# Thermal Behavior in a 180-deg Turned Channel with the Perforation Divider under Rotational Condition

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**Abstract**

To avoid the damage of the high-rotational-speed shaft by the poor thermal dissipation, this study provides a new configuration of the 180-deg turning channel with a perforation divider. The perforations cross the divider let the coolant at the first duct to bypass into the second duct early. Such design provides a uniform cooling, preventing from the local high temperature. Additionally, the perforation-induced disturbing flow should enhance the total heat transfer. This work experimentally investigates the heat transfer characteristics of such system under the rotational condition. The results indicated that the perforation would reduce the raise of the local heat transfer within the turned region. Besides, the rotation would obviously influence the local heat transfer at the leading and trailing surfaces. The perforation increased the change due to the rotation. Furthermore, the effect of rotation on the total heat transfer was insignificant. It might be due to that the present rotational velocity (600 RPM) was not large enough. Finally, the perforation system with $d/D_h$=2/4 had the similar total heat transfer capacity with that without perforation; the total heat transfer capacity of the perforation system with $d/D_h$=1/4 was around 20% higher than the non-perforation one.

***Keywords***: Heat transfer, 180-deg turning channel, Perforation.

**Nomenclature**

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| $d$ | diameter of perforations (m) |
| $D_h$ | hydraulic diameter of the test channel (m) |
| $k$ | thermal conductivity (W/m/°C) |
| $n$ | number of perforations |
| $Nu$ | mean Nusselt number at the spanwise locations along the main flow direction, Eq. (4) |
| $Re$ | Reynolds number, Eq. (3) |
| $S$ | axis along the main flow direction (m) |