Maryland Transportation Authority

Police Training Facility

Hawkins Point, Baltimore, MD

Lighting and Electrical Systems for a Police Training Facility

with an analysis of firing range acoustics and mechanical design

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Lighting/Electrical

The Pennsylvania State University
Architectural Engineering
Senior Thesis Spring 2008
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http://www.engr.psu.edu/ae/thesis/portfolios/2008/lcc142

PROJECT TEAM

Owner - Maryland Transportation Authority
Prime - Johnson, Mirmiran, & Thompson
Architecture - Rubeling & Associates
Mechanical and Electrical - Johnson, Mirmiran, & Thompson
Civil and Structural - Carroll Engineering, Inc.
Geotechnical - E2CR

CONSTRUCTION

The project is currently in a "holding" stage. The project was designed and bid in 2002, but was not built. It was being redesigned, however, confirmation of funding has halted the redesign for now.

STRUCTURAL

Range: Open web steel joist, reinvoced/ solid grouted CMU
Training: Steel frame structure, roof framing clear span with no columns on second floor

MECHANICAL

Range: Two air cooled condenser water chillers and two indoor central stations
Training: Base-board heat, indoor central station

LIGHTING

Exterior: Wall mounted fixtures wash logos, recessed canopy lighting illuminates the extrance, pole mounted shoebox fixtures provide parking lighting.
Interior: Linear fluorescent fixtures at 277 volts is the primary fixture type. Metal halides, halogens, and LEDs are also present.

GENERAL PROJECT DATA

Size: 42,100 square feet
Stories: Two stories above grade
Estimated Cost: $15,150,000
Building Features: The facility has a variety of spaces including offices, class rooms, investigation areas, storage, a physical training gymnasium, and a 14,400 square foot firing range.
Exterior: The façade is comprised of sections of ground face CMU and split face CMU. Two precast concrete logos adorn the front facade and a standing seam metal roof covers the first floor lobby entrance.

ELECTRICAL

Distribution: Radial system
Utility Service: BG&E utility transformer connects to main 1200A circuit breaker
Voltage: 480Y/277 volt main switchboard, 208Y/120 volt power provided by internal system transformers
Emergency: Outdoor generator, 450 KW, 408/277 volt, provides emergency power to most building elements.

Table of Contents

Executive Summary

The Maryland Transportation Authority Police Training Facility Thesis Project examines several of the engineering systems throughout the building, including the lighting and electrical systems, and mechanical and acoustical systems of the range.

The Lighting Depth concentrates on redesign the lighting four spaces within the building, Classroom 'A', the physical training gymnasium, the front façade and entrance canopy, and the firing range. Design criteria for each space was developed using recommendations from the IESNA and the lighting power density requirements of ASHRAE Standard 90.1. The lighting design in these spaces was focused on creating a productive and healthy learning environment and control and flexibility was a goal or each design.

Several issues were examined in the Electrical Depth portion of the thesis. The electrical panelboards were examined and updated to coordinate with the new requirements of the four lighting design from the Lighting Depth. Similarly, the electrical system was redesigned based on the new air-handling loads proposed in the Mechanical Breadth. This resulted in the upsizing of the Main Distribution Panel to meet the mechanical loads. A cost-benefit analysis of energy efficient transformers was also performed, showing that, although initial first cost of the energy efficient transformers is higher, annual energy costs are estimated to be 4% lower, resulting in a payback period of 6 years. Finally a coordination study of protective devices was performed by examining a single path through the distribution system. The study shows that the protection devices are properly coordinated.

The firing is notably an interesting space provides unique challenges. The breadths explored the mechanical and acoustical systems of the range to determine their effectiveness and suggest alternative systems to better meet the needs of the space. The existing mechanical system was cause swirling of air, which would promote lead inhalation and poisoning. The proposed solution utilizes a diffusing wall behind the shooters that introduces air to the space at low velocities. This reduces swirling and carries harmful particles down the range away from the occupants. The acoustical study examines the sound transmission between the firing range and the adjacent classroom. As the system was previously design, the classroom noise reduction from the range to classroom would not be sufficient to meet the noise criterion of 35 for a classroom. A double wall system consisting of a CMU wall, a 3" air gap, and a heavily insulated stud wall is proposed in the Acoustical Breadth to bring the noise down to an acceptable level.

MdTA Police Training Facility

For more than three decades, the Maryland Transportation Authority has provided Maryland's citizens and visitors with safe and convenient transportation facilities. The Maryland Transportation Authority Police is a nationally accredited force and is responsible for law enforcement and security of the Authority's jurisdiction. The purpose of the Maryland Transportation Authority's Police Training Facility is for officer candidates to meet professional law-enforcement standards through the completion of a rigorous training program at a fully accredited police-training facility.

Building Overview

Building Name:	Maryland Transportation Authority Police Training Facility
Location:	Hawkins Point, Baltimore, MD
Size:	42,100 square feet
Number of Stories:	2 above grade
Estimated Cost:	$15, 150,000
Project Team:	Owner – Maryland Transportation Authority Prime – Johnson, Mirmiran, & Thompson Architecture – Rubeling & Associates Mechanical and Electrical – Johnson, Mirmiran, & Thompson Civil and Structural – Carroll Engineering, Inc. Geotechnical – E2CR
Project Delivery Method:	Design-Bid-Build
Construction:	Project designed in 2002, but put on hold before construction began.

Architecture:

The building site for the Maryland Transportation Authority Police Training Facility is located on the southern side of the Chesapeake Bay, off of the Baltimore Beltway Outer Loop and the Francis Scott Key Bridge. The exterior of the building visually combines the varied textures of two different CMU types, ground-face and split-face. Glazing is framed by aluminum trim and a standing seam metal room creates a canopy along the front face of the façade where the main entrance to the facility is. Two large precast logos, one displaying the emblem of the Maryland Transportation Authority and the other the emblem of the

MdTA police, adorn the front façade as an architectural feature. This facility has a variety of spaces including offices, classrooms, investigation areas, storage, a physical training gymnasium facility, and a 14,400 square foot firing range. Primarily functioning as an educational facility for the MdTA Police, the facility is also equipped to serve as an emergency relief station serving the local area if needed.

Building Envelope:

The walls consist of 4" thick x 8" x 16" split-face and ground-face block cavity veneer, 1-1/2" rigid insulation, 10" CMU block backup, and 5/8" drywall. The roof system is comprised of a 1-1/2" metal deck with 3" roof insulation, and a white EPDM membrane.

Electrical System:

The Maryland Transportation Authority Police Training Facility utilizes a radial type distribution system. The power distribution system consists of an electrical service provided by Baltimore Gas & Electric (BG&E). Power is available from the existing 13.8 kilovolt primary overhead 3-phase lines located under the 34.5 kilovolt overhead pole mounted line crossing the property line. A combination of 480Y/277V, 3-phase, 4-wire and 208Y/120V, 3-phase, 4-wire voltages are utilized in the building. With the exception of the main utility transformer, voltages are transformed from 480Y/277V to 208Y/120V within the MdTA Police Training Facility. Emergency power is provided by an outdoor generator. The generator is 450KW at 480/277, 3-phase, 4 wire, with a 1000A circuit breaker. The Generator Distribution Panel (GDP), rated at 1200A, receives power from the generator. Two automatic transfer switches control the switch between normal and emergency power. Life safety lighting fixtures are all equipped with battery packs.

Lighting

Mainly fluorescent lighting is used in the Police Training Facility because of their energy efficiency and longer life. Incandescent halogen lamps were used in for floodlighting in the firing range. Exterior pole mounted parking lot luminaires utilized high pressure sodium lamping. Except for fixtures in the range, all indoor lights were designated to be operated from local switches. General lighting luminaires within the range were to be operated from the range entrance. A master control panel in the range control room operates all other range fixtures. All exterior lights will be controlled by photocells.

Mechanical

To allow for proper isolation between the firing range area and training areas, two separate mechanical systems service the MdTA Police Training Facility. The firing range area is serviced by two large air-handling units located on the first floor. Six smaller rooftop air-handling units service the remaining spaces in the building.

Structural

Building Framing for the firing range will be open web steel joists which provide clear span opening without columns in the range area. The structure will be designed to support a ballistic containment steel baffle system and a ricochet ceiling system. The firing range walls are load bearing construction. The walls will be constructed of reinforce/solid grouted CMU with a split face block facade. The solid grout filling is necessary for ballistic containment. The training area will be a steel framed structure.

Supporting Systems

Communications/Data Systems
A raceway system only will be provided for the telephone system. Cables will be brought by Verizon in two 4" PVC conduits (conduits provided by owner) that will be run underground from the board to a pole East of the building perimeter road and connect to the existing overhead telephone lines. A raceway system only will be provided for the computer network as well. One data outlet per workstation at offices, classrooms, reception, Weapon Repair room, control room, and Weapon Cleaning room are provided. All outlet conduits shall be run underground to a 4'x8'x0.75' thick board in Electrical Room 117.

Access Control (Security) System
A controlled access security system is capable of recording, reporting, and alarming locally and remotely based on a set of detectors within the facility. Magnetic switches are provided at exit doors and doors into weapons and ammunition storage rooms, the control room, and the weapons cleaning and the repair rooms. Door entry controllers are located at the entry doors to the weapons and ammunition storage rooms. Movement sensors are provided at the weapons and ammunition storage rooms.

Fire Alarm System
The system is a multiplex addressable type with the main panel in the electrical room and the annunciator in the reception room connected via a telephone dialer to the fire department or a remote monitoring service company. Pull stations, audio/visual signals, duct detectors, smoke detectors, and head detectors are located throughout the building.

Closed Circuit TV and TV Antenna System
A Closed Circuit TV (CCTV) system is utilized with a monitoring console at the reception desk. A
TV antenna system is provided via a concealed raceway system with a roof mounted dish to pick up regular broadcasting and other signals put out by the state and federal agencies. TV outlets are provided in each classroom for ceiling mounted TV sets.

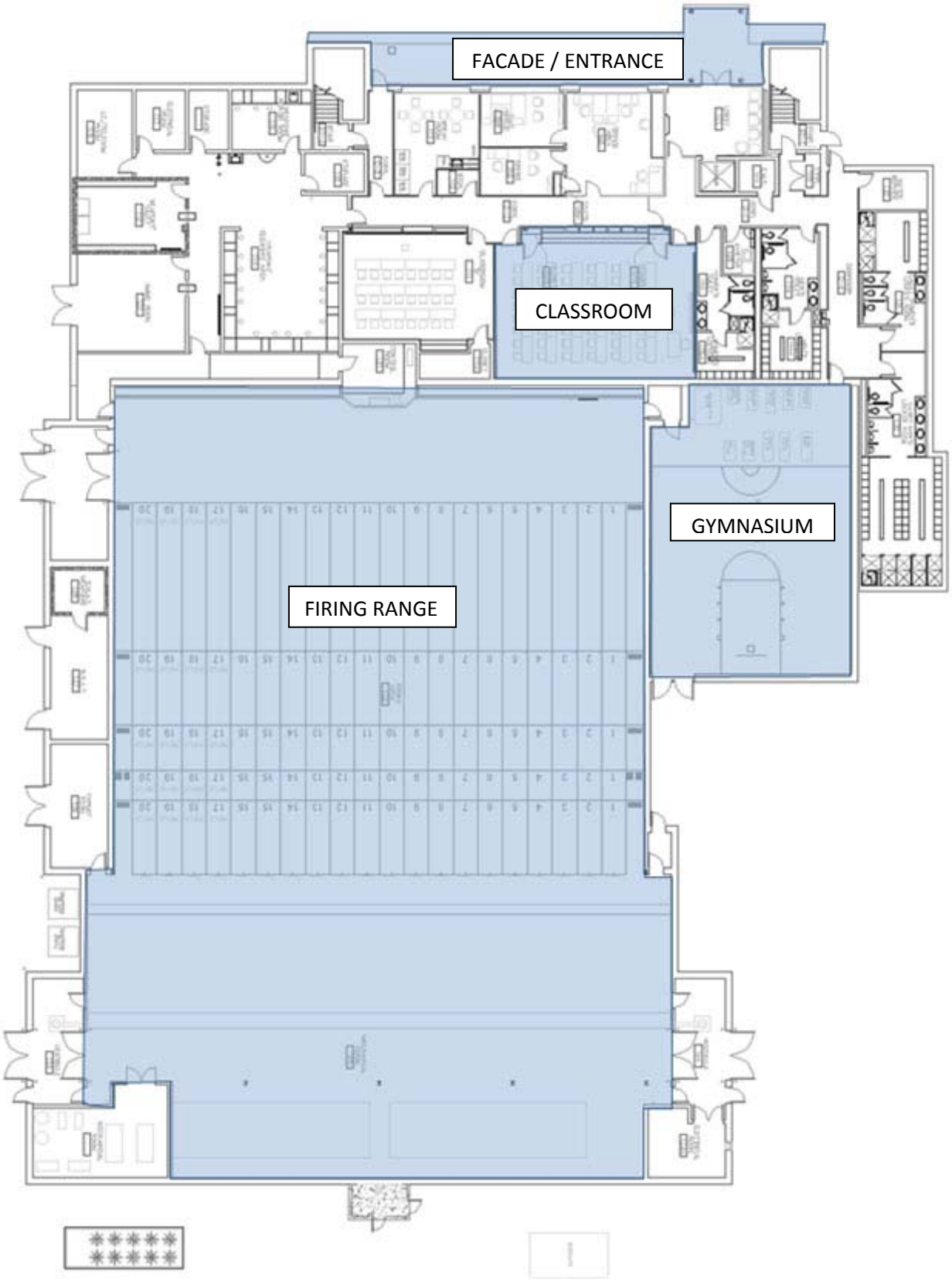
Lighting Depth

The building functions primarily as an educational training facility; the major goal of the lighting design is to facilitate learning. Specific design criteria vary based on the individual spaces being addressed, but common themes, such as control and flexibility link the designs together. While stunning visual appearance and pleasing aesthetics is not the main goal of the facility, quality lighting is still of importance. Quality lighting is necessary to adequately address the function of the building as a learning environment, to aid in the learning process, and to provide comfort to the users of the building.

Design criteria were examined closely for four spaces within the Maryland Transportation Authority Police Training Facility, and a lighting redesign was performed. The four spaces for which lighting redesigns were performed were Classroom 'A', the physical training gymnasium, the front façade and entrance canopy, and the firing range area. These selections represent diversity in the spaces and functionality of the building.

In combination with functional and aesthetic goals of each distinctive space and the owner's requirements, the IESNA Lighting Handbook was employed as the primary guide for determining the design criteria for the space. ASHRAE Standard 90.1 was utilized as the standard for energy usage in the form of lighting power density requirements. Finding a balance in aesthetics, functionality, and energy efficiency was of primary concern. AGI32 was utilized as the chief method of analysis for the lighting redesign. It provides data for illuminance values, lighting power densities, as well as renderings to verify the aesthetics of the space.

On the following page is a plan view of the ground floor of the Maryland Transportation Authority Police Training Facility. Highlighted are the areas for which lighting redesigns were performed.


FACADE / ENTRANCE
CLASSROOM
GYMNASIUM
FIRING RANGE

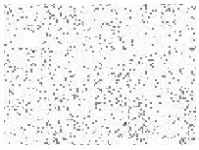
Classroom 'A'

Introduction

Classroom 'A' is the largest classroom space in the Maryland Transportation Authority Police Training Facility. Classroom 'A' has dimensions of 30'-8" by 40'-7". Each classroom is equipped with a 16' whiteboard, an 8' tack board with continuous display rail, a wall-mounted 27" TV, an 8' wide projection screen, and a 16' long countertop with base cabinets and wall shelving above.

While, the classroom can serve many different functions, including instructional lectures, training classes, large meetings, and exams, the primary goal of the classroom is to "provide a visual environment for both students and instructors that is supportive of the learning processes" (IESNA Lighting Handbook).

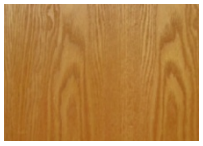
Materials and Reflectances



Ceiling
Acoustical Ceiling Tile (ACT)
Reflectance = 0.86

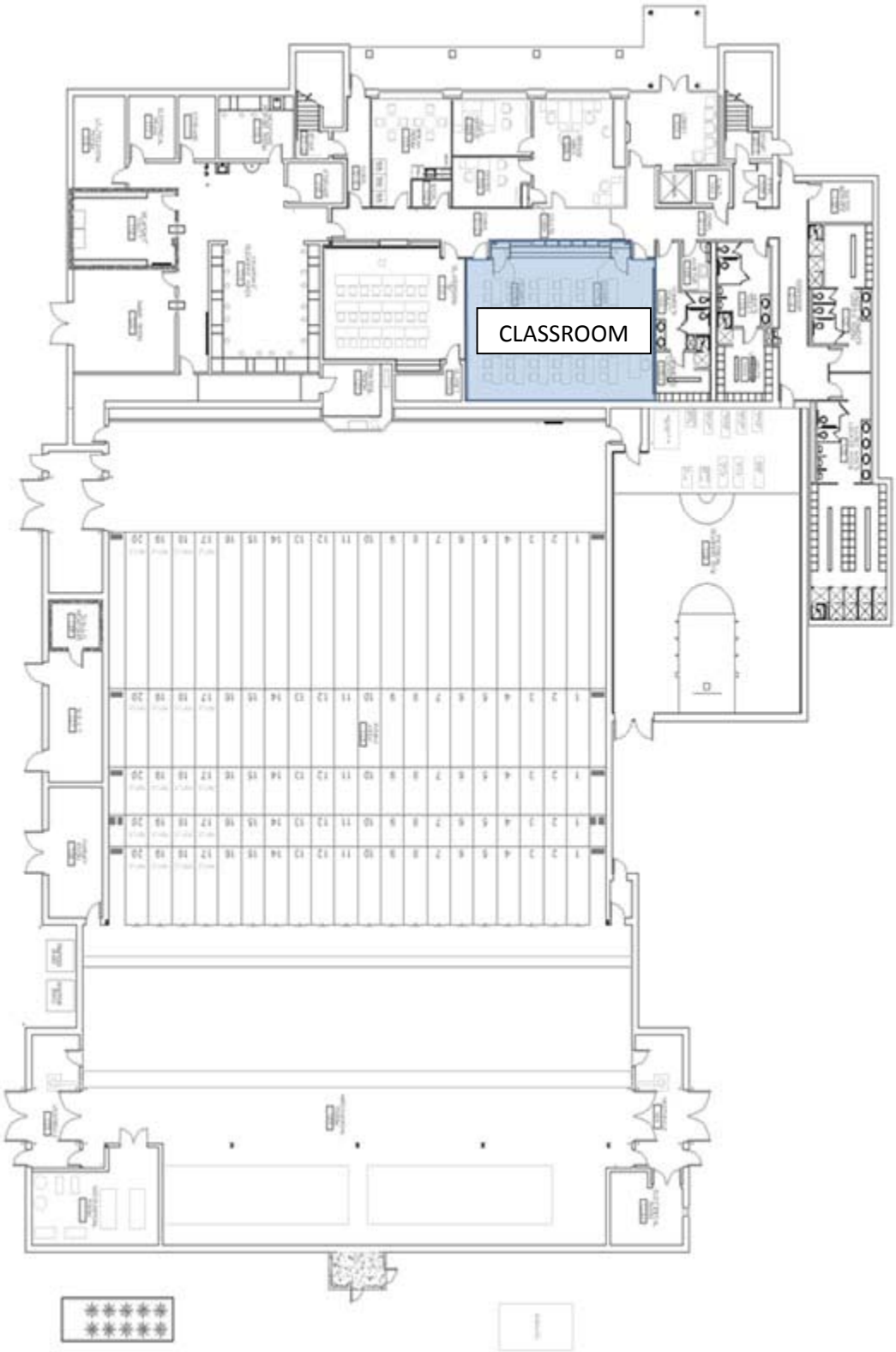
Walls
Painted Gypsum Board
Reflectance = 0.80

Floors
Vinyl Composition Tile (VCT) Flooring
Reflectance = 0.31



Desks, Cabinet, and Shelving
Wood finish
Reflectance = 0.22

Layout



Summary of Design Criteria / Design Approach

Illuminance Levels (to perform task)

The most important consideration for the lighting design of the classroom is meeting the illuminance levels required for the performance of the visual tasks at hand. Paper task on the desk plane is most crucial, but other tasks such, as viewing the white board or projection screens, should not be ignored. The IESNA recommends 50 footcandles for the performance of visual tasks of high contrast and small size, or low contrast and large size. To ensure that there is adequate light for all tasks, including the administering of examinations, 50 fc will be the target average illuminance when all luminaires are at full output. Additionally, 5 fc of vertical illuminance is desired on the whiteboard on the front wall of the classroom.

Light Distribution of Task Plane

Again, lighting for the task is crucial in a classroom space. Uniformity of light distribution on the task plane of the desk surface should be achieved to allow for easy completion of tasks throughout the room.

Control and Flexibility

The classroom may be used for different functions, such as meetings, lectures, and presentations. The desk plane, white board, or projection screen could become the critical viewing surface at any time, and the lighting system should be flexible to meet the changing needs of each situation. Multiple switching options can be utilized to achieve this versatility. Three main functions are expected to most frequently occur in the classroom, lectures, audio/visual presentations, and examinations. General design elements of each, as proposed in the IESNA Lighting Handbook, are listed below.

> ***Lectures*** *– dim general lighting and brighten front lights to direct attention to the educator and chalkboard*
> ***A/V Presentations*** *– turn front lights off and dim general lighting to low for clear screen images and easy note-taking*
> ***Examinations*** *– raise all lights to full brightness for detail*

Design Performance

The lighting system for the classroom has three parts that, when combined in various ways, allows for the flexibility of the space set forth in the design criteria. The first part is suspended linear semi-indirect luminaries over the classroom seating area. These fixtures are oriented from front to back of the room so as not to interfere with the projection system. The second aspect of the lighting system is lighting under and above the cabinets. They provide a peripheral emphasis and heighten the space. The third part is square downlights at the front of the room. They allow for the front of the room where a speaker or presentation would be to have a different illuminance level than the rest of the room.

Lutron's Radio Touch Wireless Lighting Controls system fits the control needs of the lighting redesign. The control system provides flexibility and energy savings through the use of wireless radio signals communicating with and dimming the luminaries to create scenes. The following three preset scenes will be programmed into the Radio Touch system:

1) Examination Scene
    a. Linear semi-indirect – 100%
    b. Square downlights – 100%
    c. Cabinet lighting – 100%
2) Audio/Visual Presentation Scene
    a. Linear semi-indirect – 50%
    b. Square downlights – 0%
    c. Cabinet lighting – 0%
3) Lecturing Scene
    a. Linear semi-indirect – 25%
    b. Square downlights – 100%
    c. Cabinet lighting – 0%

Projection screen and equipment can be integrated into the controls system. Occupancy sensors will also need to be included and integrated in the system to meet the automated shutoff requirements. More scenes and integration can occur as may be requested by the owner.

Luminaire Schedule

The following luminaire schedule denotes the basic luminaire, lamp, voltage and wattage information of the three luminaire types prescribed in the lighting redesign of Classroom 'A'. A full luminaire schedule is available for viewing in the appendix and includes additional information such as ballast information and starting and operating currents.

LUMINAIRE SCHEDULE - CLASSROOM 'A'								
TAG	MANUFACTURER	CATALOG NUMBER	DESCRIPTION	LAMP TYPE	WATTS	# OF LAMPS	OPERATING VOLTAGE	FIXTURE INPUT WATTS
A	PEERLESS	PRM4-1 54HO R12 277	SUSPENDED SEMI-INDIRECT	T5	54	1	277	88.5
B	LITHONIA	UC 42K 277	UNDERCABINET FIXTURE	T5	13	2	277	28
C	GOTHAM LIGHTING	SQF 1/32TRT 6AR 277	SQUARE DOWNLIGHT	CFL - TR	32	1	277	38

Light Loss Factors

Light loss factors (LLF) were determined using the method prescribed in the IESNA Lighting Handbook. Ballast factor, lamp lumen depreciation (LLD), room surface dirt depreciation (RSDD), and luminaire dirt depreciation (LDD) were evaluated in the determination of the LLF for each luminaire. Assumptions and equipment values are included in the table below.

LIGHT LOSS FACTORS - CLASSROOM 'A'											
LUMINAIRE DESIGNATION	MAINTENANCE CATEGORY	ROOM ATMOSPHERE	CLEANING INTERVAL	RCR	INITIAL LUMENS	MEAN LUMENS	BALLAST FACTOR	LLD	RSDD	LDD	LLF
A	II	CLEAN	12 MONTHS	2.74	5000	4650	0.98	0.93	0.93	0.94	**0.797**
B	V	CLEAN	12 MONTHS	2.74	700	630	0.95	0.9	0.977	0.88	**0.735**
C	IV	CLEAN	12 MONTHS	2.74	2800	2520	0.88	0.9	0.977	0.88	**0.681**

Lighting Power Density

Creating an energy efficient design is a crucial aspect for the lighting design. ASHRAE Standard 90.1 puts forth the limitations for lighting power density. Using the space-by-space method, a room classified as Classroom/Lecture/Training should have a lighting power density of no more than 1.4 W/ft^2. The following are the calculations and results for the actually lighting power density of the redesigned lighting system for Classroom 'A'. Included are the watts per square foot of room area utilized for each of the three lighting

scenarios. The actually lighting power density of the space is based on all of the luminaires on at full output, however, each scenario will show the difference in W/ft^2 when that scene is in use.

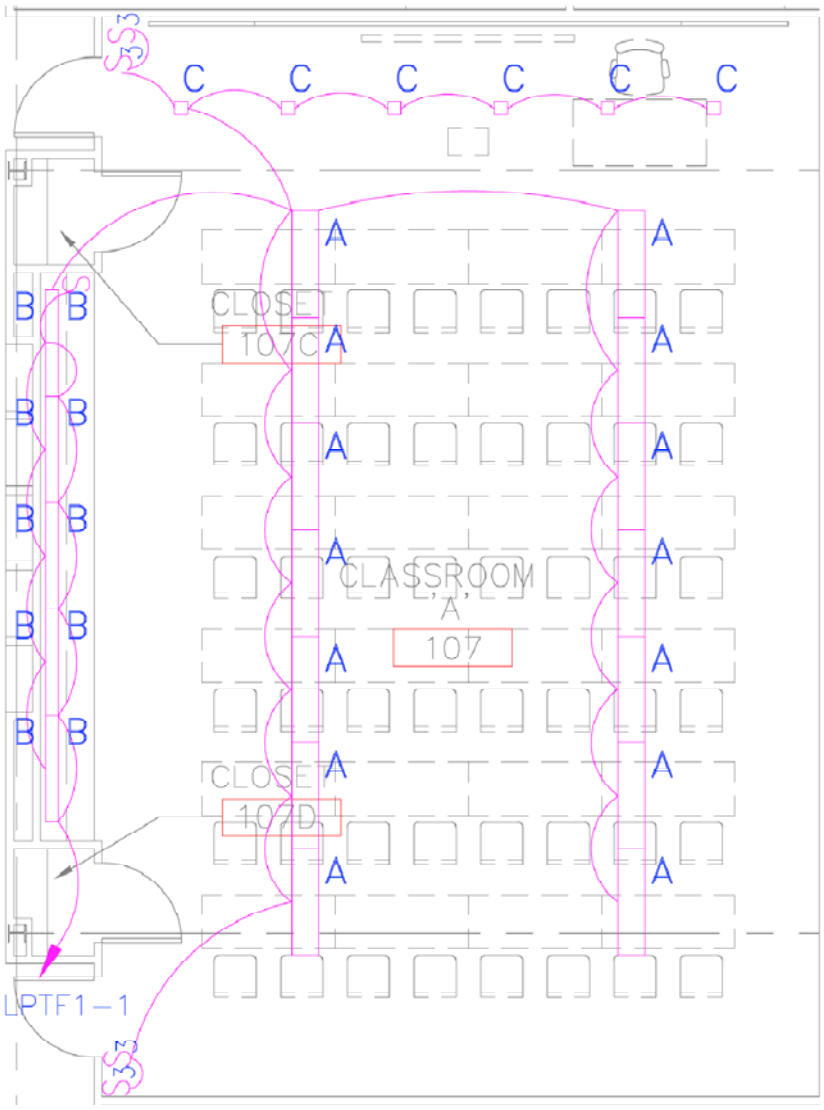
Lighting Power Density Calculation:

Area = 1144 ft^2
Total Watts = 1333.4 W
LPD = 1.166 W/ft^2

W/ft^2 for Each Scenario

1) Examination Scene
   Area = 1144 ft^2
   Total Watts = 1333.4 W
   W/ft^2 = 1.166 W/ft^2
2) Audio/Visual Presentation Scene
   Area = 1144 ft^2
   Total Watts = 827.4 W
   W/ft^2 = 0.723 W/ft^2
3) Lecture Scene
   Area = 1144 ft^2
   Total Watts = 983.4 W
   W/ft^2 = 0.860 W/ft^2

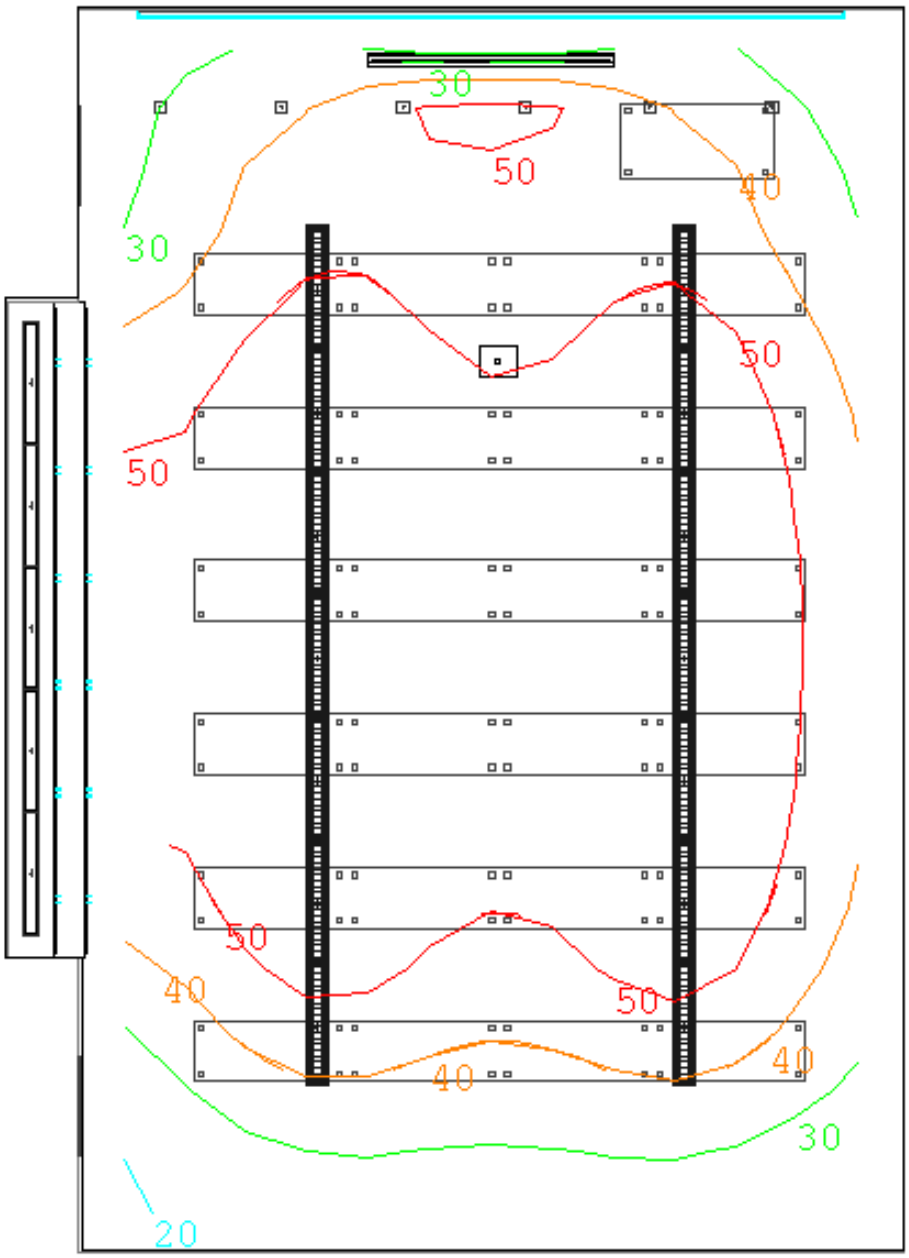
Floor Plan



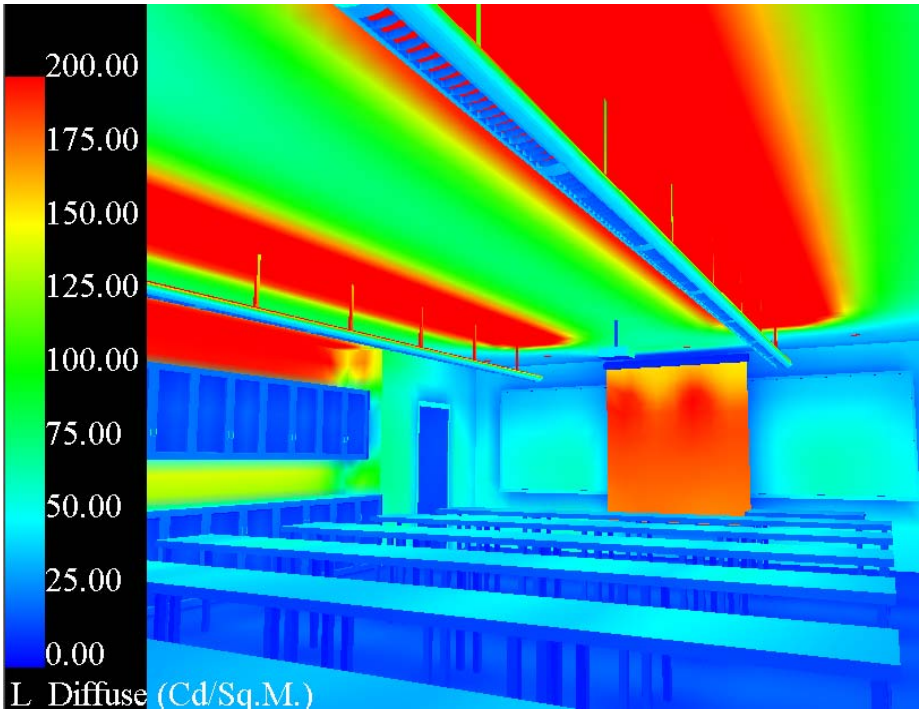
Performance Data

Examinations Scene

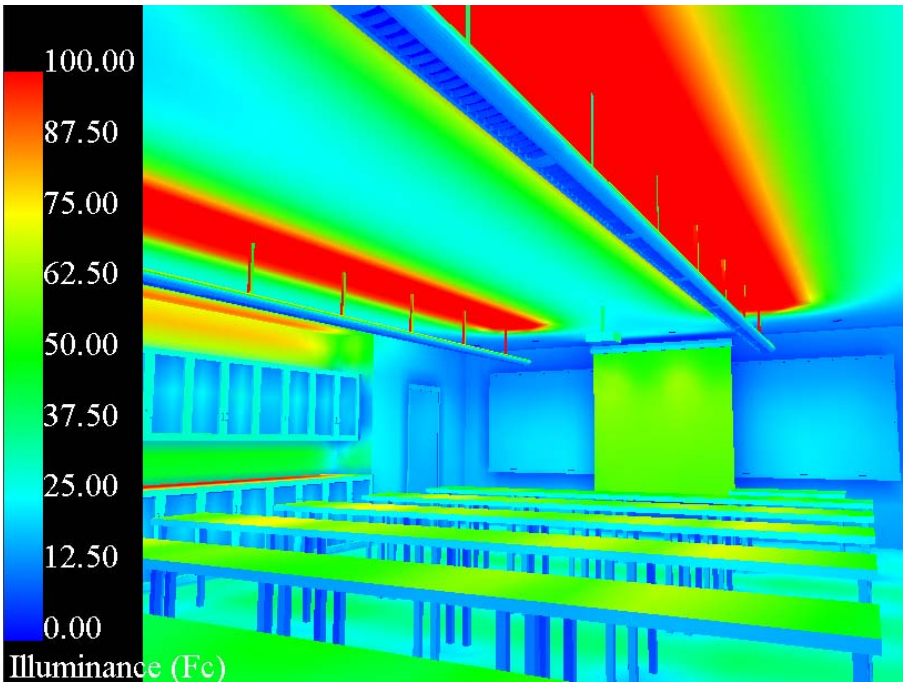
Illuminance Isolines



Pseudo-Color Luminance



Pseudo-Color Illuminance



Rendering

Project_1
Calc Pts

CalcPts_2
Illuminance Values(Fc)
Average=91.25 Maximum=106
Minimum=62.1 Avg/Min=1.47
Max/Min=1.70

CalcPts
Illuminance Values(Fc)
Average=45.67 Maximum=63.9
Minimum=19.1 Avg/Min=2.39
Max/Min=3.35

CalcPts_1
Illuminance Values(Fc)
Average=52.60 Maximum=64.1
Minimum=33.9 Avg/Min=1.55
Max/Min=1.89

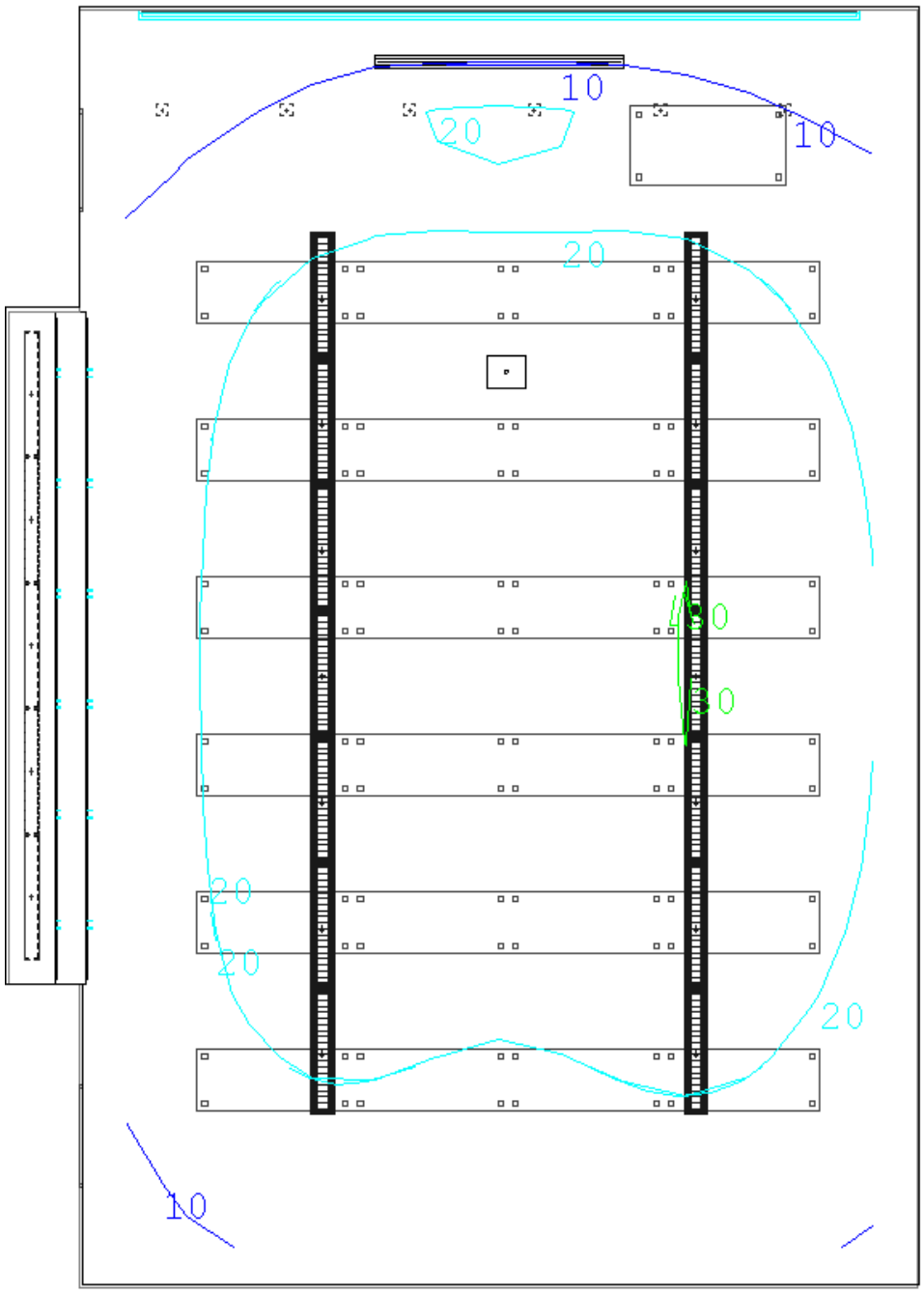
CalcPts_3
Illuminance Values(Fc)
Average=28.01 Maximum=36.3
Minimum=21.5 Avg/Min=1.30
Max/Min=1.69

LPD-UWLR Areas

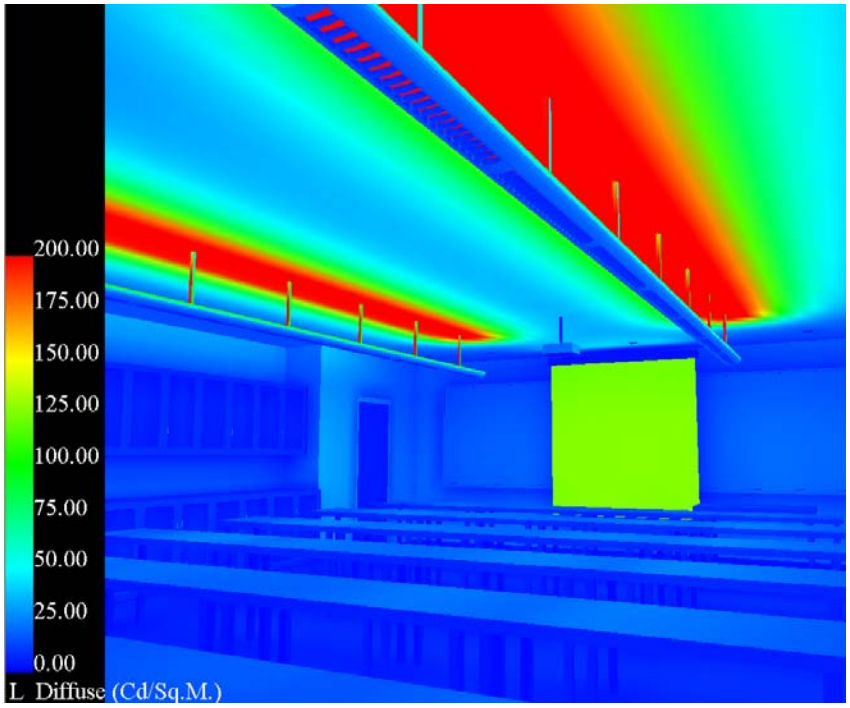
Lighting Power Density
Area(Sq.Ft.)=1144 Total Watts=
1333.4 LPD(Watts/Sq.Ft.)=1.166

Audio/Visual Presentations

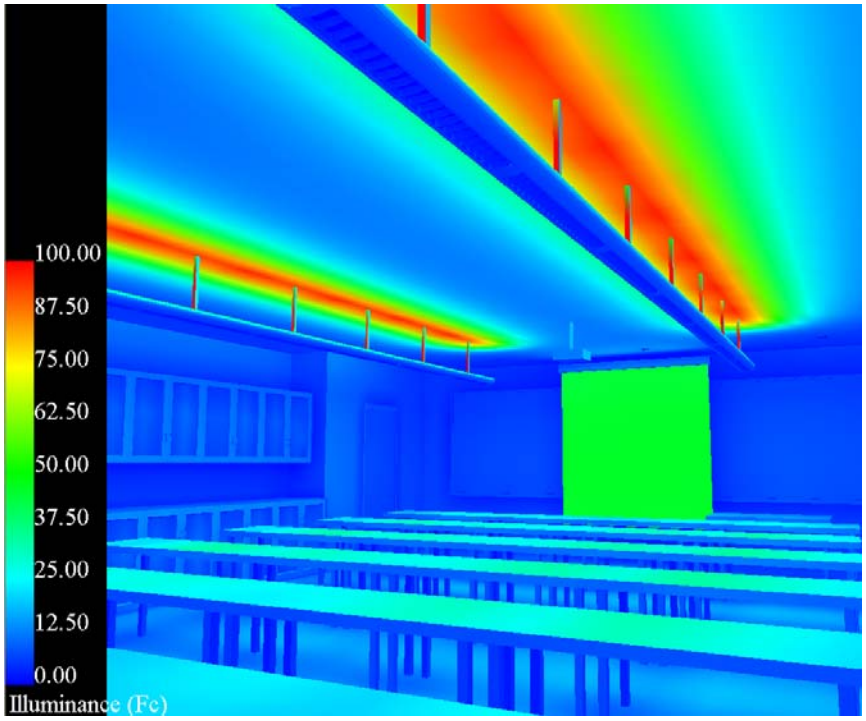
Illuminance Isolines



Pseudo-Color Luminance



Pseudo-Color Illuminance



Rendering

Cabinets
Illuminance Values(Fc)
Average=7.80 Maximum=9.0
Minimum=6.1 Avg/Min=1.28
Max/Min=1.48

