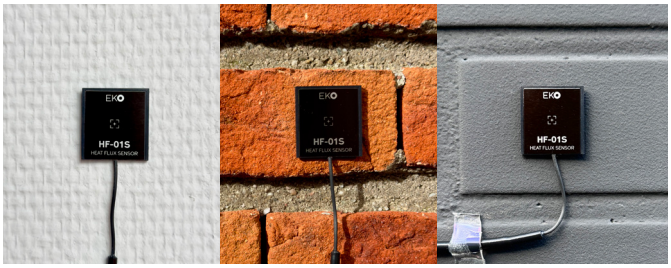
HF-01S

Standard Heat Flux Sensor

Application in Building Physics

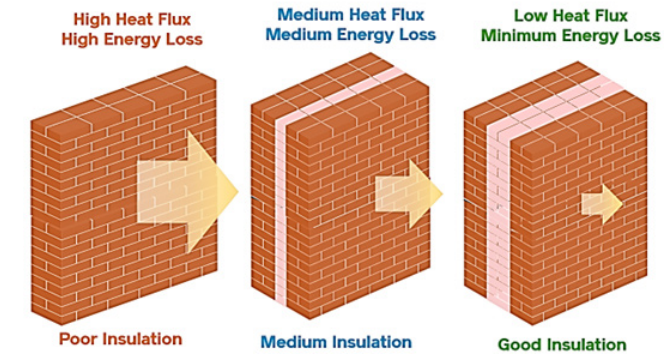
The rapid depletion of fossil fuels necessitates an enhanced focus on energy management in the field of built environment. Consequently, energy efficiency measures are being actively implemented and continuously developed. Among the critical threats related to energy conservation is the high levels of heat loss in buildings, which can be effectively quantified using heat flux sensors. EKO HF-01S heat flux sensor is used to measure the heat flux from or towards a surface of interest. This helps evaluate the insulation performance. Install the sensor on specific points, such as building façades, floors, roofs, doors, windows and any surface where the heat transfer rate is to be determined.

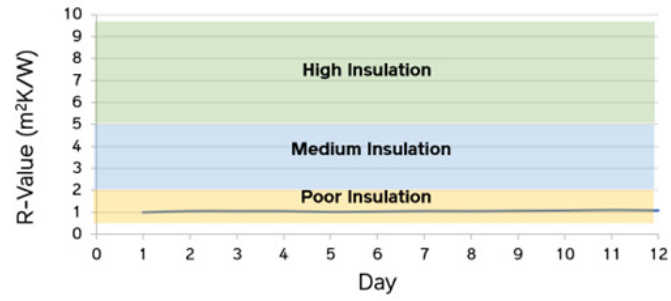


By capturing real-world conditions, heat flux sensors provide insights into the actual thermal performance of building components, aiding in informed decisions regarding energy efficiency improvements, insulation upgrades, and overall building envelope design. A wall's insulation level, for instance, can be evaluated qualitatively by observing the heat flux data on the surface, measured by a heat flux sensor, HF-01S, installed on the surface of the wall. Heat flux levels can be monitored over certain periods to evaluate the insulation condition of the wall or other building components.

By detecting high levels of heat flux on surfaces as a clear indication of inadequate insulation, one can promote attention from energy stakeholders. Below, an example data is shown from a HF-01S heat flux sensor that was installed on an office wall which is between indoor and outdoor with an average of 5K temperature gradient.

HF-01S also aids in the precise determination of in-situ thermal resistance R-Value and thermal transmittance U-Value, which are known to often depart from their nominal values. Using a single heat flux sensor in combination with two temperature sensors, one can determine these parameters following ISO 9869 standard (equivalent to ASTM C1045 and ASTM C1155). This method provides insights into the actual thermal performance of building components, facilitating informed decisions in terms of energy efficiency improvements, insulation upgrades, and overall building envelope design.





HF-01S contributes to optimizing thermal management, reducing heat loss or gain, and mitigating energy consumption and greenhouse gas emissions.

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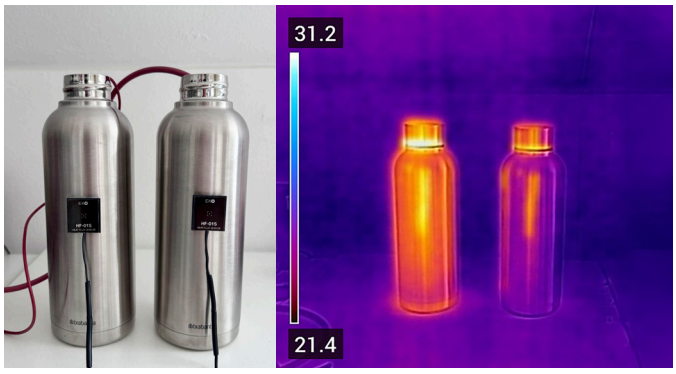
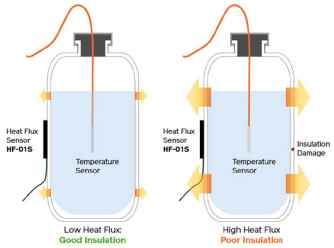
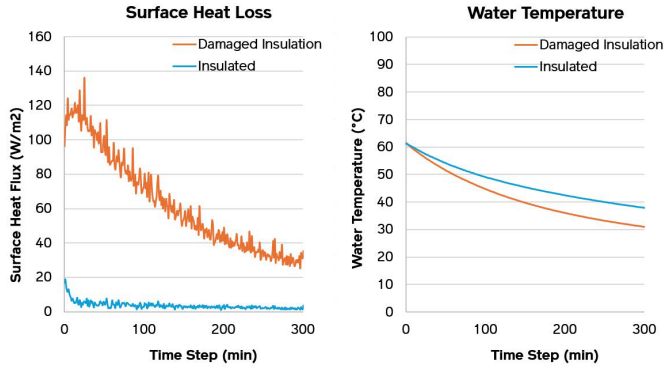
Application in Insulation Evaluation

