$P := 500 \quad T1 := 875 \quad T2 := 1400 \quad R := 16.60$

Expansion of 16.6:1 from 500 PSIA at 875F

$Pt_c := ST\_ptdata(P, T1, 1, 1)$ Cutoff point

$p_x := 14 \quad p_x := root\left(ST\_ptdata\left(p_x, Pt_{c_5}, 5, 1\right)_2 - R \cdot Pt_{c_2}, p_x\right)$ Find ending pressure

$Pt_e := ST\_ptdata\left(p_x, Pt_{c_5}, 5, 1\right)$ ending point.

$Pt_c =$

	0
0	500
1	875
2	1.53837
3	1310.7882
4	1453.12554
5	1.68899
6	1
7	0.53746
8	0.40571
9	0.00207
10	0.00085
11	2136.74213

The cutoff and expansion state points P,T,v,u,h,s,q
Expansion ratio fixed at 16.60:1

$$Pt_e = \begin{pmatrix} 14.69915 \\ 212.01085 \\ 25.53692 \\ 1035.48612 \\ 1104.94843 \\ 1.68899 \\ 0.95307 \end{pmatrix}$$

$$\frac{Pt_{e_2}}{Pt_{c_2}} = 16.6$$

$Pt_c := ST\_ptdata(P, T2, 1, 1)$ Repeate above only with cutoff steam temperature at 1400F

$p := 14 \quad p := root\left(ST\_ptdata\left(p, Pt_{c_5}, 5, 1\right)_2 - R \cdot Pt_{c_2}, p\right)$ Fnd ending pressure expansion ratio of $R = 16.6$

$Pt_e := ST\_ptdata\left(p, Pt_{c_5}, 5, 1\right)$

$Pt_c =$

	0
0	500
1	1400
2	2.19767
3	1536.97018
4	1740.30934
5	1.8702
6	1
7	0.56277
8	0.44587
9	0.00202
10	0.00056
11	2524.78359

$Pt_e =$

	0
0	13.5879
1	376.87935
2	36.48133
3	1137.44514
4	1229.17511
5	1.8702
6	1
7	0.47191
8	0.35784
9	0.07399
10	0.00122
11	1735.73344

As you can see the higher heat content causes and over expansion to 13.5879 PSIA.

$$\frac{Pt_{e_2}}{Pt_{c_2}} = 16.6$$

Now calculating expansion to exhaust pressure, we can figure the percentage of stroke where cylander pressure is below exhaust

$Pt_p := ST\_ptdata\left(p_x, Pt_{c_5}, 5, 1\right)$

State point of an expansion to $p_x = 14.69915$

$Pt_p =$

	0
0	14.69915
1	392.63561
2	34.35861
3	1142.99582
4	1236.45378
5	1.8702
6	1
7	0.4728
8	0.35879
9	0.06839
10	0.0012
11	1751.32098

The percentage of stroke above exhaust pressure is $\frac{Pt_{p_2}}{Pt_{e_2}} = 94.18136\%$ And the over expansion part is $1 - \frac{Pt_{p_2}}{Pt_{e_2}} = 5.81864\%$ In this case 5.81% of the stroke is doing negitive work.