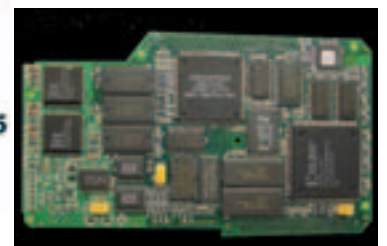
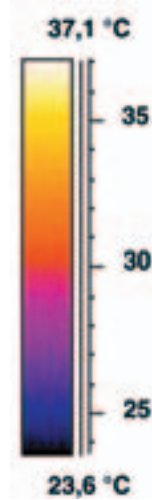
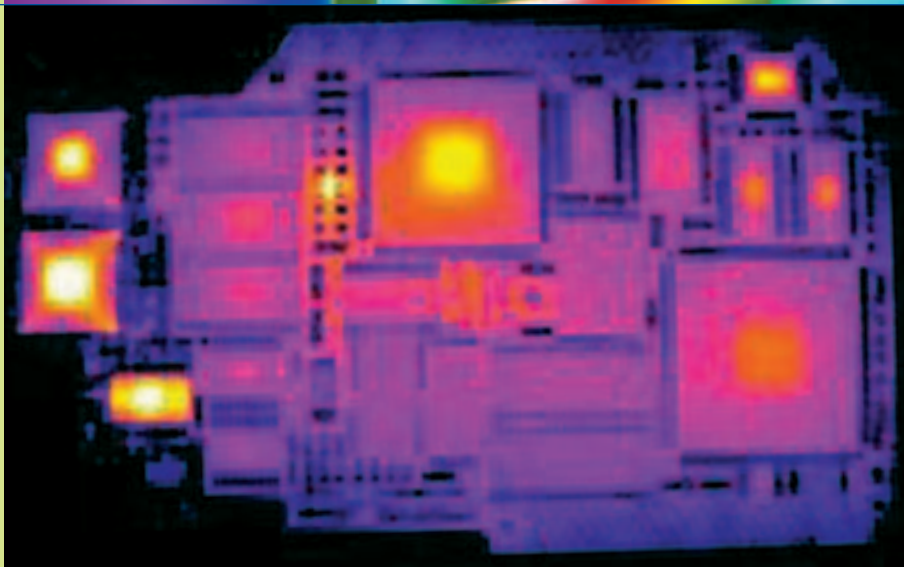
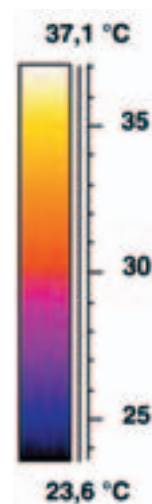
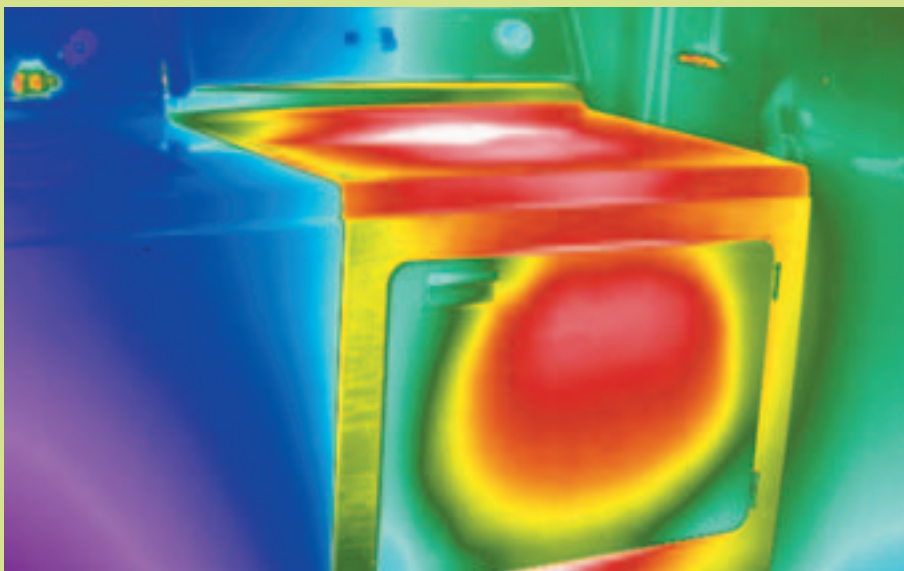
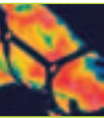
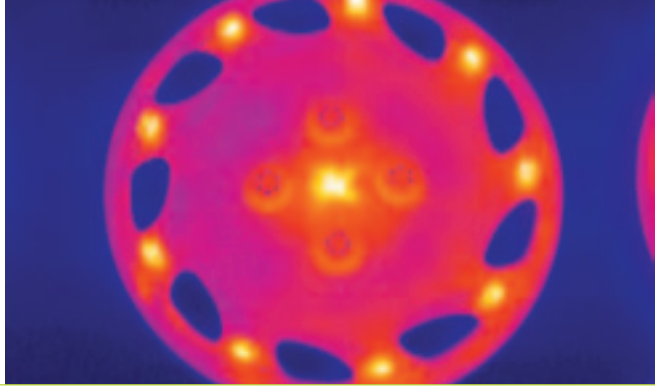
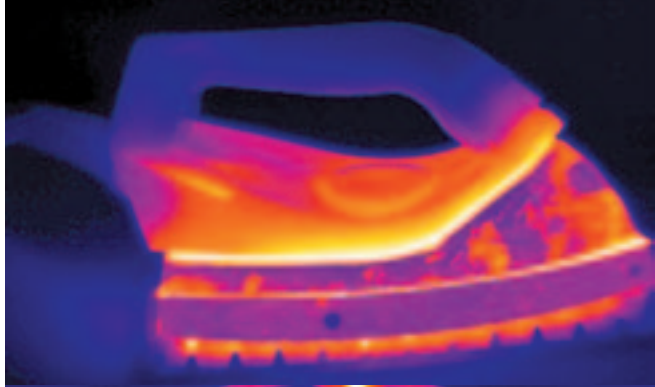
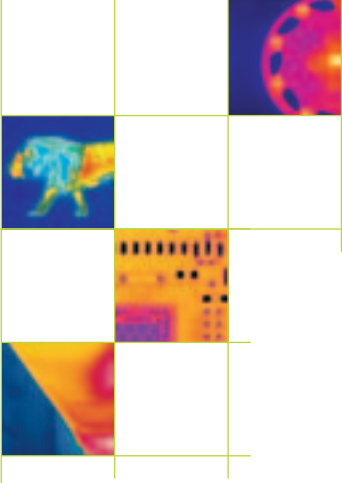
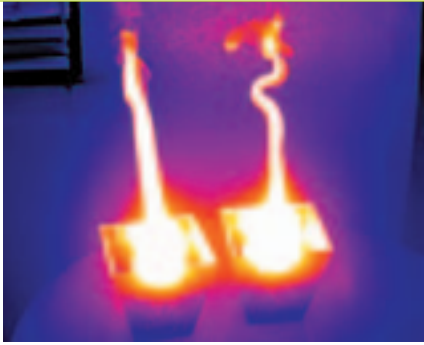


