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Poultry Housing Tips

Using Non-contact Thermometers

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Non-contact or "infrared" thermometers have proven to be a very effective tool for poultry producers with a wide variety of uses. They can be used to measure floor temperatures during brooding, to check for overheating circuit breakers during hot weather, or to evaluate the condition of ceiling and/or side wall insulation. Though the potential benefits from being able to measure various surface temperatures within a poultry house are numerous, it is important that the user understands some of the unique characteristics of non-contact thermometers in order to draw proper conclusions from temperature measurements made by these devices.

Unlike conventional air thermometers which measure the temperature of the air in the vicinity of the thermometer, a non-contact thermometer measures temperature of surfaces within the device's "field of view." To understand the field of view of a non-contact thermometer it may be best to think of it as a camera which takes circular pictures. Like a camera, the amount of area covered by a non-contact thermometer increases with distance. How big an area a non-contact thermometer is measuring the surface temperature of depends not only on distance but the "distance to spot size ratio" of the non-contact thermometer. If a non-contact thermometer has a low distance to spot size ratio it is like a camera with a wide angle lens with a wide field of view. If a non-contact thermometer has a high distance to spot size ratio it is comparable to a camera with a telephoto lens with a much more narrow field of view.

For instance, a non-contact thermometer with a distance to spot size ratio of 6:1 would measure a spot one inch in diameter at a distance of six inches. The spot size measured would double to two inches at a distance of 12", four inches at 24" and so on. In contrast, a non-contact thermometer with a distance to spot ratio of 60:1 has a much more focused field of view measuring a spot one inch in diameter at a distance of 60" which would double in size to a diameter of two inches at a distance of 10 feet (Table 1).

	Distance to spot size ratio			
Distance from object	60:1	12:1	8:1	6:1
1'	1"	1"	1 1/2"	2"
2'	1"	2"	3"	4"
4'	1"	4"	6"	8"
8'	1 5/8"	8"	12"	16"
16'	3 1/4"	16"	24"	32"

Table 1. Field of view of non-contact thermometer.

An example of a potential temperature measurement error can be seen in Figure 1. The large blue circle in Figure 1illustrates the field of view of a non-contact thermometer with a low distance to spot size ratio while the smaller blue circle illustrates the field of view of a non-contact thermometer with a higher distance to spot size ratio or one with a smaller ratio held closer to ground. The average floor temperature of the larger circle was 85°F, while the average temperature of the smaller circle was 80°F. The larger circle contained a number of chicks which had a higher surface temperature than the surrounding litter. Since a non-contact thermometer only provides an average surface temperature of whatever is in its field of view a person using, a non-contact thermometer could get the idea that the floor temperature was five degrees warmer than it actually was.

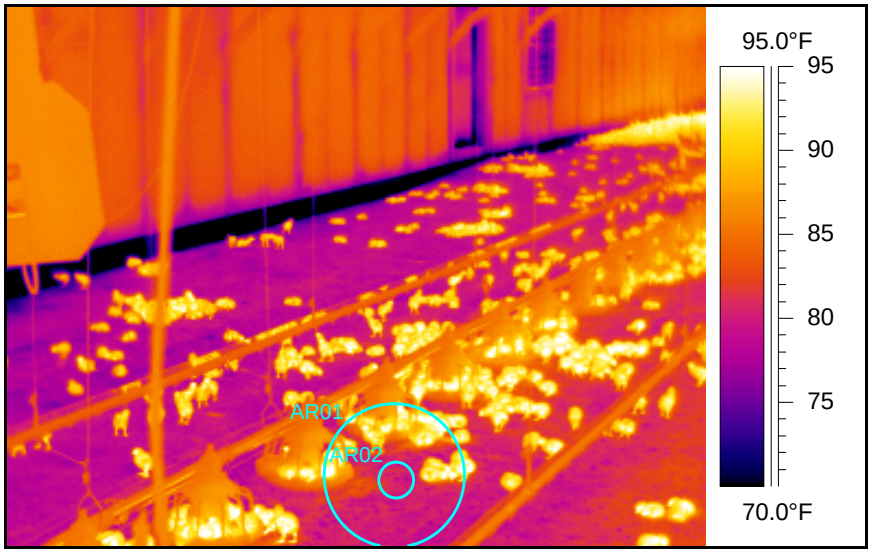

Figure 1. Thermal image of young chicks during cold weather.

