

ROBERTS GORDON®

INFRARED HEATING

**TWO-STAGE
TANDEM**

VS

**CORAYVAC®
MODULATION**

800.828.7450

www.robertsgordon.com

Facts About Two-Stage Parallel Heating Systems

Further Investigation Reveals the Proper Way to Maximize Fuel Savings

Conceptually two-stage (or sometimes referred to as "high/low") systems claim to incorporate system modulation, energy savings and improved efficiencies, but the following proves otherwise:

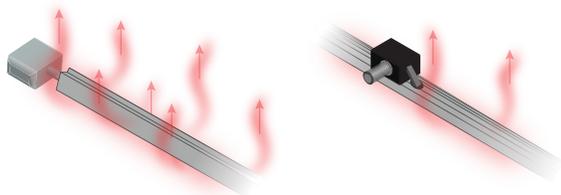
2016 ASHRAE Handbook "HVAC Systems and Equipment" 33.5: "Fuel savings with two-stage firing rate systems may not be realized unless both the gas and the combustion air are controlled."

Lower Thermal Efficiency

FACT: The thermal efficiency at low fire is 2% lower than the thermal efficiency at high fire.

High/low heaters only reduce the gas flow in the low mode; **combustion airflow remains unchanged.** This causes a diluted inefficient combustion with increased energy losses up the chimney. An independent certified testing laboratory tested a 40' 150,000 Btu heater in both the high and low modes. At full input the unit had a thermal efficiency of 79.82% and at low fire the unit had a thermal efficiency of 77.86%.

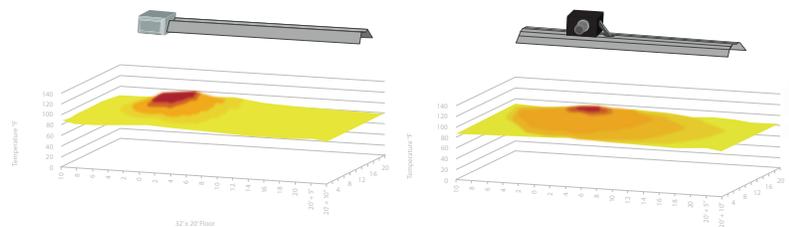
With reductions in thermal efficiency in the low fire mode, it is impossible to save energy without also sacrificing some comfort. Operating at low fire the majority of the heating season will increase operating costs. In addition, two-stage systems allow limited control over meeting heating demands because they only fire at two rates.



Lower Radiant Efficiency

FACT: The radiant efficiency of a two-stage heater at low fire can be 6.85% lower than the radiant efficiency of a heater at high fire

As stated earlier two-stage systems only reduce the gas flow in the low mode, combustion airflow is unchanged. Tested in accordance to AHRI 1330 "Performance Rating Standard for Radiant Output of Gas-Fired Infrared Heaters" verified the following: **Excess air in the heat exchanger** causes a reduction in overall tube temperatures, translating into a reduction in radiant efficiency. As demonstrated by The Stephan Boltzman Law, a small decrease in tube temperature causes a significant reduction in the emissive power due to the fourth power temperature relationship.

