

CHAPTER 1345
DEPARTMENT OF ADMINISTRATION
STATE BUILDING CODE
MECHANICAL SYSTEMS

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TITLE AND SCOPE

1345.0010 IDENTIFICATION AND TITLE.

Chapter 1345 shall be known as the "Minnesota Heating, Ventilating, Air Conditioning, and Refrigeration Code." Unless otherwise specified, subsequent references in these chapters to "this code" shall mean the Minnesota Heating, Ventilating, Air Conditioning, and Refrigeration Code.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0020 PURPOSE.

The Minnesota Heating, Ventilating, Air Conditioning, and Refrigeration Code is a system of rules, regulations, and principles formally applied in the field of heating, ventilating, air conditioning, and refrigerating, for which it is written and is established as a minimum standard for safety, health, and general welfare of the public. This code is a minimum standard and is not intended nor should it be used or considered a design manual.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0030 SCOPE.

The provisions of this code shall apply to the design, erection, installation, construction, alteration, repair, relocation, replacement, addition to, or use of any heating, ventilating, air conditioning, refrigeration, or cooling system, equipment, or miscellaneous devices whether used in connection with space, comfort, process of industrial heating, ventilating, air conditioning, or refrigeration.

Where, in any specific case, different parts of this code specify different materials, methods of construction, or other requirements, the most restrictive provision shall govern.

The inclusion of specific requirements relative to the manner of installation of any plant or equipment in any one or more parts of said code shall not limit this procedure to any particular type of installer, nor provide a basis upon which determination of the right to perform such procedures shall be made. The authority for such determination will be found in the various licensing ordinances for each type of installer who performs the work.

Statutory Authority: *MS s 16B.59 to 16B.73*

GENERAL RULES

1345.0060 CONSTRUCTION AND INTERPRETATION.

The provisions of the Minnesota Heating, Ventilating, Air Conditioning, and Refrigeration Code are based on minimum standards to safeguard life, health, and general welfare and therefore should be construed and interpreted in a manner which is consistent with and will give effect to such purposes.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0070 NEW BUILDINGS.

All materials or systems or parts thereof shall be installed to meet or exceed the minimum provisions of this code. The provisions of this code shall apply to all buildings and structures in the state, the erection of which is commenced after the date of acceptance of this code.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0080 EXISTING BUILDINGS.

The provisions of this code shall apply to the design, erection, installation, construction, alteration, repair, relocation, replacement, addition to, or use of any heating, ventilating, air conditioning plant, or refrigeration equipment or system commenced after the date of acceptance of this code. Where the administrative authority shall find that the full performance of bringing such work into compliance with all the requirements of this code would result in exceptional or undue hardship by reason of mechanical difficulty or impracticability, a deviation may be granted by the administrative authority only to the extent that the deviation can be granted without impairing the intent or purpose of this code.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0090 CHANGE IN USE.

The provisions of this code shall apply to every building or structure or portion thereof which at any date after acceptance of this code is devoted to a new use for which the requirements under this code are in any way more stringent than the requirements governing the previous use.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0100 ALTERNATE EQUIPMENT APPURTENANCES, MATERIAL, AND METHODS.

The administrative authority may approve the use of appurtenances, materials, and methods of a type not conforming with the requirements of this code after a determination that such appurtenance, material, or method is of such design or quality, or both, as to appear to be safe, suitable, and proper for the use for which it is intended.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0110 TESTS.

When there is insufficient evidence to verify claims for alternate materials, the administrative authority may require as proof of suitability a test of compliance by an approved testing laboratory at the expense of the applicant.

Tests shall be made in accordance with generally recognized standards; but in the absence of such standards the administrative authority shall specify the test procedure.

The administrative authority may require tests to be repeated if at any time there is reason to believe that an alternate material no longer conforms to the requirements on which its approval was based.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0120 SUBMITTAL AND APPROVAL OF PLANS.

Plans and specifications shall be submitted to the administrative authority as required. See specific chapters for further detail as to plans and specifications where required.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0130 SAFETY HAZARD.

Where a safety hazard exists on a premise by reason of an existing installation or lack of proper equipment or material thereof, the owner or his agent shall be responsible for making such corrections as may be necessary to abate such hazard and bring the installation within the provisions of this code.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0140 BOILER AND FURNACE EQUIPMENT ROOM SIZE.

Boilers and furnaces shall not be installed in confined spaces such as alcoves or closets unless specifically approved for such installation and then only if installed in accordance with the approval. Boilers and furnaces shall be installed in rooms that are large in comparison to the size of the appliance and shall provide proper clearance for accessibility for servicing and maintaining such equipment.

Boiler and furnace rooms in other than one- and two-family dwellings shall be such that they have an area of at least ten times the area occupied by the boiler and eight times the area occupied by the furnace. If additional appliances or equipment are to be located in the boiler or furnace room, additional area shall be provided equal to area occupied by such equipment plus required clearances.

At least three feet clear space shall be provided in front of all zone valves, controls, etc. for access and servicing.

Statutory Authority: *MS s 16B.59 to 16B.73*

LOAD CALCULATIONS**1345.0200 HEAT LOSS CALCULATION REQUIRED.**

Before designing a heating system, a heat loss calculation must be made of the maximum probable heat loss of each room or space to be heated, based on maintaining a selected indoor air temperature during periods of design outdoor weather conditions. These heat losses may be divided into groups as follows:

A. the transmission losses or heat transmitted through the confining walls, floor, ceiling, glass, or other surfaces;

B. the infiltration losses or heat required to warm outdoor air which leaks in through cracks and crevices around doors and windows, or through open doors and windows, or heat required to warm outdoor air used for ventilation; and

C. the design data and calculations for heating loads shall be in accordance with procedure outlined in ASHRAE Fundamentals and Equipment for the latest publication after acceptance of this code, or Manual J, Load Calculations, National Warm Air Heating and Air Conditioning Association.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0210 DEFINITIONS.

Subpart 1. **Scope.** The following terms shall have the meanings given them.

Subp. 2. **British thermal unit.** "British thermal unit (Btu)" means, approximately, the heat required to raise the temperature of a pound of water from 59 degrees Fahrenheit to 60 degrees Fahrenheit.

Subp. 3. **Film or surface conductance.** "Film or surface conductance" means the time rate of heat exchange by radiation, conduction, and convection of a unit area of a surface with the surroundings and the surrounding air or other fluid. Its value is expressed in Btu per (hour) (square foot of surface) (Fahrenheit degree temperature difference). Subscripts *i* and *o* are used to denote inside and outside surface conductances, respectively.

Subp. 4. **Overall coefficient of heat transmission (air to air).** "Overall coefficient of heat transmission (air to air)" means the time rate of heat flow expressed in Btu's per (hour) (square foot) (Fahrenheit degree temperature difference between air on the inside).

Subp. 5. **Specific heat.** "Specific heat" means the ratio of the quantity of heat required to raise the temperature of a given mass of any substance one degree to the quantity required to raise the temperature of an equal mass of a standard substance (usually water at 59 degrees Fahrenheit) one degree. Specific heat of air 0.24 Btu per pound per degree (standard air). Specific heat of water 1.0 Btu per pound per degree (59 degrees Fahrenheit).

Subp. 6. **Standard air.** "Standard air" means air with a density of 0.075 pounds per cubic foot. This is substantially equivalent to dry air at 70 degrees Fahrenheit and 29.92 inches Hg barometric pressure.

Subp. 7. **Temperature swing.** "Temperature swing" means an assumed indoor temperature swing of not more than three degrees on a design day when the space is conditioned 24 hours per day and the thermostat setting is 75 degrees Fahrenheit.

Subp. 8. **Thermal conductance.** "Thermal conductance" means the time rate of heat flow expressed in Btu's per (hour) (square foot) (Fahrenheit degree average temperature difference between two surfaces). The term is applied for the thickness or construction stated, not per inch of thickness.

Subp. 9. **Thermal conductance of an air space.** "Thermal conductance of an air space" means the time rate of heat flow through a unit area of an air space per unit temperature difference between the boundary surfaces. Its value is expressed in Btu's per (hour) (square foot of area) (Fahrenheit degree).

Subp. 10. **Thermal conductivity.** "Thermal conductivity" means the rate of heat flow expressed in Btu's per (hour) (square foot) (Fahrenheit degree per inch of thickness).

Subp. 11. **Thermal resistance.** "Thermal resistance" means the reciprocal of heat transfer coefficient, as expressed by U, C, f or a. Its unit is Fahrenheit degrees per Btu (hour) (square foot). For example, a wall with a U value of 0.25 would have a resistance value of R - 1/U-1/0.25-4.0.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0220 HEAT LOSS CALCULATION.

Subpart 1. **Outdoor weather conditions.** The following design outdoor weather conditions -- temperature, wind direction, and wind velocity -- shall be as follows:

A. **Outside temperature:** select the design temperature from the list in part 1345.0310. Use the city closest in proximity to the location of the installation.

B. **Wind velocity** 15 miles per hour.

C. **Wind direction** NW.

Subp. 2. **Indoor air temperature.** The indoor air temperature that is to be maintained in room or space during the coldest weather shall be in accordance with part 1345.0320.

The indoor air temperature is the dry-bulb temperature at the breathing line, five feet above the floor, or at the seating level, 30 inches above the floor at a location where the temperature-sensing device is not exposed to a condition of abnormal heat gain or heat loss.

Subp. 3. **Infiltration.** The heat losses due to infiltration shall be determined by either one of the following methods:

A. Select unit values and compute the heat equivalent of the infiltration of cold air taking place around outside doors and windows. These unit values depend on the kind or width of crack, and wind velocity assumed at

15 miles per hour. These units when multiplied by the length of crack give the volume of outdoor air entering the building in cubic feet per hour.

B. The amount of air leakage may be estimated by assuming a certain number of air changes per hour for each room, the number of changes assumed being dependent upon the type, use, and location of the room as indicated in part 1345.0320.

C. The heat loss due to the air infiltration by either the crack method or air change method can be calculated by the following equation:

$$H_s = 0.24 Qxd (t_i - t_o). \quad (1)$$

where

H_s = Heat required to raise temperature of infiltration air, Btu per hour.

0.24 = Specific heat of air.

Q = volume of outdoor air entering building, cubic feet per hour.

d = density of air at temperature t_o , pounds per cubic foot.

t_i = inside air temperature, degrees Fahrenheit.

t_o = outside air temperature, degrees Fahrenheit.

It is sufficiently accurate to use $d = 0.075$ in which case Equation (1) reduces to

$$H_s = 0.018 Q (t_i - t_o). \quad (2)$$

Subp. 4. **Positive ventilation.** When positive ventilation using outdoor air is provided by air-heating or an air-conditioning unit, the heat required to warm the outdoor air to room temperature must be provided by the unit.

A. If mechanical exhaust from the room is provided, an amount equal to the outdoor air drawn in by the unit together with the natural infiltration losses must also be provided for by the unit.

B. If no mechanical exhaust is used, and the outdoor air supply equals or exceeds the amount of natural infiltration that would occur without ventilation, the natural ventilation may be neglected.

Subp. 5. **Total heat loss.** The sum of the heat losses due to transmission through the outside walls and glass, as well as through any cold floors, ceilings, or roof, plus the heat equivalent of the cold air entering by infiltration or required to replace mechanical exhaust, represents the total heat loss equivalent for any building.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0230 INTERNAL HEAT SOURCE CREDITS.

A portion of the heat supplied by persons, lights, motors, and machinery may be deducted in the case of theaters, assembly halls, industrial plants, and commercial buildings such as stores, office buildings, etc. A credit of 70 percent of continuous lighting load and 50 percent of sensible occupancy load may be used.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0240 COOLING LOADS: GENERAL.

Parts 1345.0230 to 1345.0290 outline the methods and reference needed to be used for calculation of air conditioning cooling loads for occupancy comfort.

The code requirements are divided into two parts. Parts 1345.0230 to 1345.0270 deal with the cooling loads for commercial and public buildings: deductions from the net heat gain for storage and temperature swing when detailed load calculations are approved by the administrative authority.

Parts 1345.0280 and 1345.0290 deal with the load for residential cooling: deductions from the net heat gain for storage and temperature swing when detailed load calculations are approved by the administrative authority.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0250 COOLING LOAD CALCULATIONS; COMMERCIAL AND PUBLIC BUILDINGS.

Summer cooling load calculations for comfort application require consideration of the following factors:

A. design conditions: indoor conditions, outdoor conditions, ventilation rate;

B. instantaneous heat load, sensible and latent:

(1) load from solar radiation, sky radiation, and from outdoor-indoor temperature differential for glass areas and exterior walls and roofs, modified by periodic heat flow or lag factors depending on the type of structure;

(2) load due to heat gain through interior partitions, ceilings and floors;

(3) load due to ventilation, either natural or mechanical;

(4) load due to heat sources within the conditioned space such as people, lights, power equipment, and appliances;

(5) load due to moisture transfer through the permeable building materials;

(6) miscellaneous heat sources; and

C. determination of air quantity and apparatus dew point.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0260 DESIGN CONDITIONS: COMMERCIAL AND PUBLIC BUILDINGS.

Indoor design conditions for which summer air conditioning is selected should be chosen at 75 degrees Fahrenheit dry bulb, with a relative humidity of 50 percent.

The outdoor design conditions shall be selected from part 1345.0340.

Outdoor air requirements for ventilation of conditioned spaces shall be selected from part 1345.0350.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0270 INSTANTANEOUS HEAT LOAD: COMMERCIAL AND PUBLIC BUILDINGS.

The total cooling load shall be divided into the two components, sensible and latent heat. Other factors which have a direct effect on the cooling and must be included are: solar radiation, periodic heat flow through the walls and roofs, effect of shading, load from moisture transfer through permeable building materials, and miscellaneous heat loads (this item covers the small heat gains from exposed piping, ducts, work done by circulating fans, and other contingencies).

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0280 COOLING LOADS: RESIDENTIAL.

The design data and calculation methods for determining residential cooling load shall be in accordance with the procedure outlined in ASHRAE Fundamentals and Equipment, chapter 27, pages 487 to 529 inclusive or Manual J, Load Calculation, National Warm Air Heating and Air Conditioning Association.

They shall also conform to the requirements as set forth in this part and part 1345.0290.

Statutory Authority: *MS s 16B.59 to 16B.73*

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1345.0290 COOLING LOAD CALCULATIONS: RESIDENTIAL.

Subpart 1. **Basis for calculations.** Residential cooling load calculations for comfort application are based on the factors in subparts 2 to 6.

Subp. 2. **Design conditions.** Indoor design temperature shall be 75 degrees Fahrenheit with a relative humidity of 50 percent and a temperature swing of not more than three degrees. The outdoor design conditions shall be selected from part 1345.0340. The rate of air infiltration shall be based on one-half air change per hour. Factors for calculating natural infiltration are shown in part 1345.0330. Because of the effect of house configuration they are calculated in Btu per square foot of gross exposed wall area.

Subp. 3. **Occupancy load.** Heat release per occupant of a residence shall be taken as 300 Btuh of sensible heat.

Subp. 4. **Appliance load.** A value of 1,200 Btuh of sensible heat release shall be taken for kitchen appliances.

Subp. 5. **Total sensible heat gains.** The total sensible heat gain of the structure is the sum of the sensible heat gains of all rooms plus occupancy and appliance load.

Subp. 6. **Latent load.** The latent load of a residence is a part of the total heat gain and is estimated to be 30 percent of the calculated sensible load.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0300 TOTAL COOLING LOAD: RESIDENTIAL.

The total cooling load is the sum of the sensible load and the latent load. The total load shall be calculated as 1.3 times the calculated sensible load. Whenever the distribution system is located outside of the conditioned space -- in attics, crawl spaces, or unconditioned rooms -- heat gains to the ducts or pipes must be included as an equipment load and must be considered in equipment selection.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0310 TEMPERATURES FOR HEAT LOSS CALCULATION.

Albert Lea	-20 Degrees Fahrenheit
Alexandria	-26 Degrees Fahrenheit
Bemidji	-38 Degrees Fahrenheit
Brainerd	-31 Degrees Fahrenheit
Detroit Lakes	-35 Degrees Fahrenheit
Duluth	-25 Degrees Fahrenheit
Fairmont	-19 Degrees Fahrenheit
Fairbault	-23 Degrees Fahrenheit
Fergus Falls	-28 Degrees Fahrenheit
Grand Rapids	-37 Degrees Fahrenheit
International Falls	-35 Degrees Fahrenheit
Mankato	-23 Degrees Fahrenheit
Marshall	-23 Degrees Fahrenheit
Minneapolis	-19 Degrees Fahrenheit
Saint Paul	-19 Degrees Fahrenheit
Moorhead	-28 Degrees Fahrenheit
Rochester	-23 Degrees Fahrenheit
Roseau	-38 Degrees Fahrenheit
Saint Cloud	-26 Degrees Fahrenheit
Thief River Falls	-33 Degrees Fahrenheit
Virginia	-32 Degrees Fahrenheit
Willmar	-25 Degrees Fahrenheit
Winona	-19 Degrees Fahrenheit
Worthington	-20 Degrees Fahrenheit

Statutory Authority: *MS s 16B.59 to 16B.73*

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1345.0320 WINTER INDOOR DRY-BULB TEMPERATURES.

Type of Building	Degree Fahrenheit
Residences	75
Stores	68-70
Public buildings	72-74
Warm air baths - Saunas	120
Steam baths	110
Factories and machine shops	60-65
Foundries and boiler shops	50-60
Paint shops	75-80
Hospitals	
Private rooms and wards	72-74
Private rooms (surgical)	70-80
Operating rooms	70-75
Kitchens and laundries	68-70
Toilets	70-75
Bathrooms	70-80
Hotels	
Bedrooms and bath	75
Dining rooms	72
Kitchens and laundries	68-70
Ballrooms	65-68
Toilets and service rooms	68-70
Theaters	
Seating space	68-72
Lounge rooms	68-72
Toilets	70-75
Schools	
Classrooms	72-74
Assembly rooms	68-72
Gymnasiums	55-65
Toilets and baths	70-75
Wardrobes and locker rooms	70-75
Kitchens	68-70
Dining room and lunch room	65-70
Play rooms	65-70
Natatoriums	75

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0330 AIR CHANGES TAKING PLACE UNDER AVERAGE CONDITIONS EXCLUSIVE OF AIR PROVIDED VENTILATION.

Kind of Room or Building	Number of Air Changes Per Hour
Rooms, 1 side exposed	1
Rooms, 2 sides exposed	1 to 1-1/2
Rooms, 3 sides exposed	2
Rooms, 4 sides exposed	2
Rooms with no windows or outside doors	1/2 to 3
Entrance halls	2 to 3

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Reception halls	2
Living rooms	1 to 2
Dining rooms	1 to 2
Bath rooms	2
Drug stores	2 to 3
Clothing stores	1
Churches, factories, lofts, etc.	1/2 to 3

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0340 OUTDOOR SUMMER CLIMATIC CONDITIONS FOR MINNESOTA.

Location	Design Dry Bulb			Design Wet Bulb		
	1%	2-1/2%	5%	1%	2-1/2%	5%
Alexandria	90	88	85	76	74	72
Duluth	85	82	79	73	71	69
International Falls	86	82	79	72	69	68
Minneapolis	92	89	86	77	75	74
Saint Paul	92	89	86	77	75	74
Rochester	90	88	85	77	75	74
Saint Cloud	90	88	85	77	75	73

Note: Data compiled from official weather stations where hourly weather observations are made and from other sources. Percentage of design data show the percent of four-month period, June through September.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0350 OUTDOOR AIR REQUIREMENTS.

Application	Smoking	Cfm Per Person ^b		Cfm per Sq. ^b Ft. of Floor
		Recom- mended	Mini- mum ^c	
Apartment				
Average	Some	20	10	-
Deluxe	Some	20	10	-
Banking space	Occasional	10	7-1/2	-
Barber shops	Considerable	15	10	-
Beauty parlors	Occasional	10	7-1/2	-
Brokers' board rooms	Very heavy	50	20	-
Cocktail bars	-	40	25	-
Corridors (supply or exhaust)	-	-	-	0.25
Department stores	None	7-1/2	5	0.05
Directors' rooms	Extreme	50	30	-
Drugs stores ^c	Considerable	10	7-1/2	-
Factories ^{d,f}	None	10	7-1/2	0.10
Five and ten cent stores	None	7-1/2	5	-
Funeral parlors	None	10	7-1/2	-
Garages ^d	-	-	-	1.0

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Hospitals				
Operating rooms ^{f,g}	None	-	-	2.0
Private rooms	None	30	25	0.33
Wards	None	20	10	-
Hotel Rooms	Heavy	30	25	0.33
Kitchens				
Restaurant	-	-	-	4.0
Residence	-	-	-	2.0
Laboratories ^e	Some	20	15	-
Meeting rooms	Very heavy	50	30	1.25
Offices				
General	Some	15	10	0.25
Private	None	25	15	0.25
Private	Considerable	30	25	0.25
Restaurants				
Cafeteria ^e	Considerable	12	10	-
Dining room ^e	Considerable	15	12	-
Schoolrooms ^d	None	-	-	-
Shop, retail	None	10	7-1/2	-
Theater ^d	None	7-1/2	5	-
Theater	Some	15	10	-
Toilets ^d (exhaust)	-	-	-	2.0

^a Taken from present-day practice.

^b This is contaminant-free air.

^c When minimum is used, take the larger of the two.

^d See local codes which may govern.

^e May be governed by exhaust.

^f May be governed by special sources of contamination or local codes.

^g All outside air recommended to overcome explosion hazard of anesthetics.

For general applications a basis of estimating the cfm per person may be taken as:

People not smoking, 5 minimum.

People smoking, 15 minimum.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0360 SENSIBLE COOLING LOAD DUE TO INFILTRATION AND VENTILATION.

Outside design temperature,			
Degrees Fahrenheit	85	90	95
Infiltration, Btuh per square foot			
of gross exposed wall area	0.7	1.1	1.5
Mechanical ventilation Btuh per cfm	11.0	16.0	22.0

Statutory Authority: *MS s 16B.59 to 16B.73*

CHIMNEYS, GAS VENTS, CONNECTORS, SMOKE PIPES

1345.0400 GENERAL REQUIREMENTS.

Subpart 1. **Venting required for fuel burning.** All appliances including fireplaces and incinerators using solid, liquid, or gas fuels shall be vented to the outside unless otherwise approved by the administrative authority.

Subp. 2. **Chimney or vent required.** Every fuel-burning appliance including fireplaces and incinerators shall be connected with a chimney or vent conforming to the provisions of parts 1345.0400 to 1345.0530.

Venting systems and chimneys other than masonry chimneys shall be tested and listed by a nationally recognized testing laboratory such as Underwriters Laboratories, Inc. and shall be installed in full compliance with their listing and the manufacturer's instructions and approved for such use by the administrative authority.

A fuel-fired appliance shall not be connected to a chimney or vent until the installer has determined that the chimney or vent is properly sized to remove all of the products of combustion safely to the outside air. This requirement shall be deemed to have been fulfilled if the height, area, and configuration are in accordance with the specifications provided by the appliance, chimney, or vent manufacturer's engineered specifications.

For general data on the construction of masonry chimneys, vents, fireplaces, and barbecues, reference should be made to the Minnesota State Building Code.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0410 DEFINITIONS.

Subpart 1. **Scope.** The following terms shall have the meanings given them.

Subp. 2. **Barometric draft regulator.** "Barometric draft regulator" means a device with functions to maintain a desired draft in an appliance by automatically reducing the chimney draft to the desired value.

Subp. 3. **Chimneys.** "Chimneys" means a vertical shaft enclosing one or more passageways for the removal of combustion products.

Subp. 4. **Chimney liner, metallic.** "Chimney liner -- metallic" means a vent pipe or chimney liner inserted within a chimney for the purpose of minimizing condensation of flue products and preventing such condensation from contact with the interior of the type A flue or vent in which it is inserted.

Subp. 5. **Chimney liner, nonmetallic.** "Chimney liner -- nonmetallic" means a lining material of fire clay or other approved material that meets the requirements of the Minnesota State Building Code.

Subp. 6. **Chimney or vent.** "Chimney or vent" means a conduit or passageway, vertical or nearly so for conveying flue gasses to the outer air.

Subp. 7. **Draft hood.** "Draft hood" means a device built into an appliance or made a part of the vent connector from an appliance, which is designed to:

A. ensure the ready escape of the products of combustion in the event of no draft, back draft, or stoppage beyond the draft hood;

B. prevent a back draft from entering the appliance; and

C. neutralize the effect of stack action of the chimney or vent upon the operation of the appliance.

Subp. 8. **Type B gas vents.** "Type B gas vents" means vent piping of noncombustible, corrosion resistant material of sufficient thickness, cross-sectional area, and heat insulating quality to avoid excess temperature on adjacent combustible material and certified by nationally recognized testing agency.

Subp. 9. **Type BW gas vents.** "Type BW gas vents" means gas vents listed by a nationally recognized testing agency for venting listed or approved gas fired vented recessed heaters or furnaces. Vents are similar to type B vents, but may be placed closer to combustible materials due to the special manner in which they are required to be installed.

Subp. 10. **Type L venting systems.** "Type L venting systems" means a venting system composed of listed factory built components assembled in accordance with the items of the listing for venting appliances listed for use with

type L venting systems. They may be used where type B gas vents are permitted.

Subp. 11. **Vent connector.** "Vent connector" means the pipe connecting an appliance with the chimney, vent, or chimney liner. This corresponds to the smoke pipe used with solid or liquid fuels.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0420 CHIMNEYS.

Subpart 1. **Types.** Three general types of chimneys are:

A. masonry chimneys: field-constructed chimneys built in accordance with the requirements of the Minnesota State Building Code;

B. factory built chimneys: chimneys that are factory made, listed by a nationally recognized testing agency, for venting gas appliances, gas incinerators, and solid or liquid fuel burning appliances; and

C. metal chimneys (smoke stacks): chimneys made of metal of adequate thickness, galvanized or painted, unless suitably corrosion resistant, properly welded or riveted, and built in accordance with nationally recognized standards.

Subp. 2. **Uses.** Chimneys shall be used for venting the following: all appliances which may be converted readily to the use of solid or liquid fuels; all boilers and warm air furnaces except where approved for connection to type B gas vents approved by the administrative authority; and all incinerators.

Subp. 3. **Termination of chimneys.** Chimneys shall extend at least three feet above the highest point where they pass through the roof of a building and at least two feet higher than any portion of any building within ten feet. Chimneys or vents serving gas-fired appliances shall extend at least five feet above the highest connected appliance draft hood outlet or flue collar with natural draft.

Subp. 4. **Size of chimneys.** The effective area of the chimney when connected to a single appliance shall be not less than the area of the appliance draft hood outlet or in accordance with approved engineering methods. Ref.: Minnesota State Building Code.

The effective area of the chimney when connected to more than one gas appliance shall be not less than the area of the largest vent connector plus 50 percent of the areas of additional vent connectors or in accordance with approved engineering methods. Ref.: Minnesota State Building Code.

When an incinerator is vented by a chimney serving other fuel-burning appliances the area of the vent of the incinerator need not be included in calculating the chimney size provided the chimney size is at least one inch larger in equivalent diameter than the diameter of the incinerator vent. No other fuel-burning appliance shall be vented into a chimney having a flue-fed incinerator or garbage drops.

Subp. 5. **Inspection of chimneys.** All masonry chimneys to which heating boilers or furnaces are to be connected shall be subject to and must successfully withstand a smoke test before such connection is permitted. In the case of new chimneys, the test shall be made after the mortar has set. Such smoke tests shall be made by building a smudge fire at the bottom of the flue, using tar paper or similar material to create the smudge, and when the smoke is flowing freely from the top of the flue, closing it tightly at the top, all heater or vent openings into said flue to be tightly closed before test is started and the cleanout openings to be left open for draft. All leaks in such chimney disclosed by such test shall be closed and made tight before the chimney is accepted or a heating plant connected thereto. The contractor shall make or have made such tests.

Not more than one flue in same chimney shall be tested at one time.

All chimneys in buildings that have been moved to new locations shall be tested in the above manner before being put into use.

All chimneys shall have cleanouts and the cleanouts shall be constructed so that they will remain tightly closed when not in use. The fittings used as cleanouts shall have tight-fitting caps to prevent entrance of air into the chimney at those points.

When inspection reveals that an existing chimney is not safe for the intended application, it shall be rebuilt to conform to nationally recognized standards, relined with a suitable liner or replaced with a gas vent or chimney suitable for the appliances to be attached.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0430 CHIMNEY LINERS -- METALLIC.

Subpart 1. **Liners required.** Masonry chimneys serving gas-fired boilers, furnaces, or other heating devices, whether of the gas designed type or fired by gas conversion burners having an input not exceeding 400,000 Btu per hour, shall be lined continuously from the thimble to the top of the chimney with an approved noncombustible, acid and corrosion resisting liner of the same equivalent cross sectional area as the vent connector.

Subp. 2. **Condensation pocket.** A condensation pocket shall be provided at the base of said liner with provision for a drip, so arranged that excessive condensation of combustion products may be disposed of without damage to the chimney, foundation, floor, or footings.

Subp. 3. **Materials.** The following materials of thickness specified are approved for use as chimney liners:

A. aluminum 2S-H14, 1/2 hard, thickness .032 inches to eight inches diameter, temperatures not to exceed 550 degrees Fahrenheit at outlet of equipment;

B. stainless steel No. 302, No. 26 U.S. Standard gauge to eight inches diameter, No. 24 U.S. Standard gauge over eight inches diameter;

C. vitreous coated steel of No. 22 U.S. Standard gauge before coating;

D. class B vents approved by Underwriters Laboratories, temperatures not to exceed 550 degrees Fahrenheit at outlet of appliance.

Other types of liners shall require the approval of the administrative authority.

Subp. 4. **Chimney caps.** Chimney caps may be used on chimney liners providing they do not obstruct or impair the free emission of the products of combustion, and are approved by the administrative authority.

Subp. 5. **Release.** A chimney liner release will be granted only when the administrative authority finds it impossible to install a liner.

Subp. 6. **Flues.** Outside horizontal masonry flues shall not be used for venting of gas burning appliances.

Subp. 7. **Incinerator connection.** When a gas-fired incinerator meeting the smokeless and odorless requirements of ANSI Z21.6-1969 and approved by the Minnesota Pollution Control Agency is properly connected to a masonry chimney, having a tile flue liner, the chimney liner -- metallic required above may be omitted. If an incinerator is connected to a chimney as described above having an existing metallic liner for temperatures not to exceed 550 degrees Fahrenheit the liner shall be removed and no liner will be required.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0440 METAL CHIMNEYS.

Subpart 1. **Installation.** Single-wall metal pipe shall be constructed of sheet steel not less than No. 20 sheet gage or other approved noncombustible corrosion resistant material.

Single-wall metal pipe used to vent gas appliances shall comply with the installation provisions of part 1345.0450, subpart 9.

Single-wall metal pipe shall be used only for runs directly from the space in which the appliance is located through the roof or exterior wall to the outer air.

Single-wall metal pipe shall not originate in any unoccupied attic or concealed space, and shall not pass through any attic inside wall, concealed space, or through any floor.

When a single-wall metal pipe passes through an exterior wall constructed of combustible material, it shall be guarded at the point of passage by a method described in part 1345.0510, subpart 1.

When a single-wall metal pipe passes through a roof constructed of combustible material, it shall be guarded at the point of passage by a method described in part 1345.0500 or by a noncombustible, nonventilating thimble not less than four inches larger in diameter than the vent pipe and extending not less than 18 inches above and six inches below the roof with the annular space open at the bottom and closed only at the top.

Subp. 2. **Installation with incinerators.** Single-wall pipe not less than No. 10 galvanized sheet gauge or other equivalent noncombustible, corrosion-resistant material may be used for venting incinerators installed in locations such as open sheds, breezeways, or carports, provided the metal pipe is exposed and readily examinable for its full length.

Subp. 3. **Clearance.** Minimum clearances from a single-wall metal pipe to combustible material shall be in accordance with table of clearances following:

Vent Connector Clearances Required for

Gas Appliances
Maximum Distance from Combustible Material

Appliance	Listed Type B Gas Vent Material	Vent Connectors of Other than type B Material
Listed boiler	As listed	6 inches
Listed warm air furnace	As listed	6 inches
Listed water heater	As listed	6 inches
Listed room heater	As listed	6 inches
Listed floor furnace	As listed	6 inches
Listed incinerator	Not Permitted	18 inches
Listed conversion burner (with draft hood)	6 inches	9 inches
Unlisted appliances having draft hoods	6 inches	9 inches
Unlisted appliances without draft hoods	Not Permitted	18 inches

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0450 GAS VENTS AND FLUES, TYPES AND USE.

Subpart 1. **Venting systems.** All gas appliances required to be vented except sealed combustion system appliances shall be connected to a venting system that shall be engineered and constructed so as to develop a positive flow adequate to remove flue gasses to the outside atmosphere. When venting systems serve appliances requiring draft for proper operation they shall be designed and installed to develop adequate draft so as to satisfy the draft requirements of the appliance with the manufacturer's instructions.

Subp. 2. **Type B gas vents.** Type B gas vents:

A. application: not to be used with recessed heaters, incinerators, and appliances listed for use with chimneys only;

B. shall be round in physical shape except as approved for BW vents in the following; and

C. shall be installed in accordance with this chapter and the manufacturer's specifications.

Subp. 3. **Type BW gas vents.** The venting of recessed or surface-mounted wall heaters or furnaces shall be such that a section of type BW vent material shall extend through the plate directly above the heater. Immediately above the highest plate there shall be a transition fitting from the oval class BW vent to round class B vent material. This shall extend a minimum of total height of 12 feet above the floor on which the heater sits.

Wall heaters or furnaces which have been designed by their manufacturer for a horizontal vent takeoff and have been so tested and approved shall have their horizontal vent connector as short as possible. The maximum length of the horizontal run shall be six feet.

Subp. 4. **Single-wall vent pipe.** The material and installation of single-wall vents shall comply with the requirements as specified in part 1345.0500.

Subp. 5. **Gas vent; termination.** Gas vents may be terminated not less than 12 inches above the highest point where they pass through a roof. Each gas vent shall extend above the roof surface and through its flashing. The outlet opening of any vent shall be not less than 12 inches from any portion of the building or structure, nor less than four feet from any of that portion of the building or structure which extends at an angle of more than 45 degrees upward from the horizontal. (See Figure 6 at the end of this chapter.) Vent caps shall be as specified in parts 1345.0420 to 1345.0440.

Type B gas vents shall not terminate less than five feet in vertical height above the highest connected appliance draft hood outlet or flue collar.

Type BW gas vents serving a vented wall furnace shall not terminate less than 12 feet in vertical height above the bottom of the heater.

Subp. 6. **Size of gas vents.** The size of the common vent serving connected gas appliances shall be computed on the basis of an installation 75,000 Btu in excess of the rated input capacity of the installation being made. In no case shall the common vent be smaller than the largest connected draft hood outlet. (See part 1345.0510, subparts 1, 2, 4, and 5, which set forth minimum acceptable standards.)

In commercial and industrial buildings, the effective area of a type B gas vent when connected to a single appliance shall not be less than the area of the appliance draft hood outlet or in accordance with approved engineering methods.

Subp. 7. **Support of gas vents.** All portions of gas vents shall be adequately supported for the design and weight of the materials employed. Listed gas vents shall be supported and spaced in accordance with their listings and the manufacturer's instructions.

Subp. 8. **Gas vents serving two or more gas appliances having draft hoods.** When two or more vent connectors enter a common vertical gas vent, the smaller connector should enter at the highest level consistent with available headroom or

clearance to combustible material and the appliance located as close to vertical vent as possible.

Two or more gas appliances may be vented through a common vent connector or manifold located at the highest level consistent with available (normal) headroom or clearance to combustible material.

The manifold, all junction fittings, and the common vent connector shall be of a size adequate for the combined volume of the vent gases.

Subp. 9. **Size of single-wall metal pipe.** The effective area of single-wall metal pipe when connected to a single appliance shall be not less than the area of the appliance draft hood outlet or in accordance with approved engineering methods. (See part 1345.0510, subpart 2, which sets forth minimum acceptable standards.)

The effective area of a single-wall metal pipe when connected to more than one appliance shall be not less than the area of the largest vent connector plus 50 percent of the areas of additional vent connectors or in accordance with approved engineering methods. (See part 1345.0510, subpart 5, which sets forth minimum acceptable standards.)

Subp. 10. **Support of single-wall metal pipe.** All portions of single-wall metal pipe shall be adequately supported for the design and weight of the material employed.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0460 OUTSIDE GAS VENTS AND CHIMNEYS.

Outside gas vents and chimneys are not recommended for use in cold climates. When they must be used in these climates, the material shall possess high insulation qualities or be adequately insulated.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0470 CONDENSATE DRAIN.

When local experience indicates that condensate may be a problem, provisions shall be made to drain off the condensate.

Natural draft vents extending through outside walls shall not terminate adjacent to outside walls or below eaves or parapets.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0480 VENT CONNECTORS.

Subpart 1. **When required.** Vent connectors shall be used to connect gas appliances to the gas vent, chimney, or single-wall metal pipe except when the gas vent, chimney, or single-wall metal pipe is directly connected to the appliance.

Subp. 2. **Materials.** Vent connectors used for conversion burners without draft hoods, incinerators, and unlisted appliances without draft hoods shall be constructed of materials having a resistance to corrosion and heat not less than that of No. 24 galvanized sheet gauge.

Vent connectors used for gas appliances having draft hoods and for listed conversion burners having draft hoods shall be constructed of materials having a resistance to corrosion and heat not less than that of No. 26 galvanized sheet gauge, except that type B vent material may be used as the connector between the draft hood and the chimney.

Subp. 3. **Size of vent connector.** The effective area of the vent connector, when connected to an appliance having a single draft hood, shall be not less than the area of the draft hood outlet or shall be in accordance with approved engineering methods. (See part 1345.0510, subparts 1, 2, and 3, which set forth minimum acceptable standards.)

For single appliances having more than one draft hood outlet, the instructions of the appliance manufacturer shall be followed. If there are none.

the effective area of the vent connector shall equal the combined areas of the draft hood outlets for which it acts as a common connector to the venting system.

When two or more appliances are connected to a common vent or chimney, the effective area of each vent connector shall be not less than the area of the appliance draft hood outlet or shall be in accordance with approved engineering methods. (See part 1345.0510, subparts 4, 5, and 6, which set forth minimum acceptable standards.)

Each vent connector of a multiple venting system shall have the greatest possible vertical rise consistent with the headroom available between the draft hood outlet and the point of interconnection to a manifold, to a common vent, or to a chimney, or the vertical rise shall be in accordance with approved engineering methods. (See part 1345.0510, subparts 4, 5, and 6, which set forth minimum acceptable standards.)

When the size of a connector is increased to overcome installation limitations and obtain connector capacity equal to the appliance input, the size increase shall be made at the appliance draft hood outlet.

Two or more gas appliances may be vented through a common flue or vent connector when necessary, if joined by "Y" fittings as close as practicable to the flue or vent and provided the size of the common flue or vent is sufficient to accommodate the total volume of flue gases. "Y" fittings shall be made so that the angle at which the vent connectors intersect is as small as possible and should not exceed 45 degrees.

Subp. 4. Clearance. Minimum clearance from vent connectors to combustible material shall be in accordance with table of clearances in part 1345.0440, subpart 3. When vent connectors must pass through walls or partitions of combustible material, a thimble shall be used and installed in accordance with one of the methods outlined in the following.

Subp. 5. Avoid unnecessary bends. The vent connectors shall be installed so as to avoid excessive turns or other construction features which create unnecessary resistance to flow of vent gases.

Subp. 6. Joints. Vent connectors shall be firmly attached to draft hood outlets by sheet-metal screws or other approved means.

Vent connectors using listed type B gas vent material shall be securely assembled using the method shown in the listing and the manufacturer's instructions.

Joints of other than listed type B gas vent material shall be securely fastened by sheet-metal screws or other approved methods.

Subp. 7. Pitch. Vent connectors shall be installed without any downward pitch from the appliance and without any dips or sags.

Vent connectors attached directly to the side outlet draft hoods, such as on floor furnaces, shall be pitched upward from the appliance at least one-fourth inch per foot.

Vent connectors attached to top outlet draft hoods by means of a 90-degree elbow may be horizontal or pitched upward from the appliance.

Subp. 8. Length. The horizontal run of the vent connector shall be as short and direct as possible and the appliance shall be located as near the gas vent, chimney, or single-wall metal pipe as practicable. The maximum length of an uninsulated horizontal run of vent connector shall not exceed 75 percent of the height of the gas vent, chimney, or single-wall metal pipe or shall be in accordance with approved engineering methods.

Subp. 9. Support. Vent connectors shall be adequately supported for the design and weight of the materials employed to maintain proper clearance, to prevent physical damage, and to prevent separation of the joints.

Subp. 10. **Location.** When the vent connector used for an appliance having a draft hood must be located in or pass through a crawl space or other area difficult of access which may be cold, that portion of the vent connector shall be listed type B gas vent material or material having equivalent insulation qualities. Single-wall metal pipe used as a vent connector shall not pass through any floor or ceiling.

Subp. 11. **Chimney connection.** In entering a passageway in a masonry or metal chimney, the vent connector shall be installed above the extreme bottom to avoid stoppage. Means shall be employed which will prevent the vent connector from entering so far as to restrict the space between its end and the opposite wall of the chimney. A thimble or slip joint may be used to facilitate removal of the vent connector. The vent connector shall be firmly attached to or inserted into the thimble or slip joint to prevent it from falling out.

Subp. 12. **Fireplace.** A vent connector shall not be connected to a chimney serving a fireplace unless the fireplace opening is permanently sealed.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0490 SPECIAL VENTING ARRANGEMENTS.

Subpart 1. **Appliance with sealed combustion systems.** The provisions of draft hoods do not apply to listed appliances having sealed combustion systems constructed and installed so that all air for combustion is derived from the outside atmosphere and flue gases are discharged to the outside atmosphere. Such appliances, having integral venting, shall be considered as being properly vented when they are installed in accordance with their listing and the manufacturer's instructions.

Vent terminals of sealed combustion system appliances shall be located not less than nine inches from any opening through which combustion products could enter the building. A sealed combustion system appliance may be installed in a building opening, such as a window. The bottom of the vent terminal and the air intake shall be located at least 12 inches above grade.

Subp. 2. **Mechanical draft systems.** Venting system exhausters may be used in lieu of natural draft vents for any gas appliance except incinerators. When exhausters are used with gas appliances, requiring venting, provisions shall be made to prevent the flow of gas to the main burner in the event of failure of the exhaust system. The interlock shall prove actual air flow.

Vent connectors serving gas appliances vented by natural draft shall not be connected into the discharge side of the power exhausters.

The exit terminals of exhauster-equipped gas-venting systems shall be located not less than nine inches from any building opening nor less than two feet from an adjacent building and not less than seven feet above grade when located adjacent to public walkways.

Forced draft systems and all portions of induced draft systems under positive pressure during operation shall be designed and installed so as to be gas tight or as to prevent leakage of combustion products in a building.

Subp. 3. **Ventilating hoods and exhaust systems.** Ventilating hoods and exhaust systems may be used to vent gas burning appliances installed in commercial applications, when approved by the administrative authority.

Subp. 4. **Dampers.** Manually operated dampers shall not be placed in the vent connectors from gas appliances except that manually operated dampers may be installed in the vent connector of listed gas incinerators when recommended by the manufacturer. Such a damper or draft regulator shall be installed in accordance with the instructions accompanying the incinerator. Fixed baffles, such as baffles ahead of draft hoods, are not classified as dampers.

Subp. 5. **Use of thimbles.** When passing through combustible walls or partitions vent connectors built of listed type B gas vent material shall be installed so that the clearances required by the listing are maintained.

Vent connectors made of single-wall metal pipe shall not pass through any combustible walls unless they are guarded at the point of passage by ventilated metal thimbles not smaller than the following:

A. for listed appliances, except incinerators, four inches larger in diameter than the vent connector unless there is a run of not less than six feet of vent connector in the open, between the draft hood outlet and the thimble, in which case the thimble may be two inches larger in diameter than the vent connector;

B. for unlisted appliances having draft hoods, six inches larger in diameter than the vent connector;

C. for incinerators and unlisted appliances without draft hoods, 12 inches larger in diameter than the vent connector.

In lieu of thimble protection, all combustible materials in the wall shall be cut away from the vent connector a sufficient distance to provide the clearance required from such vent connector to combustible material. Any material used to close up such opening shall be noncombustible.

When automatically operated appliances, such as water heaters, are vented through natural draft ventilating hoods, dampers shall not be installed in the ventilating system. When the ventilating hood or exhaust system is equipped with power means of exhaust, the appliance control system shall be interlocked so as to permit appliance operation only when the power means of exhaust is in operation.

Subp. 6. Appliances with integral vents. Appliances incorporating integral venting means shall be considered properly vented when installed in accordance with their listings and the manufacturer's instructions.

Vent terminals of appliances using natural draft venting shall be located not less than nine inches from any opening through which combustion products could enter the building. Vent terminals of appliances using forced draft venting shall be located not less than 12 inches from any opening through which combustion products could enter the building.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0500 CHIMNEY CONNECTORS (SMOKE PIPES) FOR LIQUID AND SOLID FUELS.

Subpart 1. Smoke pipe installation. Each connector or breeching shall be provided with a proper damper conveniently located.

Each connector or breeching shall be welded, lock seamed, or riveted, with all joints lapped not less than 1-1/2 inches and be rigidly secured; and shall have a proper thimble for making a tight connection to the chimney flue. To facilitate installation a flange connection or a draw band connection can be used.

Connectors or breechings shall be supported by means of strap hangers spaced not less than six feet on centers. Wire hangers will not be permitted.

Each such connector or breeching shall be as short and direct to the chimney flue as possible and shall be installed with a pitch upward of not less than one-quarter inch per running foot.

Single-wall metal pipe connectors shall not pass through any floor or be nearer than 12 inches to any wood or other combustible portion of the building, except as noted below, and all combustible materials within 18 inches shall be covered with a metal or asbestos shield extending at least one foot on each side of the connector pipe and in case of a greater diameter than 12 inches and of less area than six square feet shall be kept at least 16 inches away from any woodwork, and such woodwork shall be protected as before specified for the smaller smoke pipes, a distance of three feet on each side of such smoke pipes.

Where single-wall metal pipes of 12 inches or less in diameter pass through a wood or plastered stud partition, they shall be surrounded either by a body of

brick, hollow tile, or other incombustible fireproof material of a thickness of at least four inches, around such smoke pipes, or they shall be surrounded by a sheet metal thimble of two concentric rings at least two inches apart, and the entire thimble so constructed that there will be a free circulation of air between the two rings forming the same. Single-wall metal pipes of a diameter of six inches or less may have thimbles with one inch air space.

Subp. 2. **Single-wall metal pipe connections.** Chimneys shall not have connections in more than one story of a building, unless provision is made for effectively closing the openings with devices made of noncombustible materials whenever their use is discontinued temporarily and completely closing them with masonry when discontinued permanently.

Two or more chimney connections shall not be joined for a single connection unless the common connector and chimney are of sufficient size to serve all the appliances thus connected.

The connector pipe serving a heating appliance shall not be connected into the chimney flue serving an incinerator which has the rubbish chute common with the chimney flue.

Subp. 3. **Connector pipes, weight of metal.** For each steam or hot water boiler or warm air furnace installed under the provision of this code, the area of the breeching or smoke pipe shall not be less than the area of the flue collar of the boiler or furnace to which it is connected.

Each such breeching or connector pipe shall be made of material equal in durability to galvanized sheet metal of thickness (galvanized sheet gauge) for the various diameters of such smoke pipes, shall be not less than the following:

Diameter of Connector	Sheet Gauge No.
Less than 10"	24
10" to 12"	22
14" to 16"	20
18" to 20"	18
22" to 24"	16

Statutory Authority: *MS s 16B.59 to 16B.73*

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1345.0510 TABLES.

Subpart 1. Capacity of type B double-wall vents serving a single appliance.

Height H	Lateral L	Vent Diameter—D													
		3"	4"	5"	6"	7"	8"	10"	12"	14"	16"	18"	20"	22"	24"
		Maximum Appliance Input-Rating in Thousands of Btu per Hour													
6'	0	46	86	141	205	285	370	570	850	1170	1530	1960	2430	2950	3520
	2'	36	67	105	157	217	285	455	650	890	1170	1480	1850	2220	2670
	6'	32	61	100	149	205	273	435	630	870	1150	1470	1820	2210	2650
	12'	23	55	91	137	190	255	406	610	840	1110	1430	1795	2180	2600
8'	0	50	94	155	235	320	415	660	970	1320	1740	2220	2750	3360	4010
	2'	40	75	120	180	247	322	515	745	1020	1340	1700	2110	2560	3050
	8'	35	66	109	165	227	303	490	720	1000	1320	1670	2070	2530	3030
	16'	23	58	96	148	206	281	458	685	950	1260	1600	2035	2470	2960
10'	0	53	100	166	255	345	450	720	1060	1450	1925	2450	3050	3710	4450
	2'	42	81	129	195	273	355	560	850	1130	1480	1890	2340	2840	3390
	10'	36	70	115	175	245	330	525	795	1080	1430	1840	2280	2780	3340
	20'	NR	60	100	154	217	300	486	735	1030	1360	1780	2230	2720	3250
15'	0	58	112	187	285	390	525	840	1240	1720	2270	2900	3620	4410	5300
	2'	48	93	150	225	316	414	675	985	1350	1770	2260	2800	3410	4080
	15'	37	76	128	198	275	373	610	905	1250	1675	2150	2700	3300	3980
	30'	NR	60	107	169	243	328	553	845	1180	1550	2050	2620	3210	3840
20'	0	61	119	202	307	430	575	930	1350	1900	2520	3250	4060	4980	6000
	2'	51	100	166	249	346	470	755	1100	1520	2000	2570	3200	3910	4700
	10'	44	89	150	228	321	443	710	1045	1460	1940	2500	3130	3830	4600
	20'	35	78	134	206	295	410	665	990	1390	1880	2430	3050	3760	4550
30'	NR	68	120	186	273	380	626	945	1270	1700	2330	2980	3650	4390	
30'	0	64	128	220	336	475	650	1060	1550	2170	2920	3770	4750	5850	7060
	2'	56	112	185	280	394	535	865	1310	1800	2380	3050	3810	4650	5600
	20'	NR	90	154	237	343	473	784	1185	1650	2200	2870	3650	4480	5310
	40'	NR	NR	NR	200	298	415	705	1075	1520	2060	2700	3480	4270	5140
40'	0	66	132	228	353	500	685	1140	1730	2400	3230	4180	5270	6500	7860
	2'	59	118	198	298	420	579	960	1420	2000	2660	3420	4300	5260	6320
	20'	NR	96	167	261	377	516	860	1310	1830	2460	3200	4050	5000	6070
	40'	NR	NR	NR	223	333	460	785	1205	1710	2310	3020	3840	4780	5820

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Height H	Lateral L	Vent Diameter—D													
		3'	4'	5'	6'	7'	8'	10'	12'	14'	16'	18'	20'	22'	24'
Maximum Appliance Input-Rating in Thousands of Btu per Hour															
60'	0	NR	136	236	373	535	730	1250	1920	2700	3650	4740	6000	7380	9000
	2'	NR	125	213	330	470	660	1060	1605	2250	3020	3920	4960	6130	7400
	30'	NR	NR	170	275	397	555	930	1440	2050	2780	3640	4700	5730	7000
	60'	NR	NR	NR	NR	NR	334	475	830	1285	1870	2560	3380	4330	5420
80'	0	NR	NR	239	384	550	755	1290	2020	2880	3900	5100	6450	8000	9750
	2'	NR	NR	217	350	495	683	1145	1740	2460	3320	4310	5450	6740	8200
	40'	NR	NR	NR	275	404	570	980	1515	2180	2980	3920	5000	6270	7650
	80'	NR	NR	NR	NR	NR	NR	850	1420	2000	2750	3640	4680	5850	7200
100'	0	NR	NR	NR	400	560	770	1310	2050	2950	4050	5300	6700	8600	10300
	2'	NR	NR	NR	375	510	700	1170	1820	2550	3500	4600	5800	7200	8800
	50'	NR	NR	NR	NR	405	575	1000	1550	2250	3100	4050	5300	6600	8100
	100'	NR	NR	NR	NR	NR	NR	870	1430	2050	2850	3750	4900	6100	7500

See figure 1 and notes in part 1345.0520, subparts 1 and 2 for single appliance vents.

Subp. 2. Capacity of single-wall metal pipe or type B asbestos cement vents serving a single appliance.

Height H	Lateral L	Vent Diameter—D									
		3"	4"	5"	6"	7"	8"	10"	12"		
		Maximum Appliance Input Rating in Thousands of Btu per Hour									
6'	0	39	70	116	170	232	312	500	750		
	2'	31	55	94	141	194	260	415	620		
	5'	28	51	88	128	177	242	390	600		
8'	0	42	76	126	185	252	340	542	815		
	2'	32	61	102	154	210	284	451	680		
	5'	29	56	95	141	194	264	430	648		
	10'	24*	49	86	131	180	250	406	625		
10'	0	45	84	138	202	279	372	606	912		
	2'	35	67	111	168	233	311	505	750		
	5'	32	61	104	153	215	289	480	724		
	10'	27*	54	94	143	200	274	455	700		
	15'	NR	46*	84	130	186	258	432	666		

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1345.0510 MECHANICAL SYSTEMS

Height H	Lateral L	Vent Diameter—D									
		3'	4'	5'	6'	7'	8'	10'	12'		
		Maximum Appliance Input Rating in Thousands of Btu per Hour									
15'	0	49	91	151	223	312	420	684	1040		
	2'	39	72	122	186	260	350	570	865		
	5'	35*	67	110	170	240	325	540	825		
	10'	30*	58*	103	158	223	308	514	795		
	15'	NR	50*	93*	144	207	291	488	760		
	20'	NR	NR	82*	132*	195	273	466	726		
20'	0	53*	101	163	252	342	470	770	1190		
	2'	42*	80	136	210	286	392	641	990		
	5'	38*	74*	123	192	264	364	610	945		
	10'	32*	65*	115*	178	246	345	571	910		
	15'	NR	55*	104*	163	228	326	550	870		
	20'	NR	NR	91*	149*	214*	306	525	832		
30'	0	56*	108*	183	276	384	529	878	1370		
	2'	44*	84*	148*	230	320	441	730	1140		
	5'	NR	78*	137*	210	296	410	694	1080		
	10'	NR	68*	125*	196*	274	388	656	1050		
	15'	NR	NR	113*	177*	258*	366	625	1000		
	20'	NR	NR	99*	163*	240*	344	596	960		
50'	0	NR	120*	210*	310*	443*	590	980	1550		
	2'	NR	95*	171*	260*	370*	492	820	1290		
	5'	NR	NR	159*	234*	342*	474	780	1230		
	10'	NR	NR	146*	221*	318*	456*	730	1190		
	15'	NR	NR	NR	200*	292*	407*	705	1130		
	20'	NR	NR	NR	185*	276*	384	670*	1080		
30'	NR	NR	NR	NR	222*	330*	605*	1010			

See figure 1 and notes in part 1345.0520, subparts 1 and 2 for single appliance vents.

Subp. 3. Capacity of masonry chimneys and single-wall vent connectors serving a single appliance.

SINGLE-WALL VENT CONNECTOR DIAMETER—D											
To be used with chimney areas not less than those at bottom											
Height H	Lateral L	Maximum appliance input rating in thousands of Btu per hour									
		3'	4'	5'	6'	7'	8'	10'	12'		
6'	2'	28	52	86	130	180	247	400	580		
	5'	25*	48	81	118	164	230	375	560		
8'	2'	29	55	93	145	197	265	445	650		
	5'	26*	51*	87	133	182	246	422	638		
	10'	22*	44*	79	123	169	233	400	598		
10'	2'	31	61	102	161	220	297	490	722		
	5'	28*	56	95	147	203	276	465	710		
	10'	24*	49*	86	137	189	261	441	665		
15'	15'	NR	79*		125	175	246	421	634		
	2'	35*	67	113	178	249	335	560	840		
	5'	32*	61	106	163	230	312	531	825		
20'	10'	27*	54*	96	151	214	294	504	774		
	15'	NR	46*	87*	138	198	278	481	738		
	20'	NR	NR	73*	128*	184	261	459	706		
20'	2'	38*	73	123	200	273	374	625	950		
	5'	35*	67*	115	183	252	348	594	930		
	10'	NR	59*	105*	170	235	330	562	875		
30'	15'	NR	NR	95*	156	217	311	536	835		
	20'	NR	NR	80*	144*	202	292	510	800		
	2'	41*	81*	136	215	302	420	715	1110		
30'	5'	NR	75*	127*	196	279	391	680	1090		
	10'	NR	66*	113*	182*	260	370	644	1020		
	15'	NR	NR	105*	168*	240*	349	615	975		
50'	20'	NR	NR	88*	155*	223*	327	585	932		
	30'	NR	NR	NR	NR	182*	281*	544	865		
	2'	NR	91*	160*	250*	350*	475	810	1240		
50'	5'	NR	NR	149*	228*	321*	442	770	1220		
	10'	NR	NR	136*	212*	301*	420*	728	1140		
	15'	NR	NR	124*	195*	278*	395*	695	1090		
50'	20'	NR	NR	NR	180*	258*	370*	660*	1040		
	30'	NR	NR	NR	NR	NR	318*	610*	970		
Minimum Internal Area of Chimney-A Square Inches			19	28	38	50	63	95	132		

See figure 2 and notes in part 1345.0520, subparts 1 and 2 for single appliance vents.

