

# **CALORCOL**

Expertos en Ingeniería de Aislamientos

**Cuatro beneficios en un solo producto**



**Calor**



**Ruido**



**Fuego**



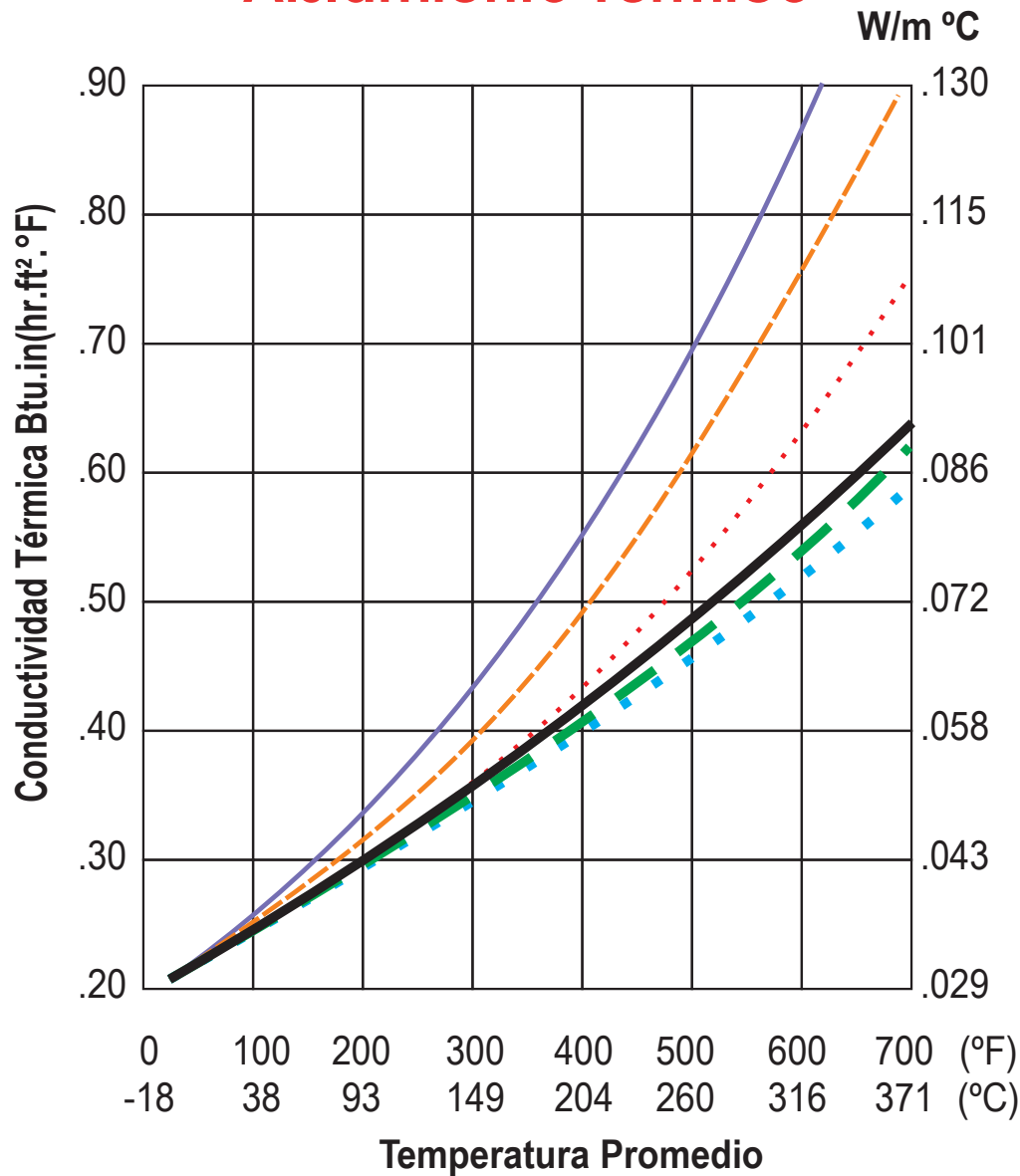
**Ambiental**

# TABLAS TÉCNICAS

[www.calorcol.com](http://www.calorcol.com)

# CONDUCTIVIDAD TÉRMICA vs DENSIDAD

## Aislamiento Térmico



**LA DENSIDAD  
SI IMPORTA !**

- Referencias:
- D3 — Densidad 3 lb/ft<sup>3</sup> (48 Kg/m<sup>3</sup>)
  - D4 - - - Densidad 4 lb/ft<sup>3</sup> (64 Kg/m<sup>3</sup>)
  - D6 . . . Densidad 6 lb/ft<sup>3</sup> (96 Kg/m<sup>3</sup>)
  - D8 ——— Densidad 8 lb/ft<sup>3</sup> (128 Kg/m<sup>3</sup>)
  - D10 - - - Densidad 10 lb/ft<sup>3</sup> (160 Kg/m<sup>3</sup>)
  - D12 . . . Densidad 12 lb/ft<sup>3</sup> (192 Kg/m<sup>3</sup>)

# CONDUCTIVIDAD TÉRMICA vs DENSIDAD

## Comportamiento térmico (unidades inglesas)

Temperatura promedio (°F)	Btu.in/(hr.ft <sup>2</sup> .°F)					
	D3	D4	D6	D8	D10	D12
25	0.21	0.21	0.22	0.22	0.22	0.22
75	0.25	0.24	0.23	0.23	0.23	0.23
100	0.27	0.26	0.25	0.25	0.25	0.25
200	0.34	0.32	0.30	0.30	0.30	0.30
300	0.43	0.40	0.36	0.36	0.35	0.35
400	0.55	0.49	0.42	0.42	0.41	0.40
500	0.70	0.62	0.53	0.49	0.47	0.46
600	0.87	0.75	0.63	0.56	0.54	0.52
700	1.06	0.90	0.75	0.64	0.62	0.59

## Comportamiento térmico (unidades inglesas)

Temperatura promedio (°C)	W/m.°C					
	D3	D4	D6	D8	D10	D12
-4	0.030	0.030	0.032	0.032	0.032	0.032
24	0.036	0.035	0.033	0.033	0.033	0.033
38	0.039	0.037	0.036	0.036	0.036	0.036
93	0.049	0.046	0.043	0.043	0.043	0.043
149	0.062	0.058	0.052	0.052	0.050	0.050
204	0.079	0.071	0.061	0.061	0.059	0.058
260	0.101	0.089	0.076	0.071	0.068	0.066
316	0.125	0.108	0.091	0.081	0.078	0.075
371	0.153	0.130	0.108	0.092	0.089	0.085

# ESPESORES ECONÓMICOS PARA OPERACIÓN EN CALIENTE

## PÉRDIDAS DE CALOR POR PIE, TEMPERATURA SUPERFICIAL EN °F

Diámetro nominal de la tubería		1/2	3/4	1	1¼	1½	2	2½	3	3½	4	
Temperatura de servicio	Espesor recomendado	1	1	1	1	1	1	1	1½	1½	1½	
150°F (65.6°C)	E=0.1	Ts	87.6	89.6	88.2	90.9	89.7	90.4	90.9	87.1	85.9	87.6
		Q	7.1	8.4	8.8	11.1	11.3	13.2	15.1	13.7	13.7	16.5
	E=0.3	Ts	85.4	87.2	85.9	88.3	87.2	87.7	88.2	84.8	83.7	85.2
		Q	7.3	8.7	9.1	11.5	11.7	13.7	15.7	14.2	14.2	17.1
	E=0.9	Ts	81.9	83.2	82.2	83.9	83.1	83.4	83.7	81.2	80.4	81.5
		Q	7.7	9.3	9.6	12.3	12.5	14.6	16.8	15.0	14.9	18.0
	Sin aislamiento	Ts	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0
		Q	39.1	47.3	57.2	70.5	79.6	97.9	115.0	139.0	158.0	176.0
Temperatura de servicio	Espesor recomendado	1	1½	1½	1½	1½	2	2	2	2	2	
250°F (121.1°C)	E=0.1	Ts	103.0	96.4	96.0	96.2	98.3	93.7	92.5	95.8	94.2	96.9
		Q	18.7	17.8	19.3	21.5	24.2	23.5	24.8	30.6	31.1	36.4
	E=0.3	Ts	98.5	92.6	92.3	92.4	94.3	90.2	89.2	92.0	60.6	92.9
		Q	19.1	18.2	19.7	21.9	24.7	24.0	25.3	31.2	31.7	37.2
	E=0.9	Ts	90.9	86.5	86.2	86.3	87.6	84.6	83.9	85.8	84.8	86.4
		Q	20.0	18.8	20.3	22.7	25.6	24.7	26.0	32.3	32.7	38.5
	Sin aislamiento	Ts	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0
		Q	114.0	138.0	168.0	207.0	234.0	289.0	344.0	412.0	466.0	520.0
Temperatura de servicio	Espesor recomendado	1½	1½	1½	1½	2	2	2½	2½	2½	2½	
350°F (176.7°C)	E=0.1	Ts	105.0	109.0	108.0	108.0	100.0	104.0	98.2	102.0	100.0	103.0
		Q	27.1	31.3	34.0	37.8	34.2	41.4	39.2	47.2	48.6	55.7
	E=0.3	Ts	99.9	103.0	102.0	103.0	95.6	99.3	93.8	97.2	95.7	98.3
		Q	27.6	31.9	34.5	38.5	34.7	42.1	39.7	47.9	49.3	56.6
	E=0.9	Ts	91.5	93.9	93.4	93.5	88.3	90.8	36.9	89.2	88.2	90.0
		Q	28.3	32.8	35.5	39.6	35.5	43.2	40.5	49.1	50.4	58.1
	Sin aislamiento	Ts	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0
		Q	212.0	258.0	314.0	388.0	439.0	542.0	646.0	775.0	787.0	981.0
Temperatura de servicio	Espesor recomendado	1½	2	2	2	2	2½	2½	2½	2½	3	
450°F (232.2°C)	E=0.1	Ts	117.0	111.0	110.0	116.0	110.0	109.0	107.0	113.0	111.0	108.0
		Q	41.4	41.9	45.1	53.3	52.2	56.3	59.8	72.1	74.1	75.1
	E=0.3	Ts	110.0	105.0	105.0	109.0	104.0	103.0	102.0	106.0	104.0	102.0
		Q	42.0	42.4	45.6	54.1	52.8	57.0	60.5	73.0	75.0	76.0
	E=0.9	Ts	98.9	95.1	94.5	97.8	94.2	93.3	92.3	95.5	94.1	92.6
		Q	43.0	43.3	46.6	55.4	53.9	58.1	61.6	74.6	76.6	77.4
	Sin aislamiento	Ts	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0
		Q	337.0	411.0	500.0	621.0	702.0	869.0	1037.0	1244.0	1411.0	1577.0

