```
"Scenario 12 - constant volume then constant pressurevheat addition"

F$ = 'Steam_IAPWS'                                  "water"

"Initial state - case A - subcooled liquid"

PA[1] = 101.325[kPa]                                "initial pressure same as external"
TA[1] = 25[C]                                       "initial temperature inside and outside"
vol[1] = 1e-3[m3]                                   "1 liter volume"

vA[1] = volume(F$, T=TA[1], P=PA[1])                "specific volume at state 1"
hA[1] = enthalpy(F$, T=TA[1], P=PA[1])              "specific enthalpy at state 1"
uA[1] = intenergy(F$, T=TA[1], P=PA[1])             "specific internal energy at state 1"
sA[1] = entropy(F$, T=TA[1], P=PA[1])               "specific entropy at state 1"
mass_A = vol[1]/vA[1]                               "mass of H2O"

"Add heat - go to state 2A the volume is constant until p_outside"
vol[3] = 2e-3[m3]                                   "final volume"
Q = 1[kW]                                           "rate of adding heat"

"state 2A - final state of constant volume"
P[2]=1000[kPa]                                      "p_outside"
PA[2]=P[2]                                          "pressure at state 2=p_outside"
vA[2]=vA[1]                                         "constant volume"
uA[2] = uA[1]+Q*time12/mass_A                       "determine internal energy from 1st law"
uA[2] = intenergy(F$,v=vA[2], P=PA[2])              "internal energy at state 2"
hA[2] = enthalpy(F$, P=PA[2], v=vA[2])              "specific enthalpy at state 2"
sA[2] = entropy(F$, P=PA[2], v=vA[2])               "specific entropy at state 2"
TA[2] = temperature(F$, P=PA[2], v=vA[2])           "temperature at state 2"

"state 3A - constant pressure"
PA[3] = PA[2]                                       "constant pressure"
vA[3]=vol[3]/mass_A                                 "specific volume at state 3"
TA[3]=temperature(F$,u=uA[3], P=PA[3])              "temperature at state 3 "
hA[3] = enthalpy(F$, u=uA[3], P=PA[3])              "specific enthalpy at state 3"
uA[3] = intenergy(F$,v=vA[3], P=PA[3])              "internal energy at state 3"
//vA[3] = volume(F$,u=uA[3], P=PA[3])               "specific volume at state 3"
sA[3] = entropy(F$, u=uA[3], P=PA[3])               "specific entropy at state 3"

uA[3] = uA[2]+Q*time23/mass_A-PA[2]*(vA[3]-vA[2])   "determine internal energy from 1st law"


"initial state - case B - two phase"
PB[1] = 101.325[kPa]                                "pressure at state 1"
xB[1] = 0.1                                         "quality at state 1B"
TB[1] =temperature(F$, P=PB[1], x=xB[1])            "temperature at state 1"
vB[1] = volume(F$, T=TB[1], x=xB[1])                "specific volume at state 1"
hB[1] = enthalpy(F$, T=TB[1], x=xB[1])              "specific enthalpy at state 1"
uB[1] = intenergy(F$, T=TB[1], x=xB[1])             "specific internal energy at state 1"
sB[1] = entropy(F$, T=TB[1], x=xB[1])               "specific entropy at state 1"
mass_B = vol[1]/vB[1]                               "mass of H2O"

 "state 2B - final state of constant volume"
PB[2]=P[2]                                          "pressure at state 2=p_outside"
vB[2]=vB[1]                                         "constant volume"
