

Be sure. **testo**



# Practical guide Thermography for heating contractors.

How thermal imagers from Testo can help you to reduce costs and increase sales.

## Introduction.

Thermography already found its way into the heating sector some years ago, and is now in widespread use. Testo thermal imagers are highly valuable diagnostic tools that can be used by specialists working in the heating market. This brochure looks at some key applications, and demonstrates how thermal imagers can be used on a daily basis to save time, reduce costs, and to generate additional lucrative activities to help expand your business.



## Content.

Tracing heating pipes and locating leaks.	4
Tracing layout and testing function of underfloor heating.	10
Checking radiators before and after flushing.	12
Inspecting concealed boiler flues.	15
Advantages of an investment.	16
Technical properties of thermal imagers.	16
Criteria for selecting an imager.	17
Thermal imagers testo 865s, testo 868s, testo 871s, testo 872s and testo 883.	19

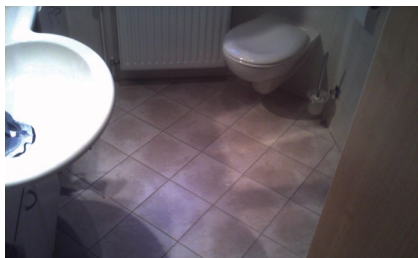
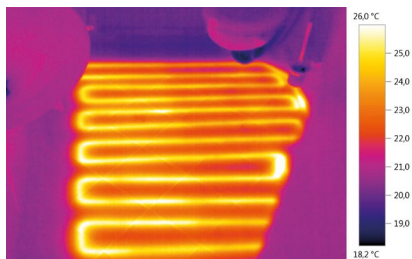
# Tracing heating pipes and locating leaks.

Heating contractors are often asked to identify and fix leaking hot water pipes. When these potential leaks are located beneath tiled or concrete flooring, this results in the extremely time-consuming and laborious task of trying to identify the location of the leak, including digging out large sections of the floor to uncover the problem. A thermal imager can help to identify problem areas almost straight away, without the additional issue of extensive, unnecessary damage to the customer's property.

## Detecting pipes:

In order to locate a leak in the heating system pipework, the first task is to trace where the pipes run. The time for this can be considerably reduced by using a thermal imager from Testo:

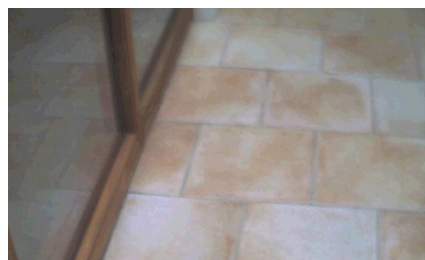
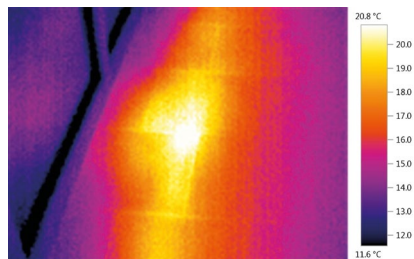
- The area to be examined is restricted to the relevant section.
- Thanks to the good visibility in the thermal image, the course of the pipework can be easily and conveniently traced (cf. adjacent illustration).





### Locating leaks:

Once the thermal imager has established the pipework runs, efforts can be focused on locating the leak. The image on the right depicts the thermal survey of a glazed walkway between a lounge and kitchen extension. The homeowner is complaining of occasional water leakage under the tiled floor. The thermal image shows the heat pattern effect from the heating pipes running under the walkway. At one point they clearly exhibit increased temperature concentration. This hot spot indicates a possible leak from the central heating system. Leaks are usually identifiable by an irregular-shaped hot spot. With the help of thermal images, the possible location of the problem in the heating pipe could be detected.



Further examinations proved that there was in fact a leak at this location.



**Avoiding unnecessary effort:**

Figures 1 –3 are taken from a thermal survey conducted in conjunction with an ongoing investigation, in relation to a suspected water leak at the property.

- In order to find the leak, large areas of flooring were unnecessarily broken open.
- It took three days to find the leak.
- Considerable work and material costs were incurred in putting everything back into its original condition.