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Subp. 4. Capacity of type B double-wall vent serving two or more appliances.

Vent Connector Capacity

Total Vent Height "H"	Connector Rise "R"	Vent Connector Diameter—D													
		3'	4'	5'	6'	7'	8'	10'	12'	14'	16'	18'	20'	22'	24'
		Maximum Appliance Input Rating in Thousands of Btu per Hour													
6'	1'	26	46	72	104	142	185	289	416	577	755	955	1180	1425	1700
	2'	31	55	86	129	168	220	345	496	653	853	1080	1335	1610	1920
	3'	35	62	96	139	189	248	386	556	740	967	1225	1510	1830	2180
8'	1'	27	48	76	109	148	194	303	439	601	805	1015	1255	1520	1810
	2'	32	57	90	129	175	230	358	516	696	910	1150	1420	1720	2050
	3'	36	64	101	145	198	258	402	580	790	1030	1305	1610	1950	2320
10'	1'	28	50	78	113	154	200	314	452	642	840	1060	1310	1585	1890
	2'	33	59	93	134	182	238	372	436	730	955	1205	1490	1800	2150
	3'	37	67	104	150	205	268	417	600	827	1080	1370	1690	2040	2430
15'	1'	30	53	83	120	163	214	333	480	697	910	1150	1420	1720	2050
	2'	35	63	99	142	193	253	394	568	790	1030	1305	1610	1950	2320
	3'	40	71	111	160	218	286	444	640	898	1175	1435	1835	2220	2640
20'	1'	31	56	87	125	171	224	347	500	740	965	1225	1510	1830	2190
	2'	37	66	104	149	202	265	414	596	840	1095	1385	1710	2070	2470
	3'	42	74	116	168	223	300	466	672	952	1245	1575	1945	2350	2800
30'	1'	33	59	93	134	182	238	372	536	805	1050	1330	1645	1990	2370
	2'	39	70	110	158	215	282	439	632	910	1190	1500	1855	2240	2670
	3'	44	79	124	178	242	317	494	712	1035	1350	1710	2110	2550	3040
40'	1'	35	62	97	140	190	248	389	560	850	1110	1405	1735	2100	2500
	2'	41	73	115	166	225	295	461	665	964	1260	1590	1965	2380	2830
	3'	46	83	129	187	253	331	520	748	1100	1435	1820	2240	2710	3230
60' to 100'	1'	37	66	104	150	204	266	417	600	926	1210	1530	1890	2230	2720
	2'	44	79	123	178	242	316	494	712	1050	1370	1740	2150	2590	3090
	3'	50	89	138	200	272	355	555	800	1198	1565	1930	2450	2960	3520

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Subp. 5. Common vent capacity.

COMMON VENT CAPACITY

Total Vent Height "H"	Common Vent Diameter													
	3'	4'	5'	6'	7'	8'	10'	12'	14'	16'	18'	20'	22'	24'
Combined Appliance Input Rating in Thousands of Btu per Hour														
6'	—	65	103	147	200	260	410	588	815	1065	1345	1660	1970	2390
8'	—	73	114	163	223	290	465	652	912	1190	1510	1860	2200	2630
10'	—	79	124	173	242	315	495	712	995	1300	1645	2030	2400	2920
15'	—	91	144	206	280	365	565	825	1158	1510	1910	2360	2790	3400
20'	—	102	160	229	310	405	640	916	1290	1690	2140	2640	3120	3800
30'	—	118	185	266	360	470	740	1025	1525	1990	2520	3110	3680	4460
40'	—	131	203	295	405	525	820	1160	1715	2240	2830	3500	4150	5050
60'	—	NR	224	324	440	575	900	1380	2010	2620	3320	4100	4850	5900
80'	—	NR	NR	344	468	610	955	1540	2250	2930	3710	4590	5420	6600
100'	—	NR	NR	NR	479	625	975	1670	2450	3200	4050	5000	5920	7200

See figure 3 and notes in part 1345.0520, subparts 3 and 4 for single appliance vents.

Subp. 6. Capacity of a single-wall metal pipe or type B asbestos cement vent serving two or more appliances.

Vent Connector Capacity

Total Vent Height "H"	Connector Rise "R"	Vent Connector Diameter -- D					
		3"	4"	5"	6"	7"	8"
		Maximum Appliance Input Rating in Thousands of Btu per hour					
6' to 8'	1'	21	40	68	102	146	205
	2'	28	53	86	124	178	235
	3'	34	61	98	147	204	275
15'	1'	23	44	77	117	179	240
	2'	30	56	92	134	194	265
	3'	35	64	102	155	216	298
30' and up	1'	25	48	84	129	190	270
	2'	31	58	97	145	211	295
	3'	36	68	107	164	232	321

Common Vent Capacity

Total Vent Height "H"	Common Vent Diameter						
	4"	5"	6"	7"	8"	10"	12"
Combined Appliance Input Rating in Thousands of Btu per hour							
6'	48	78	111	155	205	320	NR
8'	55	89	128	175	234	365	505
10'	59	95	136	190	250	395	560
15'	71	115	168	228	305	480	690
20'	80	129	186	260	340	550	790
30'	NR	147	215	300	400	650	940
50'	NR	NR	NR	360	490	810	1190

See figure 3 and notes in part 1345.0520, subparts 3 and 4 for multiple appliance vents.

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Subp. 7. Capacity of a masonry chimney and single-wall vent connectors serving two or more appliances.

Single-Wall Vent Connector Capacity

Total Vent Height "H"	Rise Connector "R"	Vent Connector Diameter -- D					
		3"	4"	5"	6"	7"	8"
		Maximum Appliance Input Rating in Thousands of Btu per hour					
6' to 8'	1'	21	39	66	100	140	200
	2'	28	52	84	123	172	231
	3'	34	61	97	142	202	269
15'	1'	23	43	73	112	171	225
	2'	30	54	88	132	189	256
	3'	34	63	101	151	213	289
30' and up	1'	24	47	80	124	183	250
	2'	31	57	93	142	205	282
	3'	35	65	105	160	229	312

Common Chimney Capacity

Total Vent Height "H"	Minimum Internal Area of Chimney - "A"						
	Square Inches						
	19	28	38	50	78	113	
		Combined Appliance Input Rating in Thousands of Btu per hour					
6'	45	71	102	142	245	NR	
8'	52	81	118	162	277	405	
10'	56	89	129	175	300	450	
15'	66	105	150	210	360	540	
20'	74	120	170	240	415	640	
30'	NR	135	195	275	490	740	
50'	NR	NR	NR	325	600	910	

See figure 4 and notes in part 1345.0520, subparts 3 and 4 for multiple appliance vents.

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Subp. 8. Table for reducing clearances.

Clearances, Inches, With Specified Forms of Protection*

Type of protection	Where the required clearance with no protection is:			
Applied to the combustible material and covering all surfaces within the distance specified as the required clearance with no protection. (See figure 1 in part 1345.0520, subpart 1.) Thicknesses are minimum.	36"	18"	9"	6"
(a) 1/4 inch asbestos millboard spaced out 1 inch**	30	12	6	3
(b) 28 gage sheet metal on 1/4 inch asbestos millboard	24	12	4	2
(c) 28 gage sheet metal spaced out 1 inch**	18	9	4	2
(d) 28 gage sheet metal on 1/8 inch asbestos millboard spaced out 1 inch**	18	9	4	2
(e) 1/4 inch asbestos millboard on 1 inch mineral wool bats reinforced with wire mesh or equivalent	18	6	4	2
(f) 22 gage sheet metal on 1 inch mineral wool bats reinforced with wire or equivalent	12	3	2	2

*All clearances shall be measured from the outer surface of the connector to the combustible material disregarding any intervening protection applied to the combustible material but in no case shall the clearance be such as to interfere with the requirements for accessibility.

**Spacers shall be of noncombustible material.

Subp. 9. Chimney connector and vent connector clearances from combustible materials.

Description of Appliance	Minimum Clearance, Inches (See Note 1)
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RESIDENTIAL TYPE APPLIANCES

Column 1, Appendix A

Single-Wall Metal Pipe Connectors	
Gas Appliances Without Draft Hoods	18
Electric, Gas, and Oil Incinerators	18
Oil and Solid-Fuel Appliances	18
Unlisted Gas Appliances with Draft Hoods	9

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Boilers and Furnaces Equipped With Listed Gas Burners and With Draft Hoods	9
Oil Appliances Listed as Suitable For Use With Type L Venting Systems, but only when connected to chimneys.	9
Listed Gas Appliances With Draft Hoods (See Note 3)	6
Type L Venting System Piping Connectors	
Gas Appliances Without Draft Hoods	9
Electric, Gas, and Oil Incinerators	9
Oil and Solid-Fuel Appliances	9
Unlisted Gas Appliances With Draft Hoods	6
Boilers and Furnaces Equipped With Listed Gas Burners and With Draft Hoods	6
Oil Appliances Listed as Suitable for Use with Type L Venting Systems	(See Note 2)
Listed Gas Appliances With Draft Hoods	(See Note 3)

Column 1, Appendix B

Type B Gas Vent Piping Connectors	
Listed Gas Appliances with Draft Hoods	(See Note 3)

COMMERCIAL-INDUSTRIAL TYPE APPLIANCES

Low-Heat Appliances

Column 2, Appendix A

Single-Wall Metal Pipe Connectors	
Gas, Oil, and Solid-Fuel Boilers, Furnaces, and Water Heaters	18
Ranges, Restaurant Type	18
Oil Unit Heaters	18
Unlisted Gas Unit Heaters	18
Listed Gas Unit Heaters with Draft Hoods	6
Other Low-Heat Industrial Appliances	18
Medium-Heat Appliances	

Column 3, Appendix A

Single-Wall Metal Pipe Connectors

Note 1: These clearances apply except if the listing of an appliance specifies different clearance, in which case the listed clearance takes precedence.

Note 2: If listed Type L venting system piping is used, the clearance may be in accordance with the venting system listing.

Note 3: If listed Type B or Type L venting system piping is used, the clearance may be in accordance with the venting system listing.

The clearances from connectors to combustible materials may be reduced if the combustible material is protected in accordance with the table in subpart 2.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0520 SIZING OF VENTING SYSTEMS SERVING APPLIANCES EQUIPPED WITH DRAFT HOODS.

Subpart 1. Diagrams of single appliance vents.

SIZING OF VENTING SYSTEMS SERVING APPLIANCES EQUIPPED WITH DRAFT HOODS

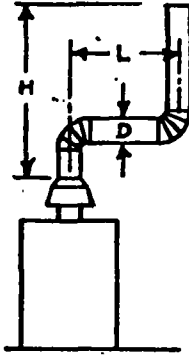


Figure 1
Double Wall or Asbestos Cement Type B Vents or Single-Wall Metal Vents Serving a Single Appliance. (See the tables in part 1345.0510, subparts 1 and 2.)

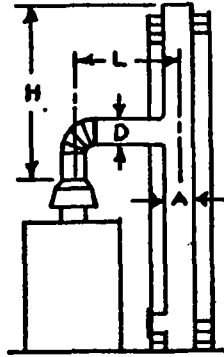


Figure 2
Masonry Chimney Serving a Single Appliance. (See the table in part 1345.0510, subpart 3.)

Subp. 2. Notes for single appliance vents. (See Tables 1, 2 and 3 in part 1345.0510, subparts 1, 2, and 3.)

In no case shall the vent serving gas burning equipment be smaller in size than the draft hood outlet.

“O” zero lateral “L” applies only to a straight vertical vent attached to a top outlet draft hood.

Designation “NR” in tables 1, 2, and 3 in part 1345.0510, subparts 1, 2, and 3 indicates not recommended.

Number followed by an asterisk in tables 2 and 3 in part 1345.0510, subparts 1, 2, and 3 indicates the possibility of continuous condensation, due to the flue gas temperature falling below the dew point temperature at some point in the vent or chimney.

Subp. 3. Diagrams of multiple appliance vents.

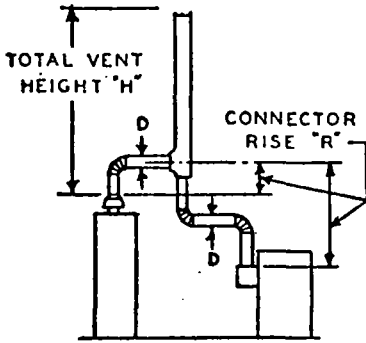


Figure 3

Double-Wall or Asbestos Cement Type B Vents or Single-Wall Metal Vents Serving Two or More Appliances. (See the tables in part 1345.0510, subparts 4, 5, and 6.)

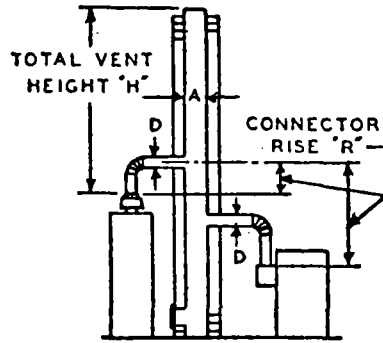


Figure 4

Masonry Chimney Serving Two or More Appliances. (See the table in part 1345.0510, subpart 7.)

Subp. 4. Notes for multiple appliance vents. See tables 4, 5, and 6 in part 1345.0510, subparts 4 to 7.

Maximum vent connector length one and one-half feet for every inch of connector diameter. Greater lengths require increase in size, rise or total vent height, to obtain full capacity.

Each 90 degree turn in excess of the first two reduces the connector capacity by ten percent.

Each 90 degree turn in the common vent reduces capacity fo ten percent.

Where possible, locate vent closer to or directly over smaller appliance connector.

Connectors must be equal to or larger than draft hood outlets.

If both connectors are same size, common vent must be at least one size larger, regardless of tabulated capacity.

Common vent must be equal to or larger than largest connector.

Interconnection fittings must be same size as common vent.

Use sea level input rating when calculating vent size for high altitude installation.

Designation "NR" in tables 4, 5, and 6 in part 1345.0510, subparts 4 to 7 indicates not recommended.

Statutory Authority: *MS s 16B.59 to 16B.73*

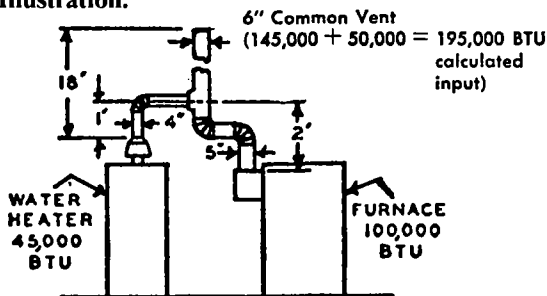
1345.0530 EXAMPLE OF MULTIPLE-VENT DESIGN; DOUBLE-WALL TYPE B VENT.Subpart 1. **Illustration.**

Figure 5

Example: Connect a 45,000 BTU water heater with a one foot connector rise "R" and a 100,000 BTU furnace with a two foot connector rise "R" to a common vent with a minimum total vent height "H" of 18 feet. See figure 5.

Subp. 2. **Water heater vent connector size.** Using table 4 in part 1345.0510, subpart 4, read down total vent height "H" column to 15 feet and read across one foot connector rise "R" line to BTU rating equal to or higher than water heater input rating. This figure shows 53,000 BTU and is in the column for four inch connector. Since this is in excess of the water heater input, it is not necessary to find the maximum input for an 18 foot minimum total vent height. Use a four inch connector.

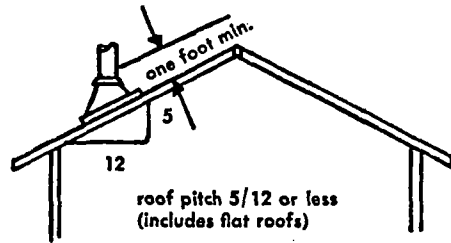
Subp. 3. **Furnace vent connector size.** Under vent connector tables read down total vent height "H" column to 15 foot and read across two foot connector rise "R" line. Note five inch vent size shows 99,000 BTU per hour or less than furnace input. However, with 20 foot total height read across two foot connector rise line. Note five inch vent size shows 104,000 BTU per hour. Since 18 foot height is three-fifths of difference between 15 and 20 foot heights take difference between 99,000 and 104,000 or 5,000 and add three-fifths of this to 15 foot figure of 99,000, $99,000 + 3,000 = 102,000$ which is maximum input for 18 foot total vent height. Therefore a five inch connector would be the correct size for the furnace, providing the furnace had a five inch or smaller draft hood outlet.

Subp. 4. **Common vent size.** Adding 50,000 BTU to the input of 45,000 BTU for the water heater and 100,000 BTU input for the furnace gives a total calculated input to the common vent of 195,000 BTUs.

Note that for 15 foot total vent height "H" maximum BTU input for six inch vent is 206,000. Therefore the common vent must be six inch.

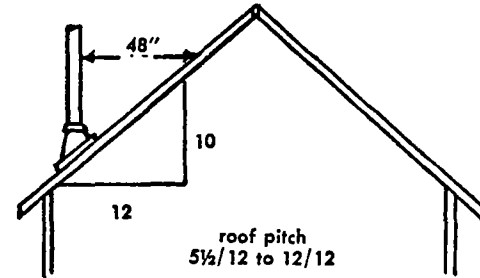
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Statutory Authority: MS s 16B.59 to 16B.73



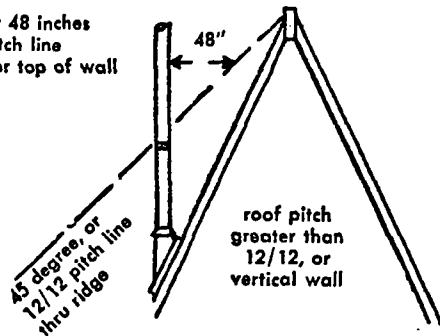
A ROOF PITCH 5'/12' (22½°) OR LESS.
Maintain minimum clearance of 12 inches as illustrated.

horizontally
48 inches to roof

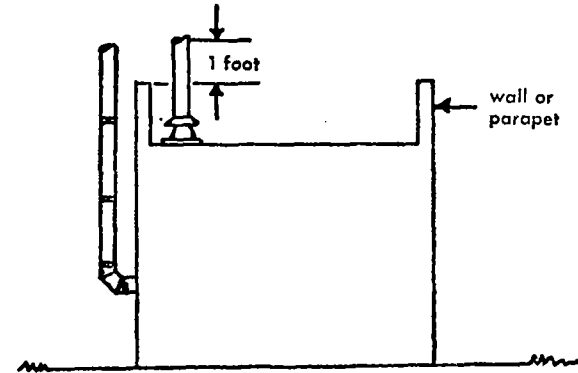


B ROOF PITCH 5½'/12' AND UP TO 12'/12' (45°)
Maintain 48 inches horizontal distance from lowest top opening and roof surface.

horizontally 48 inches
to 12/12 pitch line
thru ridge or top of wall



C ROOF PITCH GREATER THAN 12'/12'
Maintain 48 inches distance from 45° pitch line through roof ridge.



D VENT WITHIN 30 INCHES OF VERTICAL WALL, parapet, or roof ridge. Top should be located one foot above wall or ridge.

Figure 6

WARM AIR HEATING

1345.0540 GENERAL.

For fundamental and basic design data and information see parts 1345.0200 to 1345.0360. Warm air heating systems are generally classified as gravity warm air and forced or mechanical warm air. This code will deal primarily with the design and installation of mechanical warm air heating systems. Gravity warm air heating systems reference should be made to "Gravity Code and Manual for the Design and Installation of Gravity Warm Air Heating Systems" published by the National Warm Air Heating and Air Conditioning Association in Manual 5.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0550 DEFINITIONS.

Subpart 1. **Scope.** For the purpose of this code, the following terms shall have the meanings given them.

Subp. 2. **Mechanical warm air heating plant.** "Mechanical warm air heating plant" means one or more warm air furnaces enclosed within casings, together with necessary appurtenances thereto, consisting of warm air supply pipes and fittings, cold air or recirculating pipes, ducts, boxes and fittings, smoke pipes, dampers and registers, grilles, fans, or blowers, the same being intended for heating the buildings in which they may be installed. The circulation of air within such a system shall be dependent upon the motive power furnished by a fan or blower, and the duct work in connection therewith shall be designed especially for such system. However, the incorporation of a booster fan, blower, or any power driven device for the purpose of accelerating the air circulation in a gravity warm air heating plant shall be construed as changing the classification of such gravity system to a mechanical system.

The incorporation of an air washer, filters, humidifier, cooling coils, automatic controls, or other devices shall not be construed as changing the classification of such a system unless by incorporation of some one or more of the above-mentioned devices such system fulfills the requirements of one of the classifications immediately following.

Subp. 3. **Warm air all-year air conditioning system.** "Warm air all-year air conditioning system" includes a mechanical warm-air heating plant, such as hereinbefore defined, together with such other devices and such automatic controls as will secure the simultaneous control of the temperature, motion, humidity, and a reduction in the dust and odor content, of the air employed in the ventilation of rooms. This includes both warming and humidifying in winter and cooling and dehumidifying in summer.

Subp. 4. **Warm air winter air conditioning system.** "Warm air winter air conditioning system" includes a mechanical warm air heating plant, such as hereinbefore defined, together with such other devices and such automatic controls as will secure the simultaneous control of the temperature, motion, humidity, and a reduction in the dust and odor content, of the air employed in the ventilation of rooms, but not provided with such devices and automatic controls as will provide for cooling and dehumidifying in summer.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0560 AMOUNT OF AIR CIRCULATED.

The amount of air to be provided for each room or space to be heated or conditioned shall be not less than that determined in the following manner:

A. Calculate the heat loss, in Btu per hour, for each room or space to be heated, as set forth in parts 1345.0200 to 1345.0360.

B. Calculate the volume of air to be circulated to each room or space to be heated, using the formula:

$$Q = \frac{H}{68.7}$$

where:

Q = volume of air in cubic feet per minute.

H = calculated heat loss in Btu per hour.

68.7 = a constant based on supply air temperature of 135 degrees Fahrenheit and return air temperature of 65 degrees Fahrenheit.

The above formula is based on actual Btu per hour heat loss plus ten percent safety factor.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0570 DUCT DESIGN.

Ducts may either be round or rectangular. Rectangular ducts should be as nearly square as possible. Aspect ratios greater than eight to one shall not be exceeded and where possible, a ratio of four to one or less should be maintained. The radii of elbows shall be not less than one-half the pipe diameter, for round pipes, or the equivalent round pipe size in the case of rectangular ducts. However, in old buildings, where strict compliance with the foregoing provisions in regard to the elbows would be impracticable, special permission may be granted for deviations.

The ducts or piping may be designed either as a trunk line system or as a system of individual ducts from the furnace to each register. Individual ducts may be grouped to simulate a trunk duct system in appearance.

Calculate the sizes of all main and branch ducts by either of the following methods:

A. Velocity method: Arbitrarily fix the velocity in the various sections, reducing the velocity from the point of leaving the fan to the point of discharge to the room. In this case the pressure loss of each section of the duct is calculated separately and the total loss is found by adding together the losses of the various sections.

B. Friction pressure loss method: Proportion the duct for equal friction pressure loss per foot of length.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0580 TOTAL RESISTANCE DETERMINED.

Calculate the friction of the duct, both supply and return, which offers the greatest resistance to the flow of air. This shall include the resistance of all elbows or other fittings, registers, and air inlet. Add to this the resistance of filters, air washer, furnace, or other devices located in the air stream. The result, plus a ten percent factor of safety, will be the total resistance of the system, which shall be used in the selection of the fan or blower.

Friction losses for ducts and fittings shall be determined in accordance with the best engineering practices. Resistance of furnace, filters, air washers, cooling coils, and other devices shall be taken from the various manufacturers' ratings certified as to correctness.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0590 MAXIMUM ALLOWABLE VELOCITIES.

The air velocities, in feet per minute, shall not be exceeded in the various types of installations to which they apply. (See part 1345.1800.)

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0600 DAMPERS.

In an individual duct system, such duct shall be provided with a volume damper with substantial mounting and positive locking device.

In a trunk system, each branch duct shall be provided with a splitter damper where it leaves the main trunk duct, and with additional splitter dampers if again divided, or branch duct be provided with a volume damper. In finished or inaccessible areas in lieu of splitter or branch volume dampers, a friction-type register box damper may be used. Where main duct branches into two or more trunks leaving fan, each trunk shall be provided with volume or squeeze damper to regulate air volume in each trunk. All dampers shall be provided with positive locking devices.

Warm air supply ducts shall not be installed for the purpose of heating attached private garages from any forced air system serving habitable areas.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0610 SUPPLY AIR REGISTERS.

All supply registers shall be securely fastened to connecting pipe and shall be effectively sealed against leakage around the borders or margins to prevent streaking of walls. The supply outlet size and its pressure loss should be selected from the manufacturers' engineering data.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0620 RETURN AIR REGISTERS.

Return air registers shall be made of metal, plastic, or wood. The free area shall be at least equal to the free area of the duct or ducts to which they are connected.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0630 CONSTRUCTION OF DUCTS.

In connection with any mechanical warm air heating or air conditioning system, the construction of all sheet metal duct work hereafter installed shall be in accordance with parts 1345.1560 and 1345.1570.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0640 UNDERGROUND DUCT CONSTRUCTION AND INSTALLATION.

Underground duct installation for warm air heating system shall be in accordance with parts 1345.1580 to 1345.1640.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0650 SIZE OF FURNACE.

Add together the hourly Btu heat losses of the various rooms of the building or space to be heated, as determined by the calculated requirements set forth in parts 1345.0200 to 1345.0360. For continuously heated buildings, install a furnace with a capacity or register delivery not less than that determined. For intermittently heated buildings, add from 25 to 150 percent of the net calculated heat loss.

Hand-fired furnaces, converted to gas, oil, or stoker firing and having a ratio of heating surface to grate area greater than 15 to one, register delivery equals $2,265 \times S$.

Hand-fired furnaces with ratios of heating surface to grate area greater than 15 to one and less than 25 to one, register delivery equals $2265 \times S$.

Hand-fired furnaces, with ratios of heating surface to grate area in excess of 25 to one, register delivery equals $2,265 \times 25 \times G$

where:

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Register delivery is in terms of Btu per hour.

S = Heating surface in square feet.

G = Actual grate area in square feet.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0660 GAS, OIL, ELECTRIC, OR STOKER FIRED FURNACES.

The register delivery or net output rating expressed in Btu per hour/of an automatically fired furnace designed for the exclusive use of but one fuel shall be determined by means of the following:

A. For gas-fired forced air furnaces the register delivery shall be 0.65 times the input in Btu per hour.

B. For gas-fired unit heaters the register delivery shall be 0.75 times the input in Btu per hour.

C. For oil-fired forced air furnaces the register delivery shall be 2,265 times the heating surface in square feet.

D. For stoker-fired forced air furnaces, the register delivery shall be 2,265 times the heating surface in square feet.

E. For electric forced air furnaces the register delivery shall be 0.85 times the input in Btu per hour.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0670 FURNACE FOUNDATIONS.

Furnace foundations of brick, cement, or other incombustible material shall be provided.

Where it is necessary to place a furnace on a combustible floor, not less than four inches of hollow tiles shall be used, having joints matched in such a way that air passage will be free from side to side. Such foundation shall be constructed upon and covered with continuous sheet metal plates, of weight not less than 24 U.S. Standard gauge metal, having all joints riveted or double seamed and the bottom of the sheet to have all edges turned up at least one inch. This floor covering shall extend under the whole of the fire box of the furnace and outwardly not less than 12 inches on all sides and rear of casing, or base ring, and 36 inches in front.

Warm air furnaces manufactured and with underwriters approval for mounting directly on combustible materials are approved for such installations.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0680 SMOKE PIPES.

Smoke pipes shall be constructed and installed in accordance with provisions of parts 1345.0400 to 1345.0530.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0690 BASIC CONTROLS.

Mechanical warm air heating and air conditioning systems shall be equipped with automatic controls capable of performing at least the following minimum functions:

A. For oil-fired furnaces, at least three controls shall be employed as follows: Control No. 1 will stop the burner when the room temperature is too high and No. 2 will stop the burner when the temperature of the air in the plenum chamber or main duct exceeds the setting of control No. 2. Both temperatures must be below their respective settings to start the burner. Control No. 3 responds to the flame temperature and in conjunction with the control switch acts as a safety to stop the burner if the latter fails to ignite or burn properly as demanded by controls No. 1 and 2.

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B. Gas-fired furnace shall employ controls No. 1 and No. 2 as for oil-fired furnaces. Either a thermostatic pilot, so constructed and adjusted that no gas can flow through the main burner unless the pilot flame is burning, or some other type of safety device serving this same end shall be employed. The operation of this safety device shall not depend on the closing of an electrical circuit to shut off the main gas supply. A gas pressure regulator shall be installed in accordance with parts 1345.2150 to 1345.2440.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0700 NOISE ELIMINATION.

In residential installations the fan or blower housing shall not be directly connected with metal, either to the furnace casing or to the return air piping. Canvas strips may be used in making these connections. Motors shall be mounted in such a way that vibration will not be transmitted to duct work or equipment.

Electrical conduit and water piping shall not be fastened to, nor make contact with, fan housing.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0710 WARM AIR FURNACE STANDARDS.

Subpart 1. **Gas-fired furnaces.** All gas-fired furnaces shall be rated in accordance with the American Standard Approval Requirements for Central Heating Gas Appliances, Vol. II, Gravity and Forced Air Central Furnaces, ANSI Z21-47 and ANSI Z21-47a. All gravity furnaces approved by the American Gas Association under these requirements are assigned a rating based on 75 percent efficiency and forced air furnaces are assigned a rating based on 80 percent efficiency.

Subp. 2. **Oil-fired furnaces.** Oil-fired furnaces equipped with pressure atomizing or rotary burners shall be rated in accordance with Commercial Standard 195. Furnaces equipped with pot-type oil burners should be rated in accordance with Commercial Standards 104. Oil-burning floor furnaces should be rated in accordance with Commercial Standard 113. Oil furnaces which come as complete packages, including the burner and control equipment, shall be identified as follows:

A. Pressure-type or rotary burners included as a part of the package should bear the Underwriters Laboratories label showing compliance with UL 296 and Commercial Standard Label CS 75.

B. The complete furnace should bear the UL 727 label and so listed. It may also be certified by the manufacturers as complying with Commercial Standard 195.

C. Vaporizing burner furnaces should also be listed under UL 727 and CS 104.

Statutory Authority: *MS s 16B.59 to 16B.73*

STEAM AND LIQUID SYSTEMS

1345.0720 SCOPE.

Parts 1345.0720 to 1345.1330 of the code shall include work done and materials used in the installation of all boilers, piping, apparatus, and appurtenances proper to steam and hot water heating and chilled water cooling; steam piping systems, and liquid piping systems including control piping and the alterations to such systems.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0730 DEFINITIONS.

Subpart 1. **Accessible installation.** "Accessible installation" means to be accessible, such as exposed in shafts, tunnels, or concealed by readily removable enclosing construction.

Subp. 2. **Alteration.** "Alteration" means changes, replacements, additions, or removal of components of a system with resulting significant effect on the performance of the system or its parts.

Subp. 3. **ASHRAE.** "ASHRAE" refers to the American Society of Heating, Refrigeration, and Air Conditioning Engineers.

Subp. 4. **ASME.** "ASME" refers to the American Society of Mechanical Engineers.

Subp. 5. **ASTM.** "ASTM" refers to the American Society of Testing Materials.

Subp. 6. **Blowoff.** "Blowoff" is a connection to a boiler or other device for the purpose of the blowdown of scale, sludge, etc.

Subp. 7. **Capillary brazing.** "Capillary brazing" refers to the joining of tube and socket designed fittings, with proper tolerances, for the capillary attraction of a brazing alloy above 1,000 degrees Fahrenheit melting temperature.

Subp. 8. **Convertor.** "Convertor" means a device which transfers heat from one gas or liquid to another gas or liquid wherein there is no direct contact between the two gases or liquids.

Subp. 9. **Cooling piping and equipment.** The term "cooling piping and equipment" shall include all piping and equipment containing water or other liquid and designed and installed for the purpose of cooling in connection with any air conditioning or other process but shall include cooling piping and equipment in which a refrigerant is used.

Subp. 10. **District heating or cooling.** "District heating or cooling" refers to the supply of heat or cooling from a central plant to a group of buildings.

Subp. 11. **Drain connection.** "Drain connection" is the connection for emptying a boiler or system.

Subp. 12. **FS.** "FS" refers to Federal Specifications.

Subp. 13. **Heat exchanger.** "Heat exchanger": see "convertor."

Subp. 14. **Inaccessible installation.** "Inaccessible installation" refers to those sections of piping systems installed in walls, floors, ceilings, and other areas where access cannot be made without the removal of permanent construction.

Subp. 15. **Interface.** "Interface" means the surface that lies between two dissimilar parts of matter or space forming their common boundary.

Subp. 16. **Liquid piping system.** "Liquid piping system" shall mean a system in which water or other liquid is used as the medium by which heat is carried through pipes from the supply source to or from the heating or cooling units.

Subp. 17. **May.** "May" means optional.

Subp. 18. **Multiple dwelling system.** The term "multiple dwelling" refers to those heating systems serving three or more living units from the same source.

Subp. 19. **Permanent.** "Permanent" means lasting or intended to last.

Subp. 20. **Shall.** "Shall" means mandatory.

Subp. 21. **Steam heating system.** "Steam heating system" shall mean a heating system in which heat is transferred from a source of steam to steam heating units at, above or below atmospheric pressure.

Subp. 22. **Steam piping system.** "Steam piping system" shall mean a system in which steam is transferred from a source to a steam utilizing device at, above or below atmospheric pressure for a purpose other than for heating a building or other structure.

Subp. 23. **Temperature.** "Temperature": all references to temperatures are for Fahrenheit scale.

Subp. 24. **Underground.** "Underground" installations shall include those pipes buried in slabs embedded in concrete or masonry materials all below ground.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0740 BOILERS.

Subpart 1. **Construction.** All boilers shall be constructed in accordance with section IV of the current edition of the ASME Boiler and Pressure Vessel Code, or the Power Boiler Code, section I.

Subp. 2. **Capacity.** Heating boilers shall be selected commensurate with the gross load imposed on the boiler. The general factors to be considered are as follows:

A. **Radiation load:** the estimated heat emission in Btu of the connected radiation and such heat emission shall at least equal the calculated heat loss of the space to be heated. See parts 1345.0200 to 1345.0360.

B. **Hot water supply load:** the estimated maximum heat in Btu required to heat water for purposes other than space heating.

C. **Piping loss load:** the estimated heat emission in Btu from the piping which connects the radiation to the boiler.

D. **Pickup allowance:** the estimated increase in the normal load in Btu caused by the heating up of the cold system.

Items A and B constitute what is known as the "net load."

The boiler capacity to be installed shall be as published by the Institute of Boiler and Radiator Manufacturers, the Steel Boiler Institute, or the Mechanical Contractors Association of America.

In the determination of boiler capacity, consideration shall be given to conditions which could give rise to special problems of piping loss and pick up load. Also, the possibility of efficiencies other than the 80 percent usually credited to automatically fired boilers must be taken into account.

In the case of electric heat boilers, the efficiency can be taken as 100 percent but the piping loss load and pick up allowance shall be considered the same as for boilers using fossil fuels.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0750 SYSTEM DESIGN.

System design features and the sizing of steam, hot and chilled water and/or liquid piping systems shall be consistent with the practices presented in the American Society of Heating, Refrigeration, and Air Conditioning Guide, copies of which are on file in the Department of Administration.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0760 MANUFACTURER'S RECOMMENDATION.

All equipment and materials shall be installed in accordance with the manufacturer's recommendation, subject to the approval of the administrative authority. However, in the case of conflict between a manufacturer's recommendation and the limitations or provisions of this code, this code shall supersede.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0770 MATERIAL STANDARDS.

The material standards listed in part 1345.1220 shall conform at least to the standards cited, when used within the scope of this code for the construction, installation, alteration, or repair of any part of a system.

Insofar as is the custom or practice of manufacturers, all materials must be marked and suitably identified so as to provide a visual means of identification as to types, grades, weights, and strengths. This shall be accomplished as part of the manufacturing process.

The installer will position the above identification marks so as to provide the easiest inspection by the administrative authority within the limits of practicability.

All materials should be handled carefully so as to avoid damage. No defective or damaged materials, equipment, nor apparatus shall be knowingly installed.

In using the materials approved, provisions of part 1345.0790 in joints and connections shall be strictly observed.

The manufacturers working pressure rating of all system components shall be in excess of the highest operating pressure at any point in the system.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0780 APPLICATION OF MATERIALS; ACCESSIBLE INSTALLATION.

All materials in part 1345.1220 may be installed with the limits of standard engineering practices and with strict accordance with part 1345.0790 on joints and connections for accessible installation.

The application of plastic pipe is further limited to 120 degrees Fahrenheit maximum temperature.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0790 APPLICATION OF MATERIALS; INACCESSIBLE INSTALLATIONS.

The following limitations are placed on materials in part 1345.1220 when used for inaccessible installations:

A. No cast brass or bronze fittings are permitted if capillary brazing is the joining method.

B. The minimum copper tube allowed is type L except that type M may be used in wood frame construction. Type M shall not be used in steam systems.

C. No plastic pipe is permitted in any system operating in excess of 120 degrees Fahrenheit.

D. Unions, valves, and flare or compression connections are not permitted.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0800 JOINTS AND CONNECTIONS.

Subpart 1. **General.** All joints and connections shall be gas or watertight to the strength standards of the particular type of joint or connection employed. The types of approved connections are as follows.

Subp. 2. **Threaded connections.** Threaded connections shall conform to the American National Taper Pipe Thread ASA B-21 or FS GGG-P-351a. All burrs are to be removed. Pipe shall be reamed. Pipe joint compound shall be used on male thread only.

Subp. 3. **Soldered connections.** Soldered connections shall be thoroughly cleaned and fluxed with noncorrosive flux. Soft solder used for joints shall have a nominal composition of 50 percent tin and 50 percent lead for piping not to exceed 160 degrees Fahrenheit, a nominal composition of 95 percent tin and 5

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percent antimony for piping not to exceed 250 degrees Fahrenheit and conforming to ASTM Standard B-32.

Subp. 4. **Capillary brazed connections.** Capillary brazed connections shall be thoroughly cleaned and fluxed with a suitable flux. Brazing material shall conform to ASTM Standard for filler metal B-260.

Subp. 5. **Flared connections.** Flared connections for soft copper tubing shall be made with fittings meeting ASA Standards. The tubing shall be reamed and expanded with proper flaring tools.

Subp. 6. **Flareless connections.** Flareless connections for soft copper tubing shall be made with fittings meeting ASA Standards. When a bite-type fitting is used, the joint shall first be made up tight, then disassembled to make sure the depth of "bite" is adequate and then reassembled.

Subp. 7. **Expansion joints.** Expansion joints shall be of an approved type, installed in accordance with the manufacturer's recommendations. Every expansion joint, other than an expansion loop, shall be accessible. Anchors and guides shall be provided as necessary to prevent undue strain or deflection on piping systems or building structures.

Subp. 8. **Welded connections.** The welding procedure shall be such as to assure substantially full root penetration and thorough fusion of the deposited metal with the base metal.

Subp. 9. **Competency of welder.** The administrative authority reserves the right to question the competency of a welder for any welded connections made in the installation of all piping systems. In case of a disagreement as to the competency of the welder, tests may be requested by the administrative authority and the costs for such testing to be borne by the contractor; or at the contractor's option, a certificate of proficiency from a recognized testing agency attesting to the skill of the welder may be required as an alternate to such tests.

This subpart shall not relieve the requirements for certified welding where otherwise required by code.

Subp. 10. **Bending pipe.** The bending of pipe or tube is permissible provided that no kinks or excessive flattening of the pipe or tube results. Such bending must be done under a controlled process and minimum bending radii in accordance with subpart 11.

Subp. 11. **Table 1: minimum bending radii and tangent.**

Nominal pipe size in inches	Standard wall and heavier Min. bending radii in inches	Minimum tangents for pulling and holding plain or beveled end in inches
1	5	6
1-1/4	6-1/4	6
1-1/2	7-1/2	6
2	10	6
2-1/2	12-1/2	8
3	15	8
4	20	10

Note: The radius is measured to the center line of the pipe.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0810 UNDERGROUND.

Subpart 1. **No threaded joints.** Where piping is run underground or embedded in concrete or masonry, no threaded joints shall be used except as in subpart 5. Where solder joint fittings are used, for nonferrous piping the capillary brazing alloys shall be used. Underground piping shall not be placed on nor covered with fill containing cinders.

Subp. 2. **Complete embedding, support.** Piping embedded underground as defined in this code shall be embedded completely and shall not rest on an interface. Supports for positioning the piping should be nonabsorbent and inorganic. Reinforcing steel, angle iron, pieces of pipe, or stone or concrete mounds may be used. No wood, brick, concrete block, or similar materials shall be used for support of the piping.

Subp. 3. **Embedding in slabs.** Where piping is embedded in structural load supporting slabs, above grade, construction codes may affect their position. In general, their position should not be less than three-quarters of an inch from external face.

Subp. 4. **Protective coating.** Steel and wrought iron pipe joints to be installed in contact with the earth shall be coated with a bituminous enamel, or approval equal, to prevent deterioration of the pipe from external causes.

Subp. 5. **Threaded joints in conduit.** Threaded joints may be used underground if encased in conduit to protect the pipe and/or insulated from external damage; and to provide space in which the pipe is free to expand and contract while held in proper alignment. All joints to be coated with bituminous enamel or approved equal.

Subp. 6. **Type L required.** The minimum copper tube allowable for underground is type L.

Subp. 7. **No cast brass or bronze.** No cast brass or bronze fittings are permitted.

Subp. 8. **Connections.** Connections to be made underground shall be by fusion welding or capillary brazing except as otherwise noted.

Subp. 9. **Test.** All piping shall be subjected to a hydrostatic test of at least 1-1/2 times the design operating pressure, for four hours duration, but not less than 100 psig, witnessed by the administrative authority.

When there is a possibility of freezing, testing may be accomplished by using air to the above prescribed minimum pressure for 24 hours duration.

Subp. 10. **Pipe in concrete.** Where piping enters and exits concrete it shall be surrounded with a compressible material having a minimum thickness of one-half inch and extending a minimum of six inches underground.

Subp. 11. **Insulation.** Piping run underground containing liquids or steam at a greater than 20-degree difference from underground temperature shall be insulated and protected from moisture except for properly designed panel heating and snow melting systems.

Subp. 12. **No plastic pipe.** Plastic pipe shall not be used underground.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0820 ISOLATION OF MAJOR COMPONENTS.

All liquid and steam systems except those serving single- and two-family dwellings shall be provided with a means of isolating the boilers, (except in the case of single steam boilers) with motorized valves, pumps, and other devices subject to repairs, so that such repairs can be made without draining or removing the pressure of the remaining parts of the system. In some cases the isolation of certain loops or risers may fulfill this requirement, subject to the approval of the administrative authority. Union or flanged connections shall be provided for pumps and coils.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0830 PRESSURE RELIEF AND SAFETY VALVE.

Each hot liquid boiler or heat exchanger shall be equipped with a pressure relief valve and each steam boiler with a safety valve. All pressure relief and safety valves shall be rated and installed in accordance with the provisions of the ASME Boiler and Pressure Vessel Code.

Discharge piping from safety and relief valves shall be led to a position such that the danger of scalding any person is minimized, and away from operating controls, thus preventing damage thereto.

Inlet and discharge pipes are to be full size of valve opening and the discharge end shall be reamed and unthreaded.

When manifolding two or more valve discharges, the piping shall be sized so that its area is equivalent to or greater than the combined areas of the discharge openings.

Discharge piping, from safety or relief valve, when rising up shall be provided with a drain opening to prevent the accumulation of condensate at the valve.

The required relieving capacity of the pressure relieving device or devices on a boiler or heat exchanger shall be equal to, or greater than, the maximum output of the boiler or heat exchanger.

To prevent excessive loss of relieving capacity of the discharge piping because of length of pipe, such discharge piping shall be increased in size.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0840 BLOWOFF AND DRAIN PIPING.

The end of the blowoff piping from any boiler or the vent pipe from any blowoff tank shall not terminate in any location where the discharge can endanger the safety of any person or property.

The exhaust, blowoff, or drain from a boiler or heat exchanger shall not connect directly with any sewer, waste, vent pipe, or rain water leader, but may connect indirectly.

All such pipes from a high pressure steam source shall be indirectly connected by discharging into a blowoff tank or condenser as required by the state of Minnesota high pressure steam code.

All such pipes from low pressure steam boilers and hot water boilers rated at 150 horsepower or more shall also discharge into a blowoff tank or condenser as required by the state of Minnesota high pressure steam code.

In a similar manner, all other such pipes which would cause a discharge of steam or water to enter the sewer above 80 degrees for a period of more than ten minutes shall be equipped with a means of lowering the entering temperature below 180 degrees. This provision is not meant to be applied to boilers or heat exchangers which are drained on rare occasions. Drains from pressing machines and similar equipment may waste into an open floor drain.

Any closed condenser or sump shall be provided with a relief vent not less than one pipe size larger than the largest inlet, which relief pipe or vent should be taken off the top, and extend separately full size through the roof.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0850 CONTROLLING DEVICES.

All boilers shall be provided with a minimum of two independently operated controls consisting of an operating control and a high limit control for shutting off fuel supply.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0860 MIXING OF RADIATION.

There should be no intermixing of different types of cast iron radiation or Fintube radiation and coils on a common circuit zone.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0870 LOW WATER CUTOFFS.

Each automatically fired steam boiler shall be equipped with an automatic low water fuel cutoff to automatically cutoff the fuel supply when the surface of the water falls to the lowest safe water level.

Each automatically fired hot water boiler having a rated output in excess of 400 MBH shall be equipped with an automatic low water fuel cutoff to automatically stop the fuel supply when the surface of the water falls not lower than the lowest safe permissible water level established by the boiler manufacturer.

All boilers installed at elevations where all radiation in the system is below the safe boiler water level should be equipped with an automatic low water fuel cutoff to automatically stop the fuel supply when the surface of the water falls not lower than the lowest safe permissible water level established by the boiler manufacturer.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0880 PIPING SUPPORT.

Subpart 1. **General.** All piping shall be securely supported by metal hangers or other approved hangers, so spaced that there will be no sag in piping between points of suspension, and where run on walls shall be securely supported by metal brackets or pipe supports similarly spaced. Supports shall be so arranged that there will be no undue strain on the threads of any pipe or fittings and equipment connected thereto. Contact between pipe and dissimilar metals shall be avoided.

Subp. 2. **Table 2: pipe hanger spacing and size.** The maximum spacing of hangers and minimum hanger rod size for steel and copper pipe two inches and larger shall be as follows:

Nominal pipe size inches	Maximum span feet	Minimum rod diameter inches
3	10	3/8
3	12	1/2
3-1/2	13	1/2
4	14	5/8
5	16	5/8
6	17	3/4
8	19	7/8
10	22	7/8
12	23	7/8

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0890 EXPANSION AND CONTRACTION.

In all piping systems which are subject to expansion and contraction, provision shall be made for adequate anchorage and protection against damage to piping from such expansion and contraction. All risers shall be so anchored and safeguarded that the difference in length, when hot, from the length when cold, shall not disarrange the necessary provisions for drainage of the branches or distort, damage, or displace radiators or other equipment.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0900 CLEARANCE OF PIPING.

Pipes passing through walls, ceilings, floors, or beams shall be provided with clearance or sleeved. When pipes are to be covered, clearance between pipe and sleeve shall accommodate the covering.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0910 TEE CONNECTION.

Bull-headed tee connections should be avoided whenever possible. Whenever such connections cannot be avoided, flow-balancing cocks shall be provided in the split circuits.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0920 REDUCERS.

Change of pipe sizes in horizontal runs shall be by means of eccentric reducers or reducing tees properly oriented to prevent undesirable trapping of air, vapor, steam, or water at the connecting joint.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0930 WATER SUPPLY FILL CONNECTIONS.

Water fill connections to steam boilers shall be independent of any water column connections. Fill connections to all boilers, steam, hot water heating, and chilled water or other liquid systems shall be provided at least with a check valve and a stop valve. Where a system is filled with an antifreeze or toxic solution a permanent tag shall be placed in plain view stating "Caution: this system contains antifreeze/toxic solution. There shall be no permanent direct connection between this system and the potable water supply of the building."

The administrative authority may require the installation of an air gap or an approved double check -- double gate valve assembly with test cocks as protective devices against back flow in connections between a potable water system and other fluid systems which present significant health hazards. The use of automatic fill and pressure-reducing valves on closed or pressure heating or cooling liquid systems is prohibited. However, permission may be obtained from the administrative authority in isolated cases where hardship can be proven.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0940 BOILER FOUNDATIONS.

Each steam or hot water boiler to be installed shall be set level, firm, permanent, and in a manner which will prevent water from accumulating at the base, subject to the approval of the administrative authority.

Boilers to be installed at other elevations than a basement floor shall rest upon concrete, or other fireproof floor construction having no wooden or other combustible finish in close proximity, except those rated for combustion floor installation.

In boiler replacements where floor is not level, or poor quality, or if water may be encountered on floor around boiler base, a concrete base shall be provided in accordance with the weight of the boiler.

In no case shall a boiler be set where the building is not structurally capable of supporting its operating weight.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0950 INSULATION OF PIPES.

Where steam and hot water supply and return piping pass through occupied areas where their heat emission might be hazardous or where such piping is likely to freeze, it shall be properly covered with not less than three-fourths inch of insulation material.

No concealed hot water, steam, or return risers, or branches shall be located in outside walls or exposed portion of any projection of a building unless properly protected with not less than three-fourths inch of approved inorganic noncombustible insulation, or unless space around pipes is properly filled with mineral wool or other approved or equal inorganic noncombustible insulating material.

All distribution piping or fittings for chilled water systems shall be covered continuous throughout with a vapor- or moisture-proof insulation material to prevent condensation.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0960 HOLE CUTTING.

Because of the variables in hole cutting in building joist members, part 1345.1230 is offered as a guide to the installer of piping systems. Further information related to the minimum standards for hole cutting should be requested of administrative authority.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0970 DRAINAGE.

All systems should be arranged within practical limitations so that the entire system can be evacuated, or the liquid removed by other practical means to permit alterations or repairs, or to prevent possible freeze up due to a malfunction of the system. A floor drain should be provided for all boiler and heat exchanger installations.

Statutory Authority: *MS s 16B.59 to 16B.73*

STEAM SYSTEMS

1345.0980 SCOPE.

Parts 1345.0980 to 1345.1080 shall include and govern all work done and materials used in the installation of low-pressure boilers and/or steam piping systems together with their alteration. For high-pressure systems the Minnesota rules for the installation of high-pressure steam piping and appurtenances shall govern.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0981 STEAM SYSTEMS (LOW PRESSURE).

Subpart 1. Design pressure drops. The total pressure drop shall not exceed one-half of the initial pressure when condensate is flowing in the same direction of the steam.

Where condensate must flow counter to the steam, the governing factor is the velocity permissible without interfering with the condensate flow. Part 1345.1270 gives the allowable velocities for given capacities for horizontal pipe at various grades.

Subp. 2. Maximum velocity. Where the quantity of the condensate is limited, and is flowing the same direction as the stream, the velocity shall be in accordance with the pressure drop as shown in part 1345.1260.

When the condensate flows against the steam, even in limited quantity, the velocity of the stream shall not exceed the velocities for given capacities as shown in part 1345.1270.

Subp. 3. Equivalent length of run. The size of pipe required for the flow of steam must allow for the friction offered by the pipe, as well as for the additional resistance of the fittings and valves.

The length of run can be assumed to be double the actual length of pipe. This assumption shall be checked after the pipes are sized.

The resistances of the fittings and valves are stated in terms of straight pipe. Part 1345.1230, subpart 3 gives the number of feet of straight pipe that shall be allowed for the fittings and valves. See part 1345.1230.

Subp. 4. **Tables for pipe sizing low pressure steam systems.** The values in parts 1345.1280 to 1345.1300 shall be used in selecting pipe sizes for the various pressure drops for low pressure steam systems.

Subp. 5. **Sizing piping for one-pipe gravity air vent systems.** One-pipe gravity air vent systems, in which the equivalent length of run does not exceed 200 feet, shall be sized up by means of parts 1345.1280 to 1345.1300.

For the steam main and dripped runouts to risers where the steam and condensate flow in the same direction, use 1/16 psi drop Column D.

Where the riser runouts are not dripped and the steam and condensate flow in opposite directions, and also for the radiator runouts where the condition occurs, use column L.

For up-feed steam risers carrying condensate back from the radiators, use column J.

For down-feed systems, the main risers of which do not carry any radiator condensate, use column H.

For the radiator valve size and stub connection, use column K.

For the dry-return main, use column U.

For the wet-return main, use column T.

For systems exceeding an equivalent length of 200 feet, the total drop shall not exceed one-fourth psi. The return piping sizes shall correspond with the drop used on the steam side of the system. Thus, where 1/24 psi drop is being used, the steam main and dripped run-outs shall be sized from column C; radiator runouts and undripped riser run-outs from column L; up-feed risers from column J; the main riser on a down-feed system from column C (it will be noted that if column H is used, the drop would exceed the limit of 1/24 psi); the dry-return from column R; and the wet-return from column Q.

With a 1/32 psi drop, the sizing would be the same as 1/24 psi, except that the steam main and dripped run-outs would be sized from column B; the main riser on a down-feed system from column C, and the wet-return from column N.

Pitch of mains shall not be less than one-fourth inch in ten feet.

Pitch of horizontal runouts to risers and radiators shall not be less than one-half inch per foot. Where this pitch cannot be obtained, runouts over eight feet in length shall be one size larger than called for in the table.

No supply main less than two inches in diameter shall be used. The diameter of the far end of the supply main shall not be less than half its diameter at its largest part.

Supply mains, run-outs to risers, or risers, should be dripped where necessary.

Where supply mains are decreased in size, they shall be dripped or provided with eccentric couplings flush on bottom.

Subp. 6. **Sizing piping for one-pipe vapor systems.** Piping for one-pipe vapor systems is sized so as to permit only a few ounces pressure drop in the system.

The method follows that outlined in sizing for one-pipe gravity air vent systems.

Subp. 7. **Sizing piping for two-pipe gravity air vent systems.** Piping for two-pipe low pressure systems is sized in the same manner as for two-pipe vapor systems, except that the pressure drop throughout the system can be based on one-half psi to one psi drop.

Subp. 8. **Sizing piping for two-pipe vapor systems.** Small vapor systems when the equivalent length of run does not exceed 200 feet shall be sized by means of parts 1345.1280 to 1345.1300. Main and any runouts to risers that

may be dripped shall be sized for about 1/16 psi drop per 100 feet; use column D. For riser run-outs not dripped and radiator runouts use column I. For up-feed steam risers, use column H. For returns, use column U, the upper portion for mains and the lower portion for risers.

A down-feed system shall be sized as follows: For the main vertical riser, use column H. For down-feed risers, use column D, using 1/16 psi drop.

For vapor systems over 200 feet of equivalent length, the drop shall not exceed one-eighth to one-fourth psi.

For vapor systems with a 400 foot equivalent run, the drop shall not be over 1/32 psi per 100 feet and shall be sized by means of parts 1345.1280 to 1345.1300. For steam mains, use column B. For radiator and undripped riser runouts, use column I. For the risers, use column B. On a down-feed system, column B shall be used for both the main riser and the smaller riser feeding the radiators in order not to increase the drop over 1/32 psi. The return risers from the lower portion of column O and the dry return main from the upper portion of the same column, any wet returns from column N. The same pressure drop is applied on both the supply and return sides of the system.

Pitch of mains shall not be less than one-quarter inch in ten feet.

Pitch of horizontal runouts to risers and radiators shall not be less than one-half inch per foot. Where this pitch cannot be obtained, runouts over eight feet in length shall be one size larger than called for in the table.

No supply main less than two inches in diameter shall be used.

Supply mains, supply risers, or run-outs to supply risers shall be dripped separately into a wet-return or may be connected into the dry-return through a thermostatic drip trap.

Subp. 9. Sizing piping for two-pipe vacuum systems. Vacuum, atmospheric, subatmospheric, and orifice systems are usually employed in large installations and have total drops varying from one-fourth to one-half psi.

