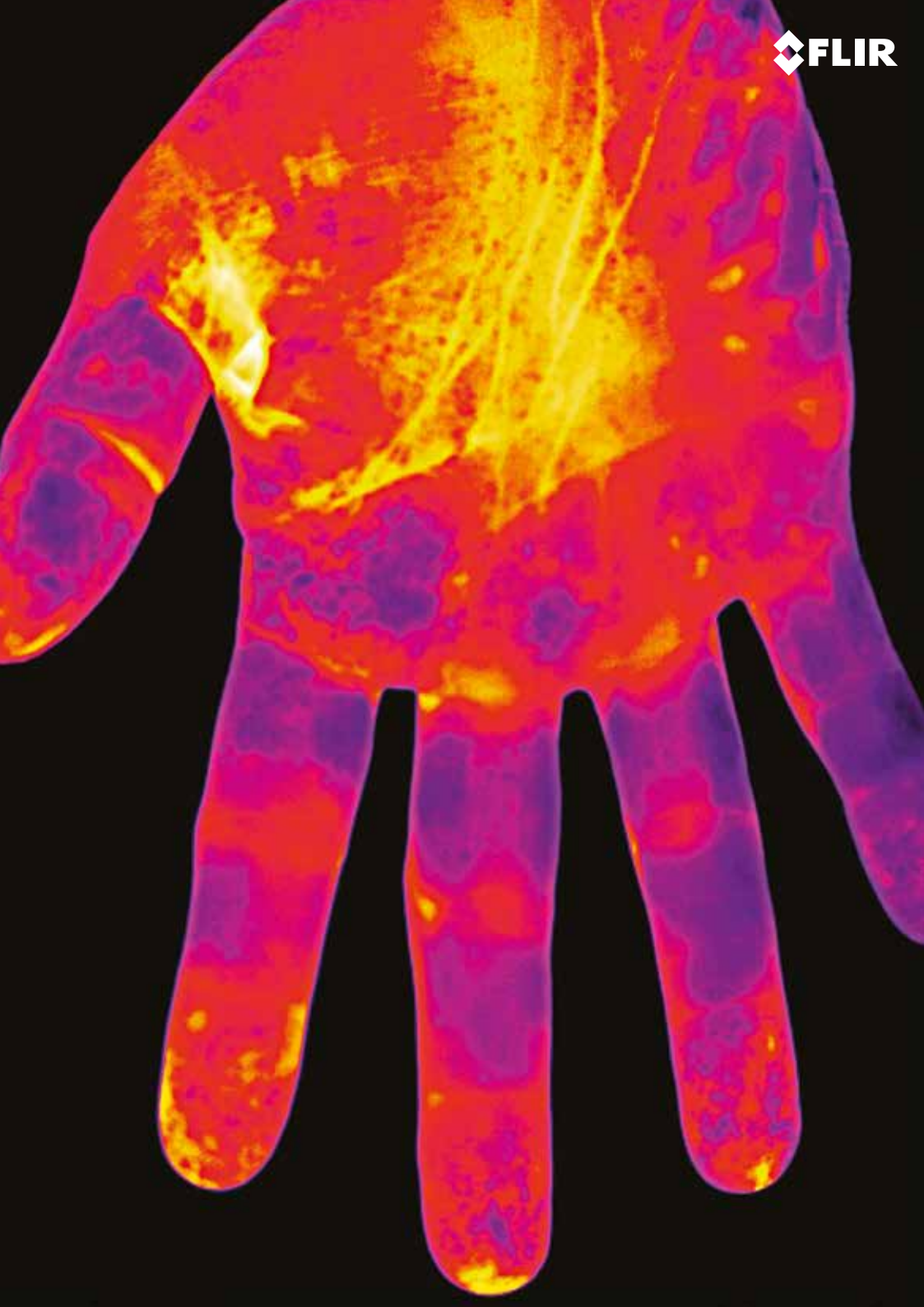
MRA
INSTRUMENTAÇÃO
FLIR®

Thermal imaging for Science / R&D

Discover a wide variety of applications


FLIR

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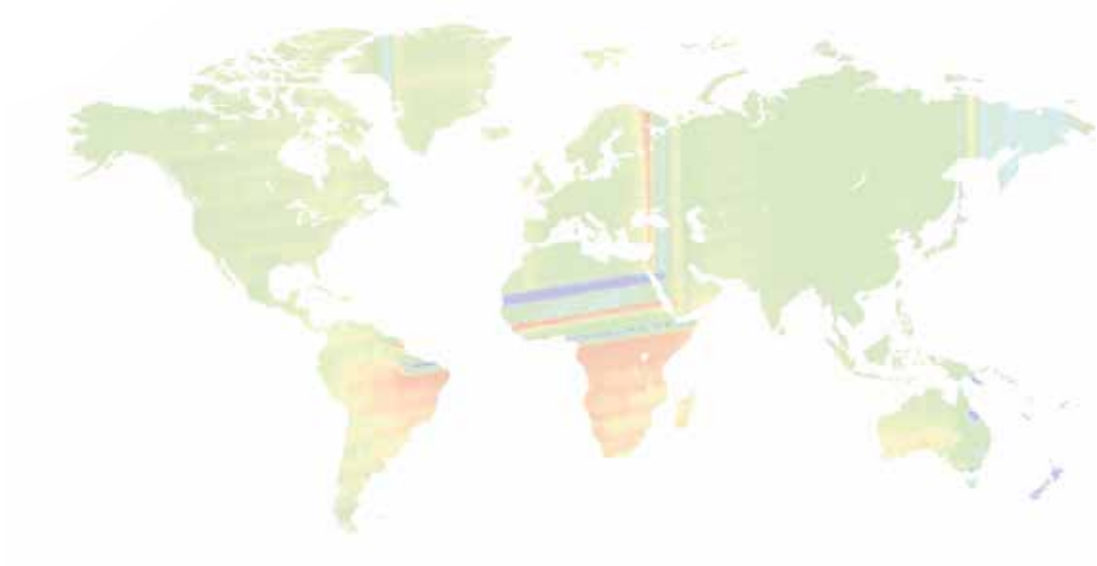
1 Introduction



FLIR Systems: the world leader in thermal imaging cameras
FLIR Systems is the world leader in the design, manufacturing and marketing of thermal imaging systems for a wide variety of commercial and government applications.

Rapidly emerging markets and organization
Interest for thermal imaging has grown considerably over the last few years in a large variety of markets. To face this increased demand, FLIR Systems has expanded its organization drastically. Today we employ more than 4,000 people. Together, these infrared specialists realize a consolidated annual turnover of more than 1 billion US dollars. This makes FLIR Systems the largest manufacturer of comercial thermal imaging cameras in the world.

Manufacturing capabilities

FLIR currently operates 6 manufacturing plants: three in the USA (Portland, Boston and Santa Barbara, California) one in Stockholm, Sweden, one in Estonia and one near Paris, France.

FLIR, Sweden

FLIR ATS, France

FLIR, Boston, USA

FLIR Santa Barbara, USA

All markets and all applications

FLIR Systems is totally focused on thermal imaging cameras. No other manufacturer produces more thermal imaging cameras than FLIR Systems.

FLIR Systems is active in all markets where thermal imaging cameras are being used: electrical / mechanical, building, automation / process control, R&D / Science, maritime and security are just a few markets in which FLIR Systems thermal imaging cameras have proven their worth.

2 The thermal imaging camera and how it works

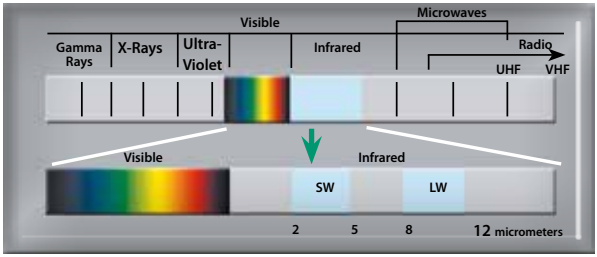
A thermal imaging camera records the intensity of radiation in the infrared part of the electromagnetic spectrum and converts it to a visible image.

What is infrared?
Our eyes are detectors that are designed to detect electromagnetic radiation in the visible light spectrum. All other forms of electromagnetic radiation, such as infrared, are invisible to the human eye.

