CHAPTER

10

BOILERS, WATER HEATERS AND PRESSURE VESSELS

SECTION 1001—GENERAL

1001.1 Scope. This chapter shall govern the installation, *alteration* and repair of boilers, water heaters and pressure vessels.

Exceptions:

1. Pressure vessels used for unheated water supply.
2. Portable unfired pressure vessels and Interstate Commerce Commission containers.
3. Containers for bulk oxygen and medical gas.
4. Unfired pressure vessels having a volume of 5 cubic feet (0.14 m^3) or less operating at pressures not exceeding 250 pounds per square inch (psi) (1724 kPa) and located within *occupancies* of Groups B, F, H, M, R, S and U.
5. Pressure vessels used in refrigeration systems that are regulated by Chapter 11 of this code.
6. Pressure tanks used in conjunction with coaxial cables, telephone cables, power cables and other similar humidity control systems.
7. Any boiler or pressure vessel subject to inspection by federal or state inspectors.
8. Boiler or pressure vessels subject to inspection as provided in the *Florida Statutes* 554-Boiler Safety Act, administered by the Boiler Safety Program, State Fire Marshal's Office.
9. Pressure vessels used in specific appliances and equipment that are regulated by Chapter 9 of this code.

SECTION 1002—WATER HEATERS

1002.1 General. Potable water heaters and hot water storage tanks shall be *listed* and *labeled* and installed in accordance with the manufacturer's instructions, the *Florida Building Code, Plumbing* and this code. All water heaters shall be capable of being removed without first removing a permanent portion of the building structure. The potable water connections and relief valves for all water heaters shall conform to the requirements of the *Florida Building Code, Plumbing*. Domestic electric water heaters shall comply with UL 174 or UL 1453. Commercial electric water heaters shall comply with UL 1453. Oil-fired water heaters shall comply with UL 732. Solid-fuel-fired water heaters shall comply with UL 2523. Thermal solar water heaters shall comply with Chapter 14 and UL 174 or UL 1453.

1002.2 Water heaters utilized for space heating. Water heaters utilized both to supply potable hot water and provide hot water for space-heating applications shall be *listed* and *labeled* for such applications by the manufacturer and shall be installed in accordance with the manufacturer's instructions and the *Florida Building Code, Plumbing*.

1002.2.1 Sizing. Water heaters utilized for both potable water heating and space-heating applications shall be sized to prevent the space-heating load from diminishing the required potable water-heating capacity.

1002.2.2 Temperature limitation. Where a combination potable water-heating and space-heating system requires water for space heating at temperatures higher than 140°F (60°C), a temperature-actuated mixing valve that conforms to ASSE 1017 shall be provided to temper the water supplied to the potable hot water distribution system to a temperature of 140°F (60°C) or less.

1002.3 Supplemental water-heating devices. Potable water-heating devices that utilize refrigerant-to-water heat exchangers shall be *approved* and installed in accordance with the *Florida Building Code, Plumbing* and the manufacturer's instructions.

SECTION 1003—PRESSURE VESSELS

1003.1 General. All pressure vessels, unless otherwise approved, shall be constructed and certified in accordance with the ASME *Boiler and Pressure Vessel Code*, and shall be installed in accordance with the manufacturer's instructions and nationally recognized standards. Directly fired pressure vessels shall meet the requirements of Section 1004.

1003.2 Piping. All piping materials, fittings, joints, connections and devices associated with systems utilized in conjunction with pressure vessels shall be designed for the specific application and shall be *approved*.

1003.3 Welding. Welding on pressure vessels shall be performed by an R-Stamp holder in accordance with the *National Board Inspection Code, Part 3* or in accordance with an *approved* standard.

SECTION 1004—BOILERS

1004.1 Standards. Boilers shall be designed, constructed and certified in accordance with the ASME *Boiler and Pressure Vessel Code*, Section I or IV. Controls and safety devices for boilers with fuel input ratings of less than 12,500,000 Btu/hr (3,662,500 W) shall meet the requirements of ASME CSD-1. Controls and safety devices for boilers with inputs greater than or equal to 12,500,000 Btu/hr (3,662,500 W) shall meet the requirements of NFPA 85. Packaged oil-fired boilers shall be *listed* and *labeled* in accordance with UL 726. Packaged electric boilers shall be *listed* and *labeled* in accordance with UL 834. Solid-fuel-fired boilers shall be *listed* and *labeled* in accordance with UL 2523.