### Convenciones:

Ts: Temperatura superficial °F

Q: Pérdidas de calor (Btu/hr.ft)

E: Emisividad

4½	5	6	7	8	9	10	12	14	16	18	20	24	30	36	48
1½	1½	1½	1½	1½	1½	1½	1½	1½	2	2	2	2	2	2	2
86.3	88.4	89.0	88.8	89.7	89.9	89.0	89.3	90.3	87.5	87.6	87.7	87.9	88.1	88.3	88.5
16.1	19.9	23.1	25.2	27.9	30.6	32.7	37.8	43.3	39.1	43.4	47.6	56.2	69.0	81.8	107.0
84.1	85.9	86.4	86.2	86.4	86.6	86.3	86.5	87.4	84.9	85.0	85.1	85.3	85.5	85.6	85.7
16.7	20.7	24.1	26.2	29.0	31.9	34.0	39.4	45.3	40.6	45.1	49.5	58.5	71.9	85.2	112.0
80.7	82.0	82.3	82.1	92.3	82.3	82.2	82.3	82.9	81.1	81.2	81.3	81.4	81.5	81.5	81.6
17.5	21.9	25.6	27.9	30.9	33.9	36.2	42.0	48.4	42.9	47.6	52.4	61.9	76.2	90.4	119.0
150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0	150.0
194.0	216.0	254.0	290.0	326.0	362.0	402.0	474.0	515.0	586.0	657.0	728.0	869.0	1081.0	1291.0	1712.0

2	2	2½	2½	2½	2½	2½	2½	2½	3	3	3	3	3	3	3
95.1	98.2	94.6	95.1	94.6	95.0	95.8	96.3	97.4	94.6	94.9	95.1	95.0	95.9	96.2	96.8
36.3	43.4	42.1	46.8	49.7	54.1	60.3	69.3	77.3	75.1	83.0	90.9	103.0	130.0	154.0	201.0
91.3	94.0	90.8	91.2	90.8	91.1	91.8	92.2	93.1	90.7	90.9	91.1	91.4	91.8	92.0	92.3
37.0	44.4	43.0	47.8	50.7	55.3	61.6	70.9	79.1	76.7	84.8	92.9	109.0	133.0	157.0	206.0
85.3	87.2	84.9	85.2	84.9	85.1	85.5	85.8	86.4	84.7	84.8	85.0	85.1	85.3	85.5	85.7
38.3	46.1	44.4	49.4	52.3	57.1	63.7	73.3	82.0	79.2	87.6	96.0	113.0	138.0	163.0	213.0
250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0	250.0
575.0	640.0	754.0	862.0	969.0	1075.0	1195.0	1408.0	1532.0	1744.0	1956.0	2167.0	2588.0	3219.0	3849.0	5106.0

2½	2½	3	3	3	3	3	3½	3½	3½	3½	3½	3½	4	4	4
101.0	104.0	101.0	101.0	102.0	102.0	103.0	100.0	102.0	102.0	102.0	103.0	103.0	100.0	101.0	102.0
55.6	64.7	65.7	70.6	77.4	84.1	93.2	95.4	105.0	117.0	129.0	141.0	165.0	176.0	207.0	269.0
96.3	99.2	96.4	96.1	96.6	97.0	98.0	95.5	96.4	96.8	97.2	97.6	98.0	95.4	95.0	96.2
56.4	65.8	66.7	71.7	78.6	85.4	94.7	96.9	107.0	119.0	132.0	144.0	168.0	179.0	209.0	273.0
88.5	90.5	88.6	88.4	88.7	88.9	89.5	87.8	88.5	88.7	88.9	98.1	89.4	87.6	87.8	88.1
57.8	67.5	68.2	73.4	80.5	87.5	97.1	99.1	109.0	122.0	135.0	147.0	173.0	183.0	215.0	280.0
350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0
1084.0	1209.0	1425.0	1628.0	1831.0	2300.0	2262.0	2665.0	2901.0	3304.0	3706.0	4107.0	4909.0	6108.0	7306.0	9696.0

3	3	3	3	3	3	3½	3½	3½	3½	4	4	4	4	4	4
107.0	110.0	112.0	111.0	112.0	108.0	110.0	110.0	112.0	113.0	108.0	109.0	110.0	110.0	111.0	112.0
76.7	87.9	100.0	108.0	118.0	116.0	127.0	146.0	160.0	179.0	173.0	189.0	221.0	268.0	316.0	410.0
101.0	104.0	105.0	105.0	106.0	102.0	103.0	104.0	105.0	106.0	102.0	102.0	103.0	104.0	104.0	105.0
77.6	89.0	102.0	109.0	120.0	117.0	129.0	148.0	162.0	181.0	176.0	192.0	224.0	272.0	320.0	416.0
91.6	93.7	94.7	94.3	94.8	92.4	93.1	93.6	94.5	64.8	92.2	92.4	92.8	93.3	93.6	94.0
79.0	90.9	104.0	112.0	122.0	119.0	132.0	151.0	166.0	185.0	179.0	196.0	229.0	278.0	327.0	425.0
450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0
1743.0	1945.0	2295.0	2624.0	2952.0	3279.0	3648.0	4302.0	4683.0	5335.0	5986.0	6636.0	7935.0	9879.0	11821.0	15696.0

**Bases de cálculo:**

**Velocidad del viento:** 0 ft/min

**Emisividad (E):** 0.1 (Aluminio nuevo)

**Emisividad (E):** 0.9 (Acabado mate)

**Emisividad (E):** 0.3 (Aluminio oxidado en servicio)

**Temperatura ambiente (Ta):** 75°F(23.8°C)

# ESPESORES ECONÓMICOS PARA OPERACIÓN EN CALIENTE

## PÉRDIDAS DE CALOR POR PIE, TEMPERATURA SUPERFICIAL EN °F

Diámetro nominal de la tubería		1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	
Temperatura de servicio	Esesor recomendado	1 1/2	2	2	2	2 1/2	2 1/2	2 1/2	3	3	3	
550°F (287.8°C)	E=0.1	Ts	130.0	123.0	122.0	129.0	114.0	120.0	118.0	117.0	115.0	119.0
		Q	58.7	59.3	63.0	75.6	67.1	79.8	84.6	91.9	94.2	106.0
	E=0.3	Ts	122.0	115.0	114.0	120.0	107.0	112.0	111.0	110.0	108.0	111.0
		Q	59.5	60.0	64.6	76.6	67.8	80.7	85.6	92.9	95.2	108.0
	E=0.9	Ts	107.0	102.0	101.0	106.0	96.2	99.8	98.5	98.1	96.3	98.9
		Q	60.8	61.1	65.8	78.2	68.9	82.1	87.0	94.5	96.7	109.0
	Sin aislamiento	Ts	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0
		Q	494.0	603.0	736.0	915.0	1036.0	1283.0	1533.0	1842.0	2090.0	2338.0
Temperatura de servicio	Esesor recomendado	2	2 1/2	2 1/2	2 1/2	2 1/2	3	3	3 1/2	3 1/2	3 1/2	
650°F (343.3°C)	E=0.1	Ts	130.0	119.0	124.0	130.0	124.0	123.0	122.0	121.0	119.0	123.0
		Q	70.6	69.0	78.1	90.7	90.7	98.4	105.0	113.0	118.0	131.0
	E=0.3	Ts	121.0	112.0	116.0	116.0	116.0	115.0	114.0	113.0	112.0	115.0
		Q	71.3	69.6	78.8	91.6	91.6	99.3	106.0	114.0	119.0	133.0
	E=0.9	Ts	106.0	99.3	102.0	106.0	102.0	102.0	101.0	99.9	99.0	101.0
		Q	72.5	70.5	79.9	93.1	92.9	101.0	107.0	115.0	120.0	135.0
	Sin aislamiento	Ts	650.0	650.0	650.0	650.0	650.0	650.0	650.0	650.0	650.0	650.0
		Q	690.0	843.0	1031.0	1283.0	1455.0	1805.0	2158.0	2595.0	2947.0	3297.0
Temperatura de servicio	Esesor recomendado	2 1/2	2 1/2	2 1/2	3	3	3 1/2	3 1/2	4	4	4	
750°F (398.9°C)	E=0.1	Ts	125.0	129.0	135.0	132.0	128.0	127.0	125.0	125.0	124.0	128.0
		Q	81.0	90.3	102.0	109.0	110.0	119.0	126.0	137.0	144.0	159.0
	E=0.3	Ts	117.0	121.0	126.0	123.0	119.0	118.0	114.0	117.0	115.0	119.0
		Q	81.6	91.0	103.0	110.0	111.0	120.0	127.0	138.0	145.0	161.0
	E=0.9	Ts	103.0	105.0	109.0	107.0	104.0	104.0	102.0	102.0	102.0	104.0
		Q	82.5	92.1	104.0	111.0	112.0	122.0	129.0	140.0	146.0	163.0
	Sin aislamiento	Ts	750.0	750.0	750.0	750.0	750.0	750.0	750.0	750.0	750.0	750.0
		Q	931.0	1141.0	1397.0	1741.0	1976.0	2454.0	2937.0	3534.0	4015.0	4495.0
Temperatura de servicio	Esesor recomendado	2 1/2	3	3	3 1/2	3 1/2	4	4	4 1/2	4 1/2	4 1/2	
850°F (454.4°C)	E=0.1	Ts	136.0	132.0	137.0	135.0	131.0	130.0	129.0	130.0	135.0	132.0
		Q	103.0	108.0	121.0	129.0	131.0	142.0	152.0	165.0	184.0	188.0
	E=0.3	Ts	126.0	122.0	127.0	125.0	122.0	121.0	120.0	120.0	125.0	122.0
		Q	104.0	108.4	122.0	130.0	132.0	143.0	153.0	166.0	185.0	189.0
	E=0.9	Ts	109.0	107.0	110.0	108.0	106.0	105.0	105.0	105.0	108.0	106.0
		Q	105.0	110.0	123.0	131.0	134.0	144.0	154.0	168.0	187.0	191.0
	Sin aislamiento	Ts	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0
		Q	1227.0	1506.0	1847.0	2305.0	2618.0	3254.0	3898.0	4693.0	5334.0	5974.0

