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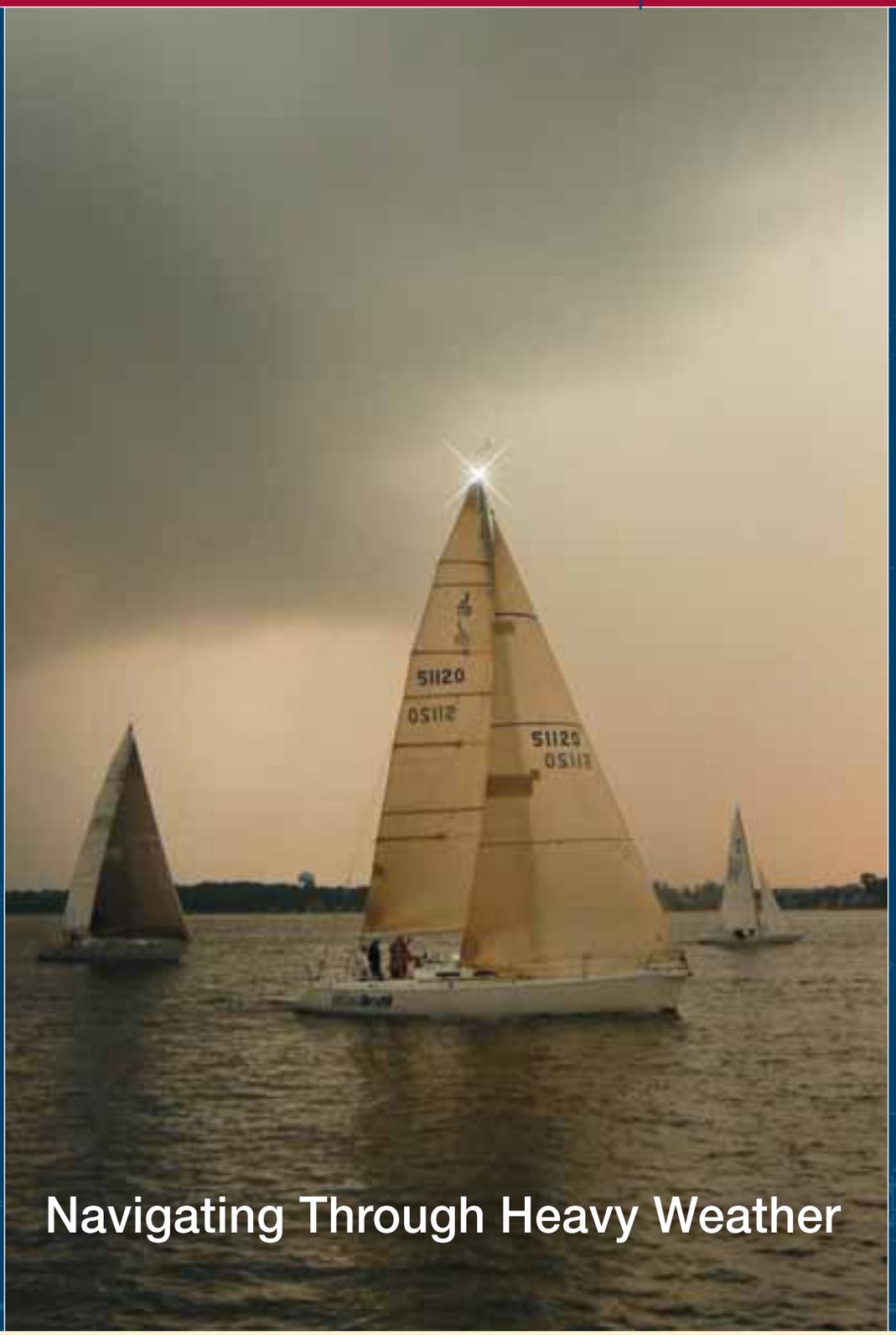

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Applying Infrared Thermal Imaging Techniques to Marine Surveying

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Marine surveyors are to the marine industry what building and home inspectors are to the commercial and residential real estate industry. A marine surveyor's opinions are heavily relied upon to document the "Condition and Value" of vessels and cargo.

When a marine surveyor conducts an inspection, they rely heavily upon their experience and four of their five primary senses (sight, hearing, smell and touch). Traditionally, experience and visual anomalies seen with the unaided eye are often the sole basis for further testing and investigation. Infrared thermography offers a marine surveyor a better set of eyes. The resultant infrared thermal images are an effective tool in extending a marine surveyor's unaided visual ability in detecting anomalies and communicating the severity of the findings.

This is the first in a series of articles that will illustrate the use of infrared thermal imaging as it can be applied to marine surveying. Throughout the series, examples will be presented on what can be found while inspecting electrical, mechanical and structural systems. A discussion, along with examples and short stories of some common findings and how they appear using infrared thermal imaging, will be presented. By the end of this series, you will certainly understand why infrared thermal imaging has become such an effective tool, not only in documentation and presentation of findings during inspections, but also in the targeting of prime candidate areas for preventative maintenance.

Keywords: *Marine Surveyor, "Condition and Value," ABYC, NFPA, USCG, USC, CFR, Underwriter, Fiberglass Reinforced Plastic (FRP), composite*

Common to most reports of a marine survey are deliverables that provide opinions of both a "Condition and Value" of a vessel. Typically, the "Condition" of a vessel is based upon its structural integrity, safety features, the performance of the systems onboard and general housekeeping as evidenced by preventative maintenance practices. Similar to the real estate industry, the "value" of a vessel is based upon a review of recent sales comparables and the documented income earning potential of the vessel.

