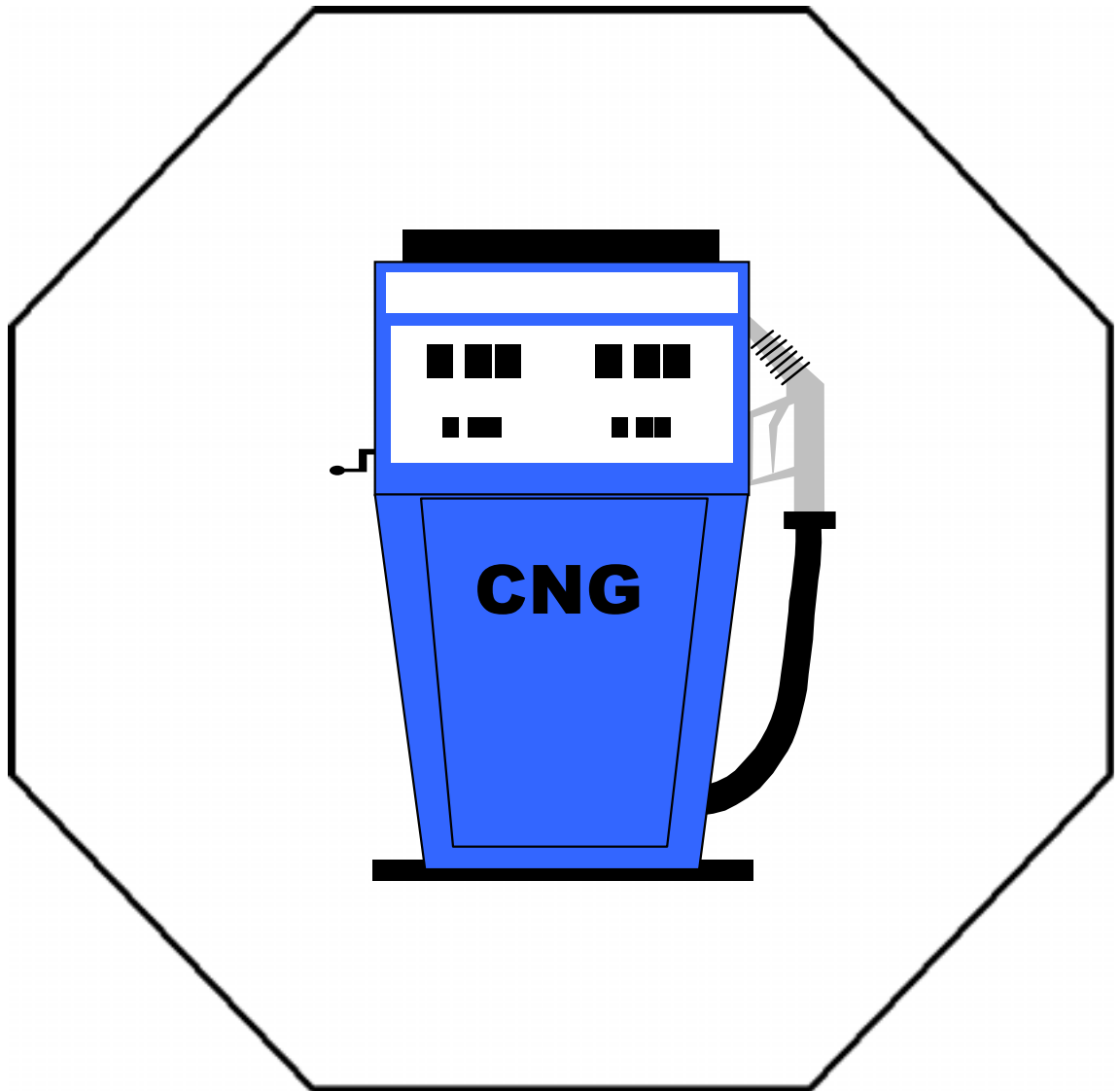


CNG GUIDE

A RECOMMENDED PERMITTING GUIDE FOR COMPRESSED NATURAL GAS FUELING STATIONS



PREPARED BY
THE CONFERENCE
OF
NORTHEAST REGIONAL FIRE SAFETY OFFICIALS

RECOMMENDED PERMITTING GUIDE FOR REFUELING STATIONS FOR VEHICLES FUELED BY COMPRESSED NATURAL GAS

This guide focuses on the permitting of new compressed natural gas stations and the effort to streamline permitting practices without sacrificing details governing safety. It is intended for use by municipal and state officials entrusted with fire protection and the safety of the people within their jurisdictions. Fire departments which heretofore have had limited exposure to the use and safety of compressed natural gas (CNG) as a fuel for motor vehicles should find these recommendations valuable.

