32	115	1114	8.7	93	2.7	9.6	35.0	41.0	46	
		38	137	1249	9.8	104	3.2	11.4	39.8	45.8	64	
2400	K	7	25	446	3.5	33	0.5	1.9	< 20	< 20	28	
		13	47	1037	8.1	77	1.0	3.5	34.1	33.1	98	
		19	68	1350	10.6	100	1.4	5.1	44.7	43.7	208	
	M	16	58	799	6.2	59	1.2	4.3	22.0	24.0	25	
		25	90	1226	9.6	91	1.9	6.7	34.5	36.5	62	0.93
		34	122	1488	11.6	110	2.5	9.1	43.0	45.0	115	
	G	30	108	1066	8.3	79	2.2	8.0	31.9	37.9	31	
		35	126	1208	9.4	89	2.6	9.3	36.2	42.2	43	
		40	144	1326	10.4	98	3.0	10.7	39.9	45.9	56	
2700	K	8	29	512	4.0	34	0.5	1.9	< 20	< 20	30	
		14	50	1104	8.6	74	0.9	3.4	34.2	33.2	92	
		21	76	1471	11.5	98	1.4	5.0	45.5	44.5	207	
	M	18	65	884	6.9	59	1.2	4.3	23.3	25.3	26	
		27	97	1311	10.3	87	1.8	6.5	34.6	36.6	58	1.02
		37	133	1605	12.5	107	2.5	8.9	43.4	45.4	108	
	G	34	122	1185	9.3	79	2.3	8.2	34.2	40.2	33	
		37	133	1271	9.9	85	2.5	8.9	36.6	42.6	39	
		41	148	1371	10.7	91	2.7	9.8	39.4	45.4	47	
3000	K	9	32	576	4.5	35	0.5	2.0	20.1	< 20	32	
		16	58	1235	9.7	75	1.0	3.5	36.1	35.1	100	
		23	83	1587	12.4	96	1.4	5.0	46.2	45.2	207	
	M	20	72	967	7.6	59	1.2	4.4	24.4	26.4	26	
		30	108	1428	11.2	87	1.8	6.5	35.7	37.7	58	1.11
		39	140	1692	13.2	103	2.4	8.5	43.0	45.0	98	
	G	38	137	1299	10.2	79	2.3	8.3	36.3	42.3	34	
		40	144	1355	10.6	82	2.4	8.7	37.7	43.7	37	
		43	155	1432	11.2	87	2.6	9.4	39.7	45.7	43	

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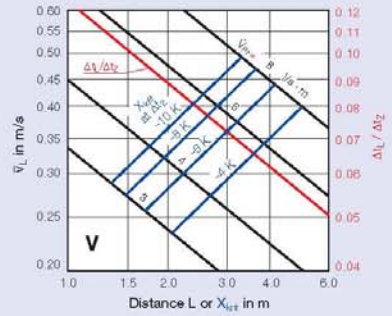
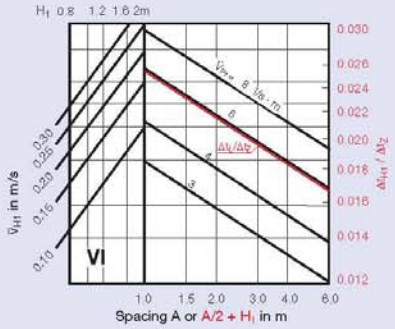
Aerodynamic data

Correction factors for diagram values depending on length of unit L_N								
L_N in mm	900	1200	1500	1800	2100	2400	2700	3000
$\dot{v}_L$, $\dot{v}_{H1}$, $X_{kvit.}$ from diagram	0.92	0.96	1.0	1.04	1.07	1.11	1.14	1.17
Δt_L, Δt_Z, $\Delta t_{H1}/\Delta t_Z$ from diagram	0.87	0.94	1.0	1.05	1.09	1.13	1.17	1.20

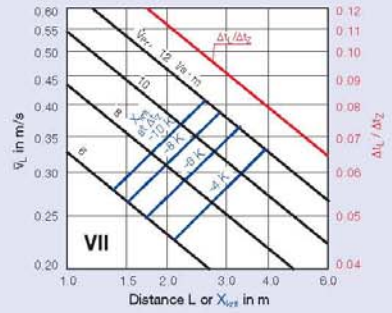
Nozzle type K



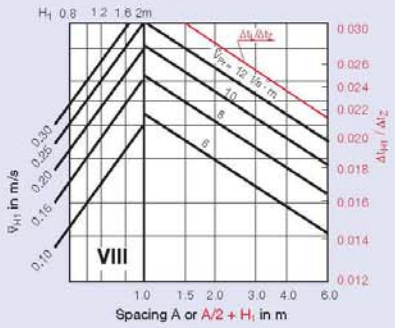
Nozzle type K



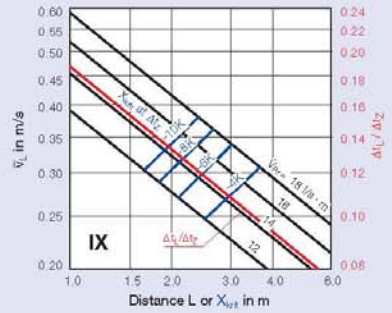
Nozzle type M



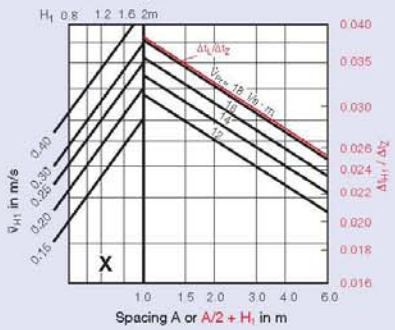
Nozzle type M



Nozzle type G



Nozzle type G



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Order details

Specification text

The active chilled beam type DID300B is suitable for dealing with high internal heat loads using a combination of air and water.
It consists of the top plenum which serves as primary air duct and a diaphragm plate with nozzles in two longitudinal rows (different nozzle sizes are available). A coil is fitted underneath the primary air plenum and diaphragm plate. The induction grille below the coil is a perforated plate. The coil can be used either for heating or cooling (2-pipe system) as well as heating and cooling (4-pipe system).
The external diameter of the bare coil tube ends is 12 mm. Primary and conditioned induced air are mixed in the unit and discharged horizontally with coanda effect into the room via the two slots formed by the external frame and the internal extrusions. There are holes in the casing to enable the unit to be hung by the customer.
A construction incorporating an extract air spigot can be provided. Spigots for supply and extract air can be either side or top mounted.

Support angles and flexible hoses are available as accessories for the DID300B unit.

Materials
Casing, including the top plenum and perforated plate induction grille are made of galvanised steel sheet.
The standard finish of the casing and the induction grille is powder-coated white (RAL 9010), the top casing (plenum) and coil remain untreated – optionally can be finished in black (RAL 9005), nozzle plate only finished in black (RAL 9005).
The heat exchanger consists of copper tubes with formed aluminium fins. The flexible hose, available as an accessory, is made of special plastic with stainless steel sheathing.

Order code

These codes do not need to be completed for standard products

DID300B - 2 - K - H - SV - ALV / 1800 x 1500 / 0 / 0 / P1 / RAL 9016 / G3

Coil:
Two-pipe 2
Four-pipe 4

Nozzle options:
small K
medium M
large G

Spigot and casing arrangements (see page 4)

1) For casing arrangement M, MV and MH
2) GE = Gloss level

L_1 x L_N (mm)
900 x 900 1200 1500 1800 1)
1200 x 1200 1500 1800
1500 x 1500 1800 2100
1800 x 1800 2100 2400
2100 x 2100 2400 2700
2400 x 2400 2700 3000
2700 x 2700 3000
3000 x 3000

L_1 = Total length (diffuser face)
L_N = Nominal length

Not used

Coil finish:
0 Standard untreated
G3 Finished to RAL 9005

0 Standard finish Powder-coated to RAL 9010 (GE 50 %)2)
P1 Powder-coated to RAL... (GE 70 %)2)

Note:
L_1 = 893 ... 3000 mm
L_N only available in standard length
L_1 maximum 7 mm shorter than L_N

Accessory:
FS12-... (see table)
AW = Support angle

Accessory: Flexible hose (FS12) (see page 6)

Available connectors		
both ends	combination	length in mm
FS12-S	FS12-S/U	500, 750, 1000
	FS12-S/A	

Order example

Make: TROX
Type: DID300B - 2 - K - H - SV - ALV / 1800 x 1500 / P1 / RAL 9016 / G3

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APPENDIX IV.E: REVISED FLOW DIAGRAMS