1004.2 Installation. In addition to the requirements of this code, the installation of boilers shall conform to the manufacturer's instructions. Operating instructions of a permanent type shall be attached to the boiler. Boilers shall have all controls set, adjusted and tested by the installer. The manufacturer's rating data and the nameplate shall be attached to the boiler.

1004.2.1 Carbon monoxide testing. Boilers shall be tested to a maximum level of 50 parts per million (ppm) of carbon monoxide as per OSHA guidelines.

1004.3 Working clearance. *Clearances* shall be maintained around boilers, generators, heaters, tanks and related *equipment* and *appliances* so as to permit inspection, servicing, repair, replacement and visibility of all gauges. When boilers are installed or replaced, *clearance* shall be provided to allow access for inspection, maintenance and repair. Passageways around all sides of boilers shall have an unobstructed width of not less than 18 inches (457 mm), unless otherwise *approved*.

1004.3.1 Top clearance. *Clearances* from the tops of boilers to the ceiling or other overhead obstruction shall be in accordance with Table 1004.3.1.

TABLE 1004.3.1—BOILER TOP CLEARANCES

BOILER TYPE	MINIMUM CLEARANCES FROM TOP OF BOILER TO CEILING OR OTHER OVERHEAD OBSTRUCTION (feet)
All boilers with manholes on top of the boiler except where a greater clearance is required in this table.	3
All boilers without manholes on top of the boiler except high-pressure steam boilers and where a greater clearance is required in this table.	2
High-pressure steam boilers with steam generating capacity not exceeding 5,000 pounds per hour.	3
High-pressure steam boilers with steam generating capacity exceeding 5,000 pounds per hour.	7
High-pressure steam boilers having heating surface not exceeding 1,000 square feet.	3
High-pressure steam boilers having heating surface in excess of 1,000 square feet.	7
High-pressure steam boilers with input not exceeding 5,000,000 Btu/h.	3
High-pressure steam boilers with input in excess of 5,000,000 Btu/h.	7
Steam-heating boilers and hot water-heating boilers with input exceeding 5,000,000 Btu/h.	3
Steam-heating boilers exceeding 5,000 pounds of steam per hour.	3
Steam-heating boilers and hot water-heating boilers having heating surface exceeding 1,000 square feet.	3
For SI: 1 foot = 304.8 mm, 1 square foot = 0.0929 m^2, 1 pound per hour = 0.4536 kg/h, 1 Btu/hr = 0.293 W.	

1004.4 Mounting. *Equipment* shall be set or mounted on a level base capable of supporting and distributing the weight contained thereon. Boilers, tanks and *equipment* shall be secured in accordance with the manufacturer's installation instructions.

1004.5 Floors. Boilers shall be mounted on floors of noncombustible construction, unless *listed* for mounting on combustible flooring.

1004.6 Boiler rooms and enclosures. Boiler rooms and enclosures and access thereto shall comply with the *Florida Building Code, Building* and Chapter 3 of this code. Boiler rooms shall be equipped with a floor drain or other *approved* means for disposing of liquid waste.

1004.7 Operating adjustments and instructions. Hot water and steam boilers shall have all operating and safety controls set and operationally tested by the installing contractor. A complete control diagram and boiler operating instructions shall be furnished by the installer for each installation.

SECTION 1005—BOILER CONNECTIONS

1005.1 Valves. Every boiler or modular boiler shall have a shutoff valve in the supply and return piping. For multiple boiler or multiple modular boiler installations, each boiler or modular boiler shall have individual shutoff valves in the supply and return piping.

Exception: Shutoff valves are not required in a system having a single low-pressure steam boiler.

1005.2 Potable water supply. The water supply to all boilers shall be connected in accordance with the *Florida Building Code, Plumbing*.

SECTION 1006—SAFETY AND PRESSURE RELIEF VALVES AND CONTROLS

1006.1 Safety valves for steam boilers. Steam boilers shall be protected with a safety valve.

1006.2 Safety relief valves for hot water boilers. Hot water boilers shall be protected with a safety relief valve.

1006.3 Pressure relief for pressure vessels. Pressure vessels shall be protected with a pressure relief valve or pressure-limiting device as required by the manufacturer's installation instructions for the pressure vessel.

