FLUKE®

Get the Facts about Focus

Application Note

In any imaging endeavor, focus is essential. Imagine having poorly focused photographs of important life events. Your wedding pictures fuzzy, your child's school photos blurry. They would be nearly worthless to you. The exact same is true for thermal images—focus is everything. Not only does poor focus give you a bad thermal image, poor adjustment of focus degrades your imager's ability to accurately measure temperature. With advances in imager software, there are many image parameters that can be adjusted in a saved image once the image is being optimized for reporting purposes. One thing that cannot be changed after an image has been saved is focus. Focus is an optical adjustment, and as such can't be adjusted in a saved image. For all of these reasons, proper focus is one of the most important aspects of thermal imaging.

An infrared field thermographer has many responsibilities while conducting inspections. First and foremost, they have to be safe and a close second is bringing back high-quality data. Fluke's new LaserSharp® Auto Focus will make sure focusing the infrared camera is no longer one of the biggest challenges. Significant time, especially for novice camera operators, is spent focusing the camera on each subject or target while conducting inspections. Hundreds of assets or thousands of components are typically inspected during an eight-hour shift. When time is saved by accurately and confidently focusing the camera on the first attempt, hours can be shaved off of inspection time resulting in higher efficiency allowing for additional assets to be inspected during the same time period.

Other challenges in the field can also be minimized, or eliminated, by utilizing LaserSharp® Auto Focus technology. For example, when working in bright or low-light conditions where image contrast on the LCD screen may not be optimal, LaserSharp® Auto Focus will assure the image is properly focused. Most industrial inspections are done wearing safety glasses and/or an arc flash face shield. Visual acuity can be a challenge wearing this equipment and yet a crisp focus can still be achieved with LaserSharp® Auto Focus. Personnel with aging eyes, where presbyopia or nearsightedness dictates the use of bifocals, can obtain a sharp focus with ease, even when doing overhead inspections.

When following industry safety best practices for electrical applications, where high incident energy is present, the objective is to quickly optimize camera settings—including focus—and then move out of the flash protection boundary. The thermographer will be able to do so more quickly and remain confident the data collected is good with the assistance of LaserSharp® Auto Focus. In all scanning situations, poorly focused thermograms will make seeing small details difficult and an important problem may be missed in the field. Fluke's LaserSharp® Auto Focus technology will create an environment where, under most conditions, an infrared technician of any level of