Task Plane
Illuminance Values(Fc)
Average=19.70 Maximum=30.2
Minimum=6.4 Avg/Min=3.08
Max/Min=4.72

Desk Surface
Illuminance Values(Fc)
Average=24.21 Maximum=30.1
Minimum=14.9 Avg/Min=1.62
Max/Min=2.02

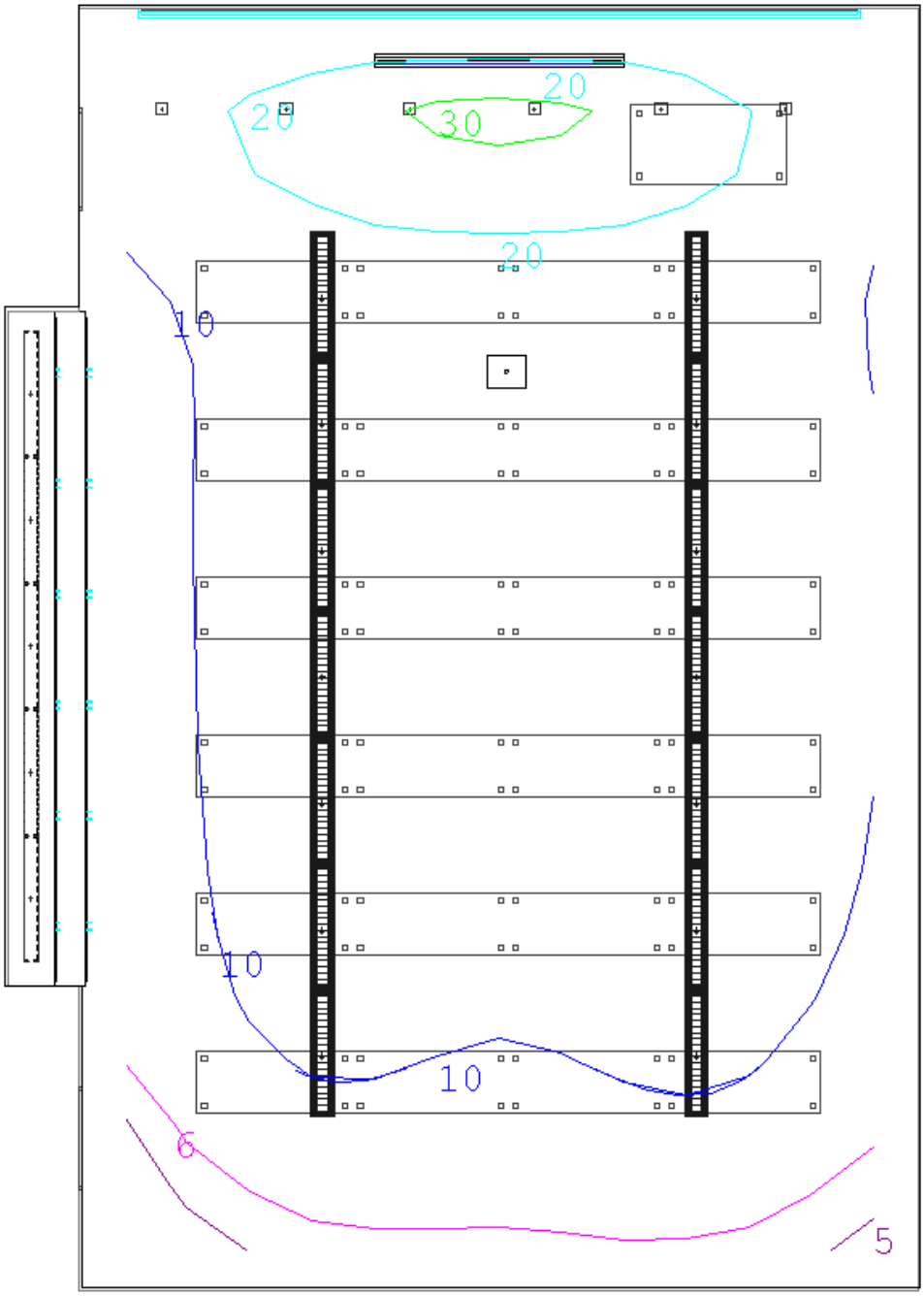
Projection Screen
Illuminance Values(Fc)
Average=9.79 Maximum=10.2
Minimum=8.9 Avg/Min=1.10
Max/Min=1.15

LPD-UWLR Areas

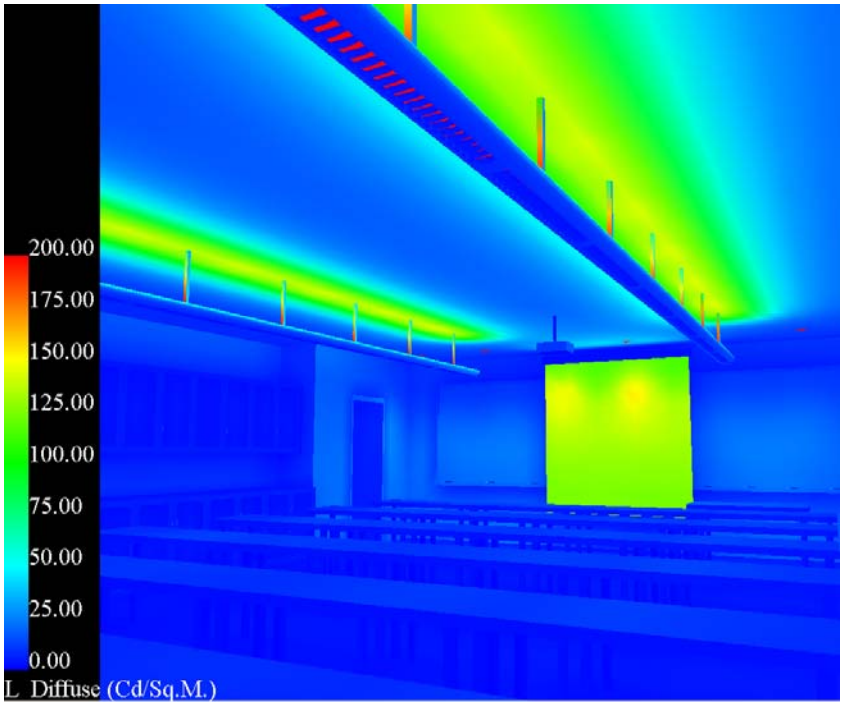
Lighting Power Density
Area(Sq.Ft.)=1144 Total Watts=
827.3999 LPD(Watts/Sq.Ft.)=0.723

Lecture Scene

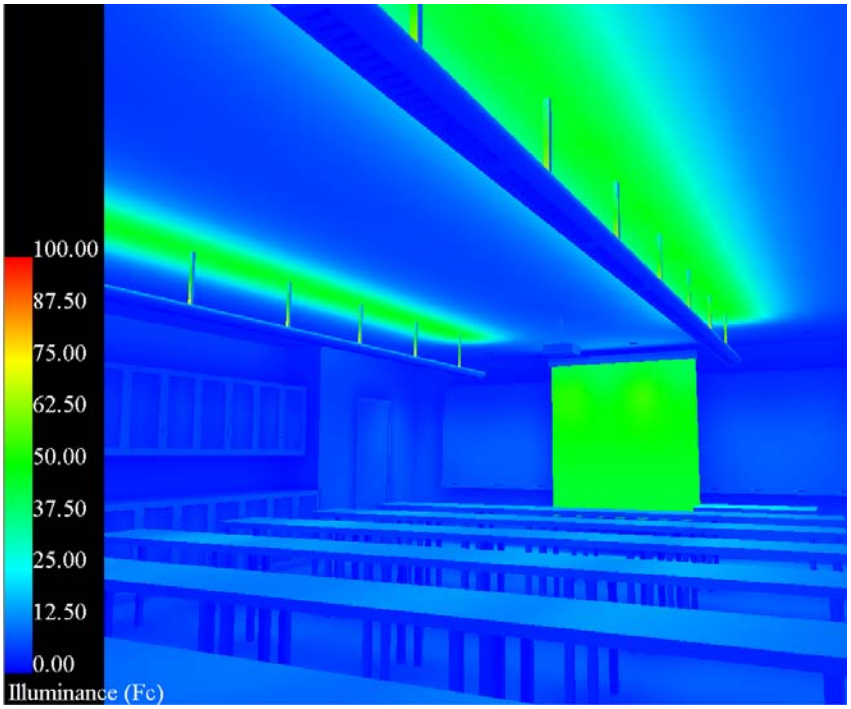
Illuminance Isolines



Pseudo-Color Luminance



Pseudo-Color Illuminance



Renderings

Cabinets
Illuminance Values(Fc)
Average=4.07 Maximum=4.7
Minimum=3.2 Avg/Min=1.27
Max/Min=1.47

Task Plane
Illuminance Values(Fc)
Average=12.72 Maximum=33.4
Minimum=4.1 Avg/Min=3.10
Max/Min=8.15

Desk Surface
Illuminance Values(Fc)
Average=13.05 Maximum=16.5
Minimum=7.3 Avg/Min=1.79
Max/Min=2.26

Projection Screen
Illuminance Values(Fc)
Average=12.69 Maximum=22.9
Minimum=8.0 Avg/Min=1.59
Max/Min=2.86

LPD-UWLR Areas

Lighting Power Density
Area(Sq.Ft.)=1144 Total Watts=
983.3999 LPD(Watts/Sq.Ft.)=0.860

Gymnasium

Space Description

The gymnasium will be used for scheduled classes in self-defense as well as personal training with exercise and weight-lifting equipment. A small half-court basketball set-up is included for pick-up games in the evenings and weekends. Measuring approximately 41' by 59', the gymnasium is the only space in the facility with exposed structural trusses. The space also has wall padding covering CMU walls for safety.

Materials and Reflectances

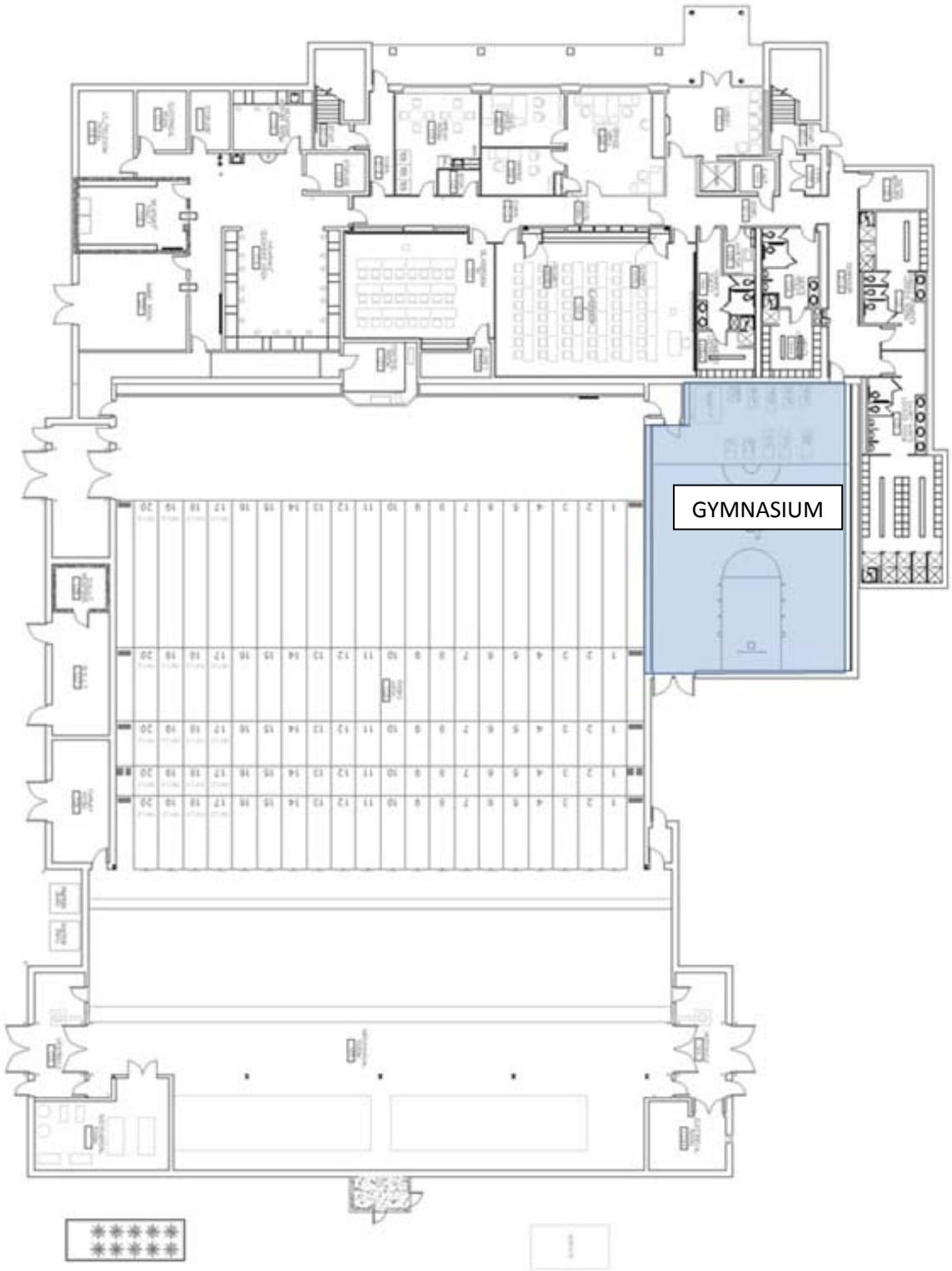
Ceiling and Trusses
Painted
Reflectance = 0.86

Walls
Painted CMU
Reflectance = 0.80

Floors
Wood Flooring
Reflectance = 0.31

Wall Panels
Blue Wall Padding
Reflectance = 0.22

Layout



Summary of Design Criteria / Design Approach

Illuminance Levels

For multidirectional aerial sports, vertical illuminance is more crucial than horizontal illuminance. For calculation purposes, horizontal illuminance is used due to its ease in determination, under the assumption that if the horizontal criterion is being met, vertical will follow. The IESNA Lighting Handbook establishes different classes of play based on the skill level of play and the number of spectators. The gymnasium in the Police Training Facility is classified as Class IV, "for social and recreational play only, with secondary consideration for spectators." Class IV spaces for basketball as well as exercise rooms, are suggested to have an average illuminance of 30 fc throughout the space.

Light Distribution of Task Plane

The horizontal distribution of light should remain fairly uniform, with a maximum-to-minimum ratio of less than 1.7:1 and a coefficient of variation of 0.13 of less.

Control and Flexibility

Unlike many educational gymnasiums, the MdTA Police Training Facility's gymnasium will not need to be lighted throughout the whole day. Therefore, having the controlability to instantly turn lights on and off should be considered a crucial part of the design. High intensity discharge lamping, which are typical for gymnasium applications, should be avoided because of their long start-up time. Being able to reduce luminaire light output for flexibility in creating environments for self-defense training should be considered.

Design Performance

The luminaire selected for the physical training gymnasium makes use of eight compact fluorescent lamps. Six fixtures provide about 32 fc on the floor area meeting the illuminance design criteria. Various light output levels can be achieved by allowing for individual lamp switching. This type of switching can be executed with multiple wall switches and does not require a complicated control system.

Luminaire Schedule

The following luminaire schedule denotes the basic luminaire, lamp, voltage and wattage information of the three luminaire types prescribed in the lighting redesign of the gymnasium. A full luminaire schedule is available for viewing in the appendix and includes additional information such as ballast information and starting and operating currents.

LUMINAIRE SCHEDULE - GYMNASIUM								
TAG	MANUFACTURER	CATALOG NUMBER	DESCRIPTION	LAMP TYPE	WATTS	# OF LAMPS	OPERATING VOLTAGE	FIXTURE INPUT WATTS
D	SPORTLITE	LX800 T42 22LEXCP 277	CFL HIGH BAY	CFL -TR	42	8	277	392

Light Loss Factors

Light loss factors (LLF) were determined using the method prescribed in the IESNA Lighting Handbook. Ballast factor, lamp lumen depreciation (LLD), room surface dirt depreciation (RSDD), and luminaire dirt depreciation (LDD) were evaluated in the determination of the LLF for each luminaire. Assumptions and equipment values are included in the table below.

LIGHT LOSS FACTORS - GYMNASIUM											
LUMINAIRE DESIGNATION	MAINTENANCE CATEGORY	ROOM ATMOSPHERE	CLEANING INTERVAL	RCR	INITIAL LUMENS	MEAN LUMENS	BALLAST FACTOR	LLD	RSDD	LDD	LLF
D	IV	CLEAN	12 MONTHS	4.01	3200	2752	0.9	0.9	0.945	0.94	**0.720**

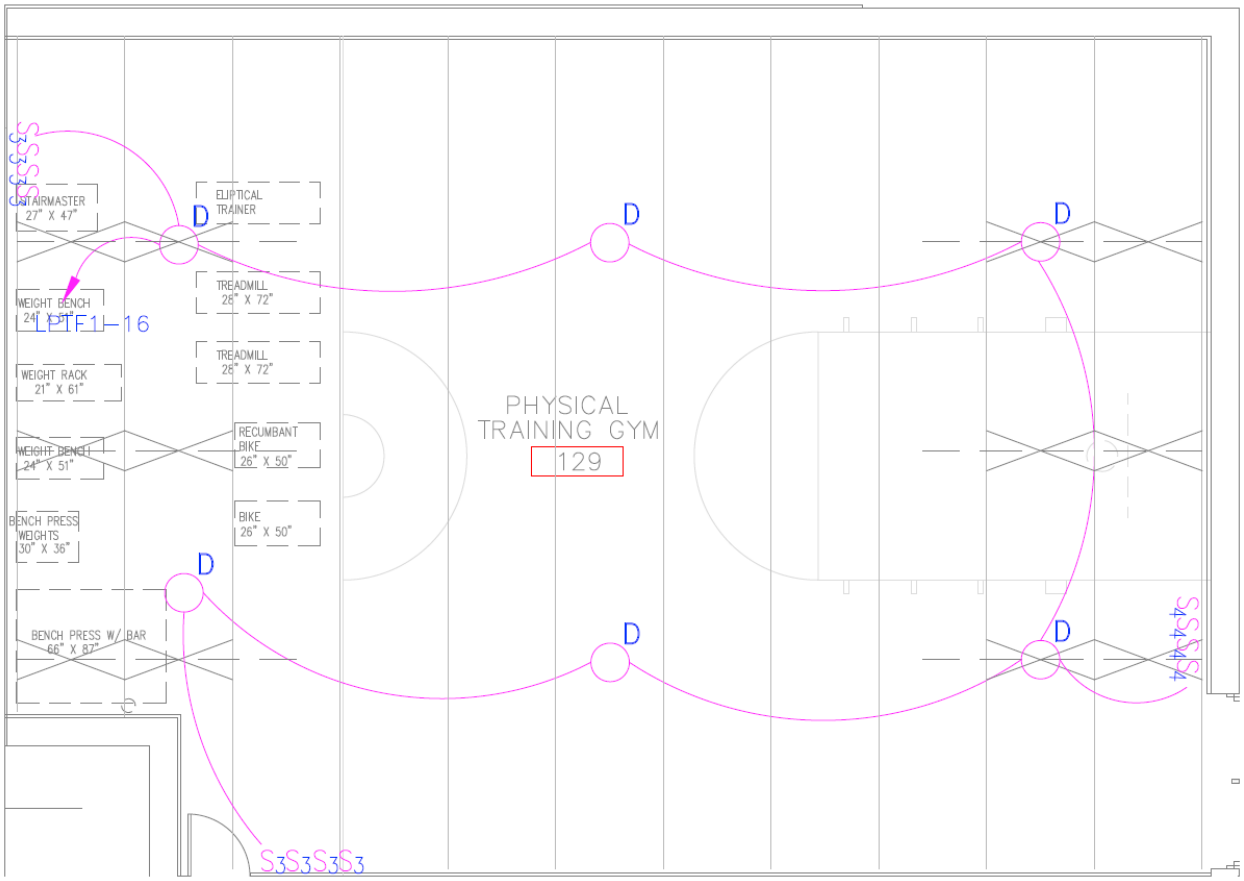
Lighting Power Density

ASHRAE Standard 90.1 establishes the lighting power density using the space-by-space method for a gymnasium / exercise center to be 1.4 W/ft^2 for playing area and 0.9 W/ft^2 for exercise areas. The following are the calculations and results for the actually lighting power density of the redesigned gymnasium lighting system.

Lighting Power Density Calculation:

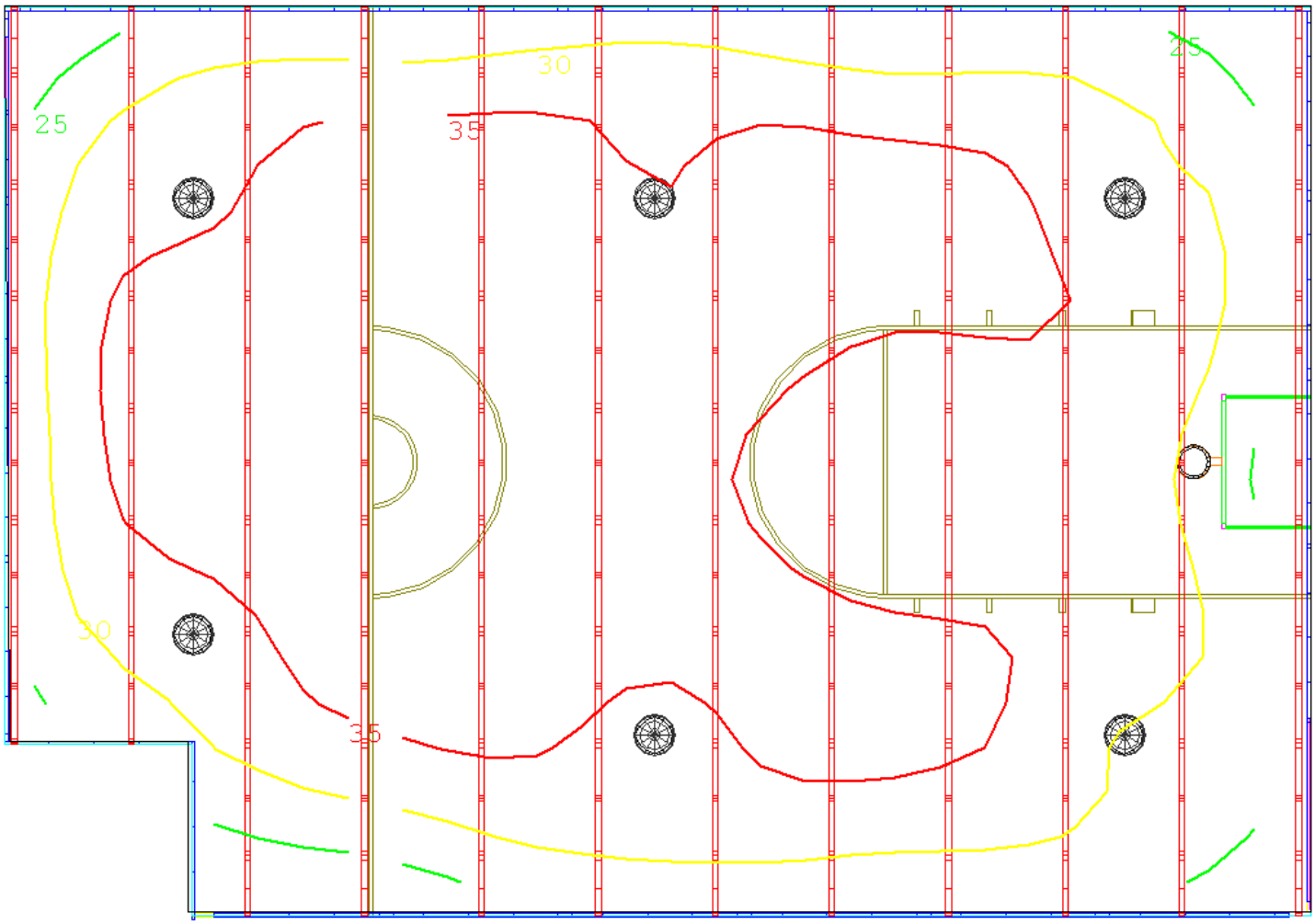
Area = 2296ft^2
Total Watts = 2124W
LPD = 0.925 W/ft^2

Floor Plan

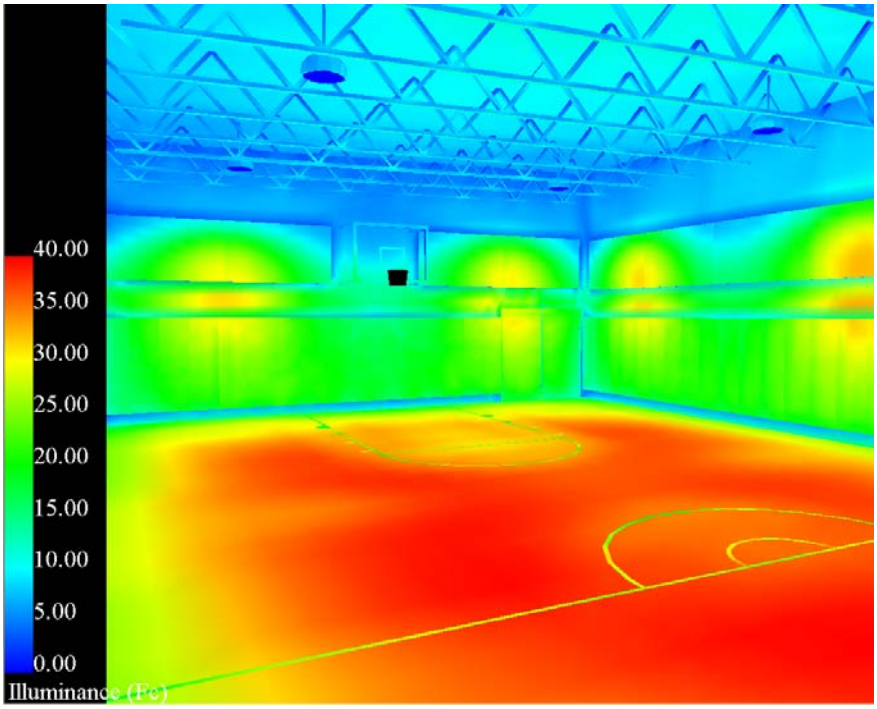

STAIRMASTER
27" X 47"
ELIPTICAL
TRAINER
TREADMILL
28" X 72"
TREADMILL
28" X 72"
WEIGHT BENCH
24" X 51"
WEIGHT RACK
21" X 61"
WEIGHT BENCH
24" X 51"
RECUMBANT
BIKE
26" X 50"
BIKE
26" X 50"
BENCH PRESS
WEIGHTS
30" X 36"
BENCH PRESS W/ BAR
66" X 87"
PHYSICAL
TRAINING GYM
129
LPTF1-16
D
D
D
D
D
D
S3S3S3S3S3
S3S3S3S3S3
S3S3S3S3S3

Performance Data

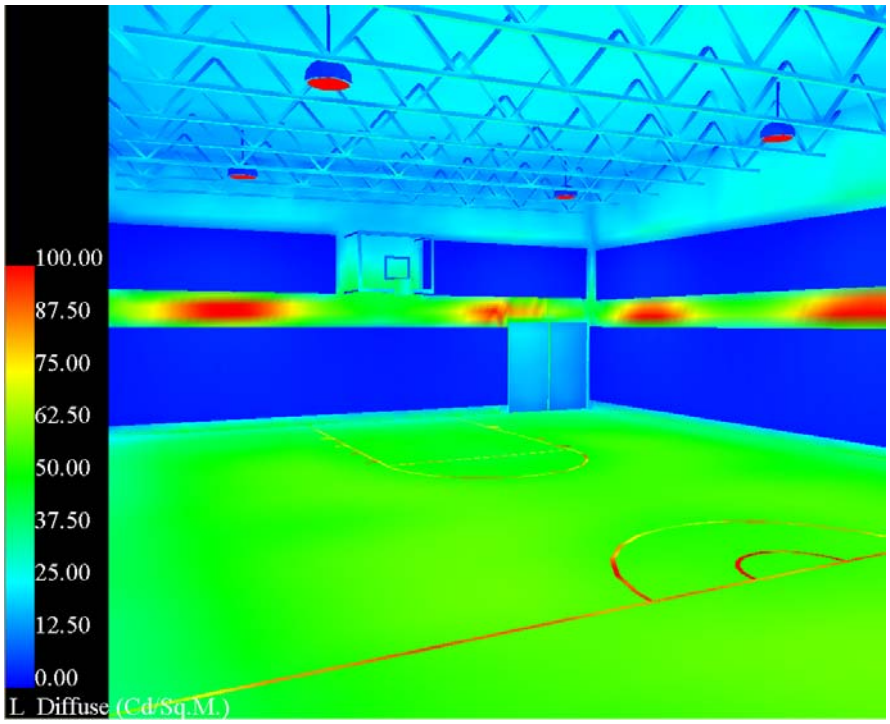
Illuminance Isolines



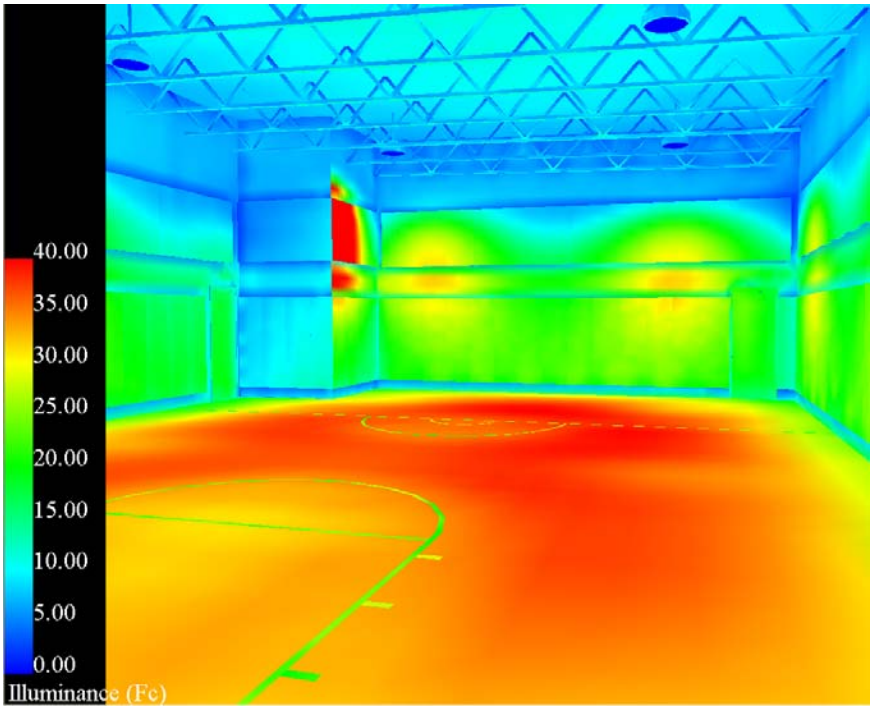
Pseudo-Color Illuminance



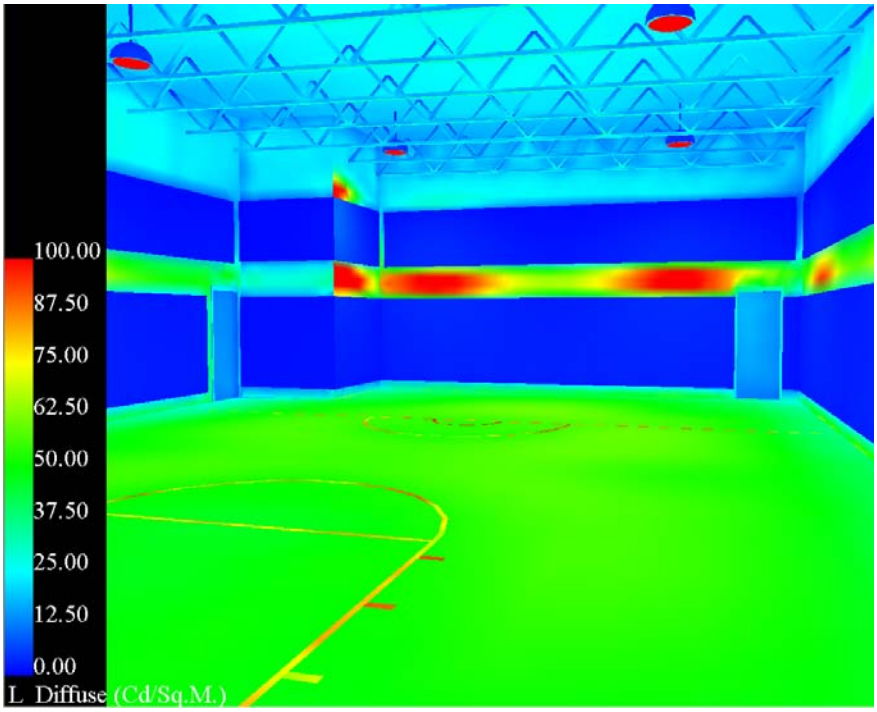
Pseudo-Color Luminance



Psuedo-Color Illuminance



Pseudo-Color Luminance



Rendering

Calc Pts

Basketball Area
Illuminance Values(Fc)
Average=33.27 Maximum=39.7
Minimum=20.6 Avg/Min=1.62
Max/Min=1.93

Fitness Area
Illuminance Values(Fc)
Average=32.89 Maximum=40.5
Minimum=20.1 Avg/Min=1.64
Max/Min=2.01

LPD-UWLR Areas

Gymnasium
Area(Sq.Ft.)=2296 Total Watts=2124
LPD(Watts/Sq.Ft.)=0.925

Firing Range

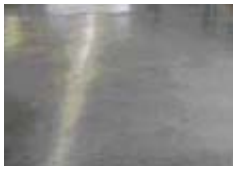
Space Description

As this is a police training facility, the Firing Area is a significant portion of the building. It is comprised of 20 firing lanes at 5'-0" width each and has overall dimensions of 110'x100'. The space is enveloped by reinforced CMU walls with 2" thick Tectum panel, acoustical in nature, attached to ½" cement board attached to a lightweight steel suspension system. Steel plates are suspended from the roof structure above the ceiling for bullet containment. The painted concrete floor has firing position insets recessed in the floor at each firing lane, a total of 80 insets. Other significant features are the 10' wide by 10' tall overhead door, 20 fixed targets that are capable of rotating 90 degrees, and a moving target track that is remote controlled. Part of the original schematic design was to provide a combination of fixtures to be used for general, target area, firing line, target lighting, and training lighting. Much flexibility and potential for different training scenarios would have been a product of this original design concept.

Materials and Reflectances

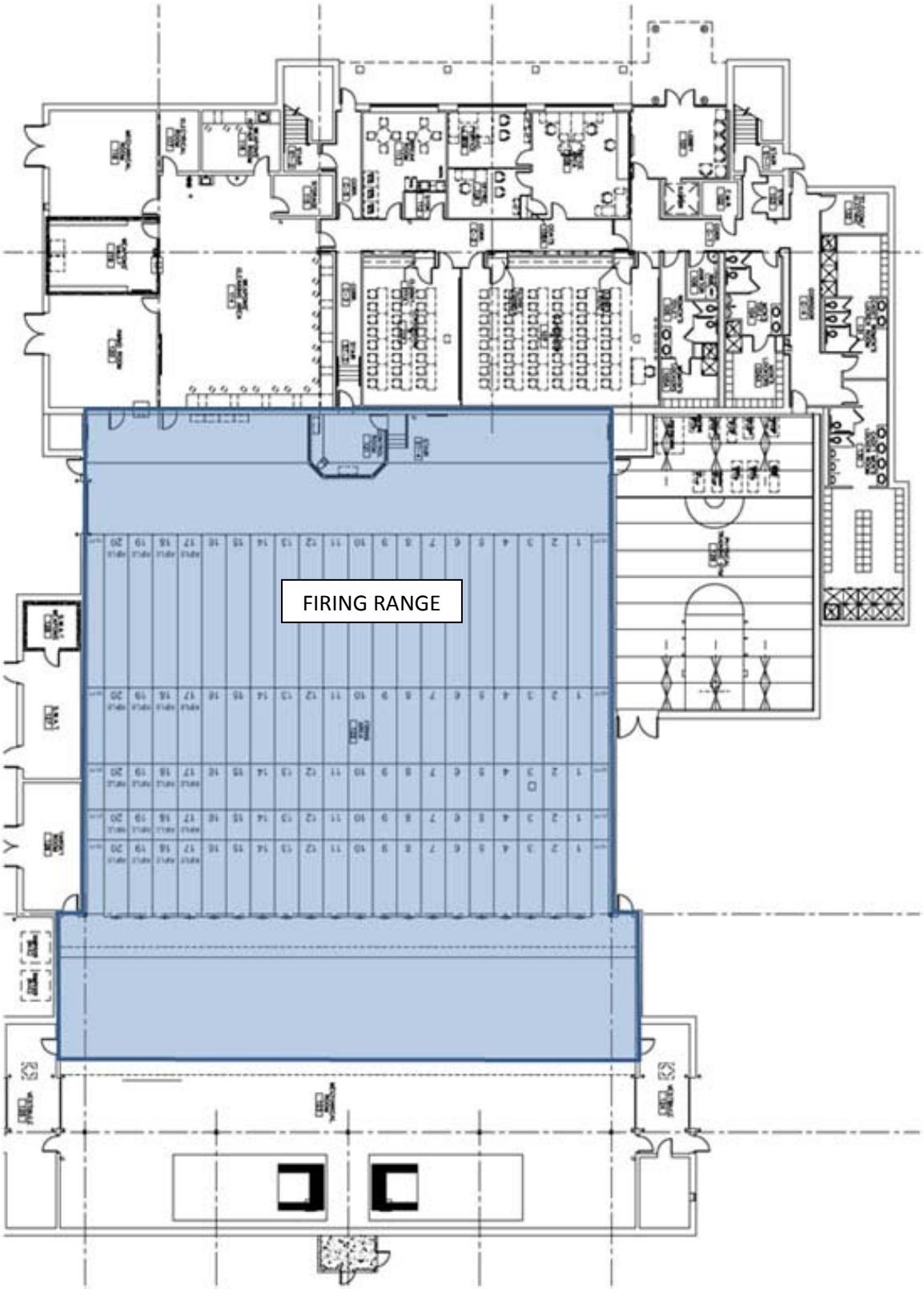
Ceilings and Walls
Tectum Paneling
Reflectance = 0.75

Walls – Lower
Painted CMU
Reflectance = 0.85



Floors
Sealed Concrete
Reflectance = 0.36

Layout



Summary of Design Criteria / Design Approach

Control and Flexibility

The firing range is an instructional and training tool. Generating pseudo-realistic training environments affords a quality learning environment. Multiple lighting systems incorporated into the design will offer diverse training scenarios. The possibility exists for the integration of a control system with preset lighting scenes that will make for easy transitions between the different lighting scenarios.

Glare

The primary concern in the firing area is safety. Direct glare from fixtures can be disabling to the shooter which can create a potentially dangerous situation. Lower cutoff angles for fixtures will avoid direct glare issues. Reflected glare from surfaces creates a similar concern as that of direct glare. Diffuse materials and luminaire placement (affecting reflection angles) should be considered to limit reflected glare.

Light Distribution on Task Plane

Typical uniformity would be of importance in a firing range. The IESNA Handbook designates that the ratio of the maxium to the minimum illuminance values should be 3:1 or less because light patterns on the task plane can be distracting or confusing. The police trainees using this space are not amature shooters and are being trained for to act to real-life situations, in which the lighting will often times be less than perfect. Therefore, distribution will vary based on the real-life situation being simulated.

Illuminance Levels

Again the IESNA Lighting Handbook has concrete values for the horizontal and vertical illuminances in a firing range. A variation of illuminance levels will allow for the widest range of scenarios.

Luminaire Schedule

The following luminaire schedule denotes the basic luminaire, lamp, voltage and wattage information of the three luminaire types prescribed in the lighting redesign of Classroom 'A'. A full luminaire schedule is available for viewing in the appendix and includes additional information such as ballast information and starting and operating currents.

LUMINAIRE SCHEDULE - FIRING RANGE								
TAG	MANUFACTURER	CATALOG NUMBER	DESCRIPTION	LAMP TYPE	WATTS	# OF LAMPS	OPERATING VOLTAGE	FIXTURE INPUT WATTS
I	ERCO	73753.023	DOWNLIGHT	HALOGEN	50	1	12	50
E	WINDIRECT	P2 - SSW - 148T5 - 277V - SCK1 - SGW -	WALLWASH	T5	28	1	277	33
J	LIGHTOLIER	DPB2S18DS340	TROFFER	T8	32	3	277	91
K	ERCO	34115.023	FLOODLIGHT	T5	28	1	277	33

Light Loss Factors

Light loss factors (LLF) were determined using the method prescribed in the IESNA Lighting Handbook. Ballast factor, lamp lumen depreciation (LLD), room surface dirt depreciation (RSDD), and luminaire dirt depreciation (LDD) were evaluated in the determination of the LLF for each luminaire. Assumptions and equipment values are included in the table below.

LIGHT LOSS FACTORS - FIRING RANGE											
LUMINAIRE DESIGNATION	MAINTENANCE CATEGORY	ROOM ATMOSPHERE	CLEANING INTERVAL	RCR	INITIAL LUMENS	MEAN LUMENS	BALLAST FACTOR	LLD	RSDD	LDD	LLF
I	IV	CLEAN	12 MONTH	1.10	2825	---	1	0.9	0.98	0.88	**0.794**
E	IV	CLEAN	12 MONTH	1.10	2600	2418	1.04	0.93	0.98	0.88	**0.882**
J	IV	CLEAN	12 MONTH	1.10	3100	2945	0.88	0.95	0.98	0.88	**0.778**
K	IV	CLEAN	12 MONTH	1.10	2600	2418	1.04	0.93	0.98	0.88	**0.882**

Lighting Power Density

ASHRAE Standard 90.1 establishes the lighting power density using the space-by-space method for a sports area indoor playing field area to be 1.4 W/ft^2. The following are the calculations and results for the actually lighting power density of the redesigned firing range lighting system.

