

PART 2- FACILITIES TO MAINTAIN PRODUCT TEMPERATURE

Sufficient hot-holding and cold-holding facilities shall comply with the standards of NSF or equivalent, and shall be designed, constructed and installed in conformance with the requirements of these standards.

REFRIGERATION FACILITIES SIZING AND DESIGN

The plan review for storage needs to provide adequate refrigeration facilities for the proper storage, transportation, display, and service of potentially hazardous foods. Specific refrigeration needs will be based upon the menu, number of meals, frequency of delivery, and preparation in advance of service. All refrigerators must be capable of maintaining potentially hazardous foods (PHF) at 41EF or below.

If potentially hazardous foods are prepared a day or more in advance of service, a rapid cooling procedure capable of cooling potentially hazardous foods from 140EF to 41EF within 6 hours (140EF to 70EF in 2 hrs. & 70EF to 41EF in 4 hrs.) should be provided. The capacity of the rapid cooling facilities must be sufficient to accommodate the volume of food required to be cooled to 41EF within 6 hours.

Provide point-of-use refrigerators and freezers at work stations for operations requiring preparation and handling of potentially hazardous foods. Refrigeration units, unless designed for such use, should not be located directly adjacent to cooking equipment or other high heat producing equipment which may tax the cooling system's operation.

SIZING CONSIDERATION FOR CALCULATING TOTAL REFRIGERATED STORAGE NEEDS, INCLUDING WALK-INS

To plan reserve storage, the following need to be considered: menu, type of service, number of meals per day, number of deliveries per week and adequate air ventilation in the area where refrigeration system will be located.

The following is a suggested formula to establish required reserve storage (note: only 40% of any walk-in unit actually provides usable space):

Total Interior Storage Volume Needed:

$$\frac{\text{Vol. per meal (Cu. ft.)} \times \text{number of meals}}{.40}$$

Below are estimated typical meal volumes for each of three types of refrigerated storage:

Meat, Poultry and Seafood	=	.010-.030 Cu. ft. per meal
Dairy	=	.007-.015 Cu. ft. per meal
Vegetables and fruit	=	.020-.040 Cu. ft. per meal

Thus for a restaurant serving 1000 meals between deliveries (assume a minimum of 4 day storage) the following storage capacities are needed:

$$\text{Meat refrigerated storage} = \frac{.030 \text{ Cu. ft./meal} \times 1000 \text{ meals}}{.40}$$

$$= 75 \text{ Cu. ft.}$$

$$\text{Vegetable refrigerated storage} = \frac{.040 \text{ Cu. ft./meal} \times 1000 \text{ meals}}{.40}$$

$$= 100 \text{ Cu. ft.}$$

$$\text{Dairy refrigerated storage} = \frac{.015 \text{ Cu. ft./meal} \times 1000 \text{ meals}}{.40}$$

$$= 37.5 \text{ Cu. ft.}$$

To calculate the interior storage space (in square feet) required for the above example, divide the volume (Cu. ft), in each case, by the height of the unit.

Example:

$$\text{For meat refrigerated storage} = \frac{75 \text{ Cu. ft.}}{6 \text{ ft. (height)}}$$

$$= 12.5 \text{ sq. ft.}$$

The interior floor area would have to be 12.5 sq. ft. to accommodate refrigeration storage of meat for 1000 meals.

To estimate total interior volume or space, add together the requirements for each type of food.

To convert interior measurements to exterior floor area, multiply by 1.25. Thus, for meat storage, in the above example an exterior floor area = 1.25 x 12.5 sq. ft., or 15.6 sq. ft. would be needed.

ADDITIONAL RECOMMENDATIONS FOR REFRIGERATED STORAGE FACILITIES

- A. Shelving for walk-in and reach-in refrigeration units should be equipment that is certified or classified for sanitation by an ANSI accredited certification program.

- B. Interior finishes of walk-in and reach-in refrigeration units should be certified or classified for sanitation by an ANSI accredited certification program. Galvanized metal is not recommended because of its tendency to rust.
- C. All refrigeration units must have numerically scaled indicating thermometers accurate to ± 3 EF. The temperature sensing device must be located in the unit to measure air temperature in the warmest part. All such thermometers should have an externally mounted indicator to facilitate easy reading of the temperature of the unit. Refrigerators and freezers shall be capable of maintaining appropriate temperatures when evaluated under test conditions of an ANSI accredited certification program.
- D. Air circulation within refrigeration and freezer units should not be obstructed and should allow for an even and consistent flow of cold air throughout the units.