Figure 2 illustrates a problem with trying to measure the surface temperature of an environmental controller sensor. Unless the temperature sensor takes up the entire field of view of a non-contact thermometer, an accurate temperature measurement cannot be obtained. For instance, the temperature sensor in Figure 2 was measuring an air temperature of 84°F, while if a non-contact thermometer were placed next to the temperature sensor the cold side wall in the background would have brought the average surface temperature down to 74°F.

Many non-contact thermometers come equipped with a laser pointer. The laser point typically represents the center of the area the non-contact thermometer is reading, not the temperature of the exact point the laser is designating. There are non-contact thermometers that actually define the area the non-contact thermometer is measuring by a series of laser points which can be very helpful in avoiding measurement mistakes (Figure 3). The down side is that these units tend to be more expensive than what most producers/service people typically own ($300 vs $150).

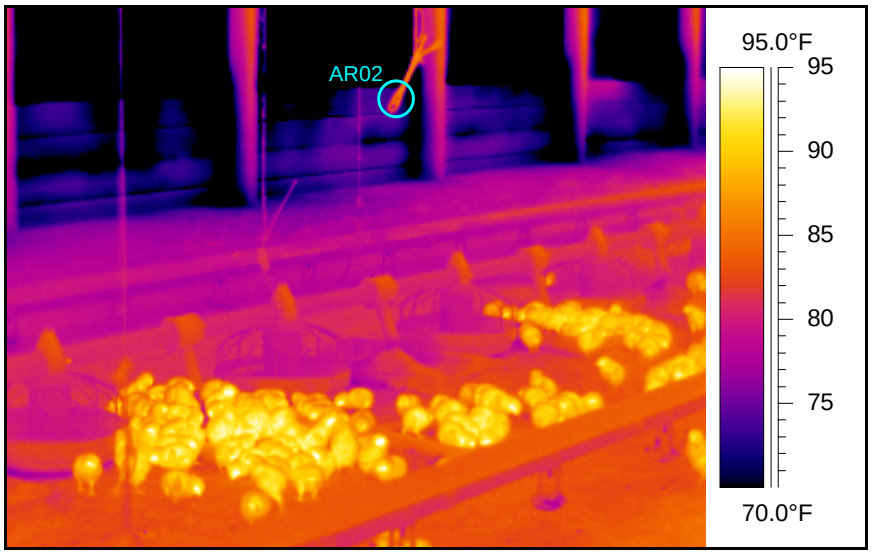

Figure 2. Thermal image of a temperature sensor.

Another potential problem with a non-contact thermometer is reflected radiant heat. Non-contact thermometers deduce surface temperature from the amount of radiant heat emanating from a surface. Though it may be hard to believe, all surfaces in a poultry house produce some radiant heat. The hotter the surface, the more radiant heat produced. Non-contact thermometers use this law of physics to determine the surface temperature of an object. The problem is that radiant heat produced by a hot object can reflect off of reflective surfaces within a house. One of the most reflective surfaces in a poultry house is a clean dropped ceiling. The reflection of radiant heat produced by radiant brooders can be seen in Figure 4. The high ceiling temperature is actually a reflection of the brooders. If you look closely you can see the reflection of the radiant heat produced by incandescent light bulbs from the ceiling. Had a non-contact thermometer been aimed at the ceiling where there was a reflection from the radiant brooders, it would have indicated a ceiling temperature well above 105ºF; whereas had it been aimed at an area not receiving reflected heat a surface temperature closer to 90ºF would have been measured. Not only can a dropped ceiling reflect radiant heat produced by brooders and light bulbs but the birds as well. During hot weather, a clean ceiling can actually reflect the radiant heat produced by a floor full of market age birds, thus producing ceiling temperature measurements higher than they actually are.

