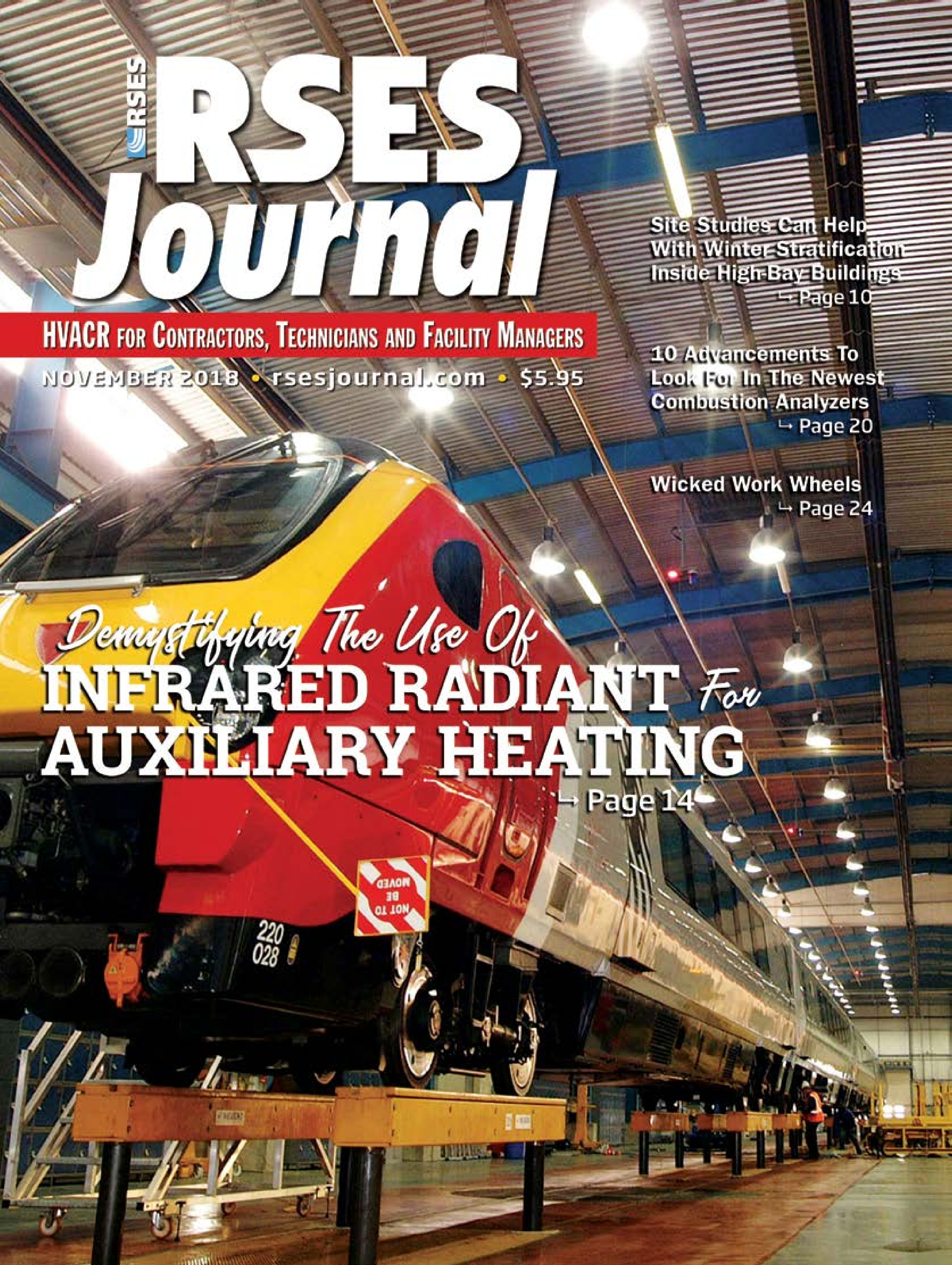

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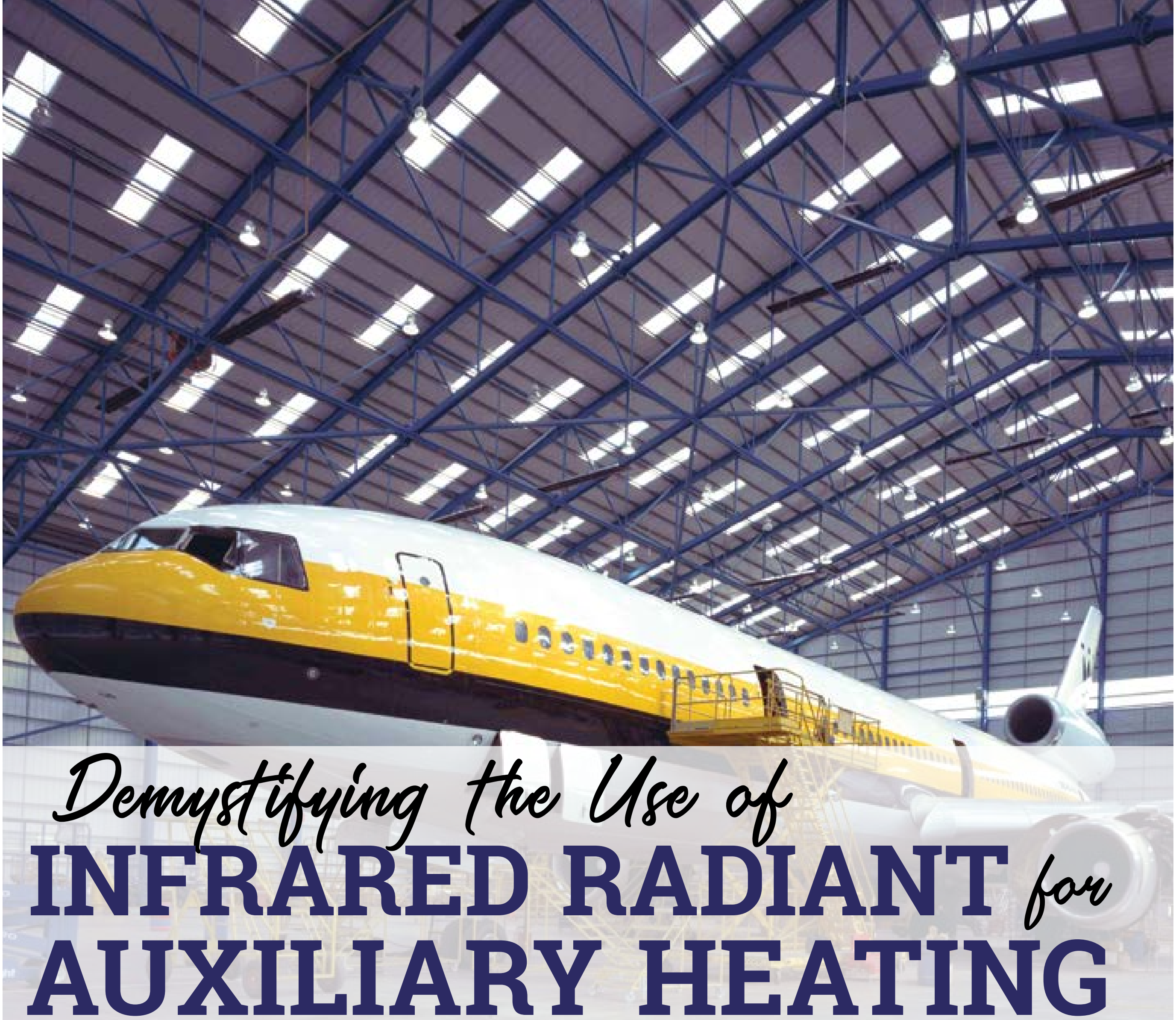


Demystifying the Use of INFRARED RADIANT for AUXILIARY HEATING

BY TOM CLARK AND NEILL GUSTAFSON

Images provided by Nortek Global HVAC

Infrared radiant (IR) is an excellent choice for auxiliary heating. However, engineers and contractors are many times challenged when treating an IR specification like other heating methodologies.

These design challenges are propagated by two things: 1. incorrect assumptions that today's IR is the same as models from decades ago, 2. that IR design specification is similar to designing forced air and other heating projects.

Today's IR has significantly improved, mainly in reflector technology, burner variety, modulation/staging of heat and continuous tube systems custom designed for specific building layouts. These and other improvements generate unprecedented flexibility, placement options, efficiency and other design benefits.

Proving this superiority is difficult to measure, but scientifically logical to assume, especially because utility companies typically offer IR rebate incentives of up to $200/unit for retrofit and new construction projects. IR equipment, consisting mainly of gas-fired heated tube (low intensity; 300°F-1,500°F) or heated ceramic (high intensity; 1,500°F-5,000°F) efficiently radiate long after deactivation, as do their targeted objects.

Aircraft hangars (top photo) and an assembly line (above photo) use tube-style radiant to warm objects and maintain indoor air comfort for employees.

