Lighting Standards

Tennessee Secondary School Athletic Association
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Standards of Lighting

The following guidelines are recommended by the Tennessee Secondary School Athletic Association. These standards apply to the lighting of all high school athletic activities sponsored by the TSSAA 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 safer, more effective lighting system.

The standards are divided into recommended minimums and desirable features. The minimums establish criteria important to safe conduct of TSSAA 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

The lighting system shall provide target illuminance level over the guaranteed lifetime of the system’s operation. The IES “Recommended Practice for Sports and Recreational Area Lighting” RP-6-15 provides design criteria for sports facilities.

A. Preferred LED Technology

The preferred lighting system technology is LED due to superior energy efficiency, increased lifespan, reduced maintenance, and minimal light depreciation over the operating life of a typical sportslighting system.

Lighting manufacturers will provide projected lumen maintenance data of the luminaires used, per TM-21-11, and will incorporate the lumen maintenance projections into the lighting designs to ensure target light levels are achieved throughout the guaranteed period of the system. Projected lumen maintenance hours should be reported based on the 6X multiplier of testing hours, and not calculated values per IES guidelines.

LEDs can range in correlated color temperature (CCT) from below 3000K to over 6000K. Currently, the most efficient LEDs for sportslighting are around 5700K.

B. HID Technology – Constant Light

By using a series of timed power adjustments, a lighting system is able to provide constant light levels and extend the life of HID lamps. In addition, this generation of HID lighting has high performance optic characteristics that enable reductions in the quantities of luminaires needed to meet design targets when compared to continuous depreciation HID technology.


C. HID Technology – Lighting with a recoverable light loss factor

Computer designs are done using two sets of values. One states “initial light levels” when lamps are new. The other predicts target (or “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. Quality manufacturers are willing to provide guarantees of lighting performance. Lamps with a lumen output above 155,000 will not be accepted due to excessive lamp depreciation.
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.

<table>
<thead>
<tr>
<th>Group lamp replacement interval</th>
<th>Recoverable light loss factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>750 hours</td>
<td>0.80</td>
</tr>
<tr>
<td>1200 hours</td>
<td>0.75</td>
</tr>
<tr>
<td>2100 hours</td>
<td>0.69</td>
</tr>
<tr>
<td>3000 hours</td>
<td>0.65</td>
</tr>
</tbody>
</table>

### D. Lighting Performance Requirements

Playing surfaces shall be lit to a target light level and uniformity as specified in the following chart. Lighting calculations shall be developed and lighting manufacturers should provide drawings showing the horizontal footcandle quantity at each point of measurement on the field. The drawings should indicate the target light level, and initial light level for prior technology HID systems. They should also contain any light loss factors applied if applicable.

<table>
<thead>
<tr>
<th>Area of Lighting</th>
<th>Initial Light Levels (HID with a RLLF)</th>
<th>Target (Maintained or Constant) Light Levels</th>
<th>Maximum to Minimum Uniformity Ratio</th>
<th>Uniformity Gradient</th>
<th>Coefficient of Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseball / Softball</td>
<td>72.5 fc Infield 43.5 fc Outfield</td>
<td>50 fc Infield 30 fc Outfield</td>
<td>2:1 Infield 2.5:1 Outfield</td>
<td>1.5</td>
<td>0.17</td>
</tr>
<tr>
<td>Football / Soccer / Lacrosse / Field Hockey / Rugby</td>
<td>Less than 2000 spectators</td>
<td>43.5 fc</td>
<td>30 fc</td>
<td>2.5:1</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>Up to 5000 spectators</td>
<td>72.5 fc</td>
<td>50 fc</td>
<td>2:1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5000 or more spectators</td>
<td>145 fc</td>
<td>100 fc</td>
<td>1.7:1</td>
<td></td>
</tr>
<tr>
<td>Gymnasium / Basketball</td>
<td>No spectators</td>
<td>72.5 fc 116 fc</td>
<td>50 fc 80 fc</td>
<td>3:1 2.5:1</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>With spectators</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natatoriums</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tennis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Track</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Competitive Use</td>
<td>43.5 fc 7.5 fc</td>
<td>30 fc 5 fc</td>
<td>5:1 N/A</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>General Use</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Walking)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combination / Multipurpose</td>
<td>Highest minimum for activities</td>
<td>Highest minimum for activities played on the field</td>
<td>Lowest minimum for activities played on the field</td>
<td>Lowest minimum for activities played on the field</td>
<td>Lowest minimum for activities played on the field</td>
</tr>
</tbody>
</table>

Consult an experienced lighting manufacturer or lighting specialist
E. **Maximum to Minimum Uniformity Ratio**

The ratio of highest illuminance value to lowest illuminance value should not exceed the value specified.