Refrigeration Unit maximum operating temperature (cabinet air) should be:

<u>Type</u>	<u>Max Temp</u>	<u>Max Compressor Operating time</u>
Refrigerated buffet units	Cabinet air temp 41EF Food temp 33-41EF	70%
Storage & display refrigerators	Cabinet air temp 41EF Food temp 33-41EF	70%
Storage & display freezer	Cabinet air temp 0EF Food Frozen	80%

Rapid pull down refrigeration units must be capable of cooling cooked PHF s from 140EF to 70EF within 2 hours, and from 70EF to 41EF within 4 hours or less.

- E. Approved coved juncture base around the interior.
- F. Approved coved junction base around the exterior.
- G. Approved enclosure between the top of the unit and the ceiling if this space is twenty-four inches or less. Fixed equipment shall be spaced to allow for cleaning along the sides and behind, or sealed to adjoining equipment or walls.

- H. Refrigeration units should not be installed exterior to the building if non-packaged foods will be transported from the unit to the food establishment.
- I. If the walk-in floors are water-flushed for cleaning or receive the discharge of liquid waste or excessive melt water, the floors should be non-absorbent (i.e. quarry tile or equal) with silicone or epoxy impregnated grout and, sloped to drain. Local jurisdictions may require drains to be located outside of the cooling box within 5 feet of the cooler box.
- J. Walk-in freezer doors should be equipped with pressure relief ports.
- K. All walk-in units should be constructed and installed in accordance with nationally recognized standards and/or code requirements and bear the certification mark of an ANSI accredited organization (e.g. NSF, UL, ETL).
- L. Each walk-in unit shall be equipped with lighting that provides 10 foot candles of light throughout the unit when it is full of product.

HOT HOLDING AND REHEATING FACILITIES

The hot holding facilities must be capable of maintaining potentially hazardous foods at an internal temperature of 140EF or above during display, service and holding periods.

Reheating equipment must be capable of raising the internal temperature of potentially hazardous foods rapidly (within a maximum of 2 hours) to at least 165EF. Appropriate product thermometers will be required to monitor the food temperature.

SAMPLE COLD STORAGE CALCULATIONS

Cited on the next few pages are examples of cold storage calculations prepared by the North Carolina Department of Health, Food Lodging and Institutional Sanitation Branch, Plan Review Subcommittee.

The following three charts are based on the volume of the meals, number of meals served and frequency of delivery.

To calculate the interior storage space required for walk-in refrigeration units for the following charts to square feet, simply divide the cu. ft. (volume), in each case by the height of the unit.

MEAT AND POULTRY COLD STORAGE CHART FOR WALK-IN UNITS

number of meals served between deliveries	storage per cu. ft. per 0.01 Cu. Ft. per meal per number meals served	storage per cu. ft. per 0.015 Cu. Ft. per meal per number meals served	storage per cu. ft. per 0.020 Cu. Ft. per meal per number meals served	storage per cu. ft. per 0.025 Cu. Ft. per meal per number meals served	storage per cu. ft. per 0.03 Cu. Ft. per meal per number meals served
200	5	7.50	10.00	12.50	15.00
250	6.25	9.38	12.50	15.63	18.75
300	7.50	11.25	15.00	18.75	22.50
350	8.75	13.13	17.50	21.88	26.25
400	10.00	15.00	20.00	25.00	30.00
450	11.25	16.88	22.50	28.13	33.75
500	12.50	18.75	25.00	31.25	37.50
550	13.75	20.63	27.50	34.38	41.25
600	15.00	22.50	30.00	37.50	45.00
650	16.25	24.38	32.50	40.63	48.75
700	17.50	26.25	35.00	43.75	52.50
750	18.75	28.13	37.50	46.88	56.25
800	20.00	30.00	40.00	50.00	60.00
850	21.25	31.88	42.50	53.13	63.75
900	22.50	33.75	45.00	56.25	67.50
950	23.75	35.63	47.50	59.38	71.25
1000	25.00	37.50	50.00	62.50	75.00
1050	26.25	39.38	52.50	65.63	78.75
1100	27.50	41.25	55.00	68.75	82.50
1150	28.75	43.13	57.50	71.88	86.25
1200	30.00	45.00	60.00	75.00	90.00
1250	31.25	46.88	62.50	78.13	93.75
1300	32.50	48.75	65.00	81.25	97.50
1350	33.75	50.63	67.50	84.38	101.25
1400	35.00	52.50	70.00	87.50	105.00
1450	36.25	54.38	72.50	90.63	108.75
1500	37.50	56.25	75.00	93.75	112.50
1550	38.75	58.13	77.50	96.88	116.25
1600	40.00	60.00	80.00	100.00	120.00
1650	41.25	61.88	82.50	103.13	123.75
1700	42.50	63.75	85.00	106.25	127.50
1750	43.75	65.63	87.50	109.38	131.25
1800	45.00	67.50	90.00	112.50	135.00
1850	46.25	69.38	92.50	115.63	138.75
1900	47.50	71.25	95.00	118.75	142.50
1950	48.75	73.13	97.50	121.88	146.25
2000	50.00	75.00	100.00	125.00	150.00

