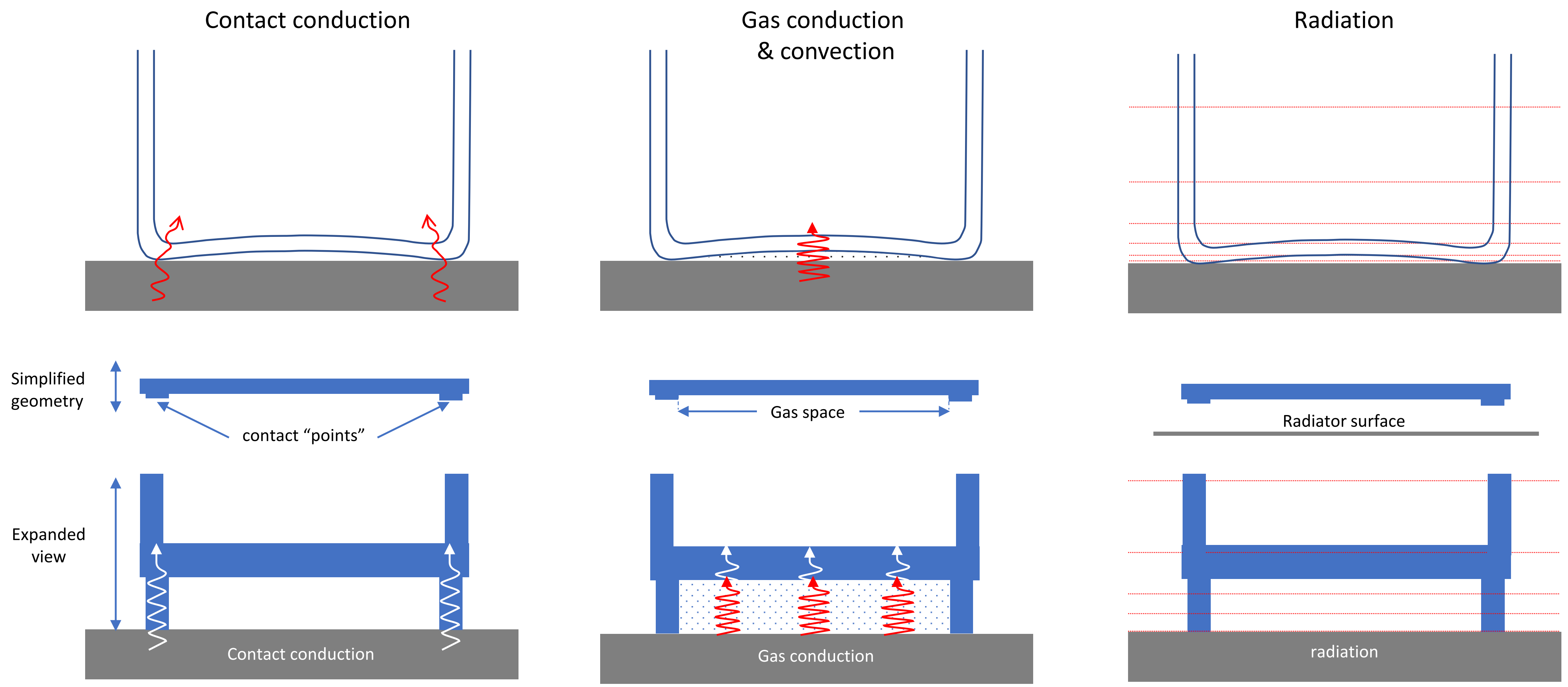


The first is via conduction through the direct contact between the vial and the shelf. Given that the base of the vial has a concave shape then the contact points are restricted to the perimeter of the base, which then limits the amount of heat flux through this mechanism.

The second is through gas conduction (and convection) between the shelf and the vial, through the void that is created by the shape of the vial base. While the thermal conductivity of gases is much lower than that of a solid object such as the borosilicate glass, this is compensated by the significantly larger area of the void, and so gas conduction represents a significant factor in the heat flux through the base of the vial.

The third mechanism is via radiation emitted by the shelf to the vial. Both the vial and the shelf are radiating heat in the direction of the other, but it is the shelf that has the higher temperature and greater emissivity that glass and so the net radiation is in the direction from shelf to vial.

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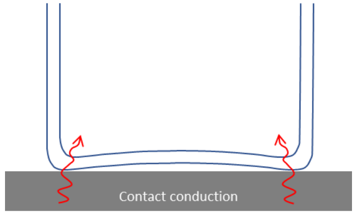


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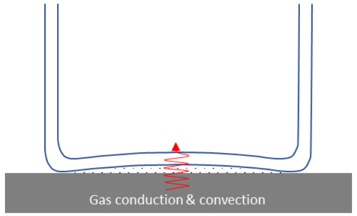