### Convenciones:

Ts: Temperatura superficial °F

Q: Pérdidas de calor (Btu/hr.ft)

E: Emisividad

4½	5	6	7	8	9	10	12	14	16	18	20	24	30	36	48
3	3	3½	3½	3½	3½	3½	4	4	4	4	4	4	4½	4½	4½
117.0	121.0	116.0	117.0	118.0	119.0	120.0	117.0	117.0	118.0	119.0	119.0	120.0	118.0	119.0	120.0
109.0	115.0	125.0	138.0	151.0	164.0	181.0	187.0	200.0	223.0	246.0	268.0	313.0	354.0	416.0	540.0
109.0	114.0	109.0	110.0	111.0	111.0	113.0	109.0	110.0	110.0	111.0	112.0	112.0	111.0	111.0	112.0
110.0	126.0	127.0	140.0	153.0	166.0	183.0	189.0	203.0	226.0	249.0	271.0	317.0	359.0	421.0	547.0
97.4	100.0	96.9	97.5	98.1	98.5	99.5	97.1	97.4	97.9	98.3	98.6	99.1	97.9	98.3	98.8
112.0	128.0	129.0	142.0	155.0	169.0	186.0	193.0	206.0	230.0	253.0	276.0	323.0	365.0	429.0	557.0
550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0
2585.0	2886.0	3407.0	3897.0	4386.0	4873.0	5423.0	6398.0	6967.0	7940.0	8911.0	9882.0	11820.0	14723.0	17622.0	23411.0

4	4	4	4	4	4½	4½	4½	4½	5	5	5	5	5½	5½	5½
116.0	119.0	121.0	123.0	124.0	120.0	121.0	123.0	125.0	121.0	122.0	123.0	124.0	122.0	123.0	124.0
123.0	138.0	156.0	171.0	187.0	187.0	204.0	232.0	255.0	261.0	287.0	312.0	363.0	408.0	478.0	617.0
108.0	112.0	113.0	114.0	115.0	112.0	113.0	114.0	116.0	113.0	114.0	114.0	115.0	113.0	114.0	115.0
124.0	140.0	157.0	173.0	189.0	188.0	206.0	234.0	257.0	263.0	289.0	315.0	366.0	412.0	482.0	623.0
96.5	98.9	100.0	101.0	101.0	98.9	99.8	101.0	102.0	99.6	100.0	101.0	101.0	99.8	100.0	101.0
126.0	141.0	159.0	175.0	191.0	191.0	209.0	238.0	261.0	267.0	293.0	320.0	372.0	418.0	489.0	632.0
650.0	650.0	650.0	650.0	650.0	650.0	650.0	650.0	650.0	650.0	650.0	650.0	650.0	650.0	650.0	650.0
3647.0	4073.0	4812.0	5506.0	6199.0	6889.0	7669.0	9051.0	9859.0	11239.0	12617.0	13995.0	16746.0	20868.0	24984.0	33205.0

4½	4½	4½	5	5	5	5	5½	5½	5½	6	6	6	6	6	6
125.0	124.0	126.0	123.0	124.0	125.0	127.0	125.0	127.0	128.0	125.0	126.0	127.0	129.0	130.0	132.0
162.0	169.0	189.0	195.0	211.0	228.0	249.0	266.0	289.0	320.0	328.0	356.0	413.0	497.0	581.0	748.0
117.0	116.0	118.0	115.0	116.0	117.0	118.0	116.0	118.0	119.0	116.0	115.0	118.0	119.0	120.0	121.0
163.0	170.0	191.0	196.0	213.0	230.0	251.0	268.0	291.0	322.0	330.0	359.0	416.0	501.0	586.0	754.0
102.0	102.0	103.0	101.0	102.0	102.0	103.0	102.0	103.0	103.0	102.0	102.0	103.0	104.0	104.0	105.0
165.0	172.0	193.0	198.0	215.0	232.0	254.0	271.0	294.0	326.0	334.0	363.0	421.0	507.0	593.0	765.0
750.0	750.0	750.0	750.0	750.0	750.0	750.0	750.0	750.0	750.0	750.0	750.0	750.0	750.0	750.0	750.0
4974.0	5557.0	6568.0	7518.0	8466.0	9411.0	10479.0	12373.0	13479.0	15370.0	17260.0	19148.0	22921.0	28572.0	34217.0	45494.0

5	5	5	5½	5½	6	6	6	6	6	6	6	6	6	6	6
130.0	129.0	131.0	129.0	131.0	128.0	129.0	131.0	133.0	135.0	136.0	137.0	138.0	140.0	142.0	144.0
194.0	203.0	225.0	236.0	256.0	263.0	283.0	320.0	346.0	382.0	419.0	455.0	527.0	635.0	742.0	955.0
121.0	120.0	121.0	120.0	121.0	119.0	120.0	121.0	123.0	124.0	125.0	126.0	127.0	129.0	130.0	131.0
195.0	204.0	227.0	237.0	257.0	264.0	285.0	322.0	348.0	385.0	422.0	458.0	531.0	639.0	748.0	963.0
105.0	104.0	106.0	104.0	105.0	104.0	104.0	105.0	106.0	107.0	108.0	108.0	109.0	110.0	111.0	112.0
197.0	206.0	229.0	240.0	260.0	267.0	288.0	325.0	352.0	389.0	426.0	463.0	537.0	647.0	757.0	976.0
850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0	850.0	350.0	850.0	850.0
6613.0	7391.0	8739.0	10006.0	11271.0	12532.0	13956.0	16485.0	17961.0	20487.0	23011.0	25533.0	30572.0	38123.0	45666.0	60737.0

