PRODUCT APPLICATION

A technical bulletin for engineers, contractors and students in the air movement and control industry

Industrial Heating Equipment Comparison and Evaluation

The purpose of this application guide is to provide an objective evaluation of five different gas-fired industrial space heating systems. Each evaluation offers a basic operational description, benefits and drawbacks. A comparison chart is included that rates each product on ten key rating categories.

With this information, you will be able to make better decisions on the type of heating system that is best suited for your specific application. In some cases, you will find that a combination of two or more of these heating technologies will provide the best overall heating system.

"80/20" Recirculation (Direct Gas-Fired)

Operation

Relatively high airflow volume turns the air about once per hour. Supply air is a mixture of recirculated air and fresh outdoor air. Outdoor air varies from 20% to 100% of the supply, often configured to respond to building pressure sensing. Discharge temperatures typically range from 80° F to 110° F.

Benefits

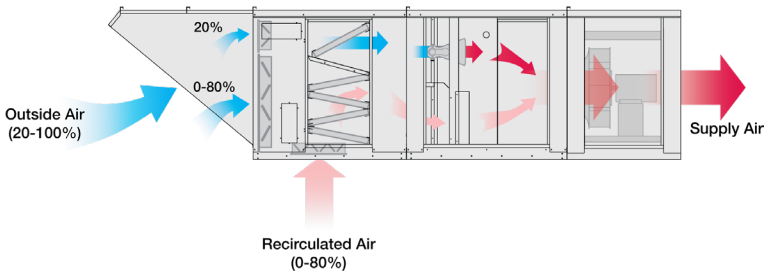
- Excellent for facilities with mechanical exhaust systems, especially when the exhaust volume is variable
- A minimal number of units is required, even for large buildings
- Very uniform wall-to-wall heating with limited stratification
- Pressurizes building to offset cold air infiltration
- Provides reasonable summer ventilation
- Does not consume valuable floor space
- No heat exchanger efficiency loss

Drawbacks

- No zoning capabilities
- Open doors will drive 100% outdoor air operation, driving up fuel consumption and operating costs
- Recirculation mode may create condensation on uninsulated walls or cold material brought inside
- Not allowed in Canada
- High initial cost for buildings under 25,000 square feet

Comments

An ANSI standard restricts the amount of recirculation based on temperature rise. In most cases, a minimum of 30% outdoor air will be required.



High Temperature 100% Outdoor Air (Direct Gas-Fired)

Operation

A relatively low airflow volume is discharged at a high velocity and temperature (140° F). Supply air is 100% outdoor air. Relatively small heating units are spaced throughout the building.

Benefits

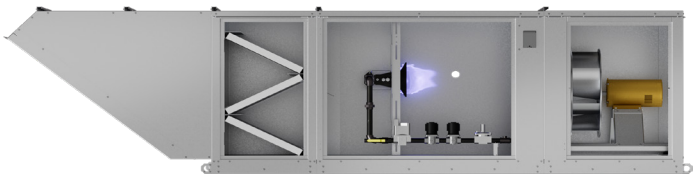
- Low initial, operating, and maintenance costs
- Low sound levels
- Direct drive fan for efficient, modulated control
- Excellent indoor air quality (IAQ) benefits
- Pressurizes building to offset cold air infiltration
- Uniform wall-to-wall heating with limited stratification
- Does not consume valuable floor space
- Good zone heating capability
- Moisture from combustion improves comfort
- Multiple units afford reasonable redundancy
- No heat exchanger efficiency loss

Drawbacks

- Additional equipment is required for summer ventilation
- May require gravity relief vent in very tight buildings
- High-velocity throw can be noisy
- Moisture is a byproduct of combustion that may cause condensation on objects brought in from cold outdoor conditions
- System design does not respond to a mechanically exhausted space

Comments

Multi-purpose unit that provides both ventilation and heating requirements.



Unit Heaters (Indirect Gas-Fired)

Operation

Provides “recirculated” warm air for spot heating. Typical configuration is a small duct furnace with a prop fan on the back side. Multiple unit heaters are spaced evenly throughout the building.

Benefits

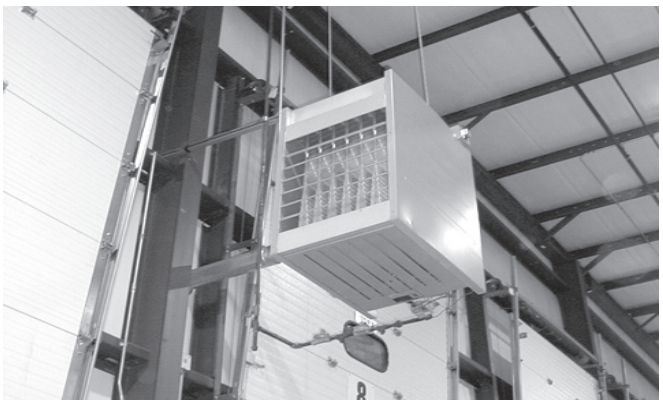
- Good familiarity by installers and maintenance personnel
- Relatively simple to service
- Good redundancy
- Low equipment first cost
- Does not consume valuable floor space
- Good zone heating capability

Drawbacks

- No indoor air quality (IAQ) benefit (outdoor air only by infiltration)
- Unable to combat infiltration at dock doors
- Multiple roof or wall penetrations required for venting
- Higher operating cost than direct gas-fired systems (70–80% efficient vs. 92% for direct gas)
- No summer ventilation benefit
- High installed initial cost for buildings over 25,000 square feet
- Ineffective at de-stratifying building air
- Additional equipment may be required

Comments

Numerous units required to effectively spot-heat the space, which do not distribute air. The technology has changed very little in the past 50 years.



