Dear Landscape Professional,

When this manual was first published nearly 11 years ago, the landscape lighting profession was still young. Hundreds of green industry professionals were designing and installing systems for the first time. Since then, the industry has matured.

CAST Lighting wishes to thank all the designers, contractors and architects whose valuable knowledge and experience made the creation of this manual possible. Our company was created in response to these professionals who demanded fixtures and systems that matched the quality of their service. We are extremely grateful to these people and are proud to support them.

The objective of this manual is to build a solid foundation for the Landscape Lighting professional. With the knowledge and skills presented here, the professional can move forward with the confidence that every lighting project will be well designed and have superior system integrity.

This manual presents the fundamental design principals that are at the heart of every lighting system. It illustrates the lighting techniques that allow the designer to apply these principles, and it gives a step by step walk-through of every stage of installation. In addition, the important stage of documenting the job is covered in detail. Also presented are valuable marketing and sales guidelines that are drawn from the combined experience of dozens of successful Landscape Lighting installers.

CAST Lighting created this manual because we are committed to those dedicated professionals who truly care about the quality of their work, and who are willing to install professional quality fixtures and systems.

Once again, we thank you for your interest and encourage you to contact us with any questions or comments.

Yours Truly,

David Beausoleil
President, CAST Lighting LLC.
Contents of the Manual
Creating a Landscape Lighting design is similar to the process of creating any kind of Landscape design. There are objectives in mind, techniques to achieve those objectives, and tools to perform the techniques. The following manual presents all the basic skills and knowledge required for Landscape Lighting:

1. Objectives. Benefits for the client that can be realized with Landscape Lighting.
2. Design. Basic principals of visual qualities that define good Landscape Lighting.
3. Techniques. An illustrated approach to the techniques of lighting, fixture selection and how they are used in different scenarios.
4. Planning. Simple worksheets and formulas to correctly select wire and transformers.
5. Fixture Installation and Wiring. Simple steps for system installation.
7. Transformer Stand. Assembly instructions for transformer mounts.
8. Voltage Adjustment. Steps for using CAST’s proven method of field testing and adjustments for delivering the right voltage.
11. Appendix. Useful worksheets, sample proposal and maintenance contract.
LIGHTING OBJECTIVES

Security

Security from theft and trespassing is a primary concern for all homeowners and is usually addressed with high voltage floodlights. A better choice is strategically placed low voltage lights that provide low levels of illumination strategically distributed around the property. This avoids the problem of glaring lights and unlit regions that allow intruders to remain unseen.

Safety

Low voltage lighting is an ideal choice for illuminating walkways and entrance ways. This ensures that residents and visitors can safely navigate through the property avoiding otherwise unseen obstacles.

Usability

Illuminating the public and private areas of a property allow the homeowner to enjoy decks, sitting areas and recreational spaces.

Beauty

Light defines textures, shapes and structures while evoking a wide range of positive emotional responses. A good lighting design can create moods that are soft and subtle or dynamic and dramatic. It can highlight features of the structure and property, while maintaining a cohesive scene. Good Landscape Lighting is a feast for the eyes.

The Power of Light

Nothing has a greater effect on the comfort of an individual than the quality of light. Think about how you feel when approaching a dark house compared to how you feel when entering the property of a beautifully illuminated home.

The lighting designer recognizes this and creates a scene where the viewer is an active participant. This scene presents a cohesive panorama framed by the borders of the property. Lighting displays the beauty of the landscape and highlights the architectural features of the building.

Cohesion refers to the overall appearance of the scene as one continuous panorama. If there are unlit areas near illuminated ones, then the viewer’s visual experience is interrupted. These “black holes” detract from the beauty of the design and fatigue the eyes.

Cohesion is achieved by illuminating borders, backgrounds, and intermediate areas with the creative use of fixtures placed for that purpose.

Depth refers to the strategic placement of fixtures using different light levels to achieve a three-dimensional scene. Depth requires lighting areas that are in the foreground, in the middle, and in the back of the scene.

The proper use of high, medium, or low wattage lamps (with varying beam spreads) helps establish depth by allowing the designer to create scenes that draw the eye from near to far.

Keep in mind that the designer is not only painting a picture with lights, he or she is also directing a scene.

In this scene, the viewers eyes are first drawn to one focal point then to another and so on. These focal points may be unique features of the property such as, statuary or water features; or they may be functional points such as entrance ways, sitting areas or gathering places.

Fig. 1. A typical lighting design for the public space. This illustration shows how the careful choice and placement of fixtures creates a scene that is both welcoming and dramatic.
Low voltage fixtures provide illumination that is highly controllable. Instead of the harsh glare of bare bulbs, light is directed to the desired places. In a good lighting design, light sources are not seen, only the reflection of their light off a variety of surfaces. The quality of lighting is changed by uplighting (more dramatic), downlighting (more natural), sidelighting (emphasizes details), or backlighting (emphasizes form).

Perspective refers to the viewers experience from various locations both outside and inside the home. The designer needs to walk the property and ensure that the lighting scene works from all possible vantage points (including from the approaching road). Inside the home, the viewer should be able to look out the windows and enjoy the scene without being blinded from fixtures illuminating the house.

A lighting designer needs to recognize the features of a landscape that define its appearance. If there are repeating patterns such as a row of bushes, fencing or stone walls, then the designer needs to light those forms in a way to preserve that symmetry.

The designer also needs to balance the lighting so that one side of the property is not brighter than the other.

**Quality and Direction**
- **Perspective**
- **Balance and Symmetry**

**DESIGN STEPS**

**Set Objectives**

You and the client discuss what can be reasonably achieved with a lighting system within the constraints of the budget. Write down all the intended objectives.

**Walk the Property**

Walk the property, viewing from every angle (including from the approaching road.) First, think about the visual composition of the entire scene. Note what is beautiful and distinctive about the property. Recognize features of the landscape and structures and note repeating patterns and interesting forms.

Next, determine focal points and decide where you want the viewer’s attention to be directed. Pay attention to transition areas and apply the basic elements of design to create a scene that satisfies your objectives.

**Flag the Job**

As you decide on the location of each fixture, place a colored flag at the spot. Use a different color for each fixture type and write lamp wattage and beam spread on each flag.

**Rough Sketch**

Make a rough sketch of the property, labeling each of the important areas and features. Indicate the placement of fixtures and transformers. Measure or estimate the distance of each wire run. Check for availability of 120V power supply.

Using the worksheets in this manual, calculate wire sizes and transformer requirements, then create a materials list.
Purpose
To highlight trees, other plant materials or architectural features; tends to be more dramatic than down-lighting, but can also look natural when applied with skill.

Fixtures Used
Directional lights, well lights

Considerations
For pine trees and other dense foliage plant material, place fixtures outside the drip line of the plant and limit spacing to 5 foot on center. Less dense trees usually require far fewer fixtures with 8 to 10 foot spacing. For tree trunks, use low intensity grazing technique to accentuate textures.

Purpose
To provide soft natural lighting over large areas, serves as an ideal transition connecting different lighting scenes together and eliminating black holes from the project.

Fixtures Used
Tree lights

Considerations
Fixtures must be at least 25 ft. high (aimed minimum 45% from horizontal). At least two lights per tree is recommended. Fasten fixtures to tree with mounting canopy. Do not screw canopy directly to tree surface, allow space behind canopy to prevent tree rot.

Purpose
Defines surface texture and shape instead of flattening effect when using a single front light.

Fixtures Used
Directional lights, well lights

Considerations
Often used to define focal points. Lamp selection and fixture placement is critical. Lights can be mounted above or below subject. When two lights are used, use lower wattage lamp on one side for a more natural effect.
MIRROR LIGHTING

**Purpose**
To take advantage of the reflective surface of water features to create a more compelling visual experience.

**Fixtures Used**
- Directional lights, well lights

**Considerations**
Consider the visual experience from all likely viewing angles. Add illumination to various regions of the background to contribute to the overall impact. Check that bare lamps do not reflect off the water into the viewers’ eyes.

WALL LIGHTING

**Purpose**
To illuminate retaining and free-standing walls and regions adjacent to them.

**Fixtures Used**
- Engineered Wall Lights

**Considerations**
Engineered wall lights are affixed with a bracket extending from the back of the fixture body. This bracket slips under the capstone or between blocks. Fixtures should be spaced equidistant from each other.

STEP LIGHTING

**Purpose**
To illuminate steps

**Fixtures Used**
- Deck lights, Path Lights

**Considerations**
Steps should receive fairly uniform illumination to prevent tripping hazards. Lights may be positioned on one side or both depending on the width of the stairs and the fixture mounting height.
**Purpose**
To light planting beds and paths. And, to provide seamless transition between lighting scenes.

**Fixtures Used**
Path Lights

**Considerations**
Space and position fixtures to provide a visually appealing illumination along the path. Alternate placement from one side of the path to the other. Provide enough illumination to prevent tripping hazards, but space fixtures far enough apart to create distinct pools of light.

---

**Purpose**
To provide a steeply angled light to accentuate texture on walls and tree trunks by utilizing the irregular surface to create broken shadows and irregular patterns.

**Fixtures Used**
Directional Lights, Well Lights

**Considerations**
Position fixtures within 1 foot of walls or tree trunks. Tilt fixture away from wall to minimize hot spot and provide a more even light distribution from top to bottom.

---

**Purpose**
To provide a lit surface that acts as a backdrop for unlit plant material or other features; the effect can be mysterious and compelling.

**Fixtures Used**
Directional Lights, Well Lights

**Considerations**
This technique produces dramatic effects and is best used for objects and features that have distinctive and interesting shapes.
### Purpose
To provide an even illumination on walls.

### Fixtures Used
- Directional Lights
- Well Lights
- Wall Wash Light

### Considerations
- Take care that these lights are not glaring for occupants inside the house.
- Wall washing provides a broad, even illumination across a house or wall. The frontal angle produces a flattening effect (no shadows from the surface texture).
- This technique can produce uninteresting lighting; visual interest can be improved by projecting the light through plant material.

---

### Purpose
To provide illumination around the edges of an object, thereby emphasizing its shape, and creating a nighttime mood.

### Fixtures Used
- Directional Lights
- Well Lights

### Considerations
- This technique is best used on objects with interesting shapes. Be sure that the fixture is hidden from view.
- When two lights are used behind an object separated by a 120° angle, the effect is of light wrapping around the object. This technique works well with small conical shaped trees and large tree trunks.

---

### Purpose
To create interesting shadows on walls.

### Fixtures Used
- Directional Lights
- Well Lights

### Considerations
- Shadows create visual interest on the structure. For houses with vinyl siding, use shadowing to break up the linear patterns.
- When plant material is used to create shadows, the plants will need to be periodically trimmed, and fixtures may need to be relocated, to compensate for plant growth.
**OBJECTIVES: PUBLIC SPACE**

- To create a welcoming feeling for family and guests
- To highlight the architectural features
- To visually lead visitors to the front entrance
- To provide safe passageway to the front entrance
- To highlight plant material
- To cast visually interesting shadows on the structure
- To create a cohesive scene with depth across the property

Left side is illuminated to define the structure, add depth and complete the scene. It also ensures that the structure looks good from side viewing perspectives.

