
FOAM FIRE SUPPRESSION SYSTEMS ON MINE VEHICLES

GUIDELINES



MOSHAB Approved

November 1997

Document Number: ZMA579BY

CONTENTS

	PAGE
FOREWORD	2
1. INTRODUCTION	3
2. DURATION TIMES AND AREA PROTECTED	4
3. MANUAL ACTUATORS	5
4. NOZZLES, VALVES AND PIPING	5
5. PRESSURE VESSELS	6
6. INTEGRATED ENGINE MANAGEMENT SYSTEMS	7
7. SYSTEM MAINTENANCE AND SERVICE	7
8. FLUSHING AND RE-CHARGING	8
9. FOAM SOLUTION	9
10. INSTALLATION	9
11. LIGHT VEHICLES	9
 APPENDIX A: MAINTENANCE SCHEDULE FOR FOAM SUPPRESSION SYSTEMS	 11

FOREWORD

This Department of Industry and Resources (DoIR) guideline has been issued following full consultation with the principal suppliers of fixed foam suppression systems in Australia.

This guideline is primarily for use with underground vehicles, but by providing minimum standards is also suitable for surface mining equipment.

The guideline has been issued to assist both equipment owners and suppliers in providing a fixed fire suppression system that will be suited to the task of reducing the risk of fires originating in and around the engine compartment from getting established.

It is emphasised that this guideline is based on minimum requirements and is not totally inclusive of all factors concerning the suppression of vehicle fires and that in some respects may not be totally suited to some equipment or individual requirements of all mines.

Comments on, and suggestions for improvements to the guideline are encouraged. The guideline will be revised as appropriate to accommodate comments, as well as to reflect legislative changes, updated or new Australian Standards, new information, or improvements in technology or operational standards.

Safety Health and Environment Division

Department of Industry and Resources

100 Plain Street

EAST PERTH WA 6004

TEL: (08) 9222 3333

FAX: (08) 9325 2280

1. INTRODUCTION

This guideline is a minimum standard that applies to vehicles registered for underground use in Western Australian mines in accordance with the Mines Safety and Inspection Inspection Regulation 10.59(1) and (2) which states:

Fire suppression

Regulation 10.59

(1) The manager of an underground mine must ensure that each diesel unit at the mine that is turbocharged or rated at 125 kW or more, and each loader or grader at the mine is equipped with an effective and properly maintained AFFF or FFFP fire suppression system with a minimum of 2 actuators.

Penalty. See Regulation 17.1

(2) If a diesel unit in an underground mine is controlled by remote control, the manager of the mine must ensure that the unit is equipped with an automatically operated AFFF or FFFP fire suppression system that has the facility to be activated from the operator's remote control unit.

Penalty. See Regulation 17.1

The definition of "diesel unit", "AFFF" and "FFFP" are given in Regulation 10.47, which states:

"AFFF" means aqueous film forming foam;

"diesel unit" means any item of equipment which has as its power source a diesel engine, and includes mobile equipment, compressors and welders; and

"FFFP" means film forming fluoroprotein foam.

The requirement to fit a fixed fire suppression system to underground equipment specified in the legislation has arisen following the numerous underground fires that have occurred in Western Australia. An effective fire suppression system provides a barrier that can reduce the risk of an engine bay originated fire from propagating to an out of control situation.

A FIXED FIRE SUPPRESSION SYSTEM DOES NOT SUBSTITUTE FOR A PORTABLE FIRE EXTINGUISHER.

All underground vehicles need to carry portable fire extinguishers classified as B(E), in accordance with Australian Standard 244 'Portable fire extinguishers - Selection and location'. The minimum rating for such fire extinguishers is recommended below. Where two or more extinguishers be used, the individual ratings should be added to establish an overall rating that is the same as or greater than the minimum rating.

Engine Rating	Extinguisher Rating	Approx. minimum weight (kg)
Less than 100 kW	30 B (E)	2-3
101 kW to 200 kW	60 B (E)	4.5 - 8
More than 200 kW	80 B (E)	6 - 11

More than one portable fire extinguisher may be fitted to a vehicle, however, the combined (extinguishers) rating, see table above, must be equal or greater than the vehicle requires. It is recommended that at least one portable fire extinguisher is within reach of the operator either in or adjacent to the driving position.

Underground vehicles that are not required by legislation to have fixed fire suppression systems fitted, eg light vehicles, are covered by section 11 of this document which provides information of a smaller type of foam suppression system installed on some minesites. Such systems are based on the 9 kg (11.2 litre) portable foam fire extinguisher and are available from the major suppliers.

2. DURATION TIMES AND AREAS PROTECTED

When activated the system should cover all electrical, (especially the starter motor) and hot areas within the engine compartment including any hydraulic lines, the turbo charger and catalytic converter if fitted in that area, and any adjacent high risk areas.

