Recommended
Lighting Standards

South Carolina High School League & South Carolina Athletic Administrators Association

Adopted XXXX, 2011

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Standards of Lighting

The following guidelines are recommended by the South Carolina High School League and the South Carolina Athletic Administrators Association. These standards apply to the lighting of all high school athletic activities sponsored by the SCHSL and SCAAA or its member schools. The intent of establishing these lighting standards for all South Carolina High School facilities is to provide an environment for safe play – for players and spectators – at sporting events, from regular season high school competition to play-offs and tournaments. These standards incorporate the most current data available regarding the lighting, electrical, and structural issues that apply to installation of a safe, effective lighting system.

The standards are divided into recommended minimums and desirable features. The minimums establish criteria important to safe conduct of SCAAA activities and include evaluation of operating costs over the expected life of the lighting system. Desirable features are established to give added values where appropriate for a facility's needs.

I. Recommended Minimum Standards

These minimum standards are recommended for all lighting installations after the date of adoption of these standards. Any modification in existing lighting systems after this date should be done so as to result in a lighting system in compliance with these standards. To be in compliance, a system must meet all recommended minimum standards.

PART 1 – GENERAL

1.1 LIGHTING PERFORMANCE

A. Light Levels – Optic System Performance

The quantity of equipment needed to produce the target light levels on a field is determined by the efficiency of the lighting system. Newest technology is capable of delivering equal or better results with as little as half the amount of equipment as common floodlighting systems. This generation of lighting has high performance optic characteristics that enable reductions in the quantities of luminaires needed to meet design targets. The lighting designs for the specified field will show a reduced fixture count for systems using a high-performance optic system. Manufacturers should provide assurance that target light levels will be met by the lighting scans when installed.

B. Light Levels –Sustaining Targets Over Time

The two methods of design are to provide a constant light level during the light-level's guaranteed period or to apply a recoverable light loss factor to the initial design.

1. Constant Light with Guaranteed Light Levels

By using a series of automatic power adjustments, a lighting system is able to provide "constant light levels" and greatly extend the life of the lamps. The basics of this method are described under "Lumen Maintenance" in the IESNA Lighting Handbook Reference and Application, Ninth Edition, page 27-2 and 27-3: "Lumen maintenance control strategy calls for reducing the initial illumination of a new system to the designed minimum level. As lumen depreciation occurs, more power is applied to the lamps in order to maintain constant output."

The term constant is intended to include any system that provides target light levels at 100 hours and maintains the target light levels throughout the system life. Light levels should be guaranteed for 25 years with this technology.

Manufacturers should provide an independent test report signed by a licensed professional engineer certifying the lumen maintenance strategy and field performance of any constant light system.

2. Floodlighting with a Recoverable Light Loss Factor

Computer designs are done using two sets of values. One predicts "initial light levels" when lamps are new. The other predicts "target maintained light levels" after the lamps have passed through depreciation in light output. It is important to have the lighting designer use a maintenance factor adequate to account for this depreciation in light output throughout the life of the lamp.

According to best sports lighting practices, the recoverable light loss factor, or the value applied to the initial light level to predict the maintained light level values, should be in accordance with recommendations in the Pennsylvania State University report "Light Loss Factors for Sports Lighting," published in IES's *Leukos*, Vol. 6, No. 3, Jan., 2010, pages 183-201. The report's findings show a recoverable light loss factor of 0.69 should be used if lamps will be replaced at 2100 hours. If lamps will be replaced at a different interval, the following chart from the report should be used to determine the appropriate recoverable light loss factor. Quality manufacturers are willing to provide guarantees of lighting performance.

Group lamp replacement interval	Recoverable Light Loss Factor
750 hours	0.8
1200 hours	0.75
2100 hours	0.69
3000 hours	0.65

C. Performance Requirements – Quantity

Playing surfaces shall be lit to an average target light level and uniformity as specified in the following chart. Lighting calculations shall be developed and field measurements taken on the grid spacing with the minimum number of grid points specified beginning on page 13 of these standards with the light meter held horizontally 36 inches above the field surface. Measured average illumination level shall be measured at the first 100 hours of operation.

D. Performance Requirements – Quality

Uniformity of the lighting shall be such that the highest measure of quantity of light on the field is not greater than the lowest measurement per the ratio listed in the table below. On the entire field area, the change in the quantity of horizontal footcandles should not occur at a greater rate than 10 percent per 10 feet, except for the outside perimeter readings which may change at a greater rate.

Area of Lighting	Average Target Light Levels (Horizontal)	Maximum to Minimum Uniformity Ratio	Maximum Rate of Change
Baseball / Softball	50 footcandles – Infield 30 footcandles - Outfield	2:1 infield 2.5:1 outfield	10% per 10 feet * See Note
Football / Soccer / Lacrosse / Field Hockey / Rugby Less than 2000 spectators More than 2000 spectators	30 footcandles 50 footcandles	2.5:1 2:1	10% per 10 feet
Gymnasium / Basketball With spectators No spectators	80 footcandles 50 footcandles	2:1	10% per 10 feet
Natatoriums	Consult an experienced lighting manufacturer or lighting specialist		
Tennis	40 footcandles	1.7:1 within lines 2:1 principal playing area	10% per 10 feet
Track - Competitive Use Stand Alone Football/Track Around Field **General Use (Walking track)**	30 footcandles 30 footcandles 5 footcandles		10% per 10 feet
Combination / Multipurpose	Highest minimum for activities played on field	Lowest minimum for activities played on field	10% per 10 feet
* Transition points between infield and outfield areas may vary by an amount greater than 10% per 10 feet.			

E. Glare for Participants

To achieve placement of lights in positions that enhance playability, pole heights, pole locations and fixture placements should be as shown on the layouts in the appendix.

1.2 ENVIRONMENTAL LIGHT CONTROL

Many facilities are located near residential properties or roadways, creating the possibility of spill and glare onto adjoining properties. They are also often located adjacent to other fields where the glare from lights on one field can affect playability on another. Consideration should be given to this issue during the initial lighting design stage to minimize this effect. Some communities are implementing ordinances designed to minimize light pollution. Contact your local planning committee or zoning board.

The lighting equipment manufacturer can assist in assessing this issue and provide drawings showing maximum footcandles at any points of concern on adjacent properties. Do not hesitate to investigate a manufacturer's reputation, abilities, and past experiences in working with local authorities and private property owners regarding glare and spill issues.

1.3 LIFE-CYCLE COSTS

Because the efficiency of lighting systems currently available can vary greatly, a life-cycle operating cost analysis should be completed when evaluating lighting systems. Owners should expect a quality lighting system to last a minimum of 25 years.

These standards provide a Life-Cycle Operating Cost Evaluation form to assist with the process. Items that should be included are energy consumption based upon the facility's expected usage, cost for group and spot lamp replacement and maintenance, and any additional savings in energy or labor cost provided by automated on/off control systems.

Contract price and life-cycle operating cost should both be considered in determining a lighting manufacturer for the project.

1.4 CONTROL AND MONITORING SYSTEM

A remote control and monitoring system will provide ease of operation and management for your facility. Manufacturers providing systems with a 25 year warranty will utilize this system to ensure your lighting performs as required.

A. Remote Monitoring

The system shall monitor lighting performance and notify manufacturer if individual luminaire outage is detected so that appropriate maintenance can be scheduled. The manufacturer shall notify the owner of outages within 24 hours, or the next business day. The controller shall determine switch position (Manual or Auto) and contactor status (open or closed).

B. Remote Lighting Control

The system shall allow owner and users with a security code to schedule on/off system operation via a web site, phone, fax, or email up to 10 years in advance. Manufacturer shall provide and maintain a two-way TCP/IP communication link. Trained staff shall be available 24/7 to provide scheduling support and assist with reporting needs.

The owner may assign various security levels to schedulers by function and/or fields. This function must be flexible to allow a range of privileges, such as full scheduling capabilities for all fields, to only having permission to execute "early off" commands by phone.

Control unit shall accept and store 7-day schedules, be protected against memory loss during power outages, and shall reboot once power is regained and execute any commands that would have occurred during outage.

C. Management Tools

Manufacturers shall provide a web-based database of actual field usage and provide reports by facility and user group.

D. Communication Costs

Manufacturers shall include communication costs for operating the controls and monitoring system for a period of 25 years.

E. Cabinet Construction

Controls and Monitoring Cabinet shall be constructed of aluminum and rated NEMA Type 4. Cabinet shall contain custom-configured contactor modules for 30, 60, and 100 amps, labeled to match field diagrams and electrical design. Manual Off-On-Auto selector switches shall be provided.

1.5 WARRANTY AND GUARANTEE

Product warranties are a good gauge of a manufacturer's confidence in their products. Warranties for typical floodlighting equipment can range from five years to 10 years, and details of covered items and conditions vary greatly. New generation technology comes with warranty periods of up to 25 years and includes guaranteed light levels, parts, labor, lamp replacements, energy usage, monitoring and control services, spill light control, and structural integrity. The manufacturer should have financial reserves to assure fulfillment of the warranty for the full term. It is highly recommended you consider these all-inclusive warranties to limit your school's future exposure to escalating costs and maintenance hassles.

PART 2 – PRODUCT

2.1 LIGHTING SYSTEM CONSTRUCTION

A lighting system should consist of lighting, electrical and structural components designed to work together as a system that is durable and provides safety features.

A. Outdoor lighting systems should consist of the following:

1. Galvanized steel poles and crossarm assembly, or concrete poles with tubular steel lighting assembly. Wood poles or direct burial steel poles, or steel pole bases with steel below grade, are not recommended.
2. Pre-stressed concrete base or concrete pole embedded in concrete backfill, or a poured-in-place foundation containing reinforcing steel cured a minimum of 28 days before any stress load is applied.
3. Luminaires constructed with a die-cast aluminum housing or external hail shroud to protect the luminaire reflector system.
4. All ballasts and supporting electrical equipment mounted remotely in aluminum enclosures approximately 10' above grade. The enclosures shall include ballast, capacitor, and fusing for each luminaire. Safety disconnect per circuit for each pole structure must be located in the enclosure.
5. Wire harness for each pole structure complete with an abrasion protection sleeve, strain relief, and plug-in connections for fast, trouble-free installation.

B. Interior sports lighting systems should consist of the following:

1. All luminaires shall consist of a lamp, lamp socket, reflector, lens, lamp cone, reinforcing retaining ring, and wire frame to mount glare reduction visor.
2. All ballasts and supporting electrical equipment shall be mounted remotely in aluminum enclosures located in an easily-accessible area but away from the playing area due to heat considerations. The enclosures shall include ballast, capacitor, and fusing for each luminaire. Safety disconnect per circuit for each pole structure must be located in the enclosure.

C. Manufacturing Requirements

All components should be designed and manufactured as a system. All luminaires, wire harnesses (if provided), and ballast and other enclosures should be factory assembled, aimed, wired, and tested for reduced installation time and trouble-free operation.

D. Durability

All exposed components shall be constructed of corrosion-resistant material and/or coated to help prevent corrosion. All exposed carbon steel shall be hot dip galvanized per ASTM A123. All exposed hardware and fasteners shall be stainless steel of 18-8 grade or better, passivated and coated for protection against corrosion and stress-corrosion cracking. All exposed aluminum shall be powder coated with high performance polyester paint or anodized. All exterior reflective inserts shall be

anodized, coated with a clear, high gloss, durable fluorocarbon, and protected from direct environmental exposure to prevent reflective degradation or corrosion. All wiring shall be enclosed within the crossarms, conduit, pole, or electrical components enclosure.

Due to the potentially corrosive effect of coastal areas, enhanced corrosion protection should be considered for all projects within five (5) miles of the Atlantic or bay areas connecting to the ocean. Galvanizing to 5 mil average thickness on horizontal steel surfaces, and Type II anodizing per MIL-STD-8625 for all exposed die cast or extruded aluminum components are recommended.

E. Lightning Protection

All outdoor structures shall be equipped with lightning protection meeting NFPA 780 standards.

F. Safety

All system components shall be UL Listed for the appropriate application.

G. Maximum total voltage drop

Voltage drop to the disconnect switch located on the poles should not exceed three (3) percent of the rated voltage per IESNA RP-6-01.

