

What are the Effects of Pressure and Temperature on Steam?

Steam Table

Pressure		Temperature	
PSIG	PSI	°F	°C
0	14.7	212.0	100.0
1	15.7	215.5	101.9
2	16.7	218.5	103.6
3	17.7	221.5	105.3
4	18.7	224.5	106.9
5	19.7	227.4	108.6
6	20.7	230.0	110.0
7	21.7	232.4	111.3
8	22.7	234.8	112.7
9	23.7	237.1	113.9
10	24.7	239.4	115.2
11	25.7	241.6	116.4
12	26.7	243.7	117.6
13	27.7	245.8	118.8
14	28.7	247.9	119.9
15	29.7	249.8	121.0
16	30.7	251.7	122.1
17	31.7	253.6	123.1
18	32.7	255.6	124.2
19	33.7	257.2	125.1
20	34.7	258.8	126.0
21	35.7	260.6	127.0
22	36.7	262.3	127.9
23	37.7	263.8	128.8
24	38.7	265.3	129.6
25	39.7	266.8	130.4
26	40.7	268.3	131.3
27	41.7	269.9	132.2

Pressure		Temperature	
PSIG	PSI	°F	°C
28	42.7	271.4	133.0
29	43.7	272.7	133.7
30	44.7	274.0	134.4
31	45.7	275.4	135.2
32	46.7	276.7	135.9
33	47.7	278.1	136.7
34	48.7	279.4	137.4
35	49.7	280.7	138.2
36	50.7	281.9	138.8
37	51.7	283.2	139.6
38	52.7	284.4	140.2
39	53.7	285.6	140.8
40	54.7	286.7	141.5
41	55.7	287.9	142.2
42	56.7	289.0	142.8
43	57.7	290.2	143.4
44	58.7	291.3	144.1
45	59.7	292.4	144.7
46	60.7	293.5	145.3
47	61.7	294.6	145.9
48	62.7	295.6	146.4
49	63.7	296.7	147.1
50	64.7	297.7	147.6
51	65.7	298.7	148.2
52	66.7	299.7	148.7
53	67.7	300.7	149.3
54	68.7	301.7	149.8
55	69.7	302.7	150.4

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Pressure vs. Temperature (Continued)

Sterility Requirements

The need to produce and maintain aseptic conditions is one of the distinguishing features of fermentation systems. The fermenter and feed-system piping must be steam sterilized prior to each fermentation cycle. The accepted procedure involves heating the entire system with steam to a minimum of 121° C for 60 minutes or more.*

Large industrial fermentation systems often prove more difficult to sterilize. Such systems may require steam heating to temperatures approaching 150° C for sterilization periods approaching 4 hours to insure that all hard-to-reach internal areas have been brought to minimum sterilization temperatures.

Steam Requirements

To achieve these elevated temperatures the steam is pressurized and continuously fed through the fermentation system. The temperature is maintained and controlled by monitoring and controlling the steam pressure. The steam table to the right lists the temperatures that are achieved at steam pressures over one atmosphere, 14.7 pounds per square inch.

Steam Table

The information given in the four columns of the table is as follows:

- PSIG** Pounds per square inch (gauge) gives the steam pressure as registered on a normal pressure gauge in psi. Atmospheric pressure (14.7 psi) is zero on such a gauge.
- PSI** Pounds per square inch (absolute) gives the total steam pressure including atmospheric pressure.
- °F** Shows the °F temperature of steam at the pressure indicated.
- °C** Shows the °C temperature of steam at the pressure indicated.

Note:

If condensate is allowed to collect inside the fermentation system it can insulate contaminating bacteria from sterilization temperatures. Fermentation vessels should be designed with smooth contours to ensure complete drainage.



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