Systems in which the maximum equivalent length does not exceed 200 feet, usually are designed for the one-fourth psi pressure drop.

Systems in which the maximum equivalent length exceeds 200 feet, usually are designed for higher drop (one-half psi), owing to the relatively greater swing in pipe sizes.

For example, a system with 1,200 feet longest equivalent length of run would be designed for a pressure drop per 100 feet of one-half psi divided by 12, or 1/24 psi. The piping would then be sized by means of parts 1345.1280 to 1345.1300. For the steam main, use column C. For the risers, use column C (column H could be used as far as critical velocity is concerned, but the drop would exceed the limit of 1/24 psi). Riser runouts, if dripped, use column C. Riser run-outs, undripped, use column I. Pipe sizes for other parts would be obtained as follows: radiator runouts, column I; return risers from lower part of column B; return runouts to radiators -- one-pipe size larger than the radiator trap connection.

Pitch of mains shall not be less than one-fourth inch in ten feet.

Pitch of horizontal runouts to risers and radiators shall not be less than one-half inch per foot. Where this pitch cannot be obtained, run-outs over eight feet in length should be one size larger than called for in the table.

When necessary, the supply mains, supply riser or runout to a supply riser shall be dripped separately through a trap into the vacuum return. A connection shall not be made between the steam and return sides of a vacuum system without interposing a trap to prevent the steam from entering the return line.

Lifts should be avoided, if possible; but when they cannot be eliminated, they shall be made in the manner described in ASHRAE Guide and Data Book, Applications, chapter 92.

No lifts can be used in orifice and atmospheric systems.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.0990 CLASSIFICATIONS.

Steam heating systems shall be classified according to any one of, or combination of, the following features: piping arrangement, pressure or vacuum conditions, and method of returning condensate to boiler.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1000 DEFINITIONS.

Subpart 1. **Scope.** The following terms are defined as follows.

Subp. 2. **Down-feed or overhead systems.** "Down-feed or overhead systems" are those in which supply mains are above the level of the radiation which they serve.

Subp. 3. **Drip.** "Drip" means a pipe (or a steam trap and a pipe considered as a unit) which conducts condensation from the supply side to the return side of a steam heating system.

Subp. 4. **Dry returns.** "Dry returns" are those returns through which both water and air are being passed.

Subp. 5. **Equivalent length of run.** "Equivalent length of run" means the actual distance in feet from source of steam supply, boiler, or pressure reducing valve, to the farthest radiator in system, and then back along return line to boiler or mechanical return device, plus resistances of all fittings and valves as expressed in terms of straight pipe.

Subp. 6. **Gravity low-pressure steam heating system.** "Gravity low-pressure steam heating system" means one in which the condensate is returned to the boiler by gravity due to the static head of water in the return mains. The elevation of the boiler water line must consequently be sufficiently below the lowest heating units and steam main and dry return mains to permit the return of condensate by gravity. The water line difference must be sufficient to overcome the maximum pressure drop in the system and the operating pressure of the boiler when radiator and drip traps are used as in two-pipe vapor systems. This applies only to closed circuit systems, where the condensation is returned to the boiler. If the condensation is wasted, no water line difference is required.

Subp. 7. **Hartford connection.** "Hartford connection" means a method of connecting pipe and pipe fittings in the bleeder or equalizer line between the steam and return headers of a boiler. The connection into the bleeder or equalizer line is made at a height which prevents the boiler water level from lowering dangerously below the normal level as a result of backward flow into the return mains.

Essentially, the Hartford connection is an inverted seal in which one or more returns are brought together below the water line, carried up and tied into the balance equalizing pipe from the header at a point just below the water line. The center line of the shoulder nipple is located at a point two to four inches below the normal water line, depending upon the size of the return main or return header.

Subp. 8. **Low-pressure steam.** "Low-pressure steam" means steam at pressures not in excess of 15 pounds above atmospheric pressure.

Subp. 9. **Mechanical return low-pressure steam heating system.** "Mechanical return low-pressure steam heating system" means one in which the condensate flows to a receiver and is then forced into the boiler against the boiler pressure. The lowest parts of the supply side of the system must be kept sufficiently above the water line of the receiver to insure adequate drainage of water from the system, but the relative elevation of the boiler water line is

unimportant in such cases except that the discharge head on the mechanical return device becomes greater as the height of the boiler water line above the pump increases.

There are three general types of mechanical returns in common use, namely, the mechanical return trap, the condensation return pump, and the vacuum return pump.

Subp. 10. **One-pipe systems.** "One-pipe systems" are those in which the flow of the steam supply to the radiation and the return of condensation flow are in opposition to each other.

Subp. 11. **Supply service mains.** "Supply service mains" are those pipes through which the steam flows from the boiler or pressure-reducing valve and to which the radiator supply branches are connected. "Return service mains" are those pipes which carry condensate to the boiler or mechanical return device, and to which the radiator return branches are connected.

Subp. 12. **Transmission mains.** "Transmission mains" are those pipes which, though not actually a part of the heating system proper, are connected to the service mains of the system and act as sources of supply to same.

Subp. 13. **Two-pipe systems.** "Two-pipe systems" are those in which one pipe is used for the supply of steam to the radiator and another for the return of condensation.

Subp. 14. **Up-feed systems.** "Up-feed systems" are those in which the supply mains are below the level of the radiation which they serve.

Subp. 15. **Vacuum returns.** "Vacuum returns" are those returns through which both water and air are being passed and upon which a vacuum is maintained at all times through the medium of a vacuum producer.

Subp. 16. **Wet returns.** "Wet returns" are those returns through which water only is being passed.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1010 BOILERS.

See part 1345.0730. In the determination of boiler capacity to be installed in boiler replacements the actual total connected load shall be counted and the Btu heat loss calculated. The greater of these calculations shall be used for boiler capacity to be installed.

Note: Due to firing rate and steam capacity of modern boilers in order to prevent early low water shutdown because of loss of water in boiler and retention of condensate in system, gravity system boiler replacements, where large mains and risers exist, (three inches and over) should be looked at individually for the possibility of having to convert the system to a mechanical return pump system or sizing the boiler capacity commensurate with piping losses and connected load.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1020 STEAM SUPPLY FROM HIGH PRESSURE BOILERS.

Subpart 1. **Capacity.** In every case where steam supply for a low-pressure heating plant is taken from a high-pressure boiler or boilers from which steam may or may not be furnished for other purposes, the capacity of such boiler or boilers shall be adequate to meet the demand to be placed upon them under peak load conditions.

Subp. 2. **Reducing valve.** A proper reducing valve or valves capable of maintaining a reduced pressure not to exceed 15 pounds per square inch on the heating system shall be installed between said high-pressure boiler or boilers and the heating system.

Subp. 3. **Steam safety valve.** A steam safety valve set at not to exceed 15 pounds per square inch shall be installed and vented to the atmosphere on the low-pressure side, and discharged at a point that will not jeopardize persons or property.

Subp. 4. **Capacity of safety valve.** The safety valve and discharge piping shall be of sufficient capacity and shall be set to relieve the entire output in the event of failure of the pressure-reducing valve or valves.

Subp. 5. **Pressure gauge.** A pressure gauge calibrated to 1-1/2 times the maximum low pressure shall be installed on the low-pressure side immediately adjacent to the reducing station.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1030 BOILER CONNECTIONS.

Subpart 1. **Headers.** Steam boiler outlets or inlets shall not be bushed. Steam boilers with multiple outlets shall have not less than two outlets connected to a header or service main, or connected in accordance with the boiler manufacturer's recommendation.

For steam boiler installations the header shall be sized in accordance with the system pressure drop and the gross rating of the boiler or boilers.

In standby boiler installations the header shall be sized in accordance with the capacity of a single boiler.

Subp. 2. **Equalizer pipe.** All steam boilers used in connection with systems having gravity returns shall be provided with a Hartford return connection. In no case will the bottom of the return connection to the equalizer pipe be lower than the safe low water level of the boiler. A scale pocket not less than one inch in size shall be provided at the bottom of the return loop connection.

The size of the equalizer pipe is based upon the grate area for hand-fired boilers as follows: 1-1/2 inch for boilers having a grate area of less than four square feet, 2-1/2 inches for boilers having a grate area of from four to 14.9 square feet, or four inches for boilers having a grate area of from 15 square feet and over.

The size of the equalizer pipe is based upon the boiler gross output for automatically fired boilers as follows: 1-1/2 inch for boilers with a gross output of 250 pounds per hour or less, 2-1/2 inches for boilers with a gross output of from 251 to 2,000 pounds per hour, or four inches for boilers with a gross output of more than 2,000 pounds per hour.

Subp. 3. **Blowoff pipe connection.** Each steam boiler shall have a blowoff pipe connection fitted with a steam service type valve or cock not less than three-quarters of an inch pipe size connected with the lowest water space practicable or not less than size of tapping provided by boiler manufacturer for this purpose, or in accordance with the following capacities: 500 pounds per hour, three-quarters of an inch; 501 to 1,250 pounds per hour, one inch; 1,250 to 2,500 pounds per hour, 1-1/4 inch; 2,501 to 6,000 pounds per hour, 1-1/2 inch; 6,000 pounds per hour and larger, two inches.

Subp. 4. **Steam gauge.** Each steam boiler shall have a steam gauge connected to its steam chamber or water column by means of a siphon or equivalent device. The dial shall be calibrated to 1-1/2 to two times the safety valve setting.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1040 BOILER FEED PUMPS, VACUUM PUMPS, AND COMBINATIONS.

Subpart 1. **Standards.** This part shall govern the capacities and manner of installation of all boiler feed pumps, vacuum pumps, and combinations thereof, traps, etc., installed after the adoption of this code in connection with steam heating plants.

Subp. 2. **Capacities.** In all cases where the boiler feed pumps or vacuum pumps, or any combinations of such devices, or traps, etc., are used in connection with steam heating plants, the capacity of each device or combination of devices shall be subject to the approval of the administrative authority, based upon certified ratings of the manufacturers.

Subp. 3. **Alignment.** All pumps and equipment shall be set on substantial foundations and secured in such manner as will prevent distortion of adjacent equipment or piping. Flexible couplings shall not be used to compensate for misalignment but only to compensate for temperature variations. Pipe connections shall be independently supported in such a manner as to prevent undue stresses in/on equipment, due either to weight or expansion.

Subp. 4. **Oil separation.** Where there is a likelihood that oil will be absorbed by condensate, such condensate shall be taken through an effective oil separator before entering any part of the heating system or other apparatus.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1050 STOP VALVES AND CHECK VALVES.

Where a manual shutoff valve is installed on the steam supply side of any boiler, branch line, or heating equipment, a corresponding return shutoff valve or check valve shall be installed on the return side of each. Multiple boiler installation: a shutoff valve shall be used in each supply and return pipe connection of two or more boilers connected to a common system.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1060 STRAINERS AND DRIP POCKETS.

A drip pocket or strainer shall be installed and so located as to protect steam traps from scale and sludge which will interfere with their operation.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1070 DRIPS.

All points at which accumulation of water or condensation is liable to occur in steam supply pipes shall be properly dripped and trapped for the removal of condensate.

No steam main shall be dripped into a dry return which carries condensate without trapping such a drip. Whenever it becomes necessary to install traps to discharge the condensate into a return main located above the elevation of the trap, or when the trap must discharge against a definite back pressure, a check valve shall be installed on the discharge side of the trap.

The dripping of high-pressure mains or of equipment using high-pressure steam into low-pressure or vacuum return shall be accomplished by the use of a flash tank device or method approved by the administrative authority.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1080 RADIATOR CONNECTIONS.

In two-pipe systems, the return connection for each radiator more than eight sections in length shall be made at the bottom of the radiator by means of either an eccentric bushing turned down or a water-leg section and the supply connection shall be made at the opposite end of the radiator either at top or bottom. In every case, connection to each radiator of a one-pipe system shall be made at the bottom by means of either an eccentric bushing turned down or a

water-leg section.

Statutory Authority: *MS s 16B.59 to 16B.73*

HOT WATER HEATING, CHILLED WATER COOLING, AND LIQUID PIPING SYSTEMS

1345.1090 SCOPE.

Parts 1345.1090 to 1345.1180 shall include and govern all work done and materials used in the installation of hot water heating boilers and systems of piping hot water, chilled water, or other liquids.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1091 HOT WATER, CLOSED SYSTEM.

Subpart 1. **Water to be circulated.** The gallons per minute to be circulated for any given system shall be calculated from the following formula:

$$\text{G.P.M.} = \frac{\text{Total Heat Loss, Btu per hour}}{20 \times 60 \times 8}$$

where

20 = 20 degree temperature drop.

60 = minutes per hour.

8 = pounds per gallons, water at 215 degrees Fahrenheit.

Subp. 2. **Equivalent length of pipe.** The length of pipe in the longest circuit shall be measured and the number of fittings determined. The total equivalent length of these fittings in terms of the average pipe size shall be calculated and added to the actual length to give the total equivalent length. Part 1345.1310 gives the elbow equivalents for different types of fittings. Part 1345.1320 gives the equivalent length of pipe for 90-degree elbows for various flow rates.

Subp. 3. **Loss of head.** The loss of head in one elbow can be expressed in terms of the velocity head by the formula:

$$h = \frac{v^2}{2g}$$

where

h = the loss of head in feet.

v = the velocity of approach in feet per second.

2g = 2 x 32.2 = 64.4 feet per second.

The loss of head in tees when water is diverted at right angles through a branch of the tee varies with the percent diverted.

When the water diverted is less than 60 percent of that approaching the tee, the loss of head, in elbow equivalents, may be expressed as follows:

$$h^c = \frac{V_1^2}{V_2^2} \text{ Formula (2)}$$

where

h^c = the loss of head in elbow equivalents.

V₁ = the velocity of approach.

V₂ = the velocity of water diverted at right angles.

Values in elbow equivalents for the most common percentages of water diverted in a 1 x 1 x 1 inch tee are as follows:

25% = 16.0 33% = 9.0 50% = 4.0 100% = 1.8

For other percentages the approximate values may be secured by interpolation. When the water is diverted from the tee into a smaller size branch as in a 1 x 1 x 3/4 inch tee, approximate values may be secured by means of the second formula in this subpart.

In small systems the equivalent length can be estimated by adding a percentage to the measured total length of the circuit, usually 50 percent.

Subp. 4. Size of pipe to be installed. Having determined the equivalent length of pipe in the longest circuit and the total gallons per minute for the entire system, the sizes of pipes to be installed throughout the various parts of the systems shall be determined from part 1345.1330.

The following example will illustrate the method of using part 1345.1330: Taking as an example a system of 235,000 Btu total radiation and a calculated equivalent length of 285 feet, the procedure would be as follows:

$$\frac{235,000}{20 \times 60 \times 8} = 24.5 \text{ gallons per minute}$$

Reading down the left-hand column of part 1345.1330, 25 gallons per minute is found to be the closest figure. Reading across to the right, 283 feet appear to be the equivalent length most nearly that of the one under consideration. Reading down from this figure to the column of friction resistance, it is found that the resistance in milinches per foot is 360. Using this figure, all of the various pipe sizes can be selected for their actual capacity in the lower part of the table in part 1345.1330. The final calculation for total resistance in feet of head is made by multiplying milinch resistance by the equivalent length of the longest circuit and converting to feet. In this instance:

$$\frac{283 \times 360}{12 \times 1000} = 8.5 \text{ feet}$$

12 = inches per foot.

1000 = milinches per inch.

Consequently, the pump in this instance should be one capable of circulating 25 gallons per minute against an 8.5 foot head. It is particularly important that the pump installed shall have an actual capacity equal to that required. Otherwise, regardless of boiler capacity, pipe sizes, and radiation amounts the system will not deliver the required heat.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1100 CLASSIFICATIONS.

Liquid systems shall be classified according to operating temperature as follows:

A. Low-temperature liquid systems: a hot liquid heating system operating within the pressure and temperature limits of the ASME Boiler Construction Code for Low Pressure Heating Boilers. The maximum allowable temperature is 250 degrees Fahrenheit.

B. Medium-temperature liquid systems: a hot liquid heating system operating at temperatures of 250 to 350 degrees Fahrenheit.

C. High-temperature liquid systems: a hot liquid heating system operating at temperatures over 350 degrees Fahrenheit.

Medium and high-temperature liquid systems are basically similar to conventional (LTW) forced hot water systems. The principal differences from low-temperature water systems are the higher pressure, the heavier equipment, the smaller pipe sizes, and the manner in which pressure is maintained on the liquid. (Reference: ASHRAE Guide and Data Book, "Applications," chapters 10, 11, and 12).

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1110 DEFINITIONS.

Subpart 1. **Scope.** The following terms shall have the meanings given them.

Subp. 2. **Closed hot water system.** "Closed hot water system" means a forced hot water system in which the circulating water is completely enclosed, under pressure above atmospheric, and closed to the atmosphere.

Subp. 3. **Expansion tank, closed system.** "Expansion tank, closed system" means an airtight tank which provides a means of pressurizing the system over a wide range of conditions.

Subp. 4. **Forced hot water system.** "Forced hot water system" means a forced hot water system in which circulation is created by means of a pump, usually driven by an electric motor.

Subp. 5. **Gravity hot water systems.** "Gravity hot water systems" means gravity hot water heating systems where circulation of water is due to the head created by the difference in density of the water between the supply and return risers.

Subp. 6. **One-pipe system.** A "one-pipe system" employs a single pipe main with special fittings installed at riser connections to the heating elements.

Subp. 7. **Purge drain valve.** "Purge drain valve" means a valve providing a hose connection at a purge point for initial removal of air.

Subp. 8. **Purge system.** "Purge system" means a system whereby the initial removal of air is accomplished from piping systems by directing the flow of water with sufficient velocity.

Subp. 9. **Purge valve.** "Purge valve" means a valve installed between the fill water pipe connection and the purge drain connection.

Subp. 10. **Series loop, one-pipe system.** "Series loop, one-pipe system" means a system in which the heated water flows through each consecutive heating element and directly back to the source.

Subp. 11. **Two-pipe direct return system.** "Two-pipe direct return system" means a system in which the heating medium after it has passed through a heat exchanger unit, is returned to the boiler by the shortest direct path, resulting in considerable differences in the lengths of the several circuits composing the system.

Subp. 12. **Two-pipe reversed returned system.** "Two-pipe reversed returned system" means a system in which the heating medium from each heat transfer unit is returned along paths arranged so that all circuits composing the system are of equal length.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1120 BOILERS.

Subpart 1. **General.** See part 1345.0740. Subpart 2 of this part sets forth factors to be used in determining net load ratings of boilers based on input. These factors when multiplied by the Btu input to the boiler will give the net rating of the hot water boiler in Btu or square feet of equivalent direct radiation.

Subp. 2. **Hot water boilers.**

Input Btu	A Output Btu	B* Output New Forced Circulation Installation
1570 M - Under	.60	.70
2470 M - Under	.61	.71
over 2470	.62	.72

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1345.1120 MECHANICAL SYSTEMS

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*These modern allowances are to be applied to modern continuous circulation installations only.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1130 GENERAL SYSTEM DESIGN.

The water velocity and water temperature drops for all terminal heating and cooling units and piping thereto shall fall within the manufacturers' published ratings for those units and piping.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1140 EXPANSION OR COMPRESSION TANKS.

Every hot water heating system shall be provided with a compression or expansion tank of a capacity as set forth in part 1345.1200 or formula below.

This formula should be used only for operating temperatures between 106 degrees Fahrenheit and 280 degrees Fahrenheit.

$$V_t = (0.00041_t - 0.0466)V_s \frac{P_a}{P_f} - \frac{P_a}{P_o}$$

where

V_t = minimum volume of the expansion tank, gallons.

V_s = system volume, gallons.

t = maximum average operating temperature, Fahrenheit.

P_a = pressure in expansion tank when water first enters usually atmosphere pressure, feet of water, absolute.

P_f = initial fill or minimum pressure at tank, feet of water absolute.

P_o = maximum operating pressure at tank, feet of water, absolute.

A widely used formula recommended for temperatures below 160 degrees Fahrenheit is:

$$V_t = \frac{E}{\frac{P_a}{P_f} - \frac{P_a}{P_o}}$$

where

E = net expansion of the water in the system when heated from minimum temperatures to maximum temperatures, gallons.

Provision shall be made for draining such tank without emptying system.

The valve between the boiler or mains and the expansion tank shall have permanently attached thereto a metal tag having substantially the following wording stamped or etched thereon: "This valve must be OPEN at all times except when draining expansion tank."

The tank shall be securely and adequately supported in such manner that no portion of the weight of the tank or contents will be borne by the piping connected thereto, and shall be provided with drain connection and valve. No attachment into bottoms of wood joists by nails is permitted.

The minimum pipe size to connect an expansion tank to the system shall be one-half inch i.d. for closed systems and three-quarters of an inch i.d. for open systems.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1150 RESIDENTIAL SYSTEM DESIGN.

Subpart 1. **Design features.** System design features and the sizing of hot water and chilled water pipe distribution systems shall be consistent with the practices presented in the ASHRAE Guide, copies of which are on file with the administrative authority.

Subp. 2. **Design limitations.** Average water temperatures in living areas for hot water space heating shall not exceed 200 degrees for residential applications. Maximum water velocities in hot water or chilled water systems shall not exceed those listed in subpart 3. Where design temperature drops in excess of 20 degrees are to be used, calculations shall be submitted to the administrative authority.

Subp. 3. **Table 1: hot water velocities.**

Pipe Diameter (inches)	1/2 to 1-1/2	2	2-1/2	3	4	5	6
Maximum Velocity (feet per second)	4	4.5	5	6	7	8.5	10

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1160 PITCH AND VENTING.

All piping shall be installed so that all gases which are liberated from the water can move freely to a vented section of the system. Whenever practicable, the pipe line shall be pitched so that gases flowing to a vent will flow in the same direction as the water. A positive means of eliminating gases and air from the system shall be provided. A purge system may be used provided that individual circuits can be individually purged.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1170 CHILLED WATER PIPING GENERAL.

Subpart 1. **Insulation.** All distribution piping and fittings for chill water systems are to be covered continuously throughout with a vapor or moisture proof insulation material.

Subp. 2. **Balance cock.** In combination heating and cooling systems using a single pump, a balance cock shall be installed in the supply pipe from the heating source.

Subp. 3. **Air vents.** Air vents shall be provided at all fan coil units and at all high points in the system.

Subp. 4. **Shutoff valve.** Units which are to be used only for heating shall be provided with a shutoff valve, to be closed when cooling system is in operation.

Subp. 5. **Condensate drains.** Condensate drains from terminal units shall not be connected directly to building plumbing systems.

Subp. 6. **Cross-connection.** The piping cross-connection between chiller and heating source shall be provided with a means of isolation to prevent the circulation of heater water through chiller or chilled water through the heating source.

Subp. 7. **Relief valves.** Each relief valve shall be placed on the chilling source side of all valves. Each valve shall be set to relieve at a pressure not to exceed the lowest maximum working pressure rating of any system component.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1180 AIR CUSHION TANK.

Due to the slight expansion in the volume of water in cooling systems, the required air cushion tank capacity in gallons for a system designed for cooling can be determined by dividing the total Btu/hr cooling load by 50,000. Method in part 1345.1140 also applies.

Whenever valves are installed in the piping to the air cushion tank, they shall be tagged in accordance with part 1345.1140.

Combination heating and cooling systems may be provided with separate air cushion tanks for the chiller and boiler.

Statutory Authority: *MS s 16B.59 to 16B.73*

SNOW MELTING**1345.1190 SNOW MELTING.**

Subpart 1. Scope. This part of the code shall include and govern the work done and materials used in the installation of steam and circulating hot fluid snow melting systems, and the alteration, repairs, and extensions to such installations.

Subp. 2. System design. The thermal design and installation of snow melting systems shall be consistent with the practices presented in the ASHRAE Guide, copies of which are on file in the Department of Administration.

Subp. 3. Safety. Snow melting systems shall be installed and maintained independently. There shall be no permanent connection between the snow melting system and the drinking water supply. (See part 1345.0930). Where petroleum distillates are used for fluids, caution or barriers to prevent possible oil leakage from being ignited shall be provided.

Subp. 4. Corrosion. Ethylene glycol solution should be tested annually to determine any change in acidity. If test indicates the inhibitor has been exhausted, the entire system should be drained and a fresh solution installed.

Subp. 5. Tag. A permanent tag shall be attached to or near the fill connection of the system stating what type of solution is present and the degree of protection that solution will provide.

Subp. 6. Thermal stresses. Design of these systems shall be limited to an average water temperature not to exceed 120 degrees Fahrenheit for piping installed in concrete.

Piping required to pass through a concrete expansion joint shall be provided with an expansion loop of sufficient length, to protect the piping from stress under normal conditions, extending underground and covered with a waterproof vapor barrier and thermal insulation.

Subp. 7. Testing. Testing piping before pouring of concrete shall be as outlined in subpart 2 with the exception that where petroleum distillates are to be used for antifreeze fluid the test will be by air.

Subp. 8. Draining and venting. Pipes shall be installed, so that they may be drained and the air completely vented during filling.

Subp. 9. Steam systems. Steam snow melting systems shall have their piping encased in a noncorrosive type conduit and installed in accordance with the provisions of this code as related to steam systems.

Subp. 10. Joints. All joints in piping shall be fusion welded or capillary brazed using appropriate fittings.

Subp. 11. Freeze protection. Fluids for snow melting systems shall be capable of withstanding -30 degrees Fahrenheit.

Subp. 12. Expansion tank. The expansion tank shall be sized in accordance with part 1345.1140 plus an additional factor depending on type of antifreeze.

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MECHANICAL SYSTEMS 1345.1190

Subp. 13. **Thermal shock.** To prevent shock, where large load variations and volumes of water are pumped through boilers, precautions must be taken to prevent a supply return temperature difference exceeding 30 degrees Fahrenheit.

Statutory Authority: *MS s 16B.59 to 16B.73*

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1345.1200 MECHANICAL SYSTEMS

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1345.1200 METHOD FOR SELECTING EXPANSION TANKS.

Maximum Tank Size Required For Boiler (Under Standard Conditions)*					Maximum Tank Size Required For Radiation (Under Standard Conditions)*						
Net Btu Rating in 1000 Btu/h	Conventional		Flash		Rad. Output in 1000 Btu/h at 200 Btu/h Emission	Large Tube		Thin Tube		Convactor	
	Gals. in Boiler	Tank Req'd	Gals. in Boiler	Tank Req'd		Gals. in Rad.	Tank Req'd	Gals. in Rad.	Tank Req'd	Gals. in Rad.	Tank Req'd
50	12	2.84	5.4	1.19	60	28.5	6.27	15.7	3.4	7	1.5
60	14.5	3.19	6.4	1.41	60	34.2	7.52	16.8	3.7	7.5	1.65
70	17	3.74	7.2	1.57	70	40	8.8	19.6	4.3	8.7	1.93
80	19.5	4.29	8.0	1.75	80	45.6	10	22.4	4.9	10	2.2
90	22	4.9	8.6	1.89	90	51.4	11.3	25.2	5.5	11.25	2.48
100	25	5.5	9.4	2.07	100	57	12.5	28	6.2	12.5	2.75
125	30	6.6	11	2.42	125	71	15.6	39	8.58	17.7	3.89
150	36	7.9	13	2.86	150	85.5	18.8	47.8	10.5	21	4.62
175	42	9.24	14.5	3.19	175	99	21.7	55	12.1	24.7	5.43
200	48	10.6	16	3.52	200	114	25.8	63.8	14.1	28.5	6.27
250	60	13.1			250	142	31.2	79.8	17.5	35.6	7.83
300	70	15.4			300	171	37.6	95.7	21.0	42.7	9.39
350	84	18.4			350	199	43.7	111	24.4	49.7	10.9
400	95	20.9			400	228	50.1	127	27.9	57	12.5
450	107	23.5			450	256	56.1	143	31.4	64	14
500	120	26.4			500	285	62.7	157	34.5	71	15.6
600	140	30.8			600	342	75.2	191	42	85.5	18.8
700	160	35.2			700	399	87.7	223	49	98.7	21.7
800	190	41.8			800	456	100	251	55.2	114	25
900	210	46			900	513	112	287	63.1	128	28.1
1000	235	51.7			1000	570	125	319	70.1	142	31.2
2000	480	106			2000	1140	250	638	140	285	62.7
3000	720	158			3000	1710	376	957	210	427	93.9
4000	960	211			4000	2280	501	1276	280	560	123
8000	1200	264			8000	4560	1003	2553	561	1140	250
12000	3000	660			12000	6840	1504	3830	832	1710	376
16000	3700	814			16000	9120	2006	5107	1123	2280	501
					20000	11400	2508	6384	1407	2850	627

Correction Factors For Initial Pressures Other Than 12 Psig (4 Psig Min. Pressure Highest Part of System, 30 Psig Relief Pressure)					Correction Factors For Attic Tanks (4 Psig Initial Pressure on Tank Press., Rise - Final Press. - Static - 4 Psig)			
Initial Pressure	Static Height	Max. Mean Temp. at Max. Mult. Factor	Multiplying Factor Maximum	Multiplying Factor Minimum	Pressure Rise	Max. Mean Temp. at Max. Mult. Factor	Multiplying Factor Maximum	Multiplying Factor Minimum
4	0	264	0.465	0.3	4	222	1.27	1.25
6	4.5	260	0.575	0.38	8	235	0.77	0.68
8	9	257	0.7	0.48	10	238	0.68	0.57
10	14	258	0.83	0.59	12	242	0.63	0.50
12	18.5	252	1.0	0.73	14	246	0.59	0.45
14	23	250	1.10	0.9	16	249	0.55	0.41
16	27.5	245	1.43	1.1	18	252	0.53	0.38
18	32	242	1.74	1.41	20	255	0.51	0.36
20	36.5	237	2.18	1.82	25	261	0.48	0.315
22	41.5	235	2.82	2.5	30	267	0.465	0.28
24	46	227	3.82	3.5	35	271	0.45	0.26

Standard conditions are: 12 psig initial pressure, 30 psig final pressure, static pressure up to 18.5 ft.

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Maximum Tank Size Required For Radiation (Under Standard Conditions)*				Maximum Tank Size Required For Forced Circulation Piping (Under Standard Conditions)*				Maximum Tank Size Req'd. For Panel (Under St'd. Conditions)*			
Cast Iron Base Board		Convactor Base Board		Heat Conveyed in 1000 Btuh	One Pipe		Two Pipe		System Btu in 1000 Btuh	Panel Gals. in Panel Piping	Tank Req'd.
Gals. in Rad.	Tank Req'd.	Gals. in Rad.	Tank Req'd.		Gals. in Piping	Tank Req'd.	Gals. in Piping	Tank Req'd.			
23.5	5.16	3.2	0.704	50	7.8	1.7	10.5	2.3	50	11	0.8
28.3	6.25	4.0	0.880	60	9.0	1.98	12.5	2.75	60	13.5	1.0
33	7.25	4.5	0.990	70	10.0	2.2	14.5	3.2	70	16	1.2
37.8	8.3	5.2	1.14	80	11.5	2.5	17	3.7	80	18.5	1.35
42.5	9.4	5.8	1.27	90	13	2.9	18	3.96	90	21	1.55
47.1	10.4	6.5	1.43	100	14	3.1	21	4.6	100	24	1.75
58.8	13	8.1	1.78	125	18	3.96	27	5.9	125	30	2.2
70.8	15.6	9.7	2.13	150	22	4.85	34	7.5	150	37	2.7
82.8	18.2	11.3	2.43	175	28	5.7	40	8.8	175	44	3.2
94.3	20.8	13	2.86	200	30	6.6	47	10.3	200	50	3.7
117.8	28	18.2	3.56	250	39	8.6	62	13.6	250	65	4.75
141.5	31	19.5	4.29	300	49	10.8	78	17.2	300	70	5.7
165	36.2	22.7	4.99	350	58	12.8	94	20.7			
188.5	41.5	26	5.72	400	70	15.4	110	24.2			
212	46.6	29.2	6.42	450	80	17.6	130	28.6			
235.8	52	32.5	7.15	500	90	19.8	150	33			
202.8	62	39	8.58	600	115	25.3	180	41.8			
330	72.5	45.5	10	700	140	30.8	225	49.5			
377	83	52	11.4	800	165	36.3	260	57.2			
424.3	93	58.5	12.8	900	195	42.9	310	65.2			
476.5	105	65	14.3	1000	225	49.5	360	79.2			
942	208	130	28.6	2000	540	119	900	195			
1414	311	195	42.5	3000	960	211	1500	330			
1885	415	260	57.2	4000	1350	297	2100	462			
3770	830	520	114	8000	3400	748	5000	1100			
3655	1250	780	171	12000	5000	1254	9000	1980			
7542	1670	1040	228	16000	8300	1826	13000	2860			
9427	2080	1300	286								

Note:
For minimum tank size under standard conditions multiply Value obtained from table by 0.73

Correction Factors For Systems Using Compressor to Charge Tank (Comp. Tank 80% Full of Air After Charging with Compressor)						Correction Factors For Safety Loop Systems				Correction Factors For Tanks that are Already Undersize	
Static Height	Initial Pressure	Relief Pressure	Max. Mean Temp. at Max. Mult. Factor	Multiplying Factor Maximum	Multiplying Factor Minimum	Initial Pressure	Max. Mean Temp. at Max. Mult. Factor	Multiplying Factor Maximum	Multiplying Factor Minimum	If Tank Reaches Final Press. At Temp.	Req'd. Tank Size Increase For Final Press. at 220F.
10	8.5	30	256	0.53	0.35	4	262	0.72	0.56		orig-
18.5	12	30	252	0.65	0.48	6	262	0.98	0.74		inal
25	15	30	245	0.85	0.67	8	262	1.24	1.0	170	2.1 x
30	17	30	244	0.97	0.79	10	262	2.16	1.5	180	1.87 x
40	21.5	45	255	0.71	0.47	12	262	3.5		190	1.63 x
50	26	45	251	0.815	0.59					200	1.34 x
60	30	45	245	1.04	0.82					210	1.24 x
75	37	75	264	0.68	0.78					220	1.13 x
100	47	75	264	0.97	0.62						
150	65	100									

Statutory Authority: MS s 16B.59 to 16B.73

SUPPLEMENTAL MATERIAL FOR STEAM AND LIQUID SYSTEMS

1345.1210 HOW SUPPLEMENTAL MATERIALS APPLY.

Part 1345.1220 shall be considered as binding and enforceable. Parts 1345.0981, 1345.1091, and 1345.1230 are provided as guides. The materials listed in part 1345.1220 are permitted (within their limitations) subject to restrictions found elsewhere in this code.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1220 APPROVED MATERIALS.

Subpart 1. **Ferrous.** The following materials are approved:

- A. Cast iron threaded fittings (125 to 250 pound) ANSI B16.4.
- B. Steel pipe, welded and seamless, schedule 40 and heavier -- ANSI B36.1 and B36.20.
- C. Wrought iron pipe, schedule 40 and heavier -- ANSI B36.2.
- D. Stainless steel pipe -- ANSI B36.19.
- E. Malleable fittings 150 psi and heavier -- ANSI B16.3.
- F. Wrought steel butt-welding fittings -- ANSI B16.9.
- G. Butt-welding ends for pipe, valves, flanges, and fittings -- ANSI B16.25.
- H. Wrought steel butt-welding short radius elbows and returns -- ANSI B16.28.

Subp. 2. **Copper base.** The following materials are approved:

- A. Red brass pipe -- ANSI B27.1; ASTM B42 and B43.
- B. Seamless brass tube -- ANSI B36.1.
- C. Brass or bronze threaded fittings, 125 psi and heavier -- ANSI B16.15, ASTM 62.
- D. Brass or bronze flare fittings, 125 psi and heavier, heavy duty long collar type -- ASTM B62.
- E. Seamless copper tube, types K and L -- ANSI B231, ASTM B88, soft temper.
- F. Seamless copper tube, tubes K, L, and M -- ANSI B231, ASTM B88, hard temper.
- G. Cast bronze and wrought solder joint fittings -- ANSI B16.22, B23.1, B16.18.

Subp. 3. **Plastic pipe and fittings.** Particular care should be taken with regard to temperatures, pressures, and other conditions of use.

- A. ABS type I -- ANSI B72.3, ASTM D2282.
- B. Polyethylene -- ANSI B72.1, ASTM D2239.
- C. Polyvinyl chloride (PVC) -- ANSI B72.2, ASTM D2241.
- D. Polybutylene-ASTM D2581.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1230 RADIATION: HEAT EMISSIONS.

Subpart 1. **General.** Radiation in square feet for any unenclosed radiator shall be defined as the minimum guaranteed heat emission of that radiator measure in Btu per hour divided by 240 for direct steam and 150 for direct hot water radiation.

Subp. 2. **Table for other temperatures.** For various other water (or steam) temperatures, various emissions per square foot are shown in the following table:

Average Temperature of Water in Radiator	Heat Emission Per Square Foot
150	110 Btu per hour
160	130 Btu per hour
170	150 Btu per hour
180	170 Btu per hour
190	190 Btu per hour
200	210 Btu per hour
215	240 Btu per hour
225	260 Btu per hour
240	295 Btu per hour

The above emissions are for a radiator in air at 70 degrees Fahrenheit.

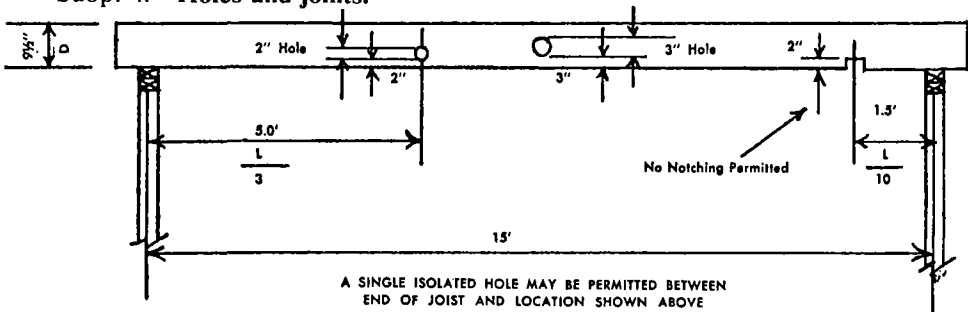
Enclosed radiators, convectors, or concealed heater emission ratings shall be determined as set forth in the American Society of Heating and Ventilating Engineers Guide.

Subp. 3. Length in feet of pipe to be added to the actual length of run owing to fittings to obtain equivalent length.

Length in Feet to be Added to Run

Size of Pipe Inches	Standard Elbow	Side Outlet Tee	Gate Valve	Globe Valve	Angle Valve
1/2	1.3	3	0.3	14	7
3/4	1.8	4	0.4	18	10
1	2.2	5	0.5	23	12
1-1/4	3.0	6	0.6	29	15
1-1/2	3.5	7	0.8	34	18
2	4.3	8	1.0	46	22
2-1/2	5.0	11	1.1	54	27
3	6.5	13	1.4	66	34
3-1/2	8	15	1.6	80	40
4	9	18	1.9	92	45
5	11	22	2.2	112	56
6	13	27	2.8	136	67
8	17	35	3.7	180	92
10	21	45	4.6	230	112
12	27	53	5.5	270	132
14	30	63	6.4	310	152

Subp. 4. Holes and joints.



A SINGLE ISOLATED HOLE MAY BE PERMITTED BETWEEN END OF JOIST AND LOCATION SHOWN ABOVE

- Maximum size of hole in center section of joist: $\frac{\text{Width of joist}}{3}$ And on center axis of joist. One hole only of the above size permitted in center section.
- Maximum size of hole in end sections of joists:
- Maximum size hole=2"
- Minimum distance from bottom of joist=2"
- Minimum space between holes in end section area=6"

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1345.1230 MECHANICAL SYSTEMS

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Subp. 5. Thermal expansion of pipe in inches per 100 feet.

Saturated Steam Elongation in inches per
100 ft. from - 20P up

Pressure Psig	Temp. Degrees F.	Cast Iron Pipe	Steel Pipe	Wrought Iron Pipe	Copper Pipe
-	-20	0	0	0	0
0.0	212	1.575	1.785	1.866	2.608
2.5	220	1.634	1.852	1.936	2.720
10.3	240	1.780	2.020	2.110	2.960
20.7	260	1.931	2.183	2.279	3.189
34.5	280	2.083	2.350	2.465	3.422
52.3	300	2.233	2.519	2.630	3.665

To obtain the amount of expansion between any two temperatures, take the difference between the figures in the table for those temperatures.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1260 PRESSURE DROPS IN COMMON USE FOR SIZING STEAM PIPE.

Initial Steam Pressure, Psig	Pressure Drop per 100 ft., Psi	Total Pressure Drop in Steam Supply Piping, Psi
Subatmospheric or vacuum return	2-4 oz	1-2 psi
0	1/2 oz	1 oz
1	2 oz	1-4 oz
2	2 oz	8 oz
5	4 oz	1-1/2 psi
10	8 oz	3 psi
15	1 psi	4 psi
30	2 psi	5-10 psi
50	2-5 psi	10-15 psi
100	2-5 psi	15-25 psi
150	2-10 psi	25-30 psi

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1270 COMPARATIVE CAPACITY OF STEAM LINES AT VARIOUS PITCHES FOR STEAM AND CONDENSATE FLOWING IN OPPOSITE DIRECTIONS.

(Pitch of Pipe in Inches per 100 Ft. Velocity in Ft. per Sec.)

Pitch of Pipe	¼ in.	½ in.	1 in.	1½ in.	2 in.	3 in.	4 in.	5 in.
Pipe Size Inches	¾	1	1¼	1½	2	3	4	5
	6.3	7.6	9.3	10.1	10.6	11.5	11.9	12.3
	11.5	13.2	15.8	17.5	18.8	20.8	22.0	22.6
	26.2	29.3	33.3	36.1	38.5	41.3	43.2	44.6
	35.7	39.8	45.3	49.1	52.3	56.0	58.7	60.7
	59.0	65.9	74.9	81.4	86.6	92.4	97.1	100.3
	12	14	18	19	20	21	21	22
	12	15	17	20	22	23	23	25
	15	20	23	25	27	28	28	29
	18	21	23	25	27	28	28	30
	19	20	23	25	27	28	28	29
	23	23	23	23	23	23	23	23
	18	20	23	23	23	23	23	23

Capacity Expressed in Pounds per Hour

From A.S. of M, R and A.C. Engineers Research Laboratory.

Statutory Authority: *MS s 16B.59 to 16B.73*

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(Reference to this table will be by column letter A through L)

This table is based on pipe size data developed through the research investigations of the American Society of Heating and Ventilating Engineers.

Pipe Size In.	CAPACITIES OF STEAM MAINS AND RISERS							SPECIAL CAPACITIES FOR ONE-PIPE SYSTEMS ONLY			
	Direction of Condensate Flow in Pipe Line							Supply Risers Upfeed	Radi- ator Valves and Vertical Con- nections	Radi- ator and Riser Run- outs	
	With the Steam in One-Pipe and Two-Pipe Systems					Against the Steam Two- Pipe Only					
	$\frac{1}{8}$ psi or $\frac{1}{2}$ oz. Drop	$\frac{1}{24}$ psi or $\frac{3}{8}$ oz. Drop	$\frac{1}{4}$ psi or 1 oz. Drop	$\frac{1}{2}$ psi or 2 oz. Drop	$\frac{3}{4}$ psi or 4 oz. Drop	$\frac{1}{2}$ psi or 8 oz. Drop	Verti- cal				Hori- zontal
	A	B	C	D	E	F	G	H ^a	I ^a	J ^b	K
CAPACITY EXPRESSED IN SQUARE FEET E D R											
$\frac{3}{4}$	—	—	30	—	—	—	30	—	25	—	—
1	39	46	56	79	111	157	56	34	45	28	28
$1\frac{1}{4}$	87	100	122	173	245	346	122	75	78	62	62
$1\frac{1}{2}$	134	155	190	269	380	538	190	108	152	93	93
2	273	315	386	546	771	1,091	386	195	283	169	169
$2\frac{1}{2}$	449	518	635	898	1,270	1,800	635	395	464	—	260
3	822	948	1,160	1,650	2,330	3,290	1,130	700	800	—	475
$3\frac{1}{2}$	1,230	1,420	1,740	2,460	3,470	4,910	1,550	1,150	1,140	—	745
4	1,740	2,010	2,460	3,480	4,910	6,950	2,040	1,700	1,520	—	1,110
5	3,210	3,710	4,550	6,430	9,090	12,900	4,200	3,150	—	—	2,180
6	5,280	6,100	7,460	10,550	14,900	21,100	7,200	5,600	—	—	—
8	11,000	12,700	15,500	21,970	31,070	43,900	15,000	12,000	—	—	—
10	20,000	23,100	28,300	40,100	56,700	80,200	28,000	23,000	—	—	—
12	32,000	32,100	45,500	64,300	91,000	129,000	46,000	38,000	—	—	—
16	61,000	69,700	84,800	121,000	170,000	242,000	88,000	76,000	—	—	—

1345.1280 MECHANICAL SYSTEMS
1345.1280 STEAM PIPE CAPACITIES FOR LOW PRESSURE SYSTEMS.

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Statutory Authority: MS s 16B.59 to 16B.73

CAPACITY EXPRESSED IN POUNDS PER HOUR											
Pipe Size In.	CAPACITIES OF STEAM MAINS AND RISERS							SPECIAL CAPACITIES FOR ONE-PIPE SYSTEMS ONLY			
	Direction of Condensate Flow in Pipe Line							Sup- ply Risers Upfeed	Radi- ator Valves and Verti- cal Con- nections	Radi- ator and Riser Run- outs	
	With the Steam in One-Pipe and Two-Pipe Systems						Against the Steam Two- Pipe Only				
	1/4 psi or 1/2 oz. Drop	1/24 psi or 3/5 oz. Drop	1/4 psi or 1 oz. Drop	1/8 psi or 2 oz. Drop	1/4 psi or 4 oz. Drop	1/2 psi or 8 oz. Drop	Verti- cal				Hori- zontal
	A	B	C	D	E	F	G	H ^a	I ^c	J ^b	K
CAPACITY EXPRESSED IN SQUARE FEET E D R											
3/4	—	—	8	—	—	—	8	—	6	—	7
1	10	12	14	20	28	40	14	9	11	7	7
1 1/4	22	25	31	43	61	87	31	19	20	16	16
1 1/2	34	39	48	67	95	135	48	27	30	23	23
2	68	79	97	137	193	273	97	49	72	42	42
2 1/2	112	130	159	225	318	449	159	99	116	—	65
3	206	237	291	411	581	822	282	175	200	—	119
3 1/2	307	355	434	614	869	1,230	387	288	286	—	186
4	435	503	614	869	1,230	1,740	511	425	380	—	278
5	806	928	1,140	1,610	2,270	3,210	1,050	788	—	—	545
6	1,320	1,520	1,870	2,640	3,730	5,250	1,800	1,400	—	—	—
8	2,750	3,170	3,880	5,490	7,770	11,000	3,750	3,000	—	—	—
10	5,010	5,750	7,090	10,000	14,200	20,000	7,000	5,700	—	—	—
12	8,040	9,290	11,400	16,100	22,700	32,200	11,500	9,500	—	—	—
16	15,100	17,400	21,200	30,300	42,400	60,500	22,000	19,000	—	—	—
All Horizontal Mains and Down-Feed Risers							Upfeed Risers	Mains & Un- dripped Run- outs	Upfeed Risers	Radi- ator Con- nec- tions	Run- outs not Dripped

Note: Steam at an average pressure of 1 psig is used as a basis for calculating capacities. All drops shown are in psi per 100 ft. of equivalent run—based on pipe properly reamed.

^a Do not use Column E for drops of 1/24 or 1/32 psi; substitute Column C or Column B as required.

^b Do not use Column J for drop 1/32 psi except on sizes 3 in. and over; below 3 in. substitute Column B.

^c Pitch of horizontal runouts to risers and radiators should be not less than 1/4 in. per ft.

Where this pitch cannot be obtained, runouts over 8 ft. in length should be one pipe size larger than called for in the table in part 1345.1290.

MINNESOTA RULES 1985

1345.1290 MECHANICAL SYSTEMS

1345.1290 RETURN PIPE CAPACITIES FOR LOW PRESSURE SYSTEMS.

Capacity Expressed in Square Feet of Equivalent Direct Radiation (Reference to this table will be by column letter M through EE)

This table is based on pipe size data developed through the research investigation of the American Society of Heating and Ventilating Engineers.

CAPACITY OF RETURN MAINS AND RISERS

MAINS

Pipe Size Inches	1/4 Pal or 1/2 oz. Drop per 100 ft.						1/2 Pal or 1 oz. Drop per 100 ft.						3/4 Pal or 2 oz. Drop per 100 ft.						1 Pal or 4 oz. Drop per 100 ft.						3/4 Pal or 8 oz. Drop per 100 ft.						
	Wet		Dry		Vac.		Wet		Dry		Vac.		Wet		Dry		Vac.		Wet		Dry		Vac.		Wet		Dry		Vac.		
	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	BB	CC	DD	EE	FF	GG	HH	II	JJ	KK	LL	MM	NN	OO	PP	QQ	RR
1	500	248	—	580	285	700	320	400	1000	412	568	1400	—	—	—	—	—	—	800	—	—	—	—	—	—	—	—	—	—	—	—
1 1/4	890	520	—	970	505	1200	670	700	1700	868	984	2400	—	—	—	—	—	—	1400	480	—	—	—	—	—	—	—	—	—	—	—
1 1/2	1050	622	—	1170	613	1500	940	1000	2100	1068	1700	3000	—	—	—	—	—	—	2400	960	—	—	—	—	—	—	—	—	—	—	—
2	2500	1880	—	2540	2260	4000	2300	4000	5400	2980	3680	6800	—	—	—	—	—	—	3800	1510	—	—	—	—	—	—	—	—	—	—	—
2 1/2	4100	3040	—	4260	3740	6700	3800	6700	9400	4900	6010	11000	—	—	—	—	—	—	6000	2340	—	—	—	—	—	—	—	—	—	—	—
3	7500	5040	—	8500	6940	10700	7000	10700	15000	8000	9700	18000	—	—	—	—	—	—	10400	3650	—	—	—	—	—	—	—	—	—	—	—
3 1/2	11000	7880	—	12200	9800	16000	10000	16000	22000	12900	15200	27000	—	—	—	—	—	—	18000	5100	—	—	—	—	—	—	—	—	—	—	—
4	15000	11700	—	18300	13400	22000	15000	22000	31000	19300	23700	38000	—	—	—	—	—	—	24000	6800	—	—	—	—	—	—	—	—	—	—	—
6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

RISERS

Pipe Size Inches	Wet		Dry		Vac.		Wet		Dry		Vac.		Wet		Dry		Vac.		Wet		Dry		Vac.		Wet		Dry		Vac.		
	MM	NN	OO	PP	QQ	RR	SS	TT	UU	VV	XX	YY	ZZ	AA	BB	CC	DD	EE	FF	GG	HH	II	JJ	KK	LL	MM	NN	OO	PP	QQ	
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
1 1/4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1 1/2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2 1/2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3 1/2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Statutory Authority: MS s 16B.59 to 16B.73

1345.1300 RETURN PIPE CAPACITIES FOR LOW PRESSURE SYSTEMS.

CAPACITY EXPRESSED IN POUNDS PER HOUR
(Reference to this table will be made by column letter M through EE.)

This table is based on pipe size data developed through the research investigation of the American Society of Heating and Ventilating Engineers.

Pipe Size Inches	CAPACITY OF RETURN MAINS AND RISERS																	
	MAINS																	
	1/8 Pal or 1/2 oz. Drop per 100 ft.		1/24 Pal or 1/4 oz. Drop per 100 ft.		1/4 Pal or 1 oz. Drop per 100 ft.		3/8 Pal or 2 oz. Drop per 100 ft.		1/2 Pal or 4 oz. Drop per 100 ft.		3/4 Pal or 8 oz. Drop per 100 ft.							
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	BB	CC	DD	EE
M	125	62	—	145	71	42	175	—	100	250	—	142	—	—	200	—	—	283
1 1/4	233	130	—	248	149	84	305	—	175	425	—	246	350	115	350	—	—	484
1 1/2	338	206	—	332	238	116	415	168	300	475	217	426	600	241	600	—	—	648
2	470	270	—	450	310	156	575	225	475	675	340	674	900	378	950	—	—	848
2 1/4	700	470	—	680	535	216	840	325	700	1000	740	1420	2000	825	2000	—	—	1340
3	1180	760	—	1180	868	336	1280	550	1000	1400	1000	2380	3350	1360	3350	—	—	2830
3 1/4	1800	1460	—	1780	1360	480	2080	850	1580	2350	1230	3380	5000	2500	5000	—	—	4730
4	2750	1970	—	2700	2200	680	3280	1700	2680	3750	2250	5000	8000	3580	8000	—	—	7580
5	3680	2630	—	3580	3350	950	4500	2500	4000	5500	3230	6880	11000	5380	11000	—	—	11300
6	—	—	—	4580	—	12600	7880	3750	5680	7750	4830	13700	19400	6380	19400	—	—	15500
	—	—	—	—	—	—	—	—	15500	—	—	22000	—	—	31000	—	—	43800
	RISERS																	
1/4	—	48	—	—	48	143	—	—	175	—	—	—	—	48	249	—	—	494
1 1/4	—	113	—	—	113	244	—	—	300	—	—	—	—	113	426	—	—	848
1 1/2	—	248	—	—	248	388	—	—	475	—	—	—	—	248	674	—	—	1340
2	—	375	—	—	375	815	—	—	1000	—	—	—	—	375	1420	—	—	2830
2 1/4	—	750	—	—	750	1860	—	—	1680	—	—	—	—	750	2380	—	—	4730
3	—	—	—	—	—	2180	—	—	2680	—	—	—	—	—	3800	—	—	7580
3 1/4	—	—	—	—	—	3250	—	—	4000	—	—	—	—	—	5680	—	—	11300
4	—	—	—	—	—	4480	—	—	5500	—	—	—	—	—	8000	—	—	15500
5	—	—	—	—	—	7880	—	—	9680	—	—	—	—	—	11000	—	—	23300
6	—	—	—	—	—	12600	—	—	15500	—	—	—	—	—	19400	—	—	31000

Statutory Authority: MS s 16B.59 to 16B.73

MINNESOTA RULES 1985

1345.1310 MECHANICAL SYSTEMS

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1345.1310 IRON AND COPPER ELBOW EQUIVALENTS.

Fitting	Iron Pipe	Copper Tubing
Elbow, 90 deg	1.0	1.0
Elbow, 45 deg	0.7	0.7
Elbow, 90 deg. long turn	0.5	0.5
Elbow, welded, 90 deg	0.5	0.5
Reduced coupling	0.4	0.4
Open return bend	1.0	1.0
Angle radiator valve	2.0	3.0
Radiator or convector	3.0	4.0
Boiler or heater	3.0	4.0
Open gate valve	0.5	0.7
Open globe valve	12.0	17.0

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1320 EQUIVALENT LENGTH OF PIPE FOR 90 DEGREE ELBOWS.

