Lighting Information for Sports Facilities

University Interscholastic League

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Thanks to Myles Wells, P.E. – Wells Doak Engineers, Inc. Fort Worth Texas; for reviewing certain portions of this document relating to Professional Engineers.

LIGHTING INFORMATION
for sports facilities

The University Interscholastic League (UIL) presents the following information. This manual is intended as a resource for those seeking information on lighting of sports facilities.

The information contained in this manual is intended as an educational tool to assist those who intend to build a new sports facility or to upgrade an existing sports facility.

Questions concerning materials presented in this manual should be directed to the University Interscholastic League at www.uil.utexas.edu.

I. Standards

These standards are for all lighting installations. Any modification in existing lighting systems should be done so as to result in a lighting system meeting these standards. **The word "should," for the purposes of this document, is to be interpreted as being advisory in nature and non-regulatory.**

A. Lighting

1. **Quantity** (also see table on page 8 for light level references)

a. Baseball/Softball

There should be maintained a minimum average quantity of 50 horizontal footcandles on the infield and a minimum average quantity of 30 horizontal footcandles on the outfield.

b. Football

There should be maintained a minimum average of 30 horizontal footcandles on the playing field for facilities with fewer than 2000 spectators. For facilities with more than 2000 spectators, there should be maintained a minimum average of 50 horizontal footcandles on the playing field. For practice fields, there should be a maintained minimum average of 20 horizontal footcandles.

c. Soccer

There should be maintained a minimum average of 30 horizontal footcandles on the playing field for facilities with fewer than 2000 spectators. For facilities with more than 2000 spectators, there should be maintained a minimum average of 50 horizontal footcandles on the playing field.

d. Tennis

There should be maintained a minimum average of 50 horizontal footcandles on the playing area.

e. Gymnasiums/Basketball Arenas[1]

There should be maintained a minimum average of 80 horizontal footcandles for events with spectators. For gymnasiums used for recreational purposes there should be maintained a minimum average of 50 horizontal footcandles.

f. Track and Field

There should be maintained a minimum average of 30 horizontal footcandles on the track and area where field events are held.

g. Combination/Multi-Purpose

Should meet the highest minimum average among the standards for activities played on field.

h. Natatoriums

Lighting natatoriums involves many variables important to the safety of participants. It is recommended that schools wishing to light a natatorium use consultants and lighting manufacturers with experience and knowledge in that specialized venue. They should also be in compliance with local codes. As national organizations develop standards and/or specifications, we will continue to update this section.

2. **Quality** (also see table on page 8 for uniformities references)

a. Baseball/Softball

The quality of the lighting should be determined on a basis of uniformity and smoothness.

- **Uniformity**

  Infield: the highest measure of quantity of light should not be greater than 2.0 times the lowest quantity of light. Outfield: the highest quantity of light should not be greater than 2.5 times the measurement of the lowest quantity of light at given target points.

- **Smoothness**

  Over the entire area of the infield and outfield, the change in the quantity of horizontal footcandles should not occur at a rate greater than 10% per 10 feet except for the outside perimeter reading which may change at a greater rate.

b. Football

The quality of the lighting should be determined on a basis of uniformity and smoothness.

- **Uniformity**

  Should be such that the highest measure of quantity of light should not be greater than 2.5 times the lowest quantity of light for fields lit to 30 footcandles or 2.0 times for fields lit to 50 footcandles.

- **Smoothness**

  Over the entire area of the field, the change in the quantity of horizontal footcandles should not occur at a rate greater than 10% per 10 feet except for the outside perimeter reading which may change at a greater rate.

- For stadiums with large seating capacities (5000 plus) or specialized television or video taping requirements, please confer with consultants and lighting manufacturers with specific experience and knowledge in the area of lighting large stadiums and for television.

c. Soccer

The quality of the lighting should be determined on a basis of uniformity and smoothness.

- **Uniformity**

  Should be such that the highest measure of quantity of light should not be greater than 2.5 times the lowest quantity of light for fields lit to 30 footcandles or 2.0 times for fields lit to 50 footcandles.

- **Smoothness**

  Over the entire area of the field, the change in the quantity of horizontal footcandles should not occur at a rate greater than 10% per 10 feet. The outside perimeter reading, except for the goal area, may change at a greater rate.

d. Tennis

The quality of the lighting should be determined on a basis of uniformity and smoothness.

- **Uniformity**

  Should be such that the highest measure of quantity of light should not be greater than 2.0 times the lowest quality of light within the principle playing area.

- **Smoothness**

  Over the entire area of the field, the change in the quantity of horizontal footcandles should not occur at a rate greater than 10% per 10 feet except for the outside perimeter reading which may change at a greater rate.

e. Gymnasiums/Basketball Arenas

The quality of the lighting should be determined on a basis of uniformity and smoothness.

- **Uniformity**

  Should be such that the highest measure of quantity of light should not be greater than 2.0 times the lowest quantity of light.

- **Smoothness**

  Over the entire area of the field, the change in the quantity of horizontal footcandles should not occur at a rate greater than 10% per 10 feet except for the outside perimeter reading which may change at a greater rate.

3. **Lamps**

The approved lamp is a 1500-watt metal halide lamp with initial design lumens of 155,000. 1500-watt lamps should have an ANSI code M48PC-1500.

In standard tennis facilities and most gymnasiums, the 1000-watt metal halide lamp is recommended as the standard lamp size with initial lumens of 110,000. 1000-watt lamps should have an ANSI code M47PA-1000.

4. **Footcandle Documents**

Lighting equipment manufacturers should provide two drawings showing the horizontal footcandle quantity at each point of measurement on the field. One drawing should indicate the initial horizontal footcandle quantity, at each measurement point on the field based on the lamp manufacturer's published initial lumens. The second drawing should indicate maintained light levels — which should be 80% of the initial light levels — at the same measurement points.