uB[2] = uB[1]+Q*time_B12/mass_B                     "determine internal energy from 1st law"
uB[2] = intenergy(F$,v=vB[2], P=PB[2])              "internal energy at state 2"
hB[2] = enthalpy(F$, P=PB[2], v=vB[2])              "specific enthalpy at state 2"
sB[2] = entropy(F$, P=PB[2], v=vB[2])               "specific entropy at state 2"
TB[2] = temperature(F$, P=PB[2], v=vB[2])           "temperature at state 2"

"state 3B - end of constant pressure"
PB[3] = PB[2]                                       "constant pressure"
vB[3]=vol[3]/mass_B                                 "specific volume at state 3"
TB[3]=temperature(F$,u=uB[3], P=PB[3])              "temperature at state 3"
hB[3] = enthalpy(F$, u=uB[3], P=PB[3])              "specific enthalpy at state 3"
uB[3] = intenergy(F$,v=vB[3], P=PB[3])              "internal energy at state 3"
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sB[3] = entropy(F$, u=uB[3], P=PB[3])                 "specific entropy at state 3"

uB[3] = uB[2]+Q*time_B23/mass_B-PB[2]*(vB[3]-vB[2])   "determine internal energy from 1st law"


"initial state - case C - superheated vapor"
PC[1] = 101.325[kPa]                                  "pressure at state 1"
TC[1] =130[C]                                         "temperture at state 1B"
vC[1] = volume(F$, T=TC[1], P=PC[1])                  "specific volume at state 1"
hC[1] = enthalpy(F$, T=TC[1],P=PC[1])                 "specific enthalpy at state 1"
uC[1] = intenergy(F$, T=TC[1],P=PC[1])                "specific internal energy at state 1"
sC[1] = entropy(F$, T=TC[1], P=PC[1])                 "specific entropy at state 1"
mass_C = vol[1]/vC[1]                                 "mass of H2O"

 "state 2C - final state of constant volume"
PC[2]=150[kPa]                                        "pressure at state 2 =p_outside"
vC[2]=vC[1]                                           "constant volume"
uC[2] = uC[1]+Q*time_C12/mass_C                       "determine internal energy from 1st law"
uC[2] = intenergy(F$,v=vC[2], P=PC[2])                "internal energy at state 2"
hC[2] = enthalpy(F$, P=PC[2], v=vC[2])                "specific enthalpy at state 2"
sC[2] = entropy(F$, P=PC[2], v=vC[2])                 "specific entropy at state 2"
TC[2] = temperature(F$, P=PC[2], v=vC[2])             "temperature at state 2"

 "state 3C - end of constant pressure"
PC[3] = PC[2]                                         "constant pressure"
vC[3]=vol[3]/mass_C                                   "specific volume at state 3"
TC[3]=temperature(F$,u=uC[3], P=PC[3])                "temperature at state 3"
hC[3] = enthalpy(F$, u=uC[3], P=PC[3])                "specific enthalpy at state 3"
uC[3] = intenergy(F$,v=vC[3], P=PC[3])                "internal energy at state 3"
sC[3] = entropy(F$, u=uC[3], P=PC[3])                 "specific entropy at state 3"

uC[3] = uC[2]+Q*time_C23/mass_C-PC[2]*(vC[3]-vC[2])                                     "determine
internal energy from 1st law"
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Parametric Table: Case C12

	$time_{C12}$ [s]	vC_2 [m3/kg]	TC_2 [C]	PC_2 [kPa]
Run 1	0	1.817	130	101.3
Run 2	0.001597	1.817	131.9	101.8
Run 3	0.003194	1.817	133.9	102.3
Run 4	0.004791	1.817	135.8	102.8
