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47 Thermal resistance and water vapour transmission measurements with a sweating cylinder

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The thermal protection effect of clothing is traditionally expressed through its thermal resistance value, measured with hot plate methods for materials and thermal manikins for garments or clothing systems. The water vapour permeability, measured with skin model type of apparatus, expresses the possibility of evaporative cooling through perspiration when using a certain clothing system. In a real wearing situation there is an interaction between the dry and the evaporative heat loss through the clothing, and particularly in extreme thermal environments the results of the standard measurements can be very misleading.

As a part of the Scandinavian Coppelia project, which aims at a sweating thermal manikin, a sweating cylinder for measurements of combined heat and moisture transmission measurements through clothing materials was constructed. The cylinder produces a controlled amount of water vapour from the surface, and heat input values, temperatures at different points, and weight changes are recorded during the tests. The cylinder is dressed with test materials and placed in the test environment. A microcomputer system regulates the surface temperature to a predetermined value **(+35°C).** The thermal resistance of the test materials is calculated from the temperature gradient and heat input values. in most cases only a part of the water input is transmitted in the form of vapour through the clothing and a part is condensated. due to the water vapour resistance **of** the textiles and to the lower saturated water vapour pressure in the colder environment than on the cylinder surface (skin). The ratio of evaporated water to water input is taken as a measure of the water vapour permeability. Measurements of cold weather clothing in different environment temperatures and at different sweating rates show the quantitative changes in thermal insulation and water vapour permeability. An increase of the water input from 0 to 145 g1d.h might cause a decrease of nearly 50% in the thermal resistance value, and a decrease of the environment temperature from +20 to -2OW causes a drastic decrease in the water vapour permeability. At -40% most textile combinations are virtually impermeable to water vapour.