Cree® XLamp® 4550 & XR Family LEDs

INTRODUCTION

This application note applies to XLamp 4550 & XR family (XR-E, XR-C & XR) LEDs, which have order codes in the following fomats:

XL4550xx-xx-xxxx
XR7090xx-xx-xxxx
XRCxxx-xx-xxxx-xxxxxx
XRExxx-xx-xxxx-xxxxxx

This application note explains how XLamp 4550 & XR family LEDs and assemblies containing these LEDs should be handled during manufacturing. Please read the entire document to understand how to properly handle XLamp 4550 & XR family LEDs.

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HANDLING XLAMP 4550 & XR FAMILY LEDS

Cree recommends the following at all times when handling XLamp 4550 & XR family LEDs or assemblies containing these LEDs:

- Avoid putting mechanical stress on the LED lens.
- Never touch the optical surface with fingers or sharp objects. The LED lens surface could be soiled or damaged, which would affect the optical performance of the LED.

Whenever possible, Cree recommends the use of a pick & place tool to remove XLamp 4550 & XR family LEDs from the factory tape & reel packaging.

Pick & Place Nozzle

For pick and place nozzles coming into contact with silicone-covered LED components, Cree recommends nozzles be constructed of non-metallic materials. Cree and several of Cree's customers have had good success using nozzles fabricated from Teflon or from 90d urethane.
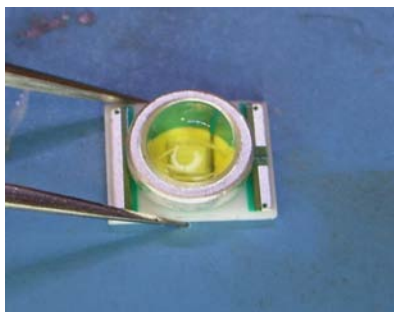
Cree recommends the pickup tool shown below for XLamp XR family LEDs.

Scale = none
All dimensions in mm
General tolerances = ± 0.1
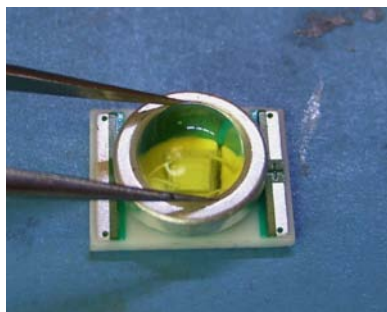
1.7

70°

$5.064 \, ^{+.05}_{-0}$

6.6
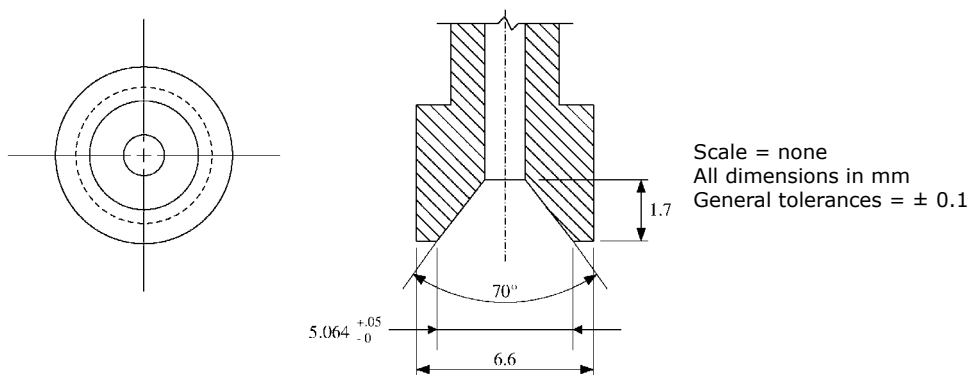
Manual Handling

Use tweezers to grab XLamp 4550 & XR family LEDs at the base. Do not touch the lens with the tweezers. Do not touch the lens with fingers. Do not push on the lens.
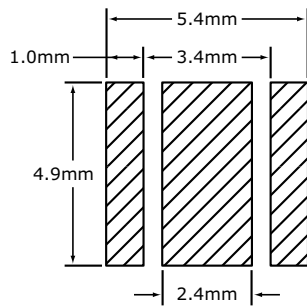
✓ CORRECT

