

Sports Lighting: Save Energy & Reduce Cost



Since 1976, Musco has specialized in the design and manufacture of sports and large area lighting. Thousands of schools, cities, and facility owners have counted on Musco as part of their team to make lighting happen for the safety and enjoyment of their participants, while providing the most value for their sports-lighting budget. Now you can purchase this industry-leading lighting directly through the Louisiana Municipal Advisory & Technical Services Bureau.

Light-Structure System™ lighting system:

- **Designed & engineered from foundation to poletop in 5 Easy Pieces™**
- **Custom to project specifications**
- **Factory-assembled, aimed and tested**
- **Choice of LED or metal halide light sources**
- **Includes system monitoring and remote on/off control services**
- **Backed by an industry-leading warranty**

For information:
Amanda Hudnut
800/825-6030
musco.contracts@musco.com
www.musco.com

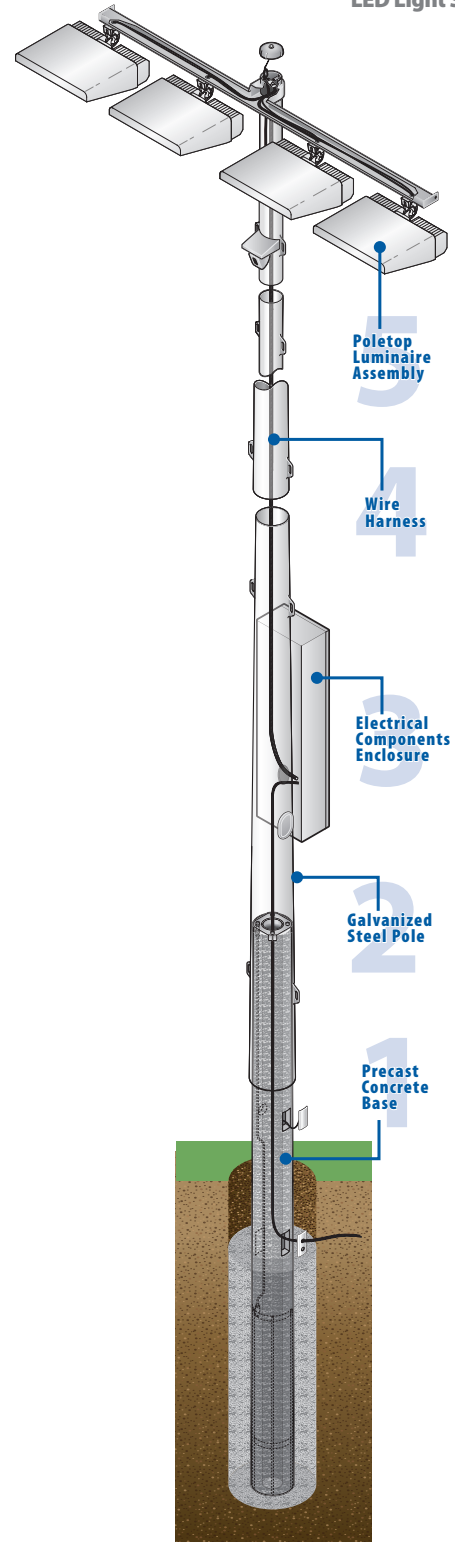


Approved Vendor RFP #01-20



Light-Structure System™

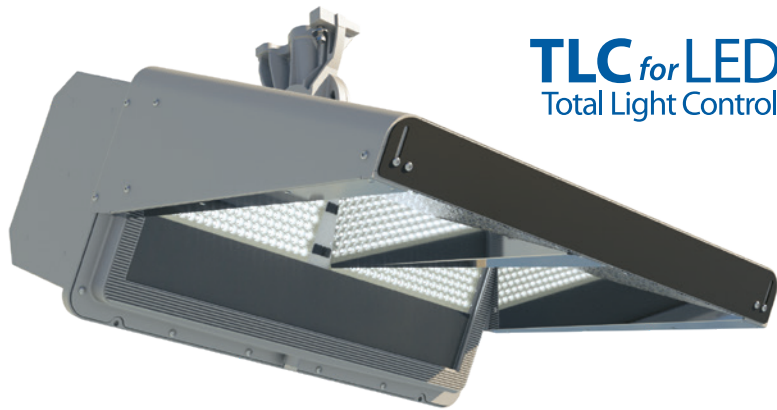
LED Light Source



Light•Structure System™

5 Easy Pieces™

Complete System from
Foundation to Poletop



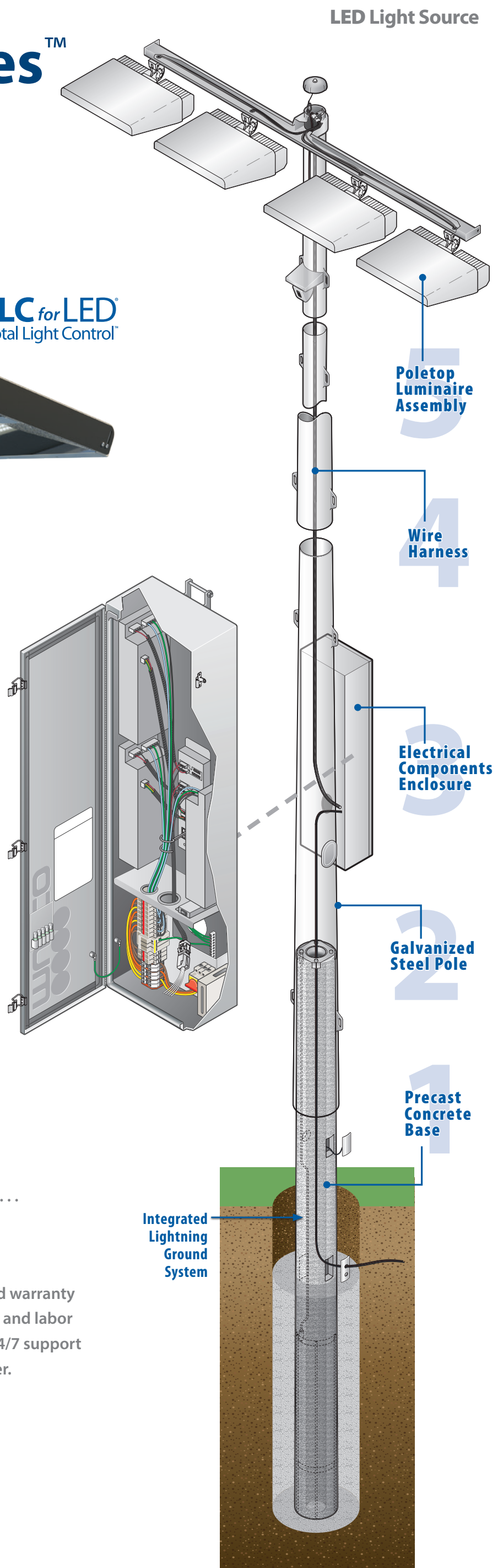
TLC for LED
Total Light Control™



All components designed to work together . . .
factory built, wired, aimed, and tested
to assure reliable, trouble-free operation

Covered by a 25-year product assurance and warranty
program with guaranteed light levels, parts and labor
for maintenance, system monitoring, and 24/7 support
from our Control-Link Central™ service center.

For your
BUDGET,
for the
ENVIRONMENT.



Introducing
TLC[®] for LED
Total Light Control[™]



We Make It Happen[®]

TLC[®] for LED[™]

Total Light Control[™]

Continuing the commitment to excellence...
Keeping good lighting affordable...
Guaranteed for 25 years, from foundation to poletop.

Light-Emitting Diode (LED) is a new tool but the issues for sports lighting are the same. For nearly a decade, the Musco Team has been testing the LED light source and applying it on projects where it was the best choice. While LED saved energy, for a typical recreational facility the hours of operation weren't great enough to offset the higher cost.

We've researched LED's distinctive challenges and advantages and applied our knowledge of light control to the unique characteristics of the diode, assuring the quality of lighting for which Musco is known.

We've paired our expertise in controlling light with the advancing output of LED to the point where we're confident it's a cost-effective option to consider for recreational facilities. With our patented BallTracker[™] technology, in-flight balls "pop" against night skies so that tracking the ball is easier than ever before.

The result is a system that makes Musco's great lighting even better.

Better for players...

who want to perform their best and be able to track the entire flight of the ball.

Better for neighbors...

who don't want glare in or around their homes or lights left on when not in use.

Better for the night sky...

with bright, uniform light directed onto the field and not spilling above it.

Better for your budget...

an affordable system that's built to last and control operating costs.

And...you can mark maintenance off your list for 25 years!

The Musco Team looks at the combination of issues to achieve the best solution to meet your needs—from structures, to quality of on-field light, to off-site impact, to energy and costs.

Control

from foundation to poletop...

from the light source to the field,
preserving the night sky...

assuring the results you expect,
day 1...year 1...and for 25 years.



Still Light-Structure System™...

5 Easy Pieces™ complete from foundation to poletop.

Our Light-Structure System™ has delivered long-term performance for thousands of customers around the world.