**Bases de cálculo:**

**Velocidad del viento:** 0 ft/min

**Emisividad (E):** 0.1 (Aluminio nuevo)

**Emisividad (E):** 0.9 (Acabado mate)

**Emisividad (E):** 0.3 (Aluminio oxidado en servicio)

**Temperatura ambiente (Ta):** 75°F(23.8°C)

# ESPESORES ECONÓMICOS PARA OPERACIÓN EN CALIENTE

## PÉRDIDAS DE CALOR POR METRO, TEMPERATURA SUPERFICIAL EN °C

Diámetro nominal de la tubería		1/2	3/4	1	1¼	1½	2	2½	3	3½	4	
Temperatura de servicio	Esesor recomendado	1	1	1	1	1	1	1	1½	1½	1½	
150°F (65.6°C)	E=0.1	Ts	30.9	32.0	31.2	32.7	32.1	32.4	32.7	30.6	29.9	30.9
		Q	23.2	27.6	28.8	36.4	37.1	43.3	49.5	44.9	44.9	54.1
	E=0.3	Ts	29.7	30.7	29.9	31.3	30.7	30.9	31.2	29.3	28.7	29.6
		Q	24.0	28.6	29.8	37.7	38.4	44.9	51.5	46.6	46.6	56.1
	E=0.9	Ts	27.7	28.4	27.9	28.8	28.4	28.6	28.7	27.3	26.9	27.5
		Q	25.0	30.4	31.5	40.4	41.0	47.9	55.1	49.2	48.9	59.1
	Sin aislamiento	Ts	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6
		Q	128.3	155.2	187.7	231.3	261.2	321.0	377.3	456.0	518.4	577.4
Temperatura de servicio	Esesor recomendado	1	1½	1½	1½	1½	2	2	2	2	2	
250°F (121.1°C)	E=0.1	Ts	39.4	35.8	35.6	35.7	36.8	34.3	33.6	35.4	34.6	36.1
		Q	61.4	58.4	63.3	70.5	79.4	77.1	81.4	100.4	102.0	119.4
	E=0.3	Ts	36.9	33.7	33.5	33.6	34.6	32.3	31.8	33.3	32.6	33.8
		Q	62.7	59.7	64.6	71.9	81.0	78.7	83.0	102.4	104.0	122.0
	E=0.9	Ts	32.7	30.3	30.1	30.2	30.9	29.2	28.8	29.9	29.3	30.2
		Q	65.6	61.7	66.6	74.5	84.0	81.0	85.3	106.0	107.3	126.3
	Sin aislamiento	Ts	121.1	121.1	121.1	121.1	121.1	121.1	121.1	121.1	121.1	121.1
		Q	374.0	452.8	551.2	679.1	767.7	948.2	1128.6	1351.7	1528.9	1706.0
Temperatura de servicio	Esesor recomendado	1½	1½	1½	1½	2	2	2½	2½	2½	2½	
350°F (176.7°C)	E=0.1	Ts	40.6	42.8	42.2	42.2	37.8	40.0	36.8	38.9	37.8	39.4
		Q	88.9	102.7	111.5	124.0	112.2	135.8	128.6	154.9	159.4	182.7
	E=0.3	Ts	39.9	39.4	38.9	39.4	35.3	37.4	34.3	36.2	35.4	36.8
		Q	90.6	104.7	113.2	126.3	113.8	138.1	130.2	157.2	161.7	185.7
	E=0.9	Ts	33.1	34.4	34.1	34.2	31.3	32.7	30.5	31.8	31.2	32.2
		Q	92.8	107.6	116.5	129.9	116.5	141.7	132.9	161.1	165.4	190.6
	Sin aislamiento	Ts	176.7	176.7	176.7	176.7	176.7	176.7	176.7	176.7	176.7	176.7
		Q	695.5	846.5	1030.2	1273.0	1440.3	1778.2	2119.4	2542.7	2880.6	3218.5
Temperatura de servicio	Esesor recomendado	1½	2	2	2	2	2½	2½	2½	2½	3	
450°F (232.2°C)	E=0.1	Ts	47.2	43.9	43.3	46.7	43.3	42.8	41.7	45.0	43.9	42.2
		Q	135.8	137.5	148.0	174.9	171.3	184.7	196.2	236.5	243.1	246.4
	E=0.3	Ts	43.3	40.6	40.6	42.8	40.0	39.4	38.9	41.1	40.0	38.9
		Q	137.8	139.1	149.6	177.5	173.2	187.0	198.5	239.5	246.1	249.3
	E=0.9	Ts	37.2	35.1	34.7	36.6	34.6	34.1	33.5	35.3	34.5	33.7
		Q	141.1	142.1	152.9	181.8	176.8	190.6	202.1	244.8	251.3	253.9
	Sin aislamiento	Ts	232.2	232.2	232.2	232.2	232.2	232.2	232.2	232.2	232.2	232.2
		Q	1105.6	1348.4	1640.4	2037.4	2303.1	2851.0	3402.2	4081.4	4629.3	5173.9

### Convenciones:

Ts: Temperatura superficial °C

Q: Pérdidas de calor (Btu/hr.m)

E: Emisividad



4½	5	6	7	8	9	10	12	14	16	18	20	24	30	36	48
1½	1½	1½	1½	1½	1½	1½	1½	1½	2	2	2	2	2	2	2
30.2	31.3	31.7	31.6	31.7	31.8	31.7	31.8	32.4	30.8	30.9	30.9	31.1	31.2	31.3	31.4
52.8	65.3	75.8	82.7	91.5	100.4	107.3	124.0	142.1	128.3	142.4	156.2	184.4	226.4	268.4	351.0
28.9	29.9	30.2	30.1	30.2	30.3	30.2	30.3	30.8	29.4	29.4	29.5	29.6	29.7	29.8	29.8
54.8	67.9	79.1	86.0	95.1	104.7	111.5	129.3	148.6	133.2	148.0	162.4	191.9	235.9	279.5	367.5
27.1	27.8	27.9	27.8	27.9	27.9	27.9	27.9	28.3	27.3	27.3	27.4	27.4	27.5	27.5	27.6
57.4	71.9	84.0	91.5	101.4	111.2	118.8	137.8	158.8	140.7	156.2	171.9	203.1	250.0	296.6	390.4
65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6
636.5	708.7	833.3	951.4	1069.6	1187.7	1318.9	1555.1	1689.6	1922.6	2155.5	2388.5	2851.0	3546.6	4235.6	5616.8

2	2	2½	2½	2½	2½	2½	2½	2½	3	3	3	3	3	3	3
35.1	36.8	34.8	35.1	34.8	35.0	35.4	35.7	36.3	34.8	34.9	35.1	35.0	35.5	35.7	36.0
119.1	142.4	138.1	153.5	163.1	177.5	197.8	227.4	253.6	246.4	272.3	298.2	337.9	426.5	505.2	659.4
32.9	34.4	32.7	32.9	32.7	32.8	33.2	33.4	33.9	32.6	32.7	32.8	33.0	33.2	33.3	33.5
121.4	145.7	141.1	156.8	166.3	181.4	202.1	232.6	259.5	251.6	278.2	304.8	357.6	436.4	515.1	675.9
29.6	30.7	29.4	29.6	29.4	29.5	29.7	29.9	30.2	29.3	29.3	29.4	29.5	29.6	29.7	29.8
125.7	151.2	145.7	162.1	171.6	187.3	209.0	240.5	269.0	259.8	287.4	315.0	370.7	452.8	534.8	698.8
121.1	121.1	121.1	121.1	121.1	121.1	121.1	121.1	121.1	121.1	121.1	121.1	121.1	121.1	121.1	121.1
1886.5	2099.7	2473.8	2828.1	3179.1	3526.9	3920.6	4619.4	5026.2	5721.8	6417.3	7109.6	8490.8	10561.0	12628.0	16752.0

2½	2½	3	3	3	3	3	3½	3½	3½	3½	3½	3½	4	4	4
38.3	40.0	38.3	38.3	38.9	38.9	39.4	37.8	38.9	38.9	38.9	39.4	39.4	37.8	38.3	38.9
182.4	212.3	215.6	231.6	253.9	275.9	305.8	313.0	344.5	383.9	423.2	462.6	541.3	577.4	679.1	882.5
35.7	37.3	35.8	35.6	35.9	36.1	36.7	35.3	35.8	36.0	36.2	36.4	36.7	35.2	35.0	35.7
185.0	215.9	218.8	235.2	257.9	280.2	310.7	317.9	351.0	390.4	429.8	472.4	551.2	587.3	685.7	895.7
31.4	32.5	31.4	31.3	31.5	31.6	31.9	31.0	31.4	31.5	31.6	31.7	31.9	30.9	31.0	31.2
189.6	221.5	223.8	240.8	264.1	287.1	318.6	325.1	357.6	400.3	442.9	482.3	567.6	600.4	705.4	918.6
176.7	176.7	176.7	176.7	176.7	176.7	176.7	176.7	176.7	176.7	176.7	176.7	176.7	176.7	176.7	176.7
3556.4	3966.5	4675.2	5341.2	6007.2	6669.9	7421.3	8743.4	9517.7	10839.9	12158.8	13474.4	16105.6	20039.4	23969.8	31811.0

3	3	3	3	3	3	3½	3½	3½	3½	4	4	4	4	4	4
41.7	43.3	44.4	43.9	44.4	42.2	43.3	43.3	44.4	45.0	42.2	42.8	43.3	43.3	43.9	44.4
251.6	288.4	328.1	354.3	387.1	380.6	416.7	479.0	524.9	587.3	567.6	620.1	725.1	879.3	1036.7	1345.1
38.3	40.0	40.6	40.6	41.1	38.9	39.4	40.0	40.6	41.1	38.9	38.9	39.4	40.0	40.0	40.6
254.6	292.0	334.6	357.6	393.7	383.9	423.2	485.6	531.5	593.8	577.4	629.9	734.9	892.4	1049.9	1364.8
33.1	34.3	34.8	34.6	34.9	33.6	33.9	34.2	34.7	34.9	33.4	33.6	33.8	34.1	34.2	34.4
259.2	298.2	341.2	367.5	400.3	390.4	433.1	495.4	544.6	607.0	587.3	643.0	751.3	912.1	1072.8	1394.4
232.2	232.2	232.2	232.2	232.2	232.2	232.2	232.2	232.2	232.2	232.2	232.2	232.2	232.2	232.2	232.2
5718.5	6381.2	7529.5	8608.9	9685.0	10757.9	11968.5	14114.2	15364.2	17503.3	19639.1	21771.7	26033.5	32411.4	38782.8	51496.1

