How to Select the BEST Space Heater

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Key Concepts

- *Determine all heating and ventilating needs for the building*
- *Consider "Total Cost" = Equipment Cost + Installation Cost + Operating Cost + Impact Cost*
- *High energy costs are a key factor in space heater selection and application*

Is the heating bill for your commercial building, manufacturing plant or warehouse facility too high? What about cold dock door areas and unbalanced temperatures? Is negative building air pressure a problem? Have you experienced employee complaints and lost productivity from heating or indoor air quality problems? How about high maintenance costs for existing heating equipment? These are just a few common problems that result from selecting the wrong heating system, misapplying space heaters or using obsolete heating/ventilating equipment in your facility.

Annual space heating costs are a significant part of operating budgets for large commercial and industrial facilities. Selection and proper application of the BEST space heating system can reduce annual heating costs by over 60% and increase company profits by millions of dollars over the long service life of this equipment.

What factors determine the BEST space heating system?

Everyone wants the BEST heating and ventilating system that meets their unique requirements at the lowest "Total Cost". So before selecting a certain type of heater, one must define the heating/ventilating requirements and understand all the cost factors that will determine the true lowest "Total Cost" solution for the specific facility.

Factors to consider:

1. How important are balanced temperatures throughout the building, from wall-to-wall and floor-to-ceiling?
2. Where will the heating system be located? Will it consume valuable floor, ceiling or racking space that could have been used for manufacturing or storage?
3. What are the facility's indoor air quality and ventilation requirements? How much fresh air is required by local codes or industry guidelines to dilute contaminates generated by LP forklift trucks welding fumes or other manufacturing processes?
4. Is spot heating or zone heating required?
5. How will the dock door areas be heated and how fast are temperatures recovered?
6. What are acceptable noise levels?
7. Is make-up air (MUA) needed to compensate for exhausted air?

Total Cost includes:

1. Initial equipment purchase price
2. Installation and start-up costs:
    - Gas piping and electric wiring
    - Labor costs
    - Roof penetrations and structural supports
    - Interference with on-going facility operations
3. Operating costs:
    - Energy Costs: Gas, oil, steam and electricity costs. How expensive is the source of energy and how efficient is the heating system?
    - Maintenance: Cost of manpower and replacement parts required to keep the heating system operational and efficient. .
    - Service life of the system
4. Facility impact costs (performance)
    - Impact on indoor air quality (IAQ)
    - Gain/loss of valuable floor or racking space
    - Employee comfort/complaints/productivity

Gas-Fired Space Heating Systems

Gas-fired heating systems normally offer the most cost effective way to heat commercial and industrial buildings. Electric and oil-fired heaters are sometimes used for very specific space heating applications or when gas is not available for the building.

*The seven commonly used gas-fired commercial industrial space heating systems are categorized as being either **indirect-fired** or **direct-fired**.*

Indirect-Fired Heating Systems use some method of heat transfer, such as a heat exchanger or radiant tubes that lower overall energy efficiency. A flue is required to vent products of combustion outside the building. They primarily recirculate inside air with little or no provision for ventilation with outside air. The four types of indirect-fired heating systems are described below.

1. **Boiler Systems (Steam and Hot Water)** have historically been a major source of industrial heat and power. These centralized systems were often used for space heating when energy costs were low, or when steam was a by-product of boilers used for near-by process heating applications. However space heating with boilers is becoming a thing of the past for many types of commercial/industrial buildings due to their poor efficiency, rising energy prices, uneven heat distribution and high maintenance costs. Many large facilities are now replacing boiler heating systems with more efficient gas-fired space heaters and using the energy savings to pay for the new equipment.

2. Unit Heaters are a common and proven method of heating small, open spaces. Multiple heaters are installed around the perimeter to match heat losses. Contractors like unit heaters because they are a stock item. Other advantages include redundancy in case

one unit fails, intermittent fan operation that reduces electrical costs and installation near the ceiling so they don't take up floor space. Due to limited air throw, their efficiency decreases with mounting height above the floor. Initial installed cost is low for small facilities with a few unit heaters but can be very high for large buildings that require many heaters. A significant amount of heat and energy go up the flue. Typical overall efficiencies vary from 60% to 75%. They provide no building ventilation and IAQ problems can occur in negative air buildings where the flue gas can back draft in to the facility. Unit heaters are often used in conjunction with make-up air (MUA) heaters in warehouses or industrial plants with constant or variable exhaust loads for ventilation.

3. Air-Turnover (Air Rotation) Heating Systems are tall, constantly running floor-mounted units that heat indoor air and typically rotate the building air a minimum 1 to 2 times per hour. Cold re-circulated air is drawn into the bottom of the unit with hot air blown out the top and directed across the ceiling. This is another way to heat larger facilities with indirect-fired technology. However these systems offer less zone control and higher ceiling temperatures reduce efficiency. These units can also be fitted with cooling coils for use in the summer. Manufacturers claim heating efficiency of 70% to 80% depending on the number of air turnovers per hour. Initial equipment costs for air-turnover systems can get expensive and the large units consume valuable floor and racking space. Since fans run constantly, electrical costs are a factor and the large floor mounted blowers can be noisy.

