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On the influence of sensible heat release on displacement ventilation in a train compartment

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Abstract

The aim of this study is to quantify the influence of heat release on ventilation efficiency and thermal comfort parameters of displacement ventilation in a generic train compartment. A series of human subject studies was conducted for various mean room temperatures. Complementary, measurements using thermal manikins with variable sensible heat release were performed for the same mean room temperatures.

Three main findings were achieved: First, values of latent and sensible heat release of human subjects in displacement ventilation are in very good agreement with the standard using T_{chest} as mean room temperature. Second, the heat removal efficiency (HRE) decreases with increasing mean cabin temperature, that is decreasing sensible heat release, during human subject tests. However, the HRE remains stable during the test with thermal manikins at a constant sensible heat release. Third, we found that variation of the sensible heat has a negligible impact on the flow velocities near the passenger dummies. This indicates that the cooling performance is limited by the rate of fresh air available through the fresh air lake.

1 Introduction

Thermal comfort in all kinds of indoor environments, such as rooms, aircraft and train compartments as well as passenger cars, has been in the focus of research for decades. Thermal comfort of humans does not only depend on a single quantity, it is rather an integral quantity of many parameters, such as e.g. air temperature, draft velocity and radiant temperature. Herewith, the heat released by the human body depends upon the above mentioned ambient conditions and thus in turn influences the surrounding airflow and thermal environment itself. Besides the thermal passenger comfort ventilation, heating and cooling efficiency are important as they govern passenger health and well being as well as energy consumption of the train couch. However, the question how much the variation of heat release influences the performance of cabin ventilation systems is still an open issue. Comprising the effects of all single quantities, Fanger. (1972) presented a study on the prediction of thermal sensation for the

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