to sanitize may not be less than 120°F.

The temperature of the wash solution for manual warewashing must be maintained to not less than 110°F. The water temperature for manual hot water sanitization must be at least 171°F.

There are two primary methods used to determine hot water needs:

- Energy Methods
- Recovery Rate Model

Method 1: Energy Methods: (BTUs vs. KWs)

The energy method for determining hot water needs of food establishments is calculated by adding together all of the energy requirements for each fixture using hot water. For these calculations, it is generally assumed that the temperature of incoming water to the food establishment is 40° F unless specific data is provided and 1 gallon of water equals 8.33 lbs. It is necessary to calculate both the demand for hot water in gallons per hour (gph) and the temperature rise[1] needed for each piece of equipment. This information can then be converted to BTU's (for gas fired heaters) or KW (for electrical heaters). The required BTU or KW capacity of the water heater will then be determined by adding up the individual BTU or KW requirements for each piece of equipment.

Formula to calculate the BTU's needed for gas hot water heaters:

For gas heaters (in BTU's):

$$\text{Required BTU} = \frac{\text{Gallons per hour of water} \times \text{Temp. rise} \times 8.33}{.70 \text{ (operating efficiency)}}$$

Formula to calculate the KW's needed for electric hot water heaters:

For electrical heaters (in KW):

$$\text{Required KW} = \frac{\text{Gallons per hour of water} \times \text{Temp. rise} \times 8.33}{3412 \text{ (BTU's per KW)}}$$

The following examples illustrate the energy method of approximating the size of the hot water heater needed for the equipment specified:

Equipment	Gallons Per Hour Demand from Chart or Spec. Sheet	Temperature Required	Temp. Rise

[1] Temperature rise is the hot water temperature required minus the temperature of the water coming into the facility. For example, if the temperature of water entering a food establishment is 40° F and 100° F is needed at a handwashing sink, then the temperature rise would be 110° F - 40° F or 70° F.

Equipment	Gallons Per Hour Demand from Chart or Spec. Sheet	Temperature Required	Temp. Rise
3 Comp't sink	60	140°F	100°F

$$\frac{60 \text{ (gph)} \times 100 \text{ degree temp. rise} \times 8.33}{.70 \text{ (operating efficiency)}} = 71{,}400 \text{ BTU's}$$

OR

$$\frac{60 \text{ (gph)} \times 100 \text{ degree temp rise} \times 8.33}{3412 \text{ (BTU's per KW)}} = 14.65 \text{ KW}$$

Equipment	Gallons Per Hour Demand from Chart or Spec. Sheet	Temperature Required	Temp. Rise
Hand sink	5	110°F	70°F

$$\frac{5 \text{ (gph)} \times 70 \text{ degree temp rise} \times 8.33}{.70 \text{ (operating efficiency)}} = 4{,}165 \text{ BTU's}$$

OR

$$\frac{5 \text{ (gph)} \times 70 \text{ degree temp rise} \times 8.33}{3412 \text{ (BTU per KW)}} = 0.85 \text{ KW}$$

Equipment	Gallons Per Hour Demand from Chart or Spec. Sheet	Temperature Required	Temp. Rise
Chemical/ Mechanical warewasher	64	140°F	100°F

$$\frac{64 \text{ (gph)} \times 100 \text{ degree temp rise} \times 8.33}{.70 \text{ (operating efficiency)}} = 76{,}160 \text{ BTU's}$$

OR

$$\frac{64 \text{ (gph)} \times 100 \text{ degree temp rise} \times 8.33}{3412 \text{ (BTU per KW)}} = 15.62 \text{ KW}$$

Equipment	Gallons Per Hour Demand from Chart or Spec. Sheet	Temperature Required	Temp. Rise
Hot water Sanitizing Mechanical warewasher	64	180°F	40°F

$$\frac{64 \text{ (gph)} \times 40 \text{ degree temp rise} \times 8.33}{.70 \text{ (operating efficiency)}} = 30{,}464 \text{ BTU's}$$

$$\frac{64 \text{ (gph)} \times 40 \text{ degree temp rise} \times 8.33}{3412 \text{ (BTU per KW)}} = 6.2 \text{ KW}$$

For mechanical warewashing, assume a hot water demand based on a primary rise in temperature to 140°F. A booster heater would then be needed to boost the required gallons per hour demand an additional 40°F to attain the required 180°F final rinse temperature. In this example, the total demand in BTU's or KW for the primary water heater would be:

3 Compartment sink	=	71,400 BTU or 14.65 KW
1 Hand sink	=	4,165 BTU or 0.85 KW
1 Mechanical warewasher	=	76,160 BTU or 15.62 KW
TOTAL DEMAND	=	151,725 BTU or 31.12 KW

In addition, a booster heater for the warewasher must be provided and sized to supply an additional 30,464 BTU or 6.2 KW.

All hot water generating equipment should conform to nationally recognized standards. The manufacturers' specification sheets (cut sheets) should be consulted for hot water supply requirements.

The above formula is one method of calculating the energy needed for water heaters. Other suitably developed calculations may be submitted for consideration.

Method 2: Recovery Rate Model For Determining Hot Water Supply Requirements

Recovery rate is defined as the amount of hot water supplied by a water heater in one hour's time. Recovery rate is expressed in gallons per hour (GPH), and is determined by the water heater's input (BTW or kW) according to the following tables.

Hot water recovery is based on fixture requirements in accordance with the following guidelines:

Fixtures must be added together to determine hot water needs.

Prep sink compartments =	5 GPH each
Hand sinks =	5 GPH
Mop sinks =	10 GPH
Clothes washer =	15 GPH
Hose reel =	10 GPH

Pot sink = sink vat size $inch^3$ X # of compartments X .003255 $inch^3$

Example for pot sink:

Sink vat size = (24X24X14) X 3 compartments X .003255 $inch^3$ = 79 GPH

Dish machine =	70% of "final rise usage" found on manufacturer's spec sheet
Pre-rinse spray =	45 GPH

GUIDELINES FOR SIZING WATER HEATERS

California Conference of Directors of Environmental Health
September, 1995

I. BACKGROUND

A critical factor in preventing foodborne illnesses in a food facility is the provision of an adequate supply of hot water for the washing of hands, utensils, equipment, and the facility itself. The installation of a properly sized water heater will ensure that a sufficient amount of hot water will be available at all times.

II. PURPOSE

The purpose of these guidelines is to provide a set of criteria that will assist architects, designers, contractors and owners in properly sizing water heaters to adequately meet the anticipated hot water demands of food facilities in California.

Food facilities with water heaters sized according to these criteria should be capable of complying with the requirements for providing an adequate hot water supply as required by the California Uniform Retail Food Facilities Law.