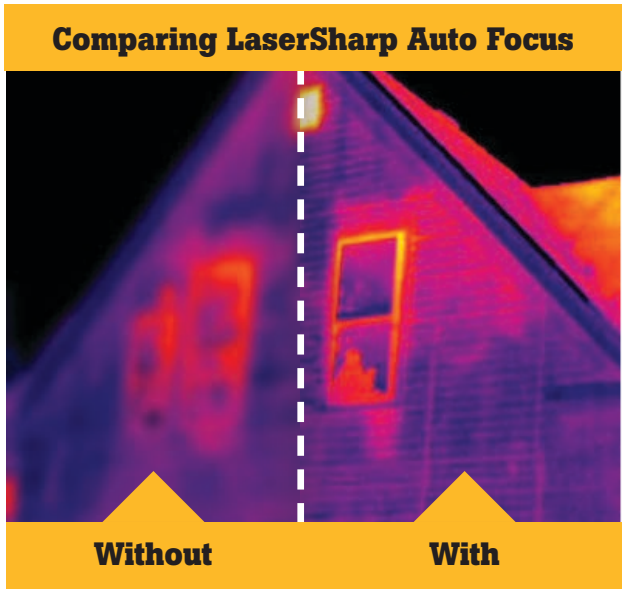

Figure 1. Abnormal heating patterns

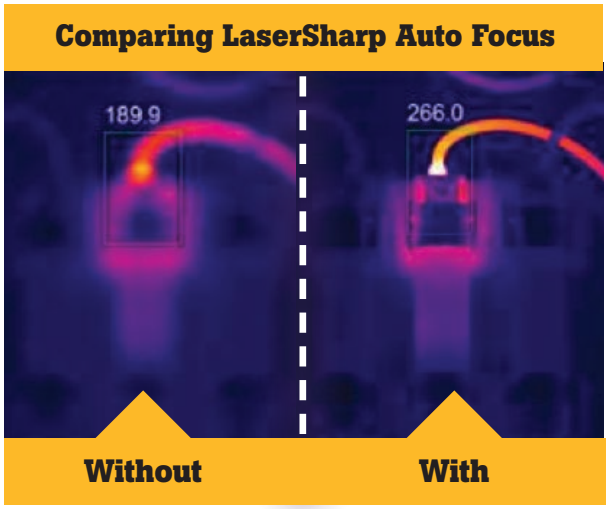

Figure 2. "Smearing" effect that occurs when focus isn't optimized

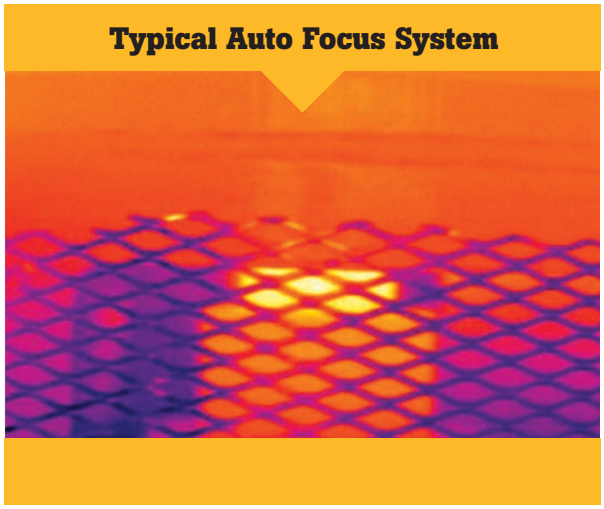

Figure 3. Typical auto focus systems will focus on the metal guard

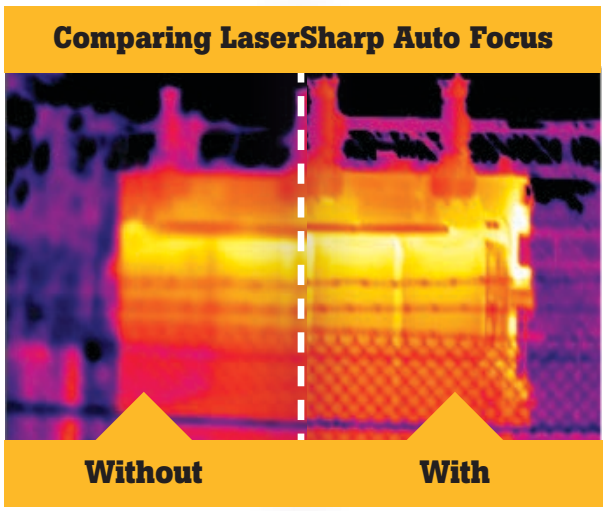

Figure 4. Substation equipment behind a fence.

experience can work with efficiency and confidence knowing that their images are in sharp focus.

First consider image quality. Which of the two images in **Figure 1** would most customers probably prefer? In the left hand image it's obvious that what's being viewed is the exterior wall system of a home. Despite the poor focus some details can be detected, for example the abnormal heating pattern around the right hand window.

The right hand image is much more crisp and clear than the other image. In every aspect, the image on the right is superior in quality. More details are evident as well, such as the orientation of the siding and the location of framing. Even the reflections in the glass of the windows are nice and sharp. Companies conducting infrared inspections want high quality images like the image on the right. This allows for better presentation, analysis and professionalism.

What about temperature measurement? Focus has an impact there as well, a fact not fully understood by many thermographers. Just behind the lens of your imager is the detector array. Mounted on an electronic chip, the detector is a two dimensional array of elements that react electrically to the presence of thermal energy. Depending upon the resolution of the imager in question, there can be various numbers of individual elements. Imagine them like tiny little squares all of which are capable of detecting and measuring thermal energy. The Ti400 for example is a 320x240 resolution detector, which essentially means that there are 76,800 individual detector elements that "see" and measure thermal energy.

With a sharply focused image, there is distinct contrast between areas of varying thermal energy on the surface being inspected. This allows the individual detector elements to clearly report the intensity of the energy being focused on them. When the focus is poor, the incoming energy isn't as distinctly concentrated on individual detectors, and their response is skewed. Think of it like smearing the energy together; averaging lower levels of energy with higher levels of energy.

In the well focused image on the right in **Figure 2**, there's a distinct difference between the area of highest energy compared to the spot directly adjacent to it. This distinction allows the detector to more accurately quantify the amount of energy focused on each detector. The area box around the anomaly assigns a value of approximately 266 °F as the maximum apparent value. Contrast this to the poorly focused image, wherein the area box assigns a vastly different value for maximum apparent temperature. This is due to the "smearing" effect that occurs when focus isn't optimized.

