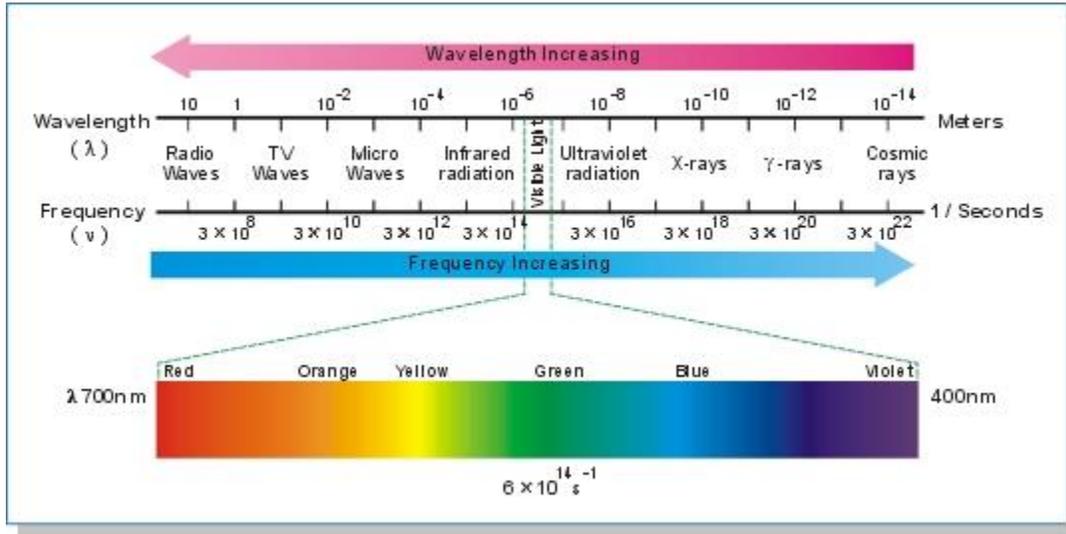


INFRARED THERMOMETERS BASICS

By: Douglas Wright, President

[Infrared thermometers](#) measure reflected infrared light, which just like any light ray is Electromagnetic Radiation, with lower frequency (or longer wavelength) that is used to correlate a specific surface temperature of the product measured. Anything above absolute zero (-273.15 degrees Celsius or 0 degrees Kelvin) radiates in the infrared. Even ice cubes, snow, & your refrigerator emit infrared.



IR sensors collect the low amounts of energy (usually 0.0001 watt) from the target, amplified by a precision amp, and convert it into voltage output. The CPU then converts this to a digital temperature reading after compensating for the ambient temperature and emissivity effect; you then get the temperature of the target within seconds after you push that switch.

The accuracy of [I.R. thermometers](#) can be quite accurate but is also affected by several factors.

- a) D: S ratio or distance to spot ratio. This indicates the size of the area measured relative to distance away from the object being measured. If D: S is 1:1 then at 1 meter the area being measured is 1 meter in diameter. If D:S is 8:1 then from 8 m away the area measured is 1 m. in diameter.
- b) Emissivity is usually set at 0.95 for most inexpensive models but can be reset on more expensive models. Emissivity varies depending on the colour, reflectivity, shape etc. of the product measured. We use 0.97 E on our high accuracy Inspector grade models. Some models have adjustable emissivity.
- c) Range: There is no technical limit as to how far away but the D: S ratio usually limits most models to a few feet. The further away from the object the lower the accuracy can be due to particulate interference in the air (dust, humidity etc.) Also unless using a laser guided model determining the spot measured is difficult
- d) Diffraction Grating of optics. This is something you rarely see discussed. Most cheap and even many overpriced models use a 5-14 um wavelength. 5-8 um is where most moisture is detected. If you are in a cold condensing environment or in a humid cook zone you need an 8-14 um unit which is what all of our [Food Inspector models](#) are.



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Can IRT measure air temperature?

Yes and No.

No, because Air does not emit infrared, the emissivity is too low to be detected.