III. LEGAL AUTHORITY

California Health and Safety Code, Chapter 4, Article 8, Sections 27623, 27624, 27625, 27627, and 27627.3.

IV. DEFINITIONS

- **Booster Heater:** An instantaneous water heater designed and intended to raise the temperature of hot water to a higher temperature for a specific purpose, such as for the sanitizing rinse on a high temperature automatic dishmachine.
- **BTU (British Thermal Unit):** The quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit.
- **GPH (Gallons Per Hour):** The amount of water, in gallons, that is used each hour by the plumbing fixtures and equipment, such as dishmachines.
- **GPM (Gallons Per Minute):** The amount of water, in gallons, flowing through a plumbing fixture or through an instantaneous water heater per minute.
- **Instantaneous Water Heater:** A water heater that generates hot water on demand.
- **KW (Kilowatt):** A unit of electric power equal to 1,000 watts.
- **Rise:** The temperature of water as it leaves the water heater minus the temperature of the water entering the water heater.
- **Storage Water Heater:** A water heater that incorporates a thermostat, a storage tank, and a burner or heating elements, to heat and maintain the water within the tank at a specific temperature.
- **Thermal Efficiency:** The measure of the overall efficiency of the water heater, taking into consideration loss of energy due to combustion, radiation, convection and conduction of heat from the unit.

V. GENERAL REQUIREMENTS

A. A water heater shall be provided which is **capable** of generating an adequate supply of hot water, at a temperature of at least 120° Fahrenheit, to all sinks, janitorial facilities, and other equipment and fixtures that use hot water, at all times.

B. Water heaters and their installation must be in compliance with all local building code requirements.

C. Water heaters that use reclaimed heat from equipment to heat water must be evaluated on a case by case basis.

VI. SIZING REQUIREMENTS FOR STORAGE WATER HEATERS

A. For food facilities that utilize multiservice eating and drinking utensils, the water heater shall have a recovery rate equal to or greater than 100% of the computed hourly hot water demand, in gallons per hour (GPH).

B. For food facilities that use only single-service eating and drinking utensils, or don't use utensils at all, the water heater shall have a recovery rate equal to or greater than 80% of the computed hourly hot water demand, in GPH.

C. For food facilities that handle and sell **only** prepackaged foods, a water heater with a minimum storage capacity of ten gallons must be provided.

D. The hourly hot water demand for the food facility, in GPH, is calculated by adding together the estimated hot water demands for all sinks and other equipment, such as dishmachines, which utilize hot water. The estimated hot water demands for sinks and other equipment that utilize hot water are listed in Appendix I. The hot water demands for automatic warewashers, such as dishmachines, glasswashers, and potwashers are found in NSF International listings or listings established by other nationally recognized testing laboratories.

E. The following examples are provided to explain how to calculate the total hourly hot water demand:

1. Food facility that utilizes only single service eating and drinking utensils:

   Assume:

1 18" X 18" three compartment sink	42 GPH
2 hand lavatories	10 GPH (5 GPH each)
1 janitorial sink	15 GPH
	67 GPH total hourly hot water demand

   67 GPH X 80% allowance for single service utensils = 54 GPH
   For the food facility in this example, a water heater would be required which will recover 54 GPH.

2. Food facility that utilizes multiservice eating and drinking utensils:

   Assume:

1 18" X 18" three compartment sink	42 GPH
automatic dishmachine	80 GPH
hand spray pre-rinse	45 GPH
one compartment food preparation sink	5 GPH

2 hand lavatories	10 GPH (5 GPH each)
1 janitorial sink	15 GPH
	197 GPH total hourly hot water demand

Since the food facility in this example uses multiservice eating and drinking utensils, 100% of the computed hourly hot water demand must be provided. Therefore, a water heater would be required which will recover 197 GPH.

F. To compute a BTU or KW rating for the required hourly hot water demand found in example #1 the following formulas should be used:

Formula 1 (for gas water heaters)

$$\text{BTU input} = \frac{\text{GPH} \times \text{°Rise}^1 \times 8.33 \text{ lb./ gallon of water}}{\text{Thermal Efficiency}^2}$$

$$\text{BTU input} = \frac{54 \text{ GPH} \times 50\text{°F} \times 8.33 \text{ lb.}}{.75}$$

BTU input = 29,988

[1] The average temperature of tap water varies throughout the state depending upon the location, elevation, and time of year. In order to properly size the water heater check with your local health agency to determine the required rise. For the purposes of these guidelines a tap water temperature of 70° Fahrenheit will be used. Therefore, to achieve a temperature of 120° Fahrenheit at the faucet, the required rise would be 50°.

[2] The thermal efficiency for gas water heaters, unless otherwise listed by NSF International or other nationally recognized testing laboratories, will be assumed to be 75%.

Formula 2 (for electric water heaters)

$$\text{KW input} = \frac{\text{GPH} \times \text{°Rise} \times 8.33 \text{ lb./ gallon of water}}{\text{Thermal Efficiency}^1 \times 3412 \text{ BTU/KW}}$$

$$\text{KW input} = \frac{54 \text{ GPH} \times 50\text{°F} \times 8.33 \text{ lb.}}{.98 \times 3412 \text{ BTU/KW}}$$

KW input = 6.7

[1] The thermal efficiency for electric water heaters, unless otherwise listed by NSF International or other nationally recognized testing laboratories, will be assumed to be 98%.

Sizing tables for gas and electric water heaters are found in Appendices II and III respectively.

VII. SIZING REQUIREMENTS FOR INSTANTANEOUS WATER HEATERS

A. One of the advantages of an instantaneous water heater is its ability to provide a continuous supply of hot water. However, since the water passes through a heat exchanger, the water must flow through the unit slowly to assure proper heat transfer. Therefore, the quantity, or rate, at which the hot water is delivered can be significantly less than that provided by a storage water heater. When hot water is utilized at several locations of the food facility at the same time the flow of hot water to each fixture can be severely restricted. As a result of the restricted output of instantaneous water heaters, more than one unit may be required, depending on the numbers and types of sinks and equipment present. Due to the limitations inherent in the design of instantaneous water heaters, some local health agencies may restrict or prohibit their usage. Check with your local health agency prior to installing an instantaneous water heater in order to

determine their requirements.

B. Instantaneous water heaters must be sized to provide hot water of at least 120° Fahrenheit, and at a rate of at least two gallons per minute (GPM), to each sink and fixture that utilizes hot water. (Note: Hand lavatories must receive at least 1/2 GPM.) The following example is provided to explain how this sizing criteria is applied:

Assume:

1 18" X 18" three compartment sink	2 GPM
2 hand lavatories	1 GPM (1/2 GPM each)
1 janitorial sink	2 GPM
	5 GPM

C. In the example given above, one or more instantaneous water heaters would have to be provided in order to supply a total of at least 5 GPM.

