

# EVALUATION OF AN INFRARED TWO-STAGE HEATING SYSTEM IN A COMMERCIAL APPLICATION

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ASHRAE Research Project Number: 4643

## OBJECTIVES

To determine effectiveness (fuel utilization and comfort) of a two-stage heating system designed to provide space heating and offset elevated losses from overhead door usage.

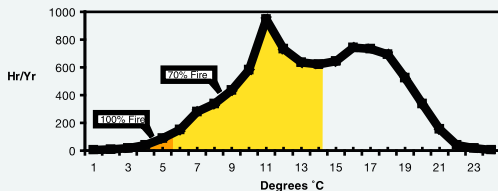


Figure 1 - Hours per Year of High Fire and Low Fire

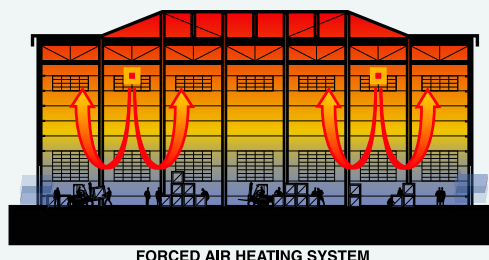
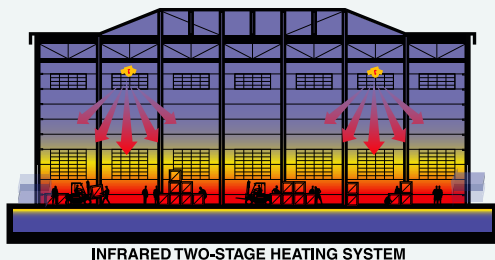
To determine how a two-stage heat system better meets heat requirements vs a forced air heat system

## SITE DESCRIPTION

Commercial facility, with frequent overhead door openings facilitating the movement of supplies.



Installed a forced-air unit heater (FA) and a tube-type infrared heater (IR) that operate by a common thermostat with a manual override switch to allow either FA or IR operation.



## Test 4

December 15-March 25 2000-2001 and 2001-2002 Target IR set-point 17 C (Average actual delta T inside to outside for two time periods was 21.3 C IR and 21.8 C)

- IR and FA systems cycled weekly 2000-2001.
- IR only 2001-2002.
- Saved 25.4 % with continuous infrared vs weekly interval IR vs FA.

## CONCLUSIONS

- IR heating saved up to 23% over a conventional FA heating system.
- The thermal flywheel effect in the slab contributes to energy use efficiency.
- A weekly cycle of FA vs IR is not a useful method of evaluating potential in either system due to the flywheel effect.
- Two stage infrared heat system ran on low fire longer than FA per on-cycle; plus only used high fire 8-23% of the total on-time for heating.

## PROCEDURES AND METHODS

- Measure temperatures at 10 minute intervals, outside and variety of inside and slab locations.
- Measure gas usage daily at designated times., conduct regular interviews with staff on comfort
- Predetermined operating cycles for FA and IR heater (i.e. alternate weeks, etc.).

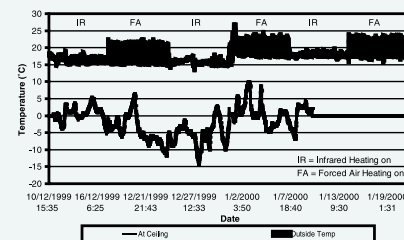


Figure 2 - IR vs. FA Temperature Cycling

## RESULTS

### Test 1

October 1, 1999-February 17, 2000 Target set point was 17 C

- To establish a test methodology using the system and verifying the controls.
- Systems operated during the heating season at 1-2 week alternating equal intervals, FA then IR.
- Energy savings comparing FA and IR proved minimal.

- 1) Was the retained IR heat energy in the concrete slab "used" by FA system?
- 2) Did the IR and FA heaters, when operating at the same set-point provide comparable comfort levels ?

### Test 2

Feb 18-Apr 28, 2000 Target set-point for IR 16 C and FA 19 C (Actual average 13.2 C IR and 17.7 C FA)

- Systems operated during the heating season at 1 week alternating intervals.
- IR savings measured 19.5%, savings influenced by the lower set-point of IR.

### Test 3

October 16, 2000-April 12, 2001 Target set-point for IR 14 C and FA 17 C (Actual average was 21.2 C IR and 18.9 C FA)

- Systems operated during the heating season at 1 week alternating intervals.
- IR savings measured 23.0% (note: average temperature higher for IR).

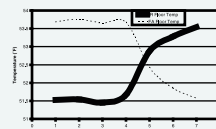


Figure 3 - Slab Temperature Changes of FA and IR

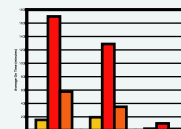


Figure 4 - Average IR Low / High Fire vs. FA Operating Time

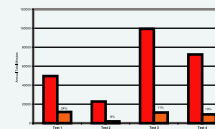


Figure 5 - IR Total On Time: Low vs. High Fire

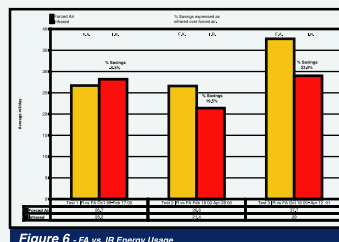


Figure 6 - FA vs. IR Energy Usage

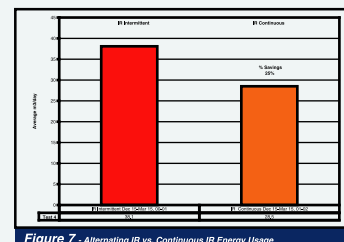


Figure 7 - Alternating IR vs. Continuous IR Energy Usage