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Storage Guidelines

For Non-Industrial Explosives

Explosives Regulatory Division
Explosives Safety and Security Branch
Minerals and Metals Sector

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Canada 

INTRODUCTION.....	1
1. PURPOSE	1
2. SCOPE.....	2
3. DESIGNATION.....	2
4. GENERAL REQUIREMENTS	2
4.1. UNITS	2
4.2. SIZE AND STORAGE CAPACITY.....	2
4.3. MATERIALS.....	2
4.4. LOCKING SYSTEMS	2
4.4.1. Mortise, locks and cylinders	2
4.4.2. Padlocks	3
4.5. DOORS.....	3
4.6. HEATING, COOLING AND INSULATION	3
4.6.1. General.....	3
4.6.2. Heating or cooling source inside the magazine	4
4.6.3. Heating or cooling source outside the magazine	4
4.6.4. Insulation	5
4.7. VENTILATION	5
4.7.1. General.....	5
4.7.2. Straight-Through Ventilators	6
4.7.3. Eave Ventilators	6
4.7.4. Roof Ventilators	6
4.8. ELECTRICITY.....	7
4.8.1. General.....	7
4.8.2. Supply of Electricity	7
4.8.3. Lightning Protection.....	8
4.8.4. Wiring.....	8
4.8.5. Electric Lighting.....	8
4.8.6. Charging Stations	8

5.	TYPE "A" MAGAZINE	9
5.1.	USES	9
5.2.	SIZE AND STORAGE CAPACITY.....	9
5.3.	MATERIALS.....	9
5.4.	STRUCTURE	9
5.5.	DOOR HINGES	9
5.5.1.	Butt hinges.....	9
5.5.2.	Piano hinges.....	9
5.6.	LOCKING SYSTEMS	10
5.7.	HEATING, COOLING AND INSULATION	10
6.	TYPE "B" MAGAZINE	10
6.1.	USES	10
6.2.	SIZE AND STORAGE CAPACITY.....	10
6.3.	MATERIALS.....	10
6.4.	STRUCTURE	10
6.5.	DOOR HINGES	10
6.6.	LOCKING SYSTEMS	10
6.7.	VENTILATION	10
7.	TYPE "C" MAGAZINE	11

7.1.	USES	11
7.2.	SIZE AND STORAGE CAPACITY.....	11
7.3.	MATERIALS.....	11
7.4.	STRUCTURE	11
7.5.	DOORS.....	11
7.6.	DOOR HINGES	11
7.7.	LOCKING SYSTEMS	11
7.8.	HEATING, COOLING AND INSULATION	11
7.9.	VENTILATION	12
7.10.	ELECTRICITY.....	12
8.	TYPE “D” MAGAZINE	12
8.1.	USES	12
8.2.	SIZE AND STORAGE CAPACITY.....	12
8.3.	MATERIALS.....	12
8.4.	STRUCTURE	12
8.5.	DOORS.....	12
8.6.	DOOR HINGES	12
8.7.	LOCKING SYSTEMS	12
8.8.	HEATING SOURCE OUTSIDE THE MAGAZINE	12
8.9.	VENTILATION	13
8.10.	ELECTRICITY.....	13
9.	TYPE “E” MAGAZINE	13

9.1.	USES	13
9.2.	SIZE AND STORAGE CAPACITY.....	13
9.3.	MATERIALS.....	13
9.4.	STRUCTURE	13
9.5.	DOORS.....	13
9.6.	DOOR HINGES	13
9.7.	LOCKING SYSTEMS	14
9.8.	HEATING SOURCE OUTSIDE THE MAGAZINE	14
9.9.	VENTILATION	14
9.10.	INTERIOR FINISH	14
9.11.	ELECTRICITY.....	14
10.	TYPE "F" MAGAZINE.....	14
10.1.	USES	14
10.2.	SIZE AND STORAGE CAPACITY.....	14
10.3.	MATERIALS.....	14
10.4.	STRUCTURE	14
10.5.	LOCKING SYSTEMS	15
10.6.	HEATING SOURCE OUTSIDE THE MAGAZINE	15
10.7.	VENTILATION	15
10.8.	ELECTRICITY.....	15

INTRODUCTION

As per Section 148 of the *Explosives Regulations, 2013*, every magazine must be constructed and maintained so that it is well-ventilated and resistant to theft, weather and fire.