D. Food facilities that install an automatic warewashing machine that utilizes a large quantity of hot water may be required to provide an instantaneous water heater exclusively for the warewashing machine. NSF International listings or listings established by other nationally recognized testing laboratories are used to determine the minimum GPM hot water demand for automatic warewashing machines.

VIII. REQUIREMENTS FOR BOOSTER HEATERS

A. When a hot water sanitizing warewashing machine is used, a booster heater must be provided that will raise the incoming general purpose hot water up to at least 180° Fahrenheit for the final sanitizing rinse cycle.

B. When sizing a booster heater, the hot water demand for the warewashing final sanitizing rinse cycle should be obtained from the NSF International listings or listings established by other nationally recognized testing laboratories.

C. The formulas for calculating BTU or KW input listed in section VI.F. should be used when determining the minimum required size for a booster heater.

D. When a booster heater is installed below a drainboard, it shall be installed at least six inches above the floor and away from the wall, and in a manner that will allow accessibility for proper cleaning and servicing.

IX. RECIRCULATION PUMPS

A. Where fixtures are located more than sixty feet from the water heater, a recirculation pump must be installed, in order to ensure that water reaches the fixture at a temperature of at least 120° Fahrenheit.

B. In some cases it may be more practical to install a separate, smaller water heater for remote fixtures, such as for restroom handsinks.

X. INSTALLATION REQUIREMENTS

A. Where feasible, water heaters should be located in an area of the food facility separated from all food and utensil handling areas.

B. The Uniform Building Code prohibits the installation of gas water heaters in restrooms or change rooms.

C. Water heaters shall be mounted in one of the following manners:
   1. On six inch high, easily cleanable legs.
   2. On a four inch high coved curb base. All openings between the water heater and the base must be sealed in a watertight manner.
   3. On a properly finished and installed wall pedestal, positioned so that it is out of the work and traffic space.
   4. In an easily accessible location above a suspended ceiling. Where a permanently installed ladder is required to access the water heater, the ladder shall not be installed above a food or utensil handling area.

   Note: The local health agency may allow alternate installation methods when a water heater is installed in an area separated from food and utensil handling areas, such as in a mechanical room.

D. A common mistake with electric water heaters is the ordering and installing of a water heater with an upper element of 4500 watts, a bottom element of 4500 watts, and a total connected (or maximum) wattage of 4500 watts. On such a water heater only one element is operating at any one time. Many individuals do not observe the total connected wattage and assume that because each of the elements is 4500 watts their water heater has an input rating of 9000 watts.
   Water heater manufacturers have specific procedures for rewiring an electric water heater so that the upper and lower elements are operating simultaneously. Some manufacturers only permit rewiring in the factory. Field modifications will normally void warranties and any listings that the unit comes with. Prior to acceptance of a field modified water heater, the local health agency should ensure that the modifications were performed according to the manufacturer's recommendations and with the approval of the local building officials. The data plate on a field modified water heater must be changed to reflect the total connected wattage rating with both elements operating simultaneously.

E. When multiple water heaters are connected, they must be installed in parallel, not in series (See Appendix IV).

APPENDIX I

HOURLY HOT WATER DEMAND TABLE

Utensil Sinks

18" X 18".....14 gallons per compartment

24" X 24".....25 gallons per compartment

Custom sink sizes can be calculated using the following formula:

