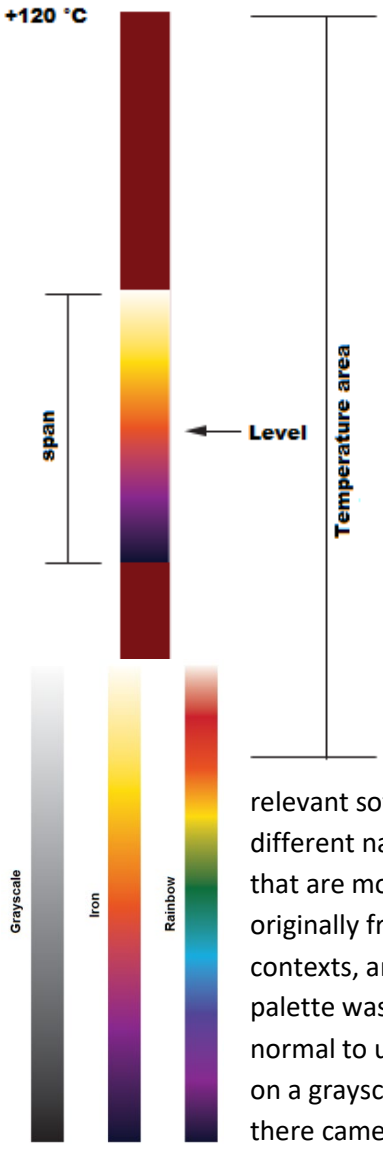
1 What does the camera detect?

The IR-camera does not show an image of the temperature of a surface. It shows the intensity of heat radiation from a surface within a specific wave band. This image is called a thermogram. The IR camera detects much more radiation than what you see. All IR-cameras work within one or multiple temperature ranges. The cheapest cameras have one range whereas the more costly have several. A common temperature range of a camera is between -40 °C to +120 °C. The illustration below explains three important concepts in thermography.

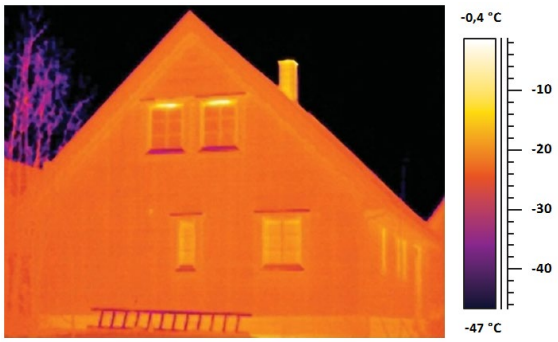


When an image is saved, all the information from the measured range is saved along with it, not just what appears in the image. The image is presented within a temperature span. The span is the difference between the top and bottom temperatures on the scale on the side of the image. The thermographer can change this span, almost in the same way as one can change the brightness and contrast in a normal picture. The thermographer can also change the color palette of the temperature, however the temperature (or more correctly, the radiation intensity) cannot be changed. This means that for example, a yellow color can represent different temperatures in different images.

The level is the mid-temperature between the top and bottom temperatures. All temperatures that are higher than the scale show as a white in the image, and all temperatures lower than the scale show as black.

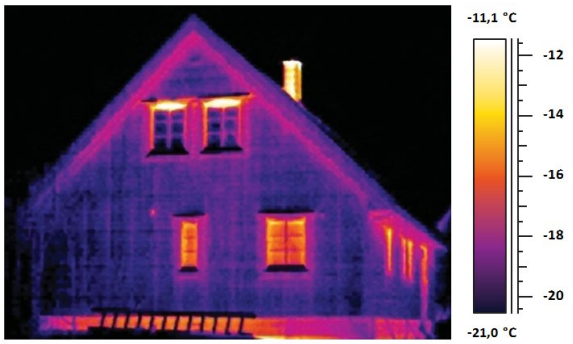
The colors are false. The image chooses different colors from a color palette. Each color represents a specific temperature in the image. Most IR-cameras have multiple color palettes and the relevant software normally has even more palettes. The color palettes can have different names depending on the manufacturer, but there are three palettes that are most popular, grayscale, iron and rainbow. The grayscale palette is originally from before the time of color. It is however still used in many contexts, among others, in airplane and helicopter thermography. The iron palette was the first color palette. This is what was used before it became normal to use color printers and color copiers. When one copies the iron palette on a grayscale copying machine, it makes a good grayscale image. After a while there came additional color palettes, including the rainbow palette which can be good for highlighting small variations in temperature.

