Major Benefits

- **Noncontact Temperature Measurement of Heating and Cooling Systems**
- **Reliable Temperature Monitoring**
- **Effective Troubleshooting**

The purpose of this application brief is to show how Raytek® Raynger® portable infrared sensors can be used to improve, maintain, and troubleshoot Heating, Ventilation, and Air Conditioning (HVAC) systems.

Description of Application

The heating, ventilation, and air conditioning of a building are very important subjects to consider in building maintenance, especially since they affect the environments you live and work in. Malfunctioning HVAC units can cause discomfort and may influence health problems.

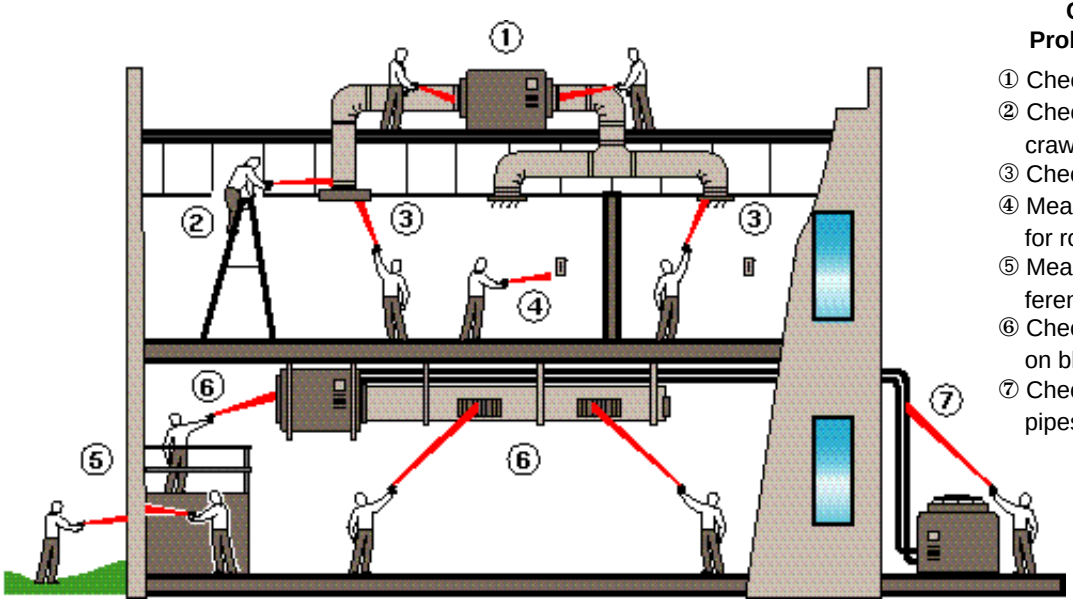
An HVAC system is comprised of a generating unit and related piping and/or duct work. Figure 1 illustrates two different types of HVAC systems. Upstairs is a roof-mounted unit with supply and return ducts installed in a suspended ceiling. Downstairs is a two-piece unit with a compressor mounted outside and a blower unit with ducts mounted inside. These are connected together by supply and return pipes. Other systems include, but are not limited to, evaporative (swamp) coolers, which are basically fans blowing across water (either in pipes or dripping down coils), and electric and gas heaters (e.g., baseboard heaters, wall heaters, etc.).

Problems

Common HVAC problems can be the following:

- Rooms are at different temperatures
- Rooms are always dusty, even after cleaning
- Air conditioners or heaters run continuously
- Mold or mildew is present
- Building air is stale
- People constantly adjust the thermostats

Enclosed buildings need to be environmentally balanced to provide comfortable heating, cooling, and ventilation levels for all the inhabitants. When the air is stale, or when people constantly adjust thermostats, or when rooms are dusty or moldy, this usually indicates there is something wrong with the HVAC system. In the past, HVAC technicians had to place thermometers on walls, floors, ceilings, and other objects



Checking for HVAC Problems the Raytek Way

① Checking rooftop HVAC unit
② Checking duct joints in attic or crawl space
③ Check return and supply ducts
④ Measuring wall temperatures for room balancing
⑤ Measure for heat/cold transference on outside wall
⑥ Checking return and supply on blower/filter unit and ducts
⑦ Checking supply and return pipes from compressor unit

Figure 1: Examples of Noncontact Temperature Measurement HVAC Applications

to find room temperatures for proper room balancing. Usually, a technician had to wait 15-20 minutes for each of the thermometers to stabilize. In large environments, this took up a lot of time.

Supply and return ducts with loose or failed joints can blow hot or cold air into the wrong areas, such as crawl spaces, attics, or the area between suspended ceilings and the floor or roof above. Sometimes these ducts can suck in air, like a vacuum cleaner, from surrounding areas. Leaks can also blow dust and/or hazardous particles into the working/living areas.

