Infrared Thermography In The Marine Industry

Skip Handlin, Vice President
Handlin Preventive Maintenance Services, Inc.
2837 Sharon Street
Kenner, LA 70062
Tel: 504-467-9671
Fax: 504-467-9672

Abstract

Infrared thermography is a widely accepted PPM technology within land-based facilities. Although less widely known, thermography may also be applied to electrical and mechanical systems of stationary and mobile marine systems. In addition to saving money and increasing uptime, thermography can play a crucial function in maintaining the safety and reliability of marine facilities where system failure could lead to catastrophic loss of a vessel or its crew. This paper will discuss applications, safety issues, similarities and differences from land-based thermography and other interesting considerations in performing infrared inspections for the marine industry.

Introduction

One of the most interesting and distinguishing points of marine thermography is that as a contractor, not just anyone performing land-based thermography surveys can legally perform marine surveys. The reason being insurance coverage as outlined by a law not heard of by many, known as the Jones Act. The Jones Act basically states that once you leave land and board a ship or vessel of any type not supported by solid land, a whole new legal world of liability, ramifications and legal action exists. Maritime workers compensation and liability insurance is a completely different policy from what normal land-only contractors are required to purchase. The policies are generally more expensive, and are not issued by all insurance companies. The high cost and liability of marine insurance is one reason the number of marine thermography companies is somewhat limited. On the other hand, it is one of the reasons why thermography rates for marine related work can be elevated as compared to land-based. Many companies are able to circumvent purchasing marine type insurance by becoming subcontractors to contractors that do have it. This is just one of the many different factors that an everyday thermographer performing maritime work must be aware of and deal with. Now, on to some of the most typical marine type applications in thermography, which may help one to understand some of the unique differences compared to land-based thermography.

Discussion

The largest marine application serviced by thermography is cargo ships. A few of the typical types regularly serviced are tankers, grain carriers, container carriers and pre-positioned navy supply ships. One of the biggest differences when performing thermography on any type or size of cargo ship is space of operation. As one can imagine, on any ship, space is limited and at a premium. Many times when trying to perform a survey on any type of ship, the target is too close to machinery or other structures to achieve a good focus or resolution. For this reason, wide-angle lenses are often required, with a little ingenuity and dexterity in order to perform a quality job.

Another interesting difference is the need for accurate recording and reporting of equipment surveyed and deficiencies found. Ships almost always have two identical pieces of equipment on board that must be surveyed. Some examples of this are port and starboard engine room supply fans, forward and aft lube oil pumps, or inboard and outboard fresh water cooling pumps. For many people who have never been down in the machinery or cargo spaces of a ship, it is very easy to become disoriented to what is forward or aft, port or starboard, etc. This, along with the fact that no two ships label or name equipment alike, can be very confusing and lead to misnaming equipment. Great care must be taken when reporting a deficiency to the person in charge, usually the chief engineer or first engineer. Most times the deficiencies found are repaired by the ship's crew after the surveyor has completed their job and left the ship. The ship could also sail to some foreign country where phone calls, e-mails or faxes to clarify the deficiency become difficult. It is not the same as Mr. Smith at Goodberger Realty calling the local thermographer to clarify a question. The accuracy of the correct equipment found with a deficiency and the communication of this to onboard personnel in charge is of utmost importance. This combined with the fact that seldom are follow-up surveys performed until the next survey due date, typically a year later, makes this element of precise reporting very important.

Another difference between ships and land-based facilities is that for equipment related to propulsion to be surveyed properly; the ship must be under way or sailing at the time of the survey. Not many thermographers have started their day in one place and ended up hundreds of miles away at the end of the day. This causes several interesting points to remember. First, the golden rule of the marine thermographer - do not be late for the scheduled survey time. If you are late and the ship sails, you may have just lost a valuable client, because the survey will not be performed as scheduled. Many times it may be weeks or even months before the opportunity to perform the survey arises again. Sometimes this may cause a major problem if the survey occurs after a Coast Guard or ABS required due date. Second, when sailing, for instance from Jacksonville, Florida, to Boston, Massachusetts in the fall, spring, or winter months, there can be drastic changes in ambient temperatures and load conditions. The surveyor must always be aware of and take into consideration these changes. A ship may depart from a port in ninety-degree weather and eighty-degree water temperature, then arrive several days later in thirty-degree weather and fifty-degree water temperature. As any experienced thermographer knows, this can mean drastic changes to some equipment surveyed. This is especially true for most deck equipment, and some equipment below the water line of the ship.