Conversely, forced air units heat air that can quickly rise above the occupied zone and stratify near the ceiling. Thus, IR is ideal for supplementing forced air heating.

IR is challenging because it must take into account many building factors. There's no off-the-shelf design software for it, such as what's available for calculating forced air equipment designs. Another factor is IR doesn't have an American Society of Heating, Refrigerating, Air-Conditioning Engineers (ASHRAE) standard, although it does have its own chapter of recommendations in the *ASHRAE Handbook–HVAC Systems and Equipment*. IR is also cited in the joint Canada and U.S. test standard guideline CAN/ANSI/AHRI 1330-2015 *Performance Rating for Radiant Output of Gas-Fired Infrared Heaters*.

However, there is typically no third-party test certification to use as a standard for enforcement, thus IR manufacturers' performance ratings vary greatly and aren't corroborated. These variations between suppliers mean contractor/engineer collaboration is needed with the IR manufacturer or their sales rep to assure confidence in designing your building project.

Applying IR as an auxiliary heat source

IR is an excellent heat source, especially where there are inherently large space heat losses from open doors/windows, such as shipping docks, public transportation hubs, shipping warehouses, department of transportation trucking depots and automotive service.

The difficulty is due to vast differences between IR and forced air systems, regardless of whether it's huge packaged rooftop units (RTU), make-up air (MUA) ventilation units or small unit heaters.

IR is an excellent auxiliary heat source for supplementing MUA that is replacing exhaust air as part of the ventilation process or code compliance. MUA tempers the amount of outdoor air being exhausted, but this typically will not cover the heat loss of the space. Thus, the advantage of combining MUA and IR is greatest in buildings with vehicles, constantly opened door access, or a presence of airborne contaminants.

MUA can also maintain a slight positive building pressure to prevent unconditioned, unheated and unfiltered outdoor air infiltration, while IR can be zoned to heat only areas in use. MUA and IR can handle ventilation code compliance and heat requirements, respectively.

Design help from reps and manufacturers

While IR can be challenging, especially for contractors and engineers who don't regularly design IR projects, help from manufacturer's representatives or factory engineers is only a phone call away. Before consultation, however, the project's drawings and the following design parameters should be available:

1. Site Parameters—Building size, specified construction materials, building use and orientation, plus U-values and R-values of the floor, roof and walls;

2. Zones—Interior temperature set point goals per zone if the building is zoned, or according to a floor plan layout defining occupied work centers;

3. Building—Outside air infiltration according to number of doors and estimated door cycles per day;

4. Interior Considerations—Overhead obstacles that can either block radiant heat, inhibit ceiling hanging, or present a fire hazard if too close in proximity to the IR appliance. Warehouse racking plans are also invaluable for IR positioning.

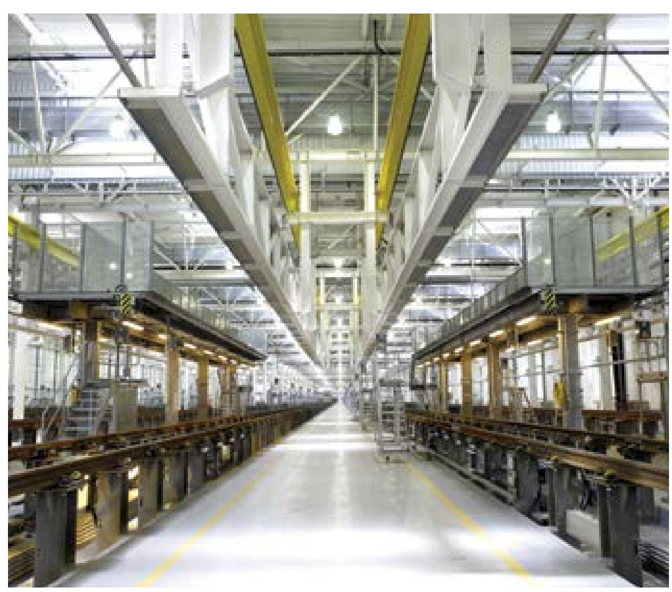
Infrared heating **primer**

Infrared radiant (IR) heating is many times referred to generically as radiant, but shouldn't be confused with low temperature in-floor or in-wall radiant piping or panels that employ the concept of convection heating a space with embedded hot water piping or electrical elements.

IR works on a totally different principle of heating steel tubes or ceramics with gas-fired burners that in turn radiate heat energy that's directed with reflectors. Consequently, this methodology is vastly different than in-floor radiant or forced air heating.