The existence of infrared was discovered in 1800 by astronomer Sir Frederick William Herschel. Curious to the thermal difference between different light colors, he directed sunlight through a glass prism to create a spectrum and then measured the temperature of each color. He found that the temperatures of the colors increased from the violet to the red part of the spectrum.

After noticing this pattern Herschel decided to measure the temperature just beyond the red portion of the spectrum in a region where no sunlight was visible. To his surprise, he found that this region had the highest temperature of all.

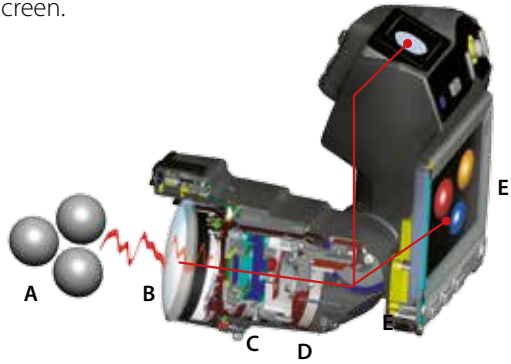
Infrared radiation lies between the visible and microwave portions of the electromagnetic spectrum. The primary source of infrared radiation is heat or thermal radiation. Any object that has a temperature above absolute zero (-273.15 degrees Celsius or 0 Kelvin) emits radiation in the infrared region. Even objects that we think of as being very cold, such as ice cubes, emit infrared radiation.



We experience infrared radiation every day. The heat that we feel from sunlight, a fire or a radiator is all infrared. Although our eyes cannot see it, the nerves in our skin can feel it as heat. The warmer the object, the more infrared radiation it emits.

The thermal imaging camera

Infrared energy (A) coming from an object is focused by the optics (B) onto an infrared detector (C). The detector sends the information to sensor electronics (D) for image processing. The electronics translate the data coming from the detector into an image (E) that can be viewed in the viewfinder or on a standard video monitor or LCD screen.



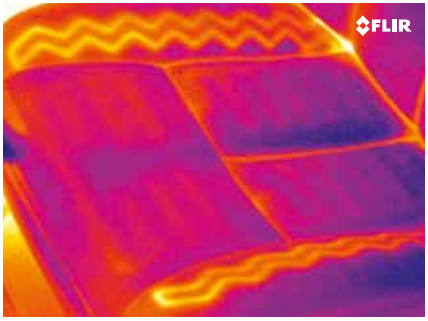
Infrared thermography is the art of transforming an infrared image into a radiometric one, which allows temperature values to be read from the image. So every pixel in the radiometric image is in fact a temperature measurement. In order to do this, complex algorithms are incorporated into the thermal imaging camera. This makes the thermal imaging camera. This makes the thermal imaging camera a perfect tool for Science / R&D applications.

3 Why use thermal imaging?

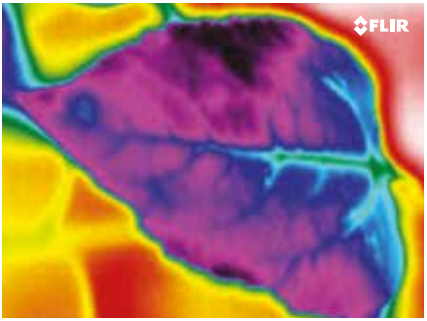
Thermal imaging cameras for Science / R&D applications are powerful and non invasive tools. With a thermal imaging camera you can identify problems early, allowing them to be documented and corrected before becoming more serious and more costly to repair.

FLIR thermal imaging cameras:

- Are as easy to use as a camcorder or a digital camera
- Give you a full image of the situation
- Identify and locate the problem
- Measure temperatures
- Store information
- Save you valuable time and money



Industrial R&D



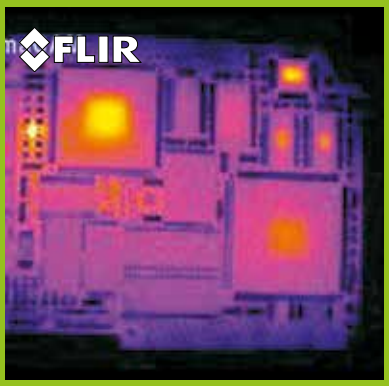
Scientific R&D

FLIR Systems offers a wide range of thermal imaging cameras. Whatever your Science / R&D project, FLIR will have just the right thermal imaging camera for you.

Why use thermal imaging cameras?
Why would you choose a FLIR thermal imaging camera? There are other technologies available to help you measure temperatures in a non-contact mode. Infrared thermometers for example.

Infrared thermometers versus thermal imaging cameras
Infrared (IR) thermometers are reliable and very useful for single-spot temperature readings, but when scanning large areas, it's easy to miss critical parts. A FLIR thermal imaging camera can scan entire areas and products at the same time. It never misses a potential problem area no matter how small this might be.

IR thermometer, measures temperature in one point.



The FLIR Thermal imaging camera scans entire surfaces at the same time.

Find problems faster and easier with extreme accuracy
It is easy to miss a critical Science / R&D problem if you are only using a spot IR thermometer. A FLIR thermal imaging camera will give you a total view of the situation and instant diagnostic insights.

4 Thermal imaging cameras for Science / R&D

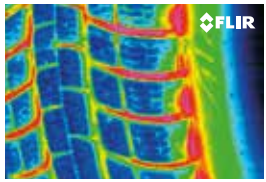
FLIR's thermal imaging cameras are used for capturing and recording thermal distribution and variations in real-time, allowing engineers and researchers to see and accurately measure heat patterns, dissipation, leakage, and other temperature factors in equipment, products and processes.

These cameras can distinguish temperature changes as subtle as 0.02°C. They feature state-of-the-art detector technology and advanced mathematical algorithms for high performance and precise measurements from -80°C to +3000°C.

The R&D camera ranges combine extremely high imaging performance and precise temperature measurements, with powerful tools and software for analysing and reporting.

This combination makes them ideal for a wide range of research, thermal testing and product validation applications.

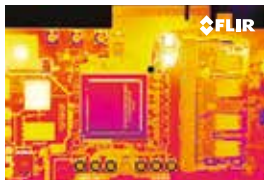
Thermal imaging has proven to be an invaluable tool to solve a wide range of scientific questions and problems.



Quality test

Industrial R&D

Numerous new products have been developed with the help of a thermal imaging camera. Product developers study the heat dissipation and thermal characteristics.



Printed Circuit Board

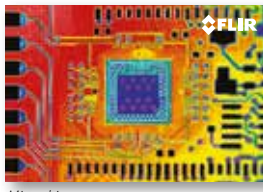
Printed Circuit Boards

Scientists designing printed circuit boards are challenged with managing the heat dissipation without sacrificing performance or cost. Accurately understanding heat has been extremely difficult. However, thanks to thermal imaging, engineers are able to easily visualize and quantify heat patterns in the devices that they create.

Glass blowing

Research & Development

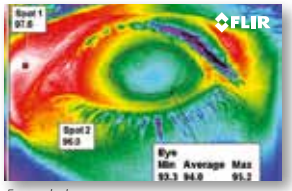
Thermal imaging cameras can characterise material properties and supply rapid non-contact temperature measurement in the most demanding conditions. A wide array of infrared sensor types and optics make thermal imaging indispensable in many research environments.



Microchip

Thermal imaging microscopy

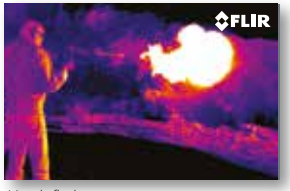
A thermal imaging camera combined with a microscope becomes a thermal imaging microscope, capable of accurate temperature measurement on targets as small as 3 microns. Electronics manufacturers use thermal imaging scopes to characterise the thermal performance of components and semiconductor substrates without physical contact.



Eye pathology

Medical thermography

Medical thermography is an accurate, quantifiable, non-contact diagnostic technique used to visualise and quantify changes in surface temperatures using high performance thermal imaging cameras. Applications include vascular evaluation, tumorous tissue identification, muscle strain assessment, and bleed point detection.