Lights, structures, and electrical components are engineered to work together. This assures the designed lighting gets in place and stays there over the life of the system, while also maintaining and protecting the operating environment so the components continue to function.

We've included features like easy to reach remote drivers, integrated grounding, and surge protection to ensure the longevity of the LED's sensitive electronic components.

The Light-Structure System™ adapts to support both LED and metal halide light sources.

25 years of proven performance



Control
from the foundation to the poletop.



Musco can light a ballfield better than ever...for players, fans, and TV cameras.

We create controlled light, not floodlights.

An LED floodlight is a serious step backward when it comes to the quality of light on your field. It may flood light into the neighborhood, into the night sky, and into the eyes of players.

New Tool

LED brings many benefits and new opportunities, but it's a tool, not a solution. Controlling the LED's intense, "rifle shot" of light is challenging. But with Total Light Control—TLC for LED®, we're able to achieve things never before possible—from pinpoint precision, to instant on/off, to varying light levels for different needs and sports presentation theatrics.

Same Issues

The key issues in sports lighting haven't changed: generating light, projecting it onto the target, keeping it out of the neighborhood and night sky, and creating an operating environment that allows it to last in real world conditions. Musco is able to carve out the area to be lighted and dramatically cut off any impact on the surrounding area. We use more of the light produced by the fixture, lose less light, and don't abuse the neighborhood. Our patented BallTracker™ light management technology puts vertical light precisely where it is needed. BallTracker minimizes impact on the night sky while lighting the underside of aerial balls, making night-time tracking easier than ever before.

When you walk onto a Musco-lighted field, it just looks better.

"When you stand at home plate and look out to center field, there's no glare, but the field is totally bright and you see how the white of the ball pops, it looks amazing."

— Tyson Kimm
Vice President of Perfect Game USA,
a major tenant at LakePoint Sports Community

Control
from the light source to the field.



San Diego Padres Petco Park - San Diego, California, USA

Theatrics and special effects enhance fan and TV experience.



Pinpoint control from 1,100 feet away highlights the target area while preserving surrounding darkness.



Sensational event lighting with dimming saves energy for high-usage, multi-use venues.



LakePoint Sports Community - Emerson, Georgia, USA

With patented BallTracker™ technology, players enjoy quality lighting, no glare, and better ability to track the entire flight of the ball.

The neighbors will love it.

Musco cares as much about preserving darkness as it does about creating light.

Emitting light is easy. But LED fixtures that can't effectively control the light being emitted brings the unintended consequences of abusive glare for players and neighbors, and wasteful spill into the night sky.

With Musco's Total Light Control—TLC for LED®, we've taken LED to a level of performance and precision never before seen in sports lighting. It means no disruptive glare into nearby homes and the preservation of dark skies above.

And it opens up new opportunities for where fields can be located within a community, and for existing fields that, until now, weren't able to install lights because of community push back.

Control
preserving the night sky.

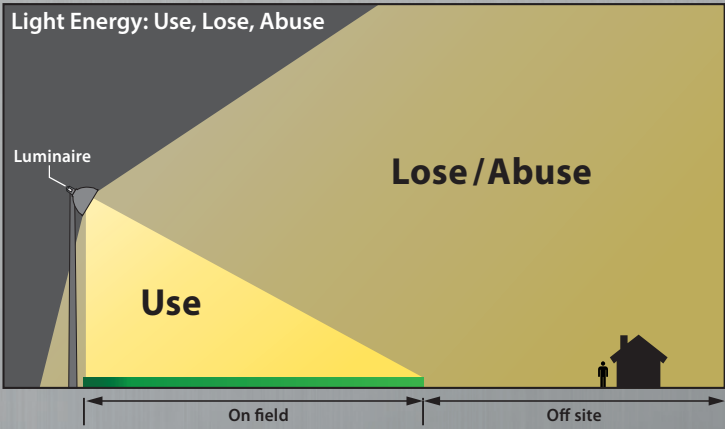


"Glyndon Park is in a naturally wooded residential area. We didn't want to illuminate the homes of neighbors in the area. I initially wasn't supportive of putting in traditional lights. The product Musco has developed allows us to light this field, yet light nothing else around it."

— Cathy Salgado,
Parks and Recreation Director, Vienna, VA



Glyndon Park Little League, Vienna, Virginia



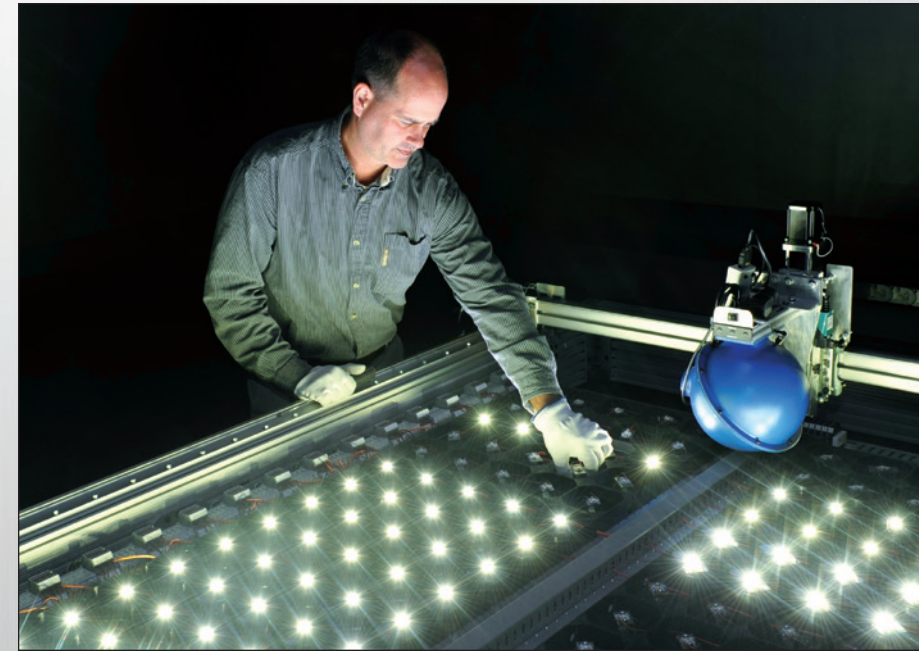
And, your field is always ready to play.

Here's a look at what the Musco Team has done in the last year as a partner in service to customers like you...

- Turned lights on and off remotely for more than 5.5 million games and events
- Conducted routine inspections and maintenance at over 11,000 fields
- Taken more than 350,000 calls, answering questions and helping with scheduling
- Carried out group lamp replacements on more than 30,000 metal halide fixtures
- Traveled enough miles servicing fields to circle the equator 24 times

And here's what our customers enjoy for 25 years...

Peace of mind for 9,125 days knowing that if a problem arises, we'll be there, and a budget with virtually **zero dollars spent on maintenance, increased staff productivity** resulting from not having to worry about managing your lights, plus **restful nights**, free from midnight calls from unhappy neighbors about lights left on.



We do the R&D to create it. We customize and apply solutions to your facility.

"Musco called to let us know there was an issue before we knew we had a problem."

— Stephen Cooke, CPRP, CYSA
Greenville County Recreation Athletics Manager, Taylors, SC



We're on the road to support it for 25 years.



We provide 24-7 Control-Link® support to monitor and operate your facility.



From metal halide to LED,
Musco's Light-Structure System™ performs
in real world conditions **for 25 years, guaranteed.**
We Make It Happen.

Control
assuring the results you expect.



Control

from foundation to poletop...

from the light source to the field,
preserving the night sky...

assuring the results you expect,
day 1... year 1... and for 25 years.



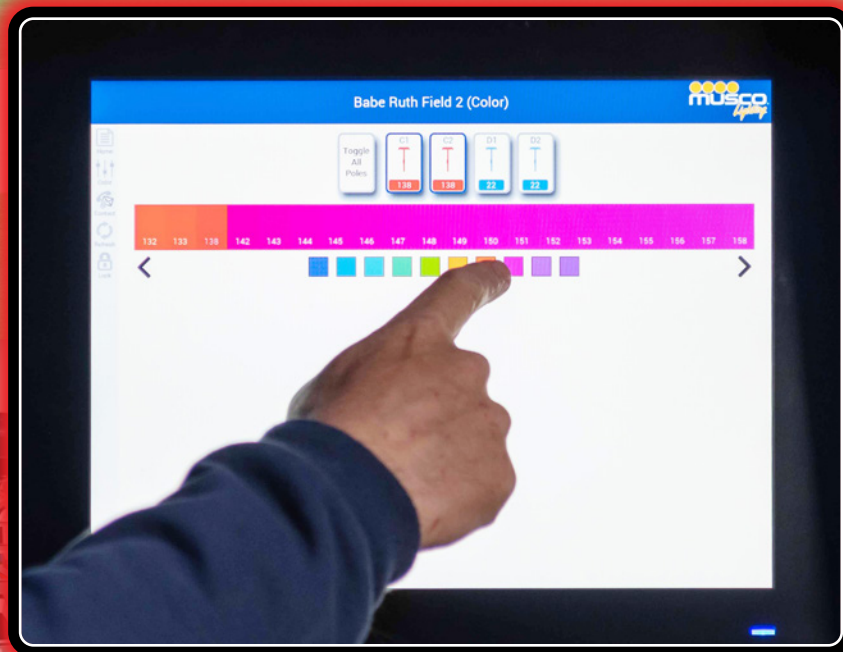
We Make It Happen®

Musco Control Solutions

24/7/365 monitoring and support

Control-Link® control and monitoring system

Show-Light™ entertainment package



Making Facility Management Easy Since 1999

The most innovative solutions are developed in response to real-world problems. In 1999 Musco introduced Control-Link® as a first-of-its-kind light management system to help customers who were getting calls from neighbors at 2 a.m. about lights left on, to help cut energy costs, and save staff time.

