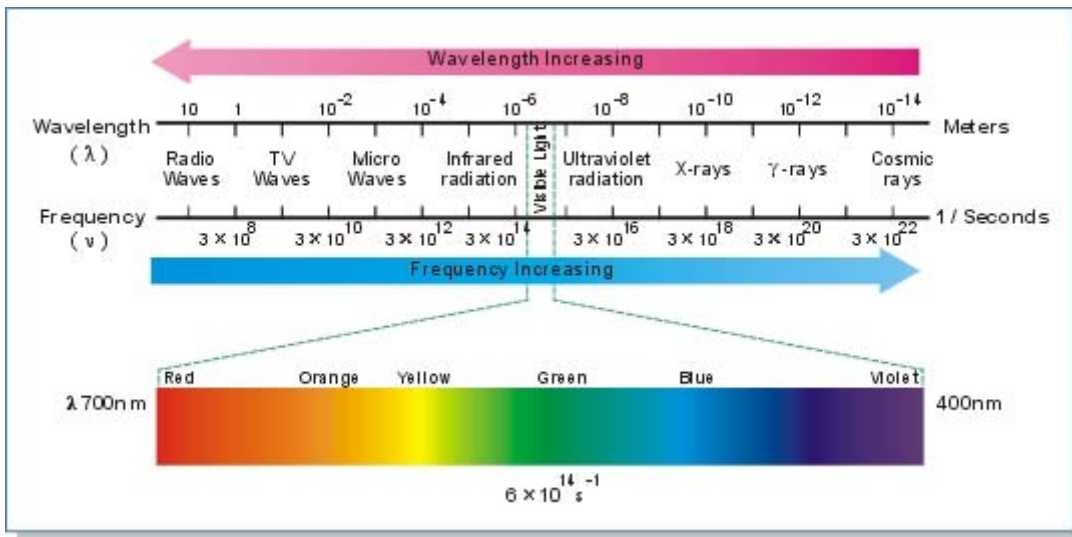




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## Infrared Thermometers

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



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

1. 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 foot the area being measured is 1 foot in diameter. If D: S is 8:1 then from 8 ft. away the area measured is 1 ft. in diameter.

2. 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 being measured. For large volume orders emissivity can be set specific to the product to be measured for greater accuracy.
3. Range: There is not technical limit to how far away an object can be measured, but the D: S ratio usually limits most models to a few feet. The farther 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.

### Can IR Thermometers Measure Air Temperature?

No and yes. No, because air does not emit infrared, the emissivity is too low to be detected. Yes, because you can by pointing the [IR thermometer](#) at anything that has the SAME temperature as the air:

Outdoor: leaf, tree, grass (in shade) has the same temperature as the air

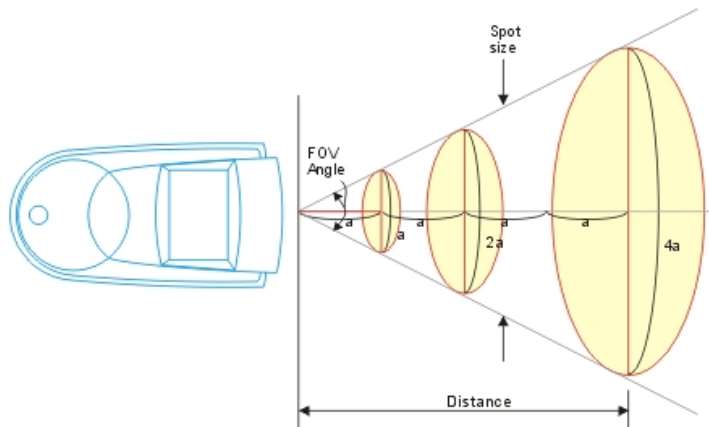
Indoor: your desk, a piece of paper, has the same temperature as the air.

The key to get "Air temperature" is to measure "anything which should have the same temp as the air."