The *Storage Guidelines 2015 for Non-industrial Explosives* are intended to set out the structural requirements for magazines to store non-industrial explosives.

For the purposes of this document, a *non-industrial explosive* is defined as one of the following types of explosives:

- Type S** Special purpose explosives:
 - S.1 — low-hazard special purpose explosives
 - S.2 — high-hazard special purpose explosives
- Type C** Cartridges:
 - C.1 — small arms cartridges
 - C.2 — power device cartridges
 - C.3 — percussion caps
- Type P** Propellant powder:
 - P.1 — black powder and hazard category PE 1 black powder substitutes
 - P.2 — smokeless powder and hazard category PE 3 black powder substitutes
- Type R** Rocket motors:
 - R.1 — model rocket motors
 - R.2 — high-power rocket motors
 - R.3 — rocket motor accessories
- Type F** Fireworks:
 - F.1 — consumer fireworks
 - F.2 — display fireworks
 - F.3 — special effect pyrotechnics
 - F.4 — fireworks accessories

These guidelines do not apply to industrial explosives which include type E (high explosives) and type I (initiation systems). Please refer to the standard, *Explosives – Magazines for Industrial Explosives*, for the construction of magazines for the secure storage of industrial explosives.

These guidelines apply to the licensed storage of finished goods. Proper storage should fulfill the following conditions:

- Protection against weather, including lightning storms;
- Provide physical security barriers against intrusions;
- Protection against fire; and,
- Protection of contents against explosions that may occur in adjacent magazines.

1. PURPOSE

These guidelines specify the minimum requirements for the construction of magazines used for the licensed storage of non-industrial explosives.

2. **SCOPE**

These guidelines are applicable to the construction of new magazines for secure storage of non-industrial explosives.

3. **DESIGNATION**

There are six types of magazines for non-industrial explosives based on their specific use: types A, B, C, D, E, and F.

4. **GENERAL REQUIREMENTS**

4.1. **UNITS**

Dimensions given in this standard are nominal. This standard uses units from the International System (SI).

4.2. **SIZE AND STORAGE CAPACITY**

The size of a magazine depends of the maximum quantity of explosives to be stored at any one time and the storage method. The minimum free volume of the magazine left for air circulation and handling of stock shall be 10%.

4.3. **MATERIALS**

Materials shall possess the essential properties necessary to perform their intended functions in the structure. Materials, unless otherwise specified in this standard, shall conform to *National Building Code of Canada*.

NOTE — Ensure any materials or fittings used in the building construction are chemically compatible with each other and with the product being stored and do not pose a hazard to the explosives.

Steel reinforcing bars shall be minimum 10M and minimum 400R or 400W (CAN/CSA-G30.18-09).

4.4. **LOCKING SYSTEMS**

Mortise, locks, cylinders and padlocks shall meet the following requirements.

4.4.1. **Mortise, locks and cylinders**

Mortise-type dead bolts for interior swing doors shall be inaccessible from the outside and strong enough to withstand vigorous pulling and pushing.

For explosive types F.2 (display fireworks); R.2 (high power rocket motors); and S.2 (high-hazard special purpose explosives); the following standards apply:

- UL437 Key Locks;
- ANSI/BHMA A156.13, Security Grade 1 Mortise Locks & Latches;
- ANSI/BHMA 156.5, Grade 1 Cylinders and input devices for locks; and,

- ANSI/BHMA A156.30, Grade A American National Standard for High Security Cylinders.

4.4.2. Padlocks

Shackles and hasps shall be of hardened steel.