Since that first introduction, Musco has installed thousands of control systems from fully automated unmanned recreational sites to complex theatrical solutions for many of the largest stadiums in the world.

Anytime, Anywhere ...Control-Link management tools allow you to access and manage your lights instantly, from anywhere via a cellular internet connection.

A Real, Live Voice ...Control-Link Central™ team will monitor, schedule, and help manage your lights 24/7/365, and a real live voice will be on the other end of the phone when you call.

Factory Wired, Programmed, and Tested ...our unique system approach streamlines installation and assures that your controls, from basic on/off to professional level light shows, will be ready to work on day one.



5.8 million

schedules managed and monitored by our Control-Link Central™ Team last year



360,000

calls fielded to assist customers last year

How can controls enhance your facility?

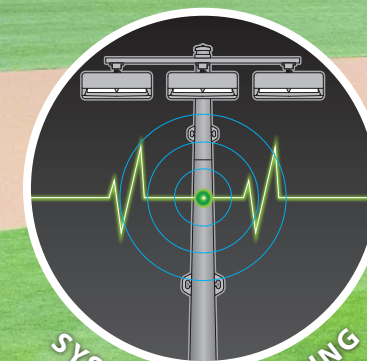
- ☐ **Remote on/off scheduling** for easy control from anywhere
- ☐ **Dimming** (3 levels) saves energy for practice and other activities
- ☐ **System monitoring** alerts Musco of any issues
- ☐ **Predesigned light shows** add excitement to events
- ☐ **Color accent option** to highlight poles and other structures
- ☐ **Custom-choreographed light shows** precisely timed to music



REMOTE ON/OFF SCHEDULING



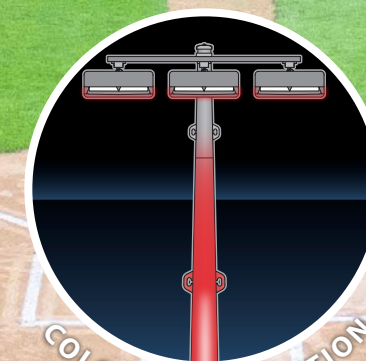
DIMMING



SYSTEM MONITORING



PREDESIGNED LIGHT SHOWS



COLOR ACCENT OPTION



CUSTOM LIGHT SHOWS

Control-Link

Show-Light™

Show-Light+™

Flexible Control, Solid Management

Your Control-Link® control and monitoring system offers efficient, cost-effective tools that are both cutting-edge and simple to use.

Musco will have your back 24/7/365 to ensure your lights are only on when needed, keeping neighbors and taxpayers happy. Because more than anything, it's about your peace of mind.

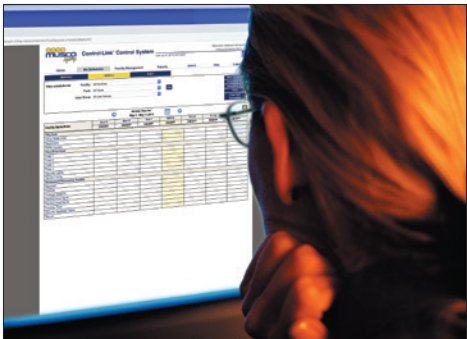
The Control-Link system provides comprehensive scheduling assistance, system monitoring, secure password-protected access, automated equipment controls, and valuable usage data.

Flexible and Reliable ... remote scheduling and controls mean no more staffing headaches, tracking multiple sets of keys, or late-night hours being on-site to turn your lights off.

24/7/365 Monitoring ... our Team will monitor your system's performance at the luminaire level, so if an issue arises we'll likely know about it before you do.

Better for Your Budget ... automated operation of your lights, as well as three levels of dimming that come standard, will reduce energy consumption and cut staffing costs.

Data You Can Use ... we'll help create usage reports and analytics for your facilities from the extensive data we store, which will help improve operational efficiencies and future planning.



Enter schedules up to 10 years in advance.

MUSCO Control-Link® Control System									
Sample Owner Today is Wednesday, August 7, 2019 Call us at: (877) 347-3319									
Home My Schedules Facility Management Reports Admin Help Logout									
DASHBOARD SERVICES									
Owner: Mahaska Comm. Rec Foundation									
Facility: Lacey Park Ballfields									
Field: All Fields									
Energy Used kWh: 519 YTD (Jul 2019): 12,847									
Service Visits: 0									
Schedules: 171 1,333									
Phone Calls to CLC: 16 90									
Web Logins: 2 13									
All Facilities for Mahaska Comm. Rec Foundation - All Fields for Lacey Park Ballfields									
MONITORING SERVICES									
FIELD	Lamp Outages	Controls	Switch Position Auto/Manual	Lamp Life	Relamps Completed	Musco Warranty Program	Warranty Start Date	Estimated Warranty Expiry Date	
SB BB Field 2-LED *			Auto	545 hrs used	0 of 1	Constant 25	03/29/2017	03/29/2042	
SB BB Field 3-LSG			Auto	1880 used 3184 remain	0 of 1	Constant 25	05/04/2008	05/04/2031	
SB BB Field 4-LSG			Auto	1545 used 2355 remain	0 of 1	Constant 25	05/04/2008	05/04/2031	
SB BB Field 5-LSG			Auto	1800 used 2195 remain	0 of 1	Constant 25	05/04/2008	05/04/2031	
* Not included in energy usage calculations. * Lamp Outages: Green = No Lamp Outages, Yellow = Lamp Outage Detected. * No Monitoring = System has On/Off controls, but not Lamp Monitoring Capability. * Controls: Green = All Control Systems are On, Yellow = Control System Issue Detected.									

Dashboard tracking allows you to see the operation and service status of your fields.

Musco Control-Link Usage Report (Auto Only)			
By Facility, Field			
Usage Type of Light Usage			
June, 2019			
Summary by Facility			
Facility	Total Auto Hours Usage	Total Hours Saved from Early Offs	
Cowley	112:50	17:08	
Dunbar	64:53	29:46	
Garland Parklet	49:48	0:00	
Herschel Field	256:47	26:05	
Total:	484:18	72:59	
Summary by Facility, Field			
Facility	Field	Total Auto Hours Usage	Total Hours Saved from Early Offs
Cowley	Baseball	63:04	17:08
Cowley	Basketball	49:46	0:00

Control-Link Central database stores usage data by field and user group.

Control-Link® Control and Monitoring System

- ✓ **Remote on/off scheduling** for easy control from anywhere
- ✓ **Dimming (3 levels)** saves energy for practice and other activities
- ✓ **System monitoring** alerts Musco of any issues

Includes Musco's management tools — user securities, usage tracking, facility status dashboard, and reports

Includes Control-Link Central™ support team — available 24/7/365

"In the past, a light could've gone out and our guys wouldn't see it for two to three weeks or until a whole pole went dark. Now if one light goes out we get an e-mail notice immediately from Musco's Control-Link Central."

– Chuck Vones, Parks and Recreation Director
Pembroke Pines, Florida

Big Time Light Shows at Hometown Fields

Our Show-Light™ entertainment package provides a cost-effective way for you to bring professional light shows to your facility. From pre-game introductions, to halftime shows, to celebrating big plays and big wins, this special effects lighting will energize players and fans and take your game atmosphere to a new level.

Special effects light shows aren't just for the pros anymore.

Musco's Show-Light technology utilizes instant on/off and the advanced control capabilities of LED, is easy to use, and delivers both predesigned and customized light shows.

Set the Scene . . . you'll get preprogrammed light shows that will set the scene and excite players and fans through the entire game night experience.

Plenty of Options . . . you can choose from Musco's library of light shows or work with our design engineers to create customized shows and scenes.

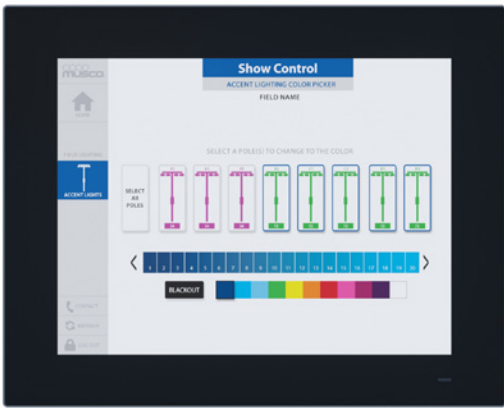
As Easy as a Touchscreen . . . you'll be provided an industrial grade 15-inch smart device with touchscreen to start and stop shows, select dimming levels, and adjust optional accent colors.

