

moviTHERM
advanced thermography solutions

Thermal Seal Inspection

A Comprehensive Guide to Ensuring Product Integrity

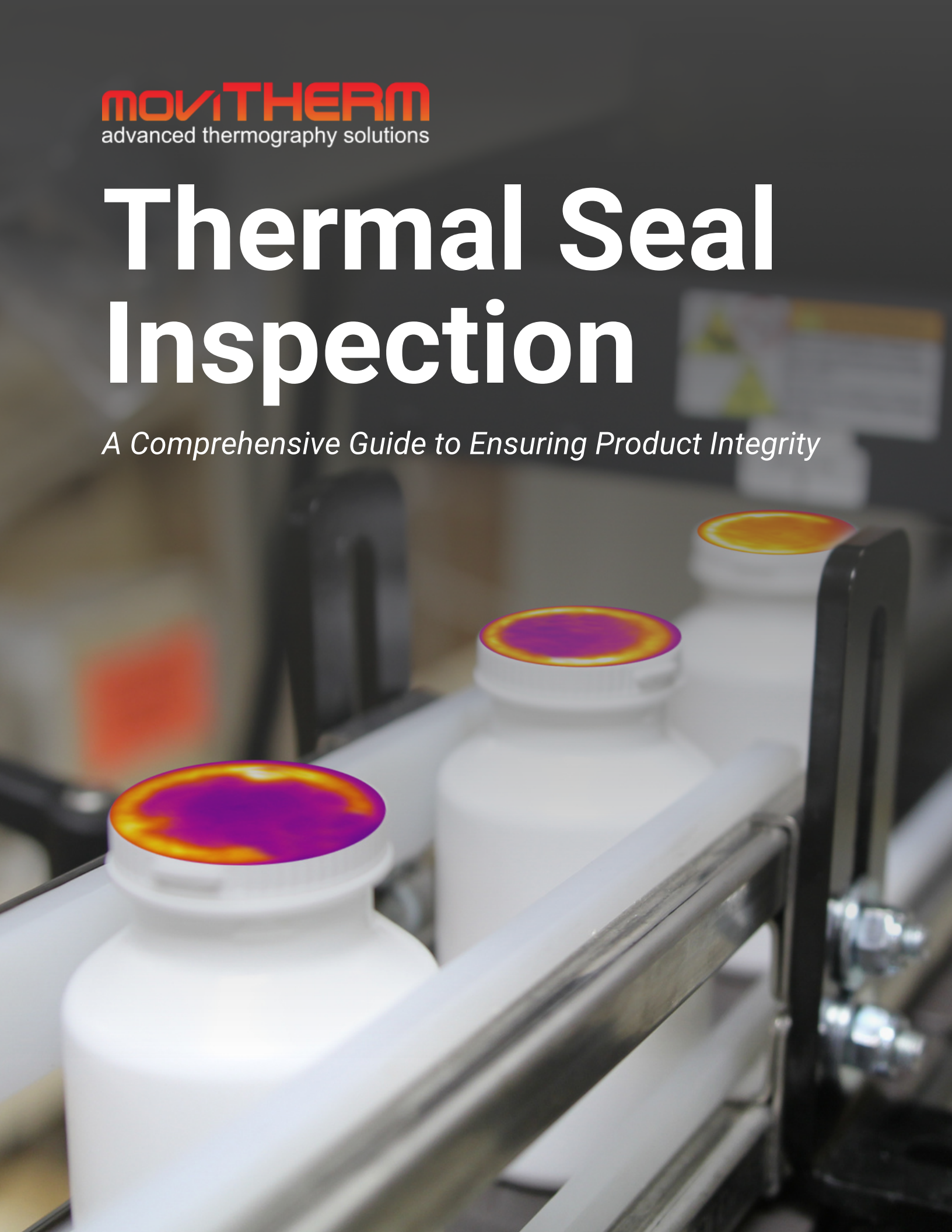


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Maximizing Quality Control

The Role of Thermal Imaging in Your Packaging Process

As someone who is responsible for maintaining high product quality standards, you understand how important it is to ensure that every aspect of the production process is closely monitored. However, one area that can be a constant source of worry is the quality of your product packaging.

