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Assessing the equilibrium wall model for Low-speed Flows with Heat Transfer HAOSEN XU, XIANG YANG, Pennsylvania State University — We report wall-modeled large-eddy simulation (WMLES) results of low-speed turbulent flows in plane channel and in ribbed ducts. We compare our WMLESs to Pirozzoli's direct numerical simulations (DNSs) of low-speed plane channel flow and our own DNSs of ribbed ducts with various pitch to height ratios. We consider Mach number effects below the often quoted low Mach number limit Ma=0.2. The results show that Mach number has significant effects on the normalized mean temperature profile even below the often quoted low Mach number limit Ma = 0.2. In addition, we compare the first-point implementation (FGI) and the third-point implementation (TGI) of the equilibrium wall model. The results show that, for WMLES with its typical resolution, TGI is likely to miss the thermal field. The objective of this study is to systematically assess WMLES in terms of its ability to predict heat transfer for low-speed flows. For the flows considered here, i.e., plane channel and ribbed duct, we show that WMLES with FGI is able to accurately model heat transfer at a much reduced cost than WRLES and DNS.

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