🚫 WRONG

CIRCUIT BOARD PREPARATION & LAYOUTS

Printed circuit boards (PCBs) should be prepared and/or cleaned according to the manufacturer's specifications before placing or soldering XLamp 4550 & XR family LEDs onto the PCB.
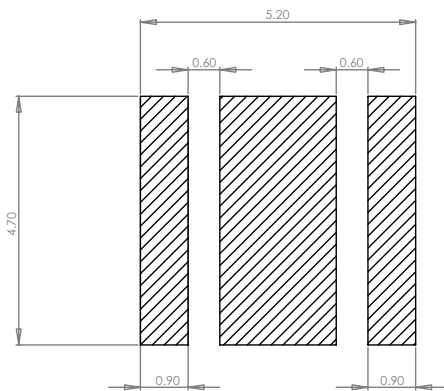
The diagram below shows the recommended PCB solder pad layout for XLamp 4550 & XR family LEDs.
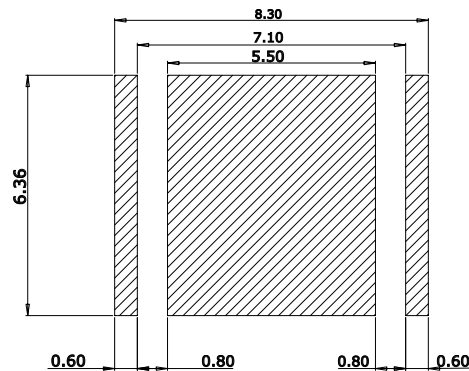
Recommended solder pad for XLamp 4550 LEDs
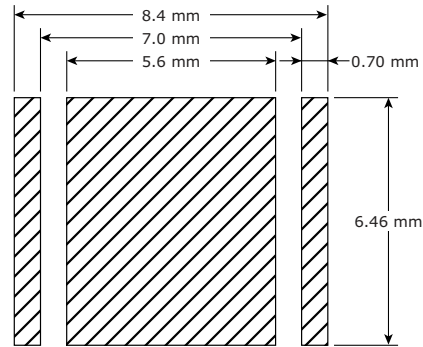
Recommended solder pad for XLamp XR family LEDs

Recommended stencil pattern for XLamp 4550 LEDs (hatched area is opening)

Recommended stencil pattern for XLamp XR family LEDs (hatched area is opening)

CASE TEMPERATURE (Ts) MEASUREMENT POINT

XLamp XR family LED case temperature (T_s) should be measured on the PCB surface, as close to the LED's thermal pad as possible. This measurement point is shown in the pictures below.
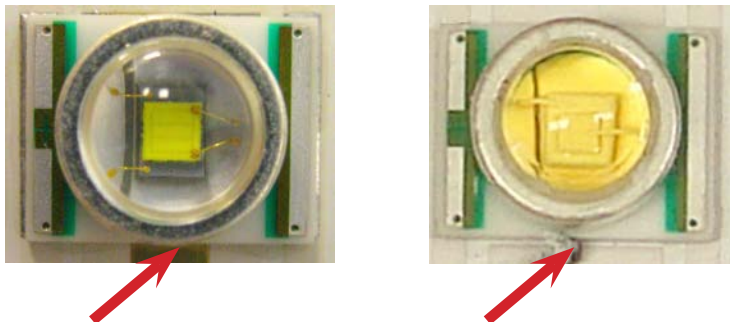
It is not required to use a solder footprint for the thermal pad that is larger than the XLamp XR family LED itself. In testing, Cree has found such a solder pad to have insignificant impact on the resulting Ts measurement.

NOTES ON SOLDERING XLAMP 4550 & XR FAMILY LEDS

XLamp 4550 & XR family LEDs are designed to be reflow soldered to a PCB. Reflow soldering may be done by a reflow oven or by placing the PCB on a hotplate and following the reflow soldering profile listed on the previous page.

Do not wave solder XLamp 4550 & XR family LEDs. Do not hand solder XLamp 4550 & XR family LEDs.

✓
CORRECT

LT-S6

✓
CORRECT

LT-260C

🚫
WRONG

Solder Paste Type

Cree strongly recommends using "no clean" solder paste with XLamp LEDs so that cleaning the PCB after reflow soldering is not required. Cree uses the following solder paste internally.

Indium Corporation of America® Part number 82676
- Sn62/Pb36/Ag2 composition
- Flux: NC-SMQ92J

Cree recommends the following solder paste compositions: SnPbAg, SnAgCu and SnAg.
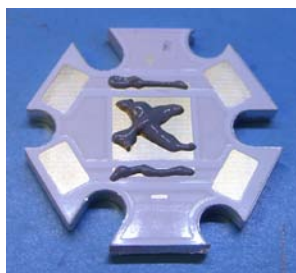
Solder Paste Thickness

The choice of solder and the application method will dictate the specific amount of solder. For the most consistent results, an automated dispensing system or a solder stencil printer is recommended. Cree has seen positive results using solder thickness that results in a 3-mil (75-µm) bond line.

