

**Lighting Standards**

**Kentucky  
High School  
Athletic Association**



**Thanks to the following professionals for their  
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# STANDARDS OF LIGHTING

The following recommended standards have been adopted by the Kentucky High School Athletic Association as a result of recommendations by our Standards Advisory Committee. These recommended minimum standards were adopted in July, 1999 and apply to the lighting of all high school athletic activities sponsored by the KHSAA or its member schools.

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. As with any school construction project, it is recommended that design professionals be consulted early in the planning stages.

The standards are divided into recommended minimums and desirable features. The minimums establish criteria which are important to safe conduct of KHSAA activities. The desirable features are established to provide guidelines for lighting systems that give added values of durability, energy-efficiency, environmental sensitivity as to spill and glare and that are more cost-effective to own and operate.

In most cases, these recommendations will be part of the criteria used to determine championship sites when the KHSAA makes site selections. These standards comply with the requirements of and are recommended by the Director of Facilities Management for the Kentucky Department of Education.

## I. Recommended Minimum Standards

These minimums 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 of the recommended minimum standards.

*\*Natatoriums and field/track venues are currently under study and will be included in the next printing. In the interim, please call KHSAA office for information.*

### A. Lighting

#### 1. Quantity

##### a. Baseball/Softball

There shall 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/Soccer

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

##### c. Tennis

There shall be maintained a minimum average of 40 horizontal footcandles on the playing area.

##### d. Gymnasiums

There shall be maintained a minimum average of 60 horizontal footcandles for events with spectators. For gymnasiums used for recreational purposes there shall be maintained a minimum average of 30 horizontal footcandles.

##### e. Combination/Multi-Purpose

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

## 2. Quality

### a. Baseball/Softball

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

- Uniformity of the lighting shall be such that on the infield the highest measure of quantity of light shall not be greater than 2.0 times the lowest quality of light. For the outfield measurements, the highest quantity of light shall 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 foot candles 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/Soccer

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

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

### c. Tennis

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

- Uniformity of the lighting shall be such that the highest measure of quantity of light shall not be greater than 1.7 times the lowest quantity of light within the lines and 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.

### d. Gymnasiums

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

- Uniformity of the lighting shall be such that the highest measure of quantity of light shall 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.

## 3. Footcandle Documents

The manufacturer of the lighting equipment shall provide two drawings showing the horizontal footcandle quantity at each point of measurement on the field. One drawing is to show the initial quantity of light to be provided when the fixtures and lamps are new. The second drawing is to show maintained light levels, which should be 80% of the initial light levels. These drawings shall be in compliance with the minimum standards established above.

## 4. 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 to meaningfully establish that the quantity and quality standards are being met for the facility.

### b. Method of Measuring Light Quantities

The light sensing surface of the light meter is to be held 36 inches above the playing surface with the sensing surface horizontal to the ground so that it detects light coming

downward to the sensing surface from all directions around the ballfield. Testing equipment for measurement of light shall be a cosine and color corrected light meter regularly calibrated in footcandles.

## **5. Maintained Alignment**

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

There shall 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 gusting to 125 mph. Because current technology of lighting equipment has precise intense beams, the misalignment of individual fixtures by a few degrees can significantly impact on the quantity and quality of light. Also, misaligned fixtures can result in undesirable glare for players.

### **b. Pole Alignment**

Twisting or leaning of poles can also result in misalignment of fixtures. Foundations for poles should be designed of sufficient strength to prohibit the pole from leaning which could likewise misalign the lights, thereby altering the quantity and quality of light on the field. Foundations shall be certified by a structural engineer.

## **6. Glare**

Pole heights, pole locations and fixture placement should be as established by the layouts on pages 13 - 18 to achieve placement of the lights in positions that enhance playability.

