



## SUBJECT: MOTOR VEHICLE BRAKES

### *Existing pertinent legislation:*

**119.** (1) In this section and in sections 119.1 and 119.2,

“emergency brake system” means a secondary brake system that is used for stopping a motor vehicle in the event of any single failure in the service brake system.

(2) The brake system on a motor vehicle that is operated on a grade, slope or ramp shall be able to perform the individual system function requirements of,

- (a) a service brake system;
- (b) an emergency brake system; and
- (c) a parking brake system.

(3) The capacity of retarders shall not be considered in determining the capacity of the brake systems described in clauses (2) (a), (b) and (c).

(4) Any combination of the system function requirements described in clauses (2) (a), (b) and (c) may be performed by a single brake system.

(5) Each brake system shall be capable of being,

- (a) tested independently; and
- (b) readily applied by a worker seated in the driver’s seat.

(6) A service brake system may consist of a hydraulic pump motor drive system.

(7) The service brake system and the emergency brake system shall be capable of safely stopping the motor vehicle while it is being operated,

- (a) on the maximum grade, slope or ramp in its area of operation;
- (b) at its maximum authorized speed; and
- (c) with its maximum authorized load.



(8) The parking brake system shall be capable of holding the motor vehicle stationary, with its maximum authorized load, on the maximum grade, slope or ramp in its area of operation.

(9) The emergency brake system shall be set up so that, whether the brake is applied automatically or manually, a deliberate act is required to release it.

(10) Before a motor vehicle is first put into service, the following systems shall be tested by a competent person for proper operation:

1. Service brake.
2. Emergency brake.
3. Parking brake.
4. Steering.
5. Warning devices.
6. Lighting.

(11) A record of the tests described in subsection (10),

- (a) shall be signed by the competent person who performed the tests;
- (b) shall be kept as long as the motor vehicle is in service; and
- (c) shall be made available to the joint health and safety committee or the health and safety representative, if any.

**119.1** (1) The brake system of a rubber-tired motor vehicle that was first used in an underground mine after September 1, 1992 shall meet the requirements of CAN/CSA-M424.3-M90, "Braking Performance — Rubber-Tired, Self-Propelled Underground Mining Machines".

(2) The brake system of a rubber-tired motor vehicle that was first used in a surface mine on or after October 1, 2007 shall meet the requirements of CSA-M3450-03, "Braking systems of rubber-tired machines — Performance requirements and test procedures".

(3) The brake system of a tracked motor vehicle that was first used in an underground mine or in a surface mine on or after October 1, 2007 shall meet the requirements of ISO 10265: 1998 "Earth-moving machinery — Crawler Machines — Performance requirements and test procedures for braking systems".

**119.2** (1) This section applies with respect to motor vehicles, other than vehicles operating on rails, that are,

- (a) first put into service by the employer on or after August 16, 1997; and
- (b) equipped with a stored energy brake system that uses a pneumatic system or a full hydraulic system to apply the service brakes.

(2) For the purposes of this section, the critical level of pressure is the level of pressure in a motor vehicle's stored energy brake system, torque converter or transmission below which the manufacturer has determined that the vehicle is unsafe to operate.

(3) A motor vehicle that is operated on the surface must be equipped with a device that warns the operator that the vehicle's stored energy brake system is approaching the critical level of pressure, so that the vehicle can be safely stopped.

(4) A motor vehicle that is operated underground must be equipped with,

- (a) a device that automatically applies the emergency brake system and stops the vehicle before the vehicle's stored energy brake system, torque converter or transmission pressure reaches the critical level of pressure; and
- (b) a device that warns the operator that the emergency brake system is about to be applied.

#### **HISTORY:**

The 1971 Handbook of Requirements Governing the Operation of Mines required that all motor vehicles be equipped with suitable brakes in section 230(6).

The introduction of diesel-powered trackless equipment brought with it the problems of operating heavy vehicles on steep ramps, and a whole new set of requirements were put into the "Underground Diesel Engine Code 1973" produced by Ministry of Natural Resources, who looked after health and safety in mines.

This Code had extensive requirements for application to use a diesel engine underground, ventilation, records, maintenance, special occurrences, fuelling and service repair garages, fuels, operating rules and brakes.

*The section on brakes was as follows:*

1. A trackless motor vehicle braking system comprises a portion of the total braking equipment on the vehicle which when independently activated will safely stop and hold the vehicle under authorized conditions of loading, direction of travel, grade and speed.
2. A hydraulic pump motor drive system may be considered a type of braking system.
3. A trackless motor vehicle must be equipped with more than one braking system.
4. Each braking system must be such that it can be tested independently of the other systems.