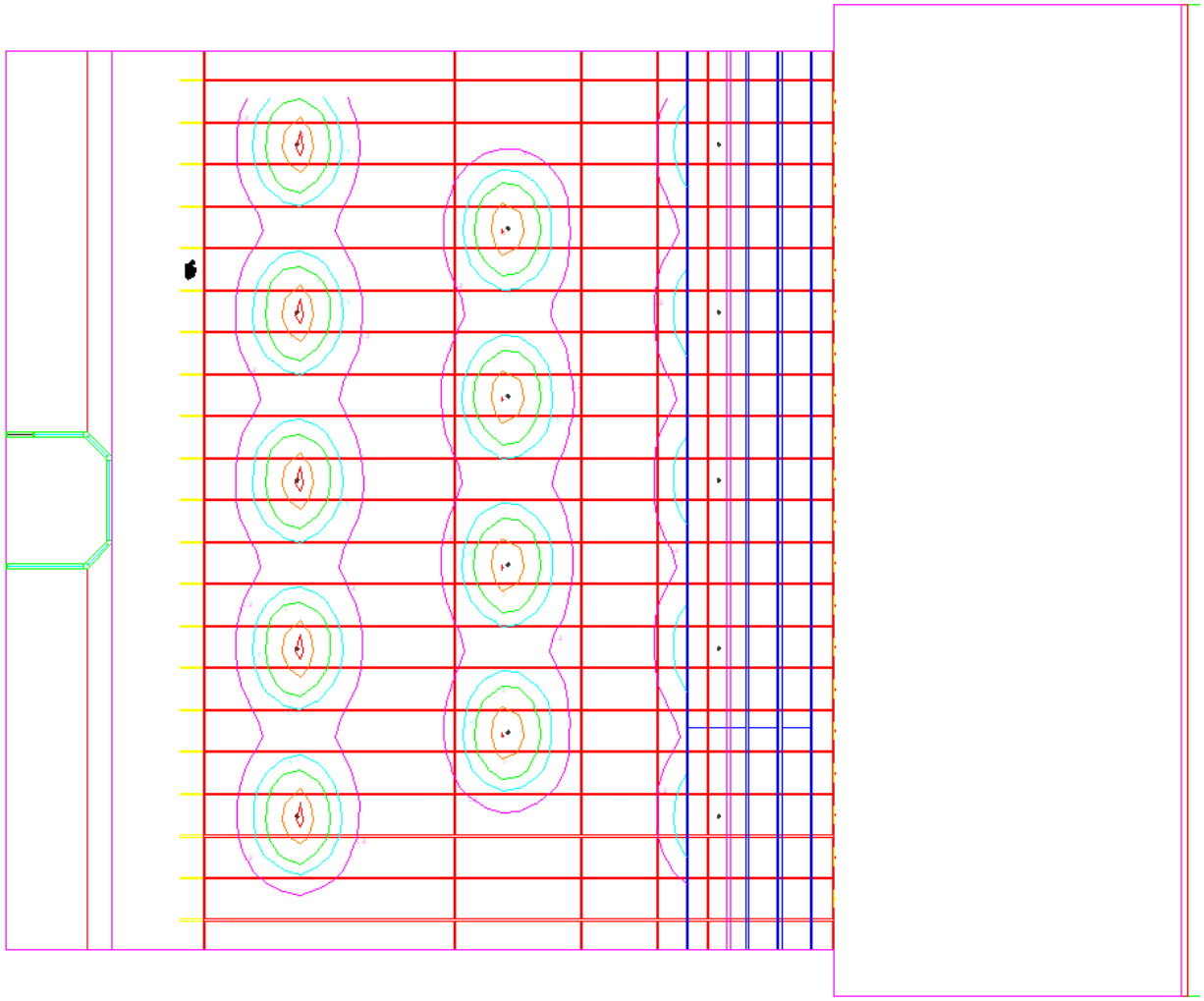
Lighting Power Density Calculation:

Area = 9322 ft^2
Total Watts = 9310 W
LPD = 0.978 W/ft^2

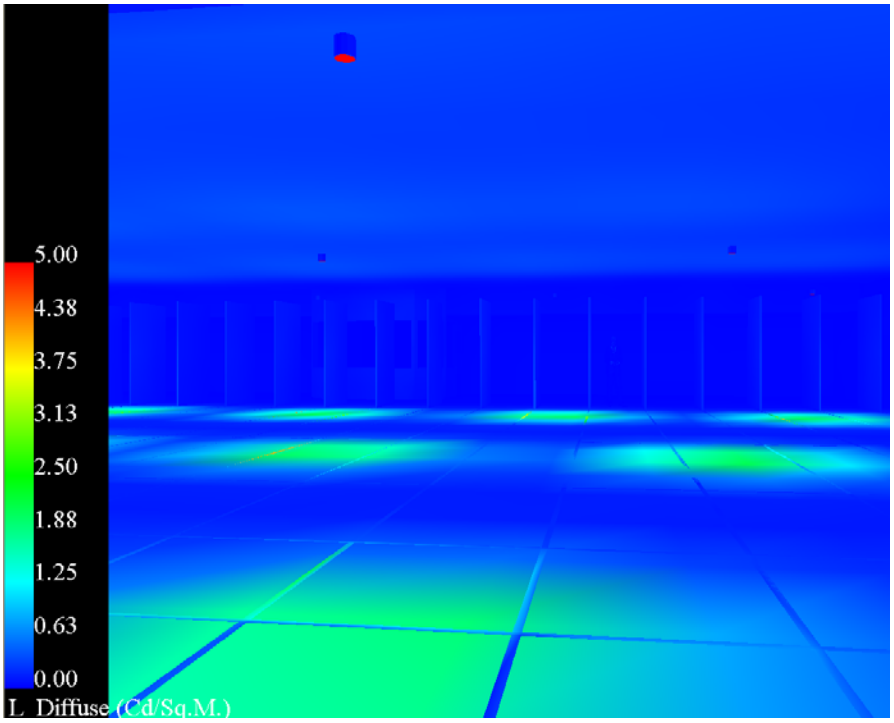
Performance Data

Night Time Exterior

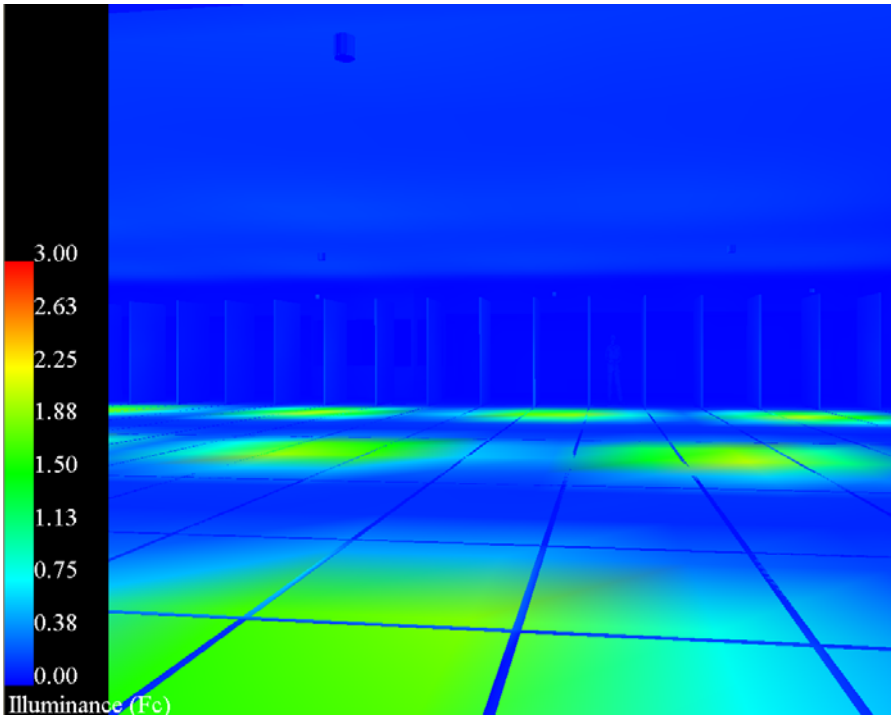
Illuminance Isolines



Pseudo-Color Luminance



Pseudo-Color Illuminance



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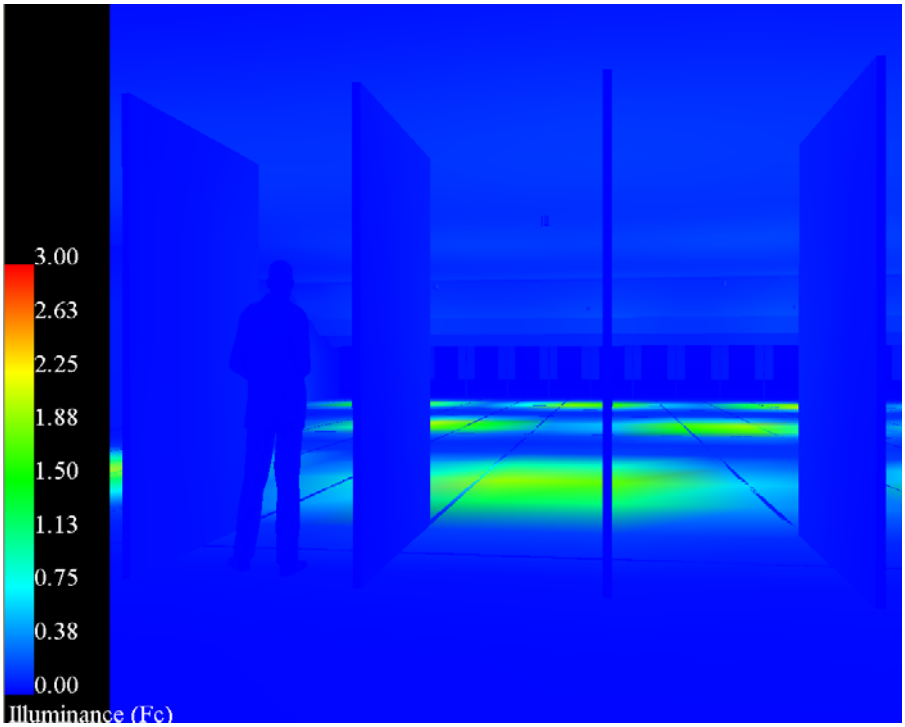

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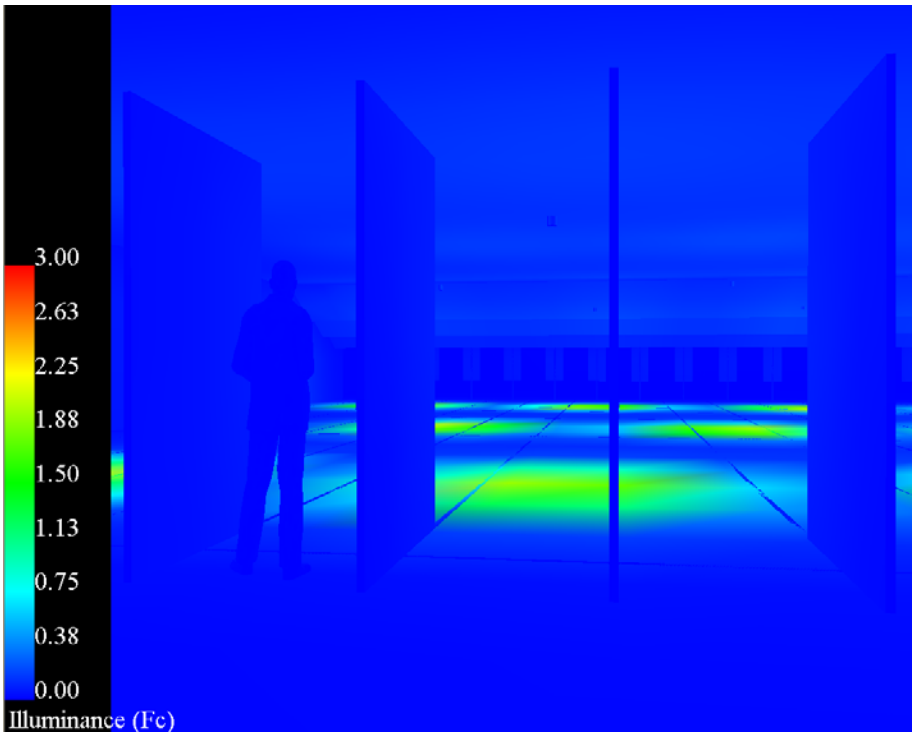

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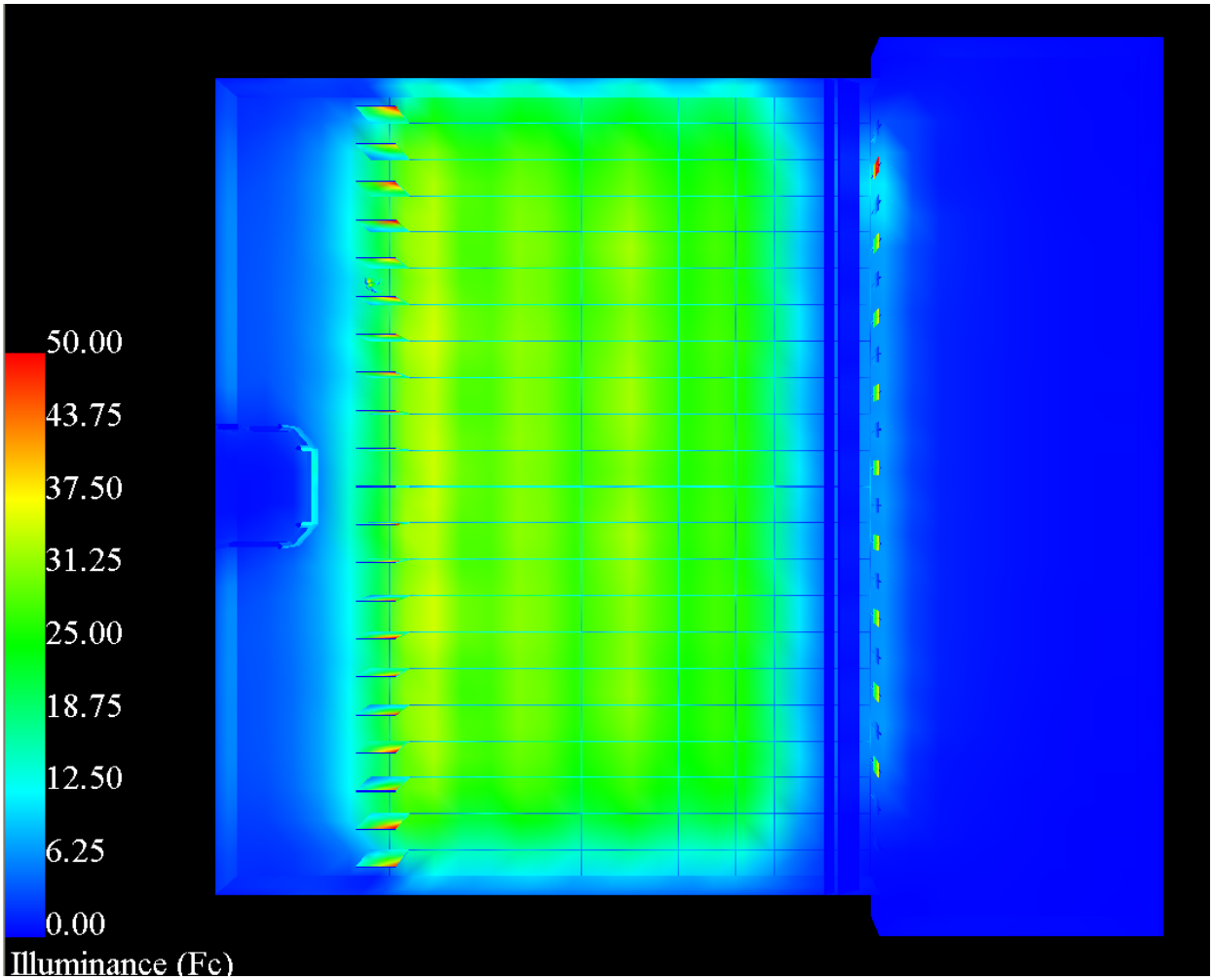


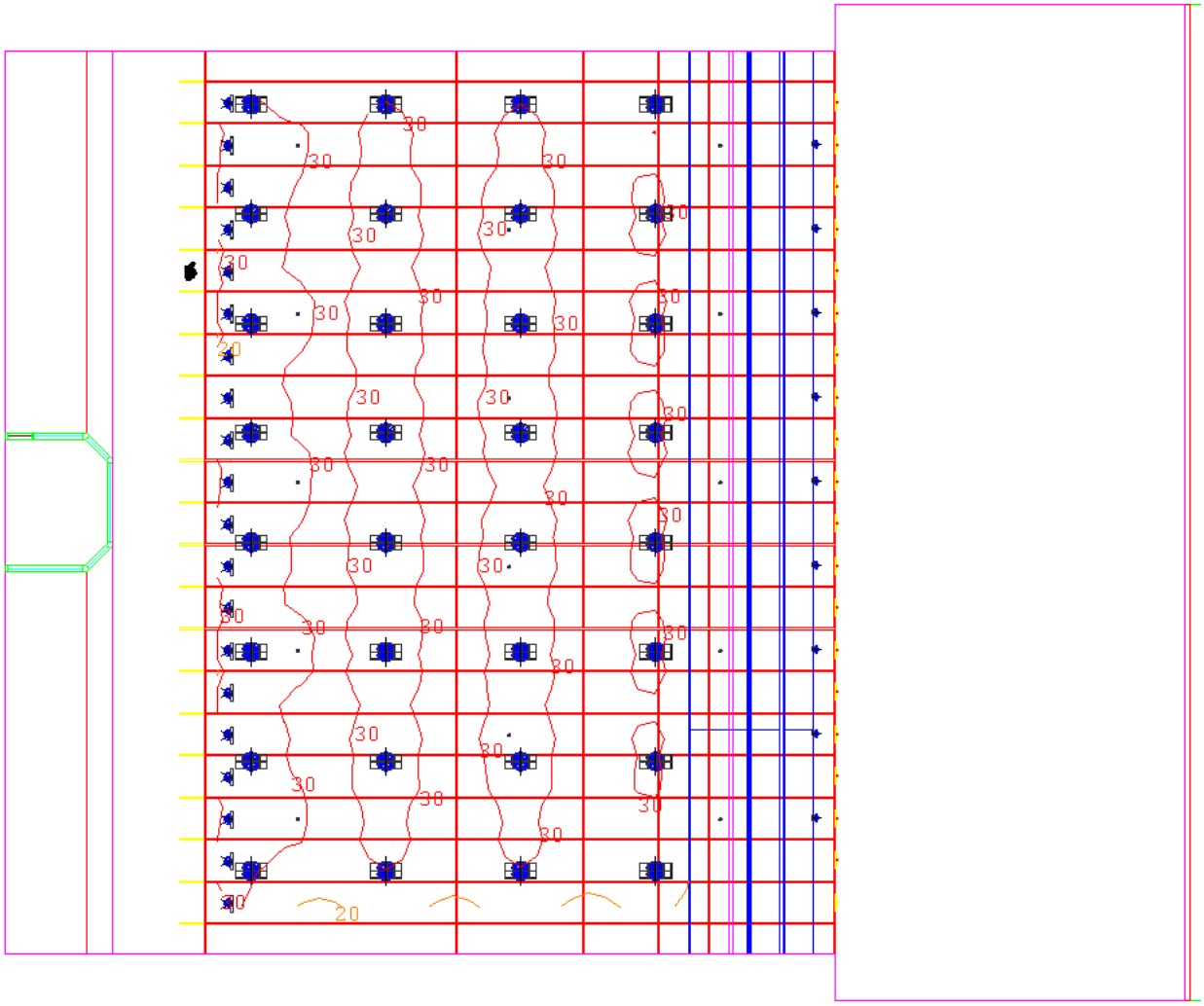
Renderings

Project_1
Calc Pts

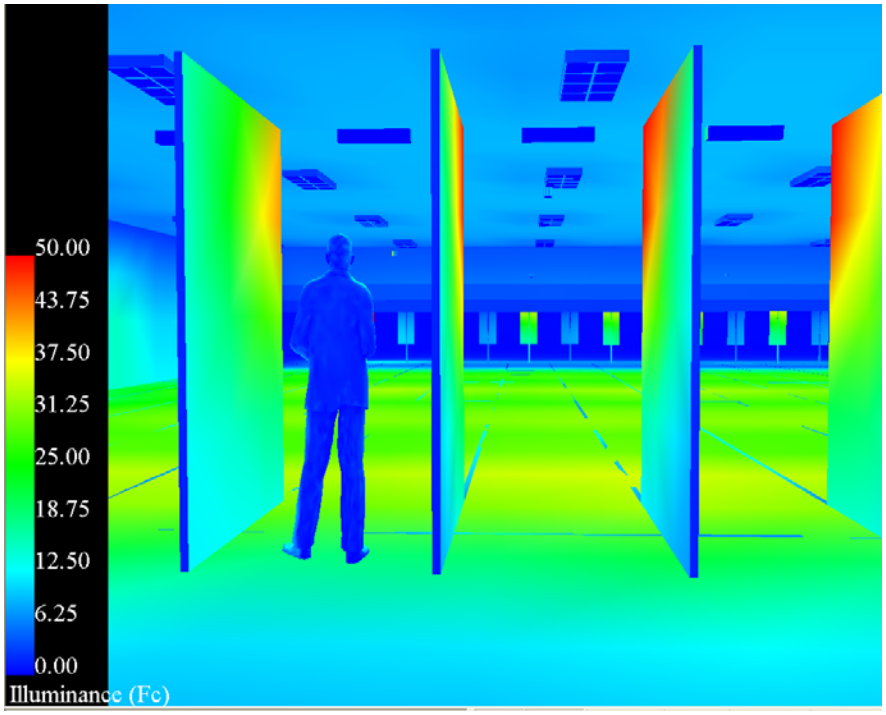
Lanes Floor
Illuminance Values(Fc)
Average=0.46 Maximum=5.7
Minimum=0.0 Avg/Min=N.A.
Max/Min=N.A.

Glare Condition

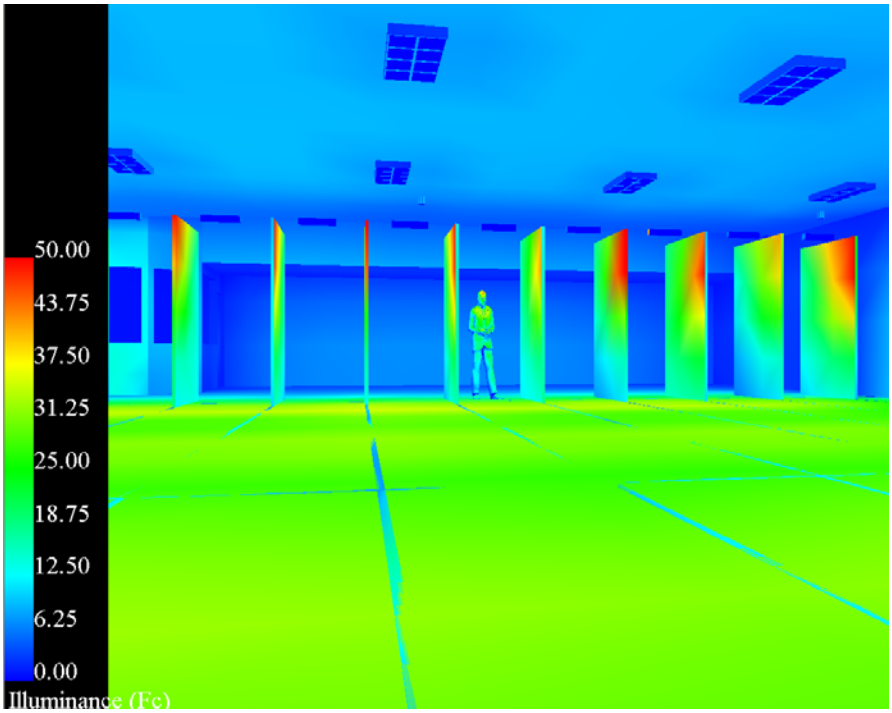
Illuminance Isolines



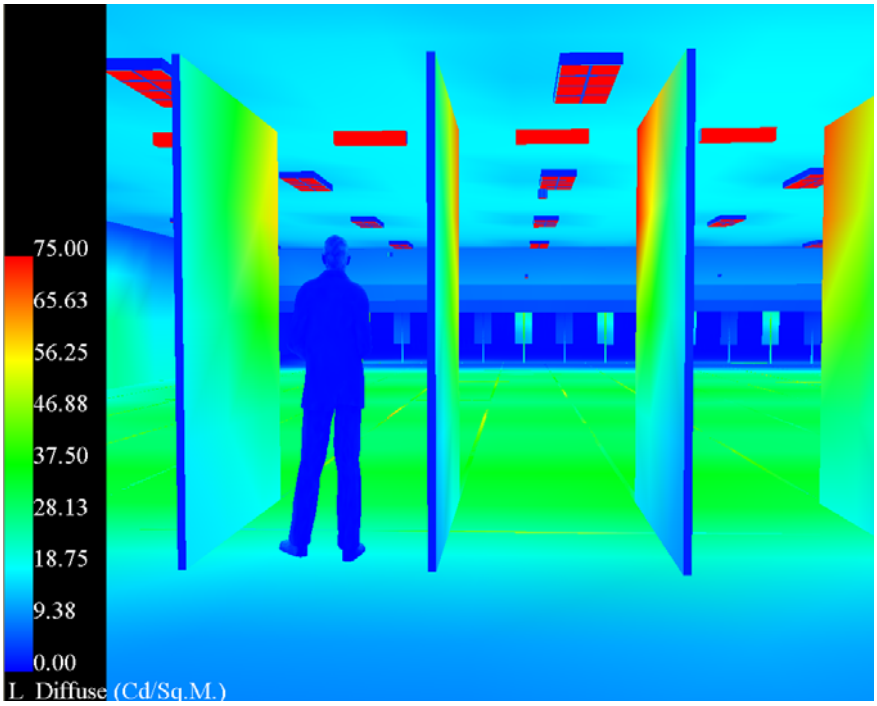
Pseudo-Color Illuminance



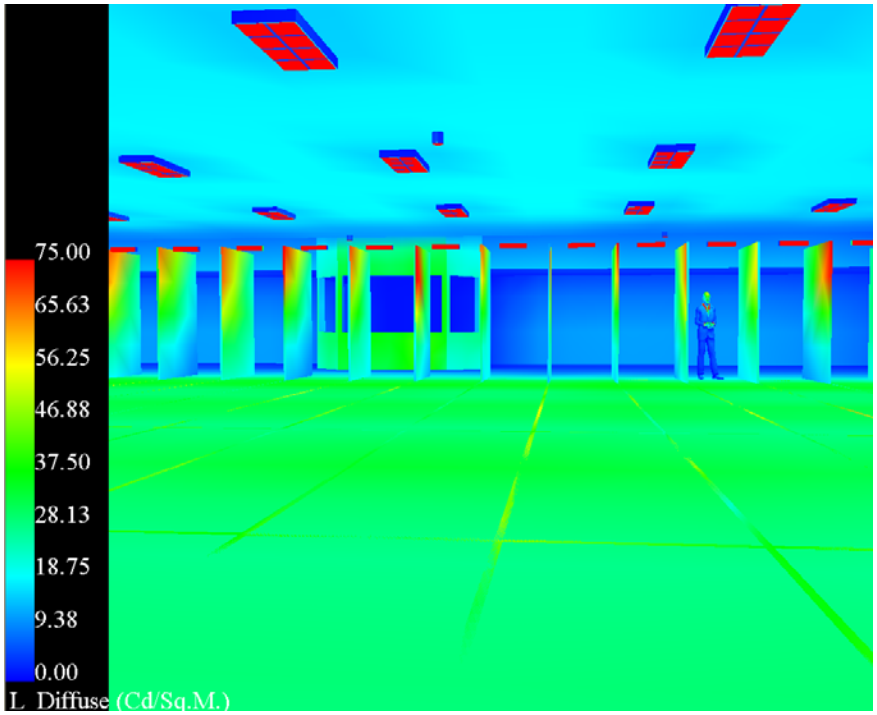
Pseudo-Color Illuminance



Pseudo-Color Luminance



Pseudo-Color Luminance



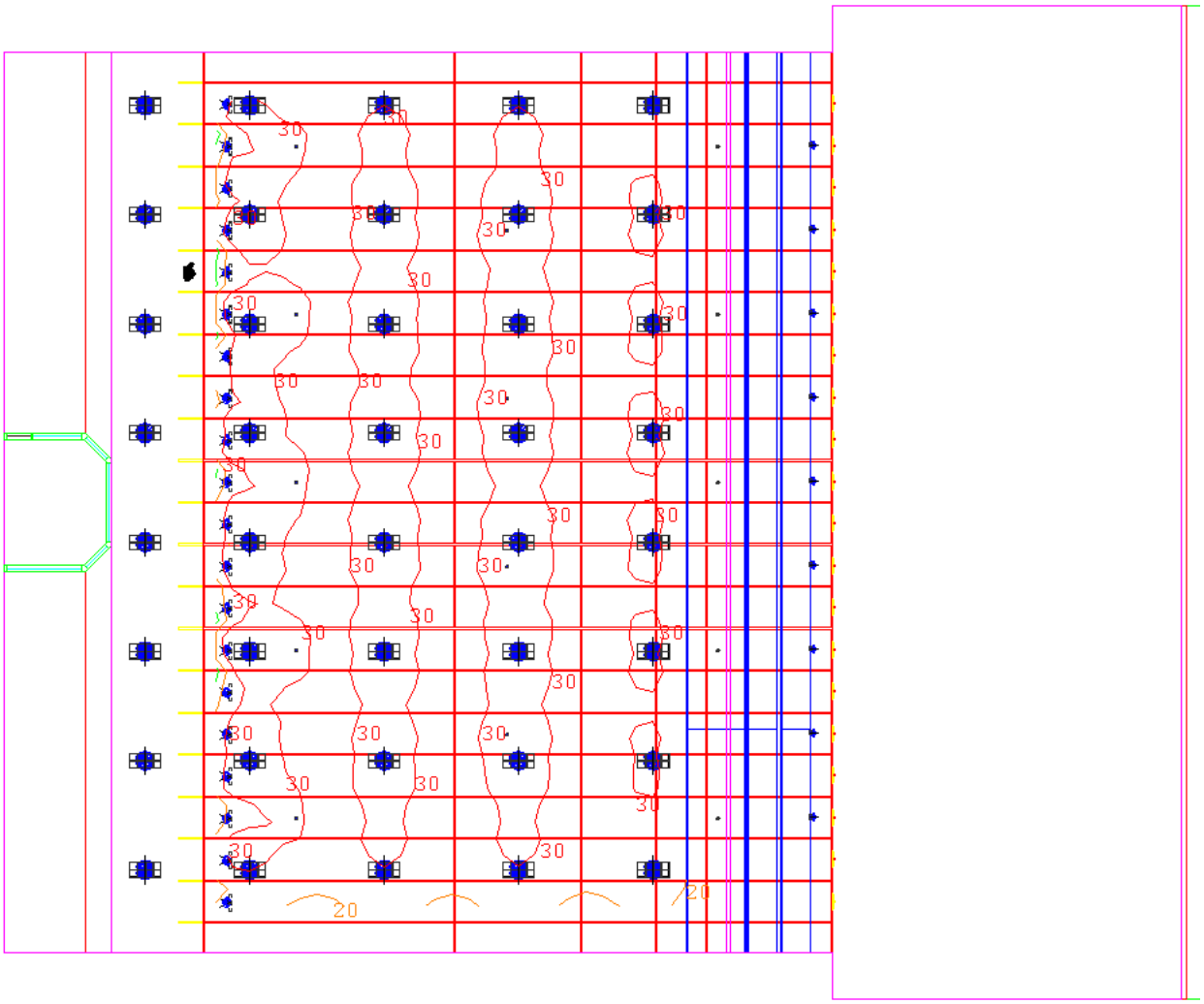
Renderings

Project_1
Calc Pts

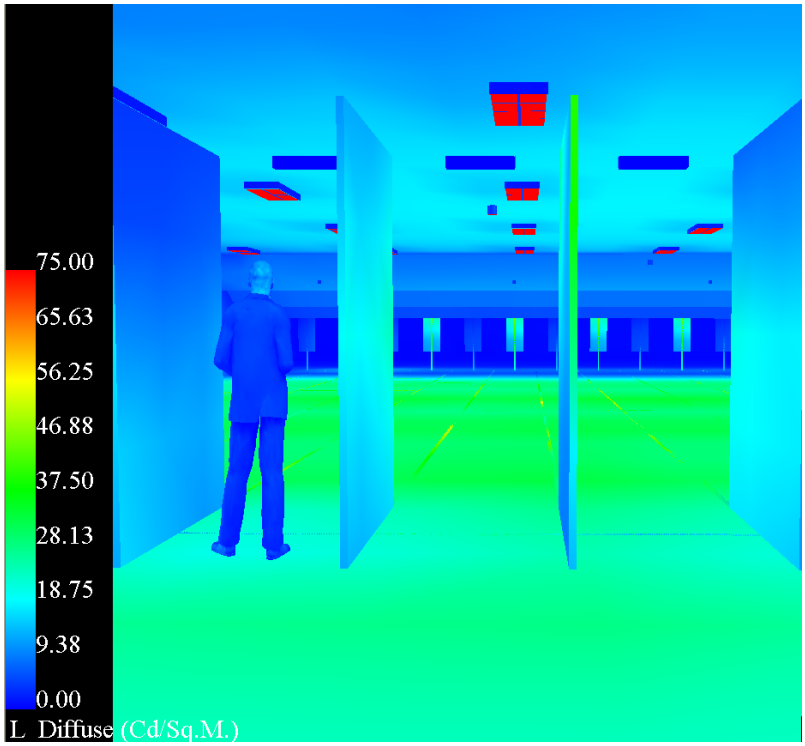
Lanes Floor
Illuminance Values(Fc)
Average=29.89 Maximum=48.8
Minimum=17.0 Avg/Min=1.76
Max/Min=2.87

Normal Interior Conditions

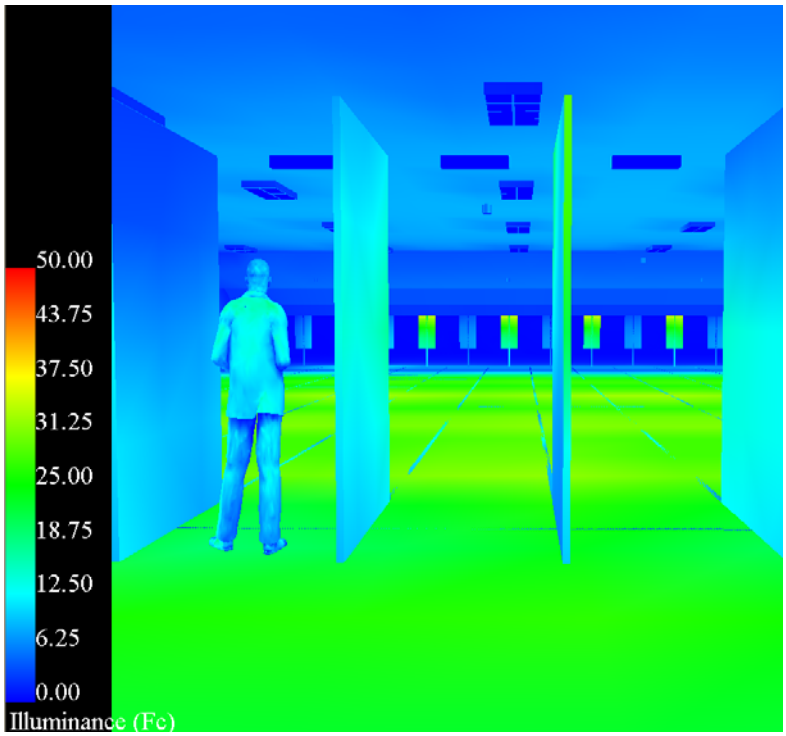
Illuminance Isolines



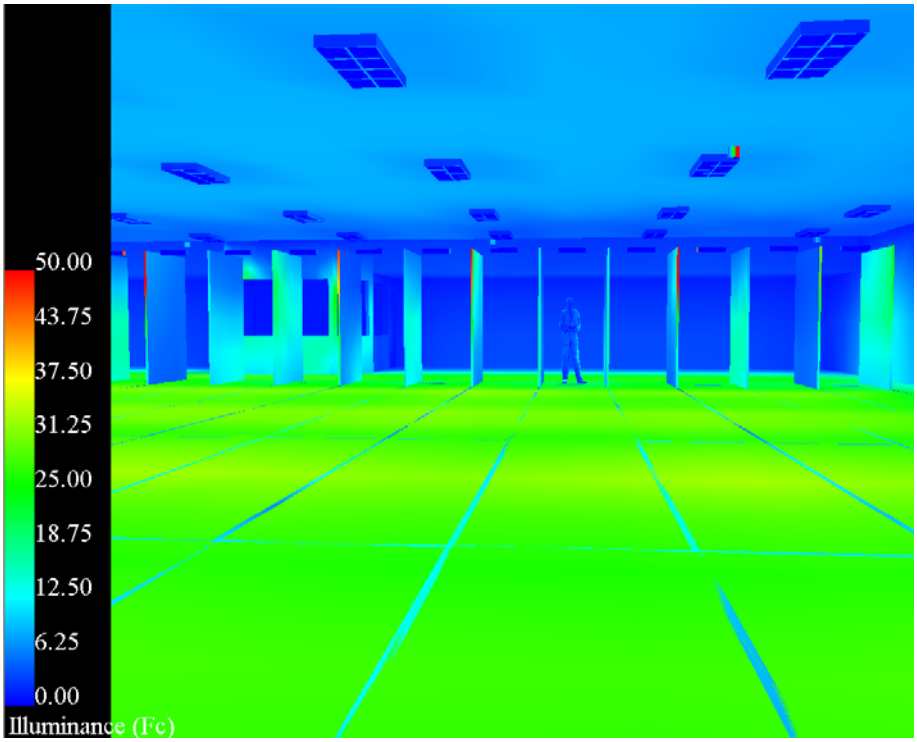
Pseudo-Color Illuminance



Pseudo-Color Illuminance



Pseudo-Color Illuminance



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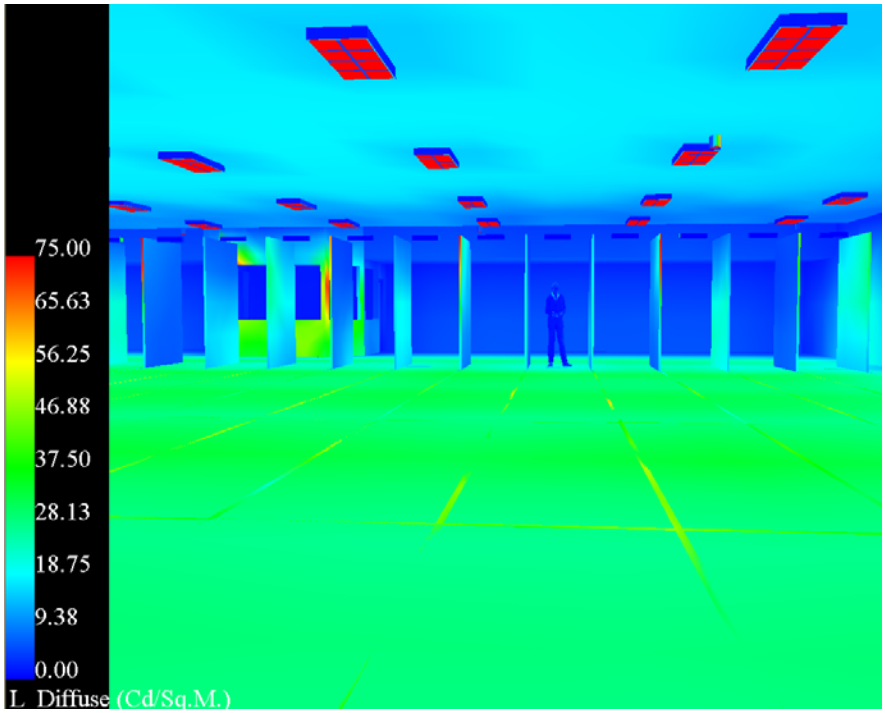

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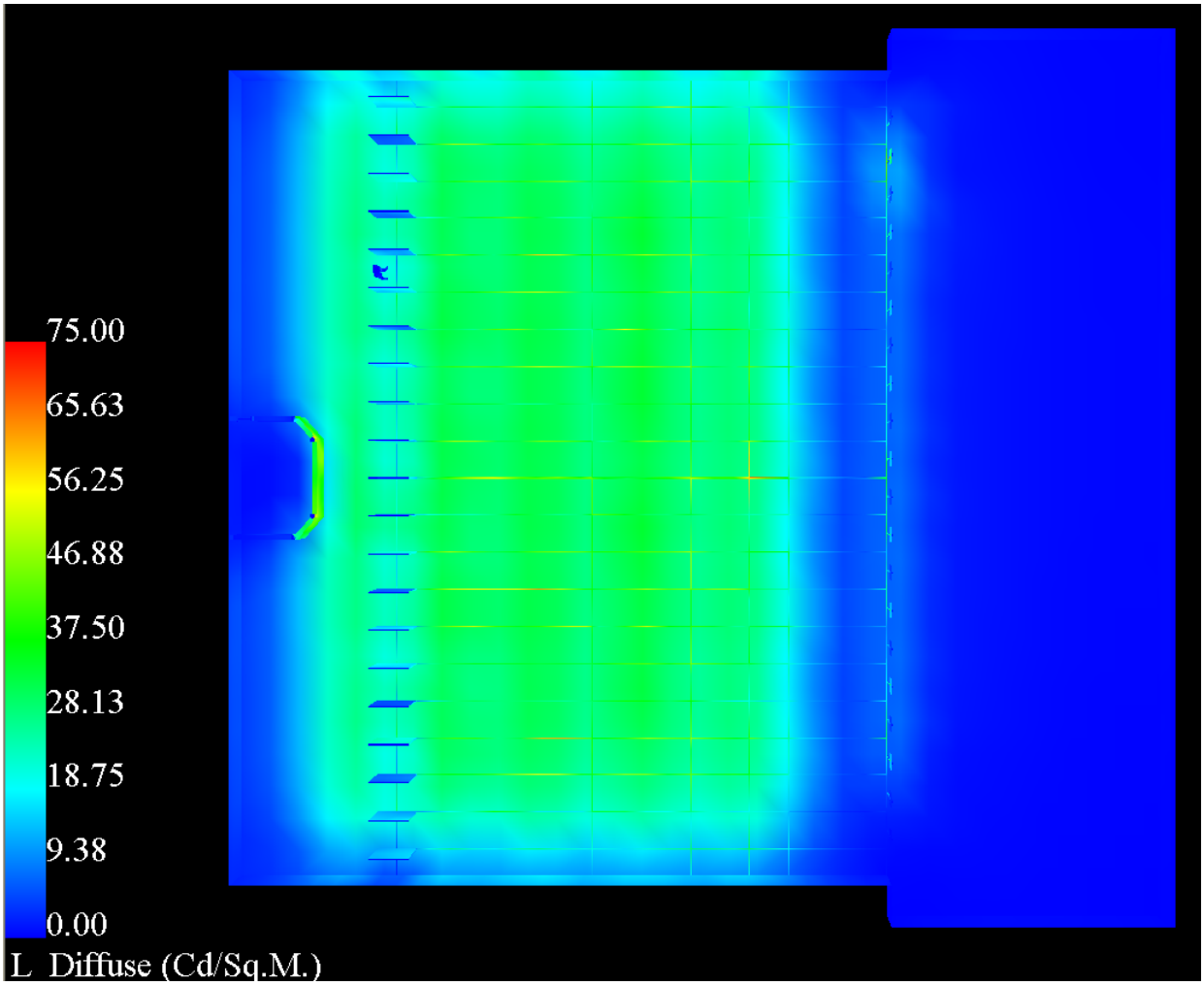


Rendering

Project 1
Calc Pts

Lanes Floor
Illuminance Values(Fc)
Average=28.64 Maximum=37.8
Minimum=4.5 Avg/Min=6.36
Max/Min=8.40

Front Façade and Entrance Canopy

Introduction

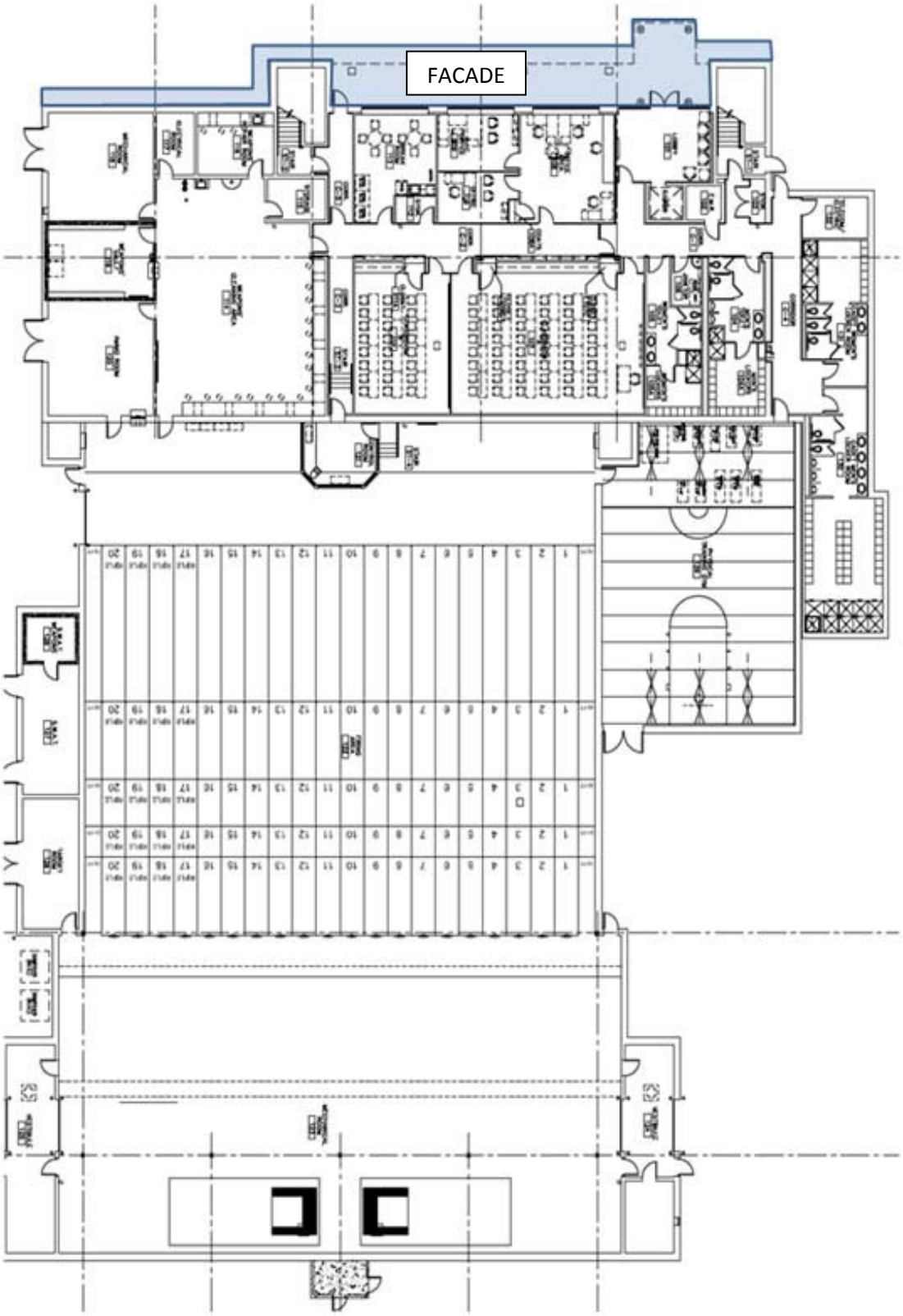
Stretching 153'-0" in length and 30'-0" in height, the façade has several different materials and architectural elements. The basic façade is comprised of sections of ground face CMU and split face CMU. There is a roof cover at the first floor level which is made of standing seam metal. Window trim and finishes are pre-finished aluminum and there are two pre-cast concrete logos, one at either end of the façade. All exterior lighting will be controlled by photocells. Primary occupancy will occur during the day, however, for security and surveillance purposes and for the low amounts of evening traffic that will occur, an adequately lighted exterior is important.

