Engineering Software

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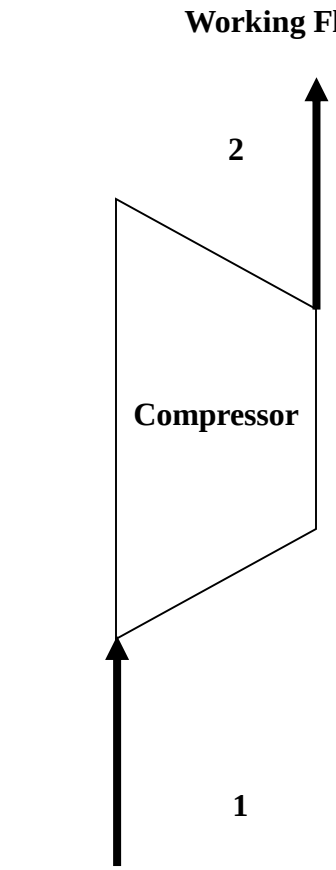
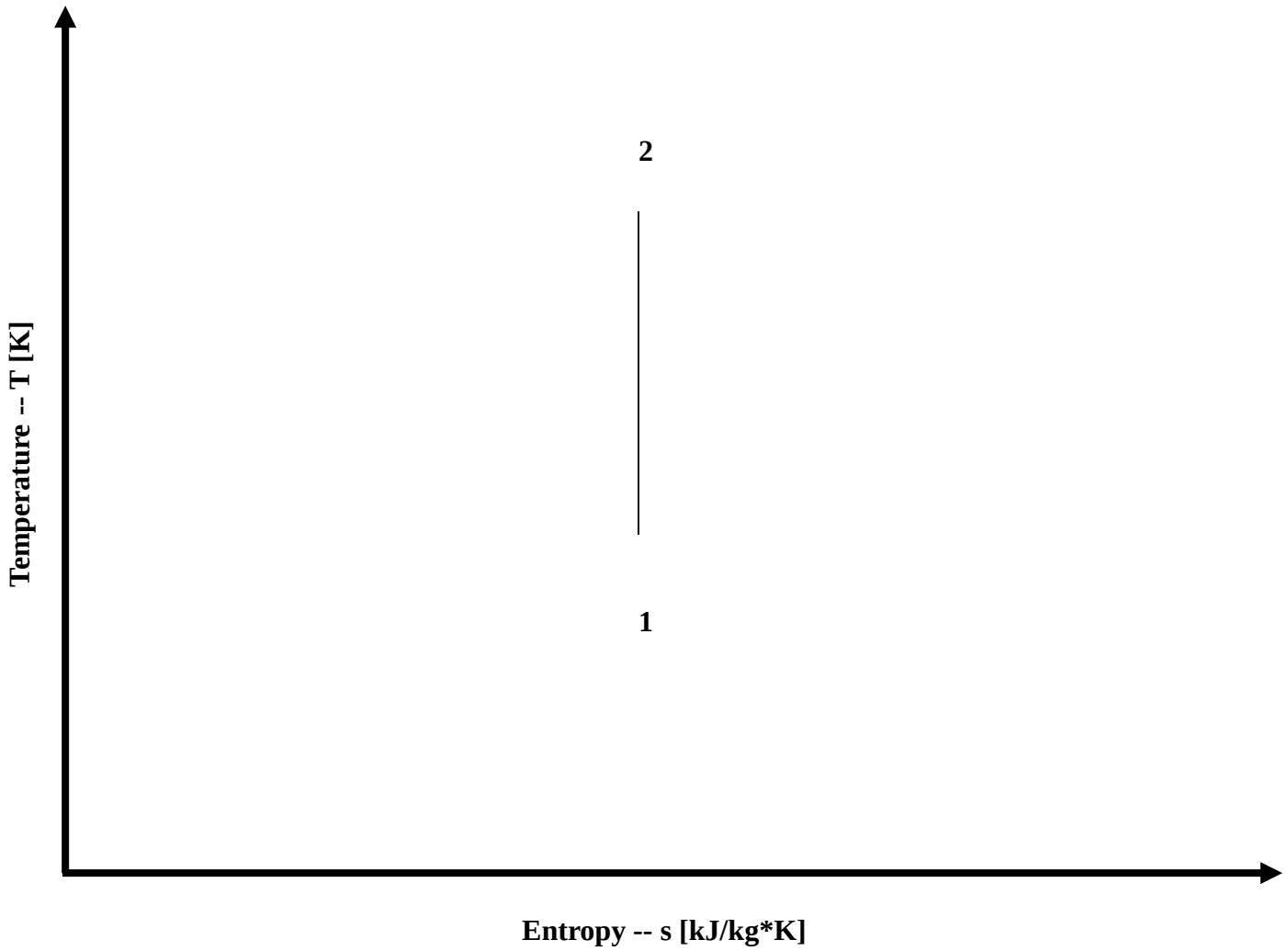
Compression

Here are some of the basic isentropic compression data tables and plots.



Compression Schematic Layout



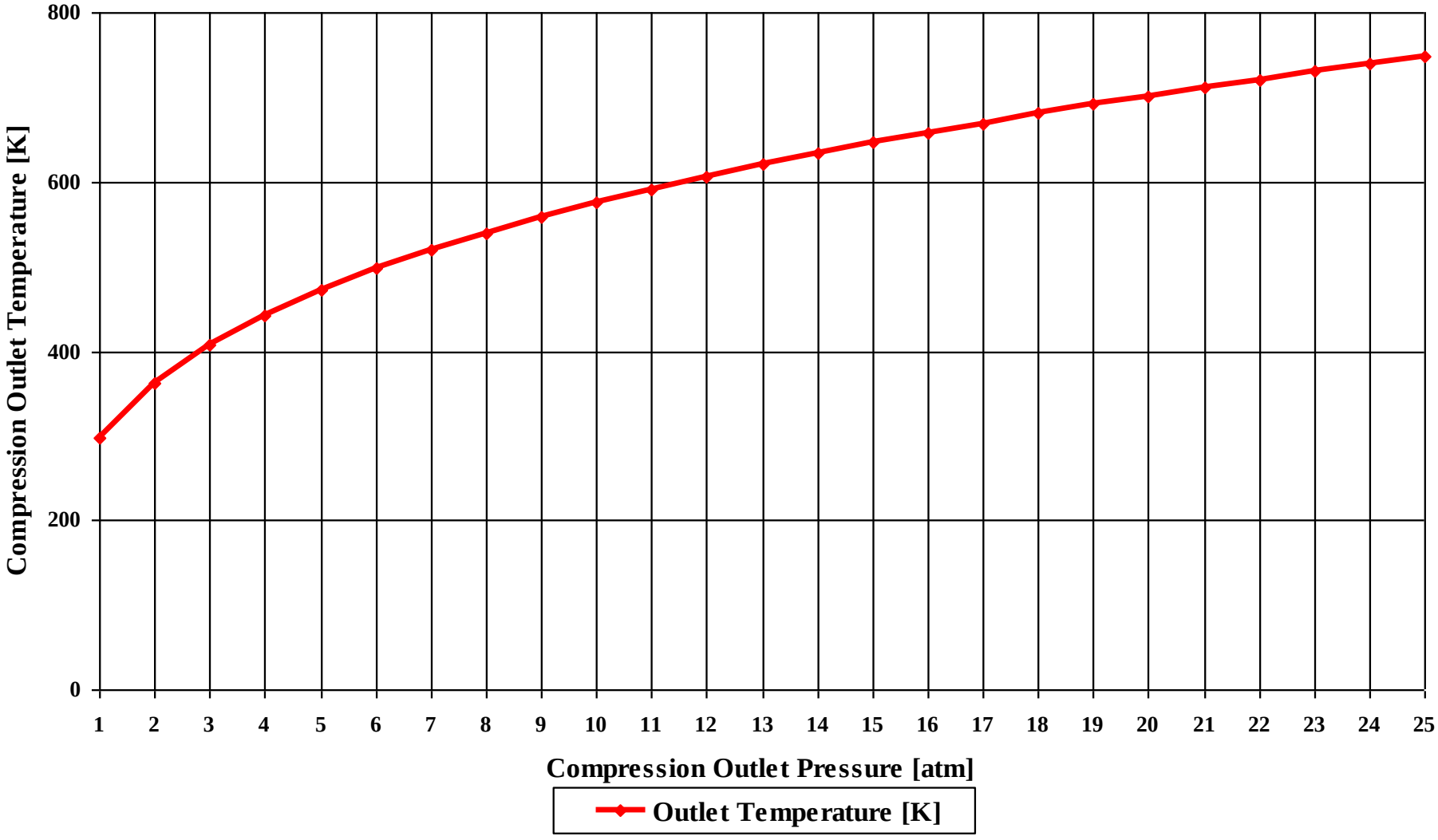
Compression T - s Diagram

Input and Output Data

```
Compression inlet temperature [K]: 298
Compression inlet pressure [atm]: 1
Compression outlet pressure [atm]: 25
Compression delta pressure step [atm]: 1
Compression fluid kappa [/]: 1.4
Compression fluid cp [kJ/kg*K]: 1.004
```

