LAND

AMETEK®

APPLICATION NOTE

GOING OFF GRID

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Thermal cameras have become a standard and highly valued tool for the continuous, automated monitoring of critical assets, including flares and gasifiers or other high-temperature surfaces. The technical benefits are clear, but the installation conditions are often challenging. Cameras therefore need to be installed inside protective housings to reduce exposure to high temperatures and corrosive, outdoor environments, or to ensure that they are not a potential source of ignition.

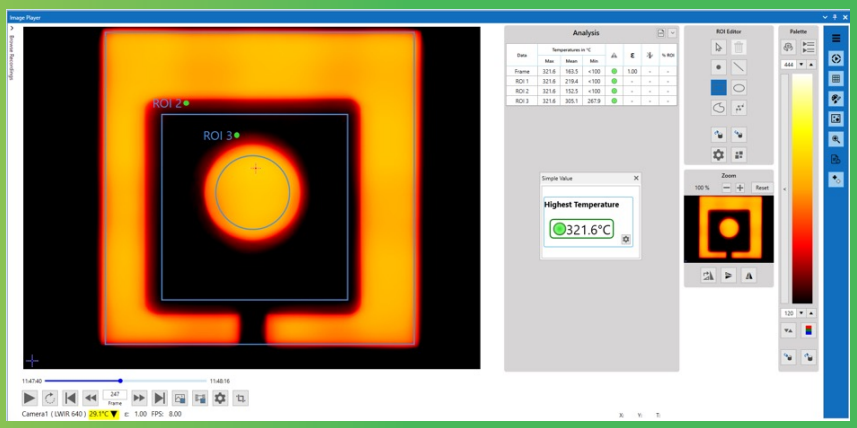
There are two main protection concepts used in hazardous areas: Ex p and Ex d. Each design is engineered to ensure the safety of operations in explosive atmospheres, but they differ in their construction and protection methods.

THE WIRE GRID PROBLEM

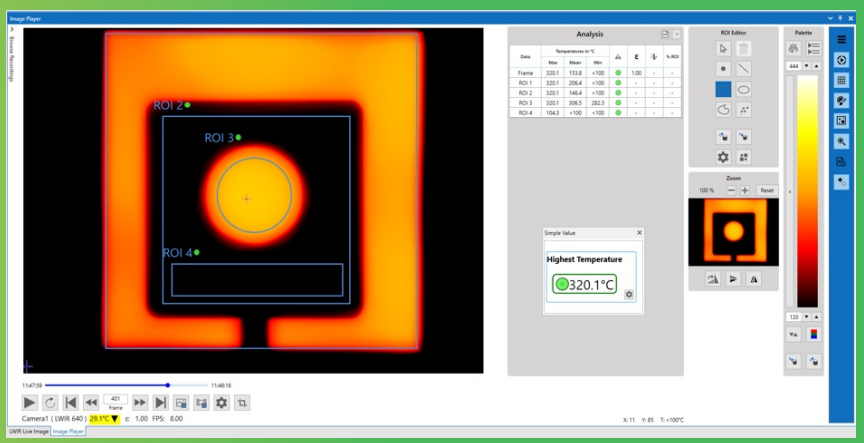
Ex d housings must meet impact test requirements that a germanium window cannot satisfy alone due to its limited impact resistance. Manufacturers overcame this challenge by resorting to a wire grid or mesh, installed in front of the germanium window, which acts as a protective layer to absorb and disperse impact energy, preventing direct contact with the germanium window.

AMETEK Land's physicists extensively tested this design, using a hot target at a typical installation distance of 2m. The grids or meshes tested provided transmission levels of between 50-70% with a commensurate impact on noise/accuracy of 2x and 1.4x. The type of fine mesh required to have a uniform effect on transmission produces significant diffraction effects, which show as a cross-hatched pattern.