Cylinders shall have anti-drill features.

For explosive types F.2 (display fireworks); R.2 (high power rocket motors); and S.2 (high-hazard special purpose explosives); the following standards apply:

- ASTM F883-13, Force 3 Standard Performance Specification for Padlocks;
- UL437 Key Locks; and,
- BS EN 12320 Building hardware. Padlocks and padlock fittings.

4.5. DOORS

All doors that are required to be commercial doors shall meet the following requirements:

Interior Doors:

- 16-gauge welded pressed steel frame, A-40 galvaneal steel. If frame is installed into a fire-rated wall, then frame and door are to have a fire label;
- 18-gauge honeycomb, hollow metal door A-40 galvaneal steel; and,
- Exposed interlocking seam.

Exterior Doors:

- 16-gauge welded pressed steel frame, A-40 galvaneal steel;
- 16-gauge insulated polystyrene hollow metal door, A-40 galvaneal steel;
- Exposed interlocking seam;
- The door shall open outwards; and,
- The door shall fit snugly and it shall be recessed to resist prying.

4.6. HEATING, COOLING AND INSULATION

4.6.1. General

The heating and cooling requirements of these guidelines only apply to the licenced storage of following types of non-industrial explosives:

- F.2 (display fireworks);
- F.3 (special effect pyrotechnics),
- F.4 (fireworks accessories);
- R.2 (high-power rocket motors);
- S.2 (high-hazard special purpose explosives); and,
- P (propellant powder).

The heating and cooling requirements of these guidelines will apply to the licenced storage of type F.1 (consumer fireworks) when storing quantities greater than 25,000 kg NEQ.

A high temperature limiting control shall be installed or accompany the heating unit (often built-in) to protect the heating core and elements from overheating.

4.6.2. Heating or cooling source inside the magazine

When installed inside the magazine, any heating or cooling sources shall conform to the following requirements:

- Comply with *Canadian Electrical Code*, Class 2 Division 2;
- Meet manufacturer's minimum standoff distance; and,
- Have mechanical protection.

The mechanical protection for the heating or cooling source shall be installed at the required standoff distance specified by the manufacturer. In addition, a welded cage fabricated of expanded steel or aluminum mesh and 6 mm angle iron shall be firmly mounted over the heating or cooling source and fixed to the wall or the roof. For the exterior opening, a flattened, expanded steel mesh of 5 mm Short Way Dimension (SWD) opening and 20-gauge shall be fixed to the wall or the roof.

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

4.6.3. Heating or cooling source outside the magazine

When a heating or cooling source is installed outside the magazine and requires some components to be installed inside the magazine, all inside components shall meet the following requirements:

- Motors, fans and electrical installation shall comply with *Canadian Electrical Code*, Class 2 Division 2;
- Heating or cooling exchange units shall be mounted above the location where the explosives are normally stacked; and,
- Heating or cooling exchange units shall have mechanical protection.

The mechanical protection shall be installed at the required standoff distance specified by the heater or cooler manufacturer. Protection will be provided by a welded cage fabricated of expanded steel or aluminum mesh and 6 mm angle iron shall be firmly mounted over the heating or cooling source and fixed to the wall or the roof. For the interior opening, a flattened, expanded steel mesh of 5 mm Short Way Dimension (SWD) opening and 20-gauge shall be fixed to the wall or the roof. The cage can be built the same way as shown in Figure 1.

Indirect flame heater, heating systems and cooling systems not complying with *Canadian Electrical Code*, Class 2 Division 2 shall be installed in a separate room with a one-hour fire rating. The heating or 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 located at least 8 metres from the magazine.

For forced air systems, a fire damper activated via a fusible link or other safety device to close and seal the duct shall be installed as near to the heating or cooling unit system as practical.

If recirculated heated air from a forced air system heating or cooling source is used, then an efficient filtering unit shall be used to prevent dust accumulation in the forced air system.

Direct flame heating is not permitted.

