

P5 SOLUTIONSWAIT 2

TO FIND MAX THRUST, USE $P_{avail} - P_{reqd} = \frac{d}{dt} P.E. + \frac{d}{dt} K.E.$
 AND SOLVE FOR T FOR EACH OF
 THE THREE MANEUVERS - THEN PICK THE BIGGEST ONE.

$$TV - DV = W \frac{dh}{dt} + \frac{d}{dt} \left(\frac{1}{2} \frac{W}{g} V^2 \right)$$

CASE 1) ⁶ ~~g~~ COMBAT TURN $\therefore \frac{dh}{dt} = 0, \frac{d}{dt} V^2 = 0$

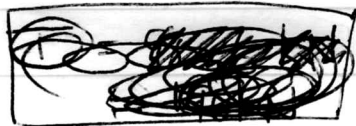
$$T = D, \quad L = 9W \quad D = \frac{1}{2} \rho V^2 S k C_L^2 + \frac{1}{2} \rho V^2 S C_{D0}$$

$$\frac{T}{W} = \frac{1}{2} \rho V^2 \left(\frac{1}{W/S} \right) k \frac{L^2}{\left(\frac{1}{2} \rho V^2 S \right)^2} + \frac{1}{2} \rho V^2 \left(\frac{1}{W/S} \right) C_{D0}$$

$$\frac{T}{W} = \underbrace{\frac{k n^2}{\frac{1}{2} \rho V^2} \left(\frac{W}{S} \right)}_{3.18} + \underbrace{\frac{C_{D0}}{\left(\frac{W}{S} \right)} \frac{1}{2} \rho V^2}_{0.0227} \quad \left\{ \begin{array}{l} V = 0.7 (295 \text{ m/s}) = 206.5 \\ \rho = 0.34 \text{ kg/m}^3 \\ k = 0.1 \text{ } 0.2 \\ C_{D0} = 0.01 \\ n = 6 \\ W/S = 3200 \text{ N/m}^2 \end{array} \right.$$

$$3.2 \text{ } \cancel{\text{scribbles}} = \frac{T}{W} \quad \left\{ \begin{array}{l} C_{D0} = 0.01 \\ n = 6 \\ W/S = 3200 \text{ N/m}^2 \end{array} \right.$$

$$\therefore T = \cancel{\text{scribbles}} (3.2) = 20,000 \cdot 9.8$$



$$\boxed{T = 627.2 \text{ kN}}$$

CASE 2) $M = 0.8$ TO $M = 2.0$ IN 15 SECONDS

$$V_{\text{final}} = 2 (295 \text{ m/s}) = 590 \text{ m/s}$$

$$V_{\text{initial}} = 0.8 (295 \text{ m/s}) = 236 \text{ m/s}$$

$$\frac{\Delta V}{\Delta t} = \frac{590 \text{ m/s} - 236 \text{ m/s}}{15 \text{ s}} = 23.6 \frac{\text{m}}{\text{s}^2} = \frac{dV}{dt}$$

$$\frac{T}{W} = \frac{kn^2}{\frac{1}{2}\rho V^2} \left(\frac{W}{S}\right) + \frac{C_{D0}}{\left(\frac{W}{S}\right)} \frac{1}{2}\rho V^2 + \frac{1}{V} \frac{dh}{dt} \left(\frac{1}{2} \frac{V^2}{g}\right)$$

$$n=1$$

TRY WORST CASE FOR $V \nless k \nless C_{D0}$ @ $M=2$

$$\frac{T}{W} = \underbrace{\frac{k}{\frac{1}{2}\rho V^2} \left(\frac{W}{S}\right)}_{0.022} + \underbrace{\frac{C_{D0}}{\left(\frac{W}{S}\right)} \frac{1}{2}\rho V^2}_{0.481} + \underbrace{\frac{1}{V} \frac{dh}{dt} \left(\frac{1}{2} \frac{V^2}{g}\right)}_{2.41}$$

$$k = \cancel{0.4} 0.4$$

$$C_{D0} = 0.026$$

$$V = 590 \text{ m/s}$$

$$\frac{W}{S} = 3200 \text{ N/m}^2$$

$$\rho = 0.34 \text{ kg/m}^3$$

$$\Rightarrow \frac{T}{W} = 2.91 \quad \therefore T = (2.91)(9.8)(20,000)$$

$$\boxed{T = 570.3 \text{ kN}}$$

CASE 3) STRAIGHTUP AT $M=0.5$

$$\frac{T}{W} = \frac{k}{\frac{1}{2}\rho V^2} \left(\frac{W}{S}\right) + \frac{C_{D0}}{\left(\frac{W}{S}\right)} \frac{1}{2}\rho V^2 + \frac{1}{V} \left(W \frac{dh}{dt}\right)$$

$$\nless \frac{dh}{dt} = V$$

so

$$\frac{T}{W} = \underbrace{\frac{k}{\frac{1}{2}\rho V^2} \left(\frac{W}{S}\right)}_{0.182} + \underbrace{\frac{C_{D0}}{\left(\frac{W}{S}\right)} \frac{1}{2}\rho V^2}_{0.016} + \underbrace{1}_1$$

$$V = 0.5(295 \text{ m/s}) = 147.5 \text{ m/s}$$

$$\frac{W}{S} = 3200 \text{ N/m}^2, \rho = 0.34, k = 0.21, C_{D0} = 0.01$$

$$\frac{T}{W} = 1.19 \quad \therefore T = 9.8 \cdot 20,000 (1.19) = \boxed{233.9 \text{ kN}}$$

$\therefore$ SIZE ENGINE FOR MAX = 627 kN