Final Report | AE Senior Thesis

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Franklin Square Hospital Center

Patient Tower and Emergency Department Addition

Baltimore, MD

Size	356,000 square feet
Occupant	MedStar Health Facilities
Overall Cost	$175 million
Number of Stories	7 stories

Building Owner	Franklin Square Hospital Center
Project Manager	Lillibridge Healthcare Services, Inc.
Architect	Wilmot/ Sanz Inc
MEP Engineer	Leach Wallace Associates
Structural Engineer	Rathgeber/Goss Associates
Civil Engineer	Dewberry & Davis

Architectural

Medical institutions are shaped for function rather then aesthetics. The rigid geometric shape of the hospital allows for a new adult emergency, pediatric emergency and fast track departments on the first level with a nurse's station located in the center of each. The patient tower allows for 291 private patient rooms each with a window, private bath and ample space for visitors and belongings. The main visitor's lobby enters into an inviting three-story open atrium space.

Structural

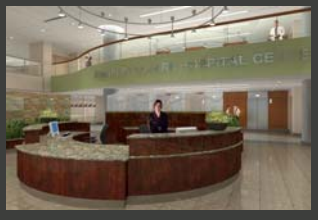
The building foundation sits on cassions with a shaft diameter ranging from 1'-6" to 5'-0". Typical concrete column sizes are 22x22 and 21x21 with vertical bars 8#9 and 8#11 respectively. W-shape steel column sizes vary and sit on concrete pier footings. Composite and concrete beams are used throughout the addition.

Lighting + Electrical

Normal power to the hospital is supplied by two 13.2 KV underground feeders that terminate in a 15 KV class switchgear rated at 1200 amperes. Emergency power to the hospital is supplied by two 480Y/277 volt, diesel engine generator sets. T8 luminaires with electronic ballasts will be utilized wherever possible due to their energy efficiency.

Mechanical

Six new air handling units shall be installed in the penthouse of the patient tower along with the new heating hot water plant. The building will be served by variable air volume terminal units with hot water reheat and the return system will be a variable volume system with return air terminal units.



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Executive Summary

The New Patient Care Tower Addition to Franklin Square Hospital Center is a big step for healthcare in Baltimore, Maryland. The overall purpose for the new addition is to improve patient's needs and comfort and provide the best healthcare possible.

This final report encompasses work focused on the lighting and electrical design of Franklin Square Hospital Center. An acoustical breadth and mechanical breadth are also provided.

The lighting depth focuses on the redesign of four distinct spaces: the main entrance and parking lot area, gift shop, emergency department lobby and waiting area, and team station. The hospital's main goals evolve around patient care therefore the lighting design of these spaces will reflect this main goal.

An electrical redesign of the panel boards that serve the normal and emergency power to the four spaces will be evaluated and recalculated for the new lighting designs. Electrical depth topics including a cost comparison of copper vs. aluminum feeders and a comparison of energy loss vs. increased feeder size will be evaluated. A short circuit analysis of a single path through a distribution system will be performed along with a coordination study.

The following report explains the process, detailed results, and conclusions of the research performed on the building. The proposed redesigns will allow Franklin Square Hospital Center to continue and improve the care of their most important customers.

Building Overview

Franklin Square Hospital Center is medical institution that provides healthcare to the people of the Baltimore area as well as visiting patients. A new 356,000 square feet addition includes a six floor patient tower atop of new emergency and pediatric emergency departments.

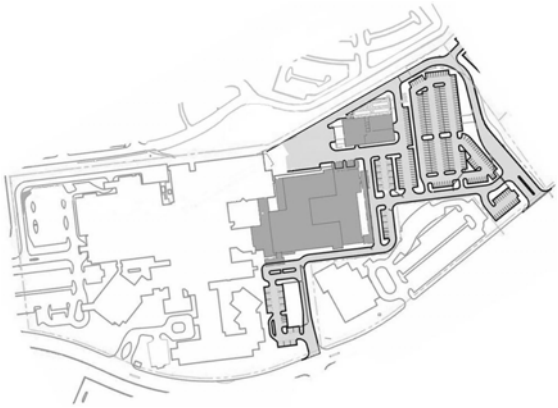
The New Patient Care Tower will provide 291 private rooms with improved environments. Each room will have a window to provide sunlight for added comfort. Private bathrooms and seating areas are also designed for each room.

The emergency department expansion will greatly speed the triage process upon the patient's arrival. The triage will have more privacy by implementing walls where curtains previously were. Easy access to diagnostic services and an expanded laboratory will greatly decrease the patient's waiting time.

Franklin Square was the first hospital in the Baltimore County area to open the doors to a pediatric emergency department in 2004. This new addition will further improve the care of children. Additional triage and inpatient rooms will be more spacious to accommodate visiting family members.

A large 3-story atrium space provides a welcoming notion to visitors. Features such as a bamboo garden, fireplaces and a gentle waterfall imply the cozy environment. The new modern style within will reflect the high-quality care delivered by the medical professionals.

Figure 1 | Patient Tower and Emergency Department Addition



Building Statistics

Building Name | Franklin Square Hospital Center Patient Tower and Emergency Department Addition

Location | 9000 Franklin Square Drive, Baltimore, MD 21237

Building Occupant Name | MedStar Health Facilities

Size | 356,000 sq. ft.

Number of Stories | 7 stories

Primary Project Team

Owner | Franklin Square Hospital Center - http://www.franklinsquare.org/

Project Manager | Lillibridge Healthcare Services, Inc. - http://www.lillibridge.com/

Architect | Wilmot/ Sanz Inc. - http://www.wilmot.com/

MEP Engineer | Leach Wallace Associates - http://www.leachwallace.com/home.cfm

Structural Engineer | Rathgeber/Goss Associates - http://www.rath-goss.com/

Civil Engineer | Dewberry & Davis - http://www.dewberry.com/

Dates of Construction | Fall 2007 - Summer 2010

Overall Project Cost | $175 million

Project Delivery Method | Design - Bid – Build

Architecture

Medical institutions are shaped for function rather than aesthetics. The rigid geometric shape of the hospital allows for a new adult emergency, pediatric emergency and fast track departments on the first level with a nurse's station in the center of each. The new patient tower allows for 291 private patient rooms each with a window, private bath and ample space for visitors. The entrance lobby is an inviting three-story open atrium space.

Building Code Analysis

Building Code | IBC 2006 Edition with Baltimore County Amendments

Fire Protection Code | NFPA 101, Life Safety Code 2006, International Fire Code 2006 Edition with Baltimore County Amendments

Health Department Code | AIA Guidelines for Hospital and Health Care Facilities, 2006

Handicapped Requirements | ADAAG, American with Disabilities Act – Public Law 101-336

Electrical Code | NEC 2005

Mechanical Code | International Mechanical Code 2006

Plumbing Code | National Standard Plumbing Code 2003 with 2004 Supplement

Energy Code | International Energy Code 2006

Zoning | Baltimore County Zoning Regulations

Historical Requirements | None

Building Enclosure

The exterior façade of the addition will resemble the façade of the existing hospital. Portland cement stucco, red face brick and precast concrete cladding units are assembled to create the matching façade. A curtain wall system composed of aluminum framing and argon filled PPG Solarban 80 insulating spandrel tempered glass is used throughout the first level and entryways. Roof construction will consist of two types of roofing. EP single-ply membrane roofing that includes a non-traffic-bearing sheet membrane system intended for weather exposure as primary roofing used on the new patient tower and entry canopies. The remaining rooftop area is covered by a modified bitumen roofing system. This system consists of two plies of type IV fiberglass felts installed in type III asphalt and coated in one ply of mineral surfaced, Class A fire rated, SBS/SIS modified cap sheet that solidly bonds to the underlying plies when heat is applied by torch, to insure a solid bond.

Sustainability Features

Not LEED Certified but there is post-design consideration for certification. Patient care was a higher concern when designing this medical center therefore the importance of facility sustainability has been sacrificed at times.

Construction

The Franklin Square Hospital Center addition consists of the construction of a new seven story tower with walk-out emergency department ground floor, six floors of new patient rooms including one floor of ICU rooms, a penthouse floor, a roof designed for a future heliport, a new three story entry lobby with a new gift shop, a new meditation room, and a new admitting suite. There will be renovations to the materials management building and existing ICU to construct new corridor tie-ins. The central energy plant will receive new boilers, chillers, generators, electrical switchgear and cooling towers. Site work includes the construction of the entrance plaza and installation of additional utilities.

Electrical System

Normal power to the hospital is supplied by the Baltimore Electric Utility Company. Two 13.2KV underground feeders enter the building at the northwest corner and terminate in a 15KV class switchgear rated at 1200A. Wiring size is #12AWG minimum for a typical 20A, 120V or 277V lighting or receptacle branch circuit with a maximum total length of 60 feet and 150 feet respectively.

The uninterrupted power system is 3Φ on-line solid state system rated at 180KVA/162KW. The input current is 260A with a power factor up to 0.98 lagging. The output voltage is 208Y/120VAC 3Φ 5W.

Emergency power of 480Y/277V 3Φ 4W, to the hospital is supplied by three 480Y/277V, diesel engine generator sets of 2000KW capacity. The generator sets are mounted on a heavy duty steel base to maintain proper alignment between components and provide power within 10 seconds. The emergency power bus is rated at 10,000A at 480Y/277V

Lighting System

Track lighting, linear/perimeter lighting, cold cathode lighting and custom fixtures are found through the entire building. All incandescent lamps will have a long life of 2500 hours and a voltage of 130V if available. Fluorescent T8 lamps contain a low amount of mercury, have a minimum life of 15,000 hours and have a CCT of 4100K. All fluorescent ballasts are electronic, "Class P" type, have a sound rating of "A" and have a high power factor of 0.95 or greater. Compact fluorescent twin-tube lamps are rated at an average life of 10,000. High intensity discharge lamps have a minimum of 20,000 hours of lamp life. Ultrasonic and infrared occupancy sensors are supplied in rooms including the lobby along with many others.

Mechanical System

Six new air handling units shall be installed in the penthouse of the patient tower along with the new heating hot water plant. The building will be served by variable air volume terminal units with hot water reheat and the return system will be a variable volume system with return air terminal units.

Structural System

The building foundation sits on caissons with a shaft diameter ranging from 1'-6" to 5'-0". Typical concrete column sizes are 22x22 and 21x21 with vertical bars 8#9 and 8#11 respectively. W-shape steel column size varies and sits on concrete pier footings. Composite and concrete beams are used throughout the addition.

Fire Protection

The building is protected with an automatic sprinkler system along with an approved automatic fire alarm system throughout the new facility. Portable fire extinguishers, manual pull stations, magnetic door closers along with an annunciation system, using horns and strobes, are located throughout the building. Selected doors on staircases are equipped with hardware to prevent re-entry

Sprayed fireproofing is applied to all new structural steel and metal decking where indicated for UL assembly. In renovated areas, the fireproofing is patched where it has been removed. Fire partitions range as well as fire and smoke barriers are rated at one or two hours.

Transportation

The building is serviced by four elevators of which two are for public use and two are strictly used as service elevators. All of the elevators are geared traction type and have a rated speed of 350 fpm. The public elevators provide access to all seven the patient tower floors and have a rated load of 3000 lbs. Service elevator #1 has a rated load of 7500 lbs and #2 has a rated load of 5000 lbs.

Two staircases connect the ground level through the seventh floor of the patient tower. These are located at the northeast and southeast ends of the tower. A centralized staircase located next to the main lobby connects the ground level to the roof. One other stair connects the exterior first floor level, next to the meditation garden, to the second floor.

Telecommunications

VOIP, data and video communications originate at local area network switch equipment that is placed on vertical freestanding equipment racks. The CATV system requires RG-6 co-axial cables in each of the patient rooms, waiting areas and other locations throughout the facility. Category 6 cables are used for the hospital standard voice/data system.

Lighting Depth

Main Entrance + Parking Lot | Exterior Space

Spatial Summary

The glass canopy stretches alongside the main entrance of Franklin Square Hospital Center. Adjacent to the canopy is a grand three story atrium space. The canopy is also located next to a car drop off area.

In the center of the parking area are walkways leading to a centralized plaza seating area under a wooden terrace. Along the walkways are wooden park benches and a curving natural rock bench. The plaza area is a pleasant place where families and workers can gather and escape from the hospital for some fresh air.

Drawings

Figure 2 | Main Entrance and Parking Lot Site Plan

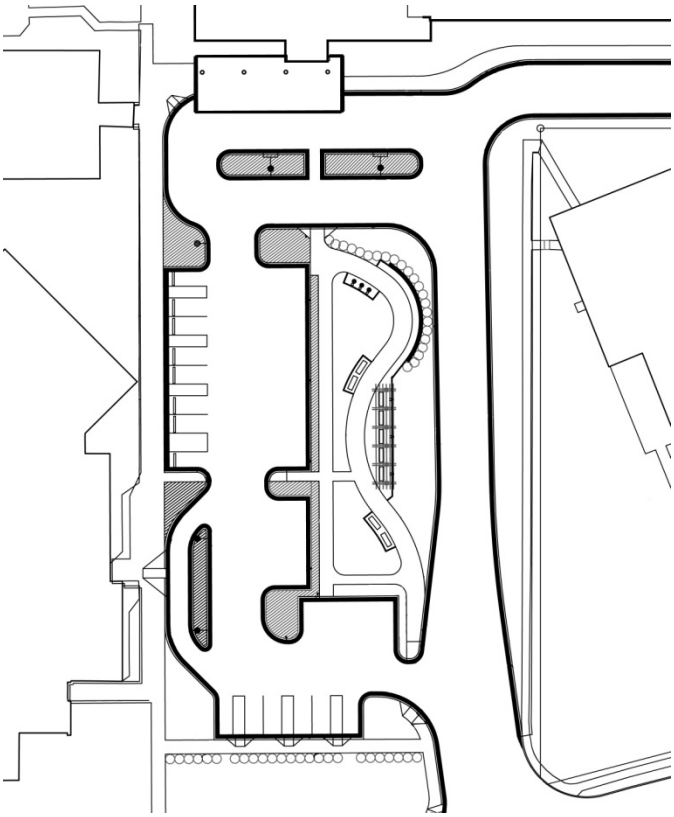


Figure 3 | South Elevation and Main Entry Canopy Elevation

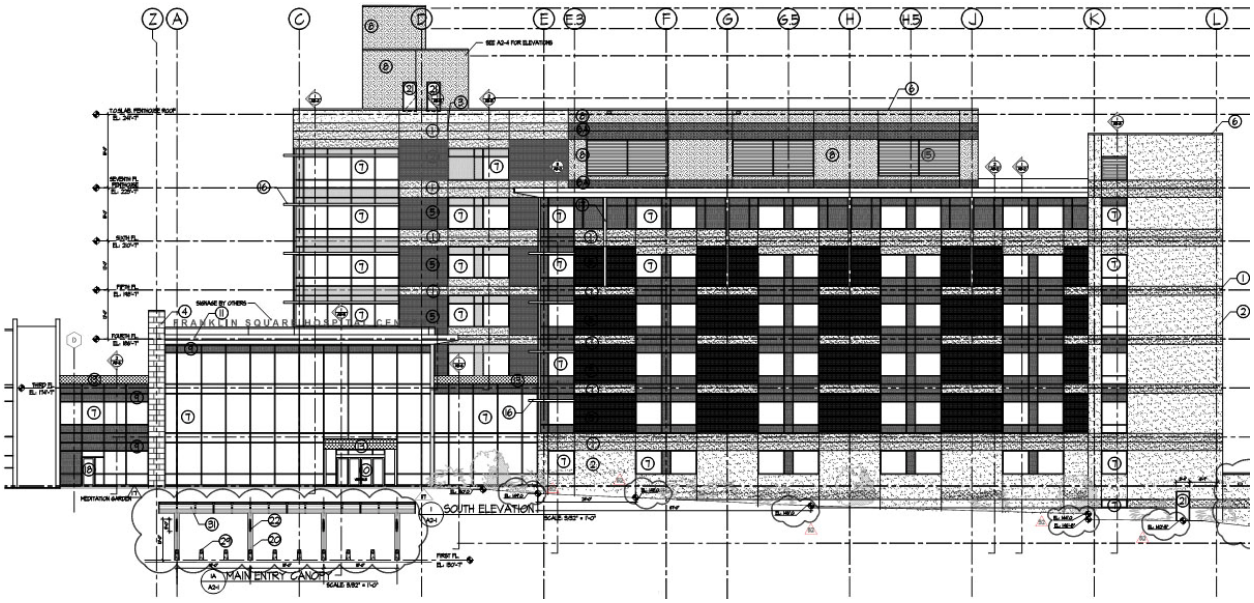


Figure 4 | South Elevation Main Entry Canopy Elevation

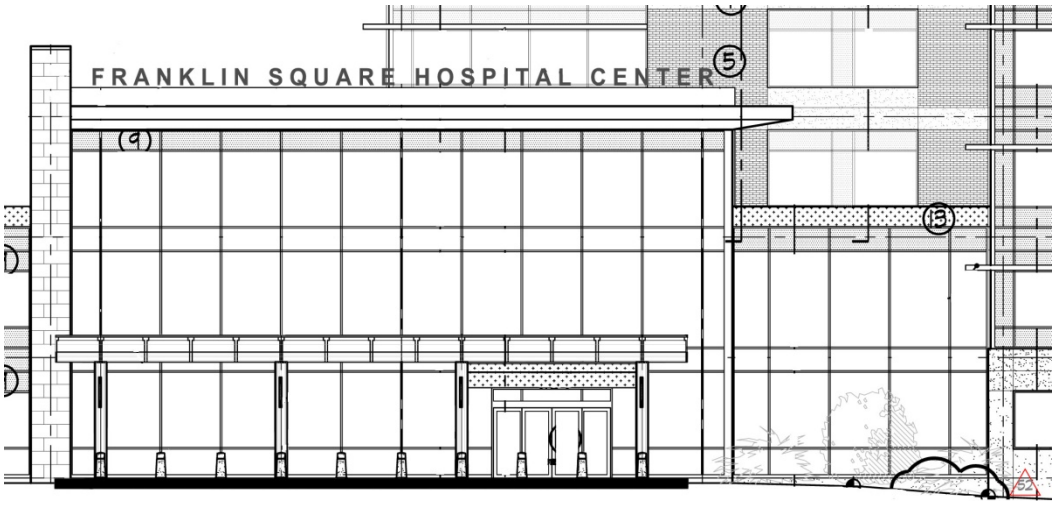
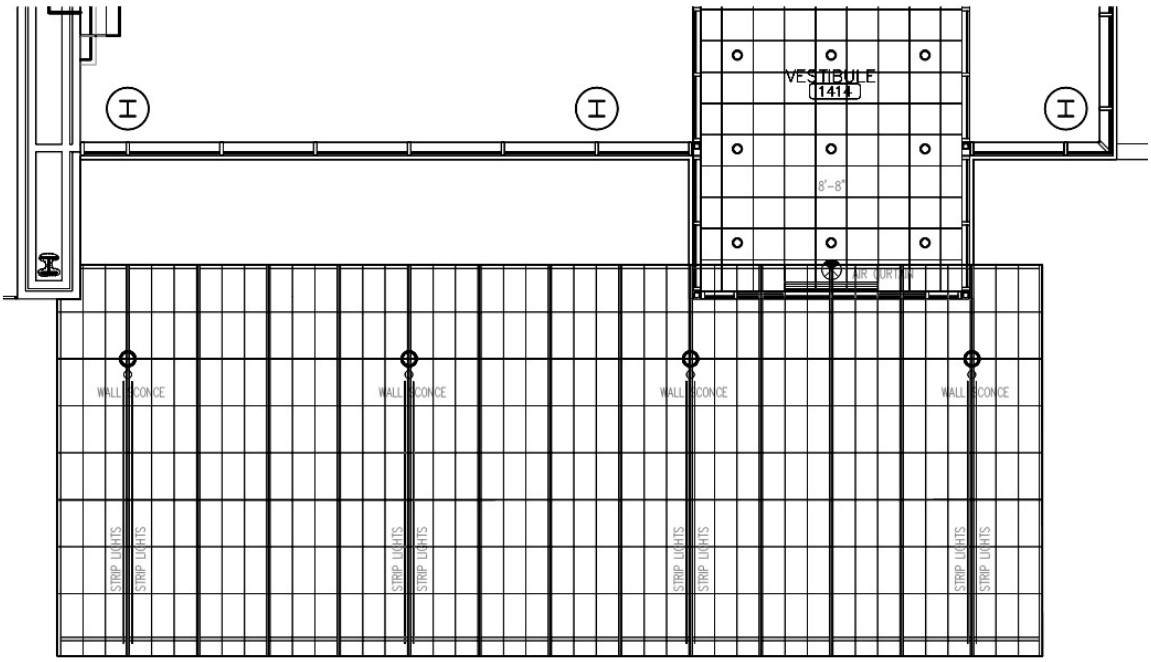


Figure 5 | Main Entry Canopy Reflected Ceiling Plan



Surface Materials

Entrance/Canopy

Roof – Aluminum composite paneling

Walls – Aluminum curtain wall system (GL-6,-6T)

Doors – Aluminum entrance sliding doors (GL-6,-6T)

Canopy Area

Canopy – Glass canopy

Columns – metal tube columns

Paving materials

Roadways – Black asphalt

Walkways - precast concrete pavers and slab on grade concrete

Tasks/Activities

Walking and driving are the main activities in the parking lot area. Under the canopy, a major task would be loading and unloading patients that may or may not need assistance. Safety is essential especially during the night. Signage and traffic markings on the roads must have adequate illumination in order for people to read them and react to them.

Design Criteria

Outdoor, Building Exteriors, Active/Parking Areas (IESNA Handbook)

Appearance of Space and Luminaires (Very Important/Important)

The appearance of the outdoor space should look clean and organized with poles aligned with each other. If the poles and luminaires were cluttered, the visitors and occupants might get the impression that the hospital is cluttered and unorganized as well. The first impression is the outside of the building so it must appear how the hospital wants to be reflected, remarkable.

Color Appearance and Color Contrast (Very Important/Not Important)

CRI is not critical in the parking area but should be at least 80 under the canopy where the pedestrian traffic is the greatest. The CCT for all the luminaires outside should be within the range of 3500K to 4000K to resemble the sun during the nighttime hours.

Direct Glare (Very Important/Very Important)

Direct glare should be avoided outdoors because it is very distracting for drivers and can be disabling for pedestrians. Both of these issues are a high safety concern.

Light Distribution on Surfaces (Important/Important)

Provide uniformity along the roadways and walkways to enable safety and easy navigation of the circulation of traffic.

Light Pollution/Trespass (Very Important/Very Important)

Full cutoff luminaires can be used to avoid light pollution. Light trespass onto adjacent sites can be reduced by the height of the luminaries and the photometric distribution of the reflector that is chosen.

Modeling of Faces or Objects (Very Important/Very Important)

Modeling of faces in the outdoor space is achieved through the photometric spread of the ambient lighting system.

Peripheral Detection (Very Important/Very Important)

The perimeter of the parking area should be illuminated to avoid accidents.

Point(s) of Interest (Very Important/Important)

The point of interest of this outdoor space is the main entrance storefront façade during the day. At night it shifts to the canopy outside of the lobby as well as the main lobby/atrium space that will be illuminated inside.

Reflected Glare (Very Important/Very Important)

Reflected glare from the curtain wall during the day should be avoided. Also avoid the reflected glare from the cars at nighttime.

Shadows (Very Important/Very Important)

Shadows create a visually pleasing area but should be avoided on the walkways and main roadways.

Source/Task/Eye geometry (Very Important/Very Important)

Keeping the luminance ratio between the outdoor spaced to a minimum will create a pleasant and more human sized outdoor area.

Sparkle/Desirable Reflected Highlights (Important/Not Important)

Sparkle is provided by the interior illumination of the lobby/atrium space at night. The desirable highlights that the space contains are shown to the people outside when the curtain wall façade becomes transparent at night.

Surface Characteristics (Very Important/Important)

The walkways have a much higher reflectance value then the roadways therefore the light levels must be adapted for each specific surface that is being illuminated.

Illuminance

Horizontal Illuminance (Very Important/Important) – Category B/N.A. – 5/0.2 fc

Vertical Illuminance (Very Important/Very Important) – Category A/N.A. – 3/1 fc

Power Allowance (ASHRAE /IESNA Std. 90.1-2007)

Parking Lots and Drives – 0.15 W/ft^2

Walkways less than 10 ft wide – 1.0 W/linear foot

Main Entries – 30 W/linear foot of door width

Canopies – 1.25 W/ft^2

Controls Criteria

Photo sensors or a timer can be used to switch the outdoor luminaires.

Luminance Ratios (max:min)

The maintained illuminance uniformity ratio, maximum-to-minimum should not be greater then 20:1 for basic parking lots

Psychological Aspects

The outdoor area should provide a transitional space for the visitor or patient at night before they reach the main canopy. A feeling of excitement should increase the interest of the occupant to enter the space to actually see the interior features that they got glimpses of from the outside.

Lighting Plans

See Appendix A for lighting plans

Luminaires

Figure 6 | Main Entrance and Parking Lot Luminaire Schedule

MAIN ENTRANCE + PARKING LOT LUMINAIRE SCHEDULE									
TYPE	IMAGE	MANUFACTURER	PRODUCT NAME	CATALOG NUMBER	DESCRIPTION	LAMP	INPUT WATTS	VOLTAGE	BALLAST
A		Williams	OER1717	OER1717/100PSMH 277/TFT/S/SQ/SLV	17" square area luminaire. Fabricated .08"aluminum housing with an extruded aluminum frame with latches to provide easy access to ballast, lamp and reflector. Clear .187" thick high-impact, heat-resistant tempered glass lens.	MXR100/C/U/MED/O 12570 - GE quartz metal halide ED17	109	277	IMH/100/D/277 Philips Advance
B		Cooper Lighting	Acorn	ANE/70/P/H/7/33/A	8" textured polycarbonate globe with internal type III refractor. Cast aluminum housing finished in standard black polyester powder coat.	CMH70CU830MED/O 31070 - GE ceramic metal halide ED17	79	277	IMH/70/D/277 Philips Advance
C		Philips Color Kinetics	eW Graze Powercore	523/000030/15	4' linear LED surface mounted luminaire with a 30° x 60° beam angle. Extruded anodized aluminum housing and clear polycarbonate lens. Certified IP66 for a wet location environment.	4000K White LED lamps included	60	277	Integrated with luminaire
D		Cooper Lighting	WP Series	683/4/WP/CFL/1/26/277V/SM	Solid aluminum with open bottom and enclosed top wall mounted luminaire coated with premium polyester powder paint. Dark Sky and ADA compliant. UL approved for wet location.	F26DBX/841/ECO4P 97613 - GE CF plug in T4	31	277	VEZ/1T42/M2/BS Philips Advance
E		Cooper Lighting	Rio	1235/RD/M/4LED/120/12/NSS	5" round, open fascia with clear diffuse lens. Die-cast aluminum alloy housing that is corrosion-resistant. Certified IP68 for a standard wet environment.	White LED lamps included	4	120	Integrated with luminaire

See Appendix A for full luminaire schedule and cut sheets

Figure 7 | Main Entrance and Parking Lot Light Loss Factors

TYPE	BF	LLD	LDD	RSDD	TOTAL LLF
A	1.0	0.69	0.88	-	0.61
B	1.0	0.72	0.88	-	0.63
C	1.0	0.85	0.88	-	0.75
D	1.05	0.84	0.88	-	0.78
E	1.0	0.85	0.88	-	0.75

Controls

An astronomical time clock will be used to automatically turn the lights on at night when they are needed. In the morning the time clock will also turn the lights back off.

Figure 8 | Main Entrance and Parking Lot Control Schedule

MAIN ENTRANCE + PARKING LOT CONTROL SCHEDULE					
TYPE	IMAGE	MANUFACTURER	PRODUCT NAME	CATALOG NUMBER	DESCRIPTION
X		Watt Stopper	Astronomical Time Clock	MSC-100	5-channel Astronomical Time Clock used for fully automating a Wireless Micro lighting control system. Provides ON/OFF control signals based on time of day, day of week, holiday and calculated sunrise/sunset time.

See Appendix A for full equipment schedule and cut sheets

Performance Data

The following are renders and calculation grids that summarize the main entrance and parking lot redesign.

Figure 9 | Exterior Pseudo Color and Render (fc)

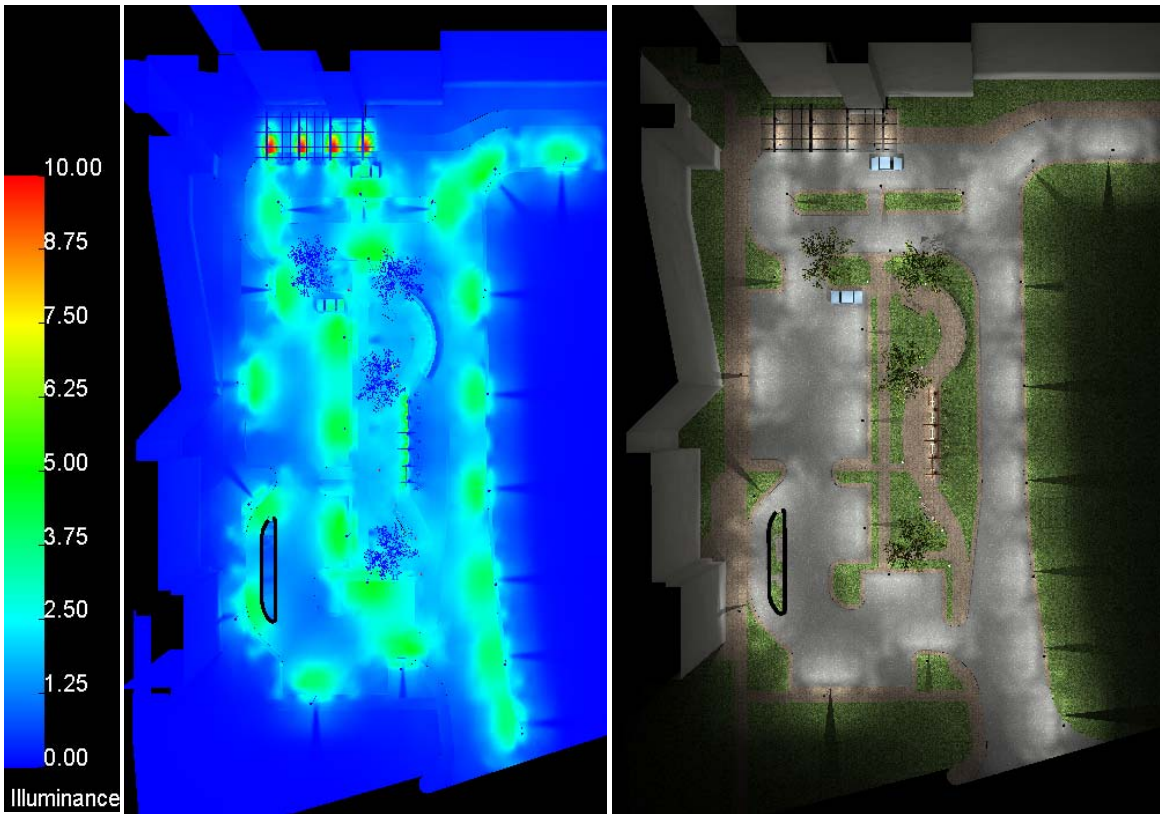


Figure 10 | Exterior View Render and Pseudo Color (fc)

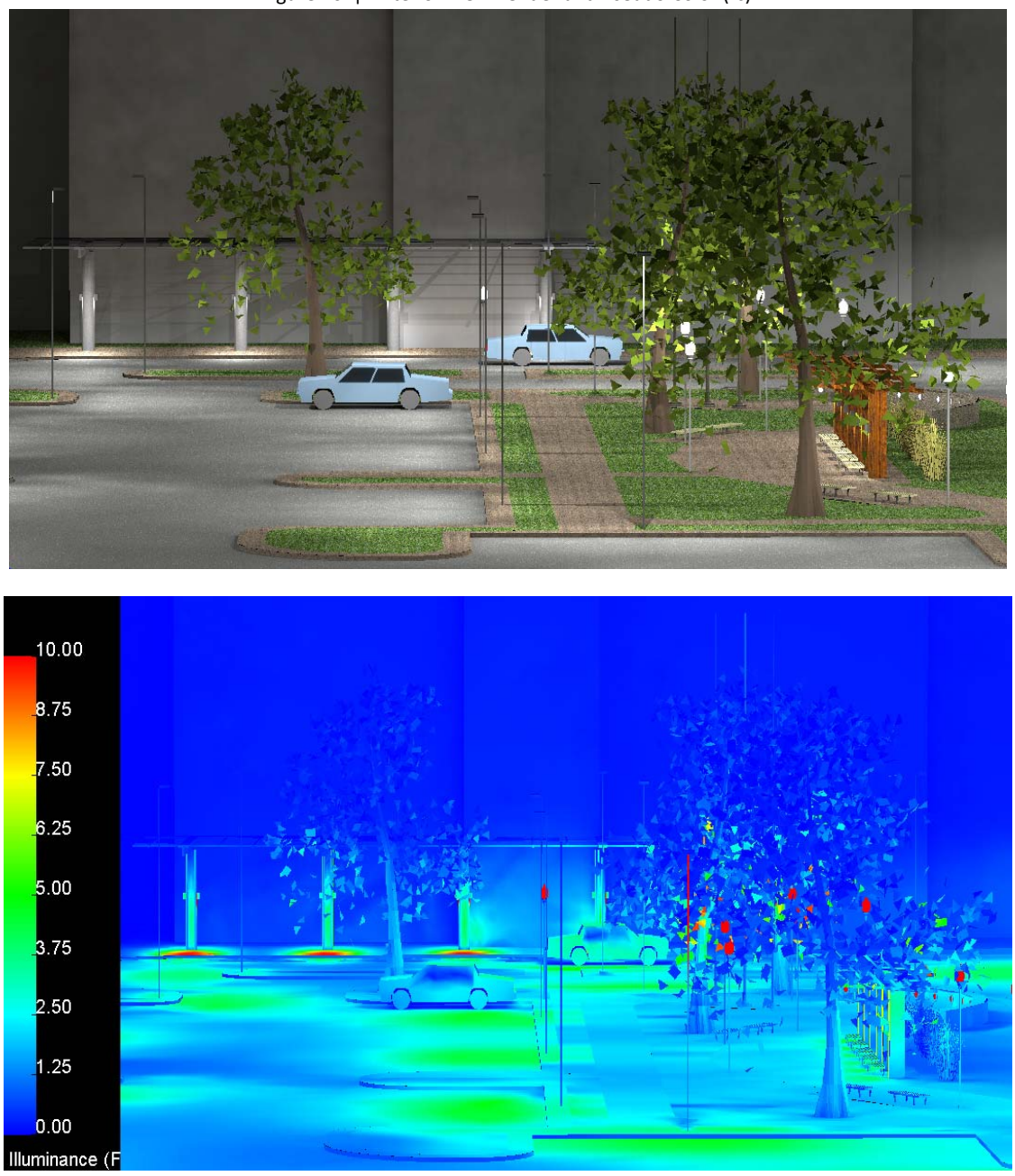


Figure 11 | Exterior View Render and Pseudo Color (fc)

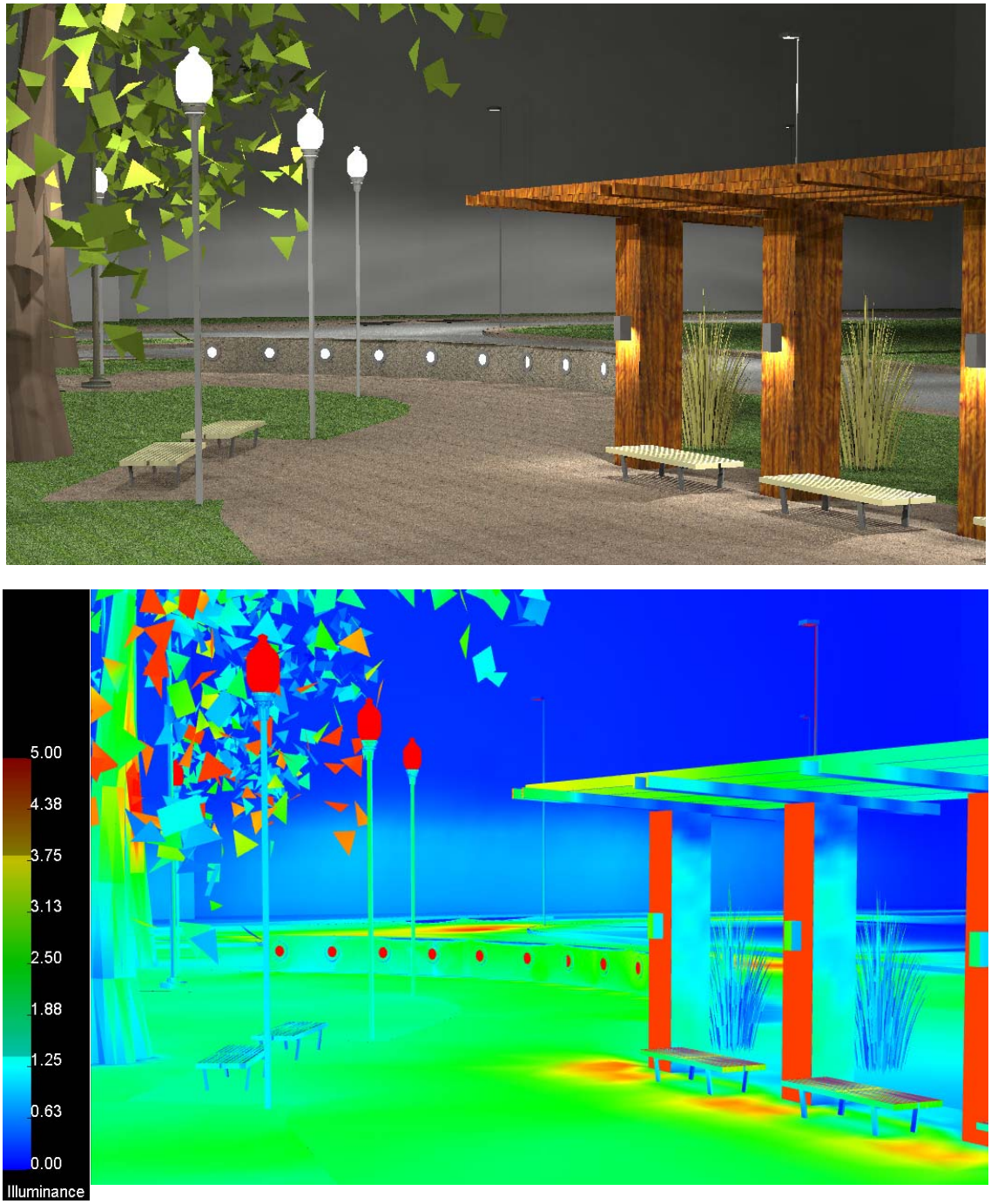


Figure 12 | Canopy Horizontal Illuminance (fc)

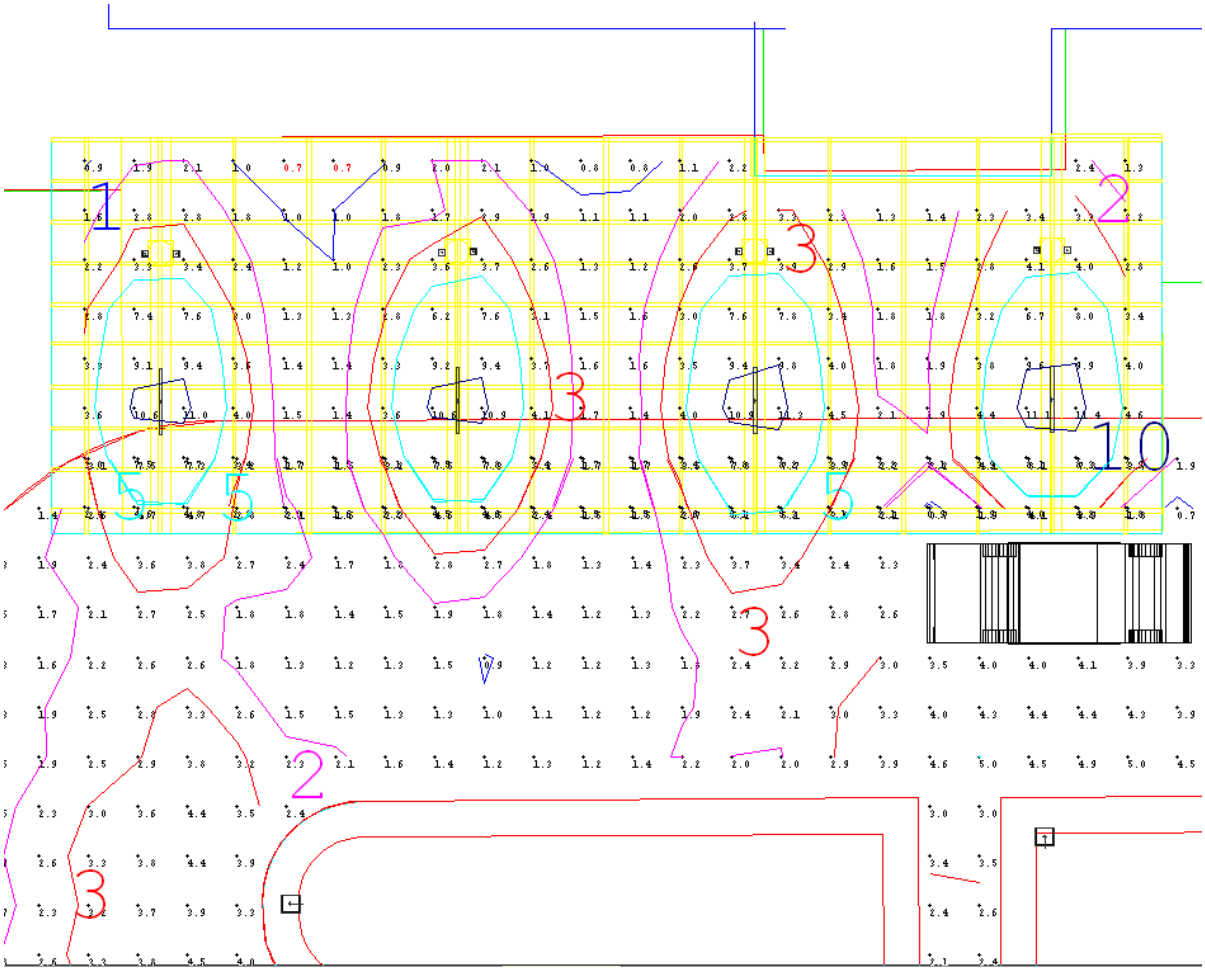
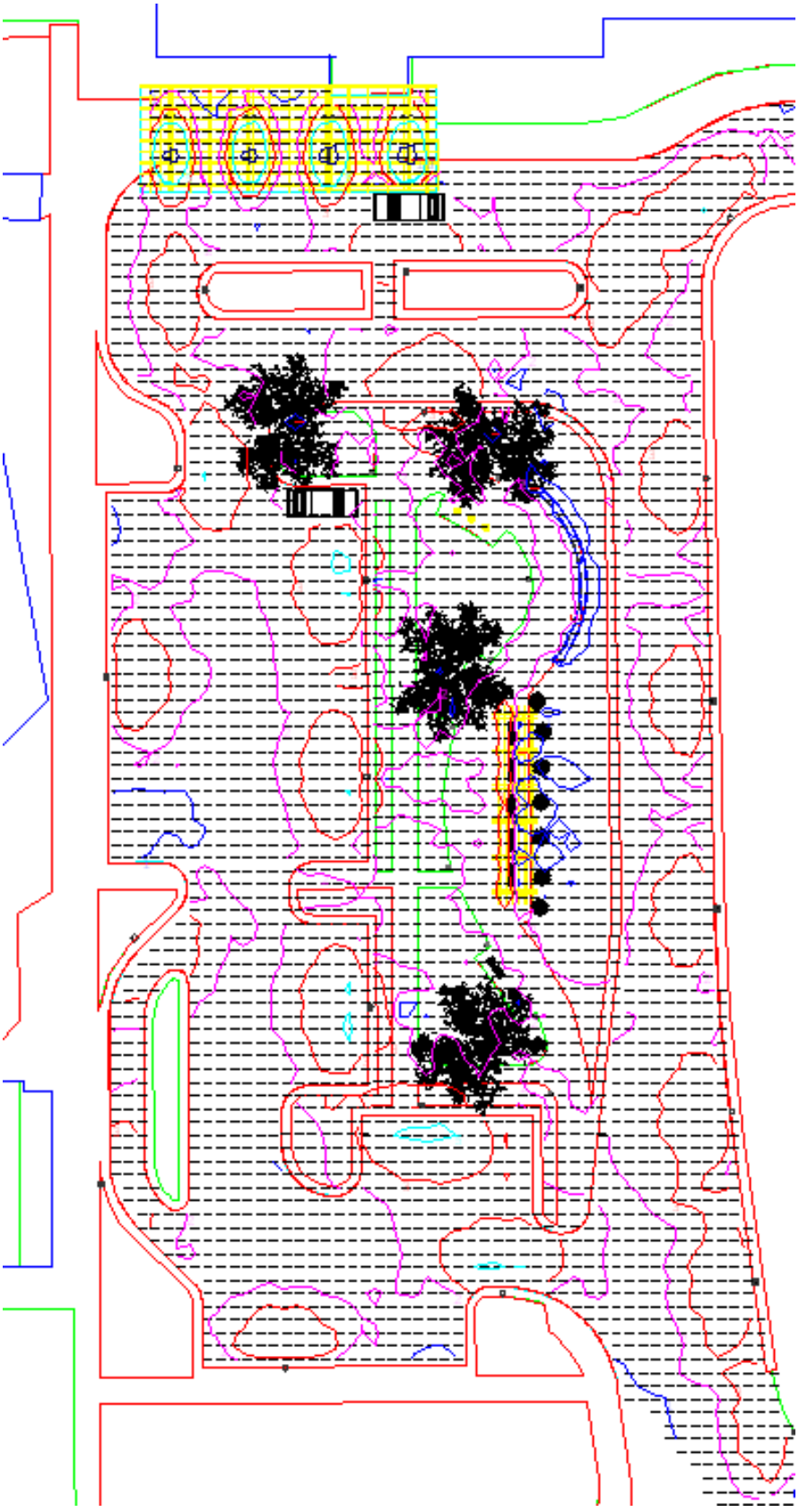


Figure 13 | Main Entrance and Parking Lot Horizontal Illuminance (fc)



Energy Code Compliance

Figure 14 | Energy Calculation Summary

ASHRAE Standard 90.1 - 2007

SPACE	AREA (SF)	ALLOWABLE LIGHTING POWER DENSITY (W/SF)	ALLOWABLE WATTS	TOTAL WATTS USED
Parking Lots and Drives	30693	0.15	4603.95	2398
Walkways Less Then 10 Feet Wide	5127.5	1	5127.5	949
Main Entries	8	30 W/LF of door width	240	124
Canopy	1465	1.25	1831.25	364

Performance Summary

The new lighting design for the exterior space provides illumination to aid visitors to the entrance and attract them to the plaza in the center of the parking lot. The ambient illumination of the parking lot is provided by the pole mounted metal halide luminaires. Decorative acorn luminaires are added to the plaza area to increase the walkway horizontal illuminance to ensure safety through the winding path. Wall mounted sconces are placed on the vertical members of the wooden terrace in the plaza. A curving rock bench lines the right side of the pathway as a visitor walks towards the main entry. Step lights were placed low on the bench to create a pattern on the pathway that is aesthetically subtle.

The acorn luminaires, sconces and the step lights bring the space to a smaller scale that is more comfortable compared to the scale of the 20 foot pole mounted luminaires.

The glass canopy is illuminated by metal halide wall sconces and LED strip luminaires mounted to aluminum frame on the ceiling of the canopy. The canopy design is simple so not to distract the visitors from seeing the features in the atrium.

The lighting design for this space meets ASHRAE Standard 90.1 – 2007 requirements and also complies with IESNA recommendations. The wall sconces are ADA compliant. The one recommendation that it did not meet was to obtain a horizontal illuminance of 5 footcandles at the main entrance. This value is assumed to be met with the glow from the three story atrium that is adjacent to the main entrance. The luminaires in the atrium will be on during the night time and give the atrium a sense of openness as the glass will seem to vanish into the night.

Figure 15 | Main Entrance and Parking Lot Performance Summary

GRID LOCATIONS	AVG (fc)	MAX (fc)	MIN (fc)	MAX/MIN
Roadway	2.43	8.1	0.5	16.2
Canopy Entrance	3.66	13.2	0.6	22.0
Plaza Walkways	2.11	4.9	0.3	16.3

Electrical Redesign

For complete spatial description of the main entrance and parking lot, see page 7.

Electrical Design Objectives/Criteria

The redesigned lighting space will be circuited to the existing panelboards that served the existing lighting circuits. The other existing loads on the panelboard will remain the same.

Two panelboards with a voltage system of 480Y/277V, 3PH, 4W will feed the new luminaires. One of the panels is normal power while the other is emergency power. All of the exterior luminaires are controlled with an astronomical time clock that will turn them on at night and turn them off in the morning. The luminaires will be wired through this equipment before reaching the panelboards.

The following are existing lighting panelboards which are highlighted to specify the redesigned circuit. The panelboard worksheets and schedules are based and calculated for the new lighting design.

See Appendix A for complete lighting plans with circuiting

Figure 16 | Existing Panelboard LPSL1 Schedule

WIRING PANEL SCHEDULE

	PANEL: LPSL1 (NORMAL)			MAINS: MLO							AMPS: 100			AIC: 35,000
	VOLTAGE: 480Y/277	WIRES: 4		PHASE: 3							MOUNTING: SURFACE			LOCATION: MAIN ELEC RM GRD FLR
CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT	A	A	B	B	C	C	CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT
1	-	-	-	-	5.7	7.5	-	-	-	-	2	-	-	-	-
3	FRONT ENTRY DRIVE POLE LTS	3	20	3/4"C.W/3#10+1#10GRD.	-	-	5.7	7.5	-	-	4	FRONT ENTRY DRIVE POLE LTS	3	20	3/4"C.W/3#10+1#10GRD.
5	-	-	-	-	-	-	-	-	5.3	7	6	-	-	-	-
7	-	-	-	-	0	0	-	-	-	-	8	-	-	-	-
9	SPARE	3	20	-	-	-	0	0	-	-	10	SPARE	3	20	-
11	-	-	-	-	-	-	-	-	0	0	12	-	-	-	-
13	LTG: EMPL/MAIN ENT CANOPY	1	20	3/4"C.W/2#12+1#12GRD.	11.5	10	-	-	-	-	14	SIGNAGE: PENTHOUSE	1	20	3/4"C.W/2#12+1#12GRD.
15	LTG: ED/AMBUL ENT CANOPY	1	20	3/4"C.W/2#12+1#12GRD.	-	-	3.64	10	-	-	16	SIGNAGE: PENTHOUSE	1	20	3/4"C.W/2#12+1#12GRD.
17	SIGNAGE: AMBULANCE CANOPY	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	10	10	18	SIGNAGE: STAIR B	1	20	3/4"C.W/2#12+1#12GRD.
19	SIGNAGE: ED ENTRY CANOPY	1	20	3/4"C.W/2#12+1#12GRD.	10	10	-	-	-	-	20	SIGNAGE: STAIR B	1	20	3/4"C.W/2#12+1#12GRD.
21	SIGNAGE: EMPL ENTRY CANOPY	1	20	3/4"C.W/2#12+1#12GRD.	-	-	10	4	-	-	22	ENTRANCE PLAZA BOLLARDS	1	20	3/4"C.W/2#12+1#12GRD.
23	SIGNAGE: EMPL ENTRY CANOPY	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	10	0	24	SPARE	1	20	-
25	SIGNAGE: MAIN ENTRY CANOPY	1	20	3/4"C.W/2#12+1#12GRD.	10	0	-	-	-	-	26	SPARE	1	20	-
27	SIGNAGE: MAIN ENTRY CANOPY	1	20	3/4"C.W/2#12+1#12GRD.	-	-	10	0	-	-	28	SPACE	1	-	-
29	SPACE	1	-	-	-	-	-	-	0	0	30	SPACE	1	-	-
31	SPACE	1	-	-	0	0	-	-	-	-	32	SPACE	1	-	-
33	SPACE	1	-	-	-	-	0	0	-	-	34	SPACE	1	-	-
35	SPACE	1	-	-	-	-	-	-	0	0	36	SPACE	1	-	-
37	SPACE	1	-	-	0	0	-	-	-	-	38	SPACE	1	-	-
39	SPACE	1	-	-	-	-	0	0	-	-	40	SPACE	1	-	-
41	SPACE	1	-	-	-	-	-	-	0	0	42	SPACE	1	-	-
	CONNECTED LOAD	53 A		TOTAL PHASE A	65 A		-		-			CONNECTED LOAD	43.7 KVA		
	DEMAND LOAD	66 A		TOTAL PHASE B	-		51 A		-						
				TOTAL PHASE C	-		-		42 A						

Figure 17 | New Panelboard LPSL1 Worksheet

PANELBOARD SIZING WORKSHEET

Panel Tag---------->				LPSL1	Panel Location:			Main Elec Rm Ground Floor			
Nominal Phase to Neutral Voltage------->				277	Phase:			3			
Nominal Phase to Phase Voltage-------->				480	Wires:			4			
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	Lighting	3	Front dr pole	4.6	A	0.90	1147	1274		
2	A	Lighting	3	Front dr pole	6.33	A	0.90	1578	1753		
3	B	Lighting	3	Front dr pole	4.6	A	0.90	1147	1274		
4	B	Lighting	3	Front dr pole	6.33	A	0.90	1578	1753		
5	C	Lighting	3	Front dr pole	4.6	A	0.90	1147	1274		
6	C	Lighting	3	Front dr pole	6.33	A	0.90	1578	1753		
7	A	Spare	9	-		A	1.00	0	0		
8	A	Spare	9	-		A	1.00	0	0		
9	B	Spare	9	-		A	1.00	0	0		
10	B	Spare	9	-		A	1.00	0	0		
11	C	Spare	9	-		A	1.00	0	0		
12	C	Spare	9	-		A	1.00	0	0		
13	A	Lighting	3	Empl canopy	9.75	A	0.90	2431	2701		
14	A	Lighting	3	Penthouse	10	A	0.90	2493	2770		
15	B	Lighting	3	D amb cano	3.64	A	0.90	907	1008		
16	B	Lighting	3	Penthouse	10	A	0.90	2493	2770		
17	C	Lighting	3	Amb canopy	10	A	0.90	2493	2770		
18	C	Lighting	3	Stair B	10	A	0.90	2493	2770		
19	A	Lighting	3	ED canopy	10	A	0.90	2493	2770		
20	A	Lighting	3	Stair B	10	A	0.90	2493	2770		
21	B	Lighting	3	Empl canopy	10	A	0.90	2493	2770		
22	B	Lighting	3	Plaza lums	3.8	A	0.90	947	1053		
23	C	Lighting	3	Empl canopy	10	A	0.90	2493	2770		
24	C	Spare	9	-		A	1.00	0	0		
25	A	Lighting	3	Main canopy	10	A	0.90	2493	2770		
26	A	Spare	9	-		A	1.00	0	0		
27	B	Lighting	3	Main canopy	10	A	0.90	2493	2770		
28	B					A	1.00	0	0		
29	C					A	1.00	0	0		
30	C					A	1.00	0	0		
31	A					A	1.00	0	0		
32	A					A	1.00	0	0		
33	B					A	1.00	0	0		
34	B					A	1.00	0	0		
35	C					A	1.00	0	0		
36	C					A	1.00	0	0		
37	A					A	1.00	0	0		
38	A					A	1.00	0	0		
39	B					A	1.00	0	0		
40	B					A	1.00	0	0		
41	C					A	1.00	0	0		
42	C					A	1.00	0	0		
PANEL TOTAL								37.4	41.5	Amps=	50.0

PHASE LOADING		kW	kVA	%	Amps	
PHASE TOTAL	A	15.1	16.8	40%	60.7	
PHASE TOTAL	B	12.1	13.4	32%	48.4	
PHASE TOTAL	C	10.2	11.3	27%	40.9	

LOAD CATAGORIES			Connected			Demand				Ver. 104
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		0.0	0.0		0.0	0.0			
2	computers		0.0	0.0		0.0	0.0			
3	fluorescent lighting		37.4	41.5		37.4	41.5	0.90		
4	HID lighting		0.0	0.0		0.0	0.0			
5	incandescent lighting		0.0	0.0		0.0	0.0			
6	HVAC fans		0.0	0.0		0.0	0.0			
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						37.4	41.5			
Spare Capacity			20%			7.5	8.3			
Total Design Loads						44.9	49.9	0.90	Amps=	60.0

Figure 18 | New Panelboard LPSL1 Schedule

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	LPSL1	MIN. C/B AIC:	35K
SIZE/TYPE BUS:	100A	PANEL LOCATION:	Main Elec Rm Ground Floor	OPTIONS:	
SIZE/TYPE MAIN:	100A/3P C/B	PANEL MOUNTING:	SURFACE		(4) #8, (1) #8 G, 3/4" C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	Front dr pole	1147	-	1	*			2	-	1578	Front dr pole	Lighting
Lighting	Front dr pole	1147	20A/3P	3		*		4	20A/3P	1578	Front dr pole	Lighting
Lighting	Front dr pole	1147	-	5			*	6	-	1578	Front dr pole	Lighting
Spare	-	0	-	7	*			8	-	0	-	Spare
Spare	-	0	-	9		*		10	-	0	-	Spare
Spare	-	0	-	11			*	12	-	0	-	Spare
Lighting	Empl canopy	2431	20A/1P	13	*			14	20A/1P	2493	Penthouse	Lighting
Lighting	ED amb canopy	907	20A/1P	15		*		16	20A/1P	2493	Penthouse	Lighting
Lighting	Amb canopy	2493	20A/1P	17			*	18	20A/1P	2493	Stair B	Lighting
Lighting	ED canopy	2493	20A/1P	19	*			20	20A/1P	2493	Stair B	Lighting
Lighting	Empl canopy	2493	20A/1P	21		*		22	20A/1P	947	Plaza lums	Lighting
Lighting	Empl canopy	2493	20A/1P	23			*	24	-	0	-	Spare
Lighting	Main canopy	2493	20A/1P	25	*			26	-	0	-	Spare
Lighting	Main canopy	2493	20A/1P	27		*		28	-	0	0	0
0	0	0	-	29			*	30	-	0	0	0
0	0	0	-	31	*			32	-	0	0	0
0	0	0	-	33		*		34	-	0	0	0
0	0	0	-	35			*	36	-	0	0	0
0	0	0	-	37	*			38	-	0	0	0
0	0	0	-	39		*		40	-	0	0	0
0	0	0	-	41			*	42	-	0	0	0

CONNECTED LOAD (KW) - A Ph.	15.13	TOTAL DESIGN LOAD (KW)	44.87
CONNECTED LOAD (KW) - B Ph.	12.06	POWER FACTOR	0.90
CONNECTED LOAD (KW) - C Ph.	10.20	TOTAL DESIGN LOAD (AMPS)	60

Feeder Size Calculation

60 A * 125% = 75 A

100A Circuit Breaker, (4) #6 AWG CU THWN, (1) #8 AWG CU Ground, 1” EMT Conduit

Figure 19 | Existing Panelboard E1DP-1 Schedule

WIRING PANEL SCHEDULE

	PANEL: E1DP-1 (LIFE SAFETY)			MAINS: MLO							AMPS: 250			AIC: 100,000
	VOLTAGE: 480Y/277	WIRES: 4		PHASE: 3							MOUNTING: SURFACE	LOCATION: EMERG DIST RM GRD FLOOR		
CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT	A	A	B	B	C	C	CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT
1	-	-	-	-	27.3	16.7	-	-	-	-	2	-	-	-	-
3	PANEL E1LG1	3	100	FEEDER 50	-	-	27.3	16.7	-	-	4	PANEL E1L31	3	100	FEEDER 105
5	-	-	-	-	-	-	-	-	27.3	16.7	6	-	-	-	-
7	-	-	-	-	24.6	15.9	-	-	-	-	8	-	-	-	-
9	PANEL E1LG5	3	100	FEEDER 64	-	-	24.6	15.9	-	-	10	PANEL E1L41	3	100	FEEDER 122
11	-	-	-	-	-	-	-	-	24.6	15.9	12	-	-	-	-
13	-	-	-	-	26.3	15.9	-	-	-	-	14	-	-	-	-
15	PANEL E1L11	3	100	FEEDER 71	-	-	26.3	15.9	-	-	16	PANEL E1L51	3	100	FEEDER 139
17	-	-	-	-	-	-	-	-	26.3	15.9	18	-	-	-	-
19	-	-	-	-	20.2	15.9	-	-	-	-	20	-	-	-	-
21	PANEL E1L21	3	100	FEEDER 88	-	-	20.2	15.9	-	-	22	PANEL E1L61	3	100	FEEDER 156
23	-	-	-	-	-	-	-	-	20.2	15.9	24	-	-	-	-
25	WALLPACKS	1	20	3/4"C.W/2#10+1#10GRD.	7.2	12.8	-	-	-	-	26	-	-	-	-
27	SPARE	1	20	-	-	-	0	12.8	-	-	28	PANEL E1L71	3	100	FEEDER 172
29	SPARE	1	20	-	-	-	-	-	0	12.8	30	-	-	-	-
31	-	-	-	-	11	0	-	-	-	-	32	-	-	-	-
33	JOCKEY PUMP	3	15	3/4"C.W/2#10+1#10GRD.	-	-	11	0	-	-	34	SPARE	3	100	-
35	-	-	-	-	-	-	-	-	11	0	36	-	-	-	-
37	-	-	-	-	0	0	-	-	-	-	38	-	-	-	-
39	100AF PREPARED SPACE	3	-	-	-	-	0	0	-	-	40	100AF PREPARED SPACE	3	-	-
41	-	-	-	-	-	-	-	-	0	0	42	-	-	-	-

	CONNECTED LOAD	189 A	TOTAL PHASE A	194 A	
	DEMAND LOAD	191 A	TOTAL PHASE B	187 A	
	25% GROWTH	238 A	TOTAL PHASE C	187 A	

Figure 20 | New Panelboard E1DP-1 Worksheet

PANELBOARD SIZING WORKSHEET

Panel Tag---------->				E1DP-1	Panel Location:			Emerg Dist Rm Ground Floor			
Nominal Phase to Neutral Voltage------->				277	Phase:			3			
Nominal Phase to Phase Voltage-------->				480	Wires:			4			
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	Lighting	3	Panel E1LG1	27.3	A	0.90	6806	7562		
2	A	Lighting	3	Panel E1L31	16.7	A	0.90	4163	4626		
3	B	Lighting	3	Panel E1LG1	27.3	A	0.90	6806	7562		
4	B	Lighting	3	Panel E1L31	16.7	A	0.90	4163	4626		
5	C	Lighting	3	Panel E1LG1	27.3	A	0.90	6806	7562		
6	C	Lighting	3	Panel E1L31	16.7	A	0.90	4163	4626		
7	A	Lighting	3	Panel E1LG9	24.6	A	0.90	6133	6814		
8	A	Lighting	3	Panel E1L41	15.9	A	0.90	3964	4404		
9	B	Lighting	3	Panel E1LG9	24.6	A	0.90	6133	6814		
10	B	Lighting	3	Panel E1L41	15.9	A	0.90	3964	4404		
11	C	Lighting	3	Panel E1LG9	24.6	A	0.90	6133	6814		
12	C	Lighting	3	Panel E1L41	15.9	A	0.90	3964	4404		
13	A	Lighting	3	Panel E1L11	26.3	A	0.90	6557	7285		
14	A	Lighting	3	Panel E1L51	15.9	A	0.90	3964	4404		
15	B	Lighting	3	Panel E1L11	26.3	A	0.90	6557	7285		
16	B	Lighting	3	Panel E1L51	15.9	A	0.90	3964	4404		
17	C	Lighting	3	Panel E1L11	26.3	A	0.90	6557	7285		
18	C	Lighting	3	Panel E1L51	15.9	A	0.90	3964	4404		
19	A	Lighting	3	Panel E1L21	20.2	A	0.90	5036	5595		
20	A	Lighting	3	Panel E1L61	15.9	A	0.90	3964	4404		
21	B	Lighting	3	Panel E1L21	20.2	A	0.90	5036	5595		
22	B	Lighting	3	Panel E1L61	15.9	A	0.90	3964	4404		
23	C	Lighting	3	Panel E1L21	20.2	A	0.90	5036	5595		
24	C	Lighting	3	Panel E1L61	15.9	A	0.90	3964	4404		
25	A	Lighting	3	Wallpacks	7.41	A	0.90	1847	2053		
26	A	Lighting	3	Panel E1L71	12.8	A	0.90	3191	3546		
27	B	Spare	9	-		A	1.00	0	0		
28	B	Lighting	3	Panel E1L71	12.8	A	0.90	3191	3546		
29	C	Spare	9	-		A	1.00	0	0		
30	C	Lighting	3	Panel E1L71	12.8	A	0.90	3191	3546		
31	A	HVAC	6	Jockey pump	11	A	0.85	2590	3047		
32	A	Spare	9	-		A	1.00	0	0		
33	B	HVAC	6	Jockey pump	11	A	0.85	2590	3047		
34	B	Spare	9	-		A	1.00	0	0		
35	C	HVAC	6	Jockey pump	11	A	0.85	2590	3047		
36	C	Spare	9	-		A	1.00	0	0		
37	A					A	1.00	0	0		
38	A					A	1.00	0	0		
39	B					A	1.00	0	0		
40	B					A	1.00	0	0		
41	C					A	1.00	0	0		
42	C					A	1.00	0	0		
PANEL TOTAL								140.9	157.1	Amps=	189.1

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					48.2	53.7	34%	194.0
PHASE TOTAL	B					46.4	51.7	33%	186.6
PHASE TOTAL	C					46.4	51.7	33%	186.6

LOAD CATAGORIES			Connected			Demand				Ver. 104
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		0.0	0.0		0.0	0.0			
2	computers		0.0	0.0		0.0	0.0			
3	fluorescent lighting		133.2	148.0		133.2	148.0	0.90		
4	HID lighting		0.0	0.0		0.0	0.0			
5	incandescent lighting		0.0	0.0		0.0	0.0			
6	HVAC fans		7.8	9.1		7.8	9.1	0.85		
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						140.9	157.1			
Spare Capacity			20%			28.2	31.4			
Total Design Loads						169.1	188.5	0.90	Amps=	226.9

Figure 21 | New Panelboard E1DP-1 Schedule

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	E1DP-1	MIN. C/B AIC:	100K
SIZE/TYPE BUS:	250A	PANEL LOCATION:	Emerg Dist Rm Ground Floor	OPTIONS:	
SIZE/TYPE MAIN:	250A/3P C/B	PANEL MOUNTING:	SURFACE		(4) 300, (1) #4 G, 2-1/2" C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	Panel E1LG1	6806	-	1	*			2	-	4163	Panel E1L31	Lighting
Lighting	Panel E1LG1	6806	100A/3P	3		*		4	100A/3P	4163	Panel E1L31	Lighting
Lighting	Panel E1LG1	6806	-	5			*	6	-	4163	Panel E1L31	Lighting
Lighting	Panel E1LG5	6133	-	7	*			8	-	3964	Panel E1L41	Lighting
Lighting	Panel E1LG5	6133	100A/3P	9		*		10	100A/3P	3964	Panel E1L41	Lighting
Lighting	Panel E1LG5	6133	-	11			*	12	-	3964	Panel E1L41	Lighting
Lighting	Panel E1L11	6557	-	13	*			14		3964	Panel E1L51	Lighting
Lighting	Panel E1L11	6557	100A/3P	15		*		16	100A/3P	3964	Panel E1L51	Lighting
Lighting	Panel E1L11	6557	-	17			*	18		3964	Panel E1L51	Lighting
Lighting	Panel E1L21	5036	-	19	*			20		3964	Panel E1L61	Lighting
Lighting	Panel E1L21	5036	100A/3P	21		*		22	100A/3P	3964	Panel E1L61	Lighting
Lighting	Panel E1L21	5036	-	23			*	24	-	3964	Panel E1L61	Lighting
Lighting	Wallpacks	1847	20A/1P	25	*			26	-	3191	Panel E1L71	Lighting
Spare	-	0	20A/1P	27		*		28	100A/3P	3191	Panel E1L71	Lighting
Spare	-	0	20A/1P	29			*	30	-	3191	Panel E1L71	Lighting
HVAC	Jockey pump	2590	-	31	*			32	20A/1P	0	-	Spare
HVAC	Jockey pump	2590	15A/3P	33		*		34	20A/1P	0	-	Spare
HVAC	Jockey pump	2590	-	35			*	36	20A/1P	0	-	Spare
0	0	0	-	37	*			38	-	0	0	0
0	0	0	-	39		*		40	-	0	0	0
0	0	0	-	41			*	42	-	0	0	0

CONNECTED LOAD (KW) - A Ph.	48.21	TOTAL DESIGN LOAD (KW)	169.14
CONNECTED LOAD (KW) - B Ph.	46.37	POWER FACTOR	0.90
CONNECTED LOAD (KW) - C Ph.	46.37	TOTAL DESIGN LOAD (AMPS)	227

Feeder Size Calculation

226.9 A * 125% = 283.625 A

300A Circuit Breaker, (4) 300 KCMIL CU THWN, (1) #4 AWG CU Ground, 2½" EMT Conduit

Gift Shop | Special Purpose Space

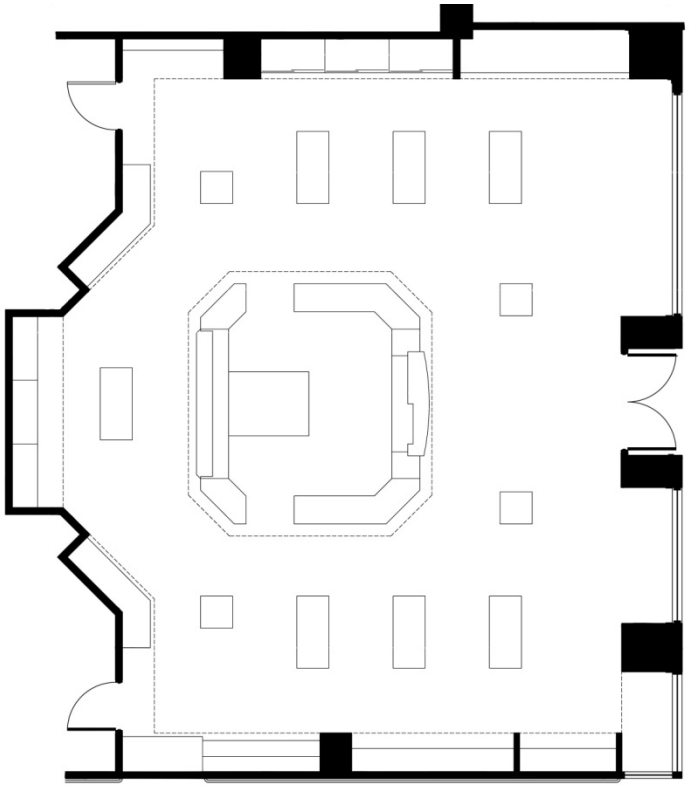
Spatial Summary

Visitors and occasionally patients visit the gift shop to shop for a desired item whether it is a needed candy bar or a get well teddy bear and a balloon. It is located on the first level of the hospital adjacent to the main entrance lobby. The space resembles a square with notches cut out of the northwest and southwest corners. These notches allow for additional display areas for merchandise.

The display tables are fixed in positions as seen on the floor plan. The tables and shelving that lines the walls of the gift shop display of a variety of different items such as flowers, stuffed animals, cards and balloons. Centrally located in the space is a check out area. Along the eastern wall, a show window is located between the gift shop and the main entrance lobby.

Drawings

Figure 22 | Gift Shop Floor Plan



Surface Materials

Ceiling – The ceiling consists of 2x2 acoustical ceiling tiles by Armstrong with angled tegular edges. (ACT-1)

Walls – The walls are painted the color Softer Tan by Sherman Williams (IPS2-A).

Storefront Walls – From the floor, a 7’ tempered clear float glass with 1.5’ of clear float glass above it with a mullion between them (GL-2, -1).

Floor – The floor is covered with 6’ wide condensed cushion with mark 2x backing 02751 Datum Strata isle colored carpet by C&A (CPT-2).

Door Frame - The door frames are painted the color Macadamia by Sherman Williams (IPS7-B).

Bulkhead – The bulkheads are painted the color Softer Tan by Sherman Williams (IPS2-A).

Base – The base is a 4” high almond colored rubber base by Roppe (RB4-A).

Figure 23 | Gift Shop Material Reflectance Properties

MATERIALS	DESCRIPTION	REFLECTANCE
ACT-1	Fine fissured #1732 2x2 acoustical ceiling tile	0.74
CPT-2	15211 Isle datum strata carpet	0.36
IPS2-A	SW 6141 Softer tan paint	0.81
IPS2-B	SW 6142 Macadamia paint	0.97
RB4-A	P184 Almond rubber base	0.72

Figure 24 | Gift shop glass transmittance properties

MATERIALS	DESCRIPTION	TRANSMITTANCE
GL-1	1/4" Clear float glass	0.88
GL-2	1/4" Tempered clear float glass	0.88

Furnishings

A centralized checkout area is surrounded by the display tables and shelves. Assume all furniture systems are wooden and are located as shown on the plan in a fixed position.

Tasks/Activities

The major tasks in the area occur in the checkout area with the use of visual display terminals and reading. The shopper's task is just to look at the merchandise which all needs to be illuminated. The checkout area requires a higher Illuminance value then the circulation and display areas of the gift shop.

Design Criteria

Interior, Merchandising Spaces, Sales Transaction Area/General Merchandise Display (IESNA Handbook)

Appearance of Space and Luminaires (Important/Important)

The arrangement of furnishings and luminaires must be organized in a way that customers will enjoy the space. A uniform layout of downlights creates a pleasant atmosphere in addition to the track fixtures that follow the walls of the space.

Color Appearance and Color Contrast (Important/Very Important)

A lamp with CRI of at least 80 would be acceptable for a retail space.

Daylighting Integration and Control (Important/Important)

There is no direct daylight into the space. Some daylight will enter from the atrium through the storefront glazing on the east wall.

Direct Glare (Very Important/Important)

A greater amount of small downlights are used to avoid direct glare.

Flicker and Strobe effect (Somewhat Important/Somewhat Important)

To avoid flicker and strobe effects, compact fluorescent lamps are used in this space.

Light Distribution on Surfaces (Somewhat Important/Important)

The illumination of the space should be distributed unevenly due to the fact that there are displays that will have higher Illuminance values then the circulation path.

Uniform Light Distribution on Surfaces (Important/Important)

The circulation areas of the space and the work plane at the checkout counter should both be uniform.

Luminances of Room Surfaces (Somewhat Important/Somewhat Important)

Luminances of the walls should be consistent as well as furnishings. The merchandise will vary therefore the displays are not as important.

Modeling of Faces or Objects (Important/Important)

The modeling of the merchandise is very important to sell the items. Point sources are used to create ambient lighting in addition to creating more directions that the light is coming from to illuminate the face.

Point(s) of Interest (Somewhat Important/Somewhat Important)

Points of interest are created when using the track fixtures for the displays.

Reflected Glare (Important/Important)

Reflected glare causes uncomfortable feelings that are unwanted to customers that are shopping. These are avoided by using matte finished oh displays, walls and floors.

Shadows (Somewhat Important/Not Important)

Shadows in the checkout area interfere with the employees but are avoid by having many luminaires in the area behind the counter.

Source/Task/Eye geometry (Important/Somewhat Important)

The increased sources with smaller apertures allows for less direct glare. The checkout uses VDT screens hence no large luminaires are located directly behind the counter.

Sparkle/Desirable Reflected Highlights (Not Important/Important)

The displays of the merchandise is essential to a retail store so sparkle is obtained by using many point sources from the ceiling as well as the track fixtures to highlight specific objects.

System Control and Flexibility (Not Important/Somewhat Important)

The flexibility of the system is found in the adjustable track luminaires.

Illuminance

Horizontal Illuminance (Important/Important) – Category D/E – 30/50 fc

Vertical Illuminance (Not Important/Important) – Category N.A./C – N.A./10 fc

VDT Criteria

Visual display terminals will only be used at the checkout area and with many luminaires in that area; the veiling reflections will be avoided.

Power Allowance (ASHRAE /IESNA Std. 90.1-2007)

Sales Area – 1.7 W/ft^2

Additional Interior Lighting Power Allowance - [1000 Watts + (Area * 1.0 W/ft^2)] = 2630 W

Controls Criteria

Switching controls three different zones in the gift shop. The zones include the ambient lighting of the space, the track luminaires and the perimeter lighting.

Accent Lighting Considerations

Accent lighting for retail spaces is very important to attract the customer to the merchandise. Point sources are used in these situations to provide focal points to the products. The displays can be up to three times brighter then the surroundings.

Luminance Ratios (max:min)

Ambient lighting – 5:1 or less

Accent lighting – 15:1 or less

Psychological Aspects

Pleasantness or calmness is aimed to be the psychological impress that customers get when they occupy the gift shop. Since the illumination level is uniform and the illumination level isn't extremely high the space is comforting and inviting.

Lighting Plans

See Appendix A for lighting plans

Luminaires

Figure 25 | Gift Shop Luminaire Schedule

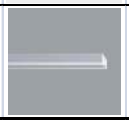
GIFT SHOP LUMINAIRE SCHEDULE									
TYPE	IMAGE	MANUFACTURER	PRODUCT NAME	CATALOG NUMBER	DESCRIPTION	LAMP	INPUT WATTS	VOLTAGE	BALLAST
F		ERCO	Lightcast Downlight	22209.000	Cast aluminum housing designed with a heat sink. White powder coated cast aluminum mounting ring. Bright anodised aluminum darklight reflector. Size 7, 30° cut-off angle.	(2)F18DBX/830/ ECO4P 97599 - GE CF plug in T4	43	277	VEZ/2Q18/ M2/BS/27 7 Philips Advance
G		ERCO	Logotec Spotlight Narrow	72409.000	Cast aluminum powder-coated housing and bracket. Silver spherolit mirror-finished anodised aluminum reflector with safety glass.	CMH20T/U830G U6.5 85086 - GE ceramic metal halide T4	24	277	IMH/G20/ G/277 Philips Advance
H		ERCO	Logotec Spotlight Flood	72410.000	Cast aluminum powder-coated housing and bracket. Silver spherolit mirror-finished anodised aluminum reflector with safety glass.	CMH20T/U830G U6.5 85086 - GE ceramic metal halide T4	24	277	IMH/G20/ G/277 Philips Advance
I		ERCO	Logotec Spotlight Wide Flood	72411.000	Cast aluminum powder-coated housing and bracket. Silver spherolit mirror-finished anodised aluminum reflector with safety glass.	CMH20T/U830G U6.5 85086 - GE ceramic metal halide T4	24	277	IMH/G20/ G/277 Philips Advance
J		ERCO	Logotec Recessed Spherolit Wallwasher	81215.000	Size 5, recessed housing of cast aluminum white powder-coated. White plastic mounting ring. Aluminum silver spherolit reflector mirror-finished anodised with a softec lens.	CMH20T/U830G U6.5 85086 - GE ceramic metal halide T4	24	277	IMH/G20/ G/277 Philips Advance
K		ERCO	Logotec Recessed Spotlight	81210.000	Size 5, recessed housing of cast aluminum white powder-coated. White plastic mounting ring. Aluminum silver spherolit reflector mirror-finished anodised with a softec lens.	CMH20T/U830G U6.5 85086 - GE ceramic metal halide T4	24	277	IMH/G20/ G/277 Philips Advance
W		ERCO	ERCO Track	78303.000	Silver finished anodised aluminum 3-circuit track allowing for three separate switchable circuits.	-	-	277	-

Figure 26 | Gift Shop Light Loss Factors

TYPE	BF	LLD	LDD	RSDD	TOTAL LLF
F	1.0	0.81	0.94	0.95	0.72
G	1.0	0.66	0.92	0.95	0.58
H	1.0	0.66	0.92	0.95	0.58
I	1.0	0.66	0.92	0.95	0.58
J	1.0	0.66	0.92	0.95	0.58
K	1.0	0.66	0.92	0.95	0.58

See Appendix A for full luminaire schedule and cut sheets

Controls

The luminaires within the gift shop are controlled in 3 zones of single switches. One zone is the task lighting over the checkout area and one recessed Logotec spotlight that illuminates the Franklin Square Hospital Center logo on the front of the checkout desk. The second zone is all the ambient downlights excluding the downlights in the checkout area. The final zone controls the fixtures that specifically highlight the merchandise including all the Logotec luminaires with an exception to the one recessed spot light highlighting the.

See Appendix A for full equipment schedule, cut sheets, and tick mark diagram

Performance Data

The following are renders and calculation grids that summarize the gift shop lighting redesign.

Figure 27 | Gift Shop Plan Pseudo Color and Render (fc)

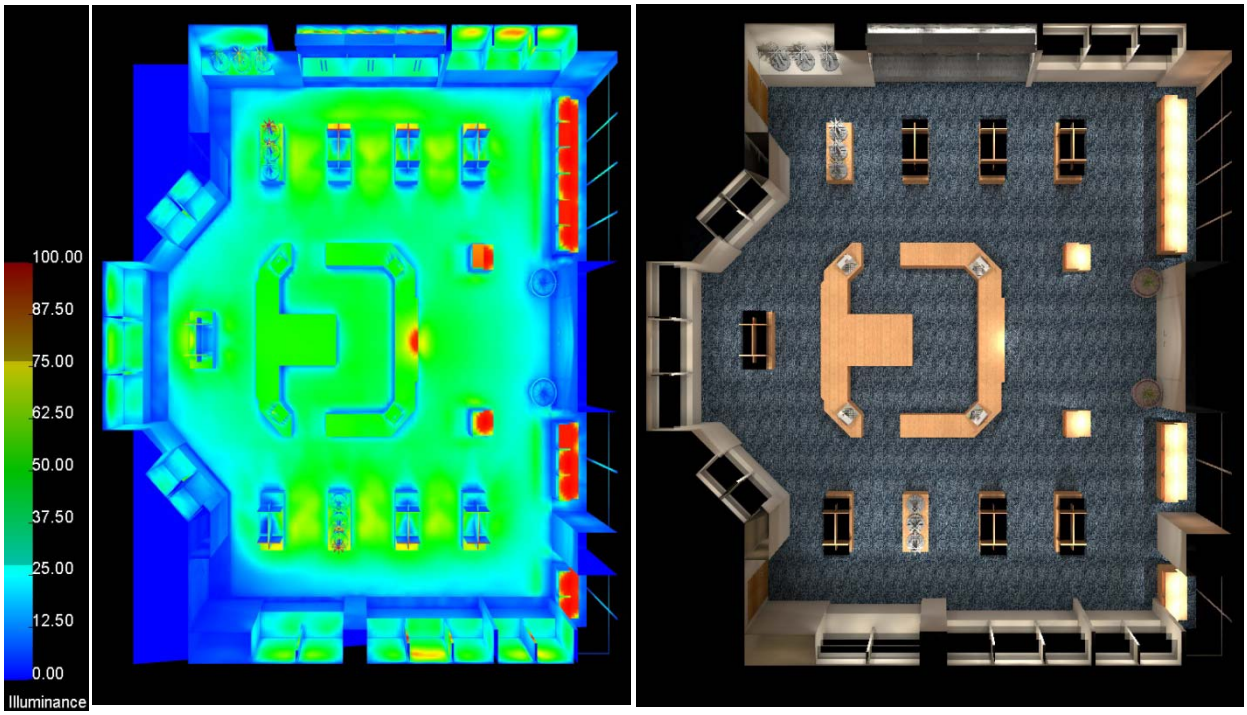


Figure 28 | Gift Shop Front Perspective Pseudo Color and Render (fc)

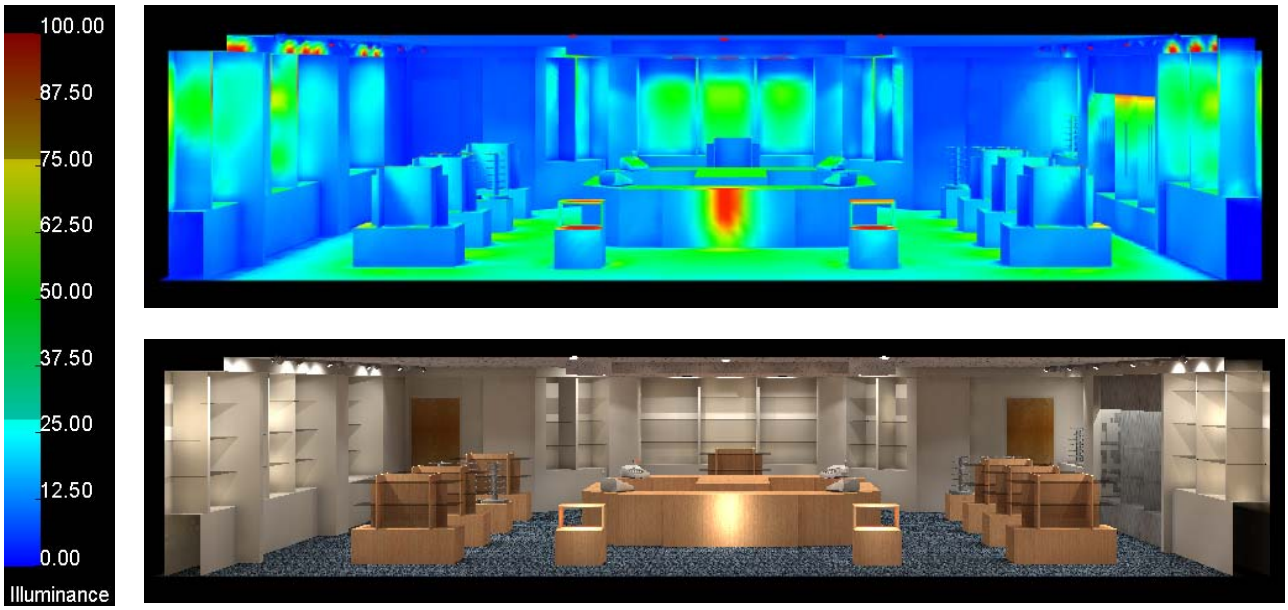


Figure 29 | Gift Shop Perspective Pseudo Color and Render (fc)

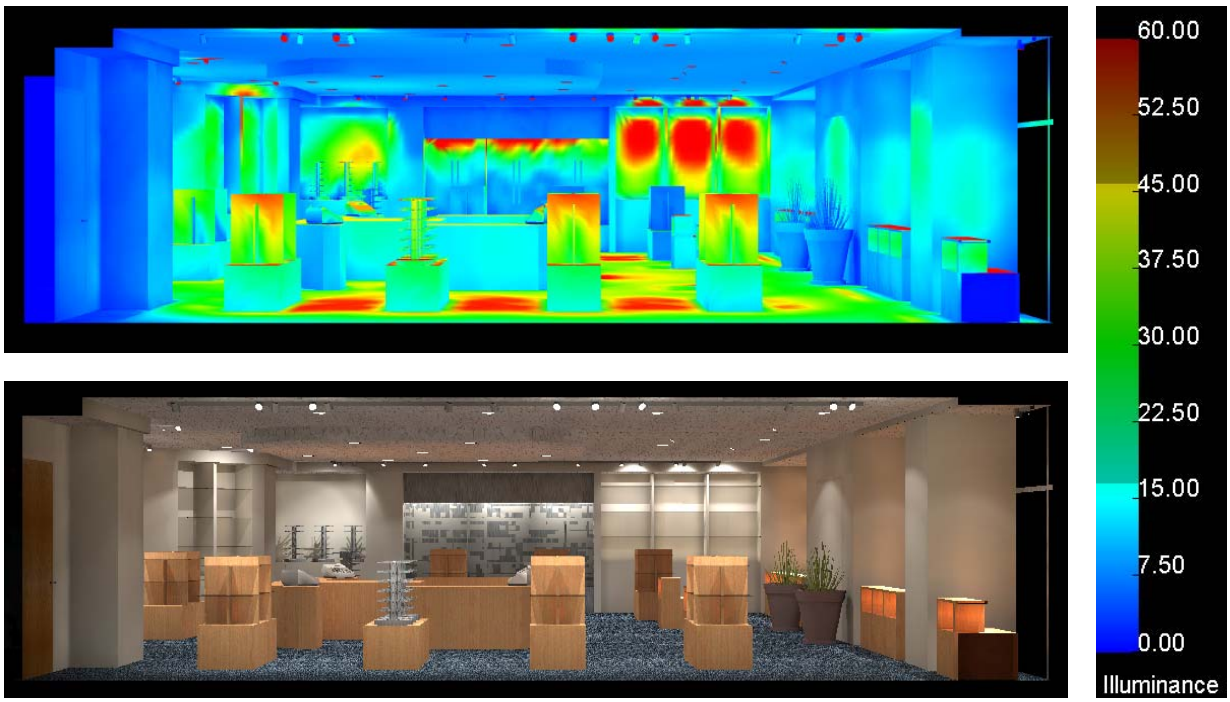


Figure 30 | Gift Shop Perspective Pseudo Color and Render (fc)

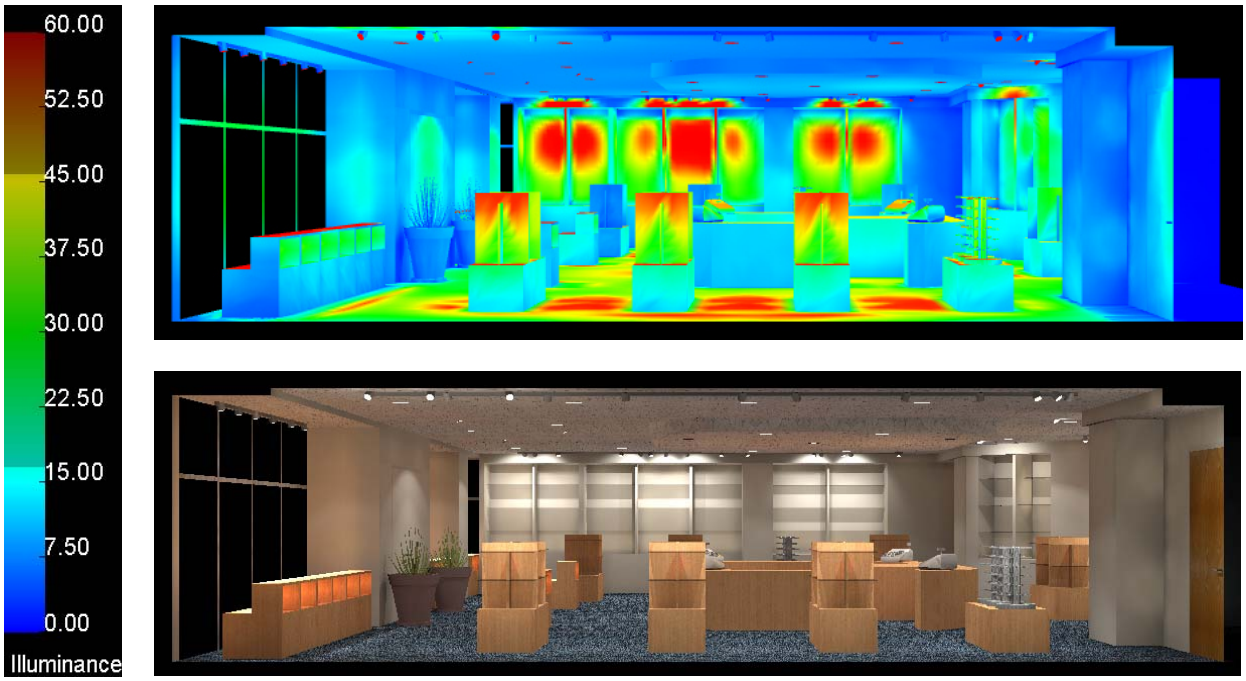


Figure 31 | Gift Shop Perspective Pseudo Color and Render (fc)

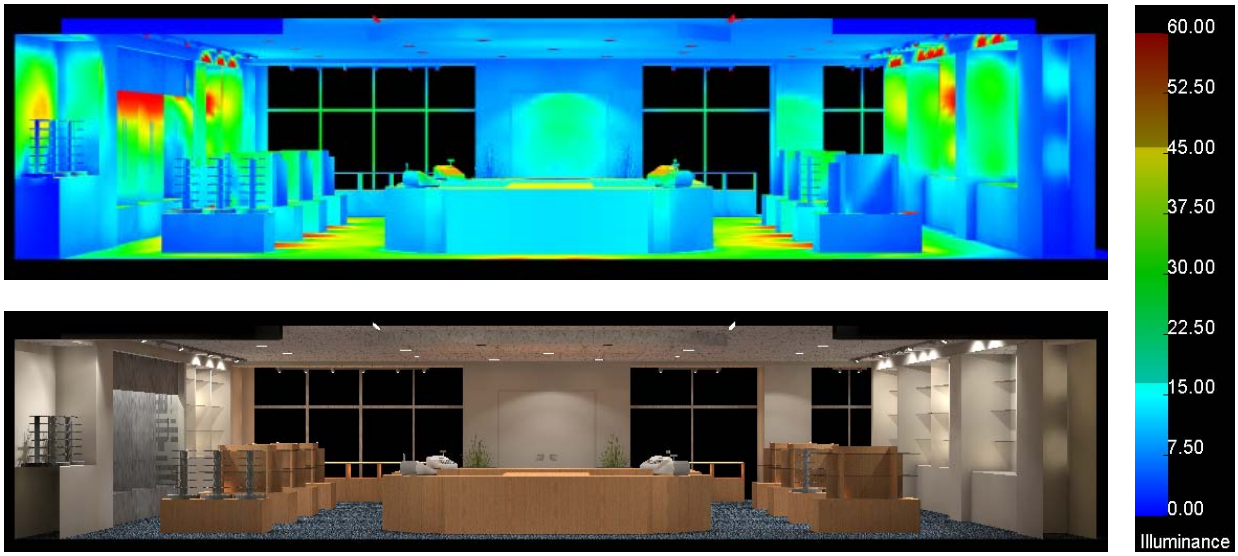


Figure 32 | Gift Shop Front Desk View Pseudo Color and Render (fc)

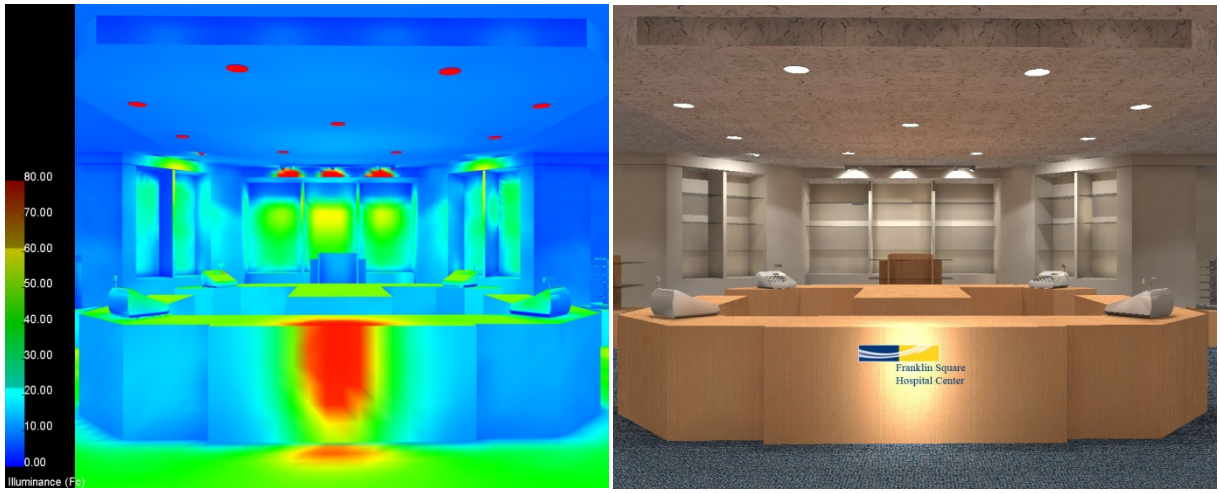


Figure 33 | Gift Shop View Pseudo Color and Render (fc)

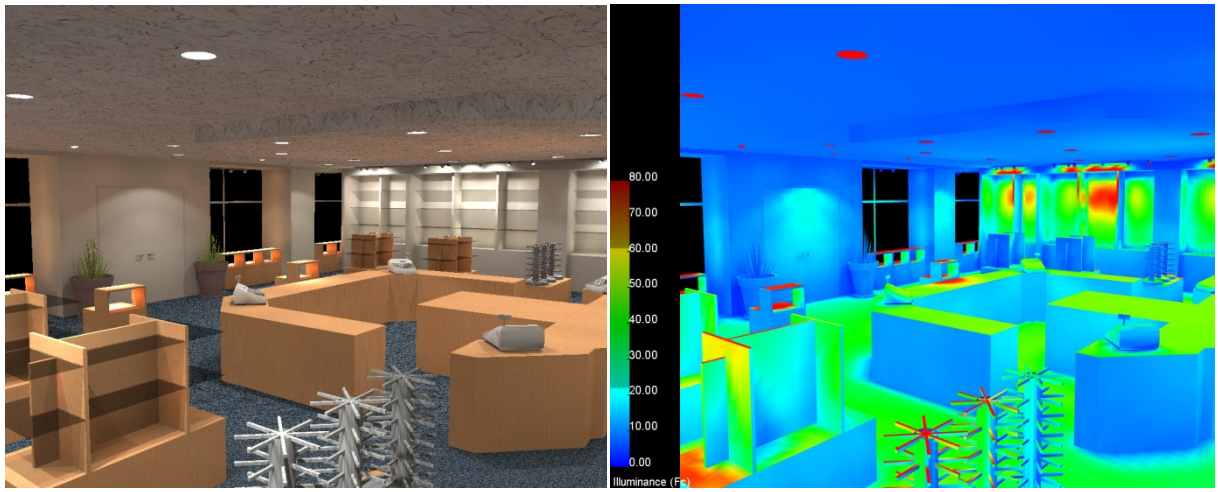


Figure 34 | Gift Shop View Pseudo Color and Render (fc)

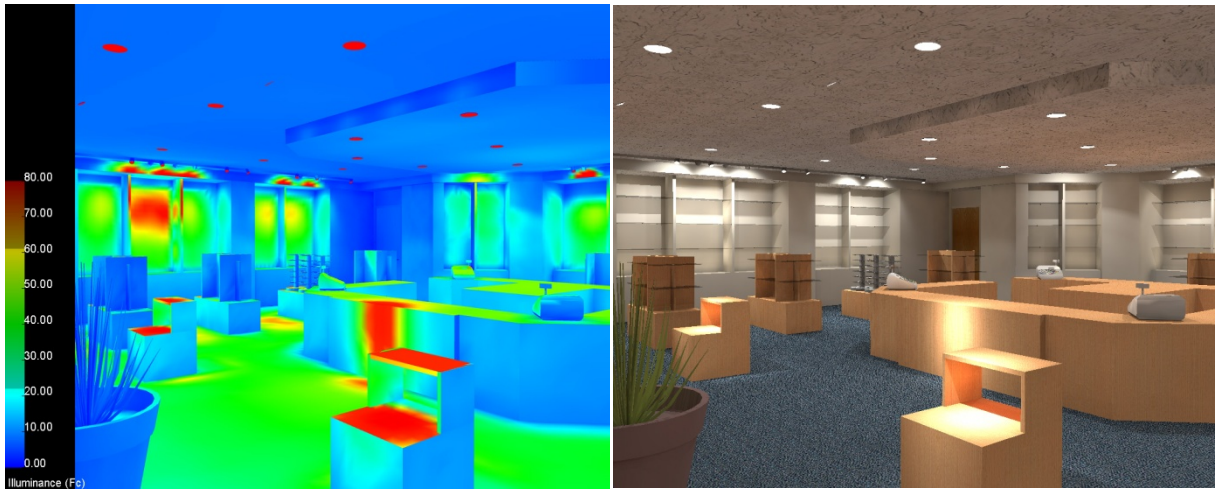


Figure 35 | Floor Horizontal Illuminance (fc)

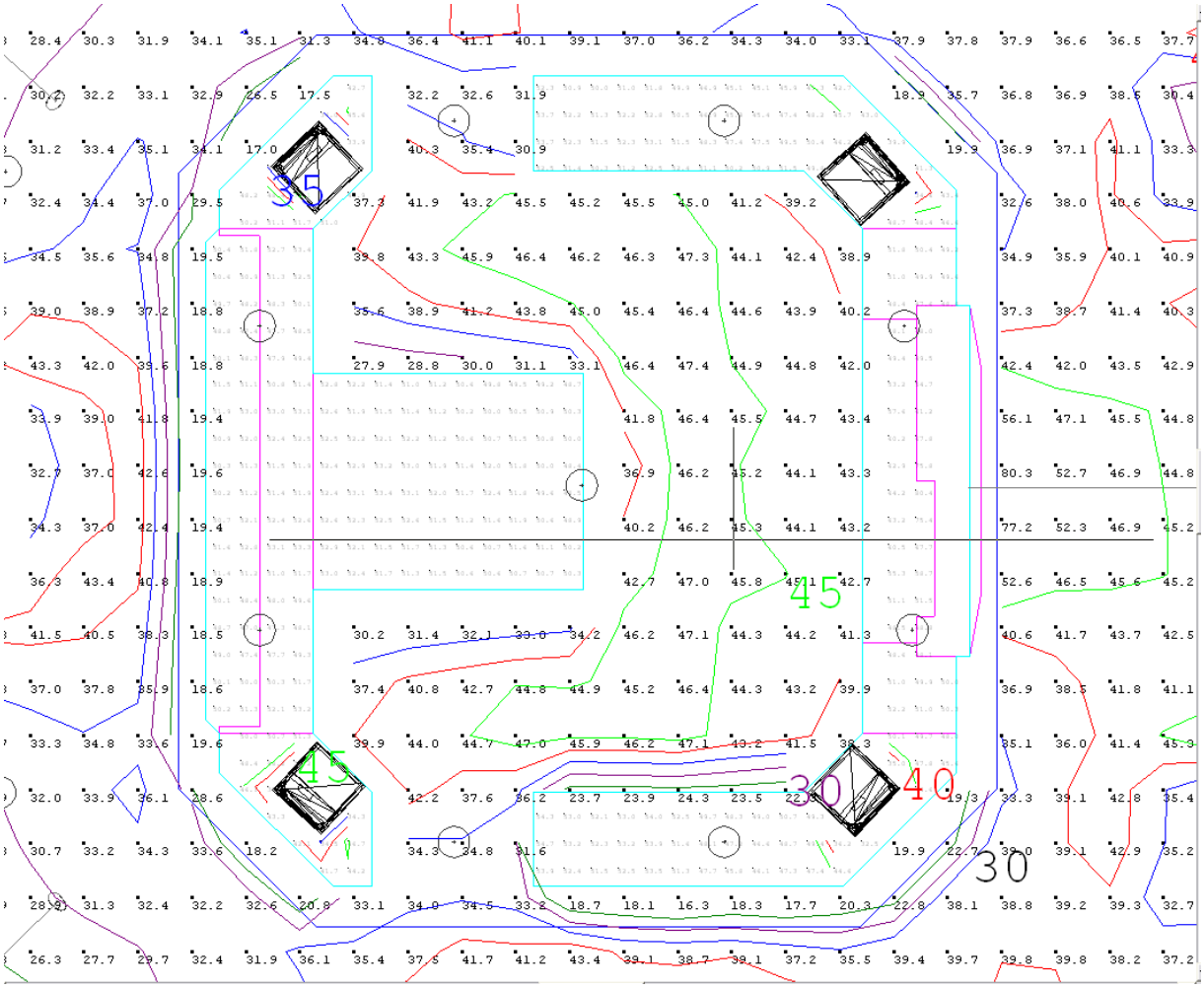
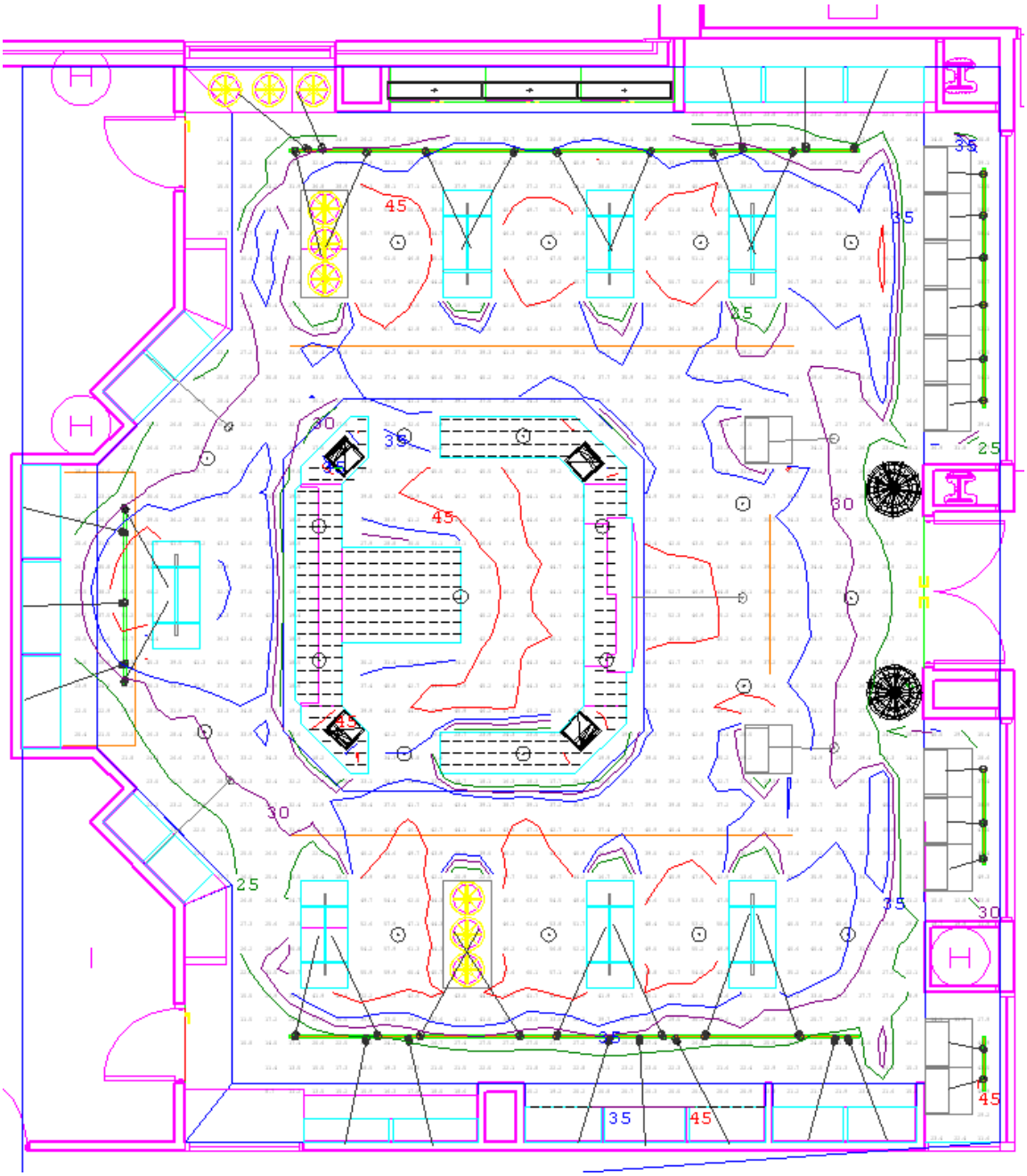


Figure 36 | Floor Horizontal Illuminance Contours (fc)



Energy Code Compliance

Figure 37 | Gift Shop Energy Calculation Summary

ASHRAE Standard 90.1 - 2007

SPACE	AREA (SF)	ALLOWABLE LIGHTING POWER DENSITY (W/SF)	ALLOWABLE WATTS	TOTAL WATTS USED
Sales Area	1630	1.7	2771	1378
Accent Lighting	-	1	2630	744

Additional Interior Lighting Power Allowance: [1000 Watts + (Area * 1.0 W/SF)] = 2630 W

Performance Summary

The lighting redesign of the gift shop creates an easy and nonchalant environment for browsing. The lighting throughout the space is not completely uniform due to the accent lighting that highlights the merchandise. The ambient lighting through the space is provided by compact fluorescent downlights. These same luminaires are used for the task lighting on the checkout desk. The horizontal illumination on the desk surface at 2.5 feet is uniform to ensure the cashier can perform tasks under proper lighting conditions.