The system shall have a foam tank solution volume which provides for an average discharge rate of 4.1 litres/min/m² or greater, over the fire risk area, for a nominal discharge time of 50 seconds. If the proposed discharge time is less than 45 seconds the matter should be referred to the Inspectorate by the supplier or installer to determine acceptability.

NB. Solution volume not to be confused with cylinder capacity.

3. MANUAL ACTUATORS

A minimum of two manual actuators shall be installed, one located in the cab within easy reach of an operator seated in the normal position, the other accessible from ground level.

There shall be 200 mm clearance above the actuator device to ensure easy access for the operator.

A device shall be installed within the cab to warn the operator when the system has been activated, eg, an alarm or a pressure gauge indicator to show a fall in pressure. If the pressurised system has not been activated the pressure indicator shall be in the green zone.

Consideration should be given to locating a ground level accessed actuator in the vicinity of the battery isolating switch when this switch is not within 3 metres of the cabin.

Consideration should be given to the location of the ground level actuator with regards to areas of fire risk.

Actuating buttons, switches or plungers shall be a primary colour, red, yellow or blue (not green) and have a contrasting background colour.

The location of actuator devices should be indicated with signs which comply with AS 1319 "Safety signs for the occupational environment" or AS 1614 "The design and use of reflectorized signs for mines and tunnels".

4. NOZZLES, VALVES AND PIPING

Nozzles shall be solid cone, non-aspirating and suitably rated to the operational pressure (aspirating nozzles on a system will need to be evaluated before consideration in this minimum standard).

While not in use the nozzles shall be fitted with blow off caps to ensure the nozzles remain clean and free flowing. Such caps must be of a material that will not melt under extreme engine operating conditions.

Preference should be given to the use of ring main piping where practicable.

The discharge valves and piping must be compatible with the foam solution used, suited to the purpose and meet the design code of the manufacturer of the discharge valve.

Discharge piping shall have a continuous fire rating of 100⁰C or more and shall be installed in such a way that the flow of solution will not be restricted.

With any electric remote control actuation system, the hoses and fittings are to be corrosion resistant.

Hose ends shall be compatible with the hose manufacturer's specifications.

The pipe or hose shall be installed to the manufacturer's recommendations and specifications.

5. PRESSURE VESSELS

The pressure vessel must be designed, manufactured, approved and maintained to an appropriate Australian Standard under the duty of care of suppliers and users.

The appropriate maximum size cylinder shall be used wherever practicable, and sized to comply with the nominated discharge and flow rates of the system.

The purchaser must be advised in writing by the supplier, of the Australian Standard to which the pressure vessel is designed and of the appropriate Australian Standards for inspection, repair and maintenance.

The pressure vessel must be supplied with a hard barrier to prevent over pressurisation eg, a burst disc or pressure relief valve as required by the cylinder code.

If the pressure vessel is installed in an horizontal position then the discharge must still comply with these minimum standards when it is at an angle of 15⁰ or less below the horizontal.

The cylinder and syphon tube shall be fitted in such a manner and be of a design that will ensure operation of the system should the vehicle roll over.

6. INTEGRATED ENGINE MANAGEMENT SYSTEMS

Any fixed fire suppression system should be capable of being adapted to activate an engine shutdown, or prevent engine starting, while the system is discharging and when the pressure in the pressure vessel drops to below the minimum operating pressure, eg a drop to 1000 kPa.

When an engine shutdown is activated by the use of the fixed fire suppression system there shall be a delay of 5 - 15 seconds before shutdown to allow the operator time to manoeuvre the machine away from any hazard.

Where engine shutdown systems are fitted there must be a manual override of the shutdown system that will allow the engine to start and the vehicle to be moved.

Where an integrated system is used that combines engine shutdown with actuation of the fixed foam device, a sign advising the vehicle operator of the delay period is to be displayed in the cabin.

7. SYSTEM MAINTENANCE AND SERVICE

Adequate maintenance and servicing documentation shall be provided by the supplier to the customer.

After the initial commissioning results of the discharge test, the discharge time shall be provided to the customer and signed by an authorised person.

Records of system maintenance and servicing shall be kept at the mine.

A competent person shall be appointed by the Mine Manager in writing to be responsible to conduct or arrange for the maintenance, servicing and testing of any fire suppression systems or fire detection systems fitted to underground vehicles. Frequency and type of maintenance shall be in accordance with the manufacturer's recommendation, or more often if appropriate.

A maintenance schedule detailing the recommended minimum inspection and service requirements is included in Section 12 of this guideline.