PIPE SIZE															
Vel. FPS	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12
1	1.2	1.7	2.2	3.0	3.5	4.5	5.4	6.7	7.7	8.6	10.5	12.2	15.4	18.7	22.2
2	1.4	1.9	2.5	3.3	3.9	5.1	6.0	7.5	8.6	9.3	11.7	13.7	17.3	20.8	24.8
3	1.5	2.0	2.7	3.4	4.2	5.4	6.4	8.0	9.2	10.2	12.5	14.6	18.4	22.3	26.5
4	1.5	2.1	2.8	3.7	4.4	5.6	6.7	8.3	9.6	10.6	13.1	15.2	19.2	23.2	27.6
5	1.6	2.2	2.9	3.9	4.5	5.9	7.0	8.7	10.0	11.1	13.6	15.8	19.8	24.2	28.8
6	1.7	2.3	3.0	4.0	4.7	6.0	7.2	8.9	10.3	11.4	14.0	16.3	20.5	24.9	29.6
7	1.7	2.3	3.0	4.1	4.8	6.2	7.4	9.1	10.5	11.7	14.3	16.7	21.0	25.5	30.3
8	1.7	2.4	3.1	4.2	4.9	6.3	7.5	9.3	10.8	11.9	14.6	17.1	21.5	26.1	31.0
9	1.8	2.4	3.2	4.3	5.0	6.4	7.7	9.5	11.0	12.2	14.9	17.9	21.9	26.6	31.6
10	1.8	2.5	3.2	4.3	5.1	6.5	7.8	9.7	11.2	12.4	15.2	17.7	22.2	27.0	32.0

Statutory Authority: *MS s 16B.59 to 16B.73*

MINNESOTA RULES 1985

1345.1330 HOT WATER HEATING, PIPE SIZES.

G.P.M	EQUIVALENT LENGTH OF PIPE—AVERAGE SIZE												
	100	120	150	200	225	250	300	375	400	450	510	600	
2.5	100	120	150	200	225	250	300	375	400	450	510	600	
5	84	100	125	167	188	208	250	312	333	375	428	500	
7.5	66	80	100	133	150	167	200	250	270	300	340	400	
10	116	140	175	223	263	291	350	437	463	525	595	700	
12.5	100	120	150	200	225	250	300	375	400	450	510	600	
15	150	180	225	300	337	375	450	562	593	675	758	900	
17.5	140	150	210	280	318	353	425	530	563	632	720	850	
20	133	160	200	266	300	333	400	500	533	600	685	800	
22.5	116	140	175	223	263	291	350	437	463	525	595	700	
25	283	340	425	568	638	708	850	1062	1103	1275	1417	1700	
30	274	330	412	550	620	695	825	1030	1085	1235	1390	1650	
35	266	320	400	533	600	666	800	1000	1070	1200	1370	1600	
40	249	300	375	500	563	623	750	937	973	1125	1252	1500	
45	217	260	325	433	483	540	650	812	843	975	1088	1300	
50	183	220	275	366	413	457	550	687	713	825	923	1100	
55	390	470	587	782	882	972	1175	1468	1566	1757	1903	2350	
60	383	460	575	766	863	955	1150	1437	1533	1725	1897	2300	
65	366	440	550	733	825	915	1100	1375	1466	1650	1835	2200	
70	349	420	525	700	788	872	1050	1312	1363	1575	1737	2100	
75	333	400	500	666	750	833	1000	1250	1333	1500	1715	2000	
80	317	380	475	633	713	789	950	1187	1233	1425	1577	1900	
85	300	360	450	600	675	750	900	1125	1200	1350	1540	1800	
90	266	320	400	533	600	666	800	1000	1070	1200	1370	1600	
95	233	280	350	465	525	580	700	875	933	1050	1200	1400	
100	200	240	300	400	450	500	600	750	800	900	1030	1200	
110	400	480	600	800	900	1000	1200	1500	1600	1800	2030	2400	
120	333	400	500	666	750	833	1000	1250	1333	1500	1715	2000	
130	266	320	400	533	600	666	800	1000	1070	1200	1370	1600	
140	200	240	300	400	450	500	600	750	800	900	1030	1200	
150	317	620	775	1023	1163	1290	1550	1935	2060	2325	2620	3100	
160	466	560	700	933	1050	1167	1400	1750	1870	2100	2370	2800	
170	400	480	600	800	900	1000	1200	1500	1600	1800	2030	2400	
180	333	400	500	666	750	833	1000	1250	1333	1500	1715	2000	
190	266	320	400	533	600	666	800	1000	1070	1200	1370	1600	
200	200	240	300	400	450	500	600	750	800	900	1030	1200	

FRICTION HEAD IN MIL INCHES PER FOOT OF PIPE												
	360	300	240	180	160	144	120	95	90	80	70	60
BTU CAPACITY OF VARIOUS PIPE SIZES IN M. B. H.												
1½"	15.5	13	12.4	10	9.6	9	8.2	6.8	6.7	6.3	6.0	4.8
2"	31	29	26.4	22	20.6	19.6	17.2	14.6	14.1	13.	12.5	11.
2½"	59	53	47	40	38	36	32	30	28	27	24	23.5
3"	124	118	101	85	80	77	69	62	58	55.6	51	48
3½"	193	175	155	132	124	120	106	93	90	83	78	71
4"	360	322	287	248	235	223	198	190	170	160	148	137
4½"	620	551	500	440	395	380	340	300	290	270	250	230
5"	1100	1000	900	760	710	660	600	540	510	480	440	410
5½"	1700	1500	1320	1120	1050	1000	900	800	770	730	670	610
6"	2350	2100	1900	1610	1500	1420	1260	1100	1080	1000	940	850
6½"	3300	3000	2700	2300	2000	1800	1650	1450	1400	1340	1250	1200
7"	4600	4100	3600	3000	2750	2600	2300	2200	2100	1950	1800	1700

TOTAL FRICTION HEAD IN FEED—EQUIVALENT LENGTH X MIL INCHES

12X1000

Statutory Authority: MS s 16B.59 to 16B.73

VENTILATION

1345.1340 DEFINITIONS.

Subpart 1. **Scope.** The following terms shall have the meaning given them.

Subp. 2. **Air conditioning.** "Air conditioning" means the process of treating air so as to control simultaneously its temperature, humidity, cleanliness, and distribution to meet the requirements of the conditioned space. The classifications of air conditioning are included in parts 1345.1340 to 1345.1850 as follows:

A. winter air conditioning which shall include the proper distribution of the cleaned, humidified, and heated air to and within the spaces to be conditioned; and

B. summer air conditioning which shall include the proper distribution of the cleaned, dehumidified, and cooled air to and within the spaces to be conditioned.

Subp. 3. **Ventilation.** "Ventilation" means the process of supplying and/or removing air by natural or mechanical means to or from any space in a manner which will protect the health, safety, and comfort of the occupants of that space. Such air may or may not have been conditioned.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1350 GENERAL REQUIREMENTS.

Subpart 1. **Scope.** For the purpose of this code, the minimum quantity and quality of outside and recirculated air for ventilation and air conditioning purposes shall be in compliance with the requirements of parts 1345.1340 to 1345.1850.

The ventilation requirements, as herein stated, shall apply to every room hereafter designed, erected, altered, or converted for the purposes enumerated.

Subp. 2. **Heating systems required.** Heating systems complying with the requirements of this code shall be provided, maintained, and operated for all occupied areas within the scope of this code. See parts 1345.0200 to 1345.0360, 1345.0540 to 1345.1330, 1345.1340 to 1345.1850, and 1345.3090 to 1345.3130.

Subp. 3. **Cooling systems.** Cooling systems complying with the requirements of this code may be provided, maintained, and operated for occupied areas within the scope of this code. See parts 1345.0200 to 1345.0360 and 1345.1860 to 1345.2130.

Subp. 4. **Ventilating systems required.** Ventilating systems complying with the requirements of this code shall be provided, maintained, and operated to accomplish required ventilation for all occupied areas within the scope of this code.

Subp. 5. **Exhaust systems.** Exhaust systems shall discharge the air in a manner whereby the discharge from the system will be prevented from contaminating the breathing zone inside the building or reentering any occupied area.

Subp. 6. **Air supply.** Where ventilation is secured by exhaust methods, a supply of outside air shall be provided to replace the air exhausted from the area, if the volume of air exhausted exceeds one air change per hour. It is desirable that the air supply should be tempered.

The heat generated by kitchen appliances or other internal heat sources may be conserved by mixing room air with a quantity of outside air provided that dampers and temperature controls are designed into the system to maintain a minimum supply temperature of not less than 55 degrees Fahrenheit.

Subp. 7. **Contamination of adjacent area.** All equipment and service rooms which house sources of odors, fumes, noxious gases, excessive smoke, steam,

dust, spray, or other contamination detrimental to health, safety, or comfort shall be ventilated in a manner which prevents spreading of any such contamination to other parts of the building.

Subp. 8. **Final test required.** The performance of every heating, ventilating, and air conditioning air distribution system shall be tested and balanced in place. Whenever plans, specifications, and other data are required, a written record of the final results of such testing and balancing shall be made and a copy thereof filed with the administrative authority.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1360 DRAWINGS, SPECIFICATIONS, AND DATA.

Subpart 1. **Approval of drawings and specifications.** Complete drawings, specifications, and data sheets in duplicate for heating, ventilating, and air conditioning of all classes of buildings and occupancies within the scope of this code shall be submitted in order to evaluate compliance with this code. Approval shall be obtained before the affected work is begun.

Subp. 2. **Approval of changes on drawings.** Where it is necessary to change the approved drawings or specifications covered by this code, revised drawings in duplicate shall be submitted in order to evaluate compliance with this before the affected work is begun.

Subp. 3. **Information required on drawings and in specifications.** All information shown on the drawings shall be permanent, clear, legible, and complete, and shall include all details and data necessary for review of the proposed installation, such as:

- A. name of the owner of the building;
- B. proper address of the building;
- C. a room schedule, indicating the intended use of all rooms;
- D. elevation and sectional plans to illustrate and clarify equipment arrangements;
- E. location, size, and type of all principal units of equipment;
- F. size and continuity of all ducts and vents; and
- G. description and location of chimney or chimneys.

Architect, engineer, or designer's name shall appear on the title sheet. A floor plan for each floor where equipment is installed shall be furnished as part of the set of drawings. Specifications shall be properly identified with and completely supplement the drawings.

Subp. 4. **Data required.** All drawings submitted for review shall be accompanied by data indicating sufficient information to determine if the capacity of the equipment and the performance of the system will meet the minimum requirements of this code. The following data shall be submitted: heat loss calculated in Btu per hour; cooling load calculated in Btu per hour; ventilation requirements and calculations; and summation of total heating, ventilating, and cooling requirements.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1370 DESIGN REQUIREMENTS.

Subpart 1. **Installation of equipment.** All heating, ventilating, air conditioning, and refrigeration installations shall be designed and installed to provide the service and results required by this code.

Subp. 2. **Air cleaning apparatus.** Where air cleaning apparatus is installed, it shall be accessible for maintenance.

Subp. 3. **Maximum inlet temperature.** The room inlet temperature of air leaving the register or grills used for heating and ventilating purposes shall be designed on the basis not to exceed 140 degrees Fahrenheit.

Subp. 4. **Air quantity.** The quantity of air used to ventilate a given space during periods of occupancy shall be sufficient to maintain the standards of air temperature, air quality, air motion, and air distribution as required by this code.

Subp. 5. **Controls.** Where ventilation is required by this code, controls shall be provided so that the minimum air circulation, supply, and exhaust shall be maintained during periods of occupancy.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1371 OCCUPANCY CLASSIFICATION; TABLE 1.

The various occupancies to which the provisions of this code apply are classified as follows:

- A. Class 1, those which require ventilation on an occupancy basis;
- B. Class 2, those which require supply or exhaust ventilation on an occupancy basis unless otherwise exempted;
- C. Class 3, those which require exhaust;
- D. Class 4, those which require ventilation on the basis of floor area.

Note: The following (table 1) indicates the individual classifications of occupancies within the scope of this code together with the method to be used in establishing the number of persons for which ventilation is to be provided.

Table 1: minimum standard occupancy classification

Use or Occupancy	Classification	Basis of Capacity
Arenas and field houses	(1)	4 sq. ft. per person. Use seated area only.
Armories (drill halls)	(1)	30 sq. ft. per person.
Assembly halls	(1) or (2)	7 sq. ft. per person See part 1345.1490
Banquet halls	(1) or (2)	15 sq. ft. per person See part 1345.1490
Bath and shower rooms	(3)	See part 1345.1450
Barber shops	(2)	20 sq. ft. per person See part 1345.1490
Beauty parlors	(2)	20 sq. ft. per person See part 1345.1490
Billiard rooms	(1) or (2)	15 sq. ft. per person See part 1345.1490
Bowling alleys	(1) or (2)	Seating capacity plus 6 persons per alley. Terminate occupied area at foul line. See part 1345.1490
Brokerage boardrooms	(1) or (2)	7 sq. ft. per person See part 1345.1490
Cafeterias	(1) or (2)	15 sq. ft. per person See part 1345.1490
(Churches and other places of worship)	(2)	Dining room: 15 sq. ft. per person See part 1345.1400
Sunday School rooms)	(2)	15 sq. ft. per person See part 1345.1400
Club rooms	(1) or (2)	7-1/2 cfm per person
Dance halls	(1) or (2)	15 sq. ft. per person

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Dining rooms	(1) or (2)	See part 1345.1490 15 sq. ft. per person
Dry cleaners	(1) or (2)	See part 1345.1490
Embalsming rooms, autopsy rooms, and morgues	(3)	4 cfm per sq. ft.
First aid rest rooms	(4)	3 cfm per sq. ft. (exhaust)
Funeral homes	(1) or (2)	15 sq. ft. per person
Garages and service stations	(2)	See part 1345.1490 See part 1345.1500
General offices (Gymnasiums and combined gymna- siums and assembly halls)	(4) (1) or (2) (1)	See part 1345.1500 See part 1345.1480 6 sq. ft. per person for seated space; 15 sq. ft. per person for space not seated.
Hospitals	(1) or (2)	See part 1345.1520
Nursing Homes	(1) or (2)	See part 1345.1520
Janitor closets	(3)	See parts 1345.1450 and 1345.1520
Kitchens	(3)	See part 1345.1460
Laboratories	(1) or (3)	25 sq. ft. per person
Laundries	(3)	15 cfm per person or 1-1/2 air changes per hour, whichever is greater
Lecture halls	(1)	7 sq. ft. per person. Use seated areas only.
Library reading rooms	(1)	20 sq. ft. per person
Locker rooms	(3) or (4)	See part 1345.1440
Lodge halls	(1) or (2)	6 sq. ft. per person for seated areas; 15 sq. ft. per person for space not seated.
Mental hospitals	(1) or (2)	See part 1345.1490
Motion picture booth	(1) or (2)	See part 1345.1510
Penal institutions	(1) or (3)	See part 1345.1410
Playroom unfinished area	(1) or (2)	See part 1345.1510
Restaurants	(3)	23 sq. ft. per person
Retail establishments	(1) or (2)	15 sq. ft. per person See part 1345.1490 Basement: 40 sq. ft. per person. Other floor: 60 sq. ft. per person. See part 1345.1490
School all-purpose, dining and recreation rooms	(1) or (2) (1)	See part 1345.1490
School auditorium	(1)	15 sq. ft. per person
School classroom	(1)	7 sq. ft. per person
School kindergarten rooms	(1)	23 sq. ft. per person
School lecture rooms	(1)	23 sq. ft. per person 7 sq. ft. per person. Use seated area only
School project rooms	(1)	23 sq. ft. per person
School study rooms	(1)	16 sq. ft. per person

Security vault (occupied)	(4)	2 cfm per sq. ft.
Skating rinks	(1) or (2)	15 sq. ft. per person. See part 1345.1490
Swimming pools	(3)	See part 1345.1450
Taverns	(1) or (2)	20 sq. ft. per person See part 1345.1490
Theaters	(1)	7 sq. ft. per person
Theater lobbies	(1)	15 sq. ft. per person
Theater lounge rooms	(1)	15 sq. ft. per person
Toilet rooms	(3)	See part 1345.1450
Vocational instruction and research	(1) or (3)	40 sq. ft. per person
Wardrobes, locker, and cloak rooms	(3)	See part 1345.1440

Note: Air which has been exhausted and reconditioned by air conditioning equipment which simultaneously controls the temperature, humidity, and cleanliness of the air may be recirculated as equivalent fresh air, except where drawn from a toilet room, kitchen, operating room, mortuary, or room or space where hazardous dust, fumes, or gases, or objectionable odors are present. The air recirculated must be supplemented by at least ten percent fresh air.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1380 GENERAL REQUIREMENTS FOR OCCUPANCIES UNDER CLASSES 1 AND 2.

Subpart 1. **Scope.** The requirements of this part shall apply to all occupancies listed under item A or B in part 1345.1371 unless otherwise exempted by this code.

Subp. 2. **Air movements.** The total air circulated (recirculated plus outside air) for all occupancies in this classification shall not be less than six air changes per hour unless otherwise provided by this code.

The air delivery capacity of all equipment supplying air for heating, ventilating, and air conditioning purposes shall be based on standard air rating (70 degrees db and 29.92 inches).

For installations, where cooling is provided and the heat gain requirements for the space have been satisfied, an air movement of less than six air changes per hour may be permitted.

Subp. 3. **Outside air supply.** The outside air supply during occupancy shall not be less than 7-1/2 cubic feet per minute per occupant and an equal amount shall be exhausted unless otherwise exempted by this code. See part 1345.1371 for method used in determination of capacity.

Subp. 4. **Air distribution.** All air outlets and returns shall be so located, arranged, or equipped to provide distribution of air without objectionable air motion.

Subp. 5. **Recirculation.** No air contaminated by other than human occupancy shall be used for recirculation, except within the same occupancy classification.

Subp. 6. **Automatic controls.** Automatic controls shall be provided to maintain temperature and ventilation to satisfy the following conditions during periods of occupancy:

A. provide a continuous air movement of not less than the minimum required by this code;

B. provide a supply of tempered outside air as determined by the number of occupants of not less than 7-1/2 cubic feet of air per minute per person; and

C. maintain design temperature.

Subp. 7. **Air cleaning devices.** Approved air cleaning devices shall be installed in a manner to filter the outside air and recirculated air used with mechanical heating and ventilating systems except as follows. Filters are not required for use with unit heaters designed for heating and recirculation. Where jet systems or blend air systems are approved, air filters are not required in the ducts that are installed for the recirculation of air within the same occupied space.

Note: Filters carrying the Fire Underwriters approved label will be recognized as approved.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1390 GENERAL REQUIREMENTS: PLACES OF ASSEMBLY.

Subpart 1. **Scope.** This classification shall include all occupancies such as arenas, armories, assembly halls, banquet halls, billiard rooms, bowling alleys, cafeterias, club rooms, dance halls, dining rooms, restaurants, school auditoriums, skating rinks, and theaters.

Note: The above occupancies which accommodate less than 100 persons shall conform to the requirements of part 1345.1490.

Subp. 2. **Air movement, supply, and distribution.** The air movement, supply, and distribution for all occupancies under this classification shall conform to the requirements of part 1345.1380.

For theaters, assembly halls, gymnasiums, and similar occupancies having a ceiling height of 15 feet or more, the total air supply shall be based on at least six air changes per hour.

For theaters, assembly halls, gymnasiums, and similar occupancies having a ceiling height of less than 15 feet, the total air supply shall be based on at least 7-1/2 air changes per hour.

Subp. 3. **Stages.** The stage in any theater or assembly hall for which a fire curtain is required, shall be supplied with sufficient air or other means to equalize the pressure to avoid deflecting the curtain.

Subp. 4. **Alternate service and capacity.** Heating and ventilating systems installed in so-called community buildings and lodge halls may be arranged for selective delivery of the entire supply to either the first floor or to the basement floor area provided these areas are not used simultaneously.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1400 GENERAL REQUIREMENTS: CHURCHES, ETC.

Subpart 1. **Scope.** This classification shall include auditoriums, social assembly rooms, Sunday school rooms, and similar areas which are part of churches or houses of worship. It shall also include chapels used in connection with funeral homes, as well as those in parochial schools, convents, and similar occupancies.

Subp. 2. **Air movement, supply, and distribution.** The air movement, supply, and distribution for all occupancies under this classification shall conform to the requirements of part 1345.1380 except that no ventilation will be required where the total openable area of the outside doors and windows is greater than three percent of the floor area served, or that in funeral homes the openable area of the outside doors and windows shall be greater than five percent of the floor area served.

Subp. 3. **Alternate service.** Heating and ventilating systems installed in occupied areas of this class may be arranged for selective delivery of the required supply to either the auditorium floor area or to the basement floor area provided

these areas are not used simultaneously.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1410 GENERAL REQUIREMENTS FOR MOTION PICTURE BOOTHS.

Subpart 1. **Inlet.** Fresh-air inlets shall be provided from the exterior of the building and shall have an area not less than one square foot protected with wire screen and installed within two inches of the projection room floor. Fresh-air inlets other than those directly to the outside shall be protected by approved fire shutters.

Subp. 2. **Exhaust.** Ventilation shall be provided by one or more mechanical exhaust systems which shall draw air from each arc lamp housing and from one or more points near the ceiling. Systems shall exhaust to the outdoors either directly or through an incombustible flue used for no other purpose. The ventilation rate shall be not less than 15 cubic feet per minute nor more than 50 cubic feet per minute for each arc lamp plus 200 cubic feet per minute for the room itself.

Systems shall be controlled from within the enclosure and have pilot lights to indicate operation. The exhaust system serving the projection room may be extended to cover rooms associated therewith, such as rewind rooms. No dampers shall be installed in such exhaust systems.

Exhaust ducts shall be of incombustible material and shall either be kept one inch from combustible material or covered with one-half inch of incombustible insulation.

Subp. 3. **Shutters.** Each port and every other opening in projection room walls, including any fresh-air inlets, but excluding exit doors and exhaust ducts, shall be provided with a shutter of not less than 10 U.S. gauge sheet metal or its equivalent large enough to overlap at least one inch on all sides of such opening.

Shutters shall be arranged to slide without binding in guides constructed of material equal to the shutters in strength and fire resistance. Each shutter shall be equipped with a 165-degree Fahrenheit fusible link, which when fused by heat will cause closure of the shutter by gravity. There shall also be a fusible link over the upper magazine of each projector, which upon operating, will close all the shutters. In addition, there shall be provided a suitable means for manually closing all shutters from any projector head and from a point within the projection room near each exit door.

Shutters may be omitted when acetate (safety) film only is used.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1420 GENERAL REQUIREMENTS: SCHOOLS.

Subpart 1. **Scope.** This classification shall include all class, study, recitation, lecture, project rooms, kindergartens, library, reading rooms, and similar areas in all school, college, and library buildings used for educational purposes. (See part 1345.1380 for assembly rooms.)

Subp. 2. **Air movement and supply.** The air movement and supply for all occupancies under this classification shall conform to the requirements of part 1345.1371. For corridors and halls used in conjunction with occupied areas of this class the air movement shall not be less than ten cubic feet per minute per lineal foot of corridor or hall. This air supply shall be accomplished by means of air inlets admitting air from direct tempered air supply.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1430 GENERAL REQUIREMENTS: LABORATORIES, ETC.

Subpart 1. **Scope.** This classification shall include all places for vocational instruction and research, such as laboratories, school shops, domestic science rooms, and similar occupied areas.

Subp. 2. **Air movement and supply.** The air movement and supply for all occupancies under this classification shall conform to the requirements of part 1345.1371.

Subp. 3. **Equipment and process exhaust.** An exhaust ventilating system shall be provided in connection with all equipment and processes which create any dusts, fumes, vapors, or gases which may be injurious.

Subp. 4. **Separate exhaust systems.** Exhaust systems serving this classification shall be separate from and independent of all other services and systems in the building.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1440 GENERAL REQUIREMENTS FOR WARDROBES AND LOCKER ROOMS, ETC.

Subpart 1. **Scope.** This classification shall include all wardrobes, cloakrooms, locker rooms, and similar areas in all buildings within the scope of this code, except as noted herein.

Subp. 2. **Ventilation required.** Ventilation shall be provided and maintained for all areas of this class. Wherever practicable, such ventilation shall be accomplished by exhaust methods and in any case the volume of the exhaust shall be greater than that of the supply.

Subp. 3. **Minimum air movement.** The air movement provided and maintained for areas of this class shall be not less than two cubic feet per minute per square foot of floor area.

Subp. 4. **Wardrobes and coat rooms in school buildings.** Where necessary in order to ensure practical results in wardrobes or coat rooms adjacent to or connected with occupied areas covered by part 1345.2040, the required ventilation shall be accomplished by use of inlets admitting air from adjacent classrooms, or corridors, or similar areas in conjunction with outlets and ducts discharging directly to the outside of building.

Subp. 5. **Locker rooms in conjunction with toilet, bath, and swimming rooms.** Occupancies in this classification are required to have a tempered air supply which may be exhausted through the adjoining toilet, shower, or swimming rooms.

Subp. 6. **Fresh air and rest rooms.** Ventilation shall be provided for all areas of this class to conform to the requirements of part 1345.1380. Mechanical ventilation is not required where the total sash area is greater than ten percent of the floor area and where the openable area is at least five percent.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1450 GENERAL REQUIREMENTS FOR TOILETS, POOLS, ETC.

Subpart 1. **Scope.** This classification shall include all toilets, bath and swimming pool rooms, janitor closets, sterilizing rooms, and similar spaces.

Subp. 2. **Exhaust ventilation.** Gravity or mechanical exhaust ventilation shall be provided for all such rooms or space except for rooms or spaces having not more than one bathroom group (water closet, bidet, lavatory, bathtub, and/or shower) if said room or space has a minimum window area of three square feet, half of which is openable.

Subp. 3. **Air movement and supply.** The air movement provided and maintained in janitor closets, sterilizing rooms, and similar spaces shall not be less than two cubic feet per minute per square foot of floor area.

Rooms or spaces having one bathroom group as provided above or less and no openable outside window shall be ventilated at the rate of one cubic foot per minute per square foot of floor area.

Toilet rooms having more than one bathroom group as provided above shall be ventilated at the rate of two cubic feet per minute per square foot of floor area.

The air movement in swimming pool areas and public baths shall not be less than six air changes per hour and the tempered air supplied and exhausted shall not be less than two cubic feet of air per minute per square foot of pool surface.

Subp. 4. **Separate exhaust systems.** Exhaust systems serving this class of occupancy shall be separate from and independent of all other services in the building.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1460 GENERAL REQUIREMENTS: COMMERCIAL KITCHENS.

Subpart 1. **Scope.** This classification shall include all areas housing cooking of food in all buildings within the scope of this code, except residences and those classified under vocational instruction.

Subp. 2. **Exhaust ventilation.** The exhaust ventilation required and maintained for every occupied area of this class shall not be less than four cubic feet per minute per square foot of floor area except that kitchens used occasionally in connection with church auditoriums, lodge halls, and schools the exhaust ventilation may be reduced to a minimum of two cubic feet per minute per square foot of floor area.

Subp. 3. **Hoods.** The design of range hoods shall provide for the effective removal of greasy fumes and excess heat. Acceptable hood designs, air volumes, and air velocities are shown in parts 1345.1760 to 1345.1780.

Hoods over cooking or similar appliances must be constructed of noncombustible materials throughout, with tight sides and tops and have at least 18-inch clearance from all unprotected combustible materials.

The length and width of kitchen hoods must extend beyond the extreme projection of the ranges, broilers, etc., over which they are installed. The minimum projection or overlap shall be six inches.

Where space conditions permit, range hoods should be two feet high to provide a reservoir to confine momentary bursts of smoke and steam until the exhaust system can evacuate the hood. Range hoods must be located as low as possible to increase their effectiveness, and not more than seven feet from the floor.

Exhaust connections to range hoods shall always be made at the top or back of hoods, and shall be spaced preferably not more than six feet apart. Exhaust ducts shall be sized to maintain a velocity of 2,000 to 3,000 feet per minute.

Subp. 4. **Ducts.** Ducts for carrying off greasy vapors and excess heat shall be of not less than No. 18 U.S. gauge steel with grease-tight joints made by welding or equal processes.

All duct work shall be properly secured to ceiling or joists or supported by substantial brackets when run along the walls.

Exhaust ducts must have no connection with other house ventilating systems. They must not be connected to stacks, chimneys, or flues used for other purposes.

Exhaust piping to range hoods, commonly called grease ducts, shall be provided with tight fitting cleanout doors of adequate size located every ten feet on horizontal ducts but not located on the bottom of a duct. An approved type of filter shall be installed in all ducts or hoods over ranges, fry kettles, or any other cooking device where grease may accumulate.

Ducts or vents connected to range hoods passing through or near combustible construction shall be installed in accordance with the National Fire Protection Association Standard for Ventilation of Restaurant Cooking Equipment NFPA No. 96, Section 3, Ducts.

Manufactured chimneys may be used without additional fire-resistive protection provided that such chimneys have been approved for use with low-heat appliances and tests for a continuous temperature of not less than 1,000 degrees Fahrenheit and 1,400 degrees Fahrenheit for infrequent periods.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1470 RESIDENTIAL VENTILATION.

Subpart 1. **General.** When power exhaust fans are used for range or range hood ventilation in the kitchen of single, double, or multiple dwellings, the installation shall comply with the following requirements:

- A. All ducts shall be galvanized iron of not less than 28 gauge.
- B. All seams in the duct system shall be tight. Pressure-sensitive tape or other methods approved by the administrative authority can be used.
- C. Back draft dampers shall be provided near the outlet of the duct. These shall be in the closed position when the fan is not operating.
- D. A one-half inch mesh screen shall be installed at each exhaust outlet.
- E. Fans and duct systems shall be designed to permit cleaning and servicing.
- F. Whenever a duct or fan scroll lies within six inches of a combustible material, it shall be insulated with one-half inch glass fiber insulation, two layers of 12-pound asbestos paper or the equivalent.
- G. When a kitchen range hood faces a combustible material less than 30 inches above the cooking surface, the hood shall be separated from the combustible material by one-fourth inch asbestos board or equivalent.
- H. Ducts passing through unheated spaces shall be insulated with a minimum of one inch of glass fiber insulation or equivalent.
- I. Ducts located in a heated space shall be insulated with one inch of glass fiber insulation or equivalent for a distance of three feet from the duct outlet.

Subp. 2. **Toilet rooms.** Toilet rooms having only one fixture (water closet or urinal) and no openable outside windows shall be ventilated at the rate of at least one cubic foot per minute per square foot of floor area. See subpart 1, items H and I.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1480 OFFICES.

Subpart 1. **Scope.** This classification shall include areas where clerical and administrative work is the chief usage.

Subp. 2. **Ventilation required.** The air movement, supply, and distribution for this classification shall conform to the requirements of part 1345.1380 unless each of the following requirements has been satisfied:

- A. the total openable area of outside doors and windows is not less than three percent of the floor area served;
- B. the available floor space for each occupant is not less than 75 square feet per person; and
- C. heat or odors are not present in sufficient quantities to be injurious to the health, safety, or comfort of the occupants.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1490 RETAIL ESTABLISHMENTS.

Subpart 1. **Scope.** This classification shall include barber shops, beauty parlors, brokerage board rooms, taverns, bowling alleys, retail establishments where goods and commodities are bought and sold, and places where not more than 100 persons assemble for recreation, entertainment, or dining purposes.

Subp. 2. **Air movement, supply, and distribution.** The air movement, supply, and distribution for all occupancies under this classification shall conform to the requirements of part 1345.1380 unless the total openable area of outside doors and windows is more than three percent of the floor area served. No window or outdoor opening which is below grade will be considered unless there is a clear space outside the windows having a width of not less than 1-1/2 times the distance below grade at the bottom of the window.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1500 GARAGES AND SERVICE STATIONS.

Subpart 1. **Scope.** Ventilation shall be provided for all repair garages, service stations, body shops, and all live storage garages, housing six or more vehicles driven by internal combustion engines.

Note: A live storage area is any area within a building used for the storage of fire trucks, tractors, automobiles, trucks, and other self-propelled vehicles driven in and out under their own power.

Subp. 2. **Ventilation required.** Supply and exhaust ventilation shall be provided for all occupied areas in this classification during periods of occupancy.

Subp. 3. **Heated live storage area.** Areas used for the storage of six or more motor-driven vehicles and where heat is provided or required by this code shall be provided with a tempered supply of outside air or uncontaminated recirculated air of not less than three-fourths cubic foot per minute per square foot of floor area. Exhaust ventilation equal to the volume of air supplied must be provided for. This can be accomplished by either gravity or mechanical means. Pickups for exhaust ventilation shall be at or near the floor level.

Subp. 4. **Unheated live storage area.** Areas used for the storage of six or more motor-driven vehicles and where heat is not required by this code, shall be provided with exhaust ventilation based on three-fourths cubic foot of air per minute per square foot of floor area unless the following requirements have been satisfied:

- A. The floor area shall be at or above grade level.
- B. Permanent open wall of the included area shall not be less than 30 percent of the total wall area and shall be arranged to cause air circulation throughout the area. Any enclosed portion used for repair or servicing vehicles powered by internal combustion engines shall be provided with mechanical ventilation as required in subpart 7.

Subp. 5. **Basement and underground garages.** Basement and underground garages shall be provided with mechanical ventilation having positive means of exhausting air at the rate of three-fourths cubic foot per minute per square foot of floor area. An approved means of introducing an equal amount of outdoor or other uncontaminated air shall be provided. Air introduced shall be tempered to maintain the heating requirements of the ventilated space.

Subp. 6. **Residential garages.** Private residential garages of three-car capacity or less (when not used for commercial repair or commercial servicing operations) shall be exempted from the provisions of this part.

Subp. 7. **Repair areas.** All areas in which the repairing of motor-driven vehicles is done shall be supplied with a volume of tempered outside air or uncontaminated air not less than three-fourths cubic foot per minute per square foot of floor area. An equal volume of exhaust ventilation shall be provided and maintained.

In addition to the ventilation requirements, exhaust gases from the internal combustion engines being tested shall be discharged to the outdoors through a duct or flexible hose of noncombustible material of suitable size attached as an extension to the exhaust pipe. Repair stalls may be located adjacent to an outside wall so that ten feet or less of extension duct will reach the outdoors through openings not more than one foot above floor level. If repair stalls are not so located, each stall shall be provided with a suitable exhaust extension duct or flexible hose which shall be equipped with a device for connecting it to the exhaust pipe of the vehicle and the exhaust system. Each outlet shall be provided with a shutoff valve which may be closed when not in use. The mechanical exhaust system shall have a capacity in accordance with the following table:

Type	H.P.	Cfm per Tailpipe	Diameter of Flexible Duct
Gasoline	200 and under	100	3 inches
Gasoline	Over 200	200	4 inches
Diesel	-	400	4-1/2 inches

Subp. 8. **No basement repair.** No basement or subbasement garage shall be used for the repair of motor-driven vehicles.

Subp. 9. **Inspection and repair pits.** Inspection and repair pits shall be provided with a ventilating system capable of assuring one complete air change every five minutes. Floors of such pits shall have a minimum pitch of one inch for each ten feet. The exhaust air inlet opening or openings shall terminate in a grille which shall be perpendicular to the floor. The bottom of the openings shall extend to the floor at the lowest point or points of the pit.

Subp. 10. **Service stations.** Buildings of this classification shall include liquid fuel dispensing stations where vehicles can be driven into the building for washing, greasing, oil change, tire, or battery replacement or similar operations.

All service rooms or work areas shall be provided with a tempered supply of outside air of not less than one-half cubic foot per minute per square foot of floor area and with the necessary gravity or mechanical vent or vents exhausting the same volume of air from a point not more than 18 inches above the floor.

Subp. 11. **General requirements.** Ventilation shall be provided for showrooms or offices where such occupancies are located adjacent to repair or live storage areas and would require ventilation in accordance with part 1345.1380 unless the openable area or outside doors and windows exceed three percent of the floor areas. This requirement does not apply to service stations.

There shall be no recirculation of air from any repair, live storage, or service area during periods of occupancy except where the total amount of air in circulation is in excess of the quantity required by this part, the excess air may be recirculated.

The air that is exhausted from the repair, live storage, and service areas in a building shall be removed at a point not more than 18 inches above the floor through properly distributed vent ducts located in areas of greatest contamination. Where the exhaust is by gravity, the vent duct or ducts shall extend from a point not more than 18 inches above the floor line up through the roof of the building and shall be capped with an approved siphon-type roof ventilator extending at least two feet above the high point of the roof or above the top of the parapet whichever is higher, unless otherwise approved.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1510 PENAL INSTITUTIONS, ETC.

Subpart 1. **Scope.** This classification shall include corridors and areas of compulsory occupancy in penal institutions, mental hospitals, and other places of detention.

Subp. 2. **Air movement, supply, and distribution.** The air movement, supply, and distribution for all occupancies under this classification shall be accomplished by mechanical means and shall conform to the requirements of parts 1345.1370 and 1345.1371. The air movement through corridors shall be a minimum of ten cubic feet per minute per lineal foot of corridor.

Subp. 3. **Overnight lockups.** Where cells are provided for not more than six occupants for the purpose of overnight detention only, exhaust ventilation shall be provided on the basis of at least six air changes per hour for the occupied area.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1520 HOSPITALS AND NURSING HOMES.

All heating, ventilating, and air conditioning in hospitals and nursing homes shall conform to Minnesota Statutes and the current rules of the Minnesota Department of Health for the construction, equipment, maintenance, operation, and licensing of hospitals and nursing homes, adopted pursuant thereto.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1530 OUTSIDE VENTILATING FRESH AIR INTAKES.

Subpart 1. **Location.** Outside air intake openings shall be located in distance of at least 20 feet horizontally or ten feet vertically from vents and chimney outlets.

Where vents and intakes are located on adjacent walls of outside corners, the horizontal distance may be reduced to ten feet.

Outside air intake openings located in exterior walls shall be located at least ten feet (measured in any direction) from any exhaust vent or chimney outlet.

Subp. 2. **Mounting height.** Outside air intake openings shall be located at least eight feet above the outside grade or two feet above roof. Exemptions of this provision must be approved.

Where outside air intake openings are located in any areaway below grade, the top of the areaway shall be not less than 12 inches above the grade level.

Subp. 3. **Screens.** All outside air intake openings shall be provided with screening not more than one-half inch nor less than one-fourth inch mesh.

Note: See part 1345.1800 for allowable velocities in the design of outside air intake openings.

Subp. 4. **Weather protection.** All outside air intake openings shall be protected against weather and water with a weather resistant hood or louvers. All outside air intakes, except intakes for combustion air, shall be equipped with a damper to prevent the admission of unheated air to the building when the heating unit is not in operation.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1540 COMBUSTION AIR INTAKES.

Subpart 1. **Fuel inputs above 500,000 Btu per hour.** All boiler rooms and furnace rooms shall be provided with an opening to the outside air. The free area of such opening shall not be less than one square inch for each 5,000 Btu per hour of fuel consumed, except the minimum free area of such opening shall not be less than 100 square inches.

The use of manual operated dampers is not approved.

The use of motorized dampers is approved where the motor is interconnected with the burner(s) of direct-fired equipment which will open the

damper, when burner(s) is operating. The burner and damper shall be so interconnected so that the burner shall not start before the damper is open.

Subp. 2. **Fuel inputs less than 500,000 Btu per hour.** Outside air to the appliance area for proper fuel combustion shall be provided by openings to the outside of the building or to spaces freely communicating to the outside of the building. The openings of ducts supplying such air shall have unobstructed areas not less than the area of the minimum required common flue or flues serving the heating system and other fuel-burning appliances in the area, and shall discharge such outside air at a point not more than one foot above the floor.

Subp. 3. **Alternate combustion air method; less than 500,000 Btu per hour.** Air for combustion may be introduced into the return air plenum of a forced air system provided that an unobstructed opening into the appliance area is installed in the supply side of the system. The opening shall have a minimum area of 50 percent of the common flue area.

Subp. 4. **Furnace in small room; less than 500,000 Btu per hour.** When a furnace is installed in a small utility room or other combined space, a sufficient quantity of air must enter the space in which the furnace is located to supply both the air required for combustion and for ventilating the space to prevent it from becoming overheated. Combustion air opening shall be as outlined in subpart 3. Ventilation air shall be supplied to the confined space through two openings to the interior of the building and located as follows:

A. Ventilation air outlet grille located in the wall or door at a height above the draft hood opening. The free area of the opening shall be one-half square inch for each 1,000 Btu per hour of input.

B. Ventilation air inlet grille located in the wall or door at or below combustion air inlet to burner. The free area of the opening shall be one-half square inch for each 1,000 Btu per hour of input.

Subp. 5. **Accessibility and cleanliness.** All outside air intakes shall be constructed and maintained accessible for cleaning. All openings through walls of buildings shall be not less than one foot above the grade level and be protected with screen of not more than one-half inch nor less than one-fourth inch mesh.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1550 AIR CLEANING APPARATUS.

Contaminated water shall not be recirculated through sprays affecting air used for ventilation purposes.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1560 DUCTS FOR RESIDENTIAL APPLICATION.

Subpart 1. **Duct construction.** The construction of all duct work hereafter installed in connection with any warm air heating system, mechanical ventilation system, or air-conditioning system shall be in accordance with the following provisions. The thickness of sheet metal ductwork shall be in accordance with the gauges listed in part 1345.1790. Materials other than sheet metal may be used for the construction of ductwork when they conform to the requirements of the National Fire Protection Association Standard for the Installation of Residence Type Warm Air Heating and Air Conditioning Systems. NFPA 90B, Sections 121, 181, 182, 183, 184, and 185, Materials for Ducts, and of the Sheet Metal and Air Conditioning Contractors National Association, Inc. duct manual, "Fibrous Glass Construction for Ventilating and Air Conditioning Systems." No duct smaller than five inches in diameter, or corresponding area for rectangular duct of equal friction loss shall be installed except for rooms with less than 75 square feet of ceiling area, or unless otherwise approved by the administrative authority.

Subp. 2. **Installation ductwork.** Ducts shall be securely supported by metal hangers, straps, lugs, or brackets. The ducts shall not be used for the support of any other materials or equipment.

No nails shall be driven through the duct walls and no unnecessary holes shall be cut in them.

When it is necessary to install heating supply ducts in outside walls or in unheated spaces, the duct must be effectively insulated against exposure with insulation having a conductivity value (k) of not more than 0.40 (See part 1345.0540).

Subp. 3. **Return air.** Where return air is taken from first floor through a register box placed between studs, the stud space containing such box shall be effectively sealed to prevent air from stud space above being drawn into the system.

Where return air from upper floors is conducted to the basement through stud spaces any thermal insulation of a flexible type installed in such stud spaces shall be so installed and secured in position as to prevent its encroachment on the open area of said stud spaces due to swelling, buckling, or sagging.

Where the space between joists is used for the purposes of conveyance of return air to the furnace, such joist spaces shall be covered on the bottom of the joists with metal not less than 32 gauge, nailed, or stapled three inches on center. A vapor-resistant material shall be used for sealing the top of the joist spaces except when sheet plywood is used for subflooring.

Return air ducts passing through attached private garages shall be sealed against fumes.

Subp. 4. **Insulation.** Exposed warm air ducts passing through attached private garages whether heated or not, shall be insulated with incombustible insulation having a conductivity value (k) of 0.40 (see part 1345.0540).

Subp. 5. **Miscellaneous.** Elbows shall be provided with splitters or diffuser vanes where necessary to maintain uniform velocities throughout duct area and reduce turbulence and impact losses. Transformation fittings shall be made with gradual slope. Fan discharge connections shall have a maximum slope of one inch in seven inches. Where a pipe or other obstruction passes through a duct, a streamlined sleeve of sheet metal shall be installed around such obstruction and shall be soldered to duct at ends to make it air tight. The area of the duct, at point of such obstruction, shall be increased by an amount equal to the streamlined sleeve.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1570 DUCTWORK FOR OTHER THAN RESIDENTIAL APPLICATION.

Subpart 1. **Design.** All ducts shall be designed to promote the unrestricted flow of air with long sweep or turning vanes.

Subp. 2. **Air velocities.** For the purpose of calculation and design, the air velocities shall not in general exceed the maximum velocities as recommended in part 1345.1800.

Subp. 3. **Construction and installation.** The recommended gauges and construction for rectangular sheet metal ducts and for round and flat oval ducts shall be in accordance to the values recommended in parts 1345.1810 to 1345.1850. Materials other than sheet metal see part 1345.1560, subpart 1.

Ducts shall be securely supported by hangers, straps, lugs, or brackets. The ducts shall not be used for the support of any other materials or equipment.

No nails shall be driven through the duct walls and no unnecessary holes shall be cut in them.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1580 UNDERGROUND DUCT CONSTRUCTION AND INSTALLATION.

Subpart 1. **General classification.** There are two general types of materials which can be used. One type must be completely encased in concrete, and the other need not be completely encased in concrete. Duct materials are classified and described below. The type numbers are arbitrarily chosen and do not indicate in anyway the degree of acceptability of the various types.

Subp. 2. **Drain tile.** No underground duct shall be installed where water conditions may occur unless means are provided to collect and drain surface and underground water by the installation of drain tile around the perimeter of the space served by the underground duct system. The top of the drain tile shall be at an elevation lower than the bottom of the underground duct.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1590 TYPES OF DUCTS.

Subpart 1. **Type 1 material.** Ducts constructed of type 1 material are described as follows:

- A. ducts which will float when concrete is being poured;
- B. material which is subject to corrosion by concrete;
- C. material which is noncombustible. An example of this material is galvanized sheet metal. See part 1345.1850, subpart 1.

Ducts of this type must be encased in not less than two inches of concrete and with a minimum of 2-1/2 inches of concrete above the duct; and equivalent in strength and durability to 26 gauge, galvanized-steel round duct of eight-inch diameter.

Subp. 2. **Type 2 material.** Ducts constructed of type 2 materials are described as follows:

- A. ducts which will float when concrete is being poured;
- B. ducts constructed of material which is not subject to corrosion by concrete;
- C. ducts constructed of material which is noncombustible. An example of this material would be stainless steel. See part 1345.1850, subpart 2. Ducts of this type must provide a minimum of 2-1/2 inch of concrete above the duct and be equivalent in strength of 26 gauge, galvanized steel, round duct of eight-inch diameter.

Subp. 3. **Type 3 material.** Ducts constructed of type 3 material are described as follows: ducts which will float when concrete is being poured; materials which is subject to moisture transmission; material which is combustible. An example is laminated paper or other organic fiber. See part 1345.1850, subpart 5.

Ducts of this material must:

A. Satisfy the requirements set forth in Federal Housing Administration, "Heating and Air Conditioning Ducts Encased and Under Concrete Slabs or Ground," Publication 838 of the National Academy of Sciences, National Research Council, Washington, D.C. (This criterion and test procedure covers fire resistance, crushing strength, bending strength, deterioration, and odor, delamination, and hydrogen ion concentration.)

B. Not be encased in not less than two inches of concrete and with a minimum of 2-1/2 inch of concrete above the duct.

C. Not be used within two feet of the furnace supply plenum nor within two feet of a vertical connection to a riser or register.

Subp. 4. **Type 4 material.** Ducts constructed of type 4 material are described as follows: material which is subject to moisture transmission; material which is not subject to corrosion by concrete; ducts which will not float when concrete is being poured; and material which is noncombustible.

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Examples of this are ceramic pipe having a moisture absorption in excess of eight percent and concrete pipe. See part 1345.1850, subpart 2.

Ducts of this material must be covered with not less than 2-1/2 inch of concrete above the duct and equivalent in strength and durability to 26 gauge galvanized steel, round duct of eight-inch diameter.

Subp. 5. **Type 5 material.** Ducts constructed of type 5 material are described as follows: material which is not subject to moisture transmission; material which is not subject to corrosion by concrete; ducts which will not float when concrete is being poured; and material which is noncombustible. Examples of this are asbestos-cement pipe and ceramic pipe, but fired to a moisture absorption not to exceed eight percent, and trademarked by its manufacturer for identification. See part 1345.1850, subpart 3.

Ducts of this material must be equivalent in strength and durability to 26 gauge galvanized-steel, round duct of eight-inch diameter and installed so that there is a minimum of 2-1/2 inch of concrete above the duct, but need not be completely encased in concrete. (Where bell and spigot joints are used, there must be a minimum of two inches of concrete above the bell.)

Part 1345.1850, subpart 6 shows construction details for the above-named types of materials.

Subp. 6. **Prevention of floating.** All ducts which tend to float, types 1, 2, and 3, should be securely held in place when the slab is poured. The ducts must be brought to the proper level and pitch by placing concrete or other suitable materials under them at eight-foot intervals for support. They must be anchored to prevent floating. This can be accomplished by either one of the two following methods:

A. Placing shovelful of concrete at eight-foot intervals on the vapor barrier and under the ducts. Wires shall be embedded in the concrete at these intervals and then wrapped around the ducts after the concrete has hardened. See part 1345.1850, subpart 4.

B. By making a preliminary pour of concrete around the bottom of the ducts, holding them in place with suitable weights or blocking and completing the operation after the first pour has set sufficiently to hold the ducts in place. See part 1345.1850, subpart 5.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1600 VAPOR BARRIER.

Subpart 1. **Residential installations.** A vapor barrier must be placed between the fill and the bottom of the slab as shown in part 1345.1850, subparts 1 to 5.

The barrier shall be polyethylene, four mil in thickness or equal.

It must completely cover the area within the foundation walls and extend up the walls to the top of the foundation.

All joints must be lapped four inches to six inches and preferably sealed with a suitable material.

Whenever the vapor barrier is pierced by tie-rods, utility pipes, etc., the hole must be sealed.

Subp. 2. **Other installations.** If duct only is encased, it should be done in accordance with subpart 1, second and fourth paragraphs (not required when duct material is both vapor resistant and noncorrosive).

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1610 MECHANICAL SYSTEMS

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1345.1610 FLOOR SLAB INSULATION.

Insulation must be placed completely around the edge of the slab when less than 42 inches below finish grade.

A minimum recommendation is that the insulation material should have a conductance at 70 degrees Fahrenheit of not more than .40 Btu per hour per square foot per degree Fahrenheit temperature difference.

The material shall be moisture-proof, vermin- and insect-proof, and resistant to deterioration.

If installed vertically on the inside surface of the footing wall, it should extend downward not less than 18 inches from the top of the slab. See part 1345.1850, subparts 5 and 6.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1620 DRAINAGE.

Underground ducts shall be provided with free drainage to a lower room of the building or to a sump to provide natural drainage of the ducts. Access openings shall be provided for inspection and cleaning service at each low point of the system. All such ducts shall be constructed without a direct sewer connection.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1630 ROOM INLETS AND OUTLETS.

All room inlets and outlets for underground ducts shall have reasonably watertight connections where the risers are connected to underground ducts.

Where supply air ducts are installed parallel and adjacent to an outside wall, a moisture-proof insulating material shall be provided having a thermal conductance factor of .125 Btu per hour per square foot per degree Fahrenheit and extending from bottom of floor to two feet below finished grade.

The insulation shall be a cellular block-type with the cell linkage providing a vapor seal. The material shall withstand a sustained minimum pressure of five pounds per square inch.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1640 PIPES IN DUCTS.

Pipes carrying nonhazardous material may be installed in underground ducts, provided that the net free area is sufficient for the flow of air and the inside dimensions of the duct are greater than four feet wide and four feet high.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1650 SUSPENDED CEILING PLENUM.

When the void above suspended ceiling is used as a supply or return air plenum, pipes carrying hazardous materials shall not be installed in the plenum unless the pipes are sleeved and the sleeve ventilated by gravity to the outside. The plenum shall be of incombustible construction. Any openings to this space not connected to the duct system that would affect the fire-resistive rating of the roof and ceiling construction are prohibited.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1660 INSULATION OF DUCTS.

Where air conditioning supply ducts are exposed in a manner which creates a temperature drop of more than ten percent for heating and a temperature rise of four percent on cooling from the plenum temperature, the duct shall be insulated to meet this requirement.

The temperature drop considered shall be from the plenum to the furthest register.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1670 SEPARATE VENT DUCTS.

Separate exhaust systems shall be provided for kitchen and bathroom exhaust. Exhaust vent ducts, serving similar occupancies, shall be continuous to a gathering chamber immediately below the point of final delivery to the outside atmosphere, such as the basin of a roof ventilator.

This requirement prohibits the use of open pipe spaces as a substitute for a continuous duct.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1680 VENT DUCTS, HORIZONTAL RUN.

Horizontal runs in vent ducts connected to siphon-type roof ventilators shall be avoided wherever possible and the maximum practicable inclination shall be provided in all cases. In no case shall the horizontal run exceed 30 percent of the vertical run unless the room has a direct mechanical supply or the vent duct is connected to an exhaust fan.

Where the interior spaces are subject to pressure changes, an automatic back draft damper shall be provided. Hand-operated dampers shall not be installed in vent ducts that are connected to a siphon-type roof ventilator.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1690 VENT DUCTS ABOVE ROOF.

Final delivery of all vent circuits shall be protected from the weather and shall be located and constructed to prevent contamination of air supply for or in any occupied area.

Gravity vent ducts shall extend not less than two feet above the high portion of the roof or parapet wall, and shall be surmounted with an approved type of siphon-roof ventilator.

A drip pan shall be provided below all gravity vents.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1700 RELIEF VENTS.

Barometric relief vents may not be used in lieu of siphon ventilators where ventilation is required by the exhaust method for occupancies classified as classes 3 and 4 in part 1345.1371.

Barometric relief vents may be used to exhaust an air volume equal to the mechanical ventilation supplied for occupancies classified as classes 1 and 2 in part 1345.1371.

Where barometric relief vents are installed on the roof, the discharge opening shall not be less than two feet above the high portion of the roof.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1710 VOLUME DAMPERS AND DEFLECTORS.

Necessary volume dampers, splitters, and deflectors shall be provided for all ducts to permit accurate balancing of the system, and such dampers, splitters, and deflectors shall be set according to air measurements of the system and shall be locked in place.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1720 MECHANICAL SYSTEMS

1345.1720 OUTLETS AND RETURNS.

Subpart 1. **Number and arrangement.** The capacity, number, and arrangement of supply outlets, returns, and exhausts shall be such as to ensure a reasonably uniform distribution of air throughout the areas served during all periods of occupancy.

Subp. 2. **Elevator shafts and stairwells.** Elevator shafts and stairwells shall not be used for ventilation purposes nor shall they be permitted to interfere with the effectiveness of the installation, except where there is a change in elevations and doors are not provided or are not required to separate the stairwell or elevator shaft from other areas.

Subp. 3. **Outlets and returns for gravity systems.** Gravity outlets and returns shall be arranged in a manner which utilizes every possible natural advantage to provide proper and effective air movement and distribution.

Subp. 4. **Grilles or diffusers required.** All air supply outlets and returns shall be equipped with grilles or devices which will provide a reasonably uniform distribution of air.

Subp. 5. **Floor registers.** Floor registers shall be specifically designed for this use.

Subp. 6. **Corridor ventilation.** Air from occupied areas uncontaminated by other than human occupancy may be discharged into corridors and recirculated or vented through auxiliary spaces, such as built-in lockers, toilet rooms, kitchens, or similar areas. Where the vent capacity of such auxiliary spaces is insufficient, additional direct vent flues shall be provided.

Where lockers installed in recessed walls are used for venting purposes, each inlet and outlet shall have a net free area of not less than 15 square inches per lineal foot of locker width.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1730 PAINT SPRAY AREAS.

Paint spray areas shall comply with the construction, mechanical ventilation, make up air, and flammable liquid storage standards set forth in the American Standard Safety Code for the Design, Construction, and Ventilation of Spray Finishing Operations (Z 9.3) published by American National Standards Institute.

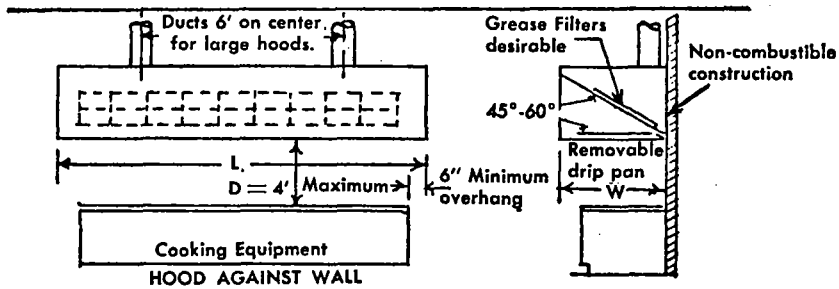
Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1740 FIRE DAMPERS IN DUCTS PASSING THROUGH FIRE SEPARATION.

Wherever ducts pass through fire walls or connect two fire areas of a building, automatic fire dampers shall be provided. The design of such dampers and other fire protective details shall be in accordance with the requirements of parts 1345.3250 to 1345.3300.

Statutory Authority: *MS s 16B.59 to 16B.73*

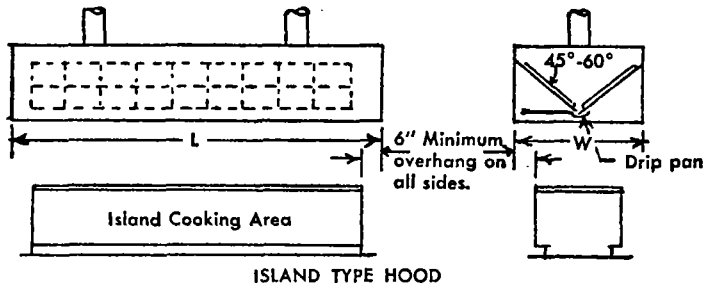
1345.1760 KITCHEN HOOD; AGAINST WALL.



$P = \text{Perimeter of hood} = 2W + L$
 $Q = 80 \text{ cfm/square feet of hood area } (80WL).$
 Not less than 50 cfm/sq. ft. of face area (50 PD).
 Duct velocity = 2000-3000 fpm
 Entry loss = 0.25 inches (filter resistance) + 0.50 duct VP.
 Grease filters - see part 1345.1780.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1770 KITCHEN HOOD; ISLAND TYPE.