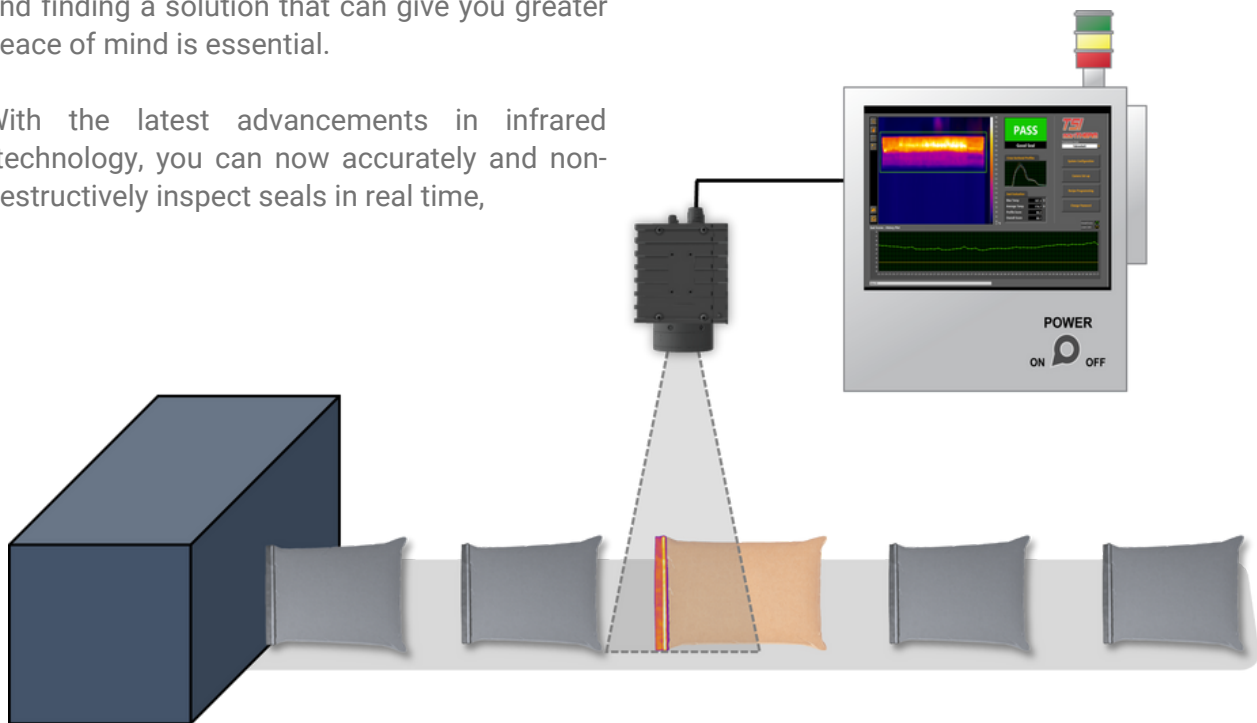
Any packaging failures can compromise product performance, result in product returns, or even worse, cause harm to end-users. Despite your best efforts to maintain stringent quality control measures, you may still feel like you need more visibility into all your products. Visual inspections and spot checks can only do so much, and you may be left wondering if there is a more reliable and efficient way to ensure that every single product's packaging quality is up to par. It's understandable to feel this way, and finding a solution that can give you greater peace of mind is essential.

With the latest advancements in infrared technology, you can now accurately and non-destructively inspect seals in real time,

ensuring that your packages meet the highest quality standards. From detecting weak or incomplete seals to identifying potential defects or contaminants, thermal imaging offers a fast, efficient, and cost-effective solution for quality inspection.

Leveraging thermal imaging as a tool to monitor your production line can lead to a decreased number of defective products, create more efficiency for your team, and protect your brand's reputation.

Whether you are a packaging professional, quality control manager, or production supervisor, this guide will provide valuable insights into how thermal imaging can enhance your packaging process.