Run 5	0.006388	1.817	137.7	103.3
Run 6	0.007985	1.817	139.6	103.8
Run 7	0.009582	1.817	141.6	104.3
Run 8	0.01118	1.817	143.5	104.8
Run 9	0.01278	1.817	145.4	105.3
Run 10	0.01437	1.817	147.4	105.9
Run 11	0.01597	1.817	149.3	106.4
Run 12	0.01757	1.817	151.3	106.9
Run 13	0.01916	1.817	153.2	107.4
Run 14	0.02076	1.817	155.1	107.9
Run 15	0.02236	1.817	157.1	108.4
Run 16	0.02395	1.817	159	108.9
Run 17	0.02555	1.817	160.9	109.4
Run 18	0.02715	1.817	162.9	109.9
Run 19	0.02875	1.817	164.8	110.4
Run 20	0.03034	1.817	166.7	110.9
Run 21	0.03194	1.817	168.7	111.4
Run 22	0.03354	1.817	170.6	111.9
Run 23	0.03513	1.817	172.6	112.4

Parametric Table: Case C12

	$time_{C12}$ [s]	vC_2 [m3/kg]	TC_2 [C]	PC_2 [kPa]
Run 24	0.03673	1.817	174.5	112.9
Run 25	0.03833	1.817	176.4	113.4
Run 26	0.03992	1.817	178.4	113.9
Run 27	0.04152	1.817	180.3	114.4
Run 28	0.04312	1.817	182.2	114.9
Run 29	0.04472	1.817	184.2	115.4
Run 30	0.04631	1.817	186.1	115.9
Run 31	0.04791	1.817	188	116.4
Run 32	0.04951	1.817	190	116.9
Run 33	0.0511	1.817	191.9	117.4
Run 34	0.0527	1.817	193.8	117.9
Run 35	0.0543	1.817	195.8	118.4
Run 36	0.05589	1.817	197.7	118.9
Run 37	0.05749	1.817	199.6	119.4
Run 38	0.05909	1.817	201.6	119.9
Run 39	0.06068	1.817	203.5	120.3
Run 40	0.06228	1.817	205.4	120.8
Run 41	0.06388	1.817	207.4	121.3
Run 42	0.06548	1.817	209.3	121.8
Run 43	0.06707	1.817	211.2	122.3
Run 44	0.06867	1.817	213.1	122.8
Run 45	0.07027	1.817	215.1	123.3
Run 46	0.07186	1.817	217	123.8
Run 47	0.07346	1.817	218.9	124.3
Run 48	0.07506	1.817	220.8	124.8
Run 49	0.07665	1.817	222.8	125.3
Run 50	0.07825	1.817	224.7	125.8
Run 51	0.07985	1.817	226.6	126.3
Run 52	0.08145	1.817	228.5	126.8
Run 53	0.08304	1.817	230.4	127.3
Run 54	0.08464	1.817	232.3	127.8
Run 55	0.08624	1.817	234.3	128.2
Run 56	0.08783	1.817	236.2	128.7
Run 57	0.08943	1.817	238.1	129.2
Run 58	0.09103	1.817	240	129.7
Run 59	0.09262	1.817	241.9	130.2
Run 60	0.09422	1.817	243.8	130.7
Run 61	0.09582	1.817	245.7	131.2
Run 62	0.09742	1.817	247.6	131.7
Run 63	0.09901	1.817	249.5	132.2
Run 64	0.1006	1.817	251.5	132.7
Run 65	0.1022	1.817	253.4	133.1
Run 66	0.1038	1.817	255.3	133.6
Run 67	0.1054	1.817	257.2	134.1
Run 68	0.107	1.817	259.1	134.6
Run 69	0.1086	1.817	261	135.1
Run 70	0.1102	1.817	262.9	135.6
Run 71	0.1118	1.817	264.8	136.1
Run 72	0.1134	1.817	266.7	136.6
Run 73	0.115	1.817	268.6	137
Run 74	0.1166	1.817	270.5	137.5
Run 75	0.1182	1.817	272.3	138
Run 76	0.1198	1.817	274.2	138.5
Run 77	0.1214	1.817	276.1	139
Run 78	0.123	1.817	278	139.5

Parametric Table: Case C12

	$time_{C12}$ [s]	vC_2 [m3/kg]	TC_2 [C]	PC_2 [kPa]
Run 79	0.1246	1.817	279.9	139.9
Run 80	0.1262	1.817	281.8	140.4
Run 81	0.1278	1.817	283.7	140.9
Run 82	0.1294	1.817	285.6	141.4
Run 83	0.131	1.817	287.5	141.9
Run 84	0.1325	1.817	289.3	142.4
Run 85	0.1341	1.817	291.2	142.8
Run 86	0.1357	1.817	293.1	143.3
Run 87	0.1373	1.817	295	143.8
Run 88	0.1389	1.817	296.9	144.3
Run 89	0.1405	1.817	298.7	144.8
Run 90	0.1421	1.817	300.6	145.2
Run 91	0.1437	1.817	302.5	145.7
Run 92	0.1453	1.817	304.4	146.2
Run 93	0.1469	1.817	306.2	146.7
Run 94	0.1485	1.817	308.1	147.1
Run 95	0.1501	1.817	310	147.6
Run 96	0.1517	1.817	311.8	148.1
Run 97	0.1533	1.817	313.7	148.6
Run 98	0.1549	1.817	315.6	149.1
Run 99	0.1565	1.817	317.4	149.5
Run 100	0.1581	1.817	319.3	150