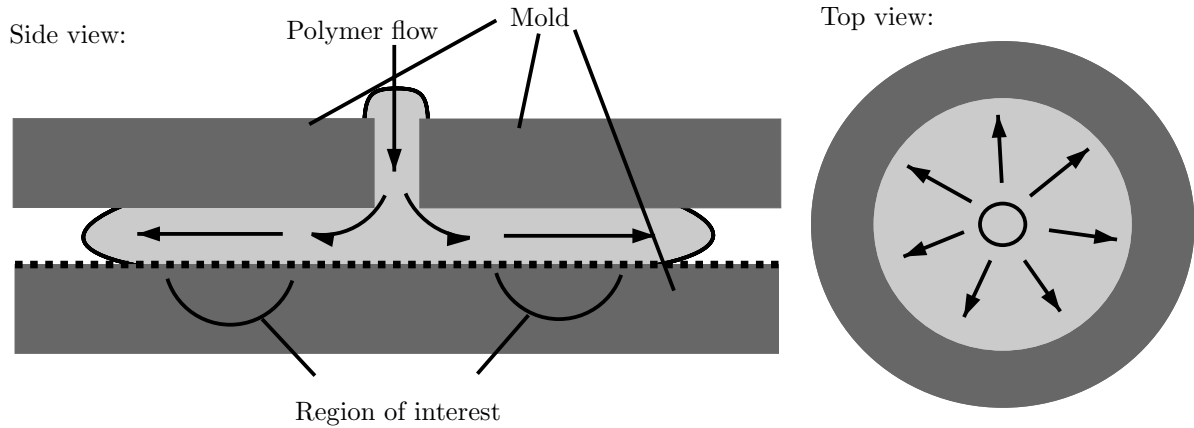


1. CD Injection Molding I: Navier-Stokes



CDs are made cheaply in large quantity by injection molding polycarbonate into a nickel mold with precisely-machined bumps which form the ones and zeroes. We would like to estimate the shear stress exerted by the polycarbonate on the nickel, in order to assess the lifetime of the mold (number of CDs it can make).

The polymer flows from the center outward, and the viscosity is high enough and the mold thin enough ($\sim 1\text{mm}$) that the “entrance length” is even smaller than the $\sim 1\text{cm}$ circle which is cut out of the center.

- Using the accompanying handout *Solving Fluid Dynamics Problems*, state the assumptions which you can make about flow through the thin mold. You can ignore the outer region near the advancing front (the “leading edge” of the polymer), and also ignore the region very close to the center.
- Cancel the appropriate terms on the cylindrical Navier-Stokes equations, which you will detach from the handout and turn in. You do *not* need to (and may not be able to) reduce it to a simple system which you can easily solve.