



QUICK CALCULATIONS for WALK-IN COOLERS and FREEZERS

BTUH LOADS for:
6' x 6' to 40' x 40' Rooms
with 8' Ceilings
at -20°F. to +35°F.

Based on **95°F.** Ambient

APPLICATIONS NOTE

Quick Calculations Tables give *typical* and *heavy* load estimates based on the conditions in each room temperature table. Conditions include construction, loading, and room surroundings.

If your conditions are very different from the *typical* or *heavy* conditions, then figure a load estimate specifically for your job. Here are three suggestions to help you get an accurate load estimate for your application:

- You can use the paper and pencil calculation in Heatcraft Refrigeration Products' Engineering Manual (H-ENG-1)
- You can use the box load software, in the Calculation Toolbox of the Cold Solutions Program provided by a Sales Rep
- Or you can call your Sales Representative for assistance

Before you do a, b, or c, get this information about your job:

- Room information:
 - Length, width, and height of the box in feet
 - Temperature of the refrigerated room (°F)
 - Relative humidity in the refrigerated room (if specified)
 - Summertime design ambient temperature (°F). This is usually the temperature expected at the location of an air cooled condensing unit which cools the room
- Insulation information:
 - Type of insulation, insulation thickness (inches), and external temperatures on walls, ceiling, floor
- Infiltration load information:
 - The temperature (°F) of the entering air and the relative humidity of the entering air. Also, an estimate of the door usage - average, heavy, etc.
 - Does the box have glass doors? Dock doors? How many?
- Product load information:
 - What is the product or product mix?
 - How many pounds of product entering at what temperature?
 - How long (hours) does it take to load the product into room?
 - How quickly (hours) should the room pull the product down to what temperature?
 - How many pounds of fruit and vegetables are in the room? (respiration load)
- Miscellaneous loads information:
 - How many people work in the room?
 - What is the lighting (watts)?
 - How many motors (HP) do work in the room?

DIMENSIONS (FEET)			ROOM AREA SQ. FT.	ROOM VOLUME CU. FT.	BTUH TYPICAL LOAD	BTUH HEAVY LOAD
W	L	H				
6	6	8	36	288	4522	6570
6	8	8	48	384	5296	7390
6	10	8	60	480	6020	8170
8	8	8	64	512	6193	8360
8	10	8	80	640	7032	9270
8	12	8	96	768	7830	10140
8	14	8	112	896	8597	10980
8	16	8	128	1024	9341	11790
8	18	8	144	1152	10065	12580
8	20	8	160	1280	11402	13800
8	22	8	176	1408	12097	14570
8	24	8	192	1536	12779	15320
8	26	8	208	1664	13451	16060
8	28	8	224	1792	14115	16800
8	30	8	240	1920	14770	17520
8	32	8	256	2048	15417	18240
10	10	8	100	800	7980	10310
10	12	8	120	960	8883	11300
10	14	8	140	1120	9752	12250
10	16	8	160	1280	11224	13630
10	18	8	180	1440	12045	14530
10	20	8	200	1600	12849	15430
10	24	8	240	1920	14413	17170
10	28	8	280	2240	15931	18860
12	12	8	144	1152	9887	12410
12	14	8	168	1344	11483	13920
12	16	8	192	1536	12423	14970
12	18	8	216	1728	13338	15990
12	20	8	240	1920	14235	16990
12	22	8	264	2112	15115	17970
14	14	8	196	1568	12547	15110
14	16	8	224	1792	13580	16260
14	20	8	280	2240	14587	17520
14	24	8	336	2688	15574	18750
16	16	8	256	2048	14704	17530
16	20	8	320	2560	17318	20420
16	24	8	384	3072	19416	22800
18	18	8	324	2592	17429	20550
18	20	8	360	2880	18592	21870
18	24	8	432	3456	20863	24460
20	20	8	400	3200	19842	23300
20	24	8	480	3840	22911	26530
20	28	8	560	4480	25289	29260
20	32	8	640	5120	28058	32380
20	36	8	720	5760	30347	35020
20	40	8	800	6400	33231	38070
40	24	8	960	7680	37745	43290
40	28	8	1120	8960	42361	48420
40	32	8	1280	10240	46722	53490
40	36	8	1440	11520	51218	58500
40	40	8	1600	12800	55479	63460

0°F. ROOM

(add 15% to loads for 10' height)

Typical Load Conditions:

The Cold Solutions Program automatically figures typical loads.