1006.4 Approval of safety and safety relief valves. Safety and safety relief valves shall be *listed* and *labeled*, and shall have a minimum rated capacity for the *equipment* or *appliances* served. Safety and safety relief valves shall be set at not greater than the nameplate pressure rating of the boiler or pressure vessel.

1006.5 Installation. Safety or relief valves shall be installed directly into the safety or relief valve opening on the boiler or pressure vessel. Valves shall not be located on either side of a safety or relief valve connection. The relief valve shall discharge by gravity.

1006.6 Safety and relief valve discharge. Safety and relief valve discharge pipes shall be of rigid pipe that is *approved* for the temperature of the system. The discharge pipe shall be the same diameter as the safety or relief valve outlet. Safety and relief valves shall not discharge so as to be a hazard, a potential cause of damage or otherwise a nuisance. High-pressure-steam safety valves shall be vented to the outside of the structure. Where a low-pressure safety valve or a relief valve discharges to the drainage system, the installation shall conform to the *Florida Building Code, Plumbing*.

1006.7 Boiler safety devices. Boilers shall be equipped with controls and limit devices as required by the manufacturer's installation instructions and the conditions of the listing.

1006.8 Electrical requirements. The power supply to the electrical control system shall be from a two-wire branch circuit that has a grounded conductor, or from an isolation transformer with a two-wire secondary. Where an isolation transformer is provided, one conductor of the secondary winding shall be grounded. Control voltage shall not exceed 150 volts nominal, line to line. Control and limit devices shall interrupt the ungrounded side of the circuit. A means of manually disconnecting the control circuit shall be provided and controls shall be arranged so that when deenergized, the burner shall be inoperative. Such disconnecting means shall be capable of being locked in the off position and shall be provided with ready access.

SECTION 1007—BOILER LOW-WATER CUTOFF

1007.1 General. Steam and hot water boilers shall be protected with a low-water cutoff control.

Exception: A low-water cutoff is not required for coil-type and water-tube-type boilers that require forced circulation of water through the boiler and that are protected with a flow sensing control.

1007.2 Operation. Low-water cutoff controls and flow sensing controls required by Section 1007.1 shall automatically stop the *combustion* operation of the *appliance* when the water level drops below the lowest safe water level as established by the manufacturer or when water circulation stops, respectively.

SECTION 1008—BOTTOM BLOWOFF VALVE

1008.1 General. Steam boilers shall be equipped with bottom blowoff valve(s). The valve(s) shall be installed in the opening provided on the boiler. The minimum size of the valve(s) and associated piping shall be the size specified by the boiler manufacturer or the size of the boiler blowoff-valve opening. Where the maximum allowable working pressure of the boiler exceeds 100 psig (689 kPa), two bottom blowoff valves shall be provided consisting of either two slow-opening valves in series or one quick-opening valve and one slow-opening valve in series, with the quick-opening valve installed closest to the boiler.

1008.2 Discharge. Blowoff valves shall discharge to a safe place of disposal. Where discharging to the drainage system, the installation shall conform to the *Florida Building Code, Plumbing*.

SECTION 1009—HOT WATER BOILER EXPANSION TANK

1009.1 Where required. An expansion tank shall be installed in every hot water system. For multiple boiler installations, not less than one expansion tank is required. Expansion tanks shall be of the closed or open type. Tanks shall be rated for the pressure of the hot water system.

1009.2 Closed-type expansion tanks. Closed-type expansion tanks shall be installed in accordance with the manufacturer's instructions. Expansion tanks for systems designed to have an operating pressure in excess of 30 psi (207 kPa) shall be constructed and certified in accordance with the ASME *Boiler and Pressure Vessel Code*. The size of the tank shall be based on the capacity of the hot-water-heating system. The minimum size of the tank shall be determined in accordance with the following equation where all necessary information is known:

Equation 10-1
$$V_t = \frac{(0.00041T - 0.0466)V_s}{\left(\frac{P_a}{P_f}\right) - \left(\frac{P_a}{P_o}\right)}$$

For SI:

$$V_t = \frac{(0.000738T - 0.03348)V_s}{\left(\frac{P_a}{P_f}\right) - \left(\frac{P_a}{P_o}\right)}$$

where:

V_t = Minimum volume of tanks (gallons) (L).

V_s = Volume of system, not including expansion tanks (gallons) (L).

T = Average operating temperature (°F) (°C).

P_a = Atmospheric pressure (psi) (kPa).