Muzzle flash

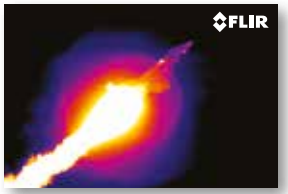
High speed/stop motion

High-speed thermal imaging allows microsecond exposure times that stop the apparent motion of dynamic scenes and permit capturing frame rates exceeding 62,000 frames per second. Applications include thermal and dynamic analysis of jet engine turbine blades, supersonic projectiles, and explosions.

Helicopter thermal signature

Thermal signatures

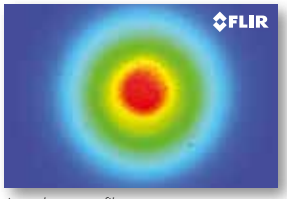
IR signatures measure a target's apparent infrared brightness as a function of wavelength and reveal the appearance of a target to sensors under varying conditions of standoff distance and atmosphere. IR signatures are valuable tools in the design of vehicle, sensor, and camouflage systems.



Jet aircraft

Tracking

Thermal imaging camera systems complement video tracking systems by increasing visibility in low light or unfavorable haze conditions, allowing the tracking system to maintain target contact and constantly update the target's bearing, range, and elevation.



Laser beam profile

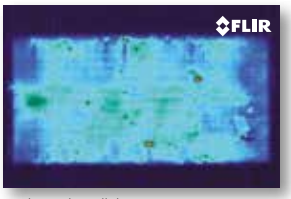
Directed energy

A directed-energy weapon (DEW) emits energy in an aimed direction without the means of a projectile. DEWs include laser, high power radio frequency, and particle beam technologies. Thermal imaging camera technology is deployed in the testing of DEW instrumentation and in the analysis of target impacts.

Laser targeting on truck

Laser Designation

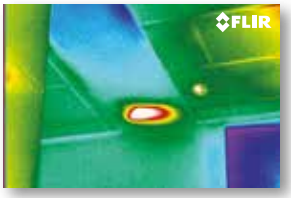
Laser designators emit a beam of laser energy used to mark a specific place or object, usually for precision-guided munitions. Thermal imaging cameras can detect these otherwise invisible beams and are used in designator research and targeting validation.



Lock-in solar cell diagnostic

Infrared Non-Destructive Testing (IR NDT)

IR NDT can detect internal defects through target excitation and the observation of thermal differences on a target surface. IR NDT is a valuable tool for detecting voids, delaminations, and water inclusion in composites. Another application is the detection of shunts and charge density in solar cells.



Hidden listening device

Technical surveillance and countermeasures

Thermal imaging is used to identify heat signatures from covert surveillance devices. Even devices hidden within objects can be revealed by the minute energy given off in the form of IR energy.

SWIR Image of moon

Short Wave Infrared (SWIR)

Short Wave IR (SWIR) Imaging provides non-destructive quantitative analysis of crops, pharmaceuticals, agricultural products, and lasers. Because SWIR can penetrate many opaque materials, it is also used to see through haze, examine art forgeries, and inspect semiconductor wafers.

5 Our customers testify

FLIR Systems has many customers that are active in a wide variety of markets. FLIR Systems thermal imaging cameras are being used by a wide variety of people.

All of them have discovered the benefits that thermal imaging has to offer. They know that thermal imaging cameras are helping them to save time and money on a daily basis.

Many have chosen for a FLIR Systems thermal imaging cameras. They have acknowledged that FLIR Systems produces the most advanced, the most ergonomic and the most user friendly systems.

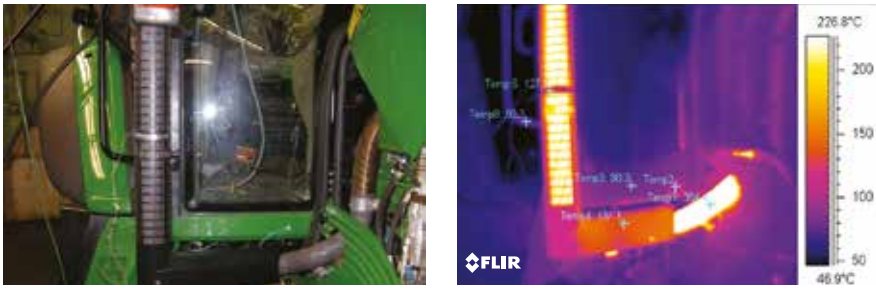
On the following pages you will find a couple of short testimonies of users of FLIR thermal imaging cameras. It are these users that are the best promotion for thermal imaging technology and for FLIR Systems.

Do not take it from us. Read what the users of FLIR thermal imaging cameras have to say.

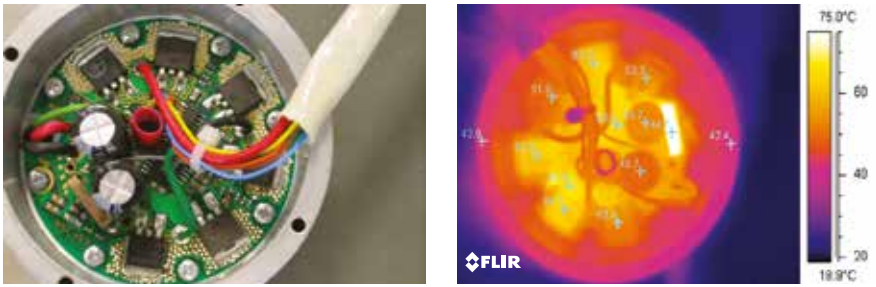
John Deere Werke Mannheim, Germany, use FLIR Systems thermal imaging camera to optimize its tractors

Tractor engines are submitted to elaborate testing procedures to be able to adapt them to their tractor environment with regard to sound intensity, heat development, durability and other features.

"We put the engines to trial with non-destructive testing methods. And very quickly, we saw the need for a thermal camera to be able to find hot spots, or to conduct temperature measurements across an entire surface area." says Waldemar Stark, Product Validation and Verification Engineer.



Visual and thermal image of a tractor exhaust system



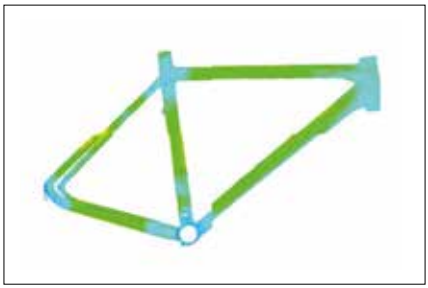
Measuring electronic components: visual and thermal image of an electric pump at work

FLIR thermal imaging cameras help detect material failures in bikes

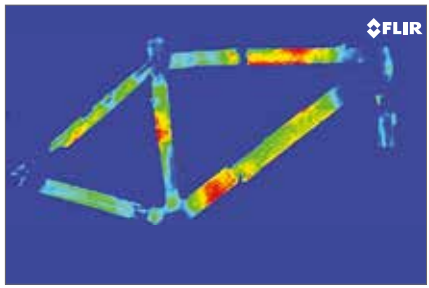
Modern bike frames are made of carbon fiber-reinforced plastics With pulse thermography quality tests, using FLIR thermal imaging cameras, defects in the carbon fiber-reinforced materials can be detected before life-threatening accidents happen.

This is what might happen to a carbon fiber based bike frame if defects remain undetected.

The bike frame is mounted on a rotary table.



Thermal image of an undamaged frame.



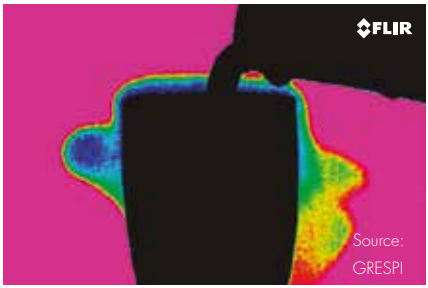
In this thermal image the broken frame clearly shows signs of delamination.

"We trigger a thermal impulse and use the FLIR thermal imaging camera to trace the heat flow. Differences in the heat flow can indicate material defects. The thermal data collected with the thermal imaging camera provides a unique insight into the flaws in carbon fiber-reinforced materials."