Here are the "typical" conditions:

Product - In at +10°

- Specific heat of product is 0.45 BTU per pound
- Product loaded in a 24 hour period
- Freezing point of product is 27°
- Reduce product to 0° in 24 hours
- Pounds of +10° product EQUALS room volume (cu. ft.)

External Temperatures

- 95° on all four walls
- 115° on the ceiling (solar effect)
- 55° on the floor

Insulation - 4" Urethane

4" urethane on the walls, ceiling, and floor with R = 25 and k = 0.16

Infiltration - 2 times Average

- 95° air enters room through the door at 50% relative humidity
- The door openings cause TWICE the number of air changes listed in 'AVERAGE AIR CHANGES FOR STORAGE ROOMS' table

Miscellaneous

- Lighting - One watt per square foot of floor area
- 'People Load' - charged at 1 person per 25000 cu. ft. of room volume
- Motors - charged at 1 HP per 12500 cu. ft. of room volume

'Heavy Load' Conditions:

Same as 'Typical' except:

- Pounds of product is 3 times cu. ft.
- People load is 1 person

Safety Factor - 10%

10% safety factor is added to the product, transmission, infiltration, and miscellaneous loads described above.

Run time - 18 hrs. electric defrost

18 hour condensing unit run time. The BTU load for 24 hours is divided by 18 to yield the hourly heat load reported in this table.

**QUICK CALCULATIONS for
FREEZERS**

DIMENSIONS (FEET)			ROOM AREA SQ. FT.	ROOM VOLUME CU. FT.	BTUH TYPICAL LOAD	BTUH HEAVY LOAD
W	L	H				
6	6	8	36	288	4859	7070
6	8	8	48	384	5692	7960
6	10	8	60	480	6573	10890
8	8	8	64	512	6654	8990
8	10	8	80	640	7555	9960
8	12	8	96	768	8413	10890
8	14	8	112	896	9239	11790
8	16	8	128	1024	10039	12660
8	18	8	144	1152	10818	13510
8	20	8	160	1280	12225	14780
8	22	8	176	1408	12973	15600
8	24	8	192	1536	13708	16400
8	26	8	208	1664	14432	17200
8	28	8	224	1792	15146	17980
8	30	8	240	1920	15851	18760
8	32	8	256	2048	16549	19520
10	10	8	100	800	8573	11070
10	12	8	120	960	9543	12130
10	14	8	140	1120	10477	13150
10	16	8	160	1280	12028	14580
10	18	8	180	1440	12911	15550
10	20	8	200	1600	13775	16500
10	24	8	240	1920	15457	18360
10	28	8	280	2240	17090	20170
12	12	8	144	1152	10621	13310
12	14	8	168	1344	12305	14890
12	16	8	192	1536	13314	16010
12	18	8	216	1728	14297	17100
12	20	8	240	1920	15260	18160
12	22	8	264	2112	16206	19220
14	14	8	196	1568	13446	16160
14	16	8	224	1792	14554	17390
14	20	8	280	2240	16696	19780
14	24	8	336	2688	19202	22530
16	16	8	256	2048	15761	18740
16	20	8	320	2560	18533	21790
16	24	8	384	3072	20786	24320
18	18	8	324	2592	18652	21930
18	20	8	360	2880	19900	23330
18	24	8	432	3456	22336	26090
20	20	8	400	3200	21240	24850
20	24	8	480	3840	24503	28260
20	28	8	560	4480	27054	31160
20	32	8	640	5120	29993	34450
20	36	8	720	5760	32449	37260
20	40	8	800	6400	35515	40470
40	24	8	960	7680	40316	45980
40	28	8	1120	8960	45232	51390
40	32	8	1280	10240	49870	56730
40	36	8	1440	11520	54656	62020
40	40	8	1600	12800	59186	67250

-10°F. ROOM

(add 15% to loads for 10' height)

Typical Load Conditions:

The Cold Solutions Program automatically figures typical loads.

