

# Creep Temperature Distributions of Incandescent Infrared Heat Lamps

## A.S. Leaflet R2152

Jeremiah Davis, graduate research assistant;  
Nathan Albers, undergraduate research assistant;  
Hongwei Xin, professor; Jay Harmon, professor, dept. of  
agricultural and biosystems engineering;  
Ron MacDonald, PE, Agviro Inc., Canada

### Summary and Implications

Temperature profiles of floor surfaces covered by heat lamps depend on lamp size and height. Heat lamps with the same power output do not necessarily produce the same temperature profiles of the heated surface. A given temperature profile of the heated area may be achieved by adjusting the height of the same heat lamp or varying the power input to the heat lamp while keeping its height. The latter will lead to energy savings.

### Introduction

Heat lamps are commonly used to provide localized creep heating in swine farrowing systems, thus meeting the different thermal needs by the newborn piglets (90-95°F) and by the sow (65-68°F) in the same room. The effectiveness of heat lamps as a local heat source depends not only on the size of the lamp but also on the spatial distribution of radiant heat.

The objective of the study was to compare temperature distribution of six commercially available heat lamps at 18-, 22- and 26-inch heights when used with a conventional metal heat lamp fixture or a newly developed, commercially available plastic lamp fixture.

### Materials and Methods

Both a conventional metal heat lamp fixture (metal) and a new Retroliter® Hang Straight™ (plastic) heat lamp fixture (Figure 1) were suspended at three heights (18 inch, 22 inch, 26 inch) from the heated surface (rubber mat on plastic slat flooring) in the center of a controlled test room (Figure 2). The room ambient temperature was held at 68±2°F. Height was measured from the mat surface to the lamp face. Six commercially available PAR 38 incandescent infrared heat lamps were used in this study. Lamp size, brand and surface treatment are described in Table 1 and illustrated in Figure 3. Three replications of each type of lamp were individually installed and allowed to stabilize for 5 minutes before acquiring a thermograph using an infrared (IR) camera (0.1°F sensitivity, model PM250, FLIR, Inc., North Billerica, MA) positioned 64 inches directly above the mat. The thermograph was taken instantly following removal of the heat lamp. The rubber

mat was cooled down for 10 minutes using a fan before the next thermographical measurement was taken.

A Retroliter® CZ20 Dual Power Controller (Figure 4) was evaluated with the plastic lamp fixture using a single 175SYL lamp at three heights (18, 22 and 26 inch) and three power settings (100W, 125W and 175W).

The thermographs were analyzed using the companion Thermonitor® software to determine mat surface temperatures. Average radial temperature profiles were constructed using eight (45° apart) temperature profiles extending 16 inches from the center of the heated mat area.

### Results and Discussion

Example thermographs of 100SYL, 125HOG, 125SLI, 175SYL, 175PLP and 250SLI lamps using the plastic lamp fixture at the 18-inch height are presented in Figures 5a-10a, respectively. Each thermograph has a 36-inch, 2-D temperature profile through the center of the heated area to illustrate the variation in mat surface temperature. The thermographs demonstrate spatial variation near the center due to the heating element for the clear surface lamps (125HOG; Figure 6a, 125SLI; Figure 7a and 250SLI; Figure 10a). The 175PLP lamp exhibited the largest radial temperature gradient (~72°F). The 100SYL and 175SYL lamps displayed a more uniform radial temperature.

The thermographs were compiled into 2D radial temperature profiles (Figures 5b-10b) for each lamp using both metal and plastic at 18, 22 and 26-inch heights. The plots illustrated little difference in radial temperature profiles between the metal and plastic lamp fixtures. The 100SYL (Figure 5b) and 175SYL (Figure 8b) lamps demonstrated a linear radial temperature gradient with temperature profiles converging at 14-inch radius. The 175PLP profile (Figure 9b) had the highest temperature gradient with mat surface temperatures nearing 144°F (62°C) at the center, resulting in rippling of the mat. The clear surfaced 125HOG, 125SLI, and 250SLI had highest temperature measurements between a 4 to 6-inch radius corresponding to the heating element and their heated areas had a 10-inch radius for all heights.

Temperature variation between bulbs decreased with increasing height for metal (Figures 11a, 12a and 13a) as well as plastic (Figures 11b, 12b and 13b) fixtures. The 175PLP and 250SLI lamps showed the largest temperature variation for all heights, while the 100SYL and 175SYL lamps produced linear temperature profiles.