Step [/]	Tin [K]	Pin [atm]	Tout [K]	Pout [atm]	Specific Power [kW/kg/s]
1	298	1	298	1	0
2	298	1	363.266	2	65.5271
3	298	1	407.884	3	110.323
4	298	1	442.826	4	145.406
5	298	1	471.978	5	174.674
6	298	1	497.216	6	200.013
7	298	1	519.604	7	222.491
8	298	1	539.811	8	242.779
9	298	1	558.286	9	261.327
10	298	1	575.348	10	278.457
11	298	1	591.231	11	294.404
12	298	1	606.113	12	309.346
13	298	1	620.134	13	323.423
14	298	1	633.405	14	336.747
15	298	1	646.015	15	349.407
16	298	1	658.037	16	361.477
17	298	1	669.535	17	373.021
18	298	1	680.559	18	384.089
19	298	1	691.153	19	394.726
20	298	1	701.357	20	404.97
21	298	1	711.202	21	414.855
22	298	1	720.718	22	424.409
23	298	1	729.93	23	433.658
24	298	1	738.86	24	442.624
25	298	1	747.528	25	451.326

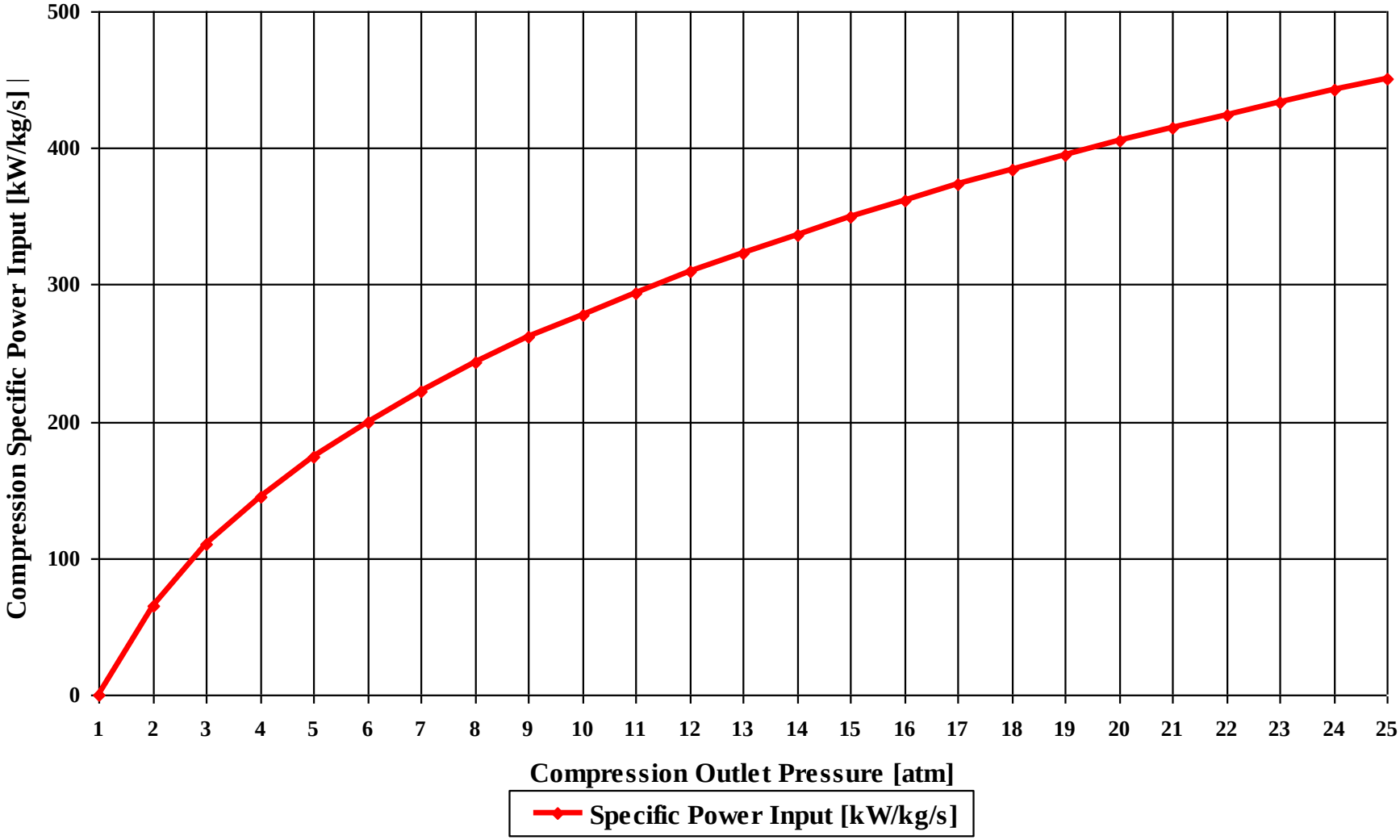
Compression Outlet Temperature



Working Fluid: Air

Compressor Inlet Temperature: 298 [K] and Inlet Pressure: 1 [atm]

Compression Specific Power Input



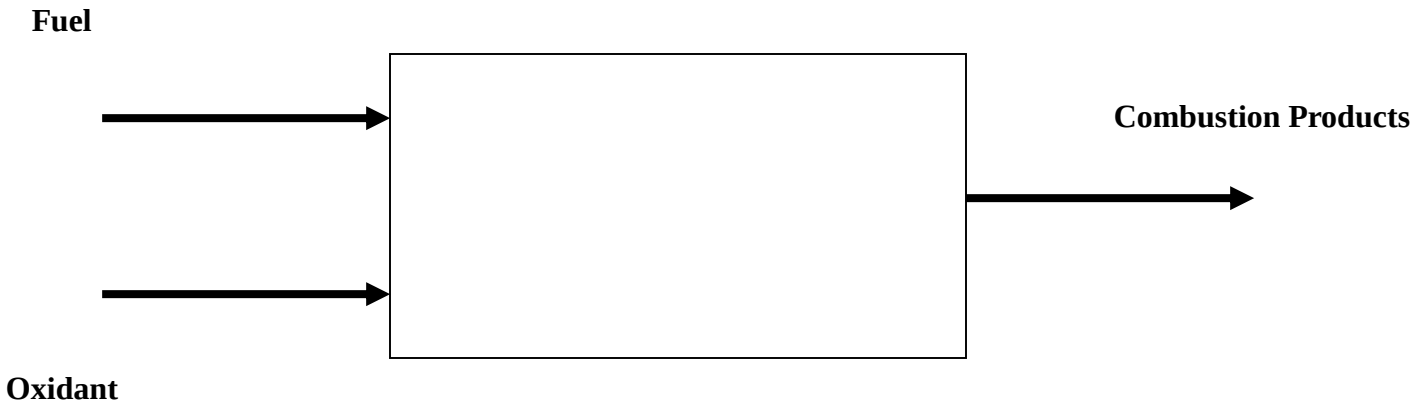
Working Fluid: Air

Compressor Inlet Temperature: 298 [K] and Inlet Pressure: 1 [atm]