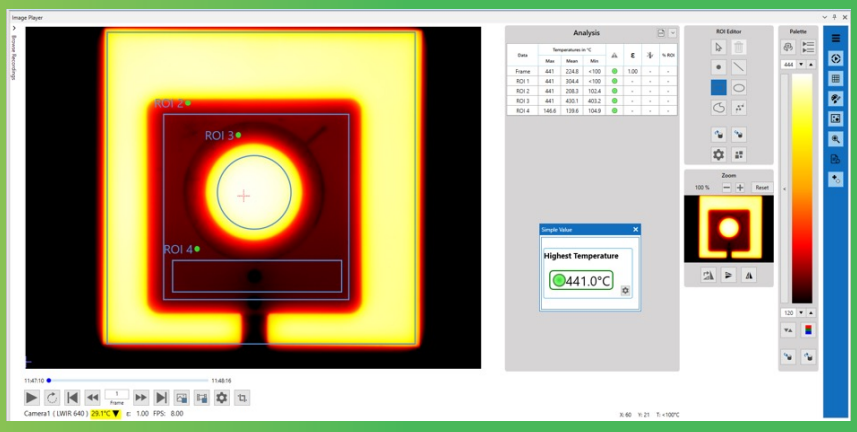
These images were taken using an emissivity setting of 1, so the effects would be significantly worse when a blanket emissivity value was applied to compensate for the transmission losses. For gasifier and reactor applications, that account for a significant volume of installations, such a pattern would affect image quality when large areas of the image are in range. Painting the mesh black did not change this, confirming it is diffraction rather than a scattering effect.



Square grid: loss of focus, the maximum temperature reading drops by 120 degrees Celsius as soon as the grid is held over the lens.

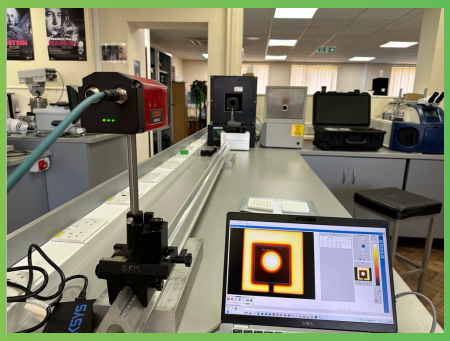


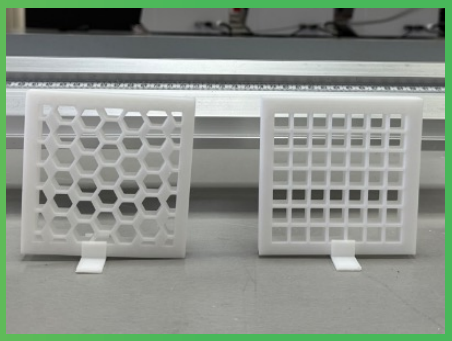
Hexagonal grid: similar loss of focus and the maximum temperature reading also drops by around 120a degrees Celsius.



Without a grid: high image clarity and temperature accuracy

So, when clear image quality, high-temperature accuracy, and sensitivity are the requirements, the wire grid is problematic. **To overcome the temperature loss caused by the grid, manufacturers calibrate the thermal imaging camera in a laboratory against blackbody source with a known temperature. This is acceptable and repeatable in laboratory conditions, but not in a real world scenario: the grid will heat and cool with ambient temperature changes. This will have a variable and unknown impact on the temperatures reported by the thermal imager and potentially cause false alarms or missed hot spots.**

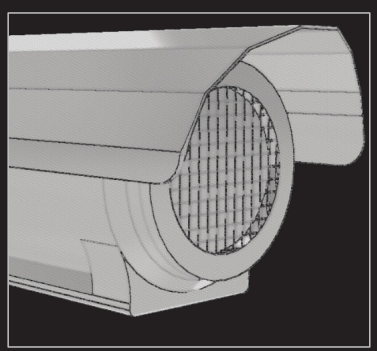




A test was performed with multiple high-temperature targets (a heated metal target at a temperature of around 150 degrees Celsius in front of a hot plate at around 440 degrees Celsius).

EX P (PURGED) HOUSINGS

Ex p housings require the enclosure to be pressurised with clean, dry gas (such as air or nitrogen) to prevent any potentially explosive gases or dust from entering the housing. This method maintains a positive internal pressure, ensuring that hazardous substances remain outside the enclosure. Extra equipment, like pressure regulators and control systems, is required to maintain the pressure, making Ex p housing more complex to set up and maintain compared to Ex d.