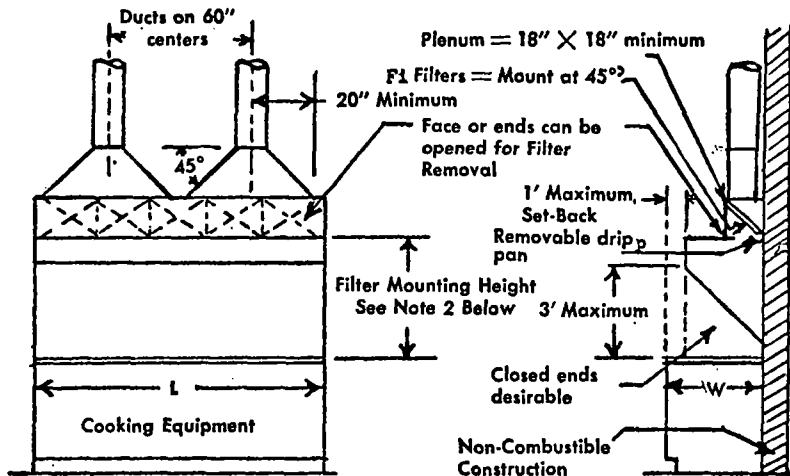


$P = \text{Perimeter of hood} = 2W + 2L$
 $Q = 125 \text{ cfm/square feet of hood area } (125 WL).$
 Not less than 50 cfm/sq. ft. of face area (50 PD).
 Duct velocity = 2000-3000 fpm
 Entry loss = 0.25 inches (filter resistance) + 0.50 duct VP.
 Grease filters - see part 1345.1780.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1780 KITCHEN HOOD, LOW SIDE WALL.

Subpart 1. Illustration.



LOW SIDE WALL HOOD

$Q = 200$ cfm per lineal foot of cooking surface ($200L$)

Duct Velocity = 2000-3000 fpm

Entry Loss = 0.25 (filters) + 0.25 duct VP

Subp. 2. **Filter requirements for kitchen hoods.** Number of filters shall be based on not more than three cubic feet per minute for each square inch of filter area and shall be installed between 45 degrees to 60 degrees to horizontal.

Filter mounting height:

A. No exposed cooking flame, two and one-half foot minimum to lowest edge of filter.

B. Charcoal and similar fires, four and one-half foot minimum to lowest edge of filter.

C. Other exposed fires, three and one-half foot minimum to lowest edge of filter.

An easily removable grease drip pan shall be provided and it should be pitched so that it will drain into the gutters of the hood.

Filter media shall be noninflammable.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1790 METAL THICKNESS OF SHEET METAL DUCTWORK USED FOR RESIDENTIAL PURPOSES.

Diameter or Width (inches)	Minimum Thickness Galvanized Iron (U.S. Gauge)	Minimum Thickness Aluminum (B and S Gauge)
Round ducts		
Less than 14	30	26
14 or more	28	24
Rectangular Ducts Enclosed in Partitions		
14 or less	30	26
Over 14	28	24

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Rectangular Ducts Not Enclosed

14 or less	28	24
Over 14	26	24

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1800 RECOMMENDED AND MAXIMUM DUCT VELOCITIES FOR LOW PRESSURE SYSTEMS.

Velocities, Fpm

Designation	Residences		Schools, Theaters, Public Buildings		Industrial Buildings	
	Rec.	Max.	Rec.	Max.	Rec.	Max.
Outdoor Air Intakes*	500	800	500	900	500	1200
Filters	250	300	300	350	350	350
Heating Coils	450	500	500	600	600	700
Air Washers	500	500	500	500	500	500
Fan Outlets	1000- 1600	1700	1300- 2000	1500- 2200	1600- 2400	1700- 2800
Main Ducts	700- 900	800- 1200	1000- 1300	1100- 1600	1200- 1800	1300- 2200
Branch Ducts	600	700- 1000	600- 900	800- 1300	800- 1000	1000- 1800
Branch Risers	500	650- 800	600- 700	800- 1200	800	1000- 1600

*Free agent







Statutory Authority: *MS s 16B.59 to 16B.73*

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1345.1810 RECOMMENDED CONSTRUCTION FOR RECTANGULAR LOW PRESSURE DUCTS.

Dimension of Longest Side, Inches	Sheet Metal Gage (All Four Sides) ^a			Transverse Reinforcing ^b								
				Between Joints ^d		At Joints ^e						
	Steel Gage	Aluminum Alloy ^b Thickness, In.	Copper Oz. Per Sq. Ft.	Minimum Reinforcing Angle Size and Maximum Longitudinal Spacing	 Flat S Slip  Drive Slip	 Standing S Slip	 Standing Seam Joint  Pocket Lock  Alternate Standing S Slip			Min. Gage for Pocket Lock or Standing S Slip	Min. Angle Size	Min. Height, Inches
							Min. Gage	Min. Gage	Min. Angle Size			
Up thru 12	26	0.020	16	None Required	26	24	None Required	24	None Required	1		
13-18	24	0.025	24	None Required	24	24	None Required	24	None Required	1		
19-30	24	0.025	24	1 x 1 x 1/4 @ 60 in.	—	24	None Required	24	None Required	1		
31-42	22	0.032	32	1 x 1 x 1/4 @ 60 in.	—	22	None Required	22	None Required	1		
43-48	22	0.032	32	1 1/2 x 1 1/2 x 1/4 @ 60 in.	—	22	1 1/2 x 1 1/2 x 1/4	22	None Required	1 1/2		
49-54	22	0.032	32	1 1/2 x 1 1/2 x 1/4 @ 48 in.	—	22	1 1/2 x 1 1/2 x 1/4	22	None Required	1 1/2		
55-60	20	0.040	36	1 1/2 x 1 1/2 x 1/4 @ 48 in.	—	22	1 1/2 x 1 1/2 x 1/4	22	None Required	1 1/2		
61-84	20	0.040	36	1 1/2 x 1 1/2 x 1/4 @ 24 in.	—	22	1 1/2 x 1 1/2 x 1/4	22	1 1/2 x 1 1/2 x 1/4	1 1/2		
85-96	18	0.050	48	1 1/2 x 1 1/2 x 1/4 @ 24 in.	—	22	1 1/2 x 1 1/2 x 1/4	22	1 1/2 x 1 1/2 x 1/4	1 1/2		
97-120	18	0.050	48	2 x 2 x 1/4 @ 24 in.	—	22	2 x 2 x 1/4	22	2 x 2 x 1/4	1 1/2		
121 and Over	18	0.050	48	2 x 2 x 1/4 @ 24 in. with tie rods @ 120 in. along angle	—	—	—	22	2 x 2 x 1/4 with tie rods @ 120 in. along joint	1 1/2		

^aFlat areas of duct over 18 in. wide shall be stiffened by crossbracing unless duct will have non-conductive covering or sound absorbing lining.
^bSuitable aluminum alloys are: Commercial Designation 3003 Temper H14 and Duct Sheet.
^cTransverse reinforcing size is determined by dimension of side to which angle is applied. Angle sizes are based on mild steel. Reinforcing made in other shapes or of other materials must be of equivalent strength and rigidity.
^dThere is no restriction on the length of duct sections between joints. Ducts are normally made in sections of 4, 8, 10 or 12 ft. in length. The longitudinal spacing of the transverse reinforcing between joints may necessarily be less than the spacing recommended in the table in order to conform to the selected length module.
^eOther joint types of equivalent strength, rigidity and air tightness may be used.
^fFor aluminum or copper ducts 43 in. through 48 in. maximum longitudinal spacing of transverse reinforcing is 48 in.
^gLow pressure considered to be 2 in. water static pressure or less.

Statutory Authority: MS s 16B.59 to 16B.73

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1345.1820 RECOMMENDED CONSTRUCTION FOR ROUND DUCTS.

Statutory Authority: MS s 16B.59 to 16B.73

Duct Diameter, Inches	Steel—Galv. Sheet Gage				Girth Reinforcing Minimum Reinforcing Angle Size and Maximum Longitudinal Spacing	Girth Joints ^a	
	Low Pressure ^b Ducts and Fittings	Medium and High Pressure Ducts ^c				(Continuously Welded or as Below)	
		Spiral Lock Seam Duct	Longitudinal Seam Duct	Welded Fittings ^a		Low Pressure Ducts	Medium and High Pressure Ducts
Up thru 8	26	26	24	22	None required	Crimped and beaded joint	2 in. long slip joint
9-13	26	24	22	20	None required	Crimped and beaded joint	4 in. long slip joint
14-22	24	24	22	20	None required	Crimped and beaded joint	4 in. long slip joint
23-36	→	22	20	20	None required	—	4 in. long slip joint
37-50	→	20	20	18	1½ × 1½ × ¼ @72 in.	—	1½ × 1½ × ¼ angle flanged joint
51-60	→	—	18	18	1½ × 1½ × ¼ @72 in.	—	1½ × 1½ × ¼ angle flanged joint
61-84	→	—	16	16	1½ × 1½ × ¼ @48 in.	—	1½ × 1½ × ¼ angle flanged joint

^a Flanged joints may be considered as girth reinforcing. → use next recommended construction.
^b Low pressure considered to be 2 in. water static pressure or less.
^c Medium and high pressure considered to be from 2 to 10 in. water static pressure.

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1345.1830 RECOMMENDED CONSTRUCTION FOR RECTANGULAR MEDIUM PRESSURE DUCTS.

		Transverse Reinforcing											
		Between Joints ^a						At Joints					
Dimension of Longest Side, Inches	Galv. Sheet Gage (All Four Sides)	Minimum Reinforcing Angle Size and Maximum Longitudinal Spacing		Welded Flange	Double Slip	Inside Slip Joint	Welded Flange	Standing Seam	Reinforced Standing Seam	Flanged Joint	Pocket Lock	Companion Angle Flanged Joint	
		With Tie Rods	Without Tie Rods										Min. Height, In.
Up thru 12	24	No tie rods required	No angle required	M	None required		M	1	1	1	1	$1\frac{1}{4} \times 1\frac{1}{4} \times \frac{1}{4}$	
13-18	24	1 tie rod @ 48 in. intervals on Center-line of duct side	1X1X16 Gage @ 48 in.	M	1X1X16 Gage		M	1	1	1	1	$1\frac{1}{4} \times 1\frac{1}{4} \times \frac{1}{4}$	
19-24	22	1 tie rod @ 48 in. intervals on center-line of duct side	1X1X14 @ 48 in.	1M	1X1X14		1M	1 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$	
25-36	22	→	1X1X14 @ 32 in. or 1 $\frac{1}{4}$ X1 $\frac{1}{4}$ X $\frac{1}{2}$ @ 40 in.	1 $\frac{1}{2}$ with tie rod in center	1 $\frac{1}{2}$ X1 $\frac{1}{2}$ X $\frac{1}{4}$		1 $\frac{1}{2}$ with tie rod in center	1 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$	
37-48	22	→	1 $\frac{1}{2}$ X1 $\frac{1}{2}$ X $\frac{1}{4}$ @ 30 in.	1 $\frac{1}{2}$ with tie rod in center	1 $\frac{1}{2}$ X1 $\frac{1}{2}$ X $\frac{1}{4}$		1 $\frac{1}{2}$ with tie rod in center	1 $\frac{1}{2}$	1 $\frac{1}{2}$	2	—	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$	

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Statutory Authority: MS s 16B.59 to 16B.73

49-60	20	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{2}$ @ 24 in. with tie rod in center	$2 \times 2 \times \frac{1}{4}$ @ 24 in.	$2 \times 2 \times \frac{1}{2}$ OR $1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{2}$ with tie rod in center	$1\frac{1}{2}$ with tie rod in center	$1\frac{1}{2}$ with tie rod in center	$1\frac{1}{2}$	$2 \times 2 \times \frac{1}{2}$	$1\frac{1}{2}$ with tie rod in center	—	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{2}$
61-72	20	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{2}$ @ 24 in. with tie rod in center	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{2}$ @ 24 in.	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{2}$ OR $1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{2}$ with tie rod in center	1M with 2 tie rods	2 with tie rod in center	$1\frac{1}{2}$	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{2}$	$1\frac{1}{2}$ with tie rod in center	—	$2 \times 2 \times \frac{1}{2}$ OR $1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{2}$ with tie rod in center
73-84	18	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{2}$ @ 24 in. with tie rod in center	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{2}$ @ 24 in.	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{2}$ OR $1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{2}$ with tie rod in center	1M with 2 tie rods	2 with tie rod in center	$1\frac{1}{2}$	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{2}$ M	$1\frac{1}{2}$ with tie	—	$2 \times 2 \times \frac{1}{2}$ OR $1\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2}$ with tie rod in center
85-96	18	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{2}$ @ 24 in. with tie rod in center	←	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{2}$ with tie rod in center	1M with 2 tie rods	2 with tie rod in center	←	←	$1\frac{1}{2}$ with tie rod in center	—	$2 \times 2 \times \frac{1}{2}$ OR $1\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2}$ tie rod in center
97 and Over	18	$2 \times 2 \times \frac{1}{2}$ @ 24 in. with tie rods @ 48 in. along angle	←	$2 \times 2 \times \frac{1}{2}$ with tie rods @ 48 in. along angle	1M with tie rods @ 32 in. along joint	2 with tie rods @ 48 in. along joint	←	←	2 with tie rods @ 48 in. along joint	—	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{2}$ with tie rods @ 48 in. along angle

→ Use next recommended construction.

*Transverse reinforcing must be applied on all four sides and tied together at each corner by riveting, bolting or welding.

Transverse reinforcing size is determined by dimension of side to which angle is applied. Angle sizes are based on mild steel. Reinforcing made in other shapes or of other materials must be of equivalent strength and rigidity.

†There is no restriction on the length of duct sections between joints. Ducts are normally made in sections of 4, 8, 10, or 12 ft. in length. The longitudinal spacing of the transverse reinforcing between joints may necessarily be less than the spacing recommended in the table in order to conform to the selected length module.


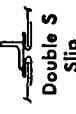

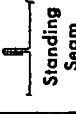



*Medium pressure considered to be 2 to 6 in. water static pressure.

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1345.1840 MECHANICAL SYSTEMS

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1345.1840 RECOMMENDED CONSTRUCTION FOR RECTANGULAR HIGH PRESSURE DUCTS.

		Transverse Reinforcing											
		Between Joints					At Joints						
Dimension of Longest Side, Inches	Galv. Sheet Gage (All Four Sides)	Minimum Reinforcing Angle Size and Maximum Longitudinal Spacing		With Tie Rods	Without Tie Rods	Inside Slip Joint 	Double S Slip 	Welded Flange 	Welded Flange	Standing Seam 	Reinforced Standing Seam 	Flanged Joint 	Companion Angle Flanged Joint 
		Min. Angle Size	Min. Height, In.										
Up thru 12	22	No tie rods required	No angle re- required	None required	M	1	1	1	1	None Required	1	1	1 1/4 X 1 1/4 X 1/4
13-18	22	1 tie rod @ 40 in. intervals on centerline of duct side	1 X 1 X 16 Gage @ 48 in.	1 X 1 X 16 Gage	M	1	1	1	1	None Required	1	1	1 1/4 X 1 1/4 X 1/4
19-24	22	2 tie rods @ 40 in.	1 X 1 X 1/4 @ 48 in.	1 X 1 X 1/4	1M	1 1/4	1 1/4	1 1/4	1 1/4	None Required	1M	1M	1 1/4 X 1 1/4 X 1/4
25-36	22	→	1 1/4 X 1 1/4 X 1/4 @ 32 in. OR 1 1/4 X 1 1/4 X 1/4 @ 40 in.	1 1/4 X 1 1/4 X 1/4	1 1/4 with tie rod in center	1 1/4 with tie rod in center	2 OR 1 1/2 with tie rod in center	1 1/2	1 1/2	1 1/2 X 1 1/2 X 1/4	2	1M X 1M X M	1 1/2 X 1 1/4 X 1/4
37-48	22	→	2 X 2 X 1/4 @ 30 in.	2 X 2 X 1/4 OR 1 1/4 X 1 1/4 with tie rod in center	1 1/4 with tie rod in center	1 1/4 with tie rod in center	1 1/4 with tie rod in center	1 1/4 with tie rod in center	1 1/4 with tie rod in center	2 X 2 X M	1 1/2	1 1/2 with tie rod in center	1 1/2 X 1M X M

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Statutory Authority: MS s 16B.59 to 16B.73

49-60	20	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$ @ 24 in. with tie rod center	$2 \times 2 \times \frac{3}{8}$ @ 24 in.	$2 \times 2 \times \frac{3}{8}$ OR $1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$ with tie rod in center	$1\frac{1}{2}$ with 2 tie rods	$1\frac{1}{2}$ with tie rod in center	$1\frac{1}{2}$	$2 \times 2 \times \frac{3}{8}$	$1\frac{1}{2}$ with tie rod in center	$2 \times 2 \times \frac{3}{8}$ OR $1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$ with tie rod in center
61-72	20	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$ @ 24 in. with tie rod in center	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{3}{8}$ @ 24 in.	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{3}{8}$ OR $1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$ with tie rod in center	$1\frac{1}{2}$ with tie rods	2 with tie rod in center	$1\frac{1}{2}$	$2\frac{1}{2} \times 2\frac{1}{2} \times \frac{3}{8}$ M	$1\frac{1}{2}$ with tie rod in center	$2 \times 2 \times \frac{3}{8}$ OR $1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$ with tie rod in center
73-84	18	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$ @ $2\frac{1}{2}$ in. with tie rod in center	←	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{3}{8}$ with tie rod in center	$1\frac{1}{2}$ with 2 tie rods	2 with tie rod in center	←	←	2 with tie rod in center	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{3}{8}$ with tie rod in center
85-96	18	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$ @ 24 in. with tie rod in center	←	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$ with tie rod in center	$1\frac{1}{2}$ with 2 tie rods	2 with tie rod in center	←	←	2 with tie rod in center	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$ with tie rod in center
97 & Over	16	$2 \times 2 \times \frac{1}{4}$ @ 24 in. with tie rods @ 48 in. along angle	←	$2 \times 2 \times \frac{1}{4}$ with tie rods @ 48 in. along angle	$1\frac{1}{2}$ with tie rods @ 32 in. along joint	2 with tie rods @ 48 in. along joint	←	←	2 with tie rods @ 48 in. along joint	$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{4}$ with tie rods @ 48 in. along angle

- *Transverse reinforcing must be applied on all four sides and tied together at each corner by riveting, bolting or welding. Transverse reinforcing size is determined by dimension of side to which angle is applied. Angle sizes are based on mild steel. Reinforcing made in other shapes or of other materials must be of equivalent strength and rigidity.
- †There is no restriction on the length of duct sections between joints. Ducts are normally made in sections of 4, 8, 10, or 12 ft. in length. The longitudinal spacing of the transverse reinforcing between joints may necessarily be less than the spacings recommended in the table in order to conform to the selected length module.
- High pressure considered to be 6 to 10 in. water static pressure.
- ← Use next recommended construction.

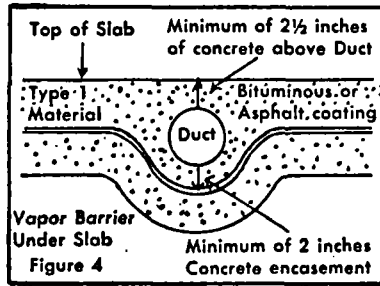
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1345.1850 MECHANICAL SYSTEMS

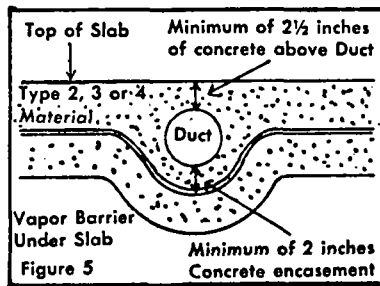
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1345.1850 UNDERGROUND DUCT CONSTRUCTION.

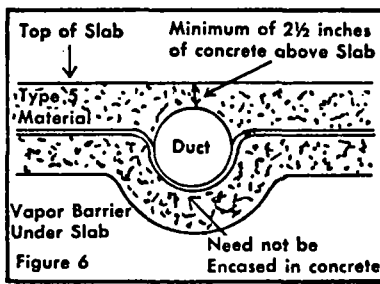
Subpart 1. Figure 4.



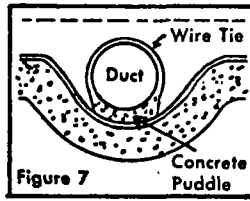
Subp. 2. Figure 5.



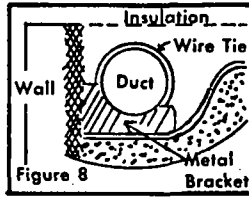
Subp. 3. Figure 6.



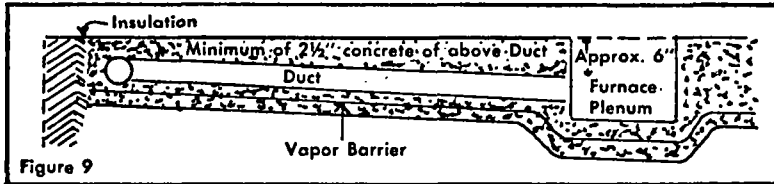
Subp. 4. Figure 7.



Subp. 5. Figure 8.



Subp. 6. Figure 9.



Statutory Authority: *MS s 16B.59 to 16B.73*

REFRIGERATION

1345.1860 REFRIGERATION; GENERAL REQUIREMENTS.

The application of parts 1345.1860 to 1345.2140 of the Minnesota Heating, Ventilating, Air Conditioning, and Refrigeration Code is intended to provide for the safe design, construction, installation, operation, and inspection of every refrigerating system employing a fluid which is vaporized and is normally liquified in its refrigeration cycle when employed under the occupancy classifications in part 1345.1900.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1870 LIMITATION.

The provisions of this code are not intended to apply to the use of water or air as a refrigerant nor to refrigerating systems installed on railroad cars, motor vehicles, motor-drawn vehicles or on shipboard, nor shall apply to:

- A. a domestic installation, alteration, maintenance, and repair of a refrigerator or freezer having a cabinet volume of 25 cubic feet or less;
- B. one- or two-family dwellings served by one condensing unit where the combined gross cubic foot volume of both cabinets is 40 cubic feet or less;
- C. any unit system, one-half horsepower or less; and
- D. a domestic installation, alteration, maintenance, and repair of a single unit plug-in type air or room conditioner.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1880 REFRIGERANTS, UNAUTHORIZED USE.

No refrigerating system shall be maintained or operated which employs a refrigerant other than is specified in the American Standard Safety Code of Mechanical Refrigeration, ANSI B9.1 unless approved by the administrative authority.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1890 DEFINITIONS.

Subpart 1. **Scope.** For the purpose of parts 1345.1860 to 1345.2140, the following definitions shall apply.

Subp. 2. **Absorber (adsorber).** "Absorber (adsorber)" is that part of the low side of an absorption system used for absorbing (adsorbing) vapor refrigerant.

Subp. 3. **Absorption system.** "Absorption system" is a refrigerating system in which the gas evolved in the evaporator is taken up by an absorber or adsorber.

Subp. 4. **Brazed joint.** "Brazed joint," for the purpose of this code, is a gas-tight joint obtained by the joining of metal parts with alloys which melt at temperatures higher than 1,000 degrees Fahrenheit but less than the melting temperatures of the joined parts.

Subp. 5. **Brine.** "Brine" is any liquid, used for the transmission of heat without a change in its state, having no flash point or a flash point above 150 degrees Fahrenheit.

Subp. 6. **Centrifugal compressor.** "Centrifugal compressor" is a nonpositive displacement compressor which depends at least in part on centrifugal force for pressure use.

Subp. 7. **Companion or block valves.** "Companion or block valves" are pairs of mating stop valves, valving off sections of systems and arranged so that these sections may be joined before opening these valves or separated after closing them.

Subp. 8. **Compressor.** "Compressor" is a specific machine, with or without accessories, for compressing a given refrigerant vapor.

Subp. 9. **Compressor unit.** "Compressor unit" is a condensing unit less the condenser and liquid receiver.

Subp. 10. **Condenser.** "Condenser" is a vessel or arrangement or pipe or tubing in which vaporized refrigerant is liquified by the removal of heat.

Subp. 11. **Condensing unit.** "Condensing unit" is a specific refrigerating machine combination for a given refrigerant, consisting of one or more power-driven compressors, condensers, liquid receivers (when required), and the regularly furnished accessories.

Subp. 12. **Container.** "Container" is a cylinder for the transportation of refrigerant.

Subp. 13. **Cooling tower.** "Cooling tower" is a fixture or structure used to cool water by vaporizing some of the water into the atmosphere.

Subp. 14. **Direct system.** "Direct system": see part 1345.1910, subpart 2.

Subp. 15. **Double indirect vented open-spray system.** "Double indirect vented open-spray system": see part 1345.1910, subpart 3, item D.

Subp. 16. **Double (or secondary) refrigerant system.** "Double (or secondary) refrigerant system": see part 1345.1910, subpart 4.

Subp. 17. **Evaporator.** "Evaporator" is that part of the system in which liquid refrigerant is vaporized to produce refrigeration.

Subp. 18. **Expansion coil.** "Expansion coil" is an evaporator constructed of pipe or tubing.

Subp. 19. **Fusible plug.** "Fusible plug" is a device having a predetermined-temperature fusible member for the relief of pressure.

Subp. 20. **Generator.** "Generator" is any device equipped with a heating element used in the refrigerating system to increase the pressure of refrigerant in its gas or vapor state for the purpose of liquifying the refrigerant.

Subp. 21. **High side.** "High side" means the parts of a refrigerating system under condensed pressure.

Subp. 22. **Indirect closed-surface system.** "Indirect closed-surface system": see part 1345.1910, subpart 3, item B.

Subp. 23. **Indirect open-spray system.** "Indirect open-spray system": see part 1345.1910, subpart 3, item D.

Subp. 24. **Indirect system.** "Indirect system": see part 1345.1910, subpart 3.

Subp. 25. **Indirect vented closed-surface system.** "Indirect vented closed-surface system": see part 1345.1910, subpart 3, item C.

Subp. 26. **Internal gross volume.** "Internal gross volume" is the volume as determined from internal dimensions of the container with no allowance for volume of internal parts.

Subp. 27. **Limited charged system.** "Limited charged system" is a system in which, with the compressor idle, the internal volume and total refrigerant charge are such that the design working pressure will not be exceeded by complete evaporation of the refrigerant charge.

Subp. 28. **Liquid receiver.** "Liquid receiver" is a vessel permanently connected to a system by inlet and outlet pipes for storage of a liquid refrigerant.

Subp. 29. **Low side.** "Low side" means the parts of a refrigerating system under evaporator pressure.

Subp. 30. **Machinery.** "Machinery" is the refrigerating equipment forming a part of the refrigerating system including any or all of the following: compressor, condenser, generator, absorber (adsorber), liquid receiver, connecting pipe, or evaporator.

Subp. 31. **Machinery room.** "Machinery room," as required by part 1345.1970, is a room in which a refrigerating system is permanently installed and operated but not including evaporators located in a cold storage room, refrigerator box, air cooled space, or other enclosed space. Closets solely contained within, and opening only into, a room shall not be considered machinery rooms but shall be considered a part of the machinery room in which they are contained or open into. It is not the intent of this definition to cause the space in which a self-contained system is located to be classified as a machinery room.

Subp. 32. **Machinery room, class T.** "Machinery room, class T," as required by part 1345.1970, is a room having machinery but no flame-producing apparatus permanently installed and operated and also conforming to the following:

A. Any doors communicating with the building shall be approved self-closing, tight-fitting fire doors.

B. Walls, floor, and ceiling shall be tight and of not less than one-hour fire-resistive construction.

C. It shall have an exit door which opens directly to the outer air or through a vestibule-type exit equipped with self-closing, tight-fitting doors.

D. Exterior openings, if present, shall not be under any fire escape or any open stairway.

E. All pipes piercing the interior walls, ceiling, or floor of such room shall be tightly sealed to the walls, ceiling, or floor through which they pass.

F. Emergency remote controls to stop the action of the refrigerant compressor shall be provided and located immediately outside the machinery room.

G. An independent mechanical ventilation system shall be provided.

H. Emergency remote controls for the mechanical means of ventilation shall be provided and located outside the machinery room.

Subp. 33. **Manifold or header.** "Manifold" or "header" is a pipe or tube into which one or more refrigerant-containing lines are connected.

Subp. 34. **Mechanical joint.** "Mechanical joint," for the purpose of this code, is a gas-tight joint, obtained by the joining of metal parts through a positive-holding mechanical construction.

Subp. 35. **Nonpositive displacement compressor.** "Nonpositive displacement compressor" is a compressor in which increase in vapor pressure is attained without changing the internal volume of the compression chamber.

Subp. 36. **Piping.** "Piping" means the pipe or tube mains for interconnecting the various parts of a refrigerating system.

Subp. 37. **Positive displacement compressor.** "Positive displacement compressor" is a compressor in which increase in vapor pressure is attained by changing the internal volume of the compression chamber.

Subp. 38. **Pressure-imposing element.** "Pressure-imposing element" is any device or portion of the equipment used for the purpose of increasing the refrigerant vapor pressure.

Subp. 39. **Pressure-limiting device.** "Pressure-limiting device" is a pressure-responsive mechanism designed to automatically stop the operation of the pressure-imposing element at a predetermined pressure.

Subp. 40. **Pressure-relief device.** "Pressure-relief device" is a pressure-actuated valve or rupture member designed to automatically relieve excessive pressure.

Subp. 41. **Pressure-relief valve.** "Pressure-relief valve" is a pressure-actuated valve held closed by a spring or other means and designed to automatically relieve pressure in excess of its setting.

Subp. 42. **Pressure vessel.** "Pressure vessel" is any refrigerant-containing receptacle of a refrigerating system, other than evaporators (each separate section of which does not exceed one-half cubic foot of refrigerant-containing volume), expansion coils, compressors, controls, headers, pipe, and pipe fittings.

Subp. 43. **Reciprocating compressor.** "Reciprocating compressor" is a positive displacement compressor with a piston or pistons moving in a straight line, but alternately in opposite directions.

Subp. 44. **Refrigerant.** "Refrigerant" is a substance used to produce refrigeration by its expansion or vaporization.

Subp. 45. **Refrigerating system.** "Refrigerating system" is a combination of interconnected refrigerant-containing parts constituting one closed refrigerant circuit in which a refrigerant is circulated for the purpose of extracting heat.

"Absorption system" is a refrigerating system in which the gas evolved in the evaporator is taken up by an absorber or adsorber.

"Sealed absorption system" is a unit system for Group 2 refrigerants only in which all refrigerant-containing parts are made permanently tight by welding or brazing against refrigerant loss.

"Self-contained system" is a complete factory-made and factory-tested system in a suitable frame or enclosure which is fabricated and shipped in one or more sections and in which no refrigerant-containing parts are connected in the field other than by companion or block valves.

"Unit system" is a self-contained system which has been assembled and tested prior to its installation and which is installed without connecting any refrigerant-containing parts. A unit system may include factory-assembled companion or block valves.

Subp. 46. **Rupture member.** "Rupture member" is a device that will rupture at a predetermined pressure.

Subp. 47. **Soldered joint.** "Soldered joint," for the purpose of this code, is a gas-tight joint obtained by the joining of metal parts with metallic mixtures or alloys which melt at temperatures below 1,000 degrees Fahrenheit and above 400 degrees Fahrenheit.

Subp. 48. **Stop valve.** "Stop valve" is a shutoff for controlling the flow of refrigerant.

Subp. 49. **Welded joint.** "Welded joint," for the purpose of this code, is a gas-tight joint, obtained by the joining of metal parts in the plastic or molten state.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1900 BUILDING OCCUPANCY CLASSIFICATION.

Subpart 1. **General.** Locations governed by this code in which refrigerating systems may be placed are grouped by occupancy as follows.

Subp. 2. **Institutional occupancy.** Institutional occupancy shall apply to that portion of the premises in which persons are confined to receive medical, charitable, educational, or other care or treatment, or in which persons are held or detained by reason of public or civic duty, including among others, hospitals, asylums, sanitariums, police stations, jails, court houses with cells, and similar occupancies.

Subp. 3. **Public assembly occupancy.** Public assembly occupancy shall apply to that portion of the premises in which persons congregate for civic, political, educational, religious, social, or recreational purposes; including among others armories, assembly rooms, auditoriums, ballrooms, bath houses, bus terminals, broadcasting studios, churches, colleges, court houses without cells, dance halls, department stores, exhibition halls, fraternity halls, libraries, lodge rooms, mortuary chapels, museums, passenger depots, schools, skating rinks, subway stations, theaters, and similar occupancies.

Subp. 4. **Residential occupancy.** Residential occupancy shall apply to that portion of the premises in which sleeping accommodations are provided, including among others, club houses, convents, dormitories, hotels, lodging houses, multiple story apartments, residences, studios, tenements, and similar occupancies.

Subp. 5. **Commercial occupancy.** Commercial occupancy shall apply to that portion of the premises used for the transaction of business; for the rendering of professional services; the supplying of food, drink, or other bodily needs and comforts; for manufacturing purposes or for the performance of work or labor (except as included under subpart 6) including among others bake shops, fur storage, laboratories, loft buildings, markets, office buildings, professional buildings, restaurants, stores other than department stores, and similar occupancies.

Subp. 6. **Industrial occupancy.** Industrial occupancy shall apply to an entire building, or premises or to that portion of a building used for manufacturing, processing, or storage of materials or products, including among others chemical, food, candy, and ice cream factories, ice-making plants, meat-packing plants, refineries, perishable food warehouses, and similar occupancies, provided the entire building is occupied by a single tenant.

Subp. 7. **Mixed occupancy.** Mixed occupancy shall apply to a building occupied or used for different purposes in different parts. When the occupancies are cut off from the rest of the building by tight partitions, floors, and ceilings and protected by self-closing doors, the requirements of each type of occupancy shall apply for its portion of the building or premises. For example, the cold storage spaces in retail frozen food lockers, hotels, and department stores in buildings occupied by a single tenant might be classified under industrial occupancy, whereas other portions of the building would be classified under other occupancies. When the occupancies are not so separated, the occupancy carrying the more stringent requirements shall govern.

Subp. 8. **Adjacent locations.** Equipment installed in locations to areas outlined in subparts 2 to 7, including outdoor installations, shall be governed by the applicable requirements of this code.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1901 OPTIONAL PROVISIONS FOR INSTALLATION OF ON-PREMISES FIRE SUPPRESSION SYSTEMS.

Subpart 1. **Purpose.** This part authorizes optional provisions for the installation of on-premises fire suppression systems in new construction. It is intended to alleviate increasing demands for additional fire suppression resources by allowing a municipality to adopt the optional provisions of this part based on its local fire suppression capabilities.

Subp. 2. **Municipal option.** The sprinkler system requirements in subpart 3 may be adopted without change by a municipality. If they are adopted, the requirements are applicable throughout the municipality for new buildings, additions to buildings, and buildings for which the occupancy classification is changed.

Subp. 3. **Requirements.** Automatic sprinkler systems must be installed and maintained in operable condition in buildings in the occupancy classifications listed in items A to L. This requirement is in addition to other minimum requirements set in the state building code. The height and area increases provided in sections 506 and 507 of the Uniform Building Code, as adopted in the state building code, are applicable.

- A. Group A-1 occupancies.
- B. Group A-2 occupancies with an occupant load of 300 or more.
- C. Group A-2.1 occupancies.

D. Group B-1 service stations with 3,000 or more gross sq. ft. of area, not including canopies.

E. Group B-1 parking garages with 5,000 or more gross sq. ft. of area.

F. Group B-2 offices and post-secondary classrooms with 8,500 or more gross sq. ft. of area or three or more stories in height.

G. Group B-2 retail, warehouse, or manufacturing areas with 2,000 or more gross sq. ft. of area or three or more stories in height.

H. Group E-1 and E-2 occupancies with 8,500 or more gross sq. ft. in area or two or more stories in height, except for minor additions that do not increase the occupant load or significantly increase the fire load.

I. Group E-3 occupancies with an occupant load of 30 or more.

J. Group H-4 occupancies with 3,000 or more gross sq. ft. of area.

K. Group R-1 apartment houses with 8,500 or more gross sq. ft. of area or with dwelling units on three or more floors, except that when they are not required by Uniform Building Code, sections 1807 or 1907, or other provisions of the state building code, automatic sprinkler systems within dwelling units in apartment occupancies are considered complete when protection is provided in all habitable rooms. Building officials, in concurrence with their fire chiefs, may accept alternate systems which have fire protection capabilities equivalent to systems which comply with Standard 38-1 of the Uniform Building Code.

L. Group R-1 hotels and motels with 8,500 or more gross sq. ft. of area or with guest rooms on three or more floors.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1910 REFRIGERATING SYSTEM, CLASSIFICATION BY TYPE.

Subpart 1. **General.** Refrigerating systems shall be divided into classes descriptive of the method employed for extracting heat in subparts 2 to 4. The direct, indirect, and double refrigerant systems are illustrated in part 1345.2070.

Subp. 2. **Direct system.** Direct system is one in which the evaporator is in direct contact with the material or space refrigerated or is located in air-circulating passages communicating with such spaces.

Subp. 3. **Indirect system.** Indirect system is one in which a liquid, such as brine or water, cooled by the refrigerant, is circulated to the material or space refrigerated or is used to cool air so circulated. Indirect systems which are distinguished by the type or method of application are as given in the following items:

A. "Indirect open-spray system" is one in which a liquid, such as brine or water, cooled by an evaporator located in an enclosure external to a cooling chamber, is circulated to such cooling chamber and is sprayed therein.

B. "Indirect closed-surface system" is one in which a liquid such as brine or water, cooled by an evaporator located in an enclosure external to a cooling chamber, is circulated to and through such a cooling chamber in pipes or other closed circuits.

C. "Indirect vented closed-surface system" is one in which a liquid, such as brine or water, cooled by an evaporator located in a vented enclosure external to a cooling chamber, is circulated to and through such cooling chamber in pipes or other closed circuits.

D. "Double indirect vented open-spray system" is one in which a liquid, such as brine or water, cooled by an evaporator located in a vented enclosure, is circulated through a closed circuit to a second enclosure where it cools another supply of a liquid, such as brine or water, and this liquid in turn is circulated to a cooling chamber and is sprayed therein.

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Subp. 4. **Double refrigerant system.** "Double (or secondary) refrigerant system" is one in which an evaporative refrigerant is used in a secondary circuit. For the purpose of this code, each system enclosing a separate body of an evaporative refrigerant shall be considered as a separate direct system.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1920 REFRIGERANT CLASSIFICATION.

Subpart 1. **General.** The numerical refrigerant designation is from ASHRAE Standard 34 (American Standard B79.1). Refrigerants are, for the purpose of this code, divided into groups as follows.

Subp. 2. Group 1.

Carbon dioxide (Refrigerant 744)	CO ₂
Dichlorodifluoromethane (Refrigerant 12)	CCl ₂ F ₂
Dichloridifluoromethane, 73.8%	CCl ₂ F ₂
and Ethylidene Fluoride, 26.2% (Refrigerant 500)	CH ₃ CHF ₂
Dichloromethane (Methylene chloride) (Refrigerant 30)	CH ₂ Cl ₂
Dichloromonofluoromethane (Refrigerant 21)	CHCl ₂ F
Dichlorotetrafluoroethane (Refrigerant 114)	C ₂ Cl ₂ F ₄
Monobromotrifluoromethane (Refrigerant 13B1)	CBF ₃
Monochlorodifluoromethane (Refrigerant 22)	CHClF ₂
Monochlorodifluoromethane, 48.8%	CHClF ₂
and Monochloropenta-fluoroethane, 51.2%	
(Refrigerant 502)	CClF ₂ CF ₃
Monochlorotrifluoromethane (Refrigerant 13)	CClF ₃
Octafluorocyclobutane (Refrigerant C318)	C ₄ F ₈
Trichloromonofluoromethane (Refrigerant 11)	CCl ₃ F
Trichlorotrifluoroethane (Refrigerant 113)	C ₂ Cl ₃ F ₃

Subp. 3. Group 2.

Ammonia	NH ₃
Dichloroethylene	C ₂ H ₂ Cl ₂
Ethyl chloride	C ₂ H ₅ Cl
Methyl chloride	CH ₃ Cl
Methyl formate	HCOOCH ₃
Sulphur dioxide	SO ₂

Subp. 4. Group 3.

Butane	C ₄ H ₁₀
Ethane	C ₂ H ₆
Ethylene	C ₂ H ₄
Isobutane	(CH ₃) ₂ CH
Propane	C ₃ H ₈

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1930 REQUIREMENTS FOR INSTITUTIONAL, PUBLIC ASSEMBLY, RESIDENTIAL, AND COMMERCIAL OCCUPANCIES.

Subpart 1. **Public stairway, stair landing, entrance, or exit.** No refrigerating system shall be installed in or on a public stairway, stair landing, entrance, or exit.

Subp. 2. **Public hallway or lobby.** No refrigerating system shall interfere with free passage. No Group 2 refrigerant shall be permitted in public hallways or lobbies of institutional or public assembly occupancies. Refrigerating systems installed in a public hallway or lobby shall be limited to unit systems containing not more than the quantities of a Group 1 refrigerant specified in part 1345.2080, or sealed absorption systems containing not more than three pounds of Group 2 refrigerant when in residential and commercial occupancies.

Subp. 3. **Refrigerant piping through floors.** Refrigerant piping shall not be carried through floors except as follows:

A. It may be carried from the basement to the first floor or from the top floor to a machinery penthouse or to the roof.

B. For the purpose of connecting to a condenser on the roof, it may be carried through an approved, rigid, and tight continuous fire-resisting pipe duct or shaft having no openings on intermediate floors, or it may be carried on the outer wall of the building provided it is not located in an air shaft, closed court, or in other similar open spaces enclosed within the outer walls of the building.

C. In systems containing Group 1 refrigerants, the refrigerant piping may also be carried in or through floors, intermediate between the first floor and the top floor, provided it is enclosed in an approved, rigid and tight continuous fire-resisting pipe duct or shaft where it passes through intermediate spaces not served by the system. Piping of direct systems, as governed by part 1345.1940, subpart 1, need not be enclosed where it passes through space served by that system. The pipe duct or shaft shall be vented to the outside or to a space served by the system.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1940 GROUP 1 REFRIGERANTS.

Subpart 1. **Direct systems.** The maximum permissible quantity of a Group 1 refrigerant in a direct system is as specified in part 1345.2080 except institutional occupancies where further limited by this subpart:

A. Direct systems in institutional occupancies shall be limited to unit systems each containing not more than 20 pounds of Group 1 refrigerants except in kitchens, laboratories, and mortuaries (see subpart 4).

B. When the refrigerant-containing parts of a system are located in one or more enclosed spaces, the cubical content of the smallest enclosed humanly occupied space other than the machinery room shall be used to determine the permissible quantity of refrigerant in the system. Where a refrigerating system has evaporator coils serving individual stories of a building, the story having the smallest volume shall be used to determine the maximum quantity of refrigerant in the entire system.

C. When the evaporator is located in an air duct system, cubical content of the smallest enclosed humanly occupied space served by the air duct system shall be used to determine the permissible quantity of refrigerant in the system; however, if the air flow to any enclosed space served by the air duct system cannot be shut off or reduced below one-quarter of its maximum, the cubical contents of the entire space served by the air duct system may be used to determine the permissible quantity of refrigerant in the system.

D. In institutional and public assembly occupancies, direct expansion coils or evaporators used for air conditioning and located downstream from, and in proximity to, a heating coil, or located upstream within 18 inches of a heating coil, shall be fitted with a pressure relief device discharging to the outside of the building in an approved manner; except that such a relief device shall not be required on unit or self-contained systems if the internal volume of the low side of the system which may be shut off by valves, divided by the total weight of refrigerant in the system less the weight of refrigerant vapor contained in the other parts of the system at 110 degrees Fahrenheit exceeds the specific volume of the refrigerant at critical conditions of temperature and pressure.

(Note: The above exemption is also stated in formula form below.)

$$\frac{V_1}{W_1 - W_2} \text{ shall be more than } V_{sp}$$

where

V_1 = low side volume, cu. ft.

V_{sp} = specific volume at critical conditions of temperature and pressure, cu. ft. per lb.

W_1 = total weight of refrigerant in system, lb.

W_2 = weight of refrigerant vapor (lb.) at 110 degrees Fahrenheit in V_2 ,

V_2

= specific volume of refrigerant, in cu. ft. per lb., at 110 degrees Fahrenheit, where V_2 = total volume of system less V_1 cu. ft.

Subp. 2. **Indirect systems.** A system containing more than the quantity of a Group 1 refrigerant allowed in part 1345.2080 shall be of the indirect type with all refrigerant-containing parts, excepting parts mounted outside the building and piping installed in accordance with part 1345.1930, subpart 3, installed in a machinery room used for no other purpose than for mechanical equipment.

Subp. 3. **Open flames in machinery rooms.** No open flames or apparatus to produce an open flame shall be installed in a machinery room where any refrigerant other than carbon dioxide is used unless the flame is enclosed and vented to the open air. The use of matches, cigarette lighters, halide leak detectors, and similar devices shall not be considered a violation of this subpart or of subpart 4.

Subp. 4. **Open flames in institutional occupancies.** In institutional occupancies, where more than one pound of a Group 1 refrigerant, other than carbon dioxide, is used in a system, any portion of which is in a room where there is an apparatus for producing an open flame, then such refrigerant shall be classed in Group 2, unless the flame-producing apparatus is provided with a hood and flue capable of removing the products of combustion to the open air.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1950 GROUP 2 REFRIGERANTS.

Subpart 1. **Direct systems.** Direct systems containing Group 2 refrigerants shall not be used for air conditioning for human comfort. For other application, the maximum permissible quantity of Group 2 refrigerants in a direct system is shown in part 1345.2090.

Subp. 2. **Indirect systems.** The maximum permissible quantity of Group 2 refrigerant in any direct system is shown in part 1345.2100. Such systems shall be of the following type:

A. institutional and public assembly occupancies: indirect vented closed-surface, or double indirect vented open-spray; and

B. residential and commercial occupancies: indirect vented closed-surface, or double indirect vented open-spray, or primary circuit of double-refrigerant type.

Subp. 3. **Machinery rooms for indirect systems, Group 2 refrigerants.** Indirect systems using Group 2 refrigerants not in excess of the quantities shown in column 1 of part 1345.2100 shall have all refrigerant-containing parts, excepting parts mounted outside the building and piping installed in accordance with part 1345.1930, subpart 3, installed in a machinery room used for no other purposes than for mechanical equipment.

Indirect systems using Group 2 refrigerants not in excess of the quantities shown in column 2 of part 1345.2100 shall have all refrigerant-containing parts installed in a Class T machinery room.

Subp. 4. **Flame-producing devices, hot surfaces, and electrical equipment in machinery rooms.** Where a machinery room is required by this code to house a refrigerating system containing any Group 2 refrigerant other than sulphur dioxide, no flame-producing device or hot surface above 800 degrees Fahrenheit

shall be permitted in such room and all electrical equipment in the room shall conform to the requirements of Hazardous Locations Class I of the latest edition of the National Electrical Code. The use of matches, cigarette lighters, halide leak detectors, and similar devices shall not be considered a violation of this subpart.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1960 GROUP 3 REFRIGERANTS.

Group 3 refrigerants shall not be used in institutional, public assembly, residential, or commercial occupancies except in laboratories for commercial occupancies. In such laboratory installations only unit systems containing no more than six pounds shall be used unless the number of persons does not exceed one person per 100 square feet of laboratory floor area, in which case the requirements for industrial occupancy shall apply.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1970 REQUIREMENTS FOR INDUSTRIAL OCCUPANCIES.

Subpart 1. **General.** There shall be no restrictions on the quantity or kind of refrigerant used in an industrial occupancy, except as specified in subpart 2 and part 1345.1980, subpart 2.

Subp. 2. **Number of persons.** When the number of persons in a refrigerated space, served by a direct system, on any floor above the first floor (ground level or deck level) exceeds one person per 100 square feet of floor area, the requirements of commercial occupancy shall apply unless that refrigerated space containing more than one person per 100 square feet of floor area above the first floor is provided with the required number of doors opening directly into approved building exits. Such refrigerated space shall be cut off from the rest of the building by tight construction with tight-fitting doors. Note: The above does not prohibit openings for the passage of products from one refrigerated space to another refrigerated space.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1980 INSTALLATION REQUIREMENTS.

Subpart 1. **General.** Foundations and supports for condensing units or compressor units shall be of substantial and noncombustible construction when more than six inches high. Moving machinery should be guarded in accordance with accepted safety standards. Clear space adequate for inspection and servicing of condensing units or compressor units shall be provided. Condensing units or compressor units with enclosures shall be readily accessible for servicing and inspection.

Water supply and discharge connections should be made in accordance with accepted safety and health standards. Discharge water lines shall not be directly connected to the waste or sewer system. The waste or discharge from such equipment shall be over and above a trapped and vented plumbing fixture.

Illumination adequate for inspection and servicing of condensing units or compressor units should be provided. Electrical equipment and wiring shall be installed in accordance with accepted safety standards. Gas fuel devices and equipment used with refrigerating systems shall be installed in accordance with accepted safety standards.

Subp. 2. **Open flames.** When the quantity of flammable refrigerant in any one refrigerating system exceeds the amount given in part 1345.2110 for each 1,000 cubic feet of room volume in which the system or any part thereof is installed, then no flame-producing device or hot surface above 800 degrees Fahrenheit shall be permitted in such room and all electrical equipment in the room shall conform to the requirements of Hazardous Locations Class I of the latest edition of the National Electrical Code.

Flammable refrigerants as listed in part 1345.2110 shall not be used in a refrigerating system in excess of 1,000 pounds unless approved by the authority having jurisdiction.

Subp. 3. **Machinery room requirements.** See definitions, "machinery room" and "machinery room, class T," part 1345.1890, subparts 31 and 32.

Each refrigerating machinery room shall be provided with tight-fitting door or doors and have no other openings.

Each refrigerating machinery room shall be provided with means for ventilation to the outer air. The ventilation shall consist of windows or doors opening to the outer air, of the size shown in part 1345.2120, or of mechanical means capable of removing air from the room in accordance with part 1345.2120. The amount of ventilation for refrigerant removal purposes shall be determined by the refrigerant content of the largest system in the machinery room.

Mechanical ventilation, when used, shall consist of one or more power-driven exhaust fans, which shall be capable of removing from the refrigerating machinery room the amount of air specified in part 1345.2120. The inlet to the fan, or fans, or air duct connection shall be located near the refrigerating equipment. The outlet from the fan, or fans, or air duct connections shall terminate outside of the building in an approved manner. Provisions should be made for the inlet of air to replace that being exhausted.

Class T machinery rooms in basements or subbasements (see part 1345.1890, subpart 32) shall have, as specified in part 1345.2120 mechanical ventilation operating continuously.

Subp. 4. **Air conditioning.** Air duct systems of air-conditioning equipment for human comfort using mechanical refrigeration should be installed in accordance with accepted safety standards.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.1990 REFRIGERANT PIPING, VALVES, FITTINGS, AND RELATED PARTS.

Subpart 1. **General.** Refrigerating piping, valves, fittings, and related parts used in the construction and installation of refrigerating systems shall conform to the American Standard Code for Pressure Piping.

Subp. 2. **Metal enclosures or pipe ducts for soft copper tubing.** Rigid or flexible metal enclosures shall be provided for soft, annealed copper tubing used for refrigerant piping erected on the premises and containing other than Group 1 refrigerants. No enclosures shall be required for connections between condensing unit and the nearest riser box, provided such connections do not exceed six feet in length.

Subp. 3. **Specific minimum requirements for refrigerant pipe and tubing.** No less than Schedule 80 wall thickness carbon steel or wrought iron pipe shall be used for Group 2 and Group 3 refrigerant liquid lines for sizes one and one-half inches and smaller.

No less than Schedule 40 wall thickness carbon steel or wrought iron pipe shall be used for Group 1 refrigerant liquid lines sizes six inches and smaller, Group 2 and Group 3 refrigerant liquid lines sizes two inches through six inches, and Group 1, Group 2, and Group 3 refrigerant vapor lines six inches and smaller.

Butt-welded carbon steel and butt-welded wrought iron pipe shall not be used for refrigerant liquid lines.

Cast iron pipe shall not be used for Group 1, Group 2, or Group 3 refrigerant lines.

Standard iron pipe size copper and red brass (not less than 80 percent copper) pipe may be used and shall conform to ASTM Specification B-42 for copper pipe and ASTM Specification B-43 for red brass pipe.

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Watertube size hard copper tubing used for refrigerant piping erected on the premises shall conform to ASTM Specifications B-88 Types K or L, for dimensions and specifications, except that copper tubing with outside diameters of one-quarter inch and three-eighths inch shall have a minimum nominal wall thickness of not less than 0.030 inch and 0.032 inch, respectively.

Soft annealed copper tubing used for refrigerant piping erected on the premises shall not be used in sizes larger than one and three-eighths inch Standard Size (1.375 inches outside diameter). Mechanical joints shall not be used on soft annealed copper tubing on sizes larger than seven-eighths inch Standard Size (0.875 inch outside diameter). It shall conform to ASTM Specifications B-280. Minimum nominal wall thickness of soft annealed copper tubing shall be as follows:

Standard Size In.	Outside Diameter In.	Wall Thickness In.
1/4	0.250	0.030
3/8	0.375	0.032
1/2	0.500	0.032
5/8	0.625	0.035
3/4	0.750	0.042
7/8	0.875	0.045
*1	1.000	0.050
1-1/8	1.125	0.050
*1-1/4	1.250	0.055
1-3/8	1.375	0.055

*Not included as standard size in ASTM B280.

Sweat joints on copper tubing used in refrigerating systems containing Group 2 or Group 3 refrigerants shall be brazed joints. Soldered joints shall not be used in such refrigerating systems.

Subp. 4. Joints and refrigerant-containing parts in air ducts. Joints and all refrigerant-containing parts of a refrigerating system located in an air duct of an air-conditioning system carrying conditioned air to and from a humanly occupied space shall be constructed to withstand without leakage, a temperature of 1,000 degrees Fahrenheit.

Subp. 5. Exposure of refrigerant pipe joints. Refrigerant pipe joints erected on the premises shall be exposed to view for visual inspection prior to being covered or enclosed.

Subp. 6. Location of refrigerant piping. Refrigerant piping crossing an open space which affords passageway in any building shall be not less than seven and one-half feet above the floor unless against the ceiling of such space.

Free passageway shall not be obstructed by refrigerant piping. Refrigerant piping shall not be placed in any elevator, dumbwaiter, or other shaft containing a moving object, or in any shaft which has openings to living quarters or to main exit hallways. Refrigerant piping shall not be placed in public hallways, lobbies, or stairways, except that such refrigerant piping may pass across a public hallway if there are no joints in the section in the public hallways, and provided nonferrous tubing of one inch nominal diameter (one and one-eighth inch outside diameter) and smaller be contained in a rigid metal pipe.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2000 STOP VALVES.

Subpart 1. **General requirements.** All systems containing more than 50 pounds of a Group 1 refrigerant or six pounds of a Group 2 or 3 refrigerant, other than systems utilizing nonpositive displacement compressors, shall have stop valves installed as follows: each inlet of each compressor, compressor unit, or condensing unit; and each discharge outlet of each compressor, compressor unit, or condensing unit, and of each liquid receiver.

Subp. 2. **Systems containing 100 pounds or more of refrigerant.** All systems containing 100 pounds or more of a refrigerant, other than systems utilizing nonpositive displacement compressors, shall have stop valves, in addition to those in subpart 1, on each inlet of each liquid receiver except that none shall be required on the inlet of a receiver in a condensing unit nor on the inlet of a receiver which is an integral part of a condenser.

Subp. 3. **Copper tubing.** Stop valves used with soft annealed copper tubing or hard drawn copper tubing seven-eighths inch standard size (0.875 inch outside diameter) or smaller shall be securely mounted, independent of tubing fastenings or supports.

Subp. 4. **Labeling.** Stop valves shall be suitably labeled if it is not obvious what they control. Numbers may be used to label the valves provided a key to the numbers is located near the valves.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2010 DESIGN AND CONSTRUCTION OF EQUIPMENT.

Subpart 1. **General.** Every part of a refrigerating system, with the exception of pressure gauges, control mechanisms, and limited charged systems, shall be designed, constructed, and assembled to be capable of withstanding a test pressure not less than the minimum refrigerant leak field test pressure specified in part 1345.2130 without being stressed beyond one-third of its ultimate strength. (See subpart 2.) Limited charged systems equipped with a pressure-relief device shall be designed, constructed, and assembled to be capable of withstanding a test pressure not less than 1.5 times the setting of the pressure relief device without being stressed beyond one-third of its ultimate strength. Note: This subpart establishes a minimum design working pressure in terms of the field test pressure so that the minimum refrigerant leak field pressure, specified in part 1345.2130, can be safely applied. Rules governing pressure-relief devices, pressure-limiting devices, etc. shall be based on the design working pressure selected.

All materials used in the construction and installation of refrigerating systems shall be suitable for conveying the refrigerant used. No material shall be used that will deteriorate because of the refrigerant, or the oil, or the combination of both.

Note: Many refrigerants are corrosive to the usual materials when moisture or air, or both, are present and it is assumed in approving these materials that the system will be charged and operated in accordance with accepted practice to prevent or minimize this corrosion.

Aluminum, zinc, or magnesium shall not be used in contact with methyl chloride in a refrigerating system. Magnesium alloys shall not be used in contact with any halogenated refrigerant.