Tree is illuminated to add detail, texture and depth to the scene.

Reflected light projects off the light colored surface of the structure and reflects out to the planting beds and walkway areas. This provides a low level fill lighting for the foreground of the scene.

Fig. 3. Typical lighting design for the public space of a property with notes on lighting treatments and design.
The entire house is selectively illuminated. This defines the structure. Lights are placed at the corners and between the windows, grazing the facade of the house.

Area/Path Lights provide clear direction to the front door as well as providing pools of illumination to reveal regions adjacent to the path.

Trees are uplit to project shadows on the front facade of the house and provide depth and detail to the foreground.

Entrance area. The light level of the entrance is the brightest part of the scene. This will direct guests to the front door.
OBJECTIVES: PRIVATE SPACE

- To create usable evening spaces for recreation
- To highlight the landscaping features
- To draw attention to the vase and pedestal
- To highlight plant materials
- To raise the ceiling of the visual space

The illumination of objects in the foreground and background creates visual depth. The illumination of objects from right to left creates a continuous and cohesive visual path.

Area/Path Lights are installed to illuminate the low ground cover and cast light onto the stone paver patio. This fill lighting in the foreground provides a compelling and safe foundation for the lighting scene. Designer uses CAST Small Mushroom Path Lights. Lights are spaced evenly apart.

The pool surface provides a perfect mirror to add depth and visual interest and to further enhance the scene. (Pool light should be off to maximize this effect.)
Larger background plant material is illuminated to the highest level in order to draw the viewer’s eye through the lighting scene and create depth.

The vase and pedestal create a focal point in the scene. Illuminating this feature using the highest light level draws attention to it above all else. Crosslighting reveals the detail of the concrete’s surface.

The stone wall is illuminated to a medium light level using a grazing technique. Fixtures are evenly spaced to maintain a balanced and symmetrical illumination.

Middle ground plant material is illuminated to a medium light level using an up lighting technique.

Large trees in the far background could be uplit to raise the ceiling of the backyard thereby adding vertical scale to the visual composition.
PLANNING STEPS

Step 1  Requirements

Working from the rough sketch, the contractor can use the “Preliminary System Requirements Worksheet” (Fig. 5) to record all the information needed to make the following calculations.

Step 2  Wire Sizing

Landscape Lighting requires either #10/2 or #12/2 direct burial wire to connect transformers to Spider Splices. The selection is based on wire run distances and wattage of fixtures on each run. This determination can be made using the “Quick Wire Sizing Guide” (Fig. 6).

Step 3  Transformer Sizing

Selecting the correct transformer(s) is a two-step process.

1. Determine total load on the system. This can be estimated by adding the total wattage of all lamps. Or, the load can be more precisely calculated using the “Transformer and Wire Sizing Calculations” worksheet (Fig. 8).

2. Select the transformer(s) based on the total load using the “Quick Transformer Sizing Guide” (Fig. 7) If you are working with the total lamp wattage, compare that number with the “75% Lamp Load” column. If you calculate load using the longer worksheet then compare that value with the “Capacity” column. In both cases, select a transformer with a capacity exceeding these numbers to allow for future additions to the system.

THE OLD HALOGEN WAY

The following worksheets and sketches on this and following pages depict a typical residential lighting installation from start to finish.

PRELIMINARY SYSTEM REQUIREMENTS WORKSHEET

<table>
<thead>
<tr>
<th>WIRE RUN</th>
<th>LOCATION</th>
<th>FIXTURE TYPE</th>
<th>QTY.</th>
<th>X</th>
<th>LAMP WATTAGE</th>
<th>=</th>
<th>TOTAL WATTAGE</th>
<th>DISTANCE FROM SPIDER SPLICE TO TRANSFORMER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Grove</td>
<td>Bullet</td>
<td>1</td>
<td>X</td>
<td>35w</td>
<td>=</td>
<td>35w</td>
<td>50'</td>
</tr>
<tr>
<td>1</td>
<td>Grove</td>
<td>Small Mushroom</td>
<td>3</td>
<td>X</td>
<td>20w</td>
<td>=</td>
<td>60w</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Front Walkway</td>
<td>Small Mushroom</td>
<td>5</td>
<td>X</td>
<td>20w</td>
<td>=</td>
<td>100w</td>
<td>85'</td>
</tr>
<tr>
<td>3</td>
<td>Side Garden</td>
<td>Bullet</td>
<td>4</td>
<td>X</td>
<td>35w</td>
<td>=</td>
<td>140w</td>
<td>120'</td>
</tr>
<tr>
<td>4</td>
<td>Side Walkway</td>
<td>Small Mushroom</td>
<td>5</td>
<td>X</td>
<td>20w</td>
<td>=</td>
<td>100w</td>
<td>29'</td>
</tr>
<tr>
<td>4</td>
<td>Side Walkway</td>
<td>Bullet</td>
<td>1</td>
<td>X</td>
<td>35w</td>
<td>=</td>
<td>35w</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Back Garden</td>
<td>Well Light</td>
<td>4</td>
<td>X</td>
<td>35w</td>
<td>=</td>
<td>140w</td>
<td>150'</td>
</tr>
<tr>
<td>6</td>
<td>Pond</td>
<td>Bullet</td>
<td>2</td>
<td>X</td>
<td>35w</td>
<td>=</td>
<td>70w</td>
<td>200'</td>
</tr>
<tr>
<td>6</td>
<td>Pond</td>
<td>Well Light</td>
<td>2</td>
<td>X</td>
<td>35w</td>
<td>=</td>
<td>70w</td>
<td></td>
</tr>
</tbody>
</table>

| TOTALS   |           |              |      |   |              | = | 750w         | 135'                                    | 499'                                    |

QUICK WIRE SIZING GUIDE

Use this guide to select wire sizes for each run (from transformer to “Spider Splice”):

1. Are there more than 100 watts lamp load on the run?
   - Yes → Use #10-2
   - No

2. Is the run longer than 100 feet?
   - No → Use #12-2
   - Yes → Use #10-2

QUICK TRANSFORMER SIZING GUIDE

<table>
<thead>
<tr>
<th>Model #</th>
<th>Capacity (Watts)</th>
<th>75% Lamp Load (Watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAST “Journeymen Series”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP900PSMT, CP900SSMT</td>
<td>900</td>
<td>675</td>
</tr>
<tr>
<td>CP1200PSMT, CP1200SSMT</td>
<td>1200</td>
<td>900</td>
</tr>
<tr>
<td>CM900SSMT</td>
<td>900</td>
<td>675</td>
</tr>
<tr>
<td>CM1200SSMT</td>
<td>1200</td>
<td>900</td>
</tr>
<tr>
<td>CM1500SSMT</td>
<td>1500</td>
<td>1125</td>
</tr>
<tr>
<td>CAST “Power Pro Series”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP900SSMT</td>
<td>900</td>
<td>675</td>
</tr>
<tr>
<td>CP1200SSMT</td>
<td>1200</td>
<td>900</td>
</tr>
</tbody>
</table>

Fig.5. Preliminary System Requirements Worksheet — used to initially record planned system details. Blank worksheet for copying on page 34.

Fig.6. Quick Wire Sizing Guide. In this example wire run 1 and 2 require #12/2 while the others need #10/2.

Fig.7. Quick Transformer Sizing Guide. In this example the 1200 watt transformer is needed because the calculated 750 watt lamp load exceeds the capacity of the 900 watt transformer. It’s always a good idea to have a slightly larger transformer in case the job requires higher wattage lamps or extra fixtures.
PLANNING

THE OLD HALOGEN WAY

TRANSFORMER AND WIRE SIZING CALCULATIONS FOR LANDSCAPE LIGHTING

Guidelines for selecting wire size to maximize the efficiency of a low voltage lighting system:

- **#12-2**: Total combined lamp wattage of 100 watts or less. Total wire run of 100 ft. or less to the Spider Splice.
- **#10-2**: Total combined lamp wattage of 140 watts or less. Total wire run in excess of 100 ft. to the Spider Splice.
- **#8-2**: Very expensive wire—better to run two pieces of #10-2 wire than one #8-2 wire.

**Operating Voltage**

Optimal voltage for lamps is between 10.8v and 11.5v.

**Wiring and Lamp Info**

<table>
<thead>
<tr>
<th>RUN #</th>
<th>WIRING METHOD (SPIDER OR TEE)</th>
<th>WIRE SIZE</th>
<th>TOTAL LAMP WATTAGE ON THE WIRE RUN (See Example Below)</th>
<th>AMP LOAD (Lamp Wattage Divided by 12)</th>
<th>X</th>
<th>WIRE LENGTH (To Spider Splice or Tee Connection)</th>
<th>X 2</th>
<th>RESISTANCE PER FOOT (See Chart Below)</th>
<th>X</th>
<th>VOLTAGE DROP</th>
<th>+12</th>
<th>TAP NEEDED (Round to nearest whole number)</th>
<th>AMP LOAD (From previous AMP LOAD column)</th>
<th>X</th>
<th>TAP NEEDED (From Previous TAP NEEDED Column)</th>
<th>TOTAL WATTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Spider</td>
<td>12-2</td>
<td>3@50w =95w</td>
<td>7.917</td>
<td>X</td>
<td>50'</td>
<td>X 2</td>
<td>.00162</td>
<td>= 1.28</td>
<td>+12 = 13</td>
<td></td>
<td></td>
<td>7.917</td>
<td>X 13</td>
<td></td>
<td>102.92</td>
</tr>
<tr>
<td>2</td>
<td>Spider</td>
<td>12-2</td>
<td>6@20w =100w</td>
<td>8.33</td>
<td>X</td>
<td>85'</td>
<td>X 2</td>
<td>.00162</td>
<td>= 2.29</td>
<td>+12 = 14</td>
<td></td>
<td></td>
<td>8.33</td>
<td>X 14</td>
<td></td>
<td>116.62</td>
</tr>
<tr>
<td>3</td>
<td>Spider</td>
<td>10-2</td>
<td>4@35w =140w</td>
<td>11.667</td>
<td>X</td>
<td>120'</td>
<td>X 2</td>
<td>.00108</td>
<td>= 3.02</td>
<td>+12 = 15</td>
<td></td>
<td></td>
<td>11.667</td>
<td>X 15</td>
<td></td>
<td>175.00</td>
</tr>
<tr>
<td>4</td>
<td>Spider</td>
<td>10-2</td>
<td>4@35w =140w</td>
<td>11.25</td>
<td>X</td>
<td>29'</td>
<td>X 2</td>
<td>.00108</td>
<td>= 0.70*</td>
<td>+12 = 12</td>
<td></td>
<td></td>
<td>11.25</td>
<td>X 12</td>
<td></td>
<td>135.00</td>
</tr>
<tr>
<td>5</td>
<td>Spider</td>
<td>10-2</td>
<td>4@35w =140w</td>
<td>11.667</td>
<td>X</td>
<td>150'</td>
<td>X 2</td>
<td>.00108</td>
<td>= 3.78</td>
<td>+12 = 16</td>
<td></td>
<td></td>
<td>11.667</td>
<td>X 16</td>
<td></td>
<td>186.67</td>
</tr>
<tr>
<td>6</td>
<td>Spider</td>
<td>10-2</td>
<td>4@35w =140w</td>
<td>11.66</td>
<td>X</td>
<td>200'</td>
<td>X 2</td>
<td>.00108</td>
<td>= 5.037</td>
<td>+12 = 17</td>
<td></td>
<td></td>
<td>11.66</td>
<td>X 17</td>
<td></td>
<td>198.83</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**To Determine Voltage Taps Required**