Any fuel storage tanks shall be located above ground, at a grade lower than the magazine itself to minimize or prevent the spread of a fire to its contents. The storage tanks shall be designed to meet the technical requirements found in *the Environmental Code of Practice for Aboveground and Underground Storage Tank System Containing Petroleum and Allied Petroleum Products* and also comply with other local, provincial and territorial codes and regulations. When the fuel storage tank is located within 8 metres of the magazine, the quantity of fuel stored shall not exceed 10,000 litres.

4.6.4. Insulation

Any insulation in ceilings or 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.

4.7. VENTILATION

4.7.1. General

Ventilators shall be provided to ensure that the interior of a magazine is kept as dry and cool as possible. The number and type of ventilators required will depend on local climatic conditions and the size of the magazine but, in any case, shall be of, or a combination of, the approved types and sizes defined in sections 4.7.2 to 4.7.4.

Ventilation shall be provided at the ceiling level as well as near the floor level to promote good air circulation.

NOTE — A guideline for the ratio of ventilation area to magazine volume is $50 \text{ cm}^2/\text{m}^3$ of magazine. When the magazine is large, it is often difficult to achieve this with regular wall ventilators. Therefore, ventilators of $25 \text{ cm}^2/\text{m}^3$ may be acceptable for large

magazines which only contain finished products in their original packaging with a minimal chance of explosive dust and fumes.

4.7.2. Straight-Through Ventilators

Straight through ventilators shall not exceed 200 mm x 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. Care must be taken to ensure that the integrity of any wire reinforcing in the wall is maintained. The stand-off plate shall be welded in position. The plate may be sloped to form a hood. The outside and inside openings shall be covered by flattened expanded steel mesh welded to a steel frame. Ventilators shall be kept free from obstructions at all times.

4.7.3. Eave Ventilators

Eave ventilators may 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 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 with at least 6 wood screws to structural members.

If rafters have been used in the construction of the roof, eave ventilators may be installed by dispensing with the blocking between some rafters provided the opening does not exceed 100 mm in width. The exterior opening shall be covered with the expanded steel from the roof. A screen fabricated of flattened expanded steel welded to a steel frame shall be installed over the interior opening. Ventilators shall be kept free from obstructions at all times.

4.7.4. Roof Ventilators

Roof ventilators shall have roof openings equal or less than 200 mm in any dimension and protected by two orthogonal 10M steel reinforcing bars welded to a 6 mm (¼ inch) steel anchor plate which is firmly fastened to the underside of the roof sheathing.

For the interior, the ventilator openings shall be covered with 50 mm Short Way Dimension (SWD) opening, 20-gauge flattened expanded steel mesh (see Figure 1).