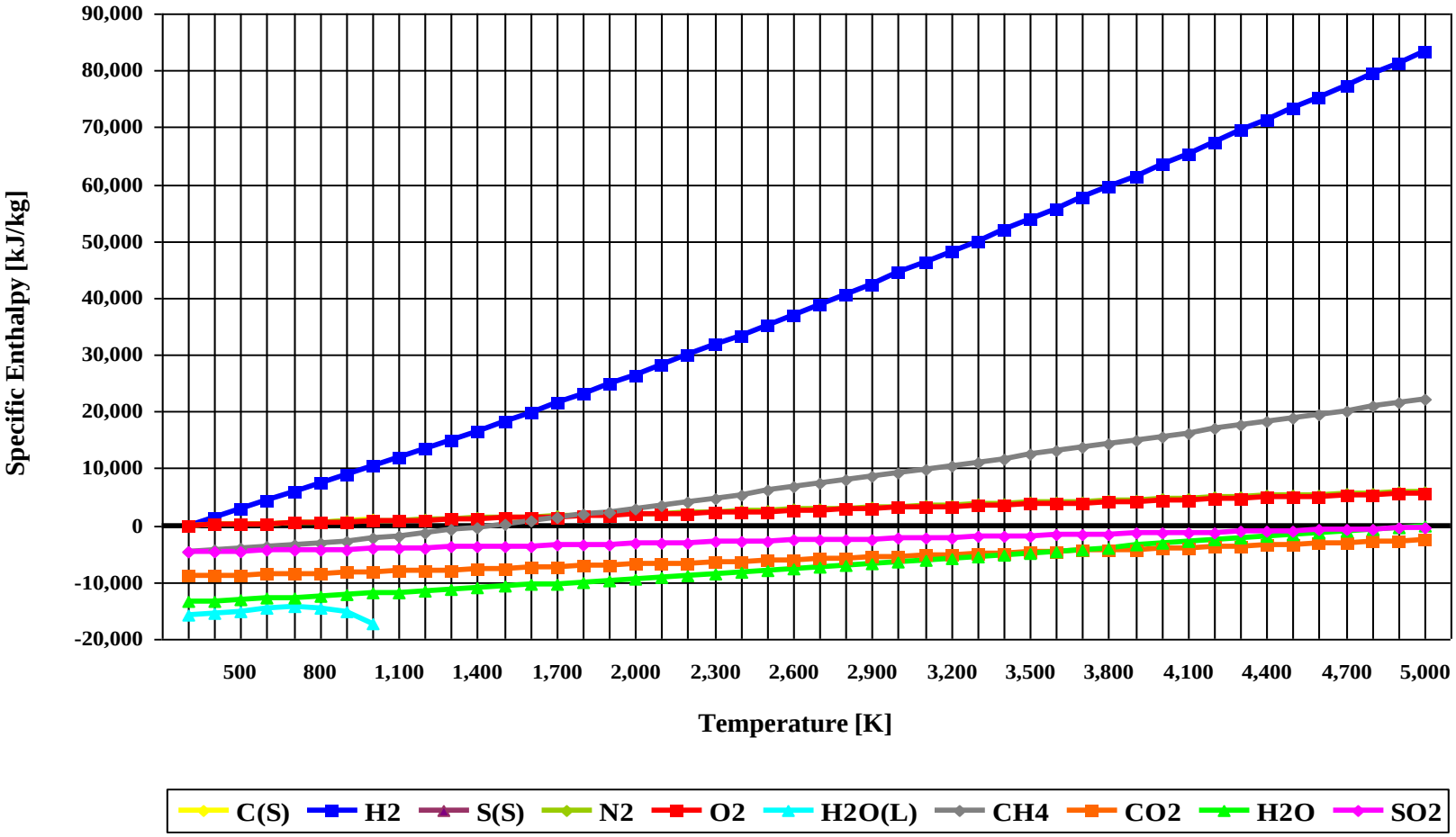
Combustion Analysis

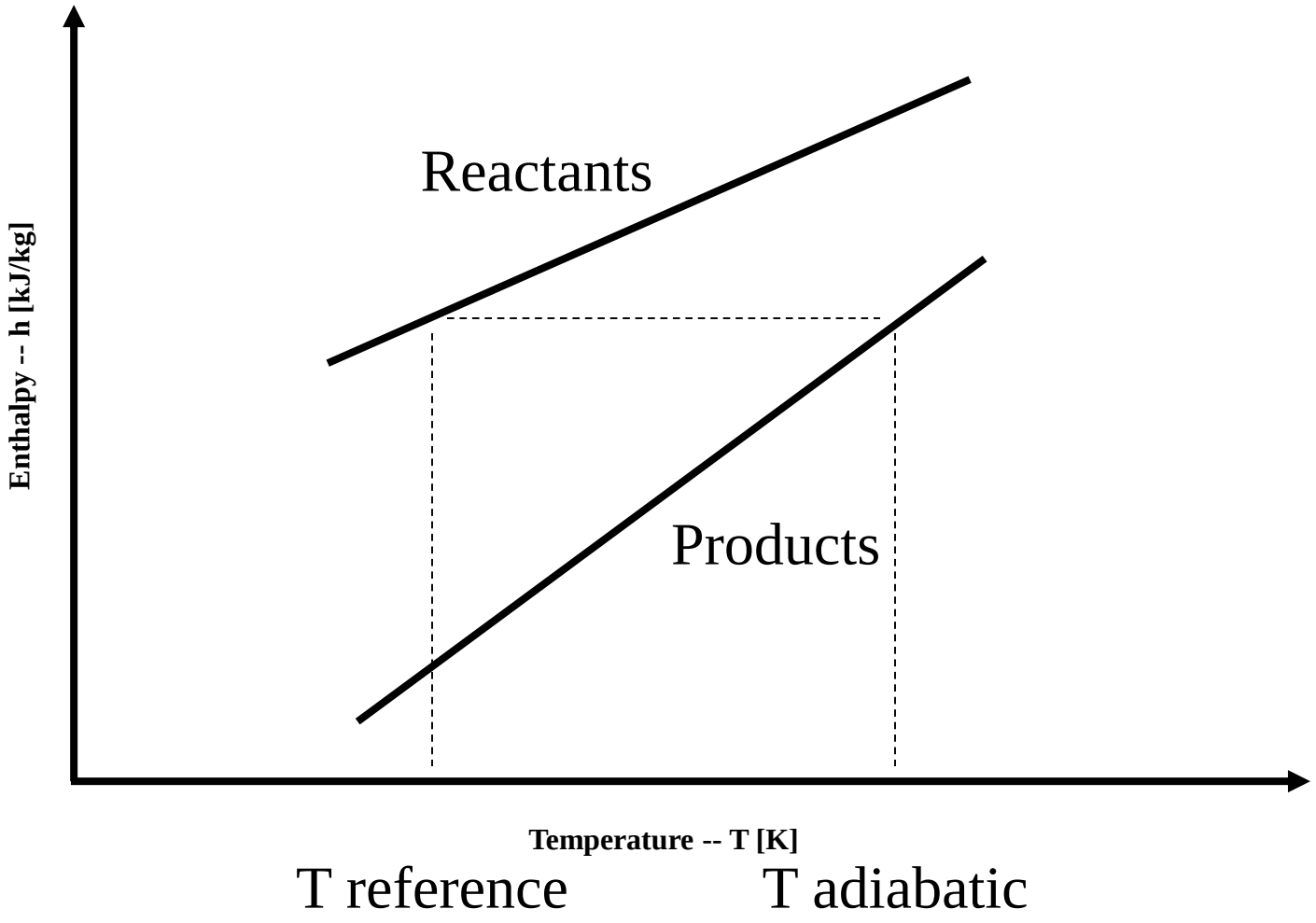
Here are some of the basic combustion data tables and plots when considering carbon, hydrogen, sulfur, coal, oil and gas (methane) as the fuel and air as the oxidant at stoichiometric conditions.