Finding leaks in ducts often meant crawling around in tight access spaces or in areas accessible only by high ladders or scaffolds. Injuries to HVAC technicians have occurred due to faulty ladder placement and to overreaching from an elevated position.

When air conditioners or heaters run continuously, instead of cycling as they are designed for, one or more factors may be at work, including duct leaks, inefficient duct installation or poorly insulated ducts, too small of an air conditioning/heater unit, or blocked filters or iced over coils. Finding the exact problem can be a long laborious task, especially on large offices or factories. In the past, HVAC technicians had to drill holes in ducts to insert thermometers for duct temperature measurements. This is a time-consuming process.

Raytek Solution

HVAC technicians with Raytek Raynger portable infrared thermometers in their toolkits can take spot temperature measurements of overhead ducts and HVAC units immediately upon entering a room. The technician doesn't have to carry a ladder around or a pocket full of thermometers to get accurate measurements. Just point and shoot. With laser sighting infrared thermometers, technicians can immediately pinpoint the exact spot to take temperatures.

If an HVAC system is not cooling or heating properly, a technician can first check the return and supply registers to see if the temperature difference is correct for the installed HVAC system (see ① and ② in Figure 2).

As an example, if the unit is cooling, the difference between the return and supply (at ① and ②) should be 9 to 12°C (18 to 22°F). If the unit is heating, the supply and return difference should be 17 to 39°C (30 to 70°F). Temperature differences other than these can mean a malfunctioning HVAC unit. For instance, if the cooling temperature difference is more than 12°C (22°F), it is possible that the air flow is too low, which makes the refrigerant too cold, which could form ice on the coils. If enough ice forms to block the air flow, the cooling temperature difference would probably be under 9°C (18°F). This could also signal that the refrigerant in the coils is blocked. Leaks in the supply duct often cause this sequence of events to happen.

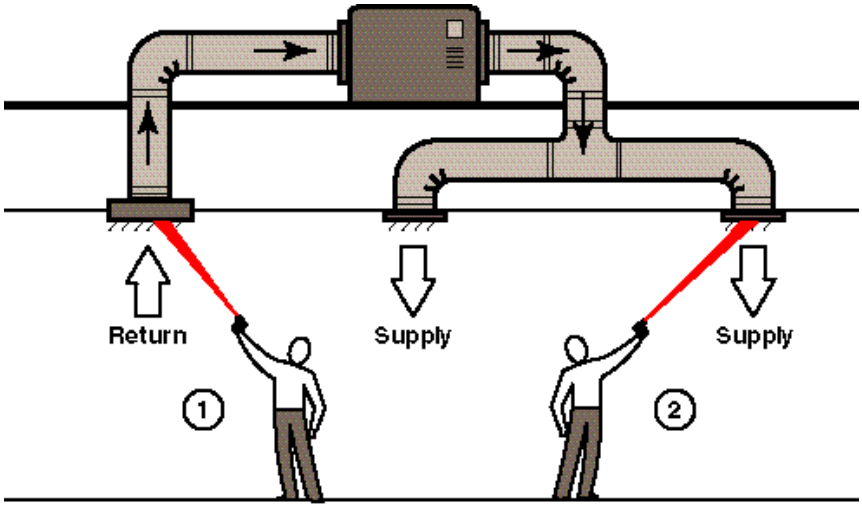


Figure 2: Checking for Return and Supply Temperature Differences with Noncontact Infrared Thermometers

Another important area to check is at each joint where the pieces of duct are attached together (Figure 3). This is perhaps the most common HVAC heating or cooling problem, since connections can vibrate and slip apart due to constant expansion and contraction from the hot and cold air. Breaks in ducts can make the HVAC unit work too hard, which shortens its operating life.

If a duct break or hole is not visible, a technician can use a portable infrared thermometer to measure along the duct to find where a temperature difference occurs. Where there is a sudden drop or rise in temperature could signal either a break, a hole, or even where insulation has come apart.

If the ducts are connected properly but the HVAC unit is still not working the way it should, a technician might look at the insulation on the ducts. Outside air can transfer into uninsulated or poorly insulated ducts very easily. Using Figure 3 as an example, imagine the area between the ceiling registers and the roof is an attic and the summer temperature in there reaches 60°C (140°F). The thermostat in the room below is set at 21°C (70°F). Optimally, returning air should be below 21°C (70°F) so the room could cool enough where the thermostat could trigger the unit to cycle off. However, with the attic so hot, it's possible for the ducts to heat the air to an extent that even with a properly functioning HVAC unit, returning air is never cooled low enough to trigger the thermostat. This causes the HVAC unit to run continuously, which can shorten its operating life.