F. **Uniformity Gradient**

The ratio between any two adjacent illuminance values on a field should not exceed the value specified.

E. **Coefficient of Variation**

The maximum ratio of the standard deviation for all of the footcandle values to the mean should not exceed the value specified.

F. **Glare for Participants**

To achieve placement of lights in positions that enhance playability, pole locations and luminaire placements should be as shown on the layouts in the appendix. Luminaire should be selected that have glare control technology. This technology may include internal and external visors - either over the individual LED packages inside the luminaire, or on the luminaire itself, or both. Not all luminaire have equal glare control performance. Select a lighting manufacturer that has proven glare control technology.

1.2 **ENVIRONMENTAL LIGHT CONTROL**

Many facilities are located near residential properties or roadways, creating the possibility of spill and glare onto adjoining properties. 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 should assess both spill and glare at all areas of concerns on adjacent properties. Manufacturer should provide both an illumination summary for spill light and an environmental glare impact summary for areas of concern. The environmental glare impact summary should show the maximum candela an observer would see when facing the brightest light source from any direction. For areas of concern, a good guideline is to keep glare from the brightest source below 5,000 candela. This is equal to roughly half what a low beam car headlight would be. Measurements are taken at the point of concern, at 60 inches above the ground.

Check local ordinances for light control restrictions.

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 considered 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 relamping (for HID systems) 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
Control 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
A. LED
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.

B. HID
Warranties for typical floodlighting equipment can range from 5 to 10 years, and the details of covered items and conditions vary greatly.

C. Fulfillment
The manufacturer should have financial reserves to assure fulfillment of the warranty for the full term. It is highly recommended you consider 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. Wood poles or direct burial steel poles are not recommended.
2. Pre-stressed concrete base 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 drivers or ballasts and supporting electrical equipment mounted remotely in aluminum enclosures approximately 10’ above grade. The enclosures shall include driver, controller, (ballast, capacitor for HID), and fusing for each luminaire. Safety disconnect per circuit for each pole structure must be located in the enclosure.

5. Wire harness complete with an abrasion protection sleeve, strain relief, and plug-in connections for fast, trouble-free installation.

B. Interior LED sports lighting systems should consist of the following:
   1. All luminaires shall consist of a die-cast aluminum heatsink for heat dissipation, and a shatter-resistant glare reduction visor.
   2. If driver is integral in luminaire, it should have a dedicated heatsink for longevity.

C. Manufacturing Requirements
   All components should be designed and manufactured as a system. All luminaires, wire harnesses (if provided), and electrical components 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 steel shall be hot dip galvanized per ASTM A123. All exposed hardware and fasteners shall be stainless steel of at least 18-8 grade, passivated and polymer coated to prevent possible galvanic corrosion to adjoining metals. All exposed aluminum shall be powder coated with high performance polyester. 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.

E. Luminaire Alignment
   The sports lighting manufacturer’s warranty should include accurate alignment of the luminaires. The current technology of lighting equipment has precise intense beams; the misalignment of individual luminaires by a few degrees can significantly impact the appearance of the field. Misaligned luminaires can also result in undesirable glare for players, spectators, and neighbors.

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

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

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 Tennessee structural engineer illustrating that the foundation design is adequate to withstand the forces imposed from the pole, luminaires, and other attachments to prevent the structure from leaning should be provided by the manufacturer.

   Recommended foundation types include: direct buried prestressed concrete poles, direct buried prestressed concrete base with a slip fit steel pole shaft, or a poured-in-place concrete foundation with anchor bolts and a base plate galvanized steel pole. It is recommended that all pole bases be of
concrete construction in the ground and to a point 18 inches above the ground to avoid corrosive
deterioration. Foundations designed with direct embedment steel components are not recommended.

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
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

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 or exceed those of a Class 5 material as defined by 2001 IBC, Table 1804.2-1-A.

F. Retrofits
To retrofit a lighting system onto existing poles, or to alter poles, the final pole assembly must comply
with current building codes. Structural integrity of all poles should be tested to ensure adequate
strength.