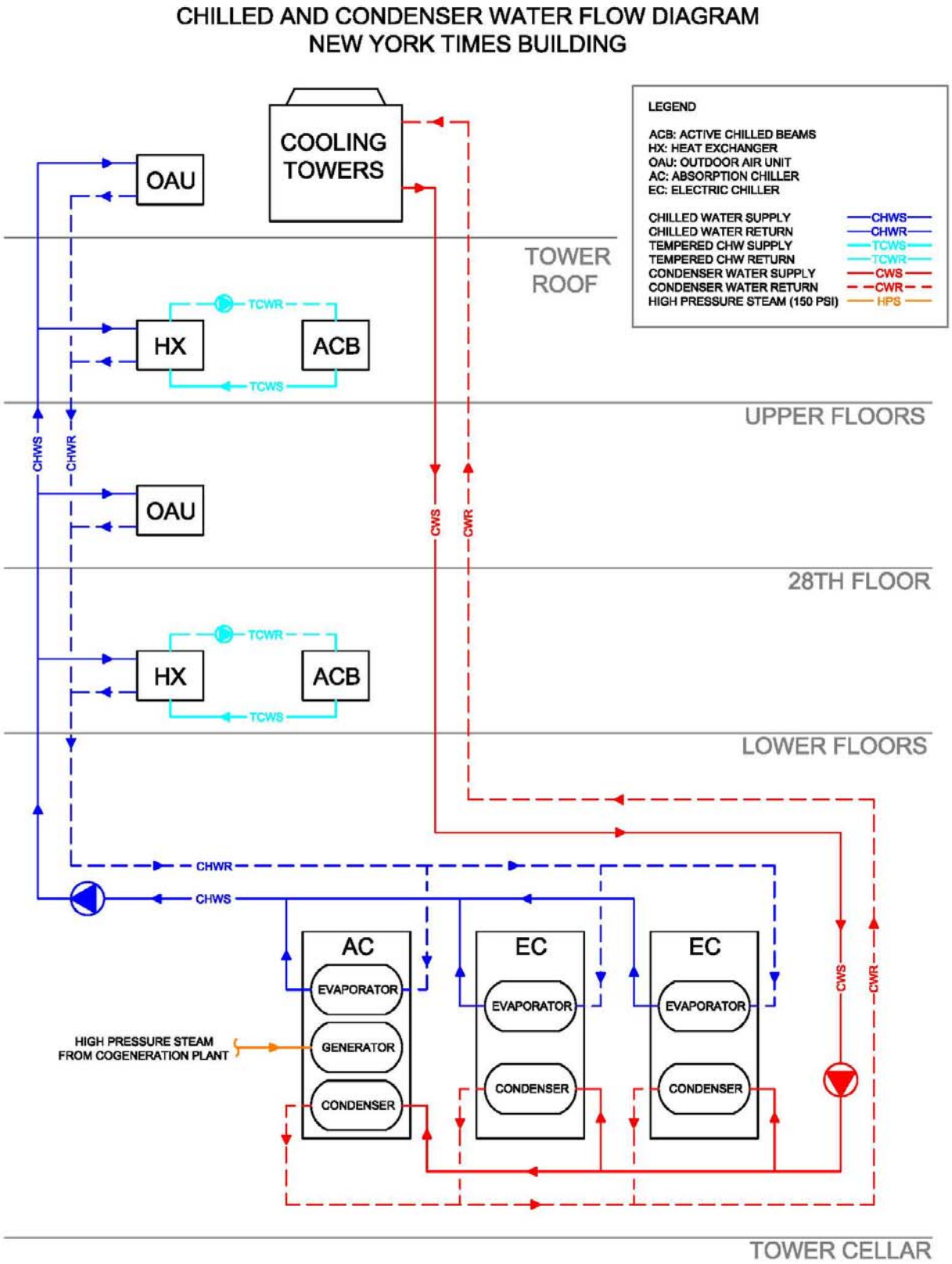


Figure 12: Chilled and condenser water flow diagram

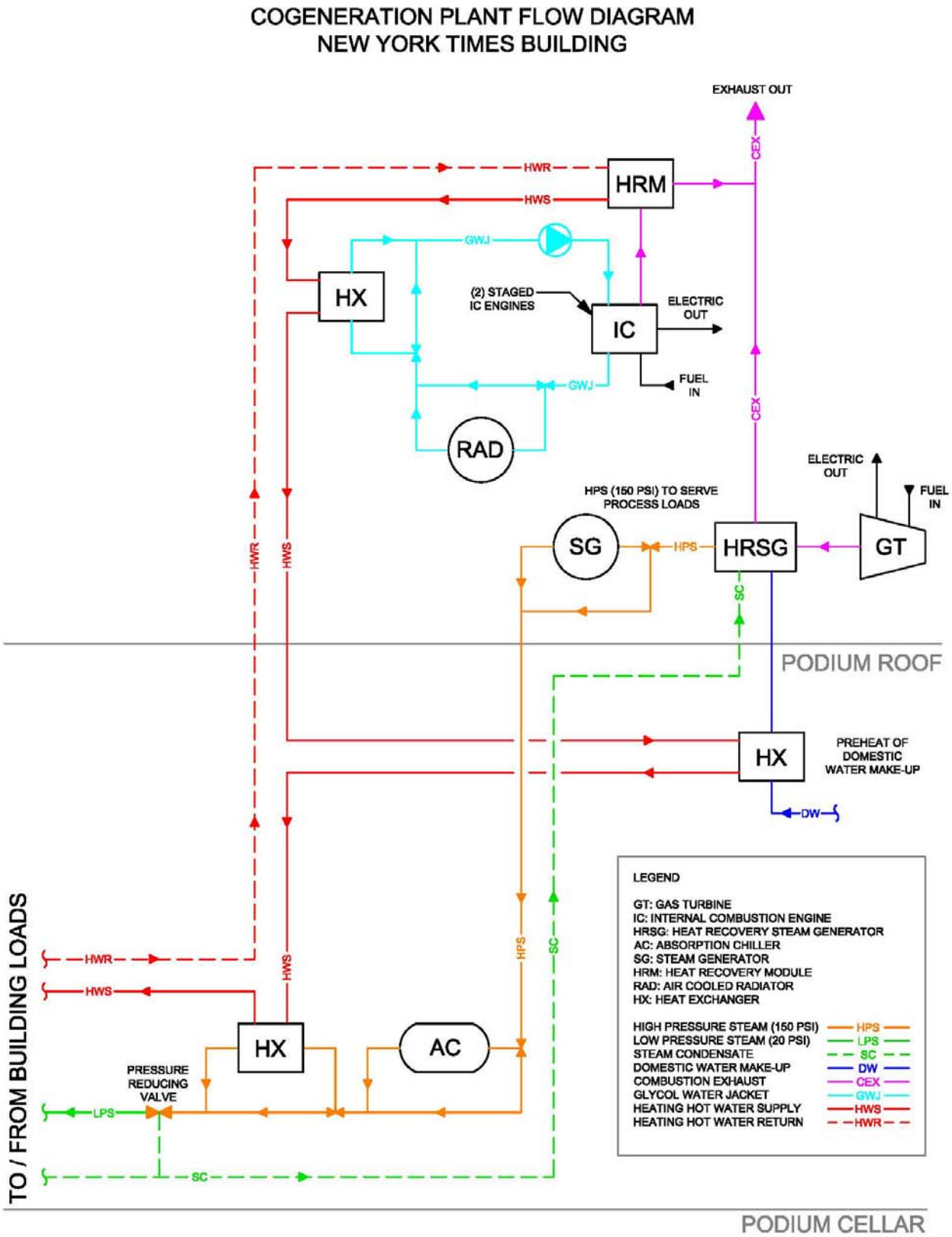


Figure 13: Cogeneration plant flow diagram

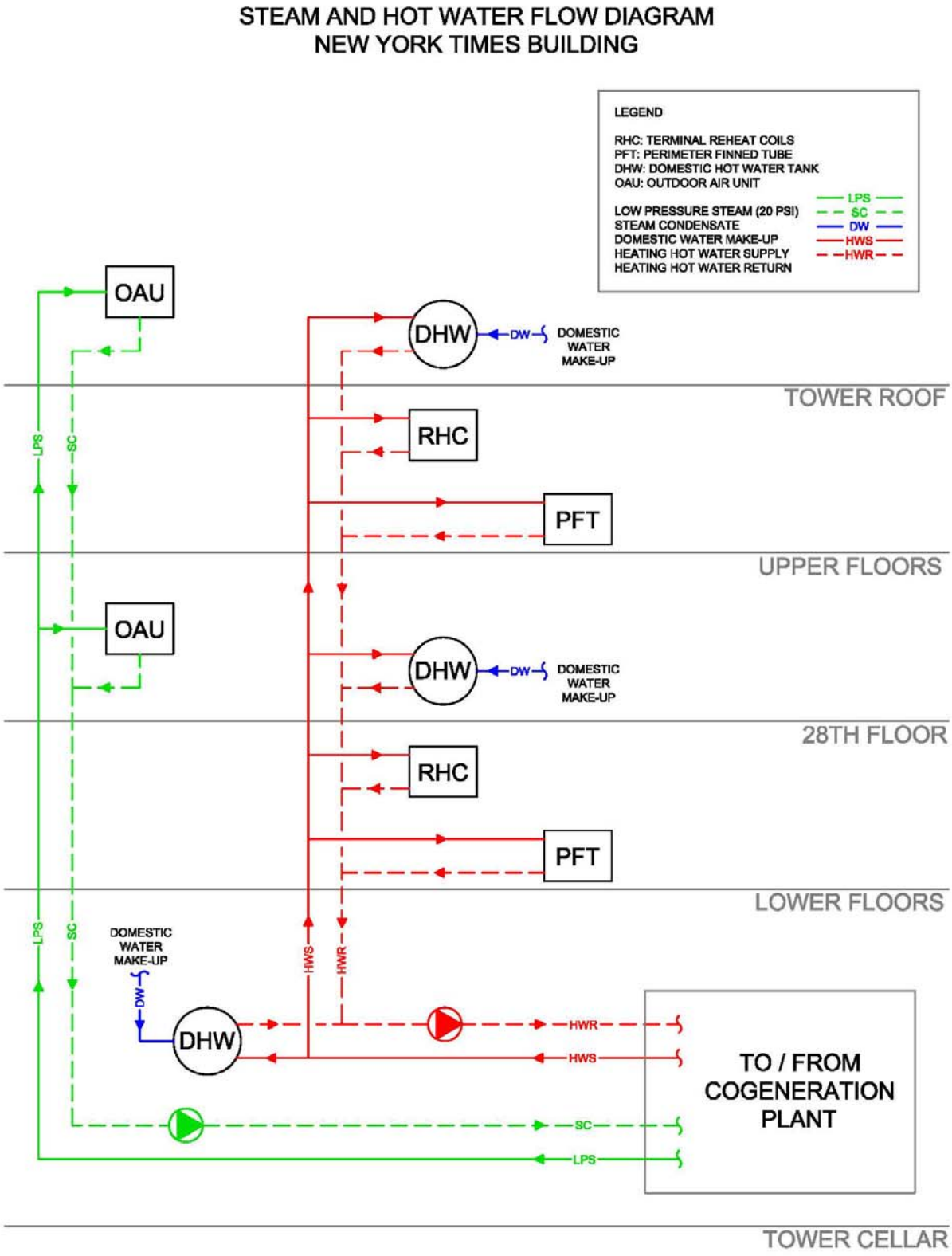


Figure 14: Steam and hot water flow diagram

APPENDIX IV.F: AIR STATE CALCULATIONS

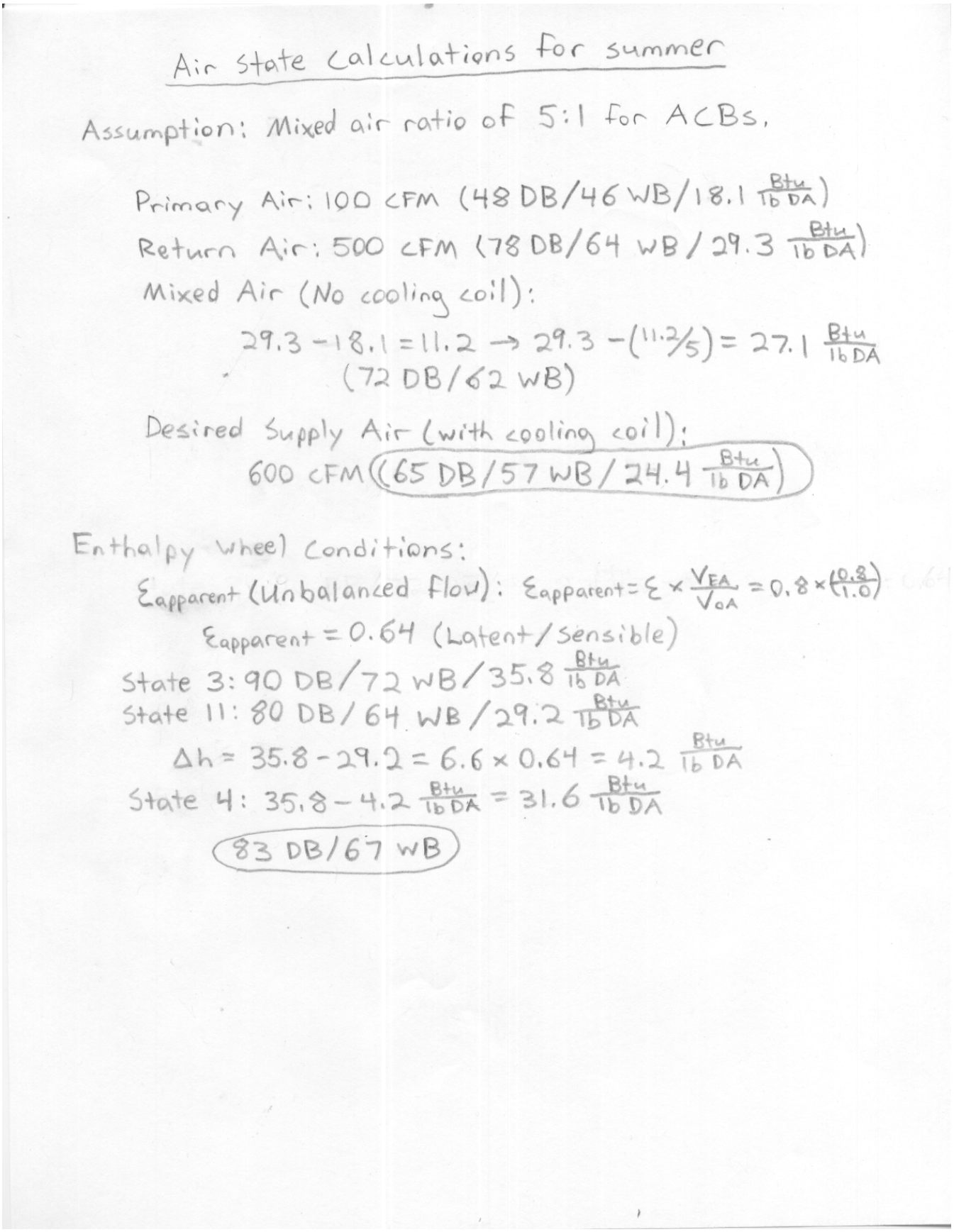
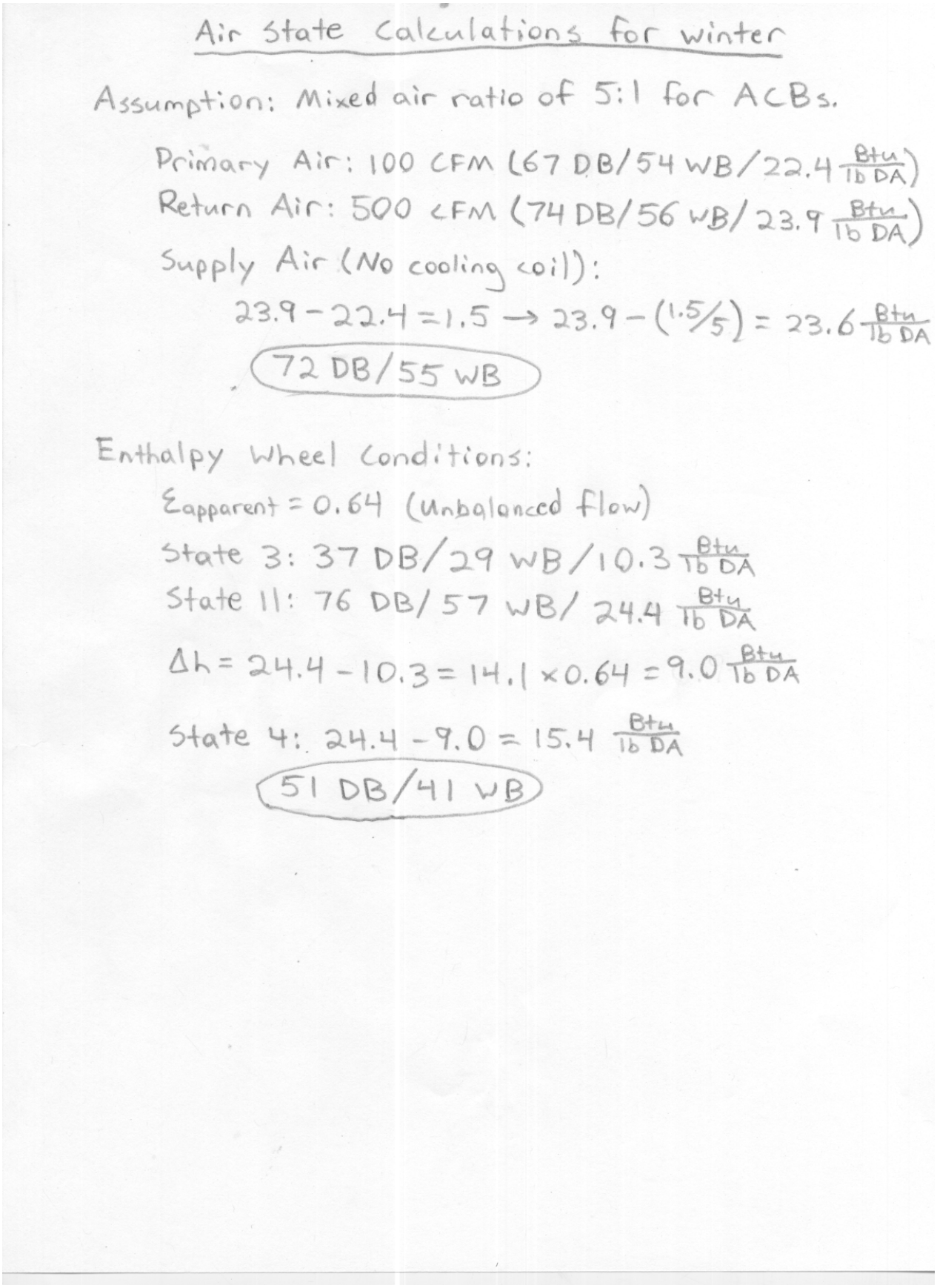


Figure 15: Air state calculations, summer



Air State Calculations for winter

Assumption: Mixed air ratio of 5:1 for ACBs.