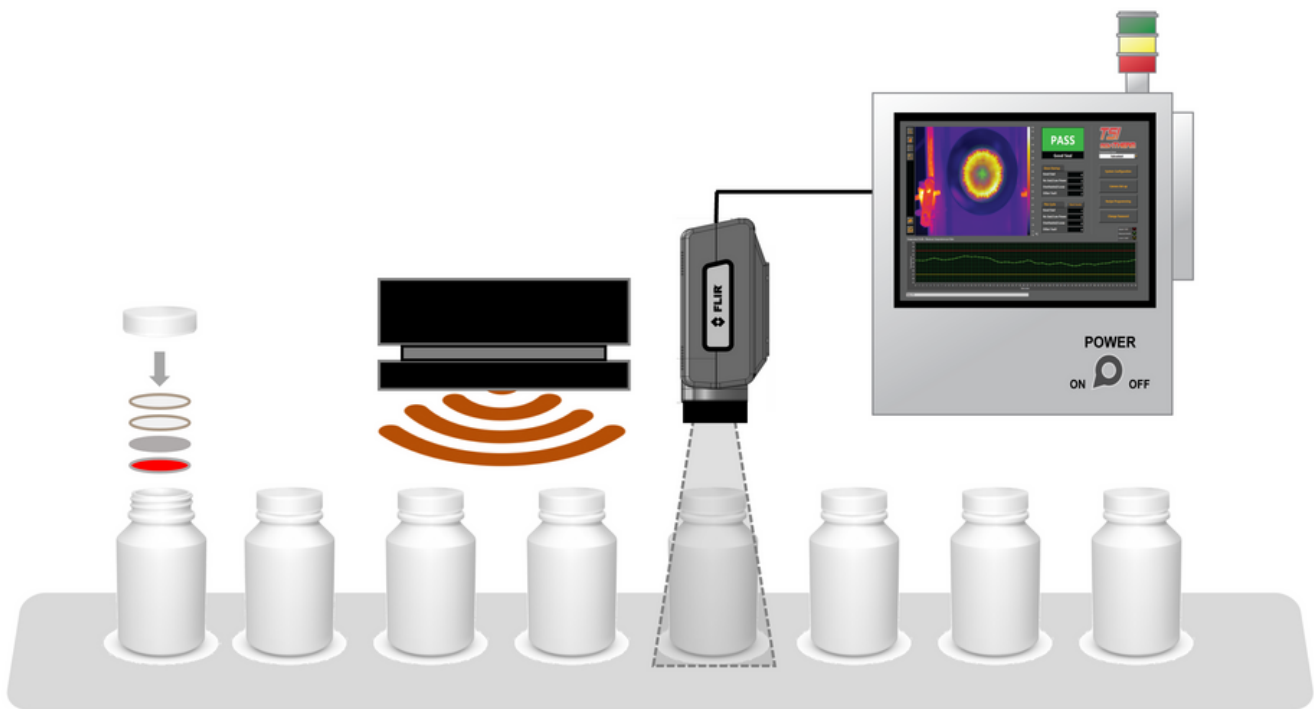


Different Types of Packages Suitable for Thermal Inspection

Thermal imaging can inspect seals in different types of packaging, including:

- **Flexible Packaging:** Pouches, bags, and sachets made from plastic films, aluminum foil, and paper.
- **Rigid Packaging:** Trays, clamshells, and blisters made from plastic, glass, and metal materials.
- **Sealed Containers:** Cans, jars, and bottles made from glass, plastic, and metal.
- **Pharmaceutical Packaging:** Blister packs, pouches, and bottles used for medication.
- **Food Packaging:** Trays, bags, and bottles used for food and beverage products.