The Guide is presented as a *checklist* for easy use by fire personnel in conducting their evaluations. NFPA 52, 1998 edition, serves as the foundation for the checklist. Other editions may govern in some jurisdictions (Connecticut, for example, bases its work with CNG on NFPA 52, 1992 edition, as well as the Connecticut Supplement to NFPA 52, 1992 edition). Reference to the 1998 edition is noted as “NFPA 52-98” throughout. Only code relevant to permitting of refueling stations is referenced herein.

The Checklist was prepared by a committee of state fire marshals and municipal fire chiefs and other personnel drawn from the four state region consisting of Connecticut, Massachusetts, New York, and Rhode Island (see back page for list of participating organizations and committee members). The checklist is advisory only, and intended to familiarize personnel with practices recommended by such reputable organizations as the National Fire Protection Association and the Natural Gas Vehicle Coalition. Additional copies of the guide are available at the CNG Guide Website, www.state.ma.us/doer/cng.

BACKGROUND & OVERVIEW

As recent events have shown, the United States is increasingly held hostage to the policies of foreign governments who control the availability and pricing of petroleum imported into this country. These imports represent over 55% of the petroleum consumed by Americans and unless efforts are made to reduce our dependence on the uncertain availability and economics of these imports will continue to be a growing menace to the well-being of all Americans.

Perhaps even more important than the politics of availability are the detrimental environmental impacts of gasoline fueled vehicles which, in the northeast, constitute over 40% of all pollution affecting the health of our

citizens. Vehicles powered by natural gas provide an economical, efficient solution to the problems of availability and health. Natural gas, the least polluting fossil fuel, burns more cleanly and costs less at the pump than traditional fuels. Natural gas is abundant and can be a vital resource in reducing our reliance on imported energy sources. Most important, the safety record of natural gas compares favorably to almost any traditional fuel, thanks greatly to superior technology and the inherent physical attributes of natural gas, which make it as safe or safer to use than gasoline. In case of a leak, for example, natural gas poses little danger because it dissipates rapidly into the air. Nor must CNG facility owners contend with the threat of leaks from underground tanks, a major consideration with liquid fuels.

THE FORMAT OF THIS GUIDE

For natural gas vehicles (NGV), the principal barrier to their success is the scarcity of locations at which to refuel. The Guide is therefore formatted as a *check list* to facilitate permitting by fire safety personnel, an essential ingredient in the rapid introduction of refueling facilities. The foundation for the check list is NFPA 52-98. In addition, states and municipalities in the northeast have regulations specific to their needs. These regulations and other foundation documents are listed below along with telephone numbers of information sources.

ORGANIZATION	REGULATIONS AND DOCUMENTS
National Fire Protection Association (617)770-3000	NFPA 52 Standard for CNG Vehicular Systems NFPA 88A Standard for Parking Structures NFPA 88B Standard for Repair Garages NFPA 70 National Electric Code
US Department of Transportation (202)366-4000	FMVSS (DOT) 304 Compress Natural Gas Container Integrity
Natural Gas Vehicle Coalition (703) 527-3022	NGV 1 Compressed Natural Gas Fueling Connections NGV 2 Basic Requirements for CNG Fuel Containers NGV 3.1 Requirements for Fuel System Components NGV 3.2 Requirements for NGV Conversion Kits NGV 4.1 Requirements for Dispensing Equipment NGV 4.2 Requirements for Hoses for NGVs and Fueling Stations NGV 4.6 Requirements for Manually Operated Valves for Pressure Natural Gas NGV 4.X Requirements for Gas Operated Valves for Pressure Natural Gas
Connecticut State Fire Marshal (860)685-8350	NFPA 52-92 and NFPA 52-92 supplement document
Massachusetts State Fire Marshal (978)567-3300	527 CMR 26.07
New York State Office of Fire Prevention & Control (518)474-6746	NYCRR Title 15 Chapter 1 Part 70 NYCRR Title 17 §7020.16
New York City Bureau of Fire Prevention (718)999-2523	Regulations City of New York §23-01 New York City Administrative Code Title 27 Chapter 4 Subchapter 1-§27-4014; 4081; Title 27-Chapter 4 Subchapter 17 §27-4099
Rhode Island State Fire Marshal (401)294-0861	NFPA 52-90