The track mounted wide flood and flood wallwasher luminaires provide an even distribution for the area on the wall display case or floor mounted shelving unit that is being highlighted. The flexibility with using track heads in the gift shop situation allows adjustments to be made depending on different merchandise for the seasons and so forth.

The store-front display cases adjacent to the three story atrium space are also highlighted with track luminaires. Narrow spots create a point of interest using a high luminance to catch the eye of people walking past to draw them into the gift shop. The adjustability of the track fixtures allows for variety of scenarios and displays to grab people's attention.

Another detail within the space is the recessed narrow spot track luminaire that provides accent light to the Franklin Square Hospital Center logo on the front of the desk. This logo is the first place that will draw a person's eye will travel when they enter the gift shop through the double doors. The spot luminaire should not be directly in someone's line of sight when working behind the desk. Veiling reflections from the desk may occur but the cash registers are places on the corners of the desk to avoid any glare from the accent light.

The gift shop lighting design meets ASHRAE Standard 90.1 – 2007 requirements and complies with the recommendations of IESNA. The one issue with the design would be that the wall washers provide a higher then desired vertical illumination. The calculations that were performed were done in a gift shop without merchandise. The reflectance of the walls will decrease with merchandise assuming it is not all white items. The decrease in reflectance will decrease the amount of illumination throughout the space.

Figure 38 | Gift Shop Performance Summary

GRID LOCATIONS	AVG (fc)	MAX (fc)	MIN (fc)	MAX/MIN
Desk Surface (2.5' AFF)	50.24	80.4	32.1	2.50
Floor	34.55	80.3	8.6	9.34
Wall Display Case (vertical)	19.88	91.6	4.5	20.36

Electrical Redesign

For complete spatial description of the gift shop, see page 26.

Electrical Design Objectives/Criteria

The gift shop is served by two panels, one normal power and the other, emergency power. Both panelboards have a 480Y/277V, 3PH, 4W voltage system. These panelboards were recalculated for the branch circuits that were affected but the lighting redesign.

The gift shop is controlled by three single pole switches. These three lighting zones within the room are all on the same branch circuit that was redesigned. The following are existing lighting panelboards which are highlighted to specify the redesigned circuit. The panelboard worksheets and schedules are based and calculated for the new lighting design.

See Appendix A for complete lighting plans with circuiting

Figure 39 | Existing Panelboard LP11 Schedule

WIRING PANEL SCHEDULE

	PANEL: LP11 (NORMAL)			MAINS: MLO								AMPS: 100			AIC: 25,000
	VOLTAGE: 480Y/277	WIRES: 4		PHASE: 3								MOUNTING: SURFACE			LOC: ELEC RM 1406
CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT	A	A	B	B	C	C	CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT
1	LTG: N TEAM STAT, PAT RM #1-7	1	20	3/4"C.W/2#12+1#12GRD.	13.8	12.6	-	-	-	-	2	LTG: WAIT, CNTRL CORR, CONF	1	20	3/4"C.W/2#12+1#12GRD.
3	LTG: NORTH CORRIDORS	1	20	3/4"C.W/2#12+1#12GRD.	-	-	14.5	4.7	-	-	4	LTG: MAIL, MAT STOR, CORR	1	20	3/4"C.W/2#12+1#12GRD.
5	LTG: PAT RM #8-21, NOURISH	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	14.1	10.5	6	LTG: WAIT, ADMIT OFF, MEDIT	1	20	3/4"C.W/2#12+1#12GRD.
7	LTG: PAT RM #22-33, MEDS 1216	1	20	3/4"C.W/2#12+1#12GRD.	13.1	13.5	-	-	-	-	8	LTG: GIFT SHOP	1	20	3/4"C.W/2#12+1#12GRD.
9	LTG: S TEAM STAT/CORRS	1	20	3/4"C.W/2#12+1#12GRD.	-	-	14	2	-	-	10	LTG: COFFEE SHOP	1	20	3/4"C.W/2#12+1#12GRD.
11	LTG: PAT RM #34-48	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	11.9	0	12	SPARE	1	20	-
13	SPARE	1	20	-	0	0	-	-	-	-	14	SPARE	1	20	-
15	SPARE	1	20	-	-	-	0	0	-	-	16	SPARE	1	20	-
17	SPARE	1	20	-	-	-	-	-	0	0	18	SPARE	1	20	-
19	SPARE	1	20	-	0	0	-	-	-	-	20	SPARE	1	20	-
21	SPARE	1	20	-	-	-	0	0	-	-	22	SPARE	1	20	-
23	SPACE	1	-	-	-	-	-	-	0	0	24	SPACE	1	-	-
25	SPACE	1	-	-	0	0	-	-	-	-	26	SPACE	1	-	-
27	SPACE	1	-	-	-	-	0	0	-	-	28	SPACE	1	-	-
29	SPACE	1	-	-	-	-	-	-	0	0	30	SPACE	1	-	-
31	-	-	-	-	26	0	-	-	-	-	32	SPACE	1	-	-
33	ACU-4: MAIN ENT VESTIBULE	3	40	M110	-	-	26	0	-	-	34	SPACE	1	-	-
35	-	-	-	-	-	-	-	-	26	0	36	SPACE	1	-	-
37	-	-	-	-	1.6	0	-	-	-	-	38	SPACE	1	-	-
39	EF-9: CHAPEL STORAGE	3	15	M99	-	-	1.6	0	-	-	40	SPACE	1	-	-
41		-	-	-	-	-	-	-	1.6	0	42	SPACE	1	-	-
	CONNECTED LOAD	69 A		TOTAL PHASE A	81 A		-		-			CONNECTED LOAD	57.5 KVA		
	DEMAND LOAD	80 A		TOTAL PHASE B	-		63 A		-						
				TOTAL PHASE C	-		-		64 A						

Figure 40 | New Panelboard LP11 Worksheet

PANELBOARD SIZING WORKSHEET

Panel Tag---------->				LP11	Panel Location:			Electrical Room 1406			
Nominal Phase to Neutral Voltage------->				277	Phase:			3			
Nominal Phase to Phase Voltage-------->				480	Wires:			4			
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	Lighting	3	Team, rm 1-	13.8	A	0.90	3440	3823		
2	A	Lighting	3	Wait, corr, co	12.6	A	0.90	3141	3490		
3	B	Lighting	3	N corridors	14.5	A	0.90	3615	4017		
4	B	Lighting	3	Mail, mat, co	4.7	A	0.90	1172	1302		
5	C	Lighting	3	m 8-21, Nou	14.1	A	0.90	3515	3906		
6	C	Lighting	3	Wait, off, mec	10.5	A	0.90	2618	2909		
7	A	Lighting	3	m 22-33, me	13.1	A	0.90	3266	3629		
8	A	Lighting	3	Gift shop	11.71	A	0.90	2919	3244		
9	B	Lighting	3	Team, corrs	14	A	0.90	3490	3878		
10	B	Lighting	3	Coffee shop	2	A	0.90	499	554		
11	C	Lighting	3	Rm 34-48	11.9	A	0.90	2967	3296		
12	C	Spare	9	-	0	A	1.00	0	0		
13	A	Spare	9	-	0	A	1.00	0	0		
14	A	Spare	9	-	0	A	1.00	0	0		
15	B	Spare	9	-	0	A	1.00	0	0		
16	B	Spare	9	-	0	A	1.00	0	0		
17	C	Spare	9	-	0	A	1.00	0	0		
18	C	Spare	9	-	0	A	1.00	0	0		
19	A	Spare	9	-	0	A	1.00	0	0		
20	A	Spare	9	-	0	A	1.00	0	0		
21	B	Spare	9	-	0	A	1.00	0	0		
22	B	Spare	9	-	0	A	1.00	0	0		
23	C				0	A	1.00	0	0		
24	C				0	A	1.00	0	0		
25	A				0	A	1.00	0	0		
26	A				0	A	1.00	0	0		
27	B				0	A	1.00	0	0		
28	B				0	A	1.00	0	0		
29	C				0	A	1.00	0	0		
30	C				0	A	1.00	0	0		
31	A	HVAC Fans	6	ACU-4 Vestil	26	A	0.85	6122	7202		
32	A				0	A	1.00	0	0		
33	B	HVAC Fans	6	ACU-4 Vestil	26	A	0.85	6122	7202		
34	B				0	A	1.00	0	0		
35	C	HVAC Fans	6	ACU-4 Vestil	26	A	0.85	6122	7202		
36	C				0	A	1.00	0	0		
37	A	HVAC Fans	6	EF-9 Chape	1.6	A	0.95	421	443		
38	A				0	A	1.00	0	0		
39	B	HVAC Fans	6	EF-9 Chape	1.6	A	0.95	421	443		
40	B				0	A	1.00	0	0		
41	C	HVAC Fans	6	EF-9 Chape	1.6	A	0.95	421	443		
42	C				0	A	1.00	0	0		
PANEL TOTAL								50.3	57.0	Amps=	68.6

PHASE LOADING		kW	kVA	%	Amps
PHASE TOTAL	A	19.3	21.8	38%	78.8
PHASE TOTAL	B	15.3	17.4	31%	62.8
PHASE TOTAL	C	15.6	17.7	31%	64.0

LOAD CATAGORIES			Connected			Demand				Ver. 104
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		0.0	0.0		0.0	0.0			
2	computers		0.0	0.0		0.0	0.0			
3	fluorescent lighting		30.6	34.0		30.6	34.0	0.90		
4	HID lighting		0.0	0.0		0.0	0.0			
5	incandescent lighting		0.0	0.0		0.0	0.0			
6	HVAC fans		19.6	22.9		19.6	22.9	0.86		
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						50.3	57.0			
Spare Capacity			20%			10.1	11.4			
Total Design Loads						60.3	68.4	0.88	Amps=	82.3

Figure 41 | New Panelboard LP11 Schedule

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	LP11	MIN. C/B AIC:	25K
SIZE/TYPE BUS:	225A	PANEL LOCATION:	Electrical Room 1406	OPTIONS:	
SIZE/TYPE MAIN:	110A/3P C/B	PANEL MOUNTING:	SURFACE		(4) #2, (1) #6 G, 1-1/4" C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	Team, rm 1-7	3440	20A/1P	1	*			2	20A/1P	3141	Wait, corr, conf	Lighting
Lighting	N corridors	3615	20A/1P	3		*		4	20A/1P	1172	Mail, mat, corr	Lighting
Lighting	Rm 8-21, Nour	3515	20A/1P	5			*	6	20A/1P	2618	Wait, off, medit	Lighting
Lighting	Rm 22-33, med	3266	20A/1P	7	*			8	20A/1P	2919	Gift shop	Lighting
Lighting	Team, corrs	3490	20A/1P	9		*		10	20A/1P	499	Coffee shop	Lighting
Lighting	Rm 34-48	2967	20A/1P	11			*	12	20A/1P	0	-	Spare
Spare	-	0	20A/1P	13	*			14	20A/1P	0	-	Spare
Spare	-	0	20A/1P	15		*		16	20A/1P	0	-	Spare
Spare	-	0	20A/1P	17			*	18	20A/1P	0	-	Spare
Spare	-	0	20A/1P	19	*			20	20A/1P	0	-	Spare
Spare	-	0	20A/1P	21		*		22	20A/1P	0	-	Spare
0	0	0	-	23			*	24	-	0	0	0
0	0	0	-	25	*			26	-	0	0	0
0	0	0	-	27		*		28	-	0	0	0
0	0	0	-	29			*	30	-	0	0	0
HVAC Fans	ACU-4 Vestib	6122	-	31	*			32	-	0	0	0
HVAC Fans	ACU-4 Vestib	6122	40A/3P	33		*		34	-	0	0	0
HVAC Fans	ACU-4 Vestib	6122	-	35			*	36	-	0	0	0
HVAC Fans	EF-9 Chapel	421	-	37	*			38	-	0	0	0
HVAC Fans	EF-9 Chapel	421	15A/3P	39		*		40	-	0	0	0
HVAC Fans	EF-9 Chapel	421	-	41			*	42	-	0	0	0

CONNECTED LOAD (KW) - A Ph.	19.31	TOTAL DESIGN LOAD (KW)	60.32
CONNECTED LOAD (KW) - B Ph.	15.32	POWER FACTOR	0.88
CONNECTED LOAD (KW) - C Ph.	15.64	TOTAL DESIGN LOAD (AMPS)	82

Feeder Size Calculation

82.3 A * 125% = 102.875 A

110A Circuit Breaker, (4) #2 AWG CU THWN, (1) #6 AWG CU Ground, 1¼ EMT Conduit

Figure 42 | Existing Panelboard E1L11 Schedule

WIRING PANEL SCHEDULE

	PANEL: E1L11 (LIFE SAFETY)			MAINS: MLO								AMPS: 100			AIC: 35,000
	VOLTAGE: 480Y/277	WIRES: 4		PHASE: 3								MOUNTING: SURFACE			LOC: ELEC RM 1406
CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT	A	A	B	B	C	C	CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT
1	-	-	-	-	18	0	-	-	-	-	2	-	-	-	-
3	XFMR T-8	3	45	FEEDER 72	-	-	18	0	-	-	4	SPACE	3	-	-
5	-	-	-	-	-	-	-	-	18	0	6	-	-	-	-
7	LTG: NORTH WING EGRESS	1	20	3/4"C.W/2#12+1#12GRD.	6.3	0	-	-	-	-	8	SPARE	1	20	-
9	LTG: SOUTH WING EGRESS	1	20	3/4"C.W/2#12+1#12GRD.	-	-	8.8	0	-	-	10	SPARE	1	20	-
11	LTG: WEST EGRESS	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	4.7	0	12	SPARE	1	20	-
13	SPACE	1	-	-	0	0	-	-	-	-	14	SPACE	1	-	-
15	SPACE	1	-	-	-	-	0	0	-	-	16	SPACE	1	-	-
17	SPACE	1	-	-	-	-	-	-	0	0	18	SPACE	1	-	-
19	SPACE	1	-	-	0	0	-	-	-	-	20	SPACE	1	-	-
21	SPACE	1	-	-	-	-	0	0	-	-	22	SPACE	1	-	-
23	SPACE	1	-	-	-	-	-	-	0	0	24	SPACE	1	-	-
25	SPACE	1	-	-	0	0	-	-	-	-	26	SPACE	1	-	-
27	SPACE	1	-	-	-	-	0	0	-	-	28	SPACE	1	-	-
29	SPACE	1	-	-	-	-	-	-	0	0	30	SPACE	1	-	-
31	SPACE	1	-	-	0	0	-	-	-	-	32	SPACE	1	-	-
33	SPACE	1	-	-	-	-	0	0	-	-	34	SPACE	1	-	-
35	SPACE	1	-	-	-	-	-	-	0	0	36	SPACE	1	-	-
37	SPACE	1	-	-	0	0	-	-	-	-	38	SPACE	1	-	-
39	SPACE	1	-	-	-	-	0	0	-	-	40	SPACE	1	-	-
41	SPACE	1	-	-	-	-	-	-	0	0	42	SPACE	1	-	-
	CONNECTED LOAD	25 A		TOTAL PHASE A	24 A		-		-			CONNECTED LOAD	20.5 KVA		
	DEMAND LOAD	26 A		TOTAL PHASE B	-		27 A		-						
				TOTAL PHASE C	-		-		23 A						

Figure 43 | New Panelboard E1L11 Worksheet

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					LP11	Panel Location:			Electrical Room 1406		
Nominal Phase to Neutral Voltage------->					277	Phase:			3		
Nominal Phase to Phase Voltage-------->					480	Wires:			4		
Pos	Ph.	Load Type	Cat.	Location	Load	Units	l. PF	Watts	VA	Remarks	
1	A	Transformer	-	xfmr T-8	18	A	0.90	4487	4986		
2	A					A	1.00	0	0		
3	B	Transformer	-	xfmr T-8	18	A	0.90	4487	4986		
4	B					A	1.00	0	0		
5	C	Transformer	-	xfmr T-8	18	A	0.90	4487	4986		
6	C					A	1.00	0	0		
7	A	Lighting	3	North egress	6.3	A	0.90	1571	1745		
8	A	Spare	9			A	1.00	0	0		
9	B	Lighting	3	South egress	8.8	A	0.90	2194	2438		
10	B	Spare	9			A	1.00	0	0		
11	C	Lighting	3	West egress	4.74	A	0.90	1182	1313		
12	C	Spare	9			A	1.00	0	0		
13	A					A	1.00	0	0		
14	A					A	1.00	0	0		
15	B					A	1.00	0	0		
16	B					A	1.00	0	0		
17	C					A	1.00	0	0		
18	C					A	1.00	0	0		
19	A					A	1.00	0	0		
20	A					A	1.00	0	0		
21	B					A	1.00	0	0		
22	B					A	1.00	0	0		
23	C					A	1.00	0	0		
24	C					A	1.00	0	0		
25	A					A	1.00	0	0		
26	A					A	1.00	0	0		
27	B					A	1.00	0	0		
28	B					A	1.00	0	0		
29	C					A	1.00	0	0		
30	C					A	1.00	0	0		
31	A					A	1.00	0	0		
32	A					A	1.00	0	0		
33	B					A	1.00	0	0		
34	B					A	1.00	0	0		
35	C					A	1.00	0	0		
36	C					A	1.00	0	0		
37	A					A	1.00	0	0		
38	A					A	1.00	0	0		
39	B					A	1.00	0	0		
40	B					A	1.00	0	0		
41	C					A	1.00	0	0		
42	C				0	A	1.00	0	0		
PANEL TOTAL								18.4	20.5	Amps=	24.6

PHASE LOADING		kW	kVA	%	Amps	
PHASE TOTAL	A	6.1	6.7	33%	24.3	
PHASE TOTAL	B	6.7	7.4	36%	26.8	
PHASE TOTAL	C	5.7	6.3	31%	22.7	

LOAD CATAGORIES		Connected			Demand				Ver. 104
		kW	kVA	DF	kW	kVA	PF		
1	receptacles	0.0	0.0		0.0	0.0			
2	computers	0.0	0.0		0.0	0.0			
3	fluorescent lighting	4.9	5.5		4.9	5.5	0.90		
4	HID lighting	0.0	0.0		0.0	0.0			
5	incandescent lighting	0.0	0.0		0.0	0.0			
6	HVAC fans	0.0	0.0		0.0	0.0			
7	heating	0.0	0.0		0.0	0.0			
8	kitchen equipment	0.0	0.0		0.0	0.0			
9	unassigned	13.5	15.0		13.5	15.0	0.90		
Total Demand Loads					18.4	20.5			
Spare Capacity		20%			3.7	4.1			
Total Design Loads					22.1	24.5	0.90	Amps=	29.5

Figure 44 | New Panelboard E1L11 Schedule

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	LP11	MIN. C/B AIC:	35K
SIZE/TYPE BUS:	100A	PANEL LOCATION:	Electrical Room 1406	OPTIONS:	
SIZE/TYPE MAIN:	100A/3P C/B	PANEL MOUNTING:	SURFACE		(4) #8, (1) #8 G, 3/4" C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Transformer	xfmr T-8	4487	-	1	*			2	-	0	0	0
Transformer	xfmr T-8	4487	45A/3P	3		*		4	-	0	0	0
Transformer	xfmr T-8	4487	-	5			*	6	-	0	0	0
Lighting	North egress	1571	20A/1P	7	*			8	20A/1P	0	0	Spare
Lighting	South egress	2194	20A/1P	9		*		10	20A/1P	0	0	Spare
Lighting	West egress	1182	20A/1P	11			*	12	20A/1P	0	0	Spare
0	0	0	-	13	*			14	-	0	0	0
0	0	0	-	15		*		16	-	0	0	0
0	0	0	-	17			*	18	-	0	0	0
0	0	0	-	19	*			20	-	0	0	0
0	0	0	-	21		*		22	-	0	0	0
0	0	0	-	23			*	24	-	0	0	0
0	0	0	-	25	*			26	-	0	0	0
0	0	0	-	27		*		28	-	0	0	0
0	0	0	-	29			*	30	-	0	0	0
0	0	0	-	31	*			32	-	0	0	0
0	0	0	-	33		*		34	-	0	0	0
0	0	0	-	35			*	36	-	0	0	0
0	0	0	-	37	*			38	-	0	0	0
0	0	0	-	39		*		40	-	0	0	0
0	0	0	-	41			*	42	-	0	0	0

CONNECTED LOAD (KW) - A Ph.	6.06	TOTAL DESIGN LOAD (KW)	22.09
CONNECTED LOAD (KW) - B Ph.	6.68	POWER FACTOR	0.90
CONNECTED LOAD (KW) - C Ph.	5.67	TOTAL DESIGN LOAD (AMPS)	30

Feeder Size Calculation

29.5 A * 125% = 36.875 A

100A Circuit Breaker, (4) #8 AWG CU THWN, (1) #8 AWG CU Ground, ¾" EMT Conduit

Lobby + Waiting Area | Circulation Space

Spatial Summary

The first area the patients see when they enter the emergency department is the lobby and reception/security desk. Paperwork will be filled out and directions will be given to the patient. The waiting areas and pediatric waiting areas are located adjacent to the reception desk. Ample seating is located against the walls of the space.

This essential circulation space brings visitors and patients into the hospital for the first time. It needs to have an inviting and welcoming impression but also be organized and easy to navigate. It is located on the ground floor of the hospital. The 2,447 square foot area encompasses a lobby with a reception/security desk, two emergency department waiting rooms and a pediatric emergency department waiting room.

The spaces are very geometric and are each rectangular in shape. The reception/security desk has an aesthetically pleasing curve on the side which breaks up the rough box shape of the rest of the space.

Drawings

Figure 45 | Lobby and Waiting Area Plan

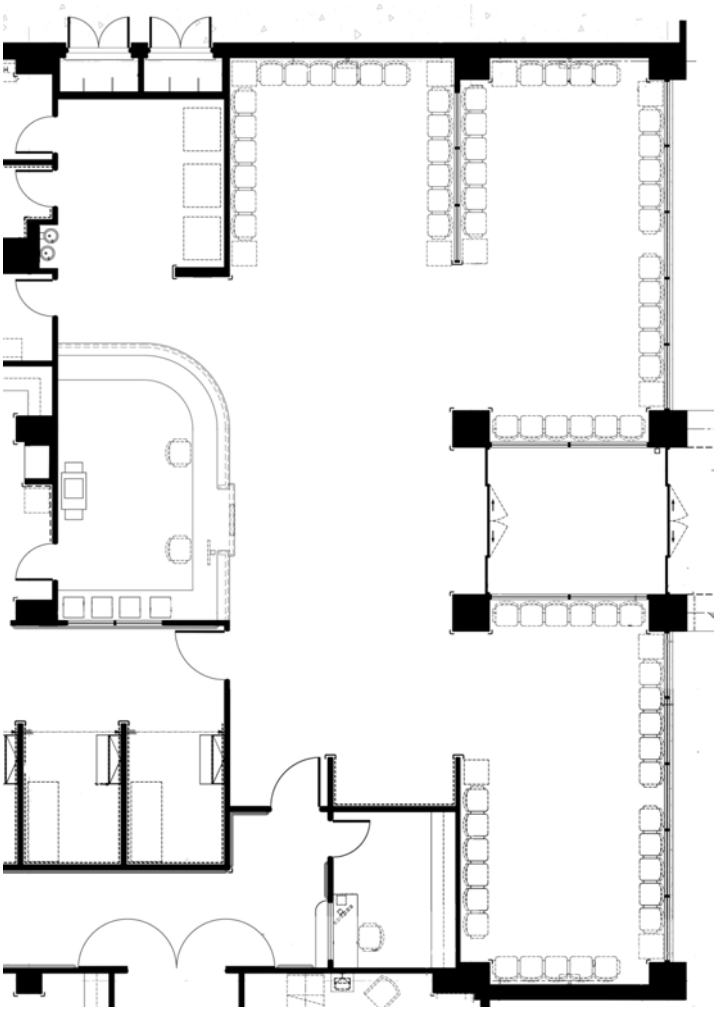


Figure 46 | Reception/Security Desk East Elevation

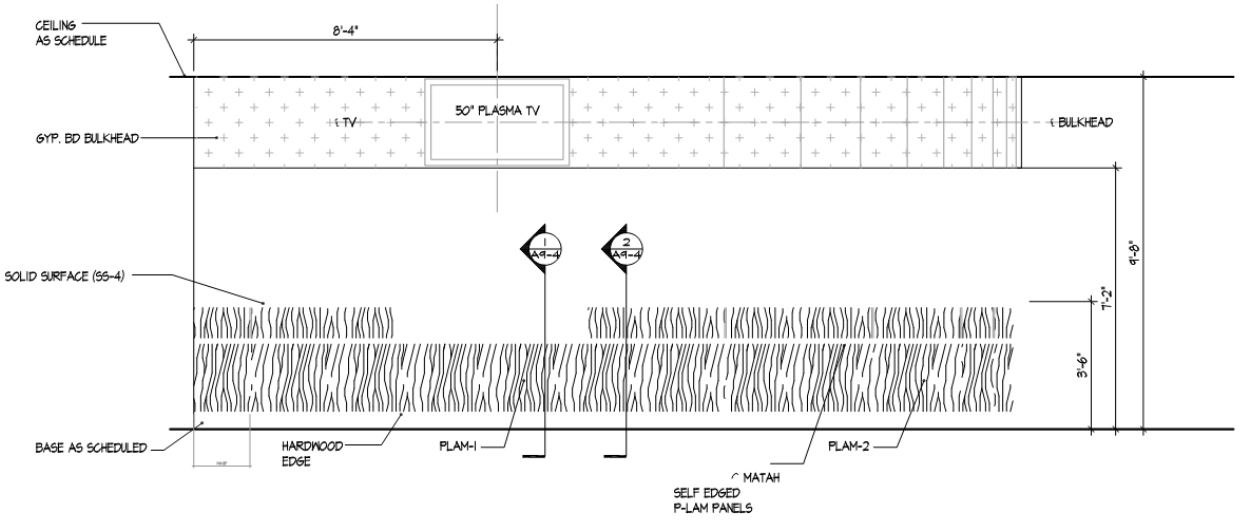


Figure 47 | Reception/Security Desk North Elevation

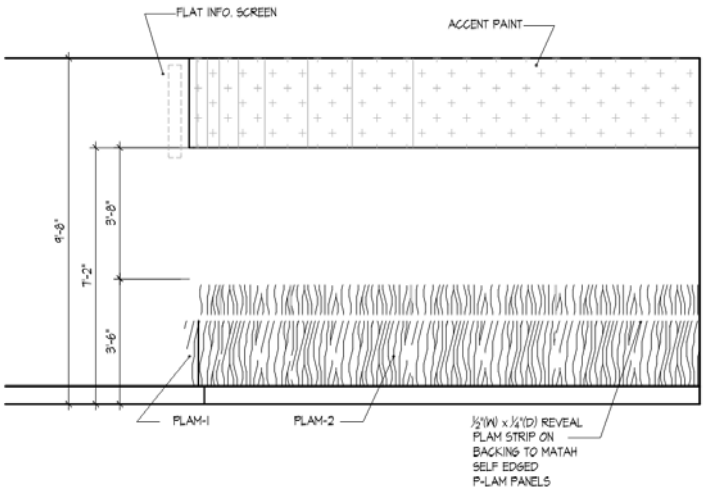


Figure 48 | Reception/Security Desk North Elevation

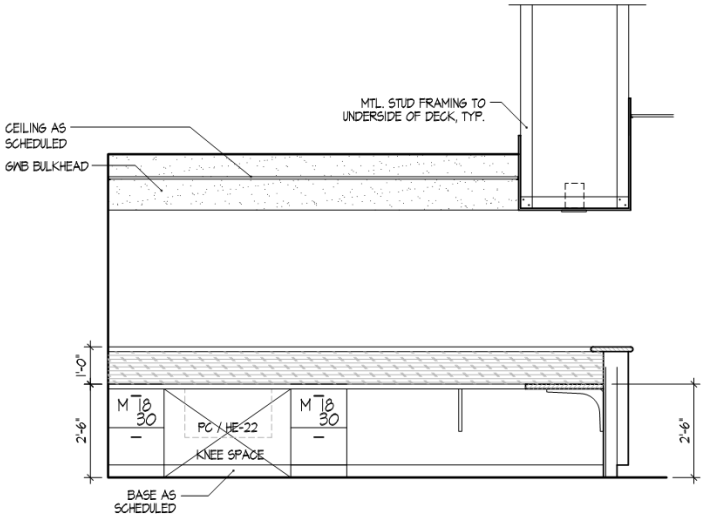


Figure 49 | Reception/Security Desk East Elevation

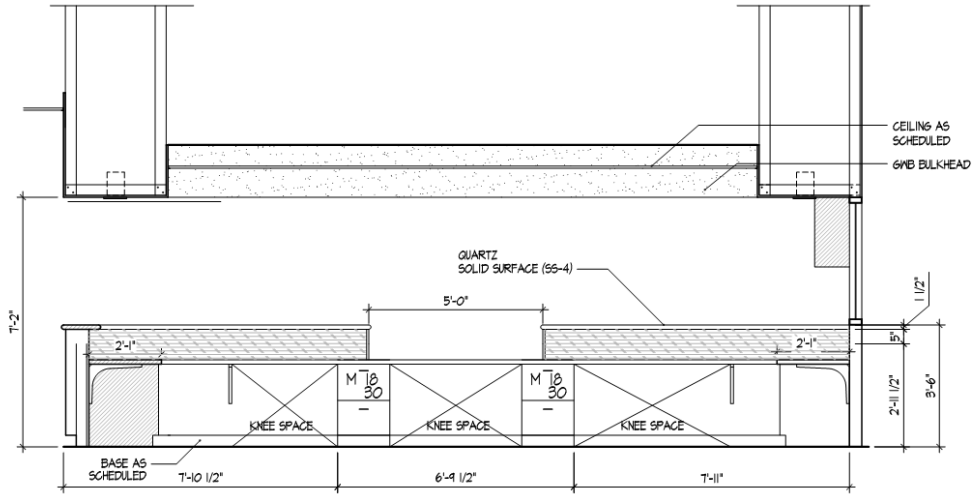
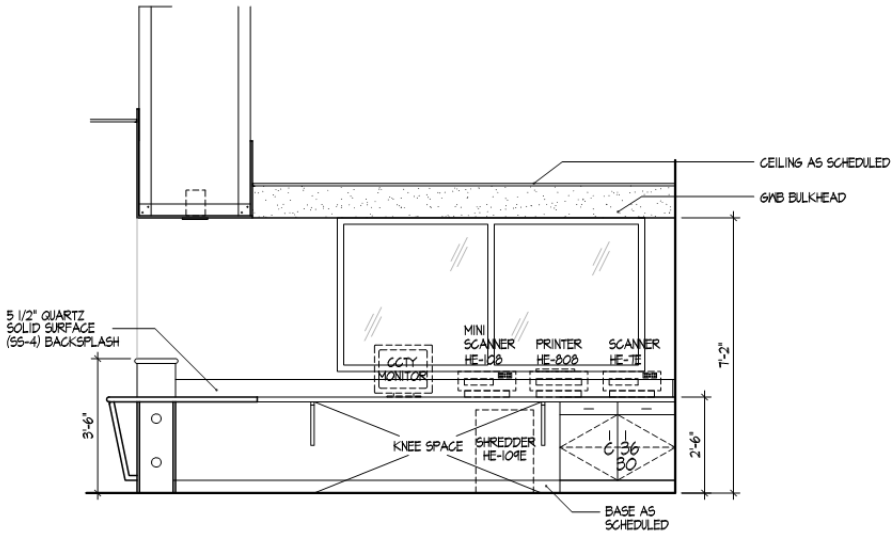


Figure 50 | Reception/Security Desk South Elevation



Surface Materials

Lobby

Ceiling – The ceiling consists of 2x2 acoustical ceiling tiles by Armstrong with angled tegular edges (ACT-1).

Walls – The walls are painted the color Softer Tan by Sherman Williams (IPS2-A).

Floor – The floor is covered with linoleum of different colors including Shell, Indian Summer and Arabesque by Forbo (LIN-1, -4, -5).

Door Frame - The door frames are painted the color Macadamia by Sherman Williams (IPS7-B).

Bulkhead – The bulkheads are painted the color Softer Tan by Sherman Williams (IPS2-A).

Base – The base is a 6” high black colored rubber base by Roppe (RE6-B).

Reception/Security

Ceiling – The ceiling consists of 2x2 acoustical ceiling tiles by Armstrong with angled tegular edges (ACT-1).

Walls – The walls are painted the color Softer Tan by Sherman Williams (IPS2-A).

Floor – The floor is covered with linoleum of color Shell by Forbo (LIN-1).

Door Frame - The door frames are painted the color Macadamia by Sherman Williams (IPS7-B).

Bulkhead – The bulkheads are painted the color Decorous Amber (orange) by Sherman Williams (IPS2-D).

Base – The base is a 6” high black colored rubber base by Roppe (RE6-B).

Waiting

Ceiling – The ceiling consists of 2x2 acoustical ceiling tiles by Armstrong with angled tegular edges (ACT-1).

Walls – The walls are painted the color Softer Tan and Ruskin Room Green (green) by Sherman Williams (IPS2-A, -E).

Storefront Walls – From the floor, a 2.75’ Solarban tempered glass with 5.25’ of Solarban tempered glass above and 2’ Solarban glass at the top all with mullions between them (GL-6T, -6).

Floor – The floor is covered with linoleum of different colors including Shell, Indian Summer and Arabesque by Forbo (LIN-1, -4, -5).

Door Frame - The door frames are painted the color Macadamia by Sherman Williams (IPS7-B).

Bulkhead – The bulkheads are painted the color Soulmate (purple) by Sherman Williams (IPS2-H).

Base – The base is a 6” high black colored rubber base by Roppe (RE6-B).

Pediatrics Waiting

Ceiling – The ceiling consists of 2x2 acoustical ceiling tiles by Armstrong with angled tegular edges (ACT-1).

Walls – The walls are painted the color Softer Tan and Ruskin Room Green (green) by Sherman Williams or the walls have a vinyl wall covering of a watercolor mural “ journey” that is 68”h x 252”w by Genesys/4walls.com (IPS2-A, -E, VWC-1).

Storefront Walls – From the floor, a 2.75’ Solarban tempered glass with 5.25’ of Solarban tempered glass above and 2’ Solarban glass at the top all with mullions between them (GL-6T, -6).

Floor – The floor is covered with linoleum of different colors including Shell, Indian Summer, Water Melon and Red Violet by Forbo (LIN-1, -4, -8, -11).

Door Frame - The door frames are painted the color Macadamia by Sherman Williams (IPS7-B).

Bulkhead – The bulkheads are painted the color Soulmate (purple) by Sherman Williams (IPS2-H).

Base – The base is a 6” high black colored rubber base by Roppe (RE6-B).

Figure 51 | Lobby and Waiting Area Material Reflectance Properties

MATERIALS	DESCRIPTION	REFLECTANCE
ACT-1	Fine fissured #1732 2x2 acoustical ceiling tile	0.74
IPS2-A	SW 6141 Softer tan paint	0.81
IPS2-D	SW 0007 Decorous amber paint	0.5
IPS2-E	SW 0042 Ruskin room green paint	0.5
IPS2-H	SW 6270 Soulmate paint	0.49
IPS7-B	SW 6142 Macadamia paint	0.97
LIN-1	ME-3075 Shell linoleum	0.45
LIN-4	ME-3164 Indian summer linoleum	0.17
LIN-5	ME-3123 Arabesque linoleum	0.23
LIN-8	ME-3133 Water melon linoleum	0.41
LIN-11	345 Red violet linoleum	0.31
RB6-B	P100 Black rubber base	0.18
VWC-1	M 5370 1 Mural vinyl wall covering	0.23

Figure 52 | Lobby and Waiting Area Glass Transmittance Properties

MATERIALS	DESCRIPTION	TRANSMITTANCE
GL-6	1" Insulated solarban glass	0.68
GL-6T	1" Insulated solarban tempered glass	0.68

Furnishings

The reception/security desk is fixed in location as well as the chairs provided for visitors and patients in the waiting areas. The desk is covered in a natural wood laminate with wood edging.

Tasks/Activities

The main tasks in this space occur at the reception/security desk which is reading, writing and conversing with patients and visitors. Within the waiting areas, the main tasks include reading and writing. Once the visitors and patients enter into the lobby they should be guided to the reception/security desk and to the respective waiting areas from there.

Design Criteria

Interior, Health Care Facilities, Waiting Areas, Local for Reading (IESNA Handbook)

Appearance of Space and Luminaires (Important)

The appearance of the space should be comforting with one or two luminaire types at most to avoid causing visual clutter. The luminaires should be organized in a manner that would not distract the visitors or patients from what they are doing.

Color Appearance and Color Contrast (Very Important)

The CRI should be no less than 70 with a CCT of about 4100K since it is exposed to daylighting.

Daylighting Integration and Control (Very Important)

Daylighting affects the space in a kinetic way throughout the entire day. This creates a more please atmosphere for the patients and visitors as they wait to he attended to. It can be controlled with blinds or shades to allow the occupants to adjust the intensity of the sun as the day progresses.

Direct Glare (Important)

Direct glare is avoided in the space by incorporating smaller luminaires versus less larger apertures.

Flicker and Strobe effect (Very Important)

Using compact fluorescent lamps in the space allows for no flicker or strobe effect.

Light Distribution on Surfaces (Very Important)

The distribution of light on the surfaces in the circulation space should be no more than a 3:1 ratio of luminance.

Uniform Light Distribution on Surfaces (Somewhat Important)

Each surface should be uniformly illuminated, especially the floor, so the visitors and patients can find their way through the space.

Luminances of Room Surfaces (Very Important)

The walls of the space should each have a uniform luminance value. Scalloping is avoided since the luminaires are far enough away from the walls.

Modeling of Faces or Objects (Very Important)

Modeling of faces in a waiting area is essential to increase comfort level.

Reflected Glare (Important)

Televisions are present in the waiting areas therefore the reflected glare from the storefront will be avoided by the use of blinds or shades. The visual display terminals at the reception/security desk will not have luminaires placed directly behind them.

Source/Task/Eye geometry (Important)

The ambient lighting throughout the space is consistent to improve visibility for the visitors and patients.

Illuminance

Horizontal Illuminance (Important) – Category D – 30 fc

Vertical Illuminance (Important) – Category B – 5 fc

VDT Criteria

The televisions located in the waiting rooms on the south façade of the building can be shaded using the blinds or shades to avoid the glare from daylight. The VDT at the reception/security desk do not have luminaires behind them and the ambient light of the space illuminates them without glare.

Power Allowance (ASHRAE /IESNA Std. 90.1-2007)

Lobby – 1.3 W/ft^2

Controls Criteria

Photo sensors can be added to the space to reduce the total building load in addition to the existing switches behind the reception/security desk.

Accent Lighting Considerations

There are no accent lights within this circulation space.

Luminance Ratios (max:min)

Information desk – 3:1 to 5:1

Paper task and adjacent VDT screen - 3:1 or less

Psychological Aspects

The desired psychological impression a visitor or patient should have when they enter this space is relaxation. In healthcare facilities, especially emergency waiting areas, this is difficult to achieve. To achieve this goal through the lighting system, the light has to take the attention away from the occupants. This can be attained by illuminating the walls or peripheral objects and the uses of indirect lighting or lower levels of direct illumination. The reflectance of the walls should be lower with a rich color or material to enhance the feeling of relaxation.

A main focal point should be created on the wall behind the reception/security desk. This would allow the visitors and patients to see their destination right when they enter the space. A higher illumination on the painted wall behind the desk or on artwork that is hung on the wall is all that is necessary to create this focal point. The difference in the luminance ratios cause's people to become attracted that point in the space.

The counterpart system involves a feeling of tension. This can be created with simple downlights that do not directly provide luminance on the walls or ceiling. In this scenario the light comes straight down on a person, giving them the impression of being under a spot light.

Lighting Plans

See Appendix A for lighting plans

Luminaires

Figure 53 | Lobby and Waiting Area Luminaire Schedule

LOBBY + WAITING AREA LUMINAIRE SCHEDULE									
TYPE	IMAGE	MANUFACTURER	PRODUCT NAME	CATALOG NUMBER	DESCRIPTION	LAMP	INPUT WATTS	VOLTAGE	BALLAST
L		Winona Lighting	Illustra Satro	4801/30/FQ/277V/OA/BAL/STD	Intersecting 2-piece standard brushed aluminum finish with an etched opal acrylic 30" lens. Pendant is mounted 2.5 feet from ceiling	(4)F26DBX/830/ECO4P 97611 - GE CF plug in T4	116	277	(2)VEZ/2Q26/M2/BS Philips Advance
F		ERCO	Lightcast Downlight	22209.000	Cast aluminum housing designed with a heat sink. White powder coated cast aluminum mounting ring. Bright anodised aluminum darklight reflector. Size 7, 30° cut-off angle.	(2)F18DBX/830/ECO4P 97599 - GE CF plug in T4	43	277	VEZ/2Q18/M2/BS/277 Philips Advance
M		ERCO	Lightcast Downlight	22267.000	Cast aluminum housing designed with a heat sink. White powder coated cast aluminum mounting ring. Bright anodised aluminum darklight reflector. Size 5, 30° cut-off angle.	F18TBX/830/A/ECO 97625 - GE CF plug in T4	22	277	VEZ/1Q18/M2/BS Philips Advance
N		Elliptipar	Style 204	M204/150G/T/02/2/00/0	Extruded high purity aluminum housing with a semi-gloss white reflector. Semi-recessed adjustable wall washer. Microprismatic tempered glass lens.	CMH150TU/830/G12 20017 - GE ceramic metal halide T6	161	277	IMH/150/H/277 Philips Advance

See Appendix A for full luminaire schedule and cut sheets

Figure 54 | Lobby and Waiting Area Light Loss Factors

TYPE	BF	LLD	LDD	RSDD	TOTAL LLF
L	1.05	0.84	0.82	0.95	0.69
F	1.0	0.81	0.94	0.95	0.72
M	1.0	0.84	0.94	0.95	0.75
N	1.0	0.79	0.92	0.95	0.69

Controls

Occupancy sensors are placed within the waiting area to save energy

Figure 55 | Lobby and Waiting Area Control Schedule

LOBBY + WAITING AREA CONTROL SCHEDULE					
TYPE	IMAGE	MANUFACTURER	PRODUCT NAME	CATALOG NUMBER	DESCRIPTION
Y		Watt Stopper	Dual Technology Line Voltage Ceiling Sensor	DT-355	Passive infrared and ultrasonic dual technologies provide 360 of coverage. Ceiling mounted with a flat and unobtrusive appearance. No adjustments are necessary after line voltage installation.

See Appendix A for full equipment schedule and cut sheets

Performance Data

The following are renders and calculation grids that summarize the lobby and waiting area lighting redesign.

Figure 56 | Lobby and Waiting Area Plan Pseudo Color and Render (fc)

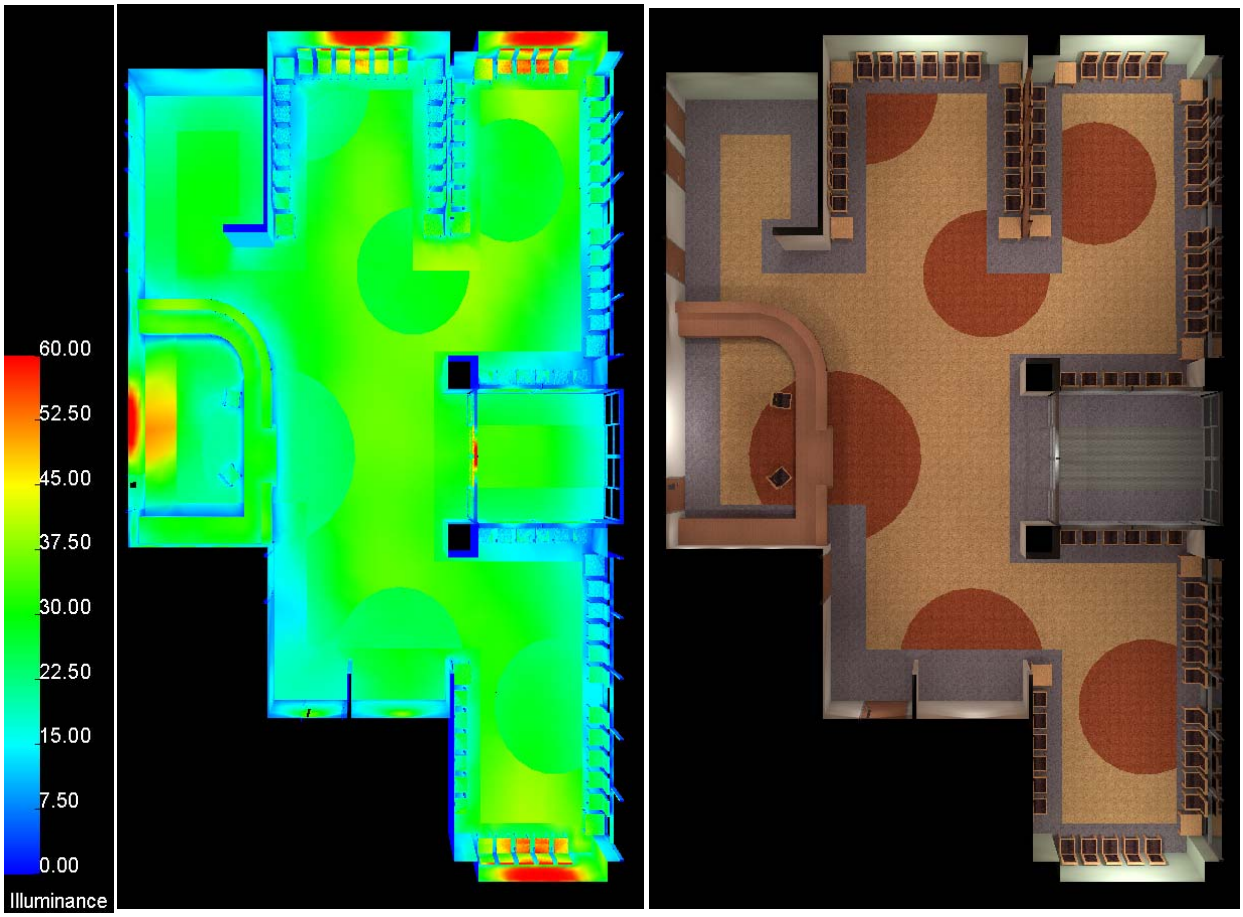


Figure 57 | Lobby and Waiting Area Perspective Pseudo Color and Render (fc)

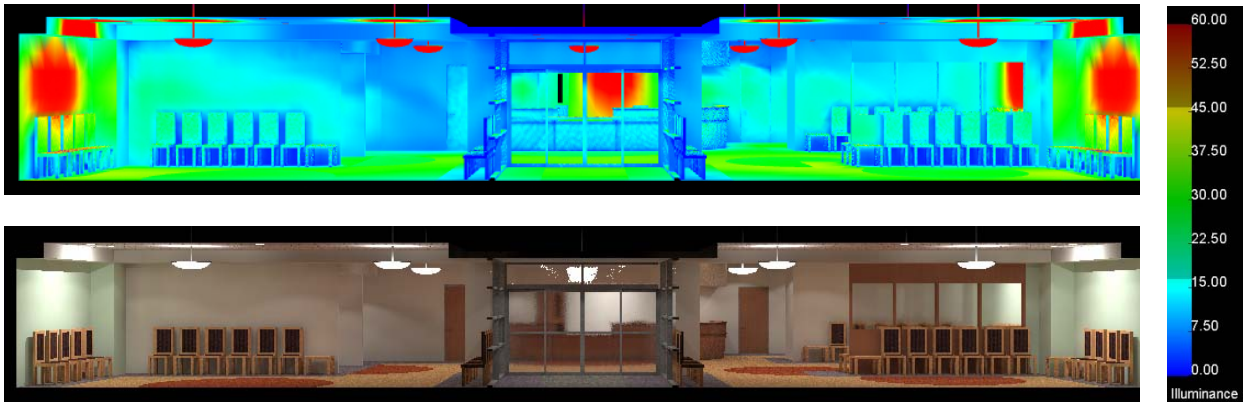


Figure 58 | Lobby and Waiting Area Perspective Pseudo Color and Render (fc)

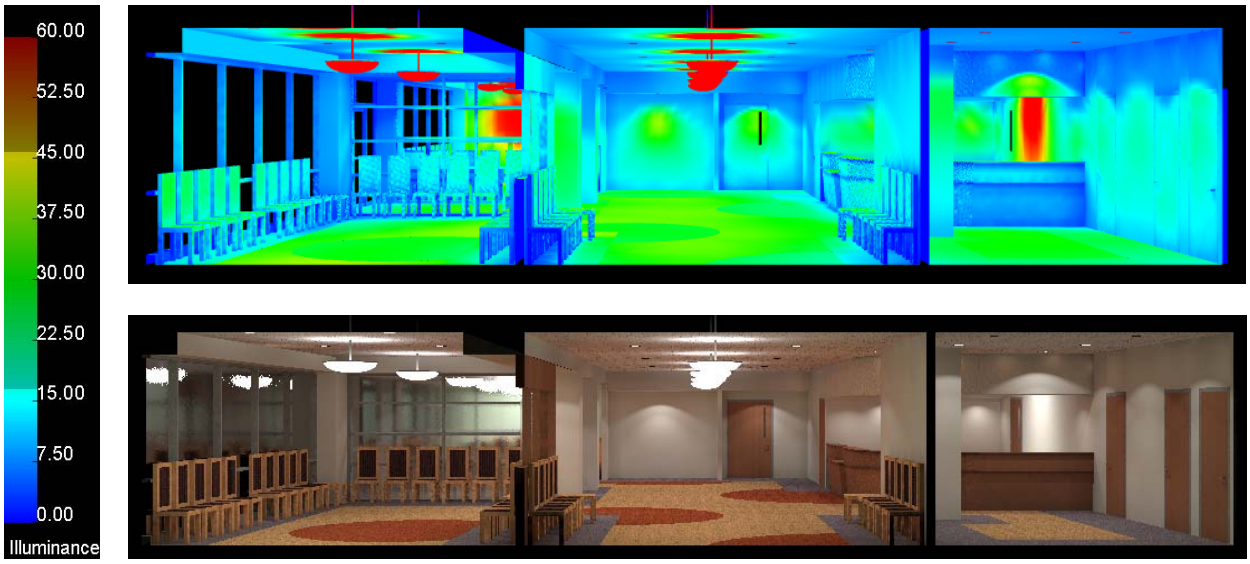


Figure 59 | Lobby and Waiting Area View Render and Pseudo Color (fc)

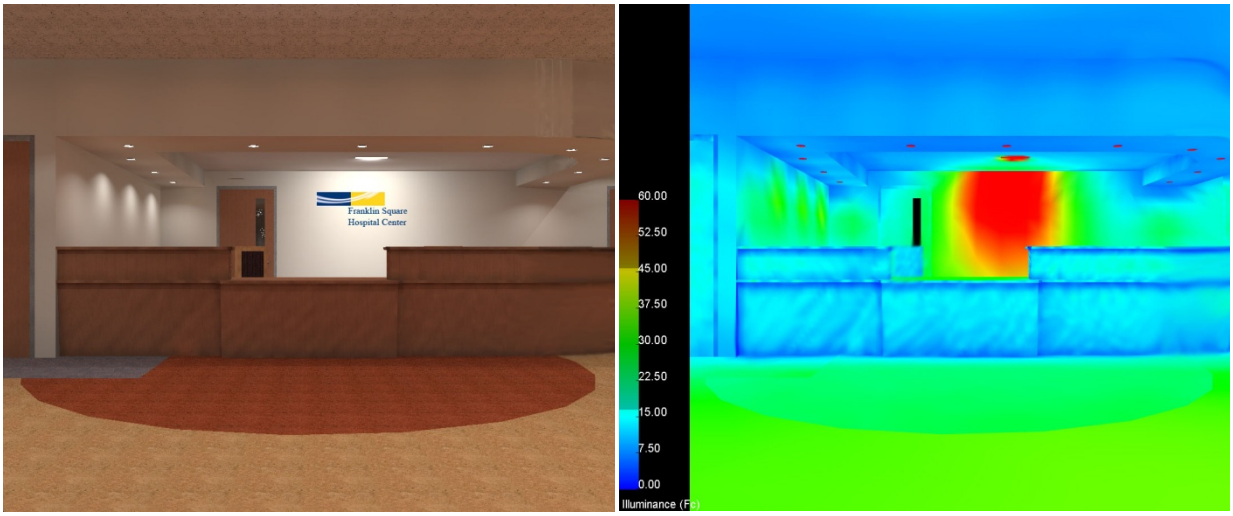


Figure 60 | Lobby and Waiting Area View Pseudo Color and Render (fc)

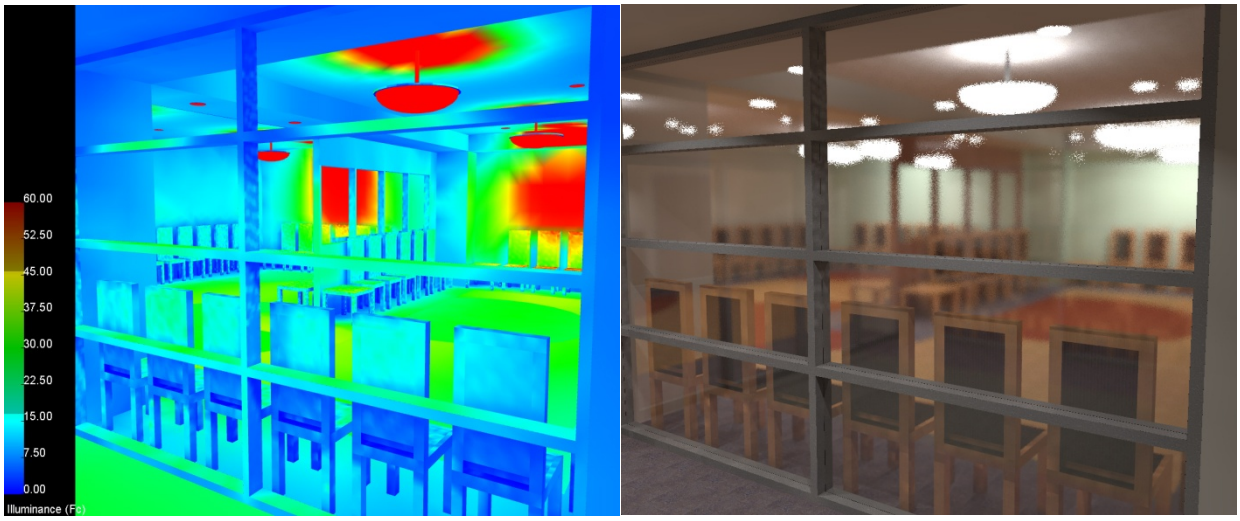


Figure 61 | Lobby and Waiting Area View Render and Pseudo Color (fc)

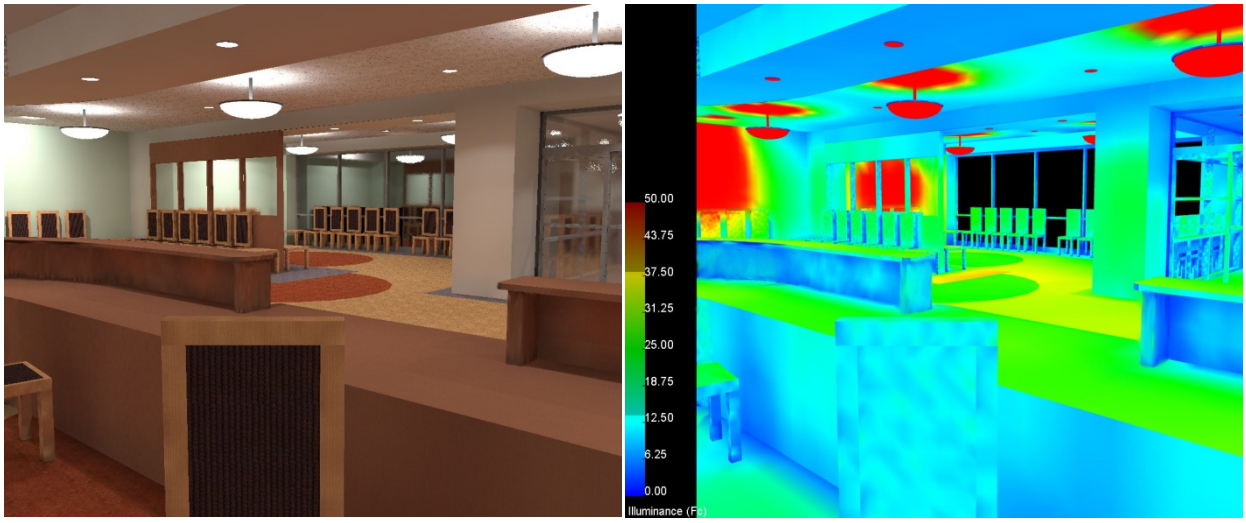


Figure 62 | Lobby and Waiting Area View Pseudo Color and Render (fc)

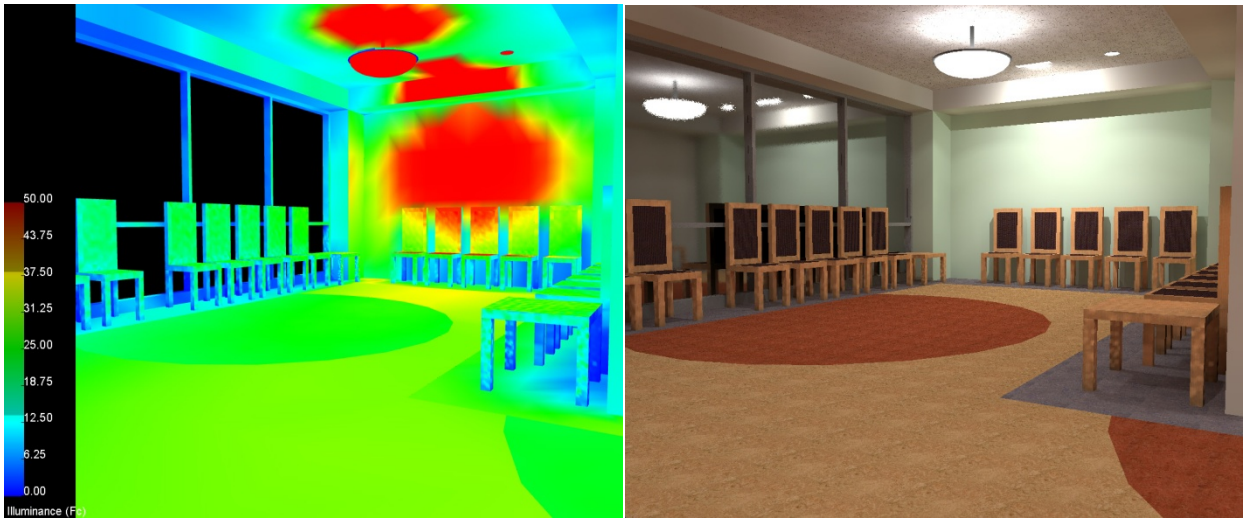
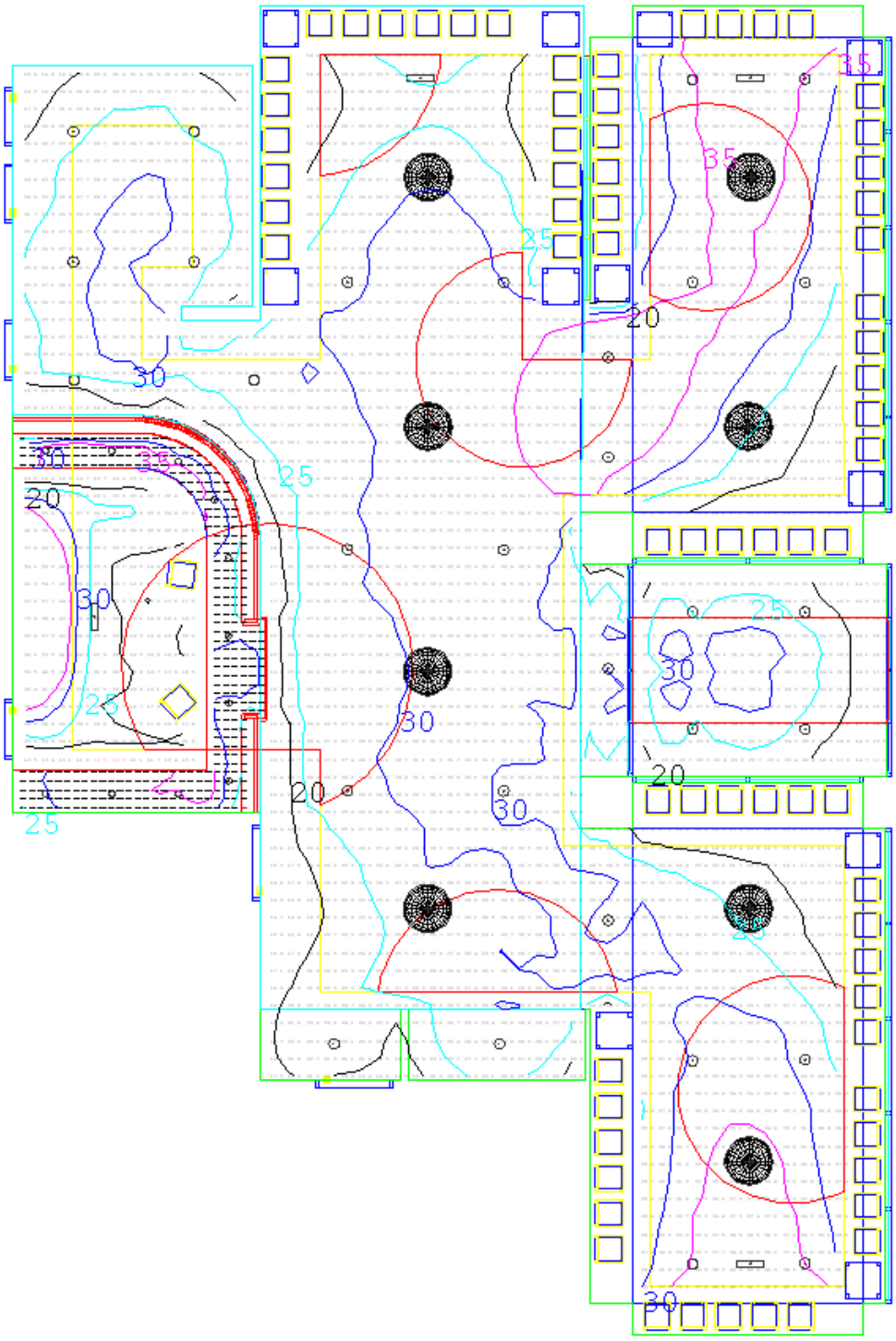


Figure 63 | Floor Horizontal Illuminance Contours (fc)



Energy Code Compliance

Figure 64 | Lobby and Waiting Area Energy Calculation Summary

ASHRAE Standard 90.1 - 2007

SPACE	AREA (SF)	ALLOWABLE LIGHTING POWER DENSITY (W/SF)	ALLOWABLE WATTS	TOTAL WATTS USED
Lobby	2776	1.3	3608.8	2760
Hospital Transition	180.7	1	180.7	172

Performance Summary

Ambient lighting in the redesigned lobby and waiting area reaches the floor directly and indirectly. The pendant luminaire is a direct-indirect fixture that allows lighting to reflect from the ceiling. The extra illumination on the ceiling makes the ceiling height look taller than normal. Direct downlights also add to the ambient lighting in the space. Smaller downlights supply task lighting for the receptionist and security attendant.

Most of the ambient light at the reception desk area is reflected off the wall behind the desk. The wall behind the desk is washed to highlight the Franklin Square Hospital Center logo that hangs there. this sign is important because the visitors enter the lobby and go straight to the reception desk to check in and immediately see the illuminated signage. This wall washer is found in the waiting area as well to accent the walls painted Ruskin Room Green.

The metal halide wallwasher's angle should be adjusted because the visitors sitting in the seats against the wall will encounter direct glare from the light source. A wall graze system was not implemented because the wall construction is flat gypsum wall board. A grazing system can accentuate any small flaws in a flat wall and this was avoided.

The space meets the ASHRAE Standard 90.1 -2007 lighting power density requirements and the IESNA recommendations.

Figure 65 | Lobby and Waiting Area Performance Summary

GRID LOCATIONS	AVG (fc)	MAX (fc)	MIN (fc)	MAX/MIN
Desk Surface (2.5' AFF)	31.18	39.8	21.9	1.82
Floor	27.96	73.7	10.6	6.95
Vestibule	24.26	32.5	12.6	2.58

Electrical Redesign

For complete spatial description of the lobby and waiting area, see page 45.

Electrical Design Objectives/Criteria

The lobby and waiting room area lighting is powered by one normal power and two emergency power panelboards that all have a 480Y/277V, 3PH, 4W voltage system. The task lighting and signage lighting by the reception desk are switched by a single pole located behind the desk. The vestibule is also switched by a single pole located on the column adjacent to the vestibule.

The remaining lighting loads will remain on until the occupancy sensor gets a vacant signal and switched the lights off. The emergency room is usually busy at any time of the day and night therefore these occupancy sensors may not be appropriate for the space.

The store-front façade in the pediatric emergency and emergency waiting room could use daylight sensors to dim or switch the luminaires in the space. HID uses step dimming which could cause confusion to the visitors that would occupy the space therefore it was not implemented in the research.

The redesigned lighting system is calculated and connected to the existing panelboards.

See Appendix A for complete lighting plans with circuiting

Figure 66 | Existing Panelboard LPG5 Schedule

WIRING PANEL SCHEDULE

	PANEL: LPG5 (NORMAL)			MAINS: MLO								AMPS: 100			AIC: 35,000
	VOLTAGE: 480Y/277	WIRES: 4		PHASE: 3								MOUNTING: SURFACE			LOC: ELEC RM 0703
CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT	A	A	B	B	C	C	CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT
1	LTG: ER CORRIDORS	1	20	3/4"C.W/2#12+1#12GRD.	13.3	12.7	-	-	-	-	2	LTG: PEDS TEAM STAT/CORRS	1	20	3/4"C.W/2#12+1#12GRD.
3	LTG: ER PSYCH WING, WAIT TLTS	1	20	3/4"C.W/2#12+1#12GRD.	-	-	9.6	11.2	-	-	4	LTG: PEDS RM #1-9, PLAYROOM	1	20	3/4"C.W/2#12+1#12GRD.
5	LTG: ER WAITING, CASHIER	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	12.4	14.2	6	LTG: CENTRAL TEAM STAT/CORRS	1	20	3/4"C.W/2#12+1#12GRD.
7	SPARE	1	20	-	0	13.6	-	-	-	-	8	LTG: TEAM #0324, 0320, CORRS	1	20	3/4"C.W/2#12+1#12GRD.
9	SPARE	1	20	-	-	-	0	0	-	-	10	SPARE	1	20	-
11	SPARE	1	20	-	-	-	-	-	0	0	12	SPARE	1	20	-
13	SPARE	1	20	-	0	0	-	-	-	-	14	SPARE	1	20	-
15	SPARE	1	20	-	-	-	0	0	-	-	16	SPARE	1	20	-
17	SPARE	1	20	-	-	-	-	-	0	0	18	SPARE	1	20	-
19	-	-	-	-	3	0	-	-	-	-	20	SPACE	1	-	-
21	DECON TANK PUMP	3	15	3/4"C.W/3#12+1#12GRD.	-	-	3	0	-	-	22	SPACE	1	-	-
23	-	-	-	-	-	-	-	-	3	0	24	SPACE	1	-	-
25	SPACE	1	-	-	0	0	-	-	-	-	26	SPACE	1	-	-
27	SPACE	1	-	-	-	-	0	0	-	-	28	SPACE	1	-	-
29	SPACE	1	-	-	-	-	-	-	0	0	30	SPACE	1	-	-
31	SPACE	1	-	-	0	0	-	-	-	-	32	SPACE	1	-	-
33	SPACE	1	-	-	-	-	0	0	-	-	34	SPACE	1	-	-
35	SPACE	1	-	-	-	-	-	-	0	0	36	SPACE	1	-	-
37	SPACE	1	-	-	0	0	-	-	-	-	38	SPACE	1	-	-
39	SPACE	1	-	-	-	-	0	0	-	-	40	SPACE	1	-	-
41	SPACE	1	-	-	-	-	-	-	0	0	42	SPACE	1	-	-
	CONNECTED LOAD	29 A		TOTAL PHASE A	43 A		-		-			CONNECTED LOAD	26.6 KVA		
	DEMAND LOAD	47 A		TOTAL PHASE B	-		24 A		-						
				TOTAL PHASE C	-		-		30 A						

Figure 67 | New Panelboard LPG5 Worksheet

PANELBOARD SIZING WORKSHEET

Panel Tag---------->				LPG5	Panel Location:			Electrical Room 0703			
Nominal Phase to Neutral Voltage------->				277	Phase:			3			
Nominal Phase to Phase Voltage-------->				480	Wires:			4			
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	Lighting	3	ER corridors	13.3	A	0.90	3316	3684		
2	A	Lighting	3	eds team, c	12.7	A	0.90	3166	3518		
3	B	Lighting	3	R psych, wa	9.14	A	0.90	2279	2532		
4	B	Lighting	3	Peds 1-9 pla	11.2	A	0.90	2792	3102		
5	C	Lighting	3	ER wait, cas	12.4	A	0.90	3091	3435		
6	C	Lighting	3	teams, cor	14.2	A	0.90	3540	3933		
7	A	Spare	9	-	0	A	1.00	0	0		
8	A	Lighting	3	Teams, corr	14.14	A	0.90	3525	3917		
9	B	Spare	9	-	0	A	1.00	0	0		
10	B	Spare	9	-	0	A	1.00	0	0		
11	C	Spare	9	-	0	A	1.00	0	0		
12	C	Spare	9	-	0	A	1.00	0	0		
13	A	Spare	9	-	0	A	1.00	0	0		
14	A	Spare	9	-	0	A	1.00	0	0		
15	B	Spare	9	-	0	A	1.00	0	0		
16	B	Spare	9	-	0	A	1.00	0	0		
17	C	Spare	9	-	0	A	1.00	0	0		
18	C	Spare	9	-	0	A	1.00	0	0		
19	A	HVAC Pump	6	Decon Pump	3	A	0.95	789	831		
20	A				0	A	1.00	0	0		
21	B	HVAC Pump	6	Decon Pump	3	A	0.95	789	831		
22	B				0	A	1.00	0	0		
23	C	HVAC Pump	6	Decon Pump	3	A	0.95	789	831		
24	C				0	A	1.00	0	0		
25	A				0	A	1.00	0	0		
26	A				0	A	1.00	0	0		
27	B				0	A	1.00	0	0		
28	B				0	A	1.00	0	0		
29	C				0	A	1.00	0	0		
30	C				0	A	1.00	0	0		
31	A				0	A	1.00	0	0		
32	A				0	A	1.00	0	0		
33	B				0	A	1.00	0	0		
34	B				0	A	1.00	0	0		
35	C				0	A	1.00	0	0		
36	C				0	A	1.00	0	0		
37	A				0	A	1.00	0	0		
38	A				0	A	1.00	0	0		
39	B				0	A	1.00	0	0		
40	B				0	A	1.00	0	0		
41	C				0	A	1.00	0	0		
42	C				0	A	1.00	0	0		
PANEL TOTAL								24.1	26.6	Amps=	32.0

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					10.8	11.9	45%	43.1
PHASE TOTAL	B					5.9	6.5	24%	23.3
PHASE TOTAL	C					7.4	8.2	31%	29.6

LOAD CATAGORIES			Connected			Demand				Ver. 104
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		0.0	0.0		0.0	0.0			
2	computers		0.0	0.0		0.0	0.0			
3	fluorescent lighting		21.7	24.1		21.7	24.1	0.90		
4	HID lighting		0.0	0.0		0.0	0.0			
5	incandescent lighting		0.0	0.0		0.0	0.0			
6	HVAC fans		2.4	2.5		2.4	2.5	0.95		
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						24.1	26.6			
Spare Capacity			20%			4.8	5.3			
Total Design Loads						28.9	31.9	0.90	Amps=	38.4

Figure 68 | New Panelboard LPG5 Schedule

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	LPG5	MIN. C/B AIC:	35K
SIZE/TYPE BUS:	100A	PANEL LOCATION:	Electrical Room 0703	OPTIONS:	
SIZE/TYPE MAIN:	100A/3P C/B	PANEL MOUNTING:	SURFACE		(4) #8, (1) #8 G, 3/4" C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	ER corridors	3316	20A/1P	1	*			2	20A/1P	3166	Peds team, cor	Lighting
Lighting	ER psych, wait	2279	20A/1P	3		*		4	20A/1P	2792	Peds 1-9 play	Lighting
Lighting	ER wait, cash	3091	20A/1P	5			*	6	20A/1P	3540	C teams, corrs	Lighting
Spare	-	0	20A/1P	7	*			8	20A/1P	3525	Teams, corrs	Lighting
Spare	-	0	20A/1P	9		*		10	20A/1P	0	-	Spare
Spare	-	0	20A/1P	11			*	12	20A/1P	0	-	Spare
Spare	-	0	20A/1P	13	*			14	20A/1P	0	-	Spare
Spare	-	0	20A/1P	15		*		16	20A/1P	0	-	Spare
Spare	-	0	20A/1P	17			*	18	20A/1P	0	-	Spare
HVAC Pump	Decon Pump	789	-	19	*			20	-	0	0	0
HVAC Pump	Decon Pump	789	15A/3P	21		*		22	-	0	0	0
HVAC Pump	Decon Pump	789	-	23			*	24	-	0	0	0
0	0	0	-	25	*			26	-	0	0	0
0	0	0	-	27		*		28	-	0	0	0
0	0	0	-	29			*	30	-	0	0	0
0	0	0	-	31	*			32	-	0	0	0
0	0	0	-	33		*		34	-	0	0	0
0	0	0	-	35			*	36	-	0	0	0
0	0	0	-	37	*			38	-	0	0	0
0	0	0	-	39		*		40	-	0	0	0
0	0	0	-	41			*	42	-	0	0	0

CONNECTED LOAD (KW) - A Ph.	10.80	TOTAL DESIGN LOAD (KW)	28.89
CONNECTED LOAD (KW) - B Ph.	5.86	POWER FACTOR	0.90
CONNECTED LOAD (KW) - C Ph.	7.42	TOTAL DESIGN LOAD (AMPS)	38

Feeder Size Calculation

38.4 A * 125% = 48 A

100A Circuit Breaker, (4) #8 AWG CU THWN, (1) #8 AWG CU Ground, ¾" EMT Conduit

Figure 69 | Existing Panelboard E2LG5 Schedule

WIRING PANEL SCHEDULE

	PANEL: E2LG5 (CRITICAL)			MAINS: MLO							AMPS: 100			AIC: 25,000
	VOLTAGE: 480Y/277	WIRES: 4		PHASE: 3							MOUNTING: SURFACE			LOC: ELEC RM 0703
CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT	A	A	B	B	C	C	CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT
1	LTG: TREAT RM #4-6, TEAM 0224	1	20	3/4"C.W/2#12+1#12GRD.	13.2	12.4	-	-	-	-	2	LTG: FAST TR #1-8, 11-16, TEAM ST	1	20	3/4"C.W/2#12+1#12GRD.
3	LTG: PEDS #4-12, TREAT RM #1-3	1	20	3/4"C.W/2#12+1#12GRD.	-	-	12.3	13.6	-	-	4	LTG: FAST TR #19-10, PSYCH TRT	1	20	3/4"C.W/2#12+1#12GRD.
5	LTG: PEDS #1-9, TEAM ST 0120	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	13.3	12.9	6	LTG: TRIAGE #1-10, WORK RM	1	20	3/4"C.W/2#12+1#12GRD.
7	LTG: TREAT RM #1-6, TEAM 0320	1	20	3/4"C.W/2#12+1#12GRD.	10.1	9.9	-	-	-	-	8	LTG: TEAM 0324, TREAT RM #7-11	1	20	3/4"C.W/2#12+1#12GRD.
9	LTG: TREAT RM #1-12	1	20	3/4"C.W/2#12+1#12GRD.	-	-	12.9	6.01	-	-	10	LTG: TEAM 0324, TREAT RM #1-6	1	20	3/4"C.W/2#12+1#12GRD.
11	LTG: TEAM 0220, TREAT RM #7-12	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	9.8	0	12	SPARE	1	20	-
13	LTG: AMBULANCE CANOPY	1	20	3/4"C.W/2#12+1#12GRD.	2.99	0	-	-	-	-	14	SPARE	1	20	-
15	SPARE	1	20	-	-	-	0	0	-	-	16	SPARE	1	20	-
17	SPARE	1	20	-	-	-	-	-	0	0	18	SPARE	1	20	-
19	SPARE	1	20	-	0	0	-	-	-	-	20	SPARE	1	20	-
21	SPARE	1	20	-	-	-	0	0	-	-	22	SPARE	1	20	-
23	SPARE	1	20	-	-	-	-	-	0	0	24	SPARE	1	20	-
25	SPARE	1	20	-	0	0	-	-	-	-	26	SPARE	1	20	-
27	SPACE	1	-	-	-	-	0	0	-	-	28	SPACE	1	-	-
29	SPACE	1	-	-	-	-	-	-	0	0	30	SPACE	1	-	-
31	SPACE	1	-	-	0	0	-	-	-	-	32	SPACE	1	-	-
33	SPACE	1	-	-	-	-	0	0	-	-	34	SPACE	1	-	-
35	SPACE	1	-	-	-	-	-	-	0	0	36	SPACE	1	-	-
37	SPACE	1	-	-	0	0	-	-	-	-	38	SPACE	1	-	-
39	SPACE	1	-	-	-	-	0	0	-	-	40	SPACE	1	-	-
41	SPACE	1	-	-	-	-	-	-	0	0	42	SPACE	1	-	-
	CONNECTED LOAD	43 A		TOTAL PHASE A	49 A		-		-			CONNECTED LOAD	35.8 KVA		
	DEMAND LOAD	54 A		TOTAL PHASE B	-		45 A		-						
				TOTAL PHASE C	-		-		36 A						

Figure 70 | New Panelboard E2LG5 Worksheet

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					E2LG5	Panel Location:			Electrical Room 0703		
Nominal Phase to Neutral Voltage------->					277	Phase:			3		
Nominal Phase to Phase Voltage-------->					480	Wires:			4		
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	Lighting	3	Rm 4-6, tean	13.2	A	0.90	3291	3656		
2	A	Lighting	3	1-8 11-16, t	12.4	A	0.90	3091	3435		
3	B	Lighting	3	ed 4-12,rm 1	12.3	A	0.90	3066	3407		
4	B	Lighting	3	19-10 psyc	13.6	A	0.90	3390	3767		
5	C	Lighting	3	eds 1-9, tea	13.3	A	0.90	3316	3684		
6	C	Lighting	3	r 1-10, wk r	12.38	A	0.90	3086	3429		
7	A	Lighting	3	R 1-6, team	9.13	A	0.90	2276	2529		
8	A	Lighting	3	Team, r 7-11	9.9	A	0.90	2468	2742		
9	B	Lighting	3	Room 1-12	12.9	A	0.90	3216	3573		
10	B	Lighting	3	Team, rm 1-	6.01	A	0.90	1498	1665		
11	C	Lighting	3	eam, rm 7-1	9.8	A	0.90	2443	2715		
12	C	Spare	9	-	0	A	1.00	0	0		
13	A	Lighting	3	Amb canopy	2.99	A	0.90	745	828		
14	A	Spare	9	-	0	A	1.00	0	0		
15	B	Spare	9	-	0	A	1.00	0	0		
16	B	Spare	9	-	0	A	1.00	0	0		
17	C	Spare	9	-	0	A	1.00	0	0		
18	C	Spare	9	-	0	A	1.00	0	0		
19	A	Spare	9	-	0	A	1.00	0	0		
20	A	Spare	9	-	0	A	1.00	0	0		
21	B	Spare	9	-	0	A	1.00	0	0		
22	B	Spare	9	-	0	A	1.00	0	0		
23	C	Spare	9	-	0	A	1.00	0	0		
24	C	Spare	9	-	0	A	1.00	0	0		
25	A	Spare	9	-	0	A	1.00	0	0		
26	A				0	A	1.00	0	0		
27	B				0	A	1.00	0	0		
28	B				0	A	1.00	0	0		
29	C				0	A	1.00	0	0		
30	C				0	A	1.00	0	0		
31	A				0	A	1.00	0	0		
32	A				0	A	1.00	0	0		
33	B				0	A	1.00	0	0		
34	B				0	A	1.00	0	0		
35	C				0	A	1.00	0	0		
36	C				0	A	1.00	0	0		
37	A				0	A	1.00	0	0		
38	A				0	A	1.00	0	0		
39	B				0	A	1.00	0	0		
40	B				0	A	1.00	0	0		
41	C				0	A	1.00	0	0		
42	C				0	A	1.00	0	0		
PANEL TOTAL								31.9	35.4	Amps=	42.6

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					11.9	13.2	37%	47.6
PHASE TOTAL	B					11.2	12.4	35%	44.8
PHASE TOTAL	C					8.8	9.8	28%	35.5

LOAD CATAGORIES			Connected			Demand				Ver. 104
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		0.0	0.0		0.0	0.0			
2	computers		0.0	0.0		0.0	0.0			
3	fluorescent lighting		31.9	35.4		31.9	35.4	0.90		
4	HID lighting		0.0	0.0		0.0	0.0			
5	incandescent lighting		0.0	0.0		0.0	0.0			
6	HVAC fans		0.0	0.0		0.0	0.0			
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						31.9	35.4			
Spare Capacity			20%			6.4	7.1			
Total Design Loads						38.3	42.5	0.90	Amps=	51.2

Figure 71 | New Panelboard E2LG5 Schedule

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	E2LG5	MIN. C/B AIC:	35K
SIZE/TYPE BUS:	100A	PANEL LOCATION:	Electrical Room 0703	OPTIONS:	
SIZE/TYPE MAIN:	100A/3P C/B	PANEL MOUNTING:	SURFACE		(4) #6, (1) #8 G, 1" C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	Rm 4-6, team	3291	20A/1P	1	*			2	20A/1P	3091	F 1-8 11-16, tm	Lighting
Lighting	Ped 4-12,rm 1-3	3066	20A/1P	3		*		4	20A/1P	3390	F 19-10 psych	Lighting
Lighting	Peds 1-9, team	3316	20A/1P	5			*	6	20A/1P	3086	Tr 1-10, wk rm	Lighting
Lighting	R 1-6, team	2276	20A/1P	7	*			8	20A/1P	2468	Team, r 7-11	Lighting
Lighting	Room 1-12	3216	20A/1P	9		*		10	20A/1P	1498	Team, rm 1-6	Lighting
Lighting	Team, rm 7-12	2443	20A/1P	11			*	12	20A/1P	0	-	Spare
Lighting	Amb canopy	745	20A/1P	13	*			14	20A/1P	0	-	Spare
Spare	-	0	20A/1P	15		*		16	20A/1P	0	-	Spare
Spare	-	0	20A/1P	17			*	18	20A/1P	0	-	Spare
Spare	-	0	20A/1P	19	*			20	20A/1P	0	-	Spare
Spare	-	0	20A/1P	21		*		22	20A/1P	0	-	Spare
Spare	-	0	20A/1P	23			*	24	20A/1P	0	-	Spare
Spare	-	0	20A/1P	25	*			26	-	0	0	0
0	0	0	-	27		*		28	-	0	0	0
0	0	0	-	29			*	30	-	0	0	0
0	0	0	-	31	*			32	-	0	0	0
0	0	0	-	33		*		34	-	0	0	0
0	0	0	-	35			*	36	-	0	0	0
0	0	0	-	37	*			38	-	0	0	0
0	0	0	-	39		*		40	-	0	0	0
0	0	0	-	41			*	42	-	0	0	0

CONNECTED LOAD (KW) - A Ph.	11.87	TOTAL DESIGN LOAD (KW)	38.27
CONNECTED LOAD (KW) - B Ph.	11.17	POWER FACTOR	0.90
CONNECTED LOAD (KW) - C Ph.	8.85	TOTAL DESIGN LOAD (AMPS)	51

Feeder Size Calculation

51.2 A * 125% = 64 A

100A Circuit Breaker, (4) #6 AWG CU THWN, (1) #8 AWG CU Ground, 1” EMT Conduit

Figure 72 | Existing Panelboard E1LG5 Schedule

WIRING PANEL SCHEDULE

	PANEL: E1LG5 (LIFE SAFETY)			MAINS: MLO							AMPS: 100			AIC: 35,000
	VOLTAGE: 480Y/277	WIRES: 4		PHASE: 3							MOUNTING: SURFACE			LOC: ELEC RM 0703
CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT	A	A	B	B	C	C	CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT
1	-	-	-	-	14.3	0	-	-	-	-	2	-	-	-	-
3	XFMR T-7	3	45	FEEDER 65	-	-	14.3	0	-	-	4	SPACE	3	-	-
5	-	-	-	-	-	-	-	-	14.3	0	6	-	-	-	-
7	LTG: FAST TR/TRIAGE EGRESS	1	20	3/4"C.W/2#12+1#12GRD.	7.6	0	-	-	-	-	8	SPARE	1	20	-
9	LTG: STAIR C	1	20	3/4"C.W/2#12+1#12GRD.	-	-	3.4	0	-	-	10	SPARE	1	20	-
11	LTG: SE ER EGRESS	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	9.7	0	12	SPARE	1	20	-
13	SPARE	1	20	-	0	0	-	-	-	-	14	SPARE	1	20	-
15	SPARE	1	20	-	-	-	0	0	-	-	16	SPARE	1	20	-
17	SPARE	1	20	-	-	-	-	-	0	0	18	SPARE	1	20	-
19	SPACE	1	-	-	0	0	-	-	-	-	20	SPACE	1	-	-
21	SPACE	1	-	-	-	-	0	0	-	-	22	SPACE	1	-	-
23	SPACE	1	-	-	-	-	-	-	0	0	24	SPACE	1	-	-
25	SPACE	1	-	-	0	0	-	-	-	-	26	SPACE	1	-	-
27	SPACE	1	-	-	-	-	0	0	-	-	28	SPACE	1	-	-
29	SPACE	1	-	-	-	-	-	-	0	0	30	SPACE	1	-	-
31	SPACE	1	-	-	0	0	-	-	-	-	32	SPACE	1	-	-
33	SPACE	1	-	-	-	-	0	0	-	-	34	SPACE	1	-	-
35	SPACE	1	-	-	-	-	-	-	0	0	36	SPACE	1	-	-
37	SPACE	1	-	-	0	0	-	-	-	-	38	SPACE	1	-	-
39	SPACE	1	-	-	-	-	0	0	-	-	40	SPACE	1	-	-
41	SPACE	1	-	-	-	-	-	-	0	0	42	SPACE	1	-	-
	CONNECTED LOAD	21 A		TOTAL PHASE A	22 A		-		-			CONNECTED LOAD	17.6 KVA		
	DEMAND LOAD	23 A		TOTAL PHASE B	-		18 A		-						
				TOTAL PHASE C	-		-		24 A						

Figure 73 | New Panelboard E1LG5 Worksheet

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					E1LG5	Panel Location:			Electrical Room 0703		
Nominal Phase to Neutral Voltage------->					277	Phase:			3		
Nominal Phase to Phase Voltage-------->					480	Wires:			4		
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	Transformer	-	xfmr T-7	14	A	0.90	3490	3878		
2	A					A	1.00	0	0		
3	B	Transformer	-	xfmr T-7	14	A	0.90	3490	3878		
4	B					A	1.00	0	0		
5	C	Transformer	-	xfmr T-7	14	A	0.90	3490	3878		
6	C					A	1.00	0	0		
7	A	Lighting	3	North egress	7.25	A	0.90	1807	2008		
8	A	Spare	9	-		A	1.00	0	0		
9	B	Lighting	3	South egress	3.4	A	0.90	848	942		
10	B	Spare	9	-		A	1.00	0	0		
11	C	Lighting	3	West egress	9.7	A	0.90	2418	2687		
12	C	Spare	9	-		A	1.00	0	0		
13	A	Spare	9	-		A	1.00	0	0		
14	A	Spare	9	-		A	1.00	0	0		
15	B	Spare	9	-		A	1.00	0	0		
16	B	Spare	9	-		A	1.00	0	0		
17	C	Spare	9	-		A	1.00	0	0		
18	C	Spare	9	-		A	1.00	0	0		
19	A					A	1.00	0	0		
20	A					A	1.00	0	0		
21	B					A	1.00	0	0		
22	B					A	1.00	0	0		
23	C					A	1.00	0	0		
24	C					A	1.00	0	0		
25	A					A	1.00	0	0		
26	A					A	1.00	0	0		
27	B					A	1.00	0	0		
28	B					A	1.00	0	0		
29	C					A	1.00	0	0		
30	C					A	1.00	0	0		
31	A					A	1.00	0	0		
32	A					A	1.00	0	0		
33	B					A	1.00	0	0		
34	B					A	1.00	0	0		
35	C					A	1.00	0	0		
36	C					A	1.00	0	0		
37	A					A	1.00	0	0		
38	A					A	1.00	0	0		
39	B					A	1.00	0	0		
40	B					A	1.00	0	0		
41	C					A	1.00	0	0		
42	C				0	A	1.00	0	0		
PANEL TOTAL								15.5	17.3	Amps=	20.8

PHASE LOADING		kW	kVA	%	Amps
PHASE TOTAL	A	5.3	5.9	34%	21.3
PHASE TOTAL	B	4.3	4.8	28%	17.4
PHASE TOTAL	C	5.9	6.6	38%	23.7

LOAD CATAGORIES		Connected			Demand				Ver. 104
		kW	kVA	DF	kW	kVA	PF		
1	receptacles	0.0	0.0		0.0	0.0			
2	computers	0.0	0.0		0.0	0.0			
3	fluorescent lighting	5.1	5.6		5.1	5.6	0.90		
4	HID lighting	0.0	0.0		0.0	0.0			
5	incandescent lighting	0.0	0.0		0.0	0.0			
6	HVAC fans	0.0	0.0		0.0	0.0			
7	heating	0.0	0.0		0.0	0.0			
8	kitchen equipment	0.0	0.0		0.0	0.0			
9	unassigned	10.5	11.6		10.5	11.6	0.90		
Total Demand Loads					15.5	17.3			
Spare Capacity		20%			3.1	3.5			
Total Design Loads					18.7	20.7	0.90	Amps=	24.9

Figure 74 | New Panelboard E1LG5 Schedule

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	E1LG5	MIN. C/B AIC:	35K
SIZE/TYPE BUS:	100A	PANEL LOCATION:	Electrical Room 0703	OPTIONS:	
SIZE/TYPE MAIN:	100A/3P C/B	PANEL MOUNTING:	SURFACE		(4) #8, (1) #8 G, 3/4" C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Transformer	xfmr T-7	3490	-	1	*			2	-	0	0	0
Transformer	xfmr T-7	3490	45A/3P	3		*		4	-	0	0	0
Transformer	xfmr T-7	3490	-	5			*	6	-	0	0	0
Lighting	North egress	1807	20A/1P	7	*			8	20A/1P	0	-	Spare
Lighting	South egress	848	20A/1P	9		*		10	20A/1P	0	-	Spare
Lighting	West egress	2418	20A/1P	11			*	12	20A/1P	0	-	Spare
Spare	-	0	-	13	*			14	-	0	-	Spare
Spare	-	0	-	15		*		16	-	0	-	Spare
Spare	-	0	-	17			*	18	-	0	-	Spare
0	0	0	-	19	*			20	-	0	0	0
0	0	0	-	21		*		22	-	0	0	0
0	0	0	-	23			*	24	-	0	0	0
0	0	0	-	25	*			26	-	0	0	0
0	0	0	-	27		*		28	-	0	0	0
0	0	0	-	29			*	30	-	0	0	0
0	0	0	-	31	*			32	-	0	0	0
0	0	0	-	33		*		34	-	0	0	0
0	0	0	-	35			*	36	-	0	0	0
0	0	0	-	37	*			38	-	0	0	0
0	0	0	-	39		*		40	-	0	0	0
0	0	0	-	41			*	42	-	0	0	0

CONNECTED LOAD (KW) - A Ph.	5.30	TOTAL DESIGN LOAD (KW)	18.65
CONNECTED LOAD (KW) - B Ph.	4.34	POWER FACTOR	0.90
CONNECTED LOAD (KW) - C Ph.	5.91	TOTAL DESIGN LOAD (AMPS)	25

Feeder Size Calculation

24.9 A * 125% = 31.125 A

100A Circuit Breaker, (4) #8 AWG CU THWN, (1) #8 AWG CU Ground, ¾" EMT Conduit

Team Station | Work Space

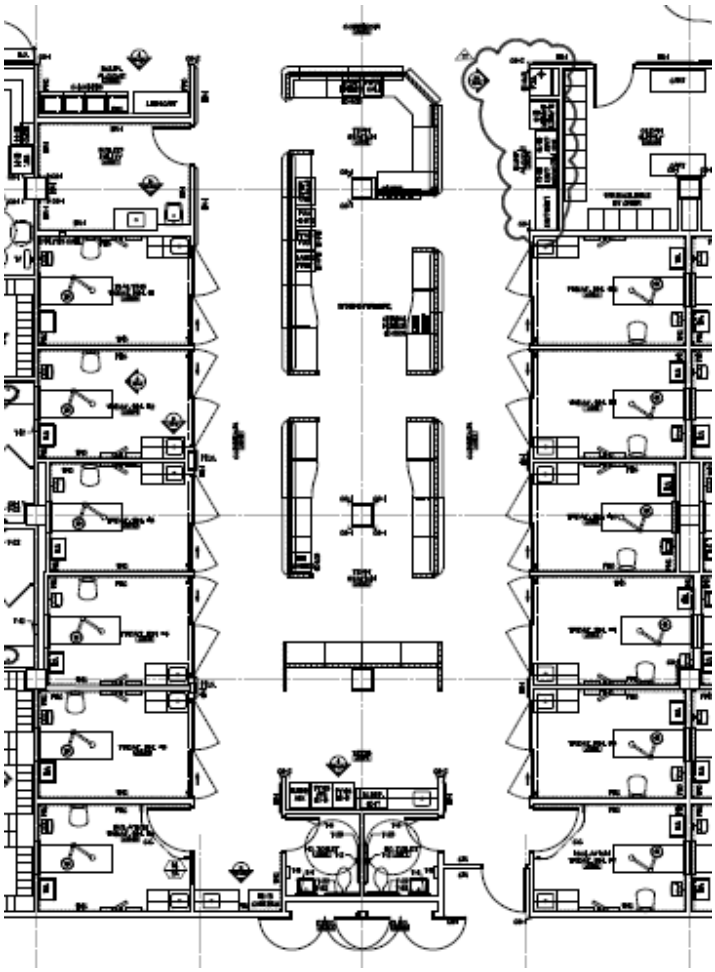
Spatial Summary

The team station is located within the emergency department and is responsible for 12 treatment rooms. The station is a twenty four hours a day work area for many doctors and to organize and file patient information and documents. Partition walls are 4.5 feet tall allowing for visual connects between patients and nurses. Visitors and patients are able to speak with the employees and have their questions answered quickly.