NOTE: It must be remembered that the main speed control is obtained by a combination of retardation and braking systems.

A modified version of the Underground Diesel Equipment Code was issued on February 1, 1977 and it expanded on the brakes section, making it almost the same as existing section 119.

The Regulations for Mines and Mining Plants modified these requirements into section 119, which included the intent that the section was for "motor vehicles operating on ramps", without defining ramps. Three braking systems are required: service, emergency and parking. In common and accepted practice, the parking and the emergency systems can be combined, as long as they meet the requirements of the entire section 119.

Section 119 (11) was added in 1992, to require that the first model of a vehicle to be used underground in an Ontario mine was to be ramp-tested in compliance with the CSA Standard CAN/CSA-M424.3-M90, "Braking Performance - Rubber-Tired, Self-Propelled Underground Mining Machines" (CSA M424.3).

Section 119 was revised in 2007 to address the inability of modern spring applied brake systems to comply with wording in the regulations that did not permit combined brake functions even though all the same brake performance objectives were being met. Additionally the regulations now address surface equipment through the referencing of CSA M3450-03 and tracked vehicles through the referencing of ISO 10265: 1998. Changes also removed duplicated definitions already contained in the referenced standards and clarified definitions for items such as ramp, grade, slope as well emergency and secondary brake systems. A new subsection was added that requires the automatic application of the brakes to be followed by a deliberate action from the operator to release the brakes.

Section 119.1 becomes section 119.2 using more modern drafting language to improve clarity.

There were 135 runaway incidents in underground mines in Ontario in the period from 1985 to 2000 (an average of 8.4 per year). In the period from 2001 to 2003 there were an additional 5 incidents (an average of 1.7 per year).

*These can be broken down as follows:*

- caused by poor service brakes – 34 incidents – 24%
- caused by parking brakes that did not hold – 35 incidents – 25%
- caused by brake failure – 18 incidents – 13%
- caused by operator error – 22 incidents – 16%
- other causes – 31 incidents – 23%

**PERFORMANCE OBJECTIVE:**

The brakes for trackless motor vehicles operating underground or on surface should be capable of stopping and holding under full load conditions on all operating grades, slopes or ramps. Each vehicle should have a redundancy built into the braking systems so that in the event of a single failure of the service brake system, a safe stop can still be made. The vehicle should be equipped with a parking brake that is unaffected by loss of pressure.

**HAZARD:**

A failure in the service brake system of a vehicle operating on a 20% ramp underground or even operating on a 10% grade in a quarry can cause a runaway and serious injuries if there is no backup brake system. Inability to be able to test all brake systems independently can lead to potential failures during operation not being detected and may result in runaways of machines.

**GUIDELINES FOR COMPLIANCE:**

**A. Scope of Sections. 119, 119.1 & 119.2**

These sections apply to "motor vehicles" operating on grades, slopes, or ramps. It does not apply to a motor vehicle running on rails.

*"Motor vehicle" is defined in the Regulations as:*

"motor vehicle" means a vehicle propelled by other than muscular power, including an automobile, a caterpillar-tracked vehicle, a truck, a tractor and a motor vehicle running on rails but does not include a locomotive."

There are three large groups of motor vehicles used in underground or surface mines: production, utility and personal. They may range in mass from less than 1 ton to greater than 700 tons.

Motor vehicles differ in mass, speed and design of braking systems. The requirements to have the performance of 3 braking functions does not mean that they have to be 3 totally separate braking systems. The service brake system, emergency brake system and the parking brake system may use common components, and indeed, some of these systems may be exactly the same providing all of the other requirements for each of these systems are met.

The requirements do not mean that 3 separate means of activation are necessary. In practice many machines have only two means of brake activation. However, separate means of demonstrating a test of each system is still necessary.

“Grade, slope or ramp” are terms that are currently understood, used in regulations and standards and utilized to indicate an inclined surface that would require braking performance above that for a flat surface where gravity is not an additional factor.

In 119 (7)(a) clause “maximum grade” indicates that the steepest inclined surface should be planned for while recognizing that in the course of ramp development there are limited numbers of very short sections (max 50 feet – typically 3 development rounds) where the actual incline of the road may be higher than the overall average or designed incline angle. These areas would not be considered as “maximum grade”.

### Revisions (2007)

Subsection 119 (2) clarifies emphasis on “systems” and the need for distinct brake “functions” as opposed to just the number of brakes.