2.3 ELECTRICAL PARAMETERS

A. Electrical System
Electrical system comprises a main service panel, control and monitoring (or contactor) cabinet(s), as
well as branch circuits feeding all light poles and luminaires, including equipment grounding
conductors. Electrical system design shall conform to National Electric Code.

B. Disconnect
There should be provided at each pole a disconnect means located at the minimum height required by
code to allow disconnecting of electrical power of the pole. This disconnect should allow for
lockout/tagout in addition to overcurrent protection provided at the distribution panel for the each
individual circuit.

C. Fusing
Each luminaire should be individually fused with UL Listed fused equipment rated for use with the
system. Fusing shall be located in the remote electrical enclosure located at ground servicing height on
the pole.

D. Lighting Protection
Each pole should be equipped with lightning protection as established by NFPA 780.

E. Surge Protection
Surge protection should be provided at each pole equal to or greater than 40 kA for each line to ground
(common mode) as recommended by IEEE C62.41.2 - 2002.

F. Rigid Conduit
It is recommended that all wiring above grade be internal to the light pole. If necessary to run outside
the pole, all conductors should be within a rigid metallic, or liquid-tight flex conduit.

G. Lockable Electrical Components Enclosures
Electrical components enclosures that are designed to be opened should be lockable and kept locked
except during times of maintenance or servicing. Access should be by means of a key or special tool.

H. Underground Supply Wiring
Supply wiring should be buried to depths required by NEC or applicable local code. Copper wire is
recommended. Do not share neutrals nor equipment grounding conductors.
I. **Strain Relief**  
Wire harness should be supported within the pole as required by electrical code with a strain relief at the top of the pole. For poles taller than 80 feet, a midpoint strain relief should also be supplied.

J. **Voltage Drop**  
The voltage drop to the disconnect switch located at the light poles should not exceed 3% of the rated voltage per IESNA RP-6-01.

K. **Underwriter Laboratory Listing**  
The lighting and electrical equipment 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.

**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, City’s Representative, and Manufacturer’s Representative, illumination measurements should be taken and verified. The illumination measurements should be conducted in accordance with IESNA RP-6-01, Annex B.

All points on the field are to be measured as specified on the lighting scan, using a cosine and color-corrected lightmeter calibrated within the last 12 months. See diagrams below for recording readings.

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 luminaires 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.

2. Manufacturer shall minimize the Owner’s additional long term luminaire maintenance and energy consumption costs created by the additional luminaires by reimbursing the Owner the amount of $1,000.00 (one thousand dollars) for each additional luminaire required.

3. Manufacturer shall remove the entire unacceptable lighting system and install a new lighting system to meet the specifications.
II. Desirable Features

The following practices are recommended for increasing the lighting system performance.

4.1 WARRANTY

When comparing products, the manufacturers’ warranty 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 provides a guarantee of light levels during the warranty period. From the owner’s perspective, the warranty offers the opportunity to reduce costs for equipment repair. Comprehensive warranties covering parts and labor are available for up to 25 years.

4.2 TV QUALITY LIGHTING

Lighting for televised events involves considerations in addition to spectators and participants. It is recommended that cities wishing to light facilities for television broadcasts 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.”

4.3 MULTI-LEVEL LIGHTING

Additional energy savings can be obtained through the use of multi-level lighting. The multi-level lighting will allow the system to operate at the light level that is most appropriate for the activity taking place. For example, a facility may only be used for competitive play a few hours a day with the remainder being used for practice or recreational use. The multi-level lighting would allow for the lights to be operated in the high mode for competition events, while operating on a medium, or a low light level during the remainder of the time, thus conserving energy.

4.4 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.

4.6 SERVICING OPTIONS

Consideration should be given to the method of servicing the top of the pole for lamp replacements and other maintenance concerns that can’t be reached with a ladder. The preferred method of servicing should be with a bucket truck or crane. However, when accessibility is restricted due to pole locations, an alternative method should be utilized. Acceptable alternative methods include steps, safety cables, and platforms.

4.7 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.