MEAT AND POULTRY COLD STORAGE CHART FOR REACH-IN UNITS

number of meals served between deliveries	storage per cu. ft. per 0.01 Cu. Ft. per meal per number meals served	storage per cu. ft. per 0.015 Cu. Ft. per meal per number meals served	storage per cu. ft. per 0.020 Cu. Ft. per meal per number meals served	storage per cu. ft. per 0.025 Cu. Ft. per meal per number meals served	storage per cu. ft. per 0.03 Cu. Ft. per meal per number meals served
200	2.67	4.00	5.33	6.67	8.00
250	3.33	5.00	6.67	8.33	10.00
300	4.00	6.00	8.00	10.00	12.00
350	4.67	7.00	9.33	11.67	14.00
400	5.33	8.00	10.67	13.33	16.00
450	6.00	9.00	12.00	15.00	18.00
500	6.67	10.00	13.33	16.67	20.00
550	7.33	11.00	14.67	18.33	22.00
600	8.00	12.00	16.00	20.00	24.00
650	8.67	13.00	17.33	21.67	26.00
700	9.33	14.00	18.67	23.33	28.00
750	10.00	15.00	20.00	25.00	30.00
800	10.67	16.00	21.33	26.67	32.00
850	11.33	17.00	22.67	28.33	34.00
900	12.00	18.00	24.00	30.00	36.00
950	12.67	19.00	25.33	31.67	38.00
1000	13.33	20.00	26.67	33.33	40.00
1050	14.00	21.00	28.00	35.00	42.00
1100	14.67	22.00	29.33	36.67	44.00
1150	15.33	23.00	30.67	38.33	46.00
1200	16.00	24.00	32.00	40.00	48.00
1250	16.67	25.00	33.33	41.67	50.00
1300	17.33	26.00	34.67	43.33	52.00
1350	18.00	27.00	36.00	45.00	54.00
1400	18.67	28.00	37.33	46.67	56.00
1450	19.33	29.00	38.67	48.33	58.00
1500	20.00	30.00	40.00	50.00	60.00
1550	20.67	31.00	41.33	51.67	62.00
1600	21.33	32.00	42.67	53.33	64.00
1650	22.00	33.00	44.00	55.00	66.00
1700	22.67	34.00	45.33	56.67	68.00
1750	23.33	35.00	46.67	58.33	70.00
1800	24.00	36.00	48.00	60.00	72.00
1850	24.67	37.00	49.33	61.67	74.00
1900	25.33	38.00	50.67	63.33	76.00
1950	26.00	39.00	52.00	65.00	78.00
2000	26.67	40.00	53.33	66.67	80.00