Figures 14a-c show the temperature profiles of the 175SYL lamp for each power setting of 100, 125 or 175W at 18, 22 and 26-inch heights, respectively. Figures 15a-c show the temperature profiles for each height at 100W,

125W and 175W setting, respectively. Temperatures increased with increasing power and/or decreasing height.

A comparison of the 175SYL, using the plastic fixture and DPC, and equivalent lamps shows the utility of the system. By varying the controller setting the 175SYL lamp can operate from 175W (Figure 16a) to 100W (Figure 16c). The combination of 175SYL and DPC at 125W setting provides a more uniform temperature profile than the 125HOG and 125SLI lamps (Figure 16b). Finally in a comparison of the 175SYL with DPC (100W, 125W and 175W settings) at a height of 18 inches and the 175SYL lamps varying from 18, 22 and 26-inch heights (Figure 17) similar results are seen. The 18-inch, 100W setting was similar to 175W at 26 inches; 18-inch, 125W setting to 175W at 22 inches; and the 18-inch, 175W settings were similar. Thus, by varying the input power instead of changing the lamp height, energy savings can be achieved.

The plastic fixture led to more visible light in the room than the metal fixture. The lamp bulb within the plastic fixture tended to hang straighter due to the flexible mounting whereas certain bulbs tended to hang off-center because of variations in screw terminals in the metal fixture.

**Figure 2: Experimental layout showing the PM250 IR camera above the plastic fixture at 22-inch height.**



**Figure 3: Lamp surface treatment (l to r) for a) 125HOG, b) 125SLI and 250SLI, c) 100SYL and 175SYL and d) 175PLP.**

**Table 1: Incandescent infrared PAR 38 heat lamps.**

	Symbol	Brand	Power (W)	Surface Treatment
1	100SYL	Sylvania	100	Fully etched
2	125HOG	Hog Slat	125	Clear
3	125SLI	SLI Lighting	125	Clear
4	175PLP	Philips	175	Etched/clear center
5	175SYL	Sylvania	175	Fully etched
6	250SLI	SLI Lighting	250	Clear



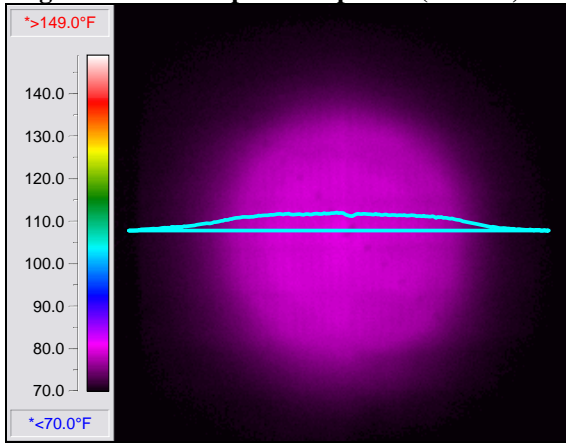
**Figure 1: Conventional metal fixture and Retroliter® Hang Straight™ plastic fixture.**



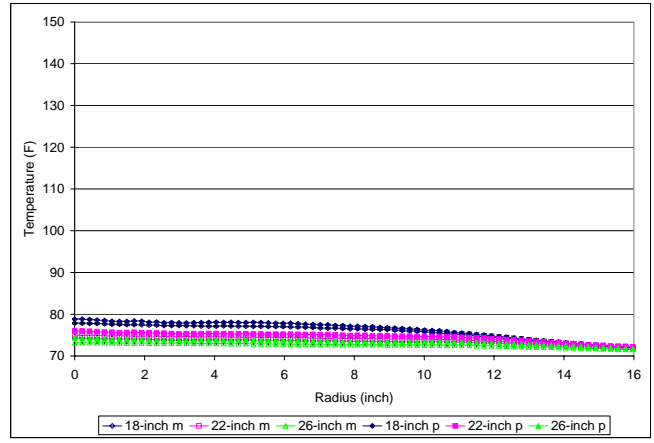
**Figure 4: Retroliter® CZ20 Dual Power Controller (DPC) with three power settings (100W, 125W and 175W) paired with the plastic fixture.**