Subp. 2. **Minimum test pressures.** Every refrigerant-containing part of every system, including pressure gauges and control mechanisms, shall be tested and proved tight by the manufacturer at not less than the minimum refrigerant leak field test pressure specified in part 1345.2130 except limited charged systems. (See subpart 3 and part 1345.2050.)

The test pressure applied to either the high or low side of each refrigerating system shall be at least equal to the design working pressure of the pressure vessels in the high or low side of the system, respectively, or to the setting of the

pressure-relief device protecting the respective pressure vessels, whichever is lower, but not less than the minimum refrigerant leak field test pressures specified in part 1345.2130. Any components connected to said pressure vessels shall be of sufficient strength to conform to the design requirements of the first paragraph of subpart 1.

Limited charged unit systems shall be tested in accordance with this subpart except that limited charged unit systems equipped with a pressure-relief device may be tested and proved tight at a pressure not less than 1-1/2 times the setting of the pressure-relief device.

Subp. 3. **National testing laboratories.** Equipment listed by an approved nationally recognized testing laboratory having a follow-up inspection service shall be deemed as meeting the intent of the requirements of subparts 1 and 2.

Subp. 4. **Pressure-limiting devices.** Pressure-limiting devices shall be provided on all systems containing more than 20 pounds of refrigerant and operating above atmospheric pressure, and on all water cooled systems so constructed that the compressor or generator is capable of producing a pressure in excess of the test pressure; except water-cooled unit systems containing not more than three pounds of a Group 1 refrigerant providing the operating pressure developed in the system with the water supply shut off does not exceed one-fifth the ultimate strength of the system, or providing an overload device will stop the action of the compressor before the pressure exceeds one-fifth the ultimate strength of the system.

The maximum setting to which a pressure-limiting device may readily be set by use of the adjusting means provided shall not exceed 90 percent of the setting of the pressure-relief device installed on the high side of a system, 90 percent of the refrigerant leak field test pressure actually applied, or 90 percent of the design working pressure of the high side of the system, whichever is smallest. The pressure-limiting device shall stop the action of the pressure-imposing element at a pressure no higher than this maximum setting. In determining this maximum setting for systems erected on the premises and field leak tested in accordance with the first paragraph of subpart 1, 90 percent of the leak field test pressures in part 1345.2130 may be utilized in lieu of the field test pressure actually applied. (See the first and second paragraphs of part 1345.2050, subpart 1, for minimum refrigerant leak field test pressures.)

On systems using nonpositive displacement compressors, the pressure-limiting device may be set at the pressure setting of the relief device, the refrigerant leak field test pressure actually applied, or the design working pressure of the high side of the system, whichever is smallest, provided the pressure-relief is subject to low side pressure and there are no stop valves on the system as exempted by part 1345.2000 for nonpositive displacement compressors.

Pressure-limiting devices shall be connected, with no intervening stop valves, between the pressure-imposing element and any stop valve on the discharge side.

Subp. 5. **Liquid level gauge glasses.** Liquid level gauge glasses, except those of the bull's-eye or reflex type, shall have automatic closing shutoff valves, and such glasses shall be adequately protected against injury.

Subp. 6. **Dial of pressure gauge.** Dial of a pressure gauge, when the gauge is permanently installed on the high side of a refrigerating system, shall be graduated up to approximately double the operating pressure, but in no case less than 1.2 times the design working pressure.

Subp. 7. **Nameplate.** Each separately sold condensing unit and each compressor or compressor unit sold for field assembly in a refrigerating system shall carry a nameplate marked with the manufacturer's name, nationally registered trademark or trade name, identification number, the test pressure applied by the manufacturer, and the refrigerant for which it is designed. The

refrigerant shall be designated according to ANSI B79.1, Number Designation of Refrigerants.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2020 REFRIGERANT-CONTAINING PRESSURE VESSELS.

Subpart 1. **Over six inches inside diameter.** Refrigerant-containing pressure vessels exceeding six inches inside diameter, except those having a maximum allowable internal or external working pressure 15 psig or less, shall comply with the rules of section VIII of the ASME Boiler and Pressure Vessel Code covering the requirements for the design, fabrication, and inspection during construction of unfired pressure vessels.

Certification for ASME "UM" Stamped Pressure Vessels. Certification requirements on pressure vessels which are built in accordance with section VIII of the ASME Boiler and Pressure Vessel Code under paragraph U-1 (g) and stamped with the "UM" symbol (see paragraph UG-116) can be met by keeping a production series record of material used and tests made. Certification for individual vessels, where required, may be made by abstracting data from the series record on data report form U-3.

Subp. 2. **At or under six inches inside diameter.** Refrigerant-containing pressure vessels not exceeding an inside diameter of six inches, irrespective of pressure, shall be listed either individually or as part of refrigeration equipment by an approved nationally recognized testing laboratory having a follow-up inspection service. Vessels not so listed shall be constructed according to subpart 1.

Subp. 3. **Relief devices.** All pressure vessels, irrespective of size or pressure, shall be equipped with relief devices in accordance with the requirements of part 1345.2040 of this code.

Subp. 4. **Standard hydrostatic tests.** Fusion welded pressure vessels shall be tested in accordance with paragraph UG-99, section VIII of the ASME Boiler and Pressure Vessel Code. (See also next paragraph.) Vessels for use in services which cannot tolerate the presence of a testing liquid and which cannot be readily dried, and the parts of which have been previously tested by hydrostatic pressure to not less than 1-1/2 times the design working pressure of the vessel, may be given a pneumatic test as prescribed in paragraph UG-100, section VIII of the ASME Boiler and Pressure Vessel Code.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2030 RELIEF DEVICES IN GENERAL.

Subpart 1. **General.** Every refrigerating system shall be protected by a pressure-relief device unless so constructed that pressure due to fire conditions will be safely relieved by some part of the system.

Subp. 2. **Stop valves.** No stop valve shall be located between any automatic pressure-relief device or fusible plug and the part or parts of the system protected thereby, except when the parallel relief devices mentioned in part 1345.2040, subpart 2 are so arranged that only one can be rendered inoperative at a time for testing or repair purposes.

Subp. 3. **Connections.** All pressure-relief devices shall be connected as nearly as practicable directly to the pressure vessel or other parts of the system protected thereby, above the liquid refrigerant level, and installed so that they are readily accessible for inspection and repair and so that they cannot be readily rendered inoperative. Fusible plugs may be located above or below the liquid refrigerant level.

Subp. 4. **Seats and discs.** The seats and discs of pressure-relief devices shall be constructed of suitable material to resist refrigerant corrosion or other chemical action caused by the refrigerant. Seats or discs of cast iron shall not be used.

Subp. 5. **Rated discharge capacity.** The rated discharge capacity of a pressure-relief valve for a refrigerant-containing vessel, expressed in pounds of air per minute, shall be determined at a pressure at the inlet of the relief valve equal to 110 percent of the valve setting in accordance with paragraph UG-131, section VIII of the ASME Boiler and Pressure Vessel Code.

The rated discharge capacity of a rupture member of fusible plug discharging to atmosphere under critical flow conditions in pounds of air per minute shall be determined by the following formulas:

$$C = 0.8 P_1 d^2$$

$$d = 1.12 \sqrt[2]{\frac{C}{P_1}} \quad (1)$$

where

C = minimum required discharge capacity, in lb. of air per min.

d = minimum diameter of bore of fusible plug or internal diameter of inlet pipe to rupture member in inches

Where for rupture members:

$P_1 = (\text{set pressure} \times 1.10) + 14.7$

For fusible plugs:

$P_1 =$ absolute saturation pressure, corresponding to the stamped temperature melting point of the fusible plug or the critical pressure of the refrigerant used, whichever is smaller, psia

Subp. 6. **Pressure actuation.** All pressure-relief devices (not fusible plugs) shall be directly pressure-actuated.

Subp. 7. **Size of discharge pipe.** The size of the discharge pipe from the pressure-relief device shall be not less than the size of the relief device outlet. The discharge from more than one relief device may be run into a common header, the area of which shall be not less than the sum of the areas of the pipes connected thereto.

Subp. 8. **Length of piping.** The length of discharge piping permitted to be installed on the outlet of a relief valve, rupture member, or fusible plug shall be determined as follows:

$$C = \frac{3 P d^{5/2}}{L^{1/2}}$$

$$d = \sqrt[3]{\frac{C^2 L}{9 P^2}} \quad (2)$$

where

C = minimum required discharge capacity, in lb. of air per min.

d = internal diameter of pipe in in.

L = length of discharge pipe in ft.

P = 0.25 P_1 (P_1 is defined under Equation 1.)

(See part 1345.2140 for computations derived from the preceding formula.)

Subp. 9. **Pressure-relief devices for positive displacement compressors.** Positive displacement compressors operating above 15 pounds per square inch gage and having a displacement exceeding 50 cubic feet per minute, shall be equipped by the manufacturer with a pressure-relief device of adequate size and pressure setting to prevent rupture of the compressor located between the compressor and stop valve on the discharge side. The discharge from such relief device may be vented to the atmosphere or into the pressure side of the system.

Subp. 10. **Discharge of devices.** Discharge of pressure-relief devices and fusible plugs on all systems containing more than six pounds of Group 2 or Group 3 refrigerants shall be to the outside of the building in an approved manner. Discharge of pressure-relief devices and fusible plugs on all systems containing more than 100 pounds of Group 1 refrigerants, unless installed in a machinery room used for no purpose other than to house mechanical equipment and complying with the provisions as specified in part 1345.1980, subpart 3, shall be to the outside of the building in an approved manner.

Pressure-relief devices may discharge into the low side of the system, provided the pressure-relief devices are of a type not appreciably affected by back pressures and provided the low side of the system is equipped with pressure-relief devices. The relief devices on the low side of the system shall have sufficient capacity to protect the pressure vessels that are relieved into the low side of the system, or to protect all pressure vessels on the low side of the system, whichever relieving capacity is the largest, as computed by the formula in part 1345.2040, subpart 11. Such low side pressure-relief devices shall be set in accordance with part 1345.2040, subpart 12, and vented to the outside of the building in an approved manner.

Subp. 11. **Ammonia discharge.** Where ammonia is used, the discharge may be into a tank of water which shall be used for no purpose except ammonia absorption. At least one gallon of fresh water shall be provided for each pound of ammonia in the system. The water used shall be prevented from freezing without the use of salt or chemicals. The tank shall be substantially constructed of not less than one-eighth inch or No. 11 U.S. gauge iron or steel. No horizontal dimension of the tank shall be greater than one-half the height. The tank shall have hinged cover, or, if of the enclosed type, shall have a vent hole at the top. All pipe connections shall be through the top of the tank only. The discharge pipe from the pressure-relief valves shall discharge the ammonia in the center of the tank near the bottom.

Subp. 12. **Sulphur dioxide discharge.** Where sulphur dioxide is used, the discharge may be into a tank of absorptive brine which shall be used for no purpose except sulphur dioxide absorption. There shall be one gallon of standard dichromate brine (two and one-half pounds sodium dichromate per gallon water) for each pound of sulphur dioxide in the system. Brines made with caustic soda or soda ash may be used in place of sodium dichromate, provided the quantity and strength give the equivalent sulphur dioxide power. The tank shall be substantially constructed of not less than one-eighth inch or No. 11 U.S. gauge iron or steel. The tank shall have a hinged cover, or, if of the enclosed type, shall have a vent hole at the top. All pipe connections shall be through the top of the tank only. The discharge pipe from the pressure-relief valve shall discharge the sulphur dioxide in the center of the tank near the bottom.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2040 RELIEF DEVICES FOR PRESSURE VESSELS.

Subpart 1. **General.** The rules of this part are based upon the rules given in paragraphs UG-125 to UG-134 inclusive, of section VIII of the ASME Boiler and Pressure Vessel Code, with such additional modifications as are necessary for control of refrigerants.

Subp. 2. **Pressure vessels over three cubic feet.** Each pressure vessel containing liquid refrigerant with internal gross volume exceeding three cubic feet, except as specified in subpart 10, and which may be shut off by valves from all other parts of a refrigerating system shall be protected by a pressure-relief device having sufficient capacity to prevent the pressure in the pressure vessel from rising more than ten percent above the setting of the pressure-relief device. (See subpart 11.)

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Subp. 3. **Pressure vessels over three cubic feet, but less than ten cubic feet.** Under conditions specified in subpart 2, a single relief device (relief valve or rupture member) may be used on pressure vessels having less than ten cubic feet internal gross volume.

Subp. 4. **Pressure vessels of ten cubic feet internal gross volume or over.** Under conditions specified in subpart 2, a relief device system consisting of a pressure-relief device in parallel with a second pressure-relief device as described in part 1345.2030, subpart 2, shall be provided on pressure vessels having internal gross volume of ten cubic feet or over. Each relief valve or rupture member shall have sufficient capacity to prevent the pressure in the pressure vessel from rising more than ten percent above the setting of the pressure-relief device. (See subpart 14.)

Subp. 5. **Relief valves discharging into low side of the system.** Under conditions permitted in part 1345.2030, subpart 10, the second paragraph, a single relief valve (not rupture member) of the required relieving capacity may be used on vessels of ten cubic feet or over.

Subp. 6. **Relief devices in parallel on large vessels.** In cases where large pressure vessels containing liquid refrigerant except as specified in subpart 11 require the use of two or more pressure-relief devices in parallel to obtain the capacity required by subpart 11, the battery of pressure-relief devices shall be considered as a unit, and therefore as one pressure-relief device.

Subp. 7. **Pressure vessels with internal gross volume of three cubic feet or less.** Each pressure vessel having an internal gross volume of three cubic feet or less, containing liquid refrigerant, except as specified in subpart 10, and which may be shut off by valves from all other parts of a refrigerating system, shall be protected by a pressure-relief device, or fusible plug. A fusible plug is permitted only on the high side of a refrigerating system. Pressure vessels of less than three inch i.d. are exempt from these requirements.

Subp. 8. **Relief valves on pressure vessels with gross volume of three cubic feet or less.** If a relief valve or rupture member is used to protect a pressure vessel, the ultimate bursting pressure of the pressure vessel so protected shall be at least two and one-half times the pressure setting of the pressure-relief valve or rupture member.

Subp. 9. **Fusible plugs and pressure vessels with gross volume of three cubic feet or less.** If a fusible plug is used, the ultimate bursting pressure of the pressure vessel so protected shall be at least two and one-half times the refrigerant saturation pressure, psia, corresponding to the stamped temperature on the fusible plug, or at least two and one-half times the critical pressure of the refrigerant used, whichever is smaller.

Subp. 10. **Relief device for pressure vessels used as, or as part of evaporator.** Pressure vessels having internal diameters greater than six inches used as, or as part of, evaporators insulated or installed in insulated space, and which may be shut off by valves from all other parts of a refrigerating system shall be protected by a pressure-relief device in accordance with the provisions of subparts 2 and 7 except that the provisions of subpart 4, requiring a second parallel relief device, shall not apply. Pressure vessels used as evaporators having internal diameters of six inches or less are exempt from pressure-relief valve requirements.

Subp. 11. **Required capacity.** The minimum required rated discharge capacity of the pressure-relief device or fusible plug for a refrigerant-containing vessel shall be determined by the following:

$$C = fDL$$

where

C = minimum required discharge capacity of the relief device in lb. of air per min.

D = outside diameter of the vessel in ft.

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L = length of the vessel in ft.

f = factor dependent upon kind of refrigerant, as follows:

Kind of refrigerant	Value of f
Ammonia (Refrigerant 717)	0.5
Refrigerants 12, 22 and 500	1.6
Refrigerants 502, 13, 13B1, and 14 when on cascaded systems	2.5
All other refrigerants	1.0

Subp. 12. **Pressure-relief device setting.** Except as permitted in subparts 7 to 9, all pressure-relief devices shall be set to start to function at a pressure not to exceed the design working pressure of the pressure vessel as determined by the manufacturer and stamped on the pressure vessel or system.

Subp. 13. **Rupture member setting.** All rupture members used in lieu of or in series with a relief valve shall function at a pressure not to exceed the design working pressure of the vessel and the conditions of application shall conform to the requirements of section VIII of the ASME Boiler and Pressure Vessel Code.

Rupture members installed ahead of relief valves need not be larger, but shall not be smaller, than the relief valve inlet. (See part 1345.2030.)

Subp. 14. **Marking of relief devices.** All pressure-relief valves for refrigerant-containing vessels shall be set and sealed by the manufacturer. Each relief valve shall be marked by the manufacturer with the data required in paragraph UG-129(a) of section VIII of the ASME Boiler and Pressure Vessel Code.

Each rupture member for refrigerant-containing pressure vessels shall be marked with the information required in paragraph UG-129(d) of section VIII of the ASME Boiler and Pressure Vessel Code.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2050 FIELD TESTS.

Subpart 1. **General.** Every refrigerant-containing part of every system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gauges, and control mechanisms, that are factory tested shall be tested and proved tight after complete installation and before operation at not less than the minimum refrigerant leak field test pressures shown in part 1345.2130, subpart 4, or in accordance with this subpart.

Systems erected on the premises using Group 1 refrigerant and with copper tubing not exceeding five-eighths inch o.d., with wall thickness as required by the sixth and seventh paragraphs of part 1345.1990, subpart 3 may be tested by means of the refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 70 degrees Fahrenheit or higher.

Limited charged systems equipped with a pressure-relief device erected on the premises shall be tested at a pressure not less than 1-1/2 times the pressure setting of the relief device.

Subp. 2. **Test medium.** No oxygen or any combustible gas or combustible mixture of gases shall be used within the system for testing.

The means used to build up the test pressure shall have either a pressure-limiting device or a pressure-reducing device and a gauge on the outlet side.

Subp. 3. **Posting of tests.** A dated declaration of test should be provided for all systems containing 50 pounds or more of refrigerant, where required by subpart 1. The declaration should be mounted in a frame, protected by glass, and posted in the machinery room and should give the name of the refrigerant and the field refrigerant leak test pressures applied to the high side and the low side of the system. The declaration of test should be signed by the installer and,

if an inspector is present at the tests, he should also sign the declaration. When requested, copies of this declaration shall be furnished to the enforcing authority.

The leak test pressure requirements of part 1345.2130 are not intended to apply to gas bulk storage tanks that are not permanently connected to a refrigeration system.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2060 INSTRUCTIONS.

Subpart 1. **Signs.** Each refrigerating system erected on the premises shall be provided with an easily legible permanent sign securely attached and easily accessible, indicating thereon the name and address of the installer, the kind and total number of pounds of refrigerant required in the system for normal operations, and the refrigerant leak field test pressure applied.

Subp. 2. **Metal signs for systems containing more than 100 pounds of refrigerant.** Systems containing more than 100 pounds of refrigerant shall be provided with metal signs having letters not less than one-half inch in height designating the main shutoff valves to each vessel, main steam or electrical control, remote control switch, and pressure-limiting device. On all exposed high-pressure and low-pressure piping in each room where installed outside the machinery room shall be signs, as specified above, with the name of the refrigerant and the letters "HP" or "LP."

Subp. 3. **New sign for changed refrigerant.** When the kind of refrigerant is changed as provided in subpart 7 (substitution of refrigerant), there shall be a new sign, of the same type as specified in subpart 2, indicating clearly that a substitution has been made, and stating the same information for the new refrigerant as was stated in the original.

Subp. 4. **Charging and discharging refrigerants.** When refrigerant is added to a system, except a unit system requiring less than six pounds of refrigerant, it shall be charged into the low-pressure side of the system. Any point on the downstream side of the main liquid line stop valve shall be considered as part of the low-pressure side when operating with said stop valve in the closed position. No service container shall be left connected to a system except while charging or withdrawing refrigerant.

Subp. 5. **Withdrawn refrigerants.** Refrigerants withdrawn from refrigerating systems shall be transferred to approved containers only. No refrigerant shall be discharged to a sewer.

Subp. 6. **Containers for withdrawn refrigerants.** Containers used for refrigerants withdrawn from a refrigerating system shall be carefully weighed each time they are used for this purpose, and the containers shall not be filled in excess of the permissible filling weight for such containers and such refrigerants as are prescribed in the pertinent regulations of the Interstate Commerce Commission.

Subp. 7. **Substitution of kind of refrigerant.** Substitution of kind of refrigerant in a system shall not be made without the permission of the approving authority, the user, and the makers of the original equipment, and due observance of safety requirements, including:

- A. the effects of the substituted refrigerant on materials in the system;
- B. the possibility of overloading the liquid receiver which should not be more than 80 percent full of liquid;
- C. the liability of exceeding motor horsepower, design working pressure, or any other element that would violate any of the provisions of this code;
- D. the proper size of refrigerant controls;
- E. the effect on the operation and setting of safety devices;

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F. the possible hazards created by mixture of the original and the substituted refrigerant; and

G. effect of the classification of the refrigerant as provided in this standard.

Subp. 8. **Refrigerant stored in machinery room.** Refrigerant stored in a machinery room shall be not more than 20 percent of the normal refrigerant charged nor more than 300 pounds of the refrigerant, in addition to the charge in the system and the refrigerant stored in a permanently attached receiver, and then only in approved storage containers.

Subp. 9. **Masks or helmets.** One mask or helmet shall be provided at a location convenient to the machinery room when an amount of a Group 2 refrigerant between 100 and 1,000 pounds, inclusive, is employed. If more than 1,000 pounds of a Group 2 refrigerant are employed, at least two masks or helmets shall be provided.

Only complete helmets or masks marked as approved by the Bureau of Mines of the United States Department of the Interior and suitable for the refrigerant employed shall be used and they shall be kept in a suitable cabinet immediately outside the machinery room or other approved accessible location.

Canisters or cartridges of helmets or masks shall be renewed immediately after having been used or the seal broken and, if unused, the canisters shall be renewed not later than the date noted on the canister labels.

Subp. 10. **Maintenance.** All refrigerating systems shall be maintained by the user in a clean condition, free from accumulations of oily dirt, waste, and other debris, and shall be kept readily accessible at all times.

Subp. 11. **Responsibility as to operation of the system.** It shall be the duty of the person in charge of the premises on which a refrigerating system containing more than 50 pounds of refrigerant is installed to place a card conspicuously as near as practicable to the refrigerant compressor giving directions for the operation of the system, including precautions to be observed in case of a breakdown or leak as follows:

A. instruction for shutting down the system in case of emergency;

B. the name, address, and day and night telephone numbers for obtaining service; and

C. the name, address, and telephone number of the municipal inspection department having jurisdiction, and instructions to notify said department immediately in case of emergency.

Subp. 12. **Pressure gauges.** Pressure gauges should be checked for accuracy prior to test and immediately after every occasion of unusually high pressure, equal to full scale reading either by comparison with master gauges or by setting the pointer as determined by a dead weight pressure gauge tester.

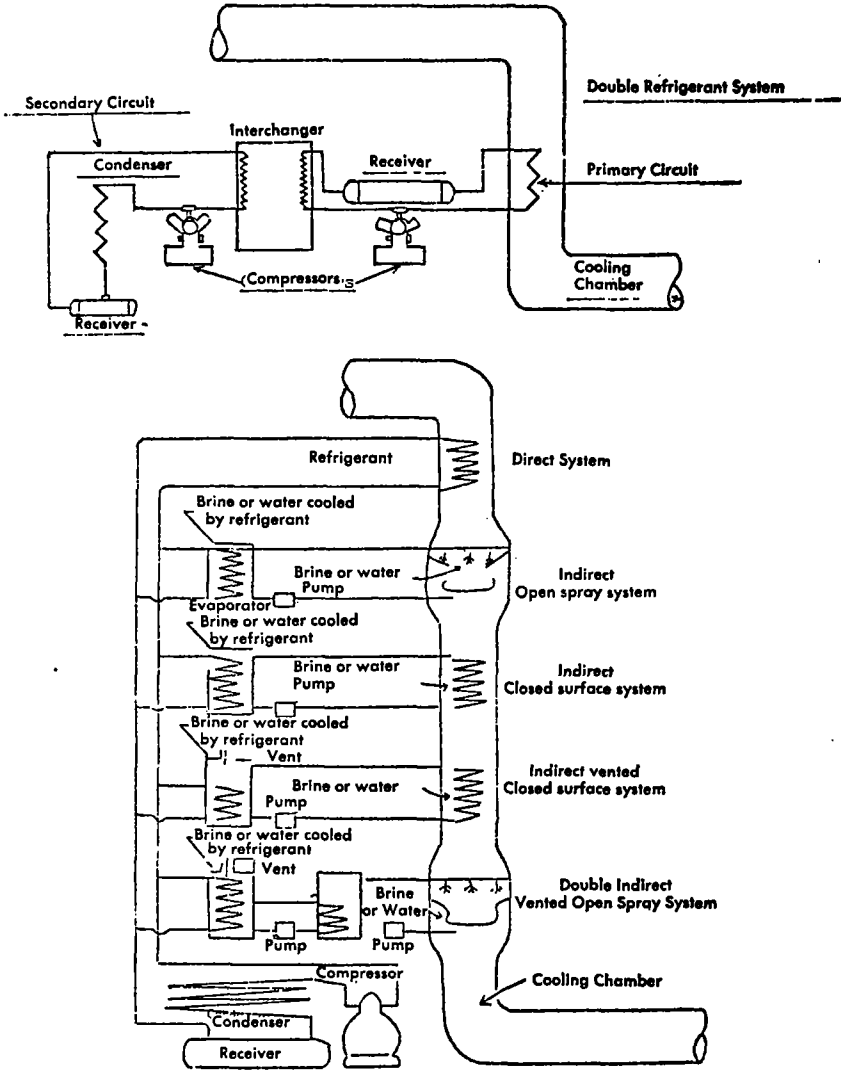
Statutory Authority: *MS s 16B.59 to 16B.73*

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1345.2070 DIRECT, INDIRECT, AND DOUBLE REFRIGERANT SYSTEMS.



Statutory Authority: *MS s 16B.59 to 16B.73*

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1345.2080 MAXIMUM PERMISSIBLE QUANTITIES OF GROUP 1 REFRIGERANTS FOR DIRECT SYSTEMS.

Refrigerant name and number**	Chemical formula	Maximum Quantity in lb. per 1,000 cu. ft. of humanly occup. space
Carbon dioxide (Refrigerant 744)	CO ₂	11
Dichlorodifluoromethane (Refrigerant 12)	CCl ₂ F ₂	31
Dichlorodifluoromethane, 73.8% and Ethylidene Fluoride, 26.2% (Refrigerant 500)	CH ₃ CHF ₂	26
Dichloromethane (Methylene chloride) Refrigerant 30)	CH ₂ Cl ₂	6
Dichloromonofluoromethane (Refrigerant 21)	CHCl ₂ F	13
Dichlorotetrafluoromethane (Refrigerant 114)	C ₂ Cl ₂ F ₄	44
Monobromotrifluoromethane (Refrigerant 13B1)	CBrF ₃	38
Monochlorodifluoromethane (Refrigerant 22)	CHClF ₂	22
Monochlorodifluoromethane, 48.8% and Monochloropentafluoroethane, 51.2% Refrigerant 502)	CClF ₂ CF	30
Monochlorotrifluoromethane (Refrigerant 13)	CClF ₃	27
Octafluorocyclobutane (Refrigerant C318)	C ₄ F ₈	50
Trichloromonofluoromethane (Refrigerant 11)	CCl ₃ F	35
Trichlorotrifluoroethane (Refrigerant 113)	C ₂ Cl ₃ F ₃	24

*Volatile charge in a control shall not be considered as refrigerant.

**ASHRAE Designation (See parts 1345.1910, 1345.1920, and 1345.2070).

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2090 MAXIMUM PERMISSIBLE QUANTITIES OF GROUP 2 REFRIGERANTS FOR DIRECT SYSTEMS.

Type of Refrigerating System	Maximum pounds for various occupancies			
	Institutional	Public Assembly	Residential	Commercial
Sealed absorption systems:				
a) In public hallways or lobbies.	0	0	3	3
b) In other than public hallways or lobbies	0*	6	6	20

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Self-contained or unit systems:

a) In public hallways or lobbies.	0	0	0	0
b) In other than public hallways or lobbies	0	0*	6	20

*Six pounds allowed when installed in kitchens, laboratories, and mortuaries.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2100 MAXIMUM PERMISSIBLE QUANTITIES OF GROUP 2 REFRIGERANTS FOR INDIRECT SYSTEMS.

Occupancy	Column 1 Machinery Rooms max. lb.	Column 2 Class T Machinery Rooms max. lb.
Institutional	0	Not more than 500 lb.
Public assembly	0	Not more than 1000 lb.
Residential	Not more than 300 lb.	No limit
Commercial	Not more than 600 lb.	No limit

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2110 MAXIMUM PERMISSIBLE QUANTITIES OF FLAMMABLE REFRIGERANTS.

Name	Chemical Formula	Maximum Quantity in Lb. per 1000 Cu. Ft. of Room Volume
Butane	C_4H_{10}	2-1/2
Ethane	C_2H_6	2-1/2
Ethyl chloride	C_2H_5Cl	6
Ethylene	C_2H_4	2
Isobutane	$(CH_3)_3CH$	2-1/2
Methyl chloride	CH_3Cl	10
Methyl formate	$HCOOCH_3$	7
Propane	C_3H_8	2-1/2

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2120 MINIMUM AIR EXHAUST QUANTITIES AND OPENINGS.

Weight of Refrigerant in System, lb.	Mechanical Discharge of Air, Cfm	Open Areas of Windows and Doors Square Feet
up to 20	150	4
50	250	6
100	400	10
150	550	12-1/2
200	680	14
250	800	15
300	900	17
400	1,100	20
500	1,275	22

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600	1,450	24
700	1,630	26
800	1,800	28
900	1,950	30
1,000	2,050	31
1,250	2,250	33
1,500	2,500	37
1,750	2,700	38
2,000	2,900	40
2,500	3,300	43
3,000	3,700	48
4,000	4,600	55
5,000	5,500	62
6,000	6,300	68
7,000	7,200	74
8,000	8,000	80
9,000	8,700	85
10,000	9,500	90
12,000	10,900	100
14,000	12,200	109
16,000	13,300	118
18,000	14,300	125
20,000	15,200	130
25,000	17,000	140
30,000	18,200	145
35,000	19,400	150
40,000	20,500	155
45,000	21,500	160

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2130 MINIMUM REFRIGERANT LEAK FIELD TEST PRESSURES.

Subpart 1. **Table of pressure.**

Refrigerant name & number*	Chemical formula	High side	Low side
Ammonia (717)	NH ₃	300	150
Butane (600)	C ₄ H ₁₀	95	50
Carbon dioxide (744)	CO ₂	1500	1000
Dichlorodifluoromethane (12)	CCl ₂ F ₂	235	140
Dichlorodifluoromethane 73.8% (500)	CCl ₂ F ₂	285	150
Ethylidene fluoride 26.2%	CH ₃ CHF ₂		
Dichloroethylene (1130)	C ₂ H ₂ Cl ₂	30	30
Dichloromethane (Methylene chloride) (30)	CH ₂ Cl ₂	30	30
Dichloromonofluoromethane (21)	CHCl ₂ F	70	40
Dichlorotetrafluoroethane (114)	C ₂ Cl ₂ F ₄	50	50
Ethane (170)	C ₂ H ₆	1200	700
Ethyl chloride (160)	C ₂ H ₅ Cl	60	50
Ethylene (1150)	C ₂ H ₄	1600	1200

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Isobutane (601)	(CH ₃) ₃ CH	130	70
Methyl chloride (40)	CH ₃ Cl	210	120
Methyl formate (611)	HCOOCH ₃	50	50
Monobromotrifluoromethane (13B1)	CBrF ₃	435	245
Monochlorodifluoromethane (22)	CHClF ₂	300	150
Monochlorodifluoromethane 48.8% and Monochloropentafluoroethane 51.2% (502)	CClF ₂ CF ₃	300	150
Monochlorotrifluoromethane (13)	CClF ₃	685**	685**
Octafluorocyclobutane (C318)	C ₄ F ₈	130	70
Propane (290)	C ₃ H ₈	300	150
Sulphur dioxide (764)	SO ₂	170	85
Trichloromonofluoromethane (11)	CCl ₃ F	20	20
Trichlorotrifluoroethane (113)	C ₂ Cl ₃ F ₃	20	20

*ASHRAE designation.

**Critical pressure is 561 psia at critical temp. of 83.9 degrees Fahrenheit (See subpart 2, item A.)

Subp. 2. **Notes.** Notes:

A. For refrigerants not listed in this part, the test pressure for the high pressure side shall not be less than the saturated vapor pressure of the refrigerant at 150 degrees Fahrenheit. The test pressure for the low pressure side shall be not less than the saturated vapor pressure of the refrigerant at 110 degrees Fahrenheit. However, the test pressure for either the high or low side need not exceed 125 percent of the critical pressure of the refrigerant. In no case shall the test pressure be less than 30 psig.

B. When a compressor is used as a booster to obtain a low pressure and discharges into the suction line of another system, the booster compressor is considered a part of the low side, and values listed under the low side column in subpart 1 shall be used for both high and low side of the booster compressor provided that a low pressure stage compressor of the positive displacement type shall have a pressure-relief valve.

C. In field testing systems using nonpositive displacement compressors, the entire system shall be considered for field test purposes as the low side pressure.

Statutory Authority: *MS s 16B.59 to 16B.73*

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1345.2140 LENGTH OF DISCHARGE PIPING FOR RELIEF VALVES OR RUPTURE MEMBERS OF VARIOUS DISCHARGE CAPACITIES.

Equiv. length of discharge pipe, ft. (L)	Discharge capacity in lg. of air per min. (C) Standard wall iron pipe sizes, in.					
	1/4	3/4	1	1 1/4	1 1/2	2
RELIEF DEVICE SET AT 25 PSIA (P₁)						
50	0.81	1.6	2.9	5.9	8.7	16.3
75	0.67	1.4	2.4	4.9	7.2	13.3
100	0.58	1.2	2.1	4.2	6.2	11.5
150	0.47	0.95	1.7	3.4	5.0	9.4
200	0.41	0.8	1.5	2.9	4.4	8.1
300	0.33	0.67	1.2	2.4	3.6	6.6
RELIEF DEVICE SET AT 50 PSIA (P₁)						
50	1.6	3.3	5.9	11.9	17.4	32.5
75	1.3	2.7	4.9	9.7	14.3	26.5
100	1.2	2.3	4.2	8.4	12.3	23.0
150	0.94	1.9	3.5	6.9	10.0	18.7
200	0.81	1.6	2.9	5.9	8.7	16.3
300	0.66	1.3	2.5	4.9	7.1	13.3
RELIEF DEVICE SET AT 75 PSIA (P₁)						
50	2.4	4.9	8.9	17.9	26.1	48.7
75	2.0	4.1	7.3	14.6	21.4	39.8
100	1.7	3.5	6.4	12.6	18.5	34.4
150	1.4	2.8	5.2	10.3	15.0	28.0
200	1.2	2.5	4.4	8.9	13.1	24.4
300	0.9	2.0	3.7	7.3	10.7	19.9
RELIEF DEVICE SET AT 100 PSIA (P₁)						
50	3.2	6.6	11.9	23.8	34.8	65.0
75	2.7	5.4	9.7	19.4	28.6	53.0
100	2.3	4.6	8.5	16.8	24.6	45.9
150	1.9	3.8	6.9	13.7	20.0	37.4
200	1.6	3.3	5.9	11.9	17.5	32.5
300	1.3	2.7	4.9	9.7	14.2	26.5

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Equip. length of discharge pipe, ft. (L)	Discharge capacity in lg. of air per min. (C) Standard wall iron pipe sizes, in.							
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3
RELIEF DEVICE SET AT 150 PSIA (P₁)								
50	4.9	9.9	17.9	35.7	52.3	97.5	151.8	262.8
75	4.0	8.1	14.6	29.2	42.9	79.5	125.4	214.5
100	3.5	6.9	12.7	25.2	36.9	68.9	108.0	185.4
150	2.8	5.7	10.4	20.6	30.0	56.1	87.6	151.8
200	2.4	4.9	8.9	17.8	26.2	48.7	75.9	131.4
300	1.9	4.0	7.4	14.6	21.1	39.7	63.0	107.1
RELIEF DEVICE SET AT 200 PSIA (P₁)								
50	6.5	13.2	23.8	47.6	69.7	130.0	202.4	350.4
75	5.3	10.8	19.4	38.9	57.2	106.0	167.2	286.0
100	4.6	9.2	16.9	33.6	49.2	91.8	144.0	247.2
150	3.8	7.6	13.8	27.4	40.0	74.8	116.8	202.4
200	3.2	6.5	11.8	23.8	34.9	64.9	101.2	175.2
300	2.6	5.3	9.8	19.4	28.4	52.9	84.0	142.8
RELIEF DEVICE SET AT 250 PSIA (P₁)								
50	8.1	16.5	29.8	59.5	87.1	162.5	253.0	437.0
75	6.7	13.5	24.3	48.6	71.5	132.5	209.0	357.5
100	5.8	11.6	21.2	42.0	61.6	114.8	180.0	309.0
150	4.7	9.5	17.3	34.3	50.0	93.5	146.0	253.0
200	4.1	8.2	14.8	29.7	43.7	81.2	126.5	219.0
300	3.3	6.7	12.3	24.3	35.5	66.2	103.0	178.5
RELIEF DEVICE SET AT 300 PSIA (P₁)								
50	9.7	19.8	35.7	71.4	104.5	195.0	303.6	525.6
75	7.9	16.2	29.1	58.3	85.8	159.0	250.8	429.0
100	6.9	13.9	25.4	50.4	73.9	137.7	216.0	370.8
150	5.6	11.3	20.7	41.1	60.0	112.2	175.2	303.6
200	4.9	9.8	17.8	35.6	52.4	97.4	151.8	262.8
300	3.9	7.9	14.7	29.1	42.6	79.4	126.0	214.2

Statutory Authority: MS s 16B.59 to 16B.73

GAS BURNERS

1345.2150 DEFINITIONS.

Subpart 1. **Scope.** For the purpose of parts 1345.2150 to 1345.2490, the following terms shall have the meanings given them.

Subp. 2. **Conversion burner.** "Conversion burner" means a gas burner accessory or device designed to supply gaseous fuel to and properly burn same within the combustion chamber of a boiler, furnace, or other device originally designed to utilize another fuel.

Subp. 3. **Dual fuel burning.** "Dual fuel burning" means a gas burner firing into the same combustion zone into which another fuel is utilized.

Subp. 4. **Direct gas-fired air heaters.** "Direct gas-fired air heaters" means a gas heating device in which gas is burned and in which the products of combustion are mixed with the air which is to be heated in passing through the heater. The term shall be taken to mean the unit and equipment from its outside air inlet to the exit where the heated air leaves the unit.

Subp. 5. **Gas burner.** "Gas burner" means a device for the final conveyance of the gas, or a mixture of gas and air, to the combustion of a boiler, furnace, device, or appliance, used in connection with a heating system and shall include gas designed appliances, conversion burners, direct gas-fired air heaters and dual fuel burners.

Subp. 6. **Gas burner equipment.** "Gas burner equipment" shall include gas burners, as above defined, vent connectors, vent flues, chimney liners, and all piping (other than supply piping from meter to appliance shutoff valve), fans, blowers, control devices, and accessories connected to the burners.

Subp. 7. **Gas designed appliance.** "Gas designed appliance" means any space heating appliance designed for the exclusive use of gaseous fuel, excepting such auxiliary heaters as may be installed in an approved masonry fireplace.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2160 APPROVAL OF EQUIPMENT.

Subpart 1. **Approval of gas burner required.** Any gas burner bearing the listing or the approved label of the American Gas Association or other nationally recognized testing laboratory may be installed without further approval, providing such gas-burning appliance also meets the appropriate requirements of the applicable sections of this code, and such other requirements as established by the administrative authority.

Gas-burning appliances not carrying the listing or approval of the American Gas Association or other nationally recognized testing laboratory shall not be installed without prior approval of the administrative authority.

Subp. 2. **Used gas burners procedures.** No person shall install any used gas burner until he has furnished the administrative authority with a statement that said gas burner has been checked and found to be equivalent to new equipment in operation and safety, and also a letter from the purchaser acknowledging that said purchaser is buying a used gas burner.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2170 APPROVAL REQUIREMENTS, GENERAL.

Subpart 1. **Pilots.** The gas supply line to the pilot or pilots shall be connected ahead of the main burner pressure regulator and appliance shutoff valve and shall be provided with a separate cock. However, where complete shutoff type automatic pilot is provided with approved flow interrupter the pilot line shall be connected to this control and such control shall be located ahead of the main burner pressure regulator and after the appliance shutoff valve.

The main burner shall light from the flame that activates the safety mechanism when this is turned down to the point where it will just actuate the safety pilot operating mechanism.

Appliances having more than one combustion chamber shall be provided with individual safety pilots or with a safety supervised runner pilot.

The flames from each burner shall freely ignite the gas from adjacent burners when operating at the prevailing gas pressure or when the gas pressure is reduced to deliver about one-third the full gas rate.

Electronic safety equipment shall be provided for all burners exceeding 400,000 Btu per hour input, except on multiple burner equipment where each section of 400,000 Btu per hour input or fraction thereof is supervised by an approved safety pilot.

Copper or iron tubing shall not be used for supply piping within the burner heat zone to pilot burners.

The construction of all safety pilots shall be such that in the event of breakage or burning out of the flame detection element they shall fail in the safe position.

Pilots shall be so located that when they are extinguished they shall relight from the main burner.

Subp. 2. **Burners.** Luminosity in burner flames will not be permitted. Burners shall be so designed and constructed that flames show no tendency to lift or blow off the burner ports.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2180 APPROVAL REQUIREMENTS FOR CONVERSION BURNERS AND DUAL FUEL BURNERS WITH INPUTS 1,000,000 BTU AND OVER.

Subpart 1. **Pilots.** Automatically lighted pilots or constant burning pilots may be used. Burners having a constant burning pilot shall be safety supervised to provide 100 percent (pilot and main burner) shutoff on flame failure.

A flame safeguard so constructed and installed that no fuel can flow to the main burner or burners or burner group unless satisfactory ignition is assured shall be employed at each burner or group of burners operating as a unit. Fuel to the main burners shall be automatically shut off in case of flame failure at point of supervision.

The response time of the flame safeguard to deenergize the main fuel shutoff device on flame failure shall not exceed five seconds. Pilot supervision by such flame safeguard shall be only at the point where the flame will effectively ignite the burner or burners. The circuit and devices shall be arranged so that the fuel will be shut off in case of electrical failure.

Electric ignition systems on gas operation shall ignite only a pilot. The input to the pilot shall not exceed two percent of the maximum input to the main burner as fired. If ignition of the pilot is not obtained in 30 seconds, the fuel shall be turned off automatically. Continuous ignition spark is prohibited.

Pilots shall effect immediate ignition of the fuel and the main burner even when the gas supply to the pilots is reduced to a point where the flame is just sufficient to actuate or energize the flame-detection device.

All pilot burners and flame safeguard units shall be so located as to assure proper ignition of all burners or ports, readily accessible for service and maintenance, and so fixed that they must be readily returned to the original position after removal for servicing. Pilot burners shall be so placed that they can be safely lighted manually if required.

Subp. 2. **Automatic or manually lit.** An automatically lighted installation shall automatically recycle to meet control requirements. Such installation shall have necessary controls and devices to automatically ignite the safety pilot and open the recycling safety shutoff valve to permit ignition of the main burner

from the safety pilot when fuel input is required and to automatically shut off all gas to pilot and main burners when fuel input is not required.

Burners which are manually lit are those which require a manual starting sequence by closing a push button start switch to open the pilot solenoid valve; the pilot being ignited by manual torch or from an electric spark ignition system which is energized with the same push button start switch. The main burner is then ignited from the safety pilot by opening the manual firing valve after having opened the manual reset safety shutoff valve.

Subp. 3. Control valves. On burners with maximum input ratings exceeding 1,000,000 Btu per hour a fuel input control valve and a safety shutoff valve shall be used. These shall be separate and independent valves.

The positioning of the gas valves shall be such that the safety shutoff valve is on the inlet side of the fuel input control valve except by special approval of the administrative authority.

Main burner safety shutoff valves shall be of an approved type. These valves shall be capable of opening only when energized and shall be so constructed that they may not be readily blocked in the open position.

Electrically operated safety shutoff valve shall not depend upon the closing of an electrical circuit to shut off the fuel supply.

Means shall be provided for any easy sensitive test for gas tightness of the safety shutoff and fuel input control valve when in the closed position.

The safety shutoff valve shall be an approved quick-closing type.

Subp. 4. Safety shutoff valve switch. The burner shall have either of the following as part of the starting sequence:

A. Automatic installations shall have a switch in the safety shutoff valve which will prove that the valve is 100 percent closed. This switch will be interlocked into the system to prevent any starting procedure unless proven closed. This switch will close when the valve has had an over travel of the valve seat.

B. Manual installations shall be equipped with an electrical limit switch which will close the firing valve before the safety pilot can be ignited. The starting switch shall consist of a momentary contact pushbutton "start-stop" switch so arranged as to prevent recycling of pilot following action of any safety device to shut off the fuel.

Subp. 5. Purge cycles. On automatic recycling jobs where intermittent or interrupted pilots are used and all combustion air is provided for by forced and/or induced draft fans, a purge time of approximately one minute shall be provided in the starting sequence and accomplished before the pilot valve is opened.

A repurge must also be accomplished before reignition can be attempted after a flame failure has been detected.

Air flow must be established and proven before the purge timer is energized to begin its timing cycle.

On manually lighted installations the combustion chamber and flue gas passages shall be purged before igniting pilots in accordance with instructions posted by the installer.

Air openings into the burner shall be provided of sufficient area to provide an adequate amount of air for complete combustion under minimum draft conditions and at the maximum rate of firing. The air shall be introduced in a manner so as to assure thorough mixing of the fuel and air in order to complete the combustion within the space provided.

For forced or induced draft operation, limiting devices shall be provided to shut off the fuel in the event of air failure.

The purge cycle shall not begin until the interlock as required in subpart 4 is proven closed.

Subp. 6. **Main burners.** All metallic parts of the burners exposed to the heat of the furnace shall be constructed of an alloy suitable for continuous operation at existing temperatures, or protected from furnace radiation when not in use.

Gas burners shall be of the inshot type. The turndown ratio shall be such as to assure positive and safe ignition and complete stability during operation of main flames on all burners or ports throughout the required range of operation.

Subp. 7. **Combustion control.** Installations primarily used for space heating shall be equipped with adequate and proper devices to control the use of gas input demand according to building requirements. Control systems shall be designed and installed to assure safe, stable, and accepted proper standards of combustion and efficiency throughout the entire range of operation. This subpart sets forth minimum standards within input demand classifications of types of control systems but it shall not preclude the use of more extensive equipment to obtain required or better results for specific jobs.

For fuel inputs not exceeding 3,000,000 Btu per hour the combustion control system may be the "on-off" type which shall consist of a pressure or heat actuated controller to operate an approved slow opening "on-off" gas input control valve properly interlocked with air louvers or dampers where such are used.

For fuel inputs not exceeding 5,000,000 Btu per hour the combustion control system may be "high-low-off" or "on-off" (with timed low fire start) type which shall consist of a pressure or heat actuated controller to operate an approved "high-low-off" or "on-off" (with timed low fire start) fuel input control valve or a group of valves to accomplish the sequence of operation properly interlocked with air louvers and dampers where such are used. This valve or valves shall be separate and in addition to the safety valve. Ignition of main flame shall be accomplished on low fire setting with the low fire setting maintained for such time as draft conditions are established to meet high fire requirements.

For fuel inputs exceeding 5,000,000 Btu per hour the combustion control system shall be the modulating type which shall consist of properly interlocked draft control dampers and fuel input control valves to operate in conjunction with each other to maintain proper ratio of fuel and air in accordance with load requirements. The fuel input control valve shall be separate and in addition to the safety valve. Ignition of main flame shall be accomplished on low fire setting maintained for such time as draft conditions are established to meet high fire requirements.

Modulating controls that are interconnected by mechanical linkage to inlet air louvers of natural draft burners, shall have this linkage so arranged that the louvers will go to the open position in the event of failure of the linkage, provided such failure could change the fuel-air ratio.

The manufacturer or authorized distributor shall file with the administrative authority drawings showing electric wirings, gas piping of the gas burner and controls, method of mounting burner and installation and operating instructions.

Subp. 8. **Dual fuel burning.** In addition to the requirements of parts 1345.2160 to 1345.2180, gas burners to be installed in conjunction with other combustion equipment shall conform to the following requirements.

Controls may be common to both fuels or may be independent. Transfer from one fuel to the other shall be by a manual interlock switching system to prevent the gas and other fuel being used simultaneously except by special permission of the administrative authority. The transfer switch shall have a center off position and will not pass through the center off position without stopping in the off position.

Proper protection of the gas and other combustion equipment shall be provided from the effects of each other.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2190 INSTALLATION REQUIREMENTS FOR ALL GAS BURNERS.

Subpart 1. **Piping.** All gas piping installed for gas burners shall be in accordance with the requirements of parts 1345.3260 to 1345.3300.

Subp. 2. **Combustion air.** Combustion air for all gas burners shall be in accordance with the requirements of parts 1345.0540 to 1345.0710.

Subp. 3. **Venting.** The venting of all gas burners shall be in accordance with parts 1345.0030 and 1345.0540 to 1345.0710.

Subp. 4. **Accessibility for service.** Every gas appliance shall be located with respect to building construction and other equipment so as to permit access to the appliance. Sufficient clearance shall be maintained to permit cleaning of heating surfaces; the replacement of filters, blowers, motors, burners, controls, and vent connections; the lubrication of moving parts where required; and the adjustment and cleaning of burners and pilots.

For attic installation the passage way and servicing area adjacent to the appliance shall be floored.

Appliances listed for outdoor installations may be installed without protection in accordance with the provision of their listing and shall be accessible for servicing.

Subp. 5. **Limiting devices.** All boilers and furnaces shall be provided with automatic safety devices arranged to prevent excessive steam pressures, water temperatures, or air temperatures by shutting off the fuel supply:

A. Steam boilers shall be provided with means to guard against firing a dry boiler or one in which the water is dangerously low.

B. Limiting devices shall not depend upon the closing of an electrical circuit to shut off the fuel supply.

C. All limiting devices shall shut off fuel to all main burners.

D. Shutoff valves shall not be installed in the piping between the boiler and pressure or water temperature limiting devices.

Subp. 6. **Electric wiring.** Electric wiring and equipment in connection with gas burners shall be installed in accordance with the provisions of this code.

Subp. 7. **Installation in residential garages.** Gas appliances may be installed on the floor of a residential garage provided a door of the garage opens to an adjacent ground or driveway level that is at or below the level of the garage floor. When this condition does not exist, appliances shall be installed so that the burners and pilots are at least 18 inches above the floor.

Gas appliances shall be located or reasonably protected, so that they are not subject to physical damage by a moving vehicle.

Subp. 8. **Installation in commercial garages.** Floor-mounted heaters in commercial garages for more than three motor vehicles shall be installed as follows:

A. Heaters may be located in a room separated from other parts of the garage by construction having at least a one-hour fire resistance rating. This room shall not be used for combustible storage and shall have no direct access from the garage storage or repair areas. All air for combustion purposes entering such a room shall be from outside of the building.

B. Overhead heaters shall be installed at least eight feet above the floor.

C. Sealed combustion system heaters may be located within a garage. They shall be protected against physical damage.

Subp. 9. **Installation in aircraft hangars.** Heaters in aircraft hangars shall be installed in accordance with National Fire Protection Association Standard on Aircraft Hangars NFPA No. 409, Chapter 11, Hangar Services and Utilities, Section 1101 Heating.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2200 INSTALLATION OF CONVERSION BURNERS; INPUTS NOT EXCEEDING 400,000 BTU PER HOUR.

Installation of conversion burners shall conform to American Standard Installation of Domestic Gas Conversion Burners, ASA Z21-8, and to the applicable sections of this code.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2210 PREPARATION OF EXISTING HEATING APPLIANCE.

Subpart 1. **Cleaning.** Thoroughly clean the ash pit, fuel passages, and combustion chamber of the furnace or boiler, removing all adhering tars, scale, or dirt.

Subp. 2. **Replacing cracked castings.** If cracks or fractures, especially above the grate level, are found in any of the castings after they have been cleaned, the castings shall be replaced. Cracks or fractures in other materials shall be repaired or the parts replaced and the appliance made gas tight as shown by smoke bomb test or equivalent.

Subp. 3. **Cementing joints.** All joints between sections shall be properly cemented and the ash pit tightly grouted to the floor. Openings for grate shaker bars, cracks around door frames, and cracks such as under clinker doors, shall be tightly sealed with furnace cement.

Subp. 4. **Firing door.** Firing door catches shall be filed or otherwise altered so that the firing door will open easily to relieve pressure. Positive latches shall be removed from the appliance and replaced by either light sheet metal catches, a spring placed on the hinge pin to keep the door closed, or an equivalent arrangement which will permit the door to open and relieve any excessive pressure which may occur in the furnace. Latches on firing doors shall hold such firing doors close to the frame without exposing or forming any cracks.

Subp. 5. **Removing refractory material.** Where the burner is installed at approximately grate level and the furnace is lined with a refractory material, this material shall be removed down to the level of the burner except where the refractory material forms the only wall between the combustion chamber and the furnace front shield.

Subp. 6. **Lining ash pit.** When inshot type conversion burners are installed in dry base boilers or gravity warm air furnaces the ash pit shall be lined for protection in accordance with the manufacturer's installation instructions, or as follows:

A. with at least two inches of insulating fire brick which covers the ash-pit bottom;

B. with at least two inches of insulating fire brick along the side walls of the ash pit up to the level of the water backed surface of a boiler or sufficiently high to protect the grate lugs of a furnace.

Subp. 7. **Floor of combustion chamber.** Where inshot type conversion burners are installed, the floor areas of a combustion chamber shall be in accordance with the burner manufacturer's instructions or recommendations; however, in the absence of such instructions it shall be at least 1-1/2 square inches per 1,000 Btu per hour input of the burner.

Subp. 8. **Water column, gauge glass.** The water column and gauge glass on a steam boiler shall be clean, with the water level plainly visible. The connections from gauge glass to boiler shall be free and unobstructed.

Subp. 9. **Chimney.** The chimney shall be examined and thoroughly cleaned, if necessary, before installation is made.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2220 INSTALLATION OF BURNER AND CONTROLS.

Subpart 1. **Scope.** The installation of gas conversion burners having inputs not exceeding 400,000 Btu per hour shall be installed in accordance with the following provisions.

Subp. 2. **General.** Gas conversion burners of all types shall consist of factory assembled and factory inspected units supplied with an automatic gas control valve, gas pressure regulator, manual main line shutoff valve, pilot shutoff valve, tubing or piping for pilot gas supply, tubing for bleed line from diaphragm valves when employed, and any automatic pilot wiring as regular equipment, and accompanied by complete and comprehensive installation and operation instructions. It shall be ascertained by close and careful inspection that parts of the unit are satisfactory and in proper working order and have not been bent, broken, or otherwise damaged as the result of shipping or transporting the unit to the place of installation. It shall be determined that the unit has been manufactured for use with the gas and electricity to which it is to be connected.

Subp. 3. **Accessibility of burner and controls.** Installation of a burner shall be so planned that it and all its controls will be readily accessible for inspection, cleaning, adjustment, and repairs.

The burner shall be solidly supported on fireproof material both front and rear and shall be level in both directions. No portion of the combustion air door opening of the burner shall be closed off by the seal covering the ash pit opening. Care shall be exercised when installing the burner to avoid undue strain on, or distortion of duct, or other components which would impair the fit, alignment, or mechanical functioning of parts such as pilots, position of orifices with respect to venturi, combustion air door, etc.

For drilled port or multijet upshot type conversion burners installed in boilers, the burner ports shall be at least one inch above grate level. For single port upshot burners the above dimension shall apply to the bottom of the flame spreader.

For drilled port or multijet upshot type conversion burners installed in warm air furnaces, the burner ports shall be set above the grate level but not more than one-third the distance between the grate and the bottom level of the firing door. For single port upshot burners the above dimension shall apply to the bottom of the flame spreader.

Burners shall be so placed with respect to the firebox dimensions as to uniformly distribute the heat over as much of the available heating surface as possible.

Where the burner is appreciably shorter than the firebox, it shall be placed at the end of the firebox which will ensure the longest flue travel. In some instances, it may be necessary to install air directing baffles to ensure proper distribution of combustion air within the flame zone and to thereby prevent floating flame conditions on one side of the burner.

Firing door (fuel door) type burners shall be installed in accordance with the burner manufacturer's instructions. The burner ports shall be located with respect to the side walls of the combustion chamber so as to provide the longest travel for the products of combustion and to avoid direct flame impingement.

After the supply line has been connected to the burner, close the space between the ash pit opening and the air duct (and/or air door shield) in a permanent manner which will preclude entrance of combustion air except through the air duct. The use of sheet metal or hard asbestos board neatly fitted will facilitate servicing at a later date.

All gas burners installed in the revertible flue type of equipment exceeding a 12-inch downdraft shall be provided with a complete shutoff type automatic pilot unless equipped with adequate bleeder connections.