Here are the "typical" conditions:

Product - In at 0°

- Specific heat of product is 0.45 BTU per pound
- Product loaded in a 24 hour period
- Freezing point of product is 27°
- Reduce product to -10° in 24 hours
- Pounds of 0° product EQUALS room volume (cu. ft.)

External Temperatures

- 95° on all four walls
- 115° on the ceiling (solar effect)
- 55° on the floor

Insulation - 4" Urethane

4" urethane on the walls, ceiling, and floor with R = 25 and k = 0.16

Infiltration - 2 times Average

- 95° air enters room through the door at 50% relative humidity
- The door openings cause TWICE the number of air changes listed in 'AVERAGE AIR CHANGES FOR STORAGE ROOMS' table

Miscellaneous

- Lighting - One watt per square foot of floor area
- 'People Load' - charged at 1 person per 25000 cu. ft. of room volume
- Motors - charged at 1 HP per 12500 cu. ft. of room volume

'Heavy Load' Conditions:

Same as 'Typical' except:

- Pounds of product is 3 times cu. ft.
- People load is 1 person

Safety Factor - 10%

10% safety factor is added to the product, transmission, infiltration, and miscellaneous loads described above.

Run time - 18 hrs. electric defrost

18 hour condensing unit run time. The BTU load for 24 hours is divided by 18 to yield the hourly heat load reported in this table.

**QUICK CALCULATIONS for
FREEZERS**

DIMENSIONS (FEET)			ROOM AREA SQ. FT.	ROOM VOLUME CU. FT.	BTUH TYPICAL LOAD	BTUH HEAVY LOAD
W	L	H				
6	6	8	36	288	5187	7570
6	8	8	48	384	6076	8510
6	10	8	60	480	6908	9390
8	8	8	64	512	7104	9610
8	10	8	80	640	8066	10640
8	12	8	96	768	8982	11620
8	14	8	112	896	9865	12580
8	16	8	128	1024	10720	13500
8	18	8	144	1152	11553	14410
8	20	8	160	1280	13031	15730
8	22	8	176	1408	13830	16600
8	24	8	192	1536	14617	17460
8	26	8	208	1664	15392	18310
8	28	8	224	1792	16156	19140
8	30	8	240	1920	16912	19970
8	32	8	256	2048	17659	20780
10	10	8	100	800	9152	11810
10	12	8	120	960	10187	12940
10	14	8	140	1120	11185	14020
10	16	8	160	1280	12815	15520
10	18	8	180	1440	13758	16550
10	20	8	200	1600	14682	17560
10	24	8	240	1920	16480	19530
10	28	8	280	2240	18227	21460
12	12	8	144	1152	11338	14190
12	14	8	168	1344	13108	15850
12	16	8	192	1536	14185	17030
12	18	8	216	1728	15236	18180
12	20	8	240	1920	16246	1930

-10°F. to 0°F. Reach-Ins	
Room Volume Cubic Feet	Approximate BTUH
4 - 10 11 - 18 19 - 35	1000 1350 1900
36 - 55 56 - 75 76 - 100	2900 4200 5500
Based on a minimum 1-1/2 inch urethane foam insulated fixture, 18 hours per day compressor run time.	

35°F. to 40°F. Reach-Ins	
Room Volume Cubic Feet	Approximate BTUH
4 - 10 11 - 18 19 - 28	950 - 1150 1100 - 1300 2100
29 - 38 39 - 68 69 - 100	2600 3500 5700
Based on a minimum 1 inch urethane foam insulated fixture, 16 hours per day compressor run time.	