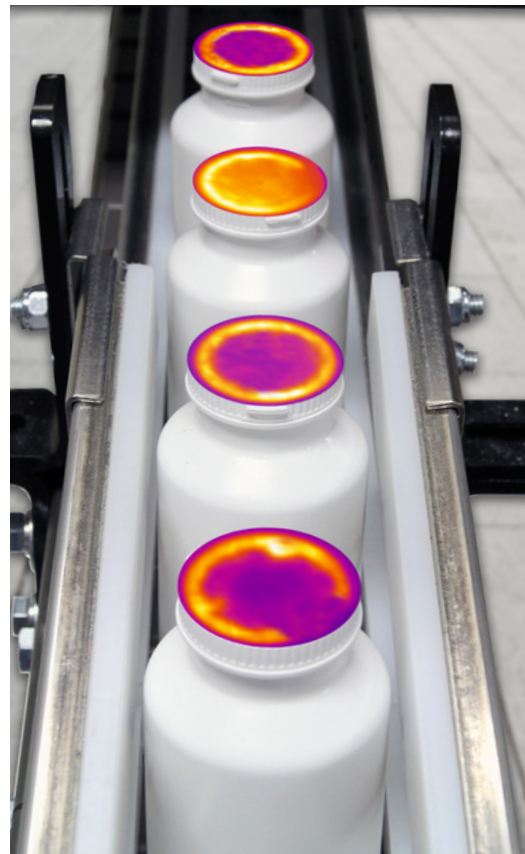




Detecting Defects With Thermal Imaging

Thermal imaging works for the inspection of heat-sealed packaging because it can detect temperature differences on the surface of the packaging. Heat-sealed packages are typically formed by applying heat to the packaging material, causing it to melt and fuse to create a seal. When the seal is formed correctly, it should be uniform without any gaps or defects. However, if there are any issues with the seal, such as incomplete sealing, contamination, or defects, it can affect the temperature distribution on the surface of the package.

Using thermal imaging, an automated inspection can detect any temperature variations that may indicate potential issues with the seal. The thermal camera can quickly and non-destructively identify any defects or anomalies in the seal, helping to ensure the quality of the packaging.



Choosing the Right Camera

High-Speed Production Lines

The speed of a packaging process line plays a crucial role in inspecting package seals with thermal imaging cameras. The faster the packaging process line, the more critical it is to have a thermal imaging camera that can keep up with the pace of production.

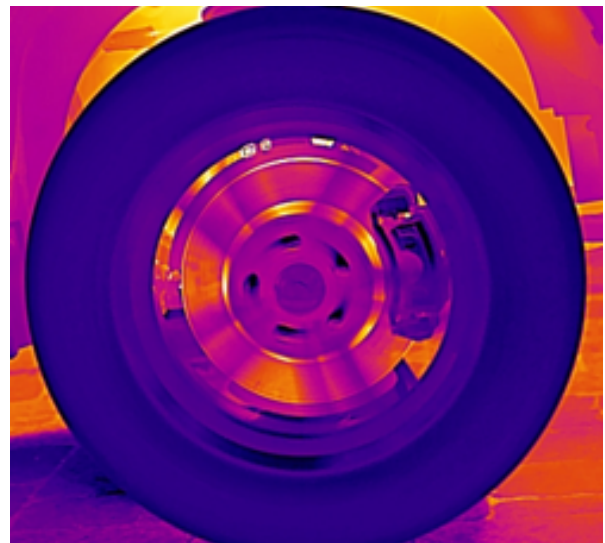
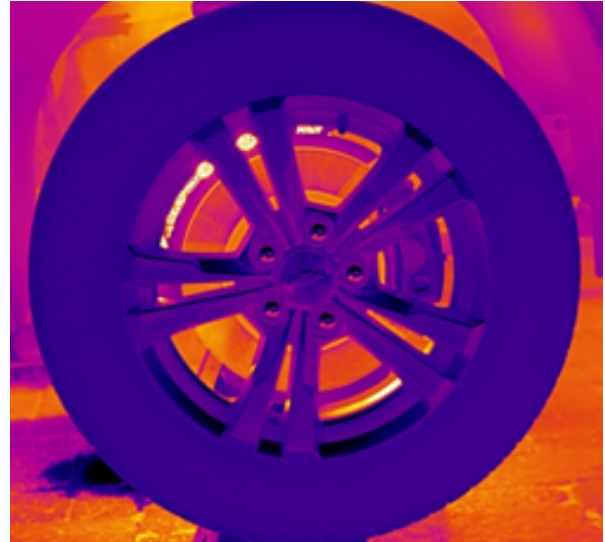
Regarding thermal imaging cameras for package seal inspection, there are two main types: cooled and uncooled. Cooled cameras offer higher resolution and sensitivity than uncooled cameras, making them ideal for high-speed packaging applications. These cameras require cooling mechanisms to maintain their temperature and are typically more expensive than uncooled cameras.

On the other hand, uncooled cameras do not require cooling mechanisms and are more affordable. However, their lower resolution and sensitivity make them more suitable for slower packaging process lines.