Primary Air: 100 CFM (67 DB/54 WB/22.4 $\frac{Btu}{lb\ DA}$)

Return Air: 500 CFM (74 DB/56 WB/23.9 $\frac{Btu}{lb\ DA}$)

Supply Air (No cooling coil):

$23.9 - 22.4 = 1.5 \rightarrow 23.9 - (1.5/5) = 23.6 \frac{Btu}{lb\ DA}$

72 DB/55 WB

Enthalpy Wheel Conditions:

$\varepsilon_{apparent} = 0.64$ (Unbalanced flow)

State 3: 37 DB/29 WB/10.3 $\frac{Btu}{lb\ DA}$

State 11: 76 DB/57 WB/24.4 $\frac{Btu}{lb\ DA}$

$\Delta h = 24.4 - 10.3 = 14.1 \times 0.64 = 9.0 \frac{Btu}{lb\ DA}$

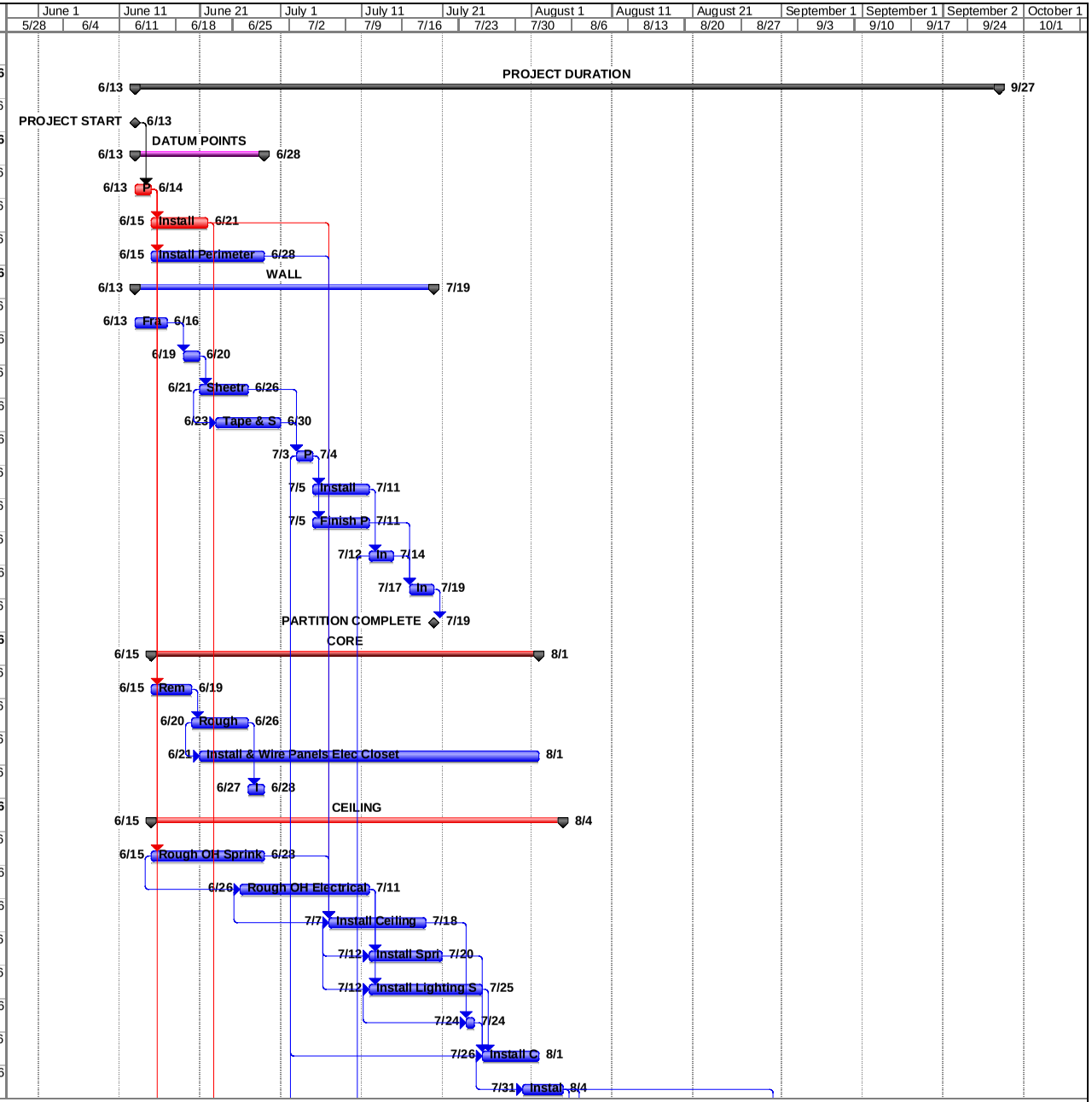
State 4: $24.4 - 9.0 = 15.4 \frac{Btu}{lb\ DA}$