### Can I Measure the Body Temperature of an Ant with an IR Thermometer?

You can point the [IR thermometer](#) on an ant on your desk, but what you get is an average temperature of the ant and the desk because the Field Of View of the IR thermometer is much larger than the Ant. But, if you can get 10,000 ants on your desk, which can cover the whole FOV of the IR thermometer, then YES, you can measure the body temp of the Ants.

This FOV issue is a key to get correct reading from an IR Thermometer.



### **Are Infrared Thermometers Harmful?**

[IR 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 safety reasons.

### **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. For example, when the sun bakes your car, and 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). With an IR thermometer you can actually see that the radiation temperature in your car can reach 80degC!

### **How Far Away Can an IR Thermometer be Used?**

Can I measure the temperature of a wall from 5m away? The temperature of a mountain from 1km? An [IR thermometer](#) uses infrared radiation with a wavelength of 8µm to 15µm; the atmosphere is almost totally transparent to this wavelength.

At 100 meters, with no rain, no fog condition, IR can be very accurate.  
At 1km, you will need some physics background to correct the reading.

### **Can the IR Thermometer Operate in Complete Darkness?**

Yes, that's why the Department of Defense and the military are so interested in IR. In fact, early IR technology was developed with military funding.

### **Can the IR Thermometer Penetrate an Object and Measure What's Inside?**

Internal temperatures cannot be measured using IR 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.  
In real life, No. It can be done only in the movies.

### **What Can IR Penetrate?**

IR can penetrate PE film (for example: a completely dark garbage bag), Silicon, and Germanium. You can hide something warm behind a PE film (your hand), and the IR Thermometer can detect the presence of the object.

### **Can I Measure the Body Temperature of a Fish in My Aquarium?**

No, water and glass are transparent for visible light only, but for IR, it's completely "opaque". The IR from the fish can't penetrate the water, so you can only measure the temperature of the glass.

How about my pet's temperature? By pointing an [IR thermometer](#) at your dog, you get the temperature of the fur. What you see is what you get.

## How do I Know, My IRT Thermometer 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](#) 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, 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 at 0°C (32°F).

Advanced users may use a home made triple-point (liquid; gas and solid co-exist) to calibrate your Contact Thermometer, see Scientific American, January 13, 1999, "Tackling the Triple Point", By Shawn Carlson. This article provides an innovative way to maintain a temperature standard about 0.0001 degree C, right in your home and costs less than \$50 to build. The triple-point of water is a very accurate temperature standard, much better than "Ice and Water coexist".

## What Else Can I Use an IR Thermometer to Measure?

You can measure the temperature of almost anything, including the universe! IR radiation was used to prove the Big Bang theory. In 1965, the remnant radiation from the Big Bang was discovered by radio astronomers Arno Penzias and Robert Wilson.

This radiation, which peaks at 3 K (-270degC), can be found in all directions in space. Such a temperature is evidence of the Big Bang (the origin of this universe). Well, you would have to carry an IR thermometer to outer space to get a correct reading. And of course, you would need some sophisticated IR thermometers and maybe a space shuttle to do this measurement.

## So this "Swiss Amy Thermometer" Can Measure Anything?

Yes, it's a Swiss Amy Thermometer. But there are still some things impossible to measure:

Gold, Shining Metal, or any low emissivity material.

For example: the reading of a 125degC gold is only about 27degC. For these materials with high reflection to IR, what you are measuring is only the REFLECTION. When IRT fail, try other contact type thermometers

## Hints to Getting Accurate Readings With an IR Thermometer?

1. The target must cover the whole FOV (Field Of View) of the IR thermometer.
2. Avoid shining surfaces (metal), rough surfaces give better accuracy.
3. Adding Electrical Insulating Tape (black is better) on metal surfaces can solve the problem and give accurate results.
4. Be sure the tape is large enough to cover to Field Of View of the [IR thermometer](#).
5. Be sure the tape will not BURN. Use with caution!
6. Avoid temperature noise (avoid other High temperature objects being nearby)  
For example: you are measuring an IC, with a solder-iron nearby
7. Try to be perpendicular to the target surface.



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