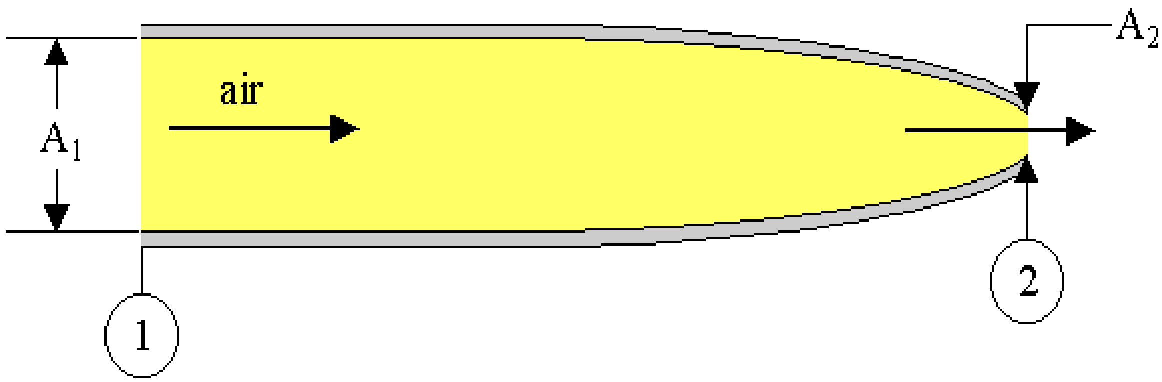
CONTINUITY

Case 3: **Steady**, **Compressible, 1-D** (or **quasi 1-D**) flow

Now let's make things a bit more complicated by looking at the nozzle of a subsonic jet engine. Assume the engine is running at const. speed, as is the case when a jet liner levels off at cruise altitude and moves with const. airspeed. The only difference between this flow and the water nozzle in case 2 is the fluid. Air (and any other gas for this mater) can be compressed. Actually, whether we can measure any changes in density from point to point depends also on the velocity of the air. For low speeds (Mach < 0.3) no appreciable changes in the density of air can be measured, so even though we have gas flow, we can still make the assumption of incompressible flow.



This, however, will not be the case with the exhaust of a jet engine because the flow velocities are very high (Mach = 0.8 – 0.95). So, we must keep the density as a variable. Starting again with the same general expression as before:

$$\dot{m}_1 = \dot{m}_2 \Rightarrow r_1 Q_1 = r_2 Q_2$$

from which we get:

Continuity eq. for **steady**, **compressible, 1-D** (or **quasi 1-D**) flow

$$r_1 V_1 A_1 = r_2 V_2 A_2$$

Note: V_1 and V_2 are the average velocities at sections 1 and 2 respectively.