As far as the typical applications of thermography for cargo ships, it is not entirely different from that of land-based facilities. The most common application is electrical system surveys that all thermographers know and love. The typical electrical survey on a ship would cover such items as switchboards, motor controllers, circuit breaker panels and major junction box connections on motors and generators. As mentioned before, this would not be all that different from an electrical survey for a building, hospital or production facility of some type. One difference however, is the amount of time and effort typically put into analyzing shipboard generators and their connections, circuit breakers, feeds and instrumentation. In common land-based electrical surveys, generators are usually for back up or emergency power only. Many times the generator is not operated or put on-line during the survey. Aboard a ship, the generator is the true lifeline since it would be hard to buy power from a utility company when five hundred miles out in the ocean and moving twenty miles per hour.

There are also typical mechanical surveys performed aboard ships for bearings, shaft alignment, steam lines and steam traps among others. Many of these mechanical surveys would again not be very different from a common land-based survey. However, some of the different mechanical applications that have been performed by this surveyor on various ships are as follows.

On some container ships, the ship has an on-board crane to move containers and barges on and off the ship. It has been found through experimental thermography that the wire ropes of the on-board cranes can be surveyed to detect weakening spots in the wire strands. The procedure is really a simple one to explain, and works as described below. The crane is tasked to repeatedly raise and lower a known weight for a minimum amount of time. The time interval depends on the type and load capacity of the crane. The wire ropes are analyzed for any developing hot spots using the infrared camera while they are passing through the sheaves. Similar to the way a roof is marked during a roofing survey, an assistant marks the noticed hot spot with marking paint or tape. The cable is then closely inspected for tears, breaks or other damage. Many times a fault with the cable is found when a hot spot is detected. If no damage to the cable is found, the sheaves are inspected next for a developing problem. Sometimes it has been found that the sheave is worn, has a rough spot, or has been damaged in some way. Some navy supply ships and car carriers have large hydraulic ramps that lower to a dock allowing vehicles of many types to be rolled on and off the ship. These ramps are also raised and lowered by wire rope hoists. The same procedure has been effective on them also. There have been several potential catastrophes prevented using this method of surveying wire rope cranes and their working parts.

Another interesting mechanical application performed on-board ships is the use of infrared on gearboxes vitally important to the operation of the ship. Some of the most typical gearboxes surveyed aboard ships are for anchor windlasses, heaving or mooring winches (used to tie the ship up dockside) and cranes. Most cargo ships have to be moored or stopped to load or unload their cargo. Mooring is when a ship is tied up to a pier, or sitting at anchor somewhere close to a port. This makes the mooring and anchoring equipment vital to the operation of the ship. Infrared has helped in quickly determining low oil levels and, used in conjunction with vibration analysis, can quickly help determine possible gear or bearing trouble within the gearbox. Again, there have been several potential catastrophes prevented by surveying vital deck equipment and associated gearboxes by quickly and effectively using an infrared camera.

Basic safety issues and precautions that apply to land-based thermography also apply when performing marine surveys. Rules such as “don’t touch it to see if it is really hot”, maintaining a safe distance and wearing proper protective equipment must all be followed aboard ships as well as on land. However, there are safety concerns to be aware of that are different when working aboard ships. One safety consideration that must always be kept in mind goes back to a previously mentioned lack of space or tight quarters. One must always be aware of the close proximity of everything aboard ships. Some of the shipboard safety hazards not typical of land-based facilities are low overheads, multitudes of tripping hazards, the close proximity of steam and hot water lines, very steep and narrow stairways and vessel motion caused by rough seas. The motion of a ship due to weather is something that is very hard to describe to someone who has never sailed in rough water. To say the least, it is not like walking on a stationary concrete slab typical of most land-based facilities. There are times when the survey cannot be performed because the ship is bouncing or rolling too much. The thermographer must always be aware of these specific marine hazards, as well as all typical hazards in order to ensure the safety of his/her self, their equipment and that of the ship and ship’s crew.