Combustion Schematic Layout



Specific Enthalpy vs Temperature





Combustion h - T Diagram

Oxidant Composition

Oxidant	N	O	N	O
	[kg/kg]	[kg/kg]	[kmol/kmol]	[kmol/kmol]
Air	0.767	0.233	0.790	0.210

Fuel Composition

Fuel	C	H	S	N	O	H_2O	CH_4
	[kg/kg]	[kg/kg]	[kg/kg]	[kg/kg]	[kg/kg]	[kg/kg]	[kg/kg]
Carbon	1.000	0.000	0.000	0.000	0.000	0.000	-
Hydrogen	0.000	1.000	0.000	0.000	0.000	0.000	-
Sulfur	0.000	0.000	1.000	0.000	0.000	0.000	-
Coal	0.780	0.050	0.030	0.040	0.080	0.020	-
Oil	0.860	0.140	0.000	0.000	0.000	0.000	-
Gas	-	-	-	-	-	-	1.000

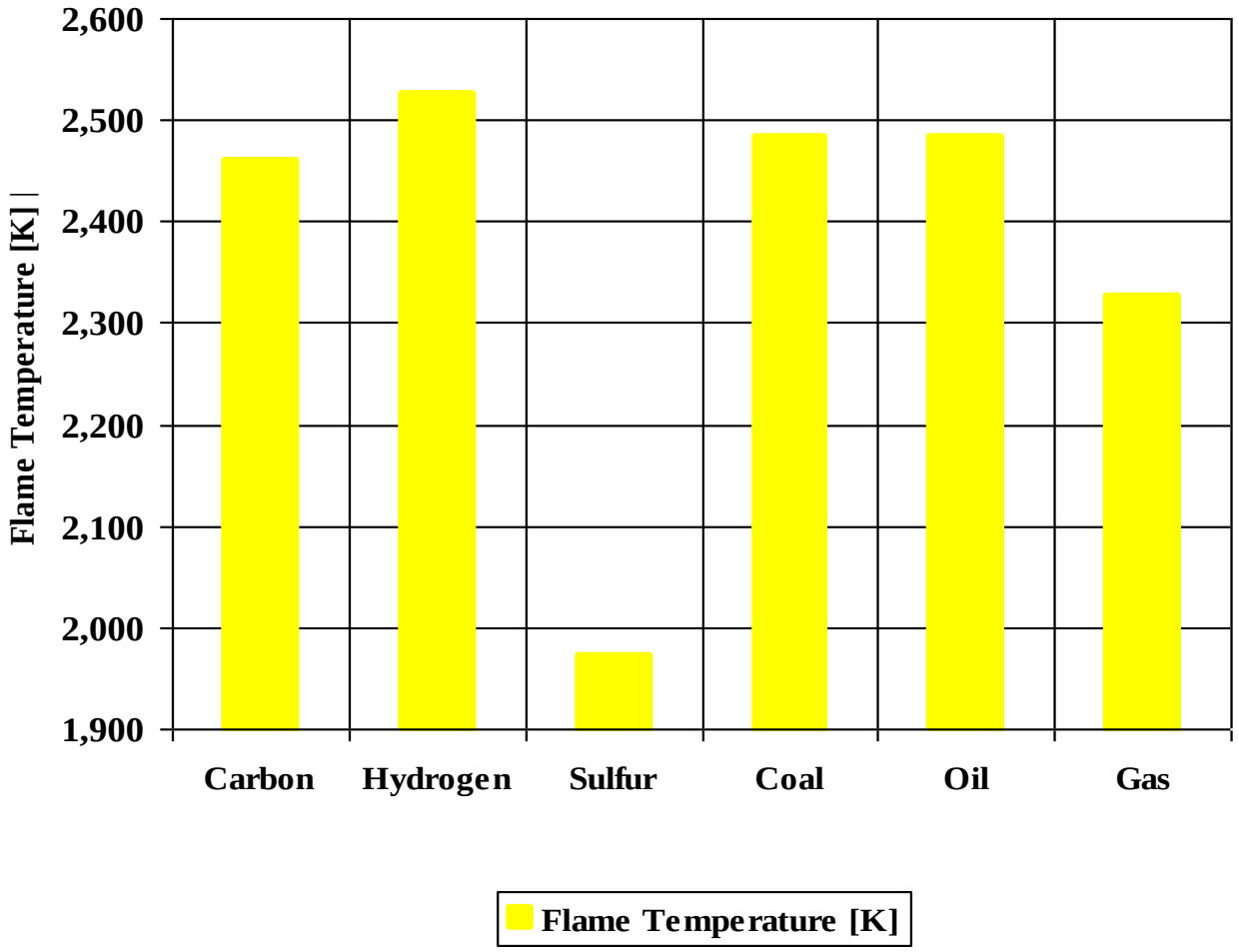
Stoichiometric Combustion
Combustion Products Composition on Weight and Mole Basis

Fuel	CO_2 [kg/kg]	H_2O [kg/kg]	SO_2 [kg/kg]	N_2 [kg/kg]	O_2 [kg/kg]	CO_2 [kmol/kmol]	H_2O [kmol/kmol]	SO_2 [kmol/kmol]	N_2 [kmol/kmol]	O_2 [kmol/kmol]
Carbon	0.295	0.000	0.000	0.705	0.000	0.210	0.000	0.000	0.790	0.000
Hydrogen	0.000	0.255	0.000	0.745	0.000	0.000	0.347	0.000	0.653	0.000
Sulfur	0.000	0.000	0.378	0.622	0.000	0.000	0.000	0.210	0.790	0.000
Coal	0.249	0.041	0.005	0.705	0.000	0.170	0.068	0.002	0.759	0.000
Oil	0.202	0.080	0.000	0.718	0.000	0.132	0.129	0.000	0.739	0.000
Gas	0.151	0.124	0.000	0.725	0.000	0.095	0.190	0.000	0.715	0.000

Combustion Products Flame Temperature, Stoichiometric Oxidant to Fuel Ratio and HHV

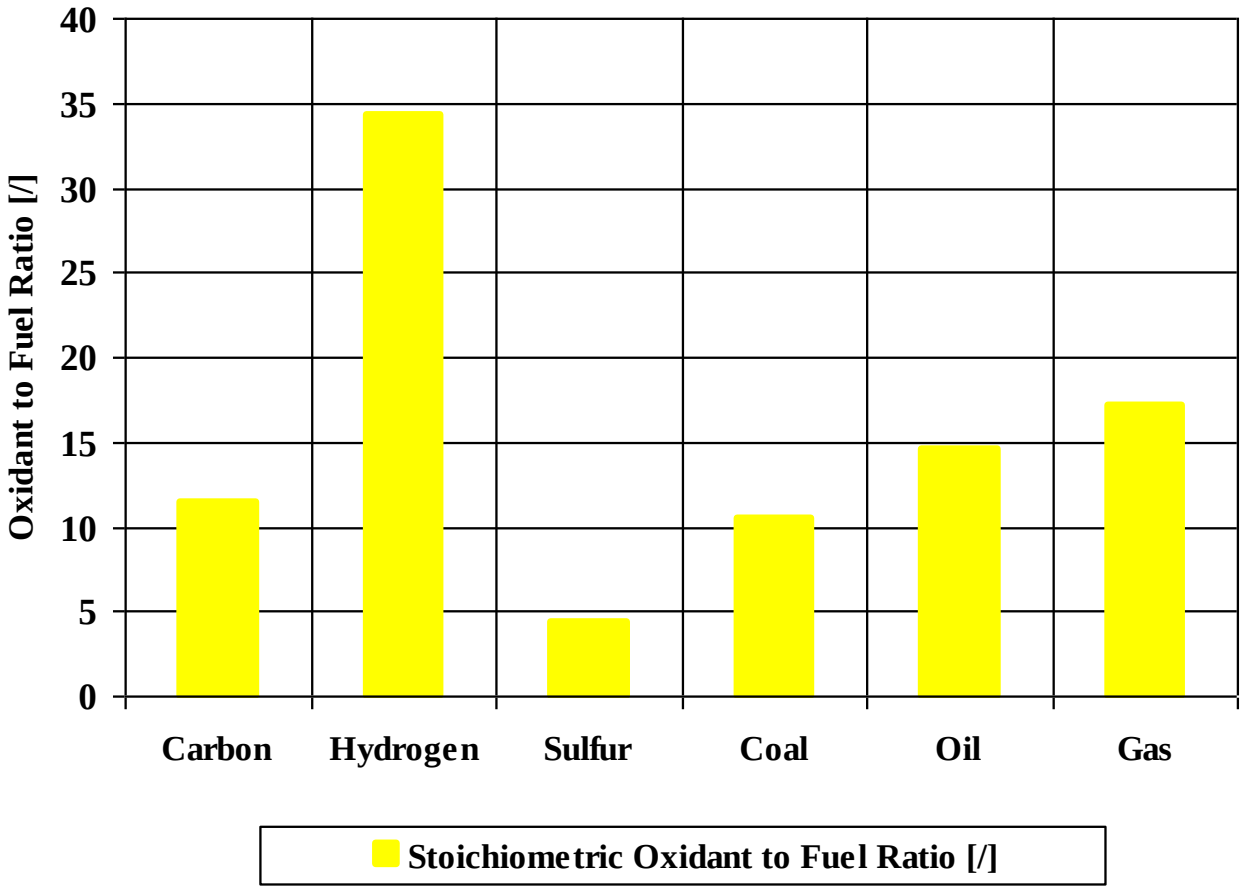
Fuel	Flame Temperature [K]	Stoichiometric Oxidant to Fuel Ratio [/]	HHV [Btu/lbm]
Carbon	2,460	11.444	14,094
Hydrogen	2,525	34.333	60,997
Sulfur	1,972	4.292	3,982
Coal	2,484	10.487	14,162
Oil	2,484	14.649	20,660
Gas	2,327	17.167	21,563