- Distance to Spider Splice Connection
- Voltage drop to Spider Splice

**To Find Transformer Wattage**

- Grand Total (Min. Transformer Wattage) 915.04

**Reference Tables**

**Wire Amp Ratings**

<table>
<thead>
<tr>
<th>Wire Size</th>
<th>Recommended</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>#12/2</td>
<td>100w/8.3A</td>
<td>192w/16A</td>
</tr>
<tr>
<td>#10/2</td>
<td>140w/12.0A</td>
<td>288w/24A</td>
</tr>
</tbody>
</table>

**AWG Resistance per Foot**

<table>
<thead>
<tr>
<th>AWG</th>
<th>Resistance per Foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>#18</td>
<td>.006385</td>
</tr>
<tr>
<td>#14</td>
<td>.005258</td>
</tr>
<tr>
<td>#10</td>
<td>.00108</td>
</tr>
<tr>
<td>#6</td>
<td>.000395</td>
</tr>
<tr>
<td>#16</td>
<td>.004016</td>
</tr>
<tr>
<td>#12</td>
<td>.00162</td>
</tr>
<tr>
<td>#8</td>
<td>.00064</td>
</tr>
<tr>
<td>#4</td>
<td>.000249</td>
</tr>
</tbody>
</table>

*No change is required; use 12 volt tap. Operating range of lamp is within acceptable range.*

Fig.8. “Transformer and Wire Sizing Calculations”. Blank form for copying can be found on p.35.
**fixture preparation**

After unloading all materials, remove fixtures from boxes. Attach stakes and stems, if necessary. Lay each fixture at its proper location.

**trenching**

Low voltage lighting wire requires a minimum of 6 inches burial and can be run without conduits. Use slit trenching technique (use CAST trenching tool CWTT) to dig narrow trenches along each wire run and between fixtures and Spider Splices®. (See photos on this page.)

**running wire**

Place correct wire size on spool or spinner (use CAST Wire Spinner CSPIN). Then, starting at the transformer, pull each wire run ending at the Spider Splice. Leave about 10 extra feet for each run at the transformer and 2 feet extra at the Spider Splice. Label each wire run with wire markers (CMPAD) at both ends. Run lead wire from each fixture to the Spider Splice leaving excess wire coiled and buried at the base of the fixture. For above-grade fixtures, leave excess wire coiled at the Spider Splice.

**lamping fixtures**

Install the fixture into the ground or mount to the appropriate surface.

Lamp each fixture with the correct lamp according to type, wattage and beam spread. Leave the lamp box at the base of the fixture so you can refer to it when you punch the “Fixture Record Tag” at the end of installation. Leaving the box also facilitates changing the lamp if that becomes necessary during the final adjustment stage.

*Note: It is your responsibility to know and follow local, state and federal electrical regulations and codes that apply to low voltage lighting installation in your region.*

The CAST Trenching Tool (CWTT) cuts a narrow 8” deep trench ideal for laying wire.

Pushing the tool back and forth widens the trench and creates a channel for the wire.
The Importance of Delivering the Right Voltage to the Lamps

Halogen lamps should operate between 10.8 and 11.3 volts. Lamps not operating in this range may fail prematurely. To ensure that lamps receive the correct voltage, a high quality multi-tap transformer is required. The multi-tap allows you to compensate for voltage loss in the cable by selecting higher voltage taps when needed.

Tools and Materials Required for Installation

- Digital Clamp-on Amp/Volt Multimeter (CMETER)
- Wire Strippers (CASTRIP1)
- Wire Labeling Pad (CMPAD)
- Numbered Stamping Set and Hand Punch (CSTAMP & CPUNCH)
- CAST Black/White C61135 Wire Nuts
- 4 3/4” Romex Strain Relief Connectors
- Phillips Screwdriver and Hammer
- Time clock (CTTC, CTDC), Photo Cell (CTPC, CTRPC) (note—don’t use Photo Cell alone), or X-10 Control System

Here is a sampling of installation details for CAST fixtures. These illustrations are especially useful for designers and architects. They can be inserted into lighting plans and bids, specifying the desired CAST fixtures. All drawings are available on CD or can be downloaded from www.cast-lighting.com.
SPIDER SPLICE CONNECTIONS

SPIDER SPLICE STEPS

Step 1 Preparation

At each Spider Splice, pull wire leads through Spider Splice body and pack into hole with soil or gravel. Allow wires to extend 12" outside the Spider Splice body (Fig. 9).

Step 2 Wire Stripping

Separate the two wires from each fixture lead and home run wire to a length of 12". Strip the ends 1", being careful not to cut or nick wire strands. Cut two additional pieces of #16-2 wire to 6" and 8" lengths for test leads. Strip both ends of these wires.

Step 3 Wire Connections

For connections that are fast, easy on the fingers and that never fail, follow the instructions for the CAST Soldering Method (Fig. 10). This method requires setting up a portable soldering station that you use in the field. Once your soldering pot is plugged in and ready, proceed to make the Spider Splice connections. Take one wire from each fixture lead, one wire from the home run, and one of the short test leads, twist them together into a silicon-filled wire nut. Repeat with the remaining wires, twisting them into the second wire nut. Cap off the two test leads with black/white wire nuts.

Step 4 Finishing and Stamping

Gather all wires together and carefully fold them into the Spider Splice body. Be sure to position test leads for easy access. Using a stamping set, stamp the wire run number on the Spider Splice Cap.

THE OLD HALOGEN WAY

SPIDER SPLICE ADVANTAGES

- Lightning fast installation.
- Reduces labor costs, saves money.
- Less field splices, reduces the chance of splice failures by 80% over other methods of wiring.
- Even voltage distribution to each fixture. Lamps operate at the same voltage — same light output.
- Lamps burn out at the same rate. Maintenance is more predictable.
- Adjustment of the fixtures in the field requires no additional wire splicing since the extra lead wire is placed at the base of the fixture.
- Individually troubleshoot each fixture at Spider Splice to eliminate guesswork.
- Reduces Repetitive Strain Injury (RSI) with employees installing wire splices.
- Spider Splice identifies the wire run # from the transformer.
- If a Spider Splices becomes buried, it can be located with a metal detector.

SPIDER SPLICE CONSTRUCTION

THE CAST Soldering Method

Strip wires 1 1/4", twist each exposed wire, line up wires ➔ Twist wires together ➔ Dip into flux

Caution: Solder is extremely hot; wear eye protection and keep away from children.
Adjust width according to the number of transformers

- 12” for (1) Transformer 1500 W
- 24” for (2) Transformers
- 36” for (3) Transformers
- 48” for (4) Transformers

120 VOLT PRIMARY POWER

- Install nothing smaller than a #10 gauge wire from the breaker panel to the outdoor transformer outlet locations.
- Install either:
  A. #10-3 (with ground) direct burial wire to the outlet locations, or
  B. 1” Schedule 40 PVC conduit installed with five #10 stranded THHN wires. Green, Black, White, Yellow & Red to each transformer stand location.
- Install a 20 amp primary breaker (GFCI protected) in the breaker panel with a 20 amp outlet receptacle.
- Install waterproof exterior boxes.
- Install Tay-Mac or equal outlet covers that are approved “waterproof while in use”. UL Listed outlet covers.
- All primary 120 volt electric must be done by a licensed electrician.
- Follow all applicable local electric/ building codes.

Fig. 11. Transformer Stand Assembly

Cut Lumber

Determine width of stand according to the number of transformers (Fig. 11). Cut lumber to indicated lengths.

Assemble Stand

Pre-drill bolt holes and securely bolt cross pieces to legs.

Insert Stand

Insert stand into holes. Use a level to ensure that the stand is both vertically and horizontally level. Pack legs tightly with soil or gravel.

Mount Transformer(s)

Using screws provided, mount transformer(s) onto stand.

Note – transformers can also be mounted to existing structures, but should never be mounted to vinyl siding or in areas where a fire hazard exists.

Dip into solder

Dip into water

Trim excess

Twist until tight

This method is quick, easy, reduces finger strain and results in a connection that will never fail!
Transformer Sizing for LED Lighting Systems

ADJUSTMENT STEPS

Step 1

A. Count up all your LED fixtures and add up the total VOLT AMPS.

B. In addition to the Volt Amps, you will also need to calculate the Resistance in the wire in order to size the transformer you will use as well as provide a buffer for additional lights that might be required. Simple rule add 40%. So a system using 90.2 fixture Volt Amps X 40% = 36 watts.

Add: 90.2 volt amps

Plus: 40% wire and Extra Space 36.00 watts

= 126.20 Watts or larger

<table>
<thead>
<tr>
<th>Qty</th>
<th>Part #</th>
<th>Description</th>
<th>Watts</th>
<th>Power Factor</th>
<th>Volt Amps</th>
<th>Total VA</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>CCSL25036</td>
<td>Craftsman Spot Light Bronze 229 Lumen 34°</td>
<td>4.3</td>
<td>0.82</td>
<td>5.24</td>
<td>20.96</td>
</tr>
<tr>
<td>4</td>
<td>CCSL10536B</td>
<td>Craftsman Spot Light Bronze 89 Lumen 31°</td>
<td>2.8</td>
<td>0.89</td>
<td>3.15</td>
<td>12.6</td>
</tr>
<tr>
<td>6</td>
<td>CCW270B</td>
<td>Craftsman Wash Light 164 Lumen 87°</td>
<td>4.33</td>
<td>0.9</td>
<td>4.81</td>
<td>28.86</td>
</tr>
<tr>
<td>4</td>
<td>CCPL1</td>
<td>Craftsman Path Light</td>
<td>4.22</td>
<td>0.89</td>
<td>4.74</td>
<td>18.96</td>
</tr>
<tr>
<td>2</td>
<td>CTLED141</td>
<td>Classic Tree Moon Light Low Setting 157 Lumen 30°</td>
<td>4.1</td>
<td>0.93</td>
<td>4.41</td>
<td>8.82</td>
</tr>
</tbody>
</table>