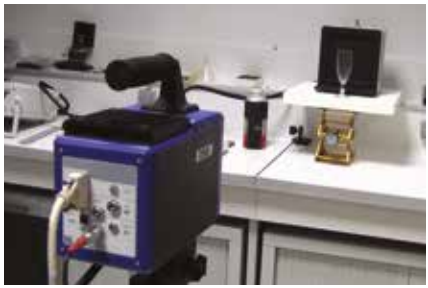
Champagne researchers use FLIR camera to visualize CO_2 dispersion during the pouring process

Most champagne research Is done at the University of Reims,France. The university's most recent discovery is that the way champagne is currently poured, causes loss of aroma and thus of taste. The researchers claim that champagne should be served like beer. Thermal imaging cameras have played a vital part in this recent discovery.

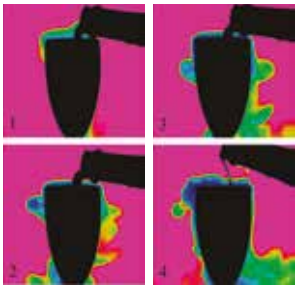
"We used the thermal imaging camera to film the CO_2 as it dissipated during the pouring process. This visually confirmed what the test results showed. The FLIR thermal imaging camera is a very flexible open system that can be adapted for any situation possible. It provides the highest possible sensitivity, accuracy, spatial resolution and speed.", explains Guillaume Polidori.



Researchers used a FLIR thermal imaging camera to visualize CO_2 as it escapes during pouring of a glass.



The FLIR thermal imaging camera is pointed at a champagne flute standing before a calibrated blackbody.



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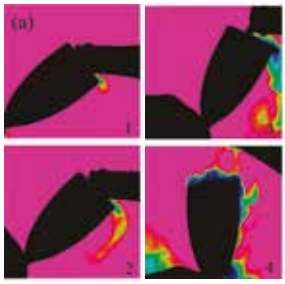

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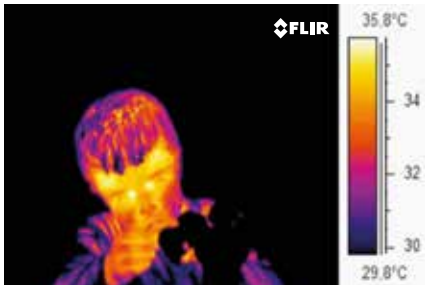
The thermal images clearly show that less CO_2 escapes if the glass is tilted while pouring champagne with the 'beer-like' way of serving (right).

Non-contact sociologic research with thermal imaging cameras

Researchers that want to study neurovascular elements of human social interaction are often confronted with the limitations of commonly used methods in neuroscience. They often involve the application of electrodes or other contact measurement instruments on the skin of the test subjects, which interferes with spontaneous behavior. A thermal Imaging camera can be a solution.

"Thanks to the flexibility of the FLIR thermal imaging cameras physiological correlates of emotional reactions were investigated in an interactive and ecological experimental context without interfering with spontaneous behavior.", concludes Dr. Arcangelo Merla, Director of the Infrared Imaging Lab at the ITAB – Institute for Advanced Biomedical Technology, University of Chieti-Pescara (Italy)



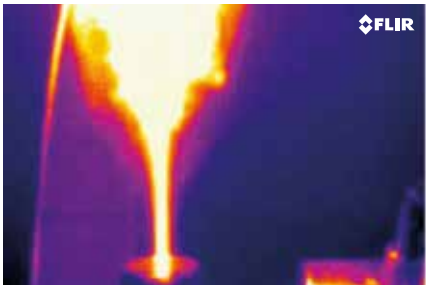
Small temperature differences in facial regions can be used to monitor autonomic responses of human test subjects without applying contact sensors or otherwise impeding the movement of the test subject.

In this experiment the toy is prepared to brake during playing (mishap). The mother observes the scene from behind a one-way mirror. Both the child and the mother are observed using a thermal imaging camera.

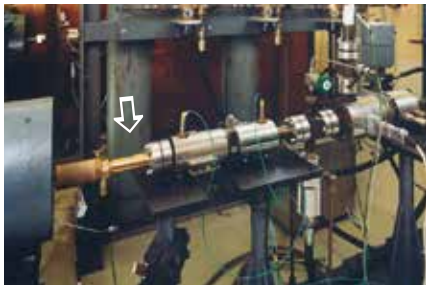
BAM ensures safe oxygen cylinder filling with FLIR thermal imaging camera

At their lab in Berlin the researchers of the working group 'Safe Handling of Oxygen' test the reactions of different materials and component designs to oxygen at varying pressures and temperatures.

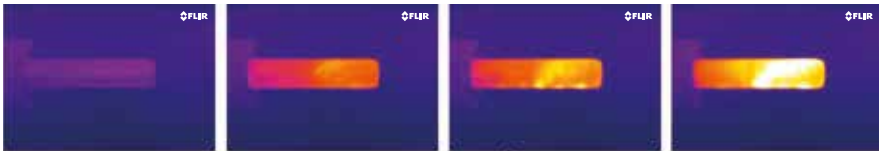
"We acquired the FLIR thermal imaging camera to perform non contact temperature measurements. Other methods to measure temperature are thermocouple sensors and spot pyrometers, but thermocouples can be easily destroyed if there is a strong reaction with oxygen and spot pyrometers measure only temperatures at one location, while the thermal imaging camera gives us temperature readings across the entire scene."



This oxygen component shows high ignition sensitivity to a promoted ignition impact during an ASTM- G175 test.



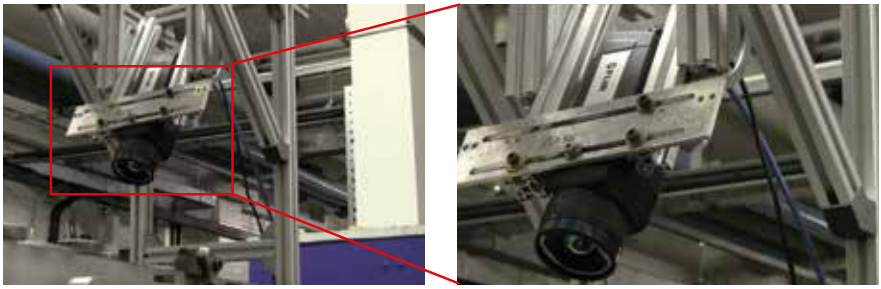
During an oxygen pressure shock test, the material in the container is exposed to a rapid pressure rise.



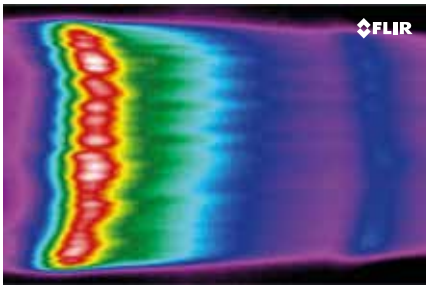
Ignition of a finely divided nonmetallic sealing material by an oxygen pressure shock; the movement of the material within the container as it reacts with the oxygen can be seen in the thermal sequence.

Thermal imaging camera helps improve hypersonic aerodynamic designs

To test components and their capability to withstand airflows at hypersonic velocities, the University of Manchester in the United Kingdom combines their hypersonic wind tunnel with a thermal imaging camera from FLIR Systems.



The thermal imaging camera is positioned above the test chamber, looking in through a Germanium window. This allows the camera to accurately map the thermal hot spots caused by the air friction, without being subjected to the force of high velocity airflows.



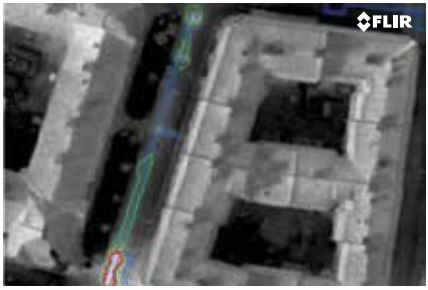
The air flows from left to right. The red area indicates the shock impingement area, where air friction causes an increase in heat.

Kontis' research associate Dr. Erinc Erdem uses FLIR ResearchIR software to analyze the thermal data.

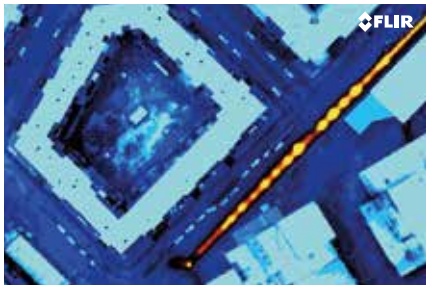
"We use a thermal imaging camera because it is capable of recording thermal maps of the entire surface of the test object. It has an excellent thermal sensitivity, so it allows us to record tiny temperature differences. With the external triggering options and high speed video capturing capabilities it is a perfect tool."