4. Tube-Style Infrared (Radiant) Heaters burn gas inside a long tube, creating radiant heat from the tube surface. A polished reflector directs the radiant heat down to the floor. They are excellent for heating objects; spot warming where people are standing around and specific zone heating applications. Published efficiency is 80% to 92% based on moderate tube length and mounting heights of 15 to 18 feet above the floor. Shorter tube lengths, higher mounting heights and dirty reflectors can reduce operating efficiency below 70%. Infrared heating systems can be expensive to install in large buildings. Maintenance costs are a factor due to dirty reflectors and the numerous gas burners required to heat large areas. Gas-fired infrared systems consume little electrical energy because they have no blowers and provide no forced air movement or ventilation. When an exhaust system is used, the building is starved for make-up air. This creates a constant path of cold air drafts when dock doors open or renders the exhaust system ineffective when the building is closed up tight. Infrared heaters are often used with MUA heaters to overcome these problems.

Direct-Fired Air Heating Systems can be very energy efficient because they do not use a flue or heat exchanger of any kind. The gas is burned directly in the air stream being heated so 100% of available BTUs are delivered to the heated space. Manufactures claim 92% burner efficiency because up to 8% of the combustion energy is not available for raising air temperature (latent vs. sensible heat). Direct gas-fired technology is an energy efficient way to provide both space heating and tempered make-up air for warehouses and industrial facilities. It has been used and proven safe for over forty years. The American National Standards Institute (ANSI) determines the US/Canadian standards for this equipment that sets safe maximum limits on the products of combustion (CO, CO_2 and NO_2). CSA, ETL and other testing labs then certify industrial direct gas-fired air heaters to ANSI standards.

There are three types of direct-fired air heating systems. Selection of the BEST direct gas-fired heater that is the most energy efficient and provides the lowest "Total Cost" is a function of the building's space heating and ventilating needs.

1. "Blow-Thru", High Efficiency Space Heaters

This is usually the BEST overall space heating system for large warehouses and manufacturing plants. This direct-fired technology uses a "blow-thru" gas burner/blower arrangement where the burner is downstream of the blower. This is important because it locates critical components in the cold air stream for longer service life; achieves the highest BTU/CFM ratio and allows this design be certified for the highest temperature-rise and outlet temperature rating of 160?F. The maximum temperature rating is crucial because it translates into lower horsepower motors, less outside air and reduced energy costs. As a non-recirculating design, the burner always heats 100% outside air. IAQ benefits are significant because these systems do not recirculate potentially contaminated inside air. When properly applied, this design should neutralize the building's natural air infiltration and heat the minimum volume of outside air. This heater type can be mounted on the roof, under the roof or thru the wall so it doesn't consume valuable floor or ceiling space and often has the lowest initial installed cost for facilities over 15,000 sq. ft. The induced rotating air effect created by the unit's air velocity creates very effective air movement in the building, thereby reducing stratification and temperature differences in the facility. High temperature rise space heaters can offer the lowest "Total Cost", including low gas and electric utility bills and require very little maintenance. Proper application is important. If mounted too low, a splash zone can be created. In very tight buildings, over pressurization may occur requiring use of relief vents. Since this system is sized to offset natural air infiltration during the winter and offer some ventilation, it should be complimented with MUA heaters for applications that require significant mechanical exhaust during cold weather.

2. "Draw-Thru" Make-Up Air (MUA) Heaters

Many people confuse low temperature-rise, Make-Up Air (MUA) heaters with the previously described, high temperature-rise space heater. Both non-recirculating, dire-fired heating systems use 100% outside air and look somewhat alike, however the technology inside is quite different. MUA heaters use a "draw-thru" burner/blower configuration where the blower draws air through the burner. It moves a large volume of warm air through a low temperature rise and provides constant CFM output. This design is best suited for facilities that exhaust large volumes of air during the heating season. MUA heaters are often used in combination with other heating systems that aren't designed to handle negative building air problems. A large MUA heater will cost more to operate as just a space heater in terms of both gas and electric energy usage because it needs to move a larger volume of air to deliver the needed BTUs to the heated space. Remember the rule, high temperature rise "blow-thru" designs are best for space heating and low-temperature rise "draw-thru" designs are best for heating make-up air.

3. Air Recirculation Heaters (80/20 – Pressurization)

This technology combines features of both Air-Turnover and MUA Heater designs. When properly applied, it can be used for both space heating and make-up air needs. The direct gas-fired burner heats a mixture of outside air and inside return air. It continuously modulates the ratio of outside air to return air to maintain a fixed positive static pressure condition inside the building. This is called pressurizing the building. The outside air percentage varies from 20% to 100% in response to building static pressure. It is often referred to as an "80/20" system meaning 80% recirculated inside air is mixed with 20% outside air. The units tend to be big and few heaters are required for even large facilities. ANSI implemented a new, separate safety Standard Z83.18 during 2003 for this heater type because they re-heat inside air. The concern is that the use of a building may change over time. Reheating inside air with direct gas-fired burners may be acceptable for the original application but not appropriate when the building's use changes creating potential IAQ problems. Also, pressurizing a building can utilize excessive air that increases energy usage. Gas consumption can be high for space heating applications when a leaky building or just one open dock door drives an 80/20 system to act like a MUA unit heating a large volume of 100% outside air. Electrical consumption is a factor because the large blowers run continuously.

Selecting the BEST space heater for a large commercial or industrial facility is an important decision that should include a complete evaluation of what system provides the lowest "Total Cost" solution for all heating and ventilating needs. When done right, the benefits include higher employee productivity, good indoor air quality, low energy costs, minimal maintenance and most important of all, a more profitable operation.