NATIONAL STANDARD OF CANADA

CAN/BNQ 2910-500/2015

Explosives – Magazines for Industrial Explosives

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BUREAU DE NORMALISATION DU QUÉBEC

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NATIONAL STANDARD OF CANADA

CAN/BNQ 2910-500/2015

Explosives – Magazines for Industrial Explosives

Explosifs – Dépôts d'explosifs industriels

ICS: 13.200; 13.310; 55.220; 71.100.30; 91.060.01

BNQ
BUREAU DE NORMALISATION DU QUÉBEC

Standards Council of Canada
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EXPLOSIVES — MAGAZINES FOR INDUSTRIAL EXPLOSIVES

Standard prepared by the Bureau de normalisation du Québec (BNQ)

and approved by the Standards Council of Canada (SCC)

Standards Council of Canada
Conseil canadien des normes

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FOREWORD

This document was approved as a reaffirmed National Standard of Canada by the Standards Council of Canada (SCC). It was prepared and approved by a Standards Development Committee, whose voting members were:

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EXPLOSIVES — MAGAZINES FOR EXPLOSIVES

INTRODUCTION

Explosives are hazardous materials. While some types of explosives are more sensitive than others, if not properly stored and handled, most will explode and can cause serious physical harm, including death and significant damage to property.

Improper storage of blasting explosives, detonating cords and initiation systems (detonators, fuses and igniters) can cause misfires, incomplete or accidental detonation and the burning of charges in boreholes.

Proper storage of explosives serves to ensure safety and security of persons and property.

Every effort must be taken to ensure that magazines used to store explosives are of substantial construction and are equipped with strong locks to prevent unauthorized access to the interior of the magazine and to thwart attempts by persons seeking to gain access to the magazine for criminal purposes.

Effective security procedures designed to control access to magazines and their contents are essential to mitigate the risk of explosion and losses due to improper handling, theft and neglect.

For these reasons, magazines used to store explosives should meet the following requirements:

- Protection against weather conditions.
- Protection against physical damage.
- Fire protection.
- Protection against theft.
- Protection from the effect of explosions occurring in adjacent magazines.

It is important that permanent magazines for the storage of explosives be capable of withstanding bullets, fire, intrusion and weather and be well ventilated.

1 PURPOSE

This standard specifies the minimum requirements for the construction and surveillance of magazines for the safe and secure storage of industrial explosives.

2 SCOPE

This standard is intended to serve as a guide for all stakeholders taking part in the planning, use or construction of explosives magazines licensed under the *Explosives Act* of Canada and the *Explosives Regulations, 2013* of Canada and other applicable regulations.

NOTE — It is recommended that regulators be consulted during the early planning stages, and definitely before purchasing or constructing a magazine or establishing a magazine area, since buildings and sites not meeting the established standards will be unacceptable for licensing and use.

3 NORMATIVE REFERENCES

In this document, a non-dated normative reference means that the latest edition of the reference shall be used.

For the purpose of this document, the following reference documents (including any amendments, errata, corrigenda, etc.) contain necessary requirements and are referred to in appropriate places in the text:

3.1 DOCUMENTS FROM STANDARDS BODIES

ASTM International [www.astm.org]

ASTM A36	*Fatigue Crack Growth Rate Behavior of A36 Steel using ASTM Load-Reduction and Compression Precracking Test Methods.*
ASTM C1107	*Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).*
ASTM F883	*Standard Performance Specification for Padlocks.*

BHMA (Builders Hardware Manufacturers Association)
[www.buildershardware.com]

ANSI/BHMA 156.5	*Cylinders and Input Devices for Locks.*
ANSI/BHMA 156.13	*Mortise Locks.*
ANSI/BHMA A156.30	*American National Standard for High Security Cylinders.*

BSI (British Standards Institution) [www.bsi-global.com]

BS EN 12320	*Building Hardware — Padlocks and Padlock Fittings — Requirements and Test Methods.*

CSA Group [www.csagroup.org/ca/en/services/codes-and-standards]

CAN/CSA A23.3	*Design of Concrete Structures.* (Calcul des ouvrages en béton.)
CAN/CSA A165.1	*CSA Standards on Concrete Masonry Units — Concrete Block Masonry Units.* (Normes CSA sur les éléments de maçonnerie en béton — Éléments de maçonnerie en bloc de béton.)
CAN/CSA A179	*Mortar and Grout for Unit Masonry.* (Mortier et coulis pour la maçonnerie en éléments.)
CAN/CSA A371	*Masonry Construction for Buildings.* (Maçonnerie des bâtiments.)
CAN/CSA B72	*Installation Code for Lightning Protection Systems.* (Code d'installation des paratonnerres.)
CSA C22.1	*Canadian Electrical Code, Part I (22nd Edition), Safety Standard for Electrical Installations.* [Code canadien de l'électricité, première partie (Vingt-deuxième édition), norme de sécurité relative aux installations électriques.]
CAN/CSA G30.18	*Carbon Steel Bars for Concrete Reinforcement.* (Barres d'acier au carbone pour l'armature du béton.)
CAN/CSA G40.21	*General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel.* (Exigences générales relatives à l'acier de construction laminé ou soudé / Acier de construction.)
CSA S304.1	*Design of Masonry Structures.* (Calcul des ouvrages en maçonnerie.)

IEEE (Institute of Electrical and Electronics Engineers) [www.ieee.org]

IEEE C62.41.1	*Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.*

UL (Underwriters Laboratories Inc.) [www.ul.com]

CAN/UL 437	*Key Locks.*

UL 752 *Standard for Bullet-Resisting Equipment.*

3.2 LAWS, REGULATIONS AND SIMILAR DOCUMENTS

CANADA. *Explosives Act.*

CANADA. *National Building Code.*

CANADA. *Explosives Regulations, 2013.*

3.3 GOVERNMENT DOCUMENTS

CANADIAN COUNCIL OF THE MINISTERS OF THE ENVIRONMENT (CCME). *Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products*, 54 p.

NATIONAL INSTITUTE OF JUSTICE (NIJ)

NIJ Standard 0108.01 *Ballistic Resistant Protective Materials*.

3.4 OTHER DOCUMENT

INSTITUTE OF MAKERS OF EXPLOSIVES (IME). *Safety Guide for the Prevention of Radio Frequency Radiation Hazards in the Use of Commercial Electric Detonators (Blasting Caps)*, Safety Library Publications, SLP 20, 54 p.

4 DEFINITIONS

For the purpose of this document, the following definitions shall apply:

explosive, n. A substance or article manufactured to produce an explosion, a detonation, or a pyrotechnic or propulsive effect. French: ***explosif***.

NOTE — The definition encompasses the term "cartridge."

industrial explosive, n. An explosive of the following types:

a) E.1 : blasting explosives;

b) E.2 : perforating explosives;

c) E.3 : special-application explosives;

d) I : initiation systems; and

e) P.1 : black powder and hazard category PE 1 black powder substitutes, when they are used in mining, quarrying, construction or avalanche control.

(Reference: Canada, *Explosives Regulations, 2013*). French: ***explosif industriel***.

magazine, n. Any building, storehouse, structure or place in which any explosive is kept or stored. (Reference: Canada, *Explosives Act*.) French: ***dépôt***; ***dépôt d'explosifs***; ***poudrière***).

5 DESIGNATION

There are four types of magazines for explosives based on their specific use: Type 1, Type 4, Type 9 and Type 12.

6 GENERAL REQUIREMENTS

6.1 UNITS SYSTEM

This standard uses units from the International System (SI).