CHECK LIST

(1) Outdoor Siting – NFPA 52-98, 4-4.2

- 4-4.2.1 Containers.** CNG storage containers charged with CNG not connected for use shall be located outdoors.
- 4-4.2.2 Equipment Shelter.** A facility in which CNG compression, storage, and dispensing equipment are sheltered by an enclosure constructed on noncombustible or limited-combustible materials that has at least one side predominantly open and a roof designed for ventilation and dispersal of escaped gas shall be considered to be located outdoors.
- 4-4.2.3 Systems.** Compression, storage, and dispensing equipment located outdoors:
 - shall be above ground;
 - shall not be beneath electric power lines or where exposed by their failure; and
 - shall be a minimum of 10 ft (3.0 m) from the nearest important building or line of adjoining property that can be built upon or from any source of ignition.
- 4-4.2.4 thru 2.8 Location.** Compression, storage, and dispensing equipment located outdoors:
 - shall be not less than 10 ft (3.0 m) from the nearest public street or sidewalk line; and
 - shall be at least 50 ft (15 m) from the nearest rail of any railroad main track.
 - A clear space of at least 3 ft (1 m) shall be provided for access to all valves and fittings of multiple groups of containers.
 - Readily ignitable material shall not be permitted within 10 ft (3.0 m) of any stationary container.
 - The minimum separation between containers and above ground tanks containing flammable or combustible liquids shall be 20 ft (6.1 m).

During outdoor fueling operations, the point of transfer (the point where the fueling connection is made):

- shall be located at least 10 ft (3.0) from any important building, mobile home, public sidewalk, highway, street, or road; and
- shall be at least 3 ft (1 m) from storage containers.

Exception: The point of transfer shall be permitted to be located at a lesser distance from buildings or walls constructed of concrete or masonry materials, or of other material having a fire resistance rating of at least 2 hours, but at least 10 ft (3.0 m) from any building openings.

Special Rules apply for Connecticut, Massachusetts and New York City:

Connecticut and Massachusetts require protection against damage of storage and/or dispensing equipment: For the Connecticut code, refer to Supplement to NFPA 52-92.

For the Massachusetts code, refer to 527 CMR 26.07 (3)

New York City set requirements for mobile CNG stations, CNG Station location, and clearance distances. For New York City code, refer to Regulation City of New York § 23-01 Page 7 (Clearance Distances) and Page 4 (Station Location and Mobile CNG Stations).

(2) Indoor Siting – NFPA 52-98, 4-4.3

- 4-4.3.1 General.** Compression, dispensing equipment, and storage containers connected for use shall be permitted to be located inside of buildings reserved exclusively for these purposes or in rooms within or attached to buildings used for other purposes in accordance with NFPA 52 4-4.3.
- 4-4.3.2 Limits of Storage in Buildings.** Storage shall be limited to not more than 10,000 SCF (283 m²) of natural gas in each building or room.

Exception: CNG Stored in vehicles-mounted fuel supply containers.

- 4-4.3.3 Deflagration Venting.** Deflagration (explosion) venting shall be provided in exterior walls or roof only. Vents shall be permitted to consist of any one or any combination of the following:
 - walls of light material;
 - lightly fastened hatch covers;
 - lightly fastened, outward opening doors in exterior walls;
 - lightly fastened walls or roofs.

Note: For information on venting of explosions see NFPA 68, *Guide for Venting of Deflagrations*.

Note: Where applicable, snow loads shall be considered.

4-4.3.4 Rooms Within Buildings.

- Rooms within or attached to other buildings shall be constructed of noncombustible or limited-combustible materials.
- Interior walls or partitions:
 - shall be continuous from floor to ceiling;
 - shall be securely anchored; and
 - shall have fire resistance rating of at least 2 hours.
 - At least one wall shall be an exterior wall.