Some things to consider when determining what type of camera is needed:

- **Packaging line speed:** The faster the speed, the higher the camera's frame rate to ensure comprehensive inspection.
- **Package size:** The camera's field of view needs to be large enough to capture the entire package's surface area.
- **Package shape:** The camera needs to capture the entire package surface, regardless of its shape.

- **Camera resolution:** Higher resolution cameras can detect smaller temperature differences, leading to more accurate inspections.



These IR images compare the capture results of a tire rotating at 20mph. The one on the top was taken with a cooled thermal camera, demonstrating the fast capture rate that has stopped the tire's motion. The image on the bottom is from an uncooled camera. The slow capture rate causes the wheel spokes to appear transparent due to motion blur.



The Placement of Your Camera Will Matter

The closer the camera is to your production line, the more accurate results you will receive.

When it comes to package seal inspection with thermal imaging cameras, the camera's position plays a crucial role in the accuracy and effectiveness of the inspection process. It is critical to minimize the time between sealing and inspection. This requires the thermal camera to be positioned as close as possible to the heat-sealing stage of the packaging process.

The reason for this is that thermal seals are better defined before the heat is allowed to dissipate as the packaging reaches thermal equilibrium. By positioning the camera close to the sealing stage, the camera can capture the

seal's temperature profile when it is still optimally defined and before it begins to cool down and blend in with the surrounding packaging.

When the thermal camera is positioned too far from the heating stage, the temperature difference between the seal and the surrounding packaging may become less pronounced, making it more challenging to identify potential defects. This can result in missed defects or false positives, leading to potential packaging failures and product quality issues.

Higher Pixel Resolution Leads to Accurate Seal Inspections

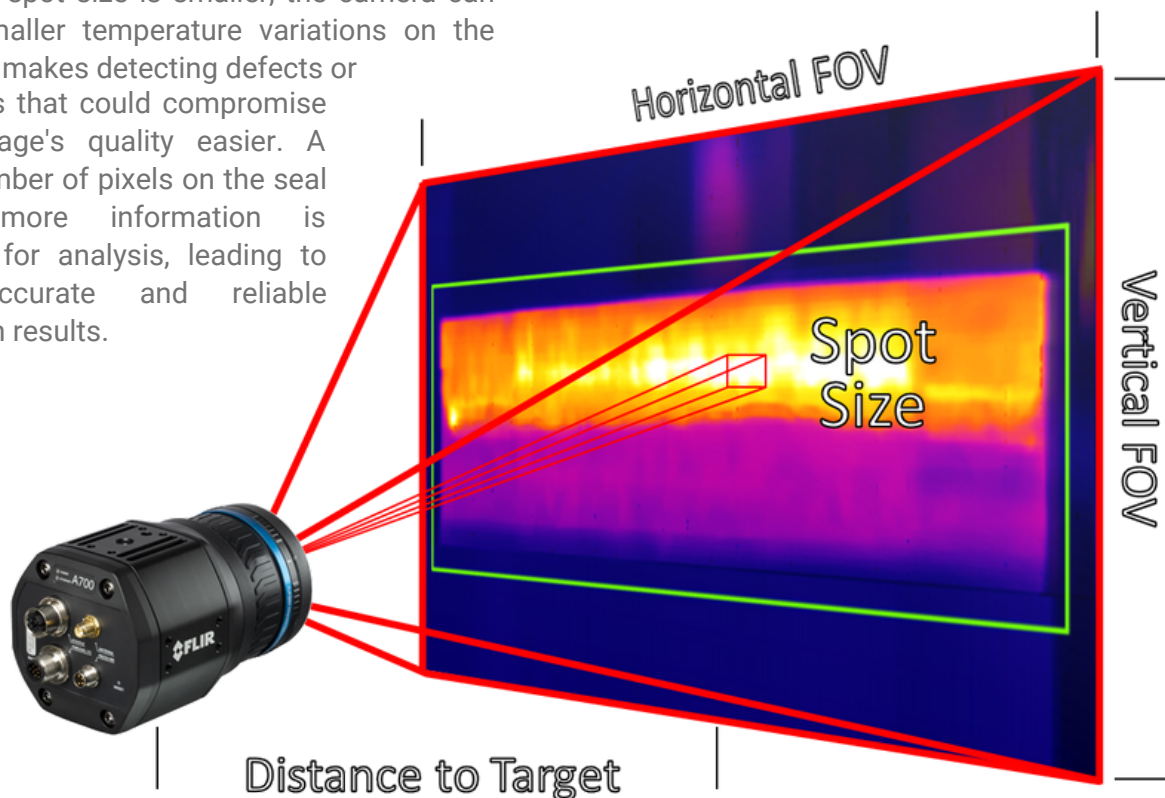
Positioning a thermal camera is crucial to the effectiveness of thermal seal inspection for heat-sealed packaging. It can affect the thermal camera's spot size and the number of pixels on the package seal, ultimately impacting inspection results.

