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Ford
100 % quality production
Thermography
perfect performance

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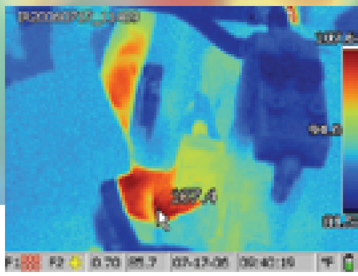
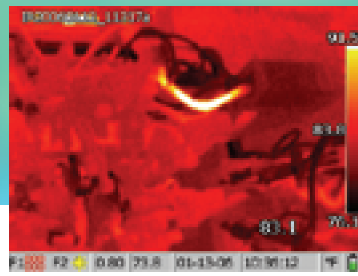
Thermography

at Ford's Dearborn Stamping Plant

From start to best-in-Ford in 30 days—and still accelerating





Far left: Hassan Koussan inspecting aluminum welding cables and transformers from above.

Below: Chuck Larabell inspecting the centering station motor for the Schuler Press.

The Ford Dearborn Stamping Plant has had thermal cameras on site in the past, but had not met the objectives of a successful thermography program. Today, DSP's thermography program is a model for the rest of Ford, and the program came on line in a matter of weeks.

Lately, there has been a stream of visitors to the Dearborn Stamping Plant (DSP) housed in the historic Ford Rouge Center in Dearborn, Michigan. What's the attraction? The DSP operation, which manufactures sub-assembly doors and hoods for the popular Ford F-150 pickup truck, achieved a perfect score in a recent independent audit of its weld effectiveness. That makes the plant best in company – perhaps the best period – when it comes to the precision with which it forms and welds sub-assemblies. Executives from Ford Motor Company corporate offices and management from other Ford operations want to know how they do it.

A significant factor is a condition-monitoring program using thermography or thermal imaging. Thermography itself isn't new to DSP or new to Ford operations, but the DSP thermography program is unique. After only 30 days, the program scored higher in an insurance audit than any other Ford thermography program had ever scored. It continued to work even when new thermography team members came on board. In the best tradition of Ford's commitment to continuous improvement, DSP's thermography program keeps getting better. And possibly the most distinctive aspect: the program is designed around a systems approach and supported by a systems solution. That means it has the potential to be quickly and easily replicated and the possibility of being deployed with equal success and equivalent return on investment in any Ford operation.

The DSP operation

The Dearborn Stamping Plant occupies much of a two-story building that has supported the manufacture of Ford vehicles since the 1930s. The first floor houses various sub-assembly lines to support the large number of F-150 styles, where inner and outer door and hood panels are spot-welded together. Before that welding can happen, sheet steel must be formed into panels using four presses located on the second floor of the facility. This includes a new very efficient Schuler Extra Large "A" Transfer Press with five successive slides (presses).

Plant Manager Frank Piazza approached Process Engineer Jim Jackson and asked him to develop a new thermographic process capable of meeting the requirements. The program had to be user-friendly, maintainable, replicable and, most importantly, reliable.

"When a press goes down, eventually door lines shut down," Jackson explains. "Ford makes a total of about 135 F-150 trucks an hour at its three assembly plants. If we were to have a catastrophic failure, we only have three days before we shut down everything (all three plants)."

Jackson says that before the present thermography program was in place, DSP lost a press for five days. "It was not a pretty picture," he recalls. "When the lines are down and not producing parts, the company is still incurring costs. Costs mount up fast." Thermography had been used to assist in determining the root cause of the failure, but the plant's original thermography program wasn't doing the job adequately. Since the new thermography program began, there have been no such incidents at DSP. In other words, the new program works.

What's different at DSP?