When vessels are inspected, they are often evaluated with respect to the mandatory standards promulgated by the United States Coast Guard (USCG), under the authority of Title 46 United States Code (USC); Title 33 and Title 46, Code of Federal Regulations (CFR), and the voluntary standards and recommended practices developed by the American Boat and Yacht Council (ABYC) and the National Fire Protection Association (NFPA).

Marine surveys typically serve two business segments:

- Commercial – tugboats, passenger vessels, shipping and fisheries
- Recreational – yachts and small craft

Within each business segment typical types of inspections can be further broken down into:

- Pre-purchase – requested by buyer when they are purchasing a new or used vessel
- Seller – requested by seller to help prepare for the sale of a vessel and offer full disclosure
- Insurance – requested by an underwriter(s) to determine if the findings on the vessel is an acceptable risk to their business practices
- Appraisal – requested by a lending institution, or legally required as documentation for estate settlements and donations
- Damage – required to settle an insurance claim or legal action
- On hire off hire – required by contractual agreement to document the condition of a vessel before it is leased versus when it is returned after the lease is up. Findings of damages that are beyond what is considered to be "normal wear and tear," often result in additional charges to the lessee.

In 1998, J.N. Allinson Associates, Inc. began offering marine surveying services. In January of 2003, these services were augmented with Infrared Thermal Imaging practices using a FLIR E2 ThermaCAM Serial #21500607, manufactured January 2002, and then later enhanced to an E4 model with image capture capabilities in radiometric format. In July 2006, Infrared Thermal Imaging services were upgraded again by the addition of a FLIR Infrared Camera model P65HS Serial #25300760, manufactured March 2006, equipped with burst recording radiometric image capture capabilities.

ELECTRICAL SYSTEMS

Typical infrared thermal imaging of electrical systems includes:

Direct Current (vDC) Systems

- Electrical primary and sub panels
- Batteries and associated systems
- Bundled electrical conducting wires
- vDC Electric motors and associated systems

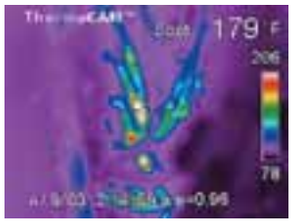
Alternating Current (vAC) Systems

Shore power

- Dock power pedestal and cord outlets
- Adapters and power cords
- Shore power inlets onboard the vessel

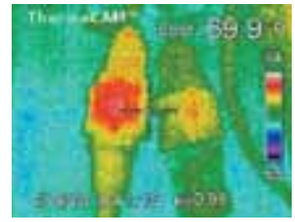
House power

- Electrical primary and sub panels
- vAC to vDC converter(s)
- Bundled electrical conducting wires
- vAC electric motors and associated systems
- vAC hot water heater(s)



vAC & vDC systems – Electrical Primary Panel

Infrared thermal and visual images are presented of the back of a main electric distribution panel in a 40-foot powerboat. The electrical power feed to panel was configured from two 30 amp 120vAC shore power cords. During the electrical inspection portion of a pre-purchase survey, breakers on the vAC side of the electrical panel would trip when placed under full electrical load. The seller was onboard and insistent that this was reasonable given the number of electrical appliances onboard. The main vAC electric distribution panel was opened and released a blast of hot air. Again, the seller insisted that this was reasonable given the number of electrical appliances onboard. The 120vAC side of the electrical panel was not shielded from the 12vDC side (an ABYC finding – *11.9.1.1 Boats equipped with AC and DC systems may have their distribution panel boards, separate or combined, and constructed such that access to the DC system does not allow access to energized AC parts without further use of tools*) and a visual inspection of the wiring did indeed show that the wires were intact and the wire insulation and terminals were free of burn or scorch marks. See, said the seller, no problems here. Out came the infrared camera, and the seller was shown the display of the infrared thermal image. He promptly changed his mind and ordered a marine electrician to fix the problem as a condition of sale.



vAC system – Shore Power Adapters and Power Cords

This is a power pedestal on a dock that supplies electric power (shore power) to a boat. A single 50 amp 220vAC shore power cord (light yellow) splits into two 30 amp 110vAC feeds. This item is known as a "Y adapter" and is commonly used with boats that have two 30 amp 120vAC shore power inlets. The infrared thermal image on the left reveals that there is electrical resistance is building up on the left leg of the "Y adapter."

Two 25-foot 30 amp 110vAC cables coupled to another set of 25-foot extensions. An infrared thermal scan of the connections shows heat build up. A visual inspection of the exterior of the power cables reveals that they appear to be in like new condition with the yellow insulation clean and pliable. Uncoupling the connections for a visual inspection reveals that the prongs are pitted and corroded. The infrared thermal image is shows excellent examples of how surface corrosion can cause resistance, resulting in heat build-up while targeting a prime candidate area for preventative maintenance.

The average infrared thermal image scan of electrical systems on vessels up to 65 feet in length beginning at dockside through the interior represents about 1.5 hours of work effort. When conducted by a properly trained and educated Infrared Thermographer with marine surveying experience, it is the opinion of J.N. Allinson Associates, Inc. that this preventative loss measure would dramatically reduce the number one cause of fires onboard vessels. The next installment of "Applying Infrared Thermography to Marine Surveying" will cover the inspection of mechanicals systems. ■

About the Author: John (Jack) N. Allinson II is a SAMS® Accredited Marine Surveyor, Accredited Claims Adjuster in Florida, and a Level I Certified Infrared Thermographer. He is the president of J.N. Allinson Associates, Inc., a firm that provides Marine Surveying Consulting Services based out of Jacksonville, Fla., and long-time ABYC member. For more information regarding Mr. Allinson's services and credentials, please visit www.allinson.com.