Infrared thermography for scientific applications







Infrared thermography for scientific applications

Each day, scientists throughout the world are looking for new methods to help them solve their problems. Infrared thermography has proven to be an invaluable tool to solve a wide range of scientific questions and problems.

Because of its non-destructive analysis capacities, thermography systems are an important instrument in a wide variety of Research and Development applications.

Thermography is the production of temperature calibrated infrared or heat pictures by utilizing an infrared camera. Based on these thermal images, accurate temperature measurements can be made to detect even the smallest temperature differences. Numerous researchers, active either in product development, applied or fundamental research, have discovered that infrared is a reliable and quick non-destructive method to help them in their daily work.

ADVANTAGES OF INFRARED

Heat patterns are very difficult to predict. This means that it is not always possible to know where to attach the thermocouples necessary to make accurate measurements and effectively evaluate heat dissipation. Furthermore, since the thermocouple needs to be in contact with the component to be tested, it can influence the results of the measurement. Infrared has the advantage that it produces very comprehensive images in a non-contact mode. Even if it is not clear where the exact location of the

problem might be, it will clearly show up, sometimes at the most unexpected location, in the easy-to-understand infrared image.

Another advantage is that, by using infrared thermography, manufacturers can avoid recall campaigns. The costs involved for recalling products because they have a failure, can run into millions of euros and can sometimes be easily avoided by using infrared in the development stage of the product.

NEW INFRARED TECHNOLOGY

Today's infrared cameras can produce very high-resolution images so that crisp thermal images can be taken of even the smallest of objects in a non-contact mode. High-end infrared cameras, especially designed for the most demanding scientific applications, detect the smallest temperature differences over a very wide temperature range. Frames can be captured, and stored, in real-time, at high frame rates allowing for detailed and extensive analysis of highly dynamic events typically found in R&D environments.