Materials & Reflectances

Split-Face CMU
Reflectance = 0.6

Ground Face CMU
Reflectance = 0.45

Layout



Summary of Design Criteria / Design Approach

Sense of Direction

The main canopy and entrance should be well lighted so that it can easily be determined where one should enter the facility. Higher light levels will inherently lead people in the desired direction.

Points of interest

The precast concrete logos can become a focal point of the building façade when illuminated at night. In this way, the building becomes more interesting and pleasant.

Direct Glare

Direct glare from fixtures should avoid being carried into parking lot areas. Glare can be disabling which could lead to safety issues.

Modeling of Faces and Objects

In the nighttime hours, safety and security becomes more of a concern. Modeling of faces and objects is important for visual recognition on the surroundings by people as well as security cameras.

Light Distribution on Surfaces

The distribution of light on the façade surfaces should be non-uniform to create visual interest, a hierarchy of light should be established to create areas of light and dark. Architectural features, such as the precast logos should be highlight as one of the upper levels of the hierarchy to stand out.

Design Performance

One of the major elements of the façade is the building name. The letters of the building name are put in silhouette by washing the wall behind the letters with light. The wall outsets that are adorned with architectural precast panels displaying the Maryland Transportation Authority and the MdTA Police logos are illuminated using Color Kinetics Color Blaze LED fixtures. Recessed step lights are housed within the columns that support the entrance canopy and floodlights illuminate the arched canopy over the entrance. All exterior lighting will be controlled by photocells.

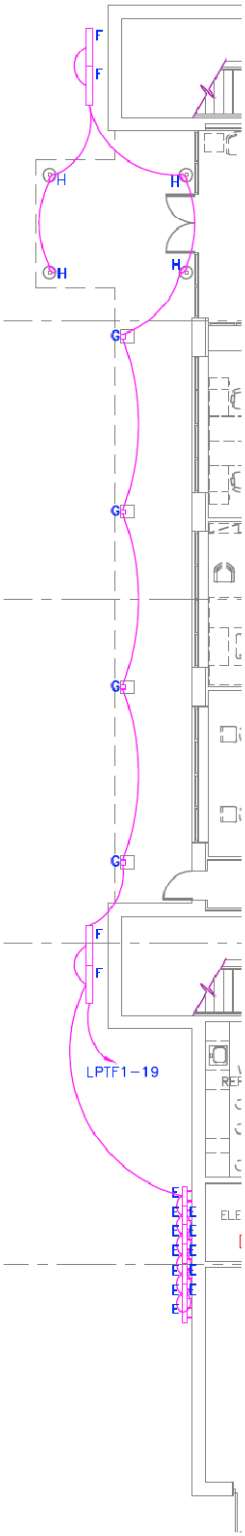
Luminaire Schedule

LUMINAIRE SCHEDULE - FAÇADE AND ENTRANCE CANOPY								
TAG	MANUFACTURER	CATALOG NUMBER	DESCRIPTION	LAMP TYPE	WATTS	# OF LAMPS	OPERATING VOLTAGE	FIXTURE INPUT WATTS
E	WINDIRECT	P2 - SSW - 148T5 - 277V - SCK1 - SGW -	WALLWASH	T5	28	1	277	33
F	COLOR KINETICS	116-000016-00	COLOR BLAZE	LED	240	---	277	240
G	ERCO	44553.023	STEP LIGHT	CFL-TR	9	1	277	12
H	COLOR KINETICS	123-000005-00	CANOPY	LED	50	---	277	50

Light Loss Factors

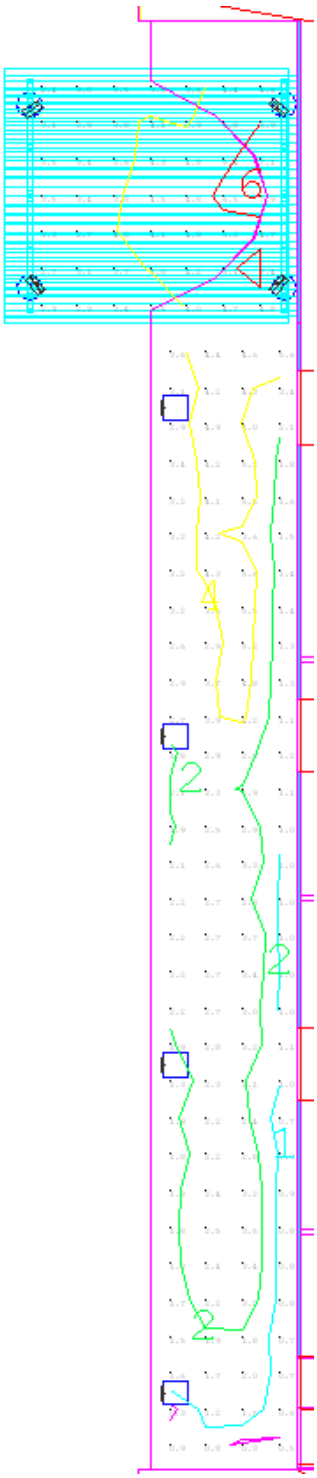
LIGHT LOSS FACTORS - FRONT FAÇADE AND ENTRANCE CANOPY									
LUMINAIRE DESIGNATION	MAINTENANCE CATEGORY	ROOM ATMOSPHERE	CLEANING INTERVAL	INITIAL LUMENS	MEAN LUMENS	BALLAST FACTOR	LLD	LDD	LLF
E	IV	DIRTY	12 MONTH	5000	4650	1.04	0.93	0.72	**0.696**
F	IV	DIRTY	12 MONTH	2282	---	1	0.90	0.72	**0.648**
G	VI	DIRTY	12 MONTH	580	599	0.94	1.03	0.74	**0.718**
H	IV	DIRTY	12 MONTH	597	---	1	0.90	0.72	**0.648**

Floor plan

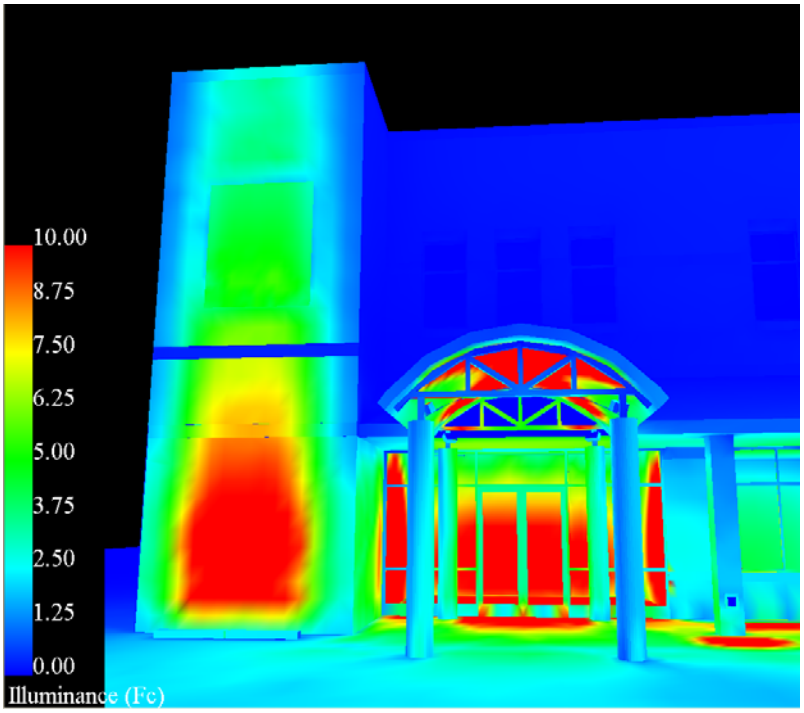


Performance Data

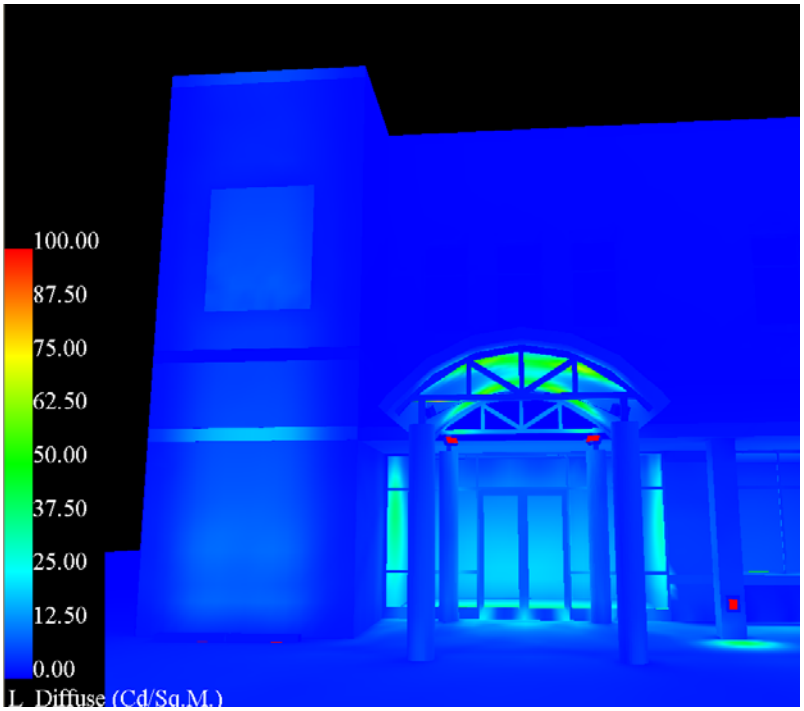
Illluminance Isolines



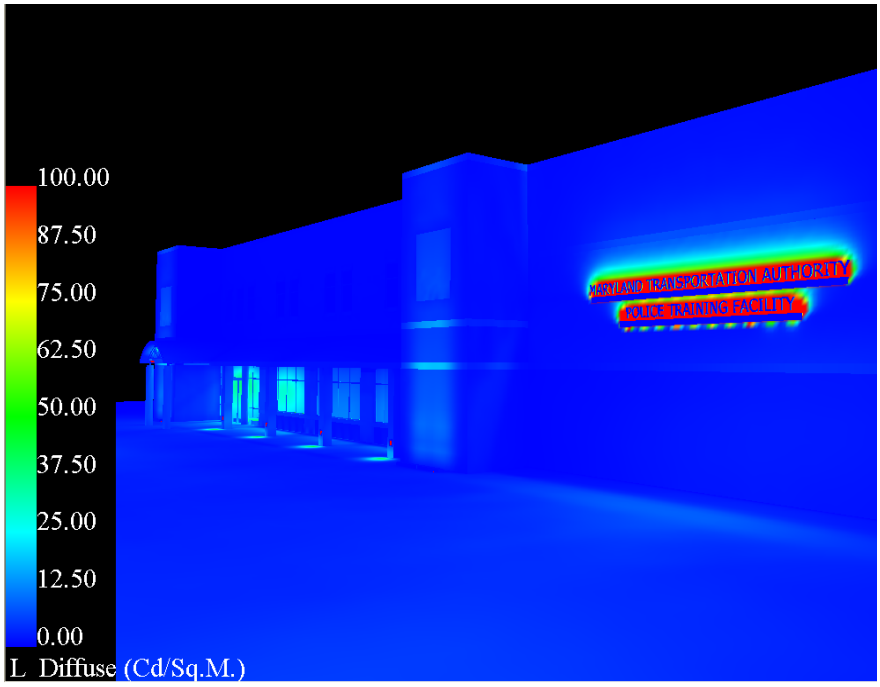
Psuedo-Color Illuminance



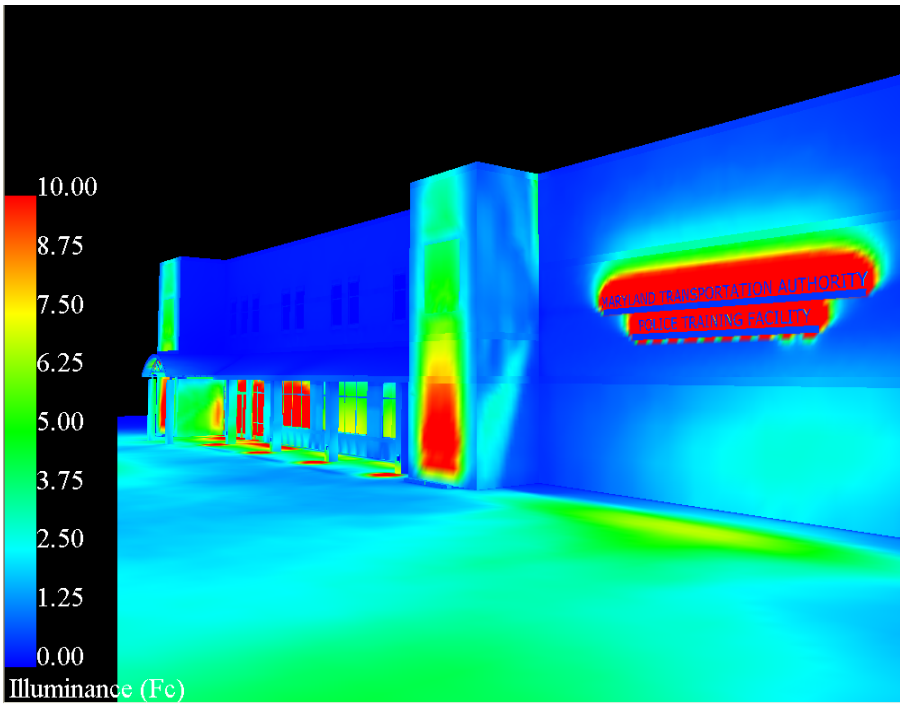
Psuedo-Color Luminance



Psuedo-Color Luminance



Psuedo-Color Illuminance



Renderings


MARYLAND TRANSPORTATION AUTHORITY
POLICE TRAINING FACILITY


MARYLAND
TRANSPORTATION
AUTHORITY
POLICE

Electrical Depth

Electrical service for the Maryland Transportation Authority Police Training Facility is fed from an existing BG&E 13.8 kv primary overhead 3-phase lines. A 1600 amp, 480 volt, 3phase, 4-wire switchboard will be provided at the service entrance. The main switchboard will serve panels rated at 480Y/277, which will power mechanical equipment, luminaires, and stepdown transformers to feed appliance and special lighting panels serving 120 volt loads, including receptacles. A dedicated panel will provide power to the exit signs, the exit or night lights, the elevator cab and machine room lights, and the security and fire alarm systems. Emergency power is supplied by a 480 kW generator at 480/277 volts during power failures.

Based on the lighting redesign of Classroom 'A', the physical training facility, the front façade and entrance canopy, and the firing range, the electrical system was re-examined and changes were made to panelboard schedules and feeder sizes as appropriate. The new lighting loads were used to update panelboard schedules and balance the loads on the three phases. Voltage drop also was calculated to ensure that no more than 3% voltage drop was experience for the branch circuits. The resulting panelboards and calculations are included in this electrical depth.

Similarly, the electrical system required updating to meet the changes established in the mechanical breadth. The air-handling units servicing the firing range were resized as part of the mechanical breadth. The new loads were applied to the panelboards. Updated panelboards and appropriate calculations are shown in this section.

A cost analysis of energy-efficient transformers versus standard transformers that were designated in the original design was performed. The analysis examines both initial costs and long-term operating costs and a resulting payback period was established. Also included is a description of the differences between energy-effficient and standard transformers and the advantages of one over the other.

Overcurrent protection device coordination and short circuit current were examined through a protection device analysis. A single path through the electrical distribution system was analyzed to determine its effectiveness.

Classroom 'A'

Classroom 'A' is the largest classroom space in the Maryland Transportation Authority Police Training Facility. Classroom 'A' has dimensions of 30'-8" by 40'-7". The intended use of this space is for instructional lectures, training classes, and large meetings. Each classroom is equipped with a 16' whiteboard, an 8' tack board with continuous display rail, a wall-mounted 27" TV, an 8' wide projection screen, and a 16' long countertop with base cabinets and wall shelving above.

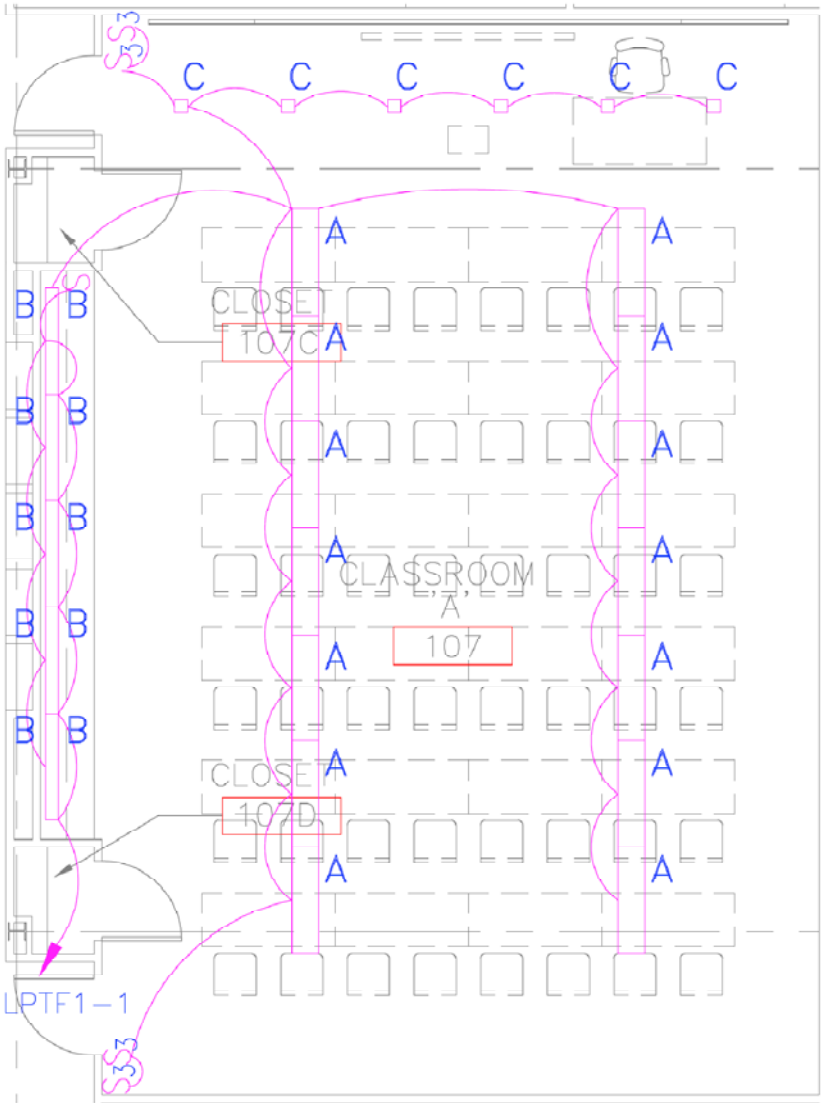
The lighting redesign consists of three different elements: general ambient lighting, cabinet-mounted fixtures, and square downlights across the front of the room. General ambient lighting is provided by suspended by semi-indirect fixtures oriented from lengthwise so as not to interfere with the projector and screen system. Cabinet-mounted fixtures provide a peripheral emphasis, with fixtures under the upper cabinet units providing task lighting for the counter surface and fixtures above the upper cabinet units heightening the space.

Lutron's Radio Touch Wireless Lighting Controls system fits the control needs of the lighting redesign. The control system provides flexibility and energy savings through the use of wireless radio signals communicating with and dimming the luminaries to create scenes. The following three preset scenes will be programmed into the Radio Touch system:

1) Audio/Visual Presentation Scene
2) Lecturing Scene
3) Examination Scene

Projection screen and equipment can be integrated into the controls system. Occupancy sensors will also need to be included and integrated in the system to meet the automated shutoff requirements.

Layout of Fixtures



Fixture Schedule

LUMINAIRE SCHEDULE - CLASSROOM 'A'								
TAG	MANUFACTURER	CATALOG NUMBER	DESCRIPTION	LAMP TYPE	WATTS	# OF LAMPS	OPERATING VOLTAGE	FIXTURE INPUT WATTS
A	PEERLESS	PRM4-1 54HO R12 277	SUSPENDED SEMI-INDIRECT	T5	54	1	277	88.5
B	LITHONIA	UC 42K 277	UNDERCABINET FIXTURE	T5	13	2	277	28
C	GOTHAM LIGHTING	SQF 1/32TRT 6AR 277	SQUARE DOWNLIGHT	CFL - TR	32	1	277	38

Original Panelboard Schedule

PANELBOARD SCHEDULE

VOLTAGE	480/277		TAG						TYPE PANEL	LTG		
MOUNTING	SURFACE		LPTF1						MIN AIC	30K		
SIZE/TYPE BUS	100A		LOCATION						REMARKS			
SIZE/TYPE MAINS	100A		ELEC RM									
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
LTG	103, 104, 105, 106	770.0	20	1	*			2	20	1240.0	217, 216, 215, 214	LTG
LTG	107, 111	2500.0	20	3		*		4	20	900.0	221, 220	LTG
LTG	CORR, LOBBY	1900.0	20	5			*	6	20	2700.0	218, 219, 211, 213	LTG
LTG	ELEV RM	70.0	20	7	*			8	20	900.0	CORR	LTG
LTG	113, 109, 110, 108	1900.0	20	9		*		10	20	1400.0	212, 210, 209, 201, 202, 203	LTG
LTG	114, 115, 116	2400.0	20	11			*	12	20	2400.0	207, 208	LTG
LTG	117, 118, 119, 120	720.0	20	13	*			14	20	800.0	204, 205, 206	LTG
LTG	STAIR & CORR NIGHT	1000.0	20	15		*		16	20	2240.0	GYM	LTG
LTG	WEAPONS CLEANING COUNTER	1000.0	20	17			*	18	20	750.0	130	LTG
LTG	EXTERIOR	890.0	20	19	*			20	20	500.0	131	LTG
LTG	ELEV PIT	100.0	20	21		*		22	20	390.0	CORR C-4	LTG
SPARE			20	23			*	24	20			SPARE
SPARE			20	25	*			26	20			SPARE
SPARE			20	27		*		28	20			SPARE
SPARE			20	29			*	30	20			SPARE
SUB-TOTAL	A PHASE	5890.0		B PHASE						10430.0	C PHASE	11150.0
TOTAL CONNECTED LOAD (WATTS)		27470.0		DEMAND LOAD						34337.5	REQUIRED AMPACITY	41.3

New Panelboard Schedule

PANELBOARD SCHEDULE

VOLTAGE	480/277		TAG						TYPE PANEL	LTG		
MOUNTING	SURFACE		LPTF1						MIN AIC	30K		
SIZE/TYPE BUS	100A		LOCATION						REMARKS			
SIZE/TYPE MAINS	100A		ELEC RM									
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
LTG	107	2953.0	20	1	*			2	20	1240.0	217, 216, 215, 214	LTG
LTG	103, 104, 105, 106	770.0	20	3		*		4	20	900.0	221, 220	LTG
LTG	CORR, LOBBY	1900.0	20	5			*	6	20	2700.0	218, 219, 211, 213	LTG
LTG	ELEV RM	70.0	20	7	*			8	20	900.0	CORR	LTG
LTG	114, 115, 116	2400.0	20	9		*		10	20	1400.0	212, 210, 209, 201, 202, 203	LTG
LTG	113, 109, 110, 108	1900.0	20	11			*	12	20	2400.0	207, 208	LTG
LTG	117, 118, 119, 120	720.0	20	13	*			14	20	800.0	204, 205, 206	LTG
LTG	STAIR & CORR NIGHT	1000.0	20	15		*		16	20	2393.0	GYM	LTG
LTG	WEAPONS CLEANING COUNTER	1000.0	20	17			*	18	20	750.0	130	LTG
LTG	EXTERIOR	3468.0	20	19	*			20	20	500.0	131	LTG
LTG	ELEV PIT	100.0	20	21		*		22	20	390.0	CORR C-4	LTG
SPARE			20	23			*	24	20			SPARE
SPARE			20	25	*			26	20			SPARE
LTG	111	1612.0	20	27		*		28	20			SPARE
SPARE			20	29			*	30	20			SPARE
SUB-TOTAL	A PHASE	10651.0		B PHASE						10965.0	C PHASE	10650.0
TOTAL CONNECTED LOAD (WATTS)		32266.0		DEMAND LOAD						40332.5	REQUIRED AMPACITY	48.5

PANEL LPTF1 - CKT 3			
TAG	QUANTITY	AMPS / FIXTURE	AMPS
A	14	0.53	7.42
B	10	0.24	2.4
C	6	0.14	0.84
VOLTAGE	277	TOTAL AMPS	10.66
VA			2953

PANEL LPTF1 - CKT 27			
TAG	QUANTITY	AMPS / FIXTURE	AMPS
A	6	0.53	3.18
B	4	0.24	0.96
C	12	0.14	1.68
VOLTAGE	277	TOTAL AMPS	5.82
VA			1612

New Feeder Size

Panelboard LPTF1 is fed with (4) #8 AWG & (1) #8 AWG ground in 3/4" conduit.

Voltage Drop

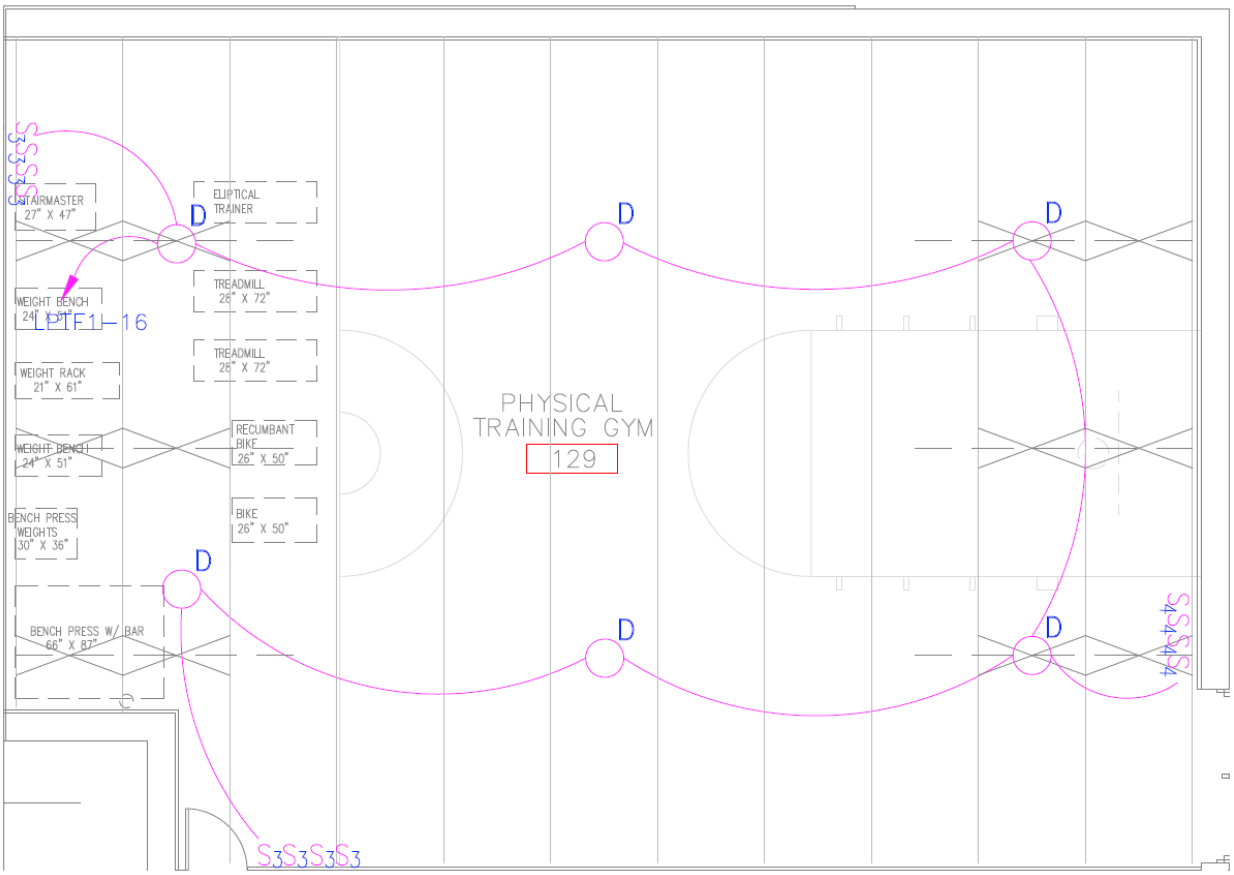
PANEL LPTF1 - CKT 1	
Voltage	277
PF	0.98
Length	160
Wire Size	#12
$V_{drop/(1000A*ft)}$	1.9
Current (A)	10.66
Single Phase Mult.	2
$V_{drop/(L-N)}$	6.481
% V_{drop}	2.34

Physical Training Gymnasium

The gymnasium will be used for scheduled classes in self-defense as well as personal training with exercise and weight-lifting equipment. A small half-court basketball set-up is included for pick-up games in the evenings and weekends. Measuring approximately 41' by 59', the gymnasium is the only space in the facility will exposed structural trusses. The space also has wall padding covering CMU walls for safety.

The luminaire selected for the physical training gymnasium makes use of eight compact fluorescent lamps. The luminaries provide the traditional look of gymnasium low-bay HID fixtures with the instant-start advantage of fluorescents. Various light output levels can be achieved by allowing for individual lamp switching. This type of switching can be executed with multiple wall switches and does not require a complicated control system.

Layout of Fixtures



Luminaire Schedule

LUMINAIRE SCHEDULE - GYMNASIUM								
TAG	MANUFACTURER	CATALOG NUMBER	DESCRIPTION	LAMP TYPE	WATTS	# OF LAMPS	OPERATING VOLTAGE	FIXTURE INPUT WATTS
D	SPORTLITE	LX800 T42 22LEXCP 277	CFL HIGH BAY	CFL -TR	42	8	277	392

Original Panelboard Schedule

PANELBOARD SCHEDULE

VOLTAGE	480/277		TAG						TYPE PANEL	LTG		
MOUNTING	SURFACE		LPTF1						MIN AIC	30K		
SIZE/TYPE BUS	100A		LOCATION						REMARKS			
SIZE/TYPE MAINS	100A		ELEC RM									
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
LTG	103, 104, 105, 106	770.0	20	1	*			2	20	1240.0	217, 216, 215, 214	LTG
LTG	107, 111	2500.0	20	3		*		4	20	900.0	221, 220	LTG
LTG	CORR, LOBBY	1900.0	20	5			*	6	20	2700.0	218, 219, 211, 213	LTG
LTG	ELEV RM	70.0	20	7	*			8	20	900.0	CORR	LTG
LTG	113, 109, 110, 108	1900.0	20	9		*		10	20	1400.0	212, 210, 209, 201, 202, 203	LTG
LTG	114, 115, 116	2400.0	20	11			*	12	20	2400.0	207, 208	LTG
LTG	117, 118, 119, 120	720.0	20	13	*			14	20	800.0	204, 205, 206	LTG
LTG	STAIR & CORR NIGHT	1000.0	20	15		*		16	20	2240.0	GYM	LTG
LTG	WEAPONS CLEANING COUNTER	1000.0	20	17			*	18	20	750.0	130	LTG
LTG	EXTERIOR	890.0	20	19	*			20	20	500.0	131	LTG
LTG	ELEV PIT	100.0	20	21		*		22	20	390.0	CORR C-4	LTG
SPARE			20	23			*	24	20			SPARE
SPARE			20	25	*			26	20			SPARE
SPARE			20	27		*		28	20			SPARE
SPARE			20	29			*	30	20			SPARE
SUB-TOTAL	A PHASE	5890.0		B PHASE						10430.0	C PHASE	11150.0
TOTAL CONNECTED LOAD (WATTS)		27470.0		DEMAND LOAD						34337.5	REQUIRED AMPACITY	41.3

New Panelboard Schedule

PANELBOARD SCHEDULE

VOLTAGE	480/277		TAG						TYPE PANEL	LTG		
MOUNTING	SURFACE		LPTF1						MIN AIC	30K		
SIZE/TYPE BUS	100A		LOCATION						REMARKS			
SIZE/TYPE MAINS	100A		ELEC RM									
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
LTG	107	2953.0	20	1	*			2	20	1240.0	217, 216, 215, 214	LTG
LTG	103, 104, 105, 106	770.0	20	3		*		4	20	900.0	221, 220	LTG
LTG	CORR, LOBBY	1900.0	20	5			*	6	20	2700.0	218, 219, 211, 213	LTG
LTG	ELEV RM	70.0	20	7	*			8	20	900.0	CORR	LTG
LTG	114, 115, 116	2400.0	20	9		*		10	20	1400.0	212, 210, 209, 201, 202, 203	LTG
LTG	113, 109, 110, 108	1900.0	20	11			*	12	20	2400.0	207, 208	LTG
LTG	117, 118, 119, 120	720.0	20	13	*			14	20	800.0	204, 205, 206	LTG
LTG	STAIR & CORR NIGHT	1000.0	20	15		*		16	20	2393.0	GYM	LTG
LTG	WEAPONS CLEANING COUNTER	1000.0	20	17			*	18	20	750.0	130	LTG
LTG	EXTERIOR	890.0	20	19	*			20	20	500.0	131	LTG
LTG	ELEV PIT	100.0	20	21		*		22	20	390.0	CORR C-4	LTG
SPARE			20	23			*	24	20			SPARE
SPARE			20	25	*			26	20			SPARE
LTG	111	1612.0	20	27		*		28	20			SPARE
SPARE			20	29			*	30	20			SPARE
SUB-TOTAL	A PHASE	8073.0		B PHASE						10965.0	C PHASE	10650.0
TOTAL CONNECTED LOAD (WATTS)		29688.0		DEMAND LOAD						37110.0	REQUIRED AMPACITY	44.7

PANEL LPTF1 - CKT 16			
TAG	**QUANTITY**	**AMPS / FIXTURE**	**TOTAL AMPS**
D	6	1.44	8.64
VOLTAGE	277	TOTAL AMPS	8.64
VA			2393

New Feeder Size

Panelboard LPTF1 is fed with (4) #8 AWG & (1) #8 AWG ground in 3/4" conduit.

Voltage Drop

PANEL LPTF1 - CKT 16	
Voltage	277
PF	0.98
Length	215
Wire Size	#12
$V_{drop/(1000A*ft)}$	1.9
Current (A)	9.64
Single Phase Mult.	2
$V_{drop/(L-N)}$	7.876
% V_{drop}	2.84

Firing Range Area

The firing range is approximately 100' by 110'. Training is the main theme and so lighting systems that simulate realistic scenerios designed. Three major cases exist: (1) an exterior night condition with too little light, (2) a glare condition with too much light, and (3) a condition to simulate normal interior conditions. A DALI system was selected to control the lighting for the range.

Luminaire Schedule

LUMINAIRE SCHEDULE - FAÇADE AND ENTRANCE CANOPY								
TAG	MANUFACTURER	CATALOG NUMBER	DESCRIPTION	LAMP TYPE	WATTS	# OF LAMPS	OPERATING VOLTAGE	FIXTURE INPUT WATTS
I	ERCO	73753.023	DOWNLIGHT	HALOGEN	50	1	12	50
E	WINDIRECT	P2 - SSW - 148T5 - 277V - SCK1 - SGW -	WALLWASH	T5	28	1	277	33
J	LIGHTOLIER	DPB2S18DS340	TROFFER	T8	32	3	277	91
K	ERCO	34115.023	FLOODLIGHT	T5	28	1	277	33

Original Panelboard Schedule

PANELBOARD SCHEDULE

VOLTAGE	480/277		TAG						TYPE PANEL	LTG		
MOUNTING	SURFACE		LPFR1						MIN AIC	65K		
SIZE/TYPE BUS	250A		LOCATION						REMARKS			
SIZE/TYPE MAINS	150A		ELEC RM - 124A									
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
SPARE			20	1	*			2	20	360.0	BULLET TRAP PIT	LTG
LTG	124, 124A	440.0	20	3		*		4	20	4155.0	RANGE	BULLET TRAP MOTOR 3 HP
BULLET TRAP MOTOR 3 HP	RANGE	4155.0	20	5			*	6				
				7	*			8				
				9		*		10	20	915.0	RANGE	BULLET TRAP MOTOR 1/2 HP
BULLET TRAP MOTOR 1/2 HP	RANGE	915.0	20	11			*	12				
				13	*			14				
				15		*		16	20	760.0	126, 127, 128	LTG
LTG	MECH RM 123	3380.0	20	17			*	18				SPARE
UH 5 & 5A	124, 124A	15000	20	19	*			20				SPARE
				21		*		22				SPARE
				23			*	24	20	10000.0	127, 128	UH 8 & 9
UH 6 & 7	125, 126	15000.0	20	25	*			26				
				27		*		28				
				29			*	30	50	24000.0	RANGE	LTG CONTACTOR PANEL CP
SEPTIC SYSTEM CONTROL PANEL	123	4000.0	20	31	*			32				
				33		*		34				
				35			*	36				SPACE
SPARE			20	37	*			38				SPACE
				39		*		40				SPACE
				41			*	42				SPACE
SUB-TOTAL	A PHASE	26406.7		B PHASE						27246.7	C PHASE	29426.7
TOTAL CONNECTED LOAD (WATTS)		83080.0		DEMAND LOAD						103850.0	REQUIRED AMPACITY	125.0

New Panelboard Schedule

PANEL LPFR1 - CKT 30,32,34			
TAG	**QUANTITY**	**AMPS / FIXTURE**	**TOTAL AMPS**
I	12	0.4	4.8
E	4	0.12	0.48
J	4	0.34	1.36
K	4	0.12	0.48
VOLTAGE	277	TOTAL AMPS	7.12
VA			1972

New Feeder Size

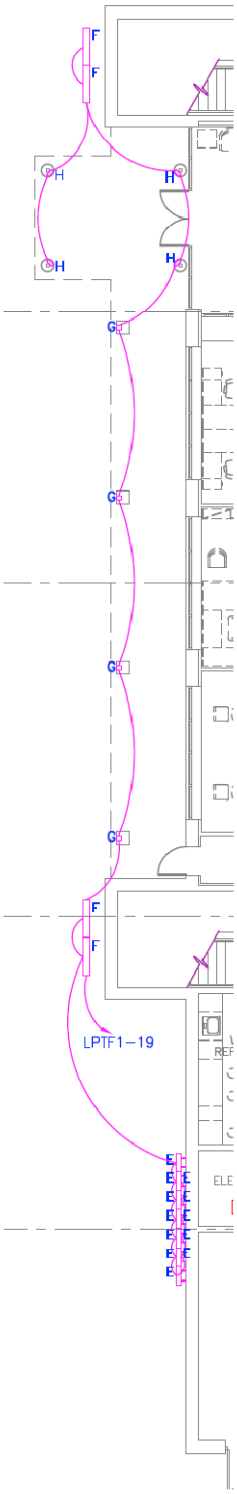
Panelboard LPTF1 is fed with (4) #8 AWG & (1) #8 AWG ground in 3/4" conduit.

Front Façade and Entry Canopy

Stretching 153'-0" in length and 30'-0" in height, the façade has several different materials and architectural elements. The basic façade is comprised of sections of ground face CMU and split face CMU. There is a roof cover at the first floor level which is made of standing seam metal. Window trim and finishes are pre-finished aluminum and there are two pre-cast concrete logos, one at either end of the façade. Primary occupancy will occur during the day, however, for security and surveillance purposes and for the low amounts of evening traffic that will occur, an adequately lighted exterior is important.

One of the major elements of the façade is the building name. The letters of the building name are put in silhouette by washing the wall behind the letters with light. The wall outsets that are adorned with architectural precast panels displaying the Maryland Transportation Authority and the MdTA Police logos are illuminated using Color Kinetics Color Blaze LED fixtures. Recessed step lights are housed within the columns that support the entrance canopy and floodlights illuminate the arched canopy over the entrance. All exterior lighting will be controlled by photocells.

Layout of Fixtures



Luminaire Schedule

LUMINAIRE SCHEDULE - FAÇADE AND ENTRANCE CANOPY								
TAG	MANUFACTURER	CATALOG NUMBER	DESCRIPTION	LAMP TYPE	WATTS	# OF LAMPS	OPERATING VOLTAGE	FIXTURE INPUT WATTS
E	WINDIRECT	P2 - SSW - 148T5 - 277V - SCK1 - SGW -	WALLWASH	T5	28	1	277	33
F	COLOR KINETICS	116-000016-00	COLOR BLAZE	LED	240	---	277	240
G	ERCO	44553.023	STEP LIGHT	CFL-TR	9	1	277	12
H	COLOR KINETICS	123-000005-00	CANOPY	LED	50	---	277	50

Original Panelboard Schedule

PANELBOARD SCHEDULE

VOLTAGE	480/277		TAG					TYPE PANEL	LTG			
MOUNTING	SURFACE		LPTF1					MIN AIC	30K			
SIZE/TYPE BUS	100A		LOCATION					REMARKS				
SIZE/TYPE MAINS	100A		ELEC RM									
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
LTG	103, 104, 105, 106	770.0	20	1	*			2	20	1240.0	217, 216, 215, 214	LTG
LTG	107, 111	2500.0	20	3		*		4	20	900.0	221, 220	LTG
LTG	CORR, LOBBY	1900.0	20	5			*	6	20	2700.0	218, 219, 211, 213	LTG
LTG	ELEV RM	70.0	20	7	*			8	20	900.0	CORR	LTG
LTG	113, 109, 110, 108	1900.0	20	9		*		10	20	1400.0	212, 210, 209, 201, 202, 203	LTG
LTG	114, 115, 116	2400.0	20	11			*	12	20	2400.0	207, 208	LTG
LTG	117, 118, 119, 120	720.0	20	13	*			14	20	800.0	204, 205, 206	LTG
LTG	STAIR & CORR NIGHT	1000.0	20	15		*		16	20	2240.0	GYM	LTG
LTG	WEAPONS CLEANING COUNTER	1000.0	20	17			*	18	20	750.0	130	LTG
LTG	EXTERIOR	890	20.0	19	*			20	20	500.0	131	LTG
LTG	ELEV PIT	100.0	20	21		*		22	20	390.0	CORR C-4	LTG
SPARE			20	23			*	24	20			SPARE
SPARE			20	25	*			26	20			SPARE
SPARE			20	27		*		28	20			SPARE
SPARE			20	29			*	30	20			SPARE
SUB-TOTAL	A PHASE	5890.0		B PHASE						10430.0	C PHASE	11150.0
TOTAL CONNECTED LOAD (WATTS)		27470.0		DEMAND LOAD						34337.5	REQUIRED AMPACITY	41.3

New Panelboard Schedule

PANELBOARD SCHEDULE

VOLTAGE	480/277		TAG							TYPE PANEL	LTG	
MOUNTING	SURFACE		LPTF1							MIN AIC	30K	
SIZE/TYPE BUS	100A		LOCATION							REMARKS		
SIZE/TYPE MAINS	100A		ELEC RM									
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
LTG	107	2953.0	20	1	*			2	20	1240.0	217, 216, 215, 214	LTG
LTG	103, 104, 105, 106	770.0	20	3		*		4	20	900.0	221, 220	LTG
LTG	CORR, LOBBY	1900.0	20	5			*	6	20	2700.0	218, 219, 211, 213	LTG
LTG	ELEV RM	70.0	20	7	*			8	20	900.0	CORR	LTG
LTG	114, 115, 116	2400.0	20	9		*		10	20	1400.0	212, 210, 209, 201, 202, 203	LTG
LTG	113, 109, 110, 108	1900.0	20	11			*	12	20	2400.0	207, 208	LTG
LTG	117, 118, 119, 120	720.0	20	13	*			14	20	800.0	204, 205, 206	LTG
LTG	STAIR & CORR NIGHT	1000.0	20	15		*		16	20	2393.0	GYM	LTG
LTG	WEAPONS CLEANING COUNTER	1000.0	20	17			*	18	20	750.0	130	LTG
LTG	EXTERIOR	3468.0	20	19	*			20	20	500.0	131	LTG
LTG	ELEV PIT	100.0	20	21		*		22	20	390.0	CORR C-4	LTG
SPARE			20	23			*	24	20			SPARE
SPARE			20	25	*			26	20			SPARE
LTG	111	1621.0	20	27		*		28	20			SPARE
SPARE			20	29			*	30	20			SPARE
SUB-TOTAL	A PHASE	10651.0		B PHASE						10974.0	C PHASE	10650.0
TOTAL CONNECTED LOAD (WATTS)		32275.0		DEMAND LOAD						40343.8	REQUIRED AMPACITY	48.5

PANEL LPTF1 - CKT 16			
TAG	**QUANTITY**	**AMPS / FIXTURE**	**TOTAL AMPS**
E	12	0.12	1.44
F	4	2.4	9.6
G	4	0.18	0.72
H	4	0.19	0.76
VOLTAGE	277	TOTAL AMPS	12.52
VA			3468

New Feeder Size

Panelboard LPTF1 is fed with (4) #8 AWG & (1) #8 AWG ground in 3/4" conduit.