Total Watts: 79.46

NOTE: The WATTS to operate (or Consumed Wattage) is different than the Volt Amps. Volt amp takes into account the inefficiency in the AC driver that runs the Light Emitting Diode. Because of this inefficiency, you need a larger transformer to run the system even though the actual watts you consume is less. What you actually pay for is watts NOT Volt Amps:

<table>
<thead>
<tr>
<th>Qty</th>
<th>Part #</th>
<th>Description</th>
<th>Watts</th>
<th>Power Factor</th>
<th>Volt Amps</th>
<th>Watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>CCSL25036</td>
<td>Craftsman Spot Light Bronze 229 Lumen 34°</td>
<td>4.3</td>
<td>0.82</td>
<td>5.24</td>
<td>17.2</td>
</tr>
<tr>
<td>4</td>
<td>CCSL10536B</td>
<td>Craftsman Spot Light Bronze 89 Lumen 31°</td>
<td>2.8</td>
<td>0.89</td>
<td>3.15</td>
<td>11.2</td>
</tr>
<tr>
<td>6</td>
<td>CCW270B</td>
<td>Craftsman Wash Light 164 Lumen 87°</td>
<td>4.33</td>
<td>0.9</td>
<td>4.81</td>
<td>25.98</td>
</tr>
<tr>
<td>4</td>
<td>CCPL1</td>
<td>Craftsman Path Light</td>
<td>4.22</td>
<td>0.89</td>
<td>4.74</td>
<td>16.88</td>
</tr>
<tr>
<td>2</td>
<td>CTLED141</td>
<td>Classic Tree Moon Light Low Setting 157 Lumen 30°</td>
<td>4.1</td>
<td>0.93</td>
<td>4.41</td>
<td>8.2</td>
</tr>
</tbody>
</table>

Total Watts: 79.46
Transformer Sizing for LED Lighting Systems

Step 2:
If you plan on running all these lights on one wire run you need to use a wire that can handle greater than 79.46 watts PLUS the watts consumed by the wire. #14-2 seems good and #12-2 would also work.

Step 3:
The wire gauge you use is a function of the distance of the wire run (resistance) and the load on the wire run.

Example #1: A Simple grouping of seven fixtures on a single wire run.

<table>
<thead>
<tr>
<th>Wire Size</th>
<th>Wire Amperage Rating</th>
<th>80% of AMPERAGE capacity (A)</th>
<th>12 VOLTS</th>
<th>MAX WATTAGE Wire Capacity @ 12 Volts</th>
<th>RECOMMEND WATTAGE load NO MORE THAN 75%</th>
</tr>
</thead>
<tbody>
<tr>
<td>#18-2</td>
<td>6</td>
<td>4.8</td>
<td>12</td>
<td>57.6</td>
<td>43.20</td>
</tr>
<tr>
<td>#16-2</td>
<td>10</td>
<td>8</td>
<td>12</td>
<td>96</td>
<td>72.00</td>
</tr>
<tr>
<td>#14-2</td>
<td>15</td>
<td>12</td>
<td>12</td>
<td>144</td>
<td>108.00</td>
</tr>
<tr>
<td>#12-2</td>
<td>20</td>
<td>16</td>
<td>12</td>
<td>192</td>
<td>144.00</td>
</tr>
<tr>
<td>#10-2</td>
<td>30</td>
<td>24</td>
<td>12</td>
<td>288</td>
<td>216.00</td>
</tr>
</tbody>
</table>

(A) as per NEC do not load more than 80% any wire operating longer than 3 hours.

(B) Using 75% gives you room to add lights if needed.

<table>
<thead>
<tr>
<th>Wire Size</th>
<th>Resistance per foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>#18-2</td>
<td>0.006385</td>
</tr>
<tr>
<td>#16-2</td>
<td>0.004016</td>
</tr>
<tr>
<td>#14-2</td>
<td>0.002525</td>
</tr>
<tr>
<td>#12-2</td>
<td>0.00162</td>
</tr>
<tr>
<td>#10-2</td>
<td>0.00108</td>
</tr>
<tr>
<td>#8-2</td>
<td>0.00064</td>
</tr>
<tr>
<td>Group A</td>
<td>Wattage</td>
</tr>
<tr>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>DISTANCE</td>
<td>100</td>
</tr>
<tr>
<td>FIXTURE # 1 Group A Wattage</td>
<td>4.3</td>
</tr>
<tr>
<td>FIXTURE # 2 Group A Wattage</td>
<td>4.3</td>
</tr>
<tr>
<td>FIXTURE # 3 Group A Wattage</td>
<td>4.3</td>
</tr>
<tr>
<td>FIXTURE # 4 Group A Wattage</td>
<td>4.3</td>
</tr>
<tr>
<td>FIXTURE # 5 Group A Wattage</td>
<td>4.1</td>
</tr>
<tr>
<td>FIXTURE # 6 Group A Wattage</td>
<td>4.1</td>
</tr>
<tr>
<td>FIXTURE # 7 Group A Wattage</td>
<td>10</td>
</tr>
</tbody>
</table>

**Lay Out System**

**Consumed Wattage**

<table>
<thead>
<tr>
<th>Total Wattage Group A</th>
<th>35.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL SYSTEM wattage</td>
<td>35.4</td>
</tr>
<tr>
<td>TOTAL DISTANCE</td>
<td>100</td>
</tr>
</tbody>
</table>

**Watts / 12= AMPS**

| AMPS | 2.95 |

**Select Wire gauge**

<table>
<thead>
<tr>
<th>Resistance per foot</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>#14-2</td>
<td>0.002525</td>
</tr>
<tr>
<td>#12-2</td>
<td>0.00162</td>
</tr>
<tr>
<td>#10-2</td>
<td>0.00108</td>
</tr>
</tbody>
</table>

**Voltage Loss and Operating Volts**

<table>
<thead>
<tr>
<th>Voltage Loss # 14-2</th>
<th>1.48975</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Loss # 12-2</td>
<td>0.9558</td>
</tr>
<tr>
<td>Voltage Loss # 10-2</td>
<td>0.6372</td>
</tr>
</tbody>
</table>

**Total Distance**

| 100 |

**Enter Starting Voltage**

| 16  |

**First Grouping Voltage**

| 14.51025 |

**Total Volts**

| 1.48975 |

**Amps**

<p>| 2.95  |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable Loss</td>
<td>4.3947625</td>
</tr>
<tr>
<td>Fixtures Consumed</td>
<td>35.4</td>
</tr>
<tr>
<td>Total Watts Consumed</td>
<td>39.7947625</td>
</tr>
</tbody>
</table>

Now in this example our cable loss of 1.48975 x amps of 2.95 = 4.394 WATTS. We add that to ALL THE FIXTURES TOTAL WATTAGE OF 35.4 AND YOU HAVE THE TOTAL SYSTEMS WATTAGE THAT YOU WILL PAY MONEY FOR and YOU NEED A TRANSFORMER WITH THIS CAPACITY OR LARGER TO OPERATE THIS SYSTEM.

Transform

100 foot #14-2

100 to here

Fixture 1,2,3,4,5,6,7
This Sheet is for determining the voltage loss in the wire

<table>
<thead>
<tr>
<th>GROUPING</th>
<th>DISTANCE</th>
<th>WATTAGE</th>
<th>TOTAL DISTANCE</th>
<th>TOTAL WATTAGE</th>
<th>TOTAL VOLTAGE LOSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>100</td>
<td>35.4</td>
<td>3.78333333</td>
<td>16.88</td>
<td></td>
</tr>
<tr>
<td>Second</td>
<td>75</td>
<td>17.32</td>
<td>34.2</td>
<td>16.88</td>
<td></td>
</tr>
<tr>
<td>Third</td>
<td>50</td>
<td>16.88</td>
<td>101.9568</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fourth</td>
<td>50</td>
<td>16.88</td>
<td>101.9568</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Watts per Fixture**: 6.73333333
- **Number of Fixtures**: 19
- **Total Wattage**: 80.8
- **Total Voltage Loss**: 21.15686278

### Resistance per Foot

- **#14-2**: 0.002525
- **#12-2**: 0.00162
- **#10-2**: 0.00108

### Voltage Loss

- **#14-2**: 3.400333333
- **#12-2**: 2.1816
- **#10-2**: 1.4544

### Total Distance

- **Total**: 275
- **Enter Starting Voltage**: 16
- **First Grouping Voltage**: 14.5456
- **Second Grouping Voltage**: 13.9327
- **Third Grouping Voltage**: 13.2131
- **Fourth Grouping Voltage**: 12.8578917

### Cable Loss

- **Total**: 21.15686278
- **Fixtures Consumed**: 80.8
- **Total Watts Consumed**: 101.9568628
## Wall Wash Data Provided for Comparative Reference Purposes

### 10 Watt Halogen 36° (DMB)

<table>
<thead>
<tr>
<th>Spot Lights</th>
<th>Dimmer Level Setting in BARS Impressions Series Only</th>
<th>% of total output in Impressions Series</th>
<th>Voltage Range AC or DC</th>
<th>Watts (Cost to operate)</th>
<th>Power Factor</th>
<th>Volt Amps (Use This # To Size Transformer)</th>
<th>Efficacy (Lumens Per Watt Consumed)</th>
<th>CRI</th>
<th>L-70 Hrs</th>
<th>Actual Beam Angle (Angle at 50% of Candela)</th>
<th>Total Lumens</th>
<th>Center Beam Candela (CBCP)</th>
<th>Beam Lumens</th>
<th>Foot Candles = CBCP/Distance Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCSL10536B or S</td>
<td>10-24</td>
<td>0.26</td>
<td>2.8</td>
<td>0.89</td>
<td>3.15</td>
<td>32</td>
<td>81</td>
<td>51,400</td>
<td>2736</td>
<td>28°</td>
<td>89</td>
<td>358</td>
<td>54</td>
<td>3.58</td>
</tr>
<tr>
<td>CID140 Series 40' Optic</td>
<td>Three</td>
<td>30%</td>
<td>10-24</td>
<td>0.122</td>
<td>1.309</td>
<td>0.871</td>
<td>1.5</td>
<td>60</td>
<td>80</td>
<td>51,400</td>
<td>2776</td>
<td>40°</td>
<td>79</td>
<td>153</td>
</tr>
<tr>
<td>C2488 Series 48' Optic</td>
<td>Five</td>
<td>50%</td>
<td>10-24</td>
<td>0.069</td>
<td>1.59</td>
<td>0.804</td>
<td>0.85</td>
<td>62</td>
<td>80</td>
<td>51,400</td>
<td>2747</td>
<td>48°</td>
<td>99</td>
<td>139</td>
</tr>
</tbody>
</table>