For example, figure that air entering the return ceiling register at 21°C (70°F), heats up in the duct another 11°C (20°F) to 32°C (90°F), then cools down in the HVAC unit 11°C (20°F). The supply duct again heats that 6 to 8°C (10 to 15°F), the air enters the room at around 30°C (85°F), actually heating the room instead of cooling it.

To find the effective cooling/heating efficiency of an HVAC unit's ducts, an HVAC technician can use a portable infrared thermometer to take spot measurements along the ducts, inside the building and outside (Figure 3), to find if ambient heat transference is a problem. If it is, and the unit is the proper size for the area it's cooling/heating, the solution would be to wrap the ducts in an insulation with a higher "R" rating. Properly installed ducts should have little or no difference in the air temperature as it enters and leaves it. An acceptable temperature difference is around 1°C (2°F).

Room balancing can be difficult. Many factors need to be researched and checked out when planning how to balance rooms and areas in a building. An HVAC technician needs to check how large the rooms are, how many people are in the rooms, and ask them whether they are comfortable or not. Since everyone has different temperature needs, a working average should be used. Then, with an infrared thermometer, the technician can measure the rooms, starting at the walls (at chest height) and the floors and ceilings to find the differences in the air "strata." The technician can then find the supply and return ducts, measure their temperatures for performance, and then figure out if vents are properly located, whether or not the HVAC unit is large enough for the space being heated or cooled, or if more ducts, or more efficient ducts, should be installed.

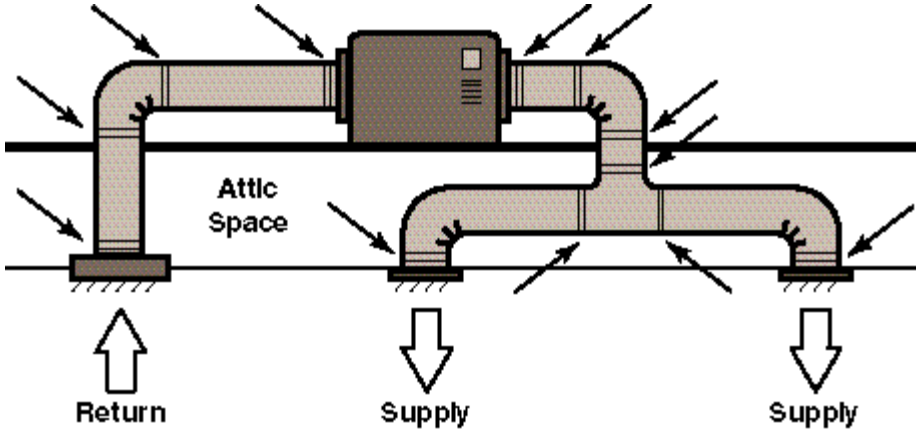


Figure 3: Where Air Leaks Can Occur

Benefits

One of the major benefits of using Raytek Raynger portable infrared sensors is that they are noncontact temperature measurement devices. An HVAC technician does not have to touch very hot or very cold coils, pipes, or ducts. And with medium to long-range infrared sensors, technicians don't have to carry around cumbersome ladders or scaffolds to take measurements of distant, out-of-reach ducts, pipes, or systems. Also, they don't have to drill holes in ducts to insert temperature probes. And the infrared thermometer's fast response means no waiting to find the temperature, like with conventional thermometers. Point, shoot, and read.

For room balancing, as well as maintenance and monitoring, technicians can take spot measurements to determine an HVAC system's efficiency. It's just a matter of walking into a room, aiming the infrared thermometer, and reading the temperature.

Raytek Raynger portable infrared thermometers are effective troubleshooting tools. Determining causes of a malfunctioning HVAC system is now easy for an HVAC technician. Point the sensor at return and supply registers or ducts to find where leaks might be occurring. Point the sensor at return and supply ducts and pipes at the HVAC unit to find out how well it's functioning. No more tearing units apart only to find the malfunction is somewhere else in the system. Just point and shoot.

Choose from a wide variety of makes and models, from the low-cost Raynger ST, for close-up work at temperatures from -20 to 500°C (-4 to 932°F), to the Raynger PM, that measures a spot less than 68mm (3 in) at 3 meters (10 ft) for temperatures from -18 to 870°C (0 to 1600°F), to the Raynger 3i, with models that can measure a 125mm (5 in) spot at 15 meters (50 ft) and temperatures from -30 to 1200°C (-20 to 2200°F).

Remember, no other portable noncontact thermometers deliver as much for the money. The more you use them, the more reasons you'll find for using them. As part of an HVAC technician's tool kit, a Raytek Raynger portable infrared thermometer can easily pay for itself in a very short time.

VÓRTEX Equipamentos

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