In the process of quality control, when ensuring the thermal efficiency of insulated containers, pinpointing the exact areas of heat loss is crucial. While traditional temperature sensors and IR thermography barely provide basic insights, they often fall short in quantifying insulation problems accurately. EKOHF-01S heat flux sensor, however, excels in this domain. It not only measures the rate of heat transfer but can also help one to identify specific areas where insulation is compromised.



In an experiment below, surface heat flux and inside liquid temperature (starting at 60 °C) are measured in two insulation containers (flask bottles), one with damaged insulation (leakage, right) and the oher one in good condition (left).

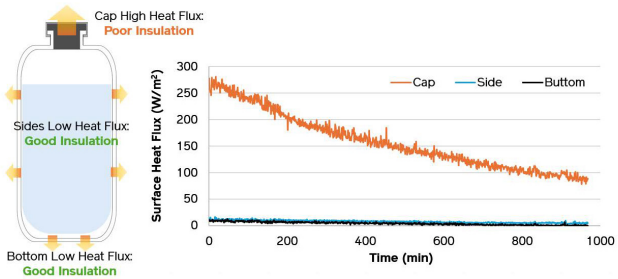




As seen in the data from heat flux and temperature for 300 minutes, measuring internal temperature will take significantly longer time to show small difference in data, leading to a long delay and difficulties in addressing the insulation problems. Heat flux data on the contrary, shows significant difference from the very beginning, aiding in qualifying the insulation condition and quantifying the heat loss level.

In an insulation container in good conditions, the heat loss level can still be investigated, when looking at different points of the body. In another measurement shown below, 3 heat flux sensors have been installed on different parts of a flask bottle: On the side (wall), Bottom, and on the cap. Heat flux level has been monitored to examine the difference on heat loss on these different points.

As seen in the measured data,heat flux values on the cap are significantly higher than the body. Such large deviations cannot be observed by IR camera or temperature sensors (See previous images and data) and therefore heat loss monitoring by heat flux sensor (In this case, HF-01S) is key to understanding the thermal performance of the product.



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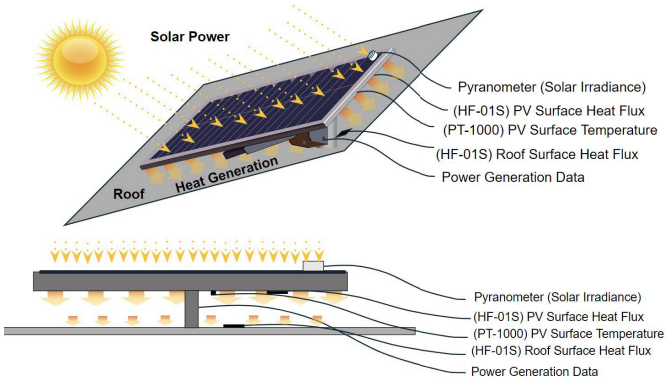


As shown above, the ML-02 Pyranometer measures solar irradiance. The HF-01S sensors measure heat flux towards the roof and the heat flux from the back of the solar panel. The PT-1000 temperature sensor measures the surface temperature of the PV panel's back. The data from the electricity generation is used to estimate the pannel's efficiency (nominal value is 21%).

Application in PV Panel Monitoring

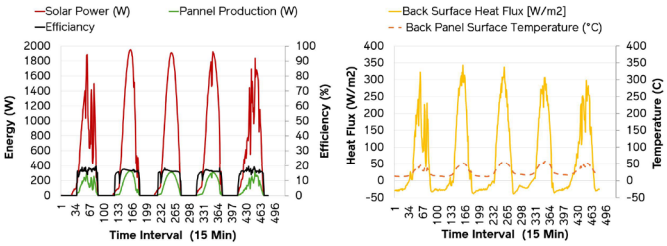
The promotion of energy conversion using renewable energy resources is essential for sustainability and environment. Photovoltaic (PV) panels are for instance, widely used to convert solar power into electricity. This process generates significant amount of heat, which transfers to the surfaces on which the panels are installed. When it comes to PV panel monitoring, heat flux sensors therefore offer substantial benefits by providing a deep understanding of the thermal dynamics at play and can be key to thermal management.