2.2 STRUCTURAL PARAMETERS

A. Location

Poles should be located as shown on the drawings in the appendix to these standards. Whenever possible, poles should be located outside of fences to avoid causing an obstruction or safety hazard to the participants.

B. Foundation Strength

Project-specific foundation drawings stamped by a registered South Carolina structural engineer illustrating that the foundation design is adequate to withstand the forces imposed from the pole, fixtures, and other attachments to prevent the structure from leaning should be provided by the manufacturer. Foundation designs shall comply with the provisions of the current state building code.

C. Support Structure Wind Load Strength

Poles and other support structures, brackets, arms, bases, anchorages, and foundations shall be determined based on the 50-year mean recurrent isotach wind maps for the appropriate county per the South Carolina State Building Code. Luminaire, visor, and crossarm shall withstand 150 mph winds and maintain accurate aiming alignment.

D. Structural Design

The stress analysis and safety factor of the poles shall conform to AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

E. Soil Conditions

The design criteria for these specifications are based on soil design parameters as outlined in the geotechnical report. If a geotechnical report is not available, the foundation design can be based on soils that meet a Class 5 material as defined by 2009 IBC, Table 1806.2.

PART 3 – EXECUTION

3.1 FIELD QUALITY CONTROL

A. Illumination Measurements

Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, School's Representative, and Manufacturer's Representative, illumination measurements shall be taken and verified. The illumination measurements shall be conducted in accordance with IESNA RP-6-01, Annex B.

B. Correcting Non-Conformance

If, in the opinion of the Owner or his appointed Representative, the actual performance levels including footcandles, uniformity ratios, and maximum kilowatt consumptions are not in conformance with the requirements of the performance specifications and submitted information, the Manufacturer shall be liable to any or all of the following:

1. Manufacturer shall at his expense provide and install any necessary additional fixtures to meet the minimum lighting standards. The Manufacturer shall also either replace the existing poles to meet the new wind load (EPA) requirements or verify by certification by a licensed structural engineer that the existing poles will withstand the additional wind load. Manufacturer shall also verify the existing electrical system is adequate to accommodate the additional fixtures, and upgrade if needed.
2. Manufacturer shall remove the entire unacceptable lighting system and install a new lighting system to meet the specifications.
3. To help ensure the safety of the players and spectators, it is recommended each school or school district develop a regularly scheduled maintenance program. At a minimum, the following should be addressed:
   a. **Visual Testing** – Should be performed annually prior to the start of a season on lamps, lenses, conduit, pole, structure for signs of cracks and fatigue, fuses, ballasts, grounding connections, and breaker boxes to ensure the integrity and performance of the system. (Refer to Maintenance Checklist in the appendix.)
   b. **Performance Audits** – Should be performed annually prior to the start of a season on light levels, lamps, lenses, conduit, pole, structure for signs of cracks and fatigue, fuses, ballasts, grounding connections, and breaker boxes to ensure the integrity and performance of the system. (Refer to Maintenance Checklist and Lighting Performance sections provided in the appendix.)

II. Optional Features

The following features should be considered when planning your overall lighting system project.

4.1 TV QUALITY LIGHTING

Lighting for televised events involves considerations in addition to spectators and participants. It is recommended that schools wishing to light facilities for television broadcast use consultants and lighting manufacturers with experience and knowledge in that area.

NOTE: For facilities that plan on hosting televised events, the facility should be lit according to the NCAA lighting standards for television broadcasts. To access these standards online, go to http://www.ncaa.org, then use the site's search feature to search for "Best Lighting Practices."

4.2 AUXILIARY BRACKETS

Sports lighting manufacturers can provide accommodations for mounting auxiliary equipment such as speakers on sport lighting poles. This ensures poles will be sized to accommodate the weight, dimensions, and EPA of the additional equipment. Brackets shall be welded to the pole and fabricated from hot-dip galvanized steel with a covered hand hole access and internal wiring in the pole.

4.3 SCOREBOARDS

Incorporating scoreboards onto the lighting poles can provide additional cost savings over installing separate structures. Lighting manufacturers can assist in providing a method for attaching a scoreboard appropriate for the sport.

4.4 FIELD PERIMETER LIGHTING

The parking areas, major areas utilized for passage, and areas immediately bordering the facilities should be lighted to an average of approximately 2 footcandles. Care should be taken to eliminate darkly shadowed areas.

4.5 EMERGENCY LIGHTING FOR SPECTATOR SEATING AREA

Consideration should be given to providing emergency lighting for spectator seating areas in case of loss of power at indoor and outdoor facilities. Refer to local codes for specific requirements as they apply to athletic facilities.

For additional information, contact:

SCAAA
113 Muddy Ford Road
Greenville, SC 29615
Phone: 864/288-2857
www.scaaa.org

SCHSL
PO Box 211575
Columbia, SC 29221
Shipping address:
121 Westpark Blvd.
Columbia, SC 29220
Phone: 803/798-0120
Fax: 803/731-9679
www.schsl.org
schsl@schsl.org

LIFE-CYCLE OPERATING COST EVALUATION

This form will assist you in comparing 25-year life-cycle operating costs from multiple manufacturers. Bid proposals should be evaluated based upon compliance with the specifications, contract price, and the following life-cycle operating cost evaluation.

BID ALTERNATE A:

A.	**Energy consumption** ____ Number of luminaires x ____ kW demand per luminaire x ____ kWh rate x ____ annual usage hours x 25 years		
B.	**Demand charges, if applicable**	+	
C.	**Spot lamp replacement and maintenance over 25 years** Assume ____ repairs at $ ____ each if not included	+	
D.	**Group lamp replacements during 25 years** ____ annual usage hours x 25 years / lamp replacement hours x $125 lamp & labor x number of fixtures	+	
E.	**Extra energy used without control system** ____% x Energy Consumption in item A.	+	
F.	**Extra labor without control system** $____ per hour x ____ hours per on/off cycle x ____ cycles over 25 years	+	
G.	**TOTAL 25-Year Life-Cycle Operating Cost**	=	

BID ALTERNATE B:

A.	**Energy consumption** ____ Number of luminaires x ____ kW demand per luminaire x ____ kWh rate x ____ annual usage hours x 25 years		
B.	**Demand charges, if applicable**	+	
C.	**Spot lamp replacement and maintenance over 25 years** Assume ____ repairs at $ ____ each if not included	+	
D.	**Group lamp replacements during 25 years** ____ annual usage hours x 25 years / lamp replacement hours x $125 lamp & labor x number of fixtures	+	
E.	**Extra energy used without control system** ____% x Energy Consumption in item A.	+	
F.	**Extra labor without control system** $____ per hour x ____ hours per on/off cycle x ____ cycles over 25 years	+	
G.	**TOTAL 25-Year Life-Cycle Operating Cost**	=	

SPORTS LIGHTING SUBMITTAL INFORMATION

Design Submittal Data Checklist and Certification

This form will assist you in comparing proposals from various lighting manufacturers. All items listed below should comply with your project's specification and be submitted according to your pre-bid submittal requirements.

Tab	Item	Description
A	Letter/ Checklist	Listing of all information being submitted must be included on the table of contents. List the name of the manufacturer's local representative and his/her phone number. Signed submittal checklist to be included.
B	On Field Lighting Design	Lighting design drawing(s) showing: a. Field Name, date, file number, prepared by, and other pertinent data b. Outline of field(s) being lighted, as well as pole locations referenced to the center of the field (x & y), Illuminance levels at grid spacing specified c. Pole height, number of fixtures per pole, as well as luminaire information including wattage, lumens and optics d. Height of light test meter above field surface e. Summary table showing the number and spacing of grid points; average, minimum and maximum illuminance levels in footcandles (fc); uniformity including maximum to minimum ratio, coefficient of variance and uniformity gradient; number of luminaries, total kilowatts, average tilt factor; light loss factor. f. Alternate manufacturers shall provide both initial and maintained light scans using a maximum Recoverable Light Loss Factor (RLLF) as specified in section 1.1.B.2.
C	Off Field Lighting Design	Lighting design drawing showing initial vertical spill light levels along the boundary line (defined on bid drawings) in footcandles. Vertical levels shall be at specified intervals along the boundary line. Readings shall be taken with the meter orientation at both horizontal and aimed towards the most intense bank lights.
D	Life-Cycle Cost Calculation	Document life-cycle cost calculations as defined in the specification. Identify energy costs for operating the luminaires, maintenance cost for the system including spot lamp replacement, and group relamping costs. All costs should be based on 25 Years.
E	Luminaire Aiming Summary	Document showing each luminaire's aiming angle and the poles on which the luminaries are mounted. Each aiming point shall identify the type of luminaire.
F	Structural Calculations	Pole structural calculations and foundation design showing foundation shape, depth backfill requirements, rebar and anchor bolts (if required). Pole base reaction forces shall be shown on the foundation drawing along with soil bearing pressures. Design must be stamped by a structural engineer in the state of Iowa.
G	Control and Monitoring	Manufacturer shall provide written definition and schematics for automated control system to include monitoring. They will also provide examples of system reporting and access for numbers for personal contact to operate the system.
H	Electrical Distribution Plans	If bidding an alternate system, manufacturer must include a revised electrical distribution plan including changes to service entrance, panels and wire sizing, signed by a licensed Electrical Engineer in the state of Iowa.
I	Performance Guarantee	Provide performance guarantee including a written commitment to undertake all corrections required to meet the performance requirements noted in these specifications at no expense to the owner. Light levels must be guaranteed per specification for 25 years.
J	Warranty	Provide written warranty information including all terms and conditions.
K	Independent Testing Report	Manufacturer bidding any form of a constant light system is to provide an independent test report certifying the system meets the lumen maintenance control strategy defined in Section 1.1.B.1, verifying the field performance of the system for the duration of the useful life of the lamp based on lamp replacement hours. Report shall be signed by a licensed professional engineer with outdoor lighting experience.
L	Project References	Manufacturer to provide a list of projects where the technology proposed for this project has been installed in Iowa. If any form of a constant light system is bid, a minimum of 5 project references completed within the last calendar year is required. For a depreciating light system a full list of projects completed within the past 3 years is required. Reference list will include project name, project city, and if requested, contact name and contact phone number.
M	Product Information	Complete set of product brochures for all components, including a complete parts list and UL Listings.
N	Non-Compliance	Manufacturer shall list all items that do not comply with the specifications.
O	Compliance	Manufacturer shall sign off that all requirements of the specifications have been met at that the manufacturer will be responsible for any future costs incurred to bring their equipment into compliance for all items not meeting specifications and not listed in item N – Non-Compliance

I understand that the information supplied herein shall be used for the purpose of complying with the specifications for _____ _____ lighting project. By signing below I agree that all requirements of the specifications have been met and that the manufacturer will be responsible for any future costs incurred to bring their equipment into compliance for all items not meeting specifications and not listed in the Non-Compliance section.