**Bases de cálculo:**

**Velocidad del viento:** 0 m/min

**Emisividad (E):** 0.1 (Aluminio nuevo)

**Emisividad (E):** 0.9 (Acabado mate)

**Emisividad (E):** 0.3 (Aluminio oxidado en servicio)

**Temperatura ambiente (Ta):** 75°F(23.8°C)

# ESPESORES ECONÓMICOS PARA OPERACIÓN EN CALIENTE

## PÉRDIDAS DE CALOR POR METRO, TEMPERATURA SUPERFICIAL EN °C

Diámetro nominal de la tubería		½	¾	1	1¼	1½	2	2½	3	3½	4	
Temperatura de servicio	Esesor recomendado	1½	2	2	2	2½	2½	2½	3	3	3	
550°F (287.8°C)	E=0.1	Ts	54.4	50.6	50.0	53.9	45.6	48.9	47.8	47.2	46.1	48.3
		Q	192.6	194.6	209.3	248.0	220.1	261.8	277.6	301.5	309.1	347.8
	E=0.3	Ts	50.0	46.1	45.6	48.9	41.7	44.4	43.9	43.3	42.2	43.9
		Q	195.2	196.9	211.9	251.3	222.4	264.8	280.8	304.8	312.3	354.3
	E=0.9	Ts	41.7	38.9	38.3	41.1	35.7	37.7	36.9	36.7	35.7	37.2
		Q	199.5	200.5	215.9	256.6	226.0	269.4	285.4	310.0	317.3	357.6
	Sin aislamiento	Ts	287.8	287.8	287.8	287.8	287.8	287.8	287.8	287.8	287.8	287.8
		Q	1620.7	1978.3	2414.7	3002.0	3399.0	4209.3	5029.5	6043.3	6857.0	7670.6
Temperatura de servicio	Esesor recomendado	2	2½	2½	2½	2½	3	3	3½	3½	3½	
650°F (343.3°C)	E=0.1	Ts	54.4	48.3	51.1	54.4	51.1	50.6	50.0	49.4	48.3	50.6
		Q	231.6	226.4	256.2	297.6	297.6	322.8	344.5	370.7	387.1	429.8
	E=0.3	Ts	49.4	44.4	46.7	49.4	46.7	46.1	45.6	45.0	44.4	46.1
		Q	233.9	228.3	258.5	300.5	300.5	325.8	347.8	374.0	390.4	436.4
	E=0.9	Ts	41.1	37.4	38.9	41.1	38.9	38.9	38.3	37.7	37.2	38.3
		Q	237.9	231.3	262.1	305.4	304.8	331.4	351.0	377.3	393.7	442.9
	Sin aislamiento	Ts	343.3	343.3	343.3	343.3	343.3	343.3	343.3	343.3	343.3	343.3
		Q	2263.8	2765.7	3382.5	4209.3	4773.6	5921.9	7080.1	8513.8	9668.6	10816.9
Temperatura de servicio	Esesor recomendado	2½	2½	2½	3	3	3½	3½	4	4	4	
750°F (398.9°C)	E=0.1	Ts	51.7	53.9	57.2	55.6	53.3	52.8	51.7	51.7	51.1	53.3
		Q	265.7	296.3	334.6	357.6	360.9	390.4	413.4	449.5	472.4	521.7
	E=0.3	Ts	47.2	49.4	52.2	50.6	48.3	47.8	47.2	47.2	46.1	48.3
		Q	267.7	298.6	337.9	360.9	364.2	393.7	416.7	452.8	475.7	528.2
	E=0.9	Ts	39.4	40.6	42.8	41.7	40.0	40.0	38.9	38.9	38.9	40.0
		Q	270.7	302.2	341.2	364.2	367.5	400.3	423.2	459.3	479.0	534.8
	Sin aislamiento	Ts	398.9	398.9	398.9	398.9	398.9	398.9	398.9	398.9	398.9	398.9
		Q	3054.5	3743.4	4583.3	5711.9	6482.9	8051.2	9635.8	11594.5	13172.6	14747.4
Temperatura de servicio	Esesor recomendado	2½	3	3	3½	3½	4	4	4½	4½	4½	
850°F (454.4°C)	E=0.1	Ts	57.8	55.6	58.3	57.2	55.0	54.4	53.9	54.4	57.2	55.6
		Q	337.9	354.3	397.0	423.2	429.8	465.9	498.7	541.3	603.7	616.8
	E=0.3	Ts	52.2	50.0	52.8	51.7	50.0	49.4	48.9	48.9	51.7	50.0
		Q	341.2	355.6	400.3	426.5	433.1	469.2	502.0	544.6	607.0	620.1
	E=0.9	Ts	42.8	41.7	43.3	42.2	41.1	40.6	40.6	40.6	42.2	41.1
		Q	344.5	360.9	403.5	429.8	439.6	472.4	505.2	551.2	613.5	626.6
	Sin aislamiento	Ts	454.4	454.4	454.4	454.4	454.4	454.4	454.4	454.4	454.4	454.4
		Q	4025.6	4940.9	6059.7	7562.3	8589.2	10675.9	12788.7	15397.0	17500.0	19599.7

### Convenciones:

Ts: Temperatura superficial °C

Q: Pérdidas de calor (Btu/hr.m)

E: Emisividad

4½	5	6	7	8	9	10	12	14	16	18	20	24	30	36	48
3	3	3½	3½	3½	3½	3½	4	4	4	4	4	4	4½	4½	4½
47.2	49.4	46.7	47.2	47.8	48.3	48.9	47.2	47.2	47.8	48.3	48.3	48.9	47.8	48.3	48.9
357.6	377.3	410.1	452.8	495.4	538.1	593.8	613.5	656.2	731.6	807.1	879.3	1026.9	1161.4	1364.8	1771.7
42.8	45.6	42.8	43.3	43.9	43.9	45.0	42.8	43.3	43.3	43.9	44.4	44.4	43.9	43.9	44.4
360.9	413.4	416.7	459.3	502.0	544.6	600.4	620.1	666.0	741.5	816.9	889.1	1040.0	1177.8	1381.2	1794.6
36.3	37.8	36.1	36.4	36.7	36.9	37.5	36.2	36.3	36.6	36.8	37.0	37.3	36.6	36.8	37.1
367.5	419.9	423.2	465.9	508.5	554.5	610.2	633.2	675.9	754.6	830.1	905.5	1059.7	1197.5	1407.5	1827.4
287.8	287.8	287.8	287.8	287.8	287.8	287.8	287.8	287.8	287.8	287.8	287.8	287.8	287.8	287.8	287.8
8481.0	9468.5	11177.8	12785.4	14389.8	15987.5	17792.2	20990.8	22857.6	26049.9	29235.6	32421.3	38779.5	48303.8	57815.0	76807.7

4	4	4	4	4	4½	4½	4½	4½	5	5	5	5	5½	5½	5½
46.7	48.3	49.4	50.6	51.1	48.9	49.4	50.6	51.7	49.4	50.0	50.6	51.1	50.0	50.6	51.1
403.5	452.8	511.8	561.0	613.5	613.5	669.3	761.2	836.6	856.3	941.6	1023.6	1190.9	1338.6	1568.2	2024.3
42.2	44.4	45.0	45.6	46.1	44.4	45.0	45.6	46.7	45.0	45.6	45.6	46.1	45.0	45.6	46.1
406.8	459.3	515.1	567.6	620.1	616.8	675.9	767.7	843.2	862.9	948.2	1033.5	1200.8	1351.7	1581.4	2044.0
35.8	37.2	37.8	38.3	38.3	37.2	37.7	38.3	38.9	37.6	37.8	38.3	38.3	37.7	37.8	38.3
413.4	462.6	521.7	574.1	626.6	626.6	685.7	780.8	856.3	876.0	961.3	1049.9	1220.5	1371.4	1604.3	2073.5
343.3	343.3	343.3	343.3	343.3	343.3	343.3	343.3	343.3	343.3	343.3	343.3	343.3	343.3	343.3	343.3
11965.2	13362.9	15787.4	18064.3	20337.9	22601.7	25160.8	29694.4	32345.8	36873.4	41394.4	45915.4	54940.9	68467.6	81968.5	108940.3

4½	4½	4½	5	5	5	5	5½	5½	5½	6	6	6	6	6	6
51.7	51.1	52.2	50.6	51.1	51.7	52.8	51.7	52.8	53.3	51.7	52.2	52.8	53.9	54.4	55.6
531.5	554.5	620.1	639.8	692.3	748.0	816.9	872.7	948.2	1049.9	1076.1	1168.0	1355.0	1630.6	1906.2	2454.1
47.2	46.7	47.8	46.1	46.7	47.2	47.8	46.7	47.8	48.3	46.7	47.2	47.8	48.3	48.9	49.4
534.8	557.7	626.6	643.0	698.8	754.6	823.5	879.3	954.7	1056.4	1082.7	1177.8	1364.8	1643.7	1922.6	2473.8
38.9	38.9	39.4	38.3	38.9	38.9	39.4	38.9	39.4	39.4	38.9	38.9	39.4	40.0	40.0	40.6
541.3	564.3	633.2	649.6	705.4	761.2	833.3	889.1	964.6	1069.6	1095.8	1190.9	1381.2	1663.4	1945.5	2509.8
398.9	398.9	398.9	398.9	398.9	398.9	398.9	396.9	398.9	398.9	398.9	398.9	398.9	398.9	398.9	398.9
16318.9	18231.6	21548.6	24665.4	27775.6	30876.0	34379.9	40593.8	44222.4	50426.5	56627.3	62821.5	75200.1	93740.2	112260.5	149258.5

5	5	5	5½	5½	6	6	6	6	6	6	6	6	6	6	6
54.4	53.9	55.0	53.9	55.0	53.3	53.9	55.0	56.1	57.2	57.8	58.3	58.9	60.0	61.1	62.2
636.5	666.0	738.2	774.3	839.9	862.9	928.5	1049.9	1135.2	1253.3	1374.7	1492.8	1729.0	2083.3	2434.4	3133.2
49.4	48.9	49.4	48.9	49.4	48.3	48.9	49.4	50.6	51.1	51.7	52.2	52.8	53.9	54.4	55.0
639.8	669.3	744.8	777.6	843.2	866.1	935.0	1056.4	1141.7	1263.1	1384.5	1502.6	1742.1	2096.5	2454.1	3159.4
40.6	40.0	41.1	40.0	40.6	40.0	40.0	40.6	41.1	41.7	42.2	42.2	42.8	43.3	43.9	44.4
646.3	675.9	751.3	787.4	853.0	876.0	944.9	1066.3	1154.9	1276.2	1397.6	1519.0	1761.8	2122.7	2483.6	3202.1
454.4	454.4	454.4	454.4	454.4	454.4	454.4	454.4	454.4	454.4	454.4	454.4	454.4	454.4	454.4	454.4
21696.2	24248.7	28671.3	32828.1	36978.3	41115.5	45787.4	54084.6	58927.2	67214.6	75495.4	83769.7	100301.8	125075.5	149822.8	199268.4