VEGETABLE AND FRUIT COLD STORAGE CHART FOR REACH-IN UNITS

number of meals served between deliveries	storage per cu. ft. per 0.020 Cu. Ft. per meal per number meals served	storage per cu. ft. per 0.025 Cu. Ft. per meal per number meals served	storage per cu. ft. per 0.030 Cu. Ft. per meal per number meals served	storage per cu. ft. per 0.035 Cu. Ft. per meal per number meals served	storage per cu. ft. per 0.040 Cu. Ft. per meal per number meals served
200	5.33	6.67	8.00	9.33	10.67
250	6.67	8.33	10.00	11.67	13.33
300	8.00	10.00	12.00	14.00	16.00
350	9.33	11.67	14.00	16.33	18.67
400	10.67	13.33	16.00	18.67	21.33
450	12.00	15.00	18.00	21.00	24.00
500	13.33	16.67	20.00	23.33	26.67
550	14.67	18.33	22.00	25.67	29.33
600	16.00	20.00	24.00	28.00	32.00
650	17.33	21.67	26.00	30.33	34.67
700	18.67	23.33	28.00	32.67	37.33
750	20.00	25.00	30.00	35.00	40.00
800	21.33	26.67	32.00	37.33	42.67
850	22.67	28.33	34.00	39.67	45.33
900	24.00	30.00	36.00	42.00	48.00
950	25.33	31.67	38.00	44.33	50.67
1000	26.67	33.33	40.00	46.67	53.33
1050	28.00	35.00	42.00	49.00	56.00
1100	29.33	36.67	44.00	51.33	58.67
1150	30.67	38.33	46.00	53.67	61.33
1200	32.00	40.00	48.00	56.00	64.00
1250	33.33	41.67	50.00	58.33	66.67
1300	34.67	43.33	52.00	60.67	69.33
1350	36.00	45.00	54.00	63.00	72.00
1400	37.33	46.67	56.00	65.33	74.67
1450	38.67	48.33	58.00	67.67	77.33
1500	40.00	50.00	60.00	70.00	80.00
1550	41.33	51.67	62.00	72.33	82.67
1600	42.67	53.33	64.00	74.67	85.33
1650	44.00	55.00	66.00	77.00	88.00
1700	45.33	56.67	68.00	79.33	90.67
1750	46.67	58.33	70.00	81.67	93.33
1800	48.00	60.00	72.00	84.00	96.00
1850	49.33	61.67	74.00	86.33	98.67
1900	50.67	63.33	76.00	88.67	101.33
1950	52.00	65.00	78.00	91.00	104.00
2000	53.33	66.67	80.00	93.33	106.67

DAIRY COLD STORAGE CHART FOR REACN- IN UNITS

number of meals served between deliveries	storage per cu. ft. per 0.007-Cu.-Fl.-per-meal per number meals served	storage per cu. ft. per 0.009-Cu.-Fl.-per-meal per number meals served	storage per cu. ft. per 0.011-Cu.-Fl.-per-meal per number meals served	storage per cu. ft. per 0.013-Cu.-Fl.-per-meal per number meals served	storage per cu. ft. per 0.015-Cu.-Fl.-per-meal per number meals served
200	1.87	2.40	2.93	3.47	4.00
250	2.33	3.00	3.67	4.33	5.00
300	2.80	3.60	4.40	5.20	6.00
350	3.27	4.20	5.13	6.07	7.00
400	3.73	4.80	5.87	6.93	8.00
450	4.20	5.40	6.60	7.80	9.00
500	4.67	6.00	7.33	8.67	10.00
550	5.13	6.60	8.07	9.53	11.00
600	5.60	7.20	8.80	10.40	12.00
650	6.07	7.80	9.53	11.27	13.00
700	6.53	8.40	10.27	12.13	14.00
750	7.00	9.00	11.00	13.00	15.00
800	7.47	9.60	11.73	13.87	16.00
850	7.93	10.20	12.47	14.73	17.00
900	8.40	10.80	13.20	15.60	18.00
950	8.87	11.40	13.93	16.47	19.00
1000	9.33	12.00	14.67	17.33	20.00
1050	9.80	12.60	15.40	18.20	21.00
1100	10.27	13.20	16.13	19.07	22.00
1150	10.73	13.80	16.87	19.93	23.00
1200	11.20	14.40	17.60	20.80	24.00
1250	11.67	15.00	18.33	21.67	25.00
1300	12.13	15.60	19.07	22.53	26.00
1350	12.60	16.20	19.80	23.40	27.00
1400	13.07	16.80	20.53	24.27	28.00
1450	13.53	17.40	21.27	25.13	29.00
1500	14.00	18.00	22.00	26.00	30.00
1550	14.47	18.60	22.73	26.87	31.00
1600	14.93	19.20	23.47	27.73	32.00
1650	15.40	19.80	24.20	28.60	33.00
1700	15.87	20.40	24.93	29.47	34.00
1750	16.33	21.00	25.67	30.33	35.00
1800	16.80	21.60	26.40	31.20	36.00
1850	17.27	22.20	27.13	32.07	37.00
1900	17.73	22.80	27.87	32.93	38.00
1950	18.20	23.40	28.60	33.80	39.00
2000	18.67	24.00	29.33	34.67	40.00

For additional formulas and information, other references to refer to include:
 North American Association of Food Equipment Manufacturers. An Introduction to the Food Service Industry. First Edition, 1995

Salvato Textbook. Environmental Engineering & Sanitation 4th Edition. John Wiley & Sons, Inc. United States, 1992.