## **7. Aiming Angles**

### **a. Baseball/Softball**

- **Infield:** Light fixtures which are set back from the foul lines between home plate to 3rd base and between home plate to 1st base shall be mounted at a height above the surface of the playing field such that the line from the lighting fixture to the point of the field where its maximum intensity is aimed is a line that is at least 25 degrees below horizontal.
- **Outfield:** Light fixtures positioned outside the outfield fence or along the foul line beyond 3rd base and beyond 1st base shall be mounted at a height with a minimum aiming angle of 25 degrees below horizontal for lights aimed toward the infield and 21 degrees for lights aimed across the outfield.

### **b. Football/Soccer**

For adequate mounting heights, a line drawn from the center of the playing area to the lowest mounted luminaire should form an angle with the horizontal of not less than 21 degrees.

### **c. Tennis**

Poles should not be located between two adjacent courts other than at the net or the fence line. It is desirable to locate some of the poles beyond the baseline to provide illumination of the approaching ball when the player is positioned behind the baseline. However luminaires on those poles may need to be shielded to avoid direct glare to the opposing players. Light fixtures minimum aiming angle should be 30 degrees below horizontal.

### **d. Gymnasium**

Lights should be placed uniformly above the playing surface to minimize direct glare for players shooting and rebounding. Luminaires should be placed in areas so as to minimize glare from floor and backboards.

### **e. Track and Field**

Light fixtures should be mounted on poles outside the track and aimed at 21 degrees or more below horizontal.

**8. Aiming Recapture**

The lighting equipment shall include a mechanical device for recapturing the original aiming when it is necessary to move the reflector for relamping.

**9. Ballast and Capacitor Weight**

Exterior Mounting

The ballast and capacitor with each fixture must be mounted off the fixture and crossarm onto the pole at stepladder height to avoid problems of misalignment of the reflector caused by the weight of the ballast and capacitor. Additionally, this creates safer conditions for servicing and maintenance.

**10. Aiming Diagram**

The manufacturer shall 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 shall be individually fused with UL Listed fused equipment rated for use with the system.

**2. Disconnects**

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

**3. Grounding**

All poles, fixtures and distribution panels shall 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 shall 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 shall 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 locking 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 System**

The manufacturer of the lighting equipment shall 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 shall show

compliance with these standards and shall provide sufficient information for maintenance personnel.

**9. Drawings of Electrical Distribution**

The electrical designer shall provide drawings of the electrical system from the base of the pole to the transformer provided by the utility company which shall show that they have been approved by the local authority regulating electrical systems.

**10. Underwriter Laboratory Listing**

The lighting and electrical equipment on ballfield and court lighting structures shall 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 shall 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 shall 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 shall not be more than 13 conductors supported by a single wire mesh grip. If harness is longer than 65', an interim wire mesh grip support shall be located approximately half way down the pole.

**13. Voltage Drop**

The electrical designer shall verify that voltage drop does not exceed 3% of nominal voltage to any fixture.

**C. Structures**

**1. Location**

Poles shall be located as shown on the drawings in the appendix to these standards. Where ever 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 shall be calculations and documentation certified by a licensed Kentucky structural engineer that foundation design is adequate to resist forces to avoid poles causing an obstruction and safety hazard to the play of the game. If site conditions are unknown, soils testing is recommended.

**3. Strength of Pole**

Information and documentation shall be obtained to establish that the pole and the attachments are of sufficient strength to comply with local and/or state building codes.

**4. Lightning Protection**

All structures must meet the NFPA 780 lightning protection code as referenced on page 7, B4.

**5. Non-Steel Poles**

Standards assume galvanized steel poles. All poles must have a structural design certifying its' ability to withstand applied loads. **Wood poles are not allowed.**

## **D. Testing and Compliance**

### **1. Compliance**

To insure compliance with these standards, each member school should permanently maintain documentation on all new or upgraded facilities.