51 DB/41 WB

Figure 16: Air state calculations, winter

APPENDIX IV.G: EXISTING FIT OUT SCHEDULES

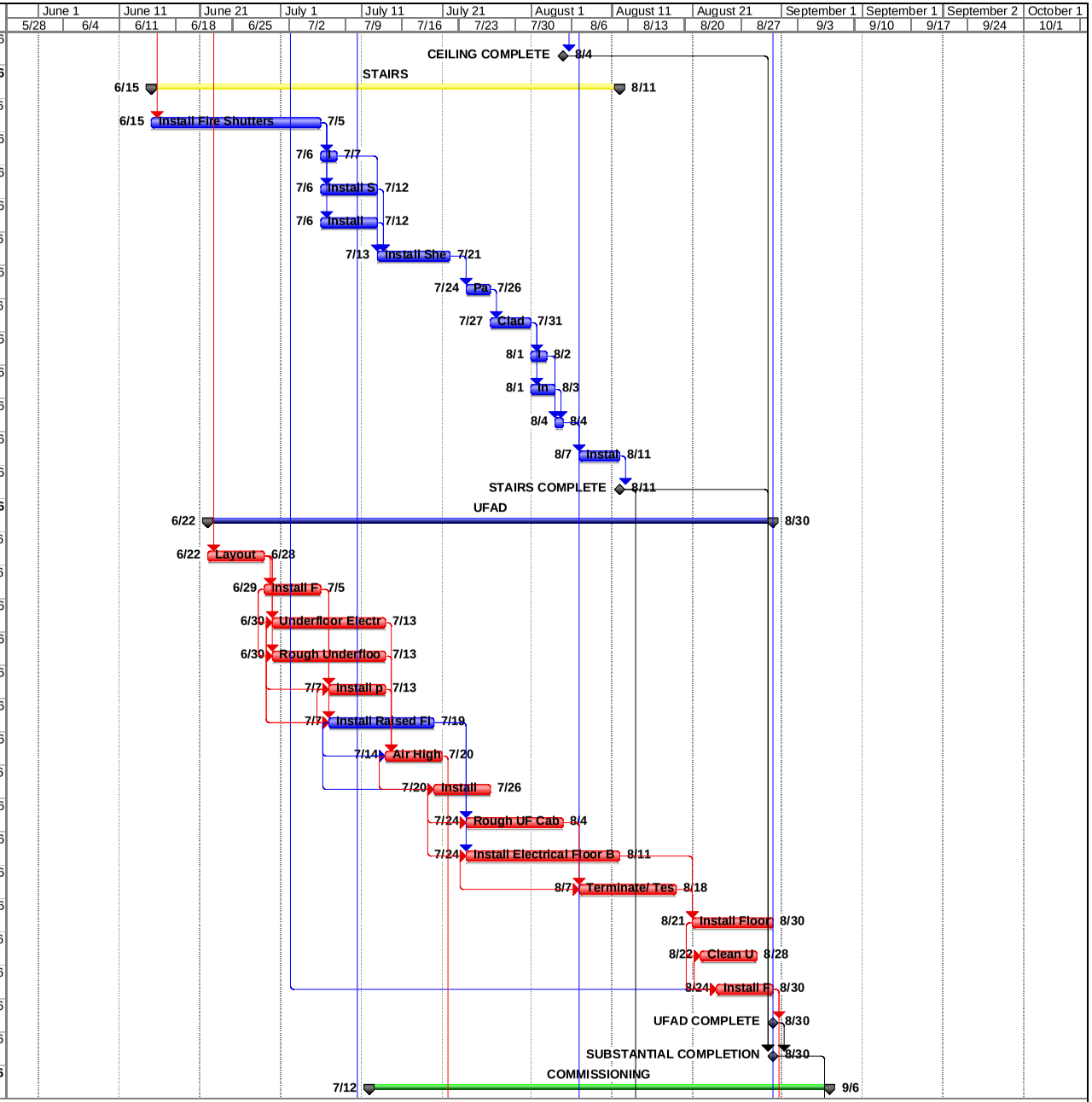
ID	Task Name	Duration	Early Start
1			
2	**PROJECT DURATION**	**77 days**	**Tue 6/13/06**
3	PROJECT START	0 days	Tue 6/13/06
4	**DATUM POINTS**	**12 days**	**Tue 6/13/06**
5	Paint Concrete Floor	2 days	Tue 6/13/06
6	Install Column Enclosures	5 days	Thu 6/15/06
7	Install Perimeter Sheetrock Fascia	10 days	Thu 6/15/06
8	**WALL**	**27 days**	**Tue 6/13/06**
9	Frame Partitions	4 days	Tue 6/13/06
10	Rough Wall Electrical	2 days	Mon 6/19/06
11	Sheetrock Partitions	4 days	Wed 6/21/06
12	Tape & Spackle Walls	6 days	Fri 6/23/06
13	Prime Paint	2 days	Mon 7/3/06
14	Install Office Fronts	5 days	Wed 7/5/06
15	Finish Paint	5 days	Wed 7/5/06
16	Install Devices	3 days	Wed 7/12/06
17	Install Doors & Hardware	3 days	Mon 7/17/06
18	PARTITION COMPLETE	0 days	Wed 7/19/06
19	**CORE**	**34 days**	**Thu 6/15/06**
20	Remove Ceilings at Core Bathroom	3 days	Thu 6/15/06
21	Rough Power Distrib at Core Bathrooms	5 days	Tue 6/20/06
22	Install & Wire Panels Elec Closet	30 days	Wed 6/21/06
23	Install Exhaust Fan Elec Closet	2 days	Tue 6/27/06
24	**CEILING**	**37 days**	**Thu 6/15/06**
25	Rough OH Sprinklers	10 days	Thu 6/15/06
26	Rough OH Electrical	12 days	Mon 6/26/06
27	Install Ceiling Grid	8 days	Fri 7/7/06
28	Install Sprinkler Heads in Grid Ceiling	7 days	Wed 7/12/06
29	Install Lighting System Grid Ceiling	10 days	Wed 7/12/06
30	Install Linear Diffusers	1 day	Mon 7/24/06
31	Install Ceiling Tile	5 days	Wed 7/26/06
32	Install Shades	5 days	Mon 7/31/06



Full Project
Existing Interior Fitout

Task	Milestone	Rolled Up Critical Task	Split	Group By Summary
Critical Task	Summary	Rolled Up Milestone	External Tasks	Deadline
Progress	Rolled Up Task	Rolled Up Progress	Project Summary	

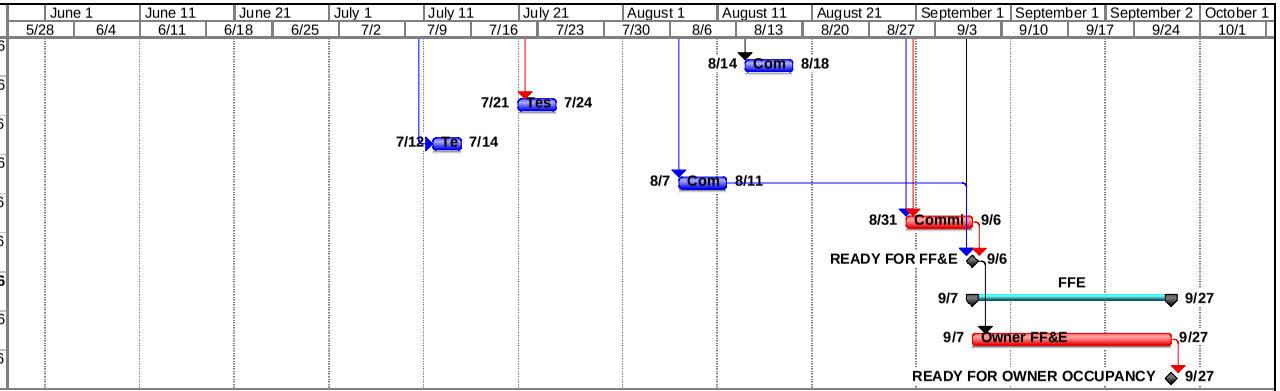
ID	Task Name	Duration	Early Start
33	CEILING COMPLETE	0 days	Fri 8/4/06
34	**STAIRS**	**42 days**	**Thu 6/15/06**
35	Install Fire Shutters	15 days	Thu 6/15/06
36	Install Smoke Exhaust Fan	2 days	Thu 7/6/06
37	Install Steel Handrail Posts	5 days	Thu 7/6/06
38	Install M. Iron Glass Wall/ Smoke Baffle	5 days	Thu 7/6/06
39	Install Sheetrock Ceiling Fascia (Stairs)	7 days	Thu 7/13/06
40	Paint Stairs	3 days	Mon 7/24/06
41	Clad Spandrel Beams	3 days	Thu 7/27/06
42	Install Fin Tubes	2 days	Tue 8/1/06
43	Install Steel infill Panels	3 days	Tue 8/1/06
44	Install Wood Handrails	1 day	Fri 8/4/06
45	Install Glass Wall & Smoke Baffles	5 days	Mon 8/7/06
46	STAIRS COMPLETE	0 days	Fri 8/11/06
47	**UFAD**	**50 days**	**Thu 6/22/06**
48	Layout Raised Floor	5 days	Thu 6/22/06
49	Install Fan Powered Boxes & Mech Piping	5 days	Thu 6/29/06
50	Underfloor Electrical	10 days	Fri 6/30/06
51	Rough Underfloor Mechanical Piping	10 days	Fri 6/30/06
52	Install perimeter Ductwork	5 days	Fri 7/7/06
53	Install Raised Floor w/ Pedestals	9 days	Fri 7/7/06
54	Air Highway Walls	5 days	Fri 7/14/06
55	Install Cable Tray	5 days	Thu 7/20/06
56	Rough UF Cable	10 days	Mon 7/24/06
57	Install Electrical Floor Boxes	15 days	Mon 7/24/06
58	Terminate/ Test Data	10 days	Mon 8/7/06
59	Install Floor Diffusers	8 days	Mon 8/21/06
60	Clean Underfloor Plenum	5 days	Tue 8/22/06
61	Install Flooring	5 days	Thu 8/24/06
62	UFAD COMPLETE	0 days	Wed 8/30/06
63	SUBSTANTIAL COMPLETION	0 days	Wed 8/30/06
64	**COMMISSIONING**	**41 days**	**Wed 7/12/06**



Full Project
Existing Interior Fitout

Task	Milestone	Rolled Up Critical Task	Split	Group By Summary
Critical Task	Summary	Rolled Up Milestone	External Tasks	Deadline
Progress	Rolled Up Task	Rolled Up Progress	Project Summary	

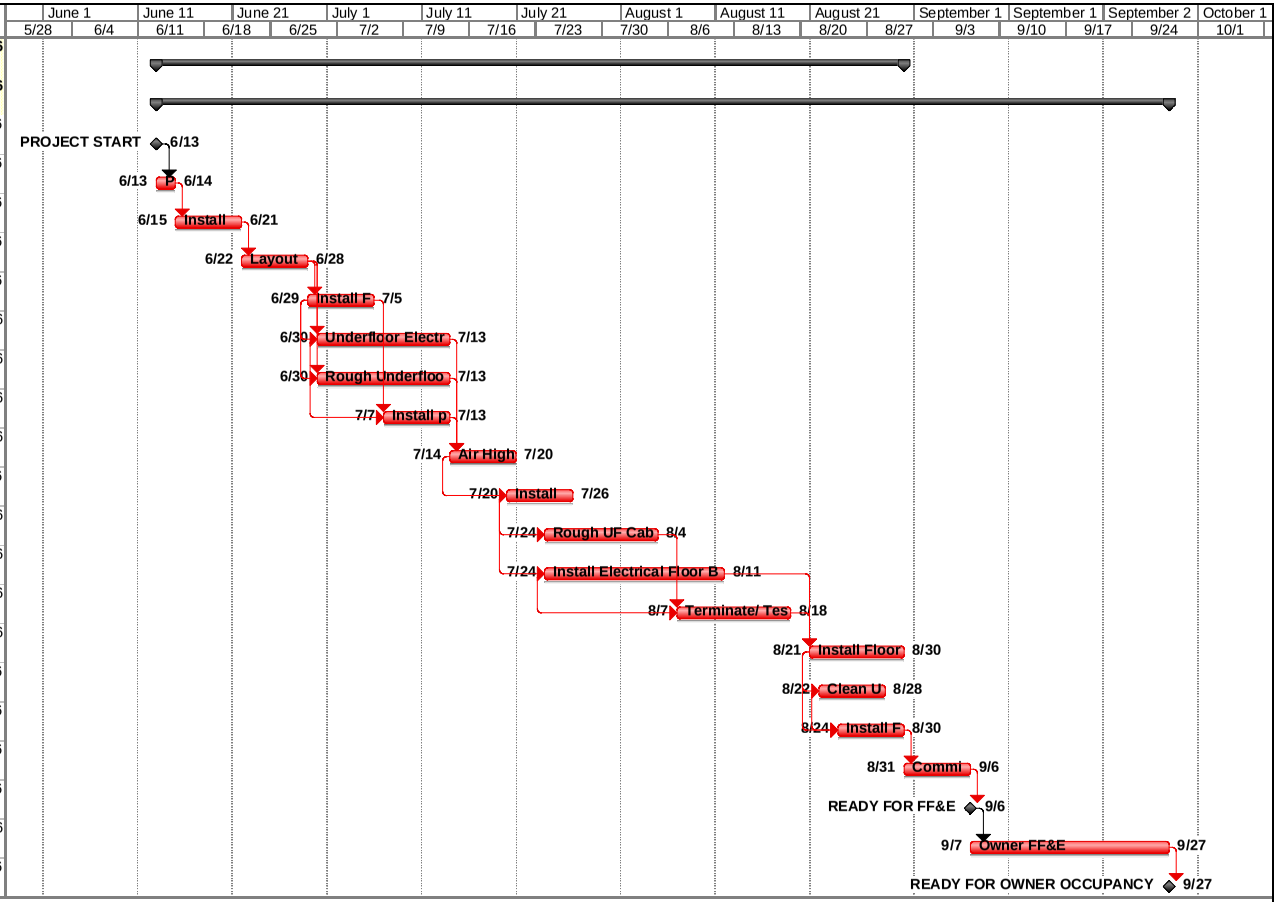
ID	Task Name	Duration	Early Start
65	Commission Fire Shutters	5 days	Mon 8/14/06
66	Test Air Highway	2 days	Fri 7/21/06
67	Test Fire Alarm	3 days	Wed 7/12/06
68	Commission Lighting/ Shades/ Sound Masking	5 days	Mon 8/7/06
69	Commission HVAC	5 days	Thu 8/31/06
70	READY FOR FF&E	0 days	Wed 9/6/06
71	**FFE**	**15 days**	**Thu 9/7/06**
72	Owner FF&E	15 days	Thu 9/7/06
73	READY FOR OWNER OCCUPANCY	0 days	Wed 9/27/06