Combustion Products Flame Temperature



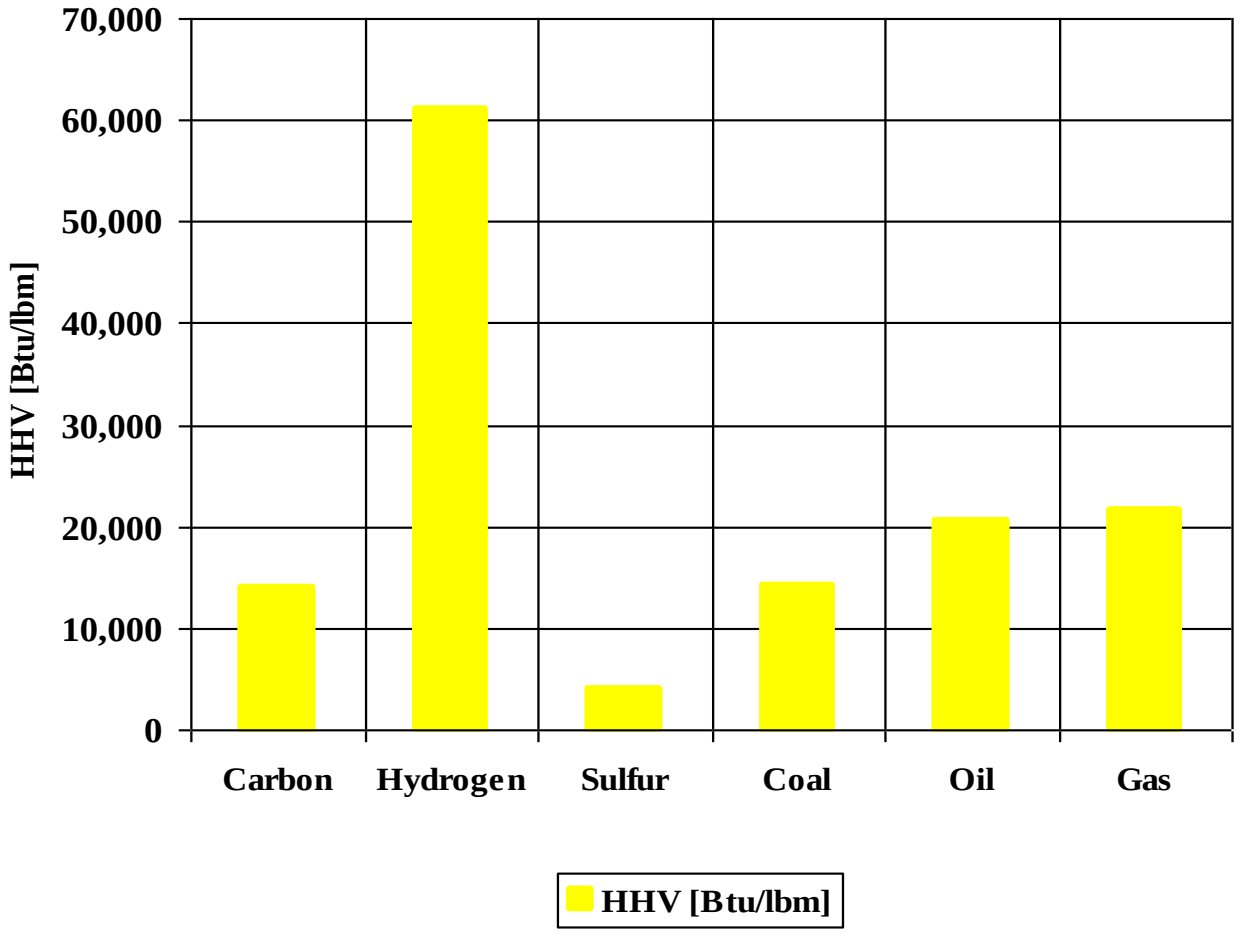
Fuel and Oxidant Inlet Temperature: 298 [K]

Combustion Stoichiometric Oxidant to Fuel Ratio



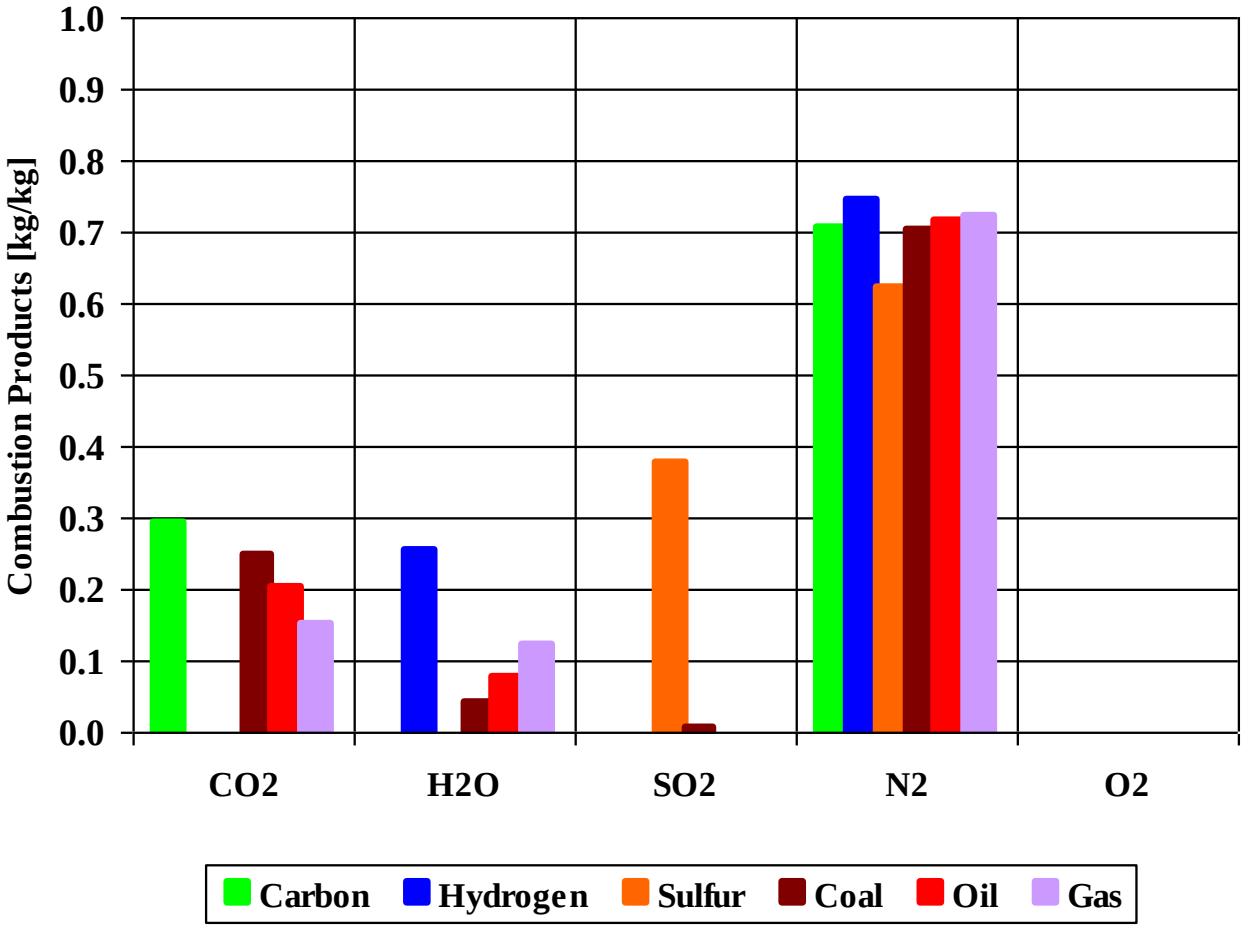
Fuel and Oxidant Inlet Temperature: 298 [K]