Exception: Window glazing shall be permitted to be plastic.

- Explosion venting shall be provided in accordance with 4-4.3.3;
- Access to the room shall be from outside the primary structure.

Exception: If such access is not possible, access from within the primary structure shall be permitted where such access is made through a barrier space having two vapor-ceiling, self-closing fire doors having the appropriate rating for the location where installed.

4-4.3.5 Ventilation.

- Indoor locations shall be ventilated using air supply units and exhaust outlets arranged to provide uniform air movement to the extent practical.
- Inlets shall be uniformly arranged on exterior walls near floor level.
- Outlets shall be located at the high point of the room in exterior walls or the roof.
- Ventilation shall be by a continuous mechanical ventilation system or by a mechanical ventilation system activated by a continuously monitoring natural gas detection system where a gas concentration of not more than one-fifth of the lower flammable limit is present. In either case, the system shall shut down the fueling system in the event of failure of the ventilation system.
- The ventilation rate shall be at least 1 ft³/min. per 12 ft³ (1 m³/min. per 12 m³) of room volume. (Note: this corresponds to 5 changes per hour)
- A ventilation system for a room within or attached to another building shall be separate from any ventilation system for the other building.

4-4.3.6 Alarm. Where installed, a gas detection system shall be equipped to sound an alarm and visually indicate when the maximum of one-fifth of the lower flammable limit is reached.

4-4.3.7 Restart. Reactivation of the fueling system shall be by manual restart and shall be conducted by trained personnel.

4-4.3.8 Electrical Installations. Buildings and rooms used for compression, storage, and dispensing shall be classified in accordance with NFPA 52-98 Table 4-12 for installations of electrical equipment. (Note: Table 4-12 is shown later in this checklist)

4-4.3.9 Non-electrical Ignition Sources, other than electrical installations as by permitted 4-4.3.8, shall not be permitted.

4-4.3.10 Pressure Relief Devices. Pressure relief devices on storage systems shall have pressure relief device channels [*See NFPA 52-98 2-5.1 (b)*] to convey escaping gas to the outdoors and then upward to a safe area to prevent impinging on buildings, other equipment, or areas open to the public (e.g., sidewalks).

Note [*from 2.5.1 (b)*]: The pressure relief device:

- shall be in direct communication with the fuel;
- shall be vented to the atmosphere by a method that can withstand the maximum pressure that results;
- flow rate shall not be reduced below that required for the capacity of the container upon which the device is installed;
- shall be located so that the temperature to which it is subjected shall be representative of the temperature to which the cylinder is subjected.

4-4.3.11 Warning Signs. Access doors shall have warning with the signs with the words “WARNING-NO SMOKING-FLAMMABLE GAS.” Such wording shall be plainly legible, bright red letters on a white background, with letters not less than 1 in. (25 mm) high.

- 4-4.3.12 Indoor Fast-Fill Fueling, Outdoor Storage, and Compression.** Fast-fill fueling indoors is permitted where storage and compression equipment is located outdoors complying with 4-4.2.1 through 4-4.2.7.
- 4-4.3.13 Indoor Fast-Fill Fueling.** Where attended fast-fill fueling is performed indoors:
 - An emergency manual shutdown device shall be installed as required by 4-11.6.
 - A gas detection system equipped to sound an alarm and visually indicate when a maximum of one-fifth of the lower flammable limit is reached shall be installed.
 - The detector shall shut down the compressor and stop the flow of gas into the structure.

Special Rules apply for Massachusetts and New York City:

Massachusetts sets requirements for container storage inside of buildings: For the Massachusetts code, refer to 527 CMR 26.07 (5).

New York City sets clearance distance standards and ventilation and building location requirements. For New York City code, refer to Regulation City of New York 23-01 Page 7 (Clearance Distances) and Page 4 (ventilation and building location requirements).

(3) Installation of Container Appurtenances – NFPA 52-98, 4-5

- 4-5.1 Storage Containers.**
 - Storage containers shall be installed above ground on stable, noncombustible foundations or in vaults with ventilation and drainage.
 - Horizontal containers shall have no more than 2 points of support longitudinally.
 - Where flooding can occur, each container shall be securely anchored to prevent floating.
- 4.5.2 Containers.**
 - Containers shall be protected by painting or other equivalent means where necessary to inhibit corrosion.
 - Horizontally installed containers shall not be in direct contact with each other.