Branch Circuit Voltage Drop

PANEL LPTF1 - CKT 19	
Voltage	277
PF	0.95
Length	150
Wire Size	#12
$V_{drop/(1000A*ft)}$	1.833
Current (A)	12.52
Single Phase Mult.	2
$V_{drop/(L-N)}$	6.885
% V_{drop}	2.49

Resizing for Mechanical Breadth

The mechanical breadth portion of this report examined and redesigned the mechanical system for the firing range. The initial design utilized two air-handling units each supplying 33,000 cfm and powered by 50 hp motors. Ceiling diffusers placed at various locations down the range, supplied air to the range. In the interest of limiting swirling of air, which increases the likelihood of ingesting harmful lead particles that can cause lead poisoning, a mechanical redesign for the range was suggested. A diffusing wall located behind the shooting line, which supplies air from two air-handling units, was the basis of the proposed redesign. Calculations in the mechanical breadth section show that the system requires two air-handling units each supplying 42,000 cfm. The affinity laws were then applied to determine the appropriate hp of the motors powering the units.

$$\frac{HP1}{HP2}=\left(\frac{cfm_1}{cfm_2}\right)^3$$

$$\frac{50}{HP2}=\left(\frac{33{,}000}{42{,}000}\right)^3$$

$$HP_2 = 103\ hp$$

The motor should then be sized up to the next standard size. Therefore, a 125 hp motor was selected.

Full-load current (FLC) for each 125 hp motor powering AHU-1 and AHU-2 servicing the range was found in NEC Table 430.250. The two motors require 156A FLC each. Minimum circuit amps (MCA) were determined as 125% of FLC.

MCA = FLC * 125% = 156A * 1.25 = 195A

Wire sizing for the branch circuits was determined based on MCA using NEC Table 310.16. Each branch circuit will be served by (4) 3/0 AWG and (1) #3 AWG ground in 2" conduit.

Next, NEC Table 430.52 was used to determine the maximum overcurrent protective device (MOPD) rating based on the maximum percentage of full-load current for an inverse time circuit breaker.

MOPD = 156A * 250% = 156A * 2.50 = 390A (max)

The next smaller circuit breaker was selected. Circuits 7 and 8 serving AHU-1 and AHU-2 are protected by 350A 3-pole circuit breakers.

The new panelboard feeder size is determined using the required ampacity for the new panelboard schedule. Wire sizes are found from NEC Table 310.16. Panelboard MDP is now fed with 5 sets of (4) 400 MCM and (1) 4/0 AWG ground in 3" conduit.

Below are the original and updated schedules for Panelboard MDP. The highlighted portions of the panel are the circuits that have been adjusted to meet the mechanical breadth redesign.

Original Panelboard Schedule

PANELBOARD SCHEDULE						
VOLTAGE	480/277	TAG				
MOUNTING	SURFACE	MDP				
SIZE/TYPE BUS	1200A	LOCATION				
SIZE/TYPE MAINS	1200A	ELEC RM				
TYPE PANEL	LTG	REMARKS				
MIN AIC	65K					
LOAD	LOAD	C/B	POS	A	B	C
DESCRIPTION	KVA	SIZE	NO	PH	PH	PH
CU-5	97.27	125	1	*		
					*	
						*
CU-4	97.27	125	2	*		
					*	
						*
AHU-5 SUPPLY	17.45	40	3	*		
					*	
						*
AHU-5 RETURN	9.15	20	4	*		
					*	
						*
AHU-4 SUPPLY	17.45	50	5	*		
					*	
						*
AHU-4 RETURN	9.15	20	6	*		
					*	
						*
AHU-1	54	100	7	*		
					*	
						*
AHU-2	54	100	8	*		
					*	
						*
AHU-1 ELEC. HEAT	60	125	9	*		
					*	
						*
AHU-2 ELEC. HEAT	60	125	10	*		
					*	
						*
WATER HEATER DWH-1	54	90	11	*		
					*	
						*
SPARE		100	12	*		
					*	
						*
SPARE		50	13	*		
					*	
						*
SPARE		20	14	*		
					*	
						*
ATS TO DPTF (NORMAL)	301.59	400	15	*		
					*	
						*
ATS TO SBDP (NORMAL)	237.72	400	16	*		
					*	
						*
SPARE			17	*		
					*	
						*
SPARE			18	*		
					*	
						*
A PHASE	356.4	TOTAL CONNECTED LOAD (KW)				1069.1
B PHASE	356.4	DEMAND LOAD				748.3
C PHASE	356.4	REQUIRED AMPACITY				900.5

New Panelboard Schedule

PANELBOARD SCHEDULE						
VOLTAGE	480/277	TAG				
MOUNTING	SURFACE	MDP				
SIZE/TYPE BUS	1600A	LOCATION				
SIZE/TYPE MAINS	1600A	ELEC RM				
TYPE PANEL	LTG	REMARKS				
MIN AIC	65K					
LOAD DESCRIPTION	LOAD KVA	C/B SIZE	POS NO	A PH	B PH	C PH
CU-5	97.27	125	1	*		
					*	
						*
CU-4	97.27	125	2	*		
					*	
						*
AHU-5 SUPPLY	17.45	40	3	*		
					*	
						*
AHU-5 RETURN	9.15	20	4	*		
					*	
						*
AHU-4 SUPPLY	17.45	50	5	*		
					*	
						*
AHU-4 RETURN	9.15	20	6	*		
					*	
						*
AHU-1	161.93	350	7	*		
					*	
						*
AHU-2	161.93	350	8	*		
					*	
						*
AHU-1 ELEC. HEAT	60	125	9	*		
					*	
						*
AHU-2 ELEC. HEAT	60	125	10	*		
					*	
						*
WATER HEATER DWH-1	54	90	11	*		
					*	
						*
SPARE		100	12	*		
					*	
						*
SPARE		50	13	*		
					*	
						*
SPARE		20	14	*		
					*	
						*
ATS TO DPTF (NORMAL)	301.59	400	15	*		
					*	
						*
ATS TO SBDP (NORMAL)	237.72	400	16	*		
					*	
						*
SPARE			17	*		
					*	
						*
SPARE			18	*		
					*	
						*
A PHASE	428.3	TOTAL CONNECTED LOAD (KW)				1284.9
B PHASE	428.3	DEMAND LOAD				1325.4
C PHASE	428.3	REQUIRED AMPACITY				1596.1

Energy Efficient Transformer Analysis

The purpose of this analysis is to determine the cost effectiveness of energy-efficient transformers over the standard transformers designated for the project when it was designed in 2002. Today's energy conscious society has many products are making a push toward being green and energy efficient, and transformers are no exception. When first on the market, energy efficient transformers had an added initial cost, but used less energy, often making them more cost effective in the long run. In 2005, an energy act, called Public Law 109-58, 2005 Energy Act, was passed which stated that "the efficiency of a low voltage dry-type distribution transformer manufactured on or after January 1, 2007, shall be the Class I Efficiency Levels for distribution transformers specified in table 4-2 of the 'Guide for Determining Energy Efficiency for Distribution Transformers' published by the National Electrical Manufacturers Association (NEMA TP-1-2002)."

An energy savings payback calculator supplied by Powersmith, a manufacturer of energy efficient transformers was utilized in the analysis to determine cost effectiveness of energy efficient transformers versus their predecessing standard type transformers. A summary of the cost analysis is provided below.

Three transformer sizes exist in the MdTA Police Training Facility:

1) 45 kVA
2) 75 kVA
3) 112.5 kVA

The facility will be primarily used during normal working hours, so it has been estimated that the facility is operational 12 hours a day, 260 days of the year. The percent of the available full load kW that is used during normal operating hours and outside operating hours was estimated at 30% and 10% respectively.

Based on this analysis, installation of energy efficient transformers instead of standard transformers will result in a 4% reduction in the annual estimated electric bill. The annual operating cost savings would be $1,480. A 20 year life cycle cost analysis yields a savings of $53,451 and a 32 year life cycle cost analysis yields a savings of $121,934. The Powersmith calculator also shows that the system will pay for itself in 6.04 years.

Energy efficient transformers are an excellent addition to the building industry. The cost savings as displayed by this analysis can be substantial, and the total energy and resource savings has major benefits for the world in which we live.

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The ESP Calculator™
Energy Savings Payback Calculator

Project Description	**new project**
Date	**1-Mar-07**

Data Entry

Transformers on Project

QTY	kVA
	15
	30
1	45
1	75
1	112.5
	150
	225
	300
	500
	750
	1000
	1500
	2000
	7.5

		Calc Load kW	Calc Annual kWh
Available Full Load kW	**232.5**		
Average kVA (calc)	**78**		
equipment operating hrs/ day	**12**		
equipment operating days/yr	**260**		
Load during normal operating hours	**30%**	70	217,620
Load outside operating hours	**10%**	23	131,130
		Total Annual Load kWh:	**348,750**

Annual Cost to Operate Load Only

kWh rate	$ 0.100	Annual Consumption:	$	34,875
demand rate ($/kW/mo) ex. $10.00	$0.00	Annual Demand:	$	-
		Total Cost to run load	**$**	**34,875**

Annual Cost of Status Quo Transformer Losses & Associated Air Conditioning (A/C) burden

Status quo Efficiency (Normal Operation)	97.0%	
Transformer kW Losses (Normal Operation)	2.2	kW
Status quo Efficiency (Outside op. hrs)	92.0%	
Transformer kW Losses (Outside op. hrs)	2.0	kW
Annual addititional kWh from transformers	18,133	kWh
Annual Cost of Transformer Losses	$ 1,813	
A/C System Performance (kW/ton)	1.25	
Additional Tons of Cooling (on peak)	0.61	tons
Annual addititional kWh from A/C	6,439	kWh
Annual Cost of Associated A/C	$ 644	

Summary with Status Quo Transformer

Annual Cost of feeding Building Load	$	34,875
Annual Cost of Transformer Losses	$	1,813
Annual Cost of Associated A/C	$	644
Electrical Bill (Status Quo Transformer)	**$**	**37,332**

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The ESP Calculator™

Energy Savings Payback Calculator

Using Powersmiths instead of status quo transformers

Powersmiths Efficiency (Normal Operation)	98.2%	
Powersmiths kW Losses (Normal Operation)	1.3	kW
Powersmiths Efficiency (Outside op. hrs)	97.6%	
Transformer kW Losses (Outside op. hrs)	0.6	kW
Annual addititional kWh from transformers	7,213	kWh
Annual Cost of Powersmiths Losses	$ 721	
Additional Tons of Cooling (on peak)	0.36	tons
Annual addititional kWh from A/C	2,562	kWh
Annual Cost of Associated A/C	$ 256	

Comparing Status Quo & Powersmiths

	Status Quo	Powersmiths	
Annual Cost of feeding Building Load	$ 34,875	$ 34,875	
Annual Cost of Transformer Losses	$ 1,813	$ 721	
Annual Cost of Associated A/C	$ 644	$ 256	**Reduction**
Annual estimated Electrical Bill	$ 37,332	$ 35,853	**4%**

Peak kW reduction (normal op hours)	**0.9**	**kW**
Annual kWh reduction	**14,797**	**kWh**
Reduction in Air Conditioning Load (on peak)	**0.25**	**tons**

Cost Analysis (calc)

Energy Cost Escalation (above inflation)	3.0%
Annual Power Quality Benefit	$ -

	Annual Operating Cost	Life Cycle Operating Cost & Savings	
		20 years	32 years
Status Quo Transformers	$2,457	$88,761	$202,483
Powersmiths Transformers	$978	$35,310	$80,549
Savings with Powersmiths	**$1,480**	**$53,451**	**$121,934**

Cost

	Cost
Powersmiths Transformers	$34,491
Status Quo Transformers	$25,549

Payback on total cost	6.04	years	current kWh rate:
Cost of Energy Savings	$ 0.019	/kWh	$0.100
Cost - Benefit Ratio	5.3	times less to save a kWh than to buy a kWh	

Leasing Option	60 Month Term	48 Month Term	36 Month Term
Total Annual Leasing Payments	**$6,460**	**$7,879**	**$10,025**
Net Annual Cost with savings	$4,980	$6,400	$8,546

Summary of Environmental Benefits

Annual Reduction in Greenhouse Gases (per EPA)	Equivalence
11 tons of CO2	2 Acres trees planted
35 tons of Coal	1 Car Emissions
86 kgs of SO2	1 homes heated
37 kgs of NOx	

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The ESP Calculator™
Energy Savings Payback Calculator

Status Quo Transformer (Normal Operation)

Enter the average efficiency of the transformers. This data is supplied by manufacturers and is based on linear load test.
Typical values for efficiency are in the 93-95% range for 15-45kVA, 95-97% range for 75-112.5kVA
and smaller, and 96-97.5% for 150 to 300kVA, and 97-98% for 300-500kVA transformers.

Status Quo Transformer (Outside Op. hours)

Transformer efficiency is typically lower than normal when lightly loaded (86-89% when 10-15% loaded for most sizes)

A/C Performance (kW/ton)

Varies widely depending on age and technology of cooling system. As low as 0.5 to over 2kW/ton (1.25-1.5 is often tp)
Unlike most substation transformers that are vented to the exterior, most building distribution transformers
are ventilated within the building, and their heat losses therefore add to the cooling load.

Powersmiths Efficiency (Normal Operation) & (Outside Op. hours)

Available on Powersmiths product data sheet

Energy Cost escalation (above inflation)

It is well recognized that energy rates are increasing much faster than inflation. Enter the % over inflation

Annual Power Quality Benefit

Savings attributable to reduced downtime, equipment locks & failures associated with poor power quality

Cost of Energy Savings

In its simplest form, the cost of energy savings represents the cost to save
a kWh as opposed to paying for it according to the prevailing kWh rate.

The equation is: Cost of Energy Savings = (Incremental Product Cost / Lifetime kWh saved)
This does not include any additional savings as energy rates go up over the installed product life

Transformer Operating Losses

Transformer Losses = kW load/net efficiency - kW load.

% load left ON, outside of normal operating hours

Typically 50-70% of normal load remains on during off-hours operation, also transformer remains energized 24hrs/day.

Cost

Cost of transformers. Enter dollar figure for transformers under consideration. If the interest is to look at the justification
for replacing existing transformers, enter $0 in the conventional transformer cost field.

Energy Operating Cost

Energy OPERATING COST (normal op) = (transformer + cooling) kW losses x kWh rate x hrs/day x days/yr + demand charge
Demand charge is not included in the calculation of losses outside normal hours to be conservative.

Return on Investment (ROI)

ROI on Incremental Cost is based on dividing the Incremental Investment in Powersmiths by the Annual Savings
ROI on Total Transformer Cost is based on dividing the Total Transformer Cost by the Annual Savings

Leasing

Powersmiths Leasing has many benefits, including avoiding the use of capital, offsetting monthly leasing payment with
the reduction in monthly energy bill from using Powersmiths

Environmental Benefits

Conversion rates from kWh to emission reduction and equivalent benefits are published by the EPA,
and reflect environmental benefits derived from reduced emissions associated with reduced power generation.

TERMS OF USE

Power Quality Institute has used its best efforts in developing the ESP Calculator ™ with the intent of providing an easy
to use and useful calculation tool. However, data entered and assumptions made may not accurately reflect all variables
that apply in a given facility. The results are therefore estimates only and may differ from actual measurements.
The user is responsible for evaluating the suitability and accuracy of the ESP Calculator ™. The Power Quality Institute
and Powersmiths International Corp. make no representations or warranties with respect to the accuracy or
completeness of the estimates generated by the ESP Calculator ™ and specifically disclaim any implied warranties of
merchantability or fitness for any particular purpose and shall in no event be liable
for any loss of profit or any other commercial damage, including, but not limited
to special, incidental, consequential or other damages.

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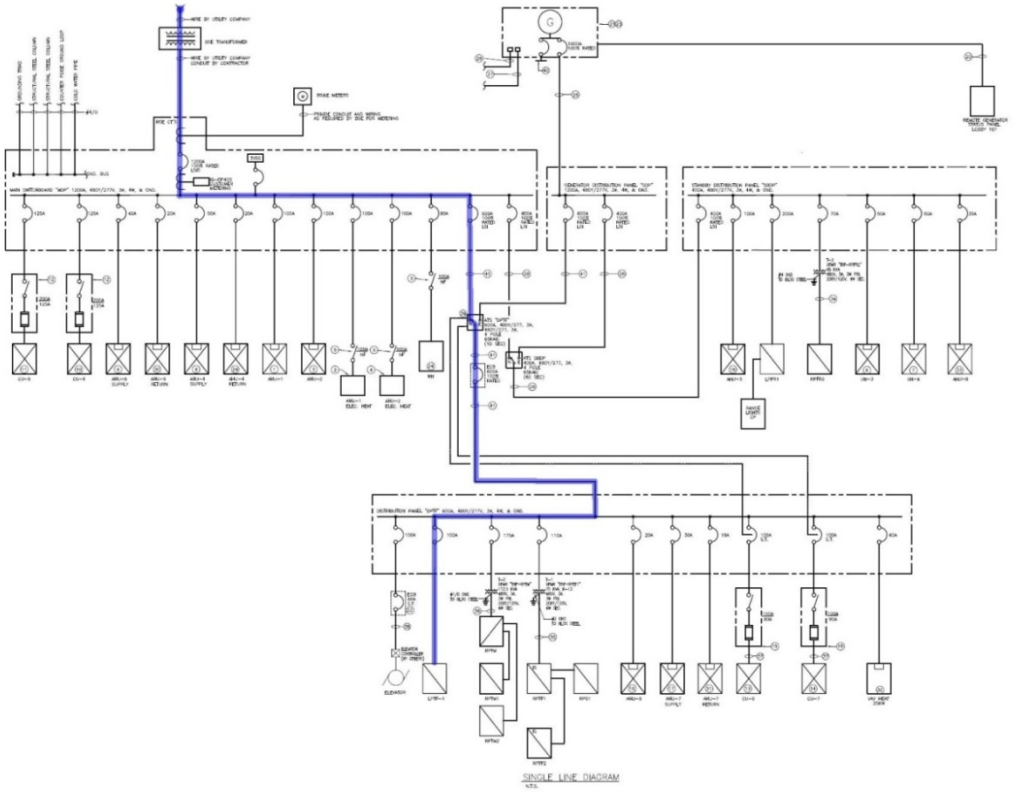
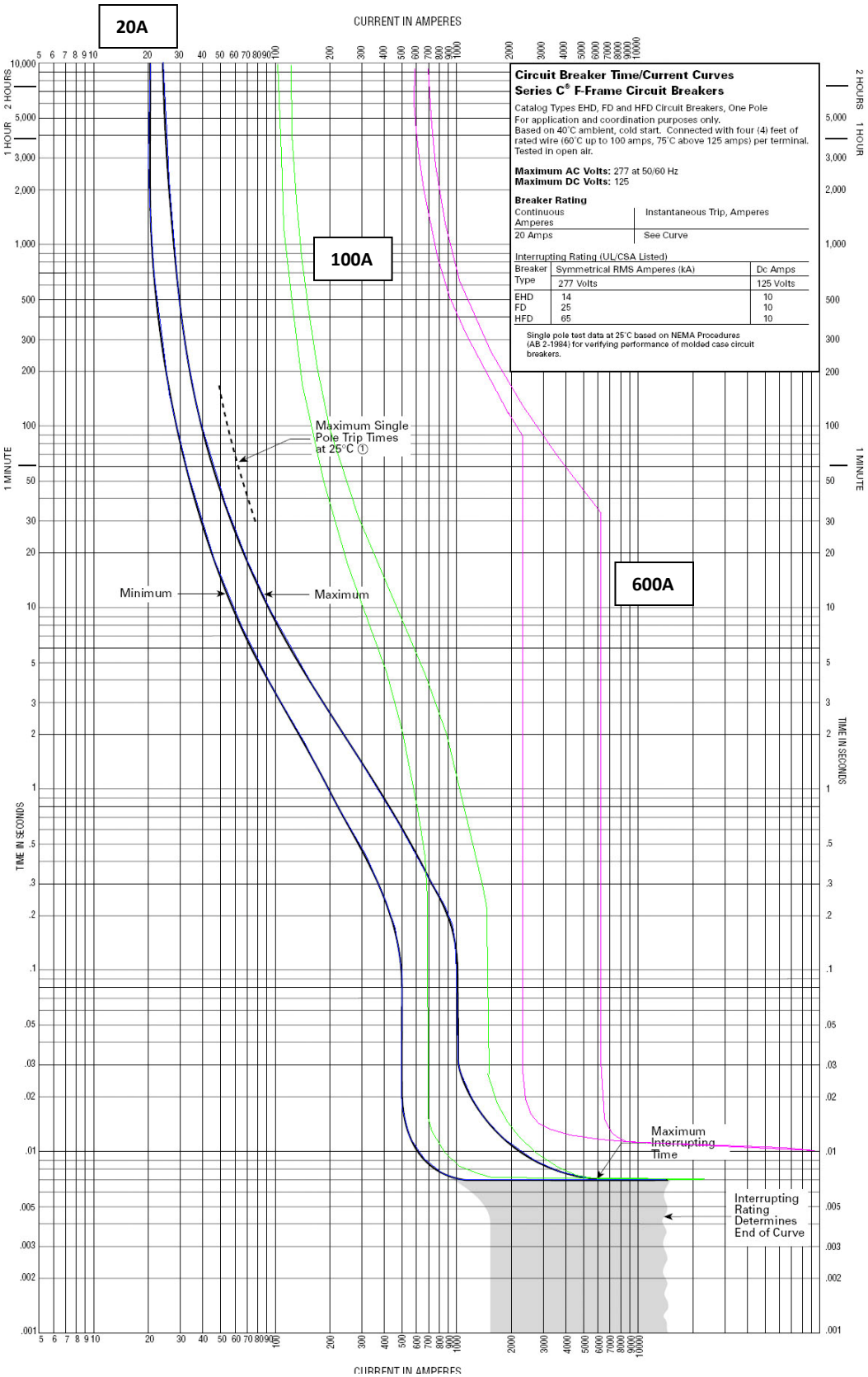
Protective Device Coordination Study

A single-path through the distribution system was selected to conduct a protective device coordination study. The path starts on the primary side of the utility transformer and continues through the main distribution panel all the way to a local lighting panel. The same path was used for both the overcurrent coordination study and the short circuit current analysis. The single-line diagram below shows the selected path.



Below are the circuit breaker trip curves for the 600A, 100A, and 20A circuit breakers on the path above. With the curves superimposed on the same graph, coordination among the breakers can be determined. As should occur, the further out on the path the circuit breaker is, the sooner it should trip if overcurrent is experienced, meaning the 20A circuit breaker will trip before the 100A circuit breaker which will trip before the 600A circuit breaker. At higher currents, there is some overlap between the 20A and 100A breakers. This will result in a race between the breakers as to which will trip first. However, it is unlikely that these high currents will be experienced, and normally the 20A breaker will trip first.


20A
100A
600A
CURRENT IN AMPERES
TIME IN SECONDS
2 HOURS
1 HOUR
1 MINUTE
Circuit Breaker Time/Current Curves
Series C® F-Frame Circuit Breakers
Catalog Types EHD, FD and HFD Circuit Breakers, One Pole
For application and coordination purposes only.
Based on 40°C ambient, cold start. Connected with four (4) feet of rated wire (60°C up to 100 amps, 75°C above 125 amps) per terminal.
Tested in open air.
Maximum AC Volts: 277 at 50/60 Hz
Maximum DC Volts: 125
Breaker Rating
Continuous Amperes
Instantaneous Trip, Amperes
20 Amps
See Curve
Interrupting Rating (UL/CSA Listed)
Breaker Type
Symmetrical RMS Amperes (kA)
277 Volts
Dc Amps
125 Volts
EHD 14 10
FD 25 10
HFD 65 10
Single pole test data at 25°C based on NEMA Procedures (AB 2-1984) for verifying performance of molded case circuit breakers.
Maximum Single Pole Trip Times at 25°C ①
Minimum
Maximum
Maximum Interrupting Time
Interrupting Rating Determines End of Curve

Short Circuit Analysis

The following short circuit analysis follows the path in the single-line diagram above. The short circuit current at each point was calculated using the spreadsheet shown below. Resulting short circuit current for each point being considered can be seen under the respective heading.

Input Data	
Base KVA	750
System Votage	480

Utility Primary

Input Data	
Transformer KVA	1000

Utility S.C. KVA	1000000
Utility per unit Z	0.00075

Utility Transformer Secondary

Transformer X%	5.347175
Transformer R%	2.246712

Transformer per unit X	0.040104
Transformer per unit R	0.01685
Sub-total per unit X	0.040854
Sub-total per unit R	0.01685
Transformer per unit Z	0.044192
$I_{s.c.\ rms\ sym}$	20413.23

MDP

Input Data	
Wire Size	500
Number of Sets	1
Length of Wire (ft)	15

Transformer X%	0.000441
Transformer R%	0.000699

Transformer per unit X	0.001436
Transformer per unit R	0.002275
Sub-total per unit X	0.042289
Sub-total per unit R	0.019126
Transformer per unit Z	0.046413
$I_{s.c.\ rms\ sym}$	19436.5

DPTF			
Input Data			
Wire Size	3/0		
Number of Sets	1		
Length of Wire (ft)	325		
Transformer X%	0.026163	Transformer per unit X	0.085164
Transformer R%	0.016868	Transformer per unit R	0.054907
		Sub-total per unit X	0.127454
		Sub-total per unit R	0.074033
		Transformer per unit Z	0.147395
		$I_{s.c.\ rms\ sym}$	6120.348

LPTF-1			
Input Data			
Wire Size	1/0		
Number of Sets	1		
Length of Wire (ft)	30		
Transformer X%	0.002415	Transformer per unit X	0.007861
Transformer R%	0	Transformer per unit R	0
		Sub-total per unit X	0.135315
		Sub-total per unit R	0.074033
		Transformer per unit Z	0.154243
		$I_{s.c.\ rms\ sym}$	5848.609

Tables shown below were used in the calculation of short circuit current.

General Purpose Transformer Standard Three-Phase		
kVA	Avg % Z	Avg X/R
15	3.6	1.94
30	6.4	0.92
45	6.6	1.13
75	5.7	1.38
112.5	6.1	1.51
150	5.5	1.53
225	6.6	2
300	3.6	1.81
500	5	2.89
750	5	1.98
1000	5.8	2.38

Cable Impedance Data 600V and 5kv Non-shielded in Metal Duct			
Wire Size	X	R	Z
8	0.811	0.0754	0.814
6	0.51	0.0685	0.515
4	0.321	0.0632	0.327
2	0.202	0.0585	0.21
1	0.16	0.057	0.17
1/0	0.128	0.054	0.139
2/0	0.102	0.0533	0.115
3/0	0.0805	0.0519	0.0958
4/0	0.064	0.0497	0.081
250	0.0552	0.0495	0.0742
300	0.0464	0.0493	0.0677
350	0.0378	0.0491	0.0617
400	0.0356	0.049	0.0606
450	0.0322	0.048	0.0578
500	0.0294	0.0466	0.0551

Breadth Studies

The Maryland Transportation Authority Police Training Facility contains a range that encompasses a significant portion of the building. Housing twenty firing lanes, the 110'x100' range provides interesting and unique challenges. Many advantages exist for the use of indoor ranges over outdoor ranges, among them, protection from harsh weather conditions, use of the facility any time of day, and the benefits of having a controlled environment. Unfortunately, indoor ranges also present health risk, most notable from lead exposure and high noise levels.

Because of the health hazards associated with firing ranges, a closer examination of the systems that will promote a healthy and effective learning environment in the range and in adjacent areas is required. The follow sections examine the mechanical and acoustical systems of the range.

Mechanical Breadth

Lead exposure and the potential for lead poisoning is a major concern in the firing range. There are many sources of lead dust and fumes in a firing range, including the bullet primer, vaporization and fragmentation of the bullet, and "side blast," dust and fumes blown at a 90^0 angle from the gun due to extreme temperature and pressure. Health and safety are obviously of high importance, and, therefore, minimizing the risk of lead exposure and poisoning is worth striving for.

Occupational Health and Safety Administration (OSHA) standards require airborne lead containment levels to be below 0.20 mg/m^3. The following suggestions for minimizing lead exposure have been made by the National Institute for Occupational Safety and Health (NIOSH).

- High Efficiency Particulate (HEPA) filters should be used to filter all air being exhausted from the firing range.
- High efficiency heating and cooling coils lower the interference with air flow balance.
- A minimum of 50 fpm should be maintained at the firing line.
- Optimum ventilation rate is 75 fpm at the firing line.
- Air should be distributed at least 15 feet behind the shooter with the supply air inlets place on the back wall.
- The range should have a dedicated ventilation system so as not to contaminate other spaces in the building.
- Supply and return air systems should be electrically interlocked so that one can not be in use without the other.

Existing (Conventional) System

The original design for the MdTA was designed but never built. Mechanically, the system has a conventional approach to ventilating the space. Supply diffusers were specified to be installed in the ceiling sporadically down the length of the range. However, the entry of air in these down range locations would cause turbulence and swirling of the air, which would kick up more dust and lead particles. It could even cause the air to flow toward the shooters instead of away from them toward the exhaust system, carrying the harmful particles into closer proximity with the occupants.

Proposed Solution

The proposed solution is to install a diffusing wall on the rear wall behind where the shooters stand. The wall would consist of a wide wall with sealed CMU, a 2' gap for air to be supplied to the wall, and stacked 2'x4' louvers creating a wall system that would supply air to the range area. By supplying air at a low velocity, low turbulence air is able to move down the lanes, away from the shooters, carrying the harmful dust and lead particles with it. Another advantage of this type of system is that not as much cooling of the air will be necessary. The air is supplied just behind where the occupants of the space will be. Even though this is a large room, the air only needs to be conditioned for the area where occupants will be. The air will heat up from the occupant latent load, the firing of the guns, luminaires, and target equipment as it moves down the range, but if only needs to be cooled to meet the load within the first 30' of the space (not the whole 110'). This will save energy on cooling energy and associated costs.

Required Cubic Feet per Minute

The goal is to have 75 fpm of air moving along the space. The cfm required by this system can be determined with this velocity and the cross-sectional area of the space.

$$Q = vA = (75 \text{ ft/min})*(100\text{ft})*(11\text{ft}) = 82{,}500 \text{ ft}^3/\text{min}$$

To create the diffusing wall system, 2'x4' louvers will be stacked the length and height of the wall. The bulkhead on the rear wall will be removed to allow for full wall area to be used as a diffusing wall.

Air-Changes per Hour

To ensure that enough air is being circulated to promote a healthy environment, the number of air changes per hour (ACH) was computed. ACH represents the number of times in an hour that the total volume of the space is exchanged with fresh or filtered air (www.energyvortex.com).

$$ACH = Q * V = (82{,}000 \text{ cfm})*(60\text{min/hr})/(121{,}000 \text{ ft}^3) = 40.7 \text{ ACH}$$

40.7 ACH is more than enough to adequately ventilate the space and will definitely meet the ASHRAE requirements.

Sizing of the Motor

If I were performing a true mechanical design, a mechanical equipment sales representative would be contacted at this point to assist in the selection of air-handling unit equipment. However, for the purpose of this simplified design, the affinity laws were used to determine the required motor power. The equations below show the affinity law calculations for motor sizing.

$$\frac{HP1}{HP2}=\left(\frac{cfm_1}{cfm_2}\right)^3$$

$$\frac{50}{HP2}=\left(\frac{33{,}000}{42{,}000}\right)^3$$

$$HP_2 = 103\ hp$$

The motor should then be sized up to the next standard size. Therefore, a 125 hp motor was selected. This motor size can now be used to determine what changes must be made to the electrical design. Please refer to the electrical depth portion of this report to view the continued effect of the proposed mechanical solution on other systems of the building.

Acoustical Breadth

Acoustics in regards to ranges is very interesting because of the extremely high sound source level created by a firing gun. Occupation Safety and Health Administration says that peak impulse sound pressure levels should not be higher than 140dB. However, the peak sound pressure level that a fired bullet makes when it breaks the sound barrier can be significantly higher than that.

Peak sound pressure level cannot be negated in the firing range since the sound travels in a direct path from the gun to the shooters ear. Precautions such as double ear protection should be taken, but architecturally, this source sound cannot be reduced. The recommendation for minimizing the effect of peak sound pressure level is that "all reflecting walls should be covered with high efficiency sound absorbing material such as fiberglass insulation covered with perforated aluminum or steel sheets with openings equivalent to 10-15% of the area to permit sound absorption." (Noise Exposure Assessment and Abatement Strategies at an Indoor Firing Range, NIOSH)

The existing design incorporates such a material into the design in the form of tectum wall panels. The acoustical absorptivity of the space cannot realistically be improved very much, so it will not be the focus of this breadth.

There is a concern, however, with the adjacency of spaces. Classroom 'A' is directly adjacent to and shares a wall with the firing range. An examination, audio/visual presentation, and lecture space is an area where loud background noise should be avoided. Transmission loss (TL) and noise reduction (NR) of the common wall is of particular interest to ensure that adequate noise criterion for the classroom is being achieved.

Goals of Classroom Noise Criteria

The classroom should be less than NC-35 as determined from the chart with NC values listed below for a classroom greater than 750 ft^2. The basic general equations for noise reduction used in calculations are listed below.

$$NR = TL + 10 \log (A_{rec}/S_{common\ wall})$$

Noise reduction is a function of transmission loss of the wall assembly as well as the absorptivity of materials of the receiving room. If the receiving room has soft, absorptive materials, it will aid the transmission loss and the noise reduction for the space will be higher than the transmission loss values. If the receiving room has hard, reflective materials, sound will be reflected and noise reduction will be lower than the transmission loss values.

Below is a bar chart displaying the dB level created by three different firearm sources (an M4 rifle, a Beretta pistol, and a Remington shotgun) for octave-band frequencies.

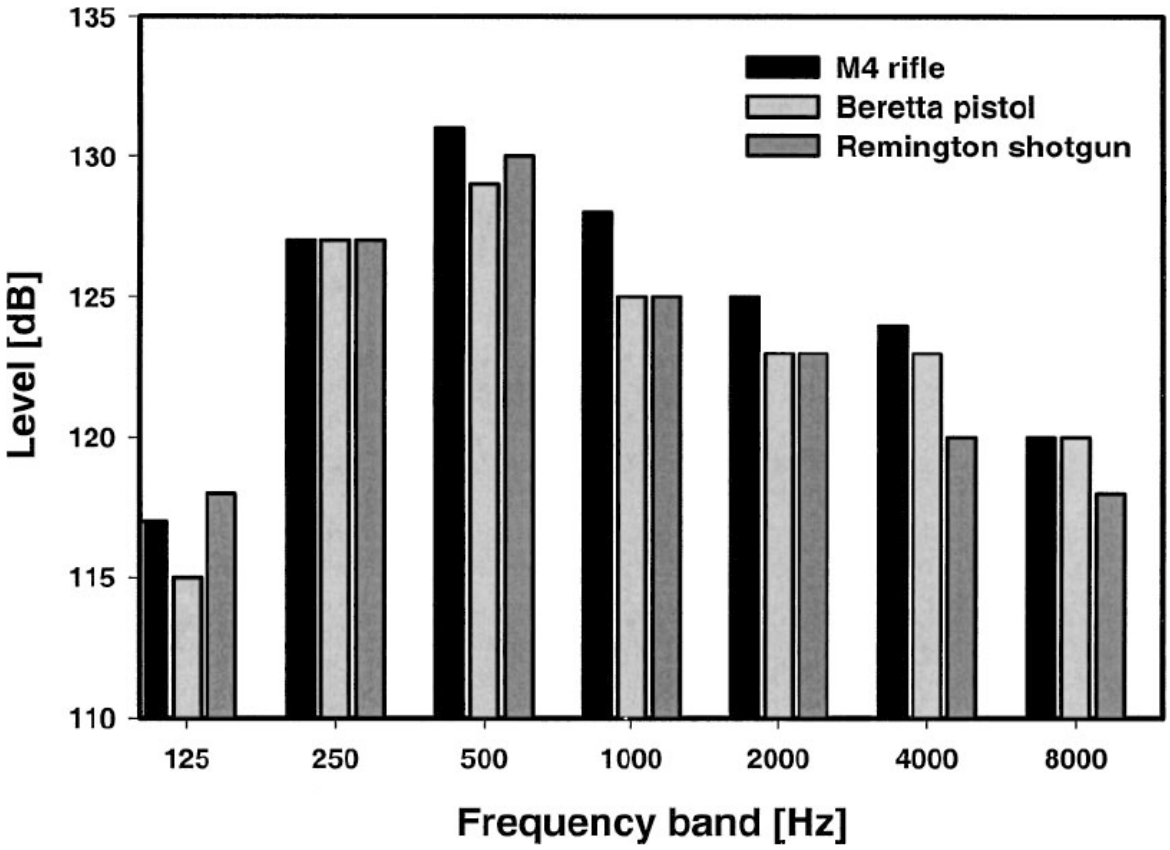


FIGURE 5
Octave-band spectra from three firearms.

The values on the chart were used as the source sound levels in the range that must be reduced by the wall assembly for the firing range to meet the recommended NC value of less than 35.

Two different wall assemblies will be examined.

- A more conventional noise reducing wall assembly consisting of painted hollow (8") CMU and 5/8” gypsum board on resilient channels with 1-1/2” fiberglass furring.
- A proposed wall assembly consisting of painted hollow (8”) CMU, a 3” inch air gap, and a 6" 20 gauge metal stud wall with resilient channels on one side with 5” fiberglass insulation with a double layer of 5/8" gypsum board on the classroom side of the wall.

Space	Recommended RC (N) value	Recommended NC value	Approximate dBA value
Private residence, apartment, condominium	25-30	25-35	33-43
Hotels or motels:			
Individual rooms, meeting rooms	25-35	25-35	33-43
Halls, corridors, lobbies	35-45	35-45	43-53
Office buildings:			
Executive and private offices	25-35	25-35	33-43
Open plan offices	30-40	30-40	38-48
Circulation areas	40-45	40-45	48-53
Hospitals and clinics:			
Private rooms and operating rooms	25-35	25-35	33-43
Wards, corridors and public spaces	30-40	30-40	38-48
Performing arts spaces:			
Drama theaters, music teaching spaces	25 (max)	25 (max)	
Music practice rooms	35 (max)	35 (max)	
Concert and recital halls	Consult an acoustical consultant		
Laboratories (with fume hoods):			
Testing/research with minimal speech communication	45-55	45-55	53-58
Research with extensive telephone use	40-50	40-50	48-58
Group teaching	35-45	35-45	43-53
Churches, mosques and synagogues	25-35	25-35	33-38
Schools:			
Classrooms up to 70 m^2 (750 ft^2)	40 (max)	40 (max)	
Classrooms over to 70 m^2 (750 ft^2)	35 (max)	35 (max)	
Libraries	30-40	30-40	38-48
Courtrooms:			
Unamplified speech	25-35	25-35	33-43
Amplified speech	30-40	30-40	38-48
Indoor stadiums and gymnasiums	40-50	40-50	48-58

NC Values	Frequency (Hz)						
	125	250	500	1000	2000	4000	8000
NC-35	52	45	40	36	34	33	32
NC-40	56	50	45	41	39	38	37
NC-45	60	54	49	46	44	43	42
NC-50	64	58	54	51	49	48	47
NC-55	67	62	58	56	54	53	52
NC-60	71	67	63	61	59	58	57
NC-65	75	71	68	66	64	63	62
NC-70	79	75	73	71	69	68	67

Existing (Conventional) Solution

Transmission loss values for the wall assembly listed below are shown in this table.

Transmission Loss Between Firing Range and Classroom						
Wall Assembly	Frequency					
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Hollow (8") CMU Painted 5/8" Gypsum Board on Resilient Channels 1-1/2" Fiberglass Furring	41	49	58	66	69	72
Total Transmission Loss	**41.0**	**49.0**	**58.0**	**66.0**	**69.0**	**72.0**

Sound source dB levels extracted from the bar chart above are shown below.

Sound Source dB Levels in Firing Range						
Source	Frequency					
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
M4 Rifle	117	127	131	128	125	124
Beretta Pistol	115	127	128	125	123	123
Remington Shotgun	118	127	130	125	123	120

Absorption of the classroom was calculated to determine the effectiveness of the transmission loss.

Classroom Absorption Coefficients						
Material	Frequency (Hz)					
	125	250	500	1000	2000	4000
Gypsum Wall	0.14	0.06	0.04	0.03	0.03	0.03
VCT	0.02	0.04	0.05	0.05	0.1	0.05
ACT	0.27	0.6	0.64	0.8	0.91	0.99

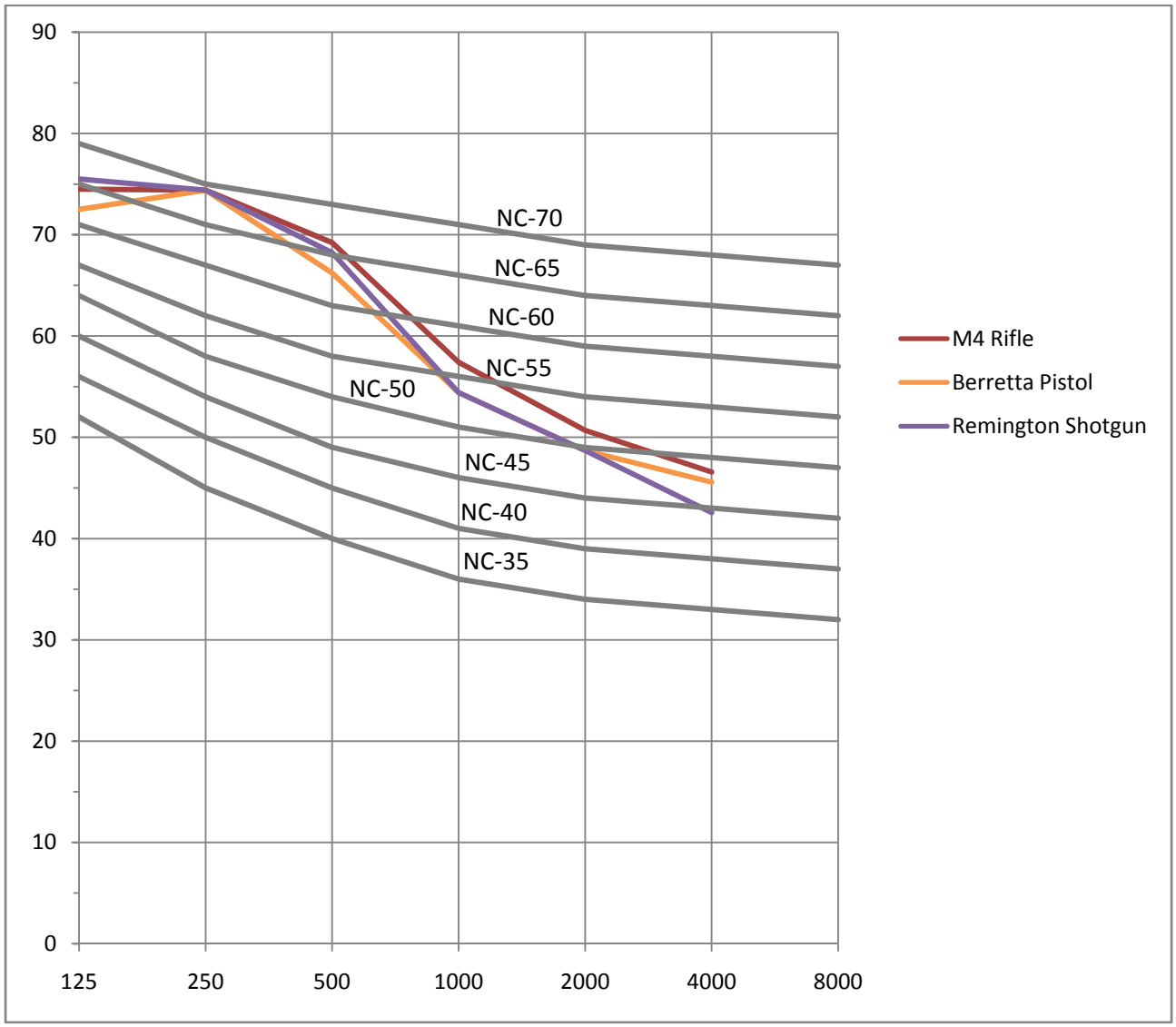
Classroom Total Absorption (Sabins)						
Surface Area	Frequency (Hz)					
	125	250	500	1000	2000	4000
1260	176.4	75.6	50.4	37.8	37.8	37.8
1240	24.8	49.6	62	62	124	62
1240	334.8	744	793.6	992	1128.4	1227.6
Absorption (Sabins)	536	869.2	906	1091.8	1290.2	1327.4

The following equation and the data from the tables above were used to determine the resulting dB levels in the classroom.

$$NR = TL + 10 \log (A_{rec}/S_{common\ wall})$$

Resulting dB Levels in Classroom						
Source	Frequency					
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
M4 Rifle	74.5	74.4	69.2	57.4	50.7	46.6
Beretta Pistol	72.5	74.4	66.2	54.4	48.7	45.6
Remington Shotgun	75.5	74.4	68.2	54.4	48.7	42.6

Below is a graph of the resulting dB levels in the classroom with the existing/conventional wall assembly for the three firearm sources. The values are plotted on top of the NC curves.