Full Project
Existing Interior Fitout

Task	Milestone	Rolled Up Critical Task	Split	Group By Summary
Critical Task	Summary	Rolled Up Milestone	External Tasks	Deadline
Progress	Rolled Up Task	Rolled Up Progress	Project Summary	

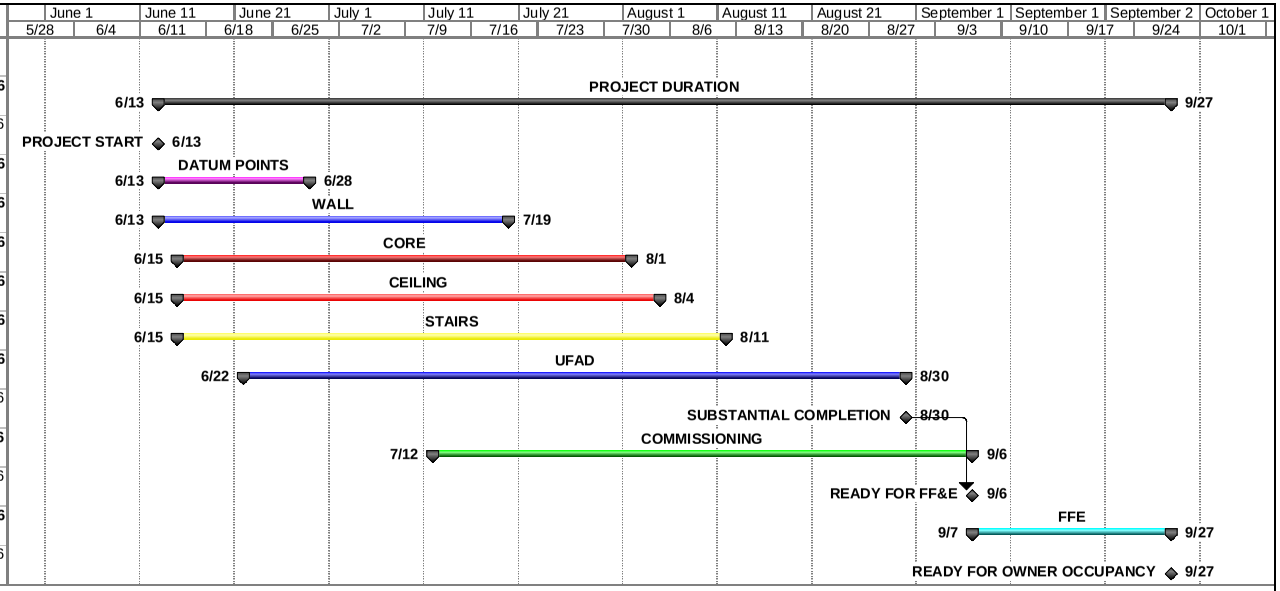
ID	Task Name	Duration	Early Start
	Critical: No	**57 days**	**Tue 6/13/06**
	Critical: Yes	**77 days**	**Tue 6/13/06**
3	PROJECT START	0 days	Tue 6/13/06
5	Paint Concrete Floor	2 days	Tue 6/13/06
6	Install Column Enclosures	5 days	Thu 6/15/06
48	Layout Raised Floor	5 days	Thu 6/22/06
49	Install Fan Powered Boxes & Mech Piping	5 days	Thu 6/29/06
50	Underfloor Electrical	10 days	Fri 6/30/06
51	Rough Underfloor Mechanical Piping	10 days	Fri 6/30/06
52	Install perimeter Ductwork	5 days	Fri 7/7/06
54	Air Highway Walls	5 days	Fri 7/14/06
55	Install Cable Tray	5 days	Thu 7/20/06
56	Rough UF Cable	10 days	Mon 7/24/06
57	Install Electrical Floor Boxes	15 days	Mon 7/24/06
58	Terminate/ Test Data	10 days	Mon 8/7/06
59	Install Floor Diffusers	8 days	Mon 8/21/06
60	Clean Underfloor Plenum	5 days	Tue 8/22/06
61	Install Flooring	5 days	Thu 8/24/06
69	Commission HVAC	5 days	Thu 8/31/06
70	READY FOR FF&E	0 days	Wed 9/6/06
72	Owner FF&E	15 days	Thu 9/7/06
73	READY FOR OWNER OCCUPANCY	0 days	Wed 9/27/06



Critical Path
Existing Interior Fitout

Task	Milestone	Rolled Up Critical Task	Split	Group By Summary
Critical Task	Summary	Rolled Up Milestone	External Tasks	Deadline
Progress	Rolled Up Task	Rolled Up Progress	Project Summary	

ID	Task Name	Duration	Early Start
1			
2	**PROJECT DURATION**	**77 days**	**Tue 6/13/06**
3	PROJECT START	0 days	Tue 6/13/06
4	**DATUM POINTS**	**12 days**	**Tue 6/13/06**
8	**WALL**	**27 days**	**Tue 6/13/06**
19	**CORE**	**34 days**	**Thu 6/15/06**
24	**CEILING**	**37 days**	**Thu 6/15/06**
34	**STAIRS**	**42 days**	**Thu 6/15/06**
47	**UFAD**	**50 days**	**Thu 6/22/06**
63	SUBSTANTIAL COMPLETION	0 days	Wed 8/30/06
64	**COMMISSIONING**	**41 days**	**Wed 7/12/06**
70	READY FOR FF&E	0 days	Wed 9/6/06
71	**FFE**	**15 days**	**Thu 9/7/06**
73	READY FOR OWNER OCCUPANCY	0 days	Wed 9/27/06

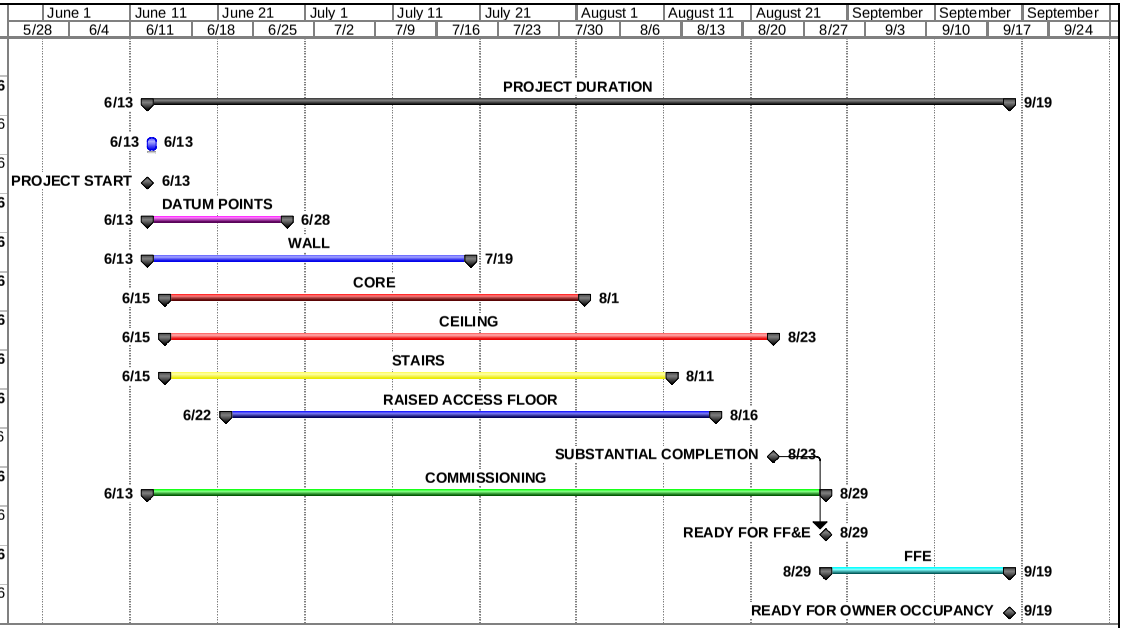


Project Overview/ Milestone
Existing Interior Fitout

Task	Milestone	Rolled Up Critical Task	Split	Group By Summary
Critical Task	Summary	Rolled Up Milestone	External Tasks	Deadline
Progress	Rolled Up Task	Rolled Up Progress	Project Summary	