5. **Measurement of Light Quantity**

   a. **Area of Measurement**

   The areas for which measurements are to be taken and the points of measurement within that area are shown in the appendix. It is important that measurements be taken at all of the points indicated.

   b. **Method of Measuring Light Quantities**

   Measurements should be taken with a cosine and color corrected light meter, regularly recalibrated to assure accuracy. The light sensing surface of the light meter should be held 36 inches above the playing surface, with the face of the lens parallel to the ground.

6. **Maintained Alignment**

   a. **Fixture Alignment for Outdoor Fields and Courts**

   There should be a manufacturer's certification that the light fixture mounting system and the crossarm to which it is attached are structurally adequate to assure that fixtures will not move or become misaligned in winds of 125 mph, gusting to 162.5 mph. Because current technology of lighting equipment has precise intense beams, the misalignment of individual fixtures by a few degrees can significantly impact the quantity and quality of light. Also, misaligned fixtures can result in undesirable glare for players that could affect playability and participant safety.

   b. **Pole Alignment**

   Twisting or leaning of poles can also result in misalignment of fixtures. Wood poles are susceptible to twisting and would not meet standards if this document was regulatory in nature. Foundations should be certified by a structural engineer and designed to prevent any leaning.

7. **Pole Locations**

Pole locations should be established by the layouts on pages 10-17 to achieve placement of the lights in positions that enhance playability.

8. **Vertical Aiming Angles**

To enhance playability on the field, reduce glare and minimize spill light, pole heights should be defined in the project specifications based on site conditions to assure proper vertical aiming angles. Refer to notes about minimum vertical aiming angles on pages 10-17. Certain sites may require steeper vertical angles due to enhanced spill and glare concerns.

9. **Aiming Recapture**

The lighting equipment should include a mechanical device for recapturing the original aiming when necessary to move the fixture for relamping.

10. **Ballast and Capacitor Weight**

The ballast and capacitor with each fixture, as well as fixture fusing, must be mounted off the fixture and crossarm onto the pole at stepladder height to avoid problems of misalignment of the fixture caused by the weight of the ballast and capacitor. Additionally, this creates safer conditions for servicing and maintenance. Refer to page 20 of the IES RP-6-01 manual for sports and recreation lighting for advantages of remote ballasts.

11. **Aiming Diagram**

The manufacturer should supply a drawing showing the aiming alignment of each fixture with the measurement referencing the field and the pole locations (when applicable).

B. Exterior Electrical

1. **Fusing**
   Each lighting fixture should be individually fused with UL Listed fused equipment rated for use with the system.

2. **Disconnects**
   There should be provided at each pole a disconnect means located at stepladder height (minimum 8 feet above ground) to allow disconnecting of electrical power to the pole. This disconnect should be ***in addition to overcurrent protection*** provided at the distribution panel for the entire field.

3. **Grounding**
   All poles, fixtures and distribution panels should be grounded according to National Electric Code recommendations. It is important to verify the ground and grounding connections.

4. **Lightning Protection**
   Each pole or structure supporting lighting equipment should be equipped with lightning protection as established by NFPA 780 (National Fire Protection Association). Note: In many instances the supplemental ground may not provide adequate lightning ground, creating the potential for a faulted electrical system in the case of a lightning strike.

5. **Enclosed Rigid Cover**
   All conductors above grade should be enclosed in rigid metallic conduit unless they are in an interior of the pole.

6. **Hinged Enclosures Lockable**
   All enclosures of electrical conductors which are hinged and designed to be opened must be lockable and should be kept locked except during times of access for operation or service. Access should be by means of key or a special tool.

7. **Electrical Conductor Wires**
   All electrical conductor wires for distribution of power around the playing field should be buried underground at depths as provided by NEC or by applicable local code that may supersede NEC. Conductor wires must be copper.

8. **Drawings of Entire Electrical Distribution**
   The lighting equipment manufacturer should provide a drawing of the entire electrical system from the light fixtures at the top of the pole to the base of the pole which should show compliance with these standards and should provide sufficient information for maintenance personnel.

9. **Drawings of Electrical Distribution**
   The electrical designer should provide drawings of the electrical system from the base of the pole to the transformer provided by the utility company which should show that they have been approved by the local authority regulating electrical systems. The electrical designer should provide electrical drawings sealed and/or stamped by a Professional Engineer who has been duly registered and licensed by the Texas State Board of Registration for Professional Engineers and whose principal practice is electrical engineering. These drawings should illustrate the electrical system from the base of the pole to the transformer provided by the utility company which should show that they have been approved by the local authority regulating electrical services.

10. **Underwriter Laboratory Listing**
    The lighting and electrical equipment on ball field and court lighting structures should have a UL Listing to confirm that the equipment has passed the safety tests of Underwriters Laboratory not only as to the individual components but also as to the use of the components in the configuration of the lighting system on the field.

11. **Non-Compliance with the Standards**
    Deviation from these standards for electrical systems may occur only after approval of written documentation signed by an electrical engineer licensed in the state. The documentation should state the reason why it is necessary to deviate from the standards and state how a safe electrical system will be achieved using the alternate standards.

12. **Strain Relief**
    The wiring harness should be supported at the top of the pole by a stainless steel wire mesh grip matched to the size and number of conductors within the harness. There should not be more than 12 conductors supported by a single wire mesh grip. If the harness is longer than 65 feet, an interim wire mesh grip support should be located approximately half way down the pole.

13. **Voltage Drop**
The electrical designer should verify that voltage drop does not exceed 3% of nominal voltage.