6.2 MARKING

Every magazine of types 1, 4, 9 and 12 shall be identified by a unique alphanumeric code tag. This unique alphanumeric code tag shall be issued by regulators and shall be secured on the interior of the magazine door at eye level. In addition, this alphanumeric code tag shall be permanently posted on the exterior of the magazine door via contrasting colour-painted alphanumeric code tag or shall be embossed welded (minimum 50 mm) or stamped (minimum 20 mm) in a manner that can be readily read upon approaching a magazine from the front.

6.3 MATERIALS

Unless otherwise specified in this standard, materials shall conform to the *National Building Code* of Canada.

> NOTE — It should be ensured any materials or fittings used in the building construction that could come into contact with ammonium nitrate during normal operations or in the event of spillage do not contain zinc, copper or other incompatibles unless suitably protected (e.g. by coating with suitable epoxy-based materials or chlorinated rubber). Mild steel may require suitable protection to prevent corrosion by ammonium nitrate.

Steel reinforcing bars shall be minimum 10M and minimum 400R or 400W in compliance with the requirements of Standard CAN/CSA G30.18.

6.4 DOOR DESIGN

Door design shall include a number of force and torch resistant characteristics. The production of all door types (single swing, large swing, double swing and sliding type) and detailed drawings shall be controlled and be entrusted with approved shops or facilities as determined by the regulators in order to maintain consistent construction quality and to limit communication of design details to necessary parties only.

Installation details shall also be part of the door drawings and are to be safeguarded the same way as door design details.

Installation shall be performed only by a door manufacturer approved by the regulators or by someone under the approved latter's supervision.

6.5 LOCKING SYSTEMS

6.5.1 General

Locks and keys shall have a valid utility patent in Canada with a minimum of five years left on the patent.

6.5.2 Locks and cylinders

Locks and cylinders of locking systems shall be obtained from distributors authorized by locking system manufacturers.

Tubular dead bolt mortise locks shall be security Grade 1 and shall conform to the requirements of Standard ANSI/BHMA 156.13.

Cylinders shall conform to either:

a) Grade 1 of Standard ANSI/BHMA 156.5 and Grade A of Standard ANSI/BHMA A156.30; or

b) the requirements of Standard CAN/UL 437.

6.5.3 Padlocks and cylinders

Padlocks shall be obtained from distributors authorized by locking system manufacturers.

Padlocks shall conform to either:

a) Force level 4 of Standard ASTM F883; or

b) Grade 3 of Method BS EN 12320.

Cylinders shall conform to either:

a) Security level S3 of Standard ASTM F883; or

b) the requirements of Standard CAN/UL 437.

6.5.4 Keys

Keys shall conform to the following requirements:

a) Shall be factory restricted, patented;

b) Shall be free of direct code stamped on them, but indirect coding on key is permitted.

6.6 HEATING, COOLING AND INSULATION

6.6.1 General

Where heating and cooling of magazines is permitted by the regulators, the requirements of Clauses 6.6.2 to 6.6.4 shall be complied with.

6.6.2 Temperature limiting devices

The heating unit shall be equipped with a high-temperature limiting control to ensure the heating core and elements do not overheat.

6.6.3 Heating or cooling sources inside the magazine

Direct-fired or indirect-fired heating or cooling sources are not permitted inside the magazine.

When a heating or cooling source is installed inside the magazine, it shall:

- comply with the requirements related to Class II, Division 2, of Code CSA C22.1;
- be mounted above the stacking line;
- have mechanical protection.

Mechanical protection shall be installed at the required standoff distance specified by the manufacturer of the heating or cooling equipment. In addition, a welded cage fabricated from expanded steel or aluminum mesh and 6-mm steel or aluminum angles shall be firmly mounted over the heating or cooling source and fixed to the wall or the ceiling. For the exterior opening, a flattened expanded steel mesh, with a 5-mm short way dimension (SWD) opening and minimum 20 gauge, shall be fixed to the wall or the roof (mechanical protection similar to the one shown in Figure 4).

6.6.4 Heating or cooling sources outside the magazine

When heating or cooling sources installed outside the magazine require certain components to be installed inside the magazine, the following requirements shall apply:

- Motors, fans and electrical installation shall comply with the requirements related to Class II, Division 2, of Code CSA C22.1.
- The heat exchanger or air cooling unit shall be mounted above the stacking line.
- The heat exchanger or air cooling unit shall have mechanical protection.

Mechanical protection shall be installed at the required standoff distance specified by the manufacturer of the heating or cooling equipment. In addition, a welded cage fabricated from expanded steel mesh or aluminum mesh and 6-mm steel or aluminum angles shall be firmly mounted over the heating or cooling sources and fixed to the wall or the ceiling. For the exterior

opening, a flattened expanded steel mesh, with a 5-mm short way dimension (SWD) opening and minimum 20 gauge, shall be fixed to the wall or the roof (mechanical protection similar to the one shown in Figure 4).

An indirect-fired heater, a heating system or a cooling system that is not in compliance with the requirements related to Class II, Division 2, of Code CSA C22.1 shall be installed in a separate room with a one-hour fire rating. The heating and cooling system room shall have no direct access from the building or part of the building that contains explosives. If this requirement cannot be met, then the heating or cooling system shall be located in a fire-resistant building sited at least 8 m from the magazine.

For forced air systems, the magazine shall be protected by a fire damper activated via a fusible link or other safety device so that the duct can be closed and sealed as close to the heating or cooling unit as practical.

The recirculation of heated air from a forced air system or direct-fired heating or cooling source in the magazine are not permitted.

Fuel tanks shall be located on the surface, at a grade lower than the magazine itself, to minimize or prevent the spread of a fire to the contents of the magazine. They shall be designed to meet environmental considerations as set out in the *Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products* and shall also comply with other local, provincial and territories codes and regulations. Fuel shall be kept to a maximum of 10,000 L and shall be stored at least 8 m from the magazine.

6.6.5 Insulation

Any insulation (e.g., in ceilings/walls) shall have a flame-spread rating of 25 or less as defined in the *National Building Code* of Canada.

All insulation shall be protected from mechanical damage.

6.7 VENTILATION

6.7.1 General

Magazines shall be ventilated.

Ventilation shall be provided above the stacking line as well as near the floor level to promote good air circulation.

Magazines with an internal volume of 100 m^3 or less shall have a minimum ventilation area of at least 5000 mm^2/m^3. Magazines with higher volume shall have a mechanical ventilation system allowing at least two air exchanges per hour or another system agreed upon in writing by the regulators.

6.7.2 Straight-through ventilators

Straight-through ventilators shall not exceed 200 mm × 200 mm and shall be protected on the exterior by a stand-off hood steel plate at least 12 mm thick and twice the dimensions of the opening, positioned not more than 80 mm from the wall. The stand-off plate shall be welded in position.

The inside openings shall be covered by a flattened expanded mesh welded to a steel frame that is fastened to the non-exposed face of the plywood. The underside of the outside ventilator shall be covered by a steel plate at least 4.7 mm thick. The plate shall be drilled with 10 mm holes minimum at a density of at least 1 hole per 1450 mm^2.

Fly screens shall be installed on the exterior of ventilators opening (see Figure 6).

6.7.3 Roof ventilators

Roof ventilators shall have openings no more than 200 mm in any dimension and protected by two orthogonal 10M steel reinforcing bars welded to a 6 mm steel anchor plate. The anchor plate shall be firmly fastened to the underside of the roof sheathing. In addition, a security cage fabricated from expanded steel or aluminum mesh and 6-mm steel or aluminum angles shall be firmly mounted over ventilators fixed to the roof sheathing.