Subp. 4. **Union for connecting burner to house piping.** A union shall be installed in the gas line downstream from the manual main shutoff valve.

Subp. 5. **Automatic main gas-control valves.** The automatic main gas-control valve shall be installed according to instructions furnished by the burner manufacturer.

Subp. 6. **Gas pressure regulators.** An approved gas pressure regulator shall be installed on all conversion burner installations. When automatic recycling ignition is used, the regulator shall not be vented into the combustion chamber. Regulators shall be in accordance with this code.

Subp. 7. **Radiants and flame spreaders.** All radiants or other refractory material, and flame spreaders employed on conversion burners shall be installed in accordance with the manufacturer's instructions.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2230 CONVERSION BURNERS, INPUTS EXCEEDING 400,000 BTU PER HOUR.

Gas burners shall be in accordance with parts 1345.2150 to 1345.2180 and with the requirements of the administrative authority.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2240 DUAL FUEL BURNERS.

Dual fuel burners shall be in accordance with part 1345.2150 and also with this part.

Gas burners shall be of the inshot type and shall be installed to fire directly into the combustion chamber. Angle or corner installations will not be permitted without special permission from the office of the administrative authority.

The installer shall be responsible for the proper functioning of both the gas equipment and the existing combustion facilities.

Proper protection of the gas and other combustion equipment shall be provided from the effects of each other.

Controls may be common to both fuels or may be independent. Transfer from one fuel to the other shall be by a manual interlock system to prevent the gas and other fuel being used simultaneously.

Where it is necessary that both fuels are to be used simultaneously, special approval must be obtained from the administrative authority.

The installer shall file with the administrative authority drawings showing electric wiring, gas piping, method of mounting burner, and operating instructions.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2250 INSTALLATION REQUIREMENTS; CENTRAL HEATING BOILERS AND FURNACES.

Subpart 1. **Manual main shutoff valves.** When a complete shutoff type automatic pilot system is not utilized, a manual main shutoff valve shall be provided ahead of all controls except the manual pilot gas valve.

When a complete shutoff type automatic pilot system is utilized, a manual main shutoff valve shall be provided ahead of all controls.

A union connection shall be provided downstream from the manual main shutoff valve to permit removal of the controls.

Subp. 2. **Clearance.** Central heating boilers and furnaces installed in rooms which are large in comparison with the size of the appliance, shall be installed with clearances not less than specified in part 1345.2443 except as provided in items A, B, and C:

A. Central heating furnaces and boilers listed for installation at lesser clearances than specified in part 1345.2441 may be installed in accordance with their listing and the manufacturer's instructions.

B. Central heating furnaces and boilers listed for installation at greater clearances than specified in part 1345.2441 shall be installed in accordance with their listing and the manufacturer's instructions unless protected as specified in item C.

C. Central heating furnaces and boilers may be installed in rooms, but not in confined spaces such as alcoves and closets, with reduced clearances to combustible material provided the combustible material or the appliance is protected as described in part 1345.2444.

Central heating furnaces and boilers may be installed in rooms, but not in confined spaces such as alcoves and closets unless they have been specifically listed for such installation and are installed in accordance with their listing. The installation clearances for furnaces and boilers in confined spaces shall not be reduced by the protection methods described in part 1345.2442.

When the plenum is adjacent to plaster on metal lath or noncombustible material attached to combustible material, the clearance shall be measured to the surface of the plaster or other noncombustible finish when the clearance specified is two inches or less.

The clearance to these appliances shall not interfere with the requirements for combustion air, draft hood clearance and relief, and accessibility for servicing.

Subp. 3. **Erection and mounting.** A central heating boiler or furnace shall be erected in accordance with the manufacturer's instructions and shall be installed on a floor of fire-resistive construction with noncombustible flooring and surface finish and with no combustible material against the underside thereof or on fire-resistive slabs or arches having no combustible material against the underside thereof unless listed for installation on a combustible floor, or the floor is protected in an approved manner.

Subp. 4. **Plenum chambers and air ducts.** A plenum chamber supplied as a part of a furnace shall be installed in accordance with the manufacturer's instructions. When a plenum chamber is not supplied with the furnace, any fabrication and installation instructions provided by the manufacturer shall be followed. The method of connecting supply and return ducts shall facilitate proper circulation of air. When the furnace is installed within a confined space, the air circulated by the furnace shall be handled by ducts which are sealed to the furnace casing and are entirely separate from the means provided for supplying combustion and ventilation air.

Subp. 5. **Refrigeration coils.** A refrigeration coil shall not be installed in conjunction with a forced air furnace when circulation of cooled air is provided by the furnace blower unless the blower has sufficient capacity to overcome the external static resistance imposed by the duct system and cooling coil for the air required for heating or cooling, whichever is greater. Furnaces shall not be located upstream from cooling units unless the cooling unit is designed or equipped so as not to develop excessive temperature or pressure. Refrigeration coils shall be installed in parallel with or on the downstream side of central furnaces to avoid condensation in the heating element unless the furnace has been specifically listed for downstream installation. With a parallel flow arrangement, the dampers or other means used to control flow of air shall be

sufficiently tight to prevent any circulation of cooled air through the furnace. Adequate means shall be provided for disposal of condensate and to prevent dripping of condensate on the heating element.

Subp. 6. **Cooling units used with heating boilers.** Boilers, when used in conjunction with refrigeration systems, shall be installed so that the chilled medium is piped in parallel with the heating boiler with appropriate valves to prevent the chilled medium from entering the heating boiler. When hot water heating boilers are connected to heating coils located in air handling units where they may be exposed to refrigerated air circulation, such boiler piping systems shall be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2260 INSTALLATION REQUIREMENTS, ROOM HEATERS.

Subpart 1. **Installation in sleeping quarters.** Room heaters shall not be installed in bedrooms or sleeping quarters when such heaters depend upon air for combustion from the room in which they are located.

Subp. 2. **Clearance.** A room heater shall be placed so as not to cause a hazard to walls, floors, curtains, furniture, doors when open, etc., and to the free movements of persons within the room. Listed room heaters shall be installed with clearances not less than specified in part 1345.2443, except that appliances listed for installation at lesser clearances may be installed in accordance with their listings. In no case shall the clearances be such as to interfere with the requirements of combustion air and accessibility.

Unlisted room heaters shall be installed with clearances from combustible material not less than the following:

A. Circulating type: room heaters having an outer jacket surrounding the combustion chamber, arranged with openings at top and bottom so that air circulates between the inner and outer jacket, and without openings in the outer jacket to permit direct radiation, shall have clearance at sides and rear of not less than 12 inches.

B. Radiating type: room heaters other than those described above as of circulating type shall have clearance at sides and rear of not less than 18 inches; except that heaters which make use of metal, asbestos, or ceramic material to direct radiation to the front of the appliance shall have a clearance of 36 inches in front, and if constructed with a double back of metal or ceramic may be installed with a clearance of 18 inches at sides and 12 inches at rear. Combustible floors under unlisted room heaters shall be protected in an approved manner.

Subp. 3. **Wall-type room heaters.** Wall type room heaters shall not be installed in or attached to walls of combustible material unless listed for such installation.

Subp. 4. **Air for combustion and ventilation.** It shall be the installer's responsibility to make provisions for adequate air for combustion and draft hood dilution.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2270 INSTALLATION REQUIREMENTS, WALL FURNACES.

Subpart 1. **General.** Wall furnaces shall be installed in accordance with their listing and the manufacturer's instructions. They may be installed in or attached to combustible material.

Subp. 2. **Vented.** Vented wall furnaces connected to a type BW gas vent system listed only for single story shall be installed only in single-story buildings or the top story of multistory buildings. Vented wall furnaces connected to a type BW gas vent system listed for installation in multistory buildings may be installed in single story buildings. Type BW gas vents shall be attached directly

to a solid header plate which may be an integral part of the vented wall furnace, and which serves as a fire stop at that point. The stud space in which the vented wall furnace is installed shall be ventilated at the ceiling level by installation of the ceiling plate spacers furnished with the gas vent. (See part 1345.2445 for type BW gas vent installation requirements.)

Subp. 3. **Sealed combustion system.** Sealed combustion system wall furnaces shall be installed with the vent-air intake terminal in the outside atmosphere. The thickness of the walls on which the appliance is mounted shall be within the range of wall thickness marked on the appliance and covered in the manufacturer's instructions for installation.

Subp. 4. **Panels, grilles, access doors.** Panels, grilles, and access doors which must be removed for normal servicing operations shall not be attached to the building.

Subp. 5. **Location.** Wall furnaces shall be located so as not to cause a hazard to walls, floors, curtains, furniture, or doors. Wall furnaces installed between bathrooms and adjoining rooms shall not circulate air from bathrooms to other parts of the building.

Subp. 6. **Manual main shutoff valve.** A manual main shutoff valve shall be installed ahead of all controls including the pilot gas valve.

Subp. 7. **Combustion and circulating air.** Adequate combustion and circulating air shall be provided.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2280 INSTALLATION REQUIREMENTS, FLOOR FURNACES.

Subpart 1. **Installation.** Floor furnaces may be installed in combustible floors.

Subp. 2. **Manual main shutoff valve.** A separate manual main shutoff valve shall be provided ahead of all controls and a union connection shall be provided downstream from this valve to permit removal of the controls or the floor furnace.

Subp. 3. **Combustion and circulating air.** Adequate combustion and circulating air shall be provided.

Subp. 4. **Placement.** The following requirements apply to furnaces to serve one story:

A. Floor furnaces shall not be installed in the floor of any aisle or passageway of any auditorium, public hall, or place of assembly, or in an exitway from any such room or space.

B. The grille of a floor furnace with a horizontal warm air outlet shall not be placed closer than six inches to the nearest wall. A distance of at least 15 inches from two adjoining sides of the floor grille to walls shall be provided to eliminate the necessity of occupants walking over the warm air discharge from grilles. Wall-register models shall not be placed closer than six inches to a corner.

C. The furnaces shall be placed so that a door drapery, or similar object, cannot be nearer than 12 inches to any portion of the register of the furnace.

D. The furnace should be installed in a central location favoring slightly the sides exposed to the prevailing winter winds.

Subp. 5. **Bracing.** The space provided for the furnace shall be framed with doubled joists and with headers not lighter than the joists.

Subp. 6. **Support.** Means shall be provided to support the furnace when the floor grille is removed.

Subp. 7. **Clearance.** The lowest portion of the floor furnace shall have at least a six-inch clearance from the general ground level, except that when the lower six-inch portion of the floor furnace is sealed by the manufacturer to

prevent entrance of water, the clearance may be reduced to not less than two inches. When these clearances are not present, the ground below and to the sides shall be excavated to form a "basin-like" pit under the furnace so that the required clearance is provided beneath the lowest portion of the furnace. A 12-inch clearance shall be provided on all sides except the control side, which shall have an 18-inch clearance.

Subp. 8. **Access.** The space in which any floor furnace is installed shall be accessible by an opening in the foundation not less than 24 by 18 inches or a trap door, not less than 24 by 24 inches in any cross section thereof, and a passageway not less than 24 by 18 inches in any cross section thereof. The serving gas supplier should be consulted with reference to the access facilities for servicing when it provides service.

Subp. 9. **Seepage pan.** When the excavation exceeds 12 inches in depth or water seepage is likely to collect, a watertight copper pan, concrete pit, or other suitable material shall be used, unless adequate drainage is provided or the equipment is sealed by the manufacturer to meet this condition. A copper pan shall be made of not less than 16 ounce per-square-foot sheet copper. The pan shall be anchored in place, so as to prevent floating, and the walls shall extend at least four inches above the ground level, with at least six inches clearance on all sides except the control side, which shall have at least 18 inches clearance.

Subp. 10. **Wind protection.** Floor furnaces shall be protected, where necessary, against severe wind conditions.

Subp. 11. **Upper floor installations.** Floor furnaces may be installed in an upper floor provided the furnace assembly projects below into a utility room, closet, garage, or similar nonhabitable space. In such installation, the floor furnace shall be enclosed completely with means for air intake and with access for servicing with minimum furnace clearances of six inches to all sides and bottom, and with the enclosure constructed of portland cement plaster on metal lath or material of equal fire resistance.

Subp. 12. **First floor installations.** Listed floor furnaces installed in the first or ground floors of buildings need not be enclosed unless the basements of these buildings have been converted to apartments or sleeping quarters, in which case the floor furnace shall be enclosed as specified for upper floor installations and shall project into a nonhabitable space.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2290 INSTALLATION REQUIREMENTS, DUCT FURNACES.

Subpart 1. **Clearance.** Listed duct furnaces shall be installed with clearances of at least six inches between adjacent walls, ceilings, and floors of combustible material and the appliance projecting flue box or draft hood, except that duct furnaces listed for installation at lesser clearances may be installed in accordance with their listings. In no case shall the clearance be such as to interfere with the requirements for combustion air and accessibility.

Subp. 2. **Erection of appliances.** Duct furnaces shall be erected and firmly supported in accordance with the manufacturer's instructions.

Subp. 3. **Access panels.** The ducts connected to duct furnaces shall have removable access panels on both the upstream and downstream sides of the furnace.

Subp. 4. **Location of draft hood and controls.** The controls, combustion air inlet, and draft hoods for duct furnaces shall be located outside the ducts. The draft hood shall be located in the same enclosure from which combustion air is taken.

Subp. 5. **Circulating air.** When a duct furnace is installed in a confined space, the air circulated by the furnace shall be handled by ducts which are sealed to the furnace casing and which separate the circulating air from the combustion and ventilating air.

Subp. 6. **Duct furnaces use with refrigeration systems.** A duct furnace shall not be installed in conjunction with a refrigeration coil when circulation of cooled air is provided by the blower unless the blower has sufficient capacity to overcome the external static resistance imposed by the duct system, furnace, and the cooling coil for the air required for heating or cooling whichever is greater.

To avoid condensation within heating elements, duct furnaces used in conjunction with cooling equipment shall be installed in parallel with or on the upstream side of cooling coils unless the duct furnace has been specifically listed for downstream installation. With a parallel flow arrangement, the dampers or other means used to control the flow of air shall be sufficiently tight to prevent any circulation of cooled air through the unit.

When duct furnaces are to be located upstream from cooling units, the cooling unit shall be so designed or equipped as to not develop excessive temperatures or pressures.

Duct furnaces may be installed downstream from evaporative coolers or air washers if the heating element is made of corrosion-resistant material. Stainless steel, ceramic-coated steel, or an aluminum-coated steel in which the bond between the steel and the aluminum is an iron-aluminum alloy are considered to be corrosion-resistant. Air washers operating with chilled water which delivers air below the dew point of the ambient air at the appliance are considered as refrigeration systems.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2300 INSTALLATION REQUIREMENTS, UNIT HEATERS.

Subpart 1. **Support.** Suspended type unit heaters shall be safely and adequately supported with due consideration given to their weight and vibration characteristics. Hangers and brackets shall be of noncombustible material.

Subp. 2. **Clearance, suspended type unit heaters.** Listed unit heaters shall be installed with clearance from combustible material of not less than 18 inches at the sides, 12 inches at the bottom, and six inches above the top when the unit heater has an internal draft hood.

Unit heaters listed for reduced clearances may be installed in accordance with the clearance marked on the unit which will require not less than six inches from the draft hood relief opening, and six inches above an elbow attached directly to the draft hood outlet.

Unlisted unit heaters shall be installed with clearance to combustible material of not less than 18 inches.

Additional clearances required for servicing shall be in accordance with the manufacturer's recommendations contained in the installation instructions.

Subp. 3. **Clearance, floor-mounted type unit heaters.** Listed unit heaters shall be installed with clearance from combustible material at the back and one side only of not less than six inches. When the flue gases are vented horizontally the six-inch clearance shall be measured from the draft hood or vent instead of the rear wall of the unit heater.

Unit heaters listed for reduced clearances may be installed at the clearances marked on the unit from the back, two side walls, and ceiling. Walls and ceiling will be required to have at least six inches clearance from the draft hood relief openings and the nearest point of the draft hood exterior to the unit.

Floor-mounted type unit heaters may be installed on combustible floors if listed for such installation.

Combustible floors under unlisted floor-mounted unit heaters shall be protected in an approved manner.

Additional clearances required for servicing shall be in accordance with the manufacturer's recommendations contained in the installation instructions.

Subp. 4. **Combustion and circulating air.** Adequate combustion and circulating air shall be provided.

Subp. 5. **Ductwork.** A unit heater shall not be attached to a warm air duct system unless listed and marked for such installation.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2310 INSTALLATION REQUIREMENTS, INFRARED HEATERS.

Subpart 1. **Support.** Suspended type infrared radiant heaters shall be safely and adequately fixed in position independent of gas and electric supply lines. Hangers and brackets shall be of noncombustible material.

Subp. 2. **Clearance.** Listed heaters shall be installed with clearances from combustible material of not less than shown on the marking plate and in the manufacturer's instructions.

Unlisted heaters shall be installed in accordance with clearances from combustible material acceptable to the administrative authority.

Subp. 3. **Combustion and ventilating air.** Mechanical exhaust shall be provided in the quantity recommended by the manufacturer and be sufficient to prevent condensation in the space to be heated. Heaters shall be installed so they will not operate until the exhaust air quantity has been proved. Provisions shall be made for makeup air in the space to be heated.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2320 INSTALLATION REQUIREMENTS, DIRECT GAS-FIRED AIR HEATERS.

Subpart 1. **General.** Listed direct gas-fired heaters shall be installed in accordance with their listing and the manufacturer's instructions. They shall conform to the following requirements and provisions.

Subp. 2. **Ignition.** All burners must be positively ignited and safely supervised. No runners or flash tubes will be permitted for burner ignition. Under no condition of burner or pilot stoppage shall such equipment discharge unburned gas into the air stream. Burners must ignite or shut off on safety. Flame safety controls shall be used which will shut off the fuel supply within five seconds in case of flame failure. Flame safety controls must fail in the safe position. For units with inputs under 400,000 Btu a flame safety control which will shut off the fuel supply within 60 seconds will be acceptable.

Subp. 3. **Air supply.** The air supply to be heated must be proved before the pilot can be ignited or main burner valve is allowed to open. Provisions shall be made to shut off the fuel supply in the event of fan air failure or reduction in 50 percent in air flow. If outside air closing louvers of either the manual or automatic type are used, the damper must be proved in the open position before the pilot can be ignited or the gas burner can operate.

Subp. 4. **Air temperature.** Proper limit controls shall be provided to limit maximum air temperatures within the unit and shall be provided a limit control to limit the discharge air temperature to 150 degrees Fahrenheit. A low temperature limit control shall be installed in the discharge air stream which will shut off the outside air supply in the event the discharge air temperature falls below 40 degrees Fahrenheit.

Subp. 5. **Interlocking.** Main burners which are subdivided into sections or zones shall be so interlocked that the gas supply to the burner adjacent to the pilot must be served first and adjacent burners sequenced so that they positively ignite from each other in proper order.

Subp. 6. **Air velocity, carbon monoxide.** Air velocity through or over the burner flames shall not adversely affect the combustion of the gas at the burner heads. A rise in concentration of carbon monoxide between the inlet and the outlet air through the heater shall not exceed ten parts per million under all burner firing rates.

Subp. 7. **Equipment ratings.** Equipment shall be rated as to its capacity in cubic feet per minute of air raised 100 degrees Fahrenheit in temperature at a given Btu input to the burners. Such equipment must deliver the manufacturer's rating at the established air temperature rise and Btu input.

Subp. 8. **Discharge air temperature.** The units shall be capable of maintaining the required discharge air temperature within plus or minus five degrees Fahrenheit of the control setting irrespective of the outside temperature. The uniformity of the discharge air temperature shall be within 30 degrees.

Subp. 9. **Installer's plans.** The installer shall submit plans showing the proposed installation indicating the location of the heater and such accessories as may be required to ensure the proper and safe performance of its function.

Subp. 10. **Combustion air.** Direct gas-fired heaters shall use 100 percent outside air for the air to be heated. Combustion air not exceeding one cubic foot per 100 Btu may be taken from the room.

All air passing through or over the burners shall be outside air and screened or filtered to prevent leaves, papers, or other objects from being picked up from the outside, ignited, and discharged into the heated space.

Direct gas-fired heaters shall be erected and firmly supported in accordance with the manufacturer's instructions.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2330 INSTALLATION REQUIREMENTS, GAS AIR CONDITIONERS.

Subpart 1. **Connection of gas engine-powered air conditioners.** To protect against the effects of normal vibration in service, gas engines shall not be rigidly connected to the gas supply pipings.

Subp. 2. **Manual main shutoff valves.** When a complete shutoff type automatic pilot system is not utilized, a manual main shutoff valve shall be provided ahead of all controls except the manual pilot gas valve. When a complete shutoff type automatic pilot system is utilized, a manual main shutoff valve shall be provided ahead of all controls. A union connection shall be provided downstream from the manual main shutoff valve to permit removal of the controls.

Subp. 3. **Clearances for indoor installation.** Listed air conditioning appliances installed in rooms which are large in comparison with the size of the appliance shall be installed with clearances not less than specified in part 1345.2441 except as provided in the following:

A. Air conditioning appliances listed for installation at lesser clearances than specified in part 1345.2441 may be installed in accordance with their listing and the manufacturer's instructions.

B. Air conditioning appliances listed for installation at greater clearances than specified in part 1345.2441 shall be installed in accordance with their listing and the manufacturer's instructions unless protected as specified in item C. However, when clearances are specified to provide access for service, they shall not be reduced.

C. Air conditioning appliances may be installed in rooms, but not in confined spaces such as alcoves and closets, with reduced clearances to combustible material provided the combustible material or the appliance is protected as described in part 1345.2442. However, when clearances are necessary or specified to provide access for service, they shall not be reduced.

Subp. 4. **Confined spaces.** Air conditioning appliances shall not be installed in confined spaces such as alcoves and closets unless they have been specifically listed for such installation and are installed in accordance with their listing. The installation clearances for air conditioning appliances in confined spaces shall not be reduced by the protection methods described in part 1345.2442.

When the plenum for an air conditioner which includes provisions for heating air is adjacent to combustible material, the clearance shall be measured to the surface of the plaster or other noncombustible finish when the clearance specified is two inches or less.

The clearance to these appliances shall not interfere with the requirements for combustion air, draft hood clearance and relief, and accessibility for servicing.

Subp. 5. **Unlisted appliances.** Unlisted air conditioning appliances shall be installed with clearances from combustible material of not less than 18 inches above the appliance and at sides, front, and rear, and nine inches from projecting flue box or draft hood.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2340 VENTING GAS BURNERS.

The venting of gas burners shall be in accordance with parts 1345.2340 to 1345.2430 and the applicable portions of parts 1345.0400 to 1345.0500.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2350 TYPES OF FLUES OR VENTS DEFINED.

Subpart 1. **Scope.** For the purposes of the code, the following definitions shall apply.

Subp. 2. **Type A flue or vent.** "Type A flue or vent" means flues or vents of masonry, reinforced concrete, or metal smoke stacks approved for use with solid or liquid fuels.

Subp. 3. **Type B gas flue or vent.** "Type B gas flue or vent" means vent piping of noncombustible corrosion-resistant material of sufficient thickness, cross-sectional area, and heat insulating quality to avoid excess temperature on adjacent combustible material and certified by a nationally recognized testing agency.

Subp. 4. **Type C gas flue or vent.** "Type C gas flue or vent" means flue or vent piping of sheet copper of not less than No. 24 U.S. Standard gauge or of galvanized iron or aluminum of not less than No. 20 U.S. Standard gauge or of other approved corrosion-resistant material.

Subp. 5. **Chimney liner.** "Chimney liner" means a vent pipe or flue inserted within a type A flue or vent for the purpose of minimizing condensation of flue products and preventing such condensation from contact with the interior of the type A flue or vent in which it is inserted.

Subp. 6. **Flue or vent.** "Flue or vent" means a conduit or passageway, vertical or nearly so, for conveying flue gases to the outer air.

Subp. 7. **Flue or vent connector.** "Flue or vent connector" means the pipe connecting an appliance with the flue or vent. This corresponds to the smoke pipe used with solid or liquid fuels.

Subp. 8. **Draft hood.** "Draft hood" means a device built into an appliance, or made a part of the flue or vent connector from an appliance, which is designed to ensure the ready escape of the products of combustion in the event of no draft, back draft, or stoppage beyond the draft hood; prevent a back draft from entering the appliance; and neutralize the effect of stack action of the flue or vent upon the operation of the appliance.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2360 DRAFT HOODS.

Subpart 1. **General.** Every vented appliance except units designed for forced venting or those using barometric dampers shall be provided with a draft hood. If the draft hood is not a part of the appliance or supplied by the appliance manufacturer, it shall be supplied by the installer and, in the absence of other instructions, shall be the same size as the appliance flue collar. However, the flue collar of a boiler or furnace fired by a conversion burner may be reduced in size by means of a tapered reducer to that size required by the input to the conversion burner.

Subp. 2. **Installation.** Where the draft hood is a part of the appliance or is supplied by the appliance manufacturer it shall be installed without alteration in accordance with the manufacturer's instructions. In the absence of the manufacturer's instructions the draft hood shall be attached to the flue collar of the appliance or as near to the appliance as conditions permit. In no case shall a draft hood be installed in a false ceiling, in a different room, or in any manner that will permit a difference in pressure between the draft hood relief opening and the combustion air supply.

Subp. 3. **Position.** A draft hood shall be installed in the position for which it was designed with reference to the horizontal and vertical planes and shall be so located that the relief opening is not obstructed by any part of the appliance or adjacent construction.

Subp. 4. **Special draft hoods.** Where, due to unusual conditions, the installer must supply a draft hood of special design, its design, construction, and installation shall be subject to the approval of the administrative authority.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2370 BAROMETRIC DAMPERS.

An approved draft regulator having a minimum free area of three-fourths of the area of the boiler or furnace breeching outlet may be used in lieu of a draft hood. Where barometric dampers are used they shall furnish positive and effective protection against back drafts and shall have means to shut off the main gas supply in the event of a down draft. Barometric dampers shall be installed in accordance with the manufacturer's instructions.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2380 INTERNAL DRAFT DAMPERS.

Subpart 1. **Counterbalancing.** Uptake dampers shall be counterbalanced to open in the event of breakage or failure of their operating means. Counterbalancing arms, weights, etc. shall be so located or shielded as to prevent personal injury or damage to equipment in case of breakage.

Subp. 2. **Interlocking.** For automatically lighted burners, automatically operated dampers, where used, shall be interlocked to prevent lighting of the main burner unless sufficient draft is available.

Subp. 3. **Safety; approval.** All combustion control systems shall be so installed as to assure stable, safe, and approved proper standards of combustion and efficiency with a minimum of 70 percent for the required range of operation. The sequence of operation of automatic damper controls shall be subject to the approval of the administrative authority.

Subp. 4. **Automatic air controls.** When air louvers, dampers, or other air controls are automatically operated, such operation shall be in conjunction with gas input control valves, either by mechanical linkage or changes in furnace pressure and/or change in fuel flow to maintain proper fuel-air ratio over the entire required range of operation. The operating medium may be electrical, pneumatic, or hydraulic. Arrangements shall be provided for shutting off the fuel supply in the event of a failure of the control medium.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2390 USE OF TYPES OF FLUES OR VENTS.

Subpart 1. **Type A.** Type A flues or vents shall be employed for venting:

A. all appliances which may be converted readily to the use of solid or liquid fuels;

B. all boilers and warm air furnaces except where approved for connection to type B gas flue or vents; and

C. all incinerators.

Subp. 2. **Type B.** Type B gas flues or vents shall be used only with an approved gas designed appliances which produce flue gas temperatures not in excess of 550 degrees Fahrenheit at the outlet of the draft hood when burning gas at the manufacturer's normal input rating and not specified by parts 1345.2340 to 1345.2430 to be vented to type A flues or vents.

For the purposes of this code, approved gas design appliances, with the exception of incinerators and conversion burners, may be accepted as producing flue gas temperatures not in excess of 550 degrees Fahrenheit at the outlet of the draft hood.

A condensation pocket shall be provided at the base of such type B flue or vent with provision for a drip, so arranged that excessive condensation of flue products may be disposed of without damage to the foundation, floor, walls, or footings.

If rainwater cannot be allowed in a vent and a cap must be used, such cap should have as little cooling surface as possible, be screened with visible one-half inch mesh screen, be corrosion proof (aluminum or galvanized steel), installed so the clearance between the vent cap and end of vent is equal to vent diameter, and so constructed and installed that it is impossible for the cap to slip down over the vent.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2400 MARKING OF GAS FLUES OR VENTS NOT SUITABLE FOR OTHER FUELS.

Chimneys, flues, or vents installed for use with gas appliances but which are not suitable for solid or liquid fuels shall be plainly and permanently labeled: "This flue is for use of gas-burning appliances only."

The label shall be attached to the wall or ceiling at a point near where the flue or vent connector enters the chimney, or, where a type B gas flue or vent is used in place of a chimney, at a point near where the type B gas flue or vent or the flue or vent connector enters the wall or ceiling.

Type C gas flues or vents shall be used for runs directly from the space in which the appliance is located through the roof or exterior wall to the outer air. Such flues or vents shall not pass through any attic or concealed space nor through any floor. Installation with reference to clearance to combustible construction and passage through wall or roof shall comply with the provisions of paragraphs d, e, and f of SBC 7403, Metal Chimneys, 1, Installation.

Statutory Authority: *MS s 16B.59 to 16B.73*

NOTE: Reference to paragraphs d, e, and f of SBC 7403 is an error that will need to be corrected by amendment.

1345.2410 VENTING, CHIMNEY LINERS.

When the administrative authority requires a metal flue liner such liner shall comply with part 1345.0410. A chimney liner release will be granted when the administrative authority finds it impossible to install a liner.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2420 VENTING, FLUE SIZE.

The vent pipe or connection should not be smaller than the size indicated by the vent pipe collar of the appliance and not less than one square inch in cross-sectional area for each 7,500 Btu per hour input to appliance. However, in no case shall the vent from any appliance be less than three inches in diameter.

Two or more gas appliances may be vented through a common flue or vent connector when necessary, if the area of the common flue or vent connector is equal to or greater than one square inch in cross-sectional area for each 7,500 Btu per hour input of the individual gas appliances.

Individual gas appliance vents shall joint the common vent by Y fittings.

Part 1345.0510, subparts 1, 2, 4, and 6 will be the minimum standards for sizing of vents.

Where high chimneys create high draft intensities, deviations from the foregoing table to the extent of practicability may be permitted by the administrative authority.

Where mechanical draft is applied, vent size shall be determined upon capacity and type of equipment, all subject to approval by the administrative authority. Where high temperatures are encountered, fan or blower construction shall be so designed as to safely operate under those temperatures.

Class B vent flues shall have a venting capacity of at least 50,000 Btu input greater than the input of the central heating gas appliance which it serves and shall in no case be less than five inches inside diameter.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2430 VENTING, INSUFFICIENT DRAFT.

In the event conditions at the time of installation are such that the chimney or vertical flue has insufficient natural draft to properly carry away the products of combustion, provision shall be made by the installer to rectify existing conditions or provide mechanical means of maintaining constant up draft during appliance operation. The draft must be proved before the burner may be operated.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2440 TESTS; BURNER OPERATION; APPLIANCE PERFORMANCE.

Subpart 1. **Placing equipment in operation.** Immediately upon completion of all installations the installer shall test all safety shutoff, operating controls, and venting before placing the burner in service. The correct input of gas should be determined and the fuel-air ratio set.

Subp. 2. **Adjusting the burner input; tests.** Each burner shall be adjusted to its proper input in accordance with the manufacturer's instructions. Overtating of burners is prohibited.

Subp. 3. **Gas designed equipment.** The rate of flow of the gas shall be adjusted to within plus or minus two percent of the required hourly Btu rating at the manifold pressure specified by the manufacturer. When the prevailing pressure is less than the manifold pressure specified, the gas rates shall be adjusted at the prevailing pressure.

Subp. 4. **Conversion burners.** For conversion burners installed in hot water boilers or warm air furnaces the rate of flow of the gas in Btu per hour shall be adjusted to within plus or minus five percent of 1.7 times the calculated hourly Btu heat loss of the building in which it is installed.

For conversion burners installed in steam boilers the gas hourly input demand shall be adjusted to meet the steam load requirements. In case of oversized boiler having rating in excess of load requirements, the gas input demand necessitated by such oversized boiler shall be established and added to the input demand for load requirements to arrive at total input demand.

Subp. 5. **Pilot operations.** Pilot flames shall be effective to ignite the gas at the main burner or burners and shall be adequately protected from drafts.

Pilot flames shall not become extinguished when the main burner or burners are turned on or off in a normal manner, either manually or by automatic controls.

Luminous flame pilots shall not show carbon deposits when adjusted according to the manufacturer's instructions.

Where escapement pilots are used, their flames shall be freely ignited by the constant burning pilot.

Subp. 6. **Burner operation.** In making the tests to determine compliance with this part, care shall be exercised to prevent the accumulation of unburned gas in the appliance or flues which might result in explosion or fire.

The flames from each burner shall freely ignite the gas from adjacent burners when operating at the prevailing gas pressure or when the main control valve is regulated to deliver about one-third the full gas rate.

Burner flames shall not flash back upon immediate ignition, nor upon turning the gas cock until the gas rate to the burner is about one-third the full supply.

Burner flames shall not flash back when the gas is turned on or off by any automatic control mechanism.

Main burner flames shall ignite freely from each constant burning pilot when the main control valve is regulated to about one-third the full gas rate or when pilot flame is reduced to minimum point at which it will actuate the safety thermostatic device.

When ignition is made in a normal manner the flame shall not flash outside the appliance.

Burners shall not expel gas through air openings in mixer faces when operating at the prevailing pressure.

Subp. 7. **Appliance performance.** The concentration of oxygen in the flue products of conversion burners shall, in no case, be less than four percent nor less than ten percent. The allowable limit of CO shall not exceed .04 percent. The flue gas temperature of gas designed appliances, as taken on the appliance side of the draft hood, shall not exceed 480 degrees Fahrenheit above that of the room air temperature surrounding the appliance.

Method of test. The appliance shall be allowed to operate until the stack temperature becomes stabilized, after which a sample of the flue products shall be taken at a point in the flue after the outlet of the appliance but ahead of the draft hood and analyzed for carbon dioxide and carbon monoxide. When carbon dioxide and carbon monoxide samples of combustion products have been analyzed an oxygen determination can be made from a combustion scale or chart.

The venting and various controls of the appliance shall be checked by the installer to insure their proper operation.

Upon completion of the test of any newly installed gas burning equipment as provided in this part, the installer shall file with authority complete records of such test including report of smoke bomb test of warm air furnace. A tag stating the date of test and name of tester shall be attached to the appliance.

Subp. 8. **Instructions to the customer.** The customer shall be thoroughly informed by the installer as to the proper and safe operation of the appliance before it is placed in continuous service.

The wiring diagram of the installation and suitable operating instructions shall be supplied and posted near the boiler or furnace.

In the absence of the customer, printed instructions enclosed in an envelope labeled "Instructions to Customers" and attached to the main shutoff valve of the appliance by the installer, shall be construed as having fulfilled the aforementioned requirements.

A metallic plate, suitably etched or stamped, setting forth detailed instructions for the safe lighting and shutting off of the appliance shall be permanently attached to the appliance in a prominent position near the lighting apertures. The size of type used shall be not smaller than ten point and the wording contained thereon shall be subject to the approval of the administrative authority.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2441 CLEARANCES TO COMBUSTIBLE MATERIAL FOR FURNACES AND BOILERS INSTALLED IN ROOMS WHICH ARE LARGE IN COMPARISON WITH SIZE OF APPLIANCE.

Subpart 1. Table.

	Minimum Clearance, Inches				
	Above and Sides of Bonnet or Plenum	Jacket Sides And Rear	Front See subpart 2, item A	Project-ing Flue Box or Draft Hood	Vent Con- nector See subpart 2, item B
1. Listed automatically fired, forced air or gravity system with 250° F. temperature limit control.	2 See Subpart 2, items C and D	6	18	6	6
2. Unlisted automatically fired, forced air or gravity system equipped with temp. limit control which cannot be set higher than 250° F.	6 See Subpart 2, item E	6	18	18 See Subpart 2, item F	18 See Subpart 2, item F
3. Listed Automatically Fired Heating Boilers- Steam Boilers operating at not over 15 psi gage pressure and hot water boilers operating at not in excess of 250° F.	6 Subpart 2, item G	6	18	6	6
4. Unlisted Automatically Fired Heating Boilers- Steam boilers operating at not over 15 psi gage pressure and hot water boilers operating at not in excess of 250° F.	6 Subpart 2, item G	6	18	18 See Subpart 2, item F	18 See Subpart 2, item F
5. Central heating boilers and furnaces, other than above.	18 Subpart 2, item H	18	18	18 See Subpart 2, item F	18 See Subpart 2, item F

Subp. 2. Notes. Notes applicable to subpart 1:

A. Front clearance shall be sufficient for servicing the burner and furnace or boiler.

B. The vent connector clearance does not apply to listed type B gas vents.

C. This clearance may be reduced to one inch for a listed forced air or gravity furnace equipped with a limit control that cannot be set higher than 200 degrees Fahrenheit, or a marking to indicate that the outlet air temperature cannot exceed 200 degrees Fahrenheit.

D. Clearance from supply ducts within three feet of the plenum shall not be less than that specified from the bonnet or plenum. No clearance is required beyond this distance.

E. Clearance from supply ducts within six feet of the plenum shall not be less than six inches. No clearance is required beyond this distance.

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F. For unlisted gas appliances equipped with an approved draft hood, this clearance may be reduced to nine inches.

G. This clearance is above top of boiler.

H. Clearance from supply ducts shall not be less than 18 inches out to three feet from the bonnet or plenum, not less than six inches from three feet to six feet, and not less than one inch beyond six feet.

I. Rooms which are large in comparison with the size of the appliance are rooms having a volume equal to at least 12 times the total volume of a furnace and at least 16 times the total volume of a boiler. Total volume of furnace or boiler is determined from exterior dimensions and is to include fan compartments and burner vestibules, when used. When the actual ceiling height of a room is greater than eight feet, the volume of a room shall be figured on the basis of a ceiling height of eight feet.

Statutory Authority: *MS s 16B.59 to 16B.73*

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1345.2442 CLEARANCE, INCHES, WITH SPECIFIED FORMS OF PROTECTION.

TYPE OF PROTECTION	WHERE THE REQUIRED CLEARANCE WITH NO PROTECTION IS:											
	36 in.			18 in.			12 in.		9 in.	6 in.		
	Above	Sides and Rear	Vent Con- nector	Above	Sides and Rear	Vent Con- nector	Above	Sides and Rear	Vent Con- nector	Above	Sides and Rear	Vent Con- nector
(a) 3/4 in. asbestos millboard spaced out 1"***	30	18	30	15	9	12	9	6	6	3	2	3
(b) 28 gage sheet metal on 1/4" asbestos millboard	24	18	24	12	9	12	9	6	4	3	2	2
(c) 28 gage sheet metal spaced out 1"***	18	12	18	9	6	9	6	4	4	2	2	2
(d) 28 gage sheet metal on 1/8" asbestos millboard spaced out 1"***	18	12	18	9	6	9	6	4	4	2	2	2
(e) 1 1/2" asbestos cement covering on heating appliance	18	12	36	9	6	18	6	4	9	2	1	6
(f) 1/4" asbestos millboard on 1" mineral wool bats reinforced with wire mesh or equivalent	18	12	18	6	6	6	4	4	4	2	2	2
(g) 22 gage sheet metal on 1" mineral wool bats reinforced with wire or equivalent	18	12	12	4	3	3	2	2	2	2	2	2
(h) 1/4" asbestos cement board or 1/4" asbestos millboard	36	36	36	18	18	18	12	12	9	4	4	4
(i) 1/4" cellular asbestos	36	36	36	18	18	18	12	12	9	3	3	3

*Except for the protection described in (e), all clearances shall be measured from the outer surface of the appliance to the combustible material disregarding any intervening protection applied to the combustible material.
 **Spacers shall be of noncombustible material.

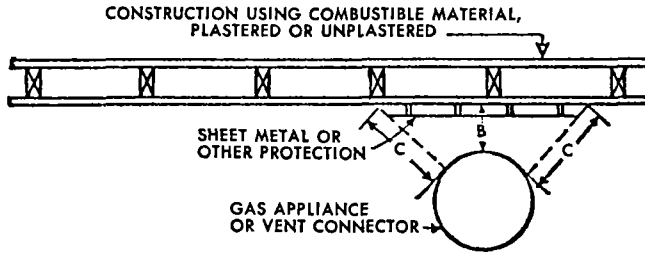
Statutory Authority: MS s 16B.59 to 16B.73

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1345.2443 EXTENT OF PROTECTION REQUIRED TO REDUCE CLEARANCES FROM GAS APPLIANCES OR VENT CONNECTORS.



B equals the reduced clearance permitted in accordance with the table in part 1345.2730. The protection applied to the construction using combustible material shall extend far enough in each direction to make C equal to A.

Statutory Authority: *MS s 16B.59 to 16B.73*

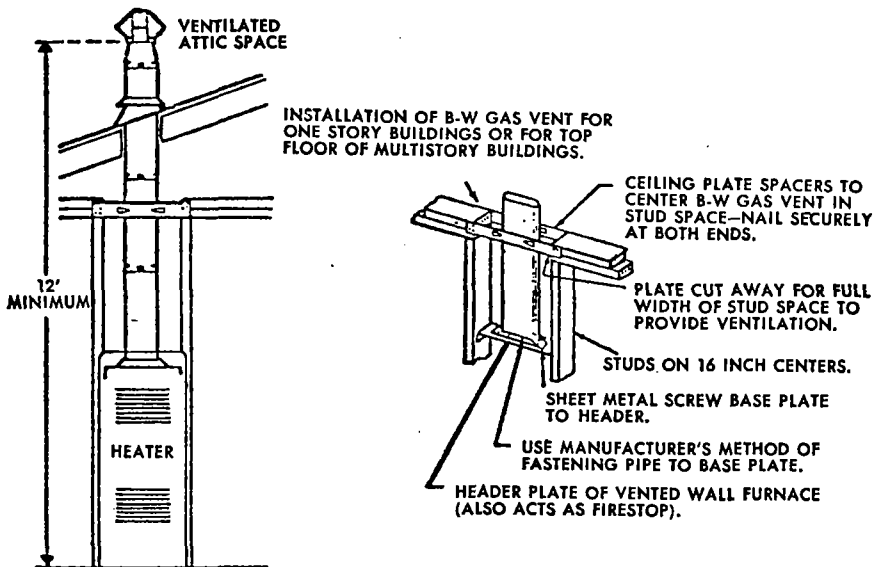
1345.2444 MINIMUM CLEARANCES FOR LISTED ROOM HEATERS.

Distance from Combustible Material, Inches

Types of Appliances	Jacket, Sides and Rear	Projecting Flue Box or Draft Hood
Warm air circulators	6	2
Radiant heaters	6	2
Wall heaters	Flush	-

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2445 INSTALLATION OF TYPE B-W GAS VENTS FOR VENTED WALL FURNACES.



Statutory Authority: *MS s 16B.59 to 16B.73*

GAS PIPING**1345.2450 APPROVAL OF MATERIALS AND APPLIANCES.**

No person shall install any material to connect same to any gas system, which material has not been approved by the administrative authority.

The administrative authority shall accept for installation any appliance or material which has been listed by a recognized national testing laboratory, until such time as experience in the field of actual service developing unforeseen factors warranting withdrawal of acceptance.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2460 GAS PIPING MATERIAL, CONNECTION.

All pipe used for the distribution of natural or liquid petroleum gas shall be steel, wrought iron, copper, or brass of full weight standard gauge and thickness. Steel and wrought iron pipe shall comply with ASA B36.10. Steel and wrought iron piping run outside exposed above ground shall be galvanized, painted, or coated with an approved rust resistant material.

All steel and wrought iron pipe 2-1/2 inches and larger shall be welded. Fittings on screw or flange piping, (except stopcocks and valves) shall be malleable iron, wrought iron, or steel.

Copper tubing or approved steel tubing shall be of standard type K or L or equivalent, complying with ASTM B88 and having a minimum wall thickness for each tubing size in compliance with ASTM specifications. Joints shall be made by approved flared gas fittings or by brazing with a material having a melting point in excess of 1,000 degrees Fahrenheit. Compression type fittings shall not be used for this purpose. Copper or iron tubing shall not be used for piping within the burner heat zone to pilot burners.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2470 FLEXIBLE GAS TUBING CONNECTIONS.

No person shall install, use, or maintain flexible gas connections between gas burning devices and the supply piping except on specific approval of the administrative authority. When a flexible connection is made, a shutoff valve must always be provided at the end where the flexible connector is attached to the rigid piping.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2480 NEW MATERIALS.

Any materials may be permitted other than as specified in this code if the administrative authority approves such materials as being of the same quality and performance as the material specified herein.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2490 DEFECTIVE PIPE AND FITTINGS.

Defects in pipe or fittings shall in no case be repaired. All such defective pipe or fittings shall, when located, be removed and replaced with perfect material. All pipe and fittings shall be of perfect material; all pipe ends shall be reamed free of burrs and welding slag.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2500 CONSTRUCTION AND INSTALLATION, GENERALLY.

All piping installed for the distribution of natural or liquid petroleum gas shall be so constructed and installed as to be durable, substantial, and gas-tight. It shall be run substantially square with the building construction in a neat orderly fashion.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2510 PIPING SUPPORTS.

Gas piping in buildings shall be supported with pipe hooks, metal pipe straps, bands, or hangers suitable for the size of piping, and of adequate strength and quality and located at proper intervals so the piping cannot be moved accidentally from the installed position. Gas piping shall not be supported by or used to support other piping. Spacing of supports in piping installations shall not be greater than the following: three-eighths inch pipe, four feet; one-half inch pipe, six feet; and three-fourths inch or one-inch pipe, ten feet.

Vertical piping shall be supported at every floor by a specific means of support.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2520 OUTSIDE EXPOSED PIPING.

Gas piping may be run inside or outside the building regardless of temperature changes. Provision shall be made to allow for expansion and contraction of the piping.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2530 DRIPS.

Condensate drips are not required when using natural or liquid petroleum gas.

A tee fitting with the bottom outlet plugged or capped shall be installed at the base of supply piping when dropping down to an automatically controlled gas burner or appliance, where dirt or foreign material could cause an automatic gas valve to malfunction.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2540 PIPE THREADS.

Subpart 1. **Specifications for pipe threads.** Pipe and fitting threads shall comply with the American Standard for Pipe Threads (except dryseal), B 2.1.

Subp. 2. **Damaged threads.** Pipe with threads which are stripped, chipped, corroded, or otherwise damaged shall not be used.

Subp. 3. **Number of threads.** Pipe shall be threaded in accordance with subpart 4.

Subp. 4. **Specifications for threading pipe.**

Iron Pipe Size (Inches)	Approximate Length of Threaded Portion (Inches)	Approximate No. of Threads to be Cut
1/2	3/4	10
3/4	3/4	10
1	7/8	10
1-1/4	1	11
1-1/2	1	11
2	1	11
2-1/2	1-1/2	12
3	1-1/2	12
4	1-5/8	13

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2550 BENDING PROHIBITED.

Pipe shall not be bent. Fittings shall be used when making turns in the gas piping. Proper bends will be allowable with copper tubing.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2560 JOINT COMPOUNDS.

Joint compounds (pipe dope) shall be applied sparingly and only to the male threads of pipe joints. Such compounds shall be resistant to the action of liquified petroleum gases.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2570 STRUCTURE PROTECTION.

The building structure shall not be weakened by the installation of any gas piping. Before the beams or joists are cut or notched, special permission shall be obtained from the administrative authority.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2580 PIPING PROTECTION.

Pipes passing through concrete, or other corrosive materials, shall pass through sleeves, casings, or be suitably coated to protect against corrosion and mechanical damage.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2590 RESTRICTED PIPE RUNS.

Gas pipes inside any building shall not be run in or through an air duct, clothes chute, chimney or flue, ventilating duct, dumb waiter or elevator shaft, or be run in false ceilings when the space is used as an air plenum. Pipe shafts specifically designed for this purpose will be acceptable.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2600 RESTRICTIONS ON CONCEALED PIPING.

Piping run in inaccessible or concealed spaces in or under buildings shall be constructed and installed to prevent a hazardous accumulation of gas. Concealed piping in walls should be located in hollow rather than solid partitions.

Piping run underground inside the building, or run in solid floors such as concrete, shall be run in conduits or casings. Piping may be laid in channels in the floor that have removable covers to permit access to the piping with a minimum of damage to the building. Such casings, conduits, or channels shall be left open into an accessible location or be vented so a leak will be readily detected.

Piping run underground inside the building and extending underground outside the building shall be encased in a gas-tight conduit. The conduit shall extend into a normally usable and accessible portion of the building and at the point where the conduit terminates in the building, the space between the conduit and gas pipe shall be sealed to prevent the possible entrance of any gas leakage. The conduit shall be vented above grade to the outside and the vent terminal shall be screened and hooded to prevent accidental closure. The conduit shall extend at least four inches beyond the outside building wall or any adjacent paved area, except the conduit need not exceed ten feet in distance from the building under any paved area. The space between the gas pipe and the conduit at the underground end shall be left open.

Concealed tubing run through joists, studs, plates, or other wood construction within two inches of the rough surface, shall be protected from physical damage by steel plates or sleeves of at least 20 gauge thickness.

Unions, flared or compression fittings, running threads, right and left couplings, or bushings shall not be used on concealed gas piping inside the building.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2610 DEPTH OF PIPING OUTSIDE UNDERGROUND.

Any gas piping to be run underground outside the building shall have not less than six inches of ground cover unless otherwise approved by the administrative authority.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2620 PIPING UNDERGROUND OUTSIDE.

Any gas piping to be run underground outside the building shall be copper, steel, or wrought iron.

Steel or wrought iron pipe shall have an approved outside protective coating of polyethylene, polyvinyl, or its equivalent of ten mil thickness or greater. The pipe shall not be threaded, but shall be joined by welding or mechanical joints, and such joints shall be suitably wrapped with an approved protective coating.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2630 METER LOCATION.

The meter location shall be such that the meter can be easily read and the connections are readily accessible for servicing. Location, space requirements, dimensions, and type of installation shall be acceptable to the servicing gas supplier.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2640 METER SUPPORT.

Meters shall be adequately supported from the structure or shall be on a substantial slab and so connected to the piping as not to exert undue strain on the connection.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2650 METER ROOM VENTILATION.

Meter room shall be ventilated, when necessary, through adequate grilles in doors, walls, or local ventilation to outer air. Grilles in doors or walls shall not be open into building interiors.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2660 MAIN GAS SUPPLY SHUTOFF.

When meters are installed inside the building, a main shutoff valve shall be installed in a readily accessible location inside the building on the street side of the meter.

When meter or meters are installed on the exterior of the building walls, a main shutoff valve the same size as the main building gas supply shall be installed on the inside of the building between the meter and the first branch gas line. This shutoff valve shall be installed in the first readily accessible location for use and operation and shall have a permanently attached handle. In multiple dwellings this main shutoff valve shall not be located in an apartment or locked room, but shall be in the utility room or otherwise so located as to be readily accessible to all occupants of the building at all times. All valves shall be clearly visible or of easy access.

All main shutoff valves shall be approved lubricated plug type, ball type, or of a type approved by the administrative authority.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2670 GAS VALVES.

Subpart 1. **General.** For each burning device there shall be provided, in the pipe supplying same, and adjacent thereto, an independent shutoff valve, placed in an accessible location.

Every valve shall be readily accessible for operation and repair. All gas valves shall be of lever handle type. Inputs exceeding 1,000,000 Btu per hour, or where metering or regulating pressure exceeds 14 inches water column, the valve shall be an approved lubricated plug-type, ball type, or of a type approved by the administrative authority.

Subp. 2. **Accessibility of gas valves.** Main shutoff valves controlling several gas piping systems shall be placed an adequate distance from each other so they will be easily accessible for operation and shall be installed so as to be protected from physical damage. It is recommended that they be plainly marked with a metal tag attached by the installing agency so that the gas piping systems supplied through them can be readily identified. It is advisable to place a shutoff valve at every point where safety, convenience of operation, and maintenance demands.

Subp. 3. **Shutoff valves for multiple house lines.** In multiple tenant buildings supplied through a master meter or one service regulator when a meter is not provided, or where meters or service regulators are not readily accessible from the appliance location, an individual shutoff valve for each apartment, or for each separate house line, shall be provided at a convenient point of general accessibility.

In a common system serving a number of individual buildings, shutoff valves shall be installed at each building.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2680 ELECTRICAL GROUNDING.

A gas piping system within a building shall not be used as a grounding electrode. Underground gas service piping shall not be used as a grounding electrode. Gas piping shall be grounded to an NEC approved ground. See ANSI C.I.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2690 GAS PRESSURE REGULATORS.

Subpart 1. **General.** All relief devices or regulators equipped with relief devices shall be vented to the outside atmosphere.

When the gas supply pressure is higher than the pressure at which the burner or appliance is designed to operate, a gas pressure regulator shall be installed.

Subp. 2. **High pressure gas regulators.** Gas regulators designed to regulate from pounds inlet pressure to pounds outlet pressure shall have a pressure rating of not less than the protected metering pressure and be of the full lockup type. All such regulators shall be vented to the outside of the building.

Subp. 3. **High pressure to low pressure regulators.** Gas regulators designed to regulate pounds inlet pressure to low outlet pressure shall have a pressure rating of not less than the protected metering pressure and be of the full lockup type. All such regulators shall be vented to the outside of the building, except that regulators equipped with vent limiting devices, to limit the escape of gas from the vent opening in the event of diaphragm failure, may be used without outside vents when approved by the administrative authority.

Subp. 4. **Low pressure regulators.** Gas regulators designed to regulate from low inlet pressure to lower outlet pressure shall:

A. Low pressure regulators are not required to be vented to the outside of the building unless the connected load exceeds 1,000,000 Btu per hour.

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B. Low pressure regulator vents shall be protected from stoppage by dirt and foreign matter.

C. Low pressure regulator vents shall not be vented into a combustion chamber that is equipped with an intermittent pilot.

Subp. 5. **Regulator installation.** All regulator installations shall comply with the following:

A. Regulators shall be installed in accordance with the manufacturer's instructions.

B. Regulators shall be rated to supply the total load required.

C. Regulators shall be readily accessible for servicing. In no case shall said regulators be covered by ceiling or other types of unventilated construction.

D. All regulators shall be provided with an accessible shutoff valve for servicing the regulator.

E. High gas pressure protection shall be provided when using a high-pressure regulator or a high-pressure to low-pressure regulator unless otherwise approved by the administrative authority. The protection device may be incorporated as part of the regulator or by separate pressure-limiting mechanism.

F. When regulators are required to be vented to the outside of the building, such vent piping shall be sized in accordance with the manufacturer's instructions. Vent piping shall terminate a minimum of six feet away from combustion or any air inlet to the building and shall be suitably screened and hooded so as to prevent accidental closure of the vent pipe.

G. Regulators shall be vented individually unless otherwise approved by the administrative authority.

H. Regular vents shall not terminate into a vent connector, breeching, stack, or chimney.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2700 SIZE OF PIPING TO GAS APPLIANCES.

Gas piping shall be of such size and so installed as to provide a supply of gas sufficient to meet the maximum demand without undue loss of pressure between the meter, or service regulator when a meter is not provided, and the appliance or appliances. The size of the gas piping depends upon the following factors:

A. allowable loss in pressure from meter, or service regulator when a meter is not provided, to appliances;

B. maximum gas consumption to be provided;

C. length of piping and number of fittings;

D. specific gravity of the gas;

E. diversity factor; and

F. manufacturers minimum pressure requirement at the appliance.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2710 GAS CONSUMPTION.

Subpart 1. **How to determine consumption.** The quantity of gas to be provided at each outlet shall be determined, whenever possible, directly from the manufacturer's Btu rating of the appliance which will be installed. In case the ratings of the appliances to be installed are not known, subpart 2 is given to show the approximate consumption of average appliances of certain types in Btu's per hour.

To obtain the cubic feet per hour of gas required, divide the total Btu input of all appliances by the average Btu heating value per cubic foot of gas (1,000 Btu's per hour) for natural gas.

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Subp. 2. Approximate gas input for some common appliances.

Appliance	Input Btu per hour Approximate
Water heater, automatic storage, 30-40 gal. tank	45,000
Water heater, automatic storage, 50 gal. tank	55,000
Water heater, automatic instantaneous (2 gal. per min.)	142,800
Water heater, automatic capacity (4 gal. per min.)	285,000
Water heater, automatic capacity (6 gal. per min.)	428,400
Water heater, domestic, circulating or side arm	35,000
Refrigerator	3,000
Clothes dryer, type 1 (domestic)	35,000
Gas light	2,500
Incinerator, domestic	35,000

For specific appliances or appliance not shown above, the input should be determined from the manufacturer's rating.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2720 DOMESTIC RANGE TABLE.