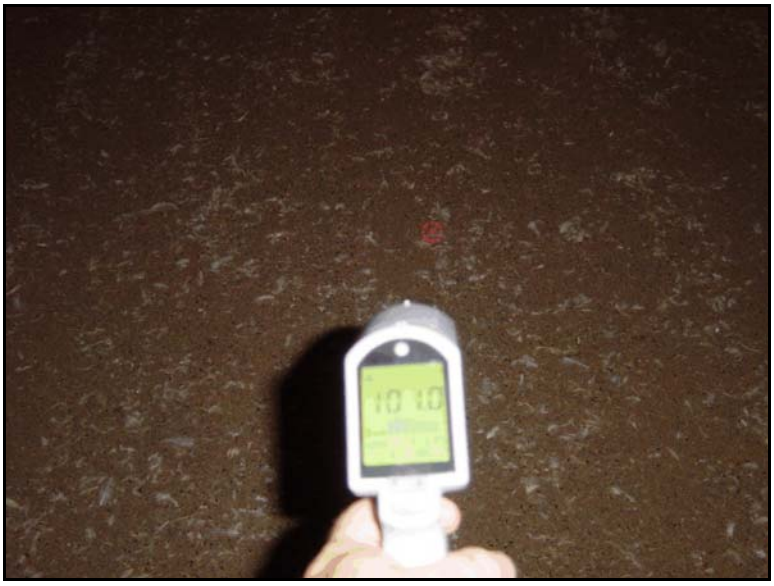
Figure 3. Non-contact thermometer with laser circle.

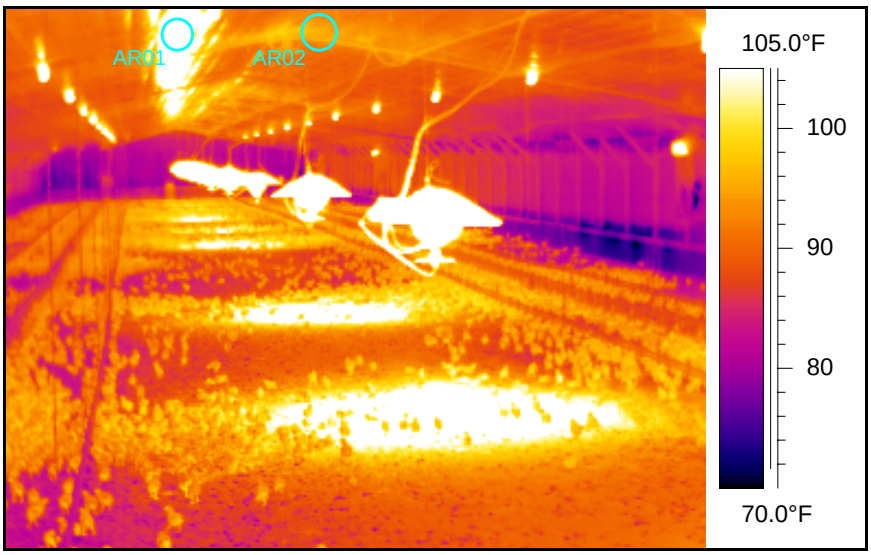

Figure 4. Reflected radiant heat from radiant brooders

A key point to keep in mind is that in general non-contact thermometers are most accurate in reading the surface temperatures of nonmetallic, nonreflective surfaces. Though metal, plastic and glass temperatures can be accurately measured, it sometimes requires adjusting the thermometer's "emissivity" setting to match the type of surface you are attempting to measure. Even after adjusting the thermometer's emissivity setting a user still has to be careful about measuring reflected radiant heat from other surfaces within the house. Complicating matters further is the fact that not all non-contact thermometers allow the user to adjust the emissivity setting. This feature is typically only available on more expensive units, not typically used by most growers and service people. The good news is that for surfaces which are dusty/dirty, which most surfaces in a poultry house tend to be, non-contact thermometers are fairly accurate.

One last factor to keep in mind when using a non-contact thermometer is its measurement accuracy. In general, most non-contact thermometers have an accuracy of +/- three to four degrees. This means that there can be as much as an eight degree difference in surface temperature measurements taken with two different non-contact thermometers. This level of accuracy is well below that of most environmental controller temperature sensors and therefore non-contact thermometers should not be used to calibrate temperature sensors. But, for general on farm trouble shooting, a non-contact thermometer is a tool that no poultry producer should be without.

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