Subsection 119 (4) provides clarifications that individual brake systems are capable of performing multiple functions providing all requirements have been satisfied.

Subsection 119 (9) a “Brake Latch / Reset” feature is required because it is proven to prevent movement of machines resulting from conditions that cause them to release inadvertently. Examples are repairs to brake systems, top up of fluids, poor wiring condition, etc.

An old subsection 119 (8) on “common components” Revoked as it is part of the CSA M424.3-M90 (1990), CSA-M3450-03 (2003) and ISO standards ISO 10265 (1998)

Subsection 119 (11) clarifies who performs the test and how records are handled. Signatures may be written or electronic as agreed to in consultation with the JH&SC.

Subsections 119 (1), (2) and (3) adopt standards to ensure that equipment which is “new to Ontario” meets recognized industry relevant CSA and ISO standards for brake systems.

Subsection 119.2 (4) clarifies the need for brake impeding is relevant only to machines equipped with ABA.

### ***B. Motor Vehicle Brake System Test Requirements***

In general, the Regulations for Mine and Mining Plants requires the following motor vehicle brake system tests:

Section 119 (10), 119 (11) - commissioning tests for a new-for-mine motor vehicle or a prototype being first tried in a mine.

- A mine must be able to provide a record for a commissioning test performed by a competent person for a newly acquired motor vehicle (never used before in this mine).
- Testing of motor vehicle brakes must be conducted according to the same procedure followed prior to initial use of the motor vehicle for the shift or when accessing a main ramp in a mine.
- The operator must be able to test the service or emergency systems alone either against the engine or by stopping from a set speed and measuring the stopping distance.
- The operator must be able to test the parking brake system against the engine or on a slope.
- Test procedures should be posted on the machine or readily available in a convenient location for access by the operator.
- The manufacturer's recommendations for testing should be incorporated into any test procedure.

Section 119.1(1), 119.1(2), 119.1(3) - commissioning tests for a new-for-Ontario motor vehicle or a prototype being first tried in Ontario - A manufacturer or a supplier of the motor vehicle first used in an Ontario mine must be able to provide a report for a commissioning tests conducted in terms of the appropriate standard on a grade, slope or ramp required by the standard.

### **C. *Industry Practice***

Vehicles having a rated gross mass of 7,000 kg or less:

Typical practice for small personnel vehicles and light trucks is to use a cable that operates mechanically on the shoes or disks of the rear brakes for an emergency / parking brake system. The cable-operated brakes are considered acceptable for an emergency / parking brakes if all of the other requirements for each of these two systems are met and confirmed by vehicle testing. However, a spring applied hydraulically release (SA/HR) system is offered by some suppliers.

It is also the typical practice for these small vehicles and light trucks to use a dual service braking system. It gives back-up protection in the event that there is a leak of brake fluid from one half of the system. Loss of brake fluid is the most common failure in the service brakes, and has led to many runaway accidents.

It should be noted that there are several manufacturers that supply mining vehicles (production, utility and personnel) with the dual service braking system.

Vehicles having a rated gross mass of 7,000 kg or more:

Larger vehicles now typically use hydraulically applied brakes of a wet disc design. Some manufacturers incorporate brakes that can be either hydraulically or of a SA/HR actuation design. Where SA/HR brakes are employed they may also serve the dual function of service and emergency brakes provided all other requirements are satisfied. On some machines the service brake function may also provide by the same brake components used by the emergency / park system but are actuated with a different control system to ensure compliance with components in common requirements.

Vehicles having specialized brake systems

Some vehicles utilize other forms of braking systems. Brake systems consisting of a closed loop pump and motor arrangement (hydrostatic drive) are used on vehicles of all sizes.

*Hydrostatic drive may act as a brake system providing that:*

- It cannot be disengaged during travel, or
- it engages automatically to retard machine speed when the brake control is actuated (on a machine where the hydrostatic drive control can be disengaged).

NOTE: A hydrostatic drive system, used to both propel and retard a machine is recognized as a brake system, whether functioning alone or in combination with a mechanical brake.

Other brake systems may exist and should be addressed individually to determine if they meet all regulation requirements.

***D. Descriptions and Definitions***

Brake Systems

“Brake system” means all the components which combine together to stop and/or hold the machine, consisting of a control, means of brake actuation, the brake(s) and, if the machine is so equipped, the retarder.

“Retarder” means energy-absorption component normally used to control machine speed. As defined in the regulation the effect of the retarder is not to be considered when determining brake performance.

Some vehicles may be equipped with additional controls that affect transmission operation.