P_f = Fill pressure (psi) (kPa).

P_o = Maximum operating pressure (psi) (kPa).

Where all necessary information is not known, the minimum size of the tank shall be determined from Table 1009.2.

TABLE 1009.2—CLOSED-TYPE EXPANSION TANK SIZING

SYSTEM VOLUME IN GALLONS	TANK CAPACITIES IN GALLONS	
	Pressurized Diaphragm Type	Nonpressurized Type
100	9	15
200	17	30
300	25	45
400	33	60
500	42	75
1,000	83	150
2,000	165	300

For SI: 1 gallon = 3.795 L.

1009.3 Open-type expansion tanks. Open-type expansion tanks shall be located not less than 4 feet (1219 mm) above the highest heating element. The tank shall be adequately sized for the hot water system. An overflow with a minimum diameter of 1 inch (25 mm) shall be installed at the top of the tank. The overflow shall discharge to the drainage system in accordance with the *Florida Building Code, Plumbing*.

SECTION 1010—GAUGES

1010.1 Hot water boiler gauges. Every hot water boiler shall have a pressure gauge and a temperature gauge, or a combination pressure and temperature gauge. The gauges shall indicate the temperature and pressure within the normal range of the system's operation.

1010.2 Steam boiler gauges. Every steam boiler shall have a water-gauge glass and a pressure gauge. The pressure gauge shall indicate the pressure within the normal range of the system's operation.

1010.2.1 Water-gauge glass. The gauge glass shall be installed so that the midpoint is at the normal boiler water level.

SECTION 1011—TESTS

1011.1 Tests. Upon completion of the assembly and installation of boilers and pressure vessels, acceptance tests shall be conducted in accordance with the requirements of the ASME *Boiler and Pressure Vessel Code* or the manufacturer's requirements, and such tests shall be approved. A copy of all test documents along with all manufacturer's data reports required by the ASME *Boiler and Pressure Vessel Code* shall be submitted to the code official.

1011.2 Test gauges. An indicating test gauge shall be connected directly to the boiler or pressure vessel where it is visible to the operator throughout the duration of the test. The pressure gauge scale shall be graduated over a range of not less than one and one-half times and not greater than four times the maximum test pressure. Gauges utilized for testing shall be calibrated and certified by the test operator.

CHAPTER

11 REFRIGERATION

SECTION 1101—GENERAL

1101.1 Scope. This chapter shall govern the design, installation, construction and repair of refrigeration systems that vaporize and liquefy a fluid during the refrigerating cycle. Refrigerant piping design and installation, including pressure vessels and pressure relief devices, shall conform to this code. Permanently installed refrigerant storage systems and other components shall be considered as part of the refrigeration system to which they are attached.

1101.2 Factory-built equipment and appliances. *Listed* and *labeled* self-contained, factory-built *equipment* and appliances shall be tested in accordance with the applicable standards specified in Table 1101.2. Such *equipment* and appliances are deemed to meet the design, manufacture and factory test requirements of this code if installed in accordance with their listing and the manufacturer's instructions.

TABLE 1101.2—FACTORY-BUILT EQUIPMENT AND APPLIANCES

EQUIPMENT	STANDARDS
Air-conditioning equipment	UL 1995 or UL/CSA 60335-2-40
Packaged terminal air conditioners and heat pumps	UL 484 or UL/CSA 60335-2-40
Split-system air conditioners and heat pumps	UL 1995 or UL/CSA 60335-2-40
Dehumidifiers	UL 474 or UL/CSA 60335-2-40
Unit coolers	UL 412 or UL/CSA 60335-2-89
Commercial refrigerators, freezers, beverage coolers and walk-in coolers	UL 471 or UL/CSA 60335-2-89
Refrigerating units and walk-in coolers	UL 427 or UL 60335-2-89
Refrigerant-containing components and accessories	UL 207

1101.2.1 Group A2L, A2, A3 and B1 high probability equipment. High probability equipment using Group A2L, A2, A3, or B1 refrigerant shall comply with UL 484, UL/CSA 60335-2-40, or UL/CSA 60335-2-89.

1101.3 Protection. Any portion of a refrigeration system that is subject to physical damage shall be protected in an *approved* manner.

1101.4 Water connection. Water supply and discharge connections associated with refrigeration systems shall be made in accordance with this code and the *Florida Building Code, Plumbing*.