All of the source lines fall completely below the NC-70 curve. The recommended level for classrooms is no greater than NC-35. This means that this design does not come close to meeting the NC requirements.

Proposed Solution

Transmission loss values for the wall assembly listed below are shown in this table.

Transmission Loss Between Firing Range and Classroom						
Wall Assembly	**Frequency**					
	125 Hz	**250 Hz**	**500 Hz**	**1000 Hz**	**2000 Hz**	**4000 Hz**
Hollow (8") CMU Painted	38	38	45	50	52	55
3" Air Gap	-6.2	-9.6	-10.0	-10.0	-9.2	-9.5
6" 20 Gauge Metal Stud Resilient Channel on One Side 5" Fiberglass Insulation 1 + 2 Layers of 5/8" Gypsum Board	38	51	58	60	62	64
Total Transmission Loss	**69.8**	**79.4**	**93.0**	**100.0**	**104.8**	**109.5**

Transmission losses of wall assemblies are not additive because the transmission of vibrations through adjoining materials decreases the overall effectiveness of each individual material. In this case, though, the materials are not adjoined and are separated by the 3" air gap. They are not necessarily additive because of the 10 log ($A_{rec}/S_{common\ wall}$) factor. The 3" air gap was treated as a small room and the function

$$10 \log (A_{rec}/S_{common\ wall})$$

from the equation

$$NR = TL + 10 \log (A_{rec}/S_{common\ wall})$$

was used to determine the transmission loss within the air gap. Essentially, because of the volume and hard surfaces surrounding the air gap, the space reflects the sound within the cavity and decreases the overall effectiveness of the transmission loss.

The tables below include the values utilized in the calculation of the effectiveness of transmission loss in the 3" air gap.

3" Air Gap Absorption Coefficients						
Material	Frequency (Hz)					
	125	250	500	1000	2000	4000
CMU	0.1	0.05	0.06	0.07	0.09	0.08
Gypsum Wall	0.14	0.06	0.04	0.03	0.03	0.03
Concrete Floor	0.01	0.01	0.01	0.02	0.02	0.02
Concrete Ceiling	0.01	0.01	0.01	0.02	0.02	0.02

3" Air Gap Total Absorption (Sabins)						
Surface Area	Frequency (Hz)					
	125	250	500	1000	2000	4000
380	38	19	22.8	26.6	34.2	30.4
380	53.2	22.8	15.2	11.4	11.4	11.4
10	0.1	0.1	0.1	0.2	0.2	0.2
10	0.1	0.1	0.1	0.2	0.2	0.2
Absorption (Sabins)	91.4	42	38.2	38.4	46	42.2

Sound source dB levels extracted from the bar chart above are shown below.

Sound Source dB Levels in Firing Range						
Source	Frequency					
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
M4 Rifle	117	127	131	128	125	124
Beretta Pistol	115	127	128	125	123	123
Remington Shotgun	118	127	130	125	123	120

Absorption of the classroom was calculated to determine the effectiveness of the transmission loss.

Classroom Absorption Coefficients						
Material	Frequency (Hz)					
	125	250	500	1000	2000	4000
Gypsum Wall	0.14	0.06	0.04	0.03	0.03	0.03
VCT	0.02	0.04	0.05	0.05	0.1	0.05
ACT	0.27	0.6	0.64	0.8	0.91	0.99

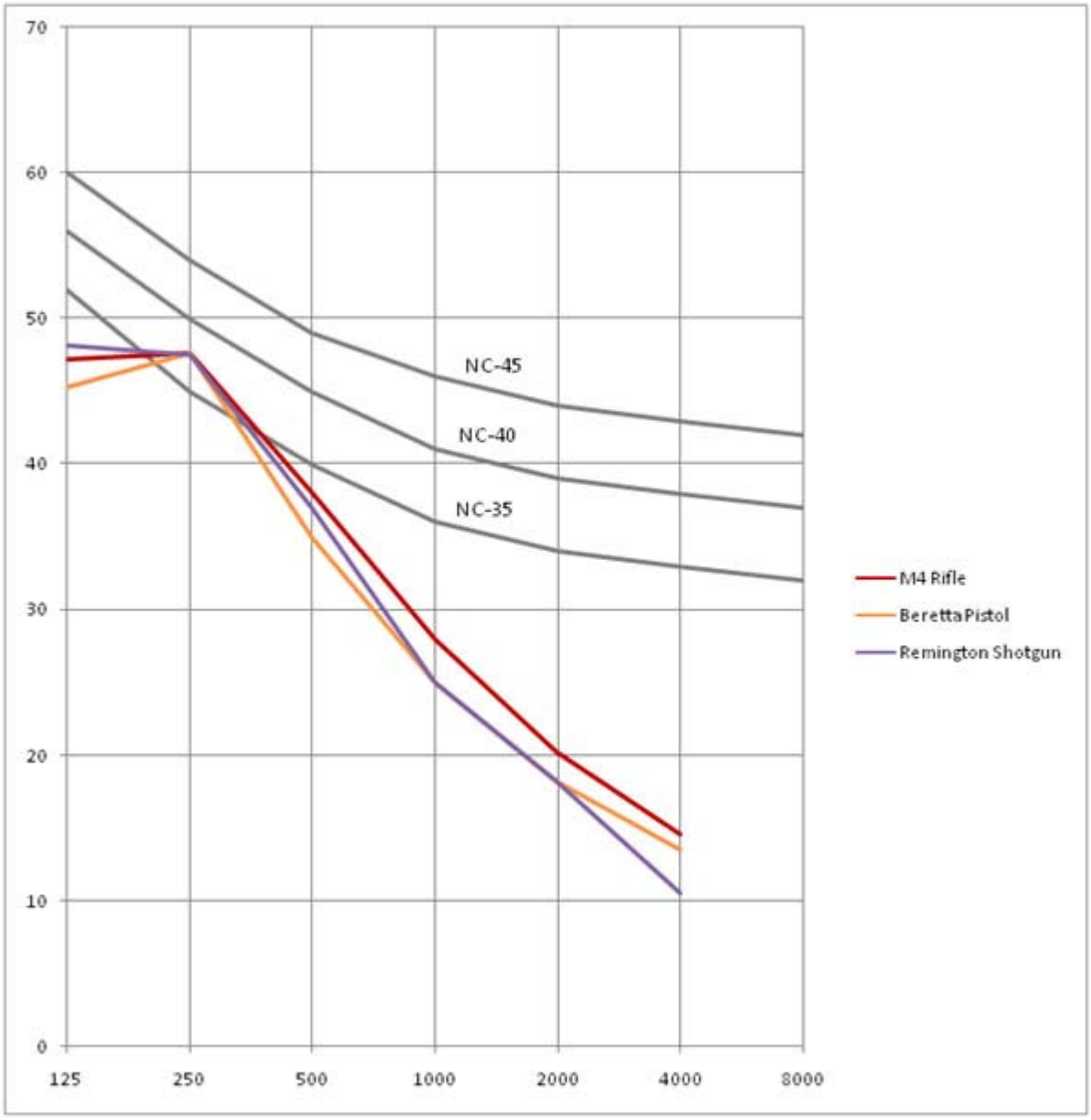
Classroom Total Absorption (Sabins)						
Surface Area	Frequency (Hz)					
	125	250	500	1000	2000	4000
1260	176.4	75.6	50.4	37.8	37.8	37.8
1240	24.8	49.6	62	62	124	62
1240	334.8	744	793.6	992	1128.4	1227.6
Absorption (Sabins)	536	869.2	906	1091.8	1290.2	1327.4

The following equation and the data from the tables above were used to determine the resulting dB levels in the classroom.

$$NR = TL + 10 \log (A_{rec}/S_{common\ wall})$$

Resulting dB Levels in Classroom						
Source	Frequency					
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
M4 Rifle	47.2	47.6	38.0	28.0	20.2	14.5
Beretta Pistol	45.2	47.6	35.0	25.0	18.2	13.5
Remington Shotgun	48.2	47.6	37.0	25.0	18.2	10.5

Below is a graph of the resulting dB levels in the classroom with the proposed wall assembly for the three firearm sources. The values are plotted on top of the NC curves.



All three of the sources fall between the NC-35 and NC-40 curves. Recommended NC value for classrooms is a maximum of 35. While the wall assembly does not quite meet the recommendation, it is very close. Considering the magnitude of the sound source in the adjacent firing range, it may not be appropriate to expect to fully meet the standard conditions. Obtaining values that are with a few dB of the target values will be accepted as adequate for the purpose of this assessment.

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My wonderful classmates, without whom I would not have survived this year - for always being willing to lend your aid.

My family – for always cheering me on as I strive to achieve my goals. Thanks for your patience and encouragement.

Peerlite BY PEERLESS

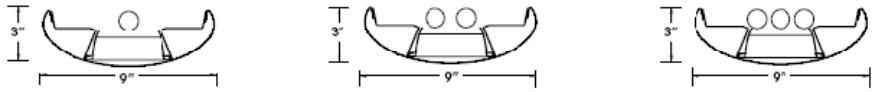
PRIMA®

WITH T8 LAMP

9 X 3
INDIRECT/DIRECT

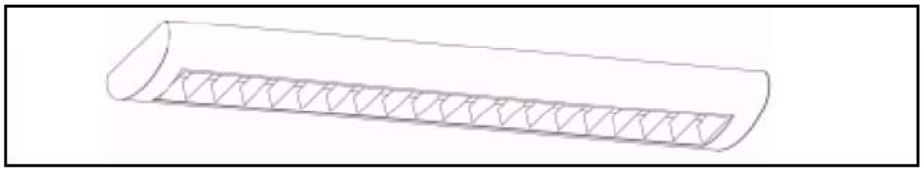
MODULAR

AVAILABLE FIXTURES



PRM4-1 PRM4-2 PRM4-3

SPECIFICATIONS



CONSTRUCTION:
Housing one-piece cold-rolled steel with flat end plate forming a 9" x 3" oval channel.

REFLECTORS:
Die-formed, white reflector with a minimum 85% reflectance.

SHIELDING:
Parabolic aluminum baffles with Achroma™ finish standard; semi-specular finish available.

FINISH:
Fine-textured white paint as standard.

ELECTRICAL:
Specify 120 volt, 277 volt or 347 volt. Pre-wired with prescribed circuits and are UL llisted. Listed and labeled to comply with Canadian standards. For special circuiting, consult factory. Lamps included.

FIXTURE LENGTH:
4'-0-1/4", 8' and 12' lengths in a single section for exact suspension spacing of 4', 8' and 12'. For total fixture length add 1/16" for each end cap.

ORDERING LOGIC

Use guide below to order complete fixture runs from four feet to three-hundred feet in increments of four.

Fixture	# of Lamps in Cross Section	Lamp Type	Reflector	Nominal Row Length[1]	Maximum Section Length	Voltage	Ballast Type	# of Emergency/Night Light Sections[2]	Emergency/Night Light Type[2,3]	Switching	Lamp Color	Mounting Type	Feed/Suspension Lengths	Options
PRM4	1 2 3	32	WHR – White Reflector (Standard) SPR – Specular Reflector	FT	R4 R8 R12	120 277 347	GEB – Generic Electronic Ballast GEB10 – <10% THD Ballast (consult factory for dimming options)	Blank – No Emergency 1SE – 1 Section 2SE – 2 Sections XSE – X Sections	Blank – No Emergency or Night Light EL – Emergency Battery Pack EC – Emergency/Night Light Circuit EN – Emergency Battery Pack with Night Light Circuit	SCT – Single Circuit DCT – Dual Circuit	L/LP – No lamps LP730 – 3000°K, 70+CRI LP735 – 3500°K, 70+CRI (Standard) LP741 – 4100°K, 70+CRI LP830 – 3000°K, 80+CRI LP835 – 3500°K, 80+CRI LP841 – 4100°K, 80+CRI	/	12 – 12" overall suspension 15 – 15" overall suspension 18 – 18" overall suspension 21 – 21" overall suspension 24 – 24" overall suspension XX – XX" overall suspension F1 – T-Bar Ceiling (Universal Mounting Bracket) F2 – Hard Ceiling (Horizontal J-Box) F4A – IDS Clip 15/16" Tee F4B – IDS Clip 9/16" Tee F4C – IDS Clip Screw Slot	ACG – Adjustable Cable Grippers APF – Alternate Power Feed CMG – Cord Manager DU – Dust Cover ELH – EM through wire/w separate feed ELS – EM through wire/w single feed GLR – Fusing (fast blow) GMF – Fusing (slow blow)

Notes:
1 Must be in 4' increments
2 Optional
3 EL and EC are installed in last 4' of fixture sections and are not available concurrently with each other. Separate feed required for each EL or EC unless ELH is specified.

EXAMPLE:

Qty	Fixture section
4	PRM4 2 32 40FT R12 120 GEB 2SE EL SCT LP741 F1/24
1	PRM4 3 32 12FT R8 277 GEB DCT LP730 F2/15 GLR

PEERLESS LIGHTING Box 2556, Berkeley, CA 94702-0556 510.845-2760 Fax 510.845-2776 www.peerless-lighting.com

PP-9

ITEM #: _____

ALKCO TASK LIGHTING A2.0

Project	
Fixture Type	
Catalog #	

SUPER INCH®
1 1/2" T8/BI-AXIAL FLUORESCENT UNDERCABINET LUMINAIRE
100/200/300 SERIES

Thin 1 1/2" Profile.

Available with economy T8, energy saving, high CRI T8 or compact fluorescent lamps in 3000K, 3500K or 4100K.

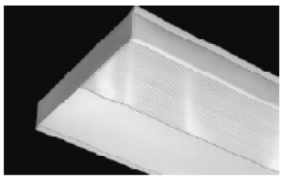
T8 models available with optional electronic ballast for maximum energy savings.

Flush ends for continuous row mounted illumination.

Hinged wireway facilitates hands-free wiring.

Choose translucent lens for diffuse illumination or opaque front task lens for 30% higher light levels while eliminating front-edge fixture brightness. Both are extruded out of Alkcorylic™ and guaranteed to remain pliable and not discolor.

Compact 1 1/2" depth, single-lamp lengths up to 4' and choice of popular T8 and 13 watt compact fluorescent lamps make the Super Inch ideal for a variety of commercial and institutional undercabinet lighting applications.



Optional "OF" Task Lens

ALKCO A Division of JJI Lighting Group, Inc.

FEATURES

OPTICAL SYSTEM

- Self-flanged, matte-diffuse high-impact polymer finishing trim with a durable, proprietary vapor deposition finish.
- Patented Bounding Ray™ Optical Principle design (U.S. Patent No. 5,800,050) provides lamp before lamp image and smooth transition from top of the reflector to bottom.
- One piece trim eliminates mitered flange corners and inside corner gaps.
- Upper reflector is painted a highly reflective matte white providing diffuse, even light with high efficiency.
- Proprietary Gotham diffusing lens available.

MECHANICAL SYSTEM

- 16-gauge painted steel mounting/plaster frame accommodates up to 1-1/2" thick ceiling materials.
- Patent pending adjustable aperture allows 1/4" adjustments in all directions and up to 5° of rotation allowing post-installation adjustments to ensure trim to trim alignment.
- 16-gauge galvanized steel mounting bars with continuous 4" vertical adjustments are shipped pre-installed. Post installation adjustment possible without the use of tools from above or below ceiling.
- Secondary housing adjustment system for precise, final ceiling to flange alignment.
- Galvanized steel junction box with hinged access covers and spring latch. Three combination 1/2"-3/4" and two 1/2" knockouts for straight-through conduit runs. Capacity: 8 (4 in, 4 out) No. 12 AWG conductors rated for 90°C.

ELECTRICAL SYSTEM

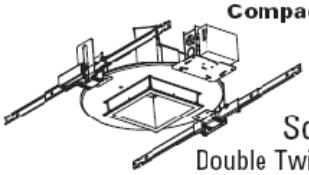
- Horizontally-mounted, four-pin, positive-latch, thermo-plastic socket.
- Class P, thermally-protected, high power factor electronic ballast mounted to the junction box.

LISTING

- Fixtures are UL Listed for thru-branch wiring, Non-IC recessed mounting and damp locations. Listed and labeled to comply with Canadian Standards.

Type ..... Catalognumber .....

.....

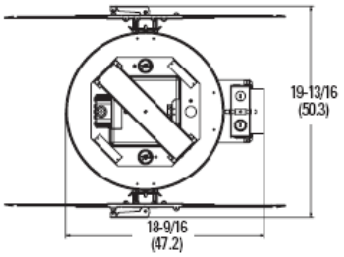


Compact Fluorescent Downlights

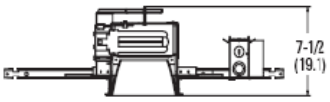
6" SQF

Square Open Reflector
Double Twin-Tube or Triple-Tube Lamp

SIMPLY5™ LIGHTING INTELLIGENCE



Aperture:	6 (15.2)
Ceiling Opening:	6-5/8 (16.8)
Overlap Trim:	7-3/16 (18.3)



All dimensions are inches (centimeters)

ORDERING INFORMATION

Example: **SQF 1/26TRT 6AR MVOLT**

Choose the boldface catalog nomenclature that best suits your needs and write it on the appropriate line.

SQF

Series	Wattage/Lamp	Aperture/Trim color	Finish
SQF	1/18DTT[1]	6AR Clear	LD Matte-diffuse
	1/26DTT[1]	6DSR Stepped	
	1/18TRT		
	1/26TRT		
	1/32TRT		
	1/42TRT		

Lens type

(blank) No lens
CSL Concentric square lens

Voltage

MVOLT[2]
120
277
347

Ballast[3]

(blank) Electronic ballast (standard)
ADEZ[5] Advance Mark 10® electronic dimming ballast. Minimum dimming level 5%
DMHL[4] Lutron Compact SE™ electronic dimming ballast. Minimum dimming level 5%
S5[5] SIMPLY5™ system ballast

Options

WLP 3500°K Lamp (shipped separately)
LRC[6] Provides compatibility with Lithonia Reloc® System. Lithonia Reloc System can be installed less this option with connectors provided by others. Access above ceiling required
ELR[7] Emergency battery pack. Remote test switch provided
ELRSD[7] Emergency battery pack with self-diagnostics. Remote test switch provided
GMF[8] Single, slow blow fuse
GLR[8] Single, fast blow fuse
CP Chicago Plenum
BDP[9] Ballast disconnect plug
HW Hardwire for S5 system; replaces Reloc®

NOTES
1 Requires 4-pin lamp. Ships as TRT fixture.
2 Multi-volt electronic ballast capable of operating on any line voltage from 120V through 277V, 50 or 60HZ.
3 For additional ballast types, refer to Technical Bulletins tab.
4 Available with 120V or 277V only.
5 SIMPLY5™ includes 9' S5 SSC Reloc wiring system. Specify voltage as 120V or 277V unless HW (hardwire) is ordered. Not available in 18W. See simply5.net for more information.
6 For compatible Reloc systems, refer to Technical Bulletins tab.
7 For dimensional changes, refer to Technical Bulletins tab.
8 Not available with MVOLT. Must specify voltage.
9 Meets codes that require in fixture disconnect.

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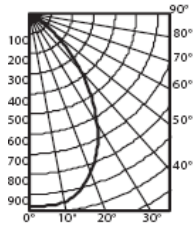
SQF 6 DCF-303

6" SQF Square Open Reflector

Distribution curve | **Distribution data** | **Output data** | **Coefficient of utilization** | **Illuminance Data at 30" Above Floor for a Single Luminaire**

SQF 1/32TRT 6AR LD, (1) 32W CF32DT/E/IN/835 lamp, 1.0 s/mh, 2400 rated lumens, Test No. LTL16269



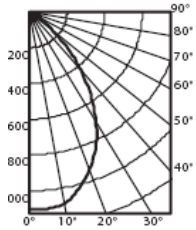
From 0°	Ave	Lumens
0	962	
5	961	91
15	912	254
25	746	340
35	505	313
45	255	196
55	78	73
65	17	18
75	5	6
85	1	1
90	0	

Zone	Lumens	% Lamp
0° - 30°	686.4	28.6
0° - 40°	999.5	41.6
0° - 60°	1268.8	52.9
0° - 90°	1293.7	53.9
90° - 180°	0.0	0.0
0° - 180°	1293.7	*53.9
*Efficiency		

pf	20%					
pc	80%		70%		50%	
pw	50%	30%	50%	30%	50%	30%
1	.59	.57	.58	.56	.56	.54
2	.54	.51	.53	.51	.51	.49
3	.50	.46	.49	.46	.47	.45
4	.45	.42	.45	.42	.44	.41
5	.42	.38	.41	.38	.40	.37
6	.39	.35	.38	.35	.37	.34
7	.36	.32	.36	.32	.35	.32
8	.33	.30	.33	.30	.32	.29
9	.31	.28	.31	.27	.30	.27
10	.29	.26	.29	.25	.28	.25

		50% beam angle 55.2°		10% beam angle 89.1°	
Mount height	Inital fc at beam center	Beam diameter	fc at beam edge	Beam diameter	fc at beam edge
8	31.8	5.7	15.9	10.8	3.2
10	17.1	7.8	8.6	14.8	1.7
12	10.7	9.9	5.3	18.7	1.1
14	7.3	12.0	3.6	22.6	0.7
16	5.3	14.1	2.6	26.6	0.5

SQF 1/42TRT 6AR LD, (1) 42W CF42DT/E/IN/835 lamp, 1.0 s/mh, 3200 rated lumens, Test No. LTL16273



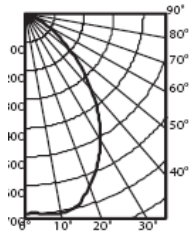
From 0°	Ave	Lumens
0	1104	
5	1104	105
15	1023	286
25	833	380
35	567	351
45	291	223
55	88	84
65	18	20
75	5	6
85	1	1
90	0	

Zone	Lumens	% Lamp
0° - 30°	770.5	24.1
0° - 40°	1121.5	35.0
0° - 60°	1428.4	44.6
0° - 90°	1455.7	45.5
90° - 180°	0.0	0.0
0° - 180°	1455.7	*45.5
*Efficiency		

pf	20%					
pc	80%		70%		50%	
pw	50%	30%	50%	30%	50%	30%
1	.50	.48	.49	.48	.47	.46
2	.46	.43	.45	.43	.43	.42
3	.42	.39	.41	.39	.40	.38
4	.38	.35	.38	.35	.37	.34
5	.35	.32	.35	.32	.34	.32
6	.33	.30	.32	.29	.32	.29
7	.30	.27	.30	.27	.29	.27
8	.28	.25	.28	.25	.27	.25
9	.26	.23	.26	.23	.26	.23
10	.25	.22	.24	.22	.24	.21

		50% beam angle 54.2°		10% beam angle 89.0°	
Mount height	Inital fc at beam center	Beam diameter	fc at beam edge	Beam diameter	fc at beam edge
8	36.5	5.6	18.2	10.8	3.6
10	19.6	7.7	9.8	14.7	2.0
12	12.2	9.7	6.1	18.7	1.2
14	8.3	11.8	4.2	22.6	0.8
16	6.1	13.8	3.0	26.5	0.6

SQF 1/32TRT 6DSR, (1) 32W CF32DT/E/IN/835 lamp, 1.1 s/mh, 2400 rated lumens, Test No. LTL16271



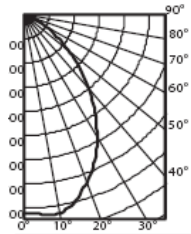
From 0°	Ave	Lumens
0	699	
5	701	67
15	691	193
25	579	265
35	432	268
45	274	210
55	139	125
65	51	53
75	15	18
85	3	3
90	0	

Zone	Lumens	% Lamp
0° - 30°	525.0	21.9
0° - 40°	793.0	33.0
0° - 60°	1128.0	47.0
0° - 90°	1201.7	50.1
90° - 180°	0.0	0.0
0° - 180°	1201.7	*50.1
*Efficiency		

pf	20%					
pc	80%		70%		50%	
pw	50%	30%	50%	30%	50%	30%
1	.54	.52	.53	.52	.51	.50
2	.49	.46	.48	.46	.46	.44
3	.44	.41	.43	.40	.42	.39
4	.40	.37	.39	.36	.38	.35
5	.37	.33	.36	.33	.35	.32
6	.33	.30	.33	.29	.32	.29
7	.31	.27	.30	.27	.30	.26
8	.28	.25	.28	.25	.28	.24
9	.26	.23	.26	.23	.26	.22
10	.25	.21	.24	.21	.24	.21

		50% beam angle 58.0°		10% beam angle 95.6°	
Mount height	Inital fc at beam center	Beam diameter	fc at beam edge	Beam diameter	fc at beam edge
8	23.1	6.1	11.6	12.1	2.3
10	12.4	8.3	6.2	16.5	1.2
12	7.7	10.5	3.9	21.0	0.8
14	5.3	12.8	2.6	25.4	0.5
16	3.8	15.0	1.9	29.8	0.4

SQF 1/42TRT 6DSR, (1) 42W CF42DT/E/IN/835 lamp, 1.1 s/mh, 3200 rated lumens, Test No. LTL16275



From 0°	Ave	Lumens
0	822	
5	828	79
15	798	223
25	665	305
35	495	307
45	318	243
55	161	145
65	59	61
75	18	20
85	3	4
90	0	

Zone	Lumens	% Lamp
0° - 30°	606.4	19.0
0° - 40°	913.4	28.5
0° - 60°	1300.9	40.7
0° - 90°	1386.7	43.3
90° - 180°	0.0	0.0
0° - 180°	1386.7	*43.3
*Efficiency		

pf	20%					
pc	80%		70%		50%	
pw	50%	30%	50%	30%	50%	30%
1	.47	.45	.46	.45	.44	.43
2	.42	.40	.41	.39	.40	.38
3	.38	.35	.38	.35	.36	.34
4	.35	.32	.34	.31	.33	.31
5	.32	.28	.31	.28	.30	.28
6	.29	.26	.29	.26	.28	.25
7	.27	.23	.26	.23	.26	.23
8	.25	.21	.24	.21	.24	.21
9	.23	.20	.23	.20	.22	.19
10	.21	.18	.21	.18	.21	.18

		50% beam angle 57.2°		10% beam angle 95.4°	
Mount height	Inital fc at beam center	Beam diameter	fc at beam edge	Beam diameter	fc at beam edge
8	27.2	6.0	13.6	12.1	2.7
10	14.6	8.2	7.3	16.5	1.5
12	9.1	10.4	4.6	20.9	0.9
14	6.2	12.5	3.1	25.3	0.6
16	4.5	14.7	2.3	29.7	0.5

NOTES:
1. For electrical characteristics consult Technical Bulletins tab.
2. Tested to current IES and NEMA standards under stabilized laboratory conditions. Various operating factors can cause differences between laboratory data and actual field measurements. Dimensions and specifications are based on the most current available data and are subject to change without notice.

DCF-303

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LX-SERIES
Starliter™

DATA SHEET

LX-Starliter
Designer Series High-Bay

For style, functionality and energy efficiency, the LX Starliter High-Bay from Sportlite provides versatile, natural up-light that is perfect for "warehouse type" retail stores, shopping centers, general retail space and high tech manufacturing facilities. The LX800 with 42 watt compact fluorescent lamps (CFL) supply 25,600 lumens and 85 percent lumen maintenance to ensure products will never be left in the dark.

Stylish Effect

Sportlite offers a stylish alternative to standard acrylic- or glass-type HID fixtures with the new LX Starliter High-Bay. Featuring an eye-pleasing ballast housing and reflector, the LX Series virtually eliminates hot spots and color shifts typical of metal halide lighting fixtures. Multiple point sources of light within each luminaire reduce the glare often associated with standard HID high-bay fixtures.

Mood Lighting

The LX Series sets the tone for any application, offering a wide variety of lamp color temperatures to create the desired effect or match existing lighting. These high-CRI (82-84) lamps produce a more natural lighting effect. The LX Series provides comfortable even light, a larger light spread, minimal shadowing and no stroboscopic effects. Individual pairs of lamps can be turned off to lower light levels and to reduce energy consumption.

Smart & Functional

The LX Series offers smart features for simple and safe use. Its modular construction featuring "AMP" snap lock electrical connectors and "spring-clip" secured ballasts allows easy installation and maintenance with minimal tools. The "instant on" feature allows control over pairs of lamps within an individual luminaire. Choose sensor-controlled, four level stepped dimming for an efficient and inexpensive way to lower light levels and save energy, without changing the photo-metrics of the fixture.

Energy Efficient

The energy saving, compact fluorescent LX800 Designer Series High-Bay is a must-have replacement for the high energy consuming, old standard HID style high-bay fixture. Realize an average 25 to 40 percent energy savings compared to 400 watt HID fixtures. This low heat lighting system is excellent for use in applications sensitive to the higher heat factor associated with 400 watt HID fixtures. It may also have a positive affect on air conditioning costs.

SPORTLITE, INC. Tel: 623.930.0074 Fax: 623.930.0045 601 North 44th Avenue Suite 102 Phoenix, AZ 85043 www.sportlite.com
R06/06

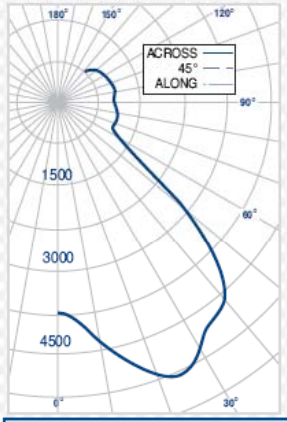
SPECIFICATIONS

Starliter™

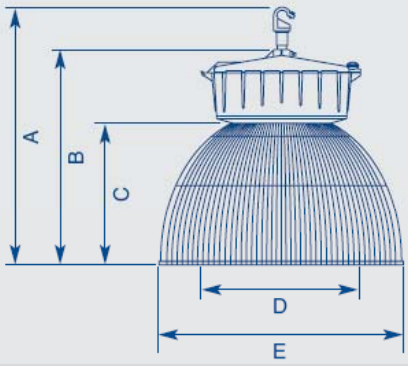
Input Watts: 336 Watts +/- 3% with 42w Lamps
Luminous Efficacy: 88.6 lm/w @ 277v (42w)

Initial Lumens per Lamp:	26w	32w	42w	57w	60w	70w	85w	120w
	1,800	2,400	3,200	4,300	4,000	5,200	6,000	9,000

Total Initial Lumens: 25,600 W/(8) 42 Watt Lamps
Lumen Maintenance: 85%
Efficiency: 81.3% of rated lumens
Color Temperature: 3,000k, 3,500k, 4,100k
Color Rendering Index: 82 - 84
Lamp Life: UP TO 20,000 hours
Base: GX24q-4 + 2G8
Electronic Ballast:.90BF, PF=99, THD<2%
Weight: 16-18lbs depending on Ballast used
Suitable for 40ºC Ambient



A	25.00"	635.00mm
B	20.75"	527.05mm
C	13.75"	349.25mm
D	x 12.00" 304.80mm	y 12.00" 304.80mm
E	∅ 22.25"	565.15mm



Ordering Information (Example – LX8-T42-41K-22LEXCP-22CLP-277-4SL-3PEN-EP94-SC)

Series

LX8	LX800 (8 Lamps)
LX8CC	LX800 Custom Color
LX6	LX600 (6 Lamps)
LX6CC	LX600 Custom Color
LX4	LX400 (4 Lamps)
LX4CC	LX400 Custom Color
LX3	LX300 (3 Lamps)
LX3CC	LX300 Custom Color
LX2	LX200 (2 Lamps)
LX2CC	LX200 Custom Color

Lamp Type

T26	26 Watt
T32	32 Watt
T42	42 Watt
T57	57 Watt
PLH60	60 Watt
T70	70 Watt
PLH85	85 Watt (Maximum 4 Lamps)
PLH120	120 Watt (Maximum 4 Lamps)

Lamp Color

27k (26w Only)
30k
35k
41k

Dome Type

22LEXCP 22" Clear Prismatic Poly

Lens Type

22CLP	22" Conical Poly Prismatic
22DL3P	22" - 3" Drop Poly Prismatic
22FLP	22" Flat Poly Clear

*Cannot use lens with lamps above 42W in LX8

Voltage

120
208
277
347 – (Extra Charge)

Switching NOTE 6

1SL	1 Switch Leg
2SL	2 Switch Legs
3SL	3 Switch Legs
4SL	4 Switch Legs
PB2S	PulseBloc (1 to 4 switch legs) Single Zone
PB2DS	PulseBloc (Dimming – To be used with one DM42-2M7 Dimming Ballast) Single Zone
PB2M	PulseBloc (1 to 4 switch legs) 2 to 4 Zone
PB2DM	PulseBloc (Dimming – To be used with one DM42-2M7 Dimming Ballast) 2 to 4 Zone

Mounting Options NOTE 1

3PEN	Pendant by Others
H	Male Hook
C	Single Circuit Cord 6'
CM	Multi-Circuit Cord 6'
HC	Male Hook & Single Circuit Cord 6'
HCM	Male Hook & Multi-Circuit Cord 6'
HCP	Male Hook, Single Circuit Cord 6' & Straight Plug
HCPL	Male Hook, Single Circuit Cord 6' & Locking Plug
HCMPL	Male Hook, Multi-Circuit Cord 6' & Locking Plug

Emergency Ballast Options (lm=lumens) NOTE 2

EP42	IOTA I-42B, One Lamp, 32w-650 lm, 42w-750 lm, IM
EP42SD	IOTA ISD-420A, One Lamp, 32W-1050 lm, 42w-1300 lm, 57w-1160 lm, 70w-1200lm, Self-Diagnostic, EX
EP420	IOTA I-420A, One Lamp, 32w -1060 lm, 42w-1300 lm, 57w-1160 lm, 70w-1200 lm, EX
EP75C	Bodine B75C, One Lamp, 32w-800 lm, 42w-800 lm, 57w-1150 lm, 70w-1300 lm, EX
EP180	IOTA I-180, Two Lamp 42w- 3000 lm, One Lamp 57w-2700 lm, One Lamp 70w-2800 lm, EX
EP94	Bodine B94C, 750 Lumens, 42w-One Lamp, IM
EP30	Bodine B30, Two Lamp, 42w-3500 lm, One Lamp, 42w-3200 lm, EX
GTD	Bodine, Generator Transfer Device, IM

Dimming Ballast Options NOTE 3, 4, 5 **

DM42-2M7	Advance, Mark VII, 32/42w- Two Lamps, 57/70w-One Lamp, – NOTE 4
DM42-2MX	Advance, Mark X, 32/42w-Two Lamp, 57/70w-One Lamp, – NOTE 3
DM42-2SE	Lutron Compact SE, 42w – Two Lamps, – NOTE 5
DM32-2SE	Lutron Compact SE, 32w – Two Lamps – NOTE 5
DM32-2TU	Lutron, Tu-Wire, 32w – Two Lamps – NOTE 3

**You must specify the quantity of dimming ballasts required per fixture.

Accessories

SC	6' Safety Cable to Ballast Box
22WG	Wire Guard
22XWG	Wire Guard (For Use with Conical Lens)
FWG	Full Wireguard (Covers Entire Reflector)
FU	In-Line Fuse (One Per Switch Leg)
DMC	Dual Mounting Crossbar
BBSW	Ballast Box Shroud – White
BBSCC	Ballast Box Shroud – Custom Color

Note 1
Plug Not Available with 4 Switch Legs.

Note 2
EX = External Mount
IM = Internal Mount
Consult Factory for EM/Cord/Plug Compatibility

Note 3
Advance Mark X and Lutron Ta-Wire Ballasts Require a 2-Wire Wall Dimmer.

Note 4
Requires a 2-Wire 0-10 Volt Dimmer in addition to the Normal Hot, Neutral and Ground.

Note 5
Requires one control wire in addition to the normal hot, neutral & ground.

Note 6
If specifying PulseBloc consult PulseBloc specification guide.

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R06/06

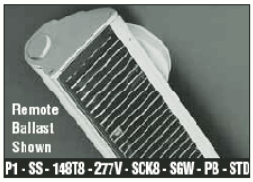
Fluorescent Small Surface Linear

WINDIRECT™

LAMP | SIZE | APPLICATION
INDOOR | OUTDOOR

TYPE

SURFACE WALL
SURFACE CEILING
SEMI-RECESSED
SURFACE LINEAR
COVE
PENDANT
CANTILEVER
BASE MOUNT
TRUSS
MODIFIED STANDARD
FINISHES
OPTIONS
TECHNICAL



P1 - SS - 148T8 - 277V - SCK8 - SGW - P3 - STD

P2 - SS - 148T8 - 277V - SCK1 - SGW - X - STD

Profile - P1 (basic): Anodized, extruded aluminum specular reflector with solid aluminum endcaps and stainless steel hardware. Extruded aluminum visors are combined with P1 basic profile to create P2, P3, P4 & *P5 profiles.

Type - Small profile with smooth or ribbed detail.
Indoor; non-gasketed, captive extruded alum. hinge for lens and baffle options.
Outdoor; silicone gasketed lens, captive extruded alum. door with window cut-out for regressed lens.
Lens; open aperture is standard for indoor fixtures. Outdoor fixtures shall be equipped with clear acrylic lens option.

Mounting - Two standard mounts are fully adjustable and lockable.
Remote Ballast; a machined alum. knuckle connects profile to mounting plate standoff tubes to create a clean appearance.
Integral Ballast; an extruded alum. ballast housing incorporates a simple or deco yoke mount. Either wall or ceiling mounted.

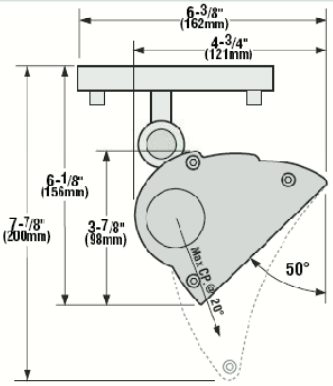
Performance - Asymmetric distribution provides a concentration of light on target surface for smooth illumination.
Ceiling; maximum candlepower aimed 20° above nadir has less than 10% spill light within the 0-20° zone and less than 2% spill light within the 90-180° zone.
Wall; maximum candlepower aimed 120° above nadir has less than 15% spill light within the 0-120° zone and less than 3% spill light within the 180-270° zone.

Electrical - Electronic, HPF ballast, lamp protection circuit, Class P and thermally protected. The minimum number of ballasts will be used. Provide 90°C supply wire.

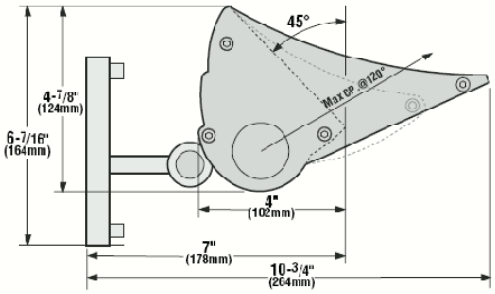
Finishes - An electrostatically applied wet paint system utilizes a multi-stage process to provide a durable acrylic enamel finish. Suitable for indoor and outdoor applications.

Options - For complete list and detailed descriptions, refer to Options Section.

SCK8: Ceiling Mount (Remote Ballast)



SCK1: Wall Mount (Remote Ballast)



Refer to mounting codes below for how to specify single and multiple fixture applications.

SPECIFICATIONS

P2 - SS - 272T8 - 277V - SCK1 - SGW - X - STD

PROFILE


P1 (basic)


P2 (solid)


P3 (perforated)


P4 (scalloped)


*P5 (short)

TYPE

Indoor Locations: (camp label)
SS: Small Smooth
SR: Small Ribbed

Outdoor Locations: (wet label)
SSW: Small Smooth **Wet**
SRW: Small Ribbed **Wet**

LAMPING - VOLTAGE

120V or 277V

Description

Linear Fluorescent

T5 Single Lamp Cross Section:
F14T5 F21T5
F28T5 F35T5

T5/HO Single or Two-Lamp Cross Section: NEW
F24T5/HO F39T5/HO
F54T5/HO F80T5/HO

T8 Single Lamp Cross Section:
F17T8 F25T8
F32T8 F40T8

NOTE: Refer to lamp chart page 69 to specify lamp code and catalog number.

MOUNTING

Remote Ballast

Ceiling Mount


SCK8 (Single)
SCK8L (Left End)
SCK8R (Right End)
SCK8I (Intermediate)

Wall Mount


SCK1 (Single)
SCK1L (Left End)
SCK1R (Right End)
SCK1I (Intermediate)

Integral Ballast

Ceiling Mount


SCS1 (Single)
SCS1L (Left End)
SCS1R (Right End)
SCS1I (Intermediate)

Wall Mount


SCS2 (Single)
SCS2L (Left End)
SCS2R (Right End)
SCS2I (Intermediate)

FINISH

SGW: Semi-Gloss White
SGB: Semi-Gloss Black
ALP: Aluminum Paint (matte finish)
LGP: Light Gold Iridescent (gloss finish)
PBP: Pale Bronze Paint(gloss finish)
SPF: (STD) Standard Painted Finish to be determined
CPF: (MOD) Custom Painted Finish

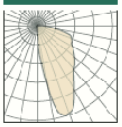
OPTIONS

X: No Options
SB: Straight Blade Baffle (external mount for use with lens)
PB: Parabolic Blade Baffle (internal mount)
EM: (remote) Emergency Battery
CA: Clear Acrylic Lens
SO: (MOD) Special Option
Options - For complete list and detailed descriptions, refer to Options Section.

CLASS

STD: Indicate only when specifying a standard.
MOD: Indicate when specifying any modification.

PHOTOMETRY


F54W15/HO
Refer to Technical Section for detailed Photometry Reports.
Report #10943

Note: *P5 (short visor) does not provide the same sightline shielding as the P2, P3 or P4 visors (see options section for details).
T8, T5 and T5/HO lamps perform poorly in temperatures below 50°F.