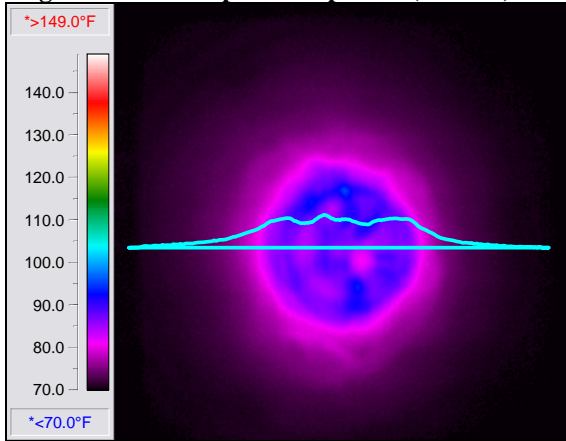
**Figure 5a: 100SYL lamp in plastic fixture at 18-inch height with 2-D temperature profile (36-inch).**



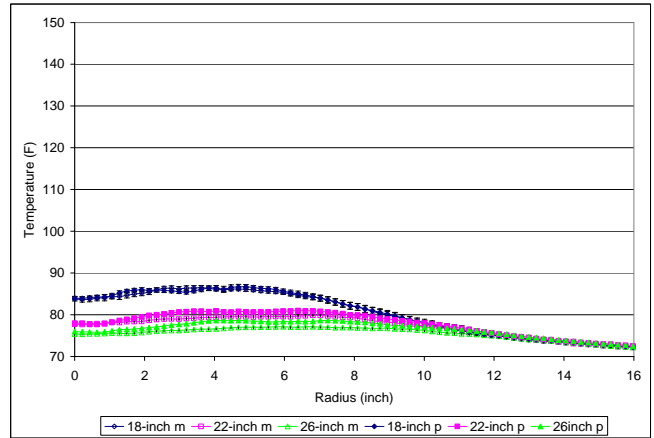
**Figure 5b: 100SYL lamp using metal or plastic fixtures at 18, 22 and 26-inch heights (3 reps).**



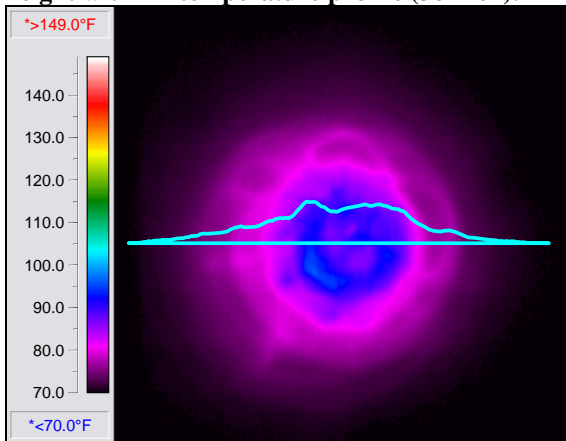
**Figure 6a: 125HOG lamp in plastic fixture at 18-inch height with 2D temperature profile (36-inch).**



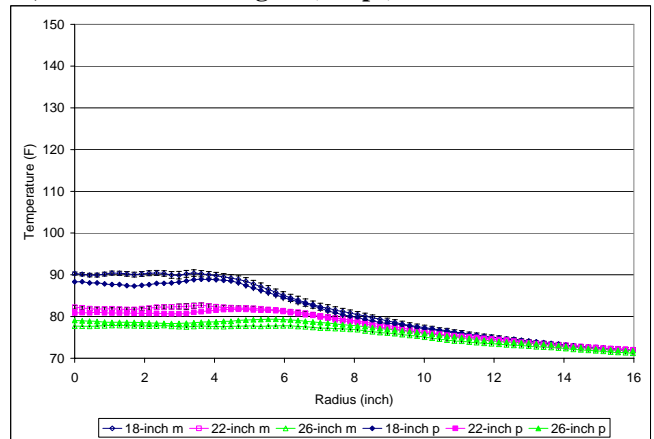
**Figure 6b: 125HOG lamp using metal or plastic fixtures at 18, 22 and 26-inch heights (3 reps).**



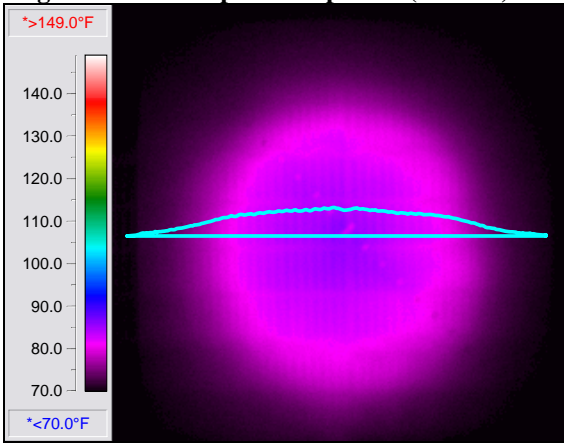
**Figure 7a: 125SLI lamp in plastic fixture at 18-inch height with 2D temperature profile (36-inch).**