Manufacturer:_____ **Signature:** _____

Contact Name: _____ **Date:** _____/_____/_____

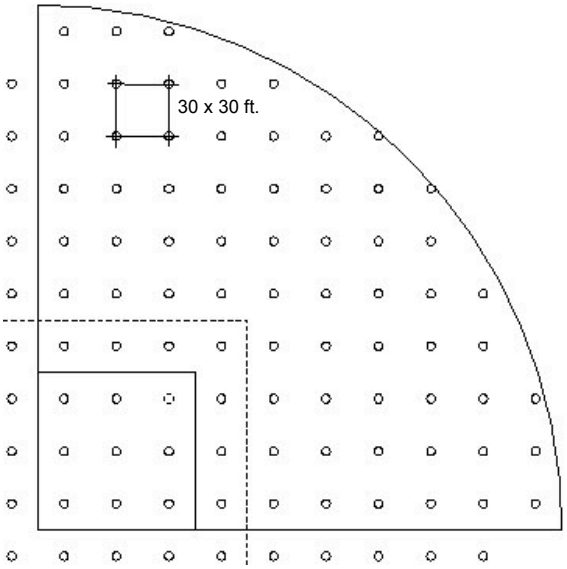
Appendix

Typical Facility Information

Area of Lighting	Playing Dimensions (feet)	Grid Spacing (feet)	Minimum # of Grids
Baseball, Infield	90' x 90'	30' x 30'	25
Baseball, Outfield	Dimensions Vary	30' x 30'	Varies
Softball, Infield	60' x 60'	20' x 20'	25
Softball, Outfield	Dimensions Vary	20' x 20'	Varies
Football	360' x 160'	30' x 30'	72
Soccer	360' x 180'	30' x 30'	72
Lacrosse	330' x 180'	30' x 30'	66
Field Hockey	300' x 180'	30' x 30'	60
Rugby	330' x 180'	30' x 30'	66
Tennis	78' x 36'	20' x 20'	15
Gymnasiums	94' x 50'	10' x 10'	50
Track and Field	Dimensions Vary	30' x 30'	Varies