Air Rotation (Indirect Gas-Fired)

Operation

High airflow volume turns the air 1 ½ to 2 ½ times per hour. Air intake is near the floor and warm air is discharged out of the top of the unit. An indirect gas-fired drum-and-tube heat exchanger provides a relatively low temperature rise of 40º F.

Benefits

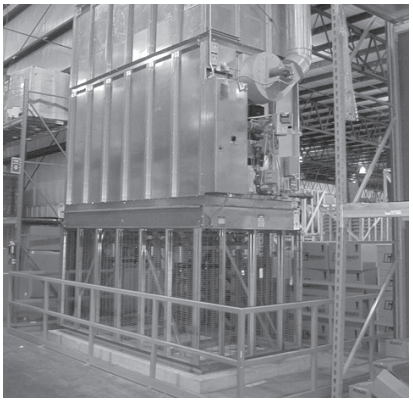
- Very few units are required, even for large buildings
- Fairly even heating with limited stratification
- Does not add moisture to the air, which eliminates condensation on cold objects or walls
- May be equipped with cooling coils
- Can be modified to provide outdoor air

Drawbacks

- Relatively high first cost
- No indoor air quality (IAQ) benefit if not equipped with outdoor air capabilities (most units are 100% recirculation only)
- If equipped for outdoor air, condensation and corrosion may shorten heat exchanger life
- Unable to combat infiltration at dock doors
- Cannot respond to a mechanically exhausted space, and no zoning capabilities
- Higher operating cost than direct gas-fired systems (70%–75% efficient vs. 92% for direct gas)
- Consumes valuable floor space

Comments

Air rotation is a proven method for heating factories and warehouses. However, it is losing market share to direct gas-fired heating systems.



Radiant Tube (Indirect Gas-Fired)

Operation

A gas burner discharges into a tube. The tube becomes hot and radiates heat to the building floor and other objects. A rear reflector panel helps maximize radiation to the floor.

Benefits

- Excellent for heating a specific, relatively small zone
- Uniform comfort and draft free (as long as there is not mechanical exhaust [or dock doors are open])
- Low operating cost
- Low equipment first cost
- Does not consume valuable floor space
- Good zone heating capability

Drawbacks

- No indoor air quality (IAQ) benefit (outdoor air only by infiltration)
- Infiltration at dock doors and cracks will yield uneven heating
- No summer ventilation benefit
- No mixing to recover stratified heat near ceiling
- Dirt and dust on the tube and reflector reduces efficiency
- High installed initial cost when used for heating an entire building. Air curtains should be used for dock door applications to prevent drafts
- Expensive replacement parts

Comments

Published efficiency is 85% to 92%. Actual operating efficiency is believed to be 70% to 80%.

Industrial Space Heating System Comparison Table					
	Direct Gas-Fired		Indirect Gas-Fired		
	"80/20" Recirculation	High Temperature 100% Outdoor Air	Unit Heaters	Air Rotation	Radiant Tube
Initial Cost (≤ 25,000 sq. ft)	4	3	1	5	2
Initial Cost (≥ 25,000 sq. ft)	2	1	4	3	5
Operating Cost	3	2	5	4	1
Indoor Air Quality Benefit	2	1	5	3	5
Infiltration Control	1	2	4	3	5
De-stratification	1	3	5	2	5
Zone Heating	5	3	2	5	1
Redundancy	4	3	2	5	1
Summer Ventilation Benefit	1	2	5	3	5
Usable Space Consumption	3	1	2	5	3
Average Rating	2.6	2.1	3.5	3.8	3.3

Scoring
1 = Most Favorable
5 = Least Favorable

Summary

The ratings above (which are not rankings) show the strengths and weaknesses of different heating technologies in various areas. Unit heaters and infrared heaters received the highest marks in the areas of initial cost in small facilities, zone heating and redundancy. Air rotation, which is a generally accepted method of heating large industrial spaces, actually receives the lowest overall score, plus takes up valuable space in the building.

Based on the overall rating average, the direct gas-fired products will generally provide the most desirable industrial space heating system by virtue of their favorable scoring in the areas of initial cost, operating cost, indoor air quality (IAQ) benefit, infiltration control, de-stratification, summer ventilation, and useable space consumption. The high temperature 100% outdoor air system turns out to be the most favorable overall.

It is important to acknowledge that no single heating product is superior in all areas. With each project, you should identify the most important heating benefits (using the above chart) and then select the appropriate product(s). As stated in the introduction, the right answer may be a combination of technologies. For example, one could use high temperature 100% outdoor air units as the primary heaters in conjunction with infrared heaters above drive-in loading bays. Strategically optimizing your industrial heating system increases cost-effectiveness and comfort for occupants.