Another marine application typically serviced by thermography is offshore oil platforms, known by many as oilrigs. Oilrigs are of two major types: the stationary or fixed location rigs, and the movable jack-up rig. The stationary oilrig is as the name says - stationary. It is put on location and anchored to the sea bottom using various methods and may never move again. These stationary rigs can remain active and on location for years or even tens of years once on a highly productive site. These rigs drill for oil and gas in water depths ranging from feet to miles. The movable jack-up rigs are smaller portable oilrigs, generally used in shallow water of one hundred feet or less. The jack-up rig is either self-propelled or towed, and is generally used to do short-term, small production jobs. In general, the applications of thermography, safety concerns and differences from land-based thermography are similar to those previously discussed. There are however differences uniquely associated with performing thermography on offshore oilrigs. Some of these differences are discussed below.

One of the most interesting and adventurous differences of thermography on offshore oilrigs is the scheduling of and actual travel to and from the job. As one can imagine by the name “offshore”, these rigs are typically located in the ocean and sometimes are hundreds of miles from the nearest land. Actually traveling to and from these rigs can be an interesting experience. The two basic modes of transportation to and from offshore rigs are high-speed personnel carrying boats known as crew boats, and rotary winged aircraft known as helicopters. The thermographer must again follow the marine thermographer’s golden rule and not be late, at the risk of losing the job and/or client. Once a crew boat or helicopter departs from its point of origin, it is not returning to pick up a tardy Mr. Thermographer. This lesson has been learned by this thermographer from personal experience. The crew boat or helicopter ride to these offshore rigs can range from minutes to hours. Getting to and from these rigs can sometimes be a journey of unexpected proportions. Weather can dictate that a one or two day job turns into several days or even weeks of unexpected delays. Personal experience has also taught this thermographer not to schedule other jobs close to offshore surveys.

Another important lesson learned by this thermographer is to not perform offshore surveys for a firm fixed price. We always perform offshore surveys on a time and material basis with built in travel and stand-by rates. Once offshore, you are solely at the mercy of the rig personnel and the weather as to when you can leave. This thermographer has personally been on an offshore platform for days and even weeks waiting for the next crew boat or helicopter to bring me back to the safety and comfort of land, any land. As one can imagine, this could be a costly arrangement if an agreed upon fixed price for two days of work turned into a fourteen day adventure. Another client can be expecting you and there is often no method of communication to let anyone know what has happened. Sometimes bosses can even think you have taken an unplanned, unannounced and unapproved vacation.

The travel in a crewboat or helicopter to and from offshore rigs can be a rough and literally sickening experience. Rough seas in a fairly small crew boat (30 to 50 ft. long) can make for a non-stop ride not simulated by any roller coaster or amusement park ride in the world. One assistant riding with me on an unusually rough crew boat ride commented: "Astroworld’s Texas Cyclone ain’t got nothing on this ride". The same can be said of long helicopter rides in rough upper altitude conditions. At least if you get sick on a crew boat you can go to the head (restroom) or over the side. In a helicopter, you better have a bunch of those little airsick bags handy. For anyone who has ever spent much time on boats and has become seasick, it is understandable why another golden rule of the marine thermographer is “don’t forget your Dramamine”. For anyone who has not been on many boats and has never been seasick, make sure to take your Dramamine because it is not one of life's more pleasurable experiences. This is just one example of some of the fun and adventure experienced by the marine thermographer not typically experienced by your run of the mill, everyday land-based thermographer.