Length X Width X Average Depth X 7.5 = gallons per compartment

Bar Sinks

6 gallons per compartment

Food Preparation Sinks

5 gallons per sink

Janitorial Sinks

15 gallons per sink

Garbage Can Wash Facility

15 gallons per facility

Hand Sinks

5 gallons per sink

Pre-rinse Units

Hand spray type.....45 gallons

Other types.....Refer to manufacturer's specifications for the equipment

Clothes Washers

9 and 12 pound washers.....45 gallons

16 pound washers.....60 gallons

Employee Shower

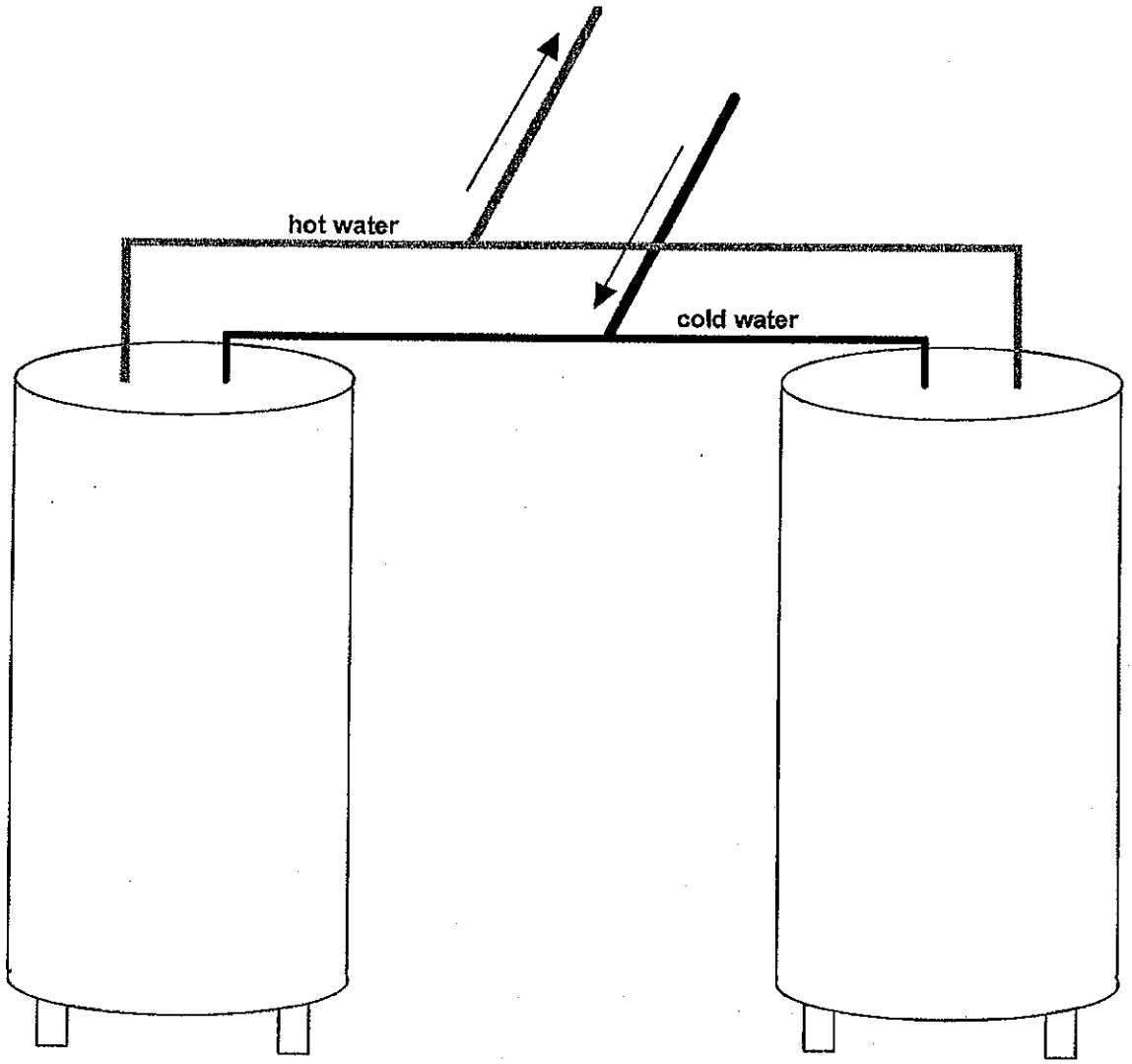
20 gallons per shower

Other Fixtures That Utilize Hot Water

Refer to manufacturer's specifications for the equipment

APPENDIX IV

Water Heaters Installed In Parallel



WATER HEATER WORKSHEET AND SAMPLE CALCULATIONS

Cited below, and on the next few pages, is information, and sample calculations from the North Carolina Department of Health, Food, Lodging, and Institutional Sanitation Branch.

DETERMINING HOT WATER SUPPLY REQUIREMENTS

The Food Service Advisory Committee has developed a uniform guideline for the sizing of hot water heaters for food service establishments. This guideline is used to insure uniformity on sizing of water heaters throughout the state and to insure food service establishments are provided with sufficient hot water for all operations.

The hot water heater should be sized as follows:

1. The minimum storage capacity for any establishment should be 50 gallons.

2. Hot water recovery is based on fixture requirements in accordance with the table on the next page.

3. A 100% degree-rise in temperature is used in calculating hot water recovery.

Hot Water Heater Size And Capacity					
HOT WATER HEATER CALCULATION WORKSHEET					
EQUIPMENT	**QUANTITY**	**TIMES**	**SIZE** (in inches)	**EQUALS**	**GPH**
One-comp. sink See note #4		X	__by__by__	=	
Two-comp. sink See note #4		X	__by__by__	=	
Three-comp. sink See note #4		X	__by__by__	=	
Four-comp. sink See note #4		X	__by__by__	=	
One-comp Prep sink		X	5 GPH	=	
Two-comp Prep sink		X	10 GPH	=	
Three-comp Prep sink		X	15 GPH	=	
Three comp. bar sink See note #4		X	__by__by__	=	
Four comp. bar sink See note #4		X	__by__by__	=	
Hand sink		X	5 GPH	=	
Pre-rinse		X	45 GPH	=	
Can wash		X	10 GPH	=	
Mop sink		X	5 GPH	=	
**Dishmachine		X	Note #1	=	
**Cloth Washer		X	Note #2	=	
**Hose reels		X	Note #3	=	
Other equipment		X		=	

Other equipment		X		=	
Other equipment		X		=	
Total 140 F GPH (gallons per hour) Recovery Requirements Total =>					
Note - 140° F Hot water heaters are to be sized at the 140° F GPH recovery required at a temperature rise of 100° F.					

Note #1	Dishwasher (____ gals/hr. FINAL RINSE x 70%)
Note #2	Cloth Washer Calculation A. Limited Use/Cloth washer used one to two times per day; beginning or ending of day operation GPH = 60 GPH x 25%. B. Intermediate Use/Cloth washer used three to four times per day; GPH = 60 GPH x 45%. C. Heavy Use/Cloth washer used once every two hours; GPH = 60 GPH x 80%. D. Continuous Use/Cloth washer used every hour; GPH = 60 GPH x 100%.
Note #3	Hose reels @ 20 GPH for first reel & 10 GPH for each additional reel.
Note #4 GPH Requirements for sink	**GPH = (Sink size in cu.in. x 7.5 gal./cu.ft. x # compartments x .75 capacity) (1,728 cu.in./cu.ft.)**
Short version for above	GPH = Sink size in cu. in. X # compartments x .003255/cu. in. Example 24"x 24"x 14" x 3 compartments x .003255 = 79 GPH
Water heater storage capacity. (_____ Gallons Storage)	
Water heater recovery rate in gallons per hour at a 100°F temperature Rise. (_____Gallons per hour)	

SAMPLE CALCULATION

Three comp. sink --------	1	x	24x24x14	=	79
Two comp.Prep sink ----	2	x	10 GPH	=	20
Hand sink ----------	5	x	5 GPH	=	25
Pre-rinse ----------	1	x	45 GPH	=	45
Dishmachine ----------	1	x	Note #1	=	52
Can wash ----------	1	x	10 GPH	=	10
Mop sink ----------	1	x	5 GPH	=	5
Cloth Washer ----------	1	x	Note #2	=	27
Hose reel ----------	2	x	Note #3	=	30

Total GPH Requirement = 293 GPH

Note #1 - Dishmachine - Hobart AM-14 Final Rinse GPH = 74
Using Note #1 - 74 gal/hr Final Rinse x .70% = 51.8(= 52 GPH)

Note #2 - Cloth Washer used 4 times per day = 60 gal x 45% = 27 GPH

Recovery Rates in Gallons per Hour - Gas Water Heaters

	Temperature Rise - Degrees Fahrenheit										
INPUT BTU	40°	50°	60°	70°	80°	90°	100°	110°	120°	130°	140°
20,000	45	36	30	26	23	20	18	17	15	14	13
26,000	59	47	39	34	30	26	24	21	20	18	17
28,000	64	51	42	36	32	28	25	23	21	20	18
30,000	68	55	45	39	34	30	27	25	23	21	19
32,000	73	58	48	42	36	32	29	26	24	22	21
34,500	78	63	52	45	39	35	31	29	26	24	22
36,000	82	65	55	47	41	36	33	30	27	25	23
37,000	84	67	56	48	42	37	34	31	28	26	24
40,000	91	73	61	52	45	40	36	33	30	28	26
50,000	114	91	76	65	57	51	45	41	38	35	32
57,000	130	104	86	74	65	58	52	47	43	40	37
60,000	136	109	91	78	68	61	55	50	45	42	39
69,000	157	125	105	90	78	70	63	57	52	48	45
75,000	170	136	114	97	85	76	68	62	57	52	49
98,000	223	178	148	127	111	99	89	81	74	69	64
100,000	227	182	152	130	114	101	91	83	76	70	65
114,000	259	207	173	148	130	115	104	94	86	80	74
156,000	355	284	236	203	177	158	142	129	118	109	101
160,000	364	291	242	208	182	162	145	132	121	112	104
180,000	409	327	273	234	205	182	164	149	136	126	117
199,900	454	363	303	260	227	202	182	165	151	140	130
250,000	568	455	379	325	284	253	227	207	189	175	162
270,000	614	491	409	351	307	273	245	223	205	189	175
300,000	682	545	455	390	341	303	273	248	227	210	195
360,000	818	655	545	468	409	364	327	298	273	252	234
399,900	909	727	606	519	454	404	364	330	303	280	260
500,000	1136	909	758	649	568	505	455	413	379	350	325

Based on 75% thermal efficiency.