The spot size of a thermal camera is the size of the area on the surface of the package that the camera is measuring. The number of pixels on the package seal refers to the number of individual temperature measurements the camera takes. The closer the camera is to the package seal, the smaller the spot size and the greater the number of pixels on the seal.

When the spot size is smaller, the camera can detect smaller temperature variations on the seal. This makes detecting defects or anomalies that could compromise the package's quality easier. A larger number of pixels on the seal means more information is available for analysis, leading to more accurate and reliable inspection results.

In contrast, when the camera is positioned further away from the seal, the spot size becomes larger, and the number of pixels on the seal decreases. This can make it more challenging to detect small defects, as the camera is less sensitive to smaller temperature variations on the seal.

The thermal camera's pixel resolution and lens combination can also impact the thermal seal inspection performance. Higher pixel resolution cameras can provide more detailed temperature information, leading to more precise inspections. The lens combination can also impact the camera's field of view, which is the packaging area the camera can capture.



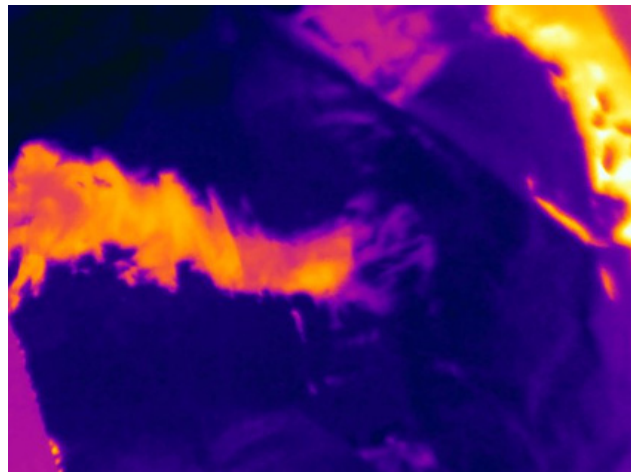
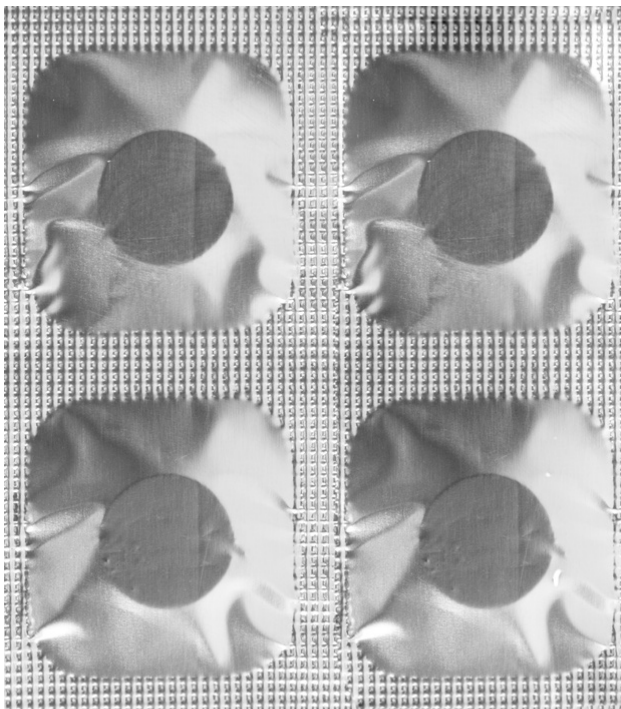
Under the IR Lens

How Different Packaging Appears in the IR Spectrum

Understanding how packaging materials appear in the infrared spectrum is crucial for effective thermal imaging inspection of heat-sealed packaging. The type of packaging material used can significantly impact the effectiveness of thermal imaging for quality inspection.