**Bases de cálculo:**

**Velocidad del viento:** 0 m/min

**Emisividad (E):** 0.1 (Aluminio nuevo)

**Emisividad (E):** 0.9 (Acabado mate)

**Emisividad (E):** 0.3 (Aluminio oxidado en servicio)

**Temperatura ambiente (Ta):** 75°F(23.8°C)

# ESPEORES ECONÓMICOS PARA OPERACIÓN EN FRÍO

Diam. nominal (in)	Temperatura del fluido °F (°C)									
	-40 (-40)		-20 (-28,9)		0 (-17,8)		20 (-6,7)		40 (4,4)	
	G.C.	E.R.	G.C.	E.R.	G.C.	E.R.	G.C.	E.R.	G.C.	E.R.
½	7.2	1½	6.7	1½	5.7	1½	5.1	1	3.9	1
¾	8.1	1½	7.2	1½	6.5	1½	5.4	1	4.4	1
1	8.8	1½	8.1	1½	7.1	1½	6.1	1	5.1	1
1¼	9.7	2	8.9	1½	8.1	1½	7.1	1	6.1	1
1½	10.5	2	9.7	1½	8.3	1½	7.3	1½	6.6	1
2	11.6	2	10.7	2	9.6	1½	8.5	1½	7.1	1
2½	12.6	2	11.6	2	11.1	1½	9.8	1½	8.2	1
3	14.4	2	13.3	2	12.1	1½	10.5	1½	9.6	1
3½	15.2	2½	14.6	2	13.2	1½	11.7	1½	10.6	1
4	16.5	2½	15.2	2	14.5	1½	12.8	1½	11.7	1
4½	17.9	2½	16.4	2	15.2	1½	13.8	1½	12.8	1
5	18.5	2½	17.8	2	16.1	2	15.2	1½	14.1	1
6	21.1	2½	19.5	2	18.6	2	16.3	1½	14.8	1
7	23.2	2½	21.6	2	19.9	2	18.5	1½	16.2	1
8	25.1	2½	24.1	2	21.8	2	20.4	1½	18.6	1
9	27.2	2½	25.8	2	24.8	2	22.8	1½	20.1	1
10	28.7	2½	27.6	2½	26.3	2	24.7	1½	22.7	1
11	31.2	2½	30.1	2½	28.4	2	26.4	1½	24.3	1
12	33.1	2½	31.9	2½	30.5	2	28.8	1½	26.5	1
14	35.9	2½	34.6	2½	33.1	2	31.3	1½	28.9	1
16	38.7	3	37.1	2½	35.3	2	35.4	1½	32.7	1
18	42.9	3	41.2	2½	39.2	2	36.7	1½	36.5	1
20	47.1	3	45.3	2½	43.1	2	40.4	1½	40.3	1
22	51.4	3	48.2	2½	45.8	2	44.4	1½	44.5	1
24	53.2	3	53.4	2½	51.1	2	47.9	1½	47.9	1
30	65.1	3	62.6	2½	62.8	2	59.1	1½	59.3	1

Humedad relativa: 80%  
 Temperatura ambiente: 90°F (32,2°C)

Velocidad del aire: 0 Km/h (0 Millas/h)  
 Temp. superficial mín. prevenir condensación: 83,0°F (28,3°C)

Convenciones: G.C. Ganancias de calor en BTU/hr.ft E.R. Espesor recomendado en pulgadas  
 Conductividad térmica con poliuretano CALORCOL (K): 0,17 BTU/hr.ft<sup>2</sup> (°F/in)

# ESPEORES ECONÓMICOS PARA OPERACIÓN EN FRÍO

Diam. nominal (in)	Temperatura del fluido °F (°C)									
	-40 (-40)		-20 (-28,9)		0 (-17,8)		20 (-6,7)		40 (4,4)	
	G.C.	E.R.	G.C.	E.R.	G.C.	E.R.	G.C.	E.R.	G.C.	E.R.
½	5.7	3	5.1	2½	4.4	2	3.8	2	3.1	1½
¾	6.2	3	5.4	2½	4.8	2½	4.1	2	3.3	1½
1	6.6	3	5.9	3	5.2	2½	4.4	2	3.7	1½
1¼	7.2	3½	6.5	3	5.7	2½	5.1	2	4.1	1½
1½	7.6	3½	6.8	3	6.2	2½	5.3	2	4.4	1½
2	8.4	3½	7.5	3	6.8	2½	5.8	2½	4.8	2
2½	9.1	3½	8.2	3½	7.4	3	6.5	2½	5.5	2
3	9.9	4	9.1	3½	8.2	3	7.2	2½	6.1	2
3½	10.7	4	9.6	3½	8.7	3	7.6	2½	6.6	2
4	11.3	4	10.4	3½	9.4	3	8.3	2½	7.2	2
4½	11.9	4	10.9	3½	9.8	3	8.9	2½	7.7	2
5	12.4	4	11.4	4	10.6	3	9.3	2½	8.1	2
6	13.7	4½	12.6	4	11.6	3½	10.6	2½	9.3	2
7	14.9	4½	13.6	4	12.1	3½	11.1	2½	10.1	2
8	15.8	4½	14.8	4	13.7	3½	12.5	3	10.9	2
9	17.1	4½	15.4	4	14.5	3½	13.1	3	11.5	2
10	18.2	5	17.1	4	15.8	3½	14.4	3	13.2	2
11	19.4	5	18.2	4	16.1	3½	15.1	3	13.8	2
12	20.3	5	19.1	4½	17.6	3½	16.6	3	14.5	2½
14	21.3	5	20.1	4½	19.1	3½	17.3	3	15.7	2½
16	23.2	5	22.3	4½	20.7	4	19.3	3	17.7	2½
18	25.5	5	23.9	4½	22.8	4	21.4	3	19.6	2½
20	27.3	5½	25.6	4½	24.3	4	22.7	3	21.6	2½
22	28.8	5½	27.2	4½	26.8	4	24.1	3	22.9	2½
24	31.1	5½	29.8	4½	28.4	4	26.6	3	24.3	2½
30	36.8	5½	35.3	5	33.6	4	31.4	3½	29.8	2½

Humedad relativa: 90%  
 Temperatura ambiente: 90°F (32,2°C)

Velocidad del aire: 0 Km/h (0 Millas/h)  
 Temp. superficial mín. prevenir condensación: 87,7°F (30,4°C)

Convenciones: G.C. Ganancias de calor en BTU/hr.ft E.R. Espesor recomendado en pulgadas  
 Conductividad térmica con poliuretano CALORCOL (K): 0,17 BTU/h.ft² °F

# CONVERSIÓN DE UNIDADES

Longitud	m	in	ft
1 m	1	39,3701	3,2808
1 in	0,0254	1	0,0833
1ft	2,3048	12	1

Superficie	m <sup>2</sup>	in <sup>2</sup>	ft <sup>2</sup>
1 m <sup>2</sup>	1	1.550	10,7639
1 in <sup>2</sup>	0,000645	1	0,0069
1ft <sup>2</sup>	0,0929	144	1

Volumen	m <sup>3</sup>	in <sup>3</sup>	ft <sup>3</sup>
1 m <sup>3</sup>	1	61.023,74	35,31467
1 in <sup>3</sup>	0,000016387	1	0,00057837
1ft <sup>3</sup>	0,028317	1.729	1

Masa	Kg	lb	oz
1 Kg	1	2,20462	35,2740
1 lb	0,453592	1	16
1oz	0,028349	0,0625	1

Densidad	1 Kg/m <sup>3</sup>	1 lb/ft <sup>3</sup>
1 Kg/m <sup>3</sup>	1	0,062428
1 lb/ft <sup>3</sup>	16,0185	1

**m** = metro

**in** = pulgada

**ft** = pie

**Kg** = kilogramo

**lb** = libra

**oz** = onza

**N** = newton

**kgf** = kilogramo fuerza

**lbf** = libra fuerza

**kpa** = kilo pascal

# CONVERSIÓN DE UNIDADES

Fuerza	N	kgf	lbf
1 N	1	0,102	0,224809
1 kgf	9,81	1	2,204
1 lbf	4,44822	0,4536	1

Potencia	W	Hp	BTU/h
1 W	1	0,0013410	3,41214
1 Hp	745,701	1	2.544,436
1 BTU/h	0,293071	0,000393	1

**atm** = atmósfera  
**s** = segundo  
**km** = kilómetro  
**h** = hora  
**Mil** = milla  
**W** = vatio  
**Hp** = caballo vapor  
**1 Pa** = 1 N/m<sup>2</sup>

Velocidad	m/s	km/h	ft/s	Mil/h
1 m/s	1	3,6	3,28084	2,23694
1 km/h	0,27777	1,	0,91134	0,621371
1 ft/s	0,3048	1,09728	1	0,681819
1 Mil/h	0,44704	1,609344	1,46666	1

Presión	k Pa	kgf/m <sup>2</sup>	lbf/ft <sup>2</sup>	lbf/in <sup>2</sup>	atm
k Pa	1	102	20,8854	0,145038	0,0098
kgf/m <sup>2</sup>	0,00981	1	0,2048	0,00142	0,00009676
lbf/ft <sup>2</sup>	0,04788	4,883	1	0,00694	0,0004725
lbf/in <sup>2</sup>	6,895	703	144	1	0,06806
atm	101,325	10.335,15	2.116,27	14,692	1

# CONVERSIÓN DE UNIDADES

Temperatura	°K	°C	°F
X °K	X	$X - 273$	$9/5(x-273)+32$
X °C	$X + 273$	X	$9/5x + 32$
X °F	$5/9(x-32)+273$	$5/9(x-32)$	X

Capacidad Calorífica	1 kj/kg	1 kcal/kg	1 BTU/lb
1 kj/kg	1	0,2389	0,429923
1 kcal/kg	4,186	1	1,7998
1 BTU/lb	2,3256	0,5556	1