Recovery Rates in Gallons per Hour - Electric Water Heaters

INPUT KW	Temperature Rise - Degrees Fahrenheit										
	40°	50°	60°	70°	80°	90°	100°	110°	120°	130°	140°
1	10	8	7	6	5	5	4	4	3	3	3
1.5	16	12	10	9	8	7	6	6	5	5	4
2	21	17	14	12	10	9	8	8	7	6	6
2.5	26	21	17	15	13	12	10	10	9	8	7
3	31	25	21	18	16	14	12	11	10	10	9
3.5	36	29	24	21	18	16	15	13	12	11	10
4	41	33	28	24	21	18	17	15	14	13	12
4.5	47	37	31	27	23	21	19	17	16	14	13
5	52	41	34	30	26	23	21	19	17	16	15
5.5	57	46	38	33	28	25	23	21	19	18	16
6	62	49	41	35	31	27	25	22	21	19	18
9	92	74	61	53	46	41	37	34	31	28	26
12	123	98	82	70	61	55	49	45	41	38	35
15	154	123	102	88	77	68	61	56	51	47	44
18	184	147	123	105	92	82	74	67	61	57	53
24	246	197	164	140	123	109	98	89	82	76	70
27	276	221	184	158	138	123	111	101	92	85	79
30	307	246	205	175	154	137	123	112	102	95	88
36	369	295	246	211	184	164	147	134	123	113	105
45	461	369	307	263	230	205	184	168	154	142	132
54	553	442	369	316	276	246	221	201	184	170	158

SAMPLE CALCULATION

Three comp. sink --------	1	x	24x24x14	=	79
Two comp.Prep sink ----	2	x	10 GPH	=	20
Hand sink ----------	5	x	5 GPH	=	25
Pre-rinse ----------	1	x	45 GPH	=	45
Dishmachine ----------	1	x	Note #1	=	52
Mop sink ----------	1	x	10 GPH	=	10
Cloth Washer ----------	1	x	15 GPH	=	15
Hose reel ----------	2	x	10 GPH	=	20
				Total =	**266 GPH**

Note #1 - Dishmachine - Hobart AM-14 Final Rinse GPH = 74
Using Note #1 - 74 gal/hr Final Rinse x .70% = 51.8(= 52 GPH)

OTHER CONSIDERATIONS

Tankless water heaters shall be installed and used in accordance with the manufacturer's recommendations.

Hot water recirculation systems should be considered when the water heater is over 100 feet from the farthest fixture served.

The use of smaller separate water heaters may be used for remote fixtures.

PLUMBING AND CROSS CONNECTION CONTROL

Plumbing shall be sized and installed according to applicable codes. There shall be no cross connections between the potable water supply and any non-potable system or a system of unknown quality. Where non-potable water systems are permitted for purposes such as air conditioning and fire protection, the non-potable water must not contact directly or indirectly: food, potable water or equipment that contacts food or utensils. The piping of any non-potable water system shall be durably identified so that it is readily distinguishable from piping that carries potable water.

DEFINITIONS

Cross connection is defined as any direct or indirect (potential) connection between a potable water system and a non-potable source, liquid or otherwise, through which backflow can occur.

Backflow is defined as the flow of water or other liquids, mixtures, or substances into a potable water system from any source, other than the intended source. There are two types of backflow: backpressure and back-siphonage.

Backpressure is defined as pressure in down stream piping greater than supply pressure causing a reversal of flow.

Back-siphonage is defined as the creation of backflow as a result of negative pressure. .

Direct connection is defined as a physical connection between a potable and non-potable system.

Indirect connection is defined as a potential connection between a potable and non-potable system.

An indirect connection may be one of two types, air gap or air break:

> For a potable water supply, an air gap means the unobstructed, vertical air space that separates a potable system from a non-potable system. See figure 5-1.
>
> For a drain, an air gap means the distance through the free atmosphere between the lowest opening from any drain pipe. See figure 5-4.
>
> An air break is a waste line from a fixture that discharges used water or liquid waste to a drain. The connection does not provide an unobstructed vertical distance through the free atmosphere and is not solidly connected, but precludes the possibility of backflow to a potable water source into a sink or dishwasher/or fixture being drained. See figure #5-4.

There shall be no cross connections between the potable water supply and any non-potable water supply. The potable water system shall be installed to preclude the possibility of back flow and back siphonage. Devices shall be installed to protect against backflow and backsiphonage at all fixtures and equipment unless an air gap is provided.

Types of Control: Backflow Control & Device Use

As stated in the Food Code, a backflow or backsiphonage prevention device installed on a water supply system shall meet American Society of Sanitary Engineering (A.S.S.E.) standards for construction, installation, maintenance, inspection, and testing for that specific application and type of device.

Type of Control	Rules of Installation
Air Gap	The air gap must be the greater of the two - **A MINIMUM OF ONE INCH OR TWICE THE INSIDE DIAMETER OF THE PIPE.** For a supply line, this distance is measured from the supply pipe to the flood level rim (the point of over flow) of the receptacle or fixture. For a drain line, the distance is measured from the pipe from which the wastewater is being discharged.
Atmospheric Vacuum Breaker	1. Must be installed 6 inches higher than the outlet.
	2. Must be installed in the vertical position only
	3. Is not for continuous water pressure
	4. Must only be installed where it is not subject to backpressure
	5. Must be installed after the last shut off valve
Dual Check Valve with an Intermediate Atmospheric Vent	1. Can be installed horizontally or vertically.
	2. Must not be located in a pit or a location subject to standing water.
	3. Relief port or vent must not be plugged.
	4. Approved for low hazard, continuous pressure and backpressure or back-siphonge.
Dual Check Valve with an Intermediate Atmospheric Vent and 100 mesh screen	Must be used for water line to soda carbonation systems.
Pressure Type Vacuum Breaker	1. Must be installed at least 12 inches above the outlet.
	2. Must have a shut off valve on each side and two test cocks for testing.
	3. Must be located in an accessible area for testing and servicing.

