FLIR APPLICATION STORY

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FLIR SYSTEMS

Picture by SNCF-CAV-Fabbro Urtado, 2005

French national railways apply thermography for maintenance and use a FLIR Systems ThermoVision A40-M to inspect overhead catenaries at a speed of 120 km/h

What is a catenary structure?

Picture by SNCF-CAV Jean-Marc Fabbro, 2006

A catenary is a system of overhead wires which supply electricity to a locomotive or a train, which takes the electricity through a pantograph. Catenary systems use at least two wires: a messenger wire or catenary supports the contact wire with vertical drop or connecting wires. The system is then suspended on pylons and subjected to mechanical tension. Picture shows a junction of two cables.

The French national railway company intensively uses thermography to keep its extensive power supply and signalization operations running. SNCF is now also testing the potential of thermography to inspect its more than 20.000 km overhead wires with a FLIR Systems camera mounted on a test wagon.

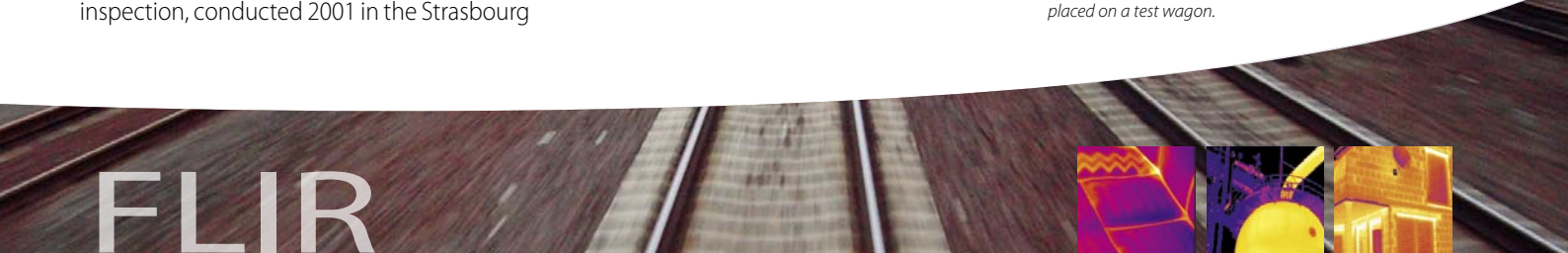
The SNCF is one of Europe's largest public transport service companies with 33,000 km of tracks, of which more than 1,500 km are high-speed track for its TGV, Europe's first commercial fast-track train. The public company uses thermography for maintenance purposes to inspect its signaling installations and power stations.

Twenty-five ThermaCAMs at work

The SNCF started to introduce infrared thermography on a large scale after a test inspection of signalization switchboards. The inspection, conducted 2001 in the Strasbourg region (eastern France) revealed that up to 45% of the installations had serious anomalies. This prompted the SNCF to procure four FLIR Systems PM 695 camera systems, a predecessor model of the current P640, and to train ten thermographers.

Convinced by the benefits of thermography, the SNCF acquired twenty-five ThermaCAM E-series handheld cameras for its regional maintenance services. More than 80 SNCF employees now use thermography on a daily basis to conduct their inspection work.

FLIR Systems Thermovision A40 camera in housing placed on a test wagon.



New applications demanded

But the SNCF maintenance authorities were faced with problems of another kind. They observed that overhead catenaries of one of the main lines in the Parisian area became often overheated, expanding to such an extent that they almost touched the wagons. At first, the maintenance team thought that this was due to the dense traffic on the busy line. However, reinforcing the system's suspension cables and feeders did not solve the problem.

So the Maintenance manager expert at SNCF, decided to turn to thermography to get a picture of the heating pattern of the catenaries. But how to get a clear and consistent picture of a heating pattern on kilometers of catenaries? The issue became pressing as the SNCF was recording over thirty failures annually due to overheated catenaries. "The scenario is always the same," says Gerard : "the failed connections cause a heating of the contact wire. This wire starts to expand, looses tension and starts to sag. In the worst case, it gets wound up around the locomotive's pantograph. The train stops and the line is blocked. Repairing overhead lines takes time and one can only imagine the consequences on busy lines at rush hour. "

First measurement experiments proved that, in order to obtain a satisfactory view on the heating of catenaries, the camera had to be mounted on a wagon. The SNCF engineers also found out that the infrared camera had to be installed on a special measurement wagon which would take electrical current from the contact line on a permanent, uninterrupted basis.