C. Structures

1. **Location**
Poles should be located as shown on the drawings in the appendix to these standards. Wherever possible, poles should be located outside of fences to avoid poles causing an obstruction and safety hazard to the play of the game.

2. **Strength of Foundation**
There should be calculations and documentation certified by a Professional Engineer who has been duly registered and licensed by the Texas State Board of Registration for Professional Engineers and whose principal practice is structural engineering, illustrating that the foundation design is adequate to withstand the forces imposed from the pole, lighting fixtures and other attachments to prevent the structure from leaning or failing.
   a. Foundations should be made of reinforced concrete and should provide for pole attachment a minimum of 18 inches above the ground to avoid corrosive deterioration. Poured foundations containing reinforcing steel should cure a minimum of 28 days before any stress loads are applied.

   b. The foundation designer should furnish structural calculations showing the foundation to be designed to resist maximum loads in accordance with the appropriate local building code or other applicable laws, rules, regulations or ordinances.

3. **Strength of Pole**
Structural calculations should be furnished to establish that the pole and the attachments are of sufficient strength to comply with local building codes, other applicable laws, rules, regulations or ordinances.
   a. Hot-dipped galvanized steel poles are recommended. Wood poles are undesirable for sports lighting applications in that the twisting of the poles often causes electrical safety problems. Wood poles would not meet standards if this document was regulatory in nature.

   b. According to the latest data, there is a question as to whether direct burial steel poles are acceptable. If direct burial poles are used, the supplier should furnish stamped foundation designs from a structural engineer licensed in Texas. A soil analysis should be conducted by a geotechnical engineering firm and appropriately analyzed to assess the interaction between the galvanizing and the surrounding soil for compatibility. The embedded portion of the steel should be sealed inside and out with a moisture impervious coating to help resist corrosion. If the coating is damaged in transit or during installation, it should be repaired using the manufacturer's recommended procedures and permitted to cure an appropriate length of time before final installation.

4. **Lightning**
All structures must meet the National Fire Protection Association (NFPA) 780 lightning protection code.

D. Quality Assurance

1. Visual testing should be performed annually on lamps, lenses, conduit, poles, fuses, ballasts, grounding connections and breaker boxes to ensure integrity and performance of the system.

2. Performance audits should be performed every other year. The UIL reserves the right to request a performance audit prior to hosting a tournament or play-off event.

3. Group re-lamping should be done at the end of the rated useful lamp life.

4. Facilities with existing wood poles should conduct an annual inspection of aiming and alignment, and correct any problems.

II. Desirable Features

The following practices are recommended for increasing the durability, energy efficiency, environmental sensitivity, and cost effectiveness of the facility itself.

A. Lighting

1. Energy Efficiency

The use of energy efficient lighting equipment may result in operating cost savings of up to 25 percent. In addition, state and federal energy laws may require that energy efficient lighting equipment be used.

2. Environmental Spill and Glare Control

Many facilities are located near residential properties, creating the possibility of spill and glare onto adjoining properties. Consideration should be given to this issue during the initial lighting design stage so as to minimize this effect. 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. Each local community may have ordinances with differing standards. Please contact your local planning committee or zoning board.

B. Warranty

When comparing products, the manufacturers' warranties should also be evaluated. The quality of the warranty reflects a manufacturer's confidence in the long-term durability of their equipment. Considerations include the extent of the equipment covered, the duration of the warranty, and whether the warranty covers parts and labor. From the owners' perspective, the warranty offers the opportunity to reduce costs for equipment repair.

C. Facility 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 horizontal footcandles. Care should be given to eliminate darkly shadowed areas.

D. Television Quality Lighting

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

For documents to assist in planning and installing lighting, contact the UIL office:

Box 8028
Austin, Texas 78713
Street address: 1701 Manor Road, Austin, Texas 78722
Phone: (512) 471-5883
Athletics Fax: (512) 471-6589
Email: uilath@uts.cc.utexas.edu

APPENDIX

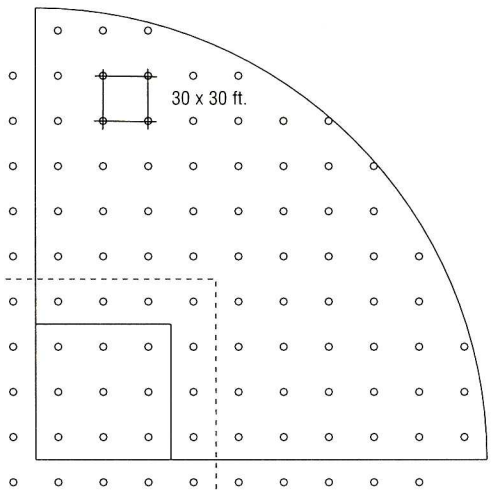
Typical Facility Information

Sport	Typical Playing Facility Dimensions (ft^2) (w x l)	Horizontal Footcandles (fc) Maintained	Uniformity (Max to Min)	Grid Size (feet)	Minimum Number of grid points
Baseball Infield Outfield	90 x 90 300 avg.	50 30	2.0 2.5	30 x 30 30 x 30	25 varies
Football	360 x 160	30 - 50*	2.5 (30 fc) 2.0 (50 fc)	30 x 30	72
Gymnasium	90 x 50	60 - 75	2.0	10 x 10	45
Soccer	360 x 225	30 - 50*	2.5 (30 fc) 2.0 (50 fc)	30 x 30	96
Softball Infield Outfield	60 x 60 200 avg.	50 30	2.5 (30 fc) 2.0 (50 fc)	20 x 20 20 x 20	25 varies
Tennis	78 x 36 single court	40	1.7 - 2.0	10 x 10	50