1101.5 Fuel gas connection. Fuel gas devices, *equipment* and *appliances* used with refrigeration systems shall be installed in accordance with the *Florida Building Code, Fuel Gas.*

1101.6 General. Refrigeration systems shall comply with the requirements of this code and, except as modified by this code, ASHRAE 15. Ammonia-refrigerating systems shall comply with this code and, except as modified by this code, ASHRAE 15 and IIAR 2.

Exception: Refrigeration systems that use A2L refrigerant shall be designed and installed in accordance with ASHRAE 15.

1101.7 Maintenance. Mechanical refrigeration systems shall be maintained in proper operating condition, free from accumulations of oil, dirt, waste, excessive corrosion, other debris and leaks.

1101.8 Changing refrigerant. Changes of refrigerant in an existing system to a refrigerant with a different refrigerant designation shall only be allowed where in accordance with the following:

1. The owner or the owner's authorized agent shall be notified prior to making a change of refrigerant, and the change of refrigerant shall not be made where the owner objects to the change.
2. The change in refrigerant shall be in accordance with one of the following.
    2.1. Written instructions of the original equipment manufacturer.
    2.2. An evaluation of the system by a registered design professional or by an approved agency that validates safety and suitability of the replacement refrigerant.
    2.3. Approved by the code official.
3. Where the replacement refrigerant is classified into the same safety group, requirements that were applicable to the existing system shall continue to apply.
4. Where the replacement refrigerant is classified into a different safety group, the system shall comply with the requirements of this standard for a new installation, and the change of refrigerant shall require code official approval.

[F] 1101.9 Refrigerant discharge. Notification of refrigerant discharge shall be provided in accordance with the *Florida Fire Prevention Code*.

1101.10 Locking access port caps. Refrigerant circuit access ports located outdoors shall be fitted with locking-type tamper-resistant caps or shall be otherwise secured to prevent unauthorized access.

Exception: This section shall not apply to refrigerant circuit access ports on *equipment* installed in controlled areas such as on roofs with locked access hatches or doors.

SECTION 1102—SYSTEM REQUIREMENTS

1102.1 General. The system classification, allowable refrigerants, maximum quantity, enclosure requirements, location limitations, and field pressure test requirements shall be determined as follows:

1. Determine the refrigeration system's classification, in accordance with Section 1103.3.
2. Determine the refrigerant classification in accordance with Section 1103.1.
3. Determine the maximum allowable quantity of refrigerant in accordance with Section 1104, based on type of refrigerant, system classification and *occupancy*.
4. Determine the system enclosure requirements in accordance with Section 1104.
5. Refrigeration *equipment* and *appliance* location and installation shall be subject to the limitations of Chapter 3.
6. Nonfactory-tested, field-erected *equipment* and appliances shall be pressure tested in accordance with Section 1108.

1102.2 Refrigerants. The refrigerant shall be that which the *equipment* or *appliance* was designed to utilize or converted to utilize. Refrigerants not identified in Table 1103.1 shall be *approved* before use.

1102.2.1 Mixing. Refrigerants with different refrigerant designations shall only be mixed in a system in accordance with both of the following:

1. The addition of a second refrigerant is allowed by the equipment manufacturer and is in accordance with the manufacturer's written instructions.
2. The resulting mixture does not change the refrigerant safety group.

1102.2.2 Purity. Refrigerants used in refrigeration systems shall be new, recovered or *reclaimed refrigerants* in accordance with Section 1102.2.2.1, 1102.2.2.2 or 1102.2.2.3. Where required by the *equipment* or *appliance* owner or the code official, the installer shall furnish a signed declaration that the refrigerant used meets the requirements of Section 1102.2.2.1, 1102.2.2.2 or 1102.2.2.3.

Exception: The refrigerant used shall meet the purity specifications set by the manufacturer of the *equipment* or *appliance* in which such refrigerant is used where such specifications are different from that specified in Sections 1102.2.2.1, 1102.2.2.2 and 1102.2.2.3.

1102.2.2.1 New refrigerants. Refrigerants shall be of a purity level specified by the *equipment* or *appliance* manufacturer.

1102.2.2.2 Recovered refrigerants. Refrigerants that are recovered from refrigeration and air-conditioning systems shall not be reused in other than the system from which they were recovered and in other systems of the same owner. *Recovered refrigerants* shall be filtered and dried before reuse. *Recovered refrigerants* that show clear signs of contamination shall not be reused unless reclaimed in accordance with Section 1102.2.2.3.

