

Student Experiments

Manual

HEAT 2

P9160-5C



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Required Kit:
P9902-5C Heat 2



Material:
1x Thermo-octagon
1x Thermopile „compact”

Additionally required:
1x Measuring cylinder
2x Measuring instruments, connecting cables
and power supply



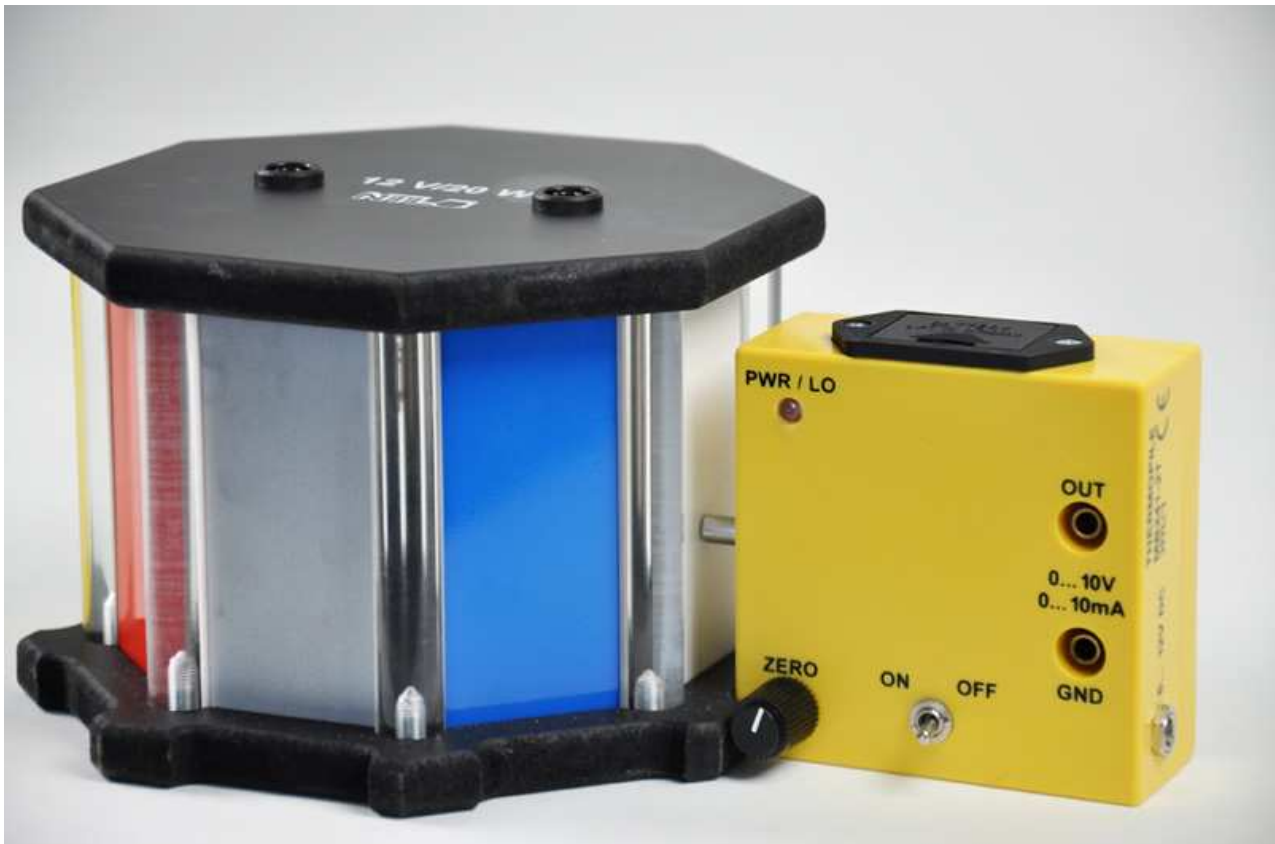
A solid body which is exposed to heat radiation, is absorbing parts of this radiation and also do radiate parts of this energy. In this experiment, we examine in which amount the emitted radiation (emission) is dependent on the surface texture and the color of the body.

Experiment:

The colored metal plates of the thermo-octagon get turned outside and get then irradiated with a halogen lamp from inside. As it takes a little bit longer to generate a constantly emitted radiation (approx. 20 minutes), the lamp should be already switched on at the beginning of the lesson (with a power supply, 12V A.C.). The thermopile gets connected to the multimeter (an analog multimeter is recommended) and set to 1V D.C. Because all plates have the same inner texture, differences in the emission-behavior can only appear at the outer surfaces of the plates.

The thermopile converts the generated heat radiation into voltage that can be read off from the multimeter.

After 20 minutes we start our measurement. The thermopile gets placed directly in front of one of the plates of the thermo-octagon (it should be positioned in the mould of the base of the octagon). At first we start with the plate "nature polished". We make sure that the thermopile is turned on and adjust the amplifier to an indicated value of 0,5 V. The octagon gets moved circularly and we do the same measurement at the other 7 surfaces. The values get transferred then into the chart. In the line "ranking" we appoint a ranking of the surfaces according to their emission-behavior, the first place gets appointed to the surface with the strongest emission.



surface	nature polished	white	red	yellow	black	nature - matt finished	blue	white - matt finished
U/V								
ranking								
U/V								
ranking								



Conclusion:
Heat radiation depends on surface texture and color.

To double-check the first measurements, we start a second round of measuring. It is important to do these measurements in a quick way. Of course, it is also possible that different values get generated in the second round than in the first round (the constant state has not reached 100% yet), but the ranking should stay the same as in the first round.

Advices for teachers:

The use of an analogue multimeter is recommended for following reasons. The emission values of the surfaces red, yellow, black and blue are nearly identical. With an analog multimeter it is easier for the student to rank these colors as "equal".

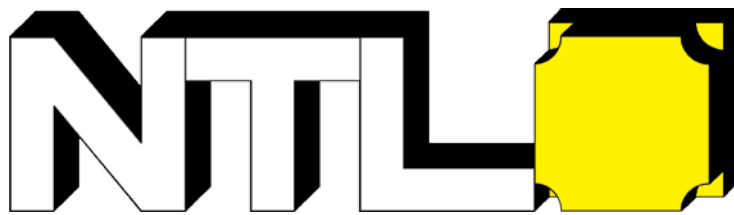
Interpretation of the result:

A rough surface radiates more energy than a smooth one (this can be observed clearly at "nature" and "white"). For the colors red, yellow, black and blue we get values with small gaps between.

There is no real coherence between the brightness of the color and the emission-behavior because the chemical structure of the color also influences the emission-behavior.

It is recommended to ask the students to turn on the thermo-octagon at the beginning. Then, they should continue with other preparations. If it is not possible to wait 20 minutes until the first measurements get done, an earlier start-up is also possible.

In this case the ranking is likely to be different in comparison to the second round of measuring. These differences might only occur at the above-listed colors red, yellow, black and blue (with the use of an analogue multimeter, the values for these 4 colors can be rated as "nearly the same").



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