Infrared Thermography for Industrial Maintenance

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Pressure relief valves

Component knowledge
There are several kinds of valves with slightly different purposes and names, but I will use the same name for all of them, because the thermography method is still the same. A pressure relief valve is designed to release overpressure in a piping system or vessel at a predetermined pressure, before it gets too high and causes damage.

Typical failure modes
The issue with pressure relief valves is that they may be passing. That means that the unit may have opened and remains open after the overpressure is gone, or that is closes but does not close completely. If that condition remains, it can cause big problems in the process and significant losses of product or raw material.

Scientific background for using thermography
A safety relief valve that is closed and holding will have a significantly higher temperature at the inlet (if the fluid inside is actually hot). When the unit is open or passing, whether it should be or not, the outlet flange and piping will heat up. If such a condition is found, as the valve closes and the overpressure condition is gone, it should eventually cool down. If it continuously stays hot, it is passing, or “stuck open”.

Typical signatures

Both valves are closed and not passing.

Both the safety relief valves above are closed and not passing. The valve bodies are partly hidden behind the framework, but you can see that they are hot. Both outlet pipes are significantly cooler than the valve bodies and have the same pattern.
The valve on the left is passing, the one on the right is not.

The image above shows one valve, the left one, that is either doing its job to release pressure, in which case it should soon close again and cool down, or it is passing and will remain hot. A re-inspection in half an hour or so should determine which way it is.

**Severity assessment**

The valve is either holding or passing, and the method is purely qualitative. Severity has to be judged based on the effects the passing valve has on the operation of the plant and the value of the lost gas.

**Characteristic difficulties or challenges**

If there is cladding covering too much of the area around the inlet and outlet, it may be difficult to see if it is passing or not. If that is the case, the cladding should be cut back enough to allow access.

If the gas in the pressurized system is too close to ambient air, it will not be possible to determine any temperature differences due to passing.

Access is sometimes a problem when the targets are far away, and/or hidden behind other structure. Long distances will require a higher resolution camera or a narrow angle lens. See “Instrument requirements” below.

**Scheduling**

Safety relief valves need to be surveyed fairly often. If a valve is passing it is necessary to find and remedy before too much valuable gas has been lost or production is disturbed. Routine scheduled surveys can be done for example monthly to start with and the frequency be increased or decreased depending on how many faulty valves are found.

It is also often a trouble shooting method. If operational parameters show a pressure loss or an unexpected outflow, a survey of the possible candidates in the affected system will likely catch the responsible component.
**Instrument requirements**

Quantitative capability is usually not needed.

Safety relief valves are sometimes located in places that are difficult or cumbersome to reach. With a high frequency of inspections, the time it takes to check each unit should not be too long. So in many cases it is a big advantage to have a telescope lens to allow the work to be done from the ground or from a nearby structure that is easier to access.

![Image of safety relief valves](image)

It is possible to view valves at a long distance, with proper camera and lens combination.

The image above was taken at a fairly long distance using a 640 x 480 pixel camera with a standard lens of 24°. It is still easy to determine that these safety relief valves are not releasing or passing. The red arrow points at the valve bodies and their temperatures are distinctly different from the exhaust pipes, indicated by the green arrow. If valve bodies and exhaust were showing similar temperature, the valve would be releasing or passing.

A 320 x 240 pixel camera would need a 2x telescope lens to give the same resolution.

**Baselining and/or trending**

Not relevant.

**Alternative or supplementary inspection methods**

Acoustic methods can be used, but they take much more time and require direct contact with the unit, which makes the survey more expensive to do. If the valves release to open air, they may sometimes be visually inspected, by watching for example condensing steam being emitted. Some valves also make a lot of noise when they are open or passing.