Exception: Containers shall not be painted without prior permission from the container manufacturer.
- 4-5.3 Flow Prevention.** Adequate means shall be provided to prevent the flow of flammable or combustible liquids under containers.

Special Rules apply for Connecticut:

Connecticut sets requirements for installation of containers. For the Connecticut code, refer to Supplement to NFPA 52-92 (Added 4-5.4)

(4) Installation of Pressure Relief Devices - NFPA 52-98, 4-6, Pressure Regulators- NFPA 52-98, 4-7, and Pressure Gauges - NFPA 52-98, 4-8

4-6.1 and 4-6.2 Discharge.

- Pressure relief valves shall be so arranged that they discharge to a safe area (See 4-4.3.10);
- Pressure relief valves on pressure vessels shall be installed so that any discharge is in a vertical position; and
- Pressure relief valves shall be fitted with rain caps.

4-6.3 Overpressure Protection Device.

- An Overpressure Protection Device, other than a rupture disc, shall be installed in the fueling transfer system to prevent over pressure in the vehicle; and
- The set pressure of the device shall not exceed 125% of the service pressure of the fueling nozzle it supplies.

4-7 Pressure Regulators. Regulators shall be designed, installed, or protected so that their operation is not affected by the elements/weather conditions.

4-8 Pressure Gauges. Gauges shall be installed to indicate compression, discharge pressure, storage pressure, and fuel supply container fill pressure.

(5) Piping and Hoses - NFPA 52-98, 4-9

4-9.1 Installation.

- Piping and hoses shall be run as directly as practical and with adequate provisions for expansion, contraction, jarring, vibration, and settling.
- Exterior Piping shall be either buried or installed above ground and shall be supported and protected against mechanical damage.
- Underground piping shall be buried not less than 18 in. (460 mm) below the surface of the ground unless otherwise protected from damage by movement of the ground.
- All piping shall be protected from corrosion in compliance with recognized practices.
- Threaded pipe and fittings shall not be used underground.

4-9.1.1 Manifolds. Manifolds connecting fuel containers:

- shall be fabricated to minimize vibration; and
- shall be installed in a protected location or shielded to prevent damage from unsecured objects.

4-9.1 ff. Jointing.

- A pipe thread jointing material impervious to the action of the natural gas used in the system shall be applied to all male pipe threads prior to assembly.
- Threaded piping and fittings shall be clear and free from cutting or threading burs and scales, and the ends of all piping shall be reamed.
- Piping or tubing bends shall not weaken the pipe or tubing.
- A joint or connection shall be located in an accessible location.

- ❑ **4-9.2 Venting.**
 - ❑ Natural gas shall be vented only to a safe point of discharge.
 - ❑ A vent pipe or stack shall have the open end protected to prevent entrance of rain, snow and solid material.
 - ❑ Vertical vent pipes and stacks shall have provision for drainage.
 - ❑ **4-9.3 The Use of Hose in an Installation.** The use of hose in an installation:
 - ❑ shall be limited to a vehicle fueling hose;
 - ❑ shall be limited to an inlet connection to compression equipment;
 - ❑ shall be limited to a section of metallic hose not exceeding 36 in. (910 mm) in length in a pipeline to provide flexibility where necessary.
 - ❑ **4-9.4 Public Fueling Stations.** At public fueling stations provisions shall be provided to recycle gas used for calibration and testing.
- (6) Emergency Shutdown Equipment - NFPA 52-98, 4-11**
- ❑ **4-11.1 - 4.11.3 Manually Operated Container Valve / Shutoff Valve.**
 - ❑ A manually operated container valve shall be provided for each DOT or TC storage cylinder. Each group of ASME storage vessels up to a maximum combined capacity of 10,000 SCF (283 m³) shall be provided with a manually operated shut-off valve.
 - ❑ The fill line on a storage container shall be equipped with a backflow check valve.
 - ❑ A manually operated shut-off valve shall be installed in a manifold as close to a container or group of containers as practical. This valve shall be located downstream of the backflow check valve specified in 4-11.2.
 - ❑ **4-11.4 Excess flow check valves.** Where excess flow check valves are used, the closing flow shall be less than the flow rating of the piping system that would result from a pipeline rupture between the excess-flow valve and the equipment downstream of the excess-flow check valve.
 - ❑ **4-11.5 Gas Piping.** Gas piping from an outdoor compressor or storage system into a building shall be provided with shut-off valves located outside the building.
 - ❑ **4-11.6 Dispensing area.**
 - ❑ An emergency manual shutdown device shall be provided at the dispensing area and also at a location remote from the dispensing area. This device, when activated, shall shut off the power supply and the gas supply to the compressor and the dispenser.
 - ❑ Emergency Shutdown devices shall be distinctly marked for easy recognition with a permanently fixed legible sign.
 - ❑ **4-11.7 Breakaway Protection.** Breakaway protection shall be provided in a manner that, in the event of a pullaway, natural gas ceases to flow at any separation.
 - ❑ **4-11.8 Breakaway Installation.** A breakaway device shall be installed at every dispensing point. The separation force shall not exceed 150 lb. (68 kg) when applied in any horizontal direction.