Like rays from the sun, radiant heat transfer does not warm the air, but rather objects in its path. The sun warms the ground and the heat is transferred to the air above it. IR operates similarly inside of buildings. It uses neither convection nor conduction, but instead radiates energy to floors, people and workspace objects where it heats the most efficiently. Electric IR is rarely used in commercial applications because of higher electric costs versus gas and liquid propane.

IR produces an even floor-to-ceiling temperature gradient with little air movement. Applications with 100% forced air can potentially circulate dust or biological contaminants, which affect productivity. Instead a forced air application might be better served by adding IR near employees and processes to limit air movement. Excessive air movement can also create drafts, noise and vibrations that can affect sensitive production processes. IR's gradient attributes and object heating also efficiently melt snow/ice on the vehicles and dry wet floors quicker than forced air units. This attribute is particularly advantageous in buildings that store vehicles during snow periods.



Continous tube-style radiant is used inam industrial settings.

Zoning for efficiency

Zoning IR can be a very energy efficient solution and is more feasible today with technology such as continuous radiant. For example, a shipping facility with 100 doors, but only 20 that are used regularly, will find better efficiency and occupant comfort with IR than with an RTU. A frequently-used IR zone can be activated to warm employees, products, dock levelers, floors, truck trailer parts that continue to radiate zone heat after the open door air filtration drops temperatures below thermostatically-controlled set points. In comparison, RTU air distribution is more subject to open door wind loads, convection, and outdoor air infiltration.

In another zone arrangement example, a small production zone in the middle of the plant can use IR to maintain a comfortable 68°F, but outside the zone where there are no employee stations, either IR and/or forced air can maintain lower, energy-saving temperatures.

Key considerations for IR design

IR equipment is now available with many options, such as 88-meter-long continuous tube modules for connecting in parallel branches, different flame lengths, firing rates, BTU output, and advanced high efficiency reflectors It's the trade-offs between these and other factors such as geographical location and seasonal temperatures where an experienced IR manufacturer's representative or factory engineer can help arrive at the best size, BTU output, configuration, IR type and heating zone center positioning. These factors all figure into the client's best return on investment (ROI). Besides application efficiency advantages, IR can also simplify installations by requiring 90% less roof or wall penetrations versus unit heaters.

New innovations are another reason for contacting reps and manufacturers for assistance. Some manufacturers are experimenting with double-wall reflector shields to radiate more heat into the space versus upward through the reflector. Other innovations include outdoor air combustion, energy-recovery strategies and the aforementioned continuous tubes.

Project design **mistakes**

→ **Inappropriate Buildings**—In buildings with low ceilings or hazardous locations with combustible materials—steer clear of IR and source appropriate forced air equipment with the required hazardous location classifications;

→ **Actual Mounting Position**—IR too low, thus making occupants uncomfortable or creating a potential fire ignition hazard with objects. Installed too near a ceiling could also cause a fire. Depending on the BTU output, six feet above people and objects is a good rule of thumb for low intensity, whereas high intensity IR should be 10-12 ft above. Contractors should always follow code and manufacturer's clearance to combustibles and mounting height recommendations; and

→ **Improper Control Programming**—IR doesn't work well with night setback or timeclock controls. This method is efficient with forced air because these systems are designed to heat up the space air quickly. However, IR should be controlled via its own dedicated thermostatic control (and remote sensors, if needed). Running 24/7 ensures a reservoir of heat is absorbed into the zone's objects walls and floors, thus limiting time, if any, for an occupied period ramp up.

These innovations, plus the fact that IR specification and project design is vastly different than forced air, emphasize the benefits of calling a rep or manufacturer when confronted with potential IR project.

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Popular applications of infrared heating

Today's infrared radiant (IR) applications have grown in diversity versus projects of decades ago. IR is best known for large industrial spaces to keep employees, objects and production processes warm during heat loss events, such as continuous door openings. Below is a broadened list of newfound uses for IR:

- → Stadium seating—keeps spectators warm, but can also be used after snow storms to melt snow and dry out the seating area;
- → Car washes;
- → Restaurant outdoor seating—*note: the 2015 international energy conservation code (iecc) section c403.2.13 stipulates that radiant heating used outside a building should be controlled with occupancy sensors;*
- → Entry way snow melting;
- → Animal housing areas;
- → Golf driving ranges;
- → Transportation hub terminals;
- → Outdoor walkways;
- → Outdoor smoking shelters;
- → Automotive repair facilities;
- → Quick oil change retailers—*note: this industry often uses special furnaces that economically reuse recovered vehicle engine oil for primary heat fuel;*
- → Indoor athletic facilities;
- → Waste water treatment plants; and
- → Loading docks.