Energía	kj	kwh	kcal	BTU
1 kj	1	0,000278	0,239	0,947817
1 kwh	3.600	1	860	3.414
1 kcal	4,187	0,001163	1	3.968
1 BTU	1,055	0,000293	0,252	1

°K = kelvin

°C = centigrado

kj = kilojulios

kwh = kilowatios hora

kcal = kilocalorias



# CONVERSIÓN DE UNIDADES

Calor Específico	$\text{kJ/kg } ^\circ\text{K}$	$\text{kJ/kg } ^\circ\text{C}$	$\text{BTU/lb } ^\circ\text{F}$
1 $\text{kJ/kg } ^\circ\text{K}$	1	0,238846	0,238846
1 $\text{kJ/kg } ^\circ\text{C}$	4,1868	1	1
1 $\text{BTU/lb } ^\circ\text{F}$	4,1868	1	1

**BTU** = unidad térmica británica

**$^\circ\text{F}$**  = centigrado

Conductividad Térmica	$\text{W/m}^\circ\text{K}$	$\text{kcal/hm}^\circ\text{C}$	$\text{BTUin/ft}^2\text{h}^\circ\text{F}$	$\text{BTU/ft.h}^\circ\text{F}$
1 $\text{W/m}^\circ\text{K}$	1	0,860	6,9335	0,577789
1 $\text{kcal/hm}^\circ\text{C}$	1,163	1	8,0645	0,67185
1 $\text{BTUin/ft}^2\text{h}^\circ\text{F}$	0,14423	0,124	1	0,83333
1 $\text{BTU/ft.h}^\circ\text{F}$	1,73073	1,48843	12	1

Conductancia Térmica	$\text{W/m}^2 \text{ } ^\circ\text{K}$	$\text{kcal/hm}^2 \text{ } ^\circ\text{C}$	$\text{BTUin/in}^2\text{h}^\circ\text{F}$	$\text{BTU/ft}^2.\text{h}^\circ\text{F}$
1 $\text{W/m}^2 \text{ } ^\circ\text{K}$	1	0,860	0,0012217	0,176110
1 $\text{kcal/hm}^2 \text{ } ^\circ\text{C}$	1,163	1	0,001421	0,20483
1 $\text{BTUin/in}^2\text{h}^\circ\text{F}$	818,53	703,73	1	144,15
1 $\text{BTU/ft}^2.\text{h}^\circ\text{F}$	5,67826	4,882	0,006937	1

# ACÚSTICA - UNIDADES

Unidad	Designación	Símbolo
Longitud de onda	metro	m
Área de absorción	metro cuadrado	m <sup>2</sup>
Periodo, tiempo	segundo	s
Frecuencia	Hertzio	Hz
	1 Hz = 1 ciclo por segundo	
Presión acústica	Pascal	Pa
	milipascal	mPa = 10 <sup>-3</sup>
	micropascal	μPa = 10 <sup>-6</sup>
Nivel de presión acústica L <sub>p</sub>	decibelio	dB
	$L_p - 20 \log \frac{\text{Presión real (Pa)}}{\text{Presión de referencia (2.10}^{-5} \text{ Pa)}}$	

# ACÚSTICA - UNIDADES

Unidad	Designación	Símbolo
<b>Potencia acústica</b>	vatio	W
	milivatio	mW = $10^{-3}$
	microvatio	$\mu$ W = $10^{-6}$
	picovatio	pW = $10^{-12}$
<b>Nivel de potencia acústica <math>L_w</math></b>	decibelio	dB
	$L_w - 10 \log \frac{\text{Potencia real (W)}}{\text{Potencia de referencia (10}^{-12}\text{W)}}$	
<b>Intensidad acústica</b>	vattios por metro cuadrado	W/m <sup>2</sup>
	picovattios por metro cuadrado	pW/m <sup>2</sup> = $10^{-12}$ W/m <sup>2</sup>
<b>Nivel de intensidad acústica <math>L_i</math></b>	decibelio	dB
	$L_i - 10 \log \frac{\text{Intensidad real (W)}}{\text{Intensidad de referencia (10}^{-12}\text{W/m}^2\text{)}}$	
<b>Impedancia acústica específica</b>	Pascal segundo por metro	Pa . s/m
	1 Pa . s/m = 1N . s/m <sup>3</sup> = 1Rayl	
<b>Impedancia acústica resistencia</b>	Pascal segundo por metro cuadrado	Pa . s/m <sup>2</sup>
	1 Pa . s/m <sup>2</sup> = 1Rayl/m	

# TABLAS DE CONVERSIÓN DE TEMPERATURA

°C	°F	°C	°F	°C	°F	°C	°F	°C	°F					
-84,44	-120	-184,00	-16,11	3	37,40	-1,11	30	86,00	13,89	57	134,60	28,89	84	183,20
-81,67	-115	-175,00	-15,56	4	39,20	-0,56	31	87,80	14,44	58	136,40	29,44	85	185,00
-78,89	-110	-166,00	-15,00	5	41,00	0,00	32	89,60	15,00	59	138,20	30,00	86	186,80
-76,11	-105	-157,00	-14,44	6	42,80	0,56	33	91,40	15,56	60	140,00	30,56	87	188,60
-73,33	-100	-148,00	-13,89	7	44,60	1,11	34	93,20	16,11	61	141,80	31,11	88	190,40
-70,56	-95	-139,00	-13,33	8	46,40	1,67	35	95,00	16,67	62	143,60	31,67	89	192,20
-67,78	-90	-130,00	-12,78	9	48,20	2,22	36	96,80	17,22	63	145,40	32,22	90	194,00
-65,00	-85	-121,00	-12,22	10	50,00	2,78	37	98,60	17,78	64	147,20	32,78	91	195,80
-62,22	-80	-112,00	-11,67	11	51,80	3,33	38	100,40	18,33	65	149,00	33,33	92	197,60
-59,44	-75	-103,00	-11,11	12	53,60	3,89	39	102,20	18,89	66	150,80	33,89	93	199,40
-56,67	-70	-94,00	-10,56	13	55,40	4,44	40	104,00	19,44	67	152,60	34,44	94	201,20
-53,89	-65	-85,00	-10,00	14	57,20	5,00	41	105,80	20,00	68	154,40	35,00	95	203,00
-51,11	-60	-76,00	-9,44	15	59,00	5,56	42	107,60	20,56	69	156,20	35,56	96	204,80
-48,33	-55	-67,00	-8,89	16	60,80	6,11	43	109,40	21,11	70	158,00	36,11	97	206,60
-45,56	-50	-58,00	-8,33	17	62,60	6,67	44	111,20	21,67	71	159,80	36,67	98	208,40
-42,78	-45	-49,00	-7,78	18	64,40	7,22	45	113,00	22,22	72	161,60	37,22	99	210,20
-40,00	-40	-40,00	-7,22	19	66,20	7,78	46	114,80	22,78	73	163,40	37,78	100	212,00
-37,22	-35	-31,00	-6,67	20	68,00	8,33	47	116,60	23,33	74	165,20	40,56	105	221,00
-34,44	-30	-22,00	-6,11	21	69,80	8,89	48	118,40	23,89	75	167,00	43,33	110	230,00
-31,67	-25	-13,00	-5,56	22	71,60	9,44	49	120,20	24,44	76	168,80	46,11	115	239,00
-28,89	-20	-4,00	-5,00	23	73,40	10,00	50	122,00	25,00	77	170,60	48,89	120	248,00
-26,11	-15	5,00	-4,44	24	75,20	10,56	51	123,80	25,56	78	172,40	51,67	125	257,00
-23,33	-10	14,00	-3,89	25	77,00	11,11	52	125,60	26,11	79	174,20	54,44	130	266,00
-20,56	-5	23,00	-3,33	26	78,80	11,67	53	127,40	26,67	80	176,00	57,22	135	275,00
-17,78	0	32,00	-2,78	27	80,60	12,22	54	129,20	27,22	81	177,80	60,00	140	284,00
-17,22	1	33,80	-2,22	28	82,40	12,78	55	131,00	27,78	82	179,60	62,78	145	293,00
-16,67	2	35,60	-1,67	29	84,20	13,33	56	132,80	28,33	83	181,40	65,56	150	302,00