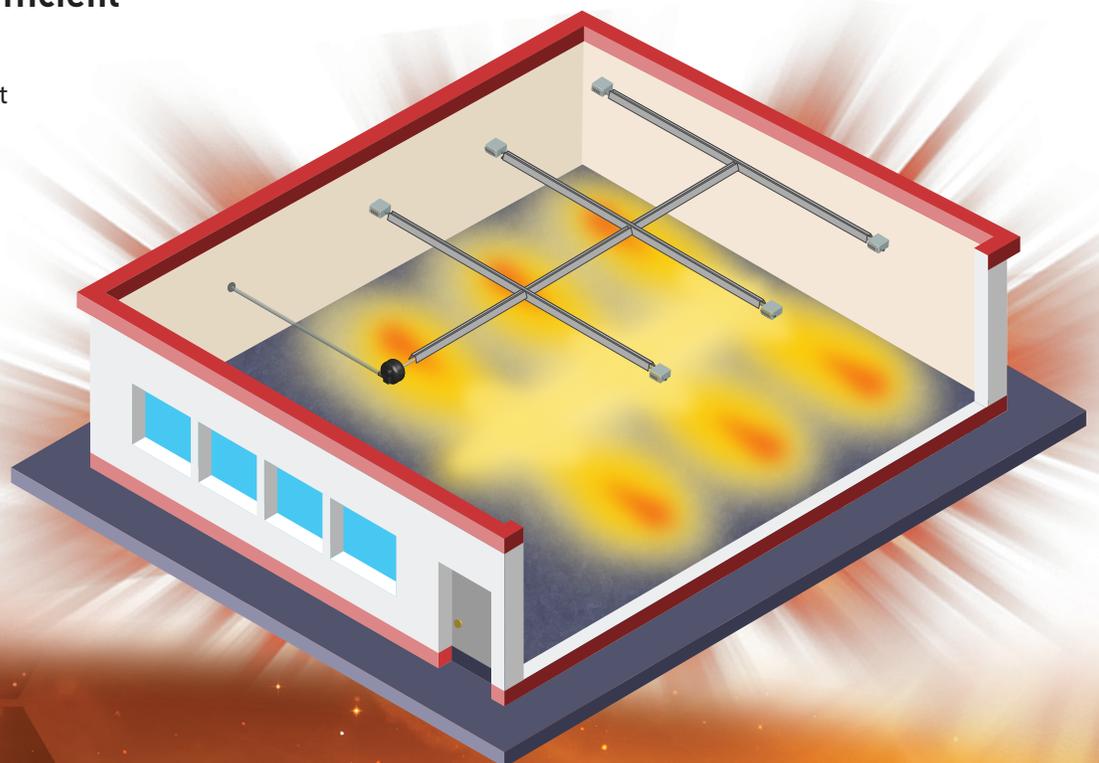


$$\text{Radiation heat flux, } q_r, \text{ Btu/ft}^2\text{hr} = 0.1713 \times 10^{-8} \times (T_s^4 - T_r^4) \times F_e \times F_a \quad \text{where } T \text{ is in degrees Rankine}$$

Two-Stage Parallel System: A good concept, but inefficient

Parallel systems, also referred to as "Tandem Burner Design" systems, are engineered systems that consist of multiple burners connected to a common manifold. Because the large majority of heat is located at the burner, this design struggles to maximize heat distribution and provide an even radiant charge, even when designed properly. (Show multi-burner heat pattern)

In addition to a decrease in heat distributor, a two-stage parallel system reduces thermal efficiency which in-turn reduces comfort levels. As the two-stage burners in the system drop to lower inputs, the system is over-aired causing a reduction in thermal efficiency, comfort levels translating into a lower radiant efficiency and reduces fuel savings.



True Heating System Modulation

CORAYVACTM

ROBERTS GORDON[®]