1102.2.2.3 Reclaimed refrigerants. Used refrigerants shall not be reused in a different owner's *equipment* or appliances unless tested and found to meet the purity requirements of AHRI 700. Contaminated refrigerants shall not be used unless reclaimed and found to meet the purity requirements of AHRI 700.

1102.3 Access port protection. Refrigerant access ports shall be protected in accordance with Section 1101.10 whenever refrigerant is added to or recovered from refrigeration or air-conditioning systems.

SECTION 1103—REFRIGERATION SYSTEM CLASSIFICATION

1103.1 Refrigerant classification. Refrigerants shall be classified in accordance with ASHRAE 34 as listed in Table 1103.1.

TABLE 1103.1—REFRIGERANT CLASSIFICATION, AMOUNT AND OEL

CHEMICAL REFRIGERANT	FORMULAS	CHEMICAL NAME OF BLENDS	REFRIGERANT SAFETY GROUP CLASSIFICATION	AMOUNT OF REFRIGERANT PER OCCUPIED SPACE							(F) DEGREES OF HAZARD[a]
				RCL			LFL			OEL	
				lb/MCf	ppm	g/m³	lb/MCf	ppm	g/m³	ppm	
R-11[c]	CCl_3F	trichlorofluoromethane	A1	0.39	1,100	6.1	—	—	—	1,000	2-0-0[b]
R-12[c]	CCl_2F_2	dichlorodifluoromethane	A1	5.6	18,000	90	—	—	—	1,000	2-0-0[b]
R-13[c]	$CClF_3$	chlorotrifluoromethane	A1	—	—	—	—	—	—	1,000	2-0-0[b]
R-13B1[c]	$CBrF_3$	bromotrifluoromethane	A1	—	—	—	—	—	—	1,000	2-0-0[b]
R-13I1	CF_3I	trifluoroiodomethane	A1	1.0	2,000	16	—	—	—	500	—
R-14	CF_4	tetrafluoromethane (carbon tetrafluoride)	A1	25	110,000	400	—	—	—	1,000	2-0-0[b]
R-22	$CHClF_2$	chlorodifluoromethane	A1	13	59,000	210	—	—	—	1,000	2-0-0[b]
R-23	CHF_3	trifluoromethane (fluoroform)	A1	7.3	41,000	120	—	—	—	1,000	2-0-0[b]
R-30	CH_2Cl_2	dichloromethane (methylene chloride)	B1	—	—	—	—	—	—	—	—