4.8 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 building codes for specific requirements as they apply to athletic facilities.
For additional information, contact the TSSAA office at:

TSSAA
P.O. Box 319
3333 Lebanon Road
Hermitage, TN 37076
Phone: 615/889-6740
# 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:**

<table>
<thead>
<tr>
<th>A. Energy consumption</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of luminaires x ____ kW demand per luminaire x ____ kW rate x ____ annual usage hours x 25 years</td>
<td></td>
</tr>
</tbody>
</table>

| B. Demand charges, if applicable | + |

| C. Spot relamping and maintenance over 25 years (HID systems) | + |
| Assume ____ repairs at $ ____ each if not included |  |

| D. Group relamps during 25 years (HID systems) | + |
| ____ annual usage hours x 25 years / lamp replacement hours x $125 lamp & labor x number of luminaires |  |

| 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:**

<table>
<thead>
<tr>
<th>A. Energy consumption</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of luminaires x ____ kW demand per luminaire x ____ kW rate x ____ annual usage hours x 25 years</td>
<td></td>
</tr>
</tbody>
</table>

| B. Demand charges, if applicable | + |

| C. Spot relamping and maintenance over 25 years (HID systems) | + |
| Assume ____ repairs at $ ____ each if not included |  |

| D. Group relamps during 25 years (HID systems) | + |
| ____ annual usage hours x 25 years / lamp replacement hours x $125 lamp & labor x number of luminaires |  |

| 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 | = |
**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.

<table>
<thead>
<tr>
<th>Included</th>
<th>Tab</th>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Letter/Checklist</td>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>
| 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), or home plate for baseball/softball fields. Illuminance levels at grid spacing specified  
   c. Pole height, number of luminaires per pole, as well as luminaire information including wattage, lumens and optics  
   d. Height of 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 luminaires, total kilowatts, average tilt factor; light loss factor.  
   f. Manufacturers shall provide scans showing target light levels. Scans should show all light loss factors applied to calculate maintained values (HID with RLLF). LED scans should show expected lumen depreciation data. |
| C | Off Field Lighting Design | Lighting design drawings showing spill light levels in footcandles as specified. |
| D | Photometric Report (glare concerns only) | Provide photometric report for a typical luminaire used showing candela tabulations as defined by IESNA Publication LM-35-02. Photometric data shall be certified by laboratory with current National Voluntary Laboratory Accreditation Program or an independent testing facility with over 5 years experience. |
| E | Life-Cycle Cost calculation | Document life-cycle cost calculations as defined on the Life-Cycle Operating Cost Evaluation. Identify energy costs for operating the luminaries, maintenance cost for the system including spot lamp replacement, and group relamping costs. All costs should be based on 25 Years. |
| F | 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. |
| G | Structural Calculations (if required) | 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 where the project is located. |
| H | 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. |
| I | Electrical distribution plans | If bidding an alternate system other than the base design, 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 where the project is located. |
| J | 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 the number of years specified. |
| K | Warranty | Provide written warranty information including all terms and conditions. |
| L | Project References | Manufacturer to provide a list of project references of similar products completed within the past three years. |
| 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 these lighting standards. |
| O | Compliance | Manufacturer shall sign off 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 item N – Non-Compliance. |

Manufacturer:  
Signature:  
Contact Name:  
Date:  

14
Appendix

Typical Facility Information

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

Light Level Grid Point Layouts

Baseball

Softball

300' radius field shown

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**
330' x 180' field shown
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 luminaire 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 luminaire 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 luminaire 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 luminaire height.
18 Luminaire Design
Designed for lighting in gymnasiums with no special provision for spectators such as smaller high schools or training facilities.

- 50 footcandles maintained

28 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 approximately 25' mounting height.

- 80 footcandles maintained

Gymnasium

1. For new facilities or upgrades, it is recommended to consult a lighting professional for optimal luminaire placement.

2. Optimal luminaire placement and mounting heights will impact playability and minimize glare and skip glare.

3. Due to mounting height restrictions, up to 200 watt LED luminaires are commonly used.
**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 luminaire height.
2 Courts