Higher Heating Value (HHV)



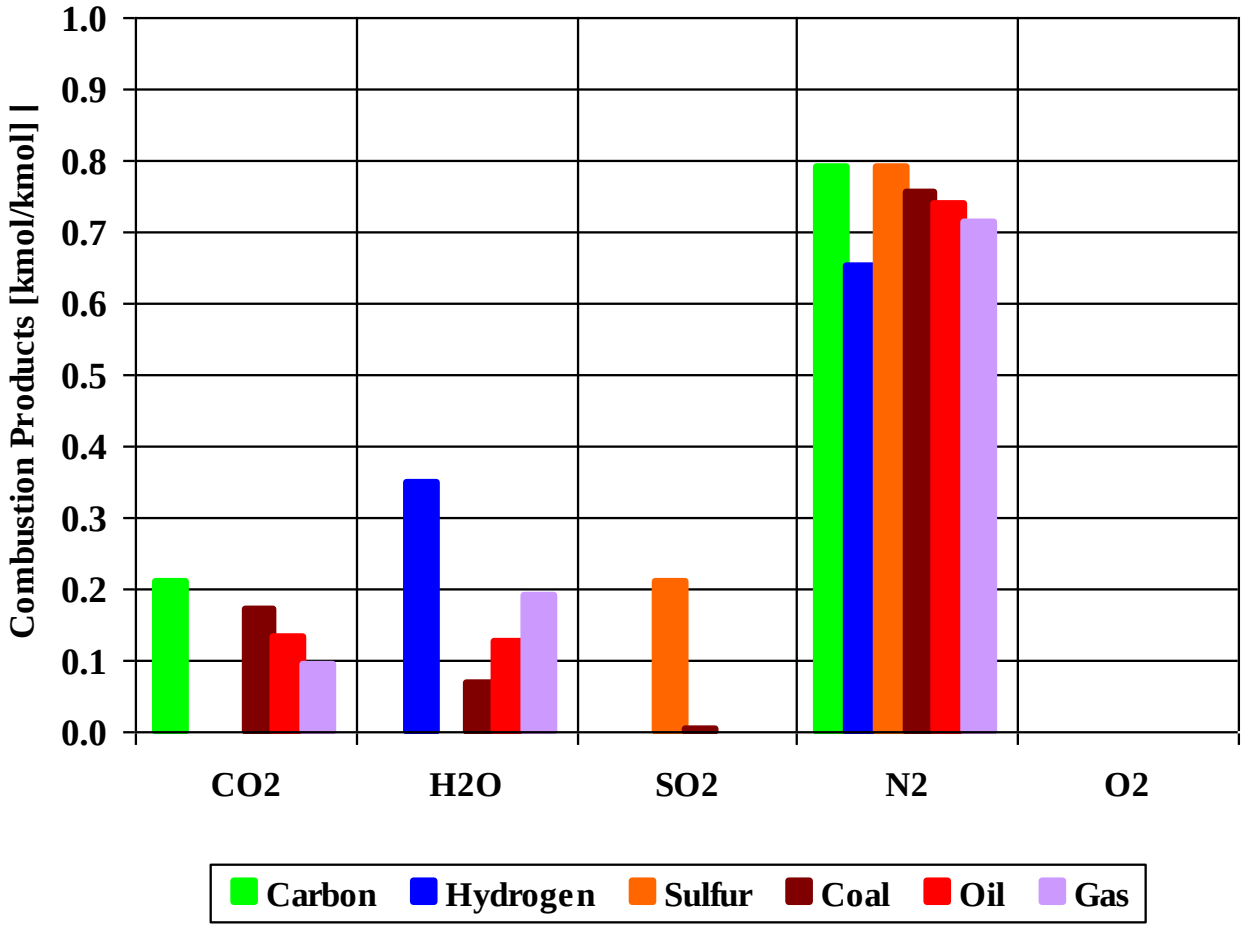
Fuel and Oxidant Inlet Temperature: 298 [K]

Combustion Products -- Weight Basis



Fuel and Oxidant Inlet Temperature: 298 [K]

Combustion Products -- Mole Basis



Fuel and Oxidant Inlet Temperature: 298 [K]

Oxidant Composition

Oxidant	N	O	N	O
	[kg/kg]	[kg/kg]	[kmol/kmol]	[kmol/kmol]
Air	0.767	0.233	0.790	0.210

Fuel Composition

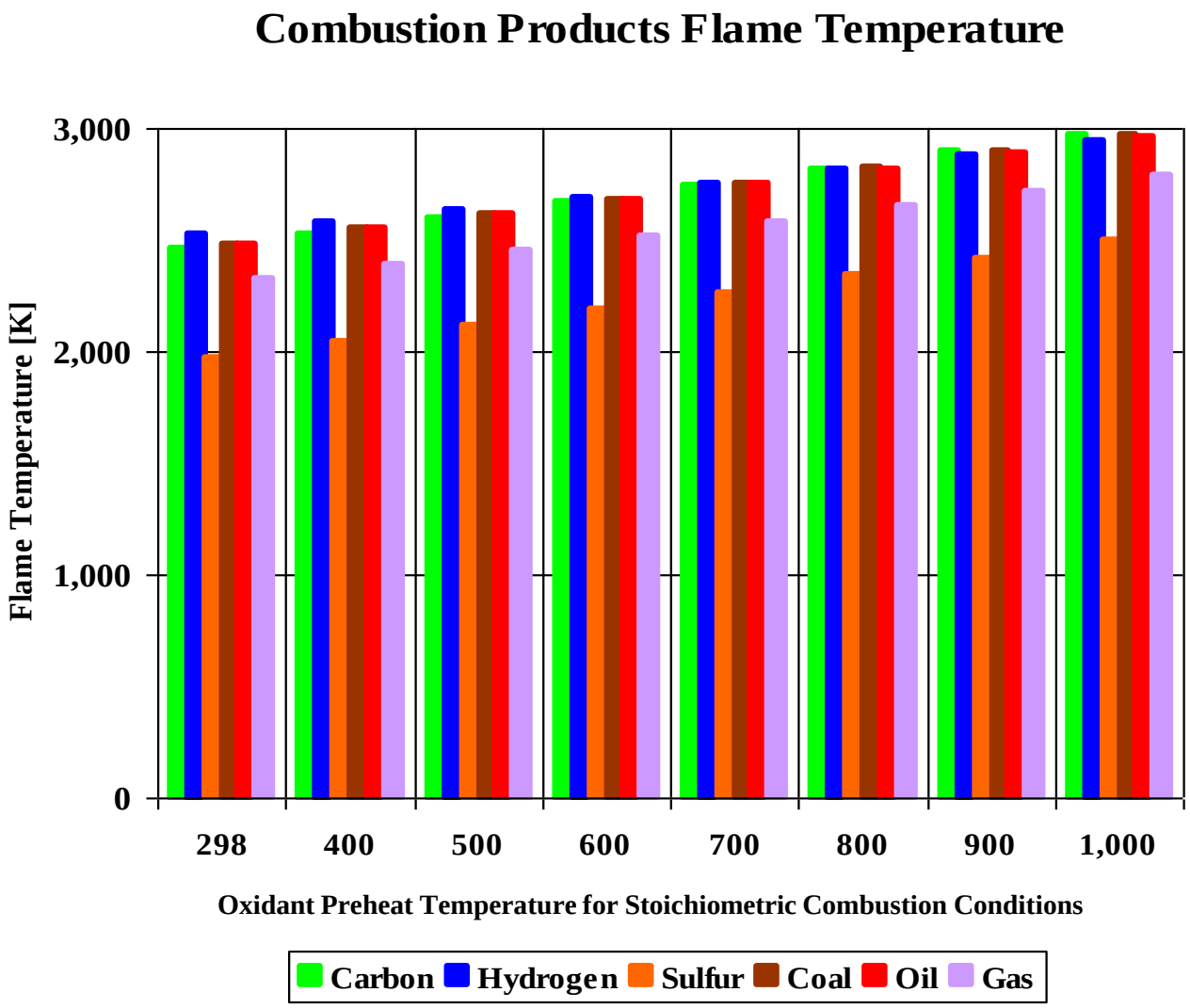
Fuel	C	H	S	N	O	H_2O	CH_4
	[kg/kg]	[kg/kg]	[kg/kg]	[kg/kg]	[kg/kg]	[kg/kg]	[kg/kg]
Carbon	1.000	0.000	0.000	0.000	0.000	0.000	-
Hydrogen	0.000	1.000	0.000	0.000	0.000	0.000	-
Sulfur	0.000	0.000	1.000	0.000	0.000	0.000	-
Coal	0.780	0.050	0.030	0.040	0.080	0.020	-
Oil	0.860	0.140	0.000	0.000	0.000	0.000	-
Gas	-	-	-	-	-	-	1.000

