## Exploring Rate of Descent

Rate of Climb = ROC = dh/dt

h = altitude

$ROC = V_T \sin(\gamma)$ [1]

$dV_T/dt = g\,[(T-D)/W - \sin(\gamma)]$ [2]

$dV_T/dt = dV_T/dh * dh/dt = dV_T/dh * ROC$ [3]

substituting [3] into [2]

$dV_T/dh * ROC = = g\,[(T-D)/W - \sin(\gamma)]$ [4]

substituting [1] into [4]

$V_T * dV_T/dh * ROC = = g\,[(T-D)/W - ROC]$ [5]

Rearranging

$ROC = g\ [VT * (T-D)/W\ ] / [\ 1 + V_T/g * dV_T/dh]$ [6]

Unaccelerated Climb

$ROC = V_T\ [\ (T-D)/W\ ]\ ]$ [7]

<u>Rate of Descent = ROD = - ROC</u>

$Drag = 0.5\ \rho\ C_D\ S\ V_T^2$ [8]

$C_D = k\ C_L^2$ [9]

$Lift = 0.5\ \rho\ C_L\ S\ V_T^2$ [10]

When Lift = Weight

$Lift = Weight = 0.5\ \rho\ C_L\ S\ V_T^2$

$C_L = W / (0.5\ \ \rho\ S\ V_T^2\ )$ [11]

$Drag = 1/8\ k\ W^2 /(\ \rho\ S\ V_T^2)$ == very small number

$ROD = V_T\ (D - T)/W$ [12]

$W^2$ in Drag term has the effect of **decreasing** ROD as weight **increases**

Effect of Weight on ROD

K = 0.1

P = 0.002 slugs per cubic foot

V = 634 fps (= 0.6 Mach)

S = 1000 $ft^2$

CL = 0.3554

D = 5965 lbs

W = 100,000 lbs

T = -500 lbs (at idle thrust in descent)

ROD = 46.9 fps = 22817 fpm

| Weight (lbs) | ROD (fpm) |
| --- | --- |
| 80,000 | 3,312 |
| 90,000 | 3,029 |
| 100,000 | 2,817 |
| 120,000 | 2,655 |

As weight increases, ROD decreases. (Note: Gliders T = 0, Gliders carry ballast weight to improve performance over long-distance trips)