### **2. Annual Testing**

- a. Visual testing must be performed annually on lamps, lenses, conduit, poles, fuses, ballasts, grounding connections, breaker boxes to insure integrity and safety of system. (See page 19)
- b. Full light and safety audits must be performed every other year.
- c. Full light and safety audits may be required before championship events on sites selected by KHSAA.

## **II. Desirable Features**

The following standards are strongly recommended as being of cost-effective value to KHSAA members.

### **A. Lighting**

#### **1. Energy Efficiency**

Differences of more than 25% in the cost of operating lighting systems may occur depending upon the efficiency of the design of the equipment. Federal regulations mandating energy efficiency for lighting equipment are in process and will likely become mandatory in the next few years. For reasons of both cost and potential compliance with federal energy laws it is recommended that energy-efficient lighting equipment be used.

#### **2. Environmental Spill and Glare Control**

Many ballfields and courts are, or soon will be, surrounded by residential properties. Significant technology is currently available to control spill and glare light from trespassing onto adjoining properties. Consideration should be given to these issues during the initial design stage to minimize and to avoid complaints and possible restriction of lighting operations. An assessment of this potential problem can be documented by the manufacturer. If this is a concern for your facility, you should ask the manufacturer to provide you with drawings showing maximum foot-candles which will occur at any points of concern (sensing surface of the light meter pointed directly at the brightest light source) on properties surrounding your ballfield. You should also determine the manufacturer's experience and ability to work with local authorities and neighbors in establishing and meeting glare and spill criteria for adjoining properties.

### **B. Electrical Enclosure**

Other than the lamp, it is not necessary that any electrical components be located at the top of the pole. It is recommended that the electrical components of ballast, capacitor, fusing and disconnect be located in an enclosure mounted on the pole at a point at least 8 feet above the surface. This allows for maintenance work from a step ladder, yet keeps the electrical components out of the reach of people standing on the ground. The equipment and methods for locating these components near the base of the pole must be a part of the Underwriters Laboratory listing.

### **C. Structures**

#### **1. Concrete Foundation**

It is recommended that all pole bases be of concrete construction in the ground and to a point at least 18 inches above the ground to avoid corrosive deterioration. Also, all excavated soil should be replaced with concrete backfill to assure adequate compressive strength which will avoid leaning and misalignment of the pole.

**2. Galvanized Steel**

Galvanized steel poles are recommended as structures because the hot-dip galvanizing assures that the pole is coated on the inside as well as the outside to protect it from corrosion.

**3. Stainless Steel Hardware**

All hardware attached to the pole that was not connected as welded steel before galvanizing, should be stainless steel with a thermoset polymer coating to protect against rust and metallurgic reactions that will cause hinges, latches and fasteners to cease to operate or cause them to structurally fail.

**4. No Secondary Threading or Cutting**

Neither the manufacturer nor the installer should perform any threading or cutting of the galvanized steel material after the galvanizing has been completed. Such operations disrupt the protective coating and create a point for deterioration of the structure.

**5. Manufacturer's Certification**

You should request a certification from the manufacturer that the steel pole and welded components are hot-dip galvanized to ASTM- A123 standards and that all latches, fasteners and hinges are stainless steel with Empiguard treatment and that no secondary threading or cutting operations have been performed after galvanizing.

**D. Warranty**

Manufacturers provide various warranties of their equipment. Considerations in evaluating the warranty include the extent of the equipment covered, the time period for which it is warranted not to fail and whether the manufacturer provides parts or the labor required to replace the parts or both. The warranty should be considered important from two perspectives. First and most importantly, the extent of the warranty indicates the manufacturer's confidence of the long-term durability of the equipment. Secondly, in the event of failure of the equipment, the warranty, of course, offers the opportunity to reduce cost for repair of the equipment.

**E. Security Lighting**

There shall be sufficient lighting in and around athletic facilities to prevent unsafe and inappropriate actions. The parking areas, major areas utilized for passage, and areas immediately bordering the facilities should be lit to approximately an average of 2 footcandles. Care should be given to eliminate darkly shadowed areas.