Different packaging materials have different emissivity levels, which measure how effectively a material emits thermal radiation. High-emissivity materials are more effective at absorbing and emitting thermal radiation and are easier to detect with thermal imaging cameras. Low-emissivity materials are less effective at emitting thermal radiation and are more challenging to detect with thermal imaging.

Low-emissivity packaging material, such as aluminum foil or metallicized films, can pose challenges for thermal imaging inspection. These materials reflect thermal radiation, making it difficult to accurately measure the packaging material's temperature. This can result in missed defects or false positives, leading to potential packaging failures and product quality issues.

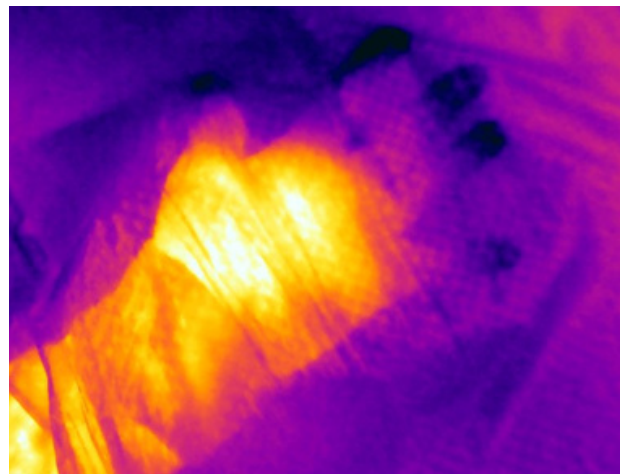


Visible and IR images of aluminum foil demonstrate how thermal reflections can interfere with temperature measurements. The yellow and orange colors in the IR image are not heat emitted from the foil but warm reflections from a hand over the foil.

Overcoming Challenges in Detecting Temperature Variations

Some packaging materials, such as plastics, can be thermally transparent in certain infrared wavebands. This means that thermal radiation can pass through the material without being absorbed, making it difficult to detect temperature variations on the material's surface. This can also result in missed defects or false positives during thermal imaging inspection.

To overcome these inspection challenges, infrared filters can be used to block out specific infrared wavelengths, allowing the camera to focus on the wavelengths emitted by the packaging material of interest. Additionally, the selection of a thermal camera waveband can impact the camera's sensitivity to specific wavelengths and materials.



Visible and IR images of a plastic bag demonstrating opacity in the visible spectrum and transparency in the infrared wavebands.



Ensuring Consistency in Your Sealing Process

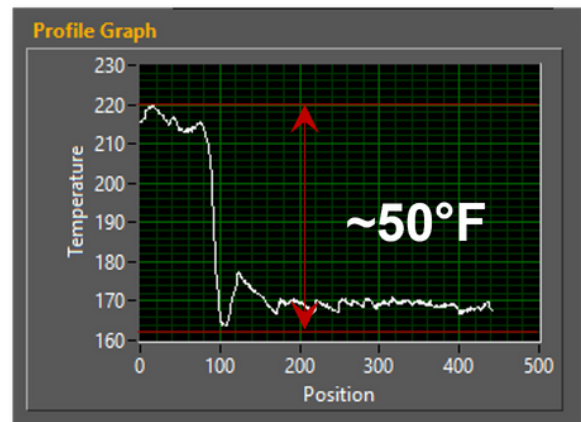
In a heat-sealed packaging process, process variation can significantly impact the effectiveness of pass-fail package seal inspection. Variations in the sealing temperature, pressure, and time can all affect the seal's quality, leading to potential packaging failures and product quality issues.

When conducting pass-fail thermal camera package seal inspection, the camera measures the temperature profile of the package seal, comparing it to predetermined pass-fail criteria. If the seal meets the predetermined criteria, it passes inspection. If it does not meet the criteria, it fails inspection.