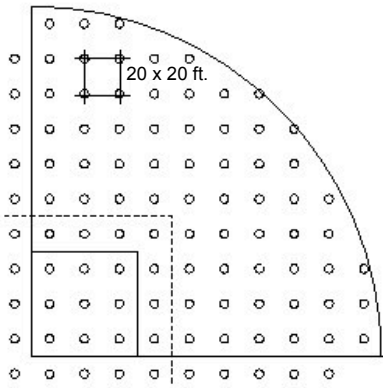
Light Level Grid Point Layouts

Baseball



300' radius field shown

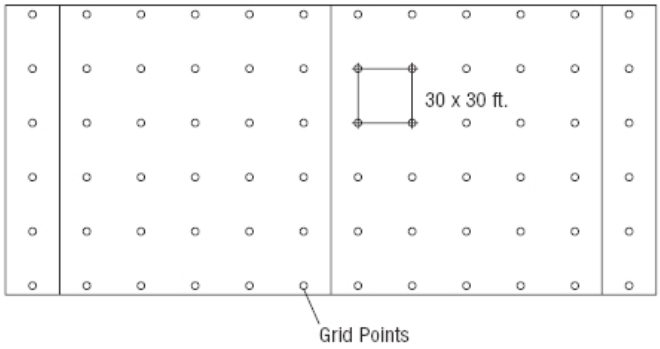
Softball



200' radius field shown

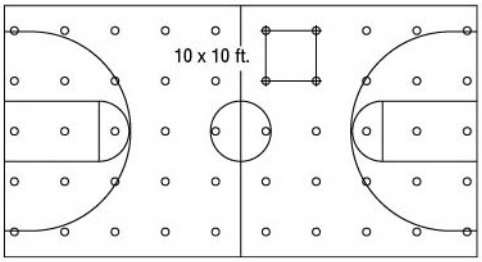
Football

360' x 160' field shown



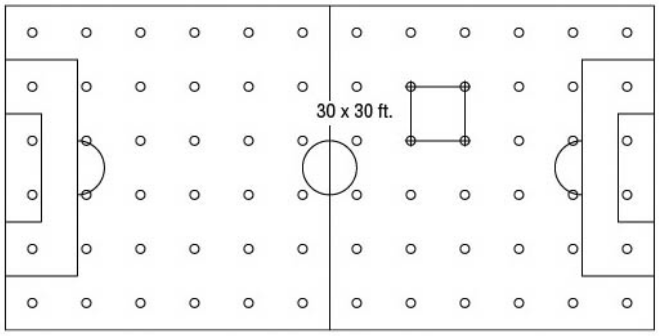
Gymnasium

94' x 50' court shown



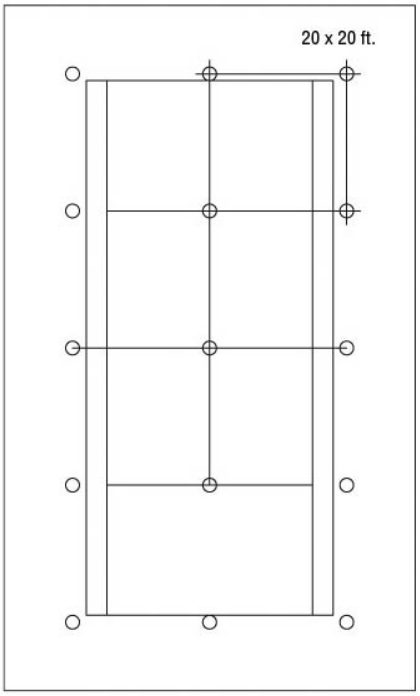
Soccer

360' x 180' field shown

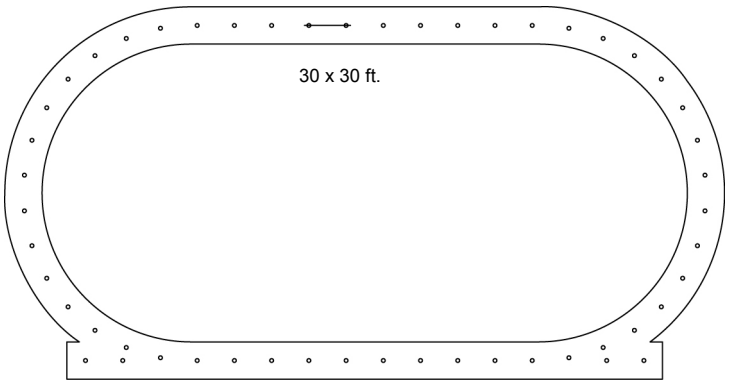


Tennis

78' x 36' court shown



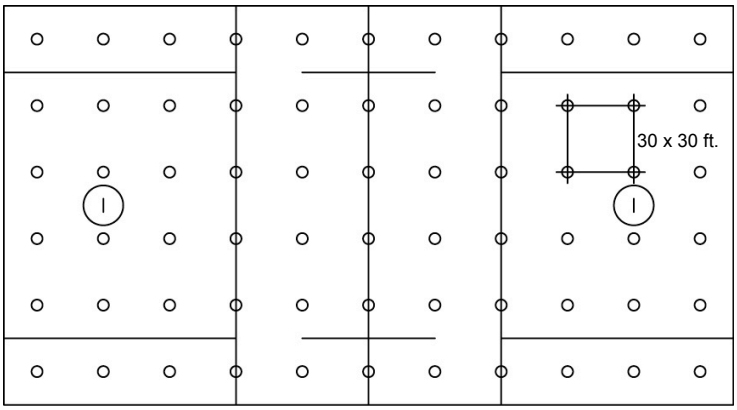
Track



400 meter, 8-lane track shown

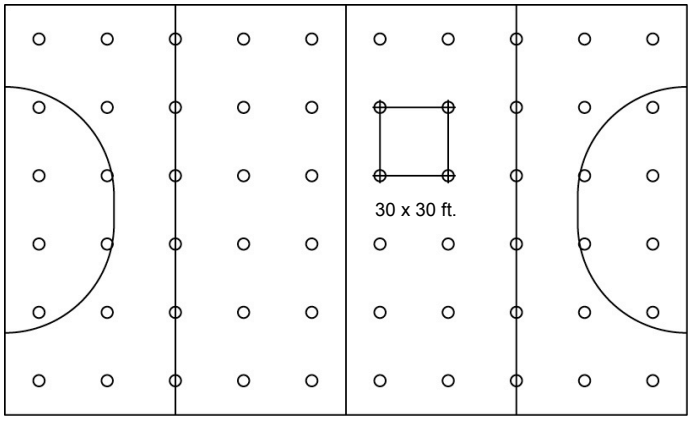
Lacrosse

330' x 180' field shown



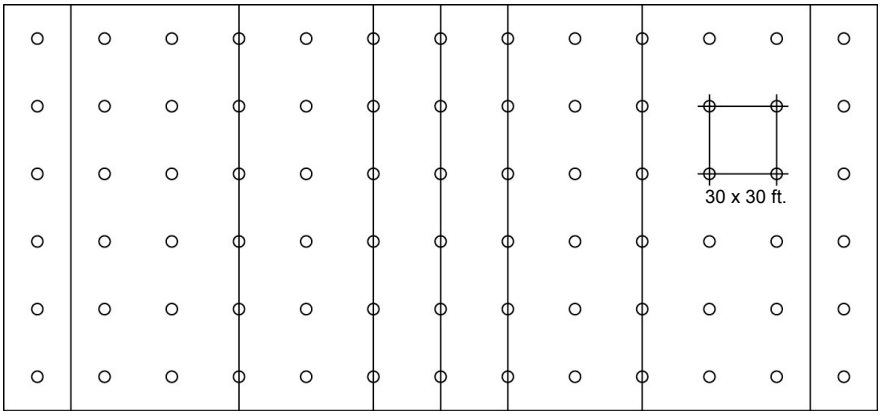
Field Hockey

300' x 180' field shown

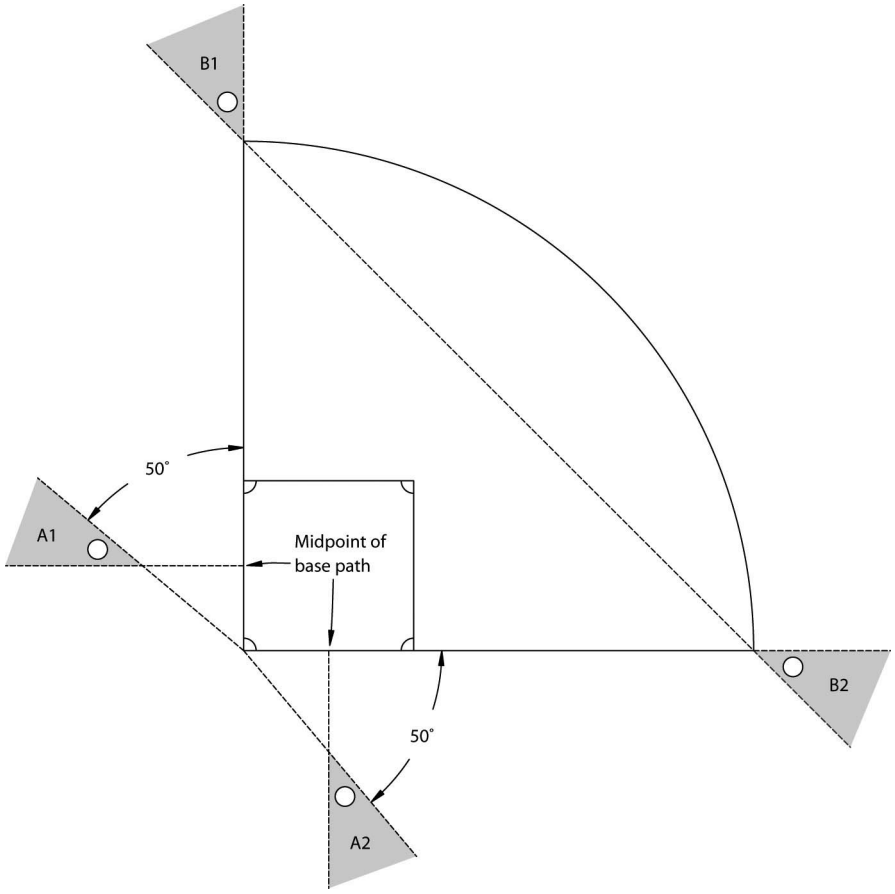


Rugby

390' x 180' field shown



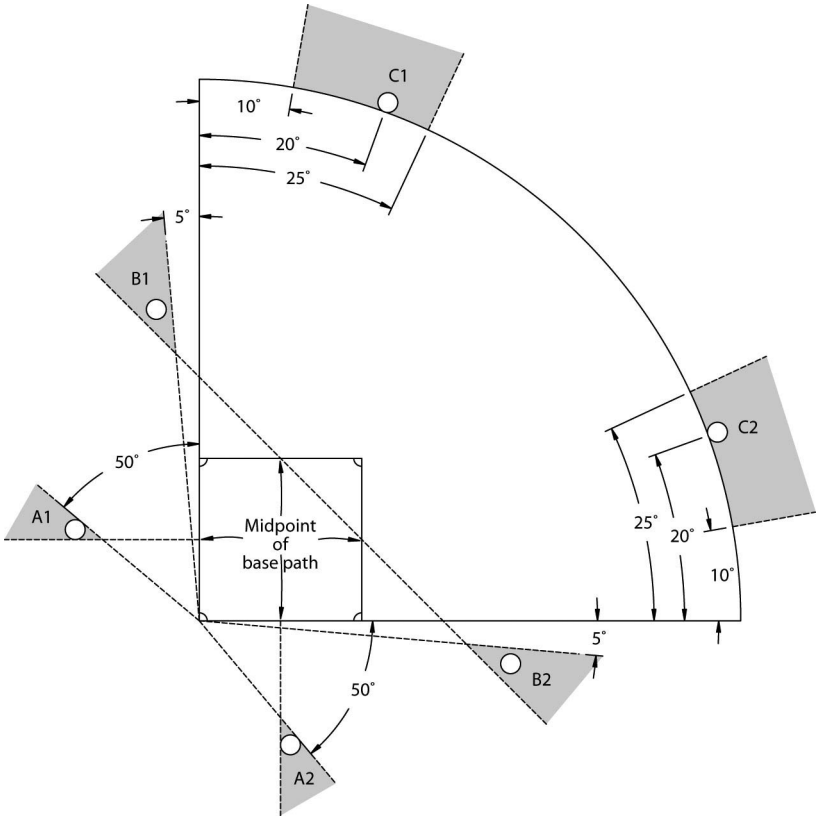
Pole Location Diagrams



4-Pole Baseball/Softball Field

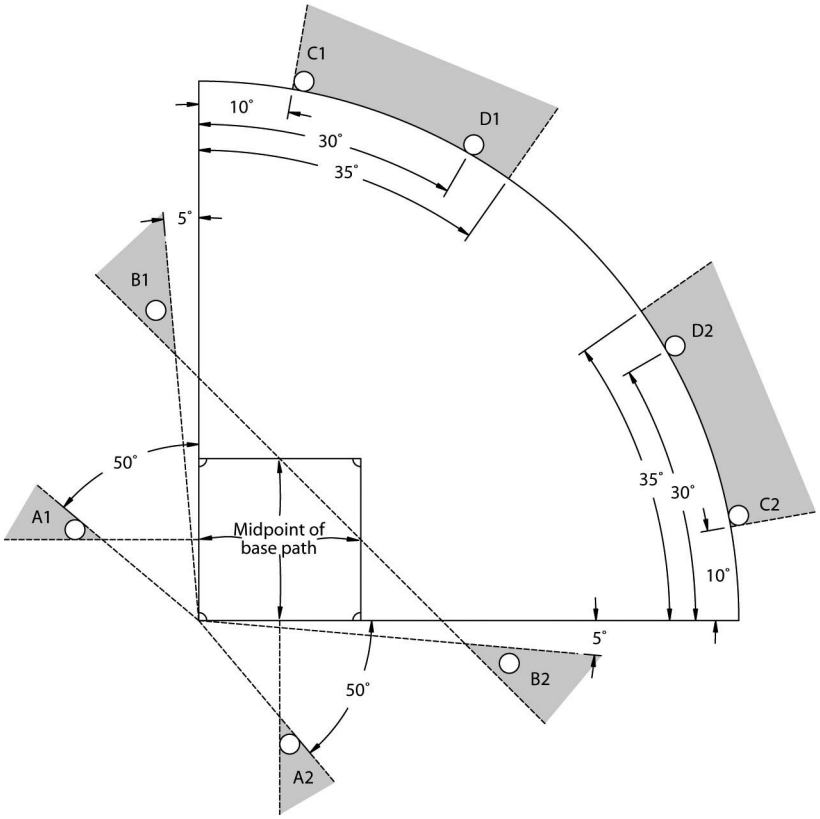
1. Poles are shown in optimal locations. Other permissible pole locations are indicated by the shaded areas.
2. For fields with a radius of 250 feet or greater, a 6-pole design is recommended.
3. Line drawn through the two "A" pole locations should be behind home plate to ensure lighting the portion of the ball the batter sees as it crosses home plate.

Note:
IES standards have not addressed issues for 4-pole design on softball fields. Design criteria are based upon actual practices used on 250' and smaller fields and standards adopted by Little League Baseball® and ASA Softball based upon testing done on their facilities.



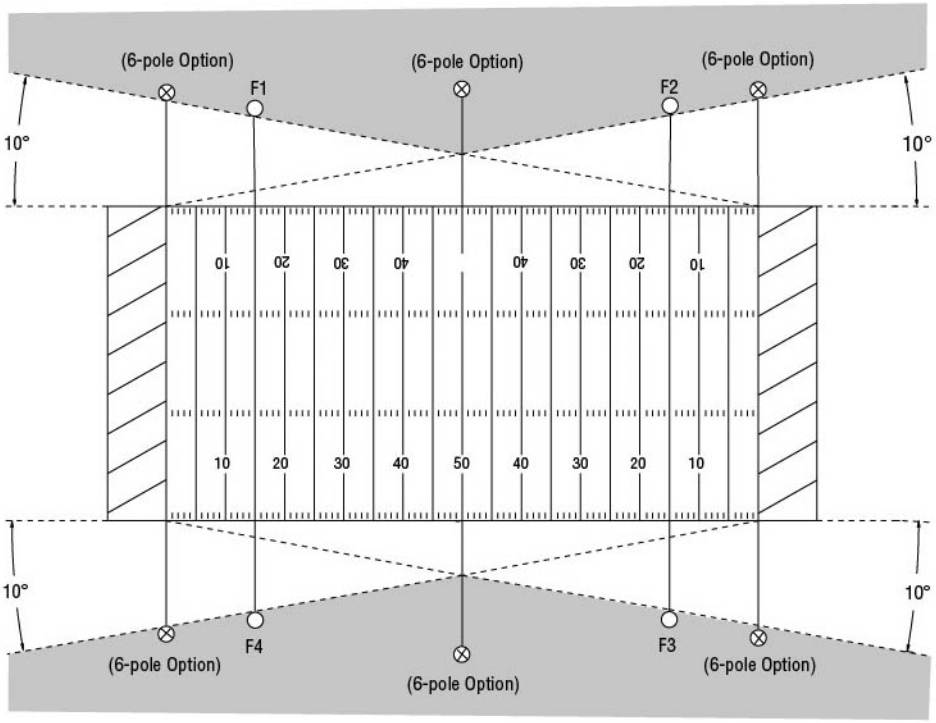
6-Pole Baseball/Softball Field

1. Poles are shown in optimal locations. Other permissible pole locations are indicated by the shaded areas.
2. For fields with a radius of 320 feet or greater, an 8-pole design is recommended.
3. Line drawn through the two “A” pole locations should be behind home plate to ensure lighting the portion of the ball the batter sees as it crosses home plate.
4. Consideration should be given to locating “B” poles further toward the outfield locations. This positioning towards the outfield foul pole allows the ball to be lighted in a more constant perpendicular illuminance as it travels from the infield to the outfield.



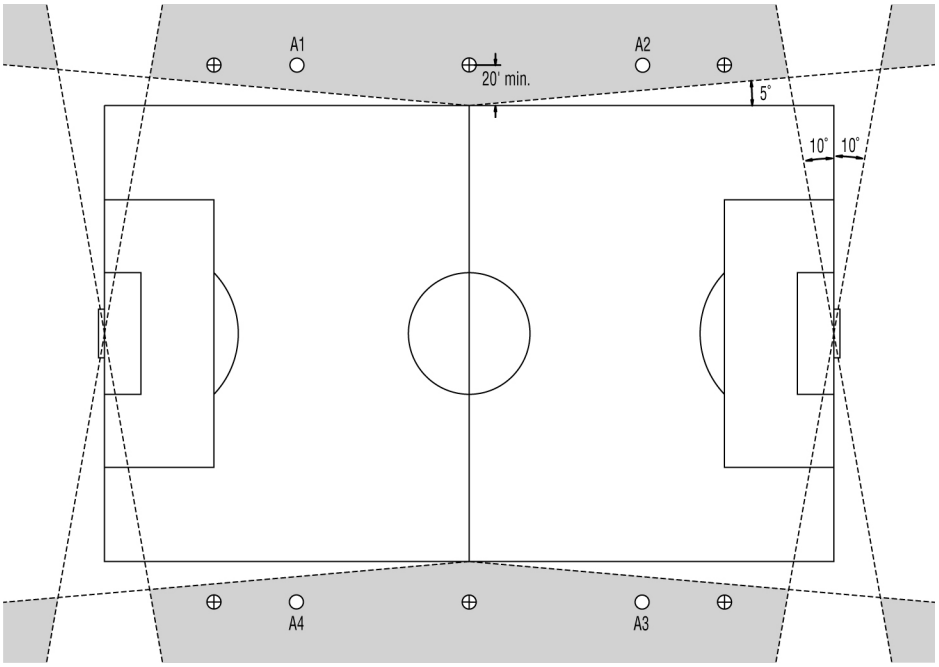
8-Pole Baseball/Softball Field

1. Shaded areas indicate recommended pole location.
2. Line drawn through each “A” pole location must be behind home plate to ensure lighting the portion of the ball the batter sees as it crosses home plate.
3. Consideration should be given to locating “B” poles further towards outfield locations. This positioning towards the outfield foul pole allows the ball to be lit in a more constant perpendicular illuminance as it travels from the infield to the outfield.
4. “B” poles may be located 10 feet closer to the infield as long as they maintain a position outside the 10 degree arc. The shaded area is preferable.



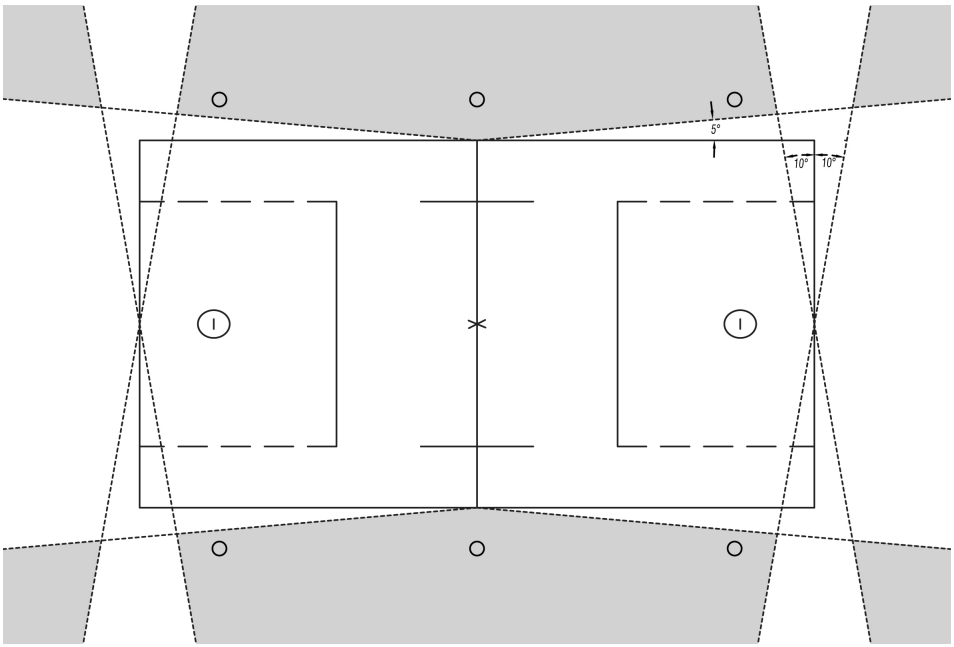
Football Field

1. Shaded areas indicate recommended pole location. All poles should be at least 45 feet from sideline.
2. On a 4-pole design, poles should be located between the 20-yard line and the goal line.
3. For the 6-pole option, setback of middle poles will depend on the presence of bleachers.
4. For TV consideration on a 6-pole design, outside poles should be located toward the end zone line. Optimum placement for TV is 10-15 feet off the end zone line for an end zone camera.
5. For practice facilities, the lighting should be approximately 20 footcandles with 2 poles on each side of the field with aiming angles of 25 degrees. Poles should be in position so not to pose a potential injury. Electrical and structural guidelines should be strictly adhered to as outlined in these standards.



