Mécanique de Propulsion (Correction) — 21/01/2020

EXO #01 : Tous les éléments des deux versions sont reversibles

1°) La T° $= T_{0i}$:

$$\frac{T_{0i}}{T_{02}} = \left(P_{0i}/P_{02}\right)^{\frac{\gamma-1}{\gamma}}$$

$$T_{0i} = T_{02}\left(P_{0i}/P_{02}\right)^{\frac{\gamma-1}{\gamma}} \quad \text{avec :} \quad T_{02} = T_a\left[1 + \frac{\gamma-1}{2} M_a^2\right] = 399{,}6\ K$$

$$\rightarrow T_{0i} = 547\ K$$

2°) La int. d'éjection des gaz "V_{e2}" :

$$F_{sp_2} = (1+f)V_{e2} - V_a \quad \text{avec } V_a = 596\ m/s$$

$$V_{e2} = \left\{2 c_p T_{05}\left[1 - \left(P_6/P_{05}\right)^{\frac{\gamma-1}{\gamma}}\right]\right\}^{1/2}$$

$$P_{05}/P_6 = \frac{P_{05}}{P_{04}} \cdot \frac{P_{04}}{P_{03}} \cdot \frac{P_{02}}{P_a} \cdot P_a/P_6 \; ; \quad \frac{P_{04}}{P_{03}} = 1 \text{ et } P_a/P_6 = 1$$

$$\frac{P_{02}}{P_a} = \left[1 + \frac{\gamma-1}{2} M_a^2\right]^{\gamma/(\gamma-1)} = 7{,}8244$$

$$P_{05}/P_{04} = \left\{1 - \frac{T_{02}}{T_{04}}\left[\left(P_{03}/P_{02}\right)^{\frac{\gamma-1}{\gamma}} - 1\right]\right\}^{\gamma/(\gamma-1)}$$

- Détermination de (P_{03}/P_{02}) :

$$P_{03}/P_{02} = 3 \cdot \left(\frac{T_{03}}{T_{0i}}\right)^{\gamma/(\gamma-1)}$$

avec : $T_{03} = \frac{(0{,}9+f)}{0{,}9} T_{04} - \frac{f Q_R}{0{,}9 c_p} = 1034{,}3\ K$ $\therefore P_{03}/P_{02} = 27{,}888$

$\Rightarrow P_6/P_{05} = 0{,}08085.$

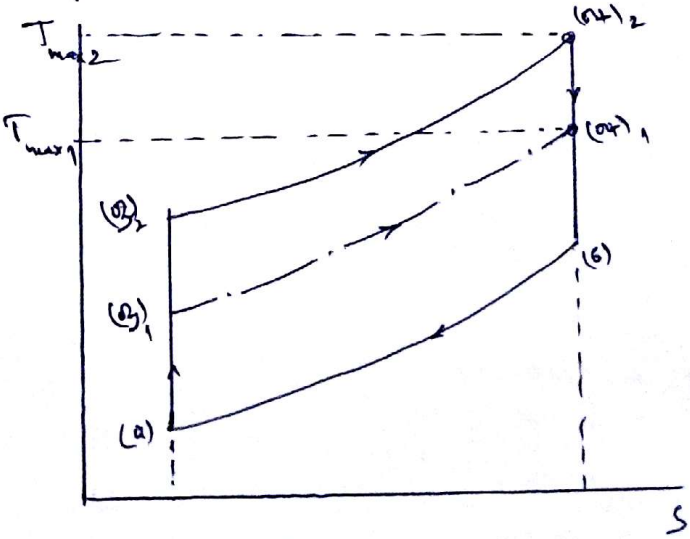
- Détermination de T_{05} : $T_{05} = T_{04}\left\{1 - \left[1 - \left(P_{05}/P_{04}\right)^{\frac{\gamma-1}{\gamma}}\right]\right\} = 499{,}4\ K$