* See A.1b and A.2b on page 3

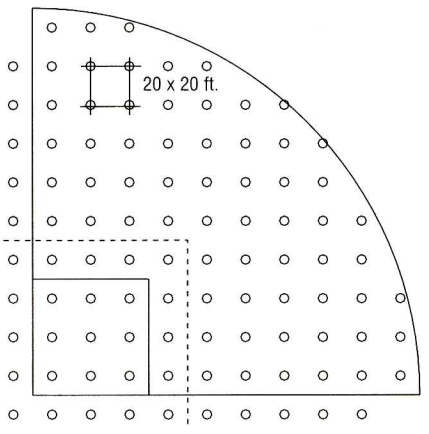
Light Level Grid Points

Baseball



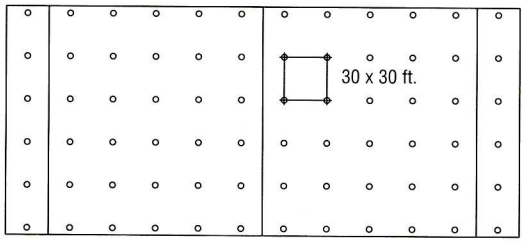
Infield area

Softball

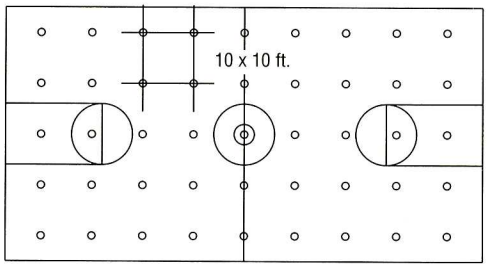


Infield area

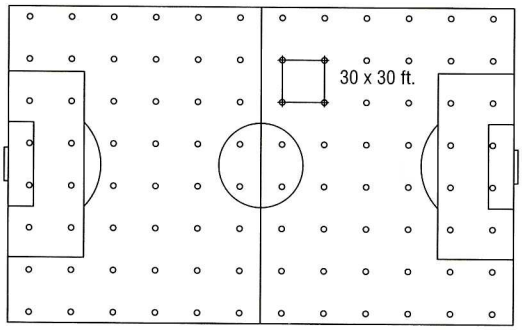
Football



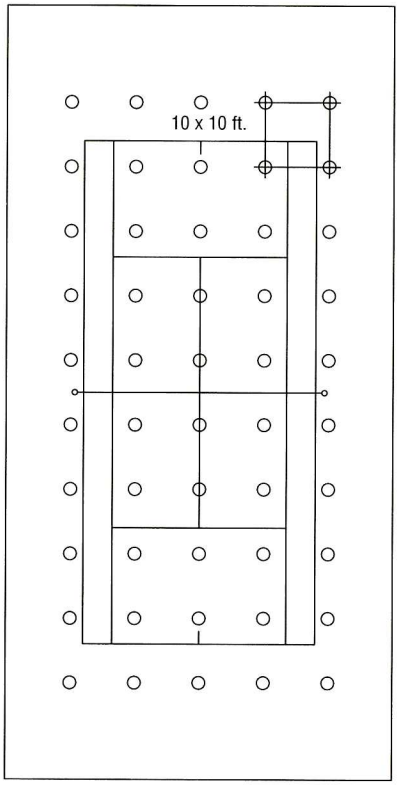
Gymnasium

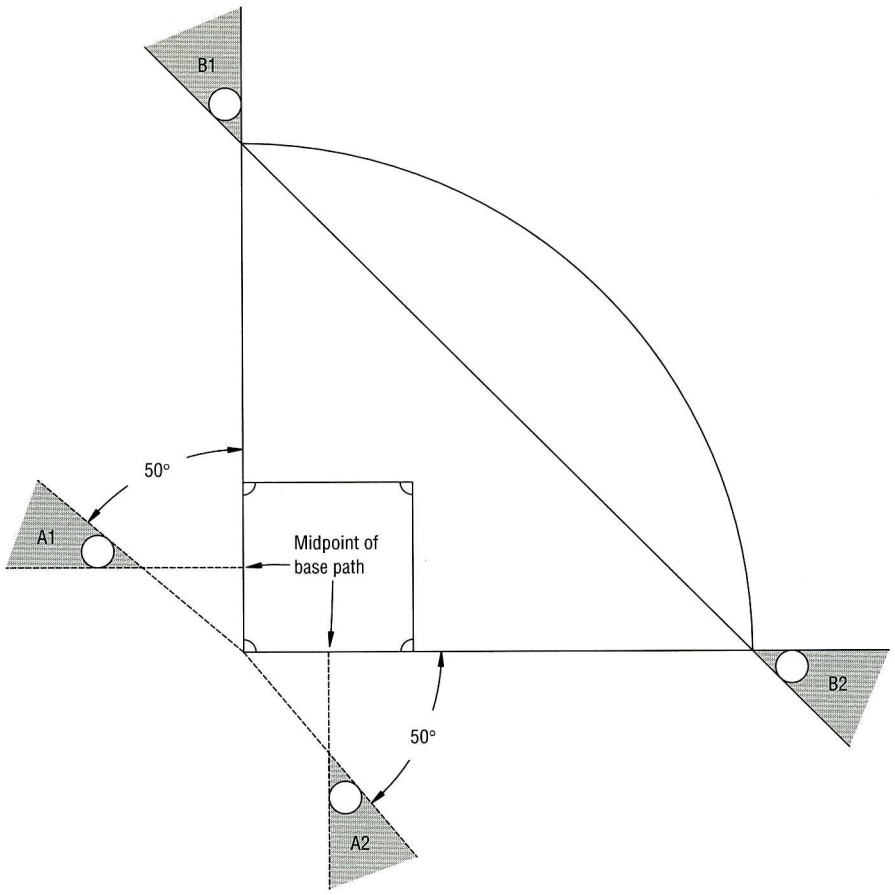


Soccer



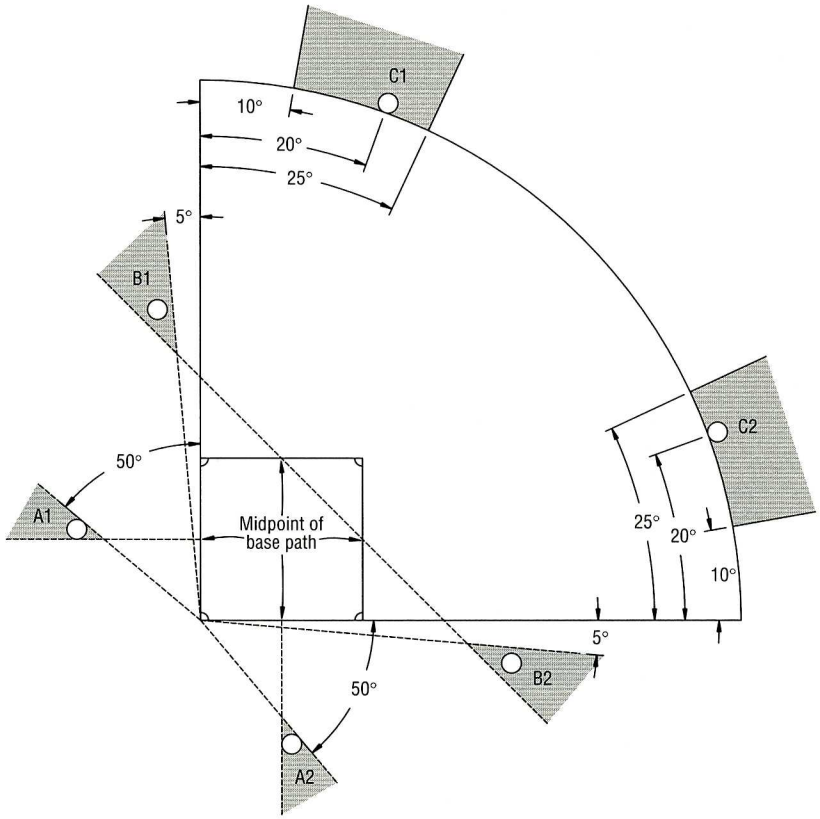
Tennis





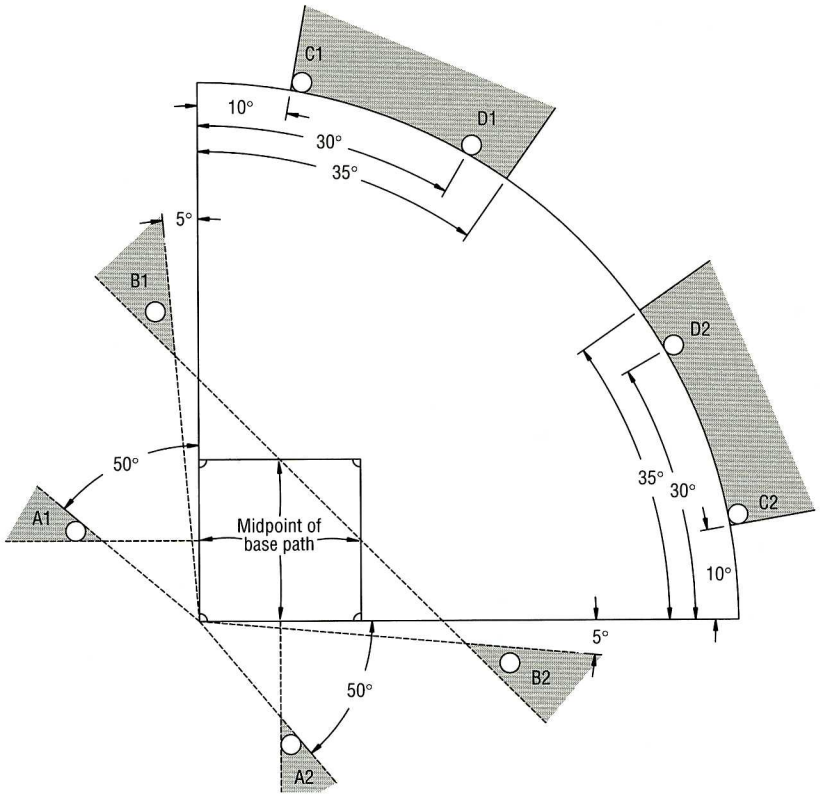
4-Pole Baseball/Softball Field[2]

1. Shaded areas indicate recommended pole locations.[3]
2. For baseball fields with a radius of 250 feet or greater, a 6-pole design is recommended.
3. Line drawn through each "A" pole location must be behind home plate to ensure lighting of the portion of the ball the batter sees as it crosses home plate.
4. Vertical aiming angle should be 25 degrees minimum on infields, and 21 degrees minimum on outfields. The angles are measured from below a horizontal plane at fixture height.



