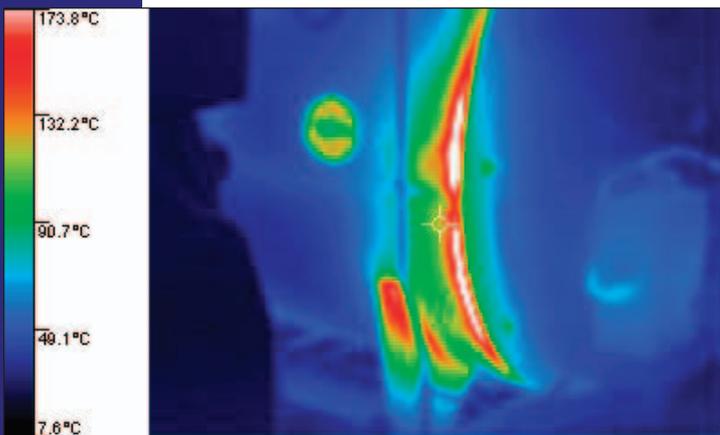


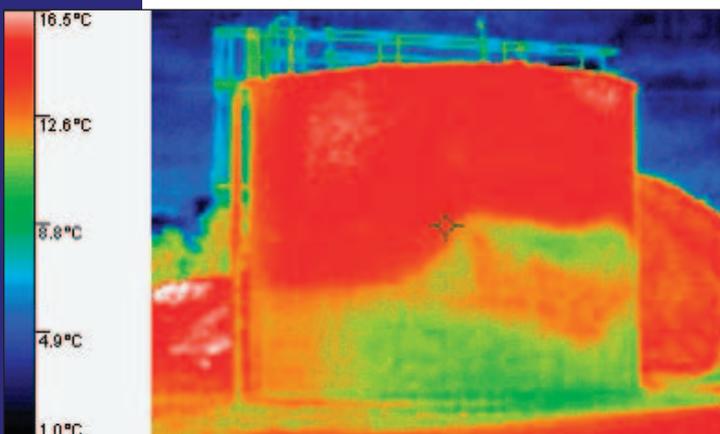
## Example: Tanks and vessels

### Application Note

When technicians want to troubleshoot tank flow disturbances or determine the product level inside a vessel without opening it, there is one especially powerful tool to assist them: a Fluke thermal imager.



This tank may have leaks in the seams.



The temperature differentiation in this image probably indicates the transition between substances (a gas and a liquid) as well as some potentially uneven settling.

Above ground tanks and vessels for liquids and gases abound in chemical, food, pharmaceutical, and other process manufacturing. These vessels may be specially lined to store a variety of fluids from potable water to acids designed for mixing, blending, leaching, heating, cooling and oil-water separation processes.

By capturing two-dimensional temperature profiles of vessels, thermal imagers can detect temperature differences on the surface that often reveals conditions inside.

#### What to check?

Scan the outside surface of tanks for differences in temperature at different points. Also pay attention to gaskets, seals, and valves at openings.

#### What to look for?

While most large process tanks have built-in visual or electronic indicators for tracking product levels, they are not always reliable. Thermography can reveal the interface between the liquid and the gas (usually air) in a vessel, indicating how full it is and whether the contents have settled or separated inappropriately. Knowing the correct levels avoids overfilling when a level sensor is faulty and ensures reliable inventory figures for raw materials and/or finished products, allowing companies to balance processes and avoid product shortages or overruns.

Tanks usually contain liquids or gases. The gases have a higher heat capacity than the liquids, meaning the liquid products change temperature much more slowly than the gas in the headspace. Since most tanks are located outside, their contents heat up during the day due to solar loading, and cool off at night. This temperature difference between the product and the headspace can usually be readily observed through most tank walls. This technique works best in the hours following sunset. Imaging the tanks in broad daylight is often difficult but favorable results are often achieved by examining the northern or shady side of the tanks during daylight hours.

**Warning:** Make sure no one attempts to add to a vessel's contents until you have confirmed the level or available capacity.

A thermal image of a tank that is completely empty or completely full, or that has a shiny reflective skin, will appear uniform and no product level will be apparent. Otherwise, the product level will appear as an obvious thermal separation between the headspace and the product.

A properly captured thermal image will also reveal sludge buildup on tank bottoms, which can lead to premature corrosion and make it difficult to calculate the amount of product stored. Periodic monitoring will help you determine a cleaning schedule and track any changes in the rate of buildup. You will save money by cleaning tanks only when they need it.

Thermography can also reveal floating materials such as wax

and foam as well as layers of different liquids, gases and even solids, such as the layer of paraffin that sometimes forms between the oil and water layers in separators, hindering their normal operation. Finding and correcting such situations will prevent loss of the separation process and subsequent loss of sales.

When performing tank and vessel inspections, be aware of factors that can introduce errors. Environmental conditions, the diverse thermal-conductive properties of different materials, natural or process-related convection within tanks and vessels, and even the curved surfaces of the vessels themselves can all affect thermal image accuracy.

Other tank and vessel conditions that can be monitored using thermography include damaged refractory or liners and leaks in tank walls. Under the right conditions, a damaged refractory or liner will show up as hot or cool spots. Most leaks occur because of the failure of a seal or gasket, although sometimes corrosion will lead to a leak in a vessel's wall. Whatever its origin, a leak is likely to manifest itself as a temperature anomaly.

### What represents a "red alert?"

Equipment conditions that pose safety or environmental risks should receive the highest repair priority. Those would include conditions that might lead to potential leaks or overflows of vessels containing hazardous materials. Any malfunction that could disrupt production must also be avoided.

### What's the potential cost of failure?

The cost of a failed tank to a company depends on many factors including whether a hazardous spill is involved. An uncontained leak in a large oil tank, for example, might cost a company US \$700,000 or more—at least US \$500,000 for an environmental cleanup and US \$200,000 for a replacement tank.

Regarding downtime caused by tank or vessel problems, here are some representative hourly downtime costs for selected industries that use tanks and vessels extensively: Pharmaceuticals, US \$1 million; Food and Beverage, US \$800,000; Chemicals, US \$700,000. These figures are tied to loss of IT performance, but are cast in terms of general downtime.\*

### Follow-up actions

Use the reporting software that comes with the imager to document findings, and include both a digital image of the equipment as well as a thermal image. It's the best way to communicate the problems you found and any suggestions for correcting them. Following corrective action, take a new thermal image to assess the repair's effectiveness.

\*Source: IT Performance Engineering and Measurement Strategies: Quantifying Performance and Loss, Meta Group, Oct. 2000; Fibre Channel Industry Association as found on the Web site of the Association of Contingency Planners, Washington State Chapter—[www.acp-wa-state.org](http://www.acp-wa-state.org).

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### An imaging tip

Trying to find a level in a tank or vessel that is covered with an aluminum cladding or some other low-emissivity coating is almost impossible. To overcome such a handicap, put a vertical strip of paint or tape down the side of the vessel. If the unit is outside, put the high-emissivity stripe on the shady side.