$\therefore V_{e2} = 715{,}51\ m/s$ & $F_{sp,2} = 419\ m/s$

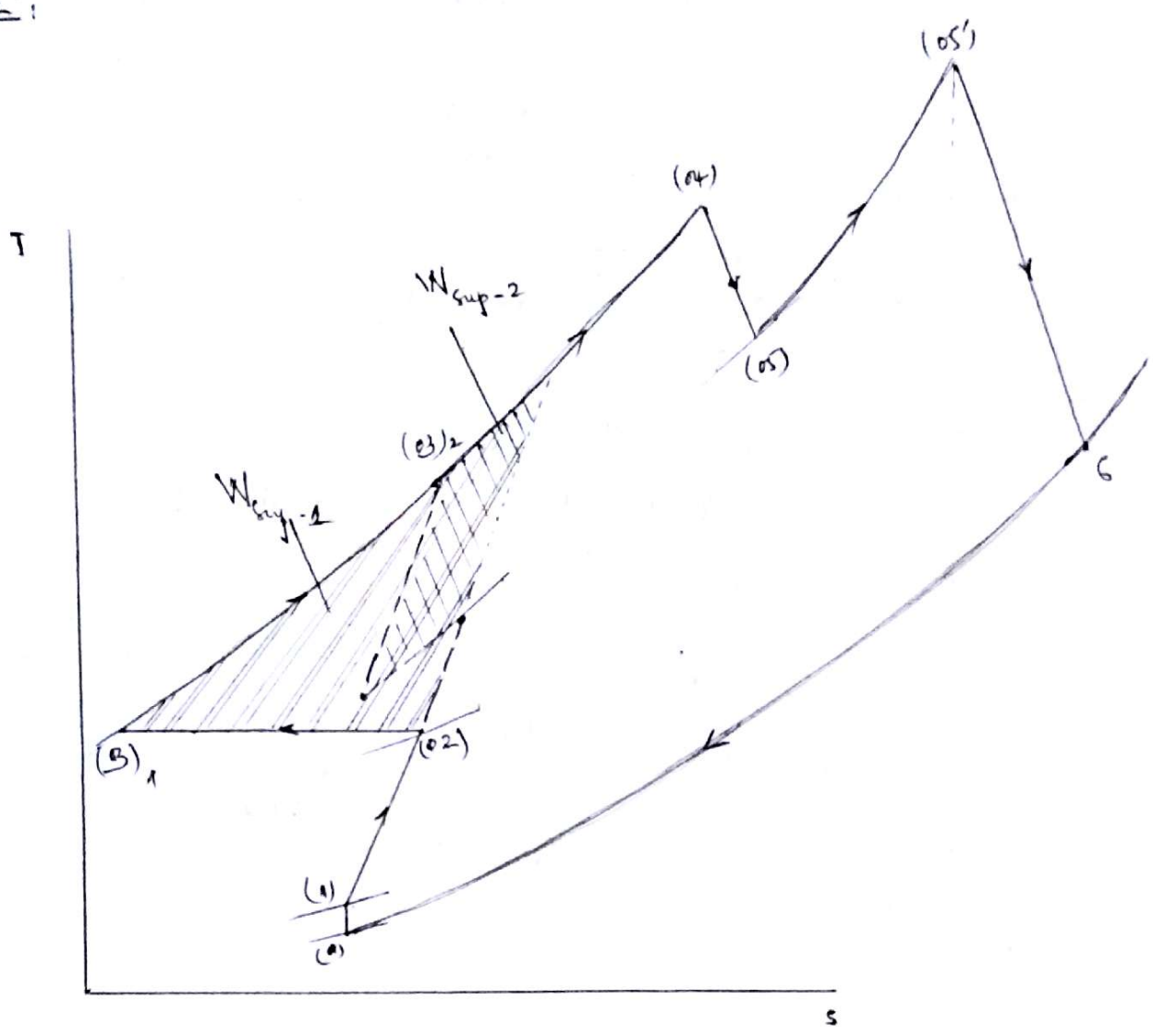
Nous aurons :

$$F_{sp,2}/F_{sp,1} = \frac{419}{115{,}6} \cong 4$$

- Le Cycle thermody :



EXO #02 :



Diag. T-S des deux versions