# TABLAS DE CONVERSIÓN DE TEMPERATURA

°C			°F			°C			°F			°C			°F		
68,33	155	311,00	146,11	295	563,00	223,89	435	815,00	301,67	575	1067,00	443,33	830	1526,00			
71,11	160	320,00	148,89	300	572,00	226,67	440	824,00	304,44	580	1076,00	448,89	840	1544,00			
73,89	165	329,00	151,67	305	581,00	229,44	445	833,00	307,22	585	1085,00	454,44	850	1562,00			
76,67	170	338,00	154,44	310	590,00	232,22	450	842,00	310,00	590	1094,00	460,00	860	1580,00			
79,44	175	347,00	157,22	315	599,00	235,00	455	851,00	312,78	595	1103,00	465,56	870	1598,00			
82,22	180	356,00	160,00	320	608,00	237,78	460	860,00	315,56	600	1112,00	471,11	880	1616,00			
85,00	185	365,00	162,78	325	617,00	240,56	465	869,00	321,11	610	1130,00	476,67	890	1634,00			
87,78	190	374,00	165,56	330	626,00	243,33	470	878,00	326,67	620	1148,00	482,22	900	1650,00			
90,56	195	383,00	168,33	335	635,00	246,11	475	887,00	332,22	630	1166,00	487,78	910	1670,00			
93,33	200	392,00	171,11	340	644,00	248,89	480	896,00	337,78	640	1184,00	493,33	920	1688,00			
96,11	205	401,00	173,89	345	653,00	251,67	485	905,00	343,33	650	1202,00	498,89	930	1706,00			
98,89	210	410,00	176,67	350	662,00	254,44	490	914,00	348,89	660	1220,00	504,44	940	1724,00			
101,67	215	419,00	179,44	355	671,00	257,22	495	923,00	354,44	670	1238,00	510,00	950	1742,00			
104,44	220	428,00	182,22	360	680,00	260,00	500	932,00	360,00	680	1256,00	515,56	960	1760,00			
107,22	225	437,00	185,00	365	689,00	262,78	505	941,00	365,56	690	1274,00	521,11	970	1778,00			
110,00	230	446,00	187,78	370	698,00	265,56	510	950,00	371,11	700	1292,00	526,67	980	1796,00			
112,78	235	455,00	190,56	375	707,00	268,33	515	959,00	376,67	710	1310,00	532,22	990	1814,00			
115,56	240	464,00	193,33	380	716,00	271,11	520	968,00	382,22	720	1328,00	537,78	1000	1832,00			
118,33	245	473,00	196,11	385	725,00	273,89	525	977,00	387,78	730	1346,00	565,56	1050	1922,00			
121,11	250	482,00	198,89	390	734,00	276,67	530	986,00	393,33	740	1364,00	593,33	1100	2012,00			
123,89	255	491,00	201,67	395	743,00	279,44	535	995,00	398,89	750	1382,00	621,11	1150	2102,00			
126,67	260	500,00	204,44	400	752,00	282,22	540	1004,00	404,44	760	1400,00	648,89	1200	2192,00			
129,44	265	509,00	207,22	405	761,00	285,00	545	1013,00	410,00	770	1418,00	676,67	1250	2282,00			
132,22	270	518,00	210,00	410	770,00	287,78	550	1022,00	415,56	780	1436,00	704,44	1300	2372,00			
135,00	275	527,00	212,78	415	779,00	290,56	555	1031,00	421,11	790	1454,00	732,22	1350	2462,00			
137,78	280	536,00	215,56	420	788,00	293,33	560	1040,00	426,67	800	1472,00	760,00	1400	2552,00			
140,56	285	545,00	218,33	425	797,00	296,11	565	1049,00	432,22	810	1490,00	787,78	1450	2642,00			
143,33	290	554,00	221,11	430	806,00	298,89	570	1058,00	437,78	820	1508,00	815,56	1500	2732,00			

# PRESIÓN VAPOR SATURADO vs TEMPERATURA

Presión relativa	
bar	psi
0,0	0,00
0,2	2,90
0,4	5,80
0,6	8,70
0,8	11,61
1,0	14,51
1,2	17,41
1,4	20,31
1,6	23,21
1,8	26,11
2,0	29,02
2,2	31,92
2,4	34,82
2,6	37,72
2,8	40,62
3,0	43,52
3,2	46,42
3,4	49,33
3,6	52,23
3,8	55,13
4,0	58,03
4,2	60,93
4,4	63,83
4,6	66,74
4,8	69,64
5,0	72,54
5,2	75,44

Presión absoluta	
bar	psi
1,013	14,70
1,213	17,60
1,413	20,50
1,613	23,40
1,813	26,30
2,013	29,20
2,213	32,11
2,413	35,01
2,613	37,91
2,813	40,81
3,013	43,71
3,213	46,61
3,413	49,51
3,613	52,42
3,813	55,32
4,013	58,22
4,213	61,12
4,413	64,02
4,613	66,92
4,813	69,83
5,013	72,73
5,213	75,63
5,413	78,53
5,613	81,43
5,813	84,33
6,013	87,23
6,213	90,14

Temperatura	
°C	°F
100,00	212,00
105,10	221,18
109,55	229,19
113,56	236,41
117,14	242,85
120,42	248,76
123,46	254,23
126,28	259,30
128,89	264,00
131,37	268,47
133,69	272,64
135,88	276,58
138,01	280,42
140,00	284,00
141,92	287,46
143,75	290,75
145,46	293,83
147,20	296,96
148,84	299,91
150,44	302,79
151,96	305,53
153,40	308,12
154,84	310,71
156,24	313,23
157,62	315,72
158,92	318,06
160,20	320,36

# PRESIÓN VAPOR SATURADO vs TEMPERATURA

Presión relativa	
bar	psi
5,4	78,34
5,6	81,24
5,8	84,14
6,0	87,05
6,2	89,95
6,4	92,85
6,6	95,75
6,8	98,65
7,0	101,55
7,2	104,46
7,4	107,36
7,6	110,26
7,8	113,16
8,0	116,06
8,2	118,96
8,4	121,86
8,6	124,77
8,8	127,67
9,0	130,57
9,2	133,47
9,4	136,37
9,6	139,27
9,8	142,18
10,0	145,05
10,2	147,98
10,4	150,88
10,6	153,78
10,8	156,68

Presión absoluta	
bar	psi
6,413	93,04
6,613	95,94
6,813	98,84
7,013	101,74
7,213	104,64
7,413	107,55
7,613	110,45
7,813	113,35
8,013	116,25
8,213	119,15
8,413	122,05
8,613	124,96
8,813	127,86
9,013	130,76
9,213	133,66
9,413	136,56
9,613	139,46
9,813	142,36
10,013	145,27
10,213	148,17
10,413	151,07
10,613	153,97
10,813	156,87
11,013	159,77
11,213	162,68
11,413	165,58
11,613	168,48
11,813	171,38

Temperatura	
°C	°F
161,45	322,61
162,68	324,82
163,86	326,95
165,04	329,07
166,16	331,09
167,29	333,12
168,38	335,08
169,43	336,97
170,50	338,90
171,53	340,75
172,53	342,55
173,50	344,30
174,46	346,03
175,43	347,77
176,37	349,47
177,27	351,09
178,20	352,76
179,08	354,34
179,97	355,95
180,83	357,49
181,68	359,02
182,51	360,52
183,31	361,96
184,13	363,43
184,83	364,86
185,68	366,22
186,49	367,68
187,25	369,05

# PRESIÓN VAPOR SATURADO vs TEMPERATURA

Presión relativa	
bar	psi
11,0	159,58
11,2	162,49
11,4	165,39
11,6	168,29
11,8	171,19
12,0	174,09
12,2	176,99
12,4	179,90
12,6	182,80
12,8	185,70
13,0	188,60
13,2	191,50
13,4	194,40
13,6	197,31
13,8	200,21
14,0	203,11
14,2	206,01
14,4	208,91
14,6	211,81
14,8	214,71
15,0	217,62
15,2	220,52
15,4	223,42
15,6	226,32
15,8	229,22
16,0	232,12
16,2	235,03
16,4	237,93

Presión absoluta	
bar	psi
12,013	174,28
12,213	177,18
12,413	180,08
12,613	182,99
12,813	185,89
13,013	188,79
13,213	191,69
13,413	194,59
13,613	197,49
13,813	200,40
14,013	203,30
14,213	206,20
14,413	209,10
14,613	212,00
14,813	214,90
15,013	217,80
15,213	220,71
15,413	223,61
15,613	226,51
15,813	229,41
16,013	232,31
16,213	235,21
16,413	238,12
16,613	241,02
16,813	243,92
17,013	246,82
17,213	249,72
17,413	252,62

Temperatura	
°C	°F
188,02	370,44
188,78	371,80
189,52	373,14
190,24	374,43
190,97	375,75
191,68	377,02
192,38	378,28
193,08	379,54
193,77	380,79
194,43	381,97
195,10	383,18
195,77	384,39
196,43	385,57
197,08	386,74
197,72	387,90
198,35	389,03
198,98	390,16
199,61	391,30
200,23	392,41
200,84	393,51
201,45	394,61
202,04	395,67
202,62	396,72
203,21	397,78
203,79	398,82
204,38	399,88
204,94	400,89
205,49	401,88



# PRESIÓN VAPOR SATURADO vs TEMPERATURA

Presión relativa	
bar	psi
16,6	240,83
16,8	243,73
17,0	246,63
17,2	249,53
17,4	252,43
17,6	255,34
17,8	258,24
18,0	261,14
18,2	264,04
18,4	266,94
18,6	269,84
18,8	272,75
19,0	275,65
19,2	278,55
19,4	281,45
19,6	284,35
19,8	287,25
20,0	290,15
20,5	297,41
21,0	304,66
21,5	311,92
22,0	319,17
22,5	326,42
23,0	333,68
23,5	340,93
24,0	348,19
24,5	355,44
25,0	362,69
26,0	377,20

Presión absoluta	
bar	psi
17,613	255,52
17,813	258,43
18,013	261,33
18,213	264,23
18,413	267,13
18,613	270,03
18,813	272,93
19,013	275,84
19,213	278,74
19,413	281,64
19,613	284,54
19,813	287,4
20,013	290,34
20,213	293,24
20,413	296,15
20,613	299,05
20,813	301,95
21,013	304,85
21,513	312,10
22,013	319,36
22,513	326,61
23,013	333,87
23,513	341,12
24,013	348,37
24,513	355,63
25,013	362,88
25,513	370,14
26,013	377,39
27,013	391,90

Temperatura	
°C	°F
206,05	402,89
206,61	403,90
207,17	404,91
207,75	405,95
208,30	406,94
208,84	407,91
209,37	408,87
209,90	409,82
210,43	410,77
210,96	411,73
211,47	412,65
211,98	413,56
212,47	414,45
212,98	415,36
213,49	416,28
213,99	417,18
214,48	418,06
214,96	418,93
216,15	421,07
217,35	423,23
218,53	425,35
219,65	427,37
220,76	429,37
221,85	431,33
222,94	433,29
224,02	435,24
225,08	437,14
226,12	439,02
228,15	442,67