Team stations are located throughout the entire hospital with many on each floor, depending on the number of patient rooms. This particular team station is located on the ground floor of the emergency department on the south west side of the hospital. It is rectangular in shape and is approximately 847 square feet

Drawings

Figure 75 | Team Station Plan



Surface Materials

Ceiling | The ceiling consists of 2x2 acoustical ceiling tiles by Armstrong with angled tegular edges. (ACT-1)

Walls | The walls are painted the color Softer Tan by Sherman Williams (IPS2-A).

Floor | The floor is covered with 12”x12” vinyl composition tiles, by Imperial Texture, that are placed in a specified pattern using four different colors (VCT-1, -2,- 3, -7).

Bulkhead | The bulkheads are painted the color Ruskin Room Green (green) by Sherman Williams (IPS2-E).

Base | The base is a 6” high black colored rubber base by Roppe (RE6-B).

Figure 76 | Team Station Material Reflectance Properties

MATERIALS	DESCRIPTION	REFLECTANCE
ACT-1	Fine fissured #1732 2x2 acoustical ceiling tile	0.74
IPS2-A	SW 6141 Softer tan paint	0.81
IPS2-E	SW 0042 Ruskin room green paint	0.5
RB6-B	P100 Black rubber base	0.18
VCT-1	51873 Brushed sand vinyl composition tile	0.61
VCT-2	51916 Dutch delft vinyl composition tile	0.56
VCT-3	51867 Cantaloupe vinyl composition tile	0.52
VCT-7	51885 Granny smith vinyl composition tile	0.59

Furnishings

The reflectance for the Herman Miller Furniture System is approximated by an average horizontal of and average vertical reflectance value of 0.30.

Frame base and vertical connectors – black umber (BU)

Exterior tiles – cherry (V3)

Interior tiles below work surface – painted black umber (BU)

Interior tiles above work surface – Painted just tan (JT)

Work surface – Laminate 2x wheat (LW)

Trans. Counters – Corian with Mojave/ black umber supports (BU)

Crash rail (2 heights) – C/S Acrovyn #103 Beige (BG)

Figure 77 | Herman Miller System material reflectance properties

MATERIALS	DESCRIPTION	REFLECTANCE
BU	Black umber paint	0.18
BG	#103 Beige paint	0.77
JT	Just tan paint	0.71
LW	Wheat work surface laminate	0.48
V3	Cherry exterior tiles	0.14

Tasks/Activities

The team station is primarily a working environment. The lighting inside the space should be slightly different then the surroundings to allow the patients and visitors to understand that the team station is a private area for the nurses' only.

Design Criteria

Interior, Health Care, Nursing Stations, General/Desk (IESNA Handbook)

Appearance of Space and Luminaires (Important/Not Important)

It is Important for the architectural and lighting layout to be clean and uniform throughout the entire area to reduce "visual clutter". The luminaires should help guide people around the space for example if cove lighting is only around the team station then the patients and visitors see this as a private area that they are not allowed to enter.

Color Appearance and Color Contrast (Very Important/Important)

Color rendering is crucial in healthcare facilities. Patients' symptoms and certain problems deal with colors that need to be seen under a high CRI lamp. Lamps with a CRI of 70 or better are recommended for a pleasant appearance of skin-tones.

Daylighting Integration and Control (Very Important/Not Important)

Daylight integration is very difficult to achieve in the team station since it is not near any windows. The next best thing to simulate the change of time over the course of the day is to use controls and settings. A daytime and nighttime scene can be set and with just push of a button the Illuminance levels of the space will adapt.

Direct Glare (Important/Somewhat Important)

Direct glare can be controlled with the choice of an indirect luminaire that or a lens or parabolic reflector to lessen the glare.

Flicker and Strobe effect (Very Important/Somewhat Important)

The use of high frequency electronic ballasts can eliminate the annoyance of flicker and strobe effect.

Light Distribution on Surfaces (Very Important/Important)

The surfaces of different objects in the space should not exceed a 3:1 ratio of luminance but the space should not create a lack of interest with exactly one uniform luminance.

Uniform Light Distribution on Task Plane (Very Important/Important)

Shadows and patterns of other light sources are distracting and can be reduced by using more luminaires or integrate luminaires that have a wide angle to cover more area of the task plane.

Luminances of Room Surfaces (Very Important/Somewhat Important)

Luminance values in the space should be uniform for each surface including the floor, cabinets and bulkheads over the work plane. Dark area towards the top of the bulkheads should be avoided for uniformity.

Modeling of Faces or Objects (Very Important/Very Important)

Non-verbal communication of patients is very important in hospital settings therefore the lighting design of the space should incorporate reflected Illuminance as well as direct. Creating more shadows on the face helps to create a more defined and easy to read facial expressions.

Reflected Glare (Important/Not Important)

Avoid veiling reflections from cabinet table tops and glossy or metallic hospital equipment. Do not place luminaires directly behind computer terminals.

Source/Task/Eye geometry (Important/Not Important)

Avoid placing luminaires behind screens of any sort such as a computer terminal or a nurse call system display.

Illuminance

Horizontal Illuminance (Important/Important) – Category D/E – 30/50 fc

Vertical Illuminance (Important/Somewhat Important) – Category B/C – 5/10 fc

VDT Criteria

Visual display terminals are used in the team station all hours of the day therefore the lighting design must reduce veiling reflections that cause glare.

Power Allowance (ASHRAE /IESNA Std. 90.1-2007)

Nurses' Station – 1.0 W/ft^2

Controls Criteria

Nurse Stations are usually located in the center of many patient rooms therefore a multilevel control system is necessary. A higher Illuminance would be used during daytime hours while a lower Illuminance level would be used during nighttime hours. The luminaires that are used for the night should not be visible to the patients through their doorways.

Luminance Ratios

Paper task and adjacent VDT screen - 3:1

Psychological Aspects

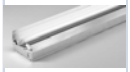
A private psychological effect within the team station will help visitors and patients understand that they are not supposed to be in that space. This private feeling also plays a role on the nurses that will occupy the space. They will be able to work more efficiently in a more intimate space due to these psychological impressions.

Lighting Plans

See Appendix A for lighting plans

Luminaires

Figure 78 | Team Station Luminaire Schedule

TEAM STATION LUMINAIRE SCHEDULE									
TYPE	IMAGE	MANUFACTURER	PRODUCT NAME	CATALOG NUMBER	DESCRIPTION	LAMP	INPUT WATTS	VOLTAGE	BALLAST
O		Zumtobel	ML	ML4F/22/2245/OL/U	Cold-rolled steel housing with powder-coated white finish. High-reflectance white interior reflector and shaped extruded white opal acrylic lens.	(2)F24W/T5/841/ECO 46701 - GE linear T5	52	277	ICN/2S24 @277V Philips Advance
M		ERCO	Lightcast Downlight	22267.000	Cast aluminum housing designed with a heat sink. White powder coated cast aluminum mounting ring. Bright anodised aluminum darklight reflector. Size 5, 30° cut-off angle.	F18TBX/830/A/ECO 97625 - GE CF plug in T4	22	277	VEZ/1Q18/M2/BS Philips Advance
P		Elliptipar	Style 306	F306/A132/S/00/2/00/0	Extruded high purity aluminum housing with clear anodized specular finish. Adjustable reflector that can be joined to other fixtures to aim together. Indirect cove lighting lay-in installation.	F32T8/SP41/ECO/C 15904 - GE linear T8	35	277	VEZ/132/SC Philips Advance

See Appendix A for full luminaire schedule and cut sheets

Figure 79 | Team Station Light Loss Factors

TYPE	BF	LLD	LDD	RSDD	TOTAL LLF
O	1.0	0.92	0.94	0.95	0.82
M	1.0	0.84	0.94	0.95	0.75
P	1.0	0.95	0.82	0.95	0.74

Controls

A Grafik Eye preset dimming control system will allow the team stations luminaires to be dimmed. This is desired to help the patients in the area with the natural circadian rhythms. The linear cove luminaires will be dimmed to the desired level and preset for easy control. The control system can hold up to four different lighting scenes.

Figure 80 | Team Station Control Schedule

TEAM STATION CONTROL SCHEDULE					
TYPE	IMAGE	MANUFACTURER	PRODUCT NAME	CATALOG NUMBER	DESCRIPTION
		Lutron	GRAFIK Eye 3000 Series	GRX/3104/T/BE	Preset dimming control that allows for the setup of lighting scenes. Easy pushbutton recall of four lighting scenes, plus off. Provides lockout options to prevent any accidental changes.

See Appendix A for full equipment schedule and cut sheets

Performance Data

The following are renders and calculation grids that summarize the team station lighting redesign.

Figure 81 | Team Station Plan Pseudo Color and Render (fc)

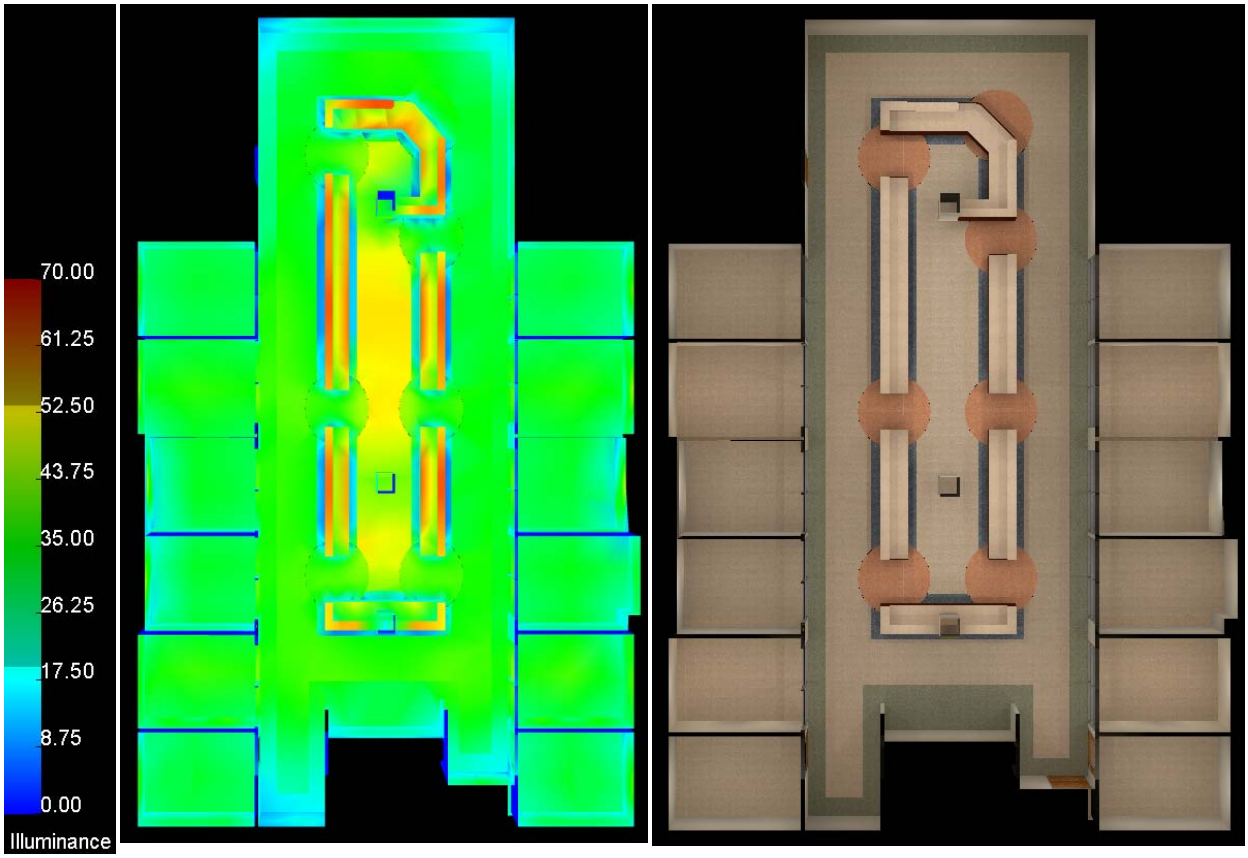


Figure 82 | Team Station Perspective Pseudo Color and Render (fc)

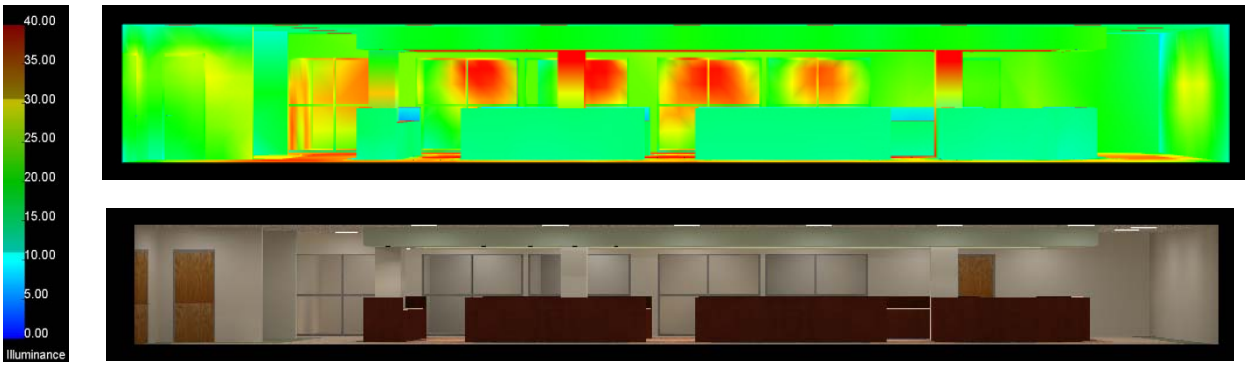


Figure 83 | Team Station View Pseudo Color and Render (fc)

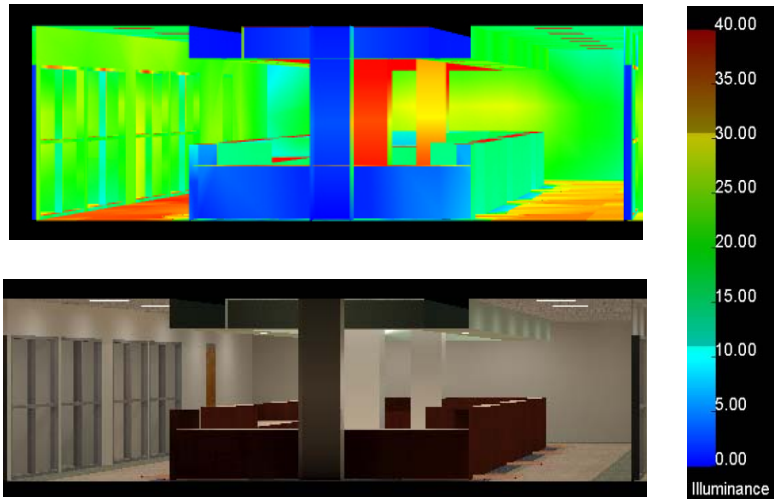


Figure 84 | Team Station View Pseudo Color and Render (fc)

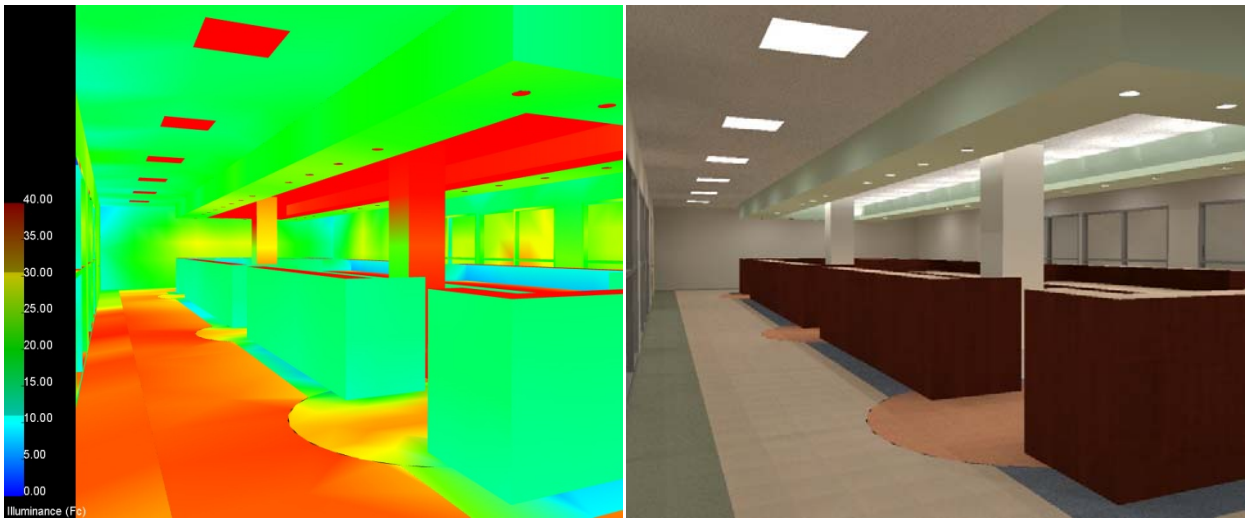


Figure 85 | Team Station View Pseudo Color and Render (fc)

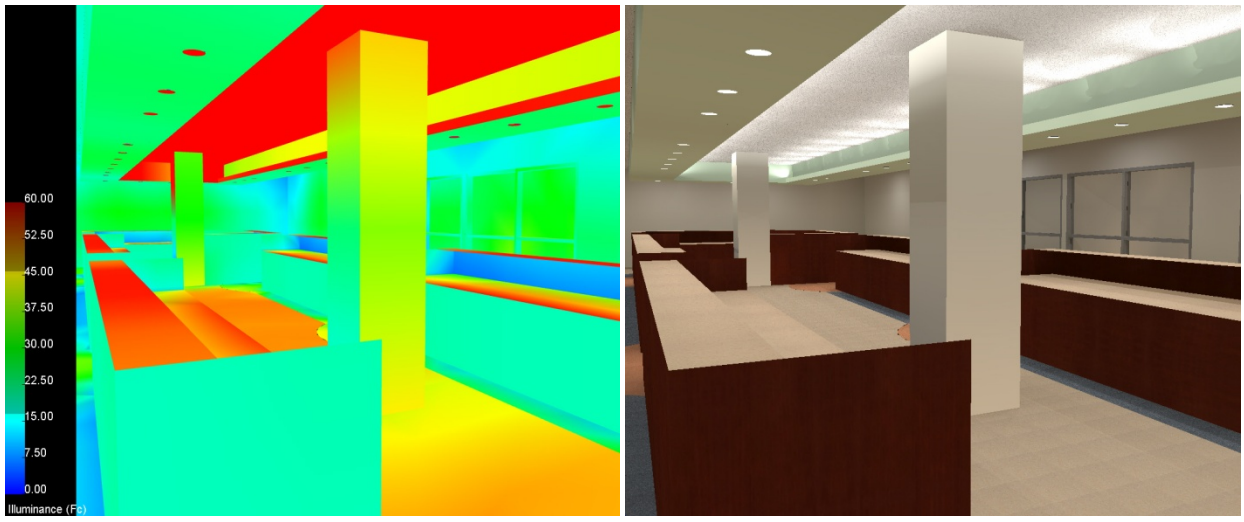


Figure 86 | Floor Horizontal Illuminance Contours (fc)

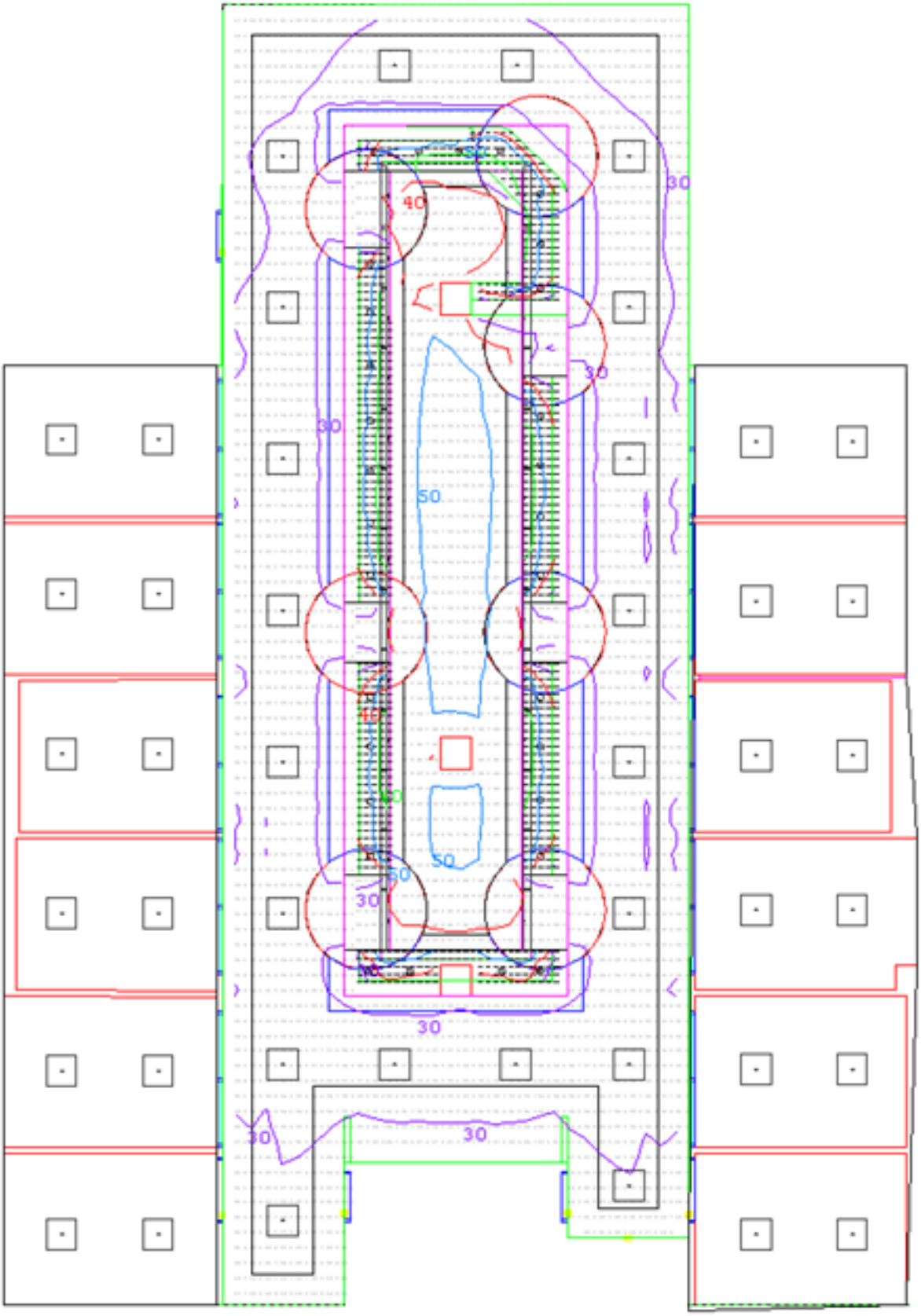


Figure 87 | 50% Dimmed Team Station Plan Pseudo Color and Render (fc)

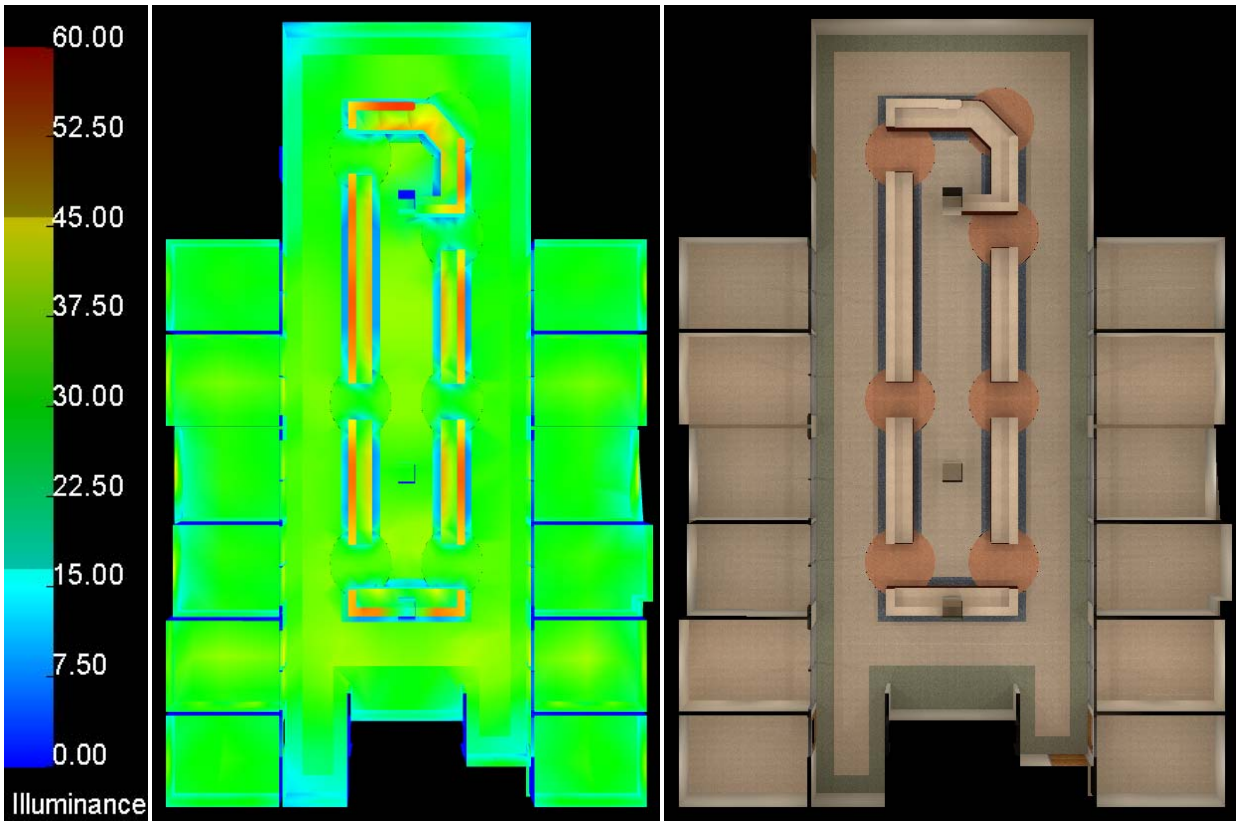


Figure 88 | 50% Dimmed Team Station Perspective Pseudo Color and Render (fc)

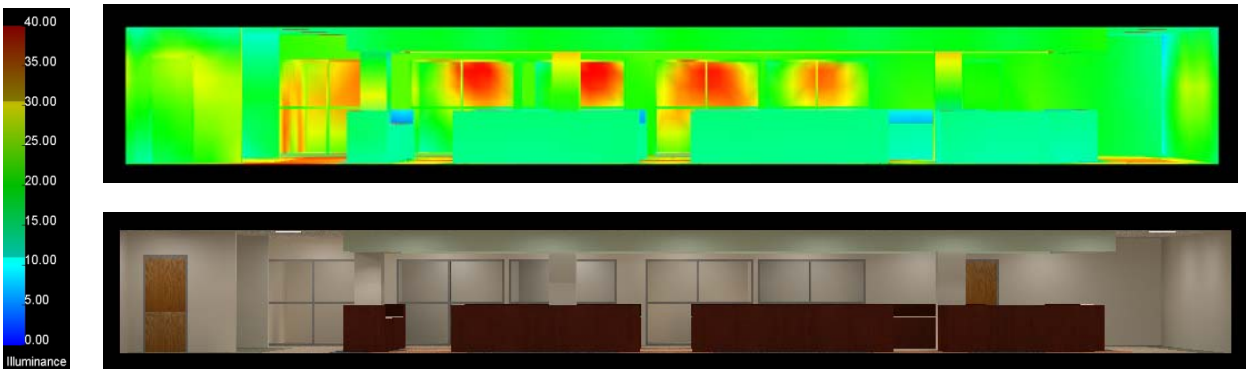


Figure 89 | 50% Dimmed Team Station View Pseudo Color and Render (fc)

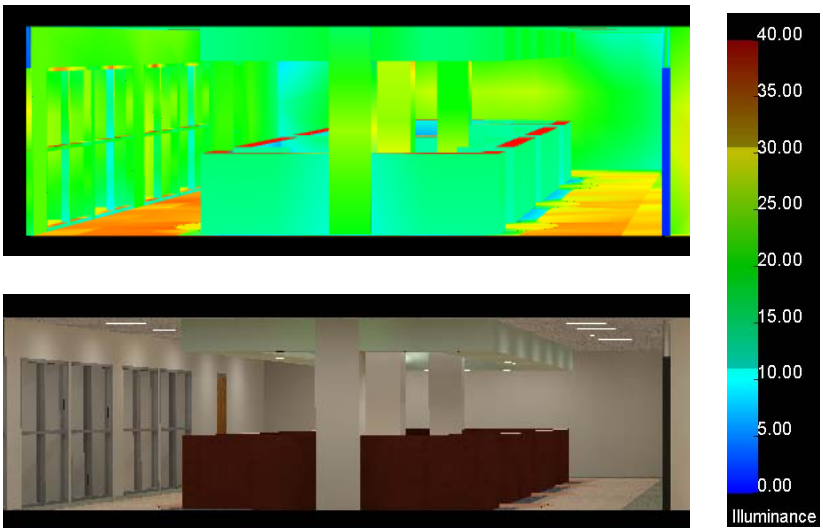


Figure 90 | Team Station View Pseudo Color and Render (fc)

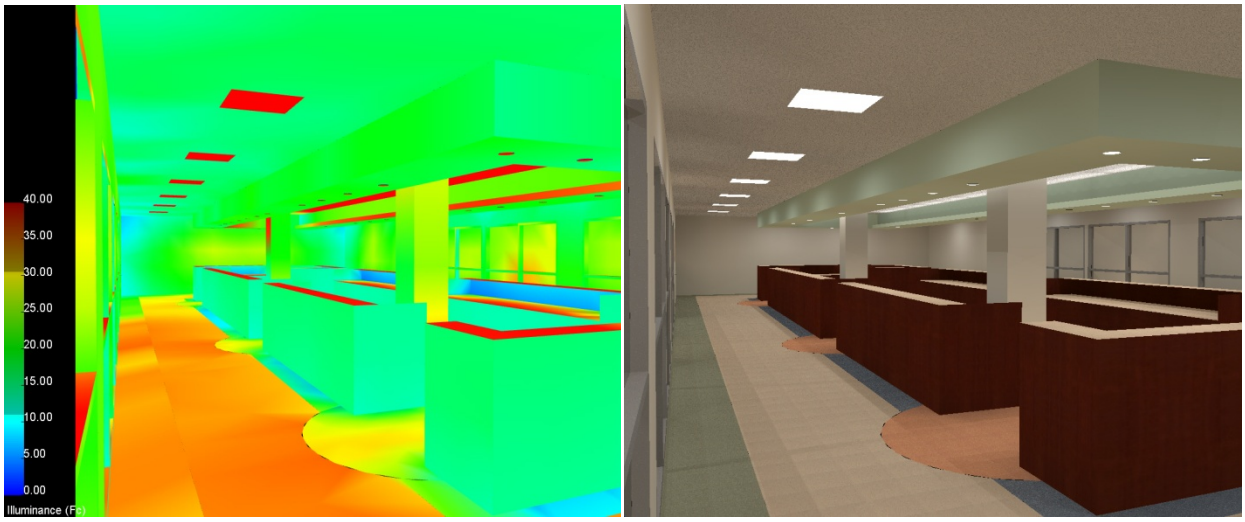


Figure 91 | Team Station View Pseudo Color and Render (fc)

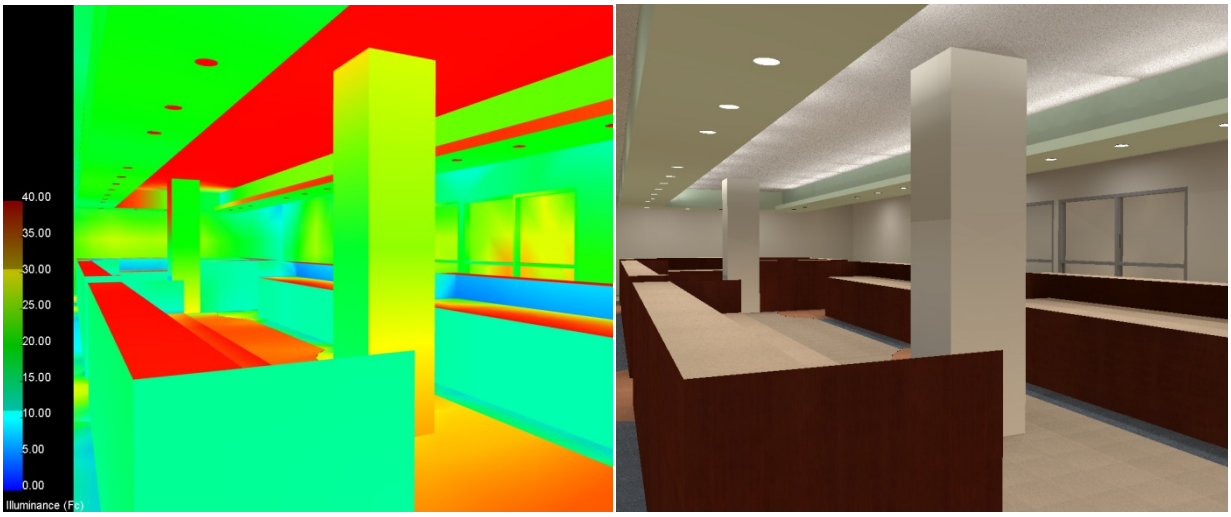
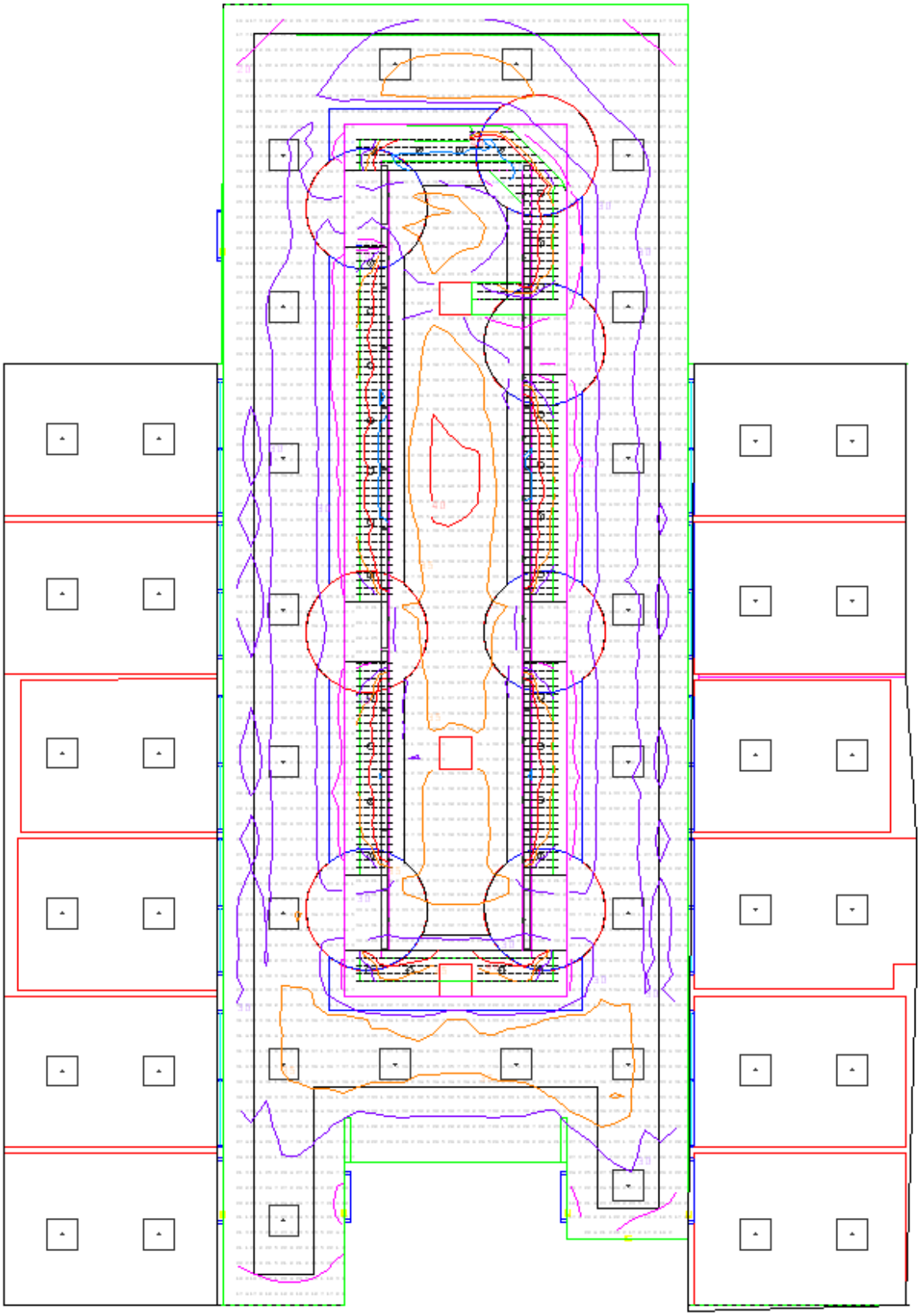


Figure 92 | 50% Dimmed Floor Horizontal Illuminance Contours (fc)



Energy Code Compliance

Figure 93 | Team Station Energy Calculation Summary

ASHRAE Standard 90.1 - 2007

SPACE	AREA (SF)	ALLOWABLE LIGHTING POWER DENSITY (W/SF)	ALLOWABLE WATTS	TOTAL WATTS USED
Nurse Station	837.1	1	837.1	1700
Emergency	1664.2	2.7	4493.34	910

Performance Summary

The ambient lighting for team station is impacted by the adjacent corridors and the patients' rooms that are surrounding. The main source of ambient lighting comes from within the station itself. The linear cove luminaires create a high luminance on the ceiling that is then reflected into the space. The ceiling wash creates a sense of openness to the emergency department.

Downlights are located over the working surfaces and provide ample illumination for tasks. The corridor luminaires contain a new diffuser technology. It distributed the light but as patients look at it while lying on a hospital bed; they will not be blinded directly from the source from underneath. The diffuser optics shields the lamps from view while directing the illumination elsewhere in a glare-free efficient way.

The design of this space was based primarily on the IESNA recommendations and the ASHRAE Standard 90.1 -2007 lighting power density allowances of which both were met. A hospital setting is focused on the care of patients and this lighting design also reflects that.

Figure 94 | Team Station Performance Summary

NO DIMMING				
GRID LOCATIONS	AVG (fc)	MAX (fc)	MIN (fc)	MAX/MIN
Desk Surface (2.5' AFF)	48.73	65.4	17.3	3.78
Corridor Floor	30.33	39.1	16.0	2.44
Team Station Floor	44.26	56.0	20.7	2.71

50% DIMMED COVE LUMINAIRES				
GRID LOCATIONS	AVG (fc)	MAX (fc)	MIN (fc)	MAX/MIN
Desk Surface (2.5' AFF)	39.32	53.8	13.7	3.93
Corridor Floor	28.87	38.5	15.8	2.44
Team Station Floor	33.04	40.9	14.4	2.84

Electrical Redesign

For complete spatial description of the team station, see page 71.

Electrical Design Objectives/Criteria

The team station redesign of the electrical system includes two panelboards with a 480Y/277V, 3PH, 4W voltage system. One panelboard is on normal power and the other, emergency.

The team station luminaires for task and ambient lighting are connected through a grafik eye control system before reach the panelboard. The grafik eye terminal contains a 12V DC power source for the interface.

The panelboard schedules below contain the highlighted circuits that were redesigned.

See Appendix A for complete lighting plans with circuiting

Figure 95 | Existing Panelboard LPG5 Schedule

WIRING PANEL SCHEDULE

	PANEL: LPG5 (NORMAL)			MAINS: MLO								AMPS: 100			AIC: 35,000
	VOLTAGE: 480Y/277	WIRES: 4		PHASE: 3								MOUNTING: SURFACE			LOC: ELEC RM 0703
CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT	A	A	B	B	C	C	CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT
1	LTG: ER CORRIDORS	1	20	3/4"C.W/2#12+1#12GRD.	13.3	12.7	-	-	-	-	2	LTG: PEDS TEAM STAT/CORRS	1	20	3/4"C.W/2#12+1#12GRD.
3	LTG: ER PSYCH WING, WAIT TLTS	1	20	3/4"C.W/2#12+1#12GRD.	-	-	9.6	11.2	-	-	4	LTG: PEDS RM #1-9, PLAYROOM	1	20	3/4"C.W/2#12+1#12GRD.
5	LTG: ER WAITING, CASHIER	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	12.4	14.2	6	LTG: CENTRAL TEAM STAT/CORRS	1	20	3/4"C.W/2#12+1#12GRD.
7	SPARE	1	20	-	0	13.6	-	-	-	-	8	LTG: TEAM #0324, 0320, CORRS	1	20	3/4"C.W/2#12+1#12GRD.
9	SPARE	1	20	-	-	-	0	0	-	-	10	SPARE	1	20	-
11	SPARE	1	20	-	-	-	-	-	0	0	12	SPARE	1	20	-
13	SPARE	1	20	-	0	0	-	-	-	-	14	SPARE	1	20	-
15	SPARE	1	20	-	-	-	0	0	-	-	16	SPARE	1	20	-
17	SPARE	1	20	-	-	-	-	-	0	0	18	SPARE	1	20	-
19	-	-	-	-	3	0	-	-	-	-	20	SPACE	1	-	-
21	DECON TANK PUMP	3	15	3/4"C.W/3#12+1#12GRD.	-	-	3	0	-	-	22	SPACE	1	-	-
23	-	-	-	-	-	-	-	-	3	0	24	SPACE	1	-	-
25	SPACE	1	-	-	0	0	-	-	-	-	26	SPACE	1	-	-
27	SPACE	1	-	-	-	-	0	0	-	-	28	SPACE	1	-	-
29	SPACE	1	-	-	-	-	-	-	0	0	30	SPACE	1	-	-
31	SPACE	1	-	-	0	0	-	-	-	-	32	SPACE	1	-	-
33	SPACE	1	-	-	-	-	0	0	-	-	34	SPACE	1	-	-
35	SPACE	1	-	-	-	-	-	-	0	0	36	SPACE	1	-	-
37	SPACE	1	-	-	0	0	-	-	-	-	38	SPACE	1	-	-
39	SPACE	1	-	-	-	-	0	0	-	-	40	SPACE	1	-	-
41	SPACE	1	-	-	-	-	-	-	0	0	42	SPACE	1	-	-
	CONNECTED LOAD	29 A		TOTAL PHASE A	43 A		-		-			CONNECTED LOAD	26.6 KVA		
	DEMAND LOAD	47 A		TOTAL PHASE B	-		24 A		-						
				TOTAL PHASE C	-		-		30 A						

Figure 96 | New Panelboard LPG5 Worksheet

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					LPG5	Panel Location:			Electrical Room 0703		
Nominal Phase to Neutral Voltage------->					277	Phase:			3		
Nominal Phase to Phase Voltage-------->					480	Wires:			4		
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	Lighting	3	ER corridors	13.3	A	0.90	3316	3684		
2	A	Lighting	3	eds team, c	12.7	A	0.90	3166	3518		
3	B	Lighting	3	R psych, wa	9.14	A	0.90	2279	2532		
4	B	Lighting	3	Peds 1-9 pla	11.2	A	0.90	2792	3102		
5	C	Lighting	3	ER wait, cas	12.4	A	0.90	3091	3435		
6	C	Lighting	3	teams, cor	14.2	A	0.90	3540	3933		
7	A	Spare	9	-	0	A	1.00	0	0		
8	A	Lighting	3	Teams, corr	14.14	A	0.90	3525	3917		
9	B	Spare	9	-	0	A	1.00	0	0		
10	B	Spare	9	-	0	A	1.00	0	0		
11	C	Spare	9	-	0	A	1.00	0	0		
12	C	Spare	9	-	0	A	1.00	0	0		
13	A	Spare	9	-	0	A	1.00	0	0		
14	A	Spare	9	-	0	A	1.00	0	0		
15	B	Spare	9	-	0	A	1.00	0	0		
16	B	Spare	9	-	0	A	1.00	0	0		
17	C	Spare	9	-	0	A	1.00	0	0		
18	C	Spare	9	-	0	A	1.00	0	0		
19	A	HVAC Pump	6	Decon Pump	3	A	0.95	789	831		
20	A				0	A	1.00	0	0		
21	B	HVAC Pump	6	Decon Pump	3	A	0.95	789	831		
22	B				0	A	1.00	0	0		
23	C	HVAC Pump	6	Decon Pump	3	A	0.95	789	831		
24	C				0	A	1.00	0	0		
25	A				0	A	1.00	0	0		
26	A				0	A	1.00	0	0		
27	B				0	A	1.00	0	0		
28	B				0	A	1.00	0	0		
29	C				0	A	1.00	0	0		
30	C				0	A	1.00	0	0		
31	A				0	A	1.00	0	0		
32	A				0	A	1.00	0	0		
33	B				0	A	1.00	0	0		
34	B				0	A	1.00	0	0		
35	C				0	A	1.00	0	0		
36	C				0	A	1.00	0	0		
37	A				0	A	1.00	0	0		
38	A				0	A	1.00	0	0		
39	B				0	A	1.00	0	0		
40	B				0	A	1.00	0	0		
41	C				0	A	1.00	0	0		
42	C				0	A	1.00	0	0		
PANEL TOTAL								24.1	26.6	Amps=	32.0

PHASE LOADING		kW	kVA	%	Amps	
PHASE TOTAL	A	10.8	11.9	45%	43.1	
PHASE TOTAL	B	5.9	6.5	24%	23.3	
PHASE TOTAL	C	7.4	8.2	31%	29.6	

LOAD CATAGORIES			Connected			Demand				Ver. 104
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		0.0	0.0		0.0	0.0			
2	computers		0.0	0.0		0.0	0.0			
3	fluorescent lighting		21.7	24.1		21.7	24.1	0.90		
4	HID lighting		0.0	0.0		0.0	0.0			
5	incandescent lighting		0.0	0.0		0.0	0.0			
6	HVAC fans		2.4	2.5		2.4	2.5	0.95		
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						24.1	26.6			
Spare Capacity			20%			4.8	5.3			
Total Design Loads						28.9	31.9	0.90	Amps=	38.4

Figure 97 | New Panelboard LPG5 Schedule

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	LPG5	MIN. C/B AIC:	35K
SIZE/TYPE BUS:	100A	PANEL LOCATION:	Electrical Room 0703	OPTIONS:	
SIZE/TYPE MAIN:	100A/3P C/B	PANEL MOUNTING:	SURFACE		(4) #8, (1) #8 G, 3/4" C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	ER corridors	3316	20A/1P	1	*			2	20A/1P	3166	Peds team, cor	Lighting
Lighting	ER psych, wait	2279	20A/1P	3		*		4	20A/1P	2792	Peds 1-9 play	Lighting
Lighting	ER wait, cash	3091	20A/1P	5			*	6	20A/1P	3540	C teams, corrs	Lighting
Spare	-	0	20A/1P	7	*			8	20A/1P	3525	Teams, corrs	Lighting
Spare	-	0	20A/1P	9		*		10	20A/1P	0	-	Spare
Spare	-	0	20A/1P	11			*	12	20A/1P	0	-	Spare
Spare	-	0	20A/1P	13	*			14	20A/1P	0	-	Spare
Spare	-	0	20A/1P	15		*		16	20A/1P	0	-	Spare
Spare	-	0	20A/1P	17			*	18	20A/1P	0	-	Spare
HVAC Pump	Decon Pump	789	-	19	*			20	-	0	0	0
HVAC Pump	Decon Pump	789	15A/3P	21		*		22	-	0	0	0
HVAC Pump	Decon Pump	789	-	23			*	24	-	0	0	0
0	0	0	-	25	*			26	-	0	0	0
0	0	0	-	27		*		28	-	0	0	0
0	0	0	-	29			*	30	-	0	0	0
0	0	0	-	31	*			32	-	0	0	0
0	0	0	-	33		*		34	-	0	0	0
0	0	0	-	35			*	36	-	0	0	0
0	0	0	-	37	*			38	-	0	0	0
0	0	0	-	39		*		40	-	0	0	0
0	0	0	-	41			*	42	-	0	0	0

CONNECTED LOAD (KW) - A Ph.	10.80	TOTAL DESIGN LOAD (KW)	28.89
CONNECTED LOAD (KW) - B Ph.	5.86	POWER FACTOR	0.90
CONNECTED LOAD (KW) - C Ph.	7.42	TOTAL DESIGN LOAD (AMPS)	38

Feeder Size Calculation

38.4 A * 125% = 48 A

100A Circuit Breaker, (4) #8 AWG CU THWN, (1) #8 AWG CU Ground, ¾" EMT Conduit

Figure 98 | Existing Panelboard E2LG5 Schedule

WIRING PANEL SCHEDULE

	PANEL: E2LG5 (CRITICAL)			MAINS: MLO							AMPS: 100			AIC: 25,000
	VOLTAGE: 480Y/277	WIRES: 4		PHASE: 3							MOUNTING: SURFACE			LOC: ELEC RM 0703
CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT	A	A	B	B	C	C	CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT
1	LTG: TREAT RM #4-6, TEAM 0224	1	20	3/4"C.W/2#12+1#12GRD.	13.2	12.4	-	-	-	-	2	LTG: FAST TR #1-8, 11-16, TEAM ST	1	20	3/4"C.W/2#12+1#12GRD.
3	LTG: PEDS #4-12, TREAT RM #1-3	1	20	3/4"C.W/2#12+1#12GRD.	-	-	12.3	13.6	-	-	4	LTG: FAST TR #19-10, PSYCH TRT	1	20	3/4"C.W/2#12+1#12GRD.
5	LTG: PEDS #1-9, TEAM ST 0120	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	13.3	12.9	6	LTG: TRIAGE #1-10, WORK RM	1	20	3/4"C.W/2#12+1#12GRD.
7	LTG: TREAT RM #1-6, TEAM 0320	1	20	3/4"C.W/2#12+1#12GRD.	10.1	9.9	-	-	-	-	8	LTG: TEAM 0324, TREAT RM #7-11	1	20	3/4"C.W/2#12+1#12GRD.
9	LTG: TREAT RM #1-12	1	20	3/4"C.W/2#12+1#12GRD.	-	-	12.9	6.01	-	-	10	LTG: TEAM 0324, TREAT RM #1-6	1	20	3/4"C.W/2#12+1#12GRD.
11	LTG: TEAM 0220, TREAT RM #7-12	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	9.8	0	12	SPARE	1	20	-
13	LTG: AMBULANCE CANOPY	1	20	3/4"C.W/2#12+1#12GRD.	2.99	0	-	-	-	-	14	SPARE	1	20	-
15	SPARE	1	20	-	-	-	0	0	-	-	16	SPARE	1	20	-
17	SPARE	1	20	-	-	-	-	-	0	0	18	SPARE	1	20	-
19	SPARE	1	20	-	0	0	-	-	-	-	20	SPARE	1	20	-
21	SPARE	1	20	-	-	-	0	0	-	-	22	SPARE	1	20	-
23	SPARE	1	20	-	-	-	-	-	0	0	24	SPARE	1	20	-
25	SPARE	1	20	-	0	0	-	-	-	-	26	SPARE	1	20	-
27	SPACE	1	-	-	-	-	0	0	-	-	28	SPACE	1	-	-
29	SPACE	1	-	-	-	-	-	-	0	0	30	SPACE	1	-	-
31	SPACE	1	-	-	0	0	-	-	-	-	32	SPACE	1	-	-
33	SPACE	1	-	-	-	-	0	0	-	-	34	SPACE	1	-	-
35	SPACE	1	-	-	-	-	-	-	0	0	36	SPACE	1	-	-
37	SPACE	1	-	-	0	0	-	-	-	-	38	SPACE	1	-	-
39	SPACE	1	-	-	-	-	0	0	-	-	40	SPACE	1	-	-
41	SPACE	1	-	-	-	-	-	-	0	0	42	SPACE	1	-	-
	CONNECTED LOAD	43 A		TOTAL PHASE A	49 A		-		-			CONNECTED LOAD	35.8 KVA		
	DEMAND LOAD	54 A		TOTAL PHASE B	-		45 A		-						
				TOTAL PHASE C	-		-		36 A						

Figure 99 | New Panelboard E2LG5 Worksheet

PANELBOARD SIZING WORKSHEET

Panel Tag---------->				E2LG5	Panel Location:			Electrical Room 0703			
Nominal Phase to Neutral Voltage------->				277	Phase:			3			
Nominal Phase to Phase Voltage-------->				480	Wires:			4			
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	Lighting	3	km 4-6, tean	13.2	A	0.90	3291	3656		
2	A	Lighting	3	1-8 11-16, t	12.4	A	0.90	3091	3435		
3	B	Lighting	3	ed 4-12,rm 1	12.3	A	0.90	3066	3407		
4	B	Lighting	3	19-10 psyc	13.6	A	0.90	3390	3767		
5	C	Lighting	3	eds 1-9, tea	13.3	A	0.90	3316	3684		
6	C	Lighting	3	r 1-10, wk r	12.38	A	0.90	3086	3429		
7	A	Lighting	3	R 1-6, team	9.13	A	0.90	2276	2529		
8	A	Lighting	3	Team, r 7-11	9.9	A	0.90	2468	2742		
9	B	Lighting	3	Room 1-12	12.9	A	0.90	3216	3573		
10	B	Lighting	3	Team, rm 1-	6.01	A	0.90	1498	1665		
11	C	Lighting	3	eam, rm 7-1	9.8	A	0.90	2443	2715		
12	C	Spare	9	-	0	A	1.00	0	0		
13	A	Lighting	3	Amb canopy	2.99	A	0.90	745	828		
14	A	Spare	9	-	0	A	1.00	0	0		
15	B	Spare	9	-	0	A	1.00	0	0		
16	B	Spare	9	-	0	A	1.00	0	0		
17	C	Spare	9	-	0	A	1.00	0	0		
18	C	Spare	9	-	0	A	1.00	0	0		
19	A	Spare	9	-	0	A	1.00	0	0		
20	A	Spare	9	-	0	A	1.00	0	0		
21	B	Spare	9	-	0	A	1.00	0	0		
22	B	Spare	9	-	0	A	1.00	0	0		
23	C	Spare	9	-	0	A	1.00	0	0		
24	C	Spare	9	-	0	A	1.00	0	0		
25	A	Spare	9	-	0	A	1.00	0	0		
26	A				0	A	1.00	0	0		
27	B				0	A	1.00	0	0		
28	B				0	A	1.00	0	0		
29	C				0	A	1.00	0	0		
30	C				0	A	1.00	0	0		
31	A				0	A	1.00	0	0		
32	A				0	A	1.00	0	0		
33	B				0	A	1.00	0	0		
34	B				0	A	1.00	0	0		
35	C				0	A	1.00	0	0		
36	C				0	A	1.00	0	0		
37	A				0	A	1.00	0	0		
38	A				0	A	1.00	0	0		
39	B				0	A	1.00	0	0		
40	B				0	A	1.00	0	0		
41	C				0	A	1.00	0	0		
42	C				0	A	1.00	0	0		
PANEL TOTAL								31.9	35.4	Amps=	42.6

PHASE LOADING		kW	kVA	%	Amps
PHASE TOTAL	A	11.9	13.2	37%	47.6
PHASE TOTAL	B	11.2	12.4	35%	44.8
PHASE TOTAL	C	8.8	9.8	28%	35.5

LOAD CATAGORIES			Connected			Demand				Ver. 104
			kW	kVA	DF	kW	kVA	PF		
1	receptacles		0.0	0.0		0.0	0.0			
2	computers		0.0	0.0		0.0	0.0			
3	fluorescent lighting		31.9	35.4		31.9	35.4	0.90		
4	HID lighting		0.0	0.0		0.0	0.0			
5	incandescent lighting		0.0	0.0		0.0	0.0			
6	HVAC fans		0.0	0.0		0.0	0.0			
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						31.9	35.4			
Spare Capacity			20%			6.4	7.1			
Total Design Loads						38.3	42.5	0.90	Amps=	51.2

Figure 100 | New Panelboard E2LG5 Schedule

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	E2LG5	MIN. C/B AIC:	35K
SIZE/TYPE BUS:	100A	PANEL LOCATION:	Electrical Room 0703	OPTIONS:	
SIZE/TYPE MAIN:	100A/3P C/B	PANEL MOUNTING:	SURFACE		(4) #6, (1) #8 G, 1" C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	Rm 4-6, team	3291	20A/1P	1	*			2	20A/1P	3091	F 1-8 11-16, tm	Lighting
Lighting	Ped 4-12,rm 1-3	3066	20A/1P	3		*		4	20A/1P	3390	F 19-10 psych	Lighting
Lighting	Peds 1-9, team	3316	20A/1P	5			*	6	20A/1P	3086	Tr 1-10, wk rm	Lighting
Lighting	R 1-6, team	2276	20A/1P	7	*			8	20A/1P	2468	Team, r 7-11	Lighting
Lighting	Room 1-12	3216	20A/1P	9		*		10	20A/1P	1498	Team, rm 1-6	Lighting
Lighting	Team, rm 7-12	2443	20A/1P	11			*	12	20A/1P	0	-	Spare
Lighting	Amb canopy	745	20A/1P	13	*			14	20A/1P	0	-	Spare
Spare	-	0	20A/1P	15		*		16	20A/1P	0	-	Spare
Spare	-	0	20A/1P	17			*	18	20A/1P	0	-	Spare
Spare	-	0	20A/1P	19	*			20	20A/1P	0	-	Spare
Spare	-	0	20A/1P	21		*		22	20A/1P	0	-	Spare
Spare	-	0	20A/1P	23			*	24	20A/1P	0	-	Spare
Spare	-	0	20A/1P	25	*			26	-	0	0	0
0	0	0	-	27		*		28	-	0	0	0
0	0	0	-	29			*	30	-	0	0	0
0	0	0	-	31	*			32	-	0	0	0
0	0	0	-	33		*		34	-	0	0	0
0	0	0	-	35			*	36	-	0	0	0
0	0	0	-	37	*			38	-	0	0	0
0	0	0	-	39		*		40	-	0	0	0
0	0	0	-	41			*	42	-	0	0	0

CONNECTED LOAD (KW) - A Ph.	11.87	TOTAL DESIGN LOAD (KW)	38.27
CONNECTED LOAD (KW) - B Ph.	11.17	POWER FACTOR	0.90
CONNECTED LOAD (KW) - C Ph.	8.85	TOTAL DESIGN LOAD (AMPS)	51

Feeder Size Calculation

51.2 A * 125% = 64 A

100A Circuit Breaker, (4) #6 AWG CU THWN, (1) #8 AWG CU Ground, 1” EMT Conduit

Electrical Depth

Overview

The main distribution of Franklin Square Hospital Center is a secondary selective system allowing for multiple paths of supply power. Two service entrances with separate transformers create two radial systems that are connected with a tie breaker. The tie breaker is located on the bus bar and remains open unless one of the feeders fails. When this happens the tie breaker closes and the entire load runs through a single feeder. Both substation feeders are sized to accommodate this increased load. Transformers located in substations step-down the voltage from 13.2KV to 480Y/277V, 3PH, 4W which is run throughout the building. Other transformers step this voltage down to 208Y/120V, 3PH, 4W for mostly lighting and receptacle loads. Three emergency generators fed by a 480Y/277V, 3PH, 4W voltage system are each rated at 2000KW along with another service entrance, supply power to equipment and life safety branches when needed. An uninterruptable power system (UPS) rated at 180KVA/162KW provides 208Y/120V, 3PH, 4W emergency power to the building.

Figure 101 | Electrical Redesign Summary

ELECTRICAL PANELBOARD REDESIGN					
PANELBOARD TAG	VOLTAGE SYSTEM	REDESIGN SPACES			
		MAIN ENTRANCE + PARKING LOT	GIFT SHOP	LOBBY + WAITING AREA	TEAM STATION
LPSL1 (Normal)	480Y/277 V	X			
E1DP-1 (Emergency)	480Y/277 V	X			
LP11 (Normal)	480Y/277 V		X		
E1L11 (Emergency)	480Y/277 V		X		
LPG5 (Normal)	480Y/277 V			X	X
E2LG5 (Emergency)	480Y/277 V			X	X
E1LG5 (Emergency)	480Y/277 V			X	

Depth Topic 1 | Copper feeders vs. aluminum feeders

Introduction

Franklin Square Hospital Center utilizes copper feeders for the building's electrical distribution system. Copper conductors are typically more expensive when compared to aluminum conductors. The price variation is due to the economic difference between the two conductor materials. The current price for copper is higher since there is not an abundance of it as there is of aluminum. Copper ore is mined in select areas of the world then put through a series of processes to purify the copper. Similarly, aluminum ore is also mined but the abundance of deposits around the world allow for more production of aluminum.

Method

A cost analysis of conductors and associated conduits was performed to determine the cost savings. The conductors table (Table X) lists the sizes of aluminum THWN wire that will replace the copper THWN size based on amperage and the cost per linear foot associated with each. Table 310.16 of the National Electric Code 2008 (NEC 2008) was used to determine the allowable ampacities of each copper and aluminum conductor. The conduit table (Table X) lists the prices per linear foot of electrical metallic tubing (EMT) and aluminum conduit. The maximum number of conductors allowed in EMT was referenced from Table C.1 in Annex C of the NEC 2008. Table C.8 found in Annex C of the NEC 2008 lists the maximum number of conductors in rigid metal conduit which is used with the copper conductors. The estimated prices are referenced from RSMeans Electrical Cost Data 2010.

Figure 102 | Copper and Aluminum Conductor Prices

CONDUCTORS					
CU			AL		
SIZE	AMPS	COST/LF	SIZE	AMPS	COST/LF
12AWG	25	$0.69	10AWG	30	$0.72
10AWG	35	$0.84	8AWG	40	$0.88
8AWG	50	$1.18	6AWG	50	$1.05
6AWG	65	$1.61	4AWG	65	$1.30
4AWG	85	$2.23	2AWG	90	$1.65
3AWG	100	$2.60	1AWG	100	$2.70
2AWG	115	$3.10	1/0AWG	120	$2.43
1AWG	130	$3.75	2/0AWG	135	$2.78
1/0AWG	150	$4.55	3/0AWG	155	$3.20
2/0AWG	175	$5.55	4/0AWG	180	$3.50
3/0AWG	200	$6.75	250KCMIL	205	$4.00
4/0AWG	230	$8.20	300KCMIL	230	$4.90
250KCMIL	255	$9.50	400KCMIL	270	$5.85
300KCMIL	285	$11.00	500KCMIL	310	$6.55
350KCMIL	310	$12.50	500KCMIL	310	$6.55
400KCMIL	335	$14.00	600KCMIL	340	$7.70
500KCMIL	380	$16.50	750KCMIL	385	$8.85
600KCMIL	420	$18.72	900KCMIL	425	$9.87
700KCMIL	460	$20.94	1250KCMIL	485	$11.41
750KCMIL	475	$21.78	1250KCMIL	485	$11.41
800KCMIL	490	$22.61	1500KCMIL	520	$12.30
900KCMIL	520	$24.28	1500KCMIL	520	$12.30
1000KCMIL	545	$25.67	1750KCMIL	545	$12.94
1250KCMIL	590	$28.17	-	-	-
1500KCMIL	625	$30.11	-	-	-
1750KCMIL	650	$31.50	-	-	-
2000KCMIL	665	$32.33	-	-	-

Figure 103 | EMT and Aluminum Conduit Prices

CONDUITS			
EMT		ALUMINUM	
SIZE	COST/LF	SIZE	COST/LF
0.5"	$4.01	0.5"	$6.06
0.75"	$5.45	0.75"	$9.65
1"	$6.90	1"	$11.50
1.25"	$8.85	1.25"	$14.10
1.5"	$10.35	1.5"	$15.95
2"	$12.35	2"	$19.40
2.5"	$22.00	2.5"	$27.50
3"	$26.50	3"	$35.00
3.5"	$29.00	3.5"	$44.00
4"	$31.50	4"	$52.00
6"	$41.50	5"	$101.00
-	-	6"	$144.00

Figure 104 | Feeder Schedule

FEEDER SCHEDULE																								
TAG	FROM	TO	LENGTH (FEET)	CONDUIT (PER SET)				CONDUTORS (PER SET)															CU TOTAL COST	AL TOTAL COST
				CU		AL		PHASE CONDUCTORS					NEUTRAL CONDUCTORS					GROUND CONDUCTORS						
				SIZE	COST	SIZE	COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST		
P10	EMERGENCY SWITCHGEAR	SWITCHBORAD EMDP-3	710	4"	$178,920.00	6"	$817,920.00	8	750KCMIL	$123,697.78	1250KCMIL	$64,783.56	1	750KCMIL	$15,462.22	1250KCMIL	$8,097.94	8	250KCMIL	$53,960.00	400KCMIL	$33,228.00	$372,040.00	$924,029.50
P11	EMERGENCY SWITCHGEAR	SWITCHBOARD EMDP-4	48	3.5"	$6,960.00	5"	$24,240.00	5	600KCMIL	$4,493.33	900KCMIL	$2,369.33	1	600KCMIL	$898.67	900KCMIL	$473.87	5	250KCMIL	$2,280.00	400KCMIL	$1,404.00	$14,632.00	$28,487.20
P12	GENSET #1	EMERGENCY SWITCHGEAR	41	3"	$8,692.00	3.5"	$14,432.00	8	500KCMIL	$5,412.00	750KCMIL	$2,902.80	-	-	-	-	-	8	400KCMIL	$4,592.00	600KCMIL	$2,525.60	$18,696.00	$19,860.40
P13	GENSET #2	EMERGENCY SWITCHGEAR	56	3"	$11,872.00	3.5"	$19,712.00	8	500KCMIL	$7,392.00	750KCMIL	$3,964.80	-	-	-	-	-	8	400KCMIL	$6,272.00	600KCMIL	$3,449.60	$25,536.00	$27,126.40
P14	GENSET #3	EMERGENCY SWITCHGEAR	67	3"	$14,204.00	3.5"	$23,584.00	8	500KCMIL	$8,844.00	750KCMIL	$4,743.60	-	-	-	-	-	8	400KCMIL	$7,504.00	600KCMIL	$4,127.20	$30,552.00	$32,454.80
P15	CHILLER SUBSTATION 2	ATS E3-3P	43	2.5"	$2,838.00	3.5"	$5,676.00	3	300KCMIL	$1,419.00	500KCMIL	$844.95	1	300KCMIL	$473.00	500KCMIL	$281.65	3	1/0AWG	$586.95	3/0AWG	$412.80	$5,316.95	$7,215.40
P16	ATS 3-3P	EMCC	42	2.5"	$2,772.00	3.5"	$5,544.00	3	300KCMIL	$1,386.00	500KCMIL	$825.30	1	300KCMIL	$462.00	500KCMIL	$275.10	3	1/0AWG	$573.30	3/0AWG	$403.20	$5,193.30	$7,047.60
P17	SWITCHBOARD EMDP-4	ATS E3-3P	53	2.5"	$3,498.00	3.5"	$6,996.00	3	300KCMIL	$1,749.00	500KCMIL	$1,041.45	1	300KCMIL	$583.00	500KCMIL	$347.15	3	1/0AWG	$723.45	3/0AWG	$508.80	$6,553.45	$8,893.40
P18	CHILLER SUBSTATION 2	SWITCHBOARD NCP1	103	3"	$13,647.50	4"	$26,780.00	5	400KCMIL	$7,210.00	600KCMIL	$3,965.50	1	400KCMIL	$1,442.00	600KCMIL	$793.10	5	4/0AWG	$4,223.00	300KCMIL	$2,523.50	$26,522.50	$34,062.10
P19	SWITCHBOARD NCP1	XFMR T-1P	58	1.25"	$513.30	1.5"	$925.10	1	2AWG	$179.80	1/0AWG	$140.94	-	-	-	-	-	1	6AWG	$93.38	4AWG	$75.40	$786.48	$1,141.44
P20	XFMR T-1P	PANEL RPCP	11	2.5"	$242.00	1.25"	$155.10	1	4AWG	$24.53	2AWG	$18.15	1	4AWG	$24.53	2AWG	$18.15	1	2AWG	$34.10	1/0AWG	$26.73	$325.16	$218.13
P21	SWITCHBOARD NCP1	ATS E1-1P	47	2"	$580.45	2"	$911.80	1	1AWG	$176.25	2/0AWG	$130.66	1	1AWG	$176.25	2/0AWG	$130.66	1	6AWG	$75.67	4AWG	$61.10	$1,008.62	$1,234.22
P22	ATS E1-1P	EX. PANEL E1LCP	37	2"	$456.95	2"	$717.80	1	1/0AWG	$168.35	3/0AWG	$118.40	1	1/0AWG	$168.35	3/0AWG	$118.40	1	6AWG	$59.57	4AWG	$48.10	$853.22	$1,002.70
P23	SWITCHBOARD EMDP-4	ATS E1-1P	12	2"	$148.20	2"	$232.80	1	1/0AWG	$54.60	3/0AWG	$38.40	1	1/0AWG	$54.60	3/0AWG	$38.40	1	6AWG	$19.32	4AWG	$15.60	$276.72	$325.20
P24	EX. PANEL E1LCP	EX. XFMR T-2P	11	0.75"	$59.95	0.75"	$106.15	1	10AWG	$9.19	8AWG	$9.72	-	-	-	-	-	1	10AWG	$9.19	8AWG	$9.72	$78.32	$125.58
P25	EX. XFMR T-2P	EX. PANEL E1RCP	9	1"	$62.10	1.25"	$126.90	1	6AWG	$14.49	4AWG	$11.70	1	6AWG	$14.49	4AWG	$11.70	1	8AWG	$10.62	6AWG	$9.45	$101.70	$159.75
P26	ATS E3-2P	PANEL E3LCP1	87	3"	$6,916.50	4"	$13,572.00	3	400KCMIL	$3,654.00	600KCMIL	$2,009.70	1	400KCMIL	$1,218.00	600KCMIL	$669.90	3	2/0AWG	$1,448.55	4/0AWG	$913.50	$13,237.05	$17,165.10
P27	EMCC	PANEL E3LCP	17	1"	$117.30	1.25"	$239.70	1	6AWG	$27.37	4AWG	$22.10	1	6AWG	$27.37	4AWG	$22.10	1	8AWG	$20.06	6AWG	$17.85	$192.10	$301.75
P28	CHILLER SUBSTATION 1	ATS E3-1P	35	3.5"	$5,075.00	5"	$17,675.00	5	600KCMIL	$3,276.39	900KCMIL	$1,727.64	1	600KCMIL	$655.28	900KCMIL	$345.53	5	250KCMIL	$1,662.50	400KCMIL	$1,023.75	$10,669.17	$20,771.92
P29	ATS E3-1P	SWGR E3CP1	82	3.5"	$11,890.00	5"	$41,410.00	5	600KCMIL	$7,676.11	900KCMIL	$4,047.61	1	600KCMIL	$1,535.22	900KCMIL	$809.52	5	250KCMIL	$3,895.00	400KCMIL	$2,398.50	$24,996.33	$48,665.63
P30	EMERGENCY SWITCHGEAR	ATS E3-1P	68	3.5"	$9,860.00	5"	$34,340.00	5	600KCMIL	$6,365.56	900KCMIL	$3,356.56	1	600KCMIL	$1,273.11	900KCMIL	$671.31	5	250KCMIL	$3,230.00	400KCMIL	$1,989.00	$20,728.67	$40,356.87
P31	SWITCHBOARD EMDP-3	EX. ATS-5	34	2.5"	$2,244.00	3.5"	$4,488.00	3	300KCMIL	$1,122.00	500KCMIL	$668.10	1	300KCMIL	$374.00	500KCMIL	$222.70	3	1/0AWG	$464.10	3/0AWG	$326.40	$4,204.10	$5,705.20
P32	EMCC	XFMR T-3P	27	1.25"	$238.95	1.5"	$430.65	1	2AWG	$83.70	1/0AWG	$65.61	-	-	-	-	-	1	6AWG	$43.47	4AWG	$35.10	$366.12	$531.36
P33	EFMR T-3P	PANEL E3RCP	10	2.5"	$220.00	3"	$350.00	1	4/0AWG	$82.00	300KCMIL	$49.00	1	4/0AWG	$82.00	300KCMIL	$49.00	1	2AWG	$31.00	1/0AWG	$24.30	$415.00	$472.30
P34	SWITCHBOARD EMDP-3	EX. ATS-2	42	2.5"	$2,772.00	3.5"	$5,544.00	3	300KCMIL	$1,386.00	500KCMIL	$825.30	1	300KCMIL	$462.00	500KCMIL	$275.10	3	1/0AWG	$573.30	3/0AWG	$403.20	$5,193.30	$7,047.60
P35	SWITCHBOARD EMDP-3	EX. ATS-3	79	2.5"	$5,214.00	3.5"	$10,428.00	3	300KCMIL	$2,607.00	500KCMIL	$1,552.35	1	300KCMIL	$869.00	500KCMIL	$517.45	3	1/0AWG	$1,078.35	3/0AWG	$758.40	$9,768.35	$13,256.20
P36	SWITCHBOARD EMDP-3	EX. ATS-6	85	2.5"	$5,610.00	3.5"	$11,220.00	3	300KCMIL	$2,805.00	500KCMIL	$1,670.25	1	300KCMIL	$935.00	500KCMIL	$556.75	3	1/0AWG	$1,160.25	3/0AWG	$816.00	$10,510.25	$14,263.00
P37	SWITCHBOARD EMDP-3	EX. ATS-4	67	2"	$827.45	2.5"	$1,842.50	1	3/0AWG	$452.25	250KCMIL	$268.00	1	3/0AWG	$452.25	250KCMIL	$268.00	1	6AWG	$107.87	4AWG	$87.10	$1,839.82	$2,465.60
P38	SWITCHBOARD EMDP-3	EX. ATS-1	38	2"	$469.30	2.5"	$1,045.00	1	3/0AWG	$256.50	250KCMIL	$152.00	1	3/0AWG	$256.50	250KCMIL	$152.00	1	6AWG	$61.18	4AWG	$49.40	$1,043.48	$1,398.40
P39	CHILLER SWITCHGEAR 1	ATS E3-2P	22	3"	$1,749.00	4"	$3,432.00	3	400KCMIL	$924.00	600KCMIL	$508.20	1	400KCMIL	$308.00	600KCMIL	$169.40	3	2/0AWG	$366.30	4/0AWG	$231.00	$3,347.30	$4,340.60
P40	EMERGENCY SWITCHGEAR	ATS E3-2P	49	3"	$3,895.50	4"	$7,644.00	3	400KCMIL	$2,058.00	600KCMIL	$1,131.90	1	400KCMIL	$686.00	600KCMIL	$377.30	3	2/0AWG	$815.85	4/0AWG	$514.50	$7,455.35	$9,667.70
P41	SWITCHBOARD NCP1	EX. PANEL LPCP	66	1.25"	$584.10	1.5"	$1,052.70	1	3AWG	$171.60	1AWG	$178.20	1	3AWG	$171.60	1AWG	$178.20	1	8AWG	$77.88	6AWG	$69.30	$1,005.18	$1,478.40
P42	EX. PANEL LPCP	EX. XFMR T-4P	127	0.75"	$692.15	1"	$1,460.50	1	6AWG	$204.47	4AWG	$165.10	-	-	-	-	-	1	10AWG	$106.05	8AWG	$112.18	$1,002.67	$1,737.78
P43	EX. XFMR T-4P	EX. PANEL RPCP2	130	1.25"	$1,150.50	1.5"	$2,073.50	1	3AWG	$338.00	1AWG	$351.00	1	3AWG	$338.00	1AWG	$351.00	1	8AWG	$153.40	6AWG	$136.50	$1,979.90	$2,912.00
P44	SWITCHBOARD NCP1	EX. PANEL LPSL	69	1.25"	$610.65	1.5"	$1,100.55	1	3AWG	$179.40	1AWG	$186.30	1	3AWG	$179.40	1AWG	$186.30	1	8AWG	$81.42	6AWG	$72.45	$1,050.87	$1,545.60
M1	SWGR E3CP1	CH-1	89	3"	$7,075.50	3.5"	$11,748.00	3	400KCMIL	$3,738.00	600KCMIL	$2,055.90	-	-	-	-	-	1	250KCMIL	$845.50	400KCMIL	$520.65	$11,659.00	$14,324.55
M2	CHILLER SUBSTATION 2	CH-2	45	3"	$3,577.50	3.5"	$5,940.00	3	400KCMIL	$1,890.00	600KCMIL	$1,039.50	-	-	-	-	-	1	250KCMIL	$427.50	400KCMIL	$263.25	$5,895.00	$7,242.75
M3	SWGR E3CP1	P-CHW-1	88	2.5"	$1,936.00	3"	$3,080.00	1	350KCMIL	$1,100.00	500KCMIL	$576.40	-	-	-	-	-	1	3AWG	$228.80	1AWG	$237.60	$3,264.80	$3,894.00
M4	CHILLER SUBSTATION 2	P-CHW-2	28	2.5"	$616.00	3"	$980.00	1	350KCMIL	$350.00	500KCMIL	$183.40	-	-	-	-	-	1	3AWG	$72.80	1AWG	$75.60	$1,038.80	$1,239.00
M5	SWGR E3CP1	P-CHW-3	83	2.5"	$1,826.00	3"	$2,905.00	1	350KCMIL	$1,037.50	500KCMIL	$543.65	-	-	-	-	-	1	3AWG	$215.80	1AWG	$224.10	$3,079.30	$3,672.75
7	EMERGENCY SWITCHGEAR	SWITCHBOARD EMDP-1	493	4"	$108,706.50	6"	$496,944.00	7	750KCMIL	$75,155.11	1250KCMIL	$39,360.57	1	750KCMIL	$10,736.44	1250KCMIL	$5,622.94	7	400KCMIL	$48,314.00	600KCMIL	$26,572.70	$242,912.06	$568,500.21
8	EMERGENCY SWITCHGEAR	SWITCHBOARD EMDP-2	479	4"	$105,619.50	6"	$482,832.00	7	750KCMIL	$73,020.89	1250KCMIL	$38,242.83	1	750KCMIL	$10,431.56	1250KCMIL	$5,463.26	7	400KCMIL	$46,942.00	600KCMIL	$25,818.10	$236,013.94	$552,356.19
9	EMERGENCY SWITCHGEAR	FIRE PUMP CONTROLLER/ATS	425	4"	$40,162.50	4"	$66,300.00	3	600KCMIL	$23,870.83	900KCMIL	$12,587.08	-	-	-	-	-	3	3/0AWG	$8,606.25	250KCMIL	$5,100.00	$72,639.58	$83,987.08
10	FIRE PUMP CONTROLLER/ATS	FIRE PUMP	20	4"	$1,890.00	4"	$3,120.00	3	600KCMIL	$1,123.33	900KCMIL	$592.33	-	-	-	-	-	3	3/0AWG	$405.00	250KCMIL	$240.00	$3,418.33	$3,952.33
11	SUBSTATION 3	PANEL FDP-2	42	3"	$3,339.00	4"	$6,552.00	3	400KCMIL	$1,764.00	600KCMIL	$970.20	1	400KCMIL	$588.00	600KCMIL	$323.40	3	2/0AWG	$699.30	4/0AWG	$441.00	$6,390.30	$8,286.60
12	SUBSTATION 3	ATS E2-2	50	2.5"	$3,300.00	3.5"	$6,600.00	3	300KCMIL	$1,650.00	500KCMIL	$982.50	1	300KCMIL	$550.00	500KCMIL	$327.50	3	1/0AWG	$682.50	3/0AWG	$480.00	$6,182.50	$8,390.00
13	ATS E2-2	PANEL E2DP-2	15	2.5"	$990.00	3.5"	$1,980.00	3	300KCMIL	$495.00	500KCMIL	$294.75	1	300KCMIL	$165.00	500KCMIL	$98.25	3	1/0AWG	$204.75	3/0AWG	$144.00	$1,854.75	$2,517.00
14	SWITCHBOARD EMDP-2	ATS E2-2	27	2.5"	$1,782.00	3.5"	$3,564.00	3	300KCMIL	$891.00	500KCMIL	$530.55	1	300KCMIL	$297.00	500KCMIL	$176.85	3	1/0AWG	$368.55	3/0AWG	$259.20	$3,338.55	$4,530.60
15	SUBSTATION 3	ATS E1-1	31	2.5"	$682.00	3"	$1,085.00	1	250KCMIL	$294.50	400KCMIL	$181.35	1	250KCMIL	$294.50	400KCMIL	$181.35	1	4AWG	$69.13	2AWG	$51.15	$1,340.13	$1,498.85
16	ATS E1-1	PANEL E1DP-1	19	2.5"	$418.00	3"	$665.00	1	250KCMIL	$180.50	400KCMIL	$111.15	1	250KCMIL	$180.50	400KCMIL	$111.15	1	4AWG	$42.37	2AWG	$31.35	$821.37	$918.65
17	SWITCHBOARD EMDP-1	ATS E1-1	21	2.5"	$462.00	3"	$735.00	1	250KCMIL	$199.50	400KCMIL	$122.85	1	250KCMIL	$199.50	400KCMIL	$122.85	1	4AWG	$46.83	2AWG	$34.65	$907.83	$1,015.35
18	SUBSTATION 3	ATS E3-4	65	2.5"	$4,290.00	3.5"	$8,580.00	3	300KCMIL	$2,145.00	500KCMIL	$1,277.25	1	300KCMIL	$715.00	500KCMIL	$425.75	3	1/0AWG	$887.25	3/0AWG	$624.00	$8,037.25	$10,907.00

FEEDER SCHEDULE (CONT.)