Nordic district heating networks monitored from the sky with thermal imaging

To help large Scandinavian cities to effectively monitor and maintain their district heating networks, the Linköping, Sweden, based company Termisk Systemteknik has developed a district heating scanning system from the sky, based on thermal imaging cameras from FLIR Systems.



District pipelines are marked with blue lines. Green outlines mark smaller leaks and red outlines mark serious leaks that require immediate attention.



This un-analyzed thermal image already clearly shows leaks in a district heating pipe.

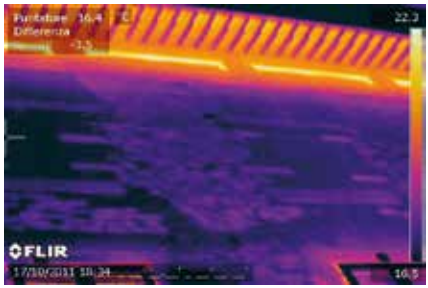
After seeing this leak in the report, the district heating company went there to investigate. It turned out to be a very large leak. Needless to say the company was very glad that this major leak was detected.

The FLIR thermal imaging camera is especially useful for this application because of its high frame rate and short integration time. It can capture the full resolution at a frame rate of 100 Hz.

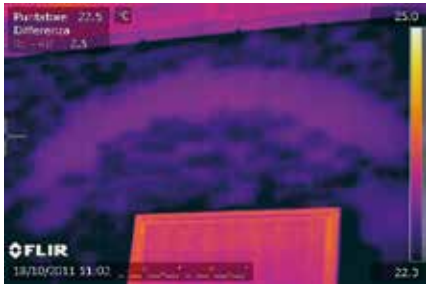
Thermal imaging cameras help preserve Italy's cultural heritage

The Altamura, Italy, based survey company IR HotSpot investigates historical buildings with a thermal imaging camera, looking for water damage and other building defects. With the information gained from thermographic surveys using a FLIR thermal imaging camera the preservation of these highlights of Italian culture is ensured.

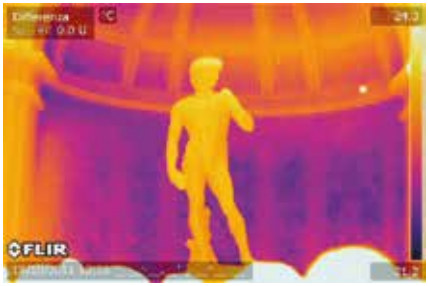
Inspections with the FLIR SC660 thermal imaging camera can help preserve cultural heritage.



Evaluation of the masonry between the Accademia Gallery and the cloister of the Academy of Fine Arts.



Below the surface of this wall along the nave contains arches for better weight distribution.



This thermal image reveals the underlying texture of the walls and pillars of the apse.

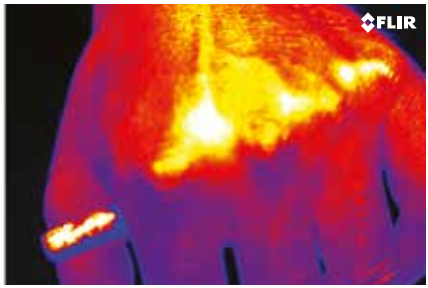
"Frescoes and sculptures are often very fragile, so regular building inspection techniques can cause them to deteriorate. That is one of the reasons why we use thermography.", explains Rosario Piergianni, thermography expert

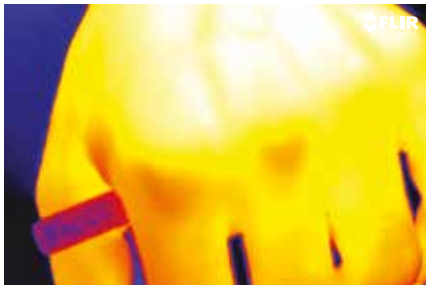
FLIR thermal imaging cameras used to detect small nerve fiber dysfunction

In research funded by the Dutch Technology Foundation STW, thermal imaging technology is used to develop an experimental setup that can detect this neuropathic phenomenon.

The IR lamp delivers a thermal stimulus to the skin. The thermoregulatory response is then recorded using the thermal imaging camera.

Thermal image, taken before IR perturbation.





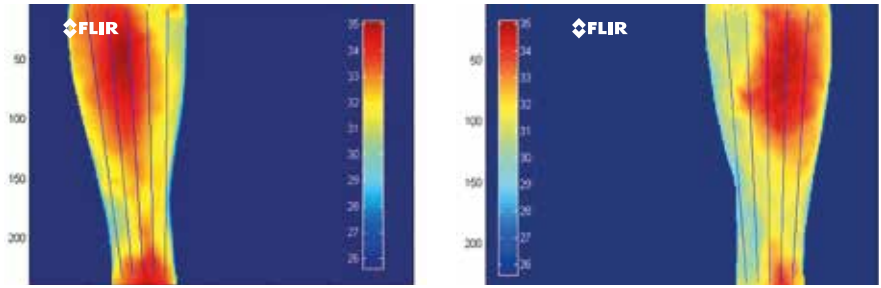
Thermal images, taken during (left) and after (right) IR perturbation showing the thermoregulatory response of the human body to thermal stimuli.

"We aim to prove that thermal imaging can be used to identify small nerve dysfunction in larger areas quickly and in a non-invasive manner. This would speed up assessment, saving time and money, while imposing minimal stress on the patient.", explains Dr. Ir. Sjoerd Niehof, thermography expert at the Anesthesiology Department of the Erasmus University Medical Center.

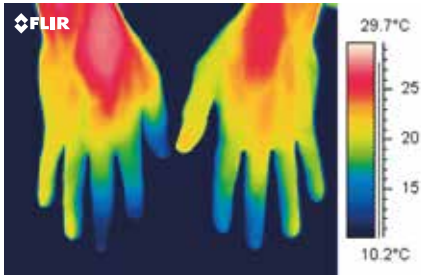
Thermal imaging helps to measure, chart and combat pain

The Erasmus Medical Centre (ErasmusMC) in the Netherlands, the university hospital of Erasmus University, Rotterdam, is working on measuring pain and carrying out research on the combating of pain. Thermal imaging helps in the research.

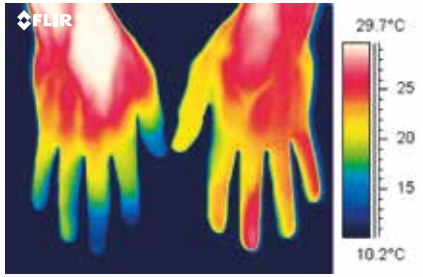
"Thanks to the skin's high level emissivity, the human body is an object that rewards investigation using a thermal imaging camera.", says Sjoerd Niehof, clinical physicist and user of the FLIR Systems thermal imaging camera. "It can produce an image of the blood supply to the limbs, up to and including the influence of capillaries."



Pain zones in left and right lower leg. Added meridians help to localize the pain zones exactly.



Cold; no Complex Regional Pain Syndrome (CPRS)
No complaints, no stress.



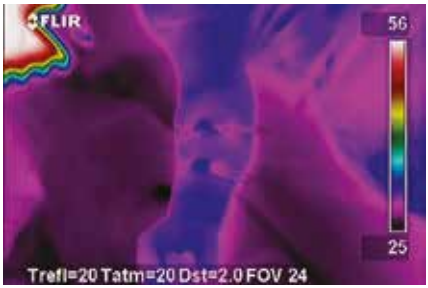
Warm; CPRS in left hand (right side).
Complaints; warm induced stress.

FLIR thermal imaging cameras help determine the functionality of anti-allergy medicine

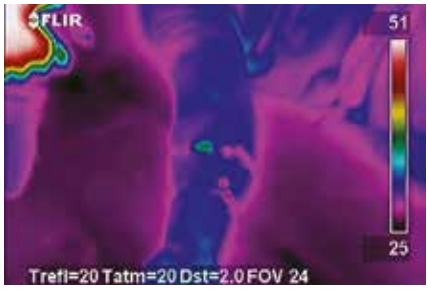
For several ongoing studies of wheal and flare reactions in the skin the research team of Professor Marcus Maurer at the Allergie-Centrum-Charité, the allergy center of Charité - Universitätsmedizin Berlin uses a FLIR thermal imaging camera to accurately measure the body's temperature.