At the other end of the spectrum, new detector technologies have made infrared cameras more affordable than ever. Thanks to this evolution, universities and smaller research centers are also discovering the benefits of infrared. Finally, today's infrared software has become extremely powerful.

Visually comparing thermal images can be difficult. There are subtle temperature changes, which can not be detected by the naked eye. Thanks to features like image subtraction, two thermal images can have the temperature of each pixel subtracted from each other. The result image will only show, the sometimes extremely small, temperature differences between the two images.

Scientific applications for infrared thermography are numerous and can be found in the most diverse markets. FLIR Systems infrared cameras provide the ability to view thermal distribution palettes in real-time for products as small as hybrid IC circuits and as large as jet or rocket engines.

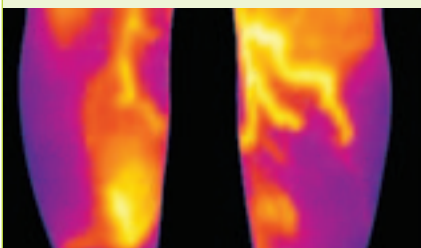
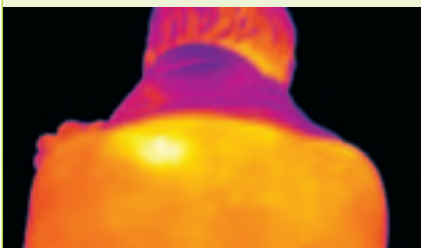
THE ADVANTAGES OF INFRARED THERMOGRAPHY FOR SCIENTIFIC APPLICATIONS

- GIVES A FULL, REAL-TIME THERMAL PATTERN OF THE SITUATION
- IS CONTACTLESS AND NON-DESTRUCTIVE
- IDENTIFIES AND LOCATES THERMAL ANOMALIES
- STORES THERMAL INFORMATION
- ALLOWS FOR DETAILED ANALYSIS
- HAS NUMEROUS APPLICATIONS AND POSSIBILITIES

MEDICAL APPLICATIONS

Human body temperature is a complex phenomenon. Man is homeothermic, and produces heat, which must be lost to the environment. The interface between that heat production and the environment is the skin. This dynamic organ is constantly adjusting to balance the internal and external conditions, while meeting the physiologic demands of the body.

Infrared is widely accepted as an accurate and reliable tool for medical assessment and diagnosis. Changes in the thermal conductivity of the skin caused by burns, skin ulceration or grafting can easily be detected and monitored with a sensitive thermal imaging system. Other common applications include early detection of skin cancer, pain management, burn depth assessment, fever detection, open heart surgery,...

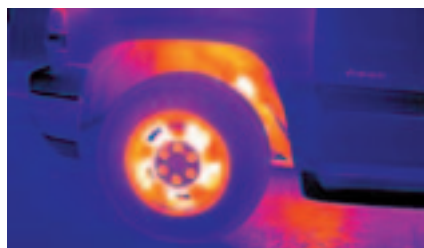
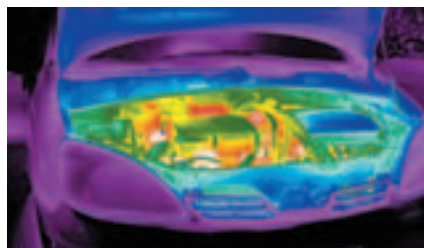
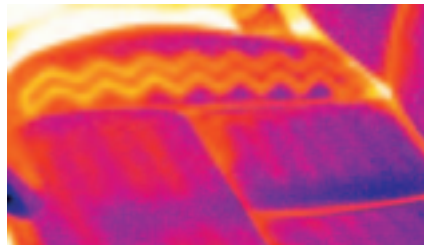


AUTOMOBILE SECTOR

The aim of Research and Development in the automobile sector is to develop new and even better models in a faster and more cost efficient way. Being able to bring new models faster to the market is one of the key factors of success in the automobile industry.

Researchers are looking at the total heat management of cars and are developing e.g. heat production solutions for the engines and under-body temperature control products. Infrared thermography gives them a real-time image of the situation, in a non-contact mode.