Testing shows results

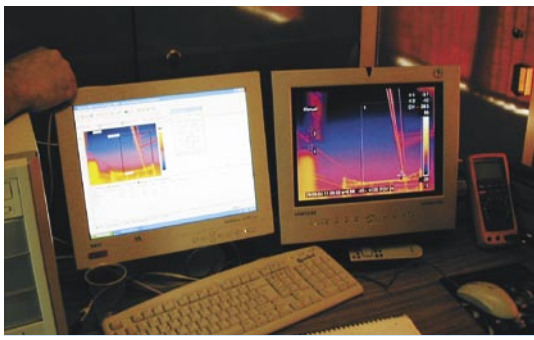
SNCF's Maintenance and Research directorates cooperated to set up a test wagon to conduct a first series of tests on a busy line between the Paris Austerlitz station and Les Aubrais, an important railroad junction in the central Orleans region. Placed in a special housing on a test wagon running at a steady 120 km/h (75 mph), a FLIR Systems ThermoVision™ A40-M fix mounted camera recorded the catenaries. Inside the wagon, a PC carried the ThermaCAM Researcher software suite to record the images. "The camera had to be rugged enough to stand in a housing outside a train wagon an it had to have an image frequency able to visualize the lines at that speed", said Millot. The ThermoVision A40, a fix mounted infrared camera with a 320 x 240 resolution, operating between -15 and +55 °C and offering an image frequency of 50 Hz, fulfilled these criteria. To geographically localize the hot spots on the lines, a mileage counter and an additional CCTV visual camera were installed. The visual camera also indicated whether hot spots on the catenaries were influenced by adjacent heat sources such as signals or lights.

The results were at hand: "we have sent maintenance teams to the sites spotted by the image analysis. In some places, parts of the cable were about to melt and could break at every moment", Millot recalls. However, some optimization will be needed to streamline the inspection and its results; analyzing the tons of infrared imagery is still a lengthy process, "500 km of track equals to 21 DVD's filled with imagery", Millot concedes. In addition, the SNCF experts need to define appropriate severity criteria for the heat development of catenaries: is a temperature deviation of five degrees Celsius acceptable? And the cable break a matter of days or months? The next step for the SNCF engineers will be to develop a tool that quickly analyzes the imagery and finds the required hot spots.

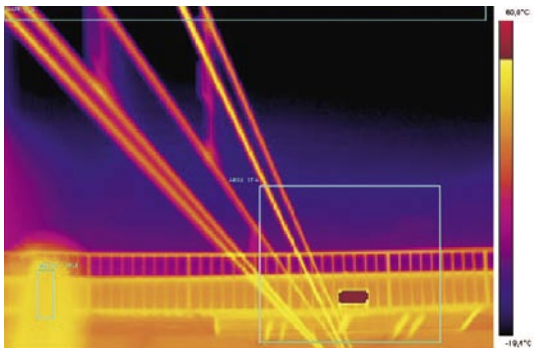
But the experiment was a success. And the SNCF has already approved the development of a special wagon to inspect the catenaries of its nationwide electrified rail network. It would turn the French public railways into the first railway company to apply this inspection technique.

Courtesy to SNCF for the pictures on page 1 "TGV Atlantique in action" and "Pantograph contact with catenary observed from TGV driving at high speed", all rights reserved.

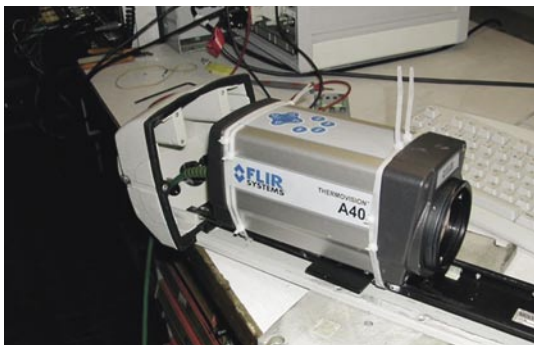
The 'Vulcain" SNCF test wagon, which in future will carry the infrared camera to inspect catenaries.



Inside the test wagon: the ThermaCAM Researcher software in action.



Thermal image of a catenary.



Camera in housing.

ThermoVision A40-M placed on SNCF test wagon.

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