CALORCOL

Expertos en Ingeniería de Aislamientos

TABLAS TÉCNICAS

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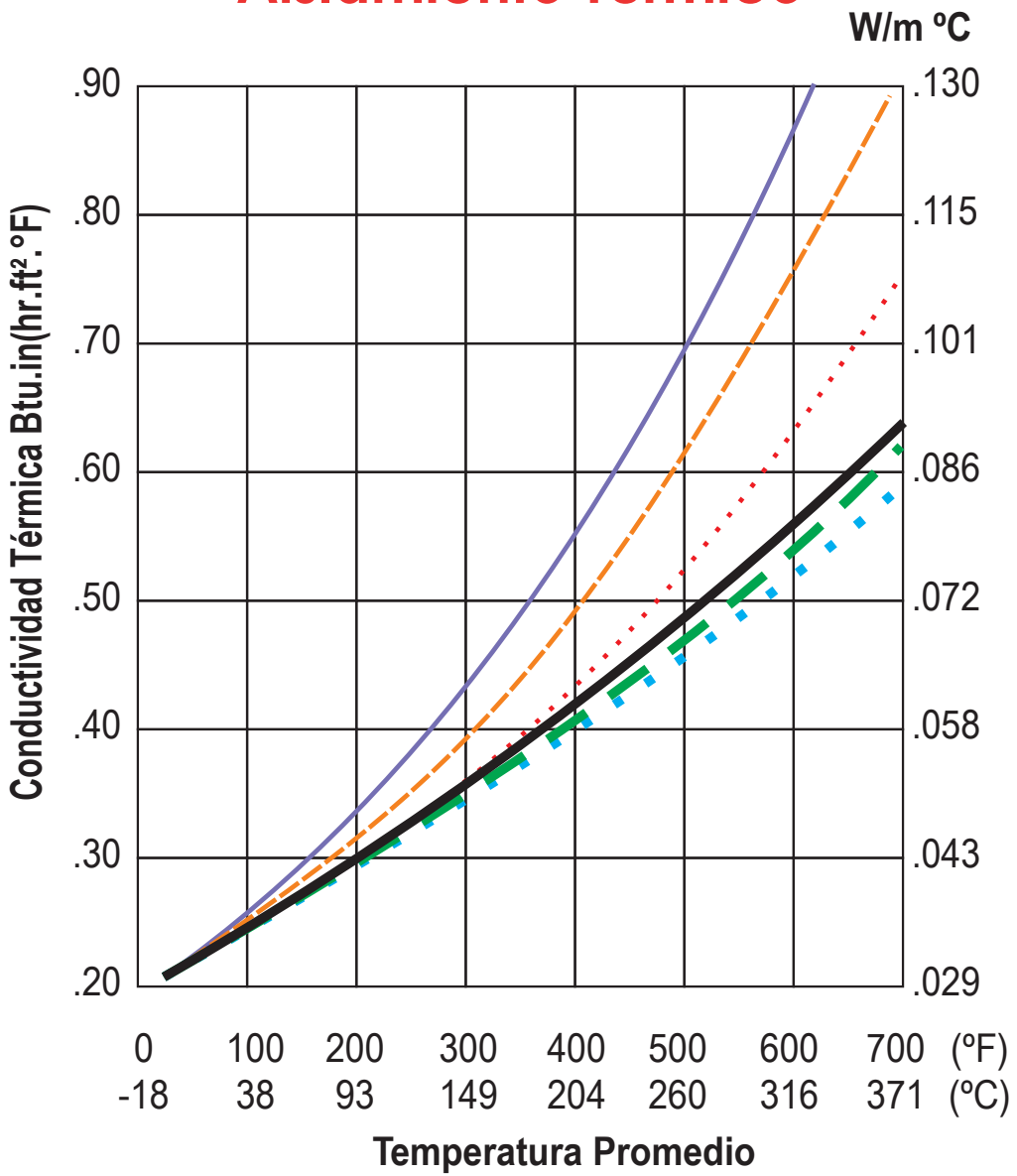
CONDUCTIVIDAD TÉRMICA vs DENSIDAD

Aislamiento Térmico



LA DENSIDAD SI IMPORTA !