APPENDIX IV.H: REDESIGNED FIT OUT SCHEDULES

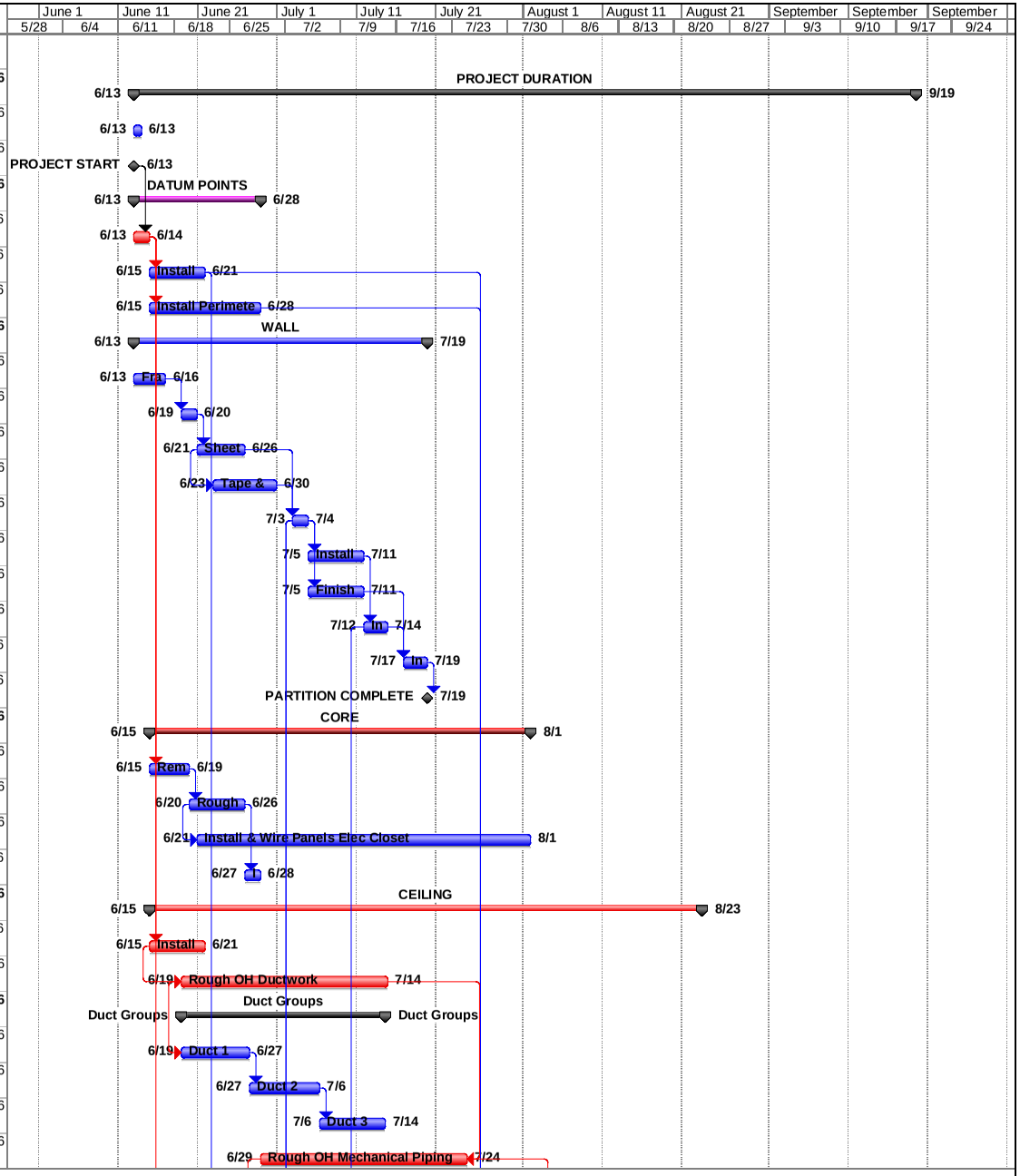
ID	Task Name	Duration	Early Start	Early Finish
1				
2	**PROJECT DURATION**	**70.67 days?**	**Tue 6/13/06**	**Tue 9/19/06**
3	Start - Substantial	1 day	Tue 6/13/06	Tue 6/13/06
4	PROJECT START	0 days	Tue 6/13/06	Tue 6/13/06
5	**DATUM POINTS**	**12 days**	**Tue 6/13/06**	**Wed 6/28/06**
9	**WALL**	**27 days**	**Tue 6/13/06**	**Wed 7/19/06**
20	**CORE**	**34 days**	**Thu 6/15/06**	**Tue 8/1/06**
25	**CEILING**	**49.67 days**	**Thu 6/15/06**	**Wed 8/23/06**
102	**STAIRS**	**42 days**	**Thu 6/15/06**	**Fri 8/11/06**
115	**RAISED ACCESS FLOOR**	**40 days**	**Thu 6/22/06**	**Wed 8/16/06**
125	SUBSTANTIAL COMPLETION	0 days	Wed 8/23/06	Wed 8/23/06
126	**COMMISSIONING**	**55.67 days**	**Tue 6/13/06**	**Tue 8/29/06**
132	READY FOR FF&E	0 days	Tue 8/29/06	Tue 8/29/06
133	**FFE**	**15 days**	**Tue 8/29/06**	**Tue 9/19/06**
135	READY FOR OWNER OCCUPANCY	0 days	Tue 9/19/06	Tue 9/19/06



Project Overview/ Milestone
Redesigned Interior Fitout

Task	Milestone	Rolled Up Critical Task	Split	Group By Summary
Critical Task	Summary	Rolled Up Milestone	External Tasks	Deadline
Progress	Rolled Up Task	Rolled Up Progress	Project Summary	

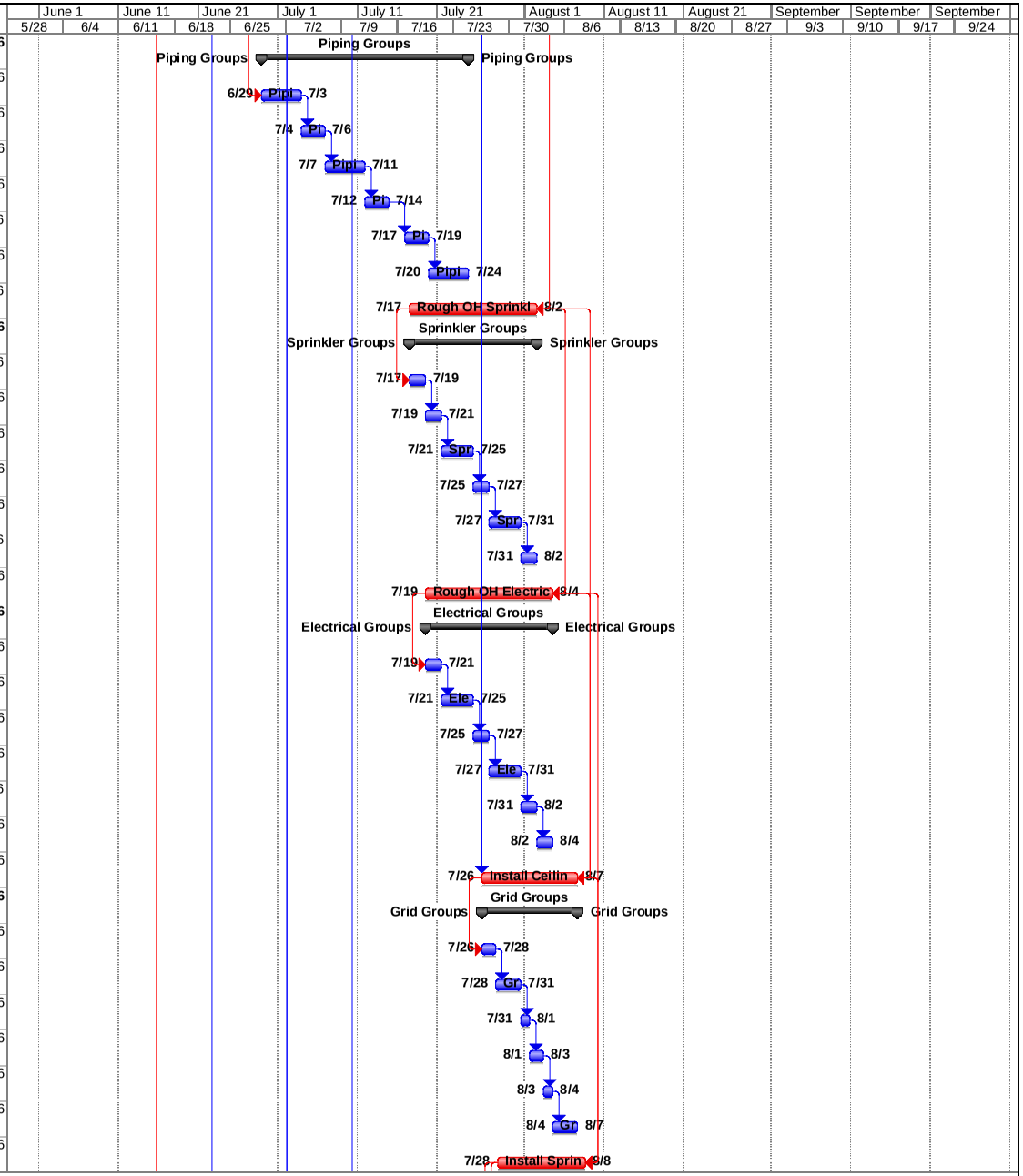
ID	Task Name	Duration	Early Start	Early Finish
1				
2	**PROJECT DURATION**	**70.67 days?**	**Tue 6/13/06**	**Tue 9/19/06**
3	Start - Substantial	1 day	Tue 6/13/06	Tue 6/13/06
4	PROJECT START	0 days	Tue 6/13/06	Tue 6/13/06
5	**DATUM POINTS**	**12 days**	**Tue 6/13/06**	**Wed 6/28/06**
6	Paint Concrete Floor	2 days	Tue 6/13/06	Wed 6/14/06
7	Install Column Enclosures	5 days	Thu 6/15/06	Wed 6/21/06
8	Install Perimeter Sheetrock Fascia	10 days	Thu 6/15/06	Wed 6/28/06
9	**WALL**	**27 days**	**Tue 6/13/06**	**Wed 7/19/06**
10	Frame Partitions	4 days	Tue 6/13/06	Fri 6/16/06
11	Rough Wall Electrical	2 days	Mon 6/19/06	Tue 6/20/06
12	Sheetrock Partitions	4 days	Wed 6/21/06	Mon 6/26/06
13	Tape & Spackle Walls	6 days	Fri 6/23/06	Fri 6/30/06
14	Prime Paint	2 days	Mon 7/3/06	Tue 7/4/06
15	Install Office Fronts	5 days	Wed 7/5/06	Tue 7/11/06
16	Finish Paint	5 days	Wed 7/5/06	Tue 7/11/06
17	Install Devices	3 days	Wed 7/12/06	Fri 7/14/06
18	Install Doors & Hardware	3 days	Mon 7/17/06	Wed 7/19/06
19	PARTITION COMPLETE	0 days	Wed 7/19/06	Wed 7/19/06
20	**CORE**	**34 days**	**Thu 6/15/06**	**Tue 8/1/06**
21	Remove Ceilings at Core Bathroom	3 days	Thu 6/15/06	Mon 6/19/06
22	Rough Power Distrib at Core Bathrooms	5 days	Tue 6/20/06	Mon 6/26/06
23	Install & Wire Panels Elec Closet	30 days	Wed 6/21/06	Tue 8/1/06
24	Install Exhaust Fan Elec Closet	2 days	Tue 6/27/06	Wed 6/28/06
25	**CEILING**	**49.67 days**	**Thu 6/15/06**	**Wed 8/23/06**
26	Install OH HVAC Equipment	5 days	Thu 6/15/06	Wed 6/21/06
27	Rough OH Ductwork	20 days	Mon 6/19/06	Fri 7/14/06
28	**Duct Groups**	**19.98 days**	**Mon 6/19/06**	**Fri 7/14/06**
29	Duct 1	6.66 days	Mon 6/19/06	Tue 6/27/06
30	Duct 2	6.66 days	Tue 6/27/06	Thu 7/6/06
31	Duct 3	6.66 days	Thu 7/6/06	Fri 7/14/06
32	Rough OH Mechanical Piping	18 days	Thu 6/29/06	Mon 7/24/06



Full Project
Redesigned Interior Fitout

Task | Milestone | Rolled Up Critical Task | Split | Group By Summary
Critical Task | Summary | Rolled Up Milestone | External Tasks | Deadline
Progress | Rolled Up Task | Rolled Up Progress | Project Summary

