

## What IS THERMAL IMAGING

Thermal imaging (sometimes referred to as thermography, thermal scanning, infrared imaging, or infrared thermal imaging) is the means and by the knowhow by which we can see the infrared portion of the light spectrum. Every object gives off some amount of thermal radiation so thermal imaging is ideal for observing temperature anomalies that are abnormal in machinery, electrical equipment, and even in solids such as wood, aluminum, steel, and fiberglass. Thermal imaging does not require light to see thermal radiation (think of the old movie "Predator" or the new movies and t. v. shows which show people inside buildings or running towards a building at night) so thermal cameras can see in absolute darkness. Thermal imaging is used widely in law enforcement, security, the military, air and sea navigation, surveillance, firefighting, private industry, medicine, and science.

The tool used for thermal imaging is the thermographic camera, which is similar in appearance and operation of a portable digital video camera. A & L MARINE SURVEYORS, LLC prefers using the Flir® brand infrared cameras. A & L MARINE SURVEYORS has used Flir® since 1992. Several years ago, FLIR® purchased by internationally known Teledyne and is now labeled FLIR-TELEDYNE. The infrared camera works by sensing electromagnetic waves within the light spectrum wavelength between approximately 0.9 and 14 micrometers (visible light that can be seen by the human eye is between .4 – .75 micrometers).

A special lens on the infrared camera focuses the infrared light emitted by all objects in view.

The focused light is scanned by a phased array of infrared detector elements. The detector elements create a very detailed temperature pattern called a thermogram. It only takes about one-thirtieth of a second for the detector array to obtain the temperature information to make the thermogram.

This information is obtained from several thousand points in the field of view of view of the detector array. The thermogram created by the detector elements is translated into electric impulses.

The impulses are sent to a signal processing unit. The signal processing unit is a circuit board with a dedicated chip that translates the information from the elements into data for the display.

The signal processing unit sends the information to the color display monitor on the camera, where it appears as various colors depending on the intensity of the infrared

emission. The combination of all the impulses from all the elements creates the infrared image. These impulses will also record surface temperatures of the image taken. Infrared cameras can be adjusted for optimum imaging by manually setting the distance to the object, humidity, and air temperature before the image is taken. Special software that we have can also adjust the thermographic image, search, and label exact temperatures outside of the spot size ratio (the center crosshairs on the infrared image), adjust the thermal tuning scale, and crop and edit the image based on how small the thermal anomaly may be. The anomaly may be shown at the exact spot on a boat, an engine, and or any other area that would have the need to be inspected. This is done in several ways with a picture in a picture (Thermographic picture over the exact spot with the target behind the FLIR® as a photo, or side by side, both taken at the exact second, so there are no mistakes about the target).

#### Thermography and How it makes Your Vessel Safer 4

Thermography can sense heat that may prevent an electrical fire. Thermal imaging can detect leaking fuel or water from tanks that may prevent an explosion or water damage to the interior of the vessel. Thermal imaging can detect temperature anomalies in the engines or transmissions that can prevent much more costly engine or transmissions repairs in the future. Thermal imaging can detect patches under the gel coat from previous damage, trapped water under laminate, delamination of the hull, or a void the new repair did not properly bond to. Obviously, thermography is an important component of a boat survey. Make sure you hire surveyors such as A & L MARINE SURVEYORS, LLC. Who are qualified with over 7000+ boats surveyed since 1992 to do the job right who has the documents to show he or she is certified to conduct the proper testing.

### Benefits of thermal Imaging item 3

There are numerous benefits to thermal imaging in many industries. Specifically in the marine industry some of the advantages are:

- No contact is needed. This keeps the user out of danger.
- It is two-dimensional. Thermographic temperatures can be measured at one point or a hundred or more points on a single thermographic image.
- It is real time. It allows fast scanning and recording of stationary targets. Objects cannot escape their own radiation.
- Thermal patterns can be seen. This helps significantly reduce the time and money spent on a technician or mechanic that would have to spend hours to disassemble and troubleshoot a component or go through miles of wiring on a boat or yacht to find the problem. The thermographic image can find the temperature anomaly quickly.
- Enhances the marine survey report. If desired, thermal imaging can be included in the survey report on components such as engines, transmissions, electrical equipment, electronic devices, tanks, and hulls to look for heat anomalies that can determine if malfunctioning components, leaks, previous fiberglass repairs or delamination exist within the vessel.

## Infrared Thermal Cameras used in A & L MARINE SURVEYORS, LLC

A & L MARINE SURVEYORS, LLC. Only uses Flir® brand high-definition professional grade infrared thermal cameras for our marine surveys, engine surveys, and inspections. My cameras are calibrated yearly, infrared thermal imaging cameras with a minimum of 320 x 240 pixels with an image frequency of 60Hz. They can detect a minimum of 43,200 individual temperature shots per digital or video image. The minimal thermal range of the cameras I use are between -4 degrees Fahrenheit – 1,202 degrees Fahrenheit (-20 degrees Celsius – 650 degrees Celsius) which means we can see thermal anomalies in cold temperatures (such as freon hoses in marine air conditioning systems and refrigeration systems) and in extremely hot temperatures (such as overheating turbochargers and overheating exhaust manifolds in engines).

Each infrared thermal image I take is properly tuned based on the environmental conditions at the time of each shot of the inspection and will give the exact distance in feet or meters to create a more accurate scan for the inspection, this upgrading with this special software it helps to reveal thermal anomalies accurately. Having been trained by Flir® and the United States Government, I am a Level Three Certified Thermographer, certified to teach thermal imaging, I know how to properly take, tune, and interpret infrared thermal images to determine if there are abnormalities in the thermal images or video taken of hull composites, engines, electrical systems, or marine components. I further understand how these systems work and what normal running temperatures are in many different engines and systems on board vessels from years of professional training in addition to my master's degree in mechanical engineering and over 53 years of experience as a surveyor, thermographer and running boats and rebuilding engines. As you can see, there is a difference in the work I offer versus the untrained surveyors who are out there imaging with small cellphones, and or cameras meant to detect a clogged drain.