### Foot Candles = CBCP/Distance Squared

- **At 10 feet**: 1.68
- **At 20 feet**: 0.42

### 20 Watt Halogen 36° (BAB)

<table>
<thead>
<tr>
<th>Spot Lights</th>
<th>Dimmer Level Setting in BARS Impressions Series Only</th>
<th>% of total output in Impressions Series</th>
<th>Voltage Range AC or DC</th>
<th>Watts (Cost to operate)</th>
<th>Power Factor</th>
<th>Volt Amps (Use This # To Size Transformer)</th>
<th>Efficacy (Lumens Per Watt Consumed)</th>
<th>CRI</th>
<th>L-70 Hrs</th>
<th>Actual Beam Angle (Angle at 50% of Candela)</th>
<th>Total Lumens</th>
<th>Center Beam Candela (CBCP)</th>
<th>Beam Lumens</th>
<th>Foot Candles = CBCP/Distance Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCSL18336B or S</td>
<td>10-24</td>
<td>0.25</td>
<td>2.69</td>
<td>0.88</td>
<td>3.06</td>
<td>57</td>
<td>80</td>
<td>51,400</td>
<td>2780</td>
<td>32°</td>
<td>164</td>
<td>94</td>
<td>118</td>
<td>0.9442</td>
</tr>
<tr>
<td>CID140 Series 48' Optic</td>
<td>Eight</td>
<td>80%</td>
<td>10-24</td>
<td>0.804</td>
<td>8.74</td>
<td>0.91</td>
<td>9.60</td>
<td>51,400</td>
<td>2747</td>
<td>51°</td>
<td>157</td>
<td>567</td>
<td>87</td>
<td>5.67</td>
</tr>
<tr>
<td>C2488 Series 48' Optic</td>
<td>Ten</td>
<td>100%</td>
<td>10-24</td>
<td>0.804</td>
<td>8.74</td>
<td>0.91</td>
<td>9.60</td>
<td>51,400</td>
<td>2747</td>
<td>51°</td>
<td>157</td>
<td>567</td>
<td>87</td>
<td>5.67</td>
</tr>
</tbody>
</table>

### 35 Watt Halogen 36° (FMW)

<table>
<thead>
<tr>
<th>Spot Lights</th>
<th>Dimmer Level Setting in BARS Impressions Series Only</th>
<th>% of total output in Impressions Series</th>
<th>Voltage Range AC or DC</th>
<th>Watts (Cost to operate)</th>
<th>Power Factor</th>
<th>Volt Amps (Use This # To Size Transformer)</th>
<th>Efficacy (Lumens Per Watt Consumed)</th>
<th>CRI</th>
<th>L-70 Hrs</th>
<th>Actual Beam Angle (Angle at 50% of Candela)</th>
<th>Total Lumens</th>
<th>Center Beam Candela (CBCP)</th>
<th>Beam Lumens</th>
<th>Foot Candles = CBCP/Distance Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>CID2488 Series 48' Optic</td>
<td>Ten</td>
<td>100%</td>
<td>10-24</td>
<td>0.804</td>
<td>8.74</td>
<td>0.91</td>
<td>9.60</td>
<td>51,400</td>
<td>2747</td>
<td>48°</td>
<td>99</td>
<td>139</td>
<td>62</td>
<td>1.39</td>
</tr>
<tr>
<td>C2488 Series 48' Optic</td>
<td>Ten</td>
<td>100%</td>
<td>10-24</td>
<td>0.804</td>
<td>8.74</td>
<td>0.91</td>
<td>9.60</td>
<td>51,400</td>
<td>2747</td>
<td>48°</td>
<td>99</td>
<td>139</td>
<td>62</td>
<td>1.39</td>
</tr>
</tbody>
</table>

### 50 Watt Halogen 36° (EXN)

<table>
<thead>
<tr>
<th>Spot Lights</th>
<th>Dimmer Level Setting in BARS Impressions Series Only</th>
<th>% of total output in Impressions Series</th>
<th>Voltage Range AC or DC</th>
<th>Watts (Cost to operate)</th>
<th>Power Factor</th>
<th>Volt Amps (Use This # To Size Transformer)</th>
<th>Efficacy (Lumens Per Watt Consumed)</th>
<th>CRI</th>
<th>L-70 Hrs</th>
<th>Actual Beam Angle (Angle at 50% of Candela)</th>
<th>Total Lumens</th>
<th>Center Beam Candela (CBCP)</th>
<th>Beam Lumens</th>
<th>Foot Candles = CBCP/Distance Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>CID2488 Series 48' Optic</td>
<td>Ten</td>
<td>100%</td>
<td>10-24</td>
<td>0.804</td>
<td>8.74</td>
<td>0.91</td>
<td>9.60</td>
<td>51,400</td>
<td>2747</td>
<td>48°</td>
<td>99</td>
<td>139</td>
<td>62</td>
<td>1.39</td>
</tr>
</tbody>
</table>

### 75 Watt Halogen 36° (ECY)

<table>
<thead>
<tr>
<th>Spot Lights</th>
<th>Dimmer Level Setting in BARS Impressions Series Only</th>
<th>% of total output in Impressions Series</th>
<th>Voltage Range AC or DC</th>
<th>Watts (Cost to operate)</th>
<th>Power Factor</th>
<th>Volt Amps (Use This # To Size Transformer)</th>
<th>Efficacy (Lumens Per Watt Consumed)</th>
<th>CRI</th>
<th>L-70 Hrs</th>
<th>Actual Beam Angle (Angle at 50% of Candela)</th>
<th>Total Lumens</th>
<th>Center Beam Candela (CBCP)</th>
<th>Beam Lumens</th>
<th>Foot Candles = CBCP/Distance Squared</th>
</tr>
</thead>
</table>
### Cast LM-79 Impressionist Technical Data

#### Technical Specifications CAST Lighting Impressionist Series CID140 and CID248 Integrated LED Directional SPOT Light (02-2015)

All specifications derived from LM-79 testing performed at full power @ 12 Volts AC. Higher drive current of 24V A/C Will increase below values by 10% (*).

Data is for model #. CID140 Spot, CID140 Area Light, CIT164 Tree Light Fitted with a model # CID140 Optic.

Data is for model #. CID140 Spot, CID248 Area Light, CIT265 Tree Light Fitted with a model # 2XCID048 Optic.

#### Power Factor

<table>
<thead>
<tr>
<th>At 10 Feet</th>
<th>At 20 Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance Sq.</td>
<td>Distance Sq.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>40⁰/48⁰ Wide</th>
<th>Dimmer Level Setting in Steps</th>
<th>% of total output</th>
<th>Voltage Range AC or DC</th>
<th>Aamps</th>
<th>Watts</th>
<th>Power Factor</th>
<th>Volt Ams</th>
<th>Efficacy (Lumens Per Watt Consumed)</th>
<th>CRI</th>
<th>L-70 Hrs</th>
<th>Color Temp</th>
<th>Actual Beam (Angle at 50% of Candela)</th>
<th>Total Lumens</th>
<th>Center Beam Candela (CBCP)</th>
<th>Beam Lumens</th>
<th>Foot Candles in Center at 10' Ft. (Illuminance)</th>
<th>Foot Candles in Center at 20' Ft. (Illuminance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CID140 Series 40⁰ Optic (*)</td>
<td>min.</td>
<td>0%</td>
<td>10-24</td>
<td>0.031</td>
<td>0.25</td>
<td>0.660</td>
<td>0.38</td>
<td>55</td>
<td>80</td>
<td>51,400</td>
<td>2776</td>
<td>40⁰</td>
<td>14</td>
<td>26</td>
<td>7</td>
<td>0.26</td>
<td>0.07</td>
</tr>
<tr>
<td>CID140 Series 40⁰ Optic (*)</td>
<td>one</td>
<td>10%</td>
<td>10-24</td>
<td>0.064</td>
<td>0.6</td>
<td>0.760</td>
<td>0.79</td>
<td>64</td>
<td>80</td>
<td>51,400</td>
<td>2776</td>
<td>40⁰</td>
<td>38</td>
<td>74</td>
<td>19</td>
<td>0.74</td>
<td>0.18</td>
</tr>
<tr>
<td>CID140 Series 40⁰ Optic (*)</td>
<td>two</td>
<td>20%</td>
<td>10-24</td>
<td>0.082</td>
<td>0.8</td>
<td>0.802</td>
<td>1.00</td>
<td>65</td>
<td>80</td>
<td>51,400</td>
<td>2776</td>
<td>40⁰</td>
<td>52</td>
<td>100</td>
<td>25</td>
<td>1.00</td>
<td>0.25</td>
</tr>
<tr>
<td>CID140 Series 40⁰ Optic (*)</td>
<td>three</td>
<td>30%</td>
<td>10-24</td>
<td>0.122</td>
<td>1.309</td>
<td>0.871</td>
<td>1.50</td>
<td>60</td>
<td>80</td>
<td>51,400</td>
<td>2776</td>
<td>40⁰</td>
<td>79</td>
<td>153</td>
<td>39</td>
<td>1.53</td>
<td>0.38</td>
</tr>
<tr>
<td>CID140 Series 40⁰ Optic (*)</td>
<td>four</td>
<td>40%</td>
<td>10-24</td>
<td>0.163</td>
<td>1.81</td>
<td>0.909</td>
<td>1.99</td>
<td>63</td>
<td>80</td>
<td>51,400</td>
<td>2776</td>
<td>40⁰</td>
<td>115</td>
<td>221</td>
<td>56</td>
<td>2.21</td>
<td>0.55</td>
</tr>
<tr>
<td>CID140 Series 40⁰ Optic (*)</td>
<td>five</td>
<td>50%</td>
<td>10-24</td>
<td>0.174</td>
<td>1.935</td>
<td>0.904</td>
<td>2.14</td>
<td>63</td>
<td>80</td>
<td>51,400</td>
<td>2776</td>
<td>40⁰</td>
<td>123</td>
<td>237</td>
<td>60</td>
<td>2.37</td>
<td>0.59</td>
</tr>
<tr>
<td>CID140 Series 40⁰ Optic (*)</td>
<td>six</td>
<td>60%</td>
<td>10-24</td>
<td>0.202</td>
<td>2.2</td>
<td>0.885</td>
<td>2.49</td>
<td>65</td>
<td>80</td>
<td>51,400</td>
<td>2776</td>
<td>40⁰</td>
<td>142</td>
<td>274</td>
<td>70</td>
<td>2.74</td>
<td>0.68</td>
</tr>
<tr>
<td>CID140 Series 40⁰ Optic (*)</td>
<td>seven</td>
<td>70%</td>
<td>10-24</td>
<td>0.283</td>
<td>3.22</td>
<td>0.929</td>
<td>3.47</td>
<td>61</td>
<td>80</td>
<td>51,400</td>
<td>2776</td>
<td>40⁰</td>
<td>197</td>
<td>379</td>
<td>96</td>
<td>3.79</td>
<td>0.95</td>
</tr>
<tr>
<td>CID140 Series 40⁰ Optic (*)</td>
<td>eight</td>
<td>80%</td>
<td>10-24</td>
<td>0.317</td>
<td>3.53</td>
<td>0.914</td>
<td>3.86</td>
<td>59</td>
<td>80</td>
<td>51,400</td>
<td>2776</td>
<td>40⁰</td>
<td>207</td>
<td>400</td>
<td>102</td>
<td>4.00</td>
<td>1.00</td>
</tr>
<tr>
<td>CID140 Series 40⁰ Optic (*)</td>
<td>nine</td>
<td>90%</td>
<td>10-24</td>
<td>0.414</td>
<td>4.55</td>
<td>0.903</td>
<td>5.04</td>
<td>55</td>
<td>80</td>
<td>51,400</td>
<td>2776</td>
<td>40⁰</td>
<td>251</td>
<td>484</td>
<td>123</td>
<td>4.84</td>
<td>1.21</td>
</tr>
<tr>
<td>CID140 Series 40⁰ Optic (*)</td>
<td>ten</td>
<td>100%</td>
<td>10-24</td>
<td>0.470</td>
<td>5.05</td>
<td>0.886</td>
<td>5.70</td>
<td>54</td>
<td>80</td>
<td>51,400</td>
<td>2776</td>
<td>40⁰</td>
<td>273</td>
<td>526</td>
<td>134</td>
<td>5.26</td>
<td>1.32</td>
</tr>
</tbody>
</table>