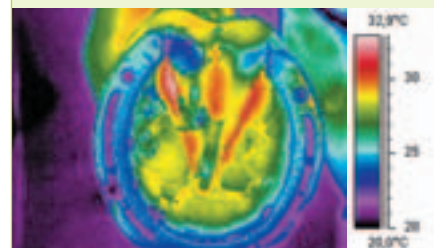
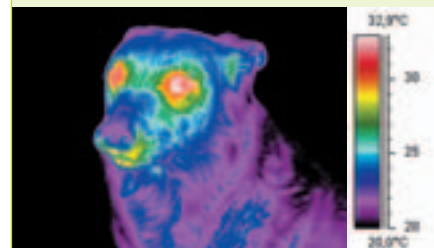
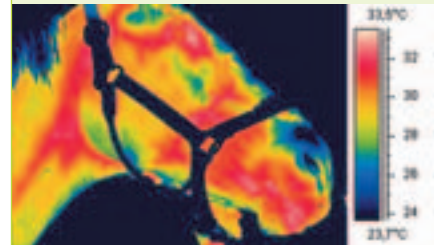
Infrared cameras can see problem areas immediately, which is an enormous advantage over thermocouples. A lot of today's common car features such as windshield defrosting, seat heating and many others have been developed and are being tested with the help of infrared thermography. Also the suppliers of the automobile industry are using the benefits of infrared to their advantage. The technique is for example commonly used in the tyre industry to develop new models.



VETERINARIAN APPLICATIONS

Numerous veterinarians have discovered that infrared thermography is a reliable and quick non-invasive method to detect hot spots, as this technique provides a visual map of skin temperature gradients in real-time. Since heat is one of the major signs that inflammations or injuries are prominent, infrared can be used to detect and diagnose these in a very early stage. Frayed nerves and muscles can also easily be detected. Typical applications include axial pathology, articular pathology, fractures, tendinopathies, podo-trochlear syndrome.

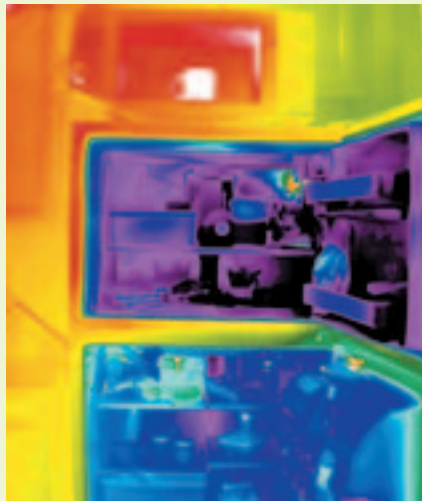
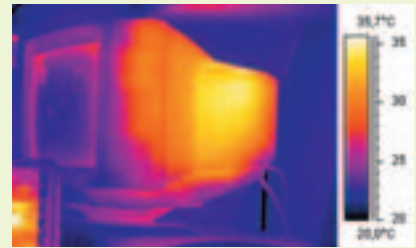
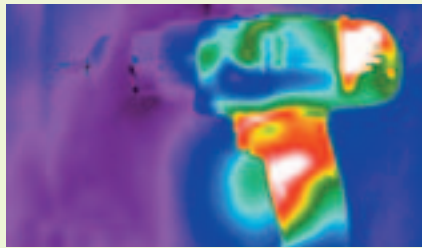
Infrared is widely used for the diagnosis of horses but numerous zoologists worldwide have learned the benefits of infrared not only to diagnose but also to learn more about the behaviour of all kinds of animals.



APPLIANCES

Bringing new products faster to the market. This is one of the “key factors of success” in many industries. It is most beneficial to make use of infrared thermography early in the product design cycle. In the development phase, before going into mass production, appliances are thoroughly tested. Consumers are expecting a perfect product at an affordable price. Thanks to infrared, companies can shorten the development phase and start getting a rapid return on their development investments.

One of the problems when developing new electrical products is to get immediate feedback on the amount of output power and the way the power is being dissipated. More and more companies are turning to infrared thermography to help and solve these complex problems.