A pressure vessel used underground as a component of the suppression system is deemed to be used in an aggressive service environment. Where such a pressure vessel shows evidence of:

- ◆ external damage
- ◆ external corrosion
- ◆ leaking
- ◆ signs of warping
- ◆ signs of distortion, or
- ◆ damage from excessive heat

it shall either be discarded, or should the relevant Australian Standard indicate that repairs can be conducted, those repairs may be authorised by a competent person.

8. FLUSHING AND RE-CHARGING

When flushing the system water shall be used, followed by air or nitrogen discharge.

AS 3676 'Portable fire extinguishers - Guide to servicing' contains guideline procedures for pressurising stored pressure extinguishers and describes the type of apparatus that should be used for the task. To carry out the recharging process safely the following minimum requirements must be observed:

- i The nitrogen bottle must be fitted with a correctly rated pressure regulator properly set at the required recharge pressure.
- ii A correctly calibrated pressure gauge must be fitted in the recharging line, after the regulator.
- iii A safety pressure valve must be fitted, in the recharging line between the pressure gauge and the connection to the fire suppression system. The relief valve should be set to "open" at a pressure not greater than 110% of the required recharging pressure of the system.
- iv Failure to observe the above requirements can result in very serious or fatal injuries to personnel in the immediate area of the recharging process.

9. FOAM SOLUTION

The foam solution used in the system shall be the AFFF or FFFP solution recommended by the supplier of the system and the supplier should nominate the standards and codes to which the foam concentrate complies.

10. INSTALLATION

Fire suppression systems shall be installed by the manufacturer or by a person authorised by the manufacturer. Such authorisation shall be provided in writing.

11. LIGHT VEHICLES

This part applies to 4 x4 service and supervisors vehicles rated at below 125 kW and not fitted with a Turbocharger (not subject to the above guidance notes).

Where it has been decided to provide a remotely operated foam extinguisher system for use in the engine compartment of a light vehicle in the event of fire, the following information should be of value.

The foam suppression system should discharge at a minimum rate of 4.1 litres/min/m² and have a foam solution charge of 9 litres or more.

The following additional specifications are recommended:

- a) minimum discharge time nominally 30 - 45 seconds;
- b) actuation may be manually operated from a single location, providing such actuation is operable from a ground level position, and at less than 3 metres from the drivers point of exit from the vehicle; and
- c) remote pressure indication is not required providing a cylinder mounted pressure indicator is visible from a position at ground level, and is less than 3 metres from the drivers point of exit from the vehicle.

APPENDIX A

**MAINTENANCE SCHEDULE FOR FOAM SUPPRESSION SYSTEMS
(RECOMMENDED MINIMUM REQUIREMENTS)**

	Day	Week	Month	3 mth / 250 hrs	6 mth / 500 hrs	Year / 1000 hrs
1. Check that pressure indicators are in the green operating zone.	✓	✓	✓	✓	✓	✓
2. Check that the anti-tamper/pull pin is in place and secure/serviceable.	✓	✓	✓	✓	✓	✓
3. Inspect and ensure manual actuators are clean, undamaged and accessible.	✓	✓	✓	✓	✓	✓
4. Check nozzle caps are in place, and if not clean nozzle and replace caps.		✓	✓	✓	✓	✓
5. Check distribution pipework, hoses and fittings and ensure they are not damaged.		✓	✓	✓	✓	✓
6. Check pressure vessel is not damaged.			✓	✓	✓	✓
7. Check pressure vessel and mounting bracket are secure.			✓	✓	✓	✓
8. Check CO ₂ cartridge mass is within limits (if fitted).				✓	✓	✓
9. Ensure CO ₂ cartridge is in place, not loose and undamaged (if fitted)				✓	✓	✓
10. Check the system including pipework to ensure components are not corroded or loose.				✓	✓	✓

APPENDIX A

**MAINTENANCE SCHEDULE FOR FOAM SUPPRESSION SYSTEMS
 (RECOMMENDED MINIMUM REQUIREMENTS)
 (Continued)**

	Day	Week	Month	3 mth / 250 hrs	6 mth / 500 hrs	Year / 1000 hrs
11. Check that all system labels and placards are securely attached and legible.					✓	✓
12. Check for free passage through the system by flushing with clean water.					✓	✓
13. Manually discharge the system from an actuator, observe discharge to ensure fire risks are adequately covered, record discharge times and, correct any deficiencies.						✓
14. Check pressure vessel and CO ₂ cartridge (if fitted) for last inspection date and if necessary have them inspected as per Australian Standards.						✓
15. Check system for leaks.						✓
16. Refill, pressure vessel and CO ₂ cartridge (if fitted), reassemble and recommission.						✓

The annual check is comprehensive and it is recommended that a person specialising in fixed fire suppression systems ie the supplier, conduct this annual maintenance responsibility.

This maintenance schedule is a guide and sets out minimum requirements only, in all cases the manufacturer's recommendations should be followed.