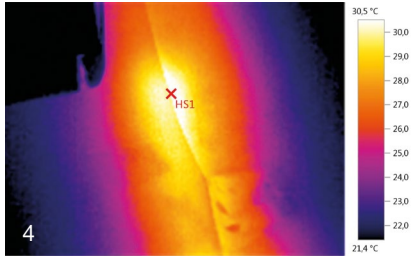
**The question is:** What other methods are available that are less time-consuming and, ideally, do not involve any kind of damage?

The thermal imager is a completely non-intrusive diagnostic tool, making it ideal for locating

- damage,
- blockages or
- leaks.



In this instance, Testo were asked to use a thermal imager to prove the existence of the leak where more conventional methods had failed. The instruments testo 865s testo 868s, testo 871s and testo 872s are best suited to this area of application. The course of the pipework could be traced beyond the exposed areas. To the frustration of the contractors



involved, the camera very quickly detected a hot spot and, after a short period of time, the hot spot began to expand, which was a good indication of a possible leak (fig. 4–5). Having located the leak, the contractor was able to expose this small section of the pipework and the leaking section of pipework was located (see fig. 6).

### Advantages of the thermal imager:

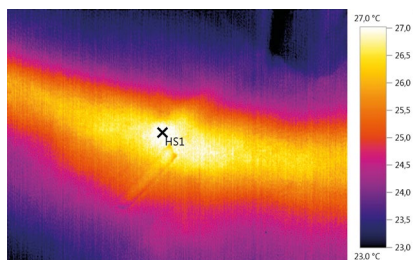
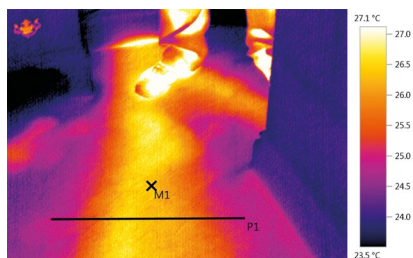
- The leak had been detected quickly, locally and non-intrusively.
- The thermographic inspection caused considerably less disturbance for the homeowner than breaking open the floor, for example.
- The costs for eliminating the leak and replacing the surface were clearly reduced.

**Conclusion:** Investing in a thermal imager makes your job considerably easier, while saving time and money for you and your customers. On top of this is the image benefit when you show that you are at the cutting edge of technology.

In the case described here, the thermal imager used was a testo 872s, with up to 320 x 240 pixels and < 50 mK thermal resolution.

## Detecting leaks under several layers of flooring:

In another instance, a heating company's customer had a problem with his heating system. The water level constantly needed topping up, which was an indication of a leak somewhere in the system. The heating was switched on and, after a short period of time, the testo 872s thermal imager was used to inspect the heating system pipework and check the various pipework runs for any leaks. Almost immediately, a hot spot was identified in the doorway between the hall and the lounge, indicating a probable leak. The hot spot was marked with masking tape for future reference, when the carpets would be lifted and an inspection hole dug to check this section of the floor. The pinpointed leak location proved to be correct. The hot spot had identified the leak on a microbore heating system, where the pipes were running approximately 70–90 mm beneath concrete screed and a substantial carpet with rubberised underlay. The testo 872s thermal imager enabled this heating contractor to inspect the heating system pipework



and identify the leak quickly and easily. This provided considerable savings in terms of the time and cost needed to locate the leak, and the customer also benefited from major savings in terms of cost and disruption. The capability of the 320 x 240 pixel resolution is fully





demonstrated in the image quality produced by Testo thermal imagers, and by its analysis software, IIRSoft.

### **Suitable thermal imagers for this application:**

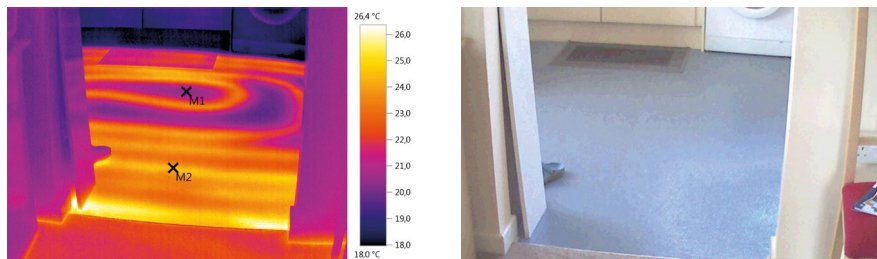
The thermal imagers in the testo 865s to testo 872s have been developed in conjunction with heating engineers and plumbers. In addition to their easy operation, they offer a high-quality detector with, depending on the imager model, 160 x 120 to 320 x 240 pixels. With the SuperResolution function, thermal images with a resolution of 640 x 480 pixels can be recorded.