TAG	FROM	TO	LENGTH (FEET)	CONDUIT (PER SET)				CONDUTORS (PER SET)														CU TOTAL COST	AL TOTAL COST
				CU		AL		PHASE CONDUCTORS					NEUTRAL CONDUCTORS					GROUND CONDUCTORS						
				SIZE	COST	SIZE	COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST		
19	ATS E3-4	PANEL E3DP-4	17	2.5"	$1,122.00	3.5"	$2,244.00	3	300KCMIL	$561.00	500KCMIL	$334.05	1	300KCMIL	$187.00	500KCMIL	$111.35	3	1/0AWG	$232.05	3/0AWG	$163.20	$2,102.05	$2,852.60
20	SWITCHBOARD EMDP-1	ATS E3-4	31	2.5"	$2,046.00	3.5"	$4,092.00	3	300KCMIL	$1,023.00	500KCMIL	$609.15	1	300KCMIL	$341.00	500KCMIL	$203.05	3	1/0AWG	$423.15	3/0AWG	$297.60	$3,833.15	$5,201.80
21	PANEL E3DP-4	PANEL E3LG1	79	3.5"	$2,291.00	4"	$4,108.00	1	500KCMIL	$1,303.50	750KCMIL	$699.15	1	500KCMIL	$1,303.50	750KCMIL	$699.15	1	3AWG	$205.40	1AWG	$213.30	$5,103.40	$5,719.60
22	PANEL E3DP-4	XFMR T-1	71	1.25"	$628.35	1.5"	$1,132.45	1	2AWG	$220.10	1/0AWG	$172.53	-	-	-	-	-	1	6AWG	$114.31	4AWG	$92.30	$962.76	$1,397.28
23	XFMR T-1	PANEL E3RG1	11	2.5"	$242.00	3"	$385.00	1	250KCMIL	$104.50	400KCMIL	$64.35	1	250KCMIL	$104.50	400KCMIL	$64.35	1	2AWG	$34.10	1/0AWG	$26.73	$485.10	$540.43
24	SUBSTATION 3	PANEL FDP-1	42	2.5"	$2,772.00	3.5"	$5,544.00	3	300KCMIL	$1,386.00	500KCMIL	$825.30	1	300KCMIL	$462.00	500KCMIL	$275.10	3	1/0AWG	$573.30	3/0AWG	$403.20	$5,193.30	$7,047.60
25	PANEL FDP-1	XFMR T-2	24	2"	$889.20	2.5"	$1,980.00	3	3/0AWG	$486.00	250KCMIL	$288.00	1	3/0AWG	$162.00	250KCMIL	$96.00	3	3AWG	$187.20	1AWG	$194.40	$1,724.40	$2,558.40
26	XFMR T-2	PANEL DRP-1	12	2.5"	$792.00	3.5"	$1,584.00	3	300KCMIL	$396.00	500KCMIL	$235.80	1	300KCMIL	$132.00	500KCMIL	$78.60	3	1/0AWG	$163.80	3/0AWG	$115.20	$1,483.80	$2,013.60
27	SUBSTATION 3	ATS E2-1	36	2.5"	$2,376.00	3.5"	$4,752.00	3	300KCMIL	$1,188.00	500KCMIL	$707.40	1	300KCMIL	$396.00	500KCMIL	$235.80	3	1/0AWG	$491.40	3/0AWG	$345.60	$4,451.40	$6,040.80
28	ATS E2-1	PANEL E2DP-1	17	2.5"	$1,122.00	3.5"	$2,244.00	3	300KCMIL	$561.00	500KCMIL	$334.05	1	300KCMIL	$187.00	500KCMIL	$111.35	3	1/0AWG	$232.05	3/0AWG	$163.20	$2,102.05	$2,852.60
29	SWITCHBOARD EMDP-1	ATS E2-1	19	2.5"	$1,254.00	3.5"	$2,508.00	3	300KCMIL	$627.00	500KCMIL	$373.35	1	300KCMIL	$209.00	500KCMIL	$124.45	3	1/0AWG	$259.35	3/0AWG	$182.40	$2,349.35	$3,188.20
30	PANEL E2DP-1	XFMR T-3	27	2"	$1,000.35	2.5"	$2,227.50	3	3/0AWG	$546.75	250KCMIL	$324.00	1	3/0AWG	$182.25	250KCMIL	$108.00	3	3AWG	$210.60	1AWG	$218.70	$1,939.95	$2,878.20
31	XFMR T-3	PANEL E2RDP-1	12	2.5"	$792.00	3.5"	$1,584.00	3	300KCMIL	$396.00	500KCMIL	$235.80	1	300KCMIL	$132.00	500KCMIL	$78.60	3	1/0AWG	$163.80	3/0AWG	$115.20	$1,483.80	$2,013.60
32	SUBSTATION 2	PANEL MDP-72	184	3"	$24,380.00	4"	$47,840.00	5	400KCMIL	$12,880.00	600KCMIL	$7,084.00	1	400KCMIL	$2,576.00	600KCMIL	$1,416.80	5	4/0AWG	$7,544.00	300KCMIL	$4,508.00	$47,380.00	$60,848.80
33	SUBSTATION 2	ATS E3-2	27	2.5"	$1,782.00	3.5"	$3,564.00	3	300KCMIL	$891.00	500KCMIL	$530.55	1	300KCMIL	$297.00	500KCMIL	$176.85	3	1/0AWG	$368.55	3/0AWG	$259.20	$3,338.55	$4,530.60
34	ATS E3-2	PANEL E3DP-72	203	2.5"	$13,398.00	3.5"	$26,796.00	3	300KCMIL	$6,699.00	500KCMIL	$3,988.95	1	300KCMIL	$2,233.00	500KCMIL	$1,329.65	3	1/0AWG	$2,770.95	3/0AWG	$1,948.80	$25,100.95	$34,063.40
35	SWITCHBOARD EMDP-2	ATS E3-2	39	2.5"	$2,574.00	3.5"	$5,148.00	3	300KCMIL	$1,287.00	500KCMIL	$766.35	1	300KCMIL	$429.00	500KCMIL	$255.45	3	1/0AWG	$532.35	3/0AWG	$374.40	$4,822.35	$6,544.20
36	SUBSTATION 1	PANEL MDP-71	152	3"	$20,140.00	4"	$39,520.00	5	400KCMIL	$10,640.00	600KCMIL	$5,852.00	1	400KCMIL	$2,128.00	600KCMIL	$1,170.40	5	4/0AWG	$6,232.00	300KCMIL	$3,724.00	$39,140.00	$50,266.40
37	SUBSTATION 1	ATS E2-3	79	2.5"	$5,214.00	3.5"	$10,428.00	3	300KCMIL	$2,607.00	500KCMIL	$1,552.35	1	300KCMIL	$869.00	500KCMIL	$517.45	3	1/0AWG	$1,078.35	3/0AWG	$758.40	$9,768.35	$13,256.20
38	ATS E2-3	PANEL E2DP-3	15	2.5"	$990.00	3.5"	$1,980.00	3	300KCMIL	$495.00	500KCMIL	$294.75	1	300KCMIL	$165.00	500KCMIL	$98.25	3	1/0AWG	$204.75	3/0AWG	$144.00	$1,854.75	$2,517.00
39	SWITCHBOARD EMDP-1	ATS E2-3	18	2.5"	$1,188.00	3.5"	$2,376.00	3	300KCMIL	$594.00	500KCMIL	$353.70	1	300KCMIL	$198.00	500KCMIL	$117.90	3	1/0AWG	$245.70	3/0AWG	$172.80	$2,225.70	$3,020.40
40	PANEL E3DP-4	PANEL E3L35	157	2.5"	$3,454.00	3.5"	$6,908.00	1	350KCMIL	$1,962.50	500KCMIL	$1,028.35	1	350KCMIL	$1,962.50	500KCMIL	$1,028.35	1	4AWG	$350.11	2AWG	$259.05	$7,729.11	$9,223.75
41	SUBSTATION 1	ATS E3-1	58	2.5"	$3,828.00	3.5"	$7,656.00	3	300KCMIL	$1,914.00	500KCMIL	$1,139.70	1	300KCMIL	$638.00	500KCMIL	$379.90	3	1/0AWG	$791.70	3/0AWG	$556.80	$7,171.70	$9,732.40
42	ATS E3-1	PANEL E3DP-71	185	2.5"	$12,210.00	3.5"	$24,420.00	3	300KCMIL	$6,105.00	500KCMIL	$3,635.25	1	300KCMIL	$2,035.00	500KCMIL	$1,211.75	3	1/0AWG	$2,525.25	3/0AWG	$1,776.00	$22,875.25	$31,043.00
43	SWITCHBOARD EMDP-1	ATS E3-1	21	2.5"	$1,386.00	3.5"	$2,772.00	3	300KCMIL	$693.00	500KCMIL	$412.65	1	300KCMIL	$231.00	500KCMIL	$137.55	3	1/0AWG	$286.65	3/0AWG	$201.60	$2,596.65	$3,523.80
44	SUBSTATION 1	ATS E3-3	52	2.5"	$3,432.00	3.5"	$6,864.00	3	300KCMIL	$1,716.00	500KCMIL	$1,021.80	1	300KCMIL	$572.00	500KCMIL	$340.60	3	1/0AWG	$709.80	3/0AWG	$499.20	$6,429.80	$8,725.60
45	ATS E3-3	PANEL E3DP-73	179	2.5"	$11,814.00	3.5"	$23,628.00	3	300KCMIL	$5,907.00	500KCMIL	$3,517.35	1	300KCMIL	$1,969.00	500KCMIL	$1,172.45	3	1/0AWG	$2,443.35	3/0AWG	$1,718.40	$22,133.35	$30,036.20
46	SWITCHBOARD EMDP-2	ATS E3-3	42	2.5"	$924.00	3"	$1,470.00	1	250KCMIL	$399.00	400KCMIL	$245.70	1	250KCMIL	$399.00	400KCMIL	$245.70	1	4AWG	$93.66	2AWG	$69.30	$1,815.66	$2,030.70
47	PANEL FDP-1	PANEL LPG1	121	2"	$1,494.35	2"	$2,347.40	1	1/0AWG	$550.55	3/0AWG	$387.20	1	1/0AWG	$550.55	3/0AWG	$387.20	1	6AWG	$194.81	4AWG	$157.30	$2,790.26	$3,279.10
48	PANEL LPG1	XFMR T-4	12	1"	$82.80	1.25"	$169.20	1	4AWG	$26.76	2AWG	$19.80	-	-	-	-	-	1	8AWG	$14.16	6AWG	$12.60	$123.72	$201.60
49	XFMR T-4	PANEL RPG1	12	2"	$148.20	2"	$232.80	1	1/0AWG	$54.60	3/0AWG	$38.40	1	1/0AWG	$54.60	3/0AWG	$38.40	1	6AWG	$19.32	4AWG	$15.60	$276.72	$325.20
50	PANEL E1DP-1	PANEL E1LG1	155	1.25"	$1,371.75	1.5"	$2,472.25	1	3AWG	$403.00	1AWG	$418.50	1	3AWG	$403.00	1AWG	$418.50	1	8AWG	$182.90	6AWG	$162.75	$2,360.65	$3,472.00
51	PANEL E1LG1	XFMR T-5	18	0.75"	$98.10	0.75"	$173.70	1	10AWG	$15.03	8AWG	$15.90	-	-	-	-	-	1	10AWG	$15.03	8AWG	$15.90	$128.16	$205.50
52	XFMR T-5	PANEL E2RG1	14	1"	$96.60	1.25"	$197.40	1	6AWG	$22.54	4AWG	$18.20	1	6AWG	$22.54	4AWG	$18.20	1	8AWG	$16.52	6AWG	$14.70	$158.20	$248.50
53	PANEL E2DP-1	PANEL E2LG1	152	2"	$1,877.20	2"	$2,948.80	1	1/0AWG	$691.60	3/0AWG	$486.40	1	1/0AWG	$691.60	3/0AWG	$486.40	1	6AWG	$244.72	4AWG	$197.60	$3,505.12	$4,119.20
54	PANEL E2LG1	XFMR T-6	14	1"	$96.60	1.25"	$197.40	1	4AWG	$31.22	2AWG	$23.10	-	-	-	-	-	1	8AWG	$16.52	6AWG	$14.70	$144.34	$235.20
55	XFMR T-6	PANEL E2RG1	14	2"	$172.90	2"	$271.60	1	1/0AWG	$63.70	3/0AWG	$44.80	1	1/0AWG	$63.70	3/0AWG	$44.80	1	6AWG	$22.54	4AWG	$18.20	$322.84	$379.40
56	PANEL DRP-1	PANEL RPG2	304	2.5"	$6,688.00	3"	$10,640.00	1	4/0AWG	$2,492.80	300KCMIL	$1,489.60	1	4/0AWG	$2,492.80	300KCMIL	$1,489.60	1	4AWG	$677.92	2AWG	$501.60	$12,351.52	$14,120.80
57	PANEL E2RDP-1	PANEL E2RG2	275	2.5"	$6,050.00	3"	$9,625.00	1	4/0AWG	$2,255.00	300KCMIL	$1,347.50	1	4/0AWG	$2,255.00	300KCMIL	$1,347.50	1	4AWG	$613.25	2AWG	$453.75	$11,173.25	$12,773.75
58	PANEL DRP-1	PANEL RPG3	141	2.5"	$3,102.00	3"	$4,935.00	1	4/0AWG	$1,156.20	300KCMIL	$690.90	1	4/0AWG	$1,156.20	300KCMIL	$690.90	1	4AWG	$314.43	2AWG	$232.65	$5,728.83	$6,549.45
59	PANEL E2RDP-1	PANEL E2RG3	130	2.5"	$2,860.00	3"	$4,550.00	1	4/0AWG	$1,066.00	300KCMIL	$637.00	1	4/0AWG	$1,066.00	300KCMIL	$637.00	1	4AWG	$289.90	2AWG	$214.50	$5,281.90	$6,038.50
60	PANEL DRP-1	PANEL RPG4	361	2.5"	$7,942.00	3"	$12,635.00	1	4/0AWG	$2,960.20	300KCMIL	$1,768.90	1	4/0AWG	$2,960.20	300KCMIL	$1,768.90	1	4AWG	$805.03	2AWG	$595.65	$14,667.43	$16,768.45
61	PANEL E2RDP-1	PANEL E2RG4	334	2.5"	$7,348.00	3"	$11,690.00	1	4/0AWG	$2,738.80	300KCMIL	$1,636.60	1	4/0AWG	$2,738.80	300KCMIL	$1,636.60	1	4AWG	$744.82	2AWG	$551.10	$13,570.42	$15,514.30
62	PANEL FDP-1	PANEL LPG5	226	1.25"	$2,000.10	1.5"	$3,604.70	1	3AWG	$587.60	1AWG	$610.20	1	3AWG	$587.60	1AWG	$610.20	1	8AWG	$266.68	6AWG	$237.30	$3,441.98	$5,062.40
63	PANEL E2DP-1	PANEL E2LG5	159	1.25"	$1,407.15	1.5"	$2,536.05	1	3AWG	$413.40	1AWG	$429.30	1	3AWG	$413.40	1AWG	$429.30	1	8AWG	$187.62	6AWG	$166.95	$2,421.57	$3,561.60
64	PANEL E1DP-1	PANEL E1LG5	168	1.25"	$1,486.80	1.5"	$2,679.60	1	3AWG	$436.80	1AWG	$453.60	1	3AWG	$436.80	1AWG	$453.60	1	8AWG	$198.24	6AWG	$176.40	$2,558.64	$3,763.20
65	PANEL E1LG5	XFMR T-7	18	0.75"	$98.10	1"	$207.00	1	6AWG	$28.98	4AWG	$23.40	-	-	-	-	-	1	10AWG	$15.03	8AWG	$15.90	$142.11	$246.30
66	XFMR T-7	PANEL E1RG5	10	1.25"	$88.50	1.5"	$159.50	1	3AWG	$26.00	1AWG	$27.00	1	3AWG	$26.00	1AWG	$27.00	1	8AWG	$11.80	6AWG	$10.50	$152.30	$224.00
67	PANEL E3RG1	PANEL E3RG5	10	3"	$265.00	2"	$194.00	1	1/0AWG	$45.50	3/0AWG	$32.00	1	1/0AWG	$45.50	3/0AWG	$32.00	1	6AWG	$16.10	4AWG	$13.00	$372.10	$271.00
68	PANEL DRP-1	PANEL RPG6	278	2.5"	$6,116.00	3"	$9,730.00	1	4/0AWG	$2,279.60	300KCMIL	$1,362.20	1	4/0AWG	$2,279.60	300KCMIL	$1,362.20	1	4AWG	$619.94	2AWG	$458.70	$11,295.14	$12,913.10
69	PANEL E2RDP-1	PANEL E2RG6	248	2.5"	$5,456.00	3"	$8,680.00	1	4/0AWG	$2,033.60	300KCMIL	$1,215.20	1	4/0AWG	$2,033.60	300KCMIL	$1,215.20	1	4AWG	$553.04	2AWG	$409.20	$10,076.24	$11,519.60
70	PANEL FDP-1	PANEL LP11	124	1.25"	$1,097.40	1.5"	$1,977.80	1	3AWG	$322.40	1AWG	$334.80	1	3AWG	$322.40	1AWG	$334.80	1	8AWG	$146.32	6AWG	$130.20	$1,888.52	$2,777.60
71	PANEL E1DP-1	PANEL E1L11	157	1.25"	$1,389.45	1.5"	$2,504.15	1	3AWG	$408.20	1AWG	$423.90	1	3AWG	$408.20	1AWG	$423.90	1	8AWG	$185.26	6AWG	$164.85	$2,391.11	$3,516.80

FEEDER SCHEDULE (CONT.)

TAG	FROM	TO	LENGTH (FEET)	CONDUIT (PER SET)				CONDUTORS (PER SET)														CU TOTAL COST	AL TOTAL COST
				CU		AL		PHASE CONDUCTORS					NEUTRAL CONDUCTORS					GROUND CONDUCTORS						
				SIZE	COST	SIZE	COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST		
72	PANEL E1L11	XFMR T-8	17	0.75"	$92.65	1"	$195.50	1	6AWG	$27.37	4AWG	$22.10	-	-	-	-	-	1	10AWG	$14.20	8AWG	$15.02	$134.22	$232.62
73	XFMR T-8	PANEL E1R11	14	1.25"	$123.90	1.5"	$223.30	1	3AWG	$36.40	1AWG	$37.80	1	3AWG	$36.40	1AWG	$37.80	1	8AWG	$16.52	6AWG	$14.70	$213.22	$313.60
74	PANEL E2DP-1	PANEL E2L11	151	1.25"	$1,336.35	1.5"	$2,408.45	1	3AWG	$392.60	1AWG	$407.70	1	3AWG	$392.60	1AWG	$407.70	1	8AWG	$178.18	6AWG	$158.55	$2,299.73	$3,382.40
75	PANEL E3DP-4	XFMR T-9	114	0.75"	$621.30	1"	$1,311.00	1	6AWG	$183.54	4AWG	$148.20	-	-	-	-	-	1	10AWG	$95.19	8AWG	$100.70	$900.03	$1,559.90
76	XFMR T-9	PANEL E3R12 (VIA ECB)	76	1.25"	$672.60	1.5"	$1,212.20	1	3AWG	$197.60	1AWG	$205.20	1	3AWG	$197.60	1AWG	$205.20	1	8AWG	$89.68	6AWG	$79.80	$1,157.48	$1,702.40
77	PANEL E2DP-1	XFMR T-10	162	2.5"	$3,564.00	3"	$5,670.00	1	250KCMIL	$1,539.00	400KCMIL	$947.70	-	-	-	-	-	1	4AWG	$361.26	2AWG	$267.30	$5,464.26	$6,885.00
78	XFMR T-10	PANEL E2R11	14	2.5"	$616.00	3"	$980.00	2	250KCMIL	$266.00	400KCMIL	$163.80	1	250KCMIL	$133.00	400KCMIL	$81.90	2	1/0AWG	$127.40	3/0AWG	$89.60	$1,142.40	$1,315.30
79	PANEL FDP-1	XFMR T-11	137	2.5"	$3,014.00	3"	$4,795.00	1	250KCMIL	$1,301.50	400KCMIL	$801.45	-	-	-	-	-	1	4AWG	$305.51	2AWG	$226.05	$4,621.01	$5,822.50
80	XFMR T-11	PANEL RP11	15	2.5"	$660.00	3"	$1,050.00	2	250KCMIL	$285.00	400KCMIL	$175.50	1	250KCMIL	$142.50	400KCMIL	$87.75	2	1/0AWG	$136.50	3/0AWG	$96.00	$1,224.00	$1,409.25
81	PANEL RP11	PANEL RP12	76	2"	$938.60	1.25"	$1,071.60	1	6AWG	$122.36	4AWG	$98.80	1	6AWG	$122.36	4AWG	$98.80	1	6AWG	$122.36	4AWG	$98.80	$1,305.68	$1,368.00
82	PANEL E2R11	PANEL E2R12	79	2"	$975.65	2"	$1,532.60	1	1/0AWG	$359.45	3/0AWG	$252.80	1	1/0AWG	$359.45	3/0AWG	$252.80	1	6AWG	$127.19	4AWG	$102.70	$1,821.74	$2,140.90
83	PANEL RP11	PANEL RP13	246	2"	$3,038.10	2"	$4,772.40	1	1/0AWG	$1,119.30	3/0AWG	$787.20	1	1/0AWG	$1,119.30	3/0AWG	$787.20	1	6AWG	$396.06	4AWG	$319.80	$5,672.76	$6,666.60
84	PANEL E2R11	PANEL E2R13	239	2"	$2,951.65	2"	$4,636.60	1	1/0AWG	$1,087.45	3/0AWG	$764.80	1	1/0AWG	$1,087.45	3/0AWG	$764.80	1	6AWG	$384.79	4AWG	$310.70	$5,511.34	$6,476.90
85	PANEL RP11	PANEL RP14	216	2"	$2,667.60	2"	$4,190.40	1	1/0AWG	$982.80	3/0AWG	$691.20	1	1/0AWG	$982.80	3/0AWG	$691.20	1	6AWG	$347.76	4AWG	$280.80	$4,980.96	$5,853.60
86	PANEL E2R11	PANEL E2R14	215	2"	$2,655.25	2"	$4,171.00	1	1/0AWG	$978.25	3/0AWG	$688.00	1	1/0AWG	$978.25	3/0AWG	$688.00	1	6AWG	$346.15	4AWG	$279.50	$4,957.90	$5,826.50
87	PANEL FDP-2	PANEL LP21	135	1.25"	$1,194.75	1.5"	$2,153.25	1	3AWG	$351.00	1AWG	$364.50	1	3AWG	$351.00	1AWG	$364.50	1	8AWG	$159.30	6AWG	$141.75	$2,056.05	$3,024.00
88	PANEL E1DP-1	PANEL E1L21	180	1.25"	$1,593.00	1.5"	$2,871.00	1	3AWG	$468.00	1AWG	$486.00	1	3AWG	$468.00	1AWG	$486.00	1	8AWG	$212.40	6AWG	$189.00	$2,741.40	$4,032.00
89	PANEL E1L21	XFMR T-12	17	0.75"	$92.65	1"	$195.50	1	6AWG	$27.37	4AWG	$22.10	-	-	-	-	-	1	10AWG	$14.20	8AWG	$15.02	$134.22	$232.62
90	XFMR T-12	PANEL E1R21	15	1.25"	$132.75	1.5"	$239.25	1	3AWG	$39.00	1AWG	$40.50	1	3AWG	$39.00	1AWG	$40.50	1	8AWG	$17.70	6AWG	$15.75	$228.45	$336.00
91	PANEL E2DP-2	PANEL E2L21	161	1.25"	$1,424.85	1.5"	$2,567.95	1	3AWG	$418.60	1AWG	$434.70	1	3AWG	$418.60	1AWG	$434.70	1	8AWG	$189.98	6AWG	$169.05	$2,452.03	$3,606.40
92	PANEL E3DP-4	XFMR T-13	130	0.75"	$708.50	1"	$1,495.00	1	6AWG	$209.30	4AWG	$169.00	-	-	-	-	-	1	10AWG	$108.55	8AWG	$114.83	$1,026.35	$1,778.83
93	XFMR T-13	PANEL E3R22 (VIA ECB)	78	1.25"	$690.30	1.5"	$1,244.10	1	3AWG	$202.80	1AWG	$210.60	1	3AWG	$202.80	1AWG	$210.60	1	8AWG	$92.04	6AWG	$81.90	$1,187.94	$1,747.20
94	PANEL E2DP-2	XFMR T-14	167	2.5"	$3,674.00	3"	$5,845.00	1	250KCMIL	$1,586.50	400KCMIL	$976.95	-	-	-	-	-	1	4AWG	$372.41	2AWG	$275.55	$5,632.91	$7,097.50
95	XFMR T-14	PANEL E2R21	15	2.5"	$660.00	3"	$1,050.00	2	250KCMIL	$285.00	400KCMIL	$175.50	1	250KCMIL	$142.50	400KCMIL	$87.75	2	1/0AWG	$136.50	3/0AWG	$96.00	$1,224.00	$1,409.25
96	PANEL FDP-2	XFMR T-15	149	2.5"	$3,278.00	3"	$5,215.00	1	250KCMIL	$1,415.50	400KCMIL	$871.65	-	-	-	-	-	1	4AWG	$332.27	2AWG	$245.85	$5,025.77	$6,332.50
97	XFMR T-15	PANEL RP21	15	2.5"	$660.00	3"	$1,050.00	2	250KCMIL	$285.00	400KCMIL	$175.50	1	250KCMIL	$142.50	400KCMIL	$87.75	2	1/0AWG	$136.50	3/0AWG	$96.00	$1,224.00	$1,409.25
98	PANEL RP21	PANEL RP22	77	2"	$950.95	2"	$1,493.80	1	1/0AWG	$350.35	3/0AWG	$246.40	1	1/0AWG	$350.35	3/0AWG	$246.40	1	6AWG	$123.97	4AWG	$100.10	$1,775.62	$2,086.70
99	PANEL E2R21	PANEL E2R22	81	2"	$1,000.35	2"	$1,571.40	1	1/0AWG	$368.55	3/0AWG	$259.20	1	1/0AWG	$368.55	3/0AWG	$259.20	1	6AWG	$130.41	4AWG	$105.30	$1,867.86	$2,195.10
100	PANEL RP21	PANEL RP23	296	2.5"	$6,512.00	3"	$10,360.00	1	4/0AWG	$2,427.20	300KCMIL	$1,450.40	1	4/0AWG	$2,427.20	300KCMIL	$1,450.40	1	4AWG	$660.08	2AWG	$488.40	$12,026.48	$13,749.20
101	PANEL E2R21	PANEL E2R23	288	2"	$3,556.80	2"	$5,587.20	1	1/0AWG	$1,310.40	3/0AWG	$921.60	1	1/0AWG	$1,310.40	3/0AWG	$921.60	1	6AWG	$463.68	4AWG	$374.40	$6,641.28	$7,804.80
102	PANEL RP21	PANEL RP24	266	2"	$3,285.10	2"	$5,160.40	1	1/0AWG	$1,210.30	3/0AWG	$851.20	1	1/0AWG	$1,210.30	3/0AWG	$851.20	1	6AWG	$428.26	4AWG	$345.80	$6,133.96	$7,208.60
103	PANEL E2R21	PANEL E2R24	259	2.5"	$5,698.00	3"	$9,065.00	1	4/0AWG	$2,123.80	300KCMIL	$1,269.10	1	4/0AWG	$2,123.80	300KCMIL	$1,269.10	1	4AWG	$577.57	2AWG	$427.35	$10,523.17	$12,030.55
104	PANEL FDP-2	PANEL LP31	128	2"	$1,580.80	2"	$2,483.20	1	1/0AWG	$582.40	3/0AWG	$409.60	1	1/0AWG	$582.40	3/0AWG	$409.60	1	6AWG	$206.08	4AWG	$166.40	$2,951.68	$3,468.80
105	PANEL E1DP-1	PANEL E1L31	168	1.25"	$1,486.80	1.5"	$2,679.60	1	3AWG	$436.80	1AWG	$453.60	1	3AWG	$436.80	1AWG	$453.60	1	8AWG	$198.24	6AWG	$176.40	$2,558.64	$3,763.20
106	PANEL E1L31	XFMR T-16	17	0.75"	$92.65	1"	$195.50	1	6AWG	$27.37	4AWG	$22.10	-	-	-	-	-	1	10AWG	$14.20	8AWG	$15.02	$134.22	$232.62
107	XFMR T-16	PANEL E1R31	15	1.25"	$132.75	1.5"	$239.25	1	3AWG	$39.00	1AWG	$40.50	1	3AWG	$39.00	1AWG	$40.50	1	8AWG	$17.70	6AWG	$15.75	$228.45	$336.00
108	PANEL E2DP-2	PANEL E2L31	158	1.25"	$1,398.30	1.5"	$2,520.10	1	3AWG	$410.80	1AWG	$426.60	1	3AWG	$410.80	1AWG	$426.60	1	8AWG	$186.44	6AWG	$165.90	$2,406.34	$3,539.20
109	PANEL E3DP-4	XFMR T-17	126	0.75"	$686.70	1"	$1,449.00	1	6AWG	$202.86	4AWG	$163.80	-	-	-	-	-	1	10AWG	$105.21	8AWG	$111.30	$994.77	$1,724.10
110	XFMR T-17	PANEL E3R32 (VIA ECB)	78	1.25"	$690.30	1.5"	$1,244.10	1	3AWG	$202.80	1AWG	$210.60	1	3AWG	$202.80	1AWG	$210.60	1	8AWG	$92.04	6AWG	$81.90	$1,187.94	$1,747.20
111	PANEL E2DP-2	XFMR T-18	165	2.5"	$3,630.00	3"	$5,775.00	1	250KCMIL	$1,567.50	400KCMIL	$965.25	-	-	-	-	-	1	4AWG	$367.95	2AWG	$272.25	$5,565.45	$7,012.50
112	XFMR T-18	PANEL E2R31	15	2.5"	$660.00	3"	$1,050.00	2	250KCMIL	$285.00	400KCMIL	$175.50	1	250KCMIL	$142.50	400KCMIL	$87.75	2	1/0AWG	$136.50	3/0AWG	$96.00	$1,224.00	$1,409.25
113	PANEL FDP-2	XFMR T-19	141	2.5"	$3,102.00	3"	$4,935.00	1	250KCMIL	$1,339.50	400KCMIL	$824.85	-	-	-	-	-	1	4AWG	$314.43	2AWG	$232.65	$4,755.93	$5,992.50
114	XFMR T-19	PANEL RP31	13	2.5"	$572.00	3"	$910.00	2	250KCMIL	$247.00	400KCMIL	$152.10	1	250KCMIL	$123.50	400KCMIL	$76.05	2	1/0AWG	$118.30	3/0AWG	$83.20	$1,060.80	$1,221.35
115	PANEL RP31	PANEL RP32	75	2"	$926.25	2"	$1,455.00	1	1/0AWG	$341.25	3/0AWG	$240.00	1	1/0AWG	$341.25	3/0AWG	$240.00	1	6AWG	$120.75	4AWG	$97.50	$1,729.50	$2,032.50
116	PANEL E2R31	PANEL E2R32	80	2"	$988.00	2"	$1,552.00	1	1/0AWG	$364.00	3/0AWG	$256.00	1	1/0AWG	$364.00	3/0AWG	$256.00	1	6AWG	$128.80	4AWG	$104.00	$1,844.80	$2,168.00
117	PANEL RP31	PANEL RP33	244	2"	$3,013.40	2"	$4,733.60	1	1/0AWG	$1,110.20	3/0AWG	$780.80	1	1/0AWG	$1,110.20	3/0AWG	$780.80	1	6AWG	$392.84	4AWG	$317.20	$5,626.64	$6,612.40
118	PANEL E2R31	PANEL E2R33	245	2"	$3,025.75	2"	$4,753.00	1	1/0AWG	$1,114.75	3/0AWG	$784.00	1	1/0AWG	$1,114.75	3/0AWG	$784.00	1	6AWG	$394.45	4AWG	$318.50	$5,649.70	$6,639.50
119	PANEL RP31	PANEL RP34	217	2"	$2,679.95	2"	$4,209.80	1	1/0AWG	$987.35	3/0AWG	$694.40	1	1/0AWG	$987.35	3/0AWG	$694.40	1	6AWG	$349.37	4AWG	$282.10	$5,004.02	$5,880.70
120	PANEL E2R31	PANEL E2R34	214	2"	$2,642.90	2"	$4,151.60	1	1/0AWG	$973.70	3/0AWG	$684.80	1	1/0AWG	$973.70	3/0AWG	$684.80	1	6AWG	$344.54	4AWG	$278.20	$4,934.84	$5,799.40
121	PANEL FDP-2	PANEL LP41	152	1.25"	$1,345.20	1.5"	$2,424.40	1	3AWG	$395.20	1AWG	$410.40	1	3AWG	$395.20	1AWG	$410.40	1	8AWG	$179.36	6AWG	$159.60	$2,314.96	$3,404.80
122	PANEL E1DP-1	PANEL E1L41	191	1.25"	$1,690.35	1.5"	$3,046.45	1	3AWG	$496.60	1AWG	$515.70	1	3AWG	$496.60	1AWG	$515.70	1	8AWG	$225.38	6AWG	$200.55	$2,908.93	$4,278.40
123	PANEL E1L41	XFMR T-20	17	0.75"	$92.65	1"	$195.50	1	6AWG	$27.37	4AWG	$22.10	-	-	-	-	-	1	10AWG	$14.20	8AWG	$15.02	$134.22	$232.62
124	XFMR T-20	PANEL E1R41	15	1.25"	$132.75	1.5"	$239.25	1	3AWG	$39.00	1AWG	$40.50	1	3AWG	$39.00	1AWG	$40.50	1	8AWG	$17.70	6AWG	$15.75	$228.45	$336.00

FEEDER SCHEDULE (CONT.)

TAG	FROM	TO	LENGTH (FEET)	CONDUIT (PER SET)				CONDUTORS (PER SET)														CU TOTAL COST	AL TOTAL COST
				CU		AL		PHASE CONDUCTORS					NEUTRAL CONDUCTORS					GROUND CONDUCTORS						
				SIZE	COST	SIZE	COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST		
125	PANEL E2DP-2	PANEL E2L41	182	1.25"	$1,610.70	1.5"	$2,902.90	1	3AWG	$473.20	1AWG	$491.40	1	3AWG	$473.20	1AWG	$491.40	1	8AWG	$214.76	6AWG	$191.10	$2,771.86	$4,076.80
126	PANEL E3DP-4	XFMR T-21	151	0.75"	$822.95	1"	$1,736.50	1	6AWG	$243.11	4AWG	$196.30	-	-	-	-	-	1	10AWG	$126.09	8AWG	$133.38	$1,192.15	$2,066.18
127	XFMR T-21	PANEL E3R42 (VIA ECB)	78	1.25"	$690.30	1.5"	$1,244.10	1	3AWG	$202.80	1AWG	$210.60	1	3AWG	$202.80	1AWG	$210.60	1	8AWG	$92.04	6AWG	$81.90	$1,187.94	$1,747.20
128	PANEL E2DP-2	XFMR T-22	189	2.5"	$4,158.00	3"	$6,615.00	1	250KCMIL	$1,795.50	400KCMIL	$1,105.65	-	-	-	-	-	1	4AWG	$421.47	2AWG	$311.85	$6,374.97	$8,032.50
129	XFMR T-22	PANEL E2R41	15	2.5"	$660.00	3"	$1,050.00	2	250KCMIL	$285.00	400KCMIL	$175.50	1	250KCMIL	$142.50	400KCMIL	$87.75	2	1/0AWG	$136.50	3/0AWG	$96.00	$1,224.00	$1,409.25
130	PANEL FDP-2	XFMR T-23	164	2.5"	$3,608.00	3"	$5,740.00	1	250KCMIL	$1,558.00	400KCMIL	$959.40	-	-	-	-	-	1	4AWG	$365.72	2AWG	$270.60	$5,531.72	$6,970.00
131	XFMR T-23	PANEL RP41	13	2.5"	$572.00	3"	$910.00	2	250KCMIL	$247.00	400KCMIL	$152.10	1	250KCMIL	$123.50	400KCMIL	$76.05	2	1/0AWG	$118.30	3/0AWG	$83.20	$1,060.80	$1,221.35
132	PANEL RP41	PANEL RP42	75	2"	$926.25	2"	$1,455.00	1	1/0AWG	$341.25	3/0AWG	$240.00	1	1/0AWG	$341.25	3/0AWG	$240.00	1	6AWG	$120.75	4AWG	$97.50	$1,729.50	$2,032.50
133	PANEL E2R41	PANEL E2R42	79	2"	$975.65	2"	$1,532.60	1	1/0AWG	$359.45	3/0AWG	$252.80	1	1/0AWG	$359.45	3/0AWG	$252.80	1	6AWG	$127.19	4AWG	$102.70	$1,821.74	$2,140.90
134	PANEL RP41	PANEL RP43	244	2"	$3,013.40	2"	$4,733.60	1	1/0AWG	$1,110.20	3/0AWG	$780.80	1	1/0AWG	$1,110.20	3/0AWG	$780.80	1	6AWG	$392.84	4AWG	$317.20	$5,626.64	$6,612.40
135	PANEL E2R41	PANEL E2R43	245	2"	$3,025.75	2"	$4,753.00	1	1/0AWG	$1,114.75	3/0AWG	$784.00	1	1/0AWG	$1,114.75	3/0AWG	$784.00	1	6AWG	$394.45	4AWG	$318.50	$5,649.70	$6,639.50
136	PANEL RP41	PANEL RP44	218	2"	$2,692.30	2"	$4,229.20	1	1/0AWG	$991.90	3/0AWG	$697.60	1	1/0AWG	$991.90	3/0AWG	$697.60	1	6AWG	$350.98	4AWG	$283.40	$5,027.08	$5,907.80
137	PANEL E2R41	PANEL E2R44	215	2"	$2,655.25	2"	$4,171.00	1	1/0AWG	$978.25	3/0AWG	$688.00	1	1/0AWG	$978.25	3/0AWG	$688.00	1	6AWG	$346.15	4AWG	$279.50	$4,957.90	$5,826.50
138	PANEL FDP-2	PANEL LP51	164	1.25"	$1,451.40	1.5"	$2,615.80	1	3AWG	$426.40	1AWG	$442.80	1	3AWG	$426.40	1AWG	$442.80	1	8AWG	$193.52	6AWG	$172.20	$2,497.72	$3,673.60
139	PANEL E1DP-1	PANEL E1L51	204	1.25"	$1,805.40	1.5"	$3,253.80	1	3AWG	$530.40	1AWG	$550.80	1	3AWG	$530.40	1AWG	$550.80	1	8AWG	$240.72	6AWG	$214.20	$3,106.92	$4,569.60
140	PANEL E1L51	XFMR T-24	17	0.75"	$92.65	1"	$195.50	1	6AWG	$27.37	4AWG	$22.10	-	-	-	-	-	1	10AWG	$14.20	8AWG	$15.02	$134.22	$232.62
141	XFMR T-24	PANEL E1R51	15	1.25"	$132.75	1.5"	$239.25	1	3AWG	$39.00	1AWG	$40.50	1	3AWG	$39.00	1AWG	$40.50	1	8AWG	$17.70	6AWG	$15.75	$228.45	$336.00
142	PANEL E2DP-2	PANEL E2L51	155	1.25"	$1,371.75	1.5"	$2,472.25	1	3AWG	$403.00	1AWG	$418.50	1	3AWG	$403.00	1AWG	$418.50	1	8AWG	$182.90	6AWG	$162.75	$2,360.65	$3,472.00
143	PANEL E3DP-4	XFMR T-25	163	0.75"	$888.35	1"	$1,874.50	1	6AWG	$262.43	4AWG	$211.90	-	-	-	-	-	1	10AWG	$136.11	8AWG	$143.98	$1,286.89	$2,230.38
144	XFMR T-25	PANEL E3R52 (VIA ECB)	78	1.25"	$690.30	1.5"	$1,244.10	1	3AWG	$202.80	1AWG	$210.60	1	3AWG	$202.80	1AWG	$210.60	1	8AWG	$92.04	6AWG	$81.90	$1,187.94	$1,747.20
145	PANEL E2DP-2	XFMR T-26	201	2.5"	$4,422.00	3"	$7,035.00	1	250KCMIL	$1,909.50	400KCMIL	$1,175.85	-	-	-	-	-	1	4AWG	$448.23	2AWG	$331.65	$6,779.73	$8,542.50
146	XFMR T-26	PANEL E2R51	15	2.5"	$660.00	3"	$1,050.00	2	250KCMIL	$285.00	400KCMIL	$175.50	1	250KCMIL	$142.50	400KCMIL	$87.75	2	1/0AWG	$136.50	3/0AWG	$96.00	$1,224.00	$1,409.25
147	PANEL FDP-2	XFMR T-27	176	2.5"	$3,872.00	3"	$6,160.00	1	250KCMIL	$1,672.00	400KCMIL	$1,029.60	-	-	-	-	-	1	4AWG	$392.48	2AWG	$290.40	$5,936.48	$7,480.00
148	XFMR T-27	PANEL RP51	13	2.5"	$572.00	3"	$910.00	2	250KCMIL	$247.00	400KCMIL	$152.10	1	250KCMIL	$123.50	400KCMIL	$76.05	2	1/0AWG	$118.30	3/0AWG	$83.20	$1,060.80	$1,221.35
149	PANEL RP51	PANEL RP52	74	2"	$913.90	2"	$1,435.60	1	1/0AWG	$336.70	3/0AWG	$236.80	1	1/0AWG	$336.70	3/0AWG	$236.80	1	6AWG	$119.14	4AWG	$96.20	$1,706.44	$2,005.40
150	PANEL E2R51	PANEL E2R52	80	2"	$988.00	2"	$1,552.00	1	1/0AWG	$364.00	3/0AWG	$256.00	1	1/0AWG	$364.00	3/0AWG	$256.00	1	6AWG	$128.80	4AWG	$104.00	$1,844.80	$2,168.00
151	PANEL RP51	PANEL RP53	244	2"	$3,013.40	2"	$4,733.60	1	1/0AWG	$1,110.20	3/0AWG	$780.80	1	1/0AWG	$1,110.20	3/0AWG	$780.80	1	6AWG	$392.84	4AWG	$317.20	$5,626.64	$6,612.40
152	PANEL E2R51	PANEL E2R53	245	2"	$3,025.75	2"	$4,753.00	1	1/0AWG	$1,114.75	3/0AWG	$784.00	1	1/0AWG	$1,114.75	3/0AWG	$784.00	1	6AWG	$394.45	4AWG	$318.50	$5,649.70	$6,639.50
153	PANEL RP51	PANEL RP54	217	2"	$2,679.95	2"	$4,209.80	1	1/0AWG	$987.35	3/0AWG	$694.40	1	1/0AWG	$987.35	3/0AWG	$694.40	1	6AWG	$349.37	4AWG	$282.10	$5,004.02	$5,880.70
154	PANEL E2R51	PANEL E2R54	214	2"	$2,642.90	2"	$4,151.60	1	1/0AWG	$973.70	3/0AWG	$684.80	1	1/0AWG	$973.70	3/0AWG	$684.80	1	6AWG	$344.54	4AWG	$278.20	$4,934.84	$5,799.40
155	PANEL FDP-2	PANEL LP61	176	1.25"	$1,557.60	1.5"	$2,807.20	1	3AWG	$457.60	1AWG	$475.20	1	3AWG	$457.60	1AWG	$475.20	1	8AWG	$207.68	6AWG	$184.80	$2,680.48	$3,942.40
156	PANEL E1DP-1	PANEL E1L61	216	1.25"	$1,911.60	1.5"	$3,445.20	1	3AWG	$561.60	1AWG	$583.20	1	3AWG	$561.60	1AWG	$583.20	1	8AWG	$254.88	6AWG	$226.80	$3,289.68	$4,838.40
157	PANEL E1L61	XFMR T-28	17	0.75"	$92.65	1"	$195.50	1	6AWG	$27.37	4AWG	$22.10	-	-	-	-	-	1	10AWG	$14.20	8AWG	$15.02	$134.22	$232.62
158	XFMR T-28	PANEL E2R61	15	1.25"	$132.75	1.5"	$239.25	1	3AWG	$39.00	1AWG	$40.50	1	3AWG	$39.00	1AWG	$40.50	1	8AWG	$17.70	6AWG	$15.75	$228.45	$336.00
159	PANEL E2DP-2	PANEL E2L61	207	1.25"	$1,831.95	1.5"	$3,301.65	1	3AWG	$538.20	1AWG	$558.90	1	3AWG	$538.20	1AWG	$558.90	1	8AWG	$244.26	6AWG	$217.35	$3,152.61	$4,636.80
160	PANEL E3DP-4	XFMR T-29	174	0.75"	$948.30	1"	$2,001.00	1	6AWG	$280.14	4AWG	$226.20	-	-	-	-	-	1	10AWG	$145.29	8AWG	$153.70	$1,373.73	$2,380.90
161	XFMR T-29	PANEL E3R62 (VIA ECB)	79	1.25"	$699.15	1.5"	$1,260.05	1	3AWG	$205.40	1AWG	$213.30	1	3AWG	$205.40	1AWG	$213.30	1	8AWG	$93.22	6AWG	$82.95	$1,203.17	$1,769.60
162	PANEL E2DP-2	XFMR T-30	214	2.5"	$4,708.00	3"	$7,490.00	1	250KCMIL	$2,033.00	400KCMIL	$1,251.90	-	-	-	-	-	1	4AWG	$477.22	2AWG	$353.10	$7,218.22	$9,095.00
163	XFMR T-30	PANEL E2R61	15	2.5"	$660.00	3"	$1,050.00	2	250KCMIL	$285.00	400KCMIL	$175.50	1	250KCMIL	$142.50	400KCMIL	$87.75	2	1/0AWG	$136.50	3/0AWG	$96.00	$1,224.00	$1,409.25
164	PANEL FDP-2	XFMR T-31	189	2.5"	$4,158.00	3"	$6,615.00	1	250KCMIL	$1,795.50	400KCMIL	$1,105.65	-	-	-	-	-	1	4AWG	$421.47	2AWG	$311.85	$6,374.97	$8,032.50
165	XFMR T-31	PANEL RP61	13	2.5"	$572.00	3"	$910.00	2	250KCMIL	$247.00	400KCMIL	$152.10	1	250KCMIL	$123.50	400KCMIL	$76.05	2	1/0AWG	$118.30	3/0AWG	$83.20	$1,060.80	$1,221.35
166	PANEL RP61	PANEL RP62	75	2"	$926.25	2"	$1,455.00	1	1/0AWG	$341.25	3/0AWG	$240.00	1	1/0AWG	$341.25	3/0AWG	$240.00	1	6AWG	$120.75	4AWG	$97.50	$1,729.50	$2,032.50
167	PANEL E2R61	PANEL E2R62	80	2"	$988.00	2"	$1,552.00	1	1/0AWG	$364.00	3/0AWG	$256.00	1	1/0AWG	$364.00	3/0AWG	$256.00	1	6AWG	$128.80	4AWG	$104.00	$1,844.80	$2,168.00
168	PANEL RP61	PANEL RP63	244	2"	$3,013.40	2"	$4,733.60	1	1/0AWG	$1,110.20	3/0AWG	$780.80	1	1/0AWG	$1,110.20	3/0AWG	$780.80	1	6AWG	$392.84	4AWG	$317.20	$5,626.64	$6,612.40
169	PANEL E2R61	PANEL E2R63	244	2"	$3,013.40	2"	$4,733.60	1	1/0AWG	$1,110.20	3/0AWG	$780.80	1	1/0AWG	$1,110.20	3/0AWG	$780.80	1	6AWG	$392.84	4AWG	$317.20	$5,626.64	$6,612.40
170	PANEL RP61	PANEL RP64	217	2"	$2,679.95	2"	$4,209.80	1	1/0AWG	$987.35	3/0AWG	$694.40	1	1/0AWG	$987.35	3/0AWG	$694.40	1	6AWG	$349.37	4AWG	$282.10	$5,004.02	$5,880.70
171	PANEL E2R61	PANEL E2R64	215	2"	$2,655.25	2"	$4,171.00	1	1/0AWG	$978.25	3/0AWG	$688.00	1	1/0AWG	$978.25	3/0AWG	$688.00	1	6AWG	$346.15	4AWG	$279.50	$4,957.90	$5,826.50
172	PANEL E1DP-1	PANEL E1L71	227	1.25"	$2,008.95	1.25"	$3,200.70	1	3AWG	$590.20	1AWG	$612.90	-	-	-	-	-	1	8AWG	$267.86	6AWG	$238.35	$2,867.01	$4,051.95
173	PANEL E1L71	XFMR T-32	9	0.75"	$49.05	1.25"	$126.90	1	6AWG	$14.49	4AWG	$11.70	1	6AWG	$14.49	4AWG	$11.70	1	10AWG	$7.52	8AWG	$7.95	$85.55	$158.25
174	XFMR T-32	PANEL E1R71	9	1.25"	$79.65	1.5"	$143.55	1	3AWG	$23.40	1AWG	$24.30	1	3AWG	$23.40	1AWG	$24.30	1	8AWG	$10.62	6AWG	$9.45	$137.07	$201.60
175	PANEL E2DP-1	PANEL E2L71	228	2"	$2,815.80	2.5"	$6,270.00	1	3/0AWG	$1,539.00	250KCMIL	$912.00	1	3/0AWG	$1,539.00	250KCMIL	$912.00	1	6AWG	$367.08	4AWG	$296.40	$6,260.88	$8,390.40
176	PANEL MDP-71	PANEL LP71	39	2"	$481.65	2.5"	$1,072.50	1	3/0AWG	$263.25	250KCMIL	$156.00	1	3/0AWG	$263.25	250KCMIL	$156.00	1	6AWG	$62.79	4AWG	$50.70	$1,070.94	$1,435.20
177	PANEL LP71	XFMR T-33	38	1.25"	$336.30	1.5"	$606.10	1	2AWG	$117.80	1/0AWG	$92.34	-	-	-	-	-	1	6AWG	$61.18	4AWG	$49.40	$515.28	$747.84

FEEDER SCHEDULE (CONT.)																							
TAG	FROM	TO	LENGTH (FEET)	CONDUIT (PER SET)				CONDUTORS (PER SET)														CU TOTAL COST	AL TOTAL COST
				CU		AL		PHASE CONDUCTORS					NEUTRAL CONDUCTORS					GROUND CONDUCTORS					
				SIZE	COST	SIZE	COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST		
178	XFMR T-33	PANEL RP71	12	2.5"	$264.00	3"	$420.00	1	250KCMIL	$114.00	400KCMIL	$70.20	1	250KCMIL	$114.00	400KCMIL	$70.20	1	2AWG	$37.20	1/0AWG	$29.16	$529.20	$589.56
179	PANEL E3DP-71	XFMR T-34	12	1.25"	$106.20	1.5"	$191.40	1	2AWG	$37.20	1/0AWG	$29.16	-	-	-	-	-	1	6AWG	$19.32	4AWG	$15.60	$162.72	$236.16
180	XFMR T-34	PANEL E3R71	10	2.5"	$220.00	3"	$350.00	1	250KCMIL	$95.00	400KCMIL	$58.50	1	250KCMIL	$95.00	400KCMIL	$58.50	1	2AWG	$31.00	1/0AWG	$24.30	$441.00	$491.30
181	PANEL FDP-1	PANEL LPSL1 (VIA CONTRACTOR)	61	1.24"	$0.00	1.5"	$972.95	1	3AWG	$158.60	1AWG	$164.70	1	3AWG	$158.60	1AWG	$164.70	1	8AWG	$71.98	6AWG	$64.05	$389.18	$1,366.40
182	BGE FEEDER #3	FIRE PUMP CONTROLLER/ATS	125	4"	$11,812.50	4"	$19,500.00	3	600KCMIL	$7,020.83	900KCMIL	$3,702.08	-	-	-	-	-	3	3/0AWG	$2,531.25	250KCMIL	$1,500.00	$21,364.58	$24,702.08
183	PANEL E2DP-1	UPS-1	83	3"	$2,199.50	4"	$4,316.00	1	500KCMIL	$1,369.50	750KCMIL	$734.55	1	500KCMIL	$1,369.50	750KCMIL	$734.55	1	3AWG	$215.80	1AWG	$224.10	$5,154.30	$6,009.20
184	UPS-1	PANEL U2RDP	19	3"	$1,007.00	3.5"	$1,672.00	2	350KCMIL	$475.00	500KCMIL	$248.90	1	350KCMIL	$237.50	500KCMIL	$124.45	2	2/0AWG	$210.90	4/0AWG	$133.00	$1,930.40	$2,178.35
185	PANEL U2RDP	PANEL U2RG1	9	1.25"	$79.65	1.5"	$143.55	1	3AWG	$23.40	1AWG	$24.30	1	3AWG	$23.40	1AWG	$24.30	1	8AWG	$10.62	6AWG	$9.45	$137.07	$201.60
186	PANEL U2RDP	PANEL U2R12	102	1.25"	$902.70	1.5"	$1,626.90	1	3AWG	$265.20	1AWG	$275.40	1	3AWG	$265.20	1AWG	$275.40	1	8AWG	$120.36	6AWG	$107.10	$1,553.46	$2,284.80
187	PANEL U2RDP	PANEL U2R22	106	1.25"	$938.10	1.5"	$1,690.70	1	3AWG	$275.60	1AWG	$286.20	1	3AWG	$275.60	1AWG	$286.20	1	8AWG	$125.08	6AWG	$111.30	$1,614.38	$2,374.40
188	PANEL U2RDP	PANEL U2R32	122	1.25"	$1,079.70	1.5"	$1,945.90	1	3AWG	$317.20	1AWG	$329.40	1	3AWG	$317.20	1AWG	$329.40	1	8AWG	$143.96	6AWG	$128.10	$1,858.06	$2,732.80
189	PANEL U2RDP	PANEL U2R42	134	1.25"	$1,185.90	1.5"	$2,137.30	1	3AWG	$348.40	1AWG	$361.80	1	3AWG	$348.40	1AWG	$361.80	1	8AWG	$158.12	6AWG	$140.70	$2,040.82	$3,001.60
190	PANEL U2RDP	PANEL U2R52	146	1.25"	$1,292.10	1.5"	$2,328.70	1	3AWG	$379.60	1AWG	$394.20	1	3AWG	$379.60	1AWG	$394.20	1	8AWG	$172.28	6AWG	$153.30	$2,223.58	$3,270.40
191	PANEL U2RDP	PANEL U2R62	158	1.25"	$1,398.30	1.5"	$2,520.10	1	3AWG	$410.80	1AWG	$426.60	1	3AWG	$410.80	1AWG	$426.60	1	8AWG	$186.44	6AWG	$165.90	$2,406.34	$3,539.20
192	PANEL E3DP-71	PANEL E3L71	18	1.5"	$186.30	2"	$349.20	1	1/0AWG	$81.90	3/0AWG	$57.60	1	1/0AWG	$81.90	3/0AWG	$57.60	1	6AWG	$28.98	4AWG	$23.40	$379.08	$487.80
193	EX. PANEL 480-L2N	PANEL 480-L2N	25	2"	$308.75	2.5"	$687.50	1	3/0AWG	$168.75	250KCMIL	$100.00	1	3/0AWG	$168.75	250KCMIL	$100.00	1	6AWG	$40.25	4AWG	$32.50	$686.50	$920.00
194	PANEL RP21	PANEL RP25	74	1.25"	$654.90	1.5"	$1,180.30	1	3AWG	$192.40	1AWG	$199.80	1	3AWG	$192.40	1AWG	$199.80	1	8AWG	$87.32	6AWG	$77.70	$1,127.02	$1,657.60
195	PANEL RP11	PANEL RP15	161	1.25"	$1,424.85	1.5"	$2,567.95	1	3AWG	$418.60	1AWG	$434.70	1	3AWG	$418.60	1AWG	$434.70	1	8AWG	$189.98	6AWG	$169.05	$2,452.03	$3,606.40
196	PANEL LP31	PANEL LP31X	74	1"	$510.60	1.25"	$1,043.40	1	6AWG	$119.14	4AWG	$96.20	1	6AWG	$119.14	4AWG	$96.20	1	10AWG	$61.79	8AWG	$65.37	$810.67	$1,301.17
197	PANEL E2DP-2	UPS-1	75	3"	$1,987.50	4"	$3,900.00	1	500KCMIL	$1,237.50	750KCMIL	$663.75	1	500KCMIL	$1,237.50	750KCMIL	$663.75	1	3AWG	$195.00	1AWG	$202.50	$4,657.50	$5,430.00

Conclusion

Overall, I would not recommend the use of aluminum feeders in the Franklin Square Hospital Center. Even though the aluminum feeders would cost $394,416.00 less than the original copper feeders, the conduit change from EMT to Aluminum will cost an additional $1.9 million. The total price increase if the conductors and conduits were replaced by aluminum would come to $1,520,162.80. This additional cost is based on the cost analysis shown below.

Figure 105 | Copper vs. Aluminum Cost Analysis Summary

COST SUMMARY ANALYSIS			
	CONDUCTORS	CONDUITS	TOTAL
CU	$964,984.17	$983,269.65	$1,948,253.82
AL	$570,568.17	$2,897,848.45	$3,468,416.62
SAVINGS	$394,416.00	-$1,914,578.80	-$1,520,162.80

Depth Topic 2 | Compare energy savings vs. first costs for increasing feeder sizes

Introduction

Feeders are appropriately sized by calculating the load that they carry. When there is a larger load on a particular feeder it might be warm when touched. The heat that is given off by the feeder is wasted energy that can be saved by increasing the feeder size. Although larger conductors save energy, they also increases the initial cost of the electrical system. Depending on the budget and owner, this may be a viable solution to save energy.

Method

A comparison between the energy savings and the increased initial cost of the system will be performed. The system for this analysis includes the lighting and appliance panel boards found throughout the building. The existing feeder size will be calculated and increased by 1, 2, and 3 sizes to produce a cost comparison. The increased feeder sizes will most likely increase the conduit sizes but were not considered in this analysis.

After determining the lengths of the feeders, the voltage drop must be calculated. The voltage drop factor was found in Table 1.3-13 in the 14th edition of Eaton 2006 Consulting Application Guide. An assumed power factor of 0.80 was applied to each panel board. Voltage drop across each conductor was calculated using the following equation:

$$Voltage\ Drop\ (Volts) = \ Current\ (Amps) * Length\ of\ Feeder\ (Ft) * \frac{Voltage\ Drop\ Factor}{100}$$

The voltage drop was then multiplied by the demand load on each respective panel board. The demand load was analyzed at 50%, 60% and 80% of the total demand load on each panel. The value calculated is the amount of watts that are lost along each feeder run. Using the primary voltage service (Schedule P) from BGE utility company the electricity rate can be applied. Transmission costs will not vary when the wire size is changed therefore they are excluded from the calculation. The utility company breaks down the generation portion of the rate into categories for summer months and non-summer months as well as peak, intermediate-peak and off-peak hours of the day. All of these rates and hours can be seen in the tables below.

Figure 106 | BGE Utility Generation Rates

NON-SUMMER GENERATION RATE (OCTOBER 1 - MAY 31)				
	RATE ($/kWh)	HOURS PER DAY	HOURS PER YEAR	COST PER YEAR ($/kWh)
PEAK	0.10797	8	1944	$209.89
INTERMEDIATE-PEAK	0.10734	6	1458	$156.50
OFF-PEAK	0.08803	10	2430	$213.91

* GENERATION RATES ARE FROM MARCH 1 - MAY 31, 2010

SUMMER GENERATION RATE (JUNE 1 - SEPTEMBER 30)				
	RATE ($/kWh)	HOURS PER DAY	HOURS PER YEAR	COST PER YEAR ($/kWh)
PEAK	0.10797	10	1220	$131.72
INTERMEDIATE-PEAK	0.10734	6	732	$78.57
OFF-PEAK	0.08803	8	976	$85.92

* GENERATION RATES ARE FROM MARCH 1 - MAY 31, 2010

TOTAL COST PER YEAR ($/kWh)	$876.52

The hours of each day were calculated in their respective rate. An assumed 7 day week of defined weekdays by the utility was implied. Holidays are considered off-peak hours but were not included in the calculation. The total cost per year if 1kW was used is $876.52 which is then multiplied by the hours used. To convert the value to kW it was then divided by 1,000.

The cost of the energy loss per year was then compared to the initial cost of the feeders. The estimated prices of the feeders are referenced from RSMeans Electrical Cost Data 2010 (Figure 107). The cost data allows for the initial cost of each feeder size to be calculated.

Figure 107 | Copper Conductor Prices

CU		
SIZE	AMPS	COST/LF
12AWG	25	$0.69
10AWG	35	$0.84
8AWG	50	$1.18
6AWG	65	$1.61
4AWG	85	$2.23
3AWG	100	$2.60
2AWG	115	$3.10
1AWG	130	$3.75
1/0AWG	150	$4.55
2/0AWG	175	$5.55
3/0AWG	200	$6.75
4/0AWG	230	$8.20
250KCMIL	255	$9.50
300KCMIL	285	$11.00
350KCMIL	310	$12.50
400KCMIL	335	$14.00
500KCMIL	380	$16.50
600KCMIL	420	$18.75
700KCMIL	460	$20.94
750KCMIL	475	$21.78
800KCMIL	490	$22.61
900KCMIL	520	$24.28
1000KCMIL	545	$25.67
1250KCMIL	590	$28.17
1500KCMIL	625	$30.11
1750KCMIL	650	$31.50
2000KCMIL	665	$32.33

Figure 108 | Energy Savings vs. First Cost Feeder Schedule

ENERGY SAVINGS VS. FIRST COST FEEDER SCHEDULE

						50% DEMAND LOAD		60% DEMAND LOAD		80% DEMAND LOAD		EXISTING SIZE				50% DEMAND LOAD		60% DEMAND LOAD		80% DEMAND LOAD		1 SIZE LARGER				50% DEMAND LOAD		60% DEMAND LOAD		80% DEMAND LOAD		2 SIZES LARGER				50% DEMAND LOAD		60% DEMAND LOAD		80% DEMAND LOAD		3 SIZES LARGER		
LENGTH (FEET)	50% DEMAND	60% DEMAN	80% DEMAN	DEMAND LOAD (A)	FACTOR	VOLTAGE DROP	ENERGY LOSS PER	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	NO.	CU SIZE	COST	FACTOR	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	NO.	CU SIZE	COST	FACTOR	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	NO.	CU SIZE	COST	FACTOR	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	NO.	CU SIZE	COST
155	13.5	16.2	21.6	27	0.0404	0.84537	$10.00	1.014444	$14.40	$1.35	$25.61	1	3AWG	$403.00	0.0323	0.675878	$8.00	0.811053	$11.52	1.081404	$20.47	1	2AWG	$480.50	0.0267	0.558698	$6.61	0.670437	$9.52	0.893916	$16.92	1	1AWG	$581.25	0.0222	0.464535	$5.50	0.557442	$7.92	0.743256	$14.07	1	1/0AWG	$705.25
14	21.5	25.8	34.4	43	0.0742	0.223342	$4.21	0.2680104	$6.06	$0.36	$10.77	1	6AWG	$22.54	0.0485	0.145985	$2.75	0.175182	$3.96	0.233576	$7.04	1	4AWG	$31.22	0.0404	0.121604	$2.29	0.145925	$3.30	0.1945664	$5.87	1	3AWG	$36.40	0.0323	0.097223	$1.83	0.116668	$2.64	0.155557	$4.69	1	2AWG	$43.40
152	13	15.6	20.8	26	0.0222	0.438672	$5.00	0.5264064	$7.20	$0.70	$12.80	1	1/0AWG	$691.60	0.0187	0.369512	$4.21	0.443414	$6.06	0.591219	$10.78	1	2/0AWG	$843.60	0.0158	0.312208	$3.56	0.37465	$5.12	0.4995328	$9.11	1	3/0AWG	$1,026.00	0.0136	0.268736	$3.06	0.322483	$4.41	0.429978	$7.84	1	4/0AWG	$1,246.40
14	18	21.6	28.8	36	0.0222	0.055944	$0.88	0.0671328	$1.27	$0.09	$2.26	1	1/0AWG	$63.70	0.0187	0.047124	$0.74	0.056549	$1.07	0.075398	$1.90	1	2/0AWG	$77.70	0.0158	0.039816	$0.63	0.047779	$0.90	0.0637056	$1.61	1	3/0AWG	$94.50	0.0136	0.034272	$0.54	0.041126	$0.78	0.054835	$1.38	1	4/0AWG	$114.80
121	46	55.2	73.6	92	0.0222	1.235652	$49.82	1.4827824	$71.74	$1.98	$127.54	1	1/0AWG	$550.55	0.0187	1.040842	$41.97	1.24901	$60.43	1.665347	$107.43	1	2/0AWG	$671.55	0.0158	0.879428	$35.46	1.055314	$51.06	1.4070848	$90.77	1	3/0AWG	$816.75	0.0136	0.756976	$30.52	0.908371	$43.95	1.211162	$78.13	1	4/0AWG	$992.20
12	74.5	89.4	119.2	149	0.0222	0.198468	$12.96	0.2381616	$18.66	$0.32	$33.18	1	1/0AWG	$54.60	0.0187	0.167178	$10.92	0.200614	$15.72	0.267485	$27.95	1	2/0AWG	$66.60	0.0158	0.141252	$9.22	0.169502	$13.28	0.2260032	$23.61	1	3/0AWG	$81.00	0.0136	0.121584	$7.94	0.145901	$11.43	0.194534	$20.33	1	4/0AWG	$98.40
141	86.5	103.8	138.4	173	0.0136	1.658724	$125.76	1.9904688	$181.10	$2.65	$321.95	1	4/0AWG	$1,156.20	0.0124	1.512366	$114.67	1.814839	$165.12	2.419786	$293.55	1	250KCMIL	$1,339.50	0.0111	1.353812	$102.64	1.624574	$147.81	2.1660984	$262.77	1	300KCMIL	$1,551.00	0.0102	1.244043	$94.32	1.492852	$135.82	1.990469	$241.47	1	350KCMIL	$1,762.50
130	43	51.6	68.8	86	0.0136	0.76024	$28.65	0.912288	$41.26	$1.22	$73.35	1	4/0AWG	$1,066.00	0.0124	0.69316	$26.13	0.831792	$37.62	1.109056	$66.88	1	250KCMIL	$1,235.00	0.0111	0.62049	$23.39	0.744588	$33.68	0.992784	$59.87	1	300KCMIL	$1,430.00	0.0102	0.57018	$21.49	0.684216	$30.95	0.912288	$55.02	1	350KCMIL	$1,625.00
168	11.5	13.8	18.4	23	0.0404	0.780528	$7.87	0.9366336	$11.33	$1.25	$20.14	1	3AWG	$436.80	0.0323	0.624036	$6.29	0.748843	$9.06	0.998458	$16.10	1	2AWG	$520.80	0.0267	0.515844	$5.20	0.619013	$7.49	0.8253504	$13.31	1	1AWG	$630.00	0.0222	0.428904	$4.32	0.514685	$6.23	0.686246	$11.07	1	1/0AWG	$764.40
159	27	32.4	43.2	54	0.0404	1.734372	$41.05	2.0812464	$59.11	$2.77	$105.08	1	3AWG	$413.40	0.0323	1.386639	$32.82	1.663967	$47.26	2.218622	$84.01	1	2AWG	$492.90	0.0267	1.146231	$27.13	1.375477	$39.06	1.8339696	$69.44	1	1AWG	$596.25	0.0222	0.953046	$22.55	1.143655	$32.48	1.524874	$57.74	1	1/0AWG	$723.45
226	23.5	28.2	37.6	47	0.0404	2.145644	$44.20	2.5747728	$63.64	$3.43	$113.14	1	3AWG	$587.60	0.0323	1.715453	$35.34	2.058544	$50.88	2.744725	$90.46	1	2AWG	$700.60	0.0267	1.418037	$29.21	1.701644	$42.06	2.2688592	$74.78	1	1AWG	$847.50	0.0222	1.179042	$24.29	1.41485	$34.97	1.886467	$62.17	1	1/0AWG	$1,028.30
10	16.5	19.8	26.4	33	0.0404	0.06666	$0.96	0.079992	$1.39	$0.11	$2.47	1	3AWG	$26.00	0.0323	0.053295	$0.77	0.063954	$1.11	0.085272	$1.97	1	2AWG	$31.00	0.0267	0.044055	$0.64	0.052866	$0.92	0.070488	$1.63	1	1AWG	$37.50	0.0222	0.03663	$0.53	0.043956	$0.76	0.058608	$1.36	1	1/0AWG	$45.50
10	67	80.4	107.2	134	0.0222	0.14874	$8.74	0.178488	$12.58	$0.24	$22.36	1	1/0AWG	$45.50	0.0187	0.12529	$7.36	0.150348	$10.60	0.200464	$18.84	1	2/0AWG	$55.50	0.0158	0.10586	$6.22	0.127032	$8.95	0.169376	$15.92	1	3/0AWG	$67.50	0.0136	0.09112	$5.35	0.109344	$7.71	0.145792	$13.70	1	4/0AWG	$82.00
248	48	57.6	76.8	96	0.0136	1.618944	$68.11	1.9427328	$98.08	$2.59	$174.37	1	4/0AWG	$2,033.60	0.0124	1.476096	$62.10	1.771315	$89.43	2.361754	$158.99	1	250KCMIL	$2,356.00	0.0111	1.321344	$55.59	1.585613	$80.05	2.1141504	$142.32	1	300KCMIL	$2,728.00	0.0102	1.214208	$51.09	1.45705	$73.56	1.942733	$130.78	1	350KCMIL	$3,100.00
278	77	92.4	123.2	154	0.0136	2.911216	$196.48	3.4934592	$282.94	$4.66	$503.00	1	4/0AWG	$2,279.60	0.0124	2.654344	$179.15	3.185213	$257.97	4.24695	$458.62	1	250KCMIL	$2,641.00	0.0111	2.376066	$160.37	2.851279	$230.93	3.8017056	$410.54	1	300KCMIL	$3,058.00	0.0102	2.183412	$147.36	2.620094	$212.20	3.493459	$377.25	1	350KCMIL	$3,475.00
79	159.5	191.4	255.2	319	0.0087	1.0962435	$153.26	1.3154922	$220.70	$1.75	$392.35	1	500KCMIL	$1,303.50	0.0082	1.033241	$144.45	1.239889	$208.01	1.653186	$369.80	1	600KCMIL	$1,481.25	0.0078	0.982839	$137.41	1.179407	$197.86	1.5725424	$351.76	1	700KCMIL	$1,654.26	0.0077	0.9702385	$135.64	1.164286	$195.33	1.552382	$347.25	1	750KCMIL	$1,720.62
11	78	93.6	124.8	156	0.0124	0.106392	$7.27	0.1276704	$10.47	$0.17	$18.62	1	250KCMIL	$104.50	0.0111	0.095238	$6.51	0.114286	$9.38	0.152381	$16.67	1	300KCMIL	$121.00	0.0102	0.087516	$5.98	0.105019	$8.62	0.1400256	$15.32	1	350KCMIL	$137.50	0.0097	0.083226	$5.69	0.099871	$8.19	0.133162	$14.57	1	400KCMIL	$154.00
61	33	39.6	52.8	66	0.0404	0.813252	$23.52	0.9759024	$33.87	$1.30	$60.22	1	3AWG	$158.60	0.0323	0.650199	$18.81	0.780239	$27.08	1.040318	$48.15	1	2AWG	$189.10	0.0267	0.537471	$15.55	0.644965	$22.39	0.8599536	$39.80	1	1AWG	$228.75	0.0222	0.446886	$12.93	0.536263	$18.61	0.715018	$33.09	1	1/0AWG	$277.55
9	38.5	46.2	61.6	77	0.0404	0.139986	$4.72	0.1679832	$6.80	$0.22	$12.09	1	3AWG	$23.40	0.0323	0.11192	$3.78	0.134303	$5.44	0.179071	$9.67	1	2AWG	$27.90	0.0267	0.092516	$3.12	0.111019	$4.50	0.1480248	$7.99	1	1AWG	$33.75	0.0222	0.076923	$2.60	0.092308	$3.74	0.123077	$6.65	1	1/0AWG	$40.95
130	20	24	32	40	0.0404	1.0504	$18.41	1.26048	$26.52	$1.68	$47.14	1	3AWG	$338.00	0.0323	0.8398	$14.72	1.00776	$21.20	1.34368	$37.69	1	2AWG	$403.00	0.0267	0.6942	$12.17	0.83304	$17.52	1.11072	$31.15	1	1AWG	$487.50	0.0222	0.5772	$10.12	0.69264	$14.57	0.92352	$25.90	1	1/0AWG	$591.50
87	166	199.2	265.6	332	0.0097	1.400874	$203.83	1.6810488	$293.52	$2.24	$521.81	3	400KCMIL	$3,654.00	0.0087	1.256454	$182.82	1.507745	$263.26	2.010326	$468.01	3	500KCMIL	$4,306.50	0.0082	1.184244	$172.31	1.421093	$248.13	1.8947904	$441.12	3	600KCMIL	$4,893.75	0.0078	1.126476	$163.91	1.351771	$236.02	1.802362	$419.60	3	700KCMIL	$5,465.34
17	8.5	10.2	13.6	17	0.0742	0.107219	$0.80	0.1286628	$1.15	$0.17	$2.05	1	6AWG	$27.37	0.0485	0.070083	$0.52	0.084099	$0.75	0.112132	$1.34	1	4AWG	$37.91	0.0404	0.058378	$0.43	0.070054	$0.63	0.0934048	$1.11	1	3AWG	$44.20	0.0323	0.0466735	$0.35	0.056008	$0.50	0.074678	$0.89	1	2AWG	$52.70
10	43.5	52.2	69.6	87	0.0136	0.05916	$2.26	0.070992	$3.25	$0.09	$5.77	1	4/0AWG	$82.00	0.0124	0.05394	$2.06	0.064728	$2.96	0.086304	$5.27	1	250KCMIL	$95.00	0.0111	0.048285	$1.84	0.057942	$2.65	0.077256	$4.71	1	300KCMIL	$110.00	0.0102	0.04437	$1.69	0.053244	$2.44	0.070992	$4.33	1	350KCMIL	$125.00
11	61	73.2	97.6	122	0.0485	0.325435	$17.40	0.390522	$25.06	$0.52	$44.54	1	4AWG	$24.53	0.0404	0.271084	$14.49	0.325301	$20.87	0.433734	$37.11	1	3AWG	$28.60	0.0323	0.216733	$11.59	0.26008	$16.69	0.3467728	$29.67	1	2AWG	$34.10	0.0267	0.179157	$9.58	0.214988	$13.79	0.286651	$24.52	1	1AWG	$41.25
37	11	13.2	17.6	22	0.0222	0.090354	$0.87	0.1084248	$1.25	$0.14	$2.23	1	1/0AWG	$168.35	0.0187	0.076109	$0.73	0.091331	$1.06	0.121774	$1.88	1	2/0AWG	$205.35	0.0158	0.064306	$0.62	0.077167	$0.89	0.1028896	$1.59	1	3/0AWG	$249.75	0.0136	0.055352	$0.53	0.066422	$0.77	0.088563	$1.37	1	4/0AWG	$303.40
9	16.5	19.8	26.4	33	0.0742	0.110187	$1.59	0.1322244	$2.29	$0.18	$4.08	1	6AWG	$14.49	0.0485	0.072023	$1.04	0.086427	$1.50	0.115236	$2.67	1	4AWG	$20.07	0.0404	0.059994	$0.87	0.071993	$1.25	0.0959904	$2.22	1	3AWG	$23.40	0.0323	0.0479655	$0.69	0.057559	$1.00	0.076745	$1.78	1	2AWG	$27.90
66	24	28.8	38.4	48	0.0404	0.639936	$13.46	0.7679232	$19.39	$1.02	$34.46	1	3AWG	$171.60	0.0323	0.511632	$10.76	0.613958	$15.50	0.818611	$27.55	1	2AWG	$204.60	0.0267	0.422928	$8.90	0.507514	$12.81	0.6766848	$22.78	1	1AWG	$247.50	0.0222	0.351648	$7.40	0.421978	$10.65	0.562637	$18.94	1	1/0AWG	$300.30
69	23	27.6	36.8	46	0.0404	0.641148	$12.93	0.7693776	$18.61	$1.03	$33.09	1	3AWG	$179.40	0.0323	0.512601	$10.33	0.615121	$14.88	0.820162	$26.46	1	2AWG	$213.90	0.0267	0.423729	$8.54	0.508475	$12.30	0.6779664	$21.87	1	1AWG	$258.75	0.0222	0.352314	$7.10	0.422777	$10.23	0.563702	$18.18	1	1/0AWG	$313.95
215	46	55.2	73.6	92	0.0222	2.19558	$88.53	2.634696	$127.48	$3.51	$226.63	1	1/0AWG	$978.25	0.0187	1.84943	$74.57	2.219316	$107.38	2.959088	$190.90	1	2/0AWG	$1,193.25	0.0158	1.56262	$63.00	1.875144	$90.73	2.500192	$161.29	1	3/0AWG	$1,451.25	0.0136	1.34504	$54.23	1.614048	$78.09	2.152064	$138.83	1	4/0AWG	$1,763.00
216	50	60	80	100	0.0222	2.3976	$105.08	2.87712	$151.31	$3.84	$269.00	1	1/0AWG	$982.80	0.0187	2.0196	$88.51	2.42352	$127.46	3.23136	$226.59	1	2/0AWG	$1,198.80	0.0158	1.7064	$74.78	2.04768	$107.69	2.73024	$191.45	1	3/0AWG	$1,458.00	0.0136	1.4688	$64.37	1.76256	$92.70	2.35008	$164.79	1	4/0AWG	$1,771.20
239	46	55.2	73.6	92	0.0222	2.440668	$98.41	2.9288016	$141.71	$3.91	$251.92	1	1/0AWG	$1,087.45	0.0187	2.055878	$82.89	2.467054	$119.37	3.289405	$212.21	1	2/0AWG	$1,326.45	0.0158	1.737052	$70.04	2.084462	$100.85	2.7792832	$179.30	1	3/0AWG	$1,613.25	0.0136	1.495184	$60.29	1.794221	$86.81	2.392294	$154.33	1	4/0AWG	$1,959.80
246	52.5	63	84	105	0.0222	2.86713	$131.94	3.440556	$189.99	$4.59	$337.76	1	1/0AWG	$1,119.30	0.0187	2.415105	$111.14	2.898126	$160.04	3.864168	$284.51	1	2/0AWG	$1,365.30	0.0158	2.04057	$93.90	2.448684	$135.22	3.264912	$240.39	1	3/0AWG	$1,660.50	0.0136	1.75644	$80.83	2.107728	$116.39	2.810304	$206.92	1	4/0AWG	$2,017.20
79	23	27.6	36.8	46	0.0222	0.403374	$8.13	0.4840488	$11.71	$0.65	$20.82	1	1/0AWG	$359.45	0.0187	0.339779	$6.85	0.407735	$9.86	0.543646	$17.54	1	2/0AWG	$438.45	0.0158	0.287086	$5.79	0.344503	$8.33	0.4593376	$14.82	1	3/0AWG	$533.25	0.0136	0.247112	$4.98	0.296534	$7.17	0.395379	$12.75	1	4/0AWG	$647.80
76	42	50.4	67.2	84	0.0404	1.289568	$47.47	1.5474816	$68.36	$2.06	$121.53	1	3AWG	$197.60	0.0323	1.031016	$37.96	1.237219	$54.66	1.649626	$97.17	1	2AWG	$235.60	0.0267	0.852264	$31.38	1.022717	$45.18	1.3636224	$80.32	1	1AWG	$285.00	0.0222	0.708624	$26.09	0.850349	$37.57	1.133798	$66.78	1	1/0AWG	$345.80
76	48.5	58.2	77.6	97	0.0742	2.735012	$116.27	3.2820144	$167.43	$4.38	$297.65	1	6AWG	$122.36	0.0485	1.78771	$76.00	2.145252	$109.44	2.860336	$194.55	1	4AWG	$169.48	0.0404	1.489144	$63.31	1.786973	$91.16	2.3826304	$162.06	1	3AWG	$197.60	0.0323	1.190578	$50.61	1.428694	$72.88	1.904925	$129.57	1	2AWG	$235.60
102	21.5	25.8	34.4	43	0.0404	0.885972	$16.70	1.0631664	$24.04	$1.42	$42.74	1	3AWG	$265.20	0.0323	0.708339	$13.35	0.850007	$19.22	1.133342	$34.17	1	2AWG	$316.20	0.0267	0.585531	$11.03	0.702637	$15.89	0.9368496	$28.25	1	1AWG	$382.50	0.0222	0.486846	$9.17	0.584215	$13.21	0.778954	$23.49	1	1/0AWG	$464.10
157	13	15.6	20.8	26	0.0404	0.824564	$9.40	0.9894768	$13.53	$1.32	$24.05	1	3AWG	$408.20	0.0323	0.659243	$7.51	0.791092	$10.82	1.054789	$19.23	1	2AWG	$486.70	0.0267	0.544947	$6.21	0.653936	$8.94	0.8719152	$15.90	1	1AWG	$588.75	0.0222	0.453102	$5.16	0.543722	$7.43	0.724963	$13.22	1	1/0AWG	$714.35
14	21	25.2	33.6	42	0.0404	0.118776	$2.19	0.1425312	$3.15	$0.19	$5.60	1	3AWG	$36.40	0.0323	0.094962	$1.75	0.113954	$2.52	0.151939	$4.47	1	2AWG	$43.40	0.0267	0.078498	$1.44	0.094198	$2.08	0.1255968	$3.70	1	1AWG	$52.50	0.0222	0.065268	$1.20	0.078322	$1.73	0.104429	$3.08	1	1/0AWG	$63.70
151	13	15.6	20.8	26	0.0404	0.793052	$9.04	0.9516624	$13.01	$1.27	$23.13	1	3AWG	$392.60	0.0323	0.634049	$7.22	0.760859	$10.40	1.014478	$18.50	1	2AWG	$468.10	0.0267	0.524121	$5.97	0.628945	$8.60	0.8385936	$15.29	1	1AWG	$566.25	0.0222	0.435786	$4.97	0.522943	$7.15	0.697258	$12.71	1	1/0AWG	$687.05
14	106	127.2	169.6	212	0.0124	0.184016	$17.10	0.2208192	$24.62	$0.29	$43.77	2	250KCMIL	$266.00	0.0111	0.164724	$15.30	0.197669	$22.04	0.263558	$39.18	2	300KCMIL	$308.00	0.0102	0.151368	$14.06	0.181642	$20.25	0.2421888	$36.00	2	350KCMIL	$350.00	0.0097	0.143948	$13.37	0.172738	$19.26	0.230317	$34.24	2	400KCMIL	$392.00
124	40	48	64	80	0.0404	2.00384	$70.26	2.404608	$101.17	$3.21	$179.86	1	3AWG	$322.40	0.0323	1.60208	$56.17	1.922496	$80.89	2.563328	$143.80	1	2AWG	$384.40	0.0267	1.32432	$46.43	1.589184	$66.86	2.118912	$118.87	1	1AWG	$465.00	0.0222	1.10112	$38.61	1.321344	$55.59	1.761792	$98.83	1	1/0AWG	$564.20
15	213.5	256.2	341.6	427	0.0124	0.39711	$74.31	0.476532	$107.01	$0.64	$190.24	2	250KCMIL	$285.00	0.0111	0.355478	$66.52	0.426573	$95.79	0.568764	$170.30	2	300KCMIL	$330.00	0.0102	0.326655	$61.13	0.391986	$88.03	0.522648	$156.49	2	350KCMIL	$375.00	0.0097	0.3106425	$58.13	0.372771	$83.71	0.497028	$148.82	2	400KCMIL	$420.00
161	36.5	43.8	58.4	73	0.0404	2.374106	$75.95	2.8489272	$109.38	$3.80	$194.44	1	3AWG	$418.60	0.0323	1.89811	$60.73	2.277731	$87.45	3.036975	$155.46	1	2AWG	$499.10	0.0267	1.569026	$50.20	1.882831	$72.28	2.5104408	$128.51	1	1AWG	$603.75	0.0222	1.304583	$41.74	1.5655	$60.10	2.087333	$106.85	1	1/0AWG	$732.55
259	94	112.8	150.4	188	0.0136	3.311056	$272.81	3.9732672	$392.84	$5.30	$698.39	1	4/0AWG	$2,123.80	0.0124	3.018904	$248.74	3.622685	$358.18	4.830246	$636.77	1	250KCMIL	$2,460.50	0.0111	2.702406	$222.66	3.242887	$320.63	4.3238496	$570.01	1	300KCMIL	$2,849.00	0.0102	2.483292	$204.61	2.97995	$294.63	3.973267	$523.79	1	350KCMIL	$3,237.50
266	54.5	65.4	87.2	109	0.0222	3.218334	$153.74	3.8620008	$221.39	$5.15	$393.58	1	1/0AWG	$1,210.30	0.0187	2.710939	$129.50	3.253127	$186.48	4.337502	$331.53	1	2/0AWG	$1,476.30	0.0158	2.290526	$109.42	2.748631	$157.56	3.6648416	$280.11	1	3/0AWG	$1,795.50	0.0136	1.971592	$94.18	2.36591	$135.62	3.154547	$241.11	1	4/0AWG	$2,181.20
288	95	114	152	190	0.0222	6.07392	$505.77	7.288704	$728.31	$9.72	$1,294.78	1	1/0AWG	$1,310.40	0.0187	5.11632	$426.03	6.139584	$613.49	8.186112	$1,090.65	1	2/0AWG	$1,598.40	0.0158	4.32288	$359.96	5.187456	$518.35	6.916608	$921.51	1	3/0AWG	$1,944.00	0.0136	3.72096	$309.84	4.465152	$446.17	5.953536	$793.20	1	4/0AWG	$2,361.60
296	47	56.4	75.2	94	0.0136	1.892032	$77.95	2.2704384	$112.24	$3.03	$199.54	1	4/0AWG	$2,427.20	0.0124	1.725088	$71.07	2.070106	$102.34	2.760141	$181.93	1	250KCMIL	$2,812.00	0.0111	1.544232	$63.62	1.853078	$91.61	2.4707712	$162.86	1	300KCMIL	$3,256.00	0.0102	1.419024	$58.46	1.702829	$84.18	2.270438	$149.65	1	350KCMIL	$3,700.00
81	39.5	47.4	63.2	79	0.0222	0.710289	$24.59	0.8523468	$35.41	$1.14	$62.96	1	1/0AWG	$368.55	0.0187	0.598307	$20.71	0.717968	$29.83	0.95729	$53.03	1	2/0AWG	$449.55	0.0158	0.505521	$17.50	0.606625	$25.20	0.8088336	$44.81	1	3/0AWG	$546.75	0.0136	0.435132	$15.07	0.522158	$21.69	0.696211	$38.57	1	4/0AWG	$664.20
78	45.5	54.6	72.8	91	0.0404	1.433796	$57.18	1.7205552	$82.34	$2.29	$146.39	1	3AWG	$202.80	0.0323	1.146327	$45.72	1.375592	$65.83	1.834123	$117.04	1	2AWG	$241.80	0.0267	0.947583	$37.79	1.1371	$54.42	1.5161328	$96.75	1	1AWG	$292.50	0.0222	0.787878	$31.42	0.945454	$45.25	1.260605	$80.44	1	1/0AWG	$354.90
77	58	69.6	92.8	116	0.0222	0.991452	$50.40	1.1897424	$72.58	$1.59	$129.03	1	1/0AWG	$350.35	0.0187	0.835142	$42.46	1.00217	$61.14	1.336227	$108.69	1	2/0AWG	$427.35	0.0158	0.705628	$35.87	0.846754	$51.66	1.1290048	$91.83	1	3/0AWG	$519.75	0.0136	0.607376	$30.88	0.728851	$44.46	0.971802	$79.05	1	4/0AWG	$631.40
106	27.5	33	44	55	0.0404	1.17766	$28.39	1.413192	$40.88	$1.88	$72.67	1	3AWG	$275.60	0.0323	0.941545	$22.70	1.129854	$32.68	1.506472	$58.10	1	2AWG	$328.60	0.0267	0.778305	$18.76	0.933966	$27.02	1.245288	$48.03	1	1AWG	$397.50	0.0222	0.64713	$15.60	0.776556	$22.46	1.035408	$39.93	1	1/0AWG	$482.30
180	10	12	16	20	0.0404	0.7272	$6.37	0.87264	$9.18	$1.16	$16.32	1	3AWG	$468.00	0.0323	0.5814	$5.10	0.69768	$7.34	0.93024	$13.05	1	2AWG	$558.00	0.0267	0.4806	$4.21	0.57672	$6.07	0.76896	$10.78	1	1AWG	$675.00	0.0222	0.3996	$3.50	0.47952	$5.04	0.63936	$8.97	1	1/0AWG	$819.00
15	13.5	16.2	21.6	27	0.0404	0.08181	$0.97	0.098172	$1.39	$0.13	$2.48	1	3AWG	$39.00	0.0323	0.065408	$0.77	0.078489	$1.11	0.104652	$1.98	1	2AWG	$46.50	0.0267	0.054068	$0.64	0.064881	$0.92	0.086508	$1.64	1	1AWG	$56.25	0.0222	0.044955	$0.53	0.053946	$0.77	0.071928	$1.36	1	1/0AWG	$68.25
161	10.5	12.6	16.8	21	0.0404	0.682962	$6.29	0.8195544	$9.05	$1.09	$16.09	1	3AWG	$418.60	0.0323	0.546032	$5.03	0.655238	$7.24	0.87365	$12.86	1	2AWG	$499.10	0.0267	0.451364	$4.15	0.541636	$5.98	0.7221816	$10.63	1	1AWG	$603.75	0.0222	0.375291	$3.45	0.450349	$4.97	0.600466	$8.84	1	1/0AWG	$732.55
15	215	258	344	430	0.0124	0.3999	$75.36	0.47988	$108.52	$0.64	$192.93	2	250KCMIL	$285.00	0.0111	0.357975	$67.46	0.42957	$97.14	0.57276	$172.70	2	300KCMIL	$330.00	0.0102	0.32895	$61.99	0.39474	$89.27	0.52632	$158.70	2	350KCMIL	$375.00	0.0097	0.312825	$58.95	0.37539	$84.89	0.50052	$150.92	2	400KCMIL	$420.00
135	19.5	23.4	31.2	39	0.0404	1.06353	$18.18	1.276236	$26.18	$1.70	$46.54	1	3AWG	$351.00	0.0323	0.850298	$14.53	1.020357	$20.93	1.360476	$37.21	1	2AWG	$418.50	0.0267	0.702878	$12.01	0.843453	$17.30	1.124604	$30.76	1	1AWG	$506.25	0.0222	0.584415	$9.99	0.701298	$14.38	0.935064	$25.57	1	1/0AWG	$614.25
15	190	228	304	380	0.0124	0.3534	$58.85	0.42408	$84.75	$0.57	$150.67	2	250KCMIL	$285.00	0.0111	0.31635	$52.68	0.37962	$75.87	0.50616	$134.87	2	300KCMIL	$330.00	0.0102	0.2907	$48.41	0.34884	$69.71	0.46512	$123.94	2	350KCMIL	$375.00	0.0097	0.27645	$46.04	0.33174	$66.30	0.44232	$117.86	2	400KCMIL	$420.00
74	18.5	22.2	29.6	37	0.0404	0.553076	$8.97	0.6636912	$12.91	$0.88	$22.96	1	3AWG	$192.40	0.0323	0.442187	$7.17	0.530624	$10.33	0.707499	$18.36	1	2AWG	$229.40	0.0267	0.365523	$5.93	0.438628	$8.54	0.5848368	$15.17	1	1AWG	$277.50	0.0222	0.303918	$4.93	0.364702	$7.10	0.486269	$12.62	1	1/0AWG	$336.70
214	58	69.6	92.8	116	0.0222	2.755464	$140.08	3.3065568	$201.72	$4.41	$358.61	1	1/0AWG	$973.70	0.0187	2.321044	$118.00	2.785253	$169.92	3.71367	$302.07	1	2/0AWG	$1,187.70	0.0158	1.961096	$99.70	2.353315	$143.57	3.1377536	$255.23	1	3/0AWG	$1,444.50	0.0136	1.688032	$85.82	2.025638	$123.58	2.700851	$219.69	1	4/0AWG	$1,754.80
217	50	60	80	100	0.0222	2.4087	$105.56	2.89044	$152.01	$3.85	$270.24	1	1/0AWG	$987.35	0.0187	2.02895	$88.92	2.43474	$128.05	3.24632	$227.64	1	2/0AWG	$1,204.35	0.0158	1.7143	$75.13	2.05716	$108.19	2.74288	$192.34	1	3/0AWG	$1,464.75	0.0136	1.4756	$64.67	1.77072	$93.12	2.36096	$165.55	1	4/0AWG	$1,779.40
245	57.5	69	92	115	0.0222	3.127425	$157.62	3.75291	$226.98	$5.00	$403.51	1	1/0AWG	$1,114.75	0.0187	2.634363	$132.77	3.161235	$191.19	4.21498	$339.90	1	2/0AWG	$1,359.75	0.0158	2.225825	$112.18	2.67099	$161.54	3.56132	$287.18	1	3/0AWG	$1,653.75	0.0136	1.9159	$96.56	2.29908	$139.05	3.06544	$247.20	1	4/0AWG	$2,009.00
244	52.5	63	84	105	0.0222	2.84382	$130.87	3.412584	$188.45	$4.55	$335.01	1	1/0AWG	$1,110.20	0.0187	2.39547	$110.23	2.874564	$158.74	3.832752	$282.20	1	2/0AWG	$1,354.20	0.0158	2.02398	$93.14	2.428776	$134.12	3.238368	$238.43	1	3/0AWG	$1,647.00	0.0136	1.74216	$80.17	2.090592	$115.44	2.787456	$205.23	1	4/0AWG	$2,000.80
80	14.5	17.4	23.2	29	0.0222	0.25752	$3.27	0.309024	$4.71	$0.41	$8.38	1	1/0AWG	$364.00	0.0187	0.21692	$2.76	0.260304	$3.97	0.347072	$7.06	1	2/0AWG	$444.00	0.0158	0.18328	$2.33	0.219936	$3.35	0.293248	$5.96	1	3/0AWG	$540.00	0.0136	0.15776	$2.01	0.189312	$2.89	0.252416	$5.13	1	4/0AWG	$656.00
78	40.5	48.6	64.8	81	0.0404	1.276236	$45.31	1.5314832	$65.24	$2.04	$115.98	1	3AWG	$202.80	0.0323	1.020357	$36.22	1.224428	$52.16	1.632571	$92.73	1	2AWG	$241.80	0.0267	0.843453	$29.94	1.012144	$43.12	1.3495248	$76.65	1	1AWG	$292.50	0.0222	0.701298	$24.90	0.841558	$35.85	1.122077	$63.73	1	1/0AWG	$354.90
75	42.5	51	68	85	0.0222	0.707625	$26.36	0.84915	$37.96	$1.13	$67.48	1	1/0AWG	$341.25	0.0187	0.596063	$22.20	0.715275	$31.97	0.9537	$56.84	1	2/0AWG	$416.25	0.0158	0.503625	$18.76	0.60435	$27.02	0.8058	$48.03	1	3/0AWG	$506.25	0.0136	0.4335	$16.15	0.5202	$23.25	0.6936	$41.34	1	4/0AWG	$615.00
122	28	33.6	44.8	56	0.0404	1.380064	$33.87	1.6560768	$48.77	$2.21	$86.71	1	3AWG	$317.20	0.0323	1.103368	$27.08	1.324042	$38.99	1.765389	$69.32	1	2AWG	$378.20	0.0267	0.912072	$22.38	1.094486	$32.23	1.4593152	$57.30	1	1AWG	$457.50	0.0222	0.758352	$18.61	0.910022	$26.80	1.213363	$47.65	1	1/0AWG	$555.10
168	8.5	10.2	13.6	17	0.0404	0.576912	$4.30	0.6922944	$6.19	$0.92	$11.00	1	3AWG	$436.80	0.0323	0.461244	$3.44	0.553493	$4.95	0.73799	$8.80	1	2AWG	$520.80	0.0267	0.381276	$2.84	0.457531	$4.09	0.6100416	$7.27	1	1AWG	$630.00	0.0222	0.317016	$2.36	0.380419	$3.40	0.507226	$6.05	1	1/0AWG	$764.40
15	12	14.4	19.2	24	0.0404	0.07272	$0.76	0.087264	$1.10	$0.12	$1.96	1	3AWG	$39.00	0.0323	0.05814	$0.61	0.069768	$0.88	0.093024	$1.57	1	2AWG	$46.50	0.0267	0.04806	$0.51	0.057672	$0.73	0.076896	$1.29	1	1AWG	$56.25	0.0222	0.03996	$0.42	0.047952	$0.61	0.063936	$1.08	1	1/0AWG	$68.25
158	12	14.4	19.2	24	0.0404	0.765984	$8.06	0.9191808	$11.60	$1.23	$20.63	1	3AWG	$410.80	0.0323	0.612408	$6.44	0.73489	$9.28	0.979853	$16.49	1	2AWG	$489.80	0.0267	0.506232	$5.32	0.607478	$7.67	0.8099712	$13.63	1	1AWG	$592.50	0.0222	0.420912	$4.43	0.505094	$6.38	0.673459	$11.33	1	1/0AWG	$718.90
15	119.5	143.4	191.2	239	0.0124	0.22227	$23.28	0.266724	$33.53	$0.36	$59.60	2	250KCMIL	$285.00	0.0111	0.198968	$20.84	0.238761	$30.01	0.318348	$53.35	2	300KCMIL	$330.00	0.0102	0.182835	$19.15	0.219402	$27.58	0.292536	$49.03	2	350KCMIL	$375.00	0.0097	0.1738725	$18.21	0.208647	$26.23	0.278196	$46.62	2	400KCMIL	$420.00
128	49	58.8	78.4	98	0.0222	1.392384	$59.80	1.6708608	$86.12	$2.23	$153.09	1	1/0AWG	$582.40	0.0187	1.172864	$50.37	1.407437	$72.54	1.876582	$128.96	1	2/0AWG	$710.40	0.0158	0.990976	$42.56	1.189171	$61.29	1.5855616	$108.96	1	3/0AWG	$864.00	0.0136	0.852992	$36.64	1.02359	$52.76	1.364787	$93.79	1	4/0AWG	$1,049.60
13	145	174	232	290	0.0124	0.23374	$29.71	0.280488	$42.78	$0.37	$76.05	2	250KCMIL	$247.00	0.0111	0.209235	$26.59	0.251082	$38.29	0.334776	$68.08	2	300KCMIL	$286.00	0.0102	0.19227	$24.44	0.230724	$35.19	0.307632	$62.56	2	350KCMIL	$325.00	0.0097	0.182845	$23.24	0.219414	$33.46	0.292552	$59.49	2	400KCMIL	$364.00
157	102.5	123	164	205	0.0102	1.641435	$147.47	1.969722	$212.36	$2.63	$377.53	1	350KCMIL	$1,962.50	0.0097	1.560973	$140.24	1.873167	$201.95	2.497556	$359.02	1	400KCMIL	$2,198.00	0.0087	1.400048	$125.79	1.680057	$181.13	2.240076	$322.01	1	500KCMIL	$2,590.50	0.0082	1.319585	$118.56	1.583502	$170.72	2.111336	$303.50	1	600KCMIL	$2,943.75
74	10.5	12.6	16.8	21	0.0742	0.576534	$5.31	0.6918408	$7.64	$0.92	$13.58	1	6AWG	$119.14	0.0485	0.376845	$3.47	0.452214	$4.99	0.602952	$8.88	1	4AWG	$165.02	0.0404	0.313908	$2.89	0.37669	$4.16	0.5022528	$7.40	1	3AWG	$192.40	0.0323	0.250971	$2.31	0.301165	$3.33	0.401554	$5.91	1	2AWG	$229.40
215	49.5	59.4	79.2	99	0.0222	2.362635	$102.51	2.835162	$147.61	$3.78	$262.42	1	1/0AWG	$978.25	0.0187	1.990148	$86.35	2.388177	$124.34	3.184236	$221.05	1	2/0AWG	$1,193.25	0.0158	1.681515	$72.96	2.017818	$105.06	2.690424	$186.77	1	3/0AWG	$1,451.25	0.0136	1.44738	$62.80	1.736856	$90.43	2.315808	$160.76	1	4/0AWG	$1,763.00
218	51.5	61.8	82.4	103	0.0222	2.492394	$112.51	2.9908728	$162.01	$3.99	$288.02	1	1/0AWG	$991.90	0.0187	2.099449	$94.77	2.519339	$136.47	3.359118	$242.61	1	2/0AWG	$1,209.90	0.0158	1.773866	$80.07	2.128639	$115.31	2.8381856	$204.99	1	3/0AWG	$1,471.50	0.0136	1.526872	$68.92	1.832246	$99.25	2.442995	$176.45	1	4/0AWG	$1,787.60
245	46	55.2	73.6	92	0.0222	2.50194	$100.88	3.002328	$145.26	$4.00	$258.25	1	1/0AWG	$1,114.75	0.0187	2.10749	$84.97	2.528988	$122.36	3.371984	$217.53	1	2/0AWG	$1,359.75	0.0158	1.78066	$71.80	2.136792	$103.39	2.849056	$183.80	1	3/0AWG	$1,653.75	0.0136	1.53272	$61.80	1.839264	$88.99	2.452352	$158.21	1	4/0AWG	$2,009.00
244	55.5	66.6	88.8	111	0.0222	3.006324	$146.25	3.6075888	$210.60	$4.81	$374.40	1	1/0AWG	$1,110.20	0.0187	2.532354	$123.19	3.038825	$177.40	4.051766	$315.37	1	2/0AWG	$1,354.20	0.0158	2.139636	$104.09	2.567563	$149.88	3.4234176	$266.46	1	3/0AWG	$1,647.00	0.0136	1.841712	$89.59	2.210054	$129.01	2.946739	$229.36	1	4/0AWG	$2,000.80
79	11.5	13.8	18.4	23	0.0222	0.201687	$2.03	0.2420244	$2.93	$0.32	$5.20	1	1/0AWG	$359.45	0.0187	0.16989	$1.71	0.203867	$2.47	0.271823	$4.38	1	2/0AWG	$438.45	0.0158	0.143543	$1.45	0.172252	$2.08	0.2296688	$3.70	1	3/0AWG	$533.25	0.0136	0.123556	$1.25	0.148267	$1.79	0.19769	$3.19	1	4/0AWG	$647.80
78	40.5	48.6	64.8	81	0.0404	1.276236	$45.31	1.5314832	$65.24	$2.04	$115.98	1	3AWG	$202.80	0.0323	1.020357	$36.22	1.224428	$52.16	1.632571	$92.73	1	2AWG	$241.80	0.0267	0.843453	$29.94	1.012144	$43.12	1.3495248	$76.65	1	1AWG	$292.50	0.0222	0.701298	$24.90	0.841558	$35.85	1.122077	$63.73	1	1/0AWG	$354.90
75	41.5	49.8	66.4	83	0.0222	0.690975	$25.13	0.82917	$36.19	$1.11	$64.34	1	1/0AWG	$341.25	0.0187	0.582038	$21.17	0.698445	$30.49	0.93126	$54.20	1	2/0AWG	$416.25	0.0158	0.491775	$17.89	0.59013	$25.76	0.78684	$45.79	1	3/0AWG	$506.25	0.0136	0.4233	$15.40	0.50796	$22.17	0.67728	$39.42	1	4/0AWG	$615.00
134	21	25.2	33.6	42	0.0404	1.136856	$20.93	1.3642272	$30.13	$1.82	$53.57	1	3AWG	$348.40	0.0323	0.908922	$16.73	1.090706	$24.09	1.454275	$42.83	1	2AWG	$415.40	0.0267	0.751338	$13.83	0.901606	$19.91	1.2021408	$35.40	1	1AWG	$502.50	0.0222	0.624708	$11.50	0.74965	$16.56	0.999533	$29.44	1	1/0AWG	$609.70
191	8	9.6	12.8	16	0.0404	0.617312	$4.33	0.7407744	$6.23	$0.99	$11.08	1	3AWG	$496.60	0.0323	0.493544	$3.46	0.592253	$4.98	0.78967	$8.86	1	2AWG	$592.10	0.0267	0.407976	$2.86	0.489571	$4.12	0.6527616	$7.32	1	1AWG	$716.25	0.0222	0.339216	$2.38	0.407059	$3.43	0.542746	$6.09	1	1/0AWG	$869.05
15	11.5	13.8	18.4	23	0.0404	0.06969	$0.70	0.083628	$1.01	$0.11	$1.80	1	3AWG	$39.00	0.0323	0.055718	$0.56	0.066861	$0.81	0.089148	$1.44	1	2AWG	$46.50	0.0267	0.046058	$0.46	0.055269	$0.67	0.073692	$1.19	1	1AWG	$56.25	0.0222	0.038295	$0.39	0.045954	$0.56	0.061272	$0.99	1	1/0AWG	$68.25
182	12	14.4	19.2	24	0.0404	0.882336	$9.28	1.0588032	$13.36	$1.41	$23.76	1	3AWG	$473.20	0.0323	0.705432	$7.42	0.846518	$10.68	1.128691	$18.99	1	2AWG	$564.20	0.0267	0.583128	$6.13	0.699754	$8.83	0.9330048	$15.70	1	1AWG	$682.50	0.0222	0.484848	$5.10	0.581818	$7.34	0.775757	$13.06	1	1/0AWG	$828.10
15	98	117.6	156.8	196	0.0124	0.18228	$15.66	0.218736	$22.55	$0.29	$40.08	2	250KCMIL	$285.00	0.0111	0.16317	$14.02	0.195804	$20.18	0.261072	$35.88	2	300KCMIL	$330.00	0.0102	0.14994	$12.88	0.179928	$18.55	0.239904	$32.97	2	350KCMIL	$375.00	0.0097	0.14259	$12.25	0.171108	$17.64	0.228144	$31.36	2	400KCMIL	$420.00
152	20	24	32	40	0.0404	1.22816	$21.53	1.473792	$31.00	$1.97	$55.12	1	3AWG	$395.20	0.0323	0.98192	$17.21	1.178304	$24.79	1.571072	$44.07	1	2AWG	$471.20	0.0267	0.81168	$14.23	0.974016	$20.49	1.298688	$36.43	1	1AWG	$570.00	0.0222	0.67488	$11.83	0.809856	$17.04	1.079808	$30.29	1	1/0AWG	$691.60
13	148	177.6	236.8	296	0.0124	0.238576	$30.95	0.2862912	$44.57	$0.38	$79.23	2	250KCMIL	$247.00	0.0111	0.213564	$27.70	0.256277	$39.89	0.341702	$70.92	2	300KCMIL	$286.00	0.0102	0.196248	$25.46	0.235498	$36.66	0.3139968	$65.17	2	350KCMIL	$325.00	0.0097	0.186628	$24.21	0.223954	$34.86	0.298605	$61.98	2	400KCMIL	$364.00
214	46	55.2	73.6	92	0.0222	2.185368	$88.11	2.6224416	$126.88	$3.50	$225.57	1	1/0AWG	$973.70	0.0187	1.840828	$74.22	2.208994	$106.88	2.945325	$190.01	1	2/0AWG	$1,187.70	0.0158	1.555352	$62.71	1.866422	$90.30	2.4885632	$160.54	1	3/0AWG	$1,444.50	0.0136	1.338784	$53.98	1.606541	$77.73	2.142054	$138.19	1	4/0AWG	$1,754.80