Referencias:

D3	Densidad 3 lb/ft³ (48 Kg/m³)
D4	Densidad 4 lb/ft³ (64 Kg/m³)
D6	Densidad 6 lb/ft³ (96 Kg/m³)
D8	Densidad 8 lb/ft³ (128 Kg/m³)
D10	Densidad 10 lb/ft³ (160 Kg/m³)
D12	Densidad 12 lb/ft³ (192 Kg/m³)

CONDUCTIVIDAD TÉRMICA vs DENSIDAD

Comportamiento térmico (unidades inglesas)						
Temperatura promedio (°F)	Btu.in/(hr.ft².°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			½	¾	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 (167.7°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.ft²) **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 vieto: 0 ft/min
Emisividad (E): 0.1 (Aluminio oxidado en servicio) **Emisividad (E):** 0.3 (Acero oxidado en servicio)
Emisividad (E): 0.9 (Acabado mate) **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			½	¾	1	1¼	1½	2	2½	3	3½	4
Temperatura de servicio	Espesor recomendado		1½	2	2	2	2½	2½	2½	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	Espesor recomendado		2	2½	2½	2½	2½	3	3	3½	3½	3½
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	Espesor recomendado		2½	2½	2½	3	3	3½	3½	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	Espesor recomendado		2½	3	3	3½	3½	4	4	4½	4½	4½
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.ft²) **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 vieto: 0 ft/min
Emisividad (E): 0.1 (Aluminio oxidado en servicio) **Emisividad (E):** 0.3 (Acero oxidado en servicio)
Emisividad (E): 0.9 (Acabado mate) **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	**Espesor 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	**Espesor 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	**Espesor recomendado**		**1½**	**1½**	**1½**	**1½**	**2**	**2**	**2½**	**2½**	**2½**	**2½**
350°F (167.7°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	**Espesor 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 vieto: 0 m/min
Emisividad (E): 0.1 (Aluminio oxidado en servicio) **Emisividad (E):** 0.3 (Acero oxidado en servicio)
Emisividad (E): 0.9 (Acabado mate) **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	Espesor 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	Espesor 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	Espesor 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	Espesor 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	3998.9	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 vieto: 0 m/min
Emisividad (E): 0.1 (Aluminio oxidado en servicio) **Emisividad (E):** 0.3 (Acero oxidado en servicio)
Emisividad (E): 0.9 (Acabado mate) **Temperatura ambiente (Ta):** 75°F(23.8°C)

ESPESORES ECONÓMICOS PARA OPERACIÓN EN FRÍO

	Temperatura del fuido °F (°C)									
	-40 (-40)		-20 (-28,9)		0 (-17,8)		20 (-6,7)		40 (4,4)	
Diam. nominal (in)	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.ft² (°F/in)

ESPESORES ECONÓMICOS PARA OPERACIÓN EN FRÍO

	Temperatura del fuido °F (°C)									
	-40 (-40)		-20 (-28,9)		0 (-17,8)		20 (-6,7)		40 (4,4)	
Diam. nominal (in)	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/hr.ft² (°F/in)

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^2	in^2	ft^2
1 m^2	1	1.550	10,7639
1 in^2	0,000645	1	0,0069
1ft^2	0,0929	144	1

Volumen	m^3	in^3	ft^3
1 m^3	1	61.023,74	35,31467
1 in^3	0,000016387	1	0,00057837
1ft^3	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^3	1 lb/m^3
1 Kg/m^3	1	0,062428
1 lb/m^3	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/m²

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/m²	lbf/ft²	lbf/in²	atm
k Pa	1	102	20,8854	0,145038	0,0098
kgf/m²	0,00981	1	0,2048	0,00142	0,00009676
lbf/ft²	0,04788	4,883	1	0,00694	0,0004725
lbf/in²	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	kj/kg °K	kj/kg °C	BTU/lb °F
1 kj/kg °K	1	0,238846	0,238846
1 kj/kg °C	4,1868	1	1
1 BTU/lb °F	4,1868	1	1

BTU = unidad térmica británica

°F = centigrado

Conductividad Térmica	W/m°K	kcal/hm°C	BTUin/ft²h°F	BTU/ft.h°F
1 W/m°K	1	0,860	6,9335	0,577789
1 kcal/hm°C	1,163	1	8,0645	0,67185
1 BTUin/ft²h°F	0,14423	0,124	1	0,83333
1 BTU/ft.h°F	1,73073	1,48843	12	1

Conductancia Térmica	W/m² °K	kcal/hm² °C	BTUin/in²h°F	BTU/ft².h°F
1 W/m² °K	1	0,860	0,0012217	0,176110
1 kcal/hm² °C	1,163	1	0,001421	0,20483
1 BTUin/in²h°F	818,53	703,73	1	144,15
1 BTU/ft².h°F	5,67826	4,882	0,006937	1