Electrical Formulas (Heaters, Resistive Loads)

Single Phase Loads:
 Watts = Amps times Volts [P = I x E]
 Amps = Watts divided by Volts [I = P / E]
 Volts = Amps divided by Watts [E = P / I]

Three Phase Loads: (where the loads on each phase are equal)
 Watts = 1.732 times Amps times Volts [P = 1.732 x I x E]
 Amps = Watts divided by Volts [I = P / (1.732 x E)]
 Volts = Amps divided by Watts [E = P / (1.732 x I)]

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HEAT EQUIVALENT in BTUH per HP of Electric Motors Openings & Infiltration		
Motor HP	Inside Refrigeration Space	Outside Refrigeration Space
1/8 to 1/2 1/2 to 3 3 to 20	4250 3700 2950	2545 2545 2545
Use "motor inside" when BOTH the motor and the work done by the motor are inside the refrigerated room.		
Use "motor outside" when the work done by the motor is inside the refrigerated room, but the motor is outside of the refrigerated room.		

LIGHTS	
Typically 1 to 1-1/2 watts per square foot. Cutting or storage rooms can be double the storage figure.	Each watt is multiplied by 3.42 BTU per watt to get BTUH and then multiplied by 24 to get the daily load.

HEAT GAIN for battery operated lift trucks (typically 4 - 5 equivalent HP)		
Battery operated load capacity, POUNDS	Heat gain per hour of lift truck operation, BTUH	Approx. total weight of lift truck, POUNDS
2000	14000	6000
4000	21000	8000
6000	23000	12000
8000	26000	14000

For the heat gain from lift trucks with internal combustion engines, derive the equivalent HP by multiplying engine HP by daily hours of operation and dividing by 24 (typically 4 - 5 equivalent HP). Multiply the equiv. HP by 75000 for the additional BTU/day.

If motor or loading conditions are not known then calculate one motor HP for each 16000 cu. ft. in a storage cooler and 12500 cu. ft. in a storage freezer. Loading docks and high distribution warehouses are heavier.

HEAT EQUIVALENT of Occupancy	
Room Temperature	Heat Equivalent per person BTU / 24 Hours
50°F. 40°F. 30°F.	17280 20160 22800
20°F. 10°F. 0°F. -10°F.	25200 28800 31200 33600
If occupancy is unknown allow one person per 24 hours for each 25,000 cubic feet of space.	

AVERAGE AIR CHANGES for Storage Rooms due to Door Openings & Infiltration		
Room Volume Cu. Ft.	Room Temp. Above 32°F.	Room Temp. Below 32°F.
200 250 300 400	44.0 38.0 34.5 29.5	33.5 29.0 26.2 22.5
500 600 800	26.0 23.0 20.0	20.0 18.0 15.3
1000 1500 2000	17.5 14.0 12.0	13.5 11.0 9.3
3000 4000 5000 6000	9.5 8.2 7.2 6.5	7.4 6.3 5.6 5.0
8000 10000 15000	5.5 4.9 3.9	4.3 3.8 3.0

REACH-IN GLASS DOOR LOADS		
Room Temperature	BTUH per Door	Glass door loads have been adjusted for run time load. Multiply number of doors by the door load listed and add to hourly heat load in the tables.
35°F.	1060	
30°F.	960	
0°F.	1730	
-10°F.	1730	
-20°F.	1730	

MEAT CUTTING / PREP ROOM			
Floor Square Feet	BTUH per Square Feet of Floor		Meat/Prep. Room loads based on continuous operation and include allowances for average number of personnel, processing equipment, etc., with glass panel in one wall and walls and ceilings insulated with 3 inches of styrene with box located in air conditioned area. Evaporator should be low outlet velocity type to avoid drafts and should be selected for continuous operation and not less than 30°F. evaporator temperature.
	55°F.	50°F.	
100	93	105	
200	88	99	
300	85	95	
400	81	90	
500	78	87	
600	75	85	
700	72	81	
800	69	78	
900	67	75	
1000	65	73	
1200	62	69	