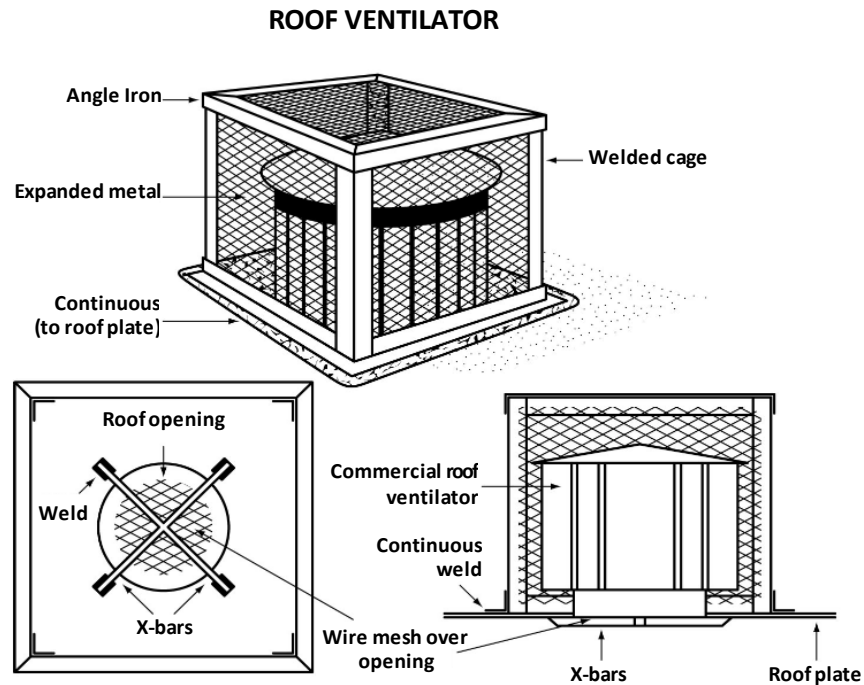


Figure 1. Typical roof ventilator design.

4.8. ELECTRICITY

4.8.1. General

The electrical requirements of these guidelines only apply to the licenced storage of the following types of non-industrial explosives:

- F.2 (display fireworks);
- F.3 (special effect pyrotechnics);
- F.4 (fireworks accessories);
- R.2 (high-power rocket motors); and,
- P (propellant powder).

The electrical requirements of these guidelines will apply to the licenced storage of type F.1 (consumer fireworks) when storing quantities greater than 25,000 kg NEQ.

4.8.2. Supply of Electricity

The supply of electricity to a standalone magazine shall be controlled by a single disconnecting means which shall be installed a minimum of 15 m away from the magazine. The single disconnecting means shall disconnect all ungrounded conductors

of that supply. The last 15 m from the disconnecting means to the magazine must be buried underground.

4.8.3. Lightning Protection

Any lightning protection must be installed according to *CSA standard CAN/CSA-B72-M87*.

All magazines with interior electrical circuits shall include lightning protection by grounding and surge protection at the main disconnect supplying the magazine. This shall be done in accordance with the requirements of *CSA standard CAN/CSA-B72-M87, Installation Code for Lightning Protection Systems* and shall be provided with Type 1 surge protection in accordance with the recommendations of *IEEE Publication C62.41.1, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits*.

4.8.4. Wiring

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 4 or be IP65 as stated in the *Canadian Electrical Code Part I*.

Each branch circuit within the magazine shall be protected by a Ground Fault Circuit Interrupter of the Class A type. The installation shall be efficiently bonded throughout. Standalone magazines shall be grounded at the point of entry into the building.

4.8.5. Electric Lighting

The area lighting shall be classed for watertight and dust-tight equipment rating. The electric lighting shall meet the *Electrical Equipment Manufacturers Association of Canada (EEMAC) 4*.

4.8.6. Charging Stations

Charging stations for electrical forklifts in a separate room shall be built in accordance with the *National Building Code of Canada* and the *Canadian Electrical Code*.

5. TYPE "A" MAGAZINE

5.1. USES

A Type A magazine (Cupboard Magazine) is a box, chest, cupboard, or container made of plywood and sheet steel. These magazines are to be anchored and not moveable.

Type A magazines are permitted to be used inside buildings only.

5.2. SIZE AND STORAGE CAPACITY

See section 4.2.

5.3. MATERIALS

See section 4.3.

5.4. STRUCTURE

A Type A magazine shall be constructed as follows:

- The layers shall be laminated together with waterproof adhesive or other equally effective means;
- Steel joints shall be secured with continuous fillet welds; and,
- All interior surfaces that could come in contact with explosives shall be lined with non-sparking material (e.g., paint, resin, plywood, gypsum board, etc.).

All surfaces, including the door, require a total of three layers and shall be arranged according to the following minimum thicknesses, inside to outside:

- Plywood, 6.4 mm;
- Gypsum board, 12.8 mm; and,
- Low-carbon sheet steel.

Plywood shall be Good One Side Exterior Grade A or B. Face exposed on the interior shall be Good One Side.