Another marine industry thermography application regularly performed is on offshore oilrig supply boats. These are normally slow-moving, heavy load capacity motorized boats. Supply boats bring all types of supplies to the offshore oilrigs. The boats average in size from one hundred to two hundred and fifty feet in length. They are mini cargo ships with minimal cargo holes and flat open decks that are reinforced to carry heavy loads. The supply boats carry supplies such as pipe, drilling mud, groceries, potable water and fuel to the offshore oilrigs. The amount of equipment to be surveyed is usually fairly limited, but many of the modern boats are now electrically propelled. The most common electrical propulsion system is known as EMD propulsion. The most important and most common survey performed on these supply boats is that of the electrical propulsion system itself. Along with the switchboards, breakers, generator controls, etc., the large DC propulsion motors are always surveyed. Thermography has often helped determine problems with the DC propulsion motors. Some of the common problems found are brush wear, bearing wear and bad motor connections. It is easy to understand why this is extremely critical to a vessel electrically propelled that is traveling hundreds of miles to sea. Once again, all the same safety, travel and application concerns previously discussed typically apply.

Another application serviced by marine thermography is dredge boats, simply known as dredges. The purpose of the dredge is to keep navigable waterways such as channels, rivers and passes deep enough to be navigated by vessels of all types. Over time, most channels, rivers or passes become too shallow to be navigated by certain vessels due to the build-up of silt. Dredges use hydraulic cutterheads and large powerful pumps to clean the silt from navigable waterways for safe passage. There are two basic types of dredges serviced by thermography and are described below.

The first and most common type of dredge is known as a cutterhead/pipeline dredge. This type of dredge is a large floating barge fully equipped with living quarters. Pipeline dredges are not commonly self-propelled to move from one location to another. These dredges must be towed or pushed by a tugboat when changing locations. Pipeline dredges use a large cutterhead and a powerful pump to remove the silt through a large pipeline attached to the rear of the dredge. Depending on the size of the dredge, the pipeline can be from eight inches to thirty-six inches in diameter. Generally speaking the bigger the pipeline, the more powerful the dredge. The pipeline is typically floatable, built on large pontoons and can stretch from several hundred yards to several miles in length. At times the pipeline is weighted and submerged, but normally only where a traffic point must be crossed. The silt and water is usually pumped into levee protected areas adjacent to the channel, river or pass known as spoil areas. The silt settles and the water runs off and back into circulation. Sometimes a land built pipeline is tied into the floatable pipeline and can carry the silt farther inland. This procedure is sometimes used to restore land that has been eroded over time. All of the electrical and mechanical applications previously discussed are common to pipeline dredges. The same applies to travel to and from, since sometimes the dredge itself can be miles from the nearest land. The same safety precautions and tight spaced quarters are also common when performing thermography surveys on pipeline dredges.

The second type of dredge using thermography is known as the hopper dredge. The hopper dredge is basically a self-propelled cargo ship with one major difference. The interior of the ship is several large holding cells for the silt. Hopper dredges also use cutterheads and large pumps to cut and remove the silt, as does a pipeline dredge. The difference is, instead of pumping the silt through a pipeline to an adjacent spoil area, the silt is pumped and held in the holding cells. The hopper dredge will operate until all of its holding cells are full, and then pick up its cutterhead and travel to some specified deep water to discharge the silt. Hopper dredges are used mainly near open water channels and passes where a close spoil area is not available. All of the same rules of marine thermography apply, including safety issues, travel and scheduling concerns, tight quarters, etc. The most common application of thermography is electrical and mechanical inspections similar to ships since the hopper dredge is basically a ship.

Conclusion

Although thermography is used for other marine applications such as pipe-laying barges, tugboats, cruise ships and gambling boats, those discussed are the most common applications in the marine industry today. Even though many of the practices are similar to those of land-based thermography, there are different potential problems, concerns and safety issues that most land-based thermographers would never think of or encounter. Thermography for the marine industry is as important and vital as it is to our land-based clients. I hope I have given some insight to a few of the differences, adventures and similarities to land-based thermography that the marine thermographer faces on an everyday basis.