6.8 ELECTRICITY

The supply of electricity to a magazine that contains explosives shall be controlled by a single disconnecting means, which shall be installed a minimum of 15 m away from the magazine. It shall disconnect all ungrounded conductors of that supply. The last 15 m from the disconnect to the magazine shall be buried underground.

Magazines shall include protection by grounding and surge protection at the main disconnect 15 m from the magazine. The protection by grounding shall meet the requirements of Code CAN/CSA B72 and the surge protection shall be of Type 1 and in accordance with the recommendations of Guide IEEE C62.41.1.

If additional lightning protection at the magazine is to be included, then it shall be installed according to Code CAN/CSA B72.

Wiring methods within magazines shall be in a threaded rigid metal conduit or armoured cables approved for hazardous locations. Below the stacking line, all electrical wiring shall have mechanical protection as per the requirements of Code CSA C22.1.

Only essential electrical equipment shall be installed in an explosives magazine. All such equipment shall have enclosure ratings of Type 4X or be IP65 corrosion resistant as specified in Code CSA C22.1, Part I, Rule 2-400.

All branch circuits within the magazine shall be protected by a Class-A type ground fault circuit interrupter.

6.9 INTERIOR FINISH

6.9.1 Furring strips and base plates

Furring strips and wood base plates shall be installed on all interior walls to provide air circulation and to prevent individual explosive boxes from being stacked directly against the walls.

Vertical furring strips shall be at least 19 mm thick and at most 75 mm wide. They shall be spaced at 300 mm (centre-to-centre), starting 150 mm from floor level and continuous to the stacking line (see Figure 5).

Wood base plates shall be at least 25 mm thick and at least 125 mm wide. They shall be installed horizontally at floor level around the perimeter of the magazine (see Figure 5).

6.9.2 Stacking line

A red stacking line at least 10 mm wide shall be painted or otherwise indelibly marked on all interior walls. The top of the line shall be at a distance of at least 150 mm from the top of the lowest wall and at least 150 mm below the bullet-resistant material (see Figure 5).

> NOTE — If the bullet-resistant material settles or leaks out over time, then the stacking line should be lowered accordingly (along with reduced quantities of explosives) or the bullet-resistant material should be topped up.

The stacking line may be lowered locally to accommodate heating and cooling systems.

6.10 SURVEILLANCE

6.10.1 General

Magazines shall have a surveillance program. There are two options for a surveillance program: physical inspection (see Clause 6.10.2) or electronic surveillance (see Clause 6.10.3).

> NOTE — Notwithstanding the requirements of Clause 6.10.1, regulators may require additional security measures if, for example, there has been a history of attempted or a successful break-in or the area is considered a high profile area with an increased risk of break-in.

6.10.2 Physical inspection

The frequency of physical inspection is set out in the terms and conditions of each license.

Physical inspection shall be completed through the use of a security patrol tracking system consisting of an identifying device fastened to the magazine, a portable electronic recording device and a software data base installed on a computer incorporating access controls.

The identifying device shall be a tamper-resistant device with a unique identifier and shall be permanently affixed to the exterior side of the magazine. Regardless of the technology used, the minimum requirement for a tamper-resistant device is that it bears a unique identifier that is immutable and non-duplicable.

Each physical inspection shall be logged by a portable electronic recorder. The information shall be captured electronically by the recorder and shall include, at a minimum, the date, the time and the unique identifier of the tamper-resistant device affixed to the exterior side of the magazine.

Electronic information captured by the portable electronic recorder shall be transferred to a computer-based software program for longer-term storage and report generation. The program shall be designed to assure the integrity of the electronic records and maintain them for not less than one year.

The alphanumeric code tag of the magazine (see Clause 6.2) shall be linked to the unique identifier permanently affixed to the magazine.

NOTE — Recording of the magazine location on each visit using GPS is strongly recommended.

6.10.3 Electronic surveillance

Monitoring through electronic surveillance shall consist of electronic equipment located at the magazine ("terminal equipment"). This terminal equipment is intended for providing continuous surveillance for entries to the magazine and transmission of information. Electronic surveillance shall also use a monitoring centre for the purpose of reception, storage and distribution of information received from the terminal equipment. Together, these are referred to as the "electronic surveillance system".

Monitoring can be performed either by the licensee or by an outside security service provider.

The electronic surveillance system shall be designed to allow a licensee/user/person/owner to verify the functionality of the surveillance system.

The alphanumeric code tag of the magazine and the magazine location shall be linked to the unique identifier of the terminal equipment.

The terminal equipment shall comply with the following hardware and electrical requirements:

- Electrical shall be in accordance with the requirements of Clause 6.8.
- Intrusion detection sensors shall include at least an internal door contact. Other sensors may be added if they conform to the electrical requirements set out in Clause 6.8.
- Notwithstanding, motion detection type intrusion detection sensors shall be at least a Class-2 circuit conforming to the requirements of Code CSA C22.1 using a Type-3 or IP65 enclosure and are permitted only if the installation conforms to all the following conditions:
  - — are inside the magazine;
  - — are above the stacking line.
- Radio transmission components shall be mounted outside the magazine and shall comply to the requirements of the *Safety Guide for the Prevention of Radio*

Frequency Radiation Hazards in the Use of Commercial Electric Detonators (Blasting Caps) of the Institute of Makers of Explosives (IME) regarding radio frequency transmission in close proximity to electric detonators. They shall be tested to the manufacturer's no-fire current limit for electric detonators or shall maintain the SLP 20 prescribed separation distance or a minimum separation of 15 m. Test results shall be acceptable to the regulators.

- If mounted on the roof, antenna and solar panels shall be less than 300 mm in height.
- Solar panels may be mounted on the walls of the magazine.
- Batteries shall be mounted inside an enclosure and outside of the magazine.
- If required, electrical masts shall be located at least 15 m from the magazine.
- Wiring entering magazines shall be buried within 15 m of the magazine and shall include grounding and surge protection.

The terminal equipment shall comply with the following functional requirements:

- It shall be capable of transmitting information ("notifications") to the monitoring centre automatically. Each notification shall include the date, time and the unique identifier of the terminal equipment and shall have additional characteristics as defined in the Terminal Equipment Notification Table below.

TERMINAL EQUIPMENT NOTIFICATION TABLE

Notification Type	Implementation	Additional information	Notification Class	Call-down List Distribution	Frequency
Access: Authorized	Mandatory	As available	Event	Optional	Per occurrence
Access: Unauthorized	Mandatory	Sensor state	Alarm	Mandatory	Per occurrence
Authorized Access: Door Left Open	Optional	Sensor state	Alarm	Mandatory if implemented	Per occurrence
Equipment: Status Notification	Mandatory	As available	Event	Optional	Every 24 hours or less
Equipment: Fault	Optional	As available	Alarm	Mandatory if implemented	Per occurrence
Equipment: Low Power	Mandatory	As available	Alarm	Mandatory	Per occurrence

NOTE — Inclusion of the magazine location using GPS with each notification is strongly recommended.

- It shall be capable of distinguishing between entries to the magazine by personnel supplying proper credentials ("authorized access") and entries associated with the activation of an intrusion detection sensor or improper credential use ("unauthorized access").

- Upon reception of proper credentials, the terminal equipment shall notify the monitoring centre of an authorized entry when a door is opened.

- It shall incorporate an auto re-arm feature. Re-arming enables transmission of access notifications and should occur following an authorized access once sensors detect all magazine doors have been closed and other intrusion detection sensors (if equipped) have returned to an inactive state. If immediate detection of the all sensors status while disarmed is not possible, it shall automatically re-arm no later than one hour following an authorized access.