3 Courts
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).
<table>
<thead>
<tr>
<th>Service Entrance &amp; Pole Distribution Boxes</th>
<th>OK</th>
<th>Needs Repair</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check service panel for proper markings.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Emergency information should be visible.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Warning stickers, wiring diagrams, circuit labels, and other servicing information signs should be posted and clearly legible.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test set action on all service breakers.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Snap all breakers on and off to ensure firm contact.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check the wiring.*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Insulation around wiring should show no signs of deterioration.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Wiring should show no heat discoloration.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check all taped connections.*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Signs of wear should be replaced.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Make sure no live parts are exposed.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Bare wires and exposed connections should be wrapped with insulated covering.*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Padlocks for service entrance &amp; distribution boxes should be in place and operational.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Poles                                      |    |              |       |
| Check that poles aren’t leaning.           |    |              |       |
| Check wood poles for decay or twisting. Twisted pole may require re-aiming of fixtures. |    |              |       |
| • Effective Sept. 1, 1994, wood poles are no longer approved on new installations. |    |              |       |
| Check base-plate of steel poles for signs of deterioration. |    |              |       |
| • Check anchor bolt for signs of corrosion. |    |              |       |
| • Check grouting under pole to make sure proper drainage exists. |    |              |       |
| Check bolts and fittings for tightness.    |    |              |       |
| • Check all metal parts for signs of corrosion. |    |              |       |
| Latch to see that wiring covers are in place. |    |              |       |
| Check all cables and conduits.             |    |              |       |
| • 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. |    |              |       |
| Check pole climbing equipment (if provided) |    |              |       |
| • Check inspection covers on climbing harness and pole equipment. Are inspections up to date? |    |              |       |
| • Check for proper cable tension. Cable should not be loose. |    |              |       |

| Luminaires                                 |    |              |       |
| Check fixture housings.                    |    |              |       |
| • Housings should show no sign of cracking, large dents, and/or water leakage. |    |              |       |
| Check lenses.                              |    |              |       |
| • Clean lenses.                            |    |              |       |
| • Replace broken lenses.                   |    |              |       |
| Replace burned-out lamps.                  |    |              |       |
| Check luminaire fuses.                     |    |              |       |
| • Fuses should be the correct size.        |    |              |       |
| • All fuses should be operational.         |    |              |       |
| 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, (metal halide) |    |              |       |
| Check that capacitors aren’t bulging. (metal halide) |    |              |       |
| Check aiming alignment of all fixtures.    |    |              |       |
| • On wooden poles, see if crossarms are still aligned with the head and horizontal. |    |              |       |

| Ground                                     |    |              |       |
| Check grounding connections.*              |    |              |       |
| Check nearby metal objects.                |    |              |       |
| • Make sure metal bleachers and other metal objects are located at least 6' from the electrical components. |    |              |       |
| • Metal objects, such as bleachers, must have their own individual grounding system. |    |              |       |
Lighting Performance Testing

To verify that your field meets the THSAA 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:

\[
\text{Maximum reading} \quad \frac{\text{Minimum reading}}{\text{Minimum reading}} = \text{Uniformity ratio}
\]

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 _______ \( \div \) 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 _______ \( \div \) 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 \[\text{______} \div \text{Minimum reading \[\text{______} = \text{______} \text{ 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 luminaires are aimed at the field. Angles are measured from a horizontal plane at luminaire 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.

**Coefficient of Variation** The ratio of the standard deviation for all of the footcandle values to the mean. A maximum ratio is specified.

**Color Rendering Index** The ability of a light source to reproduce colors accurately, compared to the same colors under daylight conditions.

**Color Temperature** The color appearance of a light source, measured in Kelvin

**Controller** A device that regulates the output of an LED driver to control LED luminaire lumen output.

**Driver** A power source that delivers the proper operating current to LED luminaires.

**Electrical Components Enclosure** An 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.

**Footcandle** The measurement of light on a surface. One footcandle equals one lumen distributed evenly 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.

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

**Illuminance, Target** The specified quantity of light to be guaranteed over the period of the lighting system.

**Illuminance, Constant** The average light level of an alternative HID technology system throughout the life of the HID lamps. Constant illuminance is achieved by increasing power to the lamps through a series of timed power adjustments.

**Illuminance, Initial** The average light level of a prior HID technology system when lamps are new. Manufacturers that do not provide constant illumination should provide scans showing what these levels will be.

**Illuminance, Maintained** The average light level of a prior technology HID system - calculated by applying a maintenance factor to initial light levels. Maintained values should be no more than 70% of initial illuminance values.

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

**Metal Halide Lamp** A type of high intensity discharge (HID) lamp that generates light by passing electrical current through metallic gases.

**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 (LED or HID) and directs light to the field. The efficiency of the reflector is one factor that determines how many luminaires you have to buy and maintain.

**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 HID 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 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.

**Uniformity Gradient**  The ratio between any two adjacent illuminance values on the field. A maximum ratio is specified.