Skin microdialysis: Where the trigger has been applied the skin is flushed with a buffer solution to capture the mediators released in the skin.

"Thermal imaging really is a great tool to objectify the body's response.", explains assistant physician and clinical trial investigator Elena Ardelean.



This thermal image shows a cold urticaria patient's arm before a wheal and flare reaction is triggered.



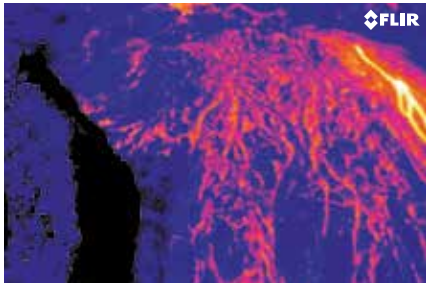
In this thermal image the wheal and flare reaction clearly shows up as a hot spot.

Flares show up clearly on the thermal image.

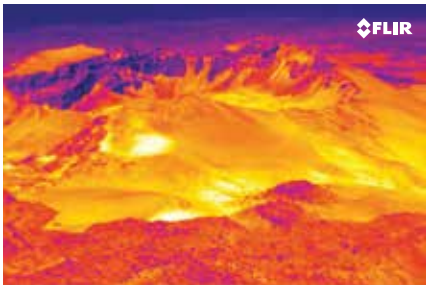
With the FLIR software the measured data can easily be analyzed.

Volcano research enhanced with FLIR thermal imaging cameras

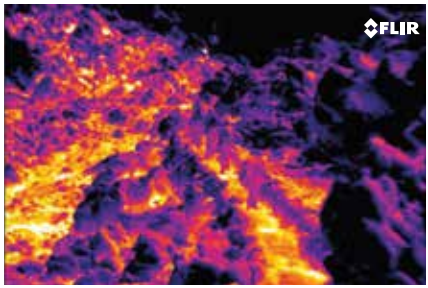
Volcanoes are arguably the world's most impressive heat related phenomena. Volcanic processes are intriguing and potentially extremely destructive. It is therefore no wonder that researchers all over the world are studying the different aspects of volcanoes and volcanic activity.



These visual and thermal images of the Stromboli volcano in Italy have been taken from a helicopter. Cracks have opened along the upper lava field. In the thermal image active lava flows are yellow, cracks are red.



Thermal imaging is a great way of visualizing volcanic heat.



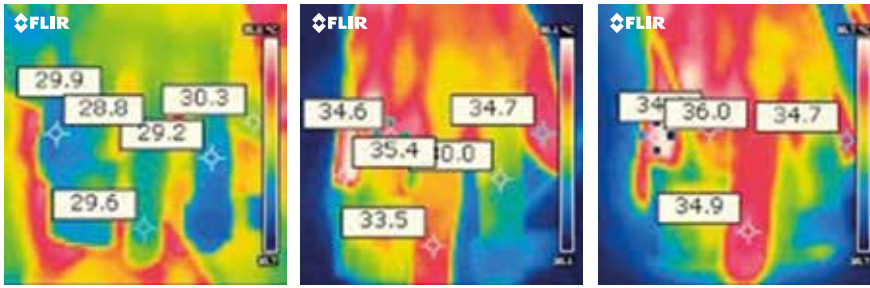
This thermal image shows that the volcanic heat emitted from the rock surface.

According to researchers that have worked with thermal imaging cameras from FLIR System this equipment is the best tool available for volcano monitoring. Thermal imaging cameras allow researchers to not only see volcanic heat, but also to get non contact temperature readings from a safe distance, which keeps the researchers out of harm's way.

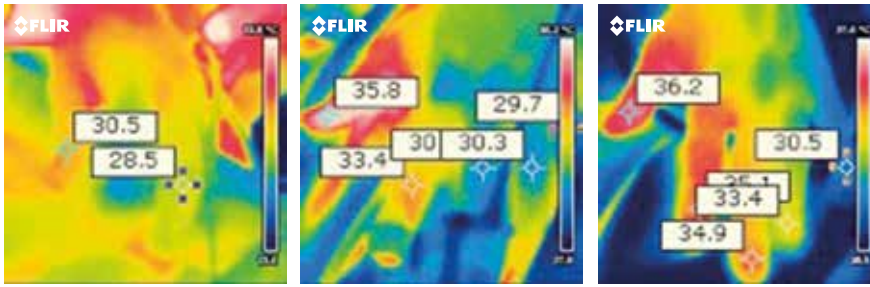
FLIR thermal imaging cameras confirm effectiveness of local anesthetics

Researchers at the Erasmus University Medical Center, Rotterdam, the Netherlands, have found a new and objective tool to determine the effectiveness of the local anesthetics: FLIR thermal imaging cameras.

"Thermal imaging provides immediate feedback. Medical personnel can use a FLIR thermal imaging camera to objectively determine the effectiveness of the local anesthetics. If the regional block is not effective it will clearly show in the thermal image.", according to Dr. Ir. Sjoerd Niehof from the Anesthesiology Department of the Erasmus University Medical Center



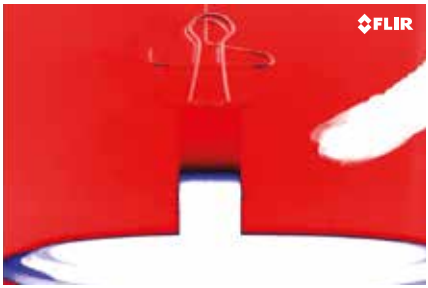
These thermal images (taken with a FLIR thermal imaging camera) show a hand after regional anesthetics are administered. The increase in temperature shows that the regional block is successful in the area that will be operated.



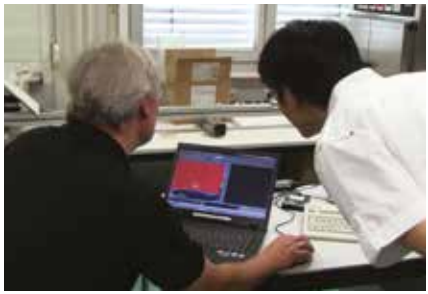
In this case the pink finger and the surrounding area show little to no rise in temperature, indicating that the ulnar nerve is not anesthetized. General anesthetics were therefore administered prior to surgery.

Thermal imaging camera helps develop new cryogenic fuel tank design

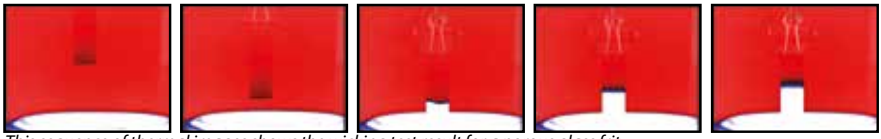
The volatile character of cryogenic fuels and the absence of gravity in deep space make the use of cryogenic liquids for on-orbit propulsion challenging. But researchers at the German research facility ZARM may find a solution to this problem using a FLIR thermal imaging camera.



Thermal imaging helps to determine the wicking front of a cryogenic liquid.



Researchers are fine-tuning the thermal footage using the accompanying FLIR software.



This sequence of thermal images shows the wicking test result for a porous glass frit.

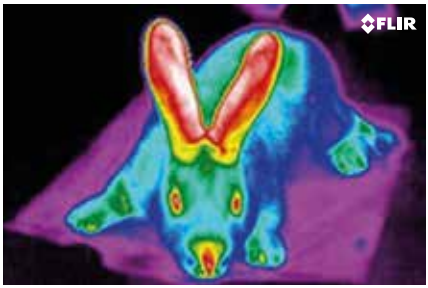
This sequence of thermal images shows the wicking test result for a woven mesh made of stainless steel.

"It was previously unknown whether cryogenic liquids would display wicking and how this would be affected by evaporation until we performed these tests and recorded them with a thermal imaging camera.", explains Ming Zhang, research assistant at ZARM.