| CID140 Series 40⁰ Optic (*) | min. | 0% | 10-24 | 0.026 | 0.22 | 0.694 | 0.32 | 49 | 80 | 51,400 | 2747 | 48⁰ | 11 | 15 | 7 | 0.15 | 0.04 |
| CID140 Series 40⁰ Optic (*) | one | 10% | 10-24 | 0.06 | 0.58 | 0.786 | 0.74 | 62 | 80 | 51,400 | 2747 | 48⁰ | 36 | 50 | 22 | 0.50 | 0.13 |
| CID140 Series 40⁰ Optic (*) | two | 20% | 10-24 | 0.069 | 0.68 | 0.804 | 0.85 | 66 | 80 | 51,400 | 2747 | 48⁰ | 45 | 63 | 28 | 0.63 | 0.16 |
| CID140 Series 40⁰ Optic (*) | three | 30% | 10-24 | 0.109 | 1.17 | 0.880 | 1.33 | 58 | 80 | 51,400 | 2747 | 48⁰ | 67 | 95 | 42 | 0.95 | 0.24 |
| CID140 Series 40⁰ Optic (*) | four | 40% | 10-24 | 0.125 | 1.35 | 0.883 | 1.53 | 60 | 80 | 51,400 | 2747 | 48⁰ | 81 | 113 | 51 | 1.13 | 0.28 |
| CID140 Series 40⁰ Optic (*) | five | 50% | 10-24 | 0.146 | 1.59 | 0.896 | 1.77 | 62 | 80 | 51,400 | 2747 | 48⁰ | 99 | 139 | 62 | 1.39 | 0.35 |
| CID140 Series 40⁰ Optic (*) | six | 60% | 10-24 | 0.217 | 2.5 | 0.947 | 2.64 | 61 | 80 | 51,400 | 2747 | 48⁰ | 153 | 214 | 96 | 2.14 | 0.54 |
| CID140 Series 40⁰ Optic (*) | seven | 70% | 10-24 | 0.269 | 3.13 | 0.955 | 3.28 | 62 | 80 | 51,400 | 2747 | 48⁰ | 193 | 271 | 121 | 2.71 | 0.68 |
| CID140 Series 40⁰ Optic (*) | eight | 80% | 10-24 | 0.401 | 4.73 | 0.964 | 4.91 | 57 | 80 | 51,400 | 2747 | 48⁰ | 269 | 378 | 169 | 3.78 | 0.95 |
| CID140 Series 40⁰ Optic (*) | nine | 90% | 10-24 | 0.505 | 5.88 | 0.958 | 6.14 | 60 | 80 | 51,400 | 2747 | 48⁰ | 350 | 491 | 219 | 4.91 | 1.23 |
| CID140 Series 40⁰ Optic (*) | ten | 100% | 10-24 | 0.804 | 8.74 | 0.910 | 9.60 | 51 | 80 | 51,400 | 2747 | 48⁰ | 449 | 630 | 281 | 6.30 | 1.58 |
## Technical Specifications CAST Lighting Path Area Lights (02-2015)

All specifications derived from LM-79 testing performed at full power @ 12 Volts AC. Higher drive current of 24V A/C Will increase below values by 10% (*)

Fixtures Below fitted with CALED2 LED Retrofit Module (A)

<table>
<thead>
<tr>
<th>Path / Area Lights</th>
<th>Voltage Range AC or DC</th>
<th>Amps</th>
<th>Watts</th>
<th>Power Factor</th>
<th>Volt Amps</th>
<th>Luminaire Efficacy Rating (LER) (Total Lumens per watt consumed)</th>
<th>CRI</th>
<th>L-70 Hrs</th>
<th>Color Temp</th>
<th>Total Lumens</th>
<th>Maximum Candela</th>
<th>45° Candela</th>
<th>BUG Rating</th>
<th>Foot Candles in Center at 10' Ft. (illuminance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMU1CB Small Mushroom(*)</td>
<td>A</td>
<td>10-24</td>
<td>0.41</td>
<td>4.4</td>
<td>0.890</td>
<td>4.94</td>
<td>24.00</td>
<td>82</td>
<td>62,000</td>
<td>2769</td>
<td>104</td>
<td>37</td>
<td>28</td>
<td>0,0,0</td>
</tr>
<tr>
<td>CMU2CB Large Mushroom(*)</td>
<td>A</td>
<td>10-24</td>
<td>0.39</td>
<td>4.22</td>
<td>0.910</td>
<td>4.64</td>
<td>31.04</td>
<td>83</td>
<td>62,000</td>
<td>2809</td>
<td>131</td>
<td>57</td>
<td>34</td>
<td>0,0,0</td>
</tr>
<tr>
<td>CCH5LED1 Mini China Hat</td>
<td>10-24</td>
<td>0.27</td>
<td>2.71</td>
<td>0.840</td>
<td>3.23</td>
<td>21.48</td>
<td>81</td>
<td>62,000</td>
<td>2829</td>
<td>58</td>
<td>18</td>
<td>13</td>
<td>0,1,0</td>
<td>0.18</td>
</tr>
<tr>
<td>CCH1CB Small China Hat(*)</td>
<td>A</td>
<td>10-24</td>
<td>0.41</td>
<td>4.42</td>
<td>0.890</td>
<td>4.97</td>
<td>18.55</td>
<td>82</td>
<td>62,000</td>
<td>2797</td>
<td>82</td>
<td>21</td>
<td>19</td>
<td>0,0,0</td>
</tr>
<tr>
<td>CCH2CB Large China Hat(*)</td>
<td>A</td>
<td>10-24</td>
<td>0.39</td>
<td>4.23</td>
<td>0.910</td>
<td>4.65</td>
<td>27.42</td>
<td>83</td>
<td>62,000</td>
<td>2804</td>
<td>116</td>
<td>39</td>
<td>29</td>
<td>0,0,0</td>
</tr>
<tr>
<td>CNO1CB New Orleans(*)</td>
<td>A</td>
<td>10-24</td>
<td>0.42</td>
<td>4.42</td>
<td>0.890</td>
<td>4.97</td>
<td>29.19</td>
<td>82</td>
<td>62,000</td>
<td>2808</td>
<td>129</td>
<td>43</td>
<td>35</td>
<td>0,1,0</td>
</tr>
<tr>
<td>CSA1CB Savannah(*)</td>
<td>A</td>
<td>10-24</td>
<td>0.4</td>
<td>4.41</td>
<td>0.910</td>
<td>4.85</td>
<td>45.45</td>
<td>82</td>
<td>62,000</td>
<td>2737</td>
<td>200</td>
<td>94</td>
<td>49</td>
<td>0,0,0</td>
</tr>
<tr>
<td>CISX2CB Insignia(*)</td>
<td>A</td>
<td>10-24</td>
<td>0.39</td>
<td>4.23</td>
<td>0.910</td>
<td>4.65</td>
<td>27.42</td>
<td>83</td>
<td>62,000</td>
<td>2804</td>
<td>116</td>
<td>39</td>
<td>29</td>
<td>0,0,0</td>
</tr>
<tr>
<td>CCP1 &amp; 2 Craftsman(*)</td>
<td>10-24</td>
<td>0.4</td>
<td>4.22</td>
<td>0.890</td>
<td>4.74</td>
<td>27.01</td>
<td>82</td>
<td>62,000</td>
<td>2790</td>
<td>114</td>
<td>46</td>
<td>30</td>
<td>0,0,0</td>
<td>0.46</td>
</tr>
</tbody>
</table>
### Deck, Engineered Wall & Wash Lights