	4. Not acceptable in a backpressure application
	5. Can be used for continuous pressure applications
Reduced Pressure Zone Device (RPZ)	1. Must be accessible for testing and service.
	2. Must be located above grade (not subject to flooding).
	3. Must be installed at least 12 inches from any wall and between 12 to 30 inches above the floor.
	4. Approved for high hazard, continuous pressure, backpressure or back-siphonage.
Hose Bibb Vacuum Breaker	Cannot be used for continuous pressure. Cannot have a shut off valve downstream of the device.

The following provides examples of equipment and their required backflow protection devices. See figure 5-2.

Equipment	Required in Lieu of Air Gap
1. Boiler with chemicals added	Reduced pressure zone device
2. Boiler with no chemicals added	Dual check valve with intermediate atmospheric vent
3. Carbonators for beverage dispensers	Dual Check Valve with intermediate atmospheric vent and 100 mesh screen
4. Lawn sprinkler system with no chemicals added	Atmospheric or pressure vacuum breaker
5. Flush valve toilets	Atmospheric or pressure vacuum breaker
Equipment	**Required in Lieu of Air Gap**
6. All hose bibbs inside & outside of establishments	Hose bibb-type vacuum breaker
7. Pre-flush hose with a nozzle	Pressure vacuum breaker

head that may be submerged	
8. Perforated pipe to woks	Atmospheric vacuum breaker
9. Submerged inlets	
a. Supply inlet to garbage grinder	Atmospheric vacuum breaker*
b. Supply inlet to dish table trough	" " "
c. Fill line for steam kettle	" " "
d. Supply line for mechanical warewashing machine	" " "
e. Garbage can washer	" " "
f. Water wash system for exhaust hood	Reduced pressure zone backflow preventer
g. Non-carbonated water line for soda guns	Dual check valve with intermediate atmospheric vent

Sewage Disposal

All sewage including liquid waste shall be disposed into a public sewage system or an individual sewage disposal system constructed and operated according to law. Where individual sewage disposal systems are utilized, the location shall be noted on the plans and certification of compliance with state and local regulations shall be provided.

Drains

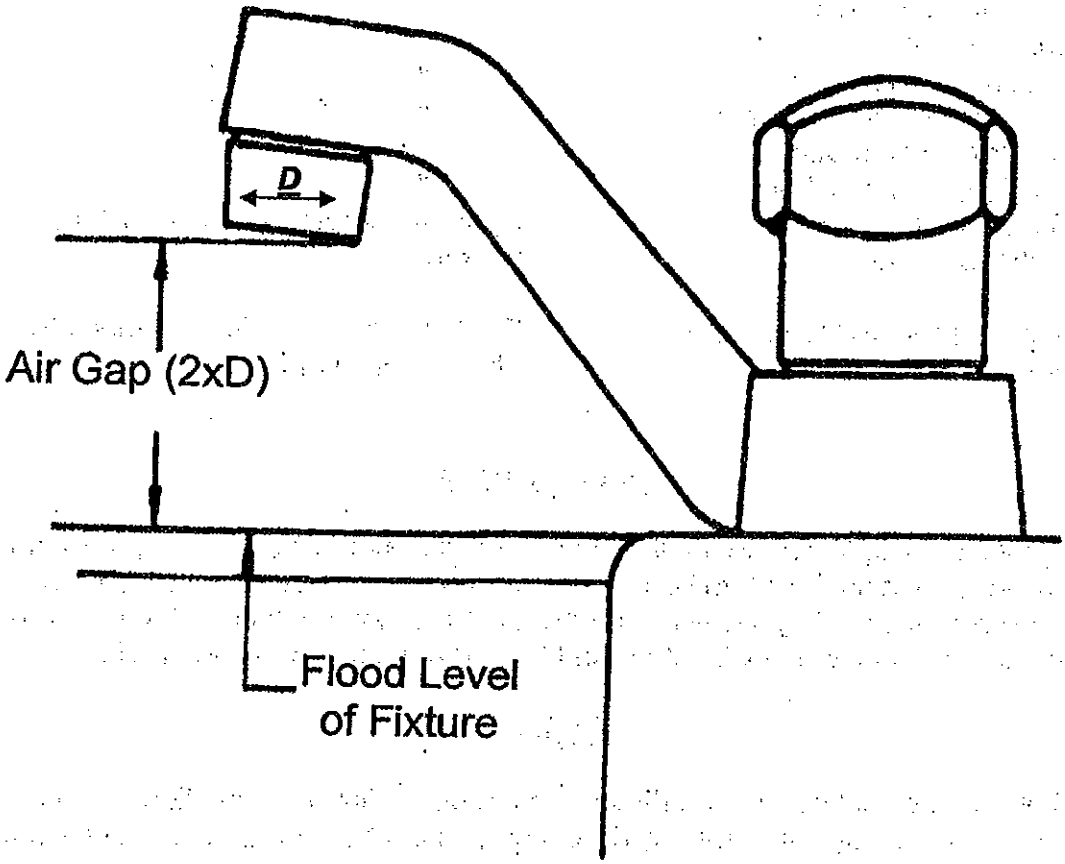
A connection to a sewer line may be direct or indirect. A direct connection may not exist between the sewerage system and any drains originating from equipment in which food, portable equipment, or utensils are placed, except if otherwise required by law. When a warewashing machine is located within 5 feet of a trapped floor drain, the dishwasher waste outlet may be connected directly on the inlet side of a properly vented floor drain trap. See figure #5-3.

Grease Traps/Interceptors

A grease trap/interceptor is a chamber designed for wastewater to pass through and allow any grease to float to the top for retention as the remainder of the wastewater passes through. If used, a grease trap shall be located to be easily accessible for cleaning. Food solids entering the grease trap/interceptor should be minimized.

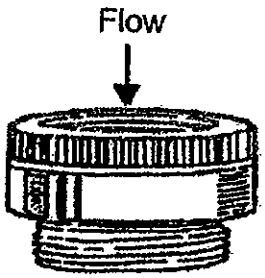
It is recommended that waste water from fixtures or drains which would allow fats, oils, and grease to be discharged be directed to a grease trap/interceptor.