ACÚSTICA - UNIDADES

Unidad	Designación	Símbolo
Longitud de onda	metro	m
Área de absorción	metro cuadrado	m^2
Periodo, tiempo	segundo	s
Frecuencia	Hertzio	Hz
	1 Hz = 1 ciclo por segundo	
Presión acústica	Pascal	Pa
	milipascal	$mPa = 10^{-3}$
	micropascal	$\mu Pa = 10^{-6}$
Nivel de presión acústica L_p	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
Potencia acústica	vatio	W
	milivatio	$mW = 10^{-3}$
	microvatio	$\mu W = 10^{-6}$
	picovatio	$pW = 10^{-12}$
Nivel de potencia acústica L_w	decibelio	dB
	$L_w - 10 \log \frac{\text{Potencia real (W)}}{\text{Potencia de referencia } (10^{-12} W)}$	
Intensidad acústica	vatios por metro cuadrado	W/m^2
	picovatios por metro cuadrado	$pW/m^2 = 10^{-12} W/m^2$
Nivel de intensidad acústica L_i	decibelio	dB
	$L_i - 10 \log \frac{\text{Intensidad real (W)}}{\text{Intensidad de referencia } (10^{-12} W/m^2)}$	
Impedancia acústica específica	Pascal segundo por metro	Pa . s/m
	1 Pa . s/m = 1N . s/m^3 = 1Rayl	
Impedancia acústica resistencia	Pascal segundo por metro cuadrado	Pa . s/m^2
	1 Pa . s/m^2 = 1Rayl/m	

TABLAS DE CONVERSIÓN DE TEMPERATURA

°C		°F
-84,44	-120	-184,00
-81,67	-115	-175,00
-78,89	-110	-166,00
-76,11	-105	-157,00
-73,33	-100	-148,00
-70,56	-95	-139,00
-67,78	-90	-130,00
-65,00	-85	-121,00
-62,22	-80	-112,00
-59,44	-75	-103,00
-56,67	-70	-94,00
-53,89	-65	-85,00
-51,11	-60	-76,00
-48,33	-55	-67,00
-45,56	-50	-58,00
-42,78	-45	-49,00
-40,00	-40	-40,00
-37,22	-35	-31,00
-34,44	-30	-22,00
-31,67	-25	-13,00
-28,89	-20	-4,00
-26,11	-15	5,00
-23,33	-10	14,00
-20,56	-5	23,00
-17,78	0	32,00
-17,22	1	33,80
-16,67	2	35,60

°C		°F
-16,11	3	37,40
-15,56	4	39,20
-15,00	5	41,00
-14,44	6	42,80
-13,89	7	44,60
-13,33	8	46,40
-12,78	9	48,20
-12,22	10	50,00
-11,67	11	51,80
-11,11	12	53,60
-10,56	13	55,40
-10,00	14	57,20
-9,44	15	59,00
-8,89	16	60,80
-8,33	17	62,60
-7,78	18	64,40
-7,22	19	66,20
-6,67	20	68,00
-6,11	21	69,80
-5,56	22	71,60
-5,00	23	73,40
-4,44	24	75,20
-3,89	25	77,00
-3,33	26	78,80
-2,78	27	80,60
-2,22	28	82,40
-1,67	29	84,20

°C		°F
-1,11	30	86,00
-0,56	31	87,80
0,00	32	89,60
0,56	33	91,40
1,11	34	93,20
1,67	35	95,00
2,22	36	96,80
2,78	37	98,60
3,33	38	100,40
3,89	39	102,20
4,44	40	104,00
5,00	41	105,80
5,56	42	107,60
6,11	43	109,40
6,67	44	111,20
7,22	45	113,00
7,78	46	114,80
8,33	47	116,60
8,89	48	118,40
9,44	49	120,20
10,00	50	122,00
10,56	51	123,80
11,11	52	125,60
11,67	53	127,40
12,22	54	129,20
12,78	55	131,00
13,33	56	132,80

°C		°F
13,89	57	134,60
14,44	58	136,40
15,00	59	138,20
15,56	60	140,00
16,11	61	141,80
16,67	62	143,60
17,22	63	145,40
17,78	64	147,20
18,33	65	149,00
18,89	66	150,80
19,44	67	152,60
20,00	68	154,40
20,56	69	156,20
21,11	70	158,00
21,67	71	159,80
22,22	72	161,60
22,78	73	163,40
23,33	74	165,20
23,89	75	167,00
24,44	76	168,80
25,00	77	170,60
25,56	78	172,40
26,11	79	174,20
26,67	80	176,00
27,22	81	177,80
27,78	82	179,60
28,33	83	181,40