EQUATION for Heat Conduction

Q Total = U x A x ("F. out - "F. in)

Legend:
 "Q Total" is total heat transfer in BTU per hour (BTUH)
 "U" is coefficient of heat transfer in BTU / (hour x sq. ft. x "F.)
 "x" is the symbol for multiply
 "A" is area in square feet
 ("F. out - "F. in)" is the temperature on the outside less the temperature on the inside of the insulation

U = 1 divided by R
 U = k x (insulation thickness)
 k = (insulation thickness) / R
 Insulation thickness is inches.

DIMENSIONS (FEET)	ROOM AREA SQ. FT.		ROOM VOLUME CU. FT.	BTUH TYPICAL LOAD	BTUH HEAVY LOAD
	W	H			
6	6	8	36	288	3483
6	8	8	48	384	4095
6	10	8	60	480	4668
8	8	8	64	512	4812
8	10	8	80	640	5485
8	12	8	96	768	6126
8	14	8	112	896	6744
8	16	8	128	1024	7343
8	18	8	144	1152	7927
8	20	8	160	1280	9078
8	22	8	176	1408	9639
8	24	8	192	1536	10192
8	26	8	208	1664	10736
8	28	8	224	1792	11273
8	30	8	240	1920	11804
8	32	8	256	2048	12330
10	10	8	100	800	6252
10	12	8	120	960	6984
10	14	8	140	1120	7691
10	16	8	160	1280	8356
10	18	8	180	1440	9026
10	20	8	200	1600	9696
10	24	8	240	1920	11560
10	28	8	280	2240	12804
12	12	8	144	1152	7805
12	14	8	168	1344	9177
12	16	8	192	1536	9948
12	18	8	216	1728	10700
12	20	8	240	1920	11438
12	22	8	264	2112	12164
14	14	8	196	1568	10054
14	16	8	224	1792	10907
14	20	8	280	2240	12560
14	24	8	336	2688	14597
16	16	8	256	2048	11842
16	20	8	320	2560	14093
16	24	8	384	3072	15846
18	18	8	324	2592	14189
18	20	8	360	2880	15164
18	24	8	432	3456	17071
20	20	8	400	3200	16216
20	24	8	480	3840	18854
20	28	8	560	4480	22108
20	32	8	640	5120	23277
20	36	8	720	5760	25219
20	40	8	800	6400	27714
40	24	8	960	7680	31681
40	28	8	1120	8960	35721
40	32	8	1280	10240	39570
40	36	8	1440	11520	43516
40	40	8	1600	12800	47289

30°F. ROOM

(add 15% to loads for 10' height)

Typical Load Conditions:
 The Cold Solutions Program automatically figures typical loads. Here are the "typical" conditions:

Product - In at +10°
 a) Specific heat of product is 0.90 BTU per pound
 b) Product loaded in a 24 hour period
 c) Freezing point of product is 27°
 d) Reduce product to 30° in 24 hours
 e) Pounds of +40° product EQUALS room volume (cu. ft.)

External Temperatures
 a) 95° on all four walls
 b) 115° on the ceiling (solar effect)
 c) 55° on the floor

Insulation - 4" Urethane
 4" urethane on the walls, ceiling, and floor with R = 25 and k = 0.16

Infiltration - 2 times Average
 a) 95° air enters room through the door at 50% relative humidity
 b) The door openings cause TWICE the number of air changes listed in 'AVERAGE AIR CHANGES FOR STORAGE ROOMS' table

Miscellaneous
 a) Lighting - One watt per square foot of floor area
 b) "People Load" - charged at 1 person per 25000 cu. ft. of room volume
 c) Motors - charged at 1 HP per 12500 cu. ft. of room volume

'Heavy Load' Conditions:
 Same as 'Typical' except:
 a) Pounds of product is 3 times cu. ft.
 b) People load is 1 person

'Safety Factor - 10%
 10% safety factor is added to the product, transmission, infiltration, and miscellaneous loads described above.