The above-mentioned cameras are also able to save the thermal images in JPEG format, in order to send them via e-mail, for example to insurance companies. With the testo 868s to 872, reports can also be created and sent to the customer directly on site with the testo Thermography App.

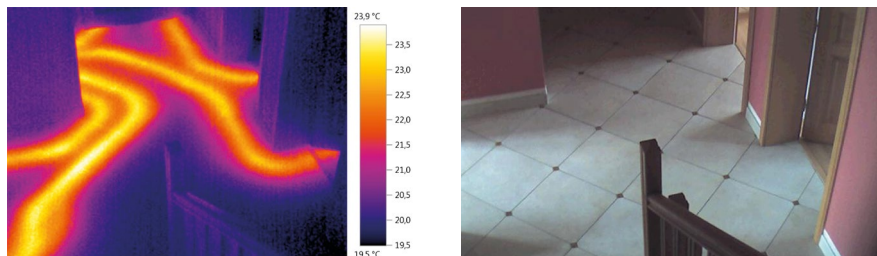
# Tracing layout and testing function of underfloor heating.

Today more and more customers are choosing underfloor heating as the ideal solution for providing reliable, consistent heat. But how can you ascertain if an existing underfloor heating system is operating efficiently or verify that a new system has been installed correctly?

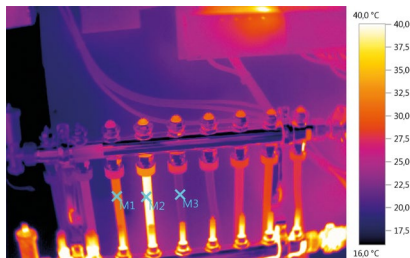
A thermal imager instantly visualizes the condition of the underfloor heating system. It moreover gives an indication of the surface temperature of the floor, which is also indicative of the heating system's performance.



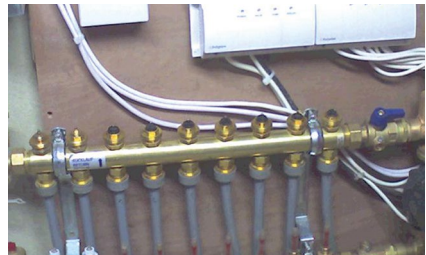
From the images it is evident that the underfloor heating system is not functioning efficiently. We can clearly see exactly where it is working and where it is not working. This is shown via the temperature distribution in the thermal image.



The thermal inspection can be used to indicate temperatures across the heating coils and to highlight any temperature variation across the floor. A thermal imager can also be used to give a visual indication of what is happening at the supply and return manifold. Large variations in return temperatures indicate that there could be a problem with the system.



Measurement object	Temp °C
Measure point 1	30.5
Measure point 2	40.2
Measure point 3	22.2

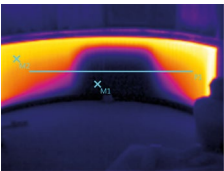


# Checking radiators before and after flushing.

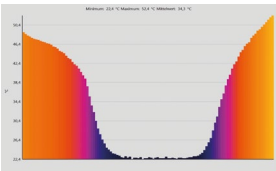
The power flushing of radiators is just one of the many services offered by a heating contractor. Rising costs mean that saving energy has become a necessity, and a service that can demonstrate and verify that power flushing saves time and money is in everyone's interest. But how can this be proven?

Thermal imagers provide the answer. This example shows how heating contractors can quickly check a radiator's condition and performance in order to easily identify problems or anomalies. The professional software IRSoft enables the heating contractor to produce a report easily, and to provide a clear analysis for the customer, thus verifying the need for improvements. Alternatively, malfunctions and anomalies can also

be presented with the testo thermography App, e.g. using a profile curve. Alternative methods of detection used by some contractors include simply touching a radiator to feel for cold areas, or using infrared thermometers, which can only pick up small areas of the radiator, not revealing the whole picture. These methods no longer suffice, and they do not offer the certainty the customer is looking for. Without equipment such as a thermal imager, convincing analysis is not possible.