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winona lighting

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WINDIRECT™ Small Surface Linear Fluorescent

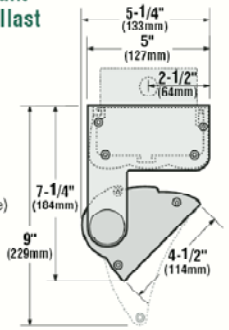
SIZE | APPLICATION | LAMP

INDOOR | OUTDOOR

SURFACE WALL | SURFACE CEILING | SEMI-RECESSED | SURFACE LINEAR | COVE | PENDANT | CANTILEVER | BASE MOUNT | TRUSS | MODIFIED STANDARD | FINISHES | OPTIONS | TECHNICAL

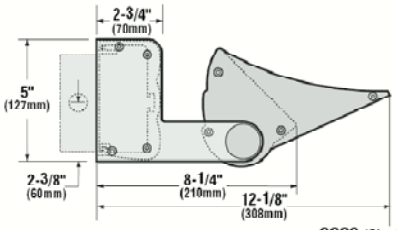
MOUNTING STYLES

Ceiling Mount Integral Ballast



SCS9 (Single)
SCS9L (Left End)
SCS9R (Right End)
SCS9I (Intermediate)

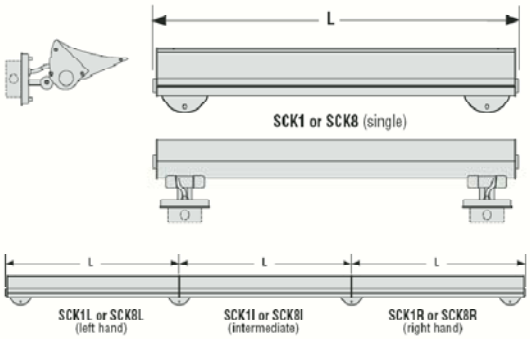
Wall Mount Integral Ballast



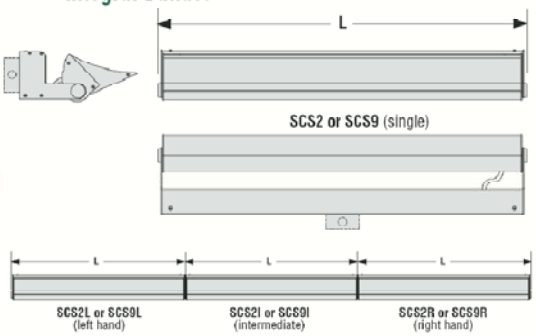
SCS2 (Single)
SCS2L (Left End)
SCS2R (Right End)
SCS2I (Intermediate)

MOUNTING DETAILS

Remote Ballast



Integral Ballast



LAMP CODES

LAMP X SECTION	LAMP SIZE	LAMP DESCRIPTION	ACTUAL LENGTHS REMOTE: LENGTH SCK1,SK8	REMOTE: LENGTH SCK1LR,SCK8LR	REMOTE: LENGTH SCK1I,SCK8I	INTEGRAL: LENGTH SCS2,SCS9	INTEGRAL: LENGTH SCS2LR,SCS9LR	INTEGRAL: LENGTH SCS2I,SCS9I	WEIGHT LBS. REMOTE/INTEGRAL
One Lamp (cross section)	124T8	1-17W/T8	25 7/8"	25 9/16"	25 1/4"	26 1/4"	25 15/16"	25 5/8"	8/13
	136T8	1-25W/T8	37 7/8"	37 9/16"	37 1/4"	38 1/4"	37 15/16"	37 5/8"	10/19
	148T8	1-32W/T8	49 7/8"	49 9/16"	49 1/4"	50 1/4"	49 15/16"	49 5/8"	16/26
	160T8	1-40W/T8	61 7/8"	61 9/16"	61 1/4"	62 1/4"	61 15/16"	61 5/8"	19/32
	272T8	2-25W/T8	74 13/16"	74 1/2"	74 3/16"	75 3/16"	74 7/8"	74 9/16"	20/38
	296T8	2-32W/T8	98 13/16"	98 1/2"	98 3/16"	99 3/16"	98 7/8"	98 9/16"	32/52
One Lamp (cross section)	select one: 124T5 or 124T5/HO	1-F14W/T5 or 24W/T5/HO	24 1/4"	23 15/16"	23 5/8"	24 5/8"	24 5/16"	24"	8/13
	136T5 or 136T5/HO	1-F21W/T5 or 39W/T5/HO	36 1/16"	35 3/4"	35 7/16"	36 7/16"	36 1/8"	35 13/16"	10/19
	148T5 or 148T5/HO	1-F28W/T5 or 54W/T5/HO	47 7/8"	47 9/16"	47 1/4"	48 1/4"	47 15/16"	47 5/8"	16/26
	160T5 or 160T5/HO	1-F35W/T5 or 80W/T5/HO	59 11/16"	59 3/8"	59 1/16"	60 1/16"	59 3/4"	59 7/16"	19/32
	272T5 or 272T5/HO	2-F21W/T5 or 39W/T5/HO	71 5/16"	71"	70 11/16"	71 11/16"	71 3/8"	71 1/16"	20/38
	296T5 or 296T5/HO	2-F28W/T5 or 54W/T5/HO	94 15/16"	94 5/8"	94 5/16"	95 5/16"	95"	94 11/16"	32/52
Two Lamp (cross section) NEW	224T5/HO	2-24W/T5/HO	24 1/4"	23 15/16"	23 5/8"	24 5/8"	24 5/16"	24"	8/13
	236T5/HO	2-39W/T5/HO	36 1/16"	35 3/4"	35 7/16"	36 7/16"	36 1/8"	35 13/16"	10/19
	248T5/HO	2-54W/T5/HO	47 7/8"	47 9/16"	47 1/4"	48 1/4"	47 15/16"	47 5/8"	16/26
	260T5/HO	2-80W/T5/HO	59 11/16"	59 3/8"	59 1/16"	60 1/16"	59 3/4"	59 7/16"	19/32
	472T5/HO	4-39W/T5/HO	71 5/16"	71"	70 11/16"	71 11/16"	71 3/8"	71 1/16"	20/38
	496T5/HO	4-54W/T5/HO	94 15/16"	94 5/8"	94 5/16"	95 5/16"	95"	94 11/16"	32/52

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COLOR KINETICS

PHILIPS

COLORBLAZE 48

The ColorBlaze® 48 fixture washes large areas with far-reaching, rich, saturated colors and color-changing lighting effects. The streamlined, four-foot black metal housing provides a simple yet powerful solution for large-area scenery and wash lighting for theaters, TV and video studios, concerts, events, casinos, and exhibits. On-board power supplies and addressing capabilities eliminate the need for dedicated support equipment and simplifies specification and installation. The auto-switching power supplies work around the world.

Designed in a rugged extruded aluminum housing, each fixture features attached mounting brackets with two, 1/2-inch (13 mm) mounting holes for use with Cheeseborough clamps or pipe clamps. Locking knobs located on the mounting brackets allow for 180° rotational adjustment and locking without the use of special tools. Optional mounting brackets are available for T-handle mount applications. The housing is equipped to support spread lenses, louvers, and other attachments. A single 3-wire, 18AWG 6-foot (1.8 m) UL/cUL rated cord with IEC and flying leads is supplied. (Consult distribution for cord sets listed for PSE or CE).

Each ColorBlaze 48 fixture has eight individual circuit board assemblies, each with 18 high-intensity LEDs. This makes it sequentially controllable in 6-inch increments by a Color Kinetics DMX controller or a third-party DMX512 controller. Each circuit board is pre-addressed for Light# 1-8/DMX# 1-24. Data can be daisy-chained from fixture to fixture with an RJ-45 data cable or an XLR-5 data cable.

For protection from overheating, ColorBlaze 48 has been designed with a temperature monitoring feature. If operating temperatures rise to an unsafe level, a compensation circuit is triggered and ColorBlaze 48 operation is interrupted causing the lights to turn dull red. After 30 minutes the lights will auto-cycle and return to full intensity.

COLORBLAZE 48 SPECIFICATIONS

COLOR RANGE	16.7 million (24 bit) additive RGB colors; continuously variable intensity output range
SOURCE	High intensity power light emitting diodes (LEDs)
BEAM ANGLE	10°
HOUSING	Extruded aluminum with black finish
POWER CONNECTOR	IEC 15A (max) with C13 plug, UL/cUL rated 2-pole, 3-wire, grounded, 15A, flying leads
DATA CONNECTORS	RJ-45 or XLR-5
LISTINGS	UL/cUL, CE, PSE

COMMUNICATION SPECIFICATIONS

DATA INTERFACE	DMX512
CONTROL	Color Kinetics' line of DMX controllers or other DMX512 (RS-485) controllers

ELECTRICAL SPECIFICATIONS

POWER REQUIREMENT	100-240VAC
POWER CONSUMPTION	280W, 2.5A nominal at full intensity (full RGB)

ENVIRONMENTAL SPECIFICATIONS

TEMPERATURE RANGE	-40°F to 122°F (-40°C to 50°C) operating temperature 14°F to 122°F (-10°C to 50°C) starting temperature

CHROMACORE® BY COLOR KINETICS

OPTIBIN® BY COLOR KINETICS

PS E CE c UL us LISTED

ITEM#116-000016-00

BR0116 Rev 07

Specifications subject to change without notice. Refer to www.colorkinetics.com for the most recent data sheet versions.

LED SOURCE LIFE

In traditional lamp sources, lifetime is defined as the point at which 50% of the lamps fail. This is also termed Mean Time Between Failure [MTBF]. LEDs are semiconductor devices and have a much longer MTBF than conventional sources. However, MTBF is not the only consideration in determining useful life. Color Kinetics uses the concept of useful light output for rating source lifetimes. Like traditional sources, LED output degrades over time (lumen depreciation) and this is the metric for SSL lifetime.

LED lumen depreciation is affected by numerous environmental conditions such as ambient temperature, humidity and ventilation. Lumen depreciation is also affected by means of control, thermal management, current levels, and a host of other electrical design considerations. Color Kinetics systems are expertly engineered to optimize LED life when used under normal operating conditions. Lumen depreciation information is based on LED manufacturers' source life data as well as other third party testing. Low temperatures and controlled effects have a beneficial effect on lumen depreciation. Overall system lifetime could vary substantially based on usage and the environment in which the system is installed.

Temperature and effects will affect lifetime. Color Kinetics rates product lifetime using lumen depreciation to 50% of original light output. When the fixture is running at room temperature using a color wash effect, the range of lifetime is in the range of 80,000-100,000 hours. This is LED manufacturers' test data. High output is defined as any LED device that is 1/2 watt or above. For more detailed information on source life, please see www.colorkinetics.com/lifetime.

OPTIBIN®

There are inherent variations in the fabrication processes of all semiconductor materials. For LEDs, this variance results in differences in the color and intensity of light output as well as electrical characteristics. Due to these differences, LED manufacturers sort production into "bins," but insuring the availability of a single bin is very difficult. To minimize this issue and achieve optimal color consistency in its products, Color Kinetics has developed and uses a proprietary technology called Optibin. Optibin is an advanced production binning optimization process that minimizes the effects of LED variance for the best possible output uniformity in the final product. Color Kinetics Optibin technology gives the most consistent control of color and intensity from product to product.

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COLORBLAZE 48

PHOTOMETRIC PERFORMANCE

Photometric data is based on test results from an independent testing lab.

SOURCE SPECIFICATIONS

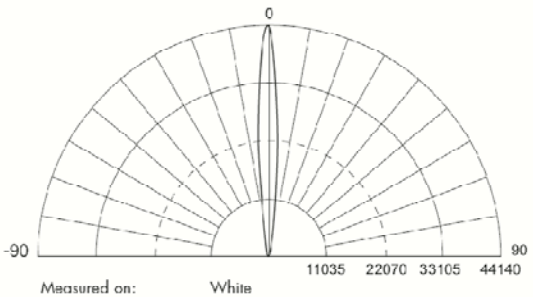
Optics:	Clear polycarbonate
Source:	144 LEDs (48 Red, 48 Green, 48 Blue)
Beam Angle:	10° (at 50% of peak illuminance)
Distribution:	Symmetric direct illumination
CCT:	Adjustable 1,000 – 10,000K
CRI:	Not measurable (CIE 13.3-1995)

ILLUMINANCE DISTRIBUTION

7.9 / 85.0	10.7 / 115.2	11.9 / 128.1	11.4 / 122.7	9.6 / 103.3	6.9 / 74.3	6.0′/2.0m
15.3 / 164.7	25.3 / 272.3	29.3 / 315.4	27.6 / 297.1	19.1 / 205.6	10.0 / 107.6	
52.8 / 568.3	99.1 / 1066.7	107.0 / 1151.7	109.0 / 1173.3	68.0 / 732.0	18.0 / 193.8	3.0′/1.0m
59.0 / 635.1	144.0 / 1550.0	183.0 / 1969.8	183.0 / 1969.8	140.0 / 1507.0	54.6 / 587.7	
23.4 / 251.9	82.5 / 888.0	127.0 / 1367.0	125.0 / 1345.5	112.0 / 1205.6	57.3 / 616.8	
10.1 / 108.7	25.5 / 274.5	38.9 / 418.7	40.5 / 435.9	35.4 / 381.0	19.6 / 211.0	0.0′/0.0m
3.0′/1.0m		0′/0m			3.0′/1.0m	

Units: Footcandles (top)/Lux (bottom)
10.8 lux = 1 fc
Measured on: All, reflectance model 80/50/20%
Distance from surface: Bottom of grid, 3′ (1.0 m) from surface, light at a 45° angle off horizontal

CANDLE POWER DISTRIBUTION



Measured on: White
Beam center: 44140 cd
Thin dashed line: Indicates 50% of peak
Multipliers: 0.33 Red, 0.50 Green, 0.18 Blue

ILLUMINANCE

COLOR	3′ / 1m	6′ / 2m	9′ / 3m	15′ / 5m
WHITE	2162.0 / 23271.8	675.0 / 7265.7	253.0 / 2723.3	127.0 / 1367.0
RED	721.2 / 7763.5	225.2 / 2423.8	84.4 / 908.5	42.4 / 456.0
GREEN	1070.2 / 11519.5	334.1 / 3596.5	125.2 / 1348.0	62.9 / 676.7
BLUE	393.5 / 4235.5	122.9 / 1322.4	46.0 / 495.6	23.1 / 248.8

Measured in Footcandles (top)/Lux (bottom) on axis.
Measured on: All, reflectance 0.

LIGHT OUTPUT

COLOR	TOTAL OUTPUT (lumens)	POWER (Watts)	EFFICACY (Lm/W)
WHITE	2282	240.0	9.5
RED	761.3	84.0	9.1
GREEN	1129.6	84.0	13.4
BLUE	415.3	84.0	4.9

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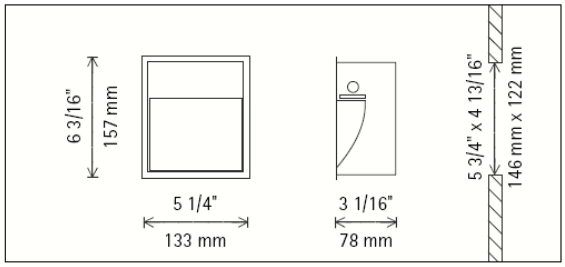
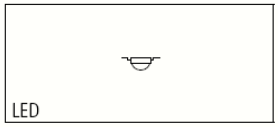
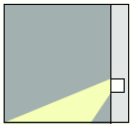
ERCO

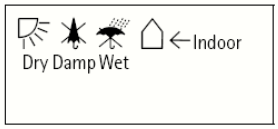
Floor washlight

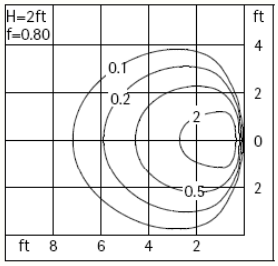
with LED











44596.023 Reflector silver LED
daylight white
LED 3.6W 135lm 5500K

Product description
Housing for recessed mounting in dry-wall partitions: plastic.
Double-sided reversible mounting frame, for covering the wall cut-out or for use as plastered-in flush wall, trim detail: plastic, white (RAL9002) lacquered. Mounting bracket: metal. Clamp extension 8-22mm.
Electronic control gear 120V, 60Hz.
5-pole terminal block. Through-wiring possible.
Version 1
Replaceable LED module.
Cover plate with reflector: plastic, surface-coated silver. Horizontal
Softec lens as safety glass.
Weight 1.81lbs / 0.82kg

ERCO Lighting, Inc.
160 Raritan Center Parkway
Suite 10
Edison, NJ 08837
USA
Tel.: +1 732 225 8856
Fax: +1 732 225 8857
info.us@erco.com

Technical Region: 120V/60Hz
Edition: 11.15.2007
Please download latest version from
www.erco.com/44596.023

1/1

PHILIPS

COLOR KINETICS

COLORBLAST12POWERCORE

PRELIMINARY SPECIFICATION - *SUBJECT TO CHANGE*

The ColorBlast® 12 Powercore fixture combines rich, saturated wall-washing color and color-changing effects with high-performance, operational efficiency, and simplified installation. Powercore® technology and low-profile mounting are combined in a stylish and durable housing.

Projecting a soft-edge beam of light, ColorBlast 12 Powercore is a sealed product designed for both indoor and outdoor installations. The fixture is fully enclosed in a rugged die-cast aluminum housing and meets or exceeds specifications for use in wet locations. ColorBlast 12 Powercore has a single 4-conductor cable and attaches to standard junction boxes with 3.5" center-to-center hole spacing. The pre-assembled mounting base provides smooth, friction-free rotation. The base is designed to simplify installation by minimizing parts and allowing for after-installation rotation, eliminating the need for precise junction box positioning. With up to 350° rotation, the locking base swivel, along with 110° locking fixture rotation, offers a versatile range of light positioning. Four mounting screws ensure a water-tight, maximum longevity seal.

Powercore technology is a digital power processing technology to drive LED systems, integrating power and data management directly into the fixture and eliminating the need for an external power supply. Powercore surpasses traditional power supply technology by streamlining multiple conversion and regulation stages into a single, flexible, microprocessor-controlled power stage that controls power output to LED systems directly from line voltage and significantly increases overall system efficiency. Built-in active power factor correction (PFC) yields higher system efficiencies and minimizes stress on building wiring, making the installation and system more cost effective.

ColorBlast 12 Powercore can be controlled by Color Kinetics' line of controllers or a third-party DMX controller and receives data via Color Kinetics' Data Enabler—a data formatting device that accepts DMX or Color Kinetics Ethernet protocol. An Installation Tool is available at http://www.colorkinetics.com to calculate the number of fixtures per Data Enabler for specific installations. For example, in an installation using a 60 foot (18.3 m), 12AWG feeder cable with 12AWG, 5 feet of cable between fixtures, each Data Enabler can support up to 25 fixtures at 120VAC (15A), 34 fixtures at 120VAC (20A), or 60 fixtures at 240VAC (20A). ColorBlast 12 Powercore.

CHROMACORE® BY COLOR KINETICS

POWERCORE® BY COLOR KINETICS

OPTIBIN® BY COLOR KINETICS

DRY

DAMP

WET

CE c UL us LISTED 13PE

COLORBLAST 12 POWERCORE PRELIMINARY SPECIFICATIONS

COLOR RANGE	16.7 million (24bit) additive RGB colors; continuously variable intensity
SOURCE	36 High intensity RGB LEDs
BEAM ANGLE	10° clear lens, 23° ground lens
HOUSING	Die cast aluminum, powder coated
LENS	Clear tempered glass or soft-focus tempered glass
CONNECTORS	Unified power and data cable
LISTINGS	UL/cUL, CE

COMMUNICATION SPECIFICATIONS

DATA INTERFACE	Color Kinetics Data Enabler
CONTROL	Color Kinetics full line of controllers or another DMX512 (RS485) source

ELECTRICAL SPECIFICATIONS

INPUT	100-240VAC, 50-60 Hz
POWER CONSUMPTION	50W @ 110-240VAC (60W @ 100VAC)
POWER FACTOR	0.95 or greater @ 120VAC

ENVIRONMENTAL SPECIFICATIONS

TEMPERATURE RANGE	-40°F to 122°F (-40°C to 50°C) operating temperature -4°F to 122°F (-20°C to 50°C) starting temperature
PROTECTION RATING	IP66 (Suitable for wet locations)

LED SOURCE LIFE

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ITEM# 123-000009-00 (UL, White, Frosted Lens)
123-000009-01 (UL, Black, Frosted Lens)
123-000009-02 (CE, White, Frosted Lens)
123-000009-03 (CE, Black, Frosted Lens)
123-000009-04 (UL, White, Clear Lens)
123-000009-05 (UL, Black, Clear Lens)
123-000009-06 (CE, White, Clear Lens)
123-000009-07 (CE, Black, Clear Lens)

BROXXX Rev 00

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Refer to www.colorkinetics.com for the most recent data sheet versions.

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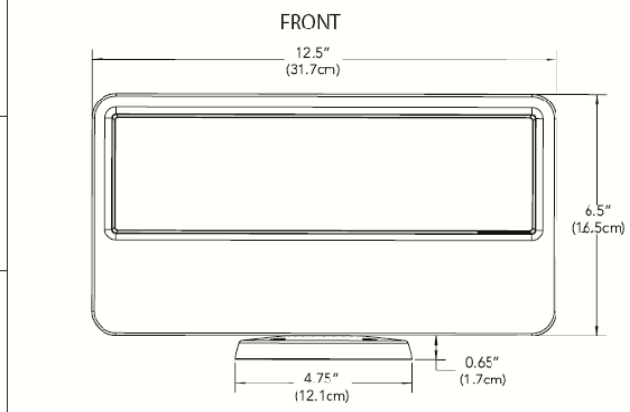
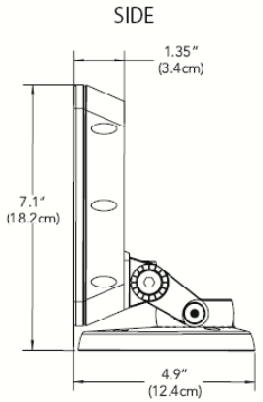
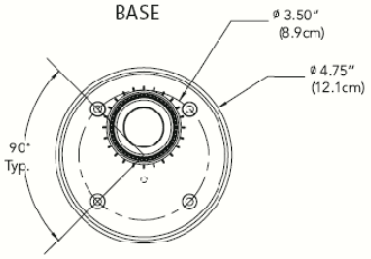
PHILIPS

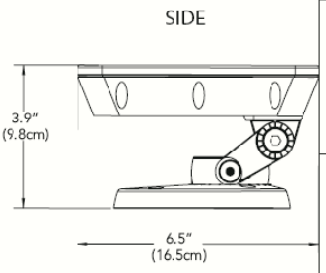
COLOR KINETICS

COLORBLAST12POWERCORE
PHYSICAL DIMENSIONS - PRELIMINARY SPECIFICATION









ColorBlast 12 Powercore SPECIFICATIONS	
DATA/POWER CONNECTOR	Hard wire in junction box
POWER REQUIREMENT	100-240VAC
WEIGHT	6.4 lbs (2.9 kg)

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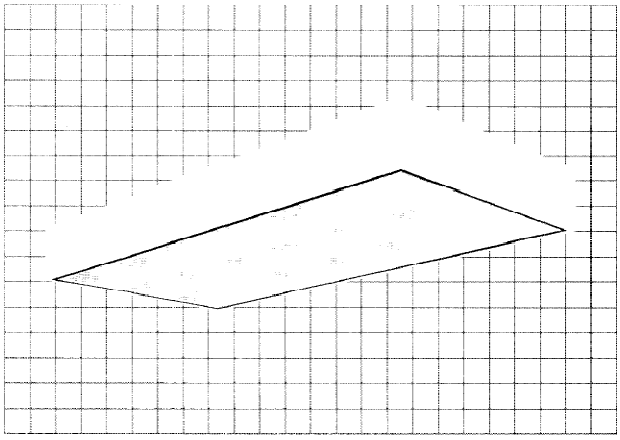
DPB2S18DS340 ☆☆☆☆

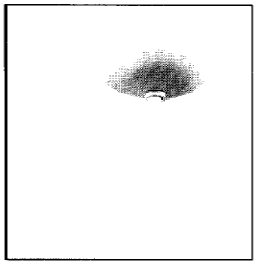
DEEPCEL SURFACE

2′ × 4′ SURFACE FLUORESCENT
3″ DEEP, 18 CELL PARABOLIC LOUVER

- Only 5½″ deep.
- Welded 20 gauge steel body.
- 45° mitered corners (body and louver).
- Side-mounted ballast for cooler operation.
- Coilzak® aluminum parabolic louver.
- Vertical grain on louver eliminates reflected lamp images on cross baffle.
- Perfectly uniform four-side black reveal.
- Spring-loaded "roosterhead" latches.
- Reversible louver hinging.
- Door jamb with integral positive light stop.
- Flush end K.O.s for smooth surface appearance (at end of row or individual).
- Interchangeable with Lytecel 1½″ × 1½″ × 1″ deep, injection molded louver or 1¼″ deep regressed (DR) aluminum lens frame.
- Protective film dust guard.
- Meets NYC Code requirements.

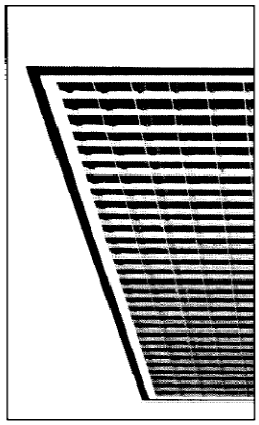


MOUNTING METHOD

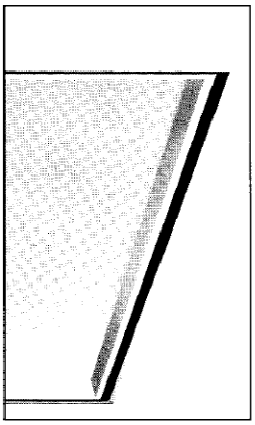


Stem mounting (four per fixture is recommended)

OPTIONS



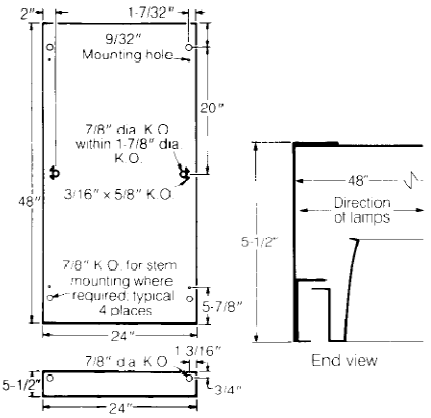
Lytecel 1½″ × 1½″ × 1″ deep, injection molded louver



1¼″ deep regressed aluminum lens frame

DIMENSIONS

All K.O.s are ⅞″ unless otherwise noted.



FIXTURE SCHEDULE

TYPE	CATALOG NO.	VOLTS

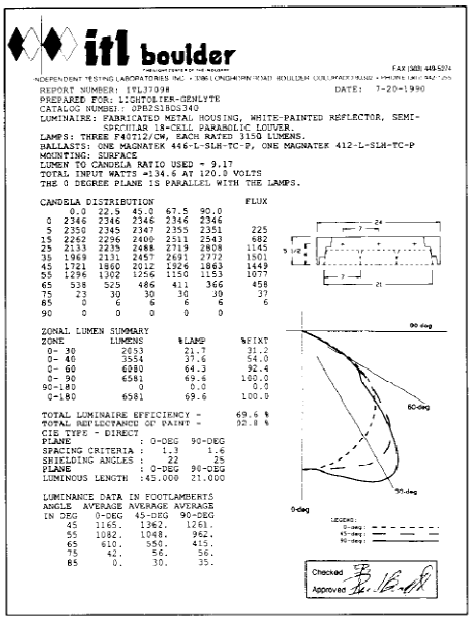
REMARKS:

LIGHTOLIER® a GENLYTE company

SECTION 2A / Folio G50-81

DPB2S18DS340 DEEPCEL SURFACE
2′ × 4′ SURFACE FLUORESCENT

PHOTOMETRY



itl boulder

INDEPENDENT TESTING LABORATORIES INC. • 3961 ONEIDA/BROADWAY ROAD BOULDER COLORADO USA • PHONE (303) 442-5274 FAX (303) 449-5074

REPORT NUMBER: ITL37098 DATE: 7-20-1990
PREPARED FOR: LIGHTOLIER-GENLYTE
CATALOG NUMBER: DPB2S18DS340
LUMINAIRE: FABRICATED METAL HOUSING, WHITE-PAINTED REFLECTOR, SEMI-SPECULAR 18-CELL PARABOLIC LOUVER.
LAMPS: THREE F40T12/CW, EACH RATED 3150 LUMENS.
BALLASTS: ONE MAGNATEK 446-L-SLH-TC-P, ONE MAGNATEK 412-L-SLH-TC-P
MOUNTING: SURFACE
LUMEN TO CANDELA RATIO USED = 9.17
TOTAL INPUT WATTS =134.6 AT 120.0 VOLTS
THE 0 DEGREE PLANE IS PARALLEL WITH THE LAMPS.

CANDELA DISTRIBUTION

	0.0	22.5	45.0	67.5	90.0	FLUX
0	2346	2346	2346	2346	2346	
5	2350	2345	2347	2355	2351	225
15	2262	2296	2400	2511	2543	682
25	2133	2235	2488	2719	2808	1145
35	1969	2131	2457	2691	2772	1501
45	1721	1860	2012	1926	1863	1449
55	1296	1302	1256	1150	1153	1077
65	538	525	486	411	366	458
75	23	30	30	30	30	37
85	0	6	6	6	6	6
90	0	0	0	0	0	

ZONAL LUMEN SUMMARY

ZONE	LUMENS	%LAMP	%FIXT
0- 30	2653	21.7	31.2
0- 40	3554	37.6	54.0
0- 60	6080	64.3	92.4
0- 90	6581	69.6	100.0
90-180	0	0.0	0.0
0-180	6581	69.6	100.0

TOTAL LUMINAIRE EFFICIENCY = 69.6 %
TOTAL REFLECTANCE OF PAINT = 92.8 %
CIE TYPE - DIRECT

PLANE	: 0-DEG	90-DEG
SPACING CRITERIA	: 1.3	1.6
SHIELDING ANGLES	: 22	25
PLANE	: 0-DEG	90-DEG
LUMINOUS LENGTH	:45.000	21.000

LUMINANCE DATA IN FOOTLAMBERTS

ANGLE IN DEG	AVERAGE 0-DEG	AVERAGE 45-DEG	AVERAGE 90-DEG
45	1165.	1362.	1261.
55	1082.	1048.	962.
65	610.	550.	415.
75	42.	56.	56.
85	0.	30.	35.

Checked
Approved

MODEL NO. DPB2S18DS340

coefficients of utilization—zonal cavity method

RF	20			20			20		
RC	80			50			30		
RW	70	50	30	50	30	10	50	30	10
1	78	75	73	71	69	68	68	67	65
2	72	68	64	64	61	59	62	60	58
3	67	61	56	58	54	51	56	53	51
4	62	55	50	52	48	45	51	47	44
5	57	49	43	47	42	39	45	41	38
6	52	44	38	42	37	34	41	37	34
7	48	39	34	38	33	29	37	33	29
8	44	35	30	34	29	25	33	29	25
9	41	31	26	30	25	22	29	25	22
10	38	28	23	27	23	19	27	22	19

room cavity ratio

visual comfort probability (VCP) average 100 fc reflectances 80/50/20

room size		luminaires lengthwise	ceiling height				luminaires crosswise	ceiling height			
W	L		8.5	10.0	13.0	16.0		8.5	10.0	13.0	16.0
20	20		75	69	69	77		77	73	71	78
20	30		78	73	67	67		80	76	72	69
20	40		80	76	71	68		83	79	76	72
20	60		80	76	74	71		84	81	79	75
30	20		80	74	69	76		82	76	71	76
30	30		83	77	68	66		84	79	73	68
30	40		84	80	72	67		86	81	76	70
30	60		84	80	75	70		87	83	79	73
30	80		84	80	75	71		88	84	80	76
40	20		80	77	73	76		82	79	74	76
40	30		84	79	72	67		85	82	75	68
40	40		85	82	75	68		87	84	78	71
40	60		86	82	78	71		88	85	81	73
40	80		86	82	78	72		89	86	82	76
40	100		86	82	78	72		89	86	84	78
60	30		84	79	74	70		85	82	77	70
60	40		86	82	77	70		87	84	80	73
60	60		86	83	80	73		88	86	82	75
60	80		86	84	80	75		89	87	84	77
60	100		86	84	80	75		89	87	84	79
100	40		86	82	77	72		87	84	80	75
100	60		86	83	80	75		88	86	83	77
100	80		86	84	81	77		89	87	84	79
100	100		86	83	81	77		89	87	85	81

ORDERING INFORMATION

Explanation of Catalog Number Example: DPB2S18DS340120LEGLR

DP	B	2	S		D	S	3	40			
3" DEEPCEL PARABOLIC: Pre-anodized aluminum louver	BODY STYLE: Surface Box	FIXTURE WIDTH	CEILING TYPE: S = Surface	NUMBER OF CELLS 18 or 24	LOUVER FINISH*: D = Semi-specular L = Low Iridescence Semi-specular P = Low Iridescence Specular S = Specular W = White Paint G = Champagne Gold	BALLAST COVER	LAMP QUANTITY	LAMP LENGTH	VOLTAGE: 120 or 277	BALLAST TYPE: LE = Low Energy OC = Octron SS = Electronic SO = Electronic Octron DIM = Dimming	OPTIONS: Add appropriate suffix to catalog no., ie: (GLR)

*Consult factory for availability of louver finishes.

OPTIONS/ACCESSORIES

STEM AND CANOPY SETS: Suspends fixture 6", 12", 18" or 24" from surface. (Four per fixture is recommended.)
CATALOG NUMBER: ASC6 (6")
ASC12 (12")
ASC18 (18")
ASC24 (24")

FUSING: Internal fast-blow fusing. SUFFIX: GLR. Internal slow-blow fusing. SUFFIX: GMF.
RADIO INTERFERENCE FILTER: 120 or 277 volt, 50 or 60 Hz. One per fixture standard. SUFFIX: RF.
ELECTRICAL/WIRING OPTIONS: Consult factory.

SPECIFICATIONS

PERFORMANCE: In an installation of 3 lamp 40W luminaires in a room cavity ratio of 1, with reflectance of 80% ceiling, 50% wall, 20% floor, the C.U. shall not be less than .75. To prevent glare the VCP shall be not less than 86 either lengthwise or crosswise (at 100 fc level) and the average brightness at 65° shall not exceed 610 foot-lamberts. To control veiling reflections, luminaire output in the 30°-90° zone shall be not less than 69%.
MATERIALS: Chassis parts are die-formed 20 gauge steel, welded for rigidity with all seams finished smooth. Louver is pre-anodized aluminum. (Coilzak® or equal.)
STANDARD FINISH: Louver—semi-specular anodized, vertical grain aluminum reflector sheet. Cavity—white baked acrylic enamel, minimum 86% reflectance. Phosphate undercoating. Chassis exterior—white baked acrylic enamel.
ELECTRICAL: Rapid start HPF, LE (low energy) thermally protected class "P" ballast C.B.M. certified by E.T.L. If K.O. is within 3" of ballast, use wire suitable for at least 90°.
LABELS: I.B.E.W. Listed by Underwriters Laboratories.

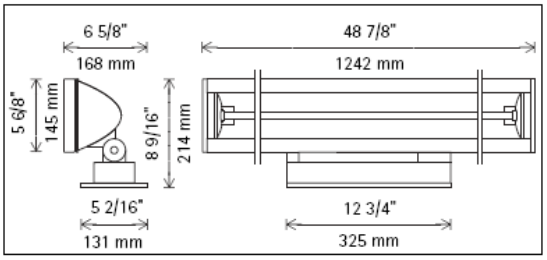
LIGHTOLIER®
a GENLYTE company
INDUSTRIAL WAY, WILMINGTON, MA 01887 • (508) 657-7600
100 LIGHTING WAY, SECAUCUS, NJ 07094 • (201) 864-3000

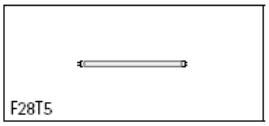
Printed in U.S.A. 10M 10/90

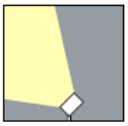
ERCO

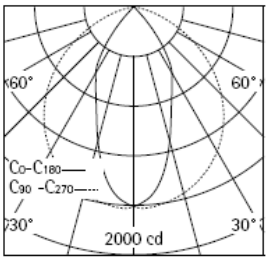
Focalflood Floodlight

with mounting plate for fluorescent lamps









F28T5 28W Min. Bipin 2900lm

h(ft)	E(fc)	D	
		C0	C90
		44°	103°
3	179	2'5"	7'7"
6	45	4'10"	15'1"
9	20	7'3"	22'8"
12	11	9'8"	30'2"
15	7	12'1"	37'9"

34115.023 Graphit m
F28T5 28W Min. Bipin 2900lm
ECG

Product description
Housing: corrosion-resistant aluminum profile, No-rinse surface treatment. Double powder-coated. Optimized surface for reduced accumulation of dirt. Hinge, graduated disc and mounting plate: corrosion-resistant aluminum. Hinges with internal wiring, 130° tilt.
Electronic control gear 120V/277V, 60Hz. 2 cable entries. Through-wiring possible. 3-pole terminal block.
Flood reflector with focal emphasis in beam direction: Aluminum, silver, specular anodized. Side reflectors to increase the visual comfort along the lamp axis, specular anodized. Cut-off angle 50° crosswise. Without spill light.
Screw-fastened cover with safety glass: corrosion-resistant aluminum profile, double powder-coated. Hinge open for lamp replacement.
Reduction of luminous flux below 0°C.
Suitable for wet location (IP65): dust-proof and water jet-proof.
Weight 24.47lbs / 11.10kg
Maximum wind load area 2.15ft²

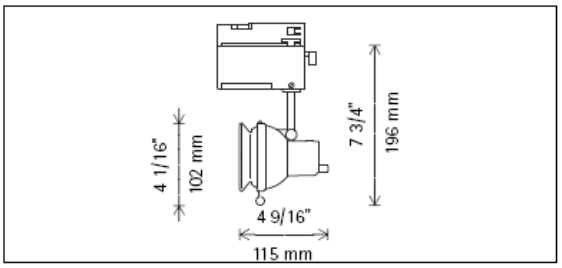
ERCO Lighting, Inc.
160 Raritan Center Parkway
Suite 10
Edison, NJ 08837
USA
Tel.: +1 732 225 8856
Fax: +1 732 225 8857
info.us@erco.com

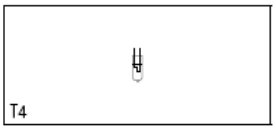
Technical Region: 120V/277V, 60Hz
Edition: 11.15.2007
Please download latest version from
www.erco.com/34115.023

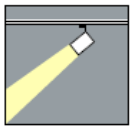
ERCO

Pollux Spotlight

with turning transadapter for low-voltage halogen lamps

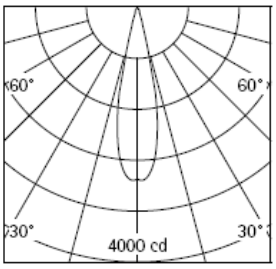






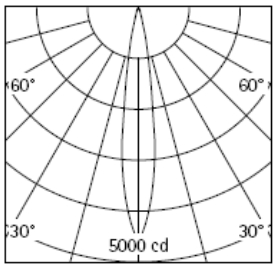
73753.023 White (RAL9002)
T4 50W 12V GY6.35 950lm
Vario reflector

Product description
Housing and bracket: cast aluminum, powder-coated. 0°-90° tiltable. Bracket on turning transadapter rotatable through 360°. Turning transadapter for ERCO 2-circuit track: plastic. Electronic transformer 120/12V, 60Hz, 20-50W.
Anti-glare ring: metal, black powder-coated, attached to the spotlight by means of a circular spring; to be removed for lamp replacement.
Vario reflector: aluminum, silver, specular anodized. Safety glass.
Focusing: adjustable lampholder, knurled screw.
Use dimmers for electronic transformers (trailing edge).
Weight 0.77lbs / 0.35kg



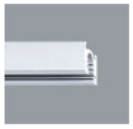
T4 50W 12V GY6.35 950lm

h(ft)	E(fc)	D 24°
3	299	1'3"
6	75	2'7"
9	33	3'10"
12	19	5'1"
15	12	6'5"



T4 50W 12V GY6.35 950lm

h(ft)	E(fc)	D 15°
3	512	0'9"
6	128	1'7"
9	57	2'4"
12	32	3'2"
15	20	3'11"



Mounting
ERCO 2-circuit track
Hi-trac 2-circuit track
Monopoll 2-circuit track

ERCO Lighting, Inc.
160 Raritan Center Parkway
Suite 10
Edison, NJ 08837
USA
Tel.: +1 732 225 8856
Fax: +1 732 225 8857
info.us@erco.com

Technical Region: 120V/60Hz
Edition: 11.15.2007
Please download latest version from
www.erco.com/73753.023

1/1

T5 Mini Bipin


Circline 4-Pin T5

FLUORESCENT

PENTRON® T5 LAMPS

PENTRON® High Output, High Performance T5 Lamps

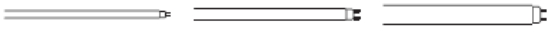
Nominal Wattage	Bulb	Nominal Length (in)	MOL (in)	Base	Product Number	Ordering Abbreviation	Pkg Qty	Avg Rated Life (hrs)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean (@35°C/95°F)	Symbols & Footnotes
39	T5	36	34	Mini Bipin	20932	FP39/830/HO/ECO	40	20000	3000	82	3100 3500	2883 3255	1,2,6, 8,9,11
					20855	FP39/835/HO	40	20000	3500	82	3100 3500	2883 3255	1,2,8,9,11
					20933	FP39/835/HO/ECO	40	20000	3500	82	3100 3500	2883 3255	1,2,6, 8,9,11
					20856	FP39/841/HO	40	20000	4100	82	3100 3500	2883 3255	1,2,8,9,11
					20934	FP39/841/HO/ECO	40	20000	4100	82	3100 3500	2883 3255	1,2,6, 8,9,11
54	T5	48	45.8	Mini Bipin	20857	FP54/830/HO	40	20000	3000	82	4450 5000	4138 4650	1,2,8,9,11
					20903	FP54/830/HO/ECO	40	20000	3000	82	4450 5000	4138 4650	1,2,6, 8,9,11
					20858	FP54/835/HO	40	20000	3500	82	4450 5000	4138 4650	1,2,8,9,11
					20904	FP54/835/HO/ECO	40	20000	3500	82	4450 5000	4138 4650	1,2,6, 8,9,11
					20860	FP54/841/HO	40	20000	4100	82	4450 5000	4138 4650	1,2,8,9,11
					20906	FP54/841/HO/ECO	40	20000	4100	82	4450 5000	4138 4650	1,2,6, 8,9,11
					20862	FP54/860/HO/ECO	40	20000	6000	82	4050 5000	3766 4418	1,2,6, 8,9,11
80	T5	60	57.6	Mini Bipin	20863	FP80/830/HO	40	20000	3000	82	6150 7000	5719 6510	1,2,8,9,11
					20935	FP80/830/HO/ECO	40	20000	3000	82	6150 7000	5719 6510	1,2,6, 8,9,11
					20864	FP80/835/HO	40	20000	3500	82	6150 7000	5719 6510	1,2,8,9,11
					20936	FP80/835/HO/ECO	40	20000	3500	82	6150 7000	5719 6510	1,2,6, 8,9,11
					20865	FP80/841/HO	40	20000	4100	82	6150 7000	5719 6510	1,2,8,9,11
					20937	FP80/841/HO/ECO	40	20000	4100	82	6150 7000	5719 6510	1,2,6, 8,9,11

PENTRON® Circline T5 Lamps

Nominal Wattage	Bulb	Outside Diameter (in)	Base	Product Number	Ordering Abbreviation	Pkg Qty	Avg Rated Life (hrs)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean	Symbols & Footnotes
22	T5	8.66 - 9.06	2GX13	20702	FPC22/830	12	12000	3000	82	1800	1585	1,2,8,9,11
				20712	FPC22/835	12	12000	3500	82	1800	1585	1,2,8,9,11
				20715	FPC22/841	12	12000	4100	82	1800	1585	1,2,8,9,11
40	T5	11.54 - 12.01	2GX13	20731	FPC40/830	12	12000	3000	82	3200	2815	1,2,8,9,11
				20732	FPC40/835	12	12000	3500	82	3200	2815	1,2,8,9,11
				20733	FPC40/841	12	12000	4100	82	3200	2815	1,2,8,9,11

For more complete product information visit www.sylvania.com

Symbols/Footnotes on page 139-143



T5 Mini Bipin | T8 Med Bipin | T12 Med Bipin

FLUORESCENT

PREHEAT LAMPS

Miniature T5 Preheat Lamps (Starter Required)

Nominal Wattage	Bulb	Nominal Length (in)	MOL (in)	Base	Product Number	Ordering Abbreviation	Pkg Qty	Avg Rated Life (hrs)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean @25°C/77°F	Symbols & Footnotes
4	T5	6	5.91	Mini Bipin	20416	F4T5/CW	24	6000	4200	62	135	117	1,2
					20415	F4T5CW/BL/1/6	6	6000	4200	62	135	117	1,2
					20420	F4T5/D	24	6000	6500	76	115	100	ES 1,2
6	T5	9	8.91	Mini Bipin	20617	F6T5/WW	24	7500	3000	52	275	239	1,2
					20616	F6T5/CW	24	7500	4200	62	270	235	1,2
					20619	F6T5CW/BL/1/6	6	7500	4200	62	270	235	1,2
					20620	F6T5/D	24	7500	6500	76	260	226	ES 1,2
8	T5	12	11.91	Mini Bipin	20817	F8T5/WW	24	7500	3000	52	400	348	1,2
					20819	F8T5/WW/BL/1/6	6	7500	3000	52	400	348	1,2
					20821	F8T5/W	24	7500	3450	57	400	348	1,2
					20837	F8T5/CWX	24	7500	4100	87	270	235	ES 1,2
					20816	F8T5/CW	24	7500	4200	62	390	339	1,2
					20834	F8T5CW/BL/1/6	6	7500	4200	62	390	339	1,2
					20824	F8T5/DSGN50	24	7500	5000	90	280	244	ES 1,2
					20820	F8T5/D	24	7500	6500	76	350	305	ES 1,2
13	T5	21	20.4	Mini Bipin	21301	L13W/25	25	7500	4000	75	700	630	ES 1,2
			20.91	Mini Bipin	21317	F13T5/WW	24	7500	3000	52	880	766	1,2
					21332	F13T5/WW/BL/1/6	6	7500	3000	52	880	766	1,2
					21316	F13T5/CW	24	7500	4200	62	860	748	1,2
					21315	F13T5CW/BL/1/6	6	7500	4200	62	860	748	1,2

Standard T8 and T12 Preheat Lamps (Starter Required)