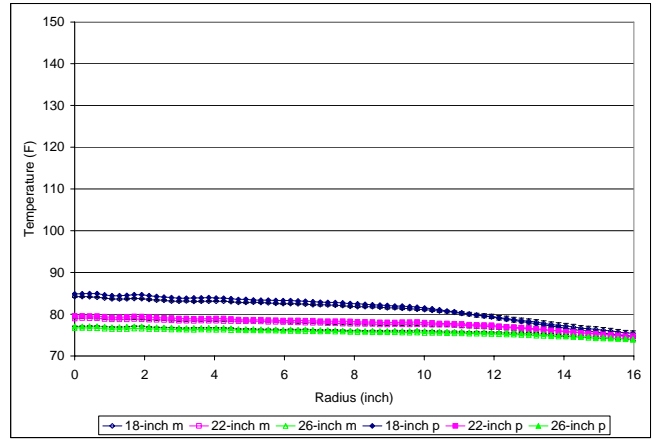
**Figure 7b: 125SLI lamp using metal or plastic fixtures at 18, 22 and 26-inch heights (3 reps).**



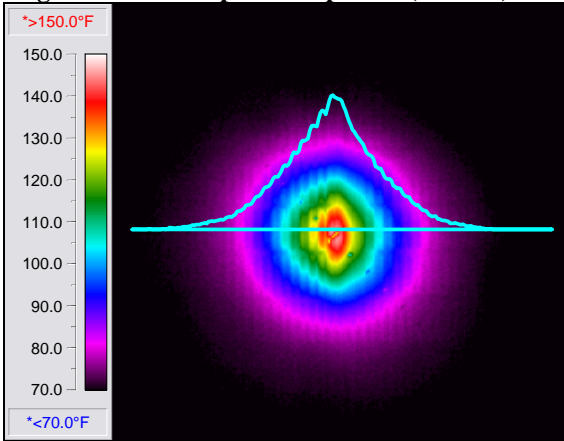
**Figure 8a: 175SYL lamp in plastic fixture at 18-inch height with 2D temperature profile (36-inch).**



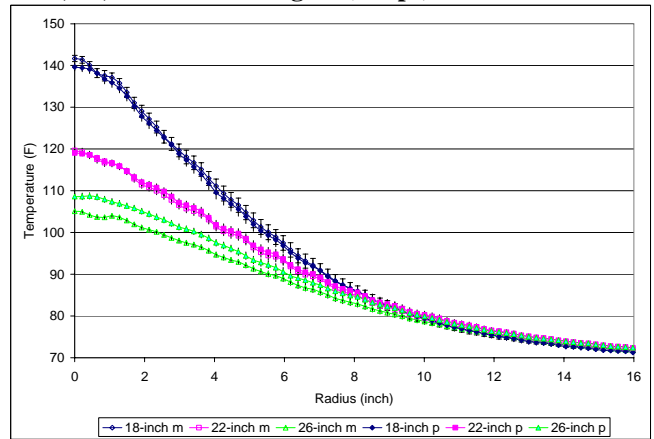
**Figure 8b: 175SYL lamp using metal or plastic fixtures at 18, 22, and 26-inch heights (3 reps).**



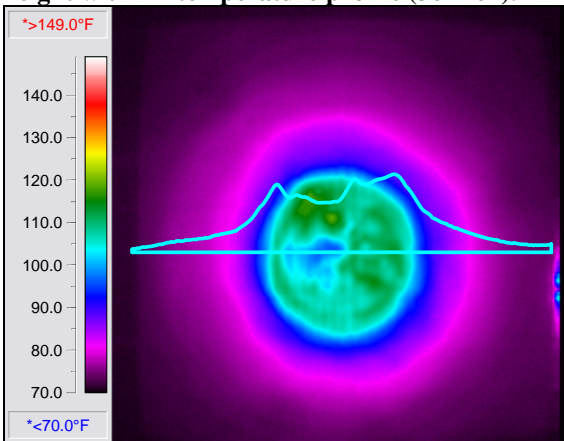
**Figure 9a: 175PLP lamp in plastic fixture at 18-inch height with 2D temperature profile (36-inch).**