**Measurement object**  
Measure point 1  
Measure point 2



Temp °C	Emissivity
22.2	0.95
54.3	0.95



Refl. Temp °C
20.00
20.00

## 1. Current status and error analysis

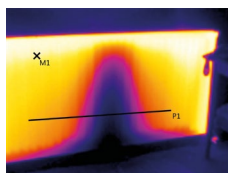
To set the scene, the thermal imager was used by a local heating contractor on a job that consisted of diagnosing a problem with the radiators in a residence. On arrival, the boiler was switched on and left to heat up. The thermal imager was used to take thermal and digital images of each of the radiators in the house, in order to verify their condition. The images gave the contractor a clear indication of temperature variation all over the radiator. Thanks to the imager's quick select buttons and clear options, it took only a few minutes to take all the images and to save them, so that the corresponding report could be created shortly afterwards using the IRSoft software included in delivery. With the help of the testo Thermography App, the reports can even be created directly on site.

It became evident that the radiators were functioning well below par. The initial images showed that the

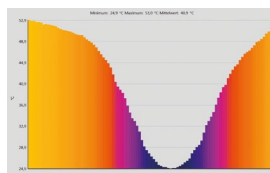
radiators were displaying a significant amount of cold area (as highlighted by the blue-coloured areas), indicating that there was substantial contaminant and sludge within the system. The temperature on the coldest part of one radiator was only 22 °C compared to the average temperature of approximately 55 °C in other areas. The images show just how inefficiently the radiators were performing, and in the process wasting a lot of the heat produced by the boiler. The temperature profile line graph, dramatically verifies the temperature variation across the radiator. This information was then presented to the customer directly on the tablet with the testo Thermography App.

Advantages of this procedure:

- The thermal images allow the customer to see and understand the problem himself.
- Accordingly, it is easier to convince him of the necessity of power flushing.



**Measurement object**  
Measure point 1



**Temp °C**  
58.2

**Emissivity**  
0.95



**Refl. Temp °C**  
20.00

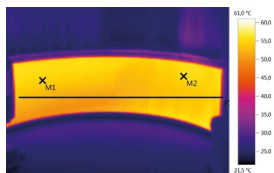


## 2. Evaluation of measurement results

While carrying out the power flushing, the contractor used the thermal imager to view each radiator in order to verify that the procedure was achieving its objectives. Once the process was complete, the thermal imager was used to assess whether all the contaminant and sludge had been removed, and to check the system's performance. The images show that the power flushing had removed the cold spots and that the temperatures were now consistent across the radiator. This proves that power flushing does indeed improve the performance of a radiator, enabling it to run efficiently and with no wastage.

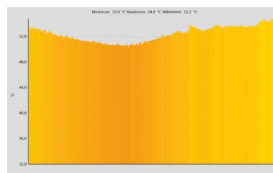
## Conclusion:

- With the help of thermography, a heating contractor can offer his customers a real and provable benefit.
- A thermal imager can be used to show the condition of radiators before, during and after power flushing, so that the resulting increase in efficiency can be clearly seen.
- The progressive analysis method bears witness to a high degree of professionalism and will impress the customer in the long term.