**F. Other Considerations**

Most outdoor athletic facilities do not provide emergency lighting in the event of power loss. Current means of providing this lighting may not be practical for most schools. It is recommended that each school have a plan for evacuating facilities if power is lost.

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

KHSAA  
2280 Executive Drive  
Lexington, Kentucky 40505  
Phone: 606/299-5472

## Typical Facility Information

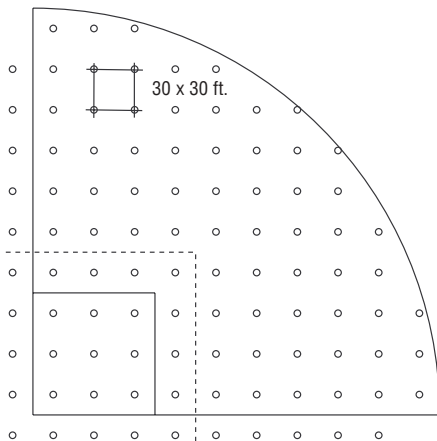
Sport	Typical Playing Facility Dimensions (ft <sup>2</sup> )	Horizontal Footcandles (fc) Maintained	Uniformity (Max to Min)	Typical Lighted Area Dimensions (ft <sup>2</sup> )	Grid Size (feet)
Baseball Infield Outfield	90 x 90 *	50 30	2.0 2.5	120 x 120 *	30 x 30 30 x 30
Football	160 x 360	30 - 50**	2.0 (50 fc) 2.5 (30 fc)	180 x 360	30 x 20
Gymnasium	50 x 90	60 - 75	2.0	75 x 105	10 x 10
Soccer	200 x 360	30 - 50**	2.0 (50 fc) 2.5 (30 fc)	210 x 370	30 x 20
Softball Infield Outfield	60 x 60 *	50 30	2.0 (50 fc) 2.5 (30 fc)	100 x 100 *	20 x 20 20 x 20
Tennis	36 x 78	40	1.7 - 2.0	48 x 98	10 x 10

\* Baseball and softball fields are pie-shaped. Outfield areas are derived from the overall area less the lighted infield area.

\*\* See A.1b and A.2b on pages 4 and 5.

