

# Cree® J Series™ LED Reliability Overview

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## INTRODUCTION

This application note details the pre-release qualification testing for Cree J Series™ LEDs. The pre-release qualification test suite is based on standard semiconductor pre-release qualification test conditions and methods defined by the Joint Electron Device Engineering Council (JEDEC).

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**PRE-RELEASE QUALIFICATION TEST LIST (OPERATING LIFE TESTS)**

Test	Applicable Standards	Test Conditions & Failure Criteria
High-Temperature Operating Life Test (HTOL)	JESD22 Method A108-D	<b>Test Conditions:</b> • Solder point temperature : Maximum in data sheet • Forward current : Maximum in data sheet • Test period : 1008 hours <b>Failure Criteria <sup>1</sup>:</b> • Forward voltage shift <sup>2</sup> : > 5% • Luminous flux degradation <sup>2</sup> : > 15% • Catastrophic Failure <sup>3</sup>
Wet High Temperature Operating Life Test (WHTOL)	JESD22 Method A101-C	<b>Test Conditions:</b> • Solder point temperature : 60 °C • Relative humidity : 90% • Forward current : Maximum in data sheet • Test period : 1008 hours <b>Failure Criteria <sup>1</sup>:</b> • Forward voltage shift <sup>2</sup> : > 5% • Luminous flux degradation <sup>2</sup> : > 15% • Catastrophic failure <sup>3</sup>
Low Temperature Operating Life Test (LTOL)	JESD22 Method A108-C	<b>Test Conditions:</b> • Ambient Temperature : -40 °C • Forward Current : Nominal in data sheet • Test Period : 1008 hours <b>Failure Criteria <sup>1</sup>:</b> • Forward Voltage shift <sup>2</sup> : > 5% • Luminous Flux degradation <sup>2</sup> : > 15% • Catastrophic failure <sup>5</sup>

Notes:

1. The entire test has failed if at least one LED from the sample set satisfies the listed failure criteria. The test is successful if no LED satisfies the listed failure criteria.
2. Comparison is made between [value at time 0] and [value at the end of the test period].
3. A catastrophic failure causes the LED to become non-functional, i.e., open or short.

**PROCEDURES FOR OPERATING LIFE TESTS**

The following procedures are followed for HTOL and WHTOL tests:

- J Series LEDs are reflow soldered onto metal-core printed-circuit boards (MCPCB).
- MCPCBs are mounted onto heat sinks within reliability test chambers.
- For HTOL and WHTOL tests, solder point temperature (case temperature) is maintained equal to the ambient temperature during the test.
- Power is applied to the lamps. In the WHTOL test, power is applied in one-hour intervals that are followed by one-hour intervals without power to let moisture penetrate the package as much as possible. This procedure results in a test that is more rigorous than one that calls for applying continuous power.
- At regular intervals power is turned off and the sample boards are removed from the tester according to JEDEC testing protocol.
  - ◊ The lamps are characterized according to reliability test criteria.
  - ◊ The boards are placed back into the test chambers and the procedure is repeated until the test has concluded.

- Test period hours are true operating hours, i.e., any time the test chamber is turned off during a test is not counted. This is in compliance with LM-80 procedures.

**PRE-RELEASE QUALIFICATION TEST LIST (NON-OPERATING LIFE TESTS)**

Test	Applicable Standards	Test Conditions & Failure Criteria
Thermal Shock	JESD22 Method A104-E	<b>Test Conditions:</b> <ul style="list-style-type: none"> <li>• Ambient temperature range : -40 °C to 125 °C</li> <li>• Transfer time : &lt; 20 seconds</li> <li>• Test period : 200 cycles</li> </ul> <b>Failure Criteria <sup>1</sup>:</b> <ul style="list-style-type: none"> <li>• LED no longer lights up after test</li> </ul>
Mechanical Shock	JESD22 Method B104-C	<b>Test Conditions:</b> <ul style="list-style-type: none"> <li>• Shock : 1500 G</li> <li>• Pulse width : 0.5 ms</li> <li>• Test period : 5 each, 6 axis (30 total)</li> </ul> <b>Failure Criteria <sup>1</sup>:</b> <ul style="list-style-type: none"> <li>• LED no longer lights up after test</li> </ul>

**Note:**

1. The entire test has failed if at least one LED from the sample set satisfies the listed failure criteria. The test is successful if no LED satisfies the listed failure criteria.