**Measurement object**

Measure point 1  
Measure point 2



**Temp °C**

55.5  
54.7

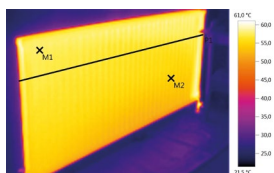
**Emissivity**

0.95  
0.95



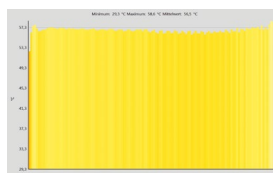
**Refl. Temp °C**

20.00  
20.00



**Measurement object**

Measure point 1  
Measure point 2



**Temp °C**

56.2  
57.6

**Emissivity**

0.95  
0.95



**Refl. Temp °C**

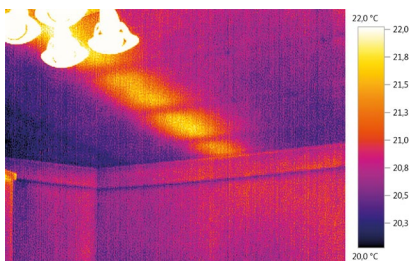
20.00  
20.00

## Inspecting concealed boiler flues.

A further example of how thermography can be adapted to individual applications is the detection of exhaust gas lines hidden under plaster. Where boilers are located away from external walls, flues often run through ceiling or wall voids. In these cases, when the gas appliance is serviced or maintained it can be difficult, or even impossible, to determine whether the flue has been installed correctly or whether it is still in good working condition. This is the reason why in buildings in which the exhaust gas flues run invisibly through wall cavities, these must be equipped with inspection apertures. Gas contractors must advise homeowners if a system represents a risk in accordance with the legal stipulations and, with the owner's permission, will turn off the gas supply to the boiler so that it cannot be used.

The question is: how do you ascertain where the concealed boiler flue is located, and where exactly does it run in the cavity?

A Testo thermal imager will provide with clear information. The location of the concealed flue can clearly be identified in the thermal image below, running in the cavity above the ceiling in an apartment. Having established where the concealed flue runs, the positions for inspection hatches can be marked and subsequently cut, and the hatches installed. Without a thermal imager, it would not have been possible to visually locate the exact position of the concealed flue.



## Advantages of an investment.

Although purchasing a thermal imager is still a significant investment, there are many reasons and justifications to prove that this cost will easily be recouped when factors such as the following are taken into consideration:

- Thermal imaging significantly reduces the time taken to locate a leak or find a fault on an underfloor heating installation or heating system pipework.
- Once located, both you and your customers will benefit from less cost and disruption due to a clear reduction in the need for unnecessary excavation work.
- Utilising thermal imaging technology to increase efficiency will enable you to accommodate additional customer visits.

## Technical properties of thermal imagers.

When choosing a thermal imager that is suitable for a variety of HVAC applications, you will need to take a number of criteria into consideration:

- Infrared resolution/number of pixels
- Thermal sensitivity
- Image display
- Field of view
- Software
- Camera functions: Scaling adjustment through manual setting of temperature span and level.
- Easy operation
- Product support

All of the above parameters are of key importance. In HVAC applications such as tracing heating system pipework and leaks, temperature differences can often be quite small, and therefore it is essential to select a suitable thermal imager that will deliver results.



## Criteria for selecting an imager.

### **Infrared resolution / number of pixels.**

The detector resolution / number of pixels determines image quality. The resolution and quality of the thermal image must be sufficient to identify all necessary details. The higher the infrared resolution, the better the presentation of details. The recommended minimum resolution is 160 x 120 pixels.

### **Thermal sensitivity.**

Good thermal sensitivity is an essential requirement for thermal imagers which are to be used by heating contractors. The aim is often to detect small temperature differences, such as when attempting to locate heating system pipework and leaks. The term “thermal sensitivity” is used to describe the size of the temperature differences the camera can detect, particularly if the differences are very small. The better the thermal sensitivity, the smaller the temperature differences that the thermal imager is able to detect and visualise. Thermal sensitivity is usually described in °C or mK. Thermal imagers for heating applications, particularly for tracing pipework and leaks under floors, should have a minimum sensitivity of 0.1 °C (100 mK).

### **Image display**

It is essential for a thermal imager to have a large display. This way, problems are immediately identifiable. The bigger the display, the more of the application will be visible. A 3.5 inch display is a must-have in order to get a good overview. You can then take the appropriate action and begin problem-solving directly.

### **Field of view**

In HVAC applications, a wide field of view is a key requirement. When tracing heating pipework or inspecting underfloor heating systems, you are often inspecting large floor areas. A wide field of view is also necessary in order to get a full view of radiators or sections of ceilings. There is also often insufficient room to be able to step further back, so a wide field of view is necessary in order to see large sections of the subject. The thermal imagers testo 865s, testo 868s, testo 871s and testo 872s are equipped with a lens with a wide aperture, and provide a large image section. The smaller the field of view, the further away from the subject it is necessary to position yourself, and the less detail is consequently visible.

### **Imager functions: Scaling adjustment through manual and automatic setting.**

An essential feature of a thermal imager is the ability to manually control the scale. This is achieved by setting the temperature span and level in order to obtain the optimum contrast on the thermal image. This allows small temperature differences to be highlighted. Using the camera in only Auto Mode can result in areas of small temperature differences being missed, or not displayed in sufficient contrast to make them visible. When locating heating system pipework and leaks, highlighting underfloor heating or tracing exhaust flues, it is often necessary to minimise the scale. This allows the detection of small temperature differences relevant in these types of application.