Reliable and Versatile . . . your light shows will be stored on site and backed up at Control-Link Central™ data center.

Color Changing Technology Option . . . by adding optional color changing luminaires you can enhance shows with pops of color, color wash, or accent lighting.



Optional color accent lighting highlights poles or other structures.



With optional color changing luminaires you can choose from over 100 color options to show your team color, highlight special events, or enhance light shows.



"The people Musco has answering the phones and adjusting the schedule are the most friendly and accommodating of any phone service I have ever called. They are always extremely friendly and professional, the service could not be better."

– Mark Buggins, Head Baseball Coach (retired)
Sitka High School

Show-Light™ Entertainment Package

- ✓ **Remote on/off scheduling**
for easy control from anywhere
- ✓ **Dimming (3 levels)**
saves energy for practice and other activities
- ✓ **System monitoring**
alerts Musco of any issues
- ✓ **Predesigned light shows**
add excitement to events
- ✓ **Color accent option**
to highlight poles and other structures

Includes industrial grade touchscreen tablet for easy control

Includes Control-Link Central™ support team — available 24/7/365



See West Des Moines Valley High School's light shows in action.

Take Your Light Shows to the Next Level

With our Show-Light+™ entertainment package, you'll tap into advanced customization capabilities and more complex light shows that incorporate music along with the special effects lighting. The Show-Light+ system is easy to use and will provide an even more memorable game night experience.

Light and sound shows that mirror what's seen at the biggest and best professional stadiums.

The equipment you'll be supplied with, and the light shows it will deliver, are exactly the same as what we provide our NFL, MLB, NBA, and NHL customers.

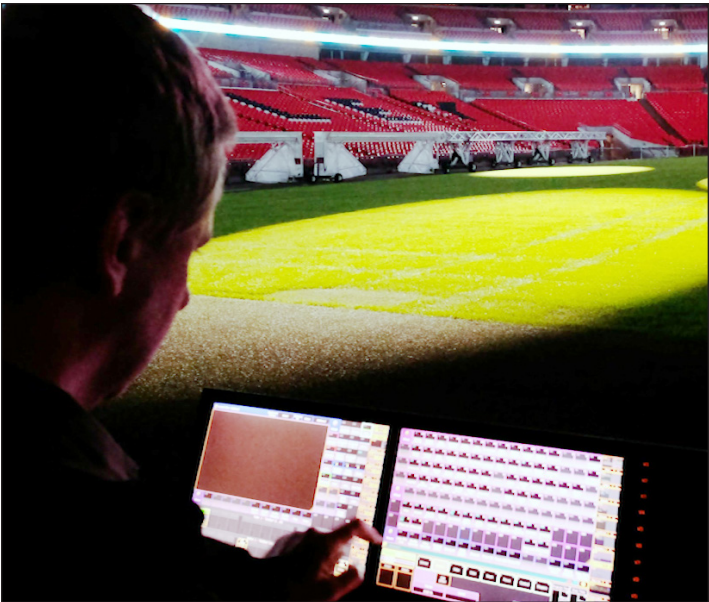
Light and Sound . . . in addition to the preprogrammed light shows from the base Show-Light package, you'll get three shows with lights synchronized to your music for an amazing visual and audio experience.

Easy to Use . . . for each light show Musco's design engineers will align lighting cues with audio files played through an on-site server, you just start and stop the shows with an easy-to-use touchscreen device.

Streamlined Solution . . . if you already have a DMX system, Show-Light+ equipment will act as a fully integrated extension of that system.



Musco's field lighting shows can interface with your separate controller for other show features, such as pyrotechnics.



Light shows are operated via an easy-to-use touchscreen.



Musco's light show programming specialists will custom time shows to your music.

Show-Light+™ Entertainment Package

- ✓ **Remote on/off scheduling**
for easy control from anywhere
- ✓ **Dimming (3 levels)**
saves energy for practice and other activities
- ✓ **System monitoring**
alerts Musco of any issues
- ✓ **Predesigned light shows**
add excitement to events
- ✓ **Color accent option**
to highlight poles and other structures
- ✓ **Custom-choreographed light shows**
precisely timed to music

Includes DMX controller and cue server

Includes Control-Link Central™ support team — available 24/7/365



"The fan reaction has been great. I look for the lights to be as much of an entertainment vehicle as I do fireworks — seventh inning stretch, when we hit a home run, when we win the game. Everybody loves it, particularly when we make the lights flash and dance to the music."

– Sam Bernabe, President & General Manager
Iowa Cubs

Innovative, Streamlined Communications Managed by Our Team 24/7/365

Each component of the Control-Link® system is designed, factory-built and tested for seamless operation and integration with your lighting system.

Proven Technology, Innovated . . . Musco's advanced powerline communication technology provides robust control and monitoring for the system.

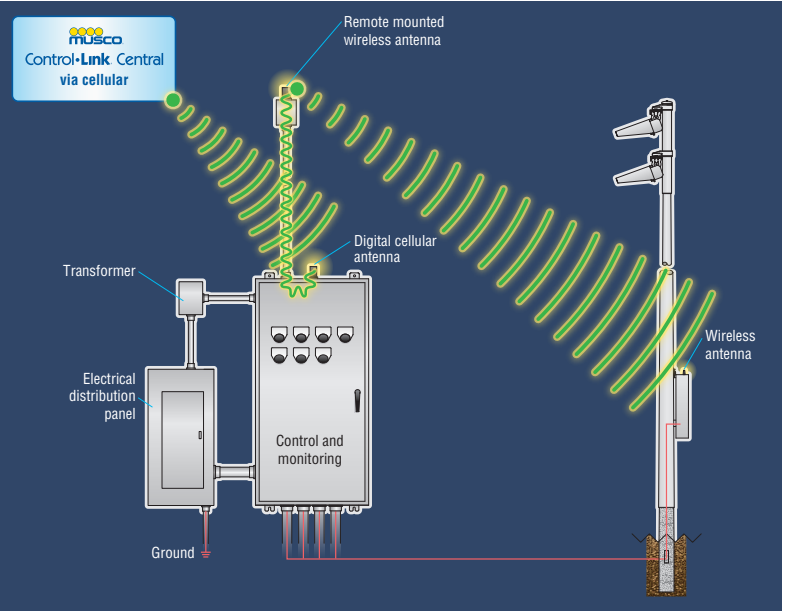
Reliable Installation and Operation . . . no added communication cable installation costs. Lights may be scheduled remotely or operated manually on site with a key switch.

Safety Features . . . electricity is only on when the system is in use, with built-in fusing and surge protection.

Monitoring and Support . . . our Control-Link Central™ Team monitors your system 24/7/365 to ensure schedules execute and to provide assistance.