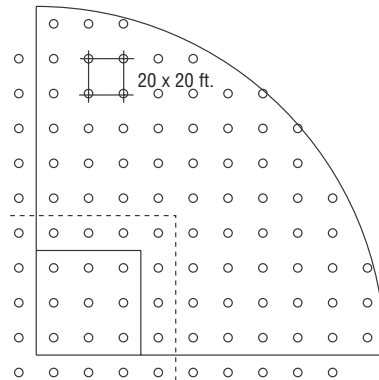
## AREA OF MEASUREMENTS

### Baseball



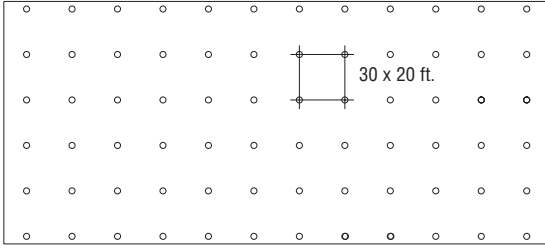
Infield area

### Softball

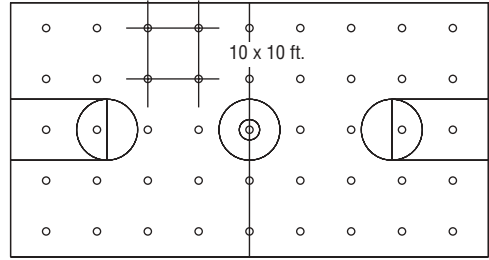


Infield area

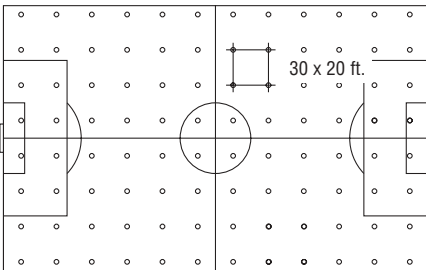
# Football



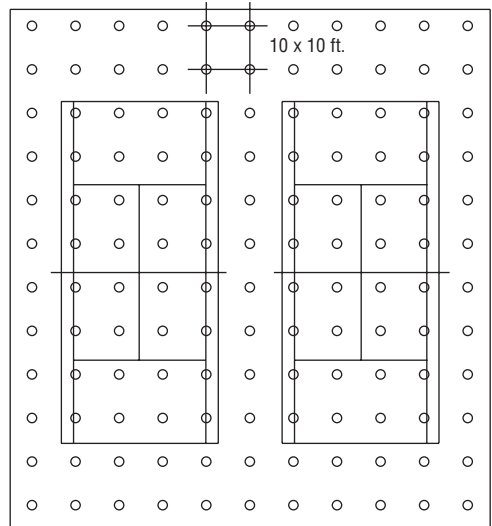
# Gymnasium

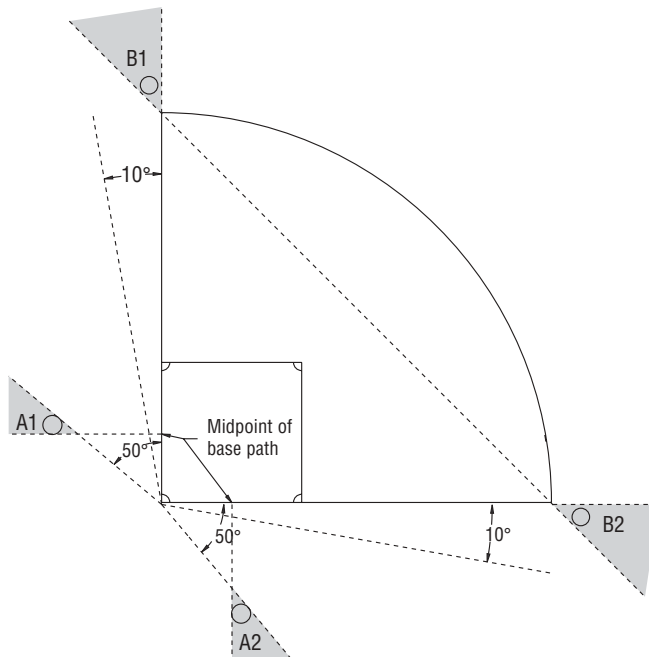


# Soccer



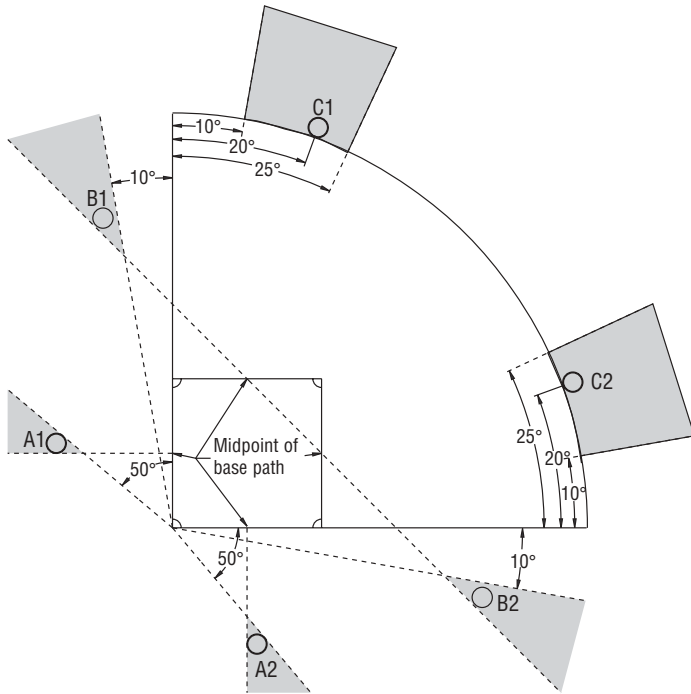