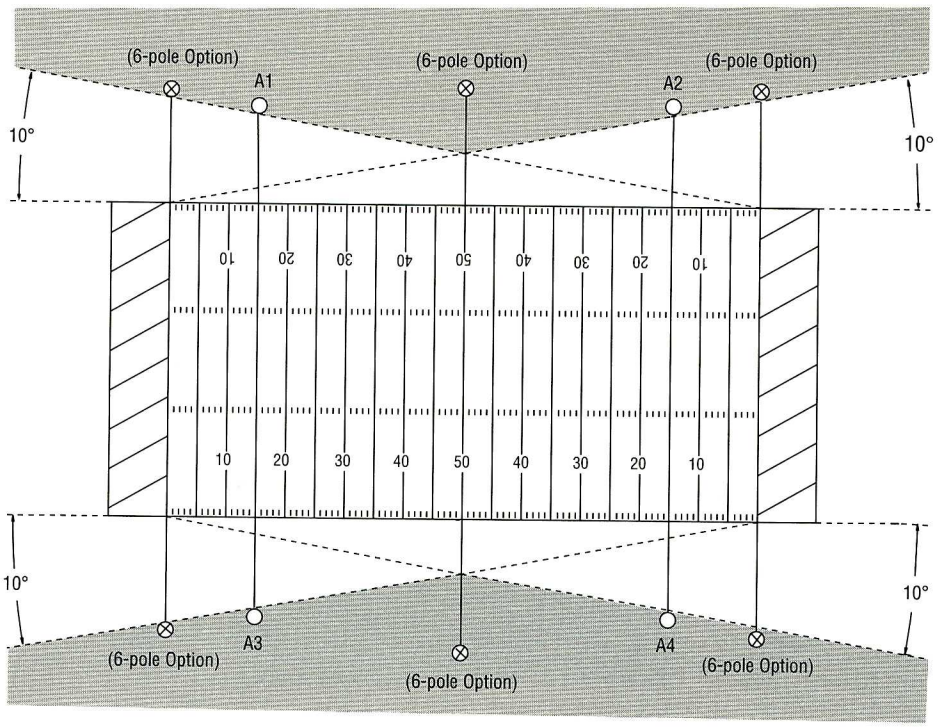
6-Pole Baseball/Softball Field

1. Shaded areas indicate recommended pole locations.
2. For baseball fields with a radius of 320 feet or greater, an 8-pole design is recommended.
3. Line drawn through each "A" pole location must be behind home plate to ensure lighting of 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 lit in a more constant perpendicular illuminance as it travels from the infield to the outfield.
5. Vertical aiming angle should be 25 degrees minimum on infields, and 21 degrees minimum on outfields. The angles are measured from below a horizontal plane at fixture height.



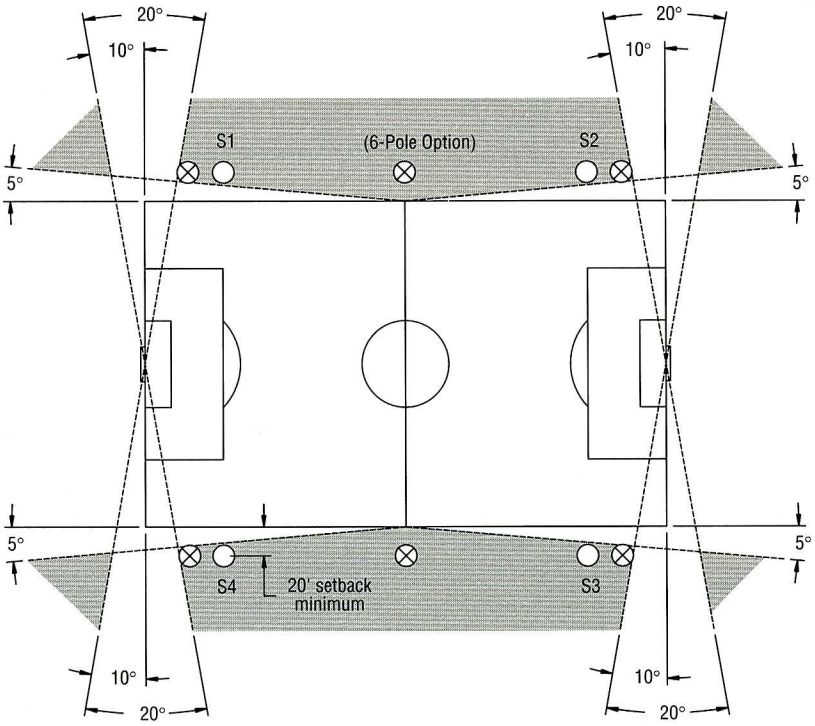
8-Pole Baseball/Softball Field

1. Shaded areas indicate recommended pole locations.
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. Vertical aiming angle should be 25 degrees minimum on infields, and 21 degrees minimum on outfields. The angles are measured from below a horizontal plane at fixture height.



