

84. We first note that when the the velocity of a projectile is simply reversed as a result of collision, its change in momentum (in magnitude) is $2mv$ (where v is its speed). If this collision takes time Δt , then the average force involved is (using Eq. 10-8) $F_{\text{avg}} = 2mv/\Delta t$. To relate this observation to the present situation, we replace m with Δm (representing just that amount of the water stream which is in contact with the blade during Δt , and since the impinging flow rate dm/dt is constant (and no water is lost or “splattered away” in the process) then we conclude $dm/dt = \Delta m/\Delta t$. Therefore,

$$F_{\text{avg}} = 2v \frac{dm}{dt} .$$