The Effects of Ambient Temperature on Refrigeration Load Sizing

The key to determining the proper refrigeration load requirement for any box rests on two general items:

1. Product load or internal heat load. This would include incoming temperature of product being stored, heat of respiration of product being stored, any change of state of the product (freezing), and any heat given off by lights, motors, people, etc.

2. External load. This would include any air infiltration load, radiant load through walls, ceiling, floors, etc.

Ambient temperature or ambient temperature difference from external box temperature to internal box temperature can have a significant impact on the load required.

On walk-in coolers for example, the difference in wall and infiltration loads from an 80°F ambient to a 90°F ambient is approximately 18-20%. From an 80°F ambient to a 100°F ambient that difference increases as much as 30%. See table 1.

Table 1
Data from Russell's Engineering Manual

Walk-in Coolers– BTU Per Hour Wall and Infiltration Losses

Note: Wall and infiltration losses based on Ambient Temperatures listed and Cooler construction incorporating 4" polyurethane or equivalent.

All loads adjusted to 16-18 hours running time.

*Chart usable for 8' and 10' heights also.

BTU Per Hour Wall & Infiltration Losses							BTU Per Hour Wall & Infiltration Losses						
Cooler Size L	D	H*	Average Temperature 80°	90°	100°	Average Product Load BTU/Hr	Cooler Size L	D	H*	Average Temperature 80°	90°	100°	Average Product Load BTU/Hr
8	6	9	3430	4200	4940	950	30	14	9	11260	13750	15900	8300
10			4140	5030	5950	1190	32			11550	14050	16250	8850
12			4820	5890	6950	1430	34			11830	14380	16500	9425
14			5490	6720	7950	1650	36			12200	14700	16950	10000
16			5640	6800	8100	1900	38			12650	15250	17500	10500
18			5930	7250	8540	2150	40			13100	15800	18100	11100
20			6490	7930	9370	2380	42			13750	16500	18850	11600
22			7070	8650	10210	2620	16	16	9	9270	11110	13370	4850
24			7690	9370	11050	2850	18			9430	11200	13510	5440
8	8	9	4290	5240	6190	1280	20			9580	11490	13670	6050
10			5120	6250	7390	1590	22			9950	12140	14360	6650
12			5210	6340	7560	1900	24			10700	13100	15460	7250
14			5810	7100	8390	2220	26			11420	13960	16500	7850
16			6530	7960	9390	2530	28			12170	14890	17610	8450
18			7240	8840	10430	2870	30			12320	15080	17810	9050
20			7390	8970	10630	3180	32			13010	15950	18850	9650
22			7560	9250	10920	3500	18	18	9	9250	11290	13340	6100
24			8180	9980	11780	3820	20			10090	12270	14560	6800
26			8400	10270	12100	4120	22			10840	13210	15630	7470
28			9070	11070	13050	4450	24			11690	14240	16850	8150
30			9580	11690	13780	4750	26			11920	14570	17250	8800
32			10140	12400	14670	5050	28			12740	15520	18350	9520

Cont. on back

On walk-in freezers, the difference in wall and infiltration loads is somewhat less due to the generally thicker insulation in the freezer walls, ceiling and floor. Typically, a 3-5% difference between 80°F ambient and 90°F ambient, and a 6-10% difference between 80°F ambient and 100°F ambient. See table 2.

Table 2
Data from Russell's Engineering Manual

Walk-in Freezers

To Determine BTU/Hour Loads
Low Temperature Walk-in Storage Freezer

Steps to Follow

1. Select Freezer size. Determine Design ambient t Temperature of location. (80° air conditioned location, 90° non-air conditioned location, 100° southern states or outdoor location.) Find BTU wall and infiltration losses per hour in appropriate Box Temperature column.
2. Add on Average Product Load BTU/HR. If a specific product is known, use Page 12 only for product load. When Page 12 is used, do not add the Average Product Load.
3. When Glass Display Doors are used, add total from Page 9.
4. Add BTU/HR load totals for the Net Refrigeration requirements.

Note: Wall and infiltration losses based on Ambient Temperatures listed and Freezer construction incorporating 4" polyurethane equivalent. All loads adjusted to 16-18 hours running time • Charts usable for 8' and 10' heights also.

Freezer Size	80° Ambient			90° Ambient			100° Ambient			Average Product Load BTU/Hr.
L D H*	Box 0°	-10°	-20°	0°	-10°	-20°	0°	-10°	-20°	
8 x 6 x 9	6,060	6,410	6,750	6,200	6,550	6,890	6,360	6,710	7,050	1210
10	6,610	7,010	7,390	6,820	7,230	7,620	7,050	7,470	7,910	1510
12	7,130	7,580	8,010	7,360	7,820	8,260	7,610	8,080	8,570	1820
14	7,640	8,130	8,610	7,880	8,390	8,870	8,150	8,670	9,210	2110
16	8,130	8,670	9,190	8,360	8,890	9,420	8,640	9,170	9,690	2420
18	8,610	9,190	9,750	8,880	9,480	10,050	9,180	9,800	10,430	2730
20	9,080	9,700	10,310	9,360	10,000	10,620	9,670	10,340	11,020	3020
22	9,540	10,200	10,850	9,840	10,520	11,180	10,170	10,870	11,600	3330
24	9,990	10,700	11,390	10,300	11,010	11,700	10,690	11,400	12,090	3630

In all cases, the refrigeration technician should use proper sizing tools such as the Russell Engineering manual RU-ENG-0313A to determine the proper load requirements.