# Tennis





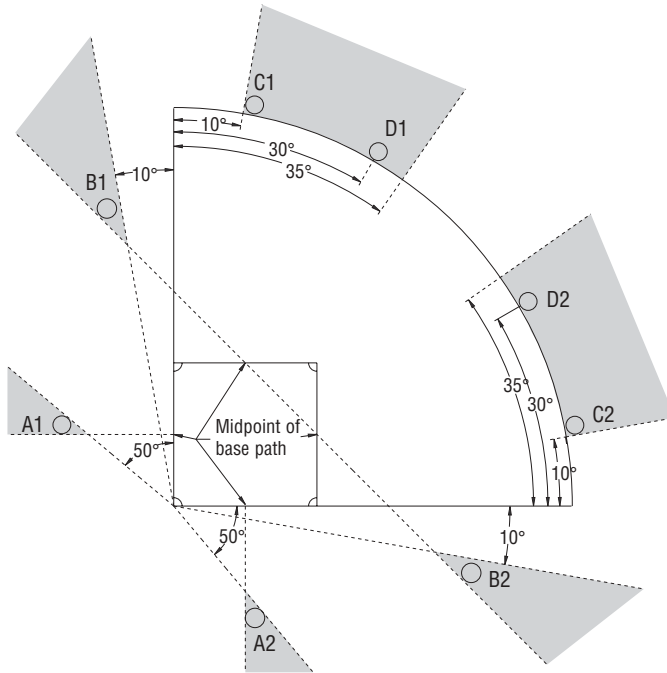
## 4-Pole Baseball/Softball Field

1. Shaded areas indicate recommended pole location.
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.



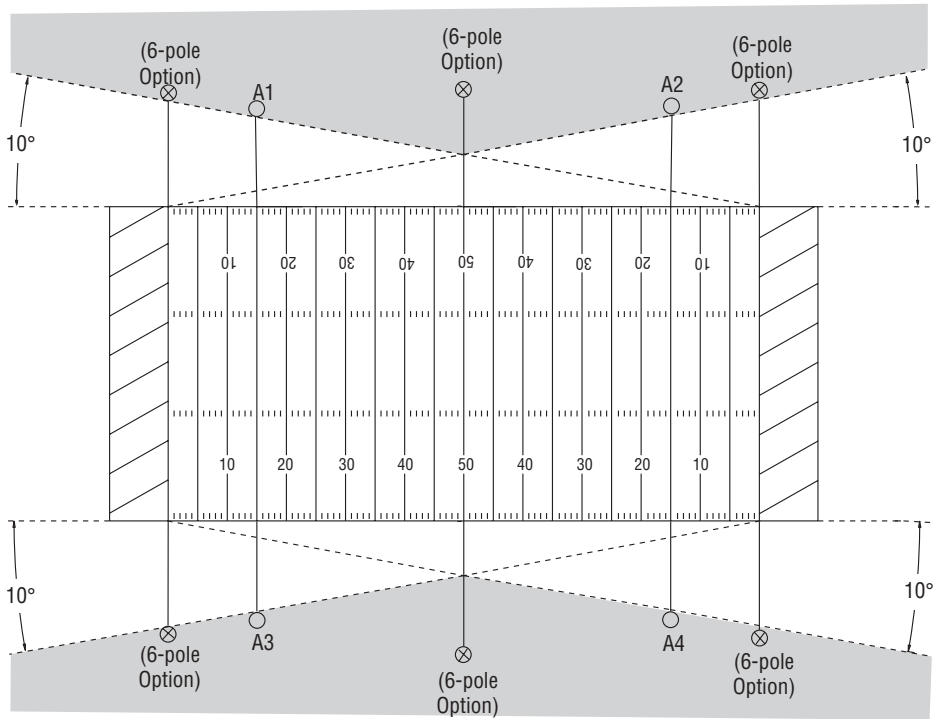
## 6-Pole Baseball/Softball Field

1. Shaded areas indicate recommended pole location.
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 towards 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.



