

TECHNICAL REPORT



SUMMARY OF AN INDEPENDENT STUDY DOCUMENTING THE ADVANTAGES OF TWO-STAGE INFRA-RED HEATING

INTRODUCTION:

DETROIT RADIANT PRODUCTS COMPANY developed and introduced the RE-VERBER-RAY Two-Stage *HL Series* (high-low) in early 1993. A study was undertaken to objectively document the benefits of two-stage infra-red heating. In cooperation with its' Canadian associate company, Brant Radiant Heaters, Ltd., Detroit Radiant contacted RDM Engineering and requested that a documented study be compiled. In October 1993 RDM Engineering, an independent research firm, engaged a test that documented and demonstrated the benefits of the *HL Series*.

The patented design of the *HL Series* features a "calculated input differential" which allows the heater to operate in a "high-fire" or a "low-fire" mode. The differential between the two levels of operation is 30%. ASHRAE weather records show that an average of 90% of the degree hours within the USA can be satisfied by operations in "low-fire." Only 10% of degree hours will require operation in the "high-fire" mode. What this means is that this heater will adjust to the environment,



The inside of the test site, representing a typical industrial building and showing the RE-VERBER-RAY Two-Stage *HL Series*. This heating system objectively documented a minimum of 12% additional energy savings - and a 35% reduction in "On and Off Cycles" - when compared to a single input system.

producing the most comfortable and economical infra-red heat available. The building will be comfortably heated during a moderately cold day, yet the heaters are capable of satisfying the design heating capacity on the coldest of winter days. The test facility was carefully selected to reflect not only typical industrial building construction, but

THE TEST SITE:



The test site selected in October 1993 to objectively document the benefits of the RE-VERBER-RAY Two-Stage *HL Series* by an independent research firm.

also a commitment by management and staff that consistent work patterns would be maintained during the test period. A detailed heat loss study of the test facility prior to the start of the test period documented a total building heat loss of 200,000 BTU/H.

[Installation Details - **Ceiling:** 20' high, R20 insulation, steel interior sheathing and fiberglass, tar and gravel roof. **Walls:** 8" concrete block, non-insulated. **Doors:** Two 3' x 8' exterior doors, one 10' x 12' overhead. **Windows:** none. **Use:** HVAC contractor, equipment repair and storage.]

TEST PROCEDURE:

Two 100/65 MBTU/H *HL Series* were installed along with Honeywell T775-A1019 controllers.

For this "real world" test, the heaters operated on alternate days one of two ways: [1] On "two-stage," whereby the heaters were either "off," or allowed to switch automatically between the "low-fire" (65 MBTU/H) and the "high-fire" mode (100 MBTU/H) or; [2] On "single stage," whereby the heaters were either "off" or running in "high-fire" mode (100 MBTU/H), simulating a single stage unit.

The two alternate operating possibilities of "low" and "high," as noted above, were switched on a controlled 24-hour cycle, with the level of heat output based on actual building heating demand. This methodology provided the necessary controls to objectively compare the two alternative heating methods.

HL SERIES

State-of-the-art, two-stage gas-fired infra-red heater

RESULTS: As the findings below will attest, the RE-VERBER-RAY *HL Series* has proven cost-saving benefits over single-stage infra-red heaters. Documented fuel savings, reductions in on/off cycles, faster recoveries and increased comfort levels are some of the benefits that one can expect by using the *HL Series*.

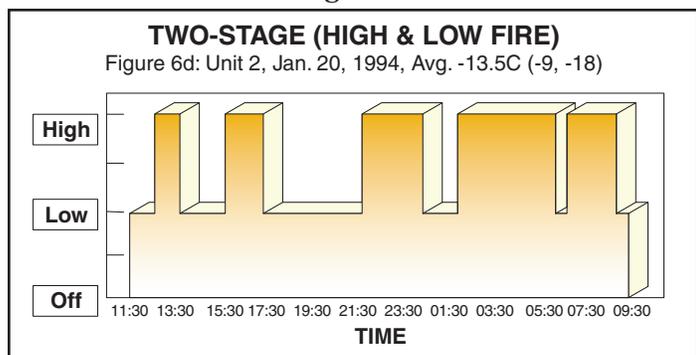
THE FINDINGS:

The test period ran from October 15, 1993, to April 15, 1994 (184 days or 1/2 year). During this time, the “single-stage” portion of the test (where the heaters ran only at 100 MBTU/H) and the “two-stage” portion of the test (where the heaters were allowed to switch between 65 MBTU/H and 100 MBTU/H based on heating demand) were each in operation for 92 days. The average outside temperature for the “high” portion was -2.3°C (28°F) and for the “two-stage” portion -1.3°C (29.5°F).

The first of the RE-VERBER-RAY *HL Series* units had an average cycle time of 39.5 minutes on “high,” and 78.1 minutes on “low,” again demonstrating longer heater operation on “low fire.” On the second unit, the number of on/off cycles was reduced by 36.5%.

Natural gas consumption was reduced using the “low” operation for the two *HL Series* units by 12% during the six-month period - **a savings of 23,018 cubic feet of natural gas.**

Figure 1



These two graphs, reproduced with permission from the RDM Engineering Report, dramatically demonstrate the operating differences between the two-stage and single-stage input infra-red alternatives.

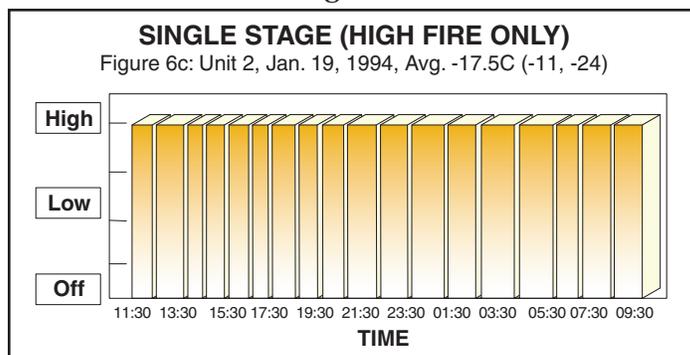
CONCLUSION:

The RE-VERBER-RAY Two-Stage *HL Series* has been shown to be a more efficient heating system than standard single-stage infra-red heaters.

A minimum savings of 12% in energy usage was documented using the *HL Series*. This is in comparison to single-stage infra-red heaters. Other benefits that this study revealed were:

- 35% reduction in on/off cycles, resulting in improved employee comfort (see figures 1 and 2).
- Improved product life due to the reduction in on/off cycles.
- Overall improved operating efficiency, reducing carbon dioxide emissions.
- Faster recoveries. Energy is not wasted reheating the exchangers when “high-fire” is called for.
- Design benefits. The *HL Series* allows you to design your building in accordance with “worst case” design temperature. Realistically, this rarely occurs and the heater will make the appropriate adjustments.

Figure 2



RDM ENGINEERING

Over the past 12 years, Guelph, Ontario based R.D. Mac Donald, P.E., and RDM Engineering have researched and produced a number of scientific, technical and informational papers on the subject of energy efficiency, as well as tested and reported on other energy matters for a wide variety of clients. Serving as an Energy Advisor and Energy Specialist to government, major utilities and private sector clients, Mr. Mac Donald and RDM Engineering remain actively involved in a broad spectrum of energy matters, including their recent testing and reporting on the RE-VERBER-RAY Two-Stage, High-Low *HL Series* detailed in this Technical Report.