✓ **CORRECT**
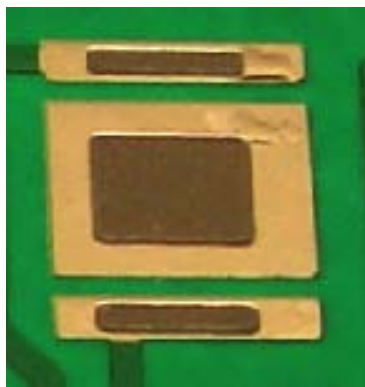
WRONG

WRONG

After Soldering

After soldering, allow XLamp 4550 & XR family LEDs to return to room temperature before subsequent handling. Premature handling of the device, especially around the lens, could result in damage to the LED.

Cree recommends verifying the solder process by checking the consistency of the solder bond of several trial PCBs after reflow. After shearing selected devices from the circuit board the solder should appear completely re-flown (no solder grains evident). The solder areas should show minimum evidence of voids on the backside of the package and the PCB.

Cleaning PCBs After Soldering

Cree recommends using "no clean" solder paste so that flux cleaning is not necessary after reflow soldering. If PCB cleaning is necessary, Cree recommends the use of isopropyl alcohol (IPA).

XLAMP 4550 & XR FAMILY LED REFLOW SOLDERING CHARACTERISTICS

In testing, Cree has found XLamp 4550 & XR family LEDs to be compatible with JEDEC J-STD-020C, using the parameters listed below. As a general guideline, Cree recommends that users follow the recommended soldering profile provided by the manufacturer of solder paste used.

Note that this general guideline may not apply to all PCB designs and configurations of reflow soldering equipment.

IPC/JEDEC J-STD-020C
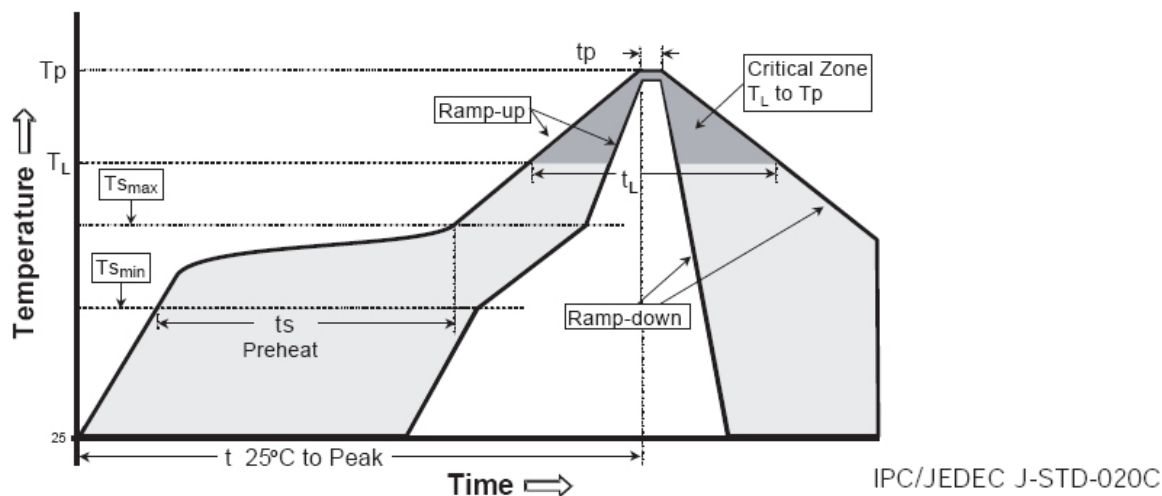
Profile Feature	Lead-Based Solder	Lead-Free Solder
Average Ramp-Up Rate (Ts_{max} to Tp)	3 °C/second max.	3 °C/second max.
Preheat: Temperature Min (Ts_{min})	100 °C	150 °C
Preheat: Temperature Max (Ts_{max})	150 °C	200 °C
Preheat: Time (ts_{min} to ts_{max})	60-120 seconds	60-180 seconds
Time Maintained Above: Temperature (T_L)	183 °C	217 °C
Time Maintained Above: Time (t_L)	60-150 seconds	60-150 seconds
Peak/Classification Temperature (Tp)	215 °C	260 °C
Time Within 5 °C of Actual Peak Temperature (tp)	10-30 seconds	20-40 seconds
Ramp-Down Rate	6 °C/second max.	6 °C/second max.
Time 25 °C to Peak Temperature	6 minutes max.	8 minutes max.