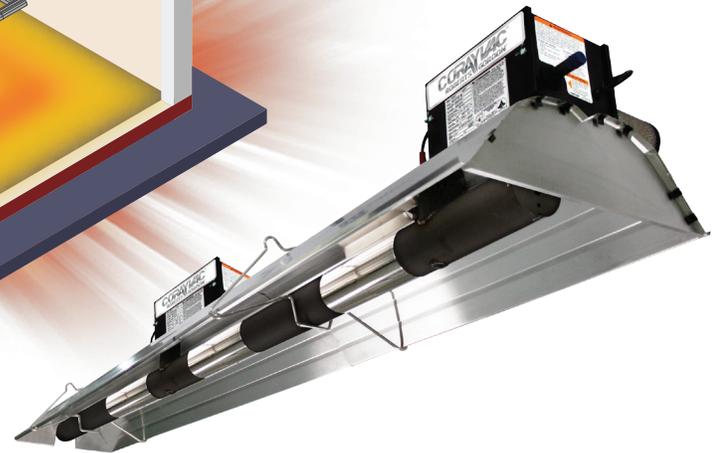
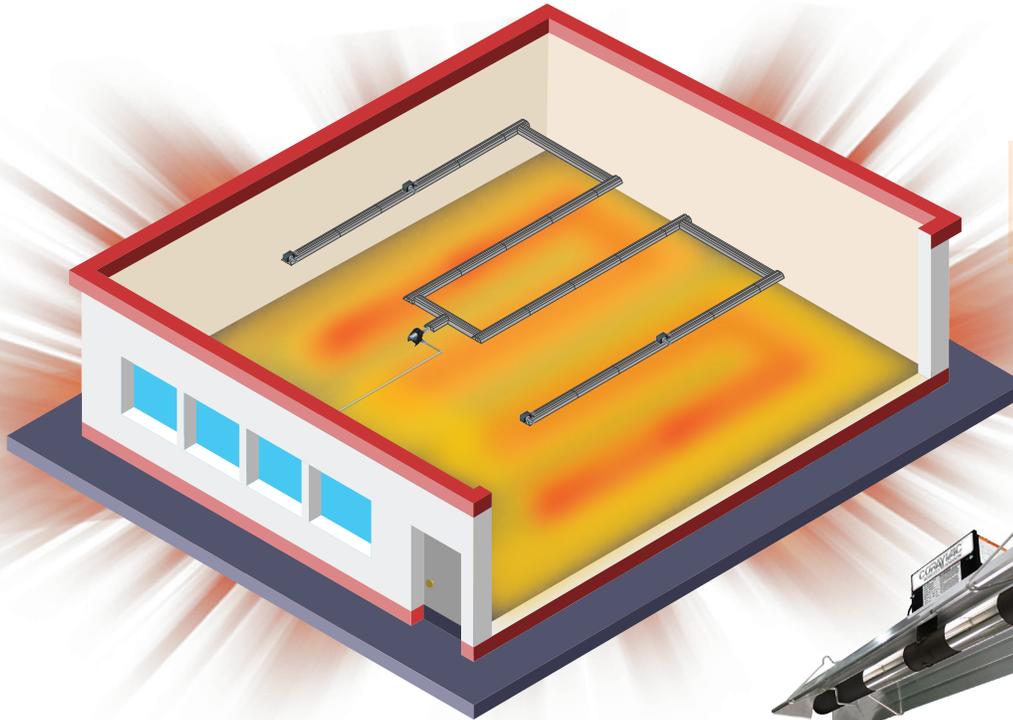
Burners-in-Series System:

Energy efficient, low maintenance, comfortable even heat

A custom engineered system with the ability to be designed to condense, CORAYVAC[®] burners-in-series heating systems are the only true way to maximize heat distribution to obtain an **even radiant charge**. The unique "burners-in-series" feature distributes heat further throughout the system than any other infrared heating system on the market. This results in overall lower tube temperatures

which increases thermal efficiency keeping consistent and comfortable heat patterns throughout the entire facility. (Show nice CRV system heat pattern)

FACT: The only way to properly operate a heater with variable input modes is to carefully control both the fuel and air ratios.



True Modulation with CORAYVAC[®]

CORAYVAC[®] burners feature a unique "zero pressure regulator" that varies gas input via system vacuum. A variable speed vacuum is incorporated to modulate system pressure. As the vacuum pressure increase and decreases the gas input in the CORAYVAC[®] burner remains linear while maintaining an even gas/air ratio. Controlling both fuel and air simultaneously provides constant and optimum combustion, thus increasing radiant efficiency and thermal efficiency **as firing rate decreases**. True energy savings and greater thermal and radiant efficiencies can only be realized when using burners-in-series heating systems with continuous modulation.

Our advanced control offerings feature a modulating control algorithm with zoning capabilities for an energy efficient approach that will provide the precise amount of heat when and where it is needed. As the only infrared heating company that modulates based on outside air temperature, the CORAYVAC[®] modulation algorithm allows your heating system to operate at peak efficiency throughout the entire heating season. HOW IT WORKS: As outside temperature rises, the system compares the outside air temperature to the inside space set points and will modulate appropriately. When the temperature outside

decreases, the output of the infrared heating system inside will increase. The opposite occurs when the outside temperature increases. The result is an increase in thermal efficiency to provide unmatched comfort and fuel savings.

- **Provides real energy savings** by matching the heating system's input to the building's heat load requirement resulting in longer heater run times, as opposed to frequent heater cycling.
- **Increases comfort and energy efficiency** by eliminating temperature setpoint "overshoot". **Maintains radiant efficiency and increases thermal efficiency as firing rate decreases.**
- **Minimizes "intense" feel** during moderate outdoor temperature conditions.
- **Provides more accurate control** over meeting heating demands **by allowing even the slightest change in heater firing rate anywhere** within the 60-100% range.



CORAYMACTM

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Printed in U.S.A.

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