ENERGY SAVINGS VS. FIRST COST FEEDER SCHEDULE (CONT.)																																											
						50% DEMAND LOAD		60% DEMAND LOAD		80% DEMAND LOAD					50% DEMAND LOAD		60% DEMAND LOAD		80% DEMAND LOAD					50% DEMAND LOAD		60% DEMAND LOAD		80% DEMAND LOAD					50% DEMAND LOAD		60% DEMAND LOAD		80% DEMAND LOAD				
LENGTH (FEET)	50% DEMAND	60% DEMAN	80% DEMAN	DEMAND LOAD (A)	FACTOR	VOLTAGE DROP	ENERGY LOSS PER	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	NO.	EXISTING SIZE CU SIZE	COST	FACTOR	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	NO.	1 SIZE LARGER CU SIZE	COST	FACTOR	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	NO.	2 SIZES LARGER CU SIZE	COST	FACTOR	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	NO.	3 SIZES LARGER CU SIZE	COST
217	50	60	80	100	0.0222	2.4087	$105.56	2.89044	$152.01	$3.85	$270.24	1	1/0AWG	$987.35	0.0187	2.02895	$88.92	2.43474	$128.05	3.24632	$227.64	1	2/0AWG	$1,204.35	0.0158	1.7143	$75.13	2.05716	$108.19	2.74288	$192.34	1	3/0AWG	$1,464.75	0.0136	1.4756	$64.67	1.77072	$93.12	2.36096	$165.55	1	4/0AWG	$1,779.40
245	46	55.2	73.6	92	0.0222	2.50194	$100.88	3.002328	$145.26	$4.00	$258.25	1	1/0AWG	$1,114.75	0.0187	2.10749	$84.97	2.528988	$122.36	3.371984	$217.53	1	2/0AWG	$1,359.75	0.0158	1.78066	$71.80	2.136792	$103.39	2.849056	$183.80	1	3/0AWG	$1,653.75	0.0136	1.53272	$61.80	1.839264	$88.99	2.452352	$158.21	1	4/0AWG	$2,009.00
244	52.5	63	84	105	0.0222	2.84382	$130.87	3.412584	$188.45	$4.55	$335.01	1	1/0AWG	$1,110.20	0.0187	2.39547	$110.23	2.874564	$158.74	3.832752	$282.20	1	2/0AWG	$1,354.20	0.0158	2.02398	$93.14	2.428776	$134.12	3.238368	$238.43	1	3/0AWG	$1,647.00	0.0136	1.74216	$80.17	2.090592	$115.44	2.787456	$205.23	1	4/0AWG	$2,000.80
80	11.5	13.8	18.4	23	0.0222	0.20424	$2.06	0.245088	$2.96	$0.33	$5.27	1	1/0AWG	$364.00	0.0187	0.17204	$1.73	0.206448	$2.50	0.275264	$4.44	1	2/0AWG	$444.00	0.0158	0.14536	$1.47	0.174432	$2.11	0.232576	$3.75	1	3/0AWG	$540.00	0.0136	0.12512	$1.26	0.150144	$1.82	0.200192	$3.23	1	4/0AWG	$656.00
78	39	46.8	62.4	78	0.0404	1.228968	$42.01	1.4747616	$60.50	$1.97	$107.55	1	3AWG	$202.80	0.0323	0.982566	$33.59	1.179079	$48.37	1.572106	$85.99	1	2AWG	$241.80	0.0267	0.812214	$27.77	0.974657	$39.98	1.2995424	$71.08	1	1AWG	$292.50	0.0222	0.675324	$23.09	0.810389	$33.24	1.080518	$59.10	1	1/0AWG	$354.90
74	41.5	49.8	66.4	83	0.0222	0.681762	$24.80	0.8181144	$35.71	$1.09	$63.49	1	1/0AWG	$336.70	0.0187	0.574277	$20.89	0.689132	$30.08	0.918843	$53.48	1	2/0AWG	$410.70	0.0158	0.485218	$17.65	0.582262	$25.42	0.7763488	$45.18	1	3/0AWG	$499.50	0.0136	0.417656	$15.19	0.501187	$21.88	0.66825	$38.89	1	4/0AWG	$606.80
146	21.5	25.8	34.4	43	0.0404	1.268156	$23.90	1.5217872	$34.41	$2.03	$61.18	1	3AWG	$379.60	0.0323	1.013897	$19.11	1.216676	$27.51	1.622235	$48.91	1	2AWG	$452.60	0.0267	0.838113	$15.79	1.005736	$22.74	1.3409808	$40.43	1	1AWG	$547.50	0.0222	0.696858	$13.13	0.83623	$18.91	1.114973	$33.62	1	1/0AWG	$664.30
204	8	9.6	12.8	16	0.0404	0.659328	$4.62	0.7911936	$6.66	$1.05	$11.84	1	3AWG	$530.40	0.0323	0.527136	$3.70	0.632563	$5.32	0.843418	$9.46	1	2AWG	$632.40	0.0267	0.435744	$3.06	0.522893	$4.40	0.6971904	$7.82	1	1AWG	$765.00	0.0222	0.362304	$2.54	0.434765	$3.66	0.579686	$6.50	1	1/0AWG	$928.20
15	11.5	13.8	18.4	23	0.0404	0.06969	$0.70	0.083628	$1.01	$0.11	$1.80	1	3AWG	$39.00	0.0323	0.055718	$0.56	0.066861	$0.81	0.089148	$1.44	1	2AWG	$46.50	0.0267	0.046058	$0.46	0.055269	$0.67	0.073692	$1.19	1	1AWG	$56.25	0.0222	0.038295	$0.39	0.045954	$0.56	0.061272	$0.99	1	1/0AWG	$68.25
155	12	14.4	19.2	24	0.0404	0.75144	$7.90	0.901728	$11.38	$1.20	$20.23	1	3AWG	$403.00	0.0323	0.60078	$6.32	0.720936	$9.10	0.961248	$16.18	1	2AWG	$480.50	0.0267	0.49662	$5.22	0.595944	$7.52	0.794592	$13.37	1	1AWG	$581.25	0.0222	0.41292	$4.34	0.495504	$6.25	0.660672	$11.12	1	1/0AWG	$705.25
15	94.5	113.4	151.2	189	0.0124	0.17577	$14.56	0.210924	$20.97	$0.28	$37.27	2	250KCMIL	$285.00	0.0111	0.157343	$13.03	0.188811	$18.77	0.251748	$33.36	2	300KCMIL	$330.00	0.0102	0.144585	$11.98	0.173502	$17.25	0.231336	$30.66	2	350KCMIL	$375.00	0.0097	0.1374975	$11.39	0.164997	$16.40	0.219996	$29.16	2	400KCMIL	$420.00
164	20	24	32	40	0.0404	1.32512	$23.23	1.590144	$33.45	$2.12	$59.47	1	3AWG	$426.40	0.0323	1.05944	$18.57	1.271328	$26.74	1.695104	$47.55	1	2AWG	$508.40	0.0267	0.87576	$15.35	1.050912	$22.11	1.401216	$39.30	1	1AWG	$615.00	0.0222	0.72816	$12.76	0.873792	$18.38	1.165056	$32.68	1	1/0AWG	$746.20
13	151	181.2	241.6	302	0.0124	0.243412	$32.22	0.2920944	$46.39	$0.39	$82.47	2	250KCMIL	$247.00	0.0111	0.217893	$28.84	0.261472	$41.53	0.348629	$73.83	2	300KCMIL	$286.00	0.0102	0.200226	$26.50	0.240271	$38.16	0.3203616	$67.84	2	350KCMIL	$325.00	0.0097	0.190411	$25.20	0.228493	$36.29	0.304658	$64.52	2	400KCMIL	$364.00
215	46	55.2	73.6	92	0.0222	2.19558	$88.53	2.634696	$127.48	$3.51	$226.63	1	1/0AWG	$978.25	0.0187	1.84943	$74.57	2.219316	$107.38	2.959088	$190.90	1	2/0AWG	$1,193.25	0.0158	1.56262	$63.00	1.875144	$90.73	2.500192	$161.29	1	3/0AWG	$1,451.25	0.0136	1.34504	$54.23	1.614048	$78.09	2.152064	$138.83	1	4/0AWG	$1,763.00
217	51	61.2	81.6	102	0.0222	2.456874	$109.83	2.9482488	$158.15	$3.93	$281.16	1	1/0AWG	$987.35	0.0187	2.069529	$92.51	2.483435	$133.22	3.311246	$236.83	1	2/0AWG	$1,204.35	0.0158	1.748586	$78.17	2.098303	$112.56	2.7977376	$200.11	1	3/0AWG	$1,464.75	0.0136	1.505112	$67.28	1.806134	$96.89	2.408179	$172.24	1	4/0AWG	$1,779.40
244	46	55.2	73.6	92	0.0222	2.491728	$100.47	2.9900736	$144.67	$3.99	$257.19	1	1/0AWG	$1,110.20	0.0187	2.098888	$84.63	2.518666	$121.86	3.358221	$216.65	1	2/0AWG	$1,354.20	0.0158	1.773392	$71.50	2.12807	$102.96	2.8374272	$183.05	1	3/0AWG	$1,647.00	0.0136	1.526464	$61.55	1.831757	$88.63	2.442342	$157.56	1	4/0AWG	$2,000.80
244	55.5	66.6	88.8	111	0.0222	3.006324	$146.25	3.6075888	$210.60	$4.81	$374.40	1	1/0AWG	$1,110.20	0.0187	2.532354	$123.19	3.038825	$177.40	4.051766	$315.37	1	2/0AWG	$1,354.20	0.0158	2.139636	$104.09	2.567563	$149.88	3.4234176	$266.46	1	3/0AWG	$1,647.00	0.0136	1.841712	$89.59	2.210054	$129.01	2.946739	$229.36	1	4/0AWG	$2,000.80
80	11.5	13.8	18.4	23	0.0222	0.20424	$2.06	0.245088	$2.96	$0.33	$5.27	1	1/0AWG	$364.00	0.0187	0.17204	$1.73	0.206448	$2.50	0.275264	$4.44	1	2/0AWG	$444.00	0.0158	0.14536	$1.47	0.174432	$2.11	0.232576	$3.75	1	3/0AWG	$540.00	0.0136	0.12512	$1.26	0.150144	$1.82	0.200192	$3.23	1	4/0AWG	$656.00
79	39	46.8	62.4	78	0.0404	1.244724	$42.55	1.4936688	$61.27	$1.99	$108.93	1	3AWG	$205.40	0.0323	0.995163	$34.02	1.194196	$48.99	1.592261	$87.09	1	2AWG	$244.90	0.0267	0.822627	$28.12	0.987152	$40.49	1.3162032	$71.99	1	1AWG	$296.25	0.0222	0.683982	$23.38	0.820778	$33.67	1.094371	$59.86	1	1/0AWG	$359.45
75	41.5	49.8	66.4	83	0.0222	0.690975	$25.13	0.82917	$36.19	$1.11	$64.34	1	1/0AWG	$341.25	0.0187	0.582038	$21.17	0.698445	$30.49	0.93126	$54.20	1	2/0AWG	$416.25	0.0158	0.491775	$17.89	0.59013	$25.76	0.78684	$45.79	1	3/0AWG	$506.25	0.0136	0.4233	$15.40	0.50796	$22.17	0.67728	$39.42	1	4/0AWG	$615.00
158	21.5	25.8	34.4	43	0.0404	1.372388	$25.86	1.6468656	$37.24	$2.20	$66.21	1	3AWG	$410.80	0.0323	1.097231	$20.68	1.316677	$29.78	1.75557	$52.93	1	2AWG	$489.80	0.0267	0.906999	$17.09	1.088399	$24.61	1.4511984	$43.76	1	1AWG	$592.50	0.0222	0.754134	$14.21	0.904961	$20.47	1.206614	$36.38	1	1/0AWG	$718.90
216	8	9.6	12.8	16	0.0404	0.698112	$4.90	0.8377344	$7.05	$1.12	$12.53	1	3AWG	$561.60	0.0323	0.558144	$3.91	0.669773	$5.64	0.89303	$10.02	1	2AWG	$669.60	0.0267	0.461376	$3.24	0.553651	$4.66	0.7382016	$8.28	1	1AWG	$810.00	0.0222	0.383616	$2.69	0.460339	$3.87	0.613786	$6.89	1	1/0AWG	$982.80
15	11.5	13.8	18.4	23	0.0404	0.06969	$0.70	0.083628	$1.01	$0.11	$1.80	1	3AWG	$39.00	0.0323	0.055718	$0.56	0.066861	$0.81	0.089148	$1.44	1	2AWG	$46.50	0.0267	0.046058	$0.46	0.055269	$0.67	0.073692	$1.19	1	1AWG	$56.25	0.0222	0.038295	$0.39	0.045954	$0.56	0.061272	$0.99	1	1/0AWG	$68.25
207	12	14.4	19.2	24	0.0404	1.003536	$10.56	1.2042432	$15.20	$1.61	$27.02	1	3AWG	$538.20	0.0323	0.802332	$8.44	0.962798	$12.15	1.283731	$21.60	1	2AWG	$641.70	0.0267	0.663228	$6.98	0.795874	$10.05	1.0611648	$17.86	1	1AWG	$776.25	0.0222	0.551448	$5.80	0.661738	$8.35	0.882317	$14.85	1	1/0AWG	$941.85
15	94.5	113.4	151.2	189	0.0124	0.17577	$14.56	0.210924	$20.97	$0.28	$37.27	2	250KCMIL	$285.00	0.0111	0.157343	$13.03	0.188811	$18.77	0.251748	$33.36	2	300KCMIL	$330.00	0.0102	0.144585	$11.98	0.173502	$17.25	0.231336	$30.66	2	350KCMIL	$375.00	0.0097	0.1374975	$11.39	0.164997	$16.40	0.219996	$29.16	2	400KCMIL	$420.00
176	20	24	32	40	0.0404	1.42208	$24.93	1.706496	$35.90	$2.28	$63.82	1	3AWG	$457.60	0.0323	1.13696	$19.93	1.364352	$28.70	1.819136	$51.02	1	2AWG	$545.60	0.0267	0.93984	$16.48	1.127808	$23.73	1.503744	$42.18	1	1AWG	$660.00	0.0222	0.78144	$13.70	0.937728	$19.73	1.250304	$35.07	1	1/0AWG	$800.80
13	154.5	185.4	247.2	309	0.0124	0.249054	$33.73	0.2988648	$48.57	$0.40	$86.34	2	250KCMIL	$247.00	0.0111	0.222944	$30.19	0.267532	$43.48	0.35671	$77.29	2	300KCMIL	$286.00	0.0102	0.204867	$27.74	0.24584	$39.95	0.3277872	$71.02	2	350KCMIL	$325.00	0.0097	0.1948245	$26.38	0.233789	$37.99	0.311719	$67.54	2	400KCMIL	$364.00
227	6.5	7.8	10.4	13	0.0404	0.596102	$3.40	0.7153224	$4.89	$0.95	$8.69	1	3AWG	$590.20	0.0323	0.476587	$2.72	0.571904	$3.91	0.762538	$6.95	1	2AWG	$703.70	0.0267	0.393959	$2.24	0.47275	$3.23	0.6303336	$5.75	1	1AWG	$851.25	0.0222	0.327561	$1.87	0.393073	$2.69	0.524098	$4.78	1	1/0AWG	$1,032.85
9	9	10.8	14.4	18	0.0404	0.032724	$0.26	0.0392688	$0.37	$0.05	$0.66	1	3AWG	$23.40	0.0323	0.026163	$0.21	0.031396	$0.30	0.041861	$0.53	1	2AWG	$27.90	0.0267	0.021627	$0.17	0.025952	$0.25	0.0346032	$0.44	1	1AWG	$33.75	0.0222	0.017982	$0.14	0.021578	$0.20	0.028771	$0.36	1	1/0AWG	$40.95
228	92.5	111	148	185	0.0158	3.33222	$270.17	3.998664	$389.05	$5.33	$691.64	1	3/0AWG	$1,539.00	0.0136	2.86824	$232.55	3.441888	$334.87	4.589184	$595.33	1	4/0AWG	$1,869.60	0.0124	2.61516	$212.03	3.138192	$305.33	4.184256	$542.80	1	250KCMIL	$2,166.00	0.0111	2.34099	$189.80	2.809188	$273.32	3.745584	$485.90	1	300KCMIL	$2,508.00
18	51	61.2	81.6	102	0.0222	0.203796	$9.11	0.2445552	$13.12	$0.33	$23.32	1	1/0AWG	$81.90	0.0187	0.171666	$7.67	0.205999	$11.05	0.274666	$19.65	1	2/0AWG	$99.90	0.0158	0.145044	$6.48	0.174053	$9.34	0.2320704	$16.60	1	3/0AWG	$121.50	0.0136	0.124848	$5.58	0.149818	$8.04	0.199757	$14.29	1	4/0AWG	$147.60
10	29	34.8	46.4	58	0.0124	0.03596	$0.91	0.043152	$1.32	$0.06	$2.34	1	250KCMIL	$95.00	0.0111	0.03219	$0.82	0.038628	$1.18	0.051504	$2.09	1	300KCMIL	$110.00	0.0102	0.02958	$0.75	0.035496	$1.08	0.047328	$1.92	1	350KCMIL	$125.00	0.0097	0.02813	$0.72	0.033756	$1.03	0.045008	$1.83	1	400KCMIL	$140.00
39	12	14.4	19.2	24	0.0158	0.073944	$0.78	0.0887328	$1.12	$0.12	$1.99	1	3/0AWG	$263.25	0.0136	0.063648	$0.67	0.076378	$0.96	0.101837	$1.71	1	4/0AWG	$319.80	0.0124	0.058032	$0.61	0.069638	$0.88	0.0928512	$1.56	1	250KCMIL	$370.50	0.0111	0.051948	$0.55	0.062338	$0.79	0.083117	$1.40	1	300KCMIL	$429.00
12	13.5	16.2	21.6	27	0.0124	0.020088	$0.24	0.0241056	$0.34	$0.03	$0.61	1	250KCMIL	$114.00	0.0111	0.017982	$0.21	0.021578	$0.31	0.028771	$0.54	1	300KCMIL	$132.00	0.0102	0.016524	$0.20	0.019829	$0.28	0.0264384	$0.50	1	350KCMIL	$150.00	0.0097	0.015714	$0.19	0.018857	$0.27	0.025142	$0.48	1	400KCMIL	$168.00
275	46.5	55.8	74.4	93	0.0136	1.7391	$70.88	2.08692	$102.07	$2.78	$181.46	1	4/0AWG	$2,255.00	0.0124	1.58565	$64.63	1.90278	$93.06	2.53704	$165.45	1	250KCMIL	$2,612.50	0.0111	1.419413	$57.85	1.703295	$83.31	2.27106	$148.10	1	300KCMIL	$3,025.00	0.0102	1.304325	$53.16	1.56519	$76.55	2.08692	$136.09	1	350KCMIL	$3,437.50
304	52	62.4	83.2	104	0.0136	2.149888	$97.99	2.5798656	$141.11	$3.44	$250.85	1	4/0AWG	$2,492.80	0.0124	1.960192	$89.34	2.35223	$128.66	3.136307	$228.72	1	250KCMIL	$2,888.00	0.0111	1.754688	$79.98	2.105626	$115.17	2.8075008	$204.74	1	300KCMIL	$3,344.00	0.0102	1.612416	$73.49	1.934899	$105.83	2.579866	$188.14	1	350KCMIL	$3,800.00
334	48	57.6	76.8	96	0.0136	2.180352	$91.73	2.6164224	$132.10	$3.49	$234.84	1	4/0AWG	$2,738.80	0.0124	1.987968	$83.64	2.385562	$120.44	3.180749	$214.12	1	250KCMIL	$3,173.00	0.0111	1.779552	$74.87	2.135462	$107.81	2.8472832	$191.67	1	300KCMIL	$3,674.00	0.0102	1.635264	$68.80	1.962317	$99.07	2.616422	$176.13	1	350KCMIL	$4,175.00
361	50.5	60.6	80.8	101	0.0136	2.479348	$109.75	2.9752176	$158.04	$3.97	$280.95	1	4/0AWG	$2,960.20	0.0124	2.260582	$100.06	2.712698	$144.09	3.616931	$256.16	1	250KCMIL	$3,429.50	0.0111	2.023586	$89.57	2.428303	$128.98	3.2377368	$229.31	1	300KCMIL	$3,971.00	0.0102	1.859511	$82.31	2.231413	$118.53	2.975218	$210.71	1	350KCMIL	$4,512.50

Conclusion

The initial cost of the conductor increases exponentially as the size is increased however; the payback period of this initial cost is not too long. After about 5 years the hospital would be making additional cost savings with larger feeder sizes. The reason that energy is saved by just increasing the size of a conductor is because there is less resistance in larger conductors. The

Figure 109 | Energy Cost Savings vs. Initial Cost Summary Graph

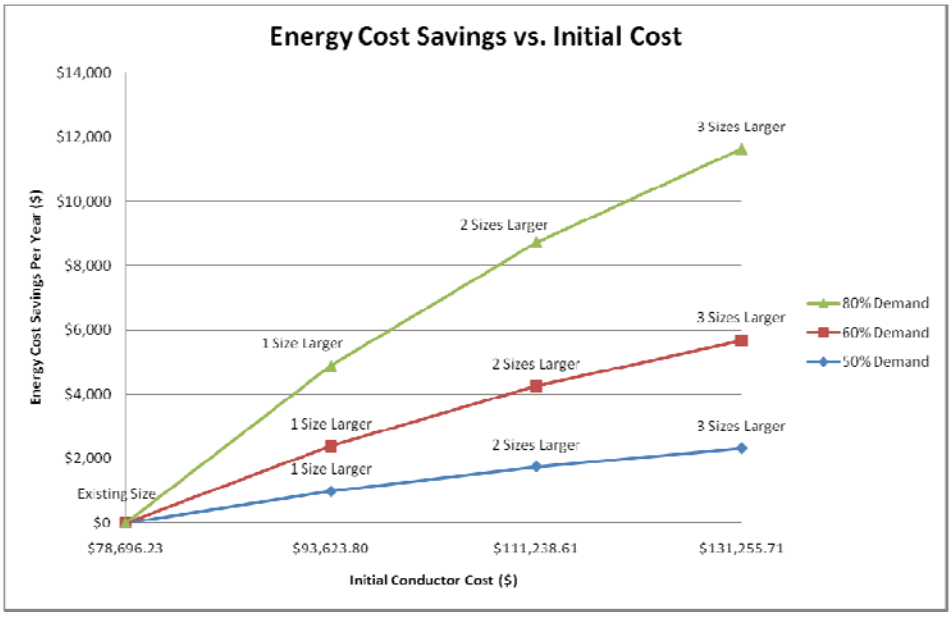


Figure 110 | Energy Cost Savings vs. Initial Cost Summary at Different Demand Loads

SUMMARY OF ENERGY SAVINGS PER YEAR - 60% DEMAND LOAD ($)					
	INITIAL CONDUCTOR COST ($)	INITIAL COST DIFFERENCE ($)	ENERGY LOSS PER YEAR ($)	ENERGY COST SAVINGS PER YEAR ($)	SIMPLE PAYBACK PERIOD (YRS)
EXISTING SIZE	$78,696.23	-	$9,688.22	-	-
1 SIZE LARGER	$93,623.80	$14,927.57	$8,282.68	$1,405.55	10.6
2 SIZES LARGER	$111,238.61	$32,542.38	$7,172.92	$2,515.30	12.9
3 SIZES LARGER	$131,255.71	$52,559.48	$6,337.81	$3,350.41	15.7

SUMMARY OF ENERGY SAVINGS PER YEAR - 50% DEMAND LOAD ($)					
	INITIAL CONDUCTOR COST ($)	INITIAL COST DIFFERENCE ($)	ENERGY LOSS PER YEAR ($)	ENERGY COST SAVINGS PER YEAR ($)	SIMPLE PAYBACK PERIOD (YRS)
EXISTING SIZE	$78,696.23	-	$6,727.93	-	-
1 SIZE LARGER	$93,623.80	$14,927.57	$5,751.86	$976.08	15.3
2 SIZES LARGER	$111,238.61	$32,542.38	$4,981.20	$1,746.74	18.6
3 SIZES LARGER	$131,255.71	$52,559.48	$4,401.26	$2,326.67	22.6

SUMMARY OF ENERGY SAVINGS PER YEAR - 80% DEMAND LOAD ($)					
	INITIAL CONDUCTOR COST ($)	INITIAL COST DIFFERENCE ($)	ENERGY LOSS PER YEAR ($)	ENERGY COST SAVINGS PER YEAR ($)	SIMPLE PAYBACK PERIOD (YRS)
EXISTING SIZE	$78,696.23	-	$17,223.51	-	-
1 SIZE LARGER	$93,623.80	$14,927.57	$14,724.76	$2,498.75	6.0
2 SIZES LARGER	$111,238.61	$32,542.38	$12,751.87	$4,471.64	7.3
3 SIZES LARGER	$131,255.71	$52,559.48	$11,267.22	$5,956.29	8.8

Protective Device Coordination Study

A protective device coordination study that addresses a single-path through Franklin Square Hospital Center's distribution system was performed to ensure the system is able to clear the fault current in the least amount of time possible. The path passes through transformer T-2S3 located in Unit Substation 3 to the Switchboard within the Substation. From there the path enters the Distribution Panel FDP-1 to the Panel Board LP11. The path can be seen in figures 110 and 111 below.

The overlay of three time current curves provided by Eaton, in figure 112 shows that this single-path through the distribution system is not coordinated. The 100A and 800A breakers are coordinated but the 2500A breaker overlaps with the time current curve of the 800A. The overlap may lead the 2500A breaker to trip first which would short out the feeders and equipment.

The distribution system specifies a 3000A circuit breaker instead of a 2500A breaker. Unfortunately a time current curve could not be obtained for a 3000A circuit breaker to check the coordination between the 800A and 100A breakers. If no overlap between the breakers, the system will perform correctly with the smaller circuit breaker tripping before the larger breaker trips.

See Appendix B for Time Current Curve Cut Sheets

Figure 111 | Location of Protective Device Coordination Path

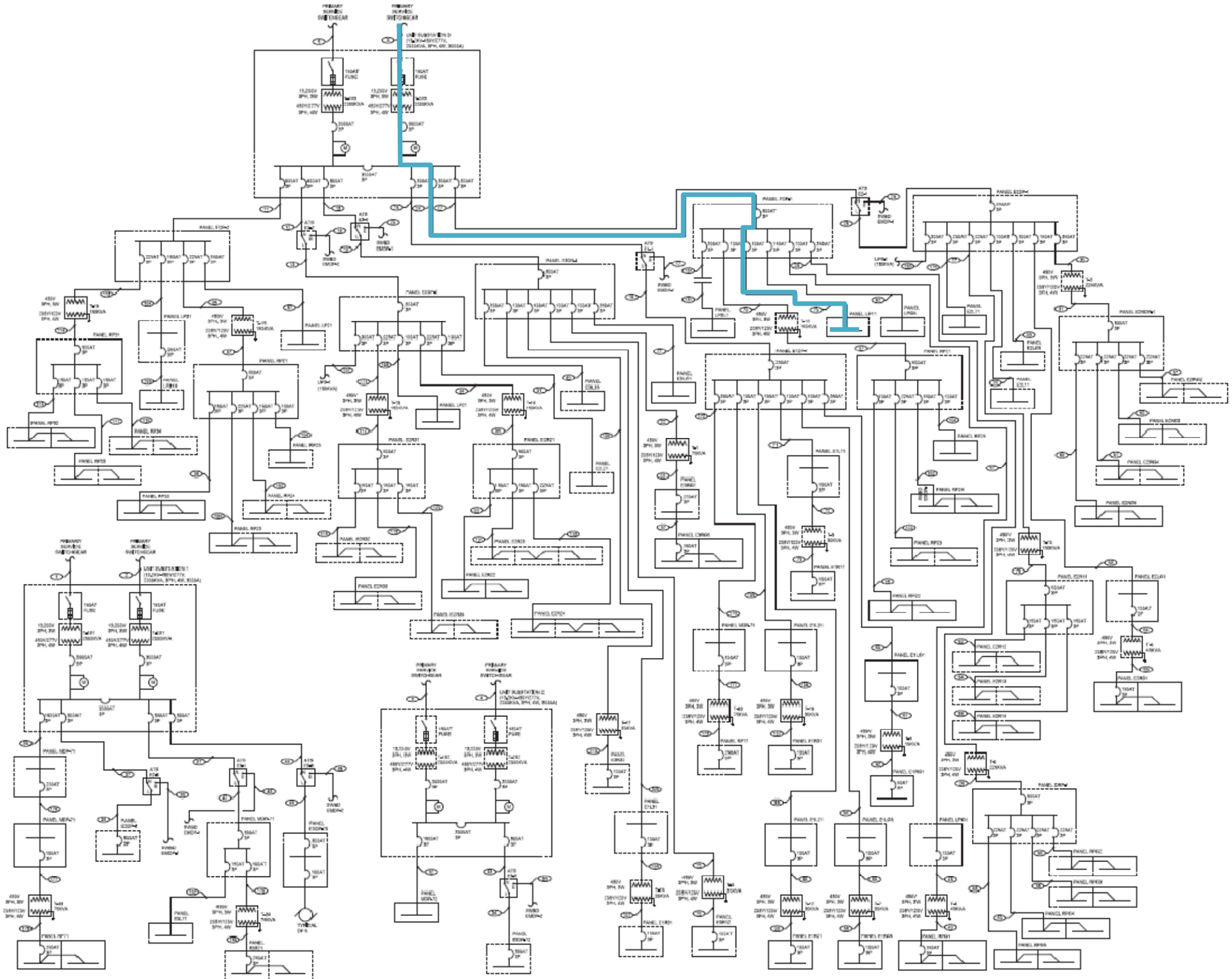


Figure 112 | Simplified Protective Device Coordination Path

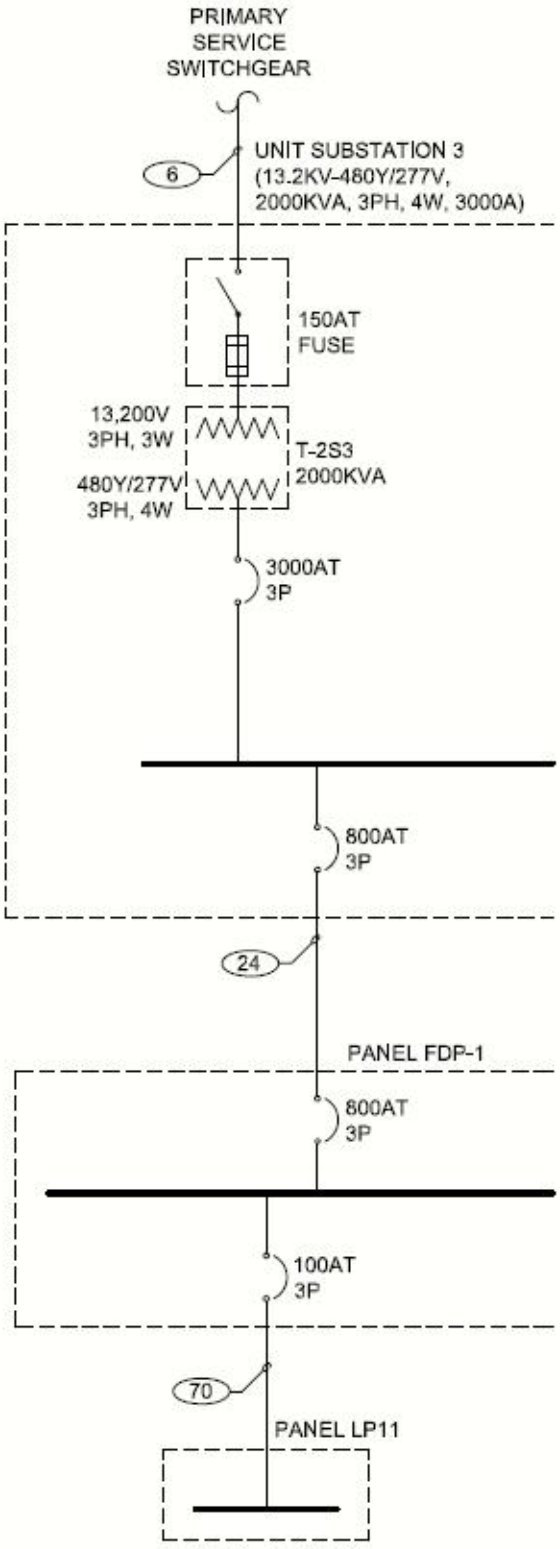
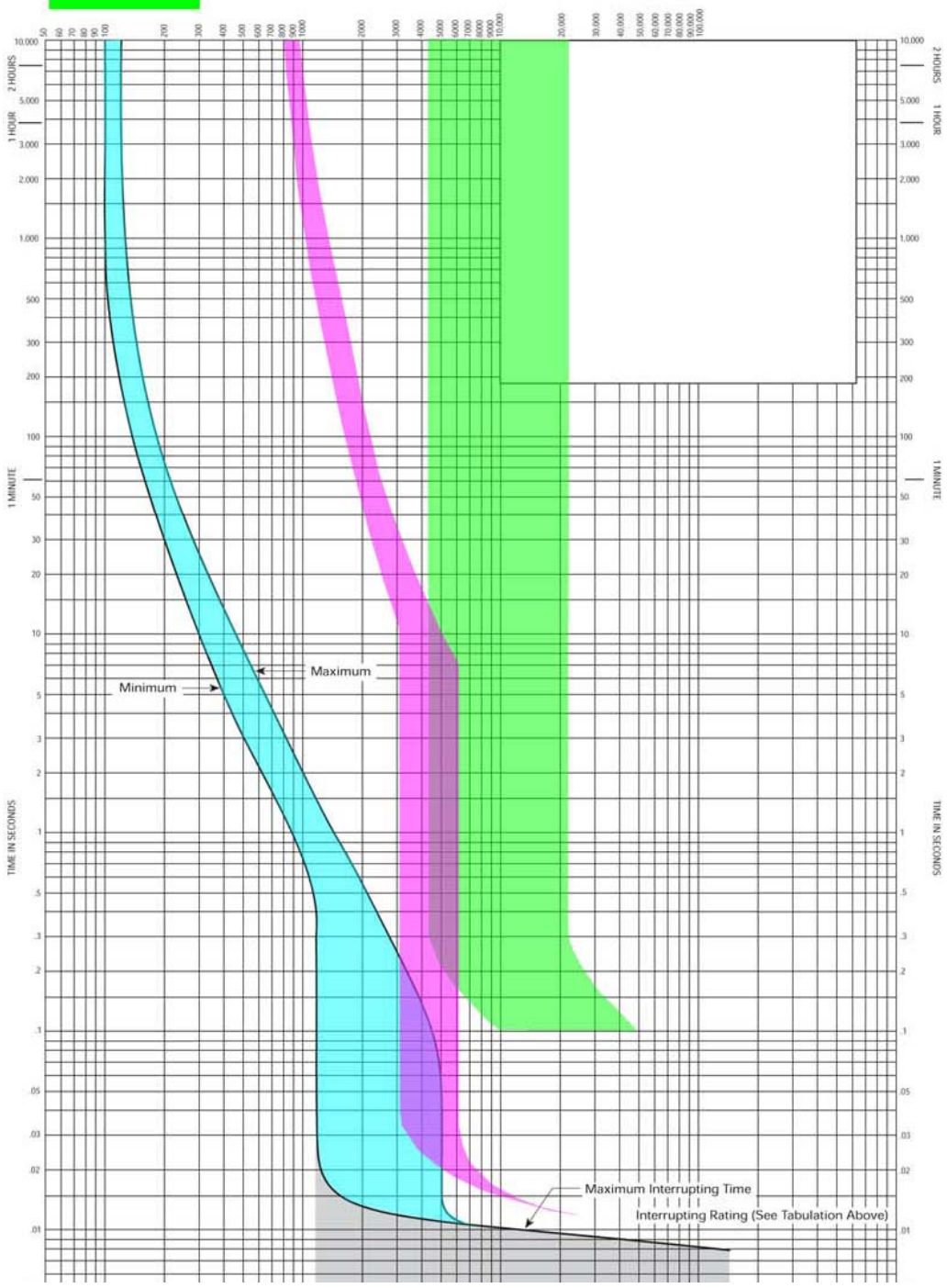


Figure 113 | Trip Curves

Series AB DE-ION GHC – 100A

Series C, M-Frame Type MDLB – 800A

Series C, R-Frame Type CRD – 2500A



Short Circuit Analysis

A short circuit analysis determines the maximum interrupting capacities of a distribution system. The following short circuit analysis provides a calculation at each component along the one-path via the per unit method. Since the building is still under construction the utility short circuit is unknown and assumed to be 100,000kVA.

Figure 114 | Short Circuit Analysis

SHORT CIRCUIT ANALYSIS (PER UNIT METHOD)								
		System Voltage		480				
		Base KVA		2000	∑ X	∑ R	∑ Z	I_{sc}(A)
		Utility Company Available Fault (kVA)		100000				
Utility Primary								
		$X_{(p.u.)} = (KVA_{base}) / (Utility\ S.C.\ KVA)$	=	0.02	0.02	0	0.02	**120281.3**
Transformer Secondary								
%Z =	5.75	$X_{(p.u.)} = (\%X * KVA_{base}) / (100 * KVA_{xfrmr})$	=	0.0548	0.0748	0.00457	0.074939	**32100.92**
X/R =	12	$R_{(p.u.)} = (\%R * KVA_{base}) / (100 * KVA_{xfrmr})$	=	0.00457				
%X =	5.48							
%R =	0.457							
KVA =	2000							
Switchboard								
Wire =	500	$X_{(p.u.)} = (L * X_L * KVA_{base})/ (1000^2 * Sets * KV^2)$	=	0.001011	0.075811	0.005208	0.07599	**31657.16**
Length =	20	$R_{(p.u.)} = (L * R * KVA_{base})/ (1000^2 * Sets * KV^2)$	=	0.000638				
Sets =	8							
X =	0.0466							
R =	0.0294							
Distribution Panel FDP-1								
Wire =	300	$X_{(p.u.)} = (L * X_L * KVA_{base})/ (1000^2 * Sets * KV^2)$	=	0.005991	0.081803	0.010725	0.082503	**29158.14**
Length =	42	$R_{(p.u.)} = (L * R * KVA_{base})/ (1000^2 * Sets * KV^2)$	=	0.005517				
Sets =	3							
X =	0.0493							
R =	0.0454							
Panel Board LP11								
Wire =	3	$X_{(p.u.)} = (L * X_L * KVA_{base})/ (1000^2 * Sets * KV^2)$	=	0.065498	0.147301	0.287357	0.322911	**7449.802**
Length =	124	$R_{(p.u.)} = (L * R * KVA_{base})/ (1000^2 * Sets * KV^2)$	=	0.276632				
Sets =	1							
X =	0.06085							
R =	0.257							

Unlike the coordination study above provided by Eaton time current curves, a 100A, 800A, and 3000A breaker were analyzed. In the short circuit analysis summary the available fault for each unit shows that the smaller breakers will trip before the larger circuit breakers.

Figure 115 | Short Circuit Analysis Summary

SHORT CIRCUIT ANALYSIS SUMMARY		
Unit Location	Available Fault (A)	Standard Breaker Rating (A)
Substation 3 transformer - T-2S3	32,101	65,000
Substation 3 Switchboard	31,657	50,000
Distribution Panel FDP-1	29,159	50,000
Panelboard LP11	7,450	14,000

Acoustical Breadth

Overview

The emergency room waiting area in Franklin Square Hospital Center has numerous functions. It is located next to the emergency room entrance canopy so the main entrance is a lobby and reception area. After the patron visits the receptionist they are directed to the waiting area or the pediatric waiting area. The specialized waiting area for pediatric patients is located to the left and to the right are two emergency waiting rooms. The space is an open plan with decorative wood and glass partition dividing the two emergency rooms. Other then the entrance vestibule which divides the pediatric and emergency waiting areas, the designated areas within the overall space flow into each other.

Open plans such as this, often cause acoustical problems. Noise will travel from one area to another since there are no boundaries. With a pediatric emergency wing, the hospital will care for many younger patients. Children seem to have a tolerance for louder behaviors and in this space their voices will travel over to the reception area and into the other emergency waiting areas. This is an undesirable solution therefore the acoustical reverberation time of the existing pediatric emergency waiting area will be calculated. Proposed scenarios will be calculated to improve the existing acoustical design.

Space Overview:

Area: 513.3 ft^2

Length: Approximately 32.5 ft

Width: Approximately 16.6 ft

Figure 116 | Emergency Lobby and Waiting Area

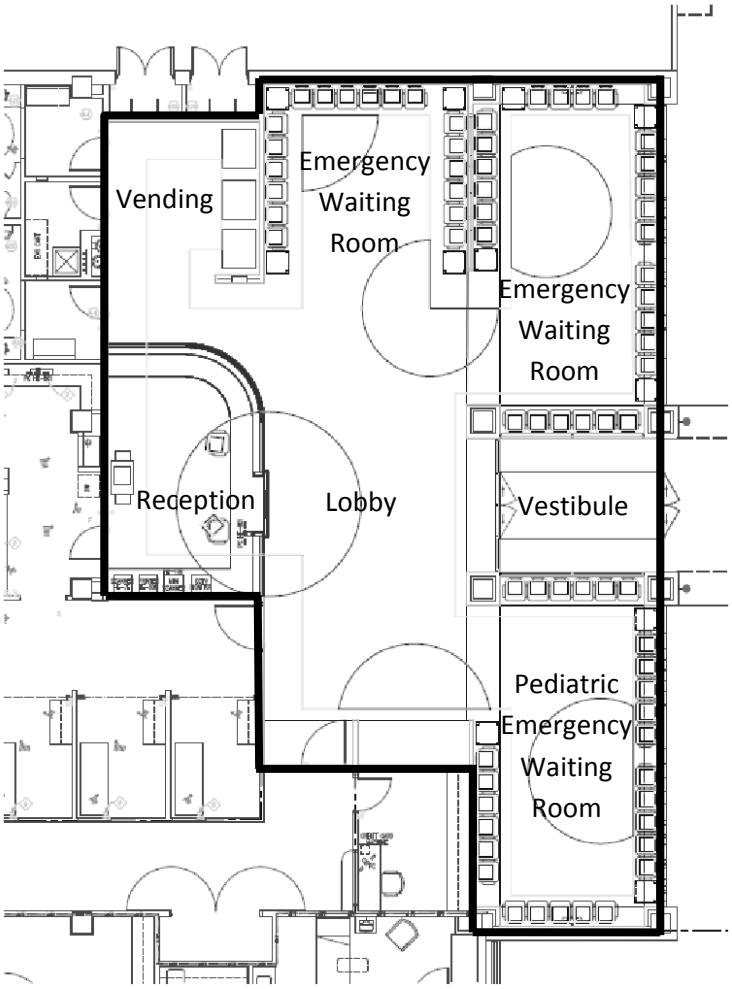
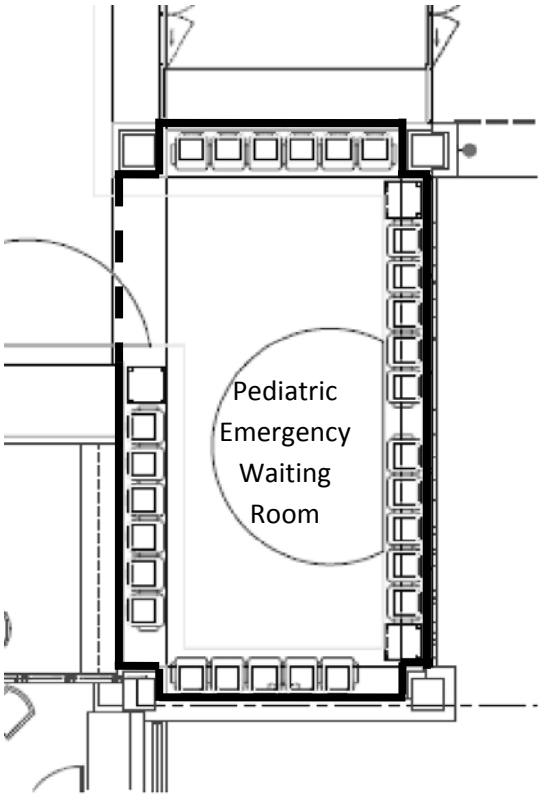


Figure 117 | Pediatric Emergency Waiting Area



Design Criteria

The acoustical analysis of the pediatric emergency waiting room will focus on the reverberation of six frequencies. The space is considered to be in the category of a lobby and large meeting room which has a preferred reverberation time of 0.65 to 0.75. The reverberation time is calculated using the Sabine formula:

Existing Condition

After calculating the average reverberation time of the existing conditions, the T_{60} time was below the desired criteria. The space is not "dead" but the absorption coefficients of some materials are high, such as the acoustical tile located on the ceiling. The open space is 100% absorptive meaning all of the sound is lost through the opening. Sound waves cannot be reflected since there is no surface present. Materials within the space will be adjusted to meet the desired reverberation time. The linoleum tile on concrete floor is a hard surface that reflects the sound. More reflective materials will be used to redesign the acoustical environment.

Figure 118 | Existing Acoustical Conditions

Existing Pediatric Waiting Room Reverberation Time								
Surface	Material	Area (ft^2)	Absorbtion Coefficient					
			125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Floor	Linoleum on Concrete	513.3	0.02	0.03	0.03	0.03	0.03	0.02
Walls	5/8" GWB on 2x4 Studs	358.2	0.29	0.10	0.05	0.04	0.07	0.09
Storefront Walls	Glass 3/32"	340.9	0.55	0.25	0.18	0.12	0.07	0.04
Ceiling	Gypsum Board	214.7	0.29	0.10	0.10	0.10	0.07	0.02
Ceiling	Acoustic Tile 3/4"	351.0	0.72	0.84	0.70	0.79	0.76	0.81
Opening	N/A	90.0	0.75	0.75	0.75	0.75	0.75	0.75
Chairs	Fabric upholstered seats, unoccupied	81.0	0.19	0.37	0.56	0.67	0.61	0.59

	Sα					
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
	10.27	15.40	15.40	15.40	15.40	10.27
	103.88	35.82	17.91	14.33	25.07	32.24
	187.50	85.23	61.36	40.91	23.86	13.64
	62.26	21.47	21.47	21.47	15.03	4.29
	252.72	294.84	245.70	277.29	266.76	284.31
	67.50	67.50	67.50	67.50	67.50	67.50
Volume = 4663.3 ft^3	15.39	29.97	45.36	54.27	49.41	47.79
$a = \sum S\alpha$	699.51	550.22	474.70	491.17	463.04	460.03
$T_{60} = .05\ V/a = .05\ V/\sum S\alpha$	0.33	0.42	0.49	0.47	0.50	0.51

Average T_{60}	**0.46**
Target Reverberation Time	$0.65 \leq T \leq 0.75$

Proposed Scenarios

Proposed Scenario 1

Scenario one encloses the pediatric emergency waiting room area by extending the gypsum board on 2x4 stud walls and adding a wooden door. The flooring material is replaced with a more absorptive carpet material while the acoustical ceiling tile is replaced with a less absorptive material of gypsum board. These changes increase the reverberation time by .21 seconds, placing it within the desired range.

Figure 119 | Proposed Acoustical Conditions

Proposed Scenario 1 - Pediatric Waiting Room Reverberation Time								
Surface	Material	Area (ft^2)	Absorbtion Coefficient					
			125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Floor	Carpet, heavy, on concrete	513.3	0.02	0.06	0.14	0.37	0.60	0.65
Walls	5/8" GWB on 2x4 Studs	420.2	0.29	0.10	0.05	0.04	0.07	0.09
Storefront Walls	Glass 3/32"	340.9	0.55	0.25	0.18	0.12	0.07	0.04
Doors	Solid core wood panel, 1 3/4"	28.0	0.10	0.07	0.05	0.04	0.04	0.04
Ceiling	Gypsum Board	565.7	0.29	0.10	0.10	0.10	0.07	0.02
Chairs	Fabric upholstered seats, unoccupied	81.0	0.19	0.37	0.56	0.67	0.61	0.59

	Sα					
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
	10.27	30.80	71.86	189.92	307.98	333.65
	121.86	42.02	21.01	16.81	29.41	37.82
	187.50	85.23	61.36	40.91	23.86	13.64
	2.80	1.96	1.40	1.12	1.12	1.12
	164.05	56.57	56.57	56.57	39.60	11.31
Volume = 4663.3 ft^3	15.39	29.97	45.36	54.27	49.41	47.79
$a = \sum S\alpha$	501.86	246.54	257.56	359.60	451.39	445.32
$T_{60} = .05\ V/a = .05\ V/\sum S\alpha$	0.46	0.95	0.91	0.65	0.52	0.52

Average T_{60}	**0.67**
Target Reverberation Time	$0.65 \leq T \leq 0.75$

Proposed Scenario 2

The second scenario resembles the existing condition leaving the opening space intact. The flooring material was replaces with carpet and the ceiling material replaced with gypsum board. The reverberation time calculated from this analysis was determined to be 0.56 seconds which is below the preferred range.

Figure 120 | Proposed Acoustical Conditions

Proposed Scenario 2 - Pediatric Waiting Room Reverberation Time								
Surface	Material	Area (ft^2)	Absorbtion Coefficient					
			125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Floor	Carpet, heavy, on concrete	513.3	0.02	0.06	0.14	0.37	0.60	0.65
Walls	5/8" GWB on 2x4 Studs	358.2	0.29	0.10	0.05	0.04	0.07	0.09
Storefront Walls	Glass 3/32"	340.9	0.55	0.25	0.18	0.12	0.07	0.04
Ceiling	Gypsum Board	565.7	0.29	0.10	0.10	0.10	0.07	0.02
Opening	N/A	90.0	0.75	0.75	0.75	0.75	0.75	0.75
Chairs	Fabric upholstered seats, unoccupied	81.0	0.19	0.37	0.56	0.67	0.61	0.59

	Sα					
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
	10.27	30.80	71.86	189.92	307.98	333.65
	103.88	35.82	17.91	14.33	25.07	32.24
	187.50	85.23	61.36	40.91	23.86	13.64
	164.05	56.57	56.57	56.57	39.60	11.31
	67.50	67.50	67.50	67.50	67.50	67.50
Volume = 4663.3 ft^3	15.39	29.97	45.36	54.27	49.41	47.79

$a = \sum S\alpha$	548.58	305.88	320.56	423.50	513.43	506.12
$T_{60} = .05\ V/a = .05\ V/\sum S\alpha$	0.43	0.76	0.73	0.55	0.45	0.46

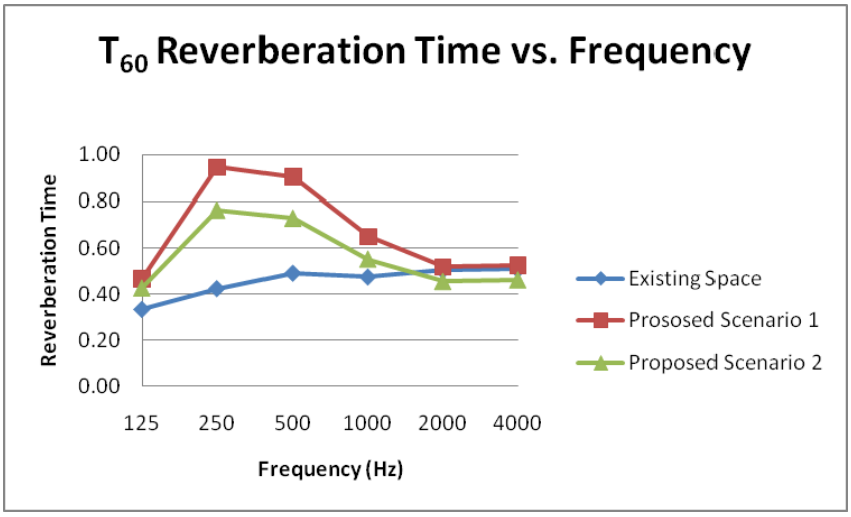
Average T_{60}	**0.56**
Target Reverberation Time	$0.65 \leq T \leq 0.75$

Conclusion

Human speech ranges across all frequencies from 80Hz to a peak at 1-3 kHz. The definition of pediatrics is the branch of medicine concerned with infants and children. This younger group of people tend to have a higher voice frequency until puberty is reached therefore the high frequency of 2-4 kHz is low in all designs.

The graph below shows the details of the reverberant conditions previously calculated. Scenario 1 has the highest reverberant times for all the frequencies listed, though it is still lower in the high frequencies. The low frequency bands of 250 and 500 Hz are not problematic in a waiting room setting.

Figure 121 | Reverberation Time vs. Frequency Graph



The existing design and scenario 2 do not meet the desired reverberation time criteria. Both designs incorporate the open area between the adjacent spaces. All the sound lost in this area is essential to reach the preferred range of reverberation time. When the space is enclosed in scenario 1, the sound is reflected back into the space allowing the desired criteria to be met.

The open space allows the adjacent noise to enter the pediatric emergency waiting room. This additional noise would possibly mask the conversations in the space leading to an elevated sound level as people speak louder to be heard. Also the noise created within the space will also travel throughout the rest of the adjacent spaces. This could lead to uncomfortable noise levels and annoyance with other patrons. Enclosing the space would diminish the noise of the children escaping as well as meet the preferred reverberation time.

Mechanical Breadth

Overview

The emergency waiting room areas, lobby and vestibule are located on the ground floor on the east side of the building which is approximately 45° north of east. The exterior wall is constructed of a glass store-front curtain wall. The heating and cooling loads are affected by this large amount of glass. The pediatric emergency waiting area's existing store-front glazing will be analyzed using Trane TRACE 700 software. The existing condition will then be compared to an alternative exterior glazing system. The glazing with a low coiling coil total capacity and a lower magnitude heating coil total capacity is desired to create a more efficient mechanical system. Average monthly energy consumption will also be considered.

Existing Conditions

The existing pediatric emergency waiting area has an exterior wall that is approximately 95% insulating glazing. The room is served by a variable volume reheat system. The cooling system is supplied and returned by ceiling diffusers. The heating is supplied from the floor and returned from ceiling diffusers.

Proposed Scenario

When assigning a different glazing type, the main variables addressed were the U-factor and the shading coefficient (Figure 121). The U-factor measures the conduction across the surface of the glazing. The conduction heating load is affect by implementing glazing with different U-factors. The shading coefficient variable indicated how much solar energy penetrates the interior space. This directly contributes to the cooling loads of the system due to solar radiation. Multiplying the shading coefficient by 0.87 computes the solar heat gain coefficient (SHGC).

By increasing the U-factor, shading coefficient and the SHGC in the proposed scenario the heating and cooling load magnitudes will vary.

Figure 122 | Existing and Proposed Conditions

	GLAZING TYPE	U-FACTOR (Btu/h-ft^2-°F)	SHADING COEFFICIENT	SOLAR HEAT GAIN COEFFICIENT
EXISTING CONDITION	6mm Dbl Low-E (e2=.04) Clr 13mm Argon	0.233	0.48	0.4176
PROPOSED SCENARIO	6mm Dbl Low-E (e3=.2) Clr 13mm Argon	0.295	0.79	0.6873

Results

The following graphs summarize the results calculated by Trane TRACE 700. The energy consumption and the cooling and heating loads are based on the existing mechanical system. Electric energy consumed is based on the cooling loads while the gas energy consumed is based on the heating loads of their respective scenarios

Figure 123 | Cooling and Heating Load Bar Graph

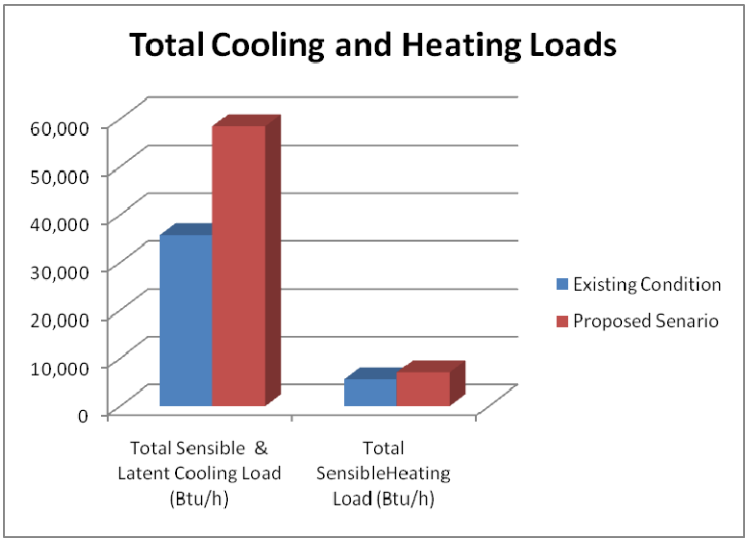


Figure 124 | Monthly Electric Energy Consumption Graph

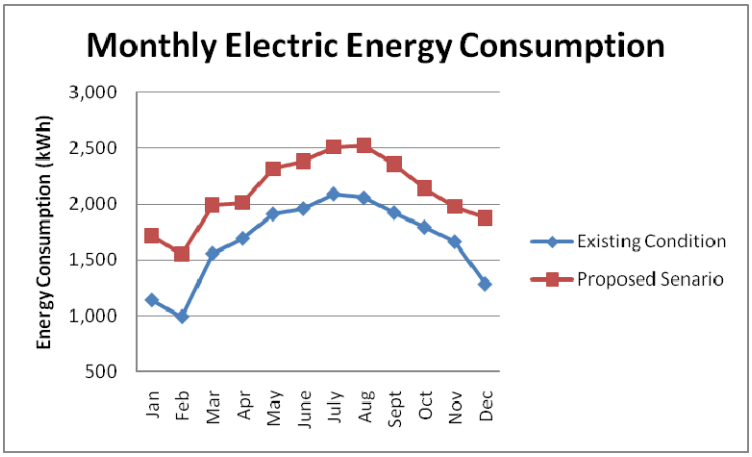


Figure 125 | Monthly Gas Energy Consumption Graph

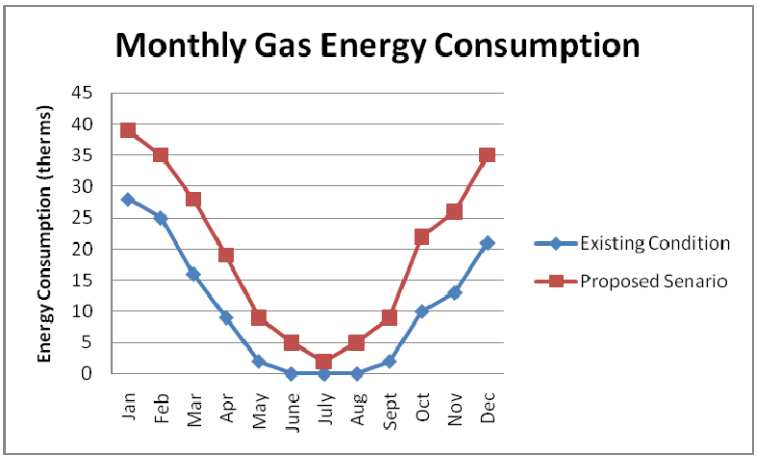


Figure 126 | Existing Condition Cooling Load Graph

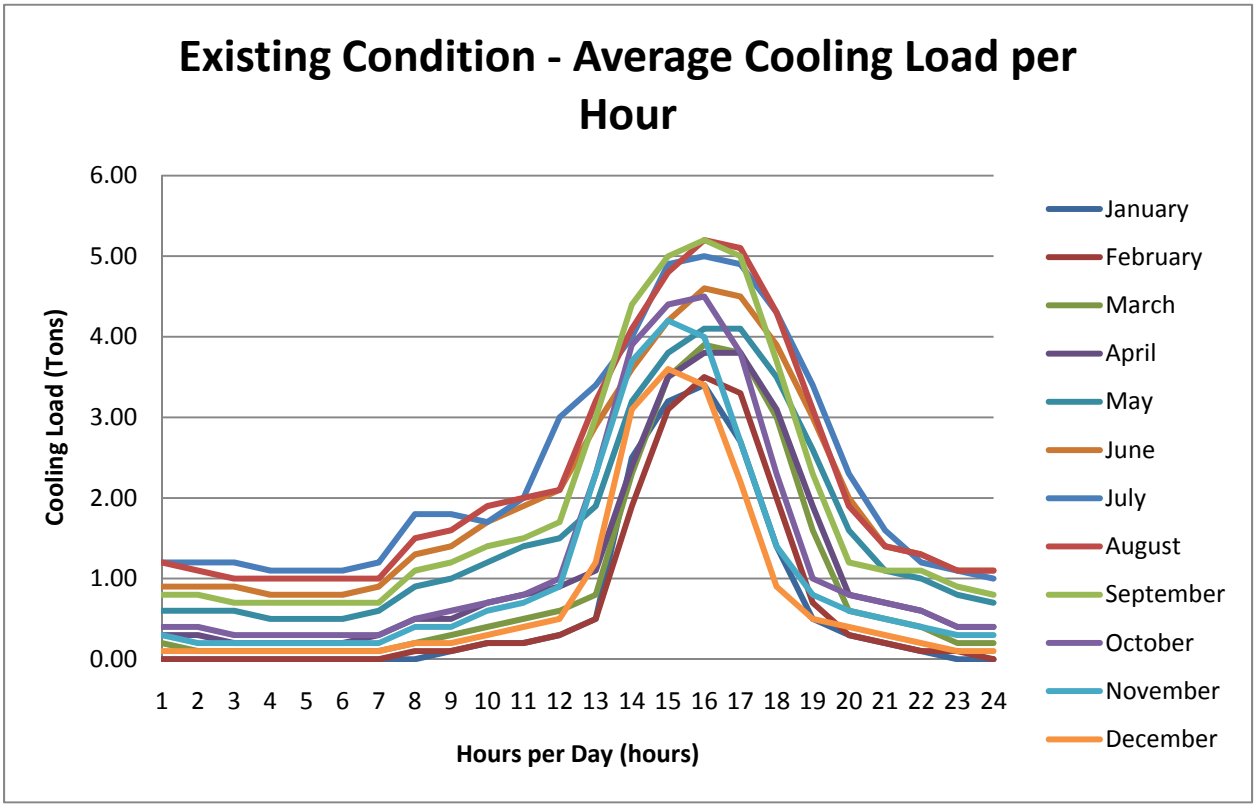


Figure 127 | Proposed Scenario Cooling Load Graph

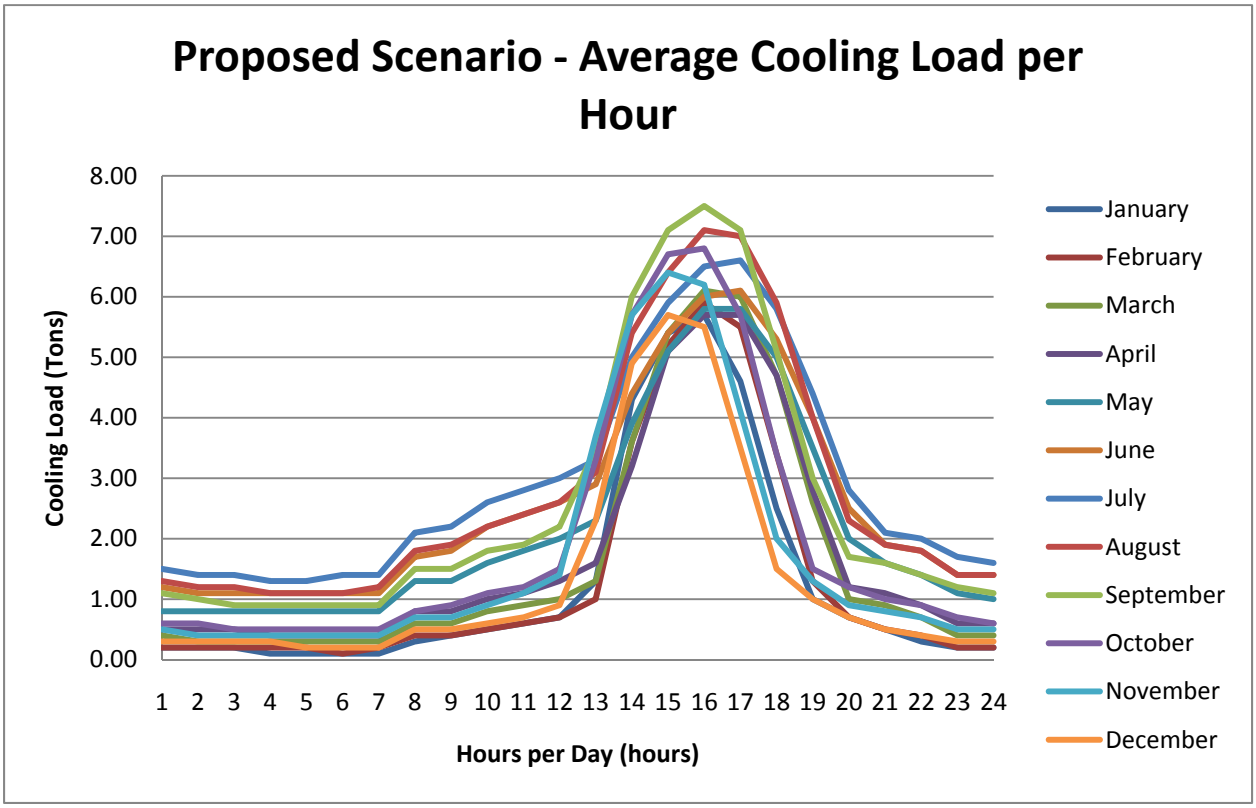


Figure 128 | Existing Condition Heating Load Graph

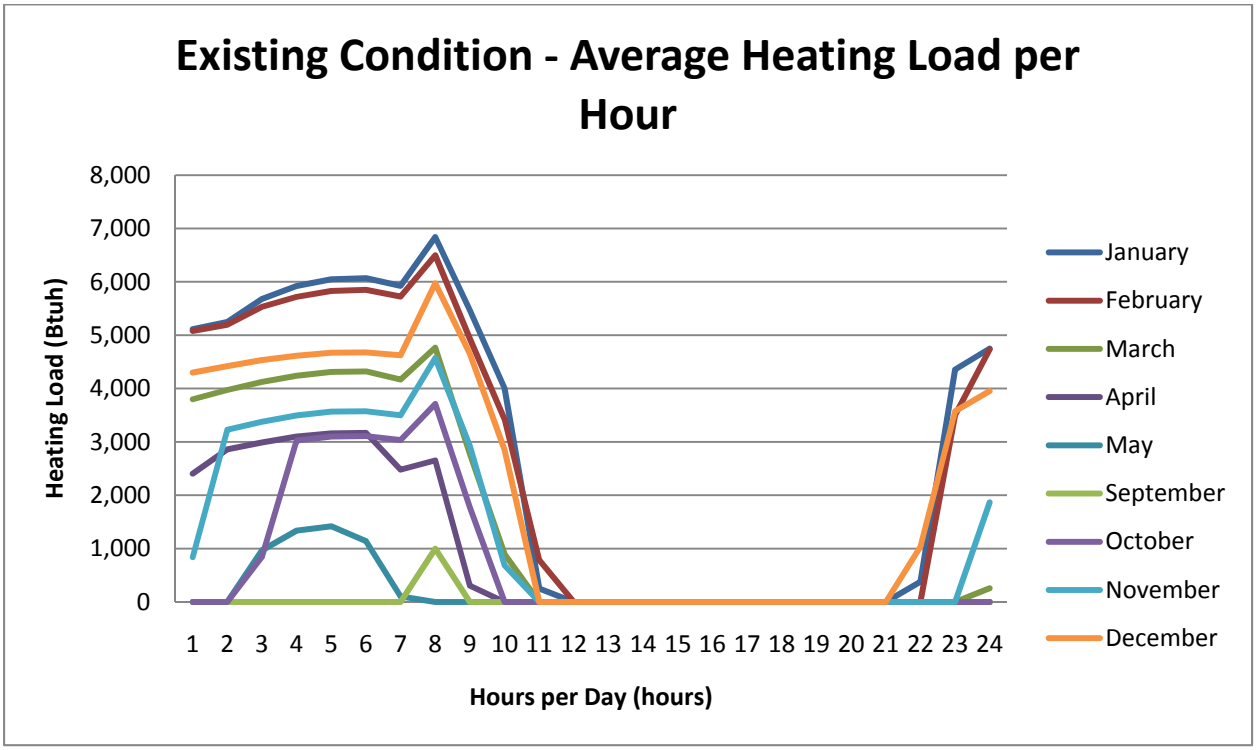
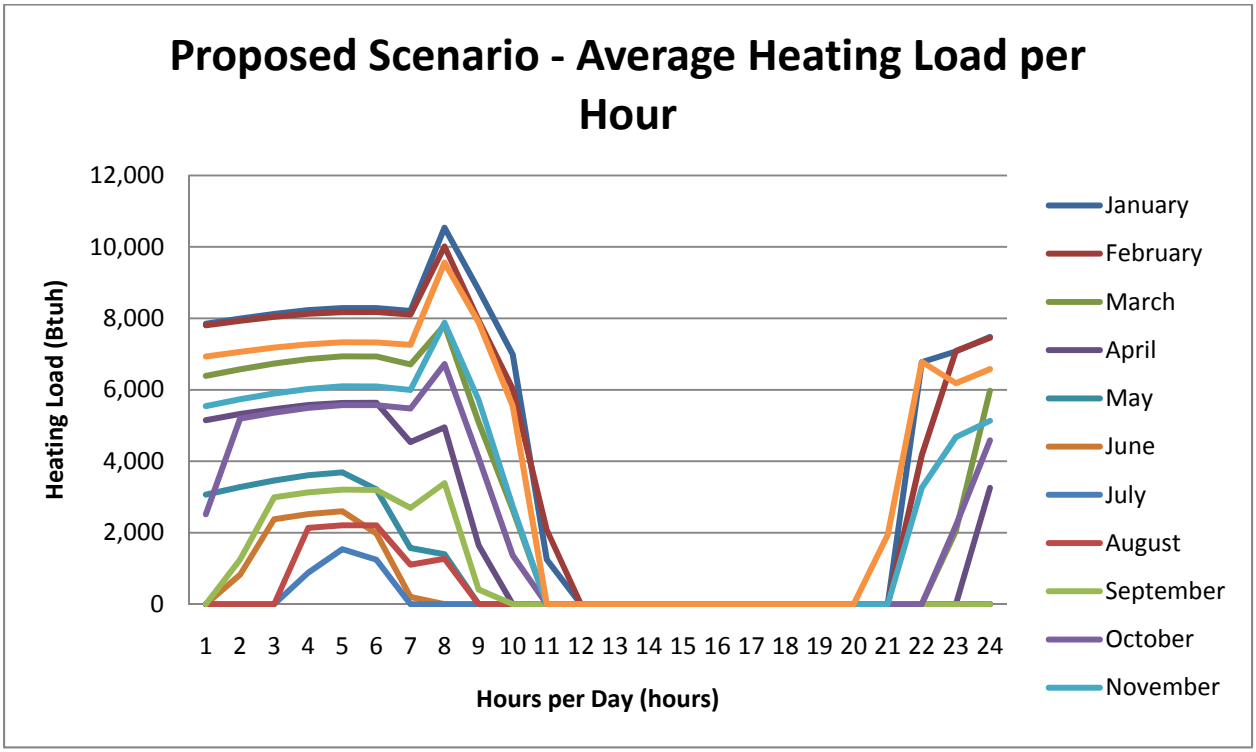


Figure 129 | Proposed Scenario Heating Load Graph



Conclusion

Based on the results above, the existing condition has a 35,684 Btu/h cooling load and a 5,548 Btu/h heating load while the proposed scenario has a 58,430 Btu/h cooling load and a 7,049 heating load. These numbers reflect the change of solar radiation in the space as a result of the shading coefficient and SHGC as well as the heat loss from the U-factor variable.

Overall, the existing condition has a more efficient glazing based on the heating and cooling loads. The proposed scenario consumes an additional 12% electric energy and 31% more gas energy when compared to the existing condition. Since Baltimore has a drastic change of seasons from winter to summer the proposed scenario glazing is not effective. The proposed glazing is more suited for a location with a mild climate change such as San Francisco, California.

See Appendix C for Trane TRACE 700 Results

Summary + Conclusions

The main goal of this final thesis report was to understand how the building is affected when small details within different building systems are altered. Proving whether or not the proposed scenario was an advantage entailed research, cost analyses, comparisons, aesthetics, life cycle costs and so forth. The intent was to comprehend that all the building systems rely on each other to perform efficiently.

The lighting design was intended to improve the functionality of the building, especially the four spaces redesigned. Better lighting designs lead to more productivity. In the case of a hospital, productivity is highly important. Increased productivity increases patient care. The desired outcome was to create a lighting design that was aesthetically pleasing for patients but also a very effective working area for the doctors and nurses.

A lighting redesign is not complete without a revaluation of the electrical system. The lighting loads were reviewed and resized on the respective panel boards to properly carry the new loads. The short circuit and coordination study proves that the breakers will perform correctly if a fault were to occur. Conductor materials have different properties and cross dimensional areas sometimes leading to upsizing conduits. This increased cost occasionally defeats the purpose of using different conductor materials. Voltage drop calculations determine that increasing wire sizes saves a substantial amount of energy. The increased conductor size initially increases the cost but over a time period the life cycle cost of the system will end up saving additional money.

Room acoustics are based on the material properties present in the space. Reverberation time is based on the absorption coefficients of all the surfaces within the space. Auditoriums are usually large volume reverberant areas while others such as the pediatric emergency waiting are small undesirably acoustically dead. Proposed options configure several reverberation times by changing the specification of well known materials to create a more comfortable place to spend time.

A proposed scenario to change a store front glazing greatly affected the mechanical system. The effect was so drastic that the proposed scenario was disregarded. The pediatric emergency waiting room has an exterior glazing façade that directly impacts the heating and cooling demand loads. Daylight penetration and cold winters are major criteria for selecting a glazing material with the proper qualities.

Through the research and proposed design changes found in this report, Franklin Square Hospital Center will be able to increase their productivity and improve the medical care to patients.

References

Software:

Adobe Photoshop CS3

AGi32

Autodesk AutoCAD 2010

Trane TRACE 700

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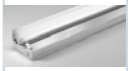
Friends, Family and especially my fellow AE Students

Appendix A | Lighting

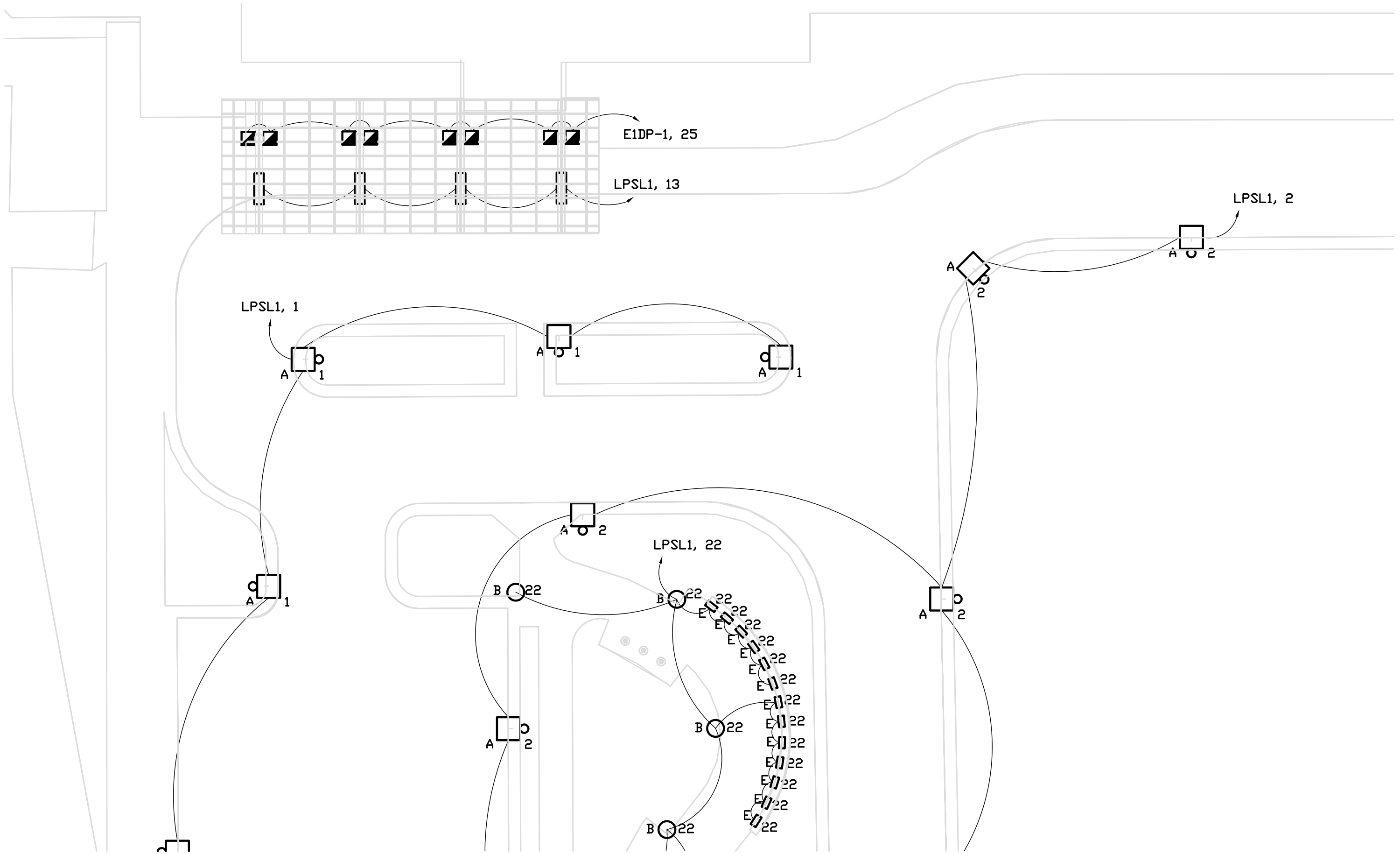
Appendix B | Electrical

Appendix C | Mechanical

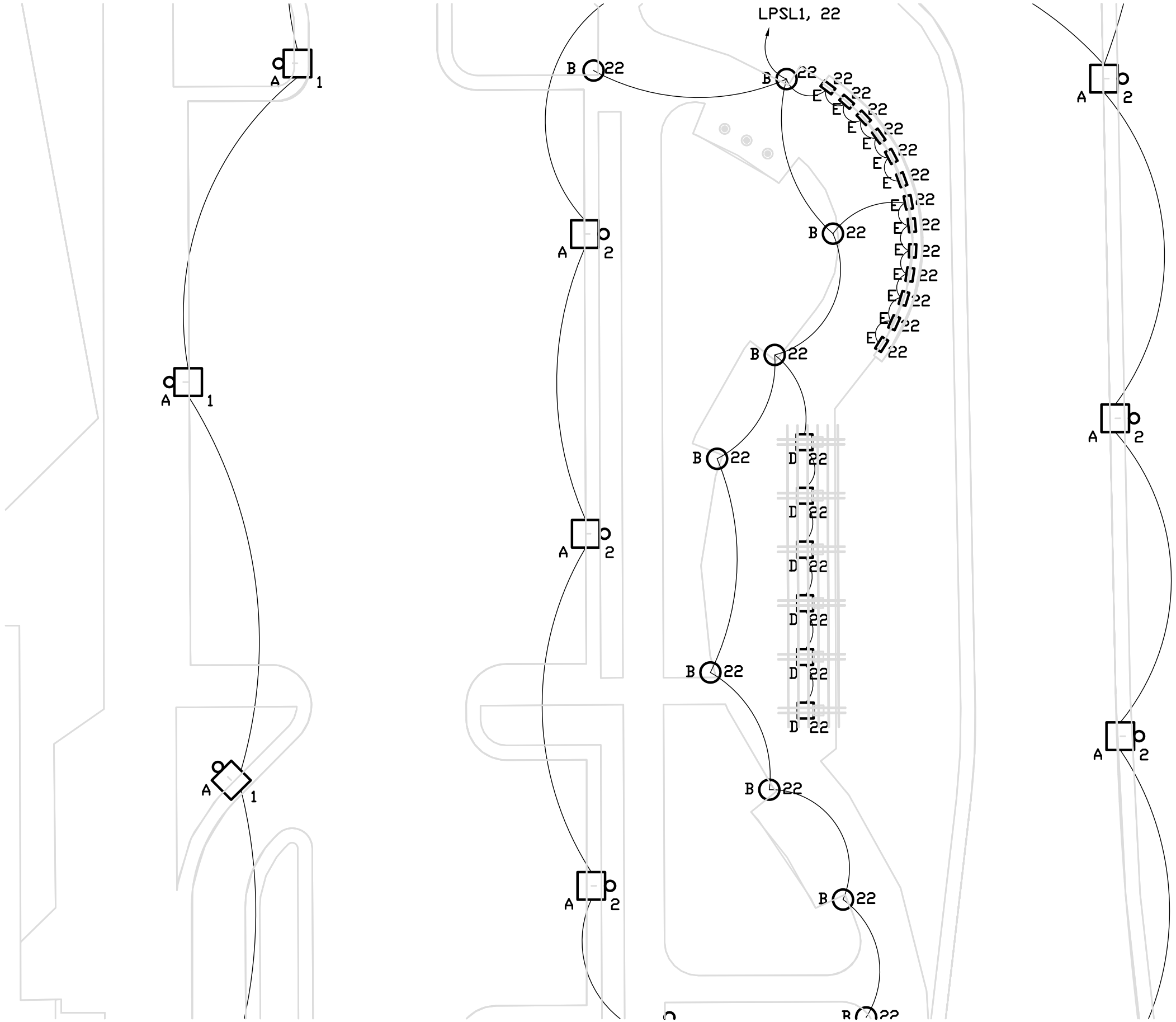
LUMINAIRE SCHEDULE									
TYPE	IMAGE	MANUFACTURER	PRODUCT NAME	CATALOG NUMBER	DESCRIPTION	LAMP	INPUT WATTS	VOLTAGE	BALLAST
A		Williams	OER1717	OER1717/100PSMH 277/TFT/S/SQ/SLV	17" square area luminaire. Fabricated .08"aluminum housing with an extruded aluminum frame with latches to provide easy access to ballast, lamp and reflector. Clear .187" thick high-impact, heat-resistant tempered glass lens.	MXR100/C/U/M ED/O 12570 - GE quartz metal halide ED17	109	277	IMH/100/ D/277 Philips Advance
B		Cooper Lighting	Acorn	ANE/70/P/H/7/33	8" textured polycarbonate globe with internal type III refractor. Cast aluminum housing finished in standard black polyester powder coat.	CMH70CU830M ED/O 31070 - GE ceramic metal halide ED17	79	277	IMH/70/D/ 277 Philips Advance
C		Philips Color Kinetics	eW Graze Powercore	523/000030/15	4' linear LED surface mounted luminaire with a 30° x 60° beam angle. Extruded anodized aluminum housing and clear polycarbonate lens. Certified IP66 for a wet location environment.	4000K White LED lamps included	60	277	Integrated with luminaire
D		Cooper Lighting	WP Series	683/4/WP/CFL/1/26 /277V/SM	Solid aluminum with open bottom and enclosed top wall mounted luminaire coated with premium polyester powder paint. Dark Sky and ADA compliant. UL approved for wet location.	F26DBX/841/EC O4P 97613 - GE CF plug in T4	31	277	VEZ/1T42/ M2/BS Philips Advance
E		Cooper Lighting	Rio	1235/RD/M/4LEED/ 120/12/NSS	5" round, open fascia with clear diffuse lens. Die-cast aluminum alloy housing that is corrosion-resistant. Certified IP68 for a standard wet environment.	White LED lamps included	4	120	Integrated with luminaire
F		ERCO	Lightcast Downlight	22209.000	Cast aluminum housing designed with a heat sink. White powder coated cast aluminum mounting ring. Bright anodised aluminum darklight reflector. Size 7, 30° cut-off angle.	(2)F18DBX/830/ ECO4P 97599 - GE CF plug in T4	43	277	VEZ/2Q18/ M2/BS/27 7 Philips Advance
G		ERCO	Logotec Spotlight Narrow	72409.000	Cast aluminum powder-coated housing and bracket. Silver spherolit mirror-finished anodised aluminum reflector with safety glass.	CMH20T/U830G U6.5 85086 - GE ceramic metal halide T4	24	277	IMH/G20/ G/277 Philips Advance
H		ERCO	Logotec Spotlight Flood	72410.000	Cast aluminum powder-coated housing and bracket. Silver spherolit mirror-finished anodised aluminum reflector with safety glass.	CMH20T/U830G U6.5 85086 - GE ceramic metal halide T4	24	277	IMH/G20/ G/277 Philips Advance
I		ERCO	Logotec Spotlight Wide Flood	72411.000	Cast aluminum powder-coated housing and bracket. Silver spherolit mirror-finished anodised aluminum reflector with safety glass.	CMH20T/U830G U6.5 85086 - GE ceramic metal halide T4	24	277	IMH/G20/ G/277 Philips Advance
J		ERCO	Logotec Recessed Spherolit Wallwasher	81215.000	Size 5, recessed housing of cast aluminum white powder-coated. White plastic mounting ring. Aluminum silver spherolit reflector mirror-finished anodised with a softec lens.	CMH20T/U830G U6.5 85086 - GE ceramic metal halide T4	24	277	IMH/G20/ G/277 Philips Advance
K		ERCO	Logotec Recessed Spotlight	81210.000	Size 5, recessed housing of cast aluminum white powder-coated. White plastic mounting ring. Aluminum silver spherolit reflector mirror-finished anodised with a softec lens.	CMH20T/U830G U6.5 85086 - GE ceramic metal halide T4	24	277	IMH/G20/ G/277 Philips Advance
L		Winona Lighting	Illustra Satro	4801/30/FQ/277V/ OA/BAL/STD	Intersecting 2-piece standard brushed aluminum finish with an etched opal acrylic 30" lens. Pendant is mounted ___' from ceiling	(4)F26DBX/830/ ECO4P 97611 - GE CF plug in T4	116	277	(2)VEZ/2Q 26/M2/BS Philips Advance
M		ERCO	Lightcast Downlight	22267.000	Cast aluminum housing designed with a heat sink. White powder coated cast aluminum mounting ring. Bright anodised aluminum darklight reflector. Size 5, 30° cut-off angle.	F18TBX/830/A/ ECO 97625 - GE CF plug in T4	22	277	VEZ/1Q18/ M2/BS Philips Advance
N		Elliptipar	Style 204	M204/150G/T/02/2/ 00	Extruded high purity aluminum housing with a semi-gloss white reflector. Semi-recessed adjustable wall washer. Microprismatic tempered glass lens.	CMH150TU/830 /G12 20017 - GE ceramic metal halide T6	161	277	IMH/150/ H/277 Philips Advance

LUMINAIRE SCHEDULE (CONT.)									
TYPE	IMAGE	MANUFACTURER	PRODUCT NAME	CATALOG NUMBER	DESCRIPTION	LAMP	INPUT WATTS	VOLTAGE	BALLAST
O		Zumtobel	ML	ML4F/22/2245/OL/U	Cold-rolled steel housing with powder-coated white finish. High-reflectance white interior reflector and shaped extruded white opal acrylic lens.	(2)F24W/T5/841/ECO 46701 - GE linear T5	52	277	ICN/2S24 @277V Philips Advance
P		Elliptipar	Style 306	F306/A132/S/00/2/00/0	Extruded high purity aluminum housing with clear anodized specular finish. Adjustable reflector that can be joined to other fixtures to aim together. Indirect cove lighting lay-in installation.	F32T8/SP41/ECO/C 15904 - GE linear T8	35	277	VEZ/132/SC Philips Advance
W		ERCO	ERCO Track	78303.000	Silver finished anodised aluminum 3-circuit track allowing for three separate switchable circuits.	-	-	277	-

CONTROL SCHEDULE					
TYPE	**IMAGE**	**MANUFACTURER**	**PRODUCT NAME**	**CATALOG NUMBER**	**DESCRIPTION**
X		Watt Stopper	Astronomical Time Clock	MSC-100	5-channel Astronomical Time Clock used for fully automating a Wireless Micro lighting control system. Provides ON/OFF control signals based on time of day, day of week, holiday and calculated sunrise/sunset time.
Y		Watt Stopper	Dual Technology Line Voltage Ceiling Sensor	DT-355	Passive infared and ultrasonic dual technologies provide 360 of coverage. Ceiling mounted with a flat and unobtrusive appearance. No adjustments are necessary after line voltage installation.
Z		Lutron	GRAFIK Eye 3000 Series	GRX/3104/T/BE	Preset dimming control that allows for the setup of lighting scenes. Easy pushbutton recall of four lighting scenes, plus off. Provides lockout options to prevent any accidental changes.

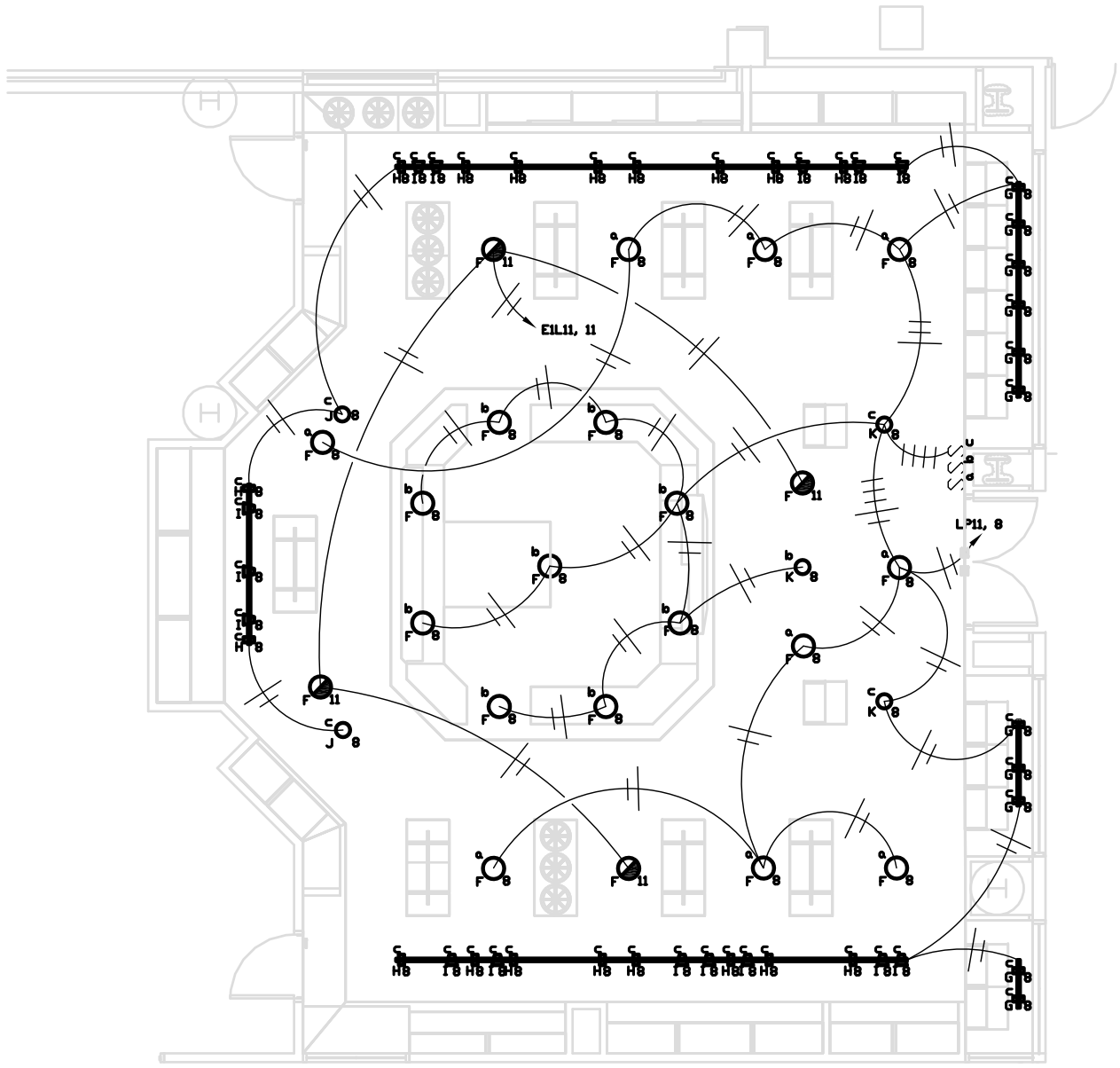


Cassandra Watson I AE Senior Thesis I 4-7-2010	Main Entrance + Parking Lot Lighting Plan Scale: 1/16″=1′0″	Franklin Square Hospital Center I Baltimore, MD

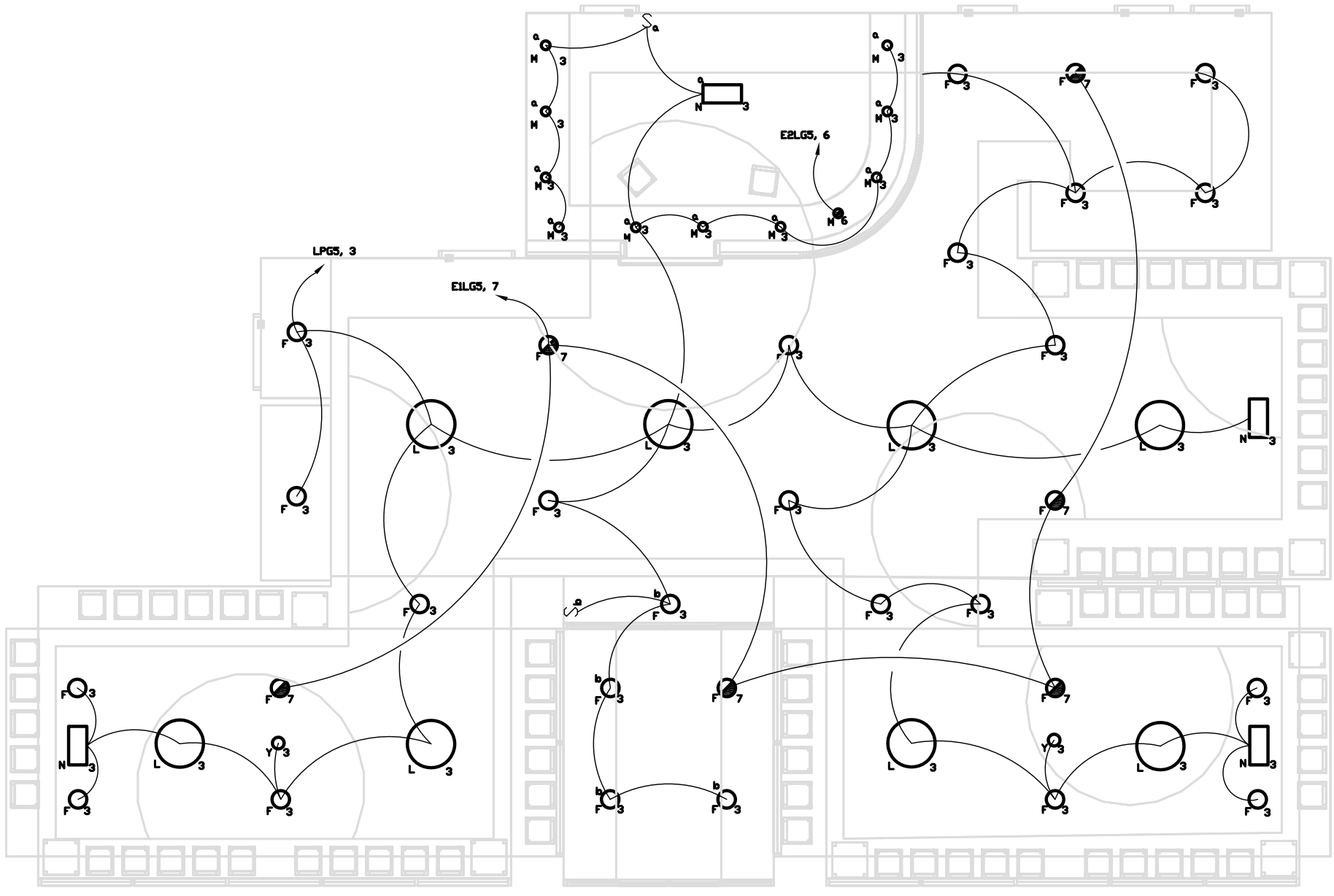


Cassandra Watson | AE Senior Thesis | 4-7-2010	Main Entrance + Parking Lot Lighting Plan Scale: 1/16"=1'0"	Franklin Square Hospital Center | Baltimore, MD

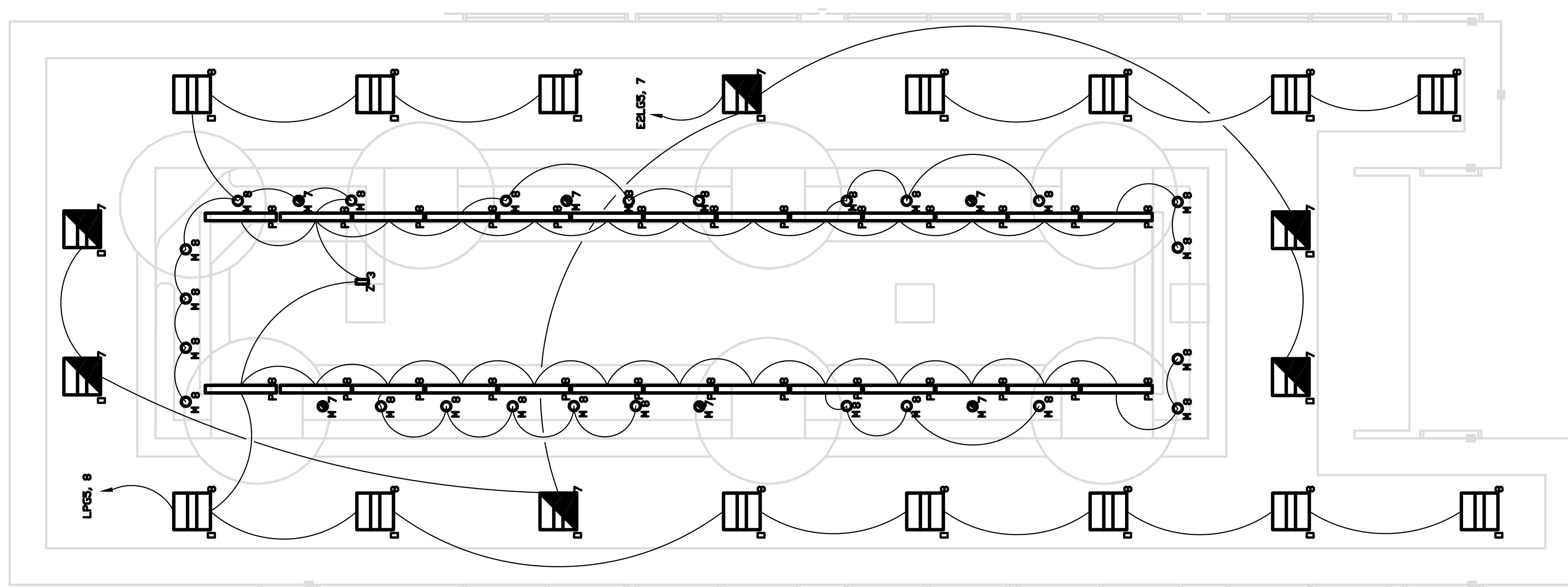
Cassandra Watson I AE Senior Thesis I 4-7-2010	Main Entrance + Parking Lot Lighting Plan Scale: 1/16"=1'0"	Franklin Square Hospital Center I Baltimore, MD



Cassandra Watson I AE Senior Thesis I 4-7-2010	Gift Shop Lighting Plan Scale: 1/8"=1'0"	Franklin Square Hospital Center I Baltimore, MD



Cassandra Watson I AE Senior Thesis I 4-7-2010	Lobby + Waiting Area Lighting Plan Scale: 1/8″=1′0″	Franklin Square Hospital Center I Baltimore, MD



Cassandra Watson | AE Senior Thesis | 4-7-2010

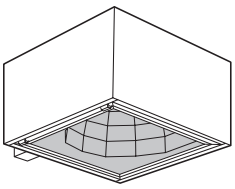
Team Station Lighting Plan
Scale: 1/8"=1'0"

Franklin Square Hospital Center | Baltimore, MD

17" SQUARE AREA LIGHT

OER1717

SUBMITTAL:	OER1717/100SMH/277/TFT/S/SQ/SLV
JOB:	AE SENIOR THESIS
TYPE:	A
VOLTAGE:	277



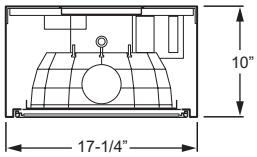
EXAMPLE: **OER1717 - 250PSMH120 - T3 - S - SQ - DBR - OPTIONS**

OER1717	250PSMH120	T3	S	SQ	DBR	OPTIONS
SERIES	ELECTRICAL PACKAGE	PHOTO. DIST.	MOUNTING CONFIG.	MOUNTING POINT	FINISH OPTIONS	OPTIONS/ ACCESSORIES

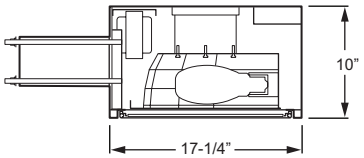
This fixture is proudly made in the USA.