Note: All temperatures refer to topside of the package, measured on the package body surface.

MOISTURE SENSITIVITY

XLamp 4550 & XR family LEDs are shipped in sealed, moisture-barrier bags (MBB) designed for long shelf life. Each MBB is backfilled with inert nitrogen gas after being evacuated. As a result, the visual appearance of pressure in the MBB will vary from one bag to another. Visual appearance of the MBB is not an indicator of humidity in the MBB.

Humidity inside the MBB can be checked immediately after opening the MBB by inspecting the humidity indicator card. The pictures below provide a guide on how to read the humidity indicator card immediately after opening the MBB.

If XLamp 4550 & XR family LEDs are exposed to moist environments after opening the MBB packaging but before soldering, damage to the LED may occur during the soldering operation.

The following derating table defines the maximum exposure time (in days) for XLamp 4550 & XR family LEDs in the listed humidity and temperature conditions. LEDs with exposure time longer than the time specified below must be baked according to the baking conditions listed below.

Temperature	Maximum Percent Relative Humidity						
	30%	40%	50%	60%	70%	80%	90%
30 ºC	9	5	4	3	1	1	1
25 ºC	12	7	5	4	2	1	1
20 ºC	17	9	7	6	2	2	1

XLamp LEDs stored at < 30 ºC and < 30% RH will not require baking before reflow soldering. One method to verify these conditions is to keep the humidity indicator card with the LEDs. If the 30% RH circle on the humidity indicator card is blue, then the LEDs do not need to be baked. If the 30% RH circle is pink, then XLamp LEDs should be baked using the baking procedure listed on the next page.

MOISTURE SENSITIVITY (CONTINUED)

Cree recommends keeping XLamp LEDs in their sealed moisture-barrier packaging until immediately prior to use. Cree also recommends returning any unused LEDS to the resealable moisture-barrier bag and closing the bag immediately after use.

Baking Conditions

It is not necessary to bake all XLamp 4550 & XR family LEDs. Only the LEDs that meet all of the following criteria must be baked:

1. LEDs that have been removed from the original MBB packaging.
2. LEDs that have been exposed to a humid environment longer than listed in the Moisture Sensitivity section above.
3. LED that have not been soldered.

Baking Procedure

Baking the LEDs will remove moisture from the package and reset the exposure time, as defined in the Moisture Sensitivity section above. Cree recommends baking any LEDs that may have been exposed to excessive moisture.

1. Remove LEDs or reel of LEDs from MBB packaging.
2. LEDs may be baked on the original reels.
3. Bake LEDs or reel of LEDs at 80 ºC for 24 hours.
4. Reflow solder the parts within one hour of baking or immediately store the parts in a container with < 20% RH (relative humidity).

IMPORTANT: Do not bake reels of LEDs at temperatures higher than 80 ºC.

Storage Conditions

XLamp 4550 & XR family LEDs that have been unsealed from the original packaging but not soldered should be stored in one of the following ways:

• Store the parts in a rigid metal container with tight fitting lid. Place fresh dessicant and a RH indicator in the container to verify < 20% RH.
• Store the parts in a dry, nitrogen-purged cabinet or container that actively maintains < 20% RH.
• For short-term storage only: LEDs can be resealed in the original MBB bag soon after opening. Fresh dessicant may be needed. Use the included humidity indicator card to verify < 20% RH.

If an environment of < 20% RH is not available for storage, XLamp 4550 & XR family LEDs should be baked (described above) one hour before reflow soldering.

CHEMICALS & CONFORMAL COATINGS

In the sections below we list a representative list of chemicals and materials to be used or avoided in LED manufacturing activities. For a complete and current list of recommended chemicals, conformormal coatings and harmful chemicals consult Cree's Chemical Compatibility Application Note (www.cree.com/products/pdf/XLamp_Chemical_Comp.pdf). You should also consult your regional Cree Field Applications Engineer.

Recommended Chemicals

In testing, Cree has found the following chemicals to be safe to use with XLamp XR family LEDs.