Stoichiometric Combustion Flame Temperature

Preheat Temperature [K]	Carbon [K]	Hydrogen [K]	Sulfur [K]	Coal [K]	Oil [K]	Gas [K]
298	2,460	2,525	1,972	2,484	2,484	2,327
400	2,531	2,583	2,045	2,551	2,551	2,391
500	2,602	2,640	2,118	2,618	2,616	2,455
600	2,674	2,689	2,191	2,686	2,683	2,520
700	2,747	2,757	2,267	2,756	2,751	2,586
800	2,822	2,818	2,343	2,827	2,820	2,653
900	2,898	2,879	2,421	2,899	2,891	2,721
1,000	2,976	2,942	2,501	2,972	2,963	2,791

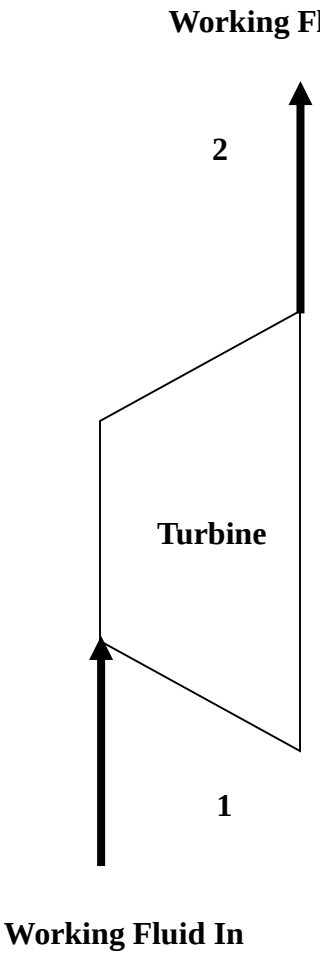
Combustion Products Stoichiometric Oxidant to Fuel Ratio and HHV

Fuel	Stoichiometric Oxidant to Fuel Ratio [/]	HHV [Btu/lbm]
Carbon	11.444	14,094
Hydrogen	34.333	60,997
Sulfur	4.292	3,982
Coal	10.487	14,162
Oil	14.649	20,660
Gas	17.167	21,563

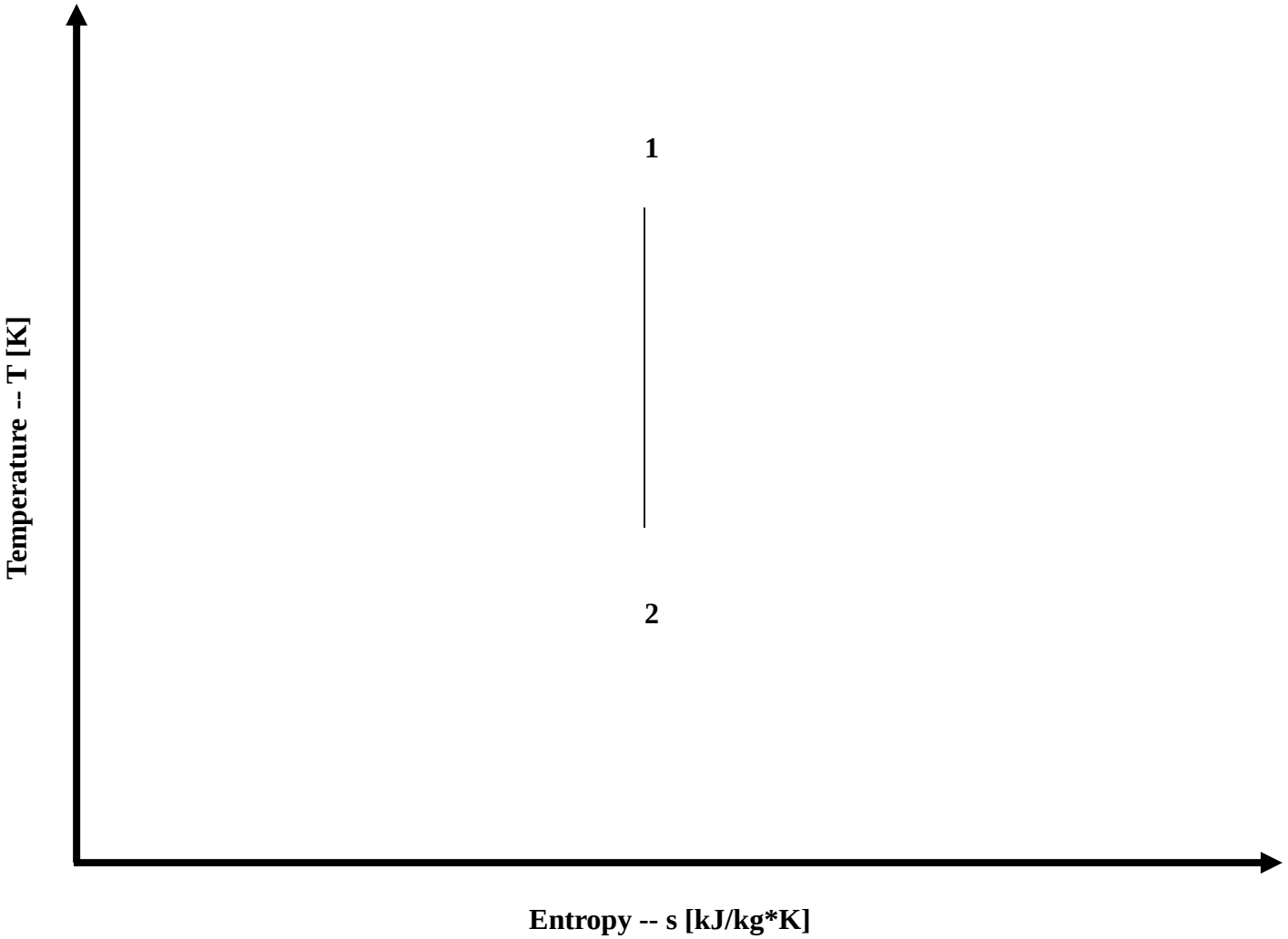

Combustion Products Flame Temperature
3,000
2,000
1,000
0
Flame Temperature [K]
298
400
500
600
700
800
900
1,000
Oxidant Preheat Temperature for Stoichiometric Combustion Conditions
Carbon
Hydrogen
Sulfur
Coal
Oil
Gas
Fuel Inlet Temperature: 298 [K]

Expansion

Here are some of the basic isentropic expansion data tables and plots.