TABLE 1103.1—REFRIGERANT CLASSIFICATION, AMOUNT AND OEL—continued

CHEMICAL REFRIGERANT	FORMULAS	CHEMICAL NAME OF BLENDS	REFRIGERANT SAFETY GROUP CLASSIFICATION	AMOUNT OF REFRIGERANT PER OCCUPIED SPACE							(F) DEGREES OF HAZARD[a]
				RCL			LFL			OEL	
				lb/MCf	ppm	g/m³	lb/MCf	ppm	g/m³	ppm	
R-31	CH_2ClF	chlorofluoromethane	—	—	—	—	—	—	—	—	—
R-32	CH_2F_2	difluoromethane (methylene fluoride)	A2L	4.8	36,000	77	19.1	144,000	306	1,000	1-4-0
R-40	CH_3Cl	chloromethane (methyl chloride)	B2	—	—	—	—	—	—	—	—
R-41	CH_3F	fluoromethane (methyl fluoride)	—	—	—	—	—	—	—	—	—
R-50	CH_4	methane	A3	—	—	—	—	50,000	—	1,000	—
R-113[c]	CCl_2FCClF_2	1,1,2-trichloro-1,2,2-trifluoroethane	A1	1.2	2,600	20	—	—	—	1,000	2-0-0[b]
R-114[c]	$CClF_2CClF_2$	1,2-dichloro-1,1,2,2-tetrafluoroethane	A1	8.7	20,000	140	—	—	—	1,000	2-0-0[b]
R-115	$CClF_2CF_3$	chloropentafluoroethane	A1	47	120,000	760	—	—	—	1,000	—
R-116	CF_3CF_3	hexafluoroethane	A1	34	97,000	550	—	—	—	1,000	1-0-0
R-123	$CHCl_2CF_3$	2,2-dichloro-1,1,1-trifluoroethane	B1	3.5	9,100	57	—	—	—	50	2-0-0[b]
R-124	$CHClFCF_3$	2-chloro-1,1,1,2-tetrafluoroethane	A1	3.5	10,000	56	—	—	—	1,000	2-0-0[b]
R-125	CHF_2CF_3	pentafluoroethane	A1	23	75,000	370	—	—	—	1,000	2-0-0[b]
R-134a	CH_2FCF_3	1,1,1,2-tetrafluoroethane	A1	13	50,000	210	—	—	—	1,000	2-0-0[b]
R-141b	CH_3CCl_2F	1,1-dichloro-1-fluoroethane	—	0.78	2,600	12	17.8	60,000	287	500	2-1-0
R-142b	CH_3CClF_2	1-chloro-1, 1-difluoroethane	A2	5.1	20,000	82	20.4	80,000	329	1,000	2-4-0
R-143a	CH_3CF_3	1,1,1-trifluoroethane	A2L	4.4	21,000	70	17.5	82,000	282	1,000	2-0-0[b]
R-152a	CH_3CHF_2	1,1-difluoroethane	A2	2.0	12,000	32	8.1	48,000	130	1,000	1-4-0
R-170	CH_3CH_3	ethane	A3	0.54	7,000	8.6	2.4	31,000	38	1,000	2-4-0
R-E170	CH_3OCH_3	Methoxymethane (dimethyl ether)	A3	1.0	8,500	16	4.0	34,000	64	1,000	—
R-218	$CF_3CF_2CF_3$	octafluoropropane	A1	43	90,000	690	—	—	—	1,000	2-0-0[b]
R-227ea	CF_3CHFCF_3	1,1,1,2,3,3,3-heptafluoropropane	A1	36	84,000	580	—	—	—	1,000	—
R-236fa	$CF_3CH_2CF_3$	1,1,1,3,3,3-hexafluoropropane	A1	21	55,000	340	—	—	—	1,000	2-0-0[b]
R-245fa	$CHF_2CH_2CF_3$	1,1,1,3,3-pentafluoropropane	B1	12	34,000	190				300	2-0-0[b]
R-290	$CH_3CH_2CH_3$	propane	A3	0.59	5,300	9.5	2.4	21,000	38	1,000	2-4-0
R-C318	$-(CF_2)_4-$	octafluorocyclobutane	A1	41	80,000	650	—	—	—	1,000	—
R-400[c]	zeotrope	R-12/114 (50.0/50.0)	A1	10	28,000	160	—	—	—	1,000	2-0-0[b]
R-400[c]	zeotrope	R-12/114 (60.0/40.0)	A1	11	30,000	170	—	—	—	1,000	—
R-401A	zeotrope	R-22/152a/124 (53.0/13.0/34.0)	A1	6.6	27,000	110	—	—	—	1,000	2-0-0[b]
R-401B	zeotrope	R-22/152a/124 (61.0/11.0/28.0)	A1	7.2	30,000	120	—	—	—	1,000	2-0-0[b]
R-401C	zeotrope	R-22/152a/124 (33.0/15.0/52.0)	A1	5.2	20,000	84	—	—	—	1,000	2-0-0[b]
R-402A	zeotrope	R-125/290/22 (60.0/2.0/38.0)	A1	17	66,000	270	—	—	—	1,000	2-0-0[b]
R-402B	zeotrope	R-125/290/22 (38.0/2.0/60.0)	A1	15	63,000	240	—	—	—	1,000	2-0-0[b]
R-403A	zeotrope	R-290/22/218 (5.0/75.0/20.0)	A2	7.6	33,000	120	—	—	—	1,000	2-0-0[b]
R-403B	zeotrope	R-290/22/218 (5.0/56.0/39.0)	A1	18	68,000	290	—	—	—	1,000	2-0-0[b]