- Water
- Isopropyl alcohol (IPA)
- Non-silicon thermal grease
- Arctic Silver & Arctic Alumina brand thermal grease
- Pledge furniture spray
- Formula 409 brand cleaner
- Fantastik brand cleaner
- Acrylic latex caulk
- Lysol brand disinfectant spray
- Scrubbing Bubbles brand bathroom cleaner
- Tilex brand mold & mildew remover
- 3M Scotch-Weld epoxy adhesive DP-190 (polymeric diamante, kaolin)
- Windex, Windex Outdoor & Windex Vinegar brand cleaners

Recommended Conformal Coatings

In testing, Cree has found the following conformal coatings to be safe to use with XLamp XR family LEDs. Conformal coating should not be applied directly to or over the LED lens, as this may affect LED optical performance and reliability.

- Dow Corning 3-1953
- Dow Corning 1-4105
- Dow Corning 1-2577
- Dymax 9-20557
- Humiseal 1H20AR1/S
- Humiseal UV40
- Humiseal 1B51NS
- Humiseal 1B73
- Humiseal 1C49LV
- Shat-R-Shield
- Specialty Coating Systems – Parylene
- TechSpray Turbo-Coat Acrylic Conformal Coating (2108-P)

Chemicals Tested as Harmful

In testing, Cree has found the following chemicals to be harmful to XLamp XR family LEDs. Cree recommends not using these chemicals anywhere in an LED system containing XLamp XR family LEDs. The fumes from even small amounts of these chemicals may damage the LEDs.

- Cyanoacrylates (i.e., "Superglue")
- Dymax 984-LVUF conformal coating
- Loctite Sumo Glue
- Gorilla Glue
- Clorox bleach
- Clorox Clean-Up Cleaner spray
- Loctite 384 adhesive
- Loctite 7387 activator
- Loctite 242 threadlocker
- Chemicals that might outgas aromatic hydrocarbons (e.g., toluene, benzene, xylene)
- Methyl acetate or ethyl acetate (i.e., nail polish remover)
- Glycol ethers (including Radio Shack® Precision Electronics Cleaner - dipropylene glycol monomethyl ether)
- Formaldehyde or butadiene (including Ashland PLIOBOND® adhesive)

Potential of Silver Tarnishing

XLamp MP-L EasyWhite LEDs contain silver plated parts that may tarnish (turn black) over time when exposed to oxidizing substances such as sulfur, chlorine, or other halogen compounds. Oxidation of the leads can reduce the ability to make a good solder connection and affect the light output of the LED. Exposure to oxidizing substances can come from materials used near the LED during manufacturing or from the air around the LEDs during storage.

To reduce the potential of tarnishing for XLamp MP-L EasyWhite LEDs, Cree recommends that customers minimize exposure of the LEDs to oxidizing substances at all times, including storage, manufacturing and product testing. Potential sources of oxidizing substances include paper, air filters, some cleaning chemicals, cardboard boxes and rubber anti-static mats

ASSEMBLY STORAGE & HANDLING

Do not stack PCBs or assemblies containing XLamp 4550 & XR family LEDs so that anything rests on the XLamp LED lens. Force applied to the XLamp LED lens may result in the lens being knocked off. PCBs or assemblies containing XLamp 4550 & XR family LEDs should be stacked in a way to allow at least 2 cm clearance above the LED lens.