- If the terminal equipment is capable of detecting door sensor status while disarmed, it shall re-arm and send a notification in the case of a door being left open or another intrusion detection sensor remaining active for a long period of time. It shall be capable of identifying this as a distinct event and not a new and unrelated unauthorized access event. The electronic surveillance system shall be capable of setting the permissible time before this notification is generated, to a maximum of 4 hours.

- Any enclosures used with the terminal equipment that can be opened shall be monitored and notifications sent in the same manner as for other accesses.

- It shall transmit a periodic status notification at least once every 24 hours to confirm the terminal equipment and surveillance functions are working properly.

- It shall be capable of detecting a low power condition and shall send a notification with sufficient notice to initiate corrective action before the electronic surveillance system becomes inactive.

The monitoring centre shall comply with the following requirements:

- It shall maintain a history in electronic format of all information received from the terminal equipment for a period of at least one year.

- It shall create an alarm if no status notification has been received from the terminal equipment within the last 24 hours.

- Alarms shall be forwarded to personnel on a call-down list. This shall repeat at least every 20 minutes until the alarm is acknowledged by at least one person

whose name appears on the call-down list. Upon acknowledgement, the monitoring centre shall inform all persons whose names appear on the call-down list that the alarm has been acknowledged. It is permissible to maintain a separate call down list for access alarms and equipment alarms.

- Event notifications do not have to be forwarded to a call down list but shall remain stored at the monitoring centre. Optionally, they may be sent to system users.

7 TYPE-1 MAGAZINES

7.1 USES

Type-1 magazines are for use as permanently located magazines for the storage of industrial explosives.

7.2 GENERAL

Type-1 magazines shall comply with the requirements of Chapter 6.

Unless otherwise specified in this standard, the construction methods used shall conform to Part 9 of the *National Building Code* of Canada.

7.3 STRUCTURE

7.3.1 Floor and foundation

The magazine floor and foundation shall be in accordance with the provincial/territorial codes where the magazine shall be used or the *National Building Code* (as applicable). It shall be either a concrete foundation with concrete floor or a concrete floor with thickened edge (acting as the footing).

The floor shall be trowelled to a smooth finish. The control joint shall be filled.

The sill of the door frame may be embedded in the floor or removed.

7.3.2 Walls

7.3.2.1 General — Type-1 magazine walls shall be constructed of standard concrete block masonry units (see Clause 7.3.2.2), precast building panels (see Clause 7.3.2.3) or reinforced concrete (see Clause 7.3.2.4).

The top of each wall shall be finished with a preservative treated wood (or commercial non-wood alternative) top plate over a sill gasket and anchored by the extended vertical steel reinforcing bars or the embedded anchor bolts.

Interior walls shall be covered with at least 12 mm thick Good One Side (G1S) Exterior Grade A or B plywood. The good side shall face the interior.

7.3.2.2 Standard Concrete Block Masonry Units (CMU) — Magazine walls shall be constructed with minimum 200-mm wide standard concrete block masonry units, with vertical steel reinforcing bars.

All assembly, materials and workmanship shall comply to Standards CAN/CSA A165.1 and CSA S304.1 and provincial/territorial codes where the magazine shall be used or the *National Building Code* (as applicable). Assembly shall be "running bond".

CMU shall have the physical properties H/15/A/M as specified in Table 1 of Standard CAN/CSA A165.1.

Vertical steel reinforcing bars shall be provided at 200-mm spacing on centre and shall run continuously for the full height of the wall (refer to Figure 1). Vertical steel reinforcing bars shall also be placed at wall ends and edges around rough openings. Shorter than full-height steel reinforcing bars may be used provided they are welded together or have at least 300 mm overlap and are tied as per normal practice.

Ladder-type masonry reinforcing shall be installed at every course.

All mortar joints shall be concave, full head and bed joints. Mortar joint thickness shall conform to Standard CAN/CSA A371. Mortar shall be Type "M" or "S" conforming to Standard CAN/CSA A179 unless a professional engineer specifies otherwise.

All cells (cores) shall be fully grouted and consolidated at the time of pouring. Grout shall conform to the requirements of Standard CAN/CSA A179 Table 3 specifications or to the requirements of Standard ASTM C1107.

Extended vertical steel reinforcing bars or anchor bolts embedded at least 100 mm in the mortar of the top course of concrete blocks and spaced not greater than 400 mm, shall be used to secure the roof. The top course shall be reinforced with two steel reinforcing bars in a continuously grouted bond beam.

Footing dowels shall be placed at a maximum spacing of 400 mm on centre and shall extend into the grouted cores of the first courses.

Expansion joints or components shall be keyed and sealed with a fire-resistant (4-hour rating) mastic or epoxy.

7.3.2.3 Precast Building Panels — The term *precast* includes tilt-up building panels. All precast/tilt-up building panels shall be designed by a professional engineer to comply to the requirements of Standard CAN/CSA A23.3 and provincial/territorial codes where the magazine shall be used or the *National Building Code* (as applicable) and good engineering practice.

> NOTE — As an alternative to the requirements stated herein, precast building panels may be designed to use very high strength concrete (VHSC) to prevent ballistic penetration with regard to the level and standard specified by the regulators. Test reports are usually required to demonstrate the effectiveness of such designs.

Precast building panels shall be made of concrete of 35 MPa or better.

Insulated panels (sandwich type with insulation in the middle) are permitted if the structure is to be heated. The inner (structural) face shall be at least 200 mm thick with steel reinforcing bars placed both horizontally and vertically to form a grid not larger than 300 mm square throughout. Any exterior insulation shall be covered with non-flammable cladding.

Uninsulated pre-cast concrete walls shall be at least 200 mm thick. Steel reinforcing bars shall be placed both horizontally and vertically to form a grid not larger than 300 mm square throughout.

Mechanical connections between the wall and the roof shall not be larger than 400 mm on centre and shall be used to secure the roof.

Panels or components shall be keyed and sealed with a fire-resistant (4-hour rating) mastic or epoxy.

7.3.2.4 Poured Reinforced Concrete — Poured reinforced concrete walls shall be at least 200 mm thick, minimum 35 MPa compressive strength and shall conform to the requirements of Standard CAN/CSA A23.3 and provincial/territorial building codes where the magazine shall be used or the *National Building Code* (as applicable). The structural and connection design shall be as specified by the Design Engineer.

Steel reinforcing bars shall be placed both horizontally and vertically to form a grid not larger than 300 mm square throughout.

Extended vertical steel reinforcing bars or anchor bolts embedded at least 100 mm in the concrete along the top edge and spaced not greater than 400 mm shall be used to secure the roof.

If formed separately, wall sections or components shall be keyed and sealed with a fire-resistant (4-hour rating) mastic or epoxy.

Holes and recesses resulting from the removal of form ties shall be filled with mortar.

7.3.3 Roof

The roof shall be of two layers of at least 19 mm T&G sheathing plywood, sandwiching a layer of expanded steel mesh. Joints shall be offset.

Plywood shall be Good One Side (G1S) Exterior Grade A or B. The good side shall face the interior.

Expanded steel mesh reinforcing in the roof shall be 8 mm short way dimension (SWD) opening and 18 gauge. It shall be attached at spacing less than 300 mm each way to inner sheathing (inner plywood) with screws and washers such that the washer sits tightly in the "V" of the mesh.

If a roof ventilator is installed, the expanded steel mesh shall run continuously across the roof opening.

The roof shall bear on the top of the wall and shall be securely fastened to it by anchor bolts embedded in the wall or by other methods, provided the roof is secure against prying forces applied from the exterior (see Figure 3).

Openings other than ventilation are not permitted (see Clauses 6.7 and 7.4).

Where roof trusses or rafters are incorporated into the walls, these shall be secured against entry.