### **Software**

The software is important from the point of view of being able to optimise and analyze the images, and also to ensure that these convey the findings clearly. The software must be easy and intuitive to use. It should also offer assistance with report generation, in order to enable reports to be generated quickly and easily. With the testo Thermography App, you can create reports directly on site, save them online and send them by e-mail. The App also offers analysis functions such as the adding of measurement points or the determination of the temperature progression via a curve. You can add comments to thermal images and transmit them live to a mobile device, using it as a second display.

### **Product support**

When purchasing a thermal imager, it is important to ensure that you select a camera that best suits your needs and requirements. Therefore, you need a reliable supplier with the technical capability and knowledge to provide the support required to help you with your selection.



## **Thermal imagers** testo 865s, testo 868s, testo 871s, testo 872s and testo 883.

Thanks to their easy operation and image quality, the thermal imagers testo 865s, testo 868s, testo 871s, testo 872s and testo 883 are perfect for detecting and visualizing leakage and defects in heating systems reliably and accurately. The thermal imagers are also suitable for the thermal inspection of materials and components in industry.

These features distinguish all models:

- Large, high-resolution 3.5 inch display
- High thermal sensitivity
- Up to 2,000 images can be saved
- Automatic hot/cold spot recognition
- High-performance analysis software
- Two-year warranty

### **testo 865s**

- Infrared resolution 160 x 120 pixels
- SuperResolution technology for 320 x 240 pixels available in the imager and App
- Thermal sensitivity < 100 mK
- FixFocus standard lens 31°



## testo 868s

- Infrared resolution 160 x 120 pixels
- SuperResolution technology for 320 x 240 pixels available in the imager and App
- Thermal sensitivity < 80 mK
- FixFocus standard lens 31°
- Free testo Thermography App for easy report creation
- Integrated digital camera



## testo 871s

- Infrared resolution 240 x 180 pixels
- SuperResolution technology for 480 x 360 pixels available in the imager and App
- Thermal sensitivity < 80 mK
- FixFocus standard lens 35°
- Integrated digital camera
- Free testo Thermography App for easy report creation
- Bluetooth connection to optionally available thermohygrometer



## testo 872s

- Infrared resolution 320 x 240 pixels
- SuperResolution technology for 640 x 480 pixels available in the imager and App
- Thermal sensitivity < 50 mK
- FixFocus standard lens 42°
- Free testo Thermography App for easy report creation
- Bluetooth connection to optionally available thermohygrometer
- Laser marker



## testo 883

- Infrared resolution 320 x 240 pixels
- SuperResolution technology for 640 x 480 pixels
- Thermal sensitivity < 40 mK
- Manually operated standard lens 30°
- Telephoto lens 12° optional
- Free testo Thermography App for easy report creation
- Bluetooth connection to optionally available thermohygrometer
- Laser marker



## Testo – the company.

Testo, whose headquarters are in Titisee in the Black Forest, is an expert for innovative measurement solutions.

### **The products: Measurement solutions for demanding target groups**

What do the storage of drugs, quality assurance in the food sector or the monitoring and optimization of the indoor climate in an industrial building have in common? They can all be conducted easily, securely and efficiently, thanks to measurement solutions from Testo. Our products help to save time and resources, to protect the environment and humans, and to increase the value of goods and services.

### **The history: a success story since 1957**

Thanks to a strategy of sustainable and profitable growth, the small Black Forest temperature measuring instrument manufacturer has developed into a global concern with 36 subsidiaries and over 80 distribution partners. Roughly 3,400 committed Testorians worldwide research, develop, produce and market for the company with passion and expertise.

### **The perspectives: onwards with strength from within**

The above-average investments in the future are a part of the firm's recipe for success. Testo AG invests approximately a tenth of the annual turnover worldwide on Research & Development, consolidating its position as a leading specialist in the field of portable and stationary measurement technology. In order to maintain this leading position, Testo places great value on training young people and ensuring the next generation of experts and management staff, for example with a classical apprenticeship, the tailor-made post-Master professional entry program VIA, or numerous qualified further training programs.