D= Inside Diameter

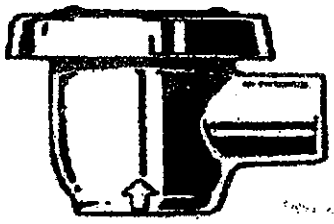


Air Gap

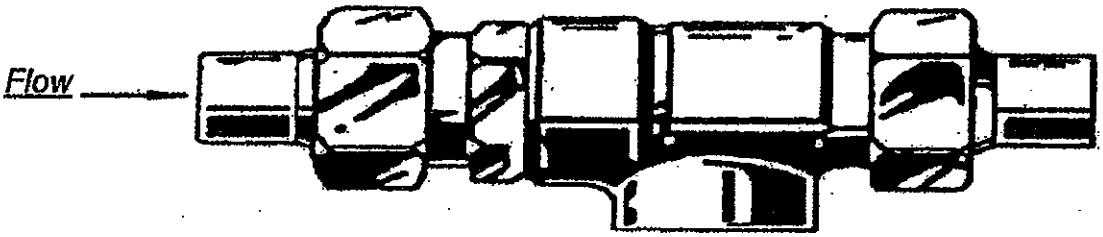
Figure 5-1



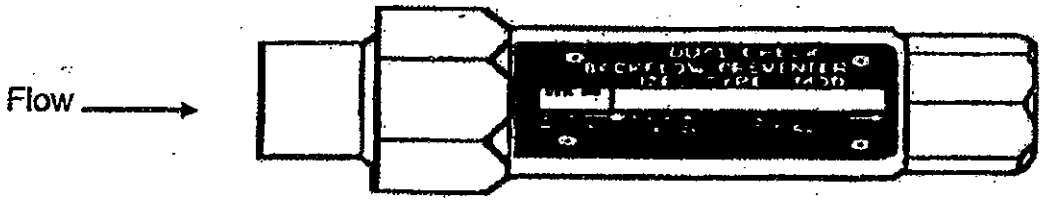
Hose Bibb Vacuum Breaker



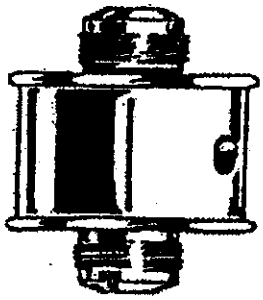
Atmospheric Vacuum Breaker



Backflow Preventer with Intermediate Vent



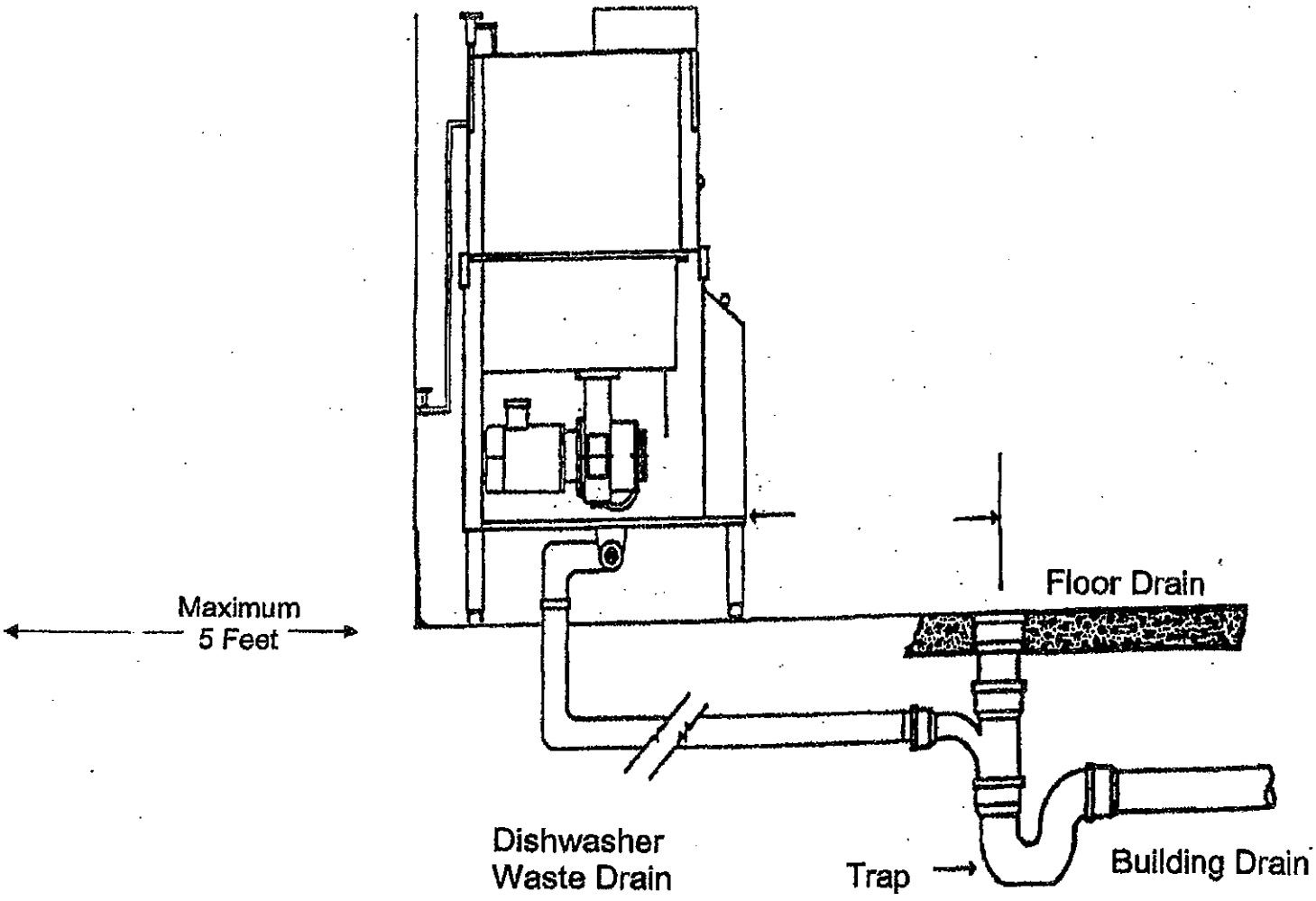
Dual Check Backflow Preventer



Carbonator Backflow Prevention

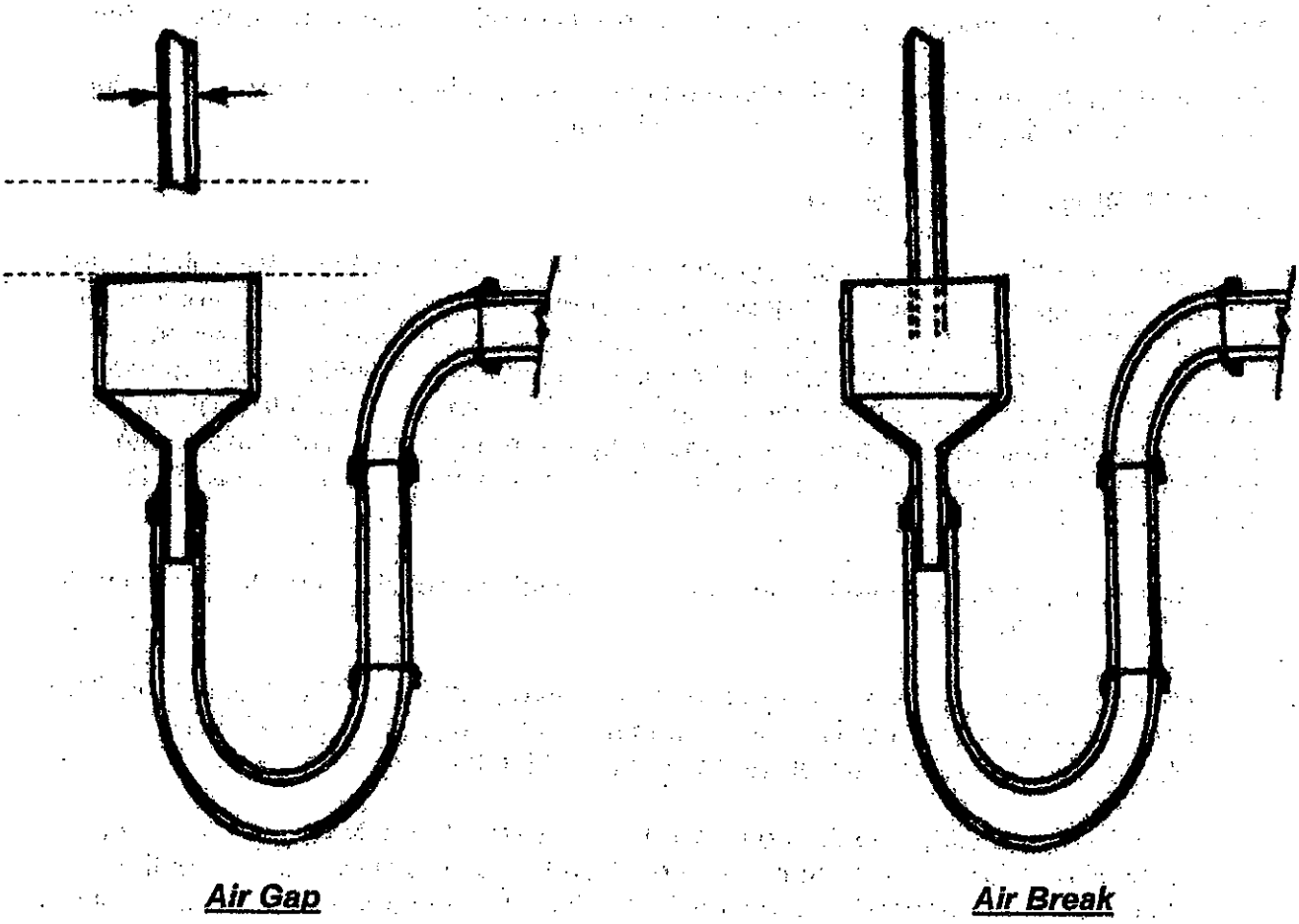
Backflow Prevention Devices

Figure 5-2



Warewashing Machine With A Direct Waste Connection

Figure 5-3



Indirect Waste

Figure 5-4

SECTION 6- EQUIPMENT AND INSTALLATION

All equipment in food establishments must comply with the design and construction standards contained in Chapter 4 of the FDA Food Code. Food equipment that is certified or classified for sanitation by an ANSI accredited program is deemed to comply with Parts 4-1 and 4-2 of the FDA Food Code.

Equipment including ice makers and ice storage equipment, shall not be located under exposed or unprotected sewer lines, open stairwells or other sources of contamination.

The following equipment installation recommendations will help ensure proper spacing and sealing allowing for adequate and easy cleaning:

FLOOR MOUNTED EQUIPMENT

Equipment should be mounted on approved lockable casters or wheels to facilitate easy moving, cleaning, and flexibility of operation whenever possible. Moveable equipment requiring utility services such as gas or electrical connections should be provided with easily accessible quick-disconnects or the utility service lines should be flexible and of sufficient length to permit moving the equipment for cleaning. If a flexible utility line is used, a safety chain that is shorter than the utility line must be installed. Check with local fire safety and building codes to ensure that such installations are acceptable. See figures 6-1 and 6-3.

Floor-mounted equipment that is not mounted on wheels or casters with the above utility connections should be:

1. Permanently sealed to the floor around the entire perimeter of the equipment. The sealing compound should be pliable and non-shrinking. It should retain its elasticity and provide a water- and vermin-tight joint; or

2. Installed on a solid, smooth, non-absorbent masonry base. Masonry bases and curbs should have a minimum height of 2" and be coved at the junction of the platform and the floor with at least a 1/4" radius. The equipment should overhang the base by at least 1" but not more than 4". Spaces between the masonry base and the equipment must be sealed as above; or

