

Ch 1: What Is Infrared?

William Herschel announced there is an invisible optical spectrum beyond visible red light. He used a prism to separate all kinds of colors from purple to red. The temperature rises gradually and still increases over red light. Therefore, infrared is existent.

Infrared has three characteristics: Invisible, Strength proportions Temperature and Strength proportions object's surface. Any object's temperature high than absolute zero - subzero 273.15°C will radiate infrared. For this reason, the higher temperature object radiates more than lower temperature one. The radiation strength proportions to temperature. Therefore, the infrared radiation also called heat radiation.

The absorb ability equals radiation ability, this ability is called Emissivity. Emissivity is largest at 1.0(100%) . This depends on object's surface. The rough object radiates more than smooth one. The most popular Emissivity is 0.95, it is also the default Emissivity of infrared thermometer.

The most popular sensor for infrared thermometer is Thermopile which comes from thermocouple sensor.

Ch 2: Thermometer

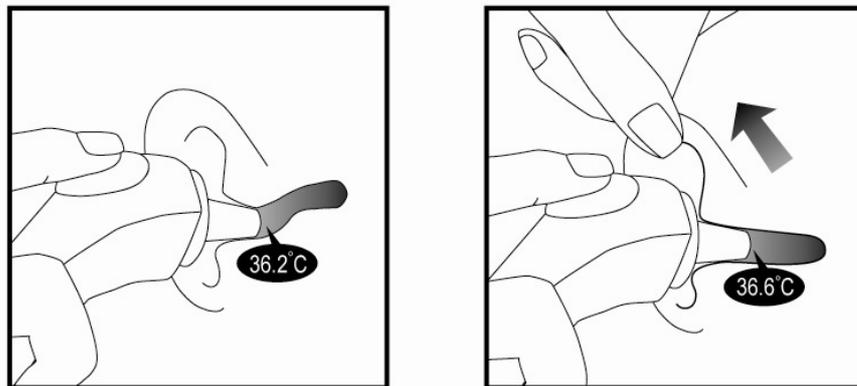
The Hypothalamus controls human body temperature and it also controls metabolic secretion to stabilize the body temperature. Some medical research indicates the ear drum temperature is close to Hypothalamus temperature. It possesses almost same accuracy with Pulmonary artery. For this reason, the ear drum reason can represent human core temperature.

If we use the infrared principle to measure ear drum's temperature through the ear canal without touching ear drum, it improves the medical temperature measurement. This thermometer also named tympanic thermometer. The way the thermometer works with infrared radiation shortens the response time (the measurement takes about 1 second) . Comparing with other thermometers, tympanic thermometer is much safer and faster. That is the reason tympanic thermometer plays an important role on medical use and family care.

Furthermore, to match up with 37°C people familiar with, ear thermometer makes compensation to display in oral temperature, it named oral mode. User does not need to measure toward the mouth and it shows the oral temperature. The compensation is called oral site-adjust. Ear thermometer in early days provides oral mode, rectal mode to emphasize the different temperature; now we unify thermometers to ear mode.

The oral site-adjust is different from each people and different brand models. The probe size, optics, heat and probe cover also effect the measurement. The way determine the oral site-adjust is called clinical test. There are regulations to test different age people's temperature and make average values. The ear temperature is usually lower than oral temperature, therefore, the compensation is usually positive numbers.

Bellowed picture shows most ear canals are crooked, user need to raise the ear to straiten the ear canal.



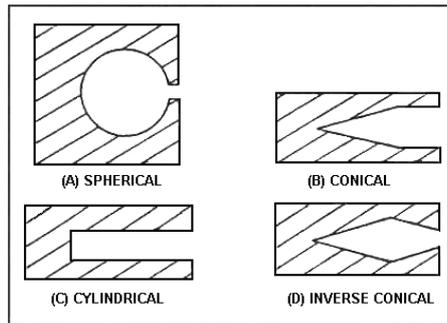
Ch 3. What is Blackbody?

Each measurement needs a standard for calibration. The standard for infrared radiation is called BlackBody. What is BlackBody? Why is named BlackBody?

As we mentioned the absorb ability equals radiation ability, it is called Emissivity. The most popular emissivity are 1.0 or 0.95.

Emissivity 1.0 means the absorb radiation ability is 100%. Any object's heat radiation will be absorbed completely. It does not exist in nature world, people design a cavity object and painted with some high-absorbed substance. When heat radiation enter, it reflex over and over and then reach 100% absorb, Emissivity=1.0, it is called Cavity BlackBody. Owing to the cavity can absorb any heat radiation, the optics use black color to name the cavity blackbody. Common cavity blackbodies are in tubal shape.