The following thermogram show the same house but the scale and palettes have been changed.

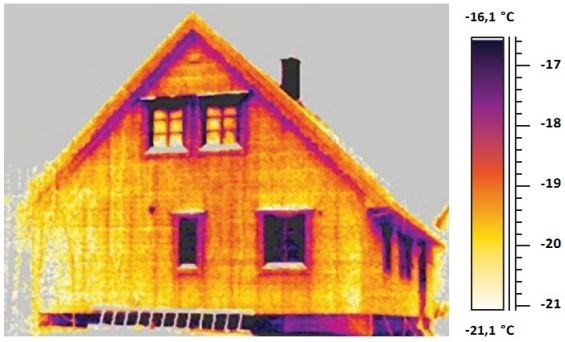


Many IR-cameras have different types of automatic control. One way to take images is to get the IR-camera itself to choose the level and span which presents itself on the scale to the right of the image. Then the IR-cameras take into consideration the highest and lowest temperatures in an image and save an image from it. The scale shows all temperatures between -47 °C and -0,4 °C. The IR-camera considers the expanse of the cold sky too. This means that the gap in temperature is much too big and there a too few details visible on the exterior walls.

By changing the scale manually, one can create a far more detailed temperature pattern of the exterior walls. Here one needs to try and get an adequately detailed image of the wall of the house. On this thermogram the temperature range of -16,1 °C to -21,1 °C has been used. The gap in temperature is significantly less than on image 1 and the details on the walls are thus more evident. It has been decided to use a temperature range around the wall temperature.



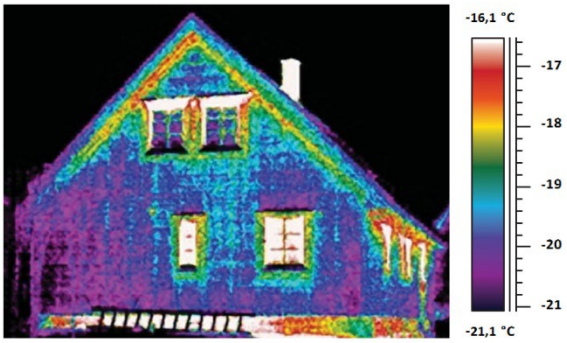
On this image the scale has been changed so that it is easier to see what is happening in the warm areas over the windows on the second floor. Here it is clear to see that warm inside air is coming out of the slit vents above the windows.



Sometimes it can be fitting to inverse the color scale to bring forth the differences in temperature in an image.

This image uses the same temperature scale as on image 1 (-16,1 -21,1 °C) but here the hottest points are black whilst the coldest parts are white.

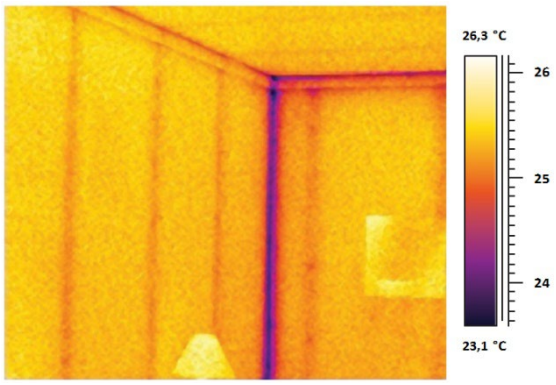
The earliest IR cameras didn't have the possibility to show color images. The temperature difference was instead shown through a grayscale palette. This palette is self-explanatory in that cold is black and hot is white. Sometimes one can highlight greater detailing in the image with the use of grayscale scaling.



The rainbow palette is used by many. It is especially popular in the USA. What one uses with regards to palettes is more to do with personal choice and comfort and what one is used to using. The rainbow palette gives big contrasts within a relatively small temperature difference. However, it can be difficult to see what the image shows. This palette is not suitable to copying into black and white.