7.4 VENTILATION

Eave ventilators shall be created by leaving out the blocking between rafters. These openings shall be protected by extending the expanded steel mesh from the roof over the opening (see Clause 7.3.3) and installing another screen on the inside. The inside screen shall be fabricated of flattened expanded steel mesh welded to a 16-gauge steel frame and secured to structural members.

Fly screen shall be installed on the exterior of eave ventilators opening (see Figure 3).

7.5 EXTERIOR FINISH

A clear, breathable, penetrating-type water repellent coating shall be applied on exterior walls. The coating shall be compatible with concrete or concrete block masonry units.

Application of water-repellent coating shall be in accordance with coating manufacturer's specifications.

8 TYPE-4 MAGAZINES

8.1 USES

Type-4 magazines are for use as permanently located or portable magazines for the storage of explosives.

8.2 GENERAL

Type-4 magazines shall comply with the requirements set out in Chapter 6.

The manufacturer is responsible for ensuring compliance with the provisions and requirements of all applicable codes, regulations and standards associated with the structural integrity of Type-4 magazines.

8.3 MATERIALS

All steel used for the construction of Type-4 magazines shall meet the requirements of Standard CAN/CSA G40.21, Grade 300W (metric) [44W imperial] or Method ASTM A36.

8.4 STRUCTURE

8.4.1 Walls

Type-4 magazines shall be fabricated with bullet-resistant material in the walls.

Exterior walls shall be fabricated from 6 mm (minimum) thick steel plate with continuously welded seams. Corner seams shall be full-penetration weld.

Inner walls shall be fully sheathed with minimum 19-mm Good One Side (G1S) Exterior Grade A or B plywood fastened to the flats of the wall spacers. The good side shall face the interior. The top of the wall may be made as a horizontal removable panel to permit the installation of the bullet-resistant material. Fasteners shall be plated and countersunk. The door and ventilators shall be the only permitted openings.

The voids between the interior and exterior walls shall be of at least 76 mm. These voids shall be filled with dry-washed 6 mm clear stone.

Lifting lugs shall be designed by a professional engineer to support the magazine weight with bullet-resistant material.

If spacers are needed, they shall be made out of steel (see Figure 5).

Regulators may accept wall designs which meet or exceed Level 8 of Standard UL 752 or Level III of NIJ Standard 0108.01. Tests shall be conducted by independent ballistic laboratories which are accepted by regulators. The regulator may require a certified copy of the detailed test report.

NOTE — Examples of alternate bullet-resistant material could be either Armortex™ bullet-resistant fibreglass rigid panels, ArmorLyte™ rigid aramid fibre in matrix (KEVLAR) or other equivalent material.

8.4.2 Skids

All Type-4 magazines shall be mounted on large steel I-beam skids giving a minimum ground clearance of at least 100 mm.

8.4.3 Floor

The floor shall be fabricated from 6 mm steel plate with continuously welded seams. Joints between the walls and floor shall be welded both inside and outside.

The floor shall be completely covered with plywood or an alternate durable non-sparking surface suitable for rolling materials-handling equipment, such as aluminum checkered plate, concrete and shiplap hardwood.

Plywood shall be Good One Side (G1S) Exterior Grade A or B. The good side shall face the interior.

The finished floor shall be level with the top of the door stop on the sill plate.

The floor shall be finished is such a way as to prevent accumulation of explosives in cracks.

8.4.4 Roof

The roof shall be fabricated from 4.7 mm or thicker steel plate with continuously welded seams.

Joints between the walls and roof shall be full penetration weld.

Seams shall be watertight.

NOTE — Internal support bracing for the roof is strongly recommended when transporting any large magazine.

8.5 INTERIOR FINISH

All exposed steel surfaces on the interior shall be painted with a rust-inhibiting paint.

8.6 EXTERIOR FINISH

Exterior steel surfaces shall be painted with rust-inhibiting paint in a heat-reflecting colour.

9 TYPE-9 MAGAZINES

9.1 USES

Type-9 magazines are used for highly mobile storage facilities.

9.2 GENERAL

Type-9 magazines shall comply with the requirements of Chapter 6.

The manufacturer is responsible for ensuring compliance with all applicable codes, regulations and standards associated with the structural integrity of Type-9 magazines.

9.3 MATERIALS

See Clause 8.3.

9.4 STRUCTURE

9.4.1 Walls

See Clause 8.4.1.

9.4.2 Skids

See Clause 8.4.2.

9.4.3 Floor

See Clause 8.4.3.

9.4.4 Roof

See Clause 8.4.4.

9.4.5 Joining magazines together

Combination of two Type-4 magazines as one with at least 50 mm separation between them shall be known as a Type-9 (multi-compartment) magazine. The minimum 50 mm air gap (separation) shall be enclosed with mild steel plate on each side such that the two separate magazines appear as one when viewed externally from the side (see Figure 7). The top and the base of the air gap (separation) can be enclosed by removable plates or parts.

Both joining walls of a combined magazine shall be bullet-resistant.

There shall be two doors, one for each compartment, located at opposite ends of the multi-compartment magazine.

9.5 LOCKING SYSTEM

The hitch of each Type-9 magazine trailer shall be equipped with a hitch cover locked by a locking system in compliance with Clause 6.5.3.

When Type-9 magazines are combined as a multi-compartment configuration and permanently fixed on a trailer or skid, both magazine doors locking systems may be keyed alike.

9.6 INTERIOR FINISH

See Clause 8.5.

9.7 EXTERIOR FINISH

See Clause 8.6.

10 TYPE-12 MAGAZINES

10.1 USES

Type-12 magazines are "unique" and may be approved as permanently located or moveable magazines for the storage of explosives.

10.2 GENERAL

The design of Type-12 magazines may be a novel approach for a portable or permanently located structure based on either an existing building, structure or part thereof that has been converted by modifying some or all components or may be of a totally unique design appropriate to the situation.

The manufacturer is responsible for ensuring compliance with all applicable codes, regulations and standards associated with the structural integrity of Type-12 magazines.

Type-12 magazines shall comply with the requirements of Chapter 6.

NOTES —

1 Every effort should be made to use one of the magazine configurations outlined in this standard. Type-12 magazines should be used only for special situations and applications where one of the other magazine types specified in this standard would not be suitable.

2 The unique characteristics of any Type-12 explosives storage structure may need to be bullet resistant, non-combustible construction, theft-resistant (i.e. with force (punch/pry), drill and torch characteristics), weatherproof and ventilated to the degree dictated by its particular circumstances and agreed to, in writing, by the regulators.

3 Regulators should be contacted prior to construction of a Type-12 magazine.

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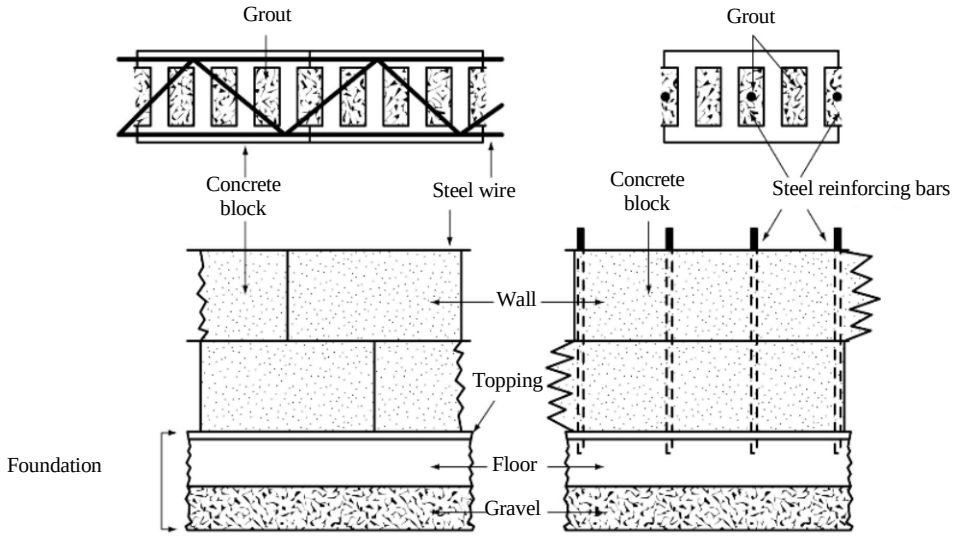