Camera manufacturers have known for some time that focus is essential to temperature measurement

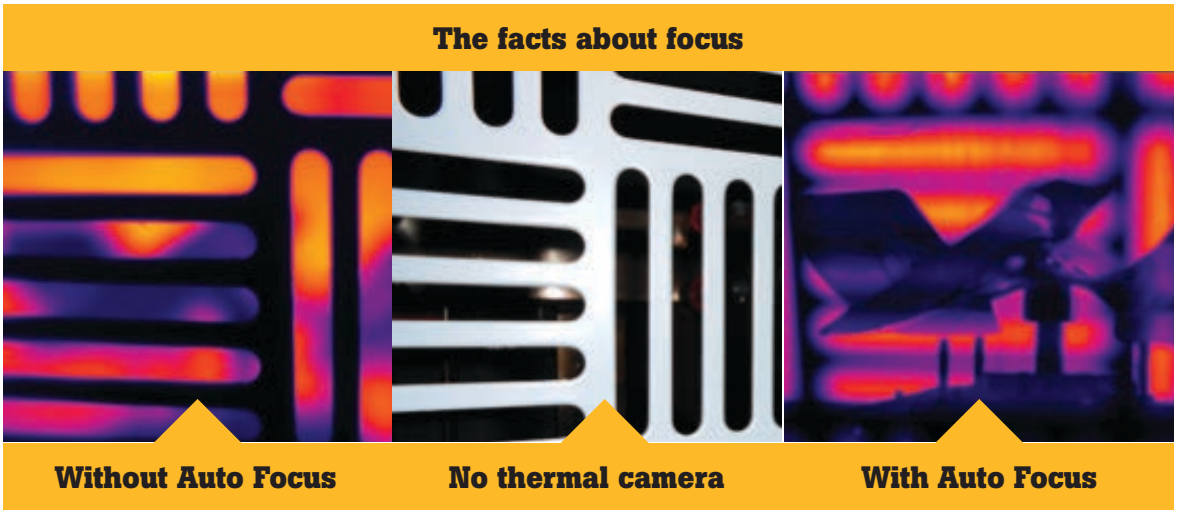

Figure 5. Focus on objects that might be obscured with traditional Auto Focus Systems

and image quality; so much has been done in imager development to make focusing easier and more accurate. In recent years the proliferation of imagers with auto-focusing capability has increased. Nearly every manufacturer offers a model of imager with this feature, and while it does make focusing less tedious, there can be drawbacks to these advancements.

Autofocus is accomplished with a fairly complex system of components. The imager performs an optical analysis of energy coming through the lens. Many cameras do a sampling on a specific line or a small or large box in the center of the image. An electromechanical system then adjusts the focus until the maximum amount of contrast is detected in the image. Anyone who has used autofocus can attest to the fact that often manual adjustment is required after the autofocus effort gives it its best try. This is due to the limitations of the technology. Often the object the thermographer is interested in the most isn't what is optimized by autofocus, because the thermographer can't choose what the imager uses as its point of detection. An example can be seen in **Figure 3**. The object of interest is the coupling behind the expanded metal guard. In this case, the focus ended up being on the guard rather than the coupling. Another example in **Figure 4**, where the represented center box sampling covered multiple areas of differing depths, like the fence, the actual transformer, items in the far background, and therefore "confuses" the autofocus and the results can be seen. Further manual adjustment of focus becomes necessary for a high quality image in both cases.

With Fluke's new LaserSharp® Auto Focus, which is new to the infrared market and is in the Ti200/300/400 series product line, the auto focus process has been greatly improved. Fluke breadth of products allows them to merge technologies from other product lines to give you innovative solutions like LaserSharp® Auto Focus. The Ti400 series of imagers give the thermographer a choice of what object is the point of interest in the autofocus operation. A separate trigger allows initiation of the LaserSharp® Auto Focus feature. A laser then can be aimed precisely at the area of interest to the thermographer. The Ti400 imager senses the distance to the object of interest and the focus adjusted to optimize the object. Now thermographers can precisely focus on objects that might be partially obscured by other objects. So the substation equipment behind the fence can be focused on, disregarding the fencing material between the imager and the object of interest. Equipment behind expanded metal guards or an electrical cabinet with slotted ventilation covers (see photos in **Figure 5**) can be accurately viewed with precise focus, because the Ti400's LaserSharp® Auto Focus can be aimed through the guard to the object that matters most to the thermographer.

Fluke's LaserSharp® Auto Focus can minimize or completely eliminate focusing errors, reducing the number of times the thermographer has to go back out to in the field to get a better image, as well as collect more accurate temperature data. It also allows the thermographer to concentrate on other critical issues—like safety—and all the other things a thermographer needs to do to get high-quality data from their imager.

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