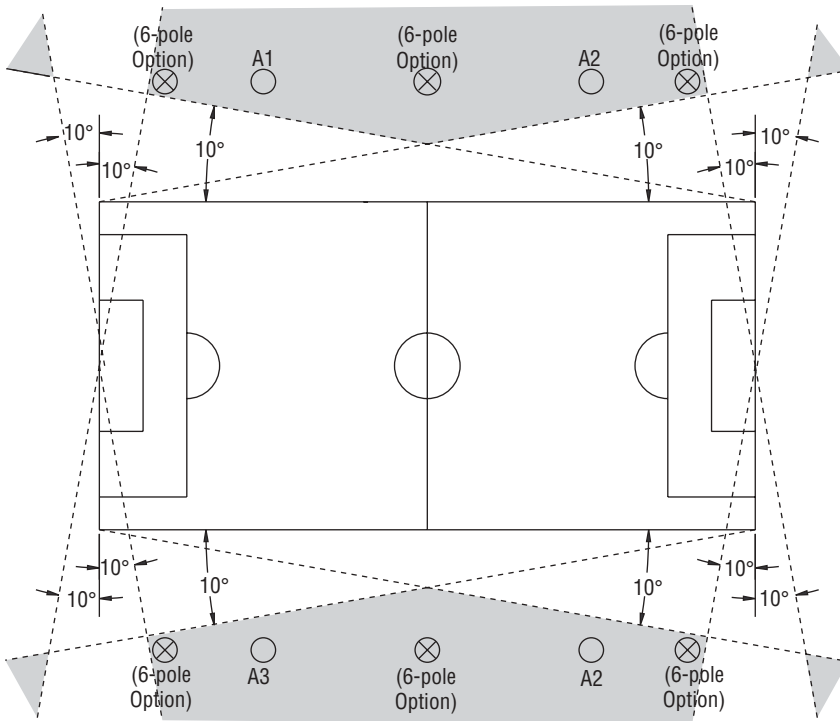
## 8-Pole Baseball/Softball Field

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.