Yes, because you can by pointing the IRT at anything that has the SAME temperature as the air:

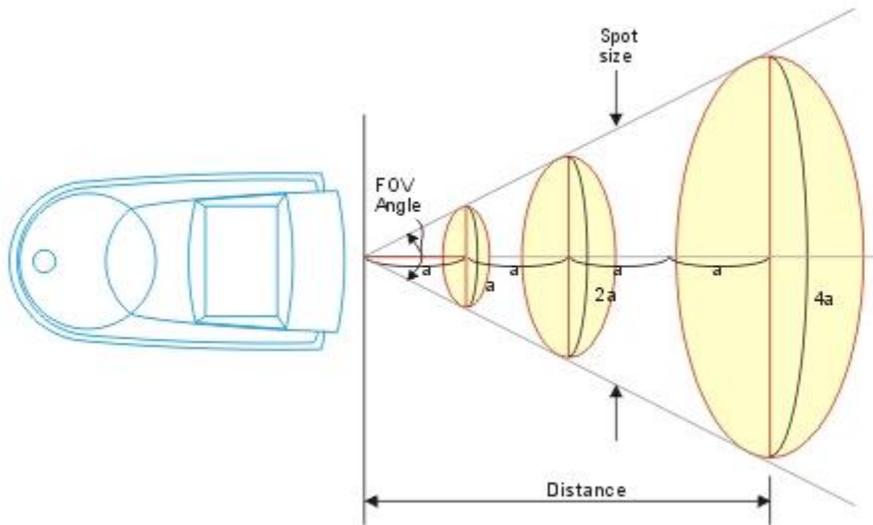
The key to get "Air temperature" is to measure "anything that has the same temp as the air"

Can I measure the body temperature of an Ant by IRT?

You can point the IRT to an Ant on your desk, but what you get is an average temperature of the Ant & the Desk because the Field Of View of the IRT is much larger than the Ant.

But, if you can get 10,000 clustered ants on your desk, which can cover the whole FOV of the IRT, then YES, you can measure the body temp of the Ants.

This FOV issue is a key to get correct reading from IRT.



Are Infrared Thermometers Harmful?

[I.R. thermometers](#) do not emit any Infrared radiation (present everywhere anyway) they only measure it. However Laser guided models although normally harmless should not be targeted near the eyes as even low power lasers can damage the eyes. Therefore for medical applications we advise non-laser guided models for reasons of safety.

Why can't I see IR?

Your eyes are designed for Sunlight, 2 kinds of species have been identified to be able to detect IR: some rattle snakes & beetles. But you still can sense the IR by your skin: Beside a campfire, you can feel the warmth from the IR.

When your car is baked by sun, you start the car, turn on Air-Conditioner, the air is cooled, But you still feel Baking-Hot, that's IR radiating from the interior of the car, reaching your sensor (skin). You may use IR to learn that the radiation temperature in your car can reach 80degC!



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How far?

Can I measure the temperature of a wall from 5 meters? The temperature of a mountain from 1km?

We are using the 8um to 15um infrared; the atmosphere is almost totally transparent for this band.

At 100 meters, no rain, no fog condition, IR can be very accurate. But as you measure farther away the F.O.V gets larger and the potential for interference (pollution moisture etc) increases thus increasing the potential error.

Can the IRT operated in complete darkness?

Yes, that's why DOD & military are so interested in IR.

In fact, the early IR technology was developed with military funding.

Can the IRT penetrate an object & measure what's inside?

Internal temperatures cannot be measured using I.R. sensors. At best if the internal temperature is consistently relative to surface temperatures then the surface reading can be used as a rough indicator of internal temperature but we do not advise this method.

What Can IR penetrate?

IR can penetrate PE film (for example: a complete dark garbage bag), Silicon, Germanium.

You can hide something warm behind a PE film (your hand); the IRT can detect the presence of the object.

How do I know, my IRT is still accurate?

1. Fill a large polystyrene (e.g., Styrofoam) cup (10 oz or larger) (or any Thermos) halfway to the surface with crushed ice.
2. Add cold tap water to 1 inch below the rim of the cup tip. Two cups, one inside the other, will provide better insulation and more stable temperatures throughout the test.
3. Immerse the tip of an accurately calibrated contact probe thermometer, that has been calibrated, into the water and vigorously stir the water's surface with the probe for one minute, or until contact [probe](#) temperature stabilizes.
4. When the probe temperature has stabilized, scoop out the ice and continue stirring the water, while taking simultaneous temperature measurements with the IR thermometer.
5. Hold the [IR thermometer](#) within 1 inch of the surface of the water for the most accurate measurement. Infrared temperature measurement should be within +/-1C (+2°F) of probe reading 0°C (32°F).
6. OR see [Scigiene Thermometer calibrator](#)

Hint to get accurate reading with IRT?

The target must cover the whole FOV (Field Of View) of the IRT.

Avoid polished metal surfaces, rough surfaces give better accuracy.

Adding Electrical Insulating Tape (black is better) on the metal surface can solve the problem and give accurate results.

Be sure the tape is large enough to cover to Field Of View of the IRT.

Be sure the tape will not BURN. Use with caution!

Avoid temperature noise (avoid other High temperature object is nearby)

for example: you are measuring an IC, with a solder-iron nearby

Try to use it perpendicular to the target surface.

Test the surface using a contact [probe](#) and adjust emissivity until they match.



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