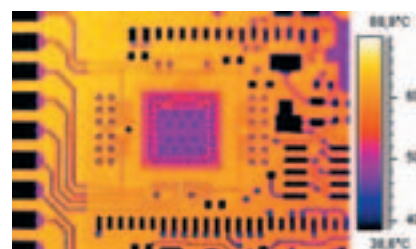
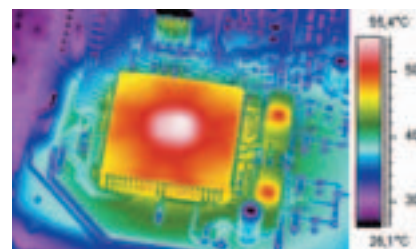
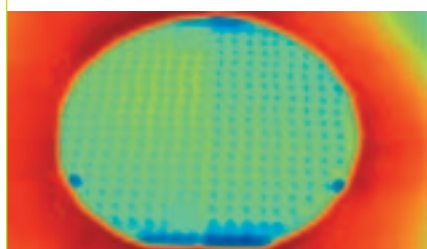
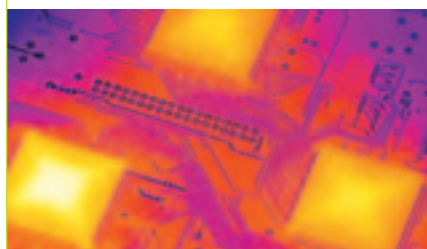
PRINTED CIRCUIT BOARDS

Scientists throughout the world seek solutions every day for their specific tasks, using the most diverse technologies. In some cases, infrared and thermographic cameras have already proved to be an indispensable instrument, successfully protecting investments through quality control, and human life

by the detection of sources of fires. In the field of electronics, however, infrared thermography is more than just an important instrument for fire protection or quality assurance. It can be used whilst complex circuitboards are still at the design stage, for the avoidance of subsequent faults and expensive recalls. In repair work, the sources of faults can often be located and eliminated with astonishing ease by means of the heat irradiated from them.

As our world becomes more computerized, the trend is to design and manufacture products that are smaller, higher performing and easier to use. Scientists designing these products are challenged with managing the heat dissipation without sacrificing performance or cost. Until recently, accurately understanding heat has been extremely difficult. However, thanks to

thermography, engineers are able to easily visualize and quantify heat patterns in the devices that they create. Available macro- and microscopic lenses make it possible to view the smallest targets. Typical examples are printed circuit boards for laptops, mobile phones, audio-visual equipment, ...

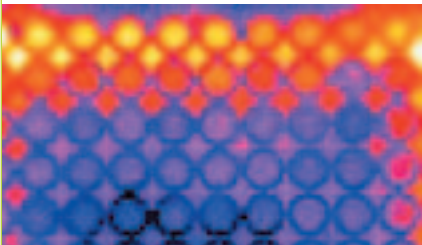


MISCELLANEOUS

Scientific applications for infrared thermography are as good as endless. In many cases it is however not possible to show what can be done with an infrared camera, because infrared is giving many companies a competitive advantage and a lot of interesting research is considered confidential. Innovating companies do not like to give up the competitive advantages that infrared has given them. Also universities, which are conducting thermodynamic, applied or fundamental research, are very protective of their innovative work. The following applications are just a very small example of what infrared can do in scientific environments.

PHARMACEUTICAL INDUSTRY

New drugs are being developed with the help of infrared. Scientists look at temperature changes in chemical reactions and study what is happening in microtyterplates.



TARGET SIGNATURE

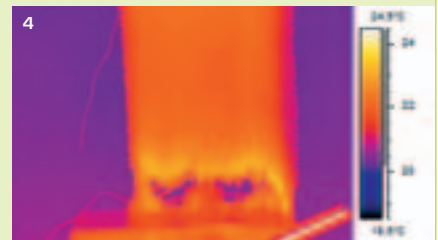
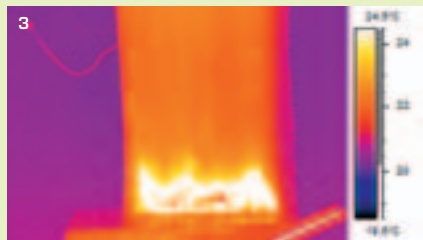
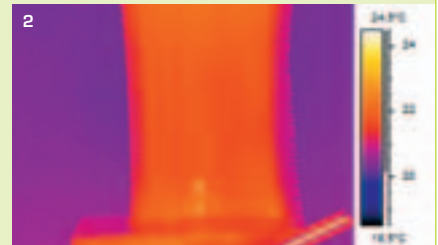
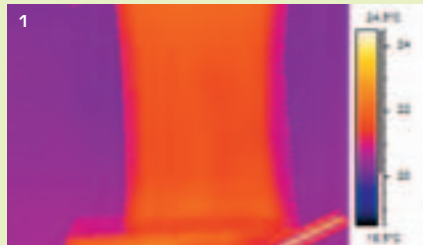
An infrared image contains an enormous amount of information. Once the thermal pattern of e.g. a plane has been established it is very easy to compare it with another one and to determine whether it is from the same type or not.