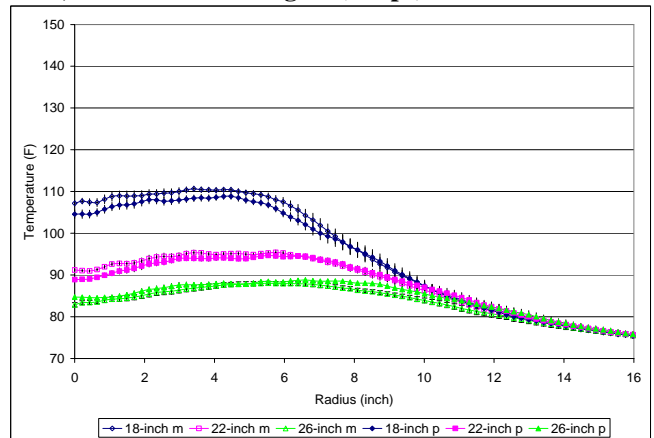
**Figure 9b: 175PLP lamp using metal or plastic fixtures at 18, 22, and 26-inch heights (3 reps).**



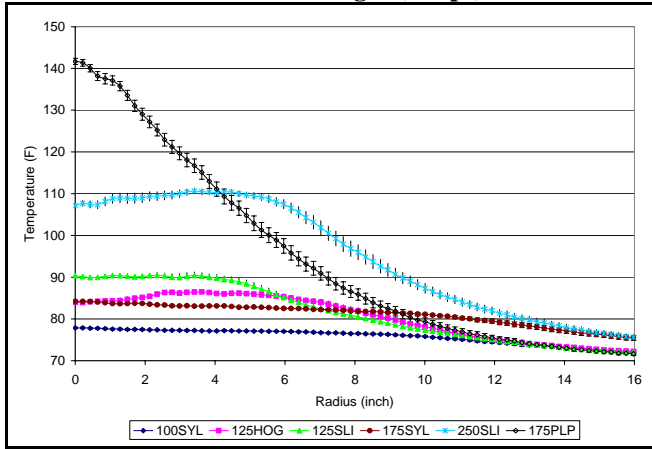
**Figure 10a: 250SLI lamp in plastic fixture at 18-inch height with 2D temperature profile (36-inch).**



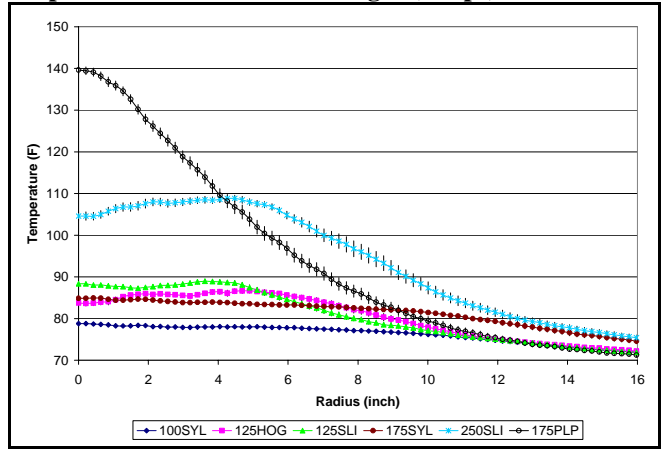
**Figure 10b: 250SLI lamp using metal or plastic fixtures at 18, 22 and 26-inch heights (3 reps).**



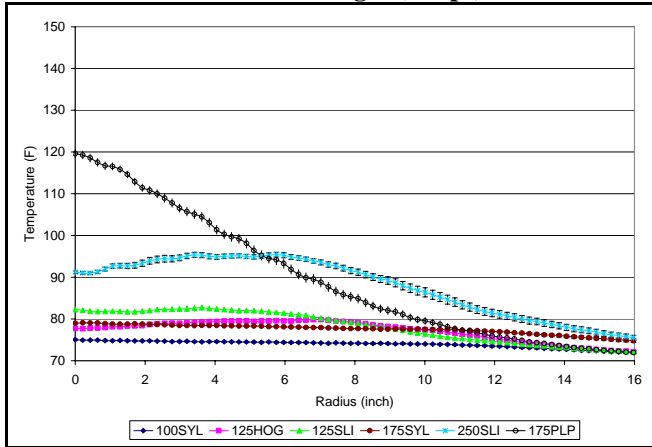
**Figure 11a: Temperature and radial length comparison for metal fixture at 18-inch height (3 reps).**