TABLE 1103.1—REFRIGERANT CLASSIFICATION, AMOUNT AND OEL—continued

CHEMICAL REFRIGERANT	FORMULAS	CHEMICAL NAME OF BLENDS	REFRIGERANT SAFETY GROUP CLASSIFICATION	AMOUNT OF REFRIGERANT PER OCCUPIED SPACE							(F) DEGREES OF HAZARD[a]
				RCL			LFL			OEL	
				lb/MCf	ppm	g/m³	lb/MCf	ppm	g/m³	ppm	
R-404A	zeotrope	R-125/143a/134a (44.0/52.0/4.0)	A1	31	130,000	500	—	—	—	1,000	2-0-0[b]
R-405A	zeotrope	R-22/152a/142b/C318 (45.0/7.0/5.5/42.5)	—	16	57,000	260	—	—	—	1,000	—
R-406A	zeotrope	R-22/600a/142b (55.0/4.0/41.0)	A2	4.7	21,000	75	18.8	82,000	301.9	1,000	—
R-407A	zeotrope	R-32/125/134a (20.0/40.0/40.0)	A1	19	83,000	300	—	—	—	1,000	2-0-0[b]
R-407B	zeotrope	R-32/125/134a (10.0/70.0/20.0)	A1	21	79,000	330	—	—	—	1,000	2-0-0[b]
R-407C	zeotrope	R-32/125/134a (23.0/25.0/52.0)	A1	18	81,000	290	—	—	—	1,000	2-0-0[b]
R-407D	zeotrope	R-32/125/134a (15.0/15.0/70.0)	A1	16	68,000	250	—	—	—	1,000	2-0-0[b]
R-407E	zeotrope	R-32/125/134a (25.0/15.0/60.0)	A1	17	80,000	280	—	—	—	1,000	2-0-0[b]
R-407F	zeotrope	R-32/125/134a (30.0/30.0/40.0)	A1	20	95,000	320	—	—	—	1,000	—
R-407G	zeotrope	R-32/125/134a (2.5/2.5/95.0)	A1	13	52,000	210	—	—	—	1,000	—
R-407H	zeotrope	R-32/125/134a (32.5/15.0/52.5)	A1	19	92,000	300	—	—	—	1,000	—
R-407I	zeotrope	R-32/125/124a (19.5/8.5/72.0)	A1	16	71,100	250	—	—	—	1,000	—
R-408A	zeotrope	R-125/143a/22 (7.0/46.0/47.0)	A1	21	94,000	330	—	—	—	1,000	2-0-0[b]
R-409A	zeotrope	R-22/124/142b (60.0/25.0/15.0)	A1	7.1	29,000	110	—	—	—	1,000	2-0-0[b]
R-409B	zeotrope	R-22/124/142b (65.0/25.0/10.0)	A1	7.3	30,000	120	—	—	—	1,000	2-0-0[b]
R-410A	zeotrope	R-32/125 (50.0/50.0)	A1	26	140,000	420	—	—	—	1,000	2-0-0[b]
R-410B	zeotrope	R-32/125 (45.0/55.0)	A1	27	140,000	430	—	—	—	1,000	2-0-0[b]
R-411A	zeotrope	R-127/22/152a (1.5/87.5/11.0)	A2	2.9	14,000	46	11.6	55,000	185.6	970	—
R-411B	zeotrope	R-1270/22/152a (3.0/94.0/3.0)	A2	2.8	13,000	45	14.8	70,000	238.3	940	—
R-412A	zeotrope	R-22/218/142b (70.0/5.0/25.0)	A2	5.1	22,000	82	20.5	87,000	328.6	1,000	—
R-413A	zeotrope	R-218/134a/600a (9.0/88.0/3.0)	A2	5.8	22,000	93	23.4	88,000	374.9	1,000	—
R-414A	zeotrope	R-22/124/600a/142b (51.0/28.5/4.0/16.5)	A1	6.4	26,000	100	—	—	—	1,000	—
R-414B	zeotrope	R-22/124/600a/142b (50.0/39.0/1.5/9.5)	A1	6.0	23,000	96	—	—	—	1,000	—
R-415A	zeotrope	R-22/152a (82.0/18.0)	A2	2.9	14,000	47	—	—	—	1,000	—
R-415B	zeotrope	R-22/152a (25.0/75.0)	A2	2.1	12,000	34	—	—	—	1,000	—
R-416A	zeotrope	R-134a/124/600 (59.0/39.5/1.5)	A1	3.9	14,000	62	—	—	—	1,000	2-0-0[b]
R-417A	zeotrope	R-125/134a/600 (46.6/50.0/3.4)	A1	3.5	13,000	55	—	—	—	1,000	2-0-0[b]
R-417B	zeotrope	R-125/134a/600 (79.0/18.3/2.7)	A1	4.3	15,000	69	—	—	—	1,000	—