The success of the program Jim Jackson put together with the help of John Lafeber, a thermal imaging consultant and a manufacturer's representative for IR cameras, has several unique elements:

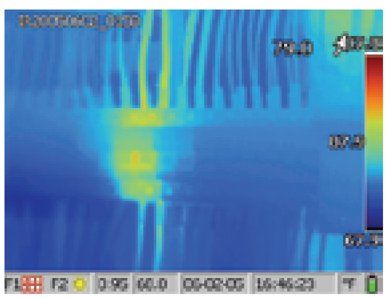
Skilled crafts trained in thermography. At the heart of DSP's thermal imaging program is Ford Motor Company's decision early on to use skilled trades to do thermography. He says, "We chose to go with members of the skilled trades (electricians, weld fixture repair specialists, etc.)," says Jackson. "We realized that once these people were trained and certified in using an infrared camera they would know what a thermal image meant and how it would impact the process."

Autonomous maintenance. Jackson also believed that to be successful, the thermography program needed to empower its thermographers to make decisions without the interference or second-guessing of anyone,

What is thermography?

Thermography is a technology for so-called predictive maintenance, a maintenance strategy that seeks to eliminate production downtime by detecting and fixing deteriorating equipment before it fails. Thermography employs an infrared (IR) camera or thermal imager to capture two-dimensional "pictures" that represent the surface temperatures of objects. Failing electrical and mechanical equipment often manifests its degradation by overheating, but abnormally low temperatures can also signal problems. In either case, the thermal imager can detect and, if necessary, record the resulting temperature anomalies, allowing for the diagnosis and correction of problems before a breakdown occurs.

Chuck Larabell inspecting the Schuler Press Main Motor Control.



including management. "I knew that they (the tradespeople) are the experts about how the equipment and processes function," he says. "So, we did what everybody talks about. We empowered people, the experts, to make decisions about what needs to be fixed and when to do it." The thermographers do the inspections, write the work orders, publish the reports and complete the follow up to ensure that the concern is addressed and management is informed of the status of repairs and all associated issues.

A "lean" operation. A product of Ford's overall commitment to continuous improvement and Jackson's embracing of the thinking of James Womack, DSP's thermography program is what Jackson calls a lean operation, one in which something is "done only once." As a model, Jackson cites the way many modern retail operations do inventory: bar codes, databases and hand-held specialty computers with scanners – one step and no paper.

Immediate and ongoing successes

Everything came together for the new thermography program on a Monday morning two years ago. Rick Cox, an electrician, and Hassan Koussan, a specialist in weld-fixture repair – were equipped with IR cameras and Pocket PCs. That same day, Jackson received word that Plant Manager Piazza wanted to see at a Wednesday morning meeting "what he had paid all this money for." This was just two days into Cox's and Koussan's training on using the new systems solution for the DSP thermography program. With the support of Jackson, their maintenance mentor (or in lean terms, their "Sensei"), Cox and Koussan went to that meeting and reported on their results. Piazza liked what he saw and heard.

Cox's initial thermographic responsibilities were to be on the press floor. Koussan, the weld-fixture expert, was assigned the welding lines in the assembly area. At the end of the first month of the program, there was an insurance audit. DSP's thermography program scored higher than any other Ford thermography program had ever scored, and that was only the beginning. Over the first two years of the program, there have been many audits: Insurance, ISO, and third-party weld audits. The results have always been the same: the best thermography program the auditors have ever seen.

The weld audits are semi-annual events at DSP. An independent auditor performs them in order to verify the integrity of the welds performed on door and hood sub-assemblies. In part, these audits are intended to confirm that DSP is meeting Federal Motor Vehicle Safety Standards for welding, including confirmation that safety-critical welds, called delta welds, are sound.

In March 2006, an independent audit performed on welds at DSP concluded, "The Dearborn Stamping Plant weld quality percentage is outstanding. The overall weld effectiveness is 100 percent. The group effectiveness is 100 percent."

William "Bill" Bushey, weld engineer at DSP, agrees that the audit exceeded expectation: "We went from 98 percent weld quality, which was the best that we could hope for, to 100 percent weld quality. We were perfect in the audit, and now we are challenged to maintain that level of performance."

Bruce Dudley, DSP's manager of engineering, puts the accomplishment into perspective. He points out that if one did an SPC (statistical process control) analysis based on the number of doors produced at DSP, even by the very best world-class standards for quality a small percentage of defects could be expected. Still, the audit at DSP found 100 percent weld effectiveness.