5.5. DOOR HINGES

5.5.1. Butt hinges

At least two steel butt hinges per door shall be welded, riveted, or installed with carriage bolts (round head on outside). Additional hinges shall be installed to ensure there is no more than 400 mm between hinges and between hinges and the top and the base of the door. The hinges shall be at least 3 mm gauge.

The hinge pins shall be non-removable and shall be at least 6.4 mm gauge.

5.5.2. Piano hinges

Piano hinges shall be made of steel and shall be at least 1.25 mm gauge.

The hinge pins shall be at least 3.2 mm gauge.

5.6. LOCKING SYSTEMS

See section 4.4.

5.7. HEATING, COOLING AND INSULATION

See section 4.6.

6. TYPE "B" MAGAZINE

6.1. USES

A Type B magazine (Flammable Cabinet Magazine) is a flammable liquids storage container made of sheet steel. These magazines are to be anchored and not moveable.

Type B magazines are permitted to be used inside buildings only.

6.2. SIZE AND STORAGE CAPACITY

See section 4.2.

6.3. MATERIALS

See section 4.3.

6.4. STRUCTURE

Type B magazines shall conform to *ULC-C1275, Storage Cabinets for Flammable Containers*, or conform to NFPA 30.

Type B magazines shall be made of steel with a double wall construction with a 3-point door latch and a liquid tight door sill raised at least 50 mm above the floor.

All interior surfaces that could come in contact with explosives shall be lined with non-sparking material (e.g., paint, resin, plywood, gypsum board).

6.5. DOOR HINGES

See section 5.5.

6.6. LOCKING SYSTEMS

See section 4.4.

6.7. VENTILATION

If there are ventilation openings in the cabinet:

- the ventilation opening shall be sealed with materials providing fire protection at least equivalent to that of the construction of the cabinet; or,
- the cabinet shall be vented outdoors, using appropriate fire protection piping.

7. TYPE "C" MAGAZINE

7.1. USES

A Type C magazine (Partition Magazine) is a walk-in type storage space that incorporates existing wall structures of a locked building.

Type C magazines are permitted to be used inside buildings only.

7.2. SIZE AND STORAGE CAPACITY

See section 4.2.

7.3. MATERIALS

See section 4.3.

7.4. STRUCTURE

Stud-frame wall partitions shall be built in accordance with the provincial, territorial, or *National Building Code*.

The exterior of wall partitions shall be covered by either plywood with minimum thickness of 16 mm or structural steel sheeting used for erecting industrial pre-engineered buildings.

The interior of the enclosure (stud-frame partitions, ceiling and floor) shall offer a fire retardant rating of at least one hour.

All interior surfaces that could come in contact with explosives shall be lined with non-sparking material (e.g., paint, resin, plywood, gypsum board).

7.5. DOORS

There should be no openings in the magazine other than the door(s).

All doors shall be a commercial steel door with a fire resistance rating of one hour. See section 4.5 for commercial steel door requirements.

Type C magazines with a floor area larger than 2.25 m² must be equipped with panic hardware on exit doors.

7.6. DOOR HINGES

See section 5.5.

7.7. LOCKING SYSTEMS

See section 4.4.

7.8. HEATING, COOLING AND INSULATION

See section 4.6.

7.9. VENTILATION

See section 4.7.

7.10. ELECTRICITY

See section 4.8.

8. TYPE "D" MAGAZINE

8.1. USES

A Type D magazine (Chamber Magazine) is a walk-in type storage space made of concrete.

Type D magazines can be used either as unique stand-alone magazines or as a magazine within a building.

8.2. SIZE AND STORAGE CAPACITY

See section 4.2.

8.3. MATERIALS

See section 4.3.

8.4. STRUCTURE

All four walls shall be built from hollow concrete blocks assembled with mortar, poured concrete or brick walls of minimum thickness of 150 mm. The concrete floor or pad must meet the provincial, territorial, or National Building Code.

The ceiling shall be constructed with material offering a fire resistance rating of at least one hour.

