TECH NOTE

LRS-9550 Fixture Temperature Range

OVERVIEW

The LRS-9550 High Power Laser Diode Test System houses up to 32 removable laser diode fixtures. Individual fixtures can be designed to hold between 4 and 16 laser diodes, depending on package geometry and thermal characteristics. On each fixture, six high-performance thermoelectric (TE) modules are used to control base temperature. The heat generated from both the laser diodes devices and the TE modules is removed from the fixtures conductively via high-performance aluminum cold plates which circulate facility water.

The fixture base temperature is defined as the temperature of the metal portion of the fixture that the laser diode is attached to, directly under the base of the device. The LRS-9550 allows for maximum fixture base temperatures up to 85°C. The minimum achievable fixture base temperature is dependent on both cooling water temperature and total heat load applied to the fixture.

When designing a custom LRS-9550 fixture, a trade-off will occur between number of devices on a fixture and minimum fixture temperature. More laser diode devices on a fixture at a given power level equals a larger heat load and thus a higher minimum temperature.

The following test was designed to quantify minimum fixture base temperature as a function of inlet water temperature and total device heat load.

TEST SET UP

The test was performed on a single shelf of a standard LRS-9550 system. Water supply to the shelf was regulated at 0.80 ±0.02 GPM. Inlet facility water temperature was monitored with a calibrated thermistor. An LRS-9550-4585 fixture was loaded with four resistive dummy loads (0.05 ohm nominal resistance) and equipped with four calibrated thermistors to monitor base temperature.

TEST PROCEDURE

The fixture was cooled at 75% maximum TE effort (to allow a margin for control and for possible TE module degradation) while the devices were driven at varying power levels. At each power level, the fixture was allowed to reach thermal equilibrium. Once a steady state condition was reached the fixture base and water inlet temperatures were recorded. The heat load (in watts) was calculated based on current and voltage for each device (P= I*V).

RESULTS

The results from the described test are displayed in Figure 1.

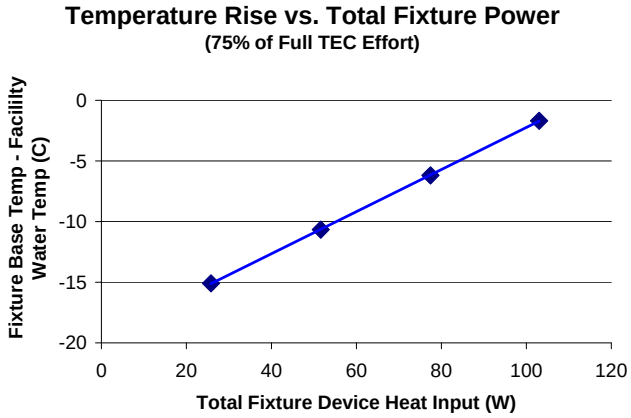

FIGURE 1

The results can be approximated by the following equation:

$$\Delta T = 0.17(P) - 19.6$$

where

ΔT = fixture base temp – facility water temp (°C)
P = total heat input to fixture from laser diodes (W)

For examining the trade-off between number of devices, water temperature, and fixture base temperature, the equation from above can be expanded as follows:

$$T_{base} = 0.17(N*(1-E)*LDI*LDV) - 19.6 + T_{water}$$

where

T_{base} = fixture base temperature (°C)
N = number of laser diode devices per fixture
E = optical efficiency of laser diodes
LDI = laser diode drive current (A)
LDV = laser diode voltage (V)
T_{water} = facility water inlet temperature (°C)

CONCLUSION

The maximum fixture base temperature of the LRS-9550 is 85°C. The minimum fixture base temperature depends on the number of devices per fixture, the amount of heat generated per device, and the facility cooling water temperature. Using the equations above, it is possible to estimate minimum fixture base temperature based on parameters of the application.