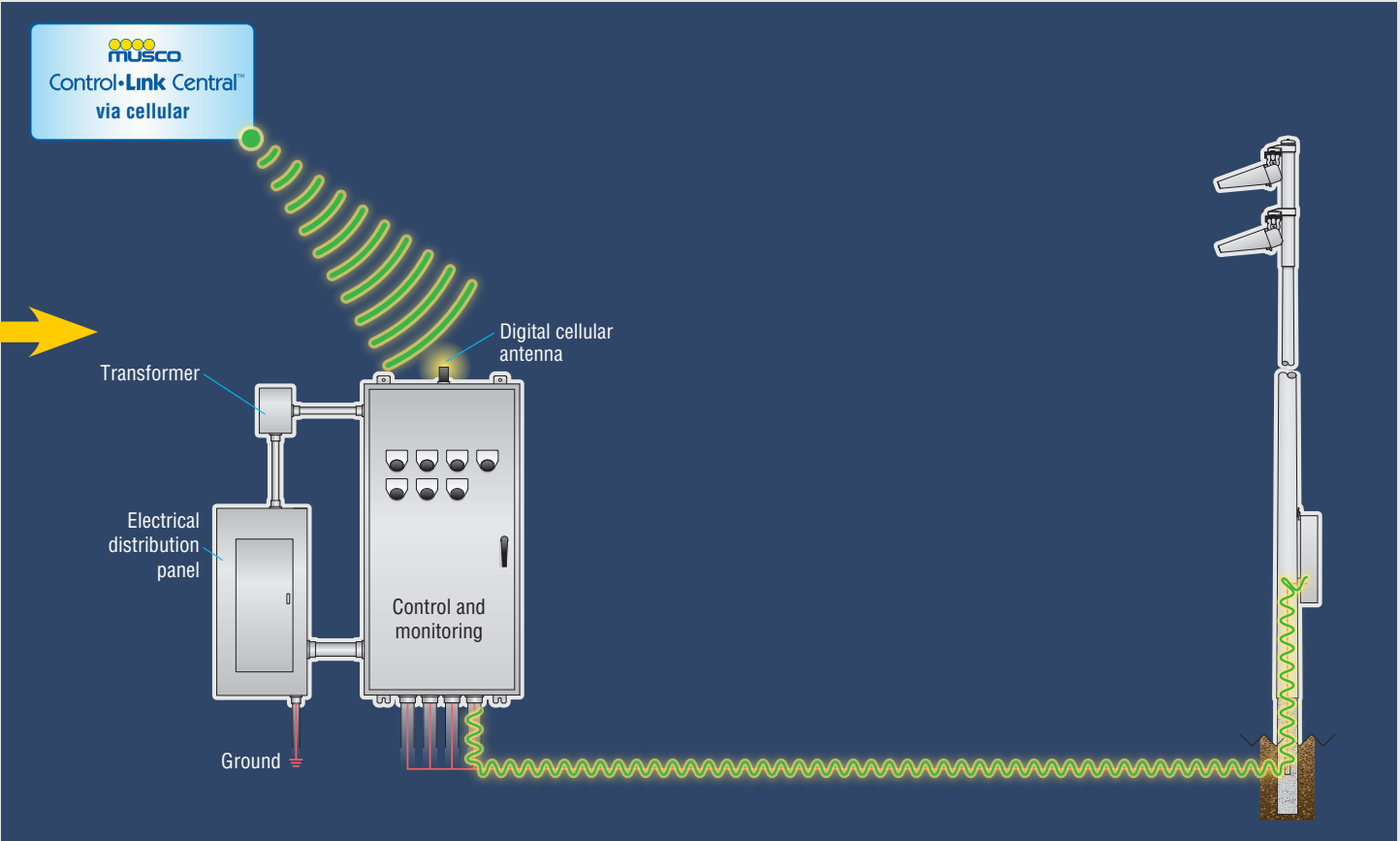
Wireless Communication

An optional wireless mesh network is available depending on your project requirements



Powerline Communication System™

Uses supply wiring for control commands and monitoring feedback



1) Enter schedules at your convenience

Based on security levels, users schedule field lighting and other equipment such as door locks, concession stands, and security lights from any location via website, smartphone app, or phone call.

2) Control-Link Central™ data center routes schedules, with 24/7/365 team member monitoring support

Schedules are received, routed to your site, and backed up at the Control-Link Central data center, where our staff provides scheduling support and verification, and monitors your lighting system operation.

3) Schedules are stored on-site

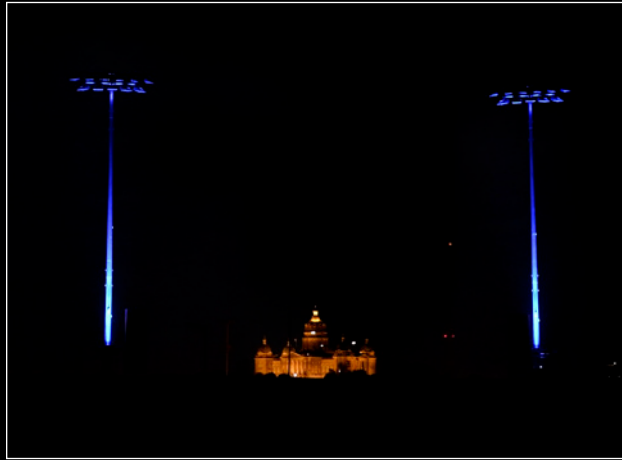
Schedules are transmitted to your facility via cellular technology and stored in the on-site equipment controller.

4) Equipment is controlled automatically with on-site show controls

Lights are operated per your schedules via Musco's Powerline Communication System technology. You can control optional Show-Light™ features with the on-site tablet.

5) Continuous monitoring

Entire system is monitored during operation and the Control-Link Central team is notified of any issues.



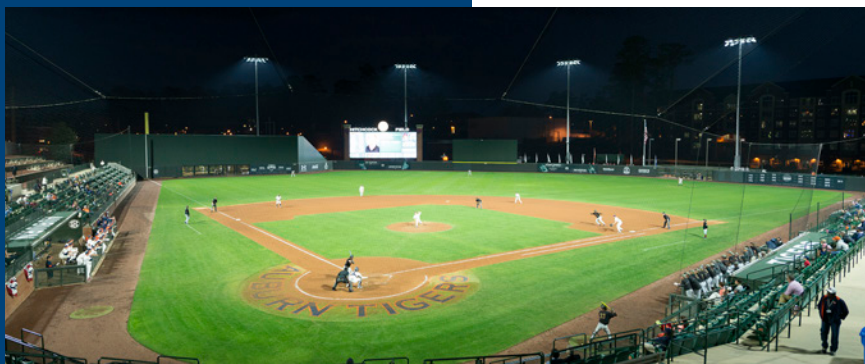
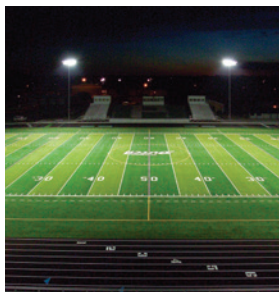
Unequaled performance . . .
for your budget, for the environment.



We Make It Happen®

www.musco.com
e-mail: lighting@musco.com

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**Is LED the right
light source
for my project?**

Sports Lighting

Answers to 9 Common Questions


We Make It Happen.®



Decisions ...

There are many decisions to make when planning a sports-field lighting project. As the decision maker, the standards you set will affect recreation or athletic programs in your community for 20 to 30 years.

Obviously, you want to select a trouble-free lighting system that will be a safe, energy-efficient source of community pride rather than a disappointing source of high-maintenance headaches and neighbor complaints.

Lighting a sports facility is a big investment. You and your design consultant should ask questions about initial and long-term benefits to ensure you get the most value from the dollars you spend. The more you know about sports lighting, the better chance you have of getting the results you want.

Read on for answers to the most common questions people have about sports lighting

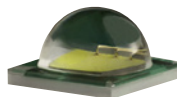
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1. Is LED right for my project?

For sports-lighting applications, the two typical light source options are metal halide and light-emitting diode (LED). If supported by a well-designed system of light control, structures, electrical, and application, both light sources can result in good quality of lighting. Choosing which light source is best for your project is one of dozens of decisions that impact the performance and cost results.



Metal halide lamp



Light-emitting diode

Benefits and Costs

Hours of use have a major impact on the economics of balancing capital and operating cost. Most indoor sports facilities are used almost daily, so the energy savings using a diode light source generally pay back its higher capital equipment cost in just a few years. Additionally, many indoor facilities have multiple uses, making the dimming ability of LED useful. The instant on/off characteristic of diode can also be of value, particularly for player introductions and halftime performances.

Outdoor recreational facilities are often used less than 500 hours per year. At 10 cents per kilowatt hour, the energy cost to light a youth soccer field with metal halide is less than \$2 per hour. In this case, payback through energy savings for increased LED capital costs would take several years.

Compare the capital and operating costs to see what fits your project needs. Be sure to incorporate any demand charges from your utility company, as this could significantly impact your payback timeframe.

Light Control

Neighborhood impact is a factor in outdoor sports lighting. The LED light source has the potential for extreme cut-off. However, if not properly controlled, the intensity of the multiple tiny light sources also has a greater risk of creating uncomfortable glare.

The unique needs of lighting sports fields make controlling the light a more critical issue than required for most other lighting situations. Relatively high quantities of light need to be projected over long distances in a manner that meets the differing viewing needs of players, spectators, and in many cases, television broadcast production.

“Two aspects of energy efficiency are important to consider: the efficiency of the LED device itself (source efficacy) and how well the device and fixture work together in providing the necessary lighting (fixture efficacy).”

Source: U.S. Department of Energy, <http://energy.gov/eere/ssl/led-basics>

Light control matters

Musco: what can be



2014 Musco Light-Structure Green™ system with LED light source
LakePoint Sporting Community · Emerson, Georgia, USA

What often is



2014 Other manufacturer's fixture with LED light source

**Musco systems offer your choice of LED or metal halide light sources
– we can help you evaluate which one fits your project needs.**

2. What affects the cost of lighting my ball field?

Each field is unique and there are many things that impact the cost. The cost of fixtures is only a small part of the overall project cost. As you compare options, it's important to look at both the initial and operating, or life-cycle, costs. (See page 8 for more information on operating costs)

Initial costs for a complete project will include three components:

- Lighting
- Structural
- Electrical

For each of these three components you will need to select someone to:

- Design
- Supply
- Install

Decisions you make in one area will affect the others. For example, variances in fixture efficiency will affect the number of fixtures needed and, as a result, could require larger poles to support the additional wind load and additional electrical components to operate the system. Your choices will also impact operating and maintenance costs.

9 Important Sports-Lighting Decisions

	Lighting	Structural	Electrical
Design	?	?	?
Supply	?	?	?
Install	?	?	?
OPERATE			

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This matrix is an easy way to quickly understand if you have covered all areas of your project when developing a cost estimate.