<table>
<thead>
<tr>
<th>Deck Lights</th>
<th>Dimmer Level Setting in BARS Impressio Series Only</th>
<th>% of total output Impressio Series</th>
<th>Voltage Range A/C or DC</th>
<th>Watts ( Cost to operate )</th>
<th>Power Factor</th>
<th>Volt Amps / Use This # to Size Transformer</th>
<th>Efficiency Lumens Per Watt Consumed</th>
<th>CRI</th>
<th>L-70 Hrs</th>
<th>Color Temp</th>
<th>Horizontal Beam (Angle at 50% of Candela)</th>
<th>Vertical Beam (Angle at 50% of Candela)</th>
<th>Total Lumens</th>
<th>Center Beam Candela (CBCP)</th>
<th>Beam Lumens</th>
<th>Foot Candles in center at 10' Ft. (Illuminance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCDL1B or S Craftsman Deck Light (*)</td>
<td>10-24</td>
<td>0.24</td>
<td>2.5</td>
<td>0.88</td>
<td>2.84</td>
<td>30</td>
<td>81</td>
<td>60,500</td>
<td>2704</td>
<td>94°</td>
<td>78°</td>
<td>76.06</td>
<td>36</td>
<td>18</td>
<td>28</td>
<td>0.18</td>
</tr>
<tr>
<td>CDL1C8LED1 Round Classic Deck Light (*)</td>
<td>10-24</td>
<td>0.24</td>
<td>2.5</td>
<td>0.88</td>
<td>2.84</td>
<td>30</td>
<td>81</td>
<td>60,500</td>
<td>2704</td>
<td>94°</td>
<td>78°</td>
<td>89</td>
<td>46</td>
<td>0.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineered Wall Lights</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CEWLSLED1 / CEWLSLED1 Engineered Wall Light (*)</td>
<td>10-24</td>
<td>0.24</td>
<td>2.5</td>
<td>0.88</td>
<td>2.84</td>
<td>30</td>
<td>81</td>
<td>60,500</td>
<td>2704</td>
<td>94°</td>
<td>78°</td>
<td>76.06</td>
<td>36</td>
<td>18</td>
<td>28</td>
<td>0.18</td>
</tr>
<tr>
<td>CEWLSLED1 /CEWLSLED1 Minus Reflector (*)</td>
<td>10-24</td>
<td>0.24</td>
<td>2.5</td>
<td>0.88</td>
<td>2.84</td>
<td>30</td>
<td>81</td>
<td>60,500</td>
<td>2704</td>
<td>94°</td>
<td>78°</td>
<td>89</td>
<td>46</td>
<td>0.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wash Lights</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CWW1LED2 Classic Wash Light (*)</td>
<td>10-24</td>
<td>0.14</td>
<td>3.33</td>
<td>0.9</td>
<td>4.81</td>
<td>38</td>
<td>82</td>
<td>60,500</td>
<td>2758</td>
<td>92°</td>
<td>84°</td>
<td>164</td>
<td>94</td>
<td>118</td>
<td>9444</td>
<td></td>
</tr>
<tr>
<td>CWW1LED2 Classic Wash Light (*)</td>
<td>10-24</td>
<td>0.14</td>
<td>3.33</td>
<td>0.9</td>
<td>4.81</td>
<td>38</td>
<td>82</td>
<td>60,500</td>
<td>2758</td>
<td>92°</td>
<td>84°</td>
<td>147.5</td>
<td>85</td>
<td>106</td>
<td>84978</td>
<td></td>
</tr>
<tr>
<td>CWWL6LED1 Hi-Power Wall Wash W/Shroud (*)</td>
<td>10-24</td>
<td>0.47</td>
<td>5.01</td>
<td>0.9</td>
<td>5.57</td>
<td>24</td>
<td>82</td>
<td>60,500</td>
<td>2801</td>
<td>81°</td>
<td>53°</td>
<td>122</td>
<td>90</td>
<td>67</td>
<td>0.8984</td>
<td></td>
</tr>
<tr>
<td>CIWL6 Impressionist Wall Wash W/ Shroud (*)</td>
<td>Min.</td>
<td>0%</td>
<td>10-24</td>
<td>0.04</td>
<td>0.22</td>
<td>0.694</td>
<td>0.32</td>
<td>66</td>
<td>82</td>
<td>51,400</td>
<td>2710</td>
<td>85°</td>
<td>62°</td>
<td>14.6</td>
<td>9</td>
<td>9.45</td>
</tr>
<tr>
<td>CIWL6 Impressionist Wall Wash W/ Shroud (*)</td>
<td>One</td>
<td>10%</td>
<td>10-24</td>
<td>0.069</td>
<td>0.58</td>
<td>0.786</td>
<td>0.74</td>
<td>50</td>
<td>82</td>
<td>51,400</td>
<td>2710</td>
<td>85°</td>
<td>62°</td>
<td>29.2</td>
<td>18</td>
<td>18.9</td>
</tr>
<tr>
<td>CIWL6 Impressionist Wall Wash W/ Shroud (*)</td>
<td>Two</td>
<td>20%</td>
<td>10-24</td>
<td>0.07</td>
<td>0.6</td>
<td>0.804</td>
<td>0.75</td>
<td>97</td>
<td>82</td>
<td>51,400</td>
<td>2710</td>
<td>85°</td>
<td>62°</td>
<td>58.4</td>
<td>37</td>
<td>37.8</td>
</tr>
<tr>
<td>CIWL6 Impressionist Wall Wash W/ Shroud (*)</td>
<td>Three</td>
<td>30%</td>
<td>10-24</td>
<td>0.11</td>
<td>1.17</td>
<td>0.88</td>
<td>1.33</td>
<td>75</td>
<td>82</td>
<td>51,400</td>
<td>2710</td>
<td>85°</td>
<td>62°</td>
<td>87.6</td>
<td>55</td>
<td>56.7</td>
</tr>
<tr>
<td>CIWL6 Impressionist Wall Wash W/ Shroud (*)</td>
<td>Four</td>
<td>40%</td>
<td>10-24</td>
<td>0.125</td>
<td>1.35</td>
<td>0.883</td>
<td>1.53</td>
<td>87</td>
<td>82</td>
<td>51,400</td>
<td>2710</td>
<td>85°</td>
<td>62°</td>
<td>116.8</td>
<td>74</td>
<td>75.6</td>
</tr>
<tr>
<td>CIWL6 Impressionist Wall Wash W/ Shroud (*)</td>
<td>Five</td>
<td>50%</td>
<td>10-24</td>
<td>0.146</td>
<td>1.6</td>
<td>0.896</td>
<td>1.79</td>
<td>91</td>
<td>82</td>
<td>51,400</td>
<td>2710</td>
<td>85°</td>
<td>62°</td>
<td>146</td>
<td>92</td>
<td>94.5</td>
</tr>
<tr>
<td>CIWL6 Impressionist Wall Wash W/ Shroud (*)</td>
<td>Six</td>
<td>60%</td>
<td>10-24</td>
<td>0.217</td>
<td>2.5</td>
<td>0.947</td>
<td>2.64</td>
<td>70</td>
<td>82</td>
<td>51,400</td>
<td>2710</td>
<td>85°</td>
<td>62°</td>
<td>175.2</td>
<td>110</td>
<td>113</td>
</tr>
<tr>
<td>CIWL6 Impressionist Wall Wash W/ Shroud (*)</td>
<td>Seven</td>
<td>70%</td>
<td>10-24</td>
<td>0.269</td>
<td>3.13</td>
<td>0.955</td>
<td>3.28</td>
<td>65</td>
<td>82</td>
<td>51,400</td>
<td>2710</td>
<td>85°</td>
<td>62°</td>
<td>204.4</td>
<td>129</td>
<td>132</td>
</tr>
<tr>
<td>CIWL6 Impressionist Wall Wash W/ Shroud (*)</td>
<td>Eight</td>
<td>80%</td>
<td>10-24</td>
<td>0.401</td>
<td>4.73</td>
<td>0.964</td>
<td>4.91</td>
<td>49</td>
<td>82</td>
<td>51,400</td>
<td>2710</td>
<td>85°</td>
<td>62°</td>
<td>233.6</td>
<td>147</td>
<td>151</td>
</tr>
<tr>
<td>CIWL6 Impressionist Wall Wash W/ Shroud (*)</td>
<td>Nine</td>
<td>90%</td>
<td>10-24</td>
<td>0.505</td>
<td>5.68</td>
<td>0.958</td>
<td>6.14</td>
<td>45</td>
<td>82</td>
<td>51,400</td>
<td>2710</td>
<td>85°</td>
<td>62°</td>
<td>262.8</td>
<td>166</td>
<td>170</td>
</tr>
<tr>
<td>CIWL6 Impressionist Wall Wash W/ Shroud (*)</td>
<td>Ten</td>
<td>100%</td>
<td>10-24</td>
<td>0.73</td>
<td>7.63</td>
<td>0.88</td>
<td>8.67</td>
<td>38</td>
<td>82</td>
<td>51,400</td>
<td>2710</td>
<td>85°</td>
<td>62°</td>
<td>292</td>
<td>184</td>
<td>189</td>
</tr>
</tbody>
</table>

All specifications as per LM-79. Integrated LED fixtures tested @ 12 Volts AC. Higher drive current of 24V A/C Will increase below values by 10% (*)
Report No: L111407103  
Date: 12/9/2014

Report Prepared For: Cast Lighting  
1120-A Goffle Rd., Hawthorne, NJ., 07506

Model Number: CCSDL18336  
Product MFG Model # Tested

Test: Electrical and Photometric tests

Standards Used: Appropriate part or all test guidelines were used for test performed:
ANSI C82.77:2002: Harmonic Emission Limits-Related Quality Requirements for Lighting Equipment

Description of Sample: Client submitted the sample. Catalog number is CCSDL18336. Received in working and undamaged condition. No modifications were necessary.

Testing Condition: Fixture is tested with no special conditions.

Sample Arrival Date: 12/4/14

Date of Tests: 12/8/14 - 12/9/14

Seasoning of Sample: No seasoning was performed in accordance with IESNA LM-79.

Equipment List

<table>
<thead>
<tr>
<th>Equipment Used</th>
<th>Model No</th>
<th>Stock No</th>
<th>Calibration Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chroma Programmable AC Source</td>
<td>61604</td>
<td>PS-AC02</td>
<td>--</td>
</tr>
<tr>
<td>Yokogawa Digital Power Meter</td>
<td>WT210</td>
<td>MT-EL06-S1</td>
<td>01/04/15</td>
</tr>
<tr>
<td>Xitron Power Analysis System</td>
<td>2503AH</td>
<td>MT-EL01</td>
<td>01/09/15</td>
</tr>
<tr>
<td>BK Precision DC Power Supply</td>
<td>1747</td>
<td>PSDC-04</td>
<td>01/08/15</td>
</tr>
<tr>
<td>Fluke Digital Thermometer</td>
<td>52k/J</td>
<td>MT-TP02-GC</td>
<td>01/04/15</td>
</tr>
<tr>
<td>LLI Type C Goniophotometer System</td>
<td>RMG-C-MKII</td>
<td>CD-LL04-GC</td>
<td>--</td>
</tr>
<tr>
<td>LLI 2M Sphere</td>
<td>2MR97</td>
<td>CD-SN03-S2</td>
<td>--</td>
</tr>
<tr>
<td>LLI Spectroradiometer</td>
<td>SPR-3000</td>
<td>MT-SC01-S2</td>
<td>Before Use</td>
</tr>
</tbody>
</table>

*All Results in accordance to IESNA LM-79-2008: Approved Method for the Electrical and Photometric Testing of Solid-State Lighting.
A Custom Light Laboratory Type C Rotating Mirror Goniophotometer was used to measure candelas(intensity) at each angle of distribution as defined by IESNA for the appropriate fixture type.

Ambient temperature is set to 25°C and is measured from the center of the fixture, within 1ft from the outside of the fixture. Temperature is maintained at 25°C throughout the testing process and the sample is stabilized for at least 30mins and longer as necessary for the sample to achieve stabilization.

Electrical measurements are measured using the listed equipment.

Spectral Measurements - Integrating Sphere
A Sensing Spectroradiometer SPR-3000, in conjunction with Light Laboratory 2 meter integrating sphere was used to measure chromaticity coordinates, correlated color temperature(CCT) and the color rendering index(CRI) for each sample.

Ambient temperature is set to 25°C and is measured from the center of the fixture, within 1ft from the outside of the fixture. Temperature is maintained at 25°C throughout the testing process and the sample is stabilized for at least 30mins and longer as necessary for the sample to achieve stabilization.

Electrical measurements are measured using the listed equipment.

Disclaimers:
This report must not be used by the customer to claim product certification, approval or endorsement by NVLAP, NIST or any agency of Federal Government.

Report Prepared by: Keyur Patel

Test Report Released by: Jeff Ahn
Engineering Manager

Test Report Reviewed by: Steve Kang
Quality Assurance

*Attached are photometric data reports. Total number of pages: 8

*All Results in accordance to IESNA LM-79-2008: Approved Method for the Electrical and Photometric Testing of Solid-State Lighting.
IES FLOOD REPORT
PHOTOMETRIC FILENAME : L111407103.IES

DESCRIPTIVE INFORMATION (From Photometric File)
IESNA:LM-63-2002
[TEST] L111407103
[TESTLAB] LIGHT LABORATORY, INC.
[ISSUEDATE] 12/09/2014
[MANUFACT] CAST LIGHTING
[LUMCAT] CCSL18336
[LUMINAIRE] 2"DIA. X 12-1/2"H. LED LUMINAIRE
[MORE] CLEAR LENS
[BALLASTCAT] N.A.
[BALLAST] N.A.
[LAMPPOSITION] 0,0
[LAMPCAT] N/A
[OTHER] INDICATING THE CANDELA VALUES ARE ABSOLUTE AND
SHOULD NOT BE FACTORED FOR DIFFERENT LAMP RATINGS.