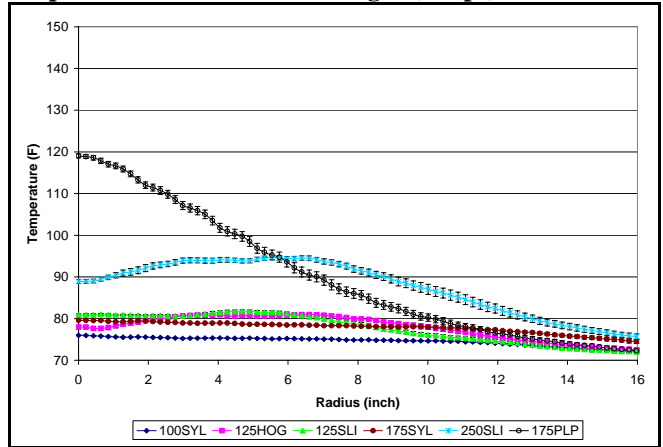
**Figure 11b: Temperature and radial length comparison for plastic fixture at 18-inch height (3 reps).**



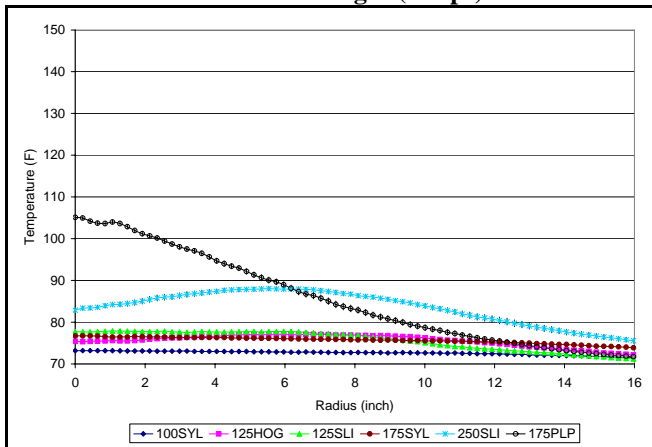
**Figure 12a: Temperature and radial length comparison for metal fixture at 22-inch height (3 reps).**



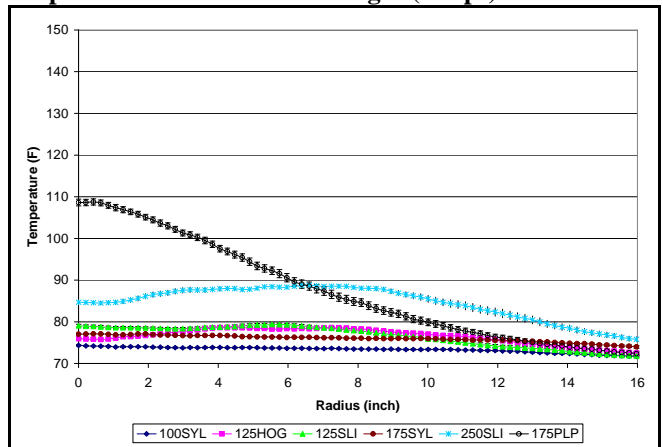
**Figure 12b: Temperature and radial length comparison for plastic fixture at 22-inch height (3 reps).**



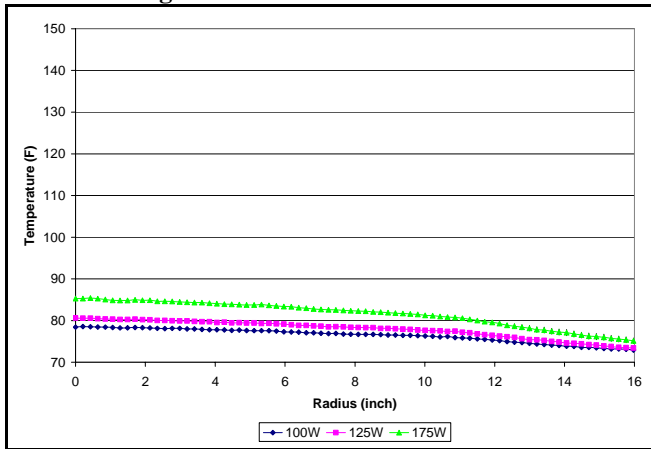
**Figure 13a: Temperature and radial length comparison for metal fixture at 26-inch height (3 reps).**



