Thermal Inspections of Mobile Equipment

A key element in making an infrared program successful on mobile equipment will be the camera operator's knowledge and training for equipment which they are assessing.

A Thermographer checks engine components such as exhaust ports, the turbo charger, accessory drives, fuel systems and heat exchangers.

The first thing that I want to make plain is what I consider to be "mobile equipment." There are thousands of machines that move around in different manners that could be considered "mobile." For the sake of this article, the mobile equipment that I am addressing is defined by the use of an internal combustion engine to make it move or operate. A few examples of mobile equipment would be trucks (both light and heavy), dozers, front-end loaders, forklifts, cranes, excavators, locomotives, boats, ships, mobile welders, pumps, generators and even cars.

Why should mobile equipment be inspected using infrared?

It is common to have some equipment costs that exceed one million dollars on today's market. Many plants and/or operations depend heavily upon mobile equipment to carry out their missions. This equipment can range from the 300-ton off-road hauler at a gold mine in the western United States to the forklift in the warehouse at a paper mill on the east coast. In either case, if the hauler or the forklift should fail to complete its mission, plant production can be effected.

Conducting thermal inspections can help ensure your equipment is going to perform its task when you expect it to do so. Thermography will work as a predictive or trouble-shooting tool for mobile equipment. A key element in making an infrared program successful on mobile equipment will be the camera operator's knowledge and training for equipment which they are assessing. It would be very difficult for a person to go from years of electrical inspections to inspecting mobile equipment if they have not been properly trained.

Safety

I had a gentleman once tell me something so simple yet so true that I have never forgotten it. He said, "Safety is first, during and after." This holds particularly true when working around mobile equipment. Quite often, a thermographer will be standing near or on a piece of mobile equipment that is going to be running, since in many cases the equipment must be operating to allow the thermographer to do the inspection. This could mean that the machine will be moving in many different directions with little or no warning. The most important objective of the person doing the inspection should be to stay in visual contact with the operator of the machine. Don't assume that the operator sees you. Get an acknowledgement of your presence before approaching any machine. For the most part, machines are designed to keep the operator safe while all others in the area are subject to harm. Never walk under anything a machine is holding up. Stay out of the machine's directional path even though the path of movement can sometimes be hard to understand. In some cases, such as a locomotive, the path of movement is well defined. If you stay off of the rails, you are most likely out of the path of movement. On the other hand, there are machines that not only go forward and

On a front end loader one can use IR to analyze fluid levels, pivot bearings, U-Joints and final drives.

Infrared can help check fluid levels, final drives, and carrying rollers on a bulldozer.

backward, but they can go right, left, up, down and, in some cases, all of these movements at the same time. So, once again, stay in sight of the operator and know where you are with regard to the path of movement at all times.

Inspections

Let's acknowledge that reading a short article about inspecting mobile equipment will never be enough to make you an expert equipment inspector. With that in mind, consider the following information an overview of where to look and what to look for during a thermal inspection of mobile equipment.

Some machines can be quite complex. I find it very helpful to break down every machine into different categories and then break the categories down to subcategories. An engine will have a fuel delivery system, lube system, cooling system, filtration, heaters, starters, alternators, pumps, drives, heat exchanges, and so on. The fuel system can have pumps, filters and assorted plumbing. Fuel filters can be inspected for bypassing due to stuck valves or dirty filters. The fuel plumbing can be inspected for proper flow patterns. If one injector line is a different temperature than all of the others, it could be and indication of a fuel flow problem.

Engine exhaust systems are inspected for proper over-all temperatures and even temperatures at each exhaust port. Hotter than normal temperatures can be an indication of a lean fuel-to-air mixture. If an engine is allowed to run lean for extended periods of time, it can cause catastrophic damage. Cooler exhaust temperatures could be an indication of either a rich fuel-to-air mixture or little to no fuel at all. If equipped with a turbocharger, the overall temperature should be checked and the lube line inlet and outlet temperatures should be monitored for proper flow to the bearing and as an indication of bearing temperature.

Heat exchangers, such as the radiator, should be inspected for proper operation by looking at the radiator face. Look for a fairly even temperature across the face. Hot or cool spots on a radiator can be an indication of internal or external plugging. Inlet and outlet lines can be inspected looking for the expected temperature drop across the heat exchanger. Be sure to look for multiple heat exchangers. Many machines will have engine coolers, hydraulic coolers, transmission coolers and don't forget the one that the operator will be most interested in, the air conditioner heat exchangers.

Engine electrical systems have many components to look at – a starter, alternator, wiring, plugs, fuses, circuit breakers, and so on. Some of these components will be very difficult to see and inspect. You should consult the equipment manual for hidden locations.

Engines will have lubrication systems. While in most cases the majority of the lube system will be internal to the engine thus making it very difficult to inspect, there will usually be some external components such as pumps, filters, plumbing and heat exchangers from which a thermographer can get useful data.

“Safety is first, during and after.”

Engines will have external drive systems attached to them for things such as the fan, alternators and pumps. These drive systems can have bearings and drive belts that can be inspected for failure indicators.

With just the engine alone, there can be hundreds of inspection points. A mobile equipment inspection should be treated no differently than a plant inspection. Your first step should be to determine what equipment you are going to inspect and then every piece of equipment should be broken down into an equipment list. The equipment list should have the component, component location and what panels, if any, that are needed to be opened or removed to gain access to the component listed. By the time you get the list completed, you may be surprised at the amount of inspection points a piece of mobile equipment may have.