Nominal Wattage	Bulb	Nominal Length (in)	MOL (in)	Base	Product Number	Ordering Abbreviation	Pkg Qty	Avg Rated Life (hrs)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean @25°C/77°F	Symbols & Footnotes
13	T8	12	11.71	Med Bipin	21766	F13T8/CW	24	7500	4200	62	530	461	1,2
14	T8	15	14.78	Med Bipin	21486	F14T8/CW	24	7500	4200	62	685	644	1,2
					21488	F14T8/D	24	7500	6500	76	575	561	ES 1,2
	T12	15	14.78	Med Bipin	21451	F14T12/DW/W/RP	6	9000	3000	70	720	648	ES 1,2
					21435	F14T12/WW	30	9000	3000	52	660	574	1,2
					21536◇	F14T12/DCW/1/6/RP	6	9000	4100	70	720	648	1,2
					21409	F14T12/CW	30	9000	4200	62	650	566	1,2
					21410	F14T12/CW/6/RP	6	9000	4200	62	650	566	1,2
					21411	F14T12/D	30	9000	6500	76	590	513	ES 1,2
15	T8	18	17.78	Med Bipin	21610	F15T8/D830	24	7500	3000	82	920	846	ES 1,2
					21701	F15T8/WW	24	7500	3000	52	845	735	1,2
					21765	F15T8/WW/RP	6	7500	3000	52	845	735	1,2
					21609	F15T8/D35	24	7500	3500	70	940	846	ES 1,2
					21682	F15T8/N	24	7500	3600	86	560	487	ES 1,2
					21627▲	F15T8/CWX	24	7500	4100	87	600	522	ES 1,2
					21603	F15T8/DCW/RP	6	7500	4100	70	900	810	ES 1,2

FLUORESCENT

DULUX® T/E 4-PIN ECOLOGIC® COMPACT FLUORESCENT LAMPS

Nominal Wattage	Bulb	MOL (in)	MOL (mm)	Base	Product Number	Ordering Abbreviation	NEMA Generic Designation	Pkg Qty	Avg Rated Life (hrs)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean @25°C/77°F	Symbols & Footnotes
13	T4	4.2	106	GX24Q-1	20893	**CF13DT/E/835**	CFTR13W/GX24Q/835	50	12000	3500	82	900	774	1,2,3, 6,8,9,10
					20894	**CF13DT/E/841**	CFTR13W/GX24Q/841	50	12000	4100	82	900	774	1,2,3, 6,8,9,10
18	T4	4.6	116	GX24Q-2	20760	**CF18DT/E/827**	CFTR18W/GX24Q/827	50	12000	2700	82	1200	1032	1,2,3, 6,8,9,10
26	T4	5.2	124	GX24Q-3	20767	**CF26DT/E/827**	CFTR26W/GX24Q/827	50	12000	2700	82	1800	1548	1,2,3, 6,8,9,10
32	T4	5.8	147	GX24Q-3	20768	**CF32DT/E/827**	CFTR32W/GX24Q/827	50	12000	2700	82	2400	2064	1,2,3, 6,8,9,10,11

DULUX® T/E/IN AMALGAM, 4-PIN ECOLOGIC® COMPACT FLUORESCENT LAMPS

for Dimming and Electronic Ballast for High and Low Temp Applications

Nominal Wattage	Bulb	MOL (in)	MOL (mm)	Base	Product Number	Ordering Abbreviation	NEMA Generic Designation	Pkg Qty	Avg Rated Life (hrs)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean @25°C/77°F	Symbols & Footnotes
18	T4	4.4	111	GX24Q-2	20875	**CF18DT/E/IN/827**	CFTR18W/GX24Q/827	50	12000	2700	82	1200	1032	1,2,3, 6,8,9,10,12
					20876	**CF18DT/E/IN/830**	CFTR18W/GX24Q/830	50	12000	3000	82	1200	1032	1,2,3, 6,8,9,10,12
					20877	**CF18DT/E/IN/835**	CFTR18W/GX24Q/835	50	12000	3500	82	1200	1032	1,2,3, 6,8,9,10,12
					20878	**CF18DT/E/IN/841**	CFTR18W/GX24Q/841	50	12000	4100	82	1200	1032	1,2,3, 6,8,9,10,12
26	T4	5.0	126	GX24Q-3	20879	**CF26DT/E/IN/827**	CFTR26W/GX24Q/827	50	12000	2700	82	1800	1548	1,2,3, 6,8,9,10,12
					20880	**CF26DT/E/IN/830**	CFTR26W/GX24Q/830	50	12000	3000	82	1800	1548	1,2,3, 6,8,9,10,12
					20881	**CF26DT/E/IN/835**	CFTR26W/GX24Q/835	50	12000	3500	82	1800	1548	1,2,3, 6,8,9,10,12
					20882	**CF26DT/E/IN/841**	CFTR26W/GX24Q/841	50	12000	4100	82	1800	1548	1,2,3, 6,8,9,10,12
32	T4	5.6	142	GX24Q-3	20883	**CF32DT/E/IN/827**	CFTR32W/GX24Q/827	50	12000	2700	82	2400	2064	1,2,3, 6,8,9,10,11,12
					20884	**CF32DT/E/IN/830**	CFTR32W/GX24Q/830	50	12000	3000	82	2400	2064	1,2,3, 6,8,9,10,11,12
					20885	**CF32DT/E/IN/835**	CFTR32W/GX24Q/835	50	12000	3500	82	2400	2064	1,2,3, 6,8,9,10,11,12
					20886	**CF32DT/E/IN/841**	CFTR32W/GX24Q/841	50	12000	4100	82	2400	2064	1,2,3, 6,8,9,10,11,12
42	T4	6.5	163	GX24Q-4	20887	**CF42DT/E/IN/827**	CFTR42W/GX24Q/827	50	12000	2700	82	3200	2752	1,2,3, 6,8,9,10,11,12
					20888	**CF42DT/E/IN/830**	CFTR42W/GX24Q/830	50	12000	3000	82	3200	2752	1,2,3, 6,8,9,10,11,12
					20871©	**CF42DT/E/IN/835**	CFTR/42W/GX24Q/835	50	12000	3500	82	3200	2752	1,2,3, 6,8,9,10,11,12
					20890	**CF42DT/E/IN/841**	CFTR42W/GX24Q/841	50	12000	4100	82	3200	2752	1,2,3, 6,8,9,10,11,12
57	T4	7.76	197	GX24Q-5	20895	**CF57DT/E/IN/827**	CFTR57W/GX24Q/827	50	12000	2700	82	4300	3698	1,2,3, 6,8,9,10,11,12

For more complete product information visit www.sylvania.com

Symbols/Footnotes on page 139-143

FLUORESCENT

DULUX® T/E 4-PIN ECOLOGIC® COMPACT FLUORESCENT LAMPS

Nominal Wattage	Bulb	MOL (in)	MOL (mm)	Base	Product Number	Ordering Abbreviation	NEMA Generic Designation	Pkg Qty	Avg Rated Life (hrs)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean @25°C/77°F	Symbols & Footnotes
13	T4	4.2	106	GX24Q-1	20893	**CF13DT/E/835**	CFTR13W/GX24Q/835	50	12000	3500	82	900	774	1,2,3, 6,8,9,10
					20894	**CF13DT/E/841**	CFTR13W/GX24Q/841	50	12000	4100	82	900	774	1,2,3, 6,8,9,10
18	T4	4.6	116	GX24Q-2	20760	**CF18DT/E/827**	CFTR18W/GX24Q/827	50	12000	2700	82	1200	1032	1,2,3, 6,8,9,10
26	T4	5.2	124	GX24Q-3	20767	**CF26DT/E/827**	CFTR26W/GX24Q/827	50	12000	2700	82	1800	1548	1,2,3, 6,8,9,10
32	T4	5.8	147	GX24Q-3	20768	**CF32DT/E/827**	CFTR32W/GX24Q/827	50	12000	2700	82	2400	2064	1,2,3, 6,8,9,10,11

DULUX® T/E/IN AMALGAM, 4-PIN ECOLOGIC® COMPACT FLUORESCENT LAMPS

for Dimming and Electronic Ballast for High and Low Temp Applications

Nominal Wattage	Bulb	MOL (in)	MOL (mm)	Base	Product Number	Ordering Abbreviation	NEMA Generic Designation	Pkg Qty	Avg Rated Life (hrs)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean @25°C/77°F	Symbols & Footnotes
18	T4	4.4	111	GX24Q-2	20875	**CF18DT/E/IN/827**	CFTR18W/GX24Q/827	50	12000	2700	82	1200	1032	1,2,3, 6,8,9,10,12
					20876	**CF18DT/E/IN/830**	CFTR18W/GX24Q/830	50	12000	3000	82	1200	1032	1,2,3, 6,8,9,10,12
					20877	**CF18DT/E/IN/835**	CFTR18W/GX24Q/835	50	12000	3500	82	1200	1032	1,2,3, 6,8,9,10,12
					20878	**CF18DT/E/IN/841**	CFTR18W/GX24Q/841	50	12000	4100	82	1200	1032	1,2,3, 6,8,9,10,12
26	T4	5.0	126	GX24Q-3	20879	**CF26DT/E/IN/827**	CFTR26W/GX24Q/827	50	12000	2700	82	1800	1548	1,2,3, 6,8,9,10,12
					20880	**CF26DT/E/IN/830**	CFTR26W/GX24Q/830	50	12000	3000	82	1800	1548	1,2,3, 6,8,9,10,12
					20881	**CF26DT/E/IN/835**	CFTR26W/GX24Q/835	50	12000	3500	82	1800	1548	1,2,3, 6,8,9,10,12
					20882	**CF26DT/E/IN/841**	CFTR26W/GX24Q/841	50	12000	4100	82	1800	1548	1,2,3, 6,8,9,10,12
32	T4	5.6	142	GX24Q-3	20883	**CF32DT/E/IN/827**	CFTR32W/GX24Q/827	50	12000	2700	82	2400	2064	1,2,3, 6,8,9,10,11,12
					20884	**CF32DT/E/IN/830**	CFTR32W/GX24Q/830	50	12000	3000	82	2400	2064	1,2,3, 6,8,9,10,11,12
					20885	**CF32DT/E/IN/835**	CFTR32W/GX24Q/835	50	12000	3500	82	2400	2064	1,2,3, 6,8,9,10,11,12
					20886	**CF32DT/E/IN/841**	CFTR32W/GX24Q/841	50	12000	4100	82	2400	2064	1,2,3, 6,8,9,10,11,12
42	T4	6.5	163	GX24Q-4	20887	**CF42DT/E/IN/827**	CFTR42W/GX24Q/827	50	12000	2700	82	3200	2752	1,2,3, 6,8,9,10,11,12
					20888	**CF42DT/E/IN/830**	CFTR42W/GX24Q/830	50	12000	3000	82	3200	2752	1,2,3, 6,8,9,10,11,12
					20871○	**CF42DT/E/IN/835**	CFTR/42W/GX24Q/835	50	12000	3500	82	3200	2752	1,2,3, 6,8,9,10,11,12
					20890	**CF42DT/E/IN/841**	CFTR42W/GX24Q/841	50	12000	4100	82	3200	2752	1,2,3, 6,8,9,10,11,12
57	T4	7.76	197	GX24Q-5	20895	**CF57DT/E/IN/827**	CFTR57W/GX24Q/827	50	12000	2700	82	4300	3698	1,2,3, 6,8,9,10,11,12

T5 Mini Bipin

PENTRON® T5 FLUORESCENT LAMPS

PENTRON® T5 lamps are designed to operate on dedicated electronic programmed rapid start (also know as programmed start) ballasts only. These lamps are globally standardized and are designed to operate with their peak light output at 35°C (95°F) ambient temperature. For comparison purposes and to accommodate existing lamp measurement standards, ratings are given at both 25°C (77°F) and 35°C (95°F). The new lamp dimensions allow for innovative fixture designs and improved fixture performance

PENTRON® High Performance T5 Lamps

Nominal Wattage	Bulb	Nominal Length (in)	MOL (in)	Base	Product Number	Ordering Abbreviation	Pkg Qty	Avg Rated Life @3hrs/start (@12hrs/start)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F (@35°C/95°F)	Mean @25°C/77°F (@35°C/95°F)	Symbols & Footnotes
28	T5	48	45.8	Mini Bipin	20868	FP28/830/ECO	40	20000	3000	85	2600 2900	2418 2697	CRI 31,3338,48, 74/6
					20901	FP28/835/ECO	40	20000	3500	85	2600 2900	2418 2697	CRI 31,3338,48, 74/6
					20902	FP28/841/ECO	40	20000	4100	85	2600 2900	2418 2697	CRI 31,3338,48, 74/6
					22203	FP28/850/ECO	40	20000	5000	85	2545 2840	2367 2641	CRI 31,3338,48, 74/6
					20990	FP28/865/ECO	40	20000	6500	85	2400 2750	2232 2558	CRI 31,3338,48, 74/6
					20977	FP28RED 40/CS 1/SKU	40	20000			2100		1531,33,3848,74
					20978	FP28GREEN 40/CS 1/SKU	40	20000			3500		1531,33,3848,74
					20986	FP28BLUE 40/CS 1/SKU	40	20000			700		1531,33,3848,74
14	T5	24	22.2	Mini Bipin	20907	FP14/830/ECO	40	20000	3000	85	1200 1350	1116 1256	CRI 31,3338,48, 74/6
					20908	FP14/835/ECO	40	20000	3500	85	1200 1350	1116 1256	CRI 31,3338,48, 74/6
					20914	FP14/841/ECO	40	20000	4100	85	1200 1350	1116 1256	CRI 31,3338,48, 74/6
					20988	FP14/865/ECO	40	20000	6500	85	1100 1300	1045 1209	CRI 31,3338,48, 74/6
21	T5	36	34	Mini Bipin	20919	FP21/830/ECO	40	20000	3000	85	1900 2100	1767 1953	CRI 31,3338,48, 74/6
					20921	FP21/835/ECO	40	20000	3500	85	1900 2100	1767 1953	CRI 31,3338,48, 74/6
					20924	FP21/841/ECO	40	20000	4100	85	1900 2100	1767 1953	CRI 31,3338,48, 74/6
					20989	FP21/865/ECO	40	20000	6500	85	1750 2000	1662 1860	CRI 31,3338,48, 74/6
35	T5	60	57.6	Mini Bipin	20925	FP35/830/ECO	40	20000	3000	85	3300 3650	3069 3394	CRI 31,3338,48, 74/6
					20926	FP35/835/ECO	40	20000	3500	85	3300 3650	3069 3394	CRI 31,3338,48, 74/6
					20927	FP35/841/ECO	40	20000	4100	85	3300 3650	3069 3394	CRI 31,3338,48, 74/6

PENTRON® PREMIER™ High Performance T5 Lamps

Nominal Wattage	Bulb	Nominal Length (in)	MOL (in)	Base	Product Number	Ordering Abbreviation	Pkg Qty	Avg Rated Life @3hrs/start (@12hrs/start)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F (@35°C/95°F)	Mean @25°C/77°F (@35°C/95°F)	Symbols & Footnotes
28	T5	48	45.8	Mini Bipin	20948	FP28/830PM/ECO	40	20000	3000	85	2730 3050	2594 2898	CRI 31,3338,48, 74/6
					20943	FP28/835PM/ECO	40	20000	3500	85	2730 3050	2594 2898	CRI 31,3338,48, 74/6
					20944	FP28/841PM/ECO	40	20000	4100	85	2730 3050	2594 2898	CRI 31,3338,48, 74/6


DULUX® S/E


DULUX® D

DULUX S/E 4-PIN COMPACT FLUORESCENT LAMPS

for Dimming and Electronic Ballast. Lamps have End-of-lamp Life (EOL) Protection

Nominal Wattage	Bulb	MOL (in)	MOL (mm)	Base	Product Number	Ordering Abbreviation	NEMA Generic Designation	Pkg Qty	Avg Rated Life (hrs)	CCT (K)	CRI	Approx Lumens Intial @25°C/77°F	Approx Lumens Mean @25°C/77°F	Symbols & Footnotes
5	S (T4)	3.4	85	2G7	20311	**CF5DS/E/827**	CFT5W/2G7/827	50	10000	2700	82	230	198	CH 1,2,5,12,16,20
					20315	**CF5DS/E/841**	CFT5W/2G7/841	50	10000	4100	82	230	198	CH 1,2,5,12,16,20
7	S (T4)	4.5	115	2G7	20312	**CF7DS/E/827**	CFT7W/2G7/827	50	10000	2700	82	400	344	CH 1,2,5,12,16,20
					20316	**CF7DS/E/841**	CFT7W/2G7/841	50	10000	4100	82	400	344	CH 1,2,5,12,16,20
9	S (T4)	5.7	145	2G7	20313	**CF9DS/E/827**	CFT9W/2G7/827	50	10000	2700	82	580	499	CH 1,2,5,12,20
					20317	**CF9DS/E/841**	CFT9W/2G7/841	50	10000	4100	82	580	499	CH 1,2,5,12,20
13	S (T4)	6.2	157	2GX7	20314	**CF13DS/E/827**	CFT13W/2GX7/827	50	10000	2700	82	800	688	CH 1,2,5,12,20
					20284	**CF13DS/E/830**	CFT13W/2GX7/830	50	10000	3000	82	800	688	CH 1,2,5,12,20
					20318	**CF13DS/E/841**	CFT13W/2GX7/841	50	10000	4100	82	800	688	CH 1,2,5,12,20

DULUX D PREHEAT 2-PIN ECOLOGIC® COMPACT FLUORESCENT LAMPS

With starter in Lamp Base for Magnetic Ballast

Nominal Wattage	Bulb	MOL (in)	MOL (mm)	Base	Product Number	Ordering Abbreviation	NEMA Generic Designation	Pkg Qty	Avg Rated Life (hrs)	CCT (K)	CRI	Approx Lumens Intial @25°C/77°F	Approx Lumens Mean @25°C/77°F	Symbols & Footnotes
9	D (T4)	4.3	110	G23-2	20537	**CF9DD/827/RP/ECO**	CFQ9W/G23/827	10	10000	2700	82	525	452	CH 1,4,6,11, 12,20,22
					20689	**CF9DD/827/ECO**	CFQ9W/G23/827	50	10000	2700	82	525	452	CH 1,4,6,11, 12,20,22
					20783	**CF9DD/830/ECO**	CFQ9W/G23/830	50	10000	3000	82	525	452	CH 1,4,6,11, 12,20,22
					20690	**CF9DD/835/ECO**	CFQ9W/G23/835	50	10000	3500	82	525	452	CH 1,4,6,11, 12,20,22
13	D (T4)	4.6	118	GX23-2	20691	**CF13DD/827/ECO**	CFQ13W/GX23/827	50	10000	2700	82	780	671	CH 1,4,6,11, 12,20,22
					20705	**CF13DD/830/ECO**	CFQ13W/GX23/830	50	10000	3000	82	780	671	CH 1,4,6,11, 12,20,22
					20692	**CF13DD/835/ECO**	CFQ13W/GX23/835	50	10000	3500	82	780	671	CH 1,4,6,11, 12,20,22
					20708	**CF13DD/841/ECO**	CFQ13W/GX23/841	50	10000	4100	82	780	671	CH 1,4,6,11, 12,20,22
18	D (T4)	6.0	153	G24D-2	20676	**CF18DD/827/ECO**	CFQ18W/G24D/827	50	10000	2700	82	1150	989	CH 1,4,6,11, 12,20,22
					20709	**CF18DD/830/ECO**	CFQ18W/G24D/830	50	10000	3000	82	1150	989	CH 1,4,6,11, 12,20,22
					20677	**CF18DD/835/ECO**	CFQ18W/G24D/835	50	10000	3500	82	1150	989	CH 1,4,6,11, 12,20,22
					20678	**CF18DD/841/ECO**	CFQ18W/G24D/841	50	10000	4100	82	1150	989	CH 1,4,6,11, 12,20,22
26	D (T4)	6.8	173	G24D-3	20679	**CF26DD/827/ECO**	CFQ26W/G24D/827	50	10000	2700	82	1710	1470	CH 1,4,6,11, 12,20,22
					20710	**CF26DD/830/ECO**	CFQ26W/G24D/830	50	10000	3000	82	1710	1470	CH 1,4,6,11, 12,20,22
					20680	**CF26DD/835/ECO**	CFQ26W/G24D/835	50	10000	3500	82	1710	1470	CH 1,4,6,11, 12,20,22
					20681	**CF26DD/841/ECO**	CFQ26W/G24D/841	50	10000	4100	82	1710	1470	CH 1,4,6,11, 12,20,22

For more complete product information visit www.sylvania.com

Symbols/Footnotes on page 124

CAPSYLITE® A-LINE

Suitable for use in unshielded fixtures.

Watts	Bulb	Base	Product Number	Symbols & Footnotes	Ordering Abbreviation	Volts	Pkg Qty	Lamp Finish	Class & Filament	Avg Rated Life(hrs)	Lumens CCT	LCL (in)	MOL (in)
42	A19	E26 Med	18907	★	42A/HAL/F	120	12	Inside Frost	C,CC-8	3500	580 2750	3.13	4.38
			18908	★ 137,154	42A/HAL/F	130	12	Inside Frost	C,CC-8	3500	580 2750	3.13	4.38
			@ 120 volts, approximate 37 watts, 450 lumens, 7000 hours										
50	A19	E26 Med	18968	★	50A/HAL/CRYSTAL	120	12	Crystal	C,CC-8	2500	860 2825	3.13	4.38
52	A19	E26 Med	18921	★	52A/HAL/F	120	12	Inside Frost	C,CC-8	3500	770 2775	3.13	4.38
			18922	★ 137,165	52A/HAL/F	130	12	Inside Frost	C,CC-8	3500	770 2775	3.13	4.38
			@ 120 volts, approximate 46 watts, 600 lumens, 7000 hours										
60	A19	E26 Med	18998	★	60A/HAL/CL/CLAM	120	6	Clear	C,CC-8	3000	965 2850	3.13	4.38
			18942	★	60A/HAL/CRYSTAL/CLAM	120	6	Crystal	C,CC-8	3000	965 2850	3.13	4.38
			18960	★	60A/HAL/F	120	12	Inside Frost	C,CC-8	3000	965 2850	3.13	4.38
			18999	★	60A/HAL/F/CLAM	120	6	Inside Frost	C,CC-8	3000	960 2850	3.13	4.38
72	A19	E26 Med	18937	★	72A/HAL/F	120	12	Inside Frost	C,CC-8	3500	1150 2825	3.13	4.38
			18938	★ 137,176	72A/HAL/F	130	12	Inside Frost	C,CC-8	3500	1150 2825	3.13	4.38
			@ 120 volts, approximate 63 watts, 900 lumens, 7000 hours										
75	A19	E26 Med	19000	★	75A/HAL/CL/CLAM	120	6	Clear	C,CC-8	3000	1330 2875	3.13	4.38
			18969	★	75A/HAL/CRYSTAL	120	12	Crystal	C,CC-8	3000	1330 2875	3.13	4.38
			18906	★	75A/HAL/CRYSTAL/CLAM	120	6	Crystal	C,CC-8	3000	1330 2875	3.13	4.38
			18965	★	75A/HAL/F	120	12	Inside Frost	C,CC-8	3000	1315 2875	3.13	4.38
			18997	★	75A/HAL/F/CLAM	120	6	Inside Frost	C,CC-8	3000	1315 2875	3.13	4.38
100	A19	E26 Med	19003	★	100A/HAL/CL/CLAM	120	6	Clear	C,CC-8	3000	1800 2900	3.13	4.38
			18911	★	100A/HAL/CRYSTAL/CLAM	120	6	Crystal	C,CC-8	3000	1800 2900	3.13	4.31
			18970	★	100A/HAL/F	120	12	Inside Frost	C,CC-8	3000	1800 2900	3.13	4.38
			18905	★	100A/HAL/F/CLAM	120	6	Inside Frost	C,CC-8	3000	1800 2900	3.13	4.38
150	A19	E26 Med	18912	★	150A/HAL/CLAM	120	6	Inside Frost	C,CC-8	3000	3000 2975	3.13	4.31

For more complete product information visit www.sylvania.com

Symbols/Footnotes on page 64-68

T8 Med Bipin

OCTRON® AND OCTRON® CURVALUME® FLUORESCENT LAMPS

OCTRON® lamps are T8 fluorescent lamps designed to be operated on dedicated magnetic rapid start or electronic instant start or programmed rapid start (also known as programmed start) ballasts. For details on various lamp/ballast system combinations, please refer to the Systems Performance Guide in the "SYLVANIA QUICKTRONIC® Ballast Technology and Specification Guide".

OCTRON® 800 XPS® Lamps

Nominal Wattage	Bulb	Nominal Length (in)	MOL (in)	Base	Product Number	Ordering Abbreviation	Pkg Qty	Avg Rated Life @3hrs/start (@12hrs/start)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean @25°C/77°F	Symbols & Footnotes
32	T8	48	47.78	Med Bipin	21680	FO32/830/XPS/ECO	30	36000 (42000)	3000	85	3100	2945	CRI 19,31,33,48, 52,75,94
					21697	FO32/835/XPS/ECO	30	36000 (42000)	3500	85	3100	2945	CRI 19,31,33,48, 52,75,94
					21681	FO32/841/XPS/ECO	30	36000 (42000)	4100	85	3100	2945	CRI 19,31,33,48, 52,75,94
					21660	FO32/850/XPS/ECO	30	36000 (42000)	5000	80	3000	2850	E CRI 19,31,33, 48,52,76,94
					21659	FO32/865/XPS/ECO	30	36000 (42000)	6500	80	2900	2750	E CRI 19,31,33, 48,52,76,94

Nominal Wattage	Bulb	Nominal Length (in)	MOL (in)	Base	Product Number	Ordering Abbreviation	Pkg Qty	Avg Rated Life @3hrs/start	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean @25°C/77°F	Symbols & Footnotes
17	T8	24	23.78	Med Bipin	22150	FO17/830/XPS/ECO	30	30000	3000	85	1400	1330	CRI 3,33,48,52, 76,93,94
					22151	FO17/835/XPS/ECO	30	30000	3500	85	1400	1330	CRI 3,33,48,52, 76,93,94
					22152	FO17/841/XPS/ECO	30	30000	4100	85	1400	1330	CRI 3,33,48,52, 76,93,94
25	T8	36	35.78	Med Bipin	22153	FO25/830/XPS/ECO	30	30000	3000	85	2200	2090	CRI 3,33,48,52, 76,93,94
					22154	FO25/835/XPS/ECO	30	30000	3500	85	2200	2090	CRI 3,33,48,52, 76,93,94
					22155	FO25/841/XPS/ECO	30	30000	4100	85	2200	2090	CRI 3,33,48,52, 76,93,94

OCTRON® 800 XP® 4 Foot SUPERSAVER® Lamps

Nominal Wattage	Bulb	Nominal Length (in)	MOL (in)	Base	Product Number	Ordering Abbreviation	Pkg Qty	Avg Rated Life @3hrs/start (@12hrs/start)	CCT (K)	CRI	Approx Lumens Initial @25°C/77°F	Approx Lumens Mean @25°C/77°F	Symbols & Footnotes
25		48	47.78	Med Bipin	22232	FO32/25W/830/XP/SS/ECO	30	36000 (42000)	3000	85	2475	2350	CRI 9,16,17,18 20,31,33,76,94
					22233	FO32/25W/835/XP/SS/ECO	30	36000 (42000)	3500	85	2475	2350	CRI 9,16,17,18 20,31,33,76,94
					22234	FO32/25W/841/XP/SS/ECO	30	36000 (42000)	4100	85	2475	2350	CRI 9,16,17,18 20,31,33,76,94
					22235	FO32/25W/850/XP/SS/ECO	30	36000 (42000)	5000	85	2300	2185	CRI 9,16,17,18 20,31,33,76,94
28	T8	48	47.78	Med Bipin	22177	FO28/830/XP/SS/ECO	30	36000 (42000)	3000	85	2725	2590	CRI 9,16,20,23 31,33,44,76,94,95
					22178	FO28/835/XP/SS/ECO	30	36000 (42000)	3500	85	2725	2590	CRI 9,16,20,23 31,33,44,76,94,95
					22179	FO28/841/XP/SS/ECO	30	36000 (42000)	4100	85	2725	2590	CRI 9,16,20,23 31,33,44,76,94,95
					22184	FO28/850XP/SS/ECO	30	36000 (42000)	5000	80	2600	2470	E CRI 9,16,20, 23,31,33,76,94,95

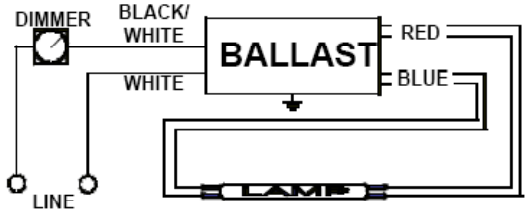
ADVANCE

REZ-154	
Brand Name	MARK 10 POWERLINE
Ballast Type	Electronic Dimming
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120
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.
* F54T5/HO	1	54	50/10	0.53	13/63	0.03/1.00	10	0.98	1.7	1.59
FC12T5/HO	1	55	50/10	0.50	13/59	0.03/0.90	10	0.98	1.7	1.53
FT55W/2G11	1	55	50/10	0.50	13/59	0.05/0.90	10	0.98	1.7	1.53

Wiring Diagram



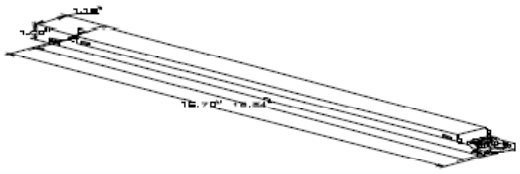
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

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 08/21/2006

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ADVANCE
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Customer Support/Technical Service: Phone: 800-372-3331 · Fax: 630-307-3071
Corporate Offices: Phone: 800-322-2086

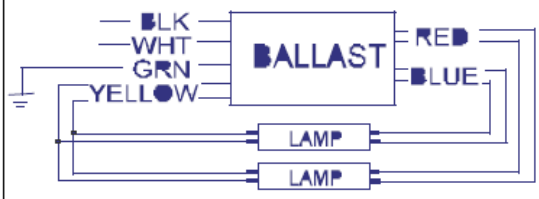
ADVANCE™

Electrical Specifications

RMB-2P13-S3-H	
Brand Name	MATCHBOX
Ballast Type	Electronic
Starting Method	Instant Start
Lamp Connection	Series
Input Voltage	120
Input Frequency	60 HZ
Status	Active

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.
CFQ13W/G24Q	2	13	0/-18	0.23	27	0.90	10	0.98	1.7	3.33
CFQ18W/G24Q	1	18	0/-18	0.13	15	0.80	15	0.96	1.7	5.33
CFT7W/2G7	2	7	0/-18	0.14	16	1.00	15	0.95	1.7	6.25
CFT9W/2G7	2	9	0/-18	0.17	20	1.05	10	0.98	1.7	5.25
CFTR13W/GX24Q	2	13	0/-18	0.23	27	0.90	10	0.98	1.7	3.33
CFTR18W/GX24Q	1	18	0/-18	0.13	15	0.80	15	0.96	1.7	5.33
* F13T5	2	13	0/-18	0.24	28	0.95	10	0.97	1.7	3.39
F14T5	2	14	0/-18	0.24	28	0.90	10	0.97	1.7	3.21
F8T5	2	8	0/-18	0.16	19	1.25	10	0.98	1.7	6.58
F8T5 & F13T5	2	813	0/-18	0.20	23	1.10	10	0.97	1.7	4.78

Wiring Diagram



Green terminal must be grounded

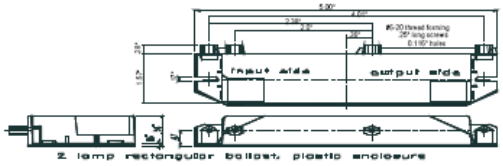
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

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



2 lamp rectangular ballast, plastic enclosure

Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
5.0 "	1.85 "	0.94 "	4.6 "
5	1 17/20	0 47/50	4 3/5
12.7 cm	4.7 cm	2.4 cm	11.7 cm

Revised 01/26/2004

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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

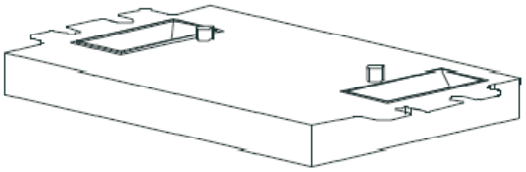
Wiring Diagram

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

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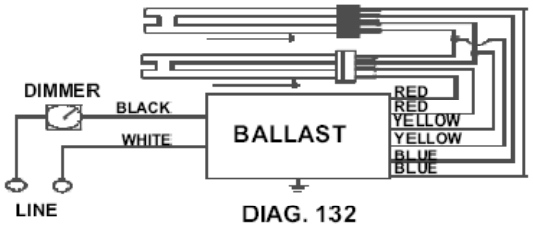
Corporate Offices: Phone: 800-322-2086

VEZ-2T42-M3-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.
CFTR32W/GX24Q	2	32	50/10	0.28	20/76	0.05/1.00	10	0.98	1.6	1.32
* CFTR42W/GX24Q	2	42	50/10	0.36	20/98	0.05/1.00	10	0.98	1.6	1.02
CFTR57W/GX24Q	1	57	50/10	0.24	18/66	0.05/1.00	10	0.98	1.6	1.52
CFTR70W/GX24Q	1	70	50/10	0.29	18/80	0.05/1.00	10	0.98	1.6	1.25

Wiring Diagram

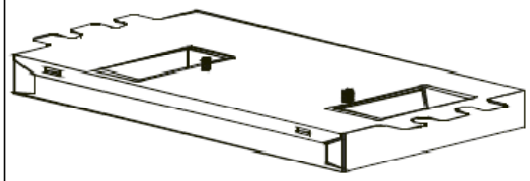


DIAG. 132

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)
6.28 "	3.00 "	1.29 "	2.00 "
6 7/25	3	1 29/100	2
16 cm	7.6 cm	3.3 cm	5.1 cm

Revised 08/17/2006

Data is based upon tests performed by Advance Transformer in a controlled environment and 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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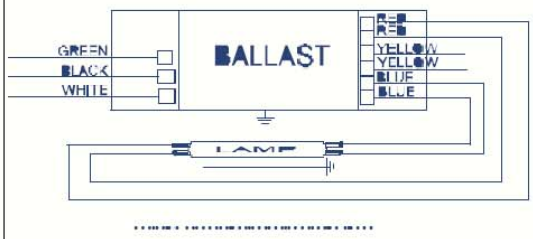
ICN-2S28@277	
Brand Name	CENTIUM T5
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	50/60 HZ
Status	Active

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.
F14T5	1	14	0/-18	0.07	19	1.07	20	0.90	1.7	5.63
F14T5	2	14	0/-18	0.13	34	1.06	10	0.98	1.7	3.12
F21T5	1	21	0/-18	0.10	26	1.03	15	0.95	1.7	3.96
F21T5	2	21	0/-18	0.17	48	1.02	10	0.98	1.7	2.13
* F28T5	1	28	0/-18	0.12	33	1.04	10	0.98	1.7	3.15
F28T5	2	28	0/-18	0.23	63	1.03	10	0.99	1.7	1.63
F35T5	1	35	0/-18	0.15	41	1.01	10	0.98	1.7	2.46
F35T5	2	35	0/-18	0.28	77	1.00	10	0.99	1.7	1.30

Wiring Diagram



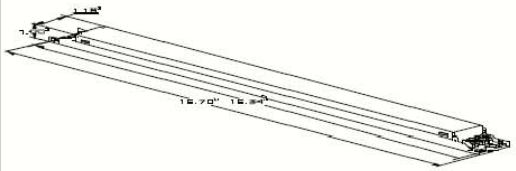
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

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 Advance Transformer in a controlled environment and 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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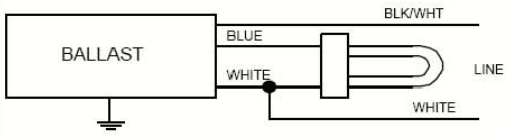
VH-1B9-TP-W	
Brand Name	COMPACT-HPF
Ballast Type	Magnetic
Starting Method	Pre-Heat
Lamp Connection	Series
Input Voltage	277
Input Frequency	60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Starting Current (Amps)	Open Circuit (Amps)	Input Power (Watts)	Ballast Factor	MAX THD %	Power Factor
CFQ9W/G23	1	9	0/-18	0.05	0.18	0.17	15	0.95	35	0.95
CFT5W/G23	1	5	0/-18	0.05	0.18	0.17	11	0.95	50	0.82
CFT7W/G23	1	7	0/-18	0.05	0.18	0.17	12	0.93	45	0.84
* CFT9W/G23	1	9	0/-18	0.05	0.18	0.17	12	0.94	35	0.89

Wiring Diagram



Diag. 47

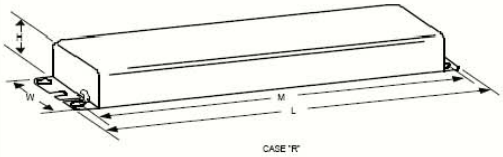
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black		0
White	15	38.1
Blue	15	38.1
Red		0
Yellow		0
Gray		0
Violet		0

	in.	cm.
Yellow/Blue		0
Blue/White		0
Brown		0
Orange		0
Orange/Black		0
Black/White	15	38.1
Red/White		0

Enclosure



Enclosure Dimensions

OverAll (L)	Width (std)/(TP)	Height (H)	Mounting (M)
4.75 "	2.21875 "/0 "	1.625 "	4.375 "
4 3/4	2 7/32 / 0	1 5/8	4 3/8
12.1 cm	5.6 cm / 0 cm	4.1 cm	11.1 cm

Revised 07/01/1999

Data is based upon tests performed by Advance Transformer in a controlled environment and 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.

ADVANCE
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FDI Interfaces

Installation Instructions
Please Leave for Occupant

FDI-INC-2000 120VAC 50/60Hz
For Incandescent and Magnetic Low-Voltage Loads
FDI-ELV-1000 120VAC 50/60Hz
For Electronic Low-Voltage Loads
FDI-FTU-16A-120 120VAC 50/60Hz
For Lutron Tu-Wire® Ballast Loads

Description

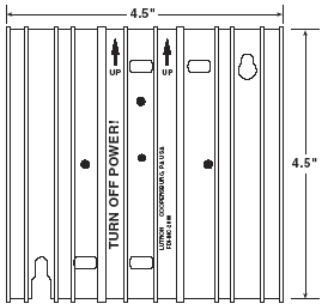
Fluorescent dimmer interfaces are used to convert a fluorescent phase control dimming signal into a dimmed hot output for incandescent, magnetic low-voltage, and Tu-Wire® ballast loads.

The FDI-INC-2000 is for use with 120V incandescent and magnetic low-voltage loads.

The FDI-ELV-1000 is for use with 120V electronic low-voltage loads.

The FDI-FTU-16A-120 is for use with Lutron 120V Tu-Wire® electronic dimming ballast loads.

The FDI Interfaces are for use with the following Lutron controller models only: RTA-RX-F-SC, RTA-RX-F, PN-IR, PN-IR-LP, MW-LC-2, DMW-LZC1 and DMW-LZC4.



Important Information

Warning: Always turn OFF the circuit breakers or remove the main fuses from the power line before doing any work. Failure to do so can result in serious personal injury. Disconnect all power sources before servicing unit.

1. This control must be installed by a qualified electrician.
2. Install in accordance with all applicable regulations.
3. Proper short-circuit and overload protection must be provided at the distribution panel.
4. Improper wiring can result in personal injury, damage to the control, or damage to other equipment.
5. This interface must be mounted with arrows facing upward to insure adequate cooling.
6. In magnetic low-voltage installations use ***only*** FDI-INC-2000 with iron core transformer low-voltage incandescent fixtures.
7. In electronic low-voltage installations use ***only*** FDI-ELV-1000 with solid state electronic low-voltage transformers that are manufacturer approved to be dimmed by reverse phase control.
8. CAUTION- Dimmed low-voltage transformers: To avoid excessively high current flow that can cause transformer overheating and failure, observe the following:
   (a) Do not operate the unit with all of the lamps removed or with any lamps inoperative.
   (b) Replace any burned out lamps immediately.
   (c) Use only transformers which incorporate thermal protection or fused primary windings.
9. The FDI-ELV-1000 contains a thermal device that turns off the interface if overloaded. The interface will turn on when it cools.

Installation & Operation

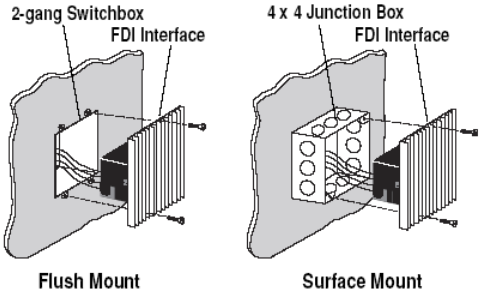
New Installations:

Check each zone for shorts or open circuits. Turn power OFF. Connect a standard switch between the live lead and a zone's load wire, then turn power on. If the load does not operate, the circuit is open. If the circuit breaker trips (fuse blows), the circuit is shorted. Correct any open or shorted condition and test again before proceeding.

1. Turn supply power OFF to the dimming controller and the feed to the FDI Interface.
2. Strip 1/2" of insulation from wires as shown:

3. Wire as shown in appropriate Wiring Diagram on reverse of this sheet. Each terminal will accept up to two wires (#12 to #18AWG). Use 75°C copper (CU) wire only. Tighten terminals to 9 in-lbs of torque.
4. Confirm all connections and mount unit using the screws provided as illustrated in the Mounting Diagram.
5. Restore power to the system. Operate the system according to the installation guide supplied with your controller.

Mounting Diagram



LUTRON®

Wiring Diagrams

Figure 1 – Wiring the FDI Interface with RadioTouch™ Controller models RTA-RX-F or RTA-RX-F-SC

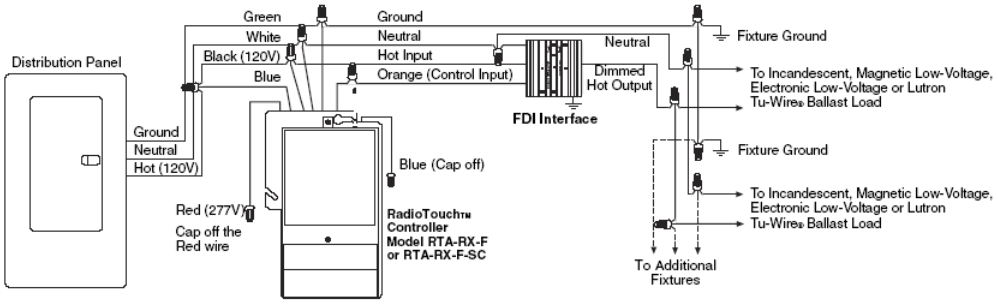


Figure 2 – Wiring the FDI Interface with microWATT® Controller models MW-LC-2, DMW-LZC1 or DMW-LZC4

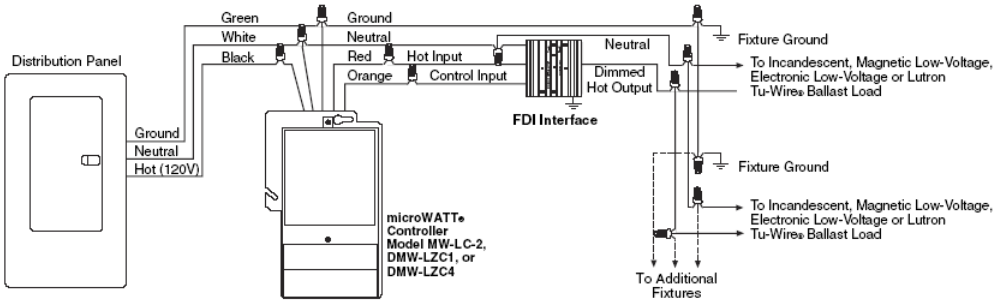
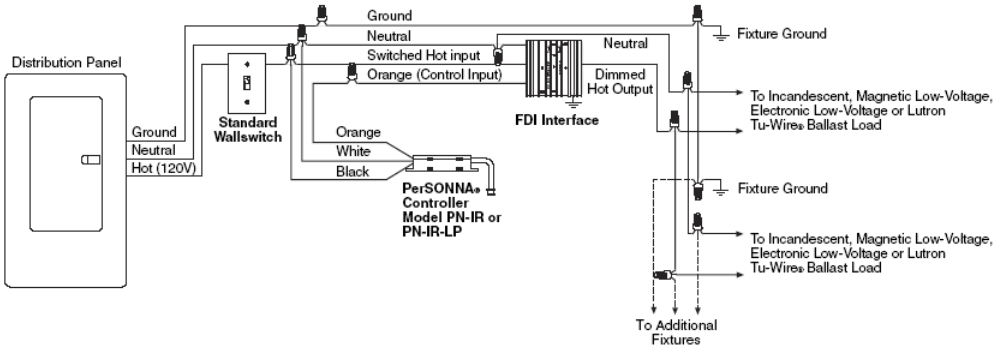


Figure 3 – Wiring the FDI Interface with PerSONNA® Controller models PN-IR or PN-IR-LP



Worldwide Technical and Sales Assistance

If you have questions concerning the installation or operation of this product, call the ***Lutron Technical Support Center.***
Please provide exact model number when calling.
(800) 523-9466 (U.S.A., Canada, and the Caribbean)
Other countries call (610) 282-3800
Fax (610) 282-3090
Visit our web site at www.lutron.com

Limited Warranty

Lutron will, at its option, repair or replace any unit that is defective in materials or manufacture within one year after purchase. For warranty service, return unit to place of purchase or mail to Lutron at 7200 Suter Rd., Coopersburg, PA 18036-1299, postage pre-paid.

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