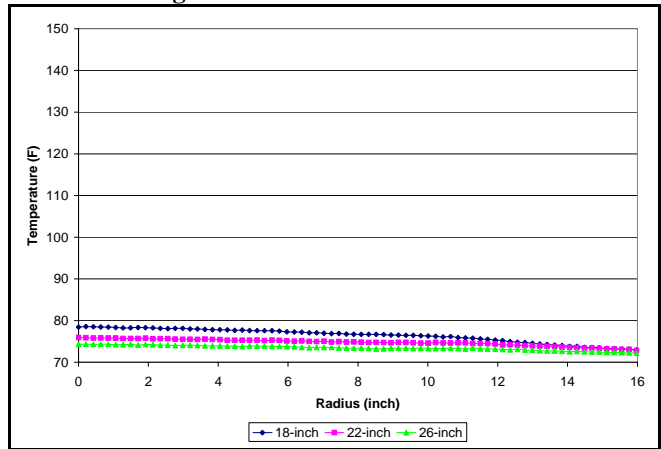
**Figure 13b: Temperature and radial length comparison for plastic fixture at 26-inch height (3 reps).**



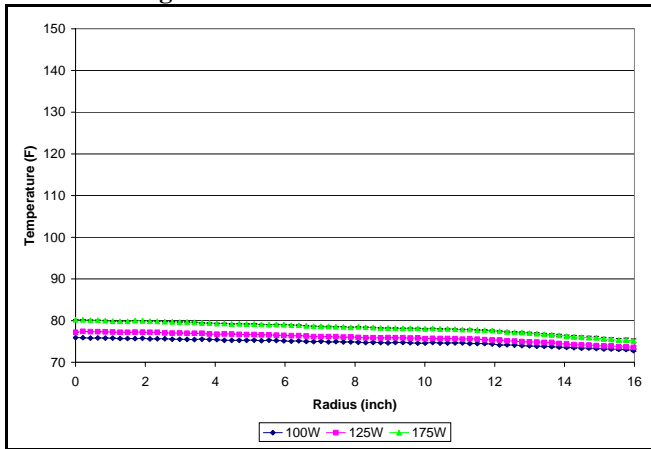
**Figure 14a: 175SYL Lamp with plastic fixture and DPC at 18-inch height.**



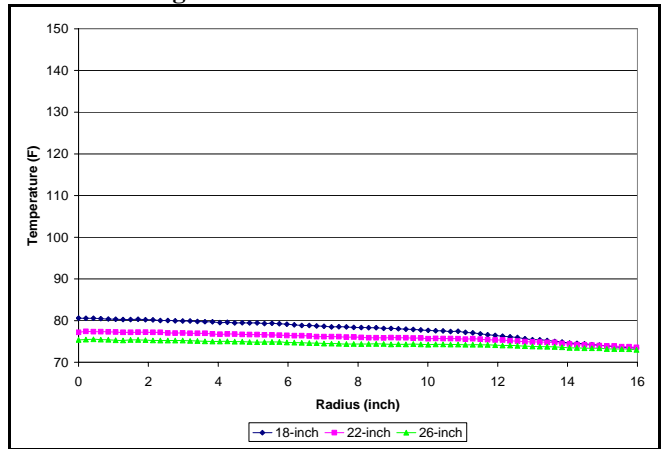
**Figure 15a: 175SYL lamp with plastic fixture and DPC at 100W setting.**



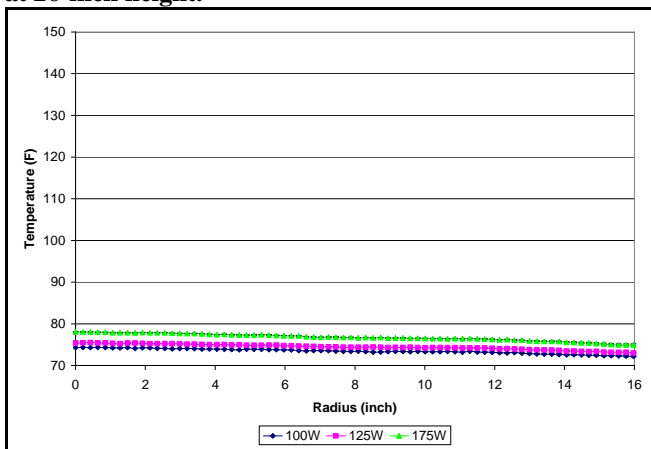
**Figure 14b: 175SYL lamp with plastic fixture and DPC at 22-inch height.**