HORIZONTAL STEEL-WIRE REINFORCEMENT

VERTICAL STEEL-BAR REINFORCEMENT

FIGURE 1 — TYPICAL FOUNDATION AND WALL DESIGN FOR STANDARD CONCRETE BLOCK MASONRY UNITS OF TYPE-1 MAGAZINES

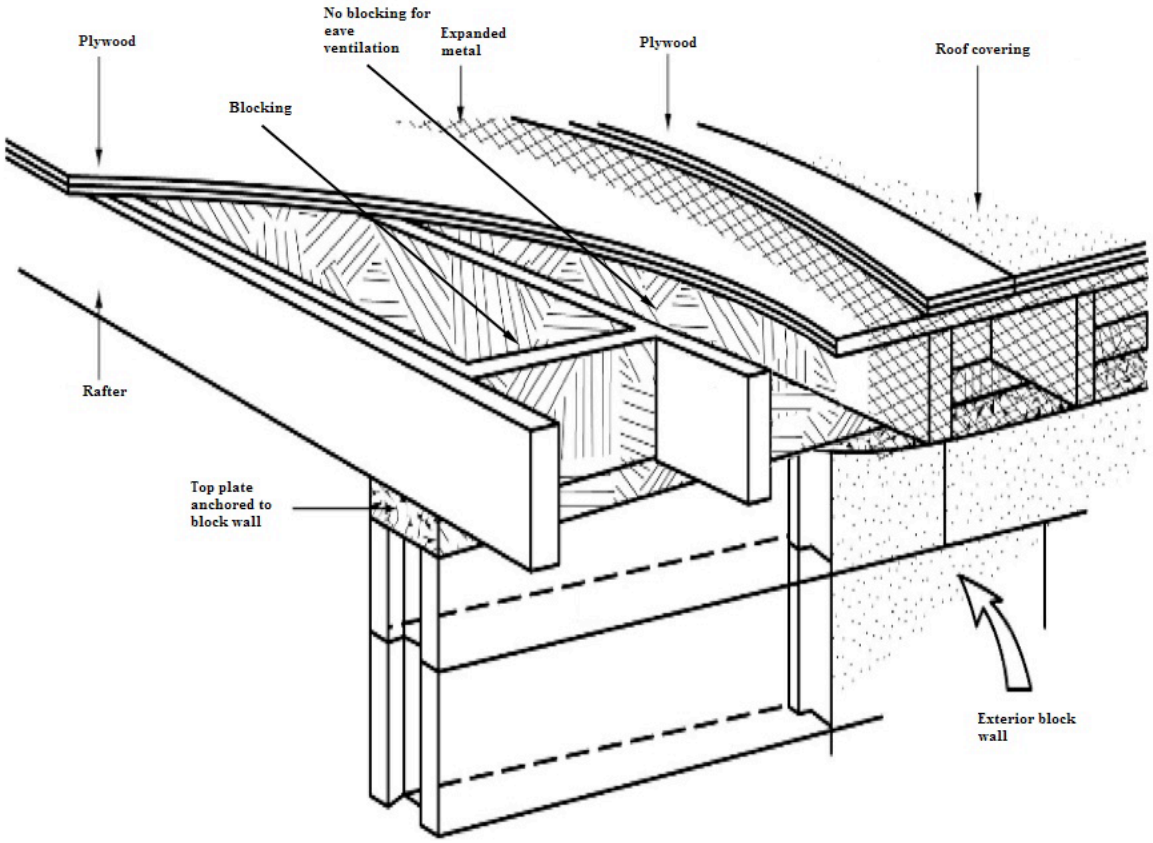
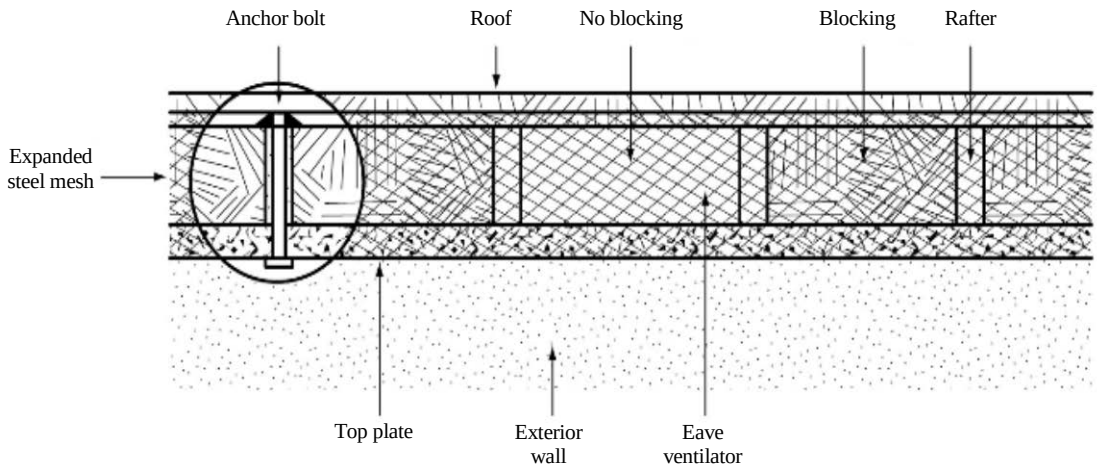