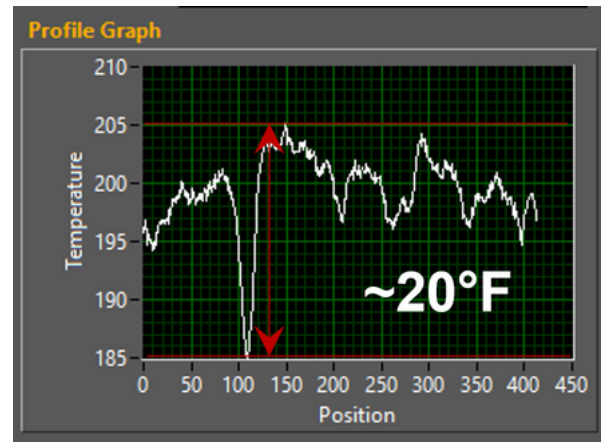
However, process variation can result in the seal's temperature profile falling outside of the predetermined pass-fail criteria, even if the seal is still of acceptable quality. This can result in false negatives, leading to potential packaging failures and product quality issues.

Process variation can also result in seals falling within the predetermined pass-fail criteria, even if they are of poor quality. This can result in false positives, leading to unnecessary rejections and potential production delays.

Reducing process variation involves identifying and addressing factors affecting seal quality. This may include monitoring and controlling variables such as temperature, pressure, and time to ensure consistency in the sealing process. By implementing process controls and reducing process variation, the heat-sealed



Process Variation Measured with Thermal Imaging



A Packaging Defect Measured with Thermal Imaging

packaging process can become more reliable, leading to a more reliable thermal camera heat seal inspection program.

In addition to monitoring the packaging process, thermal imaging can also aid in optimizing the packaging process to reduce variation. By analyzing thermal images of the seal, operators can identify areas of potential improvement in the packaging process, such as adjusting the temperature or pressure to ensure consistent seal quality.

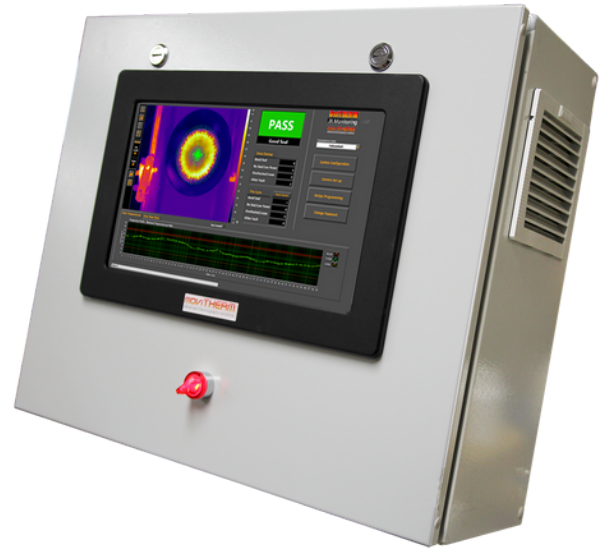
Integrator Expertise and Support

Not to be overlooked is the reputation of the system integration and the support you will receive, not only during the installation but during the operation of the system as well. You will want to be sure they have experience with successful installations. Additionally, if your system is going to incorporate thermal imaging technology, you will want to make sure the integrator understands the physics of infrared imaging and has access to reliable and proven IR camera technology.

MOViTHERM
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MoviTHERM has over 20 years of experience in engineering solutions that leverage the sensing advantages of thermal imaging. Our strategic partnerships with key suppliers provide access to the latest and greatest sensing technology. Our experience, combined with the newest tech, produces “a generation ahead” smart IR solutions for early fire detection, condition monitoring, automated quality inspection, and infrared non-destructive testing.

Our vision is to make hindsight irrelevant for our customers by eliminating surprises and guesswork. Our solutions provide the foresight needed to take best-informed actions before failures occur. We turn efforts from reactive to proactive, thus avoiding the pain of making mistakes.



MoviTHERM TSI is a turnkey Thermal Seal Inspection system that leverages Infrared Imaging to assess the quality of heat-based sealing. Infrared cameras “see” the residual heat from joining, gluing, sealing, and welding processes. The system characterizes test samples against good thermal profiles, allowing TSI to reliably detect good and bad seals. The TSI recipe manager allows the system to adapt to various seal inspection applications.

Learn more about MoviTHERM TSI at <https://movitherm.com/solutions/quality-inspection/>

Or contact one of our application specialists at [+1 \(949\) 699-6600](tel:+19496996600)

TSI