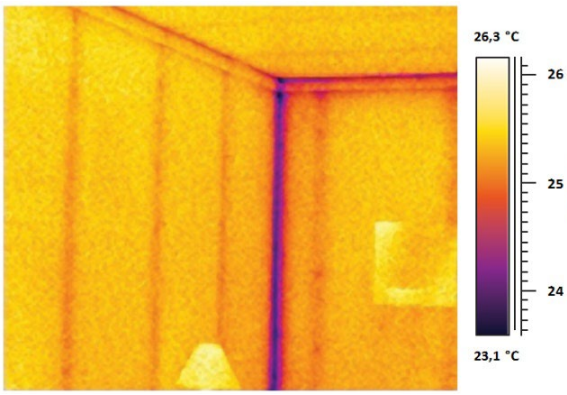
In the case of most IR cameras and/or the software that comes with them, one can illustrate temperature in the image and thereby get more information.

Interpretation of a thermogram

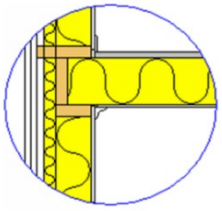


The thermogram to the left was taken of the warm side of two outer walls including a corner. There is cold room above and it is cold outside. This is an example of how an error-free wall construction should look. The studding is visible as cold bridges (dark, cold stripes), as is the joist. The color between the studs is completely uniform; something which shows that insulation is completely uniform. On the wall to the right-hand side there is a picture hanging. It is hanging a little away from the wall into the room and is thereby somewhat higher in temperature.

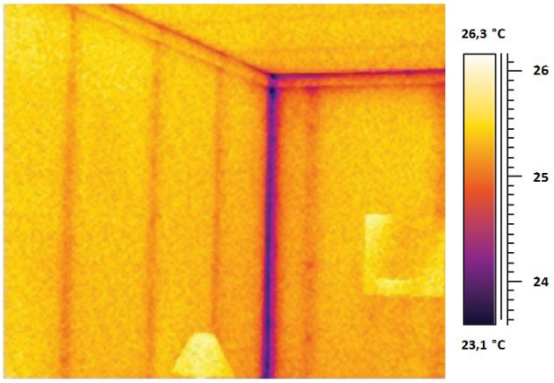
As a rule of thumb there should be a difference in temperature of at least 10 °C between the outside and inside to get good images. This enables one to see the insulation error. If one can see the studwork in the wall, one can find defects in the insulation which gives corresponding differences in temperature.



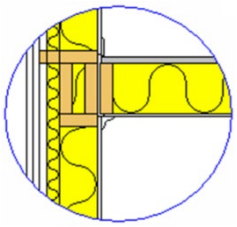
In the thermogram there is a little bit colder in the transition between the wall and the ceiling on the left. It is because there is more wood and therefore less insulation exactly at this transition.



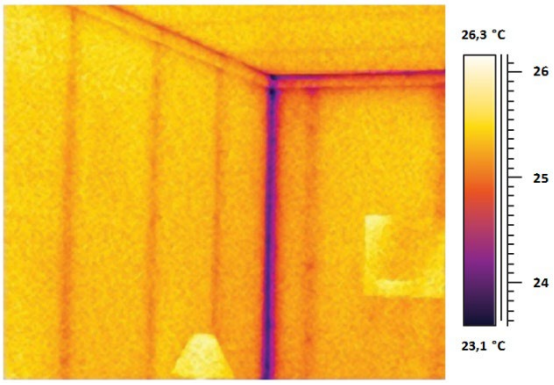
In the transition between the exterior wall and ceiling on the right-hand side, it is colder than the corresponding transition on the left-hand side. This is because of the construction and is expected.



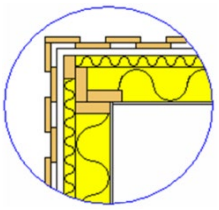
Parallel to the joists there is more wood added to the outer wall, so that it will shrink as much as the long walls. Wood shrinks a lot across the wood grain and little along the wood grain. Thus, it is to be expected that it is a little darker and colder in this transition.



The Corner Effect



A wall is heated by hot air that runs along it and radiation from the surroundings. In the corner there is less radiation, the air is stagnant and there is more wood. There is also less insulation and more outer surface in the corner, than with a plain wall. All this combined is called The Corner Effect. It is to be expected and normal that it looks colder in the corner. If the darker area in the corner looks even, there is nothing to remark. As a rule of thumb, one should measure the wall temperature at least 30 cm from the corner to be sure that the temperature is not influenced by The Corner Effect.



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