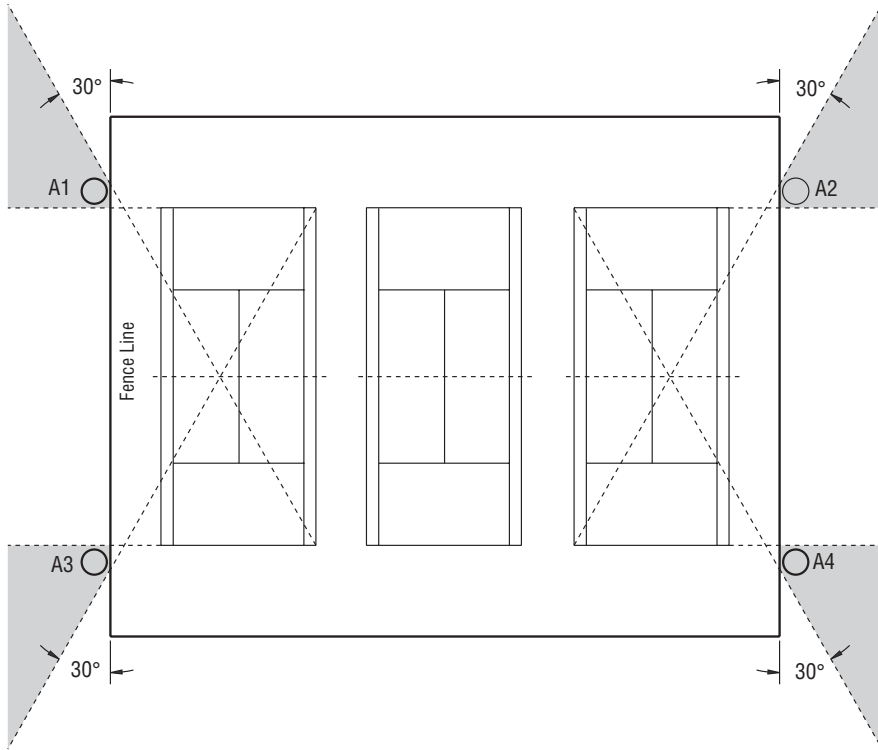
## Football Field

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 towards 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

1. Shaded areas indicated recommended pole location.
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 general consideration should be given to facility design specifically for soccer.
3. For combination football and soccer facilities, see notations on football.



## Tennis Courts

1. Shaded areas indicate recommended pole location.
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 servers sight line with toss when the ball is served.

### Notes:

<sup>1</sup> 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 75 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 75 footcandles may be desirable.

<sup>2</sup> 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.

# ANNUAL SYSTEM OPERATION & MAINTENANCE CHECKLIST

Needs  
OK Repair Notes:

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

<b>Service Entrance &amp; Pole Distribution Boxes</b>		
<b>Check service panel for proper markings.</b> • Emergency information should be visible. • Warning stickers, wiring diagrams, circuit labels and other servicing information signs should be posted and clearly legible.		
<b>Test reset action on all service breakers.</b> • Snap all breakers on and off several times to ensure firm contact. • If fuses are used at main service, check continuity.*		
<b>Check the wiring.</b> • Insulation around wiring should show no signs of deterioration. • Wiring should show no heat discoloration.		
<b>Check all taped connections.</b> • Signs of wear should be replaced.		
<b>Make sure no live parts are exposed.</b> • Bare wires and exposed connections should be wrapped with insulated covering.*		
<b>Padlocks for service entrance &amp; distribution boxes should be in place and operational.</b>		
<b>Poles</b>		
<b>Wood poles:</b> <b>Check to see that poles aren't leaning.</b> • Leaning poles may be unsafe and replacement or re-installation and/or re-aiming may be necessary.		
<b>Check for twisting.</b> • If poles have moved, re-aiming of the fixtures may be necessary.		
<b>Check for decay.</b> • Wood poles decay from the inside out. Core testing is the best method to determine the condition and safety of the pole.		
<b>Steel poles:</b> <b>Check baseplate for signs of deterioration.</b> • Check anchor bolt for signs of corrosion. • Check grouting under pole to make sure proper drainage exists.		
<b>Check for all pole access covers, replace missing covers.</b>		
<b>Cables and conduit:</b> • 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.*		
<b>Check overhead wiring.</b> • Wiring should be properly secured. • Check that new growth on tree branches and limbs won't obstruct or interfere with overhead wiring.		
<b>Luminaires</b>		
<b>Check fixture housings.</b> • Housings should show no sign of cracking and/or water leakage.		
<b>Check lenses.</b> • Clean lenses. • Replace broken lenses.		
<b>Replace burned-out lamps.</b>		
<b>Check luminaire fuses.</b> • Replace burned-out fuses. • Fuses should be the correct size.		
<b>Insulation covering on wiring should show no signs of wear or cracking.</b>		
<b>Ground wire connections must be secure.</b>		
<b>Check around ballasts for signs of blackening.</b>		
<b>Check that capacitors aren't bulging.</b>		
<b>Check aiming alignment of all fixtures.</b> • On wooden poles, see if crossarms are still aligned with the field and horizontal.		
<b>Ground</b>		
<b>Check grounding connections.*</b>		
<b>Check nearby metal objects.</b> • 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.

**Kentucky High School Athletic Association**

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Lexington, Kentucky 40505

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