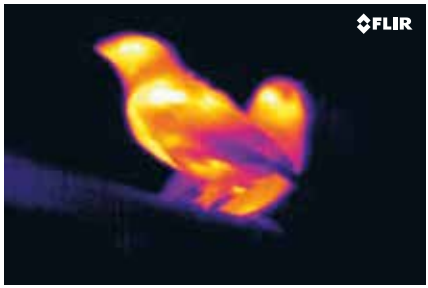
Hot biology: investigating the thermal physiology of birds and mammals

Wildlife researchers try to fill the gaps in our knowledge of these fascinating processes. One of the organizations that push the boundaries of our knowledge in this field is the Institute of Biodiversity, Animal Health and Comparative Medicine at the University of Glasgow, Scotland.

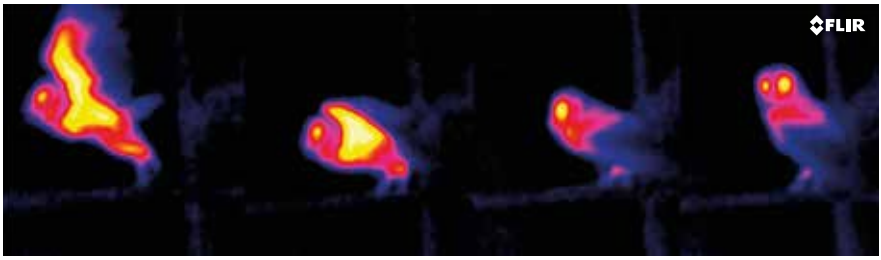
"FLIR thermal imaging cameras have been a great help in recent research projects. Whether they were used for fieldwork or in the laboratory, these cameras give an interesting perspective into the thermal world of animals.", explains Dr Dominic McCafferty, Senior Lecturer at the University of Glasgow.



This thermal image of a rabbit reveals underlying blood circulation to the animal's ears for dissipation of excess body heat.



The zebra finch body temperature measured using the FLIR thermal imaging camera is used as indicator of its level of stress.

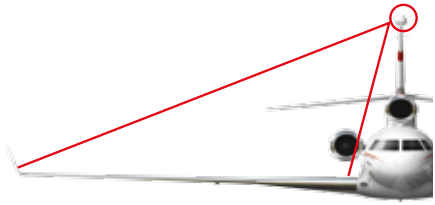


Sequence of thermal images showing barn owl during take off.

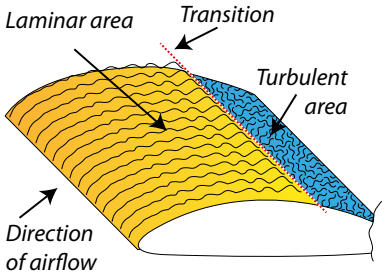
FLIR thermal imaging camera allows evaluation of laminar designs

Dassault Aviation has performed test flights with a Falcon 7X using a FLIR Systems thermal imaging camera that can differentiate between laminar flows and turbulent flows, allowing the researchers to evaluate the laminarity of the air flow on a wing during the flight.

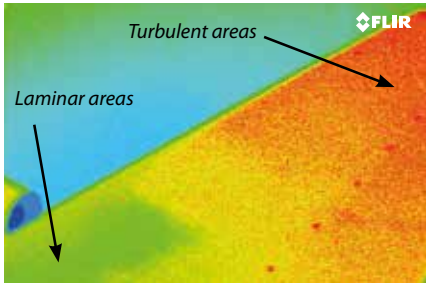
"The turbulent areas of the wing, where there is more friction, should therefore be warmer than the laminar areas. But this difference in temperature is extremely small, typically between 0.5 and 3 °C. That is why we needed a reliable thermal imaging camera that can accurately detect such small differences in temperature.", explains Philippe Rostand, Future Falcon Programs Project Manager



The FLIR thermal imaging camera was mounted in the top of the tail of the Falcon 7X, looking down on the right horizontal stabilizer.



Schematic illustration of the distribution of laminar and turbulent flow patterns in the boundary air flow around an airplane wing.

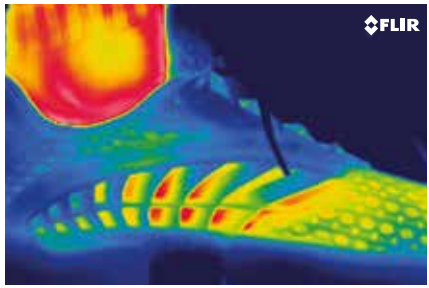


Thermal image of the air flow along the right horizontal stabilizer.

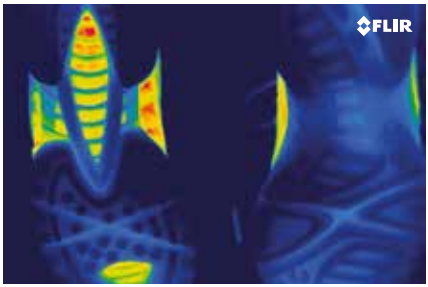
Improving the comfort of athletes worldwide with the help of thermal imaging

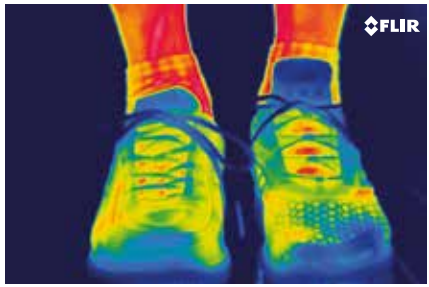
Adidas, world-wide known as one of the leading manufacturers of sports shoes, apparel, track suits, balls,… is constantly seeking for new materials and designs to satisfy the most demanding athletes. A FLIR Systems thermal imaging camera, helps them to achieve this goal.

"Initially we measured the temperature at just a few well-determined spots of the shoe with temperature sensors. Although this gave us an idea of the heat being drained we realized that we needed to see the full picture. Using a thermal imaging camera was the only solution.", Karsten Westphal explains



The thermal imaging camera finds the hot-spots on the ClimaCool™.

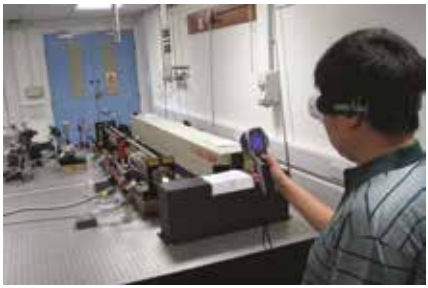




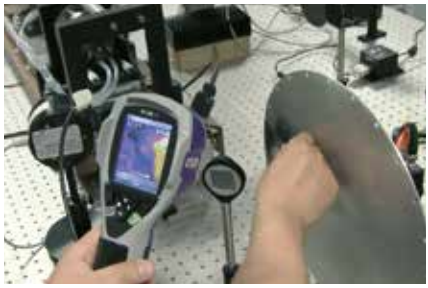
Shoe with ClimaCool technology compared to a normal shoe. The ClimaCool drains the heat from the foot. Therefore higher temperatures are measured at the outside of this shoe.

FLIR thermal imaging camera helps prevent accidents in the laser room

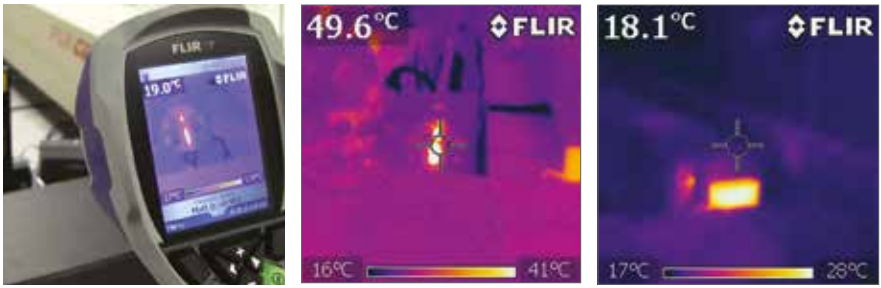
Operating lasers can be dangerous, as some lasers can produce invisible infrared beams that can potentially harm researchers or start a fire. In the laser room of the University of Glasgow researchers use a FLIR thermal imaging camera to ensure their own safety when they work with their terahertz laser research setup.



Research assistant Yong Ma demonstrates the use of the FLIR thermal imaging camera in the laser room.