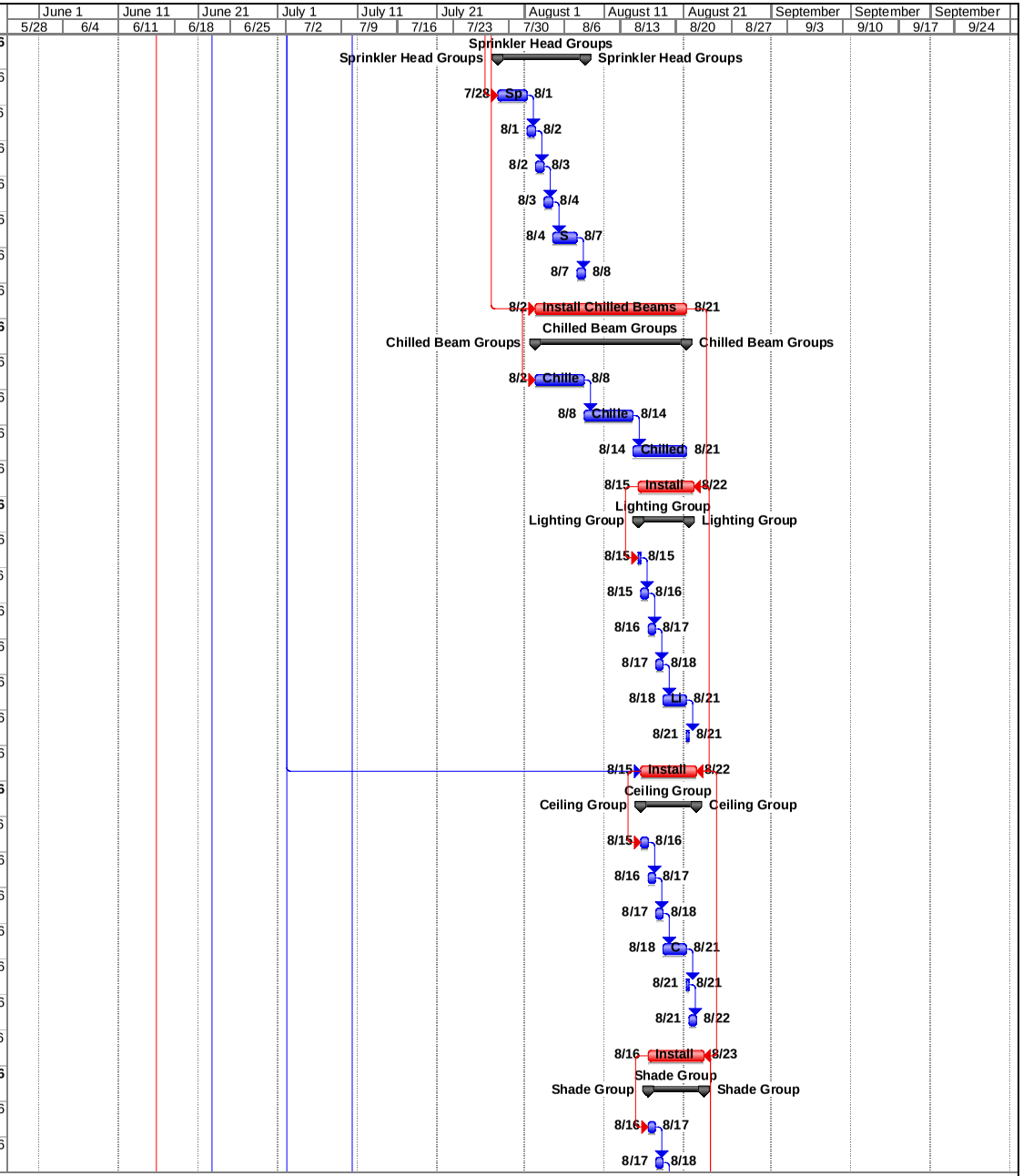
ID	Task Name	Duration	Early Start	Early Finish
33	**Piping Groups**	**18 days**	**Thu 6/29/06**	**Mon 7/24/06**
34	Piping 1	3 days	Thu 6/29/06	Mon 7/3/06
35	Piping 2	3 days	Tue 7/4/06	Thu 7/6/06
36	Piping 3	3 days	Fri 7/7/06	Tue 7/11/06
37	Piping 4	3 days	Wed 7/12/06	Fri 7/14/06
38	Piping 5	3 days	Mon 7/17/06	Wed 7/19/06
39	Piping 6	3 days	Thu 7/20/06	Mon 7/24/06
40	Rough OH Sprinklers	12 days	Mon 7/17/06	Wed 8/2/06
41	**Sprinkler Groups**	**12 days**	**Mon 7/17/06**	**Wed 8/2/06**
42	Sprinkler 1	2 days	Mon 7/17/06	Wed 7/19/06
43	Sprinkler 2	2 days	Wed 7/19/06	Fri 7/21/06
44	Sprinkler 3	2 days	Fri 7/21/06	Tue 7/25/06
45	Sprinkler 4	2 days	Tue 7/25/06	Thu 7/27/06
46	Sprinkler 5	2 days	Thu 7/27/06	Mon 7/31/06
47	Sprinkler 6	2 days	Mon 7/31/06	Wed 8/2/06
48	Rough OH Electrical	12 days	Wed 7/19/06	Fri 8/4/06
49	**Electrical Groups**	**12 days**	**Wed 7/19/06**	**Fri 8/4/06**
50	Electrical 1	2 days	Wed 7/19/06	Fri 7/21/06
51	Electrical 2	2 days	Fri 7/21/06	Tue 7/25/06
52	Electrical 3	2 days	Tue 7/25/06	Thu 7/27/06
53	Electrical 4	2 days	Thu 7/27/06	Mon 7/31/06
54	Electrical 5	2 days	Mon 7/31/06	Wed 8/2/06
55	Electrical 6	2 days	Wed 8/2/06	Fri 8/4/06
56	Install Ceiling Grid	8 days	Wed 7/26/06	Mon 8/7/06
57	**Grid Groups**	**7.98 days**	**Wed 7/26/06**	**Mon 8/7/06**
58	Grid 1	1.33 days	Wed 7/26/06	Fri 7/28/06
59	Grid 2	1.33 days	Fri 7/28/06	Mon 7/31/06
60	Grid 3	1.33 days	Mon 7/31/06	Tue 8/1/06
61	Grid 4	1.33 days	Tue 8/1/06	Thu 8/3/06
62	Grid 5	1.33 days	Thu 8/3/06	Fri 8/4/06
63	Grid 6	1.33 days	Fri 8/4/06	Mon 8/7/06
64	Install Sprinkler Heads in Grid Ceiling	7 days	Fri 7/28/06	Tue 8/8/06



Full Project
Redesigned Interior Fitout

Task | Milestone | Rolled Up Critical Task | Split | Group By Summary
Critical Task | Summary | Rolled Up Milestone | External Tasks | Deadline
Progress | Rolled Up Task | Rolled Up Progress | Project Summary

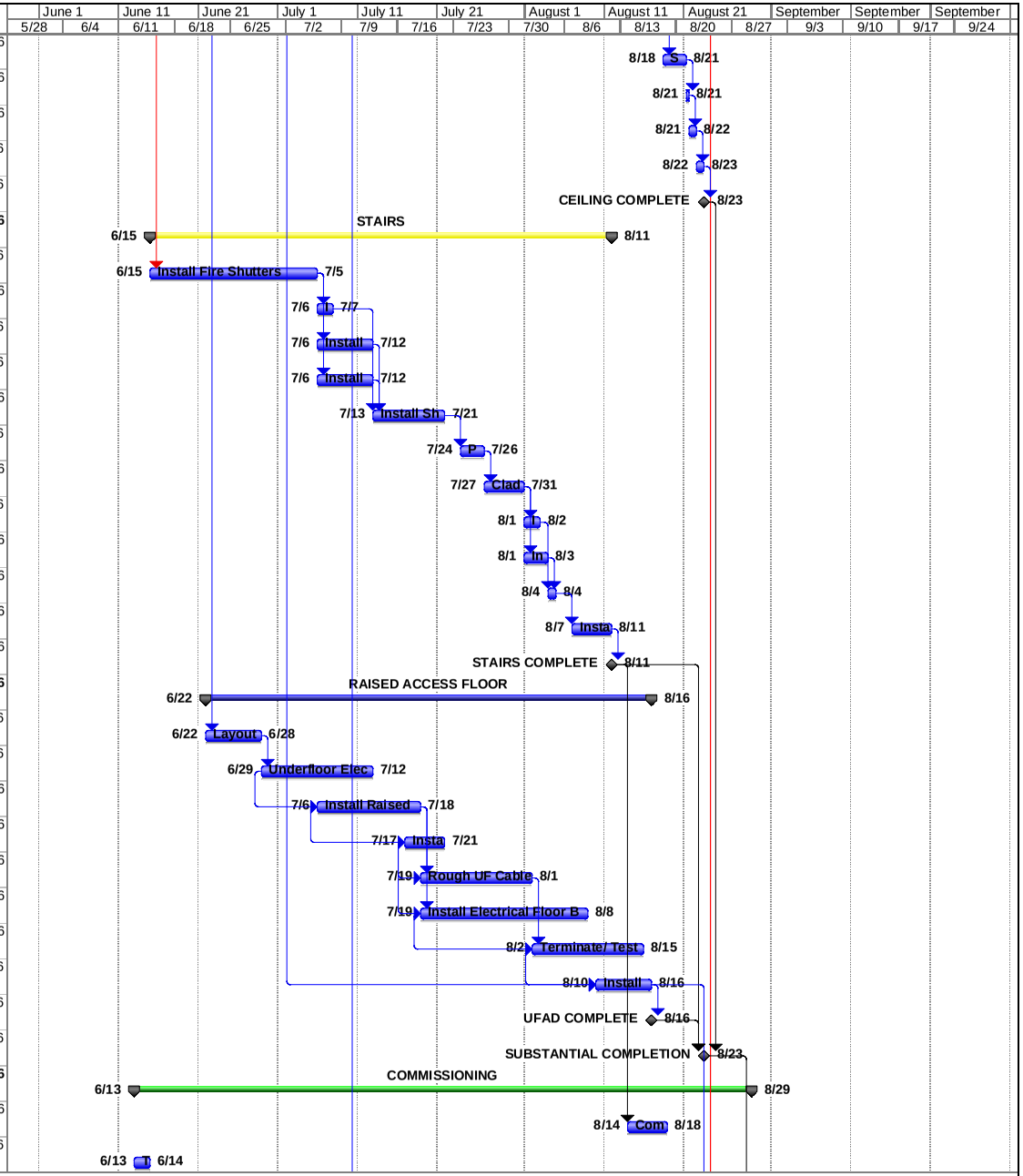
ID	Task Name	Duration	Early Start	Early Finish
65	**Sprinkler Head Groups**	**7.02 days**	**Fri 7/28/06**	**Tue 8/8/06**
66	Sprinkler Head 1	1.17 days	Fri 7/28/06	Tue 8/1/06
67	Sprinkler Head 2	1.17 days	Tue 8/1/06	Wed 8/2/06
68	Sprinkler Head 3	1.17 days	Wed 8/2/06	Thu 8/3/06
69	Sprinkler Head 4	1.17 days	Thu 8/3/06	Fri 8/4/06
70	Sprinkler Head 5	1.17 days	Fri 8/4/06	Mon 8/7/06
71	Sprinkler Head 6	1.17 days	Mon 8/7/06	Tue 8/8/06
72	Install Chilled Beams	13 days	Wed 8/2/06	Mon 8/21/06
73	**Chilled Beam Groups**	**13.02 days**	**Wed 8/2/06**	**Mon 8/21/06**
74	Chilled Beam 1	4.34 days	Wed 8/2/06	Tue 8/8/06
75	Chilled Beam 2	4.34 days	Tue 8/8/06	Mon 8/14/06
76	Chilled Beam 3	4.34 days	Mon 8/14/06	Mon 8/21/06
77	Install Lighting System Grid Ceiling	5 days	Tue 8/15/06	Tue 8/22/06
78	**Lighting Group**	**4.98 days**	**Tue 8/15/06**	**Mon 8/21/06**
79	Lighting 1	0.83 days	Tue 8/15/06	Tue 8/15/06
80	Lighting 2	0.83 days	Tue 8/15/06	Wed 8/16/06
81	Lighting 3	0.83 days	Wed 8/16/06	Thu 8/17/06
82	Lighting 4	0.83 days	Thu 8/17/06	Fri 8/18/06
83	Lighting 5	0.83 days	Fri 8/18/06	Mon 8/21/06
84	Lighting 6	0.83 days	Mon 8/21/06	Mon 8/21/06
85	Install Ceiling Tile	5 days	Tue 8/15/06	Tue 8/22/06
86	**Ceiling Group**	**4.98 days**	**Tue 8/15/06**	**Tue 8/22/06**
87	CT 1	0.83 days	Tue 8/15/06	Wed 8/16/06
88	CT 2	0.83 days	Wed 8/16/06	Thu 8/17/06
89	CT 3	0.83 days	Thu 8/17/06	Fri 8/18/06
90	CT 4	0.83 days	Fri 8/18/06	Mon 8/21/06
91	CT 5	0.83 days	Mon 8/21/06	Mon 8/21/06
92	CT 6	0.83 days	Mon 8/21/06	Tue 8/22/06
93	Install Shades	5 days	Wed 8/16/06	Wed 8/23/06
94	**Shade Group**	**4.98 days**	**Wed 8/16/06**	**Wed 8/23/06**
95	Shade 1	0.83 days	Wed 8/16/06	Thu 8/17/06
96	Shade 2	0.83 days	Thu 8/17/06	Fri 8/18/06