Run time - 18 hrs. electric defrost
 18 hour condensing unit run time. The BTU load for 24 hours is divided by 18 to yield the hourly heat load reported in this table.

QUICK CALCULATIONS for COOLERS

DIMENSIONS (FEET)	ROOM AREA SQ. FT.		ROOM VOLUME CU. FT.	BTUH TYPICAL LOAD	BTUH HEAVY LOAD
	W	H			
6	6	8	36	288	4986
6	8	8	48	384	5884
6	10	8	60	480	6729
8	8	8	64	512	6939
8	10	8	80	640	7934
8	12	8	96	768	8887
8	14	8	112	896	9808
8	16	8	128	1024	10626
8	18	8	144	1152	11581
8	20	8	160	1280	12588
8	22	8	176	1408	13434
8	24	8	192	1536	14267
8	26	8	208	1664	15585
8	28	8	224	1792	16398
8	30	8	240	1920	17203
8	32	8	256	2048	18001
10	10	8	100	800	9072
10	12	8	120	960	10164
10	14	8	140	1120	11221
10	16	8	160	1280	12398
10	18	8	180	1440	13406
10	20	8	200	1600	14890
10	24	8	240	1920	16823
10	28	8	280	2240	18709
12	12	8	144	1152	11391
12	14	8	168	1344	12728
12	16	8	192	1536	13887
12	18	8	216	1728	15518
12	20	8	240	1920	16633
12	22	8	264	2112	17732
14	14	8	196	1568	14046
14	16	8	224	1792	15828
14	20	8	280	2240	18329
14	24	8	336	2688	20756
16	16	8	256	2048	17240
16	20	8	320	2560	19987
16	24	8	384	3072	22656
18	18	8	324	2592	20132
18	20	8	360	2880	21615
18	24	8	432	3456	25018
20	20	8	400	3200	23713
20	24	8	480	3840	27005
20	28	8	560	4480	30084
20	32	8	640	5120	33608
20	36	8	720	5760	36595
20	40	8	800	6400	40190
40	24	8	960	7680	45633
40	28	8	1120	8960	51628
40	32	8	1280	10240	57408
40	36	8	1440	11520	63278
40	40	8	1600	12800	68954

QUICK CALCULATIONS for COOLERS

35°F. ROOM

(add 15% to loads for 10' height)

Typical Load Conditions:
 The Cold Solutions Program automatically figures typical loads. Here are the "typical" conditions:

Product - In at 40°
 a) Specific heat of product is 0.90 BTU per pound
 b) Product loaded in a 24 hour period
 c) Freezing point of product is 27°
 d) Reduce product to 35° in 24 hours.
 e) Pounds of 40° product entering the room is two times room cu. ft.

External Temperatures
 a) 95° on all four walls,
 b) 115° on the ceiling (solar effect)
 c) 55° on the floor

Insulation - 4" Styrofoam
 a) 4" Styrofoam on the wall & ceiling, with R = 16.7 and k = 0.24
 b) 6" concrete on the floor, with R = 4.8 and k = 1.25

Infiltration - 2 times Average
 a) 95° air enters room through the door at 50% relative humidity
 b) The door openings cause TWICE the number of air changes listed in 'AVERAGE AIR CHANGES FOR STORAGE ROOMS' table.

Miscellaneous
 a) Lighting - One watt per square foot of floor area
 b) "People Load" - charged at 1 person per 25000 cu. ft. of room volume
 c) Motors - charged at 1 HP per 16000 cu. ft. of room volume

'Heavy Load' Conditions:
 Same as 'Typical' except:
 a) Pounds of product is 3 times cu. ft.
 b) People load is 1 person

'Safety Factor - 10%
 10% safety factor is added to the product, transmission, infiltration, and miscellaneous loads described above.

Run time - 16 hrs. air defrost
 16 hour condensing unit run time. The BTU load for 24 hours is divided by 16 to yield the hourly heat load reported in this table.