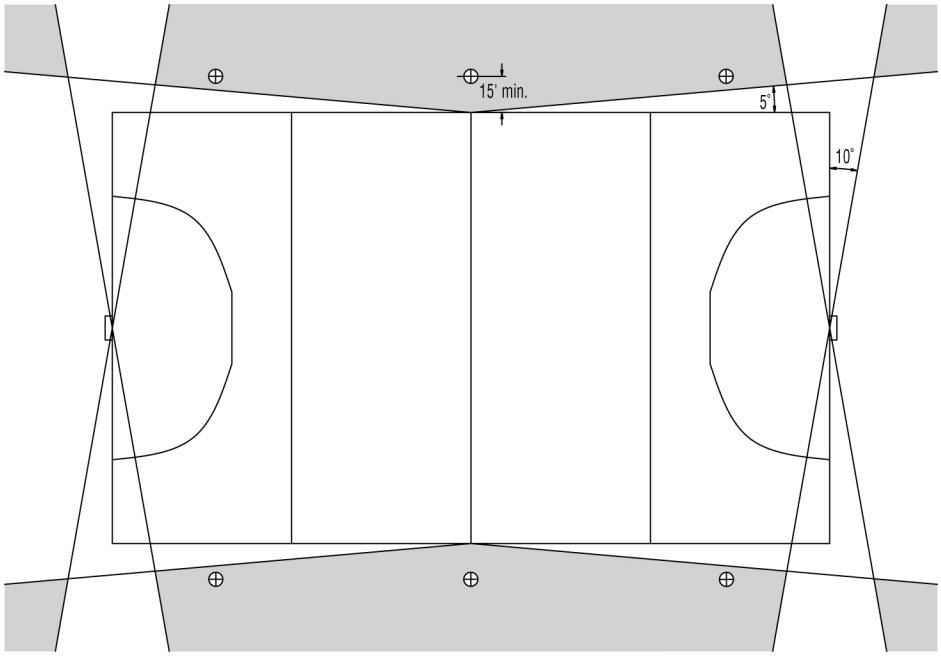
Soccer Field

1. Poles are shown in optimal locations. Other permissible pole locations are indicated by the shaded areas. All poles should be at least 20 feet from the sideline.
2. On a 4-pole design, the optimum pole locations are (.35 x field length) from center of field.
3. In general, football lighting standards apply to soccer with the following considerations:
   a. A corner kick is a specific visual task and general consideration should be given to facility design specifically for soccer.
   b. The corner grid point shall be lit to no less than 90% of the average light level.
4. For combination football and soccer facilities, soccer should take precedence.
5. Vertical aiming angles should be 21 degrees minimum. The angles are measured from below a horizontal plane at fixture height.



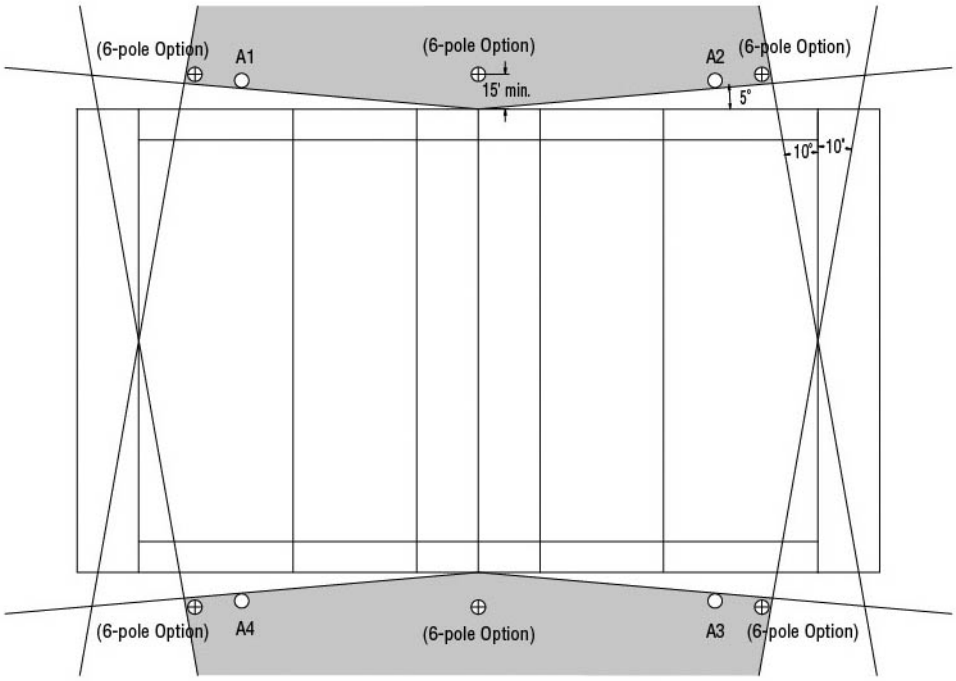
Lacrosse Field

1. Poles are shown in optimal locations. Other permissible pole locations are indicated by the shaded areas. All poles should be at least 15 feet from the sideline.
2. Vertical aiming angle should be 21 degrees minimum. The angles are measured from below a horizontal plane at fixture height.
3. A 4-pole design utilizing corner location is permissible providing minimum aiming angles can be achieved.



Field Hockey Field

1. Poles are shown in optimal locations. Other permissible pole locations are indicated by the shaded areas. All poles should be at least 15 feet from the sideline.
2. Vertical aiming angle should be 21 degrees minimum. The angles are measured from below a horizontal plane at fixture height.
3. A 4-pole design utilizing corner location is permissible providing minimum aiming angles can be achieved.

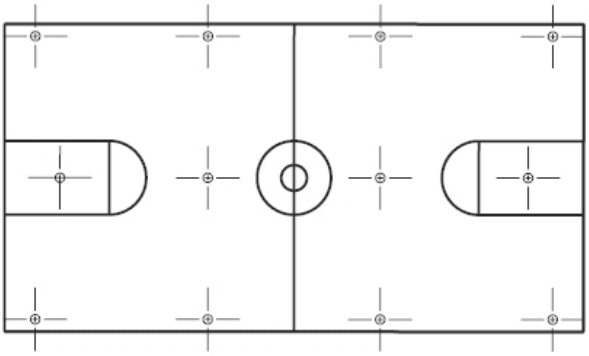


Rugby Field

1. Poles are shown in optimal locations. Other permissible pole locations are indicated by the shaded areas. All poles should be at least 15 feet from the sideline.
2. On a 4-pole design, the optimum pole locations are (.35 x field length) from center of field.
3. Poles should be positioned so as not to pose a potential injury hazard.
4. Vertical aiming angle should be 21 degrees minimum. The angles are measured from below a horizontal plane at fixture height.

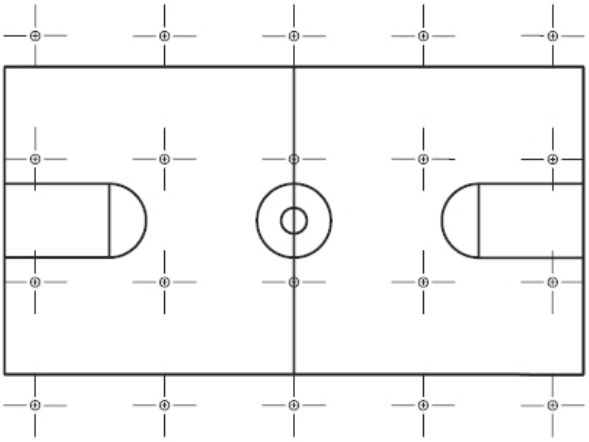
12 Luminaire Design
Designed for lighting in gymnasiums with no special provision for spectators such as smaller high schools or training facilities.

- 54 footcandles maintained



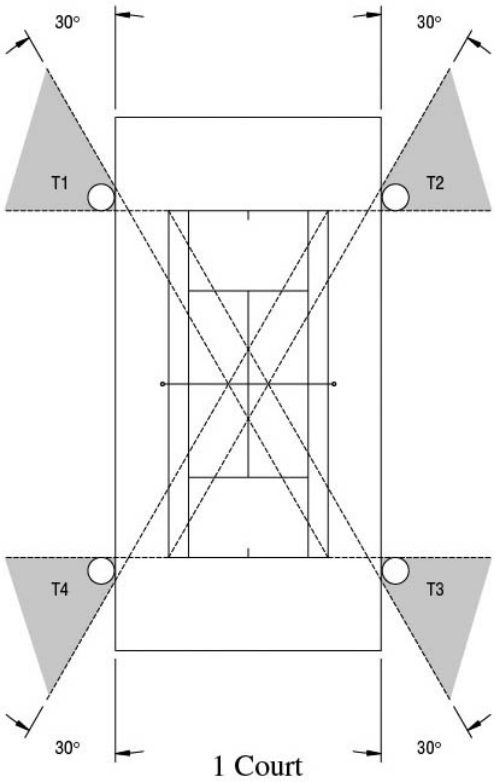
20 Luminaire Design
Ideal for college, semi-professional, or large high schools with facilities for spectators of 5000 or less. Suitable for facilities where lighted surfaces are 50' x 94' with 22' mounting heights.

- 80 footcandles maintained



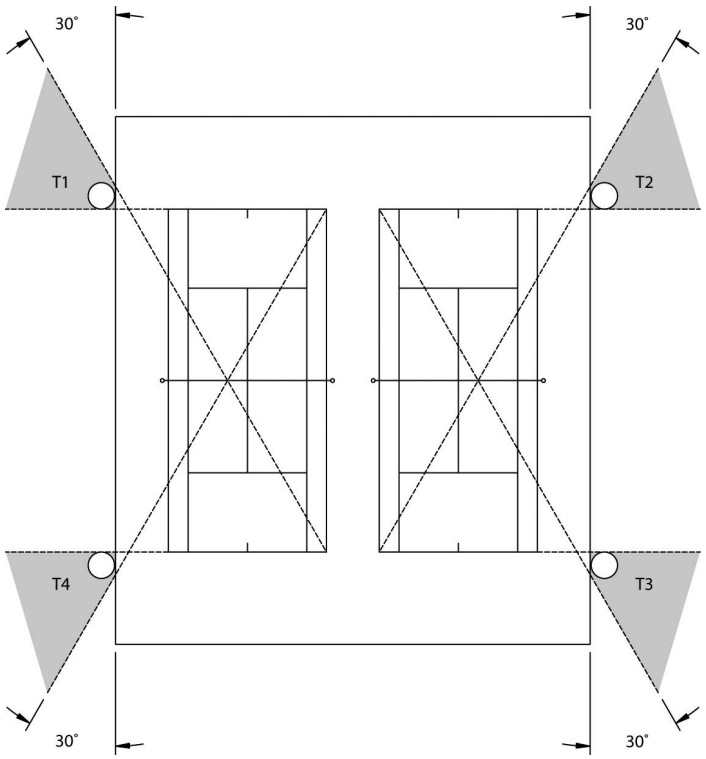
Gymnasium

1. For new facilities or upgrades, it is recommended to consult a lighting professional for optimal fixture placement.
2. Optimal fixture placement and mounting heights will impact playability and minimize glare and skip glare.
3. As a general rule, due to mounting heights, lower wattage fixtures are used, commonly 1000 watt.

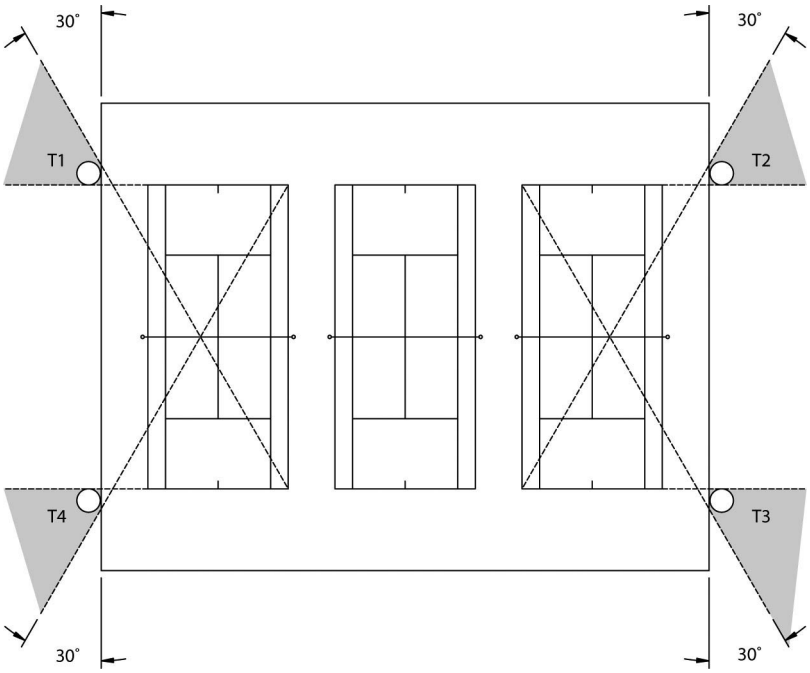


Tennis Courts

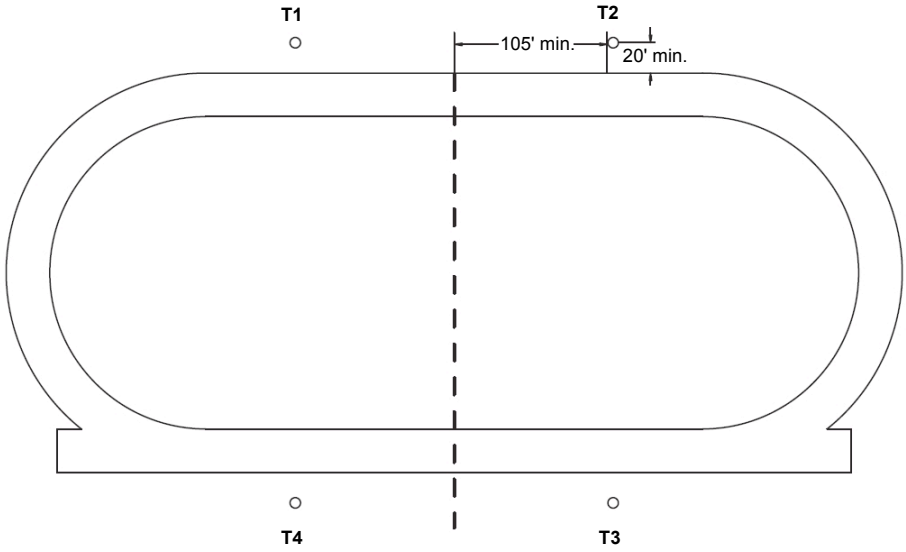
1. Poles are shown in optimal locations. Other permissible pole locations are indicated by the shaded areas.
2. It is not generally recommended to use a 6-pole layout with poles located at net lines. This position may be directly in the server's sight line with toss when the ball is served.
3. Vertical aiming angles should be 25 degrees minimum. The angles are measured from below a horizontal plane at fixture height.



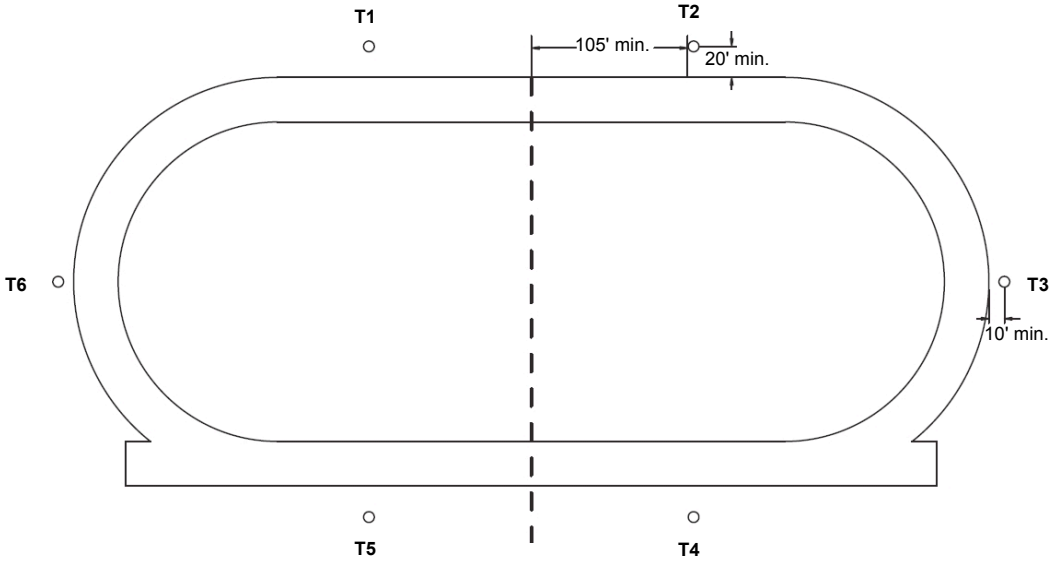
2 Courts



3 Courts



4-Pole Track



6-Pole Track

400 Meter, 8 Lane Track

1. These pole locations are for typical stand-alone tracks.
2. For tracks built in conjunction with a football or soccer field, use the standard pole locations on the football design (page 18) or soccer design (page 19).

ANNUAL SYSTEM OPERATION & MAINTENANCE CHECKLIST

WARNING!! Turn off electricity at power source and at safety disconnect on the pole.

	OK	Needs Repair	Notes:
Lighting Performance Testing			
Use test forms for appropriate sport following this checklist			
• Average footcandles meet guidelines			
• Average uniformity meets guidelines			
Service Entrance & Pole Distribution Boxes			
Check service panel for proper markings.			
• Emergency information should be visible.			
• Warning stickers, wiring diagrams, circuit labels and other servicing information signs should be posted and clearly legible.			
Test reset action on all service breakers.			
• Snap all breakers on and off several times to ensure firm contact.			
• If fuses are used at main service, check continuity.*			
Check the wiring.			
• Insulation around wiring should show no signs of deterioration.			
• Wiring should show no heat discoloration.			
Check all taped connections.			
• Signs of wear should be replaced.			
Make sure no live parts are exposed.			
• Bare wires and exposed connections should be wrapped with insulated covering.*			
Padlocks for service entrance & distribution boxes should be in place and operational.			
Poles			
Wood poles: **Check to see that poles aren't leaning.**			
• Leaning poles may be unsafe and replacement or re-installation and/or re-aiming may be necessary.			
Check for twisting.			
• If poles have moved, re-aiming of the fixtures may be necessary.			
Check for decay.			
• Wood poles decay from the inside out. Core testing is the best method to determine the condition and safety of the pole.			
Steel poles: **Check baseplate for signs of deterioration caused by corrosion or fatigue.**			
• Check anchor bolt for signs of corrosion.			
• Check grouting under pole to make sure proper drainage exists.			
Check for all pole access covers, replace missing covers.			
Cables and conduit:			
• Pull on conduit to check for looseness.			
• Check for loose fittings and damaged conduit.			
• All cables should be straight and properly strapped.*			
• If cables are exposed to the elements, make sure the insulation has the proper rating.*			
Check overhead wiring.			
• Wiring should be properly secured.			
• Check that new growth on tree branches and limbs won't obstruct or interfere with overhead wiring.			
Luminaires			
Check luminaire housings.			
• Housings should show no sign of cracking and/or water leakage.			
Check lenses.			
• Clean lenses.			
• Replace broken lenses.			
Replace burned-out lamps.			
Check luminaire fuses.			
• Replace burned-out fuses.			
• Fuses should be the correct size.			
Insulation covering on wiring should show no signs of wear or cracking.			
Ground wire connections must be secure.			
Check around ballasts for signs of blackening.			
Check that capacitors aren't bulging.			
Check aiming alignment of all fixtures.			
• On wooden poles, see if crossarms are still aligned with the field and horizontal.			
Ground			
Check grounding connections.*			
Check nearby metal objects.			
• Make sure metal bleachers and other metal objects are located at least 6 feet from the electrical components.			
• Metal objects, such as bleachers, must have their own individual grounding system.			

* These tests and/or repairs require the services of a qualified electrician.

Lighting Performance Testing

To verify that your field meets the GHSA recommended standards, complete the performance testing information below. The inspection must be done using a light meter calibrated within the last 12 months. The light meter should be held horizontally 36 inches above the middle point of each square in the grid.

Baseball/Softball

To obtain average footcandle value:

Record light readings within each square.

Infield = Total of infield readings ÷ 25

Outfield = Total of outfield readings ÷ number of readings.

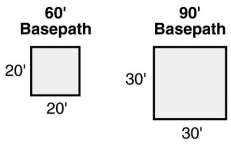
To obtain uniformity ratio for infield or outfield:

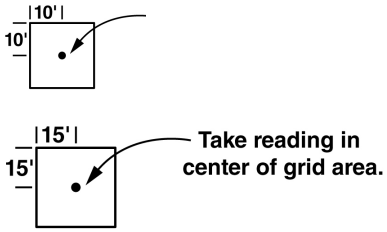
Divide highest (maximum) light level reading by the lowest (minimum) light level reading:

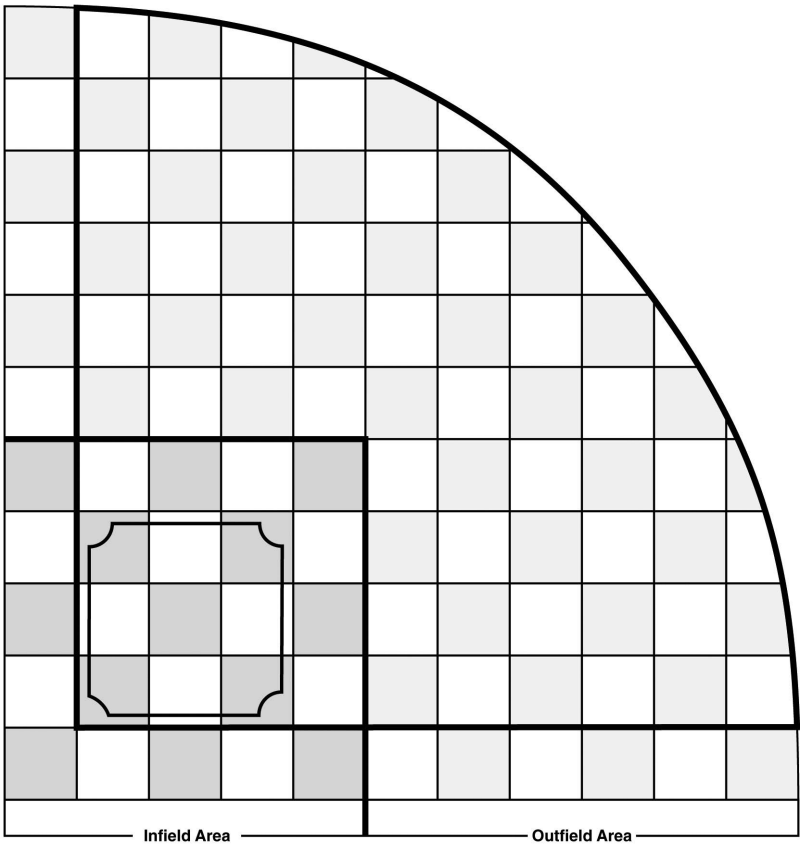
Maximum reading _____ ÷ Minimum reading _____ = _____ Uniformity ratio

For example:

61 footcandles ÷ 31 footcandles = 2.1







Football

To obtain average footcandle value:

Record light readings within each square.

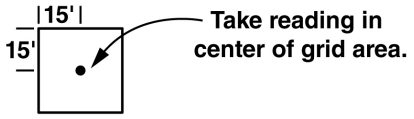
Total all readings, and divide by total number of readings taken.

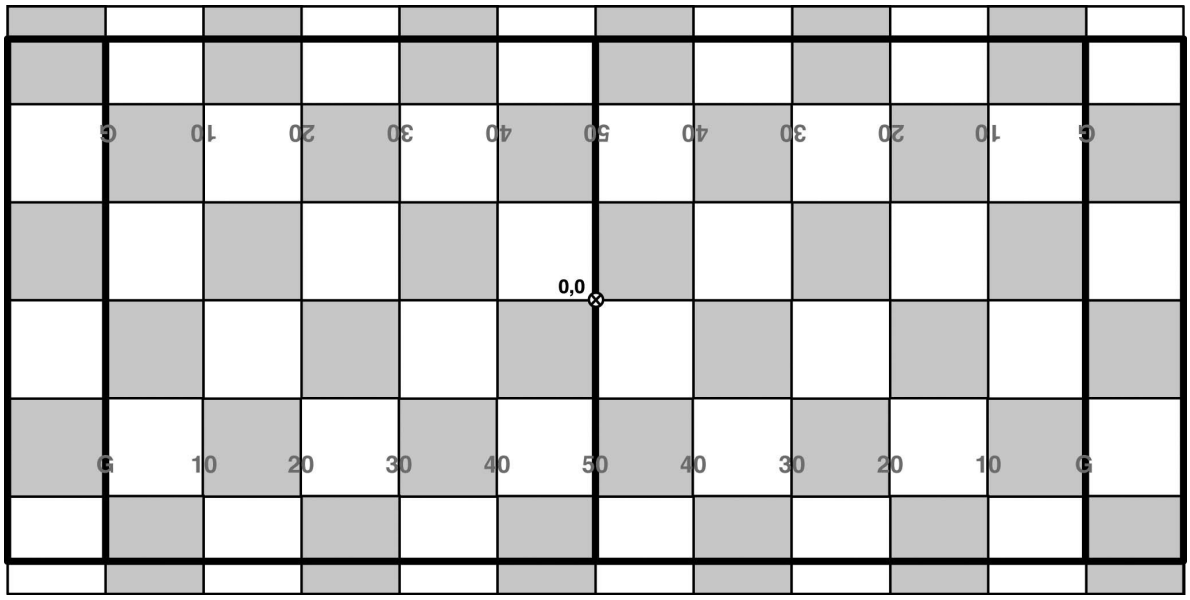
To obtain uniformity ratio:

Divide highest (maximum) light level reading by the lowest (minimum) light level reading:

Maximum reading _____ ÷ Minimum reading _____ = _____ Uniformity ratio

30' by 30' grid





Soccer

To obtain average footcandle value:

Record light readings within each square.

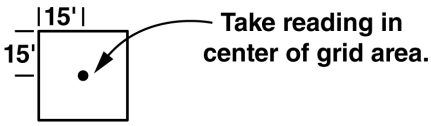
Total all readings, and divide by total number of readings taken.

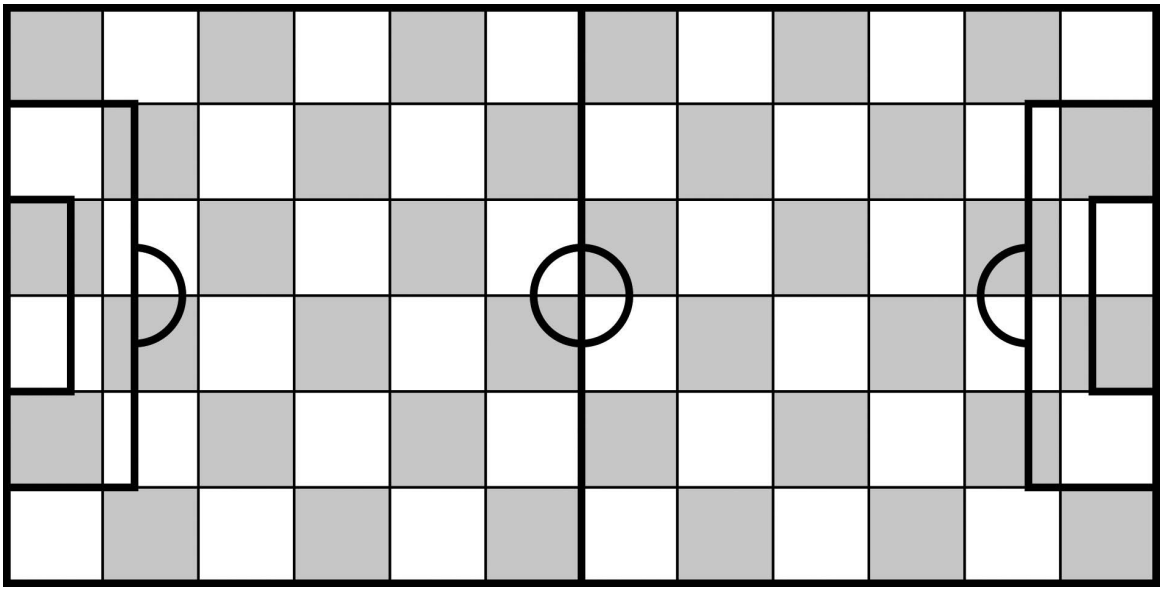
To obtain uniformity ratio:

Divide highest (maximum) light level reading by the lowest (minimum) light level reading:

Maximum reading _____ ÷ Minimum reading _____ = _____ Uniformity ratio

30' by 30' grid





Lacrosse

To obtain average footcandle value:

Record light readings within each square.

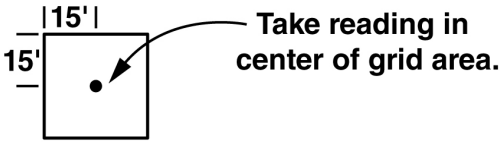
Total all readings, and divide by total number of readings taken.

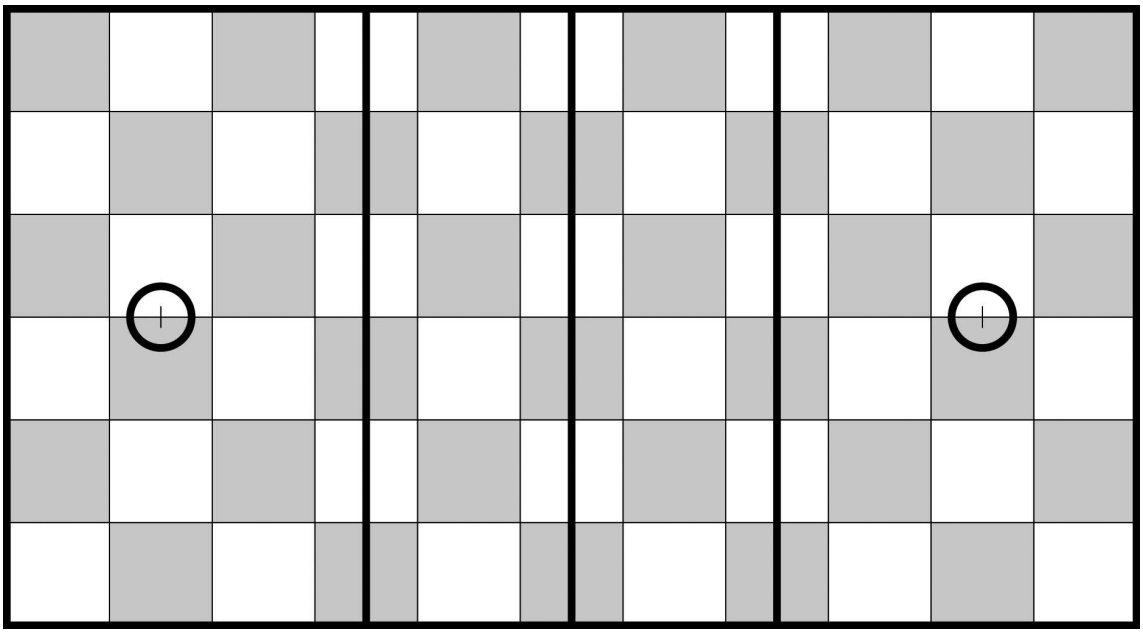
To obtain uniformity ratio:

Divide highest (maximum) light level reading by the lowest (minimum) light level reading:

Maximum reading _____ ÷ Minimum reading _____ = _____ Uniformity ratio

30' by 30' grid





Field Hockey

To obtain average footcandle value:

Record light readings within each square.

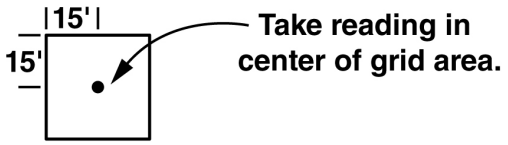
Total all readings, and divide by total number of readings taken.

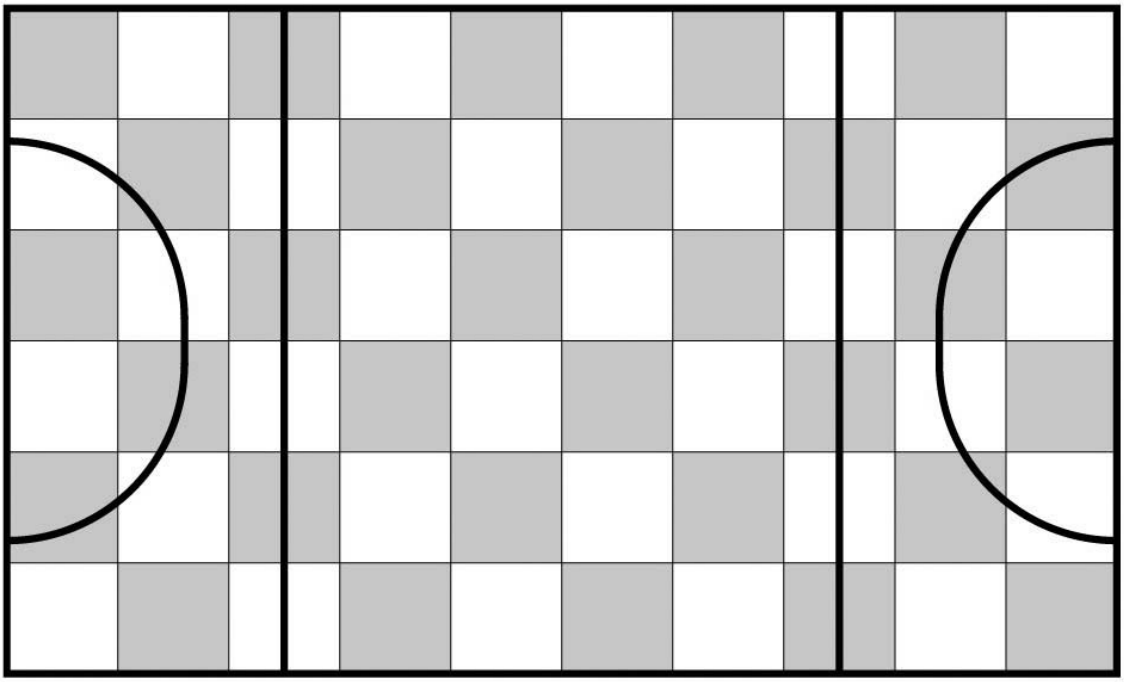
To obtain uniformity ratio:

Divide highest (maximum) light level reading by the lowest (minimum) light level reading:

Maximum reading _____ ÷ Minimum reading _____ = _____ Uniformity ratio

30' x 30' grid





Rugby

To obtain average footcandle value:

Record light readings within each square.

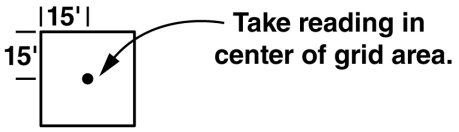
Total all readings, and divide by total number of readings taken.

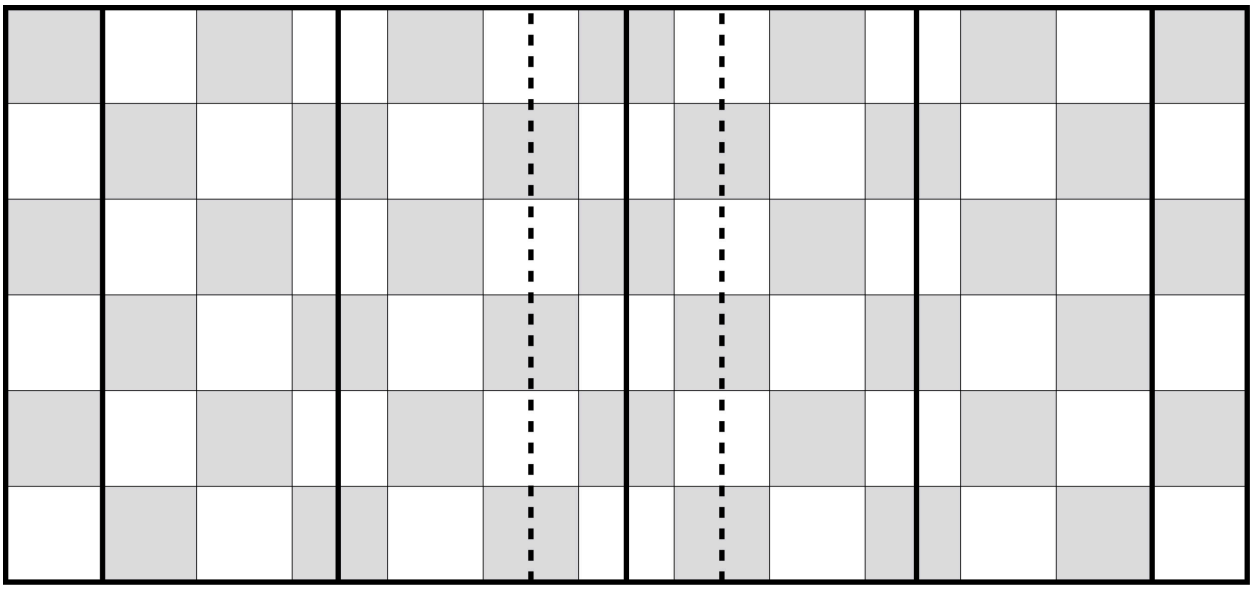
To obtain uniformity ratio:

Divide highest (maximum) light level reading by the lowest (minimum) light level reading:

Maximum reading _____ ÷ Minimum reading _____ = _____ Uniformity ratio

30’ x 30’ grid





Gymnasium

To obtain average footcandle value:

Record light readings within each square.

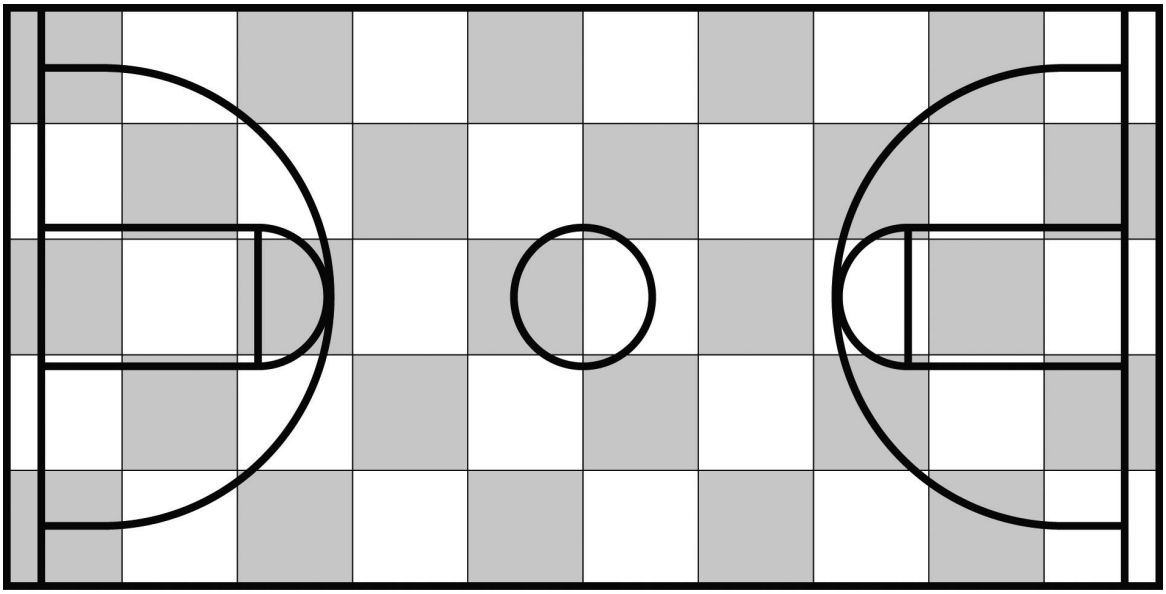
Total all readings, and divide by total number of readings taken.

To obtain uniformity ratio:

Divide highest (maximum) light level reading by the lowest (minimum) light level reading:

Maximum reading _____ ÷ Minimum reading _____ = _____ Uniformity ratio

10' by 10' grid



Tennis

To obtain average footcandle value:

Record light readings within each square.

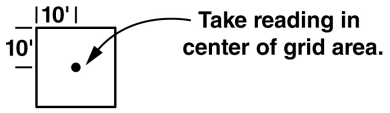
Total all readings, and divide by total number of readings taken.

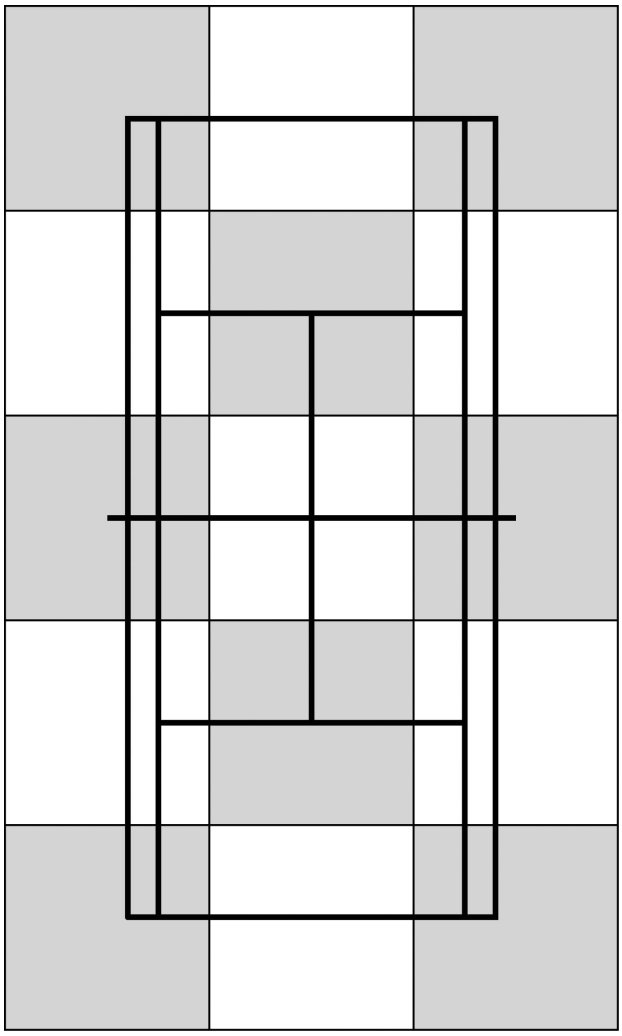
To obtain uniformity ratio:

Divide highest (maximum) light level reading by the lowest (minimum) light level reading:

Maximum reading _____ ÷ Minimum reading _____ = _____ Uniformity ratio

20' by 20' grid





Track

To obtain average footcandle value:

Record light readings within each square.

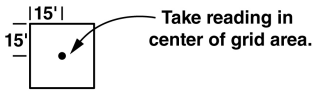
Total all readings, and divide by total number of readings taken.

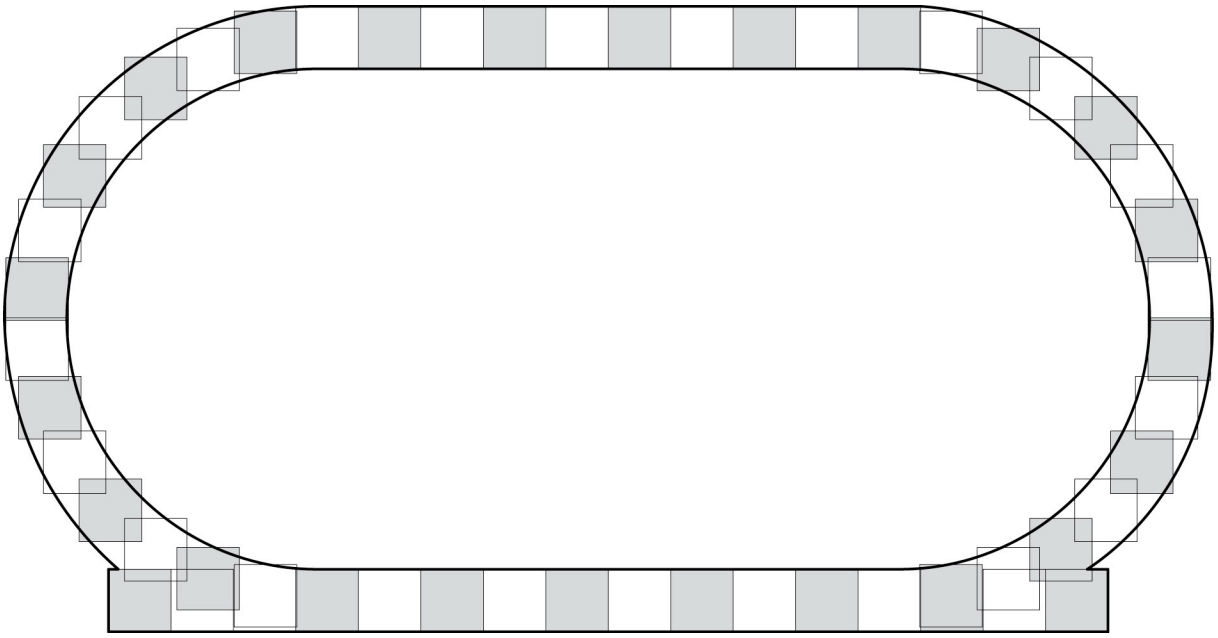
To obtain uniformity ratio:

Divide highest (maximum) light level reading by the lowest (minimum) light level reading:

Maximum reading _____ ÷ Minimum reading _____ = _____ Uniformity ratio

30' by 30' grid





Glossary

Aiming Angles The degrees below horizontal that light fixtures are aimed at the field. Angles are measured from a horizontal plane at fixture height. Critical in safe, playable lighting design.

Ballast A transformer that delivers the proper operating voltage for high intensity discharge type lamps including metal halide lamps.

Constant Light Method for achieving target light levels throughout the life of a lamp by utilizing automatic power adjustments.

Footcandle The measurement of light on a surface. One footcandle equals one lumen spread over one square foot.

Glare Light that interferes with the ability to see. Luminaire design, proper aiming angles, and pole locations are key to limiting glare for participants and spectators.

IESNA Illuminating Engineering Society of North America. An organization that develops recommendations for sports lighting.

Initial Light Levels The average light levels when your lamps are new. Manufacturers that do not provide constant illumination should provide scans showing what these levels will be.

Lumen A quantity measurement of light, used mostly in measuring the amount of light a lamp develops.

Metal Halide Lamp A lamp that generates light by passing electrical current through metallic gases. The first choice for sports facilities because of efficiency and color.

NEC National Electric Code. A national safety code for electrical systems that is the basis for most local codes.

NEMA Type A classification of reflectors. For example, a NEMA 2 reflector gathers light in a narrow, focused beam, allowing it to be projected a long distance. A NEMA 5 projects light a relatively short distance in a very wide beam. Most lighting designs use various combinations of NEMA types to get the desired results.

NFPA National Fire Protection Association. An organization that establishes and publishes various codes such as the Lightning Protection Code and the National Electric Code.

Overturning Moment The amount of force applied to a lighting structure, mostly from wind. Pole foundations must be designed to withstand this force.

Reflector Key element of lighting optics. It surrounds the lamp (bulb) and directs light to the field. The efficiency of the reflector is one factor that determines how many light fixtures you have to buy and maintain.

Remote Electrical Enclosure A weatherproof enclosure that allows the electrical gear to be moved from the top of lighting structures to a lower point where it can be serviced easily.

Smoothness The change in light levels between measuring points. The less change between points, the more even the lighting. (See also Uniformity.)

Spill Light Wasted light that falls off the field or is projected into the sky. Systems that can re-direct spill light back onto the field save dollars and keep neighbors content.

Target Light Levels The lowest average amount of light at which a lighting system should operate over its rated life to ensure performance requirements.

Tilt Factor Most lamps generate fewer lumens when tilted off of either a horizontal or vertical position. Your design should show actual tilt factor used in your design.

Underwriters Laboratories Independent, non-profit, product safety testing and certification organization. Visit www.ul.org for additional information.

Uniformity The smoothness of light on the field. Also called uniformity ratio. A design criterion to assure that light is distributed evenly across the entire field. A max/min ratio of 2:1 means that the brightest point is no more than double any other point.

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