°C		°F
28,89	84	183,20
29,44	85	185,00
30,00	86	186,80
30,56	87	188,60
31,11	88	190,40
31,67	89	192,20
32,22	90	194,00
32,78	91	195,80
33,33	92	197,60
33,879	93	199,40
34,44	94	201,20
35,00	95	203,00
35,56	96	204,80
36,11	97	206,60
36,67	98	208,40
37,22	99	210,20
37,78	100	212,00
40,56	105	221,00
43,33	110	230,00
46,11	115	239,00
48,89	120	248,00
51,67	125	257,00
54,44	130	266,00
57,22	135	275,00
60,00	140	284,00
62,78	145	293,00
65,56	150	302,00

TABLAS DE CONVERSIÓN DE TEMPERATURA

°C		°F
68,33	155	311,00
71,11	160	320,00
73,89	165	329,00
76,67	170	338,00
79,44	175	347,00
82,22	180	356,00
85,00	185	365,00
87,78	190	374,00
90,56	195	383,00
93,33	200	392,00
96,11	205	401,00
98,89	210	410,00
101,67	215	419,00
104,44	220	428,00
107,22	225	437,00
110,00	230	446,00
112,78	235	455,00
115,56	240	464,00
118,33	245	473,00
121,11	250	482,00
123,89	255	491,00
126,67	260	500,00
129,44	265	509,00
132,22	270	518,00
135,00	275	527,00
137,78	280	536,00
140,56	285	545,00
143,33	290	554,00

°C		°F
146,11	295	563,00
148,89	300	572,00
151,67	305	581,00
154,44	310	590,00
157,22	315	599,00
160,00	320	608,00
162,78	325	617,00
165,56	330	626,00
168,33	335	635,00
171,11	340	644,00
173,89	345	653,00
176,67	350	662,00
179,44	355	671,00
182,22	360	680,00
185,00	365	689,00
187,78	370	698,00
190,56	375	707,00
193,33	380	716,00
196,11	385	725,00
198,89	390	734,00
201,67	395	743,00
204,44	400	752,00
207,22	405	761,00
210,00	410	770,00
212,78	415	779,00
215,56	420	788,00
218,33	425	797,00
221,11	430	806,00

°C		°F
223,89	435	815,00
226,67	440	824,00
229,44	445	833,00
232,22	450	842,00
235,00	455	851,00
237,78	460	860,00
240,56	465	869,00
243,33	470	878,00
246,11	475	887,00
248,89	480	896,00
251,67	485	905,00
254,44	490	914,00
257,22	495	923,00
260,00	500	932,00
262,78	505	941,00
265,56	510	950,00
268,33	515	959,00
271,11	520	968,00
273,89	525	977,00
276,67	530	986,00
279,44	535	995,00
282,22	540	1004,00
285,00	545	1013,00
287,78	550	1022,00
290,56	555	1031,00
293,33	560	1040,00
296,11	565	1049,00
298,89	570	1058,00

°C		°F
301,67	575	1067,00
304,44	580	1076,00
307,22	585	1085,00
310,00	590	1094,00
312,78	595	1103,00
315,56	600	1112,00
321,11	610	1130,00
326,67	620	1148,00
332,22	630	1166,00
337,78	640	1184,00
343,33	650	1202,00
348,89	660	1220,00
354,44	670	1238,00
360,00	680	1256,00
365,56	690	1274,00
371,11	700	1292,00
376,67	710	1310,00
382,22	720	1328,00
387,78	730	1346,00
393,33	740	1364,00
398,89	750	1382,00
404,44	760	1400,00
410,00	770	1418,00
415,56	780	1436,00
421,11	790	1454,00
426,67	800	1472,00
432,22	810	1490,00
437,78	820	1508,00

°C		°F
443,33	830	1526,00
448,89	840	1544,00
454,44	850	1562,00
460,00	860	1580,00
465,56	870	1598,00
471,11	880	1616,00
476,67	890	1634,00
482,22	900	1650,00
487,78	910	1670,00
493,33	920	1688,00
498,89	930	1706,00
504,44	940	1724,00
510,00	950	1742,00
515,56	960	1760,00
521,11	970	1778,00
526,67	980	1796,00
532,22	990	1814,00
537,78	1000	1832,00
565,56	1050	1922,00
593,33	1100	2012,00
621,11	1150	2102,00
648,89	1200	2192,00
676,67	1250	2282,00
704,44	1300	2372,00
732,22	1350	2462,00
760,00	1400	2552,00
787,78	1450	2642,00
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