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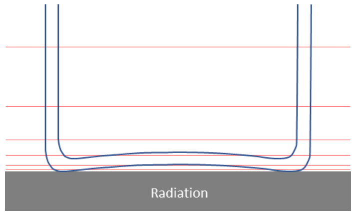
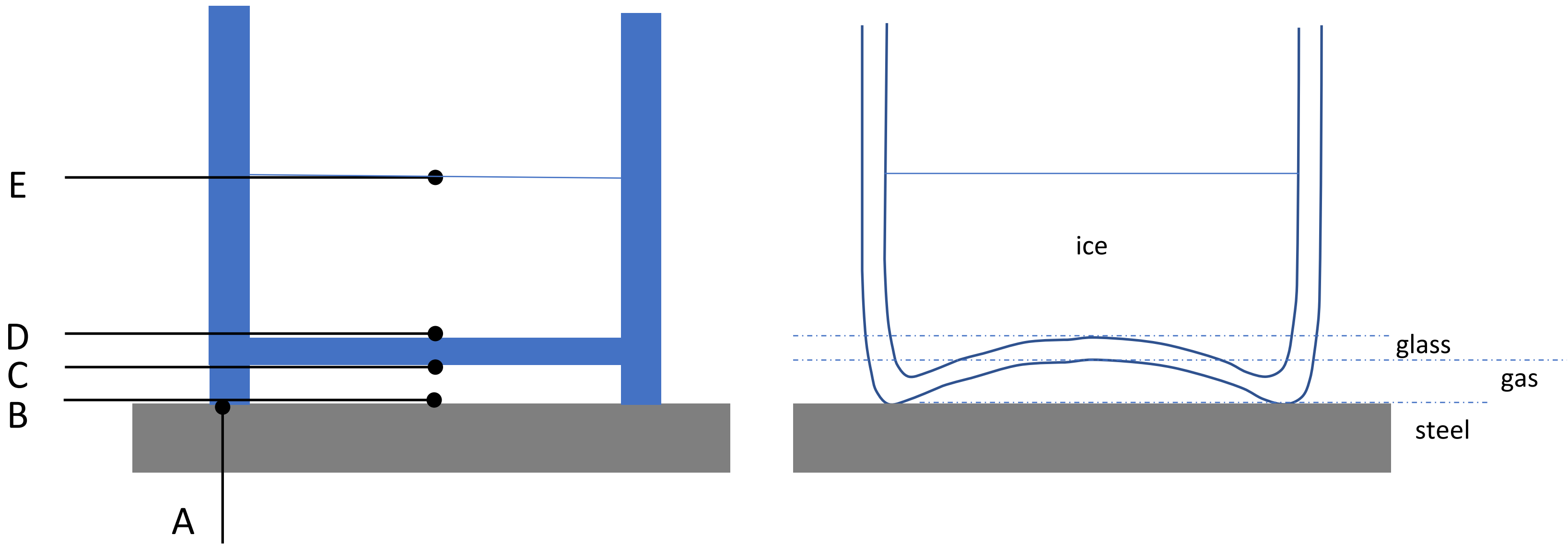
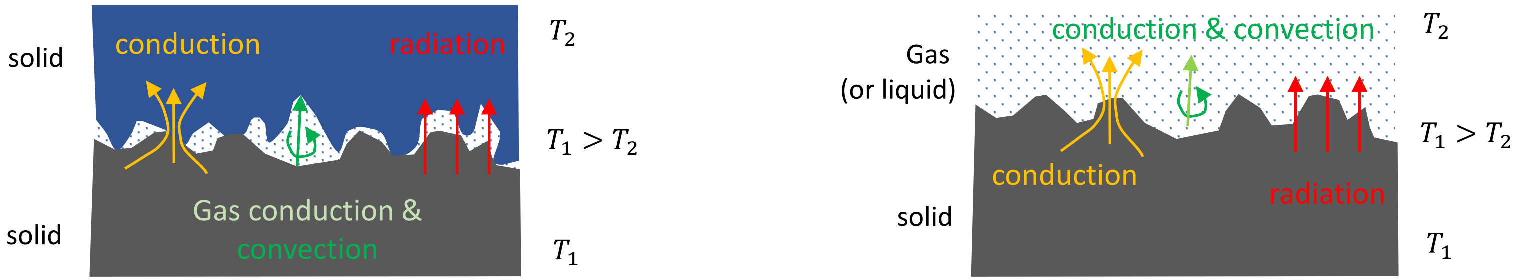





LEFT: schematic of the heat transfer processes from the shelf to the vial and from the vial to the ice mass: [A] contact conduction between the shelf and the vial; [B] contact conduction between the shelf and the void underneath the vial; [B-C] gas conduction and convection across the gas space; [C] contact conduction between the gas and the underside of the vial; [C-D] conduction across the base of the vial; [D] contact conduction between the inside surface of the base of the vial; [D-E] conduction across the ice mass. RIGHT: Distorted view of the base of the vial to illustrate the gas filled void which has a pivotal role in defining the overall heat transfer coefficient in the higher range of chamber pressures.




**Schematic of heat transfer mechanisms between a solid and a gas (or a liquid). The temperature of the solid ($T_1$) is higher than that of the gas, or liquid ($T_2$) and so heat is transferred from the solid to the gas (or liquid)**