

# Characteristics analysis of combined heat transfer coefficient on each body part of thermal manikin and its impact on equivalent temperature by means of measurement

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The purpose of the present study is to clarify the sensitivity of combined heat transfer coefficient  $h_{cal}$  of naked thermal manikin in standard environment on the equivalent temperature  $T_{eq}$  defined in ISO14505. The value of  $h_{cal}$  was investigated through the measurement in climate chamber with displacement ventilation. The results showed that calculating the reference temperature from the local operative temperature derived the more uniform value of the  $h_{cal}$  on each body part than that from the average air temperature (see Fig.1). If there is a vertical temperature difference in the climate chamber, a more accurate value can be obtained by employing the local operative temperature  $T_{o,n}$  instead of the average air temperature  $\bar{T}_a$  as the reference temperature. For this purpose, it is necessary to measure the air temperature in the vicinity of each site.

Fig.2 shows that the sensitivity of the  $h_{cal}$  to the equivalent temperature. It could be larger with the naked part under the air-cooling condition than the clothed part under the air-heating condition. Considering the comfort zone around  $T_{eq} = 25^\circ\text{C}$ , the effect of a  $1\text{ W/m}^2\text{K}$  deviation of  $h_{cal}$  is  $\Delta T_{eq} = 1^\circ\text{C}$ , even for a naked body, and is not a significant error in the evaluation of the thermal environment. When the exposed area is away from the thermally neutral state, however, especially when it is exposed to cold environment or cooling air, the deviation of  $1\text{ W/m}^2\text{K}$  in  $h_{cal}$  is not negligible and leads to an error of around  $\Delta T_{eq} = 3^\circ\text{C}$  when  $T_{eq} = 10^\circ\text{C}$  or less. Therefore, it is important to use the local operating temperature as the reference temperature of  $h_{cal}$  for the equivalent temperature evaluation in a real low-temperature environment to ensure accurate measurements.

As mentioned above, the value of  $h_{cal}$  employed has a significant influence on  $T_{eq}$ , especially in exposed part at low temperatures. The validity of the value must be thoroughly examined. Therefore, it is important to present the data together with the equivalent temperature values in order to revalidate the acquired data.

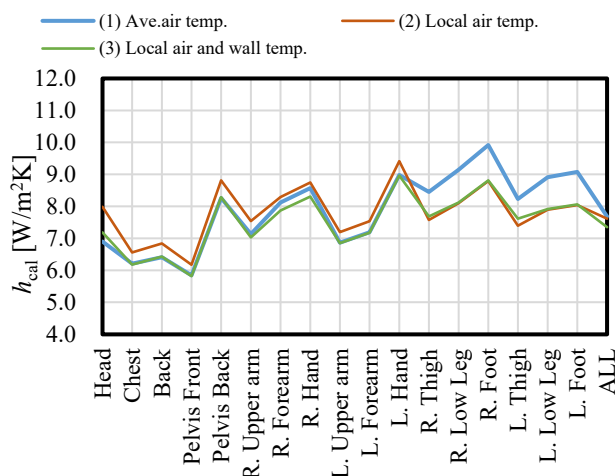


Fig.1 Impact of reference temp. on  $h_{cal}$

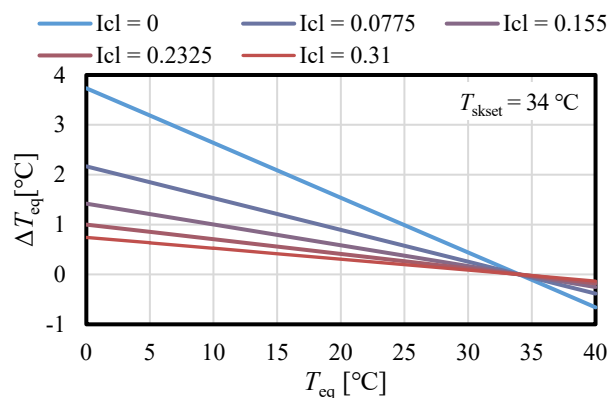


Fig. 2 Sensitivity of  $T_{eq}$  by clo value  $I_{cl}$