Expansion Schematic Layout



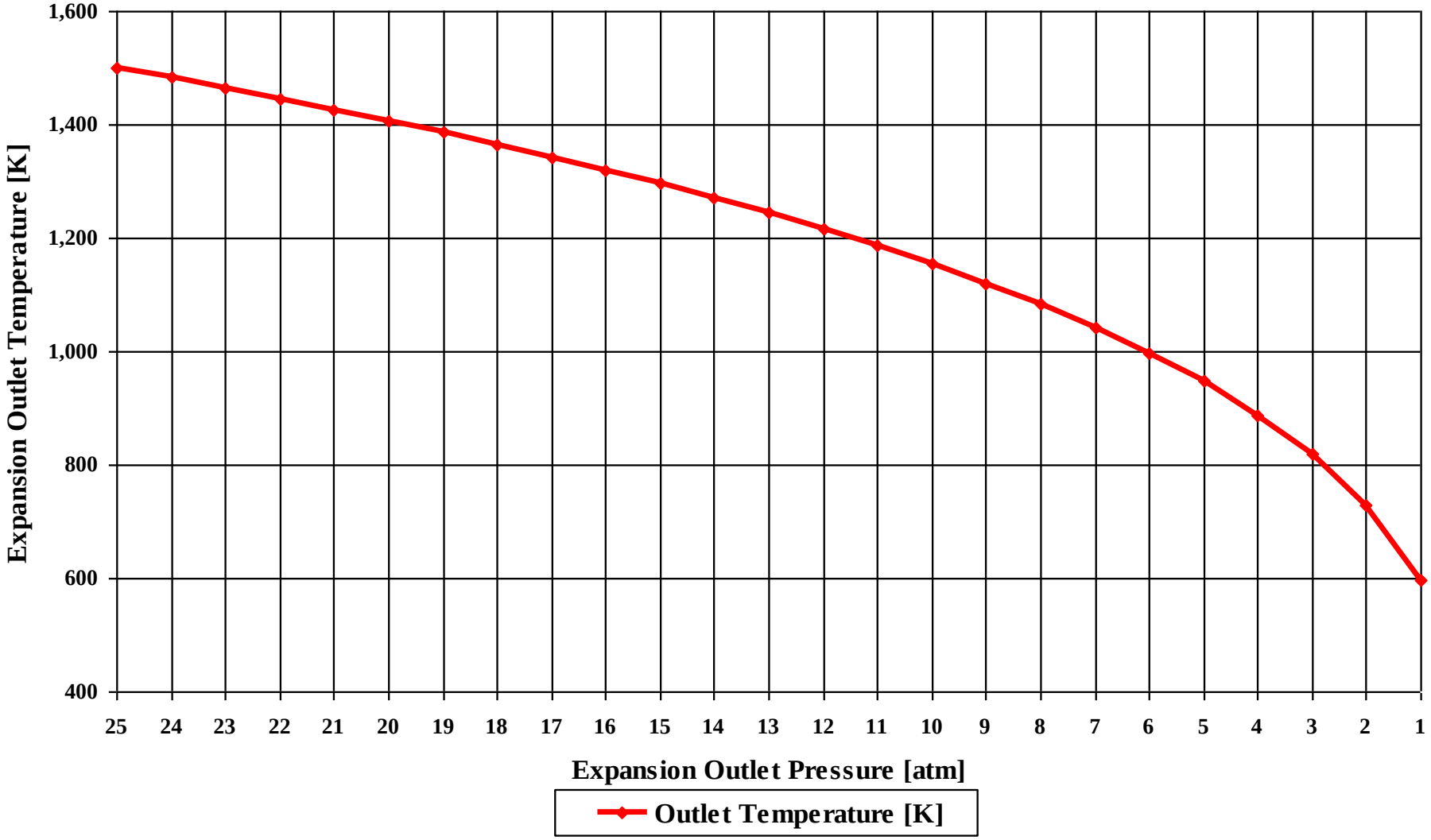
Expansion T - s Diagram

Input and Output Data

```
Expansion inlet temperature [K]: 1500
Expansion inlet pressure [atm]: 25
Expansion outlet pressure [atm]: 1
Expansion delta pressure step [atm]: 1
Expansion fluid kapa [/]: 1.4
Expansion fluid cp [kJ/kg*K]: 1.004
```

Step [/]	Tin [K]	Pin [atm]	Tout [K]	Pout [atm]	Specific Power [kW/kg/s]
1	1500	25	1500	25	0
2	1500	25	1482.61	24	17.4631
3	1500	25	1464.69	23	35.4539
4	1500	25	1446.2	22	54.0126
5	1500	25	1427.11	21	73.1838
6	1500	25	1407.35	20	93.0188
7	1500	25	1386.88	19	113.575
8	1500	25	1365.62	18	134.92
9	1500	25	1343.5	17	157.129
10	1500	25	1320.43	16	180.292
11	1500	25	1296.3	15	204.514
12	1500	25	1271	14	229.918
13	1500	25	1244.37	13	256.653
14	1500	25	1216.23	12	284.901
15	1500	25	1186.37	11	314.883
16	1500	25	1154.5	10	346.882
17	1500	25	1120.26	9	381.254
18	1500	25	1083.19	8	418.475
19	1500	25	1042.64	7	459.185
20	1500	25	997.72	6	504.289
21	1500	25	947.078	5	555.134
22	1500	25	888.581	4	613.865
23	1500	25	818.465	3	684.261
24	1500	25	728.934	2	774.15
25	1500	25	597.971	1	905.638

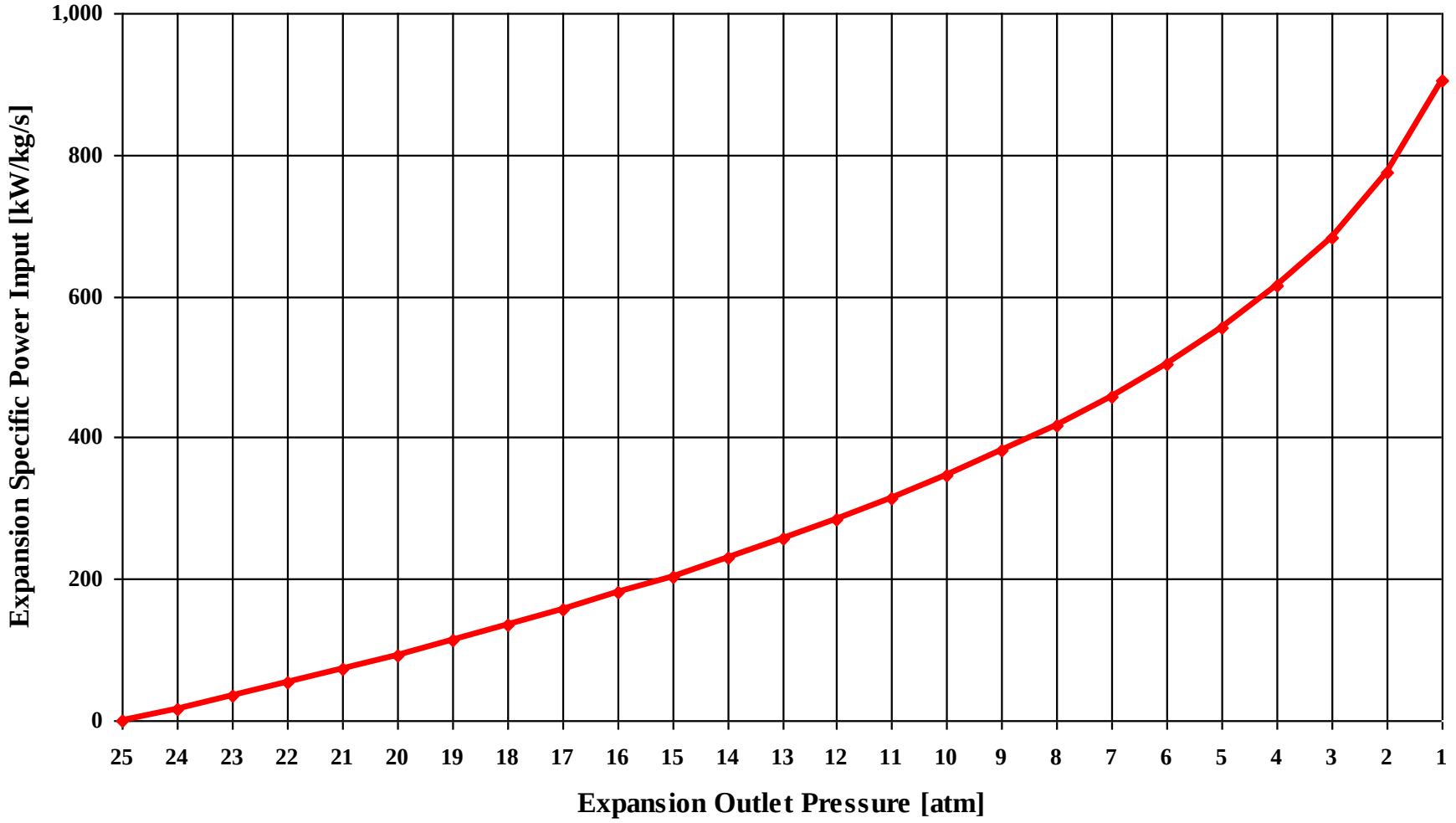
Expansion Outlet Temperature



Working Fluid: Air

Expansion Inlet Temperature: 1,500 [K] and Inlet Pressure: 25 [atm]

Expansion Specific Power Output



Working Fluid: Air

Expansion Inlet Temperature: 1,500 [K] and Inlet Pressure: 25 [atm]