RESULTS

CHARACTERISTICS
NEMA Type 4 H x 4 V
Maximum Candela 417.99
Maximum Candela Angle 0H 0V
Horizontal Beam Angle (50%) 34.1
Vertical Beam Angle (50%) 34.1
Horizontal Field Angle (10%) 55.6
Vertical Field Angle (10%) 55.1
Lumens Per Lamp N.A. (absolute)
Total Lamp Lumens N.A. (absolute)
Beam Lumens 85
Beam Efficiency N.A.
Field Lumens 131
Field Efficiency N.A.
Spill Lumens 22
Luminaire Lumens 153
Total Efficiency N.A.
Total Luminaire Watts 2.69
Ballast Factor 1.00

Lumen, Beam, Candela DATA

Center Beam Candle Power CBCP/_CANDELA

Field Lumens: 90%
Beam Lumens 85
Fixture

Calculations based on published IES Methods and recommendations, values rounded for display purposes.
Results derived from content of manufacturers photometric file.
IES FLOOD REPORT
PHOTOMETRIC FILENAME: L111407103.IES

AL CANDELA DISPLAY

Maximum Candela = 417.99   Located At Horizontal Angle = 0, Vertical Angle = 0

H - Horizontal Axial Candela
V - Vertical Axial Candela

Calculations based on published IES Methods and recommendations, values rounded for display purposes.
Results derived from content of manufacturer's photometric file.
Illumination Engineering Society (IES) standards for testing.

LM-80: the testing of a LED chip by a manufacturer of the chip to extrapolate lamp life expressed in hours of operation.

L-70: Lumen Maintenance. The point at which a LED chip’s light output reduces by 30% in hours of operation at which point the chip is considered dead. (Even though the LED could still be operating) This was chosen because your eye can only notice a 30% decrease in light level.

LM-79 The testing of the electrical and photometric measurement of solid state lighting products by a third party laboratory to determine performance as specified by the IES (illumination Engineering Society)

Lumens= (Im) is the measure of the total amount of visible light emitted by a source.

Candela. (cd) also referred as Center Beam Candela (Candle) Power (CBCP). This is the base unit of luminous intensity; that is, power emitted by a light source at the dead center of the beam angle.

High Power Light Emitting Diode. This is a high efficiency Light Source made up of two different materials that when stimulated with DC current emit photons of blue light.

Phosphor Coating: A coating placed over the LED to create a specific color (Kelvin Temperature)

Collimating Optic: A molded uv resistant plastic that fits over an LED designed to focus the light produced by a LED into a specific beam pattern or cone of light.

Foot Candle. Is equal to one lumen per square foot. Or approximately 10.74 lux

Correlated Color Temperature (CCT) Kelvin. The color output of a source of light. (Ex. 2700 to 2800K warm white)

Color Rendering Index. (CRI) is a quantitative measure of the ability of a light source to reveal the colors of various objects faithfully in comparison with an ideal or natural light source. The higher the CRI the better the source in color critical applications.

Color Shift: The change of the led output color over time usually occurring from overheating and poor thermal management of the led and poor led material used in initial production of the led. This is a problem when a lamp fails after installation and a replacement is installed the color is vastly different and the customer notices.

Optical performance:

Beam Angle: The angle from 90’ off center. 40’ beam is 20’ of center both right and left side.

Striations: Lines or scratches formed in the optical pattern creating jagged usually black lines throughout the light pattern typically emanating from center to edge.
**Halo:** A glow or dark ring around the edges of a light beam in varying widths and densities interrupting an otherwise clean bleed off of light.

**Color Consistency:** The led’s ability to project a clean uniform color across the entire surface of the beam without stray columns of differing light color appearing in the projected light pattern.

**MacAdam Ellipse:** This is the study of color vision and refers to the region on a chromaticity diagram. The led chips that have a tight “Binning” will deliver a very consistent color across the led manufactured to a tight chip binning specification. This insures that the first LED produced and the LED produced five years from now to that specification will be the same and the customer will see no difference in light color. Low quality led’s will vary in color in the same production run because of loose binning requirements. Since your eye can detect a 3% variation in color difference tight binning is extremely important with led manufacturing.

**Lumens Per Watt:** The amount of light delivered for dollars paid per hour to operate a LED. This is a measure of efficiency.

**Drive Circuits:**

**Power Factor (pf) / Volt Amps:** This is the inefficiency of the DC driver to convert the AC power to DC power and the need to compensate for this by using a larger transformer. Example CPWP1 .82pf input power is 7.0 watts Apparent power is 8.5 Watts. The customer must size the transformer using 8.5 watts. (note: the customer only pays for the 7.0 watts of electricity used)

**Cost to Operate a System:** Take an amp probe and measure the primary amps on the system. Divide this number by 1000. Multiply this number by the electrical rate expressed in KWH kilowatt hour. ( ie .15c kwh) to determine the cost per hour to run the system. Multiply by hours on per night, week, year to determine operating cost.

**Surge Protection:** The ability of a solid state circuit to handle *a prolonged increase in voltage* above normal operating conditions. Surge protectors can also be installed on the primary side of a transformer to add additional protection from line spike problems.

**Transient Spike Protection:** The ability of a solid state circuit to handle *quick spikes* in voltage above normal operating conditions.

**Operating Range:** The range in input voltage a solid state circuit is designed to operate on. Cast lighting 8-24VAC or VDC

**FCC Class A & B radiated emissions.** The design of a solid state circuit and testing of the final design by an accredited laboratory eliminating any radio interference that the circuit could emit which could interfere with household appliances such as garage door openers, wi-fi, remote controls, life safety equipment etc.
Aluminum electrolytic capacitors: An inexpensive low life electrical component used to store energy and deliver to an LED a consistent DC power supply. Without this the led would rapidly blink.

Conformal Coatings: This is a sealant placed over a circuit board to protect the solder joints, resistors etc from moisture and intrusion by the elements.

Electrical Component Selection: Voltage range and operating temperature of the solid state components determine the longevity of the circuit and the ultimate cost of the product. You get what you pay for.

E-Waste: (Electronic waste). The needless accumulation of failed solid state circuits in landfills, caused by irresponsible manufacturers producing products and distributors selling products that will fail sooner than they should. These products could be designed differently but are not. This is done with the goal of making a fast buck and fooling the users into believing the products are better than actually designed.

Thermal Management: The ability to transfer heat generated from the LED to the outside of the fixture in order to provide an operating temperature that does not overheat the led and achieve the L-70 life of the LED.

Overheating a LED: If a led is driven too hard with DC current the led will produce bright light initially but the overheating will cause the LED after a half hour or so to diminish in light output and diminish the life of the led and the brightness level considerably. This also causes color shift which causes variations in the color output from fixture to fixture on a job. This can also lead to catastrophic failure in a short time span.

Thermal Fold Back: The monitoring of an led’s operating temperature to make sure it does not overheat and damage the led. If the led does reach overheat conditions the drive circuit powering the leds reduces the current to a point where the operating temperature is acceptable thus eliminating potential heat damage to the led’s.

A Light Engine: The integrated combination of both the drive circuit and the led into one component usually affixed to a luminaire.

Junction Temperature: This is the highest operating temperature of the actual semiconductor (LED) in an electronic device. This is higher than the case temperature and the temperature of the parts exterior. The measurement of the amount of heat transferred from the junction multiplied by the junction to case thermal resistance. Since it is impossible to measure behind a led that is affixed to a FR4 (green fiberglass electronic board) or aluminum board a scientific formula is used to determine the temperature behind the led. This is the temperature that is used to determine the life of the led over time.

Thermal Couple: This is a two wire probe that is attached to a led board and elsewhere on the fixture to determine operating temperature during testing. This thermal couple can also be integrated in a circuit board for the purpose of monitoring heat conditions of a solid state circuit board.
**Thermal Path:** The ability to move the LED heat from the led inside the fixture to the outside air.

**Gap Pad:** This is a thermally conductive gasket like material usually .010” thick used to bond a led board to the underlying fixture body or casting. The purpose is to dissipate heat generated by the LED.

**Thermal Grease:** This is a thermally conductive grease material used to bond a led board to the underlying fixture body or casting. The purpose is to dissipate heat generated by the LED.

**Thermal Trap:** A led light engine that has no way of dissipating the heat generated by a led and driver to the exterior surface of a fixture. This is most common with Drop In Mr 16 LED lamps which are encased in a pocket of air in an old style halogen fixture with little or no thermal path to the exterior of the fixture.

**Pulse-width modulation (PWM) dimming:** This is a way to control the power supplied to an electrical device by essentially controlling the width (number) of wave forms supplying a transformer. This PWM dimming can be used on the primary power supply feeding a cast toroid transformer powering any cast led fixture to allow dimming of the led's manually by a homeowner. The PWM dimmer must be a MLV (magnetic Low Voltage dimming style only NOT and electronic PWM dimmer)

**Toroid:** A circular magnetic winding that takes primary power and depending on the number of windings of copper wire create a magnetic field that inducts a power on the secondary to produce a low voltage current which can be 12,13,14,15,16…..etc. volts. A toroid is a far more efficient winding than a comparable EI style transformer. Toroid’s usually operate in the 93% efficiency range. Cast Lighting will not warranty any LED product over one year that is not run on a cast lighting transformer because poorly manufactured EI transformers create uneven power that can cause spikes and damage LED driver circuitry.

**Transformer efficiency:** The efficient use of the electrical current to produce a low voltage current. A 93% efficient transformer uses 7% of the power consumed to create the low voltage power.

**A Driver:** This is an electrical circuit board made up of components that take the AC (alternating Current power) and turn the AC power into DC power which then is used to drive the LED. Cast Lighting has the driver placed in the fixture next to the LED.

**Drop-In LED products.** This term defines a series of led light engines (Engine is a driver and led together) that fit into existing legacy of old halogen products. Drop-Ins take the place if MR16, MR11, Par 36, S-8 and other halogen lamp form factors. These drop-in products for the first time in lighting history has the fixture determined the lamp form factor. In the past a lamp was developed and the fixture manufacturers designed around the lamp.

**Legacy Fixture.** These are fixtures using old halogen and incandescent lamp designs such as MR-16, MR-11, Par-36, S-8, SCB etc.
Why Take the RISK?

• Halogen Fixtures were NEVER designed for LEDs
• Hot LEDs = Hot Driver = Predictable Failure

CAST LED Fixtures...
Designed for the Technology.