3. Elevated on legs to provide at least a 6" clearance between the floor and equipment. The legs shall contain no hollow open ends. See figure 6-2.

4. For equipment not readily moveable by one person, spacing between and behind equipment must be sufficient to permit cleaning under and around the unit. Equipment shall be spaced to allow access for cleaning along the sides, behind and above. At least 6" of clear, unobstructed space under each piece of equipment must be provided or equipment must be sealed to the floor. See figure 6-4.

5. If equipment is against a wall and is not movable, the equipment must be joined to and/or sealed to the wall in a manner to prevent liquid waste, dust and debris from collecting between the wall and the equipment.

6. When equipment is joined together, or spreader plates are used between equipment, the resultant joint must be sealed to prevent liquid waste, dust and debris from collecting between the equipment.

Unobstructed and functional aisle and working spaces must be provided. A minimum width of 36" is required by fire and building codes.

All utility and service lines and openings through the floor and walls must be adequately sealed. Penetrations through walls and floors must be minimized. Exposed vertical and horizontal pipes and lines must be kept to a minimum. The installation of exposed horizontal utility lines and pipes on the floor is prohibited. Any insulation materials used on utility pipes or lines in the food preparation or dishwashing areas must be smooth, non-absorbent, and easy to clean. Electrical units which are installed in areas subject to splash from necessary cleaning operations or food preparation should be water-tight and washable.

COUNTER-MOUNTED EQUIPMENT

Counter-mounted equipment is defined as equipment that is not portable and is designed to be mounted off the floor on a table, counter, or shelf. All counter-mounted equipment shall be:

A. Sealed to the table or counter; or

B. Elevated on approved legs to provide at least a 4" clearance between the table or counter and the equipment to facilitate cleaning.

OTHER

Equipment that is open underneath, such as drain boards, dish tables, and other tables that are not moveable should be spaced to allow for ease of cleaning or should be sealed to the wall.

Non-food contact surfaces of equipment that are exposed to splash, spillage, or other food soiling or that require frequent cleaning shall be constructed of corrosion-resistant, non-absorbent, and smooth material.