All interior surfaces that could come in contact with explosives shall be lined with non-sparking material (e.g., paint, resin, plywood, gypsum board).

8.5. DOORS

There should be no accessible openings in the magazine other than the door(s).

All doors shall be a commercial steel door with a fire resistance rating of 1 hour. See section 4.5 for commercial steel door requirements.

8.6. DOOR HINGES

See section 5.5.

8.7. LOCKING SYSTEMS

See section 4.4.

8.8. HEATING SOURCE OUTSIDE THE MAGAZINE

See section 4.6.

8.9. VENTILATION

See section 4.7.

8.10. ELECTRICITY

See section 4.8.

9. TYPE "E" MAGAZINE

9.1. USES

A Type E magazine (ex. Industrial, Pre-engineered Building) is a stand-alone magazine or permanent structure.

9.2. SIZE AND STORAGE CAPACITY

See Section 4.2.

9.3. MATERIALS

See section 4.3.

9.4. STRUCTURE

All interior surfaces that could come in contact with explosives shall be lined with non-sparking material (e.g., paint, resin, plywood, gypsum board).

The magazine floor and foundation shall be in accordance with the provincial, territorial, or *National Building Code* (as applicable). The magazine foundation shall be a concrete slab or equivalent.

Any openings for windows must be protected. The openings shall be covered with shatterproof glass protected by stainless-steel security bars spaced 50 mm apart, centre to centre. Diameter of bars shall be at least equivalent to #10 rebar or 9.5 mm diameter.

Windows should be avoided, if possible.

9.5. DOORS

All doors shall be a commercial steel door with a fire resistance rating of one hour. See section 4.5 for commercial steel door requirements. Doors, including sliding or swing doors used for shipping, shall be locked from the inside.

Exit doors shall be placed every 15 meters and lead outside.

Exit man doors shall be equipped with panic hardware.

9.6. DOOR HINGES

See section 5.5.

9.7. LOCKING SYSTEMS

See section 4.4.

9.8. HEATING SOURCE OUTSIDE THE MAGAZINE

See section 4.6.

9.9. VENTILATION

See section 4.7.

9.10. INTERIOR FINISH

The interior surface shall be covered with paneling offering a fire resistance rating of one hour such as gypsum board of a thickness of at least 12 mm.

9.11. ELECTRICITY

See section 4.8.

10. TYPE "F" MAGAZINE

10.1. USES

A Type F magazine (Container Magazines) is a stand-alone magazine dedicated to the storage of large quantities of explosives.

Type F magazines are semi-permanent structures. These steel only transport containers are commonly known as ISO containers or "seacans."

Type F magazines shall be positioned on concrete blocks, a concrete slab foundation, or a proper gravel pad.

10.2. SIZE AND STORAGE CAPACITY

See section 4.2.

10.3. MATERIALS

See section 4.3.

10.4. STRUCTURE

All interior surfaces that could come in contact with explosives shall be lined with non-sparking material (e.g., paint, resin, plywood, gypsum board).

If required, roof windows, no bigger than 300 mm x 300 mm, may be installed. The openings shall be covered with shatterproof glass protected by stainless-steel security bars spaced 50 mm apart, centre to centre. Diameter of bars shall be at least equivalent to #10 rebar or 9.5 mm diameter.

The container's original doors may be retained.

10.5. LOCKING SYSTEMS

The locking mechanism shall be designed to fit snugly over or cover the container swing locking bar (hasp) in a manner that:

- Disables the vertical keeper bars from turning, including the horizontal swing locking bar pin;
- Conceals the shackle of the padlock;
- Deters a drill attack on the horizontal swing locking bar pin; and,
- Hampers a pry attack on the swing locking bar itself.

10.6. HEATING SOURCE OUTSIDE THE MAGAZINE

See section 4.6.

10.7. VENTILATION

Containers have small ventilation openings at the corners of the walls, near the roof. These openings shall be kept clear after wall modifications.

10.8. ELECTRICITY

See section 4.8.