There are multiple Ex d compliant thermal imaging housings that utilise the wire grid protection concept, using both square and hexagonal patterns

EX D (FLAMEPROOF) HOUSINGS

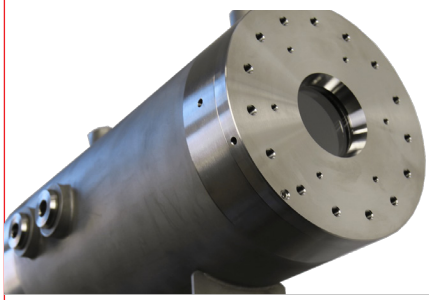
Ex d housings, preferred by most petrochemical plants and refineries, utilise a rigorously tested shell that prevents any ignition inside the enclosure from igniting the surrounding atmosphere. This is achieved through robust construction and flame paths that can prevent any flames inside the enclosure from propagating into the external atmosphere. Ex d housings do not require additional pressurization equipment, making them simpler in terms of setup and maintenance compared to Ex p.

Given that Ex d housings are preferred by most industries, thermal imaging manufacturers face a significant challenge. Traditional optical materials – such as glass – are opaque to long-wave-infrared wavelengths (LWIR, 8-14 µm). Therefore, a different material is required.

Germanium windows are completely impermeable to ultraviolet and visible light, giving them a dark, metallic appearance to the naked eye. When it comes to the infrared range, it has an excellent, broad transmission range from 2-16 µm, making it an ideal candidate for mid-wave-infrared (MWIR) and long-wave-infrared (LWIR) applications.

A GRIDLESS DESIGN

While developing our new EXSH flameproof design, AMETEK Land insisted on producing industry-leading protection without the compromise of a wire grid. We were able to achieve this, as shown below, by working closely with Ex-certifying laboratories to develop an innovative protection concept that avoided the need for any additional grid.

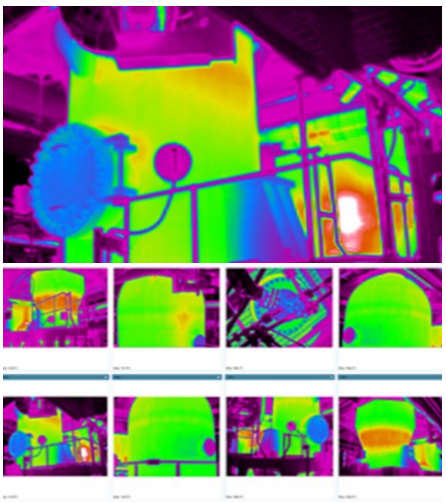


AMETEK Land's EXSH satisfies the Ex d impact test requirement without a wire grid

A protective housing with a germanium window but without an additional wire grid offers several distinct benefits, particularly in terms of optical clarity and temperature accuracy but also maintenance:

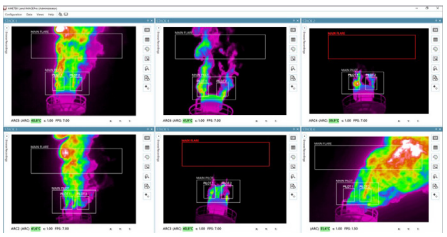
Enhanced image clarity

The unobstructed optical pathway ensures that transmitted signals, including infrared radiation, maintain their original quality.



Improved temperature accuracy

The absence of a wire grid eliminates potential sources of signal interference and diffraction, resulting in improved temperature accuracy and sensitivity.



Cleaning and Maintenance

Wire grids can become coated over time, which requires cleaning, but they can also make cleaning and maintenance of the germanium window itself more difficult. The EXSH has no fine wires to worry about, simplifying routine cleaning and lens checks required for critical applications in harsh environments.

THE RESULT

By using the gridless concept on several installations, the AMETEK Land LWIR in EXSH housing has provided LAND's famed crystal-clear images with highly accurate, sensitive, repeatable temperature data. End-users increasingly demand higher accuracy temperature values to achieve better yields, improved efficiency, and longer maintenance intervals, and we expect the demand for gridless housing designs to increase with it.

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