As you work through the 9 important sports-lighting decisions, you will need to review variables that will affect the design and final costs of your project. Here is a starting check list of items to discuss with your local sports-lighting representative:

Quantity and Quality of Light	Geographical Issues	Environmental Light Control Issues	Lighting Usage
<ul style="list-style-type: none"><input type="checkbox"/> Facility type and size<input type="checkbox"/> Players' skill level<input type="checkbox"/> Seating capacity<input type="checkbox"/> Television/video broadcast requirements<input type="checkbox"/> Lighting standards (for organizations such as Little League Baseball®)	<ul style="list-style-type: none"><input type="checkbox"/> Location – structural and local/state building codes<input type="checkbox"/> Soil conditions<input type="checkbox"/> Existing structures<input type="checkbox"/> Pole setback requirements	<ul style="list-style-type: none"><input type="checkbox"/> Proximity of neighbors<input type="checkbox"/> Community light ordinances<input type="checkbox"/> Nearby airports or observatories<input type="checkbox"/> Multi-field complexes	<ul style="list-style-type: none"><input type="checkbox"/> Anticipated hours of operation<input type="checkbox"/> Local initiatives for reducing energy usage<input type="checkbox"/> Desire for dimming or special effects



Musco provides free project planning assistance to help you navigate through the choices that impact project cost. Our foundation-to-poletop systems incorporate lighting, structural, and electrical components.

3. How many lights do I need?

What you are really buying is the quantity and quality of light on the field. It is a common practice to specify a number of fixtures, rather than the amount of light produced on the field. However, this is like buying a car based on the size of its gas tank instead of its fuel efficiency. The efficiency of reflector systems, light sources, and application experience currently available varies significantly.

Quantity of light

Light on the playing surface is measured in footcandles or lux. Several factors determine the number of footcandles or lux required to light your field:

- 1. Sports type** — More light is required to light smaller, faster moving objects. For example, baseball uses a small ball traveling at high speeds, resulting in the need for higher light levels than soccer.
- 2. Players’ skill level** — Higher light levels are needed for increased skill, speed, and accuracy.
- 3. Field size** — The size of the playing area defines the number of square feet/meters to be lighted.
- 4. Seating capacity** — More light is needed to see action that is farther away.
- 5. Television/video requirements (if any)** — A camera interprets images slower than the human eye and requires more light to be able to follow the action.

Generally Accepted Lighting Standards			
SPORT	SPORT LEVEL	TARGET / CONSTANT LIGHT LEVELS	
		FOOTCANDLES	LUX
Baseball/Softball	Recreational	30/20	300/200
	Schools/Competitive Leagues	50/30	500/300
	Little League®	50/30	500/300
	Amateur Softball Association (ASA)	50/30	500/300
	College¹	100/70	1000/700
Basketball (indoor)	Elementary	30	300
	High School	50	500
	College¹	80	800
Football	Schools/Competitive Leagues	30	300
	College¹	50	500
Soccer	Recreational/Practice	20	200
	Schools/Competitive Leagues	30	300
	College/Municipal¹	50	500
Tennis – 2 court (side by side)	Recreational	30	300
	Schools/Competitive Leagues	50	500
	College¹	75	750

¹ May vary due to seating capacity and television requirements.

Target vs initial light levels

Light levels naturally depreciate over time as the light sources age and dirt builds up on the fixtures. How fast it depreciates depends on the fixture design, light source type, and how it is operated. It's important to make sure your system is designed to provide maintained, or target, light levels over the life of your system to ensure you continue to have the quantity and quality of light you purchased.

Quality of light

When talking about light quality, you will hear the term uniformity, or evenness of light on the playing surface. It's stated as a ratio, like 3:1, the minimum standard for most sports. What that means is the brightest point on the field should be no more than three times as bright as the darkest point. This ratio is important because a ball can appear to change speed as it passes from dark to light areas, making it difficult for players to follow the flight and gauge the speed of the ball.

Each manufacturer should provide specific information on initial and maintained light levels as well as a uniformity ratio, so when you compare proposals you can be sure they all design to the same criteria. It's also a good idea to get written guarantees for the quantity and quality of light your system will provide.



Achieving and maintaining the right quantity and quality of light impacts tournament site selection

Musco provides free lighting design services to you or your consultant to help you achieve guaranteed light quantity and quality.

4. How much will it cost to operate my lights?

Electrical cost to operate lights is less than many people might think. A typical soccer field can range from \$3 – \$8 per hour. In addition to electrical cost, you should consider staff time for operating on/off schedules, tracking facility usage, routine maintenance, and unexpected repair costs.

Electrical consumption

Light source options, metal halide or LED, vary in how efficiently they convert electrical energy into light energy. Even using the same light source, differences in reflector system efficiencies and aiming design vary, which impacts the energy required to achieve the amount of light needed on the field.

Standard Soccer Field – 360 x 225 ft (110 x 69 m)
30 footcandles (300 lux)

	Musco		Other Manufacturer
	1150 W LED	1500 W Metal Halide	1500 W Metal Halide
Fixtures required	28	32	52
Hourly energy cost	\$3.22	\$5.00	\$8.42
Annual energy cost	\$1,610	\$2,502	\$4,212
25-year energy cost	\$40,250	\$62,560	\$105,300

Assumes 10¢ per kWh electrical rate, 500 hours per year operation

A properly designed LED system may cost more than a metal halide system. Facilities with higher usage will see a faster payback with energy savings. Energy savings is just one aspect to evaluate in deciding which light source and system is right for you.

Efficient management, scheduling, and monitoring

As public concern for energy conservation grows and budget constraints impact staffing, cities and organizations are considering automated lighting control systems. The systems are more reliable than timers, better accommodate last minute changes, save energy, and eliminate staff time traveling to fields to turn lights on and off.

Some systems provide reports that track hours by user helping you set user fees to offset your operating expenses. Monitoring services ensure on/off schedules are completed and alert you or your warranty provider to any fixture outages that may affect playability.

Musco’s systems are efficient, and include automated controls with 24/7 staffed support, proactive monitoring, and a no-touch warranty that covers routine maintenance and repairs.

Routine maintenance

Relamping — For metal halide light sources, it's more efficient to group relamp rather than replace lamps as they burn out. You should schedule group lamp replacements prior to the end of lamp life to ensure you maintain the target light levels on your field.

Costs include:

- Lamps (\$60 to \$75/lamp average)
- Equipment rental to get to the top of the pole (\$75 to \$150/hour)
- Labor (Approximately \$60–\$100/hour average)

LEDs used for sports lighting should not burn out before the end of system life, provided there is adequate design for the supporting structural and electrical components. Regardless of source technology, the basics of lighting maintenance remain the same: relamping (metal halide), cleaning, monitoring, aiming alignment, and troubleshooting.

Fuses — Replace as needed (average cost of \$10 to \$15/fuse). You may need to rent equipment to access the fuses if electrical components are not accessible at ground level.

Unexpected repair costs — how to avoid them

Unexpected repairs can take significant time and money to correct. A well-designed system will be durable enough to withstand the elements and have features designed to reduce unexpected cost.

Re-aiming — Make sure your manufacturer guarantees fixture alignment. Over time, factors like weather can cause misalignment resulting in less light on the field. Labor and equipment costs to correct this can be significant.



Misalignment of as little as 10 degrees shifts light off the playing field into the stands.

Multiple fixture outages — Each driver or fixture should be individually fused. This minimizes multiple or “gang” failure, as well as the need for emergency repairs.

Troubleshooting — Easy-to-access systems have electrical components such as ballasts/drivers, capacitors, and fuses located close to the ground to save time and money.

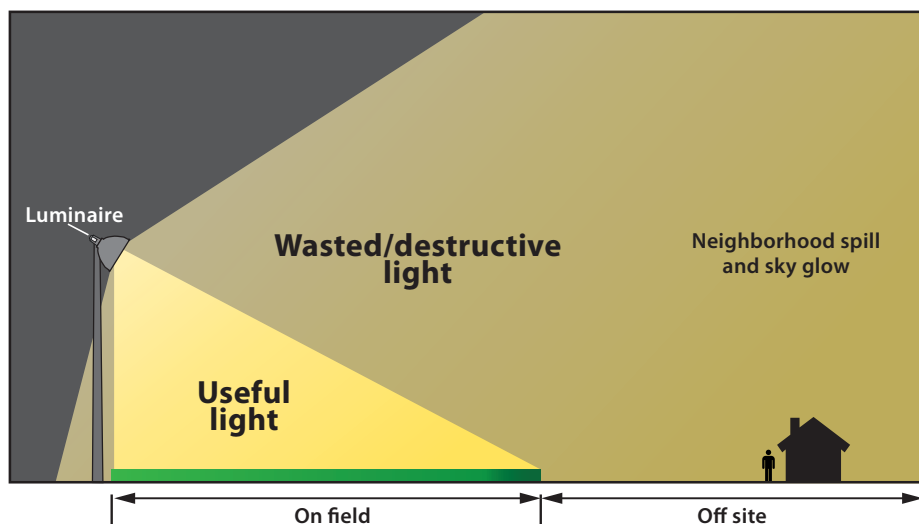
Lightning and surge protection — Built-in system grounding helps avoid equipment damage. This is especially critical with the electronics involved with LED systems.



Having major electrical components accessible at ground level avoids hiring a \$100/hour crane to replace a \$10 fuse.

5. There are no houses near my field, so why should I be concerned about spill light and glare?

Even if no houses are there now, controlling light pollution is important for several reasons. Spill light, glare, and sky glow are considered wasted or destructive.



Spill light = wasted energy

Fixtures with poor light control waste light by allowing it to go off the field into neighborhood spill and sky glow. Proper light control redirects wasted spill light back onto the playing surface. No matter which light source is used, LED or metal halide, efficient fixture and system design, along with application expertise, impacts the quantity and quality of lighting results.