FIGURE 2 — TYPICAL ROOF DESIGN FOR TYPE-1 MAGAZINES



EAVE VENTILATOR

FIGURE 3 — TYPICAL EAVE VENTILATOR DESIGN

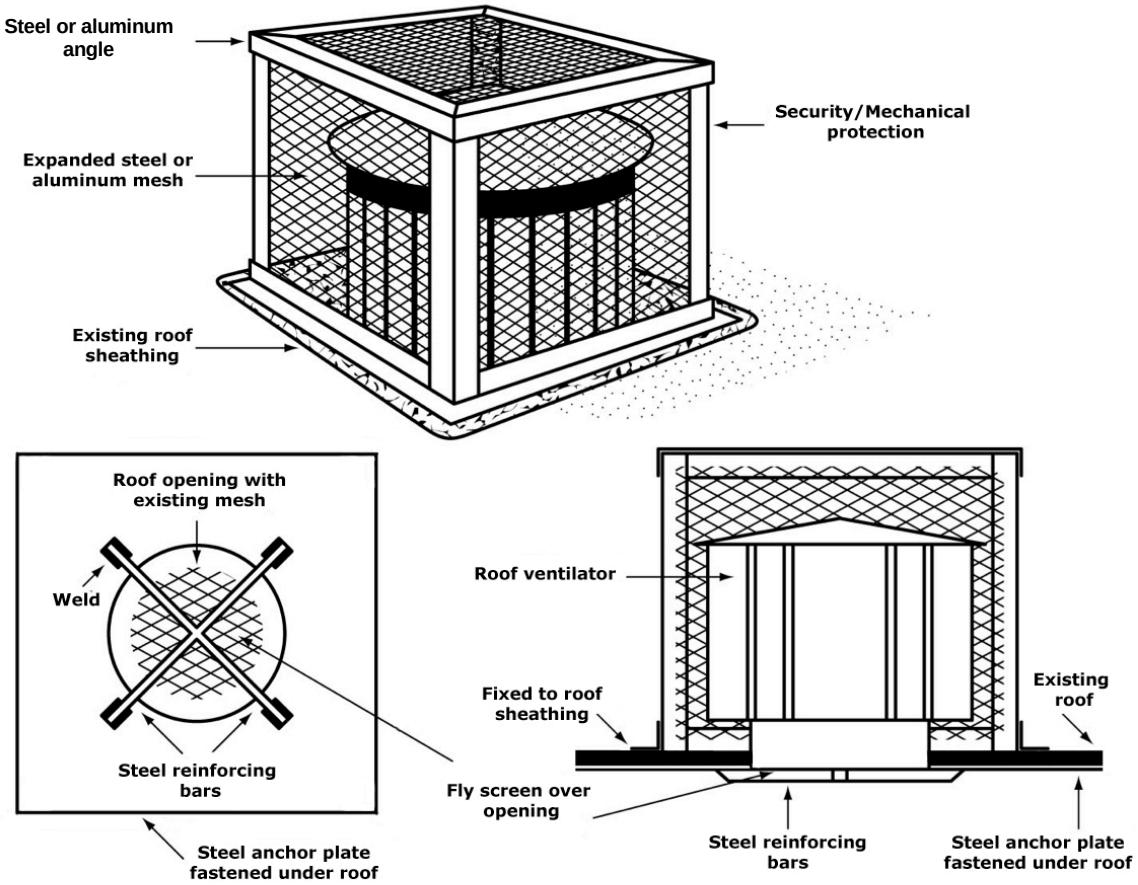


FIGURE 4 — TYPICAL ROOF VENTILATOR DESIGN

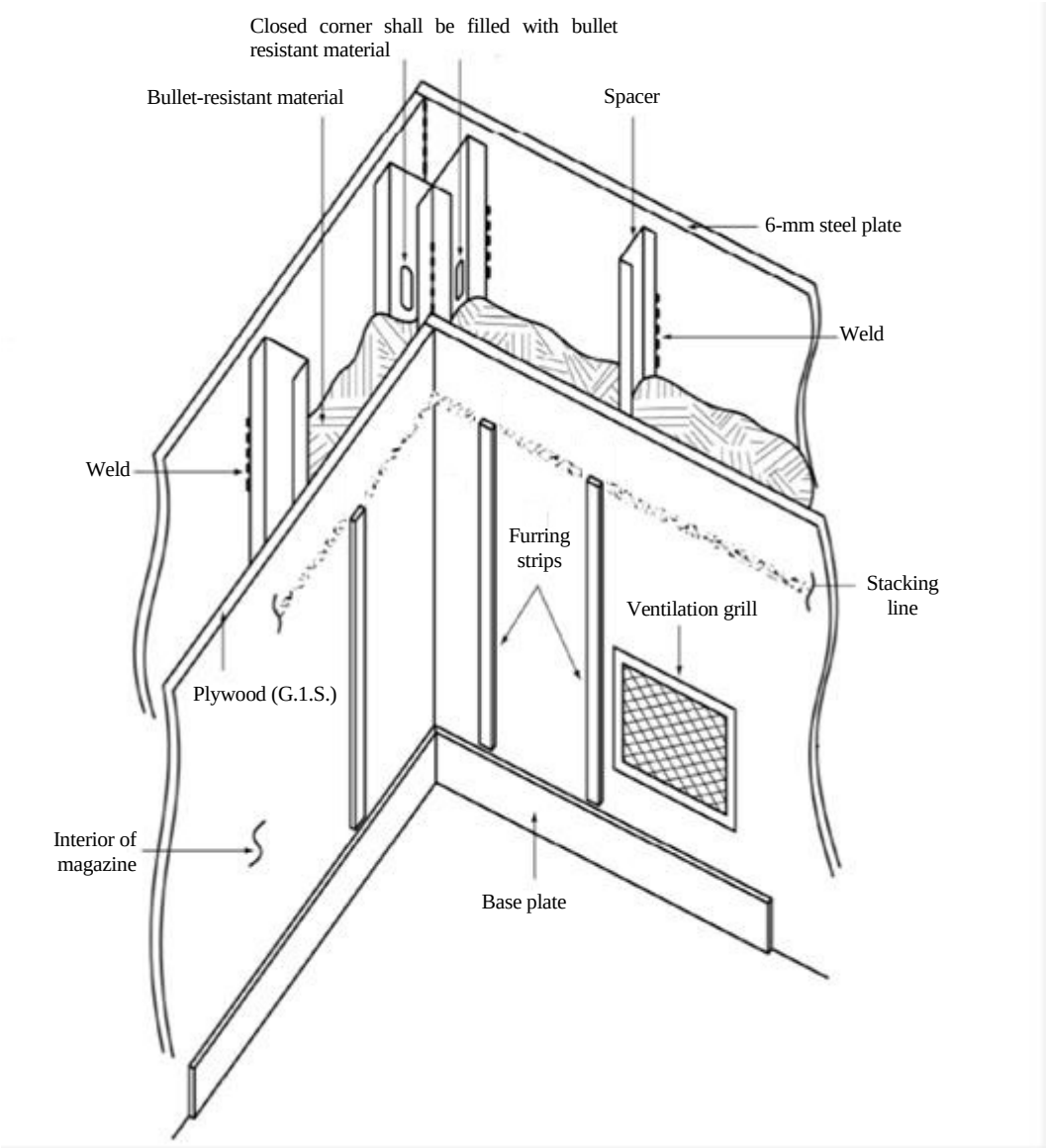


FIGURE 5 — TYPICAL WALL DESIGN FOR TYPE-4 MAGAZINES

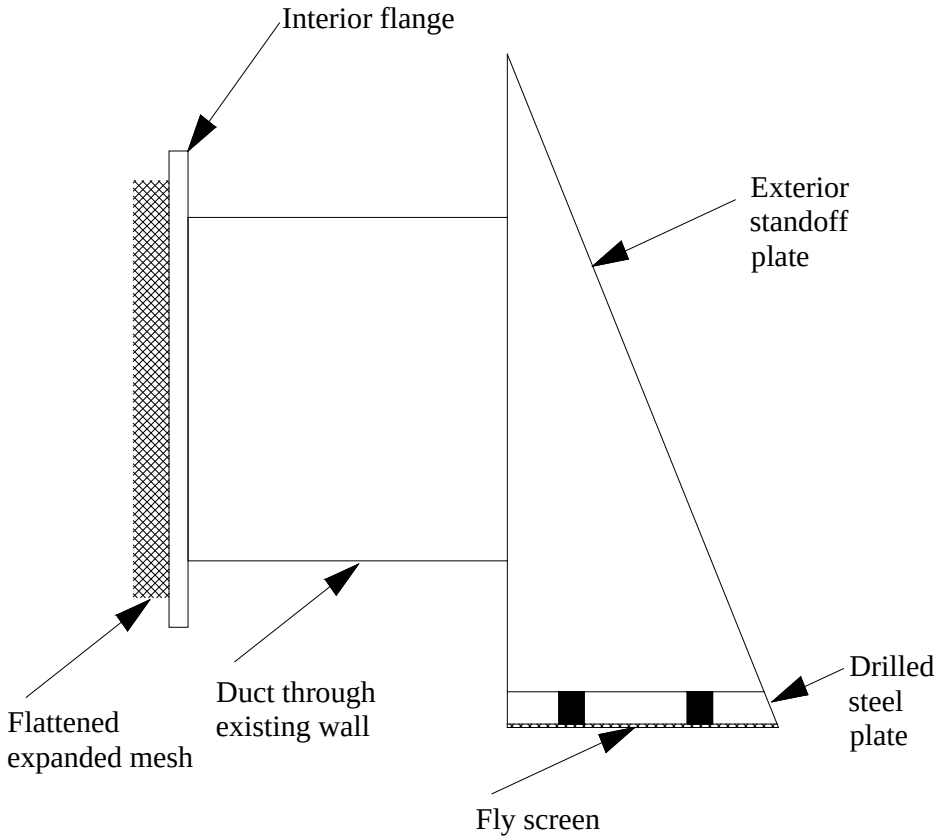
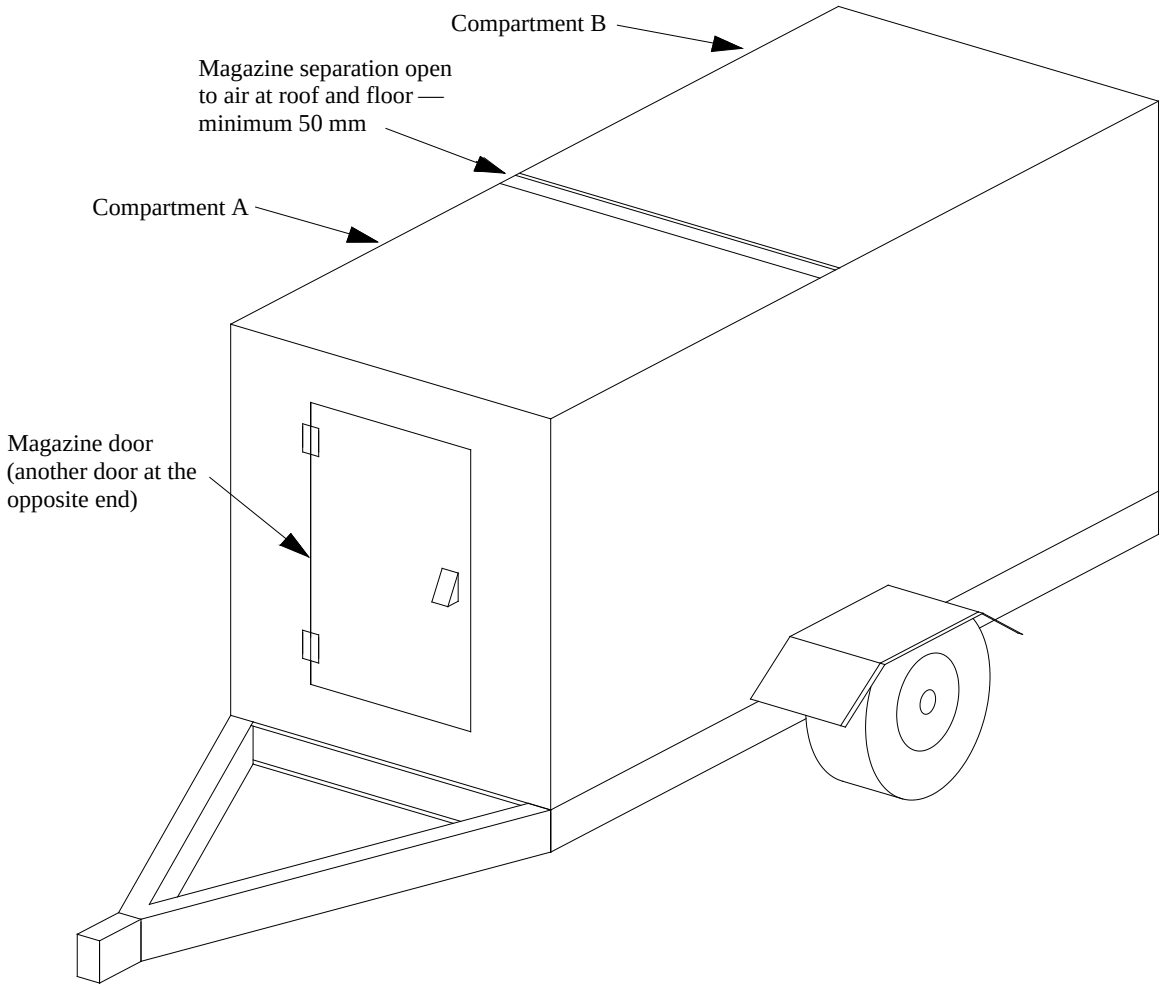


FIGURE 6 — STRAIGHT-THROUGH VENTILATOR



NOTE — May be without wheels.

FIGURE 7 — TYPICAL DESIGN FOR TYPE-9 MAGAZINES ON TRAILER

ANNEX A
(informative)
[non-mandatory]