Full Project
Redesigned Interior Fitout

Task | Milestone | Rolled Up Critical Task | Split | Group By Summary
Critical Task | Summary | Rolled Up Milestone | External Tasks | Deadline
Progress | Rolled Up Task | Rolled Up Progress | Project Summary

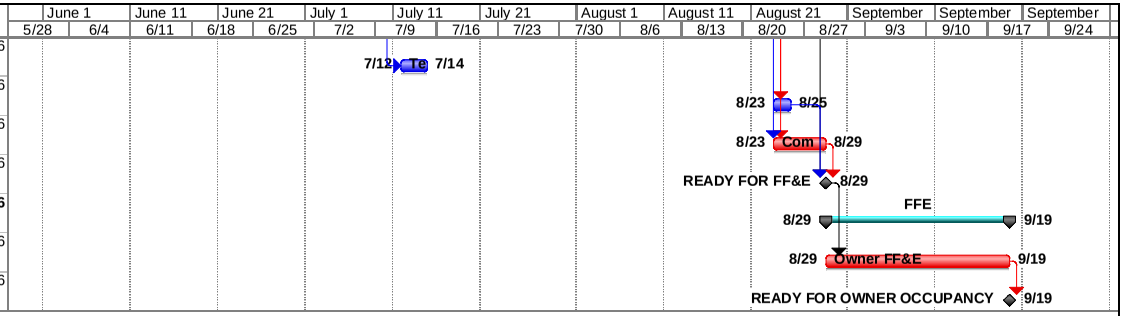
ID	Task Name	Duration	Early Start	Early Finish
97	Shade 3	0.83 days	Fri 8/18/06	Mon 8/21/06
98	Shade 4	0.83 days	Mon 8/21/06	Mon 8/21/06
99	Shade 5	0.83 days	Mon 8/21/06	Tue 8/22/06
100	Shade 6	0.83 days	Tue 8/22/06	Wed 8/23/06
101	CEILING COMPLETE	0 days	Wed 8/23/06	Wed 8/23/06
102	**STAIRS**	**42 days**	**Thu 6/15/06**	**Fri 8/11/06**
103	Install Fire Shutters	15 days	Thu 6/15/06	Wed 7/5/06
104	Install Smoke Exhaust Fan	2 days	Thu 7/6/06	Fri 7/7/06
105	Install Steel Handrail Posts	5 days	Thu 7/6/06	Wed 7/12/06
106	Install M. Iron Glass Wall/ Smoke Baffle	5 days	Thu 7/6/06	Wed 7/12/06
107	Install Sheetrock Ceiling Fascia (Stairs)	7 days	Thu 7/13/06	Fri 7/21/06
108	Paint Stairs	3 days	Mon 7/24/06	Wed 7/26/06
109	Clad Spandrel Beams	3 days	Thu 7/27/06	Mon 7/31/06
110	Install Fin Tubes	2 days	Tue 8/1/06	Wed 8/2/06
111	Install Steel infill Panels	3 days	Tue 8/1/06	Thu 8/3/06
112	Install Wood Handrails	1 day	Fri 8/4/06	Fri 8/4/06
113	Install Glass Wall & Smoke Baffles	5 days	Mon 8/7/06	Fri 8/11/06
114	STAIRS COMPLETE	0 days	Fri 8/11/06	Fri 8/11/06
115	**RAISED ACCESS FLOOR**	**40 days**	**Thu 6/22/06**	**Wed 8/16/06**
116	Layout Raised Floor	5 days	Thu 6/22/06	Wed 6/28/06
117	Underfloor Electrical	10 days	Thu 6/29/06	Wed 7/12/06
118	Install Raised Floor w/ Pedestals	9 days	Thu 7/6/06	Tue 7/18/06
119	Install Cable Tray	5 days	Mon 7/17/06	Fri 7/21/06
120	Rough UF Cable	10 days	Wed 7/19/06	Tue 8/1/06
121	Install Electrical Floor Boxes	15 days	Wed 7/19/06	Tue 8/8/06
122	Terminate/ Test Data	10 days	Wed 8/2/06	Tue 8/15/06
123	Install Flooring	5 days	Thu 8/10/06	Wed 8/16/06
124	UFAD COMPLETE	0 days	Wed 8/16/06	Wed 8/16/06
125	SUBSTANTIAL COMPLETION	0 days	Wed 8/23/06	Wed 8/23/06
126	**COMMISSIONING**	**55.67 days**	**Tue 6/13/06**	**Tue 8/29/06**
127	Commission Fire Shutters	5 days	Mon 8/14/06	Fri 8/18/06
128	Test Air Highway	2 days	Tue 6/13/06	Wed 6/14/06



Full Project
Redesigned Interior Fitout

Task | Milestone | Rolled Up Critical Task | Split | Group By Summary
Critical Task | Summary | Rolled Up Milestone | External Tasks | Deadline
Progress | Rolled Up Task | Rolled Up Progress | Project Summary

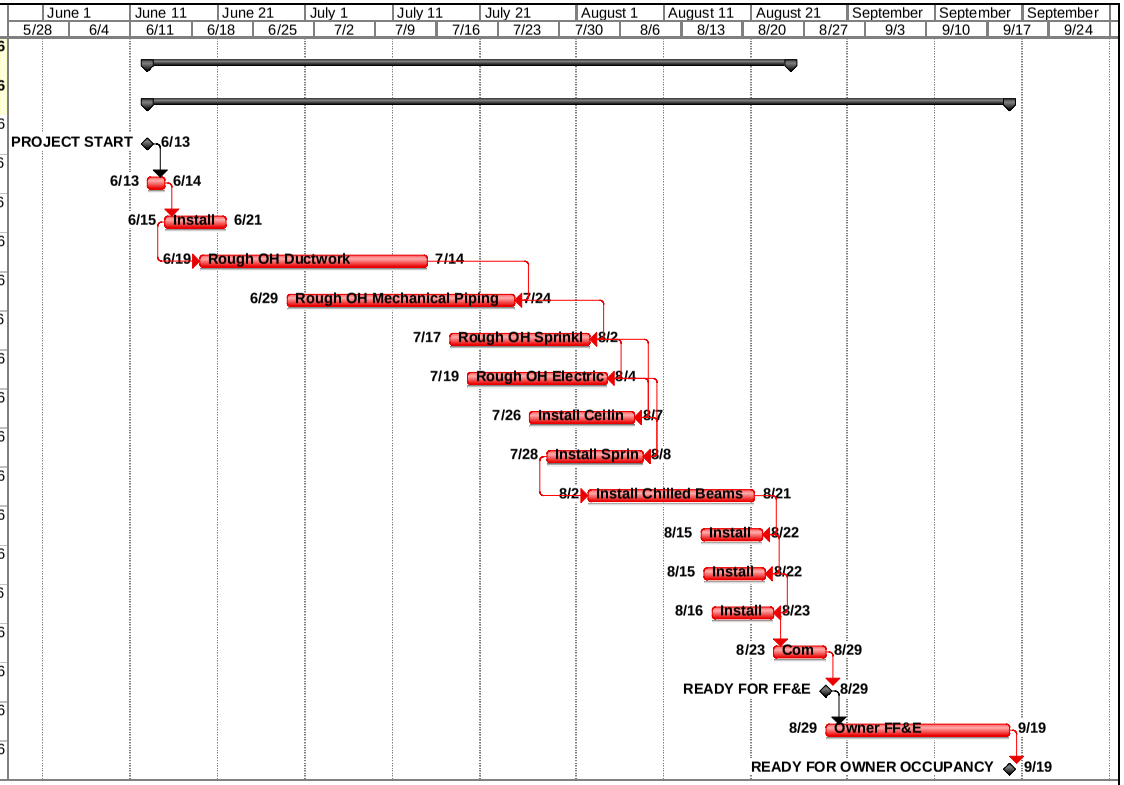
ID	Task Name	Duration	Early Start	Early Finish
129	Test Fire Alarm	3 days	Wed 7/12/06	Fri 7/14/06
130	Commission Lighting/ Shades/ Sound Masking	2 days	Wed 8/23/06	Fri 8/25/06
131	Commission HVAC	4 days	Wed 8/23/06	Tue 8/29/06
132	READY FOR FF&E	0 days	Tue 8/29/06	Tue 8/29/06
133	**FFE**	**15 days**	**Tue 8/29/06**	**Tue 9/19/06**
134	Owner FF&E	15 days	Tue 8/29/06	Tue 9/19/06
135	READY FOR OWNER OCCUPANCY	0 days	Tue 9/19/06	Tue 9/19/06



Full Project
Redesigned Interior Fitout

Task
Critical Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Critical Task
Rolled Up Milestone
Rolled Up Progress
Split
External Tasks
Project Summary
Group By Summary
Deadline

ID	Task Name	Duration	Early Start	Early Finish
	Critical: No	**53.67 days**	**Tue 6/13/06**	**Fri 8/25/06**
	Critical: Yes	**70.67 days**	**Tue 6/13/06**	**Tue 9/19/06**
4	PROJECT START	0 days	Tue 6/13/06	Tue 6/13/06
6	Paint Concrete Floor	2 days	Tue 6/13/06	Wed 6/14/06
26	Install OH HVAC Equipment	5 days	Thu 6/15/06	Wed 6/21/06
27	Rough OH Ductwork	20 days	Mon 6/19/06	Fri 7/14/06
32	Rough OH Mechanical Piping	18 days	Thu 6/29/06	Mon 7/24/06
40	Rough OH Sprinklers	12 days	Mon 7/17/06	Wed 8/2/06
48	Rough OH Electrical	12 days	Wed 7/19/06	Fri 8/4/06
56	Install Ceiling Grid	8 days	Wed 7/26/06	Mon 8/7/06
64	Install Sprinkler Heads in Grid Ceiling	7 days	Fri 7/28/06	Tue 8/8/06
72	Install Chilled Beams	13 days	Wed 8/2/06	Mon 8/21/06
77	Install Lighting System Grid Ceiling	5 days	Tue 8/15/06	Tue 8/22/06
85	Install Ceiling Tile	5 days	Tue 8/15/06	Tue 8/22/06
93	Install Shades	5 days	Wed 8/16/06	Wed 8/23/06
131	Commission HVAC	4 days	Wed 8/23/06	Tue 8/29/06
132	READY FOR FF&E	0 days	Tue 8/29/06	Tue 8/29/06
134	Owner FF&E	15 days	Tue 8/29/06	Tue 9/19/06
135	READY FOR OWNER OCCUPANCY	0 days	Tue 9/19/06	Tue 9/19/06



Critical Path
Redesigned Interior Fitout

Task	Milestone	Rolled Up Critical Task	Split	Group By Summary
Critical Task	Summary	Rolled Up Milestone	External Tasks	Deadline
Progress	Rolled Up Task	Rolled Up Progress	Project Summary	

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