SERIES

OER1717 — Designed for simplicity, the OER Series' 90° rotatable reflector allows distribution to be easily altered on-site.



FRONT VIEW



SIDE VIEW

Single fixture, standard arm mount:
EPA: 1.32/Weight: 35 Lbs.

ELECTRICAL PACKAGE (Must specify)

PULSE START METAL HALIDE

Lamp:	E17	E17	BT28
Socket:	E26 Medium	E26 Medium	E39 Mogul
ANSI Ballast Code:	M90	M102	M153
	100PSMH120	150PSMH120	250PSMH120
	100PSMH208	150PSMH208	250PSMH208
	100PSMH240	150PSMH240	250PSMH240
	100PSMH277	150PSMH277	250PSMH277
	100PSMH347	150PSMH347	250PSMH347
	100PSMH480	150PSMH480	250PSMH480

HIGH PRESSURE SODIUM

Lamp:	E17	ET18
Socket:	E26 Medium	E39 Mogul
ANSI Ballast Code:	S55	S50
	150HPS120	250HPS120
	150HPS208	250HPS208
	150HPS240	250HPS240
	150HPS277	250HPS277
	150HPS347	250HPS347
	150HPS480	250HPS480

OER1717 SERIES

HOUSING — Fabricated .080" aluminum, internally welded for strength and appearance.
DOOR — Extruded aluminum frame with mitered corners, stainless steel hinges and slide-action latches to provide easy access to ballast, lamp and reflector. Clear anodized finish.
LENS — Clear, .187" thick high-impact, heat-resistant tempered glass, secured with spring-tension glass clips, sealed with silicone.

ELECTRICAL PACKAGE

PSMH — Rated -20°F minimum starting temperature.
HPS — Rated -40°F minimum starting temperature.

All PSMH and HPS electrical packages include porcelain socket. Prewired at factory for easy field installation. HX-HPF or CWA ballast type standard. Lamp is optional, please specify when ordering.

OER1717

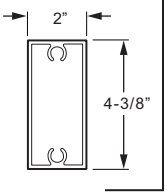
17" SQUARE AREA LIGHT

REFLECTOR

Tool-less access to the precisely formed MIRO® 4 multi-faceted, segmented reflector in a high-reflectance white frame. Secured with thumb screws, the reflector can be rotated in 90° increments allowing distribution to be altered on-site.

MOUNTING

Extruded aluminum rectangular arm mount (standard).



FINISH OPTIONS

Super durable polyester powder coat meets and exceeds AAMA 2604 specifications for outdoor durability.

LABELS

cCSAus certified as luminaire suitable for wet location.

PHOTOMETRIC DISTRIBUTION (Must specify)

T2 Type II

T3 Type III

TFT Type Forward Throw

T5 Type V

MOUNTING CONFIGURATION (Must specify)

(EPA shown for arm mount noted below)

S Single
EPA: 1.32
8" Arm

D90 Double 90°
EPA: 3.73
11" Arm

D180 Double 180°
EPA: 2.64
8" Arm

T90 Triple 90°
EPA: 3.95
11" Arm

T120 Triple 120°
EPA: 4.60
8" Arm
Round pole only

Q90 Quad 90°
EPA: 3.95
11" Arm

MOUNTING POINT (Must specify)

SQ	Square Pole Mount (Standard)	**RSD___**[1]	Round Straight Arm Mount[1]
RTD___[1]	Round Tapered Arm Mount[1]	**TM**	Tenon Mount (Pole Top Tenon Mount must be ordered separately. For all tenon options see Pole Top Assemblies, pages 1-4.)
WM[2]	Wall Mount[2]		

[1] Pole top diameter must be specified at time of order. EXAMPLE: 3" Pole top diameter = RSD300.
[2] Must anchor to appropriate wall construction.

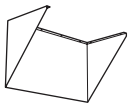
FINISH OPTIONS (Must specify)

BLK	Black (RAL# 9004)	**DBR**	Dark Bronze (Protech #PC21462)
GRAY	Standard Gray (Protech #PC18367)	**GRN**	Green (RAL# 6005)
SLV	Satin Aluminum (RAL# 9006)	**WHT**	White (RAL# 9003)
RAL#____	Specify Custom Color		

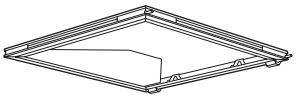
OPTIONS

SF	Single Fuse (120V, 277V, or 347V only; must specify voltage)	**DF**	Double Fuse (208V, 240V, or 480V only; must specify voltage)
PC	Factory-installed Photocell		

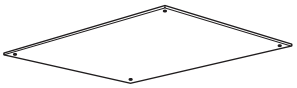
ACCESSORIES



EHS External House Shield
EPA: 1.55/Weight: 1.8 Lbs.



DHS Door-mounted House Shield



PVS Polycarbonate Vandal Shield
Weight: 1.9 Lbs.

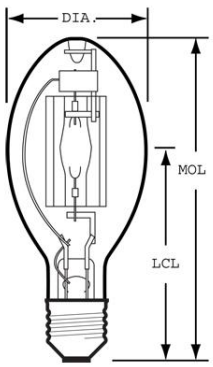
Williams OUTDOOR LIGHTING
H.E. Williams, Inc. ■ Carthage, Missouri ■ www.**hewilliams**.com ■ 417-358-4065 ■ Fax: 417-358-6015

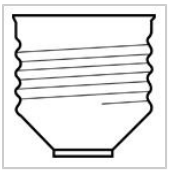
HEWJP59626 11/19/09RJ

GE Lighting

12579 - MXR100/C/U/MED/O

GE Protected Multi-Vapor® PulseArc® Quartz Metal Halide ED17





CAUTIONS & WARNINGS

R- WARNING: This lamp can cause serious skin burn and eye inflammation from shortwave ultraviolet radiation if outer envelope of the lamp is broken or punctured, and the arc tube continues to operate. Do not use where people will remain for more than a few minutes unless adequate shielding or other safety precautions are used. Certain types of lamps that will automatically extinguish when the outer envelope is broken or punctured are commercially available. Visit the FDA website for more information: http://www.fda.gov/cdrh/radhealth/products/urburns.html

Caution

- Lamp may shatter and cause injury if broken
  - Dispose of lamp in a closed container.
  - Do not use excessive force when installing lamp.
  - Do not use lamp if outer glass is scratched or broken.

Warning

- A damaged lamp emits UV radiation which may cause eye/skin injury
  - Turn power off if glass bulb is broken. Remove and dispose of lamp.
- Risk of Burn
  - Allow lamp to cool before handling.
  - Do not turn on lamp until fully installed.
- Risk of Electric Shock
  - Do not use where directly exposed to water or outdoors without an enclosed fixture.
  - Turn power off before inspection, installation or removal.
- Unexpected lamp rupture may cause injury, fire, or property damage
  - Do not exceed rated voltage.
  - Do not store flammable materials near/below lamp.
  - Do not turn on lamp until fully installed.
  - Do not use beyond rated life.
  - Do not use lamp if outer glass is scratched or broken.
  - Do not use where directly exposed to water or outdoors without an enclosed fixture.
  - Operate lamp only in specified position.
  - Turn lamp off at least once for 15 minutes per week.
  - Use only properly rated ballast.
- Risk of Fire
  - Keep combustible materials away from lamp.
  - Use in fixture rated for this product.

GRAPHS & CHARTS

Spectral Power Distribution

GENERAL CHARACTERISTICS

Lamp Type	High Intensity Discharge - Quartz Metal Halide
Bulb	ED17
Base	Medium Screw (E26)
Bulb Finish	Coated
Wattage	100
Voltage	100
Rated Life	15000 hrs
Bulb Material	Hard glass
Lamp Enclosure Type (LET)	Open or enclosed fixtures
LEED-EB MR Credit	111 picograms Hg per mean lumen hour

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	8500
Mean Lumens	5900
Nominal Initial Lumens per Watt	85
Color Temperature	3200 K
Color Rendering Index (CRI)	70

ELECTRICAL CHARACTERISTICS

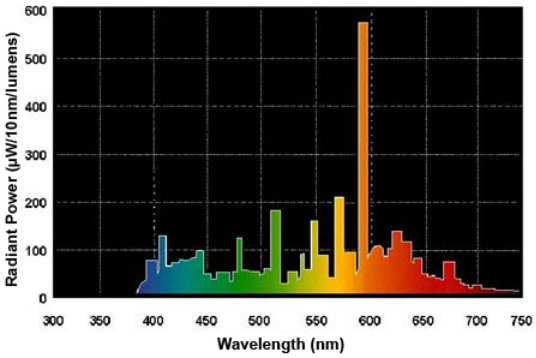
Burn Position	Universal burning position
Open Circuit Voltage (peak lead ballast)	332 V
Open Circuit Voltage (RMS lag ballast)	235 V
Warm Up Time to 90%	5 min
Warm Up Time to 90% (MIN)	2 min
Warm Up Time to 90% (MAX)	5 min
Hot Restart Time to 90% (MIN)	10 min
Hot Restart Time to 90% (MAX)	15 min

DIMENSIONS

Maximum Overall Length (MOL)	5.4300 in(137.9 mm)
Nominal Length	5.430 in(137.9 mm)
Bulb Diameter (DIA)	2.125 in(54.0 mm)
Bulb Diameter (DIA) (MAX)	2.125 in(54.0 mm)
Light Center Length (LCL)	3.430 in(87.1 mm)

PRODUCT INFORMATION

Product Code	12579
Description	MXR100/C/U/MED/O
ANSI Code	M90
Standard Package	Case
Standard Package GTIN	10043168125793
Standard Package Quantity	6
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	6
UPC	043168125796


Radiant Power (µW/10nm/lumens)
600
500
400
300
200
100
0
300
350
400
450
500
550
600
650
700
750
Wavelength (nm)

Revised: 3/5/2009

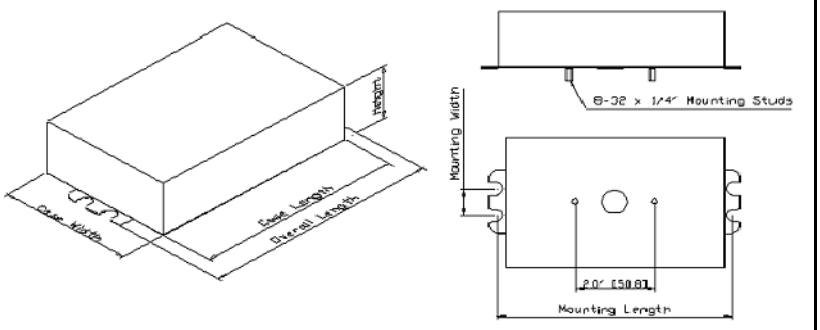
PHILIPS ADVANCE

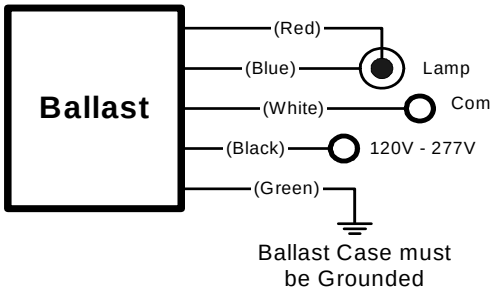
e-Vision® Electronic Ballast for Metal Halide Lamps

Catalog Number: IMH-100-D
For 100W Metal Halide Lamps
ANSI M90 or M140
120-277 50/60Hz Electronic
Status: RELEASED

DIMENSIONS AND DATA

Lamp Number	Lamp Watts	Input Volts	Catalong Number*	Line Current (Amps)	Input Power (Watts)	Min Power Factor	Wiring Diag	Fig.	Weight (lb)	Max. Distance to Lamp (ft)
100W Watt Lamp, ANSI Code M90 or M140 Minimum Starting Temp -30°C/-20°F										
1	100	120	IMH-100-D-XXX	0.92	110	0.9	3	D	1.6	5
		277		0.4	109					

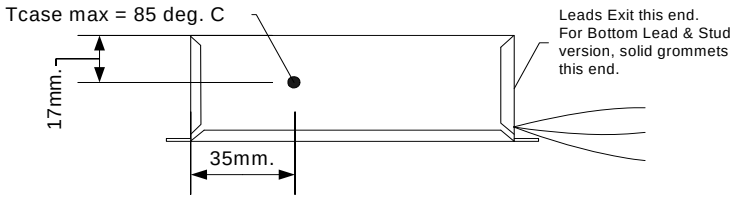




Ballast Case must be Grounded

Wiring Diagram 3

Case Figure	Overall Length	Case Length	Case Width	Height	Mountin Length	Mounting Width
D	128mm [5.0"]	108mm [4.3"]	77mm [3.0"]	38mm [1.5"]	118mm [4.6"]	19mm [0.7"]



Case Temperature Measurement Location

INSTALLATION & APPLICATION NOTES:

1. Maximum allowable case temperature is 85°C. See figure above for measurement location
2. Ignition pulse is 4 kV max
3. All leads are 12 inches long
4. Ballast output will shutdown after 20 minutes if lamp fails to ignite
5. Power must be cycled off – then on, after replacing lamp

***Ordering Information**

Order Suffix	Description
-LF	Ballast with side exit leads and mounting feet
-BLS	Ballast with bottom exit leads and mounting studs

Data is based on tests performed by Philips Advance in a controlled environment and is representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

Philips Lighting Electronics N.A.
10275 West Higgins Road • Rosemont, IL 60018 • www.philips.com/advance
Tel: 800-322-2086 • Fax: 800-423-1882 • Customer Support: 800-372-3331 • OEM Support: 866-915-5886

STREETWORKS™ energy solutions

DESCRIPTION

The Acorn tastefully compliments roadways, parks and residential roadways.

		Type
Catalog #		A
Project		
Comments		Date
Prepared by		

SPECIFICATION FEATURES

Construction
Cast aluminum housing. Standard with two position terminal block. Standard color is black. Other finish colors available. Consult your Streetworks Representative. 1" ANSI wattage/source label.

Electrical
SOCKET: Mogul-base socket for 50W through 150W High Pressure Sodium and 175W and 250W Metal Halide; 50W through 150W Metal Halide is medium-base socket. All sockets are 4KV pulse rated.
BALLAST: Easily accessable, tilt-back power module. Standard plug-in starter when applicable.
PHOTOCONTROL: Optional NEMA twistlock photocontrol receptacle also available.

Optical
GLOBE: 8" textured polycarbonate globe is standard. Optional globes include a 9" polycarbonate, 8" and 9" milk white, and 8" and 9" acrylic (Optional internal Type III refractor available).

Mounting
Post-top mount fits 3" tenons. Secures with three (3) square headed 1-1/4" polymer coated mounting bolts.

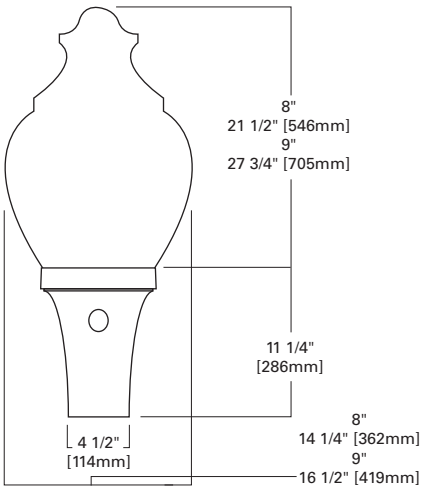
Finish
Standard polyester powder coat finish in black. Standard color is black. Optional bronze, white, grey, hartford green, dark platinum and graphite metallic finishes are available.

ANE
ACORN

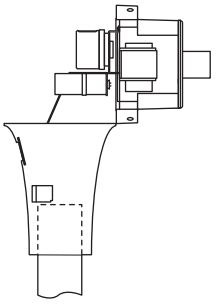
50 - 250W
Pulse Start Metal Halide
High Pressure Sodium
Metal Halide

DECORATIVE LUMINAIRE

DIMENSIONS



TILT-BACK POWER MODULE



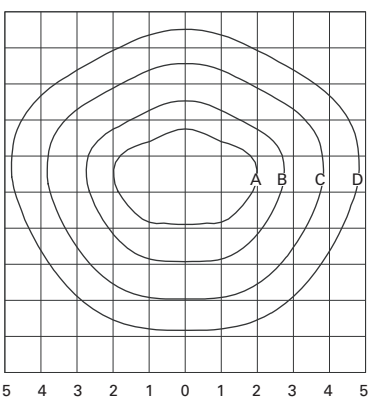
FINIAL OPTIONS (PAINTED TO MATCH HOUSING)

EPA
Effective Projected Area:
1.7 Square Feet

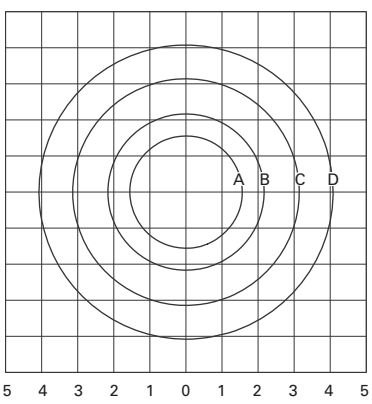
SHIPPING DATA
Approximate Net Weight:
30 lbs. (14 kgs.)

COOPER Lighting
www.cooperlighting.com

PHOTOMETRICS (Complete IES files available at www.cooperlighting.com)



ANE15S33.IES
150-Watt HPS
16,000-Lumen Lamp
Type III



ANE15S55.IES
150-Watt HPS
16,000-Lumen Lamp
Type V

FOOTCANDLE TABLE

Select mounting height and read across for footcandle values of each isofootcandle line. Distance in units of mounting height.

Mounting Height	Footcandle Values for Isofootcandle Lines			
	A	**B**	**C**	**D**
ANE15S33.IES				
12'	1.36	0.68	0.34	0.13
14'	**1.00**	**0.50**	**0.25**	**0.10**
16'	0.76	0.38	0.19	0.07
ANE15S55.IES				
12'	1.36	0.68	0.34	0.13
14'	**1.00**	**0.50**	**0.25**	**0.10**
16'	0.76	0.38	0.19	0.07

ORDERING INFORMATION

Sample Number: ANE50SR2554

ANE	70	P	H	7	33	A	

Product Family
ANE=Acorn

Lamp Wattage [1]

Pulse Start Metal Halide
70=70W
10=100W
15=150W
17=175W
25=250W

High Pressure Sodium
50=50W[2]
70=70W
10=100W
15=150W
20=200W
25=250W[2]

M (Probe Start) [3]
17=175W
25=250W

Lamp Type [1]
P=Pulse Start Metal Halide
S=High Pressure Sodium
M=Metal Halide

Ballast Type [1]
H=Reac. /HPF
K=10KV CWA[4]
N=Hi.Reac./NPF
P=Hi. Reac./HPF
R=Hi.Reac./NPF[4]
W=CWA

Voltage [1]
2=120V
0=208V
4=240V
7=277V
8=480V
F=120/240 wired 120V
W=Multi-Tap wired 120V
G=120/240 wired 240V
V=Multi-Tap wired 240V
N=Multi-Tap wired 277V

Distribution
33=Type III
55=Type V

Options
1=Single Fuse (120, 277 or 347V)
2=Double Fuse, (208, 240, or 480V)
4=NEMA Twistlock Photocontrol Receptacle
5=Internal Button[5] Photocontrol
WH=White
BZ=Bronze
AP=Grey
H=Hartford Green
DP=Dark Platinum
A=Acrylic Globe
B=Acrylic Globe 9"
9=9" Globe
M=Milk White Globe
S=Screw Secure Power Module
N=NEMA Ballast Bracket[6]
F=Finial
U=U.L./CSA Listed

Accessories
AA1000=House Side Shield (9" Globe)
AA1001=House Side Shield (8" Globe)

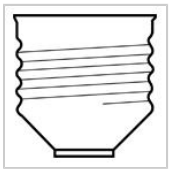
Notes:
1 Refer to the technical section for lamp/ballast voltage compatibility.
2 Available in 120V only.
3 Probe Start Metal Halide available for non-US markets only (175-250W).
4 Available 50-150W. 120/240 or single voltage only.
5 Specify single voltage.
6 Available in Reactor HPF and NPF. For Hi Reactance or CWA availability consult your Streetworks Representative.

GE Lighting

31070 - CMH70CU830MED/O

GE Protected ConstantColor® PulseArc® CMH® Ceramic Metal Halide ED17

a product of ecomagination



CAUTIONS & WARNINGS

R- WARNING: This lamp can cause serious skin burn and eye inflammation from shortwave ultraviolet radiation if outer envelope of the lamp is broken or punctured, and the arc tube continues to operate. Do not use where people will remain for more than a few minutes unless adequate shielding or other safety precautions are used. Certain types of lamps that will automatically extinguish when the outer envelope is broken or punctured are commercially available. Visit the FDA website for more information: http://www.fda.gov/cdrh/radhealth/products/urburns.html

Caution

- Lamp may shatter and cause injury if broken
  - Dispose of lamp in a closed container.
  - Do not use excessive force when installing lamp.
  - Do not use lamp if outer glass is scratched or broken.

Warning

- A damaged lamp emits UV radiation which may cause eye/skin injury
  - Turn power off if glass bulb is broken. Remove and dispose of lamp.
- Risk of Burn
  - Allow lamp to cool before handling.
  - Do not turn on lamp until fully installed.
- Risk of Electric Shock
  - Do not use where directly exposed to water or outdoors without an enclosed fixture.
  - Turn power off before inspection, installation or removal.
- Risk of Fire
  - Keep combustible materials away from lamp.
  - Use in fixture rated for this product.
- Unexpected lamp rupture may cause injury, fire, or property damage
  - Do not exceed rated voltage.
  - Do not store flammable materials near/below lamp.
  - Do not turn on lamp until fully installed.
  - Do not use beyond rated life.
  - Do not use lamp if outer glass is scratched or broken.
  - Do not use where directly exposed to water or outdoors without an enclosed fixture.
  - Operate lamp only in specified position.
  - Use only properly rated ballast.

GENERAL CHARACTERISTICS

Lamp Type	High Intensity Discharge - Ceramic Metal Halide
Bulb	ED17
Base	Medium Screw (E26)
Bulb Finish	Coated
Wattage	70
Rated Life	15000 hrs
Bulb Material	Hard glass
Lamp Enclosure Type (LET)	Open or enclosed fixtures
LEED-EB MR Credit	94 picograms Hg per mean lumen hour

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	5700
Mean Lumens	4100
Nominal Initial Lumens per Watt	81
Color Temperature	3000 K
Color Rendering Index (CRI)	80
Effective Arc Length	0.28125 cm

ELECTRICAL CHARACTERISTICS

Burn Position	Universal burning position
Warm Up Time to 90% (MIN)	2 min
Warm Up Time to 90% (MAX)	5 min
Hot Restart Time to 90%	15 min
Hot Restart Time to 90% (MAX)	15 min

DIMENSIONS

Maximum Overall Length (MOL)	5.4300 in(137.9 mm)
Nominal Length	5.430 in(137.9 mm)
Bulb Diameter (DIA)	2.125 in(54.0 mm)
Bulb Diameter (DIA) (MAX)	2.125 in(54.0 mm)
Light Center Length (LCL)	3.370 in(85.6 mm)

PRODUCT INFORMATION

Product Code	31070
Description	CMH70CU830MED/O
ANSI Code	C98/M143/M98
Standard Package	Case
Standard Package GTIN	10043168310700
Standard Package Quantity	6
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	6
UPC	043168310703

Revised: 3/5/2009

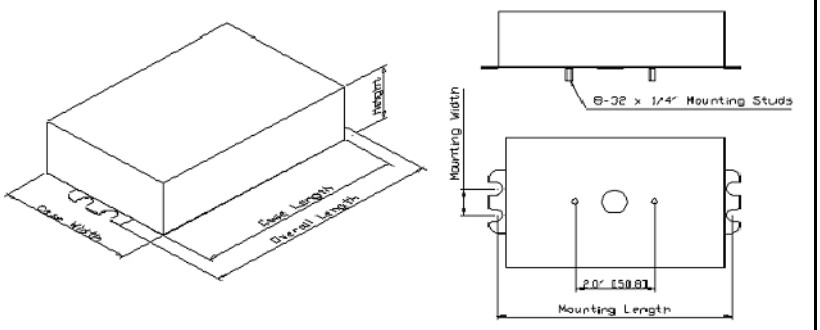
PHILIPS ADVANCE

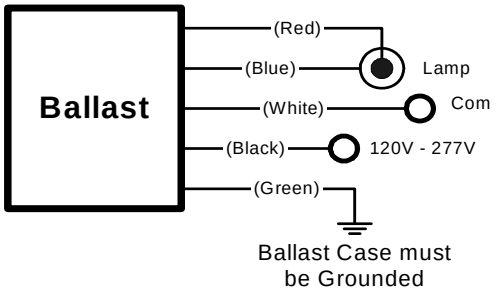
e-Vision® Electronic Ballast for Metal Halide Lamps

Catalog Number: IMH-70-D
For 70W Metal Halide Lamps
ANSI M98, M139 or M143
120-277 50/60Hz Electronic
Status: RELEASED

DIMENSIONS AND DATA

Lamp Number	Lamp Watts	Input Volts	Catalong Number*	Line Current (Amps)	Input Power (Watts)	Min Power Factor	Wiring Diag	Fig.	Weight (lb)	Max. Distance to Lamp (ft)
70W Watt Lamp, ANSI Code M98, M139 or M143 Minimum Starting Temp -30°C/-20°F										
1	70	120	IMH-70-D-XXX	0.67	80	0.9	3	D	1.6	5
		277		0.29	79					

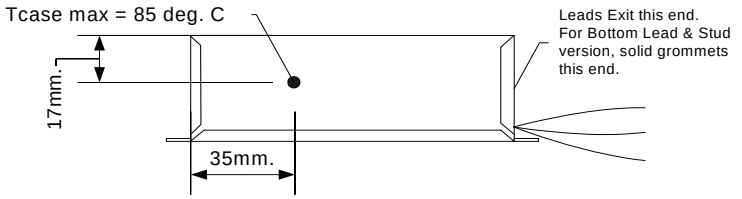




Ballast Case must be Grounded

Wiring Diagram 3

Case Figure	Overall Length	Case Length	Case Width	Height	Mountin Length	Mounting Width
D	128mm [5.0"]	108mm [4.3"]	77mm [3.0"]	38mm [1.5"]	118mm [4.6"]	19mm [0.7"]



Case Temperature Measurement Location

INSTALLATION & APPLICATION NOTES:

1. Maximum allowable case temperature is 85°C. See figure above for measurement location
2. Ignition pulse is 4 kV max
3. All leads are 12 inches long
4. Ballast output will shutdown after 20 minutes if lamp fails to ignite
5. Power must be cycled off – then on, after replacing lamp

***Ordering Information**

Order Suffix	Description
-LF	Ballast with side exit leads and mounting feet
-BLS	Ballast with bottom exit leads and mounting studs

Data is based on tests performed by Philips Advance in a controlled environment and is representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

Philips Lighting Electronics N.A.
10275 West Higgins Road • Rosemont, IL 60018 • www.philips.com/advance
Tel: 800-322-2086 • Fax: 800-423-1882 • Customer Support: 800-372-3331 • OEM Support: 866-915-5886

Date: _____ Type: _____

Firm Name: _____

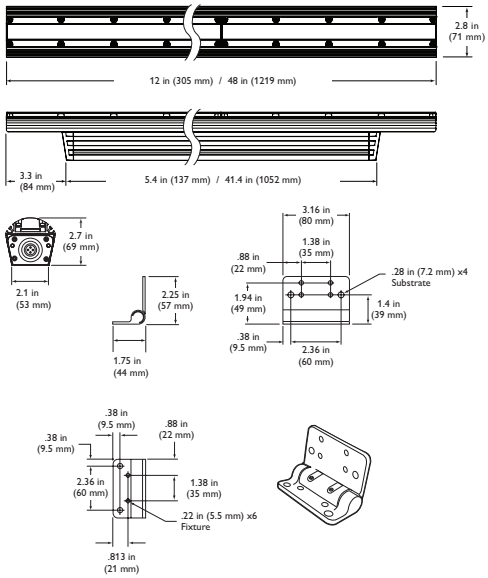
Project: _____

eW Graze Powercore

4000 K, 30° x 60° Lens

Linear LED surface light for wall washing and grazing

eW® Graze Powercore is a linear lighting fixture optimized for surface grazing and wall-washing applications requiring high-quality white or solid color light. Featuring Powercore® technology, eW Graze Powercore processes power directly from line voltage, eliminating the need for low-voltage, external power supplies. Fixtures are available in eight color temperatures, ranging from a warm 2700 K to a cool 6500 K, and five solid colors. eW Graze Powercore offers superior illumination quality and dramatic energy savings for new installations and retrofit upgrades. A space-efficient, low-profile aluminum housing and flexible mounting options allow discrete placement within a wide range of compact architectural details



- Tailor light output to specific applications — eW Graze Powercore is available in standard 1 ft and 4 ft exterior-rated housings, and standard 10° x 60° and 30° x 60° beam angles.
- High-performance illumination and beam quality — eW Graze Powercore offers superior beam quality for striation-free saturation as close as 6 in (152 mm) from fixture placement. eW Graze Powercore accommodates end-to-end or incremental placement without visible light scalloping between fixtures.
- Supports new applications for white light— Long-life LEDs (50,000 hours at 70% lumen maintenance) significantly reduce or eliminate maintenance problems, allowing the use of white or solid color lighting in spaces where bulb maintenance may be limited or unfeasible.
- Universal power input range — eW Graze Powercore accepts line voltage input of 100, 120, 220 – 240, and 277 VAC.
- Versatile installation options — Constant torque locking hinges offer simple position control from various angles without special tools. The low-profile extruded aluminum housing accommodates installation within architectural niches of many different shapes and sizes.
- Wide range of build-to-order configurations — Additional fixture lengths, beam angles, color temperatures up to 6500 K, and solid colors (Royal Blue, Blue, Green. Amber, and Red) are available as build-to-order configurations. See the eW Graze Powercore Ordering Information sheet for complete details.
- "Cool lighting" functionality — eW Graze Powercore fixtures do not heat illuminated surfaces, discharge infrared radiation or emit ultraviolet light.
- Dimming capable — Patented DIMand™ technology offers smooth dimming capability with many ELV-type dimmers.
- Trouble-free, code-compliant installation — IP66, UL wet location ratings. UL / cUL, CE, FCC, RoHS, WEEE certified.

For detailed product information, please refer to the eW Graze Powercore Product Guide at www.colorkinetics.com/ls/essentialwhite/ewgraze/

A Green Flagship Product
Our Green Flagship Products offer significantly improved environmental performance in two or more of the following Green Focal Areas: weight, energy consumption, hazardous substances, packaging, recycling, disposal, and lifetime reliability.

PHILIPS

Specifications

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

Item	Specification	1 ft (305 mm)	4 ft (1.2 m)
Output	Beam Angle	30° x 60°	
	Color Temperature	4000 K (+400 / -500)	
	Lumens†	437	1748
	Efficacy (Lm/W)	29.1	
	Mixing Distance	6 in (152 mm) to uniform beam saturation	
	Lumen Maintenance‡	100,000+ hours L_{70} @ 25° C 50,000 hours L_{70} @ 50° C	
Electrical	Input Voltage	100 / 120 / 220 – 240 / 277 VAC, 50 / 60 Hz	
	Power Consumption	15 W maximum at full output, steady state	60 W maximum at full output, steady state
Control		Commercially available ELV control dimmers	
Physical	Dimensions *(Height x Width x Depth)*	2.7 x 12 x 2.8 in (69 x 305 x 71 mm)	2.7 x 48 x 2.8 in (69 x 1219 x 71 mm)
	Weight	2.7 lb (1.2 kg)	10.8 lb (4.9 kg)
	Housing	Extruded anodized aluminum	
	Lens	Clear polycarbonate	
	Fixture Connectors	Integral male / female waterproof connectors	
	Mounting	Multi-positional, constant torque locking hinges	
	Temperature	-40° – 122° F (-40° – 50° C) Operating -4° – 122° F (-20° – 50° C) Startup	
	Humidity	0 – 95%, non-condensing	
	Fixture Run Lengths*	88 @ 110 VAC 97 @ 120 VAC 180 @ 220 VAC 197 @ 240 VAC	*Configuration:* *1 ft (305 mm) fixtures installed end-to-end, 20 A circuit, standard 50 ft (15.2 m) Leader Cable*
Certification and Safety	Certification	UL / cUL, FCC Class A, CE, RoHS, WEEE	
	LED Class	Class 2 LED product	
	Environment	Dry / Damp / Wet Location, IP66	

† Lumen measurement complies with IES LM-79-08.

‡ L_{70} = 70% maintenance of lumen output. (When light output drops below 70% of initial output.)

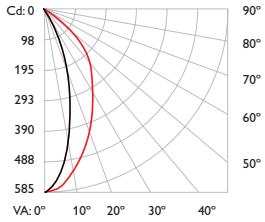
*These figures, provided as a guideline, are accurate for this configuration only. Changing the configuration can affect the fixture run lengths.

OPTIBIN® CKTECHNOLOGY | POWERCORE® CKTECHNOLOGY | DIMAND® CKTECHNOLOGY

Photometrics

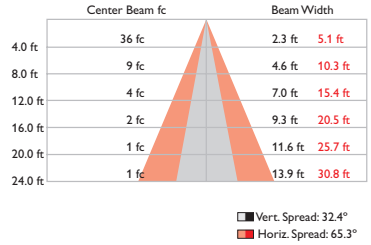
4000 K, 1 ft, 30° x 60° lens

Polar Candela Distribution



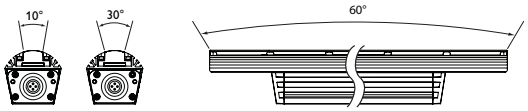
	0	22.5	44	67.5	90
0	581	581	581	581	581
5	540	543	550	557	567
15	319	334	378	434	467
25	126	140	193	292	365
35	48	54	82	171	271
45	25	27	38	87	177
55	14	15	21	42	99
65	7	8	11	19	44
75	2	2	3	7	13
85	0	0	0	0	1
90	0	0	0	0	0

Illuminance at Distance



For lux multiply fc by 10.7

Power Consumption	15 W
Lumens	437
Efficacy	29.1 Lm/W



Fixtures

Item	Beam Angle	Voltage	Size	Item Number	Philips 12NC
eW Graze Powercore 4000 K	30° x 60°	120 VAC	1 ft	523-000030-05	910503700281
			4 ft	523-000030-07	910503700283
		277 VAC	1 ft	523-000030-13	910503700289
			4 ft	523-000030-15	910503700291
		220 – 240 VAC	1 ft	523-000030-21	910503700297
			4 ft	523-000030-23	910503700299
		100 VAC	1 ft	523-000030-29	910503700305
			4 ft	523-000030-31	910503700307

Use Item Number when ordering in North America.

See the eW Graze Powercore Ordering Information sheet at www.colorkinetics.com/ls/essentialwhite/ewgraze/ for a complete list of standard and build-to-order configurations.

Accessories

Item	Type	Size	Item Number	Philips 12NC
Leader Cable	UL / cUL	50 ft (15.2 m)	108-000041-00	910503700320
	CE		108-000041-01	910503700320
Jumper Cable	UL / cUL	End-to-End	108-000039-00	910503700314
		1 ft (305 mm)	108-000039-01	910503700315
		5 ft (1.5 m)	108-000039-02	910503700316
	CE	End-to-End	108-000040-00	910503700317
		1 ft (305 mm)	108-000040-01	910503700318
		5 ft (1.5 m)	108-000040-02	910503700319
Glare Shield		1 ft (305 mm)	120-000081-00	910503700745
		2 ft (610 mm)	120-000081-01	910503700746
		3 ft (914 mm)	120-000081-02	910503700747
		4 ft (1.2 m)	120-000081-03	910503700748

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-000009-04 R04 07-09

Shaper™
shaperlighting.com

DESCRIPTION

683-WP Cylinder Wall Sconce features an aluminum cylinder. The 683/4-WP is ADA compliant.

		Type
Catalog #		A
Project		
Comments		Date
Prepared by		

SPECIFICATION FEATURES

Material
Solid aluminum with open bottom and enclosed top. [Dark Sky Compliant]

Finish
Premium TGIC polyester powder coat paint, 2.5 mil nominal thickness for superior protection against fade and wear. Standard: Black (BK) or White (WH). Premium: Grey (GY), Dark Platinum (DP), Graphite Metallic (GRM), Silver Metallic (SM), Gold Metallic (GM), Bronze Metallic (BM), Custom Color (CC).

Optics
Refer to www.shaperlighting.com for complete photometrics.

Ballast
Integral electronic HPF, multi-volt 120/277V (347V Canada), thermally protected with end-of-life circuitry to accommodate the specified lamp wattage.

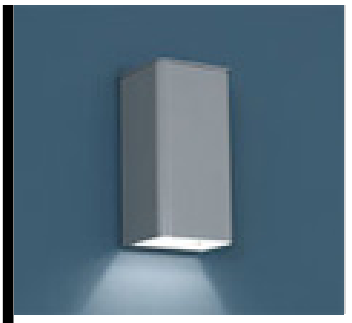
Lamp/Socket
One (1) 13W (2GX7) 4-pin quad CFL lamp, one (1) 26W (GX24q-3) triple tube CFL lamp or one (1) 60W A-19 lamp. CFL socket injection molded plastic. INC socket fired ceramic rated for 660W-250V. Lamps furnished by others.

Installation
Supplied with a universal circular strap for a standard 4" J-box or plaster ring.

Options
Custom logo - Contact factory. Energy Star Rating - Consult factory.

Labels
U.L. and C.U.L. approved for wet location. ADA compliant (683/4-WP).

Modifications
Shaper's skilled craftspeople with their depth of experience offer the designer the flexibility to modify standard exterior wall luminaires for project specific solutions. Contact the factory regarding scale options, unique finishes, mounting, additional materials/colors, or decorative detailing.



683-WP SERIES
683/4-WP SERIES

Exterior Wall Luminaire
Starter Collection Cylinder

ORDERING INFORMATION

682/4-WP	26	277V	SM

Series
683-WP: Cylinder Wall Sconce
683/4-WP: ADA Compliant Cylinder Wall Sconce

Lamp
CFL/1/13
CFL/1/26
INC/1/60

Voltage
120V
277V[1]
347V[1]

Finish [2]
Standard
BK: Black
WH: White
Premium
BM: Bronze Metallic
CC: Custom Color
DP: Dark Platinum
GM: Gold Metallic
GRM: Graphite Metallic
GY: Grey
SM: Silver Metallic

Notes: 1 Available with CFL only.
2 Premium TGIC polyester powder coat paint, 2.5 mil nominal thickness for superior protection against fade and wear.

AMERICAN DISABILITIES ACT (ADA)
Shaper offers a large selection of ADA interior and exterior wall luminaires. ADA requires all fixtures below 68" to have a maximum projection of 4".

DARK SKY
Shaper offers a selection of exterior luminaires that are "Dark Sky Compliant". The IESNA (Illuminating Engineering Society of North America) defines Full Cut-Off as fixtures with light distributions of 0% candela at 90° and 10% at 80°. Full Cut-Off luminaires carry the endorsement of the International Dark-Sky Association (IDA) for their effectiveness in limiting the detrimental effects of sky glow, also referred to as "Light Pollution". Many exterior luminaires offer a clear, tempered glass option that meets the IES criteria for Full Cut-Off.

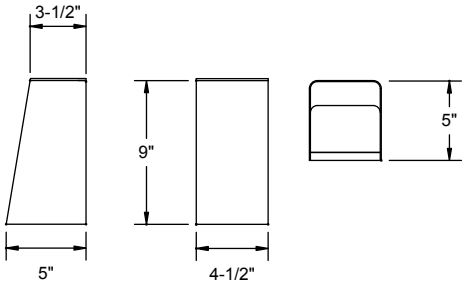
ENERGY STAR
Shaper now offers a wide variety of fixtures that can be provided with an Energy Star Rating.

STARTER COLLECTION
Shaper's exclusive Starter Collection fixtures are featured throughout the Shaper product line. The concept of offering highly styled, affordable fixtures was introduced over fourteen years ago and has become one of our fastest growing lines. The design premise, basic construction, clean lines and unadorned shapes are highly desirable in modern architectural environments.

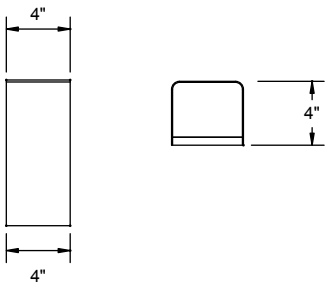
Refer to the Icon Legend
Link on shaperlighting.com.

Specifications and Dimensions subject to change without notice.
Consult your representative for additional options and finishes.

DIMENSIONS



683-WP



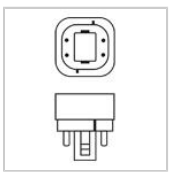
683/4-WP

GE Lighting

97613 - F26DBX/841/ECO4P

GE Ecolux® Biax® T4 - Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

High Color Rendering
Energy Savings



GENERAL CHARACTERISTICS

Lamp Type	Compact Fluorescent - Plug-In
Bulb	T4
Base	G24q-3
Wattage	26
Voltage	120/105
Rated Life	12000 hrs
Starting Temperature	0 °C (32 °F)
Cathode Resistance	2.7 Ohm
LEED-EB MR Credit	232 picograms Hg per mean lumen hour
Rated Life (rapid start) @ Time	20000.0 @ 12.0 h
Additional Info	Dimmable with appropriate dimming ballast./End of Life Protection (EOL)/TCLP compliant
Primary Application	Facilities;Retail Display;Hospitality;Office;Restaurant;Wa

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	1710
Mean Lumens	1440
Nominal Initial Lumens per Watt	65
Color Temperature	4100 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

Current (max)	5.25 A
Open Circuit Voltage (after preheating)	240 V
Open Circuit Voltage Across Starter	198 V
Lamp Current	0.325 A
Preheat Voltage	4.25 V
Current Crest Factor	1.7
Supply Current Frequency	60 Hz

DIMENSIONS

Maximum Overall Length (MOL)	6.4000 in(162.6 mm)
Nominal Length	6.400 in(162.6 mm)
Base Face to Top of Lamp	5.800 in(147.3 mm)

PRODUCT INFORMATION

Product Code	97613
Description	F26DBX/841/ECO4P
ANSI Code	60901-IEC-2562-2
Standard Package	BUNDLE
Standard Package GTIN	
Standard Package Quantity	50
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	50
UPC	043168976138

CAUTIONS & WARNINGS

Caution

• Lamp may shatter and cause injury if broken
  - Remove and install by grasping only plastic portion of the lamp.

NOTES

• 4-Pin lamp minimum starting temperature is a function of the ballast. Most ballasts are rated with a minimum starting temperature of 50 degrees F (10 C). Ballasts are also available that provide reliable starting to 0 degrees F (-18C) and -20 F (-29C).

• Based on 60Hz reference circuit.

• Fluorescent lamp lumens decline during life

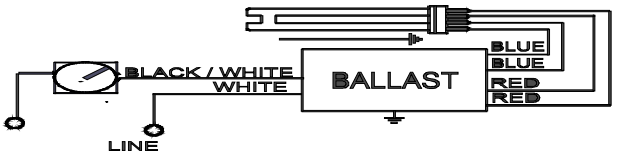
PHILIPS
ADVANCE

VEZ-1T42-M2-BS	
Brand Name	MARK 10 POWERLINE
Ballast Type	Electronic Dimming
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (Watts) (min/max)	Ballast Factor (min/max)	MAX THD %	Power Factor	Lamp Current Crest Factor	B.E.F.
* CFQ26W/G24Q	1	26	50/10	0.11	08/31	0.05/1.05	10	0.98	1.6	3.39
CFTR26W/GX24Q	1	26	50/10	0.11	08/31	0.05/1.05	10	0.98	1.6	3.39
CFTR32W/GX24Q	1	32	50/10	0.14	09/38	0.05/1.05	10	0.98	1.6	2.76
CFTR42W/GX24Q	1	42	50/10	0.18	10/49	0.05/1.05	10	0.99	1.6	2.14

Wiring Diagram

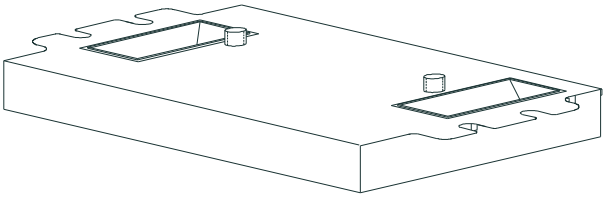


Diag. 134

The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
4.98 "	3.00 "	1.29 "	2.00 "
4 49/50	3	1 29/100	2
12.6 cm	7.6 cm	3.3 cm	5.1 cm

Revised 09/10/2002

Data is based upon tests performed by Philips Lighting Electronics N.A. in a controlled environment and is representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

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10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
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Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

PHILIPS
ADVANCE

VEZ-1T42-M2-BS	
Brand Name	MARK 10 POWERLINE
Ballast Type	Electronic Dimming
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be available in a plastic/metal can or all metal can construction to meet all plenum requirements.

1.3 Ballast shall be provided with poke-in wire trap connectors or integral leads color coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start.

2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.3 Ballast shall operate from 60 Hz input source of 120V, 277V or 347V as applicable with sustained variations of +/- 10% (voltage and frequency).

2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.5 Ballast shall have a Power Factor greater than 0.98 at full light output and greater than 0.90 throughout the dimming range for primary lamp.

2.6 Ballast shall have a minimum ballast factor of 1.00 at maximum light output and 0.05 at minimum light output for primary lamp application.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 10% at maximum light output when operated at nominal line voltage with primary lamp. Total Harmonic Current (THC) at minimum light output shall not exceed THC at maximum light output.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of 10C (50F) for primary lamp.

2.11 Ballast shall provide Lamp EOL Protection Circuit for all T5, T5/HO, and CFL lamps.

2.12 Ballast shall control lamp light output from 100% - 5% relative light output for T8 and CFL lamps and 100% - 1% relative light output for T5/HO lamps.

2.13 Ballast shall ignite the lamps at any light output setting without first going to another output setting.

2.14 Ballast shall tolerate sustained open circuit and short circuit output conditions.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.4 Ballast shall comply with ANSI C82.11 where applicable.

3.5 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

3.6 Ballast shall comply with NEMA 410 for in-rush current limits.

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9001 Quality System Standards.

4.2 Ballast shall carry a ____ warranty from date of manufacture against defects in material or workmanship for operation at a maximum case temperature of ____ (Go to our web site for up to date warranty information: www.philips.com/advancewarranty.

4.3 Manufacturer shall have a twenty-year history of producing electronic ballasts for the North American market.

4.4 Ballast shall be controlled by a compatible Mark 10 Powerline two-wire dimmer.

4.5 Ballast shall be Philips Advance part # _____ or approved equal.

Revised 09/10/2002

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LUMIÈRE® energy solutions

DESCRIPTION

Rio architectural step lights provide beauty, performance and durability. Transitional styling, low profile design and no visible fasteners provide seamless integration with architectural styles of all kinds. Logical, modular design elements facilitate fast and foolproof installation in all types of wall surfaces including drywall, concrete pour or brick/masonry. All models include IP68 rated outdoor protection, but are also suitable for indoor wall-mounted applications. All models are ADA compliant.

		Type
Catalog #		A
Project		
Comments		Date
Prepared by		

SPECIFICATION FEATURES

A ... Construction
Back box and painted fascia are die-cast from corrosion-resistant Type 383 aluminum alloy. Back box is painted white. Natural metal fascia is precision-machined from solid brass or stainless steel.

B ... Finish
Back box and fascia are double protected by a chromate conversion undercoating and polyester powdercoat paint finish. Machined, natural finish brass or stainless steel fascia is unpainted to reveal the natural beauty of the material. Brass will patina naturally over time in outdoor environments.

C ... Electrical
Fixture includes integral, electronic ballast, transformer or LED driver mounted to Lumiere's factory-assembled POWER-TRAY(TM) optical/electrical module. The POWER-TRAY(TM) module plugs directly into the back box providing fast, easy installation.

D ... Mounting
Back box is available to ship in advance for rough-in purposes. Back box includes four (4) 3/4" conduit entry ports, concrete pour cover, UP arrow and two level vials to facilitate proper alignment. Fixture also includes the patent pending FASCIAlign(TM) fascia alignment system which provides rotation of the fascia +/- 10 degrees (total of 20 degrees), insuring proper alignment.

E ... Classification / Code Compliance
UL and cUL listed, standard wet label. IP68 rated. Also suitable for indoor recessed wall-mount applications, 4W LED source is IC-rated for direct insulation contact. Manufactured to ISO 9001-2000 Quality Systems Standard. IBEW union made.

F ... Lamp
Lamp for LED source included as standard. Lamps for other sources not included (available from Lumiere as an accessory - order separately).

G ... Warranty
Lumiere warrants its fixtures against defects in materials and workmanship for three (3) years. Auxiliary equipment such as transformers, ballasts and lamps carry the original manufacturer's warranty.

Recessed Housing
Recessed housing is available to ship in advance of complete fixture for rough-in purposes. Specify option -LBB and order separately accompanying recessed housing from below:

1235-BB-C
5" back box and pour cover for concrete pour wall

1235-BB-D
5" back box and pour cover for drywall/frame construction wall

1235-BB-M
5" back box and pour cover for masonry wall

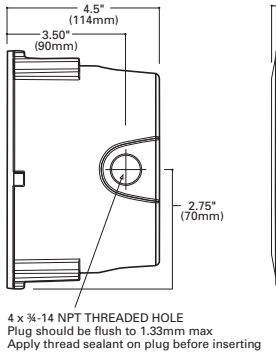


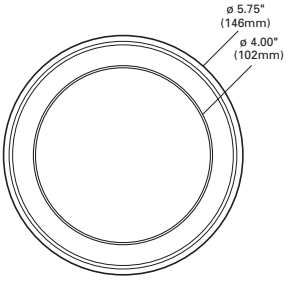

RIO
1235-RD
1235C-RD
1235E-RD
1235L-RD

4W (max.) LED
20W (max.) T3 Halogen
Low Voltage

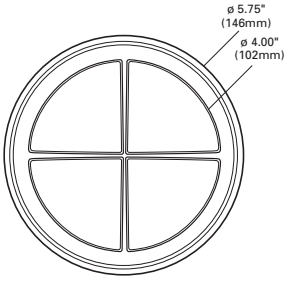
STEP LIGHT

ADA IP68

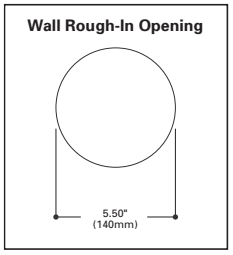


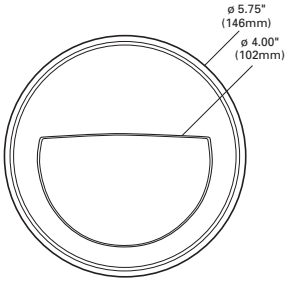


1235-RD

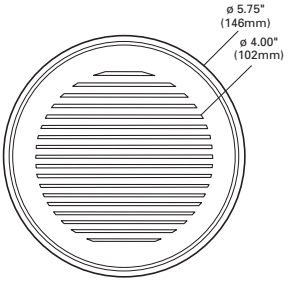


1235C-RD





1235E-RD



1235L-RD

ORDERING INFORMATION

1235-RD	M	4LED	120/12	NSS		

Model
- **1235-RD**=5" round, open fascia w/ clear, diffused lens
- **1235C-RD**=5" round, cross/guard fascia w/ clear, diffused lens
- **1235E-RD**= 5" round, eyelid fascia w/ clear, diffused lens
- **1235L-RD**= 5" round, louvered fascia w/ clear lens

Wall Type
- **C**=Concrete Pour
- **D**=Drywall
- **M**=Masonry

Source [1]

12V Halogen or LED
- **20T3**=20W / T3 / G4
- **4LED**=4W / LED (LED lamps included)[2]

Volts

12V Halogen
- **120/12**= 120/12V electronic transformer
- **277/12**= 277/12V electronic transformer

LED
- **120/12**= 120V electronic LED driver

Finish

Painted
- **BK**=black
- **BZ**=bronze
- **CS**= city silver
- **VE**= verde
- **WT**= white

Metal
- **NBR**= brass
- **NSS**= stainless steel

Options
- **LBB**=Housing and Pour Cover Shipped in Advance (select LBB option and order recessed housing separately)

Recessed Housing (order separately)

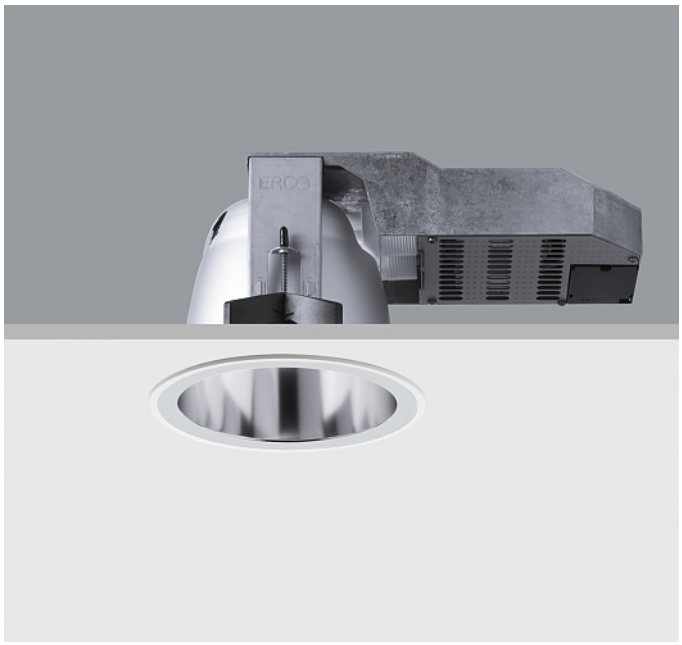
Select housing from Recessed Housing section on previous page

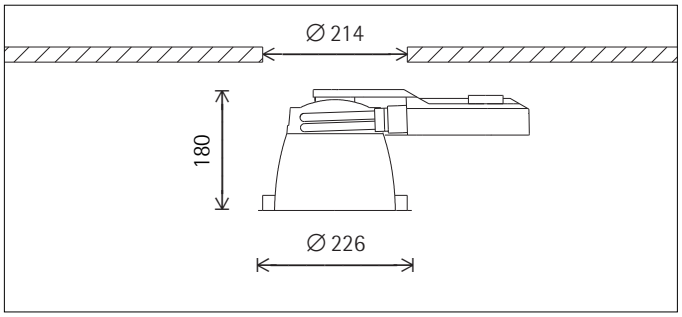
Notes: 1 Unless noted otherwise, lamps not included.
2 4W LED source is IC-rated for direct insulation contact.

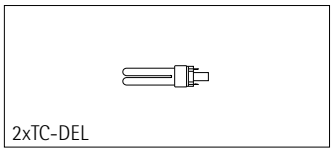
ERCO

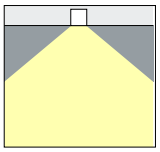
Lightcast Downlight

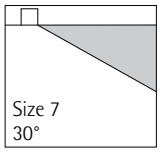
for TC-D lamps

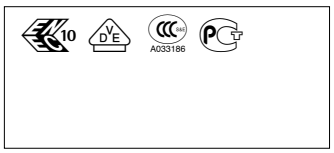






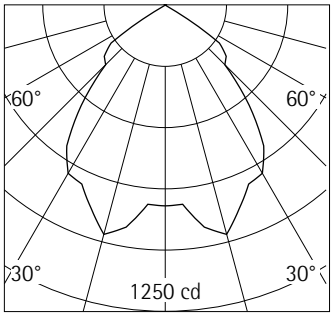






22209.000 Reflector silver
2xTC-DEL 18W G24q-2 1200lm
ECG

Product description
Housing: cast aluminium, designed as heat sink.
Mounting ring: cast aluminium, white (RAL9002) powder-coated. Fitting without tools with 4-point support and screw fixing, for ceiling thicknesses of 1-30mm.
Junction box for through-wiring, 5-pole terminal block, integrated cable clamp. Electronic control gear, plug and play connectivity with DALI version.
Darklight reflector: aluminium, bright anodised. Cut-off angle 30°.
Weight 2.10kg



2xTC-DEL 18W G24q-2 1200lm

LOR	0.68
UGR	20.7
65° <	200 cd/m²

ERCO GmbH
Brockhauser Weg 80-82
58507 Lüdenscheid
Germany
Tel.: +49 2351 551 0
Fax: +49 2351 551 300
info@erco.com

Technical Region: 230V/50Hz
We reserve the right to make technical and design changes.
Edition: 03.11.2009
Current version under
www.erco.com/22209.000

ERCO

Lightcast Downlight

Planning data

22209.000	TC-DEL 18W G24q-2 1200lm	
Connected load	P:	36 W
Connected load per 100lx	P*:	2.2 W/m^2
Number of luminaires per 100lx	n*:	6.0 1/100m^2

22209.000	TC-DEL 18W G24q-2 1200lm			
Number of luminaires per 100m^2 for	100lx	200lx	300lx	500lx
	6	13	19	31

22209.000	TC-DEL 18W G24q-2 1200lm			
Module (m)	1.2x1.8	1.8x1.8	1.8x2.4	2.4x2.4
Illuminance E_n (lx)	767	511	384	288

Correction table

Ceiling		0.70	0.70	0.70	0.50	0
Wall		0.70	0.50	0.20	0.20	0
Floor		0.50	0.20	0.20	0.10	0
k	0.6	77	58	49	49	45
k	1.0	100	77	68	67	63
k	1.5	116	90	83	80	76
k	2.5	129	100	95	90	86
k	3.0	134	103	99	93	89

Cleaning (a)	1				2				3			
Ambient conditions	P	C	N	D	P	C	N	D	P	C	N	D
LMF	0.94	0.89	0.81	0.75	0.91	0.80	0.69	0.59	0.87	0.74	0.61	0.52
RSMF	0.96	0.92	0.87	0.81	0.96	0.92	0.87	0.81	0.96	0.92	0.87	0.81

Hours of operation (h)	2000	6000	10000	1000	4000	8000
LLMF	0.94	0.89	0.85	0.97	0.91	0.87
LSF	1	1	1	1	1	1

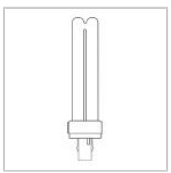
MF	LMFxRSMFxLLMFxLSF
MF	Maintainance Factor
LMF	Lumiaire Maintenance Factor
RSMF	Room Surface Maintenance Factor
LLMF	Lamp Lumens Maintenance Factor
LSF	Lamp Survival Factor
P	Room pure
C	Room clean
N	Room normal
D	Room dirty

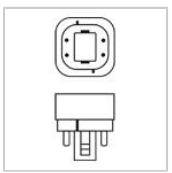
GE Lighting

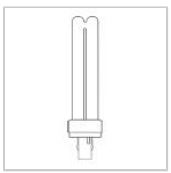
97599 - F18DBX/830/ECO4P

GE Ecolux® Biax® T4 - Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

High Color Rendering
Energy Savings







GENERAL CHARACTERISTICS

Lamp Type	Compact Fluorescent - Plug-In
Bulb	T4
Base	G24q-2
Wattage	18
Voltage	100
Rated Life	12000 hrs
Starting Temperature	0 °C (32 °F)
Cathode Resistance	6.05 Ohm
LEED-EB MR Credit	344 picograms Hg per mean lumen hour
Additional Info	Dimmable with appropriate dimming ballast./End of Life Protection (EOL)/TCLP compliant
Primary Application	Facilities;Retail Display;Hospitality;Office;Restaurant;Wa

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	1200
Mean Lumens	970
Nominal Initial Lumens per Watt	66
Color Temperature	3000 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

Current (max)	5.25 A
Open Circuit Voltage (after preheating)	220 V
Open Circuit Voltage Across Starter	198 V
Lamp Current	0.22 A
Preheat Voltage	4.25 V
Current Crest Factor	1.7
Supply Current Frequency	60 Hz

DIMENSIONS

Maximum Overall Length (MOL)	5.8000 in(147.3 mm)
Nominal Length	5.800 in(147.3 mm)
Base Face to Top of Lamp	5.200 in(132.1 mm)

PRODUCT INFORMATION

Product Code	97599
Description	F18DBX/830/ECO4P
ANSI Code	60501-IEC-2518-2
Standard Package	BUNDLE
Standard Package GTIN	
Standard Package Quantity	50
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	50
UPC	043168975995

CAUTIONS & WARNINGS

Caution

• Lamp may shatter and cause injury if broken
  - Remove and install by grasping only plastic portion of the lamp.

NOTES

• 4-Pin lamp minimum starting temperature is a function of the ballast. Most ballasts are rated with a minimum starting temperature of 50 degrees F (10 C). Ballasts are also available that provide reliable starting to 0 degrees F (-18C) and -20 F (-29C).

• Based on 60Hz reference circuit.

• Cold cathode resistance is approximately 6.0 Ohms.

• Fluorescent lamp lumens decline during life

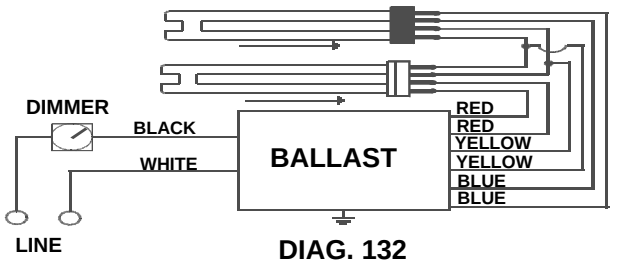
PHILIPS ADVANCE

VEZ-2Q18-M2-BS	
Brand Name	MARK 10 POWERLINE
Ballast Type	Electronic Dimming
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (Watts) (min/max)	Ballast Factor (min/max)	MAX THD %	Power Factor	Lamp Current Crest Factor	B.E.F.
* CFQ18W/G24Q	2	18	50/10	0.16	14/43	0.05/1.00	10	0.99	1.6	2.33
CFTR18W/GX24Q	2	18	50/10	0.16	14/43	0.05/1.00	10	0.99	1.6	2.33

Wiring Diagram



DIAG. 132

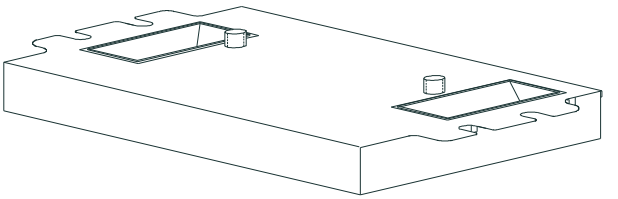
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	0	0
White	0	0
Blue	0	0
Red	0	0
Yellow	0	0
Gray		0
Violet		0

	in.	cm.
Yellow/Blue		0
Blue/White		0
Brown		0
Orange		0
Orange/Black		0
Black/White		0
Red/White		0

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
4.98 "	3.00 "	1.29 "	2.00 "
4 49/50	3	1 29/100	2
12.6 cm	7.6 cm	3.3 cm	5.1 cm

Revised 08/17/2006

Data is based upon tests performed by Philips Lighting Electronics N.A. in a controlled environment and is representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

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10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018

Tel: 800-322-2086 · Fax: 888-423-1882 · www.philips.com/advance

Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

PHILIPS
ADVANCE

VEZ-2Q18-M2-BS	
Brand Name	MARK 10 POWERLINE
Ballast Type	Electronic Dimming
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be available in a plastic/metal can or all metal can construction to meet all plenum requirements.

1.3 Ballast shall be provided with poke-in wire trap connectors or integral leads color coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start.

2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.3 Ballast shall operate from 60 Hz input source of 120V, 277V or 347V as applicable with sustained variations of +/- 10% (voltage and frequency).

2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.5 Ballast shall have a Power Factor greater than 0.98 at full light output and greater than 0.90 throughout the dimming range for primary lamp.

2.6 Ballast shall have a minimum ballast factor of 1.00 at maximum light output and 0.05 at minimum light output for primary lamp application.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 10% at maximum light output when operated at nominal line voltage with primary lamp. Total Harmonic Current (THC) at minimum light output shall not exceed THC at maximum light output.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of 10C (50F) for primary lamp.

2.11 Ballast shall provide Lamp EOL Protection Circuit for all T5, T5/HO, and CFL lamps.

2.12 Ballast shall control lamp light output from 100% - 5% relative light output for T8 and CFL lamps and 100% - 1% relative light output for T5/HO lamps.

2.13 Ballast shall ignite the lamps at any light output setting without first going to another output setting.

2.14 Ballast shall tolerate sustained open circuit and short circuit output conditions.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.4 Ballast shall comply with ANSI C82.11 where applicable.

3.5 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

3.6 Ballast shall comply with NEMA 410 for in-rush current limits.

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9001 Quality System Standards.

4.2 Ballast shall carry a ____ warranty from date of manufacture against defects in material or workmanship for operation at a maximum case temperature of ____ (Go to our web site for up to date warranty information: www.philips.com/advancewarranty.

4.3 Manufacturer shall have a twenty-year history of producing electronic ballasts for the North American market.

4.4 Ballast shall be controlled by a compatible Mark 10 Powerline two-wire dimmer.

4.5 Ballast shall be Philips Advance part # _____ or approved equal.

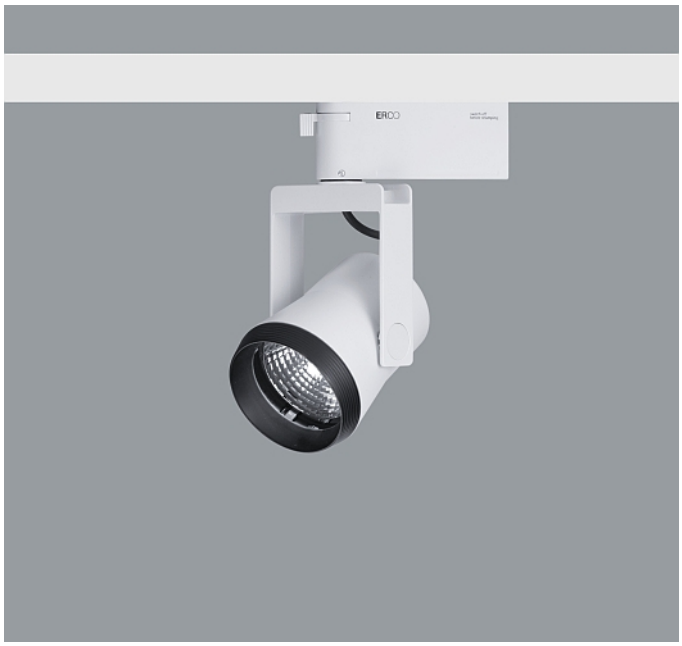
Revised 08/17/2006

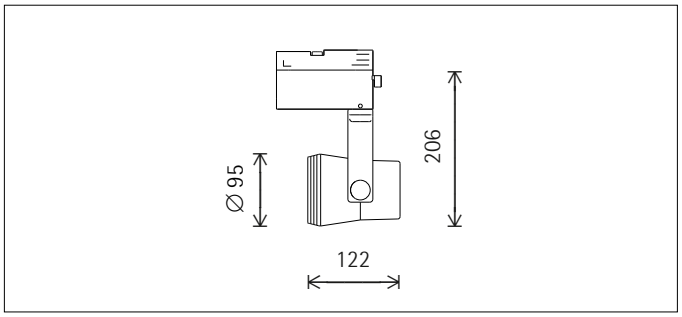
PHILIPS LIGHTING ELECTRONICS N.A.
10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Tel: 800-322-2086 · Fax: 888-423-1882 · www.philips.com/advance
Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

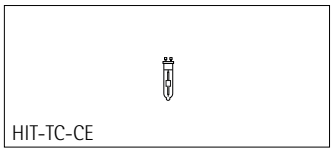
ERCO

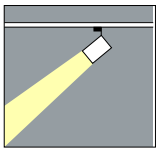
Logotec Spotlight

with transadapter for metal halide lamps



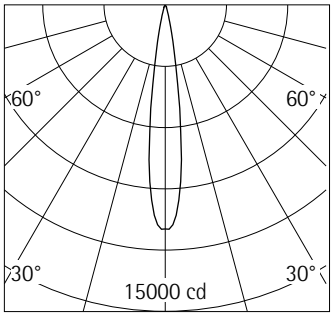






72409.000 White (RAL9002)
HIT-TC-CE 20W GU6.5 1615lm
ECG
Spherolit reflector, spot

Product description
Housing and bracket: cast aluminium, powder-coated. 0°-90° tilt. Bracket on transadapter rotatable through 360°. ERCO Transadapter for 3-circuit track: plastic. Electronic control gear. Circuit pre-selection.
Reflector: aluminium, silver, mirror-finish anodised. Safety glass.
Anti-dazzle ring: plastic, black.
Weight 0.85kg



HIT-TC-CE 20W GU6.5 1615lm

h(m)	E(lx)	D(m) 15°
1	10971	0.26
2	2743	0.53
3	1219	0.79
4	686	1.05
5	439	1.32

Mounting
ERCO 3-circuit track
Hi-trac 3-circuit track
Monopoll 3-circuit track

ERCO GmbH
Brockhauser Weg 80-82
58507 Lüdenscheid
Germany
Tel.: +49 2351 551 0
Fax: +49 2351 551 300
info@erco.com

Technical Region: 230V/50Hz
We reserve the right to make technical and design changes.
Edition: 03.11.2009
Current version under
www.erco.com/72409.000

ERCO

Logotec Spotlight

Planning data

Cleaning (a)	1				2				3			
Ambient conditions	P	C	N	D	P	C	N	D	P	C	N	D
LMF	0.94	0.89	0.81	0.75	0.91	0.80	0.69	0.59	0.87	0.74	0.61	0.52
RSMF	0.96	0.92	0.87	0.81	0.96	0.92	0.87	0.81	0.96	0.92	0.87	0.81

Hours of operation (h)	1000	2000	4000	6000	8000	9000
LLMF	0.94	0.86	0.82	0.75	0.69	0.66
LSF	1	1	1	1	1	1

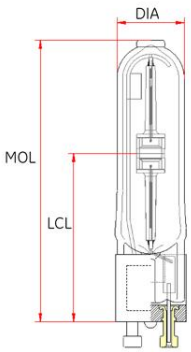
MF	LMFxRSMFxLLMFxLSF
MF	Maintainance Factor
LMF	Lumiaire Maintenance Factor
RSMF	Room Surface Maintenance Factor
LLMF	Lamp Lumens Maintenance Factor
LSF	Lamp Survival Factor
P	Room pure
C	Room clean
N	Room normal
D	Room dirty

GE Lighting

85086 - CMH20T/U830GU6.5

GE ConstantColor® PulseArc® CMH® Ceramic Metal Halide T4 - Retail Display

RoHs Compliant



CAUTIONS & WARNINGS

Caution

• Lamp may shatter and cause injury if broken
- Do not use lamp if outer glass is scratched or broken.
- Do not use excessive force when installing lamp.

• Risk of Burn
- Allow lamp to cool before handling.
- Do not turn on lamp until fully installed.

Warning

• A damaged lamp emits UV radiation which may cause eye/skin injury
- Turn power off if glass bulb is broken. Remove and dispose of lamp.

• Risk of Electric Shock
- Turn power off before inspection, installation or removal.
- Do not use where directly exposed to water or outdoors without an enclosed fixture.

• Unexpected lamp rupture may cause injury, fire, or property damage
- Do not exceed rated voltage.
- Do not turn on lamp until fully installed.
- Do not use beyond rated life.
- Do not use lamp if outer glass is scratched or broken.
- Do not use where directly exposed to water or outdoors without an enclosed fixture.
- Use in enclosed fixture rated for this product.
- Use only properly rated ballast.
- Normal handling with bare hands is acceptable. Excessive handling of the quartz outer bulb should be avoided.

• Risk of Fire
- Keep combustible materials away from lamp.
- Use in fixture approved for this product.
- Use fused or thermally protected ballast - see instructions.

GRAPHS & CHARTS

Lamp Mortality

GENERAL CHARACTERISTICS

Lamp Type	High Intensity Discharge - Ceramic Metal Halide
Bulb	T4
Base	GU6.5
Bulb Finish	Clear
Wattage	20
Rated Life	12000 hrs
Lamp Enclosure Type (LET)	Enclosed fixtures only
Base Temperature	250 K
Bulb Temperature (MAX)	400 K
LEED-EB MR Credit	198 picograms Hg per mean lumen hour
Additional Info	UV control
Primary Application	Retail Display

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	1615
Mean Lumens	1066
Nominal Initial Lumens per Watt	80
Color Temperature	3000 K
Color Rendering Index (CRI)	81

ELECTRICAL CHARACTERISTICS

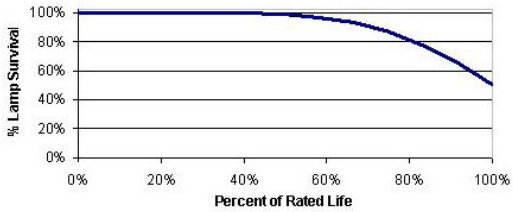
Burn Position	Universal burning position
Warm Up Time to 90%	3 min
Warm Up Time to 90% (MAX)	3 min
Hot Restart Time to 90%	5 min
Hot Restart Time to 90% (MAX)	5 min

DIMENSIONS

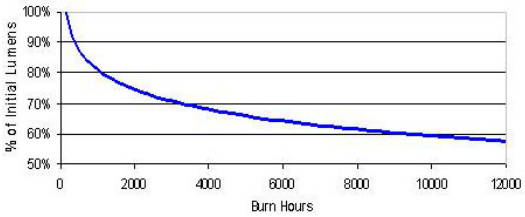
Maximum Overall Length (MOL)	2.05 cm
Bulb Diameter (DIA) (MAX)	0.47 cm
Light Center Length (LCL)	1.18 cm

PRODUCT INFORMATION

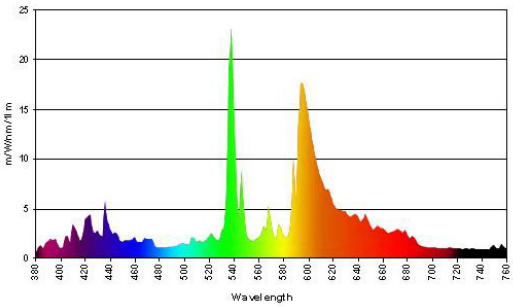
Product Code	85086
Description	CMH20T/U830GU6.5
ANSI Code	C156/M156
Standard Package	Case
Standard Package GTIN	10043168850862
Standard Package Quantity	12
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	12
UPC	043168850865



Lumen Maintenance



Spectral Power Distribution



Revised: 3/6/2009

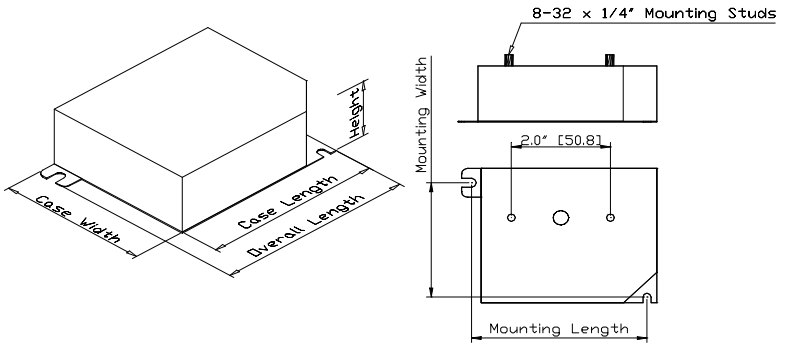
PHILIPS ADVANCE

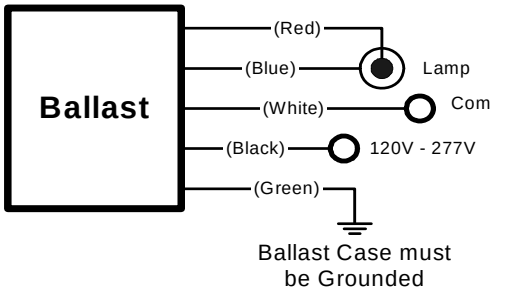
e-Vision® Electronic Ballast for Metal Halide Lamps

Catalog Number: IMH-G20-G
For 20W Metal Halide Lamps
ANSI M156
120-277 50/60Hz Electronic
Status: RELEASED

DIMENSIONS AND DATA

Lamp Number	Lamp Watts	Input Volts	Catalong Number*	Line Current (Amps)	Input Power (Watts)	Min Power Factor	Wiring Diag	Fig.	Weight (lb)	Max. Distance to Lamp (ft)
20W Watt Lamp, ANSI Code M156 Minimum Starting Temp -20°C/-4°F										
1	20	120	IMH-G20-G-XXX	0.2	24	0.95	3	G	0.9	5
		277		0.09	24					

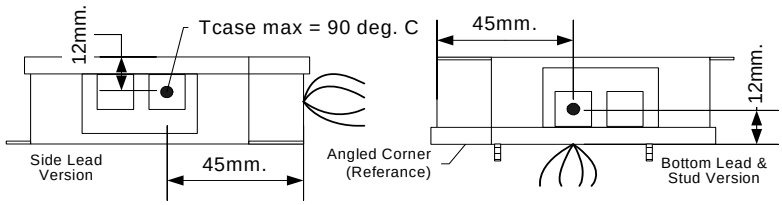




Ballast Case must be Grounded

Wiring Diagram 3

Case Figure	Overall Length	Case Length	Case Width	Height	Mountin Length	Mounting Width
G	97mm [3.8"]	90mm [3.5"]	77mm [3.0"]	30mm [1.2"]	87mm [3.4"]	67mm [2.6"]



Case Temperature Measurement Location

INSTALLATION & APPLICATION NOTES:

1. Maximum allowable case temperature is 90°C. See figure above for measurement location
2. Ignition pulse is 4 kV max
3. All leads are 9 inches long
4. Ballast output will shutdown after 20 minutes if lamp fails to ignite
5. Power must be cycled off – then on, after replacing lamp
6. Connect the red lead to the center terminals of the lamp when using screw base lamps

***Ordering Information**

Order Suffix	Description
-LF	Ballast with side exit leads and mounting feet
-BLS	Ballast with bottom exit leads and mounting studs

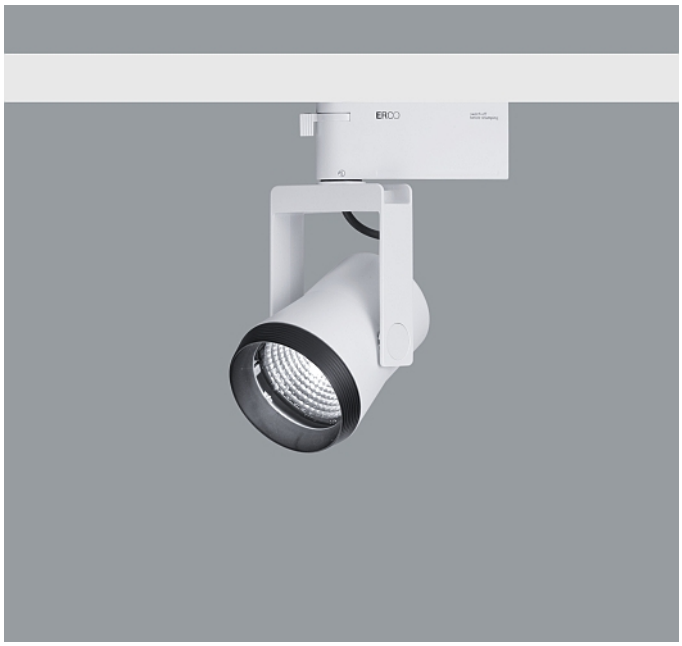
Data is based on tests performed by Philips Advance in a controlled environment and is representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

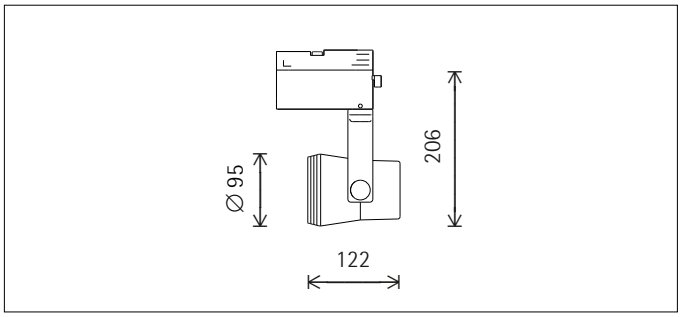
Philips Lighting Electronics N.A.
10275 West Higgins Road • Rosemont, IL 60018 • www.philips.com/advance
Tel: 800-322-2086 • Fax: 800-423-1882 • Customer Support: 800-372-3331 • OEM Support: 866-915-5886

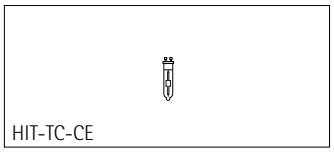
ERCO

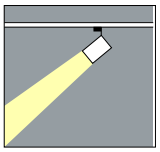
Logotec Spotlight

with transadapter for metal halide lamps



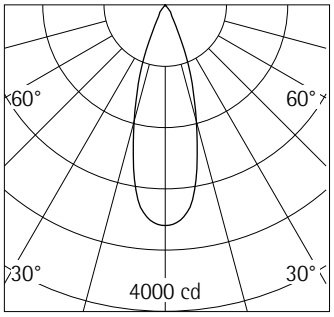






72410.000 White (RAL9002)
HIT-TC-CE 20W GU6.5 1615lm
ECG
Spherolit reflector, flood

Product description
Housing and bracket: cast aluminium, powder-coated. 0°-90° tilt. Bracket on transadapter rotatable through 360°. ERCO Transadapter for 3-circuit track: plastic. Electronic control gear. Circuit pre-selection.
Reflector: aluminium, silver, mirror-finish anodised. Safety glass.
Anti-dazzle ring: plastic, black.
Weight 0.85kg



HIT-TC-CE 20W GU6.5 1615lm

h(m)	E(lx)	D(m) 32°
1	2879	0.57
2	720	1.15
3	320	1.72
4	180	2.29
5	115	2.87

Mounting
ERCO 3-circuit track
Hi-trac 3-circuit track
Monopoll 3-circuit track

ERCO GmbH
Brockhauser Weg 80-82
58507 Lüdenscheid
Germany
Tel.: +49 2351 551 0
Fax: +49 2351 551 300
info@erco.com

Technical Region: 230V/50Hz
We reserve the right to make technical and design changes.
Edition: 03.11.2009
Current version under
www.erco.com/72410.000

ERCO

Logotec Spotlight

Planning data

Cleaning (a)	1				2				3			
Ambient conditions	P	C	N	D	P	C	N	D	P	C	N	D
LMF	0.94	0.89	0.81	0.75	0.91	0.80	0.69	0.59	0.87	0.74	0.61	0.52
RSMF	0.96	0.92	0.87	0.81	0.96	0.92	0.87	0.81	0.96	0.92	0.87	0.81

Hours of operation (h)	1000	2000	4000	6000	8000	9000
LLMF	0.94	0.86	0.82	0.75	0.69	0.66
LSF	1	1	1	1	1	1

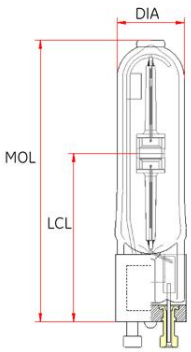
MF	LMFxRSMFxLLMFxLSF
MF	Maintainance Factor
LMF	Lumiaire Maintenance Factor
RSMF	Room Surface Maintenance Factor
LLMF	Lamp Lumens Maintenance Factor
LSF	Lamp Survival Factor
P	Room pure
C	Room clean
N	Room normal
D	Room dirty

GE Lighting

85086 - CMH20T/U830GU6.5

GE ConstantColor® PulseArc® CMH® Ceramic Metal Halide T4 - Retail Display

RoHs Compliant



CAUTIONS & WARNINGS

Caution

• Lamp may shatter and cause injury if broken
- Do not use lamp if outer glass is scratched or broken.
- Do not use excessive force when installing lamp.

• Risk of Burn
- Allow lamp to cool before handling.
- Do not turn on lamp until fully installed.

Warning

• A damaged lamp emits UV radiation which may cause eye/skin injury
- Turn power off if glass bulb is broken. Remove and dispose of lamp.

• Risk of Electric Shock
- Turn power off before inspection, installation or removal.
- Do not use where directly exposed to water or outdoors without an enclosed fixture.

• Unexpected lamp rupture may cause injury, fire, or property damage
- Do not exceed rated voltage.
- Do not turn on lamp until fully installed.
- Do not use beyond rated life.
- Do not use lamp if outer glass is scratched or broken.
- Do not use where directly exposed to water or outdoors without an enclosed fixture.
- Use in enclosed fixture rated for this product.
- Use only properly rated ballast.
- Normal handling with bare hands is acceptable. Excessive handling of the quartz outer bulb should be avoided.

• Risk of Fire
- Keep combustible materials away from lamp.
- Use in fixture approved for this product.
- Use fused or thermally protected ballast - see instructions.

GRAPHS & CHARTS

Lamp Mortality

GENERAL CHARACTERISTICS

Lamp Type	High Intensity Discharge - Ceramic Metal Halide
Bulb	T4
Base	GU6.5
Bulb Finish	Clear
Wattage	20
Rated Life	12000 hrs
Lamp Enclosure Type (LET)	Enclosed fixtures only
Base Temperature	250 K
Bulb Temperature (MAX)	400 K
LEED-EB MR Credit	198 picograms Hg per mean lumen hour
Additional Info	UV control
Primary Application	Retail Display

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	1615
Mean Lumens	1066
Nominal Initial Lumens per Watt	80
Color Temperature	3000 K
Color Rendering Index (CRI)	81

ELECTRICAL CHARACTERISTICS

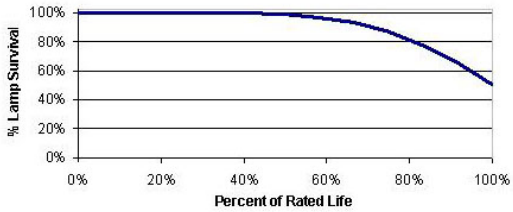
Burn Position	Universal burning position
Warm Up Time to 90%	3 min
Warm Up Time to 90% (MAX)	3 min
Hot Restart Time to 90%	5 min
Hot Restart Time to 90% (MAX)	5 min

DIMENSIONS

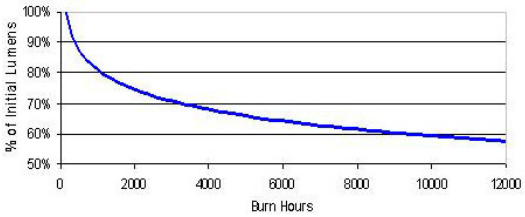
Maximum Overall Length (MOL)	2.05 cm
Bulb Diameter (DIA) (MAX)	0.47 cm
Light Center Length (LCL)	1.18 cm

PRODUCT INFORMATION

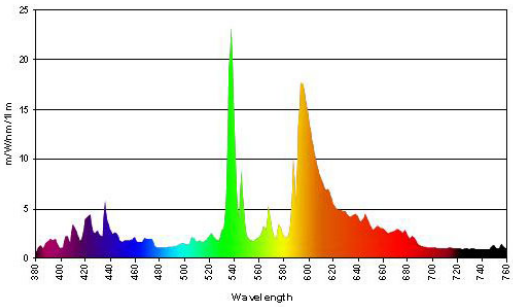
Product Code	85086
Description	CMH20T/U830GU6.5
ANSI Code	C156/M156
Standard Package	Case
Standard Package GTIN	10043168850862
Standard Package Quantity	12
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	12
UPC	043168850865



Lumen Maintenance



Spectral Power Distribution



Revised: 3/6/2009

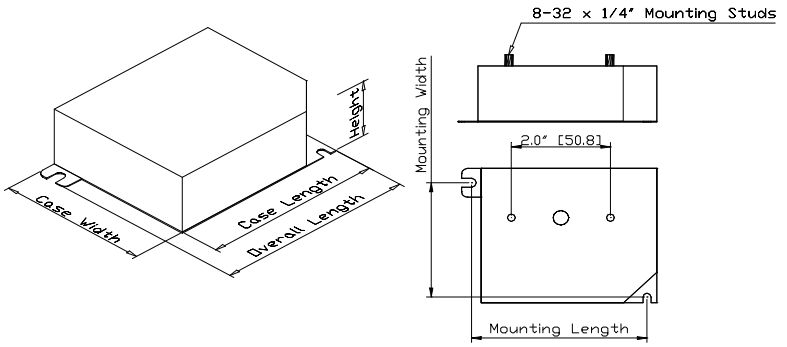
PHILIPS ADVANCE

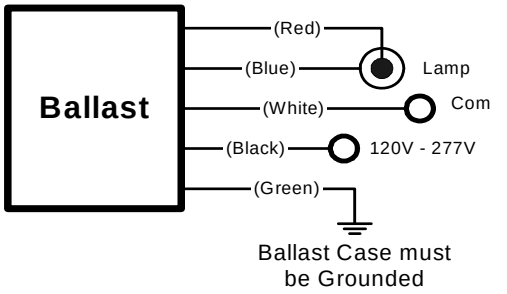
e-Vision® Electronic Ballast for Metal Halide Lamps

Catalog Number: IMH-G20-G
For 20W Metal Halide Lamps
ANSI M156
120-277 50/60Hz Electronic
Status: RELEASED

DIMENSIONS AND DATA

Lamp Number	Lamp Watts	Input Volts	Catalong Number*	Line Current (Amps)	Input Power (Watts)	Min Power Factor	Wiring Diag	Fig.	Weight (lb)	Max. Distance to Lamp (ft)
20W Watt Lamp, ANSI Code M156 Minimum Starting Temp -20°C/-4°F										
1	20	120	IMH-G20-G-XXX	0.2	24	0.95	3	G	0.9	5
		277		0.09	24					

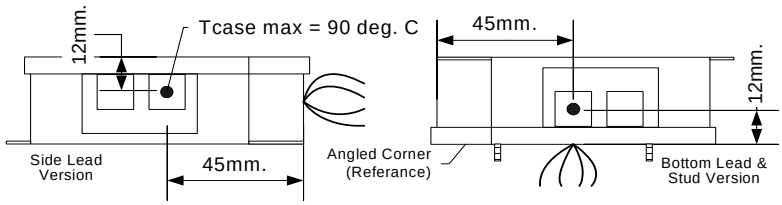




Ballast Case must be Grounded

Wiring Diagram 3

Case Figure	Overall Length	Case Length	Case Width	Height	Mountin Length	Mounting Width
G	97mm [3.8"]	90mm [3.5"]	77mm [3.0"]	30mm [1.2"]	87mm [3.4"]	67mm [2.6"]



Case Temperature Measurement Location

INSTALLATION & APPLICATION NOTES:

1. Maximum allowable case temperature is 90°C. See figure above for measurement location
2. Ignition pulse is 4 kV max
3. All leads are 9 inches long
4. Ballast output will shutdown after 20 minutes if lamp fails to ignite
5. Power must be cycled off – then on, after replacing lamp
6. Connect the red lead to the center terminals of the lamp when using screw base lamps

***Ordering Information**

Order Suffix	Description
-LF	Ballast with side exit leads and mounting feet
-BLS	Ballast with bottom exit leads and mounting studs

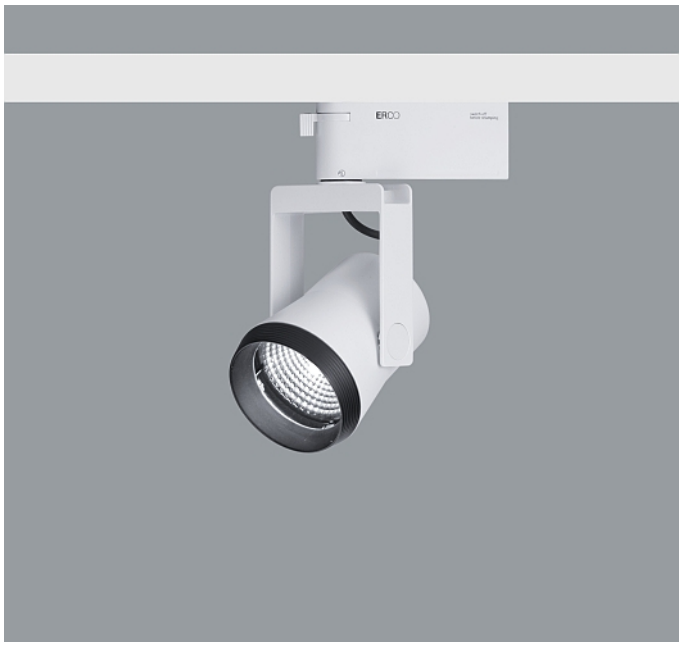
Data is based on tests performed by Philips Advance in a controlled environment and is representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

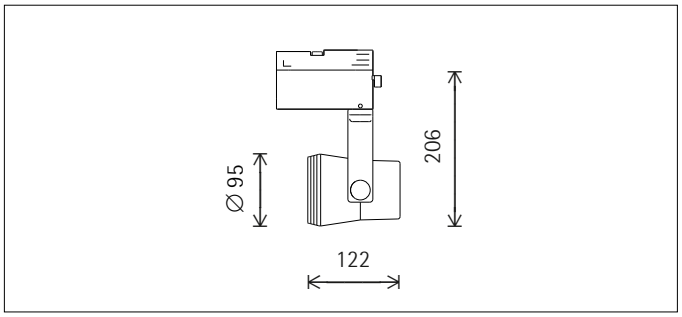
Philips Lighting Electronics N.A.
10275 West Higgins Road • Rosemont, IL 60018 • www.philips.com/advance
Tel: 800-322-2086 • Fax: 800-423-1882 • Customer Support: 800-372-3331 • OEM Support: 866-915-5886

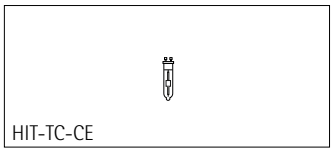
ERCO

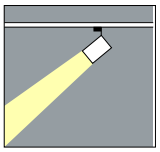
Logotec Spotlight

with transadapter for metal halide lamps



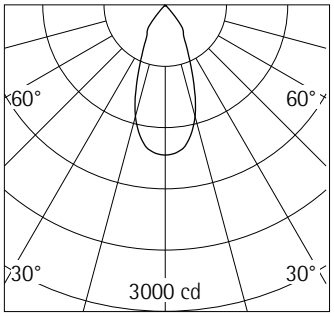






72411.000 White (RAL9002)
HIT-TC-CE 20W GU6.5 1615lm
ECG
Spherolit reflector, wide flood

Product description
Housing and bracket: cast aluminium, powder-coated. 0°-90° tilt. Bracket on transadapter rotatable through 360°. ERCO Transadapter for 3-circuit track: plastic. Electronic control gear. Circuit pre-selection.
Reflector: aluminium, silver, mirror-finish anodised. Safety glass.
Anti-dazzle ring: plastic, black.
Weight 0.85kg



HIT-TC-CE 20W GU6.5 1615lm

h(m)	E(lx)	D(m) 43°
1	1470	0.79
2	368	1.58
3	163	2.36
4	92	3.15
5	59	3.94

Mounting
ERCO 3-circuit track
Hi-trac 3-circuit track
Monopoll 3-circuit track

ERCO GmbH
Brockhauser Weg 80-82
58507 Lüdenscheid
Germany
Tel.: +49 2351 551 0
Fax: +49 2351 551 300
info@erco.com

Technical Region: 230V/50Hz
We reserve the right to make technical and design changes.
Edition: 03.11.2009
Current version under
www.erco.com/72411.000

ERCO

Logotec Spotlight

Planning data

Cleaning (a)	1				2				3			
Ambient conditions	P	C	N	D	P	C	N	D	P	C	N	D
LMF	0.94	0.89	0.81	0.75	0.91	0.80	0.69	0.59	0.87	0.74	0.61	0.52
RSMF	0.96	0.92	0.87	0.81	0.96	0.92	0.87	0.81	0.96	0.92	0.87	0.81

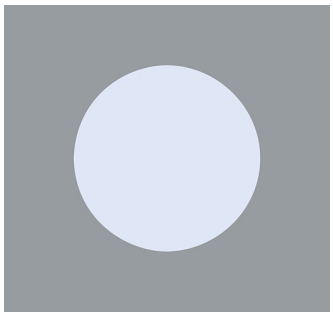
Hours of operation (h)	1000	2000	4000	6000	8000	9000
LLMF	0.94	0.86	0.82	0.75	0.69	0.66
LSF	1	1	1	1	1	1

MF	LMFxRSMFxLLMFxLSF
MF	Maintainance Factor
LMF	Lumiaire Maintenance Factor
RSMF	Room Surface Maintenance Factor
LLMF	Lamp Lumens Maintenance Factor
LSF	Lamp Survival Factor
P	Room pure
C	Room clean
N	Room normal
D	Room dirty

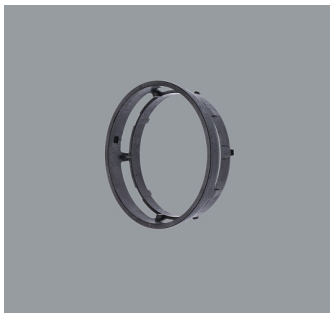
ERCO

Logotec Spotlight

Accessories



77198.000
UV filter
Only in conjunction with:
70620.000



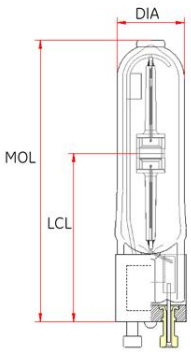
70620.000
Filter holder
Plastic.