Keep the blackbody in a stable temperature, it become the standard of infrared radiation.



There is other blackbody with 0.95 emissivity. It is painted with 0.95 emissivity substance. The blackbody painted on a plane, therefore, it is also called plane blackbody.



Ch 4. How to test Blackbody Temperature?

4-1 Blackbody

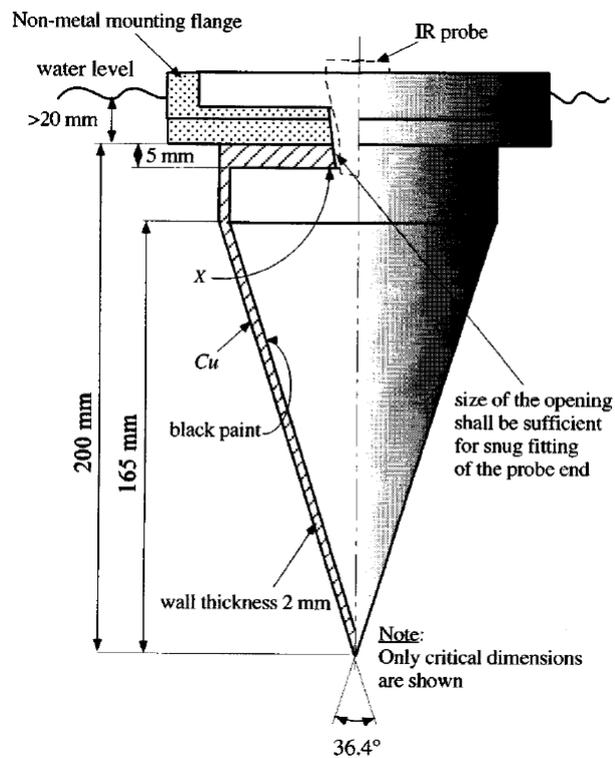


Fig. Water-Immersed Blackbody¹

1. Check if the probe cover or probe lens is dirty or broken.
2. Use fan to cool down the thermometer for 30 minutes.
3. Make sure the Constant temperature sink is in fixed temperature and stable for 30 minutes.
4. Press ON/MEM button to power on the thermometer and enter the CAL mode.
(See CAL mode instruction)
5. Insert the probe into blackbody and press Scan button to get temperature.

¹ Fig. Water-Immersed Blackbody from ASTM E1965 – 98,
Standard Specification for Infrared Thermometers for Intermittent Determination of Patient Temperature

CAL Mode

Comply with EN12470-5², ear thermometer should have calibration mode. For any kind of test about accuracy, the mode can help laboratory to get the real blackbody reading.

How to get Device into CAL mode?

- (1) Press ON/MEM key to power on device, and wait for device ready with two “Beep” sound.
- (2) Press and hold ON/MEM key about 10 seconds, the LCD will show with the sequence as below.
 - (a) Around 5th second -> --- the device will shutdown.
 - (b) Around 6th second -> --- the device shutdown
 - (c) Around 8th second -> --- the device show the dot” . “ signal.
 - (d) Around 8th -10th second -> --- please release ON/MEM key before the dot disappear.

Note: For models with clock function, response time need to add 5 seconds.



In CAL mode,

1. The LCD will show the measurement of Blackbody reading (without site-adjust) and ambient temperature reading.

Ex: CAL -> 37.0 -> Ab -> 23.5

It means: $T_{bb} = 37.0\text{degC}$, $T_{amb} = 23.5\text{ degC}$

2. If device is forehead thermometer, it will set emissivity = 1.0 for measurement. If device is ear thermometer with probe cover detector, it will judge the detector is on or off and set emissivity 100%. In other words, if the thermometer measure without probe cover, user may not touch the probe cover detector to keep the accuracy.
3. The thermometer will be extended to shut down after 2minutes.

²EN12470-5:2003 Clinical Thermometers – Part 5: Performance of infra-red ear thermometers (with maximum device)

Note: Radiant also provide thermometer samples for customers to do safety tests.

Ch 5. Cleaning

Use soft cloth to wipe the appearance. Never use benzene for cleaning and never submerge thermometer into water or any liquids. Probe lens is the most delicate part of thermometer, please use cotton swab with alcohol (70%) to wipe it.

Follow the below instruction and video to clean the probe lens.



Probe Lens Cleaning Video

1. Before using the cotton swap with 70% alcohol to wipe the lens, slightly flip the cotton swab to cut down the spare alcohol.
2. If there is no 70% alcohol, use alcohol prep pad to soak the cotton swab.

Important: Do not use sharp pointed object to wipe the lens.