STRESS ANALYSES

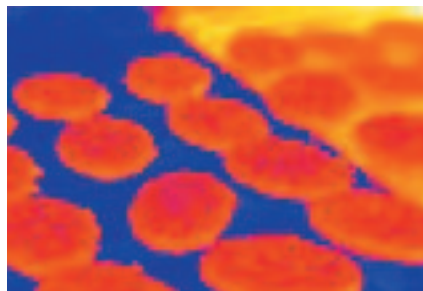
All different types of materials are tested for stress analyses. These destructive tests are done to calculate when a material

loses its strength and starts to break or rupture. These analyses are extremely important in e.g. the airplane industry.



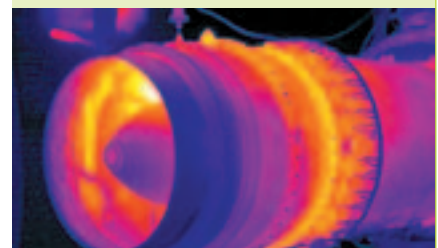
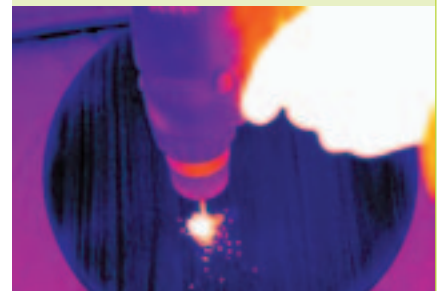
FOOD INDUSTRY

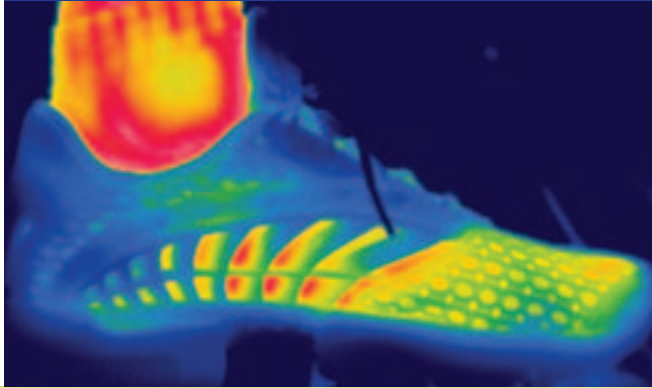
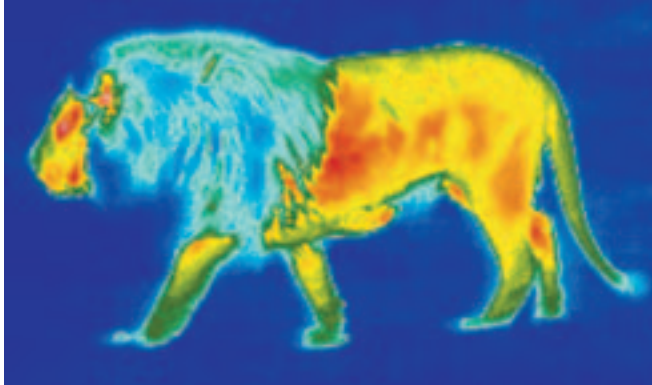
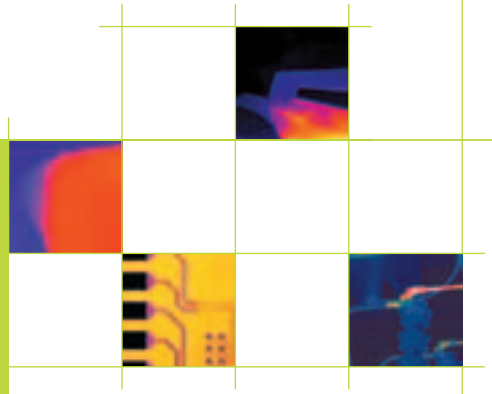
Developing new cooking, baking or freezing techniques can be a demanding task. If not properly developed and applied, certain techniques can be a danger for public health. Infrared can give vital information of what is happening during these processes.



UNIVERSITIES

Fundamental or applied research. Thermodynamical studies and many more. Infrared technology has become more and more affordable and universities are using infrared thermography for the most diverse applications.







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