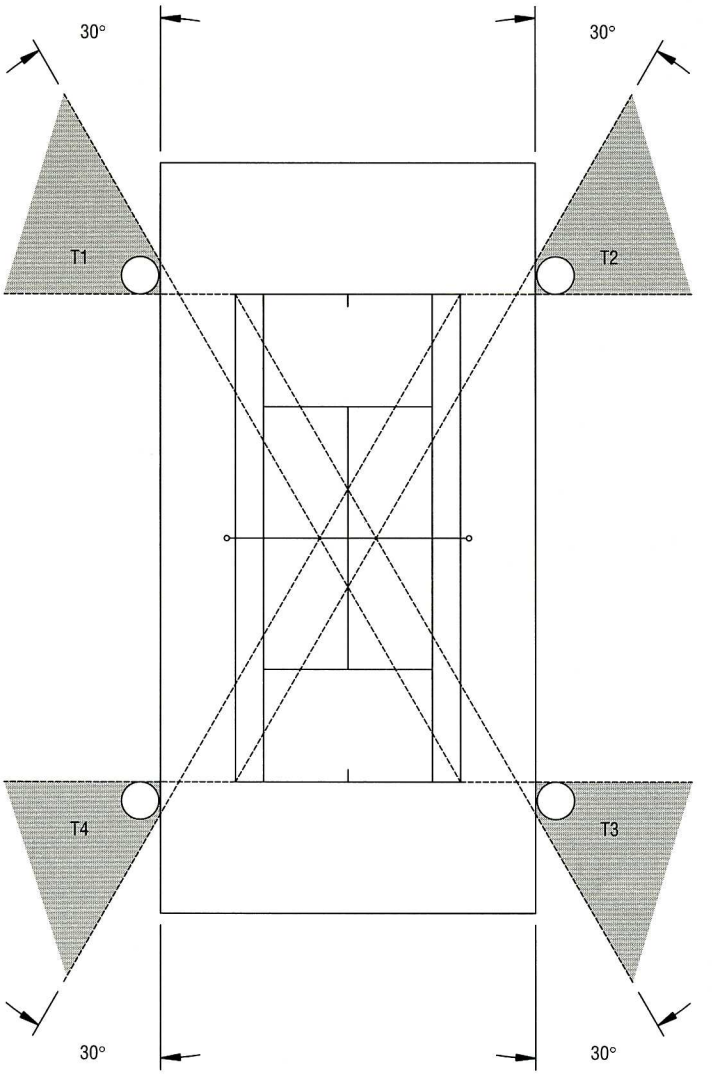
Football Field

1. Shaded areas indicate recommended pole locations. 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. Vertical aiming angle should be 21 degrees minimum. The angles are measured from below a horizontal plane at fixture height.



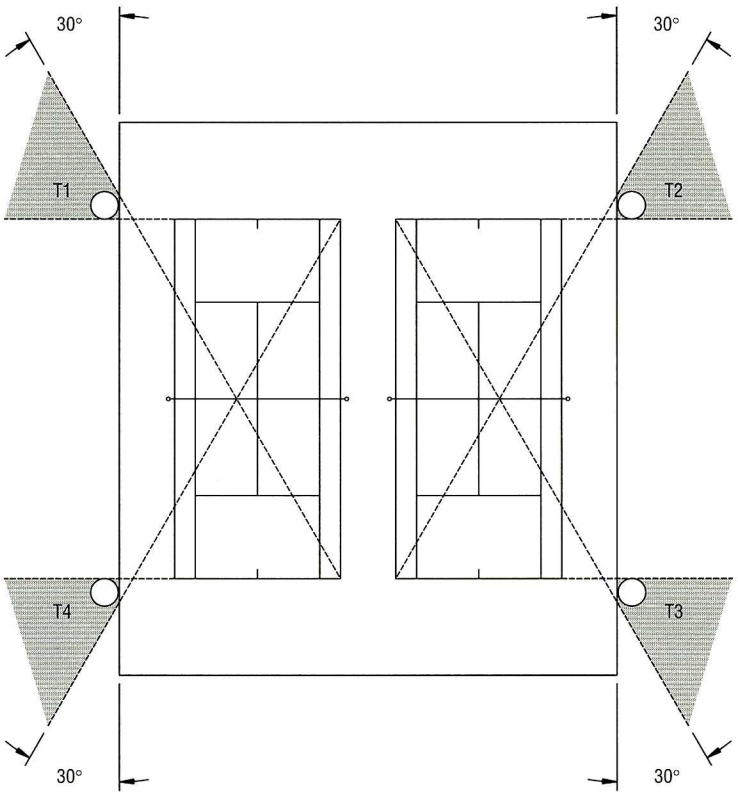
Soccer

1. Shaded areas indicate recommended pole locations.
2. In general, football lighting standards apply to soccer with the following considerations:
   a. Soccer field length generally ranges from 300 to 360 feet; width varies from 160 to 225 feet.
   b. A corner kick is a specific visual task and consideration should be given to facility design specifically for soccer.
3. For combination football and soccer facilities, see notations on football.
4. Vertical aiming angles should be 21 degrees minimum. The angles are measured from below a horizontal plane at fixture height.