By Installing a combination of sensors (EKO HF-01S, PT-1000 Temperature sensor, and EKO ML-02 Pyranometer) on a PV panel, the thermal performance of the panel is depicted.

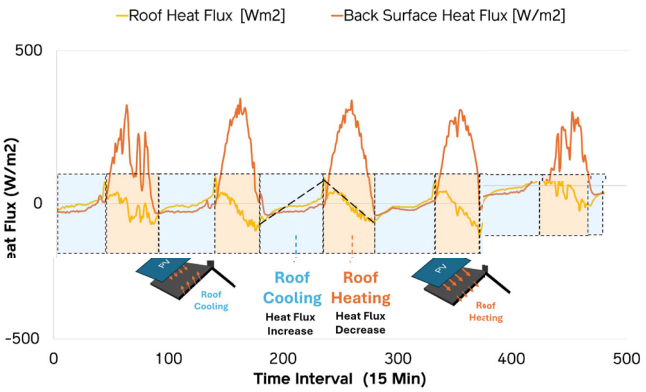
Pyranometer
(Solar Irradiance)

HF-01S (Heat Flux)
PT-1000 Sensor
(Surface Temperature)

HF-01S (Heat Flux)



As seen in the data, heat flux profile, besides being much more sensitive than the temperature, captures the thermal dynamaics and energy changes much better than the temperature profile. The data follows the same pattern as solar irradiance (and therefore the generation profile). Additionally, the roof heat flux is observed to have been



highly influenced by the PV heat generation, as seen below. HF-01S has captured the heat balance between the two surfaces (the back of the PV panel and the surface of the roof) and can be used for optimal thermal management such as insulation application and PV cooling.

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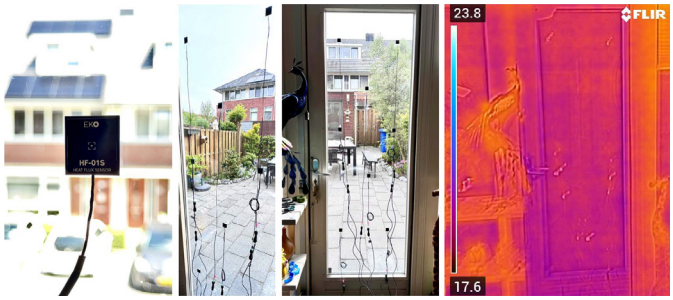
Application in Thermal Analysis of Glazing and Windows

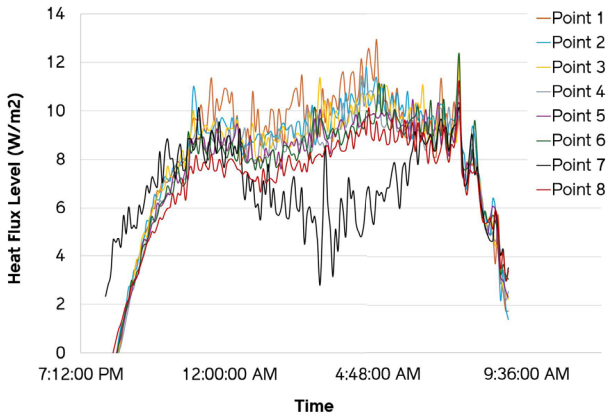
In the quest for energy efficiency, double glazing windows have globally become a popular choice for facade insulation. The performance of these windows however, can vary significantly due to factors such as thermal bridges, manufacturing defects, and installation quality decay. To optimize the insulation performance of windows, understanding the heat flux patterns across the window is crucial. EKO HF-01S is the perfect tool for performing full-scale measurements and understanding the pattern of heat flux on the surface of glazing.

Traditional methods like temperature measurement and IR thermography provide surface temperature data though fall short in offering a complete picture as well as the rate of heat transfer, missing critical insights into insulation performance. On the contrary, heat flux measurements using heat flux sensors provide precise and quantitative data regarding the heat transfer rate, allowing for the identification of weak points in insulation that might not be apparent through temperature measurement alone. By placing these sensors at strategic points, such as the center and edges of the window, one can gather detailed information on heat transfer patterns. Identifying insulation weak points with in-situ data promotes cost savings by pinpointing energy loss.



In a measurement shown above, 8 heat flux sensors have been installed on the surface of a double glazed window. The measurements have been carried out during the night in order to avoid the effects of solar radiation. Where IR Thermography does not show any quantitative data, HF-01S sensors have provided the heat flux data, showing the pattern of heat flux on the surface of the window. The sensors have been installed on 8 points as shown below:

As seen in the measured data,heat flux values vary in different points, by up to 8 W/m2, even in a window which seemed perfectly thermally homogeneous when observed with an IR camera.



HF-01S is a suitable solution for Energy auditors, Quality Control (QC) teams and professionals, building maintenance teams, architects, builders, contractors, and anyone who is involved in the field of energy saving and energy efficiency.