Do not use bubble wrap directly on top of XLamp 4550 & XR family LEDs. Force from the bubble wrap can potentially damage the LED.
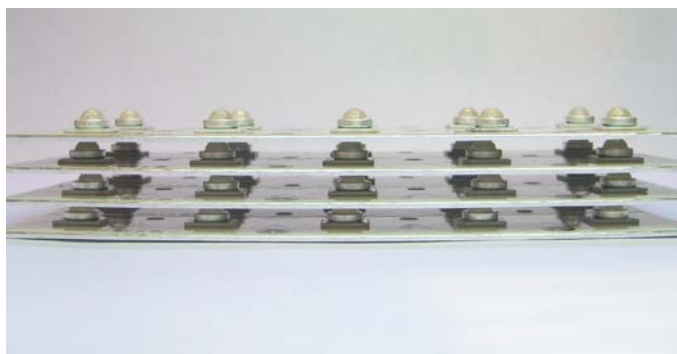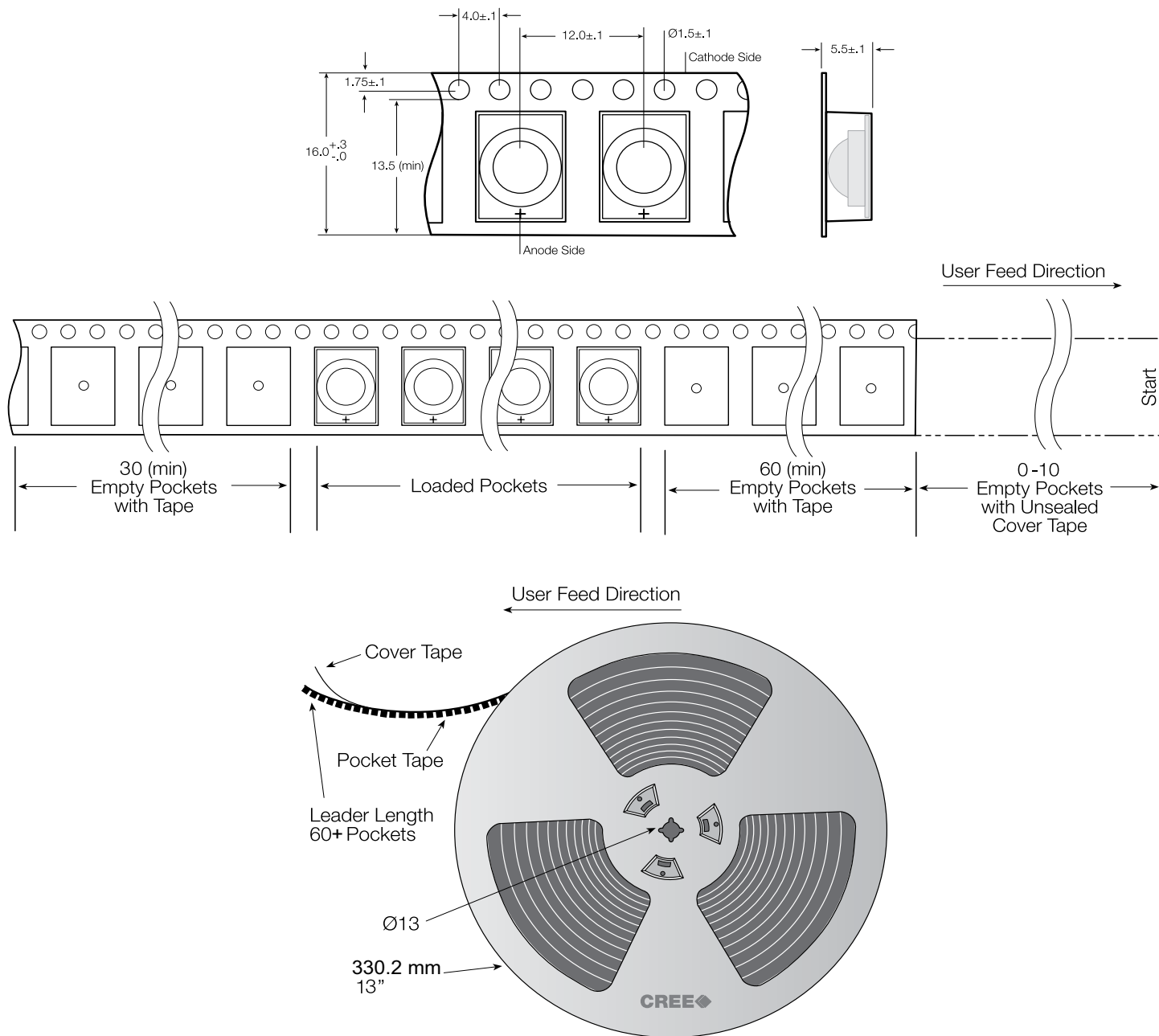
CORRECT ✓

CORRECT ✓

🚫 **WRONG**

🚫 **WRONG**

TAPE AND REEL

All Cree carrier tapes conform to EIA-481D, Automated Component Handling Systems Standard.

PACKAGING AND LABELS

The diagrams below show the packaging and labels Cree will use to ship XLamp LEDs to manufacturers. XLamp LEDs are shipped in tape loaded on a reel. Each moisture barrier bag contains only one reel. Each box may contain multiple reels.

Humidity Indicator Card (inside bag)

Dessicant (inside bag)

Label with Cree Bin Code, Qty, Lot #

Vacuum-Sealed Moisture Barrier Bag

Label with Cree Bin Code, Qty, Lot #

Label with Customer Order Code, Qty, Reel ID, P.O. #

Label with Cree Bin Code, Qty, Lot #

Patent Label