In other words, the welding operations at DSP got a perfect score, which means that F-150 doors and hoods are safe and of superior quality. Managers interviewed for this article attribute these audit results to the thermography program.

How DSP does thermography

In addition to thermal cameras, the DSP thermal imaging system has an IR reporting database program (Lean DB from Thermal Trend) that lists on desktop PCs each piece of equipment that thermographers visit on inspection routes. The equipment is listed in the order it is thermally scanned. In addition, the same routes are loaded into each thermographer's Pocket PC, which he carries with him during inspections, constantly updating the database for downloading into his desktop computer back in his office. When practical, each piece of equipment on an inspection route is bar coded, and the bar code is scanned into the Pocket PC at each inspection. This move ensures that the data collected is assigned to the correct asset (piece of equipment) and that no asset scheduled for inspection is missed. The equipment bar codes for the thermography program are linked to the plant's maintenance management system to aid in tracking the work order process/concerns for each piece of equipment/system that is inspected.

Some experts speculate that thermographers typically spend more than 25 percent of their time doing reports. In the DSP system, reports are essentially complete when a thermographer enters data into his Pocket PC on the plant floor. The data is entered into screens formatted just the way a thermographer needs them to be organized. In fact, the software actually prompts the thermographer to enter the data needed (temperatures, loads, etc.) at each inspection site. The data is downloaded into a relational database, where it can be used for any purpose (e.g., reports) by anyone with access to the network.

The process just described supports the philosophy of a lean operation. Data gathered on the plant floor goes directly into the system without further manipulation. Therefore, documentation is always 100 percent up to date – and paperless. Plans are already in the works to make the system wireless, eliminating the transfer of data "manually" back in the office.

Quick training, easy transitions

Because DSP's thermographers are skilled tradespeople first and thermographers second, their training took only 30 intense days. The fact that the relational database they use is self-guiding and intuitive helped to speed up the process.

Since the initial launch of this program, Cox has moved on to be the plant configuration administrator responsible for keeping track of all the equipment in the plant. His replacement is Chuck Larabell. Like Cox, Larabell is an electrician, and he, too, went from electrician to productive thermographer in about 30 days. Larabell was able to assume Cox's routes and database and learn the thermography requirements. He has since made his own route additions to the original. Koussan is now the sensei/mentor for a skilled trade person from another Ford plant implementing a lean thermography program, and all concerned expect the transition to take about a month, too.

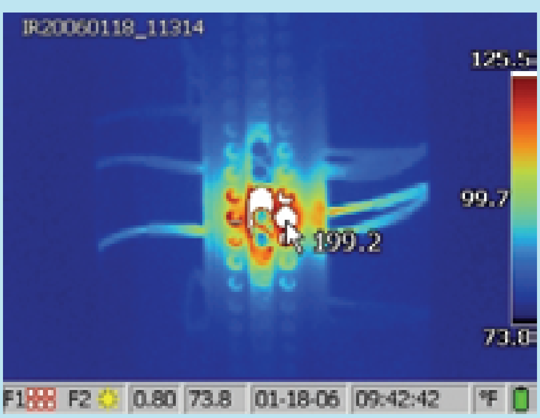
Jackson speculates that any operation willing to invest in thermal imagers, Pocket PCs, the required software, and intense 30-day training for industrious, skilled craftspeople can create a successful, lean thermography program if they are willing to support and empower the thermographers to do the job. "It takes a systems approach," he asserts. "We bought and implemented a system solution."

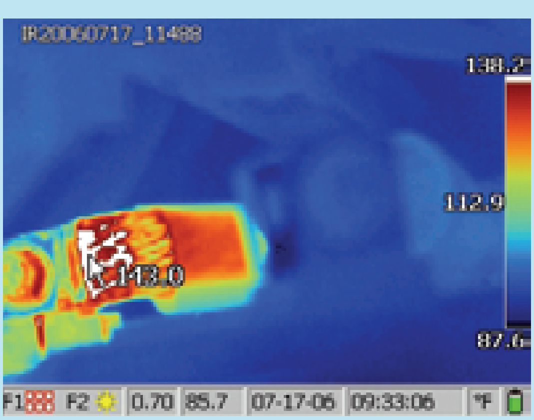
Day-to-day thermography at DSP

Hassan Koussan inspecting the welding controls.