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QUÉBEC. *Loi sur les explosifs.*

QUÉBEC. *Règlement d'application de la Loi sur les explosifs.*

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COMMENTS

The Bureau de normalisation du Québec (BNQ) welcomes your comments and suggestions regarding this document. Please use this form to send us your input.

CAN/BNQ 2910-500 *Explosives — Magazines for Industrial Explosives*.

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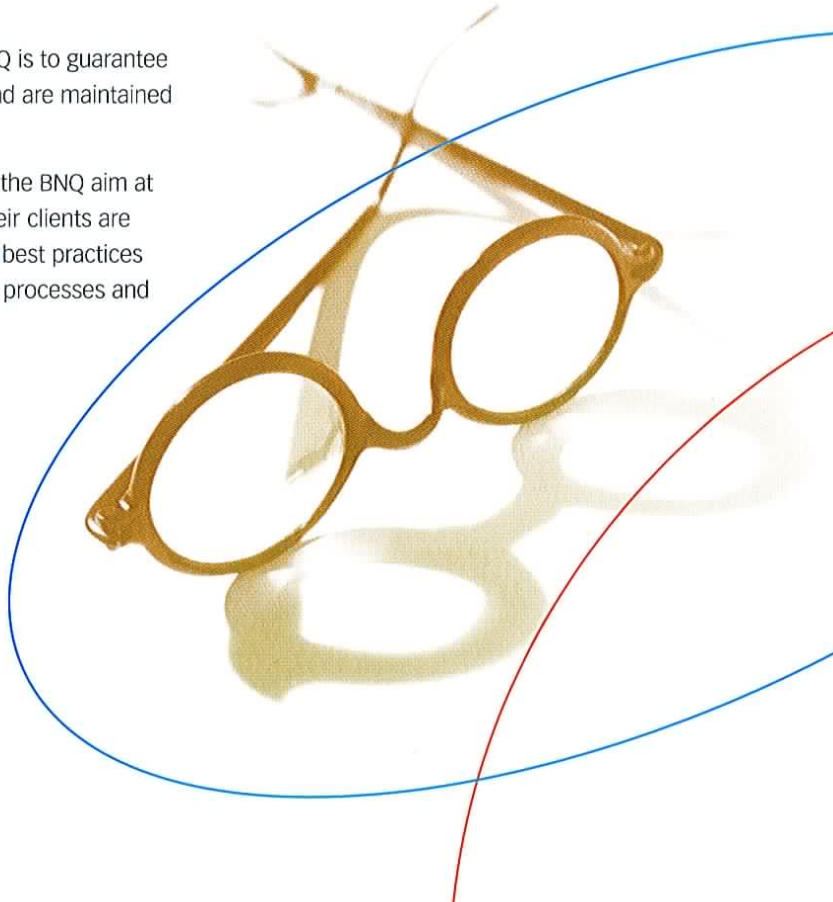

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