The following table shall be used in sizing gas piping for the domestic ranges and built-in cooking units:

Number Ranges	Demand Cubic Feet
1	60
2	90
3	110
4	130
5	145
6	160
7	175
8	190
9	200
10	210
11	225
12	235
13	250
14	260
15	275
16	285
17	295
18	315
20	330
22	356
24	375
26	390
28	420
30	430
40	500
60	690
80	820
100	900

Statutory Authority: *MS s 16B.59 to 16B.73*

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1345.2730 SIZE OF PIPE.

Subpart 1. **General.** The size of the gas pipe hereafter installed shall conform to one of the tables in subparts 2 to 5. The correct table should be selected as determined by the allowable pressure drop from parts 1345.2690 and 1345.2700. The gas capacities for various pipe sizes are given for a specific pressure drop. Due allowances for the effect of any ordinary number of fittings shall be made.

Following the sizing tables, subpart 5 can be used to determine the size of each branch and section of gas piping system based on subpart 3.

Subp. 2. **Maximum capacity of pipe in cubic feet of gas per hour based upon a pressure drop of 0.3 inch water column and 0.6 specific gravity gas.**

Length in Feet	NOMINAL IRON PIPE SIZE, INCHES								
	½	¾	1	1¼	1½	2	2½	3	4
10	132	278	520	1050	1600	3050	4800	8500	17500
20	92	190	350	730	1100	2100	3300	5900	12000
30	73	152	285	590	890	1650	2700	4700	9700
40	63	130	245	500	760	1450	2300	4100	8300
50	56	115	215	440	670	1270	2000	3600	7400
60	50	105	195	400	610	1150	1850	3250	6800
70	46	96	180	370	560	1050	1700	3000	6200
80	43	90	170	350	530	990	1600	2800	5800
90	40	84	160	320	490	930	1500	2600	5400
100	38	79	150	305	460	870	1400	2500	5100
125	34	72	130	275	410	780	1250	2200	4500
150	31	64	120	250	380	710	1130	2000	4100
175	28	59	110	225	350	650	1050	1850	3800
200	26	55	100	210	320	610	980	1700	3500

Subp. 3. **Maximum capacity of pipe in cubic feet of gas per hour based upon a pressure drop of one inch water column and .60 specific gravity gas.**

Length in Feet	NOMINAL PIPE OR I. D. TUBING SIZE									
	¾	1	1¼	1½	2	2½	3	4		
5	145	280	750	1080	2200	3450	7000	11200	20000	42000
10	96	187	500	760	1550	2450	4950	8000	14200	29500
15	76	148	395	620	1300	2000	4000	6500	11500	24000
20	66	126	335	520	1100	1700	3450	5600	10000	21000
30	52	100	265	440	900	1400	2850	4600	8300	17000
40	44	84	225	380	795	1200	2500	4000	7200	14500
50	39	74	200	345	700	1100	2200	3550	6350	13000
60	35	67	180	315	640	1000	2000	3250	5800	12000
70	32	61	165	290	600	920	1850	3000	5400	11000
80	30	57	153	270	560	860	1750	2800	5050	10400
90	28	53	142	255	520	810	1650	2650	4750	9700
100	26	50	134	240	500	770	1580	2500	4500	9300
125	23	44	118	215	450	690	1400	2250	4000	8400
150	21	39	106	195	410	620	1290	2050	3650	7600
175	19	36	97	180	380	580	1190	1900	3400	7000
200	18	34	90	170	355	540	1100	1780	3200	6600
250	16	30	79	150	315	490	980	1600	2850	5900
300	14	26	71	140	285	445	900	1460	2600	5400

Subp. 4. **Maximum capacity of pipe in cubic feet of gas per hour, based upon a pressure drop of seven inches water column and .60 specific gravity gas.**

Length in Ft.	NOMINAL PIPE OR I. D. TUBING SIZE										
	¾	1	1¼	1½	2	2½	3	4			
5	190	440	850	2300	2900	6000	9200	19000	30000	54000	110M
10	128	295	570	1540	2000	4200	6500	13000	26000	35000	80000
15	100	235	450	1200	1650	3400	5300	10800	17500	31000	64000
20	85	200	380	1030	1400	2900	4600	9300	15000	27000	55000
30	67	100	300	820	1150	2400	3700	7000	12000	22000	45000
40	57	125	255	700	1000	2100	3200	6500	10500	19000	39000
50	50	117	225	610	900	1850	2850	5800	9400	17000	35000
60	46	108	205	550	820	1700	2600	5400	8600	15500	31000
70	41	96	185	500	760	1600	2450	5000	8000	14000	28500
80	38	90	173	470	710	1500	2250	4700	7500	13000	27500
90	30	84	162	440	660	1400	2150	4400	7000	12500	26000
100	34	79	152	410	625	1300	2000	4150	6700	12000	25000
125	30	69	135	360	570	1150	1800	3700	6000	10500	22000
150	27	63	122	325	520	1080	1650	3400	5400	9600	20000
175	25	58	112	300	480	1000	1550	3100	5000	9000	18500
200	23	53	102	280	450	940	1450	2900	4750	8400	17000
250	20	47	90	240	400	850	1300	2600	4300	7500	15500
300	18	42	81	220	370	760	1150	2400	3900	7000	14000

MINNESOTA RULES 1985

1345.2730 MECHANICAL SYSTEMS

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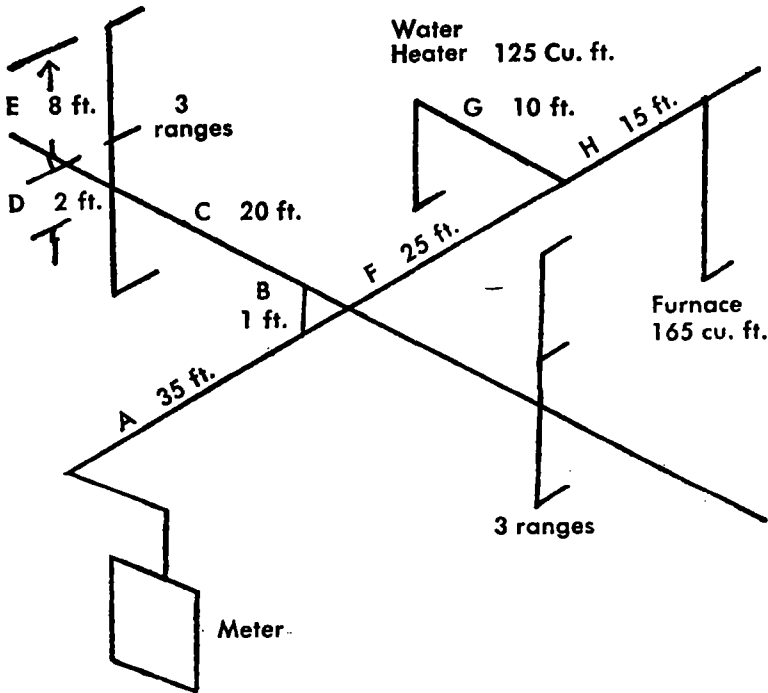
Subp. 5. Maximum capacity of pipe in cubic feet of gas per hour, based upon a pressure drop of one and one-half pounds per square inch and .60 specific gravity gas.

Length in Ft.	NOMINAL PIPE OR I. D. TUBING SIZE										
	¼	½	¾	1	1¼	1½	2	2½	3	4	
5	540	1280	2400	6500	10500	21000	31000	58000	90000	150M	310M
10	360	850	1630	4350	7600	15000	22000	41000	64000	110M	220M
15	285	670	1280	3450	6200	12000	18000	34000	52000	90000	180M
20	240	570	1080	2950	5400	10500	15000	29000	45000	790M	150M
30	192	450	860	2300	4400	8600	13000	24000	36000	630M	125M
40	163	380	730	2000	3800	7500	11000	20000	32000	55S10	110M
50	143	335	645	1750	3350	6700	9800	18000	28000	49000	97000
60	130	300	580	1560	3050	6100	9000	17000	26000	45900	90000
70	118	275	530	1430	2800	5600	8200	15000	24000	41000	82000
80	110	255	490	1330	2650	5200	7700	14000	22000	38000	77000
90	102	240	460	1230	2500	4900	7200	13500	21000	36500	72000
100	98	225	430	1160	2350	4700	6800	12500	20000	34500	70000
125	85	198	380	1025	2100	4150	6100	11300	18000	31000	62000
150	76	178	340	920	1900	3800	5600	10400	16000	28400	56000
175	69	164	315	845	1800	3550	5200	9700	15500	20000	53000
200	64	146	290	780	1700	3300	4900	9000	14000	24000	49000
250	58	140	255	690	1500	2950	4300	8100	12500	22500	44000
300	51	120	230	620	1350	2700	4000	7400	11500	19000	40000

Subp. 6. Multipliers to be used with tables when the specific gravity of the gas is other than used in the table.

Specific Gravity	Multiplier
.35	1.31
.40	1.23
.45	1.16
.50	1.10
.55	1.04
.60	1.00
.65	.962
.70	.926
.75	.895
.80	.867
.85	.841
.90	.817
1.00	.775
1.10	.740
1.20	.707
1.30	.680
1.40	.655
1.50	.633
1.60	.612
1.70	.594
1.80	.577
1.90	.565
2.00	.847
2.10	.535

Subp. 7. Example to calculate a gas piping system based on pressure drop used in subpart 3.



Subp. 8. **Directions.** The following is an example of sizing gas piping using Table 1 in part 1345.2720.

A. Use gas range table, subpart 5 for multiple range installation when sizing all main and branch line piping. Use actual input rating on water heater and furnace.

B. To size pipe A put the total input load on the distance from meter to end of longest run.

$$\text{Six ranges} + \text{water heater} + \text{furnace } 160 + 125 + 165 = 450 \text{ cu. ft. } 35 + 25 + 15 = 75 \text{ ft. developed length}$$

Chart 450 cu. ft. and 75 ft. length one and one-fourth inch pipe for section A.

C. To size pipe B, put six ranges on distance from meter to end range.

Six ranges = 160 cubic feet: $35 + 1 + 20 + 2 + 8 = 66$ ft. length, three-fourths inch pipe for section B.

D. To size pipe C put three ranges on distance from meter to end range.

Three ranges = 110 cu. ft.: $35 + 1 + 20 + 2 + 8 = 66$ ft. length, three-fourths inch pipe for section C.

E. To size pipe D put 2 ranges on distance from meter to end range.

Two ranges = 90 cu. ft.: $35 + 1 + 20 + 2 + 8 = 66$ ft. length, three-fourths inch pipe for section D.

F. To size pipe E put one range on distance from meter to the range.

One range = 60 cu. ft.: $35 + 1 + 20 + 2 + 8 = 66$ ft. length, one-half inch pipe for section E.

G. To size pipe F put water heater and furnace on the longest distance from meter.

Water heater 125 cubic feet + Furnace 165 cubic feet = 290 cubic feet.
 $35 + 25 + 15 = 75$ feet length one and one-fourth inch pipe for section F.

H. To size pipe G put water heater on the distance from the meter.

Water heater 125 cu. ft.: $35 + 25 + 10 = 70$ feet, one inch pipe for section G.

I. To size pipe H put furnace on the distance from meter.

Furnace 165 cu. ft.: $35 + 25 + 15 = 75$ feet length one inch pipe for section H.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2740 TEST OF PIPING.

Upon completion of any gas piping system and before any of the piping has been covered, concealed, or painted, the person making the installation shall notify the administrative authority that the work is ready for inspection and test. All tests shall be made in the presence of the authority. The following pressures shall be the tests required. The authority may determine the length of time such tests shall stand without showing a drop in pressure. For the purpose of this code, gas pressures not exceeding 14 inches water column shall be called the low pressure. Gas pressures exceeding 14 inches water column shall be called high pressure.

Low-pressure piping shall be air tested at a pressure of at least ten pounds per square inch.

High-pressure piping shall be air tested at a pressure 50 percent greater than the maximum operating pressure, but not less than 25 pounds per square inch.

The air gauge and pump to make the test shall be furnished by the person making the installation.

However, in the cases of minor alterations or extensions the authority may not require such tests, if in his judgment such tests are not necessary.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2750 LEAKAGE TEST AFTER GAS TURN ON.

Subpart 1. **Close gas outlets.** Before turning gas under pressure into any piping, all openings from which gas can escape will be closed.

Subp. 2. **Check for leakage.** Immediately after turning on the gas, the piping system shall be checked by one of the following methods to ascertain that no gas is escaping.

Subp. 3. **Checking leakage using the gas meter.** Immediately prior to the test it should be determined that the meter is in operating condition and has not been bypassed. Checking for leakage can be done by carefully watching the test dial of the meter to determine whether gas is passing through the meter. To assist in observing any movement of the test hand, wet a small piece of paper and paste its edge directly over the center line of the hand as soon as the gas is turned on. Allow five minutes for a one-half foot dial and proportionately longer for a larger dial in checking for gas flow. This observation should be made with the test hand on the upstroke.

In case careful observation of the test hand for a sufficient length of time reveals no movement, the piping shall be purged and a small gas burner turned on and lighted and the hand of the test dial again observed. If the dial hand moves (as it should) it will show that the meter is operating properly. If the test hand does not move or register flow of gas through the meter to the small burner, the meter is defective and the gas should be shut off and the serving gas supplier notified.

Subp. 4. **Checking for leakage not using a meter.** This can be done by attaching to an appliance orifice a manometer or equivalent device calibrated so that it can be read in increments of 0.1 inch water column, and momentarily turning on the gas supply and observing the gaging device for pressure drop with the gas supply shut off. No discernible drop in pressure shall occur during a period of three minutes.

Subp. 5. **When leakage is indicated.** If the meter test hand moves, or a pressure drop in the gauge is noted, all appliances or outlets supplied through the system shall be examined to see if they are shut off and do not leak. If they are found tight there is a leak in the piping system. The gas supply shall be shut off until the necessary repairs have been made, after which the test specified in subparts 3 and 4 shall be repeated.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2760 PURGING.

Subpart 1. **Purging all gas piping.** After piping has been checked, all gas piping shall be fully purged. A suggested method for purging the gas piping to an appliance is to disconnect the pilot piping at the outlet of the pilot valve. Piping shall not be purged into the combustion chamber of an appliance.

The open end of piping systems being purged shall not discharge into confined spaces or areas where there are sources of ignition unless precautions are taken to perform this operation in a safe manner by ventilation of the space, control of purging rate, and elimination of all hazardous conditions.

Subp. 2. **Light pilots.** After the gas piping has been sufficiently purged, all appliances shall be purged and the pilots lighted. The installing agency shall assure itself that all piping and appliances are fully purged before leaving the premises.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2770 LP GAS INSTALLATIONS.

The installation and maintenance of undiluted or diluted LP gas installations or portions of such installations shall be made to the standards of USA Standard Storage and Handling of Liquefied Petroleum Gases Z-106.1 (NFPA No. 58) and applicable sections of this code.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2780 CHECKING FOR GAS LEAKS.

When an investigation discloses a concentration of gas inside of a building, the following immediate actions shall be taken, simultaneously if possible:

- A. Clear the room, building, or area of all occupants.
- B. Shut off the supply of gas to the areas involved.
- C. Ventilate the affected portion of the building by opening windows and doors including basement windows.
- D. Use every practical means to eliminate sources of ignition. Take precautions to prevent smoking, striking matches, operating electrical switches, or devices, opening furnace doors, etc. If possible, cut off all electric circuits at a remote source to eliminate operation of automatic switches in the dangerous area. Safety flashlights designed for use in hazardous atmospheres are recommended for use in such emergencies.

E. Investigate other buildings in the immediate area to determine the presence of escaping gas therein.

F. Notify the gas supplier.

Statutory Authority: *MS s 16B.59 to 16B.73*

OIL BURNERS**1345.2790 DEFINITIONS.**

The following terms shall mean:

A. "Oil burner": a device for burning oil in heating appliances such as boilers and furnaces or process equipment. A burner of this type may be furnished with or without a primary control. It may be a pressure atomizing gun type, a horizontal or vertical rotary type, or a mechanical or natural draft vaporizing type, air or steam atomizing type.

B. "Oil-burning equipment": an oil burner of any type together with its tank, piping, wiring, controls, and related devices and shall include all oil burners, and oil-fired units.

C. "Oil-fired unit": a heating appliance equipped with one or more oil burners and all the necessary safety controls, electrical equipment, and related equipment manufactured for assembly as a complete unit.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2800 APPROVALS.

Subpart 1. **Approval of oil burner required.** No person shall install any domestic or commercial oil burner that does not carry the label of the Underwriters Laboratories or any other nationally recognized testing laboratory.

The administrative authority shall approve any oil burner listed by or carrying the label of the Underwriters Laboratory or any other nationally recognized testing laboratory, providing such oil burner also meets the approval requirements of the applicable parts of this code.

Subp. 2. **Installation of used oil burners.** No person shall install a used burner for use in connection with a heating system unless he has furnished the administrative authority with a statement that said burner has been checked and found to be equivalent to new equipment in operation and safety, together with a letter from the purchaser acknowledging that said purchaser is buying a used oil burner. Such burner shall comply with all applicable parts of this code.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2810 FUEL OIL.

Subpart 1. **Grade.** The grade of fuel oil used in a burner shall be that for which the burner is approved and as stipulated by the manufacturer. Crankcase oil or any oil containing gasoline shall not be used.

Note: The label of Underwriters Laboratories, Inc. and Underwriters Laboratories of Canada stipulates for each burner the grade of fuel oil for which the burner is listed.

Subp. 2. **Heavy oils.** Where heavy oils are used, provision shall be made for maintaining the oil at the proper atomizing temperature. Automatically operated burners requiring the preheating of oil shall be arranged so that no oil can be delivered for combustion until the oil is at a suitable atomizing temperature.

Subp. 3. **Steam coils in oil tanks.** No steam coil operating at a pressure greater than 15 pounds per square inch gauge shall be installed in an oil tank. When a pressure-reducing valve is used to limit the steam pressure to 15 psi or less, a relief valve set at not more than five psi above the normal pressure in the coil shall be provided.

Subp. 4. **Flash point.** The oil shall have a flash point not less than 100 degrees Fahrenheit and shall be free from acid, grit, and fibrous or other foreign matter likely to clog or injure the burner or valves.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2820 TANKS.

The design, construction, and installation of fuel oil tanks, both underground and inside buildings shall be in compliance with parts 7510.5100 to 7510.5400 of the Department of Public Safety.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2830 PIPING.

Subpart 1. **Material and fittings.** All piping shall be standard full weight wrought iron, steel, or brass pipe with standard fittings or approved brass or copper tubing with approved fittings except that approved flexible metal hose may be used for reducing the effects of jarring and vibration or where rigid connections are impracticable.

Subp. 2. **Domestic burners.** Pipe used in the installation of domestic type burners shall not be smaller than three-eighths inch iron pipe size; pipe used in the installation of industrial type burners shall not be smaller than one-half inch iron pipe size. Copper or brass tubing used in the installation of domestic type burners where the oil flows by gravity from the tank to the burners shall not be smaller in size than three-eighths inch outside diameter, .049 inch wall thickness tubing. For industrial type burners such copper or brass tubing shall not be smaller in size than the equivalent of the iron pipe size mentioned above, with wall thickness not less than .049 inch.

Subp. 3. **Flexible metal hose.** Flexible metal hose shall be installed strictly in accordance with the limitations of its approval.

Subp. 4. **Fastening; protection.** Piping shall be rigidly secured in place and protected from injury in a workmanlike manner, and where necessary, shall be protected against corrosion.

Subp. 5. **Joints and connections.** Pipe joints and connections shall be made tight in a workmanlike manner. Unions and tubing fittings shall be of approved type.

Subp. 6. **Allowance for movement.** Proper allowance shall be made for expansion, contraction, jarring, and vibration. Pipe lines, other than tubing, connected to underground tanks, except fill lines and test wells, shall be provided with double swing joints arranged to permit the tank to settle without impairing the efficiency of the pipe connections.

Subp. 7. **Strainers in supply lines.** Oil supply lines to burners shall be provided with approved strainers.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2840 TANK VENTS.

Subpart 1. **General.** Storage tanks shall be equipped with an open vent or an approved automatically operated vent, arranged to discharge to the open air. Vent openings and vent pipes shall be of ample size to prevent abnormal pressure in the tank during filling but not smaller than 1-1/4 inch pipe size.

Subp. 2. **Vent pipes.** Vent pipes shall be arranged to drain to the tank. The lower end of the vent pipe shall not extend through the top into the tank for a distance of more than one inch.

Vent pipes shall terminate outside of buildings at a point not less than two feet distant from any window or other building opening and not less than one foot above fill cap nor less than two feet above the ground. Outer ends of vent pipes shall be provided with a weatherproof hood to such a height that oil vapors discharging from the vent will be readily diffused without danger of ignition. However, combination fill and vent fittings approved by the administrative authority may be used if located not less than two feet distant from any window or other building opening and not less than two feet above the ground.

Vent pipes shall not be cross-connected with fill pipes or return lines from burners.

Fill and vent pipes shall not be run through windows or coal-chutes unless such openings are totally enclosed with masonry to prevent oil from entering buildings during filling operations.

The vent size shall be as shown in subpart 3.

Subp. 3. Vent size.

Capacity of Tank U.S. Gallons	Approximate Imperial Gallons	Diameter of Vent, Iron Pipe Size
500 or less	500 or less	1-1/4 inches
501 to 3,000	501 to 2,500	1-1/2 inches
3,001 to 10,000	2,501 to 8,300	2 inches
10,001 to 20,000	8,301 to 16,600	2-1/2 inches
20,001 to 35,000	16,601 to 29,000	3 inches

Subp. 4. Pump filling through tight connections. Note: Where tanks are filled by the use of a pump through tight connections, special consideration should be given to the size of the vent pipe to ensure that it is adequate to prevent the development of abnormal pressure in the tank during filling. This may be accomplished by providing a vent pipe not less in size than the discharge of the pump.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2850 TANK FILL AND OVERFLOW PIPES.

Subpart 1. Underground tanks, storage tanks. Underground tanks and storage tanks inside buildings shall be filled only through fill pipes terminating outside of buildings at a point at least two feet from any building opening at the same or lower level. Fill terminals shall be closed tight, when not in use, by a metal cover designed to prevent tampering.

Subp. 2. Auxiliary tanks. Auxiliary tanks other than vacuum tanks shall be equipped with an overflow pipe.

Subp. 3. Overflow pipes. Overflow pipes of auxiliary gravity tanks shall have no valves or obstructions. Overflow pipes of auxiliary pressure tanks shall be provided with interconnected valves or other means for automatically venting the tank during filling.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2860 OIL GAUGING.

All tanks in which a constant oil level is not maintained by an automatic pump shall be equipped with an approved method of determining the oil level.

Test wells shall not be installed inside buildings and where permitted for outside services shall be closed tight when not in use by a metal cover designed to prevent tampering.

Gauging devices such as liquid level indicators or signals shall be installed so that oil or vapor will not be discharged into the fuel supply system.

No glass gauge, or any gauge the breaking of which will permit oil to escape from the tank, shall be used.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2870 OIL PUMPS.

Oil pumps shall be of approved type, secure against leaks, and shall be rigidly fastened in place.

Automatic pumps not an integral part of the burner shall be arranged to stop automatically in case of total breakage of the supply line to the burner if such line is pressurized.

In isolated locations, where fire protection equipment is dependent upon a heating plant fired by an oil burner, oil pumps supplying the burner shall be

installed in duplicate.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2880 VALVES.

Subpart 1. **Location of shutoff valves.** Readily accessible shutoff valves of approved type shall be installed in oil supply lines near each burner and close to gravity and pressure supply tanks. Shutoff or check valves of approved type shall be installed on each side of oil strainers which are not a part of the oil burner unit and on the discharge and suction side of oil pumps which pump directly to the burner but which are not a part of the burner unit.

Subp. 2. **Pressure relief valve.** Where a shutoff valve is installed in the discharge line of an oil pump, an approved pressure relief valve shall be connected into the discharge lines between the pump and the shutoff valve and arranged to return surplus oil to the storage tank or to bypass it around the pump.

Subp. 3. **Control valves.** Control valves shall be of the approved type. Valves shall be designed to close against the supply and to prevent withdrawal of stem by continued operation of the handwheel. Packing affected by the oil or by heat shall not be used.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2885 GRAVITY FEED TO BURNERS.

Gravity feed shall be used only with burners arranged to prevent abnormal discharge of oil at the burner by automatic means specifically approved for the burner with which it is used.

A domestic supply tank shall not have a capacity of more than 550 gallons or two tanks of aggregate capacity of 550 gallons.

On multiple domestic tank installations, the fill pipe shall be so arranged that both tanks will fill equally and the vent pipe shall extend well above cross connections between tanks to prevent air binding when filling.

Where oil is supplied to the burner by gravity and a constant level device is not incorporated in the burner assembly or in an auxiliary tank used in connection with an automatic pump, an approved constant level device shall be installed in the oil feed line at the gravity tank or as close thereto as practicable. The vent opening of such constant level device shall be connected by piping or tubing to outside the building unless the constant level device is provided with an approved antiflooding device. Vent pipes or tubing of constant level devices shall not be connected to tanks or tank vents.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2890 PRESSURE FEED.

Pressure tank feed shall be used only with burners arranged to prevent abnormal discharge of oil at the burner by automatic means specifically approved for the burner with which it is used.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2900 PREHEATING OIL.

Preheating of oil, where necessary, shall be done by steam, hot water, or approved electric heaters. Heaters shall be substantially constructed with all joints made oil-tight. Thermometers shall be installed at suitable locations to indicate the temperature of the heated oil. Heaters shall be bypassed or provided with suitable means to prevent abnormal pressure.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2910 LOCKING FILL PIPE.

Whenever an oil burner is removed to be replaced with another fuel the "fill and vent" piping should be removed from the supply tank and those remaining openings of the supply tank be closed with "pipe-plugs" or complete removal of such supply tank.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2920 CONTROLS.

Subpart 1. **General.** Oil burner installations with burner inputs of less than five gallons of oil per hour shall have the following controls: a draft regulator; a stack relay or similar device providing positive shutoff for flame failure or failure to obtain ignition within 90 seconds after start of burner; and a high temperature limit control.

Oil burners having inputs of over 500,000 Btu per hour shall be in accordance with Underwriters Laboratories, Inc. and NFPA No. 31.

Subp. 2. **Manual control.** Oil burners other than oil stoves with integral tanks shall be provided with some means for manually stopping the flow of oil to the burner. Such device or devices shall be placed in a convenient location at a safe distance from the burner.

Subp. 3. **Limiting controls.** Each appliance fired by oil burners and each oil-fired unit shall be provided with automatic limit controls which will prevent unsafe pressure or low water in a steam boiler or overheating within a hot-water boiler, furnace, or heater.

Subp. 4. **Limiting controls, electrical arrangement.** Limiting controls and low-water shutoffs intended to prevent unsafe operation of heating equipment by opening an electrical circuit to the burner or oil shutoff device shall be so arranged as to effect the direct opening of that circuit, whether the switching mechanism is integral with the sensing element or remote from same.

Subp. 5. **Interlock.** In systems where either steam or air is used for atomizing the oil or where air for combustion is supplied by a source which may be interrupted without shutting off the oil supply, the oil and atomizing or air supply shall be interlocked in a manner to immediately shut off the oil supply upon failure of the atomizing or air supply.

Subp. 6. **Shutoff in case of fan failure.** When automatically operated burners are used in installations equipped with forced or induced draft fans or both, means shall be provided to immediately shut off the oil supply upon fan failure.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2925 INSTALLATION OF OIL BURNERS AND OIL BURNER EQUIPMENT.

Subpart 1. **Size of room.** Oil-fired appliances shall be installed in rooms that are large compared with the size of the appliance except that an appliance specifically approved for installation in a confined space such as an alcove or closet may be so installed when the installation is in compliance with the approval. In alcove and closet installations, the clearances from the appliance to the walls and ceiling shall be not less than as specified in the approval regardless of the type of construction.

Subp. 2. **Reasonable safety.** Oil-burning appliances shall be installed so as to be reasonably safe to persons and property. Evidence that oil-burning appliances have been installed in accordance with the applicable standard specified in this part shall be evidence that such oil-burning appliances are reasonably safe to persons and property.

Subp. 3. **Workmanship.** Oil burners shall be securely installed in a workmanlike manner, in accordance with the instructions of the manufacturer, by qualified mechanics experienced in making such installations.

Subp. 4. **Ash doors.** Where oil burners are installed in furnaces originally designed for solid fuel, the ash door of the furnace shall be removed or bottom ventilation otherwise provided to prevent the accumulation of vapors in the ash pit, unless the burner is of a type which mechanically purges the ash pit.

Subp. 5. **Draft.** Boilers and furnaces in which oil burners are installed shall be connected to flues having sufficient draft at all times to assure safe operation of the burner; a suitable draft-regulating device shall be installed where necessary to prevent excessive draft. Manually operated dampers shall be such that they cannot close off more than 80 percent of the internal cross-section area of the smoke pipe. Automatically operated dampers shall be of approved type designed to maintain a safe damper opening at all times and arranged to prevent starting of the burner unless the damper is opened at least 20 percent of the internal cross-section area of the smoke pipe.

Subp. 6. **Posted instructions.** Complete instructions for the care and operations of the oil burner equipment shall be conspicuously posted near the oil burner and shall be maintained in readable condition by user, and there shall be displayed, near the heating plant, a card which shall read as follows:

Note: This code requires that pipe dampers shall be removed or locked in the desired position and no damper closing off more than 80 percent of the pipe area shall be allowed. All check drafts must be kept closed at all times.

Subp. 7. **Diagrams.** Contractors installing industrial oil burner systems shall furnish diagrams showing the main oil lines and controlling valves, one of which shall be posted near the oil burner equipment and another at some point which will be accessible in case of fire at the burners.

Subp. 8. **Accessibility for service.** Every oil-fired appliance shall be located with respect to building construction and other equipment so as to permit access to the appliance. Sufficient clearance shall be maintained to permit cleaning of heating surfaces; the replacement of filters, blowers, motors, burners, controls, and vent connections; the lubrication of moving parts where required; and the adjustment and cleaning of burners.

Subp. 9. **Clearance and permissible temperatures.** Every oil-fired appliance and its vent connector shall be installed with clearances to combustible materials as specified by the manufacturer of the equipment so that continued or intermittent operation will not create a hazard to person or property. They shall not, during operation, raise the temperature of unprotected combustible walls, partitions, floors, or ceilings more than 90 degrees Fahrenheit above normal room temperature when measured with mercury thermometers or conventional bead type thermocouples.

Subp. 10. **Combustion air requirements.** The air required for combustion shall be in accordance with parts 1345.1340 to 1345.1740.

Subp. 11. **Electric wiring.** Electric wiring and equipment in connection with oil-burning equipment shall be in accordance with the provisions of the state of Minnesota electrical code.

Subp. 12. **Modifications.** Where the circumstances or conditions of any particular installation are unusual and such as to render the strict application of the provisions of this chapter impracticable, the administrative authority may permit such modifications as will provide a substantially equivalent degree of safety.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2930 GENERAL PRECAUTIONS FOR KEROSENE AND OIL STOVES AND PORTABLE KEROSENE HEATERS.

Subpart 1. **Following instructions.** The safety of installation and use of appliances of this kind depend largely upon the care of the installer and the care of the user in following the manufacturer's operating and installation instructions.

Subp. 2. **Cleanliness and maintenance.** Appliances of this class shall be kept clean and in good repair. If parts become worn or damaged they shall be replaced promptly, preferably by the manufacturer or his representative. Where replacements or repairs must be made by the user, such attention shall be strictly confined to procedures which have been fully covered by the manufacturer's printed instructions.

Subp. 3. **Retaining instructions.** Instructions furnished by the manufacturer shall be preserved.

Subp. 4. **Avoiding combustible materials.** Special care must be employed in the placing of kerosene stoves and portable kerosene heaters in order to avoid contact with combustible material including draperies and to avoid accidental overturning. Placing fabrics on stoves for drying is dangerous.

Subp. 5. **Noncombustible flooring.** Appliances shall be installed on noncombustible flooring unless listed for installation on combustible flooring.

Subp. 6. **Drip pan.** A range shall be equipped with a drip pan beneath the burners and with integral base or legs to locate the cooking surface at a proper height for ordinary use.

Subp. 7. **Sheet metal tray.** Portable kerosene heaters shall be equipped with a sheet metal tray underneath the burner as an integral part of the heater.

Subp. 8. **Avoiding curtains and draperies.** Stoves shall be placed so that curtains or draperies may not be blown over or into contact with heater surfaces or open flame.

Subp. 9. **Leveling.** Appliances shall be carefully leveled in accordance with manufacturer's installation instructions.

Subp. 10. **Fastening to floor.** When manufacturer's instructions specify that stoves are to be fastened to the floor these instructions shall be carefully followed, but in all cases stoves supplied with fuel from separate supply tanks shall be securely attached to the floor or otherwise secured in position to avoid strains on piping.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2940 CONTROLS FOR KEROSENE AND OIL STOVES AND PORTABLE KEROSENE HEATERS.

Kerosene and oil stoves and portable kerosene heaters shall be equipped with a primary safety control furnished as an integral part of the appliance by the manufacturer to stop the flow of oil in the event of flame failure. Barometric oil feed shall not be considered a primary safety control.

Note: Stoves and heaters listed by Underwriters Laboratories, Inc. and Underwriters Laboratories of Canada are so equipped.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2950 FLUE CONNECTIONS FOR KEROSENE AND OIL STOVES AND PORTABLE KEROSENE HEATERS.

Appliances that are provided with a flue outlet shall be connected to a suitable flue having sufficient draft at all times to assure safe operation of the appliance.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2960 SUPPLY TANKS FOR KEROSENE AND OIL STOVES AND PORTABLE KEROSENE HEATERS.

Stoves designed for barometric oil feed shall not be connected to separate supply tanks.

Stoves which are not designed for flue connection shall be equipped with integral tanks having capacity of not more than two gallons.

An oil stove specifically designed and listed for use with separate supply tanks may be directly connected for gravity feed from a supply tank or an automatic pump.

The filling of barometric tanks and kerosene stove tanks and reservoirs of portable kerosene heaters shall be done outside buildings or at a special location where precautions can be taken to minimize the spilling of oil.

A barometric tank shall not be placed in position in the stove sump until the oil has reached room temperature.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2970 CLEARANCES AND MOUNTING FOR KEROSENE AND OIL STOVES AND PORTABLE KEROSENE HEATERS.

Subpart 1. **General.** Stoves shall be installed to provide clearances to combustible material not less than as shown in subpart 2.

Stoves which are listed for installation with lesser clearances than specified in subpart 2 may be installed in accordance with their listing.

Subp. 2. **Table of clearance.**

Heating Appliances	Minimum Clearance, Inches		
	Sides	Rear	Chimney Connector
Room heater, circulating type	12	12	18
Room heater, radiant type	36	36	18

Subp. 3. **Lesser clearances.** Stoves may be installed with lesser clearances to combustible material provided the combustible material is protected. In no case shall the horizontal distance be less than six inches from a range to that portion of adjacent unprotected combustible walls or cabinets extending above the cooking top of the range.

Subp. 4. **Access to fuel tank.** Stoves which have a fuel tank attached thereto shall in all cases be installed with sufficient clearance to provide direct and easy access to the fuel tank.

Subp. 5. **Vertical clearance.** Stoves shall have a clearance vertically above the top of not less than 30 inches to combustible material or cabinets. When the underside of combustible material or cabinets is protected by asbestos millboard at least one-fourth inch thick covered with sheet metal not lighter than 28 gauge, the distance shall be not less than 24 inches. The protection shall extend nine inches beyond the sides of the stove.

Subp. 6. **Floors.** Listed stoves may be placed on combustible floors. Others shall be placed on the ground, on noncombustible floors, or on floors protected in accordance with accepted building code practice.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.2980 INSPECTION AND TESTS.

Subpart 1. **Tests of covered tanks and piping.** After installation and before being covered, tanks of 1,000 gallons capacity or more and piping shall be tested hydrostatically, or with equivalent air pressure, at a pressure not less than 1-1/2 times the maximum working pressure but not less than five pounds per square inch at the highest point of the system. Instead of a pressure test, suction lines

may be tested under a vacuum of not less than 20 inches of mercury. Such tests shall be made by the installer.

Subp. 2. **Tanks and piping.** Immediately upon the installation of the tanks and piping of an oil burner installation, the installer thereof shall notify the administrative authority that said tanks and piping are ready for inspection and tests as required in this chapter. No person shall cover up any such tank or piping until the same shall have been inspected and approved.

Subp. 3. **Oil burner inputs.** Oil burner inputs of less than 500,000 Btu per hour: upon completion of the test of any oil burner installation and placing the equipment in operation, the installer shall file with the administrative authority complete records of such test stating the date of test and name of person performing the test. Oil burners having inputs of over 500,000 Btu per hour shall be tested as required by the administrative authority. The tests required therein shall be witnessed by the authority prior to placing the burner in service. The installer shall file with the administrative authority a copy of the test report, signed by the installer or his authorized agent performing the test.

Statutory Authority: *MS s 16B.59 to 16B.73*

STOKER AND COAL-FIRED INSTALLATIONS

1345.2990 STANDARDS ESTABLISHED.

The arrangement, equipment, and manner of installation of all stokers installed for use in connection with heating plants and the alterations of all such stoker installations shall conform to the provisions of parts 1345.2990 to 1345.3080.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3000 STOKER DEFINED.

The term "stoker" shall mean a mechanical device for feeding solid fuel into the combustion chamber of a boiler or furnace used in connection with a heating plant whether automatically or manually controlled.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3010 APPROVAL OF STOKER REQUIRED.

No person shall install any stoker that does not carry the approval label of a nationally recognized testing laboratory.

The authority shall approve any stoker listed by or carrying the label of a nationally recognized laboratory providing such stoker also meets the approval requirements of the applicable parts in this code.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3020 GENERAL INSTALLATION REQUIREMENTS.

All systems and equipment shall be installed in accordance with the applicable parts of the Heating, Ventilating, Air Conditioning and Refrigeration Code.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3030 CALCULATING HEAT LOSS.

All heat loss calculations shall be determined by the methods outlined in parts 1345.0200 to 1345.0360.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3040 NONAUTOMATIC STOKERS RESTRICTED.

Stokers which are not equipped with automatic means of preventing excessive pressures or temperatures of the heating medium shall not be installed or operated in any location where a competent attendant will not be constantly on duty on the premises while the stoker is in operation.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3050 AUTOMATIC CONTROLS.

Subpart 1. **High limit control, low water cutoff.** Except as provided in part 1345.3040, each mechanical stoker shall be equipped with at least one high limit control so connected as to shut off power from stoker drive in the event of excessive pressure in a steam boiler or excessive temperature in a hot water boiler or warm air furnace casing. Each steam boiler shall be equipped with a low water cutoff.

Subp. 2. **Reserve action control.** Where there may be an overrun of heat due to sustained periods of operation for the stoker, a reserve action control or equivalent control shall be installed in hot water systems so as to relieve this condition.

Subp. 3. **Second control.** On all installations where operation of burner is controlled by an aquastat, pressurestat, or furnacestat, a second control, either aquastat, pressurestat, or furnacestat, shall be installed in the 110-volt line ahead of all controls, as a high limit of safety control.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3060 STOKER CAPACITY, SETTING HEIGHTS, COMBUSTION SPACE.

The capacity of a stoker for any given installation shall be in accordance with the manufacturer's recommended load-carrying capacities.

The distance from retort to crown sheet and the space for combustion, within any boiler or furnace, shall be such as to secure efficient smokeless combustion. Where stokers are installed in old boilers and strict compliance with the foregoing requirements cannot be met, minor modifications may be made, subject to the approval of the administrative authority.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3070 ELECTRIC WIRING AND EQUIPMENT.

Electric wiring and equipment in connection with stoker installations shall be installed in accordance with electrical sections of the State Building Code.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3080 COMBUSTION AIR REQUIREMENTS.

Combustion air shall be sized and installed in accordance with parts 1345.1860 to 1345.2140.

Statutory Authority: *MS s 16B.59 to 16B.73*

ELECTRIC SPACE HEATING**1345.3090 STANDARDS ESTABLISHED.**

The construction, arrangements, and installation of equipment which directly converts electrical energy shall be governed by the provisions hereinafter set forth, when such equipment is used in connection with any system intended to heat any space, room, or building for the comfort, health, or welfare of the occupants thereof.

Statutory Authority: *MS s 16B.59 to 16B.73*

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1345.3100 EQUIPMENT AND INSTALLATION REQUIREMENTS.

Electrical heat generating and emission units and other electrical equipment, along with their installations and associated wiring, shall comply with provisions of chapter 1315 of the State Building Code. In addition, electric heat generating and emission units shall be listed by Underwriters Laboratories, Inc. or shall bear the label of the Underwriters Laboratories, Inc. or other nationally recognized testing laboratories. Lamps, heat lamps, infrared lamps and tubes that do not carry a UL approval will be accepted.

All systems and appliances shall be installed in complete compliance with the manufacturers' requirements and specifications.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3110 HEAT LOSS CALCULATIONS.

Heat loss calculations shall be made in accordance with the provisions set forth in parts 1345.0200 to 1345.0360 of this code.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3120 ELECTRICAL ENERGY REQUIREMENTS FOR SPACE HEATING.

The total rating (or adjusted rating) of heat emission devices in each room or space to be heated shall equal or exceed the calculated heat loss of such room or space.

The total rating (or adjusted rating) of the heat emission devices shall equal or exceed the calculated aggregate heat loss of all rooms or spaces heated.

The output of each generating and emission unit shall be computed at the location where the electrical energy is converted to heat energy. The conversion of electrical energy to heat energy shall be considered at an efficiency of 100 percent. The heat output of a heat pump will be acceptable as rated by the equipment manufacturer.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3130 OTHER REQUIREMENTS.

Central heating systems of the warm air type shall have their rating as established in parts 1345.0540 to 1345.0710.

Central heating systems of the steam or hot water type shall have their rating as established in parts 1345.0720 to 1345.1330.

An automatic temperature control system shall be provided for the heated space unless otherwise approved by the administrative authority.

Statutory Authority: *MS s 16B.59 to 16B.73*

FIREPLACES AND INCINERATORS**1345.3140 FACTORY-BUILT FIREPLACES.**

Factory-built fireplaces shall be listed and shall be installed in accordance with conditions of their listing. Hearth extensions shall be provided in accordance with part 1345.3170.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3150 FACTORY-BUILT FIREPLACE STOVES.

Factory-built fireplace stoves shall be listed and shall be installed in accordance with the conditions of the listing. Hearth extensions shall be provided in accordance with part 1345.3170. (The requirement to be listed in this part and part 1345.3160 shall mean that the appliance has been tested and approved by the Underwriters Laboratory or other nationally recognized testing laboratory).

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3160 MASONRY FIREPLACES.

Subpart 1. **General.** All masonry fireplaces shall be constructed and built in accordance with parts 1345.3140 to 1345.3240.

Subp. 2. **Warm air ducts.** Warm air ducts employed with steel fireplace units of the circulating air type shall be constructed of metal or masonry.

Subp. 3. **Hearth extensions generally.** Fireplace hearth extensions shall be provided of approved noncombustible material for all fireplaces. Where the fireplace opening is less than six square feet, the hearth extension shall extend at least 16 inches in front of, and at least eight inches beyond each side of the fireplace opening. Where the fireplace opening is six square feet or larger the hearth extension shall extend at least 20 inches in front of, and at least 12 inches beyond each side of the fireplace opening. Where a fireplace is elevated above or overhangs a floor, the hearth extension shall also extend over the area under the fireplace.

Subp. 4. **Hearth extensions, masonry fireplaces.** Fireplaces constructed of masonry or reinforced concrete shall have hearth extensions of brick, concrete, stone, tile, or other noncombustible approved material properly supported and with no combustible material against the underside thereof. Wooden forms or centers used during the construction of the hearth and hearth extensions shall be removed when the construction is completed.

Subp. 5. **Hearth extensions, factory-built fireplaces.** Hearth extensions of approved factory built fireplaces and fireplace stoves shall be not less than three-eighths inch thick of asbestos, concrete, hollow metal, stone, tile, or other approved noncombustible material. Such hearth extensions may be placed on the sub or finish flooring whether the flooring is combustible or not. The hearth extension shall be readily distinguishable from the surrounding floor.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3170 CHIMNEYS AND FIREPLACES.

All chimneys used with fireplaces of either the factory-built or masonry types shall have their chimneys in compliance with parts 1345.0400 to 1345.0500 of this code and the applicable parts of the State Building Code.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3180 INCINERATORS.

All incinerators shall meet the requirements and have approval of the Minnesota Pollution Control Agency notwithstanding any provisions of this code.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3190 CLEARANCE.

Subpart 1. **General.** Incinerators shall be installed in accordance with their listing and the manufacturer's instructions, provided that in any case the clearance shall be sufficient to afford ready accessibility for firing, cleanout, and necessary servicing.

Subp. 2. **Above charging door.** The clearance above a charging door to combustible material shall be not less than 48 inches. The clearance may be reduced to 24 inches provided that the combustible material is protected with sheet metal not less than No. 28 manufacturer's standard gauge spaced out one inch on noncombustible spacers, or equivalent protection. Such protection shall extend 18 inches beyond all sides of the charging door opening. Listed incinerators designed to retain the flame during loading need not comply with this subpart.

Subp. 3. **Other clearances.** Incinerators shall be installed with clearances to combustible material of not less than 36 inches at the sides and top and not

less than 48 inches at the front, but in no case shall the clearance above a charging door be less than 48 inches. Unlisted wall-mounted incinerators shall be installed on a noncombustible wall communicating directly with a chimney.

Subp. 4. Domestic incinerators. Domestic type incinerators may be installed with reduced clearances to combustible material in rooms, provided the combustible material is protected as described. In confined spaces, such as alcoves, clearance shall be so reduced.

Subp. 5. Lined or insulated domestic incinerators. When a domestic type incinerator that is refractory lined or insulated with heat-insulating material encased in common brick not less than four inches in thickness, the clearances may be reduced to six inches at the sides and rear, and the clearances at the top may be reduced to 24 inches provided that the construction using combustible material above the charging door and within 48 inches is protected with No. 28 standard gauge sheet metal spaced out one inch, or equivalent protection.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3200 MOUNTING INCINERATORS.

Subpart 1. On floors. Listed incinerators specifically listed for installation on combustible floors may be so installed.

Subp. 2. On noncombustible surfaces. Incinerators shall be mounted on the ground or on floors of fire-resistive construction with noncombustible flooring or surface finish with no combustible material against the underside thereof, or on fire-resistive slabs or arches having no combustible material against the underside thereof. Such construction shall extend not less than 12 inches beyond the incinerator base on all sides except at the front or side where ashes are removed where it shall extend no less than 18 inches beyond the incinerator.

Subp. 3. On other surfaces. Incinerators may be mounted on floors other than as specified in subpart 2 provided the incinerator is so arranged that flame or hot gases do not come in contact with its base and, further, provided the floor under the incinerator is protected with hollow masonry not less than four inches thickness, covered with sheet metal not less than No. 24 standard gauge. Such masonry course shall be laid with ends unsealed and joints matched in such a way as to provide a free circulation of air from side to side through the masonry. The floor for 18 inches beyond the front of the incinerator or side where ashes are removed and 12 inches beyond all other sides of the incinerator shall be protected with not less than one-fourth inch asbestos millboard with sheet metal of not less than No. 24 standard gauge or with protection equivalent thereto.

Subp. 4. Incinerators set on legs. Incinerators which are set on legs that provide not less than four inches open space under the base of the appliance may be mounted on floors other than as specified in subpart 2 provided the appliance is such that flame or hot gases do not come in contact with its base, and further provided the floor under the appliance is protected with asbestos millboard not less than one-fourth inch thick covered with sheet metal of not less than No. 24 standard gauge. The above specified floor protection shall extend not less than 18 inches beyond the front of the incinerator or side where ashes are removed and 12 inches beyond all other sides of the incinerator.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3210 DRAFT HOOD PROHIBITED.

Draft hoods shall not be installed in the vent connector of an incinerator.

Statutory Authority: *MS s 16B.59 to 16B.73*

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1345.3220 VENT CONNECTOR CLEARANCE.

Vent connectors shall have at least 18 inches clearance from combustible material and shall not pass through combustible walls unless guarded at the point of passage as specified in part 1345.2140.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3230 VENT CONNECTOR MATERIAL.

The vent connector from an incinerator to a chimney shall be galvanized steel to a thickness at least No. 24 standard gauge or of a material having equivalent or superior heat and corrosion resistant properties and the joints shall be secured by sheet metal screws.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3240 CHIMNEYS.

All incinerators shall have their chimneys in compliance with parts 1345.0400 to 1345.0500 and the applicable parts of the State Building Code.

Statutory Authority: *MS s 16B.59 to 16B.73*

FIRE CONTROL

1345.3250 GENERAL REGULATIONS.

Subpart 1. **Scope.** The provisions of parts 1345.3250 to 1345.3300 shall apply to design, construction, and installation of fire dampers, smoke dampers, and fire control assemblies in duct systems, in inlets to or outlets from duct systems, or ventilating openings (transfers) where such ducts penetrate or for openings that are provided in fire walls, fire partitions, or in fire-resisting walls and ceilings and floor or roof assemblies. See NFPA No. 90A, Standard for the Installation of Air Conditioning and Ventilation Systems.

Subp. 2. **Equipment and assemblies approved.** Fire dampers, fire doors, and other fire control assemblies required under parts 1345.3250 to 1345.3300, for which the Underwriters Laboratories, Inc. provides testing and approval service, shall be tested, approved, and listed by the Underwriters Laboratories, Inc. or shall be approved by the administrative authority. When such dampers and equipment are not listed by Underwriters Laboratories, the administrative authority shall require tests to be performed by a qualified, independent laboratory where there are test procedures established, and may require such tests as he deems necessary for equipment and assemblies for which no standard test is provided in order to determine the acceptability of any such fire damper, smoke damper, or control assembly.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3260 FIRE CONTROL ASSEMBLIES REQUIRED.

Subpart 1. **Fire walls.** Where ducts or the outlets from or inlets to them pass through a fire wall or where a ventilating opening (transfer) exists in a fire wall, they shall be provided with an automatic fire assembly approved for the protection of openings in fire walls (Class A openings) on both sides of the wall through which the opening exists.

Subp. 2. **Fire partitions.** Where ducts or the outlets from or inlets to them pass through a fire partition or fire enclosure of a vertical shaft, or where a ventilating opening (transfer) exists in a fire partition or fire enclosure of a vertical shaft, they shall be provided with an approved automatic fire damper, except as otherwise provided herein.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3270 FIRE-RESISTING WALLS.

Subpart 1. **General.** Openings in fire-resisting walls other than fire walls, fire partitions, and required shaft enclosures shall be protected as provided herein.

Subp. 2. **Walls requiring fire resistance of more than one hour.** Where ducts or outlets from or inlets to them pass through walls which are required to have a protection of more than one hour, or where a ventilation opening (transfer) is provided in such wall, such opening shall be protected with approved fire dampers.

Subp. 3. **Walls requiring fire resistance of one hour or less.** Where outlets from or inlets to duct systems are provided in walls which are required to be fire-resisting with a rating of one hour or less and are required for area separation and where ventilation openings (transfer) are provided in such walls, such openings shall be protected with approved fire dampers.

Subp. 4. **Fire resisting ceilings.** Where inlets to or outlets from a duct system are provided in fire-resisting ceilings which are part of a required fire-resisting ceiling and floor or roof assembly, such inlets or outlets shall be protected in accordance with the approved design.

Subp. 5. **Fire resisting floors.** Where ducts pass through a fire resistive floor, approved fire dampers shall be provided, except as otherwise herein provided and except when such ducts are encased or enclosed in a shaft as provided in NFPA No. 90A.

Subp. 6. **Ducts serving two or more floors.** Where a duct system serves two or more floors, approved automatic fire dampers shall be provided at either each direct outlet or inlet in the enclosure for a main vertical duct, or at each point where such main vertical duct pierces the enclosure for a main vertical duct when such enclosure is required for the protection of vertical openings in the building.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3280 FIRE DAMPERS NOT REQUIRED.

Fire dampers are not required in branch ducts or in ducts that pierce the floor at one place only, when such ducts are less than 20 square inches in area and supply air conditioning units in one story only that discharge air at not over four feet above the floor.

Fire dampers are not required in ducts serving small buildings with unprotected floor openings and in duct systems serving only one floor and used only for the exhaust air to the outside and which do not penetrate a fire wall or fire partition or pass entirely through the enclosure of a vertical shaft.

Fire dampers are not required where branch ducts connect to a return riser in which the flow is upward and subducts at least 22 inches in length are carried up inside the riser from each outlet (See NFPA No. 90A).

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3290 CONSTRUCTION AND INSTALLATION OF CONTROL ASSEMBLIES.

Subpart 1. **Automatic fire doors.** Fire doors shall be approved for the protection of openings in fire walls (Class A openings) See NFPA No. 80, Fire Doors and Windows.

Fire doors shall be arranged to close automatically and shall remain tightly closed during the fire. Fire doors shall be so arranged that the disruption of the duct will not cause a failure in the protection of the fire wall opening. Fire doors required in parts 1345.3250 to 1345.3300 shall close upon the operation of an approved fusible link or other approved heat-actuated device located where readily affected by an abnormal rise in the temperature in the duct or opening. Such fusible link or device should have a temperature rating of approximately 50

degrees Fahrenheit above the maximum temperature that would normally be encountered with the system in operation or shut down.

Suitable access openings (hand holes) shall be provided to make all fire doors accessible for inspection and servicing.

Subp. 2. **Automatic fire dampers.** Fire dampers shall have a 1-1/2 hour standard fire protection rating in accordance with NFPA No. 252, Standard Method of Fire Tests of Door Assemblies, except for dampers protecting openings in rated fire-resisting ceilings which shall be in accordance with the approval. Fire dampers used for the protection of ventilating openings (transfers) in fire-resisting walls shall be approved by the administrative authority.

Fire dampers shall be arranged to close automatically, remain in a closed position, and provide the maximum practical barrier to the passage of air when in the closed position. They shall be so arranged as to stay in place at the protected opening even if the duct should be disrupted during the fire. Automatic closing of the fire damper shall be effected by the operation of an approved fusible link or other approved heat-actuated device located where readily affected by an abnormal rise in temperature in the duct space or opening. Such fusible link should have a temperature rating approximately 50 degrees Fahrenheit above the maximum temperature that would normally be encountered with the system in operation or shut down.

Fire dampers shall be corrosion resistant and when installed in ducts used solely for exhaust air to the outside shall be installed in such a way that they will not interfere with the flow of air in the main duct.

Suitable access openings (hand holes) shall be provided to make all fire dampers accessible for inspection and servicing.

Statutory Authority: *MS s 16B.59 to 16B.73*

1345.3300 SYSTEM CONTROLS REQUIRED.

Subpart 1. **Manual emergency stop.** Each installation shall be equipped with a manual emergency stop located at a conveniently accessible point approved by the administrative authority in order to be able to quickly shut down the fan in case of fire.

Subp. 2. **Systems between 2,000 and 15,000 cfm.** Systems between 2,000 cfm and 15,000 cfm shall be arranged to shut down automatically when the temperature of the air in the system becomes excessive as from a fire. This connection shall have approved thermostatic devices provided as follows: one device with a setting not in excess of 125 degrees Fahrenheit at a suitable location in the return air stream ahead of the point of exhausting from the building or being diluted by outside air, and one device with a setting not in excess of 50 degrees Fahrenheit above the maximum operating temperature, at a suitable location in the main supply duct on the downstream side of the filters. The thermostatic device shall be of the manually reset type or the control system shall be such that some manual operation is required to restart the fan after the thermostatic device has operated. Smoke detectors approved for duct installation may be used in lieu of thermostatic devices.

Subp. 3. **Systems over 15,000 cfm.** Systems over 15,000 cfm shall be provided with approved smoke detectors so installed and arranged to automatically shut down the main supply duct and the main return duct, so arranged to close automatically when the system is not in operation when the smoke detecting apparatus operates or when the fan is stopped by the manual emergency stop. Based on the foregoing requirements, the approved smoke detectors shall be provided at a suitable location in the return air stream ahead of the point of exhausting from the building or being diluted by outside air, and at a suitable location in the main supply duct on the downstream side of the filters.

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Subp. 4. **Systems incorporating automatic exhaust.** Automatic fan shutdown as required in subparts 2 and 3 will not be required when an automatic exhaust system is provided. Automatic smoke detectors shall be required for such systems.

Subp. 5. **Smoke detection on systems under 15,000 cfm.** Means for the detecting and controlling of the spread of smoke in air delivery systems which are under 15,000 cfm are recommended and shall be required on all such systems in premises where panic hazard is pronounced.

Statutory Authority: *MS s 16B.59 to 16B.73*