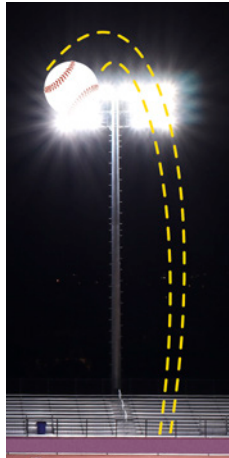
With better control, you reduce the number of fixtures needed to get useful light on the field. This also reduces operating and maintenance expenses.

Musco has developed advanced spill light and glare control systems to solve environmental concerns.

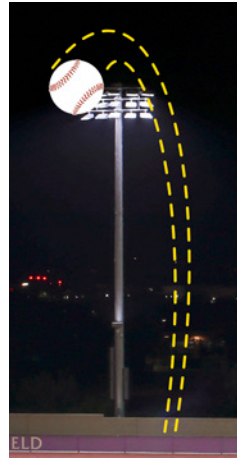
Glare problems

Glare control is important for neighbors, player safety, and spectator enjoyment. Fixture glare will make it difficult for players to follow the ball, creating the possibility for injury. Players competing on multi-field complexes can also be affected by glare from adjacent fields.

Due to the intensity of the LED light source, increased measures should be taken to provide optic controls to minimize glare. You don't have to sacrifice good light control to use a new light source.



Glare impacts players



Musco gets the glare out of the players' eyes

Community growth

Even if your facility does not have neighbors today, communities often grow up around sports facilities. Your lighting system should last more than 20 years. By minimizing spill light and glare now you will have happier neighbors and receive fewer complaints for years to come.

Growing concern

We're all aware of public concern for wasting the valuable energy resources it takes to produce light. Many communities are enacting environmental light pollution ordinances to regulate bothersome light that shines on private property, through windows, onto roadways and around astronomical research facilities. Light pollution also has negative effects on wildlife.

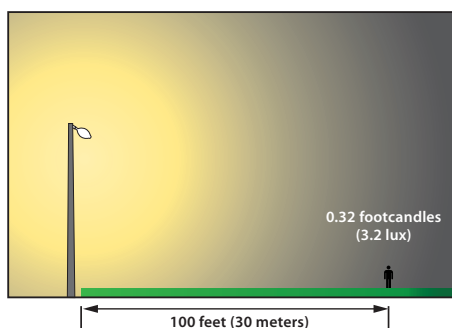


6. If they use the same wattage lamp, aren't all fixtures the same?

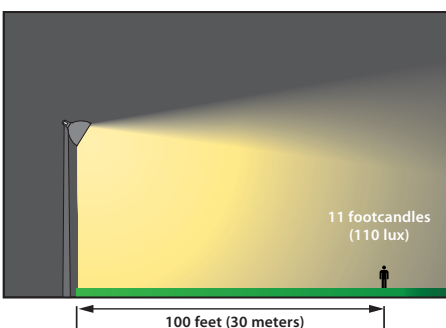
No matter what light source is used, the manufacturer's reflector design and application expertise is the critical factor in how effectively the lamp's light energy is projected onto the playing surface. Technology allows wasted spill light to be redirected back onto the playing surface, increasing the light on the field.

In the example below, the lamp produces the same amount of light at the top of the pole. Without a reflector, it projects less than 1 footcandle (10 lux) of light on an area 100 feet (30 m) away. With a well-designed reflector, it projects 30 times that amount.

Lamp with no reflector



Lamp with efficient reflector



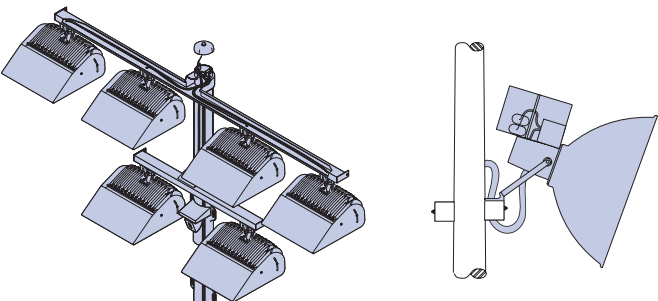
A reflector concentrates and projects the light energy onto the playing surface.

It is a common mistake to specify a number of fixtures, rather than the quantity of light produced on the field. Specifying a set number of fixtures simply spells out the amount of light that is going to be generated by the lamp at the top of the pole, rather than the light on the field.

Musco's complete system is engineered from foundation-to-poletop in 5 Easy Pieces™ for optimal light control, easy installation, and trouble-free operation.

System vs parts

Lighting may be purchased as a system or as single fixtures plus other parts and pieces from a variety of sources. Here's an analysis:

	
<div>System</div> <div>Parts</div>	
<div>Shaded areas indicate engineered components</div>	
<div>System</div> <div>Engineered as a complete system</div> <ul style="list-style-type: none">Parts selected by trained engineers for compatibilityCritical components assembled in controlled environmentTested prior to shippingSingle source accountability with light level guarantee and warranty on entire system	<div>Parts</div> <div>Parts and pieces of unknown strength and quality put together by the installer</div> <ul style="list-style-type: none">Inconsistent warranties from several sourcesExposed wiring creates maintenance problems
<div>Factory aimed</div> <ul style="list-style-type: none">Reduced installation time and expenseKnown results	<div>Individual fixture-by-fixture aiming from the top of the pole</div> <ul style="list-style-type: none">Adds installation time and costUnknown results
<div>Electrical components mounted at pole base</div> <ul style="list-style-type: none">Easier maintenanceWeight reduction better assures fixture alignment	<div>Electrical components on fixture</div> <ul style="list-style-type: none">Troubleshooting must be done from the top of the poleIncreases chance of misalignment
<div>Built-in lightning and surge protection</div> <ul style="list-style-type: none">Assures its installed and operating	<div>Unknown protection</div>

7. Why does pole type and height matter?

Poles are an integral part of a lighting system. The right poles help ensure proper aiming, long-term reliability and reduced maintenance expense.

Common pole types

Pole Type	Benefits	Drawbacks
Wood	<ul style="list-style-type: none">▪ Low cost of material	<ul style="list-style-type: none">▪ Poles not tall enough to allow proper mounting height▪ Fixture misalignment because wood twists and leans over time▪ Safety hazards: rotting wood, exposed electrical conduit, toxic preservatives
Concrete	<ul style="list-style-type: none">▪ Can be direct buried, eliminating the cost of footings▪ Corrosion and moisture resistant▪ Pleasing appearance	<ul style="list-style-type: none">▪ Poles are heavier and more expensive to set▪ High freight costs often limit their use to areas near concrete pole manufacturing plants
Base-plate Galvanized Steel	<ul style="list-style-type: none">▪ Pleasing appearance▪ Lighter weight than concrete, easy to handle	<ul style="list-style-type: none">▪ Higher initial cost▪ Require construction of concrete foundation with anchor bolts to mount poles▪ Curing time of concrete base▪ Corrosion at ground level▪ Difficulty with pole orientation
Direct Burial Galvanized Steel Pole	<ul style="list-style-type: none">▪ Pleasing appearance▪ Lightweight	<ul style="list-style-type: none">▪ Underground corrosion accelerated due to moisture and soil chemicals (often undetectable prior to pole failure)▪ Unpredictable life expectancy▪ Increase installation time and cost depending on structural engineer's criteria

Combination concrete and steel pole

This pole option combines the advantages of steel and concrete, while reducing or eliminating many of the problems. Steel pole shafts are slip-fit onto precast concrete bases that are set directly into the ground and backfilled with concrete.

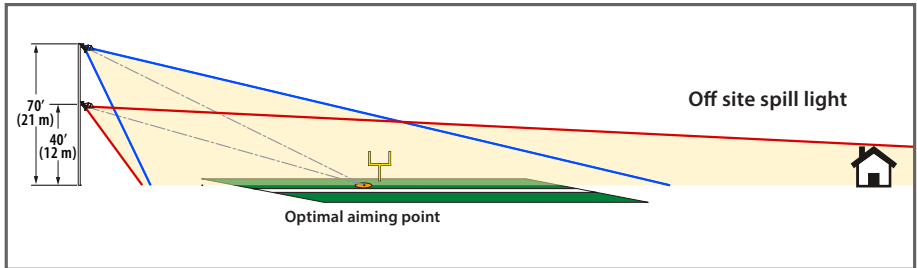
- Ease of installation - poles can be set onto pre-stressed, direct-buried bases within 24 hours
- Cost savings - poles and bases are shipped in sections and are lighter for lower freight expenses
- Corrosion resistance - concrete bases are corrosion and moisture resistant at ground level and below grade



Musco's Light-Structure Green™ system combines the benefits of both concrete and steel poles.