The two main areas of the plant where thermography is performed are the press floor and the assembly floor. Respectively, Larabell and Koussan do thermography there, Monday through Friday. While the thermographers themselves may immediately fix a problem they discover, more often than not, the repairs are done on a third shift set aside for maintenance, or on weekends when there usually is limited or no production.

When the thermal camera reveals a problem on an inspection route, Larabell and Koussan save an image so they can include it in an email report when they return to their office. The report, sent to a list of recipients that includes everyone from Plant Manager Piazza to operators on the plant floor, also incorporates a work order number to ensure that there is correlation between the report and any necessary repairs done as a result. After repairs are made, the thermographers receive a report to that effect, which alerts them to go back and verify that the repair was done effectively.





At DSP, reports are tools. They are sent on a daily basis to the teams responsible for repairing equipment. A simple report is also printed weekly for management. It shows problems that have been found and problems that have been resolved. Other special reports are printed when needed.

To gain a better understanding of DSP's thermography program, let's look briefly at how Larabell and Koussan do their work.

On the press floor, Larabell, who does thermography full time throughout the plant, monitors the four presses on two-week intervals. He concentrates on the electrical panels, each of which has an identifying bar code on the outside and scores of electrical contacts and components inside. He also scans motors, valves and other components looking for problems and potential problems.

The database in Larabell's Pocket PC includes the normal running conditions for the equipment scanned. As a result, he can compare current operational values to "what ought to be." Also, since every panel and every piece of equipment (where practical) has a bar code, it gets checked off in the database following scanning.

On the assembly floor, Koussan monitors the approximately 500 welding guns in the assembly area plus the related electrical panels and other equipment. These responsibilities translate into 1,500 pieces of equipment in his PC's database. "Weld guns get checked at least once a month," he says. "For other equipment, we know the history of incidents on each piece, and we set our inspection frequencies based on that."

Koussan typically comes to work four hours before the end of the first (midnight) shift. This allows him to monitor the weld guns when they are not in production using instruments other than a thermal imager to collect and trend data that may help him detect potential problems.

Once production starts on the first shift, Koussan begins using thermography on the assembly processes. He "shoots" weld guns, transformers, shunts and their cabling, weld control panels, and electrical panels.

Since he comes in at the end of the maintenance shift, Koussan is in a position to ask if problems from the previous day have been fixed. An affirmative answer sends him to the location with his IR camera to confirm that repairs have been made successfully. "Ninety-nine percent of the time a problem is fixed that night," he says. "If it's not, then we have to follow up on it the next day."

Looking ahead

Everyone at DSP interviewed for this article expressed a commitment to continuous improvement in all aspects of DSP's operations, including the thermography program. One tool for achieving continuous improvement in thermography is a bi-monthly meeting of the thermography team, which includes Lafeber.

"We hold these meetings to help us understand the program and how to improve it," Lafeber acknowledges. He further explains that suggestions for improvements often result from thinking about thermography as a lean process. Going wireless, for example, will eliminate a step in the reporting process.

One significant initiative that has come out of "thinking lean" is a proposal to rewrite the database software to support a continuous flow model rather than the traditional batch and queue way of operating. "In the past, thermography has been done on a batch and queue basis – a batch of inspections, then a batch of reports, then a batch of repairs," Lafeber asserts. "What is more efficient is to do continuous flow thermography. The original database used by DSP was designed for batch and queue. DSP has written specifications for new software to take better advantage of continuous flow thermography. It will reduce the time from problem detection to repair and make better use of the data in the database."

Wayne Little, facilities supervisor at DSP, is quick to point out that compared to other Ford stamping plants, DSP's yields are higher, even though the plant runs fewer presses for fewer hours. In fact, the yields are up even on the presses that were there before DSP installed the relatively new five-slide Schuler. ■

To download this article and find out more about thermal imaging go to www.fluke.com/thermography.

This article also appeared as the cover story in the January, 2007 edition of Maintenance Technology.