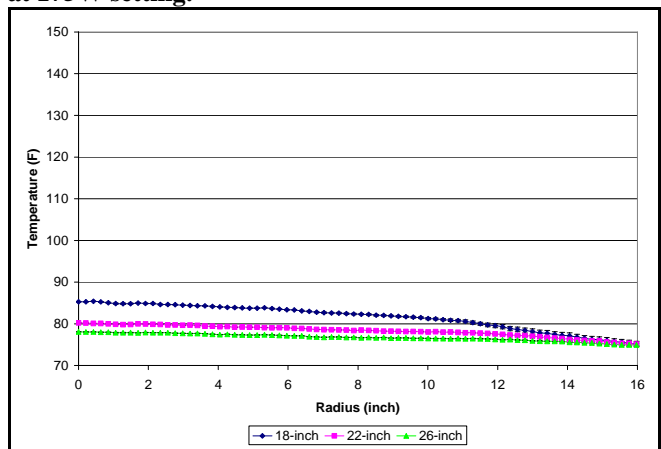
**Figure 15b: 175SYL lamp with plastic fixture and DPC at 125W setting.**



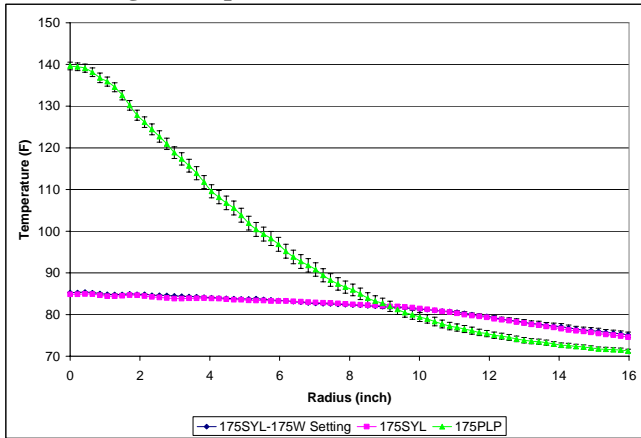
**Figure 14c: 175SYL lamp with plastic fixture and DPC at 26-inch height.**



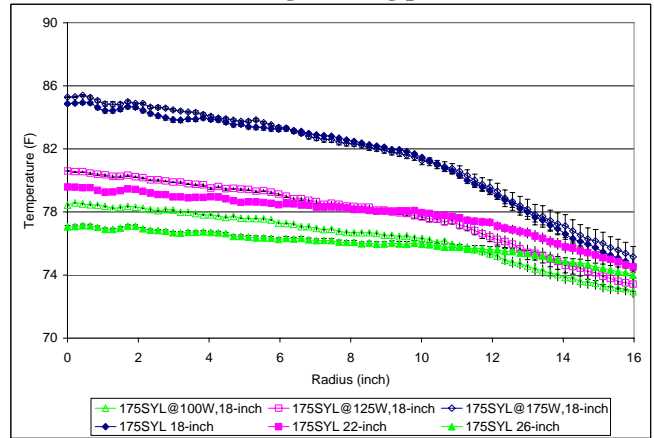
**Figure 15c: 175SYL lamp with plastic fixture and DPC at 175W setting.**



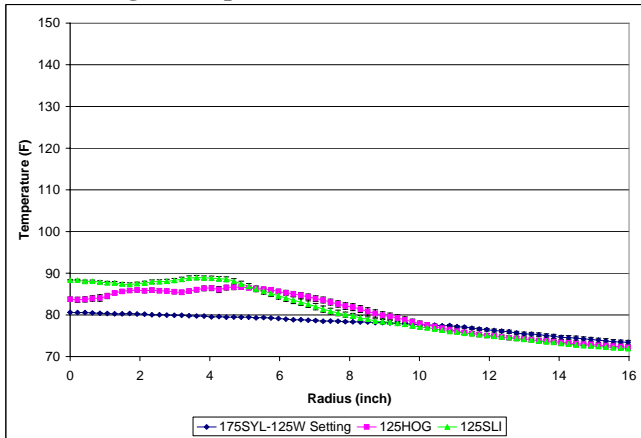
**Figure 16a: Comparison of 175SYL with DPC (175W setting) and 175SYL and 175PLP using plastic fixture at 18-inch height (3 reps each).**



**Figure 17: Comparison of 175SYL using DPC (100W, 125W and 175W settings) at 18-inch height vs. 175SYL at 18, 22 and 26-inch heights using plastic fixture.**



**Figure 16b: Comparison of 175SYL with DPC (125W setting) and 125HOG and 125SLI using plastic fixture at 18-inch height (3 reps each).**



**Figure 16c: Comparison of 175SYL with DPC (100W setting) and 100SYL using plastic fixture at 18-inch height (3 reps each).**