Pole height impacts aiming angles and the amount of spill light

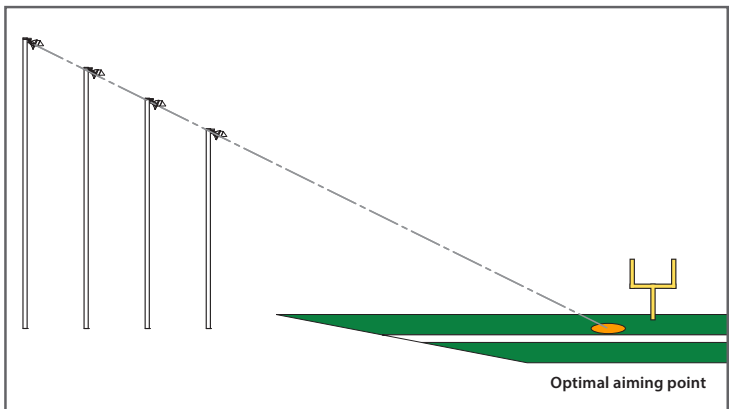
Proper fixture aiming angles ensure even light distribution across the playing area and reduce light pollution, otherwise known as spill light.



As a general rule, taller poles allow fixtures to be aimed more directly on the playing surface which reduces the amount of light spilling into unwanted surrounding areas. If city ordinances or other factors dictate the use of shorter poles, your lighting manufacturer will evaluate to see if custom measures, such as additional poles or creative aiming logic, can still allow you to meet your lighting goals on and off the field.

Distance from the aiming point determines optimal pole height

The optimal height of the poles needed for your lighting system and resulting project cost is also affected by their distance from the playing surface. Structures such as bleachers and buildings will impact pole locations. Future expansion or other facility plans should be discussed with the designer.



Musco's expert project managers and engineers will work with you to design the ideal lighting system for your specific needs.

8. How can I make sure I get the results I want?

We've reviewed some of the issues involved in choosing a lighting system. Once you've made your decisions, there are ways to ensure you get the results you want.

Define standards

It is important to have written specifications that establish the performance you expect from your system. Remember to incorporate the three components of the lighting system: lighting, structural, and electrical. Take into account the costs involved for design, supply, installation, and operation of the entire system. Specify the values you want for playability, environmental light control, life-cycle cost savings, and warranty.

Clearly defined standards will help you avoid two problems on bid date:

- Insufficient, cheap equipment substitutions to lower bid price
- High bids to cover the uncertain costs of an under-defined project

Seek accountability

Having a manufacturer that stands behind its product and provides good service will make a huge difference in long-term satisfaction with your lighting system.

Get a written guarantee — Manufacturers can provide written performance guarantees for light levels and your entire system (from the foundation to the fixtures), which will ensure the specifications you establish are met. Getting this guarantee from a single-source system provider will save you the headache of sorting out responsibility among multiple manufacturers should a problem arise.

Compare warranties and services — The warranty reflects a manufacturer's confidence in its product. Some manufacturers include services such as on/off control, monitoring, and onsite maintenance and repairs.

Evaluate their reputation — Ask for references and review the manufacturer's track record for service. A good question to ask is if there will be an on-site field performance evaluation after the installation.

Visit a lighted project — Ask to go see nearby projects similar to yours. You'll experience the results firsthand and be able to talk with the owner about how well the manufacturer helped achieve their lighting goals.

"The bitterness of poor quality remains long after the sweetness of low price is forgotten."

Benjamin Franklin

Musco's team includes more than 170 service and warranty professionals providing an industry-leading product assurance warranty with on/off control, monitoring, and on-site maintenance and repair.

9. Is there funding help available?

Finding funds can often prove to be one of the most challenging parts of the process. There are options available that can make your lighting project doable.

Utility grants/rebates

Many utility companies offer incentives to promote the use of energy-efficient products including sports lighting. Incentives vary and come in the form of rebates, grants, low-interest loans, and/or reduced kilowatt rates. Once the utility company completes an energy-savings audit, they can help fund new lights or upgrade your existing equipment with an energy-efficient system.

Financing programs

Financing programs for municipalities and public school systems provide a “budget stretcher” to help with facility improvements. The added revenue from expanded use of your facility can help make the annual payments, as well as will allow you to enjoy the benefits of your lighted facility sooner. Plus, a set payment can be built into your annual budget. This can free you from the budget uncertainties and cash flow implications of a large purchase.

Unique fundraising

Musco’s unique Pennant Program™ fundraising program provides corporate advertising opportunities using pennants displayed on Musco’s Light-Structure Green™ systems. Organizations have used this program to completely finance their project or to complement other fundraising efforts. And, others have continued the program after the purchase to help with annual operating costs.

Volunteer installation

Musco’s foundation to poletop system simplifies installation and makes it feasible to consider volunteer installation, which can reduce the total project cost by up to one third.

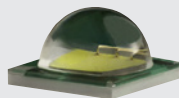
Musco has financing options and a resource database to identify grants and incentives available to help make your project happen.

Lighting terms you'll hear

Creating Light Energy

LED – Light-emitting diode

Small semiconductor device that creates light when electricity passes through it.



Light-emitting diode

High intensity discharge (HID) lamp —

Metal halide, high-pressure sodium, and mercury vapor

A group of light sources that create light when electricity ignites gasses inside an arc tube.



Metal halide lamp

Incandescent

A light source that creates light when electricity passes through a filament.

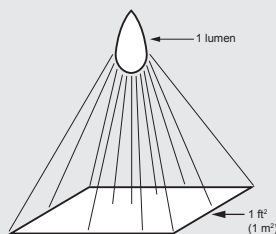
Measuring Light Energy

Lumen (1 lm)

Measure of light, much like a mile is a measure of distance.

Footcandle (fc)

One lumen of light spread over 1 square-foot of surface. A light level of 30 footcandles means that 30 lumens of light are being projected onto each square foot of playing surface.



Lux (lx)

Lux is the metric equivalent to a footcandle. A lux is 1 lumen spread over 1 square meter.

Candela (cd)

Measure of the intensity of a light source. Relates to predicting on-field and off-field glare. You can relate this to car headlights: high beam = approximately 30,000 cd. Low beam = approximately 12,000 cd.

Coloring rendering index (CRI)

A scale from 0–100 used to measure a light source's ability to show colors realistically as compared to natural light (daylight). Higher CRI values mean a light source is more true to color.

Color temperature

A unit of measure in degrees Kelvin that indicates the color of a light source. Temperatures below 3500K appear yellow or warmer. Above 4500K appear bluish white or cooler. Absolute white is 5000K.

Controlling Light – Lighting Performance

Photometrics

Control of light energy through redirection

Constant light level

The amount of light you can expect on the field at any given time over the extended life of the fixture or system.

Initial footcandles or lux

The amount of light on the field when the lighting system is first put into use.

Target (maintained) footcandles or lux

The lowest average amount of light you should always have on your field to meet minimum performance requirements.

Light loss

Amount of brightness from a fixture lost over time due to aging of the light source, dirt accumulation, temperature and voltage variations, and maintenance.

L_p lumen maintenance

The number of operating hours an LED light source will maintain the percentage (p) of its initial light output, noted as L_p.

Uniformity

The smoothness of light on the field.

Point by point

Computer-generated model of your proposed lighting system showing footcandle/lux readings at given points on your field.

Spill light

Wasted light that falls off the field into undesired areas, such as a neighbor's back yard.

Glare

Destructive light from a light source that shines in players', spectators', or neighbors' eyes, making it difficult to see.

Sky glow

Destructive light in the night sky which results from light that is reflected upwards.



Point by point

Notes

We will help get you started.

From our expert project managers to our team of certified engineers, we will work with you to design a custom foundation-to-poletop lighting solution that:

- Reduces your facility's energy and life-cycle costs
- Delivers superior controlled light guaranteed to meet specified light levels
- Controls spill light, glare, and sky glow
- Eliminates maintenance costs
- Simplifies operation and reduces cost with our Control-Link® system monitoring, management tools, and on/off control

**For free planning assistance for
your sports-lighting project contact:**



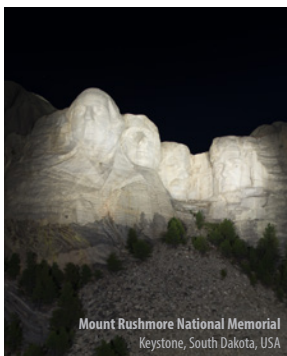
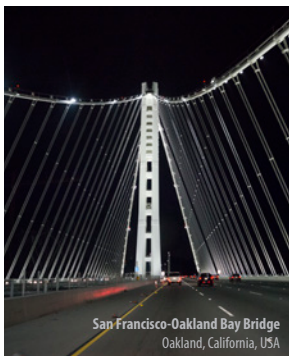
We Make It Happen®

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lighting@musco.com





Lighting solutions for your large area applications

Need to light a non-sports project?

Musco's team of expert engineers create innovative lighting solutions for a variety of applications from small parking lots to large ports and national monuments. Since 1976, Musco has established itself as the global leader in sports and large area lighting solutions. For innovative lighting systems that enhance light quality, improve effectiveness, reduce spill light and glare, cut costs, and minimize the impact on our environment, contact Musco. We make it happen®.

- Parking lots
- Buildings and architecture
- Monuments
- Ports, airports, and rail yards
- Construction sites
- Bridges
- Security
- And much more



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