GE Lighting

85086 - CMH20T/U830GU6.5

GE ConstantColor® PulseArc® CMH® Ceramic Metal Halide T4 - Retail Display

RoHs Compliant



CAUTIONS & WARNINGS

Caution

• Lamp may shatter and cause injury if broken
- Do not use lamp if outer glass is scratched or broken.
- Do not use excessive force when installing lamp.

• Risk of Burn
- Allow lamp to cool before handling.
- Do not turn on lamp until fully installed.

Warning

• A damaged lamp emits UV radiation which may cause eye/skin injury
- Turn power off if glass bulb is broken. Remove and dispose of lamp.

• Risk of Electric Shock
- Turn power off before inspection, installation or removal.
- Do not use where directly exposed to water or outdoors without an enclosed fixture.

• Unexpected lamp rupture may cause injury, fire, or property damage
- Do not exceed rated voltage.
- Do not turn on lamp until fully installed.
- Do not use beyond rated life.
- Do not use lamp if outer glass is scratched or broken.
- Do not use where directly exposed to water or outdoors without an enclosed fixture.
- Use in enclosed fixture rated for this product.
- Use only properly rated ballast.
- Normal handling with bare hands is acceptable. Excessive handling of the quartz outer bulb should be avoided.

• Risk of Fire
- Keep combustible materials away from lamp.
- Use in fixture approved for this product.
- Use fused or thermally protected ballast - see instructions.

GRAPHS & CHARTS

Lamp Mortality

GENERAL CHARACTERISTICS

Lamp Type	High Intensity Discharge - Ceramic Metal Halide
Bulb	T4
Base	GU6.5
Bulb Finish	Clear
Wattage	20
Rated Life	12000 hrs
Lamp Enclosure Type (LET)	Enclosed fixtures only
Base Temperature	250 K
Bulb Temperature (MAX)	400 K
LEED-EB MR Credit	198 picograms Hg per mean lumen hour
Additional Info	UV control
Primary Application	Retail Display

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	1615
Mean Lumens	1066
Nominal Initial Lumens per Watt	80
Color Temperature	3000 K
Color Rendering Index (CRI)	81

ELECTRICAL CHARACTERISTICS

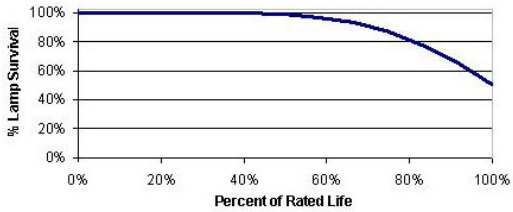
Burn Position	Universal burning position
Warm Up Time to 90%	3 min
Warm Up Time to 90% (MAX)	3 min
Hot Restart Time to 90%	5 min
Hot Restart Time to 90% (MAX)	5 min

DIMENSIONS

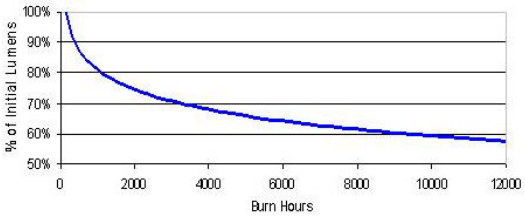
Maximum Overall Length (MOL)	2.05 cm
Bulb Diameter (DIA) (MAX)	0.47 cm
Light Center Length (LCL)	1.18 cm

PRODUCT INFORMATION

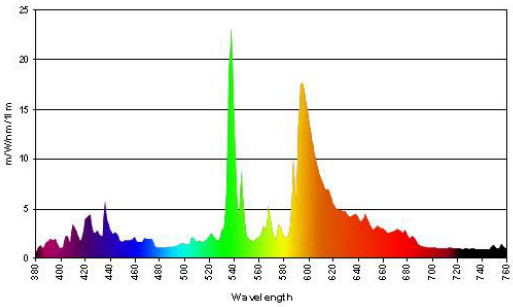
Product Code	85086
Description	CMH20T/U830GU6.5
ANSI Code	C156/M156
Standard Package	Case
Standard Package GTIN	10043168850862
Standard Package Quantity	12
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	12
UPC	043168850865



Lumen Maintenance



Spectral Power Distribution



Revised: 3/6/2009

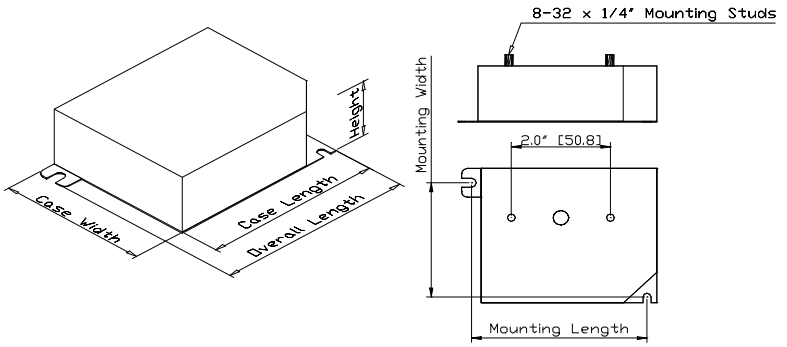
PHILIPS ADVANCE

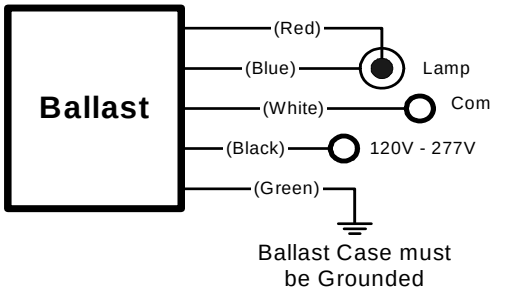
e-Vision® Electronic Ballast for Metal Halide Lamps

Catalog Number: IMH-G20-G
For 20W Metal Halide Lamps
ANSI M156
120-277 50/60Hz Electronic
Status: RELEASED

DIMENSIONS AND DATA

Lamp Number	Lamp Watts	Input Volts	Catalong Number*	Line Current (Amps)	Input Power (Watts)	Min Power Factor	Wiring Diag	Fig.	Weight (lb)	Max. Distance to Lamp (ft)
20W Watt Lamp, ANSI Code M156 Minimum Starting Temp -20°C/-4°F										
1	20	120	IMH-G20-G-XXX	0.2	24	0.95	3	G	0.9	5
		277		0.09	24					

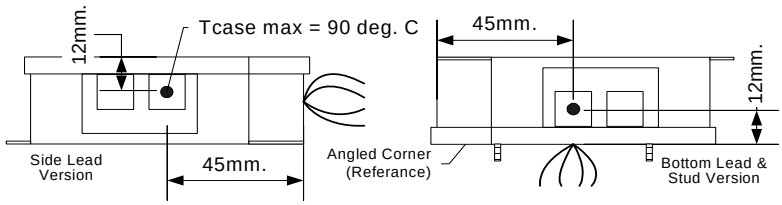




Ballast Case must be Grounded

Wiring Diagram 3

Case Figure	Overall Length	Case Length	Case Width	Height	Mountin Length	Mounting Width
G	97mm [3.8"]	90mm [3.5"]	77mm [3.0"]	30mm [1.2"]	87mm [3.4"]	67mm [2.6"]



Case Temperature Measurement Location

INSTALLATION & APPLICATION NOTES:

1. Maximum allowable case temperature is 90°C. See figure above for measurement location
2. Ignition pulse is 4 kV max
3. All leads are 9 inches long
4. Ballast output will shutdown after 20 minutes if lamp fails to ignite
5. Power must be cycled off – then on, after replacing lamp
6. Connect the red lead to the center terminals of the lamp when using screw base lamps

***Ordering Information**

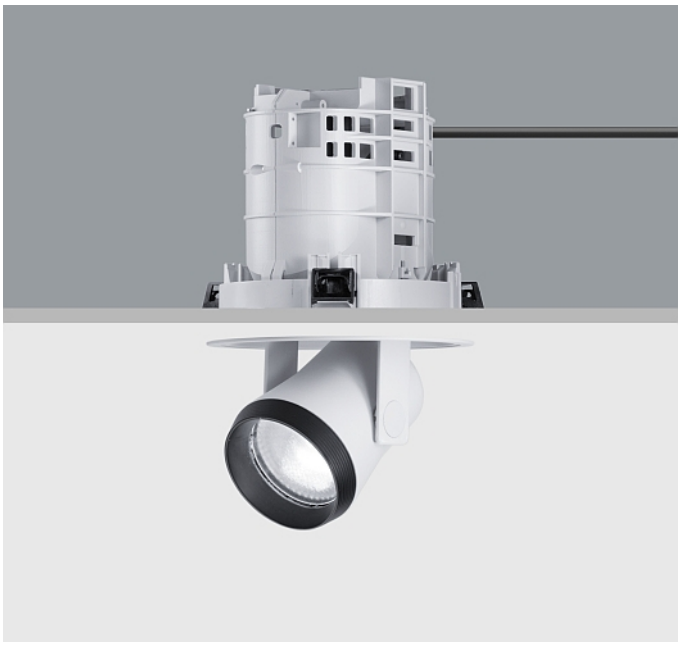
Order Suffix	Description
-LF	Ballast with side exit leads and mounting feet
-BLS	Ballast with bottom exit leads and mounting studs

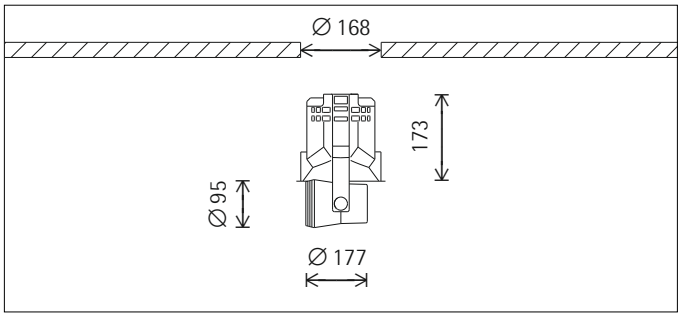
Data is based on tests performed by Philips Advance in a controlled environment and is representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

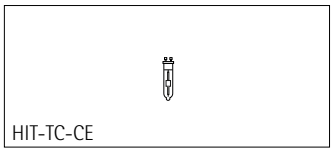
Philips Lighting Electronics N.A.
10275 West Higgins Road • Rosemont, IL 60018 • www.philips.com/advance
Tel: 800-322-2086 • Fax: 800-423-1882 • Customer Support: 800-372-3331 • OEM Support: 866-915-5886

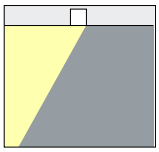
Logotec Recessed Spherolit wallwasher

for metal halide lamps









81215.000 Reflector silver
HIT-TC-CE 20W GU6.5 1615lm
Spherolit reflector, wallwash

Product description
Size 5
Recessed housing and spotlight with bracket: cast aluminium, white (RAL9002) powder-coated. Remove spotlight from the ceiling in three stages. 0°-90° tilt, 360° rotation. Mounting ring: plastic, white (RAL9002). Mounting without tools for ceiling thicknesses up to 30mm. Connection cable with plug, L 500mm. Reflector: aluminium, silver, mirror-finish anodised. Softec lens. Anti-dazzle ring: plastic, black. Control gear to be ordered separately. Weight 0.88kg

ERCO GmbH
Brockhauser Weg 80-82
58507 Lüdenscheid
Germany
Tel.: +49 2351 551 0
Fax: +49 2351 551 300
info@erco.com

Technical Region: 230V/50Hz
We reserve the right to make technical and design changes.
Edition: 03.11.2009
Current version under
www.erco.com/81215.000

Logotec Recessed Spherolit wallwasher

Planning data

Illuminance E_n (lx)
Specifications:
Number of luminaires n > 5
Wall height (m) 3
Angle of tilt 25°
HIT-TC-CE 20W GU6.5 1615lm

Offset from wall (m)	1.00		1.25	
Luminaire spacing (m)	1.00		1.25	
	below the luminaire	between the luminaires	below the luminaire	between the luminaires
0.250	9	7	6	5
0.500	93	65	45	32
0.750	233	186	109	84
1.000	323	291	181	155
1.250	327	318	212	195
1.500	285	285	210	204
1.750	237	239	189	188
2.000	195	197	164	165
2.250	160	161	140	142
2.500	131	132	120	121
2.750	108	108	102	103

Cleaning (a)	1				2				3			
Ambient conditions	P	C	N	D	P	C	N	D	P	C	N	D
LMF	0.94	0.88	0.82	0.77	0.91	0.83	0.77	0.71	0.89	0.79	0.73	0.65
RSMF	0.96	0.92	0.87	0.81	0.96	0.92	0.87	0.81	0.96	0.92	0.87	0.81

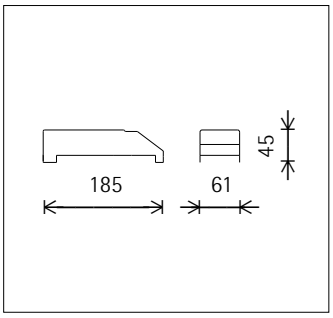
Hours of operation (h)	1000	2000	4000	6000	8000	9000
LLMF	0.94	0.86	0.82	0.75	0.69	0.66
LSF	1	1	1	1	1	1

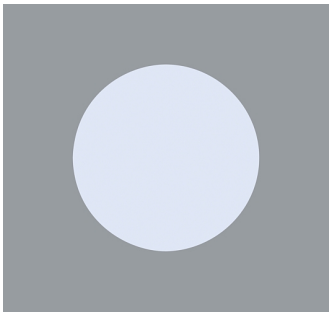
MF	LMFxRSMFxLLMFxLSF
MF	Maintainance Factor
LMF	Lumiaire Maintenance Factor
RSMF	Room Surface Maintenance Factor
LLMF	Lamp Lumens Maintenance Factor
LSF	Lamp Survival Factor
P	Room pure
C	Room clean
N	Room normal
D	Room dirty

Logotec Recessed Spherolit wallwasher

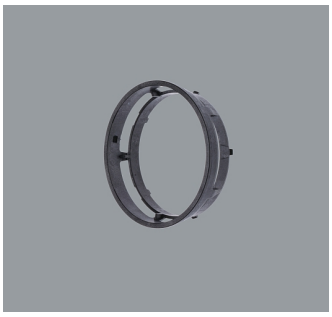
Accessories

83669.000
Control gear
for HIT-TC-CE 20W, G8.5 and GU6.5 and HIT-CE 20W, G12 and HIPAR51-CE-P 20W, GX10.
Metal, black powder-coated.
Electronic control gear 220-240V, 50-60Hz. Strain relief. Through-wiring possible. 5-pole terminal block. Luminaire connection cable with plug connection, L 200mm.
Weight 0.36kg

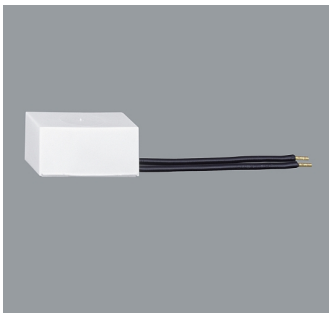




77198.000
UV filter
Only in conjunction with:
70620.000



70620.000
Filter holder
Plastic.



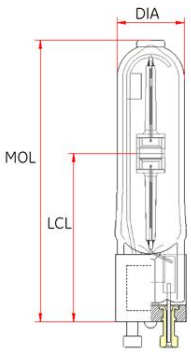
83819.000
Overvoltage protection device
for max. 10 electronic transformers.
L 45mm, B 25mm, H 22mm.
2x1,5mm^2, L 80mm.
Weight 0.05kg

GE Lighting

85086 - CMH20T/U830GU6.5

GE ConstantColor® PulseArc® CMH® Ceramic Metal Halide T4 - Retail Display

RoHs Compliant



CAUTIONS & WARNINGS

Caution

• Lamp may shatter and cause injury if broken
- Do not use lamp if outer glass is scratched or broken.
- Do not use excessive force when installing lamp.

• Risk of Burn
- Allow lamp to cool before handling.
- Do not turn on lamp until fully installed.

Warning

• A damaged lamp emits UV radiation which may cause eye/skin injury
- Turn power off if glass bulb is broken. Remove and dispose of lamp.

• Risk of Electric Shock
- Turn power off before inspection, installation or removal.
- Do not use where directly exposed to water or outdoors without an enclosed fixture.

• Unexpected lamp rupture may cause injury, fire, or property damage
- Do not exceed rated voltage.
- Do not turn on lamp until fully installed.
- Do not use beyond rated life.
- Do not use lamp if outer glass is scratched or broken.
- Do not use where directly exposed to water or outdoors without an enclosed fixture.
- Use in enclosed fixture rated for this product.
- Use only properly rated ballast.
- Normal handling with bare hands is acceptable. Excessive handling of the quartz outer bulb should be avoided.

• Risk of Fire
- Keep combustible materials away from lamp.
- Use in fixture approved for this product.
- Use fused or thermally protected ballast - see instructions.

GRAPHS & CHARTS

Lamp Mortality

GENERAL CHARACTERISTICS

Lamp Type	High Intensity Discharge - Ceramic Metal Halide
Bulb	T4
Base	GU6.5
Bulb Finish	Clear
Wattage	20
Rated Life	12000 hrs
Lamp Enclosure Type (LET)	Enclosed fixtures only
Base Temperature	250 K
Bulb Temperature (MAX)	400 K
LEED-EB MR Credit	198 picograms Hg per mean lumen hour
Additional Info	UV control
Primary Application	Retail Display

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	1615
Mean Lumens	1066
Nominal Initial Lumens per Watt	80
Color Temperature	3000 K
Color Rendering Index (CRI)	81

ELECTRICAL CHARACTERISTICS

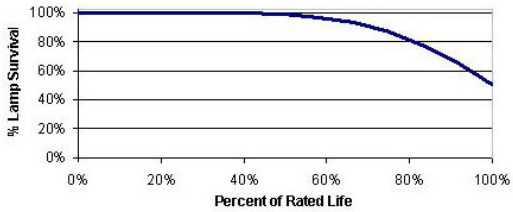
Burn Position	Universal burning position
Warm Up Time to 90%	3 min
Warm Up Time to 90% (MAX)	3 min
Hot Restart Time to 90%	5 min
Hot Restart Time to 90% (MAX)	5 min

DIMENSIONS

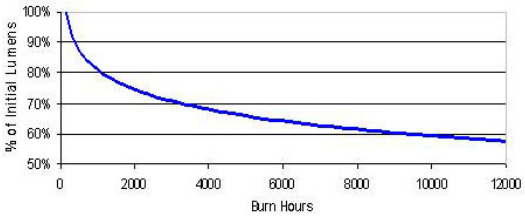
Maximum Overall Length (MOL)	2.05 cm
Bulb Diameter (DIA) (MAX)	0.47 cm
Light Center Length (LCL)	1.18 cm

PRODUCT INFORMATION

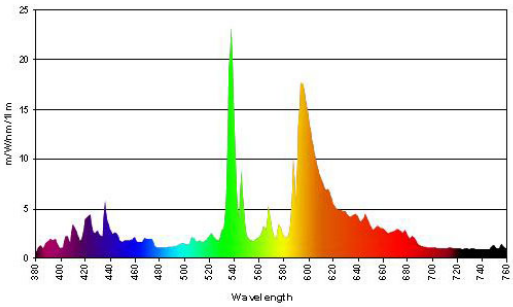
Product Code	85086
Description	CMH20T/U830GU6.5
ANSI Code	C156/M156
Standard Package	Case
Standard Package GTIN	10043168850862
Standard Package Quantity	12
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	12
UPC	043168850865



Lumen Maintenance



Spectral Power Distribution



Revised: 3/6/2009

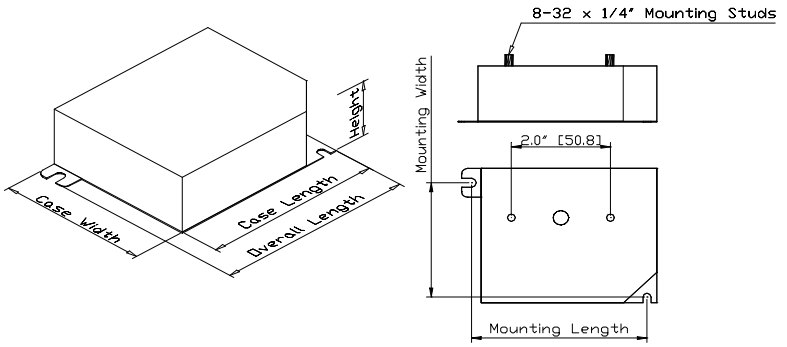
PHILIPS ADVANCE

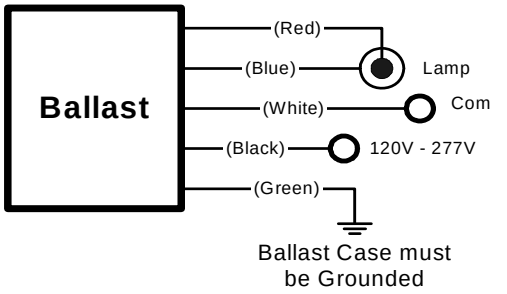
e-Vision® Electronic Ballast for Metal Halide Lamps

Catalog Number: IMH-G20-G
For 20W Metal Halide Lamps
ANSI M156
120-277 50/60Hz Electronic
Status: RELEASED

DIMENSIONS AND DATA

Lamp Number	Lamp Watts	Input Volts	Catalong Number*	Line Current (Amps)	Input Power (Watts)	Min Power Factor	Wiring Diag	Fig.	Weight (lb)	Max. Distance to Lamp (ft)
20W Watt Lamp, ANSI Code M156 Minimum Starting Temp -20°C/-4°F										
1	20	120	IMH-G20-G-XXX	0.2	24	0.95	3	G	0.9	5
		277		0.09	24					

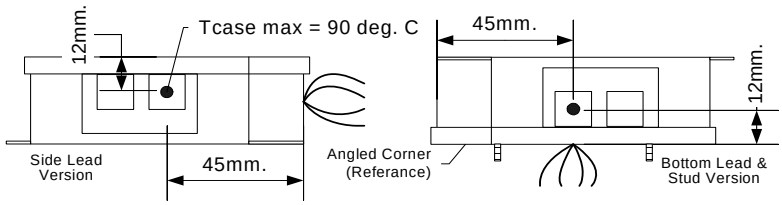




Ballast Case must be Grounded

Wiring Diagram 3

Case Figure	Overall Length	Case Length	Case Width	Height	Mountin Length	Mounting Width
G	97mm [3.8"]	90mm [3.5"]	77mm [3.0"]	30mm [1.2"]	87mm [3.4"]	67mm [2.6"]



Case Temperature Measurement Location

INSTALLATION & APPLICATION NOTES:

1. Maximum allowable case temperature is 90°C. See figure above for measurement location
2. Ignition pulse is 4 kV max
3. All leads are 9 inches long
4. Ballast output will shutdown after 20 minutes if lamp fails to ignite
5. Power must be cycled off – then on, after replacing lamp
6. Connect the red lead to the center terminals of the lamp when using screw base lamps

***Ordering Information**

Order Suffix	Description
-LF	Ballast with side exit leads and mounting feet
-BLS	Ballast with bottom exit leads and mounting studs

Data is based on tests performed by Philips Advance in a controlled environment and is representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

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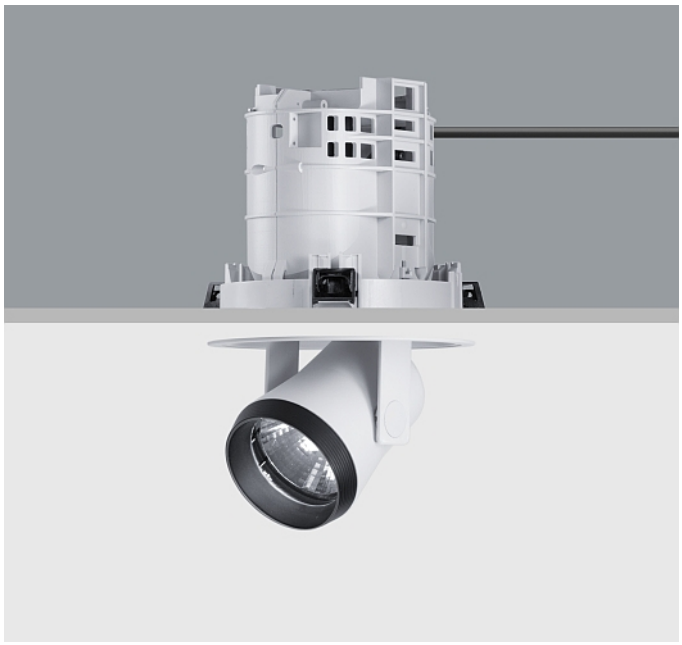
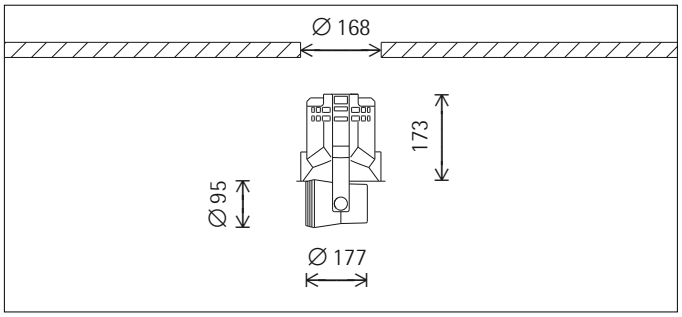
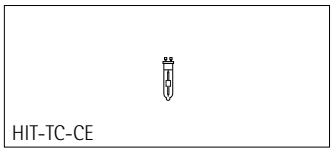
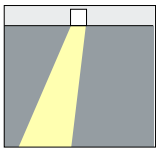
Logotec Recessed spotlight

for metal halide lamps



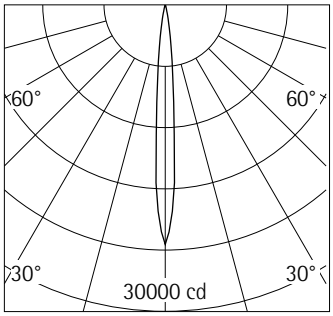






81210.000 Reflector silver
HIT-TC-CE 20W GU6.5 1615lm
Spherolit reflector, narrow spot

Product description
Size 5
Recessed housing and spotlight with bracket: cast aluminium, white (RAL9002) powder-coated. Remove spotlight from the ceiling in three stages. 0°-90° tilt, 360° rotation. Mounting ring: plastic, white (RAL9002). Mounting without tools for ceiling thicknesses up to 30mm. Connection cable with plug, L 500mm. Reflector: aluminium, silver, mirror-finish anodised. Safety glass. Anti-dazzle ring: plastic, black. Control gear to be ordered separately. Weight 0.88kg



HIT-TC-CE 20W GU6.5 1615lm

h(m)	E(lx)	D(m) 8°
1	23450	0.14
2	5862	0.28
3	2606	0.42
4	1466	0.56
5	938	0.70

ERCO GmbH
Brockhauser Weg 80-82
58507 Lüdenscheid
Germany
Tel.: +49 2351 551 0
Fax: +49 2351 551 300
info@erco.com

Technical Region: 230V/50Hz
We reserve the right to make technical and design changes.
Edition: 03.11.2009
Current version under
www.erco.com/81210.000

ERCO

Logotec Recessed spotlight

Planning data

Cleaning (a)	1				2				3			
Ambient conditions	P	C	N	D	P	C	N	D	P	C	N	D
LMF	0.94	0.88	0.82	0.77	0.91	0.83	0.77	0.71	0.89	0.79	0.73	0.65
RSMF	0.96	0.92	0.87	0.81	0.96	0.92	0.87	0.81	0.96	0.92	0.87	0.81

Hours of operation (h)	1000	2000	4000	6000	8000	9000
LLMF	0.94	0.86	0.82	0.75	0.69	0.66
LSF	1	1	1	1	1	1

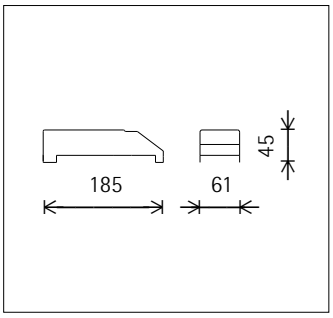
MF	LMFxRSMFxLLMFxLSF
MF	Maintainance Factor
LMF	Lumiaire Maintenance Factor
RSMF	Room Surface Maintenance Factor
LLMF	Lamp Lumens Maintenance Factor
LSF	Lamp Survival Factor
P	Room pure
C	Room clean
N	Room normal
D	Room dirty

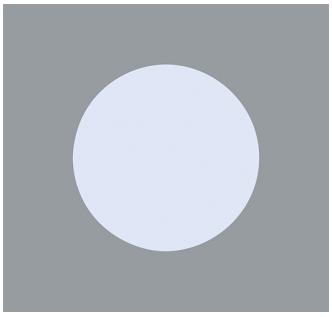
ERCO

Logotec Recessed spotlight

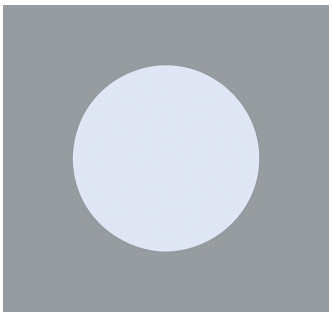
Accessories

83669.000
Control gear
for HIT-TC-CE 20W, G8.5 and GU6.5 and HIT-CE 20W, G12 and HIPAR51-CE-P 20W, GX10.
Metal, black powder-coated.
Electronic control gear 220-240V, 50-60Hz. Strain relief. Through-wiring possible. 5-pole terminal block. Luminaire connection cable with plug connection, L 200mm.
Weight 0.36kg

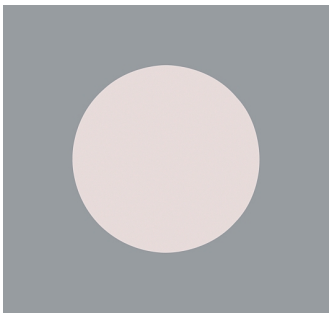




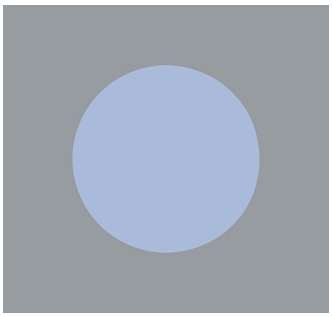
77198.000
UV filter
Only in conjunction with:
70620.000



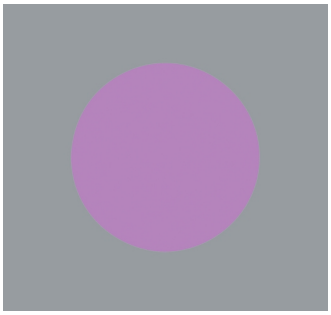
77196.000
IR filter
Only in conjunction with:
70620.000



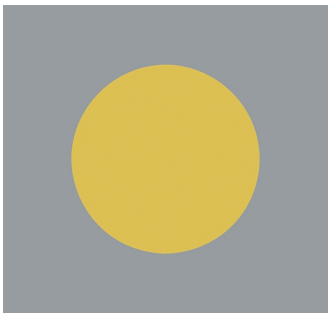
74482.000
Skintone filter
Only in conjunction with:
70620.000



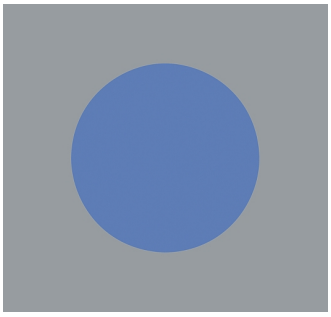
74483.000
Daylight conversion filter
Only in conjunction with:
70620.000



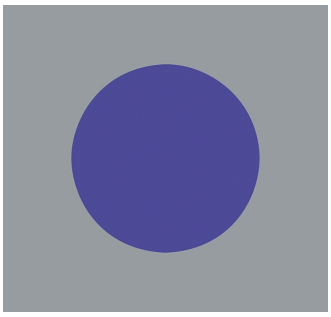
74431.000
Interference colour filter
Magenta
Only in conjunction with:
70620.000



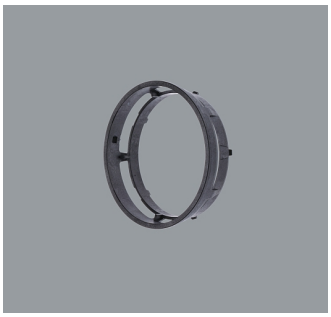
74432.000
Interference colour filter
Amber
Only in conjunction with:
70620.000



74433.000
Interference colour filter
Sky blue
Only in conjunction with:
70620.000



74434.000
Interference colour filter
Night blue
Only in conjunction with:
70620.000



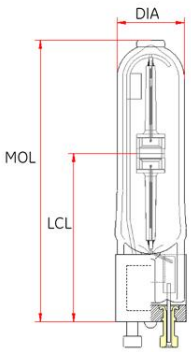
70620.000
Filter holder
Plastic.

GE Lighting

85086 - CMH20T/U830GU6.5

GE ConstantColor® PulseArc® CMH® Ceramic Metal Halide T4 - Retail Display

RoHs Compliant



CAUTIONS & WARNINGS

Caution

• Lamp may shatter and cause injury if broken
- Do not use lamp if outer glass is scratched or broken.
- Do not use excessive force when installing lamp.

• Risk of Burn
- Allow lamp to cool before handling.
- Do not turn on lamp until fully installed.

Warning

• A damaged lamp emits UV radiation which may cause eye/skin injury
- Turn power off if glass bulb is broken. Remove and dispose of lamp.

• Risk of Electric Shock
- Turn power off before inspection, installation or removal.
- Do not use where directly exposed to water or outdoors without an enclosed fixture.

• Unexpected lamp rupture may cause injury, fire, or property damage
- Do not exceed rated voltage.
- Do not turn on lamp until fully installed.
- Do not use beyond rated life.
- Do not use lamp if outer glass is scratched or broken.
- Do not use where directly exposed to water or outdoors without an enclosed fixture.
- Use in enclosed fixture rated for this product.
- Use only properly rated ballast.
- Normal handling with bare hands is acceptable. Excessive handling of the quartz outer bulb should be avoided.

• Risk of Fire
- Keep combustible materials away from lamp.
- Use in fixture approved for this product.
- Use fused or thermally protected ballast - see instructions.

GRAPHS & CHARTS

Lamp Mortality

GENERAL CHARACTERISTICS

Lamp Type	High Intensity Discharge - Ceramic Metal Halide
Bulb	T4
Base	GU6.5
Bulb Finish	Clear
Wattage	20
Rated Life	12000 hrs
Lamp Enclosure Type (LET)	Enclosed fixtures only
Base Temperature	250 K
Bulb Temperature (MAX)	400 K
LEED-EB MR Credit	198 picograms Hg per mean lumen hour
Additional Info	UV control
Primary Application	Retail Display

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	1615
Mean Lumens	1066
Nominal Initial Lumens per Watt	80
Color Temperature	3000 K
Color Rendering Index (CRI)	81

ELECTRICAL CHARACTERISTICS

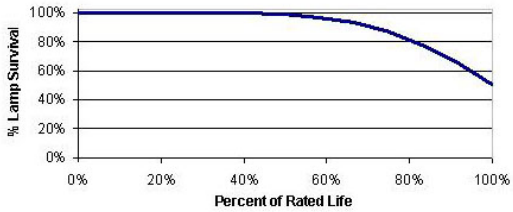
Burn Position	Universal burning position
Warm Up Time to 90%	3 min
Warm Up Time to 90% (MAX)	3 min
Hot Restart Time to 90%	5 min
Hot Restart Time to 90% (MAX)	5 min

DIMENSIONS

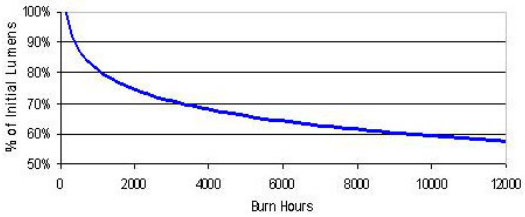
Maximum Overall Length (MOL)	2.05 cm
Bulb Diameter (DIA) (MAX)	0.47 cm
Light Center Length (LCL)	1.18 cm

PRODUCT INFORMATION

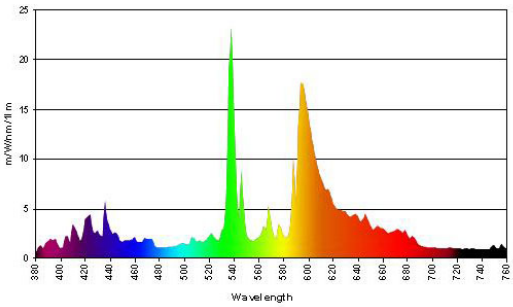
Product Code	85086
Description	CMH20T/U830GU6.5
ANSI Code	C156/M156
Standard Package	Case
Standard Package GTIN	10043168850862
Standard Package Quantity	12
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	12
UPC	043168850865



Lumen Maintenance



Spectral Power Distribution



Revised: 3/6/2009

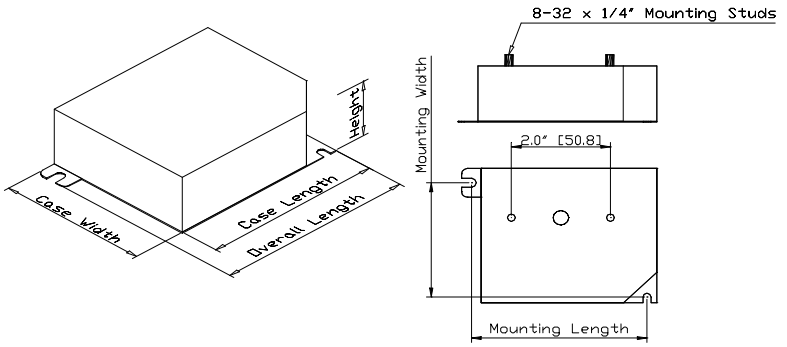
PHILIPS ADVANCE

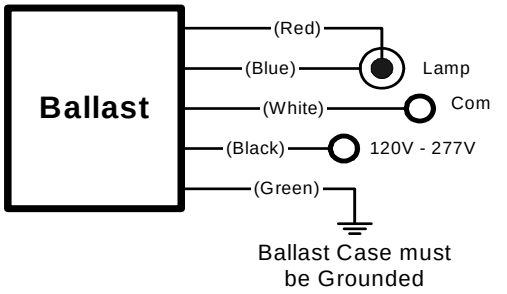
e-Vision® Electronic Ballast for Metal Halide Lamps

Catalog Number: IMH-G20-G
For 20W Metal Halide Lamps
ANSI M156
120-277 50/60Hz Electronic
Status: RELEASED

DIMENSIONS AND DATA

Lamp Number	Lamp Watts	Input Volts	Catalong Number*	Line Current (Amps)	Input Power (Watts)	Min Power Factor	Wiring Diag	Fig.	Weight (lb)	Max. Distance to Lamp (ft)
20W Watt Lamp, ANSI Code M156 Minimum Starting Temp -20°C/-4°F										
1	20	120	IMH-G20-G-XXX	0.2	24	0.95	3	G	0.9	5
		277		0.09	24					

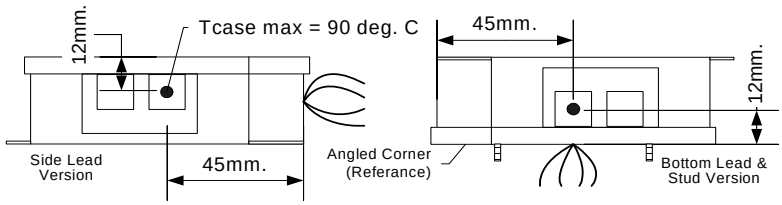




Ballast Case must be Grounded

Wiring Diagram 3

Case Figure	Overall Length	Case Length	Case Width	Height	Mountin Length	Mounting Width
G	97mm [3.8"]	90mm [3.5"]	77mm [3.0"]	30mm [1.2"]	87mm [3.4"]	67mm [2.6"]



Case Temperature Measurement Location

INSTALLATION & APPLICATION NOTES:

1. Maximum allowable case temperature is 90°C. See figure above for measurement location
2. Ignition pulse is 4 kV max
3. All leads are 9 inches long
4. Ballast output will shutdown after 20 minutes if lamp fails to ignite
5. Power must be cycled off – then on, after replacing lamp
6. Connect the red lead to the center terminals of the lamp when using screw base lamps

***Ordering Information**

Order Suffix	Description
-LF	Ballast with side exit leads and mounting feet
-BLS	Ballast with bottom exit leads and mounting studs

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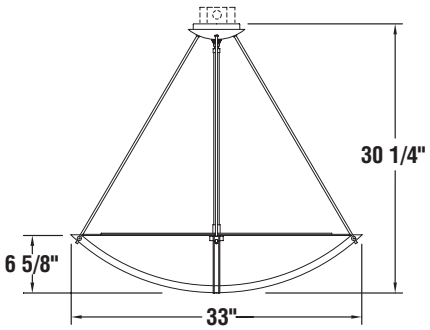
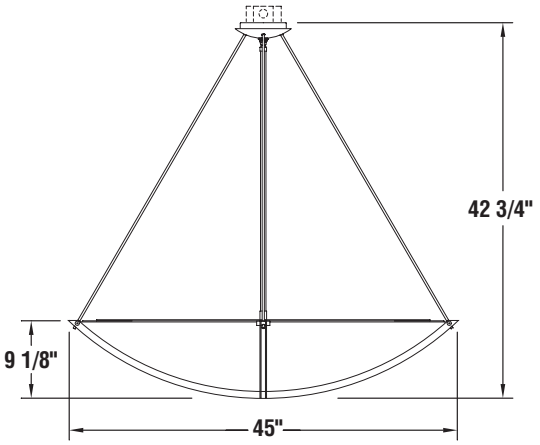
Technical Data:

4801-30



4801-42



Product Specifications:

Catalog #: 4801

Lamping:

4801-30	**I -**	(4) 60W A-19/Med.
	F -	(4) CFT13W/GX23
	FQ -	(4) CFQ26W/G24q
4801-42	**I -**	(8) 60W A-19/Med.
	F -	(4) CFQ26W/G24d
	FM -	(4) CFM42W/GX24q
	FX -	(8) CFM42W/GX24q

Voltage: **120V or 277V, Incandescent 120 Volt Only**

Lens Options:

- **OA:** Opal Acrylic (Etched)
- **FAH:** Hand Painted Faux Alabaster
  - **FAH4:** White Vein
  - **FAH5:** Antique Alabaster (Beige)
  - **FAH6:** Gray Vein
  - **FAH7:** Beige Vein
- **FGH:** Faux Glass

Finishes:

Standard	**BAL:**	Brushed Aluminum with Brushed Brass Cylinders
	BB:	Brushed Brass with Brushed Aluminum Cylinders
Custom	**CPF:**	Custom Paint Finish (Consult Factory)
	CMF:	Custom Metal Finish (Consult Factory)

Special:

- **STD:** Standard
- **MOD:** Modified Standard

Weight:

4801-30	**I:**	15 lbs.
	F:	21 lbs.
	FQ:	21 lbs.
4801-42	**I:**	25 lbs.
	F:	34 lbs.
	FM:	34 lbs.
	FX:	35 lbs.

How to Specify:

EXAMPLE: 4801-30 - F - 120V - OA - BAL - STD

- 4801-30 — Catalog Number
- F — Lamping Option
- 120V — Voltage
- OA — Lens Option
- BAL — Finish
- STD — Special (STD or MOD)

NOTES:

- UL LISTED AND CUL APPROVED.
- ALL WINONA LIGHTING PRODUCTS ARE UNION MADE.
- CUSTOM SIZES AND FINISHES AVAILABLE UPON REQUEST.
- ALL FLUORESCENT FIXTURES AVAILABLE IN 120 VOLT OR 277 VOLT. INCANDESCENT IN 120 VOLT ONLY.
- WINONA LIGHTING RESERVES THE RIGHT TO MAKE DESIGN CHANGES WITHOUT PRIOR NOTICE.
- LAMPS NOT INCLUDED.
- COMPACT FLUORESCENT LAMP BASE INFORMATION: CFT13W (GX23), CFQ26W (G24d-3), CFQ26W (G24q-3), CFM42W (GX24q-4). SEE PAGE 337 OF TECHNICAL SECTION FOR MORE INFORMATION.
- BALLAST INFORMATION: MAGNETIC (F)
- BALLAST INFORMATION: ELECTRONIC (FQ, FM, FX)

TO USE AS YOUR SUBMITTAL FORM, SIMPLY PHOTOCOPY THIS PAGE, FILL IN YOUR SPECIFICATIONS, AND FAX SUBMITTAL TO (507) 452-8528. A WINONA LIGHTING SALES REP WILL RESPOND TO YOUR REQUEST.

PRODUCT SPECIFICATIONS: 4801 - ____ - ____ - _____ - _____ - _____ - _____ TYPE: _____

TO VIEW OUR LATEST FIXTURES, CURRENT SPECIFICATIONS, FEATURE PROJECTS, AND MORE, VISIT US ONLINE AT WWW.WINONALIGHTING.COM

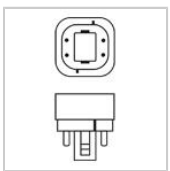
(FOR MORE INFORMATION ABOUT OUR WEBSITE SEE PAGES 346-349 FOR ALL THE DETAILS.)

GE Lighting

97611 - F26DBX/830/ECO4P

GE Ecolux® Biax® T4 - Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

High Color Rendering
Energy Savings



GENERAL CHARACTERISTICS

Lamp Type	Compact Fluorescent - Plug-In
Bulb	T4
Base	G24q-3
Wattage	26
Voltage	120/105
Rated Life	12000 hrs
Starting Temperature	0 °C (32 °F)
Cathode Resistance	2.7 Ohm
LEED-EB MR Credit	232 picograms Hg per mean lumen hour
Rated Life (rapid start) @ Time	20000.0 @ 12.0 h
Additional Info	Dimmable with appropriate dimming ballast./End of Life Protection (EOL)/TCLP compliant
Primary Application	Facilities;Retail Display;Hospitality;Office;Restaurant;Wa

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	1710
Mean Lumens	1440
Nominal Initial Lumens per Watt	65
Color Temperature	3000 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

Current (max)	5.25 A
Open Circuit Voltage (after preheating)	240 V
Open Circuit Voltage Across Starter	198 V
Lamp Current	0.325 A
Preheat Voltage	4.25 V
Current Crest Factor	1.7
Supply Current Frequency	60 Hz

DIMENSIONS

Maximum Overall Length (MOL)	6.4000 in(162.6 mm)
Nominal Length	6.400 in(162.6 mm)
Base Face to Top of Lamp	5.800 in(147.3 mm)

PRODUCT INFORMATION

Product Code	97611
Description	F26DBX/830/ECO4P
ANSI Code	60901-IEC-2562-2
Standard Package	BUNDLE
Standard Package GTIN	
Standard Package Quantity	50
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	50
UPC	043168976114

CAUTIONS & WARNINGS

Caution

• Lamp may shatter and cause injury if broken
  - Remove and install by grasping only plastic portion of the lamp.

NOTES

• 4-Pin lamp minimum starting temperature is a function of the ballast. Most ballasts are rated with a minimum starting temperature of 50 degrees F (10 C). Ballasts are also available that provide reliable starting to 0 degrees F (-18C) and -20 F (-29C).

• Based on 60Hz reference circuit.

• Fluorescent lamp lumens decline during life

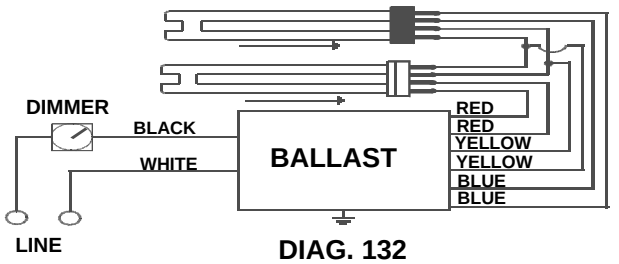
PHILIPS
ADVANCE

VEZ-2Q26-M2-BS	
Brand Name	MARK 10 POWERLINE
Ballast Type	Electronic Dimming
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (Watts) (min/max)	Ballast Factor (min/max)	MAX THD %	Power Factor	Lamp Current Crest Factor	B.E.F.
* CFQ26W/G24Q	2	26	50/10	0.21	16/58	0.05/1.05	10	0.98	1.6	1.81
CFTR26W/GX24Q	2	26	50/10	0.21	16/58	0.05/1.05	10	0.98	1.6	1.81

Wiring Diagram

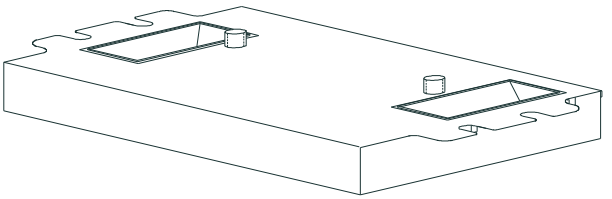


DIAG. 132

The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
4.98 "	3.00 "	1.29 "	2.00 "
4 49/50	3	1 29/100	2
12.6 cm	7.6 cm	3.3 cm	5.1 cm

Revised 09/10/2002

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Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

PHILIPS
ADVANCE

VEZ-2Q26-M2-BS	
Brand Name	MARK 10 POWERLINE
Ballast Type	Electronic Dimming
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be available in a plastic/metal can or all metal can construction to meet all plenum requirements.

1.3 Ballast shall be provided with poke-in wire trap connectors or integral leads color coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start.

2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.3 Ballast shall operate from 60 Hz input source of 120V, 277V or 347V as applicable with sustained variations of +/- 10% (voltage and frequency).

2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.5 Ballast shall have a Power Factor greater than 0.98 at full light output and greater than 0.90 throughout the dimming range for primary lamp.

2.6 Ballast shall have a minimum ballast factor of 1.00 at maximum light output and 0.05 at minimum light output for primary lamp application.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 10% at maximum light output when operated at nominal line voltage with primary lamp. Total Harmonic Current (THC) at minimum light output shall not exceed THC at maximum light output.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of 10C (50F) for primary lamp.

2.11 Ballast shall provide Lamp EOL Protection Circuit for all T5, T5/HO, and CFL lamps.

2.12 Ballast shall control lamp light output from 100% - 5% relative light output for T8 and CFL lamps and 100% - 1% relative light output for T5/HO lamps.

2.13 Ballast shall ignite the lamps at any light output setting without first going to another output setting.

2.14 Ballast shall tolerate sustained open circuit and short circuit output conditions.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.4 Ballast shall comply with ANSI C82.11 where applicable.

3.5 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

3.6 Ballast shall comply with NEMA 410 for in-rush current limits.

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9001 Quality System Standards.

4.2 Ballast shall carry a ____ warranty from date of manufacture against defects in material or workmanship for operation at a maximum case temperature of ____ (Go to our web site for up to date warranty information: www.philips.com/advancewarranty.

4.3 Manufacturer shall have a twenty-year history of producing electronic ballasts for the North American market.

4.4 Ballast shall be controlled by a compatible Mark 10 Powerline two-wire dimmer.

4.5 Ballast shall be Philips Advance part # _____ or approved equal.

Revised 09/10/2002

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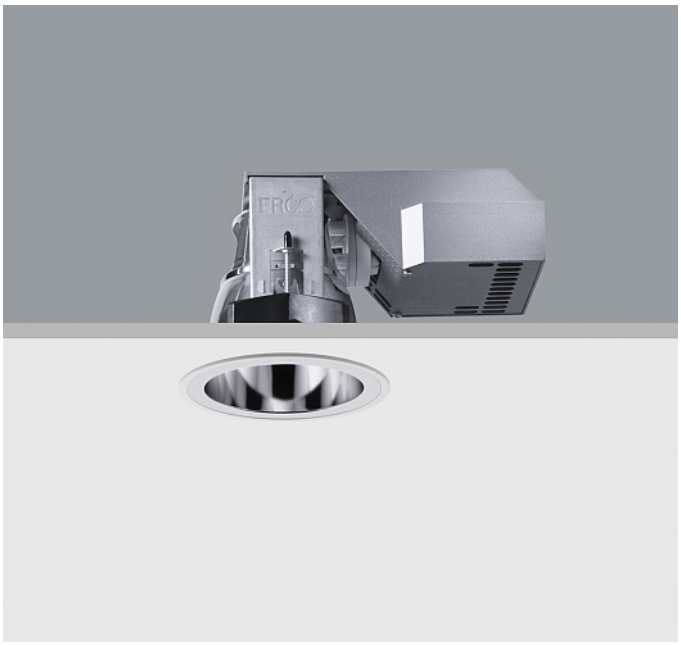
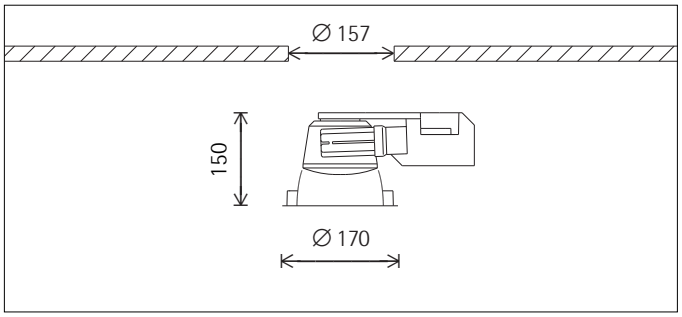
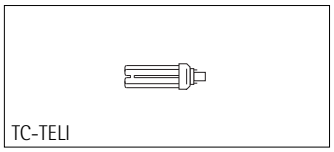
ERCO

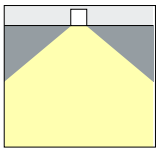
Lightcast Downlight

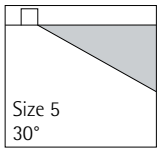
for TC-T lamps

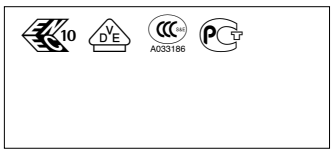






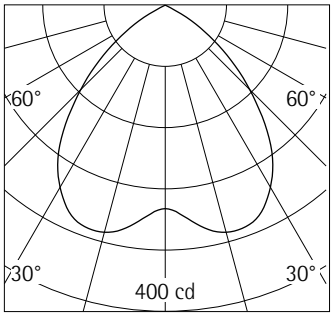






22267.000 Reflector silver
TC-TELI 18W GX24q-2 1200lm
ECG

Product description
Housing: cast aluminium, designed as heat sink.
Mounting ring: cast aluminium, white (RAL9002) powder-coated. Fitting without tools with 4-point support and screw fixing, for ceiling thicknesses of 1-30mm.
Junction box for through-wiring, 5-pole terminal block, integrated cable clamp. Electronic control gear, plug and play connectivity with DALI version.
Darklight reflector: aluminium, bright anodised. Cut-off angle 30°.
Diffuser: plastic, translucent, can be removed for lamp replacement without tools.
Weight 1.40kg



TC-TELI 18W GX24q-2 1200lm

LOR	0.49
UGR	19.4
65° <	1000 cd/m²

ERCO GmbH
Brockhauser Weg 80-82
58507 Lüdenscheid
Germany
Tel.: +49 2351 551 0
Fax: +49 2351 551 300
info@erco.com

Technical Region: 230V/50Hz
We reserve the right to make technical and design changes.
Edition: 03.11.2009
Current version under
www.erco.com/22267.000

ERCO

Lightcast Downlight

Planning data

22267.000	TC-TELI 18W GX24q-2 1200lm	
Connected load	P:	18 W
Connected load per 100lx	P*:	3.0 W/m^2
Number of luminaires per 100lx	n*:	16.8 1/100m^2

22267.000	TC-TELI 18W GX24q-2 1200lm			
Number of luminaires per 100m^2 for	100lx	200lx	300lx	500lx
	17	34	51	85

22267.000	TC-TELI 18W GX24q-2 1200lm			
Module (m)	1.2x1.8	1.8x1.8	1.8x2.4	2.4x2.4
Illuminance E_n (lx)	275	184	138	103

Correction table

Ceiling		0.70	0.70	0.70	0.50	0
Wall		0.70	0.50	0.20	0.20	0
Floor		0.50	0.20	0.20	0.10	0
k	0.6	76	57	48	47	44
k	1.0	100	76	68	66	62
k	1.5	116	90	83	80	76
k	2.5	130	100	95	90	85
k	3.0	134	103	99	93	89

Cleaning (a)	1				2				3			
Ambient conditions	P	C	N	D	P	C	N	D	P	C	N	D
LMF	0.94	0.89	0.81	0.75	0.91	0.80	0.69	0.59	0.87	0.74	0.61	0.52
RSMF	0.96	0.92	0.87	0.81	0.96	0.92	0.87	0.81	0.96	0.92	0.87	0.81

Hours of operation (h)	2000	6000	10000	1000	4000	8000
LLMF	0.94	0.89	0.85	0.97	0.91	0.87
LSF	1	1	1	1	1	1

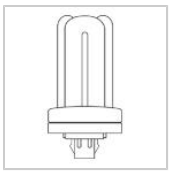
MF	LMFxRSMFxLLMFxLSF
MF	Maintainance Factor
LMF	Lumiaire Maintenance Factor
RSMF	Room Surface Maintenance Factor
LLMF	Lamp Lumens Maintenance Factor
LSF	Lamp Survival Factor
P	Room pure
C	Room clean
N	Room normal
D	Room dirty

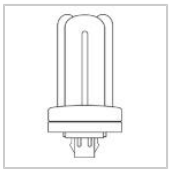
GE Lighting

97625 - F18TBX/830/A/ECO

GE Ecolux® Biax® T4 - Facilities; Retail Display; Hospitality; Office; Restaurant; Warehouse

High Color Rendering
Energy Savings





CAUTIONS & WARNINGS

Caution

• Lamp may shatter and cause injury if broken
- Remove and install by grasping only plastic portion of the lamp.

GENERAL CHARACTERISTICS

Lamp Type	Compact Fluorescent - Plug-In
Bulb	T4
Base	GX24q-2
Wattage	18
Voltage	120/100
Rated Life	12000 hrs
Cathode Resistance	6.05 Ohm
LEED-EB MR Credit	330 picograms Hg per mean lumen hour
Rated Life (rapid start) @ Time	20000.0 @ 12.0 h
Additional Info	Dimmable with appropriate dimming ballast./End of Life Protection (EOL)/TCLP compliant
Primary Application	Facilities;Retail Display;Hospitality;Office;Restaurant;Wa

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	1200
Mean Lumens	1010
Nominal Initial Lumens per Watt	66
Color Temperature	3000 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

Current (max)	5.25 A
Open Circuit Voltage (after preheating)	250 V
Open Circuit Voltage Across Starter	198 V
Lamp Current	0.225 A
Preheat Voltage	4.25 V
Current Crest Factor	1.7
Supply Current Frequency	60 Hz

DIMENSIONS

Maximum Overall Length (MOL)	4.8000 in(121.9 mm)
Nominal Length	4.800 in(121.9 mm)
Base Face to Top of Lamp	4.250 in(107.9 mm)

PRODUCT INFORMATION

Product Code	97625
Description	F18TBX/830/A/ECO
Standard Package	Case
Standard Package GTIN	10043168976258
Standard Package Quantity	10
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	10
UPC	043168976251

NOTES

• 4-Pin lamp minimum starting temperature is a function of the ballast. Most ballasts are rated with a minimum starting temperature of 50 degrees F (10 C). Ballasts are also available that provide reliable starting to 0 degrees F (-18C) and -20 F (-29C).

• Amalgam product experience stable brightness over a wider temperature range and in various operating positions.

• Based on 60Hz reference circuit.

• Fluorescent lamp lumens decline during life

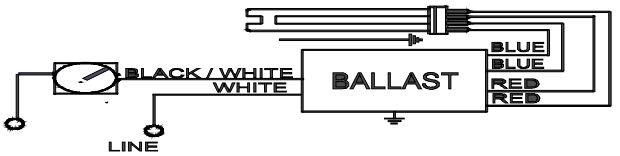
PHILIPS
ADVANCE

VEZ-1Q18-M2-BS	
Brand Name	MARK 10 POWERLINE
Ballast Type	Electronic Dimming
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (Watts) (min/max)	Ballast Factor (min/max)	MAX THD %	Power Factor	Lamp Current Crest Factor	B.E.F.
CFQ18W/G24Q	1	18	50/10	0.07	07/22	0.05/1.00	10	0.99	1.6	4.55
* CFTR18W/GX24Q	1	18	50/10	0.08	07/22	0.05/1.00	10	0.99	1.6	4.55

Wiring Diagram



Diag. 134

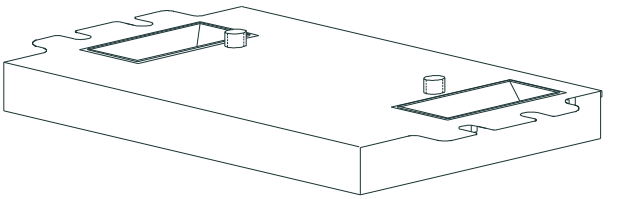
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	0	0
White	0	0
Blue	0	0
Red	0	0
Yellow		0
Gray		0
Violet		0

	in.	cm.
Yellow/Blue		0
Blue/White		0
Brown		0
Orange		0
Orange/Black		0
Black/White		0
Red/White		0

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
4.98 "	3.00 "	1.29 "	2.00 "
4 49/50	3	1 29/100	2
12.6 cm	7.6 cm	3.3 cm	5.1 cm

Revised 08/17/2006

Data is based upon tests performed by Philips Lighting Electronics N.A. in a controlled environment and is representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

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PHILIPS
ADVANCE

VEZ-1Q18-M2-BS	
Brand Name	MARK 10 POWERLINE
Ballast Type	Electronic Dimming
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be available in a plastic/metal can or all metal can construction to meet all plenum requirements.

1.3 Ballast shall be provided with poke-in wire trap connectors or integral leads color coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start.

2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.3 Ballast shall operate from 60 Hz input source of 120V, 277V or 347V as applicable with sustained variations of +/- 10% (voltage and frequency).

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2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of 10C (50F) for primary lamp.

2.11 Ballast shall provide Lamp EOL Protection Circuit for all T5, T5/HO, and CFL lamps.

2.12 Ballast shall control lamp light output from 100% - 5% relative light output for T8 and CFL lamps and 100% - 1% relative light output for T5/HO lamps.

2.13 Ballast shall ignite the lamps at any light output setting without first going to another output setting.

2.14 Ballast shall tolerate sustained open circuit and short circuit output conditions.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.4 Ballast shall comply with ANSI C82.11 where applicable.

3.5 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

3.6 Ballast shall comply with NEMA 410 for in-rush current limits.

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9001 Quality System Standards.

4.2 Ballast shall carry a ____ warranty from date of manufacture against defects in material or workmanship for operation at a maximum case temperature of ____ (Go to our web site for up to date warranty information: www.philips.com/advancewarranty.

4.3 Manufacturer shall have a twenty-year history of producing electronic ballasts for the North American market.

4.4 Ballast shall be controlled by a compatible Mark 10 Powerline two-wire dimmer.

4.5 Ballast shall be Philips Advance part # _____ or approved equal.

Revised 08/17/2006

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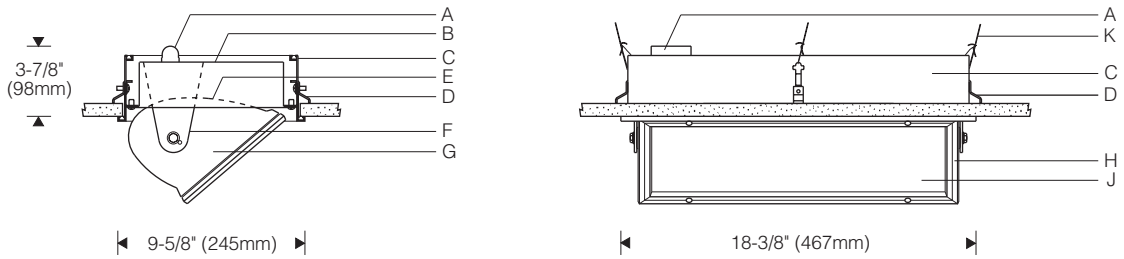
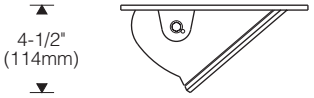
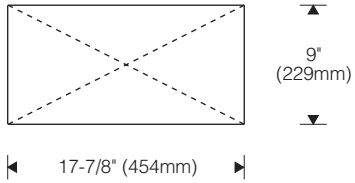
Style 204 1:10 Scale





Ceiling Cutout



Specifications

- **A** Conduit connector
- **B** Aluminum back box
- **C** Extruded aluminum mounting/trim frame
- **D** Spring clips (4 provided)
- **E** Specular extruded aluminum reflector
- **F** Aluminum yoke arms
- **G** Die-cast aluminum end plates
- **H** Mitred extruded aluminum door frame with silicone gasket
- **J** Micro-prismatic tempered glass lens
- **K** Supplemental support wires (by others)

Finish:
Semi-gloss white reflector, door frame, end plates, yoke arms and trim frame. Black back box.

Painted surfaces – 6 stage pretreatment and electrostatically applied thermoset powder coat for stable, long lasting and corrosion resistant finish.

Reflector and internal end plates – extruded high purity aluminum with clear anodized specular finish. All luminaire hardware – stainless steel. All mounting hardware – zinc or cadmium plated.

Mounting:
Mounting/trim frame installs from below finished ceiling. Retrofits into existing non-accessible ceilings.

Spring clips provided for rigid ceilings (drywall, plaster) up to 1-3/4" (44mm) thick.

Supplemental support wires, bar hangers, etc. (by others) required for accessible ceilings. Where wire suspension is prohibited, order accessory universal mounting brackets for use with 1/2" EMT, 1-1/2" lathing or C channel (by others).

Electrical:
Use 90°C wire for supply connections.

5' (1.5m) wire leads exit back box for connection to accessible junction box (by others) or remote ballast (installation prior to finished ceiling recommended).

Tungsten halogen – recessed single contact (RSC) lampholders in patented clamping supports for maximum heat dissipation.

Metal halide – remote encapsulated constant wattage autotransformer (CWA) or electronic ballast. Mogul lampholder is pulse rated for use with either horizontal or universal position reduced envelope pulse start lamps. End-of-lamp aligner ensures consistent optical performance.

For complete ballast specifications, see Accessories Section.

Standard:
UL listed or CSA certified for damp locations.

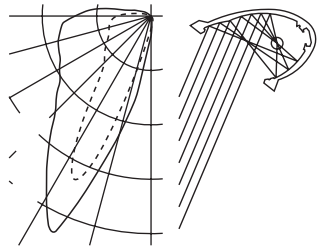
Features

- *Adjustable – tailor performance to wall height and setback*
- *Precured silicone gaskets – keep dirt and moisture out, maintain performance, prevent light leaks*
- *Lamp support on mogul base lamps ensures arc tube is in optical center*
- *Shallow recessed depth – fits under ducts at core walls*

W 45.0

Performance

Two parabolic reflector sections drive light to the bottom of the wall. An elliptical section shields the lamp from normal viewing angles and redirects its light to a parabola. Glare is minimized and asymmetry of the beam is maximized resulting in high beam efficiency and superior surface uniformity.



For complete photometrics, see www.elliptipar.com.

elliptipar

To form a Catalog Number

1	2 0 4	-	150G	-	T	-	0 2	-	2	-	00	0
1	2		3		4		5		6		7	8

1 Source

M = Metal halide
T = Tungsten halogen

2 Style

204 = Large semi-recessed adjustable, **remote** ballast

3 Lamp

Lamp Code	*Watt-age*	*Lamp Number*	*Volt-ages*	*Remote Distance*
Ceramic Arc Tube Pulse Start Metal Halide (90+ CRI)				
210C	210	CDM210/T9/930/U/E	**2, U**	30' (9m)
315C	315	CDM315/T9/930/U/E	**2, U**	30' (9m)
Ceramic Arc Tube Pulse Start Metal Halide (80+ CRI)*				
150G	150	CDM150/T6/830	**1, 2**	15' (4.5m)
			T, U	5' (1.5m)
250C	250	CMH250/U/830/R	**A, B**	50' (15m)
400C	400	CMH400/U/830/R	**A, B**	50' (15m)
Quartz Arc Tube Pulse Start Metal Halide (68 CRI)*				
250P	250	MS 250W/H75/ T15/PS/740	**A, B**	50' (15m)
			2, U	16' (4.8m)
320P	320	MS 320W/H75/ T15/S/PS/740	**A, B**	50' (15m)
			2, U	16' (4.8m)
350P	350	MS 350W/H75/ T15/PS/740	**A, B**	50' (15m)
			2, U	16' (4.8m)
Tungsten Halogen				
0300	300	Q300T3	**A**	
0350	350	Q350T3/CL/HIR	**A**	
0500	500	Q500T3	**A**	

For complete lamp and ballast information, see Accessories Section.
* Use only clear metal halide horizontal or universal position lamp with compact envelope. Standard lamp colors are 3000K for Ceramic Arc Tube Pulse Start lamps and 4000K for Quartz Arc Tube Pulse Metal Halide lamps.

W 45.1

Project: _____

4 Mounting

T = Overlapping trim

5 Finish

02 = Semi-gloss white

6 Voltage

Electronic (Metal Halide only):
1 = 120V
2 = 277V
T = 120V dim*
U = 208-277V dim*

Magnetic and Tungsten Halogen:
A = 120V
B = 277V

*100-50% dimming, 0-10V compatible controls by others. Consult factory for dimming the 210W lamp.

7 Option (See Accessories Section for specifications)

00 = No options
0C = Modified to comply with Chicago plenum code. **Note:** remote ballast must be located outside ceiling plenum. For ballast within plenum, consult factory.
0Y = Modified to comply with New York City code
XX = For modification not listed, include detailed description. Consult factory prior to specification.

8 Standard

0 = UL, Underwriters Laboratories
J = CSA, Canadian Standards Association

Example

M204 - 250C - T - 02 - B - 0C0

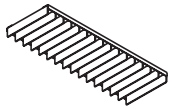
Large semi-recessed model for use with 250 watt ceramic arc tube pulse start metal halide lamp. Overlapping ceiling trim. Semi-gloss white reflector, door frame, end plates, yoke arms and trim frame, with black back box. Remote 277V ballast. Modified to comply with Chicago plenum code. UL.

Type: _____

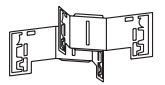
Accessories

Order separately. See Accessories Section for specifications.

AEDV ☐ **000** = External vertical blade **baffle**, black (Not for use with 500W TH units.)
2 = 25° shielding
4 = 45° shielding



ASRBKT00 = Universal **mounting brackets** (set of two), accepts 1/2" EMT, 1-1/2" lathing, C channel or bar hangers (by others)



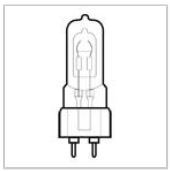
AFK000X ☐ = Ballast **fuse** kit
0 = UL
J = CSA

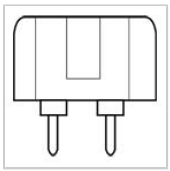
elliptipar
114 Boston Post Road, West Haven, Connecticut 06516, USA
Voice 203.931.4455 • Fax 203.931.4464 • **www.elliptipar.com**

GE Lighting

20017 - CMH150TU/830/G12

GE ConstantColor® PulseArc® CMH® Ceramic Metal Halide T6





CAUTIONS & WARNINGS

R- WARNING: This lamp can cause serious skin burn and eye inflammation from shortwave ultraviolet radiation if outer envelope of the lamp is broken or punctured, and the arc tube continues to operate. Do not use where people will remain for more than a few minutes unless adequate shielding or other safety precautions are used. Certain types of lamps that will automatically extinguish when the outer envelope is broken or punctured are commercially available. Visit the FDA website for more information: http://www.fda.gov/cdrh/radhealth/products/urburns.html

Caution

• Lamp may shatter and cause injury if broken
  - Do not use excessive force when installing lamp.
  - Do not use lamp if outer glass is scratched or broken.

Warning

• A damaged lamp emits UV radiation which may cause eye/skin injury
  - Turn power off if glass bulb is broken. Remove and dispose of lamp.
• Risk of Electric Shock
  - Do not use where directly exposed to water or outdoors without an enclosed fixture.
  - Turn power off before inspection, installation or removal.
• Unexpected lamp rupture may cause injury, fire, or property damage
  - Do not exceed rated voltage.
  - Do not turn on lamp until fully installed.
  - Do not use beyond rated life.
  - Do not use lamp if outer glass is scratched or broken.
  - Do not use where directly exposed to water or outdoors without an enclosed fixture.
  - Operate lamp only in specified position.
  - Use in enclosed fixture rated for this product.
  - Use only properly rated ballast.
• Risk of Burn
  - Allow lamp to cool before handling.
  - Do not turn on lamp until fully installed.
• Risk of Fire
  - Keep combustible materials away from lamp.
  - Use fused or thermally protected ballast - see instructions.
  - Use in fixture rated for this product.

GENERAL CHARACTERISTICS

Lamp Type	High Intensity Discharge - Ceramic Metal Halide
Bulb	T6
Base	Bi-Pin (G12)
Wattage	150
Rated Life	12000 hrs
Bulb Material	Quartz
Lamp Enclosure Type (LET)	Enclosed fixtures only
LEED-EB MR Credit	83 picograms Hg per mean lumen hour
Additional Info	UV control

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	14000
Mean Lumens	11000
Nominal Initial Lumens per Watt	93
Color Temperature	3000 K
Color Rendering Index (CRI)	82

ELECTRICAL CHARACTERISTICS

Burn Position	Universal burning position
Warm Up Time to 90% (MAX)	2 min
Hot Restart Time to 90% (MIN)	10 min
Hot Restart Time to 90% (MAX)	15 min

DIMENSIONS

Maximum Overall Length (MOL)	3.9300 in(99.8 mm)
Light Center Length (LCL)	2.180 in(55.4 mm)

PRODUCT INFORMATION

Product Code	20017
Description	CMH150TU/830/G12
ANSI Code	M102/M142
Standard Package	Case
Standard Package GTIN	10043168200179
Standard Package Quantity	12
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	12
UPC	043168200172

Revised: 3/4/2009

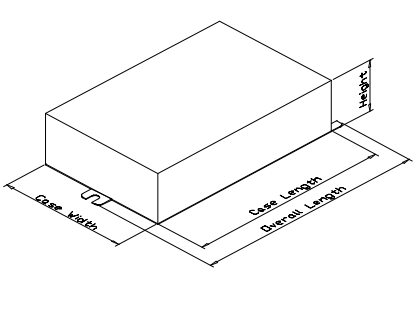
PHILIPS ADVANCE

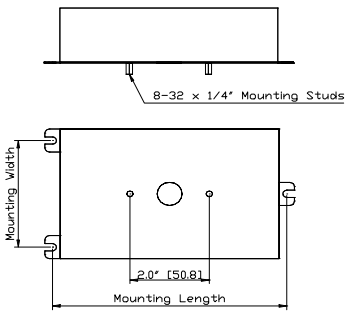
e-Vision® Electronic Ballast for Metal Halide Lamps

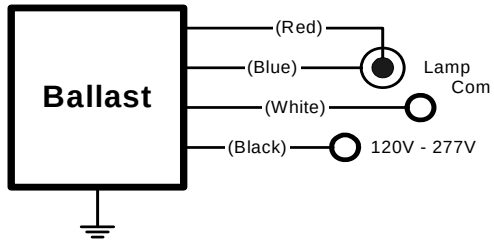
Catalog Number: IMH-150-H
For 150W Metal Halide Lamps
ANSI M102 or M142
120-277V 50/60Hz Electronic
Status: RELEASED

DIMENSIONS AND DATA

Lamp Number	Lamp Watts	Input Volts	Catalong Number*	Line Current (Amps)	Input Power (Watts)	Min Power Factor	Wiring Diag	Fig.	Weight (lb)	Max. Distance to Lamp (ft)
150 Watt Lamp, ANSI Code M102 or M142 Minimum Starting Temp -30°C/-20°F										
1	150	120	IMH-150-H-XXX	1.4	165	1	3	H	1.9	5
		277		0.6	161					



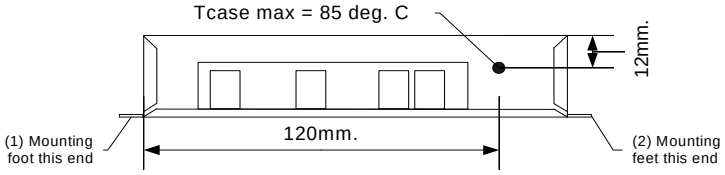




Ballast Case must be Grounded

Wiring Diagram 3

Case Figure	Overall Length	Case Length	Case Width	Height	Mountin Length	Mounting Width
H	161mm [6.3"]	144mm [5.7"]	92mm [3.6"]	38mm [1.5"]	152mm [6.0"]	73mm [2.9"]



Case Temperature Measurement Location

EISA Compliant

INSTALLATION & APPLICATION NOTES:

1. Maximum allowable case temperature is 85°C. See figure above for measurement location
2. Ignition pulse is 4 kV max
3. All leads are 12 inches long
4. Ballast output will shutdown after 20 minutes if lamp fails to ignite
5. Power must be cycled off – then on, after replacing lamp
6. Connect the red lead to the center terminal of the lamp when using screw base lamps

***Ordering Information**

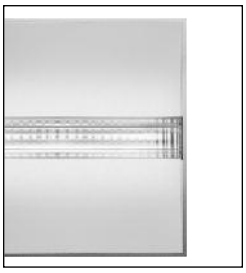
Order Suffix	Description
-LF	Ballast with side exit leads and mounting feet
-BLS	Ballast with bottom exit leads and mounting studs

Data is based on tests performed by Philips Advance in a controlled environment and is representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

Philips Lighting Electronics N.A.
10275 West Higgins Road • Rosemont, IL 60018 • www.philips.com/advance
Tel: 800-322-2086 • Fax: 800-423-1882 • Customer Support: 800-372-3331 • OEM Support: 866-915-5886

ML™

Includes SYNTO optics



Fluorescent
Two Lamp 14W T5
Two Lamp 24W T5HO
One Lamp 40W/50W/55W T5TT
Two Lamp 40W T5TT

Applications: An innovative lighting chamber concept with **five** center **diffuser options** including **SYNTO optics** shielding the lamp(s) from view, while directing light where needed in a glare-free and efficient way. Ideal for offices, retail, health care and educational facilities. Fixtures with optional blue, green and yellow acrylic color inserts give the diffusers a uniform, softly tinted glow.

Recessed 2' x 2'

online Find it Fast 312

ZOOM! 2-week delivery on items shown in gray

Meets RP-1-04 guidelines for normal (1405 MP/MD/C/W, 2405 C, 1505 C, 2245 C/W) VDT-use environments.

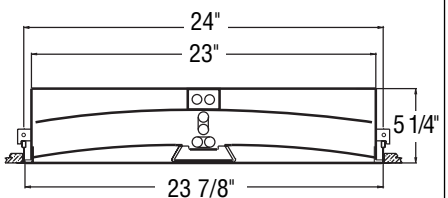
Type: _____ **Quantity:** _____ **Project:** _____

ML4___	22				

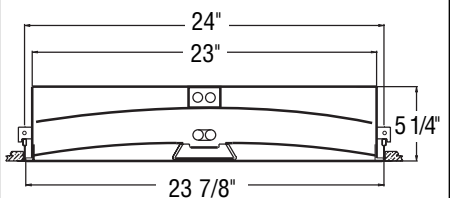
FIXTURE/CEILING TYPE	LENGTH	LAMPING	OPTIC	BALLAST/VOLTAGE	OPTIONS
ML4U ML Recessed 15/16" Lay-In, Flush 9/16" Slot-Grid, Flush 9/16" Lay-In, Tegular	**22** 2' x 2'	**1405** (1) 40W T5TT	**MP** Micro-Pyramidal Optic	**U** Universal 120/277V	**WF** Whip Flex 3/8" X 6' 14 AWG
ML4F ML Recessed 9/16" Lay-In, Flush		**1505** (1) 50W T5TT	**OL** Opal Acrylic Lens	**347** 347V	**WN_*** Whip Flex 3/8" X 6' 14 AWG (NYC)
ML4E ML Recessed Concealed		**1555** (1) 55W T5TT	**MD** MicroGrid Diffuser, Titan	**DA_*** Dimming, Analog (0-10V)	**EM1_*** Standby Battery Pack/1 lamp
For flange details, see next page		**2405** (2) 40W T5TT	**C** Matte SYNTO Louver	**DD_*** Dimming, DALI	**SS** Separate Switching
		2145 (2) 14W T5	**W** White SYNTO Louver	**DE_*** Dimming, Lutron ECO-10™	**AR** Air Return
		2245 (2) 24W T5 HO	**CO** Matte SYNTO Louver with Frosted Inlay	**DH_*** Dimming, Lutron HiLume®	**CP** Chicago Plenum
			WO White SYNTO Louver with Frosted Inlay	**DSC_*** Dimming, Lutron EcoSystem™, Control Fixture	**F** Fusing
				DSN_* Dimming, Lutron EcoSystem™, Non-control Fixture	**CB2**** Color inlay, blue
				STDM_* Dimming, Step	**CG2**** Color inlay, green
					CY2** Color inlay, yellow

** Specify "1" for 120V or "2" for 277V. Some lamp types may not be available.*
*** Can be ordered with complete fixtures only. To order separately consult factory.*
STDM only available with 14W T5 lamps.
STDM not available for 347V.

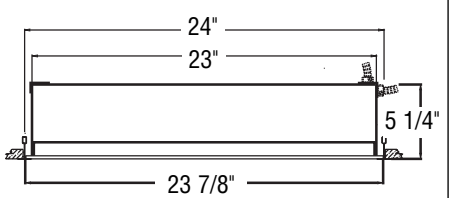
Cross-Section, Lay-In Ceiling, (2) T5TT Lamps



Cross-Section, Lay-In Ceiling, (1) T5TT Lamp



Side View, Lay-In Ceiling



c UL us LISTED

Suitable for damp locations
NYC Approved

IBEW Union Made

US patent pending PCT/EP01/01269
US patent pending PCT/EP01/01270
US Patent D 477,891

Lead Time? Double-click on http://www.zumtobel.us/PDB?lang=EN&gid=11079&iso2=US

A = ZOOM! Quick Ship - ships in 2 weeks
B = ships in 4 weeks **C =** ships in 8 weeks

1. Housing - 20 gauge cold-rolled steel. Finish is powder-coated white. Post painted. Right-angle access plate (two per fixture) allows feed from top or side of unit.

2. Light Chamber - Powder-coated high-reflectance white interior reflector and shaped extruded acrylic diffusers. Fixtures available with optional color inlays in blue, green, or yellow.

3. Optics - **MP**: Clear, extruded micro-pyramidal optic diffuser and clear acrylic inlay. **OL**: Extruded, opal acrylic lens. **MD**: Metal grid in Titan finish, backed with a translucent opal acrylic extruded lens. **C/W**: Matte or white finish 16-cell SYNTO louver has blades 7/8" high by 17/16" o.c. Optional opal inlay is white acrylic. Optic assembly pulls down for lamp access.

4. Lamps/Sockets - One or two 40W or one 50W/55W compact fluorescent lamps, with 2G11 four-pin lamp sockets. Two 14W T5 or 24W T5 HO fluorescent lamps with miniature bi-pin sockets. Lamps supplied by others.

5. Ballast - Universal voltage electronic 120/277V ballast. Consult factory for 347V. Ballasts are mounted in luminaire. Accessible from below.

6. Dimming - In control fixtures with Lutron EcoSystem dimming, control wires are brought to an interface. Consult factory for location of control wire feed. Consult factory for specific dimming requirements other than those listed above.

7. Mounting - Integral bend out tabs are provided in the universal (**ML4U** and **ML4F**) ceiling fixture types. Adjustable mounting brackets provided for selected concealed T-bar or gypsum board (**ML4E**) ceiling installations.

8. Standby Battery Pack - Integral standby battery pack with integral test switch.

9. Weight - 22.0 lbs.

OTHER ML4 FAMILY LUMINAIRES	FIF #
ML4 1X2 T5 / T5 HO / T5TT LAMPING	311
ML4 1X4 T5 / T5 HO LAMPING	313
ML4 2X4 T5 / T5 HO LAMPING	314
ML4A SURFACE MOUNT	315

OTHER ML4 FAMILY LUMINAIRES	FIF #
ML4 1X2 T8 LAMPING	608
ML4 2X2 T8 LAMPING	609
ML4 1X4 T8 LAMPING	610
ML4 2X4 T8 LAMPING	611

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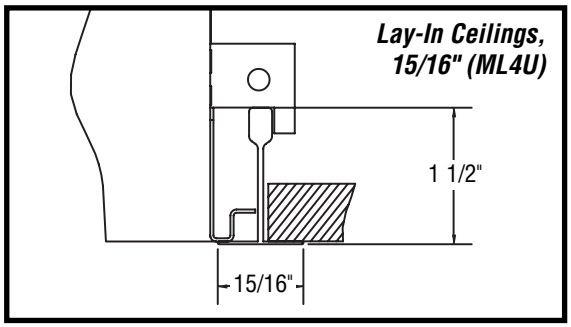
3300 Route 9W
Highland, NY 12528-2630

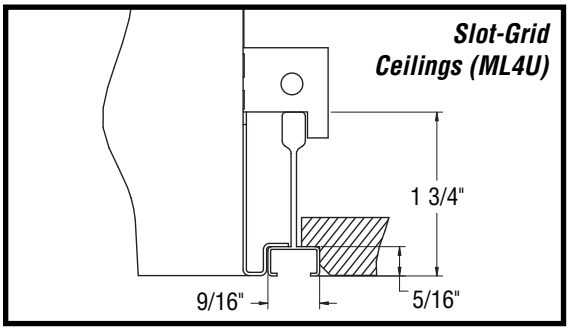
TEL (845) 691-6262
(800) 932-0633
FAX (845) 691-6289

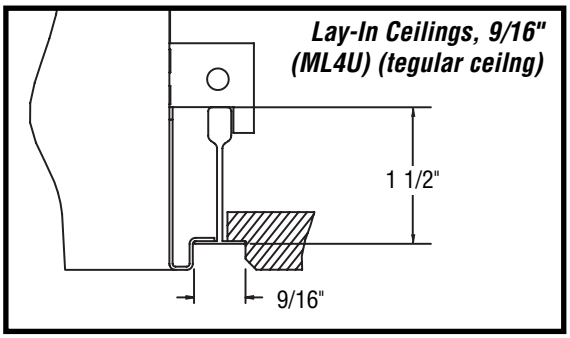
www.zumtobel.us

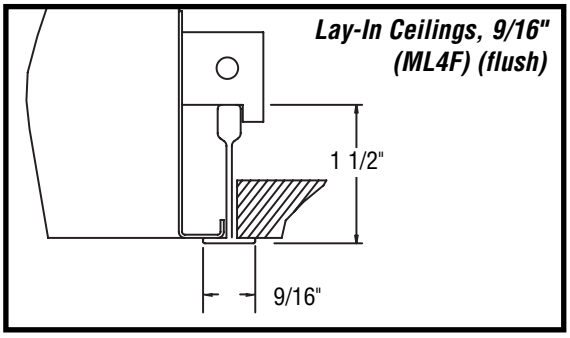
ZUMTOBEL

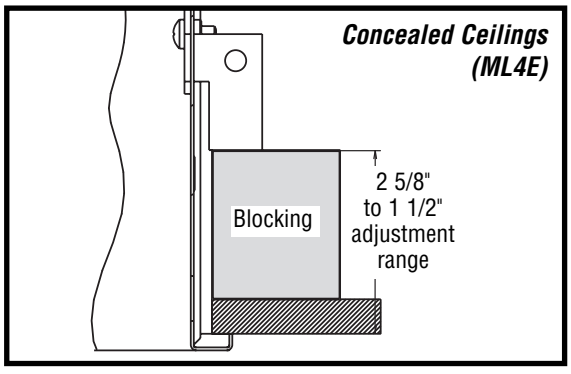
Mounting with common ceiling types











ML4 22 2405 MP (2) 40W T5TT

2x2 RECESSED, MICRO-PYRAMIDAL OPTIC DIFFUSER

LTL 11464

Total Luminaire Efficiency 74%

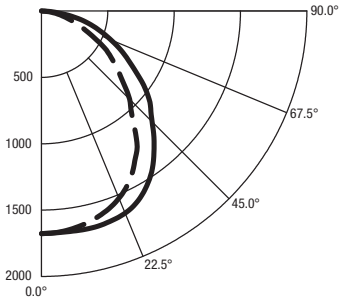
0% Uplight 100% Downlight

Spacing Criteria

Lateral Plane	0°	90°
	1.2	1.3

TOTAL LAMP LUMENS = 6300
INPUT WATTS = 76

Candela Distribution



Vertical Angle	Horizontal Angle 0°	45°	90°	Zonal Lumens
0°	1677	1677	1677	
5°	1670	1670	1675	149.1
15°	1611	1643	1676	463.8
25°	1487	1553	1628	713.9
35°	1257	1363	1455	845.1
45°	939	1104	1179	831.4
55°	661	795	920	713.9
65°	397	529	635	518.6
75°	193	306	374	310.4
85°	48	95	96	90.0
90°	0	0	0	

Luminance Data in Candela / Sq. Meter

Angle in Vertical°	Average 0°	Average 45°	Average 90°
45°	4112	4834	5163
55°	3568	4292	4967
65°	2909	3876	4653
75°	2309	3661	4474
85°	1705	3375	3411

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	88	88	88	88	86	86	86	86	82	82	82	79	79	79
1	81	77	74	71	79	76	73	70	72	70	68	70	68	66
2	74	68	63	58	72	66	62	58	63	60	56	61	58	55
3	67	59	53	49	65	58	53	48	56	51	47	54	50	47
4	62	53	46	41	60	52	46	41	50	45	41	48	44	40
5	57	47	41	36	55	46	40	36	45	39	35	43	39	35
6	52	43	36	31	51	42	36	31	41	35	31	39	34	31
7	49	39	32	28	47	38	32	28	37	31	27	36	31	27
8	45	35	29	25	44	35	29	25	34	28	25	33	28	24
9	42	32	26	22	41	32	26	22	31	26	22	30	26	22

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ZUMTOBEL

ML4 22 2405 OL (2) 40W T5TT

2x2 RECESSED, OPAL ACRYLIC DIFFUSER

LTL 11465

Total Luminaire Efficiency 77%

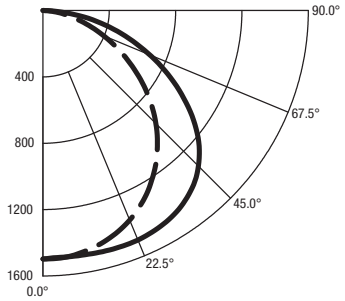
0% Uplight 100% Downlight

Spacing Criteria

Lateral Plane	0°	90°
	1.2	1.5

TOTAL LAMP LUMENS = 6300
INPUT WATTS = 76

Candela Distribution



Vertical Angle	Horizontal Angle 0°	45°	90°	Zonal Lumens
0°	1498	1498	1498	
5°	1494	1495	1492	133.4
15°	1440	1472	1498	416.3
25°	1335	1424	1492	655.0
35°	1174	1328	1447	826.1
45°	963	1171	1326	893.1
55°	715	936	1095	822.0
65°	458	642	780	624.6
75°	227	353	449	367.3
85°	56	99	117	102.0
90°	0	0	0	

Luminance Data in Candela / Sq. Meter

Angle in Vertical°	Average 0°	Average 45°	Average 90°
45°	4217	5128	5807
55°	3860	5053	5911
65°	3356	4704	5715
75°	2716	4223	5372
85°	1990	3517	4157

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	92	92	92	92	90	90	90	90	86	86	86	82	82	82
1	84	80	77	73	82	78	75	72	75	72	70	72	70	68
2	76	69	64	59	74	68	63	59	65	61	57	62	59	56
3	69	61	54	49	67	59	53	48	57	52	48	55	50	47
4	63	53	46	41	61	52	46	41	50	45	40	49	44	40
5	58	48	40	35	56	47	40	35	45	39	35	43	38	34
6	53	43	36	31	52	42	35	30	41	35	30	39	34	30
7	49	39	32	27	48	38	31	27	37	31	26	36	30	26
8	46	35	28	24	45	35	28	24	34	28	24	33	27	23
9	43	32	26	21	42	32	25	21	31	25	21	30	25	21

ML4 22 2405 MD (2) 40W T5TT

2x2 RECESSED, MICROGRID DIFFUSER

LTL 11463

Total Luminaire Efficiency 65%

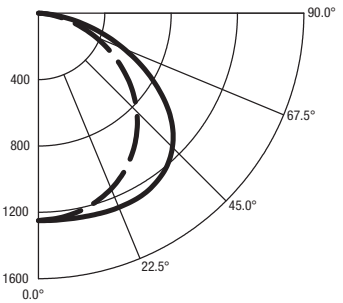
0% Uplight 100% Downlight

Spacing Criteria

Lateral Plane	0°	90°
	1.3	1.5

TOTAL LAMP LUMENS = 6300
INPUT WATTS = 76

Candela Distribution



Vertical Angle	Horizontal Angle 0°	45°	90°	Zonal Lumens
0°	1250	1250	1250	
5°	1242	1247	1252	111.3
15°	1201	1232	1260	348.3
25°	1122	1202	1267	552.8
35°	1000	1136	1241	705.7
45°	838	1011	1142	770.4
55°	641	807	933	711.4
65°	425	545	636	531.3
75°	214	280	328	291.6
85°	48	60	69	68.6
90°	0	0	0	

Luminance Data in Candela / Sq. Meter

Angle in Vertical°	Average 0°	Average 45°	Average 90°
45°	3670	4427	5001
55°	3460	4357	5037
65°	3114	3993	4660
75°	2560	3350	3924
85°	1705	2132	2451

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	78	78	78	78	76	76	76	76	73	73	73	69	69	69
1	71	68	65	62	69	66	64	61	63	61	59	61	59	58
2	64	59	54	50	63	58	53	50	55	52	49	53	50	48
3	58	51	46	42	57	50	45	41	48	44	40	47	43	40
4	53	45	39	35	52	44	39	35	43	38	34	41	37	34
5	49	40	34	30	48	40	34	30	38	33	29	37	32	29
6	45	36	30	26	44	36	30	26	34	29	26	33	29	25
7	42	33	27	23	41	32	27	23	31	26	22	30	26	22
8	39	30	24	20	38	29	24	20	28	23	20	28	23	20
9	36	27	22	18	35	27	22	18	26	21	18	25	21	18

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Highland, NY 12528-2630

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ZUMTOBEL

ML4 22 1505 W (1) 50W T5TT

2x2 RECESSED, WHITE LOUVER

PRORATED FROM LTL 09164

Total Luminaire Efficiency 73%

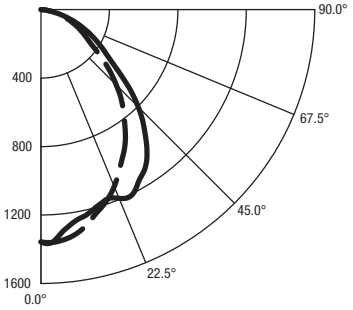
0% Uplight 100% Downlight

Spacing Criteria

Lateral Plane	0°	90°
	1.1	1.3

TOTAL LAMP LUMENS = 4000
INPUT WATTS = 60

Candela Distribution



	Horizontal Angle			
Vertical Angle	0°	45°	90°	Zonal Lumens
0°	1358	1358	1358	
5°	1355	1345	1316	117.1
15°	1236	1192	1204	339.3
25°	1067	1050	1211	502.6
35°	858	946	1077	586.2
45°	622	719	804	544.1
55°	368	458	479	396.7
65°	231	253	297	256.9
75°	119	124	135	133.8
85°	31	25	24	30.5
90°	0	0	0	

Luminance Data in Candela / Sq. Meter

Angle in Vertical°	Average 0°	Average 45°	Average 90°
45°	2596	2999	3354
55°	1895	2358	2462
65°	1613	1764	2074
75°	1361	1418	1534
85°	1033	860	816

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	87	87	87	87	85	85	85	85	81	81	81	78	78	78
1	81	77	75	72	79	76	73	71	73	71	69	70	68	67
2	74	69	64	60	72	67	63	60	65	61	58	62	59	57
3	68	61	56	51	66	60	55	51	58	53	50	56	52	49
4	63	55	49	44	61	54	48	44	52	47	43	50	46	43
5	58	49	43	39	56	48	43	38	47	42	38	45	41	38
6	54	45	38	34	52	44	38	34	43	37	34	41	37	33
7	50	41	35	30	49	40	34	30	39	34	30	38	33	30
8	47	37	31	27	46	37	31	27	36	31	27	35	30	27
9	44	34	29	25	43	34	28	25	33	28	25	32	28	24

Air Return

ML4 Return Air Volume, CFM:

Fixture Size	Negative Static Pressure, in. H20 0.04	0.05	0.07	0.08	0.1
2 x 2	80	90	100	110	120
1 x 4	150	170	210	225	250
2 x 4	150	170	210	225	250

Test performed in accordance with ASHRAE-70-1991 by Intertek ETL SEMKO. Consult factory for full report.