- 4-11.9 Control Circuits.** When an emergency shut down device is activated or electric power is cut off, systems that shut down shall remain down until manually activated or reset after a safe condition is restored.
- 4-11.10 Shutoff Valves.** Each line between a gas storage facility and a dispenser at a fast-fill station shall have a valve that closes when one of the following occurs:
 - The power supply to the dispenser is cut off.
 - Any emergency shutdown device at the refueling station is activated.
- 4-11.11 Fast-closing shutoff.** A fast-closing, “quarter turn” manual shutoff valve shall be provided at a fast-fill station upstream of the breakaway device specified in 4-11.8, where it is readily accessible to the person dispensing natural gas, unless:
 - The self-closing valve referred to in 4-11.10 is located immediately upstream of the dispenser.
 - The dispenser is equipped with a self-closing valve that closes each time the control arm is turned to the “OFF” position or when an emergency device is activated.
- 4-11.12 Compressor Inlet valve.** A self-closing valve shall be provided on the inlet of the compressor that shuts off the gas supply to the compressor when one of the following occurs:
 - An emergency shutdown device is activated.
 - A power failure occurs.
 - The power to the compressor is switched to the off position.

(7) Installation of Electrical Equipment - NFPA 52-98, 4-12

- Fixed Electrical equipment and wiring within areas specified in Table 4-12 shall comply with Table 4-12 and shall be installed in accordance with NFPA 70, *National Electric Code*.

Table 4-12 Electrical Installations

LOCATION	DIVISION	EXTENT OF CLASSIFIED AREA
Containers (other than mounted fuel supply containers)	2	Within 10 ft (3m) of container
Area Containing Compression and Ancillary Equipment		
Outdoors	2	Up to 15 ft. (4.6m) from equipment
Indoors	2	Up to 15 ft. (4.6m) from equipment
Dispensing equipment:		
Outdoors	1	Inside the dispenser enclosure
Outdoors	2	From 0 to 5 ft. (1.5m) from the dispense
Indoors	1	Inside the dispenser enclosure
Indoors	2	Entire room with adequate ventilation <small>(See 4.4.3)</small>
Outdoors		
Discharge from relief valves or vents	1	5 ft. (1.5m) from the dispenser
	2	Beyond 5 ft. (1.5m), but within 15 ft. (4.6m) in all direction from point of discharge
Valves, flanges of screwed fittings	None	Unclassified
Discharge from relief valves within 15 degrees of the line of discharge	1	15 ft. (4.6m)

Note: Connecticut conforms to NFPA 70, 1999 edition.

8) Operations - NFPA 52-98, 4-14

- **4-14.10 Signage.** A warning sign with the words “STOP MOTOR”, “NO SMOKING”, “FLAMMABLE GAS” shall be posted at dispensing station and compressor areas. The lettering must be large enough to be visible and legible from each point of transfer.

Note: Massachusetts requires a sign saying “STOP ENGINE WHILE REFUELING”

(9) Fire Protection – NFPA 52-98, 4-15

- **4-15 Fire Protection.** A portable fire extinguisher having a rating of not less than 20-B:C shall be provided at the dispensing area.

Notes

Please visit the CNG Guide Website
<http://www.state.ma.us/doer/cng>

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