Using the FLIR thermal imaging camera Ma aligns the optics in his research setup.



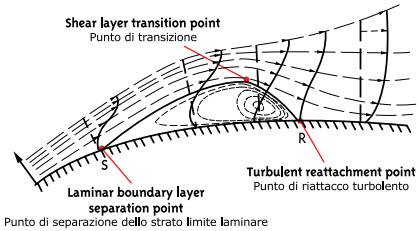
The heat from invisible infrared laser beams clearly shows up in the thermal images. By visualizing the heat from infrared laser beams FLIR helps to guarantee the researchers' safety.

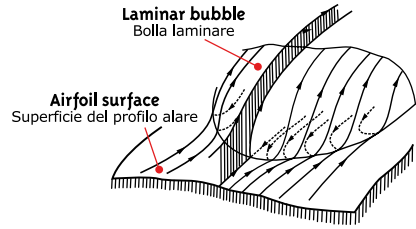
„Before I start to work with our terahertz laser research setup I always scan the entire area with the FLIR thermal imaging camera to detect infrared laser beams that are projected in the wrong direction, to make sure that it is safe. But that is not the only application I use it for. I also use it to monitor overheating electrical equipment and gas valves, tubes and tanks.", explains Yong Ma, Research Assistant at the Microsystem Technology Group , School of Engineering, at the University of Glasgow.

Università di Ancona-Università di Pescara uses thermal imaging camera for research

Professor Ricci and his team are using a FLIR Systems thermal imaging camera to visualize boundary layer separation phenomena on aerodynamic bodies such as airplane wings, at low Reynolds and Mach numbers, by thermographic investigations. The laminar separation bubble presence is mainly investigated.

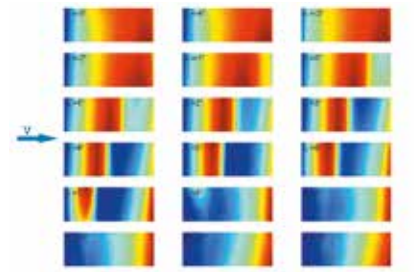
The methods normally used to investigate the presence of a Laminar Separation Bubble are the load balance, the pressure coefficient analysis and the smoke and oil visualization technique. The choice to use thermal Imaging is due to the fact that it is a non-intrusive measurement technique and gives a real time visualization of the phenomena.





Schematical overview of the principle of the laminar separation bubble

The wind tunnel with the FLIR thermal imaging camera



Thermal images of the upper surface of the airfoil for many angles of attack

6 Thermal imaging: a wide variety of applications

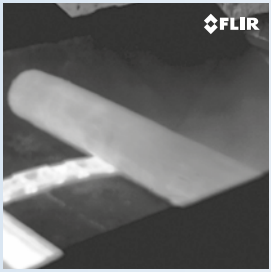
As more and more people are discovering the benefits that thermal imaging cameras have to offer, volumes have gone up and prices are coming down. This means that thermal imaging cameras are finding their way to more and more markets. FLIR Systems has the correct camera for every application.

Electrical / Mechanical

In industrial environments thermal imaging is used to find hot-spots that can lead to failures in electrical and mechanical installations. By detecting anomalies at an early stage production breakdowns can be avoided and money can be saved.

Security

Our security customers benefit from thermal imaging cameras because they help them to secure facilities like ports, airports, nuclear facilities, warehouses, estates and many more against intruders.

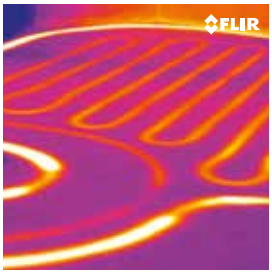


Cores & components

FLIR Systems also markets a wide variety of thermal imaging cores that other manufacturers integrate in their own products.

Building diagnostics

Building professionals look for insulation losses and other building related defects with a thermal imaging camera. Finding insulation losses and repairing them can mean huge energy savings.

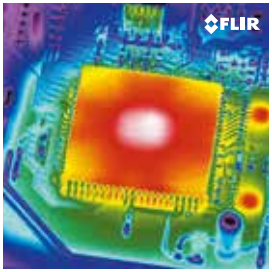


Border security

Border security specialists protect their country's border against smugglers and other intruders. With a thermal imaging camera they are able to see a man at a distance of 20 kilometers away in total darkness.

Science / R&D

Thermal imaging also plays a pivotal role in both applied and fundamental R&D. It can speed up the design cycle so that products can go to market faster. For these demanding applications FLIR Systems markets extremely high performance thermal imaging cameras.



Maritime

On both yachts and commercial vessels, FLIR thermal imaging cameras are being used for night time navigation, shipboard security, man-overboard situations and anti-piracy.

Transportation

FLIR thermal imaging cameras are installed in cars for driver vision enhancement. They help the driver to see up to 4 times further than headlights. They are also installed in specialty vehicles such as fire-trucks, mining and military vehicles.

Automation / process control

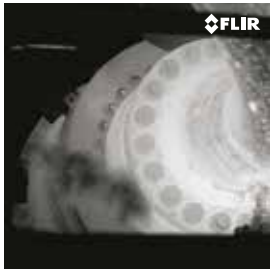
Thermal imaging cameras are also installed to continuously monitor production processes and to avoid fires..

Law enforcement

Police officers use the power of thermal imaging to see without being seen. They can easily find suspects in total darkness without giving away their position.

Optical gas imaging

Gas leaks can also be detected seamlessly with a thermal imaging camera.



Personal vision systems

Outdoor enthusiasts can see clearly at night with the help of a thermal imaging camera.

Firefighting

Firefighters are able to see through smoke. It helps them to find victims in a smoke filled room and also to see if fires are well extinguished. It helps them to save lives.

Extech

Under the Extech brand, FLIR systems is marketing a full line of test and measurement equipment.

7 Selecting the correct thermal imaging camera manufacturer

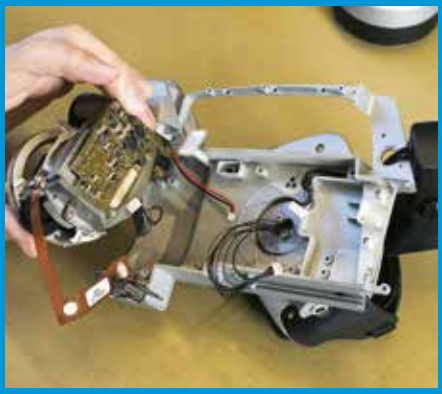
Since thermal imaging cameras have become increasingly popular over the last few years more and more manufacturers are starting to produce thermal imaging cameras.

Regardless of your application, there are some considerations to take when investing in a thermal imaging camera.

The correct camera for the correct application
Choose a thermal imaging camera manufacturer that offers you a choice. Different applications require different types of thermal imaging cameras. First time users have different needs than those that have already discovered the benefits of thermal imaging. Different image qualities are available. A reliable manufacturer offers you a thermal imaging camera that is completely suited for your application.

Choose a system that can grow with your needs
As you start to discover the benefits thermal imaging has to offer your needs will undoubtedly change. Go for a manufacturer that is able to take your first camera back and offer you a more advanced model. Make sure that accessories are available. Lenses are important. Some applications require a wide angle lens, others are better served with a telephotolens.

Software is important
For practically all applications it is important to have the correct software. It will help you analyze and report your findings. Make sure that the hardware manufacturer is able to deliver you the correct software as well.



Service
Once in operation a thermal imaging camera rapidly becomes a vital piece of equipment. Make sure that the manufacturer can service your camera in the shortest period of time if a problem should occur.

Training
Using a thermal imaging camera is as easy as using a camcorder. There are however some things you need to take into account. A reliable thermal imaging camera will be able to give you initial or extensive training so that you can get the most out of your thermal imaging camera.

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8 Send us your application

On the previous pages you could read how some of our users are using FLIR thermal imaging cameras.

We are always looking for new application stories and new customer testimonies. If you have an interesting application please contact us. We will be happy to include you in the next edition of this booklet.

Please fill out the following form, scan it and send it to flir@flir.com or fax this form to +32 3 303 56 24

Company :

Name :

Address :

Postal Code :

City :

Country :

Tel :

Application :

Short Description :

Notes

Notes