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GE Lighting

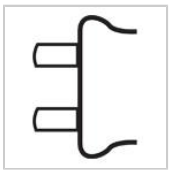
46701 - F24W/T5/841/ECO

GE Ecolux® Starcoat® T5

• Passes TCLP, which can lower disposal costs.

a product of ecomagination

High Color Rendering



CAUTIONS & WARNINGS

Caution

• Lamp may shatter and cause injury if broken

- Wear safety glasses and gloves when handling lamp.
- Do not use excessive force when installing lamp.

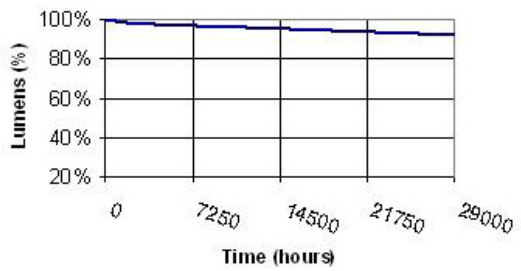
Warning

• Risk of Electric Shock

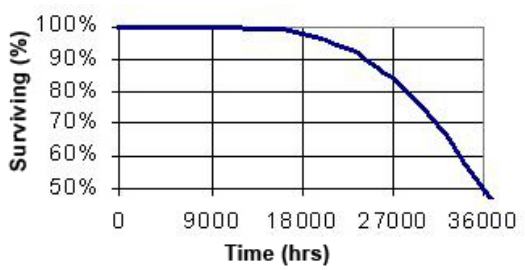
- Turn power off before inspection, installation or removal.

GRAPHS & CHARTS

Lumen Maintenance



Lamp Mortality



GENERAL CHARACTERISTICS

Lamp Type	Linear Fluorescent - Straight Linear
Bulb	T5
Base	Miniature Bi-Pin (G5)
Wattage	24
Voltage	75
Rated Life	30000 hrs
Rated Life (rapid start) @ Time	30000.0 @ 3.0/36000.0 @ 12.0 h
Bulb Material	Soda lime
Starting Temperature	-20 °C (-4 °F)
LEED-EB MR Credit	82 picograms Hg per mean lumen hour
Additional Info	TCLP compliant

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	2000
Mean Lumens	1840
Nominal Initial Lumens per Watt	83
Color Temperature	4100 K
Color Rendering Index (CRI)	85
S/P Ratio (Scotopic/Photopic Ratio)	1.7

ELECTRICAL CHARACTERISTICS

Open Circuit Voltage (rapid start) Min @ Temperature	280 V @ 10 °C
Cathode Resistance Ratio - Rh/Rc (MIN)	4.25
Cathode Resistance Ratio - Rh/Rc (MAX)	6.5
Current Crest Factor	1.7

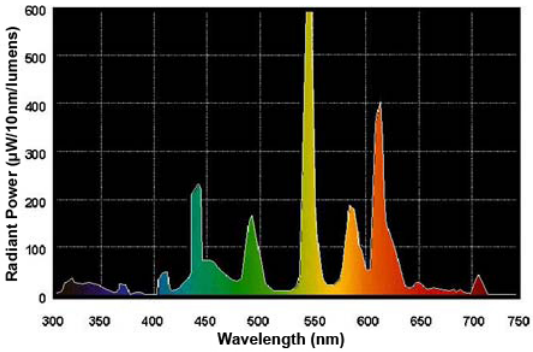
DIMENSIONS

Maximum Overall Length (MOL)	22.1700 in(563.1 mm)
Nominal Length	21.600 in(548.6 mm)
Bulb Diameter (DIA)	0.625 in(15.9 mm)
Bulb Diameter (DIA) (MAX)	0.625 in(15.9 mm)
Max Base Face to Base Face (A)	21.610 in(548.9 mm)
Face to End of Opposing Pin (B) (MIN)	21.790 in(553.5 mm)
Face to End of Opposing Pin (B) (MAX)	21.890 in(556.0 mm)

PRODUCT INFORMATION

Product Code	46701
Description	F24W/T5/841/ECO
Standard Package	Case
Standard Package GTIN	10043168467015
Standard Package Quantity	40
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	40
UPC	043168467018

Spectral Power Distribution



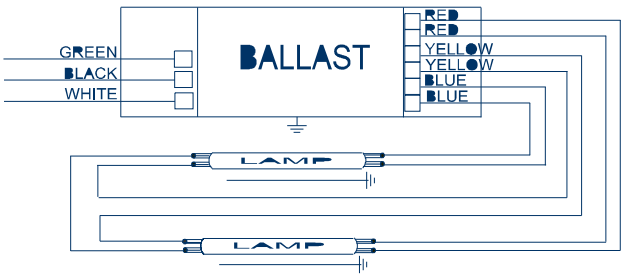
PHILIPS
ADVANCE

ICN-2S24@277V	
Brand Name	CENTIUM T5
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
F24T5/HO	1	24	0/-18	0.10	27	1.02	10	0.98	1.7	3.78
* F24T5/HO	2	24	0/-18	0.19	52	1.00	10	0.98	1.7	1.92
F39T5/HO	1	39	0/-18	0.15	40	0.90	10	0.98	1.7	2.25
FC12T5	1	40	0/-18	0.15	40	0.84	10	0.98	1.7	2.10
FC9T5	1	22	0/-18	0.10	27	1.02	10	0.98	1.7	3.78
FC9T5	2	22	0/-18	0.19	52	1.00	10	0.98	1.7	1.92
FT24W/2G11	1	24	0/-18	0.10	27	1.02	10	0.98	1.7	3.78
FT24W/2G11	2	24	0/-18	0.19	52	1.00	10	0.98	1.7	1.92
FT36W/2G11	1	36	0/-18	0.13	34	0.90	10	0.98	1.7	2.65
FT40W/2G11/RS	1	40	0/-18	0.17	47	1.00	10	0.98	1.7	2.13

Wiring Diagram



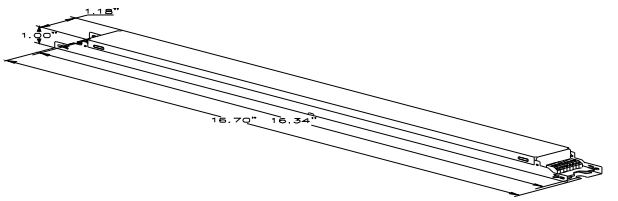
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	0	0
White	0	0
Blue	0	0
Red	0	0
Yellow	0	0
Gray	0	0
Violet	0	0

	in.	cm.
Yellow/Blue	0	0
Blue/White	0	0
Brown	0	0
Orange	0	0
Orange/Black	0	0
Black/White	0	0
Red/White	0	0

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
16.70 "	1.18 "	1.00 "	16.34 "
16 7/10	1 9/50	1	16 17/50
42.4 cm	3 cm	2.5 cm	41.5 cm

Revised 09/01/2004

Data is based upon tests performed by Philips Lighting Electronics N.A. in a controlled environment and is representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

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Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

PHILIPS
ADVANCE

ICN-2S24@277V	
Brand Name	CENTIUM T5
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be provided with integral leads or poke-in wire trap connectors color-coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start.

2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.3 Ballast shall operate from 50/60 Hz input source of _____ (120V through 277V or 347V through 480V) with sustained variations of +/- 10% (voltage and frequency).

2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.5 Ballast shall have a Power Factor greater than 0.98 for primary lamp.

2.6 Ballast shall have a minimum ballast factor of 1.00 for primary lamp application.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 20% for Standard models and THD of less than 10% for Centium models when operated at nominal line voltage with primary lamp.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of _____ {-18C (0F) or -28C (-20F)} for primary lamp. Consult lamp manufacturer for temperature versus light output characteristics.

2.11 Ballast shall provide Lamp EOL Protection Circuit.

2.12 Ballast shall tolerate sustained open circuit and short circuit output conditions.

2.13 Four-lamp ballast shall have (semi-independent or independent) lamp operation.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.4 Ballast shall comply with ANSI C82.11 where applicable.

3.5 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

3.6 Ballast shall comply with UL Type CC rating.

3.7 Ballast shall comply with NEMA 410 for in-rush current limits.

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9001 Quality System Standards.

4.2 Ballast shall carry a five-year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 70C. Ballasts with a "90C" designation in their catalog number shall also carry a three-year warranty at a maximum case temperature of 90C.

4.3 Manufacturer shall have a twenty-year history of producing electronic ballasts for the North American market.

Revised 09/01/2004

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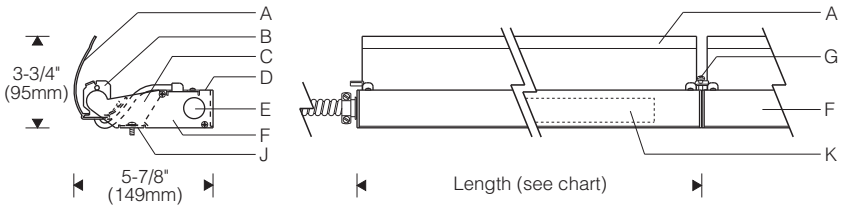
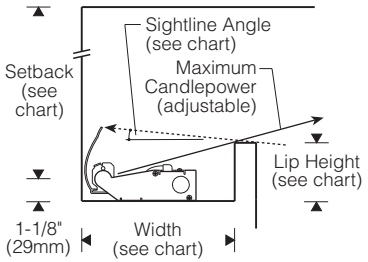
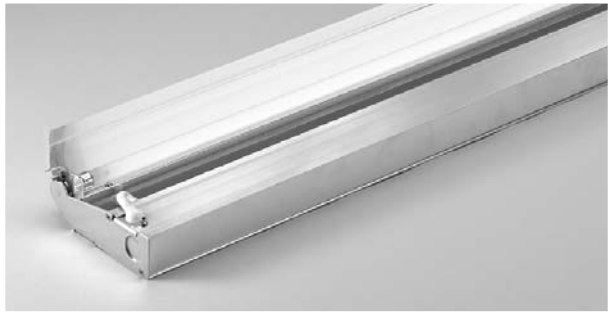
Style 306 1:8 Scale



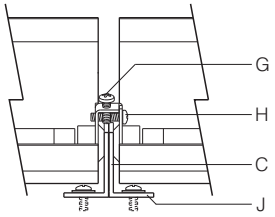
Cove 1:10 Scale





Joint 1:4 Scale

(Ballast compartment not shown for clarity.)



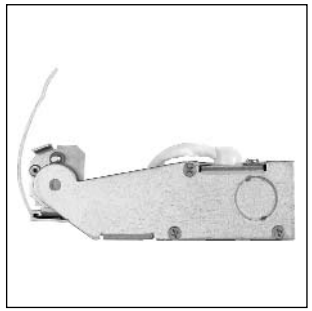
Nominal Lamp Length	*Luminaire Length*	
	T5	*T8*
1 x 2'	23-1/16" (586mm)	24-3/4" (628mm)
1 x 3'	34-7/8" (886mm)	36-3/4" (932mm)
1 x 4'	46-11/16" (1186mm)	48-3/4" (1237mm)
1 x 5'	58-1/2" (1486mm)	60-1/2" (1537mm)
2 x 3'	69-1/2" (1765mm)	73-3/16" (1859mm)
2 x 4'	93-1/8" (2365mm)	97-3/16" (2468mm)
2 x 5'	116-5/8" (2963mm)	120-7/8" (3069mm)

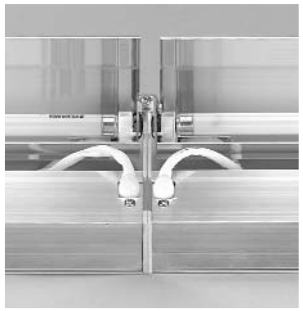
Cove Dimensions

(Max. candlepower aimed 15° above horiz.)

Sight-line	0°(horiz. cutoff)	5°	10°
Width (inside)	10-5/8" (270mm)	8-1/4" (210mm)	6-3/4" (171mm)
Lip (inside)	3-3/4" (95mm)	3" (76mm)	2-5/8" (67mm)
Setback (varies)	Recommended minimum: 12" T5 & T8, 18" T5HO		

Note: Finish interior of cove matte white for best results.





Specifications

- **A** Specular extruded aluminum reflector
- **B** Stainless steel lamp-holder/support brackets
- **C** Aluminum sidearm with mounting tab
- **D** Extruded aluminum ballast/wireway channel cover
- **E** Conduit entry (one each end, conduit and connector by others)
- **F** Extruded aluminum ballast/wireway compartment
- **G** Rotation locking screw
- **H** Joiner/alignment screw
- **J** Mounting tab (fastener by others)
- **K** Integral electronic ballast

Finish:
Reflector - extruded high purity aluminum with clear anodized specular finish. Sidearms and ballast/wireway compartment - mill finish aluminum. All luminaire hardware - stainless steel.

Mounting:
Lay-in installation requires only one fastener per joint (by others). Sidearms with mounting tabs can be base or wall mounted. Luminaires can be mounted individually or joined together to form a continuous row.

Reflector aiming is adjustable and is fixed in position by rotation locking screws at each sidearm. When mounted in a continuous row, joiner screws lock reflectors together allowing all in the row to be aimed together.

Standard:
UL listed or CSA certified for damp locations. (Style 124 painted model with lens recommended for damp locations.)

Electrical:
Use 90°C wire for supply connections.

Integral electronic HPF thermally protected class P ballast (with end-of-life protection for T5 lamps). Ballast/wireway compartment includes one conduit entry at each end. Channel cover removes for access to ballast and wiring. Luminaires may be butted end-to-end (connectors by others) for through wiring. Optional #12 AWG prewired modular through wiring with quick connectors.

Master/satellite combination is available (Configuration **3**, see ordering information). Master supplied with 2-lamp ballast. (Wiring, conduit and connectors between master and satellite units by others.)

Optional electronic dimming ballast; compatible dimmer switch required (by others). Consult sales representative for compatibility and specifications.

Optional integral emergency battery operates one lamp. Separate unswitched supply is required.

For complete ballast specifications, see Accessories Section.

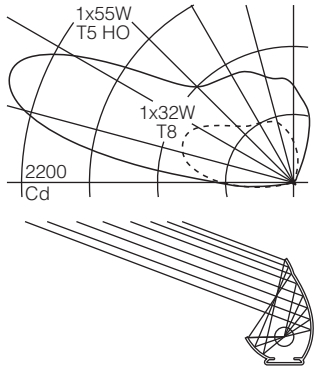
Features

- *Choose T5 for precise optical control or widely utilized T8*
- *Compact and flexible - effective indirect cove lighting for malls, offices, lobbies, conference rooms and corridors*
- *Adjustable - all reflectors in a row join and aim together; rotation locking screws secure position**
- *Integral electronic ballast thru wiring for easy installation*

C 20.0

Performance

Two parabolic reflector sections drive light across the ceiling from one edge. An elliptical section shields the lamp from normal viewing angles and redirects its light to a parabola. Glare is minimized and asymmetry of the beam is maximized resulting in high beam efficiency and superior surface uniformity.



For complete photometrics, visit www.elliptipar.com

*U.S. Patent No. 5,550,725 and foreign.

elliptipar

To form a Catalog Number

F 3 0 6 - [ ] - S - 0 0 - [ ] - [ ] [ ]
1 2 3 4 5 6 7 8

Project: Type:

1 Source

F = Linear fluorescent

2 Style

306 = Small concealed, **integral** ballast

3 Lamp

Note: To order by overall row length, enter **ROW CODE** in place of Lamp Code below (see Row Charts on page C-20.2 for T8 or C-20.4 for T5). Row Code specifies a row complete with all necessary reflectors and ballasts.

[ ] [ ] [ ] = **Lamp Code**

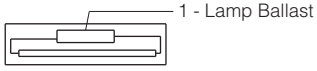
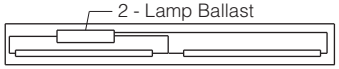
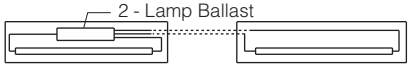
Lamp Wattage (see chart below)

Reflector Configuration, specify **1**, **2** or **3** (see chart below)

A = T8 Fluorescent
T = T5 Fluorescent

Example: **A325** = two nominal 3' reflectors, each for use with one 25W T8 lamp; one 2-lamp ballast

Reflector Configuration

1	 1-Lamp Reflector
2	 2-Lamp Reflector
3	 1-Lamp Reflector (Master) 1-Lamp Reflector (Satellite)

Lamp Wattage

Lamp Length (nominal)	*Lamp Wattage (Lamp Number)*		
	T8	*T5*	*T5 HO*
2'	**17** (F17T8)	**14** (F14T5)	**24** (F24T5/HO)
3'	**25** (F25T8)	**21** (F21T5)	**39** (F39T5/HO)
4'	**32** (F32T8)	**28** (F28T5)	**55** (F54T5/HO)
5'	**40** (F40T8)	**35** (F35T5)	**80** (F80T5/HO)

For complete lamp and ballast information, see Accessories Section. Standard T5 lamp color is 3000K / 80+ CRI. T8 lamps by others.

4 Mounting

S = Sidearms with mounting tabs

5 Finish

00 = Bright anodized reflector with mill finish ballast compartment

6 Voltage/Ballast

Electronic
1 = 120V
2 = 277V
3 = 347V (Canada)

*Dimming**
T = 120V
V = 277V

* Consult sales representative for dimming 5' lamps (lamp codes **Ax40**, **Tx35**, **Tx80**) and for Reflector Configuration **3**. Availability for wattages and voltages varies with ballast manufacturer and control type - see **www.elliptipar.com** for additional dimming specifications and limitations.

7 Option (See Accessories Section for specifications)

00 = No options
0E = Integral emergency battery pack with indicator lamp and test button. Operates one lamp. Available in nominal 4', 6' and 8' units only (lamp codes **A132**, **A225**, **A232**, **A332**, **T128**, **T221**, **T228**, **T328**, **T155**, **T239**, **T255** and **T355**).
0K = Prewired modular #12 AWG through wiring with quick connectors
EK = Combination of emergency battery pack and prewired modular through wiring as described above
XX = For modification not listed, include detailed description. Consult factory prior to specification.

8 Standard

0 = UL, Underwriters Laboratories
J = CSA, Canadian Standards Association

Example

F306 - A240 - S - 00 - 1 - 0E0

Small concealed fluorescent consisting of one nominal 10' luminaire, for use with two 40W T8 lamps. Integral 120V electronic 2-lamp ballast. Sidearm with mounting tabs. Supplied with integral emergency battery pack. UL.

REV. 7/07 elliptipar

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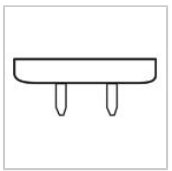
GE Lighting

15904 - F32T8/SP41/ECO/C

GE Ecolux® Starcoat® T8

• Passes TCLP, which can lower disposal costs.

High Color Rendering
Meets Federal Minimum Efficiency Standards



CAUTIONS & WARNINGS

Caution

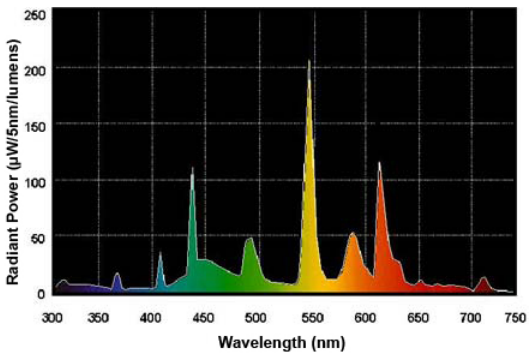
• Lamp may shatter and cause injury if broken
- Wear safety glasses and gloves when handling lamp.
- Do not use excessive force when installing lamp.

Warning

• Risk of Electric Shock
- Turn power off before inspection, installation or removal.

GRAPHS & CHARTS

Spectral Power Distribution



GENERAL CHARACTERISTICS

Lamp Type	Linear Fluorescent - Straight Linear
Bulb	T8
Base	Medium Bi-Pin (G13)
Wattage	32
Voltage	137
Rated Life	20000 hrs
Rated Life (instant start) @ Time	24000 h @ 12 h
Rated Life (rapid start) @ Time	20000 h @ 3 h
Bulb Material	24000.0 @ 12.0 h
Starting Temperature	Soda lime
LEED-EB MR Credit	10 °C (50 °F)
Additional Info	74 picograms Hg per mean lumen hour
Primary Application	TCLP compliant
	Standard

PHOTOMETRIC CHARACTERISTICS

Initial Lumens	2800
Mean Lumens	2660
Nominal Initial Lumens per Watt	87
Color Temperature	4100 K
Color Rendering Index (CRI)	78

ELECTRICAL CHARACTERISTICS

Open Circuit Voltage (rapid start) Min @ Temperature	315 V @ 10 °C
Cathode Resistance Ratio - Rh/Rc (MIN)	4.25
Cathode Resistance Ratio - Rh/Rc (MAX)	6.5
Current Crest Factor	1.7

DIMENSIONS

Maximum Overall Length (MOL)	47.7800 in(1213.6 mm)
Minimum Overall Length	47.6700 in(1210.8 mm)
Nominal Length	48.000 in(1219.2 mm)
Bulb Diameter (DIA)	1.000 in(25.4 mm)
Bulb Diameter (DIA) (MIN)	0.940 in(23.9 mm)
Bulb Diameter (DIA) (MAX)	1.000 in(25.4 mm)
Max Base Face to Base Face (A)	47.220 in(1199.4 mm)
Face to End of Opposing Pin (B) (MIN)	47.400 in(1204.0 mm)
Face to End of Opposing Pin (B) (MAX)	47.500 in(1206.5 mm)
End of Base Pin to End of Opposite Pin End (C)	47.670 in(1210.8 mm)

PRODUCT INFORMATION

Product Code	15904
Description	F32T8/SP41/ECO/C
ANSI Code	1005-2
Standard Package	Case
Standard Package GTIN	10043168159040
Standard Package Quantity	12
Sales Unit	Unit
No Of Items Per Sales Unit	1
No Of Items Per Standard Package	12
UPC	043168159043

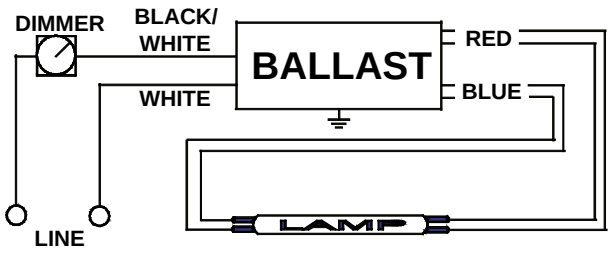
PHILIPS ADVANCE

VEZ-132-SC	
Brand Name	MARK 10 POWERLINE
Ballast Type	Electronic Dimming
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (Watts) (min/max)	Ballast Factor (min/max)	MAX THD %	Power Factor	Lamp Current Crest Factor	B.E.F.
F17T8	1	17	50/10	0.09	07/24	0.05/1.05	10	0.99	1.6	4.38
F25T8	1	25	50/10	0.11	07/30	0.05/1.05	10	0.99	1.6	3.50
* F32T8	1	32	50/10	0.13	09/35	0.05/1.00	10	0.99	1.6	2.86

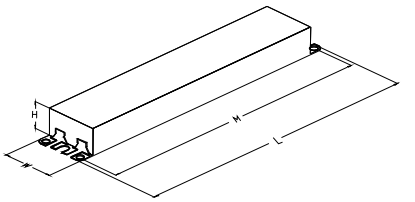
Wiring Diagram



The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
9.50 "	1.7 "	1.18 "	8.90 "
9 1/2	1 7/10	1 9/50	8 9/10
24.1 cm	4.3 cm	3 cm	22.6 cm

Revised 10/28/2005

PHILIPS LIGHTING ELECTRONICS N.A.
10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Tel: 800-322-2086 · Fax: 888-423-1882 · www.philips.com/advance
Customer Support/Technical Service: 800-372-3331 · OEM Support: 866-915-5886

PHILIPS
ADVANCE

VEZ-132-SC	
Brand Name	MARK 10 POWERLINE
Ballast Type	Electronic Dimming
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Notes:

Section I - Physical Characteristics

1.1 Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.

1.2 Ballast shall be available in a plastic/metal can or all metal can construction to meet all plenum requirements.

1.3 Ballast shall be provided with poke-in wire trap connectors or integral leads color coded per ANSI C82.11.

Section II - Performance Requirements

2.1 Ballast shall be Programmed Start.

2.2 Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.

2.3 Ballast shall operate from 60 Hz input source of 120V, 277V or 347V as applicable with sustained variations of +/- 10% (voltage and frequency).

2.4 Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.

2.5 Ballast shall have a Power Factor greater than 0.98 at full light output and greater than 0.90 throughout the dimming range for primary lamp.

2.6 Ballast shall have a minimum ballast factor of 1.00 at maximum light output and 0.05 at minimum light output for primary lamp application.

2.7 Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less.

2.8 Ballast input current shall have Total Harmonic Distortion (THD) of less than 10% at maximum light output when operated at nominal line voltage with primary lamp. Total Harmonic Current (THC) at minimum light output shall not exceed THC at maximum light output.

2.9 Ballast shall have a Class A sound rating.

2.10 Ballast shall have a minimum starting temperature of 10C (50F) for primary lamp.

2.11 Ballast shall provide Lamp EOL Protection Circuit for all T5, T5/HO, and CFL lamps.

2.12 Ballast shall control lamp light output from 100% - 5% relative light output for T8 and CFL lamps and 100% - 1% relative light output for T5/HO lamps.

2.13 Ballast shall ignite the lamps at any light output setting without first going to another output setting.

2.14 Ballast shall tolerate sustained open circuit and short circuit output conditions.

Section III - Regulatory Requirements

3.1 Ballast shall not contain any Polychlorinated Biphenyl (PCB).

3.2 Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.

3.3 Ballast shall comply with ANSI C62.41 Category A for Transient protection.

3.4 Ballast shall comply with ANSI C82.11 where applicable.

3.5 Ballast shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

3.6 Ballast shall comply with NEMA 410 for in-rush current limits.

Section IV - Other

4.1 Ballast shall be manufactured in a factory certified to ISO 9001 Quality System Standards.

4.2 Ballast shall carry a ____ warranty from date of manufacture against defects in material or workmanship for operation at a maximum case temperature of ____ (Go to our web site for up to date warranty information: www.philips.com/advancewarranty.

4.3 Manufacturer shall have a twenty-year history of producing electronic ballasts for the North American market.

4.4 Ballast shall be controlled by a compatible Mark 10 Powerline two-wire dimmer.

4.5 Ballast shall be Philips Advance part # _____ or approved equal.

Revised 10/28/2005

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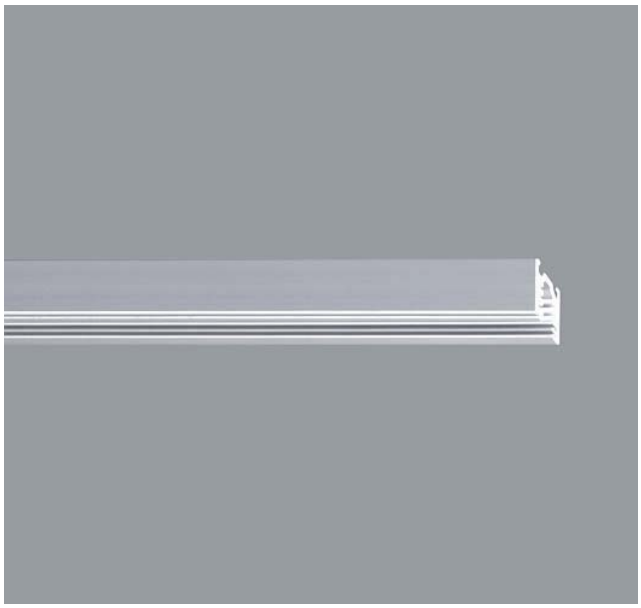
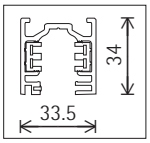
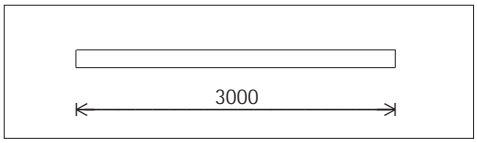
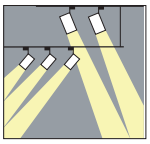
ERCO

ERCO track









日本

78303.000 Silver
Length 3000mm

Product description
Aluminium profile, anodised.
4 isolated copper conductors and pressed-in earth conductor.
When used as DALI track: one 16A circuit and two conductors for connecting to the DALI data line.
When used as a 3-circuit track: three separately switchable circuits 16A each.
The ERCO track system is approved to IEC 60570 (EN 60570/VDE 0711 part 300).
Mounting surface with easy to remove knockouts at 0.4m intervals.
Weight 3.30kg

ERCO GmbH
Brockhauser Weg 80-82
58507 Lüdenscheid
Germany
Tel.: +49 2351 551 0
Fax: +49 2351 551 300
info@erco.com

Technical Region: 230V/50Hz
We reserve the right to make technical and design changes.
Edition: 03.11.2009
Current version under
www.erco.com/78303.000

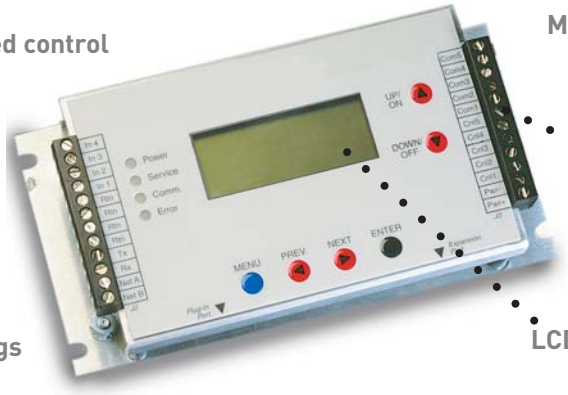
WIRELESS LIGHTING CONTROLS

MSC-100 Astronomic Time Clock

Provides time-scheduled control

Advanced holiday scheduling capability

Automatic daylight savings time adjustment



Multiple control channels

Connects to Room and House Scene Interfaces

LCD display screen

PROJECT

LOCATION/TYPE

Product Overview

Description

WattStopper's MSC-100 Astronomic Time Clock is a five-channel clock used for fully automating a Wireless Miro lighting control system. It offers simple programming, yet advanced control features. The Time Clock is used with at least one Wireless Miro Scene Interfaces.

Operation

The MSC-100 provides ON/OFF control signals based on time of day, day of week, holiday, and calculated sunrise/sunset (astronomic) time. Control signals are transmitted via hardwire connection to relay channels, giving the clock the ability to work in a range of applications from simple to complex. Clock schedules are programmed events that command channels on or off. Each schedule is assigned a number, type, time of day, channel, day, and may include other information for specific clock event operation. Schedules can be assigned to operate any combination of days or holiday types.

Programming

Programming the MSC-100 is easy. Users simply complete fill-in-the-blank prompts on the device keypad and can follow along on the LCD screen. Each clock channel can be programmed independently. All programming is securely stored in non-volatile memory.

Applications

When used in conjunction with Wireless Miro lighting controls, one MSC-100 will support connection to up to two Scene Interfaces, depending on the number of scenes required. Unused channels can be used to control third-party devices such as fountains or sprinklers.

Features

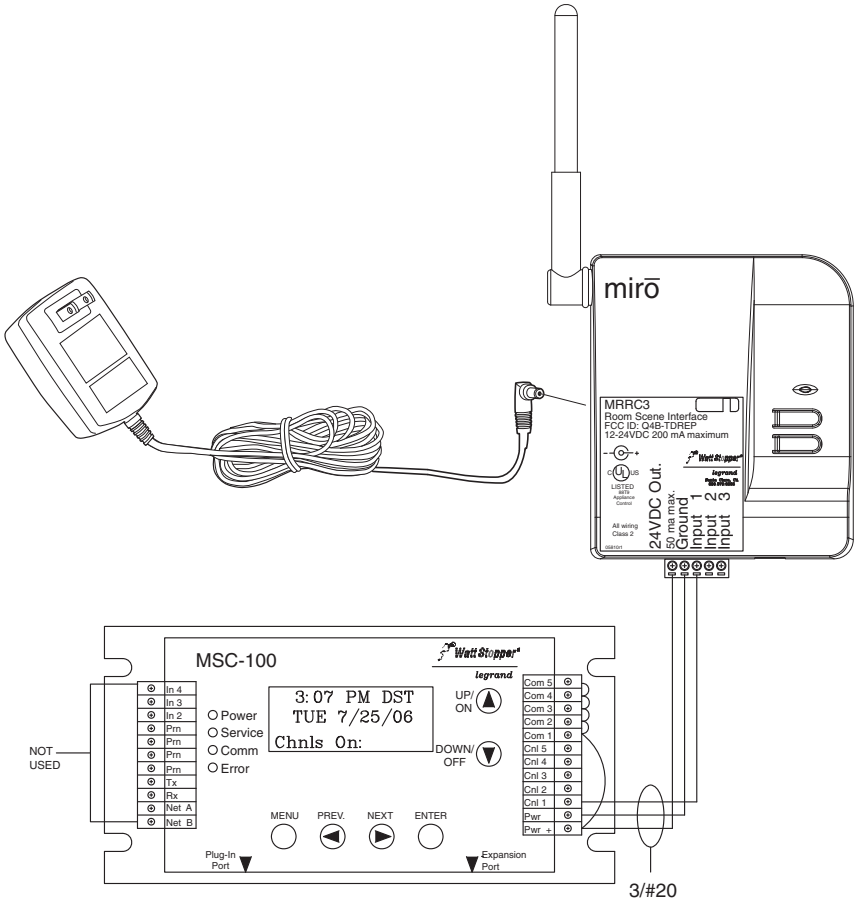
- Single date, perpetual date, perpetual day of week and perpetual Easter holidays
- 32 holidays, each up to 120 days with three holiday schedule types
- Temporary schedules that execute once then self-delete
- Repeating schedule 5 minutes to 10 hours
- 120 schedules assignable to one or more weekday or holiday
- Duration time scheduling from 1 second to 18 hours
- Continually self-adjusting astronomic control based on sunrise and sunset times
- Astronomic offset +/- 120 minutes
- Manual ON/OFF override from keypad
- Selectable 12- or 24-hour format
- Adjustable channel stagger from 1-60 seconds

Specifications

- Input voltage: 24 VAC or 24 VDC
- Five normally open isolated relays rated 1 amp 24 VAC/VDC, assigned to channels 1-5
- Battery backed clock operation for up to 8 years
- Non-volatile program memory storage
- Power-up sequence, executes missed schedules following power outage
- Dimensions: 3.6" x 6.7" x 1.3" (91.4mm x 177.8mm x 33mm) L x W x D
- FCC compliant; CE certified
- One year warranty

System Layout & Wiring

MSC-100 Controls & Wiring



The MSC-100 Time Clock interfaces to the Wireless Miro RF network through a Miro Room or House Scene Interface. The Scene Interface supplies 24 VDC to power the Time Clock. Wiring shown is typical for one channel.

Ordering Information

Catalog No.	Product Description
☐ MSC-100	5-channel astronomic time clock
Works in conjunction with:	
Catalog No.	**Description**
☐ MRHC3	House Scene Interface
☐ MRRC3	Room Scene Interface

COMMERCIAL OCCUPANCY SENSORS & CONTROLS

DT-355 Dual Technology Line Voltage Ceiling Sensor

PROJECT

LOCATION/TYPE

Product Overview

Description

WattStopper's low profile DT-355 dual technology occupancy sensor combines the benefits of passive infrared (PIR) and ultrasonic technologies. The sensor mounts on the ceiling with a flat, unobtrusive appearance and provides 360 degrees of coverage.

Operation

The DT-355 is line voltage and operates at 120, 230, 277 or 347 VAC. The sensor turns lighting on when both PIR and ultrasonic technologies detect occupancy. PIR technology senses the difference between infrared energy from a human body in motion and the background space. Ultrasonic technology uses high frequency (40KHz) ultrasound to sense motion within the space. Once lighting is on, detection by either technology holds lighting on. When no occupancy is detected for the length of the time delay, lighting turns off. The DT-355 can also be set so that only one technology is needed to trigger or both technologies are needed to hold lighting on.

Auto Set

The DT-355 requires no adjustment at installation. Auto set continuously monitors the controlled space to identify usage patterns. Using this information, it automatically adjusts the time delay and sensitivity settings for optimal performance and energy efficiency. The sensor assigns short delays (as low as 5 minutes) for times when the space is usually vacant, and longer delays (up to 30 minutes) for busier times.

Application

WattStopper's patented dual technology has the flexibility to work in a variety of applications, where one technology alone could encounter false triggers. Ideal applications include classrooms, open office spaces, large offices, and computer rooms. In addition, because the DT-355 can be mounted onto a variety of junction boxes, the sensor has the flexibility to be used in a wide range of spaces. The sensors eliminate the need for a power pack by using line voltage wiring.

Features

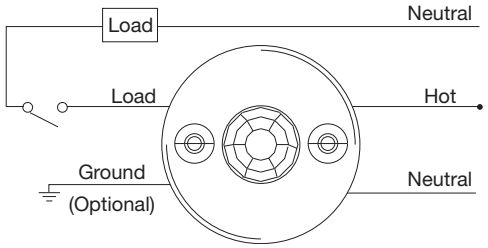
- Advanced control logic based on RISC microcontroller provides:
  - Detection Signature Processing eliminates false triggers and provides immunity to RFI and EMI
  - Walk-through mode turns lights off 3 minutes after the area is initially occupied – ideal for brief visits such as mail delivery
  - Built-in light level sensor featuring simple, one-step setup
- Ultrasonic diffusion technology spreads coverage to a wider area (patent pending)
- DIP switch simplifies sensor adjustments
- LEDs indicate occupancy detection
- Uses existing line voltage wiring and doesn't require a power pack
- Six occupancy logic options give users the ability to customize control to meet application needs
- Qualifies for ARRA-funded public works projects

Specifications

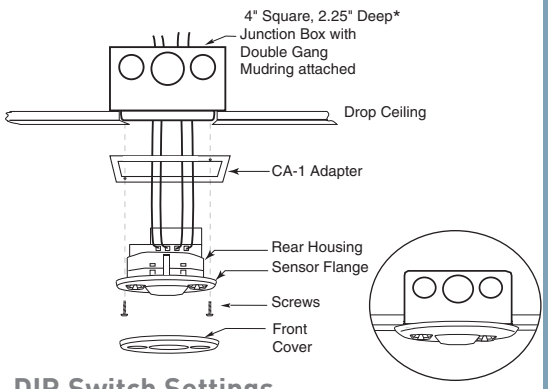
- 120/230/277/347 VAC, 50/60 Hz
- Ultrasonic frequency of 40kHz
- Time delays: Auto set, fixed (5, 10, 15, 20, or 30 minutes), walk-through, test-mode
- Sensitivity adjustment: Auto set or reduced sensitivity (for PIR sensitivity); ultrasonic sensitivity is variable with trimpot
- Built-in light level sensor – works from 10 to 300 footcandles (107.6 to 3,229.2 lux)
- Multi-level, 360° Fresnel lens for superior occupancy detection
- Mounting options: 4 square junction box with double gang mudring; 4 inch octagonal junction box
- Dimensions: 4.50" diameter x 1.45" deep (114.3mm x 25.9mm)
- UL and cUL listed
- Five year warranty

Wiring & Mounting

DT-355 Wiring Diagram

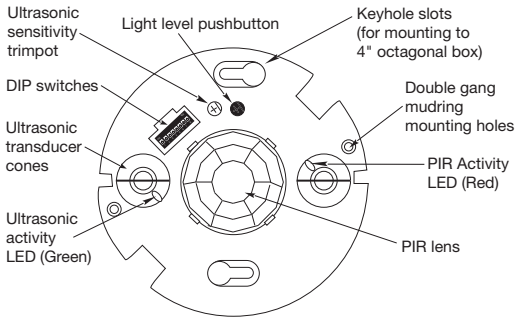


Ceiling Mounting



Controls & Settings

Product Controls



DIP Switch Settings

= Factory Setting
● = ON
– = OFF

Occupancy	Logic	Switch# 1	2	3
	Standard	–	–	–
	Option 1	●	–	–
	Option 2	–	●	–
	Option 3	●	●	–
	Option 4	–	–	●
	Option 5	●	–	●
	Option 6	–	●	●
	Option 7	●	●	●

Time Delay	4	5	6
5 sec/SmartSet	–	–	–
5 minutes	–	–	●
10 min.	–	●	–
10 minutes	–	●	●
15 min.	●	–	–
15 minutes	●	–	●
20 minutes	●	●	–
30 min.	●	●	●

= walk-through mode

Occupancy Logic	Trigger	Initial Occupancy	Maintain Occupancy	Re-trigger (seconds duration)
	Standard	Both	Either	Either(5)
	Option 1	Either	Either	Either(5)
	Option 2	PIR	Either	Either(5)
	Option 3	Both	Both	Both(5)
	Option 4	PIR	PIR	PIR(5)
	Option 5	Ultra	Ultra	Ultra(5)
	Option 6	Man.	Either	Either(30)
	Option 7	Man.	Both	Both(30)

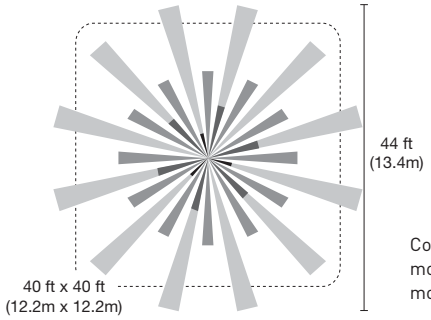
LEDs	7
Disabled	–
Enabled	●

PIR Sensitivity	8
Minimum	–
Max./SmartSet	●

The technology control (occupancy logic) options are adjustable by user. The standard setting (recommended for most applications) is both technologies to trigger on, either to hold on.

Coverage

Coverage Pattern



Coverage shown is maximum and represents half-step walking motion. Under ideal conditions, coverage for half-step walking motion can reach up to 1000 ft² (92.9 m²).

Ordering Information

Catalog No.	Voltage	Load Rating	Coverage
☐ DT-355 ☐ DT-355-U	120 VAC, 50/60 Hz 230/277 VAC, 50/60 Hz 347 VAC, 50/60 Hz	0-800W Ballast/Tungsten 0-1200W Ballast 0-1500W Ballast	up to 1000 ft², (92.9 m²)
☐ CA-1	Cosmetic adapter for ceiling installations with 4" square j-box or Wiremold #V5748-2 box		

Sensors are white.

Pub. No. 15806 rev. 10/2009

GRAFIK Eye 3000 Series Control Unit

Cover (shown open)

Description

- Provides pushbutton recall of four preset lighting scenes, plus Off.
- Allows setup of lighting scenes using buttons on the Control Unit.
- Controls many light source types directly, and others using power interfaces.
- Provides lockout options to prevent accidental changes.
- Includes built-in infrared receiver for operation with an optional remote control.

Models available to:

- Accept 120V, 220-240V (non-CE), 230V (CE) and 100V input power.
- Control two to six zones of lighting.

GRX-3100 Control Units

Provide setup using buttons on the Control Unit.

GRX-3500 Control Units

Provide optional setup using a PC, including setting lighting levels in 1% increments.

Job Name:	Model Numbers:	
Job Number:		

Specifications

Input Power

- 120V, 220-240V (non-CE), 230V (CE) or 100V, 50/60Hz.
- Lightning Strike Protection: Meets ANSI/IEEE standard 62.41-1980. Can withstand voltage surges of up to 6000V and current surges of up to 3000A.

Lighting Sources/Load Types

Controls the following lighting sources with a smooth, continuous Square Law dimming curve or on a full conduction non-dim basis:

- Incandescent, Tungsten, Magnetic Low Voltage Transformer
- Lutron Tu-Wire® Electronic Fluorescent Dimming Ballast
- Neon and Cold Cathode

Controls the following lighting sources with a smooth continuous Square Law dimming curve through separate power interfaces:

- Electronic Low Voltage Transformer
- Lutron Electronic Fluorescent Dimming Ballast

Preset Control

- 4 preset lighting scenes and off are accessible from the Control Unit front panel.
- 12 additional scenes are stored in the Control Unit. These scenes are accessible via Wallstations and/or Control Interfaces.
- Light levels fade smoothly between scenes. Fade time can be set differently for each scene, between 0-59 sec. or 1-60 min. Fade time from Off is capped at 5 sec.

Key Design Features

- Meets IEC 801-2. Tested to withstand 15kV electrostatic discharge without damage or memory loss.
- Compensates in real time for incoming line voltage variations: No visible flicker with +/-2% change in RMS voltage/cycle and +/-2% Hz change in frequency/second.
- 10-year power failure memory automatically restores lighting to levels prior to power interruption.
- Faceplate snaps on with no visible means of attachment.

System Communications and Capacities

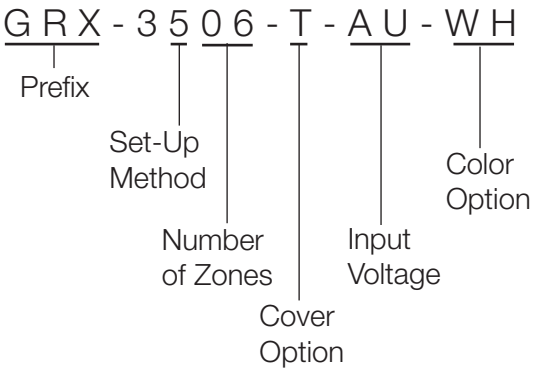
- Low-voltage type Class 2 (PELV) wiring connects Control Units, Wallstations, and Control Interfaces:
- Up to 8 Control Units may be linked to control up to 48 zones.
- Up to 16 total Wallstations and Control Interfaces may be added for a total of 24 control points.

Environment

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

Job Name:	Model Numbers:	
Job Number:		

How to Build a Model Number



Prefix:

GRX for Grafik Eye 3000 Series Control Units

Set-Up Method:

1 for standard via front panel
5 for PC setup

Number of Zones:

2, 3, 4, or 6

Cover Option:

A for Opaque
T for Translucent Black

Input Voltage

__ (no code) for 120V Single Feed
AU for 220-240V (non-CE)
CE for 230V (CE)
JA for 100V

Color Option:

See Color Options list

Cover Options

Opaque A
Cover and Base will match.

Translucent Black T
Black Cover and choice of base color.

Also available:
- Custom controls
- Color matching
- Engraving

These options ship in 4 to 6 weeks

Color Options

Architectural Matte Finishes
Standard – Ship in 48 hours
Cover Option: A or T

White	WH
Ivory	IV
Beige	BE
Gray	GR
Brown	BR
Black	BL

Designer Gloss Finishes
Ship in 4 to 6 weeks
Cover Option: A only

White	GWH
Light Almond	GLA
Almond	GAL
Ivory	GIV

Satin Color Matte Finishes
Cover Option: A or T

Hot	HT
Ochre	OC
Terracotta	TC
Desert Stone	DS
Stone	ST
Limestone	LS
Blue Mist	BT
Midnight	MN
Taupe	TP
Biscuit	BI
Eggshell	ES
Snow	SW

Architectural Metal Finishes
Cover Option: T only

Bright Brass	BB
Bright Chrome	BC
Satin Brass	SB
Satin Chrome	SC
Satin Nickel	SN
Antique Brass	QB
Antique Bronze	QZ
Bright Nickel	BN

Anodized Aluminum Finishes
Cover Option: T only

Clear	CLA
Black	BLA
Brass	BRA
Bronze	BZA

Job Name:	Model Numbers:	
Job Number:		

Model Numbers

120V Input Power

Number of Zones	Standard Setup	PC Setup	Unit Capacity (Watts/VA)	Zone Capacity (Watts/VA)
2	GRX-3102-_-__	GRX-3502-_-__	1200	800
3	GRX-3103-_-__	GRX-3503-_-__	1500	800
4	GRX-3104-_-__	GRX-3504-_-__	2000	800
6	GRX-3106-_-__	GRX-3506-_-__	2000	800

220–240V (non-CE) Input Power

Number of Zones	Standard Setup	PC Setup	Unit Capacity (Watts/VA)	Zone Capacity (Watts/VA)
2	GRX-3102-_-AU-__	GRX-3502-_-AU-__	1600	1200
3	GRX-3103-_-AU-__	GRX-3503-_-AU-__	2400	1200
4	GRX-3104-_-AU-__	GRX-3504-_-AU-__	3000	1200
6	GRX-3106-_-AU-__	GRX-3506-_-AU-__	3000	1200

230V (CE) Input Power

Number of Zones	Standard Setup	PC Setup	Unit Capacity (Watts/VA)	Zone Capacity (Watts/VA)
2	GRX-3102-_-CE-__	GRX-3502-_-CE-__	1600	800
3	GRX-3103-_-CE-__	GRX-3503-_-CE-__	2300	800
4	GRX-3104-_-CE-__	GRX-3504-_-CE-__	2300	800
6	GRX-3106-_-CE-__	GRX-3506-_-CE-__	2300	800

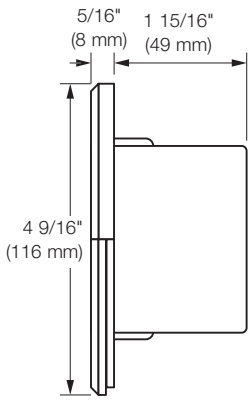
100V Input Power

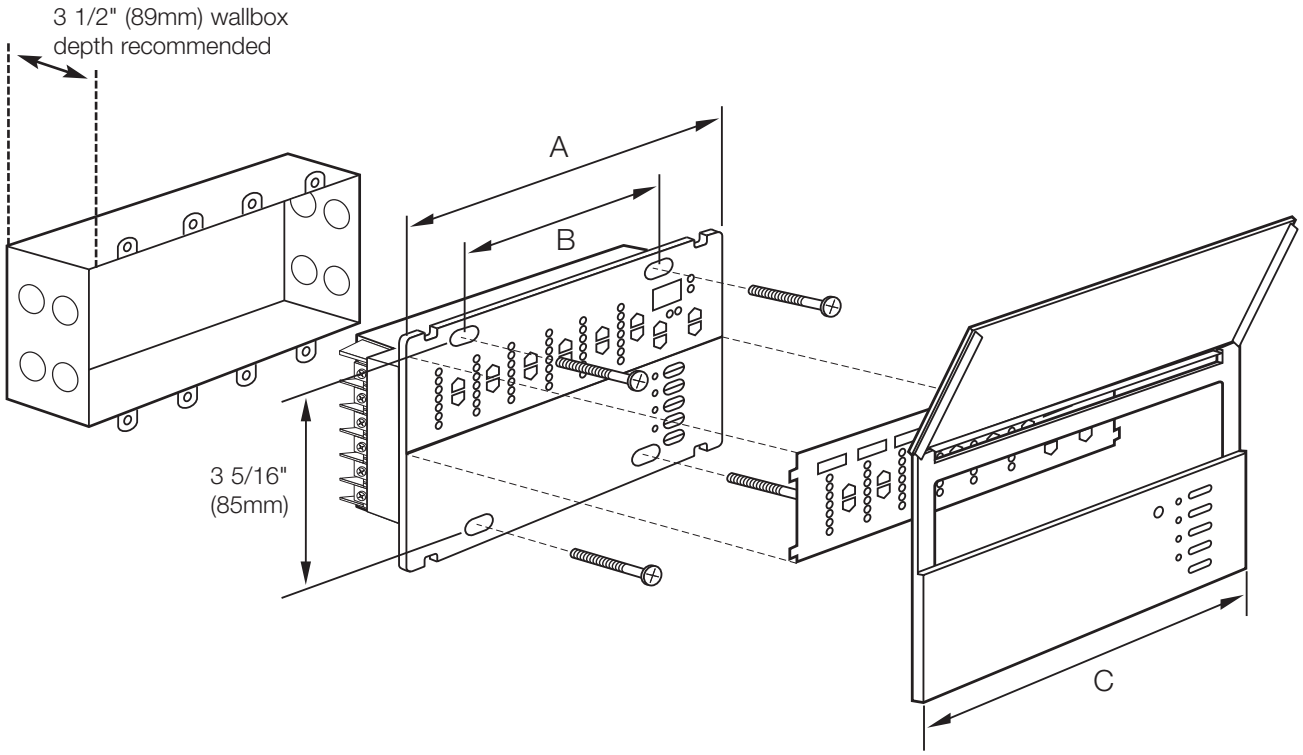
Number of Zones	Standard Setup	PC Setup	Unit Capacity (Watts/VA)	Zone Capacity (Watts/VA)
2	GRX-3102-_-JA-__	GRX-3502-_-JA-__	1000	600
3	GRX-3103-_-JA-__	GRX-3503-_-JA-__	1250	600
4	GRX-3104-_-JA-__	GRX-3504-_-JA-__	1600	600
6	GRX-3106-_-JA-__	GRX-3506-_-JA-__	1600	600

Job Name:	Model Numbers:	
Job Number:		

Dimensions and Mounting - All Voltages Except 230V (CE)

Model	Side View	A	B	C	Wallbox[1] U.S. Size	Depth
2-Zone: GRX-3102 GRX-3502		4 5/16" (123mm)	1 13/16" (46mm)	5.56" (141mm)	2 Gang	3.5" (89mm)
3-Zone: GRX-3103 GRX-3503		6 11/16" (168mm)	3 5/8" (92mm)	7.25" (184mm)	3 Gang	3.5" (89mm)
4-Zone: GRX-3104 GRX-3504		8 5/16" (208mm)	5 7/16" (138mm)	8.94" (227mm)	4 Gang	3.5" (89mm)
6-Zone: GRX-3106 GRX-3506		8 5/16" (208mm)	5 7/16" (138mm)	8.94" (227)	4 Gang	3.5" (89mm)



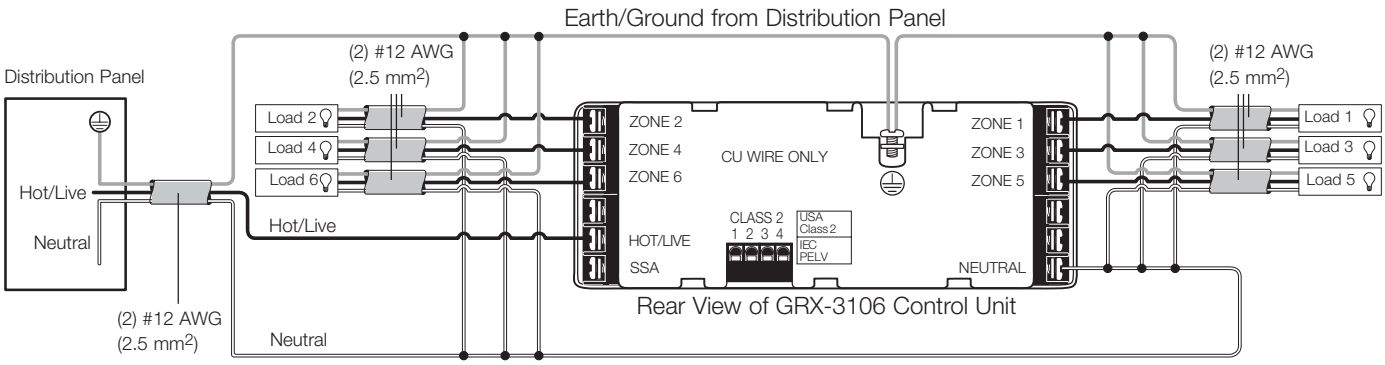


[1] Can be ordered from Lutron.

Job Name:	Model Numbers:	
Job Number:		

Line Voltage Wiring - 120V, 100V, 220-240V Models

- Pull power wiring from distribution panel and to light fixtures.
- Each line voltage terminal can accept up to two #12 AWG (2.5mm²) wires.



Consult Lutron for:

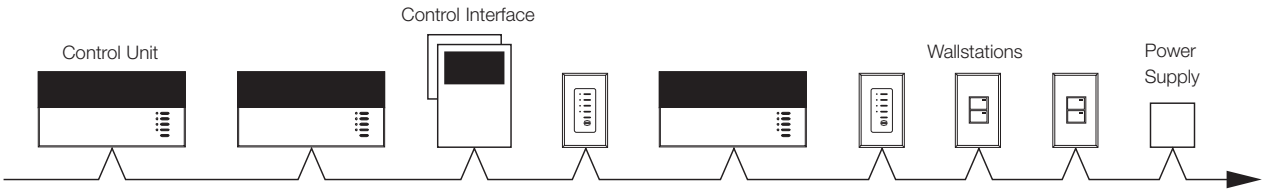
- Non-dim relay wiring.
- Load side emergency transfer wiring.

Low-Voltage Class 2 (PELV) Wiring

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

Class 2 (PELV) wiring link requires:
Two #12 AWG (2.5mm²) conductors for control power.
One twisted, shielded pair of #18 AWG (0.625mm²) for data link.

Total length of Control Link may be up to 2,000 ft. (610m).
Approved low-voltage cable is available from Lutron[1], Belden, and Liberty.
These are approved with #22 AWG data link wires.



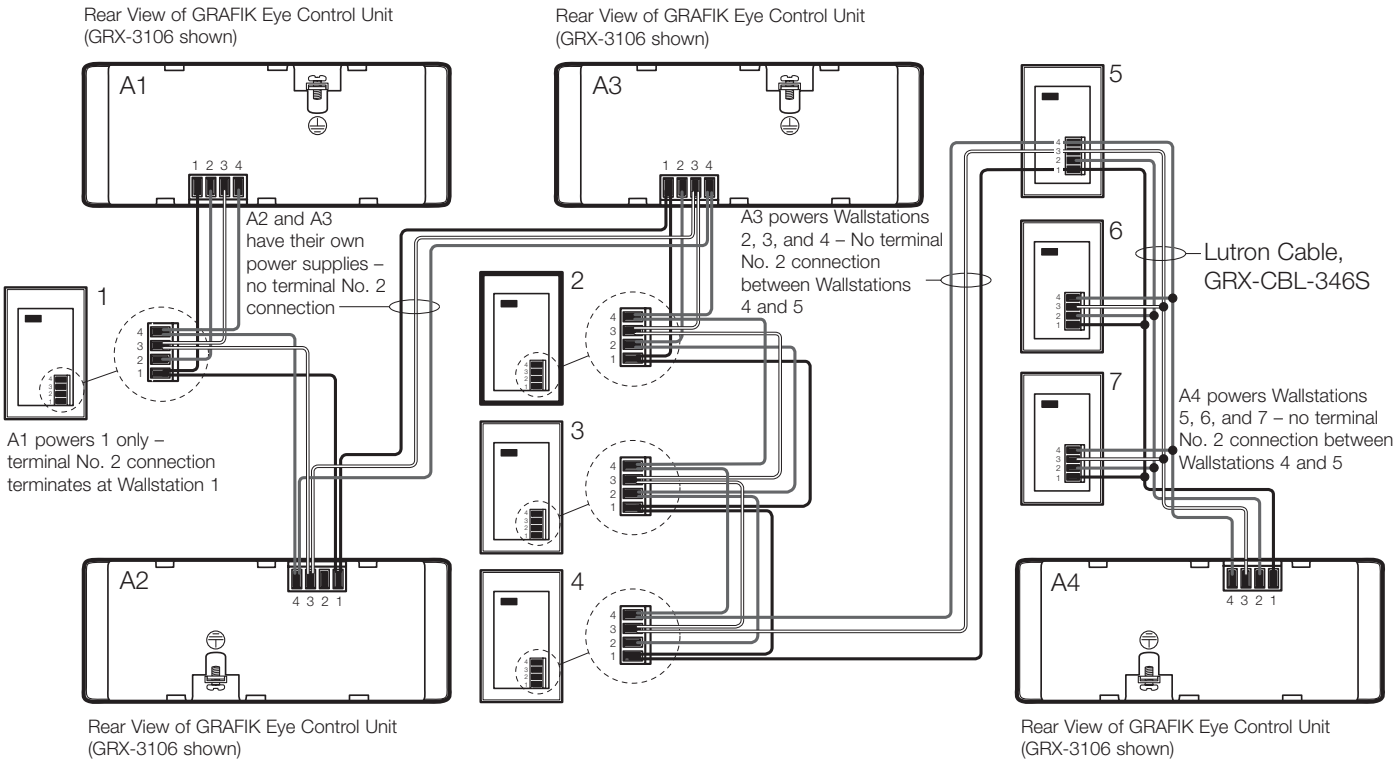
External 12VDC Power Supply is required to power more than three Wallstations and/or Control Interfaces from a single Control Unit.

[1] GRX-CBL-346S Class 2 (PELV) wiring cable is available from Lutron and contains:
Two #12 AWG (2.5mm²) conductors for control power.
One twisted, shielded pair of #22 AWG (0.625mm²) for data link.

Job Name:	Model Numbers:	
Job Number:		

Class 2 (PELV) Terminal Connections

- Each Class 2 (PELV) terminal accepts up to two #18 AWG (1.0mm²) wires.
- Daisy chain the terminal 1, 3, and 4 connections to all Control Units, Wallstations, and Control Interfaces.
- Each Control Unit has its own power supply. Terminate the terminal 2 connection (12VDC power) so that each Control Unit supplies power to a maximum of three Wallstations. Each Wallstation should receive power from only one Control Unit.
- Total length of Class 2 (PELV) wiring may be up to 2,000 ft. (600m).
- Make all connections in the Control Unit's wallbox. Remote connections (T-taps) must be in a switchbox or junction box with a maximum wire length of 8 ft. (2.5m) from the link to the connected unit.
- Do not allow Class 2 (PELV) wires to contact line/main wires.

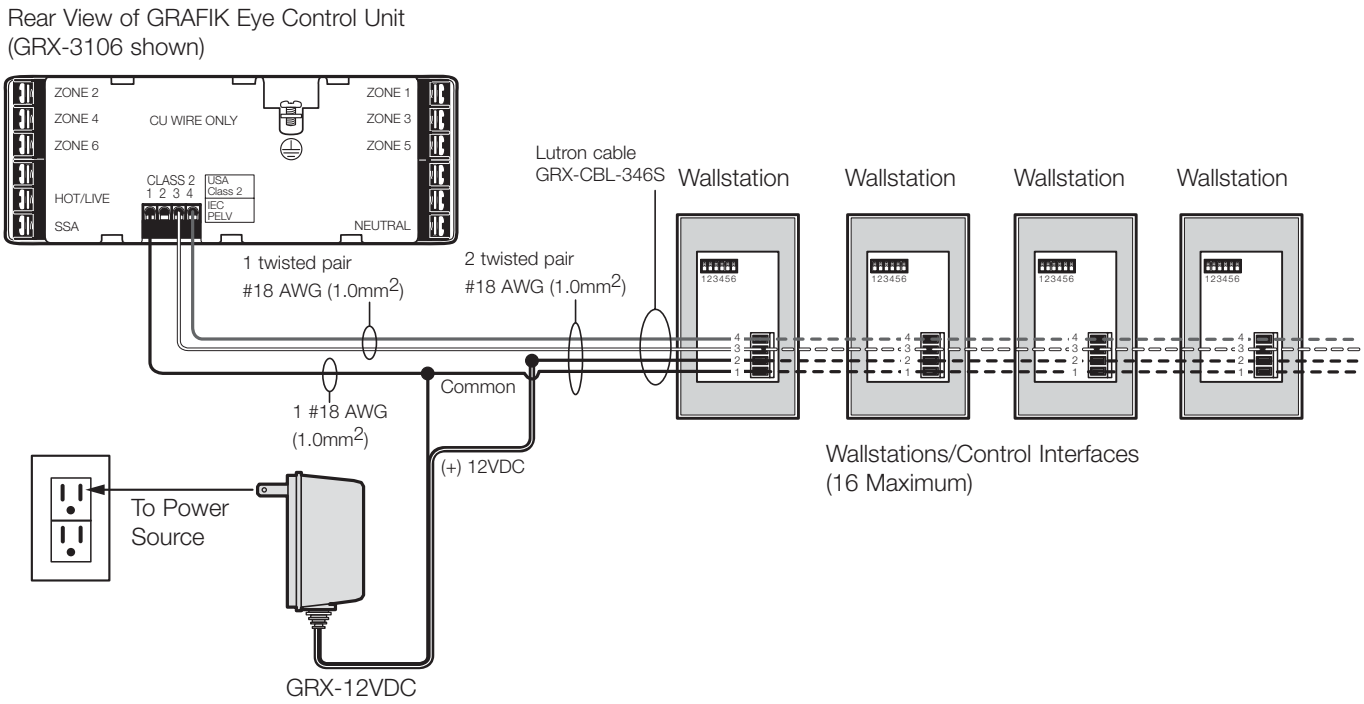


Note:
- Up to 8 GRAFIK Eye 3000 Series Control Units and 16 Wallstations/Control Interfaces may be daisy-chained together in one system.
- Class 2/PELV cable is available from Lutron - order GRX-CBL-346S.

Job Name:	Model Numbers:	
Job Number:		

GRX-12VDC Power Supply Wiring

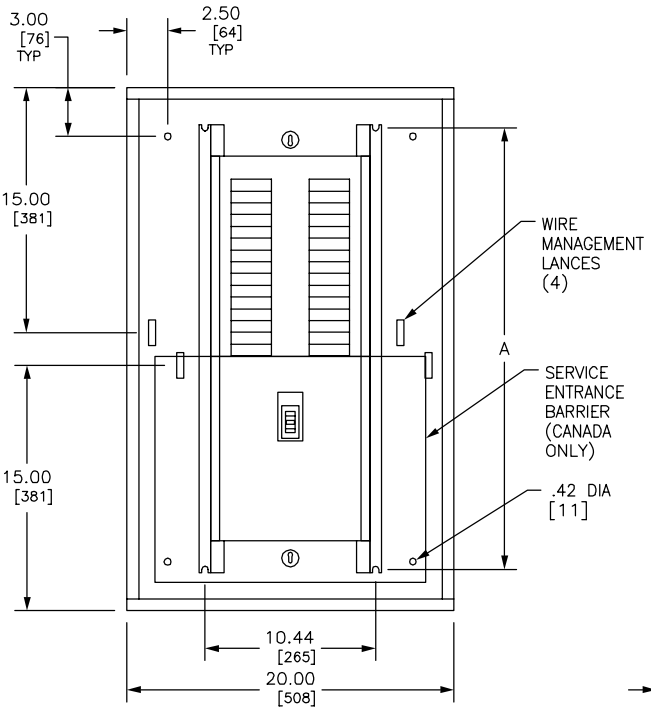
External 12VDC Power Supply is required to power more than three Wallstations and/or Control Interfaces from a single Control Unit.



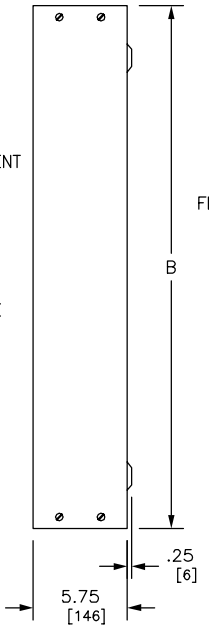
Note:
Do not connect terminal No. 2 between GRAFIK Eye 3000 Series Control Unit and GRX-12VDC Power Supply

Job Name:	Model Numbers:	
Job Number:		

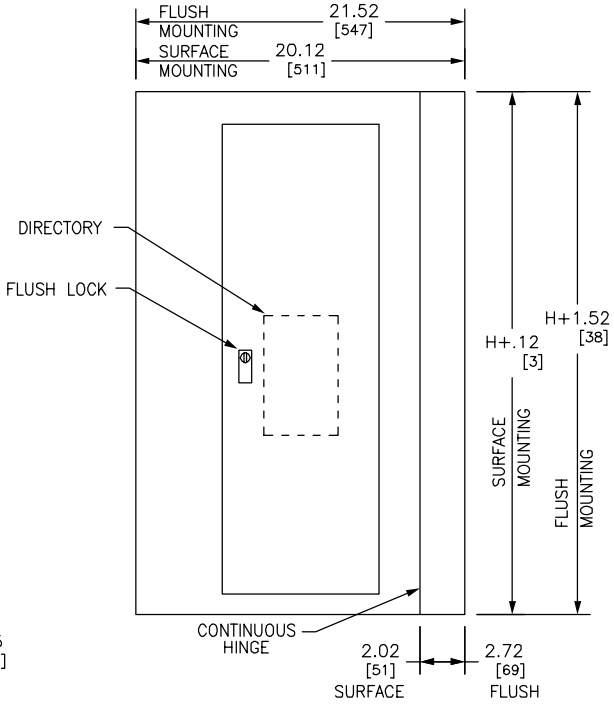
REV	DESCRIPTION	BY	DATE				
–	– – – –	– –	– – / – –	–	– – – –	– –	– – / – –



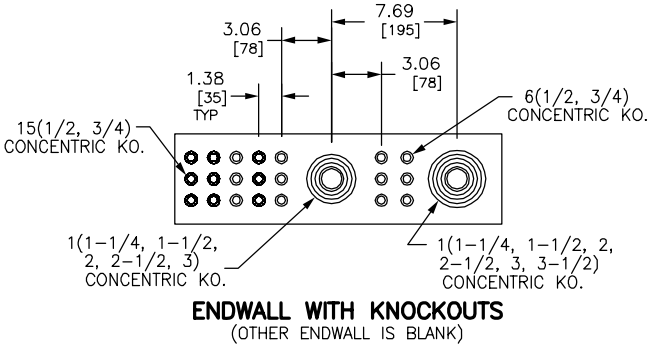
TYPICAL BOX WITH INTERIOR



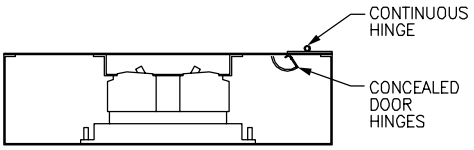
TYPICAL BOX
SIDE VIEW



TYPICAL FRONT



ENDWALL WITH KNOCKOUTS
(OTHER ENDWALL IS BLANK)



TYPICAL MOUNTING OF
QO, QOB BREAKERS

DUAL DIMENSIONS: INCHES
MILLIMETERS

REFER TO DP CATALOG CLASS 1630 FOR ADDITIONAL INFORMATION

NQOD PANELBOARDS MEET THE APPLICABLE REQUIREMENTS OF UL AND CSA.

BOX: CODE GAUGE GALVANIZED STEEL. ONE ENDWALL IS BLANK THE OTHER HAS KNOCKOUTS.

FRONT: MONO–FLAT CONSTRUCTION WITH CONCEALED TRIM SCREWS AND DOOR HINGES. CONTINUOUS HINGE ON RIGHT SIDE OF TRIM. ANSI 49 GRAY BAKED ENAMEL FINISH ELECTRODEPOSITED OVER CLEANED PHOSPHATIZED STEEL.

LOCK: FLUSH LOCK WITH BRUSHED, STAINLESS STEEL ESCUTCHEON. NSR–251 KEY CHANGE.

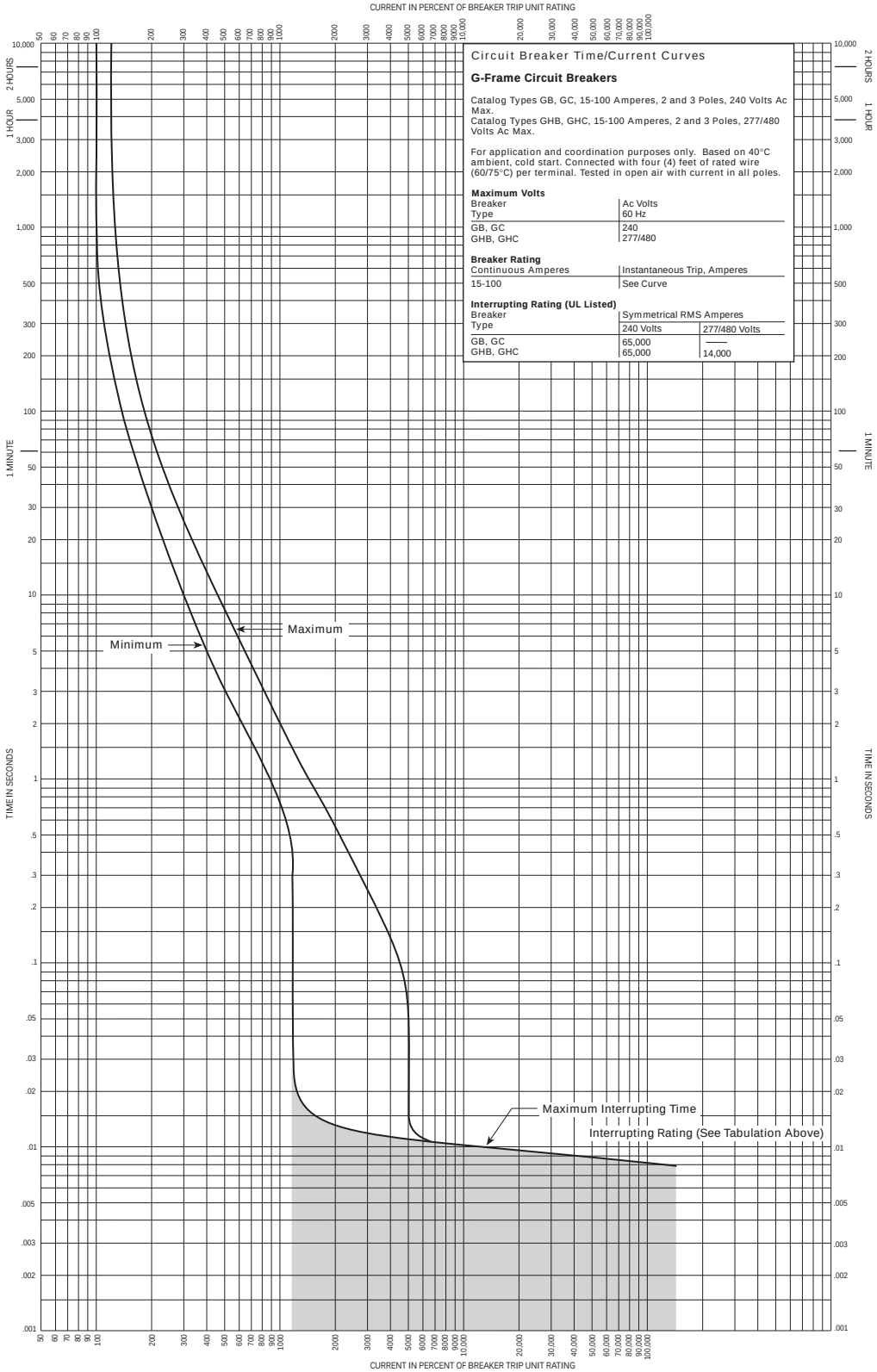
MAXIMUM MAIN BREAKER AMPERE RATING	MAXIMUM NUMBER OF CIRCUITS	H		A	
		IN	MM	IN	MM
250	30	44.00	1118	39.00	991
	42	50.00	1270	45.00	1143
	54	56.00	1422	51.00	1295
	*72	62.00	1575	57.00	1448
	*84	65.00	1651	60.00	1524
250 WITH FEED–THRU LUGS	30 42	56.00	1422	51.00	1295
	48	62.00	1575	57.00	1448
	*72 *78	71.00	1803	66.00	1676
250 WITH SUB–FEED BREAKER	30	71.00	1803	66.00	1676
	48	77.00	1956	72.00	1829

* CANADA ONLY

JOB NAME:	– – –	EQUIPMENT DESIGNATION:	– – –
JOB LOCATION:	– – –	EQUIPMENT TYPE:	– – –
DRAWN BY:	– – –	DRAWING TYPE:	– – –
ENGR:	– – –	SQUARE D Schneider Electric	
DATE:	MAY 2007		
DRAWING STATUS:	– – –	DWG# PBA507HR	PG – OF – REV –

AB DE-ION Circuit Breakers

Types GB, GHB, GC, GHC 15-100 Amperes, 2 and 3 Poles



Circuit Breaker Time/Current Curves

G-Frame Circuit Breakers

Catalog Types GB, GC, 15-100 Amperes, 2 and 3 Poles, 240 Volts Ac Max.
Catalog Types GHB, GHC, 15-100 Amperes, 2 and 3 Poles, 277/480 Volts Ac Max.

For application and coordination purposes only. Based on 40°C ambient, cold start. Connected with four (4) feet of rated wire (60/75°C) per terminal. Tested in open air with current in all poles.

Maximum Volts

Breaker Type	Ac Volts 60 Hz
GB, GC	240
GHB, GHC	277/480

Breaker Rating

Continuous Amperes	Instantaneous Trip, Amperes
15-100	See Curve

Interrupting Rating (UL Listed)

Breaker Type	Symmetrical RMS Amperes	
	240 Volts	277/480 Volts
GB, GC	65,000	—
GHB, GHC	65,000	14,000

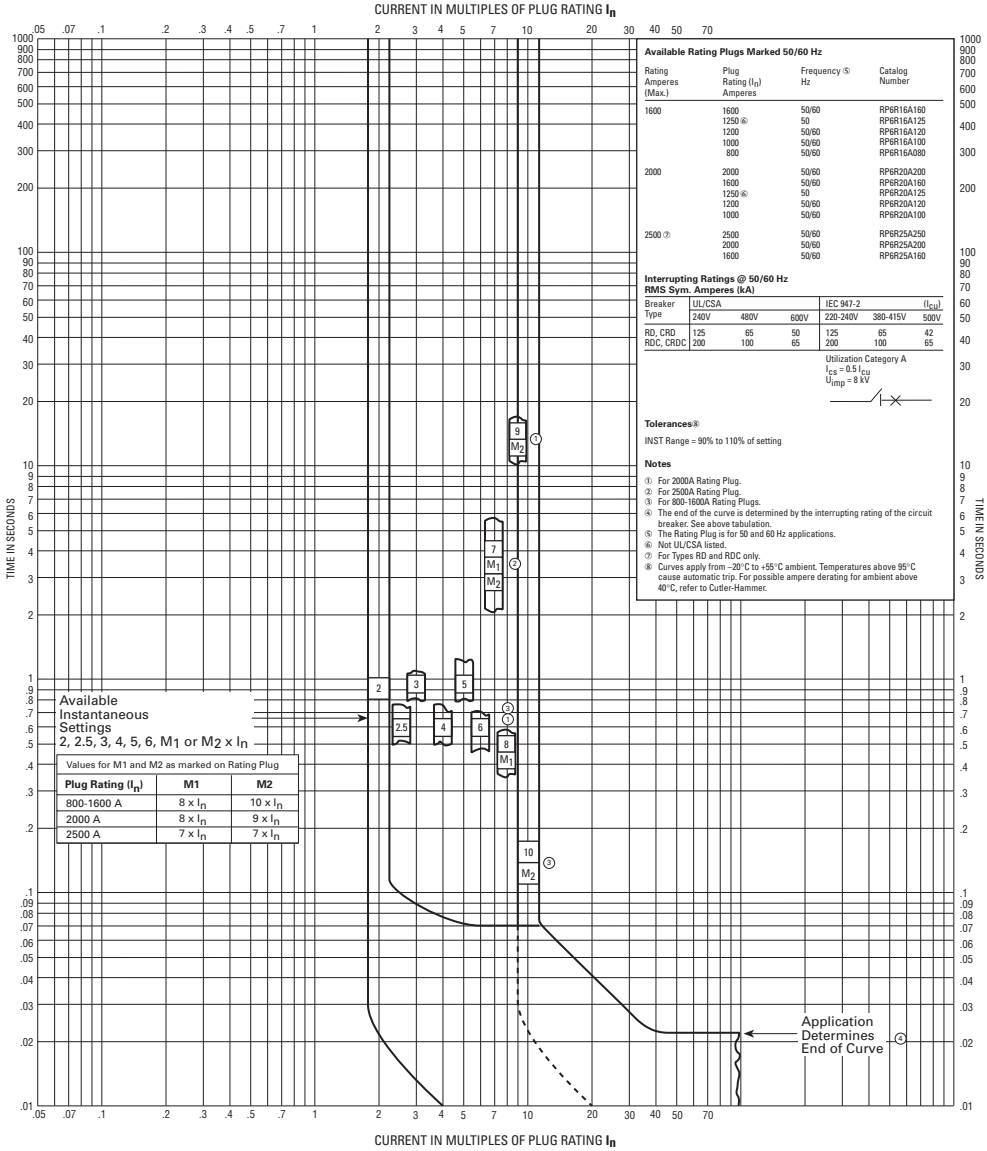
AB DE-ION Circuit Breakers

Types RD, CRD, RDC, CRDC Equipped With Digitrip RMS 510/610/810 Trip Units. Typical Instantaneous Time-Phase Current Characteristic Curve Based on I_n

I M P O R T A N T

TRIP UNITS ARE **NOT AVAILABLE** WITH **ONLY INSTANTANEOUS** PROTECTION. **THIS CURVE MUST BE USED** in conjunction **WITH** Curve No. SC-5627-93 for **LONG DELAY** (and if applicable **SHORT DELAY**) **PROTECTION** to obtain the complete time-current characteristic.

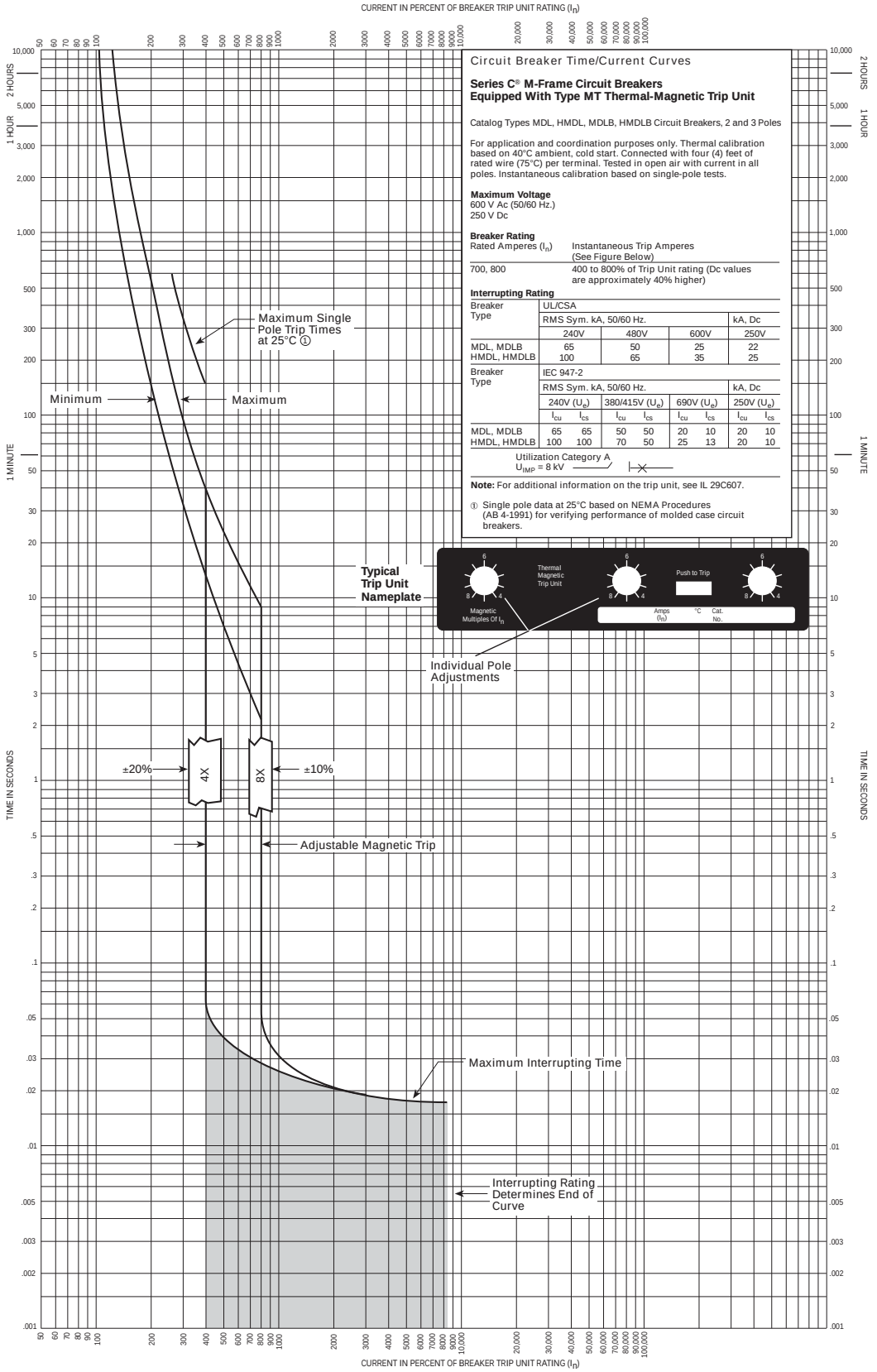
Series C® R-Frame Circuit Breakers with
DIGITRIP RMS 510/610/810 Trip Units
Typical **Instantaneous** Time-Phase Current Characteristic Curve **(I)**



Values for M1 and M2 as marked on Rating Plug

Plug Rating (I_n)	M1	M2
800-1600 A	8 x I_n	10 x I_n
2000 A	8 x I_n	9 x I_n
2500 A	7 x I_n	7 x I_n

Types MDL, HMDL, MDLB, and HMDLB Equipped with Type MT Thermal-Magnetic Trip Unit, 700 and 800 Amperes



Circuit Breaker Time/Current Curves

Series C® M-Frame Circuit Breakers Equipped With Type MT Thermal-Magnetic Trip Unit

Catalog Types MDL, HMDL, MDLB, HMDLB Circuit Breakers, 2 and 3 Poles

For application and coordination purposes only. Thermal calibration based on 40°C ambient, cold start. Connected with four (4) feet of rated wire (75°C) per terminal. Tested in open air with current in all poles. Instantaneous calibration based on single-pole tests.

Maximum Voltage
600 V Ac (50/60 Hz.)
250 V Dc

Breaker Rating

Rated Amperes (I_n)	Instantaneous Trip Amperes (See Figure Below)
700, 800	400 to 800% of Trip Unit rating (Dc values are approximately 40% higher)

Interrupting Rating

Breaker Type	UL/CSA							
	RMS Sym. kA, 50/60 Hz.						kA, Dc	
	240V		480V		600V		250V	
MDL, MDLB	65		50		25		22	
HMDL, HMDLB	100		65		35		25	
Breaker Type	IEC 947-2							
	RMS Sym. kA, 50/60 Hz.						kA, Dc	
	240V (U_e)		380/415V (U_e)		690V (U_e)		250V (U_e)	
	I_{cu}	I_{cs}	I_{cu}	I_{cs}	I_{cu}	I_{cs}	I_{cu}	I_{cs}
MDL, MDLB	65	65	50	50	20	10	20	10
HMDL, HMDLB	100	100	70	50	25	13	20	10

Utilization Category A
U_{IMP} = 8 kV

Note: For additional information on the trip unit, see IL 29C607.

① Single pole data at 25°C based on NEMA Procedures (AB 4-1991) for verifying performance of molded case circuit breakers.

Curve No. SC-6912-98

System Checksums

By PENN STATE UNIVERSITY

System - 001 **Variable Volume Reheat (30% Min Flow Default)**

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 9 / 16
Outside Air: OADB/WB/HR: 83 / 68 / 76

	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	1,361	1,361	2
Glass Solar	35,684	0	35,684	57
Glass/Door Cond	816	0	816	1
Wall Cond	0	643	643	1
Partition/Door	0		0	0
Floor	0		0	0
Adjacent Floor	0	0	0	0
Infiltration	539		539	1
Sub Total ==>	37,040	2,004	39,044	62
Internal Loads				
Lights	1,169	1,169	2,338	4
People	12,623	0	12,623	20
Misc	0	0	0	0
Sub Total ==>	13,792	1,169	14,961	24
Ceiling Load	164	-164	0	0
Ventilation Load	0	0	3,231	5
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		-436	-436	-1
Sup. Fan Heat			3,247	5
Ret. Fan Heat		2,463	2,463	4
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	50,996	5,036	62,510	100.00

CLG SPACE PEAK

Mo/Hr: 9 / 16
OADB: 83

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	35,684	78
Glass/Door Cond	816	2
Wall Cond	0	0
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	295	1
Sub Total ==>	36,795	80
Internal Loads		
Lights	1,169	3
People	7,731	17
Misc	0	0
Sub Total ==>	8,901	19
Ceiling Load	164	0
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing	0	0
Exhaust Heat		
OA Preheat Diff.		
RA Preheat Diff.		
Additional Reheat		
Underflr Sup Ht Pkup		
Supply Air Leakage		
Grand Total ==>	45,860	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 13

	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	-3,706	6.65
Glass Solar	0	0	0.00
Glass/Door Cond	-5,548	-5,548	9.96
Wall Cond	0	-313	0.56
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0
Infiltration	0	0	0.00
Sub Total ==>	-5,548	-9,567	17.18
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	-4,019	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.		-9,629	17.29
RA Preheat Diff.		-36,495	65.53
Additional Reheat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-9,567	-55,690	100.00

TEMPERATURES

	Cooling	Heating
SADB	59.9	6,197.0
Ra Plenum	76.0	45.9
Return	76.8	45.9
Ret/OA	77.2	13.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.2	0.0
Fn Frict	0.7	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	2,739	0
Terminal	2,739	0
Main Fan	2,739	0
Sec Fan	0	0
Nom Vent	189	0
AHU Vent	189	0
Infil	32	0
MinStop/Rh	822	0
Return	2,771	0
Exhaust	221	0
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	6.9	0.0
cfm/ft²	5.20	0.00
cfm/ton	525.90	
ft²/ton	101.17	
Btu/hr·ft²	118.61	-105.67
No. People	32	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB/WB/HR °F	Enter DB/WB/HR °F	Enter DB/WB/HR gr/lb	Leave DB/WB/HR °F	Leave DB/WB/HR °F	Leave DB/WB/HR gr/lb
Main Clg	5.2	62.5	55.9	2,739	77.2	63.4	65.9	58.8	55.9	62.4
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	5.2	62.5								

AREAS

	Gross Total	Glass ft²	Glass (%)
Floor	527		
Part	0		
Int Door	0		
ExFlr	0		
Roof	527	0	0
Wall	434	412	95
Ext Door	0	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-9.6	0	58.8	6,197.0
Aux Htg	0.0	0	0.0	0.0
Preheat	-46.1	2,739	43.7	58.8
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-55.7			

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													
Electric													
On-Pk Cons. (kWh)	1,139	991	1,558	1,693	1,912	1,960	2,093	2,059	1,923	1,793	1,662	1,283	20,067
On-Pk Demand (kW)	4	4	4	4	4	4	5	5	5	4	4	4	5
Gas													
On-Pk Cons. (therms)	28	25	16	9	2	0	0	0	2	10	13	21	125
On-Pk Demand (therms/hr)	0	0	0	0	0	0	0	0	0	0	0	0	0
Water													
Cons. (1000gal)	1	1	1	2	3	4	5	4	3	2	2	1	28

Energy Consumption		
Building	153,752	Btu/(ft2-year)
Source	414,965	Btu/(ft2-year)
Floor Area	527	ft2

Environmental Impact Analysis	
CO2	30,698 lbm/year
SO2	262 gm/year
NOX	59 gm/year

System Checksums

By PENN STATE UNIVERSITY

System - 001 | **Variable Volume Reheat (30% Min Flow Default)**

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 9 / 16
Outside Air: OADB/WB/HR: 83 / 68 / 76

	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	1,407	1,407	2
Glass Solar	58,430	0	58,430	65
Glass/Door Cond	1,033	0	1,033	1
Wall Cond	0	647	647	1
Partition/Door	0		0	0
Floor	0		0	0
Adjacent Floor	0	0	0	0
Infiltration	539		539	1
Sub Total ==>	60,002	2,054	62,055	69
Internal Loads				
Lights	1,169	1,169	2,338	3
People	12,623	0	12,623	14
Misc	0	0	0	0
Sub Total ==>	13,792	1,169	14,961	17
Ceiling Load	95	-95	0	0
Ventilation Load	0	0	3,229	4
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		-336	-336	0
Sup. Fan Heat			5,846	6
Ret. Fan Heat		4,413	4,413	5
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	73,888	7,205	90,169	100.00

CLG SPACE PEAK

Mo/Hr: 10 / 16
OADB: 69

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	61,053	88
Glass/Door Cond	-747	-1
Wall Cond	0	0
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	-221	0
Sub Total ==>	60,084	87
Internal Loads		
Lights	1,169	2
People	7,731	11
Misc	0	0
Sub Total ==>	8,901	13
Ceiling Load	38	0
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing	0	0
Exhaust Heat		
OA Preheat Diff.		
RA Preheat Diff.		
Additional Reheat		
Underflr Sup Ht Pkup		
Supply Air Leakage		
Grand Total ==>	69,023	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 13

	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	-3,706	3.61
Glass Solar	0	0	0.00
Glass/Door Cond	-7,049	-7,049	6.86
Wall Cond	0	-313	0.30
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0
Infiltration	0	0	0.00
Sub Total ==>	-7,049	-11,068	10.77
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	-4,019	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.		-10,159	9.89
RA Preheat Diff.		-81,504	79.34
Additional Reheat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-11,068	-102,731	100.00

TEMPERATURES

	Cooling	Heating
SADB	62.4	9,663.0
Ra Plenum	75.6	45.9
Return	76.4	45.9
Ret/OA	76.6	13.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.2	0.0
Fn Frict	0.7	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	4,952	0
Terminal	4,952	0
Main Fan	4,952	0
Sec Fan	0	0
Nom Vent	189	0
AHU Vent	189	0
Infil	32	0
MinStop/Rh	1,486	0
Return	4,984	0
Exhaust	221	0
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	3.8	0.0
cfm/ft²	9.40	0.00
cfm/ton	659.04	
ft²/ton	70.14	
Btu/hr·ft²	171.10	-194.94
No. People	32	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB/WB/HR °F	Enter DB/WB/HR °F	Enter DB/WB/HR gr/lb	Leave DB/WB/HR °F	Leave DB/WB/HR °F	Leave DB/WB/HR gr/lb
Main Clg	7.5	90.2	83.6	4,933	76.6	63.2	65.6	61.4	57.2	63.6
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	7.5	90.2								

AREAS

	Gross Total	Glass ft²	Glass (%)
Floor	527		
Part	0		
Int Door	0		
ExFlr	0		
Roof	527	0	0
Wall	434	412	95
Ext Door	0	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-11.1	0	61.4	9,663.0
Aux Htg	0.0	0	0.0	0.0
Preheat	-91.7	4,952	44.7	61.4
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-102.7			

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													
Electric													
On-Pk Cons. (kWh)	1,716	1,551	1,993	2,012	2,316	2,380	2,511	2,527	2,358	2,144	1,977	1,878	25,365
On-Pk Demand (kW)	5	5	5	5	5	5	6	6	6	5	5	5	6
Gas													
On-Pk Cons. (therms)	39	35	28	19	9	5	2	5	9	22	26	35	235
On-Pk Demand (therms/hr)	0	0	0	0	0	0	0	0	0	0	0	0	0
Water													
Cons. (1000gal)	2	1	3	3	4	5	6	6	5	3	3	2	41

Energy Consumption		
Building	208,772	Btu/(ft2-year)
Source	539,710	Btu/(ft2-year)
Floor Area	527	ft2

Environmental Impact Analysis	
CO2	41,684 lbm/year
SO2	356 gm/year
NOX	80 gm/year