“Neutralizer” devices allow the transmission to be disengaged. This actuating control is not to be considered when determining brake performance.

“Inching” devices allow a closed loop hydrostatic transmission control to be neutralized, however, the transmission system remains engaged. This actuating device may be considered as part of the brake system.

No brake system is to contain a disconnect such as a clutch or shiftable gearbox which allows the brake(s) to be disabled.

A power source disconnect designed for cold weather starting which also disables a brake system must require application of the parking brake prior to disconnection.

#### Common Components:

“Common component” means component that performs a function in two or more brake systems.

Brake components such as pads, shoes, discs and drums can be verified through routine operational testing and as such are acceptable to be used in common.

Actuating components such as lines, hoses and linkages are not easily tested and their condition verified so therefore are subject to limitations of “in common” usage between brake systems.

Brake systems may use common components. However, a failure of any single brake-actuating component must not reduce the effectiveness of the machine’s stopping capability to less than the secondary (emergency) performance.

#### Service brake system:

“Service brake system” means primary system used for stopping and holding the machine. All machines must meet the service brake performance requirements of the applicable standard.

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If other systems are provided with power from the service brake system, any failure in these systems must be considered to be the same as a failure in the service brake system. Therefore the secondary system cannot rely on power from the service system.

All machines must have brakes of equal nominal capacity rating applicable to each wheel of at least one axle. Machines with semi-trailed units must have brakes applicable to at least one axle of the towing machine and one axle of the semi-trailed units. Semi-trailed units have one end of the trailer directly connected to and carried by the power unit whereas a regular trailer is connected to the power unit via a tongue connected to a rear mounted hitch.

Tow units underground must be of suitable size and braking performance to manage a trailer without trailer axle brakes and must be tested to be compliant with stopping and stability requirements.

The service brake system must be modulated. Remote control operation may be an exception (as applicable).

“Modulated braking” means capability to continuously and progressively increase and decrease the braking force by operation of the brake control.

Secondary brake system:

“Secondary brake system” means the emergency system used for stopping the machine in the event of any single failure in the service brake system.

All machines must meet the secondary brake performance requirements of the applicable standard.

The secondary brake system must be modulated with the exception of underground as applicable.

Parking brake system:

“Parking brake system” means system used to hold a stopped machine in a stationary position without additional operator input once applied.

A parking brake disconnect (release) designed to allow movement of disabled machines must be located outside the operator’s station unless it can be reapplied immediately. This will preclude an operator from releasing the park brake and being unable to safely exit the machine in case of movement.

All machines must meet the parking brake requirements of the applicable standards. All machines must be capable of holding the machine in both the forward and reverse directions and with the load as specified as per the applicable standard.

After being applied, this system must not depend on an exhaustible energy source or additional operator input. The parking brake system may use common components with other brake systems provided the requirements of the applicable standards are met.

Warning device for stored energy sources:

If stored energy is used for the application of the service brake system, that system must be equipped with a warning device as per the applicable standard.

The device must readily attract the operator's attention by providing a continuous visible and/or audible warning. Gauges indicating pressure or vacuum do not meet this requirement.

For the purposes of brake systems, stored energy refers to hydraulic or pneumatically actuated systems that employ accumulators to store energy for application purposes. It does not apply to spring applied systems.

Automatic Brake Application (ABA):

A motorized vehicle operating underground which has a hydraulic or pneumatic stored energy braking system, must be equipped with a device that automatically applies the secondary braking system and stops the vehicle before the vehicle's stored energy braking system, torque converter or transmission reaches the critical level of pressure as per the regulation.

Warning Device for ABA:

A motor vehicle equipped with ABA as per the regulation must be equipped with a device that warns the operator that the vehicle's hydraulic or pneumatic stored energy braking system is approaching the critical level of pressure so that the vehicle can be safely stopped or the operator prepares himself for the application of the secondary brake system application. This device will activate at a setting 20% higher than the secondary brake activation pressure.

Brake Latch Reset:

Automatic or manual application of the secondary brake must require the operator to perform a deliberate control function or action (reset) prior to the brake being released.

**REVIEWED and APPROVED BY THE MINING PROGRAM PROVINCIAL ADVISORY COMMITTEE, MINING LEGISLATIVE REVIEW COMMITTEE and by the PROVINCIAL CO-ORDINATOR - MINING**

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**NOTE:** this guideline replaces the guideline for **Section 119 (1) "Motor Vehicle Brakes for Ramps"** dated May 8, 1991 **AND** the guideline for **Section 119 (11) "Mobile Vehicle Brake Testing"** dated November 29, 1995.