Tennis Courts

1. Shaded areas indicate recommended pole locations.
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.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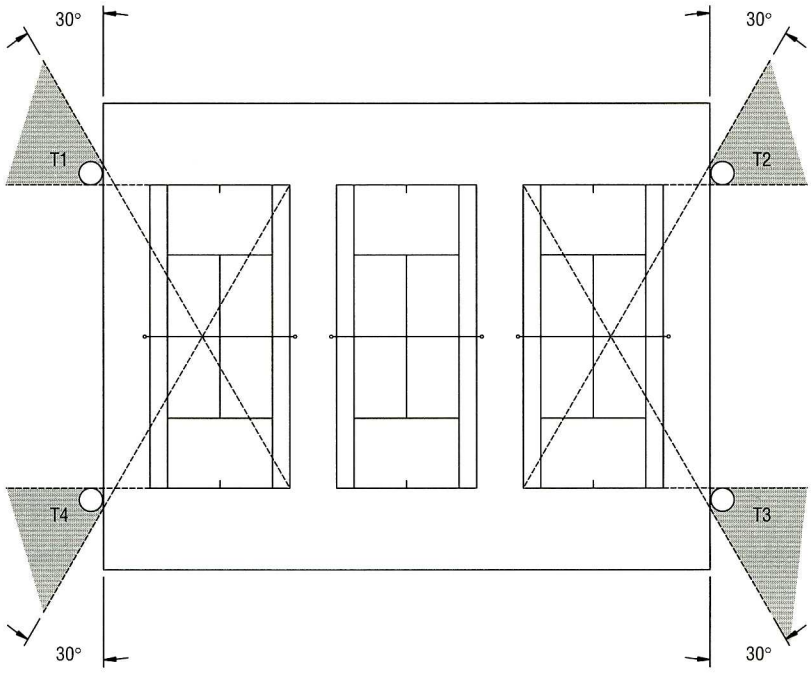
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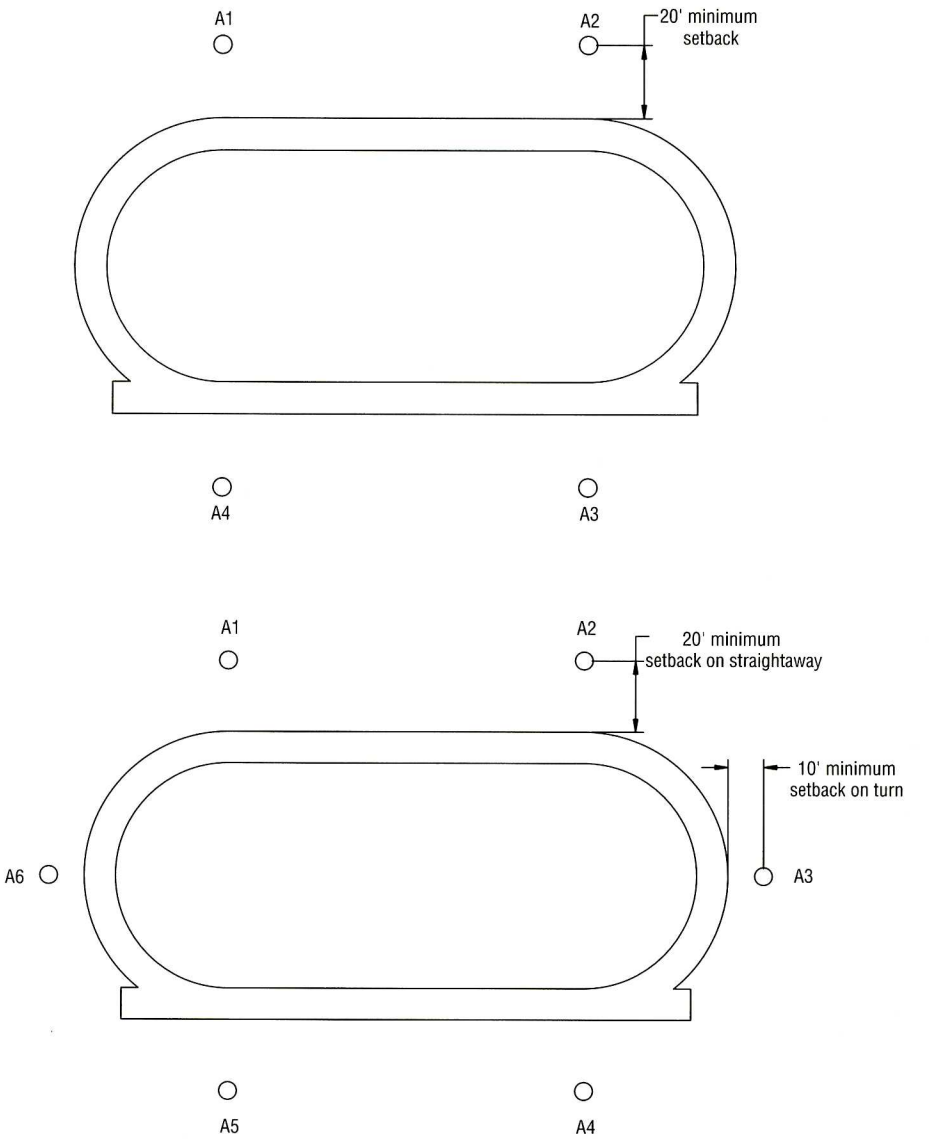

400 Meter, 8 Lane Track

1. These pole locations are for typical stand alone tracks.
2. For tracks built in conjunction with a football field, use the standard pole locations on the football design (page 13).
3. Vertical aiming angles should be 25 degrees minimum. The angles are measured from below a horizontal plane at fixture height.

Notes:

[1] There are various IES standards where safety is a concern. In these cases, IES standards should be met or exceeded, such as baseball and softball. IES standards call for 80 footcandles for basketball. This is not a safety issue but one simply for viewing. Because of energy costs and the high hours of usage of gymnasiums the IES recommendation may be excessive. For gymnasiums with a seating capacity over 4,000 the 80 footcandles may be desirable.

[2] IES standards have not addressed issues for 4-pole design on baseball and softball fields. Design criteria are based upon actual practices used on fields and standards adopted by Little League Baseball® based upon testing done on their facilities.

[3] Poles should be in positions so as not to pose a potential injury. Electrical and structural guidelines should be strictly adhered to as outlined in this booklet.

ANNUAL SYSTEM OPERATION & MAINTENANCE CHECKLIST

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

	OK	Needs Repair	Notes:
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.			
• 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 fixture 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.

GLOSSARY

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

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

Glare The sensation we experience when looking into an excessively bright light source that causes a reduction in the ability to see or causes discomfort. Glare can reduce the participant's ability to perform at their optimal level and/or cause discomfort to the spectators or surrounding neighbors.

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

Initial Levels The average light levels when your lamps are new. Measuring initial light levels assures that you receive a system that meets your specifications. Your designer 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. A standard 1500-watt metal halide lamp provides 155,000 lumens or about 100 lumens per watt. The lumen output of these lamps decreases as they are used. Good lighting design will show you what to expect when the lamps are new (initial) and over their life (maintained).

Maintained Levels Target light levels over the average life of your lamps (what you are really buying). Maintained values should be no more than 80% of initial values to be sure that lamp depreciation has been accounted for in the design. You should receive scans showing what these will be.

Max. to Min. Ratio Also called uniformity ratio. A design criteria 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.

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, which 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 determines how many light fixtures you have to buy